SAN LUIS COASTAL
UNIFIED SCHOOL DISTRICT

Bid #338 San Luis High School New Classroom Building & Modular Restroom Relocation Project
Addendum No. 01 dated August 21, 2026

1. General:

A. Receipt of this Addendum shall be acknowledged on the Bid Form. Failure to acknowledge will subject the Bidder to disqualification.

B. This Addendum forms part of the Contract Documents for the above referenced project and shall be incorporated integrally therewith.

C. Each bidder shall make necessary adjustments and submit the proposal with full knowledge of all modifications, clarifications, and supplemental data included therein. Where provisions of the following supplemental data differ from those of the original Contract Documents, this Addendum shall govern.

2. Supporting Documents:

A. The following documents are being provided as supplemental data:

- Earth Systems Pacific Geotechnical Engineering and Geologic Hazards Report for the San Luis High School New Classroom Building.
- Earth Systems Pacific Geotechnical Engineering and Geologic Hazards Report for the San Luis High School Relocation of Modular Restroom.

3. Project Clarifications:

A. Relocation of one existing modular restroom (Serial number 11360, PC 03-113910, site specific A #03-116940) is to be coordinated and completed by the awarded general contractor and is contained within the scope of work for this project.

B. The Kruger Bensen Ziemer Architects Addendum Number One dated 8/21/26 is hereby made part of the Contract Documents to the same extent as it was originally included therein and takes precedence over the original documents.

ADDENDUM NUMBER ONE

08/21/2026



SAN LUIS OBISPO HIGH SCHOOL
NEW CLASSROOM & RELOCATION OF MODULAR RESTROOM
(DSA A# 03-125456)
1499 San Luis Drive
San Luis Obispo, CA 93401

Issued By:
KRUGER BENSEN ZIEMER ARCHITECTS, INC.
30 West Arrellaga Street
Santa Barbara, CA 93101

To all bidders submitting proposal(s) for the captioned project: this Addendum is hereby made part of the Contract Documents to the same extent as though it was originally included therein and takes precedence over the original documents and any previous addenda.

Acknowledge receipt of the Addendum on the Bid Form

A. PROJECT MANUAL

ITEM NO. A1: Section 081113 Hollow Metal Doors and Frames

Revise Section 2.7.A to include:

4. Door Side and Top Flange: At frames for exterior doors, door side and top flange size is as indicated on drawings.

ITEM NO. A2 Section 26 0553 - Response to Electricraft RFI

RFI: Arc Fault stickers are asked for; is an arc fault or power study required for this project?

Specification Section 26 0553 2.1.C requires compliance with CEC 110.16 for Arc Flash Hazard Warning. Based on CEC 110.16, all equipment installed as new on this project fall under CEC 110.16A requiring arc flash labels be provided in accordance with all resulting codes and standards, which do not require a Power System/ Arc Flash Study to be performed.

Per Specification Section 260553 2.2D-should arc flash labels be required, they shall be provided in accordance with NFPA 70E requirements

It is the contractor's obligation to perform work safely, and in accordance with all applicable codes and standards.

B. DRAWINGS

ITEM NO. B1: Sheet A-100

Revise to include additional panel of concrete removal and include Keynote 063 – REMOVE (E) CONCRETE FILLED GREASE TRAP as indicated by cloud and delta 1 on attached drawing.

ITEM NO. B2: Sheet A-101

Revise to include additional asphalt demo for installation of conduits per E-103 as indicated by cloud and delta 1 on attached drawing

ITEM NO. B2: Sheet A-102

Revise to include additional panel of concrete replacement indicated by cloud and delta 1 on attached drawing

ITEM NO. B3: Sheet A-103

Revise to include additional asphalt patchback for installation of conduits per E-103 as indicated by cloud and delta 1 on attached drawing

ITEM NO. B4: Sheet A-801

Revise to include basis of design for details 2/A-801 and 3/A-801 as indicated by cloud and delta 1.

Revise to include detail 18/A-801 as indicated by cloud and delta 1.

ITEM NO. B5: Sheet A-802

Revise to include door side/top flange dimension at exterior hollow metal door frames at details 5/A-802, 6/A-802, 10/A-802, 11/A-802, 12/A-802 as indicated by cloud and delta 1 on attached drawing.

Revise to include clarification on sealant over backer rod at details 2/A-802 and 3/A-802 as indicated by cloud and delta 1 on attached drawing.

ITEM NO. B6: Sheet S-202

Revise roof joist framing spacing per Keynote 2 as indicated by cloud and delta 1 on attached drawing

ITEM NO. B7: Sheet E-004

Revise IT Room circuit at Panel LP1 as indicated by cloud and delta 1 on attached drawing

ITEM NO. B8: Sheet E-202

Revise IT Room circuit as indicated by cloud and delta 1 on attached drawing

C. ATTACHMENTS

1. **Revised** Section 081113 Hollow Metal Doors and Frames
2. **Revised** Sheet A-100
3. **Revised** Sheet A-101
4. **Revised** Sheet A-103
5. **Revised** Sheet A-801
6. **Revised** Sheet A-802
7. **Revised** Sheet S-202
8. **Revised** Sheet E-004
9. **Revised** Sheet E-202

END OF ADDENDUM NUMBER ONE

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Standard steel doors and frames.
2. Fixed transom panels.

B. Related Requirements:

1. Section 057500 “Decorative Formed Metal” for aluminum brake metal to be installed in conjunction with hollow metal door frames.
2. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.
3. Section 088000” Glazing” for insulated glazing.
4. Section 092400 “Cement Plastering” for prefabricated aluminum stucco reglets / drip caps to be installed in conjunction with hollow metal door frames.
5. Section 099100 “Painting” for field finishing of hollow metal doors and frames.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.

C. Product Schedule: For hollow-metal doors and frrames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide hollow metal doors and frames by Steelcraft; an Allegion brand, or one of the following:

1. Ceco Door; ASSA ABLOY.
2. Kewanee Corporation (The).
3. Windsor Republic Doors.

2.2 STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3; SDI A250.4, Level A.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches.
c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
d. Edge Construction: Model 2, Seamless.
e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
g. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
h. Core: Vertical steel stiffener.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch with minimum A60 coating.
b. Construction: Full profile welded.

3. Exposed Finish: Prime.

2.3 BORROWED LITES

A. Fabricate of metallic-coated steel sheet, minimum thickness of 0.053 inch.

B. Construction: Full profile welded.

C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.

D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.4 HOLLOW-METAL PANELS

A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.

2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
3. Postinstalled Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.6 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

F. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

G. Glazing: Comply with requirements in Section 088000 "Glazing."

2.7 FABRICATION

A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.

4. Door Side and Top Flange: At frames for exterior doors, door side and top flange size is as indicated on drawings.

B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule on Drawings, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.

1. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

D. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.8 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. General: Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

a. Install frames with removable stops located on secure side of opening.

2. Floor Anchors: Secure with postinstalled expansion anchors.

a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
4. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

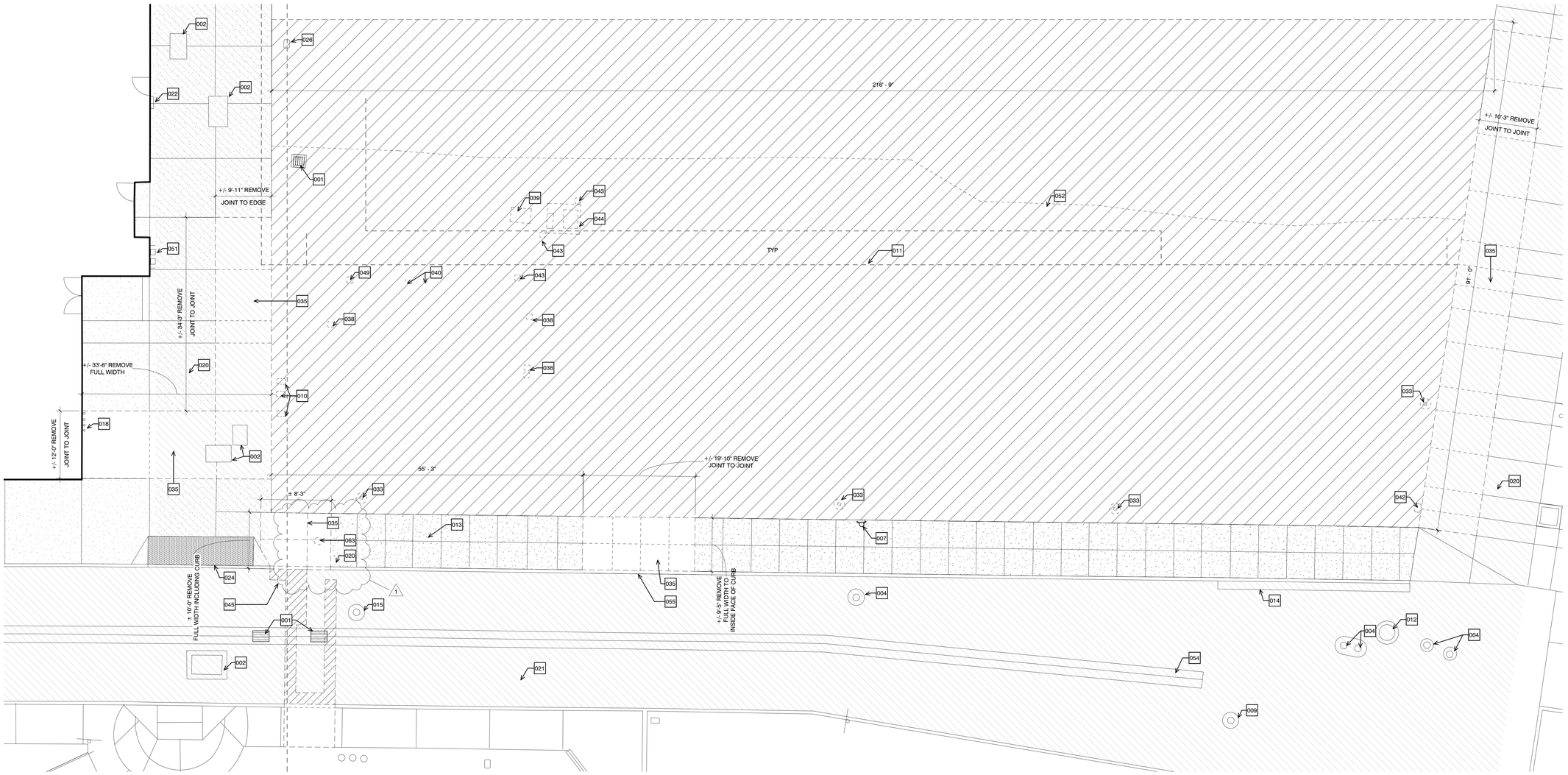
1. Non-Fire-Rated Steel Doors: Comply with SDI A250.8.

3.3 CLEANING AND TOUCHUP

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113



1 Site Demo Plan - Classroom Building
SCALE: 1/8" = 1'-0"

DEMO LEGEND

- REMOVE (E) DEBRIS, GRAVEL BASE MATERIAL, VEGETATION AND PREP FOR GRADING
- REMOVE (E) CONCRETE PAVING
- (E) FIRE LANE, DO NOT OBSTRUCT
- (E) CONCRETE TO REMAIN
- (E) FIRE HYDRANT

KEYNOTES

001 (E) STORM DRAIN TO REMAIN, PROTECT IN PLACE
002 (E) UTILITY VAULT TO REMAIN, PROTECT IN PLACE
004 (E) WATER VALVE TO REMAIN, PROTECT IN PLACE
007 (E) FIRE HYDRANT TO REMAIN, PROTECT IN PLACE
009 (E) GAS VALVE TO REMAIN, PROTECT IN PLACE
010 REMOVE (E) IRRIGATION CONTROL VALVES, CAP IRRIGATION LINES AT UPLINE IRRIGATION CONTROL VALVE
011 REMOVE (E) IRRIGATION LINES, CAP LINES AT UPLINE IRRIGATION CONTROL VALVE
012 (E) SANITARY SEWER MANHOLE TO REMAIN, PROTECT IN PLACE
013 PROVIDE TEMPORARY IRRIGATION SERVICE TO (E) CAMPUS COURTYARD
014 (E) CONCRETE GUTTER TO REMAIN, PROTECT IN PLACE
015 (E) CLEANOUT TO REMAIN, PROTECT IN PLACE
018 (E) CONDUIT TO REMAIN, PROTECT IN PLACE
020 (E) CONCRETE PAVING TO REMAIN, PROTECT IN PLACE
021 (E) ASPHALT CONCRETE PAVING TO REMAIN, PROTECT IN PLACE
022 (E) ELECTRICAL CABINET TO REMAIN, PROTECT IN PLACE
024 (E) CURB RAMP w/ DETECTABLE WARNING SURFACE TO REMAIN, PROTECT IN PLACE
026 (E) IRRIGATION CONTROL VALVE TO REMAIN, PROTECT IN PLACE
033 RELOCATE (E) LIGHT POLE: REMOVE (E) LIGHT POLE FOUNDATION
035 REMOVE (E) CONCRETE PAVING
038 REMOVE (E) CLEANOUT AND ASSOCIATED PIPING
039 REMOVE (E) UTILITY VAULT AND ASSOCIATED CONDUITS
040 REMOVE (E) CONDUITS TO LIMITS OF CONSTRUCTION, CAP OFF
042 REMOVE (E) INGROUND ELECTRICAL BOX
043 REMOVE (E) GAS VALVE
044 SALVAGE (E) TRANSFORMER AND RETURN TO DISTRICT, REMOVE (E) CONCRETE PAD
045 REMOVE (E) ASPHALT PAVING
049 REMOVE (E) WATER METER
051 (E) DRINKING FOUNTAIN TO REMAIN, PROTECT IN PLACE
052 (E) EDGE OF GRASS FIELD
054 (E) CONCRETE SWALE TO REMAIN, PROTECT IN PLACE
055 (E) CONCRETE CURB TO REMAIN, PROTECT IN PLACE
063 REMOVE (E) CONCRETE FILLED GREASE TRAP

SAN LUIS COASTAL UNIFIED SCHOOL DISTRICT

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1489 SAN LUIS DRIVE, SAN LUIS OBISPO, CA 93401

NEW CLASSROOM BUILDING & RELOCATION OF MODULAR RESTROOM

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ARCHITECT'S STAMP & SIGNATURE

ENGINEER'S STAMP & SIGNATURE

CONSULTANT INFORMATION

REVISION	DESCRIPTION	DATE	BY
1	ADDENDUM 1	08/14/26	

DRAWN	TA
CHECKED	MG/JW
DATE	08/03/26
JOB. NO.	24010
SHEET TITLE	SITE DEMO PLAN - CLASSROOM BLDG

SHEET A-100



1 Site Demo Plan - (E) Modular Restroom Building
SCALE: 1/8" = 1'-0"

PROJECT NORTH

TRUE NORTH

KEYNOTES

001 (E) STORM DRAIN TO REMAIN, PROTECT IN PLACE

006 (E) ELECTRICAL BOX TO REMAIN, PROTECT IN PLACE

017 (E) WATER SERVICE TO REMAIN, PROTECT IN PLACE

021 (E) ASPHALT CONCRETE PAVING TO REMAIN, PROTECT IN PLACE

025 (E) TREE TO REMAIN, PROTECT IN PLACE

026 (E) IRRIGATION CONTROL VALVE TO REMAIN, PROTECT IN PLACE

027 REMOVE (E) CONCRETE RAMP, LANDINGS & HANDRAILS, RETAINING WALL AND PIPE RAIL GUARD TO REMAIN, PROTECT IN PLACE

029 (E) CONCRETE RETAINING WALL TO REMAIN, PROTECT IN PLACE

030 (E) CHAINLINK FENCE TO REMAIN, PROTECT IN PLACE

031 (E) CHAIN LINK GATE TO REMAIN, PROTECT IN PLACE

032 (E) BENCH TO REMAIN, PROTECT IN PLACE

036 REMOVE (E) CHAINLINK FENCE

037 REMOVE (E) VEGETATION AND PREP FOR GRADING

045 REMOVE (E) ASPHALT PAVING

046 (E) ELECTRICAL "A" PANEL

053 (E) SEWER TO REMAIN, PROTECT IN PLACE

056 (E) POLE LIGHT TO REMAIN, POTECT IN PLACE

057 (E) ASPHALT CURB TO REMAIN, PROTECT IN PLACE

058 REMOVE (E) CONCRETE HARDSCAPE

059 REMOVE (E) CHAINLINK GATE

060 (E) ASPHALT SLOPE TO REMAIN

061 REMOVE (E) PORTION OF RETAINING WALL & GUARD

062 (E) IRRIGATION LINE TO REMAIN, PROTECT IN PLACE

DEMO LEGEND

REMOVE (E) VEGETATION, PREP FOR GRADING AND EXCAVATION

REMOVE (E) ASPHALT PAVING

(E) LANDSCAPE

(E) CONCRETE

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ARCHITECT'S STAMP & SIGNATURE

ENGINEER'S STAMP & SIGNATURE

LICENSED ARCHITECT JOE S. WILCOX No. C-26808 Rev: 2027 STATE OF CALIFORNIA

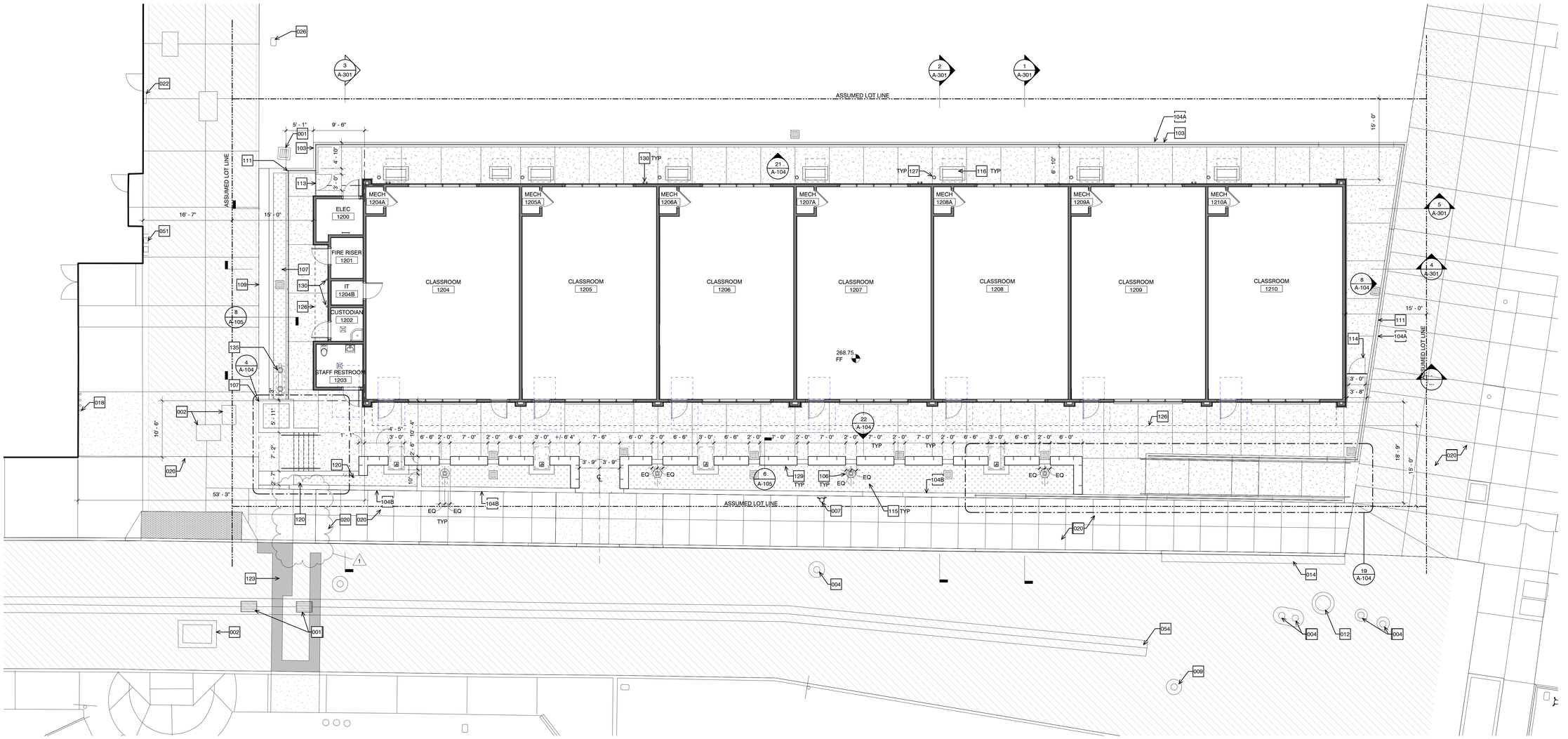
CONSULTANT INFORMATION

REVISION	DESCRIPTION	DATE	BY
1	ADDENDUM 1	08/14/26	

DRAWN TA
CHECKED MG/JW
DATE 08/03/26
JOB. NO. 24010

SHEET TITLE SITE DEMO PLAN - TAYLOR FIELD

SHEET A-101



1 Site Plan - Classroom Building
SCALE: 1/8" = 1'-0"

N

PROJECT NORTH

TRUE NORTH

LEGEND

- CONCRETE PAVING PER CIVIL
- ASPHALT PAVING PER CIVIL
- PLANTER
- FIRE ACCESS LANE
- CATCH BASIN
- RELOCATED LIGHT POLE
- (E) FIRE HYDRANT

KEYNOTES

001	(E) STORM DRAIN TO REMAIN, PROTECT IN PLACE
002	(E) UTILITY VAULT TO REMAIN, PROTECT IN PLACE
004	(E) WATER VALVE TO REMAIN, PROTECT IN PLACE
007	(E) FIRE HYDRANT TO REMAIN, PROTECT IN PLACE
009	(E) GAS VALVE TO REMAIN, PROTECT IN PLACE
012	(E) SANITARY SEWER MANHOLE TO REMAIN, PROTECT IN PLACE
014	(E) CONCRETE GUTTER TO REMAIN, PROTECT IN PLACE
018	(E) CONDUIT TO REMAIN, PROTECT IN PLACE
020	(E) CONCRETE PAVING TO REMAIN, PROTECT IN PLACE
022	(E) ELECTRICAL CABINET TO REMAIN, PROTECT IN PLACE
026	(E) IRRIGATION CONTROL VALVE TO REMAIN, PROTECT IN PLACE
051	(E) DRINKING FOUNTAIN TO REMAIN, PROTECT IN PLACE
054	(E) CONCRETE SWALE TO REMAIN, PROTECT IN PLACE
103	CHAINLINK FENCE ATOP RETAINING WALL PER 12/A-106
104A	RETAINING WALL PER 7/S-302
104B	RETAINING WALL PER OPTIONAL DETAIL 7/S-302
106	RELOCATE (E) LIGHT POLE
107	CAST-IN-PLACE CONCRETE BENCH PER 6/A-105
109	CONCRETE BENCH & RETAINING WALL PER 8/A-105
111	GUARD PER 29/A-104
113	3' WIDE CHAIN LINK SECURITY GATE PER 12/A-106
114	3' WIDE CHAIN LINK SECURITY GATE PER 15/A-106
115	STORM DRAIN PER CIVIL
116	CONDENSING UNIT ON HOUSEKEEPING PAD
120	DIRECTIONAL SIGNAGE PER 3/A-901
123	ASPHALT PAVING PER CIVIL
126	LINE OF AWNING ROOF ABOVE
127	DRYWELL PER 9/P-001
129	CONCRETE BENCH WITH SKATE STOPS PER 6/A-105
130	GALVANIZED PIPE ROOF DRAIN DOWNSPOUT & OVERFLOW DOWNSPOUT PER 12/A-105
135	6" DDCA WITH FDC CONNECTION PER CIVIL

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ENGINEER'S STAMP & SIGNATURE

LICENSED ARCHITECT JOE S. WILCOX No. C-26808 Ren. 2027 STATE OF CALIFORNIA

CONSULTANT INFORMATION

REVISION	DESCRIPTION	DATE	BY
5			
4			
3			
2			
1	ADDENDUM 1	08/14/26	

DRAWN TA
CHECKED Checker
DATE 08/03/26
JOB. NO. 24010

SHEET TITLE SITE PLAN - CLASSROOM BLDG

SHEET A-102



1 Site Plan - (E) Modular Restroom Building
SCALE: 1/8" = 1'-0"

DETERIORATION OR EXISTING NON-COMPLIANT CONSTRUCTION
IF ANY CONDITION IS DISCOVERED WHICH, IF LEFT UNCORRECTED, WOULD MAKE THE BUILDING NON-COMPLIANT WITH THE EDITION OF THE CALIFORNIA BUILDING CODE IN FORCE AT THE TIME OF ORIGINAL CONSTRUCTION, A CHANGE ORDER OR A SEPARATE SET OF PLANS AND SPECIFICATIONS DETAILING AND SPECIFYING THE REQUIRED REPAIR WORK SHALL BE SUBMITTED TO AND APPROVED BY DSA BEFORE PROCEEDING WITH THE REPAIR WORK.

EXISTING UTILITIES
TO THE BEST OF THEIR ABILITY AND WITHOUT FULLY EXPOSING ANY AND ALL UTILITITY LINES, THE RESPONSIBLE ENGINEER OR ARCHITECT HAS VERIFIED THE LOCATION OF THE EXISTING UTILITIES SHOWN AS EXISTING AND THEIR CAPACITY IS ADEQUATE TO THE ADDITIONAL LOAD.

SIGNATURE_____ DATE _____

KEYNOTES

001	(E) STORM DRAIN TO REMAIN, PROTECT IN PLACE
006	(E) ELECTRICAL BOX TO REMAIN, PROTECT IN PLACE
017	(E) WATER SERVICE TO REMAIN, PROTECT IN PLACE
021	(E) ASPHALT CONCRETE PAVING TO REMAIN, PROTECT IN PLACE
025	(E) TREE TO REMAIN, PROTECT IN PLACE
026	(E) IRRIGATION CONTROL VALVE TO REMAIN, PROTECT IN PLACE
029	(E) CONCRETE RETAINING WALL TO REMAIN, PROTECT IN PLACE
030	(E) CHAINLINK FENCE TO REMAIN, PROTECT IN PLACE
031	(E) CHAIN LINK GATE TO REMAIN, PROTECT IN PLACE
032	(E) BENCH TO REMAIN, PROTECT IN PLACE
046	(E) ELECTRICAL "A" PANEL
056	(E) POLE LIGHT TO REMAIN, POTECT IN PLACE
057	(E) ASPHALT CURB TO REMAIN, PROTECT IN PLACE
060	(E) ASPHALT SLOPE TO REMAIN
062	(E) IRRIGATION LINE TO REMAIN, PROTECT IN PLACE
104A	RETAINING WALL PER 7/S-302
110	12' WIDE SECURITY GATE PER 14/A-106
111	GUARD PER 29/A-104
119	ACCESSIBILITY SIGNAGE PER 1 & 2 /A-902
120	DIRECTIONAL SIGNAGE PER 3/A-901
121	CHAINLINK FENCE PER 14/A-106
122	HI-LOW DRINKING FOUNTAIN PER 6/A-904
123	ASPHALT PAVING PER CIVIL
125	PERIMETER FLASHING PER 30/A-801
128	CRAWL SPACE ACCESS AND CRAWL SPACE VENTS PER, 2/A-201
131	RAMP & RETAINING WALL EXTENSION PER CIVIL
132	CURB EXTENSION PER CIVIL
133	HANDRAIL RETROFIT PER 22/A-105

LEGEND

- CONCRETE PAVING
- ASHALT PAVING
- ACCESSIBLE PATH OF TRAVEL
- (E) TREE TO REMAIN

MODULAR RESTROOM

1. RELOCATION OF ONE (E) MODULAR RESTROOM BUILDING (SERIAL NUMBER 11360, PC 03-113910, SITE SPECIFIC A# 03-116940). THE FOLLOWING DOCUMENTS SHALL BE ON THE JOBSITE PRIOR TO INSTALLATION OF THE UNIT(S):

A. IN PLANT VERIFIED REPORT
B. LABORATORY VERIFIED REPORT
C. WELDING VERIFIED REPORT

2. THE SITE INSPECTOR SHALL VERIFY THE ABOVE DOCUMENTS AND SERIAL NUMBERS ARE APPLICABLE TO EACH UNIT PRIOR TO INSTALLATION OF THE UNIT(S). NOTIFY ARCHITECT AND THE DIVISION OF THE STATE ARCHITECT FIELD ENGINEER IF ANY DISCREPANCIES OCCUR.

3. SEE CIVIL FOR FINISH GRADES

TAYLOR FIELD

PROJECT NORTH TRUE NORTH

SAN LUIS OBISPO HIGH SCHOOL
SAN LUIS COASTAL UNIFIED SCHOOL DISTRICT
1489 SAN LUIS DRIVE, SAN LUIS OBISPO, CA 93401
NEW CLASSROOM BUILDING
& RELOCATION OF MODULAR RESTROOM

KRUGER BENSEN ZIEMER ARCHITECTS, INC. AIA
30 W. ARRELLAGA STREET SANTA BARBARA CA 93101
TELEPHONE (805) 963-1726 FAX (805) 963-2951
JOE S. WILCOX, AIA
PRINCIPAL-IN-CHARGE
MAT GRADIAS, AIA
PROJECT MANAGER

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ARCHITECT'S STAMP & SIGNATURE
ENGINEER'S STAMP & SIGNATURE

LICENSED ARCHITECT JOE S. WILCOX No. 29808 Ren. 2027 STATE OF CALIFORNIA

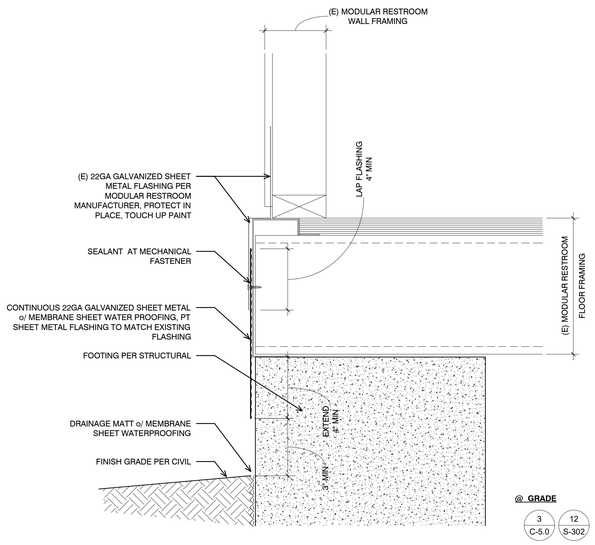
CONSULTANT INFORMATION

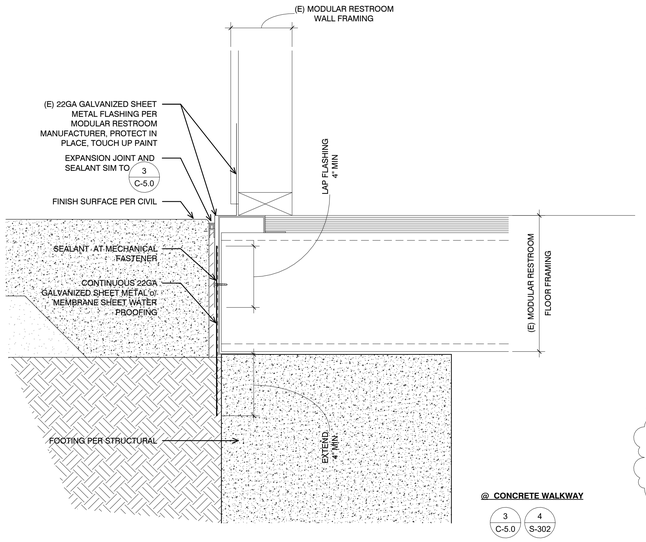
REVISION	DESCRIPTION	DATE	BY
1	ADDENDUM 1	08/14/26	
2			
3			
4			
5			

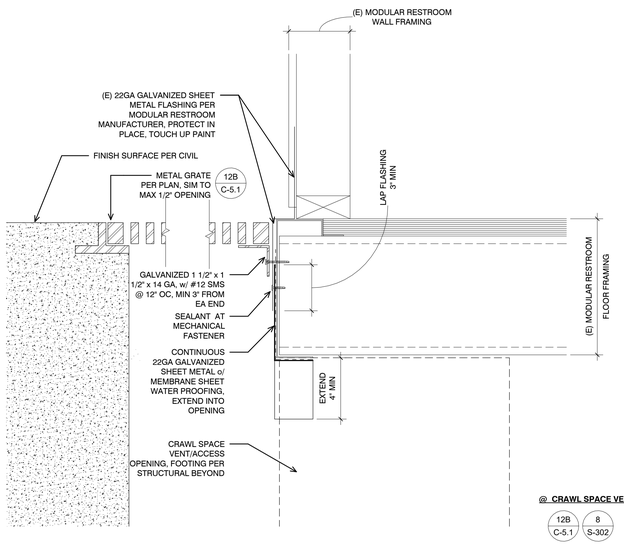
DRAWN TA
CHECKED MG/JW
DATE 08/03/26
JOB. NO. 24010

SHEET TITLE SITE PLAN - TAYLOR FIELD

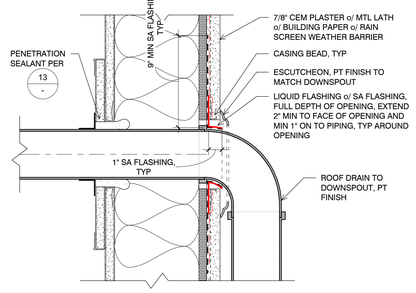
SHEET A-103





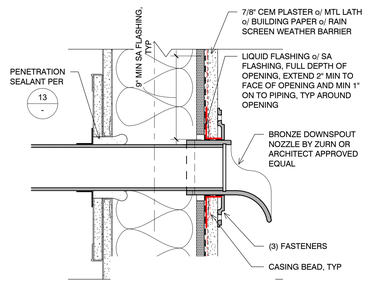


30 Modular Restroom Flashing
SCALE: 3" = 1'-0"

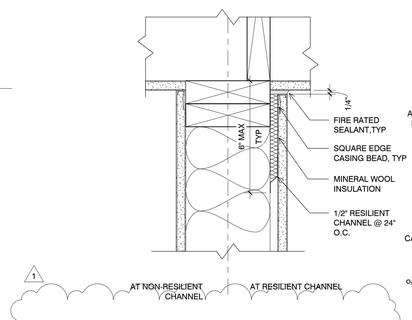


NOTE:
1. FIRE RATED SEALANT AT RATED WALLS

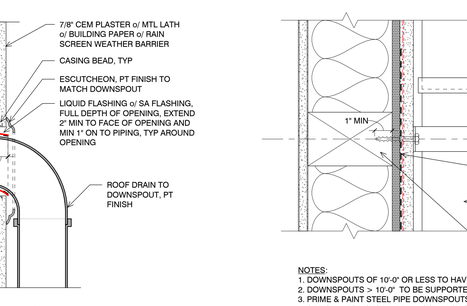
16 Roof Drain Wall Transition
SCALE: 3" = 1'-0"



17 Roof Drain Nozzle
SCALE: 3" = 1'-0"

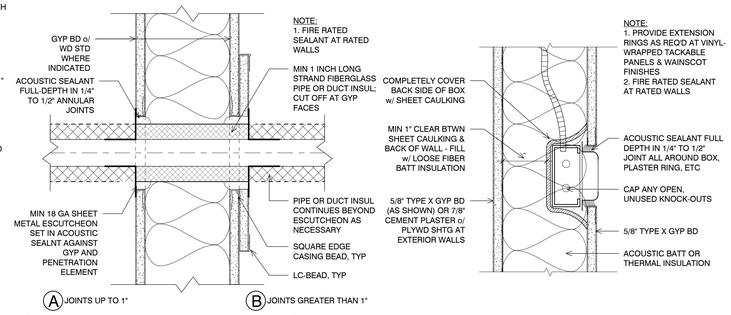


18 Typical Head of Wall Detail
SCALE: 3" = 1'-0"

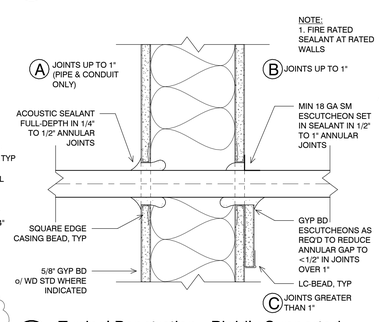


NOTES:
1. DOWNSPOUTS OF 10'-0" OR LESS TO HAVE TWO (2) STRAPS OF SUPPORT
2. DOWNSPOUTS > 10'-0" TO BE SUPPORTED AT INTERVALS OF 10'-0" MAX.
3. PRIME & PAINT STEEL PIPE DOWNSPOUTS, STRAPS AND EXPOSED FASTENERS
4. SEE CIVIL FOR STORM DRAIN CONNECTION AT GRADE

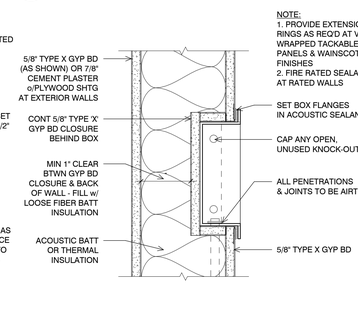
11 W_Downspout Bracket Detail
SCALE: 3" = 1'-0"



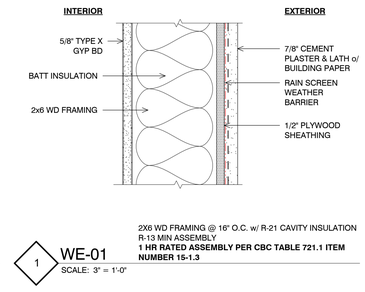
12 Typical Penetration - Resiliently Supported
SCALE: 3" = 1'-0"



13 Typical Penetration - Rigidly Supported
SCALE: 3" = 1'-0"

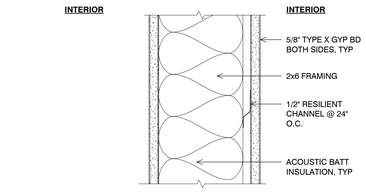


7 Typical Recessed Box
SCALE: 3" = 1'-0"



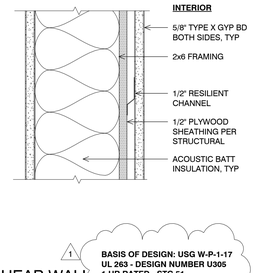
2X6 WD FRAMING @ 16" O.C. w/ R-21 CAVITY INSULATION
R-13 MIN ASSEMBLY
1 HR RATED ASSEMBLY PER CBC TABLE 721.1 ITEM NUMBER 15-1.3

1 WE-01
SCALE: 3" = 1'-0"



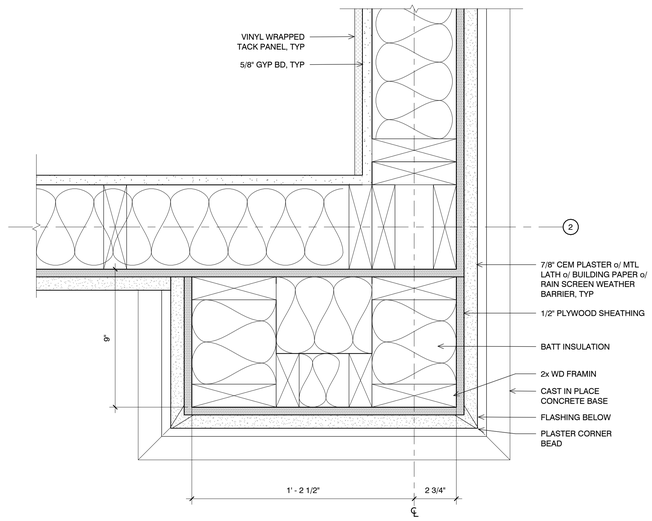
BASIS OF DESIGN: USG W-P-1-17
UL 263 - DESIGN NUMBER U305
1 HR RATED - STC 51

2 WI-01
SCALE: 3" = 1'-0"

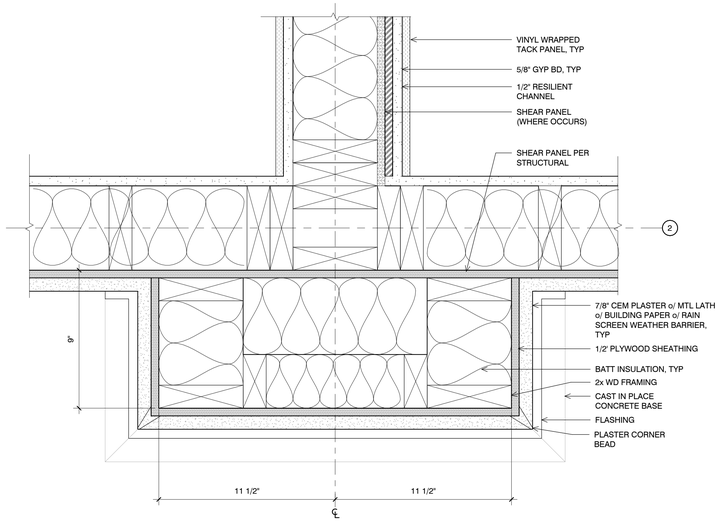


BASIS OF DESIGN: USG W-P-1-17
UL 263 - DESIGN NUMBER U305
1 HR RATED - STC 51

3 WI-02 SHEAR WALL
SCALE: 3" = 1'-0"



20 CORNER PILASTER PLAN DETAIL
SCALE: 3" = 1'-0"



10 PILASTER PLAN DETAIL
SCALE: 3" = 1'-0"

SAN LUIS OBISPO COASTAL UNIFIED SCHOOL DISTRICT

SAN LUIS OBISPO HIGH SCHOOL

NEW CLASSROOM BUILDING & RELOCATION OF MODULAR RESTROOM

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ARCHITECTS STAMP & SIGNATURE

ENGINEERS STAMP & SIGNATURE

LICENSED ARCHITECT JOE S. WILCOX No. 28808 Ren. 2027 STATE OF CALIFORNIA

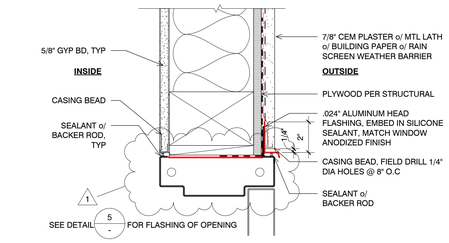
CONSULTANT INFORMATION

REVISION	DESCRIPTION	DATE	BY
1	ADDENDUM 1	08/14/26	

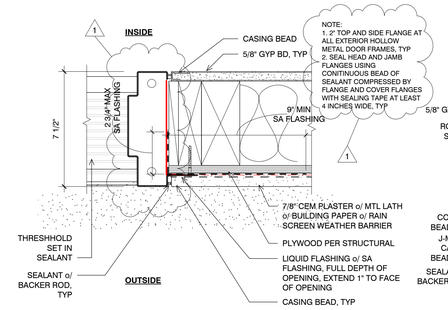
DRAWN TA
CHECKED MG/JW
DATE 08/03/26
JOB. NO. 24010

SHEET TITLE: WALL TYPES & TYP WALL DETAILS

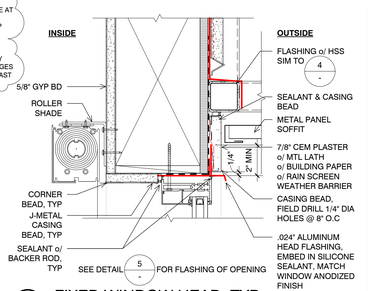
SHEET A-801



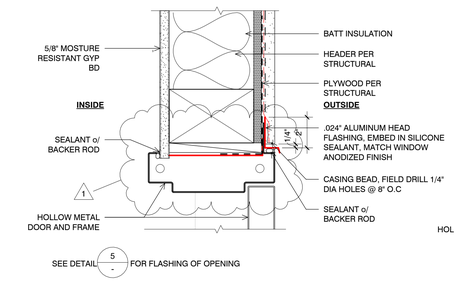
10 DOOR HEAD
SCALE: 3" = 1'-0"



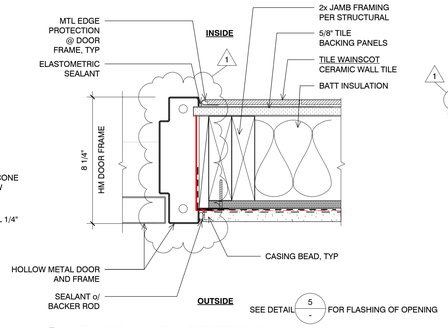
5 DOOR JAMB, TYP
SCALE: 3" = 1'-0"



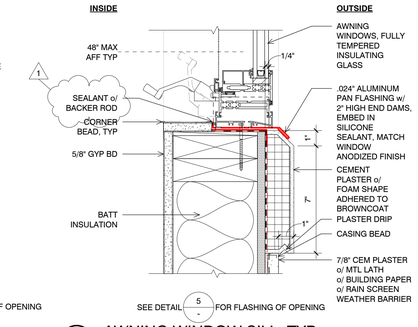
1 FIXED WINDOW HEAD, TYP
SCALE: 3" = 1'-0"



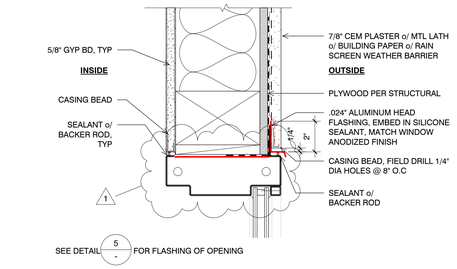
11 DOOR HEAD - RESTROOM
SCALE: 3" = 1'-0"



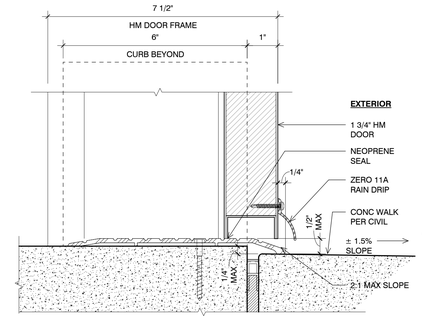
6 DOOR JAMB - RESTROOM
SCALE: 3" = 1'-0"



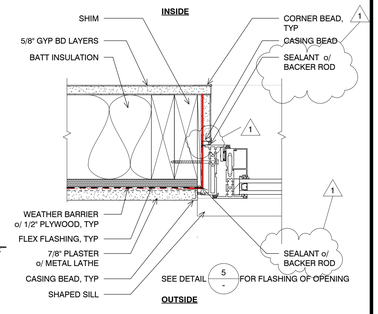
2 AWNING WINDOW SILL, TYP
SCALE: 3" = 1'-0"



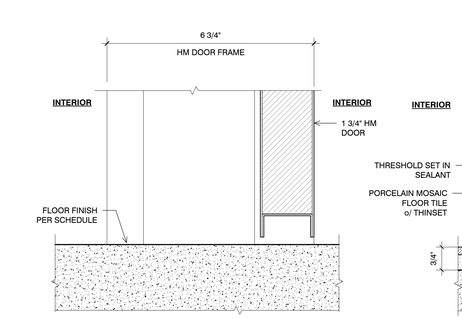
12 TRANSOM HEAD
SCALE: 3" = 1'-0"



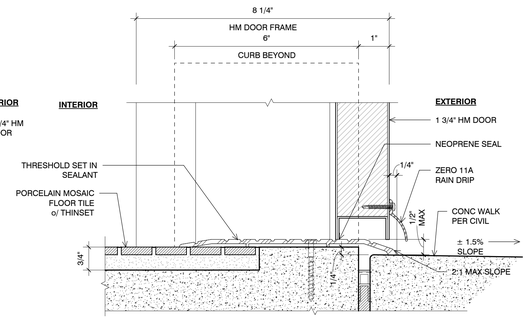
7 EXTERIOR HM DOOR THRESHOLD
SCALE: 6" = 1'-0"



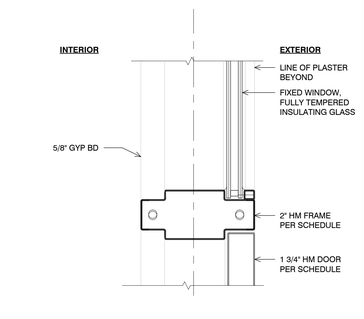
3 AWNING WINDOW JAMB, TYP
SCALE: 3" = 1'-0" FIXED WINDOW SIMILAR



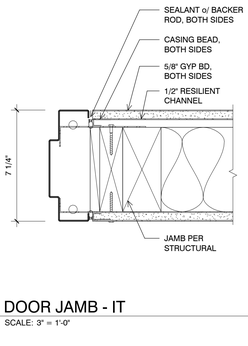
13 INTERIOR HM DOOR THRESHOLD
SCALE: 6" = 1'-0"



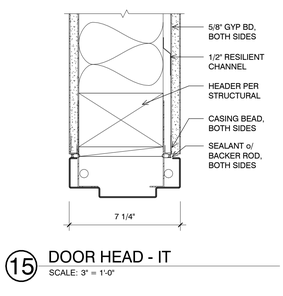
8 EXTERIOR HM DOOR THRESHOLD @ RR
SCALE: 6" = 1'-0"



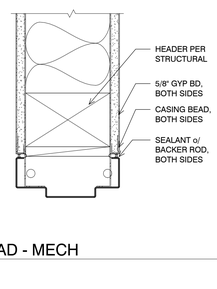
4 DOOR HEAD @ TRANSOM
SCALE: 3" = 1'-0"



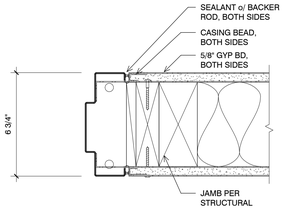
16 DOOR JAMB - IT
SCALE: 3" = 1'-0"



15 DOOR HEAD - IT
SCALE: 3" = 1'-0"



14 DOOR HEAD - MECH
SCALE: 3" = 1'-0"



9 DOOR JAMB - MECH
SCALE: 3" = 1'-0"

TYPICAL ALUMINUM WINDOW NOTES:

1. PROVIDE PERIMETER SEALANT PER SECIFICATIONS @ ALL ALUMINUM WINDOWS
2. ALL FASTENERS @ WOOD FRAMING TO BE SIMPSON SDS 252300 (ICC ESR-2236) w/ 2" MIN EMBED, UNLESS NOTED OTHERWISE
3. ALUMINUM WINDOW FASTENER LOCATIONS:
   - 3.1 AT HEADS & SILLS, INSTALL FASTENERS @ 2" FROM EACH JAMB AND 2" FROM EACH SIDE OF VERTICAL MULLIONS AND 16" OC MAX, UNLESS NOTED OTHERWISE
   - 3.2 AT JAMBS, PROVIDE FASTENERS @ 2" FROM HEAD & SILL AND 2" FROM EACH SIDE OF HORIZONTAL MULLIONS AND 16" OC MAX, UNLESS NOTED OTHERWISE
   - 3.2 FASTENERS TO BE LOCATED 3/4" MIN FROM THE EDGE OF WOOD MEMBERS

SAN LUIS COASTAL UNIFIED SCHOOL DISTRICT

SAN LUIS OBISPO HIGH SCHOOL

14489 SAN LUIS DRIVE, SAN LUIS OBISPO, CA 93401

NEW CLASSROOM BUILDING & RELOCATION OF MODULAR RESTROOM

KRUGER BENSEN ZIEMER ARCHITECTS, INC. AIA
30 W. ARRELLAGA STREET SANTA BARBARA CA 93101
TELEPHONE (805) 963-1726 FAX (805) 963-2951

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ARCHITECT'S STAMP & SIGNATURE

ENGINEER'S STAMP & SIGNATURE

REGISTERED ARCHITECT JOSEPH S. WILCOX No. C-24808 Ren. 2027 STATE OF CALIFORNIA

CONSULTANT INFORMATION

REVISION	DESCRIPTION	DATE	BY
5			
4			
3			
2			
1	ADDENDUM 1	08/14/26	

DRAWN	TA
CHECKED	MG/JW
DATE	08/03/26
JOB. NO.	24010

SHEET TITLE: OPENINGS DETAILS

SHEET A-802

ROOF FRAMING PLAN NOTES:

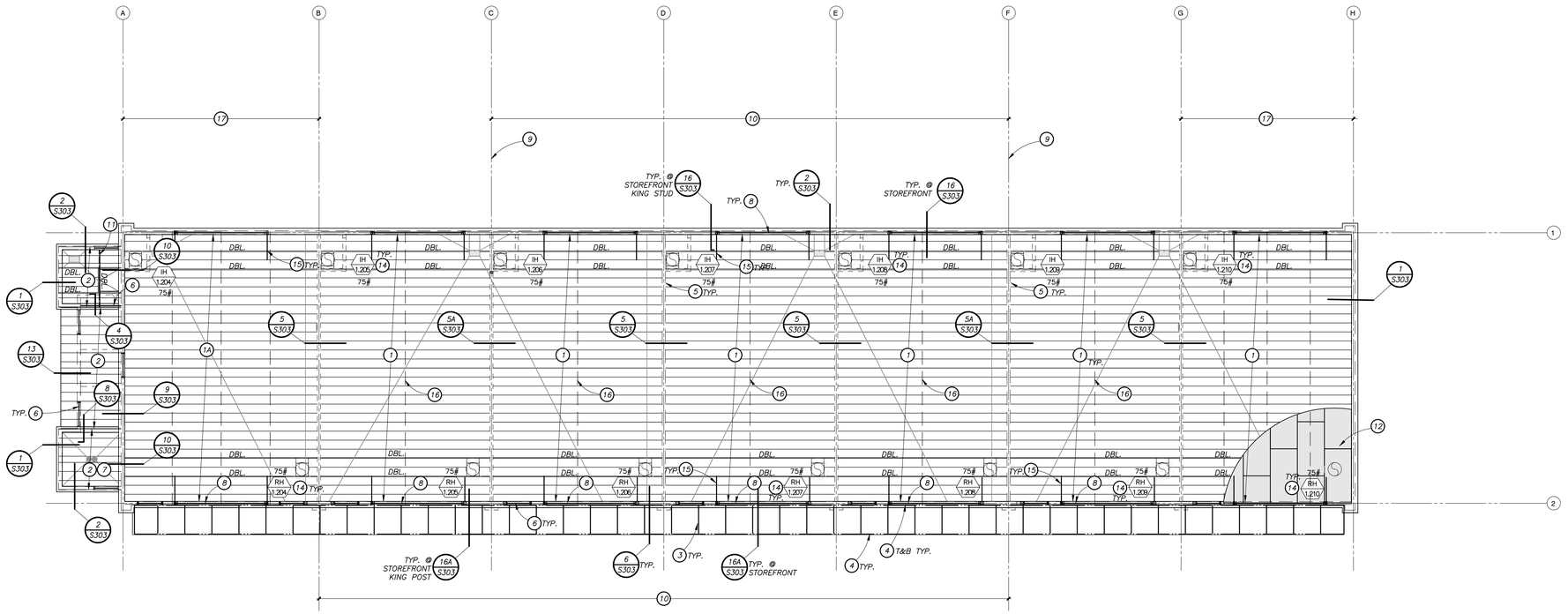
A. REFER TO GENERAL NOTES SHEET **S-001**.
B. ROOF SHEATHING SHALL BE 5/8" PLYWOOD WITH A PANEL IDENTIFICATION INDEX OF 32/16. PLACE FACE GRAIN PERPENDICULAR TO SUPPORTS. PROVIDE ONE PLYCLIP BETWEEN EACH JOIST AT ALL UNBLOCKED EDGES OF PLYWOOD SHEATHING OR USE T&G PLYWOOD. UNLESS NOTED OTHERWISE ON THE DRAWINGS:
   E.N./B.N. (EDGE / BOUNDARY NAILING) = 10d @ 6" O.C.
   F.N. (FIELD NAILING) = 10d @ 12" O.C.
   ALL NAILS SHALL BE COMMON.
C. SEE ARCHITECTURAL DRAWINGS FOR LOCATIONS OF SKYLIGHTS AND ROOF HATCHES.
D. SEE MECHANICAL DRAWINGS FOR LOCATIONS OF EQUIPMENT AND ROOF OPENINGS FOR DUCTS.
E. UNLESS SPECIFICALLY NOTED ON THE PLANS, FRAMING SHALL NOT BE CUT OR RELOCATED WITHOUT PRIOR APPROVAL OF THE STRUCTURAL ENGINEER.
F. ROOF LOADS:
   DEAD LOAD = **18** psf
   LIVE LOAD = **20** psf
G. DO NOT OVER CUT AT NOTCHES IN FRAMING.
H. FINAL LOCATION AND WEIGHTS OF MECHANICAL UNITS SHALL BE APPROVED BY THE STRUCTURAL ENGINEER PRIOR TO THE PREPARATION OF ROOF FRAMING SHOP DRAWINGS.
I. WHERE ROOF PITCH CREATES LOW SPOTS THAT WILL NOT PROPERLY DRAIN, PROVIDE CRICKETS TO ENSURE ADEQUATE ROOF DRAINAGE.
K. REFER TO ARCHITECTURAL DRAWINGS FOR TOP OF PLYWOOD ELEVATIONS, LOCATIONS OF RECESSED DRAIN PANS, HATCHES AND OTHER MISCELLANEOUS ITEMS. COORDINATE WITH FRAMING.
L. PROVIDE TOP PLATE SPLICE **TYPE '1'** PER TYP. DET. **13/S-102** AT EXT. WALLS & INT. SHEAR WALLS U.N.O.

AWNING FRAMING PLAN NOTES:

A. REFER TO GENERAL NOTES SHEET **S-001**.
B. ROOF METAL DECK TO BE VERCO 'PLB-36' **18** GA. GALV. w/ 4 - #12 SELF DRILLING, SELF TAPPING SCREW PER PANEL (36/4 PATTERN) & SIDELAPS (VSC2) PUNCHLOK @ 24"o.c. REF. TO TYP. DET. **10/S-103**
C. ROOF DESIGN LOADS:
   DEAD LOAD = 10 psf
   LIVE LOAD = 20 psf
D. AWNING NET WIND LOAD (LRFD) = +16.18 psf
   -16.18 psf (NON CONCURRENT w/ POSITIVE WIND)
E. REFER TO ARCHITECTURAL DRAWINGS FOR TOP OF STEEL BEAMS, LOCATIONS OF RECESSED DRAIN PANS, HATCHES AND OTHER MISCELLANEOUS ITEMS. COORDINATE WITH FRAMING.

KEYED NOTES:

1. 1 ¾" x 14" LVL @ 24" o.c. ROOF JOISTS (@ 16" o.c. AT **1A**)
2. 2x8 MIN. @ 16" o.c. MAX. ROOF JOISTS
3. AWNING TRIANGLE FRAMING @ 4'-0" o.c. MAX. PER DETAIL **12/S-303**
4. HSS2x2x⅛ BLK'G. REF. TO DETAIL **12/S-303**
5. INT. BEARING / SHEAR WALL BLW.
6. HEADER PER TYP. DETAIL **3/S-102**
7. CEILING JOIST BELOW. REF. TO TYP. DETAIL **9/S-102**
8. 6x12 MIN. HEADER TYP.
9. PROVIDE (2) ROWS OF ROOF E.N. AT INT. SHEAR WALL LINES TYP.
10. PROVIDE TOP PLATE SPLICE **TYPE '2'** PER TYP. DET. **13/S-102**
11. SIMP. CS16 x 8'-0" OVER PLY. SHT'G. OVER 2x BLK'G.
12. ROOF PLY STH'G. PER ROOF FRAMING PLAN NOTE B. REF. TO TYP. DET. **6/S-102** FOR LAYOUT
13. NOT USED
14. RELIEF OR INTAKE HOOD PER MECH. DRAWINGS. REF. TO DET. **12/M-020**. REF. TO DET. **8/S-102** TYP. FOR HEADOUT FRAMING AT OPENING THRU. ROOF AS REQ'D.
15. 3 ½" x 14" PSL BLK'G. (2 BAYS MIN.) CENTERED 2-2x OR 6x KING POST w/ SIMP. 'ST12' AT BOTT. CENTERED ROOF JOIST AS INDICATED ON PLAN
16. PROVIDE 1 ¾" x 14" LVL BLK'G. @ ROOF JOIST **MID.** SPAN w/ (3) 16d TOE NAILS EA. END, TYP.
17. PROVIDE 1 ¾" x 14" LVL BLK'G. @ ROOF JOIST **⅓** POINTS w/ (3) 16d TOE NAILS EA. END, TYP.



ROOF FRAMING PLAN

Scale : 1/8" = 1'-0"

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SAN LUIS OBISPO HIGH SCHOOL
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5	-	-/-/-	XX
4	-	-/-/-	XX
3	-	-/-/-	XX
2	-	-/-/-	XX
1	ADDENDUM 01	8/14/26	SWA

DRAWN VB
CHECKED GHS
DATE 07/18/2025
JOB. NO. SWA 24066

SHEET TITLE ROOF FRAMING PLAN

SHEET S-202

MDP

BUS RATING: 400A 277/480V, 3PH, 4W
NEMA 1
AIC RATING: 10K

DIST (FT)	PANEL/LOAD	TRIP	POLES	COND SIZE	CONNECTED VA (AMPS) / %VD PHASE A	PHASE B	PHASE C	CALC TYPE
20	TRANSFORMER TP	125	3	SLD	25000 (90.3A) 0.00%	25000 (90.3A) 0.00%	25000 (90.3A) 0.00%	
20	LIGHTING INVERTER UNIT INV1,InEcy	20	1	SLD	1600 (5.8A) 0.00%	0	0	
	SPD	30	3	SLD	0	0	0	
100	LIGHTING	20	1	12	0	1820 (6.6A) 0.94%	0	
100	LIGHTING	20	1	12	0	0	1485 (5.4A) 0.77%	
	SPARE - FUTURE RELOCATABLES	100	3		20000 (72.2A)	20000 (72.2A)	20000 (72.2A)	
	SPARE	20	1		0	0	0	
	SPARE	110	3		0	0	0	
					0	0	0	
					0	0	0	
					0	0	0	
					0	0	0	
					0	0	0	
					0	0	0	
					0	0	0	
					0	0	0	
					0	0	0	
					0	0	0	
					0	0	0	
					0	0	0	
	KVA (AMPS):				46.60 (168.2A)	46.82 (169.0A)	46.49 (167.8A)	

Total KVA 139.91
Total Amps 168

SERVICE ENTRANCE
LISTED PANEL

VD CALCULATION TYPE
CON CONNECTED LOAD
CB 80% OF BREAKER RATING

BUS RATING: 100A 120/208V, 3PH, 4W
MAIN: MLO MAIN LUG ONLY
SPACES: 42 FULL SIZE BOLT-ON CB SPACES
AIC RATING: 22 KAIC PANEL

(N) PANEL LP2

FLUSH MOUNT, NEMA 1
LOCATION: CLASSROOM 1209
WITH EQUIPMENT GND BUS

CKT %VD	DIST (FT)	NOTES	LOAD TYPE	CKT	DESCRIPTION	TRIP	POLES	COND SIZE	CONNECTED VA PHASE A	PHASE B	PHASE C	COND SIZE	POLES	TRIP	DESCRIPTION	CKT	LOAD TYPE	NOTES	DIST (FT)	CKT %VD
		4	M	1	HPC-1.208	30	2	10	2372 720			12	1	20	CLASSROOM 1210	2	R			
		4	M	3	HPC-1.208		2	10		2372 720		12	1	20	CLASSROOM 1210	4	R			
		4	M	5	FC-1.208	15	2	12			676 600	12	1	20	CLASSROOM 1210	6	R			
		4	M	7	FC-1.208		2	12	676 720			12	1	20	CLASSROOM 1209	8	R			
		4	M	9	HPC-1.209	30	2	10		2372 720		12	1	20	CLASSROOM 1209	10	R			
		4	M	11	HPC-1.209		2	10			2373 600	12	1	20	CLASSROOM 1209	12	R			
		4	M	13	FC-1.209	15	2	12	676 720			12	1	20	CLASSROOM 1208	14	R			
		4	M	15	FC-1.209		2	12		676 720		12	1	20	CLASSROOM 1208	16	R			
		4	M	17	HPC-1.210	30	2	10			2372 720	12	1	20	CLASSROOM 1208	18	R			
		4	M	19	HPC-1.210		2	10	2372 360			12	1	20	BUILDING EXTERIOR	20	R			
		4	M	21	FC-1.210	15	2	12		676 0			1	20	SPARE	22				
		4	M	23	FC-1.210		2	12			676					24	N			
				25	SPARE	20	1		0 0							26				
				27	SPARE	20	1			0 0						28				
				29	SPARE	20	1				0 0					30				
				31	SPARE	20	1		0 0							32				
				33	SPARE	20	1			0 0						34				
				35	SPARE	20	1				0 0					36				
				37	SPARE	20	1		0 0							38				
				39	SPARE	20	1			0 0						40				
				41	SPARE	20	1				0 0					42				
								CON:	8616	8256	8017									
								25%:	0	0	0									
								SUB:	0	0	0									
								TOT:	8616	8256	8017									
								AMPS	72	69	67									

LOAD (VA)	LOAD TYPE LEGEND	
6600	R	RECEPTACLE
0	L	LIGHTING (125% OF CONNECTED LOAD CEC 215.2)
18289	M	MECHANICAL
0	K	KITCHEN APPLIANCE
0	N	NON-CONTINUOUS MISC.
0	C	CONTINUOUS MISC. (125% OF CONNECTED LOAD CEC 215.2)

BUS RATING: 225A 120/208V, 3PH, 4W
MAIN: MLO MAIN LUG ONLY
SPACES: 60 FULL SIZE BOLT-ON CB SPACES
AIC RATING: 22 KAIC PANEL

(N) PANEL LP1

FLUSH MOUNT, NEMA 1
LOCATION: CLASSROOM 1205
WITH EQUIPMENT GND BUS

CKT %VD	DIST (FT)	NOTES	LOAD TYPE	CKT	DESCRIPTION	TRIP	POLES	COND SIZE	CONNECTED VA PHASE A	PHASE B	PHASE C	COND SIZE	POLES	TRIP	DESCRIPTION	CKT	LOAD TYPE	NOTES	DIST (FT)	CKT %VD
		4	M	1	HPC-1.204	30	2	10	2372 720			12	1	20	CLASSROOM 1204	2	R			
		4	M	3	HPC-1.204		2	10		2372 720		12	1	20	CLASSROOM 1204	4	R			
		4	M	5	FC-1.204	15	2	12			676 600	12	1	20	CLASSROOM 1204	6	R			
		4	M	7	FC-1.204		2	12	676 720			12	1	20	CLASSROOM 1205	8	R			
		4	M	9	HPC-1.205	30	2	10		2372 720		12	1	20	CLASSROOM 1205	10	R			
		4	M	11	HPC-1.205		2	10			2372 600	12	1	20	CLASSROOM 1205	12	R			
		4	M	13	FC-1.205	15	2	12	676 720			12	1	20	CLASSROOM 1206	14	R			
		4	M	15	FC-1.205		2	12		676 720		12	1	20	CLASSROOM 1206	16	R			
		4	M	17	HPC-1.206	30	2	10			2372 600	12	1	20	CLASSROOM 1206	18	R			
		4	M	19	HPC-1.206		2	10	2372 720			12	1	20	CLASSROOM 1207	20	R			
		4	M	21	FC-1.206	15	2	12		676 720		12	1	20	CLASSROOM 1207	22	R			
		4	M	23	FC-1.206		2	12			676 600	12	1	20	CLASSROOM 1207	24	R			
		4	M	25	HPC-1.207	30	2	10	2372 720			12	1	20	BUILDING EXTERIOR	26	R			
		4	M	27	HPC-1.207		2	10		2372 360		12	1	20	ELECTRIC / FIRE RISER ROOM	28	R			
		4	M	29	FC-1.207	15	2	12			676 0		1	20	SPARE	30				
		4	M	31	FC-1.207		2	12	676 360			12	1	20	TOILET / CUSTODIAN	32	R			
		4	M	33	DS-1.201	20	2	12		1716 0			1	20	SPARE	34				
		4	M	35	DS-1.201		2	12			1716 0		1	20	SPARE	36				
		4	M	37	EF-1.201	20	1	12	20 0				1	20	SPARE	38				
				39	SPARE	20	1			0 0			1	20	SPARE	40				
		3	R	41	IT ROOM	20	1	12			500 1500	10	1	30	IT ROOM	42	R	3		
		3	R	43	IT ROOM	20	1	12	180 1500			12	1	20	WH-1	44	N	4		
		3	R	45	IT ROOM	20	1	12		500 0						46				
		3	N	47	FIRE SPKLR BELL	20	1	12			500 1500	10	1	30	IT ROOM	48	R	3		
				49	SPARE	20	1		0 0							50				
				51	SPARE	20	1			0 0						52				
				53	SPARE	20	1				0 0					54				
				55	PANEL LP2	100	3	SLD	8616 0							56				
				57	PANEL LP2		3	SLD		8616 0						58				
				59	PANEL LP2		3	SLD			8017 0					60				
								CON:	23420	22540	22905									
								25%:	0	0	0									
								SUB:	0	0	0									
								TOT:	23420	22540	22905									
								AMPS	195	188	191									

LOAD (VA)	LOAD TYPE LEGEND	
13780	R	RECEPTACLE
0	L	LIGHTING (125% OF CONNECTED LOAD CEC 215.2)
27836	M	MECHANICAL
0	K	KITCHEN APPLIANCE
2000	N	NON-CONTINUOUS MISC.
0	C	CONTINUOUS MISC. (125% OF CONNECTED LOAD CEC 215.2)

ELECTRICAL PANEL SCHEDULE NOTES

1. LONG CONTINUOUS LOAD (LCL): ADDITIONAL 25% ADDED AT BOTTOM OF PANEL. FEEDER CALCULATED AT 125% OF TOTAL CONNECTED LOAD.
2. ROUTE BRANCH CIRCUIT THROUGH LIGHTING CONTROLS.
3. PROVIDE RED HANDLE AND LOCKING DEVICE ON THIS CIRCUIT BREAKER.
4. VERIFY CIRCUIT BREAKER SIZE AND LOAD WITH SERVING EQUIPMENT APPROVED SUBMITTALS, PRIOR TO PURCHASING EQUIPMENT.

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EXP 09/30/26 REF. 24-8089

CONSULTANT INFORMATION

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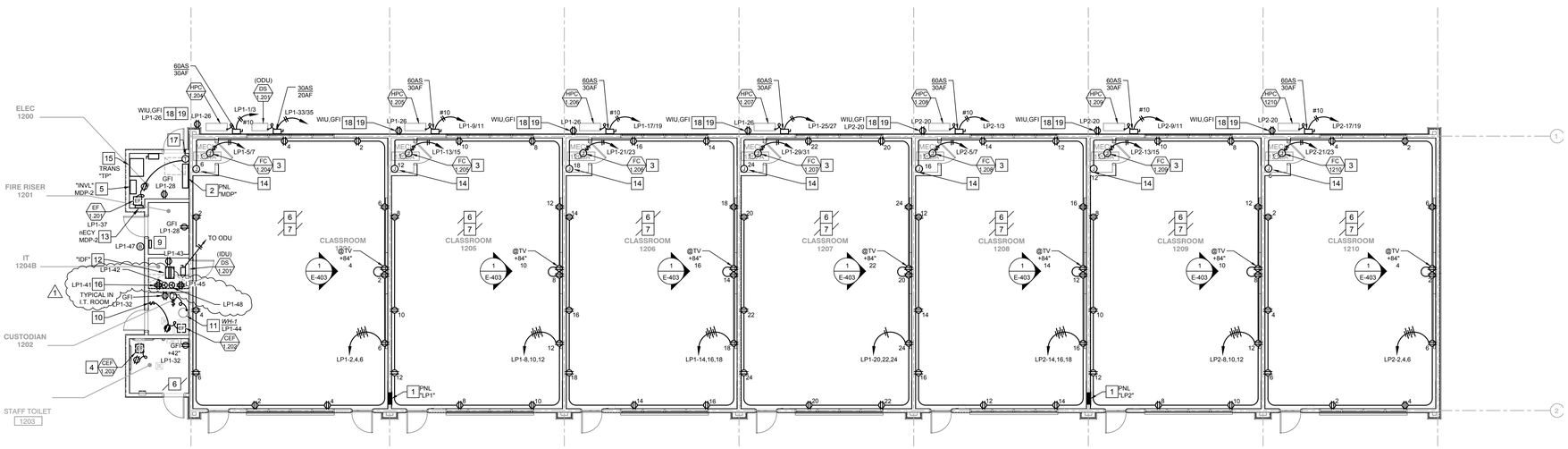
4			
3			
2			
1	ADDENDUM 01	8/14/26	

DRAWN JC/RP/TH
CHECKED JT
DATE 3/14/25
JOB. NO. 24010

SHEET TITLE PANEL SCHEDULES

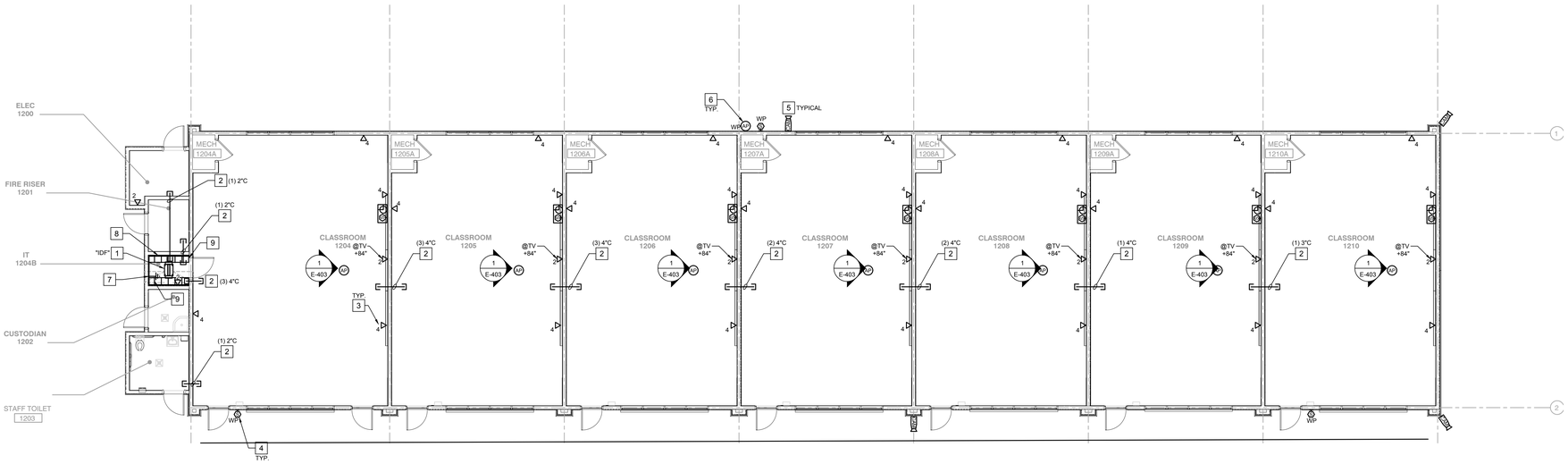
SHEET E-004



POWER FLOOR PLAN - CLASSROOM BLDG.

SCALE: 1/8" = 1'-0"

NORTH



COMMUNICATIONS FLOOR PLAN - CLASSROOM BLDG.

SCALE: 1/8" = 1'-0"

NORTH

☐ REFERENCE NOTES - POWER

1. (N) NEMA 1, BUILDING ELECTRICAL PANEL--REFER TO SINGLE LINE DIAGRAM FOR FEEDER CONDUIT AND CONDUCTOR SIZE, AND PANEL SCHEDULE FOR CIRCUITED LOADS AND PANEL REQUIREMENTS. MOUNT PER DETAIL 1/E-402.
2. (N) NEMA1, BUILDING DISTRIBUTION PANEL--REFER TO SINGLE LINE DIAGRAM FOR FEEDER CONDUIT AND CONDUCTOR SIZE, AND PANEL SCHEDULE FOR CIRCUITED LOADS AND PANEL REQUIREMENTS. MOUNT PER DETAIL 2/E-402.
3. PROVIDE LINE VOLTAGE CONNECTION TO FAN COIL UNIT FACTORY DISCONNECT SWITCH PER MECHANICAL PLANS. COORDINATE EXACT LOCATION WITH MECHANICAL CONTRACTOR PRIOR TO ROUGH-IN. UNIT ELECTRICAL REQUIREMENTS ARE 208V, 1PH, 60HZ, 6.5 MCA, 15A MOCP, UNLESS NOTED OTHERWISE. VERIFY WITH SUPPLIED EQUIPMENT.
4. INTERLOCK EXHAUST FAN TO LIGHTING IN RESTROOM VIA LINE VOLTAGE, 2-RELAY/POLE OCCUPANCY SENSING CEILING UNIT (WITH KEYED SWITCH ON/OFF). REFER TO SHEET E-201 FOR RESTROOM LIGHTING CONTROL METHOD REQUIRED AND SWITCH LOCATION. PROVIDE WITH 5-MINUTE TIME DELAY OFF FOR EXHAUST, PER MECHANICAL PLANS.
5. (N) EMERGENCY EGRESS LIGHTING INVERTER. SEE DETAIL 4/E-402 FOR MOUNTING AND DETAIL 2/E-003 FOR WIRING REQUIREMENTS.
6. RECEPTACLES IN THIS ROOM SHALL BE TAMPER RESISTANT TYPE.
7. ELECTRICAL CONTRACTOR SHALL PROVIDE PORTABLE ASSISTED LISTENING SYSTEM KIT PER DETAIL 5/E-404, TO SERVE THIS ASSEMBLY AREA (CLASSROOM), PER CBC 11B-219. PROVIDE ASSISTED LISTENING SIGNAGE IN ACCORDANCE WITH ARCHITECTURAL PLANS.
8. PROVIDE WEATHER PROOF, TAMPER RESISTANT GFI RECEPTACLE FOR GROUNDS MAINTENANCE WITH LOCKABLE, WHILE-IN-USE COVER.
9. FIRE ALARM TERMINAL CABINET.
10. PROVIDE ON/OFF, 120V, 20A TOGGLE SWITCH CONTROL OF EXHAUST FAN PER MECHANICAL. LABEL WALL SWITCH "CEF-1202".
11. PROVIDE LINE VOLTAGE CONNECTION TO WATER HEATER PER PLUMBING PLANS. ROUTE CIRCUIT THROUGH 120V, 20A TOGGLE SWITCH LOCAL TO UNIT. COORDINATE EXACT LOCATION WITH MECHANICAL CONTRACTOR PRIOR TO ROUGH-IN. UNIT ELECTRICAL REQUIREMENTS ARE 120V, 1PH, 60HZ, 1500W, UNLESS NOTED OTHERWISE. VERIFY WITH SUPPLIED EQUIPMENT.
12. INTERMEDIATE DISTRIBUTION FRAME 'IDF'. SEE 2/E-403 FOR MOUNTING REQUIREMENTS, AND COMMUNICATIONS RISER DIAGRAM SHEET E-301 FOR CONNECTIVITY REQUIREMENTS.
13. (N) NLIGHT ECLYPSE LIGHTING CONTROLLER. SEE DETAIL 3/E-003.
14. PER MECHANICAL CONTROL DRAWINGS, PROVIDE 120VAC POWER TO 50VA THERMOSTAT CONTROL TRANSFORMER. COORDINATE LOCATION WITH MECHANICAL.
15. ELECTRICAL TRANSFORMER, SEE SINGLE LINE DIAGRAM.
16. VERIFY POWER OUTLET LOCATION AND MOUNTING HEIGHT (IN RELATION TO THE IDF RACK) WITH DISTRICT IT DEPARTMENT PRIOR TO ROUGH-IN.
17. LINE VOLTAGE THERMOSTAT FOR CONTROL OF ROOM EXHAUST FAN, PER MECHANICAL. ROUTE EXHAUST FAN 120V POWER THROUGH THERMOSTAT. CONFIRM LOCATION WITH MECHANICAL CONTRACTOR PRIOR TO ROUGH-IN.
18. HVAC SERVICE EQUIPMENT RECEPTACLE OUTLET REQUIRED WITHIN 25' OF EQUIPMENT, PER CEC 210.63 & CMC 303.8.5(2).
19. PROVIDE WEATHER PROOF, TAMPER RESISTANT GFI RECEPTACLE FOR GROUNDS MAINTENANCE WITH LOCKABLE, WHILE-IN-USE COVER.

☐ REFERENCE NOTES - COMMUNICATIONS

1. 6 TYP. WP
2. 5 TYPICAL
3. TYP. 3
4. 4 TYP.

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SAN LUIS OBISPO HIGH SCHOOL

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DRAWN JC/RP/TH
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DATE 3/14/25
JOB. NO. 24010

SHEET TITLE: POWER & COMMUNICATIONS FLOOR PLAN – CLASSROOM BLDG.

SHEET E–202

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GEOTECHNICAL ENGINEERING
AND GEOLOGIC HAZARDS REPORT
SAN LUIS OBISPO HIGH SCHOOL
NEW CLASSROOM BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA

October 3, 2024

Prepared for

Mr. Ryan Harrigan
San Luis Coastal Unified School District

Prepared by

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October 3, 2024

FILE NO.: 300933-026

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PROJECT: SAN LUIS OBISPO HIGH SCHOOL
NEW CLASSROOM BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA

SUBJECT: Geotechnical Engineering and Geologic Hazards Report

CONTRACT REF: San Luis Coastal Unified School District Purchase Order No. 250887, Referencing Proposal to Provide a Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School, New Classrooms, 1499 San Luis Drive, San Luis Obispo, California, by Earth Systems Pacific, Doc. No SLO-2408-038.PRP, dated August 21. 2024

Dear Mr. Harrigan:

In accordance with the referenced agreement, this geotechnical engineering and geologic hazards report has been prepared for use in the development of plans and specifications for the new classroom building planned at San Luis Obispo High School in San Luis Obispo, California.

The geologic hazards for the campus were addressed for adjacent projects at the site by this firm for four previous nearby projects (ESP 2016a, 2016b, 2018 and 2020). In general, the geologic hazards discussed in those reports have not changed except for the seismic design values that are calculated using methods prescribed by the current California Building Code (CBC) (CBSC 2022). This report provides updated seismic hazard information, where appropriate, and updated seismic design values per the current CBC (CBSC 2022). This report also references the three previous reports (ESP 2016a, 2016b, 2018 and 2020) regarding geologic hazards and subsurface information considered applicable to this project.

Preliminary geotechnical recommendations are presented herein for site preparation, grading, utility trenches, foundations, slabs-on-grade, retaining walls, drainage and maintenance, and observation and testing. An electronic copy of this report is furnished for your use and distribution to others.

We appreciate the opportunity to have provided services for this project and look forward to working with you again in the future. If there are any questions concerning this report, please do not hesitate to contact the undersigned.

Sincerely,

Earth Systems Pacific

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1.0 INTRODUCTION

Based on information provided by the client, we understand the proposed New Classroom Building at San Luis Obispo High School will house eight individual classrooms, with a total footprint of approximately 8,400 square feet. The single-story structure will be located south of the Old Gymnasium (See Figures 1 and 2, Site Vicinity Map and Exploration Location Map, respectively, in Appendix A) and across the interior driveway (to the west) of the Main Courtyard. The structure will be of wood stud and/or steel frame construction, and it will be supported by conventional continuous and spread (pad) foundations, with interior concrete slabs-on-grade. Maximum wall and column loads on the order of 1.5 kips per linear foot and 25 kips, respectively, have been assumed. The project will also include exterior pedestrian flatwork with ramps and stairs to provide access as needed, and retaining walls less than 6 feet tall along the north and west sides of the building. Cuts and fills a maximum of 4 feet from the existing topography are anticipated. The new building will be served by the existing campus utility systems, extended underground. No other structures or vehicle pavements are planned. No drainage basins or low impact development/best management practices (LID/BMP) drainage features requiring infiltration testing will be constructed.

This project is under the jurisdiction of the Division of the State Architect (DSA), and it will be designed and constructed under the provisions of the 2022 California Building Code (CBC) (CBSC 2022). Our firm provided a geotechnical engineering and geologic hazards report for each of four previous nearby projects (ESP 2016a, 2016b, 2018 and 2020), whose locations are shown on Figure 2. These reports were approved by the California Geologic Survey (CGS) (2016a, 2016b, 2018 and 2020). Information utilized from those reports is referenced and the reports are provided in Appendix C.

2.0 SCOPE OF SERVICES

The scope of work for this report included the following: a field reconnaissance by a registered geotechnical engineer and a certified engineering geologist; review of the previous reports for nearby projects prepared by this firm (ESP 2016a, 2016b, 2018 and 2020) and attached in Appendix C; subsurface exploration; laboratory testing (geotechnical) on samples obtained during the current field investigation; geotechnical and geologic analyses of the data; and preparation of this report. The analysis and subsequent recommendations were based on the information regarding the project provided by the client.

This report and preliminary geotechnical recommendations are intended to comply with the considerations of Sections 1803A.1 through 1803A.7, J104.3 and J104.4, as applicable, of the 2022 California Building Code (CBC) (CBSC 2022); California Geological Survey (CGS) Note 48 (2022); Interpretation of Regulations (IR) Document A-4 (DSA 2021); and common geotechnical engineering and engineering geology practice in this area under similar conditions at this time. The geotechnical test procedures were accomplished in general conformance with the standards noted, as modified by common geotechnical engineering practice in this area under similar conditions at this time.

Preliminary geotechnical recommendations for site preparation, grading, utility trenches, foundations, slabs-on-grade, retaining walls, drainage and maintenance, and observation and testing are provided in this report. In addition to referencing the geologic hazards previously identified (ESP 2016a, 2016b, 2018 and 2020) that are generally considered valid for this project, we have provided a brief summary of the geologic hazards as well as provided updated seismic hazards and seismic design parameters in this report. The results of corrosivity testing with general conclusions, which were subcontracted to CERCO Analytical for the previous Pool and Equipment/Locker Building Report (ESP 2016b) are also referenced and the report is included in Appendix C. The information presented and referenced in this report is intended to guide the development of project plans and specifications. It is our intent that this geotechnical/geologic report be used exclusively by the client to form the geotechnical/geologic basis of the design, and in the preparation of plans and specifications. Application beyond this intent is strictly at the user's risk.

This report does not address issues in the domain of contractors such as, but not limited to, site safety, loss of volume due to stripping of the site, shrinkage of soils during compaction, excavatability, shoring, protection of existing slabs and foundations, temporary slope angles, dewatering, construction means and methods, etc. Analyses of the soil for mold potential, asbestos in man-made materials, lead, radioisotopes, hydrocarbons, or chemical properties (other than geotechnical corrosivity) are beyond the scope of this report. Ancillary features such as temporary access roads, and nonstructural fills are not within our scope and are also not addressed.

As there may be unresolved geotechnical issues with respect to this project, the geotechnical engineer should be retained to provide consultation as the design progresses, to review project plans as they near completion to assist in verifying that pertinent geotechnical issues have been

addressed and to aid in conformance with the intent of this report. In the event that there are any changes in the design or location of improvements, or if any assumptions used in the preparation of this report prove to be incorrect, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are verified or are modified in writing. The criteria presented in this report are considered preliminary until such time as any peer review or review by any jurisdiction has been completed, conditions are observed by the geotechnical engineer in the field during construction, and the recommendations have been verified as appropriate or modified in writing.

3.0 SITE SETTING

The approximate coordinates and elevation of the project area, as obtained from the Google Earth website (Google Earth 2024), are latitude 35.2846N, longitude 120.6507W, and approximately 262 feet above mean sea level, respectively. As seen on the Exploration Location Map – Figure 2 in Appendix A, the proposed building area is bordered by the Old Gymnasium to the north, the Classroom Annex (Building 900) to the northeast, the Wellness Center and Main Courtyard to the east, the Main Gymnasium, Locker Rooms and Pool to the south, and a turf playfield to the west. The site was previously occupied by portable buildings that have been removed. The locations and dispositions of underground utility lines on or adjacent to the site are unknown.

4.0 FIELD INVESTIGATION AND LABORATORY ANALYSIS

The subsurface exploration for the current field investigation consisted of drilling two exploratory borings in the project area on August 29, 2024, to a maximum depth of approximately 21.5 feet below the existing ground surface (bgs). The borings were drilled with a GTech GT-8 truck mounted drill rig, equipped with 6-inch outside diameter hollow stem auger and an automatic trip hammer for sampling. As the borings were drilled, soil samples were obtained at selected depths using a ring-lined barrel sampler (ASTM D 3550-17 with shoe similar to D 2937-17). Standard Penetration Test (SPT) samples were also obtained at selected depths (ASTM D 1586-18). Additionally, bulk samples were obtained from the auger cuttings. The borings were backfilled with soil cuttings. The approximate locations of the borings are shown on Figure 2 - Exploration Location Map in Appendix A.

Soils encountered in the borings were categorized and logged in general accordance with the Unified Soil Classification System and ASTM D 2488-17. Copies of the boring logs and a Boring Log Legend are also included in Appendix A. In reviewing the boring logs and legend, the reader

should recognize that the legend is intended as a guideline only, and there are a number of conditions that may influence the soil characteristics as observed during drilling. These include, but are not limited to, the presence of cobbles or boulders, cementation, variations in soil moisture, presence of groundwater, and other factors. It should also be noted that the descriptions of bedrock must span a much wider range of density and strength characteristics than soil, and are relative to other *bedrock* strata. For example, fractured and weathered bedrock may be described as "soft," yet it will be considerably harder than almost any type of soil. Conversely, a clay soil may be described as "hard," however it will not be nearly as hard as the "soft" sandstone bedrock encountered on this site. Consequently, the logger must exercise judgement in interpreting the subsurface characteristics, possibly resulting in soil and bedrock descriptions that vary somewhat from the legend.

Ring samples obtained from the currently drilled borings were tested for unit weight and moisture (ASTM D 2937-17, modified for ring liners and ASTM D 2216-19). A bulk sample of the near surface soil was tested for expansion index (ASTM D 4829-21). The current laboratory test results are presented in Appendix B.

5.0 GENERAL SUBSURFACE AND GEOLOGIC PROFILE

The two borings advanced for the current project encountered fill (loose to medium dense, poorly graded sand with gravel) from the surface to a depth of 2 feet bgs in Boring 1, and to 1.5 feet bgs in Boring 2. Below the fill in Boring 1 was alluvium that consisted of stiff to very stiff sandy lean clay and stiff lean clay. At 15 feet bgs in Boring 1, bedrock (soft, intensely weathered sandstone of the Franciscan Mélange) was encountered; the sandstone bedrock extended to the boring termination depth of 21.5 feet bgs. In Boring 2, bedrock (soft, intensely weathered sandstone of the Franciscan Mélange) was encountered directly below the fill; the sandstone bedrock extended to the boring termination depth of 15.25 feet bgs. Similar subsurface conditions (i.e., fill, clayey alluvium and bedrock) were encountered in the explorations performed for the previous field investigations by this firm (ESP 2016a, 2016b, 2018 and 2020).

Subsurface water was not encountered to the maximum depth explored of 21.5 feet bgs in the current borings. Borings referenced for the Track and Stadium Report (ESP 2020) encountered groundwater at approximately 34 feet bgs. Borings drilled for the Annex/Classroom Building (ESP 2016a), the Pool and Equipment/Locker Building (ESP 2016b) and the Building 100 Modernization project (ESP 2018) did not encounter groundwater to the maximum depth explored of up to 31 feet bgs.

Please refer to the logs for the current borings in Appendix A, and to the boring logs in the previous reports by this firm (ESP 2016a, 2016b, 2018 and 2020) in Appendix C for a more complete description of the subsurface conditions encountered at this site and the adjacent sites.

6.0 GEOLOGIC HAZARDS

The geotechnical engineering and geologic hazards report for the Annex/Classroom Building project (ESP 2016a), which is included in Appendix D of the Swimming Pool and Equipment/Locker Building (ESP 2016b), which, in turn, is included in Appendix C of this report, is located approximately 230 feet northwest of this project site. That report, and several of the references noted in it, were reviewed as part of the work scope for this project. Based on the subsurface conditions encountered in the borings for the current project, in our opinion, the conclusions and recommendations with respect to geology, seismicity (with the exception of site class), and geologic hazards presented in the report for the Annex/Classroom Building project (ESP 2016a) would also be valid for this project. The geologic hazards associated with this project are summarized below for the convenience of the reviewers.

- Surface ground rupture – the site is not within a State or County designated special studies zone for earthquake faulting. There are no known faults on-site or trending towards the site.

- Liquefaction – The site is within a County designated area of low liquefaction potential. Sandstone bedrock was encountered at shallow depth during our geotechnical investigation for this project and the potential for liquefaction at the site is considered nil.

- Seismically induced settlement – Due to the relatively shallow depth to bedrock and the presence of stiff to very stiff alluvial clay soils the potential for seismically induced settlement to occur at the site is considered nil.

- Slope stability – The site is within a generally flat and level part of campus with no significant slopes on or adjacent to it that pose a hazard from on-site or off-site slope movements. There is an un-named ridge approximately 650 feet east of campus that is roughly 1,000 feet high. A comprehensive slope stability analysis was performed for the Building 100 project (ESP 2018) and the ridge was deemed not to present a significant landslide hazard to the campus.

- Flooding – Approximately the western half of campus is within a mapped 0.2-percent annual chance flood zone associated with San Luis Obispo Creek; however, this half of campus has primarily been developed with sports fields, tennis courts, and student parking. The site is within an area mapped as Zone X, an area of minimal flood hazard.

- Naturally occurring asbestos (NOA) – The sandstone bedrock and alluvial deposits encountered in the subsurface at the site during our geotechnical investigation are not generally associated with asbestiform minerals and the potential that friable asbestos is encountered during grading and development at the site is extremely low.

- Radon gas – The California Geological Survey has mapped the site as low for indoor radon potential.

7.0 SEISMICITY

Ground Motion Analyses

In accordance with Note 48 (CGS 2022), the 2022 CBC (CBSC 2022) and ASCE 7-16 (2017, 2018 and 2021), an assessment was made to determine the need for employing "Site-Specific Ground Motion Procedures" to calculate the ground motion parameters for the project. Based on our site evaluation utilizing Standard Penetration Tests (SPT) from the current and previous investigations, the subsurface characteristics are those of Site Class C – Very Dense Soil and Soft Rock as defined by Table 20.3-1, Site Classification in ASCE 7-16 (2017); therefore, a site specific ground motion hazard analysis is not required.

The mapped and general procedure ground motion values for Site Class C were obtained from the Structural Engineers Association of California seismic design map tool (SEAOC 2024) using ASCE 7-16 (2017).

The 40 closest faults to the site that potentially could cause severe seismic shaking at the site are summarized in Table D-1, Fault Parameters, presented in Appendix D. Table D-2 in Appendix D is a summary of Historical Earthquakes in the vicinity of the project site, with magnitudes greater than or equal to 5.0.

The primary seismic hazards at the site are from earthquakes generated by the local Oceanic-West Huasna, Los Osos, Rinconada, San Luis Range, and Hosgri faults and the more distant San Andreas fault (USGS 2024). Although these listed faults are thought to potentially generate the most severe seismic shaking at the site, any regional fault could produce seismic shaking at the site.

The 2022 CBC (CBSC 2022) seismic design criteria are based on a Design Earthquake that produces ground motion ⅔ of the maximum considered earthquake (MCE) with 2 percent probability of occurrence in 50 years.

Seismic Design Category

Section 1613A.2.5 of the 2022 CBC (CBSC 2022) states that *structures classified as Risk Category I, II or III that are located where the mapped spectral response acceleration parameter at 1-second period, S_1, is greater than or equal to 0.75 shall be assigned to Seismic Design Category E, others shall be assigned to Seismic Design Category D*. The mapped S_1 for the site, based on Site Class C, is 0.397, which is less than 0.75; therefore, the site should be assigned to Seismic Design Category D.

Seismic Design Parameters

This site may be subject to strong ground shaking due to potential fault movements along regional faults. The minimum seismic design should comply with the 2022 CBC (CBSC 2022) and ASCE 7-16 (2017, 2018, 2021). The resulting seismic coefficients considering Site Class C are summarized in Table 1 below.

Table 1: General Procedure Seismic Parameters (2022 CBC/ASCE 7-16)

Seismic Design Category	D
Site Class	C
Mapped and Code Based Ground Motion	
Short Period Spectral Response, S_s	1.079 g
1 second mapped Spectral Response, S_1	0.397 g
Design Earthquake Ground Motion	
Short Period Spectral Response, S_{DS}	0.863 g
1 second Spectral Response, S_{D1}	0.397 g
Peak Ground Acceleration (PGA_M)	0.574 g
MCE Spectral Response Acceleration	
Short Period Spectral Response, S_{MS}	1.294 g
1 Second Period Spectral Response, S_{M1}	0.596 g
Site Amplification Factors	
Short Period Site Coefficient, F_a	1.20
1 Second Period Site Coefficient, F_v	1.50
Vertical Site Coefficient, C_v	1.116
Risk Coefficient (Short Period), C_{Rs}	0.898
Risk Coefficient (1 Second Period), C_{R1}	0.901

Acceleration values provided are estimates only. Vertical accelerations are typically ⅓ to ⅔ of the horizontal accelerations but can equal or exceed the horizontal accelerations depending upon the fault type, local site effects, and amplification.

8.0 CONCLUSIONS

In our opinion, the site is suitable, from a geotechnical engineering standpoint, for the construction of the proposed classroom building and other improvements as described in the "Introduction" Section of this report, provided the recommendations contained herein are implemented in the design and construction. The primary geotechnical engineering concerns at the site are considered to be the potentials for strong ground shaking, the presence of fill, and the soil's expansion, corrosion, and radon potentials. Frost depth is also discussed. Due to the shallow depth to bedrock, the stiff to very stiff condition of the clays that overlie the bedrock (where present), and the lack of groundwater, there is no potential for liquefaction and seismically induced settlement to affect the project site. Provided that the building area is prepared as recommended in the "Grading" Section of this report, continuous perimeter and interior spread (pad) foundations may be used to support the proposed classroom building.

Strong Ground Shaking

The site is in a region of high seismic activity, with the potential for large seismic events that could generate strong ground shaking. A seismic analysis was undertaken to provide current seismic acceleration design parameters. Our methods and the results of the seismic analysis are presented in the "Seismicity" Section of this report. Seismic acceleration parameters should be utilized in the design of the structures so that potential damage is reduced during a seismic event.

Presence of Fill

Approximately 1.5 to 2.0 feet of fill was found in both borings. The fill was likely placed when the project area was prepared for the portable buildings that previously occupied the site. The fill also appears to have been disturbed when the portable buildings were removed. To create acceptable and relatively uniform bearing and settlement conditions, a program of overexcavation and recompaction of the fill as well as a minor thickness of the underlying alluvium and bedrock, is recommended prior to placement of any additional fill or construction of new foundations.

Expansive Soils

An expansion index test performed on a sample of the alluvial clay soils below the fill produced a result of 55. Per Section 1803A.5.3 of the 2022 CBC (CBSC 2022), the site soils are considered

"expansive." Using the terminology typically associated with the ASTM test method for expansion, the soils are considered to have "medium" expansion potential. Expansive soils tend to swell with seasonal increases in moisture and shrink during the dry season as subsurface moisture decreases. The volume changes that these materials undergo in this cyclical pattern can stress and damage slabs and foundations if precautionary measures are not incorporated into the design and construction procedures. The foundations for the structure should be deepened below typical minimum depths for single-story structures. A layer of imported nonexpansive soil should be placed below all interior slabs-on-grade and exterior pedestrian flatwork. The fill soils, classified during drilling as poorly graded sand with gravel, were judged to be nonexpansive; this classification should be verified during construction. Assuming it is kept segregated from the underlying expansive clays and its expansion potential is verified, the existing fill may be stockpiled for reuse as nonexpansive material during the site grading process.

Corrosion Potential

As indicated in the Corrosivity Test Report by CERCO Analytical for the New Swimming Pool and Equipment/Locker Building project to the south (see Appendix C of ESP 2016b, included in Appendix C of this report) and the Soil Corrosivity Study by HDR, Inc., for the Annex/Classroom Building (ESP 2016a) project to the northeast (see Appendix D of ESP 2016b, included in Appendix C of this report), the soils were classified as severely corrosive to ferrous metals and aggressive to copper. Electrical resistivities of the samples tested were in the moderately corrosive category with as-received moisture contents and became corrosive to severely corrosive when saturated. Soil pH values were mildly alkaline, soluble salt contents were low to moderate, and soil nitrate concentrations were high. In our opinion, the recommendations regarding protection of pipelines, buried concrete structures and other improvements as contained in the Corrosivity Test Report by CERCO Analytical for the New Swimming Pool and Equipment/Locker Building project to the south (see Appendix C of ESP 2016b, included in Appendix C of this report) and the Soil Corrosivity Study by HDR, Inc., for the Annex/Classroom Building project to the northeast (see Appendix D of ESP 2016b, included in Appendix C of this report) would be appropriate for this project.

Radon Potential

The architect/engineer should incorporate appropriate measures in the design and construction of the proposed improvements, as needed, to mitigate the low potential for radon activity.

Frost Depth

The climate in the project area is moderate, and only very occasional surficial frost is anticipated during the coldest periods of the year; no ground freeze to any significant depth is anticipated. Therefore, design of foundations to accommodate frost depth is not considered necessary.

9.0 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

The following recommendations are for improvements constructed as described in the "Introduction" Section of this report. If locations, elevations, structural loads, etc., change, the recommendations contained herein may require modification. In developing the following recommendations, it was assumed that irrigated landscaping or flatwork will be installed within a zone of at least five feet around the perimeter of all improvements; the intent is to keep the soils in a relatively uniform moisture condition year-round.

Unless otherwise noted, the following definitions are used in the recommendations presented below. Where terms are not defined, definitions commonly used in the construction industry are intended.

- **Building Area –** The area within and extending a minimum of 5 feet beyond the perimeter of the new building foundations. The building area includes any retaining walls, walkways or other improvements that are connected to the structure and that are intended to act in a manner similar to it.
- **Sitework Retaining Wall Areas –** The areas within and extending a minimum of 3 feet beyond the foundation limits of all sitework retaining walls.
- **Flatwork Areas –** The areas within the footprints of all exterior pedestrian flatwork.
- **Grading Area –** The entire area to be graded, including the building, any sitework retaining walls and exterior pedestrian flatwork areas.
- **Existing Grade –** Elevations of the site that existed as of the date of this report.
- **Finish Grade –** The planned final elevation of the unimproved soil surface beyond the building, sitework retaining wall and flatwork areas.
- **Subgrade –** The elevation in exterior pedestrian flatwork areas where nonexpansive soils are placed to support flatwork.
- **Scarified –** Plowed or ripped in two orthogonal directions to a depth of not less than 8 inches.

- **Moisture Conditioned –** Adjusting the soil moisture to optimum moisture content, or just above, prior to application of compactive effort, unless stated otherwise.
- **Compacted/Recompacted –** Soils placed in level lifts not exceeding 8 inches in loose thickness and compacted to a minimum of 90 percent of maximum dry density, unless stated otherwise, based on maximum dry density by ASTM D 1557-12/21 and field density by ASTM D 6938-23, or other methods acceptable to the geotechnical engineer and jurisdiction.

Site Preparation

1. The ground surface in the grading areas should be prepared for construction by removing any existing improvements, vegetation, large roots, debris, organic topsoil, and other deleterious materials. Existing utility lines that will not remain in service should be either removed or abandoned. The appropriate method of abandonment will depend upon the type and depth of the utility. Recommendations for abandonment can be made as necessary.

2. Voids created by the removal of materials or utilities described above should be called to the attention of the geotechnical engineer. No fill should be placed unless the underlying soil has been observed by the geotechnical engineer.

3. Assuming its nonexpansive nature is verified, and it is kept clean and segregated from the underlying expansive site clays, the existing poorly graded sand with gravel fill soil may be stockpiled for later reuse as nonexpansive material during the site grading process.

Grading

1. Following site preparation, the existing soils and bedrock within the building area and sitework retaining wall areas should be overexcavated to a level plane at a minimum of 2 feet below lowest existing grade, or 1 foot below the deepest foundation element, whichever is deeper. The resulting excavated surface should be scarified, moisture conditioned, and recompacted.

2. Following site preparation and prior to the placement of any fill, the soil in exterior pedestrian flatwork areas should be removed to proposed subgrade elevation. The resulting excavated soil surfaces should then be scarified, moisture conditioned, and compacted. Please refer to the "Slabs-on-Grade" Section of this report for recommendations regarding placement of imported nonexpansive material below flatwork to provide protection from the expansive site soils.

3. Following site preparation and any excavations to grade, and prior to placement of fill, the soil in all other grading areas should be scarified, moisture conditioned and recompacted.

4. Voids created by dislodging cobbles and/or debris during scarification should be backfilled and recompacted, and the dislodged materials should be removed from the work area.

5. Previously removed site soils may be placed and compacted in thin, moisture conditioned lifts to 18 inches below bottom of slab elevation in the building area. The final 18 inches of fill to support interior slabs-on-grade should be nonexpansive and should be placed in moisture conditioned and compacted lifts.

6. Previously removed site soils and imported nonexpansive materials (if needed) may be placed and compacted in thin, moisture conditioned lifts to subgrade in flatwork areas and to finish grade in the rest of the grading areas.

4. Nonexpansive materials are defined as imported soils that fall in the GW, GM, GC, SP, SW, SC and SM categories per ASTM D 2487-17, and that have an expansion index of 10 or less (ASTM D 4829-21). Assuming its nonexpansive nature is verified, and it is kept clean and segregated from the underlying expansive site clays, the existing poorly graded sand with gravel fill soil may be used as nonexpansive material during the site grading process.

7. All imported soils used in the building area (if required to achieve design grades) should be nonexpansive and should have strength qualities equal to or better than the site soils. In addition, they should not exceed the geotechnical corrosivity potential of the site soils. See the Corrosivity Test Report by CERCO Analytical for the New Swimming Pool and Equipment/Locker Building project to the south (Appendix C of ESP 2016b, included in Appendix C of this report) and the Soil Corrosivity Study by HDR, Inc., for the Annex/Classroom Building project to the northeast (Appendix D of ESP 2016b, included in Appendix C of this report) for the corrosivity parameters of the site soils.

8. Proposed imported materials should be reviewed by the geotechnical engineer before being brought to the site, and on an intermittent basis during placement. In accordance with the requirements of the State of California's Department of Toxic Substances Control, any soil imported to the site should be sourced from SMARA (Surface Mining and

Reclamation Act) approved quarries; non-SMARA quarry material proposed for use should be tested by this firm for the presence of environmental contaminants before being imported to the site.

9. All materials used as fill should be cleaned of any debris and rocks larger than 3 inches in diameter. When fill material includes rocks, the rocks should be placed in a sufficient soil matrix to ensure that voids caused by nesting of the rocks will not occur and that the fill can be properly compacted.

10. All fill (on site or imported) should be placed in thin, moisture conditioned and level lifts, and compacted through the entire building area or the particular grading area being worked.

11. Placement of gravel layers, geotextiles, geogrids, or additional overexcavation may be recommended if loose or unstable conditions are encountered during grading. No fill should be placed in any grading area if the underlying soil is loose or unstable.

12. The recommended soil moisture content should be maintained throughout construction, and during the life of the structure and all other improvements. Failure to maintain the soil moisture content can result in desiccation cracks and disturbance, which are an indication of degradation of the soil compaction. If desiccation cracks are allowed to develop, or if soils near improvements such as foundations, flatwork, etc. are otherwise disturbed, damage to those improvements may result. Soils that have cracked or are otherwise disturbed should be removed, moisture conditioned, and recompacted.

13. The architect/engineer should incorporate appropriate measures for grading operations, as needed, to mitigate the low potential for radon activity.

Utility Trenches

1. Utility trenches adjacent to foundations should not be excavated within the zone of foundation influence, as shown in Typical Detail A in Appendix E.

2. Utilities that must pass beneath foundations should be placed with properly compacted utility trench backfill and the foundation should be designed to span the trench.

3. A select, noncorrosive, easily compacted sand should be used as bedding and shading immediately around utilities. The site soil or approved imported nonexpansive soil may

be used for trench backfill above the select material. In interior slab-on-grade and exterior pedestrian flatwork areas, trench backfill should match the thickness of any imported nonexpansive material designated to support the slabs or flatwork.

4. Prior to applying compactive effort, trench backfill should be moisture conditioned, placed in level lifts not exceeding 6 inches in loose thickness, and compacted to at least 90 percent of maximum dry density.

5. Compaction of trench backfill by jetting or flooding is not recommended at this site, due to the expansive clay soils and bedrock at depth. However, to aid in *encasing* utility conduits, particularly corrugated drainpipes, and multiple, closely spaced conduits in a single trench with the bedding and shading material, jetting or flooding may be useful. Flooding or jetting should only be attempted with extreme caution, and any flooding or jetting operation should be subject to review by the geotechnical engineer.

6. Long-term settlement of properly compacted site soils or imported nonexpansive materials should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill. Improvements that are constructed over or near trenches should be designed to accommodate the potential for settlement.

7. The Corrosivity Test Report by CERCO Analytical for the New Swimming Pool and Equipment/Locker Building project to the south (Appendix C of ESP 2016b, included in Appendix C of this report) and the Soil Corrosivity Study by HDR, Inc., for the Annex/Classroom Building project to the northeast (Appendix D of ESP 2016b, included in Appendix C of this report) should be used by the architect/engineer in specifying appropriate corrosion protection measures for utility improvements.

8. The architect/engineer should incorporate appropriate measures in the design of utility systems, as needed, to mitigate the low potential for radon activity.

9. The recommendations of this section are minimums only and may be superseded by the architect/engineer based upon soil corrosivity or the requirements of pipe manufacturers, utility companies or the governing jurisdiction.

Foundations

1. The building may be supported by continuous and spread footings bearing in firm compacted fill, as recommended in the "Grading" Section of this report.

2. All footings should have a minimum embedment depth of 21 inches below the lowest adjacent grade within 7 feet laterally from the bottom of the footing, and a minimum width of 12 inches. Spread footings should be at least 24 inches square.

3. If footings are excavated with a toothed bucket, then the footing excavation bottoms will be considered disturbed. In this case, all disturbed soil should be moisture conditioned and compacted prior to formwork, reinforcing steel and concrete placement.

4. Continuous footings and grade beams should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential only, minimum continuous footing and grade beam reinforcement should consist of two No. 4 rebar, one at the top and one at the bottom. Spread footing reinforcement should be determined by the architect/engineer.

5. Footings bearing in firm recompacted soil may be designed using maximum allowable bearing capacities of 2,000 psf for dead loads and 3,000 psf for dead plus live loads. Using these criteria, total maximum and differential static settlements are anticipated to be on the order of 0.75-inch and 0.5-inch over a horizontal distance of 25 feet, respectively.

6. Allowable bearing capacities may be increased by one-third when transient loads such as wind or seismicity are included. Foundations may be designed as necessary using the values contained in Table 1: Site-Specific Seismic Parameters in the "Seismicity" Section of this report.

7. To calculate resistance to lateral loads, an ultimate passive equivalent fluid pressure of 350 psf and an ultimate coefficient of friction value of 0.40 can be used. Lateral capacity is based on the assumption that any backfill adjacent to foundations has been properly compacted. Passive and friction components of resistance may be combined in the analysis without reduction to either value.

8. Footing excavations should be observed by the geotechnical engineer prior to placement of reinforcing steel. Footing excavations should be moistened above optimum moisture content, and no desiccation cracks should be present prior to concrete placement.

9. The Corrosivity Test Report by CERCO Analytical for the New Swimming Pool and Equipment/Locker Building project to the south (Appendix C of ESP 2016b, included in Appendix C of this report) and the Soil Corrosivity Study by HDR, Inc., for the Annex/Classroom Building project to the northeast (Appendix D of ESP 2016b, included in Appendix C of this report) should be used by the architect/engineer in specifying appropriate corrosion protection measures for foundations.

10. The architect/engineer should incorporate appropriate measures in the foundation design, as needed, to mitigate the low potential for radon activity.

Slabs-on-Grade

Interior Slabs-on-Grade

1. Interior slabs-on-grade should have a minimum thickness of 4 inches and should be reinforced and doweled to foundations per the specifications of the architect/engineer. At a minimum, interior slabs should be reinforced with No. 3 rebar at 24 inches on center each way, placed as directed by the architect/engineer. All structural slabs should contain minimum rebar meeting the criteria of ACI 318, Section 7.6.1.1 (ACI 2019). At a minimum, foundation dowels should be lap spliced to the slab rebar. The size and spacing of the dowels should match the size and spacing of the slab rebar.

Exterior Pedestrian Flatwork

1. Exterior pedestrian flatwork should have a minimum thickness of 4 inches. Based on soil expansion potential only, minimum reinforcement for exterior pedestrian flatwork should consist of No. 3 rebar placed at 24 inches on-center each way.

2. In conventional construction, it is common to use 4 to 6 inches of imported sand beneath exterior pedestrian flatwork. On this site, due to the medium expansion potential of the site soils, there will be a risk of movement and damage to the flatwork if conventional measures are used. Heaving and cracking could occur. To reduce the potential for movement and damage, flatwork should be supported by up to 18 inches of imported nonexpansive imported soils. The more nonexpansive material provided, the better the protection from the expansive soils.

3. To further reduce the risk of movement of flatwork due to seasonal moisture variations or loss of soil from erosion, thickened edges or grade beams up to 21 inches deep can be provided around the perimeters of the flatwork. The deeper the perimeter thickened edges/grade beams provided, the better the protection from the expansive soils. At a minimum, any thickened edge or grade beam should be reinforced by two No. 4 rebar, one at the top and one at the bottom.

4. It is recognized that the measures recommended in the previous paragraphs for protecting flatwork from expansive soils are an added expense, possibly more expensive than simply replacing flatwork that has moved and/or cracked. Consequently, the above measures for protecting flatwork are only suggestions for consideration by the owner and/or architect/engineer. The degree to which flatwork is protected is left to the discretion of the owner and/or architect/engineer.

5. Flatwork should be constructed with frequent joints to allow articulation as the flatwork moves in response to seasonal soil temperature and moisture variations. The soil below flatwork should be moisture conditioned prior to casting the flatwork.

6. Flatwork at doorways, and at other areas where maintaining the elevation of the flatwork is desired, should be doweled to the perimeter foundations, at a minimum, by No. 3 dowels lapped to the flatwork rebar at 24 inches on center. In other areas, the flatwork may be doweled to the foundation or the flatwork may be allowed to "float free," at the discretion of the architect/engineer. Flatwork that is intended to float free should be separated from foundations by a felt joint or other means.

7. To provide stability for curbs adjacent to exterior pedestrian flatwork, they should be set back a minimum distance equal to one-third the height of any adjacent descending slope, but not less than 5 feet from the tops of slopes. Alternately, curbs may be deepened to provide stability. The geotechnical engineer should review, on an individual basis, any situation where curbs must be deepened to meet this recommendation.

<u>Moisture Vapor Transmission</u>

1. Due to the current use of impermeable floor coverings, water-soluble flooring adhesives, and the speed at which buildings are now constructed, moisture vapor transmission through slabs is a much more common problem than in past years. Where moisture vapor transmitted from the underlying soil would be undesirable, slabs should be protected

from subsurface moisture vapor. A number of options for vapor protection are discussed below; however, the means of vapor protection, including the type and thickness of the vapor retarder, if specified, are left to the discretion of the architect/engineer.

2. Where specified, vapor retarders should conform to ASTM Standard E 1745-17. This standard specifies properties for three performance classes; Class A, B and C. The appropriate class should be selected based on the potential for damage to the vapor retarder during placement of slab reinforcement and concrete. Unless it is determined that a permeance of 0.10 perms will not allow vapor to accumulate beneath moisture-sensitive flooring, adhesives, stored products and/or equipment, then a vapor retarder permeance of 0.010 perms is recommended, per ACI 302.1-15 (ACI 2015). Permeance of vapor retarders should remain below 0.010 perms after the conditioning tests of ASTM E 1745-17/23.

   Note: ASTM E 1745-17/23 has the same permeance threshold for Class A, B and C (0.1 perms). The class that is chosen will make a difference in how resistant the vapor retarder is to punctures and tears, but it will not ensure any better permeance values to protect floor coverings.

3. Several studies, including those of American Concrete Institute Committee 302 (ACI 2015), have concluded that excess water above the vapor retarder increases the potential for moisture damage to floor coverings and could increase the potential for mold growth or other microbial contamination. The studies also concluded that it is preferable to eliminate the typical sand layer beneath the slab and place the slab concrete in direct contact with a Class A vapor retarder, particularly during wet weather construction. However, placing the concrete directly on the vapor retarder requires special attention to using the proper vapor retarder, a very low water-cement ratio in the concrete mix, and special finishing and curing techniques.

4. Another option that may be a reasonable compromise between effectiveness and cost considerations is the use of a subslab vapor retarder protected by a sand layer. If a Class A vapor retarder is specified, the retarder can be placed directly on the subgrade. The retarder should be covered with a minimum 2 inches of clean sand. If a less durable vapor retarder is specified (Class B or C), a minimum of 4 inches of clean sand should be provided, and the retarder should be placed in the center of the clean sand layer. Clean

sand is defined as a well or poorly graded sand (ASTM D 2487-17) of which less than 3 percent passes the No. 200 sieve. Clean sand is considered to be part of the minimum 18 inches of imported nonexpansive materials recommended in the "Grading" Section of this report to be placed below interior slabs-on-grade, not in addition to it.

5. Regardless of the underslab vapor retarder selected, proper installation of the retarder per ASTM E 1643-18a is critical for optimum performance. Where utilized, the vapor retarder should be placed a minimum of 1 inch above the flow line of the drainage path surrounding the structures, or 1 inch above the area drain grates if area drains are used to collect runoff around the structures. As required by ASTM E 1643-18a, all seams and utility penetrations should be properly sealed. At terminating edges of the vapor retarder, the vapor retarder should be effectively sealed with accessories specifically designed to seal the material to new or existing concrete; details for edge sealing of the vapor retarder should be provided by the architect/engineer.

6. If the sand is used between the vapor retarder and the slab, it should be moistened only as necessary to promote concrete curing; saturation of the sand should be avoided, as the excess moisture would be on top of the vapor retarder, potentially resulting in vapor transmission through the slab for months or years.

7. Positive drainage away from the structure should be maintained; see the "Drainage and Maintenance" Section of this report for additional discussion of this issue. If water is allowed to pond near the structure, it may seep into the ground and migrate laterally through cracks or utility penetrations in the foundation, ultimately gaining access above the vapor retarder.

General

1. To reduce shrinkage cracks in flatwork, the concrete aggregates should be of appropriate size and proportion, the water/cement ratio should be low, the concrete should be properly placed and finished, contraction joints should be installed, and the concrete should be properly cured. This is particularly applicable to slabs that will be cast directly upon a vapor retarder and those that will be protected from transmission of vapor by use of admixtures or surface sealers. Concrete materials, placement, and curing specifications should be at the direction of the architect/engineer; AC 302.1R-15 (ACI 2015) is suggested as a resource for the architect/engineer in preparing such specification.

2. The Corrosivity Test Report by CERCO Analytical for the New Swimming Pool and Equipment/Locker Building project to the south (Appendix C of ESP 2016b, included in Appendix C of this report) and the Soil Corrosivity Study by HDR, Inc., for the Annex/Classroom Building project to the northeast (Appendix D of ESP 2016b, included in Appendix C of this report) should be used by the architect/engineer in specifying appropriate corrosion protection measures for flatwork.

3. The architect/engineer should incorporate appropriate measures in the exterior pedestrian flatwork design, as needed, to mitigate the low potential for radon activity.

Retaining Walls

1. Retaining walls should be founded in firm soil that has been recompacted per the "Grading" Section of this report. Foundations for all retaining walls should have minimum overall depths (not including any keyway) of 21 inches below lowest grade within 7 feet laterally of any adjacent slope.

2. Retaining wall footings should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential only, minimum retaining wall footing reinforcement should consist of two No. 4 rebar, one at the top and one at the bottom.

3. Retaining wall design may be based on the following parameters:

Table 2: Retaining Wall Design Parameters

Parameter	Backfill Type	Value
Active Equivalent Fluid Pressure	On Site Soils	45 pcf
	Imported Sand/Gravel	35 pcf
At-rest Equivalent Fluid Pressure	On Site Soils	60 pcf
	Imported Sand/Gravel	50 pcf
Passive Equivalent Fluid Pressure	Recompacted On Site Soils	350 pcf
Maximum Toe Pressure	Recompacted On Site Soils	3,000 psf
Coefficient of Sliding Friction	Recompacted On Site Soils	0.40

4. No surcharges are taken into consideration in the values presented in the previous paragraph. The maximum toe pressure is an *allowable* value; no factors of safety, load factors or other factors have been applied to the remaining values. With the exception of

the maximum toe pressure, these values will require application of appropriate factors of safety, load factors, and/or other factors as deemed appropriate by the architect/engineer.

5. The upper foot of backfill behind all retaining walls should consist of native or similar imported soil per the "Grading" Section of this report, except in areas where pedestrian flatwork will abut the top of the wall. In such cases, the backfill should extend to the nonexpansive or other select material below the improved surface, as appropriate. If gravel backfill is utilized, the gravel should be encased in a permeable synthetic filter fabric conforming to standard specification section 96-1.02B – Class C (Caltrans 2024).

6. The active and at-rest pressures presented in Table 2 are applicable to a horizontal retained surface behind the wall. Walls having a retained surface that slopes upward from the wall should be designed for an additional equivalent fluid pressure of 1 pcf for the active case and 1.5 pcf for the at-rest case, for every degree of slope inclination.

7. It is assumed that retaining wall heights will not exceed 6 feet; therefore, per Section 1803A.5.12.1 of the CBC (CBSC 2022), dynamic seismic lateral earth pressures are not required for the design. If retaining walls are planned that will retain more than 6 feet of backfill, the geotechnical engineer should be notified to provide updated earthwork recommendations and dynamic seismic lateral earth pressure increments, as needed.

8. Long-term settlement of properly compacted site soils, as well as imported sand or gravel retaining wall backfill should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill. Improvements that are constructed near the tops of retaining walls should be designed to accommodate long-term settlement.

9. All retaining walls should be drained with perforated pipe encased in a free-draining gravel blanket. The pipe should be placed with perforations facing downward and should discharge in a nonerosive manner away from foundations and other improvements. The gravel blanket should have a width of approximately 1 foot and should extend upward to approximately 1 foot from the top of the wall backfill. The upper foot should be backfilled with native soil, except in areas where flatwork will abut the top of the wall. In such cases, the gravel should extend to the nonexpansive or other select material per the "Grading" Section of this report below the improved surface, as appropriate. To reduce infiltration of the soil into the gravel blanket, a permeable synthetic filter fabric conforming to

Standard Specifications Section 96-1.02B – Class C (Caltrans 2024), should be placed between the two materials. Manufactured synthetic drains, such as Miradrain or Enkadrain are acceptable alternatives to the use of gravel, provided that they are installed in accordance with the recommendations of the manufacturer.

10. Where weep hole drainage can be properly discharged, the perforated pipe may be omitted in lieu of weep holes on maximum 4-foot centers. A filter fabric as described above should be placed between the weep holes and the drain gravel.

11. Walls facing areas where moisture transmission through the wall would be undesirable should be thoroughly waterproofed in accordance with the specifications of the architect/engineer.

12. The architect/engineer should bear in mind that retaining walls by their nature are flexible structures, and that surface treatments on walls often crack. Where walls are to be plastered or otherwise have a finish applied, the flexibility should be considered in determining the suitability of the surfacing material, spacing of horizontal and vertical control joints, etc. The flexibility should also be considered where a retaining wall will abut or be connected to a rigid structure, and where the geometry of the wall is such that its flexibility will vary along its length.

13. The Corrosivity Test Report by CERCO Analytical for the New Swimming Pool and Equipment/Locker Building project to the south (Appendix C of ESP 2016b, included in Appendix C of this report) and the Soil Corrosivity Study by HDR, Inc., for the Annex/Classroom Building project to the northeast (Appendix D of ESP 2016b, included in Appendix C of this report) should be used by the architect/engineer in specifying appropriate corrosion protection measures for retaining walls.

14. The architect/engineer should incorporate appropriate measures in the design of retaining walls to mitigate the low potential for radon activity.

Drainage and Maintenance

1. Per Section 1804A.4 of the CBC (CBSC 2022) unpaved ground surfaces should be *finish graded* to direct surface runoff away from foundations and other improvements at a minimum 5 percent grade for a minimum distance of 10 feet. The site should be similarly sloped to drain away from foundations, and other improvements during construction.

Where this is not practicable due to other improvements, etc., swales with improved surfaces, area drains, or other drainage facilities, should be used to collect and discharge runoff.

2. All eaves of the building should be fitted with roof gutters. Runoff from flatwork, roof gutters, downspouts, planter drains, area drains, etc. should discharge in a non-erosive manner away from foundations and other improvements in accordance with the requirements of the governing agencies. Erosion protection should be placed at all discharge points unless the discharge is to an improved surface.

3. To reduce the potential for planter drainage gaining access to subslab areas, any raised planter boxes adjacent to foundations should be installed with drains and sealed sides and bottoms. Drains should also be provided for areas adjacent to the structures and in landscape areas that would not otherwise freely drain.

4. If soils are disturbed during construction, stabilization of soils by vegetation or other means, *during* and *following* construction, is essential to reduce erosion damage. Care should be taken to establish and maintain vegetation. The landscaping should be planned and installed to maintain the surface drainage recommended above. Surface drainage should also be maintained during construction.

5. Maintenance of drainage and other improvements is critical to the long-term stability of the site and the integrity of the structure. Site improvements should be maintained on a regular basis.

6. Finished flatwork surfaces should be sloped to freely drain toward appropriate drainage facilities. Water should not be allowed to stand or pond on or adjacent to exterior pedestrian flatwork, or other improvements as it could infiltrate into the supporting soil, causing premature deterioration of flatwork or other improvements.

7. All exterior drains and drain outlets should be maintained to be free-flowing. Care should be taken to establish and maintain vegetation. Vegetation and erosion matting (if utilized) should be maintained or augmented as needed. Irrigation systems should be maintained so that soils around the structure are maintained at a relatively uniform year-round moisture content and are neither over-watered nor allowed to dry and desiccate.

8. To reduce the potential for disruption of drainage patterns and undermining of structures, fill areas, etc., all rodent activity should be aggressively controlled.

Observation and Testing

1. The recommendations contained in this report are based on a limited number of borings and rely on continuity of the subsurface conditions encountered.

2. It is assumed that the geotechnical engineer will be retained to provide consultation during the design phase, to interpret this report during construction, and to provide construction monitoring in the form of testing and observation.

3. At a minimum, the geotechnical engineer should be retained to provide:

    - Review of project plans as they near completion, to determine compliance with the recommendations of this report
    - Professional observation during grading, trench and retaining wall backfill, and foundation construction
    - Oversight of special inspection and compaction testing grading, trench and retaining wall backfill, and foundation construction

4. Special inspection of grading and backfill should be provided as per Section 1705A.6 and Table 1706A.6 of the CBC (CBSC 2022). The special inspector should be under the direction of the geotechnical engineer and/or the engineering geologist. At a minimum, the following items should be inspected and/or tested by the special inspector:

    - Stripping and clearing of all existing improvements, vegetation, and deleterious materials
    - Segregation and stockpiling of the existing on-site fill soils (if applicable)
    - Overexcavation to the recommended depth
    - Scarification and moisture conditioning of soil prior to compaction
    - Fill quality, placement, moisture conditioning and compaction
    - Utility trench backfill
    - Foundation excavations
    - Retaining wall drains and backfill

5. A program of quality assurance should be developed prior to beginning construction. At a minimum, the program should include all geotechnical items shown on the testing and inspection schedule of the approved plans. It should also include any additional inspection items required by the engineer and/or the governing jurisdiction. These items should be discussed at a preconstruction site meeting among a representative of the owner, the geotechnical engineer, special inspector, the project inspector, the engineer, and contractors. The geotechnical engineer should be notified at least 48 hours prior to beginning grading operations.

6. Locations and frequency of compaction tests should be per the recommendation of the geotechnical engineer at the time of construction. The recommended test location and frequency may be subject to modification by the geotechnical engineer, based upon soil and moisture conditions encountered, size and type of equipment used by the contractor, the general trend of the results of compaction tests, or other factors.

10.0 CLOSURE

Our intent was to perform the investigation in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the locality of this project under similar conditions. No representation, warranty, or guarantee is either expressed or implied. This report is intended for the exclusive use by the client as discussed in the “Scope of Services” Section. Application beyond the stated intent is strictly at the user's risk.

This report is valid for conditions as they exist at this time for the type of project described herein. The conclusions and recommendations contained in this report could be rendered invalid, either in whole or in part, due to changes in building codes, regulations, standards of geotechnical or construction practice, changes in physical conditions, or the broadening of knowledge.

If changes with respect to the project become necessary, if items not addressed in this report are incorporated into plans, or if any of the assumptions used in the preparation of this report are not correct, this firm shall be notified for modifications to this report. Any items not specifically addressed in this report should comply with the CBC of other applicable standards, and the requirements of the governing jurisdiction.

The preliminary recommendations presented in this geotechnical report are based upon the geotechnical conditions encountered at the site and may be augmented by additional requirements of the client, or by additional recommendations provided by the geotechnical

engineer based on peer or jurisdiction reviews, or conditions exposed at the time of construction. If Earth Systems Pacific is *not* retained to provide construction observation and testing services, it shall not be responsible for the interpretation of the information by others or any consequences arising therefrom.

This document, the data, conclusions, and recommendations contained herein are the property of Earth Systems Pacific. This report shall be used in its entirety, with no individual sections reproduced or used out of context. Copies may be made only by Earth Systems Pacific, the client, and the client's authorized agents for use exclusively on the subject project. Any other use is subject to federal copyright laws and the written approval of Earth Systems Pacific.

Thank you for this opportunity to have been of service. If you have any questions, please feel free to contact this office at your convenience.

End of Text.

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APPENDIX A

Figure 1 – Site Vicinity Map
Figure 2 - Exploration Location Map
Boring Log Legend
Boring Logs



N

NOT TO SCALE

BASE MAP PROVIDED BY: Google Earth (2024)

Earth Systems Pacific
4378 Old Santa Fe Road, San Luis Obispo, CA 93401
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(805) 544-3276 • Fax (805) 544-1786

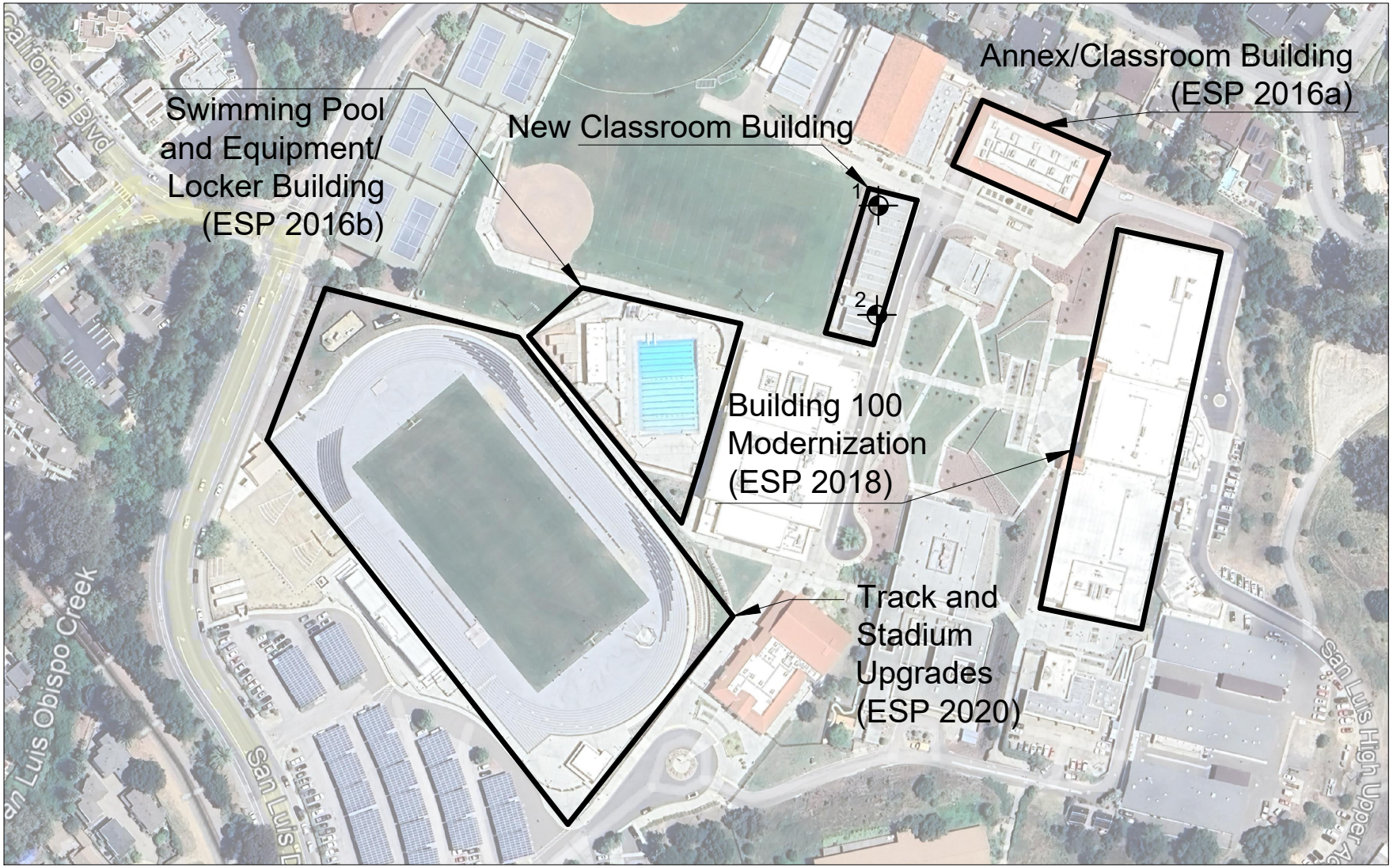
SITE VICINITY MAP

San Luis Obispo High School
New Classroom Building
1499 San Luis Drive
San Luis Obispo, California

Date
October 2024

Project No.
300933-026

Figure 1



LEGEND

Boring Location (Approx.)

BASE MAP PROVIDED BY: Google Earth (2024)

N

NOT TO SCALE

Earth Systems Pacific
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www.earthsystems.com
(805) 544-3276 • Fax (805) 544-1786

EXPLORATION LOCATION MAP

San Luis Obispo High School
New Classroom Building
1499 San Luis Drive
San Luis Obispo, California

Date
October 2024

Project No.
300933-026

Figure 2

Earth Systems Pacific

BORING LOG LEGEND

SAMPLE / SUBSURFACE WATER SYMBOLS	GRAPH. SYMBOL
CALIFORNIA MODIFIED	
STANDARD PENETRATION TEST (SPT)	
SHELBY TUBE	
BULK	
SUBSURFACE WATER DURING DRILLING	
SUBSURFACE WATER AFTER DRILLING	

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

MAJOR DIVISIONS	GROUP SYMBOL	TYPICAL DESCRIPTIONS	GRAPH. SYMBOL
COARSE GRAINED SOILS (MORE THAN HALF OF MATERIAL IS LARGER THAN #200 SIEVE SIZE)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GP	POORLY GRADED GRAVELS, OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, NON-PLASTIC FINES	
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, PLASTIC FINES	
	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
	SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES	
	SM	SILTY SANDS, SAND-SILT MIXTURES, NON-PLASTIC FINES	
	SC	CLAYEY SANDS, SAND-CLAY MIXTURES, PLASTIC FINES	
FINE GRAINED SOILS (HALF OR MORE OF MATERIAL IS SMALLER THAN #200 SIEVE SIZE)	ML	INORGANIC SILTS AND VERY FINE SANDS, 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	
	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS	
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	

OBSERVED MOISTURE CONDITION

DRY	SLIGHTLY MOIST	MOIST	VERY MOIST	WET (SATURATED)

CONSISTENCY

COARSE GRAINED SOILS			FINE GRAINED SOILS		
BLOWS/FOOT		DESCRIPTIVE TERM	BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER		SPT	CA SAMPLER	
0-10	0-16	LOOSE	0-2	0-3	VERY SOFT
11-30	17-50	MEDIUM DENSE	3-4	4-7	SOFT
31-50	51-83	DENSE	5-8	8-13	MEDIUM STIFF
OVER 50	OVER 83	VERY DENSE	9-15	14-25	STIFF
			16-30	26-50	VERY STIFF
			OVER 30	OVER 50	HARD

GRAIN SIZES

U.S. STANDARD SERIES SIEVE				CLEAR SQUARE SIEVE OPENING		
# 200	# 40	# 10	# 4	3/4"	3"	12"

SILT & CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

TYPICAL BEDROCK HARDNESS

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
EXTREMELY HARD	CORE, FRAGMENT, OR EXPOSURE CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CAN ONLY BE CHIPPED WITH REPEATED HEAVY HAMMER BLOWS
VERY HARD	CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CORE OR FRAGMENT BREAKS WITH REPEATED HEAVY HAMMER BLOWS
HARD	CAN BE SCRATCHED WITH KNIFE OR SHARP PICK WITH DIFFICULTY (HEAVY PRESSURE); HEAVY HAMMER BLOW REQUIRED TO BREAK SPECIMEN
MODERATELY HARD	CAN BE GROOVED 1/16 INCH DEEP BY KNIFE OR SHARP PICK WITH MODERATE OR HEAVY PRESSURE; CORE OR FRAGMENT BREAKS WITH LIGHT HAMMER BLOW OR HEAVY MANUAL PRESSURE
SOFT	CAN BE GROOVED OR GOUGED EASILY BY KNIFE OR SHARP PICK WITH LIGHT PRESSURE, CAN BE SCRATCHED WITH FINGERNAIL; BREAKS WITH LIGHT TO MODERATE MANUAL PRESSURE
VERY SOFT	CAN BE READILY INDENTED, GROOVED OR GOUGED WITH FINGERNAIL, OR CARVED WITH KNIFE; BREAKS WITH LIGHT MANUAL PRESSURE

TYPICAL BEDROCK WEATHERING

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
UNWEATHERED	NO DISCOLORATION, NOT OXIDIZED
SLIGHTLY WEATHERED	DISCOLORATION OR OXIDATION IS LIMITED TO SURFACE OF, OR SHORT DISTANCE FROM, FRACTURES: SOME FELDSPAR CRYSTALS ARE DULL
MODERATELY WEATHERED	DISCOLORATION OR OXIDATION EXTENDS FROM FRACTURES, USUALLY THROUGHOUT; Fe-Mg MINERALS ARE "RUSTY", FELDSPAR CRYSTALS ARE "CLOUDY"
HIGHLY WEATHERED	DISCOLORATION OR OXIDATION THROUGHOUT; FELDSPAR AND Fe-Mg MINERALS ARE ALTERED TO CLAY TO SOME EXTENT, OR CHEMICAL ALTERATION PRODUCES IN SITU DISAGGREGATION
DECOMPOSED	DISCOLORATION OR OXIDATION THROUGHOUT, BUT RESISTANT MINERALS SUCH AS QUARTZ MAY BE UNALTERED; FELDSPAR AND Fe-Mg MINERALS ARE COMPLETELY ALTERED TO CLAY

drafting/masters/Boring Log Legend 062719.dwg

Earth Systems Pacific

Boring No. 1

LOGGED BY: T. Robison
DRILL RIG: GTech GT-8 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem

PAGE 1 OF 1
JOB NO.: 300933-026
DATE: 8/29/2024

San Luis Obispo High School
New Classroom Building
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0 - 1 - 2	SP		POORLY GRADED SAND WITH GRAVEL: light brown, loose to medium dense, slightly moist (Fill)	2.0 - 5.0	◯			
2 - 3 - 4	CL		SANDY LEAN CLAY: dark brown, very stiff, slightly moist (Alluvium)	2.0 - 3.5	▬	97.1	23.1	4 11 15
5 - 6 - 7 - 8 - 9			stiff, orange mottles	5.0 - 6.5	▬	107.4	22.7	3 6 9
10 - 11 - 12 - 13 - 14	CL		LEAN CLAY: brown, stiff, slightly moist	10.0 - 11.5	▬	103.6	20.0	5 9 13
15 - 16 - 17 - 18 - 19 - 20 - 21			SANDSTONE: light brown, soft, intensely weathered, slightly moist (Franciscan Melange)	15.0 - 16.5	▬	---	---	30 50/4"
				20.0 - 21.5	●	---	---	15 29 49
22 - 23 - 24 - 25 - 26			End of Boring @ 21.5' No subsurface water encountered					

LEGEND: ▬ Ring Sample ◯ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 2

LOGGED BY: T. Robison
DRILL RIG: GTech GT-8 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem

JOB NO.: 300933-026
DATE: 8/29/2024

San Luis Obispo High School
New Classroom Building
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0 - 1	SP		POORLY GRADED SAND WITH GRAVEL: light brown, loose to medium dense, slightly moist (Fill)					
2 - 3			SANDSTONE: light brown, soft, intensely weathered, slightly moist (Franciscan Melange)	2.0 - 3.5	■	NO RECOVERY		50/4"
5 - 6				5.0 - 5.25	■	NO RECOVERY		50/3"
				5.25 - 5.5	●	NO RECOVERY		50/2"
10 - 11				10.0 - 10.2	●	---	---	50/2"
15				15.0 - 15.25	●	---	---	50/3"
16 - 26			End of Boring @ 15.25' No subsurface water encountered					

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

APPENDIX B

Geotechnical Laboratory Test Results

San Luis Obispo High School
New Classroom Building

300933-026

BULK DENSITY TEST RESULTS

ASTM D 2937-17 (modified for ring liners)

September 20, 2024

BORING NO.	DEPTH feet	MOISTURE CONTENT, %	WET DENSITY, pcf	DRY DENSITY, pcf
1	3.0 - 3.5	23.1	119.5	97.1
1	6.0 - 6.5	22.7	131.8	107.4
1	11.0 - 11.5	20.0	124.4	103.6

EXPANSION INDEX TEST RESULTS

ASTM D 4829-21

BORING NO.	DEPTH feet	EXPANSION INDEX
1	0.0 - 5.0	55

APPENDIX C

Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School, Swimming Pool and Equipment/Locker Building (ESP 2016b), with Annex/Classroom Building Report (ESP 2016a) attached

Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School, Building 100 Modernization (ESP 2018)

Updated Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School, Track and Stadium Upgrades (ESP 2020)

GEOTECHNICAL ENGINEERING
AND GEOLOGIC HAZARDS REPORT
SAN LUIS OBISPO HIGH SCHOOL – MEASURE D PROJECTS
NEW SWIMMING POOL AND EQUIPMENT/LOCKER BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3104

February 23, 2016

Prepared for

Mr. Anthony Palazzo
Director – Buildings, Grounds and Transportation
San Luis Coastal Unified School District

Prepared by

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4378 Old Santa Fe Road
San Luis Obispo, CA 93401

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February 23, 2016

FILE NO.: SL-16605-SD

Mr. Anthony Palazzo
Director – Buildings, Grounds and Transportation
San Luis Coastal Unified School District
937 Southwood Drive
San Luis Obispo, CA 93401

PROJECT: SAN LUIS OBISPO HIGH SCHOOL – MEASURE D PROJECTS
NEW SWIMMING POOL AND EQUIPMENT/LOCKER BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3104

SUBJECT: Geotechnical Engineering and Geologic Hazards Report

CONTRACT REF: Purchase Order No. 161191 for a Geotechnical Engineering and Geologic Hazards Report, with Corrosivity Testing and Evaluation, by San Luis Coastal Unified School District, dated December 7, 2015

Dear Mr. Palazzo:

In accordance with the referenced Purchase Order, this geotechnical engineering and geologic hazards report has been prepared for use in the development of plans and specifications for the new swimming pool to be constructed at San Luis Obispo High School in San Luis Obispo, California. Preliminary geotechnical recommendations for site preparation, grading, utility trenches, the swimming pool, foundations, slabs-on-grade, drainage and maintenance, and observation and testing are presented herein. Our evaluation of geologic hazards is by reference to our investigation and report submitted recently for the proposed Annex/Classroom Building project to the north of this site, and updated as applicable for the subsurface conditions encountered in the exploratory borings for this project. The results of geotechnical corrosivity testing, which was subcontracted to CERCO Analytical of Concord, California, are also included. Two bound copies and an electronic copy of this report are furnished for your use.

We appreciate the opportunity to have provided services for this project and look forward to working with you again in the future. If there are any questions concerning this report, please do not hesitate to contact the undersigned.

Sincerely,
Earth Systems Pacific

Fred J. Pothast, GE
Principal Engineer

2/23/16

Doc. No.: 1602-171 SoR/ac

REGISTERED PROFESSIONAL ENGINEER
FREDERICK J. POTHAST
No. GE 2369
EXP. 03/31/17
GEOTECHNICAL
STATE OF CALIFORNIA

Richard T. Gorman, CEG
Principal Geologist

PROFESSIONAL GEOLOGIST
RICHARD T. GORMAN
No. CEG 1325
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

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1.0 INTRODUCTION AND SITE SETTING

A new swimming pool and an equipment/locker building are planned for San Luis Obispo High School, 1499 San Luis Drive, in San Luis Obispo, California. The new facilities will be constructed in the approximate center of the campus, immediately north of the football field/track and west of the gymnasium. The area is currently utilized as the varsity baseball practice field, with dirt base paths, a grass infield, dugouts and a high fence backstop. The tennis court facility is to the west beyond the outfield, and turf playfields are to the north. The site is flat, with a barely perceptible slope to the south.

The pool will measure approximately 25 meters by 33 meters, and will range in depth from 6 to 13.5 feet. It will be of reinforced shotcrete construction, with Portland cement concrete (PCC) slab-on-grade decks. Low portable viewing stands may be placed around the pool, and light duty shade structures (i.e., net frames, large umbrellas, etc.) a maximum of 15 feet tall may also be provided. A single-story masonry equipment/locker building will be constructed to the west of the pool; it will be approximately 500 square feet in plan. The equipment/locker building is planned to be supported by conventional continuous and spread (pad) footings, with concrete slabs-on-grade. Maximum continuous loads of 2 klf and maximum isolated loads of 20 kips have been assumed. The shade structures may be supported by spread footings or drilled, cast-in-place concrete caissons; maximum loads of 2 kips have been assumed for these structures. Finish elevations of the pool decks and the equipment/locker building are expected to be a maximum of 1 foot above the existing topography. The facility will likely be enclosed by perimeter chain-link security fencing, and it could have small landscaping areas. No retaining walls, vehicle pavement, drainage basins, or LID improvements are planned. The existing campus utility systems will be extended to serve this new facility.

The approximate site coordinates and site elevation obtained from the Google Earth website (Europa Technologies 2016) are latitude 35.2841N, longitude 120.6510W, and 265 feet above mean sea level. The exact locations and dispositions of existing utility lines on the site are unknown.

2.0 SCOPE OF SERVICES

The scope of work for this report consisted of the following: a general site reconnaissance by a registered geotechnical engineer; subsurface exploration by drilled borings; geotechnical and corrosivity laboratory testing of samples secured from the borings; review of the geotechnical engineering and geologic hazards report for the nearby Annex/Classroom Building project (ESP

2016); geotechnical and geologic analyses of the data; and preparation of this report. The analysis and subsequent recommendations were based on general information provided by the client, and a concept site plan for the school (PMSM Architects 2015).

This report and preliminary geotechnical recommendations are intended to comply with the considerations of Sections 1803A.1 through 1803A.7, J104.3 and J104.4, as applicable, of the 2013 California Building Code (CBC); California Geological Survey Note 48 (CGS 2011); Interpretation of Regulations (IR) Document A-4.13 (DSA 2013); and common geotechnical engineering and engineering geology practice in this area under similar conditions at this time. The geotechnical test procedures were accomplished in general conformance with the standards noted, as modified by common geotechnical engineering practice in this area under similar conditions at this time.

Preliminary geotechnical recommendations for site preparation, grading, utility trenches, the swimming pool, foundations, slabs-on-grade, drainage and maintenance, and observation and testing are presented to guide the development of project plans and specifications. The results of the corrosivity analysis subcontracted to CERCO Analytical are also included. It is our intent that this geotechnical/geologic report be used exclusively by the client in the preparation of plans and specifications. Application beyond this intent is strictly at the user's risk.

As there may be geotechnical issues yet to be resolved, the geotechnical engineer should be retained to provide consultation as the design progresses, to assist in verifying that the pertinent geotechnical issues have been addressed and to aid in the conformance with the intent of this report. It may also be advantageous to retain the geotechnical engineer to review the project plans as they near completion, to further aid in conformance of the plans with the intent of this report.

General geotechnical conclusions regarding dewatering are provided. However, this report does not address dewatering methods and other issues in the domain of contractors such as, but not limited to, site safety, loss of volume due to stripping of the site, shrinkage of soils during compaction, excavatability, shoring, temporary slope angles, construction means and methods, etc. Analyses of the soil for mold potential, man-made asbestos, lead, radioisotopes, hydrocarbons, or chemical properties (other than geotechnical corrosivity) are beyond the scope of this report. Ancillary features such as temporary access roads, fences, flag and light poles, signage; and nonstructural fills are not within our scope and are also not addressed.

In the event that there are any changes in the nature, design, or location of improvements, or if any assumptions used in the preparation of this report prove to be incorrect, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are verified or are modified in writing. The criteria presented in this report are considered preliminary until such time as any peer review or review by any jurisdiction has been completed, conditions are observed by the geotechnical engineer in the field during construction, and the recommendations have been verified as appropriate or modified in writing.

3.0 FIELD INVESTIGATION

On December 30, 2015, four exploratory borings were drilled to a maximum of 26.5 feet below the existing ground surfaces. The borings were drilled with a Mobile Drill Model B-53 truck mounted drill rig, equipped with a 6-inch outside diameter hollow stem auger and an automatic trip hammer for sampling. The approximate locations of the borings are shown on the Boring Location Map presented in Appendix A. As the borings were drilled, soil samples were obtained using a ring-lined barrel sampler (ASTM D 3550-01/07 with shoe similar to D 2937-10). Standard penetration tests were also performed (ASTM D 1586-11) at selected depths. Bulk soil samples were obtained from the auger cuttings. The borings were backfilled per the requirements of the governing jurisdiction.

Soils encountered in the borings were categorized and logged in general accordance with the Unified Soil Classification System and ASTM D 2488-09a. Copies of the boring logs and a Boring Log Legend are included in Appendix A. In reviewing the boring logs and legend, the reader should recognize that the legend is intended as a guideline only, and there are a number of conditions that may influence the soil characteristics as observed during drilling. These include, but are not limited to, the presence of cobbles or boulders, cementation, variations in soil moisture, presence of groundwater, and other factors. Consequently, the logger must exercise judgment in interpreting the subsurface characteristics, possibly resulting in soil descriptions that vary somewhat from the legend.

4.0 LABORATORY ANALYSIS

All ring samples obtained from the borings were tested for unit weight and moisture (ASTM D 2937-10, modified for ring liners). Bulk samples were tested for maximum density and optimum moisture content (ASTM D 1557-12), expansion index (ASTM D 4829-11), and cohesion and angle of shearing resistance by direct shear (ASTM D 3080-11, recompacted to 90 percent of maximum dry density, and modified for consolidated, undrained conditions). One SPT sample was tested for plasticity index (ASTM D 4318-10). The geotechnical laboratory test results are presented in Appendix C.

Two soil samples were submitted to CERCO Analytical for geotechnical corrosivity testing. CERCO Analytical's Corrosivity Analysis is presented in Appendix D.

5.0 GENERAL SUBSURFACE AND GEOLOGIC PROFILE

The subsurface soil and geologic profile observed in the borings generally consisted of fill over alluvium. The fill was stiff sandy lean clay and medium dense to dense clayey sand, both with varying percentages of gravel. In Boring 3, the clayey sand between 9.5 and 12 feet was loose; in Boring 4, a layer of loose silty sand was encountered between 10 and 11 feet. In Boring 1, the upper 1 foot was topsoil; approximately 4 feet of poorly graded gravel up to 2 inches in greatest dimension was below the topsoil. The alluvium encountered at depth in all four borings was medium stiff to stiff sandy fat clay.

A petroleum odor was noted in the auger cuttings in Boring 4 below 21 feet, and hydrocarbon material was visible in the sample at 25 feet.

During drilling, the soils were classified as being slightly moist to moist. Please refer to the logs in Appendix A for a more complete description of the subsurface conditions encountered in the borings.

6.0 GROUNDWATER

Subsurface water was not encountered in any of the borings to the maximum depth explored of 26.5 feet.

7.0 GEOLOGY, SEISMICITY AND GEOLOGIC HAZARDS

A geotechnical engineering and geologic hazards report was recently completed by this firm for the Annex/Classroom Building project (ESP 2016), which is approximately 500 feet northwest of this project site. That report, and several of the references noted in it, were reviewed as part of the work scope for this project. Based on the subsurface conditions encountered in the borings for this project, in our opinion, the conclusions and recommendations with respect to geology, seismicity and geologic hazards presented in the report for the Annex/Classroom Building project (ESP 2016) would also be valid for this project; a copy of the report is included in Appendix D.

8.0 CONCLUSIONS

In our opinion, the site is suitable, from a geotechnical engineering and geologic hazards standpoint, for the proposed swimming pool, equipment/locker building and other site improvements, as described in the "Introduction and Site Setting" Section of this report, provided

the recommendations contained herein are implemented in the design and construction. In our opinion, the primary geotechnical engineering concerns are: 1) the presence of undocumented fill, 2) the potential for instability of soils at depth during excavations for the pool; 3) the expansion potential of the site soils; 4) the potential for subsurface water; 5) the erodible nature of the site soils; 6) the corrosive potential of the site soils, and 7) the petroleum odor and visible hydrocarbon material encountered at depth in Boring 4. General geotechnical conclusions regarding dewatering are provided, however determination of the need for dewatering and design of dewatering systems are the domain of the contractor.

Provided that the building area is prepared as recommended in the "Grading" Section of this report, continuous and spread (pad) foundations may be used to support the proposed equipment/locker building.

Undocumented Fill

Fill was encountered to depths ranging from 11 to 13.5 feet below existing grade in all four borings drilled for this project. We are unaware of any documentation (i.e., reports of grading observation and records of compaction testing) regarding the placement of this fill. Based on information gathered during discussions with the client, it appears that this fill may have been placed during site grading to prepare the building areas for the structures to the east, in excess of 40 years ago. In general, undocumented fill is considered to have a greater potential for variability than fill that has been placed and tested in a controlled earthwork program. This variability could stress and possibly damage foundations, possibility resulting in severe cracks and displacement, if the variable conditions are not mitigated. However, considering the improvements planned and the generally medium dense to dense (sands) and medium stiff to stiff) clays) nature of the fill, it is our opinion that only the upper portion of the fill material need be removed and recompacted prior to construction of foundations for the equipment/locker building and sitework improvements. The two layers of loose silty sand and clayey sand that were found at 9.5 and 10 feet in Borings 3 and 4 were only 1 to 2.5 feet thick; these layers are considered deep enough and thin enough to have little if any affect on surface improvements. Where they occur in the pool area, they will be either removed during the excavation process, or they can be recompacted if found within a few feet of the bottom of the excavation. However, these loose layers could create a potential for sidewall instability, as noted in the following section.

Instability During Excavation for Pool

The majority of the soils expected to be exposed during excavations for the pool will be medium dense to dense clayey sands or stiff sandy lean clays. Excavation of this material with conventional equipment should be relatively easy. The soils are classified as Type C per CalOSHA, meaning that all simple slope excavations 20 feet or less in depth shall have a *maximum* allowable slope of 1.5:1 (horizontal to vertical). The layer of poorly graded gravel found from 1 to 4 feet in Boring 1 was identified as being part of a drainage system for the playing field; this gravel and the loose topsoil layer above are considered to be localized conditions that should not affect the overall construction of the project. However, there is a potential for sloughing if the loose silty sand and clayey sand layers found at depth in Borings 3 and 4 are exposed in the excavation sidewalls. It is possible that the excavations could progressively slough to flatter slopes. The effect of sloughing excavations and the need for protective shoring should be determined at the time of construction, based on the actual conditions encountered. If the soils will not stand vertically (or even near vertically) to allow shotcreting directly over the soil, formwork may be necessary to cast the pool sidewalls. Proper compaction of backfill for all formed areas will be essential. The contractor's competent person should make the final determination at the time of construction regarding the CalOSHA soil classification(s) and the need for protective shoring.

Expansive Soils

Expansion index testing yielded results of 57 and 61 for two samples of the site soils; per CBC Section 1803A.5.3, the soils are considered to be expansive. The more commonly used ASTM classification is that the soils would be considered to have a "medium" expansion potential. Expansive soils tend to swell with increases in soil moisture and shrink as soil moisture decreases; the upper 3 to 5 feet of any soil profile is the zone most affected by these seasonal soil moisture fluctuations. The volume changes that the soils undergo in this cyclical pattern can stress and damage foundations and slabs-on-grade if precautionary measures are not incorporated during design and in the construction procedure. Footings are typically deepened and additional reinforcement is provided. Imported nonexpansive soils are recommended to be placed beneath slabs-on-grade, pool decks and exterior pedestrian flatwork. Below the pool shell, it is recommended that at least 18 inches of the expansive site soils be removed and replaced with imported nonexpansive materials. The gravel blanket drain, as recommended in the following paragraph, is considered to be part of the overall thickness of imported nonexpansive materials to protect the pool shell.

Potential for Subsurface Water

Free subsurface water was not found in the exploratory borings to the maximum depth explored of 26.5 feet. However, this general area is in a period of extended drought, and if rainfall conditions do return to near normal prior to or during construction, there is a will be a potential to encounter subsurface water in the excavation for the pool, particularly if construction proceeds during the rainy season. If subsurface water is encountered, a dewatering system may be necessary during construction.

A minimum thickness of 12 inches of clean, free-draining gravel along with a sump should be placed where needed in the pool shell excavation, to allow for drainage of water during construction. A hydrostatic relief valve should also be planned for the pool plumbing, regardless of the subsurface water conditions. This gravel layer for construction dewatering can be used as part of the overall 18-inch layer of gravel that is recommended for permanent dewatering below the entire pool shell, and to protect the pool shell from the expansive site soils.

While dewatering is the contractor's responsibility and specific design recommendations for dewatering are beyond the scope of this report, the following are general suggestions regarding the subject, in the event that subsurface water is encountered during construction.

1. The clayey and silty sands found at depths of 7 to 12.5 feet in Boring 1 and interlayered from 1.5 to 11 feet in Boring 4 may potentially be dewatered by means of well points. The well points should be closely spaced so that the only water removed is that which is absolutely necessary to accommodate construction. Excessive dewatering should be avoided as it could lead to settlement of surrounding improvements and structures.

2. The sandy lean clay soils are much less permeable than the sands, and will be difficult to dewater via well points. Dewatering these clays, if encountered in the bottom of the excavation, by means of a gravel blanket drain placed in the pool excavation may be more efficient. Prior to placement of the gravel blanket, the clay soil in the pool excavation should be sloped to an appropriate low point, and a sump should be constructed. A collection pipe should be placed in the gravel blanket. The collection pipe should discharge to the sump. A pump should be placed in the sump to aid in dewatering the pool excavation during construction.

3. Several monitoring wells should be placed around the excavation for the purpose of monitoring the drawdown of the groundwater, if encountered during construction. Monitoring wells should be placed between the proposed excavation and any nearby improvements that could be damaged by drawdown. If significant drawdown of the water in the immediate vicinity of improvements is observed, it may be necessary to modify the dewatering program or to underpin the improvements.

4. If needed, dewatering should be initiated well before general excavation for the pool commences. The monitoring wells should be measured periodically to gauge the progress of the dewatering program. Monitoring well construction and construction water discharge should be in accordance with the requirements of the governing jurisdiction.

Soil Erodibility

The site soils are considered to be erodible. It is essential that all surface drainage be controlled and directed to appropriate discharge points, and that surface soils, particularly those disturbed during construction, are stabilized by vegetation or other means *during and following construction*.

Corrosion Potential

As indicated in the Soil Corrosivity Study by HDR, Inc., for the Annex/Classroom Building project (ESP 2016, copy in Appendix D), the electrical resistivities of the samples tested were in the moderately corrosive categories with as received moisture contents; when saturated, the resistivities were in the corrosive to severely corrosive categories. Soil pH values were mildly alkaline. The soluble salt contents of the soils were low to moderate. Soil nitrate concentrations were high. The soils were classified as severely corrosive to ferrous metals and aggressive to copper. These results were essentially confirmed by CERCO Analytical through testing of samples from the New Swimming Pool and Equipment/Locker Building area; CERCO Analytical's corrosivity analysis is included in Appendix C of this report. Therefore, in our opinion, the recommendations regarding protection of pipelines, buried concrete structures and other improvements contained in the CERCO Analytical report (Appendix C) and in the Soil Corrosivity Study by HDR, Inc. for the Annex/Classroom Building project (ESP 2016, copy in Appendix D) would be appropriate for this project.

Petroleum Odor and Hydrocarbon Material

A petroleum odor was noted in the auger cuttings in Boring 4 below 21 feet, and hydrocarbon material was visible in the sample at 25 feet. This condition is being evaluated for the client by this firm under a separate contract, and the results of that evaluation will follow at a later date.

9.0 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

The following recommendations are for the swimming pool, the equipment/locker building, and the other site improvements as described in the "Introduction and Site Setting" Section of this report. If locations, elevations, structural loads, etc., change, the recommendations contained herein may require modification. In developing the following recommendations, it was assumed that irrigated landscaping or flatwork that would keep the soils relatively uniform, year-round moisture will be installed for a zone of at least five feet around the perimeter of all improvements.

Three distinct types of Portland cement concrete (PCC) slabs-on-grade are discussed in the following recommendations. Slabs-on-grade around the pool and the equipment/locker building are defined as "pool decks". The equipment/locker building's slabs are defined as "interior slabs-on-grade." Sidewalks that will provide access to and are beyond the pool decks are referred to as "exterior pedestrian flatwork."

Unless otherwise noted, the following definitions are used in the recommendations presented below. Where terms are not defined, definitions commonly used in the construction industry are intended.

- **Building Area –** The building area is defined as the area within and extending a minimum of 5 feet beyond the perimeter of the foundations for the equipment/locker building. The building area includes covered walkways or other improvements that are connected to the structure and that are intended to act in a manner similar to it.
- **Exterior Pedestrian Flatwork and Pool Deck Areas –** The areas within and extending a minimum of 1 foot beyond the limits of all exterior pedestrian flatwork and pool decks, as applicable.
- **Grading Area –** The entire area to be graded, including the building, exterior pedestrian flatwork and pool deck areas.
- **Existing Grade:** The elevations of the site that existed as of the date of this report.

- **Finish Pad Grade:** The elevation in the building area where earthwork operations are typically considered to be complete. It does not include any sand or gravel that might be placed below slabs-on-grade in association with vapor protection for slabs.
- **Subgrade:** The elevation in exterior pedestrian flatwork and pool deck areas where earthwork operations are typically considered to be complete. It does not include any sand or AB placed below the flatwork or decks.
- **Finish Grade:** The elevation where earthwork operations are typically considered to be complete in areas, if any, beyond the building, exterior pedestrian flatwork and pool decks.
- **Scarified:** Plowed or ripped in two orthogonal directions to a depth of not less than 8 inches.
- **Moisture Conditioned:** Adjusting the soil moisture to optimum moisture content, or just above, prior to application of compactive effort.
- **Compacted/Recompacted:** Soils placed in level lifts not exceeding 8 inches in loose thickness and compacted to a minimum of 90 percent of maximum dry density. Based on maximum dry density by ASTM D 1557-12 and field density by ASTM D 6938-15, or other methods acceptable to the geotechnical engineer and jurisdiction.

Site Preparation

1. The ground surface in the grading area should be prepared for construction by removing the existing baseball field structures, and all other improvements, vegetation, large roots, debris, organic topsoil, the gravel subdrain system (as found in Boring 1) and other deleterious materials. Existing utility lines that will not remain in service should be either removed or abandoned. The appropriate method of abandonment will depend upon the type and depth of the utility. Recommendations for abandonment can be made as necessary.

2. Voids created by the removal of materials or utilities described above should be called to the attention of the geotechnical engineer. No fill should be placed unless the underlying soil has been observed by the geotechnical engineer.

Grading

1. Following site preparation, the existing soils within the equipment/locker building area should be overexcavated to a level plane at a depth of 3 feet below the deepest foundation element. The excavation should be deepened locally where mechanical vaults or pits, if any, are to be constructed. The resulting excavated surfaces should be scarified, moisture conditioned and recompacted.

2. Following site preparation and excavation to the design depth for the swimming pool, the excavation should be deepened an additional 18 inches below the planned bottom of the pool shell. The resulting surface should be scarified, moisture conditioned and recompacted.

3. Following site preparation and any excavations to grade, or prior to placement of fill, the soil in pool deck areas should be excavated to 18 inches below bottom of slab elevation. The resulting surfaces should be scarified, moisture conditioned and recompacted.

4. Following site preparation and any excavations to grade, or prior to placement of fill, the soil in exterior pedestrian flatwork areas should be excavated to the depth below bottom of slab elevation designated by the architect/engineer for placement of nonexpansive imported material. The resulting surfaces should be scarified, moisture conditioned and recompacted.

5. Following excavations to grade or prior to placement of fill in the remainder of the grading area, the prepared soil surface should be scarified, moisture conditioned and compacted.

6. Voids created by dislodging cobbles and/or debris during scarification should be backfilled and recompacted, and the dislodged materials should be removed from the work area.

7. Previously removed site soils and other similar soils may be placed as fill to finished grade beyond the building, pool deck and exterior pedestrian flatwork areas; in the building and pool deck areas to a maximum height of 18 inches below bottom of slab elevation; and in exterior pedestrian flatwork areas to the elevation designated by the architect/engineer, as discussed in the "Slabs-on-Grade" Section of this report. The final 18 inches of fill below bottom of slab elevation in the building and pool deck areas should be nonexpansive. The architect/engineer should designate the thickness of nonexpansive material to be placed below exterior pedestrian flatwork, as discussed in the "Slabs-on-Grade" Section of this report.

8. Nonexpansive materials are defined as imported soils that fall in the GW, GM, GC, SP, SW, SC and SM categories per ASTM D 2487-11, and that have an expansion index of 10 or less (ASTM D 4829-11). The clean sand layer described in the "Slabs-on-Grade" Section of this report (if utilized below interior slabs-on-grade, exterior pedestrian flatwork or pool decks) is considered to be part of the minimum recommended thickness of nonexpansive material utilized, not in addition to it.

9. Imported nonexpansive soils used in the building area should have strength qualities equal to or better than the site soils, and they should not exceed the geotechnical corrosivity potential of the site soils. See the Corrosivity Analysis by CERCO Analytical in Appendix C, and the Soil Corrosivity Study by HDR, Inc. in the report for the Annex/Classroom Building project (ESP 2016, copy in Appendix D) for the corrosivity parameters of the site soils. Proposed imported materials should be reviewed by the geotechnical engineer before being brought to the site, and on an intermittent basis during placement.

10. A minimum of 18 inches of 0.75 to 1.5-inch clean crushed gravel (not float rock or river run gravel) should be placed at the bottom of the pool excavation, and compacted using a heavy vibrating plate compactor. The gravel is intended to serve as a blanket drain for the completed pool, and as a stabilized surface for construction. At least one rigid, 4-inch diameter PVC drain pipe should be placed from the lowest point of the gravel to daylight or a sump. Minimum slope of the drain pipe should be 1 percent.

    The drain system described above should not be relied upon to relieve all hydrostatic pressure in the event that the pool is drained. To reduce the potential for flotation of the pool shell, a hydrostatic relief valve should be provided in the pool plumbing.

    To facilitate application of shotcrete for the pool, the gravel may be overlain with a thin layer of another nonexpansive material, such as sand or Class 2 aggregate base (Caltrans 2010). However, if such a layer is utilized, a filter fabric conforming to Standard Specification 88-1.02B – Class C (Caltrans 2010) should be placed between the gravel and the overlying layer of material.

    All backfill for the pool shell should be nonexpansive, as described previously in this section. If gravel is used for backfill of the pool shell, it should be crushed (not float rock or river run gravel), and it should be compacted in maximum 1-foot lifts with a vibrating

plate compactor or a concrete vibrator. In addition, a filter fabric conforming to Standard Specification 88-1.02B – Class C (Caltrans 2010) should be placed between the gravel and the native soil.

11. All materials used as fill should be cleaned of any debris and rocks larger than 3 inches in diameter. When fill material includes rocks, the rocks should be placed in a sufficient soil matrix to ensure that voids caused by nesting of the rocks will not occur and that the fill can be properly compacted.

12. If the soils are overly moist so that they become unstable, or if the minimum recommended compaction cannot be readily achieved, drying the soil so that it is nearer optimum moisture content, may be necessary. Placement of gravel layers or geotextiles may also be necessary to help stabilize unstable soils. Additional overexcavation may also be recommended to correct unstable conditions or if soft or loose conditions are encountered during grading. No fill should be placed in any grading area if the underlying soil is unstable.

13. The recommended soil moisture content should be maintained throughout construction, and during the lives of the structure and sitework improvements. Failure to maintain the soil moisture content can result in desiccation cracks and disturbance, which are an indication of degradation of the soil compaction. If desiccation cracks are allowed to develop, or if soils near improvements such as foundations, flatwork, etc. are otherwise disturbed, damage to those improvements may result. Soils that have cracked or are otherwise disturbed should be removed, moisture conditioned, and recompacted.

14. The contractor's competent person should make the final determination at the time of construction regarding the CalOSHA soil classification(s) and the need for protective shoring.

Utility Trenches

1. Utility trenches adjacent to foundations should not be excavated within the zone of foundation influence, as shown in Typical Detail A in Appendix E.

2. Utilities that must pass beneath foundations should be placed with properly compacted utility trench backfill and the foundation should be designed to span the trench.

3. A select, noncorrosive, granular, easily compacted material should be used as bedding and shading immediately around utilities. The site soil may be used for trench backfill to within 18 inches below bottom of slab elevation in the building and pool deck areas. Within the building and pool deck areas, imported nonexpansive soils should be utilized to backfill the final 18 inches below bottom of slab elevation of all trenches. In exterior pedestrian flatwork, trench backfill should match the thickness of nonexpansive soils used to support these improvements. The site soil may be used for trench backfill to finished grade beyond the building, pool deck and exterior pedestrian flatwork areas.

4. In general, trench backfill should be compacted to a minimum of 90 percent of maximum dry density. A minimum of 85 percent of maximum dry density will generally be sufficient where trench backfill is located in landscaped or other unimproved areas, where settlement of trench backfill would not be detrimental.

5. Prior to applying compactive effort, soils should be moisture conditioned. Trench backfill should be placed in level lifts not exceeding 6 inches in loose thickness and compacted to the minimums recommended above.

6. Compaction of trench backfill by jetting or flooding is not recommended at this site due to the expansive and erodible nature of the site soils. However, to aid in *encasing* utility conduits, particularly corrugated drain pipes, and multiple, closely-spaced conduits in a single trench in the bedding and shading material, jetting or flooding may be useful. Flooding or jetting should only be attempted with extreme caution, and any jetting operation should be subject to review by the geotechnical engineer.

7. Long-term settlement of properly compacted sand should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill. Improvements that are constructed over or near trenches should be designed to accommodate the potential for settlement.

8. The Corrosivity Analysis by CERCO Analytical in Appendix C, and the Soil Corrosivity Study by HDR, Inc. in the report for the Annex/Classroom Building project (ESP 2016, copy in Appendix D) should be used by the architect/engineer in specifying appropriate corrosion protection measures for utility improvements.

9. The recommendations of this section are minimums only, and may be superseded by the architect/engineer based upon soil corrosivity or the requirements of pipe manufacturers, utility companies or the governing jurisdiction.

Swimming Pool

1. The pool area should be excavated and the bottom of the excavation filled with a gravel drainage layer as per the "Grading" Section of this report. As previously noted, the drain system should not be relied upon to relieve all hydrostatic pressure in the event that the pool is drained. To reduce the potential for flotation of the pool shell, a hydrostatic relief valve should be provided in the pool plumbing.

2. The swimming pool design may be based on the following parameters for the subsurface conditions encountered in the borings:

Active equivalent fluid pressure	55 pcf
At-rest equivalent fluid pressure	75 pcf
Passive equivalent fluid pressure	300 pcf
Maximum bearing capacity (dead plus live load)	2,200 psf
Coefficient of sliding friction	0.30

3. No surcharges are taken into consideration in the above listed parameters; the active and at-rest pressures are applicable to horizontal retained surfaces only (i.e., pool decks) at the top the pool shell. The maximum bearing capacity is an *allowable* value; no factors of safety, load factors or other factors have been applied to the remaining values. With the exception of the maximum allowable bearing capacity, these values will require application of appropriate factors of safety, load factors, surcharges and/or other factors as deemed appropriate by the architect/engineer.

4. The pool shell should be designed as necessary to accommodate "medium" expansion soil. The design parameters in Paragraph 2 are for drained conditions, and drains should be specified by the architect/engineer as necessary to ensure that water which gains access around the pool will have adequate means to be discharged.

5. The pool shell may be designed as necessary using the design response parameters contained in the Summary of Design Response Acceleration Parameters Table on Page 8 in the report for the Annex/Classroom Building Project (ESP 2016, copy in Appendix D).

6. Section 1803A.5.12.1 of the 2013 CBC requires that dynamic seismic lateral earth pressures be provided by the geotechnical engineer for walls retaining more than 6 feet of backfill. As the pool will be filled the vast majority of the time (except during maintenance), the resisting pressure of the water in the pool is generally considered to be in excess of any dynamic seismic lateral earth pressure increment, therefore the dynamic seismic lateral earth pressures be ignored in the design. If use of the seismic lateral earth pressure increment is required by the governing jurisdiction in the lateral analysis with active or at-rest pressures, a calculated equivalent fluid pressure of 4 pcf can be used for the site soils and the Peak Mean Ground Acceleration (PGA_M) value of 0.475 g previously determined for the Annex/Classroom Building Project (ESP 2016, copy in Appendix D).

7. All backfill for the pool shell should be nonexpansive, as described previously in this section. If gravel is used for backfill of the pool shell, it should be crushed (not float rock or river run gravel), and it should be compacted in maximum 1-foot lifts with a vibrating plate compactor or a concrete vibrator. In addition, a filter fabric conforming to Standard Specification 88-1.02B – Class C (Caltrans 2010), should be placed between the gravel and the native soil.

8. As the weight of the soil removed from the pool excavation will be significantly greater than the weight of the pool shell and the water in the pool, negligible settlement of the pool shell is expected under static and dynamic conditions.

9. Long-term settlement of properly compacted sand or gravel pool shell backfill should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill. Pool decks should be designed to accommodate long-term settlement.

10. The Corrosivity Analysis by CERCO Analytical in Appendix C, and the Soil Corrosivity Study by HDR, Inc. in the report for the Annex/Classroom Building project (ESP 2016, copy in Appendix D) should be used by the architect/engineer in specifying appropriate corrosion protection measures for the swimming pool.

Foundations

Conventional Foundations

1. Conventional foundations bearing in firm recompacted soils may be used to support the equipment/locker building. A minimum overall foundation depth of 21 inches below lowest adjacent grade should be maintained. Spread footings should be at least 24 inches square, and should be interconnected on at least two sides by grade beams a minimum of 12 inches wide and 21 inches deep.
2. Minimum continuous footing and grade beam reinforcement should consist of two No. 4 rebars, one at the top and one at the bottom. Spread footings should be reinforced in accordance with the requirements of the architect/engineer.
3. Footings bearing in firm recompacted soil may be designed using maximum allowable bearing capacities of 1,500 psf dead load and 2,200 psf dead plus live loads. Using these criteria, maximum settlement and differential settlement are expected to be less than 3/4-inch and less than 3/8-inch in 25 feet, respectively.
4. For resistance to lateral loads, conventional foundations may designed using a passive equivalent fluid pressure of 300 pcf and a friction factor of 0.30. Passive and friction components may be combined in the analysis without reduction to either value. Lateral capacity is based on the assumption that any backfill adjacent to foundations has been properly compacted.
5. Foundation excavations should be observed by the geotechnical engineer prior to placement of reinforcing steel. Soils in foundation excavations should be moistened to optimum moisture content, or just above, prior to application of compactive effort, and no desiccation cracks should be present prior to concrete placement.

Shade Structures

1. Light duty shade structures may be supported by conventional foundations designed using the parameters previously provided. Alternately, they may be supported by drilled, cast-in-place concrete caissons. If caissons are used, they should have a minimum diameter of 15 inches, and a minimum overall depth of 6 feet below lowest adjacent grade. The caissons may be designed using an allowable skin friction value of 600 psf; no end bearing capacity should be used in the calculations. An allowable skin friction value of 200 psf can be used under short-term tension (uplift) conditions. The self-weight of the caissons may be neglected in the determination of downward loading, however it may

be included, if needed, for resistance to uplift. Negligible settlement of caissons for light duty shade structures is expected. A passive resistance of 300 pcf, acting over 2 caisson diameters, may be taken for resistance to short term lateral loads.

2. The soils may not stand vertically during the caisson construction. Casing, drill fluid, or other means of keeping the holes open may be necessary. Caisson reinforcing should be designed to accommodate a minimum 5-inch diameter tremie pipe for concrete placement. The reinforcing should also be designed to facilitate removal of casing during concrete placement, if used. Any water encountered should be removed from the caisson excavation prior to placing concrete, or the concrete should be tremied. The recommended tremie method is described in Appendix E. Concrete used in caissons should be placed at a slump between 4 and 6 inches in dry excavations and between 7 and 9 inches when placed under water. The concrete in the caissons should be mechanically consolidated following placement. All caisson excavations should be filled with concrete on the same day as they are drilled.

3. As the caissons will utilize skin friction for support, it is not necessary to remove all loose debris and slough material from the bottoms of the excavations. The caissons should not deviate from a plumb line taken from the center of the caisson by more than 2 percent of the caisson length, from the top to the point of interest. Adequate caisson oversize may be assumed to provide required tolerance.

4. Caisson excavations should be observed by the geotechnical engineer during drilling operations and prior to placement of reinforcing steel and concrete. Special inspection of reinforcing steel and concrete placement for caissons should also be provided.

General

1. Allowable bearing capacities may be increased by one-third when transient loads such as wind or seismicity are included. Foundations may be designed as necessary using the design response parameters contained in the Summary of Design Response Acceleration Parameters Table on Page 8 in the report for the Annex/Classroom Building Project (ESP 2016, copy in Appendix D).

2. The Corrosivity Analysis by CERCO Analytical in Appendix C, and the Soil Corrosivity Study by HDR, Inc. in the report for the Annex/Classroom Building project (ESP 2016, copy in Appendix D) should be used by the architect/engineer in specifying appropriate corrosion protection measures for foundations.

Slabs-on-Grade

Interior Slabs-On-Grade

1. Interior slabs-on-grade should have a minimum thickness of 4 full inches. They should be reinforced and doweled to foundations per the specifications of the architect/engineer. At a minimum, interior slabs should be reinforced with No. 3 rebar at 18 inches on center each way. All structural slabs should contain minimum rebar meeting the criteria of ACI 318, Section 7.12.2 (ACI 2011). At a minimum, foundation dowels should be lap spliced to the slab rebar. The size and spacing of the dowels should match the size and spacing of the slab rebar.

Swimming Pool Decks

1. Swimming pool decks should have a minimum thickness of 4 full inches, not including the indentations created by any stamped patterns. Reinforcement size, placement, and dowels should be as directed by the architect/engineer; minimum deck reinforcement should consist of No. 3 rebar placed at 18 inches on-center each way.

2. It should be noted that, due to the deep backfill anticipated for the pool shell, even with the measures recommended for soil compaction, there could be minor differential movement between the pool shell and the deck. Unless there is a structural reason to do otherwise, the pool deck should be dowelled into the bond beams at the top of the pool shell by minimum No. 3 rebar lapped to the deck rebar, or as specified by the architect/engineer. A felt or other type of spacer should be placed between the deck and the pool bond beam so that the connection will act as a hinge and allow minor movement between the deck and the pool shell. If the deck is not dowelled to the shell, more differential movement should be anticipated than if it is dowelled. Without the dowelling, a trip hazard could result around the rim of the pool.

3. The pool deck should slope toward drain inlets; no uncontrolled surface drainage should flow off the edges of the pool deck. All joints in the pool deck should be sealed with a flexible, UV resistant sealer to reduce the potential for intrusion of water through the deck.

Exterior Pedestrian Flatwork

1. Exterior pedestrian flatwork should have a minimum thickness of 4 full inches. Minimum reinforcement for exterior pedestrian flatwork placed over at least 18 inches of nonexpansive imported soils per the following paragraph should consist of No. 3 rebar

placed at 24 inches on-center each way. If the thickness of nonexpansive soil below the flatwork is less than 18 inches, the minimum reinforcement should consist of No. 3 rebar at 18 inches on-center each way.

2. In conventional construction, it is common to use 4 to 6 inches of sand beneath exterior pedestrian flatwork. However, due to the medium expansion potential of the site soils, there will be a risk of movement and damage to the flatwork if conventional measures are used. Heaving and cracking could occur. This movement could be reduced by the placement of additional nonexpansive material beneath the flatwork. If it is desired to fully mitigate the expansive soil conditions, then at least 18 inches of imported nonexpansive material should be provided below the flatwork where the expansive site soils are exposed at finish grade. If it is acceptable for the flatwork to experience movement due to expansive soils, then the thickness of the nonexpansive soil can be reduced. Under all flatwork, however, the thicker the nonexpansive layer, the better the expansive soil protection.

3. Another measure that can be taken to reduce the risk of movement of flatwork due to expansive soils is to provide thickened edges or grade beams around the perimeters of the flatwork. If it is desired to fully mitigate the expansive soil conditions, then the thickened edges or grade beams could be up to 21 inches deep. If it is acceptable for the flatwork to experience movement, then the thickened edges or grade beams can be reduced. At a minimum, any thickened edge or grade beam should be reinforced by two No. 4 rebar, one at the top and one at the bottom.

4. It is recognized that the measures discussed above for protecting exterior flatwork from expansive soils are expensive, possibly more expensive than simply replacing flatwork that has heaved and/or cracked. Consequently, the above measures for protecting exterior flatwork are only suggestions for consideration by the owner and/or architect/engineer. The degree to which exterior flatwork is protected from expansive soil damage is left to the discretion of the owner and/or architect/engineer.

5. Flatwork should be constructed with frequent joints to allow articulation as the flatwork moves in response to seasonal soil temperature and moisture variations. The expansive soil underlying any nonexpansive material placed below flatwork should be moisture conditioned, and no desiccation cracks should be present, prior to casting the flatwork.

6. Flatwork at doorways, and at other areas where maintaining the elevation of the flatwork is desired when mitigating expansive soil potential, should be doweled to the perimeter foundation, at a minimum, by No. 3 dowels lapped to the flatwork rebar at 24 inches on center. In other areas, the flatwork may be doweled to the foundation or the flatwork may be allowed to "float free," at the discretion of the architect/engineer. Flatwork that is intended to float free should be separated from foundations by a felt joint or other means.

Moisture Vapor Transmission

1. Due to the current use of impermeable floor coverings, water-soluble flooring adhesives, and the speed at which buildings are now constructed, moisture vapor transmission through slabs is a much more common problem than in past years. Where moisture vapor transmitted from the underlying soil would be undesirable, slabs should be protected from subsurface moisture vapor. A number of options for vapor protection are discussed below; however, the means of vapor protection, including the type and thickness of the vapor retarder, if specified, are left to the discretion of the architect/engineer.

2. Where specified, vapor retarders should conform to ASTM Standard E 1745-11. This standard specifies properties for three performance classes; Class A, B and C. The appropriate class should be selected based on the sensitivity of floor coverings to moisture intrusion and the potential for damage to the vapor retarder during placement of slab reinforcement and concrete.

3. Several recent studies, including those of American Concrete Institute Committee 302 (ACI 2004), have concluded that excess water above the vapor retarder increases the potential for moisture damage to floor coverings and could increase the potential for mold growth or other microbial contamination. The studies also concluded that it is preferable to eliminate the typical sand layer beneath the slab and place the slab concrete in direct contact with a Class A vapor retarder, particularly during wet weather construction. However, placing the concrete directly on the vapor retarder requires special attention to using the proper vapor retarder, a very low water-cement ratio in the concrete mix, and special finishing and curing techniques.

4. Probably the next most effective option would be the use of vapor-inhibiting admixtures in the slab concrete mix and/or application of a sealer to the surface of the slab. This would also require special concrete mixes and placement procedures, depending upon the recommendations of the admixture or sealer manufacturer.

5. Another option that may be a reasonable compromise between effectiveness and cost considerations is the use of a subslab vapor retarder protected by a sand layer. If a Class A vapor retarder is specified, the retarder can be placed directly on the nonexpansive soil. The retarder should be covered with a minimum 2 inches of *clean* sand. If a less durable vapor retarder is specified (Class B or C), a minimum of 4 inches of clean sand should be provided, and the retarder should be placed in the center of the clean sand layer. Clean sand is defined as a well or poorly graded sand (ASTM D 2487-11) of which less than 3 percent passes the No. 200 sieve. The clean sand layer, if used, is considered to be a part of the minimum 18-inch thickness of nonexpansive imported materials recommended in the "Grading" section of this report to be placed below slabs-on-grade, not in addition to it.

6. Regardless of the underslab vapor retarder selected, proper installation of the retarder per ASTM E 1643-11 is critical for optimum performance. Where utilized, the vapor retarder should be placed a minimum of 1 inch above the flow line of the drainage path surrounding the structures, or 1 inch above the area drain grates if area drains are used to collect runoff around the structures. All seams must be properly lapped, and all seams and utility penetrations properly sealed in accordance with the vapor retarder manufacturer's recommendations.

7. If the sand is used between the vapor retarder and the slab, it should be moistened only as necessary to promote concrete curing; saturation of the sand should be avoided, as the excess moisture would be on top of the vapor retarder, potentially resulting in vapor transmission through the slab for months or years.

8. The architect/engineer should designate any special measures to be used in conjunction with moisture vapor transmission protection, if needed, to mitigate the high potential for indoor radon levels.

9. Positive drainage away from the equipment/locker building should be maintained; see the "Drainage and Maintenance" section of this report for additional discussion of this issue. If water is allowed to pond near the building, it may seep into the ground and migrate laterally through cracks or utility penetrations in the foundation, ultimately gaining access above the vapor retarder.

Slabs-on-Grade - General

1. To reduce shrinkage cracks in all interior and exterior slabs-on-grade, the concrete aggregates should be of appropriate size and proportion, the water/cement ratio should be low, the concrete should be properly placed and finished, contraction joints should be installed, and the concrete should be properly cured. This is particularly applicable to slabs that will be cast directly upon a vapor retarder and those that will be protected from transmission of vapor by use of admixtures or surface sealers. Concrete materials, placement, and curing specifications should be at the direction of the architect/engineer; AC 302.1R-04 (ACI 2004) is suggested as a resource for the architect/engineer in preparing such specification.

2. The Corrosivity Analysis by CERCO Analytical in Appendix C, and the Soil Corrosivity Study by HDR, Inc. in the report for the Annex/Classroom Building project (ESP 2016, copy in Appendix D) should be used by the architect/engineer in specifying appropriate corrosion protection measures for slabs-on-grade.

Drainage and Maintenance

1. Per Section 1804A.3 of the 2013 CBC, unpaved ground surfaces should be *finish graded* to direct surface runoff away from foundations and other improvements at a minimum 5 percent grade for a minimum distance of 10 feet. The site should be similarly sloped to drain away from foundation, slopes, and other improvements during construction. Where this is not practicable due to other improvements, etc., swales with improved surfaces, area drains, or other drainage facilities, should be used to collect and discharge runoff.

2. All eaves of the equipment/locker building should be fitted with roof gutters. Runoff from flatwork, roof gutters, downspouts, planter drains, area drains, etc. should discharge in a nonerosive manner away from foundations and other improvements in accordance with the requirements of the governing agencies. Erosion protection should be placed at all discharge points unless the discharge is to an improved surface.

3. To reduce the potential for planter drainage gaining access to subslab areas, any raised planter boxes adjacent to foundations, pool decks or exterior pedestrian flatwork should be installed with drains and sealed sides and bottoms. Drains should also be provided for areas adjacent to these improvements that would not otherwise freely drain.

4. The on-site soils are erodible; stabilization of soils disturbed during construction by vegetation or other means *during* and *following* construction, is essential to reduce erosion damage. Care should be taken to establish and maintain vegetation. The landscaping should be planned and installed to maintain the surface drainage recommended above. Surface drainage should also be maintained during construction.

5. Maintenance of the pool deck sealant, as well as drainage and other improvements, is critical to the long-term stability of the site and the integrity of the structures. Site improvements should be maintained on a regular basis.

6. All exterior drains and drain outlets should be maintained to be free-flowing. Vegetation and erosion matting (if utilized) should be maintained or augmented as needed. Irrigation systems should be maintained so that soils around structures are kept at a relatively uniform year-round moisture content, and are neither over-watered nor allowed to dry and desiccate.

7. To reduce the potential for disruption of drainage patterns and undermining of structures, fill areas, slopes, etc., all rodent activity should be aggressively controlled.

Observation and Testing

1. It must be recognized that the recommendations contained in this report are based on a limited number of borings, and they rely on continuity of the subsurface conditions encountered.

2. It is assumed that the geotechnical engineer will be retained to provide consultation during the design phase, to interpret this report during construction, and to provide construction monitoring in the form of testing and observation.

3. At a minimum, the geotechnical engineer should be retained to provide:

   - Professional observation during grading, trench and pool backfill, and foundation construction
   - Oversight of special inspection and compaction testing during grading and backfill
   - Oversight of special inspection during caisson drilling operations (if any)

4. Special inspection of grading and backfill should be provided as per Section 1704A.7 and Table 1704A.7 of the CBC. The special inspector should be under the direction of the geotechnical engineer. At a minimum, the following items should be inspected and/or tested by the special inspector:

   - Stripping and clearing of vegetation
   - Excavation of the swimming pool area and placement of the gravel blanket drain
   - Overexcavation of the building, pool deck and exterior pedestrian flatwork areas to the recommended depths
   - Scarification and moisture conditioning of overexcavated areas
   - Scarification and moisture conditioning of all other grading areas
   - Fill quality, placement, moisture conditioning and compaction
   - Utility trench backfill
   - Foundation excavations

5. Special inspection of drilled, cast-in-place caissons (if used) should be provided as per Section 1705A.8 and Table 1705A.8 of the CBC (CBSC 2013); the special inspector should be under the direction of the geotechnical engineer. The following operations should be subject to special inspection:

   - Drilling of caisson excavations
   - Caisson plumbness, diameters, lengths, and minimum embedment
   - Methods used to maintain caisson excavation sidewalls prior to concreting
   - Reinforcing steel placement
   - Concrete placement and concrete consolidation procedures

6. A program of quality assurance should be developed prior to beginning construction. At a minimum, the program should include all geotechnical items shown on the testing and inspection schedule of the approved plans. It should also include any additional inspection items required by the architect/engineer and/or the governing jurisdiction. These items should be discussed at a preconstruction site meeting among a representative of the owner, the geotechnical engineer, special inspector, the project inspector, the engineer, and contractors. The geotechnical engineer should be notified at least 48 hours prior to beginning grading operations.

7. Locations and frequency of compaction tests should be as per the recommendation of the geotechnical engineer at the time of construction. The recommended test location and frequency may be subject to modification by the geotechnical engineer, based upon soil and moisture conditions encountered, size and type of equipment used by the contractor, the general trend of the results of compaction tests, or other factors.

10.0 CLOSURE

Our intent was to perform the investigation in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the locality of this project under similar conditions. No representation, warranty, or guarantee is either expressed or implied. This report is intended for the exclusive use by the client as discussed in the "Scope of Services" section. Application beyond the stated intent is strictly at the user's risk.

This report is valid for conditions as they exist at this time for the type of project described herein. The conclusions and recommendations contained in this report could be rendered invalid, either in whole or in part, due to changes in building codes, regulations, standards of geotechnical or construction practice, changes in physical conditions, or the broadening of knowledge.

If changes with respect to the project become necessary, if items not addressed in this report are incorporated into plans, or if any of the assumptions used in the preparation of this report are not correct, this firm shall be notified for modifications to this report. Any items not specifically addressed in this report should comply with the CBC of other applicable standards, and the requirements of the governing jurisdiction.

The preliminary recommendations presented in this geotechnical report are based upon the geotechnical conditions encountered at the site, and may be augmented by additional requirements of the client, or by additional recommendations provided by the geotechnical engineer based on peer or jurisdiction reviews, or conditions exposed at the time of construction.

This document, the data, conclusions, and recommendations contained herein are the property of Earth Systems Pacific. This report shall be used in its entirety, with no individual sections reproduced or used out of context. Copies may be made only by Earth Systems Pacific, the client, and the client's authorized agents for use exclusively on the subject project. Any other use is subject to federal copyright laws and the written approval of Earth Systems Pacific.

Thank you for this opportunity to have been of service. If you have any questions, please feel free to contact this office at your convenience.

End of Text.

TECHNICAL REFERENCES

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APPENDIX A

Boring Location Map
Boring Log Legend
Boring Logs



LEGEND

4 ⊕ Boring Location (Approx.)

NOT TO SCALE

BORING LOCATION MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
POOL AND EQUIPMENT/ LOCKER BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3104

Earth Systems Pacific
4378 Old Santa Fe Road
San Luis Obispo, CA 93401-8116
(805) 544-3276 • FAX (805) 544-1786
E-mail: esp@earthsystems.com

January 6, 2016 CS SL-16605-SD

SLO HS MEASURE D POOL EQUIPMENT AND LOCKER– 1616BLOCATIONS

Earth Systems Pacific

BORING LOG LEGEND

SAMPLE / SUBSURFACE WATER SYMBOLS	GRAPH. SYMBOL
CALIFORNIA MODIFIED	
STANDARD PENETRATION TEST (SPT)	
SHELBY TUBE	
BULK	
SUBSURFACE WATER DURING DRILLING	
SUBSURFACE WATER AFTER DRILLING	

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

MAJOR DIVISIONS	GROUP SYMBOL	TYPICAL DESCRIPTIONS	GRAPH. SYMBOL
COARSE GRAINED SOILS (MORE THAN HALF OF MATERIAL IS LARGER THAN #200 SIEVE SIZE)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GP	POORLY GRADED GRAVELS, OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, NON-PLASTIC FINES	
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, PLASTIC FINES	
	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
	SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES	
	SM	SILTY SANDS, SAND-SILT MIXTURES, NON-PLASTIC FINES	
	SC	CLAYEY SANDS, SAND-CLAY MIXTURES, PLASTIC FINES	
FINE GRAINED SOILS (HALF OR MORE OF MATERIAL IS SMALLER THAN #200 SIEVE SIZE)	ML	INORGANIC SILTS AND VERY FINE SANDS, 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	
	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS	
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	

OBSERVED MOISTURE CONDITION

DRY	SLIGHTLY MOIST	MOIST	VERY MOIST	WET (SATURATED)

CONSISTENCY

COARSE GRAINED SOILS			FINE GRAINED SOILS		
BLOWS/FOOT		DESCRIPTIVE TERM	BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER		SPT	CA SAMPLER	
0-10	0-16	LOOSE	0-2	0-3	VERY SOFT
11-30	17-50	MEDIUM DENSE	3-4	4-7	SOFT
31-50	51-83	DENSE	5-8	8-13	MEDIUM STIFF
OVER 50	OVER 83	VERY DENSE	9-15	14-25	STIFF
			16-30	26-50	VERY STIFF
			OVER 30	OVER 50	HARD

GRAIN SIZES

U.S. STANDARD SERIES SIEVE				CLEAR SQUARE SIEVE OPENING		
# 200	# 40	# 10	# 4	3/4"	3"	12"

SILT & CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

TYPICAL BEDROCK HARDNESS

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
EXTREMELY HARD	CORE, FRAGMENT, OR EXPOSURE CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CAN ONLY BE CHIPPED WITH REPEATED HEAVY HAMMER BLOWS
VERY HARD	CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CORE OR FRAGMENT BREAKS WITH REPEATED HEAVY HAMMER BLOWS
HARD	CAN BE SCRATCHED WITH KNIFE OR SHARP PICK WITH DIFFICULTY (HEAVY PRESSURE); HEAVY HAMMER BLOW REQUIRED TO BREAK SPECIMEN
MODERATELY HARD	CAN BE GROOVED 1/16 INCH DEEP BY KNIFE OR SHARP PICK WITH MODERATE OR HEAVY PRESSURE; CORE OR FRAGMENT BREAKS WITH LIGHT HAMMER BLOW OR HEAVY MANUAL PRESSURE
SOFT	CAN BE GROOVED OR GOUGED EASILY BY KNIFE OR SHARP PICK WITH LIGHT PRESSURE, CAN BE SCRATCHED WITH FINGERNAIL; BREAKS WITH LIGHT TO MODERATE MANUAL PRESSURE
VERY SOFT	CAN BE READILY INDENTED, GROOVED OR GOUGED WITH FINGERNAIL, OR CARVED WITH KNIFE; BREAKS WITH LIGHT MANUAL PRESSURE

TYPICAL BEDROCK WEATHERING

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
FRESH	NO DISCOLORATION, NOT OXIDIZED
SLIGHTLY WEATHERED	DISCOLORATION OR OXIDATION IS LIMITED TO SURFACE OF, OR SHORT DISTANCE FROM, FRACTURES: SOME FELDSPAR CRYSTALS ARE DULL
MODERATELY WEATHERED	DISCOLORATION OR OXIDATION EXTENDS FROM FRACTURES, USUALLY THROUGHOUT; Fe-Mg MINERALS ARE "RUSTY", FELDSPAR CRYSTALS ARE "CLOUDY"
INTENSELY WEATHERED	DISCOLORATION OR OXIDATION THROUGHOUT; FELDSPAR AND Fe-Mg MINERALS ARE ALTERED TO CLAY TO SOME EXTENT, OR CHEMICAL ALTERATION PRODUCES IN SITU DISAGGREGATION
DECOMPOSED	DISCOLORATION OR OXIDATION THROUGHOUT, BUT RESISTANT MINERALS SUCH AS QUARTZ MAY BE UNALTERED; FELDSPAR AND Fe-Mg MINERALS ARE COMPLETELY ALTERED TO CLAY

drafting/masters/Boring Log Legend121714.dwg

Earth Systems Pacific

Boring No. 1
PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

JOB NO.: SL-16605-SD
DATE: 12/30/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
POOL AND EQUIPMENT/ LOCKER BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3104

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	SC		CLAYEY SAND: dark brown, loose, moist (Topsoil)					
1	GP		POORLY GRADED GRAVEL: light brown, medium dense, moist (Fill) Gravel to 2" in greatest dimension					
4	CL		SANDY LEAN CLAY: gray brown to dark brown, stiff, moist, trace fine gravel	5.0 - 6.5	■	106.6	15.6	5 9 10
7	SC		CLAYEY SAND WITH GRAVEL: brown, medium dense, moist	10.0 - 11.5	■	108.9	9.8	7 10 7
13	CH		SANDY FAT CLAY: dark brown, stiff, moist (Alluvium)	15.0 - 16.5	■	106.7	20.7	5 11 13
20			very stiff	20.0 - 21.5	●			5 7 9
25				25.0 - 26.5	●			5 9 11
26			End of Boring @ 26.5' No subsurface water encountered					

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 2

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

PAGE 1 OF 1
JOB NO.: SL-16605-SD
DATE: 12/29/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
POOL AND EQUIPMENT/ LOCKER BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3104

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL		SAND LEAN CLAY: dark brown, stiff, moist (Fill)					
3	SC		CLAYEY SAND WITH GRAVEL: gray brown, medium dense, slightly moist	3.0 - 4.5	Ring	125.5	5.8	10, 18, 18
5				5.0 - 6.5	Ring	125.4	9.6	7, 14, 16
8			moist					
10				10.0 - 11.5	Ring	104.9	15.8	5, 8, 9
14	CH		SANDY FAT CLAY WITH GRAVEL: dark brown, stiff, moist (Alluvium)					
15				15.0 - 16.5	SPT			1, 5, 5
17			End of Boring @ 16.5' No subsurface water encountered					

LEGEND: Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 3

PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

JOB NO.: SL-16605-SD
DATE: 12/30/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
POOL AND EQUIPMENT/ LOCKER BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3104

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	SC		CLAYEY SAND: brown, medium dense, slightly moist	1.0 - 2.5	Ring	116.2	14.4	4, 10, 22
2			gray brown, trace fine to coarse gravel	1.0 - 5.0	Grab			
3				3.0 - 4.5	Ring	123.0	9.5	5, 12, 18
5				5.0 - 6.5	Ring	107.9	15.6	5, 8, 10
6	CL		SANDY LEAN CLAY: dark brown, stiff, moist, trace fine gravel (Fill)					
10	SC		CLAYEY SAND: olive brown, loose, moist	10.0 - 11.5	Ring	95.5	18.7	2, 4, 6
12	CH		SANDY FAT CLAY: brown, stiff, moist (Alluvium)					
15				15.0 - 16.5	SPT			3, 6, 7
16.5			End of Boring @ 16.5' No subsurface water encountered					

LEGEND: Ring Sample Grab Sample Shelby Tube Sample SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 4
PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

JOB NO.: SL-16605-SD
DATE: 12/30/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
POOL AND EQUIPMENT/ LOCKER BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3104

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL		SANDY LEAN CLAY: gray brown to dark brown, stiff, moist, trace fine gravel (Fill)	1.0 - 2.5	Ring	122.2	7.7	9 29 39
2	SC		CLAYEY SAND WITH GRAVEL: brown, dense, slightly moist (Fill)	2.0 - 5.0	Grab			
6	CL		SANDY LEAN CLAY: dark brown, stiff, moist					
8	SC		CLAYEY SAND : brown, medium dense, moist, some fine to coarse gravel					
10	SM		SILTY SAND: olive brown, loose, moist	10.0 - 11.5	Ring	103.4	20.8	4 3 4
11	CH		SANDY FAT CLAY: brown, medium stiff, moist (Alluvium)					
15			stiff	15.0 - 16.5	SPT			3 7 8
19			gray/ brown mottled					
20				20.0 - 21.5	SPT			5 7 9
21			gray/ green, petroleum odor in sample					
24			hydrocarbon visible in sample	25.0 - 26.5	SPT			4 5 6
26			End of Boring @ 26.5' No subsurface water encountered					

LEGEND: Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

APPENDIX B

Geotechnical Laboratory Test Results

San Luis Obispo High School
Measure D - Pool and Equipment / Locker Building

SL-16605-SD

BULK DENSITY TEST RESULTS

ASTM D 2937-10 (modified for ring liners)

January 12, 2016

BORING NO.	DEPTH feet	MOISTURE CONTENT, %	WET DENSITY, pcf	DRY DENSITY, pcf
1	6.0 - 6.5	15.6	123.2	106.6
1	11.0 - 11.5	9.8	119.6	108.9
1	16.0 - 16.5	20.7	128.8	106.7
2	4.0 - 4.5	5.8	132.8	125.5
2	6.0 - 6.5	9.6	137.4	125.4
2	11.0 - 11.5	15.8	121.5	104.9
3	2.0 - 2.5	14.4	133.0	116.2
3	4.0 - 4.5	9.5	134.7	123.0
3	6.0 - 6.5	15.6	124.8	107.9
3	10.0 - 10.5	18.7	113.4	95.5
4	2.0 - 2.5	7.7	131.6	122.2
4	4.0 - 4.5	20.8	124.9	103.4

EXPANSION INDEX TEST RESULTS

ASTM D 4829-11

BORING NO.	DEPTH feet	EXPANSION INDEX
1	16.0 - 16.5	61
3	1.0 - 5.0	57

San Luis Obispo High School
Measure D - Pool and Equipment / Locker Building

SL-16605-SD

MOISTURE-DENSITY COMPACTION TEST

ASTM D 1557-12 (Modified)

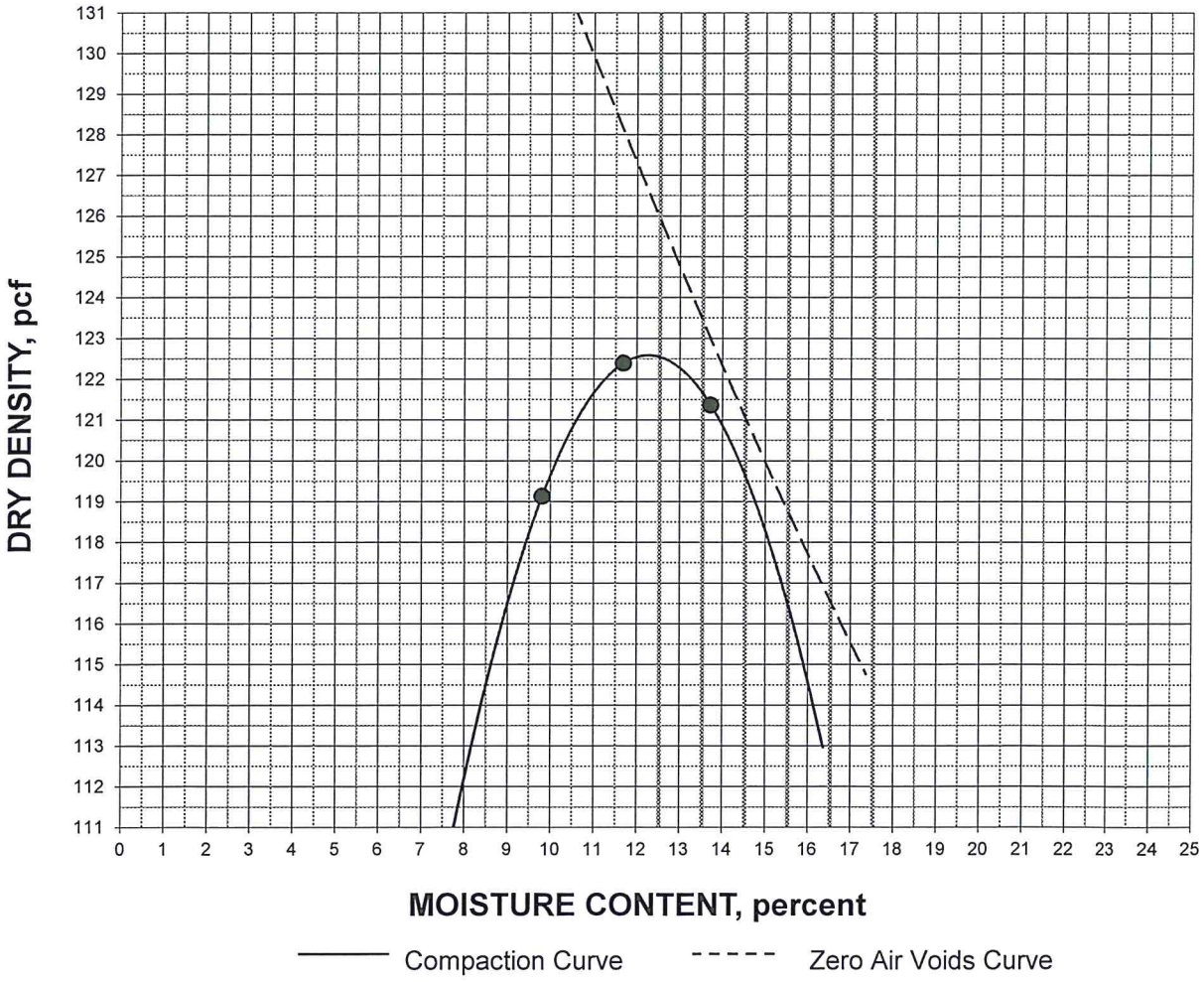
PROCEDURE USED: A
PREPARATION METHOD: Moist
RAMMER TYPE: Mechanical
SPECIFIC GRAVITY: 2.70 (assumed)

January 12, 2016
Boring #3 @ 1.0 - 5.0'
Brown Clayey Sand (SC)

SIEVE DATA:

Sieve Size	% Retained (Cumulative)
3/4"	0
3/8"	0
#4	0

MAXIMUM DRY DENSITY: 122.6 pcf
OPTIMUM MOISTURE: 12.3%



San Luis Obispo High School
Measure D - Pool and Equipment / Locker Building

SL-16605-SD

DIRECT SHEAR

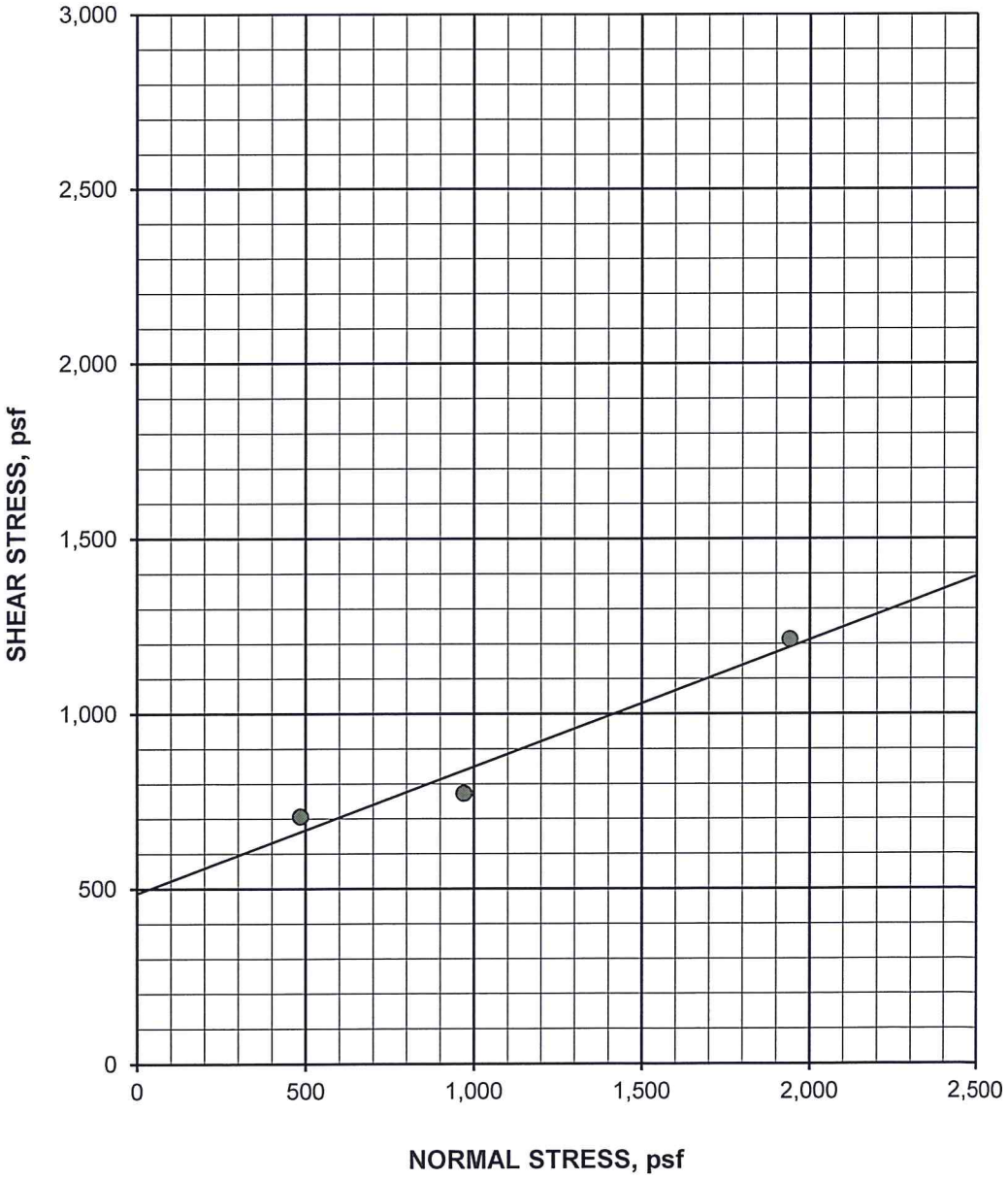
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

January 12, 2016

Boring #3 @ 1.0 - 5.0'
Clayey Sand (SC)
Compacted to 90% RC, saturated

INITIAL DRY DENSITY: 110.3 pcf
INITIAL MOISTURE CONTENT: 12.3 %
PEAK SHEAR ANGLE (Ø): 20°
COHESION (C): 486 psf

SHEAR vs. NORMAL STRESS



San Luis Obispo High School SL-16605-SD

Measure D - Pool and Equipment / Locker Building

DIRECT SHEAR continued

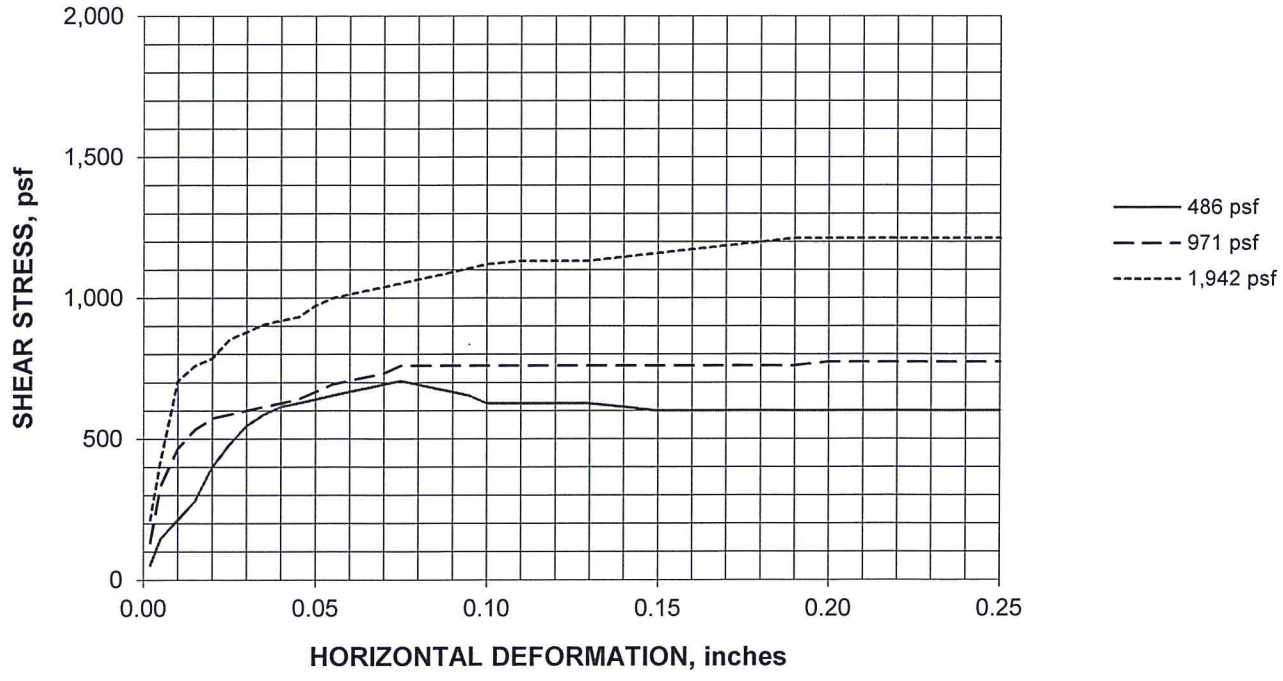
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

Boring #3 @ 1.0 - 5.0' January 12, 2016

Clayey Sand (SC)

Compacted to 90% RC, saturated SPECIFIC GRAVITY: 2.70 (assumed)

SAMPLE NO.:	1	2	3	AVERAGE
INITIAL				
WATER CONTENT, %	12.3	12.3	12.3	12.3
DRY DENSITY, pcf	110.3	110.3	110.3	110.3
SATURATION, %	63.0	63.0	63.0	63.0
VOID RATIO	0.527	0.527	0.527	0.527
DIAMETER, inches	2.410	2.410	2.410	
HEIGHT, inches	1.00	1.00	1.00	
AT TEST				
WATER CONTENT, %	22.5	22.2	23.0	
DRY DENSITY, pcf	111.0	113.3	117.7	
SATURATION, %	100.0	100.0	100.0	
VOID RATIO	0.518	0.487	0.431	
HEIGHT, inches	0.99	0.97	0.94	



San Luis Obispo High School SL-16605-SD

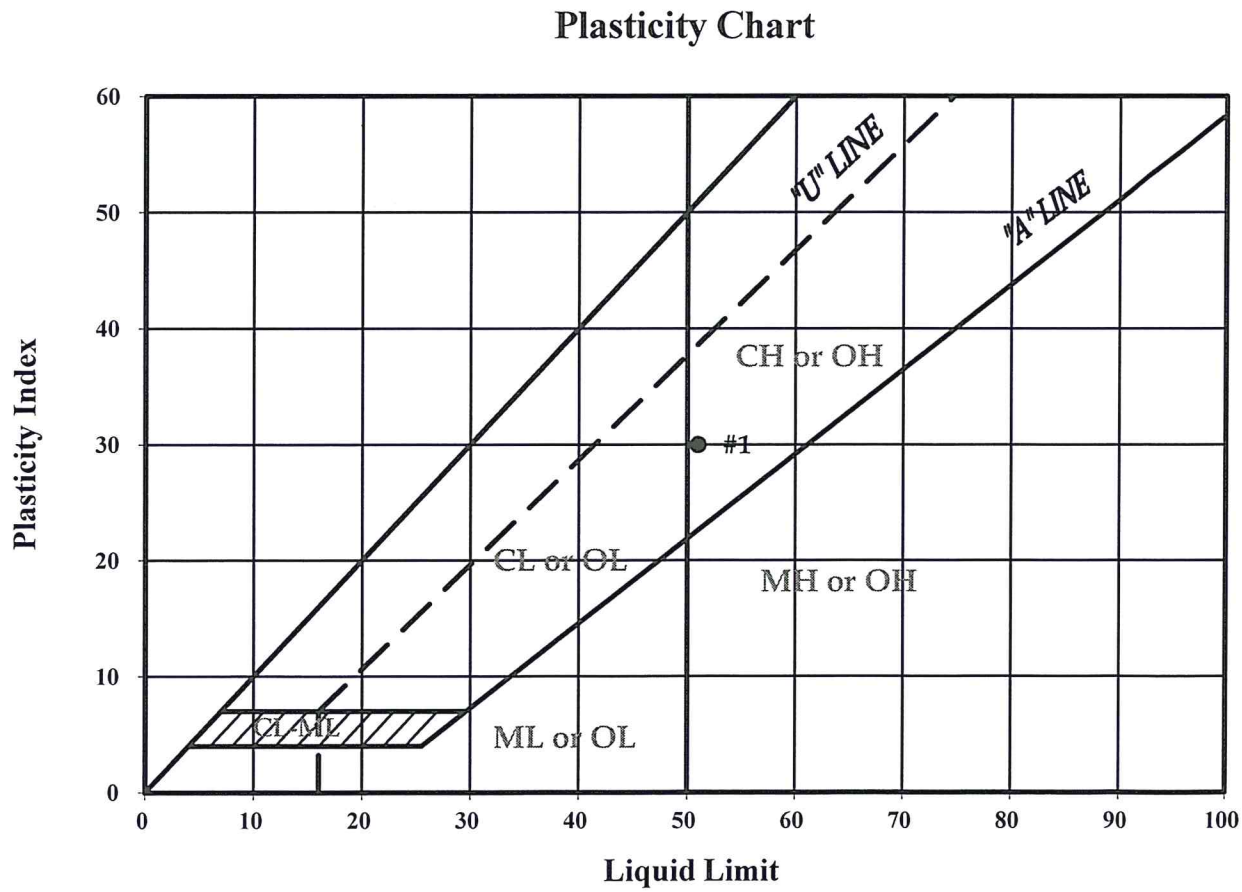
Measure D - Pool and Equipment / Locker Building

PLASTICITY INDEX

ASTM D 4318-10

January 12, 2016

Test No.:	1	2	3	4	5
Boring No.:	2				
Sample Depth:	15.0 - 16.5'				
Liquid Limit:	51				
Plastic Limit:	21				
Plasticity Index:	30				



APPENDIX C

Corrosivity Analysis by CERCO Analytical, Inc.

California State Certified Laboratory No. 2153

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax. 925 462 2775
www.cercoanalytical.com

15 January, 2016

Job No. 1601079
Cust. No. 11974

Mr. Fred J. Potthast, GE
Earth Systems Pacific
4378 Santa Fe Road
San Luis Obispo, CA 93401

Subject: Project No.: SL-16605-SD
Project Name: San Luis Obispo High School –Pool & Equipment/Locker Building
Corrosivity Analysis – ASTM Test Methods

Dear Mr. Potthast:

Pursuant to your request, CERCO Analytical has analyzed the soil samples submitted on January 07, 2016. Based on the analytical results, this brief corrosivity evaluation is enclosed for your consideration.

Based upon the 100% saturation resistivity measurements, both samples are classified as "corrosive". All buried iron, steel, cast iron, ductile iron, galvanized steel and dielectric coated steel or iron should be properly protected against corrosion depending upon the critical nature of the structure. All buried metallic pressure piping such as ductile iron firewater pipelines should be protected against corrosion.

The chloride ion concentrations were 18 & 150 mg/kg and are determined to be insufficient to attack steel embedded in a concrete mortar coating.

The sulfate ion concentrations were 29 & 480 mg/kg and are are determined to be sufficient to potentially be detrimental to reinforced concrete structures and cement mortar-coated steel at these locations. Therefore, concrete that comes into contact with this soil should use sulfate resistant cement such as Type II, with a maximum water-to-cement ratio of 0.55.

The pH of the soils were 7.45 to 7.90, which does not present corrosion problems for buried iron, steel, mortar-coated steel and reinforced concrete structures.

The redox potentials were 400 & 430-mV, which indicative of aerobic soil conditions.

This corrosivity evaluation is based on general corrosion engineering standards and is non-specific in nature. For specific long-term corrosion control design recommendations or consultation, please call *JDH Corrosion Consultants, Inc. at (925) 927-6630*.

We appreciate the opportunity of working with you on this project. If you have any questions, or if you require further information, please do not hesitate to contact us.

Very truly yours,
CERCO ANALYTICAL, INC.

J. Darby Howard, Jr., P.E.
President

JDH/jdl
Enclosure

California State Certified Laboratory No. 2153

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax. 925 462 2775
www.cercoanalytical.com

Client: EarthSystems Pacific
Client's Project No.: SL-16605-SD
Client's Project Name: San Luis Obispo High School - Pool and Equipment/Locker Building
Date Sampled: 30-Dec-15
Date Received: 7-Jan-16
Matrix: Soil
Authorization: Letter dated January 4, 2016

Date of Report: 15-Jan-2016

Job/Sample No.	Sample I.D.	Redox (mV)	pH	Resistivity (as Received) (umhos/cm)	Resistivity (100% Saturation) (ohms-cm)	Sulfide (mg/kg)*	Chloride (mg/kg)*	Sulfate (mg/kg)*
1601079-001	Boring 3 @ 1 - 5' (SC)	410	7.90	24,000	710	-	150	480
1601079-002	Boring 4 @ 15 - 16.5' (CL)	400	7.45	2,400	1,600	-	18	29

Method:	ASTM D1498	ASTM D4972	ASTM D1125M	ASTM G57	ASTM D4658M	ASTM D4327	ASTM D4327
Reporting Limit:	-	-	10	-	50	15	15
Date Analyzed:	13-Jan-2016	13-Jan-2016	13-Jan-2016	13-Jan-2016	-	14-Jan-2016	14-Jan-2016

Cheryl McMillen
Laboratory Director

* Results Reported on "As Received" Basis
N.D. - None Detected

Quality Control Summary - All laboratory quality control parameters were found to be within established limits

APPENDIX D

Geotechnical Engineering and Geologic Hazards Report
San Luis Obispo High School – Measure D Projects
Annex/Classroom Building
1499 San Luis Drive, San Luis Obispo, California
Project No. 831-3102
dated January 19, 2016

GEOTECHNICAL ENGINEERING AND GEOLOGIC HAZARDS REPORT
SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3102

January 19, 2016

Prepared for

Mr. Anthony Palazzo
San Luis Coastal Unified School District

Prepared by

Earth Systems Pacific
4378 Old Santa Fe Road
San Luis Obispo, CA 93401

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January 19, 2016

FILE NO.: SL-16605-SE

Mr. Anthony Palazzo
Director – Buildings, Grounds and Transportation
San Luis Coastal Unified School District
937 Southwood Drive
San Luis Obispo, CA 93401

PROJECT: SAN LUIS OBISPO HIGH SCHOOL -MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3102

SUBJECT: Geotechnical Engineering and Geologic Hazards Report

CONTRACT REF: Purchase Order No. 161188 by San Luis Coastal School District, dated December 7, 2015, to Provide a Geotechnical Engineering Investigation, San Luis Obispo High School, Measure D Projects, 1499 San Luis Drive, San Luis Obispo, California, per Proposal by Earth Systems Pacific, Doc. No. 1511-157.PRP, dated November 25, 2015

Dear Mr. Palazzo:

In accordance with your purchase order, this geotechnical engineering and geologic hazards report has been prepared for use in the development of plans and specifications for the Annex/Classroom Building Project at San Luis Obispo High School, in San Luis Obispo, California. This report describes the general geotechnical and geologic characteristics, identifies existing and potential geotechnical and geologic hazards, and discusses the impacts that these conditions could have upon the project. Preliminary geotechnical recommendations for site preparation, grading, utility trenches, foundations, interior slabs-on-grade and exterior pedestrian flatwork, retaining walls, asphalt concrete (AC) paths, drainage and maintenance, and observation and testing are presented herein. Soil corrosivity testing and an evaluation of the results, which were subcontracted to HDR, Inc. of Claremont, California, are also provided. Two bound copies and an electronic copy of this report are being furnished for your use.

We appreciate the opportunity to have provided services for this project and look forward to working with you again in the future. If there are any questions concerning this report, please do not hesitate to contact the undersigned.

Sincerely,
Earth Systems Pacific

Fred J. Potthast, GE 2869
Principal Engineer

1/19/16

Doc. No.: 1601.059.SGR.rf

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Principal Geologist

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1.0 INTRODUCTION AND SITE SETTING

The proposed Annex/Classroom Building at San Luis Obispo High School will have a footprint of approximately 12,000 square feet. It will be single story, of steel-frame, stud and possibly masonry construction. Conventional continuous and spread (pad) foundations are planned, with concrete slabs-on-grade. Maximum dead plus live loads on continuous footings of 2,000 plf, and maximum loads on spread footings of 75 kips, have been assumed for the purposes of this report. Retaining walls for sitework, or connected to or forming part of the structure, and a maximum of 4 feet tall, may also be utilized. The new building will be served by the existing campus utility systems via underground connections; it will be surrounded by landscaping and sidewalks of either Portland cement concrete (PCC) or asphalt concrete (AC) over aggregate base (AB). The existing service driveways in the project area may be repaired as part of the project, however no new pavement areas are anticipated. To our knowledge, no drainage basins are planned as part of the project. Infiltration systems or other types of low-impact development (LID) features may be included in the final design; however this has not been determined as of the date of this report, and therefore these potential features are not addressed.

The new building will be constructed on the site of the existing Annex/Cafeteria Building, on the north side of the campus, immediately east of the old Gymnasium. The site location on the campus is indicated on the Vicinity Map in Appendix A. Flatwork, lawns, shrubs and several scattered mature trees are present on the west, south and east sides of the existing building. The main campus service road extends along the west side of the existing building, just beyond the lawn, providing access to a paved delivery area at the rear (the north side) of the building. Drainage appears to be by sheet flow, and generally toward the south-southwest. The locations and dispositions of utility lines on the site are unknown.

2.0 SCOPE OF SERVICES

The scope of work for this report included a general site reconnaissance, subsurface exploration, site reconnaissance by a registered geotechnical engineer and certified engineering geologist, laboratory testing of samples secured during the subsurface investigation, geotechnical and geologic analyses of the data, and preparation of this report. The analysis and subsequent recommendations were based on general information provided by the client.

This report and preliminary geotechnical recommendations are intended to comply the considerations of Sections 1803A.1 through 1803A.7, J104.3 and J104.4 of the 2013 California Building Code; California Geological Survey Note 48; DSA IR A-4.13; and common geotechnical engineering and engineering geology practice in this area under similar conditions at this time.

The test procedures were accomplished in general conformance with the standards noted, as modified by common geotechnical engineering practice in this area under similar conditions at this time.

Preliminary geotechnical recommendations for site preparation, grading, utility trenches, foundations, interior slabs-on-grade and pedestrian flatwork, retaining walls, AC paths, drainage and maintenance, and observation and testing are presented to guide the development of project plans and specifications. The results of geotechnical corrosivity testing, and an evaluation of the results with recommendations for mitigation, which were subcontracted to HDR, Inc., are also provided. As there may be geotechnical issues yet to be resolved, the geotechnical engineer should be retained to provide consultation as the design progresses, to assist in verifying that pertinent geotechnical issues have been addressed and to aid in conformance with the intent of this report. It may also be advantageous to retain the geotechnical engineer to review the project plans and details as they near completion, to further aid in conformance with the intent of this report.

It is our intent that this report be used exclusively by the client in the preparation of plans and specifications. Application beyond this intent is strictly at the user's risk.

This report does not address issues in the domain of contractors such as, but not limited to, site safety, loss of volume due to stripping of the site, shrinkage of soils during compaction, excavatability, dewatering, shoring, temporary slope angles, construction means and methods, etc. Analyses of the soil for mold potential, man-made asbestos, lead, radioisotopes, hydrocarbons, or chemical properties other than geotechnical corrosivity are beyond the scope of this report. Evaluation of the site for suitability for LID improvements or drainage basins; ancillary features such as temporary access roads, fences, flag and light poles, signage; and nonstructural fills are not within our scope and are also not addressed.

