

APPENDICES

STANISLAUS ELEMENTARY SCHOOL 1,2,3-TCP MITIGATION PROJECT
DRAFT INITIAL STUDY/ MITIGATED NEGATIVE DECLARATION
MODESTO, STANISLAUS COUNTY, CALIFORNIA

NOVEMBER 14, 2024

PREPARED FOR:

CITY OF MODESTO

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PREPARED BY:

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APPENDICES

For the proposed:

Stanislaus Elementary School 1,2,3-TCP Mitigation Project
Draft Initial Study/ Mitigated Negative Declaration

MODESTO, STANISLAUS COUNTY, CALIFORNIA

NOVEMBER 14, 2024

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APPENDICIES

APPENDIX A: Air Quality and Greenhouse Gas Impact Study/Energy (Ganddini 2023)

APPENDIX B: Biological Resources (ELMT 2023)

APPENDIX C: Historic Property Identification Report (BCR 2024)

Cultural/Archaeological/Tribal/ Paleontological Resources Report (BCR Consulting 2023)

APPENDIX D: Soils and Geotechnical (Universal Engineering Services 2023)

APPENDIX E: Noise Study (Ganddini 2023)

APPENDIX A

Air Quality and Greenhouse Gas Impact Study/Energy (Ganddini 2023)

STANISLAUS ELEMENTARY SCHOOL 1,2,3-TCP MITIGATION AIR QUALITY, GLOBAL CLIMATE CHANGE, AND ENERGY IMPACT ANALYSIS

City of Modesto
December 14, 2023
(Revised October 8, 2024)

Traffic Engineering ● Transportation Planning ● Parking ● Noise & Vibration
Air Quality ● Global Climate Change ● Health Risk Assessment

STANISLAUS ELEMENTARY SCHOOL
1,2,3-TCP MITIGATION
AIR QUALITY, GLOBAL CLIMATE CHANGE, AND ENERGY IMPACT ANALYSIS

City of Modesto
December 14, 2023
(Revised October 8, 2024)

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Project No. 19689

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EXECUTIVE SUMMARY

The purpose of this air quality, global climate change, and energy impact analysis is to provide an assessment of the impacts resulting from development of the proposed Stanislaus Elementary School 1,2,3-TCP Mitigation project and to identify measures that may be necessary to reduce potentially significant impacts.

Construction-Source Emissions

Project construction-source emissions would not exceed applicable regional thresholds of significance established by the San Joaquin Valley Air Pollution Control District (SJVAPCD).

As discussed herein, the project will comply with all applicable SJVAPCD construction-source emission reduction rules and guidelines. Project construction source emissions would not cause or substantively contribute to violation of the California Ambient Air Quality Standards (CAAQS) or National Ambient Air Quality Standards (NAAQS).

Given the temporary and short-term construction schedule, the project would not result in a long-term (i.e., lifetime or 30-year) exposure to TACs as a result of project construction. Furthermore, construction-based particulate matter (PM) emissions (including diesel exhaust emissions) do not exceed any SJVAPCD regional thresholds. Therefore, impacts from TACs during construction would be less than significant.

Established requirements addressing construction equipment operations, and construction material use, storage, and disposal requirements act to minimize odor impacts that may result from construction activities. Moreover, construction-source odor emissions would be temporary, short-term, and intermittent in nature and would not result in persistent impacts that would affect substantial numbers of people. Potential construction-source odor impacts are therefore considered less than significant.

Operational-Source Emissions

Project operational-sourced emissions would not exceed applicable regional thresholds of significance established by the SJVAPCD. Project operational-source emissions would not result in or cause a significant toxic air contaminant (TAC) impact as discussed in the Operations-Related Local Air Quality Impacts section of this report. Additionally, project-related trips will not cause or result in CO concentrations exceeding applicable state and/or federal standards (CO "hotspots). Project operational-source emissions would therefore not adversely affect sensitive receptors within the vicinity of the project.

The project's emissions meet SJVAPCD thresholds and will not result in a significant cumulative impact. The project does not propose any such uses or activities that would result in potentially significant operational-source odor impacts. Potential operational-source odor impacts are therefore considered less than significant.

