ALEXANDRIA AND FIVE MILE SLOUGH CULVERT REPLACEMENT
STOCKTON, CALIFORNIA

GEOTECHNICAL EXPLORATION

SUBMITTED TO
Mr. Nathan Berend
Siegfried Engineering
4045 Coronado Avenue
Stockton, CA 95204

PREPARED BY
ENGEO Incorporated

September 29, 2021

PROJECT NO.
19161.000.001

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Project No.
19161.000.001

September 29, 2021

Mr. Nathan Berend
Siegfried Engineering
4045 Coronado Avenue
Stockton, CA 95204

Subject: Alexandria and Five Mile Slough Culvert Replacement
Alexandria Place and W Lincoln Road
Stockton, California

GEOTECHNICAL EXPLORATION

Dear Mr. Berend:

ENGEO prepared this geotechnical report for Siegfried Engineering as outlined in our agreement dated July 27, 2021. We characterized the subsurface conditions at the site to provide the enclosed geotechnical recommendations for design.

Our experience and that of our profession clearly indicate that the risk of costly design, construction, and maintenance problems can be significantly lowered by retaining the design geotechnical engineering firm to review the project plans and specifications and provide geotechnical observation and testing services during construction. Please let us know when working drawings are nearing completion, and we will be glad to discuss these additional services with you.

If you have any questions or comments regarding this report, please call and we will be glad to discuss them with you.

Sincerely,

ENGEO Incorporated

Lauren Becker

Steve Harris, GE

REGISTERED PROFESSIONAL ENGINEER
STEVE HARRIS
No. 2804
GEOTECHNICAL
STATE OF CALIFORNIA

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1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

ENGEO prepared this geotechnical report for design of Alexandria and Five Mile Slough Culvert Replacement in Stockton, California. We prepared this report as outlined in our agreement, dated July 27, 2021, and authorized by Mr. Paul J. Schnieder of Siegfried Engineering, Inc., to conduct the following scope of services.

- Service plan development
- Subsurface field exploration
- Soil laboratory testing
- Data analysis and conclusions
- Report preparation

For our use, we received a set of 90% Complete Design Plans prepared by Siegfried Engineering, Inc., undated and delivered electronically via email on June 11, 2021.

This report was prepared for the exclusive use of our client and their consultants for design of this project. In the event that any changes are made in the character, design or layout of the development, we must be contacted to review the conclusions and recommendations contained in this report to evaluate whether modifications are recommended. This document may not be reproduced in whole or in part by any means whatsoever, nor may it be quoted or excerpted without our express written consent.

1.2 PROJECT LOCATION

The site is located on Alexandria Place, just north of its intersection with Lincoln Road as shown on the Vicinity Map, Figure 1. An existing culvert runs diagonally below the street, connecting the Five-Mile Creek to the east as it flows to the west to join the Five-Mile Slough. An existing pump station is located on the west side of Alexandria Place and south of the existing culvert. The Site Plan (Figure 2) shows the approximate locations of the existing and proposed culverts and our exploration location.

1.3 PROJECT DESCRIPTION

Based on the information provided, we understand that the following site improvements are proposed.

1. 90-foot-long 42” by 72” reinforced concrete box culvert supported on a mat slab foundation.

2. Headwalls at the east and west extents of the culvert, supported on conventional strip footing and retaining backfill sloping at a maximum of 3:1 (horizontal:vertical) slope.

3. Grading in the surrounding creek area, approximately 75 feet to the east and west of the centerline of Alexandria Place.

4. Street paving and restriping above the culvert on Alexandria Place.

5. Utilities and other infrastructure improvements.

6. Concrete flatwork for curbs and gutter and sidewalk along Alexandria Place.

2.0 FINDINGS

2.1 FIELD EXPLORATION

Our field exploration included drilling one boring on the site on August 27, 2021, at the location shown on the Site Plan, Figure 1. The location of our exploration is approximate and was estimated by utilizing smart phones with GPS; they should be considered accurate only to the degree implied by the method used.

An ENGEO representative observed the drilling and logged the subsurface conditions. We retained a truck-mounted Soil Test Ranger drill rig and crew to advance the boring using 4-inch-diameter solid-flight auger methods. The boring was advanced to a maximum depth of 31½ feet below existing grade. We permitted and backfilled the boring in accordance with the requirements of San Joaquin Environmental Health Department and the City of Stockton.

We retrieved both disturbed and relatively undisturbed soil samples at various intervals in the borings using standard penetration tests, 2.5-inch I.D. split-spoon sampler, and a 3.5-inch I.D. thin-walled Shelby tube sampler.

The standard penetration resistance blow counts were obtained by dropping a 140-pound hammer through a 30-inch free fall. The 2-inch O.D. split-spoon sampler was driven 18 inches and the number of blows was recorded for each 6 inches of penetration. In addition, 2.5-inch I.D. samples were obtained using a Modified California Sampler driven into the soil with the 140-pound hammer previously described. Unless otherwise indicated, the blows per foot recorded on the boring log represent the accumulated number of blows to drive the last 1 foot of penetration; the blow counts have not been converted using any correction factors.

We used the field log to develop the report log in Appendix A. The log depict subsurface conditions at the exploration location for the date of exploration; however, subsurface conditions may vary with time.

2.2 GEOLOGY AND SEISMICITY

2.2.1 Geology

We present the following discussion of site geology based on our field reconnaissance and review of the CGS *Geologic Map of the San Francisco-San Jose Quadrangle* (Wagner, Bortugno, and McJunkin 1991) and U.S. Geologic Survey *Preliminary Geologic Map Showing Quaternary Deposits of the Lodi Quadrangle* (Marchand and Atwater 1979).

The site is located in the Great Valley geomorphic province. The Great Valley is an elongate, northwest-trending structural trough bound by the Coast Range on the west and the Sierra Nevada on the east. The Great Valley has been and is presently being filled with sediments primarily derived from the Sierra Nevada.

Our site reconnaissance and previously referenced geologic maps indicate that the underlying geologic formation at the site is basin alluvium (Qm_1b) and comprises of sand, gravel, and clay.

2.2.2 Seismicity

The site is located in an area of moderate to high seismicity. An active fault is defined by the California Geologic Survey as one that has had surface displacement within Holocene time (about the last 11,000 years). The State of California has prepared maps designating zones for special studies that contain these active earthquake faults. No known active faults cross the property and the site is not located within an Earthquake Fault Special Study Zone; however, large (greater than Moment Magnitude 7) earthquakes have historically occurred in the region and many earthquakes of low magnitude occur every year. Figure 4, Regional Faulting and Seismicity, shows the approximate locations of nearby faults and significant earthquakes recorded within the region. The two nearest earthquake faults zoned as active by the State of California Geological Survey are the Great Valley 7 fault located approximately 18 miles to the west and the Mount Diablo Thrust fault, located about 25 miles to the west.

The Great Valley fault is a blind thrust fault with no known surface expression; the postulated fault location has been based on historical regional seismic activity and isolated subsurface information. Portions of the Great Valley fault are considered seismically active thrust faults; however, since the Great Valley fault segments are not known to extend to the ground surface, the State of California has not defined Earthquake Fault Hazard Zones around the postulated traces. The Great Valley fault is considered capable of causing significant ground shaking at the site, but the recurrence interval is believed longer than for more distant, strike-slip faults. Recent studies by Eaton 1986, Moores 1991 and Wong 1989 suggest that this boundary fault may have been the cause of the Vacaville-Winters earthquake sequence of April 1892.

Further seismic activity can be expected to continue along the western margin of the Central Valley.

Other active faults capable of producing significant ground shaking at the site include the Mount Greenville fault, 28 miles southwest; Calaveras fault, 36 miles southwest; the Hayward fault, 44 miles southwest; and the San Andreas fault, 62 miles southwest of the site. Any one of these faults could generate an earthquake capable of causing strong ground shaking at the subject site. Earthquakes of Moment Magnitude 7 and larger have historically occurred in the nearby Bay Area and numerous small magnitude earthquakes occur every year.

2.3 SURFACE CONDITIONS

According to grading plans with existing conditions, the surface elevations of the site ranged from 8 to 9 feet above MSL (NAVD88).

We observed the following site features during our reconnaissance.

- The water level to the east side of Alexandria Place was approximately 4 feet below ground surface.

- Trench plates lie above the existing culvert alignment within the roadway of Alexandria Place. The roadway consists of asphaltic pavement with concrete curb, gutter, and sidewalk on the east and west sides of Alexandria Place.

- Mature trees grew within the landscaped area to the east of Alexandria Place between the creek and the sidewalk. Landscaping to the west of Alexandria Place consisted of grass lawn located between the creek and the sidewalk.

- Overhead power lines crossed Alexandria Place above the general site area.

- A pad-mounted transformer and electrical boxes are located on the west side of Alexandria Place, approximately 50 feet north of the location of the existing culvert within the landscaped area. Underground utilities from these boxes run north and south below Alexandria Place.

Please refer to the Site Plan, Figure 2, for more information on site features.

2.4 SUBSURFACE CONDITIONS

The soil observed in our exploration generally consisted of layers of medium dense to very dense clayey sand and medium stiff to very stiff lean clay with varying amounts of coarse- to fine-grained sand. Medium dense clayey sand began below the roadway pavement section and transitioned to loose clayey sand at approximately 6 feet below ground surface. A layer of sandy lean clay was encountered between 8¼ and 10½ feet bgs and was underlain by medium dense to very dense clayey sand. Below the groundwater table we encountered a thin (< 4 foot thick) layer of very dense silty sand overlaying very stiff lean clay with varying sand content that extended to the maximum depth explored of approximately 31½ feet below ground surface.

Consult the Site Plan and exploration log for specific subsurface conditions. We include our exploration log in Appendix A. The log contains the soil type, color, consistency, and visual classification in general accordance with the Unified Soil Classification System (USCS). The log graphically depict the subsurface conditions encountered at the time of the exploration.