In the event that there are any changes in the nature, design, or location of improvements, or if any assumptions used in the preparation of this report prove to be incorrect, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are verified or are modified in writing. The criteria presented in this report are considered preliminary until such time as any peer review or review by any jurisdiction has been completed, conditions are observed by the geotechnical engineer and/or geologist in the field during construction, and the recommendations have been verified as appropriate or modified in writing.

3.0 FIELD INVESTIGATION

On December 29, 2015, three borings were drilled in the planned building area to depths ranging from approximately 16.5 to 26 feet below the existing ground surface. The borings were drilled with a truck-mounted Mobile Drill rig, Model B-53, equipped with 6-inch outside diameter hollow stem auger and an automatic trip hammer for sampling. The approximate locations of the borings are shown on the Boring Location Map in Appendix A. Soil samples were obtained using a ring-lined barrel sampler (ASTM D 3550-01/07 with shoe similar to D 2937-10). Bulk soil samples were obtained from the auger cuttings. Standard penetration tests were also performed in the borings (ASTM D 1586-11) at selected depths. The borings were backfilled with auger spoils.

Soils encountered in the borings were categorized and logged in general accordance with the Unified Soil Classification System and ASTM D 2488-09a. Where bedrock was encountered, its properties were described based upon observation of the auger cuttings and the effort required to drill into it. Copies of the boring logs and a Boring Log Legend are included in Appendix A. In reviewing the boring logs and legend, the reader should recognize that the legend is intended as a guideline only, and there are a number of conditions that may influence the soil characteristics as observed during drilling. These include, but are not limited to, the presence of cobbles or boulders, cementation, variations in soil moisture, presence of groundwater, and other factors. It should also be noted that the descriptions of bedrock must span a much wider range of density and strength characteristics than soil, and are relative to other bedrock strata. For example, fractured and weathered bedrock may be described as “soft,” yet it will be considerably harder than almost any type of soil. Conversely, a clay soil may be described as “hard,” however it will not be nearly as hard as even “moderately soft” bedrock such as the sandstone and claystone encountered on this site. Consequently, the logger must exercise judgment in interpreting the subsurface characteristics, possibly resulting in soil and bedrock descriptions that vary somewhat from the legend.

4.0 LABORATORY ANALYSIS

The ring samples were tested for unit weight and moisture (ASTM D 2937-10), as modified for ring liners. One ring sample was also tested for one-dimensional consolidation (ASTM D 2435-11). Bulk samples were tested for maximum density and optimum moisture content (ASTM D 1557-12), expansion index (ASTM D 4829-11), plasticity index (ASTM D 4318-10) and cohesion and angle of shearing resistance by direct shear (ASTM D 3080-11, recompacted to 90 percent of maximum dry density and modified for consolidated, undrained conditions). The physical laboratory test results are presented in Appendix B.

Two bulk samples of the upper soils were also sent to HDR, Inc. of Claremont, California for geotechnical corrosivity testing. The results of these tests, and HDR, Inc.'s evaluation of the results, are presented in Appendix C.

5.0 GENERAL SUBSURFACE AND GEOLOGIC PROFILE

Boring 1, drilled on the west side of the existing building, found 4 feet of stiff fill (sandy lean clay with a trace of coarse gravel) over alluvium. The alluvium consisted of very stiff sandy lean clay with some fine gravel from 4 to 17 feet, and medium dense clayey gravel with sand to 23.5 feet. The alluvium was underlain by moderately soft bedrock (sandstone) of the Franciscan Mélange, which continued to drilling refusal at 26 feet.

A pavement section of 4 inches of asphalt concrete (AC) over 2 inches of aggregate base (AB) was found in Boring 2, on the north side of the existing building. Below the pavement to the boring termination depth of 16.5 feet was stiff to very stiff sandy lean clay alluvium. Some fine gravel was found in the clay to 4.5 feet.

Boring 3, on the east side of the existing building, encountered very stiff sandy lean clay with a trace of gravel (alluvium) from the surface to 7.5 feet. Bedrock of the Franciscan Mélange was found below the alluvium; the bedrock was moderately soft sandstone to 10.5 feet and moderately soft, severely sheared and weathered claystone to the drilling refusal depth of 16.5 feet.

During drilling, the soils and bedrock were described as being slightly moist to very moist. Free subsurface water was not found in any of the borings, to the maximum depth explored of 26 feet.

Please refer to the boring logs in Appendix A for a more complete description of the subsurface conditions. Cross Section A-A' in Appendix A is a graphic representation of the subsurface conditions found by the exploratory borings.

6.0 GEOLOGY

Geologic Setting

San Luis Obispo High School lies along the northeastern side of the Los Osos Valley, which is bounded to the northeast by the northwest-trending Santa Lucia Mountain Range and to the southwest by the northwest-trending Irish Hills. The proposed building area is on the north side of the campus, and it is relatively flat with a slight slope to the south/southwest. Locally, the school site area is bounded to the northeast by hillside terrain and to the southwest by San Luis Obispo Creek. The geologic map of the San Luis Obispo Quadrangle by Wiegers (2010) indicates

that the Annex/Classroom Building school site area is underlain by Holocene alluvial flood plain deposits (see the Geologic Map in Appendix D). Based on the results of our subsurface investigation and field observations, we concur with the Wiegers geologic map.

Faulting

Significant Faults

The San Andreas, Hosgri-San Simeon, and Los Osos Faults are the most significant regional *active* faults within a 65-mile radius of the school site, which could affect existing and proposed developments during their anticipated lifespan (see the Historical Earthquake/Fault Map in the Appendix D). The closest *active* fault to the site is the Irish Hills segment of the Los Osos Fault, located approximately 3.35 miles southwest. The closest mapped fault to the site (regardless of activity) is the Late Quaternary age Cambria Fault; it is located approximately 1 mile northeast (see the Historical Earthquake/Fault Map in the Appendix D). Brief descriptions of these faults are presented in the following sections. Regional faults and locations of historic earthquake events are also depicted on the Historical Earthquake/Fault Map in Appendix D.

Cambria Fault

The Cambria Fault is the closest mapped fault (regardless of activity) to the site; it is located approximately 1 mile northeast. The southern end of the Cambria fault could be considered part of the Oceanic fault group where the faults nearly join east of Cal Poly State University in San Luis Obispo. In some areas along the fault, it can be distinguished by the line of serpentine rock ridges that it bounds. Splays of the Cambria fault break late Pliocene (2 million years old) strata east of Cambria, but there is no known offset of Holocene (11,000 years old) age sediments by the system (Chipping, 1987). Weber (1983) noted that 120,000-year old marine terrace deposits north of Cayucos, near Ellysly Creek, may have been offset by the Cambria fault. However, to our knowledge, Weber's observation has never been confirmed by field exploration.

San Andreas Fault

The San Andreas Fault, considered to be the most active fault in the general region, lies 23 miles to the east of the site. The San Andreas Fault undergoes a major change in character between Parkfield and Cholame. North of Cholame, the fault moves more or less constantly in a process called creep, whereas the south end of the fault is locked, moving only in very large earthquakes. The last major quake on this part of the fault was the 1857 event (magnitude 7.9). In the immediate vicinity of Parkfield, there is a 20-mile segment that is also locked, generating an earthquake every 20 years or so on average. Dated quakes on this segment are 1881, 1901, 1922, 1934, and 1966, and are usually in the magnitude 5.5 to 6.0 range, (Bakun 1988). A 6.0 magnitude earthquake occurred on this fault segment on September 28, 2004.

Los Osos Fault

The Los Osos Fault, at its closest point to the site, is approximately 3 miles to the southwest. It consists of four distinct segments. From northwest to southeast, these are the Estero Bay, the Irish Hills, the Lopez Reservoir, and the Newsome Ridge segments. PG&E (1988) suggests that the Irish Hills segment displays the best expressed geomorphic features, displacing late Pleistocene and Holocene deposits. The Irish Hills segment starts in the vicinity of Los Osos and extends to just past San Luis Obispo Creek. A two-mile long segment west of Laguna Lake is considered to be active (Treiman 1989) and is zoned as a State Earthquake Fault Zone under the Alquist-Priolo Act (Hart 1997). This active segment lies about 3.35 miles to the southwest of the site and is the closest active fault to the site. The Los Osos Fault comprises a northwest-trending series of high- and low-angle faults that exhibit a complex history of both strike-slip and reverse displacement. However, during the late Quaternary, movement appears to have been primarily reverse displacement (PG&E 1998).

Hosgri-San Simeon Fault System

The Hosgri-San Simeon Fault System lies approximately 25 miles to the west of the site. A northwest-trending strike-slip fault, the San Simeon Fault extends from offshore of Ragged Point to just offshore of San Simeon Point, where it joins the northern end of the Hosgri Fault. From this point, the Hosgri Fault extends to an ocean shelf 2 miles west of Point Buchon, and then trends toward the Point Sal area. The fault system is considered active by the 2004 United States Geologic Survey (Jennings and Bryant 2010), based on Hall's claims of recent offset terrace deposits along San Simeon Cove, and also by a relocation of the 1927 "Lompoc Earthquake" onto the southern end of the Hosgri Fault (Hall 1975, 1976, 1977).

On December 22, 2003, a 6.5-magnitude earthquake occurred approximately 6 miles northeast of San Simeon, California and approximately 28 miles north of the subject site. Analysis by the USGS and the University of California at Berkeley indicates that the event had a thrust (reverse-faulting) mechanism (Goel 2004). The earthquake occurred in the vicinity of the northern end of the Hosgri-San Simeon Fault.

Groundwater

Soil and bedrock moisture contents encountered during drilling were generally slightly moist to very moist. Groundwater was not encountered in any of the borings to the maximum depth explored of 26 feet.

7.0 SEISMICITY

Earthquake History

The historic seismicity in the site's region was researched using EQSEARCH (Blake, updated December 2012) and the Boore and others (1997) method of analysis for Site Class "D", stiff soil sites (ASCE 2010) that is incorporated within that program. EQSEARCH performs automated searches of a custom catalog of historical Central California earthquakes. As the program searches the catalog, it computes the epicentral distance from the selected site to each of the earthquakes within the specified search area. The epicentral distances should be considered estimates, particularly for earthquake data prior to 1932, when modern instruments were first used to record earthquake data.

The parameters used for the search consisted of earthquake Richter magnitudes ranging from 5.0 to 9.0 that occurred within a 65-mile radius from the site from 1800 to December 2012. The site coordinates used in this search were latitude 35.2836N and longitude 120.6501W. The Historical Earthquake/Fault Map presented in Appendix D graphically depicts the results of the search, including historical earthquake epicenters, their corresponding magnitudes, and faults within the general region of the project.

Results of the search indicated that within the search parameters, 44 earthquakes have occurred. The highest peak horizontal ground acceleration (PGA) estimated to have occurred at the site from those historical earthquakes is 0.33g. This earthquake had a 5.9 magnitude, occurred in 1906, and was located approximately 3 miles northwest of the site. This earthquake may have occurred along the Los Osos Fault. The largest magnitude earthquake that the search revealed was 7.9. This earthquake was located approximately 48 miles east of the site, and is known as the 1857 earthquake on the San Andreas Fault. It produced an estimated PGA of 0.15g at the site.

Design Acceleration Parameters

In accordance with California Geologic Survey, Note 48 (October 2013), Item 16, an assessment was made to determine if there was a need to employ "Site Specific Ground Motion Procedures" for this site. Based on a review of the San Luis Obispo County Planning Department Permit View web site (2015), a determination was made that the site is not located in a Geologic Study Area, an Alquist-Priolo Earthquake Fault Zone, or a High Liquefaction Hazard Zone. In addition, the S_1 ground motion value obtained from the United States Geological Survey Earthquake Hazards Program website (USGS 2016) and the 2010 ASCE 7 Standard Analysis Method, for Site Class "D" (stiff soil sites), was below 0.75g (see table below). Therefore, the project does not require a site-specific ground motion analysis.

The site is in a region of generally high seismicity and has the potential to experience strong ground shaking from earthquakes on regional or local causative faults. To characterize the seismicity at the site and to provide seismic design parameters for the architect/engineer, a General Procedure Ground Motion Analysis was performed to calculate the deterministic ground motions at the site. The ground motions are based on the 2013 California Building Code General Procedure that were obtained from the United States Geological Survey Earthquake Hazards Program website (USGS 2016) and the 2010 ASCE 7 Standard Analysis Method, for Site Class "D" (stiff soil sites). The results of this analysis are presented in the following table:

SUMMARY OF DESIGN RESPONSE ACCELERATION PARAMETERS

Mapped Acceleration Values for Site Class "B"		**2013 CBC Site Coefficients and General Procedure Adjusted MCE Spectral Response Acceleration Parameters For Site Class "D"**					
Seismic Parameters	Values (g)	Site Coefficients	Values	Seismic Parameters	Values (g)	Seismic Parameters	Values (g)
S_S	1.137	F_a	1.045	S_{MS}	1.188	S_{DS}	0.792
S_1	0.434	F_v	1.566	S_{M1}	0.680	S_{D1}	0.453
Peak Mean Ground Acceleration (PGA_m): 0.475 g							
Seismic Design Category = D							

Seismic Design Category

Section 1613A.3.5 of the 2013 CBC indicates that sites will be assigned to Category D unless $S_1 \geq 0.75$. The S_1 calculated for the site is 0.434g; therefore, the site would be assigned to Category D.

8.0 GEOLOGIC HAZARDS

Surface Ground Rupture

Surface ground rupture generally occurs at sites that are traversed by, or lie very near to, a causative fault. The site is not located within a State Earthquake Fault Zone, and there are no mapped faults crossing or adjacent to the site. The closest mapped active fault to the site is the Irish Hills segment of the Los Osos Fault, located approximately 3.35 miles southwest of the site. Therefore, the potential for surface ground rupture to occur at the site is very low.

Liquefaction

The term liquefaction refers to the liquefied condition and subsequent softening that can occur in soils when they are subjected to cyclic strains, such as those generated during a seismic event. Previous studied have concluded that liquefaction within the upper 50 feet of soil can potentially affect improvements at the ground surface. Due to the relatively shallow depth to the bedrock, the stiff to very stiff alluvial clay soils above the bedrock, and the absence of groundwater to the maximum depth explored of 26 feet, the potential for liquefaction to occur is considered to be nil.

Seismically Induced Settlement

Seismically induced settlement of sufficient magnitude to cause structural damage is normally associated with poorly consolidated, predominantly sandy soils, or variable consolidation characteristics within the building areas. Due to the relatively shallow depth to the bedrock and the presence of stiff to very stiff alluvial clay soils, the potential for seismically induced settlement to occur at the site is considered to be nil.

Slope Stability

The Annex/Classroom site lies within a generally flat area with no significant slopes on or adjacent to it; therefore, there is no potential for gross slope instability or landsliding to impact the project site.

Flooding

According to the Flood Insurance Rate Map Number 06079C1067G (FEMA November 16, 2012), the Annex/Classroom Building site is not located within a 100-year flood zone, or within Flood Zone X (See the FEMA Flood Zone Map in Appendix D). Flood Zone X indicates areas that have been determined to have less than a 0.2 percent chance of being flooded in any given year.

Naturally Occurring Asbestos

Asbestos bearing rock units within the central coast area generally consist of serpentinite, ultra-mafic rock units consisting of olivine-hornblende and some schist metamorphic rock units. Based on our research and review of the borings logs, the project site is predominately underlain by a thick deposit of clayey soil alluvium, followed by sandstone and claystone bedrock of the Franciscan Mélange, which ranged in depth from 7.5 to 23.5 feet. These geologic units are not asbestos bearing, therefore, the potential for naturally occurring asbestos to occur on the site is considered to be nil.

Radon

Radon is a colorless, odorless gas present in soil and rock, which is derived from the decay of uranium. The occurrence of radon correlates with the presence of specific minerals, and its concentrations in soil or rock will vary depending on the mineralogy of the surrounding bedrock, temperature, barometric pressure, moisture and other factors. Prolonged exposure to elevated levels of radon is associated with an increased risk of lung cancer.

According to Special Report 208, by the California Geological Survey (Churchill 2008) radon is most commonly found in areas of San Luis Obispo County that are underlain by bedrock of the Monterey formation. The site is underlain by alluvial soils and bedrock of the Franciscan Melange. The report (Churchill 2008) shows that the project site is in an area of low radon potential for San Luis Obispo County.

9.0 CONCLUSIONS

Geology

It is our opinion that there are no significant local or regional geologic conditions that would preclude construction of the Annex/Classroom Building and site improvements as described in the "Introduction" section of this report.

Site Geology

The Annex/Classroom Building site area lies on relatively flat terrain that is bounded to the northeast by hillside terrain and to the southwest by San Luis Obispo Creek. The site area is underlain by Holocene alluvial flood plain deposits and bedrock of the Franciscan Melange.

Groundwater

Soil and bedrock moisture contents encountered during drilling were generally slightly moist to very moist. Groundwater was not encountered in any of the borings, to the maximum depth explored of 26 feet.

Slope Stability

There are no significant slopes on or adjacent to the Annex/Classroom Building site area; therefore, there is no potential for gross slope instability or landsliding to impact the project.

Seismicity

The site is located within the seismically active southern California area, and moderate to severe ground shaking can be expected during the life of the proposed structure. The largest historical mean peak horizontal acceleration estimated to have occurred in the vicinity of the site was 0.33g.

Surface Ground Rupture

The site is not located in a State Earthquake Fault Zone and there are no mapped faults crossing the site. The closest mapped active fault to the site is the Irish Hills segment of the Los Osos Fault, approximately 3.35 miles southwest. Therefore, the potential for surface fault rupture to occur at the site is considered to be very low.

Liquefaction, Seismically Induced Settlement, and Naturally Occurring Asbestos

As the site is underlain by stiff to very stiff condition of the clayey alluvial and relatively shallow bedrock of the Franciscan Mélange, the potentials for liquefaction and seismically-induced settlement to occur are considered to be nil. As the sandstone bedrock of the Franciscan Mélange is not an asbestos-bearing geologic unit, the potential for naturally occurring asbestos to occur on the site is also considered to be nil.

Flooding

The site is not within a 100-year flood zone, or Flood Zone X, which has been determined by FEMA (2012) to be areas that have less than a 0.20 percent chance of being flooded in any given year.

Radon

The site is underlain by clayey alluvial deposits and relatively shallow sandstone bedrock of the Franciscan Mélange, therefore the potential for radon to affect the project is low.

Geotechnical Engineering

In our opinion, the site is suitable, from a geotechnical engineering standpoint, for the proposed Annex/Classroom Building and site improvements, as described in the "Introduction" section of this report, provided the recommendations contained herein are implemented in the design and construction. The primary geotechnical engineering concerns are the potential for differential settlement from the existing fill and the potential disturbance at depth due to removal of the existing structure, the expansion potential of the upper soils, and the erodible nature and corrosive potential of the soils. Provided that the building area is prepared as recommended in the "Grading" section of this report, conventional continuous and spread (pad) foundations may be used to support the proposed structure.

Differential settlement can occur when a foundation spans materials having variable consolidation characteristics, such as the fill that was found in the upper 4 feet of Boring 1. We are unaware of any documentation (i.e., grading observation or compaction testing records) regarding the placement of the fill, but it was likely placed when the existing Annex/Cafeteria Building was constructed. Undocumented fill has a greater potential for variability than fill that has been placed and tested in a controlled earthwork program. Removal of the existing structure is also anticipated to disturb the soil to variable depths. Such conditions (i.e., undocumented fill and disturbed soil) could stress and possibly damage foundations, often resulting in severe cracks and displacement if they are not mitigated. Therefore, to reduce this potential for differential settlement, a program of overexcavation and recompaction of the soil in the building area is recommended prior to construction.

Expansion index testing yielded results of 54 and 58 for the upper fill and alluvial soils. Per CBC Section 1803A.5.3, the soils are considered to be expansive. The more commonly used ASTM classification is that the soils would be considered to have a "medium" expansion potential. Expansive soils tend to swell with increases in soil moisture and shrink as soil moisture decreases; the upper 3 to 5 feet of any soil profile is the zone most affected by these seasonal soil moisture fluctuations. The volume changes that the soils undergo in this cyclical pattern can stress and damage foundations and slabs-on-grade if precautionary measures are not incorporated during design and in the construction procedure. Footings are typically deepened and additional reinforcement is provided. Imported nonexpansive soils are recommended to be placed beneath slabs-on-grade.

The soils above the bedrock are considered to be erodible. It is essential that all surface drainage be controlled and directed to appropriate discharge points, and that surface soils, particularly those disturbed during construction, are stabilized by vegetation or other means *during and following construction*.

As indicated in the Soil Corrosivity Study by HDR, Inc., in Appendix C, the electrical resistivities of the samples tested were in the moderately corrosive categories with as received moisture contents; when saturated, the resistivities were in the corrosive to severely corrosive categories. Soil pH values were mildly alkaline. The soluble salt contents of the soils were low to moderate. Soil nitrate concentrations were high. The soils were classified as severely corrosive to ferrous metals and aggressive to copper. Please refer to the Soil Corrosivity Study in Appendix C for a complete summary of the test results, and recommendations for mitigation.

10.0 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

The following recommendations are for improvements constructed as described in the "Introduction" section of this report. If locations, elevations, structural loads, etc., change, the recommendations contained herein may require modification. In developing the following recommendations, it was assumed that irrigated landscaping or flatwork that would keep the soils relatively uniform, year-round moisture will be installed for a zone of at least five feet around the perimeter of all improvements.

Two distinct types of Portland cement concrete (PCC) slabs-on-grade are discussed in the following recommendations. The building's interior slabs are defined as "slabs-on-grade." Sidewalks that will not support vehicle traffic are referred to as "exterior pedestrian flatwork." Asphalt concrete (AC) paths may also be utilized for pedestrian access, however it is also assumed that they will not support vehicle traffic.

Unless otherwise noted, the following definitions are used in the recommendations presented below. Where terms are not defined, definitions commonly used in the construction industry are intended.

- **Building Area –** The building area is defined as the area within and extending a minimum of 5 feet beyond the perimeter of the foundations for the Annex/Classroom Building. The building area includes any retaining walls, covered walkways or other improvements that are connected to the structure and that are intended to act in a manner similar to it.
- **Exterior Pedestrian Flatwork and Asphalt Concrete (AC) Path Areas –** The areas within the footprints of all exterior pedestrian flatwork and all AC paths.
- **Sitework Retaining Wall Areas –** The areas within and extending a minimum of 3 feet beyond the foundation limits of all sitework retaining walls.
- **Grading Area –** The entire area to be graded, including the building area, exterior pedestrian flatwork and AC path areas, and sitework retaining wall areas.
- **Existing Grade:** Elevations of the site that existed as of the date of this report.
- **Finish Pad Grade:** The elevation in the building area where earthwork operations are typically considered to be complete. It does not include any sand or gravel that might be placed below slabs-on-grade in association with vapor protection for the slabs.
- **Subgrade:** The elevation in exterior pedestrian flatwork and AC path areas where imported nonexpansive materials, sand, or aggregate base (AB) are placed to support the flatwork or AC path.

- **Scarified:** Plowed or ripped in two orthogonal directions to a depth of not less than 8 inches.
- **Moisture Conditioned:** Adjusting the soil moisture to optimum moisture content, or just above, prior to application of compactive effort.
- **Compacted/Recompacted:** Soils placed in level lifts not exceeding 8 inches in loose thickness and compacted to a minimum of 90 percent of maximum dry density. Based on maximum dry density by ASTM D 1557-12 and field density by ASTM D 6938-15, or other methods acceptable to the geotechnical engineer and jurisdiction.

Site Preparation

1. The ground surface in the grading areas should be prepared for construction by removing the existing building, existing flatwork, and all other improvements, vegetation, large roots, debris, organic topsoil, and other deleterious materials. Existing utility lines that will not remain in service should be either removed or abandoned. The appropriate method of abandonment will depend upon the type and depth of the utility. Recommendations for abandonment can be made as necessary.

2. Voids created by the removal of materials or utilities described above should be called to the attention of the geotechnical engineer. No fill should be placed unless the underlying soil has been observed by the geotechnical engineer.

Grading

1. Following site preparation, all existing fill in the building area should be removed to a level plane at the deepest point of the fill. For planning purposes, the deepest point of the fill encountered during the field exploration program was 4 feet below existing grade at Boring 1. The exact depth of fill should be determined by the geotechnical engineer at the time of construction. The resulting level excavated surface should be scarified, moisture conditioned and compacted.

2. To create as uniform conditions as possible for the structure, all earthwork operations should be completed throughout the entire building area in a uniform manner at the same time, from the bottom of the overexcavation recommended in the previous paragraph through fill placement to finish grade. Earthwork operations that complete only a portion of the building area at one time (i.e., “flip-flopping”, “checkerboarding”, etc.) should not be allowed.

3. Following site preparation, all existing fill in sitework retaining wall areas should be overexcavated to the deepest point of the fill. The resulting excavated surfaces should be scarified, moisture conditioned and compacted. Overexcavation elevations may be stepped where the fill depth changes or where retaining walls are stepped to conform to any site contours. If very stiff sandy lean clay alluvium is exposed at bottom of foundation elevation, no overexcavation and recompaction is considered necessary. To reduce the potential for cracking in sitework retaining walls, construction joints should be placed in the wall and the foundation where overexcavation operation have been stepped to conform to fill depth changes or to exposure of very stiff alluvium. Unlike the recommended earthwork program for the building area, overexcavation and recompaction operations for sitework retaining walls can proceed in a non-uniform manner for individual wall segments.

4. Following site preparation and any excavations to grade, or prior to placement of fill, the soil in any exterior pedestrian flatwork and AC path areas, and in all other grading areas, should be scarified, moisture conditioned and recompacted. Unlike the recommended earthwork program for the building area, scarification and recompaction operations for exterior pedestrian flatwork and AC path areas, and in all other grading areas, can proceed in a non-uniform manner.

5. Voids created by dislodging cobbles and/or debris during scarification should be backfilled and recompacted, and the dislodged materials should be removed from the work area.

6. Previously removed site soils and other similar soils may be placed as fill beyond the building area, and in the building area to a maximum height of 18 inches below bottom of slab elevation. The final 18 inches of fill below bottom of slab elevation in the building area should be nonexpansive.

7. Nonexpansive materials are defined as imported soils that fall in the GW, GM, GC, SP, SW, SC and SM categories per ASTM D 2487-11, and that have an expansion index of 10 or less (ASTM D 4829-11). The clean sand layer described in the “Slabs-on-Grade” section of this report (if utilized below interior slabs-on-grade or exterior pedestrian flatwork) is considered to be part of the minimum recommended thickness of nonexpansive material utilized, not in addition to it.

8. Imported soils used in the building area should have strength and expansion qualities equal to or better than the site soils, and they should not exceed the geotechnical corrosivity potential of the site soils. See the Soil Corrosivity Study in Appendix C for the corrosivity parameters of the site soils. Proposed imported materials should be reviewed by the geotechnical engineer before being brought to the site, and on an intermittent basis during placement.

9. All materials used as fill should be cleaned of any debris and rocks larger than 3 inches in diameter. When fill material includes rocks, the rocks should be placed in a sufficient soil matrix to ensure that voids caused by nesting of the rocks will not occur and that the fill can be properly compacted.

10. All AB and the top 12 inches of subgrade in areas to support AC paths should be compacted to a minimum of 95 percent of maximum dry density. Imported nonexpansive materials, sand or AB used to support exterior pedestrian flatwork, as well as the top 12 inches of subgrade in these areas, need only be compacted to a minimum of 90 percent of maximum dry density.

11. If the soils are overly moist so that they become unstable, or if the minimum recommended compaction cannot be readily achieved, drying the soil so that it is nearer optimum moisture content, may be necessary. Placement of gravel layers or geotextiles may also be necessary to help stabilize unstable soils. Additional overexcavation may also be recommended to correct unstable conditions or if soft or loose conditions are encountered during grading. No fill should be placed in any grading area if the underlying soil is unstable.

12. The recommended soil moisture content should be maintained throughout construction, and during the lives of the structure and sitework improvements. Failure to maintain the soil moisture content can result in desiccation cracks and disturbance, which are an indication of degradation of the soil compaction. If desiccation cracks are allowed to develop, or if soils near improvements such as foundations, flatwork, etc. are otherwise disturbed, damage to those improvements may result. Soils that have cracked or are otherwise disturbed should be removed, moisture conditioned, and recompacted.

Utility Trenches

1. Utility trenches adjacent to foundations should not be excavated within the zone of foundation influence, as shown in Typical Detail A in Appendix E.

2. Utilities that must pass beneath foundations should be placed with properly compacted utility trench backfill and the foundation should be designed to span the trench.

3. A select, noncorrosive, granular, easily compacted material should be used as bedding and shading immediately around utilities. The site soil may be used for trench backfill above the select material beyond the building area, and to within 18 inches below bottom of slab elevation in the building area. Within the building area, imported nonexpansive soils should be utilized to backfill the final 18 inches below bottom of slab elevation of all trenches. In exterior pedestrian flatwork and AC path areas, trench backfill should match the thickness of imported nonexpansive soils, sand or AB used to support these improvements.

4. In general, trench backfill should be compacted to a minimum of 90 percent of maximum dry density. Trench backfill in the upper 12 inches of subgrade and all AB in AC path areas should be compacted to a minimum of 95 percent of maximum dry density. A minimum of 85 percent of maximum dry density will generally be sufficient where trench backfill is located in landscaped or other unimproved areas, where settlement of trench backfill would not be detrimental.

5. Prior to applying compactive effort, soils should be moisture conditioned. Trench backfill should be placed in level lifts not exceeding 6 inches in loose thickness and compacted to the minimums recommended above.

6. Compaction of trench backfill by jetting or flooding is not recommended at this site due to the expansive soils. However, to aid in *encasing* utility conduits, particularly corrugated drain pipes, and multiple, closely-spaced conduits in a single trench with the bedding and shading material, jetting or flooding may be useful. Flooding or jetting should only be attempted with extreme caution, and any flooding or jetting operation should be subject to review by the geotechnical engineer.

7. Long-term settlement of properly compacted sand should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill. Where trenches are backfilled with site soils, the anticipated settlement would be about twice that of sand. Improvements that are constructed over or near trenches should be designed to accommodate the potential for settlement.

8. The Soil Corrosivity Study by HDR, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for utility improvements.

9. The recommendations of this section are minimums only, and may be superseded by the architect/engineer based upon soil corrosivity or the requirements of pipe manufacturers, utility companies or the governing jurisdiction.

Foundations

1. The Annex/Classroom Building may be supported by continuous and spread footings bearing in firm recompacted soils, as recommended in the "Grading" section of this report.

2. Based on soil expansion potential only, minimum overall foundations depths of 21 inches below lowest adjacent grade within 6 feet laterally of the base of foundations should be maintained. Spread footings should be at least 24 inches square.

3. Continuous footings should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential only, minimum continuous footing reinforcement should consist of two No. 4 rebars, one at the top and one at the bottom. Spread footings should be reinforced in accordance with the requirements of the architect/engineer.

4. Footings bearing in firm recompacted soil may be designed using maximum allowable bearing capacities of 2,500 psf dead load and 3,500 psf dead plus live loads. Using these criteria, maximum settlement and differential settlement are expected to be less than 1/2-inch and less than 3/8-inch in 25 feet, respectively.

5. Allowable bearing capacities may be increased by one-third when transient loads such as wind or seismicity are included. Foundations may be designed using the site design response parameters contained in the table on Page 8 in the "Seismicity" section of this report.

6. To calculate resistance to lateral loads, please see the values presented in the "Retaining Walls" section of this report. Lateral capacity is based on the assumption that any backfill adjacent to foundations has been properly compacted. Passive and friction components of resistance may be combined in the analysis without reduction to either value.

7. Footing excavations should be observed by the geotechnical engineer prior to placement of reinforcing steel. Footing excavations should be lightly moistened and no desiccation cracks should be present prior to concrete placement.

8. The Soil Corrosivity Study by HDR Engineering, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for all foundation elements.

Slabs-on-Grade

Interior Slabs-On-Grade

1. Interior slabs-on-grade should have a minimum thickness of 4 full inches. They should be reinforced and doweled to foundations per the specifications of the architect/engineer. At a minimum, interior slabs should be reinforced with No. 3 rebar at 24 inches on center each way. All structural slabs should contain minimum rebar meeting the criteria of ACI 318, Section 7.12.2 (ACI 2011). At a minimum, foundation dowels should be lap spliced to the slab rebar. The size and spacing of the dowels should match the size and spacing of the slab rebar.

Exterior Pedestrian Flatwork

1. Exterior pedestrian flatwork should have a minimum thickness of 4 full inches. Minimum reinforcement for exterior pedestrian flatwork placed over at least 18 inches of nonexpansive imported soils per the following paragraph should consist of No. 3 rebar placed at 24 inches on-center each way. If the thickness of nonexpansive soil below the flatwork is less than 18 inches, the minimum reinforcement should consist of No. 3 rebar at 18 inches on-center each way.

2. In conventional construction, it is common to use 4 to 6 inches of sand beneath exterior pedestrian flatwork. However, due to the medium expansion potential of the site soils, there will be a risk of movement and damage to the flatwork if conventional measures are used. Heaving and cracking could occur. This movement could be reduced by the placement of additional nonexpansive material beneath the flatwork. If it is desired to fully mitigate the expansive soil conditions, then at least 18 inches of imported nonexpansive material should be provided below the flatwork where the expansive site soils are exposed at finish grade. If it is acceptable for the flatwork to experience movement due to expansive soils, then the thickness of the nonexpansive soil can be reduced. Under all flatwork, however, the thicker the nonexpansive layer, the better the expansive soil protection.

3. Another measure that can be taken to reduce the risk of movement of flatwork due to expansive soils is to provide thickened edges or grade beams around the perimeters of the flatwork. If it is desired to fully mitigate the expansive soil conditions, then the thickened edges or grade beams could be up to 21 inches deep. If it is acceptable for the flatwork to experience movement, then the thickened edges or grade beams can be reduced. At a minimum, any thickened edge or grade beam should be reinforced by two No. 4 rebar, one at the top and one at the bottom.

4. It is recognized that the measures discussed above for protecting exterior flatwork from expansive soils are expensive, possibly more expensive than simply replacing flatwork that has heaved and/or cracked. Consequently, the above measures for protecting exterior flatwork are only suggestions for consideration by the owner and/or architect/engineer. The degree to which exterior flatwork is protected from expansive soil damage is left to the discretion of the owner and/or architect/engineer.

5. Flatwork should be constructed with frequent joints to allow articulation as the flatwork moves in response to seasonal soil temperature and moisture variations. The expansive soil underlying any nonexpansive material placed below flatwork should be moisture conditioned, and no desiccation cracks should be present, prior to casting the flatwork.

6. Flatwork at doorways, and at other areas where maintaining the elevation of the flatwork is desired when mitigating expansive soil potential, should be doweled to the perimeter foundation, at a minimum, by No. 3 dowels lapped to the flatwork rebar at 24 inches on center. In other areas, the flatwork may be doweled to the foundation or the flatwork may be allowed to "float free," at the discretion of the architect/engineer. Flatwork that is intended to float free should be separated from foundations by a felt joint or other means.

<u>Moisture Vapor Transmission</u>

1. Due to the current use of impermeable floor coverings, water-soluble flooring adhesives, and the speed at which buildings are now constructed, moisture vapor transmission through slabs is a much more common problem than in past years. Where moisture vapor transmitted from the underlying soil would be undesirable, slabs should be protected from subsurface moisture vapor. A number of options for vapor protection are discussed below; however, the means of vapor protection, including the type and thickness of the vapor retarder, if specified, are left to the discretion of the architect/engineer.

2. Where specified, vapor retarders should conform to ASTM Standard E 1745-11. This standard specifies properties for three performance classes; Class A, B and C. The appropriate class should be selected based on the sensitivity of floor coverings to moisture intrusion and the potential for damage to the vapor retarder during placement of slab reinforcement and concrete.

3. Several recent studies, including those of American Concrete Institute Committee 302 (ACI 2004), have concluded that excess water above the vapor retarder increases the potential for moisture damage to floor coverings and could increase the potential for mold growth or other microbial contamination. The studies also concluded that it is preferable to eliminate the typical sand layer beneath the slab and place the slab concrete in direct contact with a Class A vapor retarder, particularly during wet weather construction. However, placing the concrete directly on the vapor retarder requires special attention to using the proper vapor retarder, a very low water-cement ratio in the concrete mix, and special finishing and curing techniques.

4. Probably the next most effective option would be the use of vapor-inhibiting admixtures in the slab concrete mix and/or application of a sealer to the surface of the slab. This would also require special concrete mixes and placement procedures, depending upon the recommendations of the admixture or sealer manufacturer.

5. Another option that may be a reasonable compromise between effectiveness and cost considerations is the use of a subslab vapor retarder protected by a sand layer. If a Class A vapor retarder is specified, the retarder can be placed directly on the nonexpansive soil. The retarder should be covered with a minimum 2 inches of *clean* sand. If a less durable vapor retarder is specified (Class B or C), a minimum of 4 inches of clean sand should be provided, and the retarder should be placed in the center of the clean sand layer. Clean sand is defined as a well or poorly graded sand (ASTM D 2487-11) of which less than 3 percent passes the No. 200 sieve. The clean sand layer, if used, is considered to be a part of the minimum 18-inch thickness of nonexpansive imported materials recommended in the "Grading" section of this report to be placed below slabs-on-grade, not in addition to it.

6. Regardless of the underslab vapor retarder selected, proper installation of the retarder per ASTM E 1643-11 is critical for optimum performance. Where utilized, the vapor retarder should be placed a minimum of 1 inch above the flow line of the drainage path

surrounding the structures, or 1 inch above the area drain grates if area drains are used to collect runoff around the structures. All seams must be properly lapped, and all seams and utility penetrations properly sealed in accordance with the vapor retarder manufacturer's recommendations.

7. If the sand is used between the vapor retarder and the slab, it should be moistened only as necessary to promote concrete curing; saturation of the sand should be avoided, as the excess moisture would be on top of the vapor retarder, potentially resulting in vapor transmission through the slab for months or years.

8. The architect/engineer should designate any special measures to be used in conjunction with moisture vapor transmission protection, if needed, to mitigate the high potential for indoor radon levels.

9. Positive drainage away from the building should be maintained; see the "Drainage and Maintenance" section of this report for additional discussion of this issue. If water is allowed to pond near the structure, it may seep into the ground and migrate laterally through cracks or utility penetrations in the foundation, ultimately gaining access above the vapor retarder.

Slabs-on-Grade - General

1. To reduce shrinkage cracks in all interior and exterior slabs-on-grade, the concrete aggregates should be of appropriate size and proportion, the water/cement ratio should be low, the concrete should be properly placed and finished, contraction joints should be installed, and the concrete should be properly cured. This is particularly applicable to slabs that will be cast directly upon a vapor retarder and those that will be protected from transmission of vapor by use of admixtures or surface sealers. Concrete materials, placement, and curing specifications should be at the direction of the architect/engineer; AC 302.1R-04 (ACI 2004) is suggested as a resource for the architect/engineer in preparing such specification.

2. To provide stability for curbs adjacent to exterior pedestrian flatwork, they should be set back a minimum distance equal to one-third the height of any adjacent descending slope, but not less than 5 feet from the tops of slopes. Alternately, curbs may be deepened to provide stability. The geotechnical engineer should review, on an individual basis, any situation where curbs must be deepened to meet this recommendation.

3. The Soil Corrosivity Study by HDR, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for all slabs-on-grade.

Retaining Walls

1. Retaining walls connected to or forming part of the building should be founded in firm soil that has been recompacted per the "Grading" section of this report. Sitework retaining walls may be supported by either firm soil that has been recompacted per the "Grading" section of this report, or firm sandy lean clay alluvium. If a sitework retaining wall crosses a recompacted soil/firm alluvium transition, or a transition between varying fill overexcavation depths, a construction joint should be placed in the footing and wall at the transitions. Foundations for all retaining walls should have minimum overall depths (not including any keyway) of 21 inches below lowest grade within 6 feet laterally of any adjacent slope.

2. Retaining wall footings should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential only, minimum retaining wall footing reinforcement should consist of two No. 4 rebars, one at the top and one at the bottom.

3. Retaining wall design may be based on the following parameters:

Active equivalent fluid pressure (site soils)	45 pcf
Active equivalent fluid pressure (imported sand/gravel backfill)	35 pcf
At-rest equivalent fluid pressure (site soils)	60 pcf
At-rest equivalent fluid pressure (imported sand/gravel backfill)	50 pcf
Passive equivalent fluid pressure	350 pcf
Maximum toe pressure	3,500 psf
Coefficient of sliding friction	0.35

4. No surcharges are taken into consideration in the values presented in the previous paragraph. The maximum toe pressure is an *allowable* value; no factors of safety, load factors or other factors have been applied to the remaining values. With the exception of the maximum toe pressure, these values will require application of appropriate factors of safety, load factors, and/or other factors as deemed appropriate by the architect/engineer.

5. If the active or at-rest pressures presented in Paragraph 3 for *imported sand or gravel backfill* are utilized for design of retaining walls, the sand or gravel should be used exclusively as backfill above a 1:1 plane extended upward from the back of the wall footing to approximately 1 foot from the top of the wall backfill. The upper foot should be backfilled with native soil, except in areas where AC paths or exterior pedestrian flatwork will abut the top of the wall. In such cases, the gravel should extend to the imported nonexpansive material, sand, aggregate base, or other material below the improved surface, as appropriate.

6. The active and at-rest pressures presented in Paragraph 3 are applicable to a horizontal retained surface behind the wall. Walls having a retained surface that slopes upward from the wall should be designed for an additional equivalent fluid pressure of 1 pcf for the active case and 1.5 pcf for the at-rest case, for every degree of slope inclination.

7. It is assumed that retaining wall heights will not exceed 4 feet.

8. Section 1803A.5.12.1 of the 2013 CBC requires that dynamic seismic lateral earth pressures be provided by the geotechnical engineer for walls retaining more than 6 feet of backfill. As the walls for this project will not retain more than 6 feet, design for seismic lateral earth pressures is not required.

9. Long-term settlement of properly compacted sand or gravel retaining wall backfill should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill; long-term settlement of properly compacted site soil retaining wall backfill would be about twice that of sand or gravel backfill. Improvements that are constructed near the tops of retaining walls should be designed to accommodate long-term settlement.

10. All retaining walls should be drained with perforated pipe encased in a free-draining gravel blanket. The pipe should be placed perforations downward, and should discharge in a nonerosive manner away from foundations and other improvements. The gravel blanket should have a width of approximately 1 foot and should extend upward to approximately 1 foot from the top of the wall backfill. The upper foot should be backfilled with native soil, except in areas where AC paths or exterior pedestrian flatwork will abut the top of the wall. In such cases, the gravel should extend to the imported nonexpansive material, sand, aggregate base, or other material below the improved surface, as

appropriate. To reduce infiltration of the soil into the gravel, a permeable synthetic filter fabric conforming to Standard Specifications Section 88-1.02B – Class C (Caltrans 2010), should be placed between the two. Manufactured synthetic drains, such as Miradrain or Enkadrain are acceptable alternatives to the use of gravel, provided that they are installed in accordance with the recommendations of the manufacturer.

11. Where weep hole drainage can be properly discharged, the perforated pipe may be omitted in lieu of weep holes on maximum 4-foot centers. A filter fabric as described above should be placed between the weep holes and the drain gravel.

12. Walls facing areas where moisture transmission through the wall would be undesirable should be *thoroughly* waterproofed in accordance with the specifications of the architect/engineer.

13. The architect/engineer should bear in mind that retaining walls by their nature are flexible structures, and that surface treatments on walls often crack. Where walls are to be plastered or otherwise have a finish applied, the flexibility should be considered in determining the suitability of the surfacing material, spacing of horizontal and vertical control joints, etc. The flexibility should also be considered where a retaining wall will abut or be connected to a rigid structure, and where the geometry of the wall is such that its flexibility will vary along its length.

14. The Soil Corrosivity Study by HDR, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for all retaining walls.

Asphalt Concrete (AC) Paths

1. Paths for pedestrian access may be constructed of AC over AB. Design methods for AC pavement do not typically consider pedestrian loading only. Therefore, the section design is typically based on local experience and anticipated life span. For this application, a minimum pavement section of 1.5 to 2.0 inches of AC over 2 to 4 inches of AB is considered appropriate. As with exterior pedestrian flatwork these minimum thicknesses of AC and AB will be subject to movement due to expansive soils. If it is desired to filly mitigate the expansive soil conditions, the AB thickness can be increased to as much as 18 inches.

2. It is recognized that the increased AB thickness recommended above for protecting AC paths from expansive soils will be expensive, possibly more expensive than simply replacing AC paths that has heaved and/or cracked. Consequently, this measure for protecting AC paths is only a suggestion for consideration by the client and/or architect/engineer. The degree to which AC paths are protected from expansive soil damage is left to the discretion of the owner and/ or architect/engineer.

3. AB should conform to the requirements of Section 26 of the Standard Specifications (Caltrans 2010). AC should conform to the requirements of Section 32 of the Standard Specifications (Caltrans 2010).

4. The upper 12 inches of subgrade and all AB in pavement areas should be compacted to a minimum of 95 percent of maximum dry density. Subgrade and aggregate base should be firm and unyielding when proofrolled with heavy, rubber-tired grading equipment prior to continuing construction.

Drainage and Maintenance

1. Per Section 1804A.3 of the 2013 CBC, unpaved ground surfaces should be *finish graded* to direct surface runoff away from foundations and other improvements at a minimum 5 percent grade for a minimum distance of 10 feet. The site should be similarly sloped to drain away from foundation, and other improvements during construction. Where this is not practicable due to other improvements, etc., swales with improved surfaces, area drains, or other drainage facilities, should be used to collect and discharge runoff.

2. All eaves of the building should be fitted with roof gutters. Runoff from flatwork, roof gutters, downspouts, planter drains, area drains, etc. should discharge in a nonerosive manner away from foundations and other improvements in accordance with the requirements of the governing agencies. Erosion protection should be placed at all discharge points unless the discharge is to a pavement surface.

3. To reduce the potential for planter drainage gaining access to subslab areas, any raised planter boxes adjacent to foundations should be installed with drains and sealed sides and bottoms. Drains should also be provided for areas adjacent to the structure and in landscape areas that would not otherwise freely drain.

4. The on-site soils are erodible; stabilization of soils disturbed during construction by vegetation or other means *during* and *following* construction, is essential to reduce erosion damage. Care should be taken to establish and maintain vegetation. The landscaping should be planned and installed to maintain the surface drainage recommended above. Surface drainage should also be maintained during construction.

5. Maintenance of drainage and other improvements is critical to the long-term stability of the site and the integrity of the structures. Site improvements should be maintained on a regular basis.

6. All exterior drains, retaining wall drains, and drain outlets should be maintained to be free-flowing. Vegetation and erosion matting (if utilized) should be maintained or augmented as needed. Irrigation systems should be maintained so that soils around structures are maintained at a relatively uniform year-round moisture content, and are neither over-watered nor allowed to dry and desiccate.

7. To reduce the potential for disruption of drainage patterns and undermining of structures, fill areas, etc., all rodent activity should be aggressively controlled.

Observation and Testing

1. It must be recognized that the recommendations contained in this report are based on a limited number of borings and rely on continuity of the subsurface conditions encountered.

2. It is assumed that the geotechnical engineer will be retained to provide consultation during the design phase, to interpret this report during construction, and to provide construction monitoring in the form of testing and observation.

3. At a minimum, the geotechnical engineer should be retained to provide:
    - Professional observation during grading, trench and retaining wall backfill, and foundation construction
    - Oversight of special inspection and compaction testing grading, trench and retaining wall backfill, and foundation construction

4. Special inspection of grading and backfill should be provided as per Section 1705A.6 and Table 1705A.6 of the CBC. The special inspector should be under the direction of the geotechnical engineer. At a minimum, the following items should be inspected and/or tested by the special inspector:
    - Stripping and clearing of all existing improvements, vegetation, and deleterious materials
    - Overexcavation of the building and sitework retaining wall areas to the recommended depths
    - Scarification and moisture conditioning of overexcavated areas
    - Scarification and moisture conditioning of exterior pedestrian flatwork, AC path and all other grading areas
    - Fill quality, placement, moisture conditioning and compaction
    - Utility trench backfill
    - Foundation excavations

5. A program of quality assurance should be developed prior to beginning construction. At a minimum, the program should include all geotechnical items shown on the testing and inspection schedule of the approved plans. It should also include any additional inspection items required by the engineer and/or the governing jurisdiction. These items should be discussed at a preconstruction site meeting among a representative of the owner, the geotechnical engineer, special inspector, the project inspector, the engineer, and contractors. The geotechnical engineer should be notified at least 48 hours prior to beginning grading operations.

6. Locations and frequency of compaction tests should be as per the recommendation of the geotechnical engineer at the time of construction. The recommended test location and frequency may be subject to modification by the geotechnical engineer, based upon soil and moisture conditions encountered, size and type of equipment used by the contractor, the general trend of the results of compaction tests, or other factors.

11.0 CLOSURE

Our intent was to perform the investigation in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the locality of this project under similar conditions. No representation, warranty, or guarantee is either expressed or implied. This report is intended for the exclusive use by the client as discussed in the “Scope of Services” section. Application beyond the stated intent is strictly at the user's risk.

This report is valid for conditions as they exist at this time for the type of project described herein. The conclusions and recommendations contained in this report could be rendered invalid, either in whole or in part, due to changes in building codes, regulations, standards of geotechnical or construction practice, changes in physical conditions, or the broadening of knowledge.

If changes with respect to the project become necessary, if items not addressed in this report are incorporated into plans, or if any of the assumptions used in the preparation of this report are not correct, this firm shall be notified for modifications to this report. Any items not specifically addressed in this report should comply with the CBC of other applicable standards, and the requirements of the governing jurisdiction.

The preliminary recommendations presented in this geotechnical report are based upon the geotechnical conditions encountered at the site, and may be augmented by additional requirements of the client, or by additional recommendations provided by the geotechnical engineer based on peer or jurisdiction reviews, or conditions exposed at the time of construction.

This document, the data, conclusions, and recommendations contained herein are the property of Earth Systems Pacific. This report shall be used in its entirety, with no individual sections reproduced or used out of context. Copies may be made only by Earth Systems Pacific, the client, and the client's authorized agents for use exclusively on the subject project. Any other use is subject to federal copyright laws and the written approval of Earth Systems Pacific.

Thank you for this opportunity to have been of service. If you have any questions, please feel free to contact this office at your convenience.

End of Text.

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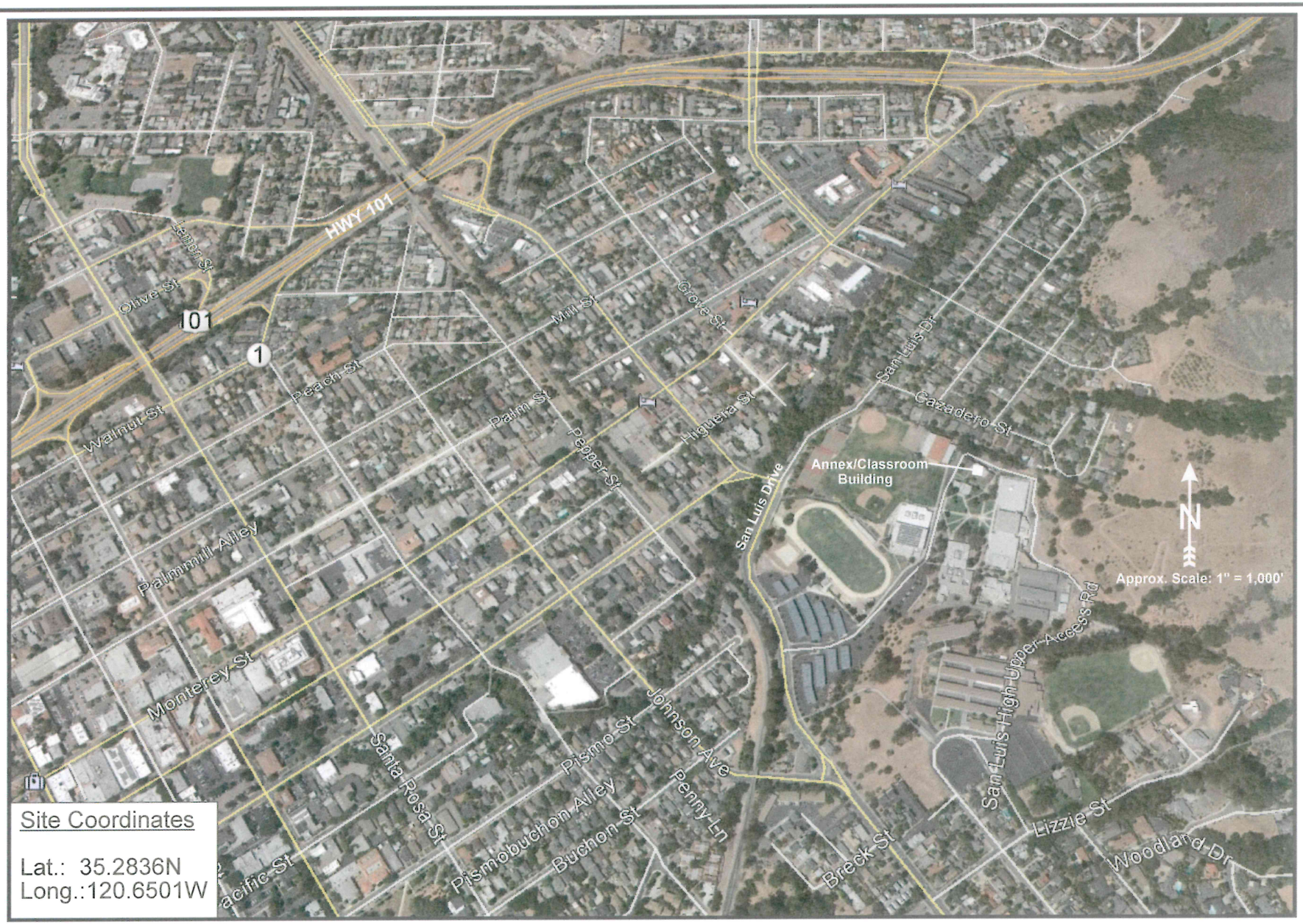
APPENDIX A

Vicinity Map
Boring Location Map
Boring Log Legend
Boring Logs
Cross Section A-A'



Reference: extract from Google Earth 2015

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VICINITY MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

Date
January 2016

Project No.
SL-16605-SE



LEGEND

3 Boring Location (Approx.)

A A' Cross Section (Approx.)

BORING LOCATION MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING

1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

NOT TO SCALE

N

Earth Systems Pacific
4378 Old Santa Fe Road
San Luis Obispo, CA 93401-8116
(805) 544-3276 • FAX (805) 544-1786
E-mail: esp@earthsystems.com

December 9, 2015 CS SL-16605-SE

SLO HS MEASURE D POOL ANNEX CLASSROOM BLDG--1816LOCATIONS

Earth Systems Pacific

BORING LOG LEGEND

SAMPLE / SUBSURFACE WATER SYMBOLS	GRAPH. SYMBOL
CALIFORNIA MODIFIED	
STANDARD PENETRATION TEST (SPT)	
SHELBY TUBE	
BULK	
SUBSURFACE WATER DURING DRILLING	
SUBSURFACE WATER AFTER DRILLING	

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

MAJOR DIVISIONS	GROUP SYMBOL	TYPICAL DESCRIPTIONS	GRAPH. SYMBOL
COARSE GRAINED SOILS (MORE THAN HALF OF MATERIAL IS LARGER THAN #200 SIEVE SIZE)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GP	POORLY GRADED GRAVELS, OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, NON-PLASTIC FINES	
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, PLASTIC FINES	
	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
	SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES	
	SM	SILTY SANDS, SAND-SILT MIXTURES, NON-PLASTIC FINES	
	SC	CLAYEY SANDS, SAND-CLAY MIXTURES, PLASTIC FINES	
FINE GRAINED SOILS (HALF OR MORE OF MATERIAL IS SMALLER THAN #200 SIEVE SIZE)	ML	INORGANIC SILTS AND VERY FINE SANDS, 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	
	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS	
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	

OBSERVED MOISTURE CONDITION

DRY	SLIGHTLY MOIST	MOIST	VERY MOIST	WET (SATURATED)

CONSISTENCY

COARSE GRAINED SOILS

BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER	
0-10	0-16	LOOSE
11-30	17-50	MEDIUM DENSE
31-50	51-83	DENSE
OVER 50	OVER 83	VERY DENSE

FINE GRAINED SOILS

BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER	
0-2	0-3	VERY SOFT
3-4	4-7	SOFT
5-8	8-13	MEDIUM STIFF
9-15	14-25	STIFF
16-30	26-50	VERY STIFF
OVER 30	OVER 50	HARD

GRAIN SIZES

U.S. STANDARD SERIES SIEVE				CLEAR SQUARE SIEVE OPENING		
# 200	# 40	# 10	# 4	3/4"	3"	12"

SILT & CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

TYPICAL BEDROCK HARDNESS

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
EXTREMELY HARD	CORE, FRAGMENT, OR EXPOSURE CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CAN ONLY BE CHIPPED WITH REPEATED HEAVY HAMMER BLOWS
VERY HARD	CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CORE OR FRAGMENT BREAKS WITH REPEATED HEAVY HAMMER BLOWS
HARD	CAN BE SCRATCHED WITH KNIFE OR SHARP PICK WITH DIFFICULTY (HEAVY PRESSURE); HEAVY HAMMER BLOW REQUIRED TO BREAK SPECIMEN
MODERATELY HARD	CAN BE GROOVED 1/16 INCH DEEP BY KNIFE OR SHARP PICK WITH MODERATE OR HEAVY PRESSURE; CORE OR FRAGMENT BREAKS WITH LIGHT HAMMER BLOW OR HEAVY MANUAL PRESSURE
SOFT	CAN BE GROOVED OR GOUGED EASILY BY KNIFE OR SHARP PICK WITH LIGHT PRESSURE, CAN BE SCRATCHED WITH FINGERNAIL; BREAKS WITH LIGHT TO MODERATE MANUAL PRESSURE
VERY SOFT	CAN BE READILY INDENTED, GROOVED OR GOUGED WITH FINGERNAIL, OR CARVED WITH KNIFE; BREAKS WITH LIGHT MANUAL PRESSURE

TYPICAL BEDROCK WEATHERING

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
FRESH	NO DISCOLORATION, NOT OXIDIZED
SLIGHTLY WEATHERED	DISCOLORATION OR OXIDATION IS LIMITED TO SURFACE OF, OR SHORT DISTANCE FROM, FRACTURES: SOME FELDSPAR CRYSTALS ARE DULL
MODERATELY WEATHERED	DISCOLORATION OR OXIDATION EXTENDS FROM FRACTURES, USUALLY THROUGHOUT; Fe-Mg MINERALS ARE "RUSTY", FELDSPAR CRYSTALS ARE "CLOUDY"
INTENSELY WEATHERED	DISCOLORATION OR OXIDATION THROUGHOUT; FELDSPAR AND Fe-Mg MINERALS ARE ALTERED TO CLAY TO SOME EXTENT, OR CHEMICAL ALTERATION PRODUCES IN SITU DISAGGREGATION
DECOMPOSED	DISCOLORATION OR OXIDATION THROUGHOUT, BUT RESISTANT MINERALS SUCH AS QUARTZ MAY BE UNALTERED; FELDSPAR AND Fe-Mg MINERALS ARE COMPLETELY ALTERED TO CLAY

drafting/masters/Boring Log Legend121714.dwg

Earth Systems Pacific

Boring No. 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

PAGE 1 OF 1
JOB NO.: SL-16605-SE
DATE: 12/29/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL		SANDY LEAN CLAY: dark brown/ olive mottled, stiff, moist, trace coarse gravel (Fill)	1.0 - 2.5	Ring	107.5	14.9	5, 6, 7
2				0.0 - 3.0	Grab			
4	CL		SANDY LEAN CLAY: dark brown, very stiff, moist, some fine gravel (Alluvium)	4.0 - 6.0	Grab			
5				5.0 - 6.5	Ring	109.1	14.8	7, 13, 18
10				10.0 - 11.5	Ring	119.6	13.0	6, 13, 21
15				15.0 - 16.5	SPT			4, 8, 11
17	GC		CLAYEY GRAVEL WITH SAND: brown, medium dense, moist					
20				20.0 - 21.5	SPT			4, 9, 12
24			SANDSTONE: dark yellow brown, moderately soft, moist (Franciscan Melange)	25.0 - 25.5	SPT			50/3"
26			End of Boring @ 26.0' due to refusal No subsurface water encountered					

LEGEND: Ring Sample Grab Sample Shelby Tube Sample SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 2
PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

JOB NO.: SL-16605-SE
DATE: 12/29/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			4.0" AC over 2" AB					
1	CL		SANDY LEAN CLAY: dark brown, stiff, moist, some fine gravel (Alluvium)					
2				1.0 - 4.0	○			4
3				3.0 - 4.5	▬	109.4	16.2	10 16
4			brown, slightly moist					5
5			dark brown, moist, gravel ends	5.0 - 6.5	▬	112.6	15.2	8 13
9			brown, very stiff to hard					7
10				10.0 - 11.5	▬	119.4	14.6	16 20
14								4
15				15.0 - 16.5	●			9 12
16			End of Boring @ 16.5'					
			No subsurface water encountered					

LEGEND: ▬ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 3
PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

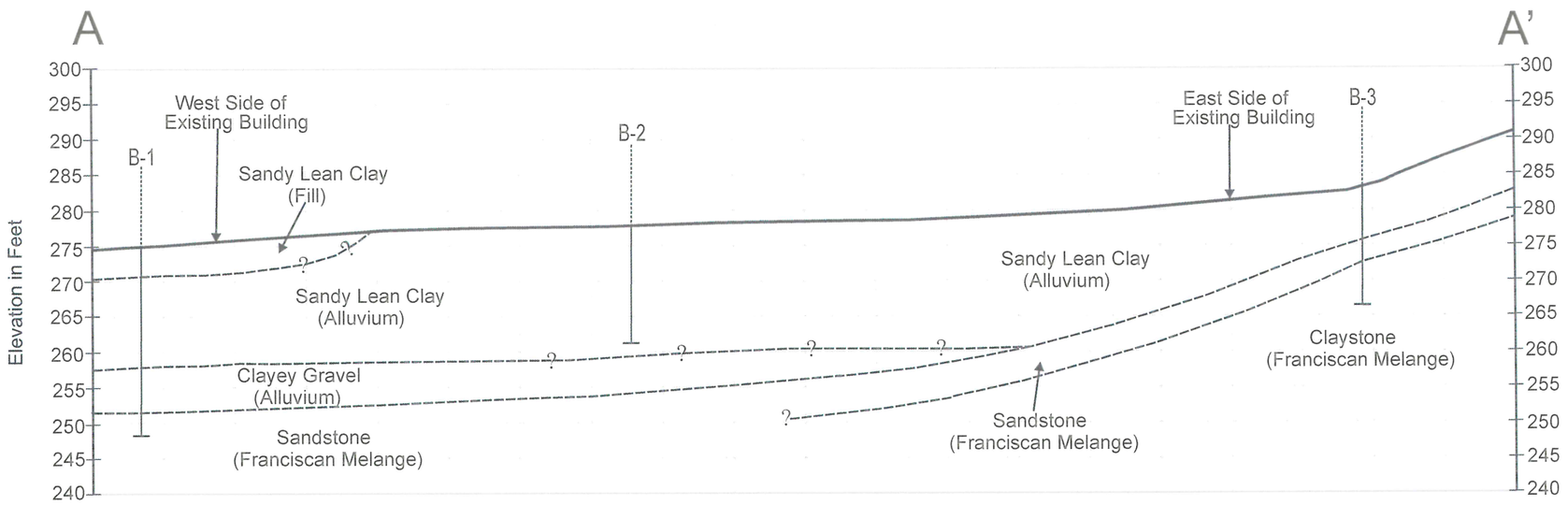
JOB NO.: SL-16605-SE
DATE: 12/29/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL		SANDY LEAN CLAY: dark brown, very stiff, very moist, trace gravel (Alluvium)	1.0 - 2.5	Ring	110.4	17.8	4, 8, 12
4			brown, slightly moist	3.5 - 6.0	Grab			8
5				5.0 - 6.5	Ring	118.7	11.6	13, 19
6				5.0 - 6.5	Grab			
8			SANDSTONE: dark yellow brown, moderately soft, moist (Franciscan Melange)	10.0 - 11.5	Ring			16, 36, 50/5"
11			CLAYSTONE: gray brown, moderately soft, moist, severely sheared, weathered	15.0 - 16.5	SPT			11, 20, 28
17			End of Boring @ 16.5' due to refusal No subsurface water encountered					

LEGEND: Ring Sample; Grab Sample; Shelby Tube Sample; SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.



Scale 1" = 20'

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CROSS SECTION A-A'
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1499 San Luis Drive
San Luis Obispo, California

Date
January 2016

Project No.
SL-16605-SE

APPENDIX B

Geotechnical Laboratory Test Results

San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

BULK DENSITY TEST RESULTS

ASTM D 2937-10 (modified for ring liners)

January 12, 2016

BORING NO.	DEPTH feet	MOISTURE CONTENT, %	WET DENSITY, pcf	DRY DENSITY, pcf
1	2.0 - 2.5	14.9	123.5	107.5
1	6.0 - 6.5	14.8	125.3	109.1
1	11.0 - 11.5	13.0	135.1	119.6
2	4.0 - 4.5	16.2	127.1	109.4
2	6.0 - 6.5	15.2	129.7	112.6
2	11.0 - 11.5	14.6	136.8	119.4
3	2.0 - 2.5	17.8	130.0	110.4
3	6.0 - 6.5	11.6	132.5	118.7

EXPANSION INDEX TEST RESULTS

ASTM D 4829-11

BORING NO.	DEPTH feet	EXPANSION INDEX
1	0.0 - 3.0	54
2	1.0 - 4.0	58

San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

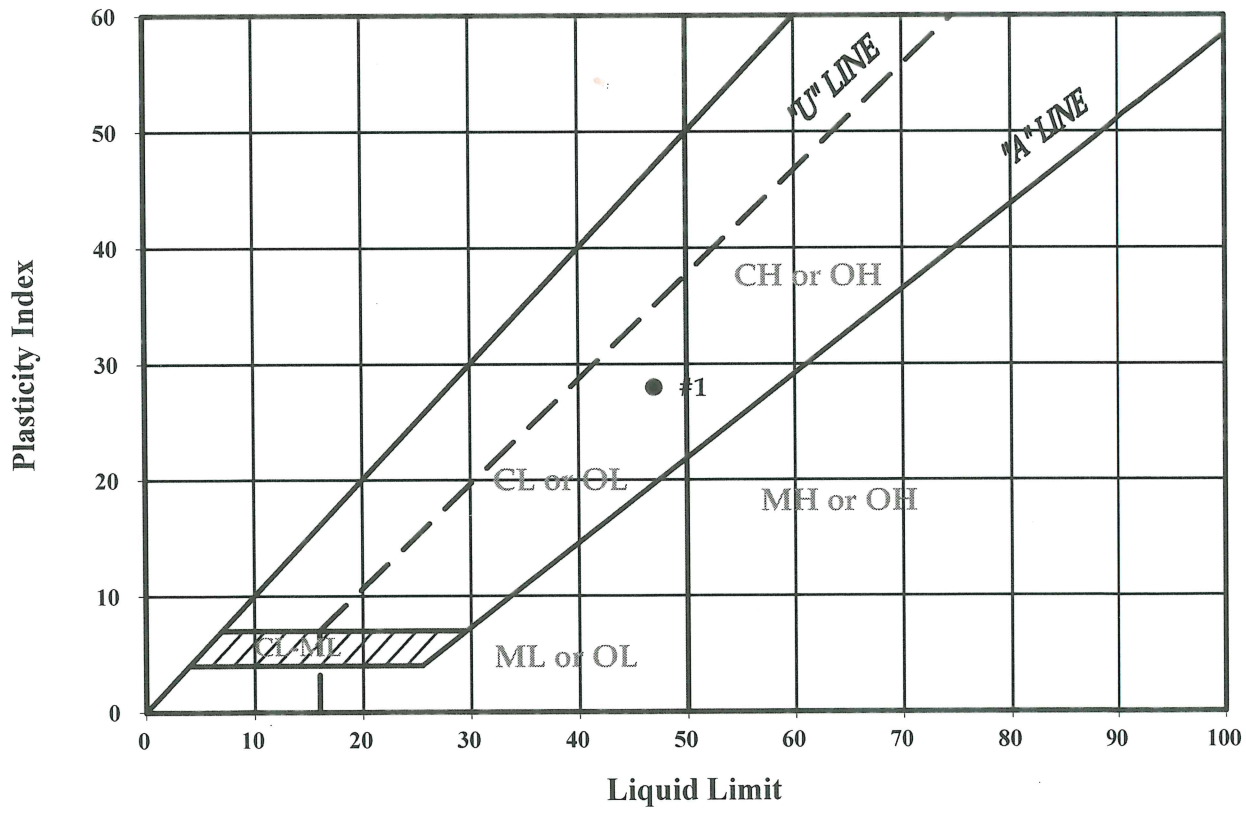
PLASTICITY INDEX

ASTM D 4318-10

January 12, 2016

Test No.:	1	2	3	4	5
Boring No.:	1				
Sample Depth:	4.0 - 6.0'				
Liquid Limit:	47				
Plastic Limit:	19				
Plasticity Index:	28				

Plasticity Chart



San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

MOISTURE-DENSITY COMPACTION TEST

ASTM D 1557-12 (Modified)

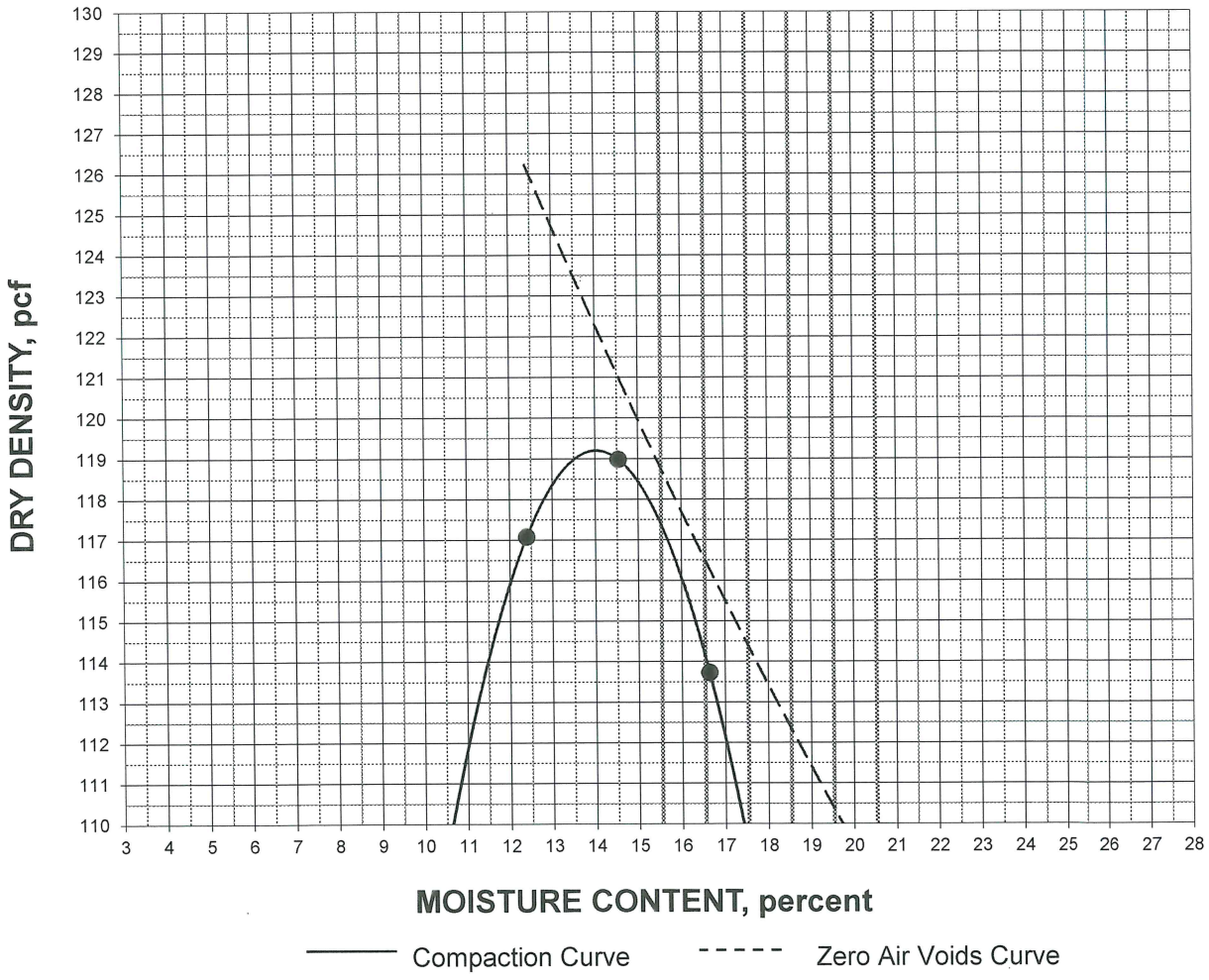
PROCEDURE USED: A
PREPARATION METHOD: Moist
RAMMER TYPE: Mechanical
SPECIFIC GRAVITY: 2.70 (assumed)

January 12, 2016
Boring #2 @ 1.0 - 4.0'
Dark Brown Sandy Lean Clay (CL)

SIEVE DATA:

Sieve Size	% Retained (Cumulative)
3/4"	0
3/8"	0
#4	0

MAXIMUM DRY DENSITY: 119.2 pcf
OPTIMUM MOISTURE: 14.0%



San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

DIRECT SHEAR

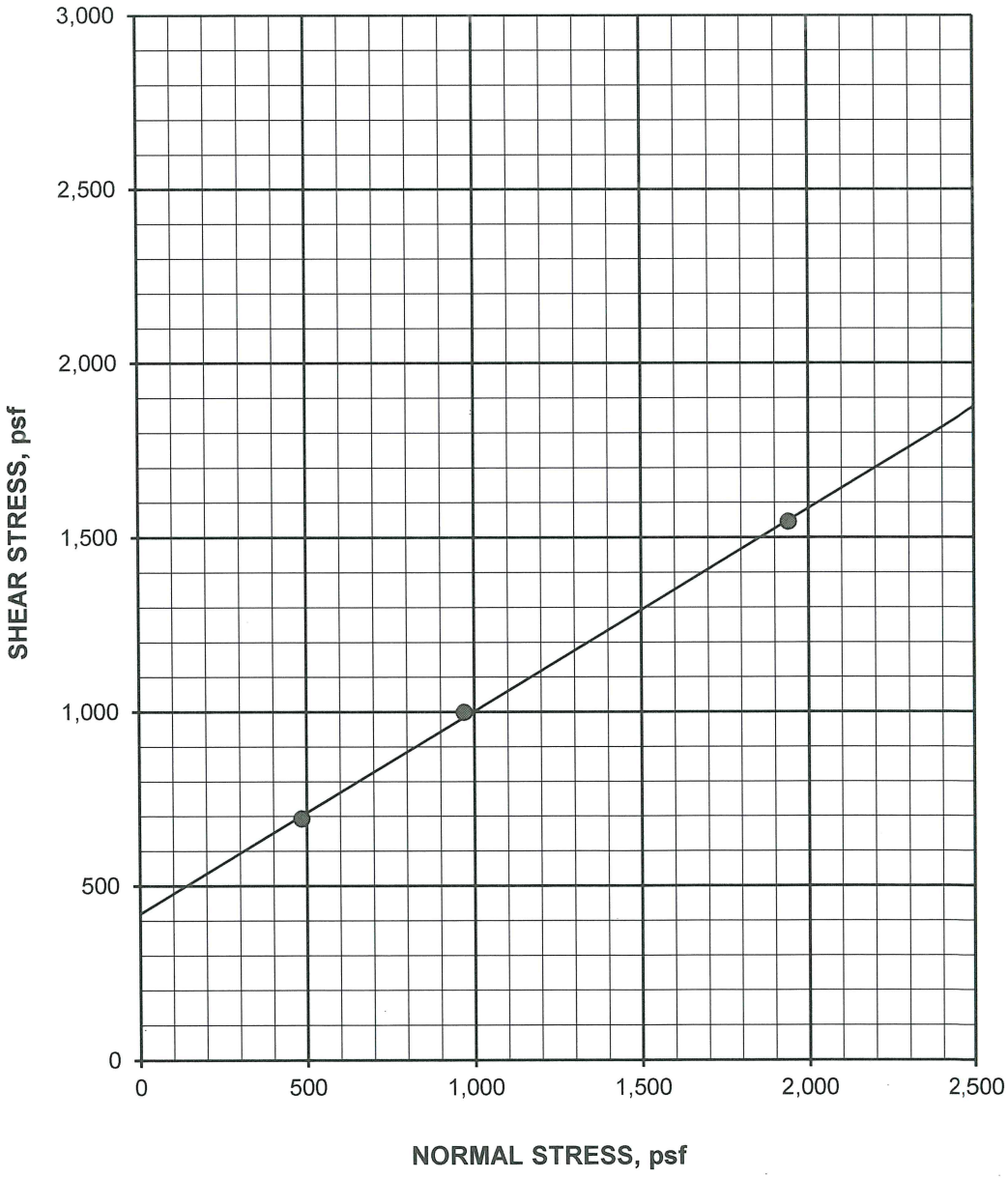
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

January 12, 2016

Boring #2 @ 1.0 - 4.0'
Sandy Lean Clay (CL)
Compacted to 90% RC, saturated

INITIAL DRY DENSITY: 107.3 pcf
INITIAL MOISTURE CONTENT: 14.0 %
PEAK SHEAR ANGLE (Ø): 30°
COHESION (C): 420 psf

SHEAR vs. NORMAL STRESS



DIRECT SHEAR continued

ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

Boring #2 @ 1.0 - 4.0'

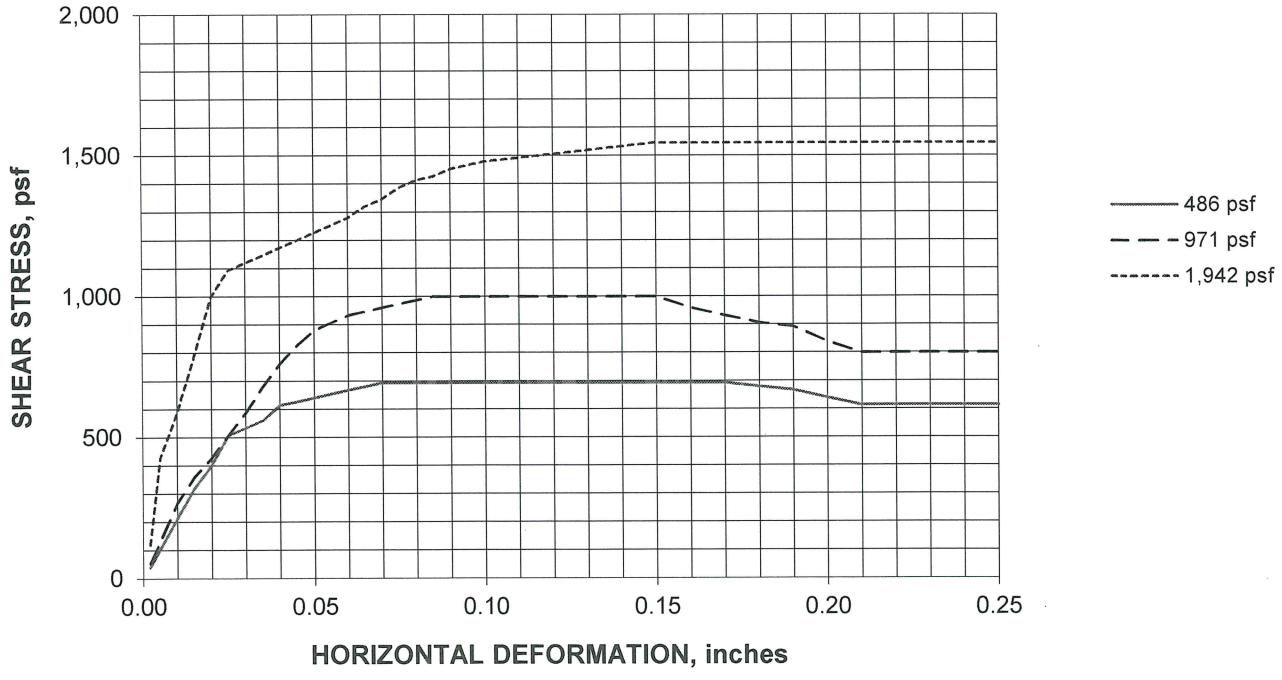
January 12, 2016

Sandy Lean Clay (CL)

Compacted to 90% RC, saturated

SPECIFIC GRAVITY: 2.70 (assumed)

SAMPLE NO.:	1	2	3	AVERAGE
INITIAL				
WATER CONTENT, %	14.0	14.0	14.0	14.0
DRY DENSITY, pcf	107.3	107.3	107.3	107.3
SATURATION, %	66.3	66.3	66.3	66.3
VOID RATIO	0.570	0.570	0.570	0.570
DIAMETER, inches	2.410	2.410	2.410	
HEIGHT, inches	1.00	1.00	1.00	
AT TEST				
WATER CONTENT, %	25.3	23.9	22.9	
DRY DENSITY, pcf	108.3	109.8	114.5	
SATURATION, %	100.0	100.0	100.0	
VOID RATIO	0.556	0.534	0.472	
HEIGHT, inches	0.99	0.98	0.94	



San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

CONSOLIDATION TEST

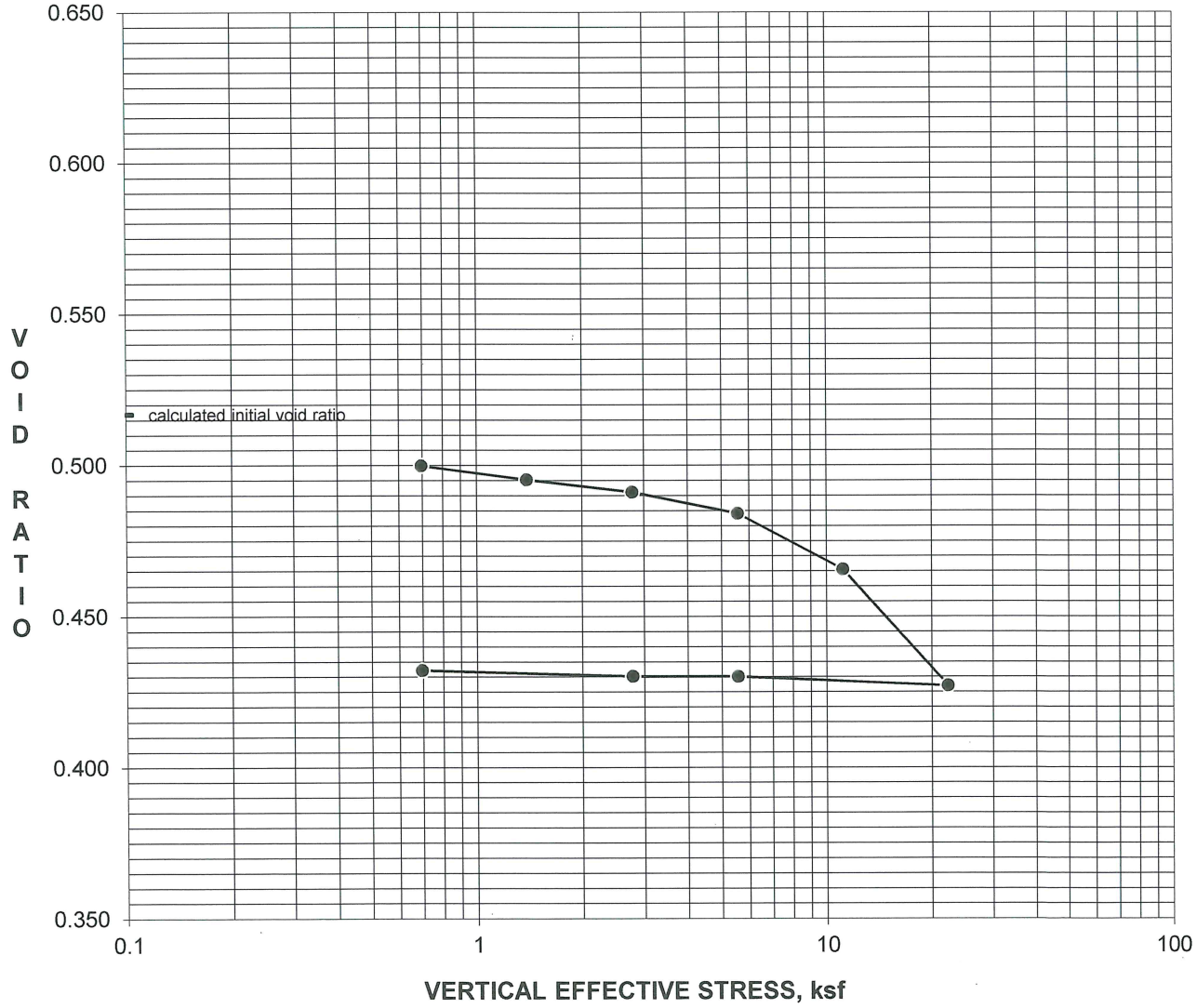
ASTM D 2435/D2435M-11

January 12, 2016

Boring #2 @ 6.0 - 6.5'
Sandy Lean Clay (CL)
Ring Sample

DRY DENSITY: 111.1 pcf
MOISTURE CONTENT: 15.2%
SPECIFIC GRAVITY: 2.70 (assumed)
INITIAL VOID RATIO: 0.517

VOID RATIO vs. NORMAL PRESSURE DIAGRAM



APPENDIX C

Soil Corrosivity Study by HDR, Inc.

January 18, 2016 via email: Fred@earthsystems.com

EARTH SYSTEMS PACIFIC
4378 Old Santa Fe Road
San Luis Obispo, CA 93401

Attention: Mr. Fred J. Potthast, GE

Re: Soil Corrosivity Study
San Luis Obispo High School
Annex/Classroom Building Project
No. 831-3102
San Luis Obispo, California
HDR #274257, ESP #SL16605-SE

Introduction

Laboratory tests have been completed on two soil samples provided for the San Luis Obispo High School project. The purpose of these tests was to determine if the soils might have deleterious effects on underground utility piping and concrete structures. HDR Engineering, Inc. (HDR) assumes that the samples provided are representative of the most corrosive soils at the site.

The proposed construction consists of a single story classroom building with conventional foundations and slabs-on-grade. The site is located at 1499 San Luis Drive in San Luis Obispo, California. The water table was reportedly not encountered during exploratory borings to a depth of 26 feet.

The scope of this study is limited to a determination of soil corrosivity and general corrosion control recommendations for materials likely to be used for construction. HDR's recommendations do not constitute, and are not meant as a substitute for, design documents for the purpose of construction. If the architects and/or engineers desire more specific information, designs, specifications, or review of design, HDR will be happy to work with them as a separate phase of this project.

Laboratory Soil Corrosivity Tests

The electrical resistivity of each sample was measured in a soil box per ASTM G187 in its as-received condition and again after saturation with distilled water. Resistivities are at about their lowest value when the soil is saturated. The pH of the saturated samples was measured per CTM 643. A 5:1 water:soil extract from each sample was chemically analyzed for the major soluble salts commonly found in soil per ASTM D4327, ASTM D6919, and Standard Method 2320-B[1]. Laboratory analysis was performed under HDR laboratory number 16-0015SCS and the test results are shown in the attached Table 1.

Soil Corrosivity

A major factor in determining soil corrosivity is electrical resistivity. The electrical resistivity of a soil is a measure of its resistance to the flow of electrical current. Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of electrical current (DC) from the metal into the soil. Corrosion currents, following Ohm's Law, are inversely proportional to soil resistivity. Lower electrical resistivities result from higher moisture and soluble salt contents and indicate corrosive soil.

A correlation between electrical resistivity and corrosivity toward ferrous metals is:[2]

Soil Resistivity in ohm-centimeters	Corrosivity Category
Greater than 10,000	Mildly Corrosive
2,001 to 10,000	Moderately Corrosive
1,001 to 2,000	Corrosive
0 to 1,000	Severely Corrosive

Other soil characteristics that may influence corrosivity towards metals are pH, soluble salt content, soil types, aeration, anaerobic conditions, and site drainage.

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[1] *American Public Health Association (APHA). 2012. Standard Methods of Water and Wastewater. 22nd ed. American Public Health Association, American Water Works Association, Water Environment Federation publication. APHA, Washington D.C.*

[2] *Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, pp. 166–167.*

Electrical resistivities were in the moderately corrosive categories with as-received moisture. When saturated, the resistivities were in the corrosive to severely corrosive categories. The resistivities dropped with added moisture because the samples were dry as-received.

Soil pH for both samples was 7.7. This value is in the mildly alkaline[3] range and does not particularly increase soil corrosivity.

The soluble salt content of the samples ranged from low to moderate.

The nitrate concentration was high enough to be aggressive to copper.

Tests were not made for sulfide and negative oxidation-reduction (redox) potential because these samples did not exhibit characteristics typically associated with anaerobic conditions.

This soil is classified as severely corrosive to ferrous metals and aggressive to copper.

Corrosion Control Recommendations

The life of buried materials depends on thickness, strength, loads, construction details, soil moisture, etc., in addition to soil corrosivity, and is, therefore, difficult to predict. Of more practical value are corrosion control methods that will increase the life of materials that would be subject to significant corrosion.

The following recommendations are based on the soil conditions discussed in the Soil Corrosivity section above. Unless otherwise indicated, these recommendations apply to the entire site or alignment.

Steel Pipe

Implement *all* the following measures:

1. Underground steel pipe with rubber gasketed, mechanical, grooved end, or other nonconductive type joints should be bonded for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.

---

[3] *Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, p. 8.*

2. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:

    a. At each end of the pipeline.

    b. At each end of all casings.

    c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.

3. To prevent dissimilar metal corrosion cells and to facilitate the application of cathodic protection, electrically isolate each buried steel pipeline per NACE SP0286 from:

    a. Dissimilar metals.

    b. Dissimilarly coated piping (cement-mortar vs. dielectric).

    c. Above ground steel pipe.

    d. All existing piping.

4. Choose one of the following corrosion control options:

    OPTION 1

    a. Apply a suitable dielectric coating intended for underground use such as:

        i. Polyurethane per AWWA C222 *or*

        ii. Extruded polyethylene per AWWA C215 *or*

        iii. A tape coating system per AWWA C214 *or*

        iv. Hot applied coal tar enamel per AWWA C203 *or*

        v. Fusion bonded epoxy per AWWA C213.

    b. Apply cathodic protection to steel piping as per NACE SP0169.

OPTION 2

a. As an alternative to dielectric coating and cathodic protection, apply a ¾-inch cement mortar coating per AWWA C205 or encase in concrete 3 inches thick, using any type of ASTM C150 cement. Joint bonds, test stations, and insulated joints are still recommended for these alternatives.

NOTE: Some steel piping systems, such as for oil, gas, and high-pressure piping systems, have special corrosion and cathodic protection requirements that must be evaluated for each specific application.

Iron Pipe

Implement *all* the following measures:

1. To prevent dissimilar metal corrosion cells and to facilitate the application of cathodic protection, electrically insulate underground iron pipe from dissimilar metals and from above ground iron pipe with insulating joints per NACE SP0286.
2. Bond all nonconductive type joints for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.
3. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:
    a. At each end of the pipeline.
    b. At each end of any casings.
    c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.
4. Choose one of the following corrosion control options:

    OPTION 1

    a. Apply a suitable coating intended for underground use such as:
        i. Polyethylene encasement per AWWA C105; *or*
        ii. Epoxy coating; *or*

iii. Polyurethane; *or*

iv. Wax tape.

NOTE: The thin factory-applied asphaltic coating applied to ductile iron pipe for transportation and aesthetic purposes does not constitute a corrosion control coating.

b. Apply cathodic protection to cast and ductile iron piping as per NACE SP0169.

OPTION 2

a. As an alternative to coating systems described in Option 1 and cathodic protection, concrete encase all buried portions of metallic piping so that there is a minimum of 3 inches of concrete cover provided over and around surfaces of pipe, fittings, and valves using any type of ASTM C150 cement.

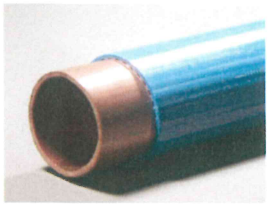
Copper Tubing

Implement *all* the following measures:

1. Electrically insulate underground copper pipe from dissimilar metals and from above ground copper pipe with insulating devices per NACE SP0286.
2. Electrically insulate cold water piping from hot water piping systems.
3. Protect buried copper tubing by one of the following measures:

    a. Prevention of soil contact. Soil contact may be prevented by placing the tubing above ground or encasing the tubing using PVC pipe with solvent-welded joints.

    b. Installation of a factory-coated copper pipe with a minimum 25-mil thickness such as Kamco's Aqua Shield™, Mueller's Streamline Protec™, or equal. The coating must be continuous with no cuts or defects.



    c. Installation of 12-mil polyethylene pipe wrapping tape with butyl rubber mastic over a suitable primer. Protect wrapped copper tubing by applying cathodic protection per NACE SP0169.

Plastic and Vitrified Clay Pipe

1. No special precautions are required for plastic and vitrified clay piping placed underground from a corrosion viewpoint.

2. Protect all metallic fittings and valves with wax tape per AWWA C217 or epoxy.

All Pipe

1. On all pipes, appurtenances, and fittings not protected by cathodic protection, coat bare metal such as valves, bolts, flange joints, joint harnesses, and flexible couplings with wax tape per AWWA C217 after assembly.

2. Where metallic pipelines penetrate concrete structures such as building floors, vault walls, and thrust blocks use plastic sleeves, rubber seals, or other dielectric material to prevent pipe contact with the concrete and reinforcing steel.

Concrete

1. From a corrosion standpoint, any type of ASTM C150 cement may be used for concrete structures and pipe because the sulfate concentration is negligible, 0 to 0.10 percent.[4,5,6]

2. Standard concrete cover over reinforcing steel may be used for concrete structures and pipe in contact with these soils due to the low chloride concentration[7] found onsite.

Closure

The analysis and recommendations presented in this report are based upon data obtained from the laboratory samples. This report does not reflect variations that may occur across the site or due to the modifying effects of construction. If variations appear, HDR should be

---

[4] *2012 International Building Code (IBC) Section 1904.3*

[5] *2012 International Residential Code (IRC) which refers to American Concrete Institute (ACI) 318 Table 19.3.2.1*

[6] *2013 California Building Code (CBC) which refers to American Concrete Institute (ACI) 318 Table 19.3.2.1*

[7] *Design Manual 303: Concrete Cylinder Pipe. Ameron. p.65*

notified immediately so that further evaluation and supplem ental recommendations can be provided.

HDR's services have been performed with the usual thoroughness and com petence of the engineering profession. No other warranty or representation, either expressed or implied, is included or intended.

Please call if you have any questions.

Respectfully Submitted,
HDR Engineering, Inc.

Jose Peña

Brien L. Clark, PE

LICENSED PROFESSIONAL ENGINEER
BRIEN L. CLARK
CH 6291
EXP 12/31/17
CHEMICAL
STATE OF CALIFORNIA

Enc: Table 1

274257_SCS_Rpt_JP_Rev00_BC.docx

Table 1 - Laboratory Tests on Soil Samples

Earth Systems Pacific
SLO High School - Annex / Classroom Building Project No. 831-3102
Your #SL-16605-SE, HDR Lab #16-0015SCS
5-Jan-16

Sample ID			B1 @ 0-3' CL	B2 @ 1-4' CL
Resistivity		**Units**		
as-received		ohm-cm	4,800	6,000
saturated		ohm-cm	1,200	800
pH			7.7	7.7
Electrical Conductivity		mS/cm	0.16	0.24
Chemical Analyses				
Cations				
calcium	Ca^{2+}	mg/kg	61	86
magnesium	Mg^{2+}	mg/kg	ND	ND
sodium	Na^{1+}	mg/kg	77	46
potassium	K^{1+}	mg/kg	7.5	12
Anions				
carbonate	CO_3^{2-}	mg/kg	ND	ND
bicarbonate	HCO_3^{1-}	mg/kg	366	174
fluoride	F^{1-}	mg/kg	4.0	1.9
chloride	Cl^{1-}	mg/kg	11	7.3
sulfate	SO_4^{2-}	mg/kg	60	292
phosphate	PO_4^{3-}	mg/kg	ND	ND
Other Tests				
ammonium	NH_4^{1+}	mg/kg	ND	ND
nitrate	NO_3^{1-}	mg/kg	7.0	127
sulfide	S^{2-}	qual	na	na
Redox		mV	na	na

Electrical conductivity in millisiemens/cm and chemical analysis were made on a 1:5 soil-to-water extract.
mg/kg = milligrams per kilogram (parts per million) of dry soil.
Redox = oxidation-reduction potential in millivolts
ND = not detected
na = not analyzed

431 West Baseline Road · Claremont, CA 91711
Phone: 909.962.5485 · Fax: 909.626.3316

APPENDIX D

Geologic Map
Historical Earthquake/Fault Map
FEMA Flood Zone Map



Extract from: Geologic Map of the San Luis Obispo Quadrangle, San Luis Obispo County, California: by Wiegers, 2010.

EXPLANATION

Geologic Units

Qya
Young Alluvial flood-Plain Deposits

Jos
Serpentinized Ultramafic Rock

KJfm
Franciscan Melange

KJfmv
Franciscan Metavolcanic Rock

Geologic Symbols

Contact
Dashed where approximately located or inferred

High-angle fault
Dashed where approximately located or inferred; dotted where concealed

Thrust or reverse fault
Dashed where approximately located or inferred; dotted where concealed. Saw-teeth on upper plate. Dip of fault plane between 30° and 80°

Anticline
Showing axis at surface. Dashed where approximately located; dotted where concealed

Syncline
Showing axis at surface. Dashed where approximately located; dotted where concealed

30 90
Horizontal Inclined Vertical
Strike and dip of beds

N

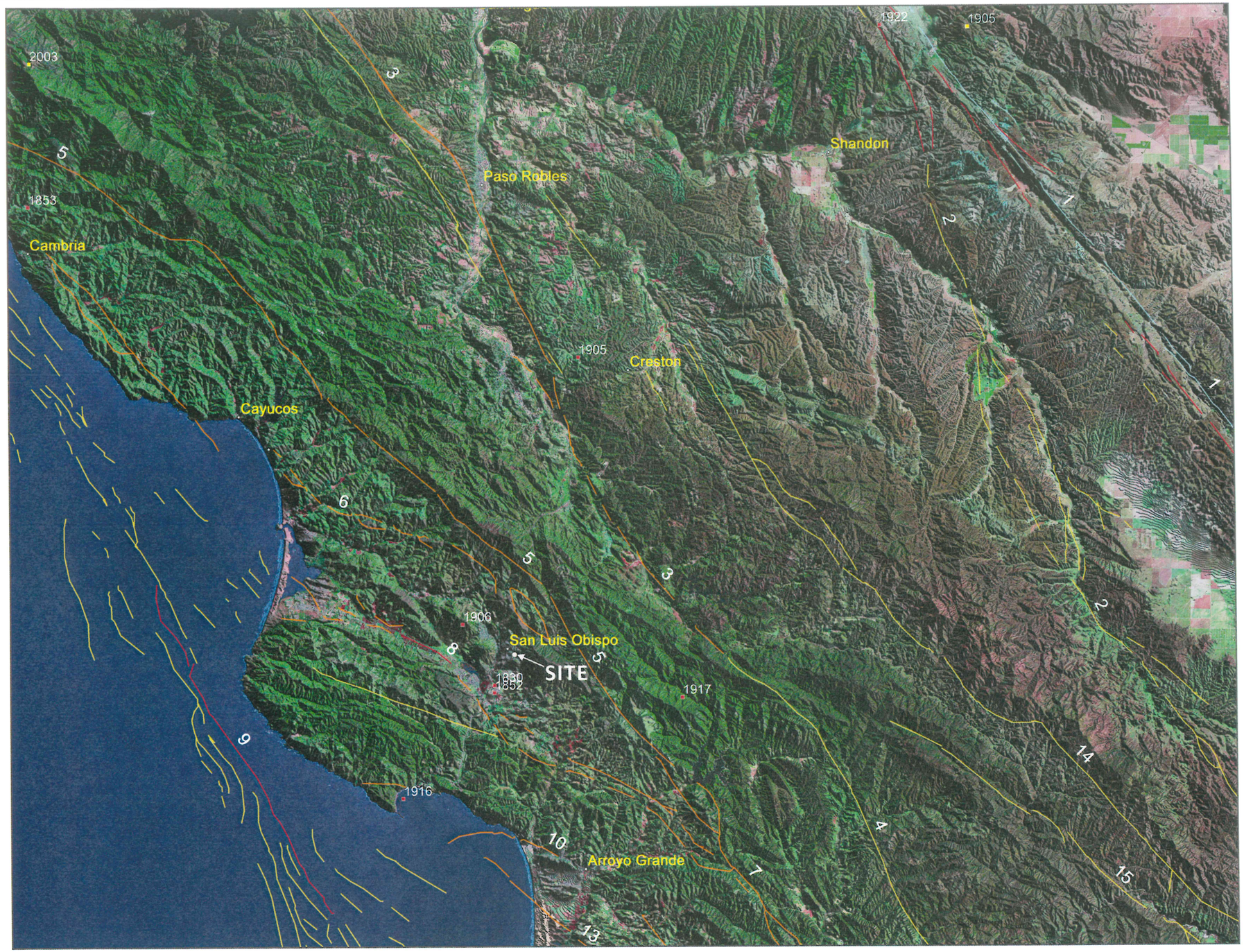
Approx. Scale: 1" = 500'

EARTH SYSTEMS PACIFIC
4378 Old Santa Fe Road, San Luis Obispo, CA 93401
www.earthsystems.com - email: esp@earthsystems.com
(805) 544-3276

GEOLOGIC MAP
SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

Date
January 2016

Project No.
SL-16605-SE



LEGEND

- Historic rupture (<200 years)
- Holocene fault (<10,000 years)
- Late Quaternary (<700,000 years)
- Quaternary fault (<1.6 million)

HISTORICAL EARTHQUAKE MAGNITUDE

5.0 to 5.9 | 6.0 to 6.9 | 7.0 to 7.9

FAULTS

1	San Andreas	11	Casmalia
2	San Juan	12	Lions Head
3	Rinconada	13	Oceano
4	East Huasna	14	La Panza
5	Oceanic	15	South Cuyama
6	Cambria		
7	West Huasna		
8	Los Osos		
9	Hosgri-San Simeon		
10	San Luis Range		

REFERENCES

Blake, T.F., EQSEARCH, 2000, updated 2010
Jennings, C.W. & Bryant, W.A., 2010

N

(Approximate Scale: 1" = 6 miles)

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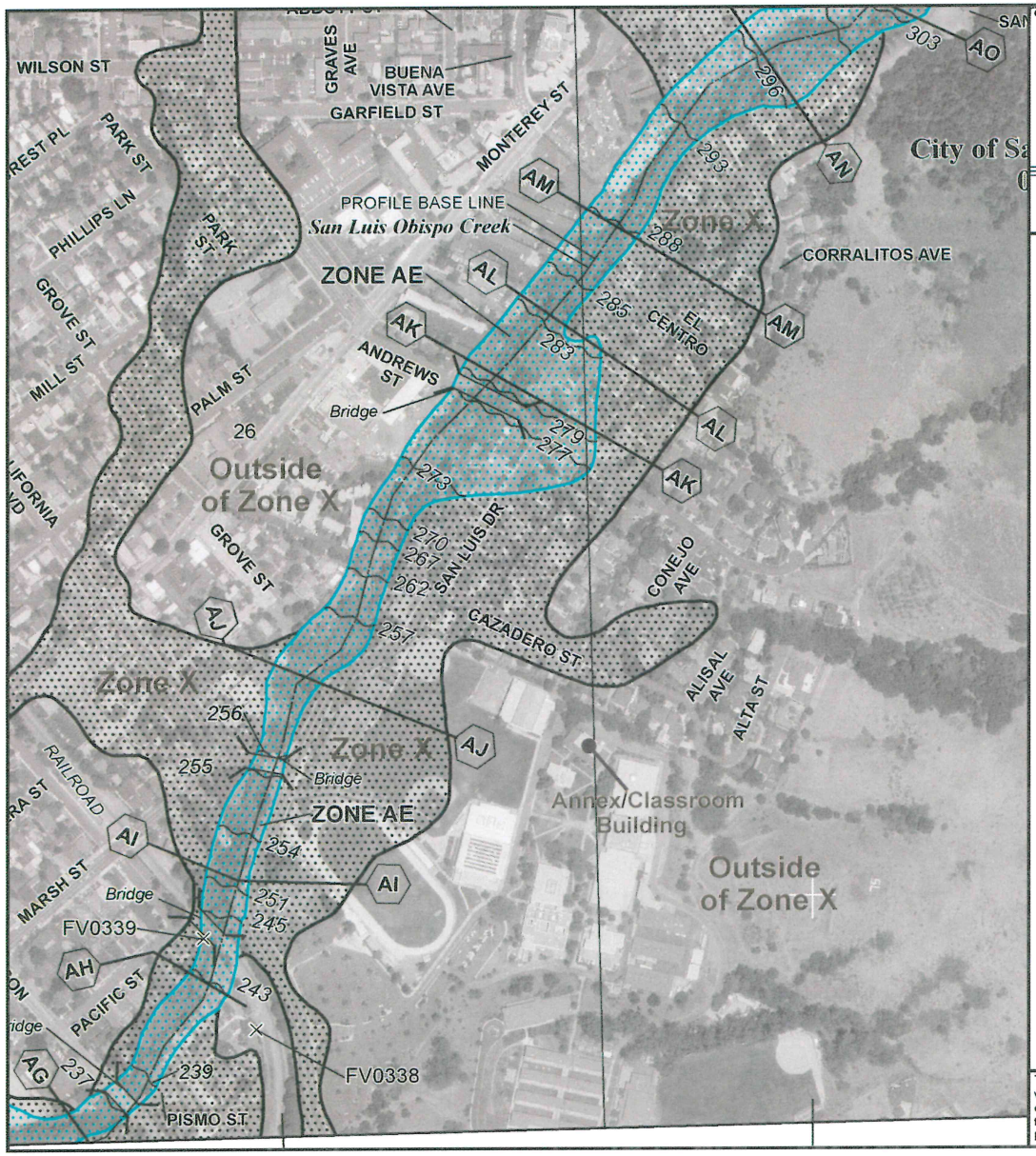
(805) 544-3276

HISTORICAL EARTHQUAKE/ FAULT MAP
SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

Date
January 2016

Project No.
SL-16605-SE



ance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

0 250 500 750 1,000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1067G

FIRM

FLOOD INSURANCE RATE MAP

SAN LUIS OBISPO COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL 1067 OF 2050

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
SAN LUIS OBISPO COUNTY	060304	1067	G
SAN LUIS OBISPO, CITY OF	060310	1067	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER 06079C1067G

MAP REVISED NOVEMBER 16, 2012

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

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FEMA FLOOD ZONE MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

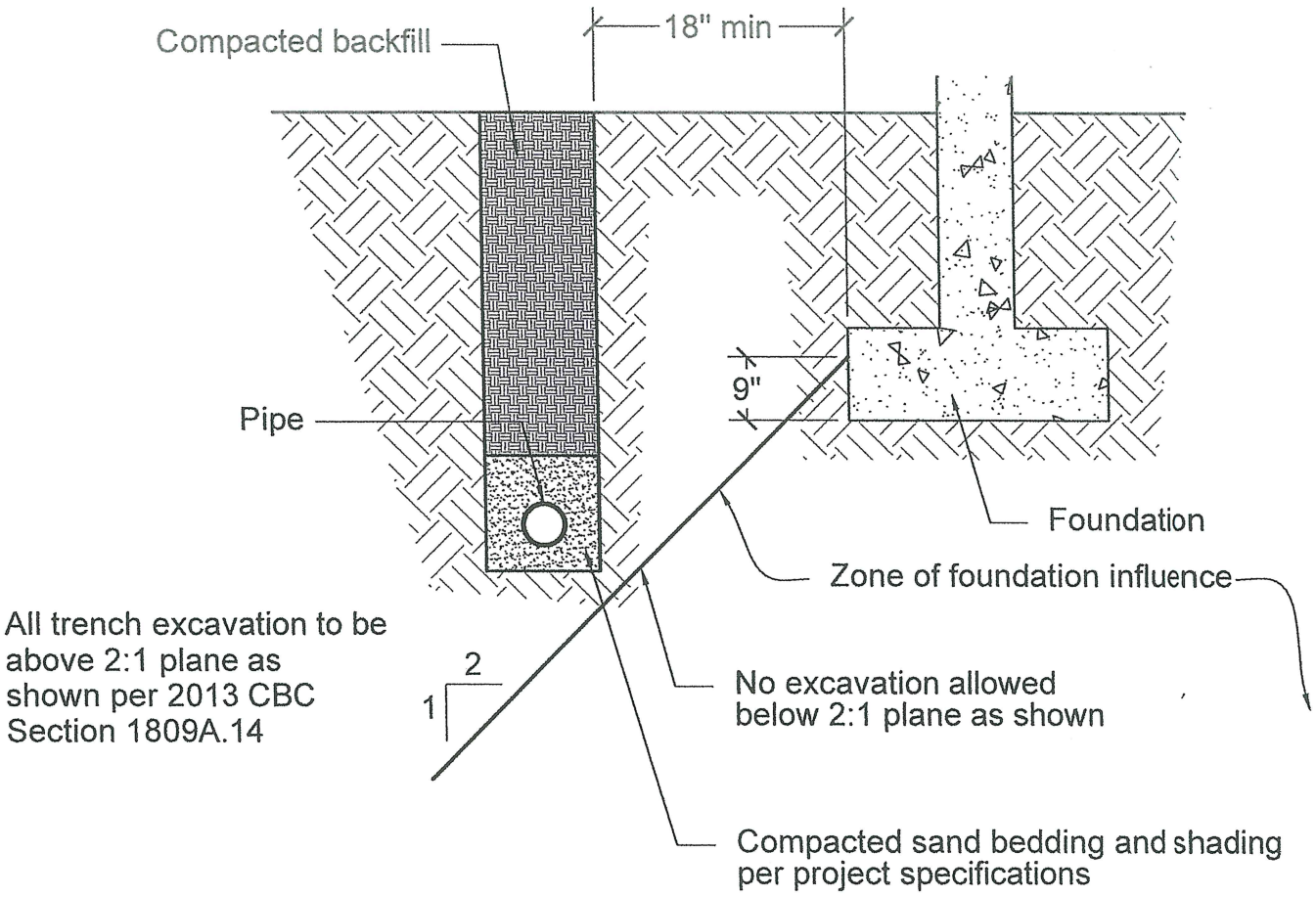
Date
January 2016

Project No.
SL-16605-SE

APPENDIX E

Typical Detail A: Pipe Placed Parallel to Foundations

TYPICAL DETAIL A
PIPE PLACED PARALLEL TO FOUNDATIONS*



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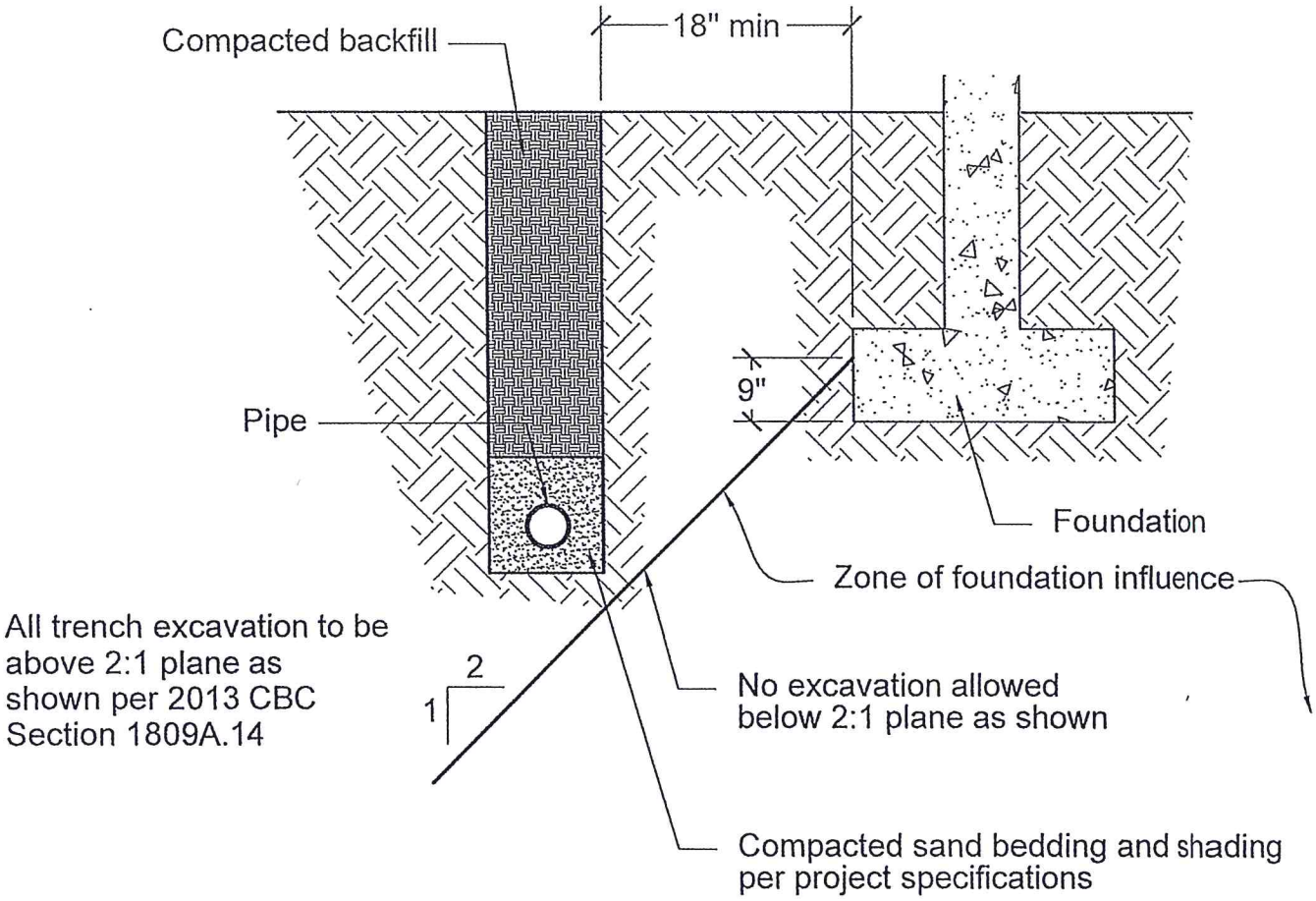
San Luis Obispo, CA 93401-8116
(805) 544-3276 • FAX (805) 544-1786
E-mail: esp@earthsys.com

APPENDIX E

Typical Detail A: Pipe Parallel to Foundations
Tremie Method

TYPICAL DETAIL A
PIPE PLACED PARALLEL TO FOUNDATIONS*



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RECOMMENDED PROCEDURE FOR TREMIE-PLACED CONCRETE IN CAISSON (DRILLED SHAFT) FOUNDATION CONSTRUCTION

The following are general guidelines only, and may be subject to modification by the architect/engineer and/or geotechnical engineer.

1. Concrete should be placed in caisson excavations by means of a tremie when the depth of water in the excavation cannot be limited to a maximum of 2 inches, or when the freefall of the concrete would result in the concrete striking the rebar or excavation walls as it falls.
2. The concrete should be pumped to the tremie pipe, or a hopper with a tremie pipe attached should be used. An "elephant's trunk" should not be used to place concrete under water; however, an elephant's trunk may be used to direct the fall of the concrete in dry excavations. The elephant's trunk should be of sufficient length to prevent the concrete from striking the rebar or excavation walls as it falls.
3. Concrete for dry excavations should be designed for, and placed at, a slump of 4 to 6 inches. Concrete to be placed below water should be designed for, and placed at, a slump of 7 to 9 inches.
4. The tremie pipe should consist of rigid steel pipe with tight couplings. The tremie pipe should be 4 to 6 inches in diameter and should be longer than the deepest caisson excavation.
5. The tremie pipe should be lowered with caution through the center of the reinforcing to within 1 foot of the bottom of the excavation; the tremie should not be allowed to penetrate into the muck on the bottom of the hole
6. The pump hose and tremie pipe should be "slicked" with Portland cement slurry. No clay, bentonite, or other material should be used unless approved by the architect/engineer and geotechnical engineer.
7. Pumping of the concrete should begin immediately after the reinforcing, and the tremie pipe have been placed in the excavation and the excavation has been inspected. The tremie pipe should not be raised until the concrete surface in the caisson excavation is at least 5 feet above the bottom of the tremie pipe. The bottom of the tremie pipe should then be kept at least 5 feet below the top of the concrete until the pour is completed.
8. The concrete should be pumped until all muck, laitance, and unsuitable concrete has been lifted above the top-of-caisson elevation. All muck, laitance, and unsuitable concrete should be immediately removed from the excavation.
9. Concrete poured at a 6-inch or greater slump should *not* be vibrated during the pour, unless directed by the architect/engineer. When vibration is required, it should *not* be started until the concrete pour is completed and the muck, laitance and unsuitable concrete have been removed. At a minimum, the upper 10 feet of the concrete should then be vibrated. Additional concrete may be added as necessary during vibration. The vibrator should not be allowed to contact the reinforcing.
10. During the pour, if the tremie pipe has to be removed from the concrete, (e.g., to allow removal of casing), it should be reset at the top of the concrete. The tremie should then be purged, as directed by the inspector, and then immediately lowered to at least 5 feet below the top of the concrete as the concrete is being pumped. All degraded concrete should be lifted with the continuing pour and removed from the top of the caisson.

GEOTECHNICAL ENGINEERING AND GEOLOGIC HAZARDS REPORT
SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA

July 20, 2018

Prepared for

Mr. Ryan Pinkerton
San Luis Coastal Unified School District

Prepared by

Earth Systems Pacific
4378 Old Santa Fe Road
San Luis Obispo, CA 93401

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July 20, 2018

FILE NO.: 300933-007

Mr. Ryan Pinkerton
San Luis Coastal Unified School District
937 Southwood Drive
San Luis Obispo, CA 93401

PROJECT: SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA

SUBJECT: Geotechnical Engineering and Geologic Hazards Report

CONTRACT
REF: Purchase Order No. 181880 by San Luis Coastal School District, dated April 11, 2018, to Provide a Geotechnical Engineering Investigation, San Luis Obispo High School Modernization, 1499 San Luis Drive, San Luis Obispo, California, per Proposal by Earth Systems Pacific, Doc. No. 1803-110.PRP.REV, revised April 26, 2018

Dear Mr. Pinkerton:

In accordance with the referenced purchase order, this geotechnical engineering and geologic hazards report has been prepared for use in the development of plans and specifications for the Building 100 Modernization project at San Luis Obispo High School in San Luis Obispo, California. This report describes the general geotechnical and geologic characteristics, identifies existing and potential geotechnical and geologic hazards, and discusses the impacts that these conditions could have upon the project. Preliminary geotechnical recommendations for site preparation, grading, utility trenches, foundations, slabs-on-grade, retaining walls, drainage and maintenance, and observation and testing are presented herein. Two bound copies and an electronic copy of this report are provided for your use. Additional electronic copies have been distributed as noted

We appreciate the opportunity to have provided services for this project and look forward to working with you again in the future. If there are any questions concerning this report, please do not hesitate to contact the undersigned.

Sincerely,
Earth Systems Pacific

Nick Zoetewey, PE
Project Engineer

Fred J. Potthast, GE
Principal Engineer

Darrin Hasham, CEG
Senior Geologist

Copy to: SLCUSD, Attn.: Chris Bonin and Stephen Stewart

Doc. No.: 1807-029.SGR/cr

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APPENDICES

APPENDIX A	Figure 1 – Site Vicinity Map Figure 2 – Exploration Location Map Boring Log Legend Boring Logs
APPENDIX B	Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School Building 100 Elevator Tower (ESP 2018) California Geological Survey, Engineering Geology and Seismology Review of Geotechnical Engineering and Geologic Hazards Report for San Luis Obispo High School – New Annex/Classroom (ESP 2016)
APPENDIX C	Geotechnical Laboratory Test Results
APPENDIX D	Typical Detail A: Pipe Placed Parallel to Foundations Tremie Method

1.0 INTRODUCTION AND SITE SETTING

Through correspondence with RRM Design Group and our review of a site plan prepared by PBK (2018), we understand the following improvements are planned at the west side, south side, and within Building 100, which, in turn, is within the San Luis Obispo High School campus (see Figure 1 – Site Vicinity Map in Appendix A):

- Regrading of the plaza area on the west side of Building 100, and the construction of multiple retaining walls, stairways, access ramps and exterior pedestrian flatwork. Cuts and fills of 5 to 10 feet are anticipated, with maximum retaining wall heights on the order of 10 to 12 feet.
- Construction of a line of canopy columns and an arched entry structure on the west side of Building 100; these features will be of steel-frame construction, and will be structurally connected to the existing building. Drilled, cast-in-place concrete caisson foundations with grade beams are anticipated to support these features.
- Reconstruction of slabs-on-grade on the north side of the interior lobby of Building 100.
- Removal of two interior columns and replacement with a single column supported by drilled, cast-in-place caisson(s) on the south side of Building 100.
- Construction of stairways and access ramps off the southeast corner of Building 100, with retaining walls up to 8 feet tall. Asphalt Concrete (AC) paths may also be utilized for pedestrian access.
- Installation or realignment of underground utility lines in the improvement areas.
- No LID/BMP improvements, drainage basins or other improvements are planned.

Structural loading information has not yet been provided; however, we anticipate dead plus live loads on the order of 15 kips, 75 kips and 3 kips per lineal foot for canopy, interior column and retaining wall loads, respectively.

2.0 SCOPE OF SERVICES

The scope of work for this report included a general site reconnaissance, subsurface exploration, site reconnaissance by a registered geotechnical engineer, laboratory testing of samples secured during the subsurface investigation, geotechnical analyses of the data, and preparation of this report. The analysis and subsequent recommendations are based on general information provided by the client, RRM Design Group, and PBK. Geologic hazards on the campus were

addressed by this firm (ESP 2016) for the Classroom/Annex project under construction off the northwest corner of Building 100, which, in turn, is included in the Building 100 Elevator Tower report (ESP 2018) in Appendix B. At this time, we are unaware of any changes to the requirements for a geologic hazards evaluation by the DSA (2015); therefore, the conclusions and recommendations of that report, which has been accepted by the California Geologic Survey (CGS) and the DSA, are still considered valid. A copy of the acceptance letter by the CGS is also included in Appendix B

This report and preliminary geotechnical recommendations are intended to comply with the considerations of Sections 1803A.1 through 1803A.7, J104.3 and J104.4 of the 2016 California Building Code (CBC); California Geological Survey Note 48 (CGS 2013); DSA IR A-4.13 (DSA 2015); and common geotechnical engineering and engineering geology practice in this area under similar conditions at this time. The test procedures were accomplished in general conformance with the standards noted, as modified by common geotechnical engineering practice in this area under similar conditions at this time.

Preliminary geotechnical recommendations for site preparation, grading, utility trenches, foundations, slabs-on-grade, retaining walls, drainage and maintenance, and observation and testing are presented to guide the development of project plans and specifications. As there may be geotechnical issues yet to be resolved, the geotechnical engineer should be retained to provide consultation as the design progresses, to assist in verifying that pertinent geotechnical issues have been addressed and to aid in conformance with the intent of this report. It may also be advantageous to retain the geotechnical engineer to review the project plans and details as they near completion, to further aid in conformance with the intent of this report.

It is our intent that this report be used exclusively by the client in the preparation of plans and specifications. Application beyond this intent is strictly at the user's risk.

This report does not address issues in the domain of contractors such as, but not limited to, site safety, loss of volume due to stripping of the site, shrinkage of soils during compaction, excavatability, dewatering, shoring, temporary slope angles, construction means and methods, etc. Analyses of the soil for mold potential, man-made products containing asbestos, lead, radioisotopes, hydrocarbons, or chemical properties other than geotechnical corrosivity are beyond the scope of this report. Evaluation of the site for suitability for LID improvements or drainage basins; ancillary features such as temporary access roads, fences, flag and light poles, signage; and nonstructural fills are not within our scope and are also not addressed.

In the event that there are any changes in the nature, design, or location of improvements, or if any assumptions used in the preparation of this report prove to be incorrect, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are verified or are modified in writing. The criteria presented in this report are considered preliminary until such time as any peer review or review by any jurisdiction has been completed, conditions are observed by the geotechnical engineer and/or geologist in the field during construction, and the recommendations have been verified as appropriate or modified in writing.

3.0 FIELD INVESTIGATION

Nine borings were drilled within the proposed improvement locations on June 22 and 25, 2018. Cores were completed through the existing PCC flatwork to allow drilling of Borings 3 through 7; borings were drilled from the ground surface at the remaining locations. The borings were drilled below the ground or PCC surfaces (bgs) to depths that ranged from 6.5 to 31 feet; drilling refusal was encountered at Borings 2, 4, and 7 through 9, at depths that ranged from 7 to 23.5 feet. The borings were drilled with truck-mounted Mobile B-53 or Simco EP200 drill rigs equipped with 4-inch outside diameter solid stem or 6-inch outside diameter hollow stem auger and automatic trip hammers for sampling. Two borings drilled previously (ESP 2018) for the Elevator Tower project to be constructed adjacent to the west side of Building 100 were drilled to depths of 7 to 7.5 feet below the ground surface on February 12, 2018. The approximate locations of the borings for both projects are shown on Figure 2 – Exploration Location Map in Appendix A. As the borings were drilled, soil samples were obtained using a ring-lined barrel sampler (ASTM D 3550-17 with shoe similar to D 2937-17). Standard penetration tests were also performed (ASTM D 1586-11) at selected depths. Bulk soil samples were obtained from the auger cuttings. The borings were backfilled per the requirements of the governing jurisdiction. Borings in flatwork areas were capped with PCC.

Soils encountered in the borings were categorized and logged in general accordance with the Unified Soil Classification System and ASTM D 2488-17a. Where bedrock was encountered, its properties were described based upon observation of the auger cuttings and the effort required to drill into it. Copies of the boring logs and a Boring Log Legend are included in Appendix A. In reviewing the boring logs and legend, the reader should recognize that the legend is intended as a guideline only, and there are a number of conditions that may influence the soil characteristics as observed during drilling. These include, but are not limited to, the presence of cobbles or

boulders, cementation, variations in soil moisture, presence of groundwater, and other factors. It should also be noted that the descriptions of bedrock must span a much wider range of density and strength characteristics than soil, and are relative to other bedrock strata. For example, fractured and weathered bedrock may be described as "soft," yet it will be considerably harder than almost any type of soil. Conversely, a clay soil may be described as "hard," however it will not be nearly as hard as even "soft" bedrock such as the sandstone encountered on this site. Consequently, the logger must exercise judgment in interpreting the subsurface characteristics, possibly resulting in soil and bedrock descriptions that vary somewhat from the legend.

4.0 LABORATORY ANALYSIS

The ring samples were tested for unit weight and moisture (ASTM D 2937-17), as modified for ring liners. Bulk samples were tested for maximum density and optimum moisture content (ASTM D 1557-12), expansion index (ASTM D 30801 D 4829-11), and cohesion and angle of shearing resistance by direct shear (ASTM D 3080 D 3080M-11, recompacted to 90 percent of maximum dry density and modified for consolidated, undrained conditions). The laboratory test results are presented in Appendix C.

5.0 GENERAL SUBSURFACE AND GEOLOGIC PROFILE

The PCC flatwork sections within the areas of Borings 3 through 7 were 4 to 4.25 inches thick, and were generally supported by 2 to 4 inches of sand or gravel. In Boring 4, no sand or gravel was found below the PCC. Below the flatwork sections or ground surfaces, fill was encountered in all borings except Boring 1. The fill generally consisted of loose to medium dense clayey sand or medium stiff sandy lean clay and extended to depths that ranged from 4.5 to 14.5 feet bgs. Traces of debris were found in the fill in Borings 3, 4 and 5. Below the surface in Boring 1, and below the fill in the remaining borings, alluvium was encountered, which consisted of medium stiff to very stiff sandy lean clay or medium dense clayey sand, which extended to depths that ranged from 4.5 to 27 feet bgs. The alluvium was underlain by soft to moderately hard sandstone bedrock of the Franciscan Mélange, which continued to the maximum depth explored of approximately 31 feet bgs.

Free subsurface water was not encountered in any of the borings. Please refer to the boring logs in Appendix A for a more complete description of the subsurface conditions.

6.0 GEOLOGY AND GEOLOGIC HAZARDS

General

Based on information from the Annex/Classroom Building Report (ESP 2016), the geologic hazards assessment is considered to be valid for the current site, with the exception of Site Class, which is discussed in more detail in the next section. A more detailed discussion of geology and geologic hazards is provided in the Annex/Classroom Building report, which is part of the Elevator Tower Report (2018) in Appendix B.

Design Acceleration Parameters

In accordance with California Geologic Survey, Note 48 (CGS 2013), Item 16, an assessment was made to determine the need for employing "Site Specific Ground Procedures" for the site area. Based on the results of standard penetration tests performed during the field investigation for the Annex/Classroom Building (ESP 2016), a site class "D – Stiff Soil" was selected. During the field investigation for the current site, bedrock was encountered at significantly shallower depths in the majority of the borings and blow counts were determined to be significantly higher at shallower depths. Where the topsoil/fill/alluvium above the rock was found in the borings to be relatively thick, cuts planned for the proposed improvements should result in finish grades closer to the bedrock surface. Given these conditions, in our opinion, this project site can be considered as site class "C – Very Dense Soil and Soft Rock." The approximate coordinates of latitude 35.2836N and longitude 120.6495W were taken near the center of the site from the Google Earth website (Google Earth 2018). Using these coordinates, the S_1 ground motion value obtained from the United States Geological Survey Earthquake Hazards Program website (USGS 2018) and the ASCE 7-10 (2013) Standard Analysis Method for a site class "C" (very dense soil and soft rock profile) was below 0.75g (see table below, S_1 = 0.434g). Therefore, the project does not require a site-specific ground motion analysis.

The site is in a region of generally high seismicity and has the potential to experience strong ground shaking from earthquakes on regional or local causative faults. To characterize the seismicity at the site and to provide seismic design parameters for the architect/engineer, a General Procedure Ground Motion Analysis was performed to calculate the deterministic ground motions at the site. The ground motions are based on the 2016 CBC General Procedure that were obtained from the United States Geological Survey Earthquake Hazards Program website (USGS 2018) and the ASCE 7-10 (2013) Standard Analysis Method, for Site Class "C" (very dense soil and soft rock profile). The results of this analysis are presented in the following table:

SUMMARY OF DESIGN RESPONSE ACCELERATION PARAMETERS

Mapped Acceleration Values for Site Class "B"		**2016 CBC Site Coefficients and General Procedure Adjusted MCE Spectral Response Acceleration Parameters For Site Class "C"**					
Seismic Parameters	Values (g)	Site Coefficients	Values	Seismic Parameters	Values (g)	Seismic Parameters	Values (g)
S_S	1.137	F_a	1.000	S_{MS}	1.137	S_{DS}	0.758
S_1	0.434	F_v	1.366	S_{M1}	0.593	S_{D1}	0.395
Peak Mean Ground Acceleration (PGA_m): 0.453 g							

7.0 CONCLUSIONS

In our opinion, the site is suitable, from a geotechnical engineering standpoint, for the proposed improvements, as described in the "Introduction and Site Setting" Section of this report, provided the recommendations contained herein are implemented in the design and construction. The primary geotechnical engineering concerns at the site are the potential for differential settlement, the expansion and corrosive potential of the on-site soil, and the erodible nature of the soil. Provided that the site is prepared as recommended in the "Grading" Section of this report, conventional continuous and/or caisson foundations may be used to support the proposed structures.

Differential Settlement

Differential settlement can occur when a foundation spans materials having variable consolidation characteristics, such as the fills that were encountered as deep as 14.5 feet bgs in the borings and the bedrock found at relatively shallow depths. We are unaware of any documentation (i.e., grading observation or compaction testing records) regarding the placement of the fills, but they were likely placed when the existing Building 100 and shop buildings were constructed in the late 1950s and early 1960s. The traces of debris found in the fill also suggest the fill may not be up to acceptable standards. Although the fills have likely already experienced a significant amount of their potential settlement, the fills still have a greater potential for variability and continued settlement than fill that has been placed and tested in a controlled earthwork program. The alluvial soils and bedrock would be expected to cause limited to negligible settlement of foundations. Such variable conditions have the potential to stress and possibly damage foundations, often resulting in severe cracks and displacement if they are not mitigated. To reduce this potential for differential settlement, a program of overexcavation and recompaction of the existing fill within foundation areas is recommended prior to foundation

construction. Where alluvium or bedrock are present, overexcavation and recompaction would not be considered necessary.

Due to their age, the existing foundations within the building have likely experienced nearly or all the settlement they will see over their design lives; therefore, to limit the potential for differential settlement of new vs. existing foundations, all new foundations should be founded on bedrock.

Expansion Potential

Expansion index testing of the existing fill materials during the Elevator Tower investigation yielded a result of 59. Additional testing of the surficial soils for the current investigation produced results of 47 and 55, consistent with the previous result. Per CBC Section 1803A.5.3, the soils are considered to be expansive. The more commonly used ASTM classification is that the fills are generally considered to have a "medium" expansion potential. The underlying bedrock is also considered to be expansive. Expansive materials tend to swell with increases in moisture content and shrink as moisture decreases. The volume changes that the materials undergo in this cyclical pattern can stress and damage foundations and slabs-on-grade if precautionary measures are not incorporated during design and construction. Footings are typically deepened and additional reinforcement is provided. Imported nonexpansive materials are recommended to be placed beneath slabs-on-grade.

Corrosion Potential

As indicated in the Soil Corrosivity Study by HDR Engineering, Inc., which was performed during the Elevator Tower investigation (see ESP 2018 report in Appendix B), electrical resistivities of the samples tested were in the moderately corrosive and corrosive categories with as received moisture contents; when saturated, the resistivities were in the corrosive category. Soil pH values were in the neutral to mildly alkaline categories. The soluble salt contents of the soils were moderate. Nitrate concentrations were low; ammonium concentrations were high enough to be aggressive to copper. The soils were classified as corrosive to ferrous metals and aggressive to copper. Recommendations for corrosive soil mitigation are included in the Soil Corrosivity Study.

Erosion Potential

The fill above the alluvium and bedrock is considered to be erodible. It is essential that all surface drainage be controlled and directed to appropriate discharge points, and that surface materials,

particularly those disturbed during construction, are stabilized by vegetation or other means *during and following construction*.

8.0 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

The following recommendations are for improvements constructed as described in the "Introduction and Site Setting" Section of this report. If locations, elevations, structural loads, etc., change, the recommendations contained herein may require modification.

Unless otherwise noted, the following definitions are used in the recommendations presented below. Where terms are not defined, definitions commonly used in the construction industry are intended.

- **Building Area –** The building area is defined as the area within the perimeter of any new foundations for the existing structure. The building area also includes any retaining walls or other improvements that are connected to the structure and that are intended to act in a manner similar to it.
- **Sitework Retaining Wall Areas –** The areas within and extending a minimum of 3 feet beyond the foundation limits of all sitework retaining walls.
- **Exterior Pedestrian Flatwork Areas –** The areas within the footprints of all exterior areas to receive new or reconstructed pedestrian flatwork.
- **Existing Grade:** Elevations of the site that existed as of the date of this report.
- **Finish Grade:** The elevation in the building area or sitework retaining wall areas where earthwork or backfill operations are typically considered to be complete. It does not include any sand or gravel that might be placed below slabs-on-grade in association with vapor protection for the slabs.
- **Subgrade:** The elevation in exterior pedestrian flatwork areas where imported nonexpansive materials, sand, or aggregate base (AB) are placed to support the flatwork.
- **Scarified:** Plowed or ripped in two orthogonal directions to a depth of not less than 8 inches.
- **Moisture Conditioned:** Adjusting the soil moisture to optimum moisture content, or just above, prior to application of compactive effort.
- **Compacted/Recompacted:** Soils placed in level lifts not exceeding 8 inches in loose thickness and compacted to a minimum of 90 percent of maximum dry density. Based on

maximum dry density by ASTM D 1557-12 and field density by ASTM D 6938-17a, or other methods acceptable to the geotechnical engineer and jurisdiction.

Site Preparation

1. The ground surface in the building, retaining wall and exterior pedestrian flatwork areas should be prepared for construction by removing the existing slabs-on-grade, flatwork and all other improvements, vegetation, large roots, debris, organic topsoil, and other deleterious materials. Existing utility lines that will not remain in service should be either removed or abandoned. The appropriate method of abandonment will depend upon the type and depth of the utility. Recommendations for abandonment can be made as necessary.

2. Voids created by the removal of materials or utilities described above should be called to the attention of the geotechnical engineer. No fill should be placed unless the underlying soil has been observed by the geotechnical engineer.

Grading

1. Following site preparation, all existing fill in sitework retaining wall areas should be overexcavated to the deepest point of the fill or a maximum of 4 feet below bottom of footing elevation, whichever is shallower. Where alluvium or bedrock is exposed, excavation operations may be terminated. The resulting excavated soil surfaces should be scarified, moisture conditioned and compacted. Excavated bedrock surfaces need not be scarified, but they should be moisture conditioned and compacted as needed to correct any disturbances caused by excavators. Overexcavation elevations may be stepped where the fill depth changes, where alluvium or bedrock are encountered, or where retaining walls are stepped to conform to any site contours. To reduce the potential for cracking in sitework retaining walls, construction joints should be placed in the wall and the foundation where overexcavation operations have been stepped to conform to fill depth changes, or where foundations will cross recompacted soil/alluvium/bedrock areas.

2. Following site preparation and removal of the existing slabs-on-grade within the building area, any slab support section (sand, aggregate base, etc.) should be removed until subgrade is reached. The exposed surface should then be scarified, moisture conditioned and compacted.

3. Following site preparation, all proposed exterior pedestrian flatwork areas should be excavated to subgrade. The exposed subgrade, and any areas where fill is needed to bring proposed flatwork areas up to subgrade, should be scarified, moisture conditioned, and recompacted.

4. Voids created by dislodging cobbles and/or debris during scarification should be backfilled and recompacted, and the dislodged materials should be removed from the work area.

5. Previously removed site soil may be placed as fill within sitework retaining wall areas to finish grade. In exterior pedestrian flatwork areas, previously removed site soil may be used to the bottom of the nonexpansive fill layer; the actual thickness of the nonexpansive layer should be determined per the "Slab-on-Grade" Section of this report. Previously removed site soil may be placed as moisture conditioned, compacted fill within building areas to a maximum height of 18 inches below bottom of slab elevation. If imported fill is needed to complete site grading, the imported materials should be nonexpansive.

6. Nonexpansive materials are defined as imported soils that fall in the GW, GM, GC, SP, SW, SC and SM categories per ASTM D 2487-17, and that have an expansion index of 10 or less (ASTM D 4829-11). The clean sand layer described in the "Slabs-on-Grade" section of this report (if utilized below interior slabs-on-grade or exterior pedestrian flatwork) is considered to be part of the minimum recommended thickness of nonexpansive material utilized, not in addition to it.

7. Imported soils used in the building area should have strength and expansion qualities equal to or better than the site soils, and they should not exceed the geotechnical corrosivity potential of the site soils. See the Soil Corrosivity Study in Appendix B for the corrosivity parameters of the site soils. Proposed imported materials should be reviewed by the geotechnical engineer before being brought to the site, and on an intermittent basis during placement.

8. All materials used as fill should be cleaned of any debris and rocks larger than 3 inches in diameter. When fill material includes rocks, the rocks should be placed in a sufficient soil matrix to ensure that voids caused by nesting of the rocks will not occur and that the fill can be properly compacted.

9. If the materials are overly moist so that they become unstable, or if the minimum recommended compaction cannot be readily achieved, drying the materials so that they are nearer optimum moisture content, may be necessary. Placement of gravel layers or geotextiles may also be necessary to help stabilize unstable materials. Additional overexcavation may also be recommended to correct unstable conditions or if soft or loose conditions are encountered during grading. No fill should be placed in any grading area if the underlying materials are unstable.

10. The recommended soil moisture content should be maintained throughout construction. Failure to maintain the soil moisture content can result in desiccation cracks and disturbance, which are an indication of degradation of the soil compaction. If desiccation cracks are allowed to develop, or if soils near improvements such as foundations, flatwork, etc. are otherwise disturbed, damage to those improvements may result. Soils that have cracked or are otherwise disturbed should be removed, moisture conditioned, and recompacted.

Utility Trenches

1. Utility trenches adjacent to foundations should not be excavated within the zone of foundation influence, as shown in Typical Detail A in Appendix D.

2. Utilities that must pass beneath foundations should be placed with properly compacted utility trench backfill and the foundation should be designed to span the trench.

3. A select, noncorrosive, granular, easily compacted material should be used as bedding and shading immediately around utilities. The site soil may be used for trench backfill above the select material beyond the building area, and to within 18 inches below bottom of slab elevation in the building area. Within the building area, imported nonexpansive soils should be utilized to backfill the final 18 inches below bottom of slab elevation of all trenches. In exterior pedestrian flatwork and AC path areas, trench backfill should match the thickness of imported nonexpansive soils, sand or AB used to support these improvements.

4. In general, trench backfill should be compacted to a minimum of 90 percent of maximum dry density. Trench backfill in AC path areas should be compacted to a minimum of 95 percent of maximum dry density at subgrade and aggregate base or top of sand grade.

5. Prior to applying compactive effort, soils should be moisture conditioned. Trench backfill should be placed in level lifts not exceeding 6 inches in loose thickness and compacted to the minimum recommended above.

6. Compaction of trench backfill by jetting or flooding is not recommended at this site due to the expansive soils and the shallow depth to bedrock. However, to aid in *encasing* utility conduits, particularly corrugated drain pipes, and multiple, closely-spaced conduits in a single trench with the bedding and shading material, jetting or flooding may be useful. Flooding or jetting should only be attempted with extreme caution, and any flooding or jetting operation should be subject to review by the geotechnical engineer.

7. Long-term settlement of properly compacted sand should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill. Where trenches are backfilled with site soils, the anticipated settlement would be about twice that of sand. Improvements that are constructed over or near trenches should be designed to accommodate the potential for settlement.

8. The Soil Corrosivity Study by HDR Engineering, Inc. in the Elevator Tower Report (ESP 2018) in Appendix B, should be used by the architect/engineer in specifying appropriate corrosion protection measures for utility improvements.

9. The recommendations of this section are minimums only, and may be superseded by the architect/engineer based upon soil corrosivity or the requirements of pipe manufacturers, utility companies or the governing jurisdiction.

Foundations

Conventional Foundations

1. The proposed sitework retaining walls may be supported by continuous footings that will bear in firm recompacted soil, as recommended in the “Grading” Section of this report, or in firm alluvium or firm bedrock, or any combination of these three. If a foundation crosses a recompacted/native soil or a soil/bedrock transition, a construction joint should be placed in the footing and the wall at the transition.

2. Based on soil expansion potential, minimum overall foundation depths (not including any keyway) of 21 inches below lowest adjacent grade should be maintained.

3. Continuous footings should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential, minimum continuous footing reinforcement should consist of two No. 4 rebars, one at the top and one at the bottom.

4. Footings bearing in firm recompacted soil or firm alluvium may be designed using maximum allowable bearing capacities of 2,500 psf for dead load and 3,500 psf for dead plus live loads. Footings bearing in firm bedrock may be designed using maximum allowable bearing capacities of 3,000 psf for dead load and 4,000 psf for dead plus live loads. Using these criteria, maximum settlement and differential settlement are for foundations bearing in soil are expected to be on the order of ½-inch and ¼-inch over a horizontal distance of 25 feet, respectively. Maximum settlement and differential settlement for foundations bearing in bedrock are expected to be negligible.

5. To calculate resistance to lateral loads, please see the values presented in the "Retaining Walls" section of this report. Lateral capacity is based on the assumption that any backfill adjacent to foundations has been properly compacted. Passive and friction components of resistance may be combined in the analysis without reduction to either value.

6. Foundation excavations should be observed by the geotechnical engineer prior to placement of reinforcing steel. Foundation excavations should be lightly moistened and no desiccation cracks should be present prior to concrete placement.

Caissons

1. The proposed interior and exterior columns within and connected to Building 100 may be supported by drilled, cast-in-place concrete caissons. The caissons should have a minimum diameter of 18 inches, and a minimum overall depth of 5 feet into firm bedrock. The caissons may be designed using an allowable skin friction value of 1,000 psf in the bedrock; no end bearing capacity should be used in the calculations. An allowable skin friction value of 750 psf in the bedrock can be used under short-term tension (uplift) conditions. The self-weight of the caissons may be neglected in the determination of downward loading, however, it may be included, if needed, for resistance to uplift. Negligible total and differential settlement of caissons to support the proposed columns is expected. To maintain negligible total and differential settlement condition, skin friction in the fill and alluvium above the bedrock should be neglected. A passive

resistance of 350 pcf in the soil beginning at 2 feet bgs and 500 pcf in the bedrock, acting over 2 caisson diameters, may be taken for resistance to short term lateral loads.

2. The soils above the bedrock may not stand vertically during the caisson construction; therefore, casing, drill fluid, or other means of keeping the holes open may be necessary and should be planned for. Caisson reinforcing should be designed to accommodate a minimum 5-inch diameter tremie pipe for concrete placement, in case any perched groundwater is encountered. The reinforcing should also be designed to facilitate removal of casing during concrete placement, if used. Any water encountered should be removed from the caisson excavation prior to placing concrete, or the concrete should be tremied. The recommended tremie method is described in Appendix D.

3. As the caissons will utilize skin friction for support, it is not necessary to remove all loose debris and slough material from the bottoms of the excavations. The caissons should not deviate from a plumb line taken from the center of the caisson by more than 2 percent of the caisson length, from the top to the point of interest. Adequate caisson oversize may be assumed to provide required tolerance.

4. Caisson excavations should be observed by the geotechnical engineer during drilling operations and prior to placement of reinforcing steel and concrete. Special inspection of reinforcing steel and concrete placement for caissons should also be provided.

5. Reinforcing steel and concrete for caissons should be placed on the same day as they are drilled. Caisson excavations that must be left overnight before concrete placement should have the sidewalls “freshened” by re-drilling, and sloughed material should be removed by use of a clean-out bucket, prior to placement of reinforcing steel and concrete.

<u>General</u>

1. Allowable bearing capacities may be increased by one-third when transient loads such as wind or seismicity are included. Foundations may be designed using the site design response parameters contained in the table in the “Geology and Geologic Hazards” section of this report.

2. The Soil Corrosivity Study by HDR Engineering, Inc. in the Elevator Tower Report (ESP 2018) in Appendix B should be used by the architect/engineer in specifying appropriate corrosion

protection measures for all foundation elements.

Slabs-on-Grade

Interior Slabs-on-Grade

1. Interior slabs-on-grade should have a minimum thickness of 4 inches or should be matched in-kind with the existing slab section thicknesses, whichever is thicker. New slabs should be reinforced and doweled to foundations and surrounding slabs per the specifications of the architect/engineer. At a minimum, interior slabs should be reinforced with No. 3 rebar at 18 inches on center each way. All structural slabs should contain minimum rebar meeting the criteria of ACI 318, Section 24.4 (ACI 2014). At a minimum, foundation dowels should be lap spliced to the slab rebar. The size and spacing of the dowels should match the size and spacing of the slab rebar.

2. Support for new interior slabs constructed within surrounding existing slabs should match the support section in-kind with the existing slabs.

Exterior Pedestrian Flatwork

1. Exterior pedestrian flatwork should have a minimum thickness of 4 inches or should be matched in-kind with the existing slab section thicknesses for new slabs adjacent to existing slabs, whichever is thicker. Minimum reinforcement should consist of No. 3 rebar placed at 24 inches on-center each way.

2. In conventional construction, it is common to use 4 to 6 inches of sand beneath exterior pedestrian flatwork. However, due to the medium expansion potential of the site soils, there will be a risk of movement and damage to the flatwork if conventional measures are used. Heaving and cracking could occur. This movement could be reduced by the placement of additional nonexpansive material beneath the flatwork. If it is desired to fully mitigate the expansive soil conditions, then at least 18 inches of imported nonexpansive material should be provided below new flatwork outside the Building 100 area where the expansive site soils are exposed at finish grade. If it is acceptable for the flatwork to experience movement due to expansive soils, then the thickness of the nonexpansive soil can be reduced. Under all flatwork, however, the thicker the nonexpansive layer, the better the expansive soil protection.

3. Another measure that can be taken to reduce the risk of movement of flatwork due to

expansive soils is to provide thickened edges or grade beams around the perimeters of the flatwork. If it is desired to fully mitigate the expansive soil conditions, then the thickened edges or grade beams could be up to 21 inches deep. If it is acceptable for the flatwork to experience movement, then the thickened edges or grade beams can be reduced. At a minimum, any thickened edge or grade beam should be reinforced by two No. 4 rebar, one at the top and one at the bottom.

4. It is recognized that the measures discussed above for protecting exterior flatwork from expansive soils are expensive, possibly more expensive than simply replacing flatwork that has heaved and/or cracked. The client may consider that the condition of the existing flatwork around Building 100 is sufficient evidence that significant protection measures for flatwork are not needed. Consequently, the above measures for protecting exterior flatwork are only suggestions for consideration by the owner and/or architect/engineer. The degree to which exterior flatwork is protected from expansive soil damage is left to the discretion of the owner and/or architect/engineer.

5. Flatwork should be constructed with frequent joints to allow articulation as the flatwork moves in response to seasonal soil temperature and moisture variations. The expansive soil underlying any nonexpansive material placed below flatwork should be moisture conditioned, and no desiccation cracks should be present, prior to casting the flatwork.

6. Flatwork at doorways, and at other areas where maintaining the elevation of the flatwork is desired when mitigating expansive soil potential, should be doweled to the perimeter foundation, at a minimum, by No. 3 dowels lapped to the flatwork rebar at 24 inches on center. In other areas, the flatwork may be doweled to the foundation or the flatwork may be allowed to "float free," at the discretion of the architect/engineer. Flatwork that is intended to float free should be separated from foundations by a felt joint or other means.

<u>Moisture Vapor Transmission</u>

1. Due to the current use of impermeable floor coverings, water-soluble flooring adhesives, and the speed at which buildings are now constructed, moisture vapor transmission through slabs is a much more common problem than in past years. Where moisture vapor transmitted from the underlying soil would be undesirable, slabs should be protected from subsurface moisture vapor. A number of options for vapor protection are discussed

below; however, the means of vapor protection, including the type and thickness of the vapor retarder, if specified, are left to the discretion of the architect/engineer.

2. Where specified, vapor retarders should conform to ASTM Standard E 1745-11. This standard specifies properties for three performance classes; Class A, B and C. The appropriate class should be selected based on the potential for damage to the vapor retarder during placement of slab reinforcement and concrete. Unless it is determined that a permeance of 0.10 perms will not allow vapor to accumulate beneath moisture-sensitive flooring, adhesives, stored products and/or equipment, then a vapor retarder permeance of 0.010 perms is recommended, per ACI 302.1-15. Permeance of vapor retarders should remain below 0.010 perms after the conditioning tests of ASTM E 1745-11.

   It should be noted that ASTM E 1745-11 has the same permeance threshold for Class A through Class C (0.1 perms). The class that is chosen will make a difference in how resistant the vapor retarder is to punctures and tears, but it will not insure any better permeance values to protect floor coverings.

3. Several recent studies, including those of American Concrete Institute Committee 302 (ACI 2015), have concluded that excess water above the vapor retarder increases the potential for moisture damage to floor coverings and could increase the potential for mold growth or other microbial contamination. The studies also concluded that it is preferable to eliminate the typical sand layer beneath the slab and place the slab concrete in direct contact with a Class A vapor retarder, particularly during wet weather construction. However, placing the concrete directly on the vapor retarder requires special attention to using the proper vapor retarder, a very low water-cement ratio in the concrete mix, and special finishing and curing techniques.

4. Another option that may be a reasonable compromise between effectiveness and cost considerations is the use of a subslab vapor retarder protected by a sand layer. If a Class A vapor retarder is specified, the retarder can be placed directly on the nonexpansive soil. The retarder should be covered with a minimum 2 inches of *clean* sand. If a less durable vapor retarder is specified (Class B or C), a minimum of 4 inches of clean sand should be provided, and the retarder should be placed in the center of the clean sand layer. Clean sand is defined as a well or poorly graded sand (ASTM D 2487-17) of which less than 3 percent passes the No. 200 sieve. The clean sand layer is considered to be part of the

minimum 18-inch layer of nonexpansive soils recommended to be placed below slabs for protection from expansive soils, not in addition to it.

5. Regardless of the underslab vapor retarder selected, proper installation of the retarder per ASTM E 1643-18a is critical for optimum performance. Where utilized, the vapor retarder should be placed a minimum of 1 inch above the flow line of the drainage path surrounding the structures, or 1 inch above the area drain grates if area drains are used to collect runoff around the structures. As required by ASTM E 1643-18a, all seams and utility penetrations should be properly sealed. At terminating edges of the vapor retarder, the vapor retarder should be effectively sealed with accessories specifically designed to seal the material to new or existing concrete; details for edge sealing of the vapor retarder should be provided by the architect/engineer.

6. If the sand is used between the vapor retarder and the slab, it should be moistened only as necessary to promote concrete curing; saturation of the sand should be avoided, as the excess moisture would be on top of the vapor retarder, potentially resulting in vapor transmission through the slab for months or years.

7. The architect/engineer should designate any special measures to be used in conjunction with moisture vapor transmission protection, if needed, to mitigate the high potential for indoor radon levels.

8. Positive drainage away from the building should be maintained; see the "Drainage and Maintenance" section of this report for additional discussion of this issue. If water is allowed to pond near the structure, it may seep into the ground and migrate laterally through cracks or utility penetrations in the foundation, ultimately gaining access above the vapor retarder.

<u>Slabs-on-Grade - General</u>

1. To reduce shrinkage cracks in all interior and exterior slabs-on-grade, the concrete aggregates should be of appropriate size and proportion, the water/cement ratio should be low, the concrete should be properly placed and finished, contraction joints should be installed, and the concrete should be properly cured. This is particularly applicable to slabs that will be cast directly upon a vapor retarder and those that will be protected from transmission of vapor by use of admixtures or surface sealers. Concrete materials, placement, and curing specifications should be at the direction of the architect/engineer;

AC 302.1R-15 (ACI 2015) is suggested as a resource for the architect/engineer in preparing such specification.

2. The Soil Corrosivity Study by HDR Engineering, Inc. in the Elevator Tower Report (ESP 2018) in Appendix B should be used by the architect/engineer in specifying appropriate corrosion protection measures for all slabs-on-grade.

Retaining Walls

1. Retaining wall design may be based on the following parameters:

Active equivalent fluid pressure (site soil backfill)	45 pcf
Active equivalent fluid pressure (imported granular or gravel backfill)	35 pcf
At-rest equivalent fluid pressure (site soil backfill)	60 pcf
At-rest equivalent fluid pressure (imported granular or gravel backfill)	50 pcf
Passive equivalent fluid pressure (soil)	350 pcf
Passive equivalent fluid pressure (rock)	500 pcf
Maximum toe pressure (soil)	3,500 psf
Maximum toe pressure (rock)	4,000 psf
Coefficient of sliding friction (soil)	0.40
Coefficient of sliding friction (rock)	0.45

2. No surcharges are taken into consideration in the values presented in the previous paragraph. The maximum toe pressure is an *allowable* value; no factors of safety, load factors or other factors have been applied to the remaining values. With the exception of the maximum toe pressure, these values will require application of appropriate factors of safety, load factors, and/or other factors as deemed appropriate by the architect/engineer.

3. If the active and at-rest pressures presented above are utilized in the design, imported granular or gravel backfill should be used exclusively above a 1:1 plane from the bottom of the footing to 1 foot below daylight. The final foot of backfill should consist of native soil to reduce the potential for drainage to enter the backfill.

4. The active and at-rest pressures presented above are applicable to a horizontal retained surface behind the wall. Walls having a retained surface that slopes upward from the wall should be designed for an additional equivalent fluid pressure of 1 pcf for the active case and 1.5 pcf for the at-rest case, for every degree of slope inclination.

5. Under the CBC, the Risk-Targeted Maximum Considered Earthquake (MCER) must be used for determining seismic pressures on walls. Further, Section 1803A.5.12.1 in the 2016 CBC requires that dynamic seismic lateral earth pressures be provided by the geotechnical engineer for walls retaining more than 6 feet of backfill. The Earthquake Hazards Program website (USGS, 2018) was used to determine the MCER-based Geometric Mean Peak Ground Acceleration (PGA_M) for a Seismic Design Category "D" project. The resulting PGA_M was 0.453g. Then, using the methods presented by Lew et al. (2010) and this PGA_M, the appropriate incremental increase in lateral soil pressure, above the static active equivalent fluid pressure for flexible (cantilevered) walls, was determined to be 5 pcf for clayey sand and/or sandy lean clay backfill, and 1 pcf for imported sand or gravel backfill. Flexible (cantilevered) walls retaining over 6 feet of backfill should be designed using these incremental seismic pressures. Walls retaining 6 feet or less of backfill need not be designed for seismic pressures.

6. Recent research by Al Atik and Sitar (2010) confirmed that for flexible (cantilevered) walls, particularly those over 12 feet tall, an increase in soil pressure does occur under significant seismic accelerations. Further, they found that the increase is due to the out-of-phase interaction between the soil and the flexible wall. When considering rigid walls (i.e. those designed using at-rest criteria); however, they found that the incremental increase due to seismicity was typically less than 50 percent of the static wall pressure. Consequently, no incremental increase in lateral soil pressure is recommended for the design of walls where the static design utilizes the at-rest equivalent fluid pressure and they are designed with factors of safety and earth load factors of at least 1.5.

7. In typical structural design methods for retaining walls such as those found in Section 1605A of the 2016 CBC, lateral soil pressure is multiplied by a load factor of 1.6. According to Lew et al. (2010), a load factor of 1.6 is too conservative for seismic loads; this paper suggests that the seismic increase in lateral pressure be separated from the static active pressure and that a load factor of 1.0 be used for the seismic increase. Further, Al Atik and Sitar (2010) found that pressure increases due to seismic earth loads were minimal for walls retaining less than 12 feet of backfill. While Al Atik and Sitar's research is generally accepted among geotechnical and structural engineers in California, it is not entirely acknowledged in the 2016 CBC, as the CBC sets the height below which seismic loads may be ignored at 6 feet. Given this disparity, it is suggested that caution be used not to over-engineer walls retaining between 6 and 12 feet of backfill.

8. Long-term settlement of properly compacted sand or gravel retaining wall backfill should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill; long-term settlement of properly compacted site soil retaining wall backfill would be about twice that of sand or gravel backfill. Improvements that are constructed near the tops of retaining walls should be designed to accommodate long-term settlement.

9. All retaining walls should be drained with perforated pipe encased in a free-draining gravel blanket. The pipe should be placed with perforations facing downward, and should discharge in a nonerosive manner away from foundations and other improvements. The gravel blanket should have a width of approximately 1 foot and should extend upward to approximately 1 foot from the top of the wall backfill. The upper foot should be backfilled with native soil, except in areas where pavement or exterior pedestrian flatwork will abut the top of the wall. In such cases, the gravel should extend to the imported nonexpansive material, sand, aggregate base, or other material below the improved surface, as appropriate. To reduce infiltration of the soil into the gravel, a permeable synthetic filter fabric conforming to Standard Specifications Section 96-1.02B – Class C (Caltrans 2015), should be placed between the two. Manufactured synthetic drains, such as Miradrain or Enkadrain are acceptable alternatives to the use of gravel, provided that they are installed in accordance with the recommendations of the manufacturer.

10. Where weep hole drainage can be properly discharged, the perforated pipe may be omitted in lieu of weep holes on maximum 4-foot centers. A filter fabric as described above should be placed between the weep holes and the drain gravel.

11. Walls facing areas where moisture transmission through the wall would be undesirable should be thoroughly waterproofed in accordance with the specifications of the architect/engineer.

12. The architect/engineer should bear in mind that retaining walls by their nature are flexible structures, and that surface treatments on walls often crack. Where walls are to be plastered or otherwise have a finish applied, the flexibility should be considered in determining the suitability of the surfacing material, spacing of horizontal and vertical control joints, etc. The flexibility should also be considered where a retaining wall will abut or be connected to a rigid structure, and where the geometry of the wall is such that its flexibility will vary along its length.

13. The Soil Corrosivity Study by HDR Engineering, Inc. in the Elevator Tower Report (ESP 2018) in Appendix B should be used by the architect/engineer in specifying appropriate corrosion protection measures for all retaining walls.

Drainage and Maintenance

1. Per Section 1804A.4 of the 2016 CBC, unpaved ground surfaces should be *finish graded* to direct surface runoff away from foundations and other improvements at a minimum 5 percent grade for a minimum distance of 10 feet. The site should be similarly sloped to drain away from foundation and other improvements during construction. Where this is not practicable due to other improvements, etc., swales with improved surfaces, area drains, or other drainage facilities, should be used to collect and discharge runoff.

2. The structure should be fitted with roof gutters. Runoff from flatwork, roof gutters, downspouts, etc. should discharge in a nonerosive manner away from foundations and other improvements in accordance with the requirements of the governing agencies. Erosion protection should be placed at all discharge points unless the discharge is to a pavement surface.

3. To reduce the potential for planter drainage gaining access to subslab areas, any raised planter boxes adjacent to foundations should be installed with drains and sealed sides and bottoms. Drains should also be provided for areas adjacent to the structure and in landscape areas that would not otherwise freely drain.

4. The on-site soils are erodible; stabilization of soils disturbed during construction by vegetation or other means *during* and *following* construction, is essential to reduce erosion damage. Care should be taken to establish and maintain vegetation. The landscaping should be planned and installed to maintain the surface drainage recommended above. Surface drainage should also be maintained during construction.

5. Maintenance of drainage and other improvements is critical to the long-term stability of the site and the integrity of the structures. Site improvements should be maintained on a regular basis.

6. All exterior drains, retaining wall drains, and drain outlets should be maintained to be free-flowing.

7. To reduce the potential for disruption of drainage patterns and undermining of structures, fill areas, etc., all rodent activity should be aggressively controlled.

Observation and Testing

1. The recommendations contained in this report are based on a limited number of borings and rely on continuity of the subsurface conditions encountered.

2. It is assumed that the geotechnical engineer will be retained to provide consultation during the design phase (including review of mat foundation data), to interpret this report during construction, and to provide construction monitoring in the form of testing and observation.

3. At a minimum, the geotechnical engineer should be retained to provide:

    - Professional observation during grading, trench and retaining wall backfill, and foundation construction
    - Oversight of special inspection and compaction testing grading, trench and retaining wall backfill, and foundation construction

4. Special inspection of grading and backfill should be provided as per Section 1705A.6 and Table 1705A.6 of the CBC. The special inspector should be under the direction of the geotechnical engineer. At a minimum, the following items should be inspected and/or tested by the special inspector:

    - Stripping and clearing of all existing improvements and deleterious materials
    - Overexcavation of the building area and sitework retaining wall areas to the recommended depths
    - Scarification and moisture conditioning of overexcavated areas
    - Scarification and moisture conditioning of exterior pedestrian flatwork and all other grading areas
    - Fill quality, placement, moisture conditioning and compaction
    - Utility trench backfill
    - Conventional foundation excavations

- Caison foundation excavations and concrete placement

5. A program of quality assurance should be developed prior to beginning construction. At a minimum, the program should include all geotechnical items shown on the testing and inspection schedule of the approved plans. It should also include any additional inspection items required by the engineer and/or the governing jurisdiction. These items should be discussed at a preconstruction site meeting among a representative of the owner, the geotechnical engineer, special inspector, the project inspector, the engineer, and contractors. The geotechnical engineer should be notified at least 48 hours prior to beginning grading operations.

6. Locations and frequency of compaction tests should be as per the recommendation of the geotechnical engineer at the time of construction. The recommended test location and frequency may be subject to modification by the geotechnical engineer, based upon soil and moisture conditions encountered, size and type of equipment used by the contractor, the general trend of the results of compaction tests, or other factors.

9.0 CLOSURE

Our intent was to perform the investigation in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the locality of this project under similar conditions. No representation, warranty, or guarantee is either expressed or implied. This report is intended for the exclusive use by the client as discussed in the "Scope of Services" section. Application beyond the stated intent is strictly at the user's risk.

This report is valid for conditions as they exist at this time for the type of project described herein. The conclusions and recommendations contained in this report could be rendered invalid, either in whole or in part, due to changes in building codes, regulations, standards of geotechnical or construction practice, changes in physical conditions, or the broadening of knowledge.

If changes with respect to the project become necessary, if items not addressed in this report are incorporated into plans, or if any of the assumptions used in the preparation of this report are not correct, this firm shall be notified for modifications to this report. Any items not specifically addressed in this report should comply with the CBC of other applicable standards, and the requirements of the governing jurisdiction.

The preliminary recommendations presented in this geotechnical report are based upon the

geotechnical conditions encountered at the site, and may be augmented by additional requirements of the client, or by additional recommendations provided by the geotechnical engineer based on peer or jurisdiction reviews, or conditions exposed at the time of construction.

This document, the data, conclusions, and recommendations contained herein are the property of Earth Systems Pacific. This report shall be used in its entirety, with no individual sections reproduced or used out of context. Copies may be made only by Earth Systems Pacific, the client, and the client's authorized agents for use exclusively on the subject project. Any other use is subject to federal copyright laws and the written approval of Earth Systems Pacific.

Thank you for this opportunity to have been of service. If you have any questions, please feel free to contact this office at your convenience.

End of Text.

TECHNICAL REFERENCES

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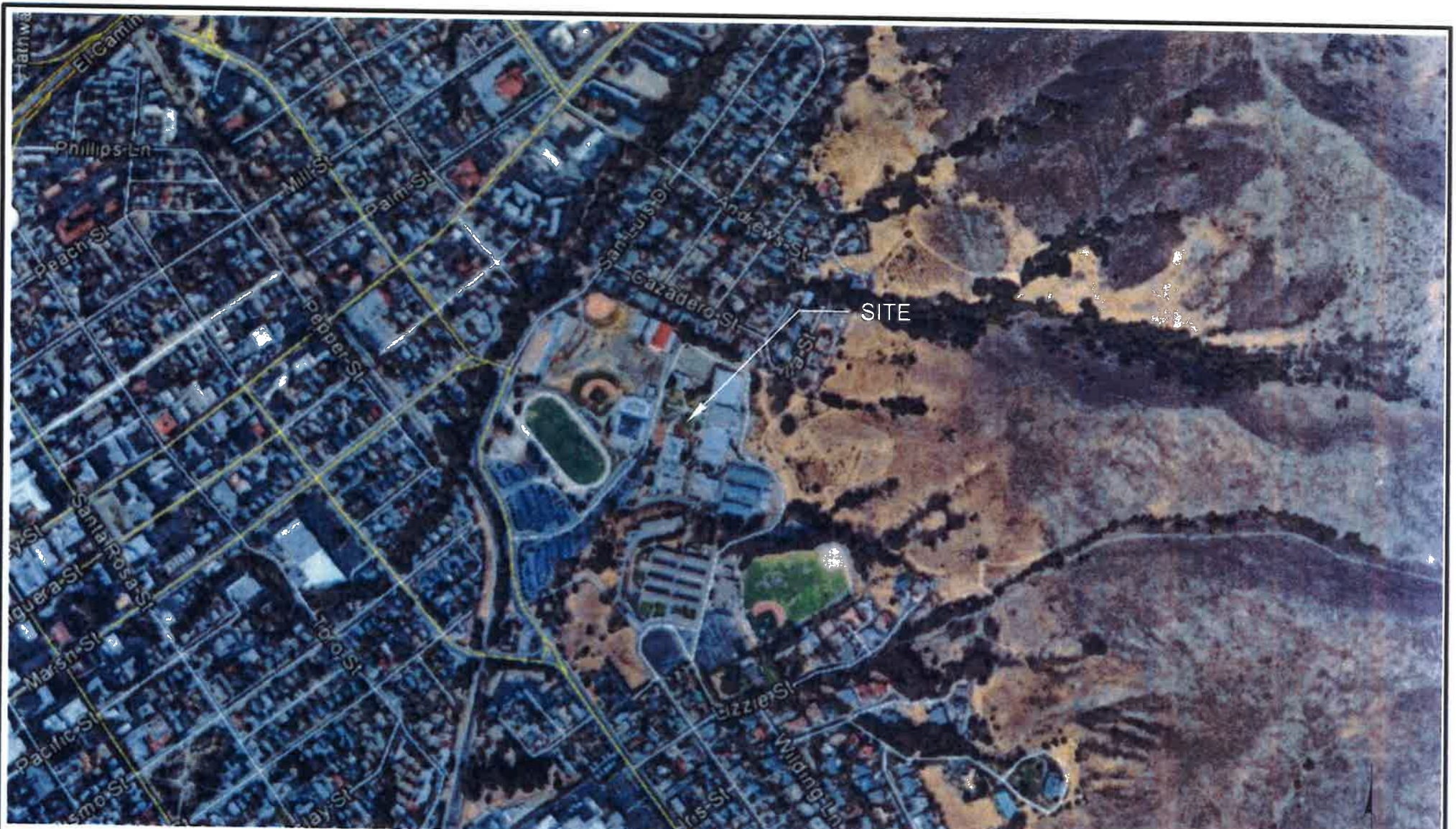
APPENDIX A

Figure 1 – Site Vicinity Map
Figure 2 – Exploration Location Map
Boring Log Legend
Boring Logs



NOT TO SCALE

SLOHSBUILDING100MODERNIZATION–062918MAPS

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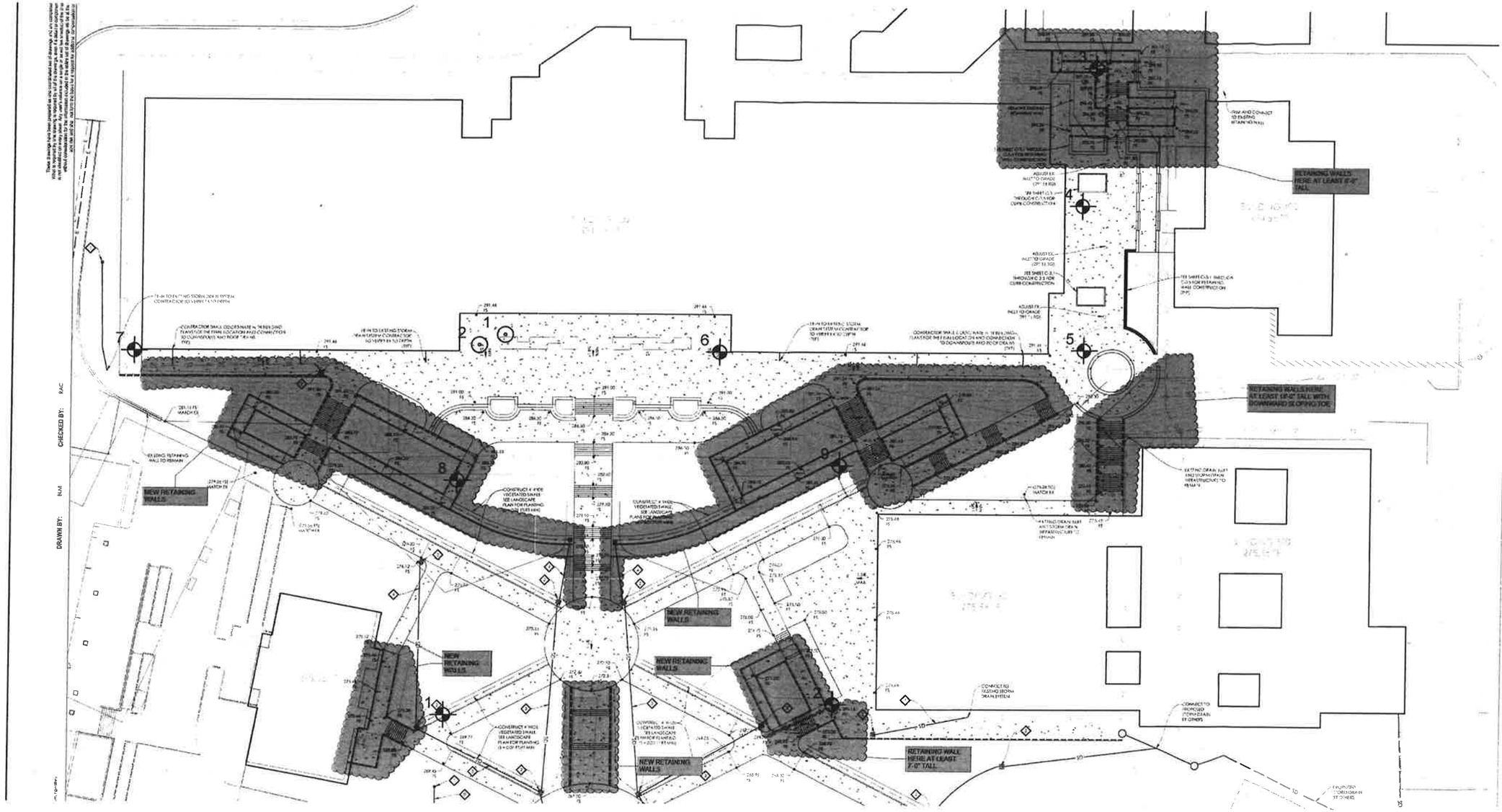
SITE VICINITY MAP

San Luis Obispo High School
Building 100 Modernization
1499 San Luis Drive
San Luis Obispo, California

Date
July 2018

Project No.
300933-007

Figure 1



design group
rrmdesign.com
(805) 543-1794
3765 S. Higuera
San Luis Obispo, CA
93401

ENGINEER OF RECORD:

SAN LUIS OBISPO HIGH SCHOOL MODERNIZATION
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CA 93401

GRADING & DRAINAGE

PBK

DRAWN BY: RLM CHECKED BY: PAC

LEGEND

9 Boring Location (Approx.)

2 Boring Location (Approx.) - Esp. February 2018 (Building 100 Elevator Tower)

BASE MAP PROVIDED BY: PBK

NOT TO SCALE

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4378 Old Santa Fe Road, San Luis Obispo, CA 93401
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EXPLORATION LOCATION MAP

San Luis Obispo High School Building 100 Modernization
1499 San Luis Drive
San Luis Obispo, California

Date
July, 2018

Project No.
300933-007

Figure 2

SLOHSBUILDING100MODERNIZATION-062918maps

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BORING LOG LEGEND

SAMPLE / SUBSURFACE WATER SYMBOLS	GRAPH. SYMBOL
CALIFORNIA MODIFIED	
STANDARD PENETRATION TEST (SPT)	
SHELBY TUBE	
BULK	
SUBSURFACE WATER DURING DRILLING	
SUBSURFACE WATER AFTER DRILLING	

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

MAJOR DIVISIONS	GROUP SYMBOL	TYPICAL DESCRIPTIONS	GRAPH. SYMBOL
COARSE GRAINED SOILS (MORE THAN HALF OF MATERIAL IS LARGER THAN #200 SIEVE SIZE)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GP	POORLY GRADED GRAVELS, OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, NON-PLASTIC FINES	
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, PLASTIC FINES	
	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
	SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES	
	SM	SILTY SANDS, SAND-SILT MIXTURES, NON-PLASTIC FINES	
	SC	CLAYEY SANDS, SAND-CLAY MIXTURES, PLASTIC FINES	
FINE GRAINED SOILS (HALF OR MORE OF MATERIAL IS SMALLER THAN #200 SIEVE SIZE)	ML	INORGANIC SILTS AND VERY FINE SANDS, 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	
	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS	
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	

OBSERVED MOISTURE CONDITION

DRY	SLIGHTLY MOIST	MOIST	VERY MOIST	WET (SATURATED)

CONSISTENCY

COARSE GRAINED SOILS			FINE GRAINED SOILS		
BLOWS/FOOT		DESCRIPTIVE TERM	BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER		SPT	CA SAMPLER	
0-10	0-16	LOOSE	0-2	0-3	VERY SOFT
11-30	17-50	MEDIUM DENSE	3-4	4-7	SOFT
31-50	51-83	DENSE	5-8	8-13	MEDIUM STIFF
OVER 50	OVER 83	VERY DENSE	9-15	14-25	STIFF
			16-30	26-50	VERY STIFF
			OVER 30	OVER 50	HARD

GRAIN SIZES

U.S. STANDARD SERIES SIEVE				CLEAR SQUARE SIEVE OPENING		
# 200	# 40	# 10	# 4	3/4"	3"	12"

SILT & CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

TYPICAL BEDROCK HARDNESS

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
EXTREMELY HARD	CORE, FRAGMENT, OR EXPOSURE CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CAN ONLY BE CHIPPED WITH REPEATED HEAVY HAMMER BLOWS
VERY HARD	CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CORE OR FRAGMENT BREAKS WITH REPEATED HEAVY HAMMER BLOWS
HARD	CAN BE SCRATCHED WITH KNIFE OR SHARP PICK WITH DIFFICULTY (HEAVY PRESSURE); HEAVY HAMMER BLOW REQUIRED TO BREAK SPECIMEN
MODERATELY HARD	CAN BE GROOVED 1/16 INCH DEEP BY KNIFE OR SHARP PICK WITH MODERATE OR HEAVY PRESSURE; CORE OR FRAGMENT BREAKS WITH LIGHT HAMMER BLOW OR HEAVY MANUAL PRESSURE
SOFT	CAN BE GROOVED OR GOUGED EASILY BY KNIFE OR SHARP PICK WITH LIGHT PRESSURE, CAN BE SCRATCHED WITH FINGERNAIL; BREAKS WITH LIGHT TO MODERATE MANUAL PRESSURE
VERY SOFT	CAN BE READILY INDENTED, GROOVED OR GOUGED WITH FINGERNAIL, OR CARVED WITH KNIFE; BREAKS WITH LIGHT MANUAL PRESSURE

TYPICAL BEDROCK WEATHERING

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
FRESH	NO DISCOLORATION, NOT OXIDIZED
SLIGHTLY WEATHERED	DISCOLORATION OR OXIDATION IS LIMITED TO SURFACE OF, OR SHORT DISTANCE FROM, FRACTURES; SOME FELDSPAR CRYSTALS ARE DULL
MODERATELY WEATHERED	DISCOLORATION OR OXIDATION EXTENDS FROM FRACTURES, USUALLY THROUGHOUT; Fe-Mg MINERALS ARE "RUSTY", FELDSPAR CRYSTALS ARE "CLOUDY"
INTENSELY WEATHERED	DISCOLORATION OR OXIDATION THROUGHOUT; FELDSPAR AND Fe-Mg MINERALS ARE ALTERED TO CLAY TO SOME EXTENT, OR CHEMICAL ALTERATION PRODUCES IN SITU DISAGGREGATION
DECOMPOSED	DISCOLORATION OR OXIDATION THROUGHOUT, BUT RESISTANT MINERALS SUCH AS QUARTZ MAY BE UNALTERED; FELDSPAR AND Fe-Mg MINERALS ARE COMPLETELY ALTERED TO CLAY

drafting/masters/Boring Log Legend121714.dwg

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Boring No. 1
PAGE 1 OF 1
JOB NO.: 300933-007
DATE: 6/22/18

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	SM		SILTY SAND: brown, loose, slightly moist (Topsoil)					
1			SANDSTONE: yellow brown, soft, weathered, fractured (Franciscan Melange)	0.5 - 4.0	○			13
2				2.0 - 3.5	■			26
3								50
4								
5				5.0 - 5.5	●			36 50/1"
6			moderately hard					
7								
8			olive to olive brown, soft					
9								
10			moderately hard	10.0 - 10.5	●			50/2"
11			End of Boring @ 10.5'					
12			No subsurface water encountered					
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 2
PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

JOB NO.: 300933-007
DATE: 6/22/18

SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	SC		CLAYEY SAND: yellow brown, loose, slightly moist, some gravel (Fill)	1.0 - 4.0	○			5
2			gray brown, moist, trace roots	2.0 - 3.5	■	109.4	11.5	6 6
5	CL		SANDY LEAN CLAY: dark brown to dark olive, stiff, moist (Alluvium)	5.0 - 6.5	■	106.2	19.9	3 7 10
				5.0 - 8.0	○			
9			SANDSTONE: dark olive, soft, severely weathered and fractured, thin beds of dark gray claystone (Franciscan Melange)	10.0 - 11.5	■	133.7	8.0	17 30 50/5"
15				15.0 - 16.5	●			13 19 35
16			moderately hard					
18			hard					
			End of Boring @ 18.0' due to refusal No subsurface water encountered					

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 3
PAGE 1 OF 2
JOB NO.: 300933-007
DATE: 6/22/18

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			4.25" PCC over approximately 3" sand					
1	CL		SANDY LEAN CLAY: brown/gray mottled, medium stiff, trace debris, trace gravel (Fill)	1.0 - 4.0	○			3
2				2.0 - 3.5	▬	105.0	25.5	6 7
3								
4								
5			olive brown/gray mottled, stiff	5.0 - 6.5	▬	114.9	11.1	6 8 8
6								
7	SC		CLAYEY SAND: olive brown, medium dense, moist, trace gravel	7.0 - 10.0	○			
8								
9								
10				10.0 - 11.5	▬	118.4	12.7	6 12 14
11								
12								
13								
14								
15	CL		SANDY LEAN CLAY: blue gray/olive/brown mottled, medium stiff, moist (Alluvium)	15.0 - 16.5	●			2 2 5
16								3
17				16.5 - 18.0	▬	105.4	19.9	6 7
18								
19								
20			stiff	20.0 - 21.5	▬	109.6	18.9	2 7 12
21								
22								
23			medium stiff					4
24				23.5 - 25.0	▬			4 8
25								
26								

LEGEND: ▬ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

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Boring No. 3
PAGE 2 OF 2
JOB NO.: 300933-007
DATE: 6/22/18

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
27			SANDSTONE: olive/dark gray, very soft, severely weathered and sheared (Franciscan Melange)	29.5 - 31.0	●			6 10 13
31			End of Boring @ 31.0' No subsurface water encountered					

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

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Boring No. 4
PAGE 1 OF 1
JOB NO.: 300933-007
DATE: 6/25/18

LOGGED BY: R. Wagner
DRILL RIG: Simco BP 200
AUGER TYPE: 4" Solid Stem Auger

SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			4" PCC					
1	SC		CLAYEY SAND: brown/olive/gray mottled, medium dense, moist, trace debris (Fill)	2.0 - 3.5	■			5, 8, 11
5	SC		CLAYEY SAND: brown, medium dense, moist (Alluvium)	5.0 - 6.5	■			8, 13, 22
7			SANDSTONE: olive brown, moderately hard, weathered and fractured (Franciscan Melange)	7.0 - 7.5	●	No Recovery		50/1"
8			End of Boring @ 7.5' due to refusal No subsurface water encountered					

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 5

LOGGED BY: R. Wagner
DRILL RIG: Simco BP 200
AUGER TYPE: 4" Solid Stem Auger

PAGE 1 OF 1
JOB NO.: 300933-007
DATE: 6/25/18

SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			4.25" PCC over 2" sand					
1	SC		CLAYEY SAND: light olive brown, loose, moist, trace gravel, trace debris and roots (Fill)					
2				2.0 - 3.5	■	118.8	12.1	9 6 6
3								
4								
5				5.0 - 6.5	■			9 18 22
6	CL		SANDY LEAN CLAY: olive brown/brown mottled, very stiff, slightly moist, trace gravel (Alluvium)					
7				7.0 - 7.5	●	No Recovery		50/2"
8			SANDSTONE: olive brown, moderately hard, weathered					
9			End of Boring @ 7.5' No subsurface water encountered					
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 6
PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Simco BP 200
AUGER TYPE: 4" Solid Stem Auger

JOB NO.: 300933-007
DATE: 6/25/18

SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			4" PCC over 3" sand					
1 - 4	SC		CLAYEY SAND: brown/gray mottled, medium dense, moist, some gravel (Fill)	2.0 - 3.5	■			5 9 12
5 - 6			SANDSTONE: olive brown, moderately hard, weathered (Franciscan Melange)	5.0 - 6.5	●			12 35 50/3"
7			End of Boring @ 6.5' No subsurface water encountered					
8 - 26								

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 7
PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Simco BP200/Mobile B-53 with Automatic Hammer
AUGER TYPE: 4" Solid Stem/6" Hollow Stem Auger

JOB NO.: 300933-007
DATE: 6/25/18

SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			4" PCC over 4" coarse gravel					
1	SC		CLAYEY SAND: brown, medium dense, moist, some gravel, trace roots (Fill)	2.0 - 7.0	○			
5				5.0 - 6.5	▬	112.8	14.4	4, 6, 8
6			loose, trace gravel, increasing clay content					
7	CL		SANDY LEAN CLAY: dark brow, stiff, moist (Alluvium)					
10			brown, very stiff	10.0 - 11.5	▬	112.3	15.9	6, 12, 19
15				15.0 - 16.5	▬			12, 16, 21
19			yellow brown					
20				20.0 - 21.5	●			6, 6, 11
22			SANDSTONE: yellow brown, soft, weathered (Franciscan Melange)	23.0 - 23.5	●	No Recovery		50/2"
24			End of Boring @ 23.5' due to refusal No subsurface water encountered					

LEGEND: ▬ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 8
PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Simco BP200
AUGER TYPE: 4" Solid Stem Auger

JOB NO.: 300933-007
DATE: 6/25/18

SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	SC		CLAYEY SAND: brown, medium dense, moist (Fill)	1.5 - 3.0	▬			7 9 10
5			SANDSTONE: olive brown, very soft, weathered and fractured	5.0 - 6.0	▬			9 50/5"
7			moderately hard	6.5 - 7.0	●	No Recovery		50/1"
			End of Boring @ 7.0' due to refusal No subsurface water encountered					

LEGEND: ▬ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 9
PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Simco BP200
AUGER TYPE: 4" Solid Stem Auger

JOB NO.: 300933-007
DATE: 6/22/18

SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	SC		CLAYEY SAND: brown, loose, moist, trace gravel, some tree roots (Fill)					
5	CL		SANDY LEAN CLAY: dark gray brown, medium stiff, moist, some tree roots (Alluvium)					
7			SANDSTONE: gray to olive brown, very soft, severely weathered and fractured (Franciscan Melange)					
9			moderately hard					
10			End of Boring @ 9.0' due to refusal No subsurface water encountered					

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

APPENDIX B

Geotechnical Engineering and
Geologic Hazards Report,
San Luis Obispo High School
Building 100 Elevator Tower (ESP 2018)

California Geological Survey,
Engineering Geology and Seismology Review
of Geotechnical Engineering and Geologic Hazards
Report for San Luis Obispo High School
New Annex/Classroom (ESP 2016)

DEPARTMENT OF CONSERVATION

CALIFORNIA GEOLOGICAL SURVEY

SCHOOL REVIEW UNIT • 801 K STREET, MS 12-31 • SACRAMENTO, CALIFORNIA 95814

PHONE 916 / 324-7324 • FAX 916 / 445-3334 • TDD 916 / 324-2555 • WEB SITE conservation.ca.gov/cgs

June 9, 2016

Anthony Palazzo
Director of Facilities, Operations, and Transportation
San Luis Coastal Unified School District
937 Southwood Drive
San Luis Obispo, CA 93401

Subject: **Engineering Geology and Seismology Review for**
San Luis Obispo High School – New Annex/Classroom Building
1499 San Luis Drive, San Luis Obispo, CA
CGS Application No. 01-CGS2281

Dear Mr. Palazzo:

In accordance with your request and transmittal of documents received on February 22, 2016, the California Geological Survey has reviewed the engineering geology and seismology aspects of the consulting report prepared for San Luis Obispo High School in San Luis Obispo. It is our understanding that this project involves demolition of an existing building and construction of a new annex/classroom building. This review was performed in accordance with Title 24, California Code of Regulations, 2013 California Building Code (CBC) and followed CGS Note 48 guidelines. We reviewed the following report:

> **Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School - Measure D Projects, Annex/Classroom Building, 1499 San Luis Drive, San Luis Obispo, California:** Earth Systems Pacific, 4378 Old Santa Fe Road, San Luis Obispo, California 93401; company File No. SL-16605-SE, report dated January 19, 2016, 31 pages, 5 appendices.

Based on our review, the consultants provide a thorough and well-documented assessment of engineering geology and seismology issues with respect to the proposed improvements. The principal concerns identified by the consultants are potential for moderate to severe ground shaking, the potential for differential settlement from undocumented fill and disturbed soil, and expansion potential and corrosive potential of site soils. The consultants recommend design spectral acceleration parameters of S_{DS} = **0.792g** and S_{D1} = **0.453g**, which are considered reasonable. Their evaluation indicates liquefaction, dynamic settlement, and deep-seated slope instability are not design concerns for the project.

In conclusion, ***the engineering geology and seismology issues at this site are adequately assessed in the referenced report.*** If you have any further questions about this review letter, please contact the reviewer at (213) 239-0884.

Respectfully submitted,

Michael DeFrisco
Engineering Geologist
PG 8624, CEG 2574



Concur:

Jennifer Thornburg
Senior Engineering Geologist
PG 5476, CEG 2240



Enclosures:

Note 48 Checklist Review Comments
Keyed to: *Note 48 - Checklist for the Review of Engineering Geology and Seismology Reports for California Public Schools, Hospitals, and Essential Services Buildings*

Copies to:

Richard T. Gorman, *Certified Engineering Geologist*, and Frederick J. Potthast, *Registered Geotechnical Engineer*
Earth Systems Pacific, 4378 Old Santa Fe Road, San Luis Obispo, CA 93401

Alan Kroeker, *Architect*
PMSM Architects, 560 Higuera Street, Suite C, San Luis Obispo, CA 93401

Karen Van Dorn, *Senior Architect*
Division of State Architect, 1515 Clay Street, Suite 1201, Oakland, CA 94612

Note 48 Checklist Review Comments

In the numbered paragraphs below, this review is keyed to the paragraph numbers of California Geological Survey Note 48 (October, 2013 edition), *Checklist for the Review of Engineering Geology and Seismology Reports for California Public Schools, Hospitals, and Essential Services Buildings.*

Project Location

1. Site Location Map, Street Address, County Name: Adequately addressed.
2. Plot Plan with Exploration Data with Building Footprint: Marginally adequate. The consultants provide a Boring Location Map which illustrates the location of 3 borings and Cross Section A-A'. CGS notes that review of the SLO High School Proposed Site Plan provided by PMSM Architects indicates that the 3 borings drilled by the consultant appear to be near the location of the Proposed Classroom Building. In future reports the consultants should provide a site plan illustrating the boring locations with respect to the building footprint.
3. Site Coordinates: Adequately addressed. Latitude and Longitude provided in report: 35.2836°N, 120.6501°W

Engineering Geology/Site Characterization

4. Regional Geology and Regional Fault Maps: Adequately addressed.
5. Geologic Map of Site: Not provided and therefore not reviewed.
6. Subsurface Geology: Adequately addressed. Based on regional mapping and 3 hollow-stem auger borings drilled to depths of 16.5 to 26 feet, the consultants report the site is underlain by fill, Holocene alluvial flood plain deposits, and sandstone and claystone of the Franciscan Mélange. Groundwater was reportedly not encountered in the borings.
7. Geologic Cross Sections: Adequately addressed.
8. Active Faulting & Coseismic Deformation Across Site: Adequately addressed. The consultants report that the site is not located in a State Earthquake Fault Zone, and there are no mapped faults crossing or adjacent to the site. They conclude that the potential for surface fault rupture to occur at the site is considered to be very low.
9. Geologic Hazard Zones (Liquefaction & Landslides): Adequately addressed. The consultants report that the site is not located in a Geologic Study Area or a High Liquefaction Hazard Zone, based on review of the San Luis Obispo County Planning Department Permit View website.
10. Geotechnical Testing of Representative Samples: Adequately addressed.
11. Geological Consideration of Grading Plans and Foundation Plans: Adequately addressed. The consultants provide recommendations for the design of retaining walls up to 4 feet tall, and for conventional continuous and spread footings. A program for overexcavation and recompaction of all existing fill in the building area is recommended by the consultants in order to reduce the potential for differential settlement from undocumented fill and disturbed soil.

Seismology & Calculation of Earthquake Ground Motion

12. Evaluation of Historic Seismicity: Adequately addressed. The consultants provide a summary of historical seismicity in the region.
13. Classify the Geologic Subgrade (Site Class): Adequately addressed. The consultants classify the site soil profile as Site Class D, Stiff Soil.
14. General Procedure Seismic Parameters: Adequately addressed. The consultants report the following parameters derived from a map-based analysis:
    S_S = 1.137g and S_1 = 0.434g
    S_{DS} = 0.792g and S_{D1} = 0.453g
15. Seismic Design Category: Adequately addressed. The consultants reports Seismic Design Category D.
16. Site-Specific Ground Motion Analysis: Not Applicable.
17. Deaggregated Seismic Source Parameters: Not applicable.
18. Time-Histories of Earthquake Ground Motion: Not applicable.

Liquefaction/Seismic Settlement Analysis

19. Geologic Setting for Occurrence of Seismically Induced Liquefaction: Adequately addressed. The consultants report that the potential for liquefaction and seismically-induced settlement to occur at the site are considered to be nil due to the underlying stiff to very stiff clayey alluvial soils and relatively shallow bedrock of the Franciscan Mélange. The data presented appear to support this conclusion.
20. Seismic Settlement Calculations: Not applicable.
21. Other Liquefaction Effects: Not applicable.
22. Mitigation Options for Liquefaction: Not applicable.

Slope Stability Analysis

23. Geologic Setting for Occurrence of Landslides: Adequately addressed. The consultants report that there are no significant slopes on or adjacent to the Annex/Classroom Building site area, therefore, there is no potential for gross slope instability or landsliding to impact the project.
24. Determination of Static and Dynamic Strength Parameters: Not applicable.
25. Determination of Pseudo-Static Coefficient (Keq): Not applicable.
26. Identify Critical Slip Surfaces for Static and Dynamic Analyses: Not applicable.
27. Dynamic Site Conditions: Not applicable.
28. Mitigation Options/Other Slope Failure: Not applicable.

Other Geologic Hazards or Adverse Site Conditions

29. Expansive Soils: Adequately addressed. The consultants report that the soils would be considered to have a "medium" expansion potential, based on expansion index testing.

30. Corrosive/Reactive Geochemistry of the Geologic Subgrade: Adequately addressed. The consultants report that the soils were classified as severely corrosive to ferrous metals and aggressive to copper.
31. Conditional Geologic Assessment: Adequately addressed. No significant conditional hazards of potential concern were identified by the consultants.

Report Documentation

32. Geology, Seismology, and Geotechnical References: Adequately addressed.
33. Certified Engineering Geologist: Adequately addressed.
    Richard T. Gorman, Certified Engineering Geologist #1325
34. Registered Geotechnical Engineer: Adequately addressed.
    Frederick J. Potthast, Registered Geotechnical Engineer #2369

Earth Systems
Pacific

4378 Old Santa Fe Road
San Luis Obispo, CA 93401
Ph: 805.544.3276
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www.earthsystems.com

March 29, 2017

FILE NO.: SL-16605-SE/TF

Mr. Anthony Palazzo
Director – Buildings, Grounds and Transportation
San Luis Coastal Unified School District
937 Southwood Drive
San Luis Obispo, CA 93401

PROJECT: SAN LUIS OBISPO HIGH SCHOOL – MEASURE D PROJECTS
ANNEX / CLASSROOM BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3102

SUBJECT: Addendum No. 2 to Geotechnical Engineering and Geologic Hazards Report – Additional Retaining Wall Recommendations

REF:
1) Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School – Measure D Projects, Annex / Classroom Building, 1499 San Luis Drive, San Luis Obispo, California, by Earth Systems Pacific, File No. SL-16605-SE, Doc. No. 1601-059.SGR, dated January 19, 2016
2) Addendum No. 1 to Geotechnical Engineering and Geologic Hazards Report – Low Radon Potential, San Luis Obispo High School – Measure D Projects, Annex / Classroom Building, 1499 San Luis Drive, San Luis Obispo, California, by Earth Systems Pacific, File No. SL-16605-SE, Doc. No. 1604-066.ADD1, dated April 18, 2016

Dear Mr. Palazzo:

Per the request of Mr. Joshua Moody, the project's structural engineer, this second addendum to the referenced geotechnical engineering and geologic hazards report (Ref. Nos. 1 and 2) has been prepared to address additional retaining wall heights that are now planned for the project. Per our discussion with Mr. Moody, the previously anticipated retaining wall heights for sitework walls will be changed from a maximum height of 4 feet to 6.5 feet, and walls connected to or forming part of the structure will be changed from a maximum height of 4 feet to 7 feet. Accordingly, the addendum provides additional retaining wall recommendations to address seismic concerns for the added wall heights. This second addendum is intended to be used in conjunction with the referenced report and first addendum. Please see the original report and first addendum for recommendations not discussed herein. Technical references for the recommendations within this addendum are attached.

Additional Retaining Wall Recommendations

The following retaining wall recommendations should be added to those provided in the referenced report (Ref. No. 1).

1. Under the 2013 CBC, the Risk-Targeted Maximum Considered Earthquake (MCE_R) must be used for determining seismic pressures on walls. Further, Section 1803.5.12.1 of the 2013 CBC requires that dynamic seismic lateral earth pressures be provided by the geotechnical engineer for walls retaining more than 6 feet of backfill. The MCE_R-based Geometric Mean Peak Ground Acceleration (PGA_M) presented in the referenced report (Ref. No. 1) was 0.475g. Using the methods presented by Lew et al. (SEAOC 2010) and this PGA_M, the incremental increase in lateral soil pressure, above the static active equivalent fluid pressure for flexible (cantilevered) walls, was determined to be 0 pcf and 3.5 pcf for the site soil backfill and imported sand or gravel backfill, respectively.

2. Recent research by Al Atik and Sitar (2010) confirmed that for flexible (cantilevered) walls, particularly those over 12 feet tall, an increase in soil pressure does occur under significant seismic accelerations. Further, they found that the increase may be due to the out-of-phase interaction between the soil and the flexible wall. When considering rigid walls (i.e. those designed using at-rest criteria), however, they found that the incremental increase due to seismicity was typically less than 50 percent of the static wall pressure. Generally, no incremental increase in lateral soil pressure is recommended for the design of walls where the static design utilizes the at-rest equivalent fluid pressure and they are designed with factors of safety and earth load factors of at least 1.5. However, per the request of Mr. Moody, the incremental increase in lateral soil pressure, above the *static active* equivalent fluid pressure for rigid (building) walls, was determined to be 0 pcf and 15 pcf for the site soil backfill and imported sand or gravel backfill, respectively. Recently, the Division of State of the State Architect has requested that an incremental increase in lateral soil pressure also be determined for walls designed for *at-rest* equivalent fluid pressure. If this is determined by others to be necessary, an incremental increase of 15 pcf, above the *static at-rest* equivalent fluid pressure, may be used. As discussed above, the research by Al Atik and Sitar (2010) suggests this to be unnecessary.

3. In typical structural design methods for retaining walls, such as those found in Section 1605 of the CBC, lateral soil pressure is multiplied by a load factor of 1.6. According to Lew et al. (2010), a load factor of 1.6 is too conservative for seismic loads; this paper suggests that the seismic increase in lateral pressure be separated from the static active pressure and that a load factor of 1.0 be used for the seismic increase. Further, Al Atik and Sitar (2010) found that pressure increases due to seismic earth loads were minimal for walls retaining less than 12 feet of backfill. While the Al Atik and Sitar's research is

generally accepted among geotechnical and structural engineers in California, it is not entirely acknowledged by the California Building Standards Commission, as the CBC sets the height below which seismic loads may be ignored at 6 feet. Given this disparity, it is suggested that caution be used not to over-engineer walls retaining between 6 and 12 feet of backfill.

End of Additional Retaining Wall Recommendations.

We appreciate the opportunity to have provided geotechnical services for this project. If there are any questions concerning this addendum, please do not hesitate to contact the undersigned.

Sincerely,

Earth Systems Pacific



3/29/17

Fred J. Potthast, GE
Principal Engineer

Attachment: Additional Technical References (1 page)

Copy to: Mr. Joshua Moody, SE

Doc. No.: 1703-145.ADD2/jr

ADDITIONAL TECHNICAL REFERENCES

Al Atik, L. A. and Sitar, N. 2010 October. "Seismic Earth Pressures on Cantilever Retaining Structures." *Journal of Geotechnical and Geoenvironmental Engineering* 136 (10). American Society of Civil Engineers.

Lew, M., et al. 2010. "Seismic Earth Pressures on Deep Building Basements." *Structural Engineers Association of California (SEAOC) Convention Proceedings.*

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April 18, 2016

FILE NO.: SL-16605-SE

Mr. Anthony Palazzo
Director – Buildings, Grounds and Transportation
San Luis Coastal Unified School District
937 Southwood Drive
San Luis Obispo, CA 93401

PROJECT: SAN LUIS OBIPSO HIGH SCHOOL – MEASURE D PROJECTS
ANNEX / CLASSROOM BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3102

SUBJECT: Addendum No. 1 to Geotechnical Engineering and Geologic Hazards Report – Low Radon Potential

REF: Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School – Measure D Projects, Annex / Classroom Building, 1499 San Luis Drive, San Luis Obispo, California, by Earth Systems Pacific, Doc. No. 1601-059.SGR, dated January 19, 2016

Dear Mr. Palazzo:

An error has been found in the **Slabs-on-Grade**, Moisture Vapor Transmission Section, Paragraph 8, on Page 22 of the referenced report. Paragraph 8, which recommends special measures to mitigate the high potential for indoor radon levels, should be *deleted entirely* from the report. As previously noted in the report, the site has been identified as having low potential for radon.

We apologize for any inconvenience that this error may have caused.

Please attach a copy of this addendum to each copy of the report that you may have.

End of Addendum No. 1.

If there are any questions regarding this addendum, please feel free to contact the undersigned.

Sincerely,
Earth Systems Pacific

REGISTERED PROFESSIONAL ENGINEER FREDERICK J. POTTHAST No. GE 2369 Exp. 03/31/17 GEOTECHNICAL STATE OF CALIFORNIA

Fred J. Potthast, GE
Principal Engineer

4/18/16

Doc. No.: 1604-066.ADD1/sr

GEOTECHNICAL ENGINEERING AND GEOLOGIC HAZARDS REPORT
SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3102

January 19, 2016

Prepared for

Mr. Anthony Palazzo
San Luis Coastal Unified School District

Prepared by

Earth Systems Pacific
4378 Old Santa Fe Road
San Luis Obispo, CA 93401

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Earth Systems
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January 19, 2016

Mr. Anthony Palazzo
Director – Buildings, Grounds and Transportation
San Luis Coastal Unified School District
937 Southwood Drive
San Luis Obispo, CA 93401

FILE NO.: SL-16605-SE

PROJECT: SAN LUIS OBISPO HIGH SCHOOL -MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3102

SUBJECT: Geotechnical Engineering and Geologic Hazards Report

CONTRACT REF: Purchase Order No. 161188 by San Luis Coastal School District, dated December 7, 2015, to Provide a Geotechnical Engineering Investigation, San Luis Obispo High School, Measure D Projects, 1499 San Luis Drive, San Luis Obispo, California, per Proposal by Earth Systems Pacific, Doc. No. 1511-157.PRP, dated November 25, 2015

Dear Mr. Palazzo:

In accordance with your purchase order, this geotechnical engineering and geologic hazards report has been prepared for use in the development of plans and specifications for the Annex/Classroom Building Project at San Luis Obispo High School, in San Luis Obispo, California. This report describes the general geotechnical and geologic characteristics, identifies existing and potential geotechnical and geologic hazards, and discusses the impacts that these conditions could have upon the project. Preliminary geotechnical recommendations for site preparation, grading, utility trenches, foundations, interior slabs-on-grade and exterior pedestrian flatwork, retaining walls, asphalt concrete (AC) paths, drainage and maintenance, and observation and testing are presented herein. Soil corrosivity testing and an evaluation of the results, which were subcontracted to HDR, Inc. of Claremont, California, are also provided. Two bound copies and an electronic copy of this report are being furnished for your use.

We appreciate the opportunity to have provided services for this project and look forward to working with you again in the future. If there are any questions concerning this report, please do not hesitate to contact the undersigned.

Sincerely,

Earth Systems Pacific

Fred J. Potthast, GE
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
FREDERICK J. POTTHAST
No. GE 2369
Exp. 03/31/16
GEOTECHNICAL
STATE OF CALIFORNIA

1/19/16

Richard T. Gorman, CEG
Principal Geologist

PROFESSIONAL GEOLOGIST
RICHARD T. GORMAN
No. CEG 1325
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Doc. No.: 1601-059 SGR/tf

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1.0 INTRODUCTION AND SITE SETTING

The proposed Annex/Classroom Building at San Luis Obispo High School will have a footprint of approximately 12,000 square feet. It will be single story, of steel-frame, stud and possibly masonry construction. Conventional continuous and spread (pad) foundations are planned, with concrete slabs-on-grade. Maximum dead plus live loads on continuous footings of 2,000 plf, and maximum loads on spread footings of 75 kips, have been assumed for the purposes of this report. Retaining walls for sitework, or connected to or forming part of the structure, and a maximum of 4 feet tall, may also be utilized. The new building will be served by the existing campus utility systems via underground connections; it will be surrounded by landscaping and sidewalks of either Portland cement concrete (PCC) or asphalt concrete (AC) over aggregate base (AB). The existing service driveways in the project area may be repaired as part of the project, however no new pavement areas are anticipated. To our knowledge, no drainage basins are planned as part of the project. Infiltration systems or other types of low-impact development (LID) features may be included in the final design; however this has not been determined as of the date of this report, and therefore these potential features are not addressed.

The new building will be constructed on the site of the existing Annex/Cafeteria Building, on the north side of the campus, immediately east of the old Gymnasium. The site location on the campus is indicated on the Vicinity Map in Appendix A. Flatwork, lawns, shrubs and several scattered mature trees are present on the west, south and east sides of the existing building. The main campus service road extends along the west side of the existing building, just beyond the lawn, providing access to a paved delivery area at the rear (the north side) of the building. Drainage appears to be by sheet flow, and generally toward the south-southwest. The locations and dispositions of utility lines on the site are unknown.

2.0 SCOPE OF SERVICES

The scope of work for this report included a general site reconnaissance, subsurface exploration, site reconnaissance by a registered geotechnical engineer and certified engineering geologist, laboratory testing of samples secured during the subsurface investigation, geotechnical and geologic analyses of the data, and preparation of this report. The analysis and subsequent recommendations were based on general information provided by the client.

This report and preliminary geotechnical recommendations are intended to comply the considerations of Sections 1803A.1 through 1803A.7, J104.3 and J104.4 of the 2013 California Building Code; California Geological Survey Note 48; DSA IR A-4.13; and common geotechnical engineering and engineering geology practice in this area under similar conditions at this time.

The test procedures were accomplished in general conformance with the standards noted, as modified by common geotechnical engineering practice in this area under similar conditions at this time.

Preliminary geotechnical recommendations for site preparation, grading, utility trenches, foundations, interior slabs-on-grade and pedestrian flatwork, retaining walls, AC paths, drainage and maintenance, and observation and testing are presented to guide the development of project plans and specifications. The results of geotechnical corrosivity testing, and an evaluation of the results with recommendations for mitigation, which were subcontracted to HDR, Inc., are also provided. As there may be geotechnical issues yet to be resolved, the geotechnical engineer should be retained to provide consultation as the design progresses, to assist in verifying that pertinent geotechnical issues have been addressed and to aid in conformance with the intent of this report. It may also be advantageous to retain the geotechnical engineer to review the project plans and details as they near completion, to further aid in conformance with the intent of this report.

It is our intent that this report be used exclusively by the client in the preparation of plans and specifications. Application beyond this intent is strictly at the user's risk.

This report does not address issues in the domain of contractors such as, but not limited to, site safety, loss of volume due to stripping of the site, shrinkage of soils during compaction, excavatability, dewatering, shoring, temporary slope angles, construction means and methods, etc. Analyses of the soil for mold potential, man-made asbestos, lead, radioisotopes, hydrocarbons, or chemical properties other than geotechnical corrosivity are beyond the scope of this report. Evaluation of the site for suitability for LID improvements or drainage basins; ancillary features such as temporary access roads, fences, flag and light poles, signage; and nonstructural fills are not within our scope and are also not addressed.

In the event that there are any changes in the nature, design, or location of improvements, or if any assumptions used in the preparation of this report prove to be incorrect, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are verified or are modified in writing. The criteria presented in this report are considered preliminary until such time as any peer review or review by any jurisdiction has been completed, conditions are observed by the geotechnical engineer and/or geologist in the field during construction, and the recommendations have been verified as appropriate or modified in writing.

3.0 FIELD INVESTIGATION

On December 29, 2015, three borings were drilled in the planned building area to depths ranging from approximately 16.5 to 26 feet below the existing ground surface. The borings were drilled with a truck-mounted Mobile Drill rig, Model B-53, equipped with 6-inch outside diameter hollow stem auger and an automatic trip hammer for sampling. The approximate locations of the borings are shown on the Boring Location Map in Appendix A. Soil samples were obtained using a ring-lined barrel sampler (ASTM D 3550-01/07 with shoe similar to D 2937-10). Bulk soil samples were obtained from the auger cuttings. Standard penetration tests were also performed in the borings (ASTM D 1586-11) at selected depths. The borings were backfilled with auger spoils.

Soils encountered in the borings were categorized and logged in general accordance with the Unified Soil Classification System and ASTM D 2488-09a. Where bedrock was encountered, its properties were described based upon observation of the auger cuttings and the effort required to drill into it. Copies of the boring logs and a Boring Log Legend are included in Appendix A. In reviewing the boring logs and legend, the reader should recognize that the legend is intended as a guideline only, and there are a number of conditions that may influence the soil characteristics as observed during drilling. These include, but are not limited to, the presence of cobbles or boulders, cementation, variations in soil moisture, presence of groundwater, and other factors. It should also be noted that the descriptions of bedrock must span a much wider range of density and strength characteristics than soil, and are relative to other bedrock strata. For example, fractured and weathered bedrock may be described as “soft,” yet it will be considerably harder than almost any type of soil. Conversely, a clay soil may be described as “hard,” however it will not be nearly as hard as even “moderately soft” bedrock such as the sandstone and claystone encountered on this site. Consequently, the logger must exercise judgment in interpreting the subsurface characteristics, possibly resulting in soil and bedrock descriptions that vary somewhat from the legend.

4.0 LABORATORY ANALYSIS

The ring samples were tested for unit weight and moisture (ASTM D 2937-10), as modified for ring liners. One ring sample was also tested for one-dimensional consolidation (ASTM D 2435-11). Bulk samples were tested for maximum density and optimum moisture content (ASTM D 1557-12), expansion index (ASTM D 4829-11), plasticity index (ASTM D 4318-10) and cohesion and angle of shearing resistance by direct shear (ASTM D 3080-11, recompacted to 90 percent of maximum dry density and modified for consolidated, undrained conditions). The physical laboratory test results are presented in Appendix B.

Two bulk samples of the upper soils were also sent to HDR, Inc. of Claremont, California for geotechnical corrosivity testing. The results of these tests, and HDR, Inc.'s evaluation of the results, are presented in Appendix C.

5.0 GENERAL SUBSURFACE AND GEOLOGIC PROFILE

Boring 1, drilled on the west side of the existing building, found 4 feet of stiff fill (sandy lean clay with a trace of coarse gravel) over alluvium. The alluvium consisted of very stiff sandy lean clay with some fine gravel from 4 to 17 feet, and medium dense clayey gravel with sand to 23.5 feet. The alluvium was underlain by moderately soft bedrock (sandstone) of the Franciscan Mélange, which continued to drilling refusal at 26 feet.

A pavement section of 4 inches of asphalt concrete (AC) over 2 inches of aggregate base (AB) was found in Boring 2, on the north side of the existing building. Below the pavement to the boring termination depth of 16.5 feet was stiff to very stiff sandy lean clay alluvium. Some fine gravel was found in the clay to 4.5 feet.

Boring 3, on the east side of the existing building, encountered very stiff sandy lean clay with a trace of gravel (alluvium) from the surface to 7.5 feet. Bedrock of the Franciscan Mélange was found below the alluvium; the bedrock was moderately soft sandstone to 10.5 feet and moderately soft, severely sheared and weathered claystone to the drilling refusal depth of 16.5 feet.

During drilling, the soils and bedrock were described as being slightly moist to very moist. Free subsurface water was not found in any of the borings, to the maximum depth explored of 26 feet.

Please refer to the boring logs in Appendix A for a more complete description of the subsurface conditions. Cross Section A-A' in Appendix A is a graphic representation of the subsurface conditions found by the exploratory borings.

6.0 GEOLOGY

Geologic Setting

San Luis Obispo High School lies along the northeastern side of the Los Osos Valley, which is bounded to the northeast by the northwest-trending Santa Lucia Mountain Range and to the southwest by the northwest-trending Irish Hills. The proposed building area is on the north side of the campus, and it is relatively flat with a slight slope to the south/southwest. Locally, the school site area is bounded to the northeast by hillside terrain and to the southwest by San Luis Obispo Creek. The geologic map of the San Luis Obispo Quadrangle by Wiegers (2010) indicates

that the Annex/Classroom Building school site area is underlain by Holocene alluvial flood plain deposits (see the Geologic Map in Appendix D). Based on the results of our subsurface investigation and field observations, we concur with the Wiegers geologic map.

Faulting

Significant Faults

The San Andreas, Hosgri-San Simeon, and Los Osos Faults are the most significant regional *active* faults within a 65-mile radius of the school site, which could affect existing and proposed developments during their anticipated lifespan (see the Historical Earthquake/Fault Map in the Appendix D). The closest *active* fault to the site is the Irish Hills segment of the Los Osos Fault, located approximately 3.35 miles southwest. The closest mapped fault to the site (regardless of activity) is the Late Quaternary age Cambria Fault; it is located approximately 1 mile northeast (see the Historical Earthquake/Fault Map in the Appendix D). Brief descriptions of these faults are presented in the following sections. Regional faults and locations of historic earthquake events are also depicted on the Historical Earthquake/Fault Map in Appendix D.

Cambria Fault

The Cambria Fault is the closest mapped fault (regardless of activity) to the site; it is located approximately 1 mile northeast. The southern end of the Cambria fault could be considered part of the Oceanic fault group where the faults nearly join east of Cal Poly State University in San Luis Obispo. In some areas along the fault, it can be distinguished by the line of serpentine rock ridges that it bounds. Splays of the Cambria fault break late Pliocene (2 million years old) strata east of Cambria, but there is no known offset of Holocene (11,000 years old) age sediments by the system (Chipping, 1987). Weber (1983) noted that 120,000-year old marine terrace deposits north of Cayucos, near Ellysly Creek, may have been offset by the Cambria fault. However, to our knowledge, Weber's observation has never been confirmed by field exploration.

San Andreas Fault

The San Andreas Fault, considered to be the most active fault in the general region, lies 23 miles to the east of the site. The San Andreas Fault undergoes a major change in character between Parkfield and Cholame. North of Cholame, the fault moves more or less constantly in a process called creep, whereas the south end of the fault is locked, moving only in very large earthquakes. The last major quake on this part of the fault was the 1857 event (magnitude 7.9). In the immediate vicinity of Parkfield, there is a 20-mile segment that is also locked, generating an earthquake every 20 years or so on average. Dated quakes on this segment are 1881, 1901, 1922, 1934, and 1966, and are usually in the magnitude 5.5 to 6.0 range, (Bakun 1988). A 6.0 magnitude earthquake occurred on this fault segment on September 28, 2004.

Los Osos Fault

The Los Osos Fault, at its closest point to the site, is approximately 3 miles to the southwest. It consists of four distinct segments. From northwest to southeast, these are the Estero Bay, the Irish Hills, the Lopez Reservoir, and the Newsome Ridge segments. PG&E (1988) suggests that the Irish Hills segment displays the best expressed geomorphic features, displacing late Pleistocene and Holocene deposits. The Irish Hills segment starts in the vicinity of Los Osos and extends to just past San Luis Obispo Creek. A two-mile long segment west of Laguna Lake is considered to be active (Treiman 1989) and is zoned as a State Earthquake Fault Zone under the Alquist-Priolo Act (Hart 1997). This active segment lies about 3.35 miles to the southwest of the site and is the closest active fault to the site. The Los Osos Fault comprises a northwest-trending series of high- and low-angle faults that exhibit a complex history of both strike-slip and reverse displacement. However, during the late Quaternary, movement appears to have been primarily reverse displacement (PG&E 1998).

Hosgri-San Simeon Fault System

The Hosgri-San Simeon Fault System lies approximately 25 miles to the west of the site. A northwest-trending strike-slip fault, the San Simeon Fault extends from offshore of Ragged Point to just offshore of San Simeon Point, where it joins the northern end of the Hosgri Fault. From this point, the Hosgri Fault extends to an ocean shelf 2 miles west of Point Buchon, and then trends toward the Point Sal area. The fault system is considered active by the 2004 United States Geologic Survey (Jennings and Bryant 2010), based on Hall's claims of recent offset terrace deposits along San Simeon Cove, and also by a relocation of the 1927 "Lompoc Earthquake" onto the southern end of the Hosgri Fault (Hall 1975, 1976, 1977).

On December 22, 2003, a 6.5-magnitude earthquake occurred approximately 6 miles northeast of San Simeon, California and approximately 28 miles north of the subject site. Analysis by the USGS and the University of California at Berkeley indicates that the event had a thrust (reverse-faulting) mechanism (Goel 2004). The earthquake occurred in the vicinity of the northern end of the Hosgri-San Simeon Fault.

Groundwater

Soil and bedrock moisture contents encountered during drilling were generally slightly moist to very moist. Groundwater was not encountered in any of the borings to the maximum depth explored of 26 feet.

7.0 SEISMICITY

Earthquake History

The historic seismicity in the site's region was researched using EQSEARCH (Blake, updated December 2012) and the Boore and others (1997) method of analysis for Site Class "D", stiff soil sites (ASCE 2010) that is incorporated within that program. EQSEARCH performs automated searches of a custom catalog of historical Central California earthquakes. As the program searches the catalog, it computes the epicentral distance from the selected site to each of the earthquakes within the specified search area. The epicentral distances should be considered estimates, particularly for earthquake data prior to 1932, when modern instruments were first used to record earthquake data.

The parameters used for the search consisted of earthquake Richter magnitudes ranging from 5.0 to 9.0 that occurred within a 65-mile radius from the site from 1800 to December 2012. The site coordinates used in this search were latitude 35.2836N and longitude 120.6501W. The Historical Earthquake/Fault Map presented in Appendix D graphically depicts the results of the search, including historical earthquake epicenters, their corresponding magnitudes, and faults within the general region of the project.

Results of the search indicated that within the search parameters, 44 earthquakes have occurred. The highest peak horizontal ground acceleration (PGA) estimated to have occurred at the site from those historical earthquakes is 0.33g. This earthquake had a 5.9 magnitude, occurred in 1906, and was located approximately 3 miles northwest of the site. This earthquake may have occurred along the Los Osos Fault. The largest magnitude earthquake that the search revealed was 7.9. This earthquake was located approximately 48 miles east of the site, and is known as the 1857 earthquake on the San Andreas Fault. It produced an estimated PGA of 0.15g at the site.

Design Acceleration Parameters

In accordance with California Geologic Survey, Note 48 (October 2013), Item 16, an assessment was made to determine if there was a need to employ "Site Specific Ground Motion Procedures" for this site. Based on a review of the San Luis Obispo County Planning Department Permit View web site (2015), a determination was made that the site is not located in a Geologic Study Area, an Alquist-Priolo Earthquake Fault Zone, or a High Liquefaction Hazard Zone. In addition, the S_1 ground motion value obtained from the United States Geological Survey Earthquake Hazards Program website (USGS 2016) and the 2010 ASCE 7 Standard Analysis Method, for Site Class "D" (stiff soil sites), was below 0.75g (see table below). Therefore, the project does not require a site-specific ground motion analysis.

The site is in a region of generally high seismicity and has the potential to experience strong ground shaking from earthquakes on regional or local causative faults. To characterize the seismicity at the site and to provide seismic design parameters for the architect/engineer, a General Procedure Ground Motion Analysis was performed to calculate the deterministic ground motions at the site. The ground motions are based on the 2013 California Building Code General Procedure that were obtained from the United States Geological Survey Earthquake Hazards Program website (USGS 2016) and the 2010 ASCE 7 Standard Analysis Method, for Site Class "D" (stiff soil sites). The results of this analysis are presented in the following table:

SUMMARY OF DESIGN RESPONSE ACCELERATION PARAMETERS

Mapped Acceleration Values for Site Class "B"		**2013 CBC Site Coefficients and General Procedure Adjusted MCE Spectral Response Acceleration Parameters For Site Class "D"**					
Seismic Parameters	Values (g)	Site Coefficients	Values	Seismic Parameters	Values (g)	Seismic Parameters	Values (g)
S_S	1.137	F_a	1.045	S_{MS}	1.188	S_{DS}	0.792
S_1	0.434	F_v	1.566	S_{M1}	0.680	S_{D1}	0.453
Peak Mean Ground Acceleration (PGA_m): 0.475 g							
Seismic Design Category = D							

Seismic Design Category

Section 1613A.3.5 of the 2013 CBC indicates that sites will be assigned to Category D unless $S_1 \geq 0.75$. The S_1 calculated for the site is 0.434g; therefore, the site would be assigned to Category D.

8.0 GEOLOGIC HAZARDS

Surface Ground Rupture

Surface ground rupture generally occurs at sites that are traversed by, or lie very near to, a causative fault. The site is not located within a State Earthquake Fault Zone, and there are no mapped faults crossing or adjacent to the site. The closest mapped active fault to the site is the Irish Hills segment of the Los Osos Fault, located approximately 3.35 miles southwest of the site. Therefore, the potential for surface ground rupture to occur at the site is very low.

Liquefaction

The term liquefaction refers to the liquefied condition and subsequent softening that can occur in soils when they are subjected to cyclic strains, such as those generated during a seismic event. Previous studied have concluded that liquefaction within the upper 50 feet of soil can potentially affect improvements at the ground surface. Due to the relatively shallow depth to the bedrock, the stiff to very stiff alluvial clay soils above the bedrock, and the absence of groundwater to the maximum depth explored of 26 feet, the potential for liquefaction to occur is considered to be nil.

Seismically Induced Settlement

Seismically induced settlement of sufficient magnitude to cause structural damage is normally associated with poorly consolidated, predominantly sandy soils, or variable consolidation characteristics within the building areas. Due to the relatively shallow depth to the bedrock and the presence of stiff to very stiff alluvial clay soils, the potential for seismically induced settlement to occur at the site is considered to be nil.

Slope Stability

The Annex/Classroom site lies within a generally flat area with no significant slopes on or adjacent to it; therefore, there is no potential for gross slope instability or landsliding to impact the project site.

Flooding

According to the Flood Insurance Rate Map Number 06079C1067G (FEMA November 16, 2012), the Annex/Classroom Building site is not located within a 100-year flood zone, or within Flood Zone X (See the FEMA Flood Zone Map in Appendix D). Flood Zone X indicates areas that have been determined to have less than a 0.2 percent chance of being flooded in any given year.

Naturally Occurring Asbestos

Asbestos bearing rock units within the central coast area generally consist of serpentinite, ultra-mafic rock units consisting of olivine-hornblende and some schist metamorphic rock units. Based on our research and review of the borings logs, the project site is predominately underlain by a thick deposit of clayey soil alluvium, followed by sandstone and claystone bedrock of the Franciscan Mélange, which ranged in depth from 7.5 to 23.5 feet. These geologic units are not asbestos bearing, therefore, the potential for naturally occurring asbestos to occur on the site is considered to be nil.

Radon

Radon is a colorless, odorless gas present in soil and rock, which is derived from the decay of uranium. The occurrence of radon correlates with the presence of specific minerals, and its concentrations in soil or rock will vary depending on the mineralogy of the surrounding bedrock, temperature, barometric pressure, moisture and other factors. Prolonged exposure to elevated levels of radon is associated with an increased risk of lung cancer.

According to Special Report 208, by the California Geological Survey (Churchill 2008) radon is most commonly found in areas of San Luis Obispo County that are underlain by bedrock of the Monterey formation. The site is underlain by alluvial soils and bedrock of the Franciscan Melange. The report (Churchill 2008) shows that the project site is in an area of low radon potential for San Luis Obispo County.

9.0 CONCLUSIONS

Geology

It is our opinion that there are no significant local or regional geologic conditions that would preclude construction of the Annex/Classroom Building and site improvements as described in the "Introduction" section of this report.

Site Geology

The Annex/Classroom Building site area lies on relatively flat terrain that is bounded to the northeast by hillside terrain and to the southwest by San Luis Obispo Creek. The site area is underlain by Holocene alluvial flood plain deposits and bedrock of the Franciscan Melange.

Groundwater

Soil and bedrock moisture contents encountered during drilling were generally slightly moist to very moist. Groundwater was not encountered in any of the borings, to the maximum depth explored of 26 feet.

Slope Stability

There are no significant slopes on or adjacent to the Annex/Classroom Building site area; therefore, there is no potential for gross slope instability or landsliding to impact the project.

Seismicity

The site is located within the seismically active southern California area, and moderate to severe ground shaking can be expected during the life of the proposed structure. The largest historical mean peak horizontal acceleration estimated to have occurred in the vicinity of the site was 0.33g.

Surface Ground Rupture

The site is not located in a State Earthquake Fault Zone and there are no mapped faults crossing the site. The closest mapped active fault to the site is the Irish Hills segment of the Los Osos Fault, approximately 3.35 miles southwest. Therefore, the potential for surface fault rupture to occur at the site is considered to be very low.

Liquefaction, Seismically Induced Settlement, and Naturally Occurring Asbestos

As the site is underlain by stiff to very stiff condition of the clayey alluvial and relatively shallow bedrock of the Franciscan Mélange, the potentials for liquefaction and seismically-induced settlement to occur are considered to be nil. As the sandstone bedrock of the Franciscan Mélange is not an asbestos-bearing geologic unit, the potential for naturally occurring asbestos to occur on the site is also considered to be nil.

Flooding

The site is not within a 100-year flood zone, or Flood Zone X, which has been determined by FEMA (2012) to be areas that have less than a 0.20 percent chance of being flooded in any given year.

Radon

The site is underlain by clayey alluvial deposits and relatively shallow sandstone bedrock of the Franciscan Mélange, therefore the potential for radon to affect the project is low.

Geotechnical Engineering

In our opinion, the site is suitable, from a geotechnical engineering standpoint, for the proposed Annex/Classroom Building and site improvements, as described in the "Introduction" section of this report, provided the recommendations contained herein are implemented in the design and construction. The primary geotechnical engineering concerns are the potential for differential settlement from the existing fill and the potential disturbance at depth due to removal of the existing structure, the expansion potential of the upper soils, and the erodible nature and corrosive potential of the soils. Provided that the building area is prepared as recommended in the "Grading" section of this report, conventional continuous and spread (pad) foundations may be used to support the proposed structure.

Differential settlement can occur when a foundation spans materials having variable consolidation characteristics, such as the fill that was found in the upper 4 feet of Boring 1. We are unaware of any documentation (i.e., grading observation or compaction testing records) regarding the placement of the fill, but it was likely placed when the existing Annex/Cafeteria Building was constructed. Undocumented fill has a greater potential for variability than fill that has been placed and tested in a controlled earthwork program. Removal of the existing structure is also anticipated to disturb the soil to variable depths. Such conditions (i.e., undocumented fill and disturbed soil) could stress and possibly damage foundations, often resulting in severe cracks and displacement if they are not mitigated. Therefore, to reduce this potential for differential settlement, a program of overexcavation and recompaction of the soil in the building area is recommended prior to construction.

Expansion index testing yielded results of 54 and 58 for the upper fill and alluvial soils. Per CBC Section 1803A.5.3, the soils are considered to be expansive. The more commonly used ASTM classification is that the soils would be considered to have a "medium" expansion potential. Expansive soils tend to swell with increases in soil moisture and shrink as soil moisture decreases; the upper 3 to 5 feet of any soil profile is the zone most affected by these seasonal soil moisture fluctuations. The volume changes that the soils undergo in this cyclical pattern can stress and damage foundations and slabs-on-grade if precautionary measures are not incorporated during design and in the construction procedure. Footings are typically deepened and additional reinforcement is provided. Imported nonexpansive soils are recommended to be placed beneath slabs-on-grade.

The soils above the bedrock are considered to be erodible. It is essential that all surface drainage be controlled and directed to appropriate discharge points, and that surface soils, particularly those disturbed during construction, are stabilized by vegetation or other means *during and following construction*.

As indicated in the Soil Corrosivity Study by HDR, Inc., in Appendix C, the electrical resistivities of the samples tested were in the moderately corrosive categories with as received moisture contents; when saturated, the resistivities were in the corrosive to severely corrosive categories. Soil pH values were mildly alkaline. The soluble salt contents of the soils were low to moderate. Soil nitrate concentrations were high. The soils were classified as severely corrosive to ferrous metals and aggressive to copper. Please refer to the Soil Corrosivity Study in Appendix C for a complete summary of the test results, and recommendations for mitigation.

