Appendix F

Preliminary Geotechnical Feasibility Investigation

ESA

PRELIMINARY GEOTECHNICAL FEASIBILITY REPORT

PROPOSED LOMA ALTA SLOUGH WETLANDS ENHANCEMENT PROJECT
OCEANSIDE, CALIFORNIA

Prepared for:

Environmental Science Associates
Attn: Lindsey Sheehan
550 West C Street, Suite 750
San Diego, CA 92101

TGI Project No. 19.00936

March 2, 2020

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Civil Engineering
Environmental Site Assessment

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March 2, 2020
TGI Project No. 19.00936

ESA / Environmental Science Associates
Attn: Lindsey Sheehan, P.E.
550 West C Street, Suite 750
San Diego, California 92101

Subject: Preliminary Geotechnical Feasibility Report
Proposed Loma Alta Slough Wetlands Enhancement Project
Oceanside, CA

Dear Lindsey Sheehan:

At your request, Taylor Group, Inc. (TGI) is currently performing a geotechnical engineering investigation of the subject site. At this time, subsurface exploration of the subject site and much of the geotechnical laboratory testing for the proposed project has been completed. However, the project is in the early stages of planning, and multiple site development alternatives are currently under consideration. TGI will perform additional analyses of the subsurface conditions and laboratory data as they pertain to the project once the proposed development plans become more defined. The results of the analyses and exploration will be presented in a comprehensive geotechnical report that will include conclusions and recommendations for design and construction of the proposed project.

This preliminary feasibility report is intended to present the preliminary results of the subsurface exploration, limited laboratory test results, discuss the encountered subsurface conditions, discuss potential seismic hazards, and provide conclusions regarding the feasibility of the project. This preliminary feasibility report is not intended for design of the project or submission to the local building official for building permit purposes. Once the development plans become more defined, a comprehensive geotechnical report will be prepared for these purposes.

Based on the preliminary results of our investigation, we conclude that the proposed project is feasible from the geotechnical engineering standpoint, provided the conclusions, recommendations, and design parameters that will be presented in the forthcoming comprehensive geotechnical report are implemented during design and construction of the proposed project.

TGI appreciates the opportunity to be of service to you. Please contact us if you have any questions regarding this report.

Sincerely,

TAYLOR GROUP, INC.

REGISTERED PROFESSIONAL ENGINEER
MICHAEL A. CAZENEUVE
No. 3114
GEOTECHNICAL
STATE OF CALIFORNIA

Michael A. Cazeneuve
Senior Engineer
G.E. 3114

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1 INTRODUCTION

1.1 GENERAL

This feasibility report presents the preliminary results of an investigation to provide geotechnical design and construction recommendations for the proposed Loma Alta Slough Wetlands Enhancement Project, which is planned along the Loma Alta Creek between South Pacific Street and South Coast Highway in the City of Oceanside, California (Figure 1). Taylor Group, Inc. ("TGI") prepared this preliminary feasibility report for the exclusive use of Environmental Science Associates (ESA).

1.2 INTENT AND COMPLETED SCOPE

This preliminary feasibility report is intended to present the preliminary results of the subsurface exploration, discuss the encountered subsurface conditions, discuss potential seismic hazards, and provide conclusions regarding the feasibility of the project. This preliminary feasibility report is not intended for design of the project or submission to the local building official for building permit purposes. Once the development plans become more defined, a comprehensive geotechnical report will be prepared for these purposes.

Based on the preliminary results of our investigation, we conclude that the proposed project is feasible from the geotechnical engineering standpoint, provided the conclusions, recommendations, and design parameters that will be presented in the forthcoming comprehensive geotechnical report are implemented during design and construction of the proposed project.

To date, the following tasks have been performed:

- Visual geotechnical reconnaissance of the Site and vicinity;
- Review of available published information and reports regarding geotechnical, geologic and seismic conditions;
- Performance of a subsurface investigation consisting of drilling four exploratory borings to a depth of approximately 20 feet below the ground surface.
- Collection of geotechnical laboratory data from tests performed on soil samples obtained from the borings. Much of the laboratory testing has been completed at this time. However, additional testing is ongoing.

1.3 SITE DESCRIPTION AND PROJECT BACKGROUND

The Loma Alta Slough is an approximate 3-acre coastal estuarine wetland located adjacent to the coast in the central portion of the City of Oceanside, California. In general, it is located approximately 0.3 miles south of Oceanside Boulevard, between South Coast Highway and South Pacific Street. The slough represents the terminus of the Loma Alta Creek, which drains from east to west towards the Pacific Ocean. It is bounded to the northwest by industrial properties and the La Salina Wastewater Treatment Plant. It is bounded to the southeast by Buccaneer Park (a community park) and a recreational vehicle (RV) resort. Bridge structures cross the wetland at 3 locations (i.e. South Coast Highway, the railroad right of way, and South Pacific Street).

Historically, the natural form of the wetland area was much larger than it is today. Development within the City of Oceanside, channel modifications, and transportation infrastructure have encroached into the wetland area, reduced its overall size, and affected water quality and natural biological habitats. Based on information provided in city proposal documents for the proposed project, the City of Oceanside has had the goal of enhancing and/or restoring the Loma Alta Slough area since the 1990s. In order to affect this change, the city has periodically acquired properties located to the northwest of the slough with the intent of expanding the slough area to the north.

In general, the immediate vicinity of the Site gently descends to the southwest and the Pacific Ocean. Parcels on the northwest portion of the project area are estimated to be approximately 5 to 10 feet above the slough elevation. Buccaneer Park and the RV park are also estimated to be on the order of 5 feet above the slough elevation. Vegetation on the site consists of grasses, bushes, and trees typical of a wetland slough.

1.4 PROJECT DESCRIPTION

Information regarding the proposed project was provided by the client, and the City of Oceanside Water Utilities Department. The proposed enhancement project is planned to expand the wetland slough area towards the northwest (i.e. on City of Oceanside property). At this time, three alternative plans are under consideration for the project. Each alternative includes different schemes for re-routing the Loma Alta Creek through the project boundaries. The various alternatives include different combinations of tributary side channels, re-routing of the main channel, and diversion berms. Improvements to an existing footpath and extension of the Oceanside Coastal Rail Trail bike path are also under consideration for the project. The stated intent of the project is to:

> "restore the functional value of the slough and accommodate public use through trails, educational signage and linkage with public transportation. Enlargement and modification of the slough's wetlands is expected to support coastal wildlife, improve water quality, buffer peak storm flows, and plan for sea level rise."

While the details of the proposed project are not well constrained at this time, it is anticipated the project will include the following geotechnically related design and/or construction aspects:

- Grading of the site in order to lower site grades, create tributary side channels, and re-route the main creek channel along the northwestern perimeter of the slough. This is expected to include:
  - Approximate 5 to 15-foot high cut slopes along the northern perimeter.
  - Construction of berms within the existing main channel in order to re-route the channel.
- Subgrade preparations for footpaths and/or bike paths, if necessary.
- Placement of miscellaneous fills in limited areas, if any.
- Construction of temporary diversion channels.
- Dewatering to allow for dry conditions during construction.
- Limited new foundations for ancillary structures, if any.
- Temporary support for existing structures during construction.

The preliminary site alternatives currently under consideration are shown on the enclosed Figures 2a through 2c. The existing site conditions are shown on Figure 2d.

Two

2 SUBSURFACE INVESTIGATION

2.1 EXPLORATORY BORINGS

The site was explored on January 13, 2020 by drilling four exploratory borings to a depth of approximately 20 feet below the ground surface. The borings were performed with a truck-mounted drilling machine equipped with 6-inch diameter hollow stem augers. The borings were generally located within the area of the proposed project.

All drilling and sampling operations were performed under the supervision of a professional engineer experienced in the performance of geotechnical field investigations. TGI's on-site personnel visually classified and logged the materials encountered in the exploratory borings and obtained relatively undisturbed samples and bulk samples at various depths for observation and laboratory testing. The boring locations are shown on the enclosed Figures 2a through 2d, and the logs are included in Appendix A of this report. The boring depths and surface elevations are summarized in Table 2.1 below.

Table 2.1 Summary of Exploratory Borings

Boring No.	Approx. Surface Elevation* (feet)	Depth of Boring (feet)
B1	14.0	20
B2	11.5	20
B3	11.0	20
B4	13.0	20

*Elevations approximate and based on site plans by Environmental Science Associates.

Drive samples were obtained at various depths using a 2.5-inch I.D. ring-lined sampler driven with a 140-pound automatic hammer dropped 30 inches. Samples were placed in plastic bags and then into 6-inch long PVC tubes. The ends of the tubes were then capped and taped. Bulk samples from selected depths were placed in plastic bags.

2.2 EARTH MATERIALS

The field investigation performed by TGI encountered undocumented fill soils underlain by natural Quaternary alluvium deposits. These geologic units are described in more detail below, in order from youngest to oldest.

2.2.1 Fill

Undocumented fill soils were observed in the borings to depths between approximately 5 and 12.5 feet below the ground surface. The fill generally consists of silty sands and clayey sands, which are light brown, brown, reddish brown, gray and dark gray, with a commonly mottled appearance. The fill soils are moist to saturated, medium dense, and fine to medium or fine to coarse grained. Some gravel and other miscellaneous debris (i.e. asphalt, brick, plastic, concrete, and wood) were also observed in the fill soils.

2.2.2 Natural Alluvium

Natural alluvial deposits were observed below the fill. In borings B1 and B2 the alluvium consisted of combinations of silty sand, clayey sand, and sands, which are gray to dark gray in color, saturated, medium dense, and predominantly fine grained. Natural alluvium encountered in borings B3 and B4 predominantly consisted of silty clay, which is gray, moist, and firm. Occasional thin interbeds of silty sand were also observed in borings B3 and B4.

2.3 GROUNDWATER AND CAVING

Groundwater was encountered in the borings during exploration at depths between 5 and 8½ feet. The depth to groundwater is summarized in the following Table 2.2.

Table 2.2 Depths to Groundwater Observed in Borings

Well No.	Depth to Groundwater (feet)*	Approximate Water Surface Elevation (feet)*
B1	8.5	5.5
B2	5.0	6.5
B3	8.5	2.5
B4	6.5	6.5

*Depth to groundwater measured from top of borehole. Surface elevations are approximate. Elevations approximate and based on site plans by Environmental Science Associates.

Seasonal and tidal variations of groundwater levels may occur, and shallower zones of perched groundwater may occasionally exist beneath the Site.

Caving was not observed in the borings during exploration on the site. However, the boreholes were cased during drilling and caving was not possible. Caving should be expected to occur in sandy soils underlying the site, or any soil below the groundwater level.

2.4 GEOTECHNICAL LABORATORY TESTING

Samples that were obtained during the field investigation were transported to TGI's lab for geotechnical laboratory testing. The laboratory testing program that has been completed for this investigation to date included tests to evaluate moisture content, dry density, maximum density, shear strength, and consolidation. The completed testing is summarized in the following Table 2.3.

Table 2.3 Summary of Completed Laboratory Testing

Test Procedure	Test Method	Number of Tests
Moisture Content / Dry Density	ASTM D 2216	7
Maximum Density	ASTM D 1557	2
Shear Strength	ASTM D 3080	5
Consolidation	ASTM D 2435	2

Tests were performed in general accordance with applicable ASTM and/or Caltrans procedures, or procedures generally accepted in geotechnical engineering practice. Laboratory testing results are included in Appendix B of this report.

Three 3 REGIONAL GEOLOGY AND FAULTING

3.1 REGIONAL GEOLOGIC SETTING

The project site lies within the Peninsular Ranges geomorphic province, an extensive uplifted fault block that occupies the southwestern portion of California and extends southward into Baja California. The Site is located within the coastal plain portion of the Peninsular Range province. Topography in the Site vicinity is relatively flat and generally descends gradually toward the southwest. The Site area is underlain at depth by sedimentary formations known as terrace deposits, which are Pleistocene in age (10,000 to 1.8 million years). Miocene bedrock of the Santiago Formation and San Onofre Breccia Formation also likely underlie the site. A local geologic map indicating the site location is presented on Figure 3.

The geologic structure of the area of investigation is dominated by a system of northwest trending faults including the San Clemente, Palos Verdes/Coronado Bank, Newport-Inglewood/Rose Canyon, Elsinore, and San Jacinto fault zones (see Figure 4). All of these faults are believed to have experienced historic or recent movement (within in the past 10,000 years). Movement along one or more of these faults or others is probable during the lifetime of the project.

3.2 FAULTING AND SEISMICITY

Figure 4 presents a map illustrating the locations of known regional faults in relation to the study area location. The following table summarizes information on the nearby regional active faults.

Table 3.1 Nearby Active Regional Faults

Fault	Approximate Distance From Study Area (km)	Direction	Maximum Credible Earthquake
Newport-Inglewood Fault	3.4	SW	6.9
Rose Canyon Fault	3.4	SW	6.9
Coronado Banks Fault	30	SW	7.4
Elsinore Fault	37	NE	6.8
San Diego Trough Fault	46	SW	>7.0 (?)
San Jacinto Fault	74	NE	6.8
San Clemente Fault	87	SW	>7.0 (?)
San Andreas Fault	100	NE	7.4

The nearest known active faults are the southern extension of the Newport-Inglewood Fault and the northern extension of the Rose Canyon Fault, both of which are part of the Offshore Zone of Deformation located approximately 3.4 kilometers (2.1 miles) southwest of the study area in the Pacific Ocean. Other active faults located within approximately 50 km (30 miles) of the study area include the Coronado Bank Fault Zone, located approximately 30 km to the southwest, the Elsinore Fault, located approximately 37 km to the northeast, and the San Diego Trough Fault, located approximately 46 km to the southwest.

Research (Rivero, et.al, 2000) has suggested that two blind thrust faults, the Thirtymile Bank thrust and the Oceanside thrust, might exist off the coast of Oceanside. These postulated thrust faults have little or no historical record. It has been suggested that the 1986 Oceanside earthquake (M_L 5.3) ruptured as a small part of the Thirtymile Bank thrust.

The Thirtymile Bank thrust runs south from Santa Catalina Island, with the closest segment located approximately 60 km (37.3 miles) southwest from the study area. The Oceanside fault runs south from Laguna Beach in Orange County, with the closest segment located approximately 16 km (9.9 miles) southwest from the study area. Both extend south to San Diego and possibly beyond the U.S.-Mexico border. The postulated faults are thought to be capable of producing earthquake events with magnitudes up to M_w 7.6 if they are linked with other fault systems. Magnitude 7.4 events on the Thirtymile Bank Fault could have a minimum recurrence interval of about 2,100 years. The largest likely earthquake events on the Oceanside Fault could be on the order of magnitude 7.5 with a recurrence interval of 1,100 to 8,800 years.

Four 4 SEISMIC HAZARDS

Southern California is a seismically active area and the Site, like virtually all of Southern California, is susceptible to earthquakes and earthquake related effects. In addition to damage caused directly by ground shaking and related ground failure, other hazards such as fires can easily start during and shortly after an earthquake. The following sections describe the relative level of risk associated with various earthquake related effects at the Site.

4.1 EARTHQUAKE FAULT RUPTURE HAZARD

Based on a review of available current maps, and observations of the subject site, there are no known active or potentially active faults crossing the site. In addition, the Site is not located within a mapped Alquist-Priolo Earthquake Fault Zone. Based on these considerations, the risk of surface fault rupture occurring at the site is judged to be negligible.

4.2 GROUND SHAKING

The Site may be subjected to strong ground motions during an earthquake on any of several known active fault systems, most specifically those identified in Section 3.2. Due to their close proximity to the site, the Rose Canyon and Newport Inglewood are believed to pose the most significant ground shaking hazard at the site. Based on recent fault parameters published by the CDMG, both the Newport-Inglewood and Rose Canyon faults are right lateral strike-slip faults and are considered to be capable of producing a Maximum Credible Earthquake (MCE) of magnitude 6.9.

Based on the *ASCE 7 Seismic Hazard Maps Tool (and ASCE/SEI7-16 Standard),* the site adjusted peak ground acceleration (PGA_M) in the area of the Site is on the order of 0.54g.