Greenhouse Gases

The project's GHG emissions would not conflict with the goals of SB-32, City of Modesto General Plan and the CARB Scoping Plan; therefore, the project's GHG emissions are less than significant and would not conflict with an applicable plan, policy or regulation of an agency adopted for the purpose of reducing the emissions of greenhouse gases.

Energy

For new development such as that proposed by the Stanislaus Elementary School 1,2,3-TCP Mitigation project, compliance with California Building Standards Code Title 24 energy efficiency requirements (CALGreen), are considered demonstrable evidence of efficient use of energy. As discussed below, the project would provide for, and promote, energy efficiencies required under other applicable federal and State of

California standards and regulations, and in so doing would meet or exceed all California Building Standards Code Title 24 standards. Moreover, energy consumed by the project's operation is calculated to be comparable to, or less than, energy consumed by other pipeline uses of similar scale and intensity that are constructed and operating in California. On this basis, the project would not result in the inefficient, wasteful, or unnecessary consumption of energy. Impacts are considered to be less than significant.

1. INTRODUCTION

This section describes the purpose of this air quality, global climate change, and energy impact analysis, project location, proposed development, and study area. Figure 1 shows the project location map and Figure 2 illustrates the project site plan.

PURPOSE AND OBJECTIVES

This study was performed to address the possibility of regional/local air quality impacts and global climate change impacts, from project related air emissions. The objectives of the study include:

- documentation of the atmospheric setting
- discussion of criteria pollutants and greenhouse gases
- discussion of the air quality and global climate change regulatory framework
- analysis of the construction related air quality and greenhouse gas emissions
- analysis of the operations related air quality and greenhouse gas emissions
- analysis of the conformity of the proposed project with the SJAPCD thresholds
- analysis of the project's energy use during construction and operation
- recommendations for mitigation measures

The City of Modesto is the lead agency for this air quality and GHG analysis, in accordance with the CEQA authorizing legislation. Although this is a technical report, effort has been made to write the report clearly and concisely. A glossary is provided in Appendix A to assist the reader with technical terms related to air quality and global climate change.

PROJECT LOCATION

The proposed project is located within northwest unincorporated Stanislaus County in central San Joaquin Valley, "Central Valley." The Project is approximately 0.5 miles north from the City Limits of Modesto, within Modesto's Sphere of Influence (SOI), and also within the Study Area of the City's Water Master Plan. The Project will be constructed in public right-of-way outside of travel lanes and outside of the center median for Kiernan Avenue, either within or adjacent to existing paved street areas, to the north of the Kiernan/ Carver North Comprehensive Planning District (CPD), and north of the City Limits of Modesto. The Project proposes to install 12-inch diameter service connections to extend water service from the City's proposed water main within the Kiernan Avenue public right-of-way to the north side of the Kiernan Avenue right-of-way; one of these service connections is proposed to connect the southeastern corner of Stanislaus Elementary School Property (APN 004-068-008) to a meter for water delivery to the existing school from the main proposed within the eastbound lanes of Kiernan Avenue and the second service connection will connect the main within the intersection of Kiernan Avenue and Tully Road to the fire hydrant on the northeast corner of this intersection that will be installed with the Project. The Project also proposes water mains within public rights-of-way connecting the City's existing potable water system in Dale Road (south of Kiernan Avenue) and in Tully Road (south of Kiernan Avenue) to the new water main in Kiernan Avenue, which will eliminate existing dead-end mains in Dale Road and Tully Road. These areas where the Project will be constructed are collectively referred to as the "Project Site" for CEQA analysis and as summarized as follows:

Public ROW	Length (LF[1])	Direction of Pipeline Construction	Lat/Long; Elevation	Area of Disturbance
Tully Road	~ 825 ft	North from the existing "dead-end" in the City's existing water system in Tully Road to a point	Beginning of proposed alignment: Latitude 37.710473 °N/Longitude 121.013059°W; 91-92 ft AMSL	Open Trenching: 6-ft x 8-ft for 11,897 linear feet

		of connection in the proposed water main proposed in Kiernan Avenue's eastbound lanes. The Project will also install a service connection continuing **north** from Kiernan Avenue's eastbound lane and terminating in the northeastern corner of Kiernan Ave. & Tully Road intersection with a fire hydrant that will be installed as part of the Project.		**Jack and Bore Pits**: ***5 Jacking Pits:*** 12-ft wide x 10-ft long x 15-ft deep ***5 Receiving Pits:*** 12-ft wide x 24-ft long x 15-ft deep
Kieran Avenue	~ 10,782 ft	**West** from Tully Road and Kiernan Avenue intersection to the Dale Road and Kiernan Avenue intersection.	---	
Dale Road	~135 ft	**South** from Kiernan Avenue and Dale Road intersection to a connection point with the City's existing water system.	**End of Proposed Alignment**: Latitude 37.710636 °N/Longitude -121.050073°W; 91-92 ft AMSL	
Stanislaus Elementary School Service Connection	~155 ft	**North** from the proposed water main in the eastbound lanes of Kiernan Avenue and across the westbound right-of-way, terminating at the southeast property corner of the school	**Beginning of Proposed Service Connection:** Latitude 37.710911 °N / Longitude -121.027040°W; 91 ft AMSL **End of Proposed Service Connection:** Latitude 37.711339 °N / Longitude -121.027053 °W; 91 ft AMSL	

Reference: See Figure 2A: Water Improvements Local Vicinity Map
Notes: 1) LF= Linear Feet
2) Average dimensions of trenching are 6-feet wide by 8-feet deep.
3) AMSL= Above Mean Sea Level

A vicinity map showing the project location is provided on Figure 1.

PROJECT DESCRIPTION

The proposed Project is the consolidation of Stanislaus Union School District (SUSD) service area (Water System No. CA5000249) with the City of Modesto, through an extension of water and wastewater services, and the abandonment of the existing Well 02. Stanislaus Elementary School is one of six schools located within SUSD (five (5) elementary schools; one (1) junior high school); however, Stanislaus Elementary School is the only school currently being serviced by Water System No. CA5000249 since it is the only school within the district located outside of Modesto's Water System and City Limits.

Proposed Water Improvements

Water improvements will construct a total of approximately 11,897 linear feet of 12-inch potable water pipeline along Tully Road; Kiernan Avenue; and Dale Road. See *Table 4: Project Alignment*. The pipeline will extend to the north from the existing dead-end 12-inch diameter potable water main in Tully Road, along approximately 700 linear feet to the Tully Road and Kiernan Avenue intersection. The Project will continue north through the Tully Road and Kiernan Avenue intersection towards the northeast intersection corner and will terminate at the fire hydrant that is proposed with the Project. The proposed fire hydrant is at the northeast corner of the Kiernan Avenue and Tully Road intersection and will require approximately 155 linear feet of pipeline connection extending between the fire hydrant and the proposed main in Kiernan Avenue. The fire hydrant is needed for fire flow compliance with the City's performance criteria throughout the City's service area. From the intersection at Tully Road and Kiernan Avenue, the Project will also extend west towards Dale Road along the southside of Kiernan Avenue. The Project will install approximately 135 linear feet of water main within Dale Road south of the Dale Road and Kiernan Avenue intersection.

Due to the connections to two existing dead-end 12-inch diameter pipelines along Tully Road and Dale Road, the proposed water improvements will meet fire flow requirements (33 psi at 4,000 gpm); meet the City's operational and performance criteria; and result in high pipeline turnover rates which benefit water quality within the distribution system. The entire alignment will be buried underground using open trench construction as well as jack and bore construction to avoid direct impacts to existing utilities and structures. Temporary areas of disturbance as a result of trenching are anticipated to be 4-feet wide and 8-feet deep along the entire 11,897 linear feet of Project Alignment, consisting of approximately 1.1 acres. Jack and bore construction will consist of not more than a total of 5 jack and bore locations, each, including two pits[1], one entry (jacking), and one exit pit. Jacking pits are approximately 12-ft wide by 10-ft long by 15-ft deep and receiving pits are approximately 12-feet wide by 204-feet long x 15-feet deep, resulting in approximately 0.03 acres of disturbance. As a result, earthwork quantities are approximately 3,348 cubic yards (CY) of export and 4,680 CY of import.