10.0 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

The following recommendations are for improvements constructed as described in the "Introduction" section of this report. If locations, elevations, structural loads, etc., change, the recommendations contained herein may require modification. In developing the following recommendations, it was assumed that irrigated landscaping or flatwork that would keep the soils relatively uniform, year-round moisture will be installed for a zone of at least five feet around the perimeter of all improvements.

Two distinct types of Portland cement concrete (PCC) slabs-on-grade are discussed in the following recommendations. The building's interior slabs are defined as "slabs-on-grade." Sidewalks that will not support vehicle traffic are referred to as "exterior pedestrian flatwork." Asphalt concrete (AC) paths may also be utilized for pedestrian access, however it is also assumed that they will not support vehicle traffic.

Unless otherwise noted, the following definitions are used in the recommendations presented below. Where terms are not defined, definitions commonly used in the construction industry are intended.

- **Building Area –** The building area is defined as the area within and extending a minimum of 5 feet beyond the perimeter of the foundations for the Annex/Classroom Building. The building area includes any retaining walls, covered walkways or other improvements that are connected to the structure and that are intended to act in a manner similar to it.
- **Exterior Pedestrian Flatwork and Asphalt Concrete (AC) Path Areas –** The areas within the footprints of all exterior pedestrian flatwork and all AC paths.
- **Sitework Retaining Wall Areas –** The areas within and extending a minimum of 3 feet beyond the foundation limits of all sitework retaining walls.
- **Grading Area –** The entire area to be graded, including the building area, exterior pedestrian flatwork and AC path areas, and sitework retaining wall areas.
- **Existing Grade:** Elevations of the site that existed as of the date of this report.
- **Finish Pad Grade:** The elevation in the building area where earthwork operations are typically considered to be complete. It does not include any sand or gravel that might be placed below slabs-on-grade in association with vapor protection for the slabs.
- **Subgrade:** The elevation in exterior pedestrian flatwork and AC path areas where imported nonexpansive materials, sand, or aggregate base (AB) are placed to support the flatwork or AC path.

- **Scarified:** Plowed or ripped in two orthogonal directions to a depth of not less than 8 inches.
- **Moisture Conditioned:** Adjusting the soil moisture to optimum moisture content, or just above, prior to application of compactive effort.
- **Compacted/Recompacted:** Soils placed in level lifts not exceeding 8 inches in loose thickness and compacted to a minimum of 90 percent of maximum dry density. Based on maximum dry density by ASTM D 1557-12 and field density by ASTM D 6938-15, or other methods acceptable to the geotechnical engineer and jurisdiction.

Site Preparation

1. The ground surface in the grading areas should be prepared for construction by removing the existing building, existing flatwork, and all other improvements, vegetation, large roots, debris, organic topsoil, and other deleterious materials. Existing utility lines that will not remain in service should be either removed or abandoned. The appropriate method of abandonment will depend upon the type and depth of the utility. Recommendations for abandonment can be made as necessary.

2. Voids created by the removal of materials or utilities described above should be called to the attention of the geotechnical engineer. No fill should be placed unless the underlying soil has been observed by the geotechnical engineer.

Grading

1. Following site preparation, all existing fill in the building area should be removed to a level plane at the deepest point of the fill. For planning purposes, the deepest point of the fill encountered during the field exploration program was 4 feet below existing grade at Boring 1. The exact depth of fill should be determined by the geotechnical engineer at the time of construction. The resulting level excavated surface should be scarified, moisture conditioned and compacted.

2. To create as uniform conditions as possible for the structure, all earthwork operations should be completed throughout the entire building area in a uniform manner at the same time, from the bottom of the overexcavation recommended in the previous paragraph through fill placement to finish grade. Earthwork operations that complete only a portion of the building area at one time (i.e., “flip-flopping”, “checkerboarding”, etc.) should not be allowed.

3. Following site preparation, all existing fill in sitework retaining wall areas should be overexcavated to the deepest point of the fill. The resulting excavated surfaces should be scarified, moisture conditioned and compacted. Overexcavation elevations may be stepped where the fill depth changes or where retaining walls are stepped to conform to any site contours. If very stiff sandy lean clay alluvium is exposed at bottom of foundation elevation, no overexcavation and recompaction is considered necessary. To reduce the potential for cracking in sitework retaining walls, construction joints should be placed in the wall and the foundation where overexcavation operation have been stepped to conform to fill depth changes or to exposure of very stiff alluvium. Unlike the recommended earthwork program for the building area, overexcavation and recompaction operations for sitework retaining walls can proceed in a non-uniform manner for individual wall segments.

4. Following site preparation and any excavations to grade, or prior to placement of fill, the soil in any exterior pedestrian flatwork and AC path areas, and in all other grading areas, should be scarified, moisture conditioned and recompacted. Unlike the recommended earthwork program for the building area, scarification and recompaction operations for exterior pedestrian flatwork and AC path areas, and in all other grading areas, can proceed in a non-uniform manner.

5. Voids created by dislodging cobbles and/or debris during scarification should be backfilled and recompacted, and the dislodged materials should be removed from the work area.

6. Previously removed site soils and other similar soils may be placed as fill beyond the building area, and in the building area to a maximum height of 18 inches below bottom of slab elevation. The final 18 inches of fill below bottom of slab elevation in the building area should be nonexpansive.

7. Nonexpansive materials are defined as imported soils that fall in the GW, GM, GC, SP, SW, SC and SM categories per ASTM D 2487-11, and that have an expansion index of 10 or less (ASTM D 4829-11). The clean sand layer described in the “Slabs-on-Grade” section of this report (if utilized below interior slabs-on-grade or exterior pedestrian flatwork) is considered to be part of the minimum recommended thickness of nonexpansive material utilized, not in addition to it.

8. Imported soils used in the building area should have strength and expansion qualities equal to or better than the site soils, and they should not exceed the geotechnical corrosivity potential of the site soils. See the Soil Corrosivity Study in Appendix C for the corrosivity parameters of the site soils. Proposed imported materials should be reviewed by the geotechnical engineer before being brought to the site, and on an intermittent basis during placement.

9. All materials used as fill should be cleaned of any debris and rocks larger than 3 inches in diameter. When fill material includes rocks, the rocks should be placed in a sufficient soil matrix to ensure that voids caused by nesting of the rocks will not occur and that the fill can be properly compacted.

10. All AB and the top 12 inches of subgrade in areas to support AC paths should be compacted to a minimum of 95 percent of maximum dry density. Imported nonexpansive materials, sand or AB used to support exterior pedestrian flatwork, as well as the top 12 inches of subgrade in these areas, need only be compacted to a minimum of 90 percent of maximum dry density.

11. If the soils are overly moist so that they become unstable, or if the minimum recommended compaction cannot be readily achieved, drying the soil so that it is nearer optimum moisture content, may be necessary. Placement of gravel layers or geotextiles may also be necessary to help stabilize unstable soils. Additional overexcavation may also be recommended to correct unstable conditions or if soft or loose conditions are encountered during grading. No fill should be placed in any grading area if the underlying soil is unstable.

12. The recommended soil moisture content should be maintained throughout construction, and during the lives of the structure and sitework improvements. Failure to maintain the soil moisture content can result in desiccation cracks and disturbance, which are an indication of degradation of the soil compaction. If desiccation cracks are allowed to develop, or if soils near improvements such as foundations, flatwork, etc. are otherwise disturbed, damage to those improvements may result. Soils that have cracked or are otherwise disturbed should be removed, moisture conditioned, and recompacted.

Utility Trenches

1. Utility trenches adjacent to foundations should not be excavated within the zone of foundation influence, as shown in Typical Detail A in Appendix E.

2. Utilities that must pass beneath foundations should be placed with properly compacted utility trench backfill and the foundation should be designed to span the trench.

3. A select, noncorrosive, granular, easily compacted material should be used as bedding and shading immediately around utilities. The site soil may be used for trench backfill above the select material beyond the building area, and to within 18 inches below bottom of slab elevation in the building area. Within the building area, imported nonexpansive soils should be utilized to backfill the final 18 inches below bottom of slab elevation of all trenches. In exterior pedestrian flatwork and AC path areas, trench backfill should match the thickness of imported nonexpansive soils, sand or AB used to support these improvements.

4. In general, trench backfill should be compacted to a minimum of 90 percent of maximum dry density. Trench backfill in the upper 12 inches of subgrade and all AB in AC path areas should be compacted to a minimum of 95 percent of maximum dry density. A minimum of 85 percent of maximum dry density will generally be sufficient where trench backfill is located in landscaped or other unimproved areas, where settlement of trench backfill would not be detrimental.

5. Prior to applying compactive effort, soils should be moisture conditioned. Trench backfill should be placed in level lifts not exceeding 6 inches in loose thickness and compacted to the minimums recommended above.

6. Compaction of trench backfill by jetting or flooding is not recommended at this site due to the expansive soils. However, to aid in *encasing* utility conduits, particularly corrugated drain pipes, and multiple, closely-spaced conduits in a single trench with the bedding and shading material, jetting or flooding may be useful. Flooding or jetting should only be attempted with extreme caution, and any flooding or jetting operation should be subject to review by the geotechnical engineer.

7. Long-term settlement of properly compacted sand should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill. Where trenches are backfilled with site soils, the anticipated settlement would be about twice that of sand. Improvements that are constructed over or near trenches should be designed to accommodate the potential for settlement.

8. The Soil Corrosivity Study by HDR, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for utility improvements.

9. The recommendations of this section are minimums only, and may be superseded by the architect/engineer based upon soil corrosivity or the requirements of pipe manufacturers, utility companies or the governing jurisdiction.

Foundations

1. The Annex/Classroom Building may be supported by continuous and spread footings bearing in firm recompacted soils, as recommended in the "Grading" section of this report.

2. Based on soil expansion potential only, minimum overall foundations depths of 21 inches below lowest adjacent grade within 6 feet laterally of the base of foundations should be maintained. Spread footings should be at least 24 inches square.

3. Continuous footings should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential only, minimum continuous footing reinforcement should consist of two No. 4 rebars, one at the top and one at the bottom. Spread footings should be reinforced in accordance with the requirements of the architect/engineer.

4. Footings bearing in firm recompacted soil may be designed using maximum allowable bearing capacities of 2,500 psf dead load and 3,500 psf dead plus live loads. Using these criteria, maximum settlement and differential settlement are expected to be less than 1/2-inch and less than 3/8-inch in 25 feet, respectively.

5. Allowable bearing capacities may be increased by one-third when transient loads such as wind or seismicity are included. Foundations may be designed using the site design response parameters contained in the table on Page 8 in the "Seismicity" section of this report.

6. To calculate resistance to lateral loads, please see the values presented in the "Retaining Walls" section of this report. Lateral capacity is based on the assumption that any backfill adjacent to foundations has been properly compacted. Passive and friction components of resistance may be combined in the analysis without reduction to either value.

7. Footing excavations should be observed by the geotechnical engineer prior to placement of reinforcing steel. Footing excavations should be lightly moistened and no desiccation cracks should be present prior to concrete placement.

8. The Soil Corrosivity Study by HDR Engineering, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for all foundation elements.

Slabs-on-Grade

Interior Slabs-On-Grade

1. Interior slabs-on-grade should have a minimum thickness of 4 full inches. They should be reinforced and doweled to foundations per the specifications of the architect/engineer. At a minimum, interior slabs should be reinforced with No. 3 rebar at 24 inches on center each way. All structural slabs should contain minimum rebar meeting the criteria of ACI 318, Section 7.12.2 (ACI 2011). At a minimum, foundation dowels should be lap spliced to the slab rebar. The size and spacing of the dowels should match the size and spacing of the slab rebar.

Exterior Pedestrian Flatwork

1. Exterior pedestrian flatwork should have a minimum thickness of 4 full inches. Minimum reinforcement for exterior pedestrian flatwork placed over at least 18 inches of nonexpansive imported soils per the following paragraph should consist of No. 3 rebar placed at 24 inches on-center each way. If the thickness of nonexpansive soil below the flatwork is less than 18 inches, the minimum reinforcement should consist of No. 3 rebar at 18 inches on-center each way.

2. In conventional construction, it is common to use 4 to 6 inches of sand beneath exterior pedestrian flatwork. However, due to the medium expansion potential of the site soils, there will be a risk of movement and damage to the flatwork if conventional measures are used. Heaving and cracking could occur. This movement could be reduced by the placement of additional nonexpansive material beneath the flatwork. If it is desired to fully mitigate the expansive soil conditions, then at least 18 inches of imported nonexpansive material should be provided below the flatwork where the expansive site soils are exposed at finish grade. If it is acceptable for the flatwork to experience movement due to expansive soils, then the thickness of the nonexpansive soil can be reduced. Under all flatwork, however, the thicker the nonexpansive layer, the better the expansive soil protection.

3. Another measure that can be taken to reduce the risk of movement of flatwork due to expansive soils is to provide thickened edges or grade beams around the perimeters of the flatwork. If it is desired to fully mitigate the expansive soil conditions, then the thickened edges or grade beams could be up to 21 inches deep. If it is acceptable for the flatwork to experience movement, then the thickened edges or grade beams can be reduced. At a minimum, any thickened edge or grade beam should be reinforced by two No. 4 rebar, one at the top and one at the bottom.

4. It is recognized that the measures discussed above for protecting exterior flatwork from expansive soils are expensive, possibly more expensive than simply replacing flatwork that has heaved and/or cracked. Consequently, the above measures for protecting exterior flatwork are only suggestions for consideration by the owner and/or architect/engineer. The degree to which exterior flatwork is protected from expansive soil damage is left to the discretion of the owner and/or architect/engineer.

5. Flatwork should be constructed with frequent joints to allow articulation as the flatwork moves in response to seasonal soil temperature and moisture variations. The expansive soil underlying any nonexpansive material placed below flatwork should be moisture conditioned, and no desiccation cracks should be present, prior to casting the flatwork.

6. Flatwork at doorways, and at other areas where maintaining the elevation of the flatwork is desired when mitigating expansive soil potential, should be doweled to the perimeter foundation, at a minimum, by No. 3 dowels lapped to the flatwork rebar at 24 inches on center. In other areas, the flatwork may be doweled to the foundation or the flatwork may be allowed to "float free," at the discretion of the architect/engineer. Flatwork that is intended to float free should be separated from foundations by a felt joint or other means.

<u>Moisture Vapor Transmission</u>

1. Due to the current use of impermeable floor coverings, water-soluble flooring adhesives, and the speed at which buildings are now constructed, moisture vapor transmission through slabs is a much more common problem than in past years. Where moisture vapor transmitted from the underlying soil would be undesirable, slabs should be protected from subsurface moisture vapor. A number of options for vapor protection are discussed below; however, the means of vapor protection, including the type and thickness of the vapor retarder, if specified, are left to the discretion of the architect/engineer.

2. Where specified, vapor retarders should conform to ASTM Standard E 1745-11. This standard specifies properties for three performance classes; Class A, B and C. The appropriate class should be selected based on the sensitivity of floor coverings to moisture intrusion and the potential for damage to the vapor retarder during placement of slab reinforcement and concrete.

3. Several recent studies, including those of American Concrete Institute Committee 302 (ACI 2004), have concluded that excess water above the vapor retarder increases the potential for moisture damage to floor coverings and could increase the potential for mold growth or other microbial contamination. The studies also concluded that it is preferable to eliminate the typical sand layer beneath the slab and place the slab concrete in direct contact with a Class A vapor retarder, particularly during wet weather construction. However, placing the concrete directly on the vapor retarder requires special attention to using the proper vapor retarder, a very low water-cement ratio in the concrete mix, and special finishing and curing techniques.

4. Probably the next most effective option would be the use of vapor-inhibiting admixtures in the slab concrete mix and/or application of a sealer to the surface of the slab. This would also require special concrete mixes and placement procedures, depending upon the recommendations of the admixture or sealer manufacturer.

5. Another option that may be a reasonable compromise between effectiveness and cost considerations is the use of a subslab vapor retarder protected by a sand layer. If a Class A vapor retarder is specified, the retarder can be placed directly on the nonexpansive soil. The retarder should be covered with a minimum 2 inches of *clean* sand. If a less durable vapor retarder is specified (Class B or C), a minimum of 4 inches of clean sand should be provided, and the retarder should be placed in the center of the clean sand layer. Clean sand is defined as a well or poorly graded sand (ASTM D 2487-11) of which less than 3 percent passes the No. 200 sieve. The clean sand layer, if used, is considered to be a part of the minimum 18-inch thickness of nonexpansive imported materials recommended in the "Grading" section of this report to be placed below slabs-on-grade, not in addition to it.

6. Regardless of the underslab vapor retarder selected, proper installation of the retarder per ASTM E 1643-11 is critical for optimum performance. Where utilized, the vapor retarder should be placed a minimum of 1 inch above the flow line of the drainage path

surrounding the structures, or 1 inch above the area drain grates if area drains are used to collect runoff around the structures. All seams must be properly lapped, and all seams and utility penetrations properly sealed in accordance with the vapor retarder manufacturer's recommendations.

7. If the sand is used between the vapor retarder and the slab, it should be moistened only as necessary to promote concrete curing; saturation of the sand should be avoided, as the excess moisture would be on top of the vapor retarder, potentially resulting in vapor transmission through the slab for months or years.

8. The architect/engineer should designate any special measures to be used in conjunction with moisture vapor transmission protection, if needed, to mitigate the high potential for indoor radon levels.

9. Positive drainage away from the building should be maintained; see the "Drainage and Maintenance" section of this report for additional discussion of this issue. If water is allowed to pond near the structure, it may seep into the ground and migrate laterally through cracks or utility penetrations in the foundation, ultimately gaining access above the vapor retarder.

Slabs-on-Grade - General

1. To reduce shrinkage cracks in all interior and exterior slabs-on-grade, the concrete aggregates should be of appropriate size and proportion, the water/cement ratio should be low, the concrete should be properly placed and finished, contraction joints should be installed, and the concrete should be properly cured. This is particularly applicable to slabs that will be cast directly upon a vapor retarder and those that will be protected from transmission of vapor by use of admixtures or surface sealers. Concrete materials, placement, and curing specifications should be at the direction of the architect/engineer; AC 302.1R-04 (ACI 2004) is suggested as a resource for the architect/engineer in preparing such specification.

2. To provide stability for curbs adjacent to exterior pedestrian flatwork, they should be set back a minimum distance equal to one-third the height of any adjacent descending slope, but not less than 5 feet from the tops of slopes. Alternately, curbs may be deepened to provide stability. The geotechnical engineer should review, on an individual basis, any situation where curbs must be deepened to meet this recommendation.

3. The Soil Corrosivity Study by HDR, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for all slabs-on-grade.

Retaining Walls

1. Retaining walls connected to or forming part of the building should be founded in firm soil that has been recompacted per the "Grading" section of this report. Sitework retaining walls may be supported by either firm soil that has been recompacted per the "Grading" section of this report, or firm sandy lean clay alluvium. If a sitework retaining wall crosses a recompacted soil/firm alluvium transition, or a transition between varying fill overexcavation depths, a construction joint should be placed in the footing and wall at the transitions. Foundations for all retaining walls should have minimum overall depths (not including any keyway) of 21 inches below lowest grade within 6 feet laterally of any adjacent slope.

2. Retaining wall footings should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential only, minimum retaining wall footing reinforcement should consist of two No. 4 rebars, one at the top and one at the bottom.

3. Retaining wall design may be based on the following parameters:

Active equivalent fluid pressure (site soils)	45 pcf
Active equivalent fluid pressure (imported sand/gravel backfill)	35 pcf
At-rest equivalent fluid pressure (site soils)	60 pcf
At-rest equivalent fluid pressure (imported sand/gravel backfill)	50 pcf
Passive equivalent fluid pressure	350 pcf
Maximum toe pressure	3,500 psf
Coefficient of sliding friction	0.35

4. No surcharges are taken into consideration in the values presented in the previous paragraph. The maximum toe pressure is an *allowable* value; no factors of safety, load factors or other factors have been applied to the remaining values. With the exception of the maximum toe pressure, these values will require application of appropriate factors of safety, load factors, and/or other factors as deemed appropriate by the architect/engineer.

5. If the active or at-rest pressures presented in Paragraph 3 for *imported sand or gravel backfill* are utilized for design of retaining walls, the sand or gravel should be used exclusively as backfill above a 1:1 plane extended upward from the back of the wall footing to approximately 1 foot from the top of the wall backfill. The upper foot should be backfilled with native soil, except in areas where AC paths or exterior pedestrian flatwork will abut the top of the wall. In such cases, the gravel should extend to the imported nonexpansive material, sand, aggregate base, or other material below the improved surface, as appropriate.

6. The active and at-rest pressures presented in Paragraph 3 are applicable to a horizontal retained surface behind the wall. Walls having a retained surface that slopes upward from the wall should be designed for an additional equivalent fluid pressure of 1 pcf for the active case and 1.5 pcf for the at-rest case, for every degree of slope inclination.

7. It is assumed that retaining wall heights will not exceed 4 feet.

8. Section 1803A.5.12.1 of the 2013 CBC requires that dynamic seismic lateral earth pressures be provided by the geotechnical engineer for walls retaining more than 6 feet of backfill. As the walls for this project will not retain more than 6 feet, design for seismic lateral earth pressures is not required.

9. Long-term settlement of properly compacted sand or gravel retaining wall backfill should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill; long-term settlement of properly compacted site soil retaining wall backfill would be about twice that of sand or gravel backfill. Improvements that are constructed near the tops of retaining walls should be designed to accommodate long-term settlement.

10. All retaining walls should be drained with perforated pipe encased in a free-draining gravel blanket. The pipe should be placed perforations downward, and should discharge in a nonerosive manner away from foundations and other improvements. The gravel blanket should have a width of approximately 1 foot and should extend upward to approximately 1 foot from the top of the wall backfill. The upper foot should be backfilled with native soil, except in areas where AC paths or exterior pedestrian flatwork will abut the top of the wall. In such cases, the gravel should extend to the imported nonexpansive material, sand, aggregate base, or other material below the improved surface, as

appropriate. To reduce infiltration of the soil into the gravel, a permeable synthetic filter fabric conforming to Standard Specifications Section 88-1.02B – Class C (Caltrans 2010), should be placed between the two. Manufactured synthetic drains, such as Miradrain or Enkadrain are acceptable alternatives to the use of gravel, provided that they are installed in accordance with the recommendations of the manufacturer.

11. Where weep hole drainage can be properly discharged, the perforated pipe may be omitted in lieu of weep holes on maximum 4-foot centers. A filter fabric as described above should be placed between the weep holes and the drain gravel.

12. Walls facing areas where moisture transmission through the wall would be undesirable should be *thoroughly* waterproofed in accordance with the specifications of the architect/engineer.

13. The architect/engineer should bear in mind that retaining walls by their nature are flexible structures, and that surface treatments on walls often crack. Where walls are to be plastered or otherwise have a finish applied, the flexibility should be considered in determining the suitability of the surfacing material, spacing of horizontal and vertical control joints, etc. The flexibility should also be considered where a retaining wall will abut or be connected to a rigid structure, and where the geometry of the wall is such that its flexibility will vary along its length.

14. The Soil Corrosivity Study by HDR, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for all retaining walls.

Asphalt Concrete (AC) Paths

1. Paths for pedestrian access may be constructed of AC over AB. Design methods for AC pavement do not typically consider pedestrian loading only. Therefore, the section design is typically based on local experience and anticipated life span. For this application, a minimum pavement section of 1.5 to 2.0 inches of AC over 2 to 4 inches of AB is considered appropriate. As with exterior pedestrian flatwork these minimum thicknesses of AC and AB will be subject to movement due to expansive soils. If it is desired to filly mitigate the expansive soil conditions, the AB thickness can be increased to as much as 18 inches.

2. It is recognized that the increased AB thickness recommended above for protecting AC paths from expansive soils will be expensive, possibly more expensive than simply replacing AC paths that has heaved and/or cracked. Consequently, this measure for protecting AC paths is only a suggestion for consideration by the client and/or architect/engineer. The degree to which AC paths are protected from expansive soil damage is left to the discretion of the owner and/ or architect/engineer.

3. AB should conform to the requirements of Section 26 of the Standard Specifications (Caltrans 2010). AC should conform to the requirements of Section 32 of the Standard Specifications (Caltrans 2010).

4. The upper 12 inches of subgrade and all AB in pavement areas should be compacted to a minimum of 95 percent of maximum dry density. Subgrade and aggregate base should be firm and unyielding when proofrolled with heavy, rubber-tired grading equipment prior to continuing construction.

Drainage and Maintenance

1. Per Section 1804A.3 of the 2013 CBC, unpaved ground surfaces should be *finish graded* to direct surface runoff away from foundations and other improvements at a minimum 5 percent grade for a minimum distance of 10 feet. The site should be similarly sloped to drain away from foundation, and other improvements during construction. Where this is not practicable due to other improvements, etc., swales with improved surfaces, area drains, or other drainage facilities, should be used to collect and discharge runoff.

2. All eaves of the building should be fitted with roof gutters. Runoff from flatwork, roof gutters, downspouts, planter drains, area drains, etc. should discharge in a nonerosive manner away from foundations and other improvements in accordance with the requirements of the governing agencies. Erosion protection should be placed at all discharge points unless the discharge is to a pavement surface.

3. To reduce the potential for planter drainage gaining access to subslab areas, any raised planter boxes adjacent to foundations should be installed with drains and sealed sides and bottoms. Drains should also be provided for areas adjacent to the structure and in landscape areas that would not otherwise freely drain.

4. The on-site soils are erodible; stabilization of soils disturbed during construction by vegetation or other means *during* and *following* construction, is essential to reduce erosion damage. Care should be taken to establish and maintain vegetation. The landscaping should be planned and installed to maintain the surface drainage recommended above. Surface drainage should also be maintained during construction.

5. Maintenance of drainage and other improvements is critical to the long-term stability of the site and the integrity of the structures. Site improvements should be maintained on a regular basis.

6. All exterior drains, retaining wall drains, and drain outlets should be maintained to be free-flowing. Vegetation and erosion matting (if utilized) should be maintained or augmented as needed. Irrigation systems should be maintained so that soils around structures are maintained at a relatively uniform year-round moisture content, and are neither over-watered nor allowed to dry and desiccate.

7. To reduce the potential for disruption of drainage patterns and undermining of structures, fill areas, etc., all rodent activity should be aggressively controlled.

Observation and Testing

1. It must be recognized that the recommendations contained in this report are based on a limited number of borings and rely on continuity of the subsurface conditions encountered.

2. It is assumed that the geotechnical engineer will be retained to provide consultation during the design phase, to interpret this report during construction, and to provide construction monitoring in the form of testing and observation.

3. At a minimum, the geotechnical engineer should be retained to provide:
    - Professional observation during grading, trench and retaining wall backfill, and foundation construction
    - Oversight of special inspection and compaction testing grading, trench and retaining wall backfill, and foundation construction

4. Special inspection of grading and backfill should be provided as per Section 1705A.6 and Table 1705A.6 of the CBC. The special inspector should be under the direction of the geotechnical engineer. At a minimum, the following items should be inspected and/or tested by the special inspector:
    - Stripping and clearing of all existing improvements, vegetation, and deleterious materials
    - Overexcavation of the building and sitework retaining wall areas to the recommended depths
    - Scarification and moisture conditioning of overexcavated areas
    - Scarification and moisture conditioning of exterior pedestrian flatwork, AC path and all other grading areas
    - Fill quality, placement, moisture conditioning and compaction
    - Utility trench backfill
    - Foundation excavations

5. A program of quality assurance should be developed prior to beginning construction. At a minimum, the program should include all geotechnical items shown on the testing and inspection schedule of the approved plans. It should also include any additional inspection items required by the engineer and/or the governing jurisdiction. These items should be discussed at a preconstruction site meeting among a representative of the owner, the geotechnical engineer, special inspector, the project inspector, the engineer, and contractors. The geotechnical engineer should be notified at least 48 hours prior to beginning grading operations.

6. Locations and frequency of compaction tests should be as per the recommendation of the geotechnical engineer at the time of construction. The recommended test location and frequency may be subject to modification by the geotechnical engineer, based upon soil and moisture conditions encountered, size and type of equipment used by the contractor, the general trend of the results of compaction tests, or other factors.

11.0 CLOSURE

Our intent was to perform the investigation in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the locality of this project under similar conditions. No representation, warranty, or guarantee is either expressed or implied. This report is intended for the exclusive use by the client as discussed in the “Scope of Services” section. Application beyond the stated intent is strictly at the user's risk.

This report is valid for conditions as they exist at this time for the type of project described herein. The conclusions and recommendations contained in this report could be rendered invalid, either in whole or in part, due to changes in building codes, regulations, standards of geotechnical or construction practice, changes in physical conditions, or the broadening of knowledge.

If changes with respect to the project become necessary, if items not addressed in this report are incorporated into plans, or if any of the assumptions used in the preparation of this report are not correct, this firm shall be notified for modifications to this report. Any items not specifically addressed in this report should comply with the CBC of other applicable standards, and the requirements of the governing jurisdiction.

The preliminary recommendations presented in this geotechnical report are based upon the geotechnical conditions encountered at the site, and may be augmented by additional requirements of the client, or by additional recommendations provided by the geotechnical engineer based on peer or jurisdiction reviews, or conditions exposed at the time of construction.

This document, the data, conclusions, and recommendations contained herein are the property of Earth Systems Pacific. This report shall be used in its entirety, with no individual sections reproduced or used out of context. Copies may be made only by Earth Systems Pacific, the client, and the client's authorized agents for use exclusively on the subject project. Any other use is subject to federal copyright laws and the written approval of Earth Systems Pacific.

Thank you for this opportunity to have been of service. If you have any questions, please feel free to contact this office at your convenience.

End of Text.

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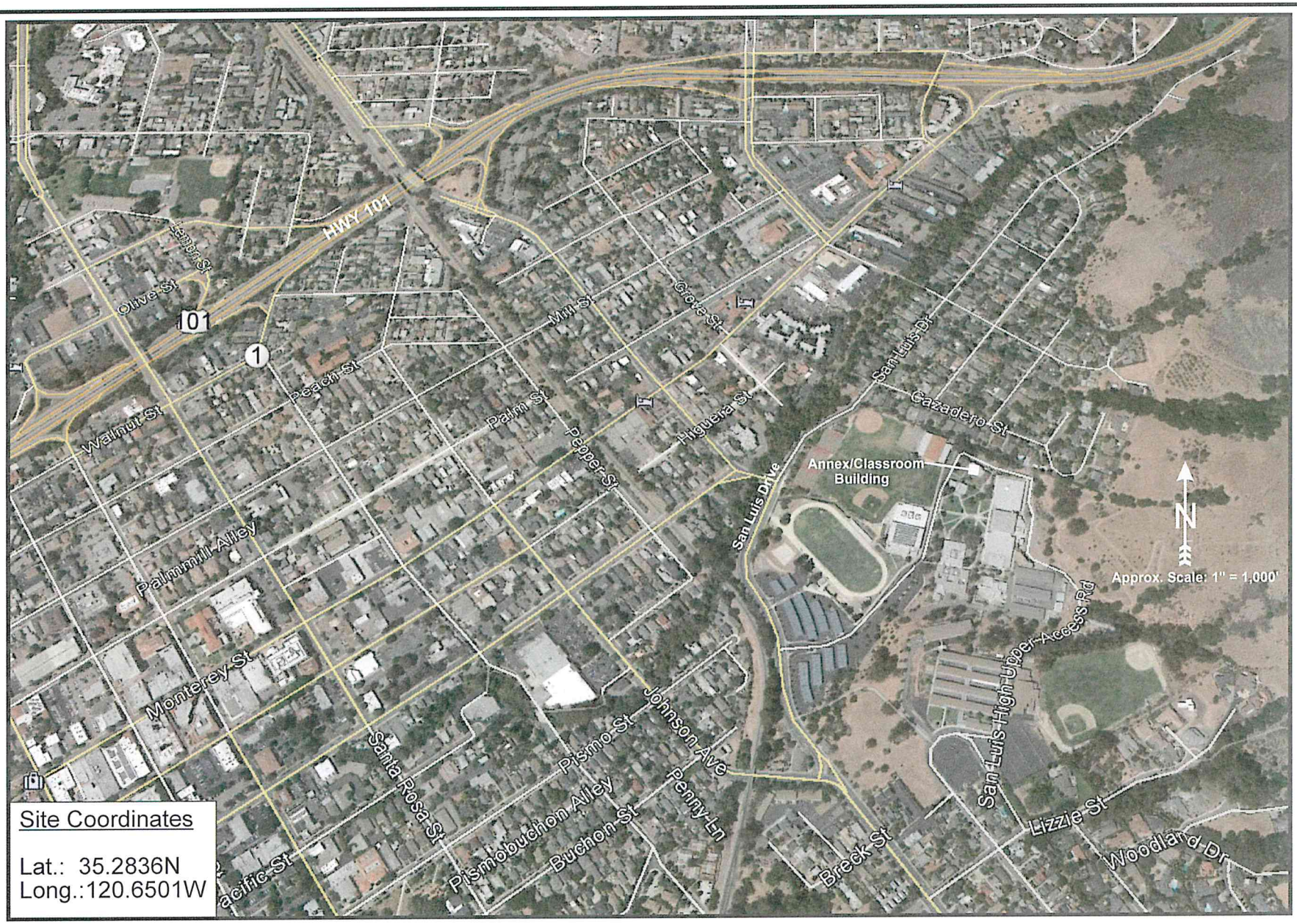
APPENDIX A

Vicinity Map
Boring Location Map
Boring Log Legend
Boring Logs
Cross Section A-A'



Reference: extract from Google Earth 2015

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VICINITY MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

Date
January 2016

Project No.
SL-16605-SE



LEGEND

3 Boring Location (Approx.)

A A' Cross Section (Approx.)

NOT TO SCALE

BORING LOCATION MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

Earth Systems Pacific
4378 Old Santa Fe Road
San Luis Obispo, CA 93401-8116
(805) 544-3276 • FAX (805) 544-1786
E-mail: esp@earthsystems.com

December 9, 2015 CS SL-16605-SE

SLO HS MEASURE D POOL ANNEX CLASSROOM BLDG-1816BLOCATIONS

Earth Systems Pacific

BORING LOG LEGEND

SAMPLE / SUBSURFACE WATER SYMBOLS	GRAPH. SYMBOL
CALIFORNIA MODIFIED	
STANDARD PENETRATION TEST (SPT)	
SHELBY TUBE	
BULK	
SUBSURFACE WATER DURING DRILLING	
SUBSURFACE WATER AFTER DRILLING	

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

MAJOR DIVISIONS	GROUP SYMBOL	TYPICAL DESCRIPTIONS	GRAPH. SYMBOL
COARSE GRAINED SOILS (MORE THAN HALF OF MATERIAL IS LARGER THAN #200 SIEVE SIZE)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GP	POORLY GRADED GRAVELS, OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, NON-PLASTIC FINES	
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, PLASTIC FINES	
	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
	SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES	
	SM	SILTY SANDS, SAND-SILT MIXTURES, NON-PLASTIC FINES	
	SC	CLAYEY SANDS, SAND-CLAY MIXTURES, PLASTIC FINES	
FINE GRAINED SOILS (HALF OR MORE OF MATERIAL IS SMALLER THAN #200 SIEVE SIZE)	ML	INORGANIC SILTS AND VERY FINE SANDS, 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	
	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS	
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	

OBSERVED MOISTURE CONDITION

DRY	SLIGHTLY MOIST	MOIST	VERY MOIST	WET (SATURATED)

CONSISTENCY

COARSE GRAINED SOILS

BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER	
0-10	0-16	LOOSE
11-30	17-50	MEDIUM DENSE
31-50	51-83	DENSE
OVER 50	OVER 83	VERY DENSE

FINE GRAINED SOILS

BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER	
0-2	0-3	VERY SOFT
3-4	4-7	SOFT
5-8	8-13	MEDIUM STIFF
9-15	14-25	STIFF
16-30	26-50	VERY STIFF
OVER 30	OVER 50	HARD

GRAIN SIZES

U.S. STANDARD SERIES SIEVE				CLEAR SQUARE SIEVE OPENING		
# 200	# 40	# 10	# 4	3/4"	3"	12"

SILT & CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

TYPICAL BEDROCK HARDNESS

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
EXTREMELY HARD	CORE, FRAGMENT, OR EXPOSURE CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CAN ONLY BE CHIPPED WITH REPEATED HEAVY HAMMER BLOWS
VERY HARD	CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CORE OR FRAGMENT BREAKS WITH REPEATED HEAVY HAMMER BLOWS
HARD	CAN BE SCRATCHED WITH KNIFE OR SHARP PICK WITH DIFFICULTY (HEAVY PRESSURE); HEAVY HAMMER BLOW REQUIRED TO BREAK SPECIMEN
MODERATELY HARD	CAN BE GROOVED 1/16 INCH DEEP BY KNIFE OR SHARP PICK WITH MODERATE OR HEAVY PRESSURE; CORE OR FRAGMENT BREAKS WITH LIGHT HAMMER BLOW OR HEAVY MANUAL PRESSURE
SOFT	CAN BE GROOVED OR GOUGED EASILY BY KNIFE OR SHARP PICK WITH LIGHT PRESSURE, CAN BE SCRATCHED WITH FINGERNAIL; BREAKS WITH LIGHT TO MODERATE MANUAL PRESSURE
VERY SOFT	CAN BE READILY INDENTED, GROOVED OR GOUGED WITH FINGERNAIL, OR CARVED WITH KNIFE; BREAKS WITH LIGHT MANUAL PRESSURE

TYPICAL BEDROCK WEATHERING

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
FRESH	NO DISCOLORATION, NOT OXIDIZED
SLIGHTLY WEATHERED	DISCOLORATION OR OXIDATION IS LIMITED TO SURFACE OF, OR SHORT DISTANCE FROM, FRACTURES: SOME FELDSPAR CRYSTALS ARE DULL
MODERATELY WEATHERED	DISCOLORATION OR OXIDATION EXTENDS FROM FRACTURES, USUALLY THROUGHOUT; Fe-Mg MINERALS ARE "RUSTY", FELDSPAR CRYSTALS ARE "CLOUDY"
INTENSELY WEATHERED	DISCOLORATION OR OXIDATION THROUGHOUT; FELDSPAR AND Fe-Mg MINERALS ARE ALTERED TO CLAY TO SOME EXTENT, OR CHEMICAL ALTERATION PRODUCES IN SITU DISAGGREGATION
DECOMPOSED	DISCOLORATION OR OXIDATION THROUGHOUT, BUT RESISTANT MINERALS SUCH AS QUARTZ MAY BE UNALTERED; FELDSPAR AND Fe-Mg MINERALS ARE COMPLETELY ALTERED TO CLAY

Earth Systems Pacific

Boring No. 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

PAGE 1 OF 1
JOB NO.: SL-16605-SE
DATE: 12/29/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL		SANDY LEAN CLAY: dark brown/ olive mottled, stiff, moist, trace coarse gravel (Fill)	1.0 - 2.5	Ring	107.5	14.9	5, 6, 7
				0.0 - 3.0	Grab			
4				4.0 - 6.0	Grab			
	CL		SANDY LEAN CLAY: dark brown, very stiff, moist, some fine gravel (Alluvium)	5.0 - 6.5	Ring	109.1	14.8	7, 13, 18
10				10.0 - 11.5	Ring	119.6	13.0	6, 13, 21
15				15.0 - 16.5	SPT			4, 8, 11
17	GC		CLAYEY GRAVEL WITH SAND: brown, medium dense, moist	20.0 - 21.5	SPT			4, 9, 12
24			SANDSTONE: dark yellow brown, moderately soft, moist (Franciscan Melange)	25.0 - 25.5	SPT			50/3"
26			End of Boring @ 26.0' due to refusal No subsurface water encountered					

LEGEND: Ring Sample Grab Sample Shelby Tube Sample SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 2

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

PAGE 1 OF 1
JOB NO.: SL-16605-SE
DATE: 12/29/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			4.0" AC over 2" AB					
1	CL		SANDY LEAN CLAY: dark brown, stiff, moist, some fine gravel (Alluvium)					
2				1.0 - 4.0	○			4
3				3.0 - 4.5	▬	109.4	16.2	10 16
4			brown, slightly moist					
5			dark brown, moist, gravel ends	5.0 - 6.5	▬	112.6	15.2	5 8 13
9			brown, very stiff to hard					
10				10.0 - 11.5	▬	119.4	14.6	7 16 20
15				15.0 - 16.5	●			4 9 12
17			End of Boring @ 16.5' No subsurface water encountered					

LEGEND: ▬ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 3

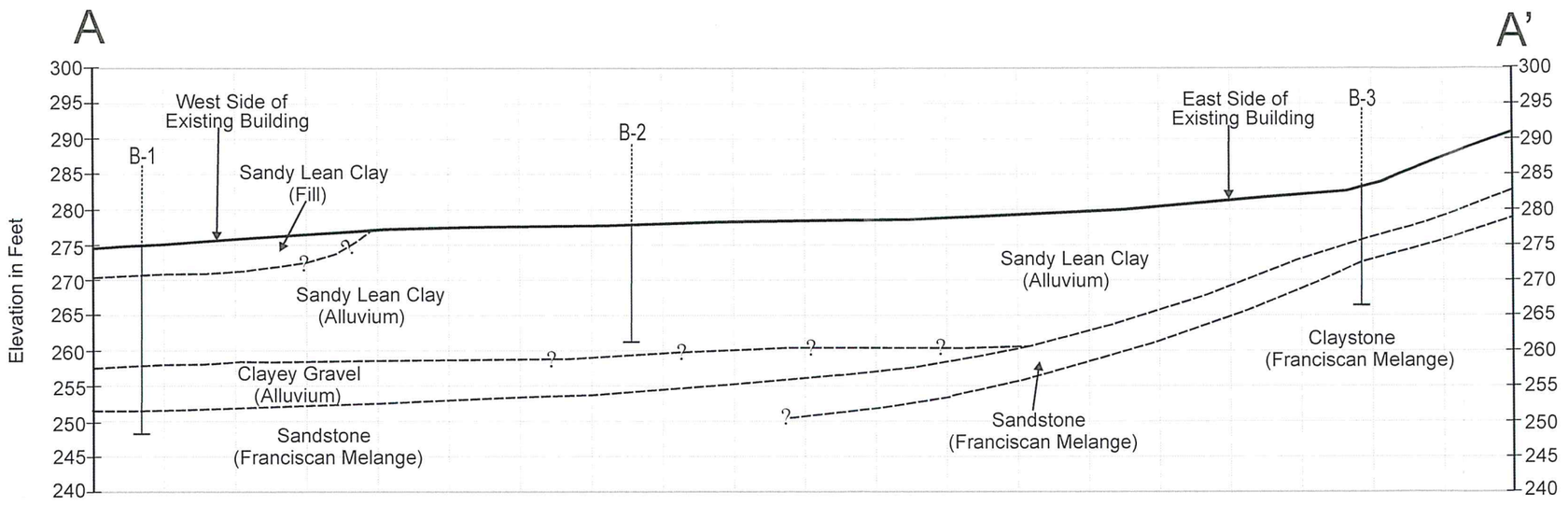
LOGGED BY: R. Wagner — PAGE 1 OF 1
DRILL RIG: Mobile B53 — JOB NO.: SL-16605-SE
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer — DATE: 12/29/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL		SANDY LEAN CLAY: dark brown, very stiff, very moist, trace gravel (Alluvium)	1.0 - 2.5	Ring	110.4	17.8	4, 8, 12
4			brown, slightly moist	3.5 - 6.0	Grab			
5				5.0 - 6.5	Ring	118.7	11.6	8, 13, 19
6				5.0 - 6.5	Grab			
8			SANDSTONE: dark yellow brown, moderately soft, moist (Franciscan Melange)					
10				10.0 - 11.5	Ring			16, 36, 50/5"
11			CLAYSTONE: gray brown, moderately soft, moist, severely sheared, weathered					
15				15.0 - 16.5	SPT			11, 20, 28
17			End of Boring @ 16.5' due to refusal No subsurface water encountered					

LEGEND: Ring Sample; Grab Sample; Shelby Tube Sample; SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.



Scale 1" = 20'

EARTH SYSTEMS PACIFIC

4378 Old Santa Fe Road, San Luis Obispo, CA 93401
www.earthsystems.com - email: esp@earthsystems.com
(805) 544-3276

CROSS SECTION A-A'

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

Date
January 2016

Project No.
SL-16605-SE

APPENDIX B

Geotechnical Laboratory Test Results

San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

BULK DENSITY TEST RESULTS

ASTM D 2937-10 (modified for ring liners)

January 12, 2016

BORING NO.	DEPTH feet	MOISTURE CONTENT, %	WET DENSITY, pcf	DRY DENSITY, pcf
1	2.0 - 2.5	14.9	123.5	107.5
1	6.0 - 6.5	14.8	125.3	109.1
1	11.0 - 11.5	13.0	135.1	119.6
2	4.0 - 4.5	16.2	127.1	109.4
2	6.0 - 6.5	15.2	129.7	112.6
2	11.0 - 11.5	14.6	136.8	119.4
3	2.0 - 2.5	17.8	130.0	110.4
3	6.0 - 6.5	11.6	132.5	118.7

EXPANSION INDEX TEST RESULTS

ASTM D 4829-11

BORING NO.	DEPTH feet	EXPANSION INDEX
1	0.0 - 3.0	54
2	1.0 - 4.0	58

San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

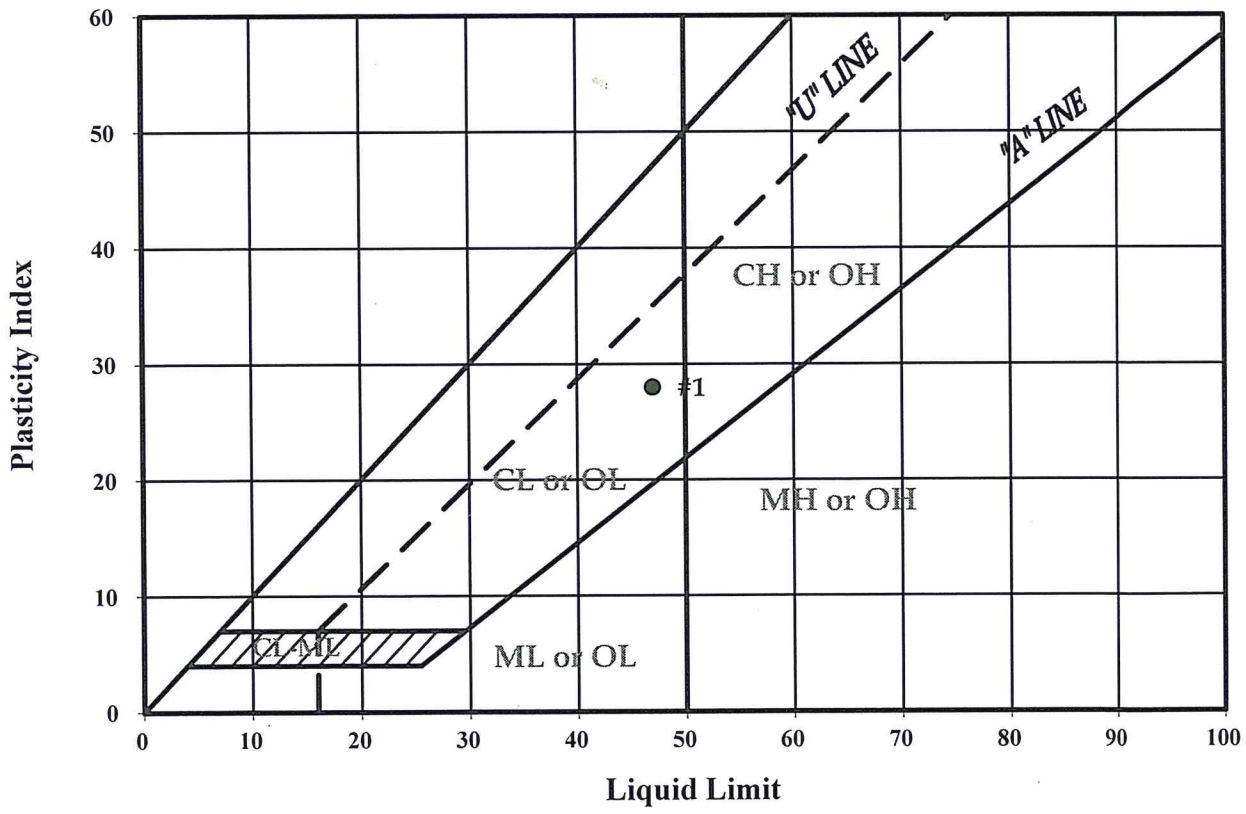
PLASTICITY INDEX

ASTM D 4318-10

January 12, 2016

Test No.:	1	2	3	4	5
Boring No.:	1				
Sample Depth:	4.0 - 6.0'				
Liquid Limit:	47				
Plastic Limit:	19				
Plasticity Index:	28				

Plasticity Chart



San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

MOISTURE-DENSITY COMPACTION TEST

ASTM D 1557-12 (Modified)

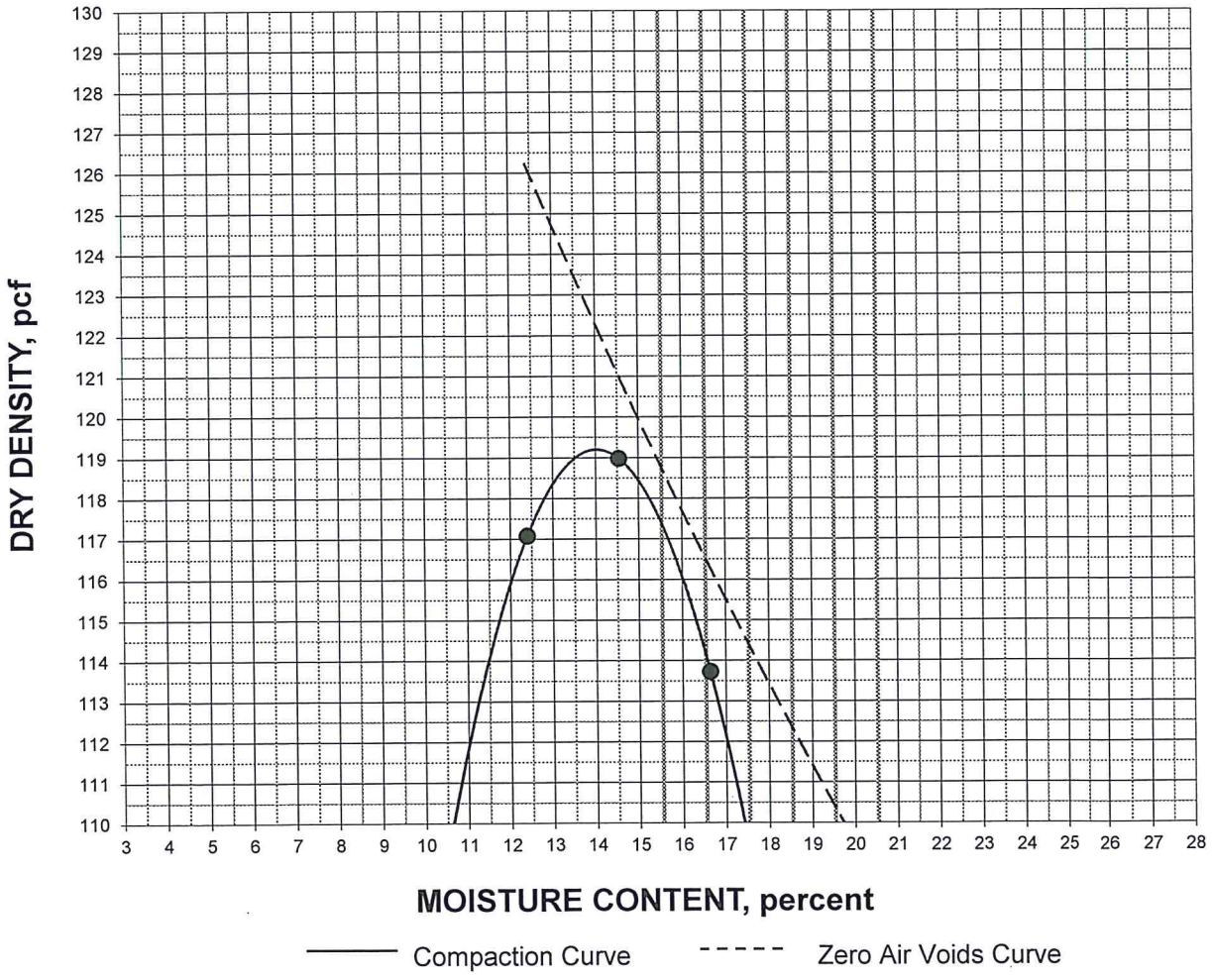
PROCEDURE USED: A
PREPARATION METHOD: Moist
RAMMER TYPE: Mechanical
SPECIFIC GRAVITY: 2.70 (assumed)

January 12, 2016
Boring #2 @ 1.0 - 4.0'
Dark Brown Sandy Lean Clay (CL)

SIEVE DATA:

Sieve Size	% Retained (Cumulative)
3/4"	0
3/8"	0
#4	0

MAXIMUM DRY DENSITY: 119.2 pcf
OPTIMUM MOISTURE: 14.0%



San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

DIRECT SHEAR

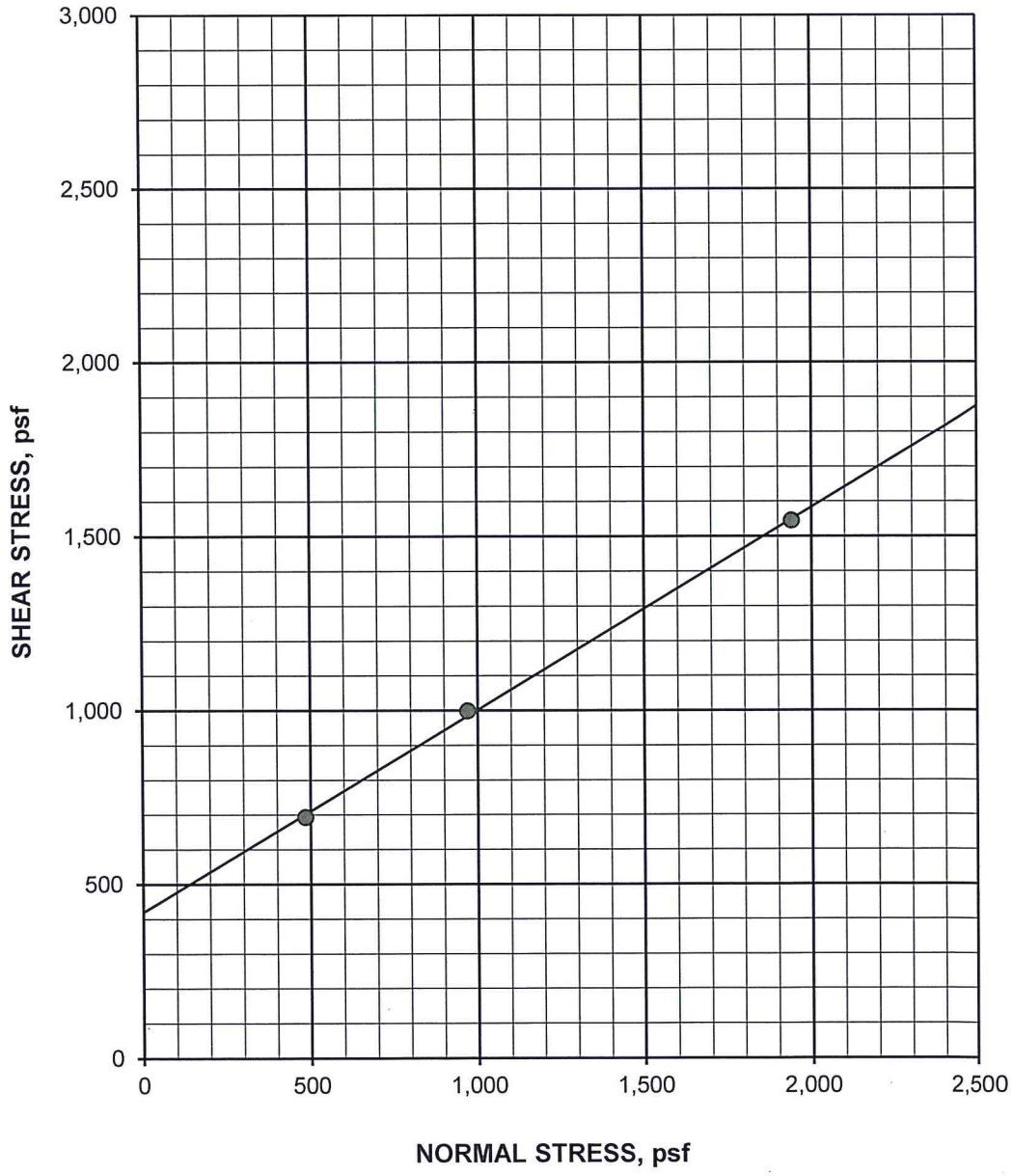
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

January 12, 2016

Boring #2 @ 1.0 - 4.0'
Sandy Lean Clay (CL)
Compacted to 90% RC, saturated

INITIAL DRY DENSITY: 107.3 pcf
INITIAL MOISTURE CONTENT: 14.0 %
PEAK SHEAR ANGLE (Ø): 30°
COHESION (C): 420 psf

SHEAR vs. NORMAL STRESS



DIRECT SHEAR continued

ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

Boring #2 @ 1.0 - 4.0'

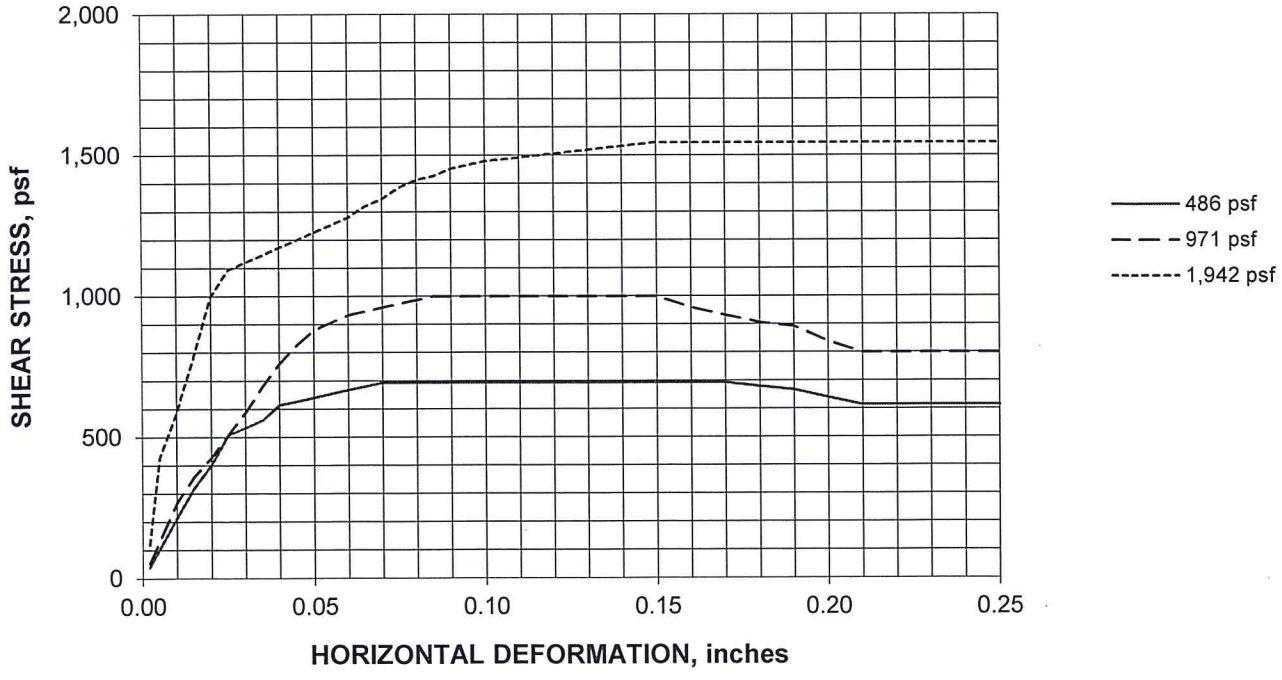
January 12, 2016

Sandy Lean Clay (CL)

Compacted to 90% RC, saturated

SPECIFIC GRAVITY: 2.70 (assumed)

SAMPLE NO.:	1	2	3	AVERAGE
INITIAL				
WATER CONTENT, %	14.0	14.0	14.0	14.0
DRY DENSITY, pcf	107.3	107.3	107.3	107.3
SATURATION, %	66.3	66.3	66.3	66.3
VOID RATIO	0.570	0.570	0.570	0.570
DIAMETER, inches	2.410	2.410	2.410	
HEIGHT, inches	1.00	1.00	1.00	
AT TEST				
WATER CONTENT, %	25.3	23.9	22.9	
DRY DENSITY, pcf	108.3	109.8	114.5	
SATURATION, %	100.0	100.0	100.0	
VOID RATIO	0.556	0.534	0.472	
HEIGHT, inches	0.99	0.98	0.94	



San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

CONSOLIDATION TEST

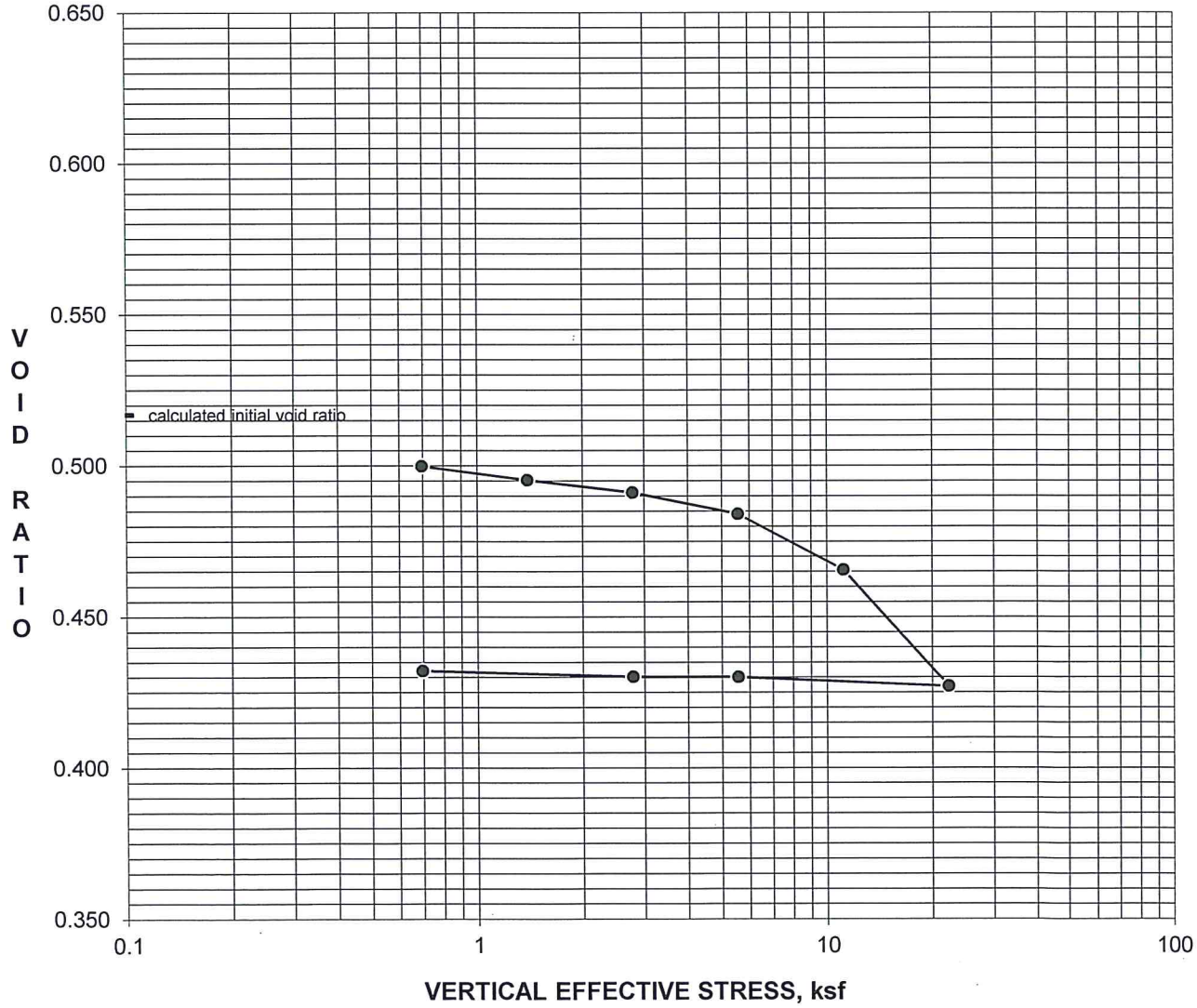
ASTM D 2435/D2435M-11

January 12, 2016

Boring #2 @ 6.0 - 6.5'
Sandy Lean Clay (CL)
Ring Sample

DRY DENSITY: 111.1 pcf
MOISTURE CONTENT: 15.2%
SPECIFIC GRAVITY: 2.70 (assumed)
INITIAL VOID RATIO: 0.517

VOID RATIO vs. NORMAL PRESSURE DIAGRAM



APPENDIX C

Soil Corrosivity Study by HDR, Inc.

January 18, 2016 via email: Fred@earthsystems.com

EARTH SYSTEMS PACIFIC
4378 Old Santa Fe Road
San Luis Obispo, CA 93401

Attention: Mr. Fred J. Potthast, GE

Re: Soil Corrosivity Study
San Luis Obispo High School
Annex/Classroom Building Project
No. 831-3102
San Luis Obispo, California
HDR #274257, ESP #SL16605-SE

Introduction

Laboratory tests have been completed on two soil samples provided for the San Luis Obispo High School project. The purpose of these tests was to determine if the soils might have deleterious effects on underground utility piping and concrete structures. HDR Engineering, Inc. (HDR) assumes that the samples provided are representative of the most corrosive soils at the site.

The proposed construction consists of a single story classroom building with conventional foundations and slabs-on-grade. The site is located at 1499 San Luis Drive in San Luis Obispo, California. The water table was reportedly not encountered during exploratory borings to a depth of 26 feet.

The scope of this study is limited to a determination of soil corrosivity and general corrosion control recommendations for materials likely to be used for construction. HDR's recommendations do not constitute, and are not meant as a substitute for, design documents for the purpose of construction. If the architects and/or engineers desire more specific information, designs, specifications, or review of design, HDR will be happy to work with them as a separate phase of this project.

Laboratory Soil Corrosivity Tests

The electrical resistivity of each sample was measured in a soil box per ASTM G187 in its as-received condition and again after saturation with distilled water. Resistivities are at about their lowest value when the soil is saturated. The pH of the saturated samples was measured per CTM 643. A 5:1 water:soil extract from each sample was chemically analyzed for the major soluble salts commonly found in soil per ASTM D4327, ASTM D6919, and Standard Method 2320-B[1]. Laboratory analysis was performed under HDR laboratory number 16-0015SCS and the test results are shown in the attached Table 1.

Soil Corrosivity

A major factor in determining soil corrosivity is electrical resistivity. The electrical resistivity of a soil is a measure of its resistance to the flow of electrical current. Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of electrical current (DC) from the metal into the soil. Corrosion currents, following Ohm's Law, are inversely proportional to soil resistivity. Lower electrical resistivities result from higher moisture and soluble salt contents and indicate corrosive soil.

A correlation between electrical resistivity and corrosivity toward ferrous metals is:[2]

Soil Resistivity in ohm-centimeters	Corrosivity Category
Greater than 10,000	Mildly Corrosive
2,001 to 10,000	Moderately Corrosive
1,001 to 2,000	Corrosive
0 to 1,000	Severely Corrosive

Other soil characteristics that may influence corrosivity towards metals are pH, soluble salt content, soil types, aeration, anaerobic conditions, and site drainage.

---

[1] *American Public Health Association (APHA). 2012. Standard Methods of Water and Wastewater. 22nd ed. American Public Health Association, American Water Works Association, Water Environment Federation publication. APHA, Washington D.C.*

[2] *Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, pp. 166–167.*

Electrical resistivities were in the moderately corrosive categories with as-received moisture. When saturated, the resistivities were in the corrosive to severely corrosive categories. The resistivities dropped with added moisture because the samples were dry as-received.

Soil pH for both samples was 7.7. This value is in the mildly alkaline[3] range and does not particularly increase soil corrosivity.

The soluble salt content of the samples ranged from low to moderate.

The nitrate concentration was high enough to be aggressive to copper.

Tests were not made for sulfide and negative oxidation-reduction (redox) potential because these samples did not exhibit characteristics typically associated with anaerobic conditions.

This soil is classified as severely corrosive to ferrous metals and aggressive to copper.

Corrosion Control Recommendations

The life of buried materials depends on thickness, strength, loads, construction details, soil moisture, etc., in addition to soil corrosivity, and is, therefore, difficult to predict. Of more practical value are corrosion control methods that will increase the life of materials that would be subject to significant corrosion.

The following recommendations are based on the soil conditions discussed in the Soil Corrosivity section above. Unless otherwise indicated, these recommendations apply to the entire site or alignment.

Steel Pipe

Implement *all* the following measures:

1. Underground steel pipe with rubber gasketed, mechanical, grooved end, or other nonconductive type joints should be bonded for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.

---

[3] *Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, p. 8.*

2. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:

    a. At each end of the pipeline.

    b. At each end of all casings.

    c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.

3. To prevent dissimilar metal corrosion cells and to facilitate the application of cathodic protection, electrically isolate each buried steel pipeline per NACE SP0286 from:

    a. Dissimilar metals.

    b. Dissimilarly coated piping (cement-mortar vs. dielectric).

    c. Above ground steel pipe.

    d. All existing piping.

4. Choose one of the following corrosion control options:

    OPTION 1

    a. Apply a suitable dielectric coating intended for underground use such as:

        i. Polyurethane per AWWA C222 *or*

        ii. Extruded polyethylene per AWWA C215 *or*

        iii. A tape coating system per AWWA C214 *or*

        iv. Hot applied coal tar enamel per AWWA C203 *or*

        v. Fusion bonded epoxy per AWWA C213.

    b. Apply cathodic protection to steel piping as per NACE SP0169.

OPTION 2

a. As an alternative to dielectric coating and cathodic protection, apply a ¾-inch cement mortar coating per AWWA C205 or encase in concrete 3 inches thick, using any type of ASTM C150 cement. Joint bonds, test stations, and insulated joints are still recommended for these alternatives.

NOTE: Some steel piping systems, such as for oil, gas, and high-pressure piping systems, have special corrosion and cathodic protection requirements that must be evaluated for each specific application.

Iron Pipe

Implement *all* the following measures:

1. To prevent dissimilar metal corrosion cells and to facilitate the application of cathodic protection, electrically insulate underground iron pipe from dissimilar metals and from above ground iron pipe with insulating joints per NACE SP0286.
2. Bond all nonconductive type joints for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.
3. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:
    a. At each end of the pipeline.
    b. At each end of any casings.
    c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.
4. Choose one of the following corrosion control options:

    OPTION 1

    a. Apply a suitable coating intended for underground use such as:
        i. Polyethylene encasement per AWWA C105; *or*
        ii. Epoxy coating; *or*

iii. Polyurethane; *or*

iv. Wax tape.

NOTE: The thin factory-applied asphaltic coating applied to ductile iron pipe for transportation and aesthetic purposes does not constitute a corrosion control coating.

b. Apply cathodic protection to cast and ductile iron piping as per NACE SP0169.

OPTION 2

a. As an alternative to coating systems described in Option 1 and cathodic protection, concrete encase all buried portions of metallic piping so that there is a minimum of 3 inches of concrete cover provided over and around surfaces of pipe, fittings, and valves using any type of ASTM C150 cement.

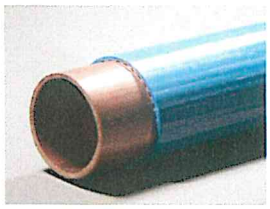
Copper Tubing

Implement *all* the following measures:

1. Electrically insulate underground copper pipe from dissimilar metals and from above ground copper pipe with insulating devices per NACE SP0286.
2. Electrically insulate cold water piping from hot water piping systems.
3. Protect buried copper tubing by one of the following measures:

    a. Prevention of soil contact. Soil contact may be prevented by placing the tubing above ground or encasing the tubing using PVC pipe with solvent-welded joints.

    b. Installation of a factory-coated copper pipe with a minimum 25-mil thickness such as Kamco's Aqua Shield™, Mueller's Streamline Protec™, or equal. The coating must be continuous with no cuts or defects.



    c. Installation of 12-mil polyethylene pipe wrapping tape with butyl rubber mastic over a suitable primer. Protect wrapped copper tubing by applying cathodic protection per NACE SP0169.

Plastic and Vitrified Clay Pipe

1. No special precautions are required for plastic and vitrified clay piping placed underground from a corrosion viewpoint.

2. Protect all metallic fittings and valves with wax tape per AWWA C217 or epoxy.

All Pipe

1. On all pipes, appurtenances, and fittings not protected by cathodic protection, coat bare metal such as valves, bolts, flange joints, joint harnesses, and flexible couplings with wax tape per AWWA C217 after assembly.

2. Where metallic pipelines penetrate concrete structures such as building floors, vault walls, and thrust blocks use plastic sleeves, rubber seals, or other dielectric material to prevent pipe contact with the concrete and reinforcing steel.

Concrete

1. From a corrosion standpoint, any type of ASTM C150 cement may be used for concrete structures and pipe because the sulfate concentration is negligible, 0 to 0.10 percent.[4,5,6]

2. Standard concrete cover over reinforcing steel may be used for concrete structures and pipe in contact with these soils due to the low chloride concentration[7] found onsite.

Closure

The analysis and recommendations presented in this report are based upon data obtained from the laboratory samples. This report does not reflect variations that may occur across the site or due to the modifying effects of construction. If variations appear, HDR should be

---

[4] *2012 International Building Code (IBC) Section 1904.3*

[5] *2012 International Residential Code (IRC) which refers to American Concrete Institute (ACI) 318 Table 19.3.2.1*

[6] *2013 California Building Code (CBC) which refers to American Concrete Institute (ACI) 318 Table 19.3.2.1*

[7] *Design Manual 303: Concrete Cylinder Pipe. Ameron. p.65*

notified immediately so that further evaluation and supplem ental recommendations can be provided.

HDR's services have been performed with the usual thoroughness and com petence of the engineering profession. No other warranty or representation, either expressed or implied, is included or intended.

Please call if you have any questions.

Respectfully Submitted,
HDR Engineering, Inc.

Jose Peña

Brien L. Clark, PE

LICENSED PROFESSIONAL ENGINEER
BRIEN L. CLARK
CH 6291
EXP. 12/31/17
CHEMICAL
STATE OF CALIFORNIA

Enc: Table 1

274257_SCS_Rpt_JP_Rev00_BC.docx

Table 1 - Laboratory Tests on Soil Samples

Earth Systems Pacific
SLO High School - Annex / Classroom Building Project No. 831-3102
Your #SL-16605-SE, HDR Lab #16-0015SCS
5-Jan-16

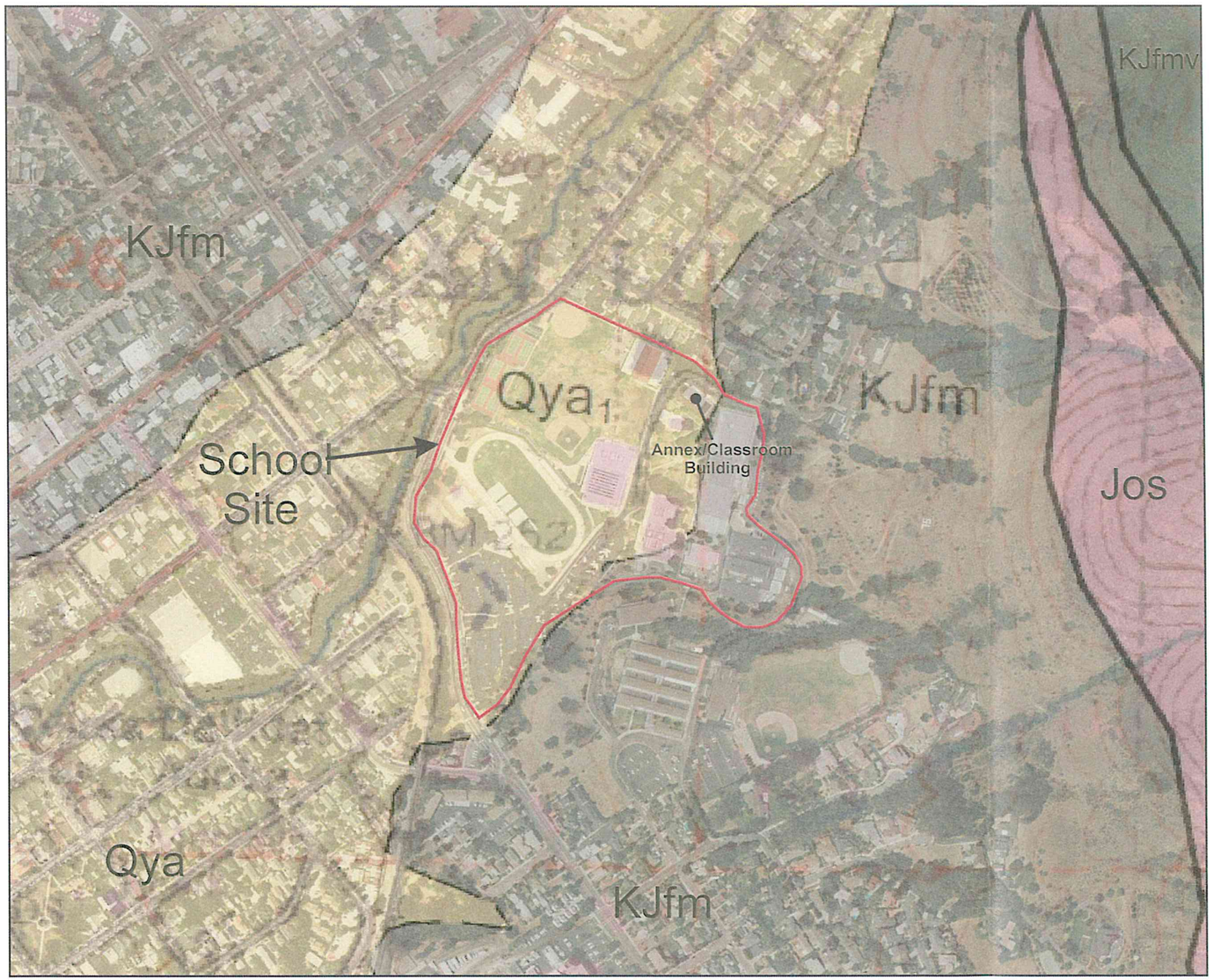
Sample ID			B1 @ 0-3' CL	B2 @ 1-4' CL
Resistivity		**Units**		
as-received		ohm-cm	4,800	6,000
saturated		ohm-cm	1,200	800
pH			7.7	7.7
Electrical Conductivity		mS/cm	0.16	0.24
Chemical Analyses				
Cations				
calcium	Ca^{2+}	mg/kg	61	86
magnesium	Mg^{2+}	mg/kg	ND	ND
sodium	Na^{1+}	mg/kg	77	46
potassium	K^{1+}	mg/kg	7.5	12
Anions				
carbonate	CO_3^{2-}	mg/kg	ND	ND
bicarbonate	HCO_3^{1-}	mg/kg	366	174
fluoride	F^{1-}	mg/kg	4.0	1.9
chloride	Cl^{1-}	mg/kg	11	7.3
sulfate	SO_4^{2-}	mg/kg	60	292
phosphate	PO_4^{3-}	mg/kg	ND	ND
Other Tests				
ammonium	NH_4^{1+}	mg/kg	ND	ND
nitrate	NO_3^{1-}	mg/kg	7.0	127
sulfide	S^{2-}	qual	na	na
Redox		mV	na	na

Electrical conductivity in millisiemens/cm and chemical analysis were made on a 1:5 soil-to-water extract.
mg/kg = milligrams per kilogram (parts per million) of dry soil.
Redox = oxidation-reduction potential in millivolts
ND = not detected
na = not analyzed

431 West Baseline Road · Claremont, CA 91711
Phone: 909.962.5485 · Fax: 909.626.3316

APPENDIX D

Geologic Map
Historical Earthquake/Fault Map
FEMA Flood Zone Map



Extract from: Geologic Map of the San Luis Obispo Quadrangle, San Luis Obispo County, California: by Wiegers, 2010.

EXPLANATION

Geologic Units

Qya
Young Alluvial flood-Plain Deposits

Jos
Serpentinized Ultramafic Rock

KJfm
Franciscan Melange

KJfmv
Franciscan Metavolcanic Rock

Geologic Symbols

Contact
Dashed where approximately located or inferred

High-angle fault
Dashed where approximately located or inferred; dotted where concealed

Thrust or reverse fault
Dashed where approximately located or inferred; dotted where concealed. Saw-teeth on upper plate. Dip of fault plane between 30° and 80°

Anticline
Showing axis at surface. Dashed where approximately located; dotted where concealed

Syncline
Showing axis at surface. Dashed where approximately located; dotted where concealed

Horizontal 30 Inclined 90 Vertical
Strike and dip of beds

N

Approx. Scale: 1" = 500'

EARTH SYSTEMS PACIFIC
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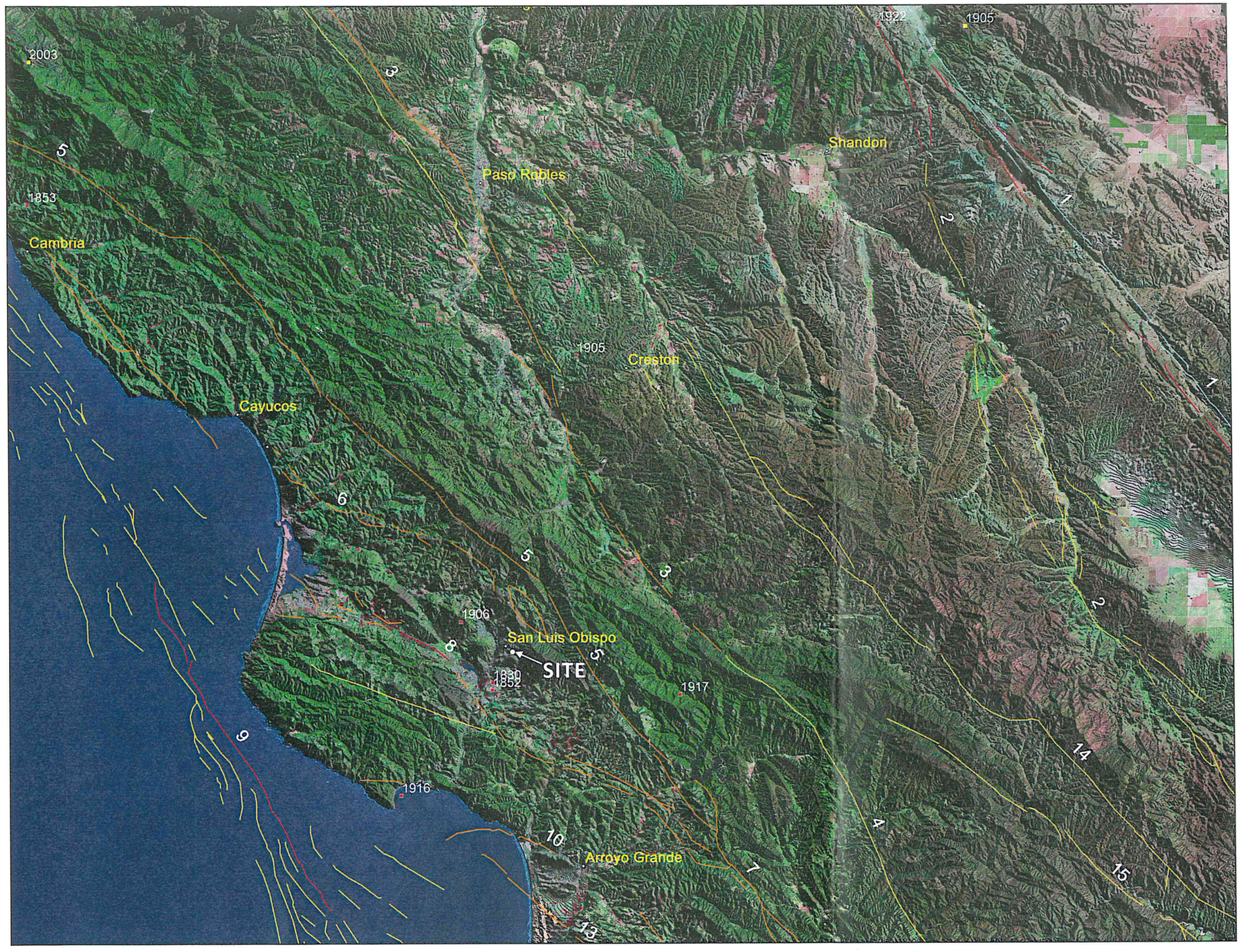
(805) 544-3276

GEOLOGIC MAP
SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

Date
January 2016

Project No.
SL-16605-SE



LEGEND

- Historic rupture (<200 years)
- Holocene fault (<10,000 years)
- Late Quaternary (<700,000 years)
- Quaternary fault (<1.6 million)

HISTORICAL EARTHQUAKE MAGNITUDE

5.0 to 5.9 | 6.0 to 6.9 | 7.0 to 7.9

FAULTS

1	San Andreas	11	Casmalia
2	San Juan	12	Lions Head
3	Rinconada	13	Oceano
4	East Huasna	14	La Panza
5	Oceanic	15	South Cuyama
6	Cambria		
7	West Huasna		
8	Los Osos		
9	Hosgri-San Simeon		
10	San Luis Range		

REFERENCES

Blake, T.F., EQSEARCH, 2000, updated 2010
Jennings, C.W. & Bryant, W.A., 2010

N

(Approximate Scale: 1" = 6 miles)

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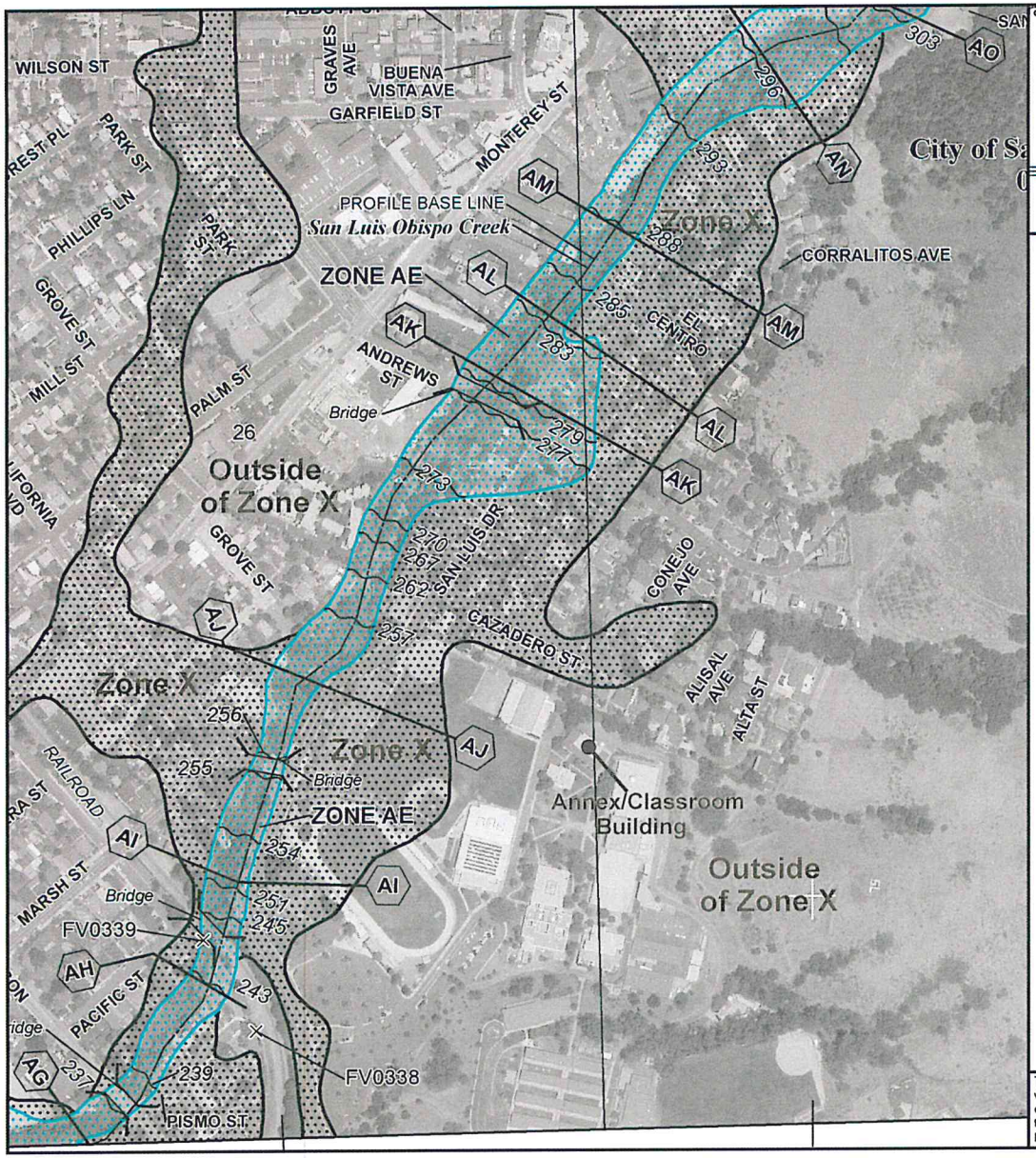
HISTORICAL EARTHQUAKE/ FAULT MAP
SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

Date
January 2016

Project No.
SL-16605-SE



ance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

0 250 500 750 1,000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1067G

FIRM

FLOOD INSURANCE RATE MAP

SAN LUIS OBISPO COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL 1067 OF 2050

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
SAN LUIS OBISPO COUNTY	060304	1067	G
SAN LUIS OBISPO, CITY OF	060310	1067	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER 06079C1067G

MAP REVISED NOVEMBER 16, 2012

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

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FEMA FLOOD ZONE MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

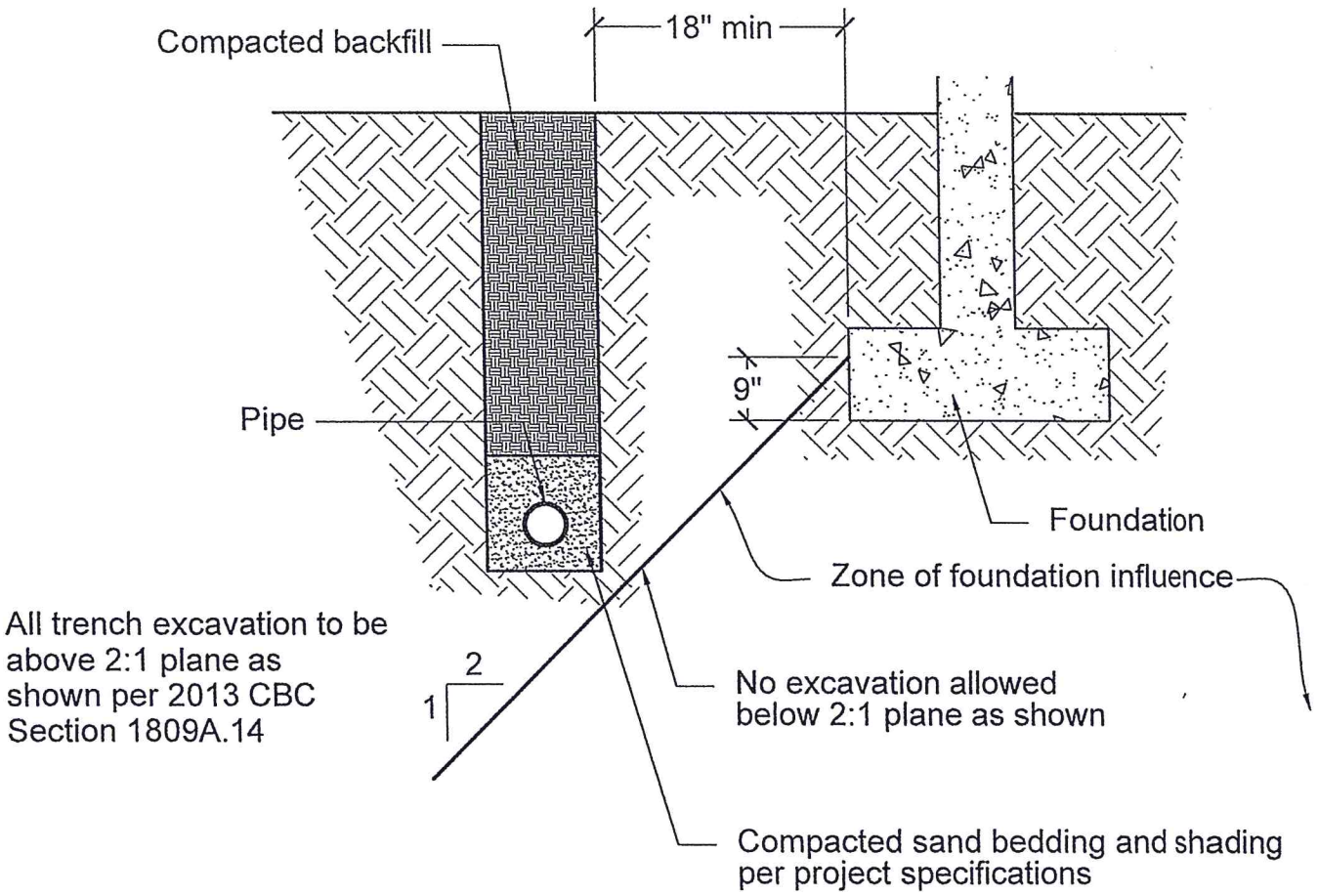
Date
January 2016

Project No.
SL-16605-SE

APPENDIX E

Typical Detail A: Pipe Placed Parallel to Foundations

TYPICAL DETAIL A
PIPE PLACED PARALLEL TO FOUNDATIONS*



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E-mail: esp@earthsys.com

APPENDIX C

Geotechnical Laboratory Test Results

San Luis Obispo High School
Building 100 Modernization

300933-007

BULK DENSITY TEST RESULTS

ASTM D 2937-17 (modified for ring liners)

July 2, 2018

BORING NO.	DEPTH feet	MOISTURE CONTENT, %	WET DENSITY, pcf	DRY DENSITY, pcf
2	3.0 - 3.5	11.5	122.0	109.4
2	6.0 - 6.5	19.9	127.3	106.2
2	11.0 - 11.5	8.0	144.4	133.7
3	3.0 - 3.5	25.5	131.9	105.0
3	6.0 - 6.5	11.1	127.6	114.9
3	11.0 - 11.5	12.7	133.5	118.4
3	17.5 - 18.0	19.9	126.4	105.4
3	21.0 - 21.5	18.9	130.3	109.6
5	3.0 - 3.5	12.1	133.1	118.8
7	6.0 - 6.5	14.4	129.0	112.8
7	11.0 - 11.5	15.9	130.1	112.3

EXPANSION INDEX TEST RESULTS

ASTM D 4829-11

BORING NO.	DEPTH feet	EXPANSION INDEX
2	1.0 - 4.0	47
3	1.0 - 4.0	55

San Luis Obispo High School
Building 100 Modernization

300933-007

MOISTURE-DENSITY COMPACTION TEST

ASTM D 1557-12 (Modified)

PROCEDURE USED: B

PREPARATION METHOD: Moist

RAMMER TYPE: Mechanical

SPECIFIC GRAVITY: 2.70 (assumed)

July 2, 2018

Boring #2 @ 1.0 - 4.0'

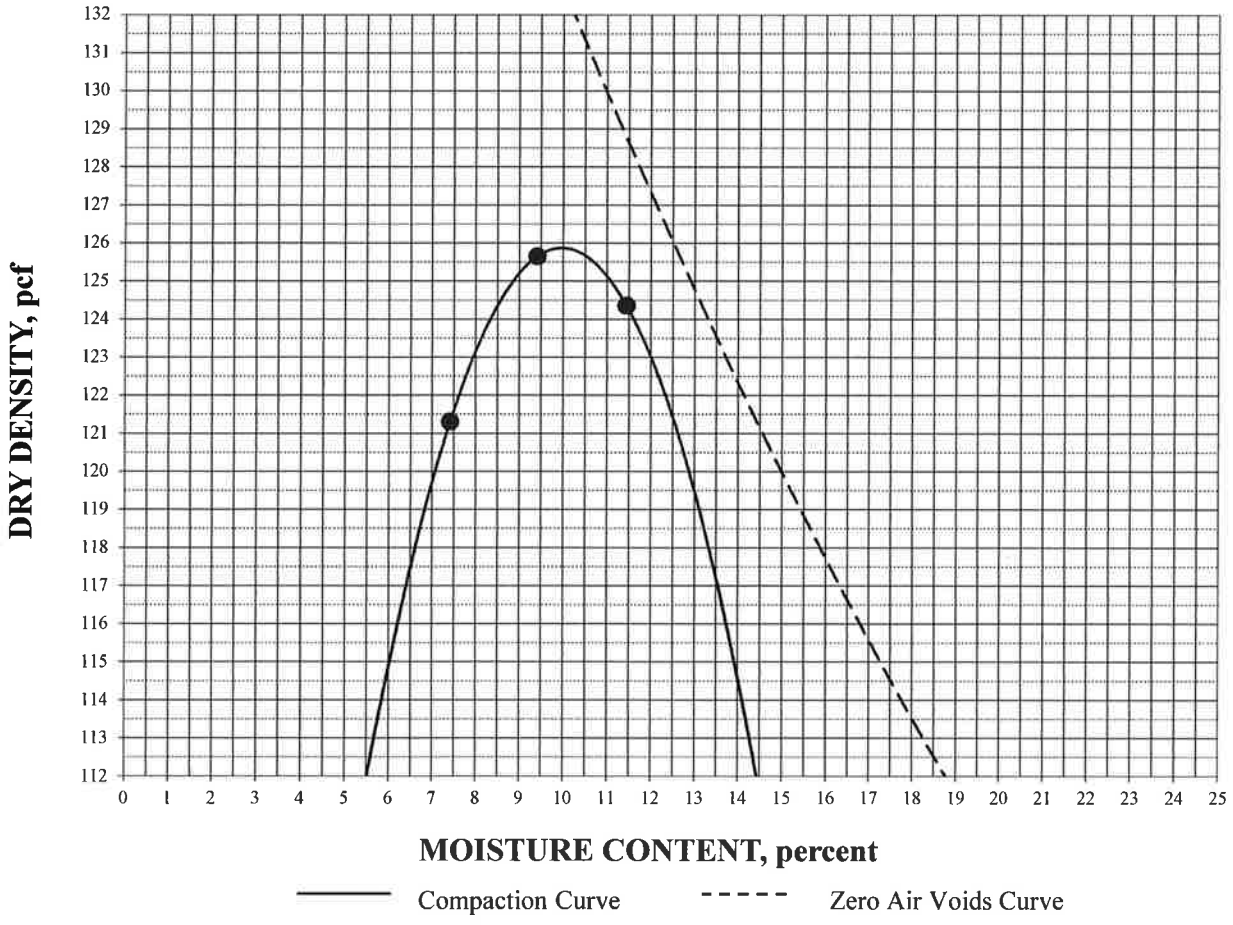
Yellow Brown Clayey Sand (SC)

SIEVE DATA:

Sieve Size	% Retained (Cumulative)
3/4"	0
3/8"	7
#4	5

MAXIMUM DRY DENSITY: 125.9 pcf

OPTIMUM MOISTURE: 10.0%



San Luis Obispo High School
Building 100 Modernization

300933-007

DIRECT SHEAR

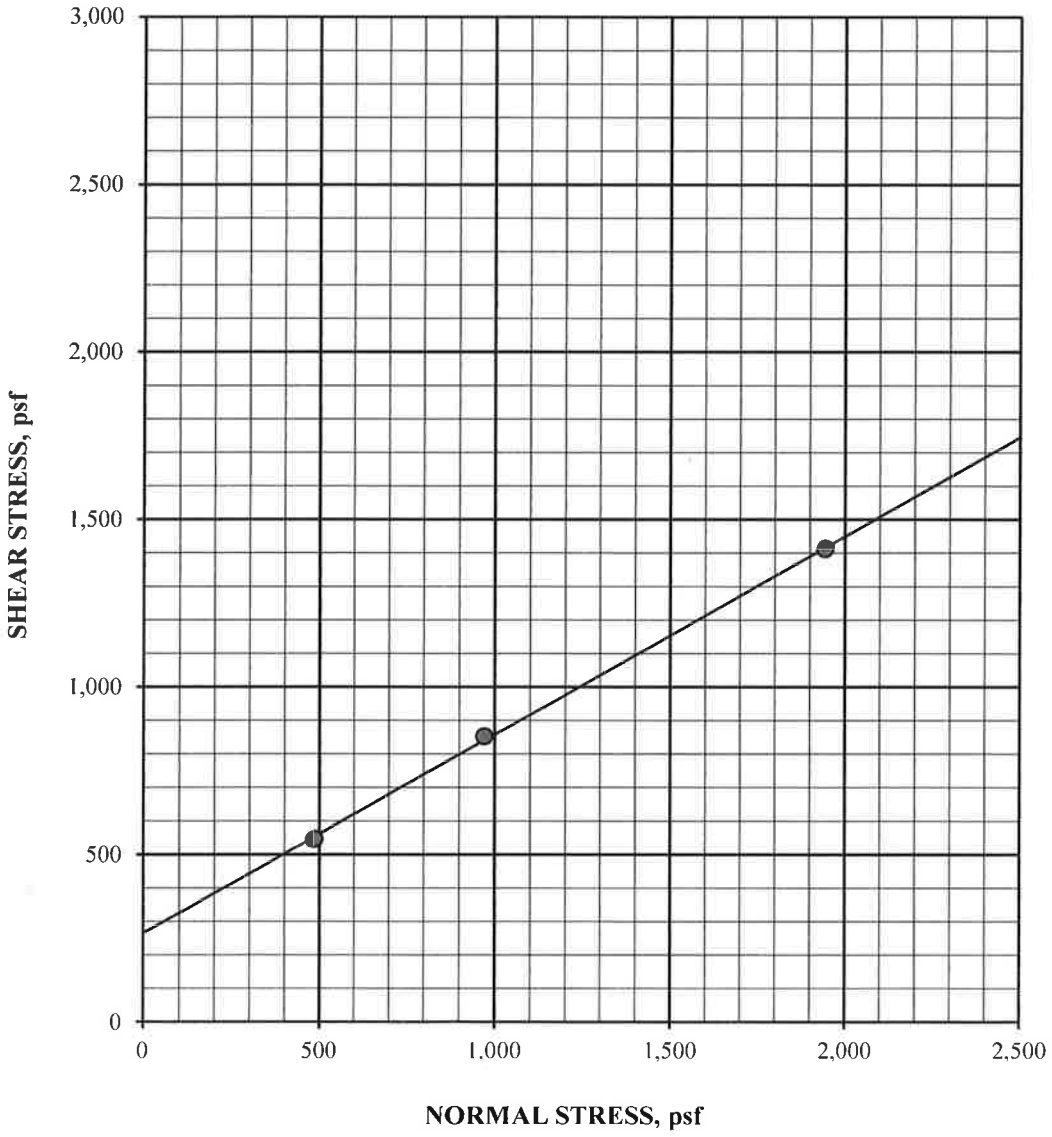
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

July 2, 2018

Boring #2 @ 1.0 - 4.0'
Clayey Sand (SC)
Compacted to 90% RC, saturated

INITIAL DRY DENSITY: 113.3 pcf
INITIAL MOISTURE CONTENT: 10.0 %
PEAK SHEAR ANGLE (Ø): 31°
COHESION (C): 266 psf

SHEAR vs. NORMAL STRESS



San Luis Obispo High School
Building 100 Modernization

300933-007

DIRECT SHEAR continued

ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

Boring #2 @ 1.0 - 4.0'

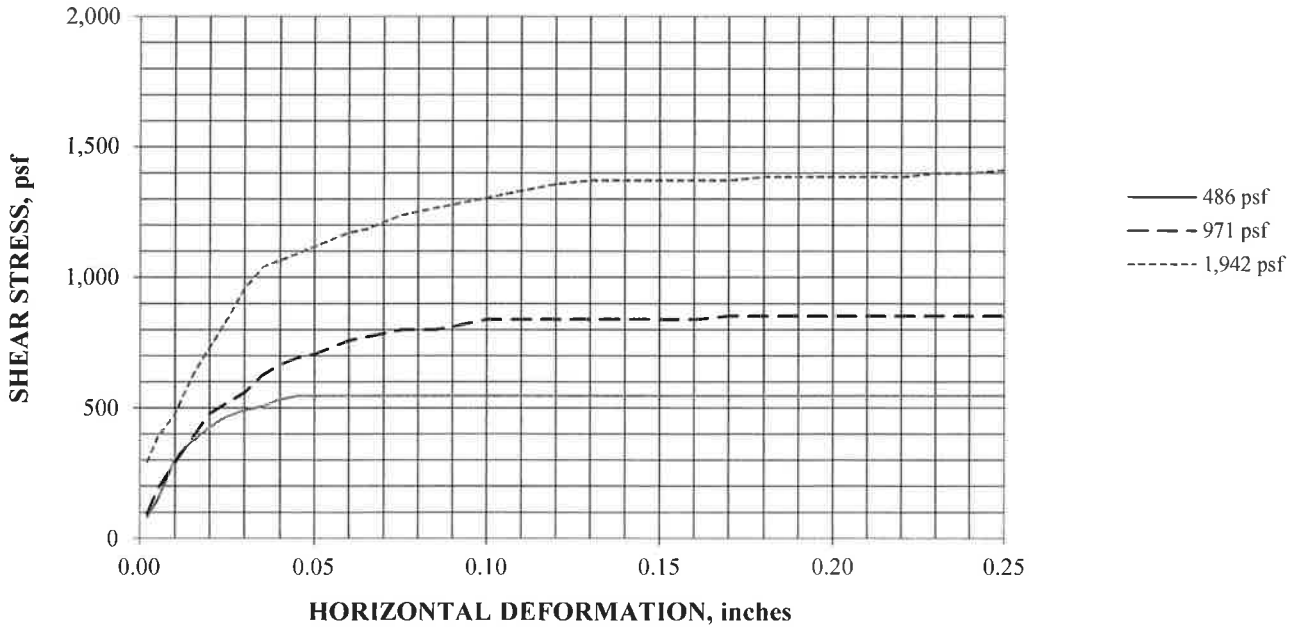
July 2, 2018

Clayey Sand (SC)

Compacted to 90% RC, saturated

SPECIFIC GRAVITY: 2.70 (assumed)

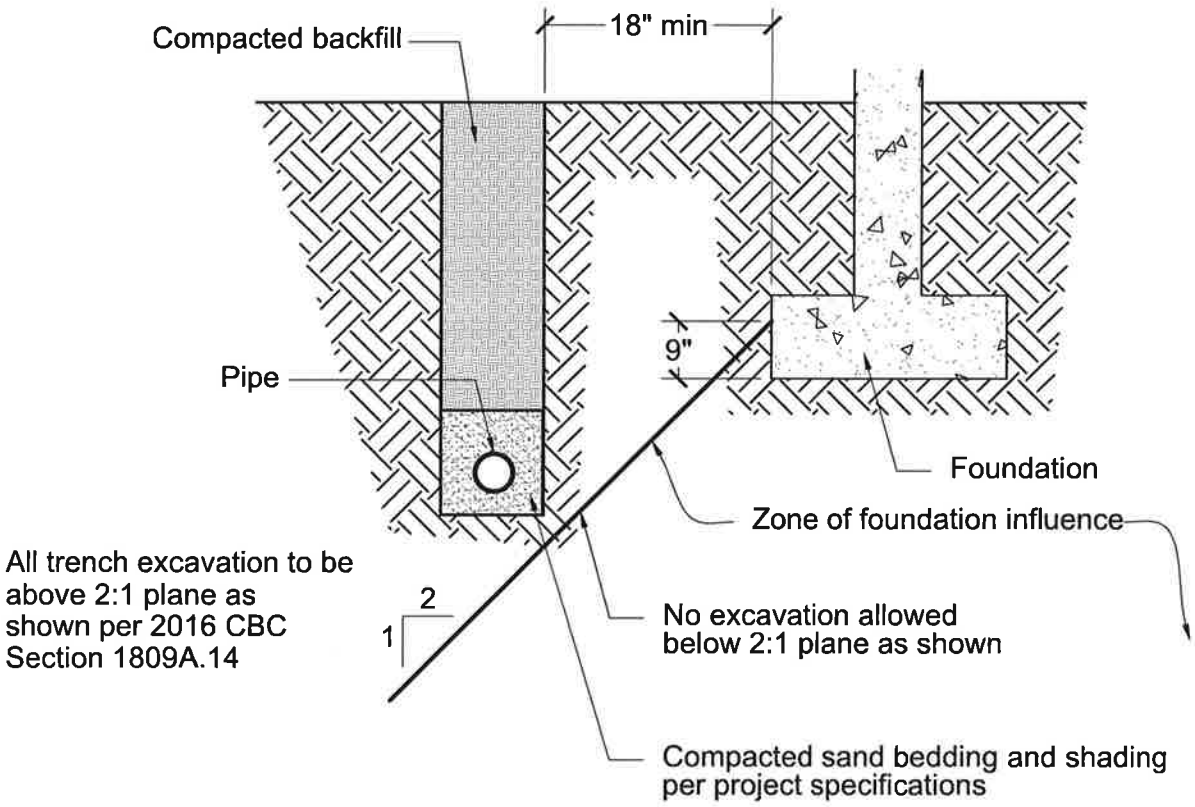
SAMPLE NO.:	1	2	3	AVERAGE
INITIAL				
WATER CONTENT, %	10.0	10.0	10.0	10.0
DRY DENSITY, pcf	113.3	113.3	113.3	113.3
SATURATION, %	55.4	55.4	55.4	55.4
VOID RATIO	0.487	0.487	0.487	0.487
DIAMETER, inches	2.410	2.410	2.410	
HEIGHT, inches	1.00	1.00	1.00	
AT TEST				
WATER CONTENT, %	21.3	19.2	18.4	
DRY DENSITY, pcf	117.8	124.1	125.5	
SATURATION, %	100.0	100.0	100.0	
VOID RATIO	0.431	0.358	0.343	
HEIGHT, inches	0.96	0.91	0.90	



APPENDIX D

Typical Detail A: Pipe Placed Parallel to Foundations
Tremie Method

TYPICAL DETAIL A
PIPE PLACED PARALLEL TO FOUNDATIONS*



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RECOMMENDED PROCEDURE FOR TREMIE-PLACED CONCRETE IN CAISSON (DRILLED SHAFT) FOUNDATION CONSTRUCTION

The following are general guidelines only, and may be subject to modification by the architect/engineer and/or geotechnical engineer.

1. Concrete should be placed in caisson excavations by means of a tremie when the depth of water in the excavation cannot be limited to a maximum of 2 inches, or when the freefall of the concrete would result in the concrete striking the rebar or excavation walls as it falls.

2. The concrete should be pumped to the tremie pipe. Alternately, a hopper with a tremie pipe attached should be used if approved by the architect/engineer. An "elephant's trunk" should not be used to place concrete under water; however, an elephant's trunk may be used to direct the fall of the concrete in dry excavations. The elephant's trunk should be of sufficient length to prevent the concrete from striking the rebar or excavation walls as it falls.

3. Concrete for dry excavations should be designed for, and placed at, a slump of 4 to 6 inches. Concrete to be placed below water should be designed and placed as a "flowable" mix with a minimum slump of 7 inches, or should be designed and placed as "self-consolidating concrete."

4. The tremie pipe should consist of rigid steel pipe with tight couplings. The tremie pipe should be 4 to 6 inches in diameter and should be longer than the deepest caisson excavation.

5. The tremie pipe should be lowered with caution through the center of the reinforcing to approximately 1 foot of the bottom of the excavation; the tremie should not be allowed to penetrate into the muck on the bottom of the hole

6. The pump hose and tremie pipe should be "slicked" with Portland cement slurry. No clay, bentonite, or other material should be used unless approved by the architect/engineer and geotechnical engineer.

7. Pumping of the concrete should begin immediately after the reinforcing and the tremie pipe have been placed in the excavation and the excavation and reinforcing have been inspected. The tremie pipe should not be raised until the concrete surface in the caisson excavation is at least 5 feet above the bottom of the tremie pipe. The bottom of the tremie pipe should then be kept at least 5 feet below the top of the concrete until the pour is completed.

8. The concrete should be pumped until all muck, laitance, and unsuitable concrete has been lifted above the top-of-caisson elevation. All muck, laitance, and unsuitable concrete should be immediately removed from the excavation.

9. Self-consolidating concrete need *not* be vibrated during the pour, unless directed by the architect/engineer. For other than self-consolidating concrete, vibration should *not* be started until the concrete pour is completed and the muck, laitance and unsuitable concrete have been removed. Then, only the upper 5 to 10 feet of the concrete should then be vibrated. Additional concrete may be added as necessary during vibration. The vibrator should not be allowed to contact the reinforcing.

10. During the pour, if the tremie pipe has to be removed from the concrete, (e.g., to allow removal of casing), it should be reset at the top of the concrete. The tremie should then be purged as directed by the inspector, and then immediately lowered to at least 5 feet below the top of the concrete as the concrete is being pumped. All degraded concrete should be lifted with the continuing pour and removed from the top of the caisson.

UPDATED GEOTECHNICAL ENGINEERING AND GEOLOGIC HAZARDS REPORT SAN LUIS OBISPO HIGH SCHOOL TRACK AND STADIUM UPGRADES 1499 SAN LUIS DRIVE SAN LUIS OBISPO, CALIFORNIA

April 28, 2020

Prepared for

Mr. Chris Bonin
Director – Buildings, Grounds and Transportation
San Luis Coastal Unified School District

Prepared by

Earth Systems Pacific
4378 Old Santa Fe Road
San Luis Obispo, CA 93401

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April 28, 2020

FILE NO.: 300933-017

Mr. Chris Bonin
Director – Buildings, Grounds and Transportation
San Luis Coastal Unified School District
937 Southwood Drive
San Luis Obispo, CA 93401

PROJECT: SAN LUIS OBISPO HIGH SCHOOL
TRACK AND STADIUM UPGRADES
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA

SUBJECT: Updated Geotechnical Engineering and Geologic Hazards Report

CONTRACT
REF: Purchase Order No. 201551 by San Luis Coastal Unified School District, dated March 30, 2020, to Provide an Updated Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School Track and Stadium Upgrades, per Proposal by Earth Systems Pacific, Doc. No. SLO-2002-054.PRP, dated February 21, 2020

Dear Mr. Bonin:

As requested by Ms. Veronica Carrasco of PBK Architects, and in accordance with the referenced purchase order, this updated geotechnical engineering and geologic hazards report has been prepared for use in the development of plans and specifications for the proposed Track and Stadium Upgrades project at San Luis Obispo High School in San Luis Obispo, California. Our initial Geotechnical Engineering and Geologic Hazards Report (Initial Report) for this project (ESP 2016a) addressed the modernization of the stadium entrance, new kiosk/restroom facilities, relocation of the main bleachers, expansion/reconstruction of the existing track, and various surface improvements; recommendations for these items were intended to comply with the 2013 California Building Code (CBC). This updated report addresses new requirements for geohazards analysis and seismicity, including updated seismic coefficients, graphs and figures, as mandated by the 2019 CBC. Recommendations for the addition of new light pole foundations, as well as updated recommendations for moisture protection of interior slabs-on-grade, are also included. For all other geotechnical recommendations not covered by this Updated Report, please refer to the project's Initial Report (ESP 2016a), which is included in Appendix B. Two bound copies and an electronic copy of this report are furnished for your use.

We appreciate the opportunity to have provided services for this project and look forward to working with you again in the future. If there are any questions concerning this report, please do not hesitate to contact the undersigned.

Sincerely,

Earth Systems Pacific

REGISTERED PROFESSIONAL ENGINEER
Nicholas B. Zoetewey
GE 3137
Geotechnical
STATE OF CALIFORNIA

REGISTERED GEOLOGIST
DARRIN G. HASHAM
NO. 2423
CERTIFIED ENGINEERING GEOLOGIST
02/28/22
STATE OF CALIFORNIA

Nick Zoetewey, GE
Senior Engineer

Darrin Hasham, CEG
Engineering Geologist

Copy to: PBK Architects, Attn.: Ms. Veronica Carrasco
Taylor & Syfan, Attn: Mr. Brian Dean

Doc. No.: 2004-082.SGR/cr

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2.0 SCOPE OF SERVICES 1
3.0 GEOLOGY AND GEOLOGIC HAZARDS 2
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5.0 GEOTECHNICAL RECOMMENDATIONS 7
Foundations 7
Moisture Protection for Interior Slabs-on-Grade 9
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APPENDICES

APPENDIX A	Figure 1 – Site Vicinity Map Figure 2 – Exploration Location Map
APPENDIX B	Geotechnical Engineering and Geologic Hazards Report San Luis Obispo High School – Measure D Projects Stadium Entrance/Bleachers/Track (ESP 2016a)
APPENDIX C	Boring Logs (ESP 2016b)
APPENDIX D	Second Engineering Geology and Seismology Review for San Luis Obispo High School – Modernization of Buildings 100 and 300 (CGS 2018c)
APPENDIX E	Site Specific Ground Motion Hazards Analyses – Tables 1 and 2
APPENDIX F	Tremie Method

1.0 INTRODUCTION

The proposed project at San Luis Obispo High School will consist of the modernization of the stadium entrance, the relocation of the main bleachers, and the construction of an all-weather track. The project location is shown on Figure 1 – Site Vicinity Map. The proposed site layout is shown on Figure 2 – Exploration Location Map; all orientation is from project north.

Through our correspondence with Ms. Veronica Carrasco of PBK Architects and review of the site plan (PBK 2020), the main changes as described in our initial Geotechnical Engineering and Geologic Hazards Report (Initial Report) for this project (ESP 2016a) will consist of a single, roughly 1,000 square foot concessions/restroom building at the stadium entrance (instead of two separate 250 square foot structures), the addition of three new lanes to the existing track (totaling nine lanes), and new light poles. The light poles will be supported by drilled, cast-in-place concrete caissons or precast concrete foundation sleeves inserted in drilled holes; the poles will be located on the north and south sides of the track/stadium. It is our understanding that this project will be designed and constructed under the jurisdiction of the Division of the State Architect (DSA).

2.0 SCOPE OF SERVICES

The scope of work for this report included review of the Initial Report (ESP 2016a), review of the boring logs from the New Swimming Pool and Equipment/Locker Building project (Swimming Pool project) (ESP 2016b) to the immediate north of the site, geotechnical and geologic analyses of the data as related to the project and updates for the 2019 California Building Code (CBC), and preparation of this updated report. The analysis and subsequent recommendations were based on the site plan provided by PBK Architects (2020).

This report and geotechnical recommendations are intended to comply with the considerations of Sections 1803A.1 through 1803A.7, J104.3 and J104.4, as applicable, of the 2019 CBC; California Geological Survey (CGS) Note 48 (2019); Interpretation of Regulations (IR) Document A-4.13 (DSA 2016); and common geotechnical engineering and engineering geology practice in this area under similar conditions at this time. At the date of this report, DSA IR A-4.13 had not been updated for the 2019 CBC. It is assumed that this most current available version (DSA 2016) would be applicable for this Updated Report. The geotechnical test procedures were accomplished in general conformance with the standards noted, as modified by common geotechnical engineering practice in this area under similar conditions at this time.

Geotechnical and geologic parameters for this updated report consist of new requirements for geohazards analysis and seismicity, including updated seismic coefficients, graphs and figures, as mandated by the 2019 CBC, as well as for new light pole foundations and updated recommendations for moisture protection of interior slabs-on-grade. For all other recommendations not included in this Updated Report, please refer to the Initial Report (ESP 2016a) in Appendix B. It is our intent that this Updated Report and the Initial Report (ESP 2016a) be used exclusively by the client to form the geotechnical/geologic basis of the design, and in the preparation of plans and specifications. Application beyond this intent is strictly at the user's risk.

These reports do not address dewatering and other issues in the domain of contractors such as, but not limited to, site safety, loss of volume due to stripping of the site, shrinkage of soils during compaction, excavatability, shoring, temporary slope angles, construction means and methods, etc. Analyses of the soil for mold potential, asbestos in man-made products, lead, radioisotopes, hydrocarbons, or chemical properties (other than geotechnical corrosivity) are beyond the scope of this report. Ancillary features such as temporary access roads, and non-structural fills are not within our scope and are also not addressed.

As there may be unresolved geotechnical or geologic issues with respect to this project, the geotechnical engineer and engineering geologist should be retained to provide consultation as the design progresses, to review project plans as they near completion to assist in verifying that pertinent geotechnical and geologic issues have been addressed, and to aid in conformance with the intent of this report. In the event that there are any changes in the nature, design, or location of improvements, or if any assumptions used in the preparation of this report prove to be incorrect, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed, and the conclusions of this report are verified or are modified in writing. The criteria presented in this report are considered preliminary until such time as any peer review or review by any jurisdiction has been completed, conditions are observed by the geotechnical engineer and/or the engineering geologist in the field during construction, and the recommendations have been verified as appropriate or modified in writing.

3.0 GEOLOGY AND GEOLOGIC HAZARDS

In addition to the boring logs from the Initial Report (ESP 2016a), boring logs from the Swimming Pool Project (ESP 2016b) were also reviewed as data for our analysis in providing foundation

design parameters for the proposed light poles on the north side of the site. The borings for the Swimming Pool project (ESP 2016b) were drilled at the approximate locations shown on Figure 2 – Exploration Location Map. These borings were drilled at an elevation roughly 5 feet higher than the ground surface elevation where the proposed light poles will be constructed (Elev. 264 vs. 259, respectively) (Google Earth 2020). Up to 13.5 feet of fill was encountered in the borings for the Swimming Pool Project, which generally consisted of loose to dense poorly graded sands with variable amounts of clay, silt and gravel, and stiff sandy lean clays. Because the elevation of the proposed light poles at the north side of the track is roughly 5 feet below that of the Swimming Pool borings, we infer that up to 8.5 feet of fill of similar composition exists at the location of the light poles, the composition of which is confirmed by Borings 5 and 6 from the Initial Report (ESP 2016a). Below the fill, the borings for the Swimming Pool project (ESP 2016b) encountered Alluvium to the maximum depth explored of 26.5 feet below the existing ground surface (bgs), which consisted of medium stiff to very stiff sandy fat clays. Copies of the logs from our report (ESP 2016b) for the Swimming Pool Project are included in Appendix C.

Earth Systems Pacific provided a geologic hazards assessment for the site in the Initial Report (ESP 2016a) for this project. The geologic hazards assessments previously published are considered applicable for this project with the updates presented in this report. A detailed discussion of geology and geologic hazards is provided in the Initial Report (ESP 2016a). For this Updated Report, we re-evaluated the geologic hazards discussed in the Initial Report (ESP 2016a) and have summarized our findings below:

- The site is not within a State or County designated hazard zone for fault rupture (CGS 2020, County of San Luis Obispo 2020);

- There are no faults mapped on the San Luis Obispo High School campus. Since the publication of the latest geologic hazards report for the campus, which was for Building 100 (ESP 2018a), the State has provided new guidance that the 3rd California Earthquake Rupture Forecast (UCERF3) (USGS 2013) be used to model seismic hazards. We re-evaluated the seismic hazards for the site and the findings of our re-evaluation are presented in the following “Ground Motion Analyses” Section of this report. The notable change to the previous analysis is the addition of the Oceanic-West Huasna fault, located 2.6 miles from the site, which supersedes the Los Osos fault as the closest active fault to the site;

- The site is in a County designated zone of low liquefaction potential (County of San Luis Obispo 2020);

- The site is in a County designated zone of low landslide potential (County of San Luis Obispo 2020). Approximately 900 feet east of the project site, a slope classified by the County as having a high landslide potential forms the eastern boundary of the campus. Earth Systems Pacific evaluated this slope for potential as an off-site hazard to the project site in an Additional Assessment letter (ESP 2018b). Our assessment concluded that the slope was stable under both static and seismic conditions under design-level seismic shaking, which was confirmed by CGS in its review letter for stability of the slope (CGS 2018c), which is attached in Appendix D;

- The site is not within any State or County designated hazard zone for tsunami or dam inundation (CGS 2020, County of San Luis Obispo 2020);

- FEMA has mapped approximately the northwest ½ of the site within Zone X (0.2 percent annual chance flood), with the approximately southeast half of the site mapped within a zone of minimal flood hazard (FEMA 2012);

- The site is in a State designated zone of low radon potential (CGS 2020); and

- The potential for naturally occurring asbestos on site is low because serpentinite or serpentinized ultramafic rocks do not occur on the site.

4.0 GROUND MOTION HAZARD ANALYSES

In accordance with the CGS Note 48 Checklist (2019), 2019 CBC and ASCE 7-16 (2017), an assessment was made to determine the need for employing "Site-Specific Ground Motion Procedures" to calculate the ground motion parameters for the project. The S_1 ground motion value obtained from the Structural Engineers Association of California website (SEAOC 2020) using ASCE 7-16 (2017), for Site Class D - Stiff Soil, was 0.397g, greater than 0.2; therefore, per Section 11.4.8 of ASCE 7-16 (2017), the project requires site-specific ground motion analyses unless certain exceptions that relate to the building's period are met. Because we have no information on the fundamental periods of the proposed improvements, we performed a site-specific ground motion analysis to develop the seismic design parameters in accordance with Sections 11.4.8 and 21.2 of ASCE 7-16 (2017).

A risk-targeted maximum considered earthquake (MCE_R) modeling procedure was performed in accordance with ASCE 7-16 (2017), including a Probabilistic Seismic Hazard Analysis (PSHA) and a Deterministic Seismic Hazard Analysis (DSHA). These analyses are based on knowledge of the regional tectonic setting, geology, and seismicity. A PSHA using the United States Geological Survey Unified Hazard Tool (USGS 2020b) was used to access the Third California Earthquake Rupture Forecast (UCERF3) database (USGS 2013) and NGA-West2 ground motion prediction equations (PEER 2013) as described in Section 21.2.1.1 (Method 1) of ASCE 7-16 (2017) to estimate the peak ground motion corresponding to the uniform hazards earthquake and MCE_R which has a 2 percent probability of being exceeded in 50 years; and the USGS Risk-Targeted Ground Motions Calculator (USGS 2020a) to estimate potential ground motions at the project site that produce a 1 percent probability of collapse in 50 years as described in Section 21.2.1.2 (Method 2) of ASCE 7-16 (2017). The results of both methods were compared and the results of Method 2 were selected as best for the project.

For analysis purposes, we assumed the Oceanic-West Huasna fault as the causative fault, located 2.6 miles from the site. The Oceanic-West Huasna fault is a reverse-oblique fault and we specified a 58-degree dip and hanging wall conditions for the attenuation relationships. A magnitude of 7.1 was used as a basis to model fault rupture. The primary seismic risks are from earthquakes generated by the local Oceanic-West Huasna, Los Osos, Rinconada and San Luis Range faults and the more distant San Andreas fault. Although these listed faults are thought to potentially generate the most severe seismic shaking, any local fault could produce seismic shaking at the site.

The 2019 CBC seismic design criteria are based on a Design Earthquake that produces ground motion $^2/_3$ of the lesser of an earthquake with 2 percent probability of occurrence in 50 years, or maximum 84th percentile of the mean deterministic MCE. In this case the probabilistic spectra governed, scaled in accordance with ASCE 7-16 (2017) procedures.

Seismic Design Category

Section 1613A.2.5 of the 2019 CBC states that *structures classified as Risk Category I, II or III that are located where the mapped spectral response acceleration parameter at 1-second period, S_1, is greater than or equal to 0.75 shall be assigned to Seismic Design Category E, others shall be assigned to Seismic Design Category D*. The S_1 calculated for the site is 0.397, less than 0.75; therefore, the site should be assigned to Seismic Design Category D.

Seismic Design Parameters

This site may be subject to strong ground shaking due to potential fault movements along regional faults including the Oceanic-West Huasna fault, whose proximity and magnitude potential was considered during our site-specific analysis. The minimum seismic design should comply with the 2019 CBC and ASCE 7-16 (2017). The resulting seismic coefficients considering Site Class D are given in the table below.

SEISMIC PARAMETERS (2019 CBC/ASCE 7-16)

Seismic Design Category	D
Site Class	D
Mapped and Code Based Ground Motion	
Short Period Spectral Response, S_s	1.077 g
1 second mapped Spectral Response, S_1	0.397 g
Design Earthquake Ground Motion	
Short Period Spectral Response, S_{DS}	0.614 g
1 second Spectral Response, S_{D1}	0.529 g
Peak Ground Acceleration (PGA_M)	0.481 g
MCE Spectral Response Acceleration	
Short Period Spectral Response, S_{MS}	0.921 g
1 Second Period Spectral Response, S_{M1}	0.794 g
Site Amplification Factors	
Short Period Site Coefficient, F_a	1.07
1 Second Period Site Coefficient, F_v	2.50
Vertical Site Coefficient, C_v	1.32
Risk Coefficient (Short Period), C_{Rs}	0.898
Risk Coefficient (1 Second Period), C_{R1}	0.901

The estimated peak horizontal site acceleration based upon a probabilistic analysis (2 percent probability of occurrence in 50 years) is approximately 0.89g for this site. Vertical accelerations are typically ⅓ to ⅔ of the horizontal accelerations but can equal or exceed the horizontal accelerations depending upon the fault type, local site effects and amplification. Acceleration values provided are estimates only. Tables presenting the fault parameters and spectral response values are presented in Appendix E.

5.0 GEOTECHNICAL RECOMMENDATIONS

Recommendations for the addition of new light pole foundations, as well as updated recommendations for moisture protection of interior slabs-on-grade, are included in the sections below. For all other geotechnical recommendations not covered by this Updated Report, please refer to the project's Initial Report (ESP 2016a), which is included in Appendix B

Foundations

1. The light poles may be supported by drilled, cast-in-place caissons. Caisson dimensions and reinforcement should be in accordance with the requirements of the architect/engineer. The minimum caisson diameter should be 18 inches.

2. The light poles may also be supported by pre-cast pole bases that are inserted into drilled borings with a minimum 18-inch diameter. The annular space between the pole base and excavation sidewalls should be filled with slurry or concrete as designated by the designer.

3. The caissons/pole bases should be designed to derive support from skin friction against the Alluvium below the existing fill, which begins at approximately 8.5 feet bgs and 6 feet bgs at the north and south sides, respectively. No vertical capacity within the existing fill should be included in the capacity calculations. Caisson/pole base foundations should have a minimum embedment of 10 feet into the underlying Alluvium.

4. The caissons/pole bases may be designed using a downward (compressive) allowable skin friction value of 500 psf within the Alluvium. Skin friction and downdrag in the fill, as well as end bearing capacity, should not be used in the calculations.

5. An allowable skin friction value of 350 psf can be used for short-term tension (uplift) conditions within the Alluvium. The self-weight of the caissons/pole bases may be neglected in the determination of loading, however it may be included, if needed, for resistance to uplift. Tension (uplift) capacity in the fill should be neglected.

6. The allowable skin friction values for the caissons/pole bases may be increased by one-third when transient loads such as wind or seismicity are included. Foundations should be designed using the site design response parameters in the "Ground Motion Hazard Analyses" Section of this report.

7. An ultimate passive resistance based on an equivalent fluid pressure of 250 pcf in the existing fill, and 350 pcf in the Alluvium, up to a maximum uniform pressure of 2,000 psf, acting over 2 caisson/pole base diameters, may be taken for resistance to short term lateral loads. The structural engineer should apply an appropriate factor of safety to the ultimate values presented above.

8. Although groundwater was not encountered in the borings for the Swimming Pool project (ESP 2016b), seasonal high groundwater levels recorded near the site were as shallow as 23 feet bgs. Perched groundwater conditions may also exist. Given the groundwater conditions above, there is a potential that subsurface water will be encountered during the caisson/pole base drilling operations, especially if construction proceeds during or immediately following the local rainy season. Therefore, caisson reinforcing should be designed to accommodate a minimum 5-inch diameter tremie pipe for concrete placement. The reinforcing should also be designed to facilitate removal of the casing during concrete placement, and additional coverage over reinforcing steel is recommended to account for likely difficult concrete placement conditions. All water encountered should be removed from the caisson/pole base excavation prior to placing concrete, or the concrete should be tremied. The tremie method is described in Appendix F.

9. Loose debris and slough material should be removed from caisson excavations by means of a clean-out bucket.

10. Concrete used in caissons and to fill the annular spaces for the pole bases should be placed at a slump between 6 and 8 inches in dry excavations and between 8 and 10 inches when placed under water. The concrete in the upper 8 to 10 feet of the caissons/pole bases should be mechanically consolidated following placement.

11. The caissons/pole bases should not deviate from a plumb line taken from the center of the caisson by more than 2 percent of the caisson/pole base length, from the top to the point of interest. Adequate caisson or pole base excavation oversize may be assumed to provide required tolerance.

12. All caisson excavations should be filled with concrete on the same day as they are drilled; the pole bases and slurry/structural concrete should be placed in the pole base

excavations the same day they are drilled. If this is not practicable, the caissons/pole base should be secured in a safe manner in conformance with OSHA requirements or other applicable safety standards until slurry/concrete can be placed. Any caisson/pole base excavation that has not been filled with slurry/concrete on the same day as it was drilled should have the surfaces "freshened" by extending the rotating auger into and out of the hole several times, immediately prior to placement of the slurry/concrete. The bottom of the hole should then be cleaned out again by means of the clean-out bucket.

13. Caisson/pole base excavations should be observed by the geotechnical engineer during drilling operations to confirm the subsurface conditions and prior to placement of reinforcing steel, pole bases and slurry/concrete. Special inspection should be provided as per Section 1705A.8 and Table 1705A.8 of the 2019 CBC; the special inspector should be under the direction of the geotechnical engineer. The following operations should be subject to special inspection:

    - Inspection of drilling operations and construction records for each element
    - Caisson/pole base location, plumbness, embedment and friction capacity
    - Reinforcing steel and concrete placement per 2019 CBC Section 1705A.3

14. The Corrosivity Analysis by CERCO Analytical, Inc. in Appendix C of the Initial Report (ESP 2016a) should be used by the architect/engineer in specifying appropriate corrosion protection measures for foundations.

Moisture Protection for Interior Slabs-on-Grade

1. Due to the current use of impermeable floor coverings, water-soluble flooring adhesives, and the speed at which buildings are now constructed, moisture vapor transmission through slabs is a much more common problem than in past years. Where moisture vapor transmitted from the underlying soil would be undesirable, slabs should be protected from subsurface moisture vapor. A number of options for vapor protection are discussed below; however, the means of vapor protection, including the type and thickness of the vapor retarder, if specified, are left to the discretion of the architect/engineer.

2. Where specified, vapor retarders should conform to ASTM Standard E 1745-17. This standard specifies properties for three performance classes; Class A, B and C. The

appropriate class should be selected based on the potential for damage to the vapor retarder during placement of slab reinforcement and concrete. Unless it is determined that a permeance of 0.10 perms will not allow vapor to accumulate beneath moisture-sensitive flooring, adhesives, stored products and/or equipment, then a vapor retarder permeance of 0.010 perms is recommended, per ACI 302.1-15. Permeance of vapor retarders should remain below 0.010 perms after the conditioning tests of ASTM E 1745-17.

Note: ASTM E 1745-17 has the same permeance threshold for Class A, B and C (0.1 perms). The class that is chosen will make a difference in how resistant the vapor retarder is to punctures and tears, but it will not ensure any better permeance values to protect floor coverings.

3. Several recent studies, including those of American Concrete Institute Committee 302 (ACI 2015), have concluded that excess water above the vapor retarder increases the potential for moisture damage to floor coverings and could increase the potential for mold growth or other microbial contamination. The studies also concluded that it is preferable to eliminate the typical sand layer beneath the slab and place the slab concrete in direct contact with a Class A vapor retarder, particularly during wet weather construction. However, placing the concrete directly on the vapor retarder requires special attention to using the proper vapor retarder, a very low water-cement ratio in the concrete mix, and special finishing and curing techniques.

4. Another option that may be a reasonable compromise between effectiveness and cost considerations is the use of a subslab vapor retarder protected by a sand layer. If a Class A vapor retarder is specified, the retarder can be placed directly on the subgrade. The retarder should be covered with a minimum 2 inches of clean sand. If a less durable vapor retarder is specified (Class B or C), a minimum of 4 inches of clean sand should be provided, and the retarder should be placed in the center of the clean sand layer. Clean sand is defined as a well or poorly graded sand (ASTM D 2487-17) of which less than 3 percent passes the No. 200 sieve. Clean sand is considered to be part of the minimum 18 inches of imported nonexpansive materials recommended in the Initial Report (ESP 2016a) to be placed below interior slabs-on-grade, not in addition to it.

5. Regardless of the underslab vapor retarder selected, proper installation of the retarder per ASTM E 1643-18a is critical for optimum performance. Where utilized, the vapor retarder should be placed a minimum of 1 inch above the flow line of the drainage path surrounding the structures, or 1 inch above the area drain grates if area drains are used to collect runoff around the structures. As required by ASTM E 1643-18a, all seams and utility penetrations should be properly sealed. At terminating edges of the vapor retarder, the vapor retarder should be effectively sealed with accessories specifically designed to seal the material to new or existing concrete; details for edge sealing of the vapor retarder should be provided by the architect/engineer.

6. If the sand is used between the vapor retarder and the slab, it should be moistened only as necessary to promote concrete curing; saturation of the sand should be avoided, as the excess moisture would be on top of the vapor retarder, potentially resulting in vapor transmission through the slab for months or years.

7. Positive drainage away from the structures should be maintained; see the "Drainage and Maintenance" Section of the Initial Report (ESP 2016a) for additional discussion of this issue. If water is allowed to pond near the structures, it may seep into the ground and migrate laterally through cracks or utility penetrations in the foundations, ultimately gaining access above the vapor retarders.

6.0 CLOSURE

Our intent was to perform the investigation in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the locality of this project under similar conditions. No representation, warranty, or guarantee is either expressed or implied. This report is intended for the exclusive use by the client as discussed in the "Scope of Services" Section. Application beyond the stated intent is strictly at the user's risk.

This report is valid for conditions as they exist at this time for the type of project described herein. The conclusions and recommendations contained in this report could be rendered invalid, either in whole or in part, due to changes in building codes, regulations, standards of geotechnical or construction practice, changes in physical conditions, or the broadening of knowledge.

If changes with respect to the project become necessary, if items not addressed in this report are incorporated into plans, or if any of the assumptions used in the preparation of this report are

not correct, this firm shall be notified for modifications to this report. Any items not specifically addressed in this report should comply with the CBC of other applicable standards, and the requirements of the governing jurisdiction.

The recommendations presented in this geotechnical report are based upon the geotechnical conditions encountered at the site and may be augmented by additional requirements of the client, or by additional recommendations provided by the geotechnical engineer based on peer or jurisdiction reviews, or conditions exposed at the time of construction. If Earth Systems Pacific is *not* retained to provide construction observation and testing services, it shall not be responsible for the interpretation of the information by others or any consequences arising therefrom.

This document, the data, conclusions, and recommendations contained herein are the property of Earth Systems Pacific. This report shall be used in its entirety, with no individual sections reproduced or used out of context. Copies may be made only by Earth Systems Pacific, the client, and the client's authorized agents for use exclusively on the subject project. Any other use is subject to federal copyright laws and the written approval of Earth Systems Pacific.

Thank you for this opportunity to have been of service. If you have any questions, please feel free to contact this office at your convenience.

End of Text.

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APPENDIX A

Figure 1 – Site Vicinity Map
Figure 2 – Exploration Location Map



N

NOT TO SCALE

BASE MAP PROVIDED BY: Google Earth

Earth Systems Pacific
4378 Old Santa Fe Road, San Luis Obispo, CA 93401
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(805) 544-3276 ● Fax (805) 544-1786

SITE VICINITY MAP

San Luis Obispo High School Track and Stadium Upgrades
1499 San Luis Drive
San Luis Obispo, California

Date
April 2020

Project No.
300933-017

Figure 1

8x11–111218Master



LEGEND

B1 — Boring Location (ESP 2016a) (Approx.)

B-1 — Boring Location (ESP 2016b) (Approx.)

BASE MAP PROVIDED BY: Google Earth

NOT TO SCALE

Earth Systems Pacific
4378 Old Santa Fe Road, San Luis Obispo, CA 93401
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(805) 544-3276 ● Fax (805) 544-1786

EXPLORATION LOCATION MAP

San Luis Obispo High School Track and Stadium Upgrades
1499 San Luis Drive
San Luis Obispo, California

Date
April 2020

Project No.
300933-017

Figure 2

8x11–012915Master

APPENDIX B

Geotechnical Engineering and Geologic Hazards Report
San Luis Obispo High School – Measure D Projects
Stadium Entrance/Bleachers/Track (ESP 2016a)

GEOTECHNICAL ENGINEERING
AND GEOLOGIC HAZARDS REPORT
SAN LUIS OBISPO HIGH SCHOOL – MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3109

April 18, 2016

Prepared for

Mr. Anthony Palazzo
Director – Buildings, Grounds and Transportation
San Luis Coastal Unified School District

Prepared by

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April 18, 2016

FILE NO.: SL-16605-SC

Mr. Anthony Palazzo
Director – Buildings, Grounds and Transportation
San Luis Coastal Unified School District
937 Southwood Drive
San Luis Obispo, CA 93401

PROJECT: SAN LUIS OBISPO HIGH SCHOOL – MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 SAN LUIS DRIVE, SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3109

SUBJECT: Geotechnical Engineering and Geologic Hazards Report

CONTRACT REF: Purchase Order No. 161190 by San Luis Coastal Unified School District, dated December 7, 2015, Referencing Earth Systems Pacific Proposal to Provide a Geotechnical Engineering Investigation, Soil Corrosivity Analysis and Geologic Hazards Assessment, dated November 25, 2015

Dear Mr. Palazzo:

In accordance with the referenced Purchase Order, this geotechnical engineering and geologic hazards report has been prepared for use in the development of plans and specifications for the Stadium Entrance / Bleachers / Track Project planned at San Luis Obispo High School in San Luis Obispo, California. Preliminary geotechnical recommendations are presented herein for the following: site preparation; grading; utility trenches; foundations and track curbs; slabs-on-grade; retaining walls; Portland cement concrete (PCC) pavers, and asphalt concrete (AC) paths and pavement; drainage and maintenance; and observation and testing. Our evaluation of geologic hazards is by reference to our investigation and report submitted recently for the proposed Annex / Classroom Building project to the north of this site, and updated as applicable for the subsurface conditions encountered in the exploratory borings for this project. The results of geotechnical corrosivity testing, which was subcontracted to CERCO Analytical of Concord, California, are also included. Two bound copies and an electronic copy of this report are furnished for your use.

We appreciate the opportunity to have provided services for this project and look forward to working with you again in the future. If there are any questions concerning this report, please do not hesitate to contact the undersigned.

Sincerely,

Earth Systems Pacific

Fred J. Potthast, GE
Principal Engineer

for Richard T. Gorman, CEG
Principal Geologist

Doc. No.: 1604-056.SGR/rw

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APPENDIX F	Typical Detail A: Pipe Placed Parallel to Foundations

1.0 INTRODUCTION AND SITE SETTING

The proposed project at San Luis Obispo High School will consist of the modernization of the stadium entrance, the relocation of the main bleachers, and the construction of an all-weather track. The stadium entrance will likely be of masonry and ornamental/structural steel design, and may include an archway. Two combination kiosk/restroom structures will be constructed on either side of the entrance; these structures will have footprints of approximately 250 square feet each, and will likely be of masonry construction. Conventional continuous and spread footings have been assumed for the entrance area improvements, with slabs-on-grade for the structures. Portland cement concrete (PCC) flatwork, PCC pavers, or asphalt concrete (AC) paths, or some combination of these, may be used for pedestrian and light maintenance vehicle traffic in the entrance area. Reconstruction of nearby AC pavement for vehicles may also be included with the project. The main bleachers will be relocated approximately 10 to 30 feet to the southwest, to allow the addition of lanes to the main straightaway portion of the track. The bleachers will continue to be supported by a combination of conventional continuous and spread footings; the area below the stands may be improved with PCC flatwork or a thin layer of aggregate base (AB) for housekeeping purposes. The track is expected to be improved with a rubberized or similar all-weather surface, and improved drainage systems. The all-weather surface may be placed over a layer of AC, however this and other details are yet to be determined.

For the purposes of this report, maximum dead plus live loads on continuous footings of 2,000 plf, and maximum dead plus live loads on spread footings of 25 kips, have been assumed for the entrance area structures. For the bleachers, maximum dead plus live loads on continuous footings of 2,000 plf, and maximum dead plus live loads on spread footings of 75 kips have been assumed. Retaining walls for sitework, or connected to or forming part of the structures, and a maximum of 5 feet tall, may also be utilized. The new and reconstructed facilities will be served by the campus utility systems via new or existing underground connections. Landscaping is anticipated beyond the limits of all improved surfaces in the project area.

To our knowledge, no drainage basins are planned. Infiltration systems or other types of low-impact development (LID) features may be included in the final design; however, these have not been determined as of the date of this report, and therefore these potential features are not addressed.

The stadium and surrounding track are on the west side of the campus, north of the student parking lot and south of the main gymnasium and varsity baseball practice field. The track is currently surfaced with a material locally termed “decomposed granite” or “DG”. Drainage around the track is fair to poor. The main bleachers are on the south side of the track; several mature trees will require removal and the AC-paved parking area south of the bleachers will require reconfiguration to allow the bleachers to be relocated. The stadium entrance area is at

the southeast corner of the track. It is delineated by a perimeter chain-link fence and several mature trees, and it is paved with AC that is in poor condition. Temporary restroom, equipment storage, barbeque and concession facilities are currently present in this area. Drainage in the entry area appears to be by sheet flow toward the parking and driveway areas to the southeast. The locations and dispositions of utility lines in this project area are unknown.

The approximate coordinates and elevation of the center of the project area, as obtained from the Google Earth website (Europa Technologies 2016), are latitude 35.2826N, longitude 120.6514W, and 254 feet above mean sea level.

2.0 SCOPE OF SERVICES

The scope of work for this report consisted of the following: a general site reconnaissance by a registered geotechnical engineer; subsurface exploration by drilled borings; geotechnical and corrosivity laboratory testing of samples secured from the borings; review of the geotechnical engineering and geologic hazards report for the nearby Annex / Classroom Building project (ESP 2016a); geotechnical and geologic analyses of the data; and preparation of this report. The analysis and subsequent recommendations were based on general information provided by the client, and a concept site plan for the school (PMSM Architects 2015).

This report and preliminary geotechnical recommendations are intended to comply with the considerations of Sections 1803A.1 through 1803A.7, J104.3 and J104.4, as applicable, of the 2013 California Building Code (CBC); California Geological Survey Note 48 (CGS 2011); Interpretation of Regulations (IR) Document A-4.13 (DSA 2013); and common geotechnical engineering and engineering geology practice in this area under similar conditions at this time. The geotechnical test procedures were accomplished in general conformance with the standards noted, as modified by common geotechnical engineering practice in this area under similar conditions at this time.

Preliminary geotechnical recommendations are presented herein for the following: site preparation; grading; utility trenches; foundations and track curbs; slabs-on-grade; retaining walls; Portland cement concrete (PCC) pavers, and asphalt concrete (AC) paths and pavement; drainage and maintenance; and observation and testing. The results of the corrosivity analysis subcontracted to CERCO Analytical are also included. It is our intent that this geotechnical/geologic report be used exclusively by the client in the preparation of plans and specifications. Application beyond this intent is strictly at the user's risk.

As there may be geotechnical issues yet to be resolved, the geotechnical engineer should be retained to provide consultation as the design progresses, to assist in verifying that the pertinent geotechnical issues have been addressed and to aid in the conformance with the intent of this

report. It may also be advantageous to retain the geotechnical engineer to review the project plans as they near completion, to further aid in conformance of the plans with the intent of this report.

This report does not address issues in the domain of contractors such as, but not limited to, site safety, loss of volume due to stripping of the site, shrinkage of soils during compaction, excavatability, shoring, temporary slope angles, construction means and methods, etc. Analyses of the soil for mold potential, man-made asbestos, lead, radioisotopes, hydrocarbons, or chemical properties (other than geotechnical corrosivity) are beyond the scope of this report. Ancillary features such as temporary access roads, fences, flag and light poles, signage; and nonstructural fills are not within our scope and are also not addressed.

In the event that there are any changes in the nature, design, or location of improvements, or if any assumptions used in the preparation of this report prove to be incorrect, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are verified or are modified in writing. The criteria presented in this report are considered preliminary until such time as any peer review or review by any jurisdiction has been completed, conditions are observed by the geotechnical engineer in the field during construction, and the recommendations have been verified as appropriate or modified in writing.

3.0 FIELD INVESTIGATION

On January 15, 2016, eight exploratory borings were drilled in the project area to a maximum depth of 43.5 feet below the existing ground surfaces. The borings were drilled with a Mobile Drill Model B-53 truck mounted drill rig, equipped with 6-inch outside diameter hollow stem auger and an automatic trip hammer for sampling. The approximate locations of the borings are shown on the Boring Location Map in Appendix A. As the borings were drilled, soil samples were obtained using a ring-lined barrel sampler (ASTM D 3550-01/07 with shoe similar to D 2937-10). Standard penetration tests were also performed (ASTM D 1586-11) at selected depths. Bulk soil samples were obtained from the auger cuttings. The borings were backfilled with auger cuttings and patched at the surface with either quick-setting PCC or cold-mix AC (where applicable).

Soils encountered in the borings were categorized and logged in general accordance with the Unified Soil Classification System and ASTM D 2488-09a. Where bedrock was encountered, its properties were described based upon observation of the auger cuttings and the effort required to drill into it. Copies of the boring logs and a Boring Log Legend are included in Appendix A. In reviewing the boring logs and legend, the reader should recognize that the legend is intended as a guideline only, and there are a number of conditions that may influence the soil characteristics as observed during drilling. These include, but are not limited to, the presence of cobbles or

boulders, cementation, variations in soil moisture, presence of groundwater, and other factors. It should also be noted that the descriptions of bedrock must span a much wider range of density and strength characteristics than soil, and are relative to other bedrock strata. For example, fractured and weathered bedrock may be described as "soft," yet it will be considerably harder than almost any type of soil. Conversely, a clay soil may be described as "stiff," however it will not be nearly as hard as even "moderately soft" bedrock such as the serpentinite encountered on this site. Consequently, the logger must exercise judgment in interpreting the subsurface characteristics, possibly resulting in soil and bedrock descriptions that vary somewhat from the legend.

4.0 LABORATORY ANALYSIS

The ring samples obtained from the borings were tested for unit weight and moisture (ASTM D 2937-10, modified for ring liners). Two bulk samples were tested for maximum density and optimum moisture content (ASTM D 1557-12), expansion index (ASTM D 4829-11), and cohesion and angle of shearing resistance by direct shear (ASTM D 3080-11, recompacted to 90 percent of maximum dry density, and modified for consolidated, undrained conditions). One SPT sample was tested for moisture content (ASTM D 2216-10) and plasticity index (ASTM D 4318-10). The geotechnical laboratory test results are presented in Appendix B.

Two soil samples were submitted to CERCO Analytical for geotechnical corrosivity testing. CERCO Analytical's Corrosivity Analysis is presented in Appendix C.

5.0 GENERAL SUBSURFACE AND GEOLOGIC PROFILE

The subsurface soil and geologic profile observed in the borings generally consisted of fill over alluvium, with bedrock at depth.

A pavement section of 2.5 inches of AC over 6 inches of AB was found in Boring 1, off the southwest corner of the existing bleachers. Below the pavement was medium dense clayey sand fill. At 4 feet, alluvium was encountered; the alluvium consisted of stiff sandy lean clay with varying percentages of gravel to 9 feet, followed by medium dense clayey sand to 15 feet, with some gravel below 12 feet. The alluvium continued as medium dense clayey sand with gravel to 23 feet, and medium dense to loose well graded sand with a trace of clay to 40.5 feet. Below the alluvium was moderately soft bedrock (serpentinite) of the Franciscan Mélange.

In Boring 2 off the southeast corner of the existing bleachers, the flatwork at the surface was 4 inches of PCC over 6 inches of well graded sand. Underlying the flatwork was fill consisting of medium dense clayey sand with a trace of gravel. The clay fraction increased below 5 feet. Stiff

sandy lean clay alluvium was found from 6 feet to the boring termination depth of 16.5 feet. The alluvium contained some gravel between 13 and 14.5 feet.

The track surface found in Borings 3 through 6 consisted of 7.5 to 8 inches of dense, dark brown silty clayey gravel, locally termed "decomposed granite" or "DG". Below the track surface was fill consisting of medium stiff to stiff sandy lean clay. The clay fill continued to the termination depth of 5 feet in Borings 3 and 6. In Borings 4 and 5, 1 foot of loose clayey sand fill was found before the termination depth of 5 feet.

In the stadium entrance area, the existing pavement sections at the surface in Borings 7 and 8 were 2.5 to 2.75 inches of AC over 6 to 7 inches of AB. Boring 7 found fill consisting of medium dense clayey sand with varying percentages of gravel to 7.5 feet, followed by stiff sandy lean clay alluvium with a trace of gravel to the boring termination depth of 16.5 feet. The fill below the pavement in Boring 8 was stiff sandy lean clay with some gravel to 4.5 feet, and medium dense clayey sand with varying percentages of gravel to 9 feet. The alluvium below the fill was stiff sandy lean clay, which extended to the termination depth of 16.5 feet.

Please refer to the logs in Appendix A for a more complete description of the subsurface conditions encountered in the borings.

6.0 GROUNDWATER

Subsurface water encountered in Boring 1 at a depth of 34 feet; subsurface water was not encountered in any of the other borings.

7.0 GEOLOGY, SEISMICITY AND GEOLOGIC HAZARDS

A geotechnical engineering and geologic hazards report was recently completed by this firm for the Annex / Classroom Building project (ESP 2016a), which is approximately 900 feet northeast of this project site. That report, and several of the references noted in it, were reviewed as part of the work scope for this project. Based on the subsurface conditions encountered in the borings for this project, in our opinion, the conclusions and recommendations with respect to geology, seismicity and geologic hazards presented in the report for the Annex / Classroom Building project (ESP 2016a) would also be valid for this project, with the exception of the following: liquefaction and seismically induced settlement, flooding and naturally occurring asbestos. A copy of the Annex / Classroom Building project report is included in Appendix D. It is our opinion that there are no significant local or regional geologic conditions, including those identified in the following paragraphs, which would preclude construction of the Bleachers / Stadium Entrance / Track project as described in the "Introduction" Section of this report.

Liquefaction and Seismically Induced Settlement

The term "liquefaction" refers to a phenomenon that tends to occur in saturated soils of low density that have grain sizes within a certain range, usually fine to medium-grained poorly graded sands, silty sands, and silts. A sufficiently strong earthquake is also required to cause liquefaction. During liquefaction, the energy from the earthquake causes the water pressure within the pores of the soil to increase. The increase in water pressure significantly decreases the friction between the soil grains, allowing the soil grains to move relative to one another. During this state, the soil will behave as a viscous liquid, temporarily losing its ability to fully support foundations and other improvements. The high pressure water will flow through the soil along the path of least resistance. As the pressure is released, the soils typically settle in a process called "seismically induced" or "dynamic" settlement. Dynamic settlement can also occur in certain types of loose to medium dense sands above the groundwater; this is typically referred to as "dry sand settlement." Dynamic settlement can cause damage to structures and other surface and subsurface improvements.

Liquefaction analysis requires various input parameters, chiefly depth to groundwater. Groundwater was encountered at a depth of 34 feet in Boring 1, drilled on the south side of the existing bleachers. The most recent information obtained for subsurface water elevations in this area was for environmental studies of monitoring wells (Trihydro Corporation, 2005) in San Luis Drive, approximately 200 feet south of Boring 1. This information indicates a seasonal high groundwater elevation of approximately 23 feet; this depth to groundwater was used in the analysis.

Liquefaction analysis also requires an earthquake magnitude and a peak mean ground acceleration (PGA_M). The seismicity of nearby faults was analyzed by deaggregating fault characteristics (USGS 2016) to determine the statistical mean and modal earthquake magnitudes that contributed to the site's PGA_M. These two magnitudes were then compared and the higher of the two was used in the analysis. In this case, the modal magnitude was higher than the mean magnitude; the modal magnitude was 6.79. The PGA_M value of 0.479g per our report for the Annex / Classroom Building project (ESP 2016a) was also utilized.

Using the developed seismic values, liquefaction potential at the site was analyzed following the guidelines of Special Publication 117A (CDMG 1997/2008), and recommended procedures for analyzing liquefaction potential (Martin and others 1999) using the "Simplified Procedure" as presented at the NCEER workshop and summarized by Youd and Idriss (2001). The analysis also considered information presented by Seed et al. (2003), and Idriss and Boulanger (2004). A factor of safety of 1.30 was used to determine the liquefaction potential.

The results of the analysis, included in Appendix E, indicate a potential for dynamic settlement of approximately 3.3 inches under the conditions analyzed. All but a few hundredths of an inch of the calculated settlement is expected to occur at depths between 27.5 feet and the bedrock surface at 40.5 feet. The surface manifestation of such liquefaction would likely be fairly well attenuated by its depth. Therefore, in our opinion, based on the considerations given in Special Publication 117A (CDMG 1997/2008), properly designed conventional foundation systems for the bleacher relocation and the entrance improvement structures should be capable of withstanding a potential liquefaction event. In addition, based on the conditions noted in our geotechnical engineering and geologic hazards report for the Student Services / Administration Building (ESP, 2016b) approximately 300 feet northwest of the stadium entrance area, bedrock was found at depths of 6 to 22.5 feet below grade. Although Borings 7 and 8 in the stadium entrance area were not extended to the rock, it is likely that the rock is significantly shallower in this area than the 40.5-foot depth found in Boring 1, therefore the potential for liquefaction in that area could be significantly reduced or even eliminated.

Flooding

According to the Flood Insurance Rate Map Number 06079C1067G (FEMA November 16, 2012), the Bleacher and Track areas are partially within Flood Zone X, and partially outside of Flood Zone X. The Stadium Entrance area is outside of Flood Zone X (See the FEMA Flood Zone Map in Appendix E). Flood Zone X indicates areas that have been determined to have less than a 0.2 percent chance of being flooded in any given year.

Naturally Occurring Asbestos

Asbestos bearing rock units within the central coast area generally consist of serpentinite, ultra-mafic rock units consisting of olivine-hornblende and some schist metamorphic rock units. Based on our research and review of the borings logs, the project site is predominately underlain by a thick deposit of clayey soil alluvium. Serpentinite was encountered in Boring 1 at a depth of 40.5 feet. As the site preparation, grading and foundation recommendations provided later in this report do not involve excavation to depths that would reach the serpentinite, in our opinion, the potential for naturally occurring asbestos to be encountered on the site during construction is considered to be nil.

8.0 CONCLUSIONS

In our opinion, the site is suitable, from a geotechnical engineering standpoint, for the proposed Stadium Entrance / Bleachers / Track project, as described in the “Introduction” Section of this report, provided the recommendations contained herein are implemented in the design and

construction. The primary geotechnical engineering concerns are the potential for differential settlement from the existing fill, the expansion potential of the soils, and the erodible nature and corrosive potential of the soils. Provided that the building areas are prepared as recommended in the "Grading" Section of this report, conventional continuous and spread (pad) foundations may be used to support the bleachers in their modified position to the south, and the structures planned at the stadium entrance.

Differential settlement can occur when a foundation spans materials having variable consolidation characteristics, such as the fill that was found in the upper 4 to 9 feet of Borings 1, 2, 7 and 8, where the structures are planned. We are unaware of any documentation (i.e., grading observation or compaction testing records) regarding the placement of the fill, but it was likely placed during the general development of the campus. Undocumented fill has a greater potential for variability than fill that has been placed and tested in a controlled earthwork program. However, given the sizes and types of the proposed structures, the risk of differential settlement due to variable fill soils at depth is considered tolerable; a program of overexcavation and recompaction of only the upper fill soils in the bleachers and stadium entrance areas is recommended prior to construction.

Expansion index testing yielded results of 67 and 62 for the upper soils. Per CBC Section 1803A.5.3, the soils are considered to be expansive. The more commonly used ASTM classification is that the soils would be considered to have "medium" expansion potential. Expansive soils tend to swell with increases in soil moisture and shrink as soil moisture decreases; the upper 3 to 5 feet of any soil profile is the zone most affected by these seasonal soil moisture fluctuations. The volume changes that the soils undergo in this cyclical pattern can stress and damage foundations and slabs-on-grade if precautionary measures are not incorporated during design and in the construction procedure. Footings are typically deepened and additional reinforcement is provided. Imported nonexpansive soils are recommended to be placed beneath slabs-on-grade. For the track, a layer of imported aggregate base (AB) with interior and exterior perimeter curbs are recommended to provide protection for the all-weather surface. To reduce the potential for loss of the AB into expansion cracks of the underlying subgrade in the event of prolonged drought, a geotextile filter fabric should be placed between the subgrade and the AB. A possible alternative to a thickened layer of AB below the all-weather surface would be lime treatment of the native soils, however this process may be more expensive, the results could be less predictable than the use of an AB layer for this type of project, and the lime could affect the adjacent football playing field turf. Therefore, lime treatment was not considered as a viable option.

The site soils are considered to be erodible. It is essential that all surface drainage be controlled and directed to appropriate discharge points, and that surface soils, particularly those disturbed during construction, are stabilized by vegetation or other means *during and following construction*.

As indicated in the Soil Corrosivity Study by HDR, Inc., for the Annex / Classroom Building project (ESP 2016a, copy in Appendix D), the electrical resistivities of the samples tested were in the moderately corrosive categories with as received moisture contents; when saturated, the resistivities were in the corrosive to severely corrosive categories. Soil pH values were mildly alkaline. The soluble salt contents of the soils were low to moderate. Soil nitrate concentrations were high. The soils were classified as severely corrosive to ferrous metals and aggressive to copper. These results were essentially confirmed by CERCO Analytical through testing of samples from the Stadium Entrance / Bleachers / Track area; CERCO Analytical's corrosivity analysis is included in Appendix C of this report. Therefore, in our opinion, the recommendations regarding protection of pipelines, buried concrete structures and other improvements contained in the CERCO Analytical report (Appendix C) and in the Soil Corrosivity Study by HDR, Inc. for the Annex / Classroom Building project (ESP 2016a, copy in Appendix D) would be appropriate for this project.

9.0 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

The following recommendations are for improvements constructed as described in the "Introduction" section of this report. If locations, elevations, structural loads, etc., change, the recommendations contained herein may require modification. In developing the following recommendations, it was assumed that irrigated landscaping or flatwork that would keep the soils relatively uniform, year-round moisture will be installed for a zone of at least five feet around the perimeter of all improvements.

Two distinct types of Portland cement concrete (PCC) slabs-on-grade are discussed in the following recommendations. Interior slabs for the kiosk/restroom structures at the stadium entrance are defined as "slabs-on-grade." Sidewalks that will not support vehicle traffic and housekeeping slabs (if any) below the bleachers referred to as "exterior pedestrian flatwork." Asphalt concrete (AC) paths may also be utilized for pedestrian and light maintenance vehicle access, however it is also assumed that they will not support conventional vehicle traffic; separate AC pavement sections for vehicle traffic are provided. Recommendations for PCC pavers for pedestrians and vehicle traffic are also provided.

Unless otherwise noted, the following definitions are used in the recommendations presented below. Where terms are not defined, definitions commonly used in the construction industry are intended.

- **Kiosk / Restroom Building Areas –** The kiosk / restroom building areas are defined as the areas within and extending a minimum of 5 feet beyond the perimeter of the foundations for the kiosk/restroom structures at the stadium entrance. The building areas include any retaining walls, covered walkways or other improvements that are connected to a structure and that are intended to act in a manner similar to it.
- **Bleacher and Entrance Structure Foundation Areas –** The foundation areas are defined as the areas within and extending a minimum of 3 feet beyond the perimeter of the continuous and/or spread foundations for the bleachers, and for the entrance structure at the stadium entrance.
- **Exterior Pedestrian Flatwork and AC Path Areas –** The areas within the footprints of all exterior pedestrian flatwork, all AC paths for pedestrian use, and housekeeping slabs (if any) placed below the relocated bleachers, including and perimeter curb and/or gutter improvements.
- **PCC Paver and AC Pavement Areas –** The areas within the footprints of PCC pavers, or AC pavement for vehicle use, including any perimeter curb and/or gutter improvements.
- **Track Area –** The area within the footprint of the track, including the interior and exterior perimeter curbs.
- **Sitework Retaining Wall Areas –** The areas within and extending a minimum of 3 feet beyond the foundation limits of all sitework retaining walls.
- **Grading Area –** The entire area to be graded, including the building, bleacher and entrance structure foundation area, exterior pedestrian flatwork, PCC paver, AC path and pavement areas, the track area and sitework retaining wall areas.
- **Existing Grade –** Elevations of the site that existed as of the date of this report.
- **Finish Pad Grade –** The elevation in the building area where earthwork operations are typically considered to be complete. It does not include any sand or gravel that might be placed below slabs-on-grade in association with vapor protection for the slabs.
- **Subgrade –** The elevation in exterior pedestrian flatwork, PCC paver and AC path and pavement areas where imported nonexpansive materials, sand, or aggregate base (AB) are placed to support the flatwork, pavers or AC.
- **Scarified –** Plowed or ripped in two orthogonal directions to a depth of not less than 8 inches.

- **Moisture Conditioned –** Adjusting the soil moisture to optimum moisture content, or just above, prior to application of compactive effort.
- **Compacted/Recompacted –** Soils placed in level lifts not exceeding 8 inches in loose thickness and compacted to a minimum of 90 percent of maximum dry density. Based on maximum dry density by ASTM D 1557-12 and field density by ASTM D 6938-15, or other methods acceptable to the geotechnical engineer and jurisdiction.

Site Preparation

1. The ground surface in the grading areas should be prepared for construction by removing the existing structures, existing AC pavement and flatwork, and all other improvements, vegetation, large roots, debris, organic topsoil, and other deleterious materials. Existing utility lines that will not remain in service should be either removed or abandoned. The appropriate method of abandonment will depend upon the type and depth of the utility. Recommendations for abandonment can be made as necessary.

2. Voids created by the removal of materials or utilities described above should be called to the attention of the geotechnical engineer. No fill should be placed unless the underlying soil has been observed by the geotechnical engineer.

Grading

1. Following site preparation, existing fill in the kiosk / restroom building areas should be removed to a level plane at a depth of 2 feet below bottom of the deepest foundation element. The resulting level excavated surfaces should be scarified, moisture conditioned and compacted.

2. To create as uniform conditions as possible for the structure, all earthwork operations should be completed throughout each building area in a uniform manner at the same time, from the bottom of the overexcavation recommended in the previous paragraph through fill placement to finish grade. Earthwork operations that complete only a portion of the building area at one time (i.e., “flip-flopping”, “checkerboarding,” etc.) should not be allowed.

3. Following site preparation, existing fill in the bleacher and entrance structure foundation areas should be overexcavated to a minimum depth of 2 feet below bottom of each foundation element. The resulting excavated surfaces should be lightly scarified, moisture conditioned and compacted. Unlike the recommended earthwork program for the building area, overexcavation and recompaction operations for the bleacher and entrance structure foundation areas can proceed in a non-uniform manner for individual foundation areas.

4. Following site preparation, the existing DG track surface and the underlying fill soils in the track area should be removed to a minimum depth of 18 inches below the improved running surface and any associated underlying special layers (i.e., AC, etc.) designated by the architect/engineer. The resulting excavated surfaces should be scarified, moisture conditioned to at least 2 percent above optimum moisture content, and compacted. Unlike the recommended earthwork program for the building area, overexcavation and recompaction operations for the track area can proceed in a non-uniform manner for individual track segments.

5. Following site preparation, existing fill in sitework retaining wall areas should be overexcavated to a minimum depth of 2 feet below bottom of foundation elevation. The resulting excavated surfaces should be lightly scarified, moisture conditioned and compacted. Overexcavation elevations may be stepped where retaining walls are stepped to conform to any site contours. If firm alluvium is exposed at bottom of foundation elevation, no overexcavation and recompaction is considered necessary. To reduce the potential for cracking in sitework retaining walls, construction joints should be placed in the wall and the foundation where overexcavation operation have been stepped to conform to fill depth changes or to exposure of very stiff alluvium or colluvium. Unlike the recommended earthwork program for the building area, overexcavation and recompaction operations for sitework retaining walls can proceed in a non-uniform manner for individual wall segments.

6. Following site preparation and any excavations to grade, or prior to placement of fill, the soil in any exterior pedestrian flatwork, PCC paver, AC path and pavement areas, and in all other grading areas, should be scarified, moisture conditioned and recompacted. Unlike the recommended earthwork program for the building area, scarification and recompaction operations for exterior pedestrian flatwork, PCC paver, AC path and pavement areas, and in all other grading areas, can proceed in a non-uniform manner.

7. Voids created by dislodging cobbles and/or debris during scarification should be backfilled and recompacted, and the dislodged materials should be removed from the work area.

8. Previously removed site soils and other similar soils may be placed as fill in the following areas: in the kiosk / restroom building area to a maximum height of 18 inches below bottom of slab elevation; to bottom of foundation elevation in the entrance structure foundation areas at the stadium entrance; to subgrade in exterior pedestrian flatwork, PCC paver, AC path and pavement areas; and to finish grade beyond all other improvements.

9. The final 18 inches of fill below bottom of slab elevation in the kiosk / restroom building area should be nonexpansive. Nonexpansive materials are defined as imported soils that fall in the GW, GM, GC, SP, SW, SC and SM categories per ASTM D 2487-11, and that have an expansion index of 10 or less (ASTM D 4829-11). The clean sand layer described in the "Slabs-on-Grade" section of this report (if utilized below interior slabs-on-grade or exterior pedestrian flatwork) is considered to be part of the minimum recommended thickness of nonexpansive material utilized, not in addition to it.

10. The final 18 inches of fill below the improved running surface and any associated special layers designated by the architect/engineer for the track, and the final 2 feet of fill below the bleacher foundations, should consist of Class 2 Aggregate Base (AB) per the Standard Specifications (Caltrans 2010). Prior to placement of the AB for the track, a permeable synthetic filter fabric conforming to standard specification Section 88-1.02B – Class C (Caltrans 2010) should be placed over the compacted subgrade per the manufacturer's recommendations. AB should be placed over the fabric per the manufacturer's recommendations, by end dumping and pushing ahead of the equipment; no equipment traffic should be allowed on the fabric without a lift of AB in place.

11. Imported nonexpansive soils used in the building area should have strength qualities equal to or better than the site soils, and they should not exceed the geotechnical corrosivity potential of the site soils. See the Corrosivity Analysis by CERCO Analytical in Appendix C, and the Soil Corrosivity Study by HDR, Inc. in the report for the Annex / Classroom Building project (ESP 2016a, copy in Appendix D) for the corrosivity parameters of the site soils. Proposed imported materials should be reviewed by the geotechnical engineer before being brought to the site, and on an intermittent basis during placement.

12. All materials used as fill should be cleaned of any debris and rocks larger than 3 inches in diameter. When fill material includes rocks, the rocks should be placed in a sufficient soil matrix to ensure that voids caused by nesting of the rocks will not occur and that the fill can be properly compacted.

13. All AB and the top 12 inches of subgrade in areas to support PCC pavers, and AC paths and pavement should be compacted to a minimum of 95 percent of maximum dry density. Imported nonexpansive materials, sand or AB used to support exterior pedestrian flatwork, as well as the top 12 inches of subgrade in these areas, need only be compacted to a minimum of 90 percent of maximum dry density.

14. If the soils are overly moist so that they become unstable, or if the minimum recommended compaction cannot be readily achieved, drying the soil so that it is nearer optimum moisture content may be necessary. Placement of gravel layers or geotextiles may also be necessary to help stabilize unstable soils. Additional overexcavation may also be recommended to correct unstable conditions or if soft or loose conditions are encountered during grading. No fill should be placed in any grading area if the underlying soil is unstable.

15. The recommended soil moisture content should be maintained throughout construction, and during the lives of the structures and all other improvements. Failure to maintain the soil moisture content can result in desiccation cracks and disturbance, which are an indication of degradation of the soil compaction. If desiccation cracks are allowed to develop, or if soils near improvements such as foundations, flatwork, etc. are otherwise disturbed, damage to those improvements may result. Soils that have cracked or are otherwise disturbed should be removed, moisture conditioned, and recompacted.

Utility Trenches

1. Utility trenches adjacent to foundations should not be excavated within the zone of foundation influence, as shown in Typical Detail A in Appendix F.

2. Utilities that must pass beneath foundations should be placed with properly compacted utility trench backfill and the foundation should be designed to span the trench.

3. A select, noncorrosive, granular, easily compacted material should be used as bedding and shading immediately around utilities. The site soil may be used for trench backfill above the select material to subgrade or finish grade beyond the building area, and to within 18 inches below bottom of slab elevation in the building area. Within the building area, imported nonexpansive soils should be utilized to backfill the final 18 inches below bottom of slab elevation of all trenches. In exterior pedestrian flatwork, PCC paver, AC path and pavement areas, trench backfill should match the thickness of imported nonexpansive soils, sand or AB used to support these improvements.

4. In general, trench backfill should be compacted to a minimum of 90 percent of maximum dry density. Trench backfill in the upper 12 inches of subgrade and all AB in PCC paver, AC path and pavement areas should be compacted to a minimum of 95 percent of maximum dry density. A minimum of 85 percent of maximum dry density will generally be sufficient where trench backfill is located in landscaped or other unimproved areas, where settlement of trench backfill would not be detrimental.

5. Prior to applying compactive effort, trench backfill should be moisture conditioned. Trench backfill should be placed in level lifts not exceeding 6 inches in loose thickness and compacted to the minimums recommended above.

6. Compaction of trench backfill by jetting or flooding is not recommended at this site due to the expansive site soils. However, to aid in *encasing* utility conduits, particularly corrugated drain pipes, and multiple, closely-spaced conduits in a single trench with the bedding and shading material, jetting or flooding may be useful. Flooding or jetting should only be attempted with extreme caution, and any flooding or jetting operation should be subject to review by the geotechnical engineer.

7. Long-term settlement of properly compacted sand should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill. Where trenches are backfilled with site soils, the anticipated settlement would be about twice that of sand. Improvements that are constructed over or near trenches should be designed to accommodate the potential for settlement.

8. The Corrosivity Analysis by CERCO Analytical in Appendix C, and the Soil Corrosivity Study by HDR, Inc. in the report for the Annex / Classroom Building project (ESP 2016a, copy in Appendix D) should be used by the architect/engineer in specifying appropriate corrosion protection measures for utility improvements.

9. The recommendations of this section are minimums only, and may be superseded by the architect/engineer based upon soil corrosivity or the requirements of pipe manufacturers, utility companies or the governing jurisdiction.

Foundations and Track Curbs

1. The kiosk / restroom buildings, the bleachers and the stadium entrance structure may be supported by continuous and spread footings bearing in firm recompacted soils, as recommended in the “Grading” Section of this report.

2. Based on soil expansion potential only, minimum overall foundation depths of 21 inches below lowest adjacent grade within 6 feet laterally of the base of foundations should be maintained. Spread footings should be at least 24 inches square.

3. Continuous footings should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential only, minimum continuous footing reinforcement should consist of two No. 4 rebar, one at the top and one at the bottom. Spread footings should be reinforced in accordance with the requirements of the architect/engineer.

4. Footings bearing in firm recompacted soil may be designed using maximum allowable bearing capacities of 2,500 psf dead load and 3,500 psf dead plus live loads. Using these criteria, maximum settlement and differential settlement are expected to be less than 1/2-inch and less than 3/8-inch in 25 feet, respectively.

5. Allowable bearing capacities may be increased by one-third when transient loads such as wind or seismicity are included. Foundations may be designed as necessary using the values contained in the Summary of Design Response Acceleration Parameters Table on Page 8 in the report for the Annex / Classroom Building Project (ESP 2016a, copy in Appendix D).

6. To calculate resistance to lateral loads, please see the values presented in the "Retaining Walls" Section of this report. Lateral capacity is based on the assumption that any backfill adjacent to foundations has been properly compacted. Passive and friction components of resistance may be combined in the analysis without reduction to either value.

7. Minimum 6-inch wide curbs should be placed around the interior, the exterior, and along the straightaways and ends of the track. The track curbs should extend to a minimum depth of 6 inches below the bottom of the 18-inch AB layer recommended to be placed below the improved running surface and any associated special layers designated by the architect/engineer. Based on soil expansion potential only, minimum reinforcement for the track curbs should consist of two No. 4 rebar, one at the top and one at the bottom. Joints for track curbs should be as specified by the architect/engineer.

8. Footing and track curb excavations should be observed by the geotechnical engineer prior to placement of reinforcing steel. Footing and track curb excavations should be lightly moistened and no desiccation cracks should be present prior to concrete placement.

9. The Corrosivity Analysis by CERCO Analytical in Appendix C, and the Soil Corrosivity Study by HDR, Inc. in the report for the Annex / Classroom Building project (ESP 2016, copy in Appendix D) should be used by the architect/engineer in specifying appropriate corrosion protection measures for foundations and track curbs.

Slabs-on-Grade

Interior Slabs-On-Grade

1. Interior slabs-on-grade should have a minimum thickness of 4 full inches. They should be reinforced and doweled to foundations per the specifications of the architect/engineer. At a minimum, interior slabs should be reinforced with No. 3 rebar at 24 inches on center each way. All structural slabs should contain minimum rebar meeting the criteria of ACI 318, Section 7.12.2 (ACI 2011). At a minimum, foundation dowels should be lap spliced to the slab rebar. The size and spacing of the dowels should match the size and spacing of the slab rebar.

Exterior Pedestrian Flatwork and Housekeeping Slabs

1. Exterior pedestrian flatwork ("flatwork") and housekeeping slabs ("slabs") should have a minimum thickness of 4 full inches. Minimum reinforcement for flatwork and slabs placed over at least 18 inches of nonexpansive imported soils per the following paragraph should consist of No. 3 rebar placed at 24 inches on-center each way. If the thickness of nonexpansive soil below the flatwork and slabs is less than 18 inches, the minimum reinforcement should consist of No. 3 rebar at 18 inches on-center each way.

2. In conventional construction, it is common to use 4 to 6 inches of sand beneath flatwork and slabs. However, due to the medium expansion potential of the site soils, there will be a risk of movement and damage to the flatwork and slabs if conventional measures are used. Heaving and cracking could occur. This movement could be reduced by the placement of additional nonexpansive material beneath the flatwork and slabs. If it is desired to fully mitigate the expansive soil conditions, then at least 18 inches of imported nonexpansive material should be provided below the flatwork and slabs where the expansive site soils are exposed at finish grade. If it is acceptable for the flatwork and slabs to experience movement due to expansive soils, then the thickness of the nonexpansive soil can be reduced. Under all flatwork and slabs, however, the thicker the nonexpansive layer, the better the expansive soil protection.

3. Another measure that can be taken to reduce the risk of movement of flatwork and slabs due to expansive soils is to provide thickened edges or grade beams around the perimeters of the flatwork. If it is desired to fully mitigate the expansive soil conditions, then the thickened edges or grade beams could be up to 21 inches deep. If it is acceptable for the flatwork and slabs to experience movement, then the thickened edges or grade beams can be reduced. At a minimum, any thickened edge or grade beam should be reinforced by two No. 4 rebar, one at the top and one at the bottom.

4. It is recognized that the measures discussed above for protecting flatwork and slabs from expansive soils are expensive, possibly more expensive than simply replacing flatwork that has heaved and/or cracked. Consequently, the above measures for protecting flatwork and slabs are only suggestions for consideration by the owner and/or architect/engineer. The degree to which flatwork and slabs are protected from expansive soil damage is left to the discretion of the owner and/or architect/engineer.

5. Flatwork and slabs should be constructed with frequent joints to allow articulation as the flatwork and slabs move in response to seasonal soil temperature and moisture variations. The expansive soil underlying any nonexpansive material placed below flatwork and slabs should be moisture conditioned, and no desiccation cracks should be present, prior to casting the flatwork.

6. Flatwork and slabs at doorways, and at other areas where maintaining the elevation of the flatwork and slabs is desired when mitigating expansive soil potential, should be doweled to the perimeter foundation (if any), at a minimum, by No. 3 dowels lapped to the flatwork rebar at 24 inches on center. In other areas, the flatwork and slabs may be doweled to the foundation or the flatwork and slabs may be allowed to "float free," at the discretion of the architect/engineer. Flatwork and slabs that are intended to float free should be separated from foundations by a felt joint or other means.

Moisture Vapor Transmission

1. Due to the current use of impermeable floor coverings, water-soluble flooring adhesives, and the speed at which buildings are now constructed, moisture vapor transmission through slabs is a much more common problem than in past years. Where moisture vapor transmitted from the underlying soil would be undesirable, slabs should be protected from subsurface moisture vapor. A number of options for vapor protection are discussed below; however, the means of vapor protection, including the type and thickness of the vapor retarder, if specified, are left to the discretion of the architect/engineer.

2. Where specified, vapor retarders should conform to ASTM Standard E 1745-11. This standard specifies properties for three performance classes; Class A, B and C. The appropriate class should be selected based on the sensitivity of floor coverings to moisture intrusion and the potential for damage to the vapor retarder during placement of slab reinforcement and concrete.

3. Several recent studies, including those of American Concrete Institute Committee 302 (ACI 2004), have concluded that excess water above the vapor retarder increases the potential for moisture damage to floor coverings and could increase the potential for

mold growth or other microbial contamination. The studies also concluded that it is preferable to eliminate the typical sand layer beneath the slab and place the slab concrete in direct contact with a Class A vapor retarder, particularly during wet weather construction. However, placing the concrete directly on the vapor retarder requires special attention to using the proper vapor retarder, a very low water-cement ratio in the concrete mix, and special finishing and curing techniques.

4. Probably the next most effective option would be the use of vapor-inhibiting admixtures in the slab concrete mix and/or application of a sealer to the surface of the slab. This would also require special concrete mixes and placement procedures, depending upon the recommendations of the admixture or sealer manufacturer.

5. Another option that may be a reasonable compromise between effectiveness and cost considerations is the use of a subslab vapor retarder protected by a sand layer. If a Class A vapor retarder is specified, the retarder can be placed directly on the nonexpansive soil. The retarder should be covered with a minimum 2 inches of *clean* sand. If a less durable vapor retarder is specified (Class B or C), a minimum of 4 inches of clean sand should be provided, and the retarder should be placed in the center of the clean sand layer. Clean sand is defined as a well or poorly graded sand (ASTM D 2487-11) of which less than 3 percent passes the No. 200 sieve. The clean sand layer, if used, is considered to be a part of the minimum 18-inch thickness of nonexpansive imported materials recommended in the "Grading" Section of this report to be placed below slabs-on-grade, not in addition to it.

6. Regardless of the underslab vapor retarder selected, proper installation of the retarder per ASTM E 1643-11 is critical for optimum performance. Where utilized, the vapor retarder should be placed a minimum of 1 inch above the flow line of the drainage path surrounding the structures, or 1 inch above the area drain grates if area drains are used to collect runoff around the structures. All seams must be properly lapped, and all seams and utility penetrations properly sealed in accordance with the vapor retarder manufacturer's recommendations.

7. If the sand is used between the vapor retarder and the slab, it should be moistened only as necessary to promote concrete curing; saturation of the sand should be avoided, as the excess moisture would be on top of the vapor retarder, potentially resulting in vapor transmission through the slab for months or years.

8. Positive drainage away from the building should be maintained; see the "Drainage and Maintenance" Section of this report for additional discussion of this issue. If water is allowed to pond near the structure, it may seep into the ground and migrate laterally through cracks or utility penetrations in the foundation, ultimately gaining access above the vapor retarder.

General

1. To reduce shrinkage cracks in all interior and exterior slabs-on-grade, the concrete aggregates should be of appropriate size and proportion, the water/cement ratio should be low, the concrete should be properly placed and finished, contraction joints should be installed, and the concrete should be properly cured. This is particularly applicable to slabs that will be cast directly upon a vapor retarder and those that will be protected from transmission of vapor by use of admixtures or surface sealers. Concrete materials, placement, and curing specifications should be at the direction of the architect/engineer; AC 302.1R-04 (ACI 2004) is suggested as a resource for the architect/engineer in preparing such specification.

2. To provide stability for curbs adjacent to exterior pedestrian flatwork, they should be set back a minimum distance equal to one-third the height of any adjacent descending slope, but not less than 5 feet from the tops of slopes. Alternately, curbs may be deepened to provide stability. The geotechnical engineer should review, on an individual basis, any situation where curbs must be deepened to meet this recommendation.

3. The Corrosivity Analysis by CERCO Analytical in Appendix C, and the Soil Corrosivity Study by HDR, Inc. in the report for the Annex / Classroom Building project (ESP 2016, copy in Appendix D) should be used by the architect/engineer in specifying appropriate corrosion protection measures for slabs-on-grade.

Retaining Walls

1. Retaining walls connected to or forming part of a building should be founded in firm soil that has been recompacted per the "Grading" Section of this report. Sitework retaining walls may be supported by either firm soil that has been recompacted per the "Grading" Section of this report, or firm sandy lean clay alluvium. If a sitework retaining wall crosses a recompacted soil/firm alluvium transition, or a transition between varying fill overexcavation depths, a construction joint should be placed in the footing and wall at the transitions. Foundations for all retaining walls should have minimum overall depths (not including any keyway) of 21 inches below lowest grade within 6 feet laterally of any adjacent slope.

2. Retaining wall footings should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential only, minimum retaining wall footing reinforcement should consist of two No. 4 rebar, one at the top and one at the bottom.

3. Retaining wall design may be based on the following parameters:

Active equivalent fluid pressure (site soils)	45 pcf
Active equivalent fluid pressure (imported sand/gravel backfill)	35 pcf
At-rest equivalent fluid pressure (site soils)	65 pcf
At-rest equivalent fluid pressure (imported sand/gravel backfill)	50 pcf
Passive equivalent fluid pressure	350 pcf
Maximum toe pressure	3,500 psf
Coefficient of sliding friction	0.35

4. No surcharges are taken into consideration in the values presented in the previous paragraph. The maximum toe pressure is an *allowable* value; no factors of safety, load factors or other factors have been applied to the remaining values. With the exception of the maximum toe pressure, these values will require application of appropriate factors of safety, load factors, and/or other factors as deemed appropriate by the architect/engineer.

5. If the active or at-rest pressures presented in Paragraph 3 for *imported sand or gravel backfill* are utilized for design of retaining walls, the sand or gravel should be used exclusively as backfill above a 1:1 plane extended upward from the back of the wall footing to approximately 1 foot from the top of the wall backfill. The upper foot should be backfilled with native soil, except in areas where PCC pavers, AC paths, pavement or exterior pedestrian flatwork will abut the top of the wall. In such cases, the gravel should extend to the imported nonexpansive material, sand, aggregate base, or other material below the improved surface, as appropriate. If gravel backfill is utilized, the gravel should be encased in a permeable synthetic filter fabric conforming to standard specification Section 88-1.02B – Class C (Caltrans 2010).

6. The active and at-rest pressures presented in Paragraph 3 are applicable to a horizontal retained surface behind the wall. Walls having a retained surface that slopes upward from the wall should be designed for an additional equivalent fluid pressure of 1 pcf for the active case and 1.5 pcf for the at-rest case, for every degree of slope inclination.

7. It is assumed that retaining wall heights will not exceed 5 feet.

8. Section 1803A.5.12.1 of the 2013 CBC requires that dynamic seismic lateral earth pressures be provided by the geotechnical engineer for walls retaining more than 6 feet of backfill. As retaining wall heights will not exceed 5 feet, consideration of seismic lateral earth pressures in the design is not needed.

9. Long-term settlement of properly compacted sand or gravel retaining wall backfill should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill; long-term settlement of properly compacted site soil retaining wall backfill would be about twice that of sand or gravel backfill. Improvements that are constructed near the tops of retaining walls should be designed to accommodate long-term settlement.

10. All retaining walls should be drained with perforated pipe encased in a free-draining gravel blanket. The pipe should be placed perforations downward, and should discharge in a nonerosive manner away from foundations and other improvements. The gravel blanket should have a width of approximately 1 foot and should extend upward to approximately 1 foot from the top of the wall backfill. The upper foot should be backfilled with native soil, except in areas where PCC pavers, AC paths, pavement or exterior pedestrian flatwork will abut the top of the wall. In such cases, the gravel should extend to the imported nonexpansive material, sand, aggregate base, or other material below the improved surface, as appropriate. To reduce infiltration of the soil into the gravel, a permeable synthetic filter fabric conforming to Standard Specifications Section 88-1.02B – Class C (Caltrans 2010), should be placed between the two. Manufactured synthetic drains, such as Miradrain or Enkadrain are acceptable alternatives to the use of gravel, provided that they are installed in accordance with the recommendations of the manufacturer.

11. Where weep hole drainage can be properly discharged, the perforated pipe may be omitted in lieu of weep holes on maximum 4-foot centers. A filter fabric as described above should be placed between the weep holes and the drain gravel.

12. Walls facing areas where moisture transmission through the wall would be undesirable should be *thoroughly* waterproofed in accordance with the specifications of the architect/engineer.

13. The architect/engineer should bear in mind that retaining walls by their nature are flexible structures, and that surface treatments on walls often crack. Where walls are to be plastered or otherwise have a finish applied, the flexibility should be considered in determining the suitability of the surfacing material, spacing of horizontal and vertical control joints, etc. The flexibility should also be considered where a retaining wall will abut or be connected to a rigid structure, and where the geometry of the wall is such that its flexibility will vary along its length.

14. The Corrosivity Analysis by CERCO Analytical in Appendix C, and the Soil Corrosivity Study by HDR, Inc. in the report for the Annex / Classroom Building project (ESP 2016, copy in Appendix D) should be used by the architect/engineer in specifying appropriate corrosion protection measures for retaining walls.

Portland Cement Concrete (PCC) Pavers, and Asphalt Concrete (AC) Paths and Pavement

PCC Pavers

1. PCC pavers should be installed per the manufacturer's recommendations.

2. Unless otherwise recommended by the paver manufacturer, the structural paver section should consist of the following (from top to bottom):

    - PCC pavers, 3.125-inch thickness, minimum
    - 1.5 to 2.0 inches No. 8 aggregate bedding course (ASTM D 448-12)
    - 10 inches Class 2 aggregate base (Caltrans 2010 Standard Specifications)
    - Subgrade, moisture conditioned and compacted to a minimum of 95 percent of maximum dry density, and firm and unyielding when proofrolled

3. At a minimum, the pavers should be properly maintained, and any ruts, depressions, broken pavers, etc. should be immediately repaired. Periodic removal of pavers and refurbishment of the No. 8 bedding course may also be necessary.

AC Paths and Pavement

1. Paths for pedestrian access may be constructed of AC over aggregate base (AB). Design methods for AC pavement do not typically consider pedestrian loading only; the section design is typically based on local experience and anticipated life span. For this application, a minimum pavement section of 2 inches of AC over 4 inches of AB is considered appropriate. As with exterior pedestrian flatwork, this minimum thickness of AC and AB will be subject to movement due to expansive soils. If it is desired to fully mitigate the expansive soil conditions, the AB thickness can be increased to as much as 18 inches.

2. It is recognized that the increased AB thickness recommended above for protecting AC paths from expansive soils will be expensive, possibly more expensive than simply replacing AC paths that has heaved and/or cracked. Consequently, this measure for protecting AC paths is only a suggestion for consideration by the client and/or architect/engineer. The degree to which AC paths are protected from expansive soil damage is left to the discretion of the owner and/ or architect/engineer.

3. The following AC pavement sections to support vehicle traffic are based upon a tested R-value, or resistance to deformation under repeated loading, of 6 for the upper soils on the adjacent Student Services / Administration Building (ESP 2016b). The pavement sections are based on assumed Traffic Indices (TIs) of 4.5 through 7.0. Determination of the appropriate TI for specific areas of the project is left to others. The AC and AB thicknesses were calculated in accordance with the method presented in the "Highway Design Manual" (Caltrans 2006, updated 2008), and are for compacted material. Normal Caltrans construction tolerances should apply.

Traffic Index	AC	AB
4.5	2.50"	9.0"
5.0	2.75"	10.0"
5.5	3.00"	11.5"
6.0	3.25"	13.0"
6.5	3.75"	14.0"
7.0	4.00"	15.5"

General

1. Pavers and pavement should be constrained by curbs, gutters, flatwork, walls, etc.; free edges to the pavers or pavement should be avoided.

2. Pavement and pavers should be set back a minimum of 5 feet from any descending slope. Alternately, deepened curbs may be used to constrain the pavers or pavement sections. Where curbs will be deepened in lieu of the recommended set back, the individual situation should be reviewed and specific recommendations prepared by the geotechnical engineer.

3. AB should conform to the requirements of Section 26 of the Standard Specifications (Caltrans 2010). AC should conform to the requirements of Section 32 of the Standard Specifications (Caltrans 2010).

4. The upper 12 inches of subgrade and all AB in paver and pavement areas should be compacted to a minimum of 95 percent of maximum dry density. Subgrade and aggregate base should be firm and unyielding when proofrolled with heavy, rubber-tired grading equipment prior to continuing construction.

5. Finished paver and pavement surfaces should be sloped to freely drain toward appropriate drainage facilities. Water should not be allowed to stand or pond on or adjacent to pavers, pavement, or other improvements as it could infiltrate into the aggregate base and/or subgrade, causing premature pavement or paver deterioration.

6. To reduce migration of surface drainage into the subgrade, maintenance of paver and pavement areas is critical. Any broken pavers should be promptly repaired and any cracks that develop in pavement should be promptly sealed.

7. The local jurisdiction may have additional requirements for pavement or pavers that could take precedence over the above recommendations.

Drainage and Maintenance

1. Per Section 1804A.3 of the 2013 CBC, unpaved ground surfaces should be *finish graded* to direct surface runoff away from foundations and other improvements at a minimum 5 percent grade for a minimum distance of 10 feet. The site should be similarly sloped to drain away from foundations, the track, and other improvements during construction. Where this is not practicable due to other improvements, etc., swales with improved surfaces, area drains, or other drainage facilities, should be used to collect and discharge runoff. Control of surface drainage around the track will be critical to maintaining the integrity of the all-weather surface.

2. All eaves of the buildings should be fitted with roof gutters. Runoff from flatwork, roof gutters, downspouts, planter drains, area drains, etc. should discharge in a nonerosive manner away from foundations and other improvements in accordance with the requirements of the governing agencies. Erosion protection should be placed at all discharge points unless the discharge is to a pavement surface.

3. To reduce the potential for planter drainage gaining access to subslab areas, any raised planter boxes adjacent to foundations should be installed with drains and sealed sides and bottoms. Drains should also be provided for areas adjacent to the structure and in landscape areas that would not otherwise freely drain.

4. The site soils are erodible; stabilization of soils disturbed during construction by vegetation or other means *during* and *following* construction, is essential to reduce erosion damage. Surface drainage should also be maintained during construction.

5. Maintenance of drainage and other improvements is critical to the long-term stability of the site and the integrity of the structures. Site improvements should be maintained on a regular basis.

6. Finished pavement surfaces should be sloped to freely drain toward appropriate drainage facilities. Water should not be allowed to stand or pond on or adjacent to AC paths, pavement or other improvements as it could infiltrate into the AB and/or subgrade, causing premature pavement deterioration.

7. All exterior drains, retaining wall drains, and drain outlets should be maintained to be free-flowing. Care should be taken to establish and maintain vegetation. The landscaping should be planned and installed to maintain the surface drainage recommended above. Vegetation and erosion matting (if utilized) should be maintained or augmented as needed. Irrigation systems should be maintained so that soils around structures are maintained at a relatively uniform year-round moisture content, and are neither over-watered nor allowed to dry and desiccate.

8. To reduce migration of surface drainage into the subgrade, maintenance of AC path and pavement areas is critical. Any cracks that develop in the AC should be promptly sealed.

9. To reduce the potential for disruption of drainage patterns and undermining of structures, fill areas, etc., all rodent activity should be aggressively controlled.

Observation and Testing

1. It must be recognized that the recommendations contained in this report are based on a limited number of borings and rely on continuity of the subsurface conditions encountered.

2. It is assumed that the geotechnical engineer will be retained to provide consultation during the design phase, to interpret this report during construction, and to provide construction monitoring in the form of testing and observation.

3. At a minimum, the geotechnical engineer should be retained to provide:

   - Professional observation during grading, trench and retaining wall backfill, and foundation construction
   - Oversight of special inspection and compaction testing grading, trench and retaining wall backfill, and foundation construction

4. Special inspection of grading and backfill should be provided as per Section 1705A.6 and Table 1706A.6 of the CBC. The special inspector should be under the direction of the geotechnical engineer. At a minimum, the following items should be inspected and/or tested by the special inspector:

   - Stripping and clearing of all existing improvements, vegetation, and deleterious materials
   - Overexcavation of the building and sitework retaining wall areas to the recommended depths
   - Scarification and moisture conditioning of overexcavated areas
   - Scarification and moisture conditioning of exterior pedestrian flatwork, PCC paver, AC path and pavement areas, and all other grading areas
   - Fill quality, placement, moisture conditioning and compaction
   - Utility trench backfill
   - Foundation excavations

5. A program of quality assurance should be developed prior to beginning construction. At a minimum, the program should include all geotechnical items shown on the testing and inspection schedule of the approved plans. It should also include any additional inspection items required by the engineer and/or the governing jurisdiction. These items should be discussed at a preconstruction site meeting among a representative of the owner, the geotechnical engineer, special inspector, the project inspector, the engineer, and contractors. The geotechnical engineer should be notified at least 48 hours prior to beginning grading operations.

6. Locations and frequency of compaction tests should be as per the recommendation of the geotechnical engineer at the time of construction. The recommended test location and frequency may be subject to modification by the geotechnical engineer, based upon soil and moisture conditions encountered, size and type of equipment used by the contractor, the general trend of the results of compaction tests, or other factors.

10.0 CLOSURE

Our intent was to perform the investigation in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the locality of this project under similar conditions. No representation, warranty, or guarantee is either expressed or implied. This report is intended for the exclusive use by the client as discussed in the "Scope of Services" section. Application beyond the stated intent is strictly at the user's risk.

This report is valid for conditions as they exist at this time for the type of project described herein. The conclusions and recommendations contained in this report could be rendered invalid, either in whole or in part, due to changes in building codes, regulations, standards of geotechnical or construction practice, changes in physical conditions, or the broadening of knowledge.

If changes with respect to the project become necessary, if items not addressed in this report are incorporated into plans, or if any of the assumptions used in the preparation of this report are not correct, this firm shall be notified for modifications to this report. Any items not specifically addressed in this report should comply with the CBC of other applicable standards, and the requirements of the governing jurisdiction.

The preliminary recommendations presented in this geotechnical report are based upon the geotechnical conditions encountered at the site, and may be augmented by additional requirements of the client, or by additional recommendations provided by the geotechnical engineer based on peer or jurisdiction reviews, or conditions exposed at the time of construction. If Earth Systems Pacific is *not* retained to provide construction observation and testing services, it shall not be responsible for the interpretation of the information by others or any consequences arising therefrom.

This document, the data, conclusions, and recommendations contained herein are the property of Earth Systems Pacific. This report shall be used in its entirety, with no individual sections reproduced or used out of context. Copies may be made only by Earth Systems Pacific, the client, and the client's authorized agents for use exclusively on the subject project. Any other use is subject to federal copyright laws and the written approval of Earth Systems Pacific.

Thank you for this opportunity to have been of service. If you have any questions, please feel free to contact this office at your convenience.

End of Text.

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APPENDIX A

Boring Location Map
Boring Log Legend
Boring Logs



LEGEND

8 Boring Location (Approx.)

NOT TO SCALE

N

BORING LOCATION MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
STADIUM ENTRANCE/ BLEACHERS/ TRACK

1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3109

Earth Systems Pacific

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January 20, 2016 CS SL-16605-SC

SLO HS STADIUM ENTRANCE-012016BLOCATIONS

Earth Systems Pacific

BORING LOG LEGEND

SAMPLE / SUBSURFACE WATER SYMBOLS	GRAPH. SYMBOL
CALIFORNIA MODIFIED	■
STANDARD PENETRATION TEST (SPT)	●
SHELBY TUBE	▭
BULK	○
SUBSURFACE WATER DURING DRILLING	▼
SUBSURFACE WATER AFTER DRILLING	▽

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

MAJOR DIVISIONS	GROUP SYMBOL	TYPICAL DESCRIPTIONS	GRAPH. SYMBOL
COARSE GRAINED SOILS (MORE THAN HALF OF MATERIAL IS LARGER THAN #200 SIEVE SIZE)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GP	POORLY GRADED GRAVELS, OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, NON-PLASTIC FINES	
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, PLASTIC FINES	
	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
	SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES	
	SM	SILTY SANDS, SAND-SILT MIXTURES, NON-PLASTIC FINES	
	SC	CLAYEY SANDS, SAND-CLAY MIXTURES, PLASTIC FINES	
FINE GRAINED SOILS (HALF OR MORE OF MATERIAL IS SMALLER THAN #200 SIEVE SIZE)	ML	INORGANIC SILTS AND VERY FINE SANDS, 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	
	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS	
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	

OBSERVED MOISTURE CONDITION

DRY	SLIGHTLY MOIST	MOIST	VERY MOIST	WET (SATURATED)

CONSISTENCY

COARSE GRAINED SOILS			FINE GRAINED SOILS		
BLOWS/FOOT		DESCRIPTIVE TERM	BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER		SPT	CA SAMPLER	
0-10	0-16	LOOSE	0-2	0-3	VERY SOFT
11-30	17-50	MEDIUM DENSE	3-4	4-7	SOFT
31-50	51-83	DENSE	5-8	8-13	MEDIUM STIFF
OVER 50	OVER 83	VERY DENSE	9-15	14-25	STIFF
			16-30	26-50	VERY STIFF
			OVER 30	OVER 50	HARD

GRAIN SIZES

U.S. STANDARD SERIES SIEVE				CLEAR SQUARE SIEVE OPENING		
# 200	# 40	# 10	# 4	3/4"	3"	12"

SILT & CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

TYPICAL BEDROCK HARDNESS

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
EXTREMELY HARD	CORE, FRAGMENT, OR EXPOSURE CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CAN ONLY BE CHIPPED WITH REPEATED HEAVY HAMMER BLOWS
VERY HARD	CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CORE OR FRAGMENT BREAKS WITH REPEATED HEAVY HAMMER BLOWS
HARD	CAN BE SCRATCHED WITH KNIFE OR SHARP PICK WITH DIFFICULTY (HEAVY PRESSURE); HEAVY HAMMER BLOW REQUIRED TO BREAK SPECIMEN
MODERATELY HARD	CAN BE GROOVED 1/16 INCH DEEP BY KNIFE OR SHARP PICK WITH MODERATE OR HEAVY PRESSURE; CORE OR FRAGMENT BREAKS WITH LIGHT HAMMER BLOW OR HEAVY MANUAL PRESSURE
SOFT	CAN BE GROOVED OR GOUGED EASILY BY KNIFE OR SHARP PICK WITH LIGHT PRESSURE, CAN BE SCRATCHED WITH FINGERNAIL; BREAKS WITH LIGHT TO MODERATE MANUAL PRESSURE
VERY SOFT	CAN BE READILY INDENTED, GROOVED OR GOUGED WITH FINGERNAIL, OR CARVED WITH KNIFE; BREAKS WITH LIGHT MANUAL PRESSURE

TYPICAL BEDROCK WEATHERING

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
FRESH	NO DISCOLORATION, NOT OXIDIZED
SLIGHTLY WEATHERED	DISCOLORATION OR OXIDATION IS LIMITED TO SURFACE OF, OR SHORT DISTANCE FROM, FRACTURES: SOME FELDSPAR CRYSTALS ARE DULL
MODERATELY WEATHERED	DISCOLORATION OR OXIDATION EXTENDS FROM FRACTURES, USUALLY THROUGHOUT; Fe-Mg MINERALS ARE "RUSTY", FELDSPAR CRYSTALS ARE "CLOUDY"
INTENSELY WEATHERED	DISCOLORATION OR OXIDATION THROUGHOUT; FELDSPAR AND Fe-Mg MINERALS ARE ALTERED TO CLAY TO SOME EXTENT, OR CHEMICAL ALTERATION PRODUCES IN SITU DISAGGREGATION
DECOMPOSED	DISCOLORATION OR OXIDATION THROUGHOUT, BUT RESISTANT MINERALS SUCH AS QUARTZ MAY BE UNALTERED; FELDSPAR AND Fe-Mg MINERALS ARE COMPLETELY ALTERED TO CLAY

drafting/masters/Boring Log Legend121714.dwg

Earth Systems Pacific

Boring No. 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

JOB NO.: SL-16605-SC
DATE: 01/15/16

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			2.5" AC over 6" AB					
1	SC		CLAYEY SAND: brown, medium dense, moist, trace gravel (Fill)	1.0 - 2.5	Ring	110.5	7.2	5, 7, 11
3				3.0 - 4.5	Ring	96.9	18.8	5, 9, 10
4	CL		SANDY LEAN CLAY: gray brown, stiff, very moist, trace fine gravel (Alluvium)					
5			moist	5.0 - 6.5	Ring	102.4	13.1	8, 10, 14
8			increasing fine to coarse gravel					
9	SC		CLAYEY SAND: brown, medium dense, moist					
12			some coarse gravel					
15	SC		CLAYEY SAND WITH GRAVEL: brown, medium dense, moist	15.0 - 16.5	SPT			8, 9, 12
20				20.0 - 21.5	SPT	---	7.8	9, 9, 10
23	SW		WELL GRADED SAND WITH GRAVEL: brown, medium dense, moist, trace clay					
25				25.0 - 26.5	SPT			5, 13, 13

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 1
PAGE 2 OF 2

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

JOB NO.: SL-16605-SC
DATE: 01/15/16

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
27	SW		as above					
30			loose	30.0 - 31.5	●			8 5 5
34			wet ▼					
35				35.0 - 36.5	●			5 7 9
40				40.0 - 41.5	●			8 27 29
41			SERPENTINITE: dark olive/ dark gray mottled, moderately soft, moist (Franciscan Melange)					
44			End of Boring @ 43.5'. Subsurface water encountered between 34.0' and 40.5'.					

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 2
PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

JOB NO.: SL-16605-SC
DATE: 01/15/16

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			4.0" PCC over 6" Well Graded Sand					
1	SC		CLAYEY SAND: brown, medium dense, moist, trace fine gravel (Fill)	1.0 - 2.5	■	111.5	14.9	3, 7, 10
2				1.0 - 3.0	○			
3			very moist	3.0 - 4.5	■	93.0	17.9	4, 7, 10
4								
5			gray brown, increasing clay	5.0 - 6.5	■	87.6	16.2	5, 8, 11
6	CL		SANDY LEAN CLAY: gray brown, stiff, moist, (Alluvium)					
7								
8								
9			brown					
10				10.0 - 11.5	●			6, 10, 12
11								
12								
13			some gravel					
14								
15			gravel ends, brown	15.0 - 16.5	●			7, 7, 9
16								
17			End of Boring @ 16.5'					
18			No subsurface water encountered					
19								
20								
21								
22								
23								
24								
25								
26								

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 3

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

PAGE 1 OF 1
JOB NO.: SL-16605-SC
DATE: 01/15/16

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	GC-GM		8.0" - Track Surface: Dark Brown Silty Clayey Gravel (decomposed granite ; "DG"), dense, moist	1.0 - 2.5	▬	106.0	18.9	7, 11, 15
1	CL		SANDY LEAN CLAY: dark brown to gray brown, stiff, very moist, trace gravel (Fill)					
2								
3				3.5 - 5.0	●			2, 3, 4
4			medium stiff					
5			End of Boring @ 5.0'					
6			No subsurface water encountered					
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								

LEGEND: ▬ Ring Sample ◯ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 4

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

PAGE 1 OF 1
JOB NO.: SL-16605-SC
DATE: 01/15/16

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	GC-GM		8.0" - Track Surface: Dark Brown Silty Clayey Gravel (decomposed granite ; "DG"), dense, moist	1.0 - 2.5	■	110.3	21.7	7 8 10
2	CL		SANDY LEAN CLAY: dark brown to dark gray brown, stiff, very moist (Fill)	1.0 - 3.0	○			
3				3.5 - 5.0	●			1 3 4
4	SC		CLAYEY SAND: light gray, loose, moist					
5			End of Boring @ 5.0' No subsurface water encountered					

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 5

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

PAGE 1 OF 1
JOB NO.: SL-16605-SC
DATE: 01/15/16

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	GC-GM		7.5" - Track Surface: Dark Brown Silty Clayey Gravel (decomposed granite ; "DG"), dense, moist	1.0 - 2.5	■	95.0	25.3	6 10 12
2	CL		SANDY LEAN CLAY: dark gray brown, stiff, very moist, trace gravel (Fill)	3.5 - 5.0	●			3 3 4
4	SC		CLAYEY SAND: light gray, loose, moist					
5			End of Boring @ 5.0' No subsurface water encountered					

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 6

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

PAGE 1 OF 1
JOB NO.: SL-16605-SC
DATE: 01/15/16

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	GC-GM		7.5" - Track Surface: Dark Brown Silty Clayey Gravel (decomposed granite ; "DG"), dense, moist	1.0 - 2.5	■	101.1	22.0	6, 9, 14
1	CL		SANDY LEAN CLAY: dark gray brown, stiff, very moist, trace gravel (Fill)	1.0 - 3.0	○			
2								
3				3.5 - 5.0	●			3, 4, 5
4								
5			End of Boring @ 5.0'					
6			No subsurface water encountered					
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 7

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

JOB NO.: SL-16605-SC
DATE: 01/15/16

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			2.75" AC over 7" AB					
1	SC		CLAYEY SAND: dark brown, medium dense, slightly moist, trace fine gravel (Fill)	1.0 - 2.5	■	124.1	8.9	5, 6, 10
2				1.0 - 3.0	○			
3			very moist	3.0 - 4.5	■	91.6	17.2	6, 9, 16
4								
5			moist, some gravel, gray brown	5.0 - 6.5	■	114.0	7.2	16, 18, 14
6								
7								
8	CL		SANDY LEAN CLAY: dark brown, stiff, slightly moist, trace fine gravel (Alluvium)					
9								
10				10.0 - 11.5	●			5, 8, 7
11								
12								
13			brown					
14								
15				15.0 - 16.5	●			8, 11, 18
16								
17			End of Boring @ 16.5'					
18			No subsurface water encountered					
19								
20								
21								
22								
23								
24								
25								
26								

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 8

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

PAGE 1 OF 1
JOB NO.: SL-16605-SC
DATE: 01/15/16

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			2.5" AC over 6" AB					
1	CL		SANDY LEAN CLAY: dark brown, stiff, very moist, some fine gravel (Fill)	1.0 - 2.5	■	105.1	17.3	5, 7, 9
2				1.0 - 3.0	○			
3			slightly moist, increasing sand content	3.0 - 4.5	■	114.7	10.0	5, 12, 16
4								
5	SC		CLAYEY SAND: dark brown, medium dense, slightly moist, some fine gravel	5.0 - 6.5	■	109.2	8.3	5, 11, 21
6				5.0 - 7.0	○			
7			increasing gravel with depth					
8								
9	CL		SANDY LEAN CLAY: dark brown, stiff, slightly moist, trace fine gravel (Alluvium)					
10				10.0 - 11.5	●			6, 8, 9
11								
12								
13								
14			gray brown					
15				15.0 - 16.5	●			9, 12, 13
16								
17			End of Boring @ 16.5' No subsurface water encountered					
18								
19								
20								
21								
22								
23								
24								
25								
26								

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

APPENDIX B

Geotechnical Laboratory Test Results

San Luis Obispo High School
Measure D - Stadium Entrance/Bleachers/Track

SL-16605-SC

BULK DENSITY TEST RESULTS

ASTM D 2937-10 (modified for ring liners)

January 22, 2016

BORING NO.	DEPTH feet	MOISTURE CONTENT, %	WET DENSITY, pcf	DRY DENSITY, pcf
1	2.0 - 2.5	7.2	118.5	110.5
1	4.0 - 4.5	18.8	115.1	96.9
1	6.0 - 6.5	13.1	115.7	102.4
1	20.0 - 21.5	7.8	---	---
2	2.0 - 2.5	14.9	128.1	111.5
2	4.0 - 4.5	17.9	109.6	93.0
2	6.0 - 6.5	16.2	101.7	87.6
3	2.0 - 2.5	18.9	126.0	106.0
4	2.0 - 2.5	21.7	134.1	110.3
5	2.0 - 2.5	25.3	119.1	95.0
6	2.0 - 2.5	22.0	123.3	101.1
7	2.0 - 2.5	8.9	135.1	124.1
7	4.0 - 4.5	17.2	107.4	91.6
7	6.0 - 6.5	7.2	122.2	114.0
8	2.0 - 2.5	17.3	123.2	105.1
8	4.0 - 4.5	10.0	126.2	114.7
8	6.0 - 6.5	8.3	118.2	109.2

EXPANSION INDEX TEST RESULTS

ASTM D 4829-11

BORING NO.	DEPTH feet	EXPANSION INDEX
4	1.0 - 3.0	67
8	1.0 - 3.0	62

San Luis Obispo High School
Measure D - Stadium Entrance/Bleachers/Track

SL-16605-SC

MOISTURE-DENSITY COMPACTION TEST

ASTM D 1557-12 (Modified)

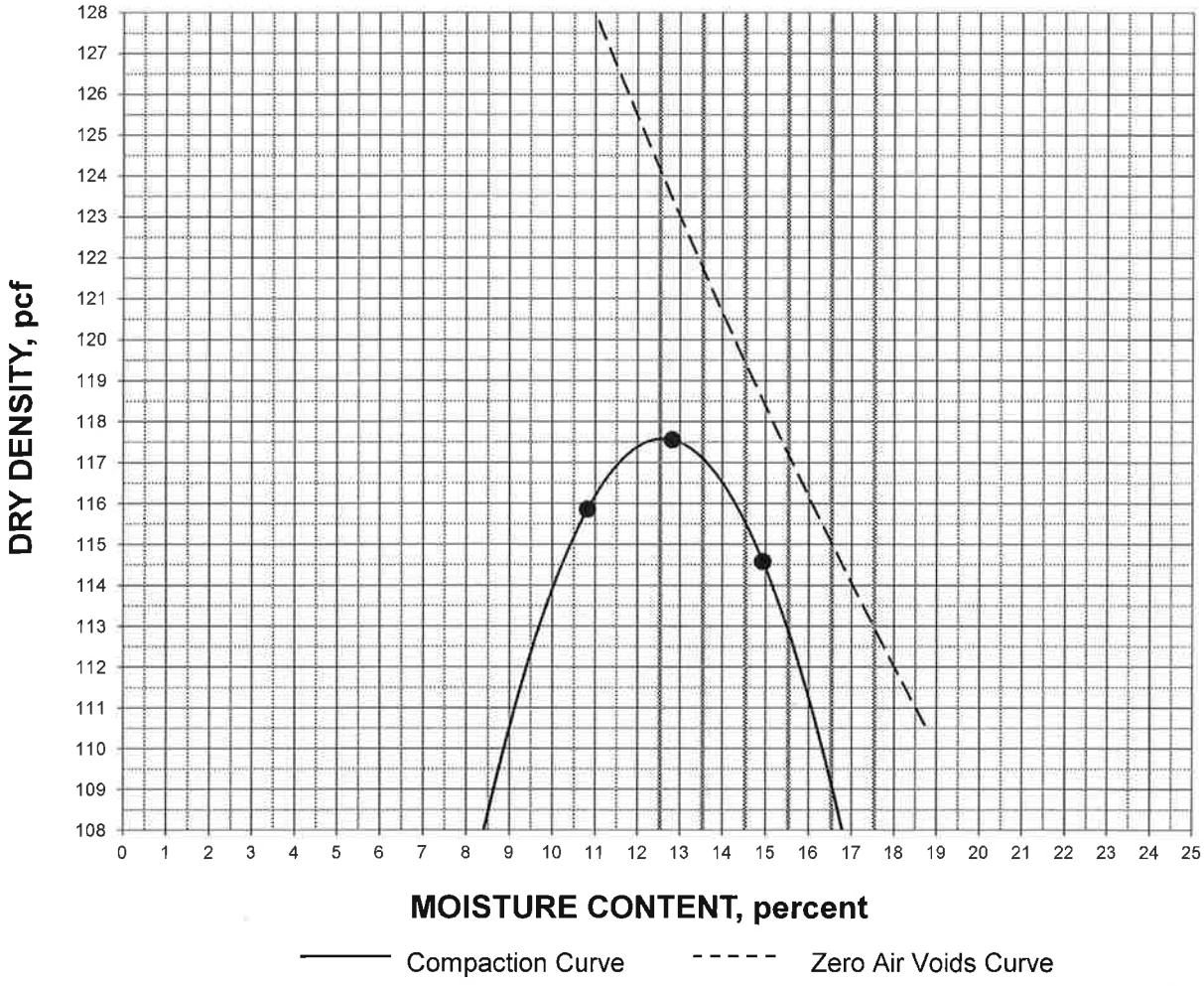
PROCEDURE USED: A
PREPARATION METHOD: Moist
RAMMER TYPE: Mechanical
SPECIFIC GRAVITY: 2.65 (assumed)

January 22, 2016
Boring #2 @ 1.0 - 3.0'
Brown Clayey Sand (SC)

SIEVE DATA:

Sieve Size	% Retained (Cumulative)
3/4"	0
3/8"	0
#4	0

MAXIMUM DRY DENSITY: 117.6 pcf
OPTIMUM MOISTURE: 12.6%



San Luis Obispo High School
Measure D - Stadium Entrance/Bleachers/Track

SL-16605-SC

DIRECT SHEAR

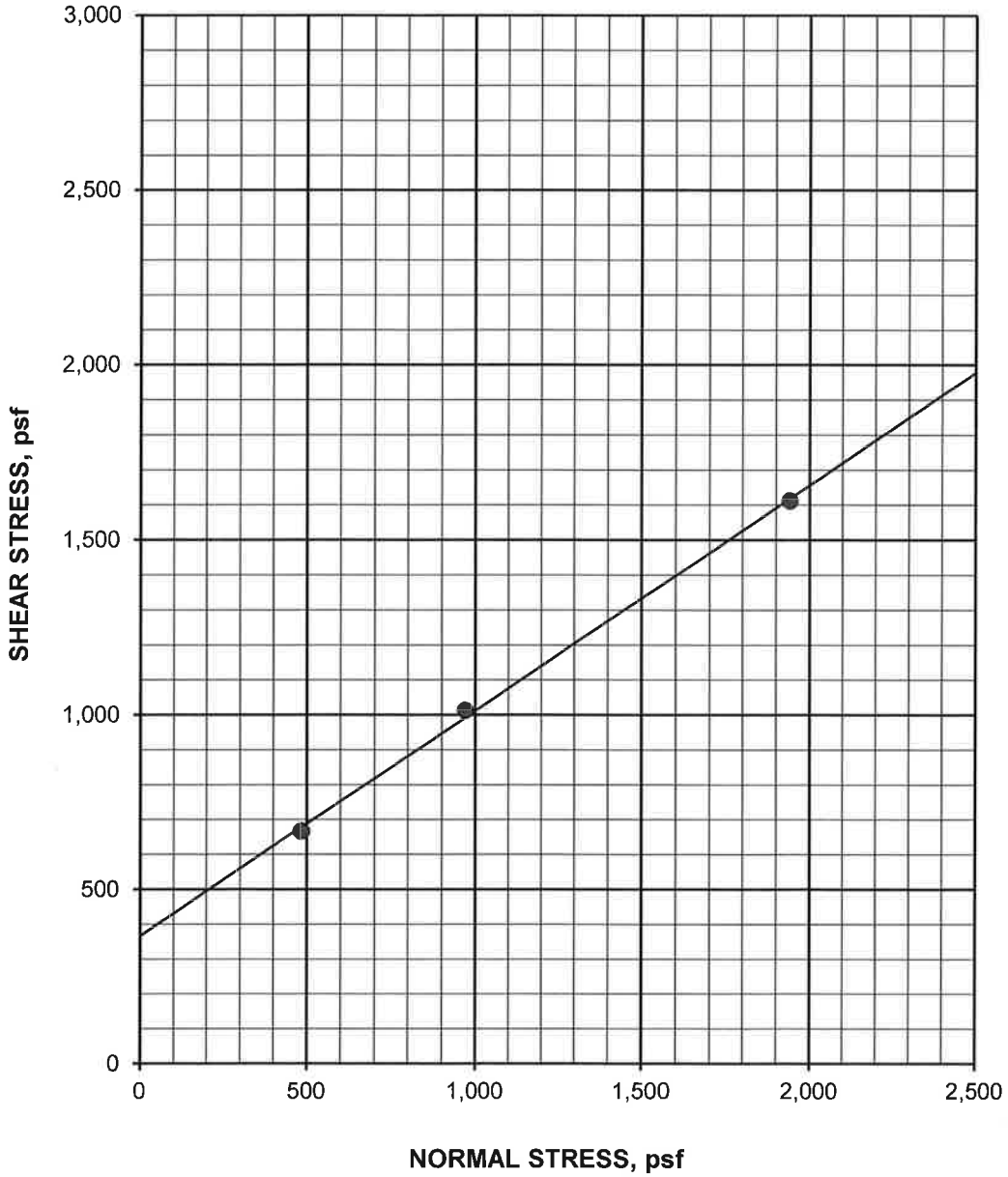
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

January 22, 2016

Boring #2 @ 1.0 - 3.0'
Clayey Sand (SC)
Compacted to 90% RC, saturated

INITIAL DRY DENSITY: 105.8 pcf
INITIAL MOISTURE CONTENT: 12.6 %
PEAK SHEAR ANGLE (Ø): 33°
COHESION (C): 366 psf

SHEAR vs. NORMAL STRESS



San Luis Obispo High School
Measure D - Stadium Entrance/Bleachers/Track

SL-16605-SC

DIRECT SHEAR continued

ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

Boring #2 @ 1.0 - 3.0'

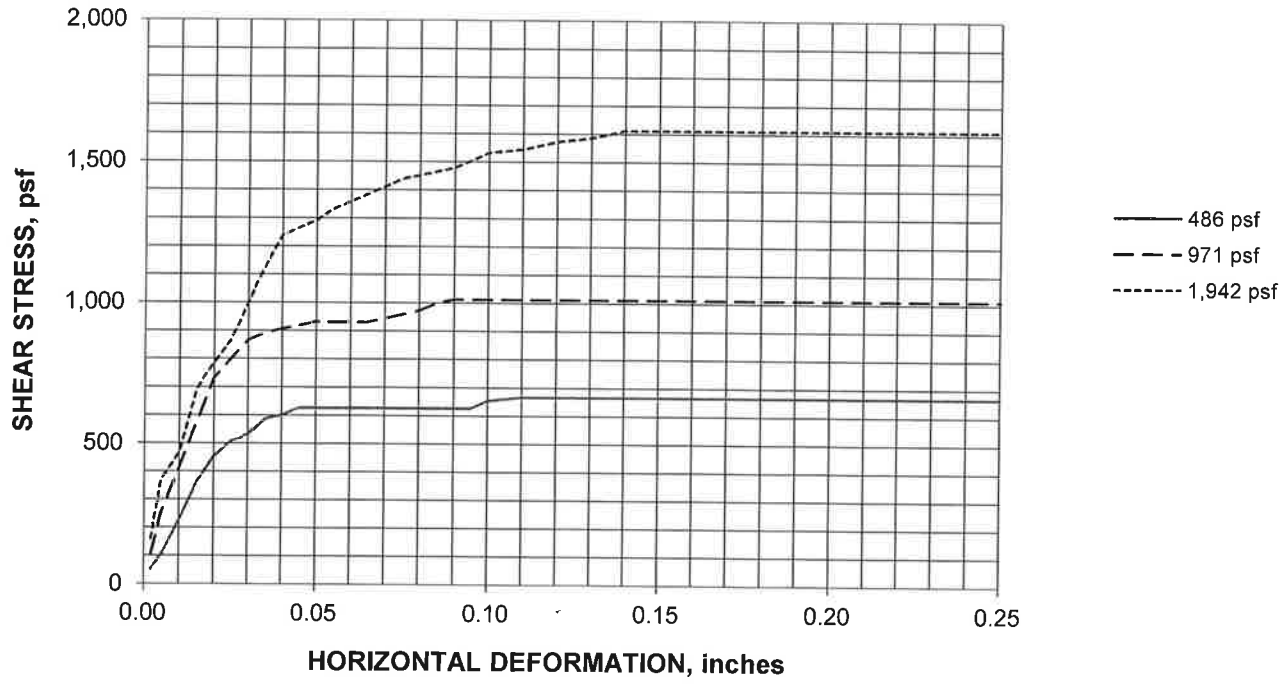
January 22, 2016

Clayey Sand (SC)

Compacted to 90% RC, saturated

SPECIFIC GRAVITY: 2.65 (assumed)

SAMPLE NO.:	1	2	3	AVERAGE
INITIAL				
WATER CONTENT, %	12.6	12.6	12.6	12.6
DRY DENSITY, pcf	105.8	105.8	105.8	105.8
SATURATION, %	59.4	59.4	59.4	59.4
VOID RATIO	0.563	0.563	0.563	0.563
DIAMETER, inches	2.410	2.410	2.410	
HEIGHT, inches	1.00	1.00	1.00	
AT TEST				
WATER CONTENT, %	23.0	22.0	26.1	
DRY DENSITY, pcf	106.3	107.3	111.3	
SATURATION, %	100.0	100.0	100.0	
VOID RATIO	0.556	0.541	0.486	
HEIGHT, inches	1.00	0.99	0.95	



San Luis Obispo High School
Measure D - Stadium Entrance/Bleachers/Track

SL-16605-SC

MOISTURE-DENSITY COMPACTION TEST

ASTM D 1557-12 (Modified)

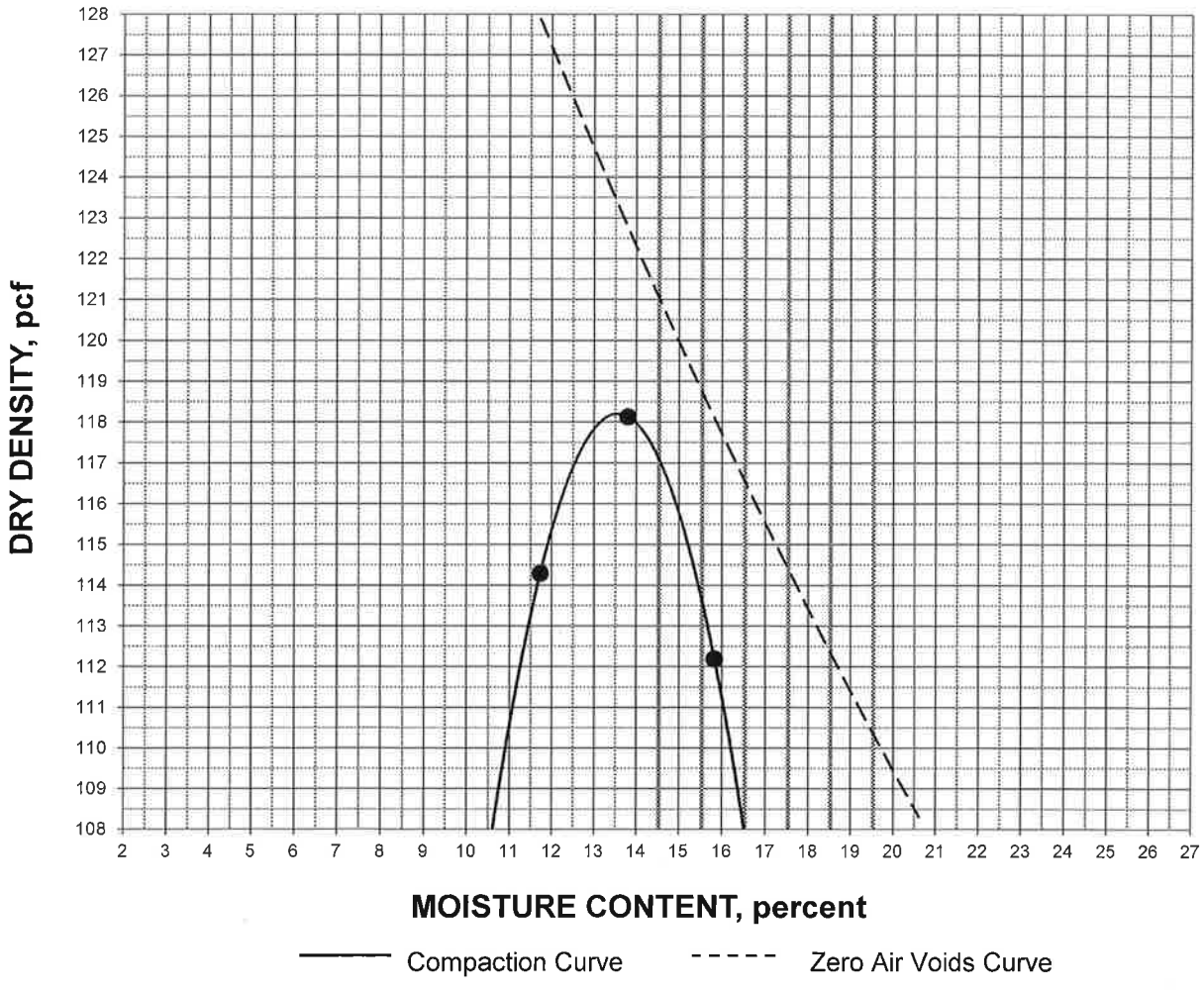
PROCEDURE USED: A
PREPARATION METHOD: Moist
RAMMER TYPE: Mechanical
SPECIFIC GRAVITY: 2.70 (assumed)

January 22, 2016
Boring #8 @ 1.0 - 3.0'
Dark Brown Sandy Lean Clay (CL)

SIEVE DATA:

Sieve Size	% Retained (Cumulative)
3/4"	0
3/8"	0
#4	0

MAXIMUM DRY DENSITY: 118.2 pcf
OPTIMUM MOISTURE: 13.6%



San Luis Obispo High School
Measure D - Stadium Entrance/Bleachers/Track

SL-16605-SC

DIRECT SHEAR

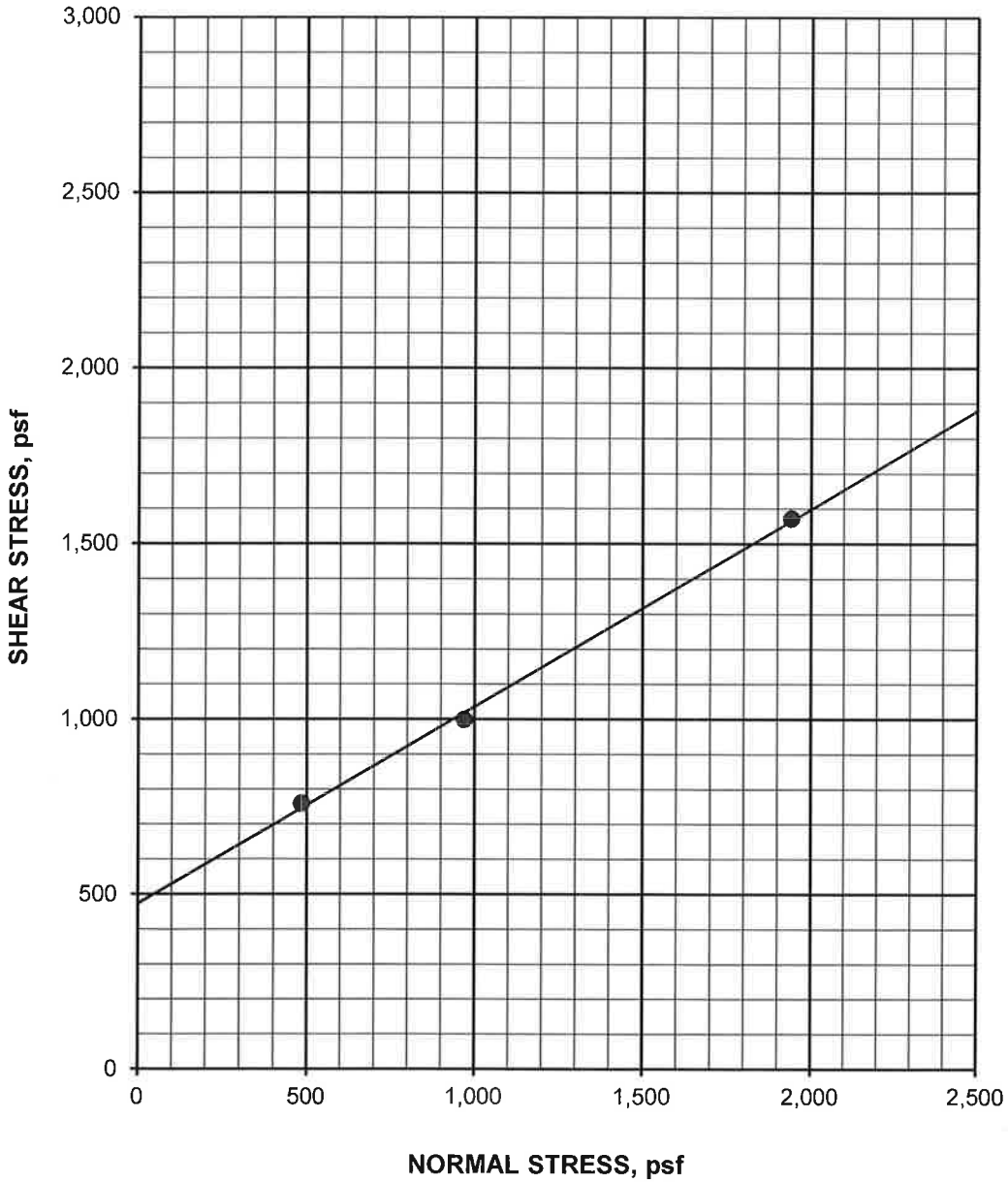
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

January 22, 2016

Boring #8 @ 1.0 - 3.0'
Sandy Lean Clay (CL)
Compacted to 90% RC, saturated

INITIAL DRY DENSITY: 106.4 pcf
INITIAL MOISTURE CONTENT: 13.6 %
PEAK SHEAR ANGLE (Ø): 29°
COHESION (C): 473 psf

SHEAR vs. NORMAL STRESS



San Luis Obispo High School
Measure D - Stadium Entrance/Bleachers/Track

SL-16605-SC

DIRECT SHEAR continued

ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

Boring #8 @ 1.0 - 3.0'

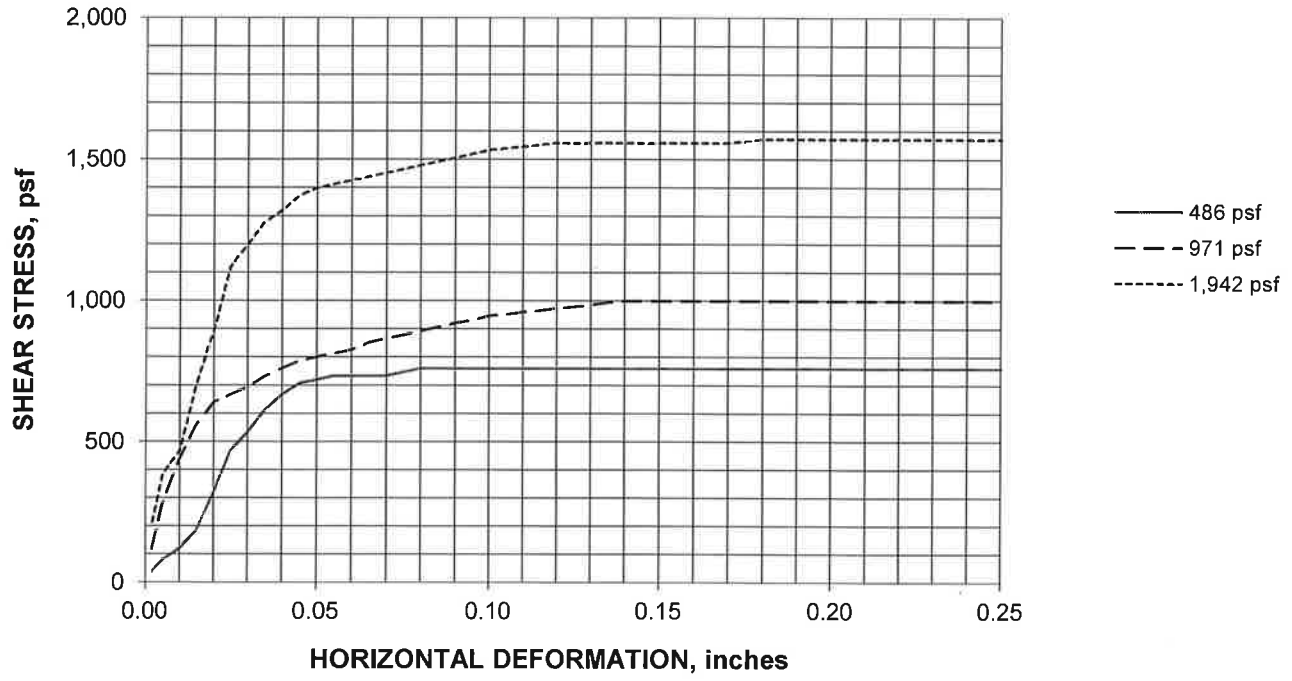
January 22, 2016

Sandy Lean Clay (CL)

Compacted to 90% RC, saturated

SPECIFIC GRAVITY: 2.70 (assumed)

SAMPLE NO.:	1	2	3	AVERAGE
INITIAL				
WATER CONTENT, %	13.6	13.6	13.6	13.6
DRY DENSITY, pcf	106.4	106.4	106.4	106.4
SATURATION, %	62.9	62.9	62.9	62.9
VOID RATIO	0.584	0.584	0.584	0.584
DIAMETER, inches	2.410	2.410	2.410	
HEIGHT, inches	1.00	1.00	1.00	
AT TEST				
WATER CONTENT, %	25.2	26.9	25.9	
DRY DENSITY, pcf	107.8	108.9	112.8	
SATURATION, %	100.0	100.0	100.0	
VOID RATIO	0.563	0.547	0.493	
HEIGHT, inches	0.99	0.98	0.94	



San Luis Obispo High School
Measure D - Stadium Entrance/Bleachers/Track

SL-16605-SC

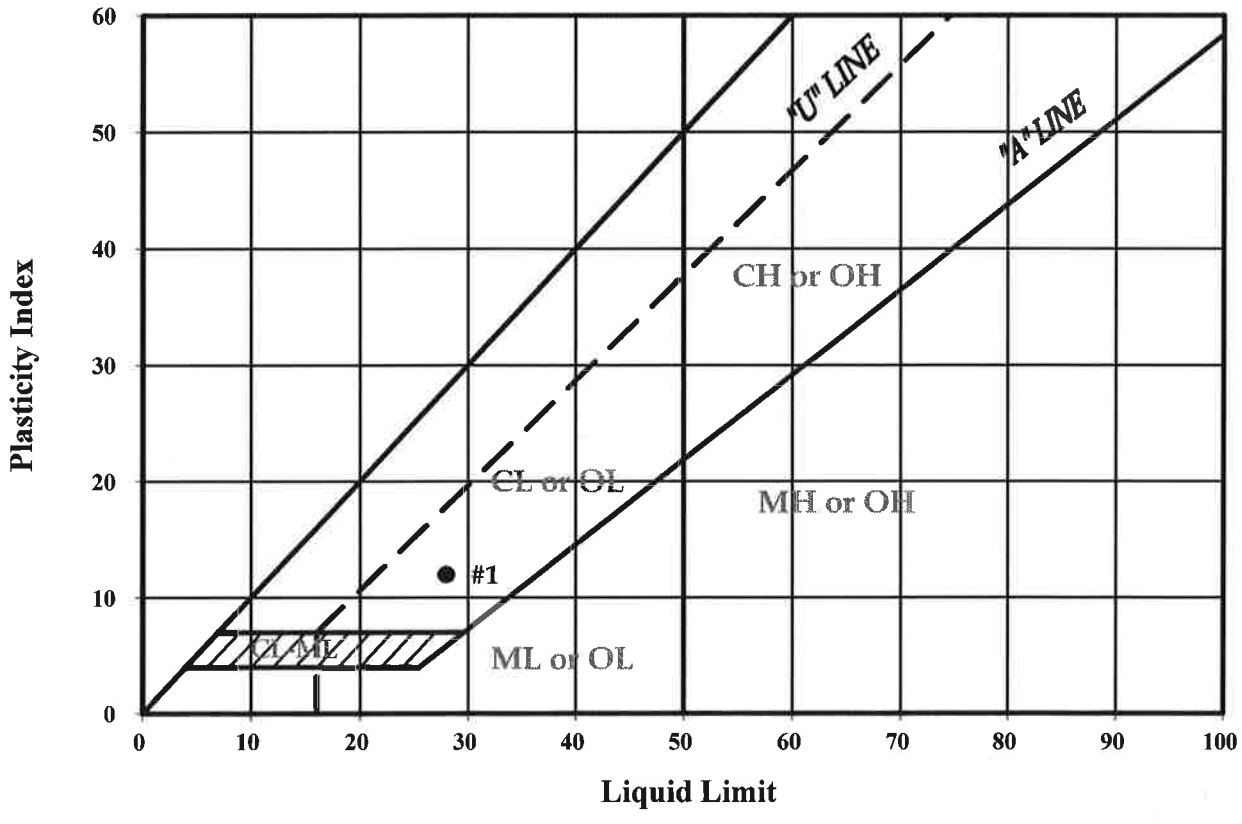
PLASTICITY INDEX

ASTM D 4318-10

January 22, 2016

Test No.:	1	2	3	4	5
Boring No.:	1				
Sample Depth:	20.0 - 21.5'				
Liquid Limit:	28				
Plastic Limit:	16				
Plasticity Index:	12				

Plasticity Chart



APPENDIX C

Corrosivity Analysis by CERCO Analytical, Inc.