2.5 GROUNDWATER CONDITIONS

We observed static groundwater in our subsurface exploration. We summarize our observations in the table below:

TABLE 2.5-1: Groundwater Observations

EXPLORATION LOCATION	APPROX. DEPTH TO GROUNDWATER (FEET)	APPROX. GROUNDWATER ELEVATION (FEET)
1-B1	17	-8.5

Fluctuations in the level of groundwater may occur due to variations in rainfall, creek water level, and other factors not evident at the time measurements were made.

2.6 LABORATORY TESTING

We performed laboratory tests on selected soil samples to evaluate their engineering properties. For this project, we performed moisture content, dry density, unconfined compression, plasticity index, hydrometer, and direct shear testing. The laboratory test results are included on the bore log in Appendix A. Individual test results are presented in Appendix B.

3.0 CONCLUSIONS

From a geotechnical engineering viewpoint, in our opinion, the site is suitable for the proposed development, provided the geotechnical recommendations in this report are properly incorporated into the design plans and specifications.

The primary geotechnical concerns that could affect development on the site are existing fill, high water levels surrounding the site, and settlement. We summarize our conclusions below.

3.1 EXISTING FILL

Our boring indicates that portions of the subsurface along the proposed culvert alignment is fill material from the original construction of the existing culvert. Non-engineered fills can undergo excessive settlement, especially under new fill or structural loads. Excessive settlement was not observed within the roadway. Although we are not aware of existing compaction tests, for the purpose of this report we assume that the material within the existing roadway was originally placed as an engineered fill. We present fill removal recommendations in Section 5.0.

3.2 EXPANSIVE SOIL

Based on our subsurface exploration, laboratory test results, and preliminary project data presented in Section 2, we opine that since expansive soil was encountered approximately 8 feet below the surface, it should have a minimal effect on the proposed development. We should be retained to review final grading and site improvement plans, and to observe and test earthwork construction at the site.

3.3 SEISMIC HAZARDS

Potential seismic hazards resulting from a nearby moderate to major earthquake can generally be classified as primary and secondary. The primary effect is ground rupture, also called surface faulting. The common secondary seismic hazards include ground shaking and ground lurching. The following sections present a discussion of these hazards as they apply to the site. Based on topographic and lithologic data, the risk of regional subsidence or uplift, soil liquefaction, lateral spreading, landslides, tsunamis, flooding or seiches is considered low to negligible at the site.

3.3.1 Ground Rupture

Since there are no known active faults crossing the property and the site is not located within an Earthquake Fault Special Study Zone, it is our opinion that ground rupture is unlikely at the subject property.

3.3.2 Ground Shaking

An earthquake of moderate to high magnitude generated within the San Francisco Bay region could cause considerable ground shaking at the site, similar to that which has occurred in the past. To mitigate the shaking effects, structures should be designed using sound engineering judgment and the 2019 California Building Code (CBC) requirements, as a minimum. Seismic design provisions of current building codes generally prescribe minimum lateral forces, applied statically to the structure, combined with the gravity forces of dead-and-live loads. The code prescribed lateral forces are generally considered to be substantially smaller than the comparable forces that would be associated with a major earthquake. Therefore, structures should be able to: (1) resist minor earthquakes without damage, (2) resist moderate earthquakes without structural damage but with some nonstructural damage, and (3) resist major earthquakes without collapse but with some structural as well as nonstructural damage. Conformance to the current building code recommendations does not constitute any kind of guarantee that significant structural damage would not occur in the event of a maximum magnitude earthquake; however, it is reasonable to expect that a well-designed and well-constructed structure will not collapse or cause loss of life in a major earthquake (SEAOC, 1996).

3.3.3 Liquefaction

Soil liquefaction results from loss of strength during cyclic loading, such as imposed by earthquakes. Soil most susceptible to liquefaction is clean, loose, saturated, uniformly graded, fine-grained sand. The sand encountered in our boring below the groundwater table was generally medium dense to very dense and contained a significant amount of fine-grained material. For these reasons and based upon engineering judgment, it is our opinion that the potential for liquefaction at the site is low during seismic shaking.

3.3.4 Flooding

The Civil Engineer should review pertinent information relating to possible flood levels for the subject site and provide appropriate design measures for development of the project, if recommended.

3.4 EXCAVATABILITY

We used a truck mounted drill rig during our exploratory work. Based upon our observation and experience, we provide the following conclusions regarding excavation resistance at the site.

1. Conventional grading and backhoe equipment will likely be able to excavate the soil deposits.

2. Due to the shallow water and nature of this construction, dewatering will likely be required for excavation and construction.

We provide the above excavatability information for general planning purposes only.

3.5 SHALLOW GROUNDWATER

Based on groundwater depth during exploration, it does not appear that the static groundwater level beneath the site is likely to affect the proposed development. However, free water levels in the creek at time of exploration was at an elevation of approximately 4½ feet WSE. Free water could impact construction activities at some locations.

Shallow perched or high groundwater can:

1. Impede grading activities and underground utility installation.

2. Cause premature pavement failure if hydrostatic pressures build up beneath the section.

3.6 2019 CBC SEISMIC DESIGN PARAMETERS

The 2019 CBC utilizes design criteria set forth in the 2016 ASCE 7 Standard. Based on the subsurface conditions encountered, we characterized the site as Site Class D in accordance with the 2019 CBC. We provide the 2019 CBC seismic design parameters in Table 3.6-1 below, which include design spectral response acceleration parameters based on the mapped Risk-Targeted Maximum Considered Earthquake (MCER) spectral response acceleration parameters.

TABLE 3.6-1: 2019 CBC Seismic Design Parameters, Latitude: 38.013071 **Longitude:** -121.339699

PARAMETER	VALUE
Site Class	D
Mapped MCE_R Spectral Response Acceleration at Short Periods, S_S (g)	0.734
Mapped MCE_R Spectral Response Acceleration at 1-second Period, S_1 (g)	0.287
Site Coefficient, F_A	1.212
Site Coefficient, F_V	Null*
MCE_R Spectral Response Acceleration at Short Periods, S_{MS} (g)	0.89
MCE_R Spectral Response Acceleration at 1-second Period, S_{M1} (g)	Null*
Design Spectral Response Acceleration at Short Periods, S_{DS} (g)	0.594
Design Spectral Response Acceleration at 1-second Period, S_{D1} (g)	Null*
Mapped MCE Geometric Mean (MCE_G) Peak Ground Acceleration, PGA (g)	0.306
Site Coefficient, F_{PGA}	1.294
MCE_G Peak Ground Acceleration adjusted for Site Class effects, PGA_M (g)	0.396
Long period transition-period, T_L	12 sec

* A site-specific seismic hazard analysis is required to obtain these values unless the exception discussed in ASCE 7-16 Section 11.4.8 is met. Under this exception, refer to ASCE 7-16 Table 11.4-2 to obtain the value for F_v for site Class D.

4.0 CONSTRUCTION MONITORING

Our experience and that of our profession clearly indicate that the risk of costly design, construction, and maintenance problems can be significantly lowered by retaining the design geotechnical engineering firm to:

1. Review the final plans and specifications prior to construction to evaluate whether our recommendations have been implemented, and to provide additional or modified recommendations, as needed. This also allows us to check if any changes have occurred in the nature, design or location of the proposed improvements and provides the opportunity to prepare a written response with updated recommendations.

2. Perform construction monitoring to check the validity of the assumptions we made to prepare this report. Earthwork operations should be performed under the observation of our representative to check that the site is properly prepared, the selected fill materials are satisfactory, and that placement and compaction of the fills has been performed in accordance with our recommendations and the project specifications. Sufficient notification to us prior to earthwork is important.

If we are not retained to perform the services described above, then we are not responsible for any party's interpretation of our report (and subsequent addenda, letters, and verbal discussions).

5.0 EARTHWORK RECOMMENDATIONS

As used in this report, relative compaction refers to the in-place dry unit weight of soil expressed as a percentage of the maximum dry unit weight of the same soil, as determined by the ASTM D1557 laboratory compaction test procedure, latest edition. Compacted soil is not acceptable if it is unstable; it should exhibit only minimal flexing or pumping, as observed by an ENGEO representative. The term “moisture condition” refers to adjusting the moisture content of the soil by either drying if too wet or adding water if too dry.

We define “structural areas” as any area sensitive to settlement of compacted soil. These areas include, but are not limited to sidewalks, pavement areas, and retaining walls.

5.1 EXISTING FILL REMOVAL

As previously discussed, we assume that the fill associated with the original construction of the existing culvert was placed as an engineered fill. Any fill that appears loose or soft during construction should be removed from the area to receive the proposed box culvert. The lateral extent and depth of fill are expected to vary. The existing corrugated metal pipe culverts below the lowest elevation of the proposed box culvert may be cut, left in place, and slurry filled as noted on the provided plans. Care should be given during demolition as to not disturb the portion(s) of pipe to remain in place. ENGEO should be given the opportunity to observe the cut pipe culvert prior to slurry placement to confirm adequate bearing conditions.

5.2 OSHA SOIL TYPES

At this time, excavations are expected to extend to a depth of approximately 10 feet below ground surface, or an elevation of approximately 0.0 feet. Based on the soil data encountered during subsurface exploration, subsurface soil from 0 to 10 feet below existing grade should be considered Type B soil for excavating and dewatered conditions. The contractor’s Competent Person is responsible to confirm or adjust these soil classifications based upon actual field conditions encountered during construction. The design of appropriate shoring systems during excavation is the sole responsibility of the Contractor and should be in conformance with OSHA. The Contractor should be familiar with applicable local, state, and federal regulations, including the current Occupational Safety and Health Administration (OSHA) Excavation and Trench Safety Standards.