4.3 LIQUEFACTION

When subjected to cyclical loading conditions like those induced by an earthquake, unconsolidated sandy deposits that are saturated with water can undergo a temporary strength loss due to buildup of excess pore water pressure. This process is called "liquefaction." Liquefied soils can undergo a loss of bearing strength, and they can experience contraction (consolidation) as excess pore pressure dissipates, resulting in settlement. Liquefied soils have a reduced ability to support the weight of surface structures, or to resist flowing downslope, even on nearly level ground. Liquefaction may result in sinking, tilt, distortion, destruction of structures, rupture of underground pipelines, and cracking and spreading of the ground surface (lateral spread).

Liquefaction generally occurs in areas where groundwater is less than 50 feet from the surface, and where the soils are composed of poorly consolidated, fine to medium-grained sand, or silts of low plasticity. In addition to the necessary soil and groundwater conditions, the ground acceleration and duration of shaking must also be of a sufficient level to initiate liquefaction.

The proposed project consists of enhancements to the existing wetland slough, which will include re-grading on the banks of the Loma Alta Creek. At this time, the proposed development would not be expected to be defined as a “project” under the State of California Seismic Hazard Act because habitable structures are not currently planned for the project. Therefore, site specific liquefaction analyses of the soils underlying the site were not performed and are considered beyond the scope of this investigation.

It is noted that the younger alluvial soils underlying the site include medium dense silty sands, sands, or silts with low plasticity. In addition, groundwater occurs at depths between approximately 5 and 8.5 feet below the ground surface. The client should be aware that these subsurface conditions may be consistent with those necessary for the occurrence of liquefaction during an earthquake on a local or regional fault. Liquefaction analyses were not performed as part of this investigation. Therefore, the potential for liquefaction below the site cannot be ruled out. The soils may or may not be prone to liquefaction, seismically induced settlement, lateral spreading, surface manifestations and loss of bearing strength. Additional discussions of these phenomena are provided in the following sections.

4.3.1 Dynamic Settlement Due to Liquefaction

Seismically-induced settlement occurs when loose to medium dense deposits of partially saturated and saturated granular soils are densified as a result of strong ground shaking during an earthquake. Seismic settlement of surface improvements at the ground surface can result in significant property damage.

Based on the nature of the proposed wetlands enhancement project, the potential for liquefaction and seismically induced settlement at the subject site was not evaluated and is considered beyond the scope of this investigation. Therefore, the occurrence of seismically induced settlement at the subject site cannot be ruled out.

4.3.2 Lateral Spreading Due to Liquefaction

Lateral spreading is a phenomenon that may occur during an earthquake event when the presence of a liquefied layer and gravity forces cause the ground to move laterally in a downslope direction. Liquefaction-induced lateral spreading can occur even on nearly flat ground and can result in tilting, distortion, or destruction of structures, rupture of underground pipelines, and cracking and spreading of the ground surface.

Based on the nature of the proposed wetlands enhancement, the potential for liquefaction and lateral spreading at the subject site was not evaluated and is considered beyond the scope of this investigation. Therefore, the occurrence of lateral spreading at the subject site cannot be ruled out.

4.3.3 Surface Manifestation of Liquefaction and Loss of Bearing Strength

Studies have shown that the visible effects of liquefaction on the ground surface are only manifested if the relative thicknesses of liquefiable soils to overlying non-liquefiable surface material fall within a certain range. Surface manifestations of liquefaction include phenomena such as sand boils. Other studies have shown that damage from liquefaction is seldom due to sand boils themselves, but rather due to the loss of strength and stiffness in the soils that have liquefied and the associated ground deformations that ensue.

Based on the nature of the proposed wetlands enhancement, the potential for liquefaction, surface manifestations, and loss of bearing strength at the subject site was not evaluated and is considered beyond the scope of this investigation. Therefore, the occurrence of these phenomena at the subject site cannot be ruled out.

4.4 TSUNAMI HAZARD

Tsunamis are large, rapidly moving ocean waves triggered by a major disturbance of the ocean floor, which is usually caused by an earthquake but sometimes can be produced by a submarine landslide or a volcanic eruption. These events displace sea water and impulsively generate wave trains that can inundate low lying areas in proximity to the ocean.

Review of the State of California Tsunami inundation map indicates most of the project site is located within the designated Tsunami inundation area. A copy of this map is included in the Appendix as Figure 6. An analysis and determination of whether a higher site elevation would remove the site from the potential Tsunami inundation area is beyond the scope of this investigation. In either case, the client should be aware that the site lies within the potential inundation area due to Tsunami.

4.5 SEICHE HAZARD AND INUNDATION

A seiche is a wave in a body of water that may be caused by long-period earthquake ground motion or landslide. An earthquake induced seiche requires a form of resonance between the natural period of vibration of the body of water and the major periods of vibration in the seismic event. Based on the site location and elevation relative to the any nearby enclosed bodies of water, the seiche hazard is judged to be negligible.

Review of Figure 4.3.2 of the San Diego County Multi-Jurisdictional Hazard Mitigation Plan (County of San Diego, 2017) indicates the site is not located within a potential inundation zone due to breach of an upgradient dam or reservoir. Therefore, the potential for inundation due to dam breach is judged to be negligible.

Five 5 GEOTECHNICAL AND CLIMATIC CONSIDERATIONS

5.1 EXPANSIVE SOILS

Expansive soils can damage surface improvements by uplift as they swell with moisture increases. Swelling soils can lift up and crack lightly-loaded, continuous strip footings, and frequently cause distress in concrete floor slabs.

Potentially expansive soils can be identified in the lab by their plastic properties. Inorganic clays of high plasticity, generally those with liquid limits exceeding 50 percent and plasticity index over 30, usually have high inherent swelling capacity. Expansion of soils can also be measured in the lab directly, by immersing a remolded soil sample and measuring its volume change.

Based on the nature of the proposed project, expansion index testing was not performed on the site soils. The granular soils encountered below much of the subject site are judged to possess a very low to low expansion character. Some clayey soils were encountered in borings B3 and B4. These clayey soils may or may not be expansive. Should these clayey soils be utilized for support of building structures, floor slabs on grade, or any surficial improvement that could be affected by swelling subgrade soils, it is recommended they be tested for their expansion character so that any such improvements may be sufficiently designed and/or specified.

5.2 COLLAPSIBLE SOILS / HYDROCONSOLIDATION

Hydroconsolidation, or soil collapse, typically occurs in soils that were recently (e.g., Holocene age) deposited in arid or semi-arid environments. Soils prone to collapse are commonly associated with poorly-compacted man-made fill, wind-laid sands and silts, and alluvial fan and mudflow sediments deposited during flash floods. The soil particles may be partially bonded by clay or silt, or chemically cemented with carbonates. When saturated, collapsible soils undergo a rearrangement of their grains and the water removes the cohesive (or cementing) material, resulting in often rapid and substantial settlement. An increase in surface water infiltration from irrigation, infiltration of surface water or a rise in the ground-water table, combined with the weight of a structure or additional fill, can initiate settlement. Settlement due to hydroconsolidation can cause foundations and walls to crack.

Positive hydroconsolidation strains did not occur during consolidation testing of the site soils. This is partially due to the near saturated conditions of the tested samples (i.e. the test samples were collected below the groundwater level). Based on these considerations, hydroconoslidation is not expected to occur in the saturated soils underlying the Site.

Where above the groundwater level, the natural alluvium and fill soils may be occasionally porous. Pore space within the soil structure could be susceptible to collapse when wetted. Therefore, the potential for hydroconsolication of the site soils above the groundwater level cannot be ruled out.

5.3 CONSOLIDATION / COMPRESSIBLE SOILS

Based on the results of consolidation testing, the soils underlying the site are considered to be compressible. Where additional new net vertical stresses will be placed on the soils (such as below creek diversion berms), they should be expected to consolidate.

Static settlement analyses and estimates will be provided in the forthcoming comprehensive geotechnical investigation. At this time, it should be anticipated that recommendations will include constructing the diversion berms to a higher elevation so that the final grades will be near the desired grades following consolidation.

5.4 LANDSLIDES / SLOPE STABILITY

Landslides or slope failures are an abrupt movement of soil and/or bedrock downhill in response to gravity. Slope failures generally occur when the driving force induced by the weight of the earth materials within a slope exceeds the strength of those materials. Unstable slope conditions can arise from a number of natural and manmade causes, including increased moisture content, earthquakes, over steepening of the slope angle, and loading at the top of the slope. Slope failure can result in damage to property and injury or loss of life.

Based on our research and evaluation, no known landslides or slope failures exist on the site. At this time, maximum planned slope gradients on the order of 4:1 (h:v) or flatter, with a maximum height of 15 feet, are anticipated for the proposed project. Cut slopes would be expected to expose existing fill and/or natural alluvial soils. Based on the anticipated slope gradients and heights for most of the proposed project, the potential for deep seated slope instability of the cut slopes (without considering toe erosion) is judged to be low.

5.5 CLIMATIC HAZARDS

Climatic hazards are extreme climatic/weather event(s) causing harm and damage to people, property, infrastructure and land uses. These may include both the direct (primary) impacts of the climate/weather event itself but also secondary hazards that are the result of such events, e.g., landslides that are 'triggered' by torrential rain.

5.5.1 Flooding

The enclosed Figure 5 – FEMA Flood Zones Map, shows the relative risk due to flooding for the area of the proposed project. Much of the subject site is located in Special Floor Hazard Areas with Base Flood Elevations.

Evaluation of the potential flood hazard on the subject site is beyond the scope of this geotechnical investigation. In either case, the client should be aware that there are potential flood risks on the subject site.

5.5.2 Sea-Level Rise

Rising sea levels caused by climate change are having profound effects on our coast and are changing coastal management planning and decision-making at all levels. Impacts from sea-level rise to the coastal zone include: flooding and inundation; increased coastal erosion; changes in supply, movement and distribution of sediment, and; saltwater intrusion into aquifers.

The subject property may be most significantly impacted in the long term by increased flooding due to sea level rise. The inland extents of 100-year floods are likely to increase. Drainage systems that outlet close to sea level could become submerged, and inland areas may become flooded if outfall pipes back up with salt water.

A variety of organizations and entities are working to quantify the effects of sea level rise and to address the effects from a policy and regulatory standpoint. The California Coastal Commission has recently prepared a draft guidance document to provide a framework for addressing sea-level rise in Local Coastal Programs and Coastal Development Permits. The draft CCC guidance includes projections included in a 2012 report by the National Research Council (NRC) Committee on Sea-Level Rise in California, Oregon and Washington. These projections, which the CCC believes "currently represents the best available science on the topic", include predictions on a relatively localized. The predictions for the Los Angeles area that are included in the NRC report are summarized in the following table.

Time Period	Projected Sea-Level Rise	
	Average	Range
2000 – 2030	14.7 ± 5.0 cm	4.6 - 30.0 cm
2000 – 2050	28.4 ± 9.0 cm	12.7 - 60.8 cm
2000 – 2100	93.1 ± 24.9 cm	44.2 - 166.5 cm

If these predictions are correct, then it can be estimated that sea-level could increase by 1.3 to 4.8 feet by 2090 (corresponding to a project life of approximately 75 years). This indicates that the project site will not be inundated as a result of sea level rise, but could become more susceptible to flooding due to rainfall events as a result of impacts on downstream storm drain systems.

Six 6 PRELIMINARY CONCLUSIONS

The preliminary results of TGI's investigation and analysis indicate that the proposed wetlands enhancement project is feasible from a geotechnical engineering standpoint provided that the conclusions, recommendations, and design parameters that will be presented in the forthcoming comprehensive geotechnical report are implemented during design and construction of the proposed project. TGI's investigation includes the following preliminary geotechnical considerations:

- The subsurface exploration performed for this investigation encountered existing fill soils overlying natural alluvium. Between approximately 5 and 12.5 feet of existing fill soil was encountered during TGI's exploration on the site. The existing fill soils are not considered to be suitable for support of foundations, floor slabs, or building structures.
- Natural alluvial deposits were encountered below the existing fill soils to the maximum depth of exploration, 20 feet. The natural alluvium is generally medium dense or firm and saturated below the groundwater level. Laboratory consolidation testing indicates the alluvium is compressible under additional loading, as would occur from placement of additional fill for diversion berms to re-route the existing creek channel. In addition, the natural alluvium is likely prone to liquefaction during an earthquake on a local or regional fault.
- Groundwater was encountered at depths between 5 and 8½ feet below the ground surface (i.e. water surface elevation between approximately 2.5 and 6.5 feet above mean sea level). The elevations reported herein are estimated based on the preliminary site plans provided by the client and, therefore, should be considered preliminary water surface elevations.
- Placement of fill berms within the existing creek in order to re-route the channel would place additional loading on the underlying compressible alluvium. Based on the results of laboratory testing, this loading should be expected to induce settlements within the compressible soils. Static settlement analyses and estimates will be provided in the forthcoming comprehensive geotechnical investigation. The magnitude of the settlements will be dependent on the planned berm geometry, including width, height, and soil properties. For preliminary purposes, it is estimated the settlements could range between a few inches to a foot (approximate). At this time, it should be anticipated that recommendations will include constructing the diversion berms to a higher elevation so that the final grades will be near the desired grades following consolidation.
- The subsurface conditions at the subject site may be consistent with those necessary for the occurrence of liquefaction during an earthquake on a local or regional fault (see Section 4.3 for detailed discussion of liquefaction potential). Based on the nature of the proposed project, liquefaction analyses were not performed as part of this investigation. In addition, re-grading of the site for the proposed wetlands enhancement project would not be expected to warrant a life safety consideration with respect to habitable structures, liquefaction, and seismic hazards. However, the client should be aware that should a liquefaction event occur on the site, it would likely manifest in the form of dynamic settlement, surface manifestation, and lateral spread towards the creek edge and/or Pacific Ocean.

  Should habitable structures become part of the project (as defined in the State of California Seismic Hazard Act), this office should be notified so that the potential for liquefaction below the structures may be further evaluated, and so that recommendations to mitigate the potential impacts of liquefaction may be provided.

- At this time, maximum slope gradients on the order of 4:1 (h:v) or flatter, with a maximum height of 15 feet, are anticipated for the proposed project. Cut slopes would be expected to expose existing fill and/or natural alluvial soils. Based on the anticipated slope gradients and heights for most of the proposed project, the potential for deep seated slope instability of the cut slopes (without considering toe erosion) is judged to be low.
- Depending on the final configuration of the proposed project, toes of cut slopes could possibly be exposed to erosion by the re-routed creek channel or tributaries. This could affect the stability of slopes if the toes are eroded away. Limited laboratory testing to determine the dispersive character of the site soils (i.e. a measure of the soils erodibility) is ongoing and will be presented in the forthcoming comprehensive report. In either case, it is recommended the project designer consult with the geotechnical engineer during the design development to ensure adequate edge or slope toe protection. The potential for erosion will be affected by water velocity and stream configuration (among other things). Edge protection may or may not include the following:
    - Placement of rip rap and/or other structural means of edge protection.
    - Placement of vegetation sufficient to provide edge protection.
    - Construction of buttress fills at the toe of slopes that are comprised of select soils less susceptible to erosion.
- It is noted that the existing fill soils were observed to contain varying amounts of debris, including asphalt, brick, plastic, concrete, and wood. Other contaminants may also exist. This geotechnical investigation is only intended to address the engineering properties of the site materials. It is not intended in any way to address the potential existence of contaminants. In either case, the planned cut slopes may expose some of these materials in the slope face, and the slope face may or may not be exposed to running stream waters that empty to the Pacific Ocean. It is recommended the client consult with a qualified environmental specialist to address any environmental issues that may affect the proposed project.
- The granular soils encountered below much of the subject site are judged to possess a very low to low expansion character. Some clayey soils were encountered in borings B3 and B4. These clayey soils may or may not be expansive. Should these clayey soils be utilized for support of building structures, floor slabs on grade, or any surficial improvement that could be affected by swelling subgrade soils, it is recommended they be tested for their expansion character so that any such improvements may be sufficiently designed and/or specified.
- Corrosivity testing was not performed as part of this investigation. Should concrete structures in contact with the site soils become part of the project (i.e. foundations or floor slabs) it is recommended the site soils should be tested for water-soluble sulfates and chlorides so that concrete and/or reinforcing steel may be properly designed and specified. In addition, if underground utilities are planned, it is recommended the site soils be tested for corrosivity to ferrous metals so that the utility materials may be properly designed and specified.
- Construction of the proposed project shall not adversely affect any existing on or offsite improvements. Consideration shall be given to all existing improvements prior to grading or excavation in their vicinity. No excavation should remove support from existing improvements without evaluation by a qualified engineer. Depending on the location of grading for the project with respect to existing structures, temporary support and/or shoring may be required in some areas.