California State Certified Laboratory No. 2153

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax. 925 462 2775
www.cercoanalytical.com

26 January, 2016

Job No. 1601156
Cust. No. 11974

Mr. Fred J. Potthast, GE
Earth Systems Pacific
4378 Santa Fe Road
San Luis Obispo, CA 93401

Subject: Project No.: SL-16605-SC
Project Name: San Luis Obispo High School
Stadium Entrance/Bleachers/Track
Corrosivity Analysis – ASTM Test Methods

Dear Mr. Potthast:

Pursuant to your request, CERCO Analytical has analyzed the soil samples submitted on January 20, 2016. Based on the analytical results, this brief corrosivity evaluation is enclosed for your consideration.

Based upon the 100% saturation resistivity measurements, both samples are classified as "moderately corrosive". All buried iron, steel, cast iron, ductile iron, galvanized steel and dielectric coated steel or iron should be properly protected against corrosion depending upon the critical nature of the structure. All buried metallic pressure piping such as ductile iron firewater pipelines should be protected against corrosion.

The chloride ion concentration is none detected to 15 mg/kg.

The sulfate ion concentrations range from 32 to 55 mg/kg and are determined to be insufficient to damage reinforced concrete structures and cement mortar-coated steel at these locations.

The pH of the soils range from 8.00 to 8.24 which does not present corrosion problems for buried iron, steel, mortar-coated steel and reinforced concrete structures.

The redox potentials range from 340 to 350-mV which is indicative of potentially "slightly corrosive" soils resulting from anaerobic soil conditions.

This corrosivity evaluation is based on general corrosion engineering standards and is non-specific in nature. For specific long-term corrosion control design recommendations or consultation, please call *JDH Corrosion Consultants, Inc. at (925) 927-6630.*

We appreciate the opportunity of working with you on this project. If you have any questions, or if you require further information, please do not hesitate to contact us.

Very truly yours,
CERCO ANALYTICAL, INC.

J. Darby Howard, Jr., P.E.
President

JDH/jdl
Enclosure

California State Certified Laboratory No. 2153

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax. 925 462 2775
www.cercoanalytical.com

Client: EarthSystems Pacific
Client's Project No.: SL-16605-SC
Client's Project Name: San Luis Obispo High School - Stadium Entrance/Bleachers/Track
Date Sampled: 15-Jan-16
Date Received: 20-Jan-16
Matrix: Soil
Authorization: Letter dated January 19, 2016

Date of Report: 26-Jan-2016

Job/Sample No.	Sample I.D.	Redox (mV)	pH	Resistivity (as Received) (umhos/cm)	Resistivity (100% Saturation) (ohms-cm)	Sulfide (mg/kg)*	Chloride (mg/kg)*	Sulfate (mg/kg)*
1601156-001	Boring 2 @ 1'-3'	340	8.24	11,000	2,900	-	N.D.	32
1601156-002	Boring 8 @ 1'-3'	350	8.00	3,100	2,600	-	N.D.	55

Method:	ASTM D1498	ASTM D4972	ASTM D1125M	ASTM G57	ASTM D4658M	ASTM D4327	ASTM D4327
Reporting Limit:	-	-	10	-	50	15	15
Date Analyzed:	25-Jan-2016	25-Jan-2016	25-Jan-2016	25-Jan-2016	-	25-Jan-2016	25-Jan-2016

Cheryl McMillen
Laboratory Director

* Results Reported on "As Received" Basis
N.D. - None Detected

Quality Control Summary - **All laboratory quality control parameters were found to be within established limits**

APPENDIX D

Geotechnical Engineering and Geologic Hazards Report
San Luis Obispo High School – Measure D Projects
Annex / Classroom Building
1499 San Luis Drive, San Luis Obispo, California
Project No. 831-3102, dated January 19, 2016

GEOTECHNICAL ENGINEERING AND GEOLOGIC HAZARDS REPORT
SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3102

January 19, 2016

Prepared for

Mr. Anthony Palazzo
San Luis Coastal Unified School District

Prepared by

Earth Systems Pacific
4378 Old Santa Fe Road
San Luis Obispo, CA 93401

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Pacific

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San Luis Obispo, CA 93401
Ph: 805.544.3276
esp@earthsystems.com
www.earthsystems.com

January 19, 2016

Mr. Anthony Palazzo
Director – Buildings, Grounds and Transportation
San Luis Coastal Unified School District
937 Southwood Drive
San Luis Obispo, CA 93401

FILE NO.: SL-16605-SE

PROJECT: SAN LUIS OBISPO HIGH SCHOOL -MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3102

SUBJECT: Geotechnical Engineering and Geologic Hazards Report

CONTRACT REF: Purchase Order No. 161188 by San Luis Coastal School District, dated December 7, 2015, to Provide a Geotechnical Engineering Investigation, San Luis Obispo High School, Measure D Projects, 1499 San Luis Drive, San Luis Obispo, California, per Proposal by Earth Systems Pacific, Doc. No. 1511-157.PRP, dated November 25, 2015

Dear Mr. Palazzo:

In accordance with your purchase order, this geotechnical engineering and geologic hazards report has been prepared for use in the development of plans and specifications for the Annex/Classroom Building Project at San Luis Obispo High School, in San Luis Obispo, California. This report describes the general geotechnical and geologic characteristics, identifies existing and potential geotechnical and geologic hazards, and discusses the impacts that these conditions could have upon the project. Preliminary geotechnical recommendations for site preparation, grading, utility trenches, foundations, interior slabs-on-grade and exterior pedestrian flatwork, retaining walls, asphalt concrete (AC) paths, drainage and maintenance, and observation and testing are presented herein. Soil corrosivity testing and an evaluation of the results, which were subcontracted to HDR, Inc. of Claremont, California, are also provided. Two bound copies and an electronic copy of this report are being furnished for your use.

We appreciate the opportunity to have provided services for this project and look forward to working with you again in the future. If there are any questions concerning this report, please do not hesitate to contact the undersigned.

Sincerely,

Earth Systems Pacific

Fred J. Potthast, GE
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
FREDERICK J. POTTHAST
No. GE 2369
Exp. 03/31/16
GEOTECHNICAL
STATE OF CALIFORNIA

1/19/16

Richard T. Gorman, CEG
Principal Geologist

PROFESSIONAL GEOLOGIST
RICHARD T. GORMAN
No. CEG 1325
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Doc. No.: 1601-059 SGR/tf

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1.0 INTRODUCTION AND SITE SETTING

The proposed Annex/Classroom Building at San Luis Obispo High School will have a footprint of approximately 12,000 square feet. It will be single story, of steel-frame, stud and possibly masonry construction. Conventional continuous and spread (pad) foundations are planned, with concrete slabs-on-grade. Maximum dead plus live loads on continuous footings of 2,000 plf, and maximum loads on spread footings of 75 kips, have been assumed for the purposes of this report. Retaining walls for sitework, or connected to or forming part of the structure, and a maximum of 4 feet tall, may also be utilized. The new building will be served by the existing campus utility systems via underground connections; it will be surrounded by landscaping and sidewalks of either Portland cement concrete (PCC) or asphalt concrete (AC) over aggregate base (AB). The existing service driveways in the project area may be repaired as part of the project, however no new pavement areas are anticipated. To our knowledge, no drainage basins are planned as part of the project. Infiltration systems or other types of low-impact development (LID) features may be included in the final design; however this has not been determined as of the date of this report, and therefore these potential features are not addressed.

The new building will be constructed on the site of the existing Annex/Cafeteria Building, on the north side of the campus, immediately east of the old Gymnasium. The site location on the campus is indicated on the Vicinity Map in Appendix A. Flatwork, lawns, shrubs and several scattered mature trees are present on the west, south and east sides of the existing building. The main campus service road extends along the west side of the existing building, just beyond the lawn, providing access to a paved delivery area at the rear (the north side) of the building. Drainage appears to be by sheet flow, and generally toward the south-southwest. The locations and dispositions of utility lines on the site are unknown.

2.0 SCOPE OF SERVICES

The scope of work for this report included a general site reconnaissance, subsurface exploration, site reconnaissance by a registered geotechnical engineer and certified engineering geologist, laboratory testing of samples secured during the subsurface investigation, geotechnical and geologic analyses of the data, and preparation of this report. The analysis and subsequent recommendations were based on general information provided by the client.

This report and preliminary geotechnical recommendations are intended to comply the considerations of Sections 1803A.1 through 1803A.7, J104.3 and J104.4 of the 2013 California Building Code; California Geological Survey Note 48; DSA IR A-4.13; and common geotechnical engineering and engineering geology practice in this area under similar conditions at this time.

The test procedures were accomplished in general conformance with the standards noted, as modified by common geotechnical engineering practice in this area under similar conditions at this time.

Preliminary geotechnical recommendations for site preparation, grading, utility trenches, foundations, interior slabs-on-grade and pedestrian flatwork, retaining walls, AC paths, drainage and maintenance, and observation and testing are presented to guide the development of project plans and specifications. The results of geotechnical corrosivity testing, and an evaluation of the results with recommendations for mitigation, which were subcontracted to HDR, Inc., are also provided. As there may be geotechnical issues yet to be resolved, the geotechnical engineer should be retained to provide consultation as the design progresses, to assist in verifying that pertinent geotechnical issues have been addressed and to aid in conformance with the intent of this report. It may also be advantageous to retain the geotechnical engineer to review the project plans and details as they near completion, to further aid in conformance with the intent of this report.

It is our intent that this report be used exclusively by the client in the preparation of plans and specifications. Application beyond this intent is strictly at the user's risk.

This report does not address issues in the domain of contractors such as, but not limited to, site safety, loss of volume due to stripping of the site, shrinkage of soils during compaction, excavatability, dewatering, shoring, temporary slope angles, construction means and methods, etc. Analyses of the soil for mold potential, man-made asbestos, lead, radioisotopes, hydrocarbons, or chemical properties other than geotechnical corrosivity are beyond the scope of this report. Evaluation of the site for suitability for LID improvements or drainage basins; ancillary features such as temporary access roads, fences, flag and light poles, signage; and nonstructural fills are not within our scope and are also not addressed.

In the event that there are any changes in the nature, design, or location of improvements, or if any assumptions used in the preparation of this report prove to be incorrect, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are verified or are modified in writing. The criteria presented in this report are considered preliminary until such time as any peer review or review by any jurisdiction has been completed, conditions are observed by the geotechnical engineer and/or geologist in the field during construction, and the recommendations have been verified as appropriate or modified in writing.

3.0 FIELD INVESTIGATION

On December 29, 2015, three borings were drilled in the planned building area to depths ranging from approximately 16.5 to 26 feet below the existing ground surface. The borings were drilled with a truck-mounted Mobile Drill rig, Model B-53, equipped with 6-inch outside diameter hollow stem auger and an automatic trip hammer for sampling. The approximate locations of the borings are shown on the Boring Location Map in Appendix A. Soil samples were obtained using a ring-lined barrel sampler (ASTM D 3550-01/07 with shoe similar to D 2937-10). Bulk soil samples were obtained from the auger cuttings. Standard penetration tests were also performed in the borings (ASTM D 1586-11) at selected depths. The borings were backfilled with auger spoils.

Soils encountered in the borings were categorized and logged in general accordance with the Unified Soil Classification System and ASTM D 2488-09a. Where bedrock was encountered, its properties were described based upon observation of the auger cuttings and the effort required to drill into it. Copies of the boring logs and a Boring Log Legend are included in Appendix A. In reviewing the boring logs and legend, the reader should recognize that the legend is intended as a guideline only, and there are a number of conditions that may influence the soil characteristics as observed during drilling. These include, but are not limited to, the presence of cobbles or boulders, cementation, variations in soil moisture, presence of groundwater, and other factors. It should also be noted that the descriptions of bedrock must span a much wider range of density and strength characteristics than soil, and are relative to other bedrock strata. For example, fractured and weathered bedrock may be described as “soft,” yet it will be considerably harder than almost any type of soil. Conversely, a clay soil may be described as “hard,” however it will not be nearly as hard as even “moderately soft” bedrock such as the sandstone and claystone encountered on this site. Consequently, the logger must exercise judgment in interpreting the subsurface characteristics, possibly resulting in soil and bedrock descriptions that vary somewhat from the legend.

4.0 LABORATORY ANALYSIS

The ring samples were tested for unit weight and moisture (ASTM D 2937-10), as modified for ring liners. One ring sample was also tested for one-dimensional consolidation (ASTM D 2435-11). Bulk samples were tested for maximum density and optimum moisture content (ASTM D 1557-12), expansion index (ASTM D 4829-11), plasticity index (ASTM D 4318-10) and cohesion and angle of shearing resistance by direct shear (ASTM D 3080-11, recompacted to 90 percent of maximum dry density and modified for consolidated, undrained conditions). The physical laboratory test results are presented in Appendix B.

Two bulk samples of the upper soils were also sent to HDR, Inc. of Claremont, California for geotechnical corrosivity testing. The results of these tests, and HDR, Inc.'s evaluation of the results, are presented in Appendix C.

5.0 GENERAL SUBSURFACE AND GEOLOGIC PROFILE

Boring 1, drilled on the west side of the existing building, found 4 feet of stiff fill (sandy lean clay with a trace of coarse gravel) over alluvium. The alluvium consisted of very stiff sandy lean clay with some fine gravel from 4 to 17 feet, and medium dense clayey gravel with sand to 23.5 feet. The alluvium was underlain by moderately soft bedrock (sandstone) of the Franciscan Mélange, which continued to drilling refusal at 26 feet.

A pavement section of 4 inches of asphalt concrete (AC) over 2 inches of aggregate base (AB) was found in Boring 2, on the north side of the existing building. Below the pavement to the boring termination depth of 16.5 feet was stiff to very stiff sandy lean clay alluvium. Some fine gravel was found in the clay to 4.5 feet.

Boring 3, on the east side of the existing building, encountered very stiff sandy lean clay with a trace of gravel (alluvium) from the surface to 7.5 feet. Bedrock of the Franciscan Mélange was found below the alluvium; the bedrock was moderately soft sandstone to 10.5 feet and moderately soft, severely sheared and weathered claystone to the drilling refusal depth of 16.5 feet.

During drilling, the soils and bedrock were described as being slightly moist to very moist. Free subsurface water was not found in any of the borings, to the maximum depth explored of 26 feet.

Please refer to the boring logs in Appendix A for a more complete description of the subsurface conditions. Cross Section A-A' in Appendix A is a graphic representation of the subsurface conditions found by the exploratory borings.

6.0 GEOLOGY

Geologic Setting

San Luis Obispo High School lies along the northeastern side of the Los Osos Valley, which is bounded to the northeast by the northwest-trending Santa Lucia Mountain Range and to the southwest by the northwest-trending Irish Hills. The proposed building area is on the north side of the campus, and it is relatively flat with a slight slope to the south/southwest. Locally, the school site area is bounded to the northeast by hillside terrain and to the southwest by San Luis Obispo Creek. The geologic map of the San Luis Obispo Quadrangle by Wiegers (2010) indicates

that the Annex/Classroom Building school site area is underlain by Holocene alluvial flood plain deposits (see the Geologic Map in Appendix D). Based on the results of our subsurface investigation and field observations, we concur with the Wiegers geologic map.

Faulting

Significant Faults

The San Andreas, Hosgri-San Simeon, and Los Osos Faults are the most significant regional *active* faults within a 65-mile radius of the school site, which could affect existing and proposed developments during their anticipated lifespan (see the Historical Earthquake/Fault Map in the Appendix D). The closest *active* fault to the site is the Irish Hills segment of the Los Osos Fault, located approximately 3.35 miles southwest. The closest mapped fault to the site (regardless of activity) is the Late Quaternary age Cambria Fault; it is located approximately 1 mile northeast (see the Historical Earthquake/Fault Map in the Appendix D). Brief descriptions of these faults are presented in the following sections. Regional faults and locations of historic earthquake events are also depicted on the Historical Earthquake/Fault Map in Appendix D.

Cambria Fault

The Cambria Fault is the closest mapped fault (regardless of activity) to the site; it is located approximately 1 mile northeast. The southern end of the Cambria fault could be considered part of the Oceanic fault group where the faults nearly join east of Cal Poly State University in San Luis Obispo. In some areas along the fault, it can be distinguished by the line of serpentine rock ridges that it bounds. Splays of the Cambria fault break late Pliocene (2 million years old) strata east of Cambria, but there is no known offset of Holocene (11,000 years old) age sediments by the system (Chipping, 1987). Weber (1983) noted that 120,000-year old marine terrace deposits north of Cayucos, near Ellysly Creek, may have been offset by the Cambria fault. However, to our knowledge, Weber's observation has never been confirmed by field exploration.

San Andreas Fault

The San Andreas Fault, considered to be the most active fault in the general region, lies 23 miles to the east of the site. The San Andreas Fault undergoes a major change in character between Parkfield and Cholame. North of Cholame, the fault moves more or less constantly in a process called creep, whereas the south end of the fault is locked, moving only in very large earthquakes. The last major quake on this part of the fault was the 1857 event (magnitude 7.9). In the immediate vicinity of Parkfield, there is a 20-mile segment that is also locked, generating an earthquake every 20 years or so on average. Dated quakes on this segment are 1881, 1901, 1922, 1934, and 1966, and are usually in the magnitude 5.5 to 6.0 range, (Bakun 1988). A 6.0 magnitude earthquake occurred on this fault segment on September 28, 2004.

Los Osos Fault

The Los Osos Fault, at its closest point to the site, is approximately 3 miles to the southwest. It consists of four distinct segments. From northwest to southeast, these are the Estero Bay, the Irish Hills, the Lopez Reservoir, and the Newsome Ridge segments. PG&E (1988) suggests that the Irish Hills segment displays the best expressed geomorphic features, displacing late Pleistocene and Holocene deposits. The Irish Hills segment starts in the vicinity of Los Osos and extends to just past San Luis Obispo Creek. A two-mile long segment west of Laguna Lake is considered to be active (Treiman 1989) and is zoned as a State Earthquake Fault Zone under the Alquist-Priolo Act (Hart 1997). This active segment lies about 3.35 miles to the southwest of the site and is the closest active fault to the site. The Los Osos Fault comprises a northwest-trending series of high- and low-angle faults that exhibit a complex history of both strike-slip and reverse displacement. However, during the late Quaternary, movement appears to have been primarily reverse displacement (PG&E 1998).

Hosgri-San Simeon Fault System

The Hosgri-San Simeon Fault System lies approximately 25 miles to the west of the site. A northwest-trending strike-slip fault, the San Simeon Fault extends from offshore of Ragged Point to just offshore of San Simeon Point, where it joins the northern end of the Hosgri Fault. From this point, the Hosgri Fault extends to an ocean shelf 2 miles west of Point Buchon, and then trends toward the Point Sal area. The fault system is considered active by the 2004 United States Geologic Survey (Jennings and Bryant 2010), based on Hall's claims of recent offset terrace deposits along San Simeon Cove, and also by a relocation of the 1927 "Lompoc Earthquake" onto the southern end of the Hosgri Fault (Hall 1975, 1976, 1977).

On December 22, 2003, a 6.5-magnitude earthquake occurred approximately 6 miles northeast of San Simeon, California and approximately 28 miles north of the subject site. Analysis by the USGS and the University of California at Berkeley indicates that the event had a thrust (reverse-faulting) mechanism (Goel 2004). The earthquake occurred in the vicinity of the northern end of the Hosgri-San Simeon Fault.

Groundwater

Soil and bedrock moisture contents encountered during drilling were generally slightly moist to very moist. Groundwater was not encountered in any of the borings to the maximum depth explored of 26 feet.

7.0 SEISMICITY

Earthquake History

The historic seismicity in the site's region was researched using EQSEARCH (Blake, updated December 2012) and the Boore and others (1997) method of analysis for Site Class "D", stiff soil sites (ASCE 2010) that is incorporated within that program. EQSEARCH performs automated searches of a custom catalog of historical Central California earthquakes. As the program searches the catalog, it computes the epicentral distance from the selected site to each of the earthquakes within the specified search area. The epicentral distances should be considered estimates, particularly for earthquake data prior to 1932, when modern instruments were first used to record earthquake data.

The parameters used for the search consisted of earthquake Richter magnitudes ranging from 5.0 to 9.0 that occurred within a 65-mile radius from the site from 1800 to December 2012. The site coordinates used in this search were latitude 35.2836N and longitude 120.6501W. The Historical Earthquake/Fault Map presented in Appendix D graphically depicts the results of the search, including historical earthquake epicenters, their corresponding magnitudes, and faults within the general region of the project.

Results of the search indicated that within the search parameters, 44 earthquakes have occurred. The highest peak horizontal ground acceleration (PGA) estimated to have occurred at the site from those historical earthquakes is 0.33g. This earthquake had a 5.9 magnitude, occurred in 1906, and was located approximately 3 miles northwest of the site. This earthquake may have occurred along the Los Osos Fault. The largest magnitude earthquake that the search revealed was 7.9. This earthquake was located approximately 48 miles east of the site, and is known as the 1857 earthquake on the San Andreas Fault. It produced an estimated PGA of 0.15g at the site.

Design Acceleration Parameters

In accordance with California Geologic Survey, Note 48 (October 2013), Item 16, an assessment was made to determine if there was a need to employ "Site Specific Ground Motion Procedures" for this site. Based on a review of the San Luis Obispo County Planning Department Permit View web site (2015), a determination was made that the site is not located in a Geologic Study Area, an Alquist-Priolo Earthquake Fault Zone, or a High Liquefaction Hazard Zone. In addition, the S_1 ground motion value obtained from the United States Geological Survey Earthquake Hazards Program website (USGS 2016) and the 2010 ASCE 7 Standard Analysis Method, for Site Class "D" (stiff soil sites), was below 0.75g (see table below). Therefore, the project does not require a site-specific ground motion analysis.

The site is in a region of generally high seismicity and has the potential to experience strong ground shaking from earthquakes on regional or local causative faults. To characterize the seismicity at the site and to provide seismic design parameters for the architect/engineer, a General Procedure Ground Motion Analysis was performed to calculate the deterministic ground motions at the site. The ground motions are based on the 2013 California Building Code General Procedure that were obtained from the United States Geological Survey Earthquake Hazards Program website (USGS 2016) and the 2010 ASCE 7 Standard Analysis Method, for Site Class "D" (stiff soil sites). The results of this analysis are presented in the following table:

SUMMARY OF DESIGN RESPONSE ACCELERATION PARAMETERS

Mapped Acceleration Values for Site Class "B"		**2013 CBC Site Coefficients and General Procedure Adjusted MCE Spectral Response Acceleration Parameters For Site Class "D"**					
Seismic Parameters	Values (g)	Site Coefficients	Values	Seismic Parameters	Values (g)	Seismic Parameters	Values (g)
S_S	1.137	F_a	1.045	S_{MS}	1.188	S_{DS}	0.792
S_1	0.434	F_v	1.566	S_{M1}	0.680	S_{D1}	0.453
Peak Mean Ground Acceleration (PGA_m): 0.475 g							
Seismic Design Category = D							

Seismic Design Category

Section 1613A.3.5 of the 2013 CBC indicates that sites will be assigned to Category D unless $S_1 \geq 0.75$. The S_1 calculated for the site is 0.434g; therefore, the site would be assigned to Category D.

8.0 GEOLOGIC HAZARDS

Surface Ground Rupture

Surface ground rupture generally occurs at sites that are traversed by, or lie very near to, a causative fault. The site is not located within a State Earthquake Fault Zone, and there are no mapped faults crossing or adjacent to the site. The closest mapped active fault to the site is the Irish Hills segment of the Los Osos Fault, located approximately 3.35 miles southwest of the site. Therefore, the potential for surface ground rupture to occur at the site is very low.

Liquefaction

The term liquefaction refers to the liquefied condition and subsequent softening that can occur in soils when they are subjected to cyclic strains, such as those generated during a seismic event. Previous studied have concluded that liquefaction within the upper 50 feet of soil can potentially affect improvements at the ground surface. Due to the relatively shallow depth to the bedrock, the stiff to very stiff alluvial clay soils above the bedrock, and the absence of groundwater to the maximum depth explored of 26 feet, the potential for liquefaction to occur is considered to be nil.

Seismically Induced Settlement

Seismically induced settlement of sufficient magnitude to cause structural damage is normally associated with poorly consolidated, predominantly sandy soils, or variable consolidation characteristics within the building areas. Due to the relatively shallow depth to the bedrock and the presence of stiff to very stiff alluvial clay soils, the potential for seismically induced settlement to occur at the site is considered to be nil.

Slope Stability

The Annex/Classroom site lies within a generally flat area with no significant slopes on or adjacent to it; therefore, there is no potential for gross slope instability or landsliding to impact the project site.

Flooding

According to the Flood Insurance Rate Map Number 06079C1067G (FEMA November 16, 2012), the Annex/Classroom Building site is not located within a 100-year flood zone, or within Flood Zone X (See the FEMA Flood Zone Map in Appendix D). Flood Zone X indicates areas that have been determined to have less than a 0.2 percent chance of being flooded in any given year.

Naturally Occurring Asbestos

Asbestos bearing rock units within the central coast area generally consist of serpentinite, ultra-mafic rock units consisting of olivine-hornblende and some schist metamorphic rock units. Based on our research and review of the borings logs, the project site is predominately underlain by a thick deposit of clayey soil alluvium, followed by sandstone and claystone bedrock of the Franciscan Mélange, which ranged in depth from 7.5 to 23.5 feet. These geologic units are not asbestos bearing, therefore, the potential for naturally occurring asbestos to occur on the site is considered to be nil.

Radon

Radon is a colorless, odorless gas present in soil and rock, which is derived from the decay of uranium. The occurrence of radon correlates with the presence of specific minerals, and its concentrations in soil or rock will vary depending on the mineralogy of the surrounding bedrock, temperature, barometric pressure, moisture and other factors. Prolonged exposure to elevated levels of radon is associated with an increased risk of lung cancer.

According to Special Report 208, by the California Geological Survey (Churchill 2008) radon is most commonly found in areas of San Luis Obispo County that are underlain by bedrock of the Monterey formation. The site is underlain by alluvial soils and bedrock of the Franciscan Melange. The report (Churchill 2008) shows that the project site is in an area of low radon potential for San Luis Obispo County.

9.0 CONCLUSIONS

Geology

It is our opinion that there are no significant local or regional geologic conditions that would preclude construction of the Annex/Classroom Building and site improvements as described in the "Introduction" section of this report.

Site Geology

The Annex/Classroom Building site area lies on relatively flat terrain that is bounded to the northeast by hillside terrain and to the southwest by San Luis Obispo Creek. The site area is underlain by Holocene alluvial flood plain deposits and bedrock of the Franciscan Melange.

Groundwater

Soil and bedrock moisture contents encountered during drilling were generally slightly moist to very moist. Groundwater was not encountered in any of the borings, to the maximum depth explored of 26 feet.

Slope Stability

There are no significant slopes on or adjacent to the Annex/Classroom Building site area; therefore, there is no potential for gross slope instability or landsliding to impact the project.

Seismicity

The site is located within the seismically active southern California area, and moderate to severe ground shaking can be expected during the life of the proposed structure. The largest historical mean peak horizontal acceleration estimated to have occurred in the vicinity of the site was 0.33g.

Surface Ground Rupture

The site is not located in a State Earthquake Fault Zone and there are no mapped faults crossing the site. The closest mapped active fault to the site is the Irish Hills segment of the Los Osos Fault, approximately 3.35 miles southwest. Therefore, the potential for surface fault rupture to occur at the site is considered to be very low.

Liquefaction, Seismically Induced Settlement, and Naturally Occurring Asbestos

As the site is underlain by stiff to very stiff condition of the clayey alluvial and relatively shallow bedrock of the Franciscan Mélange, the potentials for liquefaction and seismically-induced settlement to occur are considered to be nil. As the sandstone bedrock of the Franciscan Mélange is not an asbestos-bearing geologic unit, the potential for naturally occurring asbestos to occur on the site is also considered to be nil.

Flooding

The site is not within a 100-year flood zone, or Flood Zone X, which has been determined by FEMA (2012) to be areas that have less than a 0.20 percent chance of being flooded in any given year.

Radon

The site is underlain by clayey alluvial deposits and relatively shallow sandstone bedrock of the Franciscan Mélange, therefore the potential for radon to affect the project is low.

Geotechnical Engineering

In our opinion, the site is suitable, from a geotechnical engineering standpoint, for the proposed Annex/Classroom Building and site improvements, as described in the "Introduction" section of this report, provided the recommendations contained herein are implemented in the design and construction. The primary geotechnical engineering concerns are the potential for differential settlement from the existing fill and the potential disturbance at depth due to removal of the existing structure, the expansion potential of the upper soils, and the erodible nature and corrosive potential of the soils. Provided that the building area is prepared as recommended in the "Grading" section of this report, conventional continuous and spread (pad) foundations may be used to support the proposed structure.

Differential settlement can occur when a foundation spans materials having variable consolidation characteristics, such as the fill that was found in the upper 4 feet of Boring 1. We are unaware of any documentation (i.e., grading observation or compaction testing records) regarding the placement of the fill, but it was likely placed when the existing Annex/Cafeteria Building was constructed. Undocumented fill has a greater potential for variability than fill that has been placed and tested in a controlled earthwork program. Removal of the existing structure is also anticipated to disturb the soil to variable depths. Such conditions (i.e., undocumented fill and disturbed soil) could stress and possibly damage foundations, often resulting in severe cracks and displacement if they are not mitigated. Therefore, to reduce this potential for differential settlement, a program of overexcavation and recompaction of the soil in the building area is recommended prior to construction.

Expansion index testing yielded results of 54 and 58 for the upper fill and alluvial soils. Per CBC Section 1803A.5.3, the soils are considered to be expansive. The more commonly used ASTM classification is that the soils would be considered to have a "medium" expansion potential. Expansive soils tend to swell with increases in soil moisture and shrink as soil moisture decreases; the upper 3 to 5 feet of any soil profile is the zone most affected by these seasonal soil moisture fluctuations. The volume changes that the soils undergo in this cyclical pattern can stress and damage foundations and slabs-on-grade if precautionary measures are not incorporated during design and in the construction procedure. Footings are typically deepened and additional reinforcement is provided. Imported nonexpansive soils are recommended to be placed beneath slabs-on-grade.

The soils above the bedrock are considered to be erodible. It is essential that all surface drainage be controlled and directed to appropriate discharge points, and that surface soils, particularly those disturbed during construction, are stabilized by vegetation or other means *during and following construction*.

As indicated in the Soil Corrosivity Study by HDR, Inc., in Appendix C, the electrical resistivities of the samples tested were in the moderately corrosive categories with as received moisture contents; when saturated, the resistivities were in the corrosive to severely corrosive categories. Soil pH values were mildly alkaline. The soluble salt contents of the soils were low to moderate. Soil nitrate concentrations were high. The soils were classified as severely corrosive to ferrous metals and aggressive to copper. Please refer to the Soil Corrosivity Study in Appendix C for a complete summary of the test results, and recommendations for mitigation.

10.0 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

The following recommendations are for improvements constructed as described in the "Introduction" section of this report. If locations, elevations, structural loads, etc., change, the recommendations contained herein may require modification. In developing the following recommendations, it was assumed that irrigated landscaping or flatwork that would keep the soils relatively uniform, year-round moisture will be installed for a zone of at least five feet around the perimeter of all improvements.

Two distinct types of Portland cement concrete (PCC) slabs-on-grade are discussed in the following recommendations. The building's interior slabs are defined as "slabs-on-grade." Sidewalks that will not support vehicle traffic are referred to as "exterior pedestrian flatwork." Asphalt concrete (AC) paths may also be utilized for pedestrian access, however it is also assumed that they will not support vehicle traffic.

Unless otherwise noted, the following definitions are used in the recommendations presented below. Where terms are not defined, definitions commonly used in the construction industry are intended.

- **Building Area –** The building area is defined as the area within and extending a minimum of 5 feet beyond the perimeter of the foundations for the Annex/Classroom Building. The building area includes any retaining walls, covered walkways or other improvements that are connected to the structure and that are intended to act in a manner similar to it.
- **Exterior Pedestrian Flatwork and Asphalt Concrete (AC) Path Areas –** The areas within the footprints of all exterior pedestrian flatwork and all AC paths.
- **Sitework Retaining Wall Areas –** The areas within and extending a minimum of 3 feet beyond the foundation limits of all sitework retaining walls.
- **Grading Area –** The entire area to be graded, including the building area, exterior pedestrian flatwork and AC path areas, and sitework retaining wall areas.
- **Existing Grade:** Elevations of the site that existed as of the date of this report.
- **Finish Pad Grade:** The elevation in the building area where earthwork operations are typically considered to be complete. It does not include any sand or gravel that might be placed below slabs-on-grade in association with vapor protection for the slabs.
- **Subgrade:** The elevation in exterior pedestrian flatwork and AC path areas where imported nonexpansive materials, sand, or aggregate base (AB) are placed to support the flatwork or AC path.

- **Scarified:** Plowed or ripped in two orthogonal directions to a depth of not less than 8 inches.
- **Moisture Conditioned:** Adjusting the soil moisture to optimum moisture content, or just above, prior to application of compactive effort.
- **Compacted/Recompacted:** Soils placed in level lifts not exceeding 8 inches in loose thickness and compacted to a minimum of 90 percent of maximum dry density. Based on maximum dry density by ASTM D 1557-12 and field density by ASTM D 6938-15, or other methods acceptable to the geotechnical engineer and jurisdiction.

Site Preparation

1. The ground surface in the grading areas should be prepared for construction by removing the existing building, existing flatwork, and all other improvements, vegetation, large roots, debris, organic topsoil, and other deleterious materials. Existing utility lines that will not remain in service should be either removed or abandoned. The appropriate method of abandonment will depend upon the type and depth of the utility. Recommendations for abandonment can be made as necessary.

2. Voids created by the removal of materials or utilities described above should be called to the attention of the geotechnical engineer. No fill should be placed unless the underlying soil has been observed by the geotechnical engineer.

Grading

1. Following site preparation, all existing fill in the building area should be removed to a level plane at the deepest point of the fill. For planning purposes, the deepest point of the fill encountered during the field exploration program was 4 feet below existing grade at Boring 1. The exact depth of fill should be determined by the geotechnical engineer at the time of construction. The resulting level excavated surface should be scarified, moisture conditioned and compacted.

2. To create as uniform conditions as possible for the structure, all earthwork operations should be completed throughout the entire building area in a uniform manner at the same time, from the bottom of the overexcavation recommended in the previous paragraph through fill placement to finish grade. Earthwork operations that complete only a portion of the building area at one time (i.e., “flip-flopping”, “checkerboarding”, etc.) should not be allowed.

3. Following site preparation, all existing fill in sitework retaining wall areas should be overexcavated to the deepest point of the fill. The resulting excavated surfaces should be scarified, moisture conditioned and compacted. Overexcavation elevations may be stepped where the fill depth changes or where retaining walls are stepped to conform to any site contours. If very stiff sandy lean clay alluvium is exposed at bottom of foundation elevation, no overexcavation and recompaction is considered necessary. To reduce the potential for cracking in sitework retaining walls, construction joints should be placed in the wall and the foundation where overexcavation operation have been stepped to conform to fill depth changes or to exposure of very stiff alluvium. Unlike the recommended earthwork program for the building area, overexcavation and recompaction operations for sitework retaining walls can proceed in a non-uniform manner for individual wall segments.

4. Following site preparation and any excavations to grade, or prior to placement of fill, the soil in any exterior pedestrian flatwork and AC path areas, and in all other grading areas, should be scarified, moisture conditioned and recompacted. Unlike the recommended earthwork program for the building area, scarification and recompaction operations for exterior pedestrian flatwork and AC path areas, and in all other grading areas, can proceed in a non-uniform manner.

5. Voids created by dislodging cobbles and/or debris during scarification should be backfilled and recompacted, and the dislodged materials should be removed from the work area.

6. Previously removed site soils and other similar soils may be placed as fill beyond the building area, and in the building area to a maximum height of 18 inches below bottom of slab elevation. The final 18 inches of fill below bottom of slab elevation in the building area should be nonexpansive.

7. Nonexpansive materials are defined as imported soils that fall in the GW, GM, GC, SP, SW, SC and SM categories per ASTM D 2487-11, and that have an expansion index of 10 or less (ASTM D 4829-11). The clean sand layer described in the “Slabs-on-Grade” section of this report (if utilized below interior slabs-on-grade or exterior pedestrian flatwork) is considered to be part of the minimum recommended thickness of nonexpansive material utilized, not in addition to it.

8. Imported soils used in the building area should have strength and expansion qualities equal to or better than the site soils, and they should not exceed the geotechnical corrosivity potential of the site soils. See the Soil Corrosivity Study in Appendix C for the corrosivity parameters of the site soils. Proposed imported materials should be reviewed by the geotechnical engineer before being brought to the site, and on an intermittent basis during placement.

9. All materials used as fill should be cleaned of any debris and rocks larger than 3 inches in diameter. When fill material includes rocks, the rocks should be placed in a sufficient soil matrix to ensure that voids caused by nesting of the rocks will not occur and that the fill can be properly compacted.

10. All AB and the top 12 inches of subgrade in areas to support AC paths should be compacted to a minimum of 95 percent of maximum dry density. Imported nonexpansive materials, sand or AB used to support exterior pedestrian flatwork, as well as the top 12 inches of subgrade in these areas, need only be compacted to a minimum of 90 percent of maximum dry density.

11. If the soils are overly moist so that they become unstable, or if the minimum recommended compaction cannot be readily achieved, drying the soil so that it is nearer optimum moisture content, may be necessary. Placement of gravel layers or geotextiles may also be necessary to help stabilize unstable soils. Additional overexcavation may also be recommended to correct unstable conditions or if soft or loose conditions are encountered during grading. No fill should be placed in any grading area if the underlying soil is unstable.

12. The recommended soil moisture content should be maintained throughout construction, and during the lives of the structure and sitework improvements. Failure to maintain the soil moisture content can result in desiccation cracks and disturbance, which are an indication of degradation of the soil compaction. If desiccation cracks are allowed to develop, or if soils near improvements such as foundations, flatwork, etc. are otherwise disturbed, damage to those improvements may result. Soils that have cracked or are otherwise disturbed should be removed, moisture conditioned, and recompacted.

Utility Trenches

1. Utility trenches adjacent to foundations should not be excavated within the zone of foundation influence, as shown in Typical Detail A in Appendix E.

2. Utilities that must pass beneath foundations should be placed with properly compacted utility trench backfill and the foundation should be designed to span the trench.

3. A select, noncorrosive, granular, easily compacted material should be used as bedding and shading immediately around utilities. The site soil may be used for trench backfill above the select material beyond the building area, and to within 18 inches below bottom of slab elevation in the building area. Within the building area, imported nonexpansive soils should be utilized to backfill the final 18 inches below bottom of slab elevation of all trenches. In exterior pedestrian flatwork and AC path areas, trench backfill should match the thickness of imported nonexpansive soils, sand or AB used to support these improvements.

4. In general, trench backfill should be compacted to a minimum of 90 percent of maximum dry density. Trench backfill in the upper 12 inches of subgrade and all AB in AC path areas should be compacted to a minimum of 95 percent of maximum dry density. A minimum of 85 percent of maximum dry density will generally be sufficient where trench backfill is located in landscaped or other unimproved areas, where settlement of trench backfill would not be detrimental.

5. Prior to applying compactive effort, soils should be moisture conditioned. Trench backfill should be placed in level lifts not exceeding 6 inches in loose thickness and compacted to the minimums recommended above.

6. Compaction of trench backfill by jetting or flooding is not recommended at this site due to the expansive soils. However, to aid in *encasing* utility conduits, particularly corrugated drain pipes, and multiple, closely-spaced conduits in a single trench with the bedding and shading material, jetting or flooding may be useful. Flooding or jetting should only be attempted with extreme caution, and any flooding or jetting operation should be subject to review by the geotechnical engineer.

7. Long-term settlement of properly compacted sand should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill. Where trenches are backfilled with site soils, the anticipated settlement would be about twice that of sand. Improvements that are constructed over or near trenches should be designed to accommodate the potential for settlement.

8. The Soil Corrosivity Study by HDR, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for utility improvements.

9. The recommendations of this section are minimums only, and may be superseded by the architect/engineer based upon soil corrosivity or the requirements of pipe manufacturers, utility companies or the governing jurisdiction.

Foundations

1. The Annex/Classroom Building may be supported by continuous and spread footings bearing in firm recompacted soils, as recommended in the "Grading" section of this report.

2. Based on soil expansion potential only, minimum overall foundations depths of 21 inches below lowest adjacent grade within 6 feet laterally of the base of foundations should be maintained. Spread footings should be at least 24 inches square.

3. Continuous footings should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential only, minimum continuous footing reinforcement should consist of two No. 4 rebars, one at the top and one at the bottom. Spread footings should be reinforced in accordance with the requirements of the architect/engineer.

4. Footings bearing in firm recompacted soil may be designed using maximum allowable bearing capacities of 2,500 psf dead load and 3,500 psf dead plus live loads. Using these criteria, maximum settlement and differential settlement are expected to be less than 1/2-inch and less than 3/8-inch in 25 feet, respectively.

5. Allowable bearing capacities may be increased by one-third when transient loads such as wind or seismicity are included. Foundations may be designed using the site design response parameters contained in the table on Page 8 in the "Seismicity" section of this report.

6. To calculate resistance to lateral loads, please see the values presented in the "Retaining Walls" section of this report. Lateral capacity is based on the assumption that any backfill adjacent to foundations has been properly compacted. Passive and friction components of resistance may be combined in the analysis without reduction to either value.

7. Footing excavations should be observed by the geotechnical engineer prior to placement of reinforcing steel. Footing excavations should be lightly moistened and no desiccation cracks should be present prior to concrete placement.

8. The Soil Corrosivity Study by HDR Engineering, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for all foundation elements.

Slabs-on-Grade

Interior Slabs-On-Grade

1. Interior slabs-on-grade should have a minimum thickness of 4 full inches. They should be reinforced and doweled to foundations per the specifications of the architect/engineer. At a minimum, interior slabs should be reinforced with No. 3 rebar at 24 inches on center each way. All structural slabs should contain minimum rebar meeting the criteria of ACI 318, Section 7.12.2 (ACI 2011). At a minimum, foundation dowels should be lap spliced to the slab rebar. The size and spacing of the dowels should match the size and spacing of the slab rebar.

Exterior Pedestrian Flatwork

1. Exterior pedestrian flatwork should have a minimum thickness of 4 full inches. Minimum reinforcement for exterior pedestrian flatwork placed over at least 18 inches of nonexpansive imported soils per the following paragraph should consist of No. 3 rebar placed at 24 inches on-center each way. If the thickness of nonexpansive soil below the flatwork is less than 18 inches, the minimum reinforcement should consist of No. 3 rebar at 18 inches on-center each way.

2. In conventional construction, it is common to use 4 to 6 inches of sand beneath exterior pedestrian flatwork. However, due to the medium expansion potential of the site soils, there will be a risk of movement and damage to the flatwork if conventional measures are used. Heaving and cracking could occur. This movement could be reduced by the placement of additional nonexpansive material beneath the flatwork. If it is desired to fully mitigate the expansive soil conditions, then at least 18 inches of imported nonexpansive material should be provided below the flatwork where the expansive site soils are exposed at finish grade. If it is acceptable for the flatwork to experience movement due to expansive soils, then the thickness of the nonexpansive soil can be reduced. Under all flatwork, however, the thicker the nonexpansive layer, the better the expansive soil protection.

3. Another measure that can be taken to reduce the risk of movement of flatwork due to expansive soils is to provide thickened edges or grade beams around the perimeters of the flatwork. If it is desired to fully mitigate the expansive soil conditions, then the thickened edges or grade beams could be up to 21 inches deep. If it is acceptable for the flatwork to experience movement, then the thickened edges or grade beams can be reduced. At a minimum, any thickened edge or grade beam should be reinforced by two No. 4 rebar, one at the top and one at the bottom.

4. It is recognized that the measures discussed above for protecting exterior flatwork from expansive soils are expensive, possibly more expensive than simply replacing flatwork that has heaved and/or cracked. Consequently, the above measures for protecting exterior flatwork are only suggestions for consideration by the owner and/or architect/engineer. The degree to which exterior flatwork is protected from expansive soil damage is left to the discretion of the owner and/or architect/engineer.

5. Flatwork should be constructed with frequent joints to allow articulation as the flatwork moves in response to seasonal soil temperature and moisture variations. The expansive soil underlying any nonexpansive material placed below flatwork should be moisture conditioned, and no desiccation cracks should be present, prior to casting the flatwork.

6. Flatwork at doorways, and at other areas where maintaining the elevation of the flatwork is desired when mitigating expansive soil potential, should be doweled to the perimeter foundation, at a minimum, by No. 3 dowels lapped to the flatwork rebar at 24 inches on center. In other areas, the flatwork may be doweled to the foundation or the flatwork may be allowed to "float free," at the discretion of the architect/engineer. Flatwork that is intended to float free should be separated from foundations by a felt joint or other means.

<u>Moisture Vapor Transmission</u>

1. Due to the current use of impermeable floor coverings, water-soluble flooring adhesives, and the speed at which buildings are now constructed, moisture vapor transmission through slabs is a much more common problem than in past years. Where moisture vapor transmitted from the underlying soil would be undesirable, slabs should be protected from subsurface moisture vapor. A number of options for vapor protection are discussed below; however, the means of vapor protection, including the type and thickness of the vapor retarder, if specified, are left to the discretion of the architect/engineer.

2. Where specified, vapor retarders should conform to ASTM Standard E 1745-11. This standard specifies properties for three performance classes; Class A, B and C. The appropriate class should be selected based on the sensitivity of floor coverings to moisture intrusion and the potential for damage to the vapor retarder during placement of slab reinforcement and concrete.

3. Several recent studies, including those of American Concrete Institute Committee 302 (ACI 2004), have concluded that excess water above the vapor retarder increases the potential for moisture damage to floor coverings and could increase the potential for mold growth or other microbial contamination. The studies also concluded that it is preferable to eliminate the typical sand layer beneath the slab and place the slab concrete in direct contact with a Class A vapor retarder, particularly during wet weather construction. However, placing the concrete directly on the vapor retarder requires special attention to using the proper vapor retarder, a very low water-cement ratio in the concrete mix, and special finishing and curing techniques.

4. Probably the next most effective option would be the use of vapor-inhibiting admixtures in the slab concrete mix and/or application of a sealer to the surface of the slab. This would also require special concrete mixes and placement procedures, depending upon the recommendations of the admixture or sealer manufacturer.

5. Another option that may be a reasonable compromise between effectiveness and cost considerations is the use of a subslab vapor retarder protected by a sand layer. If a Class A vapor retarder is specified, the retarder can be placed directly on the nonexpansive soil. The retarder should be covered with a minimum 2 inches of *clean* sand. If a less durable vapor retarder is specified (Class B or C), a minimum of 4 inches of clean sand should be provided, and the retarder should be placed in the center of the clean sand layer. Clean sand is defined as a well or poorly graded sand (ASTM D 2487-11) of which less than 3 percent passes the No. 200 sieve. The clean sand layer, if used, is considered to be a part of the minimum 18-inch thickness of nonexpansive imported materials recommended in the "Grading" section of this report to be placed below slabs-on-grade, not in addition to it.

6. Regardless of the underslab vapor retarder selected, proper installation of the retarder per ASTM E 1643-11 is critical for optimum performance. Where utilized, the vapor retarder should be placed a minimum of 1 inch above the flow line of the drainage path

surrounding the structures, or 1 inch above the area drain grates if area drains are used to collect runoff around the structures. All seams must be properly lapped, and all seams and utility penetrations properly sealed in accordance with the vapor retarder manufacturer's recommendations.

7. If the sand is used between the vapor retarder and the slab, it should be moistened only as necessary to promote concrete curing; saturation of the sand should be avoided, as the excess moisture would be on top of the vapor retarder, potentially resulting in vapor transmission through the slab for months or years.

8. The architect/engineer should designate any special measures to be used in conjunction with moisture vapor transmission protection, if needed, to mitigate the high potential for indoor radon levels.

9. Positive drainage away from the building should be maintained; see the "Drainage and Maintenance" section of this report for additional discussion of this issue. If water is allowed to pond near the structure, it may seep into the ground and migrate laterally through cracks or utility penetrations in the foundation, ultimately gaining access above the vapor retarder.

Slabs-on-Grade - General

1. To reduce shrinkage cracks in all interior and exterior slabs-on-grade, the concrete aggregates should be of appropriate size and proportion, the water/cement ratio should be low, the concrete should be properly placed and finished, contraction joints should be installed, and the concrete should be properly cured. This is particularly applicable to slabs that will be cast directly upon a vapor retarder and those that will be protected from transmission of vapor by use of admixtures or surface sealers. Concrete materials, placement, and curing specifications should be at the direction of the architect/engineer; AC 302.1R-04 (ACI 2004) is suggested as a resource for the architect/engineer in preparing such specification.

2. To provide stability for curbs adjacent to exterior pedestrian flatwork, they should be set back a minimum distance equal to one-third the height of any adjacent descending slope, but not less than 5 feet from the tops of slopes. Alternately, curbs may be deepened to provide stability. The geotechnical engineer should review, on an individual basis, any situation where curbs must be deepened to meet this recommendation.

3. The Soil Corrosivity Study by HDR, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for all slabs-on-grade.

Retaining Walls

1. Retaining walls connected to or forming part of the building should be founded in firm soil that has been recompacted per the "Grading" section of this report. Sitework retaining walls may be supported by either firm soil that has been recompacted per the "Grading" section of this report, or firm sandy lean clay alluvium. If a sitework retaining wall crosses a recompacted soil/firm alluvium transition, or a transition between varying fill overexcavation depths, a construction joint should be placed in the footing and wall at the transitions. Foundations for all retaining walls should have minimum overall depths (not including any keyway) of 21 inches below lowest grade within 6 feet laterally of any adjacent slope.

2. Retaining wall footings should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential only, minimum retaining wall footing reinforcement should consist of two No. 4 rebars, one at the top and one at the bottom.

3. Retaining wall design may be based on the following parameters:

Active equivalent fluid pressure (site soils)	45 pcf
Active equivalent fluid pressure (imported sand/gravel backfill)	35 pcf
At-rest equivalent fluid pressure (site soils)	60 pcf
At-rest equivalent fluid pressure (imported sand/gravel backfill)	50 pcf
Passive equivalent fluid pressure	350 pcf
Maximum toe pressure	3,500 psf
Coefficient of sliding friction	0.35

4. No surcharges are taken into consideration in the values presented in the previous paragraph. The maximum toe pressure is an *allowable* value; no factors of safety, load factors or other factors have been applied to the remaining values. With the exception of the maximum toe pressure, these values will require application of appropriate factors of safety, load factors, and/or other factors as deemed appropriate by the architect/engineer.

5. If the active or at-rest pressures presented in Paragraph 3 for *imported sand or gravel backfill* are utilized for design of retaining walls, the sand or gravel should be used exclusively as backfill above a 1:1 plane extended upward from the back of the wall footing to approximately 1 foot from the top of the wall backfill. The upper foot should be backfilled with native soil, except in areas where AC paths or exterior pedestrian flatwork will abut the top of the wall. In such cases, the gravel should extend to the imported nonexpansive material, sand, aggregate base, or other material below the improved surface, as appropriate.

6. The active and at-rest pressures presented in Paragraph 3 are applicable to a horizontal retained surface behind the wall. Walls having a retained surface that slopes upward from the wall should be designed for an additional equivalent fluid pressure of 1 pcf for the active case and 1.5 pcf for the at-rest case, for every degree of slope inclination.

7. It is assumed that retaining wall heights will not exceed 4 feet.

8. Section 1803A.5.12.1 of the 2013 CBC requires that dynamic seismic lateral earth pressures be provided by the geotechnical engineer for walls retaining more than 6 feet of backfill. As the walls for this project will not retain more than 6 feet, design for seismic lateral earth pressures is not required.

9. Long-term settlement of properly compacted sand or gravel retaining wall backfill should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill; long-term settlement of properly compacted site soil retaining wall backfill would be about twice that of sand or gravel backfill. Improvements that are constructed near the tops of retaining walls should be designed to accommodate long-term settlement.

10. All retaining walls should be drained with perforated pipe encased in a free-draining gravel blanket. The pipe should be placed perforations downward, and should discharge in a nonerosive manner away from foundations and other improvements. The gravel blanket should have a width of approximately 1 foot and should extend upward to approximately 1 foot from the top of the wall backfill. The upper foot should be backfilled with native soil, except in areas where AC paths or exterior pedestrian flatwork will abut the top of the wall. In such cases, the gravel should extend to the imported nonexpansive material, sand, aggregate base, or other material below the improved surface, as

appropriate. To reduce infiltration of the soil into the gravel, a permeable synthetic filter fabric conforming to Standard Specifications Section 88-1.02B – Class C (Caltrans 2010), should be placed between the two. Manufactured synthetic drains, such as Miradrain or Enkadrain are acceptable alternatives to the use of gravel, provided that they are installed in accordance with the recommendations of the manufacturer.

11. Where weep hole drainage can be properly discharged, the perforated pipe may be omitted in lieu of weep holes on maximum 4-foot centers. A filter fabric as described above should be placed between the weep holes and the drain gravel.

12. Walls facing areas where moisture transmission through the wall would be undesirable should be *thoroughly* waterproofed in accordance with the specifications of the architect/engineer.

13. The architect/engineer should bear in mind that retaining walls by their nature are flexible structures, and that surface treatments on walls often crack. Where walls are to be plastered or otherwise have a finish applied, the flexibility should be considered in determining the suitability of the surfacing material, spacing of horizontal and vertical control joints, etc. The flexibility should also be considered where a retaining wall will abut or be connected to a rigid structure, and where the geometry of the wall is such that its flexibility will vary along its length.

14. The Soil Corrosivity Study by HDR, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for all retaining walls.

Asphalt Concrete (AC) Paths

1. Paths for pedestrian access may be constructed of AC over AB. Design methods for AC pavement do not typically consider pedestrian loading only. Therefore, the section design is typically based on local experience and anticipated life span. For this application, a minimum pavement section of 1.5 to 2.0 inches of AC over 2 to 4 inches of AB is considered appropriate. As with exterior pedestrian flatwork these minimum thicknesses of AC and AB will be subject to movement due to expansive soils. If it is desired to filly mitigate the expansive soil conditions, the AB thickness can be increased to as much as 18 inches.

2. It is recognized that the increased AB thickness recommended above for protecting AC paths from expansive soils will be expensive, possibly more expensive than simply replacing AC paths that has heaved and/or cracked. Consequently, this measure for protecting AC paths is only a suggestion for consideration by the client and/or architect/engineer. The degree to which AC paths are protected from expansive soil damage is left to the discretion of the owner and/ or architect/engineer.

3. AB should conform to the requirements of Section 26 of the Standard Specifications (Caltrans 2010). AC should conform to the requirements of Section 32 of the Standard Specifications (Caltrans 2010).

4. The upper 12 inches of subgrade and all AB in pavement areas should be compacted to a minimum of 95 percent of maximum dry density. Subgrade and aggregate base should be firm and unyielding when proofrolled with heavy, rubber-tired grading equipment prior to continuing construction.

Drainage and Maintenance

1. Per Section 1804A.3 of the 2013 CBC, unpaved ground surfaces should be *finish graded* to direct surface runoff away from foundations and other improvements at a minimum 5 percent grade for a minimum distance of 10 feet. The site should be similarly sloped to drain away from foundation, and other improvements during construction. Where this is not practicable due to other improvements, etc., swales with improved surfaces, area drains, or other drainage facilities, should be used to collect and discharge runoff.

2. All eaves of the building should be fitted with roof gutters. Runoff from flatwork, roof gutters, downspouts, planter drains, area drains, etc. should discharge in a nonerosive manner away from foundations and other improvements in accordance with the requirements of the governing agencies. Erosion protection should be placed at all discharge points unless the discharge is to a pavement surface.

3. To reduce the potential for planter drainage gaining access to subslab areas, any raised planter boxes adjacent to foundations should be installed with drains and sealed sides and bottoms. Drains should also be provided for areas adjacent to the structure and in landscape areas that would not otherwise freely drain.

4. The on-site soils are erodible; stabilization of soils disturbed during construction by vegetation or other means *during* and *following* construction, is essential to reduce erosion damage. Care should be taken to establish and maintain vegetation. The landscaping should be planned and installed to maintain the surface drainage recommended above. Surface drainage should also be maintained during construction.

5. Maintenance of drainage and other improvements is critical to the long-term stability of the site and the integrity of the structures. Site improvements should be maintained on a regular basis.

6. All exterior drains, retaining wall drains, and drain outlets should be maintained to be free-flowing. Vegetation and erosion matting (if utilized) should be maintained or augmented as needed. Irrigation systems should be maintained so that soils around structures are maintained at a relatively uniform year-round moisture content, and are neither over-watered nor allowed to dry and desiccate.

7. To reduce the potential for disruption of drainage patterns and undermining of structures, fill areas, etc., all rodent activity should be aggressively controlled.

Observation and Testing

1. It must be recognized that the recommendations contained in this report are based on a limited number of borings and rely on continuity of the subsurface conditions encountered.

2. It is assumed that the geotechnical engineer will be retained to provide consultation during the design phase, to interpret this report during construction, and to provide construction monitoring in the form of testing and observation.

3. At a minimum, the geotechnical engineer should be retained to provide:
    - Professional observation during grading, trench and retaining wall backfill, and foundation construction
    - Oversight of special inspection and compaction testing grading, trench and retaining wall backfill, and foundation construction

4. Special inspection of grading and backfill should be provided as per Section 1705A.6 and Table 1705A.6 of the CBC. The special inspector should be under the direction of the geotechnical engineer. At a minimum, the following items should be inspected and/or tested by the special inspector:
    - Stripping and clearing of all existing improvements, vegetation, and deleterious materials
    - Overexcavation of the building and sitework retaining wall areas to the recommended depths
    - Scarification and moisture conditioning of overexcavated areas
    - Scarification and moisture conditioning of exterior pedestrian flatwork, AC path and all other grading areas
    - Fill quality, placement, moisture conditioning and compaction
    - Utility trench backfill
    - Foundation excavations

5. A program of quality assurance should be developed prior to beginning construction. At a minimum, the program should include all geotechnical items shown on the testing and inspection schedule of the approved plans. It should also include any additional inspection items required by the engineer and/or the governing jurisdiction. These items should be discussed at a preconstruction site meeting among a representative of the owner, the geotechnical engineer, special inspector, the project inspector, the engineer, and contractors. The geotechnical engineer should be notified at least 48 hours prior to beginning grading operations.

6. Locations and frequency of compaction tests should be as per the recommendation of the geotechnical engineer at the time of construction. The recommended test location and frequency may be subject to modification by the geotechnical engineer, based upon soil and moisture conditions encountered, size and type of equipment used by the contractor, the general trend of the results of compaction tests, or other factors.

11.0 CLOSURE

Our intent was to perform the investigation in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the locality of this project under similar conditions. No representation, warranty, or guarantee is either expressed or implied. This report is intended for the exclusive use by the client as discussed in the “Scope of Services” section. Application beyond the stated intent is strictly at the user's risk.

This report is valid for conditions as they exist at this time for the type of project described herein. The conclusions and recommendations contained in this report could be rendered invalid, either in whole or in part, due to changes in building codes, regulations, standards of geotechnical or construction practice, changes in physical conditions, or the broadening of knowledge.

If changes with respect to the project become necessary, if items not addressed in this report are incorporated into plans, or if any of the assumptions used in the preparation of this report are not correct, this firm shall be notified for modifications to this report. Any items not specifically addressed in this report should comply with the CBC of other applicable standards, and the requirements of the governing jurisdiction.

The preliminary recommendations presented in this geotechnical report are based upon the geotechnical conditions encountered at the site, and may be augmented by additional requirements of the client, or by additional recommendations provided by the geotechnical engineer based on peer or jurisdiction reviews, or conditions exposed at the time of construction.

This document, the data, conclusions, and recommendations contained herein are the property of Earth Systems Pacific. This report shall be used in its entirety, with no individual sections reproduced or used out of context. Copies may be made only by Earth Systems Pacific, the client, and the client's authorized agents for use exclusively on the subject project. Any other use is subject to federal copyright laws and the written approval of Earth Systems Pacific.

Thank you for this opportunity to have been of service. If you have any questions, please feel free to contact this office at your convenience.

End of Text.

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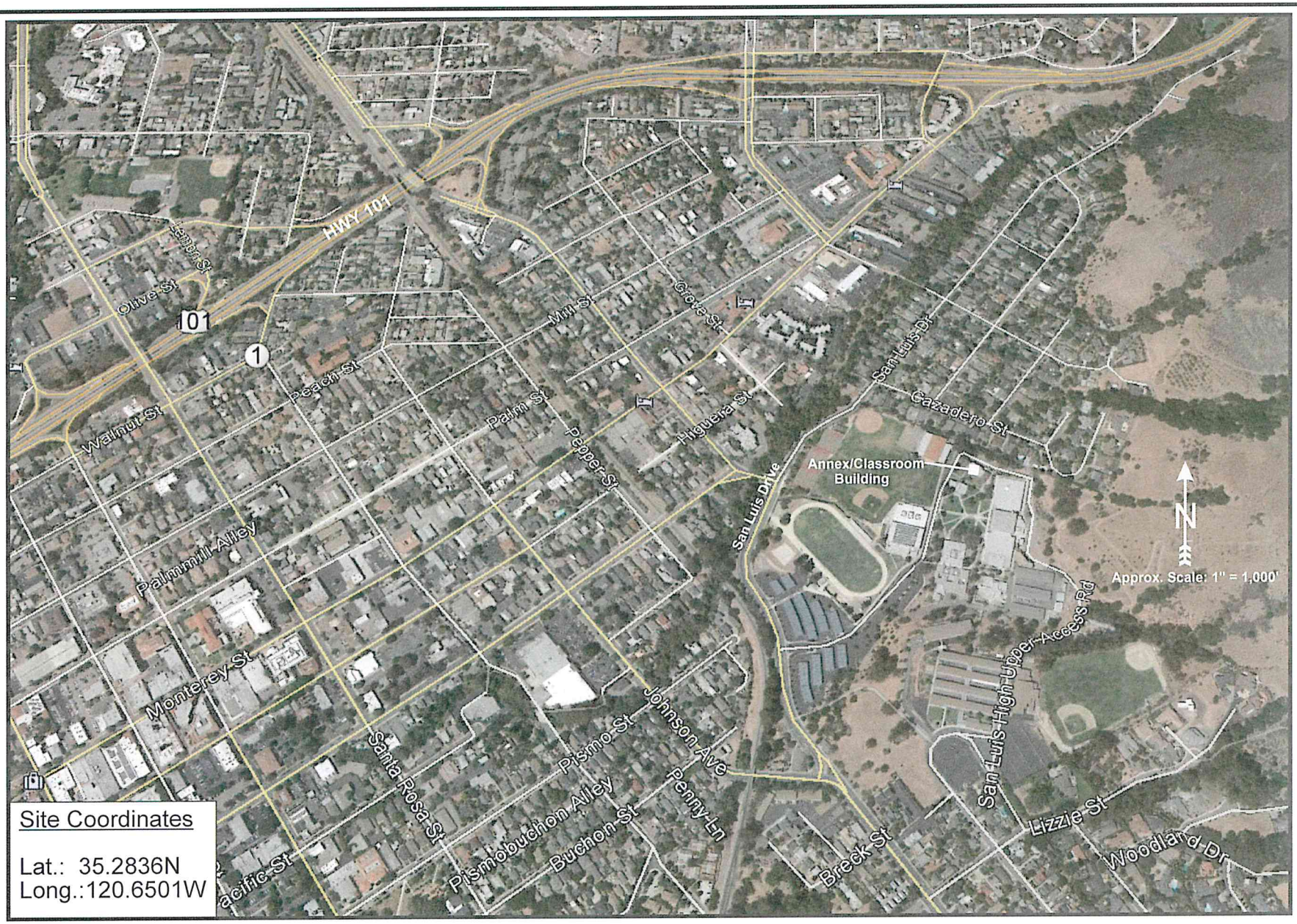
APPENDIX A

Vicinity Map
Boring Location Map
Boring Log Legend
Boring Logs
Cross Section A-A'



Reference: extract from Google Earth 2015

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VICINITY MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

Date
January 2016

Project No.
SL-16605-SE



LEGEND

3 Boring Location (Approx.)

A A' Cross Section (Approx.)

NOT TO SCALE

BORING LOCATION MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

Earth Systems Pacific
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E-mail: esp@earthsystems.com

December 9, 2015 CS SL-16605-SE

SLO HS MEASURE D POOL ANNEX CLASSROOM BLDG-1816BLOCATIONS

Earth Systems Pacific

BORING LOG LEGEND

SAMPLE / SUBSURFACE WATER SYMBOLS	GRAPH. SYMBOL
CALIFORNIA MODIFIED	
STANDARD PENETRATION TEST (SPT)	
SHELBY TUBE	
BULK	
SUBSURFACE WATER DURING DRILLING	
SUBSURFACE WATER AFTER DRILLING	

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

MAJOR DIVISIONS	GROUP SYMBOL	TYPICAL DESCRIPTIONS	GRAPH. SYMBOL
COARSE GRAINED SOILS (MORE THAN HALF OF MATERIAL IS LARGER THAN #200 SIEVE SIZE)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GP	POORLY GRADED GRAVELS, OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, NON-PLASTIC FINES	
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, PLASTIC FINES	
	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
	SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES	
	SM	SILTY SANDS, SAND-SILT MIXTURES, NON-PLASTIC FINES	
	SC	CLAYEY SANDS, SAND-CLAY MIXTURES, PLASTIC FINES	
FINE GRAINED SOILS (HALF OR MORE OF MATERIAL IS SMALLER THAN #200 SIEVE SIZE)	ML	INORGANIC SILTS AND VERY FINE SANDS, 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	
	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS	
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	

OBSERVED MOISTURE CONDITION

DRY	SLIGHTLY MOIST	MOIST	VERY MOIST	WET (SATURATED)

CONSISTENCY

COARSE GRAINED SOILS

BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER	
0-10	0-16	LOOSE
11-30	17-50	MEDIUM DENSE
31-50	51-83	DENSE
OVER 50	OVER 83	VERY DENSE

FINE GRAINED SOILS

BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER	
0-2	0-3	VERY SOFT
3-4	4-7	SOFT
5-8	8-13	MEDIUM STIFF
9-15	14-25	STIFF
16-30	26-50	VERY STIFF
OVER 30	OVER 50	HARD

GRAIN SIZES

U.S. STANDARD SERIES SIEVE				CLEAR SQUARE SIEVE OPENING		
# 200	# 40	# 10	# 4	3/4"	3"	12"

SILT & CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

TYPICAL BEDROCK HARDNESS

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
EXTREMELY HARD	CORE, FRAGMENT, OR EXPOSURE CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CAN ONLY BE CHIPPED WITH REPEATED HEAVY HAMMER BLOWS
VERY HARD	CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CORE OR FRAGMENT BREAKS WITH REPEATED HEAVY HAMMER BLOWS
HARD	CAN BE SCRATCHED WITH KNIFE OR SHARP PICK WITH DIFFICULTY (HEAVY PRESSURE); HEAVY HAMMER BLOW REQUIRED TO BREAK SPECIMEN
MODERATELY HARD	CAN BE GROOVED 1/16 INCH DEEP BY KNIFE OR SHARP PICK WITH MODERATE OR HEAVY PRESSURE; CORE OR FRAGMENT BREAKS WITH LIGHT HAMMER BLOW OR HEAVY MANUAL PRESSURE
SOFT	CAN BE GROOVED OR GOUGED EASILY BY KNIFE OR SHARP PICK WITH LIGHT PRESSURE, CAN BE SCRATCHED WITH FINGERNAIL; BREAKS WITH LIGHT TO MODERATE MANUAL PRESSURE
VERY SOFT	CAN BE READILY INDENTED, GROOVED OR GOUGED WITH FINGERNAIL, OR CARVED WITH KNIFE; BREAKS WITH LIGHT MANUAL PRESSURE

TYPICAL BEDROCK WEATHERING

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
FRESH	NO DISCOLORATION, NOT OXIDIZED
SLIGHTLY WEATHERED	DISCOLORATION OR OXIDATION IS LIMITED TO SURFACE OF, OR SHORT DISTANCE FROM, FRACTURES: SOME FELDSPAR CRYSTALS ARE DULL
MODERATELY WEATHERED	DISCOLORATION OR OXIDATION EXTENDS FROM FRACTURES, USUALLY THROUGHOUT; Fe-Mg MINERALS ARE "RUSTY", FELDSPAR CRYSTALS ARE "CLOUDY"
INTENSELY WEATHERED	DISCOLORATION OR OXIDATION THROUGHOUT; FELDSPAR AND Fe-Mg MINERALS ARE ALTERED TO CLAY TO SOME EXTENT, OR CHEMICAL ALTERATION PRODUCES IN SITU DISAGGREGATION
DECOMPOSED	DISCOLORATION OR OXIDATION THROUGHOUT, BUT RESISTANT MINERALS SUCH AS QUARTZ MAY BE UNALTERED; FELDSPAR AND Fe-Mg MINERALS ARE COMPLETELY ALTERED TO CLAY

Earth Systems Pacific

Boring No. 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

PAGE 1 OF 1
JOB NO.: SL-16605-SE
DATE: 12/29/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL		SANDY LEAN CLAY: dark brown/ olive mottled, stiff, moist, trace coarse gravel (Fill)	1.0 - 2.5	Ring	107.5	14.9	5, 6, 7
				0.0 - 3.0	Grab			
4				4.0 - 6.0	Grab			
	CL		SANDY LEAN CLAY: dark brown, very stiff, moist, some fine gravel (Alluvium)	5.0 - 6.5	Ring	109.1	14.8	7, 13, 18
10				10.0 - 11.5	Ring	119.6	13.0	6, 13, 21
15				15.0 - 16.5	SPT			4, 8, 11
17	GC		CLAYEY GRAVEL WITH SAND: brown, medium dense, moist	20.0 - 21.5	SPT			4, 9, 12
24			SANDSTONE: dark yellow brown, moderately soft, moist (Franciscan Melange)	25.0 - 25.5	SPT			50/3"
26			End of Boring @ 26.0' due to refusal No subsurface water encountered					

LEGEND: Ring Sample Grab Sample Shelby Tube Sample SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 2

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

PAGE 1 OF 1
JOB NO.: SL-16605-SE
DATE: 12/29/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			4.0" AC over 2" AB					
1	CL		SANDY LEAN CLAY: dark brown, stiff, moist, some fine gravel (Alluvium)					
2				1.0 - 4.0	○			4
3				3.0 - 4.5	▬	109.4	16.2	10 16
4			brown, slightly moist					
5			dark brown, moist, gravel ends	5.0 - 6.5	▬	112.6	15.2	5 8 13
9			brown, very stiff to hard					
10				10.0 - 11.5	▬	119.4	14.6	7 16 20
15				15.0 - 16.5	●			4 9 12
17			End of Boring @ 16.5' No subsurface water encountered					

LEGEND: ▬ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 3

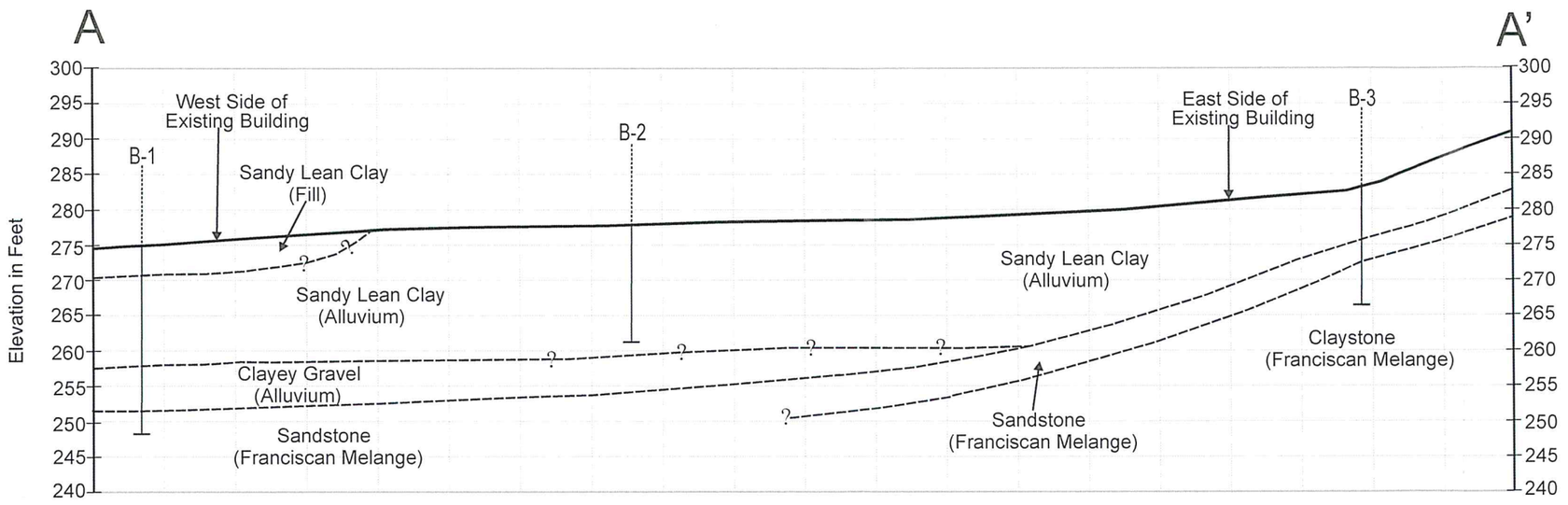
LOGGED BY: R. Wagner — PAGE 1 OF 1
DRILL RIG: Mobile B53 — JOB NO.: SL-16605-SE
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer — DATE: 12/29/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL		SANDY LEAN CLAY: dark brown, very stiff, very moist, trace gravel (Alluvium)	1.0 - 2.5	Ring	110.4	17.8	4, 8, 12
4			brown, slightly moist	3.5 - 6.0	Grab			
5				5.0 - 6.5	Ring	118.7	11.6	8, 13, 19
6				5.0 - 6.5	Grab			
8			SANDSTONE: dark yellow brown, moderately soft, moist (Franciscan Melange)					
10				10.0 - 11.5	Ring			16, 36, 50/5"
11			CLAYSTONE: gray brown, moderately soft, moist, severely sheared, weathered					
15				15.0 - 16.5	SPT			11, 20, 28
17			End of Boring @ 16.5' due to refusal No subsurface water encountered					

LEGEND: Ring Sample; Grab Sample; Shelby Tube Sample; SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.



Scale 1" = 20'

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CROSS SECTION A-A'

SAN LUIS OBISPO HIGH SCHOOL
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Date
January 2016

Project No.
SL-16605-SE

APPENDIX B

Geotechnical Laboratory Test Results

San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

BULK DENSITY TEST RESULTS

ASTM D 2937-10 (modified for ring liners)

January 12, 2016

BORING NO.	DEPTH feet	MOISTURE CONTENT, %	WET DENSITY, pcf	DRY DENSITY, pcf
1	2.0 - 2.5	14.9	123.5	107.5
1	6.0 - 6.5	14.8	125.3	109.1
1	11.0 - 11.5	13.0	135.1	119.6
2	4.0 - 4.5	16.2	127.1	109.4
2	6.0 - 6.5	15.2	129.7	112.6
2	11.0 - 11.5	14.6	136.8	119.4
3	2.0 - 2.5	17.8	130.0	110.4
3	6.0 - 6.5	11.6	132.5	118.7

EXPANSION INDEX TEST RESULTS

ASTM D 4829-11

BORING NO.	DEPTH feet	EXPANSION INDEX
1	0.0 - 3.0	54
2	1.0 - 4.0	58

San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

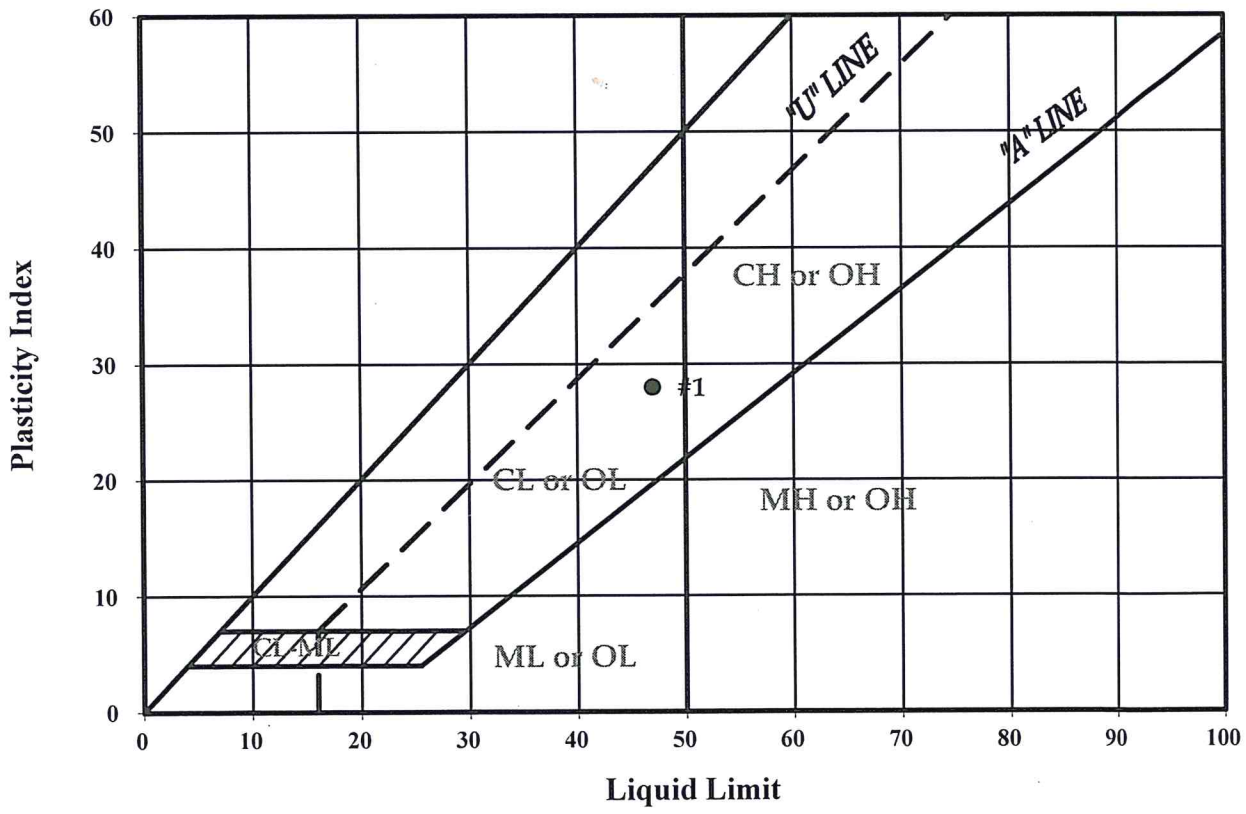
PLASTICITY INDEX

ASTM D 4318-10

January 12, 2016

Test No.:	1	2	3	4	5
Boring No.:	1				
Sample Depth:	4.0 - 6.0'				
Liquid Limit:	47				
Plastic Limit:	19				
Plasticity Index:	28				

Plasticity Chart



San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

MOISTURE-DENSITY COMPACTION TEST

ASTM D 1557-12 (Modified)

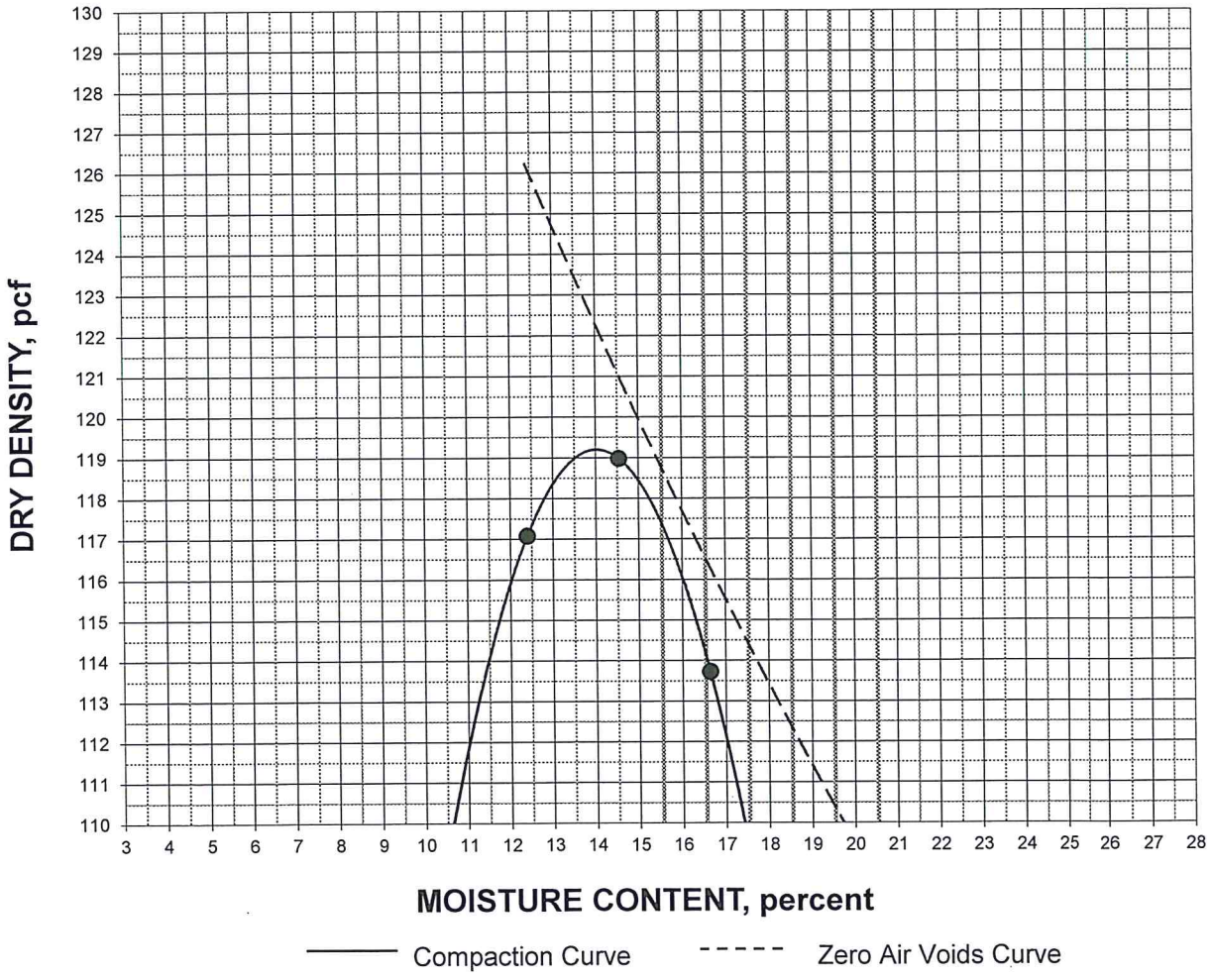
PROCEDURE USED: A
PREPARATION METHOD: Moist
RAMMER TYPE: Mechanical
SPECIFIC GRAVITY: 2.70 (assumed)

January 12, 2016
Boring #2 @ 1.0 - 4.0'
Dark Brown Sandy Lean Clay (CL)

SIEVE DATA:

Sieve Size	% Retained (Cumulative)
3/4"	0
3/8"	0
#4	0

MAXIMUM DRY DENSITY: 119.2 pcf
OPTIMUM MOISTURE: 14.0%



San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

DIRECT SHEAR

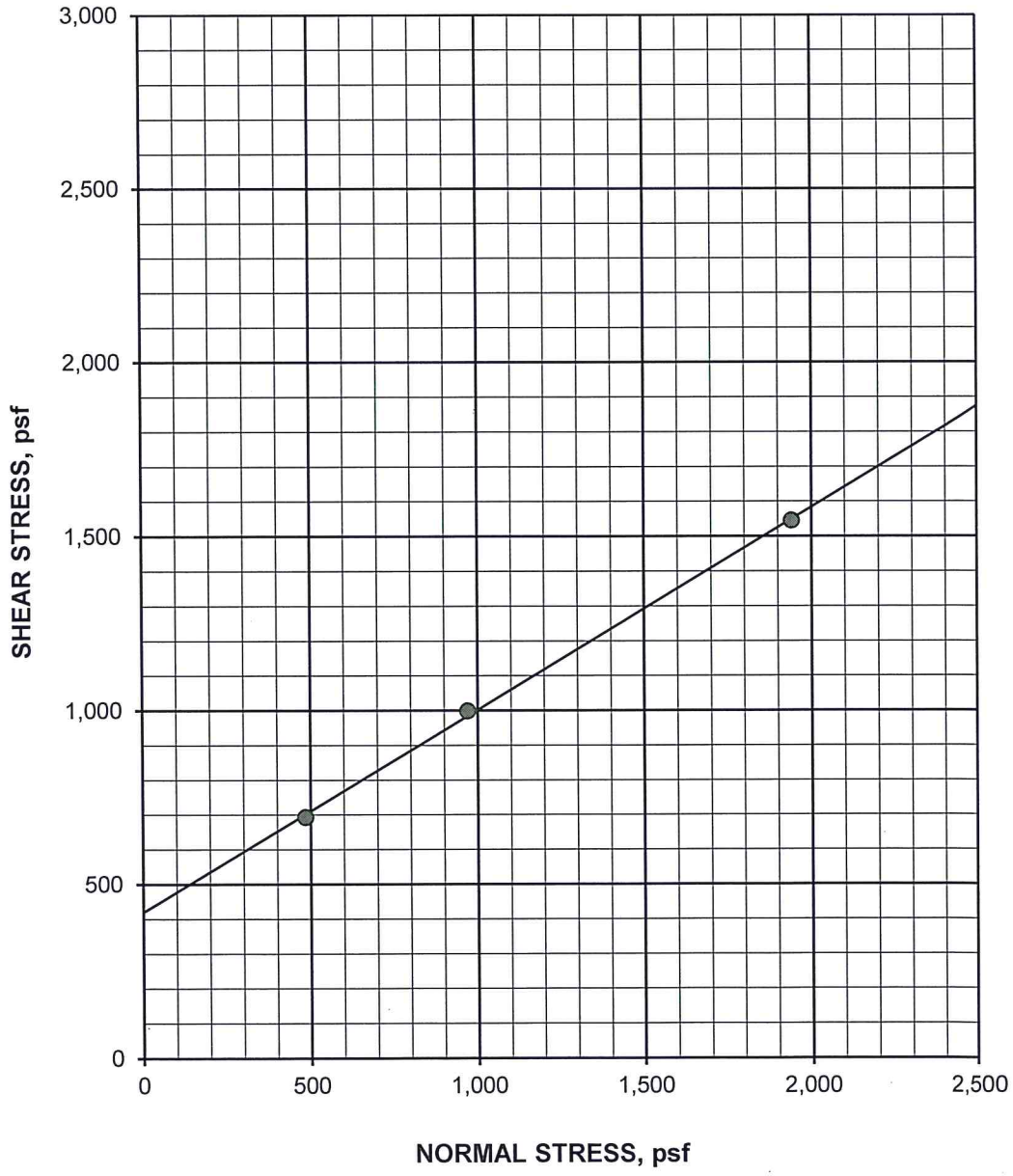
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

January 12, 2016

Boring #2 @ 1.0 - 4.0'
Sandy Lean Clay (CL)
Compacted to 90% RC, saturated

INITIAL DRY DENSITY: 107.3 pcf
INITIAL MOISTURE CONTENT: 14.0 %
PEAK SHEAR ANGLE (Ø): 30°
COHESION (C): 420 psf

SHEAR vs. NORMAL STRESS



DIRECT SHEAR continued

ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

Boring #2 @ 1.0 - 4.0'

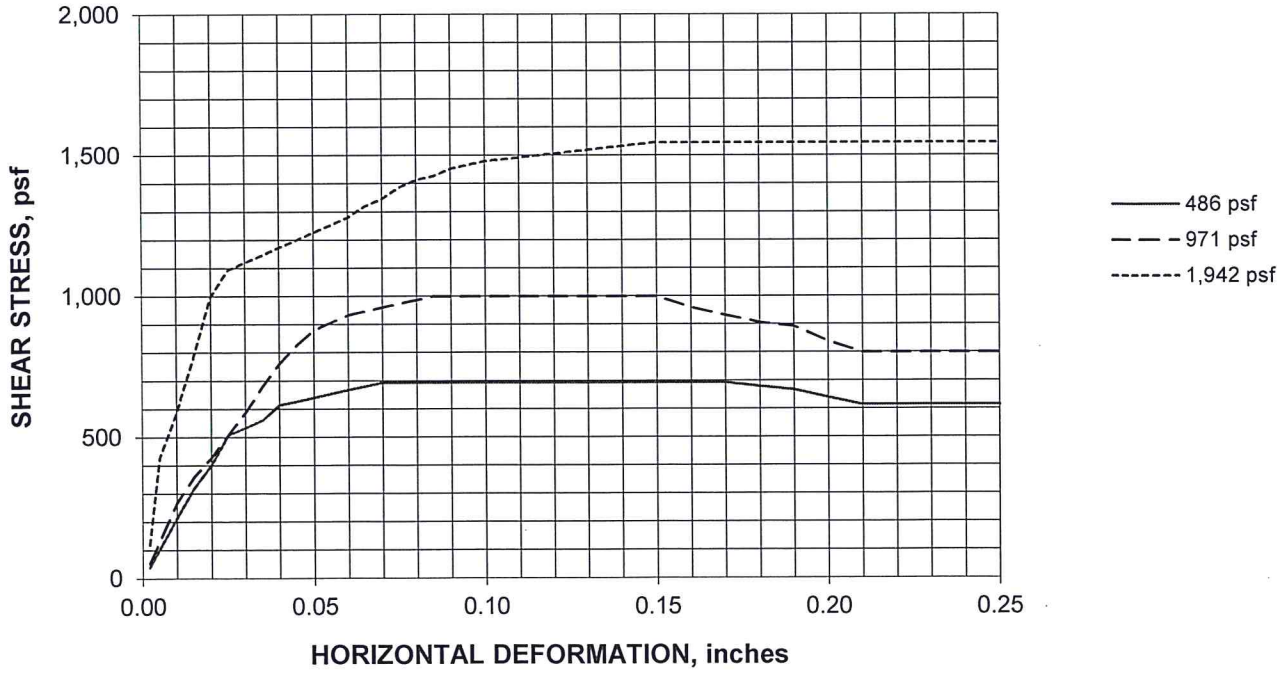
January 12, 2016

Sandy Lean Clay (CL)

Compacted to 90% RC, saturated

SPECIFIC GRAVITY: 2.70 (assumed)

SAMPLE NO.:	1	2	3	AVERAGE
INITIAL				
WATER CONTENT, %	14.0	14.0	14.0	14.0
DRY DENSITY, pcf	107.3	107.3	107.3	107.3
SATURATION, %	66.3	66.3	66.3	66.3
VOID RATIO	0.570	0.570	0.570	0.570
DIAMETER, inches	2.410	2.410	2.410	
HEIGHT, inches	1.00	1.00	1.00	
AT TEST				
WATER CONTENT, %	25.3	23.9	22.9	
DRY DENSITY, pcf	108.3	109.8	114.5	
SATURATION, %	100.0	100.0	100.0	
VOID RATIO	0.556	0.534	0.472	
HEIGHT, inches	0.99	0.98	0.94	



San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

CONSOLIDATION TEST

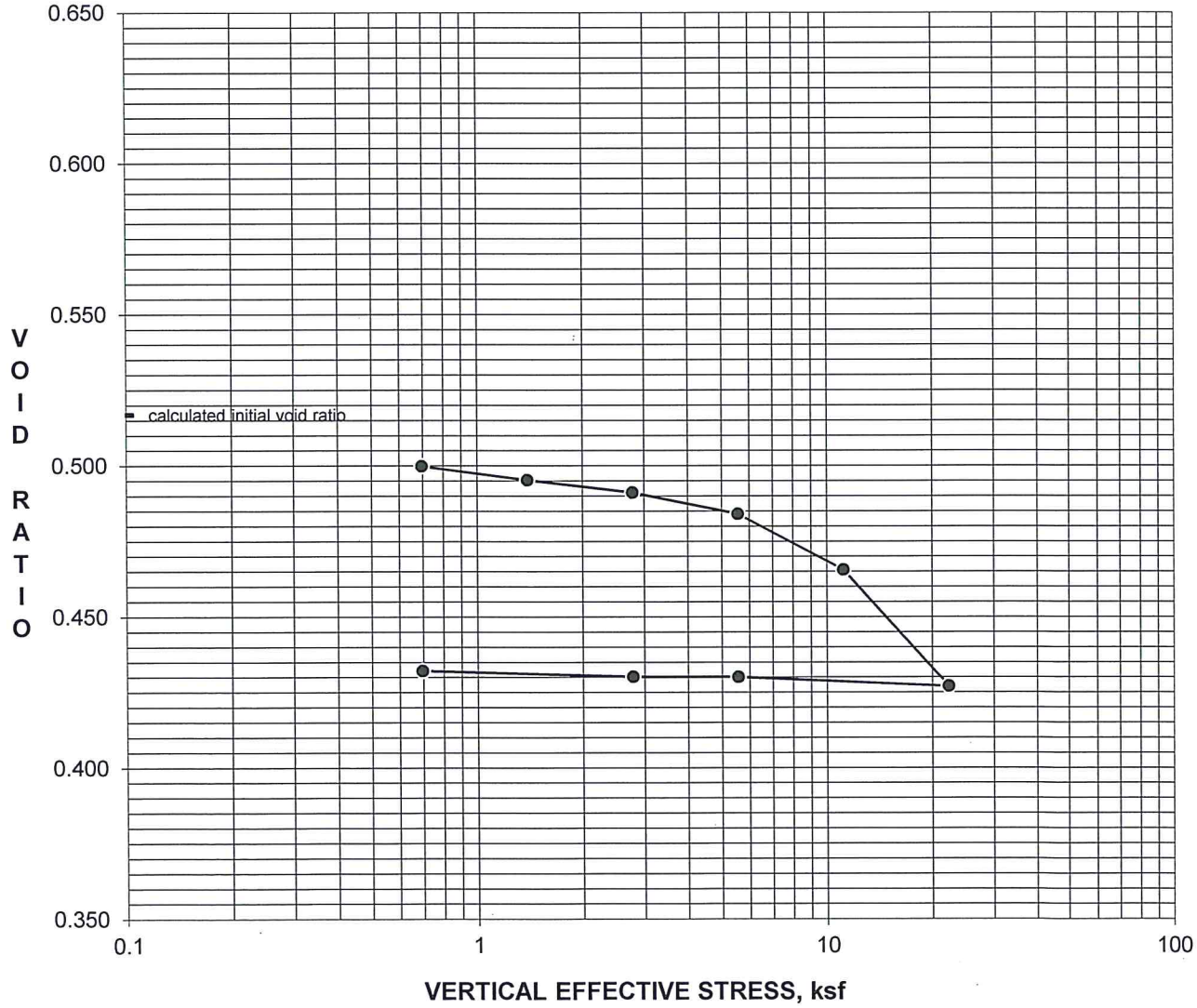
ASTM D 2435/D2435M-11

January 12, 2016

Boring #2 @ 6.0 - 6.5'
Sandy Lean Clay (CL)
Ring Sample

DRY DENSITY: 111.1 pcf
MOISTURE CONTENT: 15.2%
SPECIFIC GRAVITY: 2.70 (assumed)
INITIAL VOID RATIO: 0.517

VOID RATIO vs. NORMAL PRESSURE DIAGRAM



APPENDIX C

Soil Corrosivity Study by HDR, Inc.

January 18, 2016 via email: Fred@earthsystems.com

EARTH SYSTEMS PACIFIC
4378 Old Santa Fe Road
San Luis Obispo, CA 93401

Attention: Mr. Fred J. Potthast, GE

Re: Soil Corrosivity Study
San Luis Obispo High School
Annex/Classroom Building Project
No. 831-3102
San Luis Obispo, California
HDR #274257, ESP #SL16605-SE

Introduction

Laboratory tests have been completed on two soil samples provided for the San Luis Obispo High School project. The purpose of these tests was to determine if the soils might have deleterious effects on underground utility piping and concrete structures. HDR Engineering, Inc. (HDR) assumes that the samples provided are representative of the most corrosive soils at the site.

The proposed construction consists of a single story classroom building with conventional foundations and slabs-on-grade. The site is located at 1499 San Luis Drive in San Luis Obispo, California. The water table was reportedly not encountered during exploratory borings to a depth of 26 feet.

The scope of this study is limited to a determination of soil corrosivity and general corrosion control recommendations for materials likely to be used for construction. HDR's recommendations do not constitute, and are not meant as a substitute for, design documents for the purpose of construction. If the architects and/or engineers desire more specific information, designs, specifications, or review of design, HDR will be happy to work with them as a separate phase of this project.

Laboratory Soil Corrosivity Tests

The electrical resistivity of each sample was measured in a soil box per ASTM G187 in its as-received condition and again after saturation with distilled water. Resistivities are at about their lowest value when the soil is saturated. The pH of the saturated samples was measured per CTM 643. A 5:1 water:soil extract from each sample was chemically analyzed for the major soluble salts commonly found in soil per ASTM D4327, ASTM D6919, and Standard Method 2320-B[1]. Laboratory analysis was performed under HDR laboratory number 16-0015SCS and the test results are shown in the attached Table 1.

Soil Corrosivity

A major factor in determining soil corrosivity is electrical resistivity. The electrical resistivity of a soil is a measure of its resistance to the flow of electrical current. Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of electrical current (DC) from the metal into the soil. Corrosion currents, following Ohm's Law, are inversely proportional to soil resistivity. Lower electrical resistivities result from higher moisture and soluble salt contents and indicate corrosive soil.

A correlation between electrical resistivity and corrosivity toward ferrous metals is:[2]

Soil Resistivity in ohm-centimeters	Corrosivity Category
Greater than 10,000	Mildly Corrosive
2,001 to 10,000	Moderately Corrosive
1,001 to 2,000	Corrosive
0 to 1,000	Severely Corrosive

Other soil characteristics that may influence corrosivity towards metals are pH, soluble salt content, soil types, aeration, anaerobic conditions, and site drainage.

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[1] *American Public Health Association (APHA). 2012. Standard Methods of Water and Wastewater. 22nd ed. American Public Health Association, American Water Works Association, Water Environment Federation publication. APHA, Washington D.C.*

[2] *Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, pp. 166–167.*

Electrical resistivities were in the moderately corrosive categories with as-received moisture. When saturated, the resistivities were in the corrosive to severely corrosive categories. The resistivities dropped with added moisture because the samples were dry as-received.

Soil pH for both samples was 7.7. This value is in the mildly alkaline[3] range and does not particularly increase soil corrosivity.

The soluble salt content of the samples ranged from low to moderate.

The nitrate concentration was high enough to be aggressive to copper.

Tests were not made for sulfide and negative oxidation-reduction (redox) potential because these samples did not exhibit characteristics typically associated with anaerobic conditions.

This soil is classified as severely corrosive to ferrous metals and aggressive to copper.

Corrosion Control Recommendations

The life of buried materials depends on thickness, strength, loads, construction details, soil moisture, etc., in addition to soil corrosivity, and is, therefore, difficult to predict. Of more practical value are corrosion control methods that will increase the life of materials that would be subject to significant corrosion.

The following recommendations are based on the soil conditions discussed in the Soil Corrosivity section above. Unless otherwise indicated, these recommendations apply to the entire site or alignment.

Steel Pipe

Implement *all* the following measures:

1. Underground steel pipe with rubber gasketed, mechanical, grooved end, or other nonconductive type joints should be bonded for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.

---

[3] *Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, p. 8.*

2. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:

    a. At each end of the pipeline.

    b. At each end of all casings.

    c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.

3. To prevent dissimilar metal corrosion cells and to facilitate the application of cathodic protection, electrically isolate each buried steel pipeline per NACE SP0286 from:

    a. Dissimilar metals.

    b. Dissimilarly coated piping (cement-mortar vs. dielectric).

    c. Above ground steel pipe.

    d. All existing piping.

4. Choose one of the following corrosion control options:

    OPTION 1

    a. Apply a suitable dielectric coating intended for underground use such as:

        i. Polyurethane per AWWA C222 *or*

        ii. Extruded polyethylene per AWWA C215 *or*

        iii. A tape coating system per AWWA C214 *or*

        iv. Hot applied coal tar enamel per AWWA C203 *or*

        v. Fusion bonded epoxy per AWWA C213.

    b. Apply cathodic protection to steel piping as per NACE SP0169.

OPTION 2

a. As an alternative to dielectric coating and cathodic protection, apply a ¾-inch cement mortar coating per AWWA C205 or encase in concrete 3 inches thick, using any type of ASTM C150 cement. Joint bonds, test stations, and insulated joints are still recommended for these alternatives.

NOTE: Some steel piping systems, such as for oil, gas, and high-pressure piping systems, have special corrosion and cathodic protection requirements that must be evaluated for each specific application.

Iron Pipe

Implement *all* the following measures:

1. To prevent dissimilar metal corrosion cells and to facilitate the application of cathodic protection, electrically insulate underground iron pipe from dissimilar metals and from above ground iron pipe with insulating joints per NACE SP0286.
2. Bond all nonconductive type joints for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.
3. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:
    a. At each end of the pipeline.
    b. At each end of any casings.
    c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.
4. Choose one of the following corrosion control options:

    OPTION 1

    a. Apply a suitable coating intended for underground use such as:
        i. Polyethylene encasement per AWWA C105; *or*
        ii. Epoxy coating; *or*

iii. Polyurethane; *or*

iv. Wax tape.

NOTE: The thin factory-applied asphaltic coating applied to ductile iron pipe for transportation and aesthetic purposes does not constitute a corrosion control coating.

b. Apply cathodic protection to cast and ductile iron piping as per NACE SP0169.

OPTION 2

a. As an alternative to coating systems described in Option 1 and cathodic protection, concrete encase all buried portions of metallic piping so that there is a minimum of 3 inches of concrete cover provided over and around surfaces of pipe, fittings, and valves using any type of ASTM C150 cement.

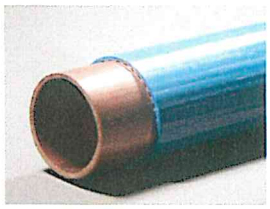
Copper Tubing

Implement *all* the following measures:

1. Electrically insulate underground copper pipe from dissimilar metals and from above ground copper pipe with insulating devices per NACE SP0286.
2. Electrically insulate cold water piping from hot water piping systems.
3. Protect buried copper tubing by one of the following measures:

    a. Prevention of soil contact. Soil contact may be prevented by placing the tubing above ground or encasing the tubing using PVC pipe with solvent-welded joints.

    b. Installation of a factory-coated copper pipe with a minimum 25-mil thickness such as Kamco's Aqua Shield™, Mueller's Streamline Protec™, or equal. The coating must be continuous with no cuts or defects.



    c. Installation of 12-mil polyethylene pipe wrapping tape with butyl rubber mastic over a suitable primer. Protect wrapped copper tubing by applying cathodic protection per NACE SP0169.

Plastic and Vitrified Clay Pipe

1. No special precautions are required for plastic and vitrified clay piping placed underground from a corrosion viewpoint.

2. Protect all metallic fittings and valves with wax tape per AWWA C217 or epoxy.

All Pipe

1. On all pipes, appurtenances, and fittings not protected by cathodic protection, coat bare metal such as valves, bolts, flange joints, joint harnesses, and flexible couplings with wax tape per AWWA C217 after assembly.

2. Where metallic pipelines penetrate concrete structures such as building floors, vault walls, and thrust blocks use plastic sleeves, rubber seals, or other dielectric material to prevent pipe contact with the concrete and reinforcing steel.

Concrete

1. From a corrosion standpoint, any type of ASTM C150 cement may be used for concrete structures and pipe because the sulfate concentration is negligible, 0 to 0.10 percent.[4,5,6]

2. Standard concrete cover over reinforcing steel may be used for concrete structures and pipe in contact with these soils due to the low chloride concentration[7] found onsite.

Closure

The analysis and recommendations presented in this report are based upon data obtained from the laboratory samples. This report does not reflect variations that may occur across the site or due to the modifying effects of construction. If variations appear, HDR should be

---

[4] *2012 International Building Code (IBC) Section 1904.3*

[5] *2012 International Residential Code (IRC) which refers to American Concrete Institute (ACI) 318 Table 19.3.2.1*

[6] *2013 California Building Code (CBC) which refers to American Concrete Institute (ACI) 318 Table 19.3.2.1*

[7] *Design Manual 303: Concrete Cylinder Pipe. Ameron. p.65*

notified immediately so that further evaluation and supplem ental recommendations can be provided.

HDR's services have been performed with the usual thoroughness and com petence of the engineering profession. No other warranty or representation, either expressed or implied, is included or intended.

Please call if you have any questions.

Respectfully Submitted,
HDR Engineering, Inc.

Jose Peña

Brien L. Clark, PE

LICENSED PROFESSIONAL ENGINEER
BRIEN L. CLARK
CH 6291
EXP. 12/31/17
CHEMICAL
STATE OF CALIFORNIA

Enc: Table 1

274257_SCS_Rpt_JP_Rev00_BC.docx

Table 1 - Laboratory Tests on Soil Samples

Earth Systems Pacific
SLO High School - Annex / Classroom Building Project No. 831-3102
Your #SL-16605-SE, HDR Lab #16-0015SCS
5-Jan-16

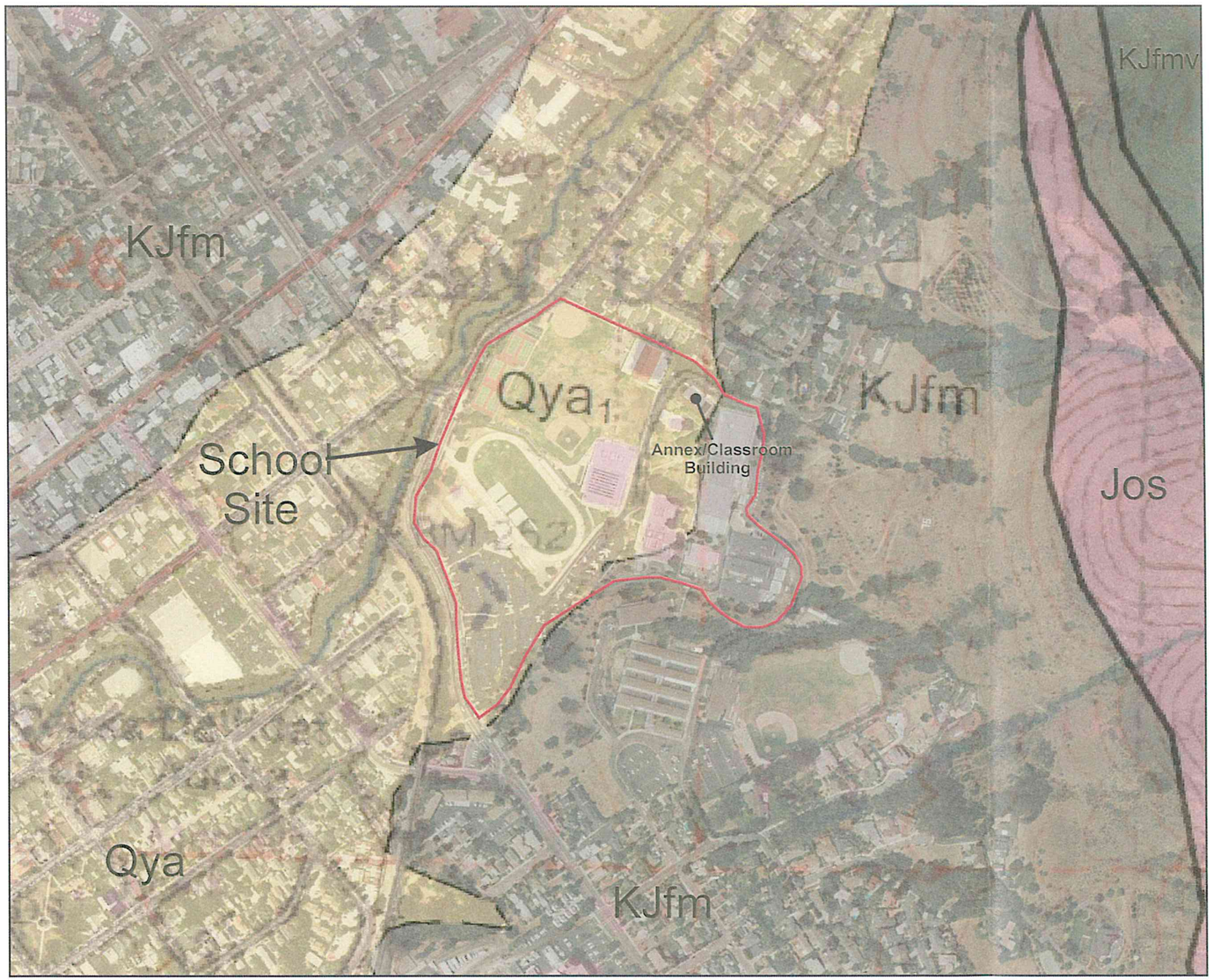
Sample ID			B1 @ 0-3' CL	B2 @ 1-4' CL
Resistivity		**Units**		
as-received		ohm-cm	4,800	6,000
saturated		ohm-cm	1,200	800
pH			7.7	7.7
Electrical Conductivity		mS/cm	0.16	0.24
Chemical Analyses				
Cations				
calcium	Ca^{2+}	mg/kg	61	86
magnesium	Mg^{2+}	mg/kg	ND	ND
sodium	Na^{1+}	mg/kg	77	46
potassium	K^{1+}	mg/kg	7.5	12
Anions				
carbonate	CO_3^{2-}	mg/kg	ND	ND
bicarbonate	HCO_3^{1-}	mg/kg	366	174
fluoride	F^{1-}	mg/kg	4.0	1.9
chloride	Cl^{1-}	mg/kg	11	7.3
sulfate	SO_4^{2-}	mg/kg	60	292
phosphate	PO_4^{3-}	mg/kg	ND	ND
Other Tests				
ammonium	NH_4^{1+}	mg/kg	ND	ND
nitrate	NO_3^{1-}	mg/kg	7.0	127
sulfide	S^{2-}	qual	na	na
Redox		mV	na	na

Electrical conductivity in millisiemens/cm and chemical analysis were made on a 1:5 soil-to-water extract.
mg/kg = milligrams per kilogram (parts per million) of dry soil.
Redox = oxidation-reduction potential in millivolts
ND = not detected
na = not analyzed

431 West Baseline Road · Claremont, CA 91711
Phone: 909.962.5485 · Fax: 909.626.3316

APPENDIX D

Geologic Map
Historical Earthquake/Fault Map
FEMA Flood Zone Map



Extract from: Geologic Map of the San Luis Obispo Quadrangle, San Luis Obispo County, California: by Wiegers, 2010.

EXPLANATION

Geologic Units

Qya
Young Alluvial flood-Plain Deposits

Jos
Serpentinized Ultramafic Rock

KJfm
Franciscan Melange

KJfmv
Franciscan Metavolcanic Rock

Geologic Symbols

Contact
Dashed where approximately located or inferred

High-angle fault
Dashed where approximately located or inferred; dotted where concealed

Thrust or reverse fault
Dashed where approximately located or inferred; dotted where concealed. Saw-teeth on upper plate. Dip of fault plane between 30° and 80°

Anticline
Showing axis at surface. Dashed where approximately located; dotted where concealed

Syncline
Showing axis at surface. Dashed where approximately located; dotted where concealed

Horizontal 30 Inclined 90 Vertical
Strike and dip of beds

N

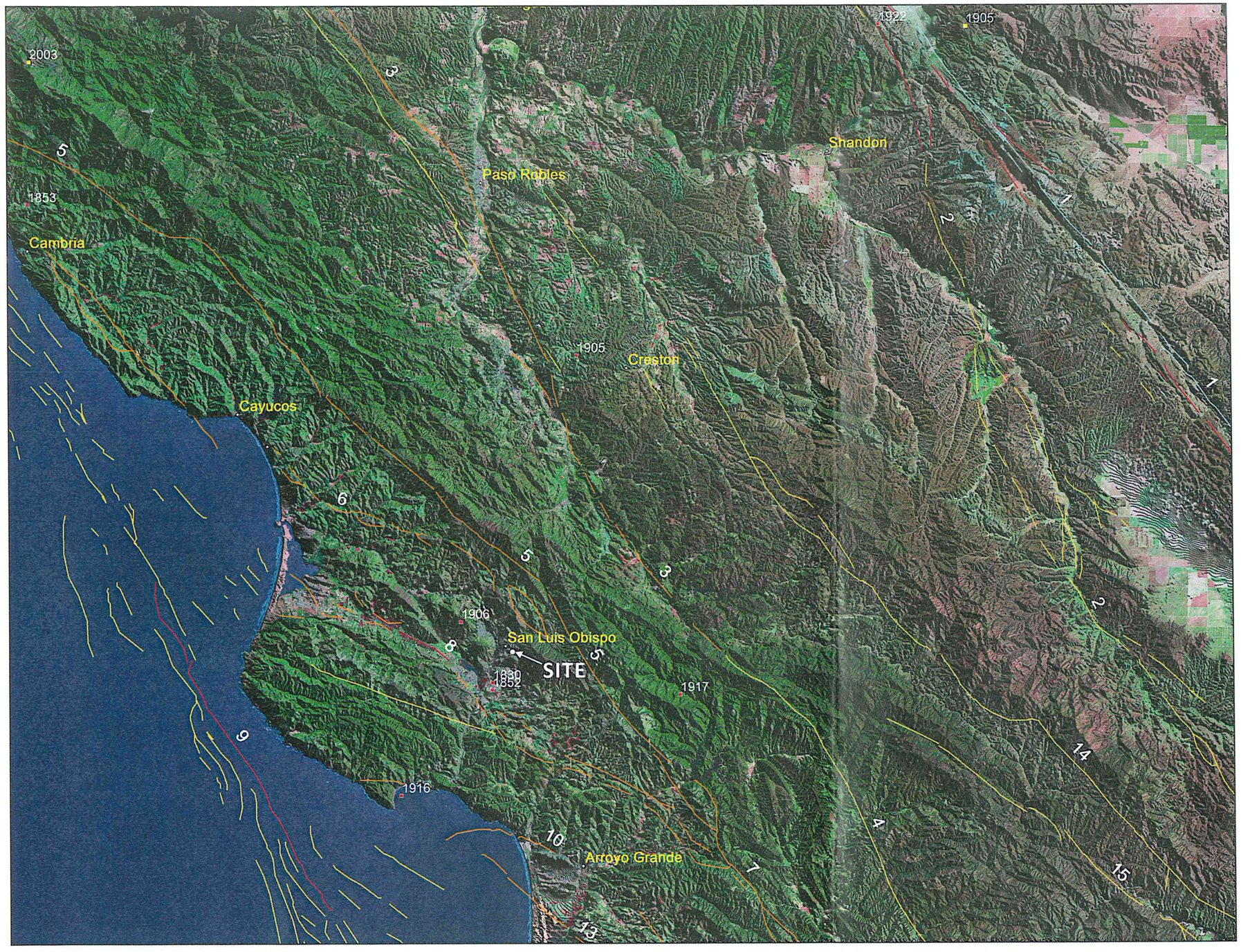
Approx. Scale: 1" = 500'

EARTH SYSTEMS PACIFIC
4378 Old Santa Fe Road, San Luis Obispo, CA 93401
www.earthsystems.com - email: esp@earthsystems.com
(805) 544-3276

GEOLOGIC MAP
SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

Date
January 2016

Project No.
SL-16605-SE



LEGEND

- Historic rupture (<200 years)
- Holocene fault (<10,000 years)
- Late Quaternary (<700,000 years)
- Quaternary fault (<1.6 million)

HISTORICAL EARTHQUAKE MAGNITUDE

5.0 to 5.9 | 6.0 to 6.9 | 7.0 to 7.9

FAULTS

1	San Andreas	11	Casmalia
2	San Juan	12	Lions Head
3	Rinconada	13	Oceano
4	East Huasna	14	La Panza
5	Oceanic	15	South Cuyama
6	Cambria		
7	West Huasna		
8	Los Osos		
9	Hosgri-San Simeon		
10	San Luis Range		

REFERENCES

Blake, T.F., EQSEARCH, 2000, updated 2010
Jennings, C.W. & Bryant, W.A., 2010

N

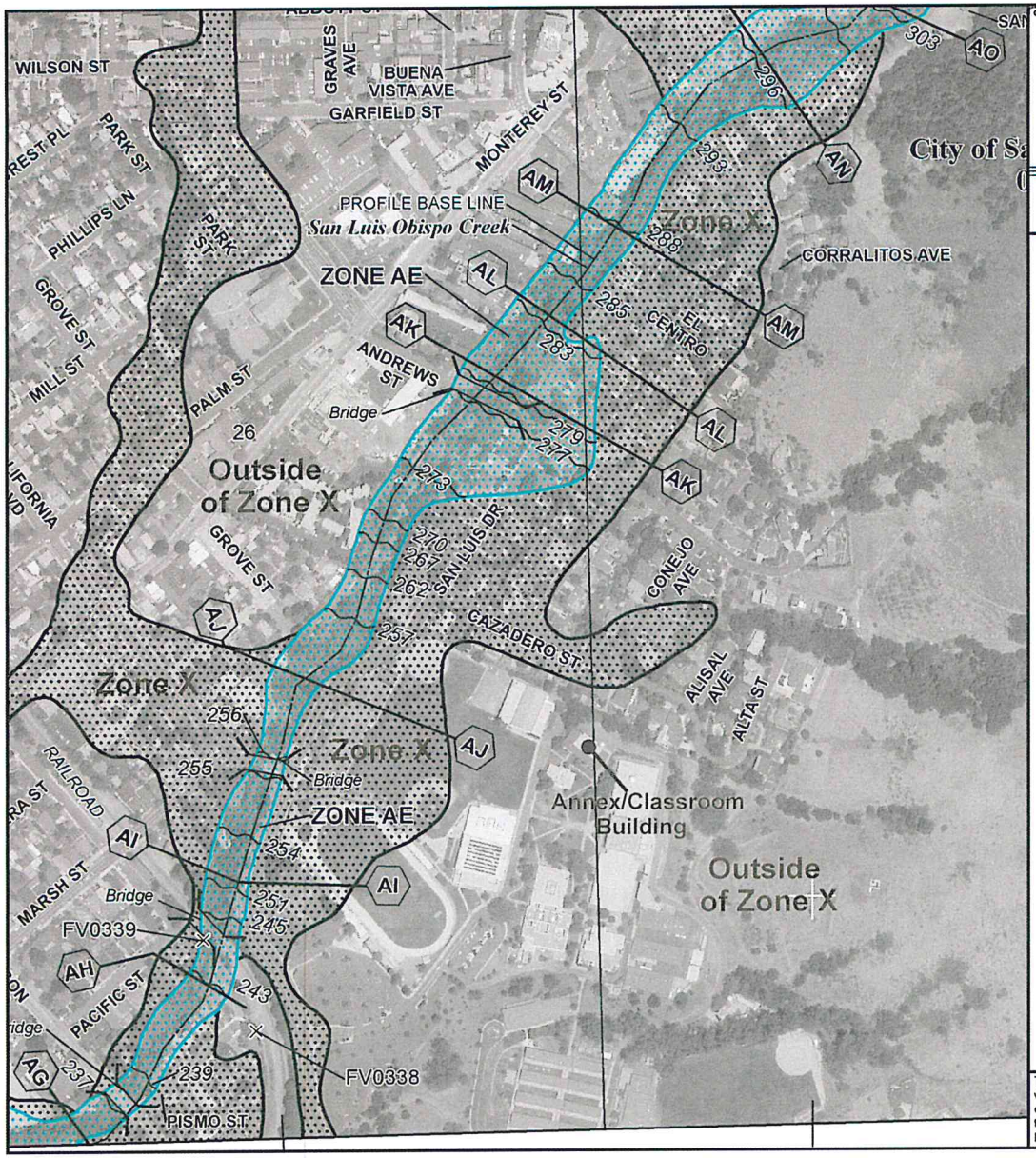
(Approximate Scale: 1" = 6 miles)

EARTH SYSTEMS PACIFIC
4378 Old Santa Fe Road, San Luis Obispo, CA 93401
www.earthsystems.com - email: esp@earthsystems.com
(805) 544-3276

HISTORICAL EARTHQUAKE/ FAULT MAP
SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

Date
January 2016

Project No.
SL-16605-SE



ance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

0 250 500 750 1,000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1067G

FIRM

FLOOD INSURANCE RATE MAP

SAN LUIS OBISPO COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL 1067 OF 2050

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
SAN LUIS OBISPO COUNTY	060304	1067	G
SAN LUIS OBISPO, CITY OF	060310	1067	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER 06079C1067G

MAP REVISED NOVEMBER 16, 2012

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

EARTH SYSTEMS PACIFIC

4378 Old Santa Fe Road, San Luis Obispo, CA 93401
www.earthsystems.com - email: esp@earthsystems.com
(805) 544-3276

FEMA FLOOD ZONE MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

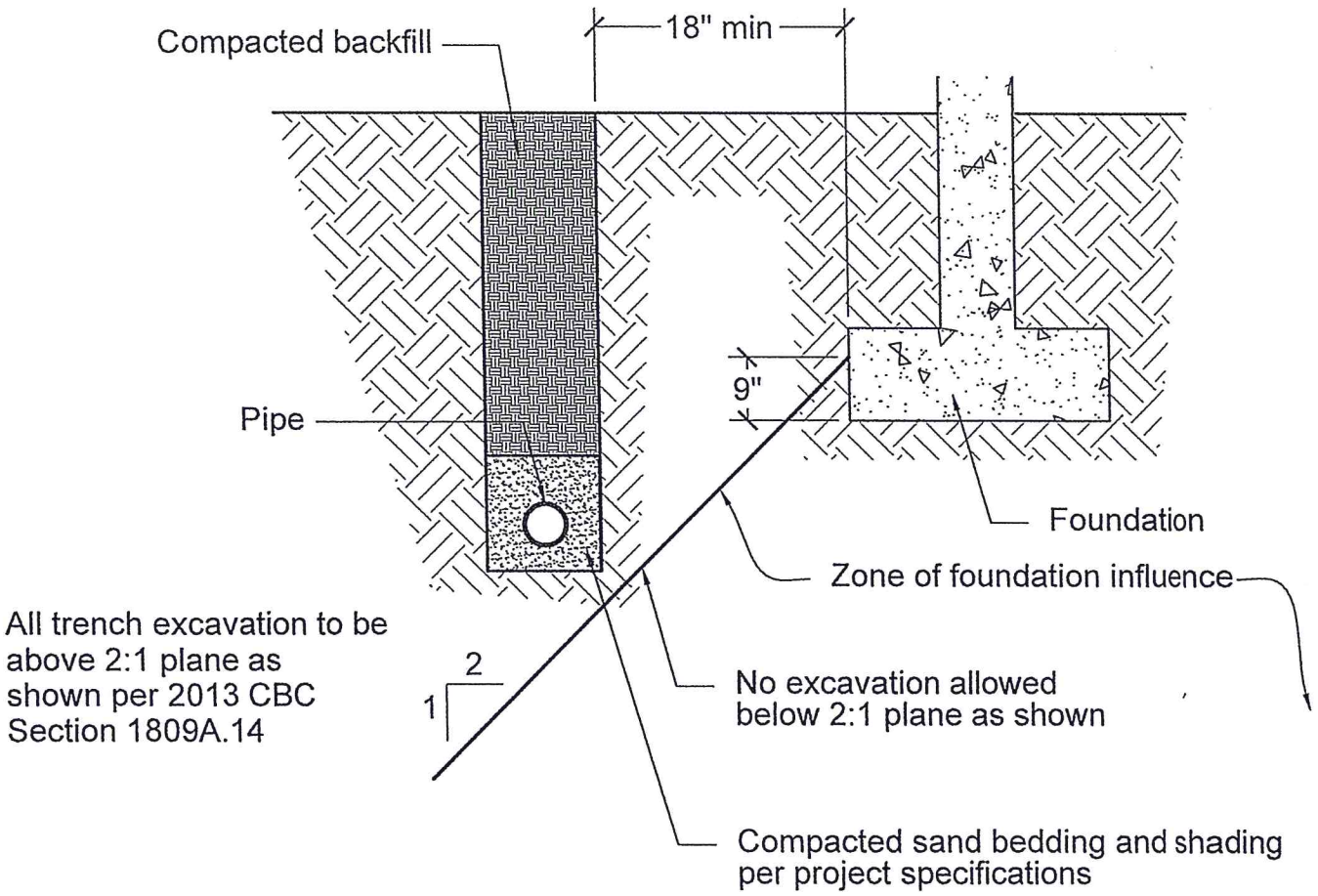
Date
January 2016

Project No.
SL-16605-SE

APPENDIX E

Typical Detail A: Pipe Placed Parallel to Foundations

TYPICAL DETAIL A
PIPE PLACED PARALLEL TO FOUNDATIONS*



SCHEMATIC ONLY
NOT TO SCALE

Earth Systems Pacific

4378 Old Santa Fe Road
San Luis Obispo, CA 93401-8116
(805) 544-3276 • FAX (805) 544-1786
E-mail: esp@earthsys.com

APPENDIX E

Liquefaction Analysis
FEMA Flood Zone Map

Project: SLOHS - Stadium Entrance / Bleachers / Track
Job No: SL-16605-SC
Date: 4/12/2016
Boring: B1 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: **6.79** 7.5
PGA, g: **0.48** 0.37
MSF: 1.29
GWT: **23.0** feet
Calc GWT: **23.0** feet
Remediate to: **3.0** **feet**

SPT N VALUE CORRECTIONS:

Energy Correction to N60 (C_E):	1.25	
Drive Rod Corr. (C_R):	1	Default
Rod Length above ground (feet):	3.0	
Borehole Dia. Corr. (C_B):	1.05	
Sampler Liner Correction for SPT?:	0	No
Cal Mod/ SPT Ratio:	0.63	

Total (ft) Liquefied Thickness	Total (in.) Induced Subsidence
13	3.3

upper 50 ft

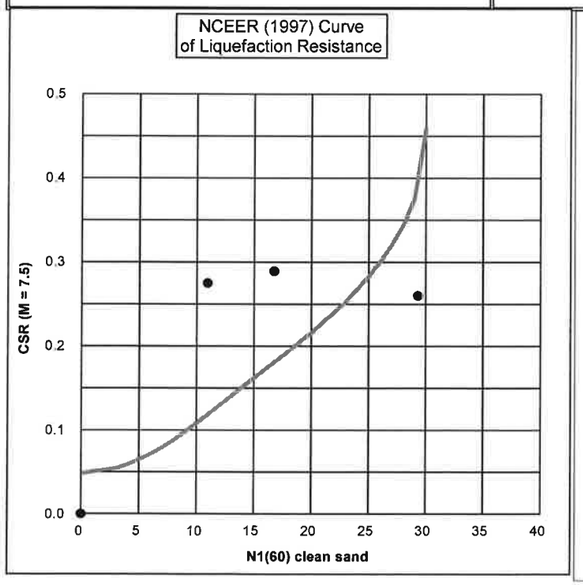
SETTLEMENT (SUBSIDENCE) OF DRY SANDS

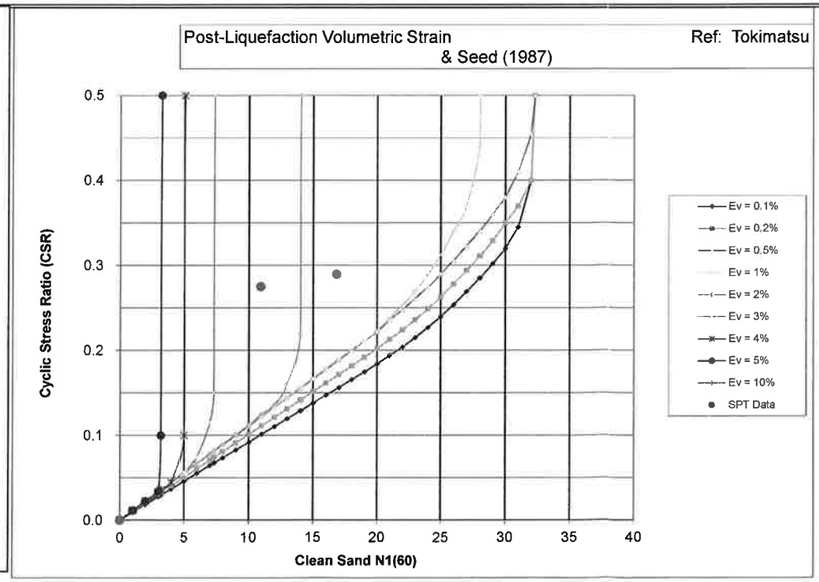
Threshold Acceler., g: **0.21** **Minimum Calculated SF:** **0.43** **Required SF:** **1.30**

Nc = 9.3

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)	Layer Thick (ft)	Tot.Stress at SPT po (tsf)	Depth m	Eff.Stress at SPT p'o (tsf)	Eff.Stress Design GWT 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* $N_{1(60)CS}$	Kσ	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.)**
									0.000																			
2.5	18	**50**	1	119	25	1.5	4.5	2.50	0.089	0.46	0.089	0.089	1.00	1.70	0.75	1.00	83.7	100	10.0	93.7	1.00	1.200	0.241	**Non-Liq.**	10.0	93.7	0.00	**0.00**
4.0	19	**12**	1	115	25	3.5	6.5	1.50	0.206	1.07	0.206	0.206	0.99	1.70	0.75	1.00	20.0	53	6.6	26.6	1.00	0.312	0.240	**Non-Liq.**	6.6	26.6	0.04	**0.01**
9.0	24	**15**		116	85	5.5	8.5	5.00	0.321	1.68	0.321	0.321	0.99	1.00	0.75	1.00	14.9				1.00	Infin.	0.239	**Non-Liq.**		14.9	0.00	**0.00**
15.0		**21**	1	115	25	13.0	16.0	6.00	0.754	3.96	0.754	0.754	0.97	1.18	0.83	1.00	27.0	62	7.4	34.4	1.00	1.200	0.235	**Non-Liq.**	7.4	34.4	0.04	**0.03**
17.5		**21**	1	115	25	15.5	18.5	2.50	0.898	4.72	0.898	0.898	0.97	1.09	0.87	1.00	26.1	61	7.3	33.4	1.00	1.200	0.234	**Non-Liq.**	7.3	33.4	0.04	**0.01**
23.0		**19**	1	115	25	20.5	23.5	5.50	1.185	6.25	1.185	1.185	0.96	0.94	0.94	1.00	22.1	56	6.8	29.0	0.97	0.373	0.239	**Non-Liq.**	6.8	29.0	0.06	**0.04**
27.5		**26**	1	115	5	25.5	28.5	4.50	1.473	7.77	1.395	1.395	0.94	0.87	0.99	1.00	29.4	65	0.0	29.4	0.92	0.392	0.260	**1.50**	0.0	29.4	0.00	**0.00**
34.0		**10**	1	115	5	30.5	33.5	6.50	1.760	9.30	1.526	1.526	0.92	0.83	1.00	1.00	10.9	40	0.0	10.9	0.93	0.118	0.275	**0.43**	0.0	10.9	2.46	**1.92**
40.5		**16**	1	115	5	35.5	38.5	6.50	2.048	10.82	1.658	1.658	0.89	0.80	1.00	1.00	16.8	49	0.0	16.8	0.91	0.181	0.289	**0.63**	0.0	16.8	1.72	**1.34**

p (tsf)	G_{max} (tsf)	τ_{av} (tsf)	Shear Strain γ	Strain E_{15}	Strain Enc	**Dry Sand Subsidence (in.)**
0.060	495	0.028	9.3E-05	1.5E-05	1.2E-05	**0.00**
0.138	495	0.064	3.3E-04	2.4E-04	1.9E-04	**0.01**
0.215						
0.505	1,033	0.228	4.3E-04	2.2E-04	1.8E-04	**0.03**
0.601	1,116	0.270	4.7E-04	2.5E-04	2.0E-04	**0.01**
0.794	1,223	0.353	5.7E-04	3.7E-04	2.9E-04	**0.04**
0.987	1,370	0.431	6.1E-04			
1.179	1,077	0.503	1.4E-03			
1.372	1,340	0.566	9.5E-04			





$N_{1(60)} = C_N*C_E*C_B*C_R*C_S*N$

C_R = 0.75 for Rod lengths < 3m, 1.0 for > 10m
= min(1,max(0.75,1.4666-2.556/(z(ft))$^{0.5}$))

$C_N = (1\ atm/p'o)^{0.5}$, max 1.7

C_S = max(1.1,min(1.3,1+$N_{1(60)}$/100)) for SPT without liners

$MSF = 10^{2.24}/M^{2.56}$

z = Depth (m)

pa = 1 atm = 101 KPa = 1.058 tsf

p = 0.67*po

τ_{av} = 0.65*PGA*po*rd

G_{max} = 447*$N_{1(60)CS}^{(1/3)}$*$p^{0.5}$

a = 0.0389*(p/1)+0.124

b = 6400*$(p/1)^{(-0.5)}$

$\gamma = [1+a*EXP(b*\tau_{av}/G_{max})]/[(1+a)*\tau_{av}/G_{max}]$

$E_{15} = \gamma*(N_{1(60)CS}/20)^{-1.2}$

$E_{nc} = (Nc/15)^{0.45}$*E15

$Nc = (MAG-4)^{2.17}$

S = 2*H*E_{nc}

rd = (1-0.4113*z^0.5+0.04052*z+0.001753*z^1.5)/(1-0.4177*z^0.5+0.05729*z-0.006205*z^1.5+0.00121*z^2))

$\Delta N_{1(60)}$ = min(10,IF(FC<35,exp(1.76-(190/FC^2)),5)+IF(FC<=5,1,IF(FC<35,0.99+(FC^1.5/1000),1.2))*N1(60) - N1(60)

$N_{1(60)CS} = N_{1(60)CS} + \Delta N_{1(60)}$

Kσ = min of 1.0 or $(p'o/1.058)^{(IF(Dr>0.7,0.6,IF(Dr<0.5,0.8,0.7))-1)}$

$Dr = (N_{1(60)}/70)^{0.5}$

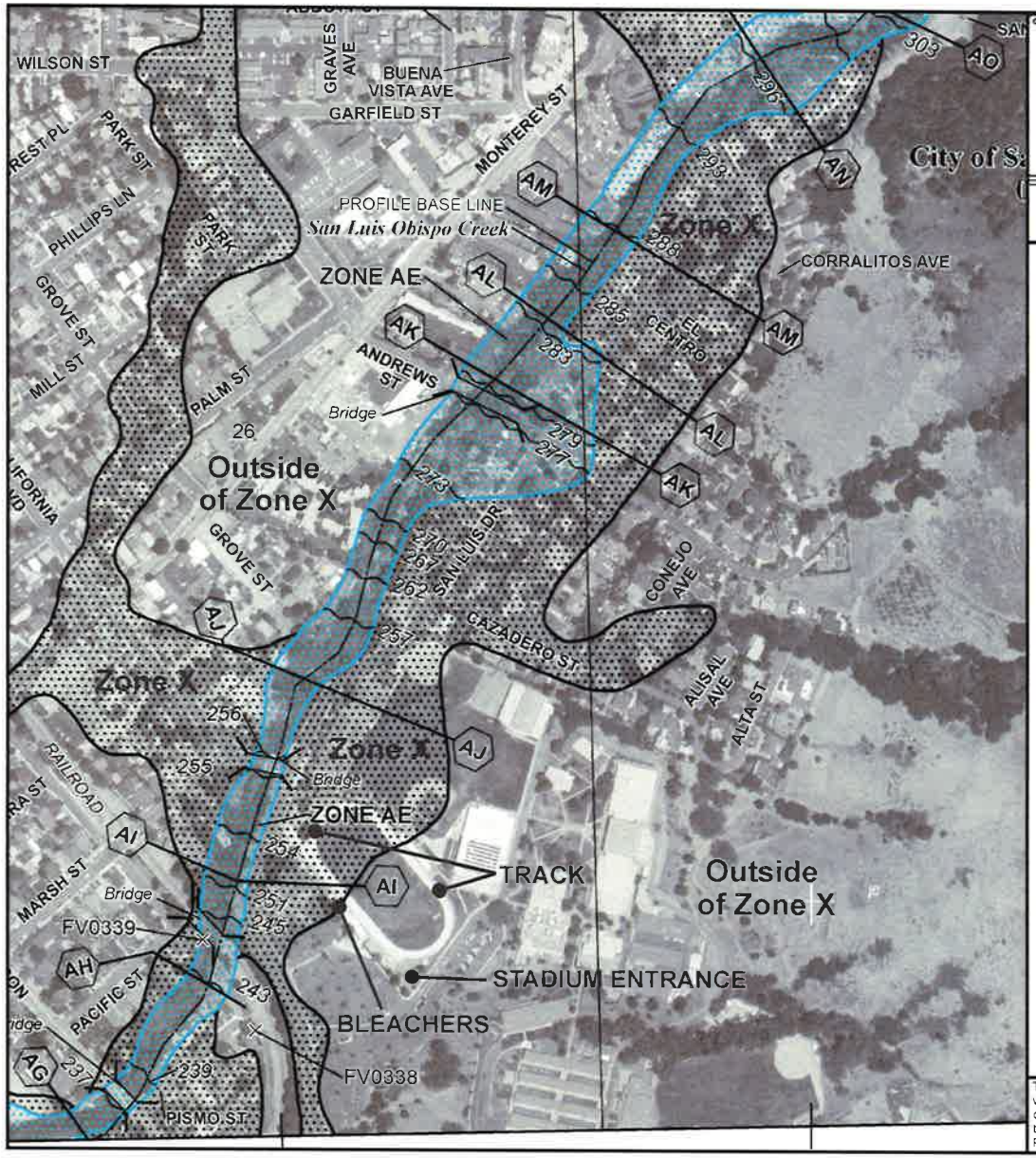
CSReq = 0.65*PGA*(po/p'o)*rd

CSR* = CSReq/MSF/Kσ

$CRR_{7.5}$ = (0.048-0.004721*N+0.0006136*N^2-0.00001673*N^3)/(1-0.1248*N+0.009578*N^2-0.0003285*N^3+0.000003714*N^4))

N = $N_{1(60)CS}$

SF = $CRR_{7.5,1atm}$/CSR*



MAP SCALE 1" = 500'

0 250 500 750 1,000 FEET

NFIP

PANEL 1067G

FIRM

FLOOD INSURANCE RATE MAP

SAN LUIS OBISPO COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL 1067 OF 2050

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
SAN LUIS OBISPO COUNTY	060294	1067	G
SAN LUIS OBISPO, CITY OF	060310	1067	G

NATIONAL FLOOD INSURANCE PROGRAM

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06079C1067G

MAP REVISED
NOVEMBER 16, 2012

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

EARTH SYSTEMS PACIFIC

4378 Old Santa Fe Road, San Luis Obispo, CA 93401
www.earthsystems.com - email: esp@earthsystems.com
(805) 544-3276

FEMA FLOOD ZONE MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 San Luis Drive
San Luis Obispo, California

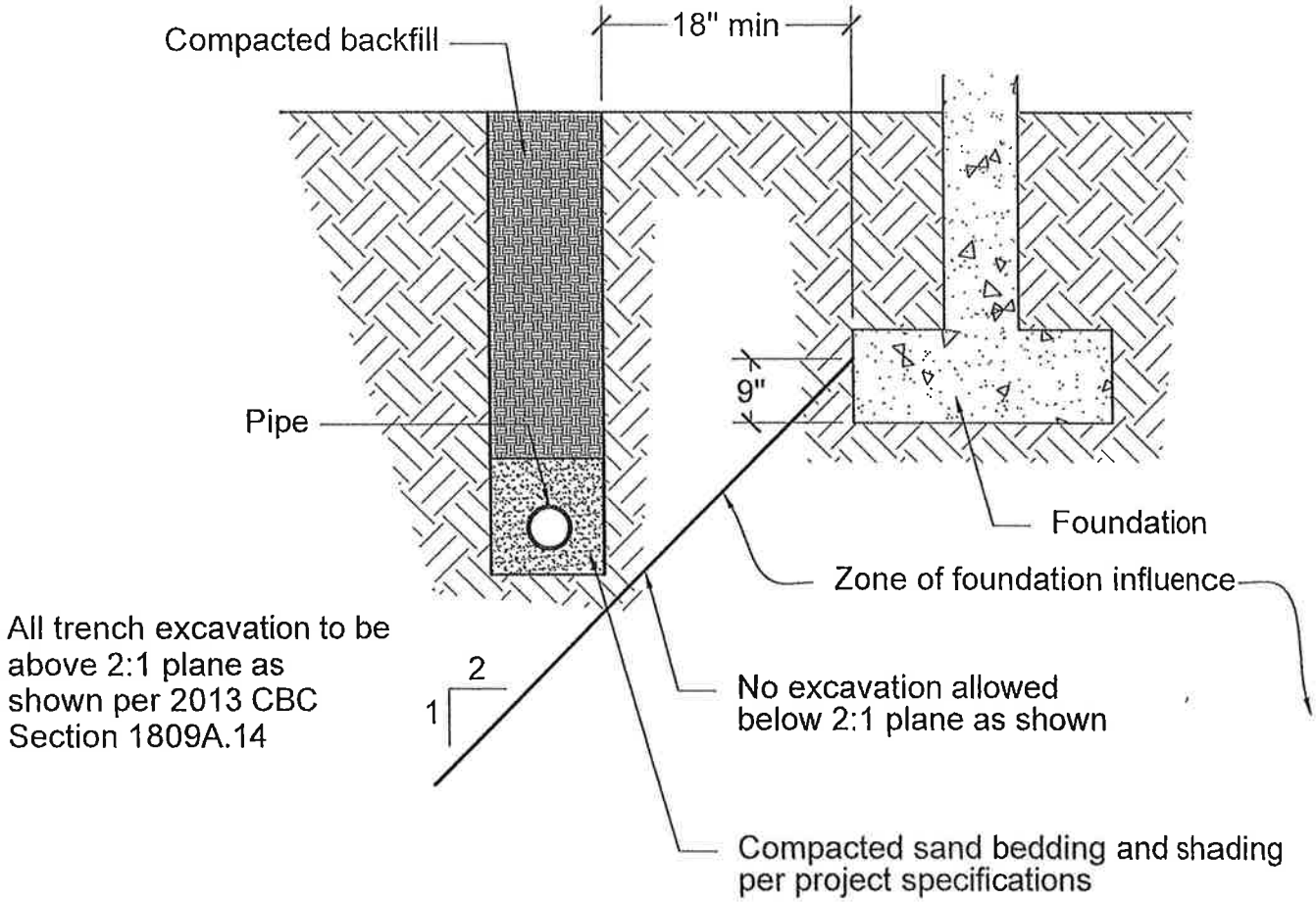
Date
April 2016

Project No.
SL-16605-SC

APPENDIX F

Typical Detail A: Pipe Parallel to Foundations

TYPICAL DETAIL A
PIPE PLACED PARALLEL TO FOUNDATIONS*



SCHEMATIC ONLY
NOT TO SCALE

Earth Systems Pacific

4378 Old Santa Fe Road
San Luis Obispo, CA 93401-8116
(805) 544-3276 • FAX (805) 544-1786
E-mail: esp@earthsys.com

APPENDIX C

Boring Logs (ESP 2016b)

Earth Systems Pacific

Boring No. 1
PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

JOB NO.: SL-16605-SD
DATE: 12/30/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
POOL AND EQUIPMENT/ LOCKER BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3104

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	SC		CLAYEY SAND: dark brown, loose, moist (Topsoil)					
1 - 4	GP		POORLY GRADED GRAVEL: light brown, medium dense, moist (Fill) Gravel to 2" in greatest dimension					
4 - 7	CL		SANDY LEAN CLAY: gray brown to dark brown, stiff, moist, trace fine gravel	5.0 - 6.5	▬	106.6	15.6	5 9 10
7 - 12	SC		CLAYEY SAND WITH GRAVEL: brown, medium dense, moist	10.0 - 11.5	▬	108.9	9.8	7 10 7
13 - 20	CH		SANDY FAT CLAY: dark brown, stiff, moist (Alluvium)	15.0 - 16.5	▬	106.7	20.7	5 11 13
20 - 25			very stiff	20.0 - 21.5	●			5 7 9
25 - 26				25.0 - 26.5	●			5 9 11
26			End of Boring @ 26.5' No subsurface water encountered					

LEGEND: ▬ Ring Sample ◯ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 2

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

PAGE 1 OF 1
JOB NO.: SL-16605-SD
DATE: 12/29/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
POOL AND EQUIPMENT/ LOCKER BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3104

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL		SAND LEAN CLAY: dark brown, stiff, moist (Fill)					
3	SC		CLAYEY SAND WITH GRAVEL: gray brown, medium dense, slightly moist	3.0 - 4.5	Ring	125.5	5.8	10, 18, 18
5				5.0 - 6.5	Ring	125.4	9.6	7, 14, 16
8			moist					
10				10.0 - 11.5	Ring	104.9	15.8	5, 8, 9
14	CH		SANDY FAT CLAY WITH GRAVEL: dark brown, stiff, moist (Alluvium)					
15				15.0 - 16.5	SPT			1, 5, 5
17			End of Boring @ 16.5' No subsurface water encountered					

LEGEND: Ring Sample ◯ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 3

PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

JOB NO.: SL-16605-SD
DATE: 12/30/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
POOL AND EQUIPMENT/ LOCKER BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3104

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	SC		CLAYEY SAND: brown, medium dense, slightly moist	1.0 - 2.5	Ring	116.2	14.4	4, 10, 22
2			gray brown, trace fine to coarse gravel	1.0 - 5.0	Grab			
3				3.0 - 4.5	Ring	123.0	9.5	5, 12, 18
5				5.0 - 6.5	Ring	107.9	15.6	5, 8, 10
6	CL		SANDY LEAN CLAY: dark brown, stiff, moist, trace fine gravel (Fill)					
10	SC		CLAYEY SAND: olive brown, loose, moist	10.0 - 11.5	Ring	95.5	18.7	2, 4, 6
12	CH		SANDY FAT CLAY: brown, stiff, moist (Alluvium)					
15				15.0 - 16.5	SPT			3, 6, 7
17			End of Boring @ 16.5' No subsurface water encountered					

LEGEND: Ring Sample Grab Sample Shelby Tube Sample SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 4

PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

JOB NO.: SL-16605-SD
DATE: 12/30/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
POOL AND EQUIPMENT/ LOCKER BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3104

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL		SANDY LEAN CLAY: gray brown to dark brown, stiff, moist, trace fine gravel (Fill)	1.0 - 2.5	Ring	122.2	7.7	9, 29, 39
2	SC		CLAYEY SAND WITH GRAVEL: brown, dense, slightly moist (Fill)	2.0 - 5.0	Grab			
6	CL		SANDY LEAN CLAY: dark brown, stiff, moist					
8	SC		CLAYEY SAND : brown, medium dense, moist, some fine to coarse gravel					
10	SM		SILTY SAND: olive brown, loose, moist	10.0 - 11.5	Ring	103.4	20.8	4, 3, 4
11	CH		SANDY FAT CLAY: brown, medium stiff, moist (Alluvium)					
15			stiff	15.0 - 16.5	SPT			3, 7, 8
19			gray/ brown mottled					
20				20.0 - 21.5	SPT			5, 7, 9
21			gray/ green, petroleum odor in sample					
24			hydrocarbon visible in sample					
25				25.0 - 26.5	SPT			4, 5, 6
26			End of Boring @ 26.5' No subsurface water encountered					

LEGEND: Ring Sample Grab Sample Shelby Tube Sample SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

APPENDIX D

Second Engineering Geology and Seismology Review for San Luis Obispo High School – Modernization of Buildings 100 and 300 (CGS 2018)

California
Department of
Conservation
California Geological Survey

Office of the State Geologist
801 K Street, MS 12-30
Sacramento, CA 95814

T: (916) 445-1825
F: (916) 445-5718
conservation.ca.gov

Ryan Pinkerton
Assistant Superintendent of Business
San Luis Coastal Unified School District
1500 Lizzie Street
San Luis Obispo, CA 93401

December 6, 2018

Subject: **Second Engineering Geology and Seismology Review for**
San Luis Obispo High School – Modernization of Buildings 100 and 300
1499 San Luis Drive, San Luis Obispo, CA
CGS Application No. 03-CGS3529 **DSA Application No. 03-118913**

Dear Mr. Pinkerton:

In accordance with your request and transmittal of documents on July 12 and November 16, 2018, the California Geological Survey has reviewed the engineering geology and seismology aspects of the consulting report prepared for the proposed developments at San Luis Obispo High School. It is our understanding that this project involves modernization of two buildings, 100 and 300, including the addition of an elevator tower to Building 100. This review was performed in accordance with Title 24, California Code of Regulations, 2016 California Building Code (CBC) and followed CGS Note 48 guidelines. We reviewed the following report:

Additional Assessment of Landslide Hazards Associated with Slopes East of the Site and Response to CGS Review Comments, San Luis Obispo High School Elevator Tower and Modernization of Building 100, 1499 San Luis Drive, San Luis Obispo, California: Earth Systems Pacific, 4378 Old Santa Fe Road, San Luis Obispo, CA 93401; company File No. 300933-005, report dated November 16, 2018, 5 pages plus attachments.

Landslide Analysis Correspondence CGS and Earth Systems Oct-Nov 2018: document including email correspondence between Darrin Hasham (PG, CEG, Earth Systems) and Judith Zachariasen (PG, California Geological Survey), with attachments documenting shear test data used in landslide analysis, dated December 6, 2018.

In addition, we previously reviewed the following reports:

Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School, Building 100 Elevator Tower, 1499 San Luis Drive, San Luis Obispo, California: Earth Systems Pacific, 4378 Old Santa Fe Road, San Luis Obispo, CA 93401; company File No. 300933-005, report dated March 21, 2018, 21 pages, 5 appendices.

Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School, Measure D Projects, Annex/Classroom Building, 1499 San Luis Drive, San Luis Obispo, California, Project No. 831-3102: Earth Systems Pacific, 4378 Old Santa Fe Road, San Luis Obispo, CA 93401; company File No. SL-16605-SE, Doc. No. 1601-059.SGR, report dated January 19, 2016, 31 pages, 5 appendices; with addenda dated April 18, 2016 and March 29, 2017; included as Appendix B in the above cited report.

The CGS previously reviewed and submitted our findings regarding this project in our review letter dated September 18, 2018, in which we requested that the consultants further address the landslide hazard posed to the school by the hills east of the project site. In addition, we requested that the consultants address the site conditions at Building 300, which was included in the site data report as part of the project, but which was not addressed in the July 20, 2018, report. The consultants have responded and addressed the concerns raised in the initial review, which are discussed below.

Landslide Hazard

In their original report, the consultants reported that there was no landslide hazard associated with slope failure of the site. However, they did not address the hazard associated with failure of slopes east of the site, which could potentially deposit landslide debris at the site. The site lies at the foot of a slope underlain by Franciscan Formation rocks in a zone designated to have a high potential for landslide hazard in the city and county safety elements. In response to our request, the consultants have reviewed published mapping, undertaken additional reconnaissance geologic mapping of the slope east of the site, and carried out a screening-level slope stability analysis. They identified three distinct lithologic units underlying the slope: serpentinite, graywacke, and residual soil/colluvium. They have provided rock strength parameters from field assessments of outcrop characteristics for the graywacke and serpentinite using Hoek-Brown criteria, which is acceptable. Soil strength parameters for the residual soil were estimated from measured shear test data from similar materials in the region; these data were not included in the November 16, 2018, report but were provided by the consultants in a follow-up email, compiled in the correspondence document listed above. The strength parameters selected by the consultants appear reasonable based on the data provided.

The consultants performed a slope stability analysis using commercially available software and a geologic cross-section developed based on their field reconnaissance mapping. They used a seismic coefficient of 0.45, which is conservative for the site. They have not provided a great deal of explanation of their model, but their results indicate that the factor of safety against failure under static conditions is about 3 for the residual soil and about 6 for the bedrock. The factor of safety under dynamic (seismic) loading is about 1.4, which exceeds CGS's recommended value of 1.15.

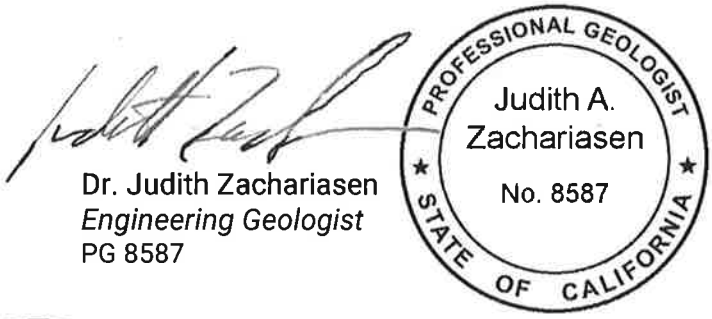
CGS notes that the analysis was carried out assuming unsaturated conditions. The consultants have reported, in email communication, that the graywacke is not water bearing. An earthquake occurring when the residual soil is saturated could decrease the factor of safety relative to that of unsaturated conditions. However, the model as developed appears adequately conservative. Therefore, CGS accepts **the consultants' conclusion that the slope east of the site is stable and does not pose a significant risk of landsliding**, and we do not request additional information.

Building 300

In our review letter dated September 18, 2018, we noted that the geohazard assessment was not adequate for the proposed improvements at Building 300, which were included as part of the project in the site data report but were not assessed in the consultants' March 21 report. In their response letter, the consultants state that the improvements at Building 300 consist of a storage room not intended for student occupancy and are thus exempt from review. CGS does not determine which projects are exempt from review; that is the purview of the Division of the State Architect. Consequently, we emphasize that **our review does not extend to the improvements at Building 300** and that any assessment of the geologic hazards for that site is not adequate per Note 48.

In conclusion, ***the engineering geology and seismology issues at this site are adequately assessed in the referenced reports for Building 100 improvements only, and no further information is requested***. If you have any further questions about this review letter, please contact the primary reviewer at judith.zachariasen@conservation.ca.gov.

Respectfully submitted,



Dr. Judith Zachariasen
Engineering Geologist
PG 8587

Concur:



Jennifer Thornburg
Senior Engineering Geologist
PG 5476, CEG 2240

Copies to:

Richard Gorman, *Certified Engineering Geologist* and Frederick Potthast, *Registered Geotechnical Engineer*
Earth Systems Pacific, 4378 Old Santa Fe Road, San Luis Obispo, CA 93401

William Graeber, *Architect*
RRM Design Group, 3765 Higuera Street, Suite 102, San Luis Obispo, CA, 93401

Ted Beckwith, *Senior Structural Engineer*
Division of State Architect, 355 South Grand Avenue, Suite 2100, Los Angeles, CA 90071

APPENDIX E

Site Specific Ground Motion Hazards Analyses – Tables 1 and 2

Table 1
Fault Parameters

Fault Section Name	Distance (miles)	Distance (km)	Upper Seis. Depth (km)	Lower Seis. Depth (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)
Oceanic-West Huasna	2.6	4.1	0.0	7.0	58	49	na	122	B'	**7.1**		
Los Osos	3.2	5.1	0.0	10.0	45	208	90	44	B	**6.9**		0.5
Rinconada	6.1	9.9	0.0	10.0	90	233	180	191	B	**7.5**		1
San Luis Range (So Margin)	8.7	14.0	0.0	10.0	45	37	90	64	B	**7.1**		0.2
Hosgri	16.1	25.9	0.0	6.8	80	59	180	171	B	**7.3**		2.5
Casmalia (Orcutt Frontal)	24.2	38.9	0.0	10.0	75	206	90	29	B	**6.6**		0.25
San Juan	28.1	45.3	0.0	13.0	90	243	180	68	B	**7.1**		1
Lions Head	28.8	46.3	0.0	10.0	75	29	90	41	B	**6.7**		0.02
Hosgri (Extension)	30.1	48.4	0.0	7.5	80	79	na	29	B'	**6.4**		
San Andreas (Cholame) rev	36.1	58.2	0.0	12.0	90	51	180	63	A	**7.5**	63	34
South Cuyama	37.5	60.3	0.0	5.6	33	210	na	48	B'	**6.8**		
San Andreas (Parkfield)	37.9	61.0	0.0	10.2	90	50	180	36	A	**6.4**	13	34
Los Alamos-West Baseline	40.8	65.7	0.0	10.0	30	211	90	28	B	**6.8**		0.7
Morales (West)	42.0	67.7	0.0	8.6	32	49	na	28	B'	**6.8**		
San Andreas (Carrizo) rev	44.3	71.3	0.0	15.1	90	224	180	59	A	**7.8**	106	34
San Andreas (Creeping Segment)	49.9	80.2	0.0	12.0	90	227	180	122	A	**7.2**	69	34
Lost Hills	54.4	87.5	4.2	12.0	29	233	na	33	B'	**6.8**		
Santa Ynez (West)	56.7	91.3	0.0	9.2	70	182	0	63	B	**6.9**		2
Morales (East)	59.0	94.9	0.0	8.6	32	14	na	18	B'	**6.6**		
Great Valley 14 (Kettleman Hills)	64.4	103.7	8.1	22.5	22	215	90	24	B	**7.1**		1.5
Red Mountain	65.7	105.7	0.0	14.1	56	2	90	101	B	**7.4**		2
Great Valley 13 (Coalinga)	67.0	107.8	9.1	15.2	15	226	90	32	B	**7.0**		1.5
Big Pine (West)	71.9	115.7	0.0	11.0	50	2	na	18	B'	**6.5**		
Mission Ridge-Arroyo Parida-Santa Ana	72.8	117.1	0.0	7.6	70	176	90	69	B	**6.8**		0.4
North Channel	73.8	118.7	1.1	4.5	26	10	90	51	B	**6.7**		1
San Andreas (Big Bend)	74.3	119.6	0.0	15.1	90	198	180	50	A	**7.8**	108	34
Pitas Point (Upper)	74.4	119.8	1.4	10.0	42	15	90	35	B	**6.8**		1
Great Valley 12	74.9	120.5	7.0	9.6	15	243	90	17	B	**6.3**		1.5
Pitas Point (Lower, West)	77.2	124.3	1.5	8.8	13	3	90	35	B	**7.2**		2.5
Oak Ridge (Offshore), west extension	77.3	124.4	0.0	3.1	67	195	na	28	B'	**6.1**		
Channel Islands Western Deep Ramp	77.8	125.3	4.8	12.5	21	204	90	62	B'	**7.3**		
Santa Ynez (East)	79.0	127.1	0.0	13.3	70	172	0	68	B	**7.2**		2
Pleito	80.1	128.9	0.0	13.6	46	181	90	44	B	**7.1**		2
Pine Mtn	81.4	130.9	0.0	16.3	45	5	na	62	B'	**7.3**		
Great Valley 11	84.4	135.9	7.0	9.6	15	221	90	24	B	**6.5**		1.5
Big Pine (Central)	84.7	136.3	0.0	6.6	76	167	na	23	B'	**6.3**		
Santa Rosa Island	87.6	141.0	0.0	8.7	90	1	30	58	B	**6.8**		1
Big Pine (East)	88.5	142.4	0.0	14.3	73	338	na	23	B'	**6.6**		
Monterey Bay-Tularcitos	89.5	144.0	0.0	14.0	90	49	150	83	B	**7.3**		0.5
Oak Ridge (Offshore)	90.1	145.0	0.0	7.9	32	180	90	38	B	**6.9**		3

Reference: USGS OFR 2007-1437 (CGS SP 203)

Based on Site Coordinates of 35.2835 Latitude, -120.6512 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.

Table 2 - Spectral Response Values
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 year MCE Spectrum (1) 2475-year (ASCE 21.2.1)	Probab. 1% collapse in 50 year MCEr Spectrum (2) 2475-year **(ASCE 21.2.1.2)**	Max 84th Percentile Determ. MCE Spectrum (3) - (ASCE 21.2.2)	Determ. Lower Limit MCE Spectrum (4) - (ASCE 21.2.2)	Determ. MCE Spectrum (5) - (ASCE 21.2.2)	Site Specific MCE Ground Response (6) Min (2),(5) (ASCE 21.2.3)	Site Specific MCE Spectrum Comparator (6b) Max (6),1.5*(8) (ASCE 21.2.3)	2019 CBC MCE Spectrum (7)	Site Specific Design Spectrum (8) (ASCE 21.3)	2019 CBC Design Spectrum (9) 2/3*(7)
0.00	0.481	0.381	-	-	-	0.381	0.381	0.461	0.254	0.307
0.05	0.774	0.603	-	-	-	0.603	0.603	0.661	0.402	0.441
0.10	1.067	0.824	-	-	-	0.824	0.824	0.861	0.549	0.574
0.15	1.095	0.858	-	-	-	0.858	0.858	1.062	0.572	0.708
0.20	1.122	0.891	-	-	-	0.891	0.921	1.152	0.614	0.768
0.30	0.928	0.750	-	-	-	0.750	0.921	1.152	0.614	0.768
0.40	0.794	0.651	-	-	-	0.651	0.921	1.152	0.614	0.768
0.50	0.661	0.551	-	-	-	0.551	0.921	1.152	0.614	0.768
0.75	0.505	0.398	-	-	-	0.398	0.921	1.152	0.614	0.768
1.00	0.348	0.299	-	-	-	0.299	0.794	0.993	0.529	0.662
1.50	0.255	0.220	-	-	-	0.220	0.529	0.662	0.353	0.441
2.00	0.161	0.140	-	-	-	0.140	0.397	0.496	0.265	0.331
3.00	0.103	0.090	-	-	-	0.090	0.265	0.331	0.176	0.221
4.00	0.076	0.066	-	-	-	0.066	0.199	0.248	0.132	0.165
5.00	0.061	0.053	-	-	-	0.053	0.159	0.199	0.106	0.132
8.00	0.051	0.000	-	-	-	-	-	-	-	-
10.00	0.050	0.000	-	-	-	-	-	-	-	-

C_{RS}:	0.898		*Deterministic MCE not considered due to Exception in 21.2.2 ASCE 7-16.*
C_{R1}:	0.901		
Site Specific To:	0.172	$= 0.2*S_{D1}/S_{DS}$	
Site Specific Ts:	0.862	$= S_{D1}/S_{DS}$	

Probabilistic Spectrum from 2014 USGS Ground Motion Mapping Program adjusted for site conditions and maximum rotated component of ground motion using NGA, Column 2 has risk coefficients C_R applied.

Reference: ASCE 7-16, Chapters 21.2, 21.3, 21.4, 11.4, and 11.8

Site Coefficients	
F_{PGA}	1.12
F_a	1.07
F_v	2.50

Mapped MCE Acceleration Values		
PGA	0.478	g
S_S	1.077	g
S_1	0.397	g

Short-Period Seismic Design Category:	1-Second Period Seismic Design Category:
D	D

Site-Specific Design Acceleration Values		
PGA_M	**0.481**	**g**
S_{DS}	**0.614**	**g**
S_{D1}	**0.529**	**g**

Vertical Coefficient (C_V)
1.32

Site-Specific MCE_R, 5% damped, Spectral Response Acceleration Parameter		
S_{MS}	**0.921**	**g**
S_{M1}	**0.794**	**g**

1 g = 980.6 cm/sec^2 =32.2 ft/sec^2
PSV (ft/sec) = $32.2(S_a)T/(2p)$

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

APPENDIX F

Tremie Method

RECOMMENDED PROCEDURE FOR TREMIE PLACEMENT OF CONCRETE IN CAISSON CONSTRUCTION

The following are general guidelines only and may be subject to modification by the architect/engineer and/or geotechnical engineer.

1. Concrete should be placed in caisson excavations by means of a tremie pipe when the depth of water in the excavation cannot be limited to a maximum of 3 inches, and/or inflow less than 1-inch in 5 minutes, per FHWA, or when the freefall of the concrete would result in the concrete striking the rebar or excavation walls as it falls.
2. The concrete should be pumped to the tremie pipe. Alternately, a hopper with a tremie pipe attached should be used if approved by the architect/engineer. An "elephant's trunk" should not be used to place concrete under water; however, an elephant's trunk may be used to direct the fall of the concrete in dry excavations. The elephant's trunk should be of sufficient length to prevent the concrete from striking the rebar or excavation walls as it falls.
3. Concrete for dry excavations should be designed for, and placed at, a slump of 6 to 8 inches. Concrete to be placed below water should be designed and placed as a "flowable" mix with a minimum slump of 8 to 10 inches or should be designed and placed as "self-consolidating concrete." Suitability of high slump (>8 inches) concrete should be verified by slump flow, slump flow velocity and visual stability testing.
4. The tremie pipe should consist of rigid steel pipe segments with waterproof joints. Gravity tremie pipes should be 6 inches in diameter or at least 6 times the maximum concrete aggregate size (whichever is greater) and should be longer than the deepest caisson excavation. Pressurized tremie systems (pump lines) may be smaller than 6 inches to accommodate rebar spacing or other factors.
5. The tremie pipe should be lowered with caution through the center of the reinforcing to within 1-foot of the bottom of the excavation; however, the tremie pipe should not be allowed to penetrate into the muck on the bottom of the hole.
6. The pump hose and tremie pipe should be "slicked" with Portland cement slurry. No clay, bentonite, or other material should be used unless approved by the architect/engineer and geotechnical engineer.
7. Pumping of the concrete should begin immediately after the reinforcing and the tremie pipe have been placed in the excavation and the excavation and reinforcing have been inspected. The tremie pipe should not be raised until the concrete surface in the caisson excavation is at least 5 feet above the bottom of the tremie pipe. The bottom of the tremie pipe should then be kept at least 5 feet below the top of the concrete until the pour is completed.
8. The concrete should be pumped until all muck, laitance, and unsuitable concrete has been lifted above the top-of-caisson elevation. All muck, laitance, and unsuitable concrete should be immediately removed from the excavation.
9. Self-consolidating concrete need *not* be vibrated during the pour, unless directed by the architect/engineer. For other than self-consolidating concrete, vibration should *not* be started until the concrete pour is completed and the muck, laitance and unsuitable concrete have been removed. Then, only the upper 5 to 10 feet of the concrete should be vibrated. Additional concrete may be added as necessary during vibration. The vibrator should not be allowed to contact the reinforcing.
10. During the pour, if the tremie pipe has to be removed from the concrete, (e.g., to allow removal of casing), it should be reset at the top of the concrete. The tremie should then be purged as directed by the inspector, and then immediately lowered to at least 5 feet below the top of the concrete as the concrete is being pumped. All degraded concrete should be lifted with the continuing pour and removed from the top of the caisson.
11. For a more thorough and in-depth discussion and recommendations on this topic, please refer to "Guide to Tremie Concrete for Deep Foundations" by the Joint EFFC/DFI Concrete Task Group (Second Edition – 2018) available at http://www.dfi.org/VIEWPUB.ASP?tid=CPF-2015-DRSH-1.
12. Unless unavoidable due to equipment or supply breakdown, all caisson excavations should be filled with concrete on the same day they are drilled.

APPENDIX D

Table D-1 – Fault Parameters

Table D-2 – Historical Earthquakes in Vicinity of Project Site

Table D-1
Fault Parameters

Fault Section Name	Distance (miles)	Distance (km)	Upper Seis. Depth (km)	Lower Seis. Depth (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)
Oceanic-West Huasna FM3.1, 3.2	2.5	4.0	0.0	7.0	58	49	na	122	B'	**7.1**		
Los Osos 2011 CFM FM3.1, 3.2	3.3	5.3	0.0	12.0	45	208	90	58	B	**6.9**		0.5
Rinconada 2011 CFM FM3.1, 3.2	7.9	12.8	0.0	8.5	82	233	180	123	B	**7.5**		1
San Luis Bay 2011 CFM FM3.2	8.6	13.8	0.0	10.0	90	na	na	16	B'	**6.3**		
San Luis Range 2011 CFM, FM3.1	8.7	14.0	0.0	12.0	52	na	na	79	B'	**7.2**		
San Luis Range (So Margin) FM3.2	8.8	14.1	0.0	12.0	45	37	90	115	B	**7.1**		0.2
East Huasna 2011 CFM FM3.1, 3.2	9.0	14.5	0.0	15.0	90	na	na	74	B'	**7.2**		
Shoreline FM3.1, 3.2	11.2	18.0	0.0	12.0	90	na	na	23	B'	**6.5**		
San Luis Range - Oceano 2011 CFM, FM3.1	11.3	18.2	0.0	12.0	45	na	na	21	B'	**6.6**		
San Luis Range - Pecho FM3.1, 3.2	13.3	21.4	0.0	12.0	90	na	na	26	B'	**6.6**		
La Panza FM3.1, 3.2	14.6	23.6	0.0	13.9	51	45	na	72	B'	**7.3**		
Hosgri FM3.1, 3.2	16.2	26.0	0.0	6.8	80	59	180	171	B	**7.3**		2.5
South Cuyama FM3.1, 3.2	17.3	27.8	0.0	13.9	33	210	na	83	B'	**7.5**		
Casmalia 2011 CFM	21.7	34.9	0.0	12.0	75	na	na	48	B'	**6.9**		
Lions Head 2011 CFM FM3.1, 3.2	27.7	44.6	0.0	12.0	75	29	90	65	B	**6.7**		0.02
San Juan FM3.1, 3.2	28.1	45.2	0.0	13.0	90	243	180	82	B	**7.1**		1
Hosgri (Extension) FM3.1, 3.2	30.2	48.5	0.0	7.5	80	79	na	29	B'	**6.4**		
San Andreas (Cholame) rev FM3.1, 3.2	36.1	58.1	0.0	12.0	90	51	180	63	A	**6.8**	89	3.5
San Andreas (Parkfield) FM3.1, 3.2	37.8	60.9	0.0	10.2	90	50	180	36	A	**6.4**	13	20
Los Alamos 2011 CFM FM3.1, 3.2	40.5	65.2	0.0	12.0	30	na	na	27	B'	**6.9**		
Morales (West) FM3.1, 3.2	42.0	67.6	0.0	8.6	32	49	na	28	B'	**6.8**		
Santa Ynez River FM3.1, 3.2	43.5	69.9	0.0	12.0	70	na	na	73	B'	**7.1**		
San Andreas (Carrizo) rev FM3.1, 3.2	44.3	71.2	0.0	15.1	90	224	180	59	A	**6.8**	89	3.5
San Andreas (Creeping Section) FM3.1, 3.2	49.8	80.2	0.0	12.0	90	227	180	121	A	**6.8**	89	9
Santa Ynez (West) FM3.1, 3.2	54.1	87.1	0.0	9.2	70	182	0	80	B	**6.9**		2
Lost Hills FM3.1, 3.2	54.3	87.4	4.2	12.0	29	233	na	33	B'	**6.8**		
Los Alamos extension FM3.1, 3.2	54.7	88.1	0.0	12.0	30	na	na	22	B'	**6.8**		
Morales (East) FM3.1, 3.2	59.0	94.9	0.0	8.6	32	14	na	18	B'	**6.6**		
Ozena FM3.1, 3.2	60.0	96.6	0.0	13.9	33	na	na	41	B'	**7.2**		
Great Valley 14 (Kettleman Hills) FM3.1, 3.2	64.4	103.6	8.1	22.5	22	215	90	24	B	**7.1**		1.5
Red Mountain FM3.1, 3.2	65.8	105.8	0.0	14.1	56	2	90	101	B	**7.4**		2
Great Valley 13 (Coalinga) FM3.1, 3.2	66.9	107.7	9.1	15.2	15	226	90	32	B	**7.0**		1.5
Big Pine (West) FM3.1, 3.2	71.9	115.8	0.0	11.0	50	2	na	18	B'	**6.5**		
Reliz 2011 CFM FM3.1, 3.2	72.1	116.1	0.0	10.9	58	240	na	127	B'	**7.4**		
Mission Ridge-Arroyo Parida-Santa Ana FM3.1, 3	72.8	117.2	0.0	7.6	70	176	90	69	B	**6.8**		0.4
North Channel FM3.2	73.8	118.8	1.1	4.5	26	10	90	51	B	**6.7**		1
San Andreas (Big Bend) FM3.1, 3.2	74.3	119.6	0.0	15.1	90	198	180	50	A	**6.8**	89	3.5
Pitas Point (Upper) FM3.2	74.5	119.9	1.4	10.0	42	15	90	35	B	**6.8**		1
Great Valley 12 FM3.1, 3.2	74.8	120.4	7.0	9.6	15	243	90	17	B	**6.3**		1.5
Pitas Point (Lower, West), FM 3.1	77.3	124.4	1.5	8.8	13	3	90	35	B	**7.2**		2.5

Reference: USGS OFR 2013-1165 (CGS SP 228) Based on Site Coordinates of 35.2846 Latitude, -120.6507 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 2008-1437). Mean magnitude is average of Ellworths-B and Hanks & Bakun moment area relationship.

Site Coordinates: 35.285 N 120.651 W

Table D-2
Historical Earthquakes in Vicinity of Project Site, M >= 5.0

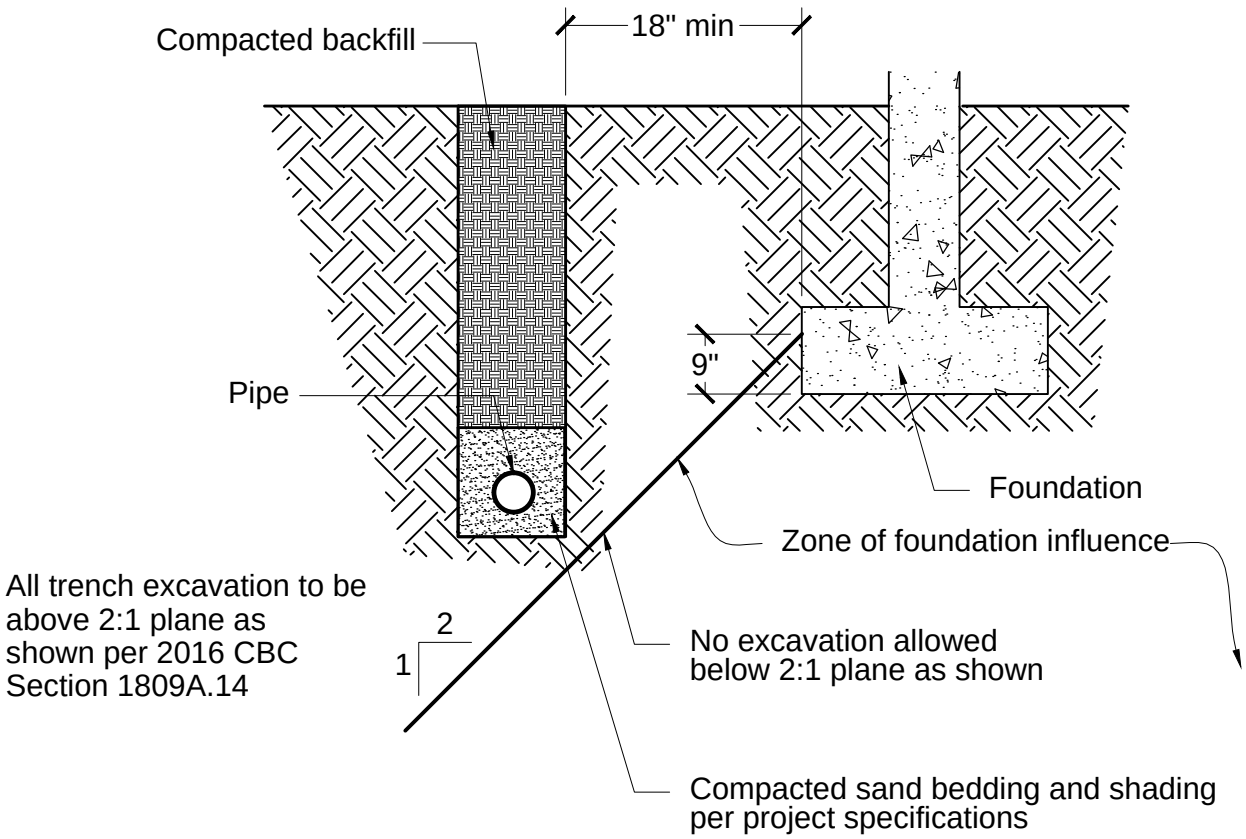
Day	Year	Epicenter Latitude (Degrees)	Epicenter Longitude (Degrees)	Distance from Site (mi)	Magnitude M_W
9/5	1922	35.30	120.70	3.0	**5.5**
99/99	1830	35.35	120.65	4.5	**6.0**
4/27	1908	35.60	120.20	33.4	**5.5**
12/7	1906	35.50	121.20	34.3	**5.7**
5/30	1877	35.70	120.30	34.8	**5.5**
7/28	1902	34.80	120.40	36.3	**5.8**
2/1	1853	35.70	121.10	38.2	**5.5**
12/22	2003	35.70	121.10	38.2	**6.6**
3/10	1922	35.75	120.25	39.2	**6.3**
8/18	1922	35.75	120.25	39.2	**5.7**
9/28	2004	35.82	120.37	40.2	**6.0**
6/8	1934	35.79	120.29	40.4	**6.0**
6/28	1966	35.81	120.27	42.1	**6.0**
7/31	1902	34.70	120.30	45.0	**5.8**
2/14	1987	35.96	120.70	46.7	**5.2**
9/29	2004	35.95	120.50	46.7	**5.1**
11/16	1956	35.95	120.47	47.0	**5.0**
11/22	1952	35.76	121.27	47.8	**6.2**
11/4	*1927	34.60	120.90	49.3	**7.1**
12/28	1939	35.97	120.92	49.7	**5.2**
9/13	1975	36.00	120.55	49.7	**5.1**
3/3	1901	36.00	120.50	50.1	**6.4**
11/2	1955	36.00	120.92	51.7	**5.2**
2/26	1932	36.00	121.00	53.1	**5.0**
2/2	1881	36.05	120.55	53.1	**6.0**
5/6	1881	36.05	120.55	53.1	**5.5**
1/12	*1915	34.60	120.20	53.7	**5.7**
1/9	1857	36.10	120.65	56.3	**6.1**
9/17	1991	35.81	121.45	57.7	**5.0**
1/14	1855	36.15	120.70	59.8	**5.5**
1/9	1857	36.20	120.80	63.8	**7.9**
4/12	1885	36.20	120.80	63.8	**6.5**

From full earthquake catalog in USGS OFR 2008-1437h as updated with current events through 2023 (ANSS 2024). For events with an asterisk, alternate solutions are given in the OFR. Ordered By Closest Event. Maximum 40 Closest Events

APPENDIX E

Typical Detail A: Pipe Parallel to Foundations

TYPICAL DETAIL A
PIPE PLACED PARALLEL TO FOUNDATIONS•



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GEOTECHNICAL ENGINEERING
AND GEOLOGIC HAZARDS REPORT
SAN LUIS OBISPO HIGH SCHOOL
RELOCATION OF MODULAR RESTROOM
1500 LIZZIE STREET
SAN LUIS OBISPO, CALIFORNIA

June 3, 2025

Prepared for

Mr. Chris Bonin
San Luis Coastal Unified School District

Prepared by

Earth Systems Pacific
4378 Old Santa Fe Road
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June 3, 2025

File No.: 300933-027

Mr. Chris Bonin
Director of Facilities, Operations and Transportation
San Luis Coastal Unified School District
937 Southwood Drive
San Luis Obispo, CA 93401

PROJECT: SAN LUIS OBISPO HIGH SCHOOL
RELOCATION OF MODULAR RESTROOM
1500 LIZZIE STREET
SAN LUIS OBISPO, CALIFORNIA

SUBJECT: Geotechnical Engineering and Geologic Hazards Report

CONTRACT REF: Proposal to Provide a Geotechnical Engineering Investigation, Soil Corrosivity Testing, and a Geologic Hazards Assessment, San Luis Obispo High School, Relocation of Modular Restroom, 1500 Lizzie Street, San Luis Obispo, California, by Earth Systems Pacific, Doc. No SLO-2504-040.PRP, dated April 18, 2025

Dear Mr. Bonin:

In accordance with your authorization of the referenced proposal, this geotechnical engineering and geologic hazards report has been prepared for use in the development of plans and specifications for the planned relocation of the modular restroom to the Adult School area of the San Luis Obispo High School campus in San Luis Obispo, California.

The geologic hazards for the campus were addressed in six previous reports by this firm (ESP 2016a, 2016b, 2018a, 2018b, 2020 and 2024) for five previous projects on the campus. In general, the geologic hazards discussed in the earlier reports have not changed except for the seismic design values that were calculated for the 2024 report using methods prescribed by the current California Building Code (CBC) (CBSC 2022). This report provides updated seismic hazard information, where appropriate, and updated seismic design values per the current CBC (CBSC 2022). This report also references the six previous reports (ESP 2016a, 2016b, 2018a, 2018b, 2020 and 2024) regarding geologic hazards and subsurface information considered applicable to this project.

Preliminary geotechnical recommendations are presented herein for site preparation, grading, utility trenches, foundations, slabs-on-grade, retaining walls, drainage and maintenance, and observation and testing. An electronic copy of this report is furnished for your use and distribution to others.

We appreciate the opportunity to have provided services for this project and look forward to working with you again in the future. If there are any questions concerning this report, please do not hesitate to contact the undersigned.

Sincerely,

Earth Systems Pacific



Nick Zoetewey, GE
Senior Engineer



Darrin Hasham, CEG
Engineering Geologist

Doc. No.: 2506-003.SGR/cr

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APPENDIX D	Soil Corrosivity Study by HDR, Inc., dated May 27, 2025
APPENDIX E	Table E-1 – Fault Parameters Table E-2 – Historical Earthquakes in Vicinity of Project Site
APPENDIX F	Typical Detail A: Pipe Placed Parallel to Foundations

1.0 INTRODUCTION

Based on information provided by Mr. Mat Gradias of KBZ Architects, Inc. (KBZ 2024), we understand a Modular Restroom is to be relocated from the area south of the Old Gymnasium to the Taylor Field (Baseball Field) area in the Adult School section of the campus, located at 1500 Lizzie Street in San Luis Obispo, California (see Figures 1 and 2, Site Vicinity Map and Campus Map, respectively, in Appendix A). The Modular Restroom has a footprint of approximately 400 square feet; it has a raised floor system and is to be supported by conventional continuous and/or spread (pad) footings. The subfloor crawlspace is anticipated to be on the order of 18 inches tall. Maximum wall and column loads on the order of 1 to 2 kips per linear foot and 10 kips, respectively, have been assumed. The project will also include exterior pedestrian flatwork to provide access as needed, and the existing campus utility systems will be extended underground to the restroom as needed. Finish floor elevation of the restroom will be just above the elevations of the existing facilities or the proposed flatwork in the area, therefore cuts and fills of 2 feet or less are anticipated. Structure and/or sitework retaining walls, if any, will not exceed 3 feet in total height. No other structures are planned. Drainage will be by sheet flow to the existing campus drainage systems; no drainage basins or low impact development/best management practices (LID/BMP) drainage features requiring infiltration testing will be constructed.

This project is under the jurisdiction of the Division of the State Architect (DSA), and it will be designed and constructed under the provisions of the 2022 California Building Code (CBC) (CBSC 2022). Our firm provided six geotechnical engineering and/or geologic hazards reports (ESP 2016a, 2016b, 2018a, 2018b, 2020 and 2024) for five previous projects on the campus. These reports were approved by the California Geologic Survey (CGS 2016a, 2016b, 2018, 2020 and 2025). Information utilized from those reports is referenced where utilized.

2.0 SCOPE OF SERVICES

The scope of work for this report included the following: a field reconnaissance by a registered geotechnical engineer; review of the previous reports (ESP 2016a, 2016b, 2018a, 2018b, 2020 and 2024) prepared by this firm for previous projects on the campus and attached in Appendix C; subsurface exploration; laboratory testing (geotechnical) on samples obtained during the current field investigation; geotechnical and geologic analyses of the data; and preparation of this report. The analysis and subsequent recommendations were based on the information regarding the project provided by KBZ Architects, Inc.

This report and preliminary geotechnical recommendations are intended to comply with the considerations of Sections 1803A.1 through 1803A.7, J104.3 and J104.4, as applicable, of the 2022 California Building Code (CBC) (CBSC 2022); California Geological Survey (CGS) Note 48 (2022); Interpretation of Regulations (IR) Document A-4 (DSA 2025); and common geotechnical engineering and engineering geology practice in this area under similar conditions at this time. The geotechnical test procedures were accomplished in general conformance with the standards noted, as modified by common geotechnical engineering practice in this area under similar conditions at this time.

Preliminary geotechnical recommendations for site preparation, grading, utility trenches, foundations, slabs-on-grade, retaining walls, drainage and maintenance, and observation and testing are provided in this report. In addition to referencing the geologic hazards previously identified (ESP 2016a, 2016b, 2018a, 2018b, 2020 and 2024) that are generally considered valid for this project, we have provided a brief summary of the geologic hazards as well as provided updated seismic hazards and seismic design parameters in this report. Figure 2 – Campus Map, in Appendix A, depicts the locations of these previous projects in relation to the current project. The results of corrosivity testing on a sample from the current field investigation, with corrosion control recommendations (subcontracted to HDR, Inc.) are included in Appendix D. The information presented and referenced in this report is intended to guide the development of project plans and specifications. It is our intent that this geotechnical/geologic report be used exclusively by the client to form the geotechnical/geologic basis of the design, and in the preparation of plans and specifications. Application beyond this intent is strictly at the user's risk.

This report does not address issues in the domain of contractors such as, but not limited to, site safety, loss of volume due to stripping of the site, shrinkage of soils during compaction, excavatability, shoring, protection of existing slabs and foundations, temporary slope angles, dewatering, construction means and methods, etc. Analyses of the soil for mold potential, asbestos in man-made materials, lead, radioisotopes, hydrocarbons, or chemical properties (other than geotechnical corrosivity) are beyond the scope of this report. Ancillary features such as temporary access roads, and nonstructural fills are not within our scope and are also not addressed.

As there may be unresolved geotechnical issues with respect to this project, the geotechnical engineer should be retained to provide consultation as the design progresses, to review project plans as they near completion to assist in verifying that pertinent geotechnical issues have been

addressed and to aid in conformance with the intent of this report. In the event that there are any changes in the design or location of improvements, or if any assumptions used in the preparation of this report prove to be incorrect, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are verified or are modified in writing. The criteria presented in this report are considered preliminary until such time as any peer review or review by any jurisdiction has been completed, conditions are observed by the geotechnical engineer in the field during construction, and the recommendations have been verified as appropriate or modified in writing.

3.0 SITE SETTING

The approximate coordinates of the current project area, as obtained from the Google Earth website (Google Earth 2025), are latitude 35.2809N, longitude 120.6486W, and elevation approximately 362 feet above mean sea level (MSL). Based on the Restroom Exhibit (F&A undated), the modular building will be located west of the home team dugout, at the top of a 7-foot tall slope with a gradient slightly flatter than 3:1 (horizontal to vertical). Terraced vehicle parking lots are beyond the toe of the slope to the west. The Adult School buildings and other facilities are to the north, and developed residential areas are to the south beyond the school property line. The locations and dispositions of underground utility lines on or adjacent to the planned building area are unknown.

4.0 FIELD INVESTIGATION AND LABORATORY ANALYSIS

The subsurface exploration for the current field investigation consisted of drilling two exploratory borings in the project area on April 30, 2025, to a maximum depth of approximately 16.0 feet below the existing ground surface (bgs). The borings were drilled with a GTech GT-8 truck mounted drill rig, equipped with 6-inch outside diameter hollow stem auger and an automatic trip hammer for sampling. As the borings were drilled, soil samples were obtained at selected depths using a ring-lined barrel sampler (ASTM D 3550-17 with shoe similar to D 2937-24). Standard Penetration Test (SPT) samples were also obtained at selected depths (ASTM D 1586-18). Additionally, bulk samples were obtained from the auger cuttings. The borings were backfilled with soil cuttings. The approximate locations of the borings are shown on Figure 3 - Exploration Location Map in Appendix A.

Soils encountered in the borings were categorized and logged in general accordance with the Unified Soil Classification System and ASTM D 2488-17. Copies of the boring logs and a Boring Log Legend are also included in Appendix A. In reviewing the boring logs and legend, the reader

should recognize that the legend is intended as a guideline only, and there are a number of conditions that may influence the soil characteristics as observed during drilling. These include, but are not limited to, the presence of cobbles or boulders, cementation, variations in soil moisture, presence of groundwater, and other factors. It should also be noted that the descriptions of bedrock must span a much wider range of density and strength characteristics than soil, and are relative to other *bedrock* strata. For example, fractured and weathered bedrock may be described as "soft," yet it will be considerably harder than almost any type of soil. Conversely, a clay soil may be described as "hard," however it will not be nearly as hard as the "soft" siltstone or meta-sandstone bedrock encountered on this site. Consequently, the logger must exercise judgement in interpreting the subsurface characteristics, possibly resulting in soil and bedrock descriptions that vary somewhat from the legend.

Ring samples obtained from the currently drilled borings were tested for unit weight and moisture (ASTM D 2937-24, modified for ring liners and ASTM D 2216-19). A bulk sample of the near surface soil was tested for expansion index (ASTM D 4829-21). The current laboratory test results are presented in Appendix B.

5.0 GENERAL SUBSURFACE AND GEOLOGIC PROFILE

The two borings advanced for the current project encountered fill consisting of medium dense decomposed granite (locally termed "DG") over moist, soft to hard sandy lean clay. The fill extended to 3.5 feet bgs in Boring 1, and 5.5 feet bgs in Boring 2. Below the fill in both borings was bedrock of the Franciscan Mélange, which consisted of soft siltstone in Boring 1 to 8 feet bgs, and moderately hard meta-sandstone to the boring termination depth of 16.0 feet bgs. In Boring 2, the bedrock was moderately hard meta-sandstone, which continued to the boring termination depth of 10.3 feet bgs.

Subsurface water was not encountered to the maximum depth explored of 16.0 feet bgs in the current borings. Borings referenced for the Track and Stadium Report (ESP 2020) encountered groundwater at approximately 34 feet bgs; the elevations reported for those borings ranged from 259 to 264 MSL, or about 100 feet below the elevation of the planned restroom relocation area. Borings drilled for the Annex/Classroom Building (ESP 2016a), the Pool and Equipment/Locker Building (ESP 2016b), the Building 100 Modernization project (ESP 2018a), and the New Classroom Building Project (ESP 2024) did not encounter groundwater to the maximum depth explored of 31 feet bgs.

Please refer to the logs for the current borings in Appendix A, and to the boring logs in the previous reports by this firm (ESP 2016a, 2016b, 2018a, 2020 and 2024) in Appendix C for a more complete description of the subsurface conditions encountered at this site and the previously explored sites.

6.0 GEOLOGIC HAZARDS

Earth Systems has performed a number of assessments for previous projects on the San Luis Obispo High School campus during the past decade or more; the reports for several of these projects are included as supporting documents in Appendix C of this report. The geologic hazards assessed for these various projects across campus are generally consistent for the campus with slight variations in ground surface elevations and associated depth to bedrock and depth to groundwater, slight variations in soil profile and bedrock composition, and the projects' proximities to graded or natural slopes. The included reports were reviewed as part of the work scope for this project. Based on the subsurface conditions encountered in the borings for the current project, in our opinion, the conclusions and recommendations with respect to geology, seismicity (with the exception of site class), and geologic hazards presented in previous reports are also valid for this project. The geologic hazards associated with this project are summarized below for the convenience of the reviewers.

- Surface ground rupture – the site is not within, nor are any State or County designated special studies zones for earthquake faulting identified on, the campus (SLOCO 2025). The closest Alquist-Priolo Special Studies Zone to the site is the Irish Hills Segment of the Los Osos fault, located approximately 3.5 miles west of the project site (CDMG 1990, Treiman 1989). The closest mapped fault to the site is the Cambria fault located approximately 1 mile northeast of the project site (Hall et al. 1979). The Cambria fault is considered pre-Holocene and is not included in the State's seismogenic model (USGS 2013). The closest fault to the site included in the State's seismogenic model is the Oceanic-West Huasna fault located approximately 2.5 miles northeast of the site (USGS 2013). The Oceanic-West Huasna fault is considered capable of a magnitude 7.21 earthquake (BSSC 2014) and is modeled as having a 0.55 percent probability of causing a magnitude ≥6.7 earthquake in the next 30 years (USGS 2013). There are no known faults on-site or trending towards the site. The hazard associated with surface fault rupture is considered low.

- Liquefaction – The project site is within a County designated area of low liquefaction potential (SLOCO 2025). Sandstone/meta-sandstone bedrock was encountered at shallow

depths during our geotechnical investigation for this project and other investigations on the eastern side of the high school campus. We therefore consider the potential for liquefaction at the project site to be nil.

- Seismically induced settlement – Due to the relatively shallow depth to bedrock and the presence of soft to hard clay soils, the potential for seismically induced settlement to occur at the site is considered to be nil.

- Slope stability – The project site is within a previously graded and developed area. The site is adjacent to an approximately 7-foot high slope graded at an inclination slightly flatter than 3:1(H:V) on the southwest that is not considered to present a hazard to the project or occupants. North and east of the project site are flat and level athletic fields with no slopes that pose a hazard to the project. South of the project site is a developed residential neighborhood with graded lots that do not present a hazard to the project. There is an un-named ridge approximately 700 feet east of the project site that is roughly 1,000 feet high. A screening level global slope stability analysis was performed for the Building 100 project (ESP 2018b) and the calculated factors of safety were greater than 1.5 for static conditions and greater than 1.15 for pseudostatic conditions. The ridge was deemed not to present a significant landslide hazard to the campus. There are no indications that rockfall is a hazard on the campus.

- Flooding – Approximately the western half of campus is within a mapped 0.2-percent annual chance flood zone (500-year) associated with San Luis Obispo Creek; however, this half of campus has primarily been developed with sports fields, tennis courts, and student parking. The project site is in the eastern part of the campus, within an area mapped as Zone X, an area of minimal flood hazard (FEMA 2012).

- Naturally occurring asbestos (NOA) – The artificial fill and bedrock encountered in the subsurface at the site during our geotechnical investigation are not generally associated with asbestiform minerals and the potential that friable asbestos is encountered during grading and development at the site is extremely low.

- Radon gas – The California Geological Survey has mapped the site as low for indoor radon potential (Churchill 2008).

7.0 SEISMICITY

Ground Motion Analyses

In accordance with Note 48 (CGS 2022), the 2022 CBC (CBSC 2022) and ASCE 7-16 (2017), an assessment was made to determine the need for employing "Site-Specific Ground Motion Procedures" to calculate the ground motion parameters for the project. Based on our site evaluation utilizing Standard Penetration Tests (SPT) from the current and previous investigations, and observations that the depth to bedrock at the site is less than 10 feet, the subsurface characteristics are those of Site Class C – Very Dense Soil and Soft Rock as defined by Table 20.3-1, Site Classification in ASCE 7-16 (2017); therefore, a site specific ground motion analysis is not required.

The mapped and general procedure ground motion values for Site Class C were obtained from the Structural Engineers Association of California seismic design map tool (SEAOC 2025) using ASCE 7-16 (2017).

The 40 closest faults to the site that potentially could cause severe seismic shaking at the site are summarized in Table E-1, Fault Parameters, presented in Appendix E. Table E-2 in Appendix E is a summary of Historical Earthquakes in the vicinity of the project site, with magnitudes greater than or equal to 5.0.

The primary seismic hazards at the site are from earthquakes generated by the local Oceanic-West Huasna, Los Osos, Rinconada, San Luis Range, and Hosgri faults and the more distant San Andreas fault (USGS 2013). Although these listed faults are thought to potentially generate the most severe seismic shaking at the site, any regional fault could produce seismic shaking at the site.

The 2022 CBC (CBSC 2022) seismic design criteria are based on a Design Earthquake that produces ground motion ⅔ of the maximum considered earthquake (MCE) with 2 percent probability of occurrence in 50 years.

Seismic Design Category

Section 1613A.2.5 of the 2022 CBC (CBSC 2022) states that *structures classified as Risk Category I, II or III that are located where the mapped spectral response acceleration parameter at 1-second period, S_1, is greater than or equal to 0.75 shall be assigned to Seismic Design Category E, others shall be assigned to Seismic Design Category D*. The mapped S_1 for the site is 0.398, which is less than 0.75; therefore, the site should be assigned to Seismic Design Category D.

Seismic Design Parameters

This site may be subject to strong ground shaking due to potential fault movements along regional faults. The minimum seismic design should comply with the 2022 CBC (CBSC 2022) and ASCE 7-16 (2017). The resulting seismic coefficients considering Site Class C are summarized in Table 1 below.

Table 1: General Procedure Seismic Parameters (2022 CBC/ASCE 7-16)

Seismic Design Category	D
Site Class	C
Mapped and Code Based Ground Motion	
Short Period Spectral Response, S_s	1.080 g
1 second mapped Spectral Response, S_1	0.398 g
Design Earthquake Ground Motion	
Short Period Spectral Response, S_{DS}	0.864 g
1 second Spectral Response, S_{D1}	0.398 g
Peak Ground Acceleration (PGA_M)	0.575 g
MCE Spectral Response Acceleration	
Short Period Spectral Response, S_{MS}	1.296 g
1 Second Period Spectral Response, S_{M1}	0.597 g
Site Amplification Factors	
Short Period Site Coefficient, F_a	1.20
1 Second Period Site Coefficient, F_v	1.50
Vertical Site Coefficient, C_v	1.12
Risk Coefficient (Short Period), C_{Rs}	0.898
Risk Coefficient (1 Second Period), C_{R1}	0.901

Acceleration values provided are estimates only. Vertical accelerations are typically ⅓ to ⅔ of the horizontal accelerations but can equal or exceed the horizontal accelerations depending upon the fault type, local site effects, and amplification.

8.0 CONCLUSIONS

In our opinion, the site is suitable, from a geotechnical engineering standpoint, for the proposed relocation of the modular restroom and other improvements as described in the "Introduction" Section of this report, provided the recommendations contained herein are implemented in the design and construction. The primary geotechnical engineering concerns at the site are

considered to be the potential for strong ground shaking, the potential for differential settlement due to the presence of fill and variable soil density conditions, and the soil's expansion, corrosion, and radon potentials.

The climate in the project area is moderate, and only very occasional surficial frost is anticipated during the coldest periods of the year; no ground freeze to any significant depth is anticipated. Therefore, design of foundations to accommodate frost depth is not considered necessary.

San Luis Obispo County (SLOCO 2025) considers the site to have low liquefaction potential. Due to the shallow depth to bedrock and the lack of groundwater, in our opinion, there is no potential for liquefaction and seismically induced settlement to affect the project site.

Provided that the building area is prepared as recommended in the "Grading" Section of this report, continuous perimeter and interior spread (pad) foundations may be used to support the relocated modular restroom.

Strong Ground Shaking

The site is in a region of high seismic activity, with the potential for large seismic events that could generate strong ground shaking. A seismic analysis was undertaken to provide current seismic acceleration design parameters. Our methods and the results of the seismic analysis are presented in the "Seismicity" Section of this report. Seismic acceleration parameters should be utilized in the design of the structures so that potential damage is reduced during a seismic event.

Differential Settlement

Approximately 3.5 to 5.5 feet of fill was found in both borings. The fill was likely placed when the project area was developed for the baseball field and its associated improvements; however, we are unaware of any documentation (i.e., reports of grading observation and compaction testing) regarding the fill placement. Laboratory testing on samples secured from the borings also indicates a variation in the in-situ densities of the fill soils. These conditions can create potentials for excessive total and differential settlement if they are not properly mitigated. As the relocated restroom building will have a subfloor crawlspace area below its raised floor, footing depths will be measured with respect to lowest adjacent grade, which will be the crawlspace elevation on the east side of the building. On the west side of the building, the depth of the footings with respect to lowest adjacent grade within 7 feet of the outside face of the footing (i.e., the existing descending slope face) will likely govern. As the structure is relatively lightweight, and as both of the noted conditions for foundation embedment will cause the bottom of footing elevations to

be near the bottom of the existing fill, in our opinion, a major program of overexcavation and recompaction of the existing fill is not warranted. In our opinion, suitable bearing and settlement conditions for the relocated restroom building can be achieved by deepening the footings as noted to meet the minimum embedment recommendations, and by utilizing small, hand-operated equipment to compact the excavation bottoms prior to formwork, reinforcing steel and concrete placement.

Expansive Soils

An expansion index test performed on a composite sample of the sandy lean clay fill found in both borings produced a result of 49. Per Section 1803A.5.3 of the 2022 CBC (CBSC 2022), the site soils are considered "expansive." Using the terminology typically associated with the ASTM test method for expansion, the soils are considered to have "low " expansion potential. Expansive soils tend to swell with seasonal increases in moisture and shrink during the dry season as subsurface moisture decreases. The volume changes that these materials undergo in this cyclical pattern can stress and damage slabs and foundations if precautionary measures are not incorporated into the design and construction procedures. The recommended minimum foundation embedment depths described in the previous section are considered sufficient to mitigate the potential effects of expansive soils on the foundations. If the subfloor area is not improved, then no additional efforts are considered necessary with respect to the expansive site soils. If the subfloor area is to be improved with a thin, lightly reinforced non-structural concrete housekeeping slab for rodent control (i.e., a "rat slab"), the slab can be protected by underlaying it with a layer of imported nonexpansive soil. If it is acceptable for the housekeeping slab to experience cracking and displacement, then it can be constructed directly over the expansive site soils. To maintain elevations and accessibility standards, exterior pedestrian flatwork should be protected from the expansive site soils by a layer of imported nonexpansive soils. Assuming it is kept segregated from the underlying expansive site soils and its expansion potential is verified, the existing decomposed granite layer found at the surface may be stockpiled for reuse as nonexpansive material during the site preparation process.

Corrosion Potential

As indicated in the Soil Corrosivity Study by HDR, Inc. in Appendix D, the sample obtained from the upper soils in the currently drilled borings was classified as moderately corrosive with its as-received moisture content, and it was corrosive when saturated. The sample's pH value was neutral. The soluble salt content of the sample was low; nitrate was detected in low concentration, and ammonium was not detected. The soils represented by the sample tested

are therefore classified as being corrosive to ferrous metals, and negligible for sulfate attack on concrete. Recommendations for corrosion control are contained in the Soil Corrosivity Study by HDR, Inc. in Appendix D.

Radon Potential

The architect/engineer should incorporate appropriate measures in the design and construction of the proposed improvements, as needed, to mitigate the low potential for radon activity.

9.0 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

The following recommendations are for improvements constructed as described in the "Introduction" Section of this report. If locations, elevations, structural loads, etc., change, the recommendations contained herein may require modification. In developing the following recommendations, it was assumed that irrigated landscaping or flatwork will be installed within a zone of at least five feet around the perimeter of all improvements; the intent is to keep the soils in a relatively uniform moisture condition year-round.

Unless otherwise noted, the following definitions are used in the recommendations presented below. Where terms are not defined, definitions commonly used in the construction industry are intended.

- **Building Area –** The area within and extending a minimum of 5 feet beyond the perimeter of the new building foundations. The building area includes any retaining walls, walkways or other improvements that are connected to the structure and that are intended to act in a manner similar to it.
- **Sitework Retaining Wall Areas –** The areas within and extending a minimum of 3 feet beyond the foundation limits of any sitework retaining walls.
- **Flatwork Areas –** The areas within the footprints of all exterior pedestrian flatwork.
- **Grading Area –** The entire area to be graded, including the building, any sitework retaining walls and exterior pedestrian flatwork areas.
- **Existing Grade –** Elevations of the site that existed as of the date of this report.
- **Finish Grade –** The planned final elevation of the unimproved soil surface beyond the building, sitework retaining wall and flatwork areas.
- **Subgrade –** The elevation in exterior pedestrian flatwork areas where nonexpansive soils are placed to support flatwork.

- **Scarified –** Plowed or ripped in two orthogonal directions to a depth of not less than 8 inches.
- **Moisture Conditioned –** Adjusting the soil moisture to optimum moisture content, or just above, prior to application of compactive effort, unless stated otherwise.
- **Compacted/Recompacted –** Soils placed in level lifts not exceeding 8 inches in loose thickness and compacted to a minimum of 90 percent of maximum dry density, unless stated otherwise, based on maximum dry density by ASTM D 1557-12/21 and field density by ASTM D 6938-23, or other methods acceptable to the geotechnical engineer and jurisdiction.

Site Preparation

1. The ground surface in the grading areas should be prepared for construction by removing any existing improvements, vegetation, large roots, debris, organic topsoil, and other deleterious materials. Existing utility lines that will not remain in service should be either removed or abandoned. The appropriate method of abandonment will depend upon the type and depth of the utility. Recommendations for abandonment can be made as necessary.

2. Voids created by the removal of materials or utilities described above should be called to the attention of the geotechnical engineer. No fill should be placed unless the underlying soil has been observed by the geotechnical engineer.

3. Assuming its nonexpansive nature is verified, and it is kept clean and segregated from the underlying expansive site clayey soils, the existing decomposed granite (DG) material found in the top 5 inches of the exploratory borings may be stockpiled for later reuse as nonexpansive material during the site grading process.

Grading

1. Following site preparation, if a housekeeping slab is to be placed in the subfloor crawlspace area of the building, and if it is desired to reduce the potential for cracking of the slab, then the crawlspace area should be overexcavated to a minimum of 1 foot below bottom of slab elevation. The resulting excavated surface should be scarified, moisture conditioned, and recompacted.

If a housekeeping slab is to be placed in the subfloor crawlspace area of the building, and if cracking and differential movement of the slab due to the expansive site soils will not be a concern, then the crawlspace area can be simply excavated to bottom of slab elevation. The resulting excavated surface should be scarified, moisture conditioned, and recompacted.

Housekeeping slabs should be sloped and provided with drainage inlets per the "Drainage and Maintenance" Section of this report.

If a housekeeping slab will not be utilized in the subfloor crawlspace area, the area should be excavated to finished grade and sloped to drainage inlets per the "Drainage and Maintenance" Section of this report. The resulting sloped surfaces should be scarified, moisture conditioned, and recompacted.

2. Following site preparation and preparation of the crawlspace area per the previous paragraph, the foundation excavations should be completed to the minimum embedment depths as recommended in the "Foundations" Section of this report. The resulting excavated trench bottoms should be moisture conditioned and recompacted.

3. Following site preparation, the existing soils in any sitework retaining wall areas should be overexcavated to a level plane at a minimum of 2 feet below the deepest foundation element or to the bedrock surface, whichever is shallower. The resulting excavated soil surface should be scarified, moisture conditioned, and recompacted; exposed bedrock need not be scarified but should be moisture conditioned and lightly compacted to remediate any disturbances caused by the excavation process. Earthwork operations may be stepped to accommodate any slope of the bedrock surface or any changes in the retaining wall foundation elevations.

4. Following site preparation and prior to the placement of any fill, the soil in exterior pedestrian flatwork areas should be removed to proposed subgrade elevation. The resulting excavated soil surfaces should then be scarified, moisture conditioned, and compacted. Please refer to the "Slabs-on-Grade" Section of this report for recommendations regarding placement of imported nonexpansive material below flatwork to provide protection from the expansive site soils.

5. Following site preparation and any excavations to grade, and prior to placement of fill, the soil in all other grading areas should be scarified, moisture conditioned and recompacted.

6. Voids created by dislodging cobbles and/or debris during scarification should be backfilled and recompacted, and the dislodged materials should be removed from the work area.

7. Previously removed site soils may be placed and compacted in thin, moisture conditioned lifts beyond the building and exterior pedestrian flatwork areas. If it is desired to protect any housekeeping slabs in the subfloor crawlspace area from the expansive site soils, the final 12 inches of fill below the slabs should be nonexpansive and should be placed in moisture conditioned and compacted lifts.

8. Previously removed site soils and imported nonexpansive materials (if needed) may be placed and compacted in thin, moisture conditioned lifts to subgrade in exterior pedestrian flatwork areas and to finish grade in the rest of the grading areas.

4. Nonexpansive materials are defined as imported soils that fall in the GW, GM, GC, SP, SW, SC and SM categories per ASTM D 2487-17, and that have an expansion index of 10 or less (ASTM D 4829-21). Assuming its nonexpansive nature is verified, and it is kept clean and segregated from the underlying expansive site clayey soils, the existing decomposed granite (DG) fill soil found at the surface across the site may be used as nonexpansive material during the site grading process.

9. All imported soils used in the building area (if required to achieve design grades) should be nonexpansive and should have strength qualities equal to or better than the site soils. In addition, they should not exceed the geotechnical corrosivity potential of the site soils. See the Corrosivity Test Report by HDR, Inc. in Appendix D for the corrosivity parameters of the site soils.

10. Proposed imported materials should be reviewed by the geotechnical engineer before being brought to the site, and on an intermittent basis during placement. In accordance with the requirements of the State of California's Department of Toxic Substances Control, any soil imported to the site should be sourced from SMARA (Surface Mining and Reclamation Act) approved quarries; non-SMARA quarry material proposed for use should be tested by this firm for the presence of environmental contaminants before being imported to the site.

11. All materials used as fill should be cleaned of any debris and rocks larger than 3 inches in diameter. When fill material includes rocks, the rocks should be placed in a sufficient soil matrix to ensure that voids caused by nesting of the rocks will not occur and that the fill can be properly compacted.

12. All fill (on site or imported) should be placed in thin, moisture conditioned and level lifts and compacted through the entire building area or the particular grading area being worked.

13. Placement of gravel layers, geotextiles, geogrids, or additional overexcavation may be recommended if loose or unstable conditions are encountered during grading. No fill should be placed in any grading area if the underlying soil is loose or unstable.

14. The recommended soil moisture content should be maintained throughout construction, and during the life of the structure and all other improvements. Failure to maintain the soil moisture content can result in desiccation cracks and disturbance, which are an indication of degradation of the soil compaction. If desiccation cracks are allowed to develop, or if soils near improvements such as foundations, flatwork, etc. are otherwise disturbed, damage to those improvements may result. Soils that have cracked or are otherwise disturbed should be removed, moisture conditioned, and recompacted.

15. The architect/engineer should incorporate appropriate measures for grading operations, as needed, to mitigate the low potential for radon activity.

Utility Trenches

1. Utility trenches adjacent to foundations should not be excavated within the zone of foundation influence, as shown in Typical Detail A in Appendix F.

2. Utilities that must pass beneath foundations should be placed with properly compacted utility trench backfill and the foundation should be designed to span the trench.

3. A select, noncorrosive, easily compacted sand should be used as bedding and shading immediately around utilities. The site soil or approved imported nonexpansive soil may be used for trench backfill above the select material. In housekeeping slab and exterior pedestrian flatwork areas, trench backfill should match the thickness of any imported nonexpansive material designated to support the slabs or flatwork.

4. Prior to applying compactive effort, trench backfill should be moisture conditioned, placed in level lifts not exceeding 6 inches in loose thickness, and compacted to at least 90 percent of maximum dry density.

5. Compaction of trench backfill by jetting or flooding is not recommended at this site, due to the expansive clayey soils and bedrock at depth. However, to aid in *encasing* utility conduits, particularly corrugated drainpipes, and multiple, closely spaced conduits in a single trench with the bedding and shading material, jetting or flooding may be useful. Flooding or jetting should only be attempted with extreme caution, and any flooding or jetting operation should be subject to review by the geotechnical engineer.

6. Long-term settlement of properly compacted site soils or imported nonexpansive materials should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill. Improvements that are constructed over or near trenches should be designed to accommodate the potential for settlement.

7. The Corrosivity Test Report by HDR, Inc., in Appendix D of this report should be used by the architect/engineer in specifying appropriate corrosion protection measures for utility improvements.

8. The architect/engineer should incorporate appropriate measures in the design of utility systems, as needed, to mitigate the low potential for radon activity.

9. The recommendations of this section are minimums only and may be superseded by the architect/engineer based upon soil corrosivity or the requirements of pipe manufacturers, utility companies or the governing jurisdiction.

Foundations

1. The building may be supported by continuous and spread footings bearing in firm excavations that have been compacted as recommended in the “Grading” Section of this report.

2. All footings should have a minimum embedment depth of 18 inches below the lowest adjacent grade within 7 feet laterally from the outside face at the bottom of the footing, and a minimum width of 12 inches. On the east side of the building area (i.e., opposite the existing descending slope), the lowest adjacent grade is considered to be the

elevation of the soil surface in the subfloor crawlspace area. Spread footings should be at least 24 inches square. All spread footings should be interconnected with grade beams on at least 2 sides that are a minimum of 18 inches deep and 12 inches wide.

3. Continuous footings and grade beams should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential only, minimum continuous footing and grade beam reinforcement should consist of two No. 4 rebar, one at the top and one at the bottom. Spread footing reinforcement should be determined by the architect/engineer.

4. Footings bearing in firm recompacted soil may be designed using maximum allowable bearing capacities of 1,650 psf for dead loads and 2,500 psf for dead plus live loads. Using these criteria, total maximum and differential static settlements are anticipated to be on the order of 0.75-inch and 0.5-inch over a horizontal distance of 25 feet, respectively.

5. Allowable bearing capacities may be increased by one-third when transient loads such as wind or seismicity are included. Foundations may be designed as necessary using the values contained in Table 1: Site-Specific Seismic Parameters in the “Seismicity” Section of this report.

6. To calculate resistance to lateral loads, an ultimate passive equivalent fluid pressure of 250 psf and an ultimate coefficient of friction value of 0.35 can be used. Lateral capacity is based on the assumption that any backfill adjacent to foundations has been properly compacted. Passive and friction components of resistance may be combined in the analysis without reduction to either value.

7. Footing excavations should be observed by the geotechnical engineer prior to placement of reinforcing steel. Footing excavations should be moistened above optimum moisture content, and no desiccation cracks should be present prior to concrete placement.

8. The Corrosivity Test Report by HDR, Inc., in Appendix D of this report)should be used by the architect/engineer in specifying appropriate corrosion protection measures for foundations.

9. The architect/engineer should incorporate appropriate measures in the foundation design, as needed, to mitigate the low potential for radon activity.

Slabs-on-Grade

Housekeeping Slabs

1. The minimum thickness and reinforcement for non-structural housekeeping slabs in the subfloor crawlspace area should be determined by the architect/engineer.

Exterior Pedestrian Flatwork

1. Exterior pedestrian flatwork should have a minimum thickness of 4 inches. Based on soil expansion potential only, minimum reinforcement for exterior pedestrian flatwork should consist of No. 3 rebar placed at 18 inches on-center each way.

2. In conventional construction, it is common to use 4 to 6 inches of imported sand beneath exterior pedestrian flatwork. On this site, due to the medium expansion potential of the site soils, there will be a risk of movement and damage to the flatwork if conventional measures are used. Heaving and cracking could occur. To reduce the potential for movement and damage, flatwork should be supported by up to 12 inches of imported nonexpansive soils. The more nonexpansive material provided, the better the protection from the expansive soils.

3. To further reduce the risk of movement of flatwork due to seasonal moisture variations or loss of soil from erosion, thickened edges or grade beams up to 18 inches deep can be provided around the perimeters of the flatwork. The deeper the perimeter thickened edges/grade beams provided, the better the protection from the expansive soils. At a minimum, any thickened edge or grade beam should be reinforced by two No. 4 rebar, one at the top and one at the bottom.

4. It is recognized that the measures recommended in the previous paragraphs for protecting flatwork from expansive soils are an added expense, possibly more expensive than simply replacing flatwork that has moved and/or cracked. Consequently, the above measures for protecting flatwork are only suggestions for consideration by the owner and/or architect/engineer. The degree to which flatwork is protected is left to the discretion of the owner and/or architect/engineer.

5. Flatwork should be constructed with frequent joints to allow articulation as the flatwork moves in response to seasonal soil temperature and moisture variations. The soil below flatwork should be moisture conditioned prior to casting the flatwork.

6. Flatwork at doorways, and at other areas where maintaining the elevation of the flatwork is desired, should be doweled to the perimeter foundations, at a minimum, by No. 3 dowels lapped to the flatwork rebar at 24 inches on center. In other areas, the flatwork may be doweled to the foundation or the flatwork may be allowed to "float free," at the discretion of the architect/engineer. Flatwork that is intended to float free should be separated from foundations by a felt joint or other means.

7. To provide stability for curbs adjacent to exterior pedestrian flatwork, they should be set back a minimum distance equal to one-third the height of any adjacent descending slope, but not less than 5 feet from the tops of slopes. Alternately, curbs may be deepened to provide stability. The geotechnical engineer should review, on an individual basis, any situation where curbs must be deepened to meet this recommendation.

Moisture Vapor Transmission

1. Where moisture vapor transmitted from the underlying soil would be undesirable, housekeeping slabs should be protected from subsurface moisture vapor. A number of options for vapor protection are discussed below; however, the means of vapor protection, including the type and thickness of the vapor retarder, if specified, are left to the discretion of the architect/engineer.