5.3 OVER-OPTIMUM SOIL MOISTURE CONDITIONS

The contractor should anticipate encountering excessively over-optimum (wet) soil moisture conditions during winter or spring grading, or during or following periods of rain. In addition, wet soil conditions may be found due to proximity to free water in the slough and creek. Wet soil can make proper compaction difficult or impossible. Wet soil conditions can be mitigated by:

1. Frequent spreading and mixing during warm dry weather,
2. Mixing with drier materials,
3. Mixing with a lime or cement product, or
4. Stabilizing with aggregate or geotextile stabilization fabric, or both.

Options 3 and 4 should be evaluated by ENGEO prior to implementation.

5.4 ACCEPTABLE FILL

On-site soil material is suitable as fill material provided it is processed to remove concentrations of organic material, debris, and particles greater than 8 inches in maximum dimension.

Fill within 2 feet of finished grade in areas to receive pavement should not contain significant concentrations of clay, as evaluated by an ENGEO field representative.

Imported fill materials should meet the above requirements and have a plasticity index less than 12, and at least 20 percent passing the No. 200 sieve. Allow ENGEO to sample and test proposed imported fill materials at least 5 days prior to delivery to the site.

Cement slurry may be used as fill in the existing pipe culverts that are to remain in place. ENGEO should be given the opportunity to review the mix specifications prior to use.

5.5 FILL COMPACTION

5.5.1 Grading in Structural Areas

Perform subgrade compaction prior to fill placement, following demolition and cutting operations, and in areas left at grade as follows.

1. Scarify to a depth of at least 8 inches.

2. Moisture condition soil to at least 3 percentage point above the optimum moisture content.

3. Compact the subgrade to at least 90 percent relative compaction. Compact the upper 6 inches of finish pavement subgrade to at least 95 percent relative compaction prior to aggregate base placement.

After the subgrade soil has been compacted, place and compact acceptable fill as follows.

1. Spread fill in loose lifts that do not exceed 8 inches.

2. Moisture condition lifts to at least 3 percentage point above the optimum moisture content.

3. Compact fill to a minimum of 90 percent relative compaction; Compact the upper 6 inches of fill in pavement areas to 95 percent relative compaction prior to aggregate base placement.

5.5.2 Underground Utility Backfill

5.5.2.1 General

The contractor is responsible for conducting trenching and shoring in accordance with CALOSHA requirements. Project consultants involved in utility design should specify pipe bedding materials.

5.5.2.2 Structural Areas

Place and compact trench backfill as follows.

1. Trench backfill should have a maximum particle size of 6 inches.

2. Moisture condition trench backfill to a minimum of 3 percentage points above the optimum moisture content. Moisture condition backfill outside the trench.

3. Place fill in loose lifts not exceeding 12 inches.

4. Compact fill to a minimum of 90 percent relative compaction (ASTM D1557).

Jetting of backfill is not an acceptable means of compaction.

5.5.3 Landscape Fill

Process, place and compact fill in accordance with Sections 5.4.1 and 5.4.2, except compact to at least 85 percent relative compaction (ASTM D1557).

6.0 BOX CULVERT RECOMMENDATIONS

It is our understanding that the planned excavation for the proposed concrete box culvert will extend to depths of approximately 8 feet below existing ground surface, ranging in elevations from approximately +0.5 to +1.0 feet. We also understand that two existing 72” by 44” arch corrugated metal pipe culverts that are currently in place below the proposed box culvert are planned to be partially demolished; the upper portion is to be cut and removed, and the portion below the lowest elevation of the box culvert will be left in place and backfilled with slurry. Referenced plans show a 3-sack concrete slurry will be used.

6.1 FOUNDATIONS

Given the above construction, provide minimum footing dimensions as follows in the Table 6.1-1 below.

TABLE 6.1-1: Foundation Design Parameters

DESIGN PARAMETER	DESIGN VALUE
Allowable Bearing Pressure	1500 psf
Passive Lateral Pressure	300 psf
Coefficient of Friction	0.3

Lateral loads may be resisted by friction along the base and by passive pressure along the sides of foundations. The passive pressure is based on an equivalent fluid pressure in pounds per cubic foot (pcf).

The above allowable values include a factor of safety of 1.5. Increase the above values by one third for the short-term effects of wind or seismic loading.

Passive lateral pressure should not be used for footings on or above slopes.

6.2 LATERAL SOIL PRESSURES

The walls of the box culvert should be designed to resist lateral earth pressures from adjoining natural materials and/or backfill and from any surcharge loads. See Section 7.1 for lateral earth pressures for use in design and drainage recommendations.

6.3 BACKFILL

Backfill behind the box culvert walls should be placed and compacted in accordance with Section 5.1. Use light compaction equipment within 5 feet of the wall face. If heavy compaction equipment is used, the walls should be temporarily braced to avoid excessive wall movement.

6.4 SETTLEMENT

Provided our report recommendations are followed and given the proposed construction (Section 1.3), we estimate total and differential foundation settlements to be less than approximately 1 inch and ½ inches, respectively.

7.0 EAST AND WEST HEADWALL RECOMMENDATIONS

It is our understanding that headwalls will be constructed at the east and west ends of the box culvert. The provided plans indicate the walls are proposed to be under 6 feet in height and that the backslopes above the headwalls will have a maximum slope of approximately 3:1 (horizontal:vertical).

7.1 FOUNDATIONS

Retaining walls may be supported on conventional strip footings designed in accordance with recommendations presented in Section 6.2. The minimum embedment depth should be 18 inches below lowest adjacent soil grade.

Foundation subgrade should be prepared in accordance with Section 6.1.

7.1.1 Reinforcement

The structural engineer should design footing reinforcement to support the intended structural loads without excessive settlement.

7.2 LATERAL SOIL PRESSURES

Design proposed retaining walls to resist lateral earth pressures from adjoining natural materials and/or backfill and from any surcharge loads.

Unrestrained drained walls should be designed for active lateral earth pressures per the following Table 7.2-1. The table provides lateral earth pressures for retaining wall design with variable backfill conditions. One-third of any surcharge loads should be added to the active pressure.

TABLE 7.2-1: Lateral Earth Pressures

BACKFILL SLOPE CONDITION (HORIZONTAL:VERTICAL)	ACTIVE PRESSURE (PCF)	SEISMIC PRESSURE (PCF)
Level	25	5
4:1	35	10
3:1	40	20

As required by the California Building Code, retaining walls greater than 6 feet in height shall incorporate seismic loading. We recommend the seismic pressures in Table 7.2-1 be applied where appropriate. Seismic pressures should be applied in a triangular pressure distribution equal to the equivalent fluid pressures provided above.

Appropriate surcharge loads from vehicles or other anticipated surcharge loads should be incorporated when the surcharge loading is situated within a 1:1 (horizontal:vertical) line of projection extending up the rear base edge of the bottom of the footing. A uniform horizontal surcharge load of 50 percent of the vertical surcharge load should be assumed to act over the height of the wall.

Construct a drainage system, as recommended below, to reduce hydrostatic forces behind the retaining wall during episodes of low water level within the culvert. If adequate drainage behind the walls is not provided, we recommend that an additional equivalent fluid pressure of 40 pcf be added to the values recommended above for both restrained and unrestrained walls. For rock drain construction, we recommend two types of rock drain alternatives.

1. A minimum 12-inch-thick layer of Class 2 Permeable Filter Material (Caltrans Specification 68-2.02F) placed directly behind the wall.

2. A minimum 12-inch-thick layer of washed, crushed rock with 100 percent passing the ¾-inch sieve and less than 5 percent passing the No. 4 sieve. Envelop rock in a minimum 6-ounce, nonwoven geotextile filter fabric.

For both types of rock drains:

1. Place the rock drain directly behind the walls of the structure.

2. Extend rock drains from the wall base to within 12 inches of the top of the wall.

3. Place a minimum of 4-inch-diameter perforated pipe (glued joints and end caps) at the base of the wall, inside the rock drain and fabric, with perforations placed down.

4. Place pipe at a gradient at least 1 percent to direct water away from the wall by gravity to a drainage facility.

ENGEO should review and approve geosynthetic composite drainage systems prior to use.

7.3 BACKFILL

Backfill behind retaining walls should be placed and compacted in accordance with Section 5.1. Use light compaction equipment within 5 feet of the wall face. If heavy compaction equipment is used, the walls should be temporarily braced to avoid excessive wall movement.

7.4 SETTLEMENT

Provided our report recommendations are followed and given the proposed construction (Section 1.3), we estimate total headwall foundation settlements to be less than approximately 1½ inches, resulting in ½ inch differential settlement possible between the headwalls and box culvert.

8.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS

This report presents geotechnical recommendations for design of the improvements discussed in Section 1.3 for the Alexandria and Five Mile Slough Culvert Replacement project. If changes occur in the nature or design of the project, we should be allowed to review this report and provide additional recommendations, if any. It is the responsibility of the owner to transmit the information and recommendations of this report to the appropriate organizations or people involved in design of the project, including but not limited to developers, owners, buyers, architects, engineers, and designers. The conclusions and recommendations contained in this report are solely professional opinions and are valid for a period of no more than 2 years from the date of report issuance.

We strived to perform our professional services in accordance with generally accepted principles and practices currently employed in the area; there is no warranty, express or implied. There are risks of earth movement and property damages inherent in building on or with earth materials. We are unable to eliminate all risks; therefore, we are unable to guarantee or warrant the results of our services.

This report is based upon field and other conditions discovered at the time of report preparation. We developed this report with limited subsurface exploration data. We assumed that our subsurface exploration data are representative of the actual subsurface conditions across the site. Considering possible underground variability of soil and groundwater, additional costs may be required to complete the project. We recommend that the owner establish a contingency fund to cover such costs. If unexpected conditions are encountered, ENGEO must be notified immediately to review these conditions and provide additional and/or modified recommendations, as necessary.

Our services did not include excavation sloping or shoring, soil volume change factors, flood potential, or a geohazard exploration. In addition, our geotechnical exploration did not include work to determine the existence of possible hazardous materials. If any hazardous materials are encountered during construction, the proper regulatory officials must be notified immediately.