One service connection, consisting of 155 linear feet of 12-inch diameter pipe will be installed from the proposed main in Kiernan Avenue to provide a water service connection for the school on the north side of Kiernan Avenue, at the southeastern corner of the Stanislaus Elementary School parcel; this component of the Project will be installed using jack and bore construction to avoid open trenches crossing Kiernan Avenue. Throughout Project construction, a traffic control plan will be implemented that includes lane closures, barricades, and signs to guide the flow of traffic through the construction zone along Kiernan Avenue, Tully Road, and Dale Road. Following the installation of the Project Alignment, the existing Well 02 is intended to be abandoned. Abandonment and permanent sealing of SUSD Well 02 will occur in accordance with requirements set forth by the Environmental Resources Department of Stanislaus County.

Project Objectives

Due to presence of 1,2,3-TCP in Well 02, the Stanislaus Elementary School's water system needs additional water services. Therefore, the intended outcome of the proposed Project is the following:

- Provide Stanislaus Elementary School with a source of drinking water that meets water quality standards;
- Provide sufficient hydraulic capacity to meet 4,000 gallons per minute (gpm) fire flow requirements while maintaining a 20-pounds per square inch (psi) residual pressure at the school;
- Build a Project that is consistent with the City's 2019 Water Master Plan (WMP) identified future improvements.

To achieve these objectives, the Project proposes to extend the City of Modesto's Water system to the school and stop the extraction of contaminated groundwater from Well 02.

Project Elements

Construction Activities

Construction activities will occur between 7:30 AM and 4:30 PM, Monday through Friday; weekend work will be avoided when feasible, however, weekend or night work might occur to accommodate traffic. The installation rate of the water and sewer mains are expected to average 100 feet per day.

[1] For the purposes of noise, air quality/GHG, and traffic modeling, assumptions were made about the location of jacking and receiving pits based on a "worst-case scenario". Under "worst-case" conditions, boring locations are located closest to sensitive receptors adjacent to the Project Alignment: one (1) along the east side of Dale Road, approximately 150 feet from sensitive receptors; three (3) along the north side of Kiernan Avenue, bordering the southern perimeter of Stanislaus Elementary School, approximately 50 ft from the closest sensitive receptors; and one (1) along the west side of Tully Road, approximately 50 ft from the closest sensitive receptors.

Construction activities will involve approximately six to eight crew members[2] at any one time for a total of 16 people on the job. Crew members will get to the construction site utilizing personal vehicles, approximately 16 vehicles at any one time, accessing the construction site via local roadways (Carver Road, Dale Road, Tully Road, etc.) or regional transportation routes (State Route (SR) 99; SR 219 (Kiernan Avenue); SR 108). Personal vehicles will be parked along the public right-of-way, adjacent to the Project Alignments within the roadway, shoulder, or the streets, or in a designated laydown yard on the Stanislaus Elementary School property. Throughout Project construction, a traffic control plan will be utilized along all impacted public rights-of-way (Kiernan Avenue, Dale Road, & Tully Road). Temporary fencing will be constructed around each work area to secure construction sites and prevent theft/vandalism that has the potential to occur overnight, concluding daily construction activities. In addition to fencing, active construction will either be backfilled or covered with trench plates at the end of each day. Water for construction and potable water during construction activities will be supplied by the City of Modesto's water system.

Construction Equipment

During Project implementation, construction activities will involve the utilization of various diesel-powered equipment along various locations of the Project Alignment for the duration of Project construction. Potential equipment on-site during construction includes one (1) scraper, five (5) tractors/ loaders/ backhoes, one (1) off-highway trucks, one (1) plate compactor, one (1) excavator, one (1) other material handling equipment, one (1) paving equipment, one (1) other construction equipment, two (2) pumps, one (1) skid steer loaders, one (1) surfacing equipment, one (1) rubber tiered dozer, and one (1) crane. During temporary Project construction, equipment will be kept at a designated laydown yard or the Project contractor's own facility.

Staging

Staging areas will be located inside existing public right-of-way along various locations of the Project Alignment or on adjacent parcels. These staging locations will depend on the portion of the alignment under construction. Staging will also be located within a portion of the Stanislaus Elementary School parking lot.