2. Where specified, vapor retarders should conform to ASTM Standard E 1745-17. This standard specifies properties for three performance classes; Class A, B and C. The appropriate class should be selected based on the potential for damage to the vapor retarder during placement of slab reinforcement and concrete. Unless it is determined that a permeance of 0.10 perms will not allow vapor to accumulate beneath moisture-sensitive flooring, adhesives, stored products and/or equipment, then a vapor retarder permeance of 0.010 perms is recommended, per ACI 302.1-15 (ACI 2015). Permeance of vapor retarders should remain below 0.010 perms after the conditioning tests of ASTM E 1745-17/23.

   Note: ASTM E 1745-17/23 has the same permeance threshold for Class A, B and C (0.1 perms). The class that is chosen will make a difference in how resistant the vapor retarder is to punctures and tears, but it will not ensure any better permeance values to protect floor coverings.

3. Several studies, including those of American Concrete Institute Committee 302 (ACI 2015), have concluded that excess water above the vapor retarder increases the potential for moisture damage to floor coverings and could increase the potential for mold growth or other microbial contamination. The studies also concluded that it is preferable to eliminate the typical sand layer beneath the slab and place the slab concrete in direct contact with a Class A vapor retarder, particularly during wet weather construction. However, placing the concrete directly on the vapor retarder requires special attention to using the proper vapor retarder, a very low water-cement ratio in the concrete mix, and special finishing and curing techniques.

4. Another option that may be a reasonable compromise between effectiveness and cost considerations is the use of a subslab vapor retarder protected by a sand layer. If a Class A vapor retarder is specified, the retarder can be placed directly on the subgrade. The retarder should be covered with a minimum 2 inches of clean sand. If a less durable vapor retarder is specified (Class B or C), a minimum of 4 inches of clean sand should be provided, and the retarder should be placed in the center of the clean sand layer. Clean sand is defined as a well or poorly graded sand (ASTM D 2487-17) of which less than 3 percent passes the No. 200 sieve. Clean sand is considered to be part of the minimum 12 inches of imported nonexpansive materials recommended in the “Grading” Section of this report to be placed below housekeeping slabs-on-grade, not in addition to it.

5. Regardless of the underslab vapor retarder selected, proper installation of the retarder per ASTM E 1643-18a is critical for optimum performance. Where utilized, the vapor retarder should be placed a minimum of 1 inch above the flow line of the drainage path surrounding the structures, or 1 inch above the area drain grates if area drains are used to collect runoff around the structures. As required by ASTM E 1643-18a, all seams and utility penetrations should be properly sealed. At terminating edges of the vapor retarder, the vapor retarder should be effectively sealed with accessories specifically designed to seal the material to new or existing concrete; details for edge sealing of the vapor retarder should be provided by the architect/engineer.

6. If the sand is used between the vapor retarder and the slab, it should be moistened only as necessary to promote concrete curing; saturation of the sand should be avoided, as the excess moisture would be on top of the vapor retarder, potentially resulting in vapor transmission through the slab for months or years.

7. Positive drainage away from the structure should be maintained; see the "Drainage and Maintenance" Section of this report for additional discussion of this issue. If water is allowed to pond near the structure, it may seep into the ground and migrate laterally through cracks or utility penetrations in the foundation, ultimately gaining access above the vapor retarder.

General

1. To reduce shrinkage cracks in housekeeping slabs and exterior pedestrian flatwork, the concrete aggregates should be of appropriate size and proportion, the water/cement ratio should be low, the concrete should be properly placed and finished, contraction joints should be installed, and the concrete should be properly cured. This is particularly applicable to slabs that will be cast directly upon a vapor retarder and those that will be protected from transmission of vapor by use of admixtures or surface sealers. Concrete materials, placement, and curing specifications should be at the direction of the architect/engineer; AC 302.1R-15 (ACI 2015) is suggested as a resource for the architect/engineer in preparing such specification.

2. The Corrosivity Test Report by HDR, Inc. in Appendix D of this report should be used by the architect/engineer in specifying appropriate corrosion protection measures for housekeeping slabs and exterior pedestrian flatwork.

3. The architect/engineer should incorporate appropriate measures in the exterior pedestrian flatwork design, as needed, to mitigate the low potential for radon activity.

Retaining Walls

1. Retaining walls should be founded in firm soil that has been recompacted per the "Grading" Section of this report. Foundations for all retaining walls should have minimum overall depths (not including any keyway) of 18 inches below lowest grade within 7 feet laterally of the outside face at the bottom of the footing.

2. Retaining wall footings should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential only, minimum retaining wall footing reinforcement should consist of two No. 4 rebar, one at the top and one at the bottom.

3. Retaining wall design may be based on the following parameters:

Table 2: Retaining Wall Design Parameters

Parameter	Backfill Type	Value
Active Equivalent Fluid Pressure	On Site Soils	45 pcf
	Imported Sand/Gravel	35 pcf
At-rest Equivalent Fluid Pressure	On Site Soils	60 pcf
	Imported Sand/Gravel	50 pcf
Passive Equivalent Fluid Pressure	On Site Soils	250 pcf
Maximum Toe Pressure	Recompacted On Site Soils	2,500 psf
Coefficient of Sliding Friction	Recompacted On Site Soils	0.35

4. No surcharges are taken into consideration in the values presented in the previous paragraph. The maximum toe pressure is an *allowable* value; no factors of safety, load factors or other factors have been applied to the remaining values. With the exception of the maximum toe pressure, these values will require application of appropriate factors of safety, load factors, and/or other factors as deemed appropriate by the architect/engineer.

5. The upper foot of backfill behind all retaining walls should consist of native or similar imported soil per the "Grading" Section of this report, except in areas where pedestrian flatwork will abut the top of the wall. In such cases, the backfill should extend to the nonexpansive or other select material below the improved surface, as appropriate. If gravel backfill is utilized, the gravel should be encased in a permeable synthetic filter fabric conforming to standard specification section 96-1.02B – Class C (Caltrans 2024).

6. The active and at-rest pressures presented in Table 2 are applicable to a horizontal retained surface behind the wall. Walls having a retained surface that slopes upward from the wall should be designed for an additional equivalent fluid pressure of 1 pcf for the active case and 1.5 pcf for the at-rest case, for every 2 degrees of slope inclination.

7. It is assumed that retaining wall heights will not exceed 6 feet; therefore, per Section 1803A.5.12.1 of the CBC (CBSC 2022), dynamic seismic lateral earth pressures are not required for the design. If retaining walls are planned that will retain more than 6 feet of backfill, the geotechnical engineer should be notified to provide updated earthwork recommendations and dynamic seismic lateral earth pressure increments, as needed.

8. Long-term settlement of properly compacted site soils, as well as imported sand or gravel retaining wall backfill should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill. Improvements that are constructed near the tops of retaining walls should be designed to accommodate long-term settlement.

9. All retaining walls should be drained with perforated pipe encased in a free-draining gravel blanket. The pipe should be placed with perforations facing downward and should discharge in a nonerosive manner away from foundations and other improvements. The gravel blanket should have a width of approximately 1 foot and should extend upward to approximately 1 foot from the top of the wall backfill. The upper foot should be backfilled with native soil, except in areas where flatwork will abut the top of the wall. In such cases, the gravel should extend to the nonexpansive or other select material per the "Grading" Section of this report below the improved surface, as appropriate. To reduce infiltration of the soil into the gravel blanket, a permeable synthetic filter fabric conforming to Standard Specifications Section 96-1.02B – Class C (Caltrans 2024), should be placed between the two materials. Manufactured synthetic drains, such as Miradrain or Enkadrain are acceptable alternatives to the use of gravel, provided that they are installed in accordance with the recommendations of the manufacturer.

10. Where weep hole drainage can be properly discharged, the perforated pipe may be omitted in lieu of weep holes on maximum 4-foot centers. A filter fabric as described above should be placed between the weep holes and the drain gravel.

11. Walls facing areas where moisture transmission through the wall would be undesirable should be thoroughly waterproofed in accordance with the specifications of the architect/engineer.

12. The architect/engineer should bear in mind that retaining walls by their nature are flexible structures, and that surface treatments on walls often crack. Where walls are to be plastered or otherwise have a finish applied, the flexibility should be considered in determining the suitability of the surfacing material, spacing of horizontal and vertical control joints, etc. The flexibility should also be considered where a retaining wall will abut or be connected to a rigid structure, and where the geometry of the wall is such that its flexibility will vary along its length.

13. The Corrosivity Test Report by HDR, Inc., in Appendix D of this report should be used by the architect/engineer in specifying appropriate corrosion protection measures for retaining walls.

14. The architect/engineer should incorporate appropriate measures in the design of retaining walls to mitigate the low potential for radon activity.

Drainage and Maintenance

1. Per Section 1804A.4 of the CBC (CBSC 2022) unpaved ground surfaces should be *finish graded* to direct surface runoff away from foundations and other improvements at a minimum 5 percent grade for a minimum distance of 10 feet. The site should be similarly sloped to drain away from foundations, and other improvements during construction. Where this is not practicable due to other improvements, etc., swales with improved surfaces, area drains, or other drainage facilities, should be used to collect and discharge runoff.

2. If housekeeping slabs are not used in the subfloor crawlspace areas, the subfloor areas should be graded to a low point or a series of low points, and drain inlets should be provided at the low points to direct any accumulated water to an appropriate outlet. As an alternative to surface drain inlets in the subfloor area, gravel drains or prefabricated panel-type intercept drains can be provided in the subfloor areas to collect and discharge accumulated water via gravity flow. The gravel drain inlets should be a minimum of 12 inches wide and 12 inches deep, and drained with a rigid perforated PVC pipe.

   If housekeeping slabs are used in the subfloor crawlspace areas, the slabs should be similarly sloped, and similar drainage inlets with gravity flow outlets should be provided.

3. All eaves of the building should be fitted with roof gutters. Runoff from flatwork, roof gutters, downspouts, planter drains, area drains, etc. should discharge in a non-erosive manner away from foundations and other improvements in accordance with the requirements of the governing agencies. Erosion protection should be placed at all discharge points unless the discharge is to an improved surface.

4. To reduce the potential for planter drainage gaining access to subslab areas, any raised planter boxes adjacent to foundations should be installed with drains and sealed sides and bottoms. Drains should also be provided for areas adjacent to the structures and in landscape areas that would not otherwise freely drain.

5. If soils are disturbed during construction, stabilization of soils by vegetation or other means, *during* and *following* construction, is essential to reduce erosion damage. Care should be taken to establish and maintain vegetation. The landscaping should be planned and installed to maintain the surface drainage recommended above. Surface drainage should also be maintained during construction.

6. Maintenance of drainage and other improvements is critical to the long-term stability of the site and the integrity of the structure. Site improvements should be maintained on a regular basis.

7. Finished flatwork surfaces should be sloped to freely drain toward appropriate drainage facilities. Water should not be allowed to stand or pond on or adjacent to exterior pedestrian flatwork, or other improvements as it could infiltrate into the supporting soil, causing premature deterioration of flatwork or other improvements.

8. All exterior drains and drain outlets should be maintained to be free-flowing. Care should be taken to establish and maintain vegetation. Vegetation and erosion matting (if utilized) should be maintained or augmented as needed. Irrigation systems should be maintained so that soils around the structure are maintained at a relatively uniform year-round moisture content and are neither over-watered nor allowed to dry and desiccate.

9. To reduce the potential for disruption of drainage patterns and undermining of structures, fill areas, etc., all rodent activity should be aggressively controlled.

Observation and Testing

1. The recommendations contained in this report are based on a limited number of borings and rely on continuity of the subsurface conditions encountered.

2. It is assumed that the geotechnical engineer will be retained to provide consultation during the design phase, to interpret this report during construction, and to provide construction monitoring in the form of testing and observation.

3. At a minimum, the geotechnical engineer should be retained to provide:

    - Review of project plans as they near completion, to determine compliance with the recommendations of this report
    - Professional observation during grading, trench and retaining wall backfill, and foundation construction

- Oversight of special inspection and compaction testing grading, trench and retaining wall backfill, and foundation construction

4. Special inspection of grading and backfill should be provided as per Section 1705A.6 and Table 1706A.6 of the CBC (CBSC 2022). The special inspector should be under the direction of the geotechnical engineer and/or the engineering geologist. At a minimum, the following items should be inspected and/or tested by the special inspector:

    - Stripping and clearing of all existing improvements, vegetation, and deleterious materials
    - Segregation and stockpiling of the existing on-site fill soils (if applicable)
    - Overexcavation to the recommended depth in the subfloor crawlspace area
    - Scarification and moisture conditioning of soil prior to compaction
    - Fill quality, placement, moisture conditioning and compaction
    - Utility trench backfill
    - Foundation excavations and recompaction
    - Retaining wall drains and backfill

5. A program of quality assurance should be developed prior to beginning construction. At a minimum, the program should include all geotechnical items shown on the testing and inspection schedule of the approved plans. It should also include any additional inspection items required by the engineer and/or the governing jurisdiction. These items should be discussed at a preconstruction site meeting among a representative of the owner, the geotechnical engineer, special inspector, the project inspector, the engineer, and contractors. The geotechnical engineer should be notified at least 48 hours prior to beginning grading operations.

6. Locations and frequency of compaction tests should be per the recommendation of the geotechnical engineer at the time of construction. The recommended test location and frequency may be subject to modification by the geotechnical engineer, based upon soil and moisture conditions encountered, size and type of equipment used by the contractor, the general trend of the results of compaction tests, or other factors.

10.0 CLOSURE

Our intent was to perform the investigation in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the locality of this project under similar conditions. No representation, warranty, or guarantee is either expressed or implied. This report is intended for the exclusive use by the client as discussed in the “Scope of Services” Section. Application beyond the stated intent is strictly at the user's risk.

This report is valid for conditions as they exist at this time for the type of project described herein. The conclusions and recommendations contained in this report could be rendered invalid, either in whole or in part, due to changes in building codes, regulations, standards of geotechnical or construction practice, changes in physical conditions, or the broadening of knowledge.

If changes with respect to the project become necessary, if items not addressed in this report are incorporated into plans, or if any of the assumptions used in the preparation of this report are not correct, this firm shall be notified for modifications to this report. Any items not specifically addressed in this report should comply with the CBC of other applicable standards, and the requirements of the governing jurisdiction.

The preliminary recommendations presented in this geotechnical report are based upon the geotechnical conditions encountered at the site and may be augmented by additional requirements of the client, or by additional recommendations provided by the geotechnical engineer based on peer or jurisdiction reviews, or conditions exposed at the time of construction. If Earth Systems Pacific is *not* retained to provide construction observation and testing services, it shall not be responsible for the interpretation of the information by others or any consequences arising therefrom.

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Thank you for this opportunity to have been of service. If you have any questions, please feel free to contact this office at your convenience.

End of Text.

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APPENDIX A

Figure 1 – Site Vicinity Map
Figure 2 - Campus Map
Figure 3 - Exploration Location Map
Boring Log Legend
Boring Logs



N

NOT TO SCALE

BASE MAP PROVIDED BY: Google Earth (2025)

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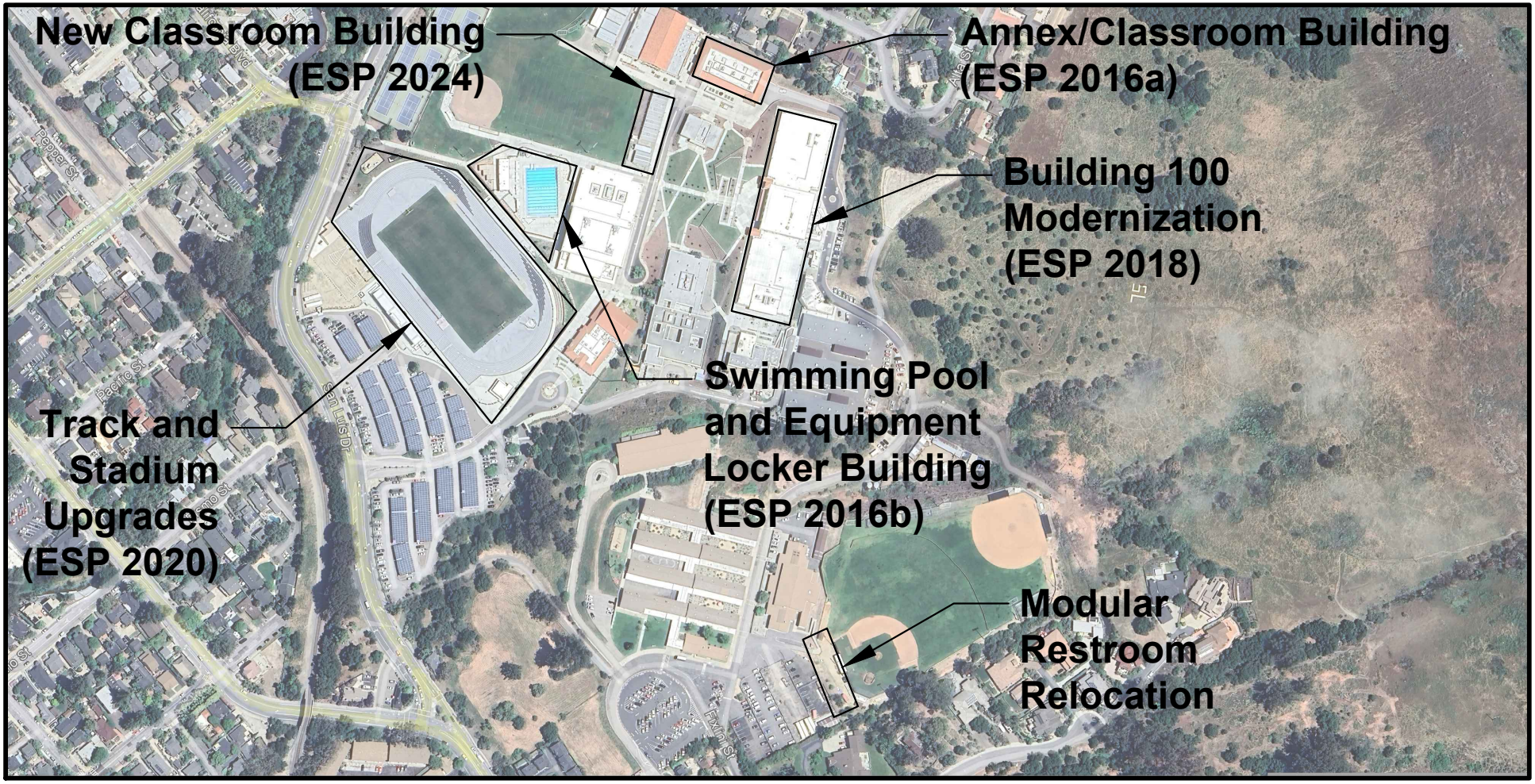
SITE VICINITY MAP
San Luis Obispo High School
Relocation of Modular Restroom
1500 Lizzie Street
San Luis Obispo, California

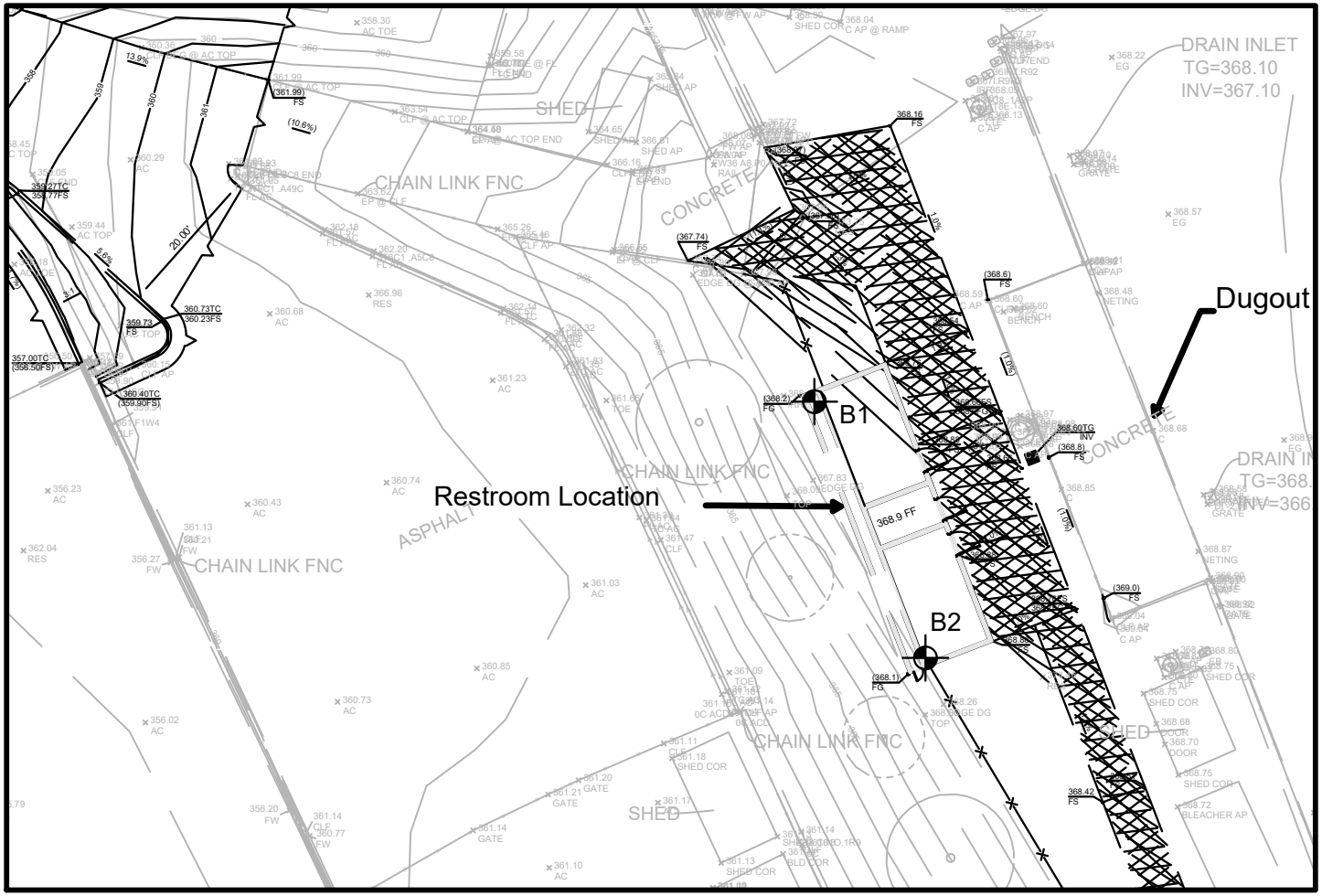
Date
May 2025

Project No.
300933-027

Figure 1

300933-027 SLO HS – Relocation of Modular Restroom Maps.dwg


New Classroom Building
(ESP 2024)
Annex/Classroom Building
(ESP 2016a)
Building 100
Modernization
(ESP 2018)
Swimming Pool
and Equipment
Locker Building
(ESP 2016b)
Track and
Stadium
Upgrades
(ESP 2020)
Modular
Restroom
Relocation
Pepper St
Bacich St
San Luis Dr
Foothill Blvd
Foothill St
Foothill Ct
Foothill Pl
Foothill Ln
Foothill Cir
Foothill Ter
Foothill Way
Foothill Rd
Foothill Dr
Foothill Ave
Foothill Pkwy
Foothill Sq
Foothill Trl
Foothill Vw
Foothill Vis
Foothill Vlg
Foothill Vly
Foothill Wk
Foothill Xing
Foothill Yd
Foothill Zn
Foothill Bnd
Foothill Cmn
Foothill Crk
Foothill Dn
Foothill Est
Foothill Fld
Foothill Gdn
Foothill Grn
Foothill Hl
Foothill Hts
Foothill Knl
Foothill Lk
Foothill Mdw
Foothill Mnr
Foothill Mtn
Foothill Orch
Foothill Pk
Foothill Plz
Foothill Rdg
Foothill Rnch
Foothill Rst
Foothill Shr
Foothill Spg
Foothill Sta
Foothill Stn
Foothill Tr
Foothill Twr
Foothill Un
Foothill Vis
Foothill Wds
Foothill Wlk
Foothill Wy
Foothill Xrd
Foothill Yr



LEGEND

B2 Boring Location (Approx.)

BASE MAP PROVIDED BY: Flowers & Associates, Inc. (2025)

N

NOT TO SCALE

Earth Systems Pacific
4378 Old Santa Fe Road, San Luis Obispo, CA 93401
www.earthsystems.com
(805) 544-3276 ● Fax (805) 544-1786

EXPLORATION LOCATION MAP

San Luis Obispo High School
Relocation of Modular Restroom
1500 Lizzie Street
San Luis Obispo, California

Date
May 2025

Project No.
300933-027

Figure 3

300933-027 SLO HS – Relocation of Modular Restroom Maps.dwg

Earth Systems Pacific

BORING LOG LEGEND

SAMPLE / SUBSURFACE WATER SYMBOLS	GRAPH. SYMBOL
CALIFORNIA MODIFIED	
STANDARD PENETRATION TEST (SPT)	
SHELBY TUBE	
BULK	
SUBSURFACE WATER DURING DRILLING	
SUBSURFACE WATER AFTER DRILLING	

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

MAJOR DIVISIONS	GROUP SYMBOL	TYPICAL DESCRIPTIONS	GRAPH. SYMBOL
COARSE GRAINED SOILS (MORE THAN HALF OF MATERIAL IS LARGER THAN #200 SIEVE SIZE)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GP	POORLY GRADED GRAVELS, OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, NON-PLASTIC FINES	
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, PLASTIC FINES	
	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
	SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES	
	SM	SILTY SANDS, SAND-SILT MIXTURES, NON-PLASTIC FINES	
	SC	CLAYEY SANDS, SAND-CLAY MIXTURES, PLASTIC FINES	
FINE GRAINED SOILS (HALF OR MORE OF MATERIAL IS SMALLER THAN #200 SIEVE SIZE)	ML	INORGANIC SILTS AND VERY FINE SANDS, 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	
	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS	
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	

OBSERVED MOISTURE CONDITION

DRY	SLIGHTLY MOIST	MOIST	VERY MOIST	WET (SATURATED)

CONSISTENCY

COARSE GRAINED SOILS			FINE GRAINED SOILS		
BLOWS/FOOT		DESCRIPTIVE TERM	BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER		SPT	CA SAMPLER	
0-10	0-16	LOOSE	0-2	0-3	VERY SOFT
11-30	17-50	MEDIUM DENSE	3-4	4-7	SOFT
31-50	51-83	DENSE	5-8	8-13	MEDIUM STIFF
OVER 50	OVER 83	VERY DENSE	9-15	14-25	STIFF
			16-30	26-50	VERY STIFF
			OVER 30	OVER 50	HARD

GRAIN SIZES

U.S. STANDARD SERIES SIEVE				CLEAR SQUARE SIEVE OPENING		
# 200	# 40	# 10	# 4	3/4"	3"	12"

SILT & CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

TYPICAL BEDROCK HARDNESS

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
EXTREMELY HARD	CORE, FRAGMENT, OR EXPOSURE CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CAN ONLY BE CHIPPED WITH REPEATED HEAVY HAMMER BLOWS
VERY HARD	CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CORE OR FRAGMENT BREAKS WITH REPEATED HEAVY HAMMER BLOWS
HARD	CAN BE SCRATCHED WITH KNIFE OR SHARP PICK WITH DIFFICULTY (HEAVY PRESSURE); HEAVY HAMMER BLOW REQUIRED TO BREAK SPECIMEN
MODERATELY HARD	CAN BE GROOVED 1/16 INCH DEEP BY KNIFE OR SHARP PICK WITH MODERATE OR HEAVY PRESSURE; CORE OR FRAGMENT BREAKS WITH LIGHT HAMMER BLOW OR HEAVY MANUAL PRESSURE
SOFT	CAN BE GROOVED OR GOUGED EASILY BY KNIFE OR SHARP PICK WITH LIGHT PRESSURE, CAN BE SCRATCHED WITH FINGERNAIL; BREAKS WITH LIGHT TO MODERATE MANUAL PRESSURE
VERY SOFT	CAN BE READILY INDENTED, GROOVED OR GOUGED WITH FINGERNAIL, OR CARVED WITH KNIFE; BREAKS WITH LIGHT MANUAL PRESSURE

TYPICAL BEDROCK WEATHERING

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
UNWEATHERED	NO DISCOLORATION, NOT OXIDIZED
SLIGHTLY WEATHERED	DISCOLORATION OR OXIDATION IS LIMITED TO SURFACE OF, OR SHORT DISTANCE FROM, FRACTURES: SOME FELDSPAR CRYSTALS ARE DULL
MODERATELY WEATHERED	DISCOLORATION OR OXIDATION EXTENDS FROM FRACTURES, USUALLY THROUGHOUT; Fe-Mg MINERALS ARE "RUSTY", FELDSPAR CRYSTALS ARE "CLOUDY"
HIGHLY WEATHERED	DISCOLORATION OR OXIDATION THROUGHOUT; FELDSPAR AND Fe-Mg MINERALS ARE ALTERED TO CLAY TO SOME EXTENT, OR CHEMICAL ALTERATION PRODUCES IN SITU DISAGGREGATION
DECOMPOSED	DISCOLORATION OR OXIDATION THROUGHOUT, BUT RESISTANT MINERALS SUCH AS QUARTZ MAY BE UNALTERED; FELDSPAR AND Fe-Mg MINERALS ARE COMPLETELY ALTERED TO CLAY

drafting/masters/Boring Log Legend 062719.dwg

Earth Systems Pacific

Boring No. 1
PAGE 1 OF 1

LOGGED BY: P. Rothwell
DRILL RIG: GTech GT8 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem

JOB NO.: 300933-027
DATE: 4/30/2025

San Luis Obispo High School
Relocation of Modular Restroom
1500 Lizzie Street
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			5.0" Decomposed Granite, slightly moist, medium dense (Fill)					
1	CL		SANDY LEAN CLAY: dark brown, mottled green and orange, moist, hard, iron oxide staining	0.5' - 5.0'	○			9
2				2.0' - 3.5'	■	110.1	15.1	17
3								24
4			SILTSTONE: light to dark grey, moderately weathered, friable, soft (Franciscan Melange)					6
5				5.0' - 6.5'	■	118.8	15.6	10
6								24
7								
8			META-SANDSTONE: light green to brown, fine to medium grained sand, moderately weathered, moderately hard					
9								
10				10' - 10'4"	●	--	--	50/4"
11								
12								
13								
14								30
15				15.0' - 16.0'	●	--	--	50/5"
16			End of Boring @ 16.0'					
17			No subsurface water encountered					
18								
19								
20								
21								
22								
23								
24								
25								
26								

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 2

LOGGED BY: P. Rothwell
DRILL RIG: GTech GT8 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem

PAGE 1 OF 1
JOB NO.: 300933-027
DATE: 4/30/2025

San Luis Obispo High School
Relocation of Modular Restroom
1500 Lizzie Street
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			5.0" Decomposed Granite, slightly moist, medium dense (Fill)					
1	CL		SANDY LEAN CLAY: dark brown, mottled green and orange, moist, soft, iron oxide staining	0.5' - 5.0'	○			3
2				2.0' - 3.5'	■	119.8	11.8	5
3								7
4								
5				5.0' - 6.5'	■	114.9	14.1	3 25
6			META-SANDSTONE: light green to light brown, medium to coarse grained sand, moderately weathered, moderately hard (Franciscan Melange)					50/3"
7								
8								
9								
10				10' - 10.3'	●	--	--	50/3.5"
11			End of Boring @ 10.3' No subsurface water encountered					
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

APPENDIX B

Geotechnical Laboratory Test Results

San Luis Obispo High School
Relocation of Modular Classroom

300933-027

BULK DENSITY TEST RESULTS

ASTM D 2937-17 (modified for ring liners)

May 21, 2025

BORING NO.	DEPTH feet	MOISTURE CONTENT, %	WET DENSITY, pcf	DRY DENSITY, pcf
1	3.0 - 3.5	15.1	126.6	110.1
1	6.0 - 6.5	15.6	137.4	118.8
2	3.0 - 3.5	11.8	134.0	119.8
2	6.0 - 6.5	14.1	131.1	114.9

EXPANSION INDEX TEST RESULTS

ASTM D 4829-21

BORING NO.	DEPTH feet	EXPANSION INDEX
1 & 2	0.0 - 5.0	49

APPENDIX C

Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School, New Classroom Building (ESP 2024), with appendix attachments: Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School, Annex/Classroom Building Report (ESP 2016a); Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School, Swimming Pool and Equipment/Locker Building (ESP 2016b); Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School, Building 100 Modernization (ESP 2018a); and Updated Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School, Track and Stadium Upgrades (ESP 2020)

Additional Assessment of Landslide Hazards Associated with Slopes East of The Site and Response to CGS Review Comments, San Luis Obispo High School, Elevator Tower and Modernization of Building 100 (ESP 2018b)

GEOTECHNICAL ENGINEERING
AND GEOLOGIC HAZARDS REPORT
SAN LUIS OBISPO HIGH SCHOOL
NEW CLASSROOM BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA

October 3, 2024

Prepared for

Mr. Ryan Harrigan
San Luis Coastal Unified School District

Prepared by

Earth Systems Pacific
4378 Old Santa Fe Road
San Luis Obispo, CA 93401

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October 3, 2024

FILE NO.: 300933-026

Mr. Ryan Harrigan
San Luis Coastal Unified School District
937 Southwood Drive
San Luis Obispo, CA 93401

PROJECT: SAN LUIS OBISPO HIGH SCHOOL
NEW CLASSROOM BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA

SUBJECT: Geotechnical Engineering and Geologic Hazards Report

CONTRACT REF: San Luis Coastal Unified School District Purchase Order No. 250887, Referencing Proposal to Provide a Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School, New Classrooms, 1499 San Luis Drive, San Luis Obispo, California, by Earth Systems Pacific, Doc. No SLO-2408-038.PRP, dated August 21. 2024

Dear Mr. Harrigan:

In accordance with the referenced agreement, this geotechnical engineering and geologic hazards report has been prepared for use in the development of plans and specifications for the new classroom building planned at San Luis Obispo High School in San Luis Obispo, California.

The geologic hazards for the campus were addressed for adjacent projects at the site by this firm for four previous nearby projects (ESP 2016a, 2016b, 2018 and 2020). In general, the geologic hazards discussed in those reports have not changed except for the seismic design values that are calculated using methods prescribed by the current California Building Code (CBC) (CBSC 2022). This report provides updated seismic hazard information, where appropriate, and updated seismic design values per the current CBC (CBSC 2022). This report also references the three previous reports (ESP 2016a, 2016b, 2018 and 2020) regarding geologic hazards and subsurface information considered applicable to this project.

Preliminary geotechnical recommendations are presented herein for site preparation, grading, utility trenches, foundations, slabs-on-grade, retaining walls, drainage and maintenance, and observation and testing. An electronic copy of this report is furnished for your use and distribution to others.

We appreciate the opportunity to have provided services for this project and look forward to working with you again in the future. If there are any questions concerning this report, please do not hesitate to contact the undersigned.

Sincerely,

Earth Systems Pacific

REGISTERED PROFESSIONAL ENGINEER Nicholas B. Zoetewey GE 3137 Geotechnical STATE OF CALIFORNIA

Nick Zoetewey, GE
Senior Engineer

REGISTERED GEOLOGIST DARRIN G. HASHAM NO. 2423 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

Darrin Hasham, CEG
Engineering Geologist

Doc. No.: 2410-008.SGR/cr

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APPENDIX E	Typical Detail A: Pipe Placed Parallel to Foundations

1.0 INTRODUCTION

Based on information provided by the client, we understand the proposed New Classroom Building at San Luis Obispo High School will house eight individual classrooms, with a total footprint of approximately 8,400 square feet. The single-story structure will be located south of the Old Gymnasium (See Figures 1 and 2, Site Vicinity Map and Exploration Location Map, respectively, in Appendix A) and across the interior driveway (to the west) of the Main Courtyard. The structure will be of wood stud and/or steel frame construction, and it will be supported by conventional continuous and spread (pad) foundations, with interior concrete slabs-on-grade. Maximum wall and column loads on the order of 1.5 kips per linear foot and 25 kips, respectively, have been assumed. The project will also include exterior pedestrian flatwork with ramps and stairs to provide access as needed, and retaining walls less than 6 feet tall along the north and west sides of the building. Cuts and fills a maximum of 4 feet from the existing topography are anticipated. The new building will be served by the existing campus utility systems, extended underground. No other structures or vehicle pavements are planned. No drainage basins or low impact development/best management practices (LID/BMP) drainage features requiring infiltration testing will be constructed.

This project is under the jurisdiction of the Division of the State Architect (DSA), and it will be designed and constructed under the provisions of the 2022 California Building Code (CBC) (CBSC 2022). Our firm provided a geotechnical engineering and geologic hazards report for each of four previous nearby projects (ESP 2016a, 2016b, 2018 and 2020), whose locations are shown on Figure 2. These reports were approved by the California Geologic Survey (CGS) (2016a, 2016b, 2018 and 2020). Information utilized from those reports is referenced and the reports are provided in Appendix C.

2.0 SCOPE OF SERVICES

The scope of work for this report included the following: a field reconnaissance by a registered geotechnical engineer and a certified engineering geologist; review of the previous reports for nearby projects prepared by this firm (ESP 2016a, 2016b, 2018 and 2020) and attached in Appendix C; subsurface exploration; laboratory testing (geotechnical) on samples obtained during the current field investigation; geotechnical and geologic analyses of the data; and preparation of this report. The analysis and subsequent recommendations were based on the information regarding the project provided by the client.

This report and preliminary geotechnical recommendations are intended to comply with the considerations of Sections 1803A.1 through 1803A.7, J104.3 and J104.4, as applicable, of the 2022 California Building Code (CBC) (CBSC 2022); California Geological Survey (CGS) Note 48 (2022); Interpretation of Regulations (IR) Document A-4 (DSA 2021); and common geotechnical engineering and engineering geology practice in this area under similar conditions at this time. The geotechnical test procedures were accomplished in general conformance with the standards noted, as modified by common geotechnical engineering practice in this area under similar conditions at this time.

Preliminary geotechnical recommendations for site preparation, grading, utility trenches, foundations, slabs-on-grade, retaining walls, drainage and maintenance, and observation and testing are provided in this report. In addition to referencing the geologic hazards previously identified (ESP 2016a, 2016b, 2018 and 2020) that are generally considered valid for this project, we have provided a brief summary of the geologic hazards as well as provided updated seismic hazards and seismic design parameters in this report. The results of corrosivity testing with general conclusions, which were subcontracted to CERCO Analytical for the previous Pool and Equipment/Locker Building Report (ESP 2016b) are also referenced and the report is included in Appendix C. The information presented and referenced in this report is intended to guide the development of project plans and specifications. It is our intent that this geotechnical/geologic report be used exclusively by the client to form the geotechnical/geologic basis of the design, and in the preparation of plans and specifications. Application beyond this intent is strictly at the user's risk.

This report does not address issues in the domain of contractors such as, but not limited to, site safety, loss of volume due to stripping of the site, shrinkage of soils during compaction, excavatability, shoring, protection of existing slabs and foundations, temporary slope angles, dewatering, construction means and methods, etc. Analyses of the soil for mold potential, asbestos in man-made materials, lead, radioisotopes, hydrocarbons, or chemical properties (other than geotechnical corrosivity) are beyond the scope of this report. Ancillary features such as temporary access roads, and nonstructural fills are not within our scope and are also not addressed.

As there may be unresolved geotechnical issues with respect to this project, the geotechnical engineer should be retained to provide consultation as the design progresses, to review project plans as they near completion to assist in verifying that pertinent geotechnical issues have been

addressed and to aid in conformance with the intent of this report. In the event that there are any changes in the design or location of improvements, or if any assumptions used in the preparation of this report prove to be incorrect, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are verified or are modified in writing. The criteria presented in this report are considered preliminary until such time as any peer review or review by any jurisdiction has been completed, conditions are observed by the geotechnical engineer in the field during construction, and the recommendations have been verified as appropriate or modified in writing.

3.0 SITE SETTING

The approximate coordinates and elevation of the project area, as obtained from the Google Earth website (Google Earth 2024), are latitude 35.2846N, longitude 120.6507W, and approximately 262 feet above mean sea level, respectively. As seen on the Exploration Location Map – Figure 2 in Appendix A, the proposed building area is bordered by the Old Gymnasium to the north, the Classroom Annex (Building 900) to the northeast, the Wellness Center and Main Courtyard to the east, the Main Gymnasium, Locker Rooms and Pool to the south, and a turf playfield to the west. The site was previously occupied by portable buildings that have been removed. The locations and dispositions of underground utility lines on or adjacent to the site are unknown.

4.0 FIELD INVESTIGATION AND LABORATORY ANALYSIS

The subsurface exploration for the current field investigation consisted of drilling two exploratory borings in the project area on August 29, 2024, to a maximum depth of approximately 21.5 feet below the existing ground surface (bgs). The borings were drilled with a GTech GT-8 truck mounted drill rig, equipped with 6-inch outside diameter hollow stem auger and an automatic trip hammer for sampling. As the borings were drilled, soil samples were obtained at selected depths using a ring-lined barrel sampler (ASTM D 3550-17 with shoe similar to D 2937-17). Standard Penetration Test (SPT) samples were also obtained at selected depths (ASTM D 1586-18). Additionally, bulk samples were obtained from the auger cuttings. The borings were backfilled with soil cuttings. The approximate locations of the borings are shown on Figure 2 - Exploration Location Map in Appendix A.

Soils encountered in the borings were categorized and logged in general accordance with the Unified Soil Classification System and ASTM D 2488-17. Copies of the boring logs and a Boring Log Legend are also included in Appendix A. In reviewing the boring logs and legend, the reader

should recognize that the legend is intended as a guideline only, and there are a number of conditions that may influence the soil characteristics as observed during drilling. These include, but are not limited to, the presence of cobbles or boulders, cementation, variations in soil moisture, presence of groundwater, and other factors. It should also be noted that the descriptions of bedrock must span a much wider range of density and strength characteristics than soil, and are relative to other *bedrock* strata. For example, fractured and weathered bedrock may be described as "soft," yet it will be considerably harder than almost any type of soil. Conversely, a clay soil may be described as "hard," however it will not be nearly as hard as the "soft" sandstone bedrock encountered on this site. Consequently, the logger must exercise judgement in interpreting the subsurface characteristics, possibly resulting in soil and bedrock descriptions that vary somewhat from the legend.

Ring samples obtained from the currently drilled borings were tested for unit weight and moisture (ASTM D 2937-17, modified for ring liners and ASTM D 2216-19). A bulk sample of the near surface soil was tested for expansion index (ASTM D 4829-21). The current laboratory test results are presented in Appendix B.

5.0 GENERAL SUBSURFACE AND GEOLOGIC PROFILE

The two borings advanced for the current project encountered fill (loose to medium dense, poorly graded sand with gravel) from the surface to a depth of 2 feet bgs in Boring 1, and to 1.5 feet bgs in Boring 2. Below the fill in Boring 1 was alluvium that consisted of stiff to very stiff sandy lean clay and stiff lean clay. At 15 feet bgs in Boring 1, bedrock (soft, intensely weathered sandstone of the Franciscan Mélange) was encountered; the sandstone bedrock extended to the boring termination depth of 21.5 feet bgs. In Boring 2, bedrock (soft, intensely weathered sandstone of the Franciscan Mélange) was encountered directly below the fill; the sandstone bedrock extended to the boring termination depth of 15.25 feet bgs. Similar subsurface conditions (i.e., fill, clayey alluvium and bedrock) were encountered in the explorations performed for the previous field investigations by this firm (ESP 2016a, 2016b, 2018 and 2020).

Subsurface water was not encountered to the maximum depth explored of 21.5 feet bgs in the current borings. Borings referenced for the Track and Stadium Report (ESP 2020) encountered groundwater at approximately 34 feet bgs. Borings drilled for the Annex/Classroom Building (ESP 2016a), the Pool and Equipment/Locker Building (ESP 2016b) and the Building 100 Modernization project (ESP 2018) did not encounter groundwater to the maximum depth explored of up to 31 feet bgs.

Please refer to the logs for the current borings in Appendix A, and to the boring logs in the previous reports by this firm (ESP 2016a, 2016b, 2018 and 2020) in Appendix C for a more complete description of the subsurface conditions encountered at this site and the adjacent sites.

6.0 GEOLOGIC HAZARDS

The geotechnical engineering and geologic hazards report for the Annex/Classroom Building project (ESP 2016a), which is included in Appendix D of the Swimming Pool and Equipment/Locker Building (ESP 2016b), which, in turn, is included in Appendix C of this report, is located approximately 230 feet northwest of this project site. That report, and several of the references noted in it, were reviewed as part of the work scope for this project. Based on the subsurface conditions encountered in the borings for the current project, in our opinion, the conclusions and recommendations with respect to geology, seismicity (with the exception of site class), and geologic hazards presented in the report for the Annex/Classroom Building project (ESP 2016a) would also be valid for this project. The geologic hazards associated with this project are summarized below for the convenience of the reviewers.

- Surface ground rupture – the site is not within a State or County designated special studies zone for earthquake faulting. There are no known faults on-site or trending towards the site.

- Liquefaction – The site is within a County designated area of low liquefaction potential. Sandstone bedrock was encountered at shallow depth during our geotechnical investigation for this project and the potential for liquefaction at the site is considered nil.

- Seismically induced settlement – Due to the relatively shallow depth to bedrock and the presence of stiff to very stiff alluvial clay soils the potential for seismically induced settlement to occur at the site is considered nil.

- Slope stability – The site is within a generally flat and level part of campus with no significant slopes on or adjacent to it that pose a hazard from on-site or off-site slope movements. There is an un-named ridge approximately 650 feet east of campus that is roughly 1,000 feet high. A comprehensive slope stability analysis was performed for the Building 100 project (ESP 2018) and the ridge was deemed not to present a significant landslide hazard to the campus.

- Flooding – Approximately the western half of campus is within a mapped 0.2-percent annual chance flood zone associated with San Luis Obispo Creek; however, this half of campus has primarily been developed with sports fields, tennis courts, and student parking. The site is within an area mapped as Zone X, an area of minimal flood hazard.

- Naturally occurring asbestos (NOA) – The sandstone bedrock and alluvial deposits encountered in the subsurface at the site during our geotechnical investigation are not generally associated with asbestiform minerals and the potential that friable asbestos is encountered during grading and development at the site is extremely low.

- Radon gas – The California Geological Survey has mapped the site as low for indoor radon potential.

7.0 SEISMICITY

Ground Motion Analyses

In accordance with Note 48 (CGS 2022), the 2022 CBC (CBSC 2022) and ASCE 7-16 (2017, 2018 and 2021), an assessment was made to determine the need for employing "Site-Specific Ground Motion Procedures" to calculate the ground motion parameters for the project. Based on our site evaluation utilizing Standard Penetration Tests (SPT) from the current and previous investigations, the subsurface characteristics are those of Site Class C – Very Dense Soil and Soft Rock as defined by Table 20.3-1, Site Classification in ASCE 7-16 (2017); therefore, a site specific ground motion hazard analysis is not required.

The mapped and general procedure ground motion values for Site Class C were obtained from the Structural Engineers Association of California seismic design map tool (SEAOC 2024) using ASCE 7-16 (2017).

The 40 closest faults to the site that potentially could cause severe seismic shaking at the site are summarized in Table D-1, Fault Parameters, presented in Appendix D. Table D-2 in Appendix D is a summary of Historical Earthquakes in the vicinity of the project site, with magnitudes greater than or equal to 5.0.

The primary seismic hazards at the site are from earthquakes generated by the local Oceanic-West Huasna, Los Osos, Rinconada, San Luis Range, and Hosgri faults and the more distant San Andreas fault (USGS 2024). Although these listed faults are thought to potentially generate the most severe seismic shaking at the site, any regional fault could produce seismic shaking at the site.

The 2022 CBC (CBSC 2022) seismic design criteria are based on a Design Earthquake that produces ground motion ⅔ of the maximum considered earthquake (MCE) with 2 percent probability of occurrence in 50 years.

Seismic Design Category

Section 1613A.2.5 of the 2022 CBC (CBSC 2022) states that *structures classified as Risk Category I, II or III that are located where the mapped spectral response acceleration parameter at 1-second period, S_1, is greater than or equal to 0.75 shall be assigned to Seismic Design Category E, others shall be assigned to Seismic Design Category D*. The mapped S_1 for the site, based on Site Class C, is 0.397, which is less than 0.75; therefore, the site should be assigned to Seismic Design Category D.

Seismic Design Parameters

This site may be subject to strong ground shaking due to potential fault movements along regional faults. The minimum seismic design should comply with the 2022 CBC (CBSC 2022) and ASCE 7-16 (2017, 2018, 2021). The resulting seismic coefficients considering Site Class C are summarized in Table 1 below.

Table 1: General Procedure Seismic Parameters (2022 CBC/ASCE 7-16)

Seismic Design Category	D
Site Class	C
Mapped and Code Based Ground Motion	
Short Period Spectral Response, S_s	1.079 g
1 second mapped Spectral Response, S_1	0.397 g
Design Earthquake Ground Motion	
Short Period Spectral Response, S_{DS}	0.863 g
1 second Spectral Response, S_{D1}	0.397 g
Peak Ground Acceleration (PGA_M)	0.574 g
MCE Spectral Response Acceleration	
Short Period Spectral Response, S_{MS}	1.294 g
1 Second Period Spectral Response, S_{M1}	0.596 g
Site Amplification Factors	
Short Period Site Coefficient, F_a	1.20
1 Second Period Site Coefficient, F_v	1.50
Vertical Site Coefficient, C_v	1.116
Risk Coefficient (Short Period), C_{Rs}	0.898
Risk Coefficient (1 Second Period), C_{R1}	0.901

Acceleration values provided are estimates only. Vertical accelerations are typically ⅓ to ⅔ of the horizontal accelerations but can equal or exceed the horizontal accelerations depending upon the fault type, local site effects, and amplification.

8.0 CONCLUSIONS

In our opinion, the site is suitable, from a geotechnical engineering standpoint, for the construction of the proposed classroom building and other improvements as described in the "Introduction" Section of this report, provided the recommendations contained herein are implemented in the design and construction. The primary geotechnical engineering concerns at the site are considered to be the potentials for strong ground shaking, the presence of fill, and the soil's expansion, corrosion, and radon potentials. Frost depth is also discussed. Due to the shallow depth to bedrock, the stiff to very stiff condition of the clays that overlie the bedrock (where present), and the lack of groundwater, there is no potential for liquefaction and seismically induced settlement to affect the project site. Provided that the building area is prepared as recommended in the "Grading" Section of this report, continuous perimeter and interior spread (pad) foundations may be used to support the proposed classroom building.

Strong Ground Shaking

The site is in a region of high seismic activity, with the potential for large seismic events that could generate strong ground shaking. A seismic analysis was undertaken to provide current seismic acceleration design parameters. Our methods and the results of the seismic analysis are presented in the "Seismicity" Section of this report. Seismic acceleration parameters should be utilized in the design of the structures so that potential damage is reduced during a seismic event.

Presence of Fill

Approximately 1.5 to 2.0 feet of fill was found in both borings. The fill was likely placed when the project area was prepared for the portable buildings that previously occupied the site. The fill also appears to have been disturbed when the portable buildings were removed. To create acceptable and relatively uniform bearing and settlement conditions, a program of overexcavation and recompaction of the fill as well as a minor thickness of the underlying alluvium and bedrock, is recommended prior to placement of any additional fill or construction of new foundations.

Expansive Soils

An expansion index test performed on a sample of the alluvial clay soils below the fill produced a result of 55. Per Section 1803A.5.3 of the 2022 CBC (CBSC 2022), the site soils are considered

"expansive." Using the terminology typically associated with the ASTM test method for expansion, the soils are considered to have "medium" expansion potential. Expansive soils tend to swell with seasonal increases in moisture and shrink during the dry season as subsurface moisture decreases. The volume changes that these materials undergo in this cyclical pattern can stress and damage slabs and foundations if precautionary measures are not incorporated into the design and construction procedures. The foundations for the structure should be deepened below typical minimum depths for single-story structures. A layer of imported nonexpansive soil should be placed below all interior slabs-on-grade and exterior pedestrian flatwork. The fill soils, classified during drilling as poorly graded sand with gravel, were judged to be nonexpansive; this classification should be verified during construction. Assuming it is kept segregated from the underlying expansive clays and its expansion potential is verified, the existing fill may be stockpiled for reuse as nonexpansive material during the site grading process.

Corrosion Potential

As indicated in the Corrosivity Test Report by CERCO Analytical for the New Swimming Pool and Equipment/Locker Building project to the south (see Appendix C of ESP 2016b, included in Appendix C of this report) and the Soil Corrosivity Study by HDR, Inc., for the Annex/Classroom Building (ESP 2016a) project to the northeast (see Appendix D of ESP 2016b, included in Appendix C of this report), the soils were classified as severely corrosive to ferrous metals and aggressive to copper. Electrical resistivities of the samples tested were in the moderately corrosive category with as-received moisture contents and became corrosive to severely corrosive when saturated. Soil pH values were mildly alkaline, soluble salt contents were low to moderate, and soil nitrate concentrations were high. In our opinion, the recommendations regarding protection of pipelines, buried concrete structures and other improvements as contained in the Corrosivity Test Report by CERCO Analytical for the New Swimming Pool and Equipment/Locker Building project to the south (see Appendix C of ESP 2016b, included in Appendix C of this report) and the Soil Corrosivity Study by HDR, Inc., for the Annex/Classroom Building project to the northeast (see Appendix D of ESP 2016b, included in Appendix C of this report) would be appropriate for this project.

Radon Potential

The architect/engineer should incorporate appropriate measures in the design and construction of the proposed improvements, as needed, to mitigate the low potential for radon activity.

Frost Depth

The climate in the project area is moderate, and only very occasional surficial frost is anticipated during the coldest periods of the year; no ground freeze to any significant depth is anticipated. Therefore, design of foundations to accommodate frost depth is not considered necessary.

9.0 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

The following recommendations are for improvements constructed as described in the "Introduction" Section of this report. If locations, elevations, structural loads, etc., change, the recommendations contained herein may require modification. In developing the following recommendations, it was assumed that irrigated landscaping or flatwork will be installed within a zone of at least five feet around the perimeter of all improvements; the intent is to keep the soils in a relatively uniform moisture condition year-round.

Unless otherwise noted, the following definitions are used in the recommendations presented below. Where terms are not defined, definitions commonly used in the construction industry are intended.

- **Building Area –** The area within and extending a minimum of 5 feet beyond the perimeter of the new building foundations. The building area includes any retaining walls, walkways or other improvements that are connected to the structure and that are intended to act in a manner similar to it.
- **Sitework Retaining Wall Areas –** The areas within and extending a minimum of 3 feet beyond the foundation limits of all sitework retaining walls.
- **Flatwork Areas –** The areas within the footprints of all exterior pedestrian flatwork.
- **Grading Area –** The entire area to be graded, including the building, any sitework retaining walls and exterior pedestrian flatwork areas.
- **Existing Grade –** Elevations of the site that existed as of the date of this report.
- **Finish Grade –** The planned final elevation of the unimproved soil surface beyond the building, sitework retaining wall and flatwork areas.
- **Subgrade –** The elevation in exterior pedestrian flatwork areas where nonexpansive soils are placed to support flatwork.
- **Scarified –** Plowed or ripped in two orthogonal directions to a depth of not less than 8 inches.

- **Moisture Conditioned –** Adjusting the soil moisture to optimum moisture content, or just above, prior to application of compactive effort, unless stated otherwise.
- **Compacted/Recompacted –** Soils placed in level lifts not exceeding 8 inches in loose thickness and compacted to a minimum of 90 percent of maximum dry density, unless stated otherwise, based on maximum dry density by ASTM D 1557-12/21 and field density by ASTM D 6938-23, or other methods acceptable to the geotechnical engineer and jurisdiction.

Site Preparation

1. The ground surface in the grading areas should be prepared for construction by removing any existing improvements, vegetation, large roots, debris, organic topsoil, and other deleterious materials. Existing utility lines that will not remain in service should be either removed or abandoned. The appropriate method of abandonment will depend upon the type and depth of the utility. Recommendations for abandonment can be made as necessary.

2. Voids created by the removal of materials or utilities described above should be called to the attention of the geotechnical engineer. No fill should be placed unless the underlying soil has been observed by the geotechnical engineer.

3. Assuming its nonexpansive nature is verified, and it is kept clean and segregated from the underlying expansive site clays, the existing poorly graded sand with gravel fill soil may be stockpiled for later reuse as nonexpansive material during the site grading process.

Grading

1. Following site preparation, the existing soils and bedrock within the building area and sitework retaining wall areas should be overexcavated to a level plane at a minimum of 2 feet below lowest existing grade, or 1 foot below the deepest foundation element, whichever is deeper. The resulting excavated surface should be scarified, moisture conditioned, and recompacted.

2. Following site preparation and prior to the placement of any fill, the soil in exterior pedestrian flatwork areas should be removed to proposed subgrade elevation. The resulting excavated soil surfaces should then be scarified, moisture conditioned, and compacted. Please refer to the "Slabs-on-Grade" Section of this report for recommendations regarding placement of imported nonexpansive material below flatwork to provide protection from the expansive site soils.

3. Following site preparation and any excavations to grade, and prior to placement of fill, the soil in all other grading areas should be scarified, moisture conditioned and recompacted.

4. Voids created by dislodging cobbles and/or debris during scarification should be backfilled and recompacted, and the dislodged materials should be removed from the work area.

5. Previously removed site soils may be placed and compacted in thin, moisture conditioned lifts to 18 inches below bottom of slab elevation in the building area. The final 18 inches of fill to support interior slabs-on-grade should be nonexpansive and should be placed in moisture conditioned and compacted lifts.

6. Previously removed site soils and imported nonexpansive materials (if needed) may be placed and compacted in thin, moisture conditioned lifts to subgrade in flatwork areas and to finish grade in the rest of the grading areas.

4. Nonexpansive materials are defined as imported soils that fall in the GW, GM, GC, SP, SW, SC and SM categories per ASTM D 2487-17, and that have an expansion index of 10 or less (ASTM D 4829-21). Assuming its nonexpansive nature is verified, and it is kept clean and segregated from the underlying expansive site clays, the existing poorly graded sand with gravel fill soil may be used as nonexpansive material during the site grading process.

7. All imported soils used in the building area (if required to achieve design grades) should be nonexpansive and should have strength qualities equal to or better than the site soils. In addition, they should not exceed the geotechnical corrosivity potential of the site soils. See the Corrosivity Test Report by CERCO Analytical for the New Swimming Pool and Equipment/Locker Building project to the south (Appendix C of ESP 2016b, included in Appendix C of this report) and the Soil Corrosivity Study by HDR, Inc., for the Annex/Classroom Building project to the northeast (Appendix D of ESP 2016b, included in Appendix C of this report) for the corrosivity parameters of the site soils.

8. Proposed imported materials should be reviewed by the geotechnical engineer before being brought to the site, and on an intermittent basis during placement. In accordance with the requirements of the State of California's Department of Toxic Substances Control, any soil imported to the site should be sourced from SMARA (Surface Mining and

Reclamation Act) approved quarries; non-SMARA quarry material proposed for use should be tested by this firm for the presence of environmental contaminants before being imported to the site.

9. All materials used as fill should be cleaned of any debris and rocks larger than 3 inches in diameter. When fill material includes rocks, the rocks should be placed in a sufficient soil matrix to ensure that voids caused by nesting of the rocks will not occur and that the fill can be properly compacted.

10. All fill (on site or imported) should be placed in thin, moisture conditioned and level lifts, and compacted through the entire building area or the particular grading area being worked.

11. Placement of gravel layers, geotextiles, geogrids, or additional overexcavation may be recommended if loose or unstable conditions are encountered during grading. No fill should be placed in any grading area if the underlying soil is loose or unstable.

12. The recommended soil moisture content should be maintained throughout construction, and during the life of the structure and all other improvements. Failure to maintain the soil moisture content can result in desiccation cracks and disturbance, which are an indication of degradation of the soil compaction. If desiccation cracks are allowed to develop, or if soils near improvements such as foundations, flatwork, etc. are otherwise disturbed, damage to those improvements may result. Soils that have cracked or are otherwise disturbed should be removed, moisture conditioned, and recompacted.

13. The architect/engineer should incorporate appropriate measures for grading operations, as needed, to mitigate the low potential for radon activity.

Utility Trenches

1. Utility trenches adjacent to foundations should not be excavated within the zone of foundation influence, as shown in Typical Detail A in Appendix E.

2. Utilities that must pass beneath foundations should be placed with properly compacted utility trench backfill and the foundation should be designed to span the trench.

3. A select, noncorrosive, easily compacted sand should be used as bedding and shading immediately around utilities. The site soil or approved imported nonexpansive soil may

be used for trench backfill above the select material. In interior slab-on-grade and exterior pedestrian flatwork areas, trench backfill should match the thickness of any imported nonexpansive material designated to support the slabs or flatwork.

4. Prior to applying compactive effort, trench backfill should be moisture conditioned, placed in level lifts not exceeding 6 inches in loose thickness, and compacted to at least 90 percent of maximum dry density.

5. Compaction of trench backfill by jetting or flooding is not recommended at this site, due to the expansive clay soils and bedrock at depth. However, to aid in *encasing* utility conduits, particularly corrugated drainpipes, and multiple, closely spaced conduits in a single trench with the bedding and shading material, jetting or flooding may be useful. Flooding or jetting should only be attempted with extreme caution, and any flooding or jetting operation should be subject to review by the geotechnical engineer.

6. Long-term settlement of properly compacted site soils or imported nonexpansive materials should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill. Improvements that are constructed over or near trenches should be designed to accommodate the potential for settlement.

7. The Corrosivity Test Report by CERCO Analytical for the New Swimming Pool and Equipment/Locker Building project to the south (Appendix C of ESP 2016b, included in Appendix C of this report) and the Soil Corrosivity Study by HDR, Inc., for the Annex/Classroom Building project to the northeast (Appendix D of ESP 2016b, included in Appendix C of this report) should be used by the architect/engineer in specifying appropriate corrosion protection measures for utility improvements.

8. The architect/engineer should incorporate appropriate measures in the design of utility systems, as needed, to mitigate the low potential for radon activity.

9. The recommendations of this section are minimums only and may be superseded by the architect/engineer based upon soil corrosivity or the requirements of pipe manufacturers, utility companies or the governing jurisdiction.

Foundations

1. The building may be supported by continuous and spread footings bearing in firm compacted fill, as recommended in the "Grading" Section of this report.

2. All footings should have a minimum embedment depth of 21 inches below the lowest adjacent grade within 7 feet laterally from the bottom of the footing, and a minimum width of 12 inches. Spread footings should be at least 24 inches square.

3. If footings are excavated with a toothed bucket, then the footing excavation bottoms will be considered disturbed. In this case, all disturbed soil should be moisture conditioned and compacted prior to formwork, reinforcing steel and concrete placement.

4. Continuous footings and grade beams should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential only, minimum continuous footing and grade beam reinforcement should consist of two No. 4 rebar, one at the top and one at the bottom. Spread footing reinforcement should be determined by the architect/engineer.

5. Footings bearing in firm recompacted soil may be designed using maximum allowable bearing capacities of 2,000 psf for dead loads and 3,000 psf for dead plus live loads. Using these criteria, total maximum and differential static settlements are anticipated to be on the order of 0.75-inch and 0.5-inch over a horizontal distance of 25 feet, respectively.

6. Allowable bearing capacities may be increased by one-third when transient loads such as wind or seismicity are included. Foundations may be designed as necessary using the values contained in Table 1: Site-Specific Seismic Parameters in the "Seismicity" Section of this report.

7. To calculate resistance to lateral loads, an ultimate passive equivalent fluid pressure of 350 psf and an ultimate coefficient of friction value of 0.40 can be used. Lateral capacity is based on the assumption that any backfill adjacent to foundations has been properly compacted. Passive and friction components of resistance may be combined in the analysis without reduction to either value.

8. Footing excavations should be observed by the geotechnical engineer prior to placement of reinforcing steel. Footing excavations should be moistened above optimum moisture content, and no desiccation cracks should be present prior to concrete placement.

9. The Corrosivity Test Report by CERCO Analytical for the New Swimming Pool and Equipment/Locker Building project to the south (Appendix C of ESP 2016b, included in Appendix C of this report) and the Soil Corrosivity Study by HDR, Inc., for the Annex/Classroom Building project to the northeast (Appendix D of ESP 2016b, included in Appendix C of this report) should be used by the architect/engineer in specifying appropriate corrosion protection measures for foundations.

10. The architect/engineer should incorporate appropriate measures in the foundation design, as needed, to mitigate the low potential for radon activity.

Slabs-on-Grade

Interior Slabs-on-Grade

1. Interior slabs-on-grade should have a minimum thickness of 4 inches and should be reinforced and doweled to foundations per the specifications of the architect/engineer. At a minimum, interior slabs should be reinforced with No. 3 rebar at 24 inches on center each way, placed as directed by the architect/engineer. All structural slabs should contain minimum rebar meeting the criteria of ACI 318, Section 7.6.1.1 (ACI 2019). At a minimum, foundation dowels should be lap spliced to the slab rebar. The size and spacing of the dowels should match the size and spacing of the slab rebar.

Exterior Pedestrian Flatwork

1. Exterior pedestrian flatwork should have a minimum thickness of 4 inches. Based on soil expansion potential only, minimum reinforcement for exterior pedestrian flatwork should consist of No. 3 rebar placed at 24 inches on-center each way.

2. In conventional construction, it is common to use 4 to 6 inches of imported sand beneath exterior pedestrian flatwork. On this site, due to the medium expansion potential of the site soils, there will be a risk of movement and damage to the flatwork if conventional measures are used. Heaving and cracking could occur. To reduce the potential for movement and damage, flatwork should be supported by up to 18 inches of imported nonexpansive imported soils. The more nonexpansive material provided, the better the protection from the expansive soils.

3. To further reduce the risk of movement of flatwork due to seasonal moisture variations or loss of soil from erosion, thickened edges or grade beams up to 21 inches deep can be provided around the perimeters of the flatwork. The deeper the perimeter thickened edges/grade beams provided, the better the protection from the expansive soils. At a minimum, any thickened edge or grade beam should be reinforced by two No. 4 rebar, one at the top and one at the bottom.

4. It is recognized that the measures recommended in the previous paragraphs for protecting flatwork from expansive soils are an added expense, possibly more expensive than simply replacing flatwork that has moved and/or cracked. Consequently, the above measures for protecting flatwork are only suggestions for consideration by the owner and/or architect/engineer. The degree to which flatwork is protected is left to the discretion of the owner and/or architect/engineer.

5. Flatwork should be constructed with frequent joints to allow articulation as the flatwork moves in response to seasonal soil temperature and moisture variations. The soil below flatwork should be moisture conditioned prior to casting the flatwork.

6. Flatwork at doorways, and at other areas where maintaining the elevation of the flatwork is desired, should be doweled to the perimeter foundations, at a minimum, by No. 3 dowels lapped to the flatwork rebar at 24 inches on center. In other areas, the flatwork may be doweled to the foundation or the flatwork may be allowed to "float free," at the discretion of the architect/engineer. Flatwork that is intended to float free should be separated from foundations by a felt joint or other means.

7. To provide stability for curbs adjacent to exterior pedestrian flatwork, they should be set back a minimum distance equal to one-third the height of any adjacent descending slope, but not less than 5 feet from the tops of slopes. Alternately, curbs may be deepened to provide stability. The geotechnical engineer should review, on an individual basis, any situation where curbs must be deepened to meet this recommendation.

<u>Moisture Vapor Transmission</u>

1. Due to the current use of impermeable floor coverings, water-soluble flooring adhesives, and the speed at which buildings are now constructed, moisture vapor transmission through slabs is a much more common problem than in past years. Where moisture vapor transmitted from the underlying soil would be undesirable, slabs should be protected

from subsurface moisture vapor. A number of options for vapor protection are discussed below; however, the means of vapor protection, including the type and thickness of the vapor retarder, if specified, are left to the discretion of the architect/engineer.

2. Where specified, vapor retarders should conform to ASTM Standard E 1745-17. This standard specifies properties for three performance classes; Class A, B and C. The appropriate class should be selected based on the potential for damage to the vapor retarder during placement of slab reinforcement and concrete. Unless it is determined that a permeance of 0.10 perms will not allow vapor to accumulate beneath moisture-sensitive flooring, adhesives, stored products and/or equipment, then a vapor retarder permeance of 0.010 perms is recommended, per ACI 302.1-15 (ACI 2015). Permeance of vapor retarders should remain below 0.010 perms after the conditioning tests of ASTM E 1745-17/23.

   Note: ASTM E 1745-17/23 has the same permeance threshold for Class A, B and C (0.1 perms). The class that is chosen will make a difference in how resistant the vapor retarder is to punctures and tears, but it will not ensure any better permeance values to protect floor coverings.

3. Several studies, including those of American Concrete Institute Committee 302 (ACI 2015), have concluded that excess water above the vapor retarder increases the potential for moisture damage to floor coverings and could increase the potential for mold growth or other microbial contamination. The studies also concluded that it is preferable to eliminate the typical sand layer beneath the slab and place the slab concrete in direct contact with a Class A vapor retarder, particularly during wet weather construction. However, placing the concrete directly on the vapor retarder requires special attention to using the proper vapor retarder, a very low water-cement ratio in the concrete mix, and special finishing and curing techniques.

4. Another option that may be a reasonable compromise between effectiveness and cost considerations is the use of a subslab vapor retarder protected by a sand layer. If a Class A vapor retarder is specified, the retarder can be placed directly on the subgrade. The retarder should be covered with a minimum 2 inches of clean sand. If a less durable vapor retarder is specified (Class B or C), a minimum of 4 inches of clean sand should be provided, and the retarder should be placed in the center of the clean sand layer. Clean

sand is defined as a well or poorly graded sand (ASTM D 2487-17) of which less than 3 percent passes the No. 200 sieve. Clean sand is considered to be part of the minimum 18 inches of imported nonexpansive materials recommended in the "Grading" Section of this report to be placed below interior slabs-on-grade, not in addition to it.

5. Regardless of the underslab vapor retarder selected, proper installation of the retarder per ASTM E 1643-18a is critical for optimum performance. Where utilized, the vapor retarder should be placed a minimum of 1 inch above the flow line of the drainage path surrounding the structures, or 1 inch above the area drain grates if area drains are used to collect runoff around the structures. As required by ASTM E 1643-18a, all seams and utility penetrations should be properly sealed. At terminating edges of the vapor retarder, the vapor retarder should be effectively sealed with accessories specifically designed to seal the material to new or existing concrete; details for edge sealing of the vapor retarder should be provided by the architect/engineer.

6. If the sand is used between the vapor retarder and the slab, it should be moistened only as necessary to promote concrete curing; saturation of the sand should be avoided, as the excess moisture would be on top of the vapor retarder, potentially resulting in vapor transmission through the slab for months or years.

7. Positive drainage away from the structure should be maintained; see the "Drainage and Maintenance" Section of this report for additional discussion of this issue. If water is allowed to pond near the structure, it may seep into the ground and migrate laterally through cracks or utility penetrations in the foundation, ultimately gaining access above the vapor retarder.

General

1. To reduce shrinkage cracks in flatwork, the concrete aggregates should be of appropriate size and proportion, the water/cement ratio should be low, the concrete should be properly placed and finished, contraction joints should be installed, and the concrete should be properly cured. This is particularly applicable to slabs that will be cast directly upon a vapor retarder and those that will be protected from transmission of vapor by use of admixtures or surface sealers. Concrete materials, placement, and curing specifications should be at the direction of the architect/engineer; AC 302.1R-15 (ACI 2015) is suggested as a resource for the architect/engineer in preparing such specification.

2. The Corrosivity Test Report by CERCO Analytical for the New Swimming Pool and Equipment/Locker Building project to the south (Appendix C of ESP 2016b, included in Appendix C of this report) and the Soil Corrosivity Study by HDR, Inc., for the Annex/Classroom Building project to the northeast (Appendix D of ESP 2016b, included in Appendix C of this report) should be used by the architect/engineer in specifying appropriate corrosion protection measures for flatwork.

3. The architect/engineer should incorporate appropriate measures in the exterior pedestrian flatwork design, as needed, to mitigate the low potential for radon activity.

Retaining Walls

1. Retaining walls should be founded in firm soil that has been recompacted per the "Grading" Section of this report. Foundations for all retaining walls should have minimum overall depths (not including any keyway) of 21 inches below lowest grade within 7 feet laterally of any adjacent slope.

2. Retaining wall footings should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential only, minimum retaining wall footing reinforcement should consist of two No. 4 rebar, one at the top and one at the bottom.

3. Retaining wall design may be based on the following parameters:

Table 2: Retaining Wall Design Parameters

Parameter	Backfill Type	Value
Active Equivalent Fluid Pressure	On Site Soils	45 pcf
	Imported Sand/Gravel	35 pcf
At-rest Equivalent Fluid Pressure	On Site Soils	60 pcf
	Imported Sand/Gravel	50 pcf
Passive Equivalent Fluid Pressure	Recompacted On Site Soils	350 pcf
Maximum Toe Pressure	Recompacted On Site Soils	3,000 psf
Coefficient of Sliding Friction	Recompacted On Site Soils	0.40

4. No surcharges are taken into consideration in the values presented in the previous paragraph. The maximum toe pressure is an *allowable* value; no factors of safety, load factors or other factors have been applied to the remaining values. With the exception of

the maximum toe pressure, these values will require application of appropriate factors of safety, load factors, and/or other factors as deemed appropriate by the architect/engineer.

5. The upper foot of backfill behind all retaining walls should consist of native or similar imported soil per the "Grading" Section of this report, except in areas where pedestrian flatwork will abut the top of the wall. In such cases, the backfill should extend to the nonexpansive or other select material below the improved surface, as appropriate. If gravel backfill is utilized, the gravel should be encased in a permeable synthetic filter fabric conforming to standard specification section 96-1.02B – Class C (Caltrans 2024).

6. The active and at-rest pressures presented in Table 2 are applicable to a horizontal retained surface behind the wall. Walls having a retained surface that slopes upward from the wall should be designed for an additional equivalent fluid pressure of 1 pcf for the active case and 1.5 pcf for the at-rest case, for every degree of slope inclination.

7. It is assumed that retaining wall heights will not exceed 6 feet; therefore, per Section 1803A.5.12.1 of the CBC (CBSC 2022), dynamic seismic lateral earth pressures are not required for the design. If retaining walls are planned that will retain more than 6 feet of backfill, the geotechnical engineer should be notified to provide updated earthwork recommendations and dynamic seismic lateral earth pressure increments, as needed.

8. Long-term settlement of properly compacted site soils, as well as imported sand or gravel retaining wall backfill should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill. Improvements that are constructed near the tops of retaining walls should be designed to accommodate long-term settlement.

9. All retaining walls should be drained with perforated pipe encased in a free-draining gravel blanket. The pipe should be placed with perforations facing downward and should discharge in a nonerosive manner away from foundations and other improvements. The gravel blanket should have a width of approximately 1 foot and should extend upward to approximately 1 foot from the top of the wall backfill. The upper foot should be backfilled with native soil, except in areas where flatwork will abut the top of the wall. In such cases, the gravel should extend to the nonexpansive or other select material per the "Grading" Section of this report below the improved surface, as appropriate. To reduce infiltration of the soil into the gravel blanket, a permeable synthetic filter fabric conforming to

Standard Specifications Section 96-1.02B – Class C (Caltrans 2024), should be placed between the two materials. Manufactured synthetic drains, such as Miradrain or Enkadrain are acceptable alternatives to the use of gravel, provided that they are installed in accordance with the recommendations of the manufacturer.

10. Where weep hole drainage can be properly discharged, the perforated pipe may be omitted in lieu of weep holes on maximum 4-foot centers. A filter fabric as described above should be placed between the weep holes and the drain gravel.

11. Walls facing areas where moisture transmission through the wall would be undesirable should be thoroughly waterproofed in accordance with the specifications of the architect/engineer.

12. The architect/engineer should bear in mind that retaining walls by their nature are flexible structures, and that surface treatments on walls often crack. Where walls are to be plastered or otherwise have a finish applied, the flexibility should be considered in determining the suitability of the surfacing material, spacing of horizontal and vertical control joints, etc. The flexibility should also be considered where a retaining wall will abut or be connected to a rigid structure, and where the geometry of the wall is such that its flexibility will vary along its length.

13. The Corrosivity Test Report by CERCO Analytical for the New Swimming Pool and Equipment/Locker Building project to the south (Appendix C of ESP 2016b, included in Appendix C of this report) and the Soil Corrosivity Study by HDR, Inc., for the Annex/Classroom Building project to the northeast (Appendix D of ESP 2016b, included in Appendix C of this report) should be used by the architect/engineer in specifying appropriate corrosion protection measures for retaining walls.

14. The architect/engineer should incorporate appropriate measures in the design of retaining walls to mitigate the low potential for radon activity.

Drainage and Maintenance

1. Per Section 1804A.4 of the CBC (CBSC 2022) unpaved ground surfaces should be *finish graded* to direct surface runoff away from foundations and other improvements at a minimum 5 percent grade for a minimum distance of 10 feet. The site should be similarly sloped to drain away from foundations, and other improvements during construction.

Where this is not practicable due to other improvements, etc., swales with improved surfaces, area drains, or other drainage facilities, should be used to collect and discharge runoff.

2. All eaves of the building should be fitted with roof gutters. Runoff from flatwork, roof gutters, downspouts, planter drains, area drains, etc. should discharge in a non-erosive manner away from foundations and other improvements in accordance with the requirements of the governing agencies. Erosion protection should be placed at all discharge points unless the discharge is to an improved surface.

3. To reduce the potential for planter drainage gaining access to subslab areas, any raised planter boxes adjacent to foundations should be installed with drains and sealed sides and bottoms. Drains should also be provided for areas adjacent to the structures and in landscape areas that would not otherwise freely drain.

4. If soils are disturbed during construction, stabilization of soils by vegetation or other means, *during* and *following* construction, is essential to reduce erosion damage. Care should be taken to establish and maintain vegetation. The landscaping should be planned and installed to maintain the surface drainage recommended above. Surface drainage should also be maintained during construction.

5. Maintenance of drainage and other improvements is critical to the long-term stability of the site and the integrity of the structure. Site improvements should be maintained on a regular basis.

6. Finished flatwork surfaces should be sloped to freely drain toward appropriate drainage facilities. Water should not be allowed to stand or pond on or adjacent to exterior pedestrian flatwork, or other improvements as it could infiltrate into the supporting soil, causing premature deterioration of flatwork or other improvements.

7. All exterior drains and drain outlets should be maintained to be free-flowing. Care should be taken to establish and maintain vegetation. Vegetation and erosion matting (if utilized) should be maintained or augmented as needed. Irrigation systems should be maintained so that soils around the structure are maintained at a relatively uniform year-round moisture content and are neither over-watered nor allowed to dry and desiccate.

8. To reduce the potential for disruption of drainage patterns and undermining of structures, fill areas, etc., all rodent activity should be aggressively controlled.

Observation and Testing

1. The recommendations contained in this report are based on a limited number of borings and rely on continuity of the subsurface conditions encountered.

2. It is assumed that the geotechnical engineer will be retained to provide consultation during the design phase, to interpret this report during construction, and to provide construction monitoring in the form of testing and observation.

3. At a minimum, the geotechnical engineer should be retained to provide:

    - Review of project plans as they near completion, to determine compliance with the recommendations of this report
    - Professional observation during grading, trench and retaining wall backfill, and foundation construction
    - Oversight of special inspection and compaction testing grading, trench and retaining wall backfill, and foundation construction

4. Special inspection of grading and backfill should be provided as per Section 1705A.6 and Table 1706A.6 of the CBC (CBSC 2022). The special inspector should be under the direction of the geotechnical engineer and/or the engineering geologist. At a minimum, the following items should be inspected and/or tested by the special inspector:

    - Stripping and clearing of all existing improvements, vegetation, and deleterious materials
    - Segregation and stockpiling of the existing on-site fill soils (if applicable)
    - Overexcavation to the recommended depth
    - Scarification and moisture conditioning of soil prior to compaction
    - Fill quality, placement, moisture conditioning and compaction
    - Utility trench backfill
    - Foundation excavations
    - Retaining wall drains and backfill

5. A program of quality assurance should be developed prior to beginning construction. At a minimum, the program should include all geotechnical items shown on the testing and inspection schedule of the approved plans. It should also include any additional inspection items required by the engineer and/or the governing jurisdiction. These items should be discussed at a preconstruction site meeting among a representative of the owner, the geotechnical engineer, special inspector, the project inspector, the engineer, and contractors. The geotechnical engineer should be notified at least 48 hours prior to beginning grading operations.

6. Locations and frequency of compaction tests should be per the recommendation of the geotechnical engineer at the time of construction. The recommended test location and frequency may be subject to modification by the geotechnical engineer, based upon soil and moisture conditions encountered, size and type of equipment used by the contractor, the general trend of the results of compaction tests, or other factors.

10.0 CLOSURE

Our intent was to perform the investigation in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the locality of this project under similar conditions. No representation, warranty, or guarantee is either expressed or implied. This report is intended for the exclusive use by the client as discussed in the “Scope of Services” Section. Application beyond the stated intent is strictly at the user's risk.

This report is valid for conditions as they exist at this time for the type of project described herein. The conclusions and recommendations contained in this report could be rendered invalid, either in whole or in part, due to changes in building codes, regulations, standards of geotechnical or construction practice, changes in physical conditions, or the broadening of knowledge.

If changes with respect to the project become necessary, if items not addressed in this report are incorporated into plans, or if any of the assumptions used in the preparation of this report are not correct, this firm shall be notified for modifications to this report. Any items not specifically addressed in this report should comply with the CBC of other applicable standards, and the requirements of the governing jurisdiction.

The preliminary recommendations presented in this geotechnical report are based upon the geotechnical conditions encountered at the site and may be augmented by additional requirements of the client, or by additional recommendations provided by the geotechnical

engineer based on peer or jurisdiction reviews, or conditions exposed at the time of construction. If Earth Systems Pacific is *not* retained to provide construction observation and testing services, it shall not be responsible for the interpretation of the information by others or any consequences arising therefrom.

This document, the data, conclusions, and recommendations contained herein are the property of Earth Systems Pacific. This report shall be used in its entirety, with no individual sections reproduced or used out of context. Copies may be made only by Earth Systems Pacific, the client, and the client's authorized agents for use exclusively on the subject project. Any other use is subject to federal copyright laws and the written approval of Earth Systems Pacific.

Thank you for this opportunity to have been of service. If you have any questions, please feel free to contact this office at your convenience.

End of Text.

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APPENDIX A

Figure 1 – Site Vicinity Map
Figure 2 - Exploration Location Map
Boring Log Legend
Boring Logs



N

NOT TO SCALE

BASE MAP PROVIDED BY: Google Earth (2024)

Earth Systems Pacific
4378 Old Santa Fe Road, San Luis Obispo, CA 93401
www.earthsystems.com
(805) 544-3276 • Fax (805) 544-1786

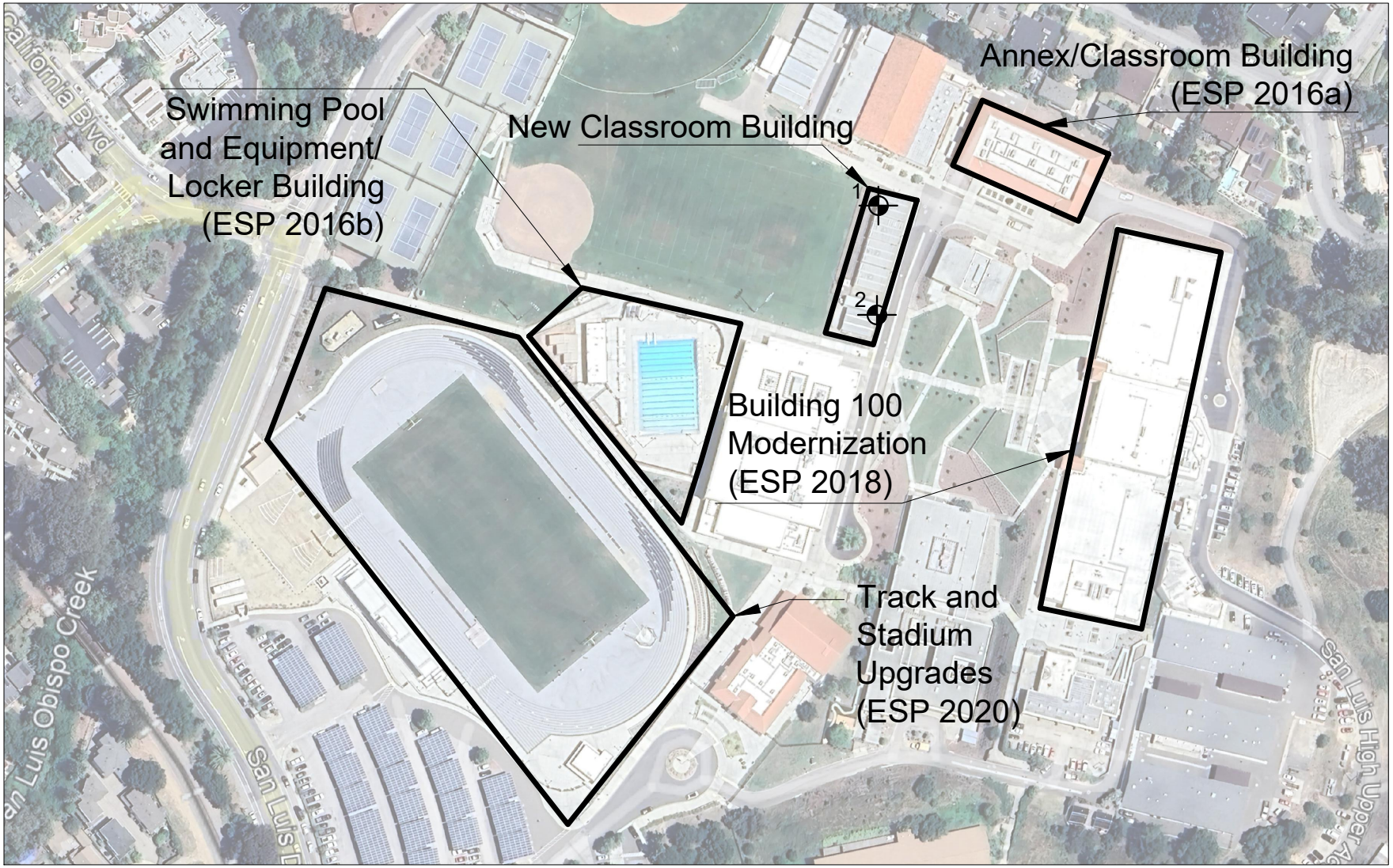
SITE VICINITY MAP

San Luis Obispo High School
New Classroom Building
1499 San Luis Drive
San Luis Obispo, California

Date
October 2024

Project No.
300933-026

Figure 1



LEGEND

Boring Location (Approx.)

BASE MAP PROVIDED BY: Google Earth (2024)

N

NOT TO SCALE

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(805) 544-3276 • Fax (805) 544-1786

EXPLORATION LOCATION MAP

San Luis Obispo High School
New Classroom Building
1499 San Luis Drive
San Luis Obispo, California

Date
October 2024

Project No.
300933-026

Figure 2

Earth Systems Pacific

BORING LOG LEGEND

SAMPLE / SUBSURFACE WATER SYMBOLS	GRAPH. SYMBOL
CALIFORNIA MODIFIED	
STANDARD PENETRATION TEST (SPT)	
SHELBY TUBE	
BULK	
SUBSURFACE WATER DURING DRILLING	
SUBSURFACE WATER AFTER DRILLING	

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

MAJOR DIVISIONS	GROUP SYMBOL	TYPICAL DESCRIPTIONS	GRAPH. SYMBOL
COARSE GRAINED SOILS (MORE THAN HALF OF MATERIAL IS LARGER THAN #200 SIEVE SIZE)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GP	POORLY GRADED GRAVELS, OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, NON-PLASTIC FINES	
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, PLASTIC FINES	
	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
	SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES	
	SM	SILTY SANDS, SAND-SILT MIXTURES, NON-PLASTIC FINES	
	SC	CLAYEY SANDS, SAND-CLAY MIXTURES, PLASTIC FINES	
FINE GRAINED SOILS (HALF OR MORE OF MATERIAL IS SMALLER THAN #200 SIEVE SIZE)	ML	INORGANIC SILTS AND VERY FINE SANDS, 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	
	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS	
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	

OBSERVED MOISTURE CONDITION

DRY	SLIGHTLY MOIST	MOIST	VERY MOIST	WET (SATURATED)

CONSISTENCY

COARSE GRAINED SOILS			FINE GRAINED SOILS		
BLOWS/FOOT		DESCRIPTIVE TERM	BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER		SPT	CA SAMPLER	
0-10	0-16	LOOSE	0-2	0-3	VERY SOFT
11-30	17-50	MEDIUM DENSE	3-4	4-7	SOFT
31-50	51-83	DENSE	5-8	8-13	MEDIUM STIFF
OVER 50	OVER 83	VERY DENSE	9-15	14-25	STIFF
			16-30	26-50	VERY STIFF
			OVER 30	OVER 50	HARD

GRAIN SIZES

U.S. STANDARD SERIES SIEVE				CLEAR SQUARE SIEVE OPENING		
# 200	# 40	# 10	# 4	3/4"	3"	12"

SILT & CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

TYPICAL BEDROCK HARDNESS

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
EXTREMELY HARD	CORE, FRAGMENT, OR EXPOSURE CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CAN ONLY BE CHIPPED WITH REPEATED HEAVY HAMMER BLOWS
VERY HARD	CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CORE OR FRAGMENT BREAKS WITH REPEATED HEAVY HAMMER BLOWS
HARD	CAN BE SCRATCHED WITH KNIFE OR SHARP PICK WITH DIFFICULTY (HEAVY PRESSURE); HEAVY HAMMER BLOW REQUIRED TO BREAK SPECIMEN
MODERATELY HARD	CAN BE GROOVED 1/16 INCH DEEP BY KNIFE OR SHARP PICK WITH MODERATE OR HEAVY PRESSURE; CORE OR FRAGMENT BREAKS WITH LIGHT HAMMER BLOW OR HEAVY MANUAL PRESSURE
SOFT	CAN BE GROOVED OR GOUGED EASILY BY KNIFE OR SHARP PICK WITH LIGHT PRESSURE, CAN BE SCRATCHED WITH FINGERNAIL; BREAKS WITH LIGHT TO MODERATE MANUAL PRESSURE
VERY SOFT	CAN BE READILY INDENTED, GROOVED OR GOUGED WITH FINGERNAIL, OR CARVED WITH KNIFE; BREAKS WITH LIGHT MANUAL PRESSURE

TYPICAL BEDROCK WEATHERING

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
UNWEATHERED	NO DISCOLORATION, NOT OXIDIZED
SLIGHTLY WEATHERED	DISCOLORATION OR OXIDATION IS LIMITED TO SURFACE OF, OR SHORT DISTANCE FROM, FRACTURES: SOME FELDSPAR CRYSTALS ARE DULL
MODERATELY WEATHERED	DISCOLORATION OR OXIDATION EXTENDS FROM FRACTURES, USUALLY THROUGHOUT; Fe-Mg MINERALS ARE "RUSTY", FELDSPAR CRYSTALS ARE "CLOUDY"
HIGHLY WEATHERED	DISCOLORATION OR OXIDATION THROUGHOUT; FELDSPAR AND Fe-Mg MINERALS ARE ALTERED TO CLAY TO SOME EXTENT, OR CHEMICAL ALTERATION PRODUCES IN SITU DISAGGREGATION
DECOMPOSED	DISCOLORATION OR OXIDATION THROUGHOUT, BUT RESISTANT MINERALS SUCH AS QUARTZ MAY BE UNALTERED; FELDSPAR AND Fe-Mg MINERALS ARE COMPLETELY ALTERED TO CLAY

drafting/masters/Boring Log Legend 062719.dwg

Earth Systems Pacific

Boring No. 1

LOGGED BY: T. Robison
DRILL RIG: GTech GT-8 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem

PAGE 1 OF 1
JOB NO.: 300933-026
DATE: 8/29/2024

San Luis Obispo High School
New Classroom Building
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0 - 1 - 2	SP		POORLY GRADED SAND WITH GRAVEL: light brown, loose to medium dense, slightly moist (Fill)	2.0 - 5.0	◯			
2 - 3 - 4	CL		SANDY LEAN CLAY: dark brown, very stiff, slightly moist (Alluvium)	2.0 - 3.5	▬	97.1	23.1	4 11 15
5 - 6 - 7 - 8 - 9			stiff, orange mottles	5.0 - 6.5	▬	107.4	22.7	3 6 9
10 - 11 - 12 - 13 - 14	CL		LEAN CLAY: brown, stiff, slightly moist	10.0 - 11.5	▬	103.6	20.0	5 9 13
15 - 16 - 17 - 18 - 19 - 20 - 21			SANDSTONE: light brown, soft, intensely weathered, slightly moist (Franciscan Melange)	15.0 - 16.5	▬	---	---	30 50/4"
				20.0 - 21.5	●	---	---	15 29 49
22 - 23 - 24 - 25 - 26			End of Boring @ 21.5' No subsurface water encountered					

LEGEND: ▬ Ring Sample ◯ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 2

LOGGED BY: T. Robison
DRILL RIG: GTech GT-8 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem

JOB NO.: 300933-026
DATE: 8/29/2024

San Luis Obispo High School
New Classroom Building
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0 - 1	SP		POORLY GRADED SAND WITH GRAVEL: light brown, loose to medium dense, slightly moist (Fill)					
2 - 3			SANDSTONE: light brown, soft, intensely weathered, slightly moist (Franciscan Melange)	2.0 - 3.5	■	NO RECOVERY		50/4"
5 - 6				5.0 - 5.25	■	NO RECOVERY		50/3"
				5.25 - 5.5	●	NO RECOVERY		50/2"
10 - 11				10.0 - 10.2	●	---	---	50/2"
15				15.0 - 15.25	●	---	---	50/3"
16 - 26			End of Boring @ 15.25' No subsurface water encountered					

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

APPENDIX B

Geotechnical Laboratory Test Results

San Luis Obispo High School
New Classroom Building

300933-026

BULK DENSITY TEST RESULTS

ASTM D 2937-17 (modified for ring liners)

September 20, 2024

BORING NO.	DEPTH feet	MOISTURE CONTENT, %	WET DENSITY, pcf	DRY DENSITY, pcf
1	3.0 - 3.5	23.1	119.5	97.1
1	6.0 - 6.5	22.7	131.8	107.4
1	11.0 - 11.5	20.0	124.4	103.6

EXPANSION INDEX TEST RESULTS

ASTM D 4829-21

BORING NO.	DEPTH feet	EXPANSION INDEX
1	0.0 - 5.0	55

APPENDIX C

Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School, Swimming Pool and Equipment/Locker Building (ESP 2016b), with Annex/Classroom Building Report (ESP 2016a) attached

Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School, Building 100 Modernization (ESP 2018)

Updated Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School, Track and Stadium Upgrades (ESP 2020)

GEOTECHNICAL ENGINEERING
AND GEOLOGIC HAZARDS REPORT
SAN LUIS OBISPO HIGH SCHOOL – MEASURE D PROJECTS
NEW SWIMMING POOL AND EQUIPMENT/LOCKER BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3104

February 23, 2016

Prepared for

Mr. Anthony Palazzo
Director – Buildings, Grounds and Transportation
San Luis Coastal Unified School District

Prepared by

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4378 Old Santa Fe Road
San Luis Obispo, CA 93401

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February 23, 2016

FILE NO.: SL-16605-SD

Mr. Anthony Palazzo
Director – Buildings, Grounds and Transportation
San Luis Coastal Unified School District
937 Southwood Drive
San Luis Obispo, CA 93401

PROJECT: SAN LUIS OBISPO HIGH SCHOOL – MEASURE D PROJECTS
NEW SWIMMING POOL AND EQUIPMENT/LOCKER BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3104

SUBJECT: Geotechnical Engineering and Geologic Hazards Report

CONTRACT REF: Purchase Order No. 161191 for a Geotechnical Engineering and Geologic Hazards Report, with Corrosivity Testing and Evaluation, by San Luis Coastal Unified School District, dated December 7, 2015

Dear Mr. Palazzo:

In accordance with the referenced Purchase Order, this geotechnical engineering and geologic hazards report has been prepared for use in the development of plans and specifications for the new swimming pool to be constructed at San Luis Obispo High School in San Luis Obispo, California. Preliminary geotechnical recommendations for site preparation, grading, utility trenches, the swimming pool, foundations, slabs-on-grade, drainage and maintenance, and observation and testing are presented herein. Our evaluation of geologic hazards is by reference to our investigation and report submitted recently for the proposed Annex/Classroom Building project to the north of this site, and updated as applicable for the subsurface conditions encountered in the exploratory borings for this project. The results of geotechnical corrosivity testing, which was subcontracted to CERCO Analytical of Concord, California, are also included. Two bound copies and an electronic copy of this report are furnished for your use.

We appreciate the opportunity to have provided services for this project and look forward to working with you again in the future. If there are any questions concerning this report, please do not hesitate to contact the undersigned.

Sincerely,
Earth Systems Pacific

Fred J. Pothast, GE
Principal Engineer

2/23/16

Doc. No.: 1602-171 SoR/ac

REGISTERED PROFESSIONAL ENGINEER
FREDERICK J. POTHAST
No. GE 2369
EXP. 03/31/17
GEOTECHNICAL
STATE OF CALIFORNIA

Richard T. Gorman, CEG
Principal Geologist

PROFESSIONAL GEOLOGIST
RICHARD T. GORMAN
No. CEG 1325
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

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APPENDIX E	Typical Detail A: Pipe Placed Parallel to Foundations Tremie Method

1.0 INTRODUCTION AND SITE SETTING

A new swimming pool and an equipment/locker building are planned for San Luis Obispo High School, 1499 San Luis Drive, in San Luis Obispo, California. The new facilities will be constructed in the approximate center of the campus, immediately north of the football field/track and west of the gymnasium. The area is currently utilized as the varsity baseball practice field, with dirt base paths, a grass infield, dugouts and a high fence backstop. The tennis court facility is to the west beyond the outfield, and turf playfields are to the north. The site is flat, with a barely perceptible slope to the south.

The pool will measure approximately 25 meters by 33 meters, and will range in depth from 6 to 13.5 feet. It will be of reinforced shotcrete construction, with Portland cement concrete (PCC) slab-on-grade decks. Low portable viewing stands may be placed around the pool, and light duty shade structures (i.e., net frames, large umbrellas, etc.) a maximum of 15 feet tall may also be provided. A single-story masonry equipment/locker building will be constructed to the west of the pool; it will be approximately 500 square feet in plan. The equipment/locker building is planned to be supported by conventional continuous and spread (pad) footings, with concrete slabs-on-grade. Maximum continuous loads of 2 klf and maximum isolated loads of 20 kips have been assumed. The shade structures may be supported by spread footings or drilled, cast-in-place concrete caissons; maximum loads of 2 kips have been assumed for these structures. Finish elevations of the pool decks and the equipment/locker building are expected to be a maximum of 1 foot above the existing topography. The facility will likely be enclosed by perimeter chain-link security fencing, and it could have small landscaping areas. No retaining walls, vehicle pavement, drainage basins, or LID improvements are planned. The existing campus utility systems will be extended to serve this new facility.

The approximate site coordinates and site elevation obtained from the Google Earth website (Europa Technologies 2016) are latitude 35.2841N, longitude 120.6510W, and 265 feet above mean sea level. The exact locations and dispositions of existing utility lines on the site are unknown.

2.0 SCOPE OF SERVICES

The scope of work for this report consisted of the following: a general site reconnaissance by a registered geotechnical engineer; subsurface exploration by drilled borings; geotechnical and corrosivity laboratory testing of samples secured from the borings; review of the geotechnical engineering and geologic hazards report for the nearby Annex/Classroom Building project (ESP

2016); geotechnical and geologic analyses of the data; and preparation of this report. The analysis and subsequent recommendations were based on general information provided by the client, and a concept site plan for the school (PMSM Architects 2015).

This report and preliminary geotechnical recommendations are intended to comply with the considerations of Sections 1803A.1 through 1803A.7, J104.3 and J104.4, as applicable, of the 2013 California Building Code (CBC); California Geological Survey Note 48 (CGS 2011); Interpretation of Regulations (IR) Document A-4.13 (DSA 2013); and common geotechnical engineering and engineering geology practice in this area under similar conditions at this time. The geotechnical test procedures were accomplished in general conformance with the standards noted, as modified by common geotechnical engineering practice in this area under similar conditions at this time.

Preliminary geotechnical recommendations for site preparation, grading, utility trenches, the swimming pool, foundations, slabs-on-grade, drainage and maintenance, and observation and testing are presented to guide the development of project plans and specifications. The results of the corrosivity analysis subcontracted to CERCO Analytical are also included. It is our intent that this geotechnical/geologic report be used exclusively by the client in the preparation of plans and specifications. Application beyond this intent is strictly at the user's risk.

As there may be geotechnical issues yet to be resolved, the geotechnical engineer should be retained to provide consultation as the design progresses, to assist in verifying that the pertinent geotechnical issues have been addressed and to aid in the conformance with the intent of this report. It may also be advantageous to retain the geotechnical engineer to review the project plans as they near completion, to further aid in conformance of the plans with the intent of this report.

General geotechnical conclusions regarding dewatering are provided. However, this report does not address dewatering methods and other issues in the domain of contractors such as, but not limited to, site safety, loss of volume due to stripping of the site, shrinkage of soils during compaction, excavatability, shoring, temporary slope angles, construction means and methods, etc. Analyses of the soil for mold potential, man-made asbestos, lead, radioisotopes, hydrocarbons, or chemical properties (other than geotechnical corrosivity) are beyond the scope of this report. Ancillary features such as temporary access roads, fences, flag and light poles, signage; and nonstructural fills are not within our scope and are also not addressed.

In the event that there are any changes in the nature, design, or location of improvements, or if any assumptions used in the preparation of this report prove to be incorrect, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are verified or are modified in writing. The criteria presented in this report are considered preliminary until such time as any peer review or review by any jurisdiction has been completed, conditions are observed by the geotechnical engineer in the field during construction, and the recommendations have been verified as appropriate or modified in writing.

3.0 FIELD INVESTIGATION

On December 30, 2015, four exploratory borings were drilled to a maximum of 26.5 feet below the existing ground surfaces. The borings were drilled with a Mobile Drill Model B-53 truck mounted drill rig, equipped with a 6-inch outside diameter hollow stem auger and an automatic trip hammer for sampling. The approximate locations of the borings are shown on the Boring Location Map presented in Appendix A. As the borings were drilled, soil samples were obtained using a ring-lined barrel sampler (ASTM D 3550-01/07 with shoe similar to D 2937-10). Standard penetration tests were also performed (ASTM D 1586-11) at selected depths. Bulk soil samples were obtained from the auger cuttings. The borings were backfilled per the requirements of the governing jurisdiction.

Soils encountered in the borings were categorized and logged in general accordance with the Unified Soil Classification System and ASTM D 2488-09a. Copies of the boring logs and a Boring Log Legend are included in Appendix A. In reviewing the boring logs and legend, the reader should recognize that the legend is intended as a guideline only, and there are a number of conditions that may influence the soil characteristics as observed during drilling. These include, but are not limited to, the presence of cobbles or boulders, cementation, variations in soil moisture, presence of groundwater, and other factors. Consequently, the logger must exercise judgment in interpreting the subsurface characteristics, possibly resulting in soil descriptions that vary somewhat from the legend.

4.0 LABORATORY ANALYSIS

All ring samples obtained from the borings were tested for unit weight and moisture (ASTM D 2937-10, modified for ring liners). Bulk samples were tested for maximum density and optimum moisture content (ASTM D 1557-12), expansion index (ASTM D 4829-11), and cohesion and angle of shearing resistance by direct shear (ASTM D 3080-11, recompacted to 90 percent of maximum dry density, and modified for consolidated, undrained conditions). One SPT sample was tested for plasticity index (ASTM D 4318-10). The geotechnical laboratory test results are presented in Appendix C.

Two soil samples were submitted to CERCO Analytical for geotechnical corrosivity testing. CERCO Analytical's Corrosivity Analysis is presented in Appendix D.

5.0 GENERAL SUBSURFACE AND GEOLOGIC PROFILE

The subsurface soil and geologic profile observed in the borings generally consisted of fill over alluvium. The fill was stiff sandy lean clay and medium dense to dense clayey sand, both with varying percentages of gravel. In Boring 3, the clayey sand between 9.5 and 12 feet was loose; in Boring 4, a layer of loose silty sand was encountered between 10 and 11 feet. In Boring 1, the upper 1 foot was topsoil; approximately 4 feet of poorly graded gravel up to 2 inches in greatest dimension was below the topsoil. The alluvium encountered at depth in all four borings was medium stiff to stiff sandy fat clay.

A petroleum odor was noted in the auger cuttings in Boring 4 below 21 feet, and hydrocarbon material was visible in the sample at 25 feet.

During drilling, the soils were classified as being slightly moist to moist. Please refer to the logs in Appendix A for a more complete description of the subsurface conditions encountered in the borings.

6.0 GROUNDWATER

Subsurface water was not encountered in any of the borings to the maximum depth explored of 26.5 feet.

7.0 GEOLOGY, SEISMICITY AND GEOLOGIC HAZARDS

A geotechnical engineering and geologic hazards report was recently completed by this firm for the Annex/Classroom Building project (ESP 2016), which is approximately 500 feet northwest of this project site. That report, and several of the references noted in it, were reviewed as part of the work scope for this project. Based on the subsurface conditions encountered in the borings for this project, in our opinion, the conclusions and recommendations with respect to geology, seismicity and geologic hazards presented in the report for the Annex/Classroom Building project (ESP 2016) would also be valid for this project; a copy of the report is included in Appendix D.

8.0 CONCLUSIONS

In our opinion, the site is suitable, from a geotechnical engineering and geologic hazards standpoint, for the proposed swimming pool, equipment/locker building and other site improvements, as described in the "Introduction and Site Setting" Section of this report, provided

the recommendations contained herein are implemented in the design and construction. In our opinion, the primary geotechnical engineering concerns are: 1) the presence of undocumented fill, 2) the potential for instability of soils at depth during excavations for the pool; 3) the expansion potential of the site soils; 4) the potential for subsurface water; 5) the erodible nature of the site soils; 6) the corrosive potential of the site soils, and 7) the petroleum odor and visible hydrocarbon material encountered at depth in Boring 4. General geotechnical conclusions regarding dewatering are provided, however determination of the need for dewatering and design of dewatering systems are the domain of the contractor.

Provided that the building area is prepared as recommended in the "Grading" Section of this report, continuous and spread (pad) foundations may be used to support the proposed equipment/locker building.

Undocumented Fill

Fill was encountered to depths ranging from 11 to 13.5 feet below existing grade in all four borings drilled for this project. We are unaware of any documentation (i.e., reports of grading observation and records of compaction testing) regarding the placement of this fill. Based on information gathered during discussions with the client, it appears that this fill may have been placed during site grading to prepare the building areas for the structures to the east, in excess of 40 years ago. In general, undocumented fill is considered to have a greater potential for variability than fill that has been placed and tested in a controlled earthwork program. This variability could stress and possibly damage foundations, possibility resulting in severe cracks and displacement, if the variable conditions are not mitigated. However, considering the improvements planned and the generally medium dense to dense (sands) and medium stiff to stiff) clays) nature of the fill, it is our opinion that only the upper portion of the fill material need be removed and recompacted prior to construction of foundations for the equipment/locker building and sitework improvements. The two layers of loose silty sand and clayey sand that were found at 9.5 and 10 feet in Borings 3 and 4 were only 1 to 2.5 feet thick; these layers are considered deep enough and thin enough to have little if any affect on surface improvements. Where they occur in the pool area, they will be either removed during the excavation process, or they can be recompacted if found within a few feet of the bottom of the excavation. However, these loose layers could create a potential for sidewall instability, as noted in the following section.

Instability During Excavation for Pool

The majority of the soils expected to be exposed during excavations for the pool will be medium dense to dense clayey sands or stiff sandy lean clays. Excavation of this material with conventional equipment should be relatively easy. The soils are classified as Type C per CalOSHA, meaning that all simple slope excavations 20 feet or less in depth shall have a *maximum* allowable slope of 1.5:1 (horizontal to vertical). The layer of poorly graded gravel found from 1 to 4 feet in Boring 1 was identified as being part of a drainage system for the playing field; this gravel and the loose topsoil layer above are considered to be localized conditions that should not affect the overall construction of the project. However, there is a potential for sloughing if the loose silty sand and clayey sand layers found at depth in Borings 3 and 4 are exposed in the excavation sidewalls. It is possible that the excavations could progressively slough to flatter slopes. The effect of sloughing excavations and the need for protective shoring should be determined at the time of construction, based on the actual conditions encountered. If the soils will not stand vertically (or even near vertically) to allow shotcreting directly over the soil, formwork may be necessary to cast the pool sidewalls. Proper compaction of backfill for all formed areas will be essential. The contractor's competent person should make the final determination at the time of construction regarding the CalOSHA soil classification(s) and the need for protective shoring.

Expansive Soils

Expansion index testing yielded results of 57 and 61 for two samples of the site soils; per CBC Section 1803A.5.3, the soils are considered to be expansive. The more commonly used ASTM classification is that the soils would be considered to have a "medium" expansion potential. Expansive soils tend to swell with increases in soil moisture and shrink as soil moisture decreases; the upper 3 to 5 feet of any soil profile is the zone most affected by these seasonal soil moisture fluctuations. The volume changes that the soils undergo in this cyclical pattern can stress and damage foundations and slabs-on-grade if precautionary measures are not incorporated during design and in the construction procedure. Footings are typically deepened and additional reinforcement is provided. Imported nonexpansive soils are recommended to be placed beneath slabs-on-grade, pool decks and exterior pedestrian flatwork. Below the pool shell, it is recommended that at least 18 inches of the expansive site soils be removed and replaced with imported nonexpansive materials. The gravel blanket drain, as recommended in the following paragraph, is considered to be part of the overall thickness of imported nonexpansive materials to protect the pool shell.

Potential for Subsurface Water

Free subsurface water was not found in the exploratory borings to the maximum depth explored of 26.5 feet. However, this general area is in a period of extended drought, and if rainfall conditions do return to near normal prior to or during construction, there is a will be a potential to encounter subsurface water in the excavation for the pool, particularly if construction proceeds during the rainy season. If subsurface water is encountered, a dewatering system may be necessary during construction.

A minimum thickness of 12 inches of clean, free-draining gravel along with a sump should be placed where needed in the pool shell excavation, to allow for drainage of water during construction. A hydrostatic relief valve should also be planned for the pool plumbing, regardless of the subsurface water conditions. This gravel layer for construction dewatering can be used as part of the overall 18-inch layer of gravel that is recommended for permanent dewatering below the entire pool shell, and to protect the pool shell from the expansive site soils.

While dewatering is the contractor's responsibility and specific design recommendations for dewatering are beyond the scope of this report, the following are general suggestions regarding the subject, in the event that subsurface water is encountered during construction.

1. The clayey and silty sands found at depths of 7 to 12.5 feet in Boring 1 and interlayered from 1.5 to 11 feet in Boring 4 may potentially be dewatered by means of well points. The well points should be closely spaced so that the only water removed is that which is absolutely necessary to accommodate construction. Excessive dewatering should be avoided as it could lead to settlement of surrounding improvements and structures.

2. The sandy lean clay soils are much less permeable than the sands, and will be difficult to dewater via well points. Dewatering these clays, if encountered in the bottom of the excavation, by means of a gravel blanket drain placed in the pool excavation may be more efficient. Prior to placement of the gravel blanket, the clay soil in the pool excavation should be sloped to an appropriate low point, and a sump should be constructed. A collection pipe should be placed in the gravel blanket. The collection pipe should discharge to the sump. A pump should be placed in the sump to aid in dewatering the pool excavation during construction.

3. Several monitoring wells should be placed around the excavation for the purpose of monitoring the drawdown of the groundwater, if encountered during construction. Monitoring wells should be placed between the proposed excavation and any nearby improvements that could be damaged by drawdown. If significant drawdown of the water in the immediate vicinity of improvements is observed, it may be necessary to modify the dewatering program or to underpin the improvements.

4. If needed, dewatering should be initiated well before general excavation for the pool commences. The monitoring wells should be measured periodically to gauge the progress of the dewatering program. Monitoring well construction and construction water discharge should be in accordance with the requirements of the governing jurisdiction.

Soil Erodibility

The site soils are considered to be erodible. It is essential that all surface drainage be controlled and directed to appropriate discharge points, and that surface soils, particularly those disturbed during construction, are stabilized by vegetation or other means *during and following construction*.

Corrosion Potential

As indicated in the Soil Corrosivity Study by HDR, Inc., for the Annex/Classroom Building project (ESP 2016, copy in Appendix D), the electrical resistivities of the samples tested were in the moderately corrosive categories with as received moisture contents; when saturated, the resistivities were in the corrosive to severely corrosive categories. Soil pH values were mildly alkaline. The soluble salt contents of the soils were low to moderate. Soil nitrate concentrations were high. The soils were classified as severely corrosive to ferrous metals and aggressive to copper. These results were essentially confirmed by CERCO Analytical through testing of samples from the New Swimming Pool and Equipment/Locker Building area; CERCO Analytical's corrosivity analysis is included in Appendix C of this report. Therefore, in our opinion, the recommendations regarding protection of pipelines, buried concrete structures and other improvements contained in the CERCO Analytical report (Appendix C) and in the Soil Corrosivity Study by HDR, Inc. for the Annex/Classroom Building project (ESP 2016, copy in Appendix D) would be appropriate for this project.

Petroleum Odor and Hydrocarbon Material

A petroleum odor was noted in the auger cuttings in Boring 4 below 21 feet, and hydrocarbon material was visible in the sample at 25 feet. This condition is being evaluated for the client by this firm under a separate contract, and the results of that evaluation will follow at a later date.

9.0 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

The following recommendations are for the swimming pool, the equipment/locker building, and the other site improvements as described in the "Introduction and Site Setting" Section of this report. If locations, elevations, structural loads, etc., change, the recommendations contained herein may require modification. In developing the following recommendations, it was assumed that irrigated landscaping or flatwork that would keep the soils relatively uniform, year-round moisture will be installed for a zone of at least five feet around the perimeter of all improvements.

Three distinct types of Portland cement concrete (PCC) slabs-on-grade are discussed in the following recommendations. Slabs-on-grade around the pool and the equipment/locker building are defined as "pool decks". The equipment/locker building's slabs are defined as "interior slabs-on-grade." Sidewalks that will provide access to and are beyond the pool decks are referred to as "exterior pedestrian flatwork."

Unless otherwise noted, the following definitions are used in the recommendations presented below. Where terms are not defined, definitions commonly used in the construction industry are intended.

- **Building Area –** The building area is defined as the area within and extending a minimum of 5 feet beyond the perimeter of the foundations for the equipment/locker building. The building area includes covered walkways or other improvements that are connected to the structure and that are intended to act in a manner similar to it.
- **Exterior Pedestrian Flatwork and Pool Deck Areas –** The areas within and extending a minimum of 1 foot beyond the limits of all exterior pedestrian flatwork and pool decks, as applicable.
- **Grading Area –** The entire area to be graded, including the building, exterior pedestrian flatwork and pool deck areas.
- **Existing Grade:** The elevations of the site that existed as of the date of this report.

- **Finish Pad Grade:** The elevation in the building area where earthwork operations are typically considered to be complete. It does not include any sand or gravel that might be placed below slabs-on-grade in association with vapor protection for slabs.
- **Subgrade:** The elevation in exterior pedestrian flatwork and pool deck areas where earthwork operations are typically considered to be complete. It does not include any sand or AB placed below the flatwork or decks.
- **Finish Grade:** The elevation where earthwork operations are typically considered to be complete in areas, if any, beyond the building, exterior pedestrian flatwork and pool decks.
- **Scarified:** Plowed or ripped in two orthogonal directions to a depth of not less than 8 inches.
- **Moisture Conditioned:** Adjusting the soil moisture to optimum moisture content, or just above, prior to application of compactive effort.
- **Compacted/Recompacted:** Soils placed in level lifts not exceeding 8 inches in loose thickness and compacted to a minimum of 90 percent of maximum dry density. Based on maximum dry density by ASTM D 1557-12 and field density by ASTM D 6938-15, or other methods acceptable to the geotechnical engineer and jurisdiction.

Site Preparation

1. The ground surface in the grading area should be prepared for construction by removing the existing baseball field structures, and all other improvements, vegetation, large roots, debris, organic topsoil, the gravel subdrain system (as found in Boring 1) and other deleterious materials. Existing utility lines that will not remain in service should be either removed or abandoned. The appropriate method of abandonment will depend upon the type and depth of the utility. Recommendations for abandonment can be made as necessary.

2. Voids created by the removal of materials or utilities described above should be called to the attention of the geotechnical engineer. No fill should be placed unless the underlying soil has been observed by the geotechnical engineer.

Grading

1. Following site preparation, the existing soils within the equipment/locker building area should be overexcavated to a level plane at a depth of 3 feet below the deepest foundation element. The excavation should be deepened locally where mechanical vaults or pits, if any, are to be constructed. The resulting excavated surfaces should be scarified, moisture conditioned and recompacted.

2. Following site preparation and excavation to the design depth for the swimming pool, the excavation should be deepened an additional 18 inches below the planned bottom of the pool shell. The resulting surface should be scarified, moisture conditioned and recompacted.

3. Following site preparation and any excavations to grade, or prior to placement of fill, the soil in pool deck areas should be excavated to 18 inches below bottom of slab elevation. The resulting surfaces should be scarified, moisture conditioned and recompacted.

4. Following site preparation and any excavations to grade, or prior to placement of fill, the soil in exterior pedestrian flatwork areas should be excavated to the depth below bottom of slab elevation designated by the architect/engineer for placement of nonexpansive imported material. The resulting surfaces should be scarified, moisture conditioned and recompacted.

5. Following excavations to grade or prior to placement of fill in the remainder of the grading area, the prepared soil surface should be scarified, moisture conditioned and compacted.

6. Voids created by dislodging cobbles and/or debris during scarification should be backfilled and recompacted, and the dislodged materials should be removed from the work area.

7. Previously removed site soils and other similar soils may be placed as fill to finished grade beyond the building, pool deck and exterior pedestrian flatwork areas; in the building and pool deck areas to a maximum height of 18 inches below bottom of slab elevation; and in exterior pedestrian flatwork areas to the elevation designated by the architect/engineer, as discussed in the "Slabs-on-Grade" Section of this report. The final 18 inches of fill below bottom of slab elevation in the building and pool deck areas should be nonexpansive. The architect/engineer should designate the thickness of nonexpansive material to be placed below exterior pedestrian flatwork, as discussed in the "Slabs-on-Grade" Section of this report.

8. Nonexpansive materials are defined as imported soils that fall in the GW, GM, GC, SP, SW, SC and SM categories per ASTM D 2487-11, and that have an expansion index of 10 or less (ASTM D 4829-11). The clean sand layer described in the "Slabs-on-Grade" Section of this report (if utilized below interior slabs-on-grade, exterior pedestrian flatwork or pool decks) is considered to be part of the minimum recommended thickness of nonexpansive material utilized, not in addition to it.

9. Imported nonexpansive soils used in the building area should have strength qualities equal to or better than the site soils, and they should not exceed the geotechnical corrosivity potential of the site soils. See the Corrosivity Analysis by CERCO Analytical in Appendix C, and the Soil Corrosivity Study by HDR, Inc. in the report for the Annex/Classroom Building project (ESP 2016, copy in Appendix D) for the corrosivity parameters of the site soils. Proposed imported materials should be reviewed by the geotechnical engineer before being brought to the site, and on an intermittent basis during placement.

10. A minimum of 18 inches of 0.75 to 1.5-inch clean crushed gravel (not float rock or river run gravel) should be placed at the bottom of the pool excavation, and compacted using a heavy vibrating plate compactor. The gravel is intended to serve as a blanket drain for the completed pool, and as a stabilized surface for construction. At least one rigid, 4-inch diameter PVC drain pipe should be placed from the lowest point of the gravel to daylight or a sump. Minimum slope of the drain pipe should be 1 percent.

    The drain system described above should not be relied upon to relieve all hydrostatic pressure in the event that the pool is drained. To reduce the potential for flotation of the pool shell, a hydrostatic relief valve should be provided in the pool plumbing.

    To facilitate application of shotcrete for the pool, the gravel may be overlain with a thin layer of another nonexpansive material, such as sand or Class 2 aggregate base (Caltrans 2010). However, if such a layer is utilized, a filter fabric conforming to Standard Specification 88-1.02B – Class C (Caltrans 2010) should be placed between the gravel and the overlying layer of material.

    All backfill for the pool shell should be nonexpansive, as described previously in this section. If gravel is used for backfill of the pool shell, it should be crushed (not float rock or river run gravel), and it should be compacted in maximum 1-foot lifts with a vibrating

plate compactor or a concrete vibrator. In addition, a filter fabric conforming to Standard Specification 88-1.02B – Class C (Caltrans 2010) should be placed between the gravel and the native soil.

11. All materials used as fill should be cleaned of any debris and rocks larger than 3 inches in diameter. When fill material includes rocks, the rocks should be placed in a sufficient soil matrix to ensure that voids caused by nesting of the rocks will not occur and that the fill can be properly compacted.

12. If the soils are overly moist so that they become unstable, or if the minimum recommended compaction cannot be readily achieved, drying the soil so that it is nearer optimum moisture content, may be necessary. Placement of gravel layers or geotextiles may also be necessary to help stabilize unstable soils. Additional overexcavation may also be recommended to correct unstable conditions or if soft or loose conditions are encountered during grading. No fill should be placed in any grading area if the underlying soil is unstable.

13. The recommended soil moisture content should be maintained throughout construction, and during the lives of the structure and sitework improvements. Failure to maintain the soil moisture content can result in desiccation cracks and disturbance, which are an indication of degradation of the soil compaction. If desiccation cracks are allowed to develop, or if soils near improvements such as foundations, flatwork, etc. are otherwise disturbed, damage to those improvements may result. Soils that have cracked or are otherwise disturbed should be removed, moisture conditioned, and recompacted.

14. The contractor's competent person should make the final determination at the time of construction regarding the CalOSHA soil classification(s) and the need for protective shoring.

Utility Trenches

1. Utility trenches adjacent to foundations should not be excavated within the zone of foundation influence, as shown in Typical Detail A in Appendix E.

2. Utilities that must pass beneath foundations should be placed with properly compacted utility trench backfill and the foundation should be designed to span the trench.

3. A select, noncorrosive, granular, easily compacted material should be used as bedding and shading immediately around utilities. The site soil may be used for trench backfill to within 18 inches below bottom of slab elevation in the building and pool deck areas. Within the building and pool deck areas, imported nonexpansive soils should be utilized to backfill the final 18 inches below bottom of slab elevation of all trenches. In exterior pedestrian flatwork, trench backfill should match the thickness of nonexpansive soils used to support these improvements. The site soil may be used for trench backfill to finished grade beyond the building, pool deck and exterior pedestrian flatwork areas.

4. In general, trench backfill should be compacted to a minimum of 90 percent of maximum dry density. A minimum of 85 percent of maximum dry density will generally be sufficient where trench backfill is located in landscaped or other unimproved areas, where settlement of trench backfill would not be detrimental.

5. Prior to applying compactive effort, soils should be moisture conditioned. Trench backfill should be placed in level lifts not exceeding 6 inches in loose thickness and compacted to the minimums recommended above.

6. Compaction of trench backfill by jetting or flooding is not recommended at this site due to the expansive and erodible nature of the site soils. However, to aid in *encasing* utility conduits, particularly corrugated drain pipes, and multiple, closely-spaced conduits in a single trench in the bedding and shading material, jetting or flooding may be useful. Flooding or jetting should only be attempted with extreme caution, and any jetting operation should be subject to review by the geotechnical engineer.

7. Long-term settlement of properly compacted sand should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill. Improvements that are constructed over or near trenches should be designed to accommodate the potential for settlement.

8. The Corrosivity Analysis by CERCO Analytical in Appendix C, and the Soil Corrosivity Study by HDR, Inc. in the report for the Annex/Classroom Building project (ESP 2016, copy in Appendix D) should be used by the architect/engineer in specifying appropriate corrosion protection measures for utility improvements.

9. The recommendations of this section are minimums only, and may be superseded by the architect/engineer based upon soil corrosivity or the requirements of pipe manufacturers, utility companies or the governing jurisdiction.

Swimming Pool

1. The pool area should be excavated and the bottom of the excavation filled with a gravel drainage layer as per the "Grading" Section of this report. As previously noted, the drain system should not be relied upon to relieve all hydrostatic pressure in the event that the pool is drained. To reduce the potential for flotation of the pool shell, a hydrostatic relief valve should be provided in the pool plumbing.

2. The swimming pool design may be based on the following parameters for the subsurface conditions encountered in the borings:

Active equivalent fluid pressure	55 pcf
At-rest equivalent fluid pressure	75 pcf
Passive equivalent fluid pressure	300 pcf
Maximum bearing capacity (dead plus live load)	2,200 psf
Coefficient of sliding friction	0.30

3. No surcharges are taken into consideration in the above listed parameters; the active and at-rest pressures are applicable to horizontal retained surfaces only (i.e., pool decks) at the top the pool shell. The maximum bearing capacity is an *allowable* value; no factors of safety, load factors or other factors have been applied to the remaining values. With the exception of the maximum allowable bearing capacity, these values will require application of appropriate factors of safety, load factors, surcharges and/or other factors as deemed appropriate by the architect/engineer.

4. The pool shell should be designed as necessary to accommodate "medium" expansion soil. The design parameters in Paragraph 2 are for drained conditions, and drains should be specified by the architect/engineer as necessary to ensure that water which gains access around the pool will have adequate means to be discharged.

5. The pool shell may be designed as necessary using the design response parameters contained in the Summary of Design Response Acceleration Parameters Table on Page 8 in the report for the Annex/Classroom Building Project (ESP 2016, copy in Appendix D).

6. Section 1803A.5.12.1 of the 2013 CBC requires that dynamic seismic lateral earth pressures be provided by the geotechnical engineer for walls retaining more than 6 feet of backfill. As the pool will be filled the vast majority of the time (except during maintenance), the resisting pressure of the water in the pool is generally considered to be in excess of any dynamic seismic lateral earth pressure increment, therefore the dynamic seismic lateral earth pressures be ignored in the design. If use of the seismic lateral earth pressure increment is required by the governing jurisdiction in the lateral analysis with active or at-rest pressures, a calculated equivalent fluid pressure of 4 pcf can be used for the site soils and the Peak Mean Ground Acceleration (PGA_M) value of 0.475 g previously determined for the Annex/Classroom Building Project (ESP 2016, copy in Appendix D).

7. All backfill for the pool shell should be nonexpansive, as described previously in this section. If gravel is used for backfill of the pool shell, it should be crushed (not float rock or river run gravel), and it should be compacted in maximum 1-foot lifts with a vibrating plate compactor or a concrete vibrator. In addition, a filter fabric conforming to Standard Specification 88-1.02B – Class C (Caltrans 2010), should be placed between the gravel and the native soil.

8. As the weight of the soil removed from the pool excavation will be significantly greater than the weight of the pool shell and the water in the pool, negligible settlement of the pool shell is expected under static and dynamic conditions.

9. Long-term settlement of properly compacted sand or gravel pool shell backfill should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill. Pool decks should be designed to accommodate long-term settlement.

10. The Corrosivity Analysis by CERCO Analytical in Appendix C, and the Soil Corrosivity Study by HDR, Inc. in the report for the Annex/Classroom Building project (ESP 2016, copy in Appendix D) should be used by the architect/engineer in specifying appropriate corrosion protection measures for the swimming pool.

Foundations

Conventional Foundations

1. Conventional foundations bearing in firm recompacted soils may be used to support the equipment/locker building. A minimum overall foundation depth of 21 inches below lowest adjacent grade should be maintained. Spread footings should be at least 24 inches square, and should be interconnected on at least two sides by grade beams a minimum of 12 inches wide and 21 inches deep.
2. Minimum continuous footing and grade beam reinforcement should consist of two No. 4 rebars, one at the top and one at the bottom. Spread footings should be reinforced in accordance with the requirements of the architect/engineer.
3. Footings bearing in firm recompacted soil may be designed using maximum allowable bearing capacities of 1,500 psf dead load and 2,200 psf dead plus live loads. Using these criteria, maximum settlement and differential settlement are expected to be less than 3/4-inch and less than 3/8-inch in 25 feet, respectively.
4. For resistance to lateral loads, conventional foundations may designed using a passive equivalent fluid pressure of 300 pcf and a friction factor of 0.30. Passive and friction components may be combined in the analysis without reduction to either value. Lateral capacity is based on the assumption that any backfill adjacent to foundations has been properly compacted.
5. Foundation excavations should be observed by the geotechnical engineer prior to placement of reinforcing steel. Soils in foundation excavations should be moistened to optimum moisture content, or just above, prior to application of compactive effort, and no desiccation cracks should be present prior to concrete placement.

Shade Structures

1. Light duty shade structures may be supported by conventional foundations designed using the parameters previously provided. Alternately, they may be supported by drilled, cast-in-place concrete caissons. If caissons are used, they should have a minimum diameter of 15 inches, and a minimum overall depth of 6 feet below lowest adjacent grade. The caissons may be designed using an allowable skin friction value of 600 psf; no end bearing capacity should be used in the calculations. An allowable skin friction value of 200 psf can be used under short-term tension (uplift) conditions. The self-weight of the caissons may be neglected in the determination of downward loading, however it may

be included, if needed, for resistance to uplift. Negligible settlement of caissons for light duty shade structures is expected. A passive resistance of 300 pcf, acting over 2 caisson diameters, may be taken for resistance to short term lateral loads.

2. The soils may not stand vertically during the caisson construction. Casing, drill fluid, or other means of keeping the holes open may be necessary. Caisson reinforcing should be designed to accommodate a minimum 5-inch diameter tremie pipe for concrete placement. The reinforcing should also be designed to facilitate removal of casing during concrete placement, if used. Any water encountered should be removed from the caisson excavation prior to placing concrete, or the concrete should be tremied. The recommended tremie method is described in Appendix E. Concrete used in caissons should be placed at a slump between 4 and 6 inches in dry excavations and between 7 and 9 inches when placed under water. The concrete in the caissons should be mechanically consolidated following placement. All caisson excavations should be filled with concrete on the same day as they are drilled.

3. As the caissons will utilize skin friction for support, it is not necessary to remove all loose debris and slough material from the bottoms of the excavations. The caissons should not deviate from a plumb line taken from the center of the caisson by more than 2 percent of the caisson length, from the top to the point of interest. Adequate caisson oversize may be assumed to provide required tolerance.

4. Caisson excavations should be observed by the geotechnical engineer during drilling operations and prior to placement of reinforcing steel and concrete. Special inspection of reinforcing steel and concrete placement for caissons should also be provided.

General

1. Allowable bearing capacities may be increased by one-third when transient loads such as wind or seismicity are included. Foundations may be designed as necessary using the design response parameters contained in the Summary of Design Response Acceleration Parameters Table on Page 8 in the report for the Annex/Classroom Building Project (ESP 2016, copy in Appendix D).

2. The Corrosivity Analysis by CERCO Analytical in Appendix C, and the Soil Corrosivity Study by HDR, Inc. in the report for the Annex/Classroom Building project (ESP 2016, copy in Appendix D) should be used by the architect/engineer in specifying appropriate corrosion protection measures for foundations.

Slabs-on-Grade

Interior Slabs-On-Grade

1. Interior slabs-on-grade should have a minimum thickness of 4 full inches. They should be reinforced and doweled to foundations per the specifications of the architect/engineer. At a minimum, interior slabs should be reinforced with No. 3 rebar at 18 inches on center each way. All structural slabs should contain minimum rebar meeting the criteria of ACI 318, Section 7.12.2 (ACI 2011). At a minimum, foundation dowels should be lap spliced to the slab rebar. The size and spacing of the dowels should match the size and spacing of the slab rebar.

Swimming Pool Decks

1. Swimming pool decks should have a minimum thickness of 4 full inches, not including the indentations created by any stamped patterns. Reinforcement size, placement, and dowels should be as directed by the architect/engineer; minimum deck reinforcement should consist of No. 3 rebar placed at 18 inches on-center each way.

2. It should be noted that, due to the deep backfill anticipated for the pool shell, even with the measures recommended for soil compaction, there could be minor differential movement between the pool shell and the deck. Unless there is a structural reason to do otherwise, the pool deck should be dowelled into the bond beams at the top of the pool shell by minimum No. 3 rebar lapped to the deck rebar, or as specified by the architect/engineer. A felt or other type of spacer should be placed between the deck and the pool bond beam so that the connection will act as a hinge and allow minor movement between the deck and the pool shell. If the deck is not dowelled to the shell, more differential movement should be anticipated than if it is dowelled. Without the dowelling, a trip hazard could result around the rim of the pool.

3. The pool deck should slope toward drain inlets; no uncontrolled surface drainage should flow off the edges of the pool deck. All joints in the pool deck should be sealed with a flexible, UV resistant sealer to reduce the potential for intrusion of water through the deck.

Exterior Pedestrian Flatwork

1. Exterior pedestrian flatwork should have a minimum thickness of 4 full inches. Minimum reinforcement for exterior pedestrian flatwork placed over at least 18 inches of nonexpansive imported soils per the following paragraph should consist of No. 3 rebar

placed at 24 inches on-center each way. If the thickness of nonexpansive soil below the flatwork is less than 18 inches, the minimum reinforcement should consist of No. 3 rebar at 18 inches on-center each way.

2. In conventional construction, it is common to use 4 to 6 inches of sand beneath exterior pedestrian flatwork. However, due to the medium expansion potential of the site soils, there will be a risk of movement and damage to the flatwork if conventional measures are used. Heaving and cracking could occur. This movement could be reduced by the placement of additional nonexpansive material beneath the flatwork. If it is desired to fully mitigate the expansive soil conditions, then at least 18 inches of imported nonexpansive material should be provided below the flatwork where the expansive site soils are exposed at finish grade. If it is acceptable for the flatwork to experience movement due to expansive soils, then the thickness of the nonexpansive soil can be reduced. Under all flatwork, however, the thicker the nonexpansive layer, the better the expansive soil protection.

3. Another measure that can be taken to reduce the risk of movement of flatwork due to expansive soils is to provide thickened edges or grade beams around the perimeters of the flatwork. If it is desired to fully mitigate the expansive soil conditions, then the thickened edges or grade beams could be up to 21 inches deep. If it is acceptable for the flatwork to experience movement, then the thickened edges or grade beams can be reduced. At a minimum, any thickened edge or grade beam should be reinforced by two No. 4 rebar, one at the top and one at the bottom.

4. It is recognized that the measures discussed above for protecting exterior flatwork from expansive soils are expensive, possibly more expensive than simply replacing flatwork that has heaved and/or cracked. Consequently, the above measures for protecting exterior flatwork are only suggestions for consideration by the owner and/or architect/engineer. The degree to which exterior flatwork is protected from expansive soil damage is left to the discretion of the owner and/or architect/engineer.

5. Flatwork should be constructed with frequent joints to allow articulation as the flatwork moves in response to seasonal soil temperature and moisture variations. The expansive soil underlying any nonexpansive material placed below flatwork should be moisture conditioned, and no desiccation cracks should be present, prior to casting the flatwork.

6. Flatwork at doorways, and at other areas where maintaining the elevation of the flatwork is desired when mitigating expansive soil potential, should be doweled to the perimeter foundation, at a minimum, by No. 3 dowels lapped to the flatwork rebar at 24 inches on center. In other areas, the flatwork may be doweled to the foundation or the flatwork may be allowed to "float free," at the discretion of the architect/engineer. Flatwork that is intended to float free should be separated from foundations by a felt joint or other means.

Moisture Vapor Transmission

1. Due to the current use of impermeable floor coverings, water-soluble flooring adhesives, and the speed at which buildings are now constructed, moisture vapor transmission through slabs is a much more common problem than in past years. Where moisture vapor transmitted from the underlying soil would be undesirable, slabs should be protected from subsurface moisture vapor. A number of options for vapor protection are discussed below; however, the means of vapor protection, including the type and thickness of the vapor retarder, if specified, are left to the discretion of the architect/engineer.

2. Where specified, vapor retarders should conform to ASTM Standard E 1745-11. This standard specifies properties for three performance classes; Class A, B and C. The appropriate class should be selected based on the sensitivity of floor coverings to moisture intrusion and the potential for damage to the vapor retarder during placement of slab reinforcement and concrete.

3. Several recent studies, including those of American Concrete Institute Committee 302 (ACI 2004), have concluded that excess water above the vapor retarder increases the potential for moisture damage to floor coverings and could increase the potential for mold growth or other microbial contamination. The studies also concluded that it is preferable to eliminate the typical sand layer beneath the slab and place the slab concrete in direct contact with a Class A vapor retarder, particularly during wet weather construction. However, placing the concrete directly on the vapor retarder requires special attention to using the proper vapor retarder, a very low water-cement ratio in the concrete mix, and special finishing and curing techniques.

4. Probably the next most effective option would be the use of vapor-inhibiting admixtures in the slab concrete mix and/or application of a sealer to the surface of the slab. This would also require special concrete mixes and placement procedures, depending upon the recommendations of the admixture or sealer manufacturer.

5. Another option that may be a reasonable compromise between effectiveness and cost considerations is the use of a subslab vapor retarder protected by a sand layer. If a Class A vapor retarder is specified, the retarder can be placed directly on the nonexpansive soil. The retarder should be covered with a minimum 2 inches of *clean* sand. If a less durable vapor retarder is specified (Class B or C), a minimum of 4 inches of clean sand should be provided, and the retarder should be placed in the center of the clean sand layer. Clean sand is defined as a well or poorly graded sand (ASTM D 2487-11) of which less than 3 percent passes the No. 200 sieve. The clean sand layer, if used, is considered to be a part of the minimum 18-inch thickness of nonexpansive imported materials recommended in the "Grading" section of this report to be placed below slabs-on-grade, not in addition to it.

6. Regardless of the underslab vapor retarder selected, proper installation of the retarder per ASTM E 1643-11 is critical for optimum performance. Where utilized, the vapor retarder should be placed a minimum of 1 inch above the flow line of the drainage path surrounding the structures, or 1 inch above the area drain grates if area drains are used to collect runoff around the structures. All seams must be properly lapped, and all seams and utility penetrations properly sealed in accordance with the vapor retarder manufacturer's recommendations.

7. If the sand is used between the vapor retarder and the slab, it should be moistened only as necessary to promote concrete curing; saturation of the sand should be avoided, as the excess moisture would be on top of the vapor retarder, potentially resulting in vapor transmission through the slab for months or years.

8. The architect/engineer should designate any special measures to be used in conjunction with moisture vapor transmission protection, if needed, to mitigate the high potential for indoor radon levels.

9. Positive drainage away from the equipment/locker building should be maintained; see the "Drainage and Maintenance" section of this report for additional discussion of this issue. If water is allowed to pond near the building, it may seep into the ground and migrate laterally through cracks or utility penetrations in the foundation, ultimately gaining access above the vapor retarder.

Slabs-on-Grade - General

1. To reduce shrinkage cracks in all interior and exterior slabs-on-grade, the concrete aggregates should be of appropriate size and proportion, the water/cement ratio should be low, the concrete should be properly placed and finished, contraction joints should be installed, and the concrete should be properly cured. This is particularly applicable to slabs that will be cast directly upon a vapor retarder and those that will be protected from transmission of vapor by use of admixtures or surface sealers. Concrete materials, placement, and curing specifications should be at the direction of the architect/engineer; AC 302.1R-04 (ACI 2004) is suggested as a resource for the architect/engineer in preparing such specification.

2. The Corrosivity Analysis by CERCO Analytical in Appendix C, and the Soil Corrosivity Study by HDR, Inc. in the report for the Annex/Classroom Building project (ESP 2016, copy in Appendix D) should be used by the architect/engineer in specifying appropriate corrosion protection measures for slabs-on-grade.

Drainage and Maintenance

1. Per Section 1804A.3 of the 2013 CBC, unpaved ground surfaces should be *finish graded* to direct surface runoff away from foundations and other improvements at a minimum 5 percent grade for a minimum distance of 10 feet. The site should be similarly sloped to drain away from foundation, slopes, and other improvements during construction. Where this is not practicable due to other improvements, etc., swales with improved surfaces, area drains, or other drainage facilities, should be used to collect and discharge runoff.

2. All eaves of the equipment/locker building should be fitted with roof gutters. Runoff from flatwork, roof gutters, downspouts, planter drains, area drains, etc. should discharge in a nonerosive manner away from foundations and other improvements in accordance with the requirements of the governing agencies. Erosion protection should be placed at all discharge points unless the discharge is to an improved surface.

3. To reduce the potential for planter drainage gaining access to subslab areas, any raised planter boxes adjacent to foundations, pool decks or exterior pedestrian flatwork should be installed with drains and sealed sides and bottoms. Drains should also be provided for areas adjacent to these improvements that would not otherwise freely drain.

4. The on-site soils are erodible; stabilization of soils disturbed during construction by vegetation or other means *during* and *following* construction, is essential to reduce erosion damage. Care should be taken to establish and maintain vegetation. The landscaping should be planned and installed to maintain the surface drainage recommended above. Surface drainage should also be maintained during construction.

5. Maintenance of the pool deck sealant, as well as drainage and other improvements, is critical to the long-term stability of the site and the integrity of the structures. Site improvements should be maintained on a regular basis.

6. All exterior drains and drain outlets should be maintained to be free-flowing. Vegetation and erosion matting (if utilized) should be maintained or augmented as needed. Irrigation systems should be maintained so that soils around structures are kept at a relatively uniform year-round moisture content, and are neither over-watered nor allowed to dry and desiccate.

7. To reduce the potential for disruption of drainage patterns and undermining of structures, fill areas, slopes, etc., all rodent activity should be aggressively controlled.

Observation and Testing

1. It must be recognized that the recommendations contained in this report are based on a limited number of borings, and they rely on continuity of the subsurface conditions encountered.

2. It is assumed that the geotechnical engineer will be retained to provide consultation during the design phase, to interpret this report during construction, and to provide construction monitoring in the form of testing and observation.

3. At a minimum, the geotechnical engineer should be retained to provide:

   - Professional observation during grading, trench and pool backfill, and foundation construction
   - Oversight of special inspection and compaction testing during grading and backfill
   - Oversight of special inspection during caisson drilling operations (if any)

4. Special inspection of grading and backfill should be provided as per Section 1704A.7 and Table 1704A.7 of the CBC. The special inspector should be under the direction of the geotechnical engineer. At a minimum, the following items should be inspected and/or tested by the special inspector:

   - Stripping and clearing of vegetation
   - Excavation of the swimming pool area and placement of the gravel blanket drain
   - Overexcavation of the building, pool deck and exterior pedestrian flatwork areas to the recommended depths
   - Scarification and moisture conditioning of overexcavated areas
   - Scarification and moisture conditioning of all other grading areas
   - Fill quality, placement, moisture conditioning and compaction
   - Utility trench backfill
   - Foundation excavations

5. Special inspection of drilled, cast-in-place caissons (if used) should be provided as per Section 1705A.8 and Table 1705A.8 of the CBC (CBSC 2013); the special inspector should be under the direction of the geotechnical engineer. The following operations should be subject to special inspection:

   - Drilling of caisson excavations
   - Caisson plumbness, diameters, lengths, and minimum embedment
   - Methods used to maintain caisson excavation sidewalls prior to concreting
   - Reinforcing steel placement
   - Concrete placement and concrete consolidation procedures

6. A program of quality assurance should be developed prior to beginning construction. At a minimum, the program should include all geotechnical items shown on the testing and inspection schedule of the approved plans. It should also include any additional inspection items required by the architect/engineer and/or the governing jurisdiction. These items should be discussed at a preconstruction site meeting among a representative of the owner, the geotechnical engineer, special inspector, the project inspector, the engineer, and contractors. The geotechnical engineer should be notified at least 48 hours prior to beginning grading operations.

7. Locations and frequency of compaction tests should be as per the recommendation of the geotechnical engineer at the time of construction. The recommended test location and frequency may be subject to modification by the geotechnical engineer, based upon soil and moisture conditions encountered, size and type of equipment used by the contractor, the general trend of the results of compaction tests, or other factors.

10.0 CLOSURE

Our intent was to perform the investigation in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the locality of this project under similar conditions. No representation, warranty, or guarantee is either expressed or implied. This report is intended for the exclusive use by the client as discussed in the "Scope of Services" section. Application beyond the stated intent is strictly at the user's risk.

This report is valid for conditions as they exist at this time for the type of project described herein. The conclusions and recommendations contained in this report could be rendered invalid, either in whole or in part, due to changes in building codes, regulations, standards of geotechnical or construction practice, changes in physical conditions, or the broadening of knowledge.

If changes with respect to the project become necessary, if items not addressed in this report are incorporated into plans, or if any of the assumptions used in the preparation of this report are not correct, this firm shall be notified for modifications to this report. Any items not specifically addressed in this report should comply with the CBC of other applicable standards, and the requirements of the governing jurisdiction.

The preliminary recommendations presented in this geotechnical report are based upon the geotechnical conditions encountered at the site, and may be augmented by additional requirements of the client, or by additional recommendations provided by the geotechnical engineer based on peer or jurisdiction reviews, or conditions exposed at the time of construction.

This document, the data, conclusions, and recommendations contained herein are the property of Earth Systems Pacific. This report shall be used in its entirety, with no individual sections reproduced or used out of context. Copies may be made only by Earth Systems Pacific, the client, and the client's authorized agents for use exclusively on the subject project. Any other use is subject to federal copyright laws and the written approval of Earth Systems Pacific.

Thank you for this opportunity to have been of service. If you have any questions, please feel free to contact this office at your convenience.

End of Text.

TECHNICAL REFERENCES

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APPENDIX A

Boring Location Map
Boring Log Legend
Boring Logs



LEGEND

4 ⊕ Boring Location (Approx.)

NOT TO SCALE

BORING LOCATION MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
POOL AND EQUIPMENT/ LOCKER BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3104

Earth Systems Pacific
4378 Old Santa Fe Road
San Luis Obispo, CA 93401-8116
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January 6, 2016 CS SL-16605-SD

SLO HS MEASURE D POOL EQUIPMENT AND LOCKER– 1616BLOCATIONS

Earth Systems Pacific

BORING LOG LEGEND

SAMPLE / SUBSURFACE WATER SYMBOLS	GRAPH. SYMBOL
CALIFORNIA MODIFIED	
STANDARD PENETRATION TEST (SPT)	
SHELBY TUBE	
BULK	
SUBSURFACE WATER DURING DRILLING	
SUBSURFACE WATER AFTER DRILLING	

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

MAJOR DIVISIONS	GROUP SYMBOL	TYPICAL DESCRIPTIONS	GRAPH. SYMBOL
COARSE GRAINED SOILS (MORE THAN HALF OF MATERIAL IS LARGER THAN #200 SIEVE SIZE)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GP	POORLY GRADED GRAVELS, OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, NON-PLASTIC FINES	
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, PLASTIC FINES	
	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
	SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES	
	SM	SILTY SANDS, SAND-SILT MIXTURES, NON-PLASTIC FINES	
	SC	CLAYEY SANDS, SAND-CLAY MIXTURES, PLASTIC FINES	
FINE GRAINED SOILS (HALF OR MORE OF MATERIAL IS SMALLER THAN #200 SIEVE SIZE)	ML	INORGANIC SILTS AND VERY FINE SANDS, 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	
	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS	
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	

OBSERVED MOISTURE CONDITION

DRY	SLIGHTLY MOIST	MOIST	VERY MOIST	WET (SATURATED)

CONSISTENCY

COARSE GRAINED SOILS			FINE GRAINED SOILS		
BLOWS/FOOT		DESCRIPTIVE TERM	BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER		SPT	CA SAMPLER	
0-10	0-16	LOOSE	0-2	0-3	VERY SOFT
11-30	17-50	MEDIUM DENSE	3-4	4-7	SOFT
31-50	51-83	DENSE	5-8	8-13	MEDIUM STIFF
OVER 50	OVER 83	VERY DENSE	9-15	14-25	STIFF
			16-30	26-50	VERY STIFF
			OVER 30	OVER 50	HARD

GRAIN SIZES

U.S. STANDARD SERIES SIEVE				CLEAR SQUARE SIEVE OPENING		
# 200	# 40	# 10	# 4	3/4"	3"	12"

SILT & CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

TYPICAL BEDROCK HARDNESS

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
EXTREMELY HARD	CORE, FRAGMENT, OR EXPOSURE CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CAN ONLY BE CHIPPED WITH REPEATED HEAVY HAMMER BLOWS
VERY HARD	CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CORE OR FRAGMENT BREAKS WITH REPEATED HEAVY HAMMER BLOWS
HARD	CAN BE SCRATCHED WITH KNIFE OR SHARP PICK WITH DIFFICULTY (HEAVY PRESSURE); HEAVY HAMMER BLOW REQUIRED TO BREAK SPECIMEN
MODERATELY HARD	CAN BE GROOVED 1/16 INCH DEEP BY KNIFE OR SHARP PICK WITH MODERATE OR HEAVY PRESSURE; CORE OR FRAGMENT BREAKS WITH LIGHT HAMMER BLOW OR HEAVY MANUAL PRESSURE
SOFT	CAN BE GROOVED OR GOUGED EASILY BY KNIFE OR SHARP PICK WITH LIGHT PRESSURE, CAN BE SCRATCHED WITH FINGERNAIL; BREAKS WITH LIGHT TO MODERATE MANUAL PRESSURE
VERY SOFT	CAN BE READILY INDENTED, GROOVED OR GOUGED WITH FINGERNAIL, OR CARVED WITH KNIFE; BREAKS WITH LIGHT MANUAL PRESSURE

TYPICAL BEDROCK WEATHERING

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
FRESH	NO DISCOLORATION, NOT OXIDIZED
SLIGHTLY WEATHERED	DISCOLORATION OR OXIDATION IS LIMITED TO SURFACE OF, OR SHORT DISTANCE FROM, FRACTURES: SOME FELDSPAR CRYSTALS ARE DULL
MODERATELY WEATHERED	DISCOLORATION OR OXIDATION EXTENDS FROM FRACTURES, USUALLY THROUGHOUT; Fe-Mg MINERALS ARE "RUSTY", FELDSPAR CRYSTALS ARE "CLOUDY"
INTENSELY WEATHERED	DISCOLORATION OR OXIDATION THROUGHOUT; FELDSPAR AND Fe-Mg MINERALS ARE ALTERED TO CLAY TO SOME EXTENT, OR CHEMICAL ALTERATION PRODUCES IN SITU DISAGGREGATION
DECOMPOSED	DISCOLORATION OR OXIDATION THROUGHOUT, BUT RESISTANT MINERALS SUCH AS QUARTZ MAY BE UNALTERED; FELDSPAR AND Fe-Mg MINERALS ARE COMPLETELY ALTERED TO CLAY

drafting/masters/Boring Log Legend121714.dwg

Earth Systems Pacific

Boring No. 1
PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

JOB NO.: SL-16605-SD
DATE: 12/30/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
POOL AND EQUIPMENT/ LOCKER BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3104

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	SC		CLAYEY SAND: dark brown, loose, moist (Topsoil)					
1	GP		POORLY GRADED GRAVEL: light brown, medium dense, moist (Fill) Gravel to 2" in greatest dimension					
4	CL		SANDY LEAN CLAY: gray brown to dark brown, stiff, moist, trace fine gravel	5.0 - 6.5	■	106.6	15.6	5 9 10
7	SC		CLAYEY SAND WITH GRAVEL: brown, medium dense, moist	10.0 - 11.5	■	108.9	9.8	7 10 7
13	CH		SANDY FAT CLAY: dark brown, stiff, moist (Alluvium)	15.0 - 16.5	■	106.7	20.7	5 11 13
20			very stiff	20.0 - 21.5	●			5 7 9
25				25.0 - 26.5	●			5 9 11
26			End of Boring @ 26.5' No subsurface water encountered					

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 2

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

PAGE 1 OF 1
JOB NO.: SL-16605-SD
DATE: 12/29/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
POOL AND EQUIPMENT/ LOCKER BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3104

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL		SAND LEAN CLAY: dark brown, stiff, moist (Fill)					
3	SC		CLAYEY SAND WITH GRAVEL: gray brown, medium dense, slightly moist	3.0 - 4.5	Ring	125.5	5.8	10, 18, 18
5				5.0 - 6.5	Ring	125.4	9.6	7, 14, 16
8			moist					
10				10.0 - 11.5	Ring	104.9	15.8	5, 8, 9
14	CH		SANDY FAT CLAY WITH GRAVEL: dark brown, stiff, moist (Alluvium)					
15				15.0 - 16.5	SPT			1, 5, 5
17			End of Boring @ 16.5' No subsurface water encountered					

LEGEND: Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 3

PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

JOB NO.: SL-16605-SD
DATE: 12/30/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
POOL AND EQUIPMENT/ LOCKER BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3104

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	SC		CLAYEY SAND: brown, medium dense, slightly moist	1.0 - 2.5	Ring	116.2	14.4	4, 10, 22
2			gray brown, trace fine to coarse gravel	1.0 - 5.0	Grab			
3				3.0 - 4.5	Ring	123.0	9.5	5, 12, 18
5				5.0 - 6.5	Ring	107.9	15.6	5, 8, 10
6	CL		SANDY LEAN CLAY: dark brown, stiff, moist, trace fine gravel (Fill)					
10	SC		CLAYEY SAND: olive brown, loose, moist	10.0 - 11.5	Ring	95.5	18.7	2, 4, 6
12	CH		SANDY FAT CLAY: brown, stiff, moist (Alluvium)					
15				15.0 - 16.5	SPT			3, 6, 7
16.5			End of Boring @ 16.5' No subsurface water encountered					

LEGEND: Ring Sample Grab Sample Shelby Tube Sample SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 4
PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

JOB NO.: SL-16605-SD
DATE: 12/30/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
POOL AND EQUIPMENT/ LOCKER BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3104

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL		SANDY LEAN CLAY: gray brown to dark brown, stiff, moist, trace fine gravel (Fill)	1.0 - 2.5	Ring	122.2	7.7	9 29 39
2	SC		CLAYEY SAND WITH GRAVEL: brown, dense, slightly moist (Fill)	2.0 - 5.0	Grab			
6	CL		SANDY LEAN CLAY: dark brown, stiff, moist					
8	SC		CLAYEY SAND : brown, medium dense, moist, some fine to coarse gravel					
10	SM		SILTY SAND: olive brown, loose, moist	10.0 - 11.5	Ring	103.4	20.8	4 3 4
11	CH		SANDY FAT CLAY: brown, medium stiff, moist (Alluvium)					
15			stiff	15.0 - 16.5	SPT			3 7 8
19			gray/ brown mottled					
20				20.0 - 21.5	SPT			5 7 9
21			gray/ green, petroleum odor in sample					
24			hydrocarbon visible in sample	25.0 - 26.5	SPT			4 5 6
26			End of Boring @ 26.5' No subsurface water encountered					

LEGEND: Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

APPENDIX B

Geotechnical Laboratory Test Results

San Luis Obispo High School
Measure D - Pool and Equipment / Locker Building

SL-16605-SD

BULK DENSITY TEST RESULTS

ASTM D 2937-10 (modified for ring liners)

January 12, 2016

BORING NO.	DEPTH feet	MOISTURE CONTENT, %	WET DENSITY, pcf	DRY DENSITY, pcf
1	6.0 - 6.5	15.6	123.2	106.6
1	11.0 - 11.5	9.8	119.6	108.9
1	16.0 - 16.5	20.7	128.8	106.7
2	4.0 - 4.5	5.8	132.8	125.5
2	6.0 - 6.5	9.6	137.4	125.4
2	11.0 - 11.5	15.8	121.5	104.9
3	2.0 - 2.5	14.4	133.0	116.2
3	4.0 - 4.5	9.5	134.7	123.0
3	6.0 - 6.5	15.6	124.8	107.9
3	10.0 - 10.5	18.7	113.4	95.5
4	2.0 - 2.5	7.7	131.6	122.2
4	4.0 - 4.5	20.8	124.9	103.4

EXPANSION INDEX TEST RESULTS

ASTM D 4829-11

BORING NO.	DEPTH feet	EXPANSION INDEX
1	16.0 - 16.5	61
3	1.0 - 5.0	57

San Luis Obispo High School
Measure D - Pool and Equipment / Locker Building

SL-16605-SD

MOISTURE-DENSITY COMPACTION TEST

ASTM D 1557-12 (Modified)

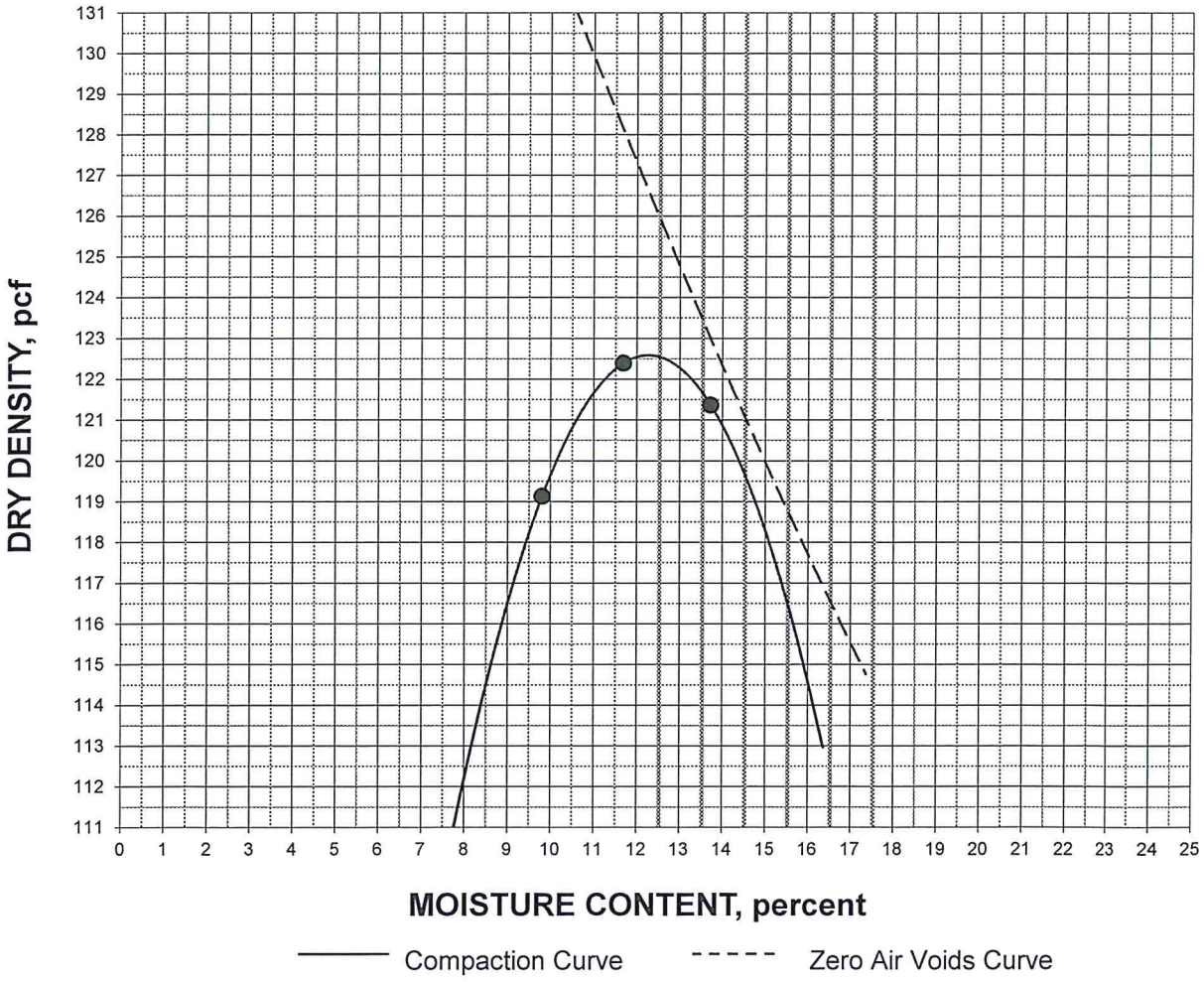
PROCEDURE USED: A
PREPARATION METHOD: Moist
RAMMER TYPE: Mechanical
SPECIFIC GRAVITY: 2.70 (assumed)

January 12, 2016
Boring #3 @ 1.0 - 5.0'
Brown Clayey Sand (SC)

SIEVE DATA:

Sieve Size	% Retained (Cumulative)
3/4"	0
3/8"	0
#4	0

MAXIMUM DRY DENSITY: 122.6 pcf
OPTIMUM MOISTURE: 12.3%



San Luis Obispo High School
Measure D - Pool and Equipment / Locker Building

SL-16605-SD

DIRECT SHEAR

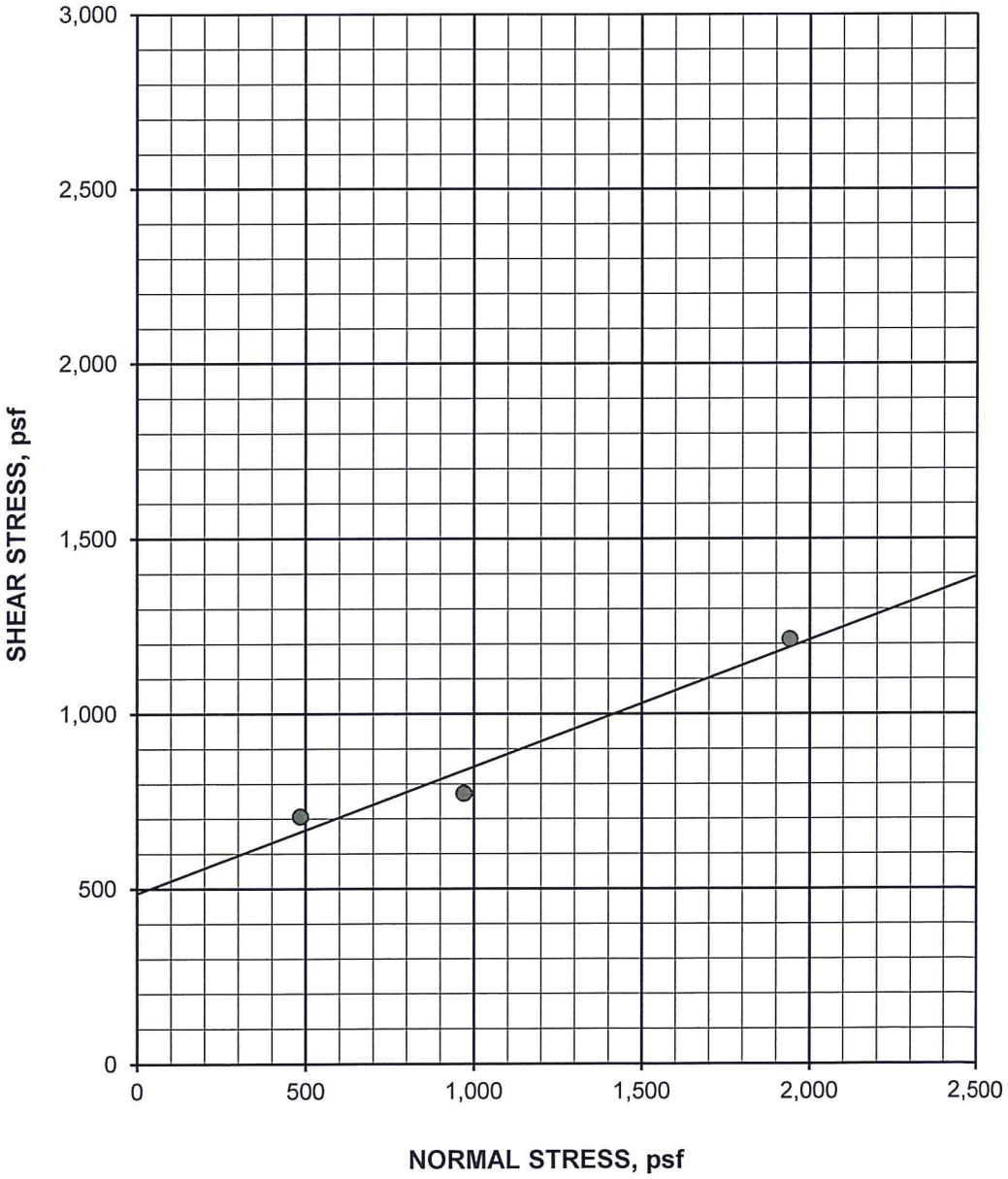
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

January 12, 2016

Boring #3 @ 1.0 - 5.0'
Clayey Sand (SC)
Compacted to 90% RC, saturated

INITIAL DRY DENSITY: 110.3 pcf
INITIAL MOISTURE CONTENT: 12.3 %
PEAK SHEAR ANGLE (Ø): 20°
COHESION (C): 486 psf

SHEAR vs. NORMAL STRESS



San Luis Obispo High School SL-16605-SD

Measure D - Pool and Equipment / Locker Building

DIRECT SHEAR continued

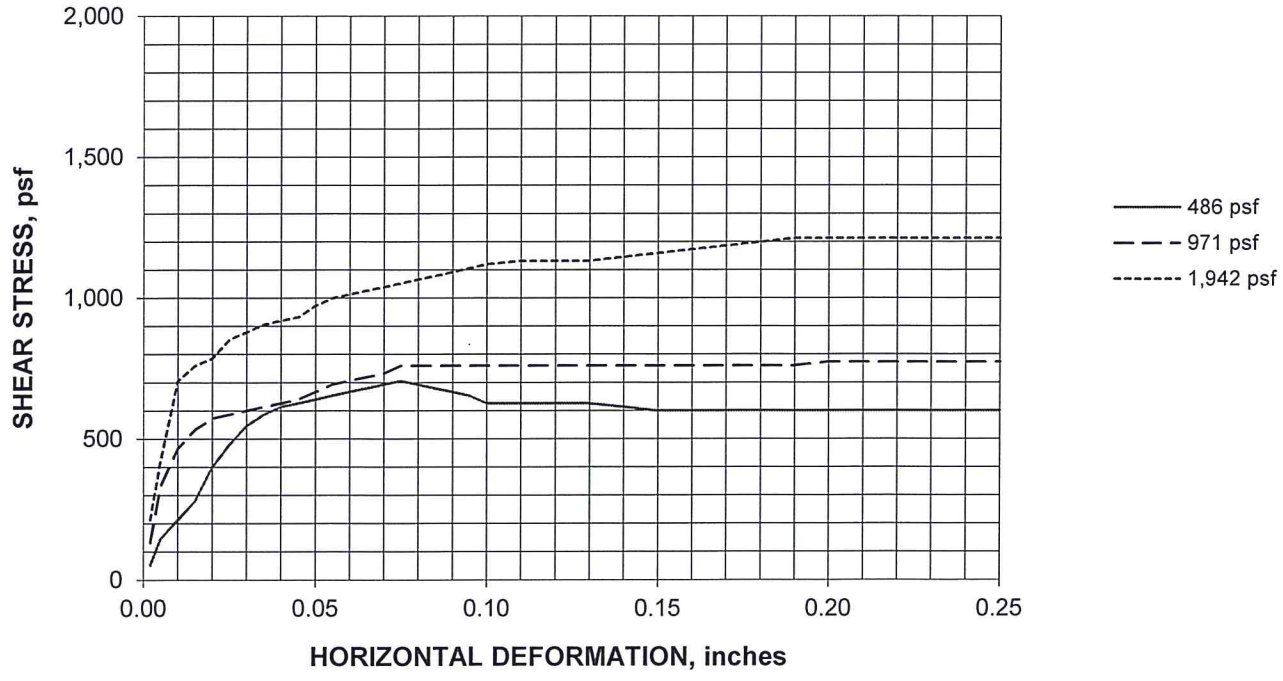
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

Boring #3 @ 1.0 - 5.0' January 12, 2016

Clayey Sand (SC)

Compacted to 90% RC, saturated SPECIFIC GRAVITY: 2.70 (assumed)

SAMPLE NO.:	1	2	3	AVERAGE
INITIAL				
WATER CONTENT, %	12.3	12.3	12.3	12.3
DRY DENSITY, pcf	110.3	110.3	110.3	110.3
SATURATION, %	63.0	63.0	63.0	63.0
VOID RATIO	0.527	0.527	0.527	0.527
DIAMETER, inches	2.410	2.410	2.410	
HEIGHT, inches	1.00	1.00	1.00	
AT TEST				
WATER CONTENT, %	22.5	22.2	23.0	
DRY DENSITY, pcf	111.0	113.3	117.7	
SATURATION, %	100.0	100.0	100.0	
VOID RATIO	0.518	0.487	0.431	
HEIGHT, inches	0.99	0.97	0.94	



San Luis Obispo High School SL-16605-SD

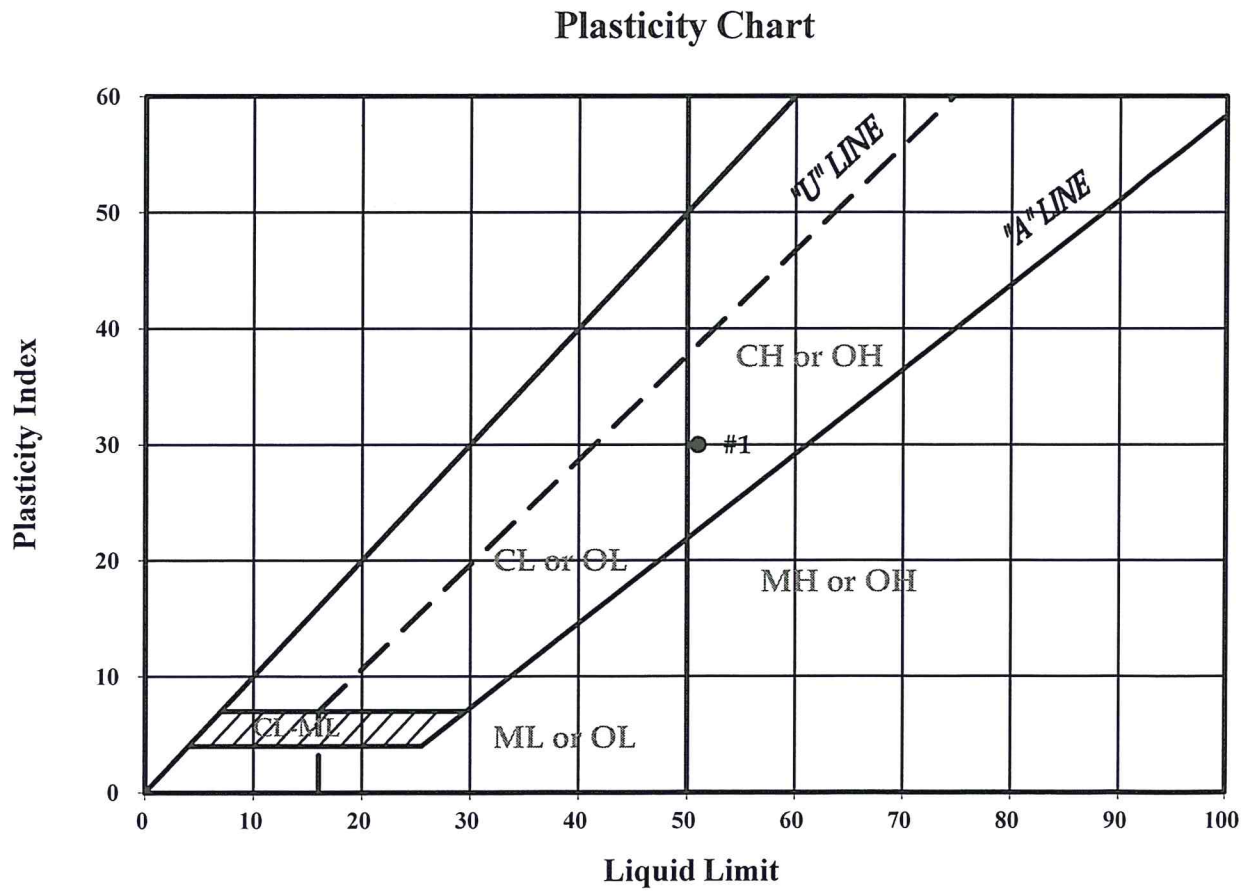
Measure D - Pool and Equipment / Locker Building

PLASTICITY INDEX

ASTM D 4318-10

January 12, 2016

Test No.:	1	2	3	4	5
Boring No.:	2				
Sample Depth:	15.0 - 16.5'				
Liquid Limit:	51				
Plastic Limit:	21				
Plasticity Index:	30				



APPENDIX C

Corrosivity Analysis by CERCO Analytical, Inc.

California State Certified Laboratory No. 2153

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax. 925 462 2775
www.cercoanalytical.com

15 January, 2016

Job No. 1601079
Cust. No. 11974

Mr. Fred J. Potthast, GE
Earth Systems Pacific
4378 Santa Fe Road
San Luis Obispo, CA 93401

Subject: Project No.: SL-16605-SD
Project Name: San Luis Obispo High School –Pool & Equipment/Locker Building
Corrosivity Analysis – ASTM Test Methods

Dear Mr. Potthast:

Pursuant to your request, CERCO Analytical has analyzed the soil samples submitted on January 07, 2016. Based on the analytical results, this brief corrosivity evaluation is enclosed for your consideration.

Based upon the 100% saturation resistivity measurements, both samples are classified as "corrosive". All buried iron, steel, cast iron, ductile iron, galvanized steel and dielectric coated steel or iron should be properly protected against corrosion depending upon the critical nature of the structure. All buried metallic pressure piping such as ductile iron firewater pipelines should be protected against corrosion.

The chloride ion concentrations were 18 & 150 mg/kg and are determined to be insufficient to attack steel embedded in a concrete mortar coating.

The sulfate ion concentrations were 29 & 480 mg/kg and are are determined to be sufficient to potentially be detrimental to reinforced concrete structures and cement mortar-coated steel at these locations. Therefore, concrete that comes into contact with this soil should use sulfate resistant cement such as Type II, with a maximum water-to-cement ratio of 0.55.

The pH of the soils were 7.45 to 7.90, which does not present corrosion problems for buried iron, steel, mortar-coated steel and reinforced concrete structures.

The redox potentials were 400 & 430-mV, which indicative of aerobic soil conditions.

This corrosivity evaluation is based on general corrosion engineering standards and is non-specific in nature. For specific long-term corrosion control design recommendations or consultation, please call *JDH Corrosion Consultants, Inc. at (925) 927-6630*.

We appreciate the opportunity of working with you on this project. If you have any questions, or if you require further information, please do not hesitate to contact us.

Very truly yours,
CERCO ANALYTICAL, INC.

J. Darby Howard, Jr., P.E.
President

JDH/jdl
Enclosure

California State Certified Laboratory No. 2153

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax. 925 462 2775
www.cercoanalytical.com

Client: EarthSystems Pacific
Client's Project No.: SL-16605-SD
Client's Project Name: San Luis Obispo High School - Pool and Equipment/Locker Building
Date Sampled: 30-Dec-15
Date Received: 7-Jan-16
Matrix: Soil
Authorization: Letter dated January 4, 2016

Date of Report: 15-Jan-2016

Job/Sample No.	Sample I.D.	Redox (mV)	pH	Resistivity (as Received) (umhos/cm)	Resistivity (100% Saturation) (ohms-cm)	Sulfide (mg/kg)*	Chloride (mg/kg)*	Sulfate (mg/kg)*
1601079-001	Boring 3 @ 1 - 5' (SC)	410	7.90	24,000	710	-	150	480
1601079-002	Boring 4 @ 15 - 16.5' (CL)	400	7.45	2,400	1,600	-	18	29

Method:	ASTM D1498	ASTM D4972	ASTM D1125M	ASTM G57	ASTM D4658M	ASTM D4327	ASTM D4327
Reporting Limit:	-	-	10	-	50	15	15
Date Analyzed:	13-Jan-2016	13-Jan-2016	13-Jan-2016	13-Jan-2016	-	14-Jan-2016	14-Jan-2016

Cheryl McMillen
Laboratory Director

* Results Reported on "As Received" Basis
N.D. - None Detected

Quality Control Summary - All laboratory quality control parameters were found to be within established limits

APPENDIX D

Geotechnical Engineering and Geologic Hazards Report
San Luis Obispo High School – Measure D Projects
Annex/Classroom Building
1499 San Luis Drive, San Luis Obispo, California
Project No. 831-3102
dated January 19, 2016

GEOTECHNICAL ENGINEERING AND GEOLOGIC HAZARDS REPORT
SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3102

January 19, 2016

Prepared for

Mr. Anthony Palazzo
San Luis Coastal Unified School District

Prepared by

Earth Systems Pacific
4378 Old Santa Fe Road
San Luis Obispo, CA 93401

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Pacific

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San Luis Obispo, CA 93401
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esp@earthsystems.com
www.earthsystems.com

January 19, 2016

FILE NO.: SL-16605-SE

Mr. Anthony Palazzo
Director – Buildings, Grounds and Transportation
San Luis Coastal Unified School District
937 Southwood Drive
San Luis Obispo, CA 93401

PROJECT: SAN LUIS OBISPO HIGH SCHOOL -MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3102

SUBJECT: Geotechnical Engineering and Geologic Hazards Report

CONTRACT REF: Purchase Order No. 161188 by San Luis Coastal School District, dated December 7, 2015, to Provide a Geotechnical Engineering Investigation, San Luis Obispo High School, Measure D Projects, 1499 San Luis Drive, San Luis Obispo, California, per Proposal by Earth Systems Pacific, Doc. No. 1511-157.PRP, dated November 25, 2015

Dear Mr. Palazzo:

In accordance with your purchase order, this geotechnical engineering and geologic hazards report has been prepared for use in the development of plans and specifications for the Annex/Classroom Building Project at San Luis Obispo High School, in San Luis Obispo, California. This report describes the general geotechnical and geologic characteristics, identifies existing and potential geotechnical and geologic hazards, and discusses the impacts that these conditions could have upon the project. Preliminary geotechnical recommendations for site preparation, grading, utility trenches, foundations, interior slabs-on-grade and exterior pedestrian flatwork, retaining walls, asphalt concrete (AC) paths, drainage and maintenance, and observation and testing are presented herein. Soil corrosivity testing and an evaluation of the results, which were subcontracted to HDR, Inc. of Claremont, California, are also provided. Two bound copies and an electronic copy of this report are being furnished for your use.

We appreciate the opportunity to have provided services for this project and look forward to working with you again in the future. If there are any questions concerning this report, please do not hesitate to contact the undersigned.

Sincerely,
Earth Systems Pacific

Fred J. Potthast, GE 2869
Principal Engineer

1/19/16

Doc. No.: 1601.059.SGR.rf

Richard T. Gorman, CEG
Principal Geologist

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1.0 INTRODUCTION AND SITE SETTING

The proposed Annex/Classroom Building at San Luis Obispo High School will have a footprint of approximately 12,000 square feet. It will be single story, of steel-frame, stud and possibly masonry construction. Conventional continuous and spread (pad) foundations are planned, with concrete slabs-on-grade. Maximum dead plus live loads on continuous footings of 2,000 plf, and maximum loads on spread footings of 75 kips, have been assumed for the purposes of this report. Retaining walls for sitework, or connected to or forming part of the structure, and a maximum of 4 feet tall, may also be utilized. The new building will be served by the existing campus utility systems via underground connections; it will be surrounded by landscaping and sidewalks of either Portland cement concrete (PCC) or asphalt concrete (AC) over aggregate base (AB). The existing service driveways in the project area may be repaired as part of the project, however no new pavement areas are anticipated. To our knowledge, no drainage basins are planned as part of the project. Infiltration systems or other types of low-impact development (LID) features may be included in the final design; however this has not been determined as of the date of this report, and therefore these potential features are not addressed.

The new building will be constructed on the site of the existing Annex/Cafeteria Building, on the north side of the campus, immediately east of the old Gymnasium. The site location on the campus is indicated on the Vicinity Map in Appendix A. Flatwork, lawns, shrubs and several scattered mature trees are present on the west, south and east sides of the existing building. The main campus service road extends along the west side of the existing building, just beyond the lawn, providing access to a paved delivery area at the rear (the north side) of the building. Drainage appears to be by sheet flow, and generally toward the south-southwest. The locations and dispositions of utility lines on the site are unknown.

2.0 SCOPE OF SERVICES

The scope of work for this report included a general site reconnaissance, subsurface exploration, site reconnaissance by a registered geotechnical engineer and certified engineering geologist, laboratory testing of samples secured during the subsurface investigation, geotechnical and geologic analyses of the data, and preparation of this report. The analysis and subsequent recommendations were based on general information provided by the client.

This report and preliminary geotechnical recommendations are intended to comply the considerations of Sections 1803A.1 through 1803A.7, J104.3 and J104.4 of the 2013 California Building Code; California Geological Survey Note 48; DSA IR A-4.13; and common geotechnical engineering and engineering geology practice in this area under similar conditions at this time.

The test procedures were accomplished in general conformance with the standards noted, as modified by common geotechnical engineering practice in this area under similar conditions at this time.

Preliminary geotechnical recommendations for site preparation, grading, utility trenches, foundations, interior slabs-on-grade and pedestrian flatwork, retaining walls, AC paths, drainage and maintenance, and observation and testing are presented to guide the development of project plans and specifications. The results of geotechnical corrosivity testing, and an evaluation of the results with recommendations for mitigation, which were subcontracted to HDR, Inc., are also provided. As there may be geotechnical issues yet to be resolved, the geotechnical engineer should be retained to provide consultation as the design progresses, to assist in verifying that pertinent geotechnical issues have been addressed and to aid in conformance with the intent of this report. It may also be advantageous to retain the geotechnical engineer to review the project plans and details as they near completion, to further aid in conformance with the intent of this report.

It is our intent that this report be used exclusively by the client in the preparation of plans and specifications. Application beyond this intent is strictly at the user's risk.

This report does not address issues in the domain of contractors such as, but not limited to, site safety, loss of volume due to stripping of the site, shrinkage of soils during compaction, excavatability, dewatering, shoring, temporary slope angles, construction means and methods, etc. Analyses of the soil for mold potential, man-made asbestos, lead, radioisotopes, hydrocarbons, or chemical properties other than geotechnical corrosivity are beyond the scope of this report. Evaluation of the site for suitability for LID improvements or drainage basins; ancillary features such as temporary access roads, fences, flag and light poles, signage; and nonstructural fills are not within our scope and are also not addressed.

In the event that there are any changes in the nature, design, or location of improvements, or if any assumptions used in the preparation of this report prove to be incorrect, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are verified or are modified in writing. The criteria presented in this report are considered preliminary until such time as any peer review or review by any jurisdiction has been completed, conditions are observed by the geotechnical engineer and/or geologist in the field during construction, and the recommendations have been verified as appropriate or modified in writing.

3.0 FIELD INVESTIGATION

On December 29, 2015, three borings were drilled in the planned building area to depths ranging from approximately 16.5 to 26 feet below the existing ground surface. The borings were drilled with a truck-mounted Mobile Drill rig, Model B-53, equipped with 6-inch outside diameter hollow stem auger and an automatic trip hammer for sampling. The approximate locations of the borings are shown on the Boring Location Map in Appendix A. Soil samples were obtained using a ring-lined barrel sampler (ASTM D 3550-01/07 with shoe similar to D 2937-10). Bulk soil samples were obtained from the auger cuttings. Standard penetration tests were also performed in the borings (ASTM D 1586-11) at selected depths. The borings were backfilled with auger spoils.

Soils encountered in the borings were categorized and logged in general accordance with the Unified Soil Classification System and ASTM D 2488-09a. Where bedrock was encountered, its properties were described based upon observation of the auger cuttings and the effort required to drill into it. Copies of the boring logs and a Boring Log Legend are included in Appendix A. In reviewing the boring logs and legend, the reader should recognize that the legend is intended as a guideline only, and there are a number of conditions that may influence the soil characteristics as observed during drilling. These include, but are not limited to, the presence of cobbles or boulders, cementation, variations in soil moisture, presence of groundwater, and other factors. It should also be noted that the descriptions of bedrock must span a much wider range of density and strength characteristics than soil, and are relative to other bedrock strata. For example, fractured and weathered bedrock may be described as “soft,” yet it will be considerably harder than almost any type of soil. Conversely, a clay soil may be described as “hard,” however it will not be nearly as hard as even “moderately soft” bedrock such as the sandstone and claystone encountered on this site. Consequently, the logger must exercise judgment in interpreting the subsurface characteristics, possibly resulting in soil and bedrock descriptions that vary somewhat from the legend.

4.0 LABORATORY ANALYSIS

The ring samples were tested for unit weight and moisture (ASTM D 2937-10), as modified for ring liners. One ring sample was also tested for one-dimensional consolidation (ASTM D 2435-11). Bulk samples were tested for maximum density and optimum moisture content (ASTM D 1557-12), expansion index (ASTM D 4829-11), plasticity index (ASTM D 4318-10) and cohesion and angle of shearing resistance by direct shear (ASTM D 3080-11, recompacted to 90 percent of maximum dry density and modified for consolidated, undrained conditions). The physical laboratory test results are presented in Appendix B.

Two bulk samples of the upper soils were also sent to HDR, Inc. of Claremont, California for geotechnical corrosivity testing. The results of these tests, and HDR, Inc.'s evaluation of the results, are presented in Appendix C.

5.0 GENERAL SUBSURFACE AND GEOLOGIC PROFILE

Boring 1, drilled on the west side of the existing building, found 4 feet of stiff fill (sandy lean clay with a trace of coarse gravel) over alluvium. The alluvium consisted of very stiff sandy lean clay with some fine gravel from 4 to 17 feet, and medium dense clayey gravel with sand to 23.5 feet. The alluvium was underlain by moderately soft bedrock (sandstone) of the Franciscan Mélange, which continued to drilling refusal at 26 feet.

A pavement section of 4 inches of asphalt concrete (AC) over 2 inches of aggregate base (AB) was found in Boring 2, on the north side of the existing building. Below the pavement to the boring termination depth of 16.5 feet was stiff to very stiff sandy lean clay alluvium. Some fine gravel was found in the clay to 4.5 feet.

Boring 3, on the east side of the existing building, encountered very stiff sandy lean clay with a trace of gravel (alluvium) from the surface to 7.5 feet. Bedrock of the Franciscan Mélange was found below the alluvium; the bedrock was moderately soft sandstone to 10.5 feet and moderately soft, severely sheared and weathered claystone to the drilling refusal depth of 16.5 feet.

During drilling, the soils and bedrock were described as being slightly moist to very moist. Free subsurface water was not found in any of the borings, to the maximum depth explored of 26 feet.

Please refer to the boring logs in Appendix A for a more complete description of the subsurface conditions. Cross Section A-A' in Appendix A is a graphic representation of the subsurface conditions found by the exploratory borings.

6.0 GEOLOGY

Geologic Setting

San Luis Obispo High School lies along the northeastern side of the Los Osos Valley, which is bounded to the northeast by the northwest-trending Santa Lucia Mountain Range and to the southwest by the northwest-trending Irish Hills. The proposed building area is on the north side of the campus, and it is relatively flat with a slight slope to the south/southwest. Locally, the school site area is bounded to the northeast by hillside terrain and to the southwest by San Luis Obispo Creek. The geologic map of the San Luis Obispo Quadrangle by Wiegers (2010) indicates

that the Annex/Classroom Building school site area is underlain by Holocene alluvial flood plain deposits (see the Geologic Map in Appendix D). Based on the results of our subsurface investigation and field observations, we concur with the Wiegers geologic map.

Faulting

Significant Faults

The San Andreas, Hosgri-San Simeon, and Los Osos Faults are the most significant regional *active* faults within a 65-mile radius of the school site, which could affect existing and proposed developments during their anticipated lifespan (see the Historical Earthquake/Fault Map in the Appendix D). The closest *active* fault to the site is the Irish Hills segment of the Los Osos Fault, located approximately 3.35 miles southwest. The closest mapped fault to the site (regardless of activity) is the Late Quaternary age Cambria Fault; it is located approximately 1 mile northeast (see the Historical Earthquake/Fault Map in the Appendix D). Brief descriptions of these faults are presented in the following sections. Regional faults and locations of historic earthquake events are also depicted on the Historical Earthquake/Fault Map in Appendix D.

Cambria Fault

The Cambria Fault is the closest mapped fault (regardless of activity) to the site; it is located approximately 1 mile northeast. The southern end of the Cambria fault could be considered part of the Oceanic fault group where the faults nearly join east of Cal Poly State University in San Luis Obispo. In some areas along the fault, it can be distinguished by the line of serpentine rock ridges that it bounds. Splays of the Cambria fault break late Pliocene (2 million years old) strata east of Cambria, but there is no known offset of Holocene (11,000 years old) age sediments by the system (Chipping, 1987). Weber (1983) noted that 120,000-year old marine terrace deposits north of Cayucos, near Ellysly Creek, may have been offset by the Cambria fault. However, to our knowledge, Weber's observation has never been confirmed by field exploration.

San Andreas Fault

The San Andreas Fault, considered to be the most active fault in the general region, lies 23 miles to the east of the site. The San Andreas Fault undergoes a major change in character between Parkfield and Cholame. North of Cholame, the fault moves more or less constantly in a process called creep, whereas the south end of the fault is locked, moving only in very large earthquakes. The last major quake on this part of the fault was the 1857 event (magnitude 7.9). In the immediate vicinity of Parkfield, there is a 20-mile segment that is also locked, generating an earthquake every 20 years or so on average. Dated quakes on this segment are 1881, 1901, 1922, 1934, and 1966, and are usually in the magnitude 5.5 to 6.0 range, (Bakun 1988). A 6.0 magnitude earthquake occurred on this fault segment on September 28, 2004.

Los Osos Fault

The Los Osos Fault, at its closest point to the site, is approximately 3 miles to the southwest. It consists of four distinct segments. From northwest to southeast, these are the Estero Bay, the Irish Hills, the Lopez Reservoir, and the Newsome Ridge segments. PG&E (1988) suggests that the Irish Hills segment displays the best expressed geomorphic features, displacing late Pleistocene and Holocene deposits. The Irish Hills segment starts in the vicinity of Los Osos and extends to just past San Luis Obispo Creek. A two-mile long segment west of Laguna Lake is considered to be active (Treiman 1989) and is zoned as a State Earthquake Fault Zone under the Alquist-Priolo Act (Hart 1997). This active segment lies about 3.35 miles to the southwest of the site and is the closest active fault to the site. The Los Osos Fault comprises a northwest-trending series of high- and low-angle faults that exhibit a complex history of both strike-slip and reverse displacement. However, during the late Quaternary, movement appears to have been primarily reverse displacement (PG&E 1998).

Hosgri-San Simeon Fault System

The Hosgri-San Simeon Fault System lies approximately 25 miles to the west of the site. A northwest-trending strike-slip fault, the San Simeon Fault extends from offshore of Ragged Point to just offshore of San Simeon Point, where it joins the northern end of the Hosgri Fault. From this point, the Hosgri Fault extends to an ocean shelf 2 miles west of Point Buchon, and then trends toward the Point Sal area. The fault system is considered active by the 2004 United States Geologic Survey (Jennings and Bryant 2010), based on Hall's claims of recent offset terrace deposits along San Simeon Cove, and also by a relocation of the 1927 "Lompoc Earthquake" onto the southern end of the Hosgri Fault (Hall 1975, 1976, 1977).

On December 22, 2003, a 6.5-magnitude earthquake occurred approximately 6 miles northeast of San Simeon, California and approximately 28 miles north of the subject site. Analysis by the USGS and the University of California at Berkeley indicates that the event had a thrust (reverse-faulting) mechanism (Goel 2004). The earthquake occurred in the vicinity of the northern end of the Hosgri-San Simeon Fault.

Groundwater

Soil and bedrock moisture contents encountered during drilling were generally slightly moist to very moist. Groundwater was not encountered in any of the borings to the maximum depth explored of 26 feet.

7.0 SEISMICITY

Earthquake History

The historic seismicity in the site's region was researched using EQSEARCH (Blake, updated December 2012) and the Boore and others (1997) method of analysis for Site Class "D", stiff soil sites (ASCE 2010) that is incorporated within that program. EQSEARCH performs automated searches of a custom catalog of historical Central California earthquakes. As the program searches the catalog, it computes the epicentral distance from the selected site to each of the earthquakes within the specified search area. The epicentral distances should be considered estimates, particularly for earthquake data prior to 1932, when modern instruments were first used to record earthquake data.

The parameters used for the search consisted of earthquake Richter magnitudes ranging from 5.0 to 9.0 that occurred within a 65-mile radius from the site from 1800 to December 2012. The site coordinates used in this search were latitude 35.2836N and longitude 120.6501W. The Historical Earthquake/Fault Map presented in Appendix D graphically depicts the results of the search, including historical earthquake epicenters, their corresponding magnitudes, and faults within the general region of the project.

Results of the search indicated that within the search parameters, 44 earthquakes have occurred. The highest peak horizontal ground acceleration (PGA) estimated to have occurred at the site from those historical earthquakes is 0.33g. This earthquake had a 5.9 magnitude, occurred in 1906, and was located approximately 3 miles northwest of the site. This earthquake may have occurred along the Los Osos Fault. The largest magnitude earthquake that the search revealed was 7.9. This earthquake was located approximately 48 miles east of the site, and is known as the 1857 earthquake on the San Andreas Fault. It produced an estimated PGA of 0.15g at the site.

Design Acceleration Parameters

In accordance with California Geologic Survey, Note 48 (October 2013), Item 16, an assessment was made to determine if there was a need to employ "Site Specific Ground Motion Procedures" for this site. Based on a review of the San Luis Obispo County Planning Department Permit View web site (2015), a determination was made that the site is not located in a Geologic Study Area, an Alquist-Priolo Earthquake Fault Zone, or a High Liquefaction Hazard Zone. In addition, the S_1 ground motion value obtained from the United States Geological Survey Earthquake Hazards Program website (USGS 2016) and the 2010 ASCE 7 Standard Analysis Method, for Site Class "D" (stiff soil sites), was below 0.75g (see table below). Therefore, the project does not require a site-specific ground motion analysis.

The site is in a region of generally high seismicity and has the potential to experience strong ground shaking from earthquakes on regional or local causative faults. To characterize the seismicity at the site and to provide seismic design parameters for the architect/engineer, a General Procedure Ground Motion Analysis was performed to calculate the deterministic ground motions at the site. The ground motions are based on the 2013 California Building Code General Procedure that were obtained from the United States Geological Survey Earthquake Hazards Program website (USGS 2016) and the 2010 ASCE 7 Standard Analysis Method, for Site Class "D" (stiff soil sites). The results of this analysis are presented in the following table:

SUMMARY OF DESIGN RESPONSE ACCELERATION PARAMETERS

Mapped Acceleration Values for Site Class "B"		**2013 CBC Site Coefficients and General Procedure Adjusted MCE Spectral Response Acceleration Parameters For Site Class "D"**					
Seismic Parameters	Values (g)	Site Coefficients	Values	Seismic Parameters	Values (g)	Seismic Parameters	Values (g)
S_S	1.137	F_a	1.045	S_{MS}	1.188	S_{DS}	0.792
S_1	0.434	F_v	1.566	S_{M1}	0.680	S_{D1}	0.453
Peak Mean Ground Acceleration (PGA_m): 0.475 g							
Seismic Design Category = D							

Seismic Design Category

Section 1613A.3.5 of the 2013 CBC indicates that sites will be assigned to Category D unless $S_1 \geq 0.75$. The S_1 calculated for the site is 0.434g; therefore, the site would be assigned to Category D.

8.0 GEOLOGIC HAZARDS

Surface Ground Rupture

Surface ground rupture generally occurs at sites that are traversed by, or lie very near to, a causative fault. The site is not located within a State Earthquake Fault Zone, and there are no mapped faults crossing or adjacent to the site. The closest mapped active fault to the site is the Irish Hills segment of the Los Osos Fault, located approximately 3.35 miles southwest of the site. Therefore, the potential for surface ground rupture to occur at the site is very low.

Liquefaction

The term liquefaction refers to the liquefied condition and subsequent softening that can occur in soils when they are subjected to cyclic strains, such as those generated during a seismic event. Previous studied have concluded that liquefaction within the upper 50 feet of soil can potentially affect improvements at the ground surface. Due to the relatively shallow depth to the bedrock, the stiff to very stiff alluvial clay soils above the bedrock, and the absence of groundwater to the maximum depth explored of 26 feet, the potential for liquefaction to occur is considered to be nil.

Seismically Induced Settlement

Seismically induced settlement of sufficient magnitude to cause structural damage is normally associated with poorly consolidated, predominantly sandy soils, or variable consolidation characteristics within the building areas. Due to the relatively shallow depth to the bedrock and the presence of stiff to very stiff alluvial clay soils, the potential for seismically induced settlement to occur at the site is considered to be nil.

Slope Stability

The Annex/Classroom site lies within a generally flat area with no significant slopes on or adjacent to it; therefore, there is no potential for gross slope instability or landsliding to impact the project site.

Flooding

According to the Flood Insurance Rate Map Number 06079C1067G (FEMA November 16, 2012), the Annex/Classroom Building site is not located within a 100-year flood zone, or within Flood Zone X (See the FEMA Flood Zone Map in Appendix D). Flood Zone X indicates areas that have been determined to have less than a 0.2 percent chance of being flooded in any given year.

Naturally Occurring Asbestos

Asbestos bearing rock units within the central coast area generally consist of serpentinite, ultra-mafic rock units consisting of olivine-hornblende and some schist metamorphic rock units. Based on our research and review of the borings logs, the project site is predominately underlain by a thick deposit of clayey soil alluvium, followed by sandstone and claystone bedrock of the Franciscan Mélange, which ranged in depth from 7.5 to 23.5 feet. These geologic units are not asbestos bearing, therefore, the potential for naturally occurring asbestos to occur on the site is considered to be nil.

Radon

Radon is a colorless, odorless gas present in soil and rock, which is derived from the decay of uranium. The occurrence of radon correlates with the presence of specific minerals, and its concentrations in soil or rock will vary depending on the mineralogy of the surrounding bedrock, temperature, barometric pressure, moisture and other factors. Prolonged exposure to elevated levels of radon is associated with an increased risk of lung cancer.

According to Special Report 208, by the California Geological Survey (Churchill 2008) radon is most commonly found in areas of San Luis Obispo County that are underlain by bedrock of the Monterey formation. The site is underlain by alluvial soils and bedrock of the Franciscan Melange. The report (Churchill 2008) shows that the project site is in an area of low radon potential for San Luis Obispo County.

9.0 CONCLUSIONS

Geology

It is our opinion that there are no significant local or regional geologic conditions that would preclude construction of the Annex/Classroom Building and site improvements as described in the "Introduction" section of this report.

Site Geology

The Annex/Classroom Building site area lies on relatively flat terrain that is bounded to the northeast by hillside terrain and to the southwest by San Luis Obispo Creek. The site area is underlain by Holocene alluvial flood plain deposits and bedrock of the Franciscan Melange.

Groundwater

Soil and bedrock moisture contents encountered during drilling were generally slightly moist to very moist. Groundwater was not encountered in any of the borings, to the maximum depth explored of 26 feet.

Slope Stability

There are no significant slopes on or adjacent to the Annex/Classroom Building site area; therefore, there is no potential for gross slope instability or landsliding to impact the project.

Seismicity

The site is located within the seismically active southern California area, and moderate to severe ground shaking can be expected during the life of the proposed structure. The largest historical mean peak horizontal acceleration estimated to have occurred in the vicinity of the site was 0.33g.

Surface Ground Rupture

The site is not located in a State Earthquake Fault Zone and there are no mapped faults crossing the site. The closest mapped active fault to the site is the Irish Hills segment of the Los Osos Fault, approximately 3.35 miles southwest. Therefore, the potential for surface fault rupture to occur at the site is considered to be very low.

Liquefaction, Seismically Induced Settlement, and Naturally Occurring Asbestos

As the site is underlain by stiff to very stiff condition of the clayey alluvial and relatively shallow bedrock of the Franciscan Mélange, the potentials for liquefaction and seismically-induced settlement to occur are considered to be nil. As the sandstone bedrock of the Franciscan Mélange is not an asbestos-bearing geologic unit, the potential for naturally occurring asbestos to occur on the site is also considered to be nil.

Flooding

The site is not within a 100-year flood zone, or Flood Zone X, which has been determined by FEMA (2012) to be areas that have less than a 0.20 percent chance of being flooded in any given year.

Radon

The site is underlain by clayey alluvial deposits and relatively shallow sandstone bedrock of the Franciscan Mélange, therefore the potential for radon to affect the project is low.

Geotechnical Engineering

In our opinion, the site is suitable, from a geotechnical engineering standpoint, for the proposed Annex/Classroom Building and site improvements, as described in the "Introduction" section of this report, provided the recommendations contained herein are implemented in the design and construction. The primary geotechnical engineering concerns are the potential for differential settlement from the existing fill and the potential disturbance at depth due to removal of the existing structure, the expansion potential of the upper soils, and the erodible nature and corrosive potential of the soils. Provided that the building area is prepared as recommended in the "Grading" section of this report, conventional continuous and spread (pad) foundations may be used to support the proposed structure.

Differential settlement can occur when a foundation spans materials having variable consolidation characteristics, such as the fill that was found in the upper 4 feet of Boring 1. We are unaware of any documentation (i.e., grading observation or compaction testing records) regarding the placement of the fill, but it was likely placed when the existing Annex/Cafeteria Building was constructed. Undocumented fill has a greater potential for variability than fill that has been placed and tested in a controlled earthwork program. Removal of the existing structure is also anticipated to disturb the soil to variable depths. Such conditions (i.e., undocumented fill and disturbed soil) could stress and possibly damage foundations, often resulting in severe cracks and displacement if they are not mitigated. Therefore, to reduce this potential for differential settlement, a program of overexcavation and recompaction of the soil in the building area is recommended prior to construction.

Expansion index testing yielded results of 54 and 58 for the upper fill and alluvial soils. Per CBC Section 1803A.5.3, the soils are considered to be expansive. The more commonly used ASTM classification is that the soils would be considered to have a "medium" expansion potential. Expansive soils tend to swell with increases in soil moisture and shrink as soil moisture decreases; the upper 3 to 5 feet of any soil profile is the zone most affected by these seasonal soil moisture fluctuations. The volume changes that the soils undergo in this cyclical pattern can stress and damage foundations and slabs-on-grade if precautionary measures are not incorporated during design and in the construction procedure. Footings are typically deepened and additional reinforcement is provided. Imported nonexpansive soils are recommended to be placed beneath slabs-on-grade.

The soils above the bedrock are considered to be erodible. It is essential that all surface drainage be controlled and directed to appropriate discharge points, and that surface soils, particularly those disturbed during construction, are stabilized by vegetation or other means *during and following construction*.

As indicated in the Soil Corrosivity Study by HDR, Inc., in Appendix C, the electrical resistivities of the samples tested were in the moderately corrosive categories with as received moisture contents; when saturated, the resistivities were in the corrosive to severely corrosive categories. Soil pH values were mildly alkaline. The soluble salt contents of the soils were low to moderate. Soil nitrate concentrations were high. The soils were classified as severely corrosive to ferrous metals and aggressive to copper. Please refer to the Soil Corrosivity Study in Appendix C for a complete summary of the test results, and recommendations for mitigation.

10.0 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

The following recommendations are for improvements constructed as described in the "Introduction" section of this report. If locations, elevations, structural loads, etc., change, the recommendations contained herein may require modification. In developing the following recommendations, it was assumed that irrigated landscaping or flatwork that would keep the soils relatively uniform, year-round moisture will be installed for a zone of at least five feet around the perimeter of all improvements.

Two distinct types of Portland cement concrete (PCC) slabs-on-grade are discussed in the following recommendations. The building's interior slabs are defined as "slabs-on-grade." Sidewalks that will not support vehicle traffic are referred to as "exterior pedestrian flatwork." Asphalt concrete (AC) paths may also be utilized for pedestrian access, however it is also assumed that they will not support vehicle traffic.

Unless otherwise noted, the following definitions are used in the recommendations presented below. Where terms are not defined, definitions commonly used in the construction industry are intended.

- **Building Area –** The building area is defined as the area within and extending a minimum of 5 feet beyond the perimeter of the foundations for the Annex/Classroom Building. The building area includes any retaining walls, covered walkways or other improvements that are connected to the structure and that are intended to act in a manner similar to it.
- **Exterior Pedestrian Flatwork and Asphalt Concrete (AC) Path Areas –** The areas within the footprints of all exterior pedestrian flatwork and all AC paths.
- **Sitework Retaining Wall Areas –** The areas within and extending a minimum of 3 feet beyond the foundation limits of all sitework retaining walls.
- **Grading Area –** The entire area to be graded, including the building area, exterior pedestrian flatwork and AC path areas, and sitework retaining wall areas.
- **Existing Grade:** Elevations of the site that existed as of the date of this report.
- **Finish Pad Grade:** The elevation in the building area where earthwork operations are typically considered to be complete. It does not include any sand or gravel that might be placed below slabs-on-grade in association with vapor protection for the slabs.
- **Subgrade:** The elevation in exterior pedestrian flatwork and AC path areas where imported nonexpansive materials, sand, or aggregate base (AB) are placed to support the flatwork or AC path.

- **Scarified:** Plowed or ripped in two orthogonal directions to a depth of not less than 8 inches.
- **Moisture Conditioned:** Adjusting the soil moisture to optimum moisture content, or just above, prior to application of compactive effort.
- **Compacted/Recompacted:** Soils placed in level lifts not exceeding 8 inches in loose thickness and compacted to a minimum of 90 percent of maximum dry density. Based on maximum dry density by ASTM D 1557-12 and field density by ASTM D 6938-15, or other methods acceptable to the geotechnical engineer and jurisdiction.

Site Preparation

1. The ground surface in the grading areas should be prepared for construction by removing the existing building, existing flatwork, and all other improvements, vegetation, large roots, debris, organic topsoil, and other deleterious materials. Existing utility lines that will not remain in service should be either removed or abandoned. The appropriate method of abandonment will depend upon the type and depth of the utility. Recommendations for abandonment can be made as necessary.

2. Voids created by the removal of materials or utilities described above should be called to the attention of the geotechnical engineer. No fill should be placed unless the underlying soil has been observed by the geotechnical engineer.

Grading

1. Following site preparation, all existing fill in the building area should be removed to a level plane at the deepest point of the fill. For planning purposes, the deepest point of the fill encountered during the field exploration program was 4 feet below existing grade at Boring 1. The exact depth of fill should be determined by the geotechnical engineer at the time of construction. The resulting level excavated surface should be scarified, moisture conditioned and compacted.

2. To create as uniform conditions as possible for the structure, all earthwork operations should be completed throughout the entire building area in a uniform manner at the same time, from the bottom of the overexcavation recommended in the previous paragraph through fill placement to finish grade. Earthwork operations that complete only a portion of the building area at one time (i.e., “flip-flopping”, “checkerboarding”, etc.) should not be allowed.

3. Following site preparation, all existing fill in sitework retaining wall areas should be overexcavated to the deepest point of the fill. The resulting excavated surfaces should be scarified, moisture conditioned and compacted. Overexcavation elevations may be stepped where the fill depth changes or where retaining walls are stepped to conform to any site contours. If very stiff sandy lean clay alluvium is exposed at bottom of foundation elevation, no overexcavation and recompaction is considered necessary. To reduce the potential for cracking in sitework retaining walls, construction joints should be placed in the wall and the foundation where overexcavation operation have been stepped to conform to fill depth changes or to exposure of very stiff alluvium. Unlike the recommended earthwork program for the building area, overexcavation and recompaction operations for sitework retaining walls can proceed in a non-uniform manner for individual wall segments.

4. Following site preparation and any excavations to grade, or prior to placement of fill, the soil in any exterior pedestrian flatwork and AC path areas, and in all other grading areas, should be scarified, moisture conditioned and recompacted. Unlike the recommended earthwork program for the building area, scarification and recompaction operations for exterior pedestrian flatwork and AC path areas, and in all other grading areas, can proceed in a non-uniform manner.

5. Voids created by dislodging cobbles and/or debris during scarification should be backfilled and recompacted, and the dislodged materials should be removed from the work area.

6. Previously removed site soils and other similar soils may be placed as fill beyond the building area, and in the building area to a maximum height of 18 inches below bottom of slab elevation. The final 18 inches of fill below bottom of slab elevation in the building area should be nonexpansive.

7. Nonexpansive materials are defined as imported soils that fall in the GW, GM, GC, SP, SW, SC and SM categories per ASTM D 2487-11, and that have an expansion index of 10 or less (ASTM D 4829-11). The clean sand layer described in the “Slabs-on-Grade” section of this report (if utilized below interior slabs-on-grade or exterior pedestrian flatwork) is considered to be part of the minimum recommended thickness of nonexpansive material utilized, not in addition to it.

8. Imported soils used in the building area should have strength and expansion qualities equal to or better than the site soils, and they should not exceed the geotechnical corrosivity potential of the site soils. See the Soil Corrosivity Study in Appendix C for the corrosivity parameters of the site soils. Proposed imported materials should be reviewed by the geotechnical engineer before being brought to the site, and on an intermittent basis during placement.

9. All materials used as fill should be cleaned of any debris and rocks larger than 3 inches in diameter. When fill material includes rocks, the rocks should be placed in a sufficient soil matrix to ensure that voids caused by nesting of the rocks will not occur and that the fill can be properly compacted.

10. All AB and the top 12 inches of subgrade in areas to support AC paths should be compacted to a minimum of 95 percent of maximum dry density. Imported nonexpansive materials, sand or AB used to support exterior pedestrian flatwork, as well as the top 12 inches of subgrade in these areas, need only be compacted to a minimum of 90 percent of maximum dry density.

11. If the soils are overly moist so that they become unstable, or if the minimum recommended compaction cannot be readily achieved, drying the soil so that it is nearer optimum moisture content, may be necessary. Placement of gravel layers or geotextiles may also be necessary to help stabilize unstable soils. Additional overexcavation may also be recommended to correct unstable conditions or if soft or loose conditions are encountered during grading. No fill should be placed in any grading area if the underlying soil is unstable.

12. The recommended soil moisture content should be maintained throughout construction, and during the lives of the structure and sitework improvements. Failure to maintain the soil moisture content can result in desiccation cracks and disturbance, which are an indication of degradation of the soil compaction. If desiccation cracks are allowed to develop, or if soils near improvements such as foundations, flatwork, etc. are otherwise disturbed, damage to those improvements may result. Soils that have cracked or are otherwise disturbed should be removed, moisture conditioned, and recompacted.

Utility Trenches

1. Utility trenches adjacent to foundations should not be excavated within the zone of foundation influence, as shown in Typical Detail A in Appendix E.

2. Utilities that must pass beneath foundations should be placed with properly compacted utility trench backfill and the foundation should be designed to span the trench.

3. A select, noncorrosive, granular, easily compacted material should be used as bedding and shading immediately around utilities. The site soil may be used for trench backfill above the select material beyond the building area, and to within 18 inches below bottom of slab elevation in the building area. Within the building area, imported nonexpansive soils should be utilized to backfill the final 18 inches below bottom of slab elevation of all trenches. In exterior pedestrian flatwork and AC path areas, trench backfill should match the thickness of imported nonexpansive soils, sand or AB used to support these improvements.

4. In general, trench backfill should be compacted to a minimum of 90 percent of maximum dry density. Trench backfill in the upper 12 inches of subgrade and all AB in AC path areas should be compacted to a minimum of 95 percent of maximum dry density. A minimum of 85 percent of maximum dry density will generally be sufficient where trench backfill is located in landscaped or other unimproved areas, where settlement of trench backfill would not be detrimental.

5. Prior to applying compactive effort, soils should be moisture conditioned. Trench backfill should be placed in level lifts not exceeding 6 inches in loose thickness and compacted to the minimums recommended above.

6. Compaction of trench backfill by jetting or flooding is not recommended at this site due to the expansive soils. However, to aid in *encasing* utility conduits, particularly corrugated drain pipes, and multiple, closely-spaced conduits in a single trench with the bedding and shading material, jetting or flooding may be useful. Flooding or jetting should only be attempted with extreme caution, and any flooding or jetting operation should be subject to review by the geotechnical engineer.

7. Long-term settlement of properly compacted sand should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill. Where trenches are backfilled with site soils, the anticipated settlement would be about twice that of sand. Improvements that are constructed over or near trenches should be designed to accommodate the potential for settlement.

8. The Soil Corrosivity Study by HDR, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for utility improvements.

9. The recommendations of this section are minimums only, and may be superseded by the architect/engineer based upon soil corrosivity or the requirements of pipe manufacturers, utility companies or the governing jurisdiction.

Foundations

1. The Annex/Classroom Building may be supported by continuous and spread footings bearing in firm recompacted soils, as recommended in the "Grading" section of this report.

2. Based on soil expansion potential only, minimum overall foundations depths of 21 inches below lowest adjacent grade within 6 feet laterally of the base of foundations should be maintained. Spread footings should be at least 24 inches square.

3. Continuous footings should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential only, minimum continuous footing reinforcement should consist of two No. 4 rebars, one at the top and one at the bottom. Spread footings should be reinforced in accordance with the requirements of the architect/engineer.

4. Footings bearing in firm recompacted soil may be designed using maximum allowable bearing capacities of 2,500 psf dead load and 3,500 psf dead plus live loads. Using these criteria, maximum settlement and differential settlement are expected to be less than 1/2-inch and less than 3/8-inch in 25 feet, respectively.

5. Allowable bearing capacities may be increased by one-third when transient loads such as wind or seismicity are included. Foundations may be designed using the site design response parameters contained in the table on Page 8 in the "Seismicity" section of this report.

6. To calculate resistance to lateral loads, please see the values presented in the "Retaining Walls" section of this report. Lateral capacity is based on the assumption that any backfill adjacent to foundations has been properly compacted. Passive and friction components of resistance may be combined in the analysis without reduction to either value.

7. Footing excavations should be observed by the geotechnical engineer prior to placement of reinforcing steel. Footing excavations should be lightly moistened and no desiccation cracks should be present prior to concrete placement.

8. The Soil Corrosivity Study by HDR Engineering, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for all foundation elements.

Slabs-on-Grade

Interior Slabs-On-Grade

1. Interior slabs-on-grade should have a minimum thickness of 4 full inches. They should be reinforced and doweled to foundations per the specifications of the architect/engineer. At a minimum, interior slabs should be reinforced with No. 3 rebar at 24 inches on center each way. All structural slabs should contain minimum rebar meeting the criteria of ACI 318, Section 7.12.2 (ACI 2011). At a minimum, foundation dowels should be lap spliced to the slab rebar. The size and spacing of the dowels should match the size and spacing of the slab rebar.

Exterior Pedestrian Flatwork

1. Exterior pedestrian flatwork should have a minimum thickness of 4 full inches. Minimum reinforcement for exterior pedestrian flatwork placed over at least 18 inches of nonexpansive imported soils per the following paragraph should consist of No. 3 rebar placed at 24 inches on-center each way. If the thickness of nonexpansive soil below the flatwork is less than 18 inches, the minimum reinforcement should consist of No. 3 rebar at 18 inches on-center each way.

2. In conventional construction, it is common to use 4 to 6 inches of sand beneath exterior pedestrian flatwork. However, due to the medium expansion potential of the site soils, there will be a risk of movement and damage to the flatwork if conventional measures are used. Heaving and cracking could occur. This movement could be reduced by the placement of additional nonexpansive material beneath the flatwork. If it is desired to fully mitigate the expansive soil conditions, then at least 18 inches of imported nonexpansive material should be provided below the flatwork where the expansive site soils are exposed at finish grade. If it is acceptable for the flatwork to experience movement due to expansive soils, then the thickness of the nonexpansive soil can be reduced. Under all flatwork, however, the thicker the nonexpansive layer, the better the expansive soil protection.

3. Another measure that can be taken to reduce the risk of movement of flatwork due to expansive soils is to provide thickened edges or grade beams around the perimeters of the flatwork. If it is desired to fully mitigate the expansive soil conditions, then the thickened edges or grade beams could be up to 21 inches deep. If it is acceptable for the flatwork to experience movement, then the thickened edges or grade beams can be reduced. At a minimum, any thickened edge or grade beam should be reinforced by two No. 4 rebar, one at the top and one at the bottom.

4. It is recognized that the measures discussed above for protecting exterior flatwork from expansive soils are expensive, possibly more expensive than simply replacing flatwork that has heaved and/or cracked. Consequently, the above measures for protecting exterior flatwork are only suggestions for consideration by the owner and/or architect/engineer. The degree to which exterior flatwork is protected from expansive soil damage is left to the discretion of the owner and/or architect/engineer.

5. Flatwork should be constructed with frequent joints to allow articulation as the flatwork moves in response to seasonal soil temperature and moisture variations. The expansive soil underlying any nonexpansive material placed below flatwork should be moisture conditioned, and no desiccation cracks should be present, prior to casting the flatwork.

6. Flatwork at doorways, and at other areas where maintaining the elevation of the flatwork is desired when mitigating expansive soil potential, should be doweled to the perimeter foundation, at a minimum, by No. 3 dowels lapped to the flatwork rebar at 24 inches on center. In other areas, the flatwork may be doweled to the foundation or the flatwork may be allowed to "float free," at the discretion of the architect/engineer. Flatwork that is intended to float free should be separated from foundations by a felt joint or other means.

<u>Moisture Vapor Transmission</u>

1. Due to the current use of impermeable floor coverings, water-soluble flooring adhesives, and the speed at which buildings are now constructed, moisture vapor transmission through slabs is a much more common problem than in past years. Where moisture vapor transmitted from the underlying soil would be undesirable, slabs should be protected from subsurface moisture vapor. A number of options for vapor protection are discussed below; however, the means of vapor protection, including the type and thickness of the vapor retarder, if specified, are left to the discretion of the architect/engineer.

2. Where specified, vapor retarders should conform to ASTM Standard E 1745-11. This standard specifies properties for three performance classes; Class A, B and C. The appropriate class should be selected based on the sensitivity of floor coverings to moisture intrusion and the potential for damage to the vapor retarder during placement of slab reinforcement and concrete.

3. Several recent studies, including those of American Concrete Institute Committee 302 (ACI 2004), have concluded that excess water above the vapor retarder increases the potential for moisture damage to floor coverings and could increase the potential for mold growth or other microbial contamination. The studies also concluded that it is preferable to eliminate the typical sand layer beneath the slab and place the slab concrete in direct contact with a Class A vapor retarder, particularly during wet weather construction. However, placing the concrete directly on the vapor retarder requires special attention to using the proper vapor retarder, a very low water-cement ratio in the concrete mix, and special finishing and curing techniques.

4. Probably the next most effective option would be the use of vapor-inhibiting admixtures in the slab concrete mix and/or application of a sealer to the surface of the slab. This would also require special concrete mixes and placement procedures, depending upon the recommendations of the admixture or sealer manufacturer.

5. Another option that may be a reasonable compromise between effectiveness and cost considerations is the use of a subslab vapor retarder protected by a sand layer. If a Class A vapor retarder is specified, the retarder can be placed directly on the nonexpansive soil. The retarder should be covered with a minimum 2 inches of *clean* sand. If a less durable vapor retarder is specified (Class B or C), a minimum of 4 inches of clean sand should be provided, and the retarder should be placed in the center of the clean sand layer. Clean sand is defined as a well or poorly graded sand (ASTM D 2487-11) of which less than 3 percent passes the No. 200 sieve. The clean sand layer, if used, is considered to be a part of the minimum 18-inch thickness of nonexpansive imported materials recommended in the "Grading" section of this report to be placed below slabs-on-grade, not in addition to it.

6. Regardless of the underslab vapor retarder selected, proper installation of the retarder per ASTM E 1643-11 is critical for optimum performance. Where utilized, the vapor retarder should be placed a minimum of 1 inch above the flow line of the drainage path

surrounding the structures, or 1 inch above the area drain grates if area drains are used to collect runoff around the structures. All seams must be properly lapped, and all seams and utility penetrations properly sealed in accordance with the vapor retarder manufacturer's recommendations.

7. If the sand is used between the vapor retarder and the slab, it should be moistened only as necessary to promote concrete curing; saturation of the sand should be avoided, as the excess moisture would be on top of the vapor retarder, potentially resulting in vapor transmission through the slab for months or years.

8. The architect/engineer should designate any special measures to be used in conjunction with moisture vapor transmission protection, if needed, to mitigate the high potential for indoor radon levels.

9. Positive drainage away from the building should be maintained; see the "Drainage and Maintenance" section of this report for additional discussion of this issue. If water is allowed to pond near the structure, it may seep into the ground and migrate laterally through cracks or utility penetrations in the foundation, ultimately gaining access above the vapor retarder.

Slabs-on-Grade - General

1. To reduce shrinkage cracks in all interior and exterior slabs-on-grade, the concrete aggregates should be of appropriate size and proportion, the water/cement ratio should be low, the concrete should be properly placed and finished, contraction joints should be installed, and the concrete should be properly cured. This is particularly applicable to slabs that will be cast directly upon a vapor retarder and those that will be protected from transmission of vapor by use of admixtures or surface sealers. Concrete materials, placement, and curing specifications should be at the direction of the architect/engineer; AC 302.1R-04 (ACI 2004) is suggested as a resource for the architect/engineer in preparing such specification.

2. To provide stability for curbs adjacent to exterior pedestrian flatwork, they should be set back a minimum distance equal to one-third the height of any adjacent descending slope, but not less than 5 feet from the tops of slopes. Alternately, curbs may be deepened to provide stability. The geotechnical engineer should review, on an individual basis, any situation where curbs must be deepened to meet this recommendation.

3. The Soil Corrosivity Study by HDR, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for all slabs-on-grade.

Retaining Walls

1. Retaining walls connected to or forming part of the building should be founded in firm soil that has been recompacted per the "Grading" section of this report. Sitework retaining walls may be supported by either firm soil that has been recompacted per the "Grading" section of this report, or firm sandy lean clay alluvium. If a sitework retaining wall crosses a recompacted soil/firm alluvium transition, or a transition between varying fill overexcavation depths, a construction joint should be placed in the footing and wall at the transitions. Foundations for all retaining walls should have minimum overall depths (not including any keyway) of 21 inches below lowest grade within 6 feet laterally of any adjacent slope.

2. Retaining wall footings should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential only, minimum retaining wall footing reinforcement should consist of two No. 4 rebars, one at the top and one at the bottom.

3. Retaining wall design may be based on the following parameters:

Active equivalent fluid pressure (site soils)	45 pcf
Active equivalent fluid pressure (imported sand/gravel backfill)	35 pcf
At-rest equivalent fluid pressure (site soils)	60 pcf
At-rest equivalent fluid pressure (imported sand/gravel backfill)	50 pcf
Passive equivalent fluid pressure	350 pcf
Maximum toe pressure	3,500 psf
Coefficient of sliding friction	0.35

4. No surcharges are taken into consideration in the values presented in the previous paragraph. The maximum toe pressure is an *allowable* value; no factors of safety, load factors or other factors have been applied to the remaining values. With the exception of the maximum toe pressure, these values will require application of appropriate factors of safety, load factors, and/or other factors as deemed appropriate by the architect/engineer.

5. If the active or at-rest pressures presented in Paragraph 3 for *imported sand or gravel backfill* are utilized for design of retaining walls, the sand or gravel should be used exclusively as backfill above a 1:1 plane extended upward from the back of the wall footing to approximately 1 foot from the top of the wall backfill. The upper foot should be backfilled with native soil, except in areas where AC paths or exterior pedestrian flatwork will abut the top of the wall. In such cases, the gravel should extend to the imported nonexpansive material, sand, aggregate base, or other material below the improved surface, as appropriate.

6. The active and at-rest pressures presented in Paragraph 3 are applicable to a horizontal retained surface behind the wall. Walls having a retained surface that slopes upward from the wall should be designed for an additional equivalent fluid pressure of 1 pcf for the active case and 1.5 pcf for the at-rest case, for every degree of slope inclination.

7. It is assumed that retaining wall heights will not exceed 4 feet.

8. Section 1803A.5.12.1 of the 2013 CBC requires that dynamic seismic lateral earth pressures be provided by the geotechnical engineer for walls retaining more than 6 feet of backfill. As the walls for this project will not retain more than 6 feet, design for seismic lateral earth pressures is not required.

9. Long-term settlement of properly compacted sand or gravel retaining wall backfill should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill; long-term settlement of properly compacted site soil retaining wall backfill would be about twice that of sand or gravel backfill. Improvements that are constructed near the tops of retaining walls should be designed to accommodate long-term settlement.

10. All retaining walls should be drained with perforated pipe encased in a free-draining gravel blanket. The pipe should be placed perforations downward, and should discharge in a nonerosive manner away from foundations and other improvements. The gravel blanket should have a width of approximately 1 foot and should extend upward to approximately 1 foot from the top of the wall backfill. The upper foot should be backfilled with native soil, except in areas where AC paths or exterior pedestrian flatwork will abut the top of the wall. In such cases, the gravel should extend to the imported nonexpansive material, sand, aggregate base, or other material below the improved surface, as

appropriate. To reduce infiltration of the soil into the gravel, a permeable synthetic filter fabric conforming to Standard Specifications Section 88-1.02B – Class C (Caltrans 2010), should be placed between the two. Manufactured synthetic drains, such as Miradrain or Enkadrain are acceptable alternatives to the use of gravel, provided that they are installed in accordance with the recommendations of the manufacturer.

11. Where weep hole drainage can be properly discharged, the perforated pipe may be omitted in lieu of weep holes on maximum 4-foot centers. A filter fabric as described above should be placed between the weep holes and the drain gravel.

12. Walls facing areas where moisture transmission through the wall would be undesirable should be *thoroughly* waterproofed in accordance with the specifications of the architect/engineer.

13. The architect/engineer should bear in mind that retaining walls by their nature are flexible structures, and that surface treatments on walls often crack. Where walls are to be plastered or otherwise have a finish applied, the flexibility should be considered in determining the suitability of the surfacing material, spacing of horizontal and vertical control joints, etc. The flexibility should also be considered where a retaining wall will abut or be connected to a rigid structure, and where the geometry of the wall is such that its flexibility will vary along its length.

14. The Soil Corrosivity Study by HDR, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for all retaining walls.

Asphalt Concrete (AC) Paths

1. Paths for pedestrian access may be constructed of AC over AB. Design methods for AC pavement do not typically consider pedestrian loading only. Therefore, the section design is typically based on local experience and anticipated life span. For this application, a minimum pavement section of 1.5 to 2.0 inches of AC over 2 to 4 inches of AB is considered appropriate. As with exterior pedestrian flatwork these minimum thicknesses of AC and AB will be subject to movement due to expansive soils. If it is desired to filly mitigate the expansive soil conditions, the AB thickness can be increased to as much as 18 inches.

2. It is recognized that the increased AB thickness recommended above for protecting AC paths from expansive soils will be expensive, possibly more expensive than simply replacing AC paths that has heaved and/or cracked. Consequently, this measure for protecting AC paths is only a suggestion for consideration by the client and/or architect/engineer. The degree to which AC paths are protected from expansive soil damage is left to the discretion of the owner and/ or architect/engineer.

3. AB should conform to the requirements of Section 26 of the Standard Specifications (Caltrans 2010). AC should conform to the requirements of Section 32 of the Standard Specifications (Caltrans 2010).

4. The upper 12 inches of subgrade and all AB in pavement areas should be compacted to a minimum of 95 percent of maximum dry density. Subgrade and aggregate base should be firm and unyielding when proofrolled with heavy, rubber-tired grading equipment prior to continuing construction.

Drainage and Maintenance

1. Per Section 1804A.3 of the 2013 CBC, unpaved ground surfaces should be *finish graded* to direct surface runoff away from foundations and other improvements at a minimum 5 percent grade for a minimum distance of 10 feet. The site should be similarly sloped to drain away from foundation, and other improvements during construction. Where this is not practicable due to other improvements, etc., swales with improved surfaces, area drains, or other drainage facilities, should be used to collect and discharge runoff.

2. All eaves of the building should be fitted with roof gutters. Runoff from flatwork, roof gutters, downspouts, planter drains, area drains, etc. should discharge in a nonerosive manner away from foundations and other improvements in accordance with the requirements of the governing agencies. Erosion protection should be placed at all discharge points unless the discharge is to a pavement surface.

3. To reduce the potential for planter drainage gaining access to subslab areas, any raised planter boxes adjacent to foundations should be installed with drains and sealed sides and bottoms. Drains should also be provided for areas adjacent to the structure and in landscape areas that would not otherwise freely drain.

4. The on-site soils are erodible; stabilization of soils disturbed during construction by vegetation or other means *during* and *following* construction, is essential to reduce erosion damage. Care should be taken to establish and maintain vegetation. The landscaping should be planned and installed to maintain the surface drainage recommended above. Surface drainage should also be maintained during construction.

5. Maintenance of drainage and other improvements is critical to the long-term stability of the site and the integrity of the structures. Site improvements should be maintained on a regular basis.

6. All exterior drains, retaining wall drains, and drain outlets should be maintained to be free-flowing. Vegetation and erosion matting (if utilized) should be maintained or augmented as needed. Irrigation systems should be maintained so that soils around structures are maintained at a relatively uniform year-round moisture content, and are neither over-watered nor allowed to dry and desiccate.

7. To reduce the potential for disruption of drainage patterns and undermining of structures, fill areas, etc., all rodent activity should be aggressively controlled.

Observation and Testing

1. It must be recognized that the recommendations contained in this report are based on a limited number of borings and rely on continuity of the subsurface conditions encountered.

2. It is assumed that the geotechnical engineer will be retained to provide consultation during the design phase, to interpret this report during construction, and to provide construction monitoring in the form of testing and observation.