- It is anticipated the project may or may not include construction of a temporary diversion channel so that construction may occur under dry conditions and drainage through the Loma Alta Creek may continue simultaneously. It is recommended the project designer consult with the geotechnical engineer for design of any temporary diversion systems.
- Dewatering of the site may or may not be advantageous in order to lower the groundwater surface and allow for dry conditions during grading activities. It is recommended the project designer consult with the geotechnical engineer to evaluate if dewatering will be necessary for the project. If so, it will be recommended a qualified dewatering specialist be retained to provide dewatering recommendations.
- This report is preliminary in nature. It is intended to present the preliminary results of the subsurface exploration, discuss the encountered subsurface conditions, discuss potential seismic hazards, and provide conclusions regarding the feasibility of the project. It is not intended for design of the project or submission to the local building official for building permit purposes. Once the project grading plan is more developed, a comprehensive geotechnical report should be prepared to provide recommendations for all earthwork and foundation design associated with the project.

Seven

7 LIMITATIONS

The findings, conclusions and recommendations presented in this report are based on various assumptions regarding the anticipated site improvements. TGI has reviewed conceptual plans for the proposed improvements at the time this report was prepared. If the improvements vary significantly from the stated assumptions presented herein, TGI should be consulted to update and modify, as needed, the conclusions and recommendations presented in this report.

The subsurface conditions and engineering evaluation presented in this report were based on the results of a limited subsurface investigation. Subsurface conditions are, by their nature, uncertain and may vary from those documented in published reports and maps. The analysis and evaluation described in this report is limited. A more extensive geotechnical investigation performed at greater cost would provide more accurate and reliable information regarding subsurface conditions and geotechnical characteristics of the site.

TGI's evaluation was performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical engineering firms practicing in this or similar localities. The findings, recommendations and professional opinions presented in this report were developed in general accordance with generally accepted principles and practices of the geotechnical engineering profession at the time of the report preparation. TGI makes no other warranty, either expressed or implied, in fact or by law.

The findings of this report are valid at the time the report was prepared. Changes in the condition of a property can and do occur with the passage of time as a result of natural processes or the work of man on the subject property or adjacent properties. Changes in applicable regulations, guidelines and standards of practice may also occur as a result of government action, legislation, and the broadening of knowledge. Consequently, the findings, conclusions and recommendations contained herein might be invalidated in whole or part by changes outside the control of TGI. Therefore, this report is subject to review and should not be relied on after a period of three (3) years.

This report has been prepared for the exclusive use of the client and their consultants for this project. Any reliance by other parties upon the data, conclusions, opinions and recommendations presented herein is at such party's sole risk. It is the responsibility of the client or their representative to ensure that the information and recommendations contained in this report are provided to the necessary design consultants for the project and are incorporated into the project plans. It is also the responsibility of the owners or their representative to ensure that contractors carry out the recommendations during construction.

--- §§§ ---

8 REFERENCES

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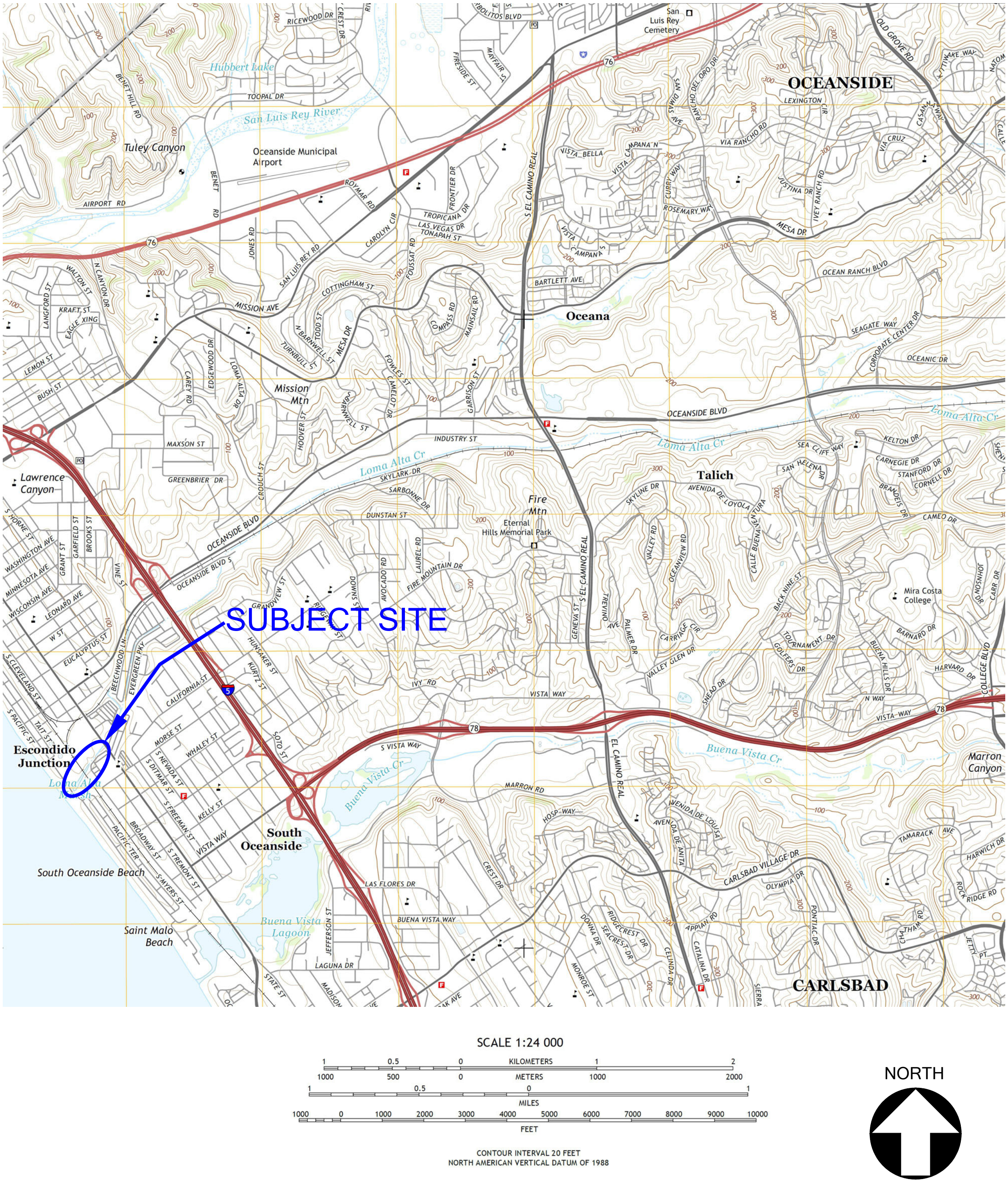
FIGURES

Loma Alta Slough Wetlands Enhancement Project
Oceanside, CA



Reference: USGS Topographic Maps, San Luis Rey 7.5 Minute Quadrangle, California, San Diego County, 2015

TAYLOR GROUP, INC. Geoscience & Engineering Consultants	TGI Project No. 19.00936	FIGURE 1. SITE LOCATION AND VICINITY
	Drawn by: MC / Checked by: MC	
	Date: February 2020	ESA - Loma Alta Slough Wetlands Enhancement Project, Oceanside, CA

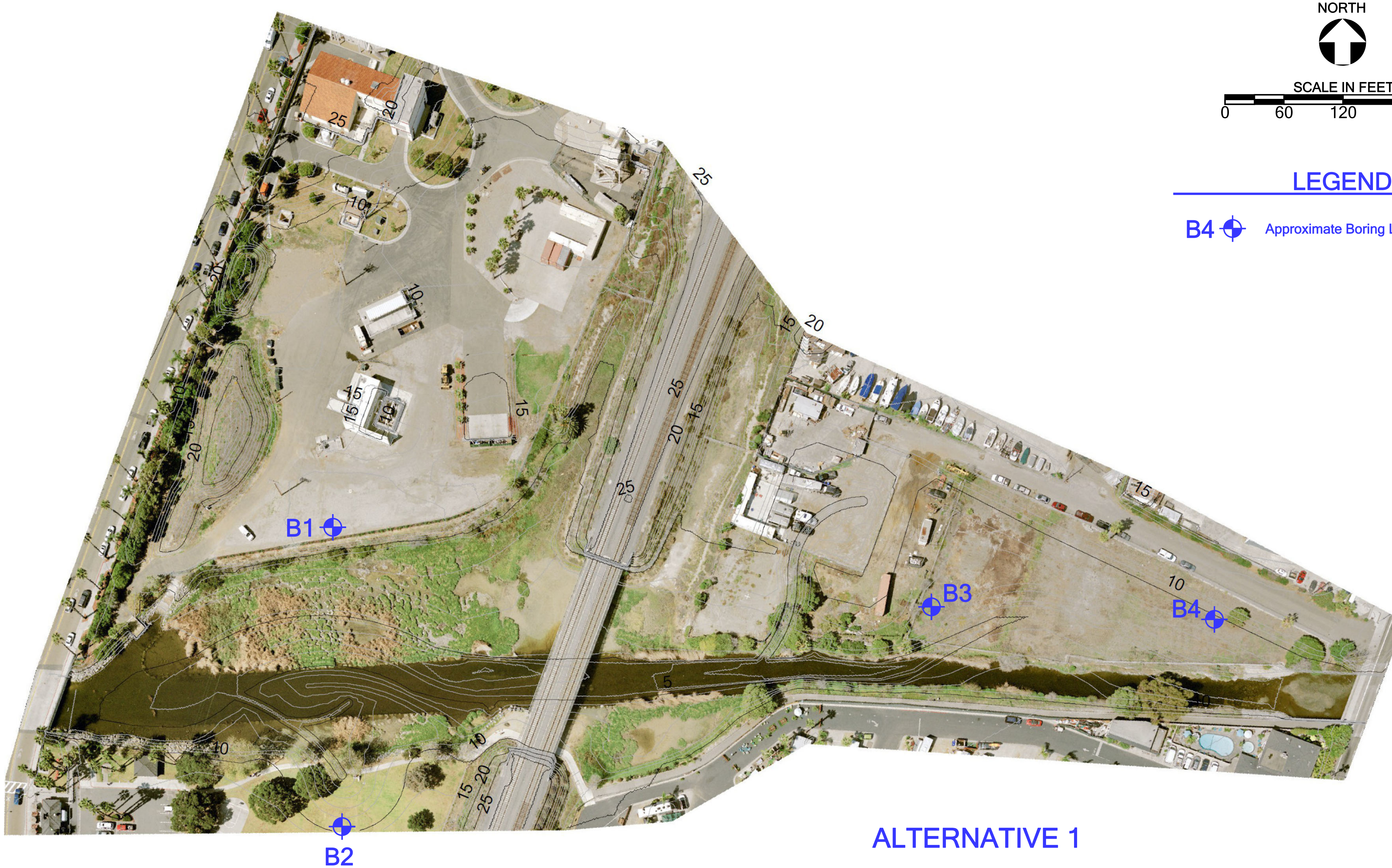
NORTH

SCALE IN FEET

0 60 120 240

LEGEND

B4 ⌖ Approximate Boring Location by TGI



ALTERNATIVE 1

REFERNCE: Site Plans Provided by ESA.

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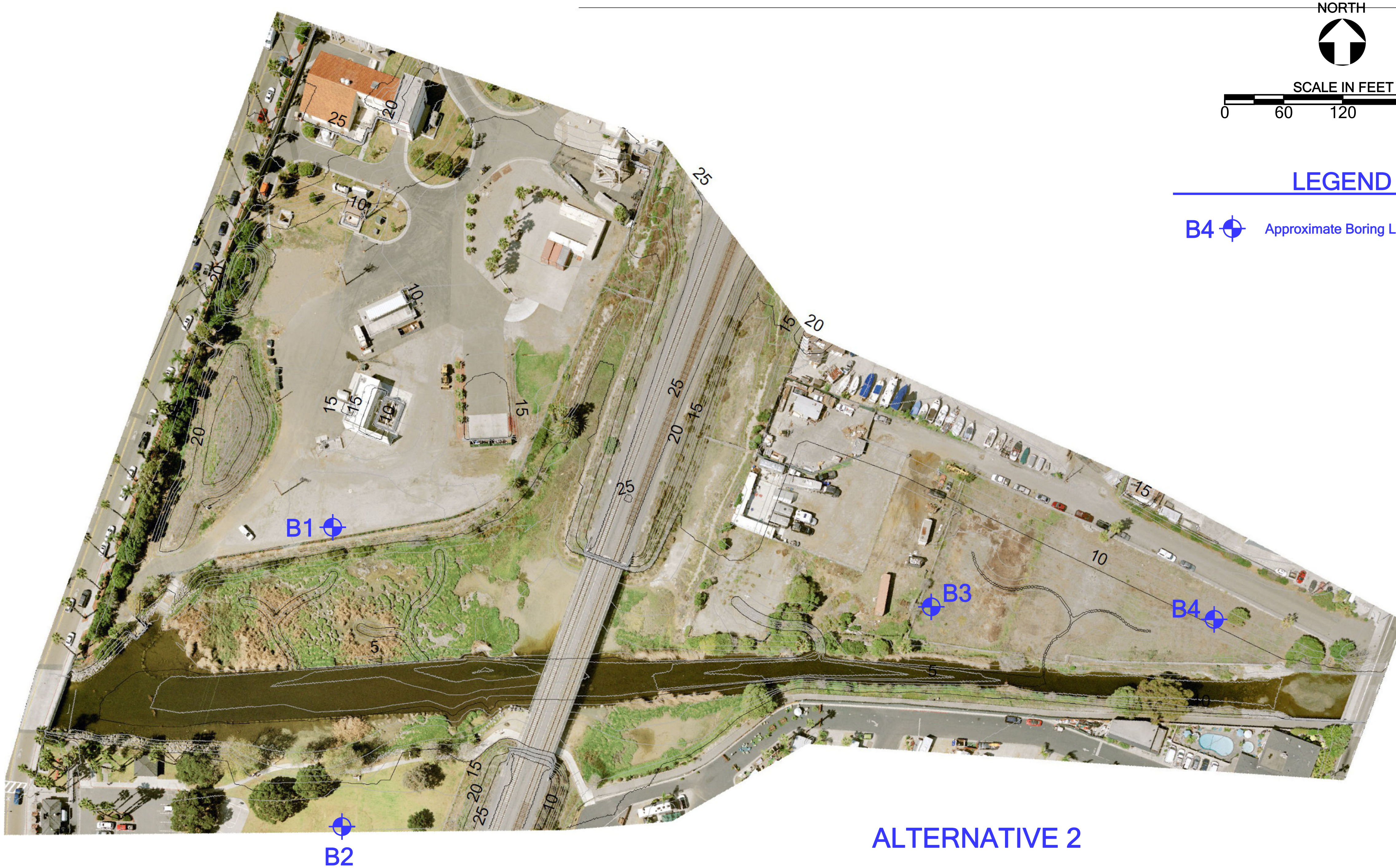
FIGURE 2a. PLOT PLAN

(ALTERNATIVE NO. 1)

Project Name:	Loma Alta Slough Wetlands Enhancement Project		
Project Number:	19.00936		
Client Name:	Environmental Science Associates		
Drawn by:	MC	Date:	February 2020
Checked by:	MC	Date:	February 2020



NORTH

SCALE IN FEET

0 60 120 240

LEGEND

B4 Approximate Boring Location by TGI

REFERNCE: Site Plans Provided by ESA.