This document must not be subject to unauthorized reuse, that is, reusing without written authorization of ENGEO. Such authorization is essential because it requires ENGEO to evaluate the document's applicability given new circumstances, not the least of which is passage of time.

Actual field or other conditions will necessitate clarifications, adjustments, modifications or other changes to ENGEO's documents. Therefore, ENGEO must be engaged to prepare the necessary clarifications, adjustments, modifications or other changes before construction activities commence or further activity proceeds. If ENGEO's scope of services does not include on-site construction observation, or if other persons or entities are retained to provide such services, ENGEO cannot be held responsible for any or all claims arising from or resulting from the performance of such services by other persons or entities, and from any or all claims arising from or resulting from clarifications, adjustments, modifications, discrepancies or other changes necessary to reflect changed field or other conditions.

We determined the lines designating the interface between layers on the exploration logs using visual observations. The transition between the materials may be abrupt or gradual. The exploration logs contain information concerning samples recovered, indications of the presence of various materials such as clay, sand, silt, rock, existing fill, etc., and observations of groundwater encountered. The field logs also contain our interpretation of the subsurface conditions between sample locations. Therefore, the logs contain both factual and interpretative information. Our recommendations are based on the contents of the final logs, which represent our interpretation of the field logs.

SELECTED REFERENCES

Bryant, W. and Hart, E. (2007). Special Publication 42, “Fault-Rupture Hazard Zones in California”, Interim Revision 2007, California Department of Conservation.

California Building Code, 2019.

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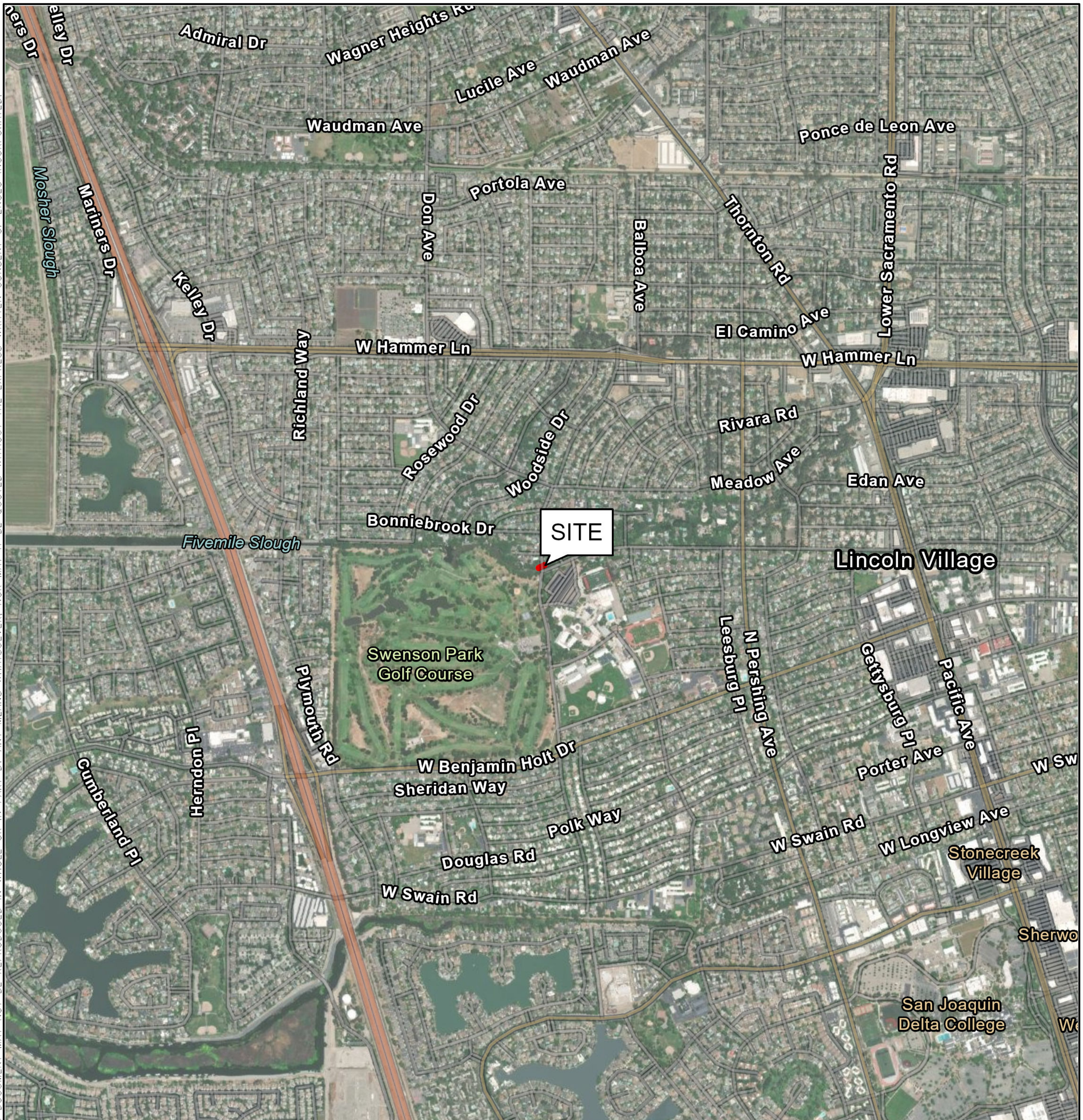
FIGURES



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FEET

BASEMAP SOURCE: ESRI MAPPING SERVICE 2020

ENGEO
Expect Excellence

VICINITY MAP ALEXANDRIA AND FIVE MILE SLOUGH CULVERT STOCKTON, CALIFORNIA	PROJECT NO. : 19161.000.001		FIGURE NO. 1
	SCALE: AS SHOWN		
	DRAWN BY: JV	CHECKED BY: ZAC	

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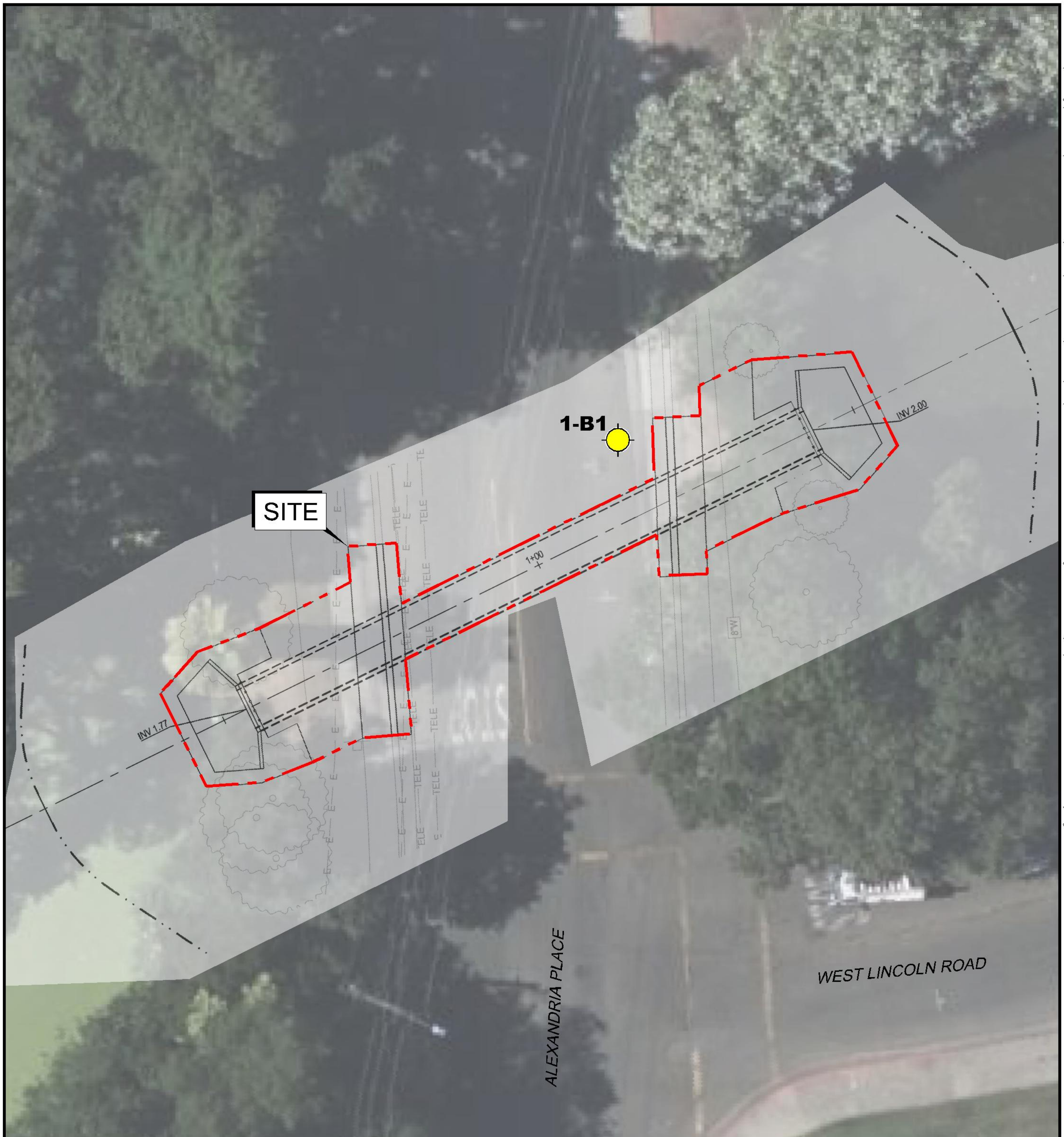
LAYOUT: VICINITY USER: JVERGARA