3. At a minimum, the geotechnical engineer should be retained to provide:
    - Professional observation during grading, trench and retaining wall backfill, and foundation construction
    - Oversight of special inspection and compaction testing grading, trench and retaining wall backfill, and foundation construction

4. Special inspection of grading and backfill should be provided as per Section 1705A.6 and Table 1705A.6 of the CBC. The special inspector should be under the direction of the geotechnical engineer. At a minimum, the following items should be inspected and/or tested by the special inspector:
    - Stripping and clearing of all existing improvements, vegetation, and deleterious materials
    - Overexcavation of the building and sitework retaining wall areas to the recommended depths
    - Scarification and moisture conditioning of overexcavated areas
    - Scarification and moisture conditioning of exterior pedestrian flatwork, AC path and all other grading areas
    - Fill quality, placement, moisture conditioning and compaction
    - Utility trench backfill
    - Foundation excavations

5. A program of quality assurance should be developed prior to beginning construction. At a minimum, the program should include all geotechnical items shown on the testing and inspection schedule of the approved plans. It should also include any additional inspection items required by the engineer and/or the governing jurisdiction. These items should be discussed at a preconstruction site meeting among a representative of the owner, the geotechnical engineer, special inspector, the project inspector, the engineer, and contractors. The geotechnical engineer should be notified at least 48 hours prior to beginning grading operations.

6. Locations and frequency of compaction tests should be as per the recommendation of the geotechnical engineer at the time of construction. The recommended test location and frequency may be subject to modification by the geotechnical engineer, based upon soil and moisture conditions encountered, size and type of equipment used by the contractor, the general trend of the results of compaction tests, or other factors.

11.0 CLOSURE

Our intent was to perform the investigation in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the locality of this project under similar conditions. No representation, warranty, or guarantee is either expressed or implied. This report is intended for the exclusive use by the client as discussed in the “Scope of Services” section. Application beyond the stated intent is strictly at the user's risk.

This report is valid for conditions as they exist at this time for the type of project described herein. The conclusions and recommendations contained in this report could be rendered invalid, either in whole or in part, due to changes in building codes, regulations, standards of geotechnical or construction practice, changes in physical conditions, or the broadening of knowledge.

If changes with respect to the project become necessary, if items not addressed in this report are incorporated into plans, or if any of the assumptions used in the preparation of this report are not correct, this firm shall be notified for modifications to this report. Any items not specifically addressed in this report should comply with the CBC of other applicable standards, and the requirements of the governing jurisdiction.

The preliminary recommendations presented in this geotechnical report are based upon the geotechnical conditions encountered at the site, and may be augmented by additional requirements of the client, or by additional recommendations provided by the geotechnical engineer based on peer or jurisdiction reviews, or conditions exposed at the time of construction.

This document, the data, conclusions, and recommendations contained herein are the property of Earth Systems Pacific. This report shall be used in its entirety, with no individual sections reproduced or used out of context. Copies may be made only by Earth Systems Pacific, the client, and the client's authorized agents for use exclusively on the subject project. Any other use is subject to federal copyright laws and the written approval of Earth Systems Pacific.

Thank you for this opportunity to have been of service. If you have any questions, please feel free to contact this office at your convenience.

End of Text.

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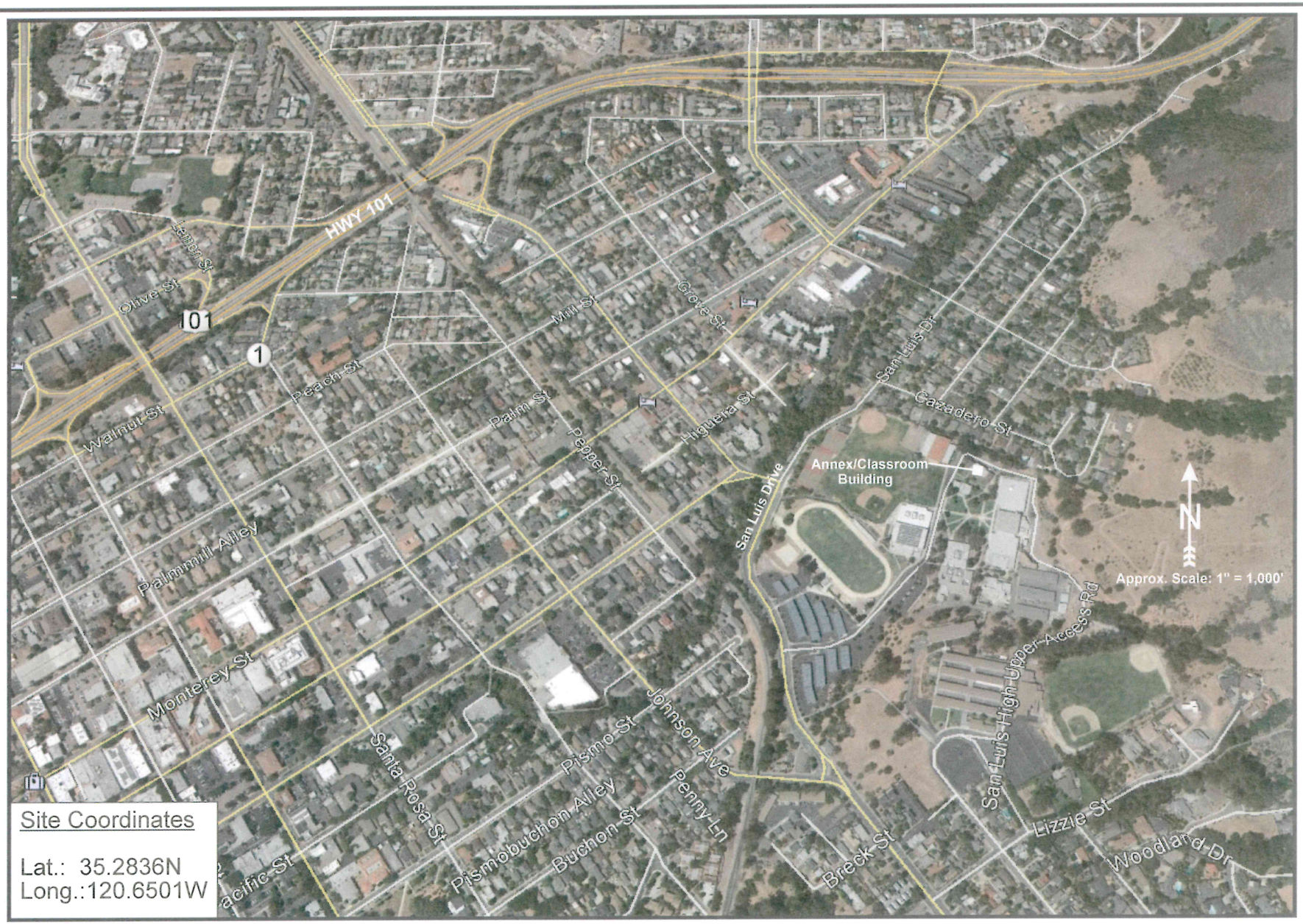
APPENDIX A

Vicinity Map
Boring Location Map
Boring Log Legend
Boring Logs
Cross Section A-A'



Reference: extract from Google Earth 2015

EARTH SYSTEMS PACIFIC
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(805) 544-3276

VICINITY MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

Date
January 2016

Project No.
SL-16605-SE



LEGEND

3 Boring Location (Approx.)

A A' Cross Section (Approx.)

BORING LOCATION MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING

1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

NOT TO SCALE

N

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E-mail: esp@earthsystems.com

December 9, 2015 CS SL-16605-SE

SLO HS MEASURE D POOL ANNEX CLASSROOM BLDG--1816LOCATIONS

Earth Systems Pacific

BORING LOG LEGEND

SAMPLE / SUBSURFACE WATER SYMBOLS	GRAPH. SYMBOL
CALIFORNIA MODIFIED	
STANDARD PENETRATION TEST (SPT)	
SHELBY TUBE	
BULK	
SUBSURFACE WATER DURING DRILLING	
SUBSURFACE WATER AFTER DRILLING	

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

MAJOR DIVISIONS	GROUP SYMBOL	TYPICAL DESCRIPTIONS	GRAPH. SYMBOL
COARSE GRAINED SOILS (MORE THAN HALF OF MATERIAL IS LARGER THAN #200 SIEVE SIZE)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GP	POORLY GRADED GRAVELS, OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, NON-PLASTIC FINES	
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, PLASTIC FINES	
	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
	SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES	
	SM	SILTY SANDS, SAND-SILT MIXTURES, NON-PLASTIC FINES	
	SC	CLAYEY SANDS, SAND-CLAY MIXTURES, PLASTIC FINES	
FINE GRAINED SOILS (HALF OR MORE OF MATERIAL IS SMALLER THAN #200 SIEVE SIZE)	ML	INORGANIC SILTS AND VERY FINE SANDS, 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	
	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS	
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	

OBSERVED MOISTURE CONDITION

DRY	SLIGHTLY MOIST	MOIST	VERY MOIST	WET (SATURATED)

CONSISTENCY

COARSE GRAINED SOILS

BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER	
0-10	0-16	LOOSE
11-30	17-50	MEDIUM DENSE
31-50	51-83	DENSE
OVER 50	OVER 83	VERY DENSE

FINE GRAINED SOILS

BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER	
0-2	0-3	VERY SOFT
3-4	4-7	SOFT
5-8	8-13	MEDIUM STIFF
9-15	14-25	STIFF
16-30	26-50	VERY STIFF
OVER 30	OVER 50	HARD

GRAIN SIZES

U.S. STANDARD SERIES SIEVE				CLEAR SQUARE SIEVE OPENING		
# 200	# 40	# 10	# 4	3/4"	3"	12"

SILT & CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

TYPICAL BEDROCK HARDNESS

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
EXTREMELY HARD	CORE, FRAGMENT, OR EXPOSURE CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CAN ONLY BE CHIPPED WITH REPEATED HEAVY HAMMER BLOWS
VERY HARD	CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CORE OR FRAGMENT BREAKS WITH REPEATED HEAVY HAMMER BLOWS
HARD	CAN BE SCRATCHED WITH KNIFE OR SHARP PICK WITH DIFFICULTY (HEAVY PRESSURE); HEAVY HAMMER BLOW REQUIRED TO BREAK SPECIMEN
MODERATELY HARD	CAN BE GROOVED 1/16 INCH DEEP BY KNIFE OR SHARP PICK WITH MODERATE OR HEAVY PRESSURE; CORE OR FRAGMENT BREAKS WITH LIGHT HAMMER BLOW OR HEAVY MANUAL PRESSURE
SOFT	CAN BE GROOVED OR GOUGED EASILY BY KNIFE OR SHARP PICK WITH LIGHT PRESSURE, CAN BE SCRATCHED WITH FINGERNAIL; BREAKS WITH LIGHT TO MODERATE MANUAL PRESSURE
VERY SOFT	CAN BE READILY INDENTED, GROOVED OR GOUGED WITH FINGERNAIL, OR CARVED WITH KNIFE; BREAKS WITH LIGHT MANUAL PRESSURE

TYPICAL BEDROCK WEATHERING

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
FRESH	NO DISCOLORATION, NOT OXIDIZED
SLIGHTLY WEATHERED	DISCOLORATION OR OXIDATION IS LIMITED TO SURFACE OF, OR SHORT DISTANCE FROM, FRACTURES: SOME FELDSPAR CRYSTALS ARE DULL
MODERATELY WEATHERED	DISCOLORATION OR OXIDATION EXTENDS FROM FRACTURES, USUALLY THROUGHOUT; Fe-Mg MINERALS ARE "RUSTY", FELDSPAR CRYSTALS ARE "CLOUDY"
INTENSELY WEATHERED	DISCOLORATION OR OXIDATION THROUGHOUT; FELDSPAR AND Fe-Mg MINERALS ARE ALTERED TO CLAY TO SOME EXTENT, OR CHEMICAL ALTERATION PRODUCES IN SITU DISAGGREGATION
DECOMPOSED	DISCOLORATION OR OXIDATION THROUGHOUT, BUT RESISTANT MINERALS SUCH AS QUARTZ MAY BE UNALTERED; FELDSPAR AND Fe-Mg MINERALS ARE COMPLETELY ALTERED TO CLAY

drafting/masters/Boring Log Legend121714.dwg

Earth Systems Pacific

Boring No. 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

PAGE 1 OF 1
JOB NO.: SL-16605-SE
DATE: 12/29/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL		SANDY LEAN CLAY: dark brown/ olive mottled, stiff, moist, trace coarse gravel (Fill)	1.0 - 2.5	Ring	107.5	14.9	5, 6, 7
2				0.0 - 3.0	Grab			
4	CL		SANDY LEAN CLAY: dark brown, very stiff, moist, some fine gravel (Alluvium)	4.0 - 6.0	Grab			
5				5.0 - 6.5	Ring	109.1	14.8	7, 13, 18
10				10.0 - 11.5	Ring	119.6	13.0	6, 13, 21
15				15.0 - 16.5	SPT			4, 8, 11
17	GC		CLAYEY GRAVEL WITH SAND: brown, medium dense, moist					
20				20.0 - 21.5	SPT			4, 9, 12
24			SANDSTONE: dark yellow brown, moderately soft, moist (Franciscan Melange)	25.0 - 25.5	SPT			50/3"
26			End of Boring @ 26.0' due to refusal No subsurface water encountered					

LEGEND: Ring Sample Grab Sample Shelby Tube Sample SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

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Boring No. 2
PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

JOB NO.: SL-16605-SE
DATE: 12/29/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			4.0" AC over 2" AB					
1	CL		SANDY LEAN CLAY: dark brown, stiff, moist, some fine gravel (Alluvium)					
2				1.0 - 4.0	○			4
3				3.0 - 4.5	▬	109.4	16.2	10 16
4			brown, slightly moist					5
5			dark brown, moist, gravel ends	5.0 - 6.5	▬	112.6	15.2	8 13
9			brown, very stiff to hard					7
10				10.0 - 11.5	▬	119.4	14.6	16 20
14								4
15				15.0 - 16.5	●			9 12
16			End of Boring @ 16.5'					
			No subsurface water encountered					

LEGEND: ▬ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 3
PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

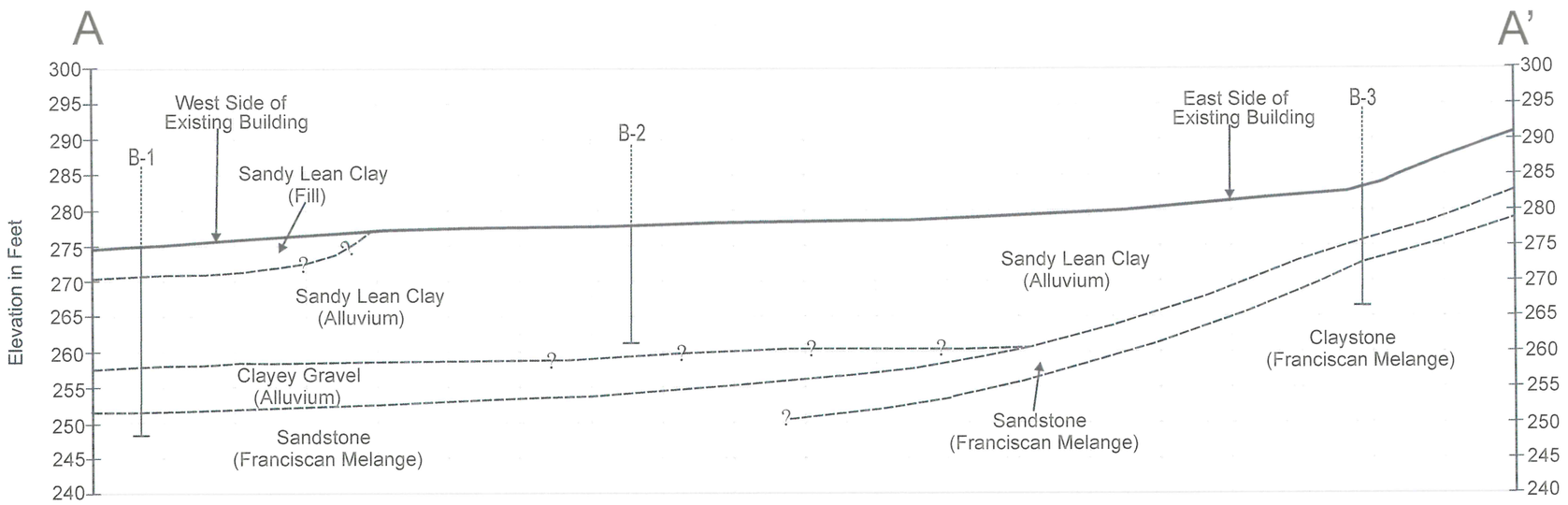
JOB NO.: SL-16605-SE
DATE: 12/29/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL		SANDY LEAN CLAY: dark brown, very stiff, very moist, trace gravel (Alluvium)	1.0 - 2.5	Ring	110.4	17.8	4, 8, 12
4			brown, slightly moist	3.5 - 6.0	Grab			8
5				5.0 - 6.5	Ring	118.7	11.6	13, 19
6				5.0 - 6.5	Grab			
8			SANDSTONE: dark yellow brown, moderately soft, moist (Franciscan Melange)	10.0 - 11.5	Ring			16, 36, 50/5"
11			CLAYSTONE: gray brown, moderately soft, moist, severely sheared, weathered	15.0 - 16.5	SPT			11, 20, 28
17			End of Boring @ 16.5' due to refusal No subsurface water encountered					

LEGEND: Ring Sample; Grab Sample; Shelby Tube Sample; SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.



Scale 1" = 20'

EARTH SYSTEMS PACIFIC
4378 Old Santa Fe Road, San Luis Obispo, CA 93401
www.earthsystems.com - email: esp@earthsystems.com
(805) 544-3276

CROSS SECTION A-A'
SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

Date
January 2016

Project No.
SL-16605-SE

APPENDIX B

Geotechnical Laboratory Test Results

San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

BULK DENSITY TEST RESULTS

ASTM D 2937-10 (modified for ring liners)

January 12, 2016

BORING NO.	DEPTH feet	MOISTURE CONTENT, %	WET DENSITY, pcf	DRY DENSITY, pcf
1	2.0 - 2.5	14.9	123.5	107.5
1	6.0 - 6.5	14.8	125.3	109.1
1	11.0 - 11.5	13.0	135.1	119.6
2	4.0 - 4.5	16.2	127.1	109.4
2	6.0 - 6.5	15.2	129.7	112.6
2	11.0 - 11.5	14.6	136.8	119.4
3	2.0 - 2.5	17.8	130.0	110.4
3	6.0 - 6.5	11.6	132.5	118.7

EXPANSION INDEX TEST RESULTS

ASTM D 4829-11

BORING NO.	DEPTH feet	EXPANSION INDEX
1	0.0 - 3.0	54
2	1.0 - 4.0	58

San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

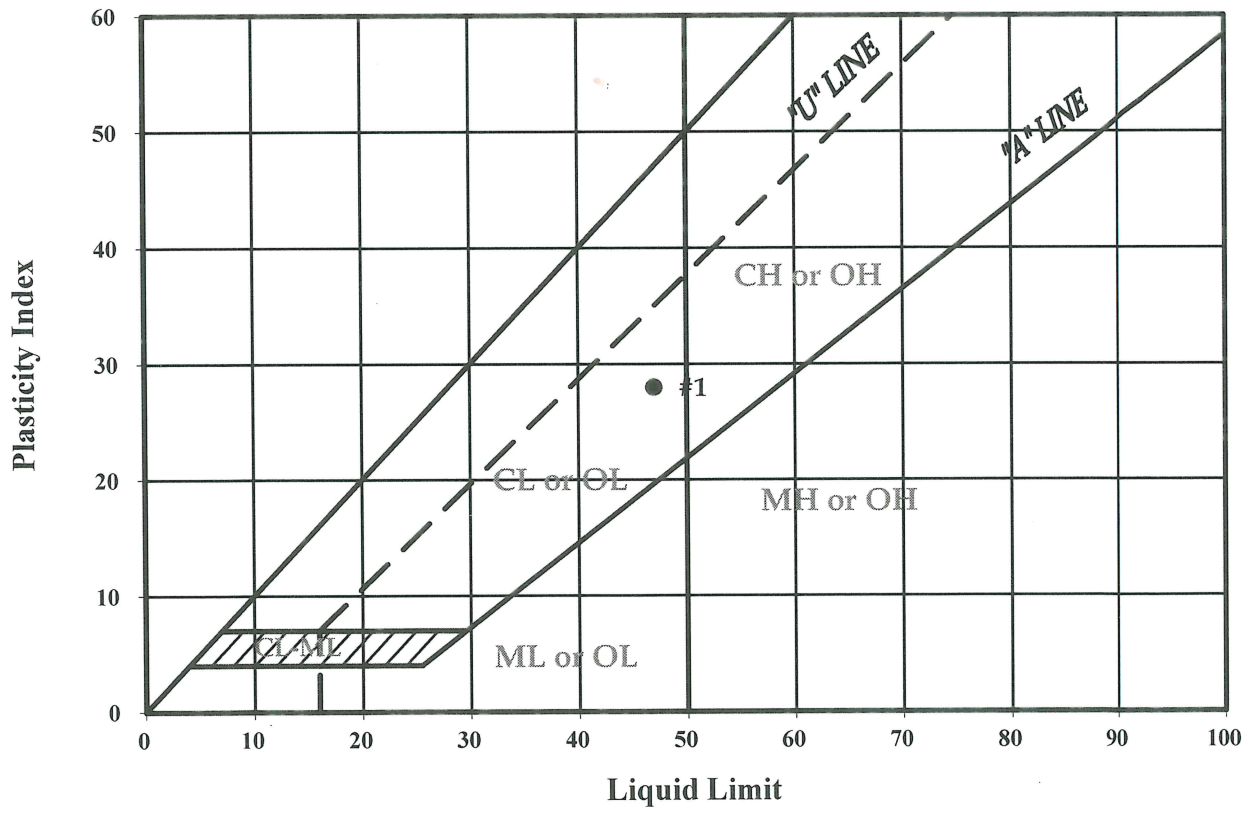
PLASTICITY INDEX

ASTM D 4318-10

January 12, 2016

Test No.:	1	2	3	4	5
Boring No.:	1				
Sample Depth:	4.0 - 6.0'				
Liquid Limit:	47				
Plastic Limit:	19				
Plasticity Index:	28				

Plasticity Chart



San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

MOISTURE-DENSITY COMPACTION TEST

ASTM D 1557-12 (Modified)

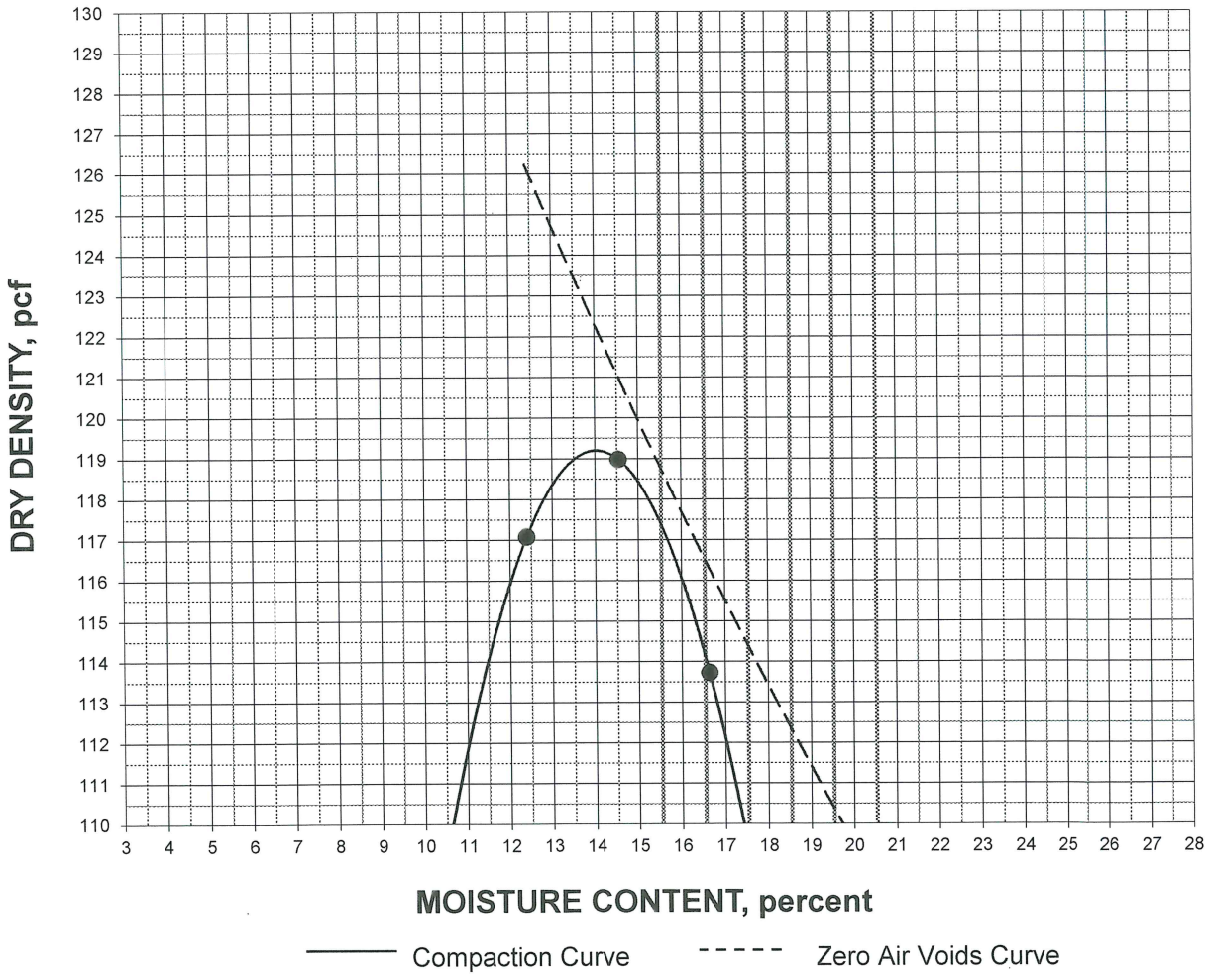
PROCEDURE USED: A
PREPARATION METHOD: Moist
RAMMER TYPE: Mechanical
SPECIFIC GRAVITY: 2.70 (assumed)

January 12, 2016
Boring #2 @ 1.0 - 4.0'
Dark Brown Sandy Lean Clay (CL)

SIEVE DATA:

Sieve Size	% Retained (Cumulative)
3/4"	0
3/8"	0
#4	0

MAXIMUM DRY DENSITY: 119.2 pcf
OPTIMUM MOISTURE: 14.0%



San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

DIRECT SHEAR

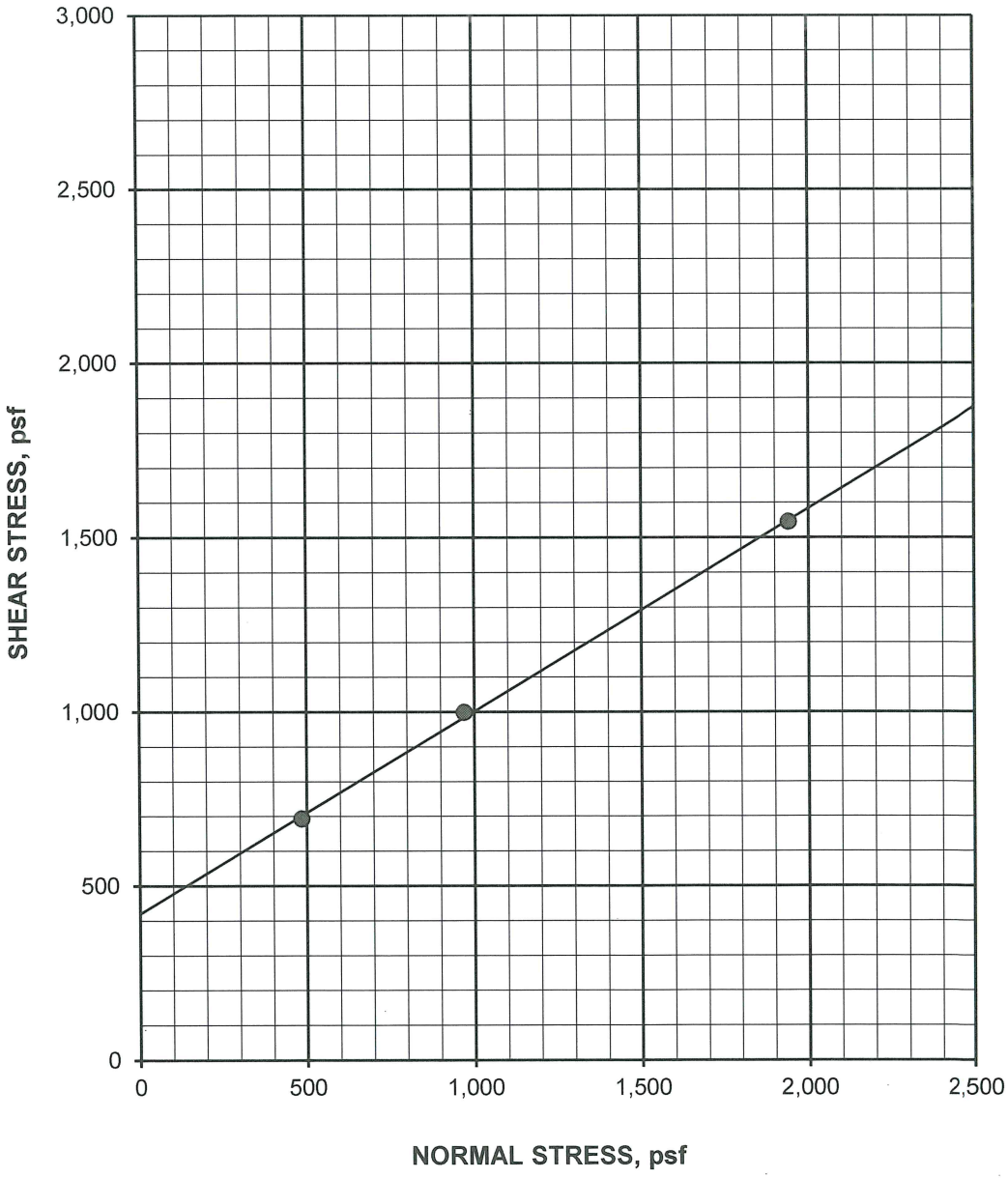
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

January 12, 2016

Boring #2 @ 1.0 - 4.0'
Sandy Lean Clay (CL)
Compacted to 90% RC, saturated

INITIAL DRY DENSITY: 107.3 pcf
INITIAL MOISTURE CONTENT: 14.0 %
PEAK SHEAR ANGLE (Ø): 30°
COHESION (C): 420 psf

SHEAR vs. NORMAL STRESS



DIRECT SHEAR continued

ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

Boring #2 @ 1.0 - 4.0'

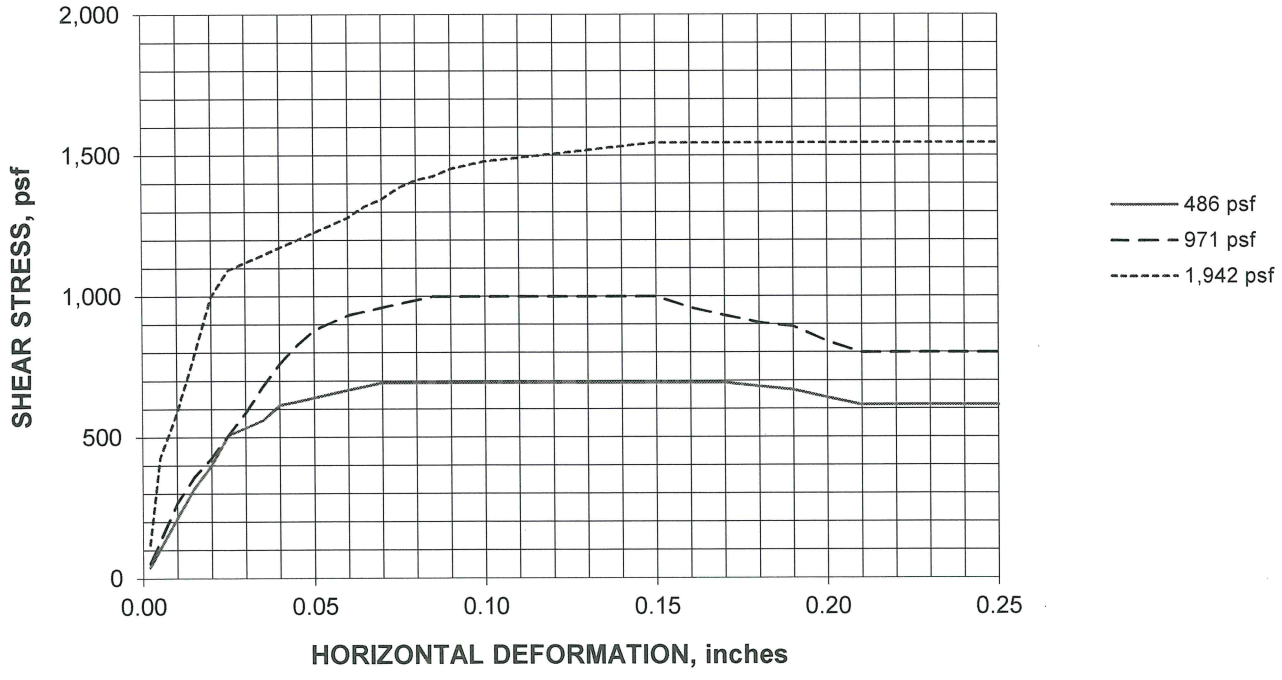
January 12, 2016

Sandy Lean Clay (CL)

Compacted to 90% RC, saturated

SPECIFIC GRAVITY: 2.70 (assumed)

SAMPLE NO.:	1	2	3	AVERAGE
INITIAL				
WATER CONTENT, %	14.0	14.0	14.0	14.0
DRY DENSITY, pcf	107.3	107.3	107.3	107.3
SATURATION, %	66.3	66.3	66.3	66.3
VOID RATIO	0.570	0.570	0.570	0.570
DIAMETER, inches	2.410	2.410	2.410	
HEIGHT, inches	1.00	1.00	1.00	
AT TEST				
WATER CONTENT, %	25.3	23.9	22.9	
DRY DENSITY, pcf	108.3	109.8	114.5	
SATURATION, %	100.0	100.0	100.0	
VOID RATIO	0.556	0.534	0.472	
HEIGHT, inches	0.99	0.98	0.94	



San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

CONSOLIDATION TEST

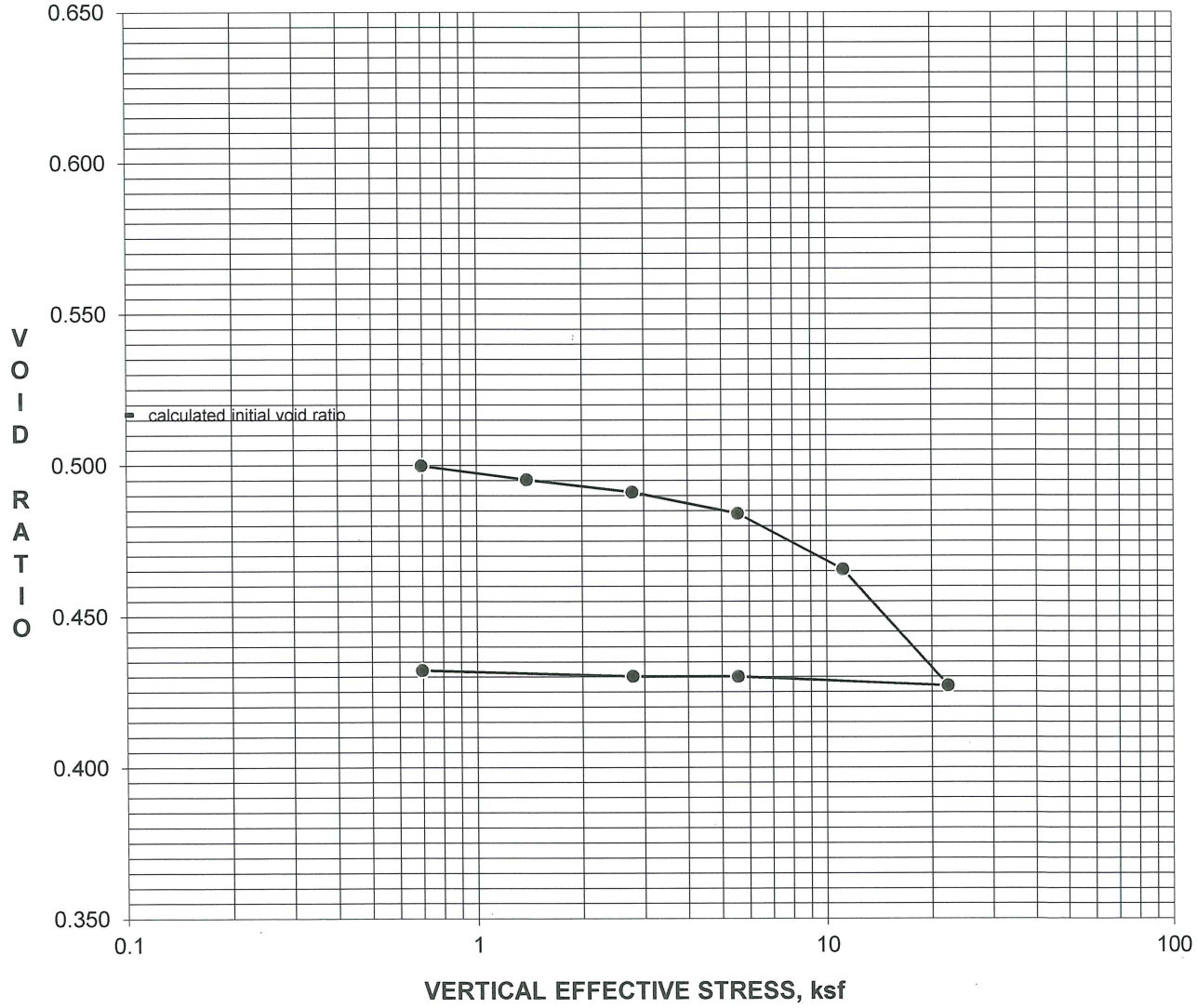
ASTM D 2435/D2435M-11

January 12, 2016

Boring #2 @ 6.0 - 6.5'
Sandy Lean Clay (CL)
Ring Sample

DRY DENSITY: 111.1 pcf
MOISTURE CONTENT: 15.2%
SPECIFIC GRAVITY: 2.70 (assumed)
INITIAL VOID RATIO: 0.517

VOID RATIO vs. NORMAL PRESSURE DIAGRAM



APPENDIX C

Soil Corrosivity Study by HDR, Inc.

January 18, 2016 via email: Fred@earthsystems.com

EARTH SYSTEMS PACIFIC
4378 Old Santa Fe Road
San Luis Obispo, CA 93401

Attention: Mr. Fred J. Potthast, GE

Re: Soil Corrosivity Study
San Luis Obispo High School
Annex/Classroom Building Project
No. 831-3102
San Luis Obispo, California
HDR #274257, ESP #SL16605-SE

Introduction

Laboratory tests have been completed on two soil samples provided for the San Luis Obispo High School project. The purpose of these tests was to determine if the soils might have deleterious effects on underground utility piping and concrete structures. HDR Engineering, Inc. (HDR) assumes that the samples provided are representative of the most corrosive soils at the site.

The proposed construction consists of a single story classroom building with conventional foundations and slabs-on-grade. The site is located at 1499 San Luis Drive in San Luis Obispo, California. The water table was reportedly not encountered during exploratory borings to a depth of 26 feet.

The scope of this study is limited to a determination of soil corrosivity and general corrosion control recommendations for materials likely to be used for construction. HDR's recommendations do not constitute, and are not meant as a substitute for, design documents for the purpose of construction. If the architects and/or engineers desire more specific information, designs, specifications, or review of design, HDR will be happy to work with them as a separate phase of this project.

Laboratory Soil Corrosivity Tests

The electrical resistivity of each sample was measured in a soil box per ASTM G187 in its as-received condition and again after saturation with distilled water. Resistivities are at about their lowest value when the soil is saturated. The pH of the saturated samples was measured per CTM 643. A 5:1 water:soil extract from each sample was chemically analyzed for the major soluble salts commonly found in soil per ASTM D4327, ASTM D6919, and Standard Method 2320-B[1]. Laboratory analysis was performed under HDR laboratory number 16-0015SCS and the test results are shown in the attached Table 1.

Soil Corrosivity

A major factor in determining soil corrosivity is electrical resistivity. The electrical resistivity of a soil is a measure of its resistance to the flow of electrical current. Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of electrical current (DC) from the metal into the soil. Corrosion currents, following Ohm's Law, are inversely proportional to soil resistivity. Lower electrical resistivities result from higher moisture and soluble salt contents and indicate corrosive soil.

A correlation between electrical resistivity and corrosivity toward ferrous metals is:[2]

Soil Resistivity in ohm-centimeters	Corrosivity Category
Greater than 10,000	Mildly Corrosive
2,001 to 10,000	Moderately Corrosive
1,001 to 2,000	Corrosive
0 to 1,000	Severely Corrosive

Other soil characteristics that may influence corrosivity towards metals are pH, soluble salt content, soil types, aeration, anaerobic conditions, and site drainage.

---

[1] *American Public Health Association (APHA). 2012. Standard Methods of Water and Wastewater. 22nd ed. American Public Health Association, American Water Works Association, Water Environment Federation publication. APHA, Washington D.C.*

[2] *Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, pp. 166–167.*

Electrical resistivities were in the moderately corrosive categories with as-received moisture. When saturated, the resistivities were in the corrosive to severely corrosive categories. The resistivities dropped with added moisture because the samples were dry as-received.

Soil pH for both samples was 7.7. This value is in the mildly alkaline[3] range and does not particularly increase soil corrosivity.

The soluble salt content of the samples ranged from low to moderate.

The nitrate concentration was high enough to be aggressive to copper.

Tests were not made for sulfide and negative oxidation-reduction (redox) potential because these samples did not exhibit characteristics typically associated with anaerobic conditions.

This soil is classified as severely corrosive to ferrous metals and aggressive to copper.

Corrosion Control Recommendations

The life of buried materials depends on thickness, strength, loads, construction details, soil moisture, etc., in addition to soil corrosivity, and is, therefore, difficult to predict. Of more practical value are corrosion control methods that will increase the life of materials that would be subject to significant corrosion.

The following recommendations are based on the soil conditions discussed in the Soil Corrosivity section above. Unless otherwise indicated, these recommendations apply to the entire site or alignment.

Steel Pipe

Implement *all* the following measures:

1. Underground steel pipe with rubber gasketed, mechanical, grooved end, or other nonconductive type joints should be bonded for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.

---

[3] *Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, p. 8.*

2. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:

    a. At each end of the pipeline.

    b. At each end of all casings.

    c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.

3. To prevent dissimilar metal corrosion cells and to facilitate the application of cathodic protection, electrically isolate each buried steel pipeline per NACE SP0286 from:

    a. Dissimilar metals.

    b. Dissimilarly coated piping (cement-mortar vs. dielectric).

    c. Above ground steel pipe.

    d. All existing piping.

4. Choose one of the following corrosion control options:

    OPTION 1

    a. Apply a suitable dielectric coating intended for underground use such as:

        i. Polyurethane per AWWA C222 *or*

        ii. Extruded polyethylene per AWWA C215 *or*

        iii. A tape coating system per AWWA C214 *or*

        iv. Hot applied coal tar enamel per AWWA C203 *or*

        v. Fusion bonded epoxy per AWWA C213.

    b. Apply cathodic protection to steel piping as per NACE SP0169.

OPTION 2

a. As an alternative to dielectric coating and cathodic protection, apply a ¾-inch cement mortar coating per AWWA C205 or encase in concrete 3 inches thick, using any type of ASTM C150 cement. Joint bonds, test stations, and insulated joints are still recommended for these alternatives.

NOTE: Some steel piping systems, such as for oil, gas, and high-pressure piping systems, have special corrosion and cathodic protection requirements that must be evaluated for each specific application.

Iron Pipe

Implement *all* the following measures:

1. To prevent dissimilar metal corrosion cells and to facilitate the application of cathodic protection, electrically insulate underground iron pipe from dissimilar metals and from above ground iron pipe with insulating joints per NACE SP0286.
2. Bond all nonconductive type joints for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.
3. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:
    a. At each end of the pipeline.
    b. At each end of any casings.
    c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.
4. Choose one of the following corrosion control options:

    OPTION 1

    a. Apply a suitable coating intended for underground use such as:
        i. Polyethylene encasement per AWWA C105; *or*
        ii. Epoxy coating; *or*

iii. Polyurethane; *or*

iv. Wax tape.

NOTE: The thin factory-applied asphaltic coating applied to ductile iron pipe for transportation and aesthetic purposes does not constitute a corrosion control coating.

b. Apply cathodic protection to cast and ductile iron piping as per NACE SP0169.

OPTION 2

a. As an alternative to coating systems described in Option 1 and cathodic protection, concrete encase all buried portions of metallic piping so that there is a minimum of 3 inches of concrete cover provided over and around surfaces of pipe, fittings, and valves using any type of ASTM C150 cement.

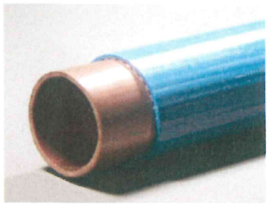
Copper Tubing

Implement *all* the following measures:

1. Electrically insulate underground copper pipe from dissimilar metals and from above ground copper pipe with insulating devices per NACE SP0286.
2. Electrically insulate cold water piping from hot water piping systems.
3. Protect buried copper tubing by one of the following measures:

    a. Prevention of soil contact. Soil contact may be prevented by placing the tubing above ground or encasing the tubing using PVC pipe with solvent-welded joints.

    b. Installation of a factory-coated copper pipe with a minimum 25-mil thickness such as Kamco's Aqua Shield™, Mueller's Streamline Protec™, or equal. The coating must be continuous with no cuts or defects.



    c. Installation of 12-mil polyethylene pipe wrapping tape with butyl rubber mastic over a suitable primer. Protect wrapped copper tubing by applying cathodic protection per NACE SP0169.

Plastic and Vitrified Clay Pipe

1. No special precautions are required for plastic and vitrified clay piping placed underground from a corrosion viewpoint.

2. Protect all metallic fittings and valves with wax tape per AWWA C217 or epoxy.

All Pipe

1. On all pipes, appurtenances, and fittings not protected by cathodic protection, coat bare metal such as valves, bolts, flange joints, joint harnesses, and flexible couplings with wax tape per AWWA C217 after assembly.

2. Where metallic pipelines penetrate concrete structures such as building floors, vault walls, and thrust blocks use plastic sleeves, rubber seals, or other dielectric material to prevent pipe contact with the concrete and reinforcing steel.

Concrete

1. From a corrosion standpoint, any type of ASTM C150 cement may be used for concrete structures and pipe because the sulfate concentration is negligible, 0 to 0.10 percent.[4,5,6]

2. Standard concrete cover over reinforcing steel may be used for concrete structures and pipe in contact with these soils due to the low chloride concentration[7] found onsite.

Closure

The analysis and recommendations presented in this report are based upon data obtained from the laboratory samples. This report does not reflect variations that may occur across the site or due to the modifying effects of construction. If variations appear, HDR should be

---

[4] *2012 International Building Code (IBC) Section 1904.3*

[5] *2012 International Residential Code (IRC) which refers to American Concrete Institute (ACI) 318 Table 19.3.2.1*

[6] *2013 California Building Code (CBC) which refers to American Concrete Institute (ACI) 318 Table 19.3.2.1*

[7] *Design Manual 303: Concrete Cylinder Pipe. Ameron. p.65*

notified immediately so that further evaluation and supplem ental recommendations can be provided.

HDR's services have been performed with the usual thoroughness and com petence of the engineering profession. No other warranty or representation, either expressed or implied, is included or intended.

Please call if you have any questions.

Respectfully Submitted,
HDR Engineering, Inc.

Jose Peña

Brien L. Clark, PE

LICENSED PROFESSIONAL ENGINEER
BRIEN L. CLARK
CH 6291
EXP 12/31/17
CHEMICAL
STATE OF CALIFORNIA

Enc: Table 1

274257_SCS_Rpt_JP_Rev00_BC.docx

Table 1 - Laboratory Tests on Soil Samples

Earth Systems Pacific
SLO High School - Annex / Classroom Building Project No. 831-3102
Your #SL-16605-SE, HDR Lab #16-0015SCS
5-Jan-16

Sample ID			B1 @ 0-3' CL	B2 @ 1-4' CL
Resistivity		**Units**		
as-received		ohm-cm	4,800	6,000
saturated		ohm-cm	1,200	800
pH			7.7	7.7
Electrical Conductivity		mS/cm	0.16	0.24
Chemical Analyses				
Cations				
calcium	Ca^{2+}	mg/kg	61	86
magnesium	Mg^{2+}	mg/kg	ND	ND
sodium	Na^{1+}	mg/kg	77	46
potassium	K^{1+}	mg/kg	7.5	12
Anions				
carbonate	CO_3^{2-}	mg/kg	ND	ND
bicarbonate	HCO_3^{1-}	mg/kg	366	174
fluoride	F^{1-}	mg/kg	4.0	1.9
chloride	Cl^{1-}	mg/kg	11	7.3
sulfate	SO_4^{2-}	mg/kg	60	292
phosphate	PO_4^{3-}	mg/kg	ND	ND
Other Tests				
ammonium	NH_4^{1+}	mg/kg	ND	ND
nitrate	NO_3^{1-}	mg/kg	7.0	127
sulfide	S^{2-}	qual	na	na
Redox		mV	na	na

Electrical conductivity in millisiemens/cm and chemical analysis were made on a 1:5 soil-to-water extract.
mg/kg = milligrams per kilogram (parts per million) of dry soil.
Redox = oxidation-reduction potential in millivolts
ND = not detected
na = not analyzed

431 West Baseline Road · Claremont, CA 91711
Phone: 909.962.5485 · Fax: 909.626.3316

APPENDIX D

Geologic Map
Historical Earthquake/Fault Map
FEMA Flood Zone Map



Extract from: Geologic Map of the San Luis Obispo Quadrangle, San Luis Obispo County, California: by Wiegers, 2010.

EXPLANATION

Geologic Units

Qya
Young Alluvial flood-Plain Deposits

Jos
Serpentinized Ultramafic Rock

KJfm
Franciscan Melange

KJfmv
Franciscan Metavolcanic Rock

Geologic Symbols

Contact
Dashed where approximately located or inferred

High-angle fault
Dashed where approximately located or inferred; dotted where concealed

Thrust or reverse fault
Dashed where approximately located or inferred; dotted where concealed. Saw-teeth on upper plate. Dip of fault plane between 30° and 80°

Anticline
Showing axis at surface. Dashed where approximately located; dotted where concealed

Syncline
Showing axis at surface. Dashed where approximately located; dotted where concealed

30 90
Horizontal Inclined Vertical
Strike and dip of beds

N

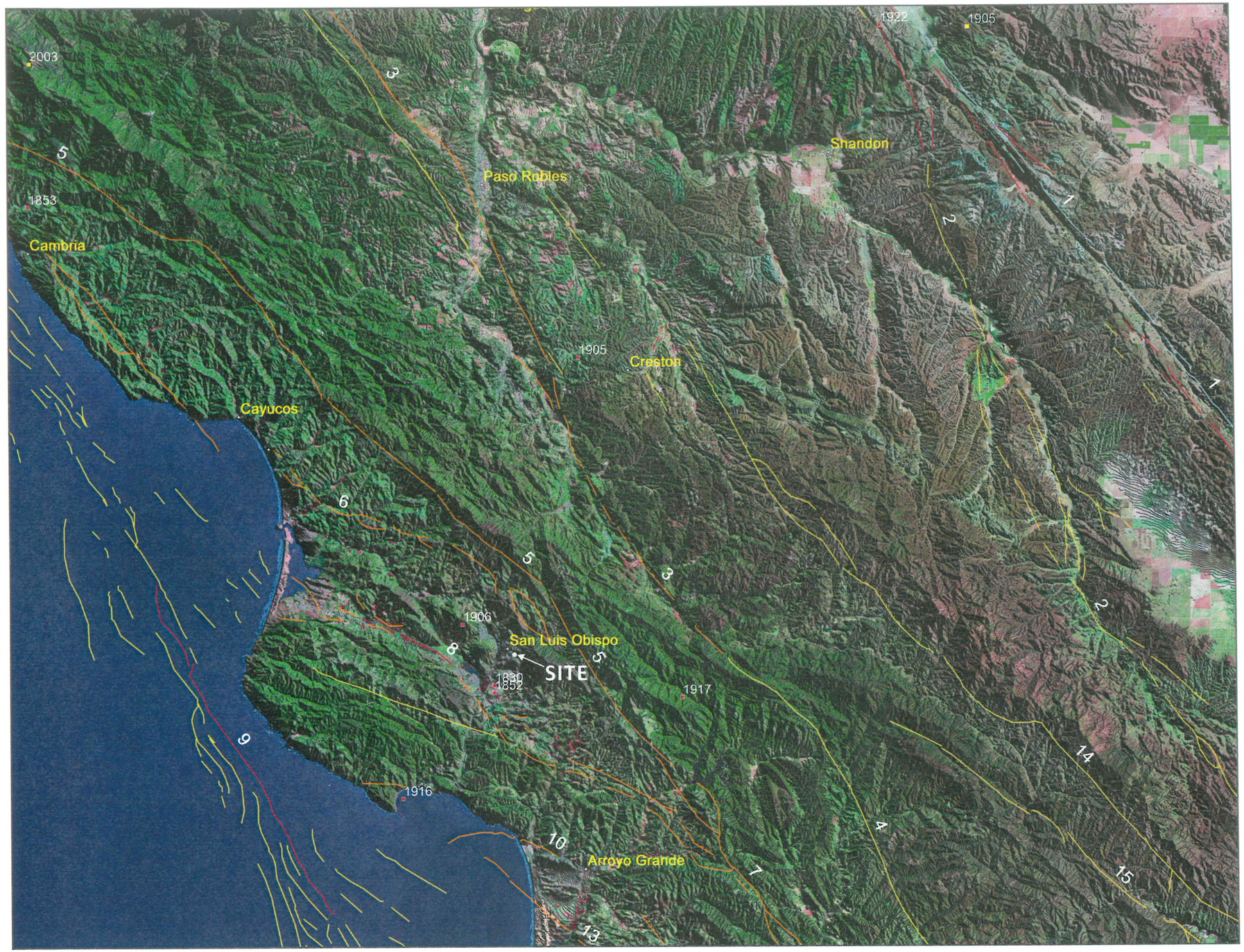
Approx. Scale: 1" = 500'

EARTH SYSTEMS PACIFIC
4378 Old Santa Fe Road, San Luis Obispo, CA 93401
www.earthsystems.com - email: esp@earthsystems.com
(805) 544-3276

GEOLOGIC MAP
SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

Date
January 2016

Project No.
SL-16605-SE



LEGEND

- Historic rupture (<200 years)
- Holocene fault (<10,000 years)
- Late Quaternary (<700,000 years)
- Quaternary fault (<1.6 million)

HISTORICAL EARTHQUAKE MAGNITUDE

5.0 to 5.9 | 6.0 to 6.9 | 7.0 to 7.9

FAULTS

1	San Andreas	11	Casmalia
2	San Juan	12	Lions Head
3	Rinconada	13	Oceano
4	East Huasna	14	La Panza
5	Oceanic	15	South Cuyama
6	Cambria		
7	West Huasna		
8	Los Osos		
9	Hosgri-San Simeon		
10	San Luis Range		

REFERENCES

Blake, T.F., EQSEARCH, 2000, updated 2010
Jennings, C.W. & Bryant, W.A., 2010

N

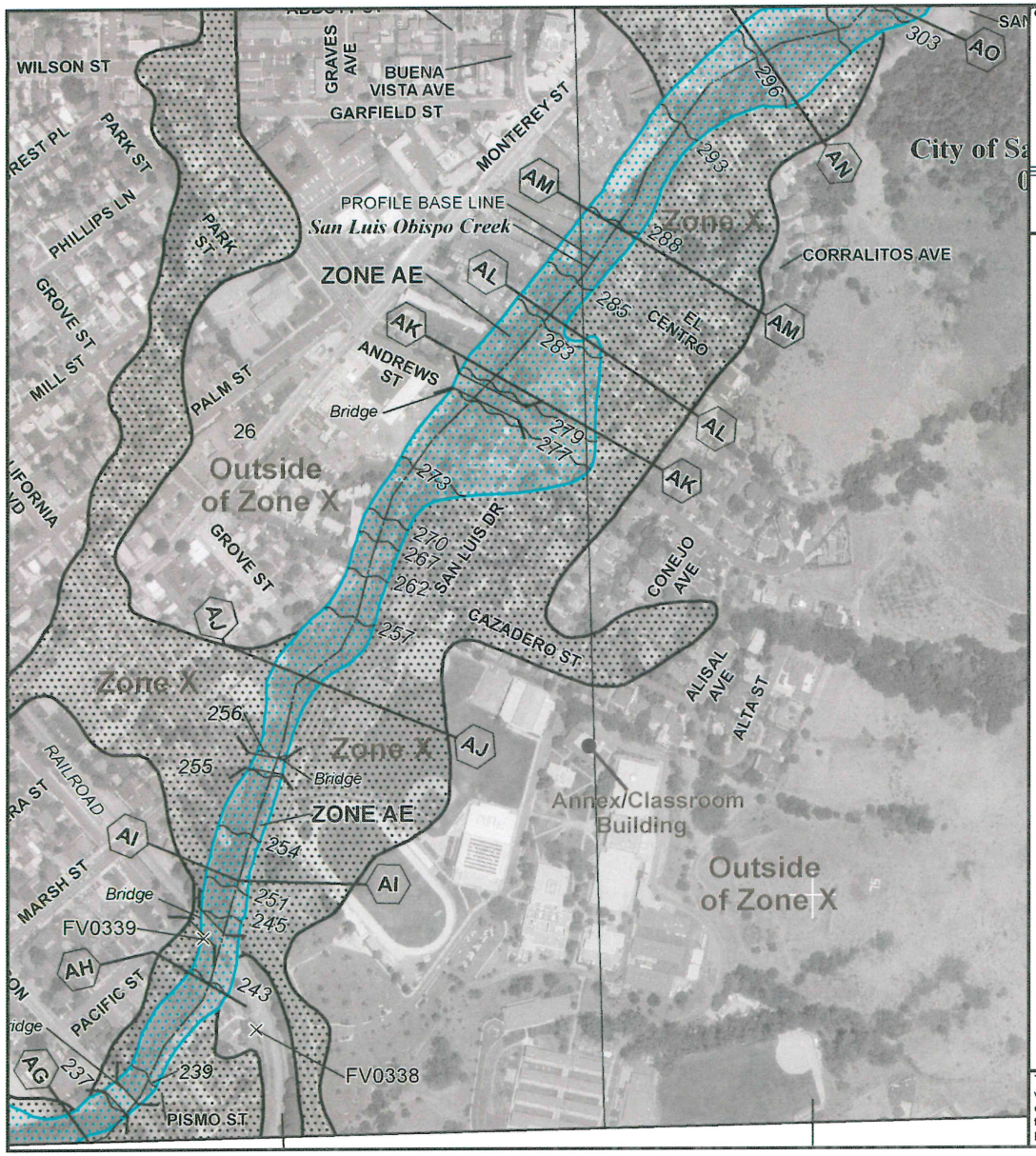
(Approximate Scale: 1" = 6 miles)

EARTH SYSTEMS PACIFIC
4378 Old Santa Fe Road, San Luis Obispo, CA 93401
www.earthsystems.com - email: esp@earthsystems.com
(805) 544-3276

HISTORICAL EARTHQUAKE/ FAULT MAP
SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

Date
January 2016

Project No.
SL-16605-SE



ance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

0 250 500 750 1,000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1067G

FIRM

FLOOD INSURANCE RATE MAP

SAN LUIS OBISPO COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL 1067 OF 2050

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
SAN LUIS OBISPO COUNTY	060304	1067	G
SAN LUIS OBISPO, CITY OF	060310	1067	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER 06079C1067G

MAP REVISED NOVEMBER 16, 2012

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

EARTH SYSTEMS PACIFIC

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FEMA FLOOD ZONE MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

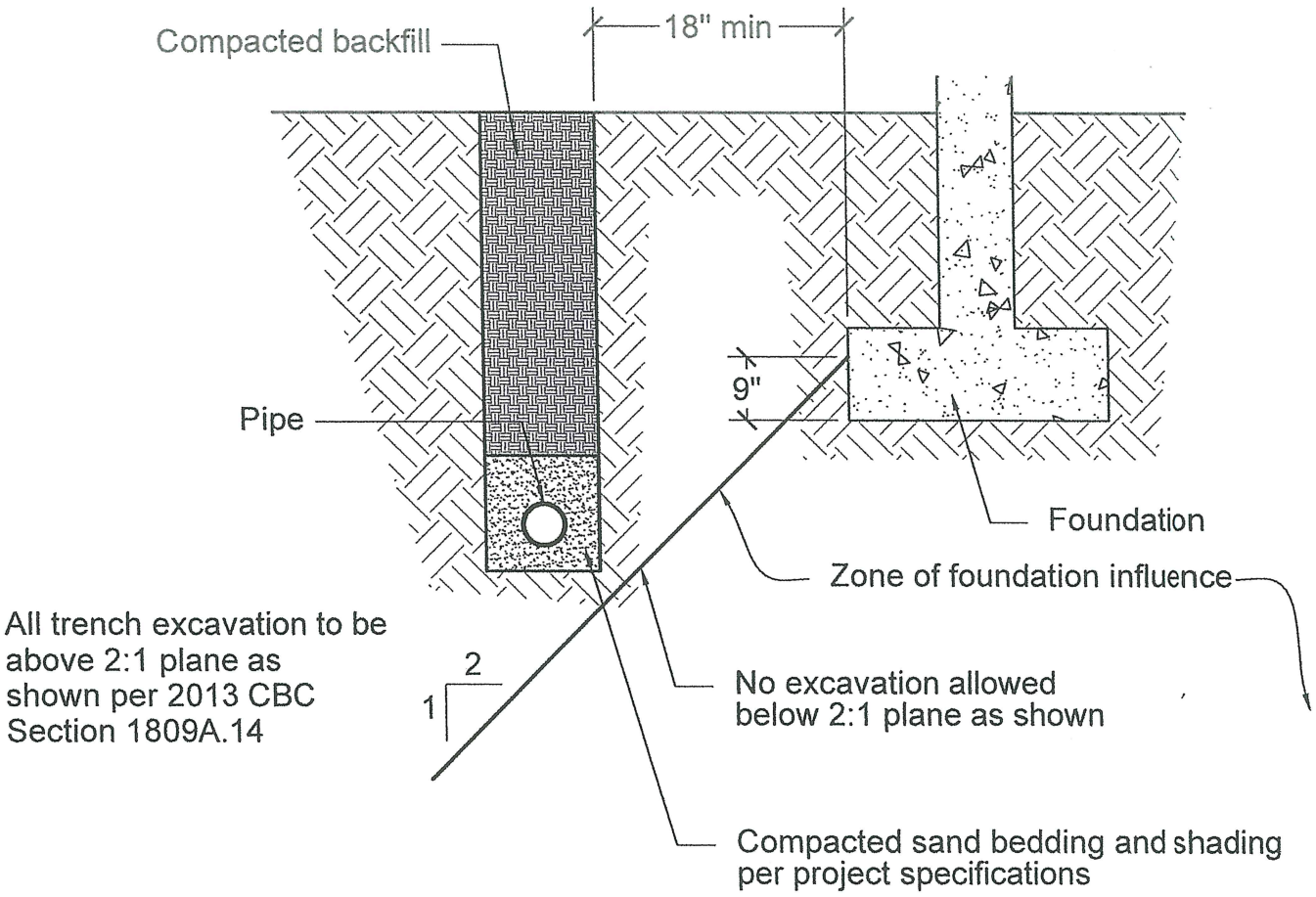
Date
January 2016

Project No.
SL-16605-SE

APPENDIX E

Typical Detail A: Pipe Placed Parallel to Foundations

TYPICAL DETAIL A
PIPE PLACED PARALLEL TO FOUNDATIONS*



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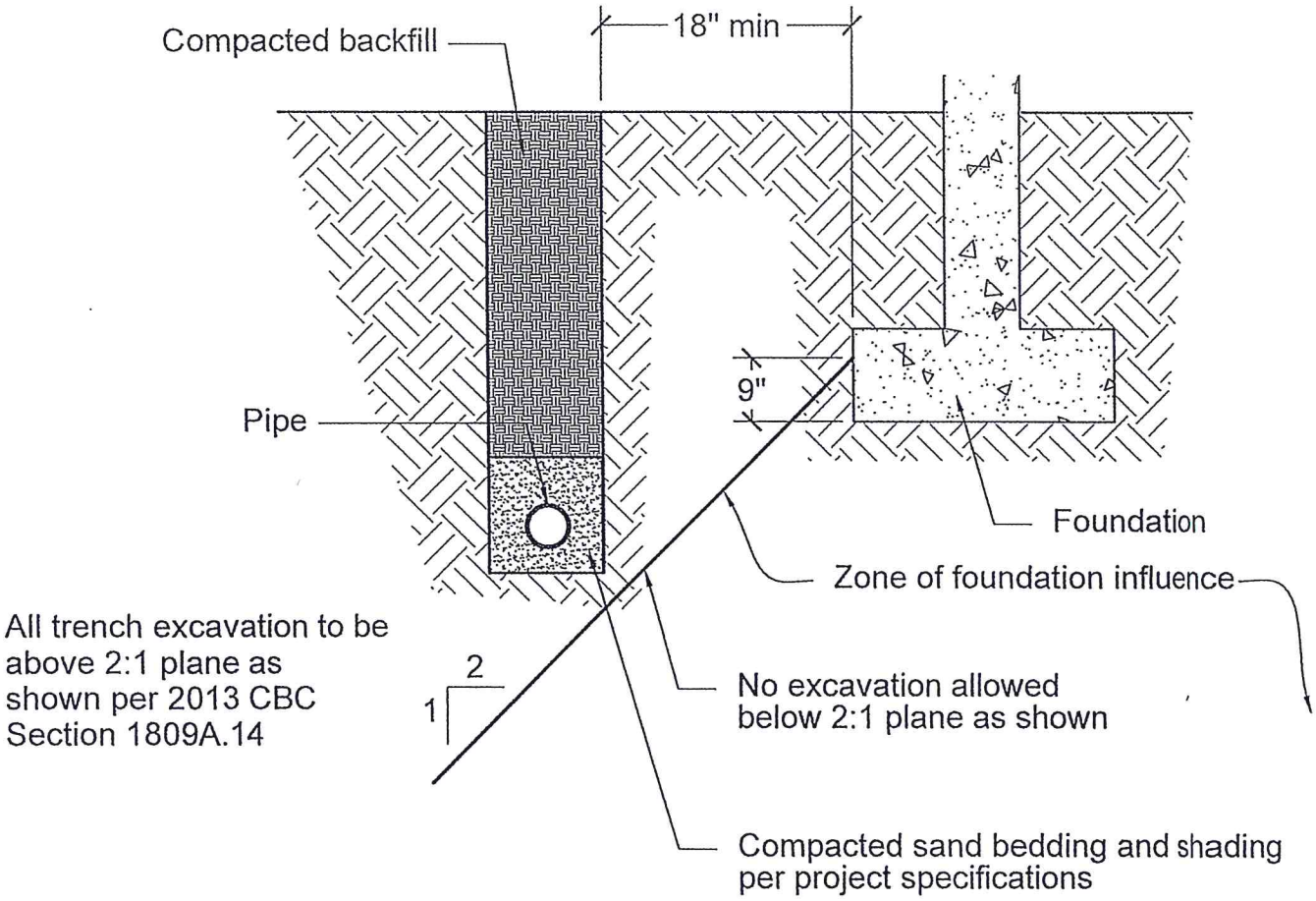
APPENDIX E

Typical Detail A: Pipe Parallel to Foundations
Tremie Method

TYPICAL DETAIL A
PIPE PLACED PARALLEL TO FOUNDATIONS*



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RECOMMENDED PROCEDURE FOR TREMIE-PLACED CONCRETE IN CAISSON (DRILLED SHAFT) FOUNDATION CONSTRUCTION

The following are general guidelines only, and may be subject to modification by the architect/engineer and/or geotechnical engineer.

1. Concrete should be placed in caisson excavations by means of a tremie when the depth of water in the excavation cannot be limited to a maximum of 2 inches, or when the freefall of the concrete would result in the concrete striking the rebar or excavation walls as it falls.
2. The concrete should be pumped to the tremie pipe, or a hopper with a tremie pipe attached should be used. An "elephant's trunk" should not be used to place concrete under water; however, an elephant's trunk may be used to direct the fall of the concrete in dry excavations. The elephant's trunk should be of sufficient length to prevent the concrete from striking the rebar or excavation walls as it falls.
3. Concrete for dry excavations should be designed for, and placed at, a slump of 4 to 6 inches. Concrete to be placed below water should be designed for, and placed at, a slump of 7 to 9 inches.
4. The tremie pipe should consist of rigid steel pipe with tight couplings. The tremie pipe should be 4 to 6 inches in diameter and should be longer than the deepest caisson excavation.
5. The tremie pipe should be lowered with caution through the center of the reinforcing to within 1 foot of the bottom of the excavation; the tremie should not be allowed to penetrate into the muck on the bottom of the hole
6. The pump hose and tremie pipe should be "slicked" with Portland cement slurry. No clay, bentonite, or other material should be used unless approved by the architect/engineer and geotechnical engineer.
7. Pumping of the concrete should begin immediately after the reinforcing, and the tremie pipe have been placed in the excavation and the excavation has been inspected. The tremie pipe should not be raised until the concrete surface in the caisson excavation is at least 5 feet above the bottom of the tremie pipe. The bottom of the tremie pipe should then be kept at least 5 feet below the top of the concrete until the pour is completed.
8. The concrete should be pumped until all muck, laitance, and unsuitable concrete has been lifted above the top-of-caisson elevation. All muck, laitance, and unsuitable concrete should be immediately removed from the excavation.
9. Concrete poured at a 6-inch or greater slump should *not* be vibrated during the pour, unless directed by the architect/engineer. When vibration is required, it should *not* be started until the concrete pour is completed and the muck, laitance and unsuitable concrete have been removed. At a minimum, the upper 10 feet of the concrete should then be vibrated. Additional concrete may be added as necessary during vibration. The vibrator should not be allowed to contact the reinforcing.
10. During the pour, if the tremie pipe has to be removed from the concrete, (e.g., to allow removal of casing), it should be reset at the top of the concrete. The tremie should then be purged, as directed by the inspector, and then immediately lowered to at least 5 feet below the top of the concrete as the concrete is being pumped. All degraded concrete should be lifted with the continuing pour and removed from the top of the caisson.

GEOTECHNICAL ENGINEERING AND GEOLOGIC HAZARDS REPORT
SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA

July 20, 2018

Prepared for

Mr. Ryan Pinkerton
San Luis Coastal Unified School District

Prepared by

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4378 Old Santa Fe Road
San Luis Obispo, CA 93401

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July 20, 2018

FILE NO.: 300933-007

Mr. Ryan Pinkerton
San Luis Coastal Unified School District
937 Southwood Drive
San Luis Obispo, CA 93401

PROJECT: SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA

SUBJECT: Geotechnical Engineering and Geologic Hazards Report

CONTRACT
REF: Purchase Order No. 181880 by San Luis Coastal School District, dated April 11, 2018, to Provide a Geotechnical Engineering Investigation, San Luis Obispo High School Modernization, 1499 San Luis Drive, San Luis Obispo, California, per Proposal by Earth Systems Pacific, Doc. No. 1803-110.PRP.REV, revised April 26, 2018

Dear Mr. Pinkerton:

In accordance with the referenced purchase order, this geotechnical engineering and geologic hazards report has been prepared for use in the development of plans and specifications for the Building 100 Modernization project at San Luis Obispo High School in San Luis Obispo, California. This report describes the general geotechnical and geologic characteristics, identifies existing and potential geotechnical and geologic hazards, and discusses the impacts that these conditions could have upon the project. Preliminary geotechnical recommendations for site preparation, grading, utility trenches, foundations, slabs-on-grade, retaining walls, drainage and maintenance, and observation and testing are presented herein. Two bound copies and an electronic copy of this report are provided for your use. Additional electronic copies have been distributed as noted

We appreciate the opportunity to have provided services for this project and look forward to working with you again in the future. If there are any questions concerning this report, please do not hesitate to contact the undersigned.

Sincerely,
Earth Systems Pacific

Nick Zoetewey, PE
Project Engineer

Fred J. Potthast, GE
Principal Engineer

Darrin Hasham, CEG
Senior Geologist

Copy to: SLCUSD, Attn.: Chris Bonin and Stephen Stewart

Doc. No.: 1807-029.SGR/cr

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APPENDIX B	Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School Building 100 Elevator Tower (ESP 2018) California Geological Survey, Engineering Geology and Seismology Review of Geotechnical Engineering and Geologic Hazards Report for San Luis Obispo High School – New Annex/Classroom (ESP 2016)
APPENDIX C	Geotechnical Laboratory Test Results
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1.0 INTRODUCTION AND SITE SETTING

Through correspondence with RRM Design Group and our review of a site plan prepared by PBK (2018), we understand the following improvements are planned at the west side, south side, and within Building 100, which, in turn, is within the San Luis Obispo High School campus (see Figure 1 – Site Vicinity Map in Appendix A):

- Regrading of the plaza area on the west side of Building 100, and the construction of multiple retaining walls, stairways, access ramps and exterior pedestrian flatwork. Cuts and fills of 5 to 10 feet are anticipated, with maximum retaining wall heights on the order of 10 to 12 feet.
- Construction of a line of canopy columns and an arched entry structure on the west side of Building 100; these features will be of steel-frame construction, and will be structurally connected to the existing building. Drilled, cast-in-place concrete caisson foundations with grade beams are anticipated to support these features.
- Reconstruction of slabs-on-grade on the north side of the interior lobby of Building 100.
- Removal of two interior columns and replacement with a single column supported by drilled, cast-in-place caisson(s) on the south side of Building 100.
- Construction of stairways and access ramps off the southeast corner of Building 100, with retaining walls up to 8 feet tall. Asphalt Concrete (AC) paths may also be utilized for pedestrian access.
- Installation or realignment of underground utility lines in the improvement areas.
- No LID/BMP improvements, drainage basins or other improvements are planned.

Structural loading information has not yet been provided; however, we anticipate dead plus live loads on the order of 15 kips, 75 kips and 3 kips per lineal foot for canopy, interior column and retaining wall loads, respectively.

2.0 SCOPE OF SERVICES

The scope of work for this report included a general site reconnaissance, subsurface exploration, site reconnaissance by a registered geotechnical engineer, laboratory testing of samples secured during the subsurface investigation, geotechnical analyses of the data, and preparation of this report. The analysis and subsequent recommendations are based on general information provided by the client, RRM Design Group, and PBK. Geologic hazards on the campus were

addressed by this firm (ESP 2016) for the Classroom/Annex project under construction off the northwest corner of Building 100, which, in turn, is included in the Building 100 Elevator Tower report (ESP 2018) in Appendix B. At this time, we are unaware of any changes to the requirements for a geologic hazards evaluation by the DSA (2015); therefore, the conclusions and recommendations of that report, which has been accepted by the California Geologic Survey (CGS) and the DSA, are still considered valid. A copy of the acceptance letter by the CGS is also included in Appendix B

This report and preliminary geotechnical recommendations are intended to comply with the considerations of Sections 1803A.1 through 1803A.7, J104.3 and J104.4 of the 2016 California Building Code (CBC); California Geological Survey Note 48 (CGS 2013); DSA IR A-4.13 (DSA 2015); and common geotechnical engineering and engineering geology practice in this area under similar conditions at this time. The test procedures were accomplished in general conformance with the standards noted, as modified by common geotechnical engineering practice in this area under similar conditions at this time.

Preliminary geotechnical recommendations for site preparation, grading, utility trenches, foundations, slabs-on-grade, retaining walls, drainage and maintenance, and observation and testing are presented to guide the development of project plans and specifications. As there may be geotechnical issues yet to be resolved, the geotechnical engineer should be retained to provide consultation as the design progresses, to assist in verifying that pertinent geotechnical issues have been addressed and to aid in conformance with the intent of this report. It may also be advantageous to retain the geotechnical engineer to review the project plans and details as they near completion, to further aid in conformance with the intent of this report.

It is our intent that this report be used exclusively by the client in the preparation of plans and specifications. Application beyond this intent is strictly at the user's risk.

This report does not address issues in the domain of contractors such as, but not limited to, site safety, loss of volume due to stripping of the site, shrinkage of soils during compaction, excavatability, dewatering, shoring, temporary slope angles, construction means and methods, etc. Analyses of the soil for mold potential, man-made products containing asbestos, lead, radioisotopes, hydrocarbons, or chemical properties other than geotechnical corrosivity are beyond the scope of this report. Evaluation of the site for suitability for LID improvements or drainage basins; ancillary features such as temporary access roads, fences, flag and light poles, signage; and nonstructural fills are not within our scope and are also not addressed.

In the event that there are any changes in the nature, design, or location of improvements, or if any assumptions used in the preparation of this report prove to be incorrect, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are verified or are modified in writing. The criteria presented in this report are considered preliminary until such time as any peer review or review by any jurisdiction has been completed, conditions are observed by the geotechnical engineer and/or geologist in the field during construction, and the recommendations have been verified as appropriate or modified in writing.

3.0 FIELD INVESTIGATION

Nine borings were drilled within the proposed improvement locations on June 22 and 25, 2018. Cores were completed through the existing PCC flatwork to allow drilling of Borings 3 through 7; borings were drilled from the ground surface at the remaining locations. The borings were drilled below the ground or PCC surfaces (bgs) to depths that ranged from 6.5 to 31 feet; drilling refusal was encountered at Borings 2, 4, and 7 through 9, at depths that ranged from 7 to 23.5 feet. The borings were drilled with truck-mounted Mobile B-53 or Simco EP200 drill rigs equipped with 4-inch outside diameter solid stem or 6-inch outside diameter hollow stem auger and automatic trip hammers for sampling. Two borings drilled previously (ESP 2018) for the Elevator Tower project to be constructed adjacent to the west side of Building 100 were drilled to depths of 7 to 7.5 feet below the ground surface on February 12, 2018. The approximate locations of the borings for both projects are shown on Figure 2 – Exploration Location Map in Appendix A. As the borings were drilled, soil samples were obtained using a ring-lined barrel sampler (ASTM D 3550-17 with shoe similar to D 2937-17). Standard penetration tests were also performed (ASTM D 1586-11) at selected depths. Bulk soil samples were obtained from the auger cuttings. The borings were backfilled per the requirements of the governing jurisdiction. Borings in flatwork areas were capped with PCC.

Soils encountered in the borings were categorized and logged in general accordance with the Unified Soil Classification System and ASTM D 2488-17a. Where bedrock was encountered, its properties were described based upon observation of the auger cuttings and the effort required to drill into it. Copies of the boring logs and a Boring Log Legend are included in Appendix A. In reviewing the boring logs and legend, the reader should recognize that the legend is intended as a guideline only, and there are a number of conditions that may influence the soil characteristics as observed during drilling. These include, but are not limited to, the presence of cobbles or

boulders, cementation, variations in soil moisture, presence of groundwater, and other factors. It should also be noted that the descriptions of bedrock must span a much wider range of density and strength characteristics than soil, and are relative to other bedrock strata. For example, fractured and weathered bedrock may be described as "soft," yet it will be considerably harder than almost any type of soil. Conversely, a clay soil may be described as "hard," however it will not be nearly as hard as even "soft" bedrock such as the sandstone encountered on this site. Consequently, the logger must exercise judgment in interpreting the subsurface characteristics, possibly resulting in soil and bedrock descriptions that vary somewhat from the legend.

4.0 LABORATORY ANALYSIS

The ring samples were tested for unit weight and moisture (ASTM D 2937-17), as modified for ring liners. Bulk samples were tested for maximum density and optimum moisture content (ASTM D 1557-12), expansion index (ASTM D 30801 D 4829-11), and cohesion and angle of shearing resistance by direct shear (ASTM D 3080 D 3080M-11, recompacted to 90 percent of maximum dry density and modified for consolidated, undrained conditions). The laboratory test results are presented in Appendix C.

5.0 GENERAL SUBSURFACE AND GEOLOGIC PROFILE

The PCC flatwork sections within the areas of Borings 3 through 7 were 4 to 4.25 inches thick, and were generally supported by 2 to 4 inches of sand or gravel. In Boring 4, no sand or gravel was found below the PCC. Below the flatwork sections or ground surfaces, fill was encountered in all borings except Boring 1. The fill generally consisted of loose to medium dense clayey sand or medium stiff sandy lean clay and extended to depths that ranged from 4.5 to 14.5 feet bgs. Traces of debris were found in the fill in Borings 3, 4 and 5. Below the surface in Boring 1, and below the fill in the remaining borings, alluvium was encountered, which consisted of medium stiff to very stiff sandy lean clay or medium dense clayey sand, which extended to depths that ranged from 4.5 to 27 feet bgs. The alluvium was underlain by soft to moderately hard sandstone bedrock of the Franciscan Mélange, which continued to the maximum depth explored of approximately 31 feet bgs.

Free subsurface water was not encountered in any of the borings. Please refer to the boring logs in Appendix A for a more complete description of the subsurface conditions.

6.0 GEOLOGY AND GEOLOGIC HAZARDS

General

Based on information from the Annex/Classroom Building Report (ESP 2016), the geologic hazards assessment is considered to be valid for the current site, with the exception of Site Class, which is discussed in more detail in the next section. A more detailed discussion of geology and geologic hazards is provided in the Annex/Classroom Building report, which is part of the Elevator Tower Report (2018) in Appendix B.

Design Acceleration Parameters

In accordance with California Geologic Survey, Note 48 (CGS 2013), Item 16, an assessment was made to determine the need for employing "Site Specific Ground Procedures" for the site area. Based on the results of standard penetration tests performed during the field investigation for the Annex/Classroom Building (ESP 2016), a site class "D – Stiff Soil" was selected. During the field investigation for the current site, bedrock was encountered at significantly shallower depths in the majority of the borings and blow counts were determined to be significantly higher at shallower depths. Where the topsoil/fill/alluvium above the rock was found in the borings to be relatively thick, cuts planned for the proposed improvements should result in finish grades closer to the bedrock surface. Given these conditions, in our opinion, this project site can be considered as site class "C – Very Dense Soil and Soft Rock." The approximate coordinates of latitude 35.2836N and longitude 120.6495W were taken near the center of the site from the Google Earth website (Google Earth 2018). Using these coordinates, the S_1 ground motion value obtained from the United States Geological Survey Earthquake Hazards Program website (USGS 2018) and the ASCE 7-10 (2013) Standard Analysis Method for a site class "C" (very dense soil and soft rock profile) was below 0.75g (see table below, S_1 = 0.434g). Therefore, the project does not require a site-specific ground motion analysis.

The site is in a region of generally high seismicity and has the potential to experience strong ground shaking from earthquakes on regional or local causative faults. To characterize the seismicity at the site and to provide seismic design parameters for the architect/engineer, a General Procedure Ground Motion Analysis was performed to calculate the deterministic ground motions at the site. The ground motions are based on the 2016 CBC General Procedure that were obtained from the United States Geological Survey Earthquake Hazards Program website (USGS 2018) and the ASCE 7-10 (2013) Standard Analysis Method, for Site Class "C" (very dense soil and soft rock profile). The results of this analysis are presented in the following table:

SUMMARY OF DESIGN RESPONSE ACCELERATION PARAMETERS

Mapped Acceleration Values for Site Class "B"		**2016 CBC Site Coefficients and General Procedure Adjusted MCE Spectral Response Acceleration Parameters For Site Class "C"**					
Seismic Parameters	Values (g)	Site Coefficients	Values	Seismic Parameters	Values (g)	Seismic Parameters	Values (g)
S_S	1.137	F_a	1.000	S_{MS}	1.137	S_{DS}	0.758
S_1	0.434	F_v	1.366	S_{M1}	0.593	S_{D1}	0.395
Peak Mean Ground Acceleration (PGA_m): 0.453 g							

7.0 CONCLUSIONS

In our opinion, the site is suitable, from a geotechnical engineering standpoint, for the proposed improvements, as described in the "Introduction and Site Setting" Section of this report, provided the recommendations contained herein are implemented in the design and construction. The primary geotechnical engineering concerns at the site are the potential for differential settlement, the expansion and corrosive potential of the on-site soil, and the erodible nature of the soil. Provided that the site is prepared as recommended in the "Grading" Section of this report, conventional continuous and/or caisson foundations may be used to support the proposed structures.

Differential Settlement

Differential settlement can occur when a foundation spans materials having variable consolidation characteristics, such as the fills that were encountered as deep as 14.5 feet bgs in the borings and the bedrock found at relatively shallow depths. We are unaware of any documentation (i.e., grading observation or compaction testing records) regarding the placement of the fills, but they were likely placed when the existing Building 100 and shop buildings were constructed in the late 1950s and early 1960s. The traces of debris found in the fill also suggest the fill may not be up to acceptable standards. Although the fills have likely already experienced a significant amount of their potential settlement, the fills still have a greater potential for variability and continued settlement than fill that has been placed and tested in a controlled earthwork program. The alluvial soils and bedrock would be expected to cause limited to negligible settlement of foundations. Such variable conditions have the potential to stress and possibly damage foundations, often resulting in severe cracks and displacement if they are not mitigated. To reduce this potential for differential settlement, a program of overexcavation and recompaction of the existing fill within foundation areas is recommended prior to foundation

construction. Where alluvium or bedrock are present, overexcavation and recompaction would not be considered necessary.

Due to their age, the existing foundations within the building have likely experienced nearly or all the settlement they will see over their design lives; therefore, to limit the potential for differential settlement of new vs. existing foundations, all new foundations should be founded on bedrock.

Expansion Potential

Expansion index testing of the existing fill materials during the Elevator Tower investigation yielded a result of 59. Additional testing of the surficial soils for the current investigation produced results of 47 and 55, consistent with the previous result. Per CBC Section 1803A.5.3, the soils are considered to be expansive. The more commonly used ASTM classification is that the fills are generally considered to have a "medium" expansion potential. The underlying bedrock is also considered to be expansive. Expansive materials tend to swell with increases in moisture content and shrink as moisture decreases. The volume changes that the materials undergo in this cyclical pattern can stress and damage foundations and slabs-on-grade if precautionary measures are not incorporated during design and construction. Footings are typically deepened and additional reinforcement is provided. Imported nonexpansive materials are recommended to be placed beneath slabs-on-grade.

Corrosion Potential

As indicated in the Soil Corrosivity Study by HDR Engineering, Inc., which was performed during the Elevator Tower investigation (see ESP 2018 report in Appendix B), electrical resistivities of the samples tested were in the moderately corrosive and corrosive categories with as received moisture contents; when saturated, the resistivities were in the corrosive category. Soil pH values were in the neutral to mildly alkaline categories. The soluble salt contents of the soils were moderate. Nitrate concentrations were low; ammonium concentrations were high enough to be aggressive to copper. The soils were classified as corrosive to ferrous metals and aggressive to copper. Recommendations for corrosive soil mitigation are included in the Soil Corrosivity Study.

Erosion Potential

The fill above the alluvium and bedrock is considered to be erodible. It is essential that all surface drainage be controlled and directed to appropriate discharge points, and that surface materials,

particularly those disturbed during construction, are stabilized by vegetation or other means *during and following construction*.

8.0 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

The following recommendations are for improvements constructed as described in the "Introduction and Site Setting" Section of this report. If locations, elevations, structural loads, etc., change, the recommendations contained herein may require modification.

Unless otherwise noted, the following definitions are used in the recommendations presented below. Where terms are not defined, definitions commonly used in the construction industry are intended.

- **Building Area –** The building area is defined as the area within the perimeter of any new foundations for the existing structure. The building area also includes any retaining walls or other improvements that are connected to the structure and that are intended to act in a manner similar to it.
- **Sitework Retaining Wall Areas –** The areas within and extending a minimum of 3 feet beyond the foundation limits of all sitework retaining walls.
- **Exterior Pedestrian Flatwork Areas –** The areas within the footprints of all exterior areas to receive new or reconstructed pedestrian flatwork.
- **Existing Grade:** Elevations of the site that existed as of the date of this report.
- **Finish Grade:** The elevation in the building area or sitework retaining wall areas where earthwork or backfill operations are typically considered to be complete. It does not include any sand or gravel that might be placed below slabs-on-grade in association with vapor protection for the slabs.
- **Subgrade:** The elevation in exterior pedestrian flatwork areas where imported nonexpansive materials, sand, or aggregate base (AB) are placed to support the flatwork.
- **Scarified:** Plowed or ripped in two orthogonal directions to a depth of not less than 8 inches.
- **Moisture Conditioned:** Adjusting the soil moisture to optimum moisture content, or just above, prior to application of compactive effort.
- **Compacted/Recompacted:** Soils placed in level lifts not exceeding 8 inches in loose thickness and compacted to a minimum of 90 percent of maximum dry density. Based on

maximum dry density by ASTM D 1557-12 and field density by ASTM D 6938-17a, or other methods acceptable to the geotechnical engineer and jurisdiction.

Site Preparation

1. The ground surface in the building, retaining wall and exterior pedestrian flatwork areas should be prepared for construction by removing the existing slabs-on-grade, flatwork and all other improvements, vegetation, large roots, debris, organic topsoil, and other deleterious materials. Existing utility lines that will not remain in service should be either removed or abandoned. The appropriate method of abandonment will depend upon the type and depth of the utility. Recommendations for abandonment can be made as necessary.

2. Voids created by the removal of materials or utilities described above should be called to the attention of the geotechnical engineer. No fill should be placed unless the underlying soil has been observed by the geotechnical engineer.

Grading

1. Following site preparation, all existing fill in sitework retaining wall areas should be overexcavated to the deepest point of the fill or a maximum of 4 feet below bottom of footing elevation, whichever is shallower. Where alluvium or bedrock is exposed, excavation operations may be terminated. The resulting excavated soil surfaces should be scarified, moisture conditioned and compacted. Excavated bedrock surfaces need not be scarified, but they should be moisture conditioned and compacted as needed to correct any disturbances caused by excavators. Overexcavation elevations may be stepped where the fill depth changes, where alluvium or bedrock are encountered, or where retaining walls are stepped to conform to any site contours. To reduce the potential for cracking in sitework retaining walls, construction joints should be placed in the wall and the foundation where overexcavation operations have been stepped to conform to fill depth changes, or where foundations will cross recompacted soil/alluvium/bedrock areas.

2. Following site preparation and removal of the existing slabs-on-grade within the building area, any slab support section (sand, aggregate base, etc.) should be removed until subgrade is reached. The exposed surface should then be scarified, moisture conditioned and compacted.

3. Following site preparation, all proposed exterior pedestrian flatwork areas should be excavated to subgrade. The exposed subgrade, and any areas where fill is needed to bring proposed flatwork areas up to subgrade, should be scarified, moisture conditioned, and recompacted.

4. Voids created by dislodging cobbles and/or debris during scarification should be backfilled and recompacted, and the dislodged materials should be removed from the work area.

5. Previously removed site soil may be placed as fill within sitework retaining wall areas to finish grade. In exterior pedestrian flatwork areas, previously removed site soil may be used to the bottom of the nonexpansive fill layer; the actual thickness of the nonexpansive layer should be determined per the "Slab-on-Grade" Section of this report. Previously removed site soil may be placed as moisture conditioned, compacted fill within building areas to a maximum height of 18 inches below bottom of slab elevation. If imported fill is needed to complete site grading, the imported materials should be nonexpansive.

6. Nonexpansive materials are defined as imported soils that fall in the GW, GM, GC, SP, SW, SC and SM categories per ASTM D 2487-17, and that have an expansion index of 10 or less (ASTM D 4829-11). The clean sand layer described in the "Slabs-on-Grade" section of this report (if utilized below interior slabs-on-grade or exterior pedestrian flatwork) is considered to be part of the minimum recommended thickness of nonexpansive material utilized, not in addition to it.

7. Imported soils used in the building area should have strength and expansion qualities equal to or better than the site soils, and they should not exceed the geotechnical corrosivity potential of the site soils. See the Soil Corrosivity Study in Appendix B for the corrosivity parameters of the site soils. Proposed imported materials should be reviewed by the geotechnical engineer before being brought to the site, and on an intermittent basis during placement.

8. All materials used as fill should be cleaned of any debris and rocks larger than 3 inches in diameter. When fill material includes rocks, the rocks should be placed in a sufficient soil matrix to ensure that voids caused by nesting of the rocks will not occur and that the fill can be properly compacted.

9. If the materials are overly moist so that they become unstable, or if the minimum recommended compaction cannot be readily achieved, drying the materials so that they are nearer optimum moisture content, may be necessary. Placement of gravel layers or geotextiles may also be necessary to help stabilize unstable materials. Additional overexcavation may also be recommended to correct unstable conditions or if soft or loose conditions are encountered during grading. No fill should be placed in any grading area if the underlying materials are unstable.

10. The recommended soil moisture content should be maintained throughout construction. Failure to maintain the soil moisture content can result in desiccation cracks and disturbance, which are an indication of degradation of the soil compaction. If desiccation cracks are allowed to develop, or if soils near improvements such as foundations, flatwork, etc. are otherwise disturbed, damage to those improvements may result. Soils that have cracked or are otherwise disturbed should be removed, moisture conditioned, and recompacted.

Utility Trenches

1. Utility trenches adjacent to foundations should not be excavated within the zone of foundation influence, as shown in Typical Detail A in Appendix D.

2. Utilities that must pass beneath foundations should be placed with properly compacted utility trench backfill and the foundation should be designed to span the trench.

3. A select, noncorrosive, granular, easily compacted material should be used as bedding and shading immediately around utilities. The site soil may be used for trench backfill above the select material beyond the building area, and to within 18 inches below bottom of slab elevation in the building area. Within the building area, imported nonexpansive soils should be utilized to backfill the final 18 inches below bottom of slab elevation of all trenches. In exterior pedestrian flatwork and AC path areas, trench backfill should match the thickness of imported nonexpansive soils, sand or AB used to support these improvements.

4. In general, trench backfill should be compacted to a minimum of 90 percent of maximum dry density. Trench backfill in AC path areas should be compacted to a minimum of 95 percent of maximum dry density at subgrade and aggregate base or top of sand grade.

5. Prior to applying compactive effort, soils should be moisture conditioned. Trench backfill should be placed in level lifts not exceeding 6 inches in loose thickness and compacted to the minimum recommended above.

6. Compaction of trench backfill by jetting or flooding is not recommended at this site due to the expansive soils and the shallow depth to bedrock. However, to aid in *encasing* utility conduits, particularly corrugated drain pipes, and multiple, closely-spaced conduits in a single trench with the bedding and shading material, jetting or flooding may be useful. Flooding or jetting should only be attempted with extreme caution, and any flooding or jetting operation should be subject to review by the geotechnical engineer.

7. Long-term settlement of properly compacted sand should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill. Where trenches are backfilled with site soils, the anticipated settlement would be about twice that of sand. Improvements that are constructed over or near trenches should be designed to accommodate the potential for settlement.

8. The Soil Corrosivity Study by HDR Engineering, Inc. in the Elevator Tower Report (ESP 2018) in Appendix B, should be used by the architect/engineer in specifying appropriate corrosion protection measures for utility improvements.

9. The recommendations of this section are minimums only, and may be superseded by the architect/engineer based upon soil corrosivity or the requirements of pipe manufacturers, utility companies or the governing jurisdiction.

Foundations

Conventional Foundations

1. The proposed sitework retaining walls may be supported by continuous footings that will bear in firm recompacted soil, as recommended in the “Grading” Section of this report, or in firm alluvium or firm bedrock, or any combination of these three. If a foundation crosses a recompacted/native soil or a soil/bedrock transition, a construction joint should be placed in the footing and the wall at the transition.

2. Based on soil expansion potential, minimum overall foundation depths (not including any keyway) of 21 inches below lowest adjacent grade should be maintained.

3. Continuous footings should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential, minimum continuous footing reinforcement should consist of two No. 4 rebars, one at the top and one at the bottom.

4. Footings bearing in firm recompacted soil or firm alluvium may be designed using maximum allowable bearing capacities of 2,500 psf for dead load and 3,500 psf for dead plus live loads. Footings bearing in firm bedrock may be designed using maximum allowable bearing capacities of 3,000 psf for dead load and 4,000 psf for dead plus live loads. Using these criteria, maximum settlement and differential settlement are for foundations bearing in soil are expected to be on the order of ½-inch and ¼-inch over a horizontal distance of 25 feet, respectively. Maximum settlement and differential settlement for foundations bearing in bedrock are expected to be negligible.

5. To calculate resistance to lateral loads, please see the values presented in the "Retaining Walls" section of this report. Lateral capacity is based on the assumption that any backfill adjacent to foundations has been properly compacted. Passive and friction components of resistance may be combined in the analysis without reduction to either value.

6. Foundation excavations should be observed by the geotechnical engineer prior to placement of reinforcing steel. Foundation excavations should be lightly moistened and no desiccation cracks should be present prior to concrete placement.

Caissons

1. The proposed interior and exterior columns within and connected to Building 100 may be supported by drilled, cast-in-place concrete caissons. The caissons should have a minimum diameter of 18 inches, and a minimum overall depth of 5 feet into firm bedrock. The caissons may be designed using an allowable skin friction value of 1,000 psf in the bedrock; no end bearing capacity should be used in the calculations. An allowable skin friction value of 750 psf in the bedrock can be used under short-term tension (uplift) conditions. The self-weight of the caissons may be neglected in the determination of downward loading, however, it may be included, if needed, for resistance to uplift. Negligible total and differential settlement of caissons to support the proposed columns is expected. To maintain negligible total and differential settlement condition, skin friction in the fill and alluvium above the bedrock should be neglected. A passive

resistance of 350 pcf in the soil beginning at 2 feet bgs and 500 pcf in the bedrock, acting over 2 caisson diameters, may be taken for resistance to short term lateral loads.

2. The soils above the bedrock may not stand vertically during the caisson construction; therefore, casing, drill fluid, or other means of keeping the holes open may be necessary and should be planned for. Caisson reinforcing should be designed to accommodate a minimum 5-inch diameter tremie pipe for concrete placement, in case any perched groundwater is encountered. The reinforcing should also be designed to facilitate removal of casing during concrete placement, if used. Any water encountered should be removed from the caisson excavation prior to placing concrete, or the concrete should be tremied. The recommended tremie method is described in Appendix D.

3. As the caissons will utilize skin friction for support, it is not necessary to remove all loose debris and slough material from the bottoms of the excavations. The caissons should not deviate from a plumb line taken from the center of the caisson by more than 2 percent of the caisson length, from the top to the point of interest. Adequate caisson oversize may be assumed to provide required tolerance.

4. Caisson excavations should be observed by the geotechnical engineer during drilling operations and prior to placement of reinforcing steel and concrete. Special inspection of reinforcing steel and concrete placement for caissons should also be provided.

5. Reinforcing steel and concrete for caissons should be placed on the same day as they are drilled. Caisson excavations that must be left overnight before concrete placement should have the sidewalls “freshened” by re-drilling, and sloughed material should be removed by use of a clean-out bucket, prior to placement of reinforcing steel and concrete.

<u>General</u>

1. Allowable bearing capacities may be increased by one-third when transient loads such as wind or seismicity are included. Foundations may be designed using the site design response parameters contained in the table in the “Geology and Geologic Hazards” section of this report.

2. The Soil Corrosivity Study by HDR Engineering, Inc. in the Elevator Tower Report (ESP 2018) in Appendix B should be used by the architect/engineer in specifying appropriate corrosion

protection measures for all foundation elements.

Slabs-on-Grade

Interior Slabs-on-Grade

1. Interior slabs-on-grade should have a minimum thickness of 4 inches or should be matched in-kind with the existing slab section thicknesses, whichever is thicker. New slabs should be reinforced and doweled to foundations and surrounding slabs per the specifications of the architect/engineer. At a minimum, interior slabs should be reinforced with No. 3 rebar at 18 inches on center each way. All structural slabs should contain minimum rebar meeting the criteria of ACI 318, Section 24.4 (ACI 2014). At a minimum, foundation dowels should be lap spliced to the slab rebar. The size and spacing of the dowels should match the size and spacing of the slab rebar.

2. Support for new interior slabs constructed within surrounding existing slabs should match the support section in-kind with the existing slabs.

Exterior Pedestrian Flatwork

1. Exterior pedestrian flatwork should have a minimum thickness of 4 inches or should be matched in-kind with the existing slab section thicknesses for new slabs adjacent to existing slabs, whichever is thicker. Minimum reinforcement should consist of No. 3 rebar placed at 24 inches on-center each way.

2. In conventional construction, it is common to use 4 to 6 inches of sand beneath exterior pedestrian flatwork. However, due to the medium expansion potential of the site soils, there will be a risk of movement and damage to the flatwork if conventional measures are used. Heaving and cracking could occur. This movement could be reduced by the placement of additional nonexpansive material beneath the flatwork. If it is desired to fully mitigate the expansive soil conditions, then at least 18 inches of imported nonexpansive material should be provided below new flatwork outside the Building 100 area where the expansive site soils are exposed at finish grade. If it is acceptable for the flatwork to experience movement due to expansive soils, then the thickness of the nonexpansive soil can be reduced. Under all flatwork, however, the thicker the nonexpansive layer, the better the expansive soil protection.

3. Another measure that can be taken to reduce the risk of movement of flatwork due to

expansive soils is to provide thickened edges or grade beams around the perimeters of the flatwork. If it is desired to fully mitigate the expansive soil conditions, then the thickened edges or grade beams could be up to 21 inches deep. If it is acceptable for the flatwork to experience movement, then the thickened edges or grade beams can be reduced. At a minimum, any thickened edge or grade beam should be reinforced by two No. 4 rebar, one at the top and one at the bottom.

4. It is recognized that the measures discussed above for protecting exterior flatwork from expansive soils are expensive, possibly more expensive than simply replacing flatwork that has heaved and/or cracked. The client may consider that the condition of the existing flatwork around Building 100 is sufficient evidence that significant protection measures for flatwork are not needed. Consequently, the above measures for protecting exterior flatwork are only suggestions for consideration by the owner and/or architect/engineer. The degree to which exterior flatwork is protected from expansive soil damage is left to the discretion of the owner and/or architect/engineer.

5. Flatwork should be constructed with frequent joints to allow articulation as the flatwork moves in response to seasonal soil temperature and moisture variations. The expansive soil underlying any nonexpansive material placed below flatwork should be moisture conditioned, and no desiccation cracks should be present, prior to casting the flatwork.

6. Flatwork at doorways, and at other areas where maintaining the elevation of the flatwork is desired when mitigating expansive soil potential, should be doweled to the perimeter foundation, at a minimum, by No. 3 dowels lapped to the flatwork rebar at 24 inches on center. In other areas, the flatwork may be doweled to the foundation or the flatwork may be allowed to "float free," at the discretion of the architect/engineer. Flatwork that is intended to float free should be separated from foundations by a felt joint or other means.

<u>Moisture Vapor Transmission</u>

1. Due to the current use of impermeable floor coverings, water-soluble flooring adhesives, and the speed at which buildings are now constructed, moisture vapor transmission through slabs is a much more common problem than in past years. Where moisture vapor transmitted from the underlying soil would be undesirable, slabs should be protected from subsurface moisture vapor. A number of options for vapor protection are discussed

below; however, the means of vapor protection, including the type and thickness of the vapor retarder, if specified, are left to the discretion of the architect/engineer.

2. Where specified, vapor retarders should conform to ASTM Standard E 1745-11. This standard specifies properties for three performance classes; Class A, B and C. The appropriate class should be selected based on the potential for damage to the vapor retarder during placement of slab reinforcement and concrete. Unless it is determined that a permeance of 0.10 perms will not allow vapor to accumulate beneath moisture-sensitive flooring, adhesives, stored products and/or equipment, then a vapor retarder permeance of 0.010 perms is recommended, per ACI 302.1-15. Permeance of vapor retarders should remain below 0.010 perms after the conditioning tests of ASTM E 1745-11.

   It should be noted that ASTM E 1745-11 has the same permeance threshold for Class A through Class C (0.1 perms). The class that is chosen will make a difference in how resistant the vapor retarder is to punctures and tears, but it will not insure any better permeance values to protect floor coverings.

3. Several recent studies, including those of American Concrete Institute Committee 302 (ACI 2015), have concluded that excess water above the vapor retarder increases the potential for moisture damage to floor coverings and could increase the potential for mold growth or other microbial contamination. The studies also concluded that it is preferable to eliminate the typical sand layer beneath the slab and place the slab concrete in direct contact with a Class A vapor retarder, particularly during wet weather construction. However, placing the concrete directly on the vapor retarder requires special attention to using the proper vapor retarder, a very low water-cement ratio in the concrete mix, and special finishing and curing techniques.

4. Another option that may be a reasonable compromise between effectiveness and cost considerations is the use of a subslab vapor retarder protected by a sand layer. If a Class A vapor retarder is specified, the retarder can be placed directly on the nonexpansive soil. The retarder should be covered with a minimum 2 inches of *clean* sand. If a less durable vapor retarder is specified (Class B or C), a minimum of 4 inches of clean sand should be provided, and the retarder should be placed in the center of the clean sand layer. Clean sand is defined as a well or poorly graded sand (ASTM D 2487-17) of which less than 3 percent passes the No. 200 sieve. The clean sand layer is considered to be part of the

minimum 18-inch layer of nonexpansive soils recommended to be placed below slabs for protection from expansive soils, not in addition to it.

5. Regardless of the underslab vapor retarder selected, proper installation of the retarder per ASTM E 1643-18a is critical for optimum performance. Where utilized, the vapor retarder should be placed a minimum of 1 inch above the flow line of the drainage path surrounding the structures, or 1 inch above the area drain grates if area drains are used to collect runoff around the structures. As required by ASTM E 1643-18a, all seams and utility penetrations should be properly sealed. At terminating edges of the vapor retarder, the vapor retarder should be effectively sealed with accessories specifically designed to seal the material to new or existing concrete; details for edge sealing of the vapor retarder should be provided by the architect/engineer.

6. If the sand is used between the vapor retarder and the slab, it should be moistened only as necessary to promote concrete curing; saturation of the sand should be avoided, as the excess moisture would be on top of the vapor retarder, potentially resulting in vapor transmission through the slab for months or years.

7. The architect/engineer should designate any special measures to be used in conjunction with moisture vapor transmission protection, if needed, to mitigate the high potential for indoor radon levels.

8. Positive drainage away from the building should be maintained; see the "Drainage and Maintenance" section of this report for additional discussion of this issue. If water is allowed to pond near the structure, it may seep into the ground and migrate laterally through cracks or utility penetrations in the foundation, ultimately gaining access above the vapor retarder.

<u>Slabs-on-Grade - General</u>

1. To reduce shrinkage cracks in all interior and exterior slabs-on-grade, the concrete aggregates should be of appropriate size and proportion, the water/cement ratio should be low, the concrete should be properly placed and finished, contraction joints should be installed, and the concrete should be properly cured. This is particularly applicable to slabs that will be cast directly upon a vapor retarder and those that will be protected from transmission of vapor by use of admixtures or surface sealers. Concrete materials, placement, and curing specifications should be at the direction of the architect/engineer;

AC 302.1R-15 (ACI 2015) is suggested as a resource for the architect/engineer in preparing such specification.

2. The Soil Corrosivity Study by HDR Engineering, Inc. in the Elevator Tower Report (ESP 2018) in Appendix B should be used by the architect/engineer in specifying appropriate corrosion protection measures for all slabs-on-grade.

Retaining Walls

1. Retaining wall design may be based on the following parameters:

Active equivalent fluid pressure (site soil backfill)	45 pcf
Active equivalent fluid pressure (imported granular or gravel backfill)	35 pcf
At-rest equivalent fluid pressure (site soil backfill)	60 pcf
At-rest equivalent fluid pressure (imported granular or gravel backfill)	50 pcf
Passive equivalent fluid pressure (soil)	350 pcf
Passive equivalent fluid pressure (rock)	500 pcf
Maximum toe pressure (soil)	3,500 psf
Maximum toe pressure (rock)	4,000 psf
Coefficient of sliding friction (soil)	0.40
Coefficient of sliding friction (rock)	0.45

2. No surcharges are taken into consideration in the values presented in the previous paragraph. The maximum toe pressure is an *allowable* value; no factors of safety, load factors or other factors have been applied to the remaining values. With the exception of the maximum toe pressure, these values will require application of appropriate factors of safety, load factors, and/or other factors as deemed appropriate by the architect/engineer.

3. If the active and at-rest pressures presented above are utilized in the design, imported granular or gravel backfill should be used exclusively above a 1:1 plane from the bottom of the footing to 1 foot below daylight. The final foot of backfill should consist of native soil to reduce the potential for drainage to enter the backfill.

4. The active and at-rest pressures presented above are applicable to a horizontal retained surface behind the wall. Walls having a retained surface that slopes upward from the wall should be designed for an additional equivalent fluid pressure of 1 pcf for the active case and 1.5 pcf for the at-rest case, for every degree of slope inclination.

5. Under the CBC, the Risk-Targeted Maximum Considered Earthquake (MCER) must be used for determining seismic pressures on walls. Further, Section 1803A.5.12.1 in the 2016 CBC requires that dynamic seismic lateral earth pressures be provided by the geotechnical engineer for walls retaining more than 6 feet of backfill. The Earthquake Hazards Program website (USGS, 2018) was used to determine the MCER-based Geometric Mean Peak Ground Acceleration (PGA_M) for a Seismic Design Category "D" project. The resulting PGA_M was 0.453g. Then, using the methods presented by Lew et al. (2010) and this PGA_M, the appropriate incremental increase in lateral soil pressure, above the static active equivalent fluid pressure for flexible (cantilevered) walls, was determined to be 5 pcf for clayey sand and/or sandy lean clay backfill, and 1 pcf for imported sand or gravel backfill. Flexible (cantilevered) walls retaining over 6 feet of backfill should be designed using these incremental seismic pressures. Walls retaining 6 feet or less of backfill need not be designed for seismic pressures.

6. Recent research by Al Atik and Sitar (2010) confirmed that for flexible (cantilevered) walls, particularly those over 12 feet tall, an increase in soil pressure does occur under significant seismic accelerations. Further, they found that the increase is due to the out-of-phase interaction between the soil and the flexible wall. When considering rigid walls (i.e. those designed using at-rest criteria); however, they found that the incremental increase due to seismicity was typically less than 50 percent of the static wall pressure. Consequently, no incremental increase in lateral soil pressure is recommended for the design of walls where the static design utilizes the at-rest equivalent fluid pressure and they are designed with factors of safety and earth load factors of at least 1.5.

7. In typical structural design methods for retaining walls such as those found in Section 1605A of the 2016 CBC, lateral soil pressure is multiplied by a load factor of 1.6. According to Lew et al. (2010), a load factor of 1.6 is too conservative for seismic loads; this paper suggests that the seismic increase in lateral pressure be separated from the static active pressure and that a load factor of 1.0 be used for the seismic increase. Further, Al Atik and Sitar (2010) found that pressure increases due to seismic earth loads were minimal for walls retaining less than 12 feet of backfill. While Al Atik and Sitar's research is generally accepted among geotechnical and structural engineers in California, it is not entirely acknowledged in the 2016 CBC, as the CBC sets the height below which seismic loads may be ignored at 6 feet. Given this disparity, it is suggested that caution be used not to over-engineer walls retaining between 6 and 12 feet of backfill.

8. Long-term settlement of properly compacted sand or gravel retaining wall backfill should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill; long-term settlement of properly compacted site soil retaining wall backfill would be about twice that of sand or gravel backfill. Improvements that are constructed near the tops of retaining walls should be designed to accommodate long-term settlement.

9. All retaining walls should be drained with perforated pipe encased in a free-draining gravel blanket. The pipe should be placed with perforations facing downward, and should discharge in a nonerosive manner away from foundations and other improvements. The gravel blanket should have a width of approximately 1 foot and should extend upward to approximately 1 foot from the top of the wall backfill. The upper foot should be backfilled with native soil, except in areas where pavement or exterior pedestrian flatwork will abut the top of the wall. In such cases, the gravel should extend to the imported nonexpansive material, sand, aggregate base, or other material below the improved surface, as appropriate. To reduce infiltration of the soil into the gravel, a permeable synthetic filter fabric conforming to Standard Specifications Section 96-1.02B – Class C (Caltrans 2015), should be placed between the two. Manufactured synthetic drains, such as Miradrain or Enkadrain are acceptable alternatives to the use of gravel, provided that they are installed in accordance with the recommendations of the manufacturer.

10. Where weep hole drainage can be properly discharged, the perforated pipe may be omitted in lieu of weep holes on maximum 4-foot centers. A filter fabric as described above should be placed between the weep holes and the drain gravel.

11. Walls facing areas where moisture transmission through the wall would be undesirable should be thoroughly waterproofed in accordance with the specifications of the architect/engineer.

12. The architect/engineer should bear in mind that retaining walls by their nature are flexible structures, and that surface treatments on walls often crack. Where walls are to be plastered or otherwise have a finish applied, the flexibility should be considered in determining the suitability of the surfacing material, spacing of horizontal and vertical control joints, etc. The flexibility should also be considered where a retaining wall will abut or be connected to a rigid structure, and where the geometry of the wall is such that its flexibility will vary along its length.

13. The Soil Corrosivity Study by HDR Engineering, Inc. in the Elevator Tower Report (ESP 2018) in Appendix B should be used by the architect/engineer in specifying appropriate corrosion protection measures for all retaining walls.

Drainage and Maintenance

1. Per Section 1804A.4 of the 2016 CBC, unpaved ground surfaces should be *finish graded* to direct surface runoff away from foundations and other improvements at a minimum 5 percent grade for a minimum distance of 10 feet. The site should be similarly sloped to drain away from foundation and other improvements during construction. Where this is not practicable due to other improvements, etc., swales with improved surfaces, area drains, or other drainage facilities, should be used to collect and discharge runoff.

2. The structure should be fitted with roof gutters. Runoff from flatwork, roof gutters, downspouts, etc. should discharge in a nonerosive manner away from foundations and other improvements in accordance with the requirements of the governing agencies. Erosion protection should be placed at all discharge points unless the discharge is to a pavement surface.

3. To reduce the potential for planter drainage gaining access to subslab areas, any raised planter boxes adjacent to foundations should be installed with drains and sealed sides and bottoms. Drains should also be provided for areas adjacent to the structure and in landscape areas that would not otherwise freely drain.

4. The on-site soils are erodible; stabilization of soils disturbed during construction by vegetation or other means *during* and *following* construction, is essential to reduce erosion damage. Care should be taken to establish and maintain vegetation. The landscaping should be planned and installed to maintain the surface drainage recommended above. Surface drainage should also be maintained during construction.

5. Maintenance of drainage and other improvements is critical to the long-term stability of the site and the integrity of the structures. Site improvements should be maintained on a regular basis.

6. All exterior drains, retaining wall drains, and drain outlets should be maintained to be free-flowing.

7. To reduce the potential for disruption of drainage patterns and undermining of structures, fill areas, etc., all rodent activity should be aggressively controlled.

Observation and Testing

1. The recommendations contained in this report are based on a limited number of borings and rely on continuity of the subsurface conditions encountered.

2. It is assumed that the geotechnical engineer will be retained to provide consultation during the design phase (including review of mat foundation data), to interpret this report during construction, and to provide construction monitoring in the form of testing and observation.

3. At a minimum, the geotechnical engineer should be retained to provide:

    - Professional observation during grading, trench and retaining wall backfill, and foundation construction
    - Oversight of special inspection and compaction testing grading, trench and retaining wall backfill, and foundation construction

4. Special inspection of grading and backfill should be provided as per Section 1705A.6 and Table 1705A.6 of the CBC. The special inspector should be under the direction of the geotechnical engineer. At a minimum, the following items should be inspected and/or tested by the special inspector:

    - Stripping and clearing of all existing improvements and deleterious materials
    - Overexcavation of the building area and sitework retaining wall areas to the recommended depths
    - Scarification and moisture conditioning of overexcavated areas
    - Scarification and moisture conditioning of exterior pedestrian flatwork and all other grading areas
    - Fill quality, placement, moisture conditioning and compaction
    - Utility trench backfill
    - Conventional foundation excavations

- Caison foundation excavations and concrete placement

5. A program of quality assurance should be developed prior to beginning construction. At a minimum, the program should include all geotechnical items shown on the testing and inspection schedule of the approved plans. It should also include any additional inspection items required by the engineer and/or the governing jurisdiction. These items should be discussed at a preconstruction site meeting among a representative of the owner, the geotechnical engineer, special inspector, the project inspector, the engineer, and contractors. The geotechnical engineer should be notified at least 48 hours prior to beginning grading operations.

6. Locations and frequency of compaction tests should be as per the recommendation of the geotechnical engineer at the time of construction. The recommended test location and frequency may be subject to modification by the geotechnical engineer, based upon soil and moisture conditions encountered, size and type of equipment used by the contractor, the general trend of the results of compaction tests, or other factors.

9.0 CLOSURE

Our intent was to perform the investigation in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the locality of this project under similar conditions. No representation, warranty, or guarantee is either expressed or implied. This report is intended for the exclusive use by the client as discussed in the "Scope of Services" section. Application beyond the stated intent is strictly at the user's risk.

This report is valid for conditions as they exist at this time for the type of project described herein. The conclusions and recommendations contained in this report could be rendered invalid, either in whole or in part, due to changes in building codes, regulations, standards of geotechnical or construction practice, changes in physical conditions, or the broadening of knowledge.

If changes with respect to the project become necessary, if items not addressed in this report are incorporated into plans, or if any of the assumptions used in the preparation of this report are not correct, this firm shall be notified for modifications to this report. Any items not specifically addressed in this report should comply with the CBC of other applicable standards, and the requirements of the governing jurisdiction.

The preliminary recommendations presented in this geotechnical report are based upon the

geotechnical conditions encountered at the site, and may be augmented by additional requirements of the client, or by additional recommendations provided by the geotechnical engineer based on peer or jurisdiction reviews, or conditions exposed at the time of construction.

This document, the data, conclusions, and recommendations contained herein are the property of Earth Systems Pacific. This report shall be used in its entirety, with no individual sections reproduced or used out of context. Copies may be made only by Earth Systems Pacific, the client, and the client's authorized agents for use exclusively on the subject project. Any other use is subject to federal copyright laws and the written approval of Earth Systems Pacific.

Thank you for this opportunity to have been of service. If you have any questions, please feel free to contact this office at your convenience.

End of Text.

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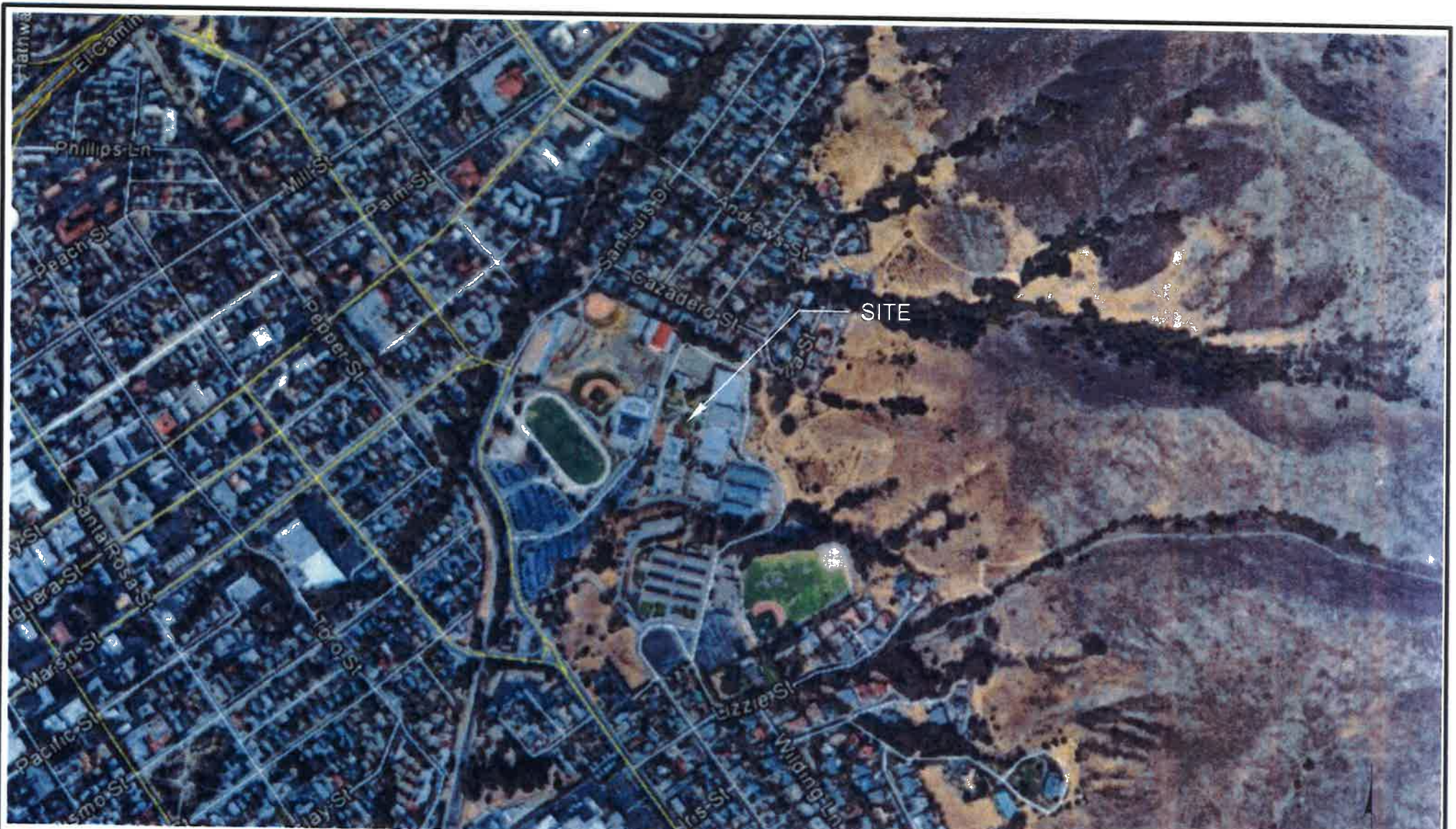
APPENDIX A

Figure 1 – Site Vicinity Map
Figure 2 – Exploration Location Map
Boring Log Legend
Boring Logs



NOT TO SCALE

SLOHSBUILDING100MODERNIZATION–062918MAPS

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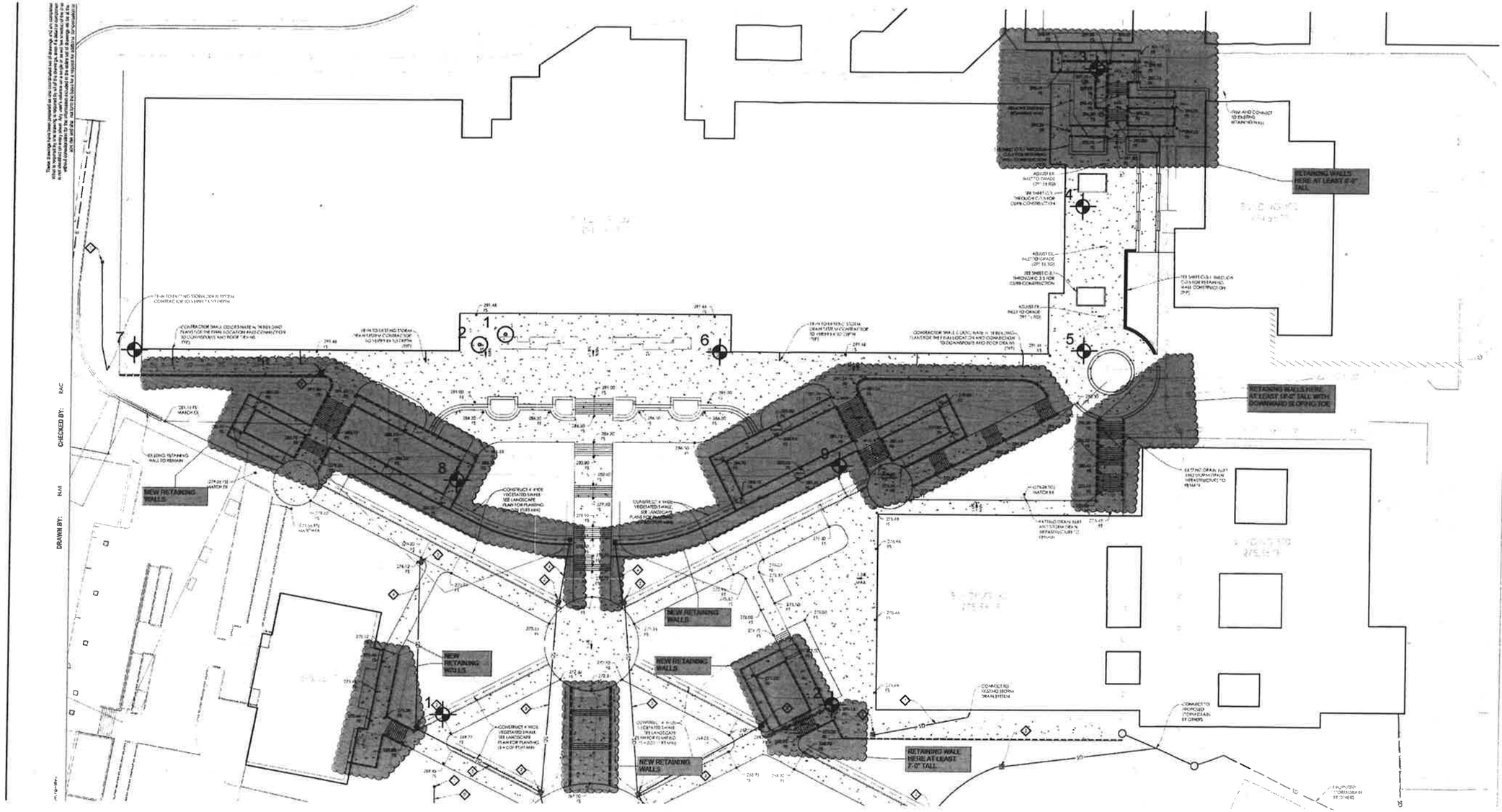
SITE VICINITY MAP

San Luis Obispo High School
Building 100 Modernization
1499 San Luis Drive
San Luis Obispo, California

Date
July 2018

Project No.
300933-007

Figure 1



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GRADING & DRAINAGE

PBK

DRAWN BY: RLM CHECKED BY: PAC

LEGEND

9 Boring Location (Approx.)

2 Boring Location (Approx.) - Esp. February 2018 (Building 100 Elevator Tower)

BASE MAP PROVIDED BY: PBK

NOT TO SCALE

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EXPLORATION LOCATION MAP

San Luis Obispo High School Building 100 Modernization
1499 San Luis Drive
San Luis Obispo, California

Date
July, 2018

Project No.
300933-007

Figure 2

SLOHSBUILDING100MODERNIZATION-062918maps

Earth Systems Pacific

BORING LOG LEGEND

SAMPLE / SUBSURFACE WATER SYMBOLS	GRAPH. SYMBOL
CALIFORNIA MODIFIED	
STANDARD PENETRATION TEST (SPT)	
SHELBY TUBE	
BULK	
SUBSURFACE WATER DURING DRILLING	
SUBSURFACE WATER AFTER DRILLING	

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

MAJOR DIVISIONS	GROUP SYMBOL	TYPICAL DESCRIPTIONS	GRAPH. SYMBOL
COARSE GRAINED SOILS (MORE THAN HALF OF MATERIAL IS LARGER THAN #200 SIEVE SIZE)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GP	POORLY GRADED GRAVELS, OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, NON-PLASTIC FINES	
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, PLASTIC FINES	
	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
	SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES	
	SM	SILTY SANDS, SAND-SILT MIXTURES, NON-PLASTIC FINES	
	SC	CLAYEY SANDS, SAND-CLAY MIXTURES, PLASTIC FINES	
FINE GRAINED SOILS (HALF OR MORE OF MATERIAL IS SMALLER THAN #200 SIEVE SIZE)	ML	INORGANIC SILTS AND VERY FINE SANDS, 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	
	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS	
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	

OBSERVED MOISTURE CONDITION

DRY	SLIGHTLY MOIST	MOIST	VERY MOIST	WET (SATURATED)

CONSISTENCY

COARSE GRAINED SOILS			FINE GRAINED SOILS		
BLOWS/FOOT		DESCRIPTIVE TERM	BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER		SPT	CA SAMPLER	
0-10	0-16	LOOSE	0-2	0-3	VERY SOFT
11-30	17-50	MEDIUM DENSE	3-4	4-7	SOFT
31-50	51-83	DENSE	5-8	8-13	MEDIUM STIFF
OVER 50	OVER 83	VERY DENSE	9-15	14-25	STIFF
			16-30	26-50	VERY STIFF
			OVER 30	OVER 50	HARD

GRAIN SIZES

U.S. STANDARD SERIES SIEVE				CLEAR SQUARE SIEVE OPENING		
# 200	# 40	# 10	# 4	3/4"	3"	12"

SILT & CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

TYPICAL BEDROCK HARDNESS

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
EXTREMELY HARD	CORE, FRAGMENT, OR EXPOSURE CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CAN ONLY BE CHIPPED WITH REPEATED HEAVY HAMMER BLOWS
VERY HARD	CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CORE OR FRAGMENT BREAKS WITH REPEATED HEAVY HAMMER BLOWS
HARD	CAN BE SCRATCHED WITH KNIFE OR SHARP PICK WITH DIFFICULTY (HEAVY PRESSURE); HEAVY HAMMER BLOW REQUIRED TO BREAK SPECIMEN
MODERATELY HARD	CAN BE GROOVED 1/16 INCH DEEP BY KNIFE OR SHARP PICK WITH MODERATE OR HEAVY PRESSURE; CORE OR FRAGMENT BREAKS WITH LIGHT HAMMER BLOW OR HEAVY MANUAL PRESSURE
SOFT	CAN BE GROOVED OR GOUGED EASILY BY KNIFE OR SHARP PICK WITH LIGHT PRESSURE, CAN BE SCRATCHED WITH FINGERNAIL; BREAKS WITH LIGHT TO MODERATE MANUAL PRESSURE
VERY SOFT	CAN BE READILY INDENTED, GROOVED OR GOUGED WITH FINGERNAIL, OR CARVED WITH KNIFE; BREAKS WITH LIGHT MANUAL PRESSURE

TYPICAL BEDROCK WEATHERING

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
FRESH	NO DISCOLORATION, NOT OXIDIZED
SLIGHTLY WEATHERED	DISCOLORATION OR OXIDATION IS LIMITED TO SURFACE OF, OR SHORT DISTANCE FROM, FRACTURES; SOME FELDSPAR CRYSTALS ARE DULL
MODERATELY WEATHERED	DISCOLORATION OR OXIDATION EXTENDS FROM FRACTURES, USUALLY THROUGHOUT; Fe-Mg MINERALS ARE "RUSTY", FELDSPAR CRYSTALS ARE "CLOUDY"
INTENSELY WEATHERED	DISCOLORATION OR OXIDATION THROUGHOUT; FELDSPAR AND Fe-Mg MINERALS ARE ALTERED TO CLAY TO SOME EXTENT, OR CHEMICAL ALTERATION PRODUCES IN SITU DISAGGREGATION
DECOMPOSED	DISCOLORATION OR OXIDATION THROUGHOUT, BUT RESISTANT MINERALS SUCH AS QUARTZ MAY BE UNALTERED; FELDSPAR AND Fe-Mg MINERALS ARE COMPLETELY ALTERED TO CLAY

drafting/masters/Boring Log Legend121714.dwg

Earth Systems Pacific

Boring No. 1
PAGE 1 OF 1
JOB NO.: 300933-007
DATE: 6/22/18

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	SM		SILTY SAND: brown, loose, slightly moist (Topsoil)					
1			SANDSTONE: yellow brown, soft, weathered, fractured (Franciscan Melange)	0.5 - 4.0	○			13
2				2.0 - 3.5	■			26
3								50
4								
5				5.0 - 5.5	●			36 50/1"
6			moderately hard					
7								
8			olive to olive brown, soft					
9								
10			moderately hard	10.0 - 10.5	●			50/2"
11			End of Boring @ 10.5'					
12			No subsurface water encountered					
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 2
PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

JOB NO.: 300933-007
DATE: 6/22/18

SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	SC		CLAYEY SAND: yellow brown, loose, slightly moist, some gravel (Fill)	1.0 - 4.0	○			5
2			gray brown, moist, trace roots	2.0 - 3.5	■	109.4	11.5	6 6
5	CL		SANDY LEAN CLAY: dark brown to dark olive, stiff, moist (Alluvium)	5.0 - 6.5	■	106.2	19.9	3 7 10
				5.0 - 8.0	○			
9			SANDSTONE: dark olive, soft, severely weathered and fractured, thin beds of dark gray claystone (Franciscan Melange)	10.0 - 11.5	■	133.7	8.0	17 30 50/5"
15				15.0 - 16.5	●			13 19 35
16			moderately hard					
18			hard					
			End of Boring @ 18.0' due to refusal No subsurface water encountered					

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 3
PAGE 1 OF 2
JOB NO.: 300933-007
DATE: 6/22/18

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			4.25" PCC over approximately 3" sand					
1	CL		SANDY LEAN CLAY: brown/gray mottled, medium stiff, trace debris, trace gravel (Fill)	1.0 - 4.0	○			3
2				2.0 - 3.5	▬	105.0	25.5	6 7
3								
4								
5			olive brown/gray mottled, stiff	5.0 - 6.5	▬	114.9	11.1	6 8 8
6								
7	SC		CLAYEY SAND: olive brown, medium dense, moist, trace gravel	7.0 - 10.0	○			
8								
9								
10				10.0 - 11.5	▬	118.4	12.7	6 12 14
11								
12								
13								
14								
15	CL		SANDY LEAN CLAY: blue gray/olive/brown mottled, medium stiff, moist (Alluvium)	15.0 - 16.5	●			2 2 5
16								3
17				16.5 - 18.0	▬	105.4	19.9	6 7
18								
19								
20			stiff	20.0 - 21.5	▬	109.6	18.9	2 7 12
21								
22								
23			medium stiff					4
24				23.5 - 25.0	▬			4 8
25								
26								

LEGEND: ▬ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 3
PAGE 2 OF 2
JOB NO.: 300933-007
DATE: 6/22/18

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
27			SANDSTONE: olive/dark gray, very soft, severely weathered and sheared (Franciscan Melange)	29.5 - 31.0	●			6 10 13
31			End of Boring @ 31.0' No subsurface water encountered					

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 4
PAGE 1 OF 1
JOB NO.: 300933-007
DATE: 6/25/18

LOGGED BY: R. Wagner
DRILL RIG: Simco BP 200
AUGER TYPE: 4" Solid Stem Auger

SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			4" PCC					
1	SC		CLAYEY SAND: brown/olive/gray mottled, medium dense, moist, trace debris (Fill)	2.0 - 3.5	■			5, 8, 11
5	SC		CLAYEY SAND: brown, medium dense, moist (Alluvium)	5.0 - 6.5	■			8, 13, 22
7			SANDSTONE: olive brown, moderately hard, weathered and fractured (Franciscan Melange)	7.0 - 7.5	●	No Recovery		50/1"
8			End of Boring @ 7.5' due to refusal No subsurface water encountered					

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 5

LOGGED BY: R. Wagner
DRILL RIG: Simco BP 200
AUGER TYPE: 4" Solid Stem Auger

PAGE 1 OF 1
JOB NO.: 300933-007
DATE: 6/25/18

SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			4.25" PCC over 2" sand					
1	SC		CLAYEY SAND: light olive brown, loose, moist, trace gravel, trace debris and roots (Fill)					
2				2.0 - 3.5	■	118.8	12.1	9 6 6
3								
4								
5				5.0 - 6.5	■			9 18 22
6	CL		SANDY LEAN CLAY: olive brown/brown mottled, very stiff, slightly moist, trace gravel (Alluvium)					
7				7.0 - 7.5	●	No Recovery		50/2"
8			SANDSTONE: olive brown, moderately hard, weathered					
9			End of Boring @ 7.5' No subsurface water encountered					
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 6
PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Simco BP 200
AUGER TYPE: 4" Solid Stem Auger

JOB NO.: 300933-007
DATE: 6/25/18

SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			4" PCC over 3" sand					
1 - 4	SC		CLAYEY SAND: brown/gray mottled, medium dense, moist, some gravel (Fill)	2.0 - 3.5	■			5 9 12
5 - 6			SANDSTONE: olive brown, moderately hard, weathered (Franciscan Melange)	5.0 - 6.5	●			12 35 50/3"
7			End of Boring @ 6.5' No subsurface water encountered					
8 - 26								

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 7
PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Simco BP200/Mobile B-53 with Automatic Hammer
AUGER TYPE: 4" Solid Stem/6" Hollow Stem Auger

JOB NO.: 300933-007
DATE: 6/25/18

SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			4" PCC over 4" coarse gravel					
1	SC		CLAYEY SAND: brown, medium dense, moist, some gravel, trace roots (Fill)	2.0 - 7.0	○			
5				5.0 - 6.5	▬	112.8	14.4	4, 6, 8
6			loose, trace gravel, increasing clay content					
7	CL		SANDY LEAN CLAY: dark brow, stiff, moist (Alluvium)					
10			brown, very stiff	10.0 - 11.5	▬	112.3	15.9	6, 12, 19
15				15.0 - 16.5	▬			12, 16, 21
19			yellow brown					
20				20.0 - 21.5	●			6, 6, 11
22			SANDSTONE: yellow brown, soft, weathered (Franciscan Melange)	23.0 - 23.5	●	No Recovery		50/2"
24			End of Boring @ 23.5' due to refusal No subsurface water encountered					

LEGEND: ▬ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 8
PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Simco BP200
AUGER TYPE: 4" Solid Stem Auger

JOB NO.: 300933-007
DATE: 6/25/18

SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	SC		CLAYEY SAND: brown, medium dense, moist (Fill)	1.5 - 3.0	▬			7 9 10
5			SANDSTONE: olive brown, very soft, weathered and fractured	5.0 - 6.0	▬			9 50/5"
7			moderately hard	6.5 - 7.0	●	No Recovery		50/1"
			End of Boring @ 7.0' due to refusal No subsurface water encountered					

LEGEND: ▬ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 9
PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Simco BP200
AUGER TYPE: 4" Solid Stem Auger

JOB NO.: 300933-007
DATE: 6/22/18

SAN LUIS OBISPO HIGH SCHOOL
BUILDING 100 MODERNIZATION
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	SC		CLAYEY SAND: brown, loose, moist, trace gravel, some tree roots (Fill)					
5	CL		SANDY LEAN CLAY: dark gray brown, medium stiff, moist, some tree roots (Alluvium)					
7			SANDSTONE: gray to olive brown, very soft, severely weathered and fractured (Franciscan Melange)					
9			moderately hard					
10			End of Boring @ 9.0' due to refusal No subsurface water encountered					

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

APPENDIX B

Geotechnical Engineering and
Geologic Hazards Report,
San Luis Obispo High School
Building 100 Elevator Tower (ESP 2018)

California Geological Survey,
Engineering Geology and Seismology Review
of Geotechnical Engineering and Geologic Hazards
Report for San Luis Obispo High School
New Annex/Classroom (ESP 2016)

DEPARTMENT OF CONSERVATION

CALIFORNIA GEOLOGICAL SURVEY

SCHOOL REVIEW UNIT • 801 K STREET, MS 12-31 • SACRAMENTO, CALIFORNIA 95814

PHONE 916 / 324-7324 • FAX 916 / 445-3334 • TDD 916 / 324-2555 • WEB SITE conservation.ca.gov/cgs

June 9, 2016

Anthony Palazzo
Director of Facilities, Operations, and Transportation
San Luis Coastal Unified School District
937 Southwood Drive
San Luis Obispo, CA 93401

Subject: **Engineering Geology and Seismology Review for**
San Luis Obispo High School – New Annex/Classroom Building
1499 San Luis Drive, San Luis Obispo, CA
CGS Application No. 01-CGS2281

Dear Mr. Palazzo:

In accordance with your request and transmittal of documents received on February 22, 2016, the California Geological Survey has reviewed the engineering geology and seismology aspects of the consulting report prepared for San Luis Obispo High School in San Luis Obispo. It is our understanding that this project involves demolition of an existing building and construction of a new annex/classroom building. This review was performed in accordance with Title 24, California Code of Regulations, 2013 California Building Code (CBC) and followed CGS Note 48 guidelines. We reviewed the following report:

> **Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School - Measure D Projects, Annex/Classroom Building, 1499 San Luis Drive, San Luis Obispo, California:** Earth Systems Pacific, 4378 Old Santa Fe Road, San Luis Obispo, California 93401; company File No. SL-16605-SE, report dated January 19, 2016, 31 pages, 5 appendices.

Based on our review, the consultants provide a thorough and well-documented assessment of engineering geology and seismology issues with respect to the proposed improvements. The principal concerns identified by the consultants are potential for moderate to severe ground shaking, the potential for differential settlement from undocumented fill and disturbed soil, and expansion potential and corrosive potential of site soils. The consultants recommend design spectral acceleration parameters of S_{DS} = **0.792g** and S_{D1} = **0.453g**, which are considered reasonable. Their evaluation indicates liquefaction, dynamic settlement, and deep-seated slope instability are not design concerns for the project.

In conclusion, ***the engineering geology and seismology issues at this site are adequately assessed in the referenced report.*** If you have any further questions about this review letter, please contact the reviewer at (213) 239-0884.

Respectfully submitted,

Michael DeFrisco
Engineering Geologist
PG 8624, CEG 2574



Concur:

Jennifer Thornburg
Senior Engineering Geologist
PG 5476, CEG 2240



Enclosures:

Note 48 Checklist Review Comments
Keyed to: *Note 48 - Checklist for the Review of Engineering Geology and Seismology Reports for California Public Schools, Hospitals, and Essential Services Buildings*

Copies to:

Richard T. Gorman, *Certified Engineering Geologist*, and Frederick J. Potthast, *Registered Geotechnical Engineer*
Earth Systems Pacific, 4378 Old Santa Fe Road, San Luis Obispo, CA 93401

Alan Kroeker, *Architect*
PMSM Architects, 560 Higuera Street, Suite C, San Luis Obispo, CA 93401

Karen Van Dorn, *Senior Architect*
Division of State Architect, 1515 Clay Street, Suite 1201, Oakland, CA 94612

Note 48 Checklist Review Comments

In the numbered paragraphs below, this review is keyed to the paragraph numbers of California Geological Survey Note 48 (October, 2013 edition), *Checklist for the Review of Engineering Geology and Seismology Reports for California Public Schools, Hospitals, and Essential Services Buildings.*

Project Location

1. Site Location Map, Street Address, County Name: Adequately addressed.
2. Plot Plan with Exploration Data with Building Footprint: Marginally adequate. The consultants provide a Boring Location Map which illustrates the location of 3 borings and Cross Section A-A'. CGS notes that review of the SLO High School Proposed Site Plan provided by PMSM Architects indicates that the 3 borings drilled by the consultant appear to be near the location of the Proposed Classroom Building. In future reports the consultants should provide a site plan illustrating the boring locations with respect to the building footprint.
3. Site Coordinates: Adequately addressed. Latitude and Longitude provided in report: 35.2836°N, 120.6501°W

Engineering Geology/Site Characterization

4. Regional Geology and Regional Fault Maps: Adequately addressed.
5. Geologic Map of Site: Not provided and therefore not reviewed.
6. Subsurface Geology: Adequately addressed. Based on regional mapping and 3 hollow-stem auger borings drilled to depths of 16.5 to 26 feet, the consultants report the site is underlain by fill, Holocene alluvial flood plain deposits, and sandstone and claystone of the Franciscan Mélange. Groundwater was reportedly not encountered in the borings.
7. Geologic Cross Sections: Adequately addressed.
8. Active Faulting & Coseismic Deformation Across Site: Adequately addressed. The consultants report that the site is not located in a State Earthquake Fault Zone, and there are no mapped faults crossing or adjacent to the site. They conclude that the potential for surface fault rupture to occur at the site is considered to be very low.
9. Geologic Hazard Zones (Liquefaction & Landslides): Adequately addressed. The consultants report that the site is not located in a Geologic Study Area or a High Liquefaction Hazard Zone, based on review of the San Luis Obispo County Planning Department Permit View website.
10. Geotechnical Testing of Representative Samples: Adequately addressed.
11. Geological Consideration of Grading Plans and Foundation Plans: Adequately addressed. The consultants provide recommendations for the design of retaining walls up to 4 feet tall, and for conventional continuous and spread footings. A program for overexcavation and recompaction of all existing fill in the building area is recommended by the consultants in order to reduce the potential for differential settlement from undocumented fill and disturbed soil.

Seismology & Calculation of Earthquake Ground Motion

12. Evaluation of Historic Seismicity: Adequately addressed. The consultants provide a summary of historical seismicity in the region.
13. Classify the Geologic Subgrade (Site Class): Adequately addressed. The consultants classify the site soil profile as Site Class D, Stiff Soil.
14. General Procedure Seismic Parameters: Adequately addressed. The consultants report the following parameters derived from a map-based analysis:
    S_S = 1.137g and S_1 = 0.434g
    S_{DS} = 0.792g and S_{D1} = 0.453g
15. Seismic Design Category: Adequately addressed. The consultants reports Seismic Design Category D.
16. Site-Specific Ground Motion Analysis: Not Applicable.
17. Deaggregated Seismic Source Parameters: Not applicable.
18. Time-Histories of Earthquake Ground Motion: Not applicable.

Liquefaction/Seismic Settlement Analysis

19. Geologic Setting for Occurrence of Seismically Induced Liquefaction: Adequately addressed. The consultants report that the potential for liquefaction and seismically-induced settlement to occur at the site are considered to be nil due to the underlying stiff to very stiff clayey alluvial soils and relatively shallow bedrock of the Franciscan Mélange. The data presented appear to support this conclusion.
20. Seismic Settlement Calculations: Not applicable.
21. Other Liquefaction Effects: Not applicable.
22. Mitigation Options for Liquefaction: Not applicable.

Slope Stability Analysis

23. Geologic Setting for Occurrence of Landslides: Adequately addressed. The consultants report that there are no significant slopes on or adjacent to the Annex/Classroom Building site area, therefore, there is no potential for gross slope instability or landsliding to impact the project.
24. Determination of Static and Dynamic Strength Parameters: Not applicable.
25. Determination of Pseudo-Static Coefficient (Keq): Not applicable.
26. Identify Critical Slip Surfaces for Static and Dynamic Analyses: Not applicable.
27. Dynamic Site Conditions: Not applicable.
28. Mitigation Options/Other Slope Failure: Not applicable.

Other Geologic Hazards or Adverse Site Conditions

29. Expansive Soils: Adequately addressed. The consultants report that the soils would be considered to have a "medium" expansion potential, based on expansion index testing.

30. Corrosive/Reactive Geochemistry of the Geologic Subgrade: Adequately addressed. The consultants report that the soils were classified as severely corrosive to ferrous metals and aggressive to copper.
31. Conditional Geologic Assessment: Adequately addressed. No significant conditional hazards of potential concern were identified by the consultants.

Report Documentation

32. Geology, Seismology, and Geotechnical References: Adequately addressed.
33. Certified Engineering Geologist: Adequately addressed.
    Richard T. Gorman, Certified Engineering Geologist #1325
34. Registered Geotechnical Engineer: Adequately addressed.
    Frederick J. Potthast, Registered Geotechnical Engineer #2369

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March 29, 2017

FILE NO.: SL-16605-SE/TF

Mr. Anthony Palazzo
Director – Buildings, Grounds and Transportation
San Luis Coastal Unified School District
937 Southwood Drive
San Luis Obispo, CA 93401

PROJECT: SAN LUIS OBISPO HIGH SCHOOL – MEASURE D PROJECTS
ANNEX / CLASSROOM BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3102

SUBJECT: Addendum No. 2 to Geotechnical Engineering and Geologic Hazards Report – Additional Retaining Wall Recommendations

REF:
1) Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School – Measure D Projects, Annex / Classroom Building, 1499 San Luis Drive, San Luis Obispo, California, by Earth Systems Pacific, File No. SL-16605-SE, Doc. No. 1601-059.SGR, dated January 19, 2016
2) Addendum No. 1 to Geotechnical Engineering and Geologic Hazards Report – Low Radon Potential, San Luis Obispo High School – Measure D Projects, Annex / Classroom Building, 1499 San Luis Drive, San Luis Obispo, California, by Earth Systems Pacific, File No. SL-16605-SE, Doc. No. 1604-066.ADD1, dated April 18, 2016

Dear Mr. Palazzo:

Per the request of Mr. Joshua Moody, the project's structural engineer, this second addendum to the referenced geotechnical engineering and geologic hazards report (Ref. Nos. 1 and 2) has been prepared to address additional retaining wall heights that are now planned for the project. Per our discussion with Mr. Moody, the previously anticipated retaining wall heights for sitework walls will be changed from a maximum height of 4 feet to 6.5 feet, and walls connected to or forming part of the structure will be changed from a maximum height of 4 feet to 7 feet. Accordingly, the addendum provides additional retaining wall recommendations to address seismic concerns for the added wall heights. This second addendum is intended to be used in conjunction with the referenced report and first addendum. Please see the original report and first addendum for recommendations not discussed herein. Technical references for the recommendations within this addendum are attached.

Additional Retaining Wall Recommendations

The following retaining wall recommendations should be added to those provided in the referenced report (Ref. No. 1).

1. Under the 2013 CBC, the Risk-Targeted Maximum Considered Earthquake (MCE_R) must be used for determining seismic pressures on walls. Further, Section 1803.5.12.1 of the 2013 CBC requires that dynamic seismic lateral earth pressures be provided by the geotechnical engineer for walls retaining more than 6 feet of backfill. The MCE_R-based Geometric Mean Peak Ground Acceleration (PGA_M) presented in the referenced report (Ref. No. 1) was 0.475g. Using the methods presented by Lew et al. (SEAOC 2010) and this PGA_M, the incremental increase in lateral soil pressure, above the static active equivalent fluid pressure for flexible (cantilevered) walls, was determined to be 0 pcf and 3.5 pcf for the site soil backfill and imported sand or gravel backfill, respectively.

2. Recent research by Al Atik and Sitar (2010) confirmed that for flexible (cantilevered) walls, particularly those over 12 feet tall, an increase in soil pressure does occur under significant seismic accelerations. Further, they found that the increase may be due to the out-of-phase interaction between the soil and the flexible wall. When considering rigid walls (i.e. those designed using at-rest criteria), however, they found that the incremental increase due to seismicity was typically less than 50 percent of the static wall pressure. Generally, no incremental increase in lateral soil pressure is recommended for the design of walls where the static design utilizes the at-rest equivalent fluid pressure and they are designed with factors of safety and earth load factors of at least 1.5. However, per the request of Mr. Moody, the incremental increase in lateral soil pressure, above the *static active* equivalent fluid pressure for rigid (building) walls, was determined to be 0 pcf and 15 pcf for the site soil backfill and imported sand or gravel backfill, respectively. Recently, the Division of State of the State Architect has requested that an incremental increase in lateral soil pressure also be determined for walls designed for *at-rest* equivalent fluid pressure. If this is determined by others to be necessary, an incremental increase of 15 pcf, above the *static at-rest* equivalent fluid pressure, may be used. As discussed above, the research by Al Atik and Sitar (2010) suggests this to be unnecessary.

3. In typical structural design methods for retaining walls, such as those found in Section 1605 of the CBC, lateral soil pressure is multiplied by a load factor of 1.6. According to Lew et al. (2010), a load factor of 1.6 is too conservative for seismic loads; this paper suggests that the seismic increase in lateral pressure be separated from the static active pressure and that a load factor of 1.0 be used for the seismic increase. Further, Al Atik and Sitar (2010) found that pressure increases due to seismic earth loads were minimal for walls retaining less than 12 feet of backfill. While the Al Atik and Sitar's research is

generally accepted among geotechnical and structural engineers in California, it is not entirely acknowledged by the California Building Standards Commission, as the CBC sets the height below which seismic loads may be ignored at 6 feet. Given this disparity, it is suggested that caution be used not to over-engineer walls retaining between 6 and 12 feet of backfill.

End of Additional Retaining Wall Recommendations.

We appreciate the opportunity to have provided geotechnical services for this project. If there are any questions concerning this addendum, please do not hesitate to contact the undersigned.

Sincerely,

Earth Systems Pacific



3/29/17

Fred J. Potthast, GE
Principal Engineer

Attachment: Additional Technical References (1 page)

Copy to: Mr. Joshua Moody, SE

Doc. No.: 1703-145.ADD2/jr

ADDITIONAL TECHNICAL REFERENCES

Al Atik, L. A. and Sitar, N. 2010 October. "Seismic Earth Pressures on Cantilever Retaining Structures." *Journal of Geotechnical and Geoenvironmental Engineering* 136 (10). American Society of Civil Engineers.

Lew, M., et al. 2010. "Seismic Earth Pressures on Deep Building Basements." *Structural Engineers Association of California (SEAOC) Convention Proceedings.*

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April 18, 2016

FILE NO.: SL-16605-SE

Mr. Anthony Palazzo
Director – Buildings, Grounds and Transportation
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937 Southwood Drive
San Luis Obispo, CA 93401

PROJECT: SAN LUIS OBIPSO HIGH SCHOOL – MEASURE D PROJECTS
ANNEX / CLASSROOM BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3102

SUBJECT: Addendum No. 1 to Geotechnical Engineering and Geologic Hazards Report – Low Radon Potential

REF: Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School – Measure D Projects, Annex / Classroom Building, 1499 San Luis Drive, San Luis Obispo, California, by Earth Systems Pacific, Doc. No. 1601-059.SGR, dated January 19, 2016

Dear Mr. Palazzo:

An error has been found in the **Slabs-on-Grade**, Moisture Vapor Transmission Section, Paragraph 8, on Page 22 of the referenced report. Paragraph 8, which recommends special measures to mitigate the high potential for indoor radon levels, should be *deleted entirely* from the report. As previously noted in the report, the site has been identified as having low potential for radon.

We apologize for any inconvenience that this error may have caused.

Please attach a copy of this addendum to each copy of the report that you may have.

End of Addendum No. 1.

If there are any questions regarding this addendum, please feel free to contact the undersigned.

Sincerely,
Earth Systems Pacific

REGISTERED PROFESSIONAL ENGINEER FREDERICK J. POTTHAST No. GE 2369 Exp. 03/31/17 GEOTECHNICAL STATE OF CALIFORNIA

Fred J. Potthast, GE
Principal Engineer

4/18/16

Doc. No.: 1604-066.ADD1/sr

GEOTECHNICAL ENGINEERING AND GEOLOGIC HAZARDS REPORT
SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3102

January 19, 2016

Prepared for

Mr. Anthony Palazzo
San Luis Coastal Unified School District

Prepared by

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January 19, 2016

Mr. Anthony Palazzo
Director – Buildings, Grounds and Transportation
San Luis Coastal Unified School District
937 Southwood Drive
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FILE NO.: SL-16605-SE

PROJECT: SAN LUIS OBISPO HIGH SCHOOL -MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3102

SUBJECT: Geotechnical Engineering and Geologic Hazards Report

CONTRACT REF: Purchase Order No. 161188 by San Luis Coastal School District, dated December 7, 2015, to Provide a Geotechnical Engineering Investigation, San Luis Obispo High School, Measure D Projects, 1499 San Luis Drive, San Luis Obispo, California, per Proposal by Earth Systems Pacific, Doc. No. 1511-157.PRP, dated November 25, 2015

Dear Mr. Palazzo:

In accordance with your purchase order, this geotechnical engineering and geologic hazards report has been prepared for use in the development of plans and specifications for the Annex/Classroom Building Project at San Luis Obispo High School, in San Luis Obispo, California. This report describes the general geotechnical and geologic characteristics, identifies existing and potential geotechnical and geologic hazards, and discusses the impacts that these conditions could have upon the project. Preliminary geotechnical recommendations for site preparation, grading, utility trenches, foundations, interior slabs-on-grade and exterior pedestrian flatwork, retaining walls, asphalt concrete (AC) paths, drainage and maintenance, and observation and testing are presented herein. Soil corrosivity testing and an evaluation of the results, which were subcontracted to HDR, Inc. of Claremont, California, are also provided. Two bound copies and an electronic copy of this report are being furnished for your use.

We appreciate the opportunity to have provided services for this project and look forward to working with you again in the future. If there are any questions concerning this report, please do not hesitate to contact the undersigned.

Sincerely,

Earth Systems Pacific

Fred J. Potthast, GE
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
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1/19/16

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Principal Geologist

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STATE OF CALIFORNIA

Doc. No.: 1601-059 SGR/tf

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1.0 INTRODUCTION AND SITE SETTING

The proposed Annex/Classroom Building at San Luis Obispo High School will have a footprint of approximately 12,000 square feet. It will be single story, of steel-frame, stud and possibly masonry construction. Conventional continuous and spread (pad) foundations are planned, with concrete slabs-on-grade. Maximum dead plus live loads on continuous footings of 2,000 plf, and maximum loads on spread footings of 75 kips, have been assumed for the purposes of this report. Retaining walls for sitework, or connected to or forming part of the structure, and a maximum of 4 feet tall, may also be utilized. The new building will be served by the existing campus utility systems via underground connections; it will be surrounded by landscaping and sidewalks of either Portland cement concrete (PCC) or asphalt concrete (AC) over aggregate base (AB). The existing service driveways in the project area may be repaired as part of the project, however no new pavement areas are anticipated. To our knowledge, no drainage basins are planned as part of the project. Infiltration systems or other types of low-impact development (LID) features may be included in the final design; however this has not been determined as of the date of this report, and therefore these potential features are not addressed.

The new building will be constructed on the site of the existing Annex/Cafeteria Building, on the north side of the campus, immediately east of the old Gymnasium. The site location on the campus is indicated on the Vicinity Map in Appendix A. Flatwork, lawns, shrubs and several scattered mature trees are present on the west, south and east sides of the existing building. The main campus service road extends along the west side of the existing building, just beyond the lawn, providing access to a paved delivery area at the rear (the north side) of the building. Drainage appears to be by sheet flow, and generally toward the south-southwest. The locations and dispositions of utility lines on the site are unknown.

2.0 SCOPE OF SERVICES

The scope of work for this report included a general site reconnaissance, subsurface exploration, site reconnaissance by a registered geotechnical engineer and certified engineering geologist, laboratory testing of samples secured during the subsurface investigation, geotechnical and geologic analyses of the data, and preparation of this report. The analysis and subsequent recommendations were based on general information provided by the client.

This report and preliminary geotechnical recommendations are intended to comply the considerations of Sections 1803A.1 through 1803A.7, J104.3 and J104.4 of the 2013 California Building Code; California Geological Survey Note 48; DSA IR A-4.13; and common geotechnical engineering and engineering geology practice in this area under similar conditions at this time.

The test procedures were accomplished in general conformance with the standards noted, as modified by common geotechnical engineering practice in this area under similar conditions at this time.

Preliminary geotechnical recommendations for site preparation, grading, utility trenches, foundations, interior slabs-on-grade and pedestrian flatwork, retaining walls, AC paths, drainage and maintenance, and observation and testing are presented to guide the development of project plans and specifications. The results of geotechnical corrosivity testing, and an evaluation of the results with recommendations for mitigation, which were subcontracted to HDR, Inc., are also provided. As there may be geotechnical issues yet to be resolved, the geotechnical engineer should be retained to provide consultation as the design progresses, to assist in verifying that pertinent geotechnical issues have been addressed and to aid in conformance with the intent of this report. It may also be advantageous to retain the geotechnical engineer to review the project plans and details as they near completion, to further aid in conformance with the intent of this report.

It is our intent that this report be used exclusively by the client in the preparation of plans and specifications. Application beyond this intent is strictly at the user's risk.

This report does not address issues in the domain of contractors such as, but not limited to, site safety, loss of volume due to stripping of the site, shrinkage of soils during compaction, excavatability, dewatering, shoring, temporary slope angles, construction means and methods, etc. Analyses of the soil for mold potential, man-made asbestos, lead, radioisotopes, hydrocarbons, or chemical properties other than geotechnical corrosivity are beyond the scope of this report. Evaluation of the site for suitability for LID improvements or drainage basins; ancillary features such as temporary access roads, fences, flag and light poles, signage; and nonstructural fills are not within our scope and are also not addressed.

In the event that there are any changes in the nature, design, or location of improvements, or if any assumptions used in the preparation of this report prove to be incorrect, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are verified or are modified in writing. The criteria presented in this report are considered preliminary until such time as any peer review or review by any jurisdiction has been completed, conditions are observed by the geotechnical engineer and/or geologist in the field during construction, and the recommendations have been verified as appropriate or modified in writing.

3.0 FIELD INVESTIGATION

On December 29, 2015, three borings were drilled in the planned building area to depths ranging from approximately 16.5 to 26 feet below the existing ground surface. The borings were drilled with a truck-mounted Mobile Drill rig, Model B-53, equipped with 6-inch outside diameter hollow stem auger and an automatic trip hammer for sampling. The approximate locations of the borings are shown on the Boring Location Map in Appendix A. Soil samples were obtained using a ring-lined barrel sampler (ASTM D 3550-01/07 with shoe similar to D 2937-10). Bulk soil samples were obtained from the auger cuttings. Standard penetration tests were also performed in the borings (ASTM D 1586-11) at selected depths. The borings were backfilled with auger spoils.

Soils encountered in the borings were categorized and logged in general accordance with the Unified Soil Classification System and ASTM D 2488-09a. Where bedrock was encountered, its properties were described based upon observation of the auger cuttings and the effort required to drill into it. Copies of the boring logs and a Boring Log Legend are included in Appendix A. In reviewing the boring logs and legend, the reader should recognize that the legend is intended as a guideline only, and there are a number of conditions that may influence the soil characteristics as observed during drilling. These include, but are not limited to, the presence of cobbles or boulders, cementation, variations in soil moisture, presence of groundwater, and other factors. It should also be noted that the descriptions of bedrock must span a much wider range of density and strength characteristics than soil, and are relative to other bedrock strata. For example, fractured and weathered bedrock may be described as “soft,” yet it will be considerably harder than almost any type of soil. Conversely, a clay soil may be described as “hard,” however it will not be nearly as hard as even “moderately soft” bedrock such as the sandstone and claystone encountered on this site. Consequently, the logger must exercise judgment in interpreting the subsurface characteristics, possibly resulting in soil and bedrock descriptions that vary somewhat from the legend.

4.0 LABORATORY ANALYSIS

The ring samples were tested for unit weight and moisture (ASTM D 2937-10), as modified for ring liners. One ring sample was also tested for one-dimensional consolidation (ASTM D 2435-11). Bulk samples were tested for maximum density and optimum moisture content (ASTM D 1557-12), expansion index (ASTM D 4829-11), plasticity index (ASTM D 4318-10) and cohesion and angle of shearing resistance by direct shear (ASTM D 3080-11, recompacted to 90 percent of maximum dry density and modified for consolidated, undrained conditions). The physical laboratory test results are presented in Appendix B.

Two bulk samples of the upper soils were also sent to HDR, Inc. of Claremont, California for geotechnical corrosivity testing. The results of these tests, and HDR, Inc.'s evaluation of the results, are presented in Appendix C.

5.0 GENERAL SUBSURFACE AND GEOLOGIC PROFILE

Boring 1, drilled on the west side of the existing building, found 4 feet of stiff fill (sandy lean clay with a trace of coarse gravel) over alluvium. The alluvium consisted of very stiff sandy lean clay with some fine gravel from 4 to 17 feet, and medium dense clayey gravel with sand to 23.5 feet. The alluvium was underlain by moderately soft bedrock (sandstone) of the Franciscan Mélange, which continued to drilling refusal at 26 feet.

A pavement section of 4 inches of asphalt concrete (AC) over 2 inches of aggregate base (AB) was found in Boring 2, on the north side of the existing building. Below the pavement to the boring termination depth of 16.5 feet was stiff to very stiff sandy lean clay alluvium. Some fine gravel was found in the clay to 4.5 feet.

Boring 3, on the east side of the existing building, encountered very stiff sandy lean clay with a trace of gravel (alluvium) from the surface to 7.5 feet. Bedrock of the Franciscan Mélange was found below the alluvium; the bedrock was moderately soft sandstone to 10.5 feet and moderately soft, severely sheared and weathered claystone to the drilling refusal depth of 16.5 feet.

During drilling, the soils and bedrock were described as being slightly moist to very moist. Free subsurface water was not found in any of the borings, to the maximum depth explored of 26 feet.

Please refer to the boring logs in Appendix A for a more complete description of the subsurface conditions. Cross Section A-A' in Appendix A is a graphic representation of the subsurface conditions found by the exploratory borings.

6.0 GEOLOGY

Geologic Setting

San Luis Obispo High School lies along the northeastern side of the Los Osos Valley, which is bounded to the northeast by the northwest-trending Santa Lucia Mountain Range and to the southwest by the northwest-trending Irish Hills. The proposed building area is on the north side of the campus, and it is relatively flat with a slight slope to the south/southwest. Locally, the school site area is bounded to the northeast by hillside terrain and to the southwest by San Luis Obispo Creek. The geologic map of the San Luis Obispo Quadrangle by Wiegers (2010) indicates

that the Annex/Classroom Building school site area is underlain by Holocene alluvial flood plain deposits (see the Geologic Map in Appendix D). Based on the results of our subsurface investigation and field observations, we concur with the Wiegers geologic map.

Faulting

Significant Faults

The San Andreas, Hosgri-San Simeon, and Los Osos Faults are the most significant regional *active* faults within a 65-mile radius of the school site, which could affect existing and proposed developments during their anticipated lifespan (see the Historical Earthquake/Fault Map in the Appendix D). The closest *active* fault to the site is the Irish Hills segment of the Los Osos Fault, located approximately 3.35 miles southwest. The closest mapped fault to the site (regardless of activity) is the Late Quaternary age Cambria Fault; it is located approximately 1 mile northeast (see the Historical Earthquake/Fault Map in the Appendix D). Brief descriptions of these faults are presented in the following sections. Regional faults and locations of historic earthquake events are also depicted on the Historical Earthquake/Fault Map in Appendix D.

Cambria Fault

The Cambria Fault is the closest mapped fault (regardless of activity) to the site; it is located approximately 1 mile northeast. The southern end of the Cambria fault could be considered part of the Oceanic fault group where the faults nearly join east of Cal Poly State University in San Luis Obispo. In some areas along the fault, it can be distinguished by the line of serpentine rock ridges that it bounds. Splays of the Cambria fault break late Pliocene (2 million years old) strata east of Cambria, but there is no known offset of Holocene (11,000 years old) age sediments by the system (Chipping, 1987). Weber (1983) noted that 120,000-year old marine terrace deposits north of Cayucos, near Ellysly Creek, may have been offset by the Cambria fault. However, to our knowledge, Weber's observation has never been confirmed by field exploration.

San Andreas Fault

The San Andreas Fault, considered to be the most active fault in the general region, lies 23 miles to the east of the site. The San Andreas Fault undergoes a major change in character between Parkfield and Cholame. North of Cholame, the fault moves more or less constantly in a process called creep, whereas the south end of the fault is locked, moving only in very large earthquakes. The last major quake on this part of the fault was the 1857 event (magnitude 7.9). In the immediate vicinity of Parkfield, there is a 20-mile segment that is also locked, generating an earthquake every 20 years or so on average. Dated quakes on this segment are 1881, 1901, 1922, 1934, and 1966, and are usually in the magnitude 5.5 to 6.0 range, (Bakun 1988). A 6.0 magnitude earthquake occurred on this fault segment on September 28, 2004.

Los Osos Fault

The Los Osos Fault, at its closest point to the site, is approximately 3 miles to the southwest. It consists of four distinct segments. From northwest to southeast, these are the Estero Bay, the Irish Hills, the Lopez Reservoir, and the Newsome Ridge segments. PG&E (1988) suggests that the Irish Hills segment displays the best expressed geomorphic features, displacing late Pleistocene and Holocene deposits. The Irish Hills segment starts in the vicinity of Los Osos and extends to just past San Luis Obispo Creek. A two-mile long segment west of Laguna Lake is considered to be active (Treiman 1989) and is zoned as a State Earthquake Fault Zone under the Alquist-Priolo Act (Hart 1997). This active segment lies about 3.35 miles to the southwest of the site and is the closest active fault to the site. The Los Osos Fault comprises a northwest-trending series of high- and low-angle faults that exhibit a complex history of both strike-slip and reverse displacement. However, during the late Quaternary, movement appears to have been primarily reverse displacement (PG&E 1998).

Hosgri-San Simeon Fault System

The Hosgri-San Simeon Fault System lies approximately 25 miles to the west of the site. A northwest-trending strike-slip fault, the San Simeon Fault extends from offshore of Ragged Point to just offshore of San Simeon Point, where it joins the northern end of the Hosgri Fault. From this point, the Hosgri Fault extends to an ocean shelf 2 miles west of Point Buchon, and then trends toward the Point Sal area. The fault system is considered active by the 2004 United States Geologic Survey (Jennings and Bryant 2010), based on Hall's claims of recent offset terrace deposits along San Simeon Cove, and also by a relocation of the 1927 "Lompoc Earthquake" onto the southern end of the Hosgri Fault (Hall 1975, 1976, 1977).

On December 22, 2003, a 6.5-magnitude earthquake occurred approximately 6 miles northeast of San Simeon, California and approximately 28 miles north of the subject site. Analysis by the USGS and the University of California at Berkeley indicates that the event had a thrust (reverse-faulting) mechanism (Goel 2004). The earthquake occurred in the vicinity of the northern end of the Hosgri-San Simeon Fault.

Groundwater

Soil and bedrock moisture contents encountered during drilling were generally slightly moist to very moist. Groundwater was not encountered in any of the borings to the maximum depth explored of 26 feet.

7.0 SEISMICITY

Earthquake History

The historic seismicity in the site's region was researched using EQSEARCH (Blake, updated December 2012) and the Boore and others (1997) method of analysis for Site Class "D", stiff soil sites (ASCE 2010) that is incorporated within that program. EQSEARCH performs automated searches of a custom catalog of historical Central California earthquakes. As the program searches the catalog, it computes the epicentral distance from the selected site to each of the earthquakes within the specified search area. The epicentral distances should be considered estimates, particularly for earthquake data prior to 1932, when modern instruments were first used to record earthquake data.

The parameters used for the search consisted of earthquake Richter magnitudes ranging from 5.0 to 9.0 that occurred within a 65-mile radius from the site from 1800 to December 2012. The site coordinates used in this search were latitude 35.2836N and longitude 120.6501W. The Historical Earthquake/Fault Map presented in Appendix D graphically depicts the results of the search, including historical earthquake epicenters, their corresponding magnitudes, and faults within the general region of the project.

Results of the search indicated that within the search parameters, 44 earthquakes have occurred. The highest peak horizontal ground acceleration (PGA) estimated to have occurred at the site from those historical earthquakes is 0.33g. This earthquake had a 5.9 magnitude, occurred in 1906, and was located approximately 3 miles northwest of the site. This earthquake may have occurred along the Los Osos Fault. The largest magnitude earthquake that the search revealed was 7.9. This earthquake was located approximately 48 miles east of the site, and is known as the 1857 earthquake on the San Andreas Fault. It produced an estimated PGA of 0.15g at the site.

Design Acceleration Parameters

In accordance with California Geologic Survey, Note 48 (October 2013), Item 16, an assessment was made to determine if there was a need to employ "Site Specific Ground Motion Procedures" for this site. Based on a review of the San Luis Obispo County Planning Department Permit View web site (2015), a determination was made that the site is not located in a Geologic Study Area, an Alquist-Priolo Earthquake Fault Zone, or a High Liquefaction Hazard Zone. In addition, the S_1 ground motion value obtained from the United States Geological Survey Earthquake Hazards Program website (USGS 2016) and the 2010 ASCE 7 Standard Analysis Method, for Site Class "D" (stiff soil sites), was below 0.75g (see table below). Therefore, the project does not require a site-specific ground motion analysis.

The site is in a region of generally high seismicity and has the potential to experience strong ground shaking from earthquakes on regional or local causative faults. To characterize the seismicity at the site and to provide seismic design parameters for the architect/engineer, a General Procedure Ground Motion Analysis was performed to calculate the deterministic ground motions at the site. The ground motions are based on the 2013 California Building Code General Procedure that were obtained from the United States Geological Survey Earthquake Hazards Program website (USGS 2016) and the 2010 ASCE 7 Standard Analysis Method, for Site Class "D" (stiff soil sites). The results of this analysis are presented in the following table:

SUMMARY OF DESIGN RESPONSE ACCELERATION PARAMETERS

Mapped Acceleration Values for Site Class "B"		**2013 CBC Site Coefficients and General Procedure Adjusted MCE Spectral Response Acceleration Parameters For Site Class "D"**					
Seismic Parameters	Values (g)	Site Coefficients	Values	Seismic Parameters	Values (g)	Seismic Parameters	Values (g)
S_S	1.137	F_a	1.045	S_{MS}	1.188	S_{DS}	0.792
S_1	0.434	F_v	1.566	S_{M1}	0.680	S_{D1}	0.453
Peak Mean Ground Acceleration (PGA_m): 0.475 g							
Seismic Design Category = D							

Seismic Design Category

Section 1613A.3.5 of the 2013 CBC indicates that sites will be assigned to Category D unless $S_1 \geq 0.75$. The S_1 calculated for the site is 0.434g; therefore, the site would be assigned to Category D.

8.0 GEOLOGIC HAZARDS

Surface Ground Rupture

Surface ground rupture generally occurs at sites that are traversed by, or lie very near to, a causative fault. The site is not located within a State Earthquake Fault Zone, and there are no mapped faults crossing or adjacent to the site. The closest mapped active fault to the site is the Irish Hills segment of the Los Osos Fault, located approximately 3.35 miles southwest of the site. Therefore, the potential for surface ground rupture to occur at the site is very low.

Liquefaction

The term liquefaction refers to the liquefied condition and subsequent softening that can occur in soils when they are subjected to cyclic strains, such as those generated during a seismic event. Previous studied have concluded that liquefaction within the upper 50 feet of soil can potentially affect improvements at the ground surface. Due to the relatively shallow depth to the bedrock, the stiff to very stiff alluvial clay soils above the bedrock, and the absence of groundwater to the maximum depth explored of 26 feet, the potential for liquefaction to occur is considered to be nil.

Seismically Induced Settlement

Seismically induced settlement of sufficient magnitude to cause structural damage is normally associated with poorly consolidated, predominantly sandy soils, or variable consolidation characteristics within the building areas. Due to the relatively shallow depth to the bedrock and the presence of stiff to very stiff alluvial clay soils, the potential for seismically induced settlement to occur at the site is considered to be nil.

Slope Stability

The Annex/Classroom site lies within a generally flat area with no significant slopes on or adjacent to it; therefore, there is no potential for gross slope instability or landsliding to impact the project site.

Flooding

According to the Flood Insurance Rate Map Number 06079C1067G (FEMA November 16, 2012), the Annex/Classroom Building site is not located within a 100-year flood zone, or within Flood Zone X (See the FEMA Flood Zone Map in Appendix D). Flood Zone X indicates areas that have been determined to have less than a 0.2 percent chance of being flooded in any given year.

Naturally Occurring Asbestos

Asbestos bearing rock units within the central coast area generally consist of serpentinite, ultra-mafic rock units consisting of olivine-hornblende and some schist metamorphic rock units. Based on our research and review of the borings logs, the project site is predominately underlain by a thick deposit of clayey soil alluvium, followed by sandstone and claystone bedrock of the Franciscan Mélange, which ranged in depth from 7.5 to 23.5 feet. These geologic units are not asbestos bearing, therefore, the potential for naturally occurring asbestos to occur on the site is considered to be nil.

Radon

Radon is a colorless, odorless gas present in soil and rock, which is derived from the decay of uranium. The occurrence of radon correlates with the presence of specific minerals, and its concentrations in soil or rock will vary depending on the mineralogy of the surrounding bedrock, temperature, barometric pressure, moisture and other factors. Prolonged exposure to elevated levels of radon is associated with an increased risk of lung cancer.

According to Special Report 208, by the California Geological Survey (Churchill 2008) radon is most commonly found in areas of San Luis Obispo County that are underlain by bedrock of the Monterey formation. The site is underlain by alluvial soils and bedrock of the Franciscan Melange. The report (Churchill 2008) shows that the project site is in an area of low radon potential for San Luis Obispo County.

9.0 CONCLUSIONS

Geology

It is our opinion that there are no significant local or regional geologic conditions that would preclude construction of the Annex/Classroom Building and site improvements as described in the "Introduction" section of this report.

Site Geology

The Annex/Classroom Building site area lies on relatively flat terrain that is bounded to the northeast by hillside terrain and to the southwest by San Luis Obispo Creek. The site area is underlain by Holocene alluvial flood plain deposits and bedrock of the Franciscan Melange.

Groundwater

Soil and bedrock moisture contents encountered during drilling were generally slightly moist to very moist. Groundwater was not encountered in any of the borings, to the maximum depth explored of 26 feet.

Slope Stability

There are no significant slopes on or adjacent to the Annex/Classroom Building site area; therefore, there is no potential for gross slope instability or landsliding to impact the project.

Seismicity

The site is located within the seismically active southern California area, and moderate to severe ground shaking can be expected during the life of the proposed structure. The largest historical mean peak horizontal acceleration estimated to have occurred in the vicinity of the site was 0.33g.

Surface Ground Rupture

The site is not located in a State Earthquake Fault Zone and there are no mapped faults crossing the site. The closest mapped active fault to the site is the Irish Hills segment of the Los Osos Fault, approximately 3.35 miles southwest. Therefore, the potential for surface fault rupture to occur at the site is considered to be very low.

Liquefaction, Seismically Induced Settlement, and Naturally Occurring Asbestos

As the site is underlain by stiff to very stiff condition of the clayey alluvial and relatively shallow bedrock of the Franciscan Mélange, the potentials for liquefaction and seismically-induced settlement to occur are considered to be nil. As the sandstone bedrock of the Franciscan Mélange is not an asbestos-bearing geologic unit, the potential for naturally occurring asbestos to occur on the site is also considered to be nil.

Flooding

The site is not within a 100-year flood zone, or Flood Zone X, which has been determined by FEMA (2012) to be areas that have less than a 0.20 percent chance of being flooded in any given year.

Radon

The site is underlain by clayey alluvial deposits and relatively shallow sandstone bedrock of the Franciscan Mélange, therefore the potential for radon to affect the project is low.

Geotechnical Engineering

In our opinion, the site is suitable, from a geotechnical engineering standpoint, for the proposed Annex/Classroom Building and site improvements, as described in the "Introduction" section of this report, provided the recommendations contained herein are implemented in the design and construction. The primary geotechnical engineering concerns are the potential for differential settlement from the existing fill and the potential disturbance at depth due to removal of the existing structure, the expansion potential of the upper soils, and the erodible nature and corrosive potential of the soils. Provided that the building area is prepared as recommended in the "Grading" section of this report, conventional continuous and spread (pad) foundations may be used to support the proposed structure.

Differential settlement can occur when a foundation spans materials having variable consolidation characteristics, such as the fill that was found in the upper 4 feet of Boring 1. We are unaware of any documentation (i.e., grading observation or compaction testing records) regarding the placement of the fill, but it was likely placed when the existing Annex/Cafeteria Building was constructed. Undocumented fill has a greater potential for variability than fill that has been placed and tested in a controlled earthwork program. Removal of the existing structure is also anticipated to disturb the soil to variable depths. Such conditions (i.e., undocumented fill and disturbed soil) could stress and possibly damage foundations, often resulting in severe cracks and displacement if they are not mitigated. Therefore, to reduce this potential for differential settlement, a program of overexcavation and recompaction of the soil in the building area is recommended prior to construction.

Expansion index testing yielded results of 54 and 58 for the upper fill and alluvial soils. Per CBC Section 1803A.5.3, the soils are considered to be expansive. The more commonly used ASTM classification is that the soils would be considered to have a "medium" expansion potential. Expansive soils tend to swell with increases in soil moisture and shrink as soil moisture decreases; the upper 3 to 5 feet of any soil profile is the zone most affected by these seasonal soil moisture fluctuations. The volume changes that the soils undergo in this cyclical pattern can stress and damage foundations and slabs-on-grade if precautionary measures are not incorporated during design and in the construction procedure. Footings are typically deepened and additional reinforcement is provided. Imported nonexpansive soils are recommended to be placed beneath slabs-on-grade.

The soils above the bedrock are considered to be erodible. It is essential that all surface drainage be controlled and directed to appropriate discharge points, and that surface soils, particularly those disturbed during construction, are stabilized by vegetation or other means *during and following construction*.

As indicated in the Soil Corrosivity Study by HDR, Inc., in Appendix C, the electrical resistivities of the samples tested were in the moderately corrosive categories with as received moisture contents; when saturated, the resistivities were in the corrosive to severely corrosive categories. Soil pH values were mildly alkaline. The soluble salt contents of the soils were low to moderate. Soil nitrate concentrations were high. The soils were classified as severely corrosive to ferrous metals and aggressive to copper. Please refer to the Soil Corrosivity Study in Appendix C for a complete summary of the test results, and recommendations for mitigation.

10.0 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

The following recommendations are for improvements constructed as described in the "Introduction" section of this report. If locations, elevations, structural loads, etc., change, the recommendations contained herein may require modification. In developing the following recommendations, it was assumed that irrigated landscaping or flatwork that would keep the soils relatively uniform, year-round moisture will be installed for a zone of at least five feet around the perimeter of all improvements.

Two distinct types of Portland cement concrete (PCC) slabs-on-grade are discussed in the following recommendations. The building's interior slabs are defined as "slabs-on-grade." Sidewalks that will not support vehicle traffic are referred to as "exterior pedestrian flatwork." Asphalt concrete (AC) paths may also be utilized for pedestrian access, however it is also assumed that they will not support vehicle traffic.

Unless otherwise noted, the following definitions are used in the recommendations presented below. Where terms are not defined, definitions commonly used in the construction industry are intended.

- **Building Area –** The building area is defined as the area within and extending a minimum of 5 feet beyond the perimeter of the foundations for the Annex/Classroom Building. The building area includes any retaining walls, covered walkways or other improvements that are connected to the structure and that are intended to act in a manner similar to it.
- **Exterior Pedestrian Flatwork and Asphalt Concrete (AC) Path Areas –** The areas within the footprints of all exterior pedestrian flatwork and all AC paths.
- **Sitework Retaining Wall Areas –** The areas within and extending a minimum of 3 feet beyond the foundation limits of all sitework retaining walls.
- **Grading Area –** The entire area to be graded, including the building area, exterior pedestrian flatwork and AC path areas, and sitework retaining wall areas.
- **Existing Grade:** Elevations of the site that existed as of the date of this report.
- **Finish Pad Grade:** The elevation in the building area where earthwork operations are typically considered to be complete. It does not include any sand or gravel that might be placed below slabs-on-grade in association with vapor protection for the slabs.
- **Subgrade:** The elevation in exterior pedestrian flatwork and AC path areas where imported nonexpansive materials, sand, or aggregate base (AB) are placed to support the flatwork or AC path.

- **Scarified:** Plowed or ripped in two orthogonal directions to a depth of not less than 8 inches.
- **Moisture Conditioned:** Adjusting the soil moisture to optimum moisture content, or just above, prior to application of compactive effort.
- **Compacted/Recompacted:** Soils placed in level lifts not exceeding 8 inches in loose thickness and compacted to a minimum of 90 percent of maximum dry density. Based on maximum dry density by ASTM D 1557-12 and field density by ASTM D 6938-15, or other methods acceptable to the geotechnical engineer and jurisdiction.

Site Preparation

1. The ground surface in the grading areas should be prepared for construction by removing the existing building, existing flatwork, and all other improvements, vegetation, large roots, debris, organic topsoil, and other deleterious materials. Existing utility lines that will not remain in service should be either removed or abandoned. The appropriate method of abandonment will depend upon the type and depth of the utility. Recommendations for abandonment can be made as necessary.

2. Voids created by the removal of materials or utilities described above should be called to the attention of the geotechnical engineer. No fill should be placed unless the underlying soil has been observed by the geotechnical engineer.

Grading

1. Following site preparation, all existing fill in the building area should be removed to a level plane at the deepest point of the fill. For planning purposes, the deepest point of the fill encountered during the field exploration program was 4 feet below existing grade at Boring 1. The exact depth of fill should be determined by the geotechnical engineer at the time of construction. The resulting level excavated surface should be scarified, moisture conditioned and compacted.

2. To create as uniform conditions as possible for the structure, all earthwork operations should be completed throughout the entire building area in a uniform manner at the same time, from the bottom of the overexcavation recommended in the previous paragraph through fill placement to finish grade. Earthwork operations that complete only a portion of the building area at one time (i.e., “flip-flopping”, “checkerboarding”, etc.) should not be allowed.

3. Following site preparation, all existing fill in sitework retaining wall areas should be overexcavated to the deepest point of the fill. The resulting excavated surfaces should be scarified, moisture conditioned and compacted. Overexcavation elevations may be stepped where the fill depth changes or where retaining walls are stepped to conform to any site contours. If very stiff sandy lean clay alluvium is exposed at bottom of foundation elevation, no overexcavation and recompaction is considered necessary. To reduce the potential for cracking in sitework retaining walls, construction joints should be placed in the wall and the foundation where overexcavation operation have been stepped to conform to fill depth changes or to exposure of very stiff alluvium. Unlike the recommended earthwork program for the building area, overexcavation and recompaction operations for sitework retaining walls can proceed in a non-uniform manner for individual wall segments.

4. Following site preparation and any excavations to grade, or prior to placement of fill, the soil in any exterior pedestrian flatwork and AC path areas, and in all other grading areas, should be scarified, moisture conditioned and recompacted. Unlike the recommended earthwork program for the building area, scarification and recompaction operations for exterior pedestrian flatwork and AC path areas, and in all other grading areas, can proceed in a non-uniform manner.

5. Voids created by dislodging cobbles and/or debris during scarification should be backfilled and recompacted, and the dislodged materials should be removed from the work area.

6. Previously removed site soils and other similar soils may be placed as fill beyond the building area, and in the building area to a maximum height of 18 inches below bottom of slab elevation. The final 18 inches of fill below bottom of slab elevation in the building area should be nonexpansive.

7. Nonexpansive materials are defined as imported soils that fall in the GW, GM, GC, SP, SW, SC and SM categories per ASTM D 2487-11, and that have an expansion index of 10 or less (ASTM D 4829-11). The clean sand layer described in the “Slabs-on-Grade” section of this report (if utilized below interior slabs-on-grade or exterior pedestrian flatwork) is considered to be part of the minimum recommended thickness of nonexpansive material utilized, not in addition to it.

8. Imported soils used in the building area should have strength and expansion qualities equal to or better than the site soils, and they should not exceed the geotechnical corrosivity potential of the site soils. See the Soil Corrosivity Study in Appendix C for the corrosivity parameters of the site soils. Proposed imported materials should be reviewed by the geotechnical engineer before being brought to the site, and on an intermittent basis during placement.

9. All materials used as fill should be cleaned of any debris and rocks larger than 3 inches in diameter. When fill material includes rocks, the rocks should be placed in a sufficient soil matrix to ensure that voids caused by nesting of the rocks will not occur and that the fill can be properly compacted.

10. All AB and the top 12 inches of subgrade in areas to support AC paths should be compacted to a minimum of 95 percent of maximum dry density. Imported nonexpansive materials, sand or AB used to support exterior pedestrian flatwork, as well as the top 12 inches of subgrade in these areas, need only be compacted to a minimum of 90 percent of maximum dry density.

11. If the soils are overly moist so that they become unstable, or if the minimum recommended compaction cannot be readily achieved, drying the soil so that it is nearer optimum moisture content, may be necessary. Placement of gravel layers or geotextiles may also be necessary to help stabilize unstable soils. Additional overexcavation may also be recommended to correct unstable conditions or if soft or loose conditions are encountered during grading. No fill should be placed in any grading area if the underlying soil is unstable.

12. The recommended soil moisture content should be maintained throughout construction, and during the lives of the structure and sitework improvements. Failure to maintain the soil moisture content can result in desiccation cracks and disturbance, which are an indication of degradation of the soil compaction. If desiccation cracks are allowed to develop, or if soils near improvements such as foundations, flatwork, etc. are otherwise disturbed, damage to those improvements may result. Soils that have cracked or are otherwise disturbed should be removed, moisture conditioned, and recompacted.

Utility Trenches

1. Utility trenches adjacent to foundations should not be excavated within the zone of foundation influence, as shown in Typical Detail A in Appendix E.

2. Utilities that must pass beneath foundations should be placed with properly compacted utility trench backfill and the foundation should be designed to span the trench.

3. A select, noncorrosive, granular, easily compacted material should be used as bedding and shading immediately around utilities. The site soil may be used for trench backfill above the select material beyond the building area, and to within 18 inches below bottom of slab elevation in the building area. Within the building area, imported nonexpansive soils should be utilized to backfill the final 18 inches below bottom of slab elevation of all trenches. In exterior pedestrian flatwork and AC path areas, trench backfill should match the thickness of imported nonexpansive soils, sand or AB used to support these improvements.

4. In general, trench backfill should be compacted to a minimum of 90 percent of maximum dry density. Trench backfill in the upper 12 inches of subgrade and all AB in AC path areas should be compacted to a minimum of 95 percent of maximum dry density. A minimum of 85 percent of maximum dry density will generally be sufficient where trench backfill is located in landscaped or other unimproved areas, where settlement of trench backfill would not be detrimental.

5. Prior to applying compactive effort, soils should be moisture conditioned. Trench backfill should be placed in level lifts not exceeding 6 inches in loose thickness and compacted to the minimums recommended above.

6. Compaction of trench backfill by jetting or flooding is not recommended at this site due to the expansive soils. However, to aid in *encasing* utility conduits, particularly corrugated drain pipes, and multiple, closely-spaced conduits in a single trench with the bedding and shading material, jetting or flooding may be useful. Flooding or jetting should only be attempted with extreme caution, and any flooding or jetting operation should be subject to review by the geotechnical engineer.

7. Long-term settlement of properly compacted sand should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill. Where trenches are backfilled with site soils, the anticipated settlement would be about twice that of sand. Improvements that are constructed over or near trenches should be designed to accommodate the potential for settlement.

8. The Soil Corrosivity Study by HDR, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for utility improvements.

9. The recommendations of this section are minimums only, and may be superseded by the architect/engineer based upon soil corrosivity or the requirements of pipe manufacturers, utility companies or the governing jurisdiction.

Foundations

1. The Annex/Classroom Building may be supported by continuous and spread footings bearing in firm recompacted soils, as recommended in the "Grading" section of this report.

2. Based on soil expansion potential only, minimum overall foundations depths of 21 inches below lowest adjacent grade within 6 feet laterally of the base of foundations should be maintained. Spread footings should be at least 24 inches square.

3. Continuous footings should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential only, minimum continuous footing reinforcement should consist of two No. 4 rebars, one at the top and one at the bottom. Spread footings should be reinforced in accordance with the requirements of the architect/engineer.

4. Footings bearing in firm recompacted soil may be designed using maximum allowable bearing capacities of 2,500 psf dead load and 3,500 psf dead plus live loads. Using these criteria, maximum settlement and differential settlement are expected to be less than 1/2-inch and less than 3/8-inch in 25 feet, respectively.

5. Allowable bearing capacities may be increased by one-third when transient loads such as wind or seismicity are included. Foundations may be designed using the site design response parameters contained in the table on Page 8 in the "Seismicity" section of this report.

6. To calculate resistance to lateral loads, please see the values presented in the "Retaining Walls" section of this report. Lateral capacity is based on the assumption that any backfill adjacent to foundations has been properly compacted. Passive and friction components of resistance may be combined in the analysis without reduction to either value.

7. Footing excavations should be observed by the geotechnical engineer prior to placement of reinforcing steel. Footing excavations should be lightly moistened and no desiccation cracks should be present prior to concrete placement.

8. The Soil Corrosivity Study by HDR Engineering, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for all foundation elements.

Slabs-on-Grade

Interior Slabs-On-Grade

1. Interior slabs-on-grade should have a minimum thickness of 4 full inches. They should be reinforced and doweled to foundations per the specifications of the architect/engineer. At a minimum, interior slabs should be reinforced with No. 3 rebar at 24 inches on center each way. All structural slabs should contain minimum rebar meeting the criteria of ACI 318, Section 7.12.2 (ACI 2011). At a minimum, foundation dowels should be lap spliced to the slab rebar. The size and spacing of the dowels should match the size and spacing of the slab rebar.

Exterior Pedestrian Flatwork

1. Exterior pedestrian flatwork should have a minimum thickness of 4 full inches. Minimum reinforcement for exterior pedestrian flatwork placed over at least 18 inches of nonexpansive imported soils per the following paragraph should consist of No. 3 rebar placed at 24 inches on-center each way. If the thickness of nonexpansive soil below the flatwork is less than 18 inches, the minimum reinforcement should consist of No. 3 rebar at 18 inches on-center each way.

2. In conventional construction, it is common to use 4 to 6 inches of sand beneath exterior pedestrian flatwork. However, due to the medium expansion potential of the site soils, there will be a risk of movement and damage to the flatwork if conventional measures are used. Heaving and cracking could occur. This movement could be reduced by the placement of additional nonexpansive material beneath the flatwork. If it is desired to fully mitigate the expansive soil conditions, then at least 18 inches of imported nonexpansive material should be provided below the flatwork where the expansive site soils are exposed at finish grade. If it is acceptable for the flatwork to experience movement due to expansive soils, then the thickness of the nonexpansive soil can be reduced. Under all flatwork, however, the thicker the nonexpansive layer, the better the expansive soil protection.

3. Another measure that can be taken to reduce the risk of movement of flatwork due to expansive soils is to provide thickened edges or grade beams around the perimeters of the flatwork. If it is desired to fully mitigate the expansive soil conditions, then the thickened edges or grade beams could be up to 21 inches deep. If it is acceptable for the flatwork to experience movement, then the thickened edges or grade beams can be reduced. At a minimum, any thickened edge or grade beam should be reinforced by two No. 4 rebar, one at the top and one at the bottom.

4. It is recognized that the measures discussed above for protecting exterior flatwork from expansive soils are expensive, possibly more expensive than simply replacing flatwork that has heaved and/or cracked. Consequently, the above measures for protecting exterior flatwork are only suggestions for consideration by the owner and/or architect/engineer. The degree to which exterior flatwork is protected from expansive soil damage is left to the discretion of the owner and/or architect/engineer.

5. Flatwork should be constructed with frequent joints to allow articulation as the flatwork moves in response to seasonal soil temperature and moisture variations. The expansive soil underlying any nonexpansive material placed below flatwork should be moisture conditioned, and no desiccation cracks should be present, prior to casting the flatwork.

6. Flatwork at doorways, and at other areas where maintaining the elevation of the flatwork is desired when mitigating expansive soil potential, should be doweled to the perimeter foundation, at a minimum, by No. 3 dowels lapped to the flatwork rebar at 24 inches on center. In other areas, the flatwork may be doweled to the foundation or the flatwork may be allowed to "float free," at the discretion of the architect/engineer. Flatwork that is intended to float free should be separated from foundations by a felt joint or other means.

<u>Moisture Vapor Transmission</u>

1. Due to the current use of impermeable floor coverings, water-soluble flooring adhesives, and the speed at which buildings are now constructed, moisture vapor transmission through slabs is a much more common problem than in past years. Where moisture vapor transmitted from the underlying soil would be undesirable, slabs should be protected from subsurface moisture vapor. A number of options for vapor protection are discussed below; however, the means of vapor protection, including the type and thickness of the vapor retarder, if specified, are left to the discretion of the architect/engineer.

2. Where specified, vapor retarders should conform to ASTM Standard E 1745-11. This standard specifies properties for three performance classes; Class A, B and C. The appropriate class should be selected based on the sensitivity of floor coverings to moisture intrusion and the potential for damage to the vapor retarder during placement of slab reinforcement and concrete.

3. Several recent studies, including those of American Concrete Institute Committee 302 (ACI 2004), have concluded that excess water above the vapor retarder increases the potential for moisture damage to floor coverings and could increase the potential for mold growth or other microbial contamination. The studies also concluded that it is preferable to eliminate the typical sand layer beneath the slab and place the slab concrete in direct contact with a Class A vapor retarder, particularly during wet weather construction. However, placing the concrete directly on the vapor retarder requires special attention to using the proper vapor retarder, a very low water-cement ratio in the concrete mix, and special finishing and curing techniques.

4. Probably the next most effective option would be the use of vapor-inhibiting admixtures in the slab concrete mix and/or application of a sealer to the surface of the slab. This would also require special concrete mixes and placement procedures, depending upon the recommendations of the admixture or sealer manufacturer.

5. Another option that may be a reasonable compromise between effectiveness and cost considerations is the use of a subslab vapor retarder protected by a sand layer. If a Class A vapor retarder is specified, the retarder can be placed directly on the nonexpansive soil. The retarder should be covered with a minimum 2 inches of *clean* sand. If a less durable vapor retarder is specified (Class B or C), a minimum of 4 inches of clean sand should be provided, and the retarder should be placed in the center of the clean sand layer. Clean sand is defined as a well or poorly graded sand (ASTM D 2487-11) of which less than 3 percent passes the No. 200 sieve. The clean sand layer, if used, is considered to be a part of the minimum 18-inch thickness of nonexpansive imported materials recommended in the "Grading" section of this report to be placed below slabs-on-grade, not in addition to it.

6. Regardless of the underslab vapor retarder selected, proper installation of the retarder per ASTM E 1643-11 is critical for optimum performance. Where utilized, the vapor retarder should be placed a minimum of 1 inch above the flow line of the drainage path

surrounding the structures, or 1 inch above the area drain grates if area drains are used to collect runoff around the structures. All seams must be properly lapped, and all seams and utility penetrations properly sealed in accordance with the vapor retarder manufacturer's recommendations.

7. If the sand is used between the vapor retarder and the slab, it should be moistened only as necessary to promote concrete curing; saturation of the sand should be avoided, as the excess moisture would be on top of the vapor retarder, potentially resulting in vapor transmission through the slab for months or years.

8. The architect/engineer should designate any special measures to be used in conjunction with moisture vapor transmission protection, if needed, to mitigate the high potential for indoor radon levels.

9. Positive drainage away from the building should be maintained; see the "Drainage and Maintenance" section of this report for additional discussion of this issue. If water is allowed to pond near the structure, it may seep into the ground and migrate laterally through cracks or utility penetrations in the foundation, ultimately gaining access above the vapor retarder.

Slabs-on-Grade - General

1. To reduce shrinkage cracks in all interior and exterior slabs-on-grade, the concrete aggregates should be of appropriate size and proportion, the water/cement ratio should be low, the concrete should be properly placed and finished, contraction joints should be installed, and the concrete should be properly cured. This is particularly applicable to slabs that will be cast directly upon a vapor retarder and those that will be protected from transmission of vapor by use of admixtures or surface sealers. Concrete materials, placement, and curing specifications should be at the direction of the architect/engineer; AC 302.1R-04 (ACI 2004) is suggested as a resource for the architect/engineer in preparing such specification.

2. To provide stability for curbs adjacent to exterior pedestrian flatwork, they should be set back a minimum distance equal to one-third the height of any adjacent descending slope, but not less than 5 feet from the tops of slopes. Alternately, curbs may be deepened to provide stability. The geotechnical engineer should review, on an individual basis, any situation where curbs must be deepened to meet this recommendation.

3. The Soil Corrosivity Study by HDR, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for all slabs-on-grade.

Retaining Walls

1. Retaining walls connected to or forming part of the building should be founded in firm soil that has been recompacted per the "Grading" section of this report. Sitework retaining walls may be supported by either firm soil that has been recompacted per the "Grading" section of this report, or firm sandy lean clay alluvium. If a sitework retaining wall crosses a recompacted soil/firm alluvium transition, or a transition between varying fill overexcavation depths, a construction joint should be placed in the footing and wall at the transitions. Foundations for all retaining walls should have minimum overall depths (not including any keyway) of 21 inches below lowest grade within 6 feet laterally of any adjacent slope.

2. Retaining wall footings should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential only, minimum retaining wall footing reinforcement should consist of two No. 4 rebars, one at the top and one at the bottom.

3. Retaining wall design may be based on the following parameters:

Active equivalent fluid pressure (site soils)	45 pcf
Active equivalent fluid pressure (imported sand/gravel backfill)	35 pcf
At-rest equivalent fluid pressure (site soils)	60 pcf
At-rest equivalent fluid pressure (imported sand/gravel backfill)	50 pcf
Passive equivalent fluid pressure	350 pcf
Maximum toe pressure	3,500 psf
Coefficient of sliding friction	0.35

4. No surcharges are taken into consideration in the values presented in the previous paragraph. The maximum toe pressure is an *allowable* value; no factors of safety, load factors or other factors have been applied to the remaining values. With the exception of the maximum toe pressure, these values will require application of appropriate factors of safety, load factors, and/or other factors as deemed appropriate by the architect/engineer.

5. If the active or at-rest pressures presented in Paragraph 3 for *imported sand or gravel backfill* are utilized for design of retaining walls, the sand or gravel should be used exclusively as backfill above a 1:1 plane extended upward from the back of the wall footing to approximately 1 foot from the top of the wall backfill. The upper foot should be backfilled with native soil, except in areas where AC paths or exterior pedestrian flatwork will abut the top of the wall. In such cases, the gravel should extend to the imported nonexpansive material, sand, aggregate base, or other material below the improved surface, as appropriate.

6. The active and at-rest pressures presented in Paragraph 3 are applicable to a horizontal retained surface behind the wall. Walls having a retained surface that slopes upward from the wall should be designed for an additional equivalent fluid pressure of 1 pcf for the active case and 1.5 pcf for the at-rest case, for every degree of slope inclination.

7. It is assumed that retaining wall heights will not exceed 4 feet.

8. Section 1803A.5.12.1 of the 2013 CBC requires that dynamic seismic lateral earth pressures be provided by the geotechnical engineer for walls retaining more than 6 feet of backfill. As the walls for this project will not retain more than 6 feet, design for seismic lateral earth pressures is not required.

9. Long-term settlement of properly compacted sand or gravel retaining wall backfill should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill; long-term settlement of properly compacted site soil retaining wall backfill would be about twice that of sand or gravel backfill. Improvements that are constructed near the tops of retaining walls should be designed to accommodate long-term settlement.

10. All retaining walls should be drained with perforated pipe encased in a free-draining gravel blanket. The pipe should be placed perforations downward, and should discharge in a nonerosive manner away from foundations and other improvements. The gravel blanket should have a width of approximately 1 foot and should extend upward to approximately 1 foot from the top of the wall backfill. The upper foot should be backfilled with native soil, except in areas where AC paths or exterior pedestrian flatwork will abut the top of the wall. In such cases, the gravel should extend to the imported nonexpansive material, sand, aggregate base, or other material below the improved surface, as

appropriate. To reduce infiltration of the soil into the gravel, a permeable synthetic filter fabric conforming to Standard Specifications Section 88-1.02B – Class C (Caltrans 2010), should be placed between the two. Manufactured synthetic drains, such as Miradrain or Enkadrain are acceptable alternatives to the use of gravel, provided that they are installed in accordance with the recommendations of the manufacturer.

11. Where weep hole drainage can be properly discharged, the perforated pipe may be omitted in lieu of weep holes on maximum 4-foot centers. A filter fabric as described above should be placed between the weep holes and the drain gravel.

12. Walls facing areas where moisture transmission through the wall would be undesirable should be *thoroughly* waterproofed in accordance with the specifications of the architect/engineer.

13. The architect/engineer should bear in mind that retaining walls by their nature are flexible structures, and that surface treatments on walls often crack. Where walls are to be plastered or otherwise have a finish applied, the flexibility should be considered in determining the suitability of the surfacing material, spacing of horizontal and vertical control joints, etc. The flexibility should also be considered where a retaining wall will abut or be connected to a rigid structure, and where the geometry of the wall is such that its flexibility will vary along its length.

14. The Soil Corrosivity Study by HDR, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for all retaining walls.

Asphalt Concrete (AC) Paths

1. Paths for pedestrian access may be constructed of AC over AB. Design methods for AC pavement do not typically consider pedestrian loading only. Therefore, the section design is typically based on local experience and anticipated life span. For this application, a minimum pavement section of 1.5 to 2.0 inches of AC over 2 to 4 inches of AB is considered appropriate. As with exterior pedestrian flatwork these minimum thicknesses of AC and AB will be subject to movement due to expansive soils. If it is desired to filly mitigate the expansive soil conditions, the AB thickness can be increased to as much as 18 inches.

2. It is recognized that the increased AB thickness recommended above for protecting AC paths from expansive soils will be expensive, possibly more expensive than simply replacing AC paths that has heaved and/or cracked. Consequently, this measure for protecting AC paths is only a suggestion for consideration by the client and/or architect/engineer. The degree to which AC paths are protected from expansive soil damage is left to the discretion of the owner and/ or architect/engineer.

3. AB should conform to the requirements of Section 26 of the Standard Specifications (Caltrans 2010). AC should conform to the requirements of Section 32 of the Standard Specifications (Caltrans 2010).

4. The upper 12 inches of subgrade and all AB in pavement areas should be compacted to a minimum of 95 percent of maximum dry density. Subgrade and aggregate base should be firm and unyielding when proofrolled with heavy, rubber-tired grading equipment prior to continuing construction.

Drainage and Maintenance

1. Per Section 1804A.3 of the 2013 CBC, unpaved ground surfaces should be *finish graded* to direct surface runoff away from foundations and other improvements at a minimum 5 percent grade for a minimum distance of 10 feet. The site should be similarly sloped to drain away from foundation, and other improvements during construction. Where this is not practicable due to other improvements, etc., swales with improved surfaces, area drains, or other drainage facilities, should be used to collect and discharge runoff.

2. All eaves of the building should be fitted with roof gutters. Runoff from flatwork, roof gutters, downspouts, planter drains, area drains, etc. should discharge in a nonerosive manner away from foundations and other improvements in accordance with the requirements of the governing agencies. Erosion protection should be placed at all discharge points unless the discharge is to a pavement surface.

3. To reduce the potential for planter drainage gaining access to subslab areas, any raised planter boxes adjacent to foundations should be installed with drains and sealed sides and bottoms. Drains should also be provided for areas adjacent to the structure and in landscape areas that would not otherwise freely drain.

4. The on-site soils are erodible; stabilization of soils disturbed during construction by vegetation or other means *during* and *following* construction, is essential to reduce erosion damage. Care should be taken to establish and maintain vegetation. The landscaping should be planned and installed to maintain the surface drainage recommended above. Surface drainage should also be maintained during construction.

5. Maintenance of drainage and other improvements is critical to the long-term stability of the site and the integrity of the structures. Site improvements should be maintained on a regular basis.

6. All exterior drains, retaining wall drains, and drain outlets should be maintained to be free-flowing. Vegetation and erosion matting (if utilized) should be maintained or augmented as needed. Irrigation systems should be maintained so that soils around structures are maintained at a relatively uniform year-round moisture content, and are neither over-watered nor allowed to dry and desiccate.

7. To reduce the potential for disruption of drainage patterns and undermining of structures, fill areas, etc., all rodent activity should be aggressively controlled.

Observation and Testing

1. It must be recognized that the recommendations contained in this report are based on a limited number of borings and rely on continuity of the subsurface conditions encountered.

2. It is assumed that the geotechnical engineer will be retained to provide consultation during the design phase, to interpret this report during construction, and to provide construction monitoring in the form of testing and observation.

3. At a minimum, the geotechnical engineer should be retained to provide:
    - Professional observation during grading, trench and retaining wall backfill, and foundation construction
    - Oversight of special inspection and compaction testing grading, trench and retaining wall backfill, and foundation construction

4. Special inspection of grading and backfill should be provided as per Section 1705A.6 and Table 1705A.6 of the CBC. The special inspector should be under the direction of the geotechnical engineer. At a minimum, the following items should be inspected and/or tested by the special inspector:
    - Stripping and clearing of all existing improvements, vegetation, and deleterious materials
    - Overexcavation of the building and sitework retaining wall areas to the recommended depths
    - Scarification and moisture conditioning of overexcavated areas
    - Scarification and moisture conditioning of exterior pedestrian flatwork, AC path and all other grading areas
    - Fill quality, placement, moisture conditioning and compaction
    - Utility trench backfill
    - Foundation excavations

5. A program of quality assurance should be developed prior to beginning construction. At a minimum, the program should include all geotechnical items shown on the testing and inspection schedule of the approved plans. It should also include any additional inspection items required by the engineer and/or the governing jurisdiction. These items should be discussed at a preconstruction site meeting among a representative of the owner, the geotechnical engineer, special inspector, the project inspector, the engineer, and contractors. The geotechnical engineer should be notified at least 48 hours prior to beginning grading operations.

6. Locations and frequency of compaction tests should be as per the recommendation of the geotechnical engineer at the time of construction. The recommended test location and frequency may be subject to modification by the geotechnical engineer, based upon soil and moisture conditions encountered, size and type of equipment used by the contractor, the general trend of the results of compaction tests, or other factors.

11.0 CLOSURE

Our intent was to perform the investigation in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the locality of this project under similar conditions. No representation, warranty, or guarantee is either expressed or implied. This report is intended for the exclusive use by the client as discussed in the “Scope of Services” section. Application beyond the stated intent is strictly at the user's risk.

This report is valid for conditions as they exist at this time for the type of project described herein. The conclusions and recommendations contained in this report could be rendered invalid, either in whole or in part, due to changes in building codes, regulations, standards of geotechnical or construction practice, changes in physical conditions, or the broadening of knowledge.

If changes with respect to the project become necessary, if items not addressed in this report are incorporated into plans, or if any of the assumptions used in the preparation of this report are not correct, this firm shall be notified for modifications to this report. Any items not specifically addressed in this report should comply with the CBC of other applicable standards, and the requirements of the governing jurisdiction.

The preliminary recommendations presented in this geotechnical report are based upon the geotechnical conditions encountered at the site, and may be augmented by additional requirements of the client, or by additional recommendations provided by the geotechnical engineer based on peer or jurisdiction reviews, or conditions exposed at the time of construction.

This document, the data, conclusions, and recommendations contained herein are the property of Earth Systems Pacific. This report shall be used in its entirety, with no individual sections reproduced or used out of context. Copies may be made only by Earth Systems Pacific, the client, and the client's authorized agents for use exclusively on the subject project. Any other use is subject to federal copyright laws and the written approval of Earth Systems Pacific.

Thank you for this opportunity to have been of service. If you have any questions, please feel free to contact this office at your convenience.

End of Text.

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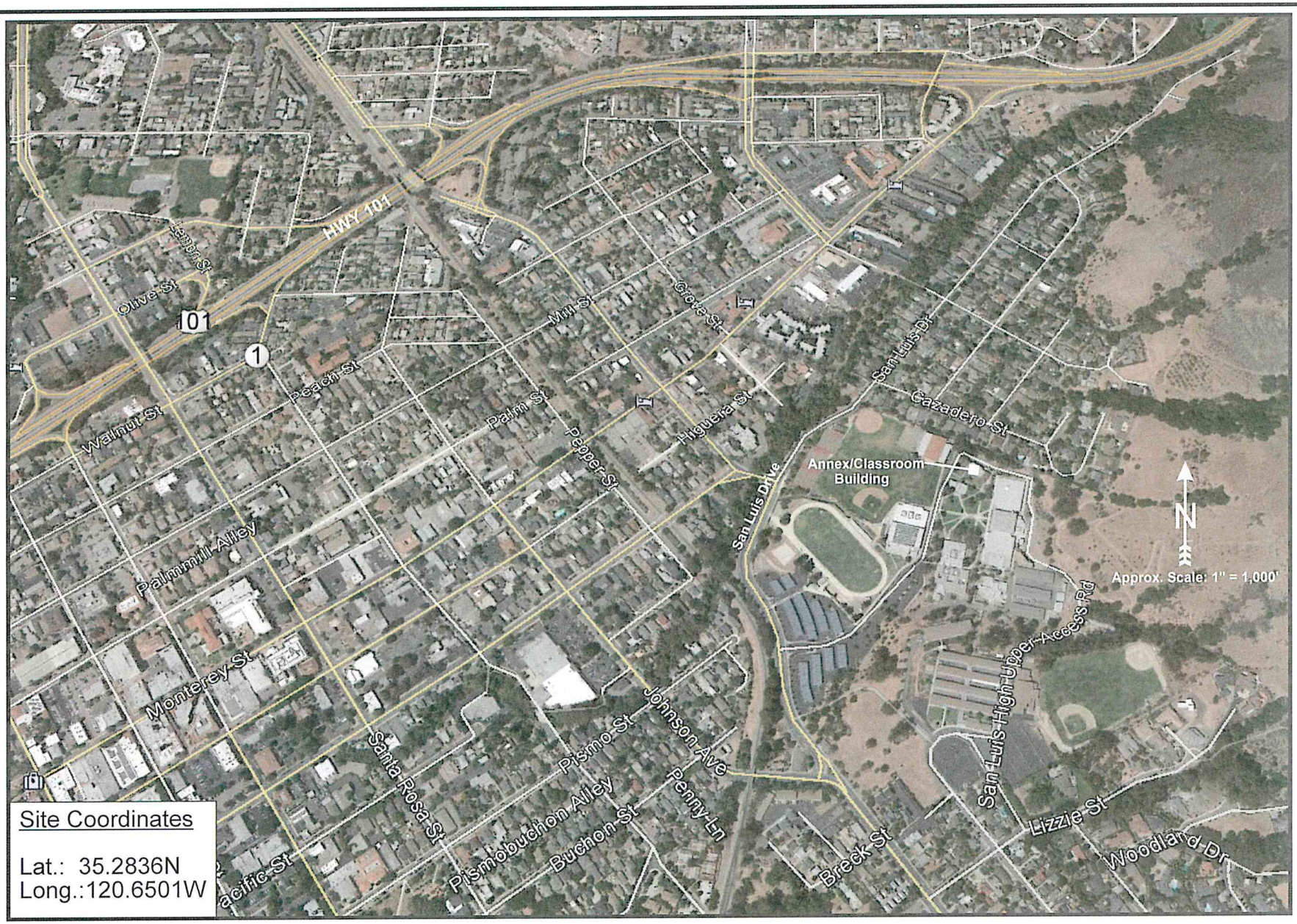
APPENDIX A

Vicinity Map
Boring Location Map
Boring Log Legend
Boring Logs
Cross Section A-A'



Reference: extract from Google Earth 2015

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VICINITY MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

Date
January 2016

Project No.
SL-16605-SE



LEGEND

3 Boring Location (Approx.)

A A' Cross Section (Approx.)

NOT TO SCALE

BORING LOCATION MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

Earth Systems Pacific
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E-mail: esp@earthsystems.com

December 9, 2015 CS SL-16605-SE

SLO HS MEASURE D POOL ANNEX CLASSROOM BLDG-1816BLOCATIONS

Earth Systems Pacific

BORING LOG LEGEND

SAMPLE / SUBSURFACE WATER SYMBOLS	GRAPH. SYMBOL
CALIFORNIA MODIFIED	
STANDARD PENETRATION TEST (SPT)	
SHELBY TUBE	
BULK	
SUBSURFACE WATER DURING DRILLING	
SUBSURFACE WATER AFTER DRILLING	

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

MAJOR DIVISIONS	GROUP SYMBOL	TYPICAL DESCRIPTIONS	GRAPH. SYMBOL
COARSE GRAINED SOILS (MORE THAN HALF OF MATERIAL IS LARGER THAN #200 SIEVE SIZE)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GP	POORLY GRADED GRAVELS, OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, NON-PLASTIC FINES	
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, PLASTIC FINES	
	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
	SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES	
	SM	SILTY SANDS, SAND-SILT MIXTURES, NON-PLASTIC FINES	
	SC	CLAYEY SANDS, SAND-CLAY MIXTURES, PLASTIC FINES	
FINE GRAINED SOILS (HALF OR MORE OF MATERIAL IS SMALLER THAN #200 SIEVE SIZE)	ML	INORGANIC SILTS AND VERY FINE SANDS, 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	
	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS	
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	

OBSERVED MOISTURE CONDITION

DRY	SLIGHTLY MOIST	MOIST	VERY MOIST	WET (SATURATED)

CONSISTENCY

COARSE GRAINED SOILS

BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER	
0-10	0-16	LOOSE
11-30	17-50	MEDIUM DENSE
31-50	51-83	DENSE
OVER 50	OVER 83	VERY DENSE

FINE GRAINED SOILS

BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER	
0-2	0-3	VERY SOFT
3-4	4-7	SOFT
5-8	8-13	MEDIUM STIFF
9-15	14-25	STIFF
16-30	26-50	VERY STIFF
OVER 30	OVER 50	HARD

GRAIN SIZES

U.S. STANDARD SERIES SIEVE				CLEAR SQUARE SIEVE OPENING		
# 200	# 40	# 10	# 4	3/4"	3"	12"

SILT & CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

TYPICAL BEDROCK HARDNESS

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
EXTREMELY HARD	CORE, FRAGMENT, OR EXPOSURE CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CAN ONLY BE CHIPPED WITH REPEATED HEAVY HAMMER BLOWS
VERY HARD	CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CORE OR FRAGMENT BREAKS WITH REPEATED HEAVY HAMMER BLOWS
HARD	CAN BE SCRATCHED WITH KNIFE OR SHARP PICK WITH DIFFICULTY (HEAVY PRESSURE); HEAVY HAMMER BLOW REQUIRED TO BREAK SPECIMEN
MODERATELY HARD	CAN BE GROOVED 1/16 INCH DEEP BY KNIFE OR SHARP PICK WITH MODERATE OR HEAVY PRESSURE; CORE OR FRAGMENT BREAKS WITH LIGHT HAMMER BLOW OR HEAVY MANUAL PRESSURE
SOFT	CAN BE GROOVED OR GOUGED EASILY BY KNIFE OR SHARP PICK WITH LIGHT PRESSURE, CAN BE SCRATCHED WITH FINGERNAIL; BREAKS WITH LIGHT TO MODERATE MANUAL PRESSURE
VERY SOFT	CAN BE READILY INDENTED, GROOVED OR GOUGED WITH FINGERNAIL, OR CARVED WITH KNIFE; BREAKS WITH LIGHT MANUAL PRESSURE

TYPICAL BEDROCK WEATHERING

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
FRESH	NO DISCOLORATION, NOT OXIDIZED
SLIGHTLY WEATHERED	DISCOLORATION OR OXIDATION IS LIMITED TO SURFACE OF, OR SHORT DISTANCE FROM, FRACTURES: SOME FELDSPAR CRYSTALS ARE DULL
MODERATELY WEATHERED	DISCOLORATION OR OXIDATION EXTENDS FROM FRACTURES, USUALLY THROUGHOUT; Fe-Mg MINERALS ARE "RUSTY", FELDSPAR CRYSTALS ARE "CLOUDY"
INTENSELY WEATHERED	DISCOLORATION OR OXIDATION THROUGHOUT; FELDSPAR AND Fe-Mg MINERALS ARE ALTERED TO CLAY TO SOME EXTENT, OR CHEMICAL ALTERATION PRODUCES IN SITU DISAGGREGATION
DECOMPOSED	DISCOLORATION OR OXIDATION THROUGHOUT, BUT RESISTANT MINERALS SUCH AS QUARTZ MAY BE UNALTERED; FELDSPAR AND Fe-Mg MINERALS ARE COMPLETELY ALTERED TO CLAY

Earth Systems Pacific

Boring No. 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

PAGE 1 OF 1
JOB NO.: SL-16605-SE
DATE: 12/29/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL		SANDY LEAN CLAY: dark brown/ olive mottled, stiff, moist, trace coarse gravel (Fill)	1.0 - 2.5	Ring	107.5	14.9	5, 6, 7
				0.0 - 3.0	Grab			
4				4.0 - 6.0	Grab			
	CL		SANDY LEAN CLAY: dark brown, very stiff, moist, some fine gravel (Alluvium)	5.0 - 6.5	Ring	109.1	14.8	7, 13, 18
10				10.0 - 11.5	Ring	119.6	13.0	6, 13, 21
15				15.0 - 16.5	SPT			4, 8, 11
17	GC		CLAYEY GRAVEL WITH SAND: brown, medium dense, moist	20.0 - 21.5	SPT			4, 9, 12
24			SANDSTONE: dark yellow brown, moderately soft, moist (Franciscan Melange)	25.0 - 25.5	SPT			50/3"
26			End of Boring @ 26.0' due to refusal No subsurface water encountered					

LEGEND: Ring Sample Grab Sample Shelby Tube Sample SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 2

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

PAGE 1 OF 1
JOB NO.: SL-16605-SE
DATE: 12/29/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			4.0" AC over 2" AB					
1	CL		SANDY LEAN CLAY: dark brown, stiff, moist, some fine gravel (Alluvium)					
2				1.0 - 4.0	○			4
3				3.0 - 4.5	▬	109.4	16.2	10 16
4			brown, slightly moist					
5			dark brown, moist, gravel ends	5.0 - 6.5	▬	112.6	15.2	5 8 13
9			brown, very stiff to hard					
10				10.0 - 11.5	▬	119.4	14.6	7 16 20
15				15.0 - 16.5	●			4 9 12
17			End of Boring @ 16.5' No subsurface water encountered					

LEGEND: ▬ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 3

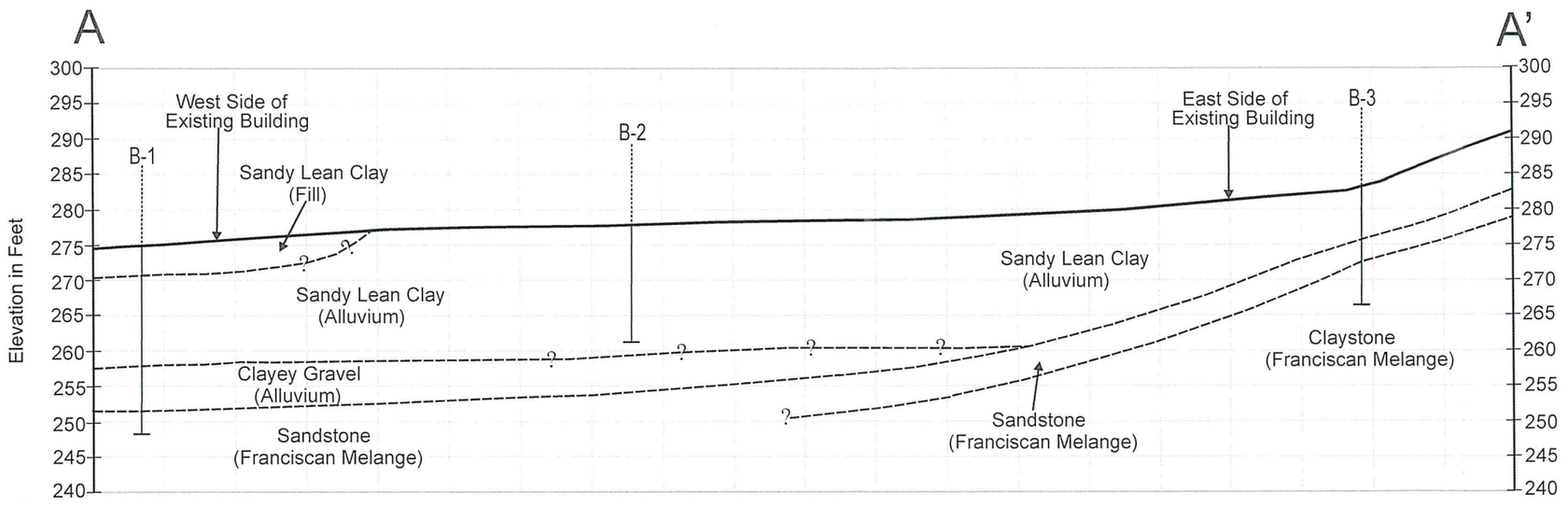
LOGGED BY: R. Wagner — PAGE 1 OF 1
DRILL RIG: Mobile B53 — JOB NO.: SL-16605-SE
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer — DATE: 12/29/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL		SANDY LEAN CLAY: dark brown, very stiff, very moist, trace gravel (Alluvium)	1.0 - 2.5	Ring	110.4	17.8	4, 8, 12
4			brown, slightly moist	3.5 - 6.0	Grab			
5				5.0 - 6.5	Ring	118.7	11.6	8, 13, 19
6				5.0 - 6.5	Grab			
8			SANDSTONE: dark yellow brown, moderately soft, moist (Franciscan Melange)					
10				10.0 - 11.5	Ring			16, 36, 50/5"
11			CLAYSTONE: gray brown, moderately soft, moist, severely sheared, weathered					
15				15.0 - 16.5	SPT			11, 20, 28
17			End of Boring @ 16.5' due to refusal No subsurface water encountered					

LEGEND: Ring Sample; Grab Sample; Shelby Tube Sample; SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.