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FIGURE 2b. PLOT PLAN
(ALTERNATIVE NO. 2)

Project Name:	Loma Alta Slough Wetlands Enhancement Project
Project Number:	19.00936
Client Name:	Environmental Science Associates
Drawn by:	MC Date: February 2020
Checked by:	MC Date: February 2020

NORTH

SCALE IN FEET

0 60 120 240

LEGEND

B4 Approximate Boring Location by TGI

ALTERNATIVE 3

REFERNCE: Site Plans Provided by ESA.

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FIGURE 2c. PLOT PLAN
(ALTERNATIVE NO. 3)

Project Name:	Loma Alta Slough Wetlands Enhancement Project		
Project Number:	19.00936		
Client Name:	Environmental Science Associates		
Drawn by:	MC	Date:	February 2020
Checked by:	MC	Date:	February 2020

NORTH

SCALE IN FEET

0 60 120 240

LEGEND

B4 ⌖ Approximate Boring Location by TGI

EXISTING CONDITIONS

REFERNCE: Site Plans Provided by ESA.

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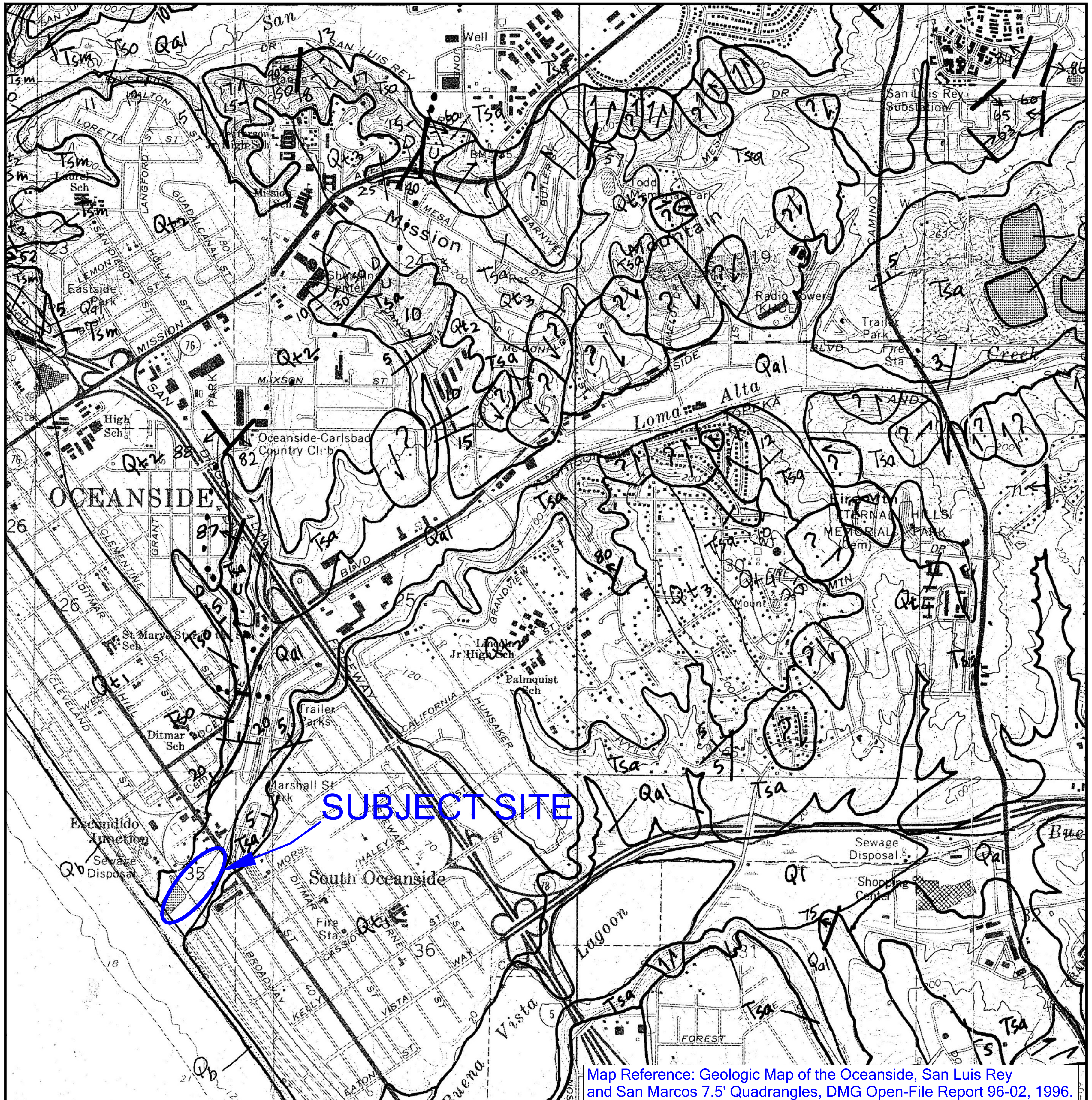
FIGURE 2d. PLOT PLAN
(EXISTING CONDITIONS)

Project Name:	Loma Alta Slough Wetlands Enhancement Project
Project Number:	19.00936
Client Name:	Environmental Science Associates
Drawn by:	MC Date: February 2020
Checked by:	MC Date: February 2020



NORTH

Scale in Miles

0 0.25 0.5 1.0

MAP UNITS

Qal	Alluvium and colluvium Unconsolidated silt, clay, sand and gravel.
Ql	Lake, reservoir and pond deposits; partly submerged, unconsolidated clay, silt, sand and gravel.
Qt1-4	Terrace deposits; reddish brown, poorly bedded, poorly- to moderately-indurated sandstone, siltstone and conglomerate. Subscripts indicate relative level with 1 the lowest elevation (youngest age). The three lower levels have been correlated with the Bay Point Formation and the highest level with the Linda Vista Formation; see Kennedy (1975), Weber (1982), and Wilson (1972).
Tso	San Onofre Breccia; greenish red, poorly-to moderately-bedded, well-indurated, breccia with Catalina Schist clasts. Resistant to landsliding.
Tsa / Tt	Santiago Formation; light-colored, poorly-bedded, poorly-indurated, fine- to medium-grained sandstone interbedded with landslide-prone siltstone and claystone. Local coarse-grained sandstone and conglomerate. Renamed from Scripps Formation in the Encinitas (Tan, 1986) and Rancho Santa Fe (Tan, 1987) quadrangles. It interfingers with Torrey Sandstone. Torrey Sandstone (La Jolla Group); light-colored, massive and thick-bedded, well-indurated, medium-to coarse-grained arkosic sandstone. Resistant to landsliding. It interfingers with Santiago Formation.

MAP SYMBOLS

Contact (boundary) between map units . Most boundaries are not exposed and are inferred.

5 — Strike, and dip of inclined beds. Most bedding attitudes are estimated.

82 U D — Fault; dotted where concealed. Arrow and number indicate direction and amount of dip of exposed fault plane. U indicates upthrown side; D indicates downthrown side.

70 — Strike, direction, and amount of dip of minor fault (shear joint) plane. Most fault displacements are less than 5 feet.

Landslide; arrows indicate general direction of movement. Both the headscarp area and debris deposit are included within the map symbol. Landslides are depicted prior to urban development. Only landslides larger than 300 feet across are shown on the map. For further information see California Division of Mines and Geology Open-File Report 95-04.

? — Questionable landslide.

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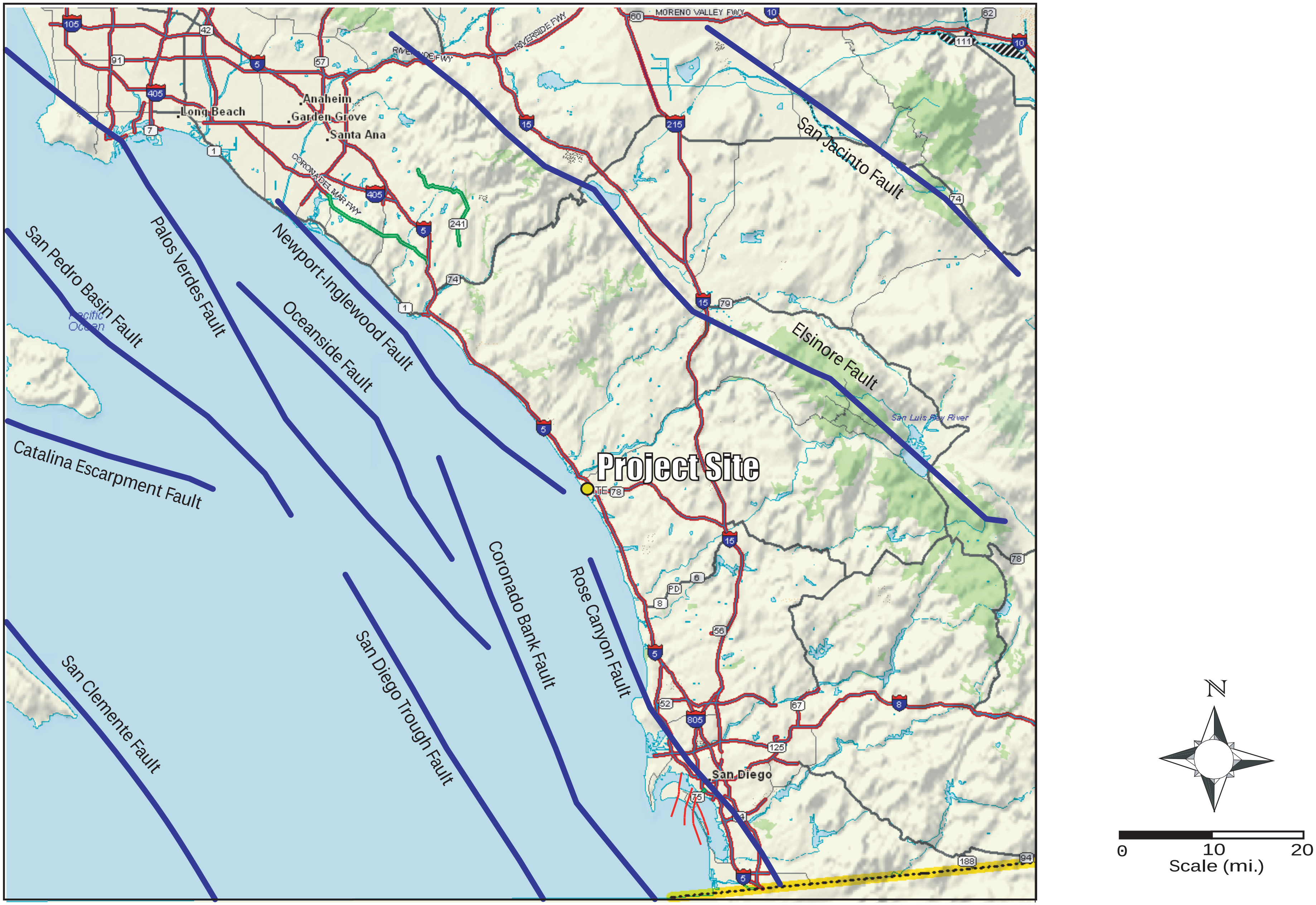
FIGURE 3. LOCAL GEOLOGIC MAP

Project Name:	Loma Alta Slough Wetlands Enhancement Project		
Project Number:	19.00936		
Client Name:	ESA		
Drawn by:	MC	Date:	February 2020
Checked by:	MC	Date:	February 2020

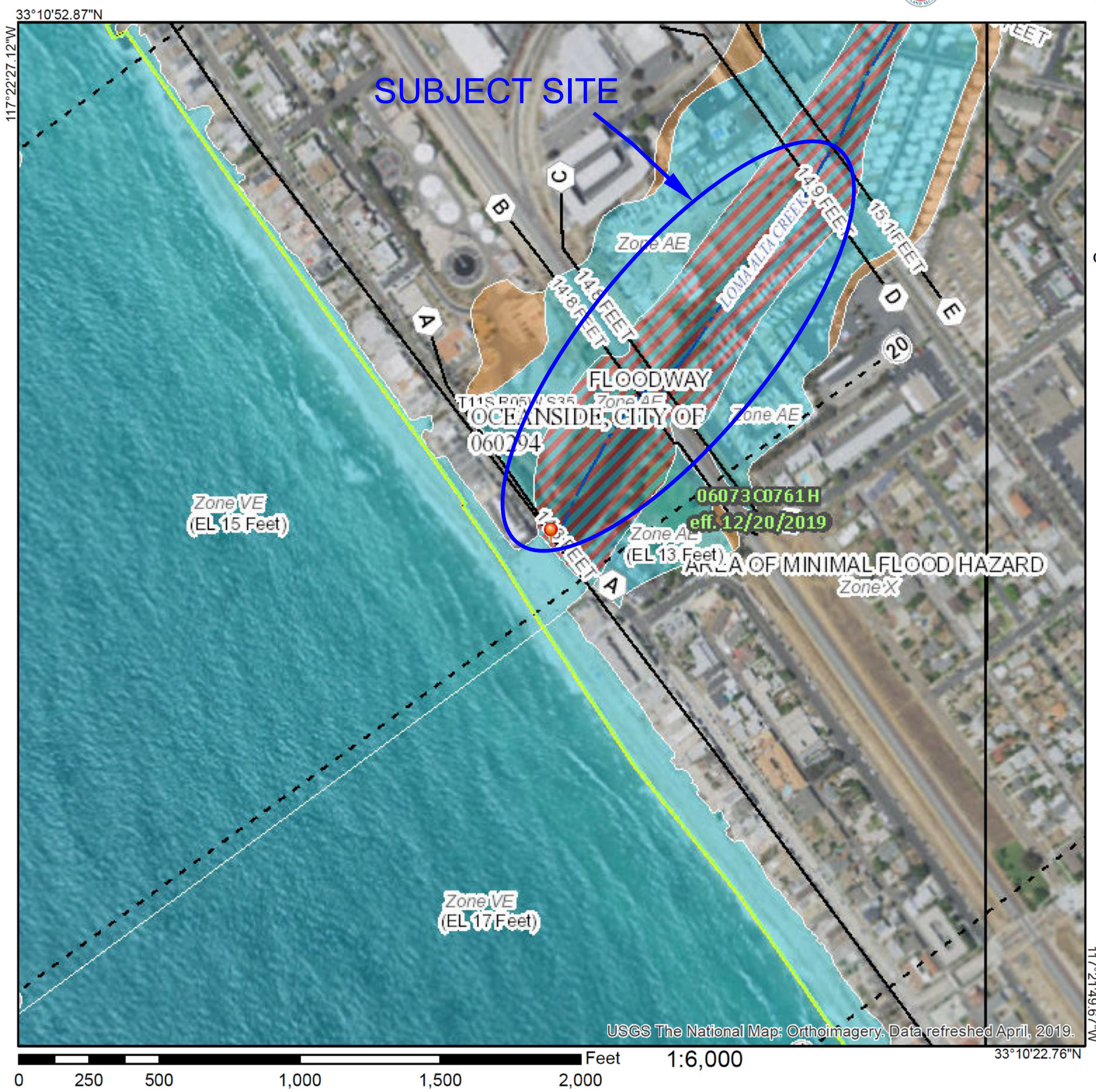


Source: Modified from base map from Scripp's Institute of Oceanography

TAYLOR GROUP, INC. Geoscience & Engineering Consultants - Oceanside, California	TGI Project No. 19.00936		Date: February 2020	FIGURE 4. MAP OF ACTIVE REGIONAL FAULTS
	Drawn by: MC	Checked by: MC	Source: Scripps Institute	
			Scale: as shown	ESA - Loma Alta Slough Wetlands Enhancement Project, Oceanside, CA