ORIGINAL FIGURE PRINTED IN COLOR



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FEET

EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

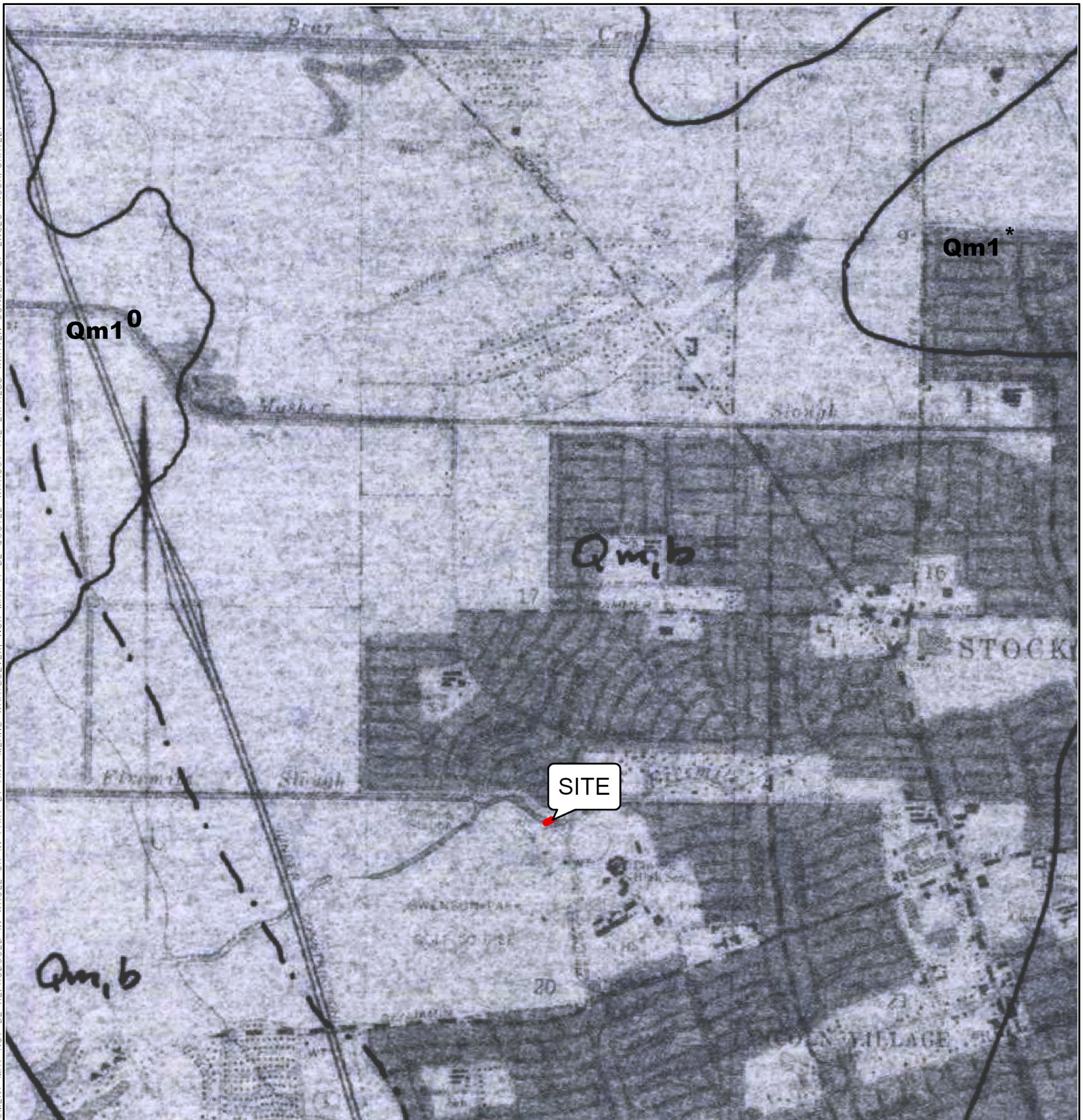
1-B1 BORING (ENGEO, 2021)

BASE MAP SOURCE: SIEGFRIED AND BING MAPPING SERVICE

ENGEO Expect Excellence	SITE PLAN ALEXANDRIA AND FIVE MILE SLOUGH CULVERT STOCKTON, CALIFORNIA	PROJECT NO.: 19161.000.001		FIGURE NO. 2
		SCALE: AS SHOWN		
		DRAWN BY: JV	CHECKED BY: ZAC	

ORIGINAL FIGURE PRINTED IN COLOR

FILE PATH: G:\Drafting\PROJECTS_18000 to 19999\19161\19161000001\Geotech\GEX\19161000001-2-SitePlan-0921.dwg SAVE DATE: 9/10/2021 4:09:23 PM SAVED BY: jvergara



EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

Qm1b	BASIN ALLUVIUM
Qm1o	QM1 AND QM1B DEPOSITS OVERLAIN BY 0.5 TO 2M OF QM2 DEPOSITS (MERCED SOILS)
Qm1*	QM1 AND QM1B DEPOSITS OVERLAIN BY 0.5 TO 1.5M OF QM2FB DEPOSITS MERCED SOILS (STOCKTON SOILS)

N

0 1,000 2,000

FEET

BASEMAP SOURCE: ATWATER, 1979

ENGEO
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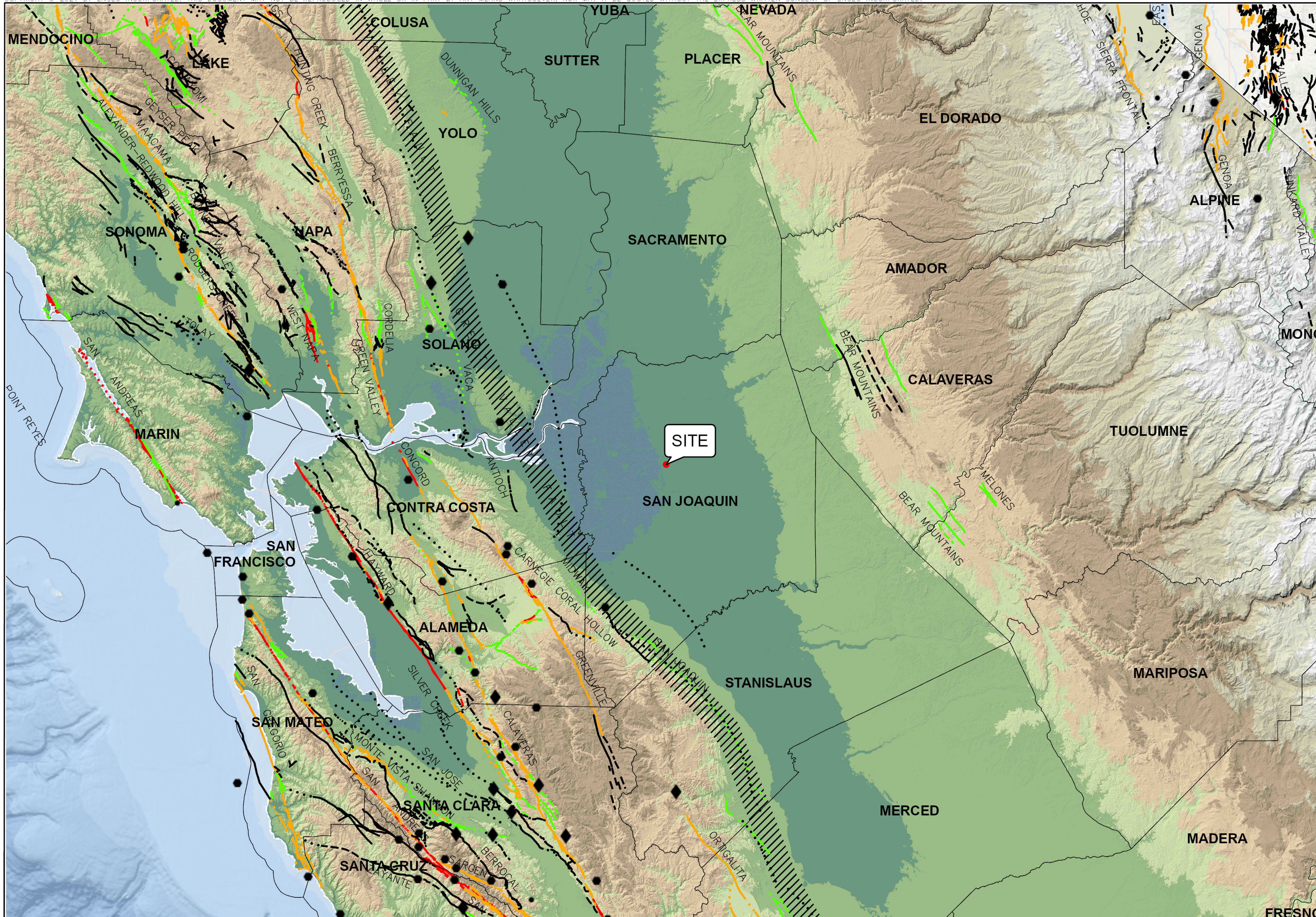
REGIONAL GEOLOGIC MAP ALEXANDRIA AND FIVE MILE SLOUGH CULVERT STOCKTON, CALIFORNIA	PROJECT NO.: 19161.000.001		FIGURE NO. 3
	SCALE: AS SHOWN		
	DRAWN BY: JV	CHECKED BY: ZAC	

PATH: G:\DRAFTING\PROJECTS_18000 TO 19999\19161\19161000001\GEOTECH\GEX\19161000001_GEX.APRX
LAYOUT: GEOLOGIC USER: JVERGARA