Phasing

The Project Construction is not anticipated to be phased. As mentioned above, the contractor will lay approximately 100 feet of pipeline per day for approximately eight months until the entire Project Alignment has been implemented. Utility potholing and determining locations of existing "dead-end" connections will occur prior to open trench construction and excavation.

Long-Term Operations and Maintenance

The proposed Project Alignment is anticipated to be operational for 50 or more years upon initial construction. The City will operate and manage the potable water conveyance pipeline to Stanislaus Elementary School, serving approximately 360 students and staff. The City of Modesto does not anticipate additional staffing needs for long-term operation and maintenance of the proposed Project. Monthly worker trips over the lifetime of the proposed Project will be required to conduct routine inspections and ensure proper long-term maintenance. Since a portion of the proposed Project will occur within CALTRANS right-of-way (Kiernan Avenue), the City will establish a long-term maintenance agreement with CALTRANS pursuant to a parallel encroachment policy exception for an arterial.

Figure 2 illustrates the proposed site plan.

[2] The number of construction crew members is an assumption based on the scale of the proposed Project and type of infrastructure being implemented.

PHASING AND TIMING

The proposed project is anticipated to be operational in 2025. The project is anticipated to be built in one phase with project construction anticipated to start no sooner than the beginning of fall 2024 and conclude in fall of 2025, lasting for approximately eleven months. The construction schedule utilized in the analysis represents a "worst-case" analysis scenario even if construction was to occur any time after the respective dates since emission factors for construction decrease as time passes and the analysis year increases due to emission regulations becoming more stringent.[3]

SENSITIVE RECEPTORS IN PROJECT VICINITY

The surrounding land uses are primarily agricultural fields and urban commercial uses as shown in the table below.

	Land Use	Stanislaus County General Plan	City of Modesto General Plan	Zoning
Project Location	County and City Right-of-Way; Stanislaus Elementary School	General Agriculture (Deciduous Fruits and Nuts)	Village Residential (VR)-Keiran/ Carver North Comprehensive Planning District	AG-40
North	Large-scale agriculture	General Agriculture (Deciduous Fruits and Nuts, Field Crops)	Village Residential (VR)	AG-40
South	Large-scale agriculture; Kaiser Permanente Modesto Medical Center	Community Commercial; Urban Vacant; Urban Industrial; General Agriculture (Pasture, Deciduous Fruits and Nuts)	Village Residential (VR); Business Park (BP); Mixed Use (MU)	AG 10; Modesto
East	Large-scale agriculture	General Agriculture (Deciduous Fruits and Nuts, Field Crops)	Business Park (BP)	AG-40
West	Large-scale agriculture	General Agriculture (Deciduous Fruits and Nuts)	Business Park (BP)	AG-40

Source: (1) Stanislaus County GIS, Updated May 2023. (2) Modesto General Plan EIR, 2019.

Those who are sensitive to air pollution include children, the elderly, and persons with preexisting respiratory or cardiovascular illness. For CEQA purposes, a sensitive receptor is generically defined as a location where human populations, especially children, seniors, and sick persons are found, and there is reasonable expectation of continuous human exposure according to the averaging period for the AAQS (e.g., 24-hour, 8-hour, 1-hour). These typically include residences, hospitals, and schools.[4] Commercial and industrial facilities are not included in the definition because employees do not typically remain on-site for 24 hours.

The nearest sensitive receptors to the project site are the existing residential, school, and transient lodging uses located adjacent or near Kiernan Avenue between Tully Road to Dale Road. Other air quality sensitive land uses are located further from the project site and would experience lower impacts.

[3] As shown in the California Emissions Estimator Model (CalEEMod) User's Guide Version 2020.4.0, Section 4.3.2 "OFFROAD Equipment" as the analysis year increases, emission factors for the same equipment pieces decrease due to the natural turnover of older equipment being replaced by newer less polluting equipment and new regulatory requirements.

[4] San Joaquin Valley Air Pollution Control District (SJVAPCD) Guidance for Assessing and Mitigation Air Quality Impacts, March 19, 2015. http://valleyair.org/transportation/GAMAQI.pdf