National Flood Hazard Layer FIRMette

FEMA



Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

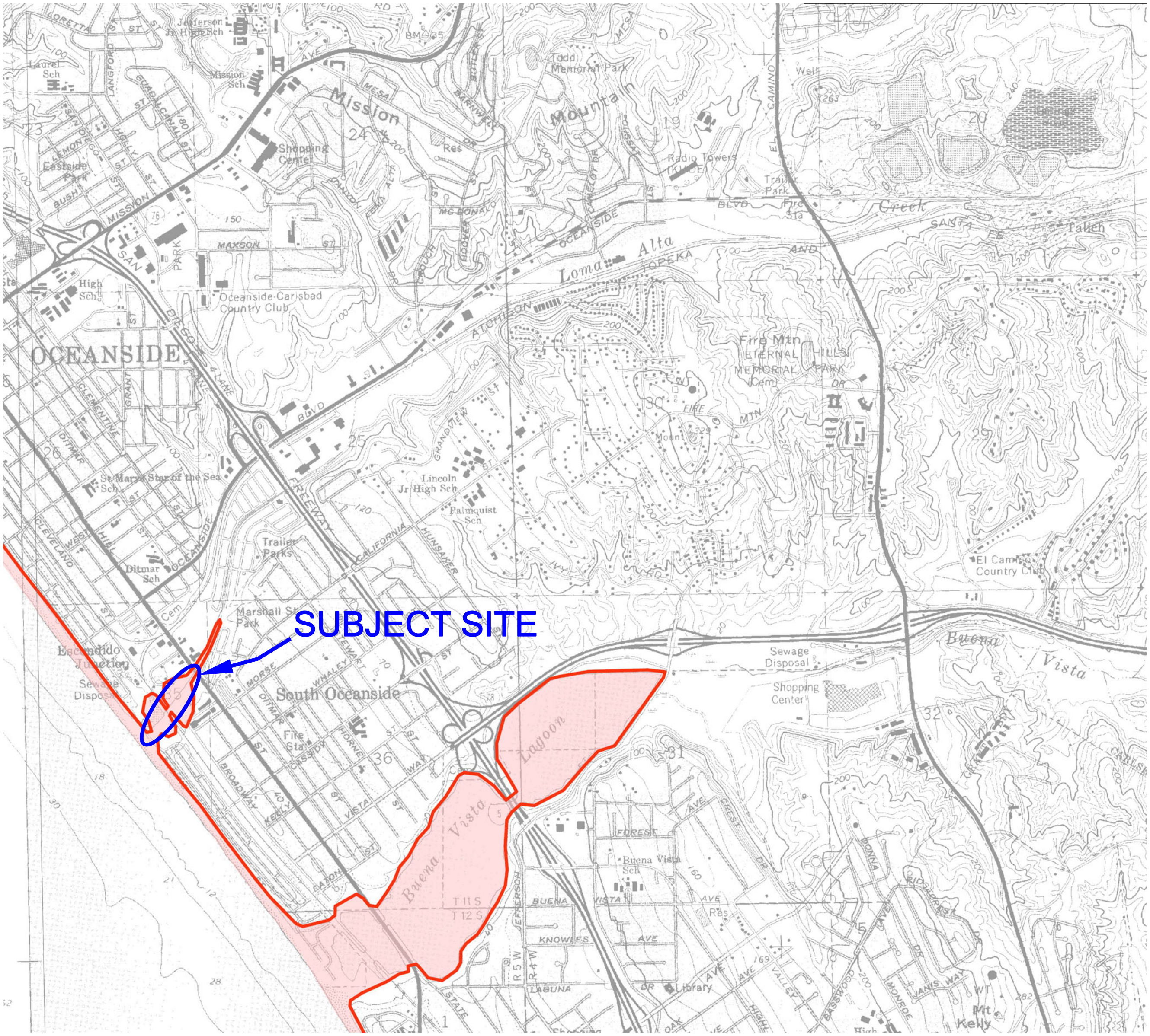
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 2/24/2020 at 12:40:23 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

TAYLOR GROUP, INC. Geoscience & Engineering Consultants	TGI Project No. 19.00936		Date: February 2020	FIGURE 5. FEMA FLOOD INSURANCE RATE MAP
	Drawn by: MC	Checked by: MC		
	Reference: FEMA			ESA - Loma Alta Slough Wetlands Enhancement Project, Oceanside, CA



California Emergency Management Agency
California Geological Survey
University of Southern California

TSUNAMI INUNDATION MAP FOR EMERGENCY PLANNING

State of California ~ County of San Diego

OCEANSIDE QUADRANGLE
SAN LUIS REY QUADRANGLE

June 1, 2009

SCALE 1:24,000

MAP EXPLANATION

Tsunami Inundation Line

Tsunami Inundation Area

TAYLOR GROUP, INC. Geoscience & Engineering Consultants	TGI Project No. 19.00936		FIGURE 6. TSUNAMI INUNDATION MAP
	Drawn by: MC	Checked by: MC	
	Date: February 2020		ESA - Loma Alta Slough Wetlands Enhancement Project, Oceanside, CA

Appendix A
Boring Logs

Loma Alta Slough Wetlands Enhancement Project
Oceanside, CA

Boring Number B1

DATE STARTED 1/13/20 **COMPLETED** 1/13/20 **GROUND ELEVATION** 14.0 ft* **HOLE SIZE** 6-inch

DRILLING CONTRACTOR Baja Exploration

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem Auger

- **AT TIME OF DRILLING** 8.5 ft
- **AT END OF DRILLING** 8.5 ft
- **AFTER DRILLING** 8.5 ft

LOGGED BY MC **CHECKED BY** MC

NOTES *Elevation estimated based on site plan.

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0	**FILL:** Silty Sand (SM), mottled brown and grayish brown, moist to very moist, medium dense, fine grained, minor gravel, minor asphalt and brick debris										
	less silty, minor debris	MC BULK	100 100	9-5-6 (11)		106	10				
5	abundant asphalt fragments, dark gray	MC	100	17-20-24 (44)							
	Clayey Sand (SC), gray to dark gray, very moist, medium dense, fine to medium grained, some asphalt fragments	MC	100	3-8-14 (22)							
	(Groundwater at 8.5 feet)										
10	**NATURAL ALLUVIUM:** Silty Sand (SM), gray, wet, medium dense, fine grained	MC	100	5-9-11 (20)		100	20				
15	Silty Sand to Sand (SM/SP), gray, wet to saturated, medium dense, fine grained	MC	100	4-8-12 (20)							
20	**End 20 feet, Water at 8.5 feet, Fill to 10 feet**	MC	100	5-13-17 (30)							
	Bottom of hole at 20.0 feet.										
25											

TAYLOR GROUP, INC.
Geoscience & Engineering Consultants - Oceanside, California

PROJECT NAME Loma Alta Slough Wetlands Enhancement Project

CLIENT Environmental Science Associates **PROJECT NUMBER** 19.00936

PROJECT LOCATION Loma Alta Slough, Oceanside, San Diego

Boring Number B2

DATE STARTED 1/13/20 **COMPLETED** 1/13/20 **GROUND ELEVATION** 11.5 ft* **HOLE SIZE** 6-inch
DRILLING CONTRACTOR Baja Exploration **GROUND WATER LEVELS:**
DRILLING METHOD Hollow Stem Auger **AT TIME OF DRILLING** 5.0 ft
LOGGED BY CT **CHECKED BY** MC **AT END OF DRILLING** 5.0 ft
NOTES *Elevation estimated based on site plan. **AFTER DRILLING** 5.0 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		**FILL:** Silty Sand (SM), dark brown, moist, medium dense, fine to medium grained, minor gravel, minor plastic debris										
		mottled dark brown and light brown, some asphalt debris	MC BULK	100 100	4-6-6 (12)							
5		**NATURAL ALLUVIUM:** Clayey Sand to Silty Sand (SC/SM), dark gray and gray, saturated, medium dense, fine grained, trace organics. *(Groundwater at 5 feet)*	MC	100	2-1-3 (4)		61	71				
		Sand to Silty Sand (SP/SM), dark gray and gray, saturated, medium dense, fine grained	MC	100	6-11-5 (16)							
10			MC	100	4-3-4 (7)		94	41				
15		gray	MC	100	5-6-7 (13)							
20		**End 20 feet, Water at 5 feet, Fill to 5 feet** Bottom of hole at 20.0 feet.										
25												

TAYLOR GROUP, INC.
Geoscience & Engineering Consultants - Oceanside, California

PROJECT NAME Loma Alta Slough Wetlands Enhancement Project
CLIENT Environmental Science Associates **PROJECT NUMBER** 19.00936
PROJECT LOCATION Loma Alta Slough, Oceanside, San Diego

Boring Number B3

DATE STARTED 1/13/20 **COMPLETED** 1/13/20 **GROUND ELEVATION** 11.0 ft* **HOLE SIZE** 6-inch

DRILLING CONTRACTOR Baja Exploration **GROUND WATER LEVELS:**

DRILLING METHOD Hollow Stem Auger — AT TIME OF DRILLING 8.5 ft

LOGGED BY CT **CHECKED BY** MC — AT END OF DRILLING 8.5 ft

NOTES *Elevation estimated based on site plan. — AFTER DRILLING 8.5 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		**FILL:** Silty Sand to Clayey Sand (SM/SC), brown, slightly moist, medium dense, fine to coarse grained, some gravel										
		moist to very moist	MC BULK	100 100	3-3-2 (5)							
5		**NATURAL ALLUVIUM:** Silty Clay (CL), gray, moist, firm	MC	100	2-1-1 (2)							
			MC	100	2-4-5 (9)		79	38				
		(Groundwater at 8.5 feet)										
10			MC	100	2-3-3 (6)		68	56				
15			MC	100	2-2-15 (17)							
		occassional thin layers of Silty Sand (SM), gray, wet, medium dense, fine grained										
		slightly porous										
		End 20 feet, Water at 8.5 feet, Fill to 5 feet										
20		Bottom of hole at 20.0 feet.	MC	100	3-3-5 (8)							
25												

TAYLOR GROUP, INC.
Geoscience & Engineering Consultants - Oceanside, California

PROJECT NAME Loma Alta Slough Wetlands Enhancement Project

CLIENT Environmental Science Associates **PROJECT NUMBER** 19.00936

PROJECT LOCATION Loma Alta Slough, Oceanside, San Diego

Boring Number B4

DATE STARTED 1/13/20 **COMPLETED** 1/13/20 **GROUND ELEVATION** 13.0 ft* **HOLE SIZE** 6-inch

DRILLING CONTRACTOR Baja Exploration

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem Auger

AT TIME OF DRILLING 6.5 ft

LOGGED BY CT **CHECKED BY** MC

AT END OF DRILLING 6.5 ft

NOTES *Elevation estimated base on site plan.

AFTER DRILLING 6.5 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		**FILL:** Silty Sand (SM), brown, moist, medium dense, fine to coarse grained, minor asphalt debris, some gravel										
		mottled reddish brown and brown, fine to coarse grained,	MC BULK	100 100	12-16-12 (28)							
5		mottled gray, reddish brown, brown and dark gray	MC	100	9-9-4 (13)							
		dark brown, very moist										
		(Groundwater at 6.5 feet)										
		Silty Sand to Clayey Sand (SM/SC), dark gray, saturated, medium dense, fine to medium grained, some gravel, some concrete debris, some organics, organic odor, abundant wood debris	MC	100	3-9-17 (26)							
10			MC	100	5-4-5 (9)		85	43				
		NATURAL ALLUVIUM: Silty Clay (CL), gray, moist, firm										
15			MC	100	2-3-3 (6)							
20		**End 20 feet, Water at 6.5 feet, Fill to 12.5 feet** Bottom of hole at 20.0 feet.	MC	100	2-3-2 (5)							
25												

TAYLOR GROUP, INC.
Geoscience & Engineering Consultants - Oceanside, California

PROJECT NAME Loma Alta Slough Wetlands Enhancement Project

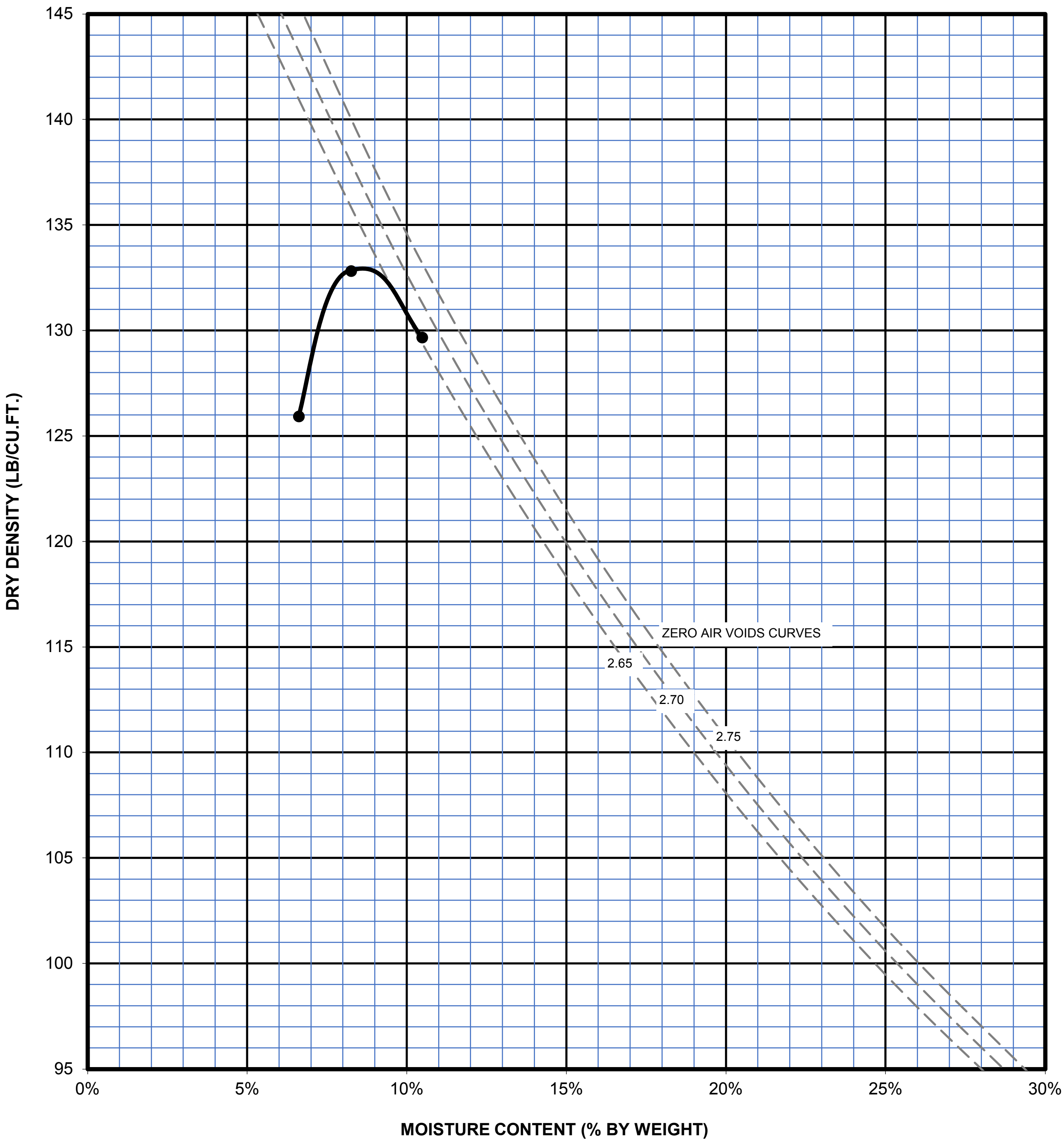
CLIENT Environmental Science Associates **PROJECT NUMBER** 19.00936

PROJECT LOCATION Loma Alta Slough, Oceanside, San Diego

Appendix B
Laboratory Testing Data

Loma Alta Slough Wetlands Enhancement Project
Oceanside, CA

Dry Density vs. Moisture Content



Boring No. B1

Depth: 1-5'

Bulk Sample: Silty Sand (SM)

Test Method: ASTM D 1557 (Method A)

Maximum Dry Density and Moisture Content:

Maximum Dry Density: 132.8 lb/ft^2

Optimum Moisture Content: 8.5%

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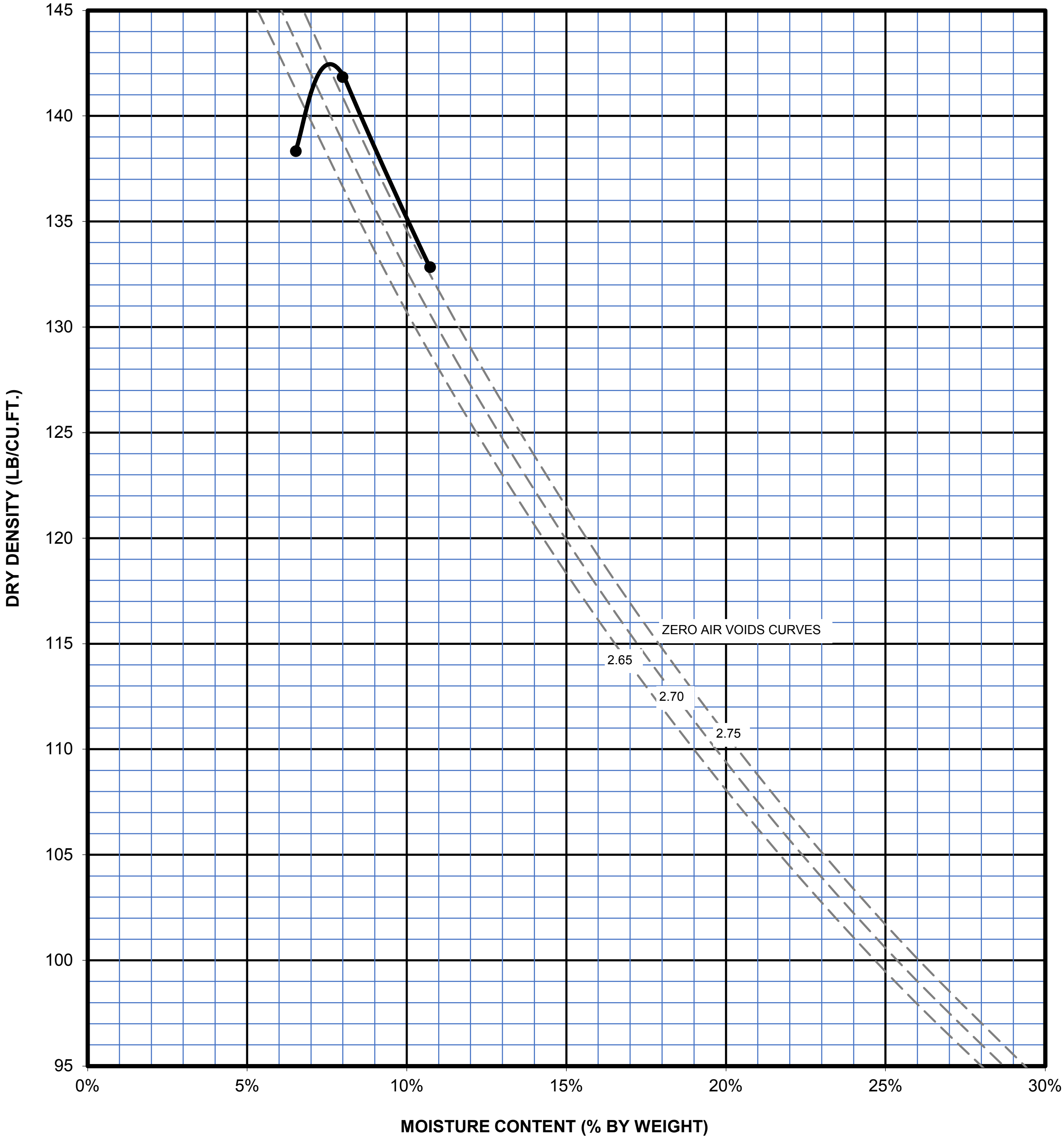
MAXIMUM DENSITY DETERMINATION

Project Name: ESA - Loma Alta Slough Wetlands Enhancement Project

Location: Oceanside, California

Project Number: 19.00936

Dry Density vs. Moisture Content



Boring No.	B4	Bulk Sample: Silty Sand (SM)	**Maximum Dry Density and Moisture Content:**
Depth:	1-5'		Maximum Dry Density: 142.5 lb/ft^2
Test Method:	ASTM D 1557 (Method A)		Optimum Moisture Content: 7.5%

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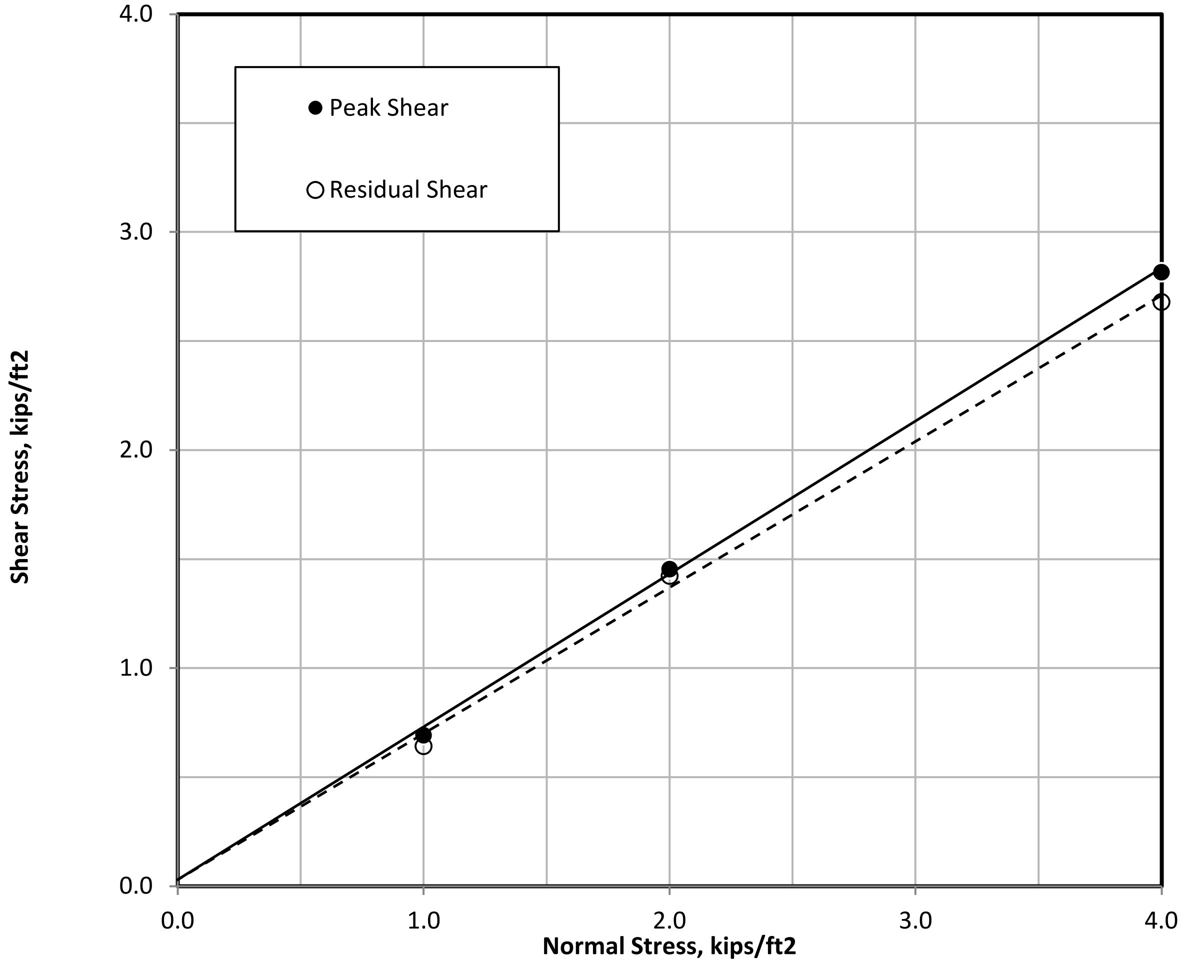
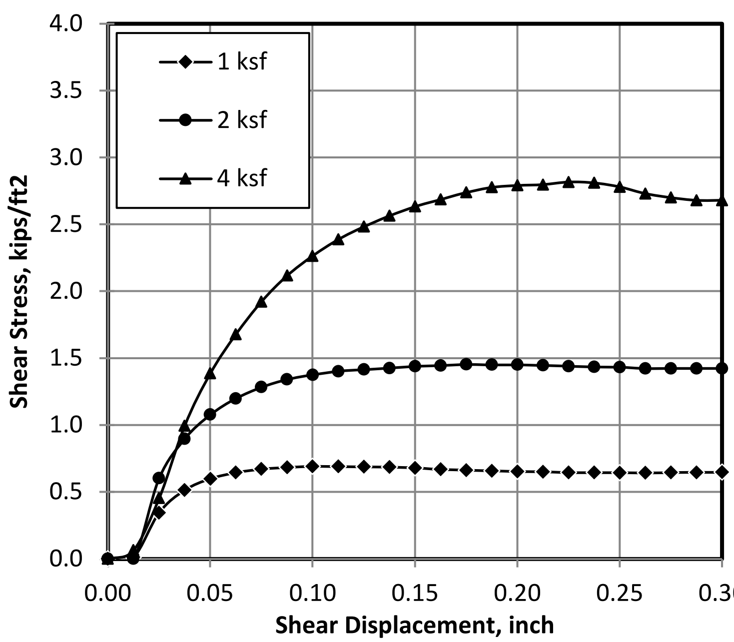
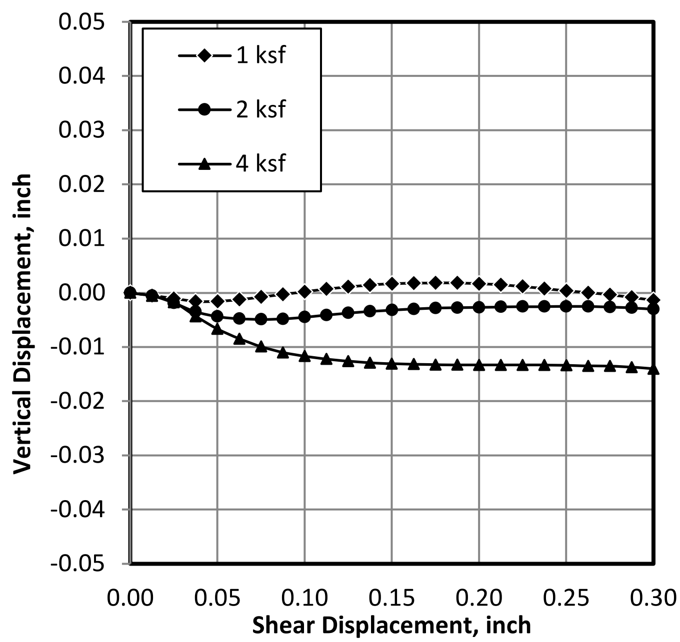
MAXIMUM DENSITY DETERMINATION

Project Name:	ESA - Loma Alta Slough Wetlands Enhancement Project
Location:	Oceanside, California
Project Number:	19.00936







Boring No.	B1	Cal. Mod. Ring Lined Sampler (Saturated)	**Shear Strength Parameters:**
Depth:	2'	γ_d=105.7 pcf w(i)=10.2% w(f)=15.8%	Peak: ϕ =35° c = 10 lb/ft^2
Test Parameters:	CU @ 0.02 in/min	(E) FILL - Silty Sand (SM)	Residual: ϕ =34° c = 15 lb/ft2

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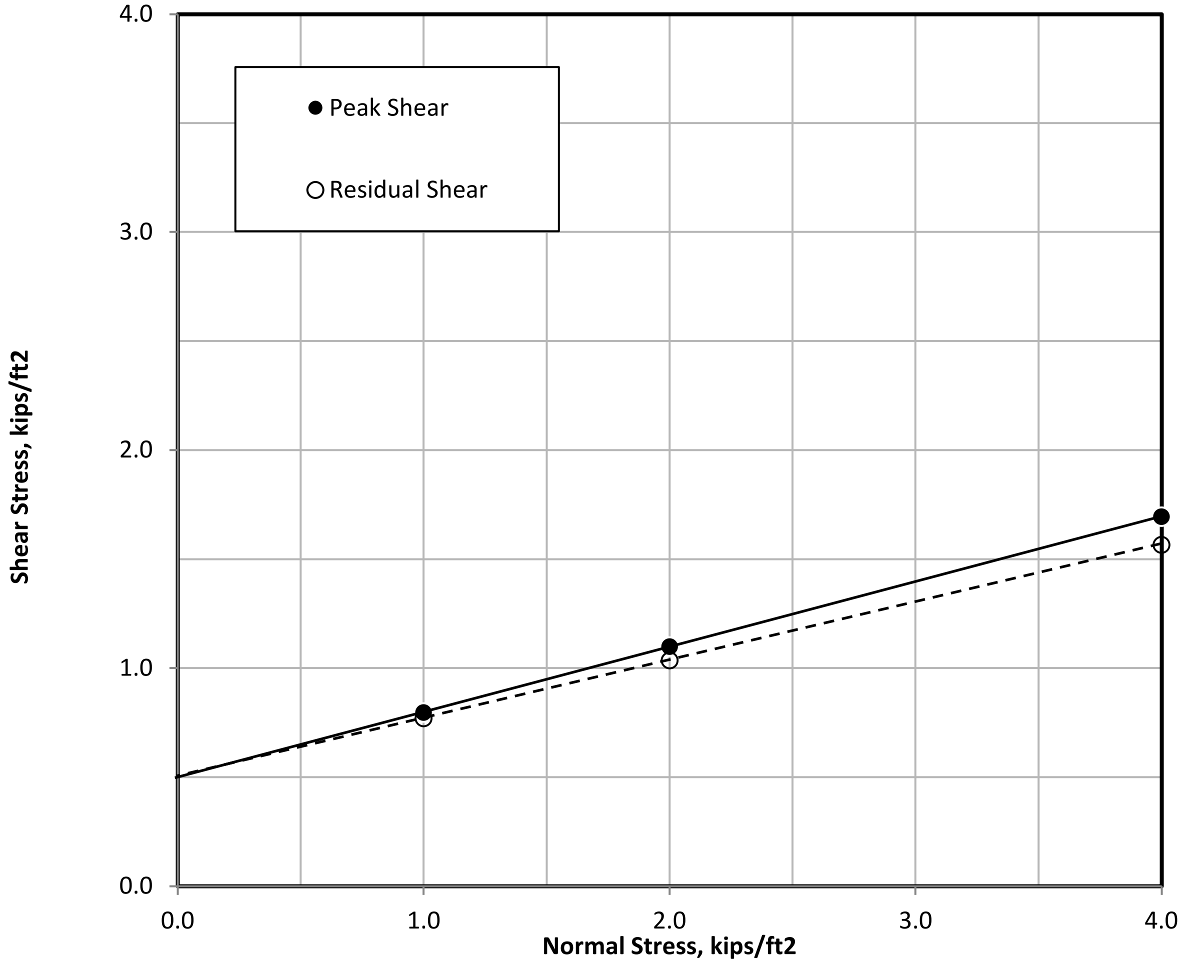
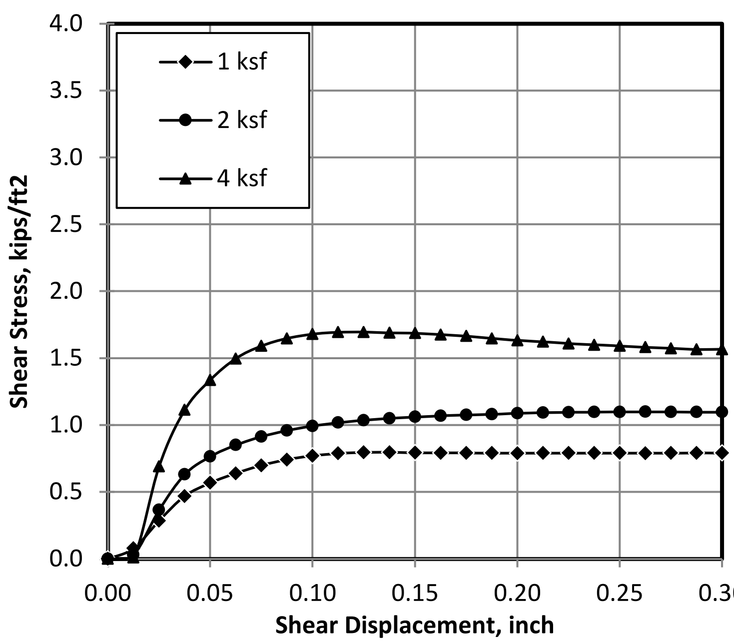
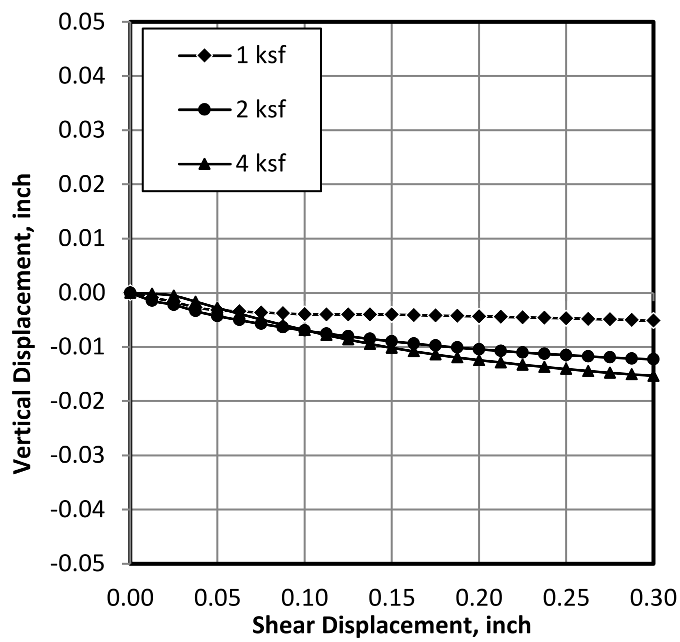
DIRECT SHEAR TEST