ORIGINAL FIGURE PRINTED IN COLOR



EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

EARTHQUAKE

- MAGNITUDE 7+
- MAGNITUDE 6-7
- MAGNITUDE 5-6

QUATERNARY FAULTS

BASED ON TIME OF MOST RECENT SURFACE DEFORMATION

- HISTORICAL (<150 YEARS), WELL CONSTRAINED LOCATION
- HISTORICAL (<150 YEARS), MODERATELY CONSTRAINED LOCATION
- HISTORICAL (<150 YEARS), INFERRED LOCATION
- LATEST QUATERNARY (<15,000 YEARS), WELL CONSTRAINED LOCATION
- LATEST QUATERNARY (<15,000 YEARS), MODERATELY CONSTRAINED LOCATION
- LATEST QUATERNARY (<15,000 YEARS), INFERRED LOCATION
- LATE QUATERNARY (<130,000 YEARS), WELL CONSTRAINED LOCATION
- LATE QUATERNARY (<130,000 YEARS), MODERATELY CONSTRAINED LOCATION
- LATE QUATERNARY (<130,000 YEARS), INFERRED LOCATION
- UNDIFFERENTIATED QUATERNARY(<1.6 MILLION YEARS), WELL CONSTRAINED LOCATION
- UNDIFFERENTIATED QUATERNARY(<1.6 MILLION YEARS), MODERATELY CONSTRAINED LOCATION
- UNDIFFERENTIATED QUATERNARY(<1.6 MILLION YEARS), INFERRED LOCATION
- GREAT VALLEY FAULT ZONE

BASE MAP SOURCE
ESRI, GEBCO, DELORME, NATURALVUE
COLOR HILLSHADE IMAGE BASED ON THE NATIONAL ELEVATION DATA SET (NED) AT 30 METER RESOLUTION
U.S.G.S. QUATERNARY FAULT DATABASE, 2020
U.S.G.S. HISTORIC EARTHQUAKE DATABASE (1800-PRESENT)
U.S.G.S OPEN-FILE REPORT 96-705

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REGIONAL FAULTING AND SEISMICITY
ALEXANDRIA AND FIVE MILE SLOUGH CULVERT
STOCKTON, CALIFORNIA

PROJECT NO. : 19161.000.001	FIGURE NO. 4
SCALE: AS SHOWN	
DRAWN BY: JV	CHECKED BY: ZAC

PATH: G:\DRAFTING\PROJECTS_18000 TO 19999\19161\19161000001\GEOTECH\GEX\19161000001_GEX.APRX
LAYOUT: FAULT&SEISMICITY USER: JVERGARA

ORIGINAL FIGURE PRINTED IN COLOR

APPENDIX A

BORING LOG KEY
EXPLORATION LOGS

KEY TO BORING LOGS

MAJOR TYPES			DESCRIPTION
COARSE-GRAINED SOILS MORE THAN HALF OF MAT'L LARGER THAN #200 SIEVE	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELS WITH LESS THAN 5% FINES	GW - Well graded gravels or gravel-sand mixtures
			GP - Poorly graded gravels or gravel-sand mixtures
		GRAVELS WITH OVER 12 % FINES	GM - Silty gravels, gravel-sand and silt mixtures
			GC - Clayey gravels, gravel-sand and clay mixtures
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS WITH LESS THAN 5% FINES	SW - Well graded sands, or gravelly sand mixtures
			SP - Poorly graded sands or gravelly sand mixtures
		SANDS WITH OVER 12 % FINES	SM - Silty sand, sand-silt mixtures
			SC - Clayey sand, sand-clay mixtures
FINE-GRAINED SOILS MORE THAN HALF OF MAT'L SMALLER THAN #200 SIEVE	SILTS AND CLAYS LIQUID LIMIT 50 % OR LESS		ML - Inorganic silt with low to medium plasticity
			CL - Inorganic clay with low to medium plasticity
			OL - Low plasticity organic silts and clays
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50 %		MH - Elastic silt with high plasticity
			CH - Fat clay with high plasticity
			OH - Highly plastic organic silts and clays
	HIGHLY ORGANIC SOILS		PT - Peat and other highly organic soils

For fine-grained soils with 15 to 29% retained on the #200 sieve, the words "with sand" or "with gravel" (whichever is predominant) are added to the group name.

For fine-grained soil with >30% retained on the #200 sieve, the words "sandy" or "gravelly" (whichever is predominant) are added to the group name.

GRAIN SIZES

U.S. STANDARD SERIES SIEVE SIZE: 200 — 40 — 10 — 4

CLEAR SQUARE SIEVE OPENINGS: 3/4" — 3" — 12"

SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

RELATIVE DENSITY

SANDS AND GRAVELS	BLOWS/FOOT (S.P.T.)
VERY LOOSE	0-4
LOOSE	4-10
MEDIUM DENSE	10-30
DENSE	30-50
VERY DENSE	OVER 50

CONSISTENCY

SILTS AND CLAYS	STRENGTH*
VERY SOFT	0-1/4
SOFT	1/4-1/2
MEDIUM STIFF	1/2-1
STIFF	1-2
VERY STIFF	2-4
HARD	OVER 4

MOISTURE CONDITION

DRY	Dusty, dry to touch
MOIST	Damp but no visible water
WET	Visible freewater

SAMPLER SYMBOLS

- Modified California (3" O.D.) sampler
- California (2.5" O.D.) sampler
- S.P.T. - Split spoon sampler
- Shelby Tube
- Dames and Moore Piston
- Continuous Core
- Bag Samples
- Grab Samples
- NR No Recovery

LINE TYPES

- Solid - Layer Break
- Dashed - Gradational or approximate layer break

GROUNDWATER SYMBOLS

- Groundwater level during drilling
- Stabilized groundwater level

(S.P.T.) Number of blows of 140 lb. hammer falling 30" to drive a 2-inch O.D. (1-3/8 inch I.D.) sampler

* Unconfined compressive strength in tons/sq. ft., asterisk on log means determined by pocket penetrometer

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LOG OF BORING 1-B1

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LATITUDE: 38.013071 LONGITUDE: -121.339699

Geotechnical Exploration
Five Mile Slough Culvert
Stockton, CA
19161.000.001

DATE DRILLED: 8/27/2021
HOLE DEPTH: Approx. 31½ ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (NAVD88): Approx. 8½ ft.

LOGGED / REVIEWED BY: L. Becker / ZAC
DRILLING CONTRACTOR: West Coast Exploration
DRILLING METHOD: Solid Flight Auger
HAMMER TYPE: 140 lb. Rope and Cathead

Depth in Feet	Elevation in Feet	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Shear Strength (psf) *field approximation	Unconfined Strength (tsf) *field approximation	Strength Test Type
			ASPHALTIC CONCRETE (AC)												
			CLAYEY SAND (SC), olive brown, medium dense, dry to moist, medium- to fine-grained sand, 15-25% fines			40					10	116			
	5					15									
5											19	102			
			CLAYEY SAND (SC), dark greenish gray, loose, moist, coarse- to fine-grained sand, 20-30% fines, contains dark greenish gray clay lens sample			13									
	0		SANDY LEAN CLAY (CL), black, moist, 30-40% fine-grained sand, micaceous, contains organics			PUSH	45	17	28	65	28	94	955		UU
10															
			CLAYEY SAND (SC), greenish gray to dark greenish gray, medium dense, moist, low plasticity, medium- to fine-grained sand, 40-45% fines, contains roots			23				42	18				
	-5		CLAYEY SAND (SC), dark greenish gray, medium dense to dense, moist to wet, coarse- to fine-grained sand, 12-20% fines												
15						30					10	112			
					▽										
	-10														
20															

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LOG OF BORING 1-B1

LATITUDE: 38.013071 LONGITUDE: -121.339699

Geotechnical Exploration
Five Mile Slough Culvert
Stockton, CA
19161.000.001

DATE DRILLED: 8/27/2021
HOLE DEPTH: Approx. 31½ ft.
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LOGGED / REVIEWED BY: L. Becker / ZAC
DRILLING CONTRACTOR: West Coast Exploration
DRILLING METHOD: Solid Flight Auger
HAMMER TYPE: 140 lb. Rope and Cathead

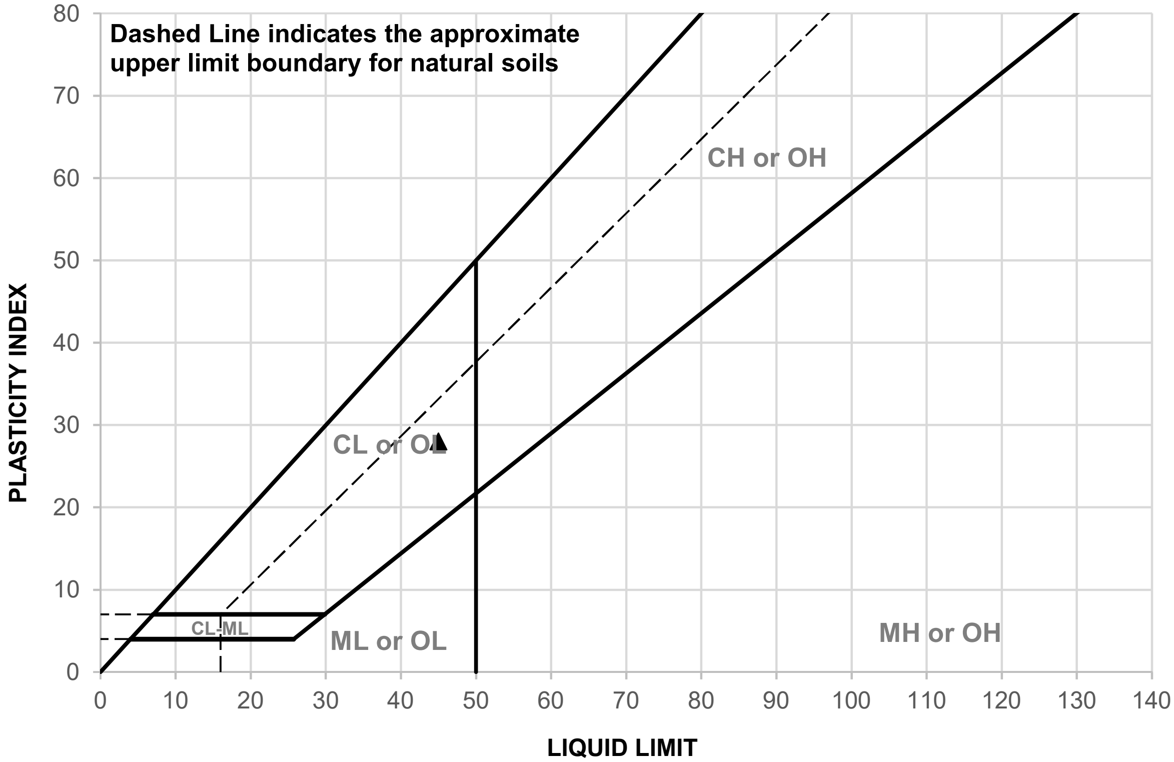
Depth in Feet	Elevation in Feet	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Shear Strength (psf) *field approximation	Unconfined Strength (tsf) *field approximation	Strength Test Type
			15-25% fines			62									
			SILTY SAND (SM), very dark greenish gray, very dense, wet, non plastic, fine-grained sand, 20-30% fines												
	-15														
			LEAN CLAY (CL), gray mottled with olive yellow, very stiff, wet, low plasticity, 10-15% fine-grained sand, contains silt												
25						22									
			Grades to grayish brown												
	-20														
			LEAN CLAY (CL), dark greenish gray, very stiff, wet, medium plasticity, 5-15% coarse- to fine-grained sand, less than 5% fine gravel												
30						21									
			End of boring at approximately 31 1/2 feet below ground surface. Groundwater encountered at approximately 17 feet below ground surface at time of drilling.												