Scale 1" = 20'

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CROSS SECTION A-A'

SAN LUIS OBISPO HIGH SCHOOL
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San Luis Obispo, California

Date
January 2016

Project No.
SL-16605-SE

APPENDIX B

Geotechnical Laboratory Test Results

San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

BULK DENSITY TEST RESULTS

ASTM D 2937-10 (modified for ring liners)

January 12, 2016

BORING NO.	DEPTH feet	MOISTURE CONTENT, %	WET DENSITY, pcf	DRY DENSITY, pcf
1	2.0 - 2.5	14.9	123.5	107.5
1	6.0 - 6.5	14.8	125.3	109.1
1	11.0 - 11.5	13.0	135.1	119.6
2	4.0 - 4.5	16.2	127.1	109.4
2	6.0 - 6.5	15.2	129.7	112.6
2	11.0 - 11.5	14.6	136.8	119.4
3	2.0 - 2.5	17.8	130.0	110.4
3	6.0 - 6.5	11.6	132.5	118.7

EXPANSION INDEX TEST RESULTS

ASTM D 4829-11

BORING NO.	DEPTH feet	EXPANSION INDEX
1	0.0 - 3.0	54
2	1.0 - 4.0	58

San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

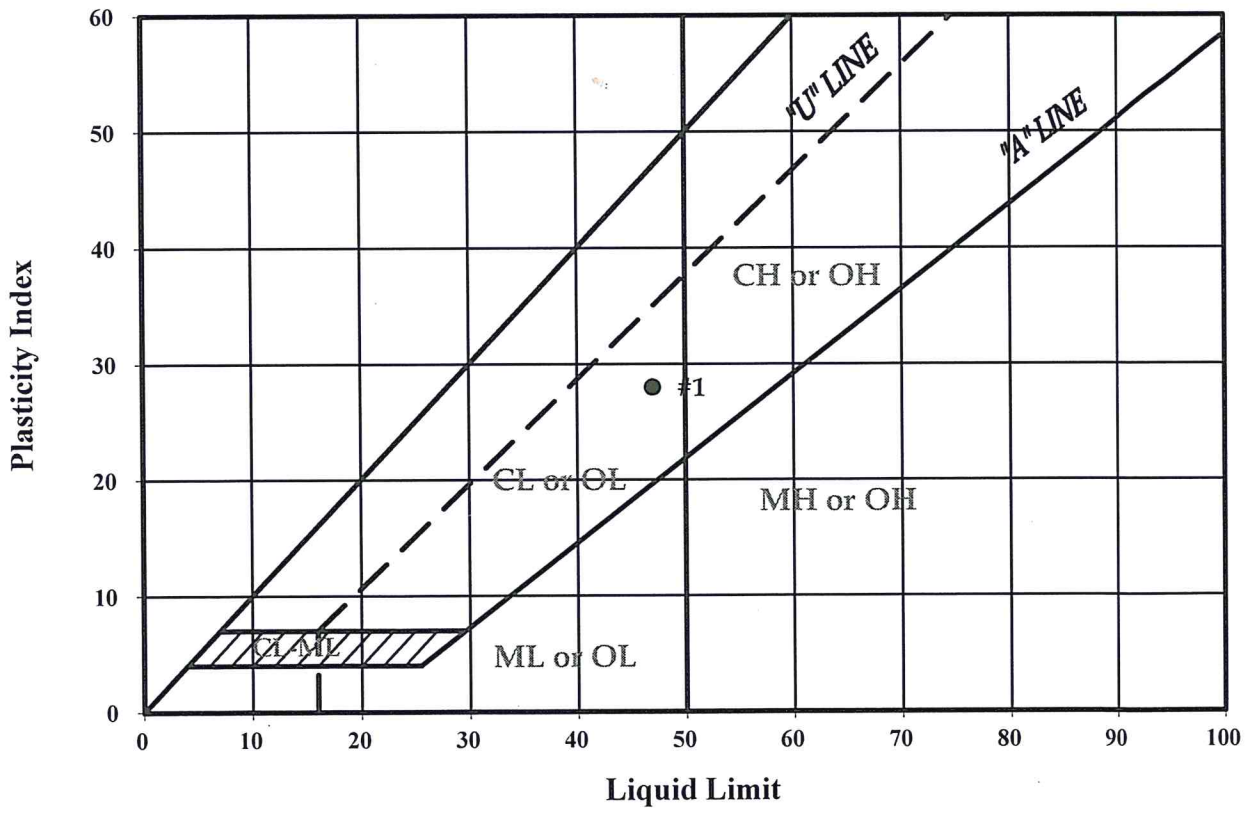
PLASTICITY INDEX

ASTM D 4318-10

January 12, 2016

Test No.:	1	2	3	4	5
Boring No.:	1				
Sample Depth:	4.0 - 6.0'				
Liquid Limit:	47				
Plastic Limit:	19				
Plasticity Index:	28				

Plasticity Chart



San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

MOISTURE-DENSITY COMPACTION TEST

ASTM D 1557-12 (Modified)

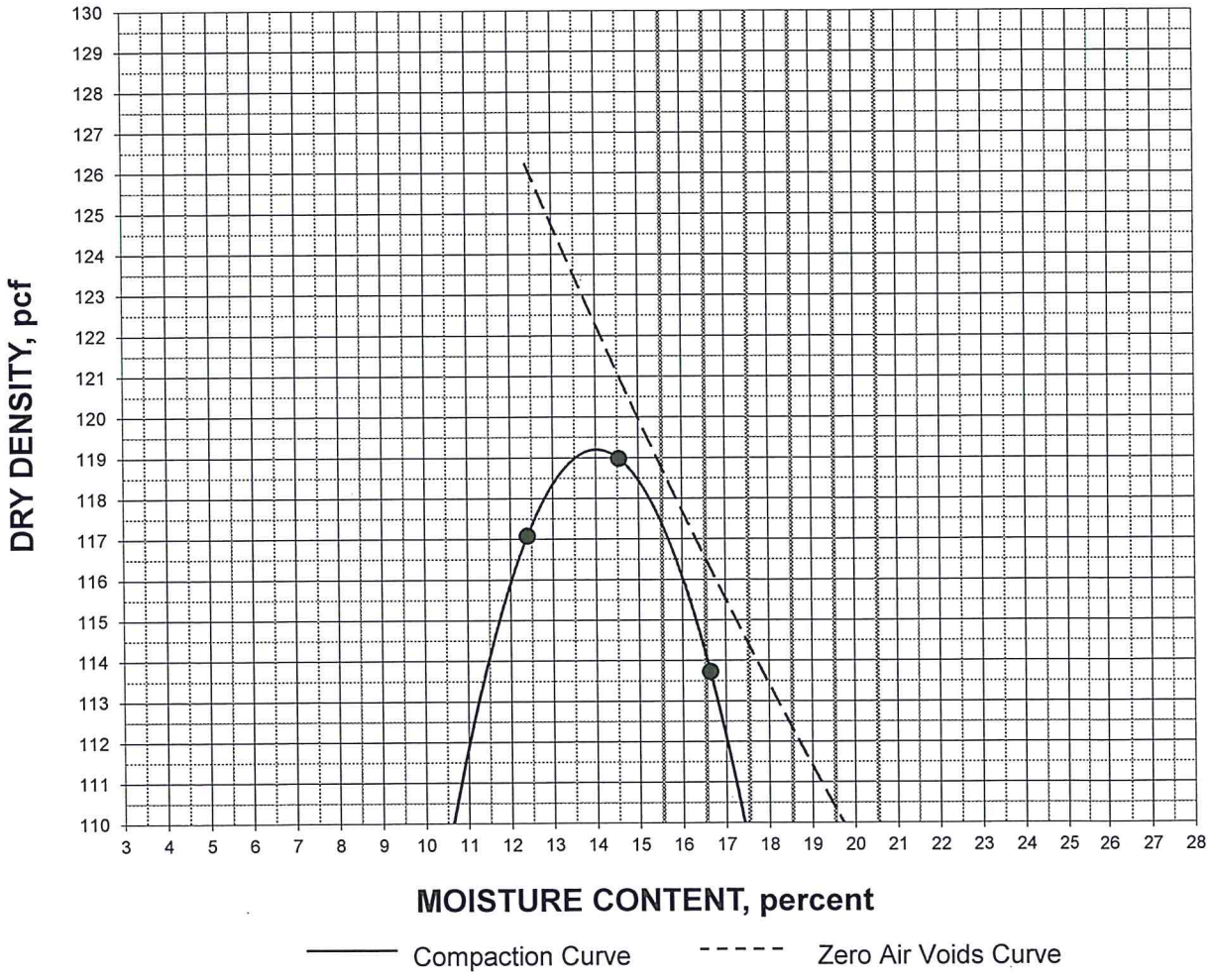
PROCEDURE USED: A
PREPARATION METHOD: Moist
RAMMER TYPE: Mechanical
SPECIFIC GRAVITY: 2.70 (assumed)

January 12, 2016
Boring #2 @ 1.0 - 4.0'
Dark Brown Sandy Lean Clay (CL)

SIEVE DATA:

Sieve Size	% Retained (Cumulative)
3/4"	0
3/8"	0
#4	0

MAXIMUM DRY DENSITY: 119.2 pcf
OPTIMUM MOISTURE: 14.0%



San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

DIRECT SHEAR

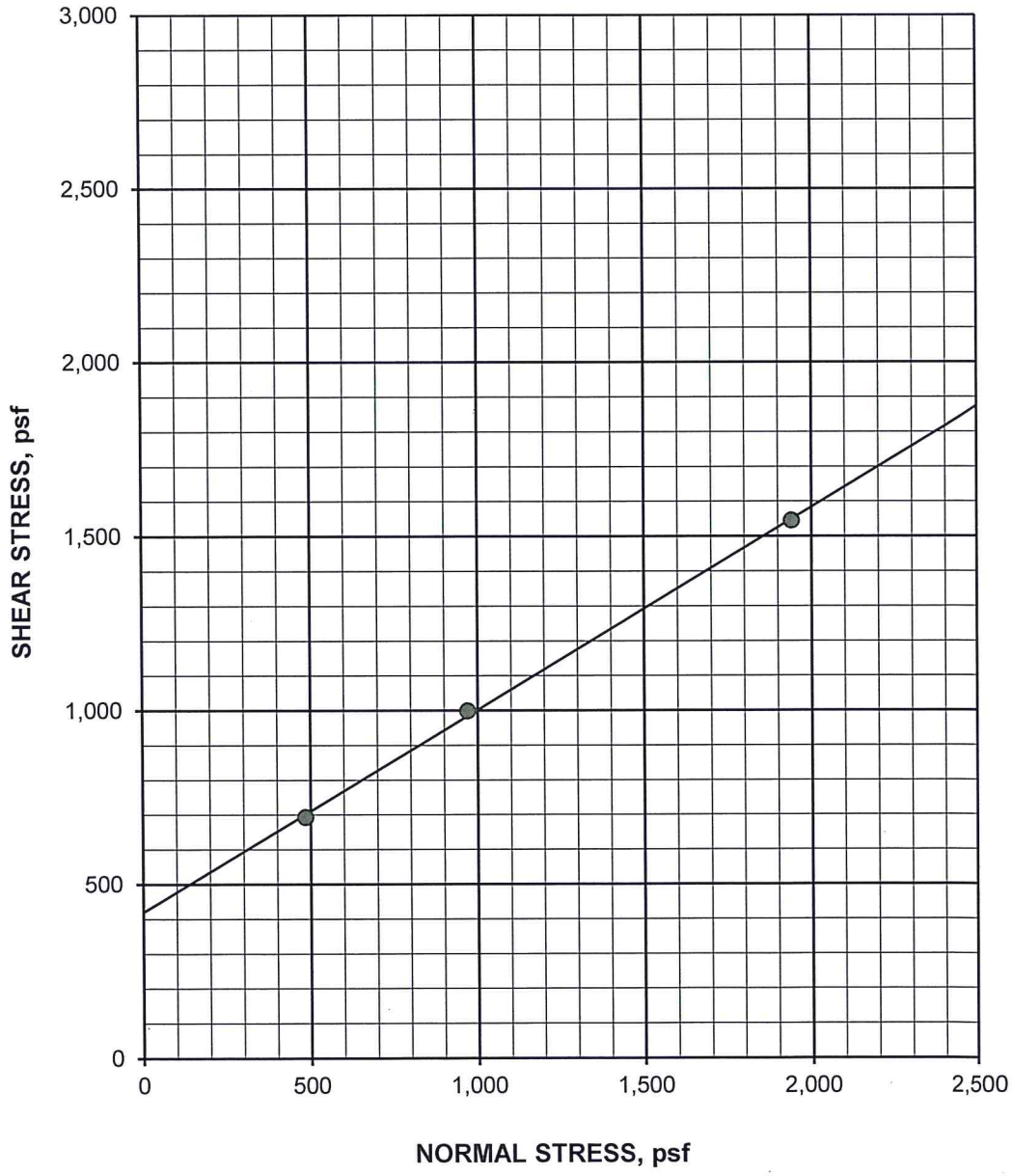
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

January 12, 2016

Boring #2 @ 1.0 - 4.0'
Sandy Lean Clay (CL)
Compacted to 90% RC, saturated

INITIAL DRY DENSITY: 107.3 pcf
INITIAL MOISTURE CONTENT: 14.0 %
PEAK SHEAR ANGLE (Ø): 30°
COHESION (C): 420 psf

SHEAR vs. NORMAL STRESS



DIRECT SHEAR continued

ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

Boring #2 @ 1.0 - 4.0'

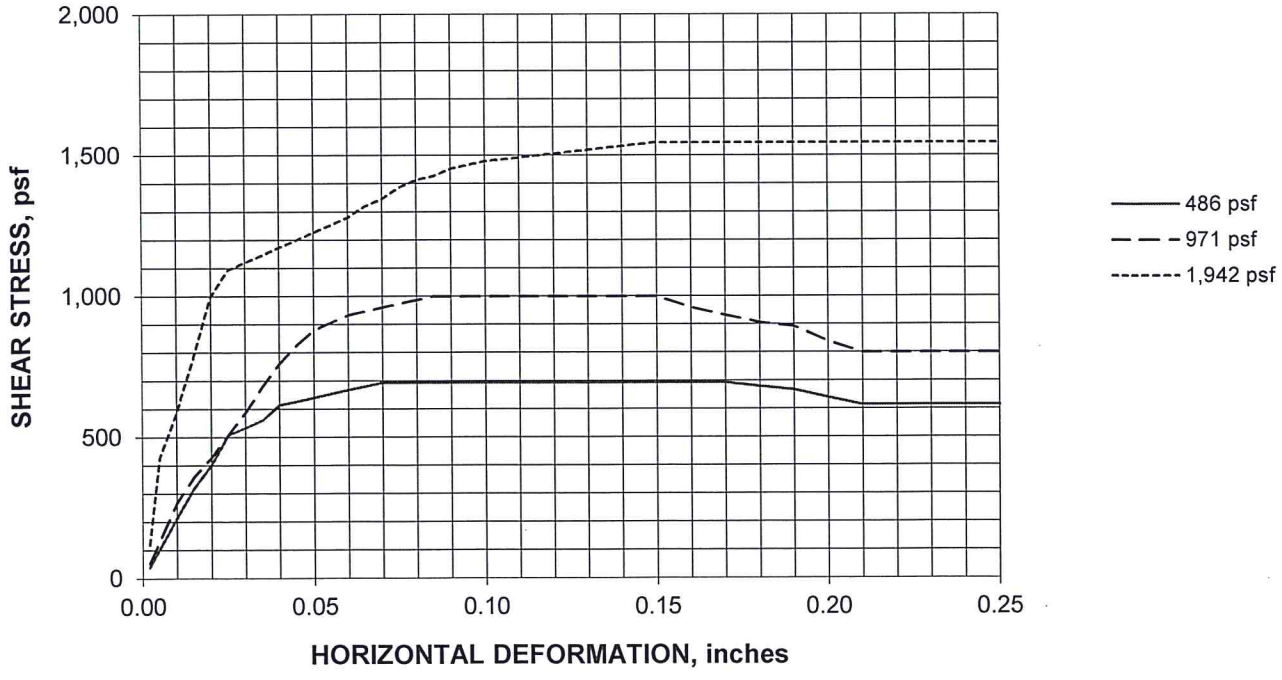
January 12, 2016

Sandy Lean Clay (CL)

Compacted to 90% RC, saturated

SPECIFIC GRAVITY: 2.70 (assumed)

SAMPLE NO.:	1	2	3	AVERAGE
INITIAL				
WATER CONTENT, %	14.0	14.0	14.0	14.0
DRY DENSITY, pcf	107.3	107.3	107.3	107.3
SATURATION, %	66.3	66.3	66.3	66.3
VOID RATIO	0.570	0.570	0.570	0.570
DIAMETER, inches	2.410	2.410	2.410	
HEIGHT, inches	1.00	1.00	1.00	
AT TEST				
WATER CONTENT, %	25.3	23.9	22.9	
DRY DENSITY, pcf	108.3	109.8	114.5	
SATURATION, %	100.0	100.0	100.0	
VOID RATIO	0.556	0.534	0.472	
HEIGHT, inches	0.99	0.98	0.94	



San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

CONSOLIDATION TEST

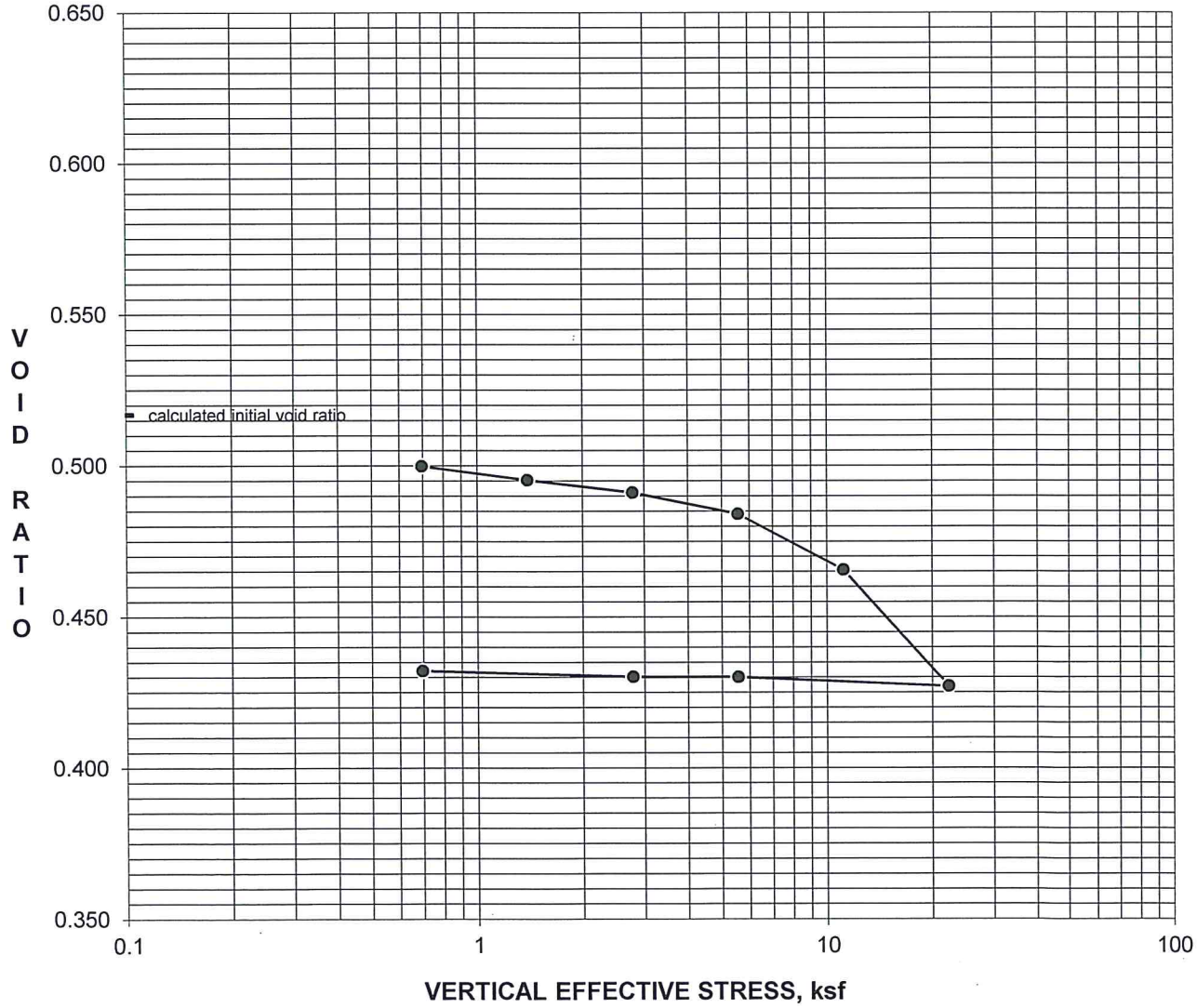
ASTM D 2435/D2435M-11

January 12, 2016

Boring #2 @ 6.0 - 6.5'
Sandy Lean Clay (CL)
Ring Sample

DRY DENSITY: 111.1 pcf
MOISTURE CONTENT: 15.2%
SPECIFIC GRAVITY: 2.70 (assumed)
INITIAL VOID RATIO: 0.517

VOID RATIO vs. NORMAL PRESSURE DIAGRAM



APPENDIX C

Soil Corrosivity Study by HDR, Inc.

January 18, 2016 via email: Fred@earthsystems.com

EARTH SYSTEMS PACIFIC
4378 Old Santa Fe Road
San Luis Obispo, CA 93401

Attention: Mr. Fred J. Potthast, GE

Re: Soil Corrosivity Study
San Luis Obispo High School
Annex/Classroom Building Project
No. 831-3102
San Luis Obispo, California
HDR #274257, ESP #SL16605-SE

Introduction

Laboratory tests have been completed on two soil samples provided for the San Luis Obispo High School project. The purpose of these tests was to determine if the soils might have deleterious effects on underground utility piping and concrete structures. HDR Engineering, Inc. (HDR) assumes that the samples provided are representative of the most corrosive soils at the site.

The proposed construction consists of a single story classroom building with conventional foundations and slabs-on-grade. The site is located at 1499 San Luis Drive in San Luis Obispo, California. The water table was reportedly not encountered during exploratory borings to a depth of 26 feet.

The scope of this study is limited to a determination of soil corrosivity and general corrosion control recommendations for materials likely to be used for construction. HDR's recommendations do not constitute, and are not meant as a substitute for, design documents for the purpose of construction. If the architects and/or engineers desire more specific information, designs, specifications, or review of design, HDR will be happy to work with them as a separate phase of this project.

Laboratory Soil Corrosivity Tests

The electrical resistivity of each sample was measured in a soil box per ASTM G187 in its as-received condition and again after saturation with distilled water. Resistivities are at about their lowest value when the soil is saturated. The pH of the saturated samples was measured per CTM 643. A 5:1 water:soil extract from each sample was chemically analyzed for the major soluble salts commonly found in soil per ASTM D4327, ASTM D6919, and Standard Method 2320-B[1]. Laboratory analysis was performed under HDR laboratory number 16-0015SCS and the test results are shown in the attached Table 1.

Soil Corrosivity

A major factor in determining soil corrosivity is electrical resistivity. The electrical resistivity of a soil is a measure of its resistance to the flow of electrical current. Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of electrical current (DC) from the metal into the soil. Corrosion currents, following Ohm's Law, are inversely proportional to soil resistivity. Lower electrical resistivities result from higher moisture and soluble salt contents and indicate corrosive soil.

A correlation between electrical resistivity and corrosivity toward ferrous metals is:[2]

Soil Resistivity in ohm-centimeters	Corrosivity Category
Greater than 10,000	Mildly Corrosive
2,001 to 10,000	Moderately Corrosive
1,001 to 2,000	Corrosive
0 to 1,000	Severely Corrosive

Other soil characteristics that may influence corrosivity towards metals are pH, soluble salt content, soil types, aeration, anaerobic conditions, and site drainage.

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[1] *American Public Health Association (APHA). 2012. Standard Methods of Water and Wastewater. 22nd ed. American Public Health Association, American Water Works Association, Water Environment Federation publication. APHA, Washington D.C.*

[2] *Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, pp. 166–167.*

Electrical resistivities were in the moderately corrosive categories with as-received moisture. When saturated, the resistivities were in the corrosive to severely corrosive categories. The resistivities dropped with added moisture because the samples were dry as-received.

Soil pH for both samples was 7.7. This value is in the mildly alkaline[3] range and does not particularly increase soil corrosivity.

The soluble salt content of the samples ranged from low to moderate.

The nitrate concentration was high enough to be aggressive to copper.

Tests were not made for sulfide and negative oxidation-reduction (redox) potential because these samples did not exhibit characteristics typically associated with anaerobic conditions.

This soil is classified as severely corrosive to ferrous metals and aggressive to copper.

Corrosion Control Recommendations

The life of buried materials depends on thickness, strength, loads, construction details, soil moisture, etc., in addition to soil corrosivity, and is, therefore, difficult to predict. Of more practical value are corrosion control methods that will increase the life of materials that would be subject to significant corrosion.

The following recommendations are based on the soil conditions discussed in the Soil Corrosivity section above. Unless otherwise indicated, these recommendations apply to the entire site or alignment.

Steel Pipe

Implement *all* the following measures:

1. Underground steel pipe with rubber gasketed, mechanical, grooved end, or other nonconductive type joints should be bonded for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.

---

[3] *Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, p. 8.*

2. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:

    a. At each end of the pipeline.

    b. At each end of all casings.

    c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.

3. To prevent dissimilar metal corrosion cells and to facilitate the application of cathodic protection, electrically isolate each buried steel pipeline per NACE SP0286 from:

    a. Dissimilar metals.

    b. Dissimilarly coated piping (cement-mortar vs. dielectric).

    c. Above ground steel pipe.

    d. All existing piping.

4. Choose one of the following corrosion control options:

    OPTION 1

    a. Apply a suitable dielectric coating intended for underground use such as:

        i. Polyurethane per AWWA C222 *or*

        ii. Extruded polyethylene per AWWA C215 *or*

        iii. A tape coating system per AWWA C214 *or*

        iv. Hot applied coal tar enamel per AWWA C203 *or*

        v. Fusion bonded epoxy per AWWA C213.

    b. Apply cathodic protection to steel piping as per NACE SP0169.

OPTION 2

a. As an alternative to dielectric coating and cathodic protection, apply a ¾-inch cement mortar coating per AWWA C205 or encase in concrete 3 inches thick, using any type of ASTM C150 cement. Joint bonds, test stations, and insulated joints are still recommended for these alternatives.

NOTE: Some steel piping systems, such as for oil, gas, and high-pressure piping systems, have special corrosion and cathodic protection requirements that must be evaluated for each specific application.

Iron Pipe

Implement *all* the following measures:

1. To prevent dissimilar metal corrosion cells and to facilitate the application of cathodic protection, electrically insulate underground iron pipe from dissimilar metals and from above ground iron pipe with insulating joints per NACE SP0286.
2. Bond all nonconductive type joints for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.
3. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:
    a. At each end of the pipeline.
    b. At each end of any casings.
    c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.
4. Choose one of the following corrosion control options:

    OPTION 1

    a. Apply a suitable coating intended for underground use such as:
        i. Polyethylene encasement per AWWA C105; *or*
        ii. Epoxy coating; *or*

iii. Polyurethane; *or*

iv. Wax tape.

NOTE: The thin factory-applied asphaltic coating applied to ductile iron pipe for transportation and aesthetic purposes does not constitute a corrosion control coating.

b. Apply cathodic protection to cast and ductile iron piping as per NACE SP0169.

OPTION 2

a. As an alternative to coating systems described in Option 1 and cathodic protection, concrete encase all buried portions of metallic piping so that there is a minimum of 3 inches of concrete cover provided over and around surfaces of pipe, fittings, and valves using any type of ASTM C150 cement.

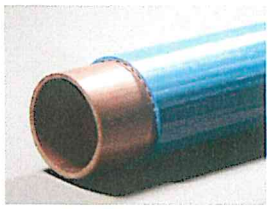
Copper Tubing

Implement *all* the following measures:

1. Electrically insulate underground copper pipe from dissimilar metals and from above ground copper pipe with insulating devices per NACE SP0286.
2. Electrically insulate cold water piping from hot water piping systems.
3. Protect buried copper tubing by one of the following measures:

    a. Prevention of soil contact. Soil contact may be prevented by placing the tubing above ground or encasing the tubing using PVC pipe with solvent-welded joints.

    b. Installation of a factory-coated copper pipe with a minimum 25-mil thickness such as Kamco's Aqua Shield™, Mueller's Streamline Protec™, or equal. The coating must be continuous with no cuts or defects.



    c. Installation of 12-mil polyethylene pipe wrapping tape with butyl rubber mastic over a suitable primer. Protect wrapped copper tubing by applying cathodic protection per NACE SP0169.

Plastic and Vitrified Clay Pipe

1. No special precautions are required for plastic and vitrified clay piping placed underground from a corrosion viewpoint.

2. Protect all metallic fittings and valves with wax tape per AWWA C217 or epoxy.

All Pipe

1. On all pipes, appurtenances, and fittings not protected by cathodic protection, coat bare metal such as valves, bolts, flange joints, joint harnesses, and flexible couplings with wax tape per AWWA C217 after assembly.

2. Where metallic pipelines penetrate concrete structures such as building floors, vault walls, and thrust blocks use plastic sleeves, rubber seals, or other dielectric material to prevent pipe contact with the concrete and reinforcing steel.

Concrete

1. From a corrosion standpoint, any type of ASTM C150 cement may be used for concrete structures and pipe because the sulfate concentration is negligible, 0 to 0.10 percent.[4,5,6]

2. Standard concrete cover over reinforcing steel may be used for concrete structures and pipe in contact with these soils due to the low chloride concentration[7] found onsite.

Closure

The analysis and recommendations presented in this report are based upon data obtained from the laboratory samples. This report does not reflect variations that may occur across the site or due to the modifying effects of construction. If variations appear, HDR should be

---

[4] *2012 International Building Code (IBC) Section 1904.3*

[5] *2012 International Residential Code (IRC) which refers to American Concrete Institute (ACI) 318 Table 19.3.2.1*

[6] *2013 California Building Code (CBC) which refers to American Concrete Institute (ACI) 318 Table 19.3.2.1*

[7] *Design Manual 303: Concrete Cylinder Pipe. Ameron. p.65*

notified immediately so that further evaluation and supplem ental recommendations can be provided.

HDR's services have been performed with the usual thoroughness and com petence of the engineering profession. No other warranty or representation, either expressed or implied, is included or intended.

Please call if you have any questions.

Respectfully Submitted,
HDR Engineering, Inc.

Jose Peña

Brien L. Clark, PE

LICENSED PROFESSIONAL ENGINEER
BRIEN L. CLARK
CH 6291
EXP. 12/31/17
CHEMICAL
STATE OF CALIFORNIA

Enc: Table 1

274257_SCS_Rpt_JP_Rev00_BC.docx

Table 1 - Laboratory Tests on Soil Samples

Earth Systems Pacific
SLO High School - Annex / Classroom Building Project No. 831-3102
Your #SL-16605-SE, HDR Lab #16-0015SCS
5-Jan-16

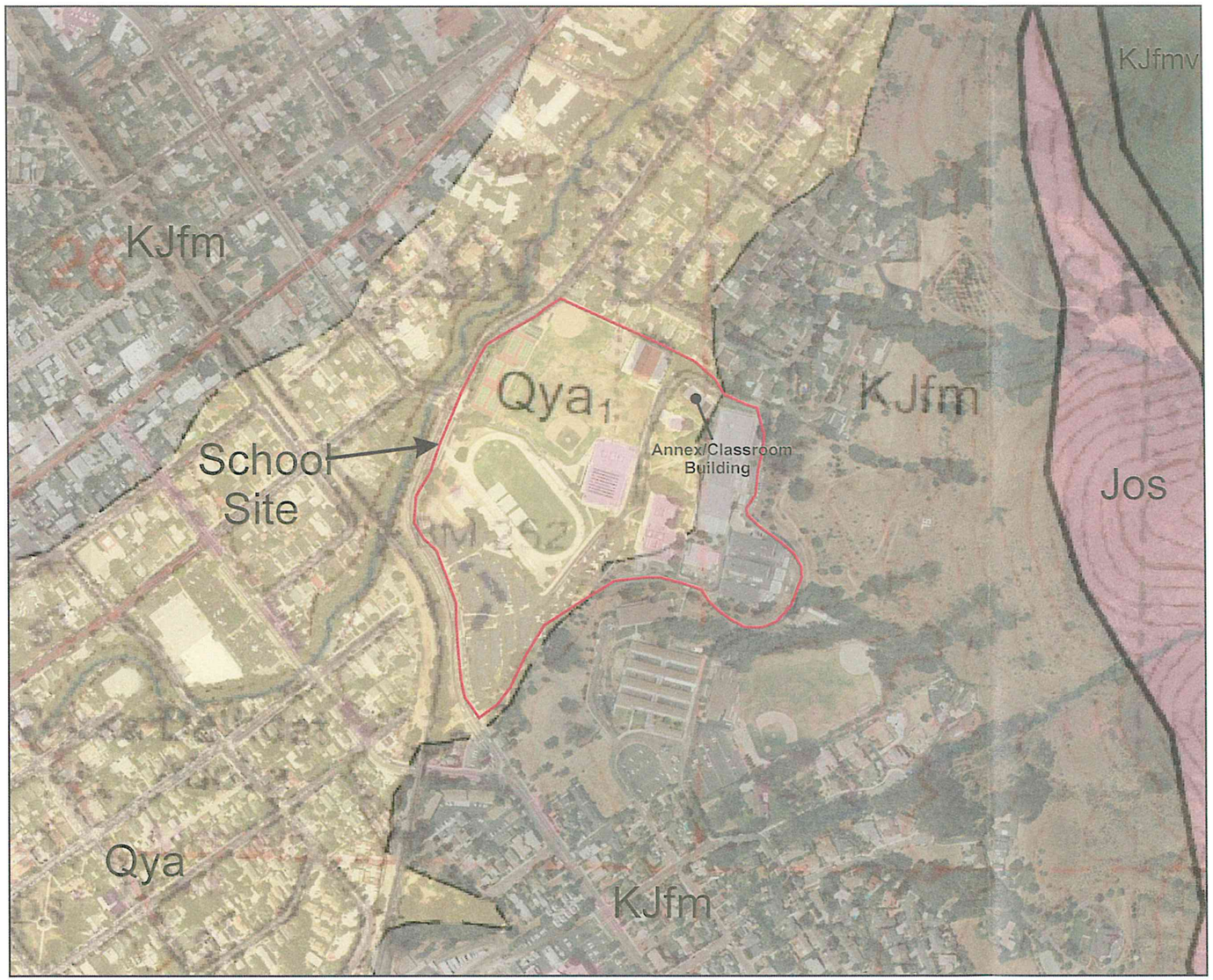
Sample ID			B1 @ 0-3' CL	B2 @ 1-4' CL
Resistivity		**Units**		
as-received		ohm-cm	4,800	6,000
saturated		ohm-cm	1,200	800
pH			7.7	7.7
Electrical Conductivity		mS/cm	0.16	0.24
Chemical Analyses				
Cations				
calcium	Ca^{2+}	mg/kg	61	86
magnesium	Mg^{2+}	mg/kg	ND	ND
sodium	Na^{1+}	mg/kg	77	46
potassium	K^{1+}	mg/kg	7.5	12
Anions				
carbonate	CO_3^{2-}	mg/kg	ND	ND
bicarbonate	HCO_3^{1-}	mg/kg	366	174
fluoride	F^{1-}	mg/kg	4.0	1.9
chloride	Cl^{1-}	mg/kg	11	7.3
sulfate	SO_4^{2-}	mg/kg	60	292
phosphate	PO_4^{3-}	mg/kg	ND	ND
Other Tests				
ammonium	NH_4^{1+}	mg/kg	ND	ND
nitrate	NO_3^{1-}	mg/kg	7.0	127
sulfide	S^{2-}	qual	na	na
Redox		mV	na	na

Electrical conductivity in millisiemens/cm and chemical analysis were made on a 1:5 soil-to-water extract.
mg/kg = milligrams per kilogram (parts per million) of dry soil.
Redox = oxidation-reduction potential in millivolts
ND = not detected
na = not analyzed

431 West Baseline Road · Claremont, CA 91711
Phone: 909.962.5485 · Fax: 909.626.3316

APPENDIX D

Geologic Map
Historical Earthquake/Fault Map
FEMA Flood Zone Map



Extract from: Geologic Map of the San Luis Obispo Quadrangle, San Luis Obispo County, California: by Wiegers, 2010.

EXPLANATION

Geologic Units

Qya
Young Alluvial flood-Plain Deposits

Jos
Serpentinized Ultramafic Rock

KJfm
Franciscan Melange

KJfmv
Franciscan Metavolcanic Rock

Geologic Symbols

Contact
Dashed where approximately located or inferred

High-angle fault
Dashed where approximately located or inferred; dotted where concealed

Thrust or reverse fault
Dashed where approximately located or inferred; dotted where concealed. Saw-teeth on upper plate. Dip of fault plane between 30° and 80°

Anticline
Showing axis at surface. Dashed where approximately located; dotted where concealed

Syncline
Showing axis at surface. Dashed where approximately located; dotted where concealed

Horizontal 30 Inclined 90 Vertical
Strike and dip of beds

N

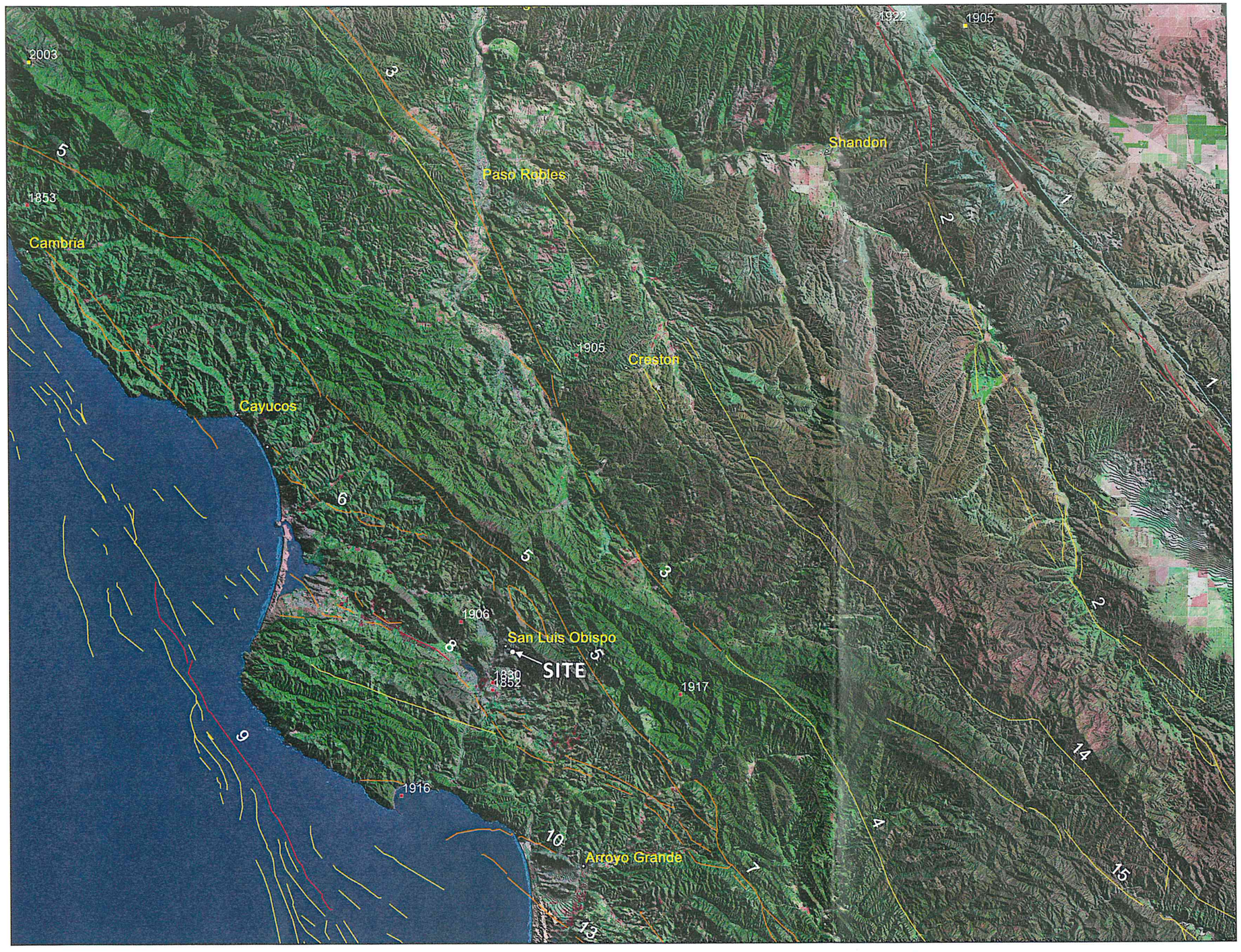
Approx. Scale: 1" = 500'

EARTH SYSTEMS PACIFIC
4378 Old Santa Fe Road, San Luis Obispo, CA 93401
www.earthsystems.com - email: esp@earthsystems.com
(805) 544-3276

GEOLOGIC MAP
SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

Date
January 2016

Project No.
SL-16605-SE



LEGEND

- Historic rupture (<200 years)
- Holocene fault (<10,000 years)
- Late Quaternary (<700,000 years)
- Quaternary fault (<1.6 million)

HISTORICAL EARTHQUAKE MAGNITUDE

5.0 to 5.9 | 6.0 to 6.9 | 7.0 to 7.9

FAULTS

1	San Andreas	11	Casmalia
2	San Juan	12	Lions Head
3	Rinconada	13	Oceano
4	East Huasna	14	La Panza
5	Oceanic	15	South Cuyama
6	Cambria		
7	West Huasna		
8	Los Osos		
9	Hosgri-San Simeon		
10	San Luis Range		

REFERENCES

Blake, T.F., EQSEARCH, 2000, updated 2010
Jennings, C.W. & Bryant, W.A., 2010

N

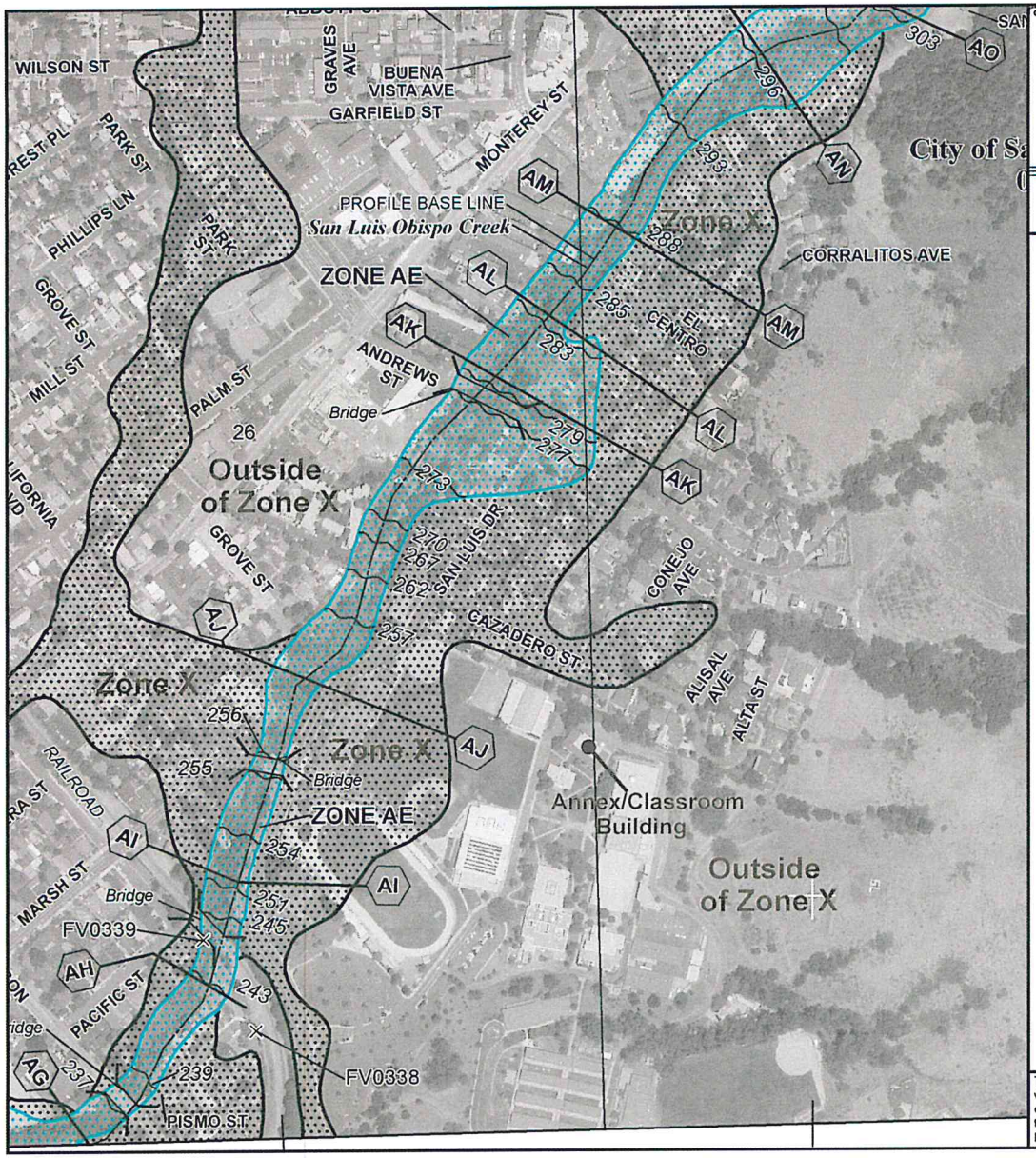
(Approximate Scale: 1" = 6 miles)

EARTH SYSTEMS PACIFIC
4378 Old Santa Fe Road, San Luis Obispo, CA 93401
www.earthsystems.com - email: esp@earthsystems.com
(805) 544-3276

HISTORICAL EARTHQUAKE/ FAULT MAP
SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

Date
January 2016

Project No.
SL-16605-SE



ance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

0 250 500 750 1,000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1067G

FIRM

FLOOD INSURANCE RATE MAP

SAN LUIS OBISPO COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL 1067 OF 2050

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
SAN LUIS OBISPO COUNTY	060304	1067	G
SAN LUIS OBISPO, CITY OF	060310	1067	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER 06079C1067G

MAP REVISED NOVEMBER 16, 2012

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

EARTH SYSTEMS PACIFIC

4378 Old Santa Fe Road, San Luis Obispo, CA 93401
www.earthsystems.com - email: esp@earthsystems.com
(805) 544-3276

FEMA FLOOD ZONE MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

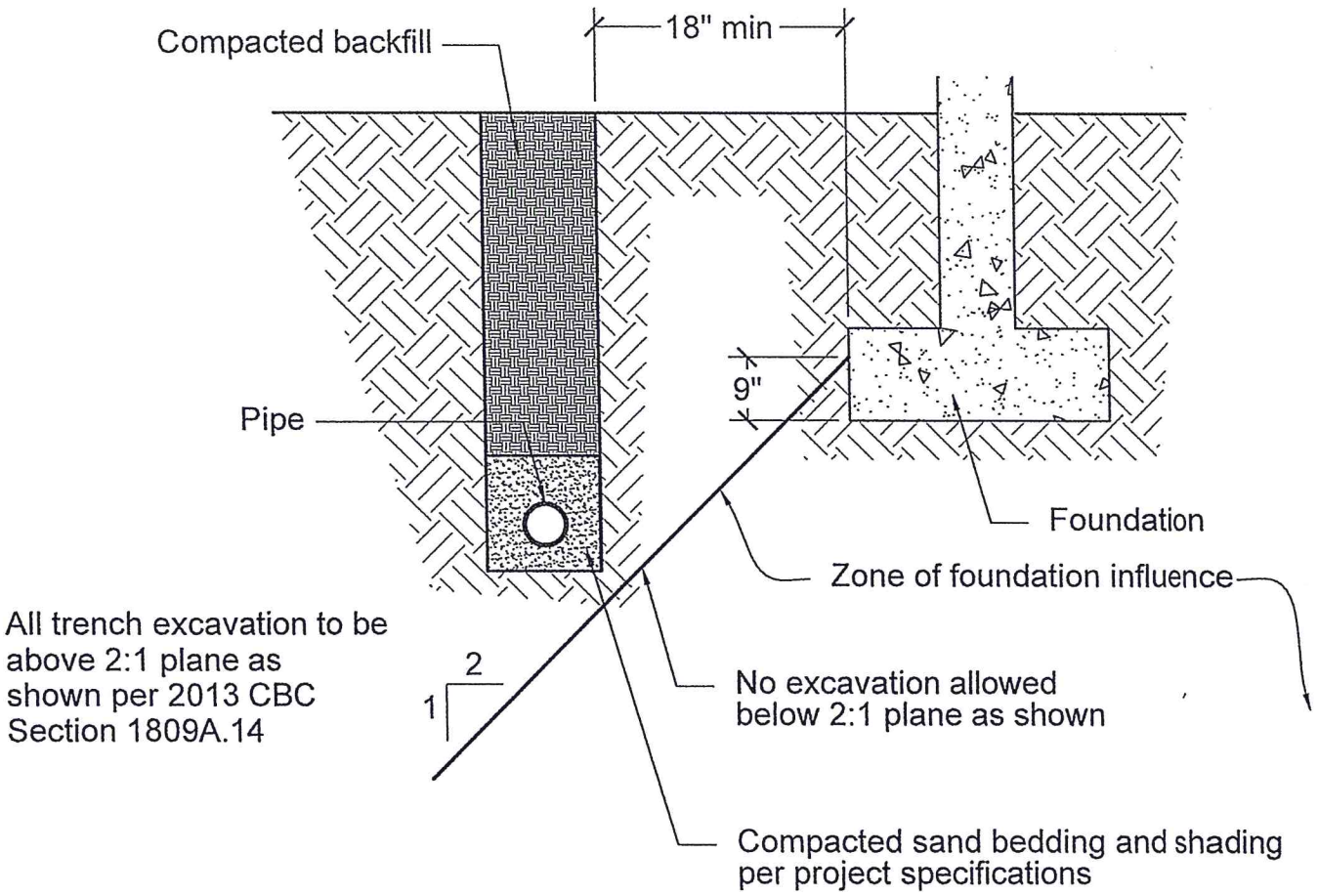
Date
January 2016

Project No.
SL-16605-SE

APPENDIX E

Typical Detail A: Pipe Placed Parallel to Foundations

TYPICAL DETAIL A
PIPE PLACED PARALLEL TO FOUNDATIONS*



SCHEMATIC ONLY
NOT TO SCALE

Earth Systems Pacific

4378 Old Santa Fe Road
San Luis Obispo, CA 93401-8116
(805) 544-3276 • FAX (805) 544-1786
E-mail: esp@earthsys.com

APPENDIX C

Geotechnical Laboratory Test Results

San Luis Obispo High School
Building 100 Modernization

300933-007

BULK DENSITY TEST RESULTS

ASTM D 2937-17 (modified for ring liners)

July 2, 2018

BORING NO.	DEPTH feet	MOISTURE CONTENT, %	WET DENSITY, pcf	DRY DENSITY, pcf
2	3.0 - 3.5	11.5	122.0	109.4
2	6.0 - 6.5	19.9	127.3	106.2
2	11.0 - 11.5	8.0	144.4	133.7
3	3.0 - 3.5	25.5	131.9	105.0
3	6.0 - 6.5	11.1	127.6	114.9
3	11.0 - 11.5	12.7	133.5	118.4
3	17.5 - 18.0	19.9	126.4	105.4
3	21.0 - 21.5	18.9	130.3	109.6
5	3.0 - 3.5	12.1	133.1	118.8
7	6.0 - 6.5	14.4	129.0	112.8
7	11.0 - 11.5	15.9	130.1	112.3

EXPANSION INDEX TEST RESULTS

ASTM D 4829-11

BORING NO.	DEPTH feet	EXPANSION INDEX
2	1.0 - 4.0	47
3	1.0 - 4.0	55

San Luis Obispo High School
Building 100 Modernization

300933-007

MOISTURE-DENSITY COMPACTION TEST

ASTM D 1557-12 (Modified)

PROCEDURE USED: B

PREPARATION METHOD: Moist

RAMMER TYPE: Mechanical

SPECIFIC GRAVITY: 2.70 (assumed)

July 2, 2018

Boring #2 @ 1.0 - 4.0'

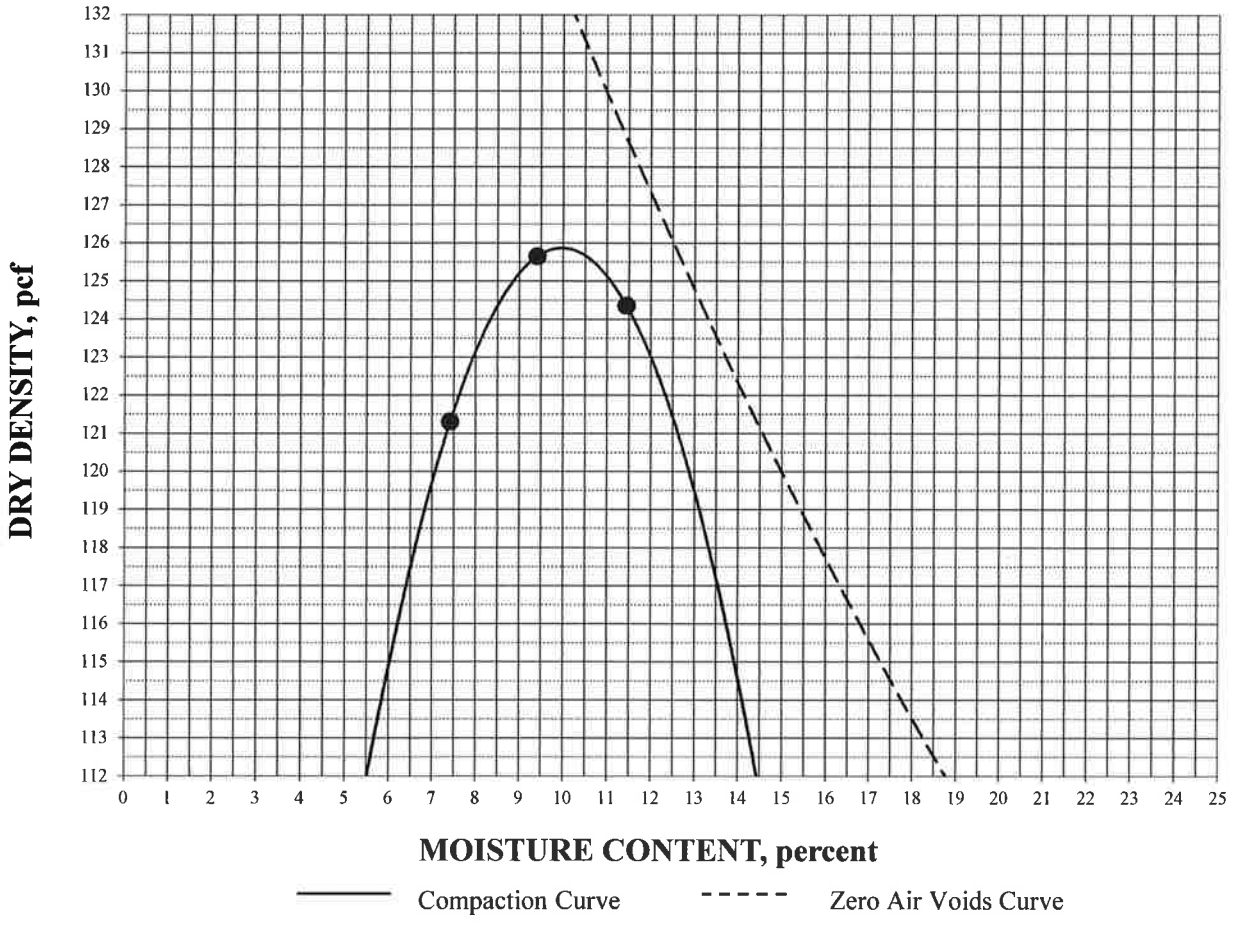
Yellow Brown Clayey Sand (SC)

SIEVE DATA:

Sieve Size	% Retained (Cumulative)
3/4"	0
3/8"	7
#4	5

MAXIMUM DRY DENSITY: 125.9 pcf

OPTIMUM MOISTURE: 10.0%



San Luis Obispo High School
Building 100 Modernization

300933-007

DIRECT SHEAR

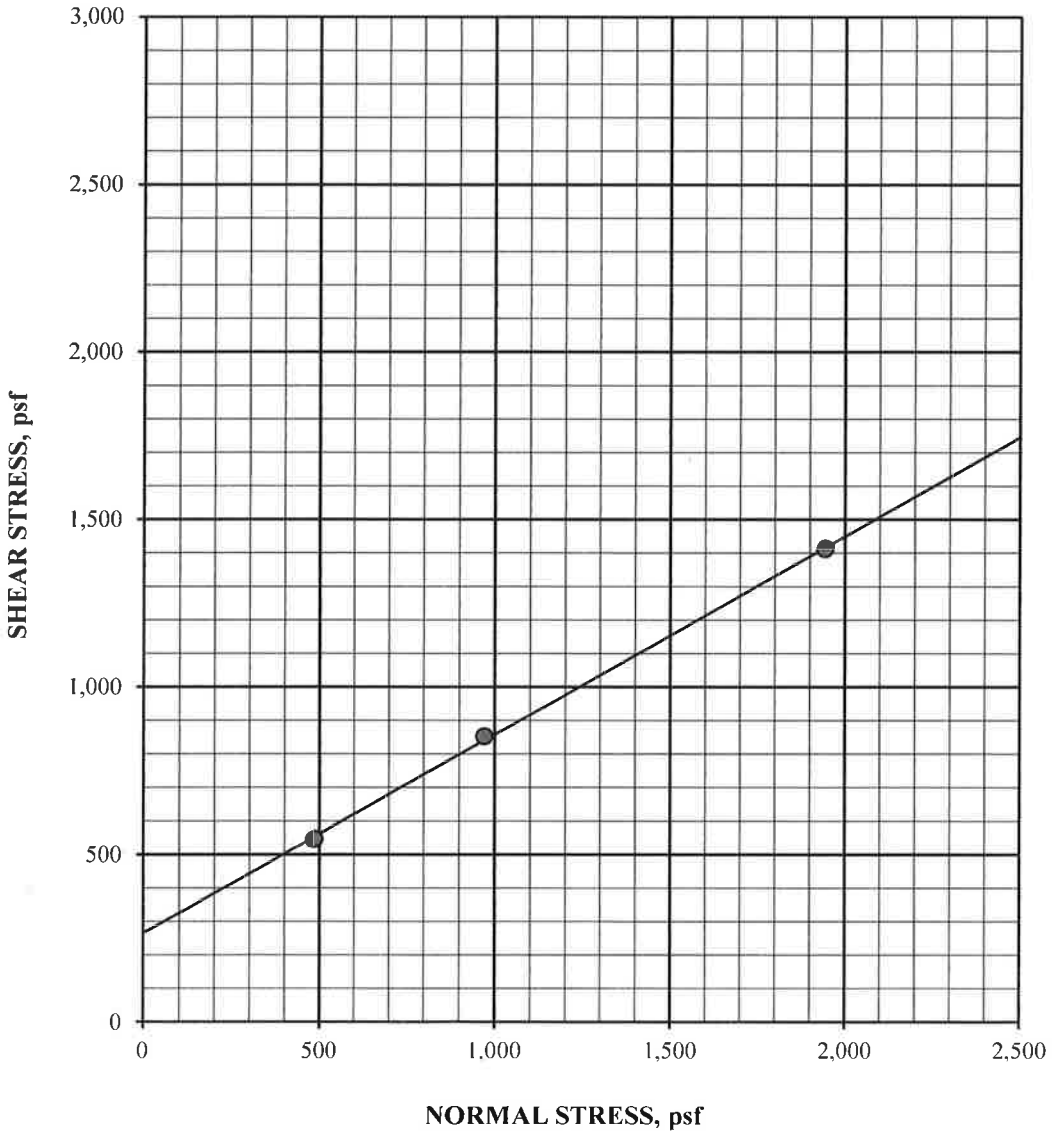
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

July 2, 2018

Boring #2 @ 1.0 - 4.0'
Clayey Sand (SC)
Compacted to 90% RC, saturated

INITIAL DRY DENSITY: 113.3 pcf
INITIAL MOISTURE CONTENT: 10.0 %
PEAK SHEAR ANGLE (Ø): 31°
COHESION (C): 266 psf

SHEAR vs. NORMAL STRESS



San Luis Obispo High School
Building 100 Modernization

300933-007

DIRECT SHEAR continued

ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

Boring #2 @ 1.0 - 4.0'

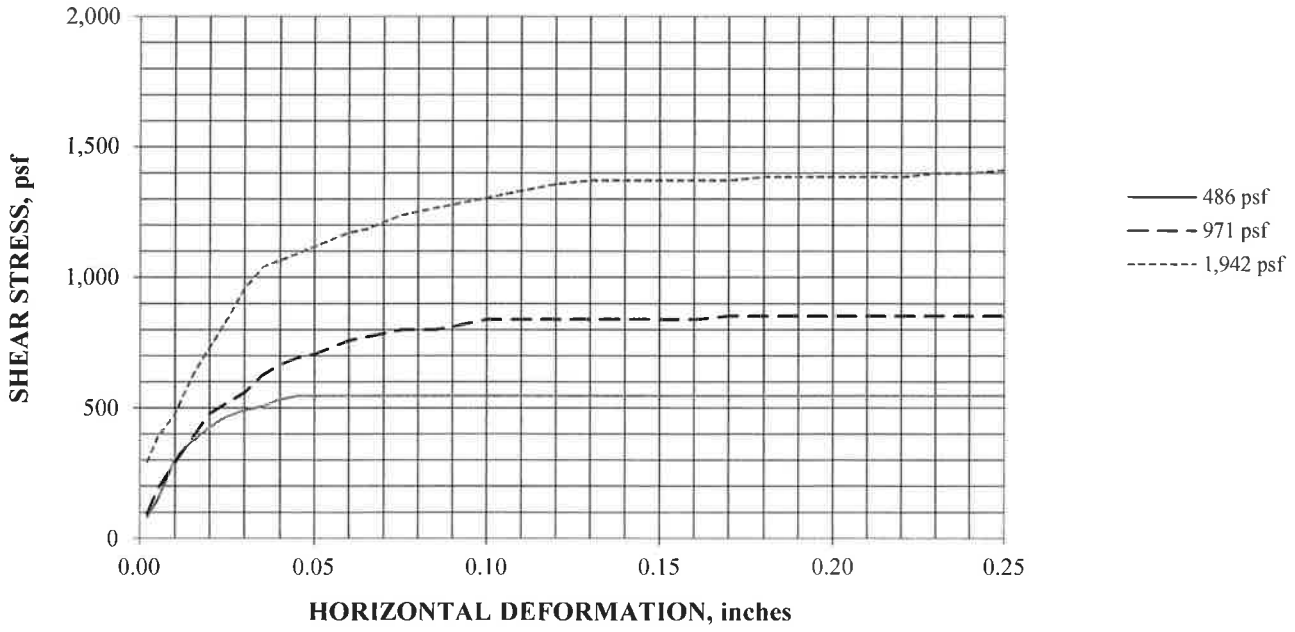
July 2, 2018

Clayey Sand (SC)

Compacted to 90% RC, saturated

SPECIFIC GRAVITY: 2.70 (assumed)

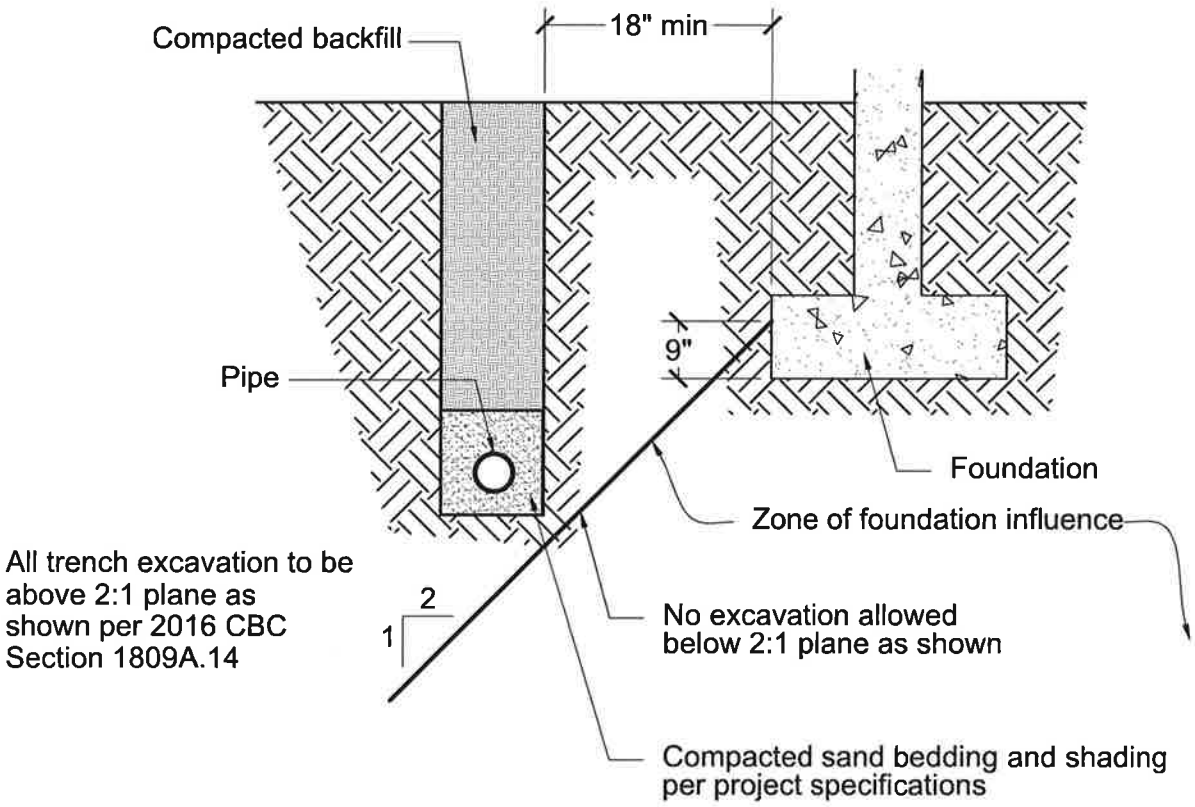
SAMPLE NO.:	1	2	3	AVERAGE
INITIAL				
WATER CONTENT, %	10.0	10.0	10.0	10.0
DRY DENSITY, pcf	113.3	113.3	113.3	113.3
SATURATION, %	55.4	55.4	55.4	55.4
VOID RATIO	0.487	0.487	0.487	0.487
DIAMETER, inches	2.410	2.410	2.410	
HEIGHT, inches	1.00	1.00	1.00	
AT TEST				
WATER CONTENT, %	21.3	19.2	18.4	
DRY DENSITY, pcf	117.8	124.1	125.5	
SATURATION, %	100.0	100.0	100.0	
VOID RATIO	0.431	0.358	0.343	
HEIGHT, inches	0.96	0.91	0.90	



APPENDIX D

Typical Detail A: Pipe Placed Parallel to Foundations
Tremie Method

TYPICAL DETAIL A
PIPE PLACED PARALLEL TO FOUNDATIONS*



SCHEMATIC ONLY
NOT TO SCALE

Earth Systems Pacific

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RECOMMENDED PROCEDURE FOR TREMIE-PLACED CONCRETE IN CAISSON (DRILLED SHAFT) FOUNDATION CONSTRUCTION

The following are general guidelines only, and may be subject to modification by the architect/engineer and/or geotechnical engineer.

1. Concrete should be placed in caisson excavations by means of a tremie when the depth of water in the excavation cannot be limited to a maximum of 2 inches, or when the freefall of the concrete would result in the concrete striking the rebar or excavation walls as it falls.

2. The concrete should be pumped to the tremie pipe. Alternately, a hopper with a tremie pipe attached should be used if approved by the architect/engineer. An "elephant's trunk" should not be used to place concrete under water; however, an elephant's trunk may be used to direct the fall of the concrete in dry excavations. The elephant's trunk should be of sufficient length to prevent the concrete from striking the rebar or excavation walls as it falls.

3. Concrete for dry excavations should be designed for, and placed at, a slump of 4 to 6 inches. Concrete to be placed below water should be designed and placed as a "flowable" mix with a minimum slump of 7 inches, or should be designed and placed as "self-consolidating concrete."

4. The tremie pipe should consist of rigid steel pipe with tight couplings. The tremie pipe should be 4 to 6 inches in diameter and should be longer than the deepest caisson excavation.

5. The tremie pipe should be lowered with caution through the center of the reinforcing to approximately 1 foot of the bottom of the excavation; the tremie should not be allowed to penetrate into the muck on the bottom of the hole

6. The pump hose and tremie pipe should be "slicked" with Portland cement slurry. No clay, bentonite, or other material should be used unless approved by the architect/engineer and geotechnical engineer.

7. Pumping of the concrete should begin immediately after the reinforcing and the tremie pipe have been placed in the excavation and the excavation and reinforcing have been inspected. The tremie pipe should not be raised until the concrete surface in the caisson excavation is at least 5 feet above the bottom of the tremie pipe. The bottom of the tremie pipe should then be kept at least 5 feet below the top of the concrete until the pour is completed.

8. The concrete should be pumped until all muck, laitance, and unsuitable concrete has been lifted above the top-of-caisson elevation. All muck, laitance, and unsuitable concrete should be immediately removed from the excavation.

9. Self-consolidating concrete need *not* be vibrated during the pour, unless directed by the architect/engineer. For other than self-consolidating concrete, vibration should *not* be started until the concrete pour is completed and the muck, laitance and unsuitable concrete have been removed. Then, only the upper 5 to 10 feet of the concrete should then be vibrated. Additional concrete may be added as necessary during vibration. The vibrator should not be allowed to contact the reinforcing.

10. During the pour, if the tremie pipe has to be removed from the concrete, (e.g., to allow removal of casing), it should be reset at the top of the concrete. The tremie should then be purged as directed by the inspector, and then immediately lowered to at least 5 feet below the top of the concrete as the concrete is being pumped. All degraded concrete should be lifted with the continuing pour and removed from the top of the caisson.

UPDATED GEOTECHNICAL ENGINEERING AND GEOLOGIC HAZARDS REPORT SAN LUIS OBISPO HIGH SCHOOL TRACK AND STADIUM UPGRADES 1499 SAN LUIS DRIVE SAN LUIS OBISPO, CALIFORNIA

April 28, 2020

Prepared for

Mr. Chris Bonin
Director – Buildings, Grounds and Transportation
San Luis Coastal Unified School District

Prepared by

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April 28, 2020

FILE NO.: 300933-017

Mr. Chris Bonin
Director – Buildings, Grounds and Transportation
San Luis Coastal Unified School District
937 Southwood Drive
San Luis Obispo, CA 93401

PROJECT: SAN LUIS OBISPO HIGH SCHOOL
TRACK AND STADIUM UPGRADES
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA

SUBJECT: Updated Geotechnical Engineering and Geologic Hazards Report

CONTRACT
REF: Purchase Order No. 201551 by San Luis Coastal Unified School District, dated March 30, 2020, to Provide an Updated Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School Track and Stadium Upgrades, per Proposal by Earth Systems Pacific, Doc. No. SLO-2002-054.PRP, dated February 21, 2020

Dear Mr. Bonin:

As requested by Ms. Veronica Carrasco of PBK Architects, and in accordance with the referenced purchase order, this updated geotechnical engineering and geologic hazards report has been prepared for use in the development of plans and specifications for the proposed Track and Stadium Upgrades project at San Luis Obispo High School in San Luis Obispo, California. Our initial Geotechnical Engineering and Geologic Hazards Report (Initial Report) for this project (ESP 2016a) addressed the modernization of the stadium entrance, new kiosk/restroom facilities, relocation of the main bleachers, expansion/reconstruction of the existing track, and various surface improvements; recommendations for these items were intended to comply with the 2013 California Building Code (CBC). This updated report addresses new requirements for geohazards analysis and seismicity, including updated seismic coefficients, graphs and figures, as mandated by the 2019 CBC. Recommendations for the addition of new light pole foundations, as well as updated recommendations for moisture protection of interior slabs-on-grade, are also included. For all other geotechnical recommendations not covered by this Updated Report, please refer to the project's Initial Report (ESP 2016a), which is included in Appendix B. Two bound copies and an electronic copy of this report are furnished for your use.

We appreciate the opportunity to have provided services for this project and look forward to working with you again in the future. If there are any questions concerning this report, please do not hesitate to contact the undersigned.

Sincerely,

Earth Systems Pacific

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Copy to: PBK Architects, Attn.: Ms. Veronica Carrasco
Taylor & Syfan, Attn: Mr. Brian Dean

Doc. No.: 2004-082.SGR/cr

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APPENDIX B	Geotechnical Engineering and Geologic Hazards Report San Luis Obispo High School – Measure D Projects Stadium Entrance/Bleachers/Track (ESP 2016a)
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1.0 INTRODUCTION

The proposed project at San Luis Obispo High School will consist of the modernization of the stadium entrance, the relocation of the main bleachers, and the construction of an all-weather track. The project location is shown on Figure 1 – Site Vicinity Map. The proposed site layout is shown on Figure 2 – Exploration Location Map; all orientation is from project north.

Through our correspondence with Ms. Veronica Carrasco of PBK Architects and review of the site plan (PBK 2020), the main changes as described in our initial Geotechnical Engineering and Geologic Hazards Report (Initial Report) for this project (ESP 2016a) will consist of a single, roughly 1,000 square foot concessions/restroom building at the stadium entrance (instead of two separate 250 square foot structures), the addition of three new lanes to the existing track (totaling nine lanes), and new light poles. The light poles will be supported by drilled, cast-in-place concrete caissons or precast concrete foundation sleeves inserted in drilled holes; the poles will be located on the north and south sides of the track/stadium. It is our understanding that this project will be designed and constructed under the jurisdiction of the Division of the State Architect (DSA).

2.0 SCOPE OF SERVICES

The scope of work for this report included review of the Initial Report (ESP 2016a), review of the boring logs from the New Swimming Pool and Equipment/Locker Building project (Swimming Pool project) (ESP 2016b) to the immediate north of the site, geotechnical and geologic analyses of the data as related to the project and updates for the 2019 California Building Code (CBC), and preparation of this updated report. The analysis and subsequent recommendations were based on the site plan provided by PBK Architects (2020).

This report and geotechnical recommendations are intended to comply with the considerations of Sections 1803A.1 through 1803A.7, J104.3 and J104.4, as applicable, of the 2019 CBC; California Geological Survey (CGS) Note 48 (2019); Interpretation of Regulations (IR) Document A-4.13 (DSA 2016); and common geotechnical engineering and engineering geology practice in this area under similar conditions at this time. At the date of this report, DSA IR A-4.13 had not been updated for the 2019 CBC. It is assumed that this most current available version (DSA 2016) would be applicable for this Updated Report. The geotechnical test procedures were accomplished in general conformance with the standards noted, as modified by common geotechnical engineering practice in this area under similar conditions at this time.

Geotechnical and geologic parameters for this updated report consist of new requirements for geohazards analysis and seismicity, including updated seismic coefficients, graphs and figures, as mandated by the 2019 CBC, as well as for new light pole foundations and updated recommendations for moisture protection of interior slabs-on-grade. For all other recommendations not included in this Updated Report, please refer to the Initial Report (ESP 2016a) in Appendix B. It is our intent that this Updated Report and the Initial Report (ESP 2016a) be used exclusively by the client to form the geotechnical/geologic basis of the design, and in the preparation of plans and specifications. Application beyond this intent is strictly at the user's risk.

These reports do not address dewatering and other issues in the domain of contractors such as, but not limited to, site safety, loss of volume due to stripping of the site, shrinkage of soils during compaction, excavatability, shoring, temporary slope angles, construction means and methods, etc. Analyses of the soil for mold potential, asbestos in man-made products, lead, radioisotopes, hydrocarbons, or chemical properties (other than geotechnical corrosivity) are beyond the scope of this report. Ancillary features such as temporary access roads, and non-structural fills are not within our scope and are also not addressed.

As there may be unresolved geotechnical or geologic issues with respect to this project, the geotechnical engineer and engineering geologist should be retained to provide consultation as the design progresses, to review project plans as they near completion to assist in verifying that pertinent geotechnical and geologic issues have been addressed, and to aid in conformance with the intent of this report. In the event that there are any changes in the nature, design, or location of improvements, or if any assumptions used in the preparation of this report prove to be incorrect, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed, and the conclusions of this report are verified or are modified in writing. The criteria presented in this report are considered preliminary until such time as any peer review or review by any jurisdiction has been completed, conditions are observed by the geotechnical engineer and/or the engineering geologist in the field during construction, and the recommendations have been verified as appropriate or modified in writing.

3.0 GEOLOGY AND GEOLOGIC HAZARDS

In addition to the boring logs from the Initial Report (ESP 2016a), boring logs from the Swimming Pool Project (ESP 2016b) were also reviewed as data for our analysis in providing foundation

design parameters for the proposed light poles on the north side of the site. The borings for the Swimming Pool project (ESP 2016b) were drilled at the approximate locations shown on Figure 2 – Exploration Location Map. These borings were drilled at an elevation roughly 5 feet higher than the ground surface elevation where the proposed light poles will be constructed (Elev. 264 vs. 259, respectively) (Google Earth 2020). Up to 13.5 feet of fill was encountered in the borings for the Swimming Pool Project, which generally consisted of loose to dense poorly graded sands with variable amounts of clay, silt and gravel, and stiff sandy lean clays. Because the elevation of the proposed light poles at the north side of the track is roughly 5 feet below that of the Swimming Pool borings, we infer that up to 8.5 feet of fill of similar composition exists at the location of the light poles, the composition of which is confirmed by Borings 5 and 6 from the Initial Report (ESP 2016a). Below the fill, the borings for the Swimming Pool project (ESP 2016b) encountered Alluvium to the maximum depth explored of 26.5 feet below the existing ground surface (bgs), which consisted of medium stiff to very stiff sandy fat clays. Copies of the logs from our report (ESP 2016b) for the Swimming Pool Project are included in Appendix C.

Earth Systems Pacific provided a geologic hazards assessment for the site in the Initial Report (ESP 2016a) for this project. The geologic hazards assessments previously published are considered applicable for this project with the updates presented in this report. A detailed discussion of geology and geologic hazards is provided in the Initial Report (ESP 2016a). For this Updated Report, we re-evaluated the geologic hazards discussed in the Initial Report (ESP 2016a) and have summarized our findings below:

- The site is not within a State or County designated hazard zone for fault rupture (CGS 2020, County of San Luis Obispo 2020);

- There are no faults mapped on the San Luis Obispo High School campus. Since the publication of the latest geologic hazards report for the campus, which was for Building 100 (ESP 2018a), the State has provided new guidance that the 3rd California Earthquake Rupture Forecast (UCERF3) (USGS 2013) be used to model seismic hazards. We re-evaluated the seismic hazards for the site and the findings of our re-evaluation are presented in the following “Ground Motion Analyses” Section of this report. The notable change to the previous analysis is the addition of the Oceanic-West Huasna fault, located 2.6 miles from the site, which supersedes the Los Osos fault as the closest active fault to the site;

- The site is in a County designated zone of low liquefaction potential (County of San Luis Obispo 2020);

- The site is in a County designated zone of low landslide potential (County of San Luis Obispo 2020). Approximately 900 feet east of the project site, a slope classified by the County as having a high landslide potential forms the eastern boundary of the campus. Earth Systems Pacific evaluated this slope for potential as an off-site hazard to the project site in an Additional Assessment letter (ESP 2018b). Our assessment concluded that the slope was stable under both static and seismic conditions under design-level seismic shaking, which was confirmed by CGS in its review letter for stability of the slope (CGS 2018c), which is attached in Appendix D;

- The site is not within any State or County designated hazard zone for tsunami or dam inundation (CGS 2020, County of San Luis Obispo 2020);

- FEMA has mapped approximately the northwest ½ of the site within Zone X (0.2 percent annual chance flood), with the approximately southeast half of the site mapped within a zone of minimal flood hazard (FEMA 2012);

- The site is in a State designated zone of low radon potential (CGS 2020); and

- The potential for naturally occurring asbestos on site is low because serpentinite or serpentinized ultramafic rocks do not occur on the site.

4.0 GROUND MOTION HAZARD ANALYSES

In accordance with the CGS Note 48 Checklist (2019), 2019 CBC and ASCE 7-16 (2017), an assessment was made to determine the need for employing "Site-Specific Ground Motion Procedures" to calculate the ground motion parameters for the project. The S_1 ground motion value obtained from the Structural Engineers Association of California website (SEAOC 2020) using ASCE 7-16 (2017), for Site Class D - Stiff Soil, was 0.397g, greater than 0.2; therefore, per Section 11.4.8 of ASCE 7-16 (2017), the project requires site-specific ground motion analyses unless certain exceptions that relate to the building's period are met. Because we have no information on the fundamental periods of the proposed improvements, we performed a site-specific ground motion analysis to develop the seismic design parameters in accordance with Sections 11.4.8 and 21.2 of ASCE 7-16 (2017).

A risk-targeted maximum considered earthquake (MCE_R) modeling procedure was performed in accordance with ASCE 7-16 (2017), including a Probabilistic Seismic Hazard Analysis (PSHA) and a Deterministic Seismic Hazard Analysis (DSHA). These analyses are based on knowledge of the regional tectonic setting, geology, and seismicity. A PSHA using the United States Geological Survey Unified Hazard Tool (USGS 2020b) was used to access the Third California Earthquake Rupture Forecast (UCERF3) database (USGS 2013) and NGA-West2 ground motion prediction equations (PEER 2013) as described in Section 21.2.1.1 (Method 1) of ASCE 7-16 (2017) to estimate the peak ground motion corresponding to the uniform hazards earthquake and MCE_R which has a 2 percent probability of being exceeded in 50 years; and the USGS Risk-Targeted Ground Motions Calculator (USGS 2020a) to estimate potential ground motions at the project site that produce a 1 percent probability of collapse in 50 years as described in Section 21.2.1.2 (Method 2) of ASCE 7-16 (2017). The results of both methods were compared and the results of Method 2 were selected as best for the project.

For analysis purposes, we assumed the Oceanic-West Huasna fault as the causative fault, located 2.6 miles from the site. The Oceanic-West Huasna fault is a reverse-oblique fault and we specified a 58-degree dip and hanging wall conditions for the attenuation relationships. A magnitude of 7.1 was used as a basis to model fault rupture. The primary seismic risks are from earthquakes generated by the local Oceanic-West Huasna, Los Osos, Rinconada and San Luis Range faults and the more distant San Andreas fault. Although these listed faults are thought to potentially generate the most severe seismic shaking, any local fault could produce seismic shaking at the site.

The 2019 CBC seismic design criteria are based on a Design Earthquake that produces ground motion $^2/_3$ of the lesser of an earthquake with 2 percent probability of occurrence in 50 years, or maximum 84th percentile of the mean deterministic MCE. In this case the probabilistic spectra governed, scaled in accordance with ASCE 7-16 (2017) procedures.

Seismic Design Category

Section 1613A.2.5 of the 2019 CBC states that *structures classified as Risk Category I, II or III that are located where the mapped spectral response acceleration parameter at 1-second period, S_1, is greater than or equal to 0.75 shall be assigned to Seismic Design Category E, others shall be assigned to Seismic Design Category D*. The S_1 calculated for the site is 0.397, less than 0.75; therefore, the site should be assigned to Seismic Design Category D.

Seismic Design Parameters

This site may be subject to strong ground shaking due to potential fault movements along regional faults including the Oceanic-West Huasna fault, whose proximity and magnitude potential was considered during our site-specific analysis. The minimum seismic design should comply with the 2019 CBC and ASCE 7-16 (2017). The resulting seismic coefficients considering Site Class D are given in the table below.

SEISMIC PARAMETERS (2019 CBC/ASCE 7-16)

Seismic Design Category	D
Site Class	D
Mapped and Code Based Ground Motion	
Short Period Spectral Response, S_s	1.077 g
1 second mapped Spectral Response, S_1	0.397 g
Design Earthquake Ground Motion	
Short Period Spectral Response, S_{DS}	0.614 g
1 second Spectral Response, S_{D1}	0.529 g
Peak Ground Acceleration (PGA_M)	0.481 g
MCE Spectral Response Acceleration	
Short Period Spectral Response, S_{MS}	0.921 g
1 Second Period Spectral Response, S_{M1}	0.794 g
Site Amplification Factors	
Short Period Site Coefficient, F_a	1.07
1 Second Period Site Coefficient, F_v	2.50
Vertical Site Coefficient, C_v	1.32
Risk Coefficient (Short Period), C_{Rs}	0.898
Risk Coefficient (1 Second Period), C_{R1}	0.901

The estimated peak horizontal site acceleration based upon a probabilistic analysis (2 percent probability of occurrence in 50 years) is approximately 0.89g for this site. Vertical accelerations are typically ⅓ to ⅔ of the horizontal accelerations but can equal or exceed the horizontal accelerations depending upon the fault type, local site effects and amplification. Acceleration values provided are estimates only. Tables presenting the fault parameters and spectral response values are presented in Appendix E.

5.0 GEOTECHNICAL RECOMMENDATIONS

Recommendations for the addition of new light pole foundations, as well as updated recommendations for moisture protection of interior slabs-on-grade, are included in the sections below. For all other geotechnical recommendations not covered by this Updated Report, please refer to the project's Initial Report (ESP 2016a), which is included in Appendix B

Foundations

1. The light poles may be supported by drilled, cast-in-place caissons. Caisson dimensions and reinforcement should be in accordance with the requirements of the architect/engineer. The minimum caisson diameter should be 18 inches.

2. The light poles may also be supported by pre-cast pole bases that are inserted into drilled borings with a minimum 18-inch diameter. The annular space between the pole base and excavation sidewalls should be filled with slurry or concrete as designated by the designer.

3. The caissons/pole bases should be designed to derive support from skin friction against the Alluvium below the existing fill, which begins at approximately 8.5 feet bgs and 6 feet bgs at the north and south sides, respectively. No vertical capacity within the existing fill should be included in the capacity calculations. Caisson/pole base foundations should have a minimum embedment of 10 feet into the underlying Alluvium.

4. The caissons/pole bases may be designed using a downward (compressive) allowable skin friction value of 500 psf within the Alluvium. Skin friction and downdrag in the fill, as well as end bearing capacity, should not be used in the calculations.

5. An allowable skin friction value of 350 psf can be used for short-term tension (uplift) conditions within the Alluvium. The self-weight of the caissons/pole bases may be neglected in the determination of loading, however it may be included, if needed, for resistance to uplift. Tension (uplift) capacity in the fill should be neglected.

6. The allowable skin friction values for the caissons/pole bases may be increased by one-third when transient loads such as wind or seismicity are included. Foundations should be designed using the site design response parameters in the "Ground Motion Hazard Analyses" Section of this report.

7. An ultimate passive resistance based on an equivalent fluid pressure of 250 pcf in the existing fill, and 350 pcf in the Alluvium, up to a maximum uniform pressure of 2,000 psf, acting over 2 caisson/pole base diameters, may be taken for resistance to short term lateral loads. The structural engineer should apply an appropriate factor of safety to the ultimate values presented above.

8. Although groundwater was not encountered in the borings for the Swimming Pool project (ESP 2016b), seasonal high groundwater levels recorded near the site were as shallow as 23 feet bgs. Perched groundwater conditions may also exist. Given the groundwater conditions above, there is a potential that subsurface water will be encountered during the caisson/pole base drilling operations, especially if construction proceeds during or immediately following the local rainy season. Therefore, caisson reinforcing should be designed to accommodate a minimum 5-inch diameter tremie pipe for concrete placement. The reinforcing should also be designed to facilitate removal of the casing during concrete placement, and additional coverage over reinforcing steel is recommended to account for likely difficult concrete placement conditions. All water encountered should be removed from the caisson/pole base excavation prior to placing concrete, or the concrete should be tremied. The tremie method is described in Appendix F.

9. Loose debris and slough material should be removed from caisson excavations by means of a clean-out bucket.

10. Concrete used in caissons and to fill the annular spaces for the pole bases should be placed at a slump between 6 and 8 inches in dry excavations and between 8 and 10 inches when placed under water. The concrete in the upper 8 to 10 feet of the caissons/pole bases should be mechanically consolidated following placement.

11. The caissons/pole bases should not deviate from a plumb line taken from the center of the caisson by more than 2 percent of the caisson/pole base length, from the top to the point of interest. Adequate caisson or pole base excavation oversize may be assumed to provide required tolerance.

12. All caisson excavations should be filled with concrete on the same day as they are drilled; the pole bases and slurry/structural concrete should be placed in the pole base

excavations the same day they are drilled. If this is not practicable, the caissons/pole base should be secured in a safe manner in conformance with OSHA requirements or other applicable safety standards until slurry/concrete can be placed. Any caisson/pole base excavation that has not been filled with slurry/concrete on the same day as it was drilled should have the surfaces "freshened" by extending the rotating auger into and out of the hole several times, immediately prior to placement of the slurry/concrete. The bottom of the hole should then be cleaned out again by means of the clean-out bucket.

13. Caisson/pole base excavations should be observed by the geotechnical engineer during drilling operations to confirm the subsurface conditions and prior to placement of reinforcing steel, pole bases and slurry/concrete. Special inspection should be provided as per Section 1705A.8 and Table 1705A.8 of the 2019 CBC; the special inspector should be under the direction of the geotechnical engineer. The following operations should be subject to special inspection:

    - Inspection of drilling operations and construction records for each element
    - Caisson/pole base location, plumbness, embedment and friction capacity
    - Reinforcing steel and concrete placement per 2019 CBC Section 1705A.3

14. The Corrosivity Analysis by CERCO Analytical, Inc. in Appendix C of the Initial Report (ESP 2016a) should be used by the architect/engineer in specifying appropriate corrosion protection measures for foundations.

Moisture Protection for Interior Slabs-on-Grade

1. Due to the current use of impermeable floor coverings, water-soluble flooring adhesives, and the speed at which buildings are now constructed, moisture vapor transmission through slabs is a much more common problem than in past years. Where moisture vapor transmitted from the underlying soil would be undesirable, slabs should be protected from subsurface moisture vapor. A number of options for vapor protection are discussed below; however, the means of vapor protection, including the type and thickness of the vapor retarder, if specified, are left to the discretion of the architect/engineer.

2. Where specified, vapor retarders should conform to ASTM Standard E 1745-17. This standard specifies properties for three performance classes; Class A, B and C. The

appropriate class should be selected based on the potential for damage to the vapor retarder during placement of slab reinforcement and concrete. Unless it is determined that a permeance of 0.10 perms will not allow vapor to accumulate beneath moisture-sensitive flooring, adhesives, stored products and/or equipment, then a vapor retarder permeance of 0.010 perms is recommended, per ACI 302.1-15. Permeance of vapor retarders should remain below 0.010 perms after the conditioning tests of ASTM E 1745-17.

Note: ASTM E 1745-17 has the same permeance threshold for Class A, B and C (0.1 perms). The class that is chosen will make a difference in how resistant the vapor retarder is to punctures and tears, but it will not ensure any better permeance values to protect floor coverings.

3. Several recent studies, including those of American Concrete Institute Committee 302 (ACI 2015), have concluded that excess water above the vapor retarder increases the potential for moisture damage to floor coverings and could increase the potential for mold growth or other microbial contamination. The studies also concluded that it is preferable to eliminate the typical sand layer beneath the slab and place the slab concrete in direct contact with a Class A vapor retarder, particularly during wet weather construction. However, placing the concrete directly on the vapor retarder requires special attention to using the proper vapor retarder, a very low water-cement ratio in the concrete mix, and special finishing and curing techniques.

4. Another option that may be a reasonable compromise between effectiveness and cost considerations is the use of a subslab vapor retarder protected by a sand layer. If a Class A vapor retarder is specified, the retarder can be placed directly on the subgrade. The retarder should be covered with a minimum 2 inches of clean sand. If a less durable vapor retarder is specified (Class B or C), a minimum of 4 inches of clean sand should be provided, and the retarder should be placed in the center of the clean sand layer. Clean sand is defined as a well or poorly graded sand (ASTM D 2487-17) of which less than 3 percent passes the No. 200 sieve. Clean sand is considered to be part of the minimum 18 inches of imported nonexpansive materials recommended in the Initial Report (ESP 2016a) to be placed below interior slabs-on-grade, not in addition to it.

5. Regardless of the underslab vapor retarder selected, proper installation of the retarder per ASTM E 1643-18a is critical for optimum performance. Where utilized, the vapor retarder should be placed a minimum of 1 inch above the flow line of the drainage path surrounding the structures, or 1 inch above the area drain grates if area drains are used to collect runoff around the structures. As required by ASTM E 1643-18a, all seams and utility penetrations should be properly sealed. At terminating edges of the vapor retarder, the vapor retarder should be effectively sealed with accessories specifically designed to seal the material to new or existing concrete; details for edge sealing of the vapor retarder should be provided by the architect/engineer.

6. If the sand is used between the vapor retarder and the slab, it should be moistened only as necessary to promote concrete curing; saturation of the sand should be avoided, as the excess moisture would be on top of the vapor retarder, potentially resulting in vapor transmission through the slab for months or years.

7. Positive drainage away from the structures should be maintained; see the "Drainage and Maintenance" Section of the Initial Report (ESP 2016a) for additional discussion of this issue. If water is allowed to pond near the structures, it may seep into the ground and migrate laterally through cracks or utility penetrations in the foundations, ultimately gaining access above the vapor retarders.

6.0 CLOSURE

Our intent was to perform the investigation in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the locality of this project under similar conditions. No representation, warranty, or guarantee is either expressed or implied. This report is intended for the exclusive use by the client as discussed in the "Scope of Services" Section. Application beyond the stated intent is strictly at the user's risk.

This report is valid for conditions as they exist at this time for the type of project described herein. The conclusions and recommendations contained in this report could be rendered invalid, either in whole or in part, due to changes in building codes, regulations, standards of geotechnical or construction practice, changes in physical conditions, or the broadening of knowledge.

If changes with respect to the project become necessary, if items not addressed in this report are incorporated into plans, or if any of the assumptions used in the preparation of this report are

not correct, this firm shall be notified for modifications to this report. Any items not specifically addressed in this report should comply with the CBC of other applicable standards, and the requirements of the governing jurisdiction.

The recommendations presented in this geotechnical report are based upon the geotechnical conditions encountered at the site and may be augmented by additional requirements of the client, or by additional recommendations provided by the geotechnical engineer based on peer or jurisdiction reviews, or conditions exposed at the time of construction. If Earth Systems Pacific is *not* retained to provide construction observation and testing services, it shall not be responsible for the interpretation of the information by others or any consequences arising therefrom.

This document, the data, conclusions, and recommendations contained herein are the property of Earth Systems Pacific. This report shall be used in its entirety, with no individual sections reproduced or used out of context. Copies may be made only by Earth Systems Pacific, the client, and the client's authorized agents for use exclusively on the subject project. Any other use is subject to federal copyright laws and the written approval of Earth Systems Pacific.

Thank you for this opportunity to have been of service. If you have any questions, please feel free to contact this office at your convenience.

End of Text.

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APPENDIX A

Figure 1 – Site Vicinity Map
Figure 2 – Exploration Location Map



N

NOT TO SCALE

BASE MAP PROVIDED BY: Google Earth

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SITE VICINITY MAP

San Luis Obispo High School Track and Stadium Upgrades
1499 San Luis Drive
San Luis Obispo, California

Date
April 2020

Project No.
300933-017

Figure 1

8x11–111218Master



LEGEND

B1 — Boring Location (ESP 2016a) (Approx.)

B-1 — Boring Location (ESP 2016b) (Approx.)

BASE MAP PROVIDED BY: Google Earth

NOT TO SCALE

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EXPLORATION LOCATION MAP

San Luis Obispo High School Track and Stadium Upgrades
1499 San Luis Drive
San Luis Obispo, California

Date
April 2020

Project No.
300933-017

Figure 2

8x11–012915Master

APPENDIX B

Geotechnical Engineering and Geologic Hazards Report
San Luis Obispo High School – Measure D Projects
Stadium Entrance/Bleachers/Track (ESP 2016a)

GEOTECHNICAL ENGINEERING
AND GEOLOGIC HAZARDS REPORT
SAN LUIS OBISPO HIGH SCHOOL – MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3109

April 18, 2016

Prepared for

Mr. Anthony Palazzo
Director – Buildings, Grounds and Transportation
San Luis Coastal Unified School District

Prepared by

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April 18, 2016

FILE NO.: SL-16605-SC

Mr. Anthony Palazzo
Director – Buildings, Grounds and Transportation
San Luis Coastal Unified School District
937 Southwood Drive
San Luis Obispo, CA 93401

PROJECT: SAN LUIS OBISPO HIGH SCHOOL – MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 SAN LUIS DRIVE, SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3109

SUBJECT: Geotechnical Engineering and Geologic Hazards Report

CONTRACT REF: Purchase Order No. 161190 by San Luis Coastal Unified School District, dated December 7, 2015, Referencing Earth Systems Pacific Proposal to Provide a Geotechnical Engineering Investigation, Soil Corrosivity Analysis and Geologic Hazards Assessment, dated November 25, 2015

Dear Mr. Palazzo:

In accordance with the referenced Purchase Order, this geotechnical engineering and geologic hazards report has been prepared for use in the development of plans and specifications for the Stadium Entrance / Bleachers / Track Project planned at San Luis Obispo High School in San Luis Obispo, California. Preliminary geotechnical recommendations are presented herein for the following: site preparation; grading; utility trenches; foundations and track curbs; slabs-on-grade; retaining walls; Portland cement concrete (PCC) pavers, and asphalt concrete (AC) paths and pavement; drainage and maintenance; and observation and testing. Our evaluation of geologic hazards is by reference to our investigation and report submitted recently for the proposed Annex / Classroom Building project to the north of this site, and updated as applicable for the subsurface conditions encountered in the exploratory borings for this project. The results of geotechnical corrosivity testing, which was subcontracted to CERCO Analytical of Concord, California, are also included. Two bound copies and an electronic copy of this report are furnished for your use.

We appreciate the opportunity to have provided services for this project and look forward to working with you again in the future. If there are any questions concerning this report, please do not hesitate to contact the undersigned.

Sincerely,

Earth Systems Pacific

Fred J. Potthast, GE
Principal Engineer

for Richard T. Gorman, CEG
Principal Geologist

Doc. No.: 1604-056.SGR/rw

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1.0 INTRODUCTION AND SITE SETTING

The proposed project at San Luis Obispo High School will consist of the modernization of the stadium entrance, the relocation of the main bleachers, and the construction of an all-weather track. The stadium entrance will likely be of masonry and ornamental/structural steel design, and may include an archway. Two combination kiosk/restroom structures will be constructed on either side of the entrance; these structures will have footprints of approximately 250 square feet each, and will likely be of masonry construction. Conventional continuous and spread footings have been assumed for the entrance area improvements, with slabs-on-grade for the structures. Portland cement concrete (PCC) flatwork, PCC pavers, or asphalt concrete (AC) paths, or some combination of these, may be used for pedestrian and light maintenance vehicle traffic in the entrance area. Reconstruction of nearby AC pavement for vehicles may also be included with the project. The main bleachers will be relocated approximately 10 to 30 feet to the southwest, to allow the addition of lanes to the main straightaway portion of the track. The bleachers will continue to be supported by a combination of conventional continuous and spread footings; the area below the stands may be improved with PCC flatwork or a thin layer of aggregate base (AB) for housekeeping purposes. The track is expected to be improved with a rubberized or similar all-weather surface, and improved drainage systems. The all-weather surface may be placed over a layer of AC, however this and other details are yet to be determined.

For the purposes of this report, maximum dead plus live loads on continuous footings of 2,000 plf, and maximum dead plus live loads on spread footings of 25 kips, have been assumed for the entrance area structures. For the bleachers, maximum dead plus live loads on continuous footings of 2,000 plf, and maximum dead plus live loads on spread footings of 75 kips have been assumed. Retaining walls for sitework, or connected to or forming part of the structures, and a maximum of 5 feet tall, may also be utilized. The new and reconstructed facilities will be served by the campus utility systems via new or existing underground connections. Landscaping is anticipated beyond the limits of all improved surfaces in the project area.

To our knowledge, no drainage basins are planned. Infiltration systems or other types of low-impact development (LID) features may be included in the final design; however, these have not been determined as of the date of this report, and therefore these potential features are not addressed.

The stadium and surrounding track are on the west side of the campus, north of the student parking lot and south of the main gymnasium and varsity baseball practice field. The track is currently surfaced with a material locally termed “decomposed granite” or “DG”. Drainage around the track is fair to poor. The main bleachers are on the south side of the track; several mature trees will require removal and the AC-paved parking area south of the bleachers will require reconfiguration to allow the bleachers to be relocated. The stadium entrance area is at

the southeast corner of the track. It is delineated by a perimeter chain-link fence and several mature trees, and it is paved with AC that is in poor condition. Temporary restroom, equipment storage, barbeque and concession facilities are currently present in this area. Drainage in the entry area appears to be by sheet flow toward the parking and driveway areas to the southeast. The locations and dispositions of utility lines in this project area are unknown.

The approximate coordinates and elevation of the center of the project area, as obtained from the Google Earth website (Europa Technologies 2016), are latitude 35.2826N, longitude 120.6514W, and 254 feet above mean sea level.

2.0 SCOPE OF SERVICES

The scope of work for this report consisted of the following: a general site reconnaissance by a registered geotechnical engineer; subsurface exploration by drilled borings; geotechnical and corrosivity laboratory testing of samples secured from the borings; review of the geotechnical engineering and geologic hazards report for the nearby Annex / Classroom Building project (ESP 2016a); geotechnical and geologic analyses of the data; and preparation of this report. The analysis and subsequent recommendations were based on general information provided by the client, and a concept site plan for the school (PMSM Architects 2015).

This report and preliminary geotechnical recommendations are intended to comply with the considerations of Sections 1803A.1 through 1803A.7, J104.3 and J104.4, as applicable, of the 2013 California Building Code (CBC); California Geological Survey Note 48 (CGS 2011); Interpretation of Regulations (IR) Document A-4.13 (DSA 2013); and common geotechnical engineering and engineering geology practice in this area under similar conditions at this time. The geotechnical test procedures were accomplished in general conformance with the standards noted, as modified by common geotechnical engineering practice in this area under similar conditions at this time.

Preliminary geotechnical recommendations are presented herein for the following: site preparation; grading; utility trenches; foundations and track curbs; slabs-on-grade; retaining walls; Portland cement concrete (PCC) pavers, and asphalt concrete (AC) paths and pavement; drainage and maintenance; and observation and testing. The results of the corrosivity analysis subcontracted to CERCO Analytical are also included. It is our intent that this geotechnical/geologic report be used exclusively by the client in the preparation of plans and specifications. Application beyond this intent is strictly at the user's risk.

As there may be geotechnical issues yet to be resolved, the geotechnical engineer should be retained to provide consultation as the design progresses, to assist in verifying that the pertinent geotechnical issues have been addressed and to aid in the conformance with the intent of this

report. It may also be advantageous to retain the geotechnical engineer to review the project plans as they near completion, to further aid in conformance of the plans with the intent of this report.

This report does not address issues in the domain of contractors such as, but not limited to, site safety, loss of volume due to stripping of the site, shrinkage of soils during compaction, excavatability, shoring, temporary slope angles, construction means and methods, etc. Analyses of the soil for mold potential, man-made asbestos, lead, radioisotopes, hydrocarbons, or chemical properties (other than geotechnical corrosivity) are beyond the scope of this report. Ancillary features such as temporary access roads, fences, flag and light poles, signage; and nonstructural fills are not within our scope and are also not addressed.

In the event that there are any changes in the nature, design, or location of improvements, or if any assumptions used in the preparation of this report prove to be incorrect, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are verified or are modified in writing. The criteria presented in this report are considered preliminary until such time as any peer review or review by any jurisdiction has been completed, conditions are observed by the geotechnical engineer in the field during construction, and the recommendations have been verified as appropriate or modified in writing.

3.0 FIELD INVESTIGATION

On January 15, 2016, eight exploratory borings were drilled in the project area to a maximum depth of 43.5 feet below the existing ground surfaces. The borings were drilled with a Mobile Drill Model B-53 truck mounted drill rig, equipped with 6-inch outside diameter hollow stem auger and an automatic trip hammer for sampling. The approximate locations of the borings are shown on the Boring Location Map in Appendix A. As the borings were drilled, soil samples were obtained using a ring-lined barrel sampler (ASTM D 3550-01/07 with shoe similar to D 2937-10). Standard penetration tests were also performed (ASTM D 1586-11) at selected depths. Bulk soil samples were obtained from the auger cuttings. The borings were backfilled with auger cuttings and patched at the surface with either quick-setting PCC or cold-mix AC (where applicable).

Soils encountered in the borings were categorized and logged in general accordance with the Unified Soil Classification System and ASTM D 2488-09a. Where bedrock was encountered, its properties were described based upon observation of the auger cuttings and the effort required to drill into it. Copies of the boring logs and a Boring Log Legend are included in Appendix A. In reviewing the boring logs and legend, the reader should recognize that the legend is intended as a guideline only, and there are a number of conditions that may influence the soil characteristics as observed during drilling. These include, but are not limited to, the presence of cobbles or

boulders, cementation, variations in soil moisture, presence of groundwater, and other factors. It should also be noted that the descriptions of bedrock must span a much wider range of density and strength characteristics than soil, and are relative to other bedrock strata. For example, fractured and weathered bedrock may be described as "soft," yet it will be considerably harder than almost any type of soil. Conversely, a clay soil may be described as "stiff," however it will not be nearly as hard as even "moderately soft" bedrock such as the serpentinite encountered on this site. Consequently, the logger must exercise judgment in interpreting the subsurface characteristics, possibly resulting in soil and bedrock descriptions that vary somewhat from the legend.

4.0 LABORATORY ANALYSIS

The ring samples obtained from the borings were tested for unit weight and moisture (ASTM D 2937-10, modified for ring liners). Two bulk samples were tested for maximum density and optimum moisture content (ASTM D 1557-12), expansion index (ASTM D 4829-11), and cohesion and angle of shearing resistance by direct shear (ASTM D 3080-11, recompacted to 90 percent of maximum dry density, and modified for consolidated, undrained conditions). One SPT sample was tested for moisture content (ASTM D 2216-10) and plasticity index (ASTM D 4318-10). The geotechnical laboratory test results are presented in Appendix B.

Two soil samples were submitted to CERCO Analytical for geotechnical corrosivity testing. CERCO Analytical's Corrosivity Analysis is presented in Appendix C.

5.0 GENERAL SUBSURFACE AND GEOLOGIC PROFILE

The subsurface soil and geologic profile observed in the borings generally consisted of fill over alluvium, with bedrock at depth.

A pavement section of 2.5 inches of AC over 6 inches of AB was found in Boring 1, off the southwest corner of the existing bleachers. Below the pavement was medium dense clayey sand fill. At 4 feet, alluvium was encountered; the alluvium consisted of stiff sandy lean clay with varying percentages of gravel to 9 feet, followed by medium dense clayey sand to 15 feet, with some gravel below 12 feet. The alluvium continued as medium dense clayey sand with gravel to 23 feet, and medium dense to loose well graded sand with a trace of clay to 40.5 feet. Below the alluvium was moderately soft bedrock (serpentinite) of the Franciscan Mélange.

In Boring 2 off the southeast corner of the existing bleachers, the flatwork at the surface was 4 inches of PCC over 6 inches of well graded sand. Underlying the flatwork was fill consisting of medium dense clayey sand with a trace of gravel. The clay fraction increased below 5 feet. Stiff

sandy lean clay alluvium was found from 6 feet to the boring termination depth of 16.5 feet. The alluvium contained some gravel between 13 and 14.5 feet.

The track surface found in Borings 3 through 6 consisted of 7.5 to 8 inches of dense, dark brown silty clayey gravel, locally termed "decomposed granite" or "DG". Below the track surface was fill consisting of medium stiff to stiff sandy lean clay. The clay fill continued to the termination depth of 5 feet in Borings 3 and 6. In Borings 4 and 5, 1 foot of loose clayey sand fill was found before the termination depth of 5 feet.

In the stadium entrance area, the existing pavement sections at the surface in Borings 7 and 8 were 2.5 to 2.75 inches of AC over 6 to 7 inches of AB. Boring 7 found fill consisting of medium dense clayey sand with varying percentages of gravel to 7.5 feet, followed by stiff sandy lean clay alluvium with a trace of gravel to the boring termination depth of 16.5 feet. The fill below the pavement in Boring 8 was stiff sandy lean clay with some gravel to 4.5 feet, and medium dense clayey sand with varying percentages of gravel to 9 feet. The alluvium below the fill was stiff sandy lean clay, which extended to the termination depth of 16.5 feet.

Please refer to the logs in Appendix A for a more complete description of the subsurface conditions encountered in the borings.

6.0 GROUNDWATER

Subsurface water encountered in Boring 1 at a depth of 34 feet; subsurface water was not encountered in any of the other borings.

7.0 GEOLOGY, SEISMICITY AND GEOLOGIC HAZARDS

A geotechnical engineering and geologic hazards report was recently completed by this firm for the Annex / Classroom Building project (ESP 2016a), which is approximately 900 feet northeast of this project site. That report, and several of the references noted in it, were reviewed as part of the work scope for this project. Based on the subsurface conditions encountered in the borings for this project, in our opinion, the conclusions and recommendations with respect to geology, seismicity and geologic hazards presented in the report for the Annex / Classroom Building project (ESP 2016a) would also be valid for this project, with the exception of the following: liquefaction and seismically induced settlement, flooding and naturally occurring asbestos. A copy of the Annex / Classroom Building project report is included in Appendix D. It is our opinion that there are no significant local or regional geologic conditions, including those identified in the following paragraphs, which would preclude construction of the Bleachers / Stadium Entrance / Track project as described in the "Introduction" Section of this report.

Liquefaction and Seismically Induced Settlement

The term "liquefaction" refers to a phenomenon that tends to occur in saturated soils of low density that have grain sizes within a certain range, usually fine to medium-grained poorly graded sands, silty sands, and silts. A sufficiently strong earthquake is also required to cause liquefaction. During liquefaction, the energy from the earthquake causes the water pressure within the pores of the soil to increase. The increase in water pressure significantly decreases the friction between the soil grains, allowing the soil grains to move relative to one another. During this state, the soil will behave as a viscous liquid, temporarily losing its ability to fully support foundations and other improvements. The high pressure water will flow through the soil along the path of least resistance. As the pressure is released, the soils typically settle in a process called "seismically induced" or "dynamic" settlement. Dynamic settlement can also occur in certain types of loose to medium dense sands above the groundwater; this is typically referred to as "dry sand settlement." Dynamic settlement can cause damage to structures and other surface and subsurface improvements.

Liquefaction analysis requires various input parameters, chiefly depth to groundwater. Groundwater was encountered at a depth of 34 feet in Boring 1, drilled on the south side of the existing bleachers. The most recent information obtained for subsurface water elevations in this area was for environmental studies of monitoring wells (Trihydro Corporation, 2005) in San Luis Drive, approximately 200 feet south of Boring 1. This information indicates a seasonal high groundwater elevation of approximately 23 feet; this depth to groundwater was used in the analysis.

Liquefaction analysis also requires an earthquake magnitude and a peak mean ground acceleration (PGA_M). The seismicity of nearby faults was analyzed by deaggregating fault characteristics (USGS 2016) to determine the statistical mean and modal earthquake magnitudes that contributed to the site's PGA_M. These two magnitudes were then compared and the higher of the two was used in the analysis. In this case, the modal magnitude was higher than the mean magnitude; the modal magnitude was 6.79. The PGA_M value of 0.479g per our report for the Annex / Classroom Building project (ESP 2016a) was also utilized.

Using the developed seismic values, liquefaction potential at the site was analyzed following the guidelines of Special Publication 117A (CDMG 1997/2008), and recommended procedures for analyzing liquefaction potential (Martin and others 1999) using the "Simplified Procedure" as presented at the NCEER workshop and summarized by Youd and Idriss (2001). The analysis also considered information presented by Seed et al. (2003), and Idriss and Boulanger (2004). A factor of safety of 1.30 was used to determine the liquefaction potential.

The results of the analysis, included in Appendix E, indicate a potential for dynamic settlement of approximately 3.3 inches under the conditions analyzed. All but a few hundredths of an inch of the calculated settlement is expected to occur at depths between 27.5 feet and the bedrock surface at 40.5 feet. The surface manifestation of such liquefaction would likely be fairly well attenuated by its depth. Therefore, in our opinion, based on the considerations given in Special Publication 117A (CDMG 1997/2008), properly designed conventional foundation systems for the bleacher relocation and the entrance improvement structures should be capable of withstanding a potential liquefaction event. In addition, based on the conditions noted in our geotechnical engineering and geologic hazards report for the Student Services / Administration Building (ESP, 2016b) approximately 300 feet northwest of the stadium entrance area, bedrock was found at depths of 6 to 22.5 feet below grade. Although Borings 7 and 8 in the stadium entrance area were not extended to the rock, it is likely that the rock is significantly shallower in this area than the 40.5-foot depth found in Boring 1, therefore the potential for liquefaction in that area could be significantly reduced or even eliminated.

Flooding

According to the Flood Insurance Rate Map Number 06079C1067G (FEMA November 16, 2012), the Bleacher and Track areas are partially within Flood Zone X, and partially outside of Flood Zone X. The Stadium Entrance area is outside of Flood Zone X (See the FEMA Flood Zone Map in Appendix E). Flood Zone X indicates areas that have been determined to have less than a 0.2 percent chance of being flooded in any given year.

Naturally Occurring Asbestos

Asbestos bearing rock units within the central coast area generally consist of serpentinite, ultra-mafic rock units consisting of olivine-hornblende and some schist metamorphic rock units. Based on our research and review of the borings logs, the project site is predominately underlain by a thick deposit of clayey soil alluvium. Serpentinite was encountered in Boring 1 at a depth of 40.5 feet. As the site preparation, grading and foundation recommendations provided later in this report do not involve excavation to depths that would reach the serpentinite, in our opinion, the potential for naturally occurring asbestos to be encountered on the site during construction is considered to be nil.

8.0 CONCLUSIONS

In our opinion, the site is suitable, from a geotechnical engineering standpoint, for the proposed Stadium Entrance / Bleachers / Track project, as described in the “Introduction” Section of this report, provided the recommendations contained herein are implemented in the design and

construction. The primary geotechnical engineering concerns are the potential for differential settlement from the existing fill, the expansion potential of the soils, and the erodible nature and corrosive potential of the soils. Provided that the building areas are prepared as recommended in the "Grading" Section of this report, conventional continuous and spread (pad) foundations may be used to support the bleachers in their modified position to the south, and the structures planned at the stadium entrance.

Differential settlement can occur when a foundation spans materials having variable consolidation characteristics, such as the fill that was found in the upper 4 to 9 feet of Borings 1, 2, 7 and 8, where the structures are planned. We are unaware of any documentation (i.e., grading observation or compaction testing records) regarding the placement of the fill, but it was likely placed during the general development of the campus. Undocumented fill has a greater potential for variability than fill that has been placed and tested in a controlled earthwork program. However, given the sizes and types of the proposed structures, the risk of differential settlement due to variable fill soils at depth is considered tolerable; a program of overexcavation and recompaction of only the upper fill soils in the bleachers and stadium entrance areas is recommended prior to construction.

Expansion index testing yielded results of 67 and 62 for the upper soils. Per CBC Section 1803A.5.3, the soils are considered to be expansive. The more commonly used ASTM classification is that the soils would be considered to have "medium" expansion potential. Expansive soils tend to swell with increases in soil moisture and shrink as soil moisture decreases; the upper 3 to 5 feet of any soil profile is the zone most affected by these seasonal soil moisture fluctuations. The volume changes that the soils undergo in this cyclical pattern can stress and damage foundations and slabs-on-grade if precautionary measures are not incorporated during design and in the construction procedure. Footings are typically deepened and additional reinforcement is provided. Imported nonexpansive soils are recommended to be placed beneath slabs-on-grade. For the track, a layer of imported aggregate base (AB) with interior and exterior perimeter curbs are recommended to provide protection for the all-weather surface. To reduce the potential for loss of the AB into expansion cracks of the underlying subgrade in the event of prolonged drought, a geotextile filter fabric should be placed between the subgrade and the AB. A possible alternative to a thickened layer of AB below the all-weather surface would be lime treatment of the native soils, however this process may be more expensive, the results could be less predictable than the use of an AB layer for this type of project, and the lime could affect the adjacent football playing field turf. Therefore, lime treatment was not considered as a viable option.

The site soils are considered to be erodible. It is essential that all surface drainage be controlled and directed to appropriate discharge points, and that surface soils, particularly those disturbed during construction, are stabilized by vegetation or other means *during and following construction*.

As indicated in the Soil Corrosivity Study by HDR, Inc., for the Annex / Classroom Building project (ESP 2016a, copy in Appendix D), the electrical resistivities of the samples tested were in the moderately corrosive categories with as received moisture contents; when saturated, the resistivities were in the corrosive to severely corrosive categories. Soil pH values were mildly alkaline. The soluble salt contents of the soils were low to moderate. Soil nitrate concentrations were high. The soils were classified as severely corrosive to ferrous metals and aggressive to copper. These results were essentially confirmed by CERCO Analytical through testing of samples from the Stadium Entrance / Bleachers / Track area; CERCO Analytical's corrosivity analysis is included in Appendix C of this report. Therefore, in our opinion, the recommendations regarding protection of pipelines, buried concrete structures and other improvements contained in the CERCO Analytical report (Appendix C) and in the Soil Corrosivity Study by HDR, Inc. for the Annex / Classroom Building project (ESP 2016a, copy in Appendix D) would be appropriate for this project.

9.0 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

The following recommendations are for improvements constructed as described in the "Introduction" section of this report. If locations, elevations, structural loads, etc., change, the recommendations contained herein may require modification. In developing the following recommendations, it was assumed that irrigated landscaping or flatwork that would keep the soils relatively uniform, year-round moisture will be installed for a zone of at least five feet around the perimeter of all improvements.

Two distinct types of Portland cement concrete (PCC) slabs-on-grade are discussed in the following recommendations. Interior slabs for the kiosk/restroom structures at the stadium entrance are defined as "slabs-on-grade." Sidewalks that will not support vehicle traffic and housekeeping slabs (if any) below the bleachers referred to as "exterior pedestrian flatwork." Asphalt concrete (AC) paths may also be utilized for pedestrian and light maintenance vehicle access, however it is also assumed that they will not support conventional vehicle traffic; separate AC pavement sections for vehicle traffic are provided. Recommendations for PCC pavers for pedestrians and vehicle traffic are also provided.

Unless otherwise noted, the following definitions are used in the recommendations presented below. Where terms are not defined, definitions commonly used in the construction industry are intended.

- **Kiosk / Restroom Building Areas –** The kiosk / restroom building areas are defined as the areas within and extending a minimum of 5 feet beyond the perimeter of the foundations for the kiosk/restroom structures at the stadium entrance. The building areas include any retaining walls, covered walkways or other improvements that are connected to a structure and that are intended to act in a manner similar to it.
- **Bleacher and Entrance Structure Foundation Areas –** The foundation areas are defined as the areas within and extending a minimum of 3 feet beyond the perimeter of the continuous and/or spread foundations for the bleachers, and for the entrance structure at the stadium entrance.
- **Exterior Pedestrian Flatwork and AC Path Areas –** The areas within the footprints of all exterior pedestrian flatwork, all AC paths for pedestrian use, and housekeeping slabs (if any) placed below the relocated bleachers, including and perimeter curb and/or gutter improvements.
- **PCC Paver and AC Pavement Areas –** The areas within the footprints of PCC pavers, or AC pavement for vehicle use, including any perimeter curb and/or gutter improvements.
- **Track Area –** The area within the footprint of the track, including the interior and exterior perimeter curbs.
- **Sitework Retaining Wall Areas –** The areas within and extending a minimum of 3 feet beyond the foundation limits of all sitework retaining walls.
- **Grading Area –** The entire area to be graded, including the building, bleacher and entrance structure foundation area, exterior pedestrian flatwork, PCC paver, AC path and pavement areas, the track area and sitework retaining wall areas.
- **Existing Grade –** Elevations of the site that existed as of the date of this report.
- **Finish Pad Grade –** The elevation in the building area where earthwork operations are typically considered to be complete. It does not include any sand or gravel that might be placed below slabs-on-grade in association with vapor protection for the slabs.
- **Subgrade –** The elevation in exterior pedestrian flatwork, PCC paver and AC path and pavement areas where imported nonexpansive materials, sand, or aggregate base (AB) are placed to support the flatwork, pavers or AC.
- **Scarified –** Plowed or ripped in two orthogonal directions to a depth of not less than 8 inches.

- **Moisture Conditioned –** Adjusting the soil moisture to optimum moisture content, or just above, prior to application of compactive effort.
- **Compacted/Recompacted –** Soils placed in level lifts not exceeding 8 inches in loose thickness and compacted to a minimum of 90 percent of maximum dry density. Based on maximum dry density by ASTM D 1557-12 and field density by ASTM D 6938-15, or other methods acceptable to the geotechnical engineer and jurisdiction.

Site Preparation

1. The ground surface in the grading areas should be prepared for construction by removing the existing structures, existing AC pavement and flatwork, and all other improvements, vegetation, large roots, debris, organic topsoil, and other deleterious materials. Existing utility lines that will not remain in service should be either removed or abandoned. The appropriate method of abandonment will depend upon the type and depth of the utility. Recommendations for abandonment can be made as necessary.

2. Voids created by the removal of materials or utilities described above should be called to the attention of the geotechnical engineer. No fill should be placed unless the underlying soil has been observed by the geotechnical engineer.

Grading

1. Following site preparation, existing fill in the kiosk / restroom building areas should be removed to a level plane at a depth of 2 feet below bottom of the deepest foundation element. The resulting level excavated surfaces should be scarified, moisture conditioned and compacted.

2. To create as uniform conditions as possible for the structure, all earthwork operations should be completed throughout each building area in a uniform manner at the same time, from the bottom of the overexcavation recommended in the previous paragraph through fill placement to finish grade. Earthwork operations that complete only a portion of the building area at one time (i.e., “flip-flopping”, “checkerboarding,” etc.) should not be allowed.

3. Following site preparation, existing fill in the bleacher and entrance structure foundation areas should be overexcavated to a minimum depth of 2 feet below bottom of each foundation element. The resulting excavated surfaces should be lightly scarified, moisture conditioned and compacted. Unlike the recommended earthwork program for the building area, overexcavation and recompaction operations for the bleacher and entrance structure foundation areas can proceed in a non-uniform manner for individual foundation areas.

4. Following site preparation, the existing DG track surface and the underlying fill soils in the track area should be removed to a minimum depth of 18 inches below the improved running surface and any associated underlying special layers (i.e., AC, etc.) designated by the architect/engineer. The resulting excavated surfaces should be scarified, moisture conditioned to at least 2 percent above optimum moisture content, and compacted. Unlike the recommended earthwork program for the building area, overexcavation and recompaction operations for the track area can proceed in a non-uniform manner for individual track segments.

5. Following site preparation, existing fill in sitework retaining wall areas should be overexcavated to a minimum depth of 2 feet below bottom of foundation elevation. The resulting excavated surfaces should be lightly scarified, moisture conditioned and compacted. Overexcavation elevations may be stepped where retaining walls are stepped to conform to any site contours. If firm alluvium is exposed at bottom of foundation elevation, no overexcavation and recompaction is considered necessary. To reduce the potential for cracking in sitework retaining walls, construction joints should be placed in the wall and the foundation where overexcavation operation have been stepped to conform to fill depth changes or to exposure of very stiff alluvium or colluvium. Unlike the recommended earthwork program for the building area, overexcavation and recompaction operations for sitework retaining walls can proceed in a non-uniform manner for individual wall segments.

6. Following site preparation and any excavations to grade, or prior to placement of fill, the soil in any exterior pedestrian flatwork, PCC paver, AC path and pavement areas, and in all other grading areas, should be scarified, moisture conditioned and recompacted. Unlike the recommended earthwork program for the building area, scarification and recompaction operations for exterior pedestrian flatwork, PCC paver, AC path and pavement areas, and in all other grading areas, can proceed in a non-uniform manner.

7. Voids created by dislodging cobbles and/or debris during scarification should be backfilled and recompacted, and the dislodged materials should be removed from the work area.

8. Previously removed site soils and other similar soils may be placed as fill in the following areas: in the kiosk / restroom building area to a maximum height of 18 inches below bottom of slab elevation; to bottom of foundation elevation in the entrance structure foundation areas at the stadium entrance; to subgrade in exterior pedestrian flatwork, PCC paver, AC path and pavement areas; and to finish grade beyond all other improvements.

9. The final 18 inches of fill below bottom of slab elevation in the kiosk / restroom building area should be nonexpansive. Nonexpansive materials are defined as imported soils that fall in the GW, GM, GC, SP, SW, SC and SM categories per ASTM D 2487-11, and that have an expansion index of 10 or less (ASTM D 4829-11). The clean sand layer described in the "Slabs-on-Grade" section of this report (if utilized below interior slabs-on-grade or exterior pedestrian flatwork) is considered to be part of the minimum recommended thickness of nonexpansive material utilized, not in addition to it.

10. The final 18 inches of fill below the improved running surface and any associated special layers designated by the architect/engineer for the track, and the final 2 feet of fill below the bleacher foundations, should consist of Class 2 Aggregate Base (AB) per the Standard Specifications (Caltrans 2010). Prior to placement of the AB for the track, a permeable synthetic filter fabric conforming to standard specification Section 88-1.02B – Class C (Caltrans 2010) should be placed over the compacted subgrade per the manufacturer's recommendations. AB should be placed over the fabric per the manufacturer's recommendations, by end dumping and pushing ahead of the equipment; no equipment traffic should be allowed on the fabric without a lift of AB in place.

11. Imported nonexpansive soils used in the building area should have strength qualities equal to or better than the site soils, and they should not exceed the geotechnical corrosivity potential of the site soils. See the Corrosivity Analysis by CERCO Analytical in Appendix C, and the Soil Corrosivity Study by HDR, Inc. in the report for the Annex / Classroom Building project (ESP 2016a, copy in Appendix D) for the corrosivity parameters of the site soils. Proposed imported materials should be reviewed by the geotechnical engineer before being brought to the site, and on an intermittent basis during placement.

12. All materials used as fill should be cleaned of any debris and rocks larger than 3 inches in diameter. When fill material includes rocks, the rocks should be placed in a sufficient soil matrix to ensure that voids caused by nesting of the rocks will not occur and that the fill can be properly compacted.

13. All AB and the top 12 inches of subgrade in areas to support PCC pavers, and AC paths and pavement should be compacted to a minimum of 95 percent of maximum dry density. Imported nonexpansive materials, sand or AB used to support exterior pedestrian flatwork, as well as the top 12 inches of subgrade in these areas, need only be compacted to a minimum of 90 percent of maximum dry density.

14. If the soils are overly moist so that they become unstable, or if the minimum recommended compaction cannot be readily achieved, drying the soil so that it is nearer optimum moisture content may be necessary. Placement of gravel layers or geotextiles may also be necessary to help stabilize unstable soils. Additional overexcavation may also be recommended to correct unstable conditions or if soft or loose conditions are encountered during grading. No fill should be placed in any grading area if the underlying soil is unstable.

15. The recommended soil moisture content should be maintained throughout construction, and during the lives of the structures and all other improvements. Failure to maintain the soil moisture content can result in desiccation cracks and disturbance, which are an indication of degradation of the soil compaction. If desiccation cracks are allowed to develop, or if soils near improvements such as foundations, flatwork, etc. are otherwise disturbed, damage to those improvements may result. Soils that have cracked or are otherwise disturbed should be removed, moisture conditioned, and recompacted.

Utility Trenches

1. Utility trenches adjacent to foundations should not be excavated within the zone of foundation influence, as shown in Typical Detail A in Appendix F.

2. Utilities that must pass beneath foundations should be placed with properly compacted utility trench backfill and the foundation should be designed to span the trench.

3. A select, noncorrosive, granular, easily compacted material should be used as bedding and shading immediately around utilities. The site soil may be used for trench backfill above the select material to subgrade or finish grade beyond the building area, and to within 18 inches below bottom of slab elevation in the building area. Within the building area, imported nonexpansive soils should be utilized to backfill the final 18 inches below bottom of slab elevation of all trenches. In exterior pedestrian flatwork, PCC paver, AC path and pavement areas, trench backfill should match the thickness of imported nonexpansive soils, sand or AB used to support these improvements.

4. In general, trench backfill should be compacted to a minimum of 90 percent of maximum dry density. Trench backfill in the upper 12 inches of subgrade and all AB in PCC paver, AC path and pavement areas should be compacted to a minimum of 95 percent of maximum dry density. A minimum of 85 percent of maximum dry density will generally be sufficient where trench backfill is located in landscaped or other unimproved areas, where settlement of trench backfill would not be detrimental.

5. Prior to applying compactive effort, trench backfill should be moisture conditioned. Trench backfill should be placed in level lifts not exceeding 6 inches in loose thickness and compacted to the minimums recommended above.

6. Compaction of trench backfill by jetting or flooding is not recommended at this site due to the expansive site soils. However, to aid in *encasing* utility conduits, particularly corrugated drain pipes, and multiple, closely-spaced conduits in a single trench with the bedding and shading material, jetting or flooding may be useful. Flooding or jetting should only be attempted with extreme caution, and any flooding or jetting operation should be subject to review by the geotechnical engineer.

7. Long-term settlement of properly compacted sand should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill. Where trenches are backfilled with site soils, the anticipated settlement would be about twice that of sand. Improvements that are constructed over or near trenches should be designed to accommodate the potential for settlement.

8. The Corrosivity Analysis by CERCO Analytical in Appendix C, and the Soil Corrosivity Study by HDR, Inc. in the report for the Annex / Classroom Building project (ESP 2016a, copy in Appendix D) should be used by the architect/engineer in specifying appropriate corrosion protection measures for utility improvements.

9. The recommendations of this section are minimums only, and may be superseded by the architect/engineer based upon soil corrosivity or the requirements of pipe manufacturers, utility companies or the governing jurisdiction.

Foundations and Track Curbs

1. The kiosk / restroom buildings, the bleachers and the stadium entrance structure may be supported by continuous and spread footings bearing in firm recompacted soils, as recommended in the “Grading” Section of this report.

2. Based on soil expansion potential only, minimum overall foundation depths of 21 inches below lowest adjacent grade within 6 feet laterally of the base of foundations should be maintained. Spread footings should be at least 24 inches square.

3. Continuous footings should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential only, minimum continuous footing reinforcement should consist of two No. 4 rebar, one at the top and one at the bottom. Spread footings should be reinforced in accordance with the requirements of the architect/engineer.

4. Footings bearing in firm recompacted soil may be designed using maximum allowable bearing capacities of 2,500 psf dead load and 3,500 psf dead plus live loads. Using these criteria, maximum settlement and differential settlement are expected to be less than 1/2-inch and less than 3/8-inch in 25 feet, respectively.

5. Allowable bearing capacities may be increased by one-third when transient loads such as wind or seismicity are included. Foundations may be designed as necessary using the values contained in the Summary of Design Response Acceleration Parameters Table on Page 8 in the report for the Annex / Classroom Building Project (ESP 2016a, copy in Appendix D).

6. To calculate resistance to lateral loads, please see the values presented in the "Retaining Walls" Section of this report. Lateral capacity is based on the assumption that any backfill adjacent to foundations has been properly compacted. Passive and friction components of resistance may be combined in the analysis without reduction to either value.

7. Minimum 6-inch wide curbs should be placed around the interior, the exterior, and along the straightaways and ends of the track. The track curbs should extend to a minimum depth of 6 inches below the bottom of the 18-inch AB layer recommended to be placed below the improved running surface and any associated special layers designated by the architect/engineer. Based on soil expansion potential only, minimum reinforcement for the track curbs should consist of two No. 4 rebar, one at the top and one at the bottom. Joints for track curbs should be as specified by the architect/engineer.

8. Footing and track curb excavations should be observed by the geotechnical engineer prior to placement of reinforcing steel. Footing and track curb excavations should be lightly moistened and no desiccation cracks should be present prior to concrete placement.

9. The Corrosivity Analysis by CERCO Analytical in Appendix C, and the Soil Corrosivity Study by HDR, Inc. in the report for the Annex / Classroom Building project (ESP 2016, copy in Appendix D) should be used by the architect/engineer in specifying appropriate corrosion protection measures for foundations and track curbs.

Slabs-on-Grade

Interior Slabs-On-Grade

1. Interior slabs-on-grade should have a minimum thickness of 4 full inches. They should be reinforced and doweled to foundations per the specifications of the architect/engineer. At a minimum, interior slabs should be reinforced with No. 3 rebar at 24 inches on center each way. All structural slabs should contain minimum rebar meeting the criteria of ACI 318, Section 7.12.2 (ACI 2011). At a minimum, foundation dowels should be lap spliced to the slab rebar. The size and spacing of the dowels should match the size and spacing of the slab rebar.

Exterior Pedestrian Flatwork and Housekeeping Slabs

1. Exterior pedestrian flatwork ("flatwork") and housekeeping slabs ("slabs") should have a minimum thickness of 4 full inches. Minimum reinforcement for flatwork and slabs placed over at least 18 inches of nonexpansive imported soils per the following paragraph should consist of No. 3 rebar placed at 24 inches on-center each way. If the thickness of nonexpansive soil below the flatwork and slabs is less than 18 inches, the minimum reinforcement should consist of No. 3 rebar at 18 inches on-center each way.

2. In conventional construction, it is common to use 4 to 6 inches of sand beneath flatwork and slabs. However, due to the medium expansion potential of the site soils, there will be a risk of movement and damage to the flatwork and slabs if conventional measures are used. Heaving and cracking could occur. This movement could be reduced by the placement of additional nonexpansive material beneath the flatwork and slabs. If it is desired to fully mitigate the expansive soil conditions, then at least 18 inches of imported nonexpansive material should be provided below the flatwork and slabs where the expansive site soils are exposed at finish grade. If it is acceptable for the flatwork and slabs to experience movement due to expansive soils, then the thickness of the nonexpansive soil can be reduced. Under all flatwork and slabs, however, the thicker the nonexpansive layer, the better the expansive soil protection.

3. Another measure that can be taken to reduce the risk of movement of flatwork and slabs due to expansive soils is to provide thickened edges or grade beams around the perimeters of the flatwork. If it is desired to fully mitigate the expansive soil conditions, then the thickened edges or grade beams could be up to 21 inches deep. If it is acceptable for the flatwork and slabs to experience movement, then the thickened edges or grade beams can be reduced. At a minimum, any thickened edge or grade beam should be reinforced by two No. 4 rebar, one at the top and one at the bottom.

4. It is recognized that the measures discussed above for protecting flatwork and slabs from expansive soils are expensive, possibly more expensive than simply replacing flatwork that has heaved and/or cracked. Consequently, the above measures for protecting flatwork and slabs are only suggestions for consideration by the owner and/or architect/engineer. The degree to which flatwork and slabs are protected from expansive soil damage is left to the discretion of the owner and/or architect/engineer.

5. Flatwork and slabs should be constructed with frequent joints to allow articulation as the flatwork and slabs move in response to seasonal soil temperature and moisture variations. The expansive soil underlying any nonexpansive material placed below flatwork and slabs should be moisture conditioned, and no desiccation cracks should be present, prior to casting the flatwork.

6. Flatwork and slabs at doorways, and at other areas where maintaining the elevation of the flatwork and slabs is desired when mitigating expansive soil potential, should be doweled to the perimeter foundation (if any), at a minimum, by No. 3 dowels lapped to the flatwork rebar at 24 inches on center. In other areas, the flatwork and slabs may be doweled to the foundation or the flatwork and slabs may be allowed to "float free," at the discretion of the architect/engineer. Flatwork and slabs that are intended to float free should be separated from foundations by a felt joint or other means.

Moisture Vapor Transmission

1. Due to the current use of impermeable floor coverings, water-soluble flooring adhesives, and the speed at which buildings are now constructed, moisture vapor transmission through slabs is a much more common problem than in past years. Where moisture vapor transmitted from the underlying soil would be undesirable, slabs should be protected from subsurface moisture vapor. A number of options for vapor protection are discussed below; however, the means of vapor protection, including the type and thickness of the vapor retarder, if specified, are left to the discretion of the architect/engineer.

2. Where specified, vapor retarders should conform to ASTM Standard E 1745-11. This standard specifies properties for three performance classes; Class A, B and C. The appropriate class should be selected based on the sensitivity of floor coverings to moisture intrusion and the potential for damage to the vapor retarder during placement of slab reinforcement and concrete.

3. Several recent studies, including those of American Concrete Institute Committee 302 (ACI 2004), have concluded that excess water above the vapor retarder increases the potential for moisture damage to floor coverings and could increase the potential for

mold growth or other microbial contamination. The studies also concluded that it is preferable to eliminate the typical sand layer beneath the slab and place the slab concrete in direct contact with a Class A vapor retarder, particularly during wet weather construction. However, placing the concrete directly on the vapor retarder requires special attention to using the proper vapor retarder, a very low water-cement ratio in the concrete mix, and special finishing and curing techniques.

4. Probably the next most effective option would be the use of vapor-inhibiting admixtures in the slab concrete mix and/or application of a sealer to the surface of the slab. This would also require special concrete mixes and placement procedures, depending upon the recommendations of the admixture or sealer manufacturer.

5. Another option that may be a reasonable compromise between effectiveness and cost considerations is the use of a subslab vapor retarder protected by a sand layer. If a Class A vapor retarder is specified, the retarder can be placed directly on the nonexpansive soil. The retarder should be covered with a minimum 2 inches of *clean* sand. If a less durable vapor retarder is specified (Class B or C), a minimum of 4 inches of clean sand should be provided, and the retarder should be placed in the center of the clean sand layer. Clean sand is defined as a well or poorly graded sand (ASTM D 2487-11) of which less than 3 percent passes the No. 200 sieve. The clean sand layer, if used, is considered to be a part of the minimum 18-inch thickness of nonexpansive imported materials recommended in the "Grading" Section of this report to be placed below slabs-on-grade, not in addition to it.

6. Regardless of the underslab vapor retarder selected, proper installation of the retarder per ASTM E 1643-11 is critical for optimum performance. Where utilized, the vapor retarder should be placed a minimum of 1 inch above the flow line of the drainage path surrounding the structures, or 1 inch above the area drain grates if area drains are used to collect runoff around the structures. All seams must be properly lapped, and all seams and utility penetrations properly sealed in accordance with the vapor retarder manufacturer's recommendations.

7. If the sand is used between the vapor retarder and the slab, it should be moistened only as necessary to promote concrete curing; saturation of the sand should be avoided, as the excess moisture would be on top of the vapor retarder, potentially resulting in vapor transmission through the slab for months or years.

8. Positive drainage away from the building should be maintained; see the "Drainage and Maintenance" Section of this report for additional discussion of this issue. If water is allowed to pond near the structure, it may seep into the ground and migrate laterally through cracks or utility penetrations in the foundation, ultimately gaining access above the vapor retarder.

General

1. To reduce shrinkage cracks in all interior and exterior slabs-on-grade, the concrete aggregates should be of appropriate size and proportion, the water/cement ratio should be low, the concrete should be properly placed and finished, contraction joints should be installed, and the concrete should be properly cured. This is particularly applicable to slabs that will be cast directly upon a vapor retarder and those that will be protected from transmission of vapor by use of admixtures or surface sealers. Concrete materials, placement, and curing specifications should be at the direction of the architect/engineer; AC 302.1R-04 (ACI 2004) is suggested as a resource for the architect/engineer in preparing such specification.

2. To provide stability for curbs adjacent to exterior pedestrian flatwork, they should be set back a minimum distance equal to one-third the height of any adjacent descending slope, but not less than 5 feet from the tops of slopes. Alternately, curbs may be deepened to provide stability. The geotechnical engineer should review, on an individual basis, any situation where curbs must be deepened to meet this recommendation.

3. The Corrosivity Analysis by CERCO Analytical in Appendix C, and the Soil Corrosivity Study by HDR, Inc. in the report for the Annex / Classroom Building project (ESP 2016, copy in Appendix D) should be used by the architect/engineer in specifying appropriate corrosion protection measures for slabs-on-grade.

Retaining Walls

1. Retaining walls connected to or forming part of a building should be founded in firm soil that has been recompacted per the "Grading" Section of this report. Sitework retaining walls may be supported by either firm soil that has been recompacted per the "Grading" Section of this report, or firm sandy lean clay alluvium. If a sitework retaining wall crosses a recompacted soil/firm alluvium transition, or a transition between varying fill overexcavation depths, a construction joint should be placed in the footing and wall at the transitions. Foundations for all retaining walls should have minimum overall depths (not including any keyway) of 21 inches below lowest grade within 6 feet laterally of any adjacent slope.

2. Retaining wall footings should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential only, minimum retaining wall footing reinforcement should consist of two No. 4 rebar, one at the top and one at the bottom.

3. Retaining wall design may be based on the following parameters:

Active equivalent fluid pressure (site soils)	45 pcf
Active equivalent fluid pressure (imported sand/gravel backfill)	35 pcf
At-rest equivalent fluid pressure (site soils)	65 pcf
At-rest equivalent fluid pressure (imported sand/gravel backfill)	50 pcf
Passive equivalent fluid pressure	350 pcf
Maximum toe pressure	3,500 psf
Coefficient of sliding friction	0.35

4. No surcharges are taken into consideration in the values presented in the previous paragraph. The maximum toe pressure is an *allowable* value; no factors of safety, load factors or other factors have been applied to the remaining values. With the exception of the maximum toe pressure, these values will require application of appropriate factors of safety, load factors, and/or other factors as deemed appropriate by the architect/engineer.

5. If the active or at-rest pressures presented in Paragraph 3 for *imported sand or gravel backfill* are utilized for design of retaining walls, the sand or gravel should be used exclusively as backfill above a 1:1 plane extended upward from the back of the wall footing to approximately 1 foot from the top of the wall backfill. The upper foot should be backfilled with native soil, except in areas where PCC pavers, AC paths, pavement or exterior pedestrian flatwork will abut the top of the wall. In such cases, the gravel should extend to the imported nonexpansive material, sand, aggregate base, or other material below the improved surface, as appropriate. If gravel backfill is utilized, the gravel should be encased in a permeable synthetic filter fabric conforming to standard specification Section 88-1.02B – Class C (Caltrans 2010).

6. The active and at-rest pressures presented in Paragraph 3 are applicable to a horizontal retained surface behind the wall. Walls having a retained surface that slopes upward from the wall should be designed for an additional equivalent fluid pressure of 1 pcf for the active case and 1.5 pcf for the at-rest case, for every degree of slope inclination.

7. It is assumed that retaining wall heights will not exceed 5 feet.

8. Section 1803A.5.12.1 of the 2013 CBC requires that dynamic seismic lateral earth pressures be provided by the geotechnical engineer for walls retaining more than 6 feet of backfill. As retaining wall heights will not exceed 5 feet, consideration of seismic lateral earth pressures in the design is not needed.

9. Long-term settlement of properly compacted sand or gravel retaining wall backfill should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill; long-term settlement of properly compacted site soil retaining wall backfill would be about twice that of sand or gravel backfill. Improvements that are constructed near the tops of retaining walls should be designed to accommodate long-term settlement.

10. All retaining walls should be drained with perforated pipe encased in a free-draining gravel blanket. The pipe should be placed perforations downward, and should discharge in a nonerosive manner away from foundations and other improvements. The gravel blanket should have a width of approximately 1 foot and should extend upward to approximately 1 foot from the top of the wall backfill. The upper foot should be backfilled with native soil, except in areas where PCC pavers, AC paths, pavement or exterior pedestrian flatwork will abut the top of the wall. In such cases, the gravel should extend to the imported nonexpansive material, sand, aggregate base, or other material below the improved surface, as appropriate. To reduce infiltration of the soil into the gravel, a permeable synthetic filter fabric conforming to Standard Specifications Section 88-1.02B – Class C (Caltrans 2010), should be placed between the two. Manufactured synthetic drains, such as Miradrain or Enkadrain are acceptable alternatives to the use of gravel, provided that they are installed in accordance with the recommendations of the manufacturer.

11. Where weep hole drainage can be properly discharged, the perforated pipe may be omitted in lieu of weep holes on maximum 4-foot centers. A filter fabric as described above should be placed between the weep holes and the drain gravel.

12. Walls facing areas where moisture transmission through the wall would be undesirable should be *thoroughly* waterproofed in accordance with the specifications of the architect/engineer.

13. The architect/engineer should bear in mind that retaining walls by their nature are flexible structures, and that surface treatments on walls often crack. Where walls are to be plastered or otherwise have a finish applied, the flexibility should be considered in determining the suitability of the surfacing material, spacing of horizontal and vertical control joints, etc. The flexibility should also be considered where a retaining wall will abut or be connected to a rigid structure, and where the geometry of the wall is such that its flexibility will vary along its length.

14. The Corrosivity Analysis by CERCO Analytical in Appendix C, and the Soil Corrosivity Study by HDR, Inc. in the report for the Annex / Classroom Building project (ESP 2016, copy in Appendix D) should be used by the architect/engineer in specifying appropriate corrosion protection measures for retaining walls.

Portland Cement Concrete (PCC) Pavers, and Asphalt Concrete (AC) Paths and Pavement

PCC Pavers

1. PCC pavers should be installed per the manufacturer's recommendations.

2. Unless otherwise recommended by the paver manufacturer, the structural paver section should consist of the following (from top to bottom):

    - PCC pavers, 3.125-inch thickness, minimum
    - 1.5 to 2.0 inches No. 8 aggregate bedding course (ASTM D 448-12)
    - 10 inches Class 2 aggregate base (Caltrans 2010 Standard Specifications)
    - Subgrade, moisture conditioned and compacted to a minimum of 95 percent of maximum dry density, and firm and unyielding when proofrolled

3. At a minimum, the pavers should be properly maintained, and any ruts, depressions, broken pavers, etc. should be immediately repaired. Periodic removal of pavers and refurbishment of the No. 8 bedding course may also be necessary.

AC Paths and Pavement

1. Paths for pedestrian access may be constructed of AC over aggregate base (AB). Design methods for AC pavement do not typically consider pedestrian loading only; the section design is typically based on local experience and anticipated life span. For this application, a minimum pavement section of 2 inches of AC over 4 inches of AB is considered appropriate. As with exterior pedestrian flatwork, this minimum thickness of AC and AB will be subject to movement due to expansive soils. If it is desired to fully mitigate the expansive soil conditions, the AB thickness can be increased to as much as 18 inches.

2. It is recognized that the increased AB thickness recommended above for protecting AC paths from expansive soils will be expensive, possibly more expensive than simply replacing AC paths that has heaved and/or cracked. Consequently, this measure for protecting AC paths is only a suggestion for consideration by the client and/or architect/engineer. The degree to which AC paths are protected from expansive soil damage is left to the discretion of the owner and/ or architect/engineer.

3. The following AC pavement sections to support vehicle traffic are based upon a tested R-value, or resistance to deformation under repeated loading, of 6 for the upper soils on the adjacent Student Services / Administration Building (ESP 2016b). The pavement sections are based on assumed Traffic Indices (TIs) of 4.5 through 7.0. Determination of the appropriate TI for specific areas of the project is left to others. The AC and AB thicknesses were calculated in accordance with the method presented in the "Highway Design Manual" (Caltrans 2006, updated 2008), and are for compacted material. Normal Caltrans construction tolerances should apply.

Traffic Index	AC	AB
4.5	2.50"	9.0"
5.0	2.75"	10.0"
5.5	3.00"	11.5"
6.0	3.25"	13.0"
6.5	3.75"	14.0"
7.0	4.00"	15.5"

General

1. Pavers and pavement should be constrained by curbs, gutters, flatwork, walls, etc.; free edges to the pavers or pavement should be avoided.

2. Pavement and pavers should be set back a minimum of 5 feet from any descending slope. Alternately, deepened curbs may be used to constrain the pavers or pavement sections. Where curbs will be deepened in lieu of the recommended set back, the individual situation should be reviewed and specific recommendations prepared by the geotechnical engineer.

3. AB should conform to the requirements of Section 26 of the Standard Specifications (Caltrans 2010). AC should conform to the requirements of Section 32 of the Standard Specifications (Caltrans 2010).

4. The upper 12 inches of subgrade and all AB in paver and pavement areas should be compacted to a minimum of 95 percent of maximum dry density. Subgrade and aggregate base should be firm and unyielding when proofrolled with heavy, rubber-tired grading equipment prior to continuing construction.

5. Finished paver and pavement surfaces should be sloped to freely drain toward appropriate drainage facilities. Water should not be allowed to stand or pond on or adjacent to pavers, pavement, or other improvements as it could infiltrate into the aggregate base and/or subgrade, causing premature pavement or paver deterioration.

6. To reduce migration of surface drainage into the subgrade, maintenance of paver and pavement areas is critical. Any broken pavers should be promptly repaired and any cracks that develop in pavement should be promptly sealed.

7. The local jurisdiction may have additional requirements for pavement or pavers that could take precedence over the above recommendations.

Drainage and Maintenance

1. Per Section 1804A.3 of the 2013 CBC, unpaved ground surfaces should be *finish graded* to direct surface runoff away from foundations and other improvements at a minimum 5 percent grade for a minimum distance of 10 feet. The site should be similarly sloped to drain away from foundations, the track, and other improvements during construction. Where this is not practicable due to other improvements, etc., swales with improved surfaces, area drains, or other drainage facilities, should be used to collect and discharge runoff. Control of surface drainage around the track will be critical to maintaining the integrity of the all-weather surface.

2. All eaves of the buildings should be fitted with roof gutters. Runoff from flatwork, roof gutters, downspouts, planter drains, area drains, etc. should discharge in a nonerosive manner away from foundations and other improvements in accordance with the requirements of the governing agencies. Erosion protection should be placed at all discharge points unless the discharge is to a pavement surface.

3. To reduce the potential for planter drainage gaining access to subslab areas, any raised planter boxes adjacent to foundations should be installed with drains and sealed sides and bottoms. Drains should also be provided for areas adjacent to the structure and in landscape areas that would not otherwise freely drain.

4. The site soils are erodible; stabilization of soils disturbed during construction by vegetation or other means *during* and *following* construction, is essential to reduce erosion damage. Surface drainage should also be maintained during construction.

5. Maintenance of drainage and other improvements is critical to the long-term stability of the site and the integrity of the structures. Site improvements should be maintained on a regular basis.

6. Finished pavement surfaces should be sloped to freely drain toward appropriate drainage facilities. Water should not be allowed to stand or pond on or adjacent to AC paths, pavement or other improvements as it could infiltrate into the AB and/or subgrade, causing premature pavement deterioration.

7. All exterior drains, retaining wall drains, and drain outlets should be maintained to be free-flowing. Care should be taken to establish and maintain vegetation. The landscaping should be planned and installed to maintain the surface drainage recommended above. Vegetation and erosion matting (if utilized) should be maintained or augmented as needed. Irrigation systems should be maintained so that soils around structures are maintained at a relatively uniform year-round moisture content, and are neither over-watered nor allowed to dry and desiccate.

8. To reduce migration of surface drainage into the subgrade, maintenance of AC path and pavement areas is critical. Any cracks that develop in the AC should be promptly sealed.

9. To reduce the potential for disruption of drainage patterns and undermining of structures, fill areas, etc., all rodent activity should be aggressively controlled.

Observation and Testing

1. It must be recognized that the recommendations contained in this report are based on a limited number of borings and rely on continuity of the subsurface conditions encountered.

2. It is assumed that the geotechnical engineer will be retained to provide consultation during the design phase, to interpret this report during construction, and to provide construction monitoring in the form of testing and observation.

3. At a minimum, the geotechnical engineer should be retained to provide:

   - Professional observation during grading, trench and retaining wall backfill, and foundation construction
   - Oversight of special inspection and compaction testing grading, trench and retaining wall backfill, and foundation construction

4. Special inspection of grading and backfill should be provided as per Section 1705A.6 and Table 1706A.6 of the CBC. The special inspector should be under the direction of the geotechnical engineer. At a minimum, the following items should be inspected and/or tested by the special inspector:

   - Stripping and clearing of all existing improvements, vegetation, and deleterious materials
   - Overexcavation of the building and sitework retaining wall areas to the recommended depths
   - Scarification and moisture conditioning of overexcavated areas
   - Scarification and moisture conditioning of exterior pedestrian flatwork, PCC paver, AC path and pavement areas, and all other grading areas
   - Fill quality, placement, moisture conditioning and compaction
   - Utility trench backfill
   - Foundation excavations

5. A program of quality assurance should be developed prior to beginning construction. At a minimum, the program should include all geotechnical items shown on the testing and inspection schedule of the approved plans. It should also include any additional inspection items required by the engineer and/or the governing jurisdiction. These items should be discussed at a preconstruction site meeting among a representative of the owner, the geotechnical engineer, special inspector, the project inspector, the engineer, and contractors. The geotechnical engineer should be notified at least 48 hours prior to beginning grading operations.

6. Locations and frequency of compaction tests should be as per the recommendation of the geotechnical engineer at the time of construction. The recommended test location and frequency may be subject to modification by the geotechnical engineer, based upon soil and moisture conditions encountered, size and type of equipment used by the contractor, the general trend of the results of compaction tests, or other factors.

10.0 CLOSURE

Our intent was to perform the investigation in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the locality of this project under similar conditions. No representation, warranty, or guarantee is either expressed or implied. This report is intended for the exclusive use by the client as discussed in the "Scope of Services" section. Application beyond the stated intent is strictly at the user's risk.

This report is valid for conditions as they exist at this time for the type of project described herein. The conclusions and recommendations contained in this report could be rendered invalid, either in whole or in part, due to changes in building codes, regulations, standards of geotechnical or construction practice, changes in physical conditions, or the broadening of knowledge.

If changes with respect to the project become necessary, if items not addressed in this report are incorporated into plans, or if any of the assumptions used in the preparation of this report are not correct, this firm shall be notified for modifications to this report. Any items not specifically addressed in this report should comply with the CBC of other applicable standards, and the requirements of the governing jurisdiction.

The preliminary recommendations presented in this geotechnical report are based upon the geotechnical conditions encountered at the site, and may be augmented by additional requirements of the client, or by additional recommendations provided by the geotechnical engineer based on peer or jurisdiction reviews, or conditions exposed at the time of construction. If Earth Systems Pacific is *not* retained to provide construction observation and testing services, it shall not be responsible for the interpretation of the information by others or any consequences arising therefrom.

This document, the data, conclusions, and recommendations contained herein are the property of Earth Systems Pacific. This report shall be used in its entirety, with no individual sections reproduced or used out of context. Copies may be made only by Earth Systems Pacific, the client, and the client's authorized agents for use exclusively on the subject project. Any other use is subject to federal copyright laws and the written approval of Earth Systems Pacific.

Thank you for this opportunity to have been of service. If you have any questions, please feel free to contact this office at your convenience.

End of Text.

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APPENDIX A

Boring Location Map
Boring Log Legend
Boring Logs



LEGEND

8 Boring Location (Approx.)

NOT TO SCALE

N

BORING LOCATION MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
STADIUM ENTRANCE/ BLEACHERS/ TRACK

1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3109

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January 20, 2016 CS SL-16605-SC

SLO HS STADIUM ENTRANCE-012016BLOCATIONS

Earth Systems Pacific

BORING LOG LEGEND

SAMPLE / SUBSURFACE WATER SYMBOLS	GRAPH. SYMBOL
CALIFORNIA MODIFIED	■
STANDARD PENETRATION TEST (SPT)	●
SHELBY TUBE	▭
BULK	○
SUBSURFACE WATER DURING DRILLING	▼
SUBSURFACE WATER AFTER DRILLING	▽

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

MAJOR DIVISIONS	GROUP SYMBOL	TYPICAL DESCRIPTIONS	GRAPH. SYMBOL
COARSE GRAINED SOILS (MORE THAN HALF OF MATERIAL IS LARGER THAN #200 SIEVE SIZE)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GP	POORLY GRADED GRAVELS, OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, NON-PLASTIC FINES	
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, PLASTIC FINES	
	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
	SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES	
	SM	SILTY SANDS, SAND-SILT MIXTURES, NON-PLASTIC FINES	
	SC	CLAYEY SANDS, SAND-CLAY MIXTURES, PLASTIC FINES	
FINE GRAINED SOILS (HALF OR MORE OF MATERIAL IS SMALLER THAN #200 SIEVE SIZE)	ML	INORGANIC SILTS AND VERY FINE SANDS, 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	
	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS	
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	

OBSERVED MOISTURE CONDITION

DRY	SLIGHTLY MOIST	MOIST	VERY MOIST	WET (SATURATED)

CONSISTENCY

COARSE GRAINED SOILS			FINE GRAINED SOILS		
BLOWS/FOOT		DESCRIPTIVE TERM	BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER		SPT	CA SAMPLER	
0-10	0-16	LOOSE	0-2	0-3	VERY SOFT
11-30	17-50	MEDIUM DENSE	3-4	4-7	SOFT
31-50	51-83	DENSE	5-8	8-13	MEDIUM STIFF
OVER 50	OVER 83	VERY DENSE	9-15	14-25	STIFF
			16-30	26-50	VERY STIFF
			OVER 30	OVER 50	HARD

GRAIN SIZES

U.S. STANDARD SERIES SIEVE				CLEAR SQUARE SIEVE OPENING		
# 200	# 40	# 10	# 4	3/4"	3"	12"

SILT & CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

TYPICAL BEDROCK HARDNESS

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
EXTREMELY HARD	CORE, FRAGMENT, OR EXPOSURE CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CAN ONLY BE CHIPPED WITH REPEATED HEAVY HAMMER BLOWS
VERY HARD	CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CORE OR FRAGMENT BREAKS WITH REPEATED HEAVY HAMMER BLOWS
HARD	CAN BE SCRATCHED WITH KNIFE OR SHARP PICK WITH DIFFICULTY (HEAVY PRESSURE); HEAVY HAMMER BLOW REQUIRED TO BREAK SPECIMEN
MODERATELY HARD	CAN BE GROOVED 1/16 INCH DEEP BY KNIFE OR SHARP PICK WITH MODERATE OR HEAVY PRESSURE; CORE OR FRAGMENT BREAKS WITH LIGHT HAMMER BLOW OR HEAVY MANUAL PRESSURE
SOFT	CAN BE GROOVED OR GOUGED EASILY BY KNIFE OR SHARP PICK WITH LIGHT PRESSURE, CAN BE SCRATCHED WITH FINGERNAIL; BREAKS WITH LIGHT TO MODERATE MANUAL PRESSURE
VERY SOFT	CAN BE READILY INDENTED, GROOVED OR GOUGED WITH FINGERNAIL, OR CARVED WITH KNIFE; BREAKS WITH LIGHT MANUAL PRESSURE

TYPICAL BEDROCK WEATHERING

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
FRESH	NO DISCOLORATION, NOT OXIDIZED
SLIGHTLY WEATHERED	DISCOLORATION OR OXIDATION IS LIMITED TO SURFACE OF, OR SHORT DISTANCE FROM, FRACTURES: SOME FELDSPAR CRYSTALS ARE DULL
MODERATELY WEATHERED	DISCOLORATION OR OXIDATION EXTENDS FROM FRACTURES, USUALLY THROUGHOUT; Fe-Mg MINERALS ARE "RUSTY", FELDSPAR CRYSTALS ARE "CLOUDY"
INTENSELY WEATHERED	DISCOLORATION OR OXIDATION THROUGHOUT; FELDSPAR AND Fe-Mg MINERALS ARE ALTERED TO CLAY TO SOME EXTENT, OR CHEMICAL ALTERATION PRODUCES IN SITU DISAGGREGATION
DECOMPOSED	DISCOLORATION OR OXIDATION THROUGHOUT, BUT RESISTANT MINERALS SUCH AS QUARTZ MAY BE UNALTERED; FELDSPAR AND Fe-Mg MINERALS ARE COMPLETELY ALTERED TO CLAY

drafting/masters/Boring Log Legend121714.dwg

Earth Systems Pacific

Boring No. 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

JOB NO.: SL-16605-SC
DATE: 01/15/16

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			2.5" AC over 6" AB					
1	SC		CLAYEY SAND: brown, medium dense, moist, trace gravel (Fill)	1.0 - 2.5	Ring	110.5	7.2	5, 7, 11
3				3.0 - 4.5	Ring	96.9	18.8	5, 9, 10
4	CL		SANDY LEAN CLAY: gray brown, stiff, very moist, trace fine gravel (Alluvium)					
5			moist	5.0 - 6.5	Ring	102.4	13.1	8, 10, 14
8			increasing fine to coarse gravel					
9	SC		CLAYEY SAND: brown, medium dense, moist					
12			some coarse gravel					
15	SC		CLAYEY SAND WITH GRAVEL: brown, medium dense, moist	15.0 - 16.5	SPT			8, 9, 12
20				20.0 - 21.5	SPT	---	7.8	9, 9, 10
23	SW		WELL GRADED SAND WITH GRAVEL: brown, medium dense, moist, trace clay					
25				25.0 - 26.5	SPT			5, 13, 13

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

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Boring No. 1
PAGE 2 OF 2

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SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
27	SW		as above					
30			loose	30.0 - 31.5	●			8 5 5
34			wet ▼					
35				35.0 - 36.5	●			5 7 9
40				40.0 - 41.5	●			8 27 29
41			SERPENTINITE: dark olive/ dark gray mottled, moderately soft, moist (Franciscan Melange)					
44			End of Boring @ 43.5'. Subsurface water encountered between 34.0' and 40.5'.					

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

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Boring No. 2
PAGE 1 OF 1

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SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			4.0" PCC over 6" Well Graded Sand					
1	SC		CLAYEY SAND: brown, medium dense, moist, trace fine gravel (Fill)	1.0 - 2.5	■	111.5	14.9	3, 7, 10
2				1.0 - 3.0	○			
3			very moist	3.0 - 4.5	■	93.0	17.9	4, 7, 10
4								
5			gray brown, increasing clay	5.0 - 6.5	■	87.6	16.2	5, 8, 11
6	CL		SANDY LEAN CLAY: gray brown, stiff, moist, (Alluvium)					
7								
8								
9			brown					
10				10.0 - 11.5	●			6, 10, 12
11								
12								
13			some gravel					
14								
15			gravel ends, brown	15.0 - 16.5	●			7, 7, 9
16								
17			End of Boring @ 16.5'					
18			No subsurface water encountered					
19								
20								
21								
22								
23								
24								
25								
26								

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

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Boring No. 3

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AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

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JOB NO.: SL-16605-SC
DATE: 01/15/16

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	GC-GM		8.0" - Track Surface: Dark Brown Silty Clayey Gravel (decomposed granite ; "DG"), dense, moist	1.0 - 2.5	▬	106.0	18.9	7, 11, 15
1	CL		SANDY LEAN CLAY: dark brown to gray brown, stiff, very moist, trace gravel (Fill)					
2								
3				3.5 - 5.0	●			2, 3, 4
4			medium stiff					
5			End of Boring @ 5.0'					
6			No subsurface water encountered					
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								

LEGEND: ▬ Ring Sample ◯ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 4

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AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

PAGE 1 OF 1
JOB NO.: SL-16605-SC
DATE: 01/15/16

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	GC-GM		8.0" - Track Surface: Dark Brown Silty Clayey Gravel (decomposed granite ; "DG"), dense, moist	1.0 - 2.5	■	110.3	21.7	7 8 10
2	CL		SANDY LEAN CLAY: dark brown to dark gray brown, stiff, very moist (Fill)	1.0 - 3.0	○			
3				3.5 - 5.0	●			1 3 4
4	SC		CLAYEY SAND: light gray, loose, moist					
5			End of Boring @ 5.0' No subsurface water encountered					

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 5

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

PAGE 1 OF 1
JOB NO.: SL-16605-SC
DATE: 01/15/16

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	GC-GM		7.5" - Track Surface: Dark Brown Silty Clayey Gravel (decomposed granite ; "DG"), dense, moist	1.0 - 2.5	■	95.0	25.3	6 10 12
2	CL		SANDY LEAN CLAY: dark gray brown, stiff, very moist, trace gravel (Fill)	3.5 - 5.0	●			3 3 4
4	SC		CLAYEY SAND: light gray, loose, moist					
5			End of Boring @ 5.0' No subsurface water encountered					

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 6

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

PAGE 1 OF 1
JOB NO.: SL-16605-SC
DATE: 01/15/16

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	GC-GM		7.5" - Track Surface: Dark Brown Silty Clayey Gravel (decomposed granite ; "DG"), dense, moist	1.0 - 2.5	■	101.1	22.0	6, 9, 14
1	CL		SANDY LEAN CLAY: dark gray brown, stiff, very moist, trace gravel (Fill)	1.0 - 3.0	○			
2								
3				3.5 - 5.0	●			3, 4, 5
4								
5			End of Boring @ 5.0'					
6			No subsurface water encountered					
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 7

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

JOB NO.: SL-16605-SC
DATE: 01/15/16

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			2.75" AC over 7" AB					
1	SC		CLAYEY SAND: dark brown, medium dense, slightly moist, trace fine gravel (Fill)	1.0 - 2.5	■	124.1	8.9	5, 6, 10
2				1.0 - 3.0	○			
3			very moist	3.0 - 4.5	■	91.6	17.2	6, 9, 16
4								
5			moist, some gravel, gray brown	5.0 - 6.5	■	114.0	7.2	16, 18, 14
6								
7								
8	CL		SANDY LEAN CLAY: dark brown, stiff, slightly moist, trace fine gravel (Alluvium)					
9								
10				10.0 - 11.5	●			5, 8, 7
11								
12								
13			brown					
14								
15				15.0 - 16.5	●			8, 11, 18
16								
17			End of Boring @ 16.5'					
18			No subsurface water encountered					
19								
20								
21								
22								
23								
24								
25								
26								

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 8

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

PAGE 1 OF 1
JOB NO.: SL-16605-SC
DATE: 01/15/16

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 San Luis Drive
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			2.5" AC over 6" AB					
1	CL		SANDY LEAN CLAY: dark brown, stiff, very moist, some fine gravel (Fill)	1.0 - 2.5	■	105.1	17.3	5, 7, 9
2				1.0 - 3.0	○			
3			slightly moist, increasing sand content	3.0 - 4.5	■	114.7	10.0	5, 12, 16
4								
5	SC		CLAYEY SAND: dark brown, medium dense, slightly moist, some fine gravel	5.0 - 6.5	■	109.2	8.3	5, 11, 21
6				5.0 - 7.0	○			
7			increasing gravel with depth					
8								
9	CL		SANDY LEAN CLAY: dark brown, stiff, slightly moist, trace fine gravel (Alluvium)					
10				10.0 - 11.5	●			6, 8, 9
11								
12								
13								
14			gray brown					
15				15.0 - 16.5	●			9, 12, 13
16								
17			End of Boring @ 16.5' No subsurface water encountered					
18								
19								
20								
21								
22								
23								
24								
25								
26								

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

APPENDIX B

Geotechnical Laboratory Test Results

San Luis Obispo High School
Measure D - Stadium Entrance/Bleachers/Track

SL-16605-SC

BULK DENSITY TEST RESULTS

ASTM D 2937-10 (modified for ring liners)

January 22, 2016

BORING NO.	DEPTH feet	MOISTURE CONTENT, %	WET DENSITY, pcf	DRY DENSITY, pcf
1	2.0 - 2.5	7.2	118.5	110.5
1	4.0 - 4.5	18.8	115.1	96.9
1	6.0 - 6.5	13.1	115.7	102.4
1	20.0 - 21.5	7.8	---	---
2	2.0 - 2.5	14.9	128.1	111.5
2	4.0 - 4.5	17.9	109.6	93.0
2	6.0 - 6.5	16.2	101.7	87.6
3	2.0 - 2.5	18.9	126.0	106.0
4	2.0 - 2.5	21.7	134.1	110.3
5	2.0 - 2.5	25.3	119.1	95.0
6	2.0 - 2.5	22.0	123.3	101.1
7	2.0 - 2.5	8.9	135.1	124.1
7	4.0 - 4.5	17.2	107.4	91.6
7	6.0 - 6.5	7.2	122.2	114.0
8	2.0 - 2.5	17.3	123.2	105.1
8	4.0 - 4.5	10.0	126.2	114.7
8	6.0 - 6.5	8.3	118.2	109.2

EXPANSION INDEX TEST RESULTS

ASTM D 4829-11

BORING NO.	DEPTH feet	EXPANSION INDEX
4	1.0 - 3.0	67
8	1.0 - 3.0	62

San Luis Obispo High School
Measure D - Stadium Entrance/Bleachers/Track

SL-16605-SC

MOISTURE-DENSITY COMPACTION TEST

ASTM D 1557-12 (Modified)

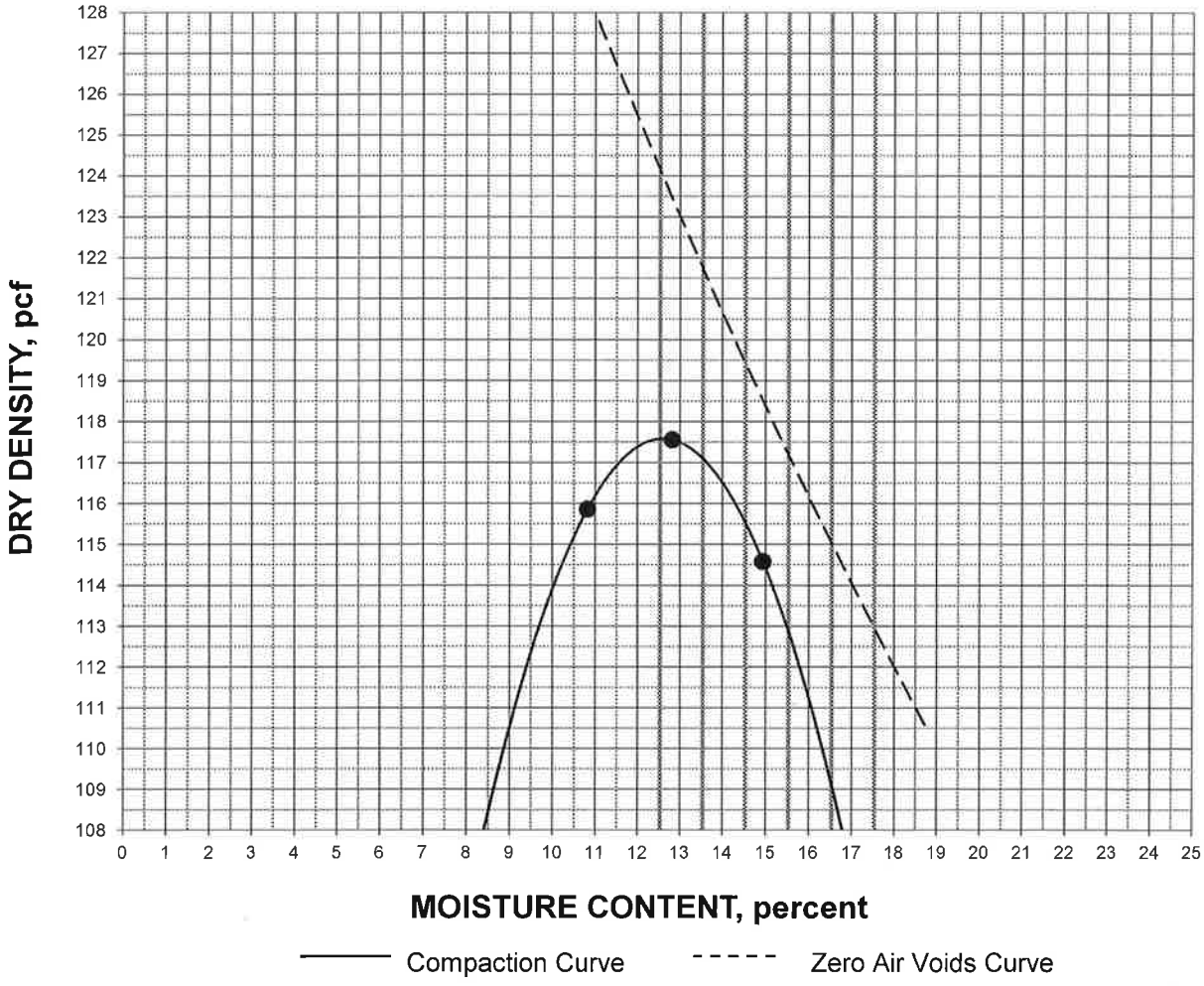
PROCEDURE USED: A
PREPARATION METHOD: Moist
RAMMER TYPE: Mechanical
SPECIFIC GRAVITY: 2.65 (assumed)

January 22, 2016
Boring #2 @ 1.0 - 3.0'
Brown Clayey Sand (SC)

SIEVE DATA:

Sieve Size	% Retained (Cumulative)
3/4"	0
3/8"	0
#4	0

MAXIMUM DRY DENSITY: 117.6 pcf
OPTIMUM MOISTURE: 12.6%



San Luis Obispo High School
Measure D - Stadium Entrance/Bleachers/Track

SL-16605-SC

DIRECT SHEAR

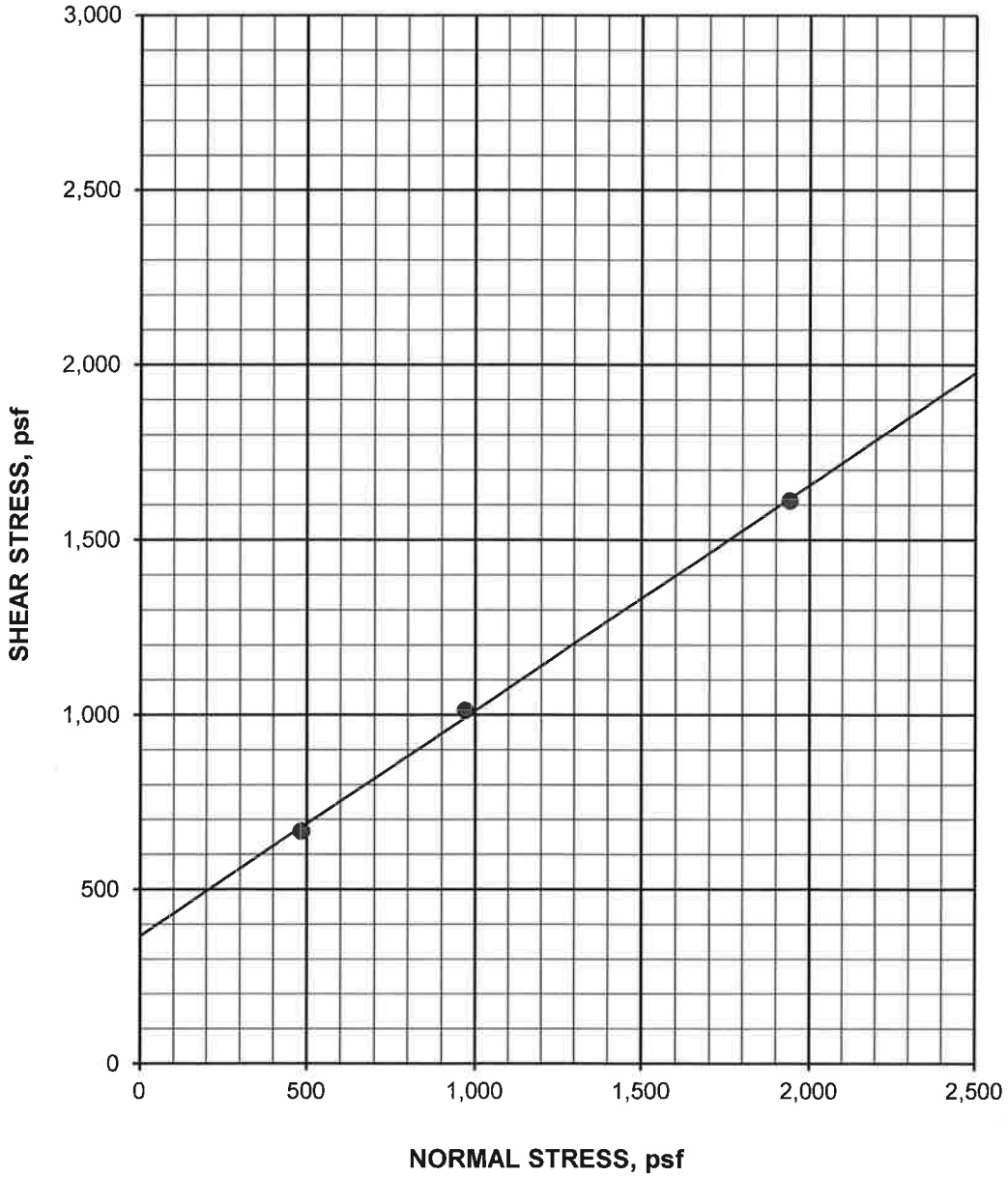
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

January 22, 2016

Boring #2 @ 1.0 - 3.0'
Clayey Sand (SC)
Compacted to 90% RC, saturated

INITIAL DRY DENSITY: 105.8 pcf
INITIAL MOISTURE CONTENT: 12.6 %
PEAK SHEAR ANGLE (Ø): 33°
COHESION (C): 366 psf

SHEAR vs. NORMAL STRESS



San Luis Obispo High School
Measure D - Stadium Entrance/Bleachers/Track

SL-16605-SC

DIRECT SHEAR continued

ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

Boring #2 @ 1.0 - 3.0'

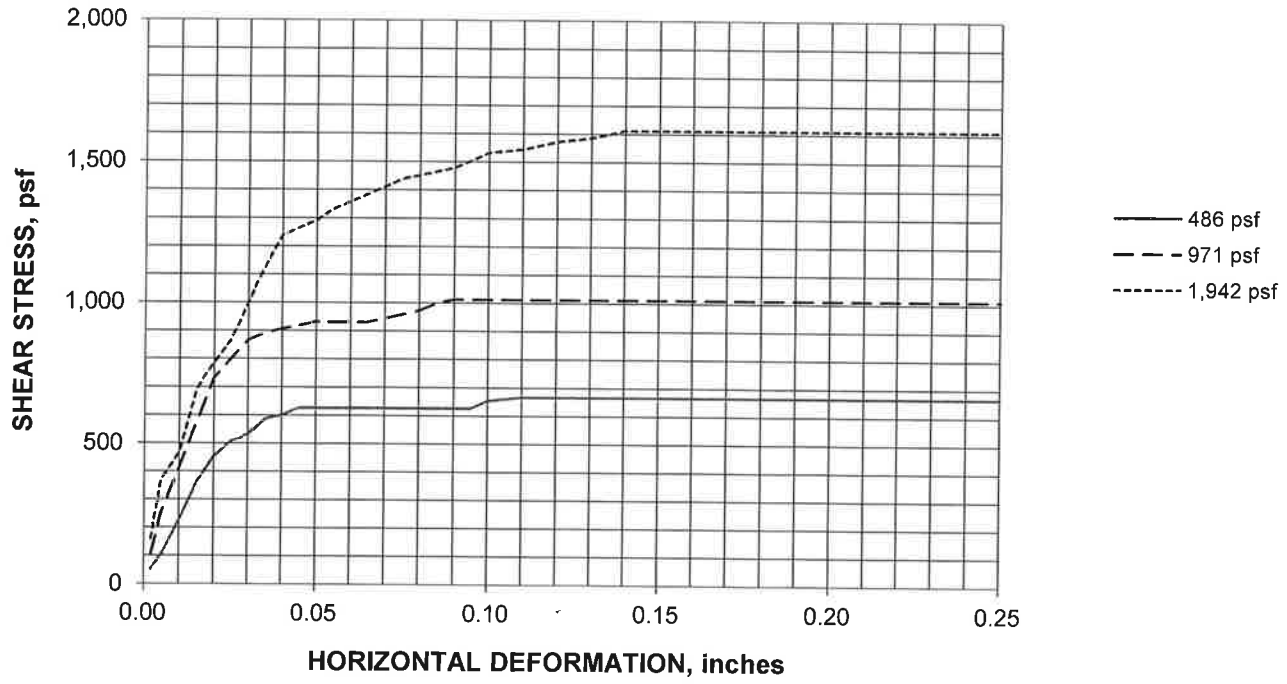
January 22, 2016

Clayey Sand (SC)

Compacted to 90% RC, saturated

SPECIFIC GRAVITY: 2.65 (assumed)

SAMPLE NO.:	1	2	3	AVERAGE
INITIAL				
WATER CONTENT, %	12.6	12.6	12.6	12.6
DRY DENSITY, pcf	105.8	105.8	105.8	105.8
SATURATION, %	59.4	59.4	59.4	59.4
VOID RATIO	0.563	0.563	0.563	0.563
DIAMETER, inches	2.410	2.410	2.410	
HEIGHT, inches	1.00	1.00	1.00	
AT TEST				
WATER CONTENT, %	23.0	22.0	26.1	
DRY DENSITY, pcf	106.3	107.3	111.3	
SATURATION, %	100.0	100.0	100.0	
VOID RATIO	0.556	0.541	0.486	
HEIGHT, inches	1.00	0.99	0.95	



San Luis Obispo High School
Measure D - Stadium Entrance/Bleachers/Track

SL-16605-SC

MOISTURE-DENSITY COMPACTION TEST

ASTM D 1557-12 (Modified)

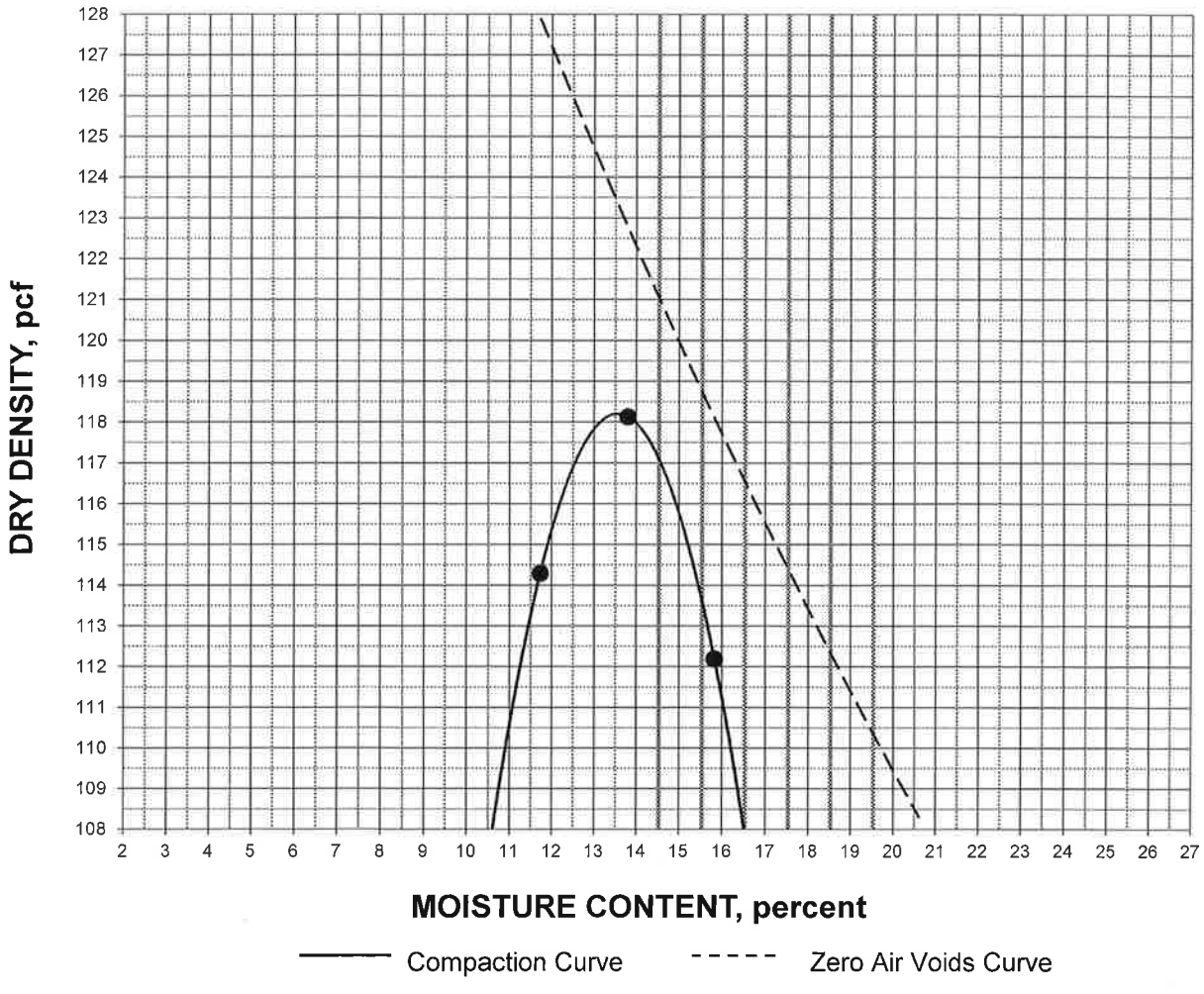
PROCEDURE USED: A
PREPARATION METHOD: Moist
RAMMER TYPE: Mechanical
SPECIFIC GRAVITY: 2.70 (assumed)

January 22, 2016
Boring #8 @ 1.0 - 3.0'
Dark Brown Sandy Lean Clay (CL)

SIEVE DATA:

Sieve Size	% Retained (Cumulative)
3/4"	0
3/8"	0
#4	0

MAXIMUM DRY DENSITY: 118.2 pcf
OPTIMUM MOISTURE: 13.6%



San Luis Obispo High School
Measure D - Stadium Entrance/Bleachers/Track

SL-16605-SC

DIRECT SHEAR

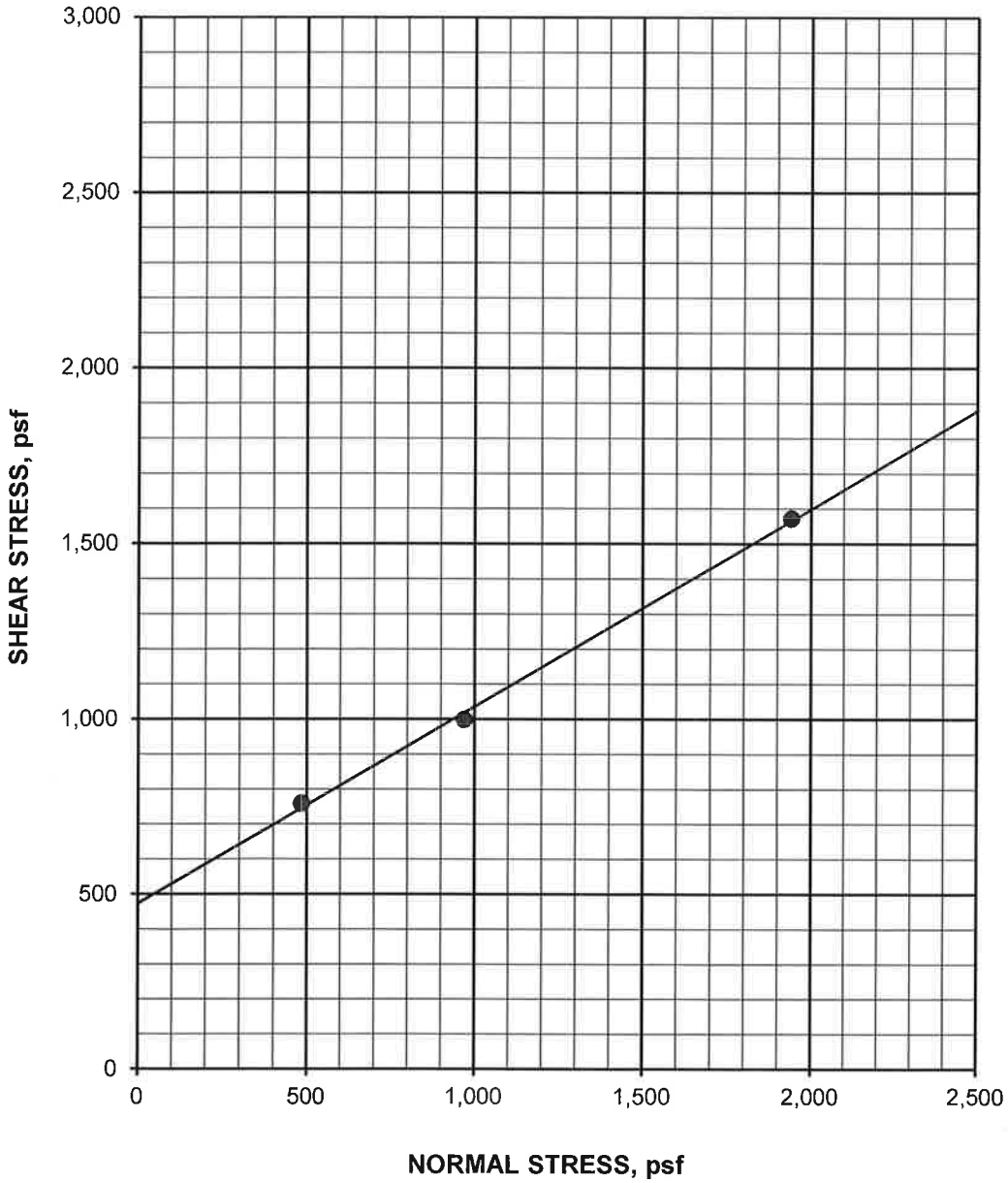
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

January 22, 2016

Boring #8 @ 1.0 - 3.0'
Sandy Lean Clay (CL)
Compacted to 90% RC, saturated

INITIAL DRY DENSITY: 106.4 pcf
INITIAL MOISTURE CONTENT: 13.6 %
PEAK SHEAR ANGLE (Ø): 29°
COHESION (C): 473 psf

SHEAR vs. NORMAL STRESS



San Luis Obispo High School
Measure D - Stadium Entrance/Bleachers/Track

SL-16605-SC

DIRECT SHEAR continued

ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

Boring #8 @ 1.0 - 3.0'

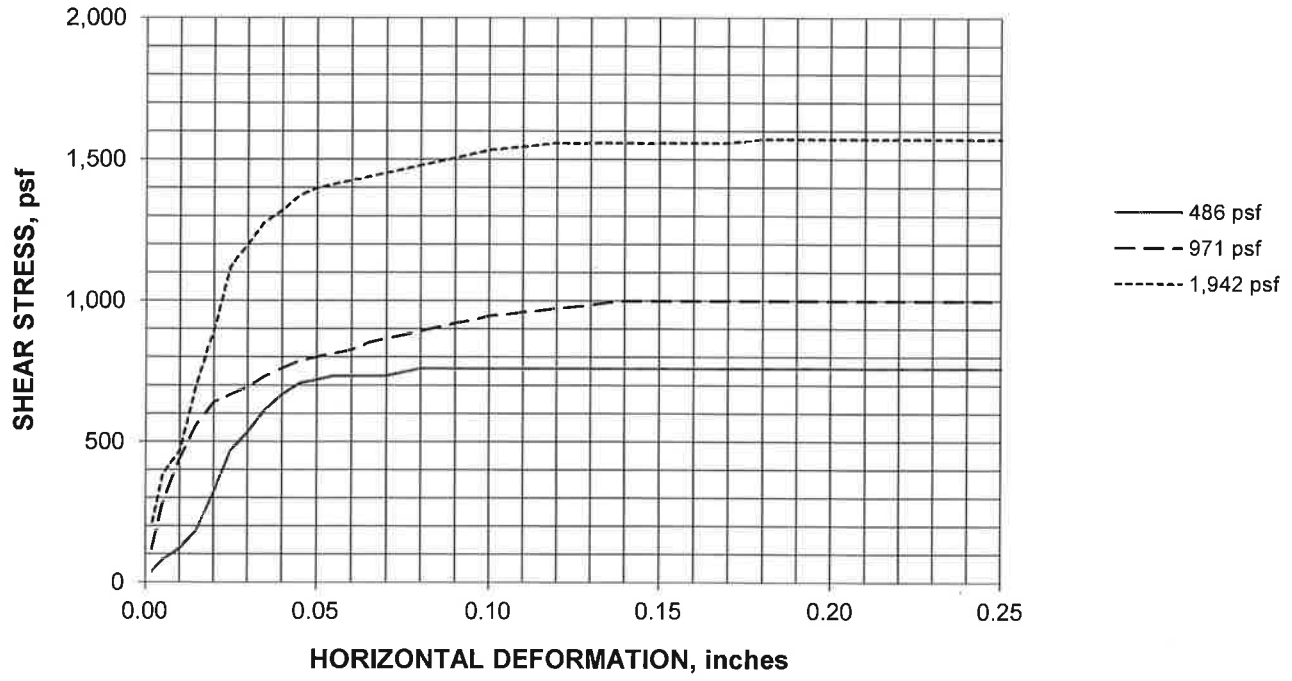
January 22, 2016

Sandy Lean Clay (CL)

Compacted to 90% RC, saturated

SPECIFIC GRAVITY: 2.70 (assumed)

SAMPLE NO.:	1	2	3	AVERAGE
INITIAL				
WATER CONTENT, %	13.6	13.6	13.6	13.6
DRY DENSITY, pcf	106.4	106.4	106.4	106.4
SATURATION, %	62.9	62.9	62.9	62.9
VOID RATIO	0.584	0.584	0.584	0.584
DIAMETER, inches	2.410	2.410	2.410	
HEIGHT, inches	1.00	1.00	1.00	
AT TEST				
WATER CONTENT, %	25.2	26.9	25.9	
DRY DENSITY, pcf	107.8	108.9	112.8	
SATURATION, %	100.0	100.0	100.0	
VOID RATIO	0.563	0.547	0.493	
HEIGHT, inches	0.99	0.98	0.94	



San Luis Obispo High School
Measure D - Stadium Entrance/Bleachers/Track

SL-16605-SC

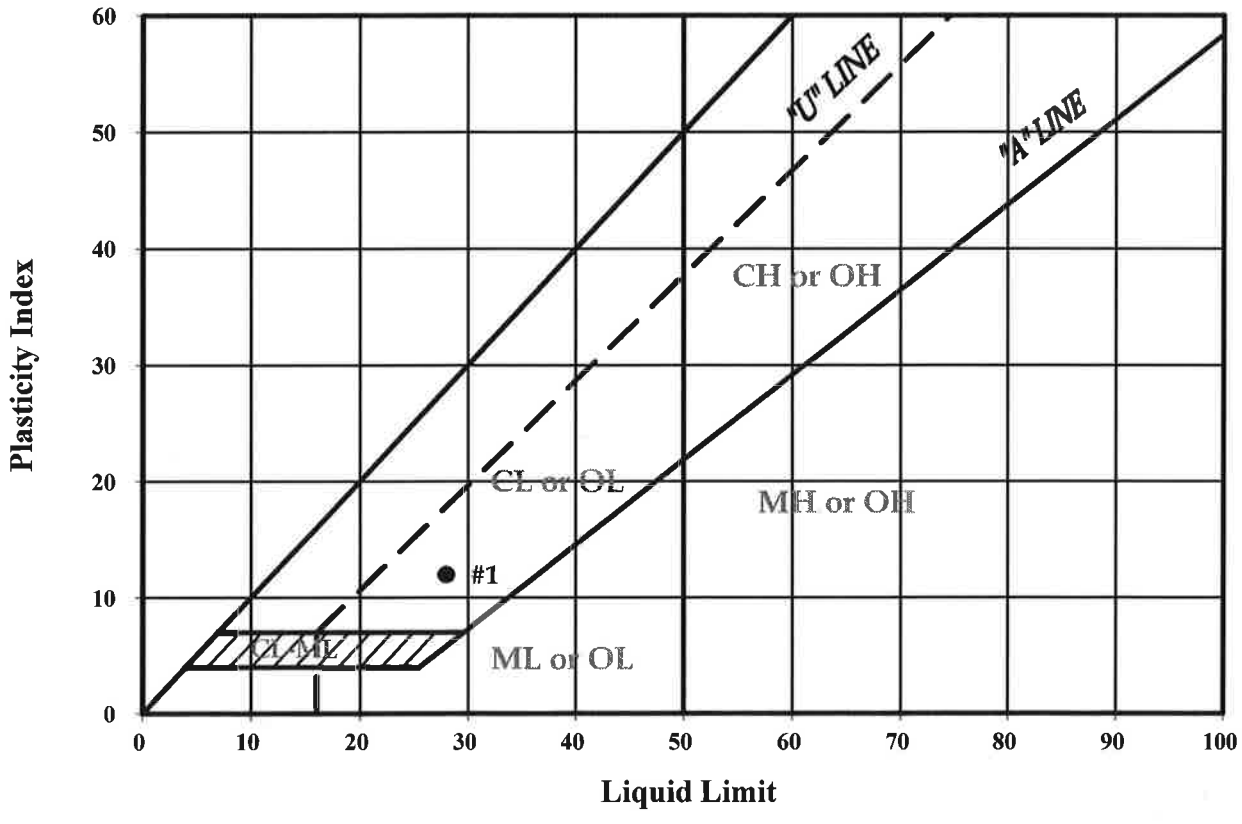
PLASTICITY INDEX

ASTM D 4318-10

January 22, 2016

Test No.:	1	2	3	4	5
Boring No.:	1				
Sample Depth:	20.0 - 21.5'				
Liquid Limit:	28				
Plastic Limit:	16				
Plasticity Index:	12				

Plasticity Chart



APPENDIX C

Corrosivity Analysis by CERCO Analytical, Inc.

California State Certified Laboratory No. 2153

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax. 925 462 2775
www.cercoanalytical.com

26 January, 2016

Job No. 1601156
Cust. No. 11974

Mr. Fred J. Potthast, GE
Earth Systems Pacific
4378 Santa Fe Road
San Luis Obispo, CA 93401

Subject: Project No.: SL-16605-SC
Project Name: San Luis Obispo High School
Stadium Entrance/Bleachers/Track
Corrosivity Analysis – ASTM Test Methods

Dear Mr. Potthast:

Pursuant to your request, CERCO Analytical has analyzed the soil samples submitted on January 20, 2016. Based on the analytical results, this brief corrosivity evaluation is enclosed for your consideration.

Based upon the 100% saturation resistivity measurements, both samples are classified as "moderately corrosive". All buried iron, steel, cast iron, ductile iron, galvanized steel and dielectric coated steel or iron should be properly protected against corrosion depending upon the critical nature of the structure. All buried metallic pressure piping such as ductile iron firewater pipelines should be protected against corrosion.

The chloride ion concentration is none detected to 15 mg/kg.

The sulfate ion concentrations range from 32 to 55 mg/kg and are determined to be insufficient to damage reinforced concrete structures and cement mortar-coated steel at these locations.

The pH of the soils range from 8.00 to 8.24 which does not present corrosion problems for buried iron, steel, mortar-coated steel and reinforced concrete structures.

The redox potentials range from 340 to 350-mV which is indicative of potentially "slightly corrosive" soils resulting from anaerobic soil conditions.

This corrosivity evaluation is based on general corrosion engineering standards and is non-specific in nature. For specific long-term corrosion control design recommendations or consultation, please call *JDH Corrosion Consultants, Inc. at (925) 927-6630.*

We appreciate the opportunity of working with you on this project. If you have any questions, or if you require further information, please do not hesitate to contact us.

Very truly yours,
CERCO ANALYTICAL, INC.

J. Darby Howard, Jr., P.E.
President

JDH/jdl
Enclosure

California State Certified Laboratory No. 2153

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax. 925 462 2775
www.cercoanalytical.com

Client: EarthSystems Pacific
Client's Project No.: SL-16605-SC
Client's Project Name: San Luis Obispo High School - Stadium Entrance/Bleachers/Track
Date Sampled: 15-Jan-16
Date Received: 20-Jan-16
Matrix: Soil
Authorization: Letter dated January 19, 2016

Date of Report: 26-Jan-2016

Job/Sample No.	Sample I.D.	Redox (mV)	pH	Resistivity (as Received) (umhos/cm)	Resistivity (100% Saturation) (ohms-cm)	Sulfide (mg/kg)*	Chloride (mg/kg)*	Sulfate (mg/kg)*
1601156-001	Boring 2 @ 1'-3'	340	8.24	11,000	2,900	-	N.D.	32
1601156-002	Boring 8 @ 1'-3'	350	8.00	3,100	2,600	-	N.D.	55

Method:	ASTM D1498	ASTM D4972	ASTM D1125M	ASTM G57	ASTM D4658M	ASTM D4327	ASTM D4327
Reporting Limit:	-	-	10	-	50	15	15
Date Analyzed:	25-Jan-2016	25-Jan-2016	25-Jan-2016	25-Jan-2016	-	25-Jan-2016	25-Jan-2016

Cheryl McMillen
Laboratory Director

* Results Reported on "As Received" Basis
N.D. - None Detected

Quality Control Summary - **All laboratory quality control parameters were found to be within established limits**

APPENDIX D

Geotechnical Engineering and Geologic Hazards Report
San Luis Obispo High School – Measure D Projects
Annex / Classroom Building
1499 San Luis Drive, San Luis Obispo, California
Project No. 831-3102, dated January 19, 2016

GEOTECHNICAL ENGINEERING AND GEOLOGIC HAZARDS REPORT
SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3102

January 19, 2016

Prepared for

Mr. Anthony Palazzo
San Luis Coastal Unified School District

Prepared by

Earth Systems Pacific
4378 Old Santa Fe Road
San Luis Obispo, CA 93401

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Earth Systems
Pacific

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Ph: 805.544.3276
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www.earthsystems.com

January 19, 2016

Mr. Anthony Palazzo
Director – Buildings, Grounds and Transportation
San Luis Coastal Unified School District
937 Southwood Drive
San Luis Obispo, CA 93401

FILE NO.: SL-16605-SE

PROJECT: SAN LUIS OBISPO HIGH SCHOOL -MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA
PROJECT NO. 831-3102

SUBJECT: Geotechnical Engineering and Geologic Hazards Report

CONTRACT REF: Purchase Order No. 161188 by San Luis Coastal School District, dated December 7, 2015, to Provide a Geotechnical Engineering Investigation, San Luis Obispo High School, Measure D Projects, 1499 San Luis Drive, San Luis Obispo, California, per Proposal by Earth Systems Pacific, Doc. No. 1511-157.PRP, dated November 25, 2015

Dear Mr. Palazzo:

In accordance with your purchase order, this geotechnical engineering and geologic hazards report has been prepared for use in the development of plans and specifications for the Annex/Classroom Building Project at San Luis Obispo High School, in San Luis Obispo, California. This report describes the general geotechnical and geologic characteristics, identifies existing and potential geotechnical and geologic hazards, and discusses the impacts that these conditions could have upon the project. Preliminary geotechnical recommendations for site preparation, grading, utility trenches, foundations, interior slabs-on-grade and exterior pedestrian flatwork, retaining walls, asphalt concrete (AC) paths, drainage and maintenance, and observation and testing are presented herein. Soil corrosivity testing and an evaluation of the results, which were subcontracted to HDR, Inc. of Claremont, California, are also provided. Two bound copies and an electronic copy of this report are being furnished for your use.

We appreciate the opportunity to have provided services for this project and look forward to working with you again in the future. If there are any questions concerning this report, please do not hesitate to contact the undersigned.

Sincerely,

Earth Systems Pacific

REGISTERED PROFESSIONAL ENGINEER
FREDERICK J. POTTHAST
No. GE 2369
Exp. 03/31/16
GEOTECHNICAL
STATE OF CALIFORNIA

Fred J. Potthast, GE
Principal Engineer

1/19/16

Richard T. Gorman, CEG
Principal Geologist

PROFESSIONAL GEOLOGIST
RICHARD T. GORMAN
No. CEG 1325
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Doc. No.: 1601-059 SGR/tf

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APPENDIX E	Typical Detail A: Pipe Placed Parallel to Foundations

1.0 INTRODUCTION AND SITE SETTING

The proposed Annex/Classroom Building at San Luis Obispo High School will have a footprint of approximately 12,000 square feet. It will be single story, of steel-frame, stud and possibly masonry construction. Conventional continuous and spread (pad) foundations are planned, with concrete slabs-on-grade. Maximum dead plus live loads on continuous footings of 2,000 plf, and maximum loads on spread footings of 75 kips, have been assumed for the purposes of this report. Retaining walls for sitework, or connected to or forming part of the structure, and a maximum of 4 feet tall, may also be utilized. The new building will be served by the existing campus utility systems via underground connections; it will be surrounded by landscaping and sidewalks of either Portland cement concrete (PCC) or asphalt concrete (AC) over aggregate base (AB). The existing service driveways in the project area may be repaired as part of the project, however no new pavement areas are anticipated. To our knowledge, no drainage basins are planned as part of the project. Infiltration systems or other types of low-impact development (LID) features may be included in the final design; however this has not been determined as of the date of this report, and therefore these potential features are not addressed.

The new building will be constructed on the site of the existing Annex/Cafeteria Building, on the north side of the campus, immediately east of the old Gymnasium. The site location on the campus is indicated on the Vicinity Map in Appendix A. Flatwork, lawns, shrubs and several scattered mature trees are present on the west, south and east sides of the existing building. The main campus service road extends along the west side of the existing building, just beyond the lawn, providing access to a paved delivery area at the rear (the north side) of the building. Drainage appears to be by sheet flow, and generally toward the south-southwest. The locations and dispositions of utility lines on the site are unknown.

2.0 SCOPE OF SERVICES

The scope of work for this report included a general site reconnaissance, subsurface exploration, site reconnaissance by a registered geotechnical engineer and certified engineering geologist, laboratory testing of samples secured during the subsurface investigation, geotechnical and geologic analyses of the data, and preparation of this report. The analysis and subsequent recommendations were based on general information provided by the client.

This report and preliminary geotechnical recommendations are intended to comply the considerations of Sections 1803A.1 through 1803A.7, J104.3 and J104.4 of the 2013 California Building Code; California Geological Survey Note 48; DSA IR A-4.13; and common geotechnical engineering and engineering geology practice in this area under similar conditions at this time.

The test procedures were accomplished in general conformance with the standards noted, as modified by common geotechnical engineering practice in this area under similar conditions at this time.

Preliminary geotechnical recommendations for site preparation, grading, utility trenches, foundations, interior slabs-on-grade and pedestrian flatwork, retaining walls, AC paths, drainage and maintenance, and observation and testing are presented to guide the development of project plans and specifications. The results of geotechnical corrosivity testing, and an evaluation of the results with recommendations for mitigation, which were subcontracted to HDR, Inc., are also provided. As there may be geotechnical issues yet to be resolved, the geotechnical engineer should be retained to provide consultation as the design progresses, to assist in verifying that pertinent geotechnical issues have been addressed and to aid in conformance with the intent of this report. It may also be advantageous to retain the geotechnical engineer to review the project plans and details as they near completion, to further aid in conformance with the intent of this report.

It is our intent that this report be used exclusively by the client in the preparation of plans and specifications. Application beyond this intent is strictly at the user's risk.

This report does not address issues in the domain of contractors such as, but not limited to, site safety, loss of volume due to stripping of the site, shrinkage of soils during compaction, excavatability, dewatering, shoring, temporary slope angles, construction means and methods, etc. Analyses of the soil for mold potential, man-made asbestos, lead, radioisotopes, hydrocarbons, or chemical properties other than geotechnical corrosivity are beyond the scope of this report. Evaluation of the site for suitability for LID improvements or drainage basins; ancillary features such as temporary access roads, fences, flag and light poles, signage; and nonstructural fills are not within our scope and are also not addressed.

In the event that there are any changes in the nature, design, or location of improvements, or if any assumptions used in the preparation of this report prove to be incorrect, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are verified or are modified in writing. The criteria presented in this report are considered preliminary until such time as any peer review or review by any jurisdiction has been completed, conditions are observed by the geotechnical engineer and/or geologist in the field during construction, and the recommendations have been verified as appropriate or modified in writing.

3.0 FIELD INVESTIGATION

On December 29, 2015, three borings were drilled in the planned building area to depths ranging from approximately 16.5 to 26 feet below the existing ground surface. The borings were drilled with a truck-mounted Mobile Drill rig, Model B-53, equipped with 6-inch outside diameter hollow stem auger and an automatic trip hammer for sampling. The approximate locations of the borings are shown on the Boring Location Map in Appendix A. Soil samples were obtained using a ring-lined barrel sampler (ASTM D 3550-01/07 with shoe similar to D 2937-10). Bulk soil samples were obtained from the auger cuttings. Standard penetration tests were also performed in the borings (ASTM D 1586-11) at selected depths. The borings were backfilled with auger spoils.

Soils encountered in the borings were categorized and logged in general accordance with the Unified Soil Classification System and ASTM D 2488-09a. Where bedrock was encountered, its properties were described based upon observation of the auger cuttings and the effort required to drill into it. Copies of the boring logs and a Boring Log Legend are included in Appendix A. In reviewing the boring logs and legend, the reader should recognize that the legend is intended as a guideline only, and there are a number of conditions that may influence the soil characteristics as observed during drilling. These include, but are not limited to, the presence of cobbles or boulders, cementation, variations in soil moisture, presence of groundwater, and other factors. It should also be noted that the descriptions of bedrock must span a much wider range of density and strength characteristics than soil, and are relative to other bedrock strata. For example, fractured and weathered bedrock may be described as “soft,” yet it will be considerably harder than almost any type of soil. Conversely, a clay soil may be described as “hard,” however it will not be nearly as hard as even “moderately soft” bedrock such as the sandstone and claystone encountered on this site. Consequently, the logger must exercise judgment in interpreting the subsurface characteristics, possibly resulting in soil and bedrock descriptions that vary somewhat from the legend.

4.0 LABORATORY ANALYSIS

The ring samples were tested for unit weight and moisture (ASTM D 2937-10), as modified for ring liners. One ring sample was also tested for one-dimensional consolidation (ASTM D 2435-11). Bulk samples were tested for maximum density and optimum moisture content (ASTM D 1557-12), expansion index (ASTM D 4829-11), plasticity index (ASTM D 4318-10) and cohesion and angle of shearing resistance by direct shear (ASTM D 3080-11, recompacted to 90 percent of maximum dry density and modified for consolidated, undrained conditions). The physical laboratory test results are presented in Appendix B.

Two bulk samples of the upper soils were also sent to HDR, Inc. of Claremont, California for geotechnical corrosivity testing. The results of these tests, and HDR, Inc.'s evaluation of the results, are presented in Appendix C.

5.0 GENERAL SUBSURFACE AND GEOLOGIC PROFILE

Boring 1, drilled on the west side of the existing building, found 4 feet of stiff fill (sandy lean clay with a trace of coarse gravel) over alluvium. The alluvium consisted of very stiff sandy lean clay with some fine gravel from 4 to 17 feet, and medium dense clayey gravel with sand to 23.5 feet. The alluvium was underlain by moderately soft bedrock (sandstone) of the Franciscan Mélange, which continued to drilling refusal at 26 feet.

A pavement section of 4 inches of asphalt concrete (AC) over 2 inches of aggregate base (AB) was found in Boring 2, on the north side of the existing building. Below the pavement to the boring termination depth of 16.5 feet was stiff to very stiff sandy lean clay alluvium. Some fine gravel was found in the clay to 4.5 feet.

Boring 3, on the east side of the existing building, encountered very stiff sandy lean clay with a trace of gravel (alluvium) from the surface to 7.5 feet. Bedrock of the Franciscan Mélange was found below the alluvium; the bedrock was moderately soft sandstone to 10.5 feet and moderately soft, severely sheared and weathered claystone to the drilling refusal depth of 16.5 feet.

During drilling, the soils and bedrock were described as being slightly moist to very moist. Free subsurface water was not found in any of the borings, to the maximum depth explored of 26 feet.

Please refer to the boring logs in Appendix A for a more complete description of the subsurface conditions. Cross Section A-A' in Appendix A is a graphic representation of the subsurface conditions found by the exploratory borings.

6.0 GEOLOGY

Geologic Setting

San Luis Obispo High School lies along the northeastern side of the Los Osos Valley, which is bounded to the northeast by the northwest-trending Santa Lucia Mountain Range and to the southwest by the northwest-trending Irish Hills. The proposed building area is on the north side of the campus, and it is relatively flat with a slight slope to the south/southwest. Locally, the school site area is bounded to the northeast by hillside terrain and to the southwest by San Luis Obispo Creek. The geologic map of the San Luis Obispo Quadrangle by Wiegers (2010) indicates

that the Annex/Classroom Building school site area is underlain by Holocene alluvial flood plain deposits (see the Geologic Map in Appendix D). Based on the results of our subsurface investigation and field observations, we concur with the Wiegers geologic map.

Faulting

Significant Faults

The San Andreas, Hosgri-San Simeon, and Los Osos Faults are the most significant regional *active* faults within a 65-mile radius of the school site, which could affect existing and proposed developments during their anticipated lifespan (see the Historical Earthquake/Fault Map in the Appendix D). The closest *active* fault to the site is the Irish Hills segment of the Los Osos Fault, located approximately 3.35 miles southwest. The closest mapped fault to the site (regardless of activity) is the Late Quaternary age Cambria Fault; it is located approximately 1 mile northeast (see the Historical Earthquake/Fault Map in the Appendix D). Brief descriptions of these faults are presented in the following sections. Regional faults and locations of historic earthquake events are also depicted on the Historical Earthquake/Fault Map in Appendix D.

Cambria Fault

The Cambria Fault is the closest mapped fault (regardless of activity) to the site; it is located approximately 1 mile northeast. The southern end of the Cambria fault could be considered part of the Oceanic fault group where the faults nearly join east of Cal Poly State University in San Luis Obispo. In some areas along the fault, it can be distinguished by the line of serpentine rock ridges that it bounds. Splays of the Cambria fault break late Pliocene (2 million years old) strata east of Cambria, but there is no known offset of Holocene (11,000 years old) age sediments by the system (Chipping, 1987). Weber (1983) noted that 120,000-year old marine terrace deposits north of Cayucos, near Ellysly Creek, may have been offset by the Cambria fault. However, to our knowledge, Weber's observation has never been confirmed by field exploration.

San Andreas Fault

The San Andreas Fault, considered to be the most active fault in the general region, lies 23 miles to the east of the site. The San Andreas Fault undergoes a major change in character between Parkfield and Cholame. North of Cholame, the fault moves more or less constantly in a process called creep, whereas the south end of the fault is locked, moving only in very large earthquakes. The last major quake on this part of the fault was the 1857 event (magnitude 7.9). In the immediate vicinity of Parkfield, there is a 20-mile segment that is also locked, generating an earthquake every 20 years or so on average. Dated quakes on this segment are 1881, 1901, 1922, 1934, and 1966, and are usually in the magnitude 5.5 to 6.0 range, (Bakun 1988). A 6.0 magnitude earthquake occurred on this fault segment on September 28, 2004.

Los Osos Fault

The Los Osos Fault, at its closest point to the site, is approximately 3 miles to the southwest. It consists of four distinct segments. From northwest to southeast, these are the Estero Bay, the Irish Hills, the Lopez Reservoir, and the Newsome Ridge segments. PG&E (1988) suggests that the Irish Hills segment displays the best expressed geomorphic features, displacing late Pleistocene and Holocene deposits. The Irish Hills segment starts in the vicinity of Los Osos and extends to just past San Luis Obispo Creek. A two-mile long segment west of Laguna Lake is considered to be active (Treiman 1989) and is zoned as a State Earthquake Fault Zone under the Alquist-Priolo Act (Hart 1997). This active segment lies about 3.35 miles to the southwest of the site and is the closest active fault to the site. The Los Osos Fault comprises a northwest-trending series of high- and low-angle faults that exhibit a complex history of both strike-slip and reverse displacement. However, during the late Quaternary, movement appears to have been primarily reverse displacement (PG&E 1998).

Hosgri-San Simeon Fault System

The Hosgri-San Simeon Fault System lies approximately 25 miles to the west of the site. A northwest-trending strike-slip fault, the San Simeon Fault extends from offshore of Ragged Point to just offshore of San Simeon Point, where it joins the northern end of the Hosgri Fault. From this point, the Hosgri Fault extends to an ocean shelf 2 miles west of Point Buchon, and then trends toward the Point Sal area. The fault system is considered active by the 2004 United States Geologic Survey (Jennings and Bryant 2010), based on Hall's claims of recent offset terrace deposits along San Simeon Cove, and also by a relocation of the 1927 "Lompoc Earthquake" onto the southern end of the Hosgri Fault (Hall 1975, 1976, 1977).

On December 22, 2003, a 6.5-magnitude earthquake occurred approximately 6 miles northeast of San Simeon, California and approximately 28 miles north of the subject site. Analysis by the USGS and the University of California at Berkeley indicates that the event had a thrust (reverse-faulting) mechanism (Goel 2004). The earthquake occurred in the vicinity of the northern end of the Hosgri-San Simeon Fault.

Groundwater

Soil and bedrock moisture contents encountered during drilling were generally slightly moist to very moist. Groundwater was not encountered in any of the borings to the maximum depth explored of 26 feet.

7.0 SEISMICITY

Earthquake History

The historic seismicity in the site's region was researched using EQSEARCH (Blake, updated December 2012) and the Boore and others (1997) method of analysis for Site Class "D", stiff soil sites (ASCE 2010) that is incorporated within that program. EQSEARCH performs automated searches of a custom catalog of historical Central California earthquakes. As the program searches the catalog, it computes the epicentral distance from the selected site to each of the earthquakes within the specified search area. The epicentral distances should be considered estimates, particularly for earthquake data prior to 1932, when modern instruments were first used to record earthquake data.

The parameters used for the search consisted of earthquake Richter magnitudes ranging from 5.0 to 9.0 that occurred within a 65-mile radius from the site from 1800 to December 2012. The site coordinates used in this search were latitude 35.2836N and longitude 120.6501W. The Historical Earthquake/Fault Map presented in Appendix D graphically depicts the results of the search, including historical earthquake epicenters, their corresponding magnitudes, and faults within the general region of the project.

Results of the search indicated that within the search parameters, 44 earthquakes have occurred. The highest peak horizontal ground acceleration (PGA) estimated to have occurred at the site from those historical earthquakes is 0.33g. This earthquake had a 5.9 magnitude, occurred in 1906, and was located approximately 3 miles northwest of the site. This earthquake may have occurred along the Los Osos Fault. The largest magnitude earthquake that the search revealed was 7.9. This earthquake was located approximately 48 miles east of the site, and is known as the 1857 earthquake on the San Andreas Fault. It produced an estimated PGA of 0.15g at the site.

Design Acceleration Parameters

In accordance with California Geologic Survey, Note 48 (October 2013), Item 16, an assessment was made to determine if there was a need to employ "Site Specific Ground Motion Procedures" for this site. Based on a review of the San Luis Obispo County Planning Department Permit View web site (2015), a determination was made that the site is not located in a Geologic Study Area, an Alquist-Priolo Earthquake Fault Zone, or a High Liquefaction Hazard Zone. In addition, the S_1 ground motion value obtained from the United States Geological Survey Earthquake Hazards Program website (USGS 2016) and the 2010 ASCE 7 Standard Analysis Method, for Site Class "D" (stiff soil sites), was below 0.75g (see table below). Therefore, the project does not require a site-specific ground motion analysis.

The site is in a region of generally high seismicity and has the potential to experience strong ground shaking from earthquakes on regional or local causative faults. To characterize the seismicity at the site and to provide seismic design parameters for the architect/engineer, a General Procedure Ground Motion Analysis was performed to calculate the deterministic ground motions at the site. The ground motions are based on the 2013 California Building Code General Procedure that were obtained from the United States Geological Survey Earthquake Hazards Program website (USGS 2016) and the 2010 ASCE 7 Standard Analysis Method, for Site Class "D" (stiff soil sites). The results of this analysis are presented in the following table:

SUMMARY OF DESIGN RESPONSE ACCELERATION PARAMETERS

Mapped Acceleration Values for Site Class "B"		**2013 CBC Site Coefficients and General Procedure Adjusted MCE Spectral Response Acceleration Parameters For Site Class "D"**					
Seismic Parameters	Values (g)	Site Coefficients	Values	Seismic Parameters	Values (g)	Seismic Parameters	Values (g)
S_S	1.137	F_a	1.045	S_{MS}	1.188	S_{DS}	0.792
S_1	0.434	F_v	1.566	S_{M1}	0.680	S_{D1}	0.453
Peak Mean Ground Acceleration (PGA_m): 0.475 g							
Seismic Design Category = D							

Seismic Design Category

Section 1613A.3.5 of the 2013 CBC indicates that sites will be assigned to Category D unless $S_1 \geq 0.75$. The S_1 calculated for the site is 0.434g; therefore, the site would be assigned to Category D.

8.0 GEOLOGIC HAZARDS

Surface Ground Rupture

Surface ground rupture generally occurs at sites that are traversed by, or lie very near to, a causative fault. The site is not located within a State Earthquake Fault Zone, and there are no mapped faults crossing or adjacent to the site. The closest mapped active fault to the site is the Irish Hills segment of the Los Osos Fault, located approximately 3.35 miles southwest of the site. Therefore, the potential for surface ground rupture to occur at the site is very low.

Liquefaction

The term liquefaction refers to the liquefied condition and subsequent softening that can occur in soils when they are subjected to cyclic strains, such as those generated during a seismic event. Previous studied have concluded that liquefaction within the upper 50 feet of soil can potentially affect improvements at the ground surface. Due to the relatively shallow depth to the bedrock, the stiff to very stiff alluvial clay soils above the bedrock, and the absence of groundwater to the maximum depth explored of 26 feet, the potential for liquefaction to occur is considered to be nil.

Seismically Induced Settlement

Seismically induced settlement of sufficient magnitude to cause structural damage is normally associated with poorly consolidated, predominantly sandy soils, or variable consolidation characteristics within the building areas. Due to the relatively shallow depth to the bedrock and the presence of stiff to very stiff alluvial clay soils, the potential for seismically induced settlement to occur at the site is considered to be nil.

Slope Stability

The Annex/Classroom site lies within a generally flat area with no significant slopes on or adjacent to it; therefore, there is no potential for gross slope instability or landsliding to impact the project site.

Flooding

According to the Flood Insurance Rate Map Number 06079C1067G (FEMA November 16, 2012), the Annex/Classroom Building site is not located within a 100-year flood zone, or within Flood Zone X (See the FEMA Flood Zone Map in Appendix D). Flood Zone X indicates areas that have been determined to have less than a 0.2 percent chance of being flooded in any given year.

Naturally Occurring Asbestos

Asbestos bearing rock units within the central coast area generally consist of serpentinite, ultra-mafic rock units consisting of olivine-hornblende and some schist metamorphic rock units. Based on our research and review of the borings logs, the project site is predominately underlain by a thick deposit of clayey soil alluvium, followed by sandstone and claystone bedrock of the Franciscan Mélange, which ranged in depth from 7.5 to 23.5 feet. These geologic units are not asbestos bearing, therefore, the potential for naturally occurring asbestos to occur on the site is considered to be nil.

Radon

Radon is a colorless, odorless gas present in soil and rock, which is derived from the decay of uranium. The occurrence of radon correlates with the presence of specific minerals, and its concentrations in soil or rock will vary depending on the mineralogy of the surrounding bedrock, temperature, barometric pressure, moisture and other factors. Prolonged exposure to elevated levels of radon is associated with an increased risk of lung cancer.

According to Special Report 208, by the California Geological Survey (Churchill 2008) radon is most commonly found in areas of San Luis Obispo County that are underlain by bedrock of the Monterey formation. The site is underlain by alluvial soils and bedrock of the Franciscan Melange. The report (Churchill 2008) shows that the project site is in an area of low radon potential for San Luis Obispo County.

9.0 CONCLUSIONS

Geology

It is our opinion that there are no significant local or regional geologic conditions that would preclude construction of the Annex/Classroom Building and site improvements as described in the "Introduction" section of this report.

Site Geology

The Annex/Classroom Building site area lies on relatively flat terrain that is bounded to the northeast by hillside terrain and to the southwest by San Luis Obispo Creek. The site area is underlain by Holocene alluvial flood plain deposits and bedrock of the Franciscan Melange.

Groundwater

Soil and bedrock moisture contents encountered during drilling were generally slightly moist to very moist. Groundwater was not encountered in any of the borings, to the maximum depth explored of 26 feet.

Slope Stability

There are no significant slopes on or adjacent to the Annex/Classroom Building site area; therefore, there is no potential for gross slope instability or landsliding to impact the project.

Seismicity

The site is located within the seismically active southern California area, and moderate to severe ground shaking can be expected during the life of the proposed structure. The largest historical mean peak horizontal acceleration estimated to have occurred in the vicinity of the site was 0.33g.

Surface Ground Rupture

The site is not located in a State Earthquake Fault Zone and there are no mapped faults crossing the site. The closest mapped active fault to the site is the Irish Hills segment of the Los Osos Fault, approximately 3.35 miles southwest. Therefore, the potential for surface fault rupture to occur at the site is considered to be very low.

Liquefaction, Seismically Induced Settlement, and Naturally Occurring Asbestos

As the site is underlain by stiff to very stiff condition of the clayey alluvial and relatively shallow bedrock of the Franciscan Mélange, the potentials for liquefaction and seismically-induced settlement to occur are considered to be nil. As the sandstone bedrock of the Franciscan Mélange is not an asbestos-bearing geologic unit, the potential for naturally occurring asbestos to occur on the site is also considered to be nil.

Flooding

The site is not within a 100-year flood zone, or Flood Zone X, which has been determined by FEMA (2012) to be areas that have less than a 0.20 percent chance of being flooded in any given year.

Radon

The site is underlain by clayey alluvial deposits and relatively shallow sandstone bedrock of the Franciscan Mélange, therefore the potential for radon to affect the project is low.

Geotechnical Engineering

In our opinion, the site is suitable, from a geotechnical engineering standpoint, for the proposed Annex/Classroom Building and site improvements, as described in the "Introduction" section of this report, provided the recommendations contained herein are implemented in the design and construction. The primary geotechnical engineering concerns are the potential for differential settlement from the existing fill and the potential disturbance at depth due to removal of the existing structure, the expansion potential of the upper soils, and the erodible nature and corrosive potential of the soils. Provided that the building area is prepared as recommended in the "Grading" section of this report, conventional continuous and spread (pad) foundations may be used to support the proposed structure.

Differential settlement can occur when a foundation spans materials having variable consolidation characteristics, such as the fill that was found in the upper 4 feet of Boring 1. We are unaware of any documentation (i.e., grading observation or compaction testing records) regarding the placement of the fill, but it was likely placed when the existing Annex/Cafeteria Building was constructed. Undocumented fill has a greater potential for variability than fill that has been placed and tested in a controlled earthwork program. Removal of the existing structure is also anticipated to disturb the soil to variable depths. Such conditions (i.e., undocumented fill and disturbed soil) could stress and possibly damage foundations, often resulting in severe cracks and displacement if they are not mitigated. Therefore, to reduce this potential for differential settlement, a program of overexcavation and recompaction of the soil in the building area is recommended prior to construction.

Expansion index testing yielded results of 54 and 58 for the upper fill and alluvial soils. Per CBC Section 1803A.5.3, the soils are considered to be expansive. The more commonly used ASTM classification is that the soils would be considered to have a "medium" expansion potential. Expansive soils tend to swell with increases in soil moisture and shrink as soil moisture decreases; the upper 3 to 5 feet of any soil profile is the zone most affected by these seasonal soil moisture fluctuations. The volume changes that the soils undergo in this cyclical pattern can stress and damage foundations and slabs-on-grade if precautionary measures are not incorporated during design and in the construction procedure. Footings are typically deepened and additional reinforcement is provided. Imported nonexpansive soils are recommended to be placed beneath slabs-on-grade.

The soils above the bedrock are considered to be erodible. It is essential that all surface drainage be controlled and directed to appropriate discharge points, and that surface soils, particularly those disturbed during construction, are stabilized by vegetation or other means *during and following construction*.

As indicated in the Soil Corrosivity Study by HDR, Inc., in Appendix C, the electrical resistivities of the samples tested were in the moderately corrosive categories with as received moisture contents; when saturated, the resistivities were in the corrosive to severely corrosive categories. Soil pH values were mildly alkaline. The soluble salt contents of the soils were low to moderate. Soil nitrate concentrations were high. The soils were classified as severely corrosive to ferrous metals and aggressive to copper. Please refer to the Soil Corrosivity Study in Appendix C for a complete summary of the test results, and recommendations for mitigation.

10.0 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

The following recommendations are for improvements constructed as described in the "Introduction" section of this report. If locations, elevations, structural loads, etc., change, the recommendations contained herein may require modification. In developing the following recommendations, it was assumed that irrigated landscaping or flatwork that would keep the soils relatively uniform, year-round moisture will be installed for a zone of at least five feet around the perimeter of all improvements.

Two distinct types of Portland cement concrete (PCC) slabs-on-grade are discussed in the following recommendations. The building's interior slabs are defined as "slabs-on-grade." Sidewalks that will not support vehicle traffic are referred to as "exterior pedestrian flatwork." Asphalt concrete (AC) paths may also be utilized for pedestrian access, however it is also assumed that they will not support vehicle traffic.

Unless otherwise noted, the following definitions are used in the recommendations presented below. Where terms are not defined, definitions commonly used in the construction industry are intended.

- **Building Area –** The building area is defined as the area within and extending a minimum of 5 feet beyond the perimeter of the foundations for the Annex/Classroom Building. The building area includes any retaining walls, covered walkways or other improvements that are connected to the structure and that are intended to act in a manner similar to it.
- **Exterior Pedestrian Flatwork and Asphalt Concrete (AC) Path Areas –** The areas within the footprints of all exterior pedestrian flatwork and all AC paths.
- **Sitework Retaining Wall Areas –** The areas within and extending a minimum of 3 feet beyond the foundation limits of all sitework retaining walls.
- **Grading Area –** The entire area to be graded, including the building area, exterior pedestrian flatwork and AC path areas, and sitework retaining wall areas.
- **Existing Grade:** Elevations of the site that existed as of the date of this report.
- **Finish Pad Grade:** The elevation in the building area where earthwork operations are typically considered to be complete. It does not include any sand or gravel that might be placed below slabs-on-grade in association with vapor protection for the slabs.
- **Subgrade:** The elevation in exterior pedestrian flatwork and AC path areas where imported nonexpansive materials, sand, or aggregate base (AB) are placed to support the flatwork or AC path.

- **Scarified:** Plowed or ripped in two orthogonal directions to a depth of not less than 8 inches.
- **Moisture Conditioned:** Adjusting the soil moisture to optimum moisture content, or just above, prior to application of compactive effort.
- **Compacted/Recompacted:** Soils placed in level lifts not exceeding 8 inches in loose thickness and compacted to a minimum of 90 percent of maximum dry density. Based on maximum dry density by ASTM D 1557-12 and field density by ASTM D 6938-15, or other methods acceptable to the geotechnical engineer and jurisdiction.

Site Preparation

1. The ground surface in the grading areas should be prepared for construction by removing the existing building, existing flatwork, and all other improvements, vegetation, large roots, debris, organic topsoil, and other deleterious materials. Existing utility lines that will not remain in service should be either removed or abandoned. The appropriate method of abandonment will depend upon the type and depth of the utility. Recommendations for abandonment can be made as necessary.

2. Voids created by the removal of materials or utilities described above should be called to the attention of the geotechnical engineer. No fill should be placed unless the underlying soil has been observed by the geotechnical engineer.

Grading

1. Following site preparation, all existing fill in the building area should be removed to a level plane at the deepest point of the fill. For planning purposes, the deepest point of the fill encountered during the field exploration program was 4 feet below existing grade at Boring 1. The exact depth of fill should be determined by the geotechnical engineer at the time of construction. The resulting level excavated surface should be scarified, moisture conditioned and compacted.

2. To create as uniform conditions as possible for the structure, all earthwork operations should be completed throughout the entire building area in a uniform manner at the same time, from the bottom of the overexcavation recommended in the previous paragraph through fill placement to finish grade. Earthwork operations that complete only a portion of the building area at one time (i.e., “flip-flopping”, “checkerboarding”, etc.) should not be allowed.

3. Following site preparation, all existing fill in sitework retaining wall areas should be overexcavated to the deepest point of the fill. The resulting excavated surfaces should be scarified, moisture conditioned and compacted. Overexcavation elevations may be stepped where the fill depth changes or where retaining walls are stepped to conform to any site contours. If very stiff sandy lean clay alluvium is exposed at bottom of foundation elevation, no overexcavation and recompaction is considered necessary. To reduce the potential for cracking in sitework retaining walls, construction joints should be placed in the wall and the foundation where overexcavation operation have been stepped to conform to fill depth changes or to exposure of very stiff alluvium. Unlike the recommended earthwork program for the building area, overexcavation and recompaction operations for sitework retaining walls can proceed in a non-uniform manner for individual wall segments.

4. Following site preparation and any excavations to grade, or prior to placement of fill, the soil in any exterior pedestrian flatwork and AC path areas, and in all other grading areas, should be scarified, moisture conditioned and recompacted. Unlike the recommended earthwork program for the building area, scarification and recompaction operations for exterior pedestrian flatwork and AC path areas, and in all other grading areas, can proceed in a non-uniform manner.

5. Voids created by dislodging cobbles and/or debris during scarification should be backfilled and recompacted, and the dislodged materials should be removed from the work area.

6. Previously removed site soils and other similar soils may be placed as fill beyond the building area, and in the building area to a maximum height of 18 inches below bottom of slab elevation. The final 18 inches of fill below bottom of slab elevation in the building area should be nonexpansive.

7. Nonexpansive materials are defined as imported soils that fall in the GW, GM, GC, SP, SW, SC and SM categories per ASTM D 2487-11, and that have an expansion index of 10 or less (ASTM D 4829-11). The clean sand layer described in the “Slabs-on-Grade” section of this report (if utilized below interior slabs-on-grade or exterior pedestrian flatwork) is considered to be part of the minimum recommended thickness of nonexpansive material utilized, not in addition to it.

8. Imported soils used in the building area should have strength and expansion qualities equal to or better than the site soils, and they should not exceed the geotechnical corrosivity potential of the site soils. See the Soil Corrosivity Study in Appendix C for the corrosivity parameters of the site soils. Proposed imported materials should be reviewed by the geotechnical engineer before being brought to the site, and on an intermittent basis during placement.

9. All materials used as fill should be cleaned of any debris and rocks larger than 3 inches in diameter. When fill material includes rocks, the rocks should be placed in a sufficient soil matrix to ensure that voids caused by nesting of the rocks will not occur and that the fill can be properly compacted.