Client:	ESA - Loma Alta Slough Wetlands Enhancement Project
Location:	Oceanside, California
Project Number:	19.00936







Boring No.	B3	Cal. Mod. Ring Lined Sampler (Saturated)	**Shear Strength Parameters:**
Depth:	7'	γ_d=79.1 pcf w(i)=38.3% w(f)=44.4%	Peak: ϕ =17° c = 500 lb/ft^2
Test Parameters:	CU @ 0.002 in/min	Silty Clay (CL)	Residual: ϕ =15° c = 505 lb/ft2

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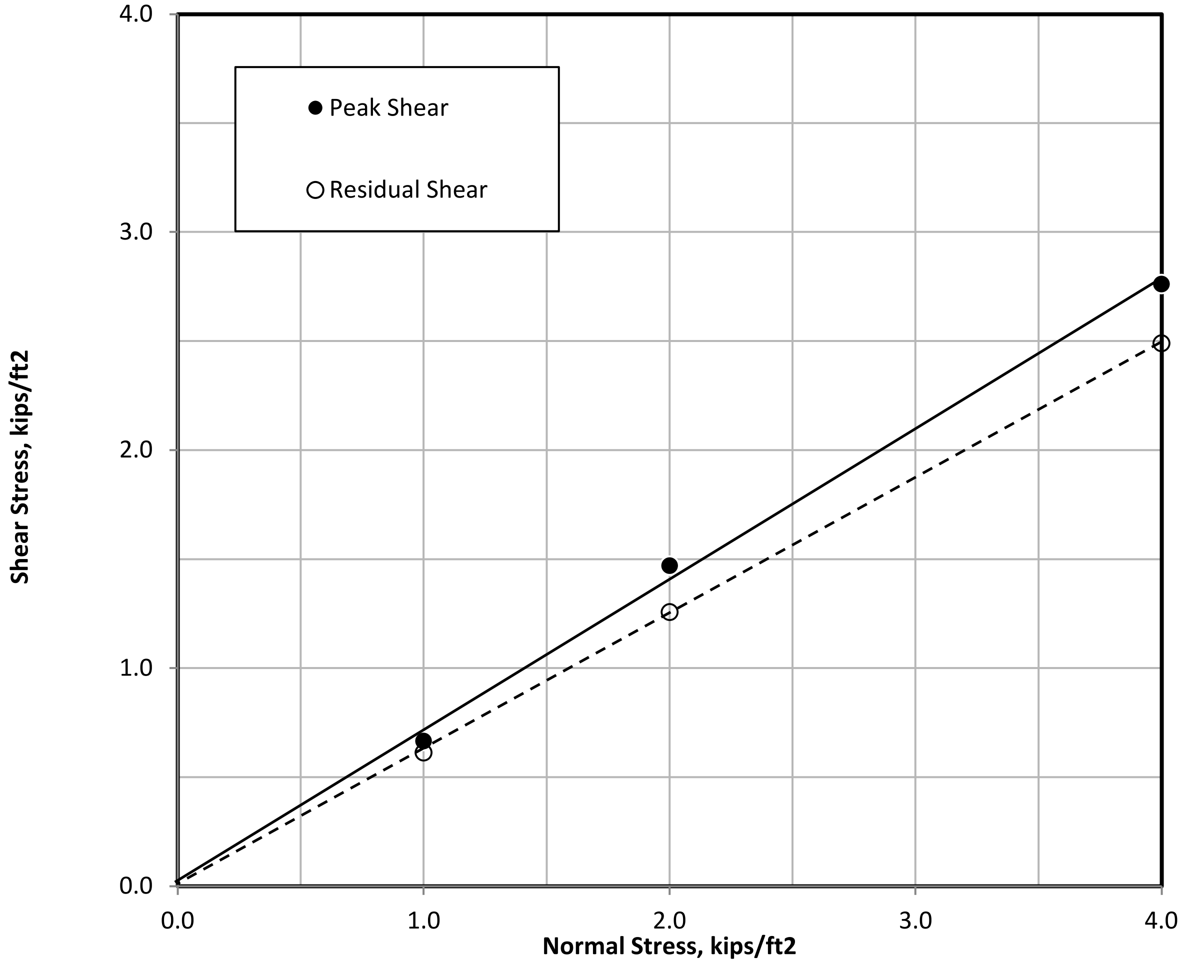
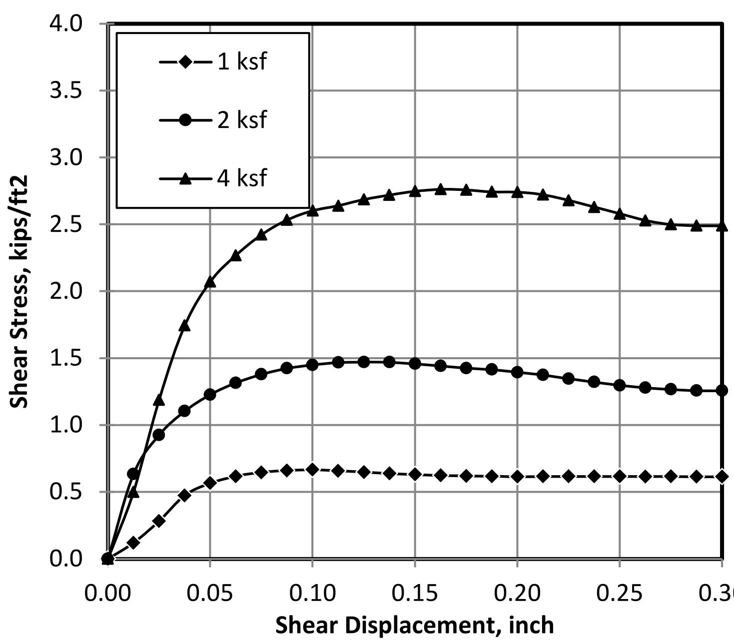
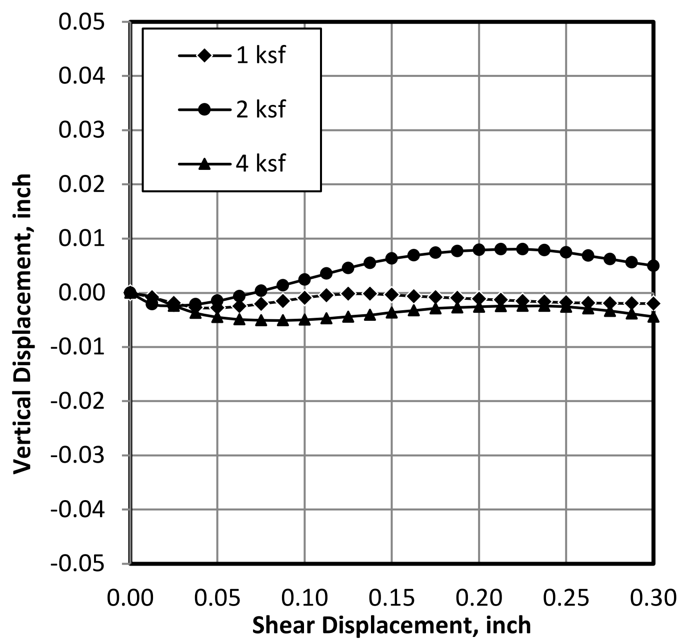
DIRECT SHEAR TEST

Client:	ESA - Loma Alta Slough Wetlands Enhancement Project
Location:	Oceanside, California
Project Number:	19.00936







Boring No.	B1	Cal. Mod. Ring Lined Sampler (Saturated)	**Shear Strength Parameters:**
Depth:	10'	γ_d=99.5 pcf w(i)=20.3% w(f)=32.8%	Peak: ϕ =35° c = 20 lb/ft^2
Test Parameters:	CU @ 0.01 in/min	Silty Sand (SM)	Residual: ϕ =32° c = 0 lb/ft2

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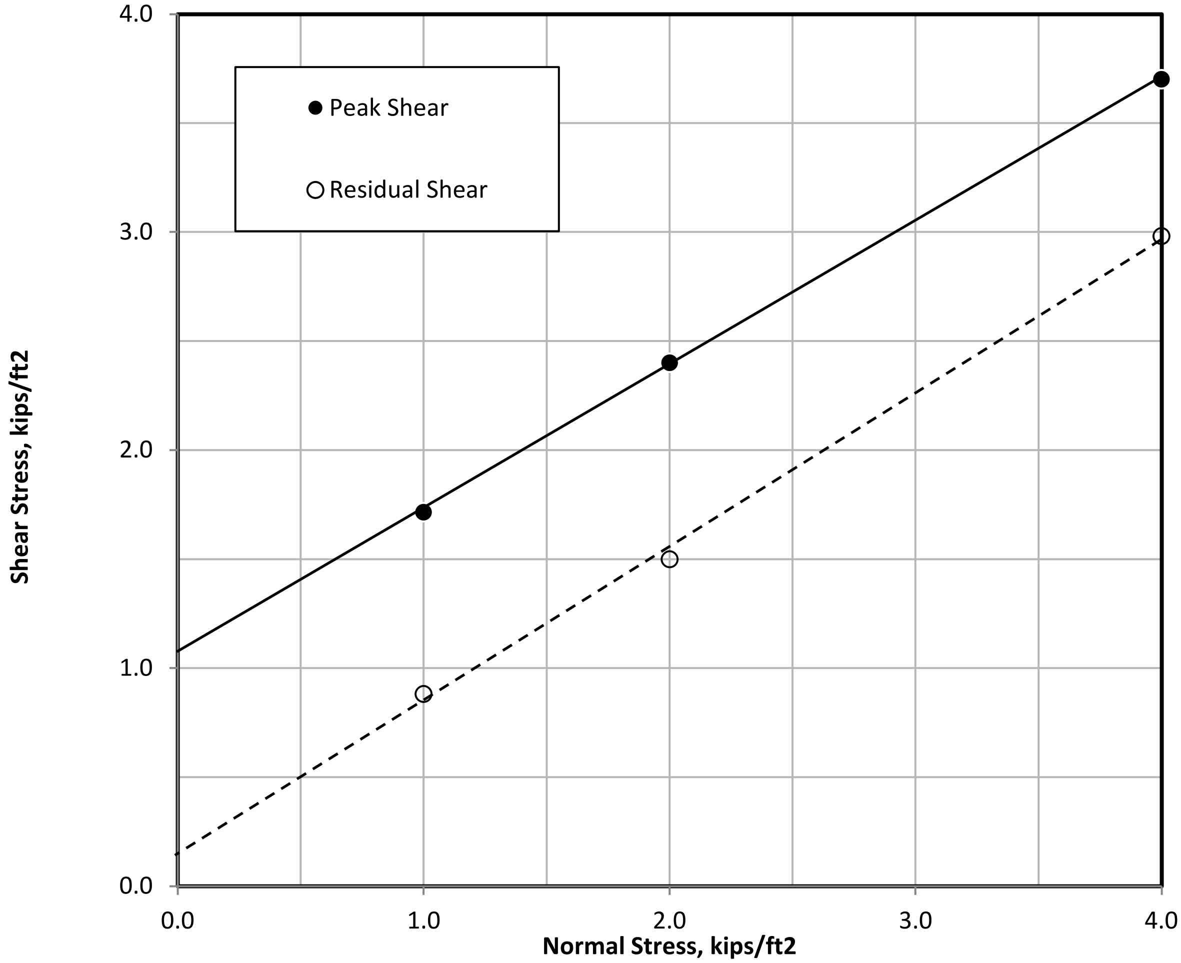
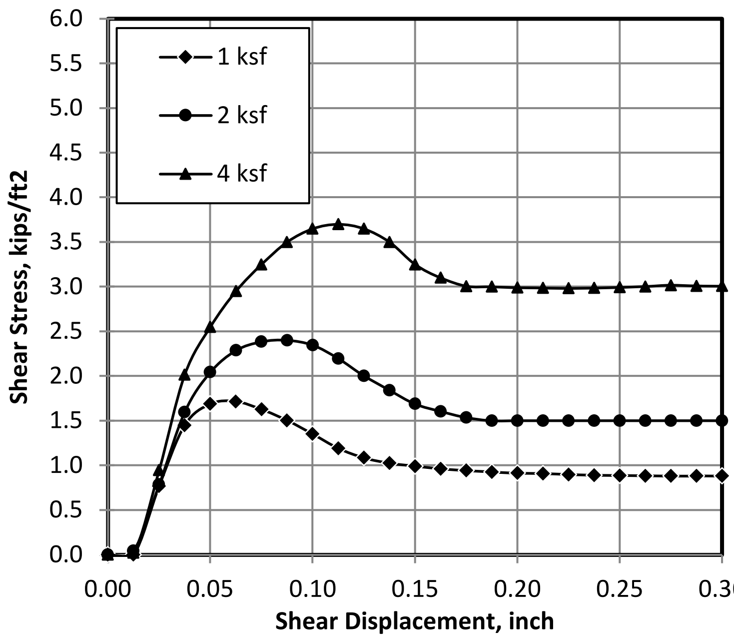
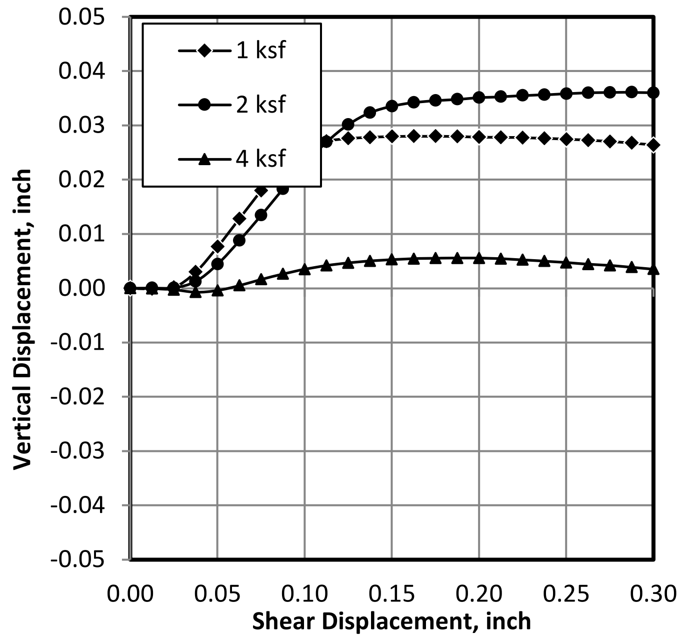
DIRECT SHEAR TEST

Client:	ESA - Loma Alta Slough Wetlands Enhancement Project
Location:	Oceanside, California
Project Number:	19.00936







Boring No.	B1	Bulk Sample Remolded (Saturated)	**Shear Strength Parameters:**
Depth:	1-5'	γ_d=127.2 pcf w(i)=9.6% w(f)=13.3%	Peak: ϕ =33^o c = 1,065 lb/ft^2
Test Parameters:	CU @ 0.02 in/min	Silty Sand (SM)	Residual: ϕ =35^o c = 140 lb/ft2