APPENDIX B

LABORATORY TEST DATA

Liquid and Plastic Limits Test Report
Unconsolidated Undrained Triaxial Test
Particle Size Distribution Report
Direct Shear Test

LIQUID AND PLASTIC LIMITS TEST REPORT
ASTM D4318



	SAMPLE ID	DEPTH	MATERIAL DESCRIPTION	LL	PL	PI
▲	1-B1@9	9.0 feet	See exploration logs	45	17	28

	SAMPLE ID	TEST METHOD	REMARKS
▲	1-B1@9	PI: ASTM D4318, Wet Method	

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CLIENT: Siegfried Engineering
PROJECT NAME: Alexandria and Five Mile Slough Culvert Replacement
PROJECT NO: 19161.000.001 PH001
PROJECT LOCATION: Stockton, California
REPORT DATE: 9/17/2021
TESTED BY: G. Criste
REVIEWED BY: K. Lecce

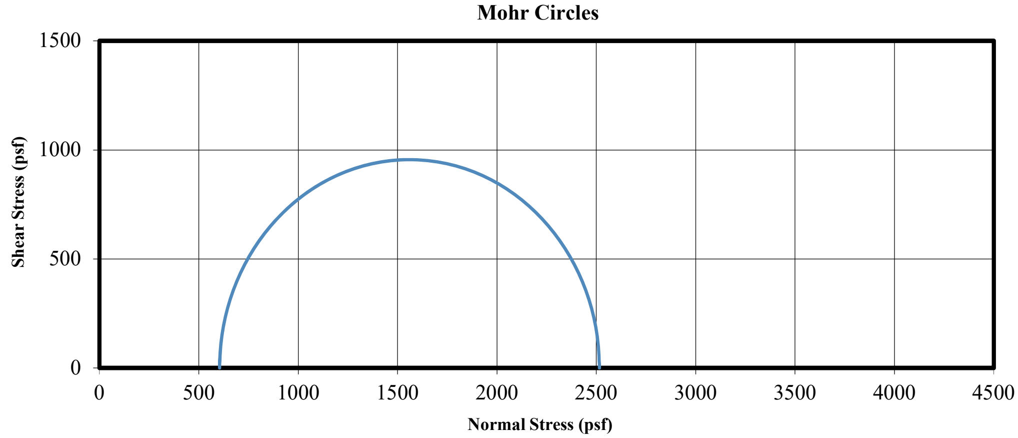
Isotropic Unconsolidated Undrained Triaxial Test
ASTM D2850

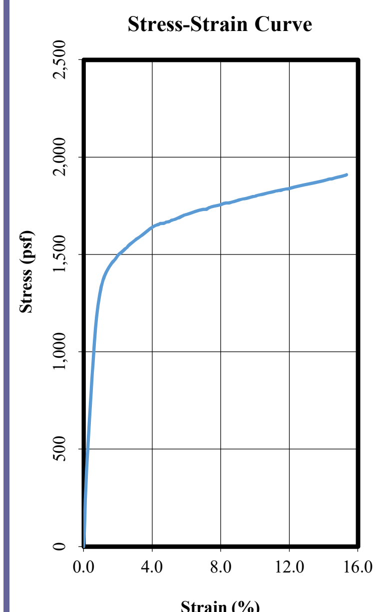
Date: 09/13/21

Checked By: K. Lecce

Date: 9/10/2021

Tested By: G. Criste





	Specimen			
Before Test	**1-B1@9**			
Water Content (%)	28.42			
Dry Density (pcf)	94.00			
Saturation (%)	95.77			
Void Ratio	0.81			
Diameter (in)	2.856			
Height (in)	6.023			
Height-to-Diameter Ratio	2.109			
ASTM D4318 - Wet Method				
Liquid Limit				
Plastic Limit				
ASTM D854 - Assumed				
Specific Gravity	2.720			
After Test	**1-B1@9**			
Water Content (%)	28.42			
Saturation (%)	95.77			
Strain Rate (%/min)	0.06			
Peak Deviator Stress (psf)	1910.5			
Axial Strain @ Failure (%)	15.330			
	Cell Pressure			
Cell (psf)	604.8			
Back (psf)	n/a			
	Principle Stresses at Failure			
σ1 (psf)	2515.3			
σ3 (psf)	604.8			
Corrected Peak Deviator Stress				

Mohr-Coulomb Parameters with a Non-zero Friction Angle (Ø≠0)			**Cohesion at Failure with a Zero Friction Angle (Ø=0)**			
Cohesion, c (psf)	n/a		955.2			
Friction Angle Ø	n/a		n/a			

Project Information	
Project Name:	Alexandria and Five Mile Slough Culvert Replacement
Project Number:	19161.000.001 PH001
Project Location:	Stockton, California
Client:	Siegfried Engineering
Description:	See exploration logs
Test Remarks:	

ENGEO
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Isotropic Unconsolidated Undrained Triaxial Test
ASTM D2850

Date: 09/13/21

Checked By: K. Lecce

Date: 9/10/2021

Tested By: G. Criste

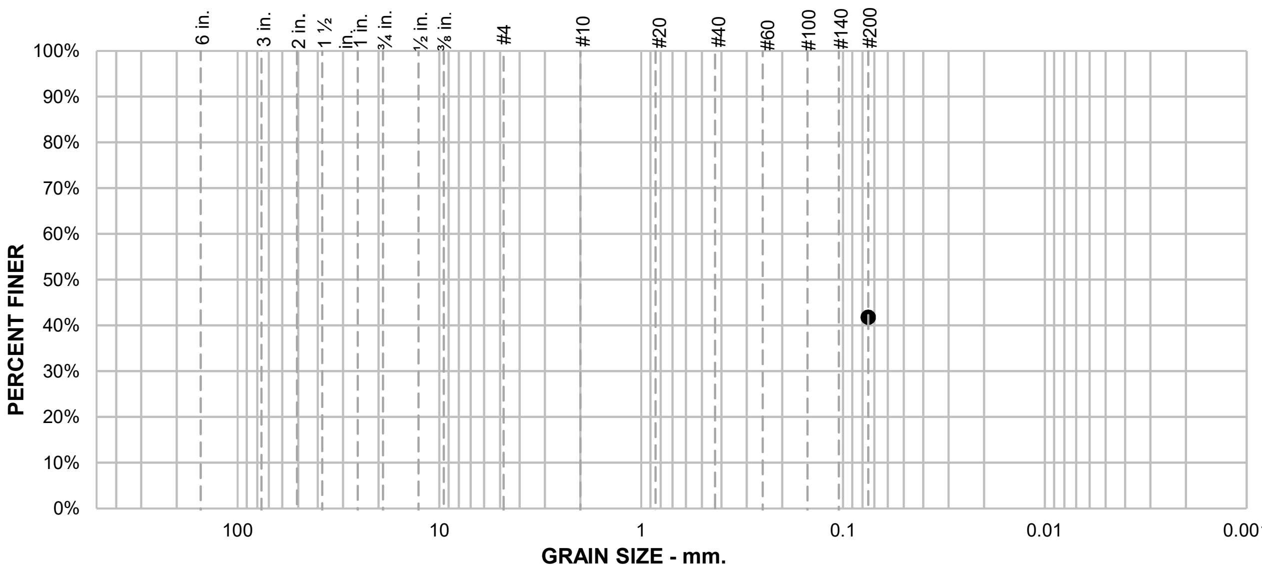
SPECIMEN PHOTOS

SAMPLE NUMBER: 1-B1@9	
	

Project Information		
Project Name:	Alexandria and Five Mile Slough Culvert Replacement	
Project Number:	19161.000.001 PH001	ENGEO Expect Excellence
Project Location:	Stockton, California	
Client:	Siegfried Engineering	
Description:	See exploration logs	
Test Remarks:		

PARTICLE SIZE DISTRIBUTION REPORT

ASTM D1140, Method B



SAMPLE ID: 1-B1@11

DEPTH (ft): 11

% +75mm	% GRAVEL		% SAND			% FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
						41.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	41.8		

SOIL DESCRIPTION

See exploration logs

ATTERBERG LIMITS

PL = LL = PI =

COEFFICIENTS

D_{90} = D_{85} = D_{60} =
D_{50} = D_{30} = D_{15} =
D_{10} = C_u = C_c =

CLASSIFICATION

USCS =

REMARKS

Soak time = 240 min
Dry sample weight = 250.7 g

* (no specification provided)