10. All AB and the top 12 inches of subgrade in areas to support AC paths should be compacted to a minimum of 95 percent of maximum dry density. Imported nonexpansive materials, sand or AB used to support exterior pedestrian flatwork, as well as the top 12 inches of subgrade in these areas, need only be compacted to a minimum of 90 percent of maximum dry density.

11. If the soils are overly moist so that they become unstable, or if the minimum recommended compaction cannot be readily achieved, drying the soil so that it is nearer optimum moisture content, may be necessary. Placement of gravel layers or geotextiles may also be necessary to help stabilize unstable soils. Additional overexcavation may also be recommended to correct unstable conditions or if soft or loose conditions are encountered during grading. No fill should be placed in any grading area if the underlying soil is unstable.

12. The recommended soil moisture content should be maintained throughout construction, and during the lives of the structure and sitework improvements. Failure to maintain the soil moisture content can result in desiccation cracks and disturbance, which are an indication of degradation of the soil compaction. If desiccation cracks are allowed to develop, or if soils near improvements such as foundations, flatwork, etc. are otherwise disturbed, damage to those improvements may result. Soils that have cracked or are otherwise disturbed should be removed, moisture conditioned, and recompacted.

Utility Trenches

1. Utility trenches adjacent to foundations should not be excavated within the zone of foundation influence, as shown in Typical Detail A in Appendix E.

2. Utilities that must pass beneath foundations should be placed with properly compacted utility trench backfill and the foundation should be designed to span the trench.

3. A select, noncorrosive, granular, easily compacted material should be used as bedding and shading immediately around utilities. The site soil may be used for trench backfill above the select material beyond the building area, and to within 18 inches below bottom of slab elevation in the building area. Within the building area, imported nonexpansive soils should be utilized to backfill the final 18 inches below bottom of slab elevation of all trenches. In exterior pedestrian flatwork and AC path areas, trench backfill should match the thickness of imported nonexpansive soils, sand or AB used to support these improvements.

4. In general, trench backfill should be compacted to a minimum of 90 percent of maximum dry density. Trench backfill in the upper 12 inches of subgrade and all AB in AC path areas should be compacted to a minimum of 95 percent of maximum dry density. A minimum of 85 percent of maximum dry density will generally be sufficient where trench backfill is located in landscaped or other unimproved areas, where settlement of trench backfill would not be detrimental.

5. Prior to applying compactive effort, soils should be moisture conditioned. Trench backfill should be placed in level lifts not exceeding 6 inches in loose thickness and compacted to the minimums recommended above.

6. Compaction of trench backfill by jetting or flooding is not recommended at this site due to the expansive soils. However, to aid in *encasing* utility conduits, particularly corrugated drain pipes, and multiple, closely-spaced conduits in a single trench with the bedding and shading material, jetting or flooding may be useful. Flooding or jetting should only be attempted with extreme caution, and any flooding or jetting operation should be subject to review by the geotechnical engineer.

7. Long-term settlement of properly compacted sand should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill. Where trenches are backfilled with site soils, the anticipated settlement would be about twice that of sand. Improvements that are constructed over or near trenches should be designed to accommodate the potential for settlement.

8. The Soil Corrosivity Study by HDR, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for utility improvements.

9. The recommendations of this section are minimums only, and may be superseded by the architect/engineer based upon soil corrosivity or the requirements of pipe manufacturers, utility companies or the governing jurisdiction.

Foundations

1. The Annex/Classroom Building may be supported by continuous and spread footings bearing in firm recompacted soils, as recommended in the "Grading" section of this report.

2. Based on soil expansion potential only, minimum overall foundations depths of 21 inches below lowest adjacent grade within 6 feet laterally of the base of foundations should be maintained. Spread footings should be at least 24 inches square.

3. Continuous footings should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential only, minimum continuous footing reinforcement should consist of two No. 4 rebars, one at the top and one at the bottom. Spread footings should be reinforced in accordance with the requirements of the architect/engineer.

4. Footings bearing in firm recompacted soil may be designed using maximum allowable bearing capacities of 2,500 psf dead load and 3,500 psf dead plus live loads. Using these criteria, maximum settlement and differential settlement are expected to be less than 1/2-inch and less than 3/8-inch in 25 feet, respectively.

5. Allowable bearing capacities may be increased by one-third when transient loads such as wind or seismicity are included. Foundations may be designed using the site design response parameters contained in the table on Page 8 in the "Seismicity" section of this report.

6. To calculate resistance to lateral loads, please see the values presented in the "Retaining Walls" section of this report. Lateral capacity is based on the assumption that any backfill adjacent to foundations has been properly compacted. Passive and friction components of resistance may be combined in the analysis without reduction to either value.

7. Footing excavations should be observed by the geotechnical engineer prior to placement of reinforcing steel. Footing excavations should be lightly moistened and no desiccation cracks should be present prior to concrete placement.

8. The Soil Corrosivity Study by HDR Engineering, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for all foundation elements.

Slabs-on-Grade

Interior Slabs-On-Grade

1. Interior slabs-on-grade should have a minimum thickness of 4 full inches. They should be reinforced and doweled to foundations per the specifications of the architect/engineer. At a minimum, interior slabs should be reinforced with No. 3 rebar at 24 inches on center each way. All structural slabs should contain minimum rebar meeting the criteria of ACI 318, Section 7.12.2 (ACI 2011). At a minimum, foundation dowels should be lap spliced to the slab rebar. The size and spacing of the dowels should match the size and spacing of the slab rebar.

Exterior Pedestrian Flatwork

1. Exterior pedestrian flatwork should have a minimum thickness of 4 full inches. Minimum reinforcement for exterior pedestrian flatwork placed over at least 18 inches of nonexpansive imported soils per the following paragraph should consist of No. 3 rebar placed at 24 inches on-center each way. If the thickness of nonexpansive soil below the flatwork is less than 18 inches, the minimum reinforcement should consist of No. 3 rebar at 18 inches on-center each way.

2. In conventional construction, it is common to use 4 to 6 inches of sand beneath exterior pedestrian flatwork. However, due to the medium expansion potential of the site soils, there will be a risk of movement and damage to the flatwork if conventional measures are used. Heaving and cracking could occur. This movement could be reduced by the placement of additional nonexpansive material beneath the flatwork. If it is desired to fully mitigate the expansive soil conditions, then at least 18 inches of imported nonexpansive material should be provided below the flatwork where the expansive site soils are exposed at finish grade. If it is acceptable for the flatwork to experience movement due to expansive soils, then the thickness of the nonexpansive soil can be reduced. Under all flatwork, however, the thicker the nonexpansive layer, the better the expansive soil protection.

3. Another measure that can be taken to reduce the risk of movement of flatwork due to expansive soils is to provide thickened edges or grade beams around the perimeters of the flatwork. If it is desired to fully mitigate the expansive soil conditions, then the thickened edges or grade beams could be up to 21 inches deep. If it is acceptable for the flatwork to experience movement, then the thickened edges or grade beams can be reduced. At a minimum, any thickened edge or grade beam should be reinforced by two No. 4 rebar, one at the top and one at the bottom.

4. It is recognized that the measures discussed above for protecting exterior flatwork from expansive soils are expensive, possibly more expensive than simply replacing flatwork that has heaved and/or cracked. Consequently, the above measures for protecting exterior flatwork are only suggestions for consideration by the owner and/or architect/engineer. The degree to which exterior flatwork is protected from expansive soil damage is left to the discretion of the owner and/or architect/engineer.

5. Flatwork should be constructed with frequent joints to allow articulation as the flatwork moves in response to seasonal soil temperature and moisture variations. The expansive soil underlying any nonexpansive material placed below flatwork should be moisture conditioned, and no desiccation cracks should be present, prior to casting the flatwork.

6. Flatwork at doorways, and at other areas where maintaining the elevation of the flatwork is desired when mitigating expansive soil potential, should be doweled to the perimeter foundation, at a minimum, by No. 3 dowels lapped to the flatwork rebar at 24 inches on center. In other areas, the flatwork may be doweled to the foundation or the flatwork may be allowed to "float free," at the discretion of the architect/engineer. Flatwork that is intended to float free should be separated from foundations by a felt joint or other means.

<u>Moisture Vapor Transmission</u>

1. Due to the current use of impermeable floor coverings, water-soluble flooring adhesives, and the speed at which buildings are now constructed, moisture vapor transmission through slabs is a much more common problem than in past years. Where moisture vapor transmitted from the underlying soil would be undesirable, slabs should be protected from subsurface moisture vapor. A number of options for vapor protection are discussed below; however, the means of vapor protection, including the type and thickness of the vapor retarder, if specified, are left to the discretion of the architect/engineer.

2. Where specified, vapor retarders should conform to ASTM Standard E 1745-11. This standard specifies properties for three performance classes; Class A, B and C. The appropriate class should be selected based on the sensitivity of floor coverings to moisture intrusion and the potential for damage to the vapor retarder during placement of slab reinforcement and concrete.

3. Several recent studies, including those of American Concrete Institute Committee 302 (ACI 2004), have concluded that excess water above the vapor retarder increases the potential for moisture damage to floor coverings and could increase the potential for mold growth or other microbial contamination. The studies also concluded that it is preferable to eliminate the typical sand layer beneath the slab and place the slab concrete in direct contact with a Class A vapor retarder, particularly during wet weather construction. However, placing the concrete directly on the vapor retarder requires special attention to using the proper vapor retarder, a very low water-cement ratio in the concrete mix, and special finishing and curing techniques.

4. Probably the next most effective option would be the use of vapor-inhibiting admixtures in the slab concrete mix and/or application of a sealer to the surface of the slab. This would also require special concrete mixes and placement procedures, depending upon the recommendations of the admixture or sealer manufacturer.

5. Another option that may be a reasonable compromise between effectiveness and cost considerations is the use of a subslab vapor retarder protected by a sand layer. If a Class A vapor retarder is specified, the retarder can be placed directly on the nonexpansive soil. The retarder should be covered with a minimum 2 inches of *clean* sand. If a less durable vapor retarder is specified (Class B or C), a minimum of 4 inches of clean sand should be provided, and the retarder should be placed in the center of the clean sand layer. Clean sand is defined as a well or poorly graded sand (ASTM D 2487-11) of which less than 3 percent passes the No. 200 sieve. The clean sand layer, if used, is considered to be a part of the minimum 18-inch thickness of nonexpansive imported materials recommended in the "Grading" section of this report to be placed below slabs-on-grade, not in addition to it.

6. Regardless of the underslab vapor retarder selected, proper installation of the retarder per ASTM E 1643-11 is critical for optimum performance. Where utilized, the vapor retarder should be placed a minimum of 1 inch above the flow line of the drainage path

surrounding the structures, or 1 inch above the area drain grates if area drains are used to collect runoff around the structures. All seams must be properly lapped, and all seams and utility penetrations properly sealed in accordance with the vapor retarder manufacturer's recommendations.

7. If the sand is used between the vapor retarder and the slab, it should be moistened only as necessary to promote concrete curing; saturation of the sand should be avoided, as the excess moisture would be on top of the vapor retarder, potentially resulting in vapor transmission through the slab for months or years.

8. The architect/engineer should designate any special measures to be used in conjunction with moisture vapor transmission protection, if needed, to mitigate the high potential for indoor radon levels.

9. Positive drainage away from the building should be maintained; see the "Drainage and Maintenance" section of this report for additional discussion of this issue. If water is allowed to pond near the structure, it may seep into the ground and migrate laterally through cracks or utility penetrations in the foundation, ultimately gaining access above the vapor retarder.

Slabs-on-Grade - General

1. To reduce shrinkage cracks in all interior and exterior slabs-on-grade, the concrete aggregates should be of appropriate size and proportion, the water/cement ratio should be low, the concrete should be properly placed and finished, contraction joints should be installed, and the concrete should be properly cured. This is particularly applicable to slabs that will be cast directly upon a vapor retarder and those that will be protected from transmission of vapor by use of admixtures or surface sealers. Concrete materials, placement, and curing specifications should be at the direction of the architect/engineer; AC 302.1R-04 (ACI 2004) is suggested as a resource for the architect/engineer in preparing such specification.

2. To provide stability for curbs adjacent to exterior pedestrian flatwork, they should be set back a minimum distance equal to one-third the height of any adjacent descending slope, but not less than 5 feet from the tops of slopes. Alternately, curbs may be deepened to provide stability. The geotechnical engineer should review, on an individual basis, any situation where curbs must be deepened to meet this recommendation.

3. The Soil Corrosivity Study by HDR, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for all slabs-on-grade.

Retaining Walls

1. Retaining walls connected to or forming part of the building should be founded in firm soil that has been recompacted per the "Grading" section of this report. Sitework retaining walls may be supported by either firm soil that has been recompacted per the "Grading" section of this report, or firm sandy lean clay alluvium. If a sitework retaining wall crosses a recompacted soil/firm alluvium transition, or a transition between varying fill overexcavation depths, a construction joint should be placed in the footing and wall at the transitions. Foundations for all retaining walls should have minimum overall depths (not including any keyway) of 21 inches below lowest grade within 6 feet laterally of any adjacent slope.

2. Retaining wall footings should be reinforced in accordance with the requirements of the architect/engineer; based on soil expansion potential only, minimum retaining wall footing reinforcement should consist of two No. 4 rebars, one at the top and one at the bottom.

3. Retaining wall design may be based on the following parameters:

Active equivalent fluid pressure (site soils)	45 pcf
Active equivalent fluid pressure (imported sand/gravel backfill)	35 pcf
At-rest equivalent fluid pressure (site soils)	60 pcf
At-rest equivalent fluid pressure (imported sand/gravel backfill)	50 pcf
Passive equivalent fluid pressure	350 pcf
Maximum toe pressure	3,500 psf
Coefficient of sliding friction	0.35

4. No surcharges are taken into consideration in the values presented in the previous paragraph. The maximum toe pressure is an *allowable* value; no factors of safety, load factors or other factors have been applied to the remaining values. With the exception of the maximum toe pressure, these values will require application of appropriate factors of safety, load factors, and/or other factors as deemed appropriate by the architect/engineer.

5. If the active or at-rest pressures presented in Paragraph 3 for *imported sand or gravel backfill* are utilized for design of retaining walls, the sand or gravel should be used exclusively as backfill above a 1:1 plane extended upward from the back of the wall footing to approximately 1 foot from the top of the wall backfill. The upper foot should be backfilled with native soil, except in areas where AC paths or exterior pedestrian flatwork will abut the top of the wall. In such cases, the gravel should extend to the imported nonexpansive material, sand, aggregate base, or other material below the improved surface, as appropriate.

6. The active and at-rest pressures presented in Paragraph 3 are applicable to a horizontal retained surface behind the wall. Walls having a retained surface that slopes upward from the wall should be designed for an additional equivalent fluid pressure of 1 pcf for the active case and 1.5 pcf for the at-rest case, for every degree of slope inclination.

7. It is assumed that retaining wall heights will not exceed 4 feet.

8. Section 1803A.5.12.1 of the 2013 CBC requires that dynamic seismic lateral earth pressures be provided by the geotechnical engineer for walls retaining more than 6 feet of backfill. As the walls for this project will not retain more than 6 feet, design for seismic lateral earth pressures is not required.

9. Long-term settlement of properly compacted sand or gravel retaining wall backfill should be assumed to be about 0.25 to 0.5 percent of the depth of the backfill; long-term settlement of properly compacted site soil retaining wall backfill would be about twice that of sand or gravel backfill. Improvements that are constructed near the tops of retaining walls should be designed to accommodate long-term settlement.

10. All retaining walls should be drained with perforated pipe encased in a free-draining gravel blanket. The pipe should be placed perforations downward, and should discharge in a nonerosive manner away from foundations and other improvements. The gravel blanket should have a width of approximately 1 foot and should extend upward to approximately 1 foot from the top of the wall backfill. The upper foot should be backfilled with native soil, except in areas where AC paths or exterior pedestrian flatwork will abut the top of the wall. In such cases, the gravel should extend to the imported nonexpansive material, sand, aggregate base, or other material below the improved surface, as

appropriate. To reduce infiltration of the soil into the gravel, a permeable synthetic filter fabric conforming to Standard Specifications Section 88-1.02B – Class C (Caltrans 2010), should be placed between the two. Manufactured synthetic drains, such as Miradrain or Enkadrain are acceptable alternatives to the use of gravel, provided that they are installed in accordance with the recommendations of the manufacturer.

11. Where weep hole drainage can be properly discharged, the perforated pipe may be omitted in lieu of weep holes on maximum 4-foot centers. A filter fabric as described above should be placed between the weep holes and the drain gravel.

12. Walls facing areas where moisture transmission through the wall would be undesirable should be *thoroughly* waterproofed in accordance with the specifications of the architect/engineer.

13. The architect/engineer should bear in mind that retaining walls by their nature are flexible structures, and that surface treatments on walls often crack. Where walls are to be plastered or otherwise have a finish applied, the flexibility should be considered in determining the suitability of the surfacing material, spacing of horizontal and vertical control joints, etc. The flexibility should also be considered where a retaining wall will abut or be connected to a rigid structure, and where the geometry of the wall is such that its flexibility will vary along its length.

14. The Soil Corrosivity Study by HDR, Inc. in Appendix C should be used by the architect/engineer in specifying appropriate corrosion protection measures for all retaining walls.

Asphalt Concrete (AC) Paths

1. Paths for pedestrian access may be constructed of AC over AB. Design methods for AC pavement do not typically consider pedestrian loading only. Therefore, the section design is typically based on local experience and anticipated life span. For this application, a minimum pavement section of 1.5 to 2.0 inches of AC over 2 to 4 inches of AB is considered appropriate. As with exterior pedestrian flatwork these minimum thicknesses of AC and AB will be subject to movement due to expansive soils. If it is desired to filly mitigate the expansive soil conditions, the AB thickness can be increased to as much as 18 inches.

2. It is recognized that the increased AB thickness recommended above for protecting AC paths from expansive soils will be expensive, possibly more expensive than simply replacing AC paths that has heaved and/or cracked. Consequently, this measure for protecting AC paths is only a suggestion for consideration by the client and/or architect/engineer. The degree to which AC paths are protected from expansive soil damage is left to the discretion of the owner and/ or architect/engineer.

3. AB should conform to the requirements of Section 26 of the Standard Specifications (Caltrans 2010). AC should conform to the requirements of Section 32 of the Standard Specifications (Caltrans 2010).

4. The upper 12 inches of subgrade and all AB in pavement areas should be compacted to a minimum of 95 percent of maximum dry density. Subgrade and aggregate base should be firm and unyielding when proofrolled with heavy, rubber-tired grading equipment prior to continuing construction.

Drainage and Maintenance

1. Per Section 1804A.3 of the 2013 CBC, unpaved ground surfaces should be *finish graded* to direct surface runoff away from foundations and other improvements at a minimum 5 percent grade for a minimum distance of 10 feet. The site should be similarly sloped to drain away from foundation, and other improvements during construction. Where this is not practicable due to other improvements, etc., swales with improved surfaces, area drains, or other drainage facilities, should be used to collect and discharge runoff.

2. All eaves of the building should be fitted with roof gutters. Runoff from flatwork, roof gutters, downspouts, planter drains, area drains, etc. should discharge in a nonerosive manner away from foundations and other improvements in accordance with the requirements of the governing agencies. Erosion protection should be placed at all discharge points unless the discharge is to a pavement surface.

3. To reduce the potential for planter drainage gaining access to subslab areas, any raised planter boxes adjacent to foundations should be installed with drains and sealed sides and bottoms. Drains should also be provided for areas adjacent to the structure and in landscape areas that would not otherwise freely drain.

4. The on-site soils are erodible; stabilization of soils disturbed during construction by vegetation or other means *during* and *following* construction, is essential to reduce erosion damage. Care should be taken to establish and maintain vegetation. The landscaping should be planned and installed to maintain the surface drainage recommended above. Surface drainage should also be maintained during construction.

5. Maintenance of drainage and other improvements is critical to the long-term stability of the site and the integrity of the structures. Site improvements should be maintained on a regular basis.

6. All exterior drains, retaining wall drains, and drain outlets should be maintained to be free-flowing. Vegetation and erosion matting (if utilized) should be maintained or augmented as needed. Irrigation systems should be maintained so that soils around structures are maintained at a relatively uniform year-round moisture content, and are neither over-watered nor allowed to dry and desiccate.

7. To reduce the potential for disruption of drainage patterns and undermining of structures, fill areas, etc., all rodent activity should be aggressively controlled.

Observation and Testing

1. It must be recognized that the recommendations contained in this report are based on a limited number of borings and rely on continuity of the subsurface conditions encountered.

2. It is assumed that the geotechnical engineer will be retained to provide consultation during the design phase, to interpret this report during construction, and to provide construction monitoring in the form of testing and observation.

3. At a minimum, the geotechnical engineer should be retained to provide:
    - Professional observation during grading, trench and retaining wall backfill, and foundation construction
    - Oversight of special inspection and compaction testing grading, trench and retaining wall backfill, and foundation construction

4. Special inspection of grading and backfill should be provided as per Section 1705A.6 and Table 1705A.6 of the CBC. The special inspector should be under the direction of the geotechnical engineer. At a minimum, the following items should be inspected and/or tested by the special inspector:
    - Stripping and clearing of all existing improvements, vegetation, and deleterious materials
    - Overexcavation of the building and sitework retaining wall areas to the recommended depths
    - Scarification and moisture conditioning of overexcavated areas
    - Scarification and moisture conditioning of exterior pedestrian flatwork, AC path and all other grading areas
    - Fill quality, placement, moisture conditioning and compaction
    - Utility trench backfill
    - Foundation excavations

5. A program of quality assurance should be developed prior to beginning construction. At a minimum, the program should include all geotechnical items shown on the testing and inspection schedule of the approved plans. It should also include any additional inspection items required by the engineer and/or the governing jurisdiction. These items should be discussed at a preconstruction site meeting among a representative of the owner, the geotechnical engineer, special inspector, the project inspector, the engineer, and contractors. The geotechnical engineer should be notified at least 48 hours prior to beginning grading operations.

6. Locations and frequency of compaction tests should be as per the recommendation of the geotechnical engineer at the time of construction. The recommended test location and frequency may be subject to modification by the geotechnical engineer, based upon soil and moisture conditions encountered, size and type of equipment used by the contractor, the general trend of the results of compaction tests, or other factors.

11.0 CLOSURE

Our intent was to perform the investigation in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the locality of this project under similar conditions. No representation, warranty, or guarantee is either expressed or implied. This report is intended for the exclusive use by the client as discussed in the “Scope of Services” section. Application beyond the stated intent is strictly at the user's risk.

This report is valid for conditions as they exist at this time for the type of project described herein. The conclusions and recommendations contained in this report could be rendered invalid, either in whole or in part, due to changes in building codes, regulations, standards of geotechnical or construction practice, changes in physical conditions, or the broadening of knowledge.

If changes with respect to the project become necessary, if items not addressed in this report are incorporated into plans, or if any of the assumptions used in the preparation of this report are not correct, this firm shall be notified for modifications to this report. Any items not specifically addressed in this report should comply with the CBC of other applicable standards, and the requirements of the governing jurisdiction.

The preliminary recommendations presented in this geotechnical report are based upon the geotechnical conditions encountered at the site, and may be augmented by additional requirements of the client, or by additional recommendations provided by the geotechnical engineer based on peer or jurisdiction reviews, or conditions exposed at the time of construction.

This document, the data, conclusions, and recommendations contained herein are the property of Earth Systems Pacific. This report shall be used in its entirety, with no individual sections reproduced or used out of context. Copies may be made only by Earth Systems Pacific, the client, and the client's authorized agents for use exclusively on the subject project. Any other use is subject to federal copyright laws and the written approval of Earth Systems Pacific.

Thank you for this opportunity to have been of service. If you have any questions, please feel free to contact this office at your convenience.

End of Text.

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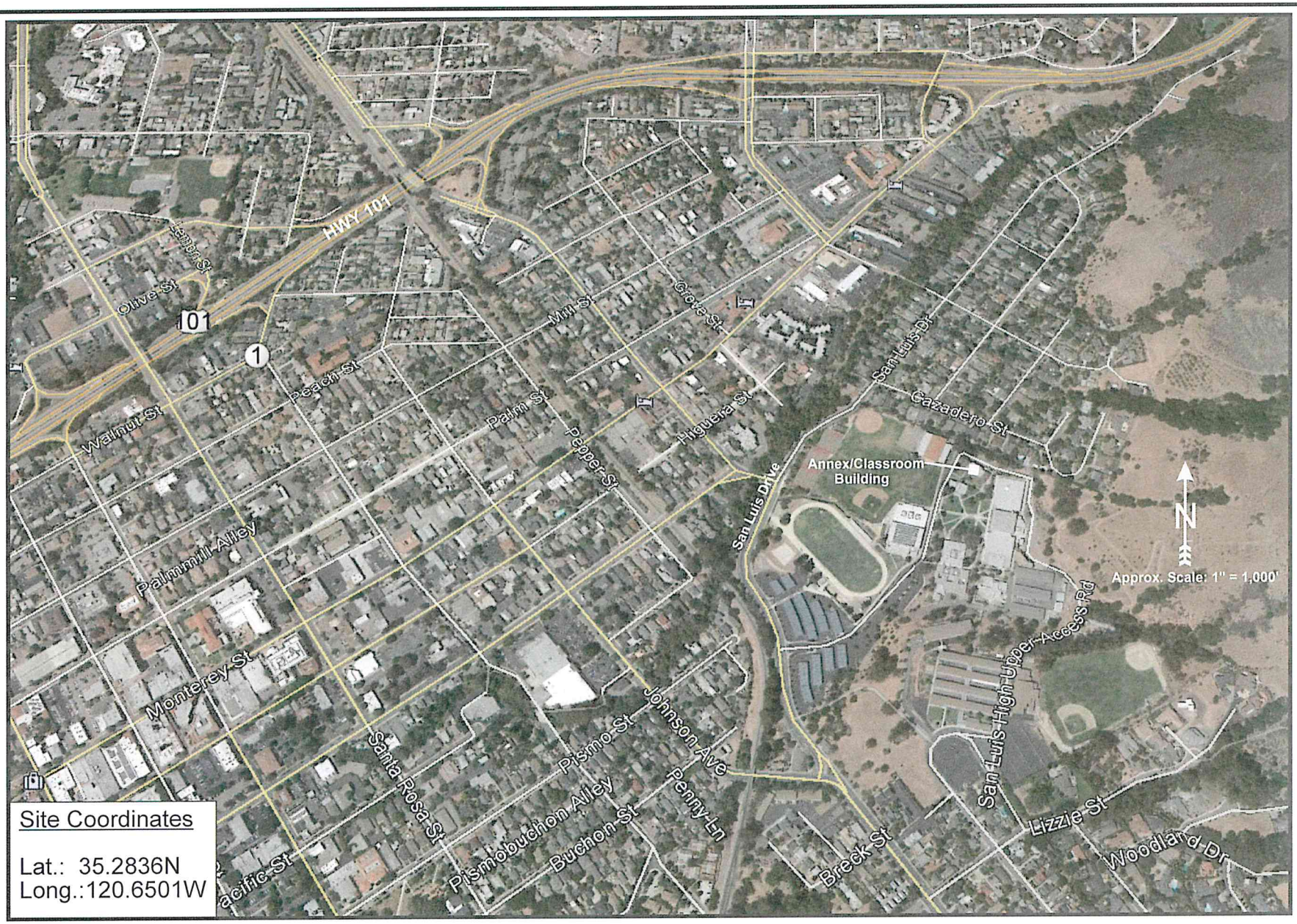
APPENDIX A

Vicinity Map
Boring Location Map
Boring Log Legend
Boring Logs
Cross Section A-A'



Reference: extract from Google Earth 2015

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VICINITY MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

Date
January 2016

Project No.
SL-16605-SE



LEGEND

3 Boring Location (Approx.)

A A' Cross Section (Approx.)

NOT TO SCALE

BORING LOCATION MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

Earth Systems Pacific
4378 Old Santa Fe Road
San Luis Obispo, CA 93401-8116
(805) 544-3276 • FAX (805) 544-1786
E-mail: esp@earthsystems.com

December 9, 2015 CS SL-16605-SE

SLO HS MEASURE D POOL ANNEX CLASSROOM BLDG-1816BLOCATIONS

Earth Systems Pacific

BORING LOG LEGEND

SAMPLE / SUBSURFACE WATER SYMBOLS	GRAPH. SYMBOL
CALIFORNIA MODIFIED	
STANDARD PENETRATION TEST (SPT)	
SHELBY TUBE	
BULK	
SUBSURFACE WATER DURING DRILLING	
SUBSURFACE WATER AFTER DRILLING	

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

MAJOR DIVISIONS	GROUP SYMBOL	TYPICAL DESCRIPTIONS	GRAPH. SYMBOL
COARSE GRAINED SOILS (MORE THAN HALF OF MATERIAL IS LARGER THAN #200 SIEVE SIZE)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GP	POORLY GRADED GRAVELS, OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, NON-PLASTIC FINES	
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, PLASTIC FINES	
	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
	SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES	
	SM	SILTY SANDS, SAND-SILT MIXTURES, NON-PLASTIC FINES	
	SC	CLAYEY SANDS, SAND-CLAY MIXTURES, PLASTIC FINES	
FINE GRAINED SOILS (HALF OR MORE OF MATERIAL IS SMALLER THAN #200 SIEVE SIZE)	ML	INORGANIC SILTS AND VERY FINE SANDS, 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	
	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS	
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	

OBSERVED MOISTURE CONDITION

DRY	SLIGHTLY MOIST	MOIST	VERY MOIST	WET (SATURATED)

CONSISTENCY

COARSE GRAINED SOILS

BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER	
0-10	0-16	LOOSE
11-30	17-50	MEDIUM DENSE
31-50	51-83	DENSE
OVER 50	OVER 83	VERY DENSE

FINE GRAINED SOILS

BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER	
0-2	0-3	VERY SOFT
3-4	4-7	SOFT
5-8	8-13	MEDIUM STIFF
9-15	14-25	STIFF
16-30	26-50	VERY STIFF
OVER 30	OVER 50	HARD

GRAIN SIZES

U.S. STANDARD SERIES SIEVE				CLEAR SQUARE SIEVE OPENING		
# 200	# 40	# 10	# 4	3/4"	3"	12"

SILT & CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

TYPICAL BEDROCK HARDNESS

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
EXTREMELY HARD	CORE, FRAGMENT, OR EXPOSURE CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CAN ONLY BE CHIPPED WITH REPEATED HEAVY HAMMER BLOWS
VERY HARD	CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CORE OR FRAGMENT BREAKS WITH REPEATED HEAVY HAMMER BLOWS
HARD	CAN BE SCRATCHED WITH KNIFE OR SHARP PICK WITH DIFFICULTY (HEAVY PRESSURE); HEAVY HAMMER BLOW REQUIRED TO BREAK SPECIMEN
MODERATELY HARD	CAN BE GROOVED 1/16 INCH DEEP BY KNIFE OR SHARP PICK WITH MODERATE OR HEAVY PRESSURE; CORE OR FRAGMENT BREAKS WITH LIGHT HAMMER BLOW OR HEAVY MANUAL PRESSURE
SOFT	CAN BE GROOVED OR GOUGED EASILY BY KNIFE OR SHARP PICK WITH LIGHT PRESSURE, CAN BE SCRATCHED WITH FINGERNAIL; BREAKS WITH LIGHT TO MODERATE MANUAL PRESSURE
VERY SOFT	CAN BE READILY INDENTED, GROOVED OR GOUGED WITH FINGERNAIL, OR CARVED WITH KNIFE; BREAKS WITH LIGHT MANUAL PRESSURE

TYPICAL BEDROCK WEATHERING

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
FRESH	NO DISCOLORATION, NOT OXIDIZED
SLIGHTLY WEATHERED	DISCOLORATION OR OXIDATION IS LIMITED TO SURFACE OF, OR SHORT DISTANCE FROM, FRACTURES: SOME FELDSPAR CRYSTALS ARE DULL
MODERATELY WEATHERED	DISCOLORATION OR OXIDATION EXTENDS FROM FRACTURES, USUALLY THROUGHOUT; Fe-Mg MINERALS ARE "RUSTY", FELDSPAR CRYSTALS ARE "CLOUDY"
INTENSELY WEATHERED	DISCOLORATION OR OXIDATION THROUGHOUT; FELDSPAR AND Fe-Mg MINERALS ARE ALTERED TO CLAY TO SOME EXTENT, OR CHEMICAL ALTERATION PRODUCES IN SITU DISAGGREGATION
DECOMPOSED	DISCOLORATION OR OXIDATION THROUGHOUT, BUT RESISTANT MINERALS SUCH AS QUARTZ MAY BE UNALTERED; FELDSPAR AND Fe-Mg MINERALS ARE COMPLETELY ALTERED TO CLAY

Earth Systems Pacific

Boring No. 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

PAGE 1 OF 1
JOB NO.: SL-16605-SE
DATE: 12/29/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL		SANDY LEAN CLAY: dark brown/ olive mottled, stiff, moist, trace coarse gravel (Fill)	1.0 - 2.5	Ring	107.5	14.9	5, 6, 7
				0.0 - 3.0	Grab			
4				4.0 - 6.0	Grab			
	CL		SANDY LEAN CLAY: dark brown, very stiff, moist, some fine gravel (Alluvium)	5.0 - 6.5	Ring	109.1	14.8	7, 13, 18
10				10.0 - 11.5	Ring	119.6	13.0	6, 13, 21
15				15.0 - 16.5	SPT			4, 8, 11
17	GC		CLAYEY GRAVEL WITH SAND: brown, medium dense, moist	20.0 - 21.5	SPT			4, 9, 12
24			SANDSTONE: dark yellow brown, moderately soft, moist (Franciscan Melange)	25.0 - 25.5	SPT			50/3"
26			End of Boring @ 26.0' due to refusal No subsurface water encountered					

LEGEND: Ring Sample Grab Sample Shelby Tube Sample SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 2

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer

PAGE 1 OF 1
JOB NO.: SL-16605-SE
DATE: 12/29/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0			4.0" AC over 2" AB					
1	CL		SANDY LEAN CLAY: dark brown, stiff, moist, some fine gravel (Alluvium)					
2				1.0 - 4.0	○			4
3				3.0 - 4.5	▬	109.4	16.2	10 16
4			brown, slightly moist					
5			dark brown, moist, gravel ends	5.0 - 6.5	▬	112.6	15.2	5 8 13
9			brown, very stiff to hard					
10				10.0 - 11.5	▬	119.4	14.6	7 16 20
15				15.0 - 16.5	●			4 9 12
17			End of Boring @ 16.5' No subsurface water encountered					

LEGEND: ▬ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 3

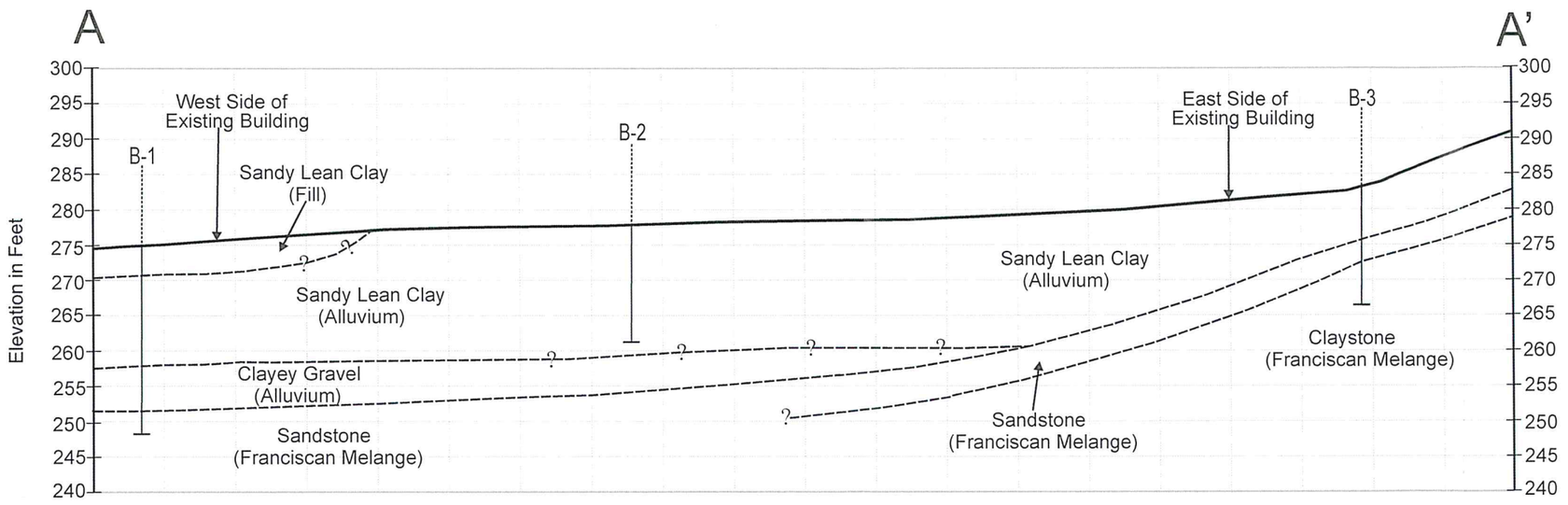
LOGGED BY: R. Wagner — PAGE 1 OF 1
DRILL RIG: Mobile B53 — JOB NO.: SL-16605-SE
AUGER TYPE: 6" Hollow Stem Auger with Automatic Hammer — DATE: 12/29/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3102

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL		SANDY LEAN CLAY: dark brown, very stiff, very moist, trace gravel (Alluvium)	1.0 - 2.5	Ring	110.4	17.8	4, 8, 12
4			brown, slightly moist	3.5 - 6.0	Grab			
5				5.0 - 6.5	Ring	118.7	11.6	8, 13, 19
6				5.0 - 6.5	Grab			
8			SANDSTONE: dark yellow brown, moderately soft, moist (Franciscan Melange)					
10				10.0 - 11.5	Ring			16, 36, 50/5"
11			CLAYSTONE: gray brown, moderately soft, moist, severely sheared, weathered					
15				15.0 - 16.5	SPT			11, 20, 28
17			End of Boring @ 16.5' due to refusal No subsurface water encountered					

LEGEND: Ring Sample; Grab Sample; Shelby Tube Sample; SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.



Scale 1" = 20'

EARTH SYSTEMS PACIFIC

4378 Old Santa Fe Road, San Luis Obispo, CA 93401
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(805) 544-3276

CROSS SECTION A-A'

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

Date
January 2016

Project No.
SL-16605-SE

APPENDIX B

Geotechnical Laboratory Test Results

San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

BULK DENSITY TEST RESULTS

ASTM D 2937-10 (modified for ring liners)

January 12, 2016

BORING NO.	DEPTH feet	MOISTURE CONTENT, %	WET DENSITY, pcf	DRY DENSITY, pcf
1	2.0 - 2.5	14.9	123.5	107.5
1	6.0 - 6.5	14.8	125.3	109.1
1	11.0 - 11.5	13.0	135.1	119.6
2	4.0 - 4.5	16.2	127.1	109.4
2	6.0 - 6.5	15.2	129.7	112.6
2	11.0 - 11.5	14.6	136.8	119.4
3	2.0 - 2.5	17.8	130.0	110.4
3	6.0 - 6.5	11.6	132.5	118.7

EXPANSION INDEX TEST RESULTS

ASTM D 4829-11

BORING NO.	DEPTH feet	EXPANSION INDEX
1	0.0 - 3.0	54
2	1.0 - 4.0	58

San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

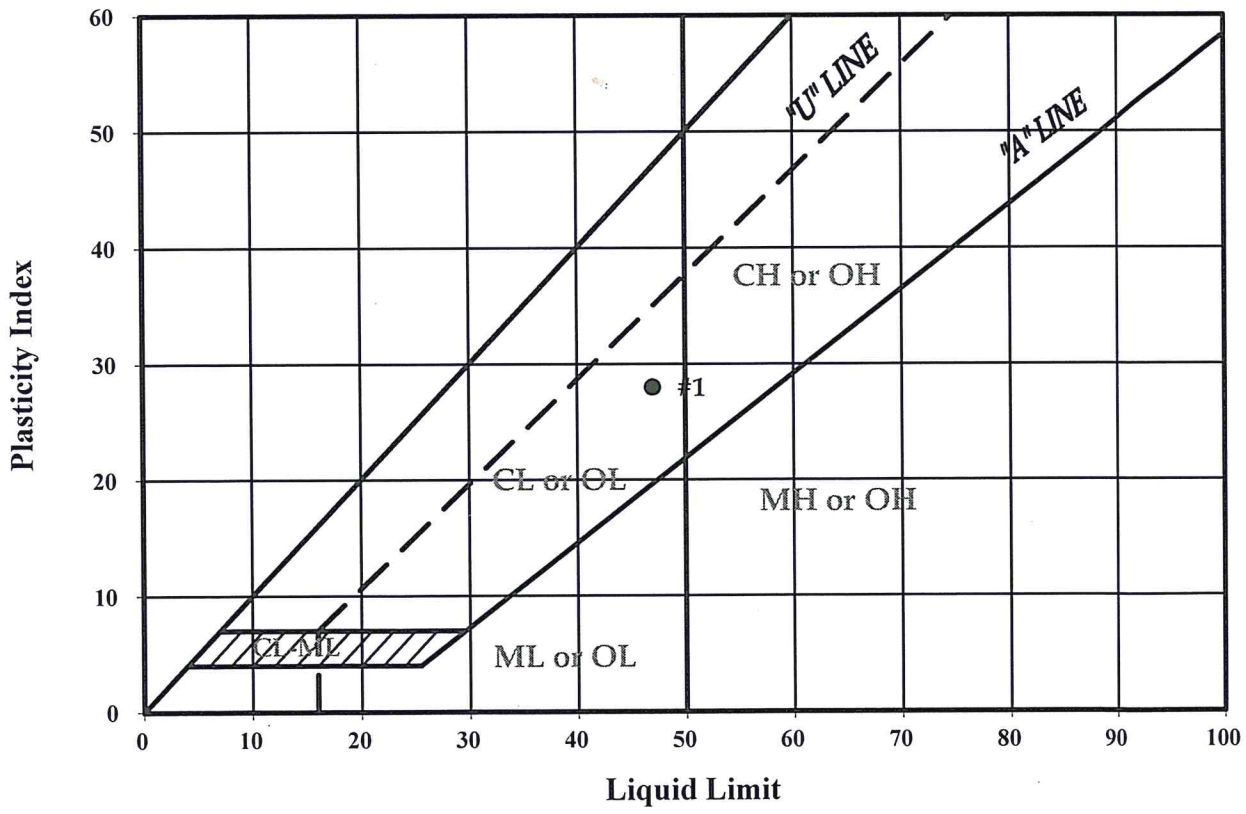
PLASTICITY INDEX

ASTM D 4318-10

January 12, 2016

Test No.:	1	2	3	4	5
Boring No.:	1				
Sample Depth:	4.0 - 6.0'				
Liquid Limit:	47				
Plastic Limit:	19				
Plasticity Index:	28				

Plasticity Chart



San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

MOISTURE-DENSITY COMPACTION TEST

ASTM D 1557-12 (Modified)

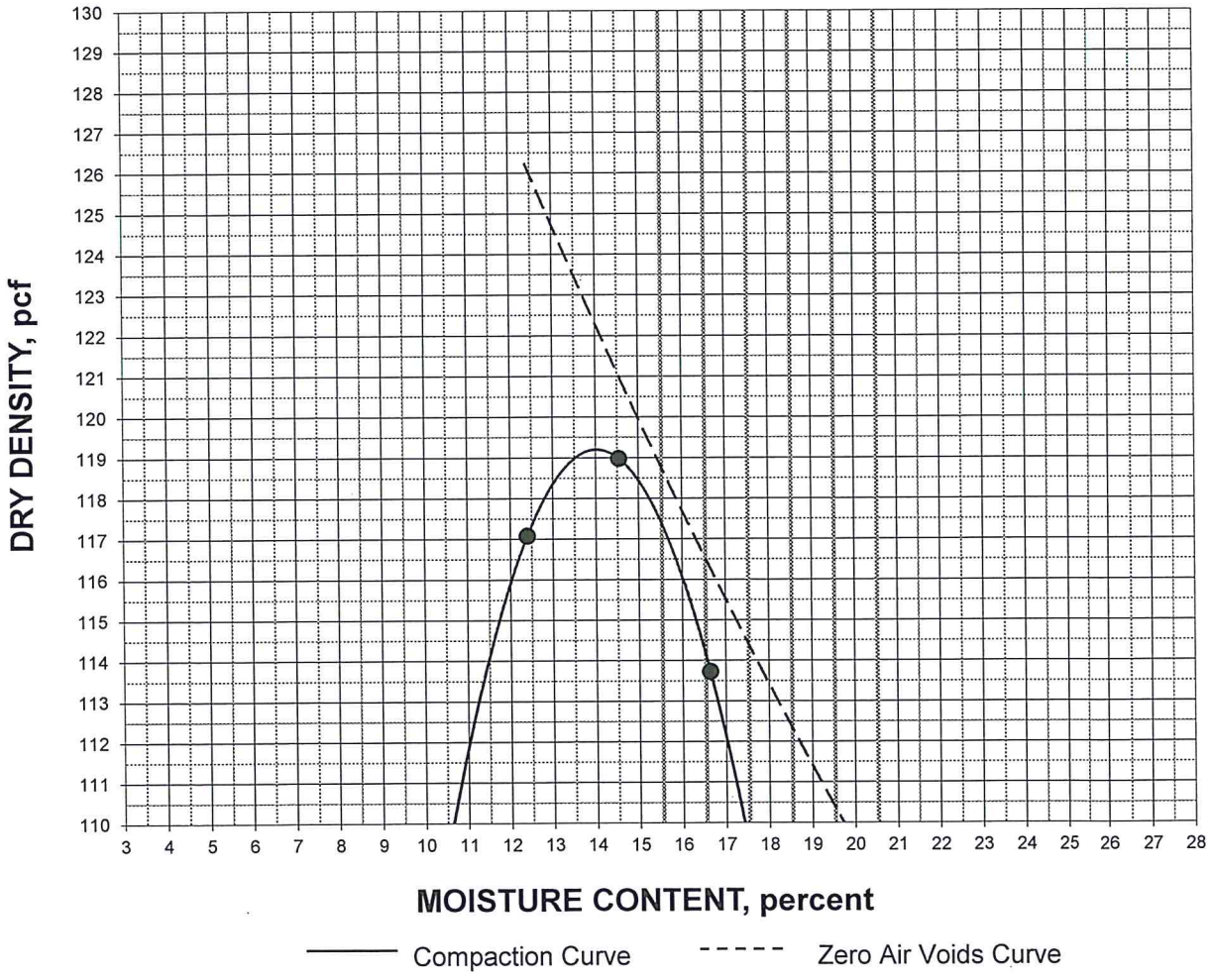
PROCEDURE USED: A
PREPARATION METHOD: Moist
RAMMER TYPE: Mechanical
SPECIFIC GRAVITY: 2.70 (assumed)

January 12, 2016
Boring #2 @ 1.0 - 4.0'
Dark Brown Sandy Lean Clay (CL)

SIEVE DATA:

Sieve Size	% Retained (Cumulative)
3/4"	0
3/8"	0
#4	0

MAXIMUM DRY DENSITY: 119.2 pcf
OPTIMUM MOISTURE: 14.0%



San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

DIRECT SHEAR

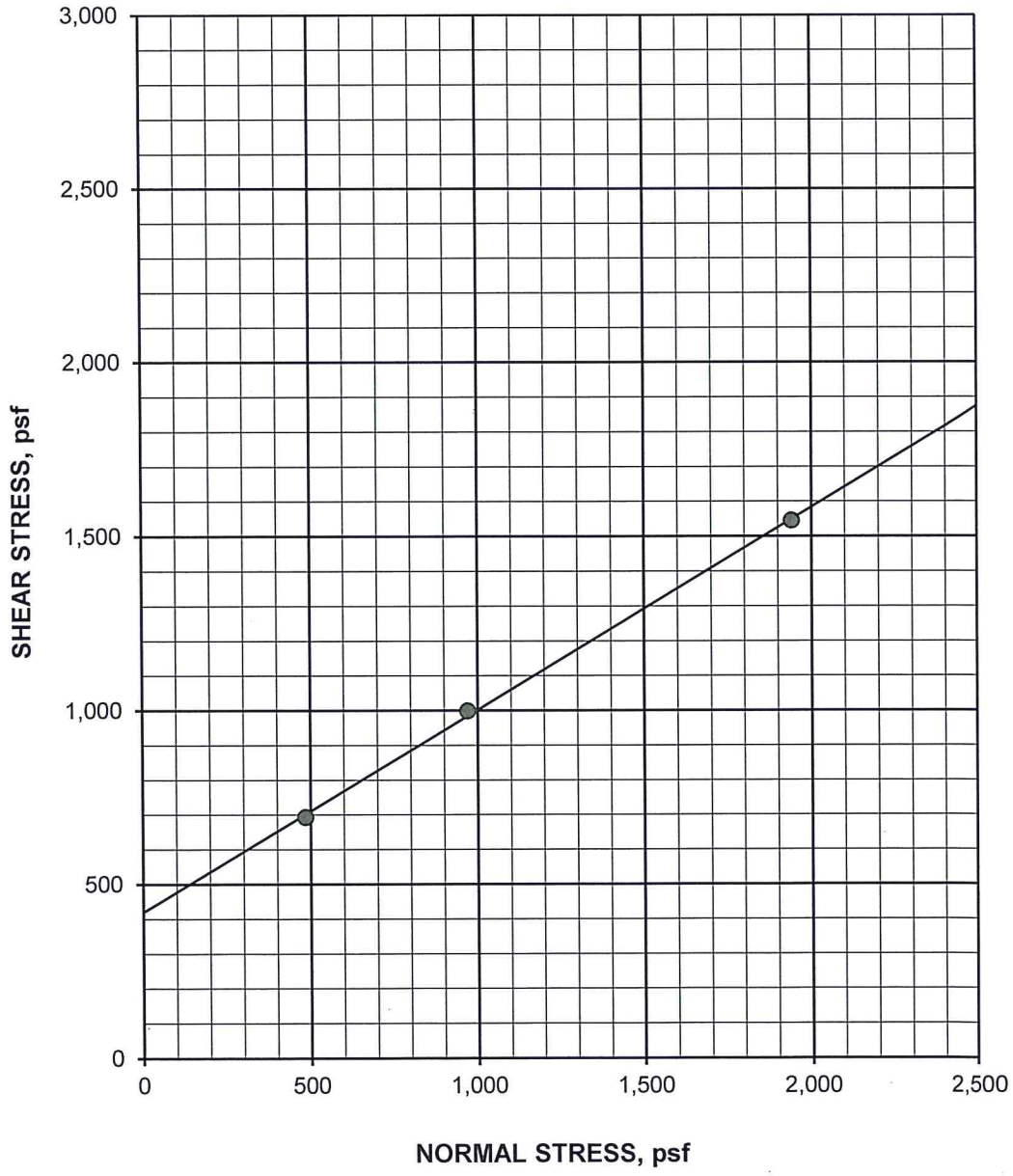
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

January 12, 2016

Boring #2 @ 1.0 - 4.0'
Sandy Lean Clay (CL)
Compacted to 90% RC, saturated

INITIAL DRY DENSITY: 107.3 pcf
INITIAL MOISTURE CONTENT: 14.0 %
PEAK SHEAR ANGLE (Ø): 30°
COHESION (C): 420 psf

SHEAR vs. NORMAL STRESS



DIRECT SHEAR continued

ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

Boring #2 @ 1.0 - 4.0'

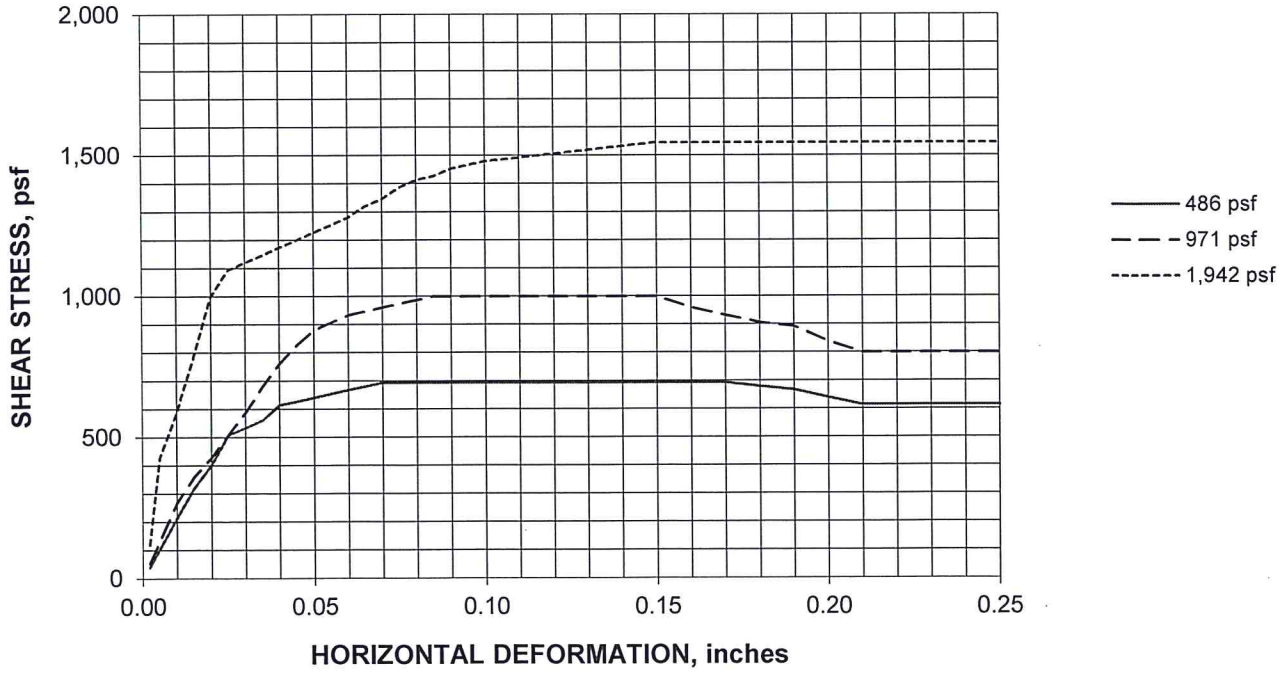
January 12, 2016

Sandy Lean Clay (CL)

Compacted to 90% RC, saturated

SPECIFIC GRAVITY: 2.70 (assumed)

SAMPLE NO.:	1	2	3	AVERAGE
INITIAL				
WATER CONTENT, %	14.0	14.0	14.0	14.0
DRY DENSITY, pcf	107.3	107.3	107.3	107.3
SATURATION, %	66.3	66.3	66.3	66.3
VOID RATIO	0.570	0.570	0.570	0.570
DIAMETER, inches	2.410	2.410	2.410	
HEIGHT, inches	1.00	1.00	1.00	
AT TEST				
WATER CONTENT, %	25.3	23.9	22.9	
DRY DENSITY, pcf	108.3	109.8	114.5	
SATURATION, %	100.0	100.0	100.0	
VOID RATIO	0.556	0.534	0.472	
HEIGHT, inches	0.99	0.98	0.94	



San Luis Obispo High School
Measure D - Annex / Classroom Building

SL-16605-SE

CONSOLIDATION TEST

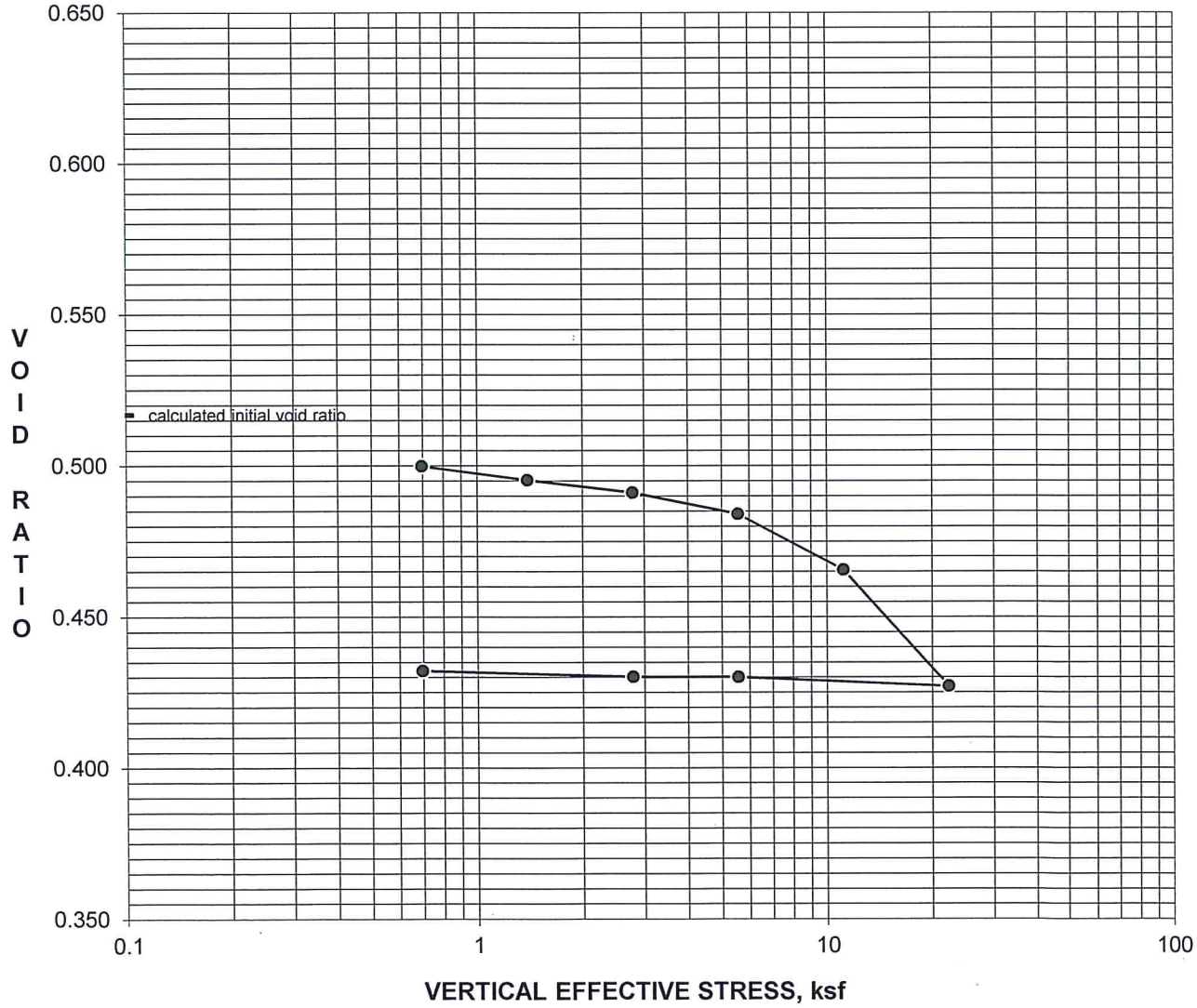
ASTM D 2435/D2435M-11

January 12, 2016

Boring #2 @ 6.0 - 6.5'
Sandy Lean Clay (CL)
Ring Sample

DRY DENSITY: 111.1 pcf
MOISTURE CONTENT: 15.2%
SPECIFIC GRAVITY: 2.70 (assumed)
INITIAL VOID RATIO: 0.517

VOID RATIO vs. NORMAL PRESSURE DIAGRAM



APPENDIX C

Soil Corrosivity Study by HDR, Inc.

January 18, 2016 via email: Fred@earthsystems.com

EARTH SYSTEMS PACIFIC
4378 Old Santa Fe Road
San Luis Obispo, CA 93401

Attention: Mr. Fred J. Potthast, GE

Re: Soil Corrosivity Study
San Luis Obispo High School
Annex/Classroom Building Project
No. 831-3102
San Luis Obispo, California
HDR #274257, ESP #SL16605-SE

Introduction

Laboratory tests have been completed on two soil samples provided for the San Luis Obispo High School project. The purpose of these tests was to determine if the soils might have deleterious effects on underground utility piping and concrete structures. HDR Engineering, Inc. (HDR) assumes that the samples provided are representative of the most corrosive soils at the site.

The proposed construction consists of a single story classroom building with conventional foundations and slabs-on-grade. The site is located at 1499 San Luis Drive in San Luis Obispo, California. The water table was reportedly not encountered during exploratory borings to a depth of 26 feet.

The scope of this study is limited to a determination of soil corrosivity and general corrosion control recommendations for materials likely to be used for construction. HDR's recommendations do not constitute, and are not meant as a substitute for, design documents for the purpose of construction. If the architects and/or engineers desire more specific information, designs, specifications, or review of design, HDR will be happy to work with them as a separate phase of this project.

Laboratory Soil Corrosivity Tests

The electrical resistivity of each sample was measured in a soil box per ASTM G187 in its as-received condition and again after saturation with distilled water. Resistivities are at about their lowest value when the soil is saturated. The pH of the saturated samples was measured per CTM 643. A 5:1 water:soil extract from each sample was chemically analyzed for the major soluble salts commonly found in soil per ASTM D4327, ASTM D6919, and Standard Method 2320-B[1]. Laboratory analysis was performed under HDR laboratory number 16-0015SCS and the test results are shown in the attached Table 1.

Soil Corrosivity

A major factor in determining soil corrosivity is electrical resistivity. The electrical resistivity of a soil is a measure of its resistance to the flow of electrical current. Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of electrical current (DC) from the metal into the soil. Corrosion currents, following Ohm's Law, are inversely proportional to soil resistivity. Lower electrical resistivities result from higher moisture and soluble salt contents and indicate corrosive soil.

A correlation between electrical resistivity and corrosivity toward ferrous metals is:[2]

Soil Resistivity in ohm-centimeters	Corrosivity Category
Greater than 10,000	Mildly Corrosive
2,001 to 10,000	Moderately Corrosive
1,001 to 2,000	Corrosive
0 to 1,000	Severely Corrosive

Other soil characteristics that may influence corrosivity towards metals are pH, soluble salt content, soil types, aeration, anaerobic conditions, and site drainage.

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[1] *American Public Health Association (APHA). 2012. Standard Methods of Water and Wastewater. 22nd ed. American Public Health Association, American Water Works Association, Water Environment Federation publication. APHA, Washington D.C.*

[2] *Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, pp. 166–167.*

Electrical resistivities were in the moderately corrosive categories with as-received moisture. When saturated, the resistivities were in the corrosive to severely corrosive categories. The resistivities dropped with added moisture because the samples were dry as-received.

Soil pH for both samples was 7.7. This value is in the mildly alkaline[3] range and does not particularly increase soil corrosivity.

The soluble salt content of the samples ranged from low to moderate.

The nitrate concentration was high enough to be aggressive to copper.

Tests were not made for sulfide and negative oxidation-reduction (redox) potential because these samples did not exhibit characteristics typically associated with anaerobic conditions.

This soil is classified as severely corrosive to ferrous metals and aggressive to copper.

Corrosion Control Recommendations

The life of buried materials depends on thickness, strength, loads, construction details, soil moisture, etc., in addition to soil corrosivity, and is, therefore, difficult to predict. Of more practical value are corrosion control methods that will increase the life of materials that would be subject to significant corrosion.

The following recommendations are based on the soil conditions discussed in the Soil Corrosivity section above. Unless otherwise indicated, these recommendations apply to the entire site or alignment.

Steel Pipe

Implement *all* the following measures:

1. Underground steel pipe with rubber gasketed, mechanical, grooved end, or other nonconductive type joints should be bonded for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.

---

[3] *Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, p. 8.*

2. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:

    a. At each end of the pipeline.

    b. At each end of all casings.

    c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.

3. To prevent dissimilar metal corrosion cells and to facilitate the application of cathodic protection, electrically isolate each buried steel pipeline per NACE SP0286 from:

    a. Dissimilar metals.

    b. Dissimilarly coated piping (cement-mortar vs. dielectric).

    c. Above ground steel pipe.

    d. All existing piping.

4. Choose one of the following corrosion control options:

    OPTION 1

    a. Apply a suitable dielectric coating intended for underground use such as:

        i. Polyurethane per AWWA C222 *or*

        ii. Extruded polyethylene per AWWA C215 *or*

        iii. A tape coating system per AWWA C214 *or*

        iv. Hot applied coal tar enamel per AWWA C203 *or*

        v. Fusion bonded epoxy per AWWA C213.

    b. Apply cathodic protection to steel piping as per NACE SP0169.

OPTION 2

a. As an alternative to dielectric coating and cathodic protection, apply a ¾-inch cement mortar coating per AWWA C205 or encase in concrete 3 inches thick, using any type of ASTM C150 cement. Joint bonds, test stations, and insulated joints are still recommended for these alternatives.

NOTE: Some steel piping systems, such as for oil, gas, and high-pressure piping systems, have special corrosion and cathodic protection requirements that must be evaluated for each specific application.

Iron Pipe

Implement *all* the following measures:

1. To prevent dissimilar metal corrosion cells and to facilitate the application of cathodic protection, electrically insulate underground iron pipe from dissimilar metals and from above ground iron pipe with insulating joints per NACE SP0286.
2. Bond all nonconductive type joints for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.
3. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:
    a. At each end of the pipeline.
    b. At each end of any casings.
    c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.
4. Choose one of the following corrosion control options:

    OPTION 1

    a. Apply a suitable coating intended for underground use such as:
        i. Polyethylene encasement per AWWA C105; *or*
        ii. Epoxy coating; *or*

iii. Polyurethane; *or*

iv. Wax tape.

NOTE: The thin factory-applied asphaltic coating applied to ductile iron pipe for transportation and aesthetic purposes does not constitute a corrosion control coating.

b. Apply cathodic protection to cast and ductile iron piping as per NACE SP0169.

OPTION 2

a. As an alternative to coating systems described in Option 1 and cathodic protection, concrete encase all buried portions of metallic piping so that there is a minimum of 3 inches of concrete cover provided over and around surfaces of pipe, fittings, and valves using any type of ASTM C150 cement.

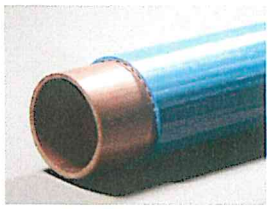
Copper Tubing

Implement *all* the following measures:

1. Electrically insulate underground copper pipe from dissimilar metals and from above ground copper pipe with insulating devices per NACE SP0286.
2. Electrically insulate cold water piping from hot water piping systems.
3. Protect buried copper tubing by one of the following measures:

    a. Prevention of soil contact. Soil contact may be prevented by placing the tubing above ground or encasing the tubing using PVC pipe with solvent-welded joints.

    b. Installation of a factory-coated copper pipe with a minimum 25-mil thickness such as Kamco's Aqua Shield™, Mueller's Streamline Protec™, or equal. The coating must be continuous with no cuts or defects.



    c. Installation of 12-mil polyethylene pipe wrapping tape with butyl rubber mastic over a suitable primer. Protect wrapped copper tubing by applying cathodic protection per NACE SP0169.

Plastic and Vitrified Clay Pipe

1. No special precautions are required for plastic and vitrified clay piping placed underground from a corrosion viewpoint.

2. Protect all metallic fittings and valves with wax tape per AWWA C217 or epoxy.

All Pipe

1. On all pipes, appurtenances, and fittings not protected by cathodic protection, coat bare metal such as valves, bolts, flange joints, joint harnesses, and flexible couplings with wax tape per AWWA C217 after assembly.

2. Where metallic pipelines penetrate concrete structures such as building floors, vault walls, and thrust blocks use plastic sleeves, rubber seals, or other dielectric material to prevent pipe contact with the concrete and reinforcing steel.

Concrete

1. From a corrosion standpoint, any type of ASTM C150 cement may be used for concrete structures and pipe because the sulfate concentration is negligible, 0 to 0.10 percent.[4,5,6]

2. Standard concrete cover over reinforcing steel may be used for concrete structures and pipe in contact with these soils due to the low chloride concentration[7] found onsite.

Closure

The analysis and recommendations presented in this report are based upon data obtained from the laboratory samples. This report does not reflect variations that may occur across the site or due to the modifying effects of construction. If variations appear, HDR should be

---

[4] *2012 International Building Code (IBC) Section 1904.3*

[5] *2012 International Residential Code (IRC) which refers to American Concrete Institute (ACI) 318 Table 19.3.2.1*

[6] *2013 California Building Code (CBC) which refers to American Concrete Institute (ACI) 318 Table 19.3.2.1*

[7] *Design Manual 303: Concrete Cylinder Pipe. Ameron. p.65*

notified immediately so that further evaluation and supplem ental recommendations can be provided.

HDR's services have been performed with the usual thoroughness and com petence of the engineering profession. No other warranty or representation, either expressed or implied, is included or intended.

Please call if you have any questions.

Respectfully Submitted,
HDR Engineering, Inc.

Jose Peña

Brien L. Clark, PE

LICENSED PROFESSIONAL ENGINEER
BRIEN L. CLARK
CH 6291
EXP. 12/31/17
CHEMICAL
STATE OF CALIFORNIA

Enc: Table 1

274257_SCS_Rpt_JP_Rev00_BC.docx

Table 1 - Laboratory Tests on Soil Samples

Earth Systems Pacific
SLO High School - Annex / Classroom Building Project No. 831-3102
Your #SL-16605-SE, HDR Lab #16-0015SCS
5-Jan-16

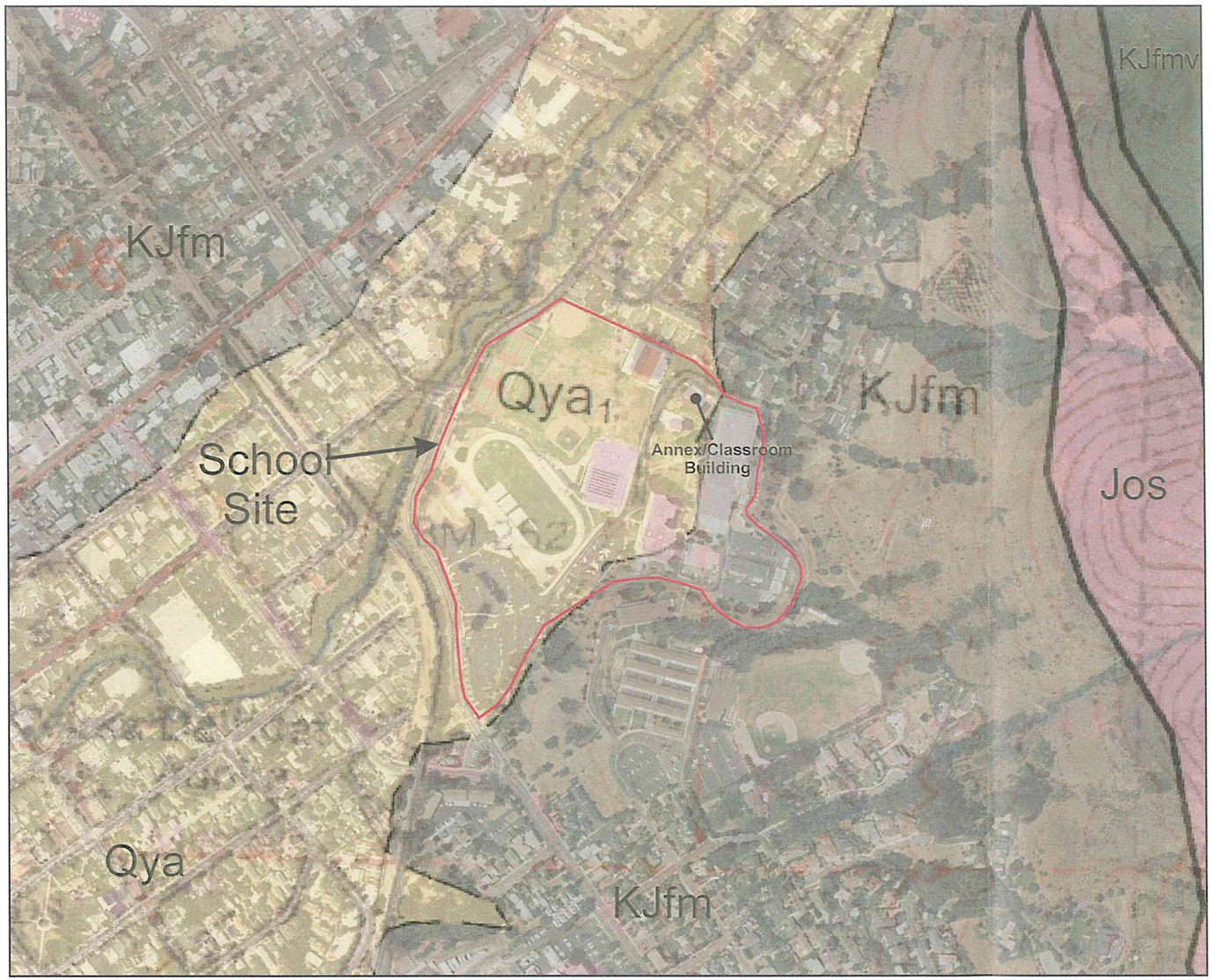
Sample ID			B1 @ 0-3' CL	B2 @ 1-4' CL
Resistivity		**Units**		
as-received		ohm-cm	4,800	6,000
saturated		ohm-cm	1,200	800
pH			7.7	7.7
Electrical Conductivity		mS/cm	0.16	0.24
Chemical Analyses				
Cations				
calcium	Ca^{2+}	mg/kg	61	86
magnesium	Mg^{2+}	mg/kg	ND	ND
sodium	Na^{1+}	mg/kg	77	46
potassium	K^{1+}	mg/kg	7.5	12
Anions				
carbonate	CO_3^{2-}	mg/kg	ND	ND
bicarbonate	HCO_3^{1-}	mg/kg	366	174
fluoride	F^{1-}	mg/kg	4.0	1.9
chloride	Cl^{1-}	mg/kg	11	7.3
sulfate	SO_4^{2-}	mg/kg	60	292
phosphate	PO_4^{3-}	mg/kg	ND	ND
Other Tests				
ammonium	NH_4^{1+}	mg/kg	ND	ND
nitrate	NO_3^{1-}	mg/kg	7.0	127
sulfide	S^{2-}	qual	na	na
Redox		mV	na	na

Electrical conductivity in millisiemens/cm and chemical analysis were made on a 1:5 soil-to-water extract.
mg/kg = milligrams per kilogram (parts per million) of dry soil.
Redox = oxidation-reduction potential in millivolts
ND = not detected
na = not analyzed

431 West Baseline Road · Claremont, CA 91711
Phone: 909.962.5485 · Fax: 909.626.3316

APPENDIX D

Geologic Map
Historical Earthquake/Fault Map
FEMA Flood Zone Map



Extract from: Geologic Map of the San Luis Obispo Quadrangle, San Luis Obispo County, California: by Wiegers, 2010.

EXPLANATION

Geologic Units

Qya
Young Alluvial flood-Plain Deposits

Jos
Serpentinized Ultramafic Rock

KJfm
Franciscan Melange

KJfmv
Franciscan Metavolcanic Rock

Geologic Symbols

Contact
Dashed where approximately located or inferred

High-angle fault
Dashed where approximately located or inferred; dotted where concealed

Thrust or reverse fault
Dashed where approximately located or inferred; dotted where concealed. Saw-teeth on upper plate. Dip of fault plane between 30° and 80°

Anticline
Showing axis at surface. Dashed where approximately located; dotted where concealed

Syncline
Showing axis at surface. Dashed where approximately located; dotted where concealed

Horizontal 30 Inclined 90 Vertical
Strike and dip of beds

N

Approx. Scale: 1" = 500'

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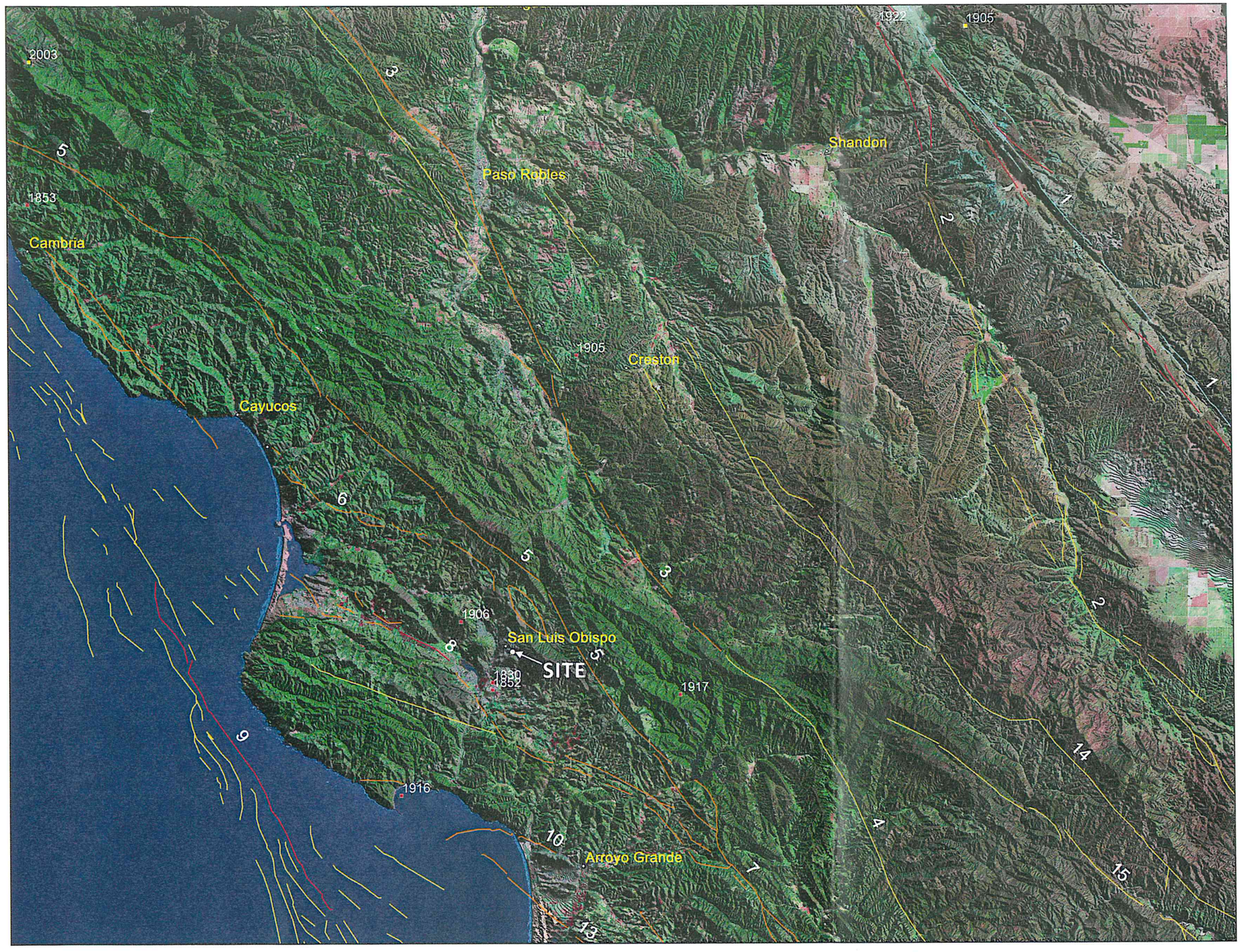
(805) 544-3276

GEOLOGIC MAP
SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

Date
January 2016

Project No.
SL-16605-SE



LEGEND

- Historic rupture (<200 years)
- Holocene fault (<10,000 years)
- Late Quaternary (<700,000 years)
- Quaternary fault (<1.6 million)

HISTORICAL EARTHQUAKE MAGNITUDE

5.0 to 5.9 | 6.0 to 6.9 | 7.0 to 7.9

FAULTS

1	San Andreas	11	Casmalia
2	San Juan	12	Lions Head
3	Rinconada	13	Oceano
4	East Huasna	14	La Panza
5	Oceanic	15	South Cuyama
6	Cambria		
7	West Huasna		
8	Los Osos		
9	Hosgri-San Simeon		
10	San Luis Range		

REFERENCES

Blake, T.F., EQSEARCH, 2000, updated 2010
Jennings, C.W. & Bryant, W.A., 2010

N

(Approximate Scale: 1" = 6 miles)

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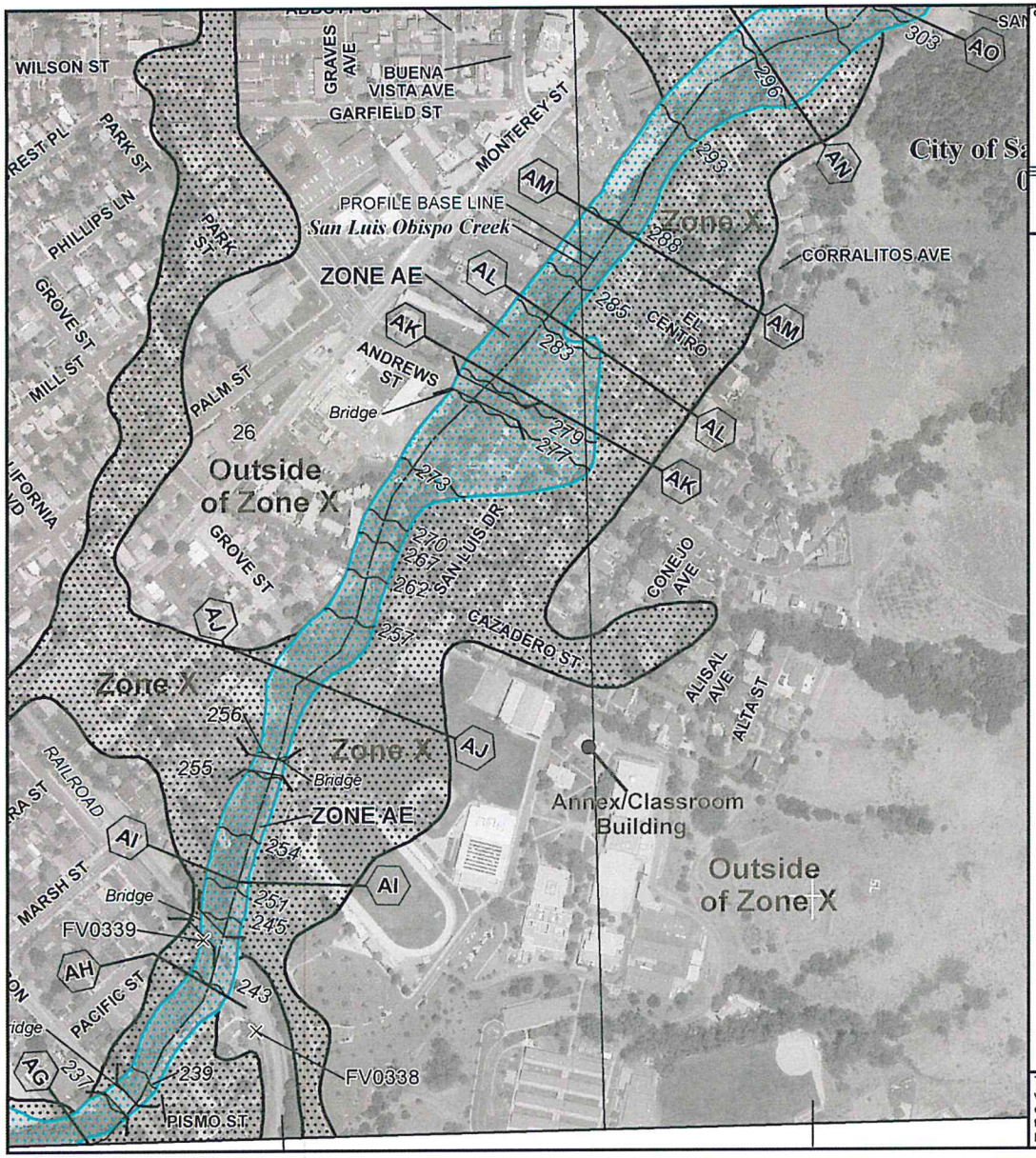
HISTORICAL EARTHQUAKE/ FAULT MAP
SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

Date
January 2016

Project No.
SL-16605-SE



ance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

0 250 500 750 1,000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1067G

FIRM

FLOOD INSURANCE RATE MAP

SAN LUIS OBISPO COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL 1067 OF 2050

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
SAN LUIS OBISPO COUNTY	060304	1067	G
SAN LUIS OBISPO, CITY OF	060310	1067	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER 06079C1067G

MAP REVISED NOVEMBER 16, 2012

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

EARTH SYSTEMS PACIFIC

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FEMA FLOOD ZONE MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
ANNEX/CLASSROOM BUILDING
1499 San Luis Drive
San Luis Obispo, California

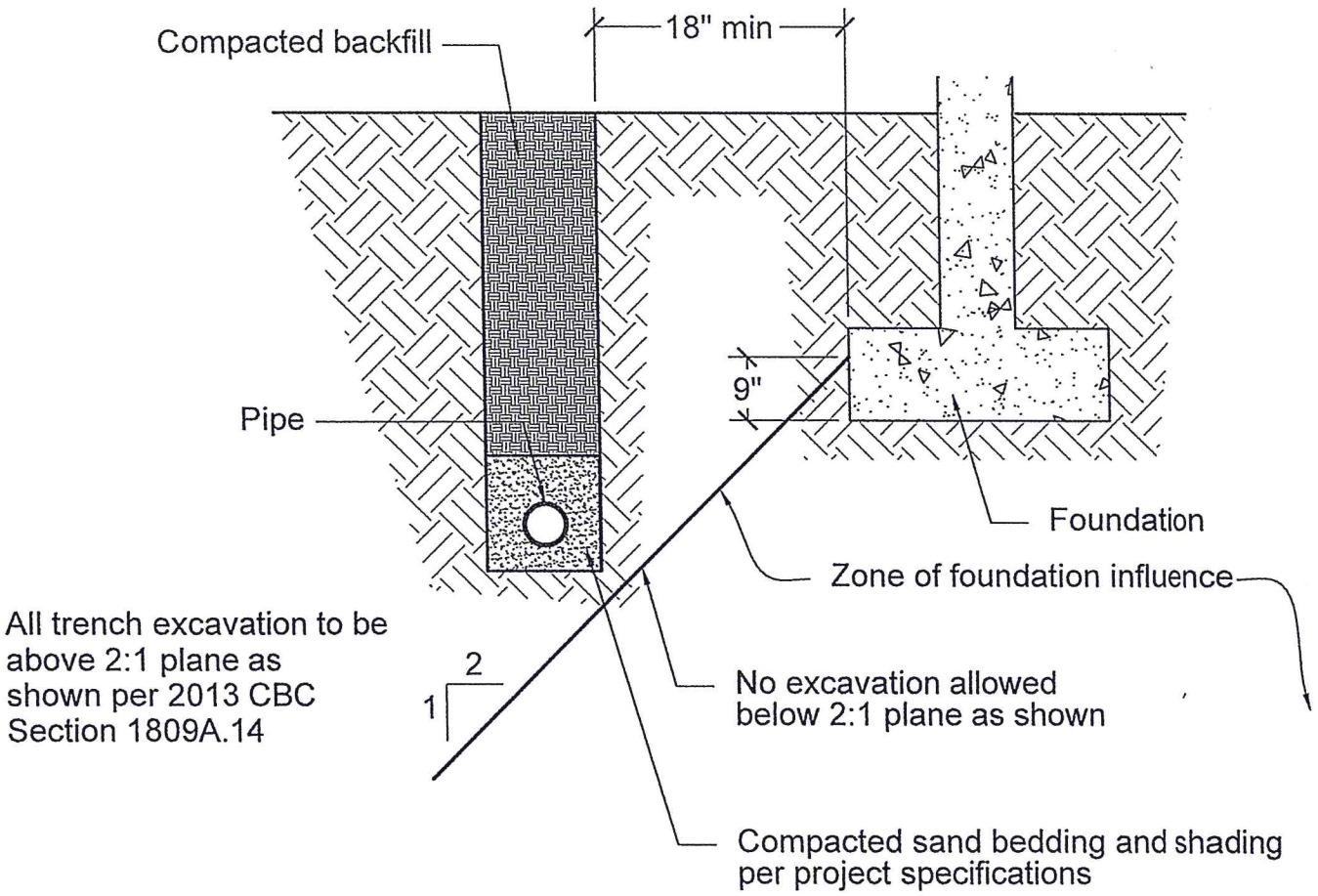
Date
January 2016

Project No.
SL-16605-SE

APPENDIX E

Typical Detail A: Pipe Placed Parallel to Foundations

TYPICAL DETAIL A
PIPE PLACED PARALLEL TO FOUNDATIONS*



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E-mail: esp@earthsys.com

APPENDIX E

Liquefaction Analysis
FEMA Flood Zone Map

Project: SLOHS - Stadium Entrance / Bleachers / Track
Job No: SL-16605-SC
Date: 4/12/2016
Boring: B1 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: **6.79** 7.5
PGA, g: **0.48** 0.37
MSF: 1.29
GWT: **23.0** feet
Calc GWT: **23.0** feet
Remediate to: **3.0** **feet**

SPT N VALUE CORRECTIONS:

Energy Correction to N60 (C_E):	1.25	
Drive Rod Corr. (C_R):	1	Default
Rod Length above ground (feet):	3.0	
Borehole Dia. Corr. (C_B):	1.05	
Sampler Liner Correction for SPT?:	0	No
Cal Mod/ SPT Ratio:	0.63	

Total (ft) Liquefied Thickness	Total (in.) Induced Subsidence
13	3.3

upper 50 ft

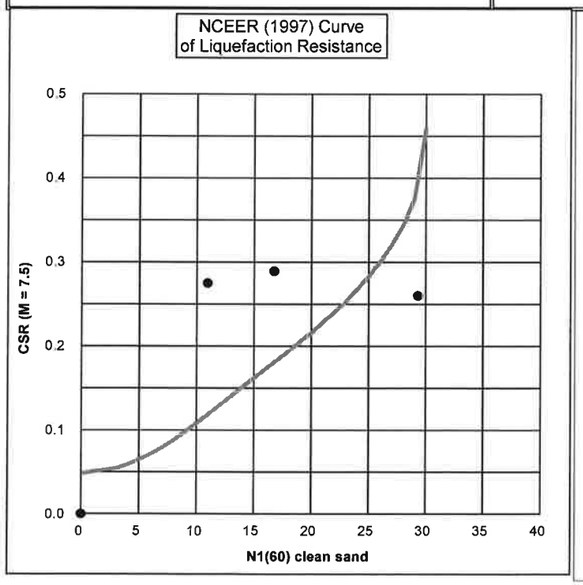
SETTLEMENT (SUBSIDENCE) OF DRY SANDS

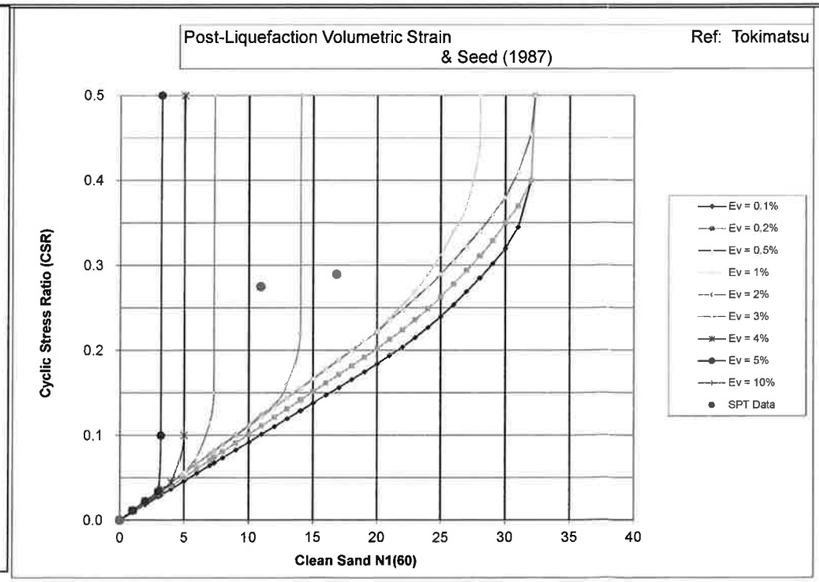
Threshold Acceler., g: **0.21** **Minimum Calculated SF:** **0.43** **Required SF:** **1.30**

Nc = 9.3

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)	Layer Thick (ft)	Tot.Stress at SPT po (tsf)	Depth m	Eff.Stress at SPT p'o (tsf)	Eff.Stress Design GWT 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* $N_{1(60)CS}$	Kσ	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.)**
									0.000																			
2.5	18	**50**	1	119	25	1.5	4.5	2.50	0.089	0.46	0.089	0.089	1.00	1.70	0.75	1.00	83.7	100	10.0	93.7	1.00	1.200	0.241	**Non-Liq.**	10.0	93.7	0.00	**0.00**
4.0	19	**12**	1	115	25	3.5	6.5	1.50	0.206	1.07	0.206	0.206	0.99	1.70	0.75	1.00	20.0	53	6.6	26.6	1.00	0.312	0.240	**Non-Liq.**	6.6	26.6	0.04	**0.01**
9.0	24	**15**		116	85	5.5	8.5	5.00	0.321	1.68	0.321	0.321	0.99	1.00	0.75	1.00	14.9				1.00	Infin.	0.239	**Non-Liq.**		14.9	0.00	**0.00**
15.0		**21**	1	115	25	13.0	16.0	6.00	0.754	3.96	0.754	0.754	0.97	1.18	0.83	1.00	27.0	62	7.4	34.4	1.00	1.200	0.235	**Non-Liq.**	7.4	34.4	0.04	**0.03**
17.5		**21**	1	115	25	15.5	18.5	2.50	0.898	4.72	0.898	0.898	0.97	1.09	0.87	1.00	26.1	61	7.3	33.4	1.00	1.200	0.234	**Non-Liq.**	7.3	33.4	0.04	**0.01**
23.0		**19**	1	115	25	20.5	23.5	5.50	1.185	6.25	1.185	1.185	0.96	0.94	0.94	1.00	22.1	56	6.8	29.0	0.97	0.373	0.239	**Non-Liq.**	6.8	29.0	0.06	**0.04**
27.5		**26**	1	115	5	25.5	28.5	4.50	1.473	7.77	1.395	1.395	0.94	0.87	0.99	1.00	29.4	65	0.0	29.4	0.92	0.392	0.260	**1.50**	0.0	29.4	0.00	**0.00**
34.0		**10**	1	115	5	30.5	33.5	6.50	1.760	9.30	1.526	1.526	0.92	0.83	1.00	1.00	10.9	40	0.0	10.9	0.93	0.118	0.275	**0.43**	0.0	10.9	2.46	**1.92**
40.5		**16**	1	115	5	35.5	38.5	6.50	2.048	10.82	1.658	1.658	0.89	0.80	1.00	1.00	16.8	49	0.0	16.8	0.91	0.181	0.289	**0.63**	0.0	16.8	1.72	**1.34**

p (tsf)	G_{max} (tsf)	τ_{av} (tsf)	Shear Strain γ	Strain E_{15}	Strain Enc	**Dry Sand Subsidence (in.)**
0.060	495	0.028	9.3E-05	1.5E-05	1.2E-05	**0.00**
0.138	495	0.064	3.3E-04	2.4E-04	1.9E-04	**0.01**
0.215						
0.505	1,033	0.228	4.3E-04	2.2E-04	1.8E-04	**0.03**
0.601	1,116	0.270	4.7E-04	2.5E-04	2.0E-04	**0.01**
0.794	1,223	0.353	5.7E-04	3.7E-04	2.9E-04	**0.04**
0.987	1,370	0.431	6.1E-04			
1.179	1,077	0.503	1.4E-03			
1.372	1,340	0.566	9.5E-04			





$N_{1(60)} = C_N*C_E*C_B*C_R*C_S*N$

C_R = 0.75 for Rod lengths < 3m, 1.0 for > 10m
= min(1,max(0.75,1.4666-2.556/(z(ft))$^{0.5}$))

$C_N = (1\ atm/p'o)^{0.5}$, max 1.7

C_S = max(1.1,min(1.3,1+$N_{1(60)}$/100)) for SPT without liners

$MSF = 10^{2.24}/M^{2.56}$

z = Depth (m)

pa = 1 atm = 101 KPa = 1.058 tsf

p = 0.67*po

τ_{av} = 0.65*PGA*po*rd

G_{max} = 447*$N_{1(60)CS}^{(1/3)}$*$p^{0.5}$

a = 0.0389*(p/1)+0.124

b = 6400*$(p/1)^{(-0.5)}$

$\gamma = [1+a*EXP(b*\tau_{av}/G_{max})]/[(1+a)*\tau_{av}/G_{max}]$

$E_{15} = \gamma*(N_{1(60)CS}/20)^{-1.2}$

$E_{nc} = (Nc/15)^{0.45}$*E15

$Nc = (MAG-4)^{2.17}$

S = 2*H*E_{nc}

rd = (1-0.4113*z^0.5+0.04052*z+0.001753*z^1.5)/(1-0.4177*z^0.5+0.05729*z-0.006205*z^1.5+0.00121*z^2))

$\Delta N_{1(60)}$ = min(10,IF(FC<35,exp(1.76-(190/FC^2)),5)+IF(FC<=5,1,IF(FC<35,0.99+(FC^1.5/1000),1.2))*N1(60) - N1(60)

$N_{1(60)CS} = N_{1(60)CS} + \Delta N_{1(60)}$

Kσ = min of 1.0 or $(p'o/1.058)^{(IF(Dr>0.7,0.6,IF(Dr<0.5,0.8,0.7))-1)}$

$Dr = (N_{1(60)}/70)^{0.5}$

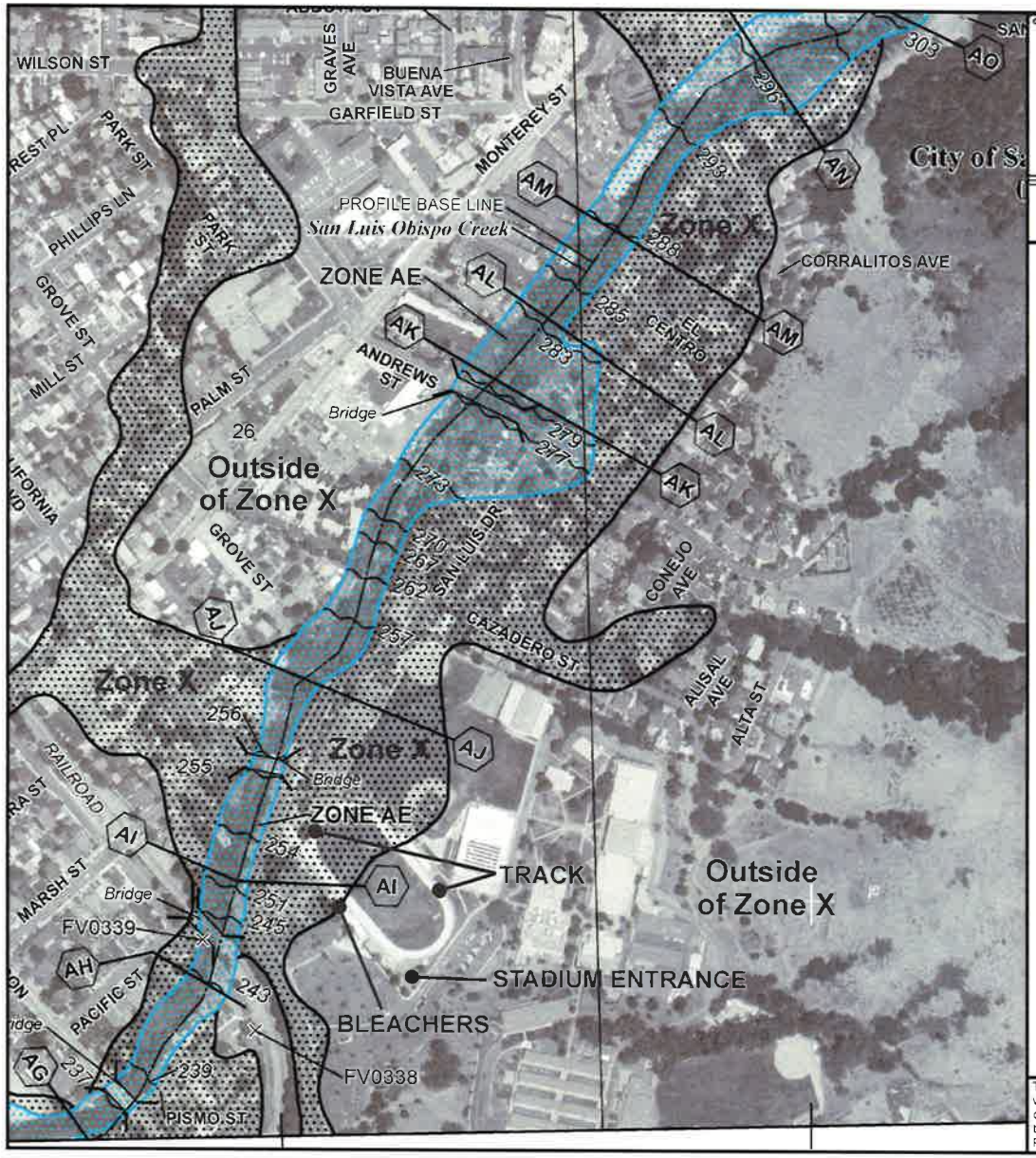
CSReq = 0.65*PGA*(po/p'o)*rd

CSR* = CSReq/MSF/Kσ

$CRR_{7.5}$ = (0.048-0.004721*N+0.0006136*N^2-0.00001673*N^3)/(1-0.1248*N+0.009578*N^2-0.0003285*N^3+0.000003714*N^4))

N = $N_{1(60)CS}$

SF = $CRR_{7.5,1atm}$/CSR*



MAP SCALE 1" = 500'

0 250 500 750 1,000 FEET

NFIP

PANEL 1067G

FIRM

FLOOD INSURANCE RATE MAP

SAN LUIS OBISPO COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL 1067 OF 2050

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
SAN LUIS OBISPO COUNTY	060294	1067	G
SAN LUIS OBISPO, CITY OF	060310	1067	G

NATIONAL FLOOD INSURANCE PROGRAM

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06079C1067G

MAP REVISED
NOVEMBER 16, 2012

Federal Emergency Management Agency

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FEMA FLOOD ZONE MAP

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
STADIUM ENTRANCE / BLEACHERS / TRACK
1499 San Luis Drive
San Luis Obispo, California

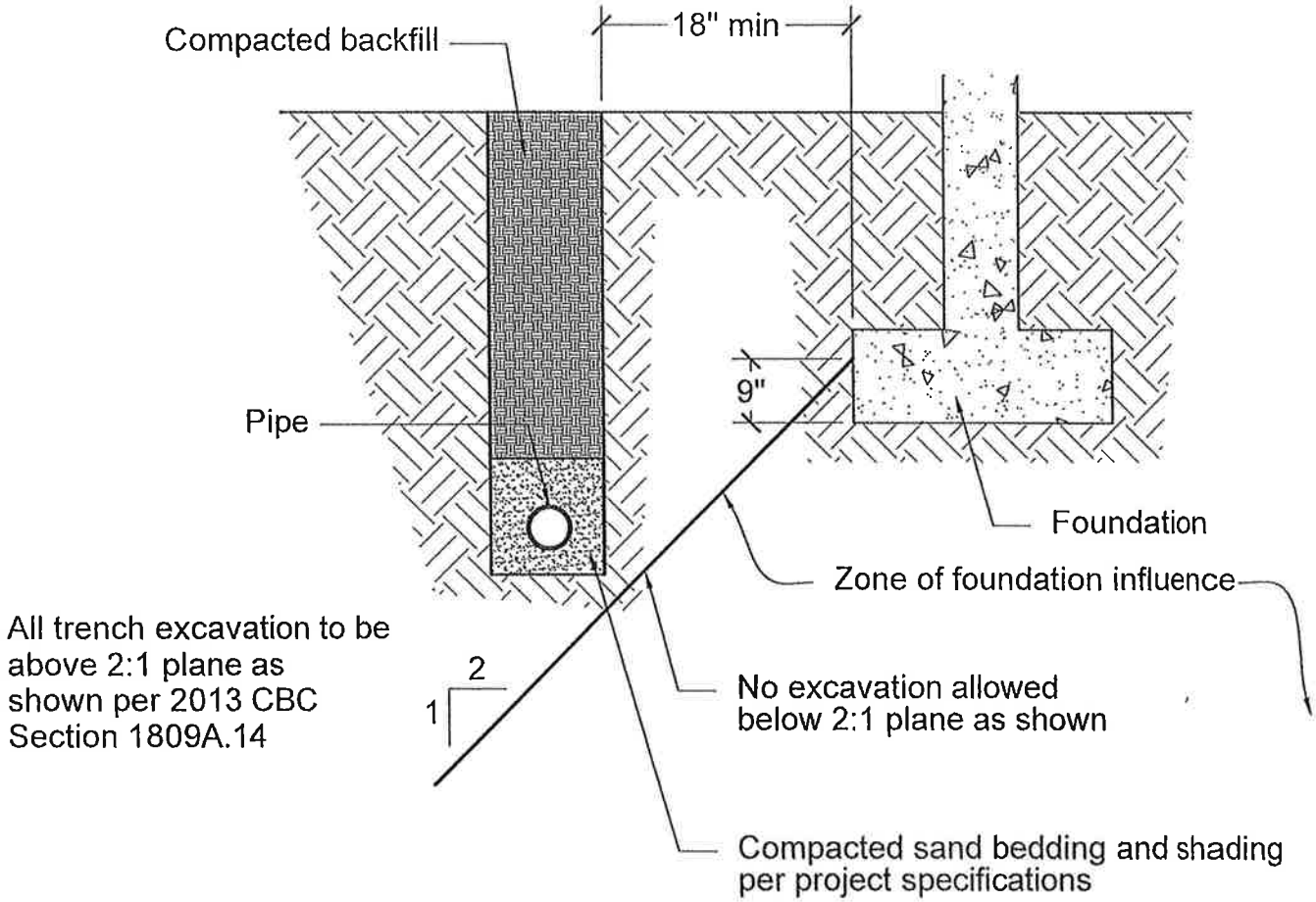
Date
April 2016

Project No.
SL-16605-SC

APPENDIX F

Typical Detail A: Pipe Parallel to Foundations

TYPICAL DETAIL A
PIPE PLACED PARALLEL TO FOUNDATIONS*



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E-mail: esp@earthsys.com

APPENDIX C

Boring Logs (ESP 2016b)

Earth Systems Pacific

Boring No. 1
PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

JOB NO.: SL-16605-SD
DATE: 12/30/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
POOL AND EQUIPMENT/ LOCKER BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3104

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	SC		CLAYEY SAND: dark brown, loose, moist (Topsoil)					
1 - 4	GP		POORLY GRADED GRAVEL: light brown, medium dense, moist (Fill) Gravel to 2" in greatest dimension					
4 - 7	CL		SANDY LEAN CLAY: gray brown to dark brown, stiff, moist, trace fine gravel	5.0 - 6.5	▬	106.6	15.6	5 9 10
7 - 12	SC		CLAYEY SAND WITH GRAVEL: brown, medium dense, moist	10.0 - 11.5	▬	108.9	9.8	7 10 7
13 - 20	CH		SANDY FAT CLAY: dark brown, stiff, moist (Alluvium)	15.0 - 16.5	▬	106.7	20.7	5 11 13
20 - 25			very stiff	20.0 - 21.5	●			5 7 9
25 - 26				25.0 - 26.5	●			5 9 11
26			End of Boring @ 26.5' No subsurface water encountered					

LEGEND: ▬ Ring Sample ◯ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 2

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

PAGE 1 OF 1
JOB NO.: SL-16605-SD
DATE: 12/29/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
POOL AND EQUIPMENT/ LOCKER BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3104

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL		SAND LEAN CLAY: dark brown, stiff, moist (Fill)					
3	SC		CLAYEY SAND WITH GRAVEL: gray brown, medium dense, slightly moist	3.0 - 4.5	Ring	125.5	5.8	10, 18, 18
5				5.0 - 6.5	Ring	125.4	9.6	7, 14, 16
8			moist					
10				10.0 - 11.5	Ring	104.9	15.8	5, 8, 9
14	CH		SANDY FAT CLAY WITH GRAVEL: dark brown, stiff, moist (Alluvium)					
15				15.0 - 16.5	SPT			1, 5, 5
17			End of Boring @ 16.5' No subsurface water encountered					

LEGEND: Ring Sample ◯ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 3

PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

JOB NO.: SL-16605-SD
DATE: 12/30/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
POOL AND EQUIPMENT/ LOCKER BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3104

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	SC		CLAYEY SAND: brown, medium dense, slightly moist	1.0 - 2.5	Ring	116.2	14.4	4, 10, 22
2			gray brown, trace fine to coarse gravel	1.0 - 5.0	Grab			
3				3.0 - 4.5	Ring	123.0	9.5	5, 12, 18
5				5.0 - 6.5	Ring	107.9	15.6	5, 8, 10
6	CL		SANDY LEAN CLAY: dark brown, stiff, moist, trace fine gravel (Fill)					
10	SC		CLAYEY SAND: olive brown, loose, moist	10.0 - 11.5	Ring	95.5	18.7	2, 4, 6
12	CH		SANDY FAT CLAY: brown, stiff, moist (Alluvium)					
15				15.0 - 16.5	SPT			3, 6, 7
17			End of Boring @ 16.5' No subsurface water encountered					

LEGEND: Ring Sample Grab Sample Shelby Tube Sample SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 4

PAGE 1 OF 1

LOGGED BY: R. Wagner
DRILL RIG: Mobile B53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem Auger

JOB NO.: SL-16605-SD
DATE: 12/30/15

SAN LUIS OBISPO HIGH SCHOOL
MEASURE D PROJECTS
POOL AND EQUIPMENT/ LOCKER BUILDING
1499 San Luis Drive
San Luis Obispo, California
Project No. 831-3104

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL		SANDY LEAN CLAY: gray brown to dark brown, stiff, moist, trace fine gravel (Fill)	1.0 - 2.5	Ring	122.2	7.7	9, 29, 39
2	SC		CLAYEY SAND WITH GRAVEL: brown, dense, slightly moist (Fill)	2.0 - 5.0	Grab			
6	CL		SANDY LEAN CLAY: dark brown, stiff, moist					
8	SC		CLAYEY SAND : brown, medium dense, moist, some fine to coarse gravel					
10	SM		SILTY SAND: olive brown, loose, moist	10.0 - 11.5	Ring	103.4	20.8	4, 3, 4
11	CH		SANDY FAT CLAY: brown, medium stiff, moist (Alluvium)					
15			stiff	15.0 - 16.5	SPT			3, 7, 8
19			gray/ brown mottled					
20				20.0 - 21.5	SPT			5, 7, 9
21			gray/ green, petroleum odor in sample					
24			hydrocarbon visible in sample					
25				25.0 - 26.5	SPT			4, 5, 6
26			End of Boring @ 26.5' No subsurface water encountered					

LEGEND: Ring Sample Grab Sample Shelby Tube Sample SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

APPENDIX D

Second Engineering Geology and Seismology Review for San Luis Obispo High School – Modernization of Buildings 100 and 300 (CGS 2018)

California
Department of
Conservation
California Geological Survey

Office of the State Geologist
801 K Street, MS 12-30
Sacramento, CA 95814

T: (916) 445-1825
F: (916) 445-5718
conservation.ca.gov

Ryan Pinkerton
Assistant Superintendent of Business
San Luis Coastal Unified School District
1500 Lizzie Street
San Luis Obispo, CA 93401

December 6, 2018

Subject: **Second Engineering Geology and Seismology Review for**
San Luis Obispo High School – Modernization of Buildings 100 and 300
1499 San Luis Drive, San Luis Obispo, CA
CGS Application No. 03-CGS3529 **DSA Application No. 03-118913**

Dear Mr. Pinkerton:

In accordance with your request and transmittal of documents on July 12 and November 16, 2018, the California Geological Survey has reviewed the engineering geology and seismology aspects of the consulting report prepared for the proposed developments at San Luis Obispo High School. It is our understanding that this project involves modernization of two buildings, 100 and 300, including the addition of an elevator tower to Building 100. This review was performed in accordance with Title 24, California Code of Regulations, 2016 California Building Code (CBC) and followed CGS Note 48 guidelines. We reviewed the following report:

Additional Assessment of Landslide Hazards Associated with Slopes East of the Site and Response to CGS Review Comments, San Luis Obispo High School Elevator Tower and Modernization of Building 100, 1499 San Luis Drive, San Luis Obispo, California: Earth Systems Pacific, 4378 Old Santa Fe Road, San Luis Obispo, CA 93401; company File No. 300933-005, report dated November 16, 2018, 5 pages plus attachments.

Landslide Analysis Correspondence CGS and Earth Systems Oct-Nov 2018: document including email correspondence between Darrin Hasham (PG, CEG, Earth Systems) and Judith Zachariasen (PG, California Geological Survey), with attachments documenting shear test data used in landslide analysis, dated December 6, 2018.

In addition, we previously reviewed the following reports:

Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School, Building 100 Elevator Tower, 1499 San Luis Drive, San Luis Obispo, California: Earth Systems Pacific, 4378 Old Santa Fe Road, San Luis Obispo, CA 93401; company File No. 300933-005, report dated March 21, 2018, 21 pages, 5 appendices.

Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School, Measure D Projects, Annex/Classroom Building, 1499 San Luis Drive, San Luis Obispo, California, Project No. 831-3102: Earth Systems Pacific, 4378 Old Santa Fe Road, San Luis Obispo, CA 93401; company File No. SL-16605-SE, Doc. No. 1601-059.SGR, report dated January 19, 2016, 31 pages, 5 appendices; with addenda dated April 18, 2016 and March 29, 2017; included as Appendix B in the above cited report.

The CGS previously reviewed and submitted our findings regarding this project in our review letter dated September 18, 2018, in which we requested that the consultants further address the landslide hazard posed to the school by the hills east of the project site. In addition, we requested that the consultants address the site conditions at Building 300, which was included in the site data report as part of the project, but which was not addressed in the July 20, 2018, report. The consultants have responded and addressed the concerns raised in the initial review, which are discussed below.

Landslide Hazard

In their original report, the consultants reported that there was no landslide hazard associated with slope failure of the site. However, they did not address the hazard associated with failure of slopes east of the site, which could potentially deposit landslide debris at the site. The site lies at the foot of a slope underlain by Franciscan Formation rocks in a zone designated to have a high potential for landslide hazard in the city and county safety elements. In response to our request, the consultants have reviewed published mapping, undertaken additional reconnaissance geologic mapping of the slope east of the site, and carried out a screening-level slope stability analysis. They identified three distinct lithologic units underlying the slope: serpentinite, graywacke, and residual soil/colluvium. They have provided rock strength parameters from field assessments of outcrop characteristics for the graywacke and serpentinite using Hoek-Brown criteria, which is acceptable. Soil strength parameters for the residual soil were estimated from measured shear test data from similar materials in the region; these data were not included in the November 16, 2018, report but were provided by the consultants in a follow-up email, compiled in the correspondence document listed above. The strength parameters selected by the consultants appear reasonable based on the data provided.

The consultants performed a slope stability analysis using commercially available software and a geologic cross-section developed based on their field reconnaissance mapping. They used a seismic coefficient of 0.45, which is conservative for the site. They have not provided a great deal of explanation of their model, but their results indicate that the factor of safety against failure under static conditions is about 3 for the residual soil and about 6 for the bedrock. The factor of safety under dynamic (seismic) loading is about 1.4, which exceeds CGS's recommended value of 1.15.

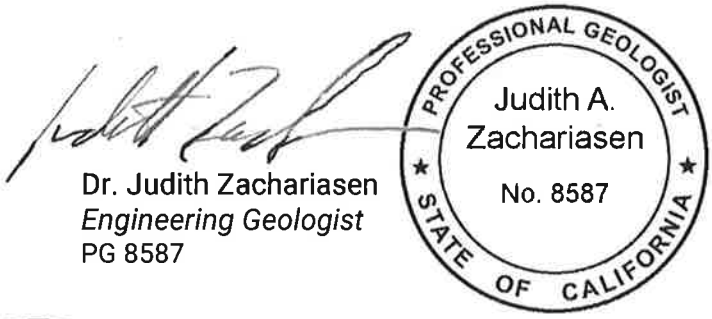
CGS notes that the analysis was carried out assuming unsaturated conditions. The consultants have reported, in email communication, that the graywacke is not water bearing. An earthquake occurring when the residual soil is saturated could decrease the factor of safety relative to that of unsaturated conditions. However, the model as developed appears adequately conservative. Therefore, CGS accepts **the consultants' conclusion that the slope east of the site is stable and does not pose a significant risk of landsliding**, and we do not request additional information.

Building 300

In our review letter dated September 18, 2018, we noted that the geohazard assessment was not adequate for the proposed improvements at Building 300, which were included as part of the project in the site data report but were not assessed in the consultants' March 21 report. In their response letter, the consultants state that the improvements at Building 300 consist of a storage room not intended for student occupancy and are thus exempt from review. CGS does not determine which projects are exempt from review; that is the purview of the Division of the State Architect. Consequently, we emphasize that **our review does not extend to the improvements at Building 300** and that any assessment of the geologic hazards for that site is not adequate per Note 48.

In conclusion, ***the engineering geology and seismology issues at this site are adequately assessed in the referenced reports for Building 100 improvements only, and no further information is requested***. If you have any further questions about this review letter, please contact the primary reviewer at judith.zachariasen@conservation.ca.gov.

Respectfully submitted,



Dr. Judith Zachariasen
Engineering Geologist
PG 8587

Concur:



Jennifer Thornburg
Senior Engineering Geologist
PG 5476, CEG 2240

Copies to:

Richard Gorman, *Certified Engineering Geologist* and Frederick Potthast, *Registered Geotechnical Engineer*
Earth Systems Pacific, 4378 Old Santa Fe Road, San Luis Obispo, CA 93401

William Graeber, *Architect*
RRM Design Group, 3765 Higuera Street, Suite 102, San Luis Obispo, CA, 93401

Ted Beckwith, *Senior Structural Engineer*
Division of State Architect, 355 South Grand Avenue, Suite 2100, Los Angeles, CA 90071

APPENDIX E

Site Specific Ground Motion Hazards Analyses – Tables 1 and 2

Table 1
Fault Parameters

Fault Section Name	Distance (miles)	Distance (km)	Upper Seis. Depth (km)	Lower Seis. Depth (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)
Oceanic-West Huasna	2.6	4.1	0.0	7.0	58	49	na	122	B'	**7.1**		
Los Osos	3.2	5.1	0.0	10.0	45	208	90	44	B	**6.9**		0.5
Rinconada	6.1	9.9	0.0	10.0	90	233	180	191	B	**7.5**		1
San Luis Range (So Margin)	8.7	14.0	0.0	10.0	45	37	90	64	B	**7.1**		0.2
Hosgri	16.1	25.9	0.0	6.8	80	59	180	171	B	**7.3**		2.5
Casmalia (Orcutt Frontal)	24.2	38.9	0.0	10.0	75	206	90	29	B	**6.6**		0.25
San Juan	28.1	45.3	0.0	13.0	90	243	180	68	B	**7.1**		1
Lions Head	28.8	46.3	0.0	10.0	75	29	90	41	B	**6.7**		0.02
Hosgri (Extension)	30.1	48.4	0.0	7.5	80	79	na	29	B'	**6.4**		
San Andreas (Cholame) rev	36.1	58.2	0.0	12.0	90	51	180	63	A	**7.5**	63	34
South Cuyama	37.5	60.3	0.0	5.6	33	210	na	48	B'	**6.8**		
San Andreas (Parkfield)	37.9	61.0	0.0	10.2	90	50	180	36	A	**6.4**	13	34
Los Alamos-West Baseline	40.8	65.7	0.0	10.0	30	211	90	28	B	**6.8**		0.7
Morales (West)	42.0	67.7	0.0	8.6	32	49	na	28	B'	**6.8**		
San Andreas (Carrizo) rev	44.3	71.3	0.0	15.1	90	224	180	59	A	**7.8**	106	34
San Andreas (Creeping Segment)	49.9	80.2	0.0	12.0	90	227	180	122	A	**7.2**	69	34
Lost Hills	54.4	87.5	4.2	12.0	29	233	na	33	B'	**6.8**		
Santa Ynez (West)	56.7	91.3	0.0	9.2	70	182	0	63	B	**6.9**		2
Morales (East)	59.0	94.9	0.0	8.6	32	14	na	18	B'	**6.6**		
Great Valley 14 (Kettleman Hills)	64.4	103.7	8.1	22.5	22	215	90	24	B	**7.1**		1.5
Red Mountain	65.7	105.7	0.0	14.1	56	2	90	101	B	**7.4**		2
Great Valley 13 (Coalinga)	67.0	107.8	9.1	15.2	15	226	90	32	B	**7.0**		1.5
Big Pine (West)	71.9	115.7	0.0	11.0	50	2	na	18	B'	**6.5**		
Mission Ridge-Arroyo Parida-Santa Ana	72.8	117.1	0.0	7.6	70	176	90	69	B	**6.8**		0.4
North Channel	73.8	118.7	1.1	4.5	26	10	90	51	B	**6.7**		1
San Andreas (Big Bend)	74.3	119.6	0.0	15.1	90	198	180	50	A	**7.8**	108	34
Pitas Point (Upper)	74.4	119.8	1.4	10.0	42	15	90	35	B	**6.8**		1
Great Valley 12	74.9	120.5	7.0	9.6	15	243	90	17	B	**6.3**		1.5
Pitas Point (Lower, West)	77.2	124.3	1.5	8.8	13	3	90	35	B	**7.2**		2.5
Oak Ridge (Offshore), west extension	77.3	124.4	0.0	3.1	67	195	na	28	B'	**6.1**		
Channel Islands Western Deep Ramp	77.8	125.3	4.8	12.5	21	204	90	62	B'	**7.3**		
Santa Ynez (East)	79.0	127.1	0.0	13.3	70	172	0	68	B	**7.2**		2
Pleito	80.1	128.9	0.0	13.6	46	181	90	44	B	**7.1**		2
Pine Mtn	81.4	130.9	0.0	16.3	45	5	na	62	B'	**7.3**		
Great Valley 11	84.4	135.9	7.0	9.6	15	221	90	24	B	**6.5**		1.5
Big Pine (Central)	84.7	136.3	0.0	6.6	76	167	na	23	B'	**6.3**		
Santa Rosa Island	87.6	141.0	0.0	8.7	90	1	30	58	B	**6.8**		1
Big Pine (East)	88.5	142.4	0.0	14.3	73	338	na	23	B'	**6.6**		
Monterey Bay-Tularcitos	89.5	144.0	0.0	14.0	90	49	150	83	B	**7.3**		0.5
Oak Ridge (Offshore)	90.1	145.0	0.0	7.9	32	180	90	38	B	**6.9**		3

Reference: USGS OFR 2007-1437 (CGS SP 203)

Based on Site Coordinates of 35.2835 Latitude, -120.6512 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.

Table 2 - Spectral Response Values
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 year MCE Spectrum (1) 2475-year (ASCE 21.2.1)	Probab. 1% collapse in 50 year MCEr Spectrum (2) 2475-year **(ASCE 21.2.1.2)**	Max 84th Percentile Determ. MCE Spectrum (3) - (ASCE 21.2.2)	Determ. Lower Limit MCE Spectrum (4) - (ASCE 21.2.2)	Determ. MCE Spectrum (5) - (ASCE 21.2.2)	Site Specific MCE Ground Response (6) Min (2),(5) (ASCE 21.2.3)	Site Specific MCE Spectrum Comparator (6b) Max (6),1.5*(8) (ASCE 21.2.3)	2019 CBC MCE Spectrum (7)	Site Specific Design Spectrum (8) (ASCE 21.3)	2019 CBC Design Spectrum (9) 2/3*(7)
0.00	0.481	0.381	-	-	-	0.381	0.381	0.461	0.254	0.307
0.05	0.774	0.603	-	-	-	0.603	0.603	0.661	0.402	0.441
0.10	1.067	0.824	-	-	-	0.824	0.824	0.861	0.549	0.574
0.15	1.095	0.858	-	-	-	0.858	0.858	1.062	0.572	0.708
0.20	1.122	0.891	-	-	-	0.891	0.921	1.152	0.614	0.768
0.30	0.928	0.750	-	-	-	0.750	0.921	1.152	0.614	0.768
0.40	0.794	0.651	-	-	-	0.651	0.921	1.152	0.614	0.768
0.50	0.661	0.551	-	-	-	0.551	0.921	1.152	0.614	0.768
0.75	0.505	0.398	-	-	-	0.398	0.921	1.152	0.614	0.768
1.00	0.348	0.299	-	-	-	0.299	0.794	0.993	0.529	0.662
1.50	0.255	0.220	-	-	-	0.220	0.529	0.662	0.353	0.441
2.00	0.161	0.140	-	-	-	0.140	0.397	0.496	0.265	0.331
3.00	0.103	0.090	-	-	-	0.090	0.265	0.331	0.176	0.221
4.00	0.076	0.066	-	-	-	0.066	0.199	0.248	0.132	0.165
5.00	0.061	0.053	-	-	-	0.053	0.159	0.199	0.106	0.132
8.00	0.051	0.000	-	-	-	-	-	-	-	-
10.00	0.050	0.000	-	-	-	-	-	-	-	-

C_{RS}:	0.898		*Deterministic MCE not considered due to Exception in 21.2.2 ASCE 7-16.*
C_{R1}:	0.901		
Site Specific To:	0.172	$= 0.2*S_{D1}/S_{DS}$	
Site Specific Ts:	0.862	$= S_{D1}/S_{DS}$	

Probabilistic Spectrum from 2014 USGS Ground Motion Mapping Program adjusted for site conditions and maximum rotated component of ground motion using NGA, Column 2 has risk coefficients C_R applied.

Reference: ASCE 7-16, Chapters 21.2, 21.3, 21.4, 11.4, and 11.8

Site Coefficients	
F_{PGA}	1.12
F_a	1.07
F_v	2.50

Mapped MCE Acceleration Values		
PGA	0.478	g
S_S	1.077	g
S_1	0.397	g

Short-Period Seismic Design Category:	1-Second Period Seismic Design Category:
D	D

Site-Specific Design Acceleration Values		
PGA_M	**0.481**	**g**
S_{DS}	**0.614**	**g**
S_{D1}	**0.529**	**g**

Vertical Coefficient (C_V)
1.32

Site-Specific MCE_R, 5% damped, Spectral Response Acceleration Parameter		
S_{MS}	**0.921**	**g**
S_{M1}	**0.794**	**g**

1 g = 980.6 cm/sec^2 =32.2 ft/sec^2
PSV (ft/sec) = $32.2(S_a)T/(2p)$

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

APPENDIX F

Tremie Method

RECOMMENDED PROCEDURE FOR TREMIE PLACEMENT OF CONCRETE IN CAISSON CONSTRUCTION

The following are general guidelines only and may be subject to modification by the architect/engineer and/or geotechnical engineer.

1. Concrete should be placed in caisson excavations by means of a tremie pipe when the depth of water in the excavation cannot be limited to a maximum of 3 inches, and/or inflow less than 1-inch in 5 minutes, per FHWA, or when the freefall of the concrete would result in the concrete striking the rebar or excavation walls as it falls.
2. The concrete should be pumped to the tremie pipe. Alternately, a hopper with a tremie pipe attached should be used if approved by the architect/engineer. An "elephant's trunk" should not be used to place concrete under water; however, an elephant's trunk may be used to direct the fall of the concrete in dry excavations. The elephant's trunk should be of sufficient length to prevent the concrete from striking the rebar or excavation walls as it falls.
3. Concrete for dry excavations should be designed for, and placed at, a slump of 6 to 8 inches. Concrete to be placed below water should be designed and placed as a "flowable" mix with a minimum slump of 8 to 10 inches or should be designed and placed as "self-consolidating concrete." Suitability of high slump (>8 inches) concrete should be verified by slump flow, slump flow velocity and visual stability testing.
4. The tremie pipe should consist of rigid steel pipe segments with waterproof joints. Gravity tremie pipes should be 6 inches in diameter or at least 6 times the maximum concrete aggregate size (whichever is greater) and should be longer than the deepest caisson excavation. Pressurized tremie systems (pump lines) may be smaller than 6 inches to accommodate rebar spacing or other factors.
5. The tremie pipe should be lowered with caution through the center of the reinforcing to within 1-foot of the bottom of the excavation; however, the tremie pipe should not be allowed to penetrate into the muck on the bottom of the hole.
6. The pump hose and tremie pipe should be "slicked" with Portland cement slurry. No clay, bentonite, or other material should be used unless approved by the architect/engineer and geotechnical engineer.
7. Pumping of the concrete should begin immediately after the reinforcing and the tremie pipe have been placed in the excavation and the excavation and reinforcing have been inspected. The tremie pipe should not be raised until the concrete surface in the caisson excavation is at least 5 feet above the bottom of the tremie pipe. The bottom of the tremie pipe should then be kept at least 5 feet below the top of the concrete until the pour is completed.
8. The concrete should be pumped until all muck, laitance, and unsuitable concrete has been lifted above the top-of-caisson elevation. All muck, laitance, and unsuitable concrete should be immediately removed from the excavation.
9. Self-consolidating concrete need *not* be vibrated during the pour, unless directed by the architect/engineer. For other than self-consolidating concrete, vibration should *not* be started until the concrete pour is completed and the muck, laitance and unsuitable concrete have been removed. Then, only the upper 5 to 10 feet of the concrete should be vibrated. Additional concrete may be added as necessary during vibration. The vibrator should not be allowed to contact the reinforcing.
10. During the pour, if the tremie pipe has to be removed from the concrete, (e.g., to allow removal of casing), it should be reset at the top of the concrete. The tremie should then be purged as directed by the inspector, and then immediately lowered to at least 5 feet below the top of the concrete as the concrete is being pumped. All degraded concrete should be lifted with the continuing pour and removed from the top of the caisson.
11. For a more thorough and in-depth discussion and recommendations on this topic, please refer to "Guide to Tremie Concrete for Deep Foundations" by the Joint EFFC/DFI Concrete Task Group (Second Edition – 2018) available at http://www.dfi.org/VIEWPUB.ASP?tid=CPF-2015-DRSH-1.
12. Unless unavoidable due to equipment or supply breakdown, all caisson excavations should be filled with concrete on the same day they are drilled.

APPENDIX D

Table D-1 – Fault Parameters

Table D-2 – Historical Earthquakes in Vicinity of Project Site

Table D-1
Fault Parameters

Fault Section Name	Distance (miles)	Distance (km)	Upper Seis. Depth (km)	Lower Seis. Depth (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)
Oceanic-West Huasna FM3.1, 3.2	2.5	4.0	0.0	7.0	58	49	na	122	B'	**7.1**		
Los Osos 2011 CFM FM3.1, 3.2	3.3	5.3	0.0	12.0	45	208	90	58	B	**6.9**		0.5
Rinconada 2011 CFM FM3.1, 3.2	7.9	12.8	0.0	8.5	82	233	180	123	B	**7.5**		1
San Luis Bay 2011 CFM FM3.2	8.6	13.8	0.0	10.0	90	na	na	16	B'	**6.3**		
San Luis Range 2011 CFM, FM3.1	8.7	14.0	0.0	12.0	52	na	na	79	B'	**7.2**		
San Luis Range (So Margin) FM3.2	8.8	14.1	0.0	12.0	45	37	90	115	B	**7.1**		0.2
East Huasna 2011 CFM FM3.1, 3.2	9.0	14.5	0.0	15.0	90	na	na	74	B'	**7.2**		
Shoreline FM3.1, 3.2	11.2	18.0	0.0	12.0	90	na	na	23	B'	**6.5**		
San Luis Range - Oceano 2011 CFM, FM3.1	11.3	18.2	0.0	12.0	45	na	na	21	B'	**6.6**		
San Luis Range - Pecho FM3.1, 3.2	13.3	21.4	0.0	12.0	90	na	na	26	B'	**6.6**		
La Panza FM3.1, 3.2	14.6	23.6	0.0	13.9	51	45	na	72	B'	**7.3**		
Hosgri FM3.1, 3.2	16.2	26.0	0.0	6.8	80	59	180	171	B	**7.3**		2.5
South Cuyama FM3.1, 3.2	17.3	27.8	0.0	13.9	33	210	na	83	B'	**7.5**		
Casmalia 2011 CFM	21.7	34.9	0.0	12.0	75	na	na	48	B'	**6.9**		
Lions Head 2011 CFM FM3.1, 3.2	27.7	44.6	0.0	12.0	75	29	90	65	B	**6.7**		0.02
San Juan FM3.1, 3.2	28.1	45.2	0.0	13.0	90	243	180	82	B	**7.1**		1
Hosgri (Extension) FM3.1, 3.2	30.2	48.5	0.0	7.5	80	79	na	29	B'	**6.4**		
San Andreas (Cholame) rev FM3.1, 3.2	36.1	58.1	0.0	12.0	90	51	180	63	A	**6.8**	89	3.5
San Andreas (Parkfield) FM3.1, 3.2	37.8	60.9	0.0	10.2	90	50	180	36	A	**6.4**	13	20
Los Alamos 2011 CFM FM3.1, 3.2	40.5	65.2	0.0	12.0	30	na	na	27	B'	**6.9**		
Morales (West) FM3.1, 3.2	42.0	67.6	0.0	8.6	32	49	na	28	B'	**6.8**		
Santa Ynez River FM3.1, 3.2	43.5	69.9	0.0	12.0	70	na	na	73	B'	**7.1**		
San Andreas (Carrizo) rev FM3.1, 3.2	44.3	71.2	0.0	15.1	90	224	180	59	A	**6.8**	89	3.5
San Andreas (Creeping Section) FM3.1, 3.2	49.8	80.2	0.0	12.0	90	227	180	121	A	**6.8**	89	9
Santa Ynez (West) FM3.1, 3.2	54.1	87.1	0.0	9.2	70	182	0	80	B	**6.9**		2
Lost Hills FM3.1, 3.2	54.3	87.4	4.2	12.0	29	233	na	33	B'	**6.8**		
Los Alamos extension FM3.1, 3.2	54.7	88.1	0.0	12.0	30	na	na	22	B'	**6.8**		
Morales (East) FM3.1, 3.2	59.0	94.9	0.0	8.6	32	14	na	18	B'	**6.6**		
Ozena FM3.1, 3.2	60.0	96.6	0.0	13.9	33	na	na	41	B'	**7.2**		
Great Valley 14 (Kettleman Hills) FM3.1, 3.2	64.4	103.6	8.1	22.5	22	215	90	24	B	**7.1**		1.5
Red Mountain FM3.1, 3.2	65.8	105.8	0.0	14.1	56	2	90	101	B	**7.4**		2
Great Valley 13 (Coalinga) FM3.1, 3.2	66.9	107.7	9.1	15.2	15	226	90	32	B	**7.0**		1.5
Big Pine (West) FM3.1, 3.2	71.9	115.8	0.0	11.0	50	2	na	18	B'	**6.5**		
Reliz 2011 CFM FM3.1, 3.2	72.1	116.1	0.0	10.9	58	240	na	127	B'	**7.4**		
Mission Ridge-Arroyo Parida-Santa Ana FM3.1, 3	72.8	117.2	0.0	7.6	70	176	90	69	B	**6.8**		0.4
North Channel FM3.2	73.8	118.8	1.1	4.5	26	10	90	51	B	**6.7**		1
San Andreas (Big Bend) FM3.1, 3.2	74.3	119.6	0.0	15.1	90	198	180	50	A	**6.8**	89	3.5
Pitas Point (Upper) FM3.2	74.5	119.9	1.4	10.0	42	15	90	35	B	**6.8**		1
Great Valley 12 FM3.1, 3.2	74.8	120.4	7.0	9.6	15	243	90	17	B	**6.3**		1.5
Pitas Point (Lower, West), FM 3.1	77.3	124.4	1.5	8.8	13	3	90	35	B	**7.2**		2.5

Reference: USGS OFR 2013-1165 (CGS SP 228) Based on Site Coordinates of 35.2846 Latitude, -120.6507 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 2008-1437). Mean magnitude is average of Ellworths-B and Hanks & Bakun moment area relationship.

Site Coordinates: 35.285 N 120.651 W

Table D-2
Historical Earthquakes in Vicinity of Project Site, M >= 5.0

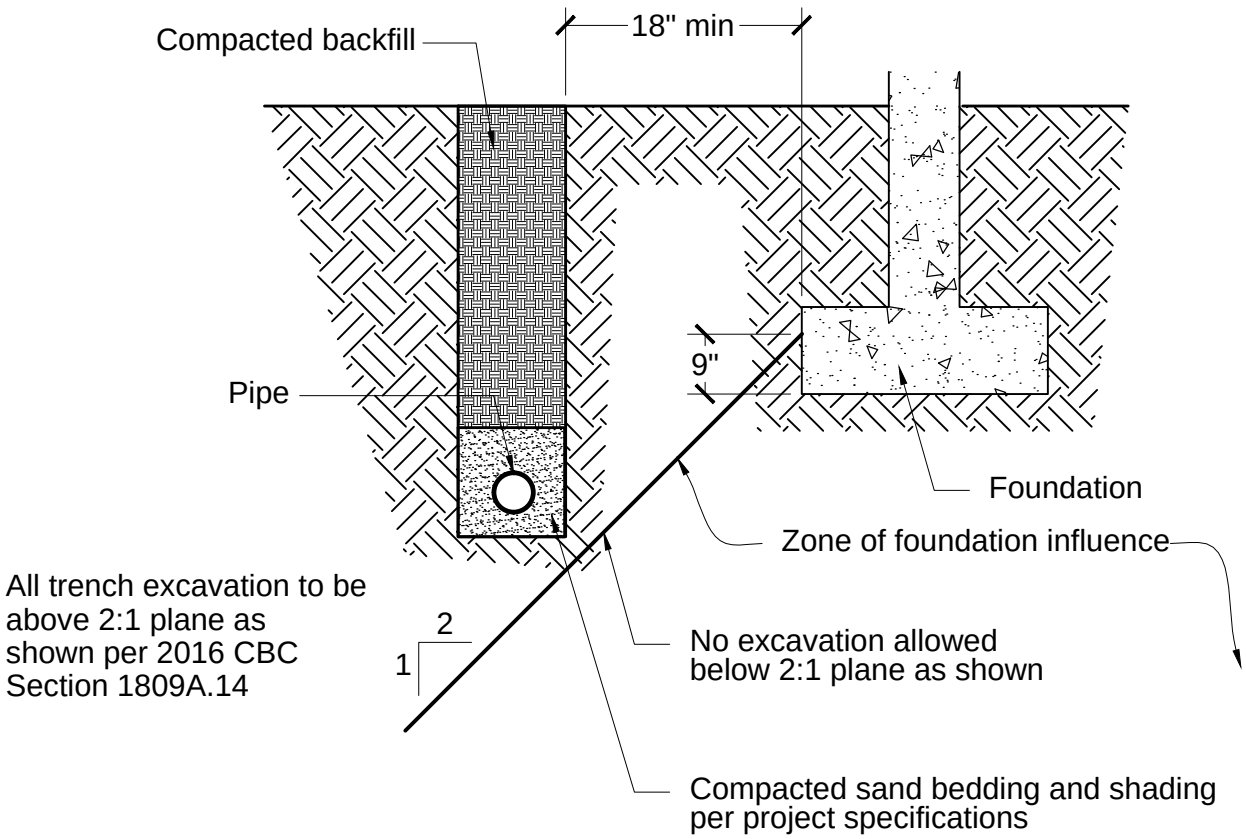
Day	Year	Epicenter Latitude (Degrees)	Epicenter Longitude (Degrees)	Distance from Site (mi)	Magnitude M_W
9/5	1922	35.30	120.70	3.0	**5.5**
99/99	1830	35.35	120.65	4.5	**6.0**
4/27	1908	35.60	120.20	33.4	**5.5**
12/7	1906	35.50	121.20	34.3	**5.7**
5/30	1877	35.70	120.30	34.8	**5.5**
7/28	1902	34.80	120.40	36.3	**5.8**
2/1	1853	35.70	121.10	38.2	**5.5**
12/22	2003	35.70	121.10	38.2	**6.6**
3/10	1922	35.75	120.25	39.2	**6.3**
8/18	1922	35.75	120.25	39.2	**5.7**
9/28	2004	35.82	120.37	40.2	**6.0**
6/8	1934	35.79	120.29	40.4	**6.0**
6/28	1966	35.81	120.27	42.1	**6.0**
7/31	1902	34.70	120.30	45.0	**5.8**
2/14	1987	35.96	120.70	46.7	**5.2**
9/29	2004	35.95	120.50	46.7	**5.1**
11/16	1956	35.95	120.47	47.0	**5.0**
11/22	1952	35.76	121.27	47.8	**6.2**
11/4	*1927	34.60	120.90	49.3	**7.1**
12/28	1939	35.97	120.92	49.7	**5.2**
9/13	1975	36.00	120.55	49.7	**5.1**
3/3	1901	36.00	120.50	50.1	**6.4**
11/2	1955	36.00	120.92	51.7	**5.2**
2/26	1932	36.00	121.00	53.1	**5.0**
2/2	1881	36.05	120.55	53.1	**6.0**
5/6	1881	36.05	120.55	53.1	**5.5**
1/12	*1915	34.60	120.20	53.7	**5.7**
1/9	1857	36.10	120.65	56.3	**6.1**
9/17	1991	35.81	121.45	57.7	**5.0**
1/14	1855	36.15	120.70	59.8	**5.5**
1/9	1857	36.20	120.80	63.8	**7.9**
4/12	1885	36.20	120.80	63.8	**6.5**

From full earthquake catalog in USGS OFR 2008-1437h as updated with current events through 2023 (ANSS 2024). For events with an asterisk, alternate solutions are given in the OFR. Ordered By Closest Event. Maximum 40 Closest Events

APPENDIX E

Typical Detail A: Pipe Parallel to Foundations

TYPICAL DETAIL A
PIPE PLACED PARALLEL TO FOUNDATIONS•



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November 16, 2018

File No.: 300933-005

Mr. Ryan Pinkerton
San Luis Coastal Unified School District
937 Southwood Drive
San Luis Obispo, CA 93401

PROJECT: SAN LUIS OBISPO HIGH SCHOOL
ELEVATOR TOWER AND MODERNIZATION OF BUILDING 100
1499 SAN LUIS DRIVE
SAN LUIS OBISPO, CALIFORNIA

SUBJECT: Additional Assessment of Landslide Hazards Associated with Slopes East of the Site and Response to CGS Review Comments

REF.:
1) Engineering Geology and Seismology Review for San Luis Obispo High School – Modernization of Buildings 100 and 300, 1499 San Luis Drive, San Luis Obispo, CA, CGS Application No. 03-CGS3529, DSA Application No. 03-118913, by California Geological Survey (CGS), dated September 18, 2018
2) Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School, Building 100 Elevator Tower, 1499 San Luis Drive, San Luis Obispo, by Earth Systems Pacific, Doc. No. 1803-017.SGR, dated March 21, 2018
3) Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School, Building 100 Modernization, 1499 San Luis Drive, San Luis Obispo, by Earth Systems Pacific, Doc. No. 1807-029.SGR, dated July 20, 2018

Dear Mr. Pinkerton:

Per your authorization of our proposal dated October 5, 2018, we have prepared this letter in response to review comments provided by California Geological Survey [Ref. No. 1 (CGS)] where additional geotechnical information was requested to supplement our report for the San Luis Obispo High School Building 100 Elevator Tower project (Ref. No. 2). The geotechnical information provided herein is also applicable to projects associated with our report for the Building 100 Modernization (Ref. No. 3). In summary, CGS has requested that additional information be provided consisting of further analysis of the stability hazard of the existing slopes to the east of the campus; details are provided in their review letter referenced above. Within the letter CGS also notes that the geotechnical report reviewed is not adequate for the Building 300 site. We understand that, based on correspondence with the project architect, Building 300 improvements will consist of an addition to a storage room and not intended for student occupancy; it is exempt from review and was not covered in our geotechnical reports.

To fulfill the requests from CGS, we performed a field reconnaissance of the slope, developed a conceptual site model, and performed a screening level slope stability analysis. A description of the field reconnaissance, analysis, and our findings along with conclusions and recommendations are described in the following sections. The analysis, conclusions, and recommendations provided herein are an addendum to the Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School, Building 100 Elevator Tower (Ref. No. 2), and the Geotechnical Engineering and Geologic Hazards Report, San Luis Obispo High School, Building 100 Modernization (Ref. No. 3).

Review of Published Maps and Field Reconnaissance

The regional geologic map by Wiegers (2010) depicts the slope to the east of Building 100 as Cretaceous- to Jurassic-age Franciscan Mélange on about the lower half of the slope and the serpentinized ultramafic rocks on the upper half of the slope. According to the San Luis Obispo County Land Use Maps (2018), the slopes to the east of the high school site are mapped as having a high potential for landslide risk.

Our field reconnaissance included traversing the slope and performing mapping to document geologic conditions evident at the ground surface. The regional geologic map by Wiegers, supplemented with topographic contours from an open source digital elevation model (DEM), was used as a base map during the field reconnaissance. The area of supplemental geologic mapping for this study is shown on Figure 1, Engineering Geologic Map.

We confirmed that the regional geologic map is generally consistent with on-site geologic conditions observed. We observed the lower part of the slope to be composed of graywacke sandstone (graywacke), which is one of the component units of the Franciscan Mélange. Approximately the upper half of the slope is composed of serpentinized ultramafic rocks (serpentinite). The graywacke was observed at several outcrops on the slope and has been observed in recent excavations at the toe of the slope on the high school campus. We also observed that parts of the slope are covered with a mantle of residual soil that has formed by weathering of the underlying graywacke. The distribution of outcrops supports our model depicting graywacke uniformly underlying the lower half of the slope, and serpentinite underlying the upper half. Photographs of graywacke observed in outcrop are presented in Figures 2 through 7. The approximate locations of the outcrops, referenced by photo number, are indicated on Figure 1, Engineering Geologic Map.

The photographs of the outcrops consistently depict the graywacke as massive, highly weathered, and intensely to moderately fractured. We know from our local expertise and from on-site observations in trench exposures that the highly weathered rind is generally less than 20 feet thick, and that below the weathered zone the rock is moderately to very slightly fractured. No bedding was observed or measured and the fractures within the rock mass and the unconfined compressive strength control the geomechanical behavior of this rock.

Analysis

For slope stability analyses, we developed a conceptual site model (cross section) from our base map modified with observations of rock and soil types observed during our site reconnaissance. Cross Section A-A', (location depicted on Figure 1 and section provided in the stability analysis attached), represents the slope east of Building 100. The bedrock units included in the model are graywacke and serpentinite. A veneer of surficial soils (residual soil/colluvium) mantles the bedrock locally and has been modeled on the cross section as a tapering wedge downslope of the contact between the graywacke and the serpentinite.

Slope stability analyses were performed using the computer program Slide Version 2018 (Rocscience). Static and dynamic analyses were performed on Cross Section A-A' to calculate a factor of safety (FOS) against failure. Generally, the satisfactory FOS against failure for slopes is 1.5 for static conditions and 1.15 for dynamic (earthquake loading) conditions (CGS 2008). A FOS of less than one (< 1.0) indicates that the driving forces exceed the resisting forces and failure is predicted.

Soil strength parameters for the shallow subsurface materials (residual soil/colluvium) were derived from our local expertise with residual soils in the Franciscan Mélange. Conservative Mohr-Coulomb values were selected for the residual soil/colluvium as shown in Table 1 below.

Table 1
Soil Strength Parameters

Material Type	Total Weight (pcf)	Phi Angle (degrees)	Cohesion (psf)
Residual Soil	110	15	700

Rock strength parameters for the graywacke and serpentinite are based on rock mass classifications systems (Marinos et al 2005, Hoek 1999). Field estimates for the uniaxial compressive strength and geological strength index (GSI) were made by our engineering geologist. These values were applied by the software with other published values to estimate the rock strength. Table 2 presents a summary of the rock strength parameters utilized in the analyses. The results of our slope stability analysis is presented in the attachments.

Table 2
Hoek and Brown - Rock Strength Parameters

Material Type	Total Weight (pcf)	Unconfined Compressive Strength (ksf)	Geologic Strength Index (GSI)	Intact Rock Constant (mi)
Serpentinite	140	800	35	12
Graywacke	130	1,000	45	18

Findings

The analyses indicate that for the given cross-section and conservative material strength parameters, a FOS against failure is greater than 1.5 for static conditions. In general, the veneer of residual soil/colluvium returns a static FOS of approximately 3.0. Failure paths within the underlying bedrock of Serpentinite and Graywacke indicate a FOS against failure greater than approximately 6 for static conditions. Factors of safety against failure under dynamic loading conditions are greater than 1.15. Copies of our analysis are provided in the attachments.

Conclusions and Recommendations

Although the slopes to the east of the high school are mapped by the County of San Luis Obispo as having a high potential for landslide risk, our analyses indicate the risk is much lower. Based on our field reconnaissance and slope stability analysis, it is our opinion that the slope east of Building 100 and as shown on Figure 1, has a static factor of safety against failure greater than 1.5, is considered stable, and does not pose a significant risk for landsliding as modelled. The geotechnical recommendations provided in the project geotechnical report (Ref. No. 2) remain applicable for the proposed project.

Closure

If there are any questions concerning this addendum, please do not hesitate to contact the undersigned.

Sincerely,

Earth Systems Pacific

REGISTERED GEOLOGIST
DARRIN G. HASHAM
NO. 2423
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Darrin Hasham, CEG
Senior Geologist

REGISTERED PROFESSIONAL ENGINEER
KEITH P. ASKEW
GE 2946
GEOTECHNICAL
STATE OF CALIFORNIA

Keith P. Askew, GE
Principal Engineer

Attachments:
Figure 1 – Engineering Geology Map
Figure 2 – Photo No. 1
Figure 3 – Photo No. 2
Figure 4 – Photo No. 3
Figure 5 – Photo No. 4
Figure 6 – Photo No. 5
Figure 7 – Photo No. 6
Slope Stability Analysis

Copy To:
PBK, Attn: Ms. Veronica Carrasco
PBK, Attn.: Mr. Gary Geny
SLCUSD, Attn.: Mr. Chris Bonin
CGS, Attn: Ms. Judith Zachariasen

Doc. No. 1811-062.GEO/cr

REFERENCES

California Geological Survey (CGS). 2008. Guidelines for Evaluating and Mitigating Seismic Hazards in California, Special Publication 117A.

Hoek, Evert. 1999. Putting Numbers to Geology – an Engineer's Viewpoint, in Quarterly Journal of Engineering Geology, Vol. 32, No. 1, pp. 1-19.

Marinos, V., P. Marinos, and E. Hoek. 2005. The Geological Strength Index: Applications and Limitations, in Bulletin of Engineering Geology and the Environment, v. 64, pp. 55-65.

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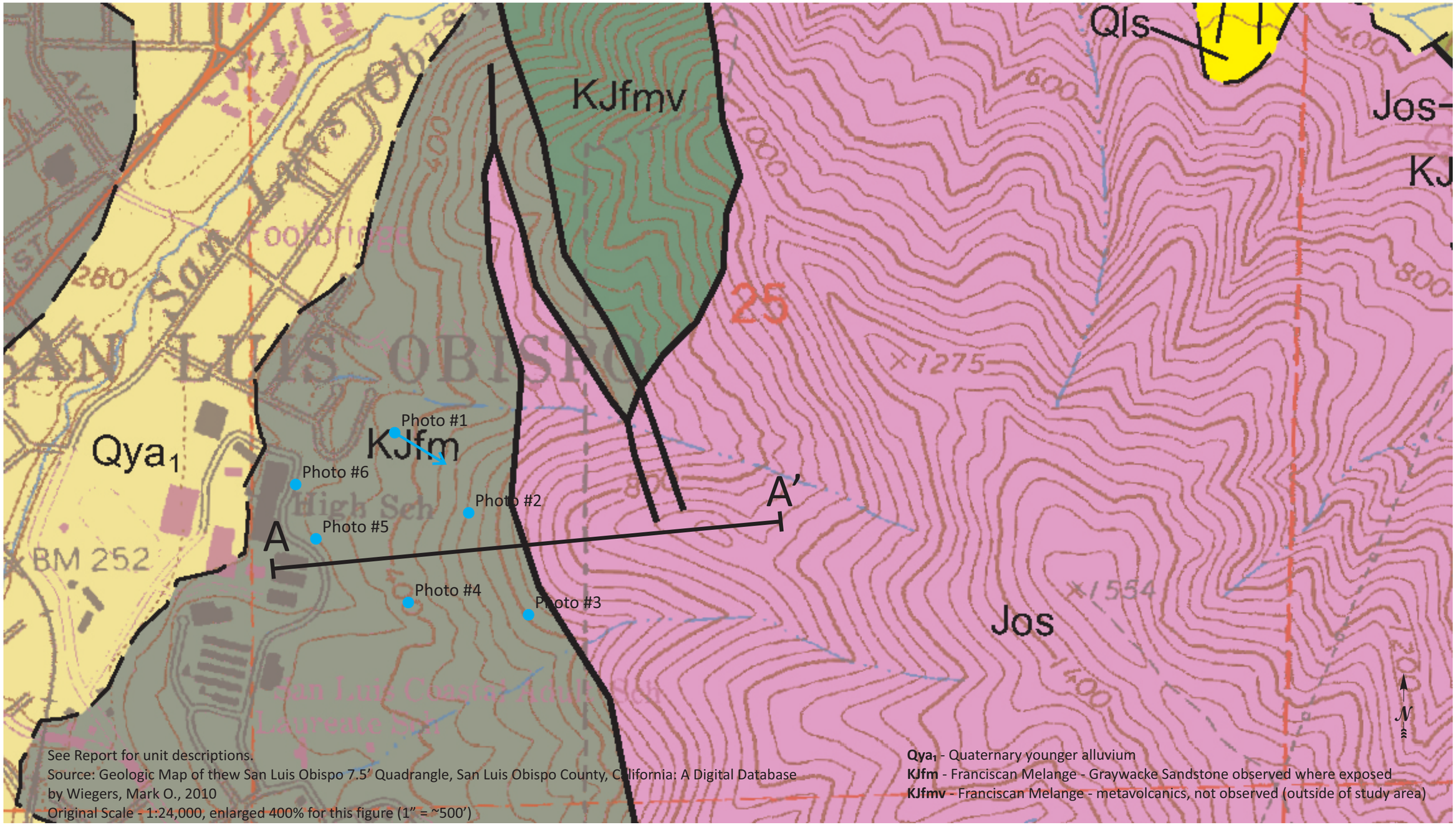
Wiegers, M.O., 2010, Preliminary geologic map of the San Luis Obispo 7.5' quadrangle, San Luis Obispo County, California: a digital database: California Geological Survey, Preliminary Geologic Maps, scale 1:24,000

ATTACHMENTS



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ENGINEERING GEOLOGIC MAP
San Luis Obispo High School, Building 100
1499 San Luis Drive
San Luis Obispo, California

Figure 1

Date
November 2018

Project No.
300933-005



Photo No. 1: The hillside of interest at San Luis Obispo High School: Generally speaking, the slope is concave, consistent with a wash slope. There is a nickpoint about half way up the slope that is likely controlled by the contact between the graywacke and the serpentinized ultramafic rocks forming the upper part of the slope. Some hummocky topography is present on the slope, resulting from shallow soils slips in the veneer of residual soil. The shallow soil slips appear to have moved towards the drainage which is northeast of Building 100 and do not present a hazard to the project. Building 100 is behind the photographer, to the right.

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San Luis Obispo High School
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1499 San Luis Drive
San Luis Obispo, California

FIGURE 2

Date
November 2018

Project No.
300933-005

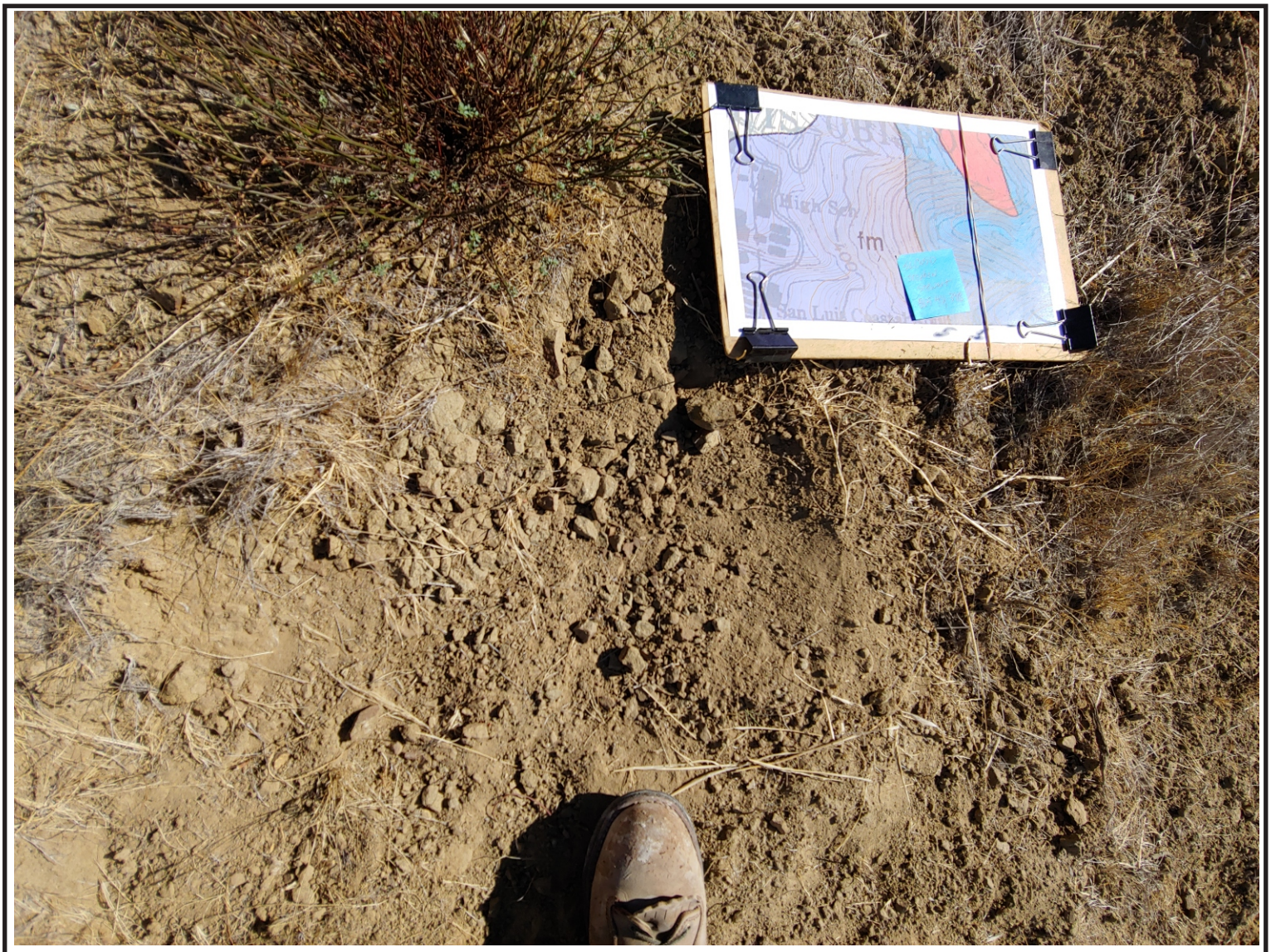

Photo No. 2: Graywacke sandstone outcrop on slope adjacent to Building 100. This outcrop is on the hillside where livestock have cleared a path.

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FIGURE 3
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Gra

Photo No. 3: Graywacke sandstone outcrop along cattle path.

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San Luis Obispo High School
Building 100

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FIGURE 4

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November 2018

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Photo No. 4: Graywacke sandstone exposed in access trail east of Building 100.

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FIGURE 5
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November 2018
Project No.
300933-005

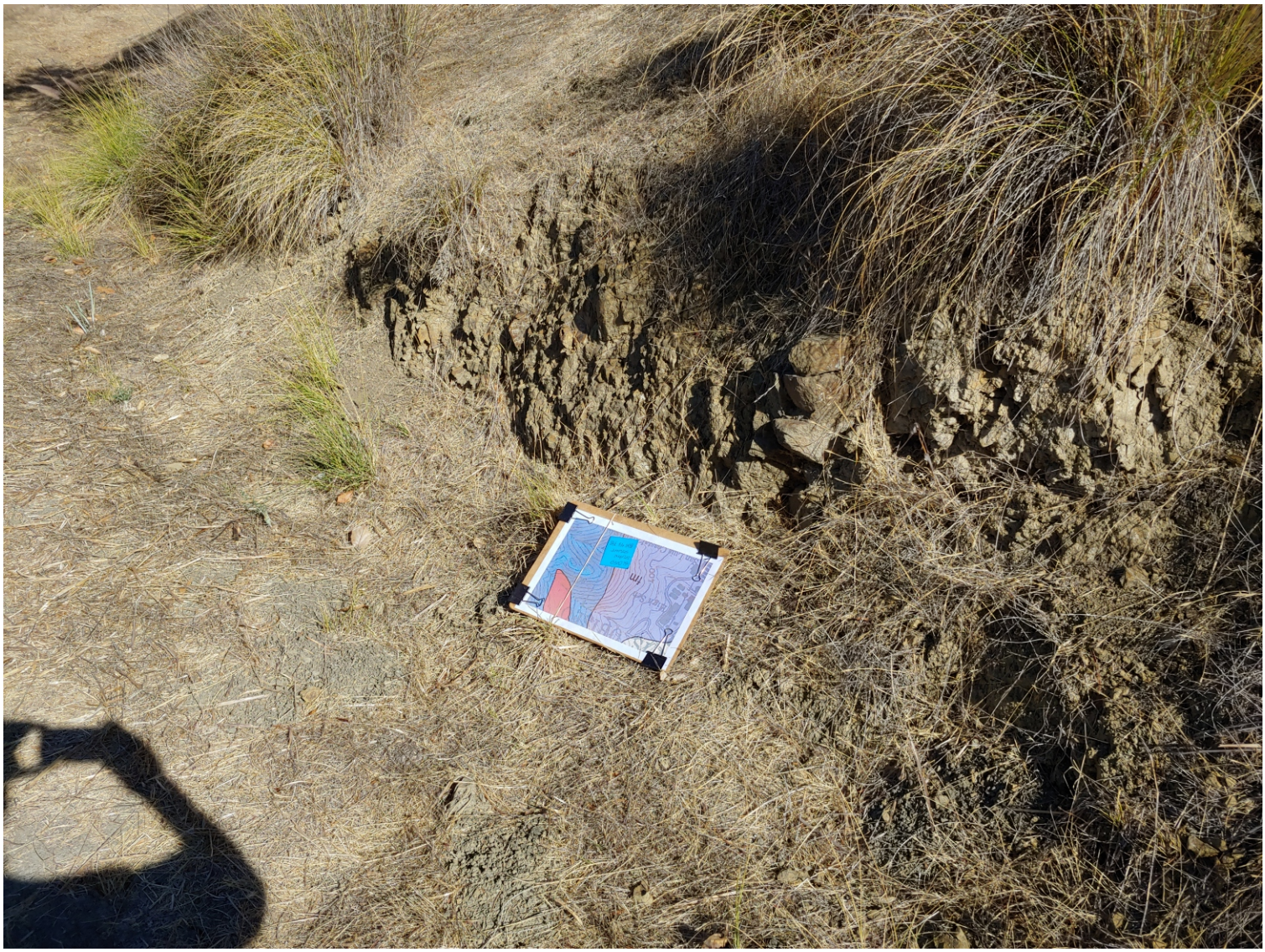

Photo No. 5: Graywacke sandstone outcrop on slope adjacent to Building 100. This outcrop is at a cut for a service road on the slope.

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San Luis Obispo, California

FIGURE 6
Date
November 2018
Project No.
300933-005



ESP File Photo

Photo No. 6: Graywacke sandstone exposed in a trench excavated for utilities at the toe of the slope of interest in 2018. The excavation is between Building 100 and the slope. The exposure supports our opinion that the rock quality improves rapidly with depth and the strength parameters used in our stability analysis are conservative. The rock strength and GSI estimated for our analysis are based on outcrop exposures on the hillside.

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San Luis Obispo High School
Building 100
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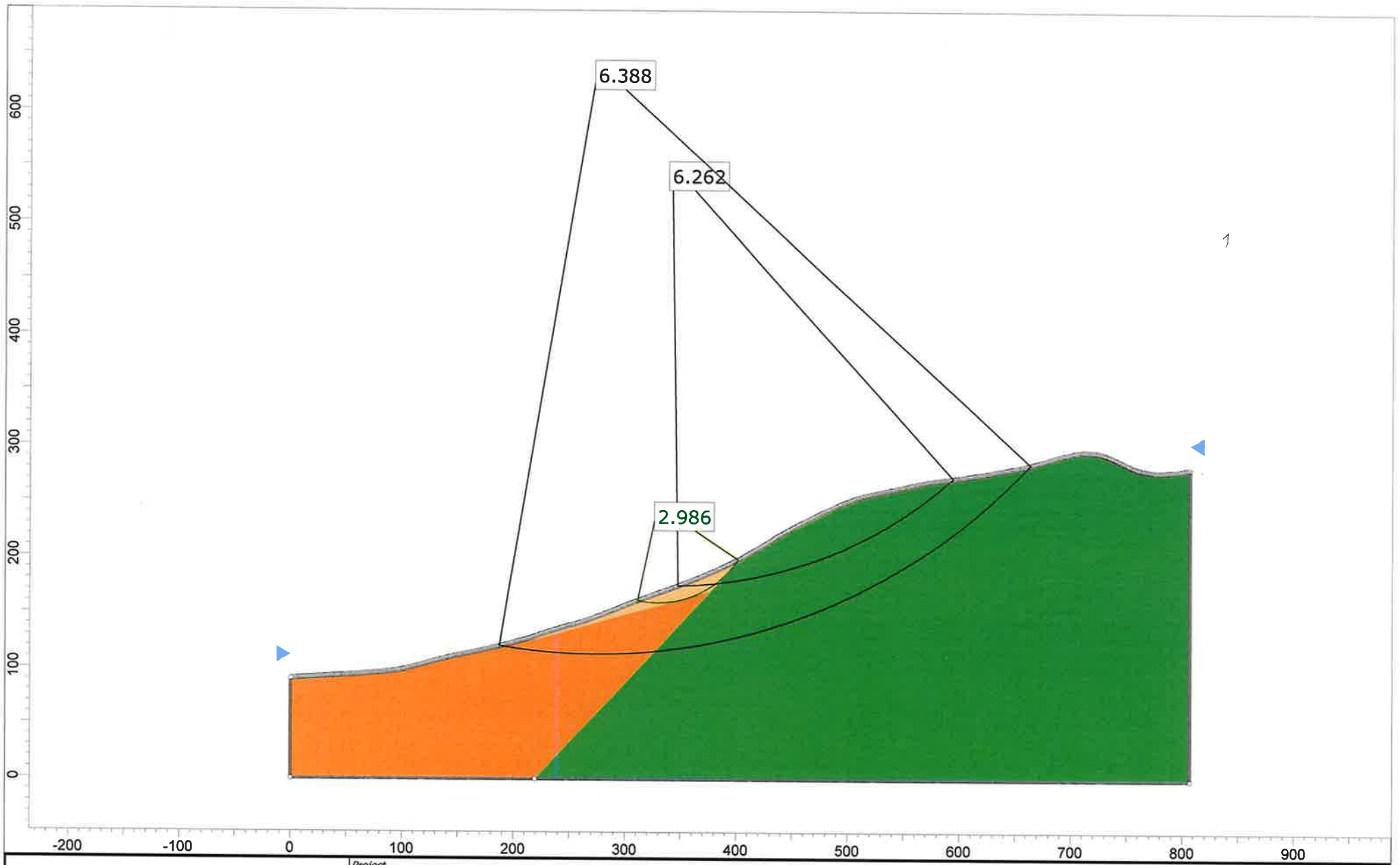
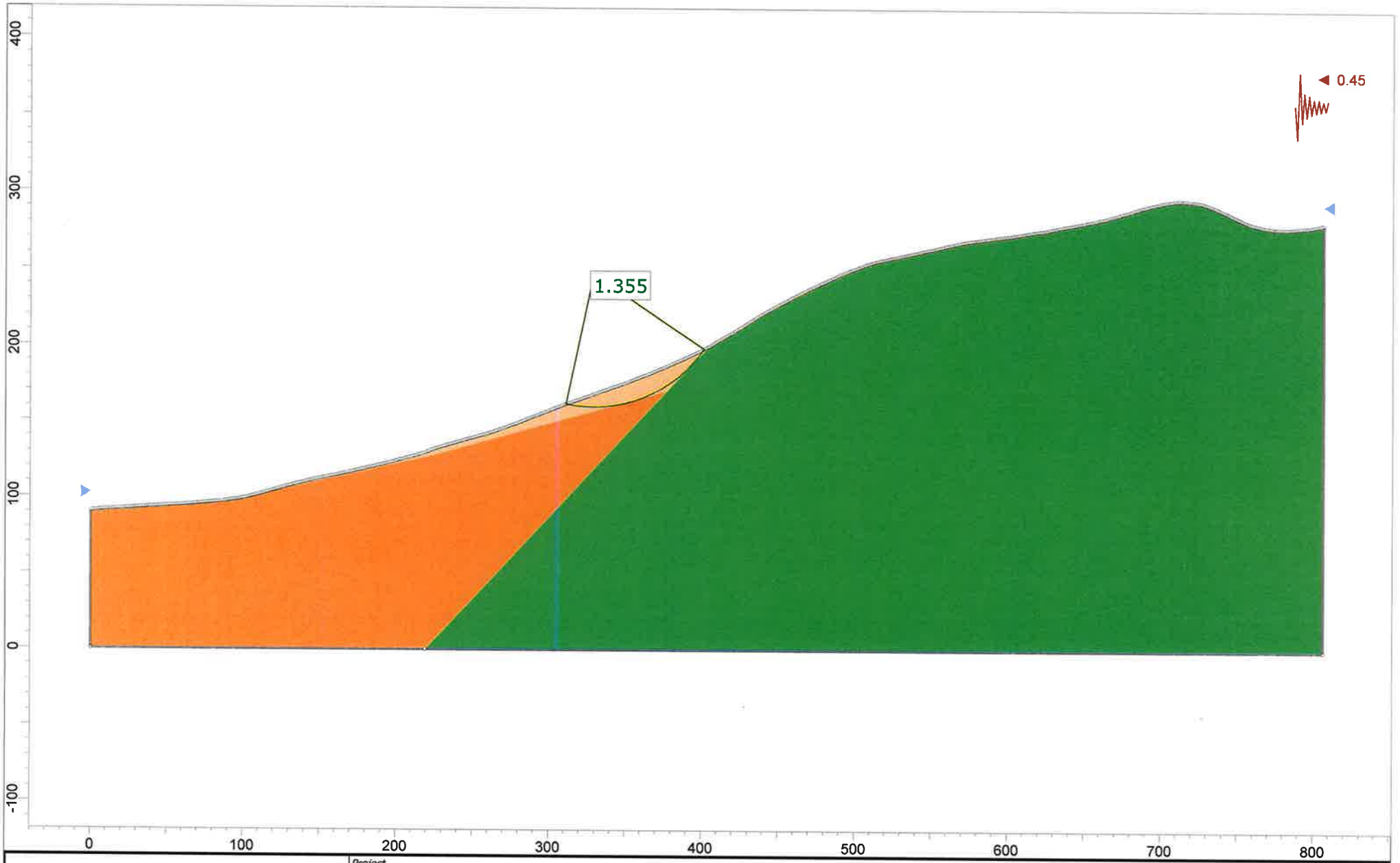
FIGURE 7
Date
November 2018
Project No.
300933-005



rocscience

SLIDEINTERPRET 8.018

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By		Scale 1:1425	Company
Date	11/15/2018, 11:42:25 AM		File Name Cross Section A.slmd



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SLIDEINTERPRET 8.018

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By		Scale 1:1038	Company
Date	11/15/2018, 11:42:25 AM		File Name Cross Section A.slmd

Slide Analysis Information

Cross Section A

Project Summary

File Name:	Cross Section A.slmd
Slide Modeler Version:	8.018
Compute Time:	00h:00m:27.576s
Project Title:	SLIDE - An Interactive Slope Stability Program
Date Created:	11/15/2018, 11:42:25 AM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical

Analysis Methods Used

	Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

Property	Serpentine	Graywacke	Weathered
Color			
Strength Type	Generalized Hoek-Brown	Generalized Hoek-Brown	Mohr-Coulomb
Unit Weight [lbs/ft3]	140	130	110
Cohesion [psf]			700
Friction Angle [°]			15
Unconfined Compressive Strength (intact) [psf]	800000	1e+06	
GSI	35	45	
mi	12	18	
Disturbance	0	0	
Water Surface	None	None	None
Ru Value	0	0	0

Global Minimums

Method: spencer

FS	2.985560
Center:	329.053, 246.896
Radius:	87.464
Left Slip Surface Endpoint:	311.111, 161.292
Right Slip Surface Endpoint:	401.611, 198.055
Resisting Moment:	8.53513e+06 lb-ft
Driving Moment:	2.8588e+06 lb-ft
Resisting Horizontal Force:	86302.9 lb
Driving Horizontal Force:	28906.8 lb
Total Slice Area:	880.844 ft2
Surface Horizontal Width:	90.4992 ft
Surface Average Height:	9.73317 ft

Valid/Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	10677
Number of Invalid Surfaces:	0

Slice Data

- **Global Minimum Query (spencer) - Safety Factor: 2.98556**

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.81426	91.4551	-11.2314	Weathered	700	15	249.646	745.332	169.182	0	169.182	119.609	119.609
2	1.81426	290.032	-10.0221	Weathered	700	15	259.715	775.394	281.376	0	281.376	235.478	235.478
3	1.81426	489.516	-8.81729	Weathered	700	15	269.683	805.155	392.444	0	392.444	350.612	350.612
4	1.81426	659.865	-7.6164	Weathered	700	15	277.962	829.871	484.685	0	484.685	447.516	447.516
5	1.81426	839.393	-6.41886	Weathered	700	15	286.604	855.674	580.986	0	580.986	548.743	548.743
6	1.81426	1014.09	-5.22413	Weathered	700	15	294.872	880.357	673.099	0	673.099	646.138	646.138
7	1.81426	1165.82	-4.03167	Weathered	700	15	301.832	901.138	750.659	0	750.659	729.385	729.385
8	1.81426	1322.22	-2.84097	Weathered	700	15	308.936	922.346	829.808	0	829.808	814.477	814.477
9	1.81426	1465.17	-1.65149	Weathered	700	15	315.252	941.204	900.186	0	900.186	891.096	891.096
10	1.81426	1598.43	-0.462718	Weathered	700	15	320.989	958.333	964.108	0	964.108	961.516	961.516
11	1.81426	1737.13	0.72585	Weathered	700	15	326.919	976.036	1030.18	0	1030.18	1034.32	1034.32
12	1.81426	1849.35	1.91473	Weathered	700	15	331.44	989.533	1080.55	0	1080.55	1091.63	1091.63
13	1.81426	1964.97	3.10444	Weathered	700	15	336.064	1003.34	1132.07	0	1132.07	1150.3	1150.3
14	1.81426	2080.61	4.29549	Weathered	700	15	340.62	1016.94	1182.84	0	1182.84	1208.42	1208.42
15	1.81426	2169.24	5.4884	Weathered	700	15	343.784	1026.39	1218.1	0	1218.1	1251.13	1251.13
16	1.81426	2266.35	6.6837	Weathered	700	15	347.31	1036.91	1257.38	0	1257.38	1298.08	1298.08
17	1.81426	2356.75	7.88194	Weathered	700	15	350.454	1046.3	1292.41	0	1292.41	1340.93	1340.93
18	1.81426	2431.09	9.08366	Weathered	700	15	352.773	1053.23	1318.26	0	1318.26	1374.66	1374.66
19	1.81426	2499.11	10.2894	Weathered	700	15	354.747	1059.12	1340.25	0	1340.25	1404.65	1404.65
20	1.81426	2563.49	11.4998	Weathered	700	15	356.506	1064.37	1359.85	0	1359.85	1432.38	1432.38
21	1.81426	2608.75	12.7154	Weathered	700	15	357.327	1066.82	1368.99	0	1368.99	1449.62	1449.62
22	1.81426	2660.81	13.9369	Weathered	700	15	358.434	1070.13	1381.33	0	1381.33	1470.28	1470.28
23	1.81426	2711.83	15.1649	Weathered	700	15	359.457	1073.18	1392.73	0	1392.73	1490.15	1490.15
24	1.81426	2755.98	16.4	Weathered	700	15	360.126	1075.18	1400.19	0	1400.19	1506.18	1506.18
25	1.81426	2800.83	17.643	Weathered	700	15	360.793	1077.17	1407.61	0	1407.61	1522.36	1522.36
26	1.81426	2824.58	18.8947	Weathered	700	15	360.465	1076.19	1403.97	0	1403.97	1527.34	1527.34
27	1.81426	2831.94	20.1558	Weathered	700	15	359.376	1072.94	1391.83	0	1391.83	1523.74	1523.74
28	1.81426	2832.12	21.4272	Weathered	700	15	357.95	1068.68	1375.93	0	1375.93	1516.41	1516.41
29	1.81426	2826.67	22.7098	Weathered	700	15	356.26	1063.63	1357.11	0	1357.11	1506.2	1506.2
30	1.81426	2806.06	24.0045	Weathered	700	15	353.891	1056.56	1330.71	0	1330.71	1488.3	1488.3
31	1.81426	2788.28	25.3124	Weathered	700	15	351.641	1049.84	1305.63	0	1305.63	1471.95	1471.95
32	1.81426	2773	26.6346	Weathered	700	15	349.489	1043.42	1281.66	0	1281.66	1456.93	1456.93
33	1.81426	2750.8	27.9722	Weathered	700	15	347.026	1036.07	1254.22	0	1254.22	1438.52	1438.52
34	1.81426	2711.67	29.3267	Weathered	700	15	343.833	1026.53	1218.64	0	1218.64	1411.8	1411.8
35	1.81426	2661.12	30.6994	Weathered	700	15	340.155	1015.55	1177.67	0	1177.67	1379.63	1379.63
36	1.81426	2602.01	32.092	Weathered	700	15	336.124	1003.52	1132.75	0	1132.75	1343.53	1343.53
37	1.81426	2531.56	33.5061	Weathered	700	15	331.631	990.104	1082.68	0	1082.68	1302.23	1302.23
38	1.81426	2443.3	34.9437	Weathered	700	15	326.421	974.549	1024.63	0	1024.63	1252.71	1252.71
39	1.81426	2333.36	36.407	Weathered	700	15	320.356	956.442	957.054	0	957.054	1193.3	1193.3
40	1.81426	2234.3	37.8985	Weathered	700	15	314.766	939.754	894.774	0	894.774	1139.8	1139.8
41	1.81426	2112.82	39.4208	Weathered	700	15	308.315	920.492	822.887	0	822.887	1076.33	1076.33
42	1.81426	1971.89	40.9772	Weathered	700	15	301.145	899.085	742.998	0	742.998	1004.57	1004.57
43	1.81426	1812.82	42.5713	Weathered	700	15	293.331	875.757	655.935	0	655.935	925.395	925.395
44	1.81426	1645.51	44.2073	Weathered	700	15	285.277	851.711	566.193	0	566.193	843.682	843.682
45	1.81426	1456.41	45.8901	Weathered	700	15	276.481	825.451	468.189	0	468.189	753.396	753.396
46	0.769891	552.877	47.1144	Weathered	700	15	269.579	804.845	391.288	0	391.288	681.536	681.536
47	2.02189	1252.3	48.4841	Weathered	700	15	261.694	781.304	303.43	0	303.43	599.056	599.056
48	2.02189	940.289	50.525	Weathered	700	15	249.698	745.489	169.769	0	169.769	472.947	472.947
49	2.02189	597.333	52.6586	Weathered	700	15	236.929	707.365	27.4862	0	27.4862	338.034	338.034

50	2.02189	207.525	54.9024	Weathered	700	15	223.038	665.893	-127.287	0	-127.287	190.092	190.092

Interslice Data

- **Global Minimum Query (spencer) - Safety Factor: 2.98556**

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	311.111	161.292	0	0	0
2	312.926	160.931	514.484	125.743	13.7342
3	314.74	160.611	1076.53	263.109	13.7341
4	316.554	160.329	1676.9	409.845	13.7342
5	318.368	160.087	2299.46	562.003	13.7342
6	320.183	159.883	2938.72	718.242	13.7342
7	321.997	159.717	3586.07	876.458	13.7342
8	323.811	159.589	4230.4	1033.94	13.7343
9	325.625	159.499	4866.36	1189.37	13.7342
10	327.44	159.447	5486.16	1340.85	13.7342
11	329.254	159.432	6083.43	1486.83	13.7342
12	331.068	159.455	6653.67	1626.2	13.7342
13	332.883	159.516	7190.26	1757.34	13.7342
14	334.697	159.614	7689.4	1879.34	13.7342
15	336.511	159.75	8147.01	1991.18	13.7342
16	338.325	159.925	8559.23	2091.93	13.7342
17	340.14	160.137	8922.86	2180.8	13.7342
18	341.954	160.388	9234.92	2257.07	13.7342
19	343.768	160.678	9493.43	2320.25	13.7342
20	345.582	161.008	9696.47	2369.88	13.7342
21	347.397	161.377	9842.21	2405.5	13.7342
22	349.211	161.786	9930.93	2427.18	13.7342
23	351.025	162.237	9960.19	2434.33	13.7342
24	352.839	162.728	9928.38	2426.56	13.7342
25	354.654	163.262	9834.97	2403.73	13.7342
26	356.468	163.839	9678.21	2365.41	13.7342
27	358.282	164.46	9461.24	2312.39	13.7342
28	360.096	165.126	9187.26	2245.42	13.7342
29	361.911	165.838	8857.89	2164.92	13.7342
30	363.725	166.597	8474.68	2071.26	13.7342
31	365.539	167.405	8042.47	1965.63	13.7342
32	367.353	168.263	7560.97	1847.95	13.7342
33	369.168	169.173	7029.72	1718.11	13.7342
34	370.982	170.137	6451.69	1576.83	13.7342
35	372.796	171.156	5834.26	1425.93	13.7342
36	374.61	172.233	5183.64	1266.91	13.7342
37	376.425	173.371	4505.52	1101.18	13.7342
38	378.239	174.572	3807.58	930.595	13.7342
39	380.053	175.84	3101.66	758.065	13.7342
40	381.868	177.178	2403.18	587.351	13.7342
41	383.682	178.59	1711.34	418.261	13.7342
42	385.496	180.081	1044.23	255.217	13.7342
43	387.31	181.657	420.477	102.767	13.7342
44	389.125	183.324	-139.824	-34.1739	13.7342
45	390.939	185.089	-620.742	-151.713	13.7342
46	392.753	186.96	-994.681	-243.106	13.7342
47	393.523	187.789	-1111.2	-271.584	13.7342
48	395.545	190.073	-1274.42	-311.476	13.7342
49	397.567	192.528	-1185.65	-289.78	13.7342
50	399.589	195.178	-778.802	-190.344	13.7342

51	401.611	198.055	0	0	0

Entity Information

Group: Group 1

Shared Entities

Type	Coordinates	
External Boundary	X	Y
	0	0
	219.106	0
	806.5	0
	806.5	280.5
	805.7	280.4
	804.9	280.2
	804.1	280.1
	803.3	279.9
	802.5	279.8
	801.7	279.6
	800.9	279.5
	800.2	279.3
	799.4	279.2
	798.6	279
	797.8	278.9
	797	278.8
	796.2	278.7
	795.4	278.6
	794.6	278.6
	793.9	278.5
	793.1	278.4
	792.3	278.4
	791.5	278.3
	790.7	278.2
	789.9	278.2
	789.1	278.1
	788.3	278
	787.5	277.9
	786.8	277.8
	786	277.8
	785.2	277.7
	784.4	277.6
	783.6	277.6
	782.8	277.5
	782	277.4
	781.2	277.4
	780.5	277.4
	779.7	277.5
	778.9	277.5
	778.1	277.5
	777.3	277.6
	776.5	277.6
	775.7	277.7
	774.9	277.7
	774.1	277.7
	773.4	277.8
	772.6	278
	771.8	278.1
	771	278.2
	770.2	278.3

		769.4	278.5		
		768.6	278.6		
		767.8	278.7		
		767.1	278.8		
		766.3	279		
		765.5	279.1		
		764.7	279.3		
		763.9	279.5		
		763.1	279.7		
		762.3	279.9		
		761.5	280.1		
		760.7	280.3		
		760	280.5		
		759.2	280.7		
		758.4	280.9		
		757.6	281.2		
		756.8	281.5		
		756	281.9		
		755.2	282.2		
		754.4	282.5		
		753.6	282.9		
		752.9	283.2		
		752.1	283.5		
		751.3	283.9		
		750.5	284.2		
		749.7	284.6		
		748.9	285		
		748.1	285.3		
		747.3	285.7		
		746.6	286.1		
		745.8	286.5		
		745	286.8		
		744.2	287.2		
		743.4	287.6		
		742.6	288		
		741.8	288.4		
		741	288.7		
		740.2	289.1		
		739.5	289.4		
		738.7	289.8		
		737.9	290.1		
		737.1	290.5		
		736.3	290.8		
		735.5	291.2		
		734.7	291.6		
		733.9	291.8		
		733.2	292.1		
		732.4	292.4		
		731.6	292.7		
		730.8	292.9		
		730	293.2		
		729.2	293.5		

		728.4	293.7	
		727.6	294	
		726.8	294.3	
		726.1	294.4	
		725.3	294.6	
		724.5	294.7	
		723.7	294.9	
		722.9	295	
		722.1	295.1	
		721.3	295.2	
		720.5	295.3	
		719.8	295.4	
		719	295.5	
		718.2	295.6	
		717.4	295.6	
		716.6	295.6	
		715.8	295.7	
		715	295.7	
		714.2	295.7	
		713.4	295.7	
		712.7	295.8	
		711.9	295.8	
		711.1	295.8	
		710.3	295.7	
		709.5	295.6	
		708.7	295.5	
		707.9	295.4	
		707.1	295.3	
		706.3	295.2	
		705.6	295.1	
		704.8	295	
		704	294.9	
		703.2	294.8	
		702.4	294.6	
		701.6	294.4	
		700.8	294.3	
		700	294.1	
		699.3	293.9	
		698.5	293.7	
		697.7	293.6	
		696.9	293.4	
		696.1	293.2	
		695.3	293	
		694.5	292.8	
		693.7	292.7	
		692.9	292.5	
		692.2	292.3	
		691.4	292.1	
		690.6	291.9	
		689.8	291.7	
		689	291.5	
		688.2	291.3	

687.4	291.1
686.6	290.9
685.9	290.6
685.1	290.3
684.3	290.1
683.5	289.8
682.7	289.6
681.9	289.3
681.1	289
680.3	288.8
679.5	288.5
678.8	288.3
678	288.1
677.2	287.9
676.4	287.6
675.6	287.4
674.8	287.2
674	287
673.2	286.8
672.5	286.5
671.7	286.3
670.9	286.1
670.1	285.8
669.3	285.6
668.5	285.4
667.7	285.1
666.9	284.9
666.1	284.7
665.4	284.4
664.6	284.2
663.8	284
663	283.8
662.2	283.6
661.4	283.4
660.6	283.3
659.8	283.1
659	282.9
658.3	282.7
657.5	282.5
656.7	282.4
655.9	282.2
655.1	282
654.3	281.9
653.5	281.7
652.7	281.6
652	281.4
651.2	281.3
650.4	281.1
649.6	280.9
648.8	280.8
648	280.6
647.2	280.5

		646.4	280.3		
		645.6	280.2		
		644.9	280		
		644.1	279.9		
		643.3	279.7		
		642.5	279.6		
		641.7	279.4		
		640.9	279.3		
		640.1	279.1		
		639.3	279		
		638.6	278.9		
		637.8	278.7		
		637	278.6		
		636.2	278.4		
		635.4	278.3		
		634.6	278.2		
		633.8	278		
		633	277.9		
		632.2	277.7		
		631.5	277.5		
		630.7	277.4		
		629.9	277.2		
		629.1	277		
		628.3	276.8		
		627.5	276.6		
		626.7	276.5		
		625.9	276.3		
		625.2	276.1		
		624.4	275.9		
		623.6	275.8		
		622.8	275.7		
		622	275.6		
		621.2	275.5		
		620.4	275.4		
		619.6	275.3		
		618.8	275.2		
		618.1	275.1		
		617.3	275		
		616.5	274.9		
		615.7	274.8		
		614.9	274.6		
		614.1	274.5		
		613.3	274.4		
		612.5	274.2		
		611.7	274.1		
		611	273.9		
		610.2	273.8		
		609.4	273.7		
		608.6	273.5		
		607.8	273.4		
		607	273.3		
		606.2	273.1		

605.4	273
604.7	272.9
603.9	272.8
603.1	272.6
602.3	272.5
601.5	272.4
600.7	272.3
599.9	272.2
599.1	272.1
598.3	272
597.6	271.9
596.8	271.8
596	271.7
595.2	271.6
594.4	271.5
593.6	271.4
592.8	271.3
592	271.2
591.3	271.1
590.5	271
589.7	270.8
588.9	270.7
588.1	270.6
587.3	270.5
586.5	270.4
585.7	270.3
584.9	270.2
584.2	270.1
583.4	270
582.6	269.9
581.8	269.8
581	269.7
580.2	269.6
579.4	269.5
578.6	269.4
577.9	269.3
577.1	269.2
576.3	269
575.5	268.9
574.7	268.8
573.9	268.7
573.1	268.6
572.3	268.5
571.5	268.3
570.8	268.2
570	268.1
569.2	267.9
568.4	267.8
567.6	267.6
566.8	267.4
566	267.2
565.2	267.1

		564.4	266.9	
		563.7	266.7	
		562.9	266.5	
		562.1	266.4	
		561.3	266.2	
		560.5	266	
		559.7	265.8	
		558.9	265.6	
		558.1	265.4	
		557.4	265.2	
		556.6	265	
		555.8	264.9	
		555	264.7	
		554.2	264.5	
		553.4	264.3	
		552.6	264.1	
		551.8	264	
		551	263.8	
		550.3	263.6	
		549.5	263.4	
		548.7	263.3	
		547.9	263.1	
		547.1	262.9	
		546.3	262.7	
		545.5	262.6	
		544.7	262.4	
		544	262.2	
		543.2	262	
		542.4	261.8	
		541.6	261.7	
		540.8	261.5	
		540	261.3	
		539.2	261.1	
		538.4	261	
		537.6	260.8	
		536.9	260.6	
		536.1	260.4	
		535.3	260.3	
		534.5	260.1	
		533.7	259.9	
		532.9	259.8	
		532.1	259.6	
		531.3	259.4	
		530.6	259.2	
		529.8	259.1	
		529	258.9	
		528.2	258.7	
		527.4	258.6	
		526.6	258.4	
		525.8	258.2	
		525	258.1	
		524.2	257.9	

523.5	257.7
522.7	257.6
521.9	257.4
521.1	257.2
520.3	257
519.5	256.9
518.7	256.7
517.9	256.5
517.1	256.4
516.4	256.2
515.6	256
514.8	255.8
514	255.6
513.2	255.4
512.4	255.1
511.6	254.9
510.8	254.6
510.1	254.4
509.3	254.1
508.5	253.9
507.7	253.7
506.9	253.4
506.1	253.1
505.3	252.8
504.5	252.5
503.7	252.2
503	251.9
502.2	251.6
501.4	251.3
500.6	251
499.8	250.7
499	250.4
498.2	250.1
497.4	249.8
496.7	249.5
495.9	249.2
495.1	248.8
494.3	248.5
493.5	248.2
492.7	247.9
491.9	247.6
491.1	247.3
490.3	246.9
489.6	246.5
488.8	246.2
488	245.8
487.2	245.4
486.4	245
485.6	244.7
484.8	244.3
484	243.9
483.3	243.6

482.5	243.2
481.7	242.8
480.9	242.5
480.1	242.1
479.3	241.7
478.5	241.4
477.7	241
476.9	240.6
476.2	240.3
475.4	239.9
474.6	239.5
473.8	239.1
473	238.7
472.2	238.3
471.4	238
470.6	237.6
469.8	237.2
469.1	236.8
468.3	236.4
467.5	236
466.7	235.6
465.9	235.2
465.1	234.8
464.3	234.4
463.5	234
462.8	233.6
462	233.2
461.2	232.8
460.4	232.4
459.6	232
458.8	231.6
458	231.2
457.2	230.7
456.4	230.3
455.7	229.9
454.9	229.5
454.1	229.1
453.3	228.7
452.5	228.3
451.7	227.8
450.9	227.4
450.1	227
449.4	226.5
448.6	226.1
447.8	225.7
447	225.2
446.2	224.8
445.4	224.4
444.6	223.9
443.8	223.5
443	223
442.3	222.6

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		440.7	221.7	
		439.9	221.3	
		439.1	220.8	
		438.3	220.4	
		437.5	219.9	
		436.7	219.5	
		436	219	
		435.2	218.5	
		434.4	217.9	
		433.6	217.4	
		432.8	216.9	
		432	216.4	
		431.2	215.8	
		430.4	215.3	
		429.6	214.8	
		428.9	214.3	
		428.1	213.8	
		427.3	213.3	
		426.5	212.8	
		425.7	212.3	
		424.9	211.8	
		424.1	211.3	
		423.3	210.8	
		422.5	210.4	
		421.8	209.9	
		421	209.4	
		420.2	208.9	
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		418.6	208	
		417.8	207.6	
		417	207.1	
		416.2	206.7	
		415.5	206.2	
		414.7	205.8	
		413.9	205.3	
		413.1	204.9	
		412.3	204.4	
		411.5	203.9	
		410.7	203.4	
		409.9	202.9	
		409.1	202.4	
		408.4	201.9	
		407.6	201.5	
		406.8	201	
		406	200.5	
		405.2	200	
		404.4	199.5	
		403.6	199.1	
		402.8	198.7	
		402.1	198.3	
		401.3	197.9	

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		399.7	197.1		
		398.9	196.7		
		398.1	196.3		
		397.3	195.9		
		396.5	195.5		
		395.7	195.1		
		395	194.8		
		394.2	194.4		
		393.4	194		
		392.6	193.7		
		391.8	193.3		
		391	192.9		
		390.2	192.5		
		389.4	192.2		
		388.7	191.8		
		387.9	191.4		
		387.1	191.1		
		386.3	190.7		
		385.5	190.3		
		384.7	190		
		383.9	189.6		
		383.1	189.2		
		382.3	188.9		
		381.6	188.5		
		380.8	188.1		
		380	187.8		
		379.2	187.5		
		378.4	187.1		
		377.6	186.8		
		376.8	186.4		
		376	186.1		
		375.3	185.7		
		374.5	185.4		
		373.7	185		
		372.9	184.7		
		372.1	184.3		
		371.3	184		
		370.5	183.6		
		369.7	183.3		
		368.9	182.9		
		368.2	182.6		
		367.4	182.2		
		366.6	181.9		
		365.8	181.5		
		365	181.2		
		364.2	180.9		
		363.4	180.6		
		362.6	180.3		
		361.8	180		
		361.1	179.7		
		360.3	179.4		

		359.5	179.1		
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		357.9	178.5		
		357.1	178.2		
		356.3	177.9		
		355.5	177.6		
		354.8	177.2		
		354	176.9		
		353.2	176.6		
		352.4	176.3		
		351.6	175.9		
		350.8	175.6		
		350	175.3		
		349.2	175		
		348.4	174.7		
		347.7	174.4		
		346.9	174.2		
		346.1	173.9		
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		343.7	173		
		342.9	172.7		
		342.1	172.5		
		341.4	172.2		
		340.6	171.9		
		339.8	171.6		
		339	171.3		
		338.2	171		
		337.4	170.7		
		336.6	170.4		
		335.8	170.2		
		335	169.9		
		334.3	169.6		
		333.5	169.3		
		332.7	169		
		331.9	168.7		
		331.1	168.5		
		330.3	168.2		
		329.5	167.9		
		328.7	167.6		
		328	167.3		
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		326.4	166.8		
		325.6	166.5		
		324.8	166.2		
		324	165.9		
		323.2	165.6		
		322.4	165.3		
		321.6	165.1		
		320.9	164.8		
		320.1	164.5		
		319.3	164.2		

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		317.7	163.6	
		316.9	163.3	
		316.1	163.1	
		315.3	162.8	
		314.5	162.5	
		313.8	162.2	
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		309	160.5	
		308.2	160.2	
		307.5	159.9	
		306.7	159.6	
		305.9	159.3	
		305.1	159	
		304.3	158.7	
		303.5	158.4	
		302.7	158.1	
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		301.1	157.4	
		300.4	157.1	
		299.6	156.8	
		298.8	156.5	
		298	156.1	
		297.2	155.8	
		296.4	155.5	
		295.6	155.2	
		294.8	154.8	
		294.1	154.5	
		293.3	154.2	
		292.5	153.9	
		291.7	153.6	
		290.9	153.3	
		290.1	153	
		289.3	152.7	
		288.5	152.3	
		287.7	152	
		287	151.7	
		286.2	151.4	
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		284.6	150.8	
		283.8	150.4	
		283	150.1	
		282.2	149.8	
		281.4	149.5	
		280.7	149.1	
		279.9	148.8	
		279.1	148.5	
		278.3	148.2	

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276.7	147.6
275.9	147.4
275.1	147.1
274.3	146.8
273.6	146.5
272.8	146.2
272	145.9
271.2	145.6
270.4	145.4
269.6	145.1
268.8	144.8
268	144.5
267.2	144.2
266.5	143.9
265.7	143.7
264.9	143.4
264.1	143.1
263.3	142.8
262.5	142.6
261.7	142.3
260.9	142.1
260.2	141.8
259.4	141.6
258.6	141.4
257.8	141.1
257	140.9
256.2	140.6
255.4	140.4
254.6	140.2
253.8	140
253.1	139.8
252.3	139.5
251.5	139.3
250.7	139.1
249.9	138.9
249.1	138.7
248.3	138.5
247.5	138.3
246.8	138.1
246	137.8
245.2	137.6
244.4	137.4
243.6	137.1
242.8	136.9
242	136.6
241.2	136.4
240.4	136.2
239.7	135.9
238.9	135.7
238.1	135.5
237.3	135.2

236.5	135
235.7	134.8
234.9	134.6
234.1	134.3
233.4	134.1
232.6	133.9
231.8	133.6
231	133.4
230.2	133.2
229.4	132.9
228.6	132.7
227.8	132.4
227	132.2
226.3	131.9
225.5	131.7
224.7	131.4
223.9	131.2
223.1	130.8
222.3	130.5
221.5	130.2
220.7	129.9
219.9	129.6
219.2	129.3
218.4	129
217.6	128.7
216.8	128.4
216	128.2
215.2	127.9
214.4	127.7
213.6	127.5
212.9	127.3
212.1	127
211.3	126.8
210.5	126.6
209.7	126.3
208.9	126.1
208.1	125.9
207.3	125.7
206.5	125.5
205.8	125.3
205	125.1
204.2	124.9
203.4	124.7
202.6	124.5
201.8	124.3
201	124
200.2	123.8
199.5	123.6
198.7	123.4
197.9	123.2
197.1	123
196.3	122.7

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		194.7	122.3		
		193.9	122.1		
		193.1	121.9		
		192.4	121.7		
		191.6	121.5		
		190.8	121.3		
		190	121.1		
		189.2	120.9		
		188.4	120.8		
		187.6	120.6		
		186.8	120.4		
		186.1	120.2		
		185.3	120		
		184.5	119.8		
		183.7	119.6		
		182.9	119.4		
		182.1	119.3		
		181.3	119.1		
		180.5	118.9		
		179.7	118.7		
		179	118.5		
		178.2	118.3		
		177.4	118.1		
		176.6	117.9		
		175.8	117.7		
		175	117.6		
		174.2	117.4		
		173.4	117.2		
		172.6	117		
		171.9	116.8		
		171.1	116.6		
		170.3	116.5		
		169.5	116.3		
		168.7	116.1		
		167.9	115.9		
		167.1	115.8		
		166.3	115.6		
		165.6	115.4		
		164.8	115.2		
		164	115		
		163.2	114.9		
		162.4	114.7		
		161.6	114.5		
		160.8	114.3		
		160	114.2		
		159.2	114		
		158.5	113.9		
		157.7	113.7		
		156.9	113.5		
		156.1	113.4		
		155.3	113.2		

		154.5	113		
		153.7	112.9		
		152.9	112.7		
		152.2	112.5		
		151.4	112.4		
		150.6	112.2		
		149.8	112.1		
		149	111.9		
		148.2	111.7		
		147.4	111.6		
		146.6	111.4		
		145.8	111.2		
		145.1	111		
		144.3	110.8		
		143.5	110.6		
		142.7	110.4		
		141.9	110.2		
		141.1	110		
		140.3	109.8		
		139.5	109.6		
		138.8	109.4		
		138	109.2		
		137.2	109		
		136.4	108.8		
		135.6	108.6		
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		133.2	108.1		
		132.4	107.9		
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		130.9	107.5		
		130.1	107.3		
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		127.7	106.6		
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		125.3	106		
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		122.2	105		
		121.4	104.8		
		120.6	104.6		
		119.8	104.4		
		119	104.1		
		118.3	103.9		
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		116.7	103.5		
		115.9	103.2		
		115.1	103		
		114.3	102.8		

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		111.9	102.1		
		111.2	101.9		
		110.4	101.7		
		109.6	101.4		
		108.8	101.2		
		108	101		
		107.2	100.8		
		106.4	100.6		
		105.6	100.4		
		104.9	100.2		
		104.1	100		
		103.3	99.9		
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		101.7	99.5		
		100.9	99.3		
		100.1	99.1		
		99.3	99		
		98.5	98.8		
		97.8	98.7		
		97	98.6		
		96.2	98.4		
		95.4	98.3		
		94.6	98.2		
		93.8	98.1		
		93	97.9		
		92.2	97.8		
		91.4	97.7		
		90.7	97.6		
		89.9	97.5		
		89.1	97.4		
		88.3	97.3		
		87.5	97.2		
		86.7	97.1		
		85.9	97		
		85.1	96.9		
		84.4	96.8		
		83.6	96.7		
		82.8	96.7		
		82	96.6		
		81.2	96.5		
		80.4	96.5		
		79.6	96.4		
		78.8	96.3		
		78	96.2		
		77.3	96.2		
		76.5	96.1		
		75.7	96		
		74.9	96		
		74.1	95.9		
		73.3	95.8		

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		71.7	95.7		
		71	95.6		
		70.2	95.5		
		69.4	95.4		
		68.6	95.4		
		67.8	95.3		
		67	95.2		
		66.2	95.2		
		65.4	95.1		
		64.6	95		
		63.9	95		
		63.1	94.9		
		62.3	94.8		
		61.5	94.8		
		60.7	94.7		
		59.9	94.6		
		59.1	94.6		
		58.3	94.5		
		57.5	94.5		
		56.8	94.5		
		56	94.4		
		55.2	94.4		
		54.4	94.3		
		53.6	94.3		
		52.8	94.3		
		52	94.2		
		51.2	94.2		
		50.5	94.1		
		49.7	94		
		48.9	94		
		48.1	93.9		
		47.3	93.9		
		46.5	93.8		
		45.7	93.7		
		44.9	93.7		
		44.1	93.6		
		43.4	93.6		
		42.6	93.5		
		41.8	93.5		
		41	93.4		
		40.2	93.4		
		39.4	93.4		
		38.6	93.3		
		37.8	93.3		
		37.1	93.3		
		36.3	93.2		
		35.5	93.2		
		34.7	93.1		
		33.9	93		
		33.1	93		
		32.3	92.9		

31.5	92.9
30.7	92.8
30	92.8
29.2	92.7
28.4	92.6
27.6	92.6
26.8	92.5
26	92.5
25.2	92.4
24.4	92.4
23.7	92.3
22.9	92.3
22.1	92.2
21.3	92.2
20.5	92.1
19.7	92.1
18.9	92
18.1	92
17.3	91.9
16.6	91.9
15.8	91.9
15	91.8
14.2	91.8
13.4	91.7
12.6	91.7
11.8	91.6
11	91.6
10.2	91.5
9.5	91.5
8.7	91.4
7.9	91.4
7.1	91.3
6.3	91.2
5.5	91.2
4.7	91.1
3.9	91.1
3.2	91
2.4	90.9
1.6	90.9
0.8	90.8
0	90.7

Material Boundary

X	Y
219.106	0
376.303	169.248
391.064	185.142
404.4	199.5

Material Boundary

X	Y
105.6	100.4
224.858	127.012
376.303	169.248



APPENDIX D

Soil Corrosivity Study by HDR, Inc., dated May 27, 2025

May 27, 2025 via email: nzoetewey@earthsystems.com

Earth Systems
4378 Old Santa Fe Road
San Luis Obispo, CA, 93401
Attention: Nick Zoetewey

Re: Soil Corrosivity Study
San Luis Obispo High School Relocation of Modular Restroom
San Luis Obispo, CA
HDR #25-0233SCS, Earth Systems #300933-027

Introduction

Laboratory tests have been completed on one soil sample provided to HDR for the San Luis Obispo High School Relocation of Modular Restroom project. The purpose of these tests was to determine whether the soil is likely to have deleterious effects on underground utility piping and concrete structures. HDR assumes that the sample provided is representative of the most corrosive soils at the site.

The proposed structure has one story and no subterranean levels. The site is located at 1500 Lizzie Street in San Luis Obispo, California, and the water table is reportedly greater than 50 feet deep.

The scope of this study is limited to a determination of soil corrosivity and general corrosion control recommendations for materials likely to be used for construction. HDR's recommendations do not constitute, and are not meant as a substitute for, design documents for the purpose of construction. If the architects and/or engineers desire more specific information, designs, specifications, or review of design, HDR will be happy to work with them as a separate phase of this project.

Soil Corrosivity Testing

Laboratory Testing

The electrical resistivity of the sample was measured in a soil box per *ASTM International (ASTM)* G187 in its as-received condition and again after saturation with distilled water. Resistivities are at about their lowest value when the soil is saturated. The pH of the saturated sample was measured per ASTM G51. A 5:1 water:soil extract from the sample was chemically analyzed for the major soluble salts commonly found in soil per ASTM D4327, ASTM D6919, and *American Water Works Association (AWWA*) Standard Method 2320-B.

The laboratory analyses were performed under HDR laboratory number 25-0233SCS. The full set of test results are shown in the attached Table A1.

Discussion

A major factor in determining soil corrosivity is electrical resistivity. The electrical resistivity of a soil is a measure of its resistance to the flow of electrical current. Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of electrical current (DC) from the metal into the soil. Corrosion currents, following Ohm's Law, are inversely proportional to soil resistivity. Lower electrical resistivities result from higher moisture and soluble salt contents and indicate corrosive soil. A correlation between electrical resistivity and corrosivity toward ferrous metals is shown in Table 1.[1]

Table 1: Soil Corrosivity Categories

Soil Resistivity (ohm-cm)	Corrosivity Category
Greater than 10,000	Mildly Corrosive
2,001 to 10,000	Moderately Corrosive
1,001 to 2,000	Corrosive
0 to 1,000	Severely Corrosive

Other soil characteristics that may influence corrosivity towards metals are pH, soluble salt content, soil types, aeration, anaerobic conditions, and site drainage.

The electrical resistivity was in the moderately corrosive category with as-received moisture. When saturated, the resistivity was in the corrosive category.

The soil pH value is 7.1. This value is neutral.[2] This value does not particularly increase soil corrosivity.

The soluble salt content of the sample was low.

Per ACI-318, the soil is classified as negligible (S0) with respect to sulfate concentration.[3]

Nitrate was detected in low concentration. Ammonium was not detected.

Tests were not made for sulfide and oxidation-reduction (redox) potential because these samples did not exhibit characteristics typically associated with anaerobic conditions.

In conclusion, this soil is classified as corrosive to ferrous metals and negligible (S0) for sulfate attack on concrete.

Corrosion Control Recommendations

The life of buried materials depends on thickness, strength, loads, construction details, soil moisture, etc., in addition to soil corrosivity, and is, therefore, difficult to predict. Of more practical value are corrosion control methods that will increase the life of materials that would be subject to significant corrosion. The following recommendations are based on the evaluation of

[1] Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, pp. 166–167.
[2] Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, p. 8.
[3] American Concrete Institute (ACI) 318-19 Table 19.3.1.1.

soil corrosivity described above. Unless otherwise indicated, these recommendations apply to the entire site or alignment.

All Pipe

1. On all pipes, appurtenances, and fittings not protected by cathodic protection, coat bare metal such as valves, bolts, flange joints, joint harnesses, and flexible couplings with wax tape per AWWA C217 after assembly.

2. Where metallic pipelines penetrate concrete structures such as building floors, vault walls, and thrust blocks use plastic sleeves, rubber seals, or other dielectric material to prevent pipe contact with the concrete and reinforcing steel.

3. To prevent differential aeration corrosion cells, provide at least 2 inches of pipe bedding or backfill material all around metallic piping, including the bottom. Do not lay pipe directly on undisturbed soil.

Steel Pipe

1. Underground steel pipe with rubber gasketed, mechanical, grooved end, or other nonconductive type joints should be bonded for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.

2. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:

    a. At each end of the pipeline.

    b. At each end of all casings.

    c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.

3. To prevent dissimilar metal corrosion cells and to facilitate the application of cathodic protection, electrically isolate each buried steel pipeline per NACE SP0286 from:

    a. Dissimilar metals.

    b. Dissimilarly coated piping (cement-mortar vs. dielectric).

    c. Above ground steel pipe.

    d. All existing piping.

4. Choose one of the following corrosion control options:

    OPTION 1

    a. Apply a suitable dielectric coating intended for underground use such as:

i. Polyurethane per AWWA C222 *or*

ii. Extruded polyethylene per AWWA C215 *or*

iii. A tape coating system per AWWA C214 *or*

iv. Hot applied coal tar enamel per AWWA C203 *or*

v. Fusion bonded epoxy per AWWA C213.

b. Apply cathodic protection to steel piping as per NACE SP0169.

OPTION 2

a. As an alternative to the coating systems described in Option 1 and cathodic protection, apply a ¾-inch cement mortar coating per AWWA C205 or encase all buried portions of metallic piping so that there is a minimum of 3 inches of concrete cover provided over and around surfaces of pipe, fittings, and valves using any type of ASTM C150 cement. Install joint bonds, test stations, and insulated joints to provide for corrosion monitoring and/or the future application of cathodic protection if needed.

NOTE: Some steel piping systems, such as oil, gas, insulated, or high-pressure piping systems, have special corrosion and cathodic protection requirements that must be evaluated for each specific application.

Ductile Iron Pipe

1. To prevent dissimilar metal corrosion cells and to facilitate the application of cathodic protection, electrically insulate underground iron pipe from dissimilar metals and from above ground iron pipe with insulating joints per NACE SP0286.

2. Bond all nonconductive type joints for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.

3. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:

    a. At each end of the pipeline.

    b. At each end of any casings.

    c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.

4. Choose one of the following corrosion control options:

    OPTION 1

    a. Apply a suitable coating intended for underground use such as:

i. Polyethylene encasement per AWWA C105; *or*

ii. Epoxy coating; *or*

iii. Polyurethane; *or*

iv. Wax tape.

NOTE: The thin factory-applied asphaltic coating applied to ductile iron pipe for transportation and aesthetic purposes does not constitute a corrosion control coating.

b. Apply cathodic protection to ductile iron piping as per NACE SP0169.

OPTION 2

a. As an alternative to the coating systems described in Option 1 and cathodic protection, encase all buried portions of metallic piping so that there is a minimum of 3 inches of concrete cover provided over and around surfaces of pipe, fittings, and valves using any type of ASTM C150 cement. Install joint bonds, test stations, and insulated joints to provide for corrosion monitoring and/or the future application of cathodic protection if needed.

NOTE: Some iron piping systems, such as for fire water piping, have special corrosion and cathodic protection requirements that must be evaluated for each specific application.

Cast Iron Soil Pipe

1. Protect cast iron soil pipe with either a double wrap 4-mil or single wrap 8-mil polyethylene encasement per AWWA C105.
2. It is not necessary to bond the pipe joints or apply cathodic protection.
3. Provide 6 inches of clean sand backfill all around the pipe. Use the following parameters for clean sand backfill:
    a. Minimum saturated resistivity of no less than 3,000 ohm-cm; *and*
    b. pH between 6.0 and 8.0.
    c. All backfill testing should be performed by a corrosion engineering laboratory.

Copper Tubing

1. Use Type K or Type L copper tubing as required by the applicable local plumbing code. Type M tubing should not be used for buried applications.[4]

[4] *2022 California Plumbing Code (CPC) Section 604.3.*

2. Electrically insulate underground copper pipe from dissimilar metals and from above ground copper pipe with insulating devices per NACE SP0286. Sleeve copper pipe through footings and foundations to prevent pH concentration cells and prevent leaks caused by settlement.

3. Electrically insulate cold water piping from hot water piping systems.

4. Protect cold water pipe using all of the following measures:

    a. Place cold water copper tubing in an 8-mil polyethylene sleeve or encase in double 4-mil thick polyethylene sleeves. Ensure that sleeves are intact and free of cuts, tears, punctures, or other damage.

    b. Remove any construction debris, rocks, wood, or organic matter from the trench prior to backfill.

    c. Bed and backfill with at least 2 inches of clean sand all around the tubing, including the bedding. Use the following parameters for clean sand backfill:

        i. Minimum saturated resistivity of no less than 3,000 ohm-cm; and

        ii. pH between 6.0 and 8.0.

        iii. All backfill testing should be performed by a corrosion engineering laboratory.

    d. Copper tubing for cold water can also be treated the same as for hot water.

5. Hot water tubing may be subject to a higher corrosion rate. Protect hot copper tubing using one of the following measures:

    a. Prevent soil contact. Soil contact may be prevented by placing the tubing above ground or encasing the tubing with PVC pipe with solvent-welded joints. Either seal the PVC pipe at both ends using ammonia- and methanol-free caulk, or terminate both ends above-grade in a manner that doesn't allow water to infiltrate; *or*

    b. Applying cathodic protection per NACE SP0169. The amount of cathodic protection current needed can be minimized by coating the tubing with a suitable dielectric coating that is compatible with cathodic protection, such as Polyken 930.

Plastic and Vitrified Clay Pipe

1. No special corrosion control measures are required for plastic and vitrified clay piping placed underground.

2. Protect all metallic fittings and valves with wax tape per AWWA C217, or with epoxy and appropriately designed cathodic protection system per NACE SP0169.

Concrete Structures and Pipe

1. From a corrosion standpoint, any type of ASTM C150 cement may be used for concrete structures and pipe because the sulfate concentration is negligible (S0), from 0 to 0.10 percent. Use a minimum strength of 2,500 psi per applicable codes.[5,6,7]

2. Standard concrete cover over reinforcing steel may be used for concrete structures and pipe in contact with these soils due to the low chloride concentrations found on site.[8] Limit the water-soluble chloride ion content in the concrete mix design to less than 0.06 percent by weight of cement.[9]

[5] *2021 International Building Code (IBC) which refers to American Concrete Institute (ACI) 318-19 Table 19.3.2.1*
[6] *2021 International Residential Code (IRC) which refers to American Concrete Institute (ACI) 318-19 Table 19.3.2.1*
[7] *2022 California Building Code (CBC) which refers to American Concrete Institute (ACI) 318-19 Table 19.3.2.1*
[8] *Design Manual 303: Concrete Cylinder Pipe. Ameron. p.65*
[9] *American Concrete Institute (ACI) 318-19 Table 19.3.2.1*

Closure

The analysis and recommendations presented in this report are based upon data obtained from the laboratory sample. This report does not reflect variations that may occur across the site or due to the modifying effects of construction. If variations appear, HDR should be notified immediately so that further evaluation and supplemental recommendations can be provided.

HDR's services have been performed with the usual thoroughness and competence of the engineering profession. No other warranty or representation, either expressed or implied, is included or intended.

Please call if you have any questions.

Respectfully Submitted,
HDR Engineering, Inc.



Teddie Algorri
Laboratory Manager

Bradley M. Stuart, PE
Corrosion Engineer

Enc: Table A1 – Laboratory Tests on Soil Samples

25-0233SCS SCS TA_BS_TA.docx

Table A1 - Laboratory Tests on Soil Samples

Earth Systems Pacific
San Luis Obispo High School Relocation of Modular Restroom
Your #300933-027, HDR Lab #25-0233SCS
15-May-25

Sample ID			Borings 1 and 2 @ 0-5'
Resistivity		**Units**	
as-received		ohm-cm	2,680
saturated		ohm-cm	1,720
pH			7.1
Electrical Conductivity		mS/cm	0.10
Chemical Analyses			
Cations			
calcium	Ca^{2+}	mg/kg	36
magnesium	Mg^{2+}	mg/kg	28
sodium	Na^{1+}	mg/kg	31
potassium	K^{1+}	mg/kg	13
ammonium	NH_4^{1+}	mg/kg	ND
Anions			
carbonate	CO_3^{2-}	mg/kg	ND
bicarbonate	HCO_3^{1-}	mg/kg	174
fluoride	F^{1-}	mg/kg	17
chloride	Cl^{1-}	mg/kg	4.0
sulfate	SO_4^{2-}	mg/kg	29
nitrate	NO_3^{1-}	mg/kg	4.0
phosphate	PO_4^{3-}	mg/kg	5.0
Other Tests			
% moisture	H_2O	%	na
total acidity	H^{1+}	mmol/kg	na
sulfide	S^{2-}	qual	na
Redox		mV	na

Resistivity per ASTM G187, pH per ASTM G51, Cations per ASTM D6919, Anions per ASTM D4327, and Alkalinity per APHA 2320-B.

Electrical conductivity in millisiemens/cm and chemical analyses were made on a 1:5 soil-to-water extract.

mg/kg = milligrams per kilogram (parts per million) of dry soil.

Redox = oxidation-reduction potential in millivolts

ND = not detected

na = not analyzed

APPENDIX E

Table E-1 – Fault Parameters

Table E-2 – Historical Earthquakes in Vicinity of Project Site

Table E-1
Fault Parameters

Fault Section Name	Distance (miles)	Distance (km)	Upper Seis. Depth (km)	Lower Seis. Depth (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)
Oceanic-West Huasna FM3.1, 3.2	2.5	4.1	0.0	7.0	58	49	na	122	B'	**7.1**		
Los Osos 2011 CFM FM3.1, 3.2	3.1	5.0	0.0	12.0	45	208	90	58	B	**6.9**		0.5
Rinconada 2011 CFM FM3.1, 3.2	8.0	12.9	0.0	8.5	82	233	180	123	B	**7.5**		1
San Luis Bay 2011 CFM FM3.2	8.4	13.6	0.0	10.0	90	na	na	16	B'	**6.3**		
San Luis Range 2011 CFM, FM3.1	8.5	13.7	0.0	12.0	52	na	na	79	B'	**7.2**		
San Luis Range (So Margin) FM3.2	8.6	13.8	0.0	12.0	45	37	90	115	B	**7.1**		0.2
East Huasna 2011 CFM FM3.1, 3.2	8.9	14.4	0.0	15.0	90	na	na	74	B'	**7.2**		
San Luis Range - Oceano 2011 CFM, FM3.1	11.1	17.8	0.0	12.0	45	na	na	21	B'	**6.6**		
Shoreline FM3.1, 3.2	11.1	17.9	0.0	12.0	90	na	na	23	B'	**6.5**		
San Luis Range - Pecho FM3.1, 3.2	13.1	21.1	0.0	12.0	90	na	na	26	B'	**6.6**		
La Panza FM3.1, 3.2	14.7	23.6	0.0	13.9	51	45	na	72	B'	**7.3**		
Hosgri FM3.1, 3.2	16.1	25.9	0.0	6.8	80	59	180	171	B	**7.3**		2.5
South Cuyama FM3.1, 3.2	17.1	27.5	0.0	13.9	33	210	na	83	B'	**7.5**		
Casmalia 2011 CFM	21.5	34.6	0.0	12.0	75	na	na	48	B'	**6.9**		
Lions Head 2011 CFM FM3.1, 3.2	27.5	44.2	0.0	12.0	75	29	90	65	B	**6.7**		0.02
San Juan FM3.1, 3.2	28.1	45.2	0.0	13.0	90	243	180	82	B	**7.1**		1
Hosgri (Extension) FM3.1, 3.2	29.9	48.2	0.0	7.5	80	79	na	29	B'	**6.4**		
San Andreas (Cholame) rev FM3.1, 3.2	36.1	58.1	0.0	12.0	90	51	180	63	A	**6.8**	89	3.5
San Andreas (Parkfield) FM3.1, 3.2	38.0	61.1	0.0	10.2	90	50	180	36	A	**6.4**	13	20
Los Alamos 2011 CFM FM3.1, 3.2	40.2	64.7	0.0	12.0	30	na	na	27	B'	**6.9**		
Morales (West) FM3.1, 3.2	41.9	67.4	0.0	8.6	32	49	na	28	B'	**6.8**		
Santa Ynez River FM3.1, 3.2	43.2	69.5	0.0	12.0	70	na	na	73	B'	**7.1**		
San Andreas (Carrizo) rev FM3.1, 3.2	44.2	71.1	0.0	15.1	90	224	180	59	A	**6.8**	89	3.5
San Andreas (Creeping Section) FM3.1, 3.2	50.1	80.6	0.0	12.0	90	227	180	121	A	**6.8**	89	9
Santa Ynez (West) FM3.1, 3.2	53.9	86.7	0.0	9.2	70	182	0	80	B	**6.9**		2
Lost Hills FM3.1, 3.2	54.3	87.5	4.2	12.0	29	233	na	33	B'	**6.8**		
Los Alamos extension FM3.1, 3.2	54.5	87.6	0.0	12.0	30	na	na	22	B'	**6.8**		
Morales (East) FM3.1, 3.2	58.8	94.6	0.0	8.6	32	14	na	18	B'	**6.6**		
Ozena FM3.1, 3.2	59.8	96.2	0.0	13.9	33	na	na	41	B'	**7.2**		
Great Valley 14 (Kettleman Hills) FM3.1, 3.2	64.5	103.8	8.1	22.5	22	215	90	24	B	**7.1**		1.5
Red Mountain FM3.1, 3.2	65.5	105.4	0.0	14.1	56	2	90	101	B	**7.4**		2
Great Valley 13 (Coalinga) FM3.1, 3.2	67.1	107.9	9.1	15.2	15	226	90	32	B	**7.0**		1.5
Big Pine (West) FM3.1, 3.2	71.7	115.4	0.0	11.0	50	2	na	18	B'	**6.5**		
Reliz 2011 CFM FM3.1, 3.2	72.4	116.5	0.0	10.9	58	240	na	127	B'	**7.4**		
Mission Ridge-Arroyo Parida-Santa Ana FM3.1, 3	72.5	116.8	0.0	7.6	70	176	90	69	B	**6.8**		0.4
North Channel FM3.2	73.5	118.4	1.1	4.5	26	10	90	51	B	**6.7**		1
San Andreas (Big Bend) FM3.1, 3.2	74.1	119.3	0.0	15.1	90	198	180	50	A	**6.8**	89	3.5
Pitas Point (Upper) FM3.2	74.2	119.4	1.4	10.0	42	15	90	35	B	**6.8**		1
Great Valley 12 FM3.1, 3.2	75.0	120.7	7.0	9.6	15	243	90	17	B	**6.3**		1.5
Pitas Point (Lower, West), FM 3.1	77.0	124.0	1.5	8.8	13	3	90	35	B	**7.2**		2.5

Reference: USGS OFR 2013-1165 (CGS SP 228)

Based on Site Coordinates of 35.2809 Latitude, -120.6486 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 2008-1437). Mean magnitude is average of Ellworths-B and Hanks & Bakun moment area relationship.

Site Coordinates: 35.2809 N 120.6486 W

Table F-2
Historical Earthquakes in Vicinity of Project Site, M >= 5.0

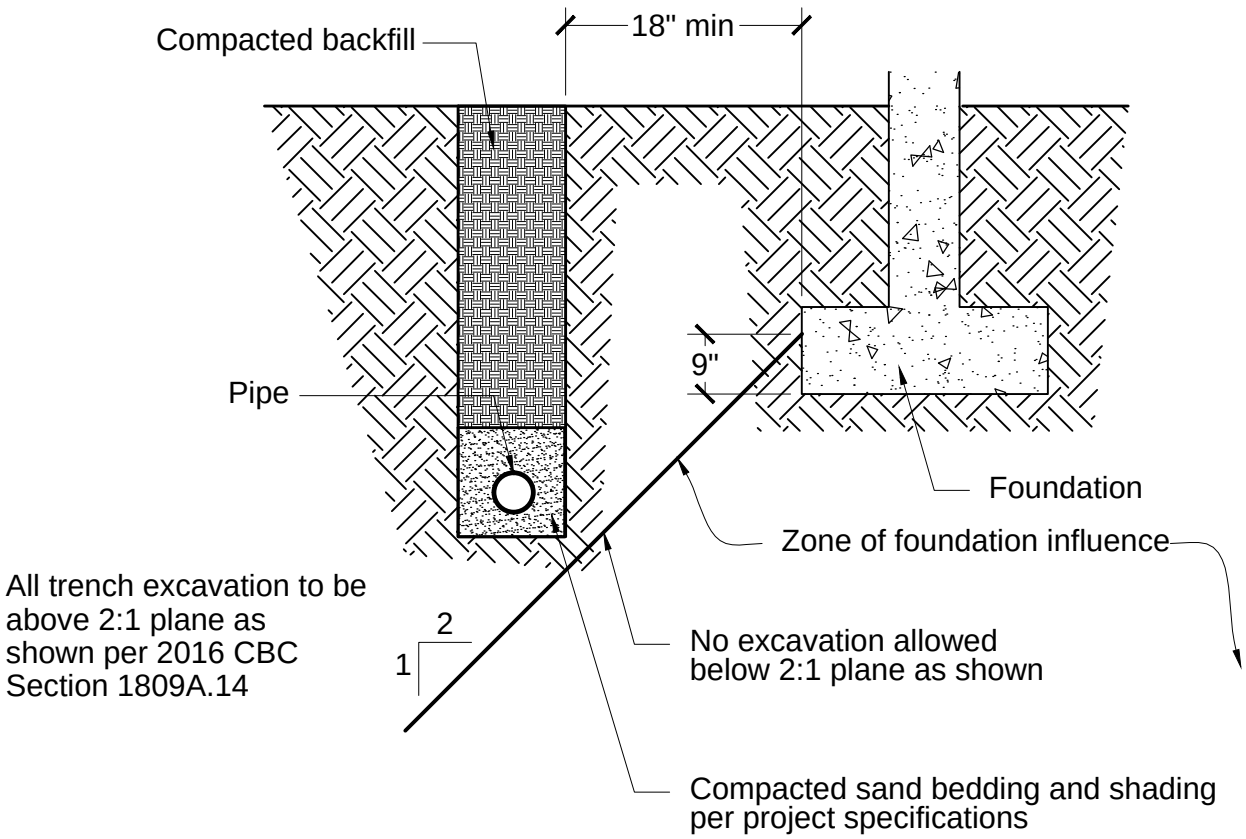
Day	Year	Epicenter Latitude (Degrees)	Epicenter Longitude (Degrees)	Distance from Site (mi)	Magnitude M_W
9/5	1922	35.30	120.70	3.2	**5.5**
99/99	1830	35.35	120.65	4.8	**6.0**
4/27	1908	35.60	120.20	33.5	**5.5**
12/7	1906	35.50	121.20	34.5	**5.7**
5/30	1877	35.70	120.30	34.9	**5.5**
7/28	1902	34.80	120.40	36.1	**5.8**
2/1	1853	35.70	121.10	38.5	**5.5**
12/22	2003	35.70	121.10	38.5	**6.6**
3/10	1922	35.75	120.25	39.4	**6.3**
8/18	1922	35.75	120.25	39.4	**5.7**
9/28	2004	35.82	120.37	40.4	**6.0**
6/8	1934	35.79	120.29	40.5	**6.0**
6/28	1966	35.81	120.27	42.3	**6.0**
7/31	1902	34.70	120.30	44.7	**5.8**
9/29	2004	35.95	120.50	46.9	**5.1**
2/14	1987	35.96	120.70	47.0	**5.2**
11/16	1956	35.95	120.47	47.3	**5.0**
11/22	1952	35.76	121.27	48.1	**6.2**
11/4	*1927	34.60	120.90	49.1	**7.1**
12/28	1939	35.97	120.92	50.0	**5.2**
9/13	1975	36.00	120.55	50.0	**5.1**
3/3	1901	36.00	120.50	50.3	**6.4**
11/2	1955	36.00	120.92	51.9	**5.2**
2/2	1881	36.05	120.55	53.4	**6.0**
5/6	1881	36.05	120.55	53.4	**5.5**
2/26	1932	36.00	121.00	53.4	**5.0**
1/12	*1915	34.60	120.20	53.4	**5.7**
1/9	1857	36.10	120.65	56.6	**6.1**
9/17	1991	35.81	121.45	58.0	**5.0**
1/14	1855	36.15	120.70	60.1	**5.5**
1/9	1857	36.20	120.80	64.0	**7.9**
4/12	1885	36.20	120.80	64.0	**6.5**
11/5	1969	34.65	121.50	64.9	**5.5**

From full earthquake catalog in USGS OFR 2008-1437h as updated with current events through 2024 (ANSS 2025). For events with an asterisk, alternate solutions are given in the OFR. Ordered By Closest Event. Maximum 40 Closest Events

APPENDIX F

Typical Detail A: Pipe Parallel to Foundations

TYPICAL DETAIL A
PIPE PLACED PARALLEL TO FOUNDATIONS•



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NOT TO SCALE

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