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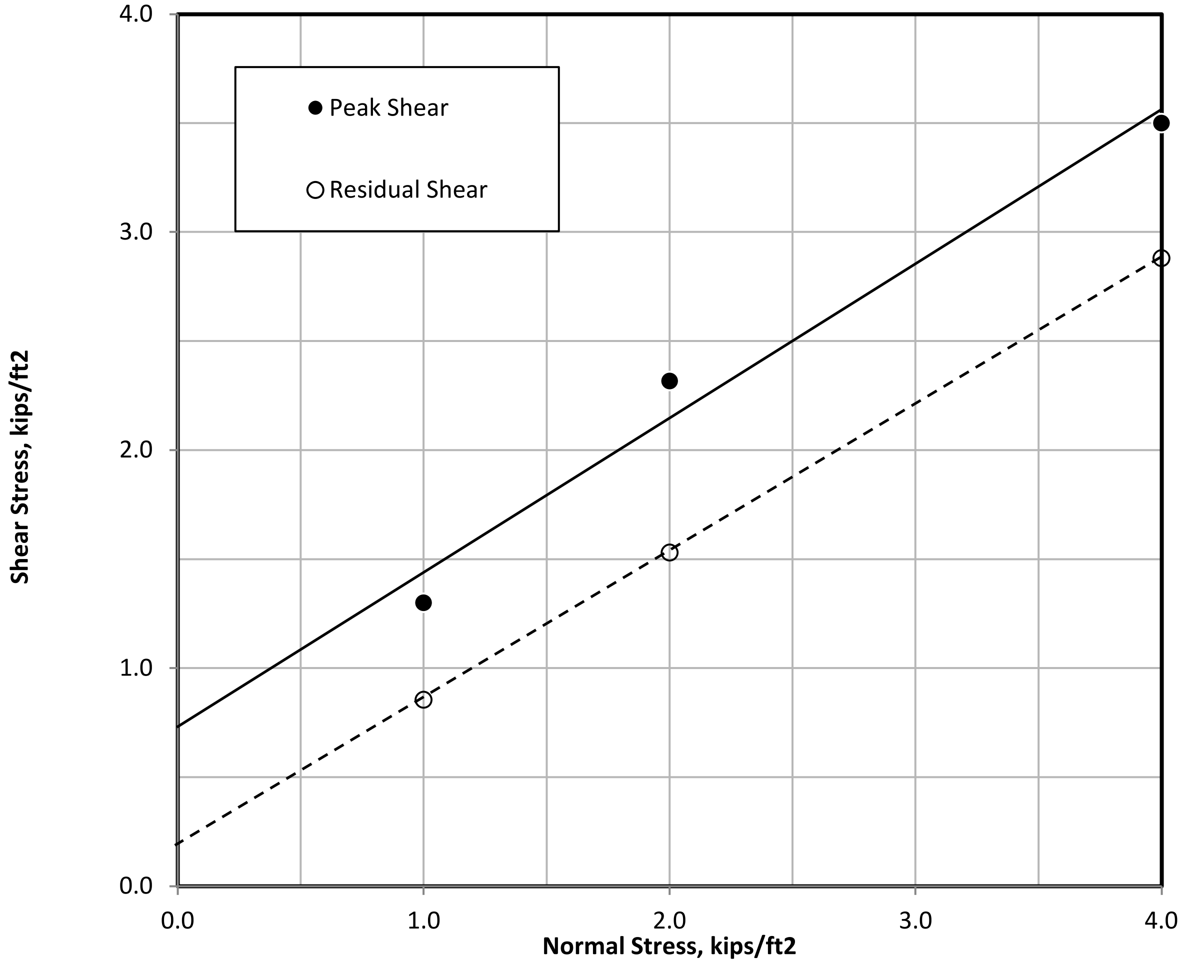
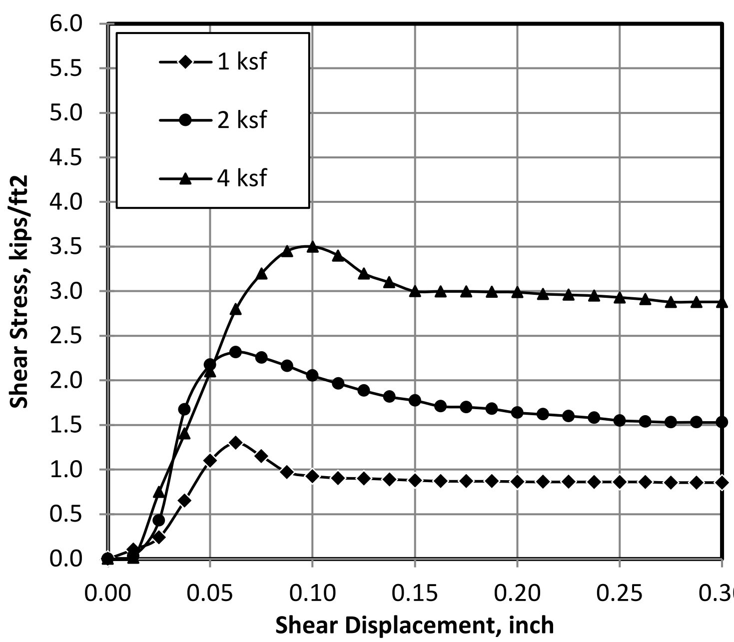
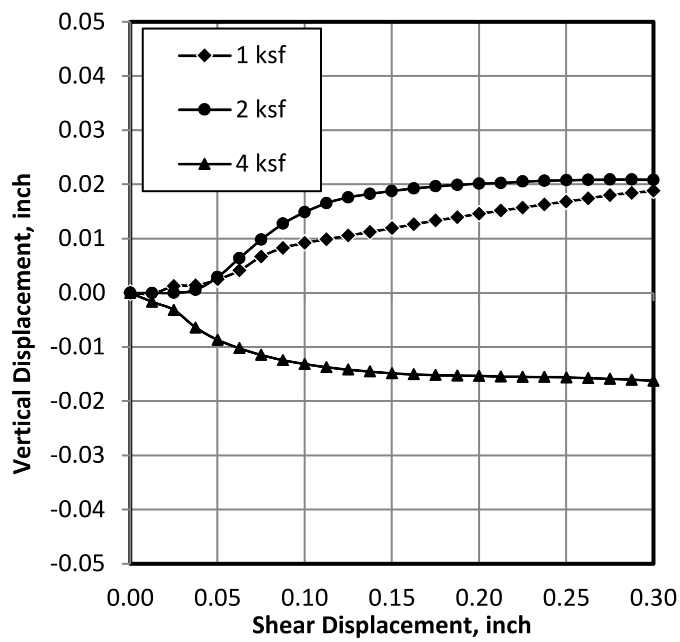
DIRECT SHEAR TEST

Client:	ESA - Loma Alta Slough Wetlands Enhancement Project
Location:	Oceanside, California
Project Number:	19.00936







Boring No.	B4	Bulk Sample Remolded (Saturated)	**Shear Strength Parameters:**
Depth:	1-5'	γ_d=128.2 pcf w(i)=8.0% w(f)=13.8%	Peak: ϕ =35° c = 710 lb/ft^2
Test Parameters:	CU @ 0.02 in/min	Silty Sand (SM)	Residual: ϕ =34° c = 180 lb/ft2

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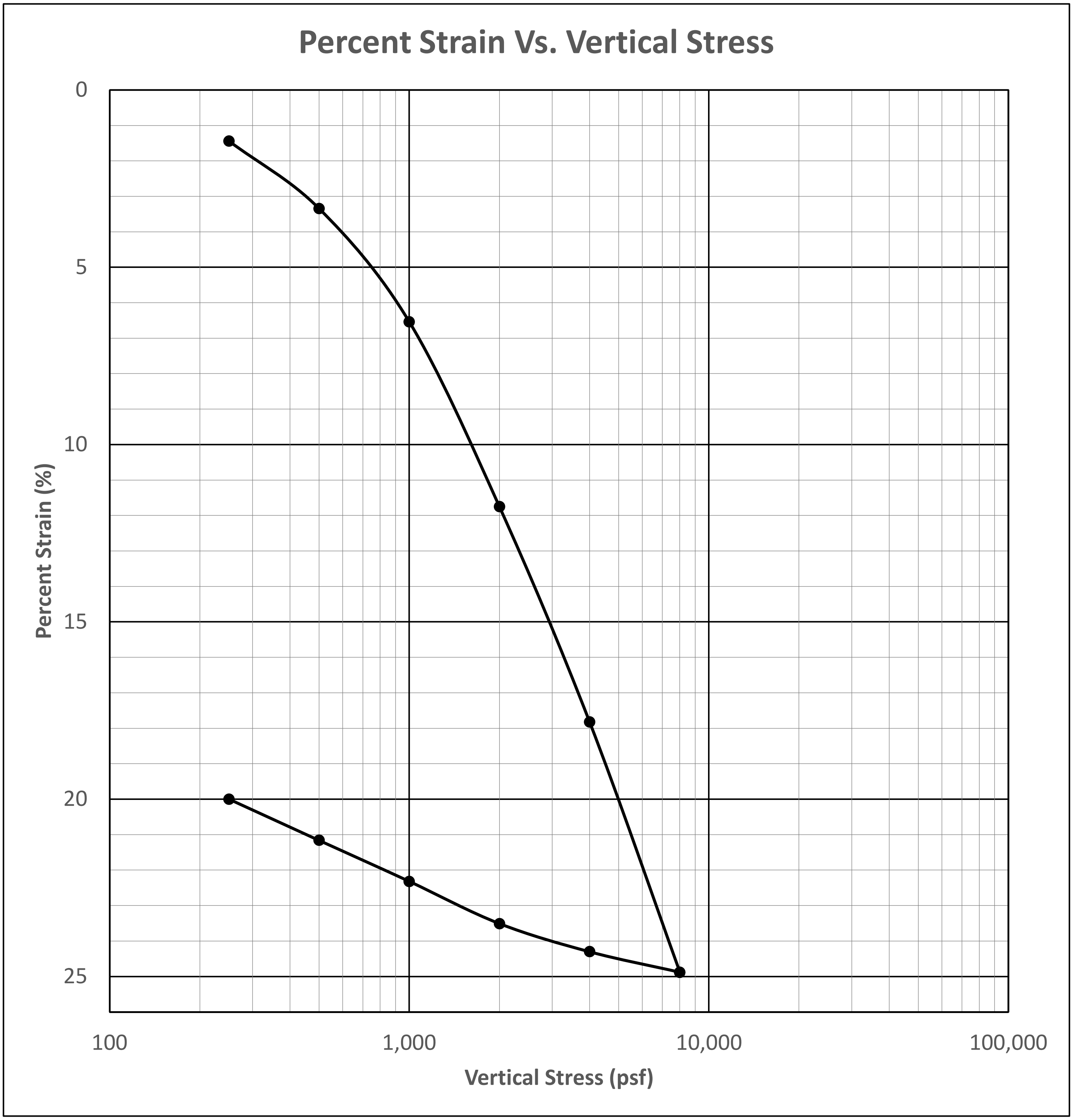
DIRECT SHEAR TEST

Client:	ESA - Loma Alta Slough Wetlands Enhancement Project
Location:	Oceanside, California
Project Number:	19.00936



Boring No.	B2	Sample:	Cal. Mod. Ring Lined Sampler	Dry Density	60.5 pcf
Depth:	5		Inundated at 250 psf	Moisture % (Initial)	70.6 %
Test:	ASTM D 2435	Soil Type:	Clayey Silty Sand (SM/SC)	Moisture % (Final)	44.8 %

TAYLOR GROUP, INC.
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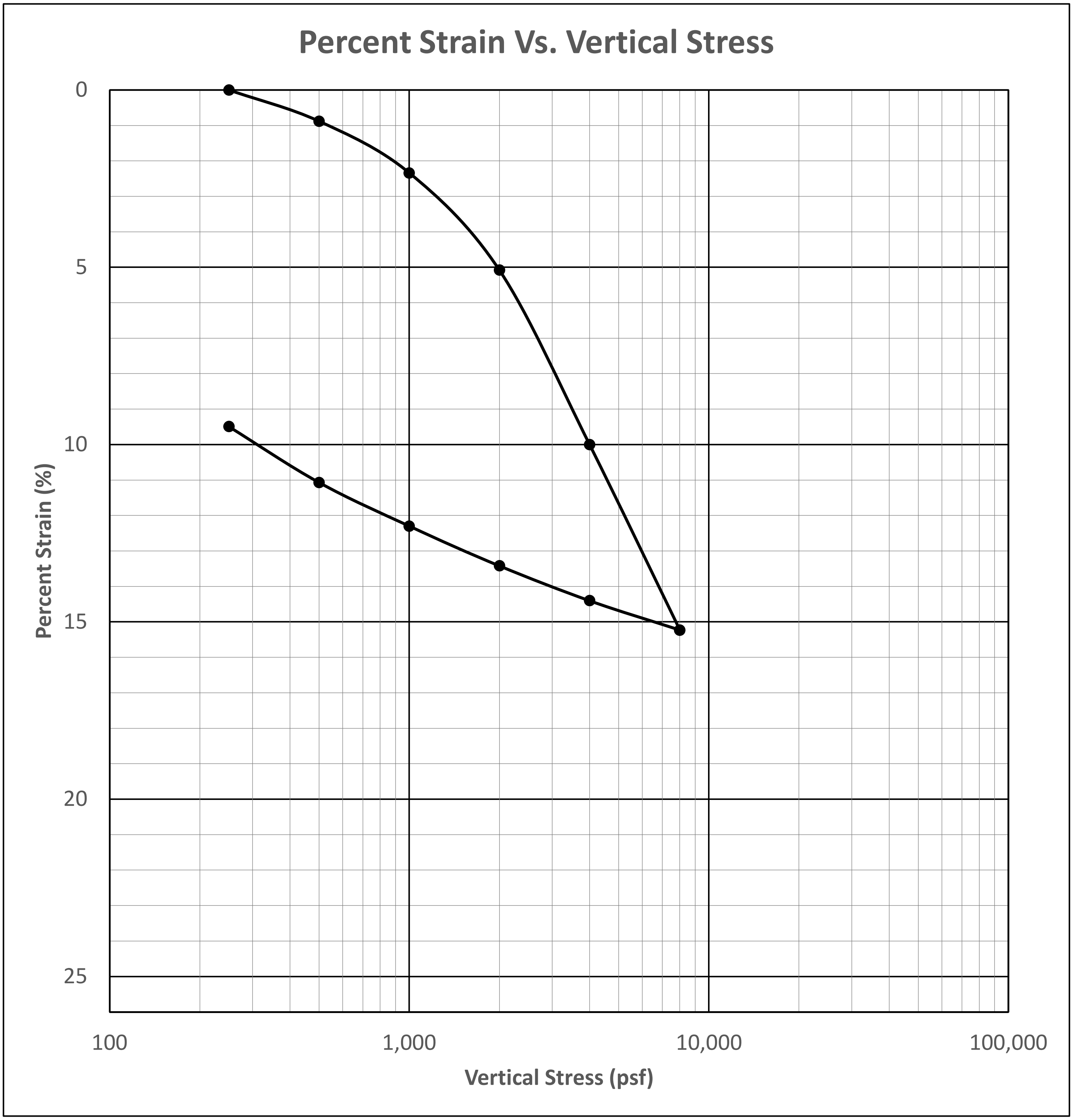
CONSOLIDATION TEST

Project Name: ESA - Loma Alta Slough Wetlands Enhancement Project
Location: Oceanside, California
Project Number: 09.00936



Boring No.	B3	Sample:	Cal. Mod. Ring Lined Sampler	Dry Density	67.5 pcf
Depth:	10		Inundated at 250 psf	Moisture % (Initial)	56.0 %
Test:	ASTM D 2435	Soil Type:	Silty Clay (CL)	Moisture % (Final)	38.1 %

TAYLOR GROUP, INC.
Geoscience & Engineering Consultants

CONSOLIDATION TEST

Project Name: ESA - Loma Alta Slough Wetlands Enhancement Project
Location: Oceanside, California
Project Number: 09.00936