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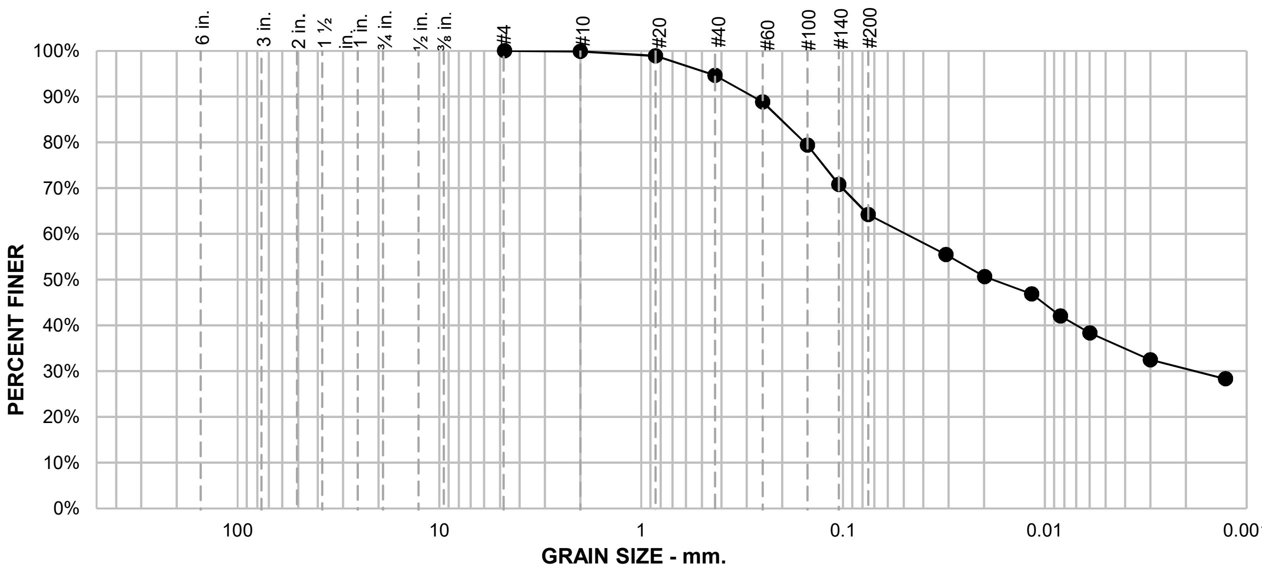
CLIENT: Siegfried Engineering
PROJECT NAME: Alexandria and Five Mile Slough Culvert Replacement
PROJECT NO: 19161.000.001 PH001
PROJECT LOCATION: Stockton, California
REPORT DATE: 9/14/2021
TESTED BY: G. Criste
REVIEWED BY: K. Lecce

PARTICLE SIZE DISTRIBUTION REPORT
ASTM D422



SAMPLE ID: 1-B1@9

DEPTH (ft): 9

% +75mm	% GRAVEL		% SAND			% FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
			0.1	5.3	30.4	33.7	30.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#20	98.9		
#40	94.6		
#60	88.8		
#100	79.4		
#140	70.8		
#200	64.2		
0.0309 mm.	55.5		
0.0199 mm.	50.7		
0.0116 mm.	46.9		
0.0084 mm.	42.1		
0.0060 mm.	38.3		
0.0030 mm.	32.5		
0.0013 mm.	28.3		

SOIL DESCRIPTION

See exploration logs

ATTERBERG LIMITS

PL = 17 LL = 45 PI = 28

COEFFICIENTS

D_{90} = 0.2797 mm	D_{85} = 0.2034 mm	D_{60} = 0.0489 mm
D_{50} = 0.0180 mm	D_{30} = 0.0018 mm	D_{15} =
D_{10} =	C_u =	C_c =

CLASSIFICATION

USCS = CL

REMARKS

Silt/clay division of 0.002mm used
PI: ASTM D4318, Wet Method
USCS: ASTM D2487

* (no specification provided)

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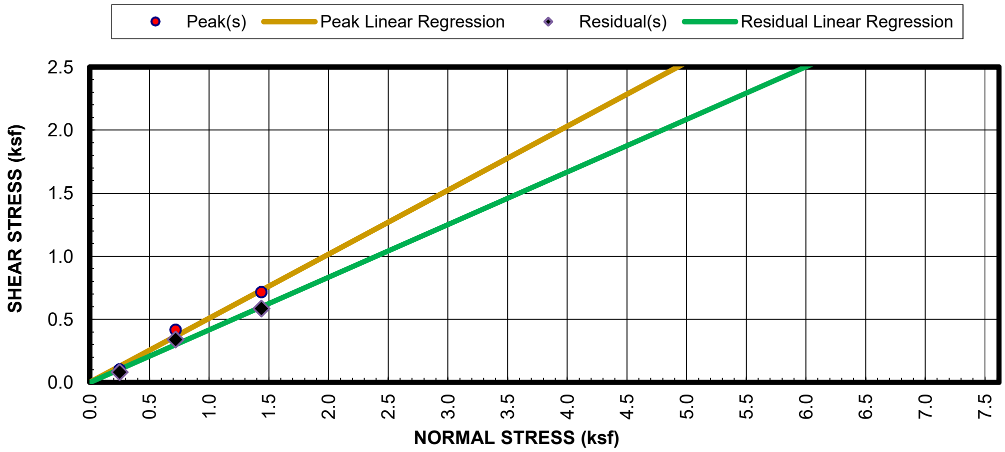
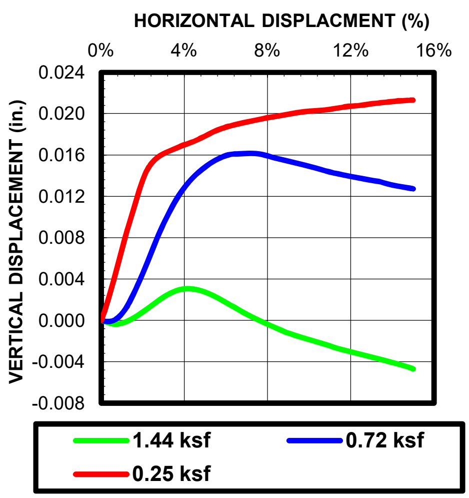
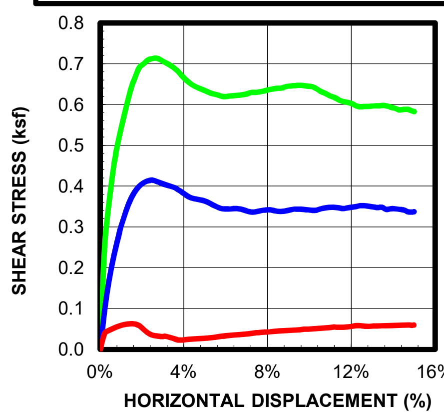
CLIENT: Siegfried Engineering
PROJECT NAME: Alexandria and Five Mile Slough Culvert Replacement
PROJECT NO: 19161.000.001 PH001
PROJECT LOCATION: Stockton, California
REPORT DATE: 9/17/2021
TESTED BY: G. Criste
REVIEWED BY: K. Lecce

CONSOLIDATED DRAINED DIRECT SHEAR
ASTM D3080







	SPECIMEN			
INITIAL PARAMETERS	**1.44 ksf**	**0.72 ksf**	**0.25 ksf**	
MOISTURE (%)	18.72	25.86	24.25	
DRY DENSITY (PCF)	101.85	98.84	95.58	
VOID RATIO	0.657	0.749	0.801	
SATURATION (%)	77.06	95.59	83.47	
DIAMETER (IN.)	2.415	2.415	2.415	
HEIGHT (IN.)	1.002	0.996	1.013	
DIAMETER-TO-HEIGHT RATIO	2.411	2.424	2.384	
SPECIFIC GRAVITY (ASTM D854)	2.703	2.770	2.758	
FINAL PARAMETERS	**1.44 ksf**	**0.72 ksf**	**0.25 ksf**	
MOISTURE (%)	23.29	27.12	29.15	
DRY DENSITY (PCF)	103.56	98.75	95.44	
VOID RATIO	0.629	0.751	0.804	
SATURATION (%)	100.00	99.99	100.00	
DIAMETER (IN.)	2.415	2.415	2.415	
HEIGHT (IN.)	0.980	0.988	1.013	
NORMAL STRESS (ksf)	1.44	0.72	0.25	
PEAK STRESS (ksf)	0.71	0.41	0.06	
PEAK STRAIN (%)	2.69	2.48	1.45	
RESIDUAL STRESS (ksf)	0.58	0.34	0.06	
RESIDUAL STRAIN (%)	15.00	15.00	14.99	
RATE (IN/MIN)	0.00181	0.00181	0.00181	
DIAMETER-TO-HEIGHT RATIO	2.465	2.445	2.385	

SPECIMEN INFORMATION		STRENGTH PARAMETERS	$\phi°$	C(ksf)
SAMPLE ID:	1-B1@5.5			
DEPTH (ft):	5.5 feet	PEAK:	26.9	0.00
SAMPLE TYPE:	In-situ	RESIDUAL:	22.6	0.00
DESCRIPTION:	See exploration logs	**ASTM D4318**		
		LIQUID LIMIT	n/a	
		PLASTIC LIMIT:	n/a	
REMARKS:	Consolidation data inconclusive. Default shear rate used.			

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CLIENT: Siegfried Engineering
PROJECT NAME: Alexandria and Five Mile Slough Culvert Replacement
PROJECT NO: 19161.000.001 PH001
PROJECT LOCATION: Stockton, California
REPORT DATE: 9/16/2021
TESTED BY: G. Criste
REVIEWED BY: K. Lecce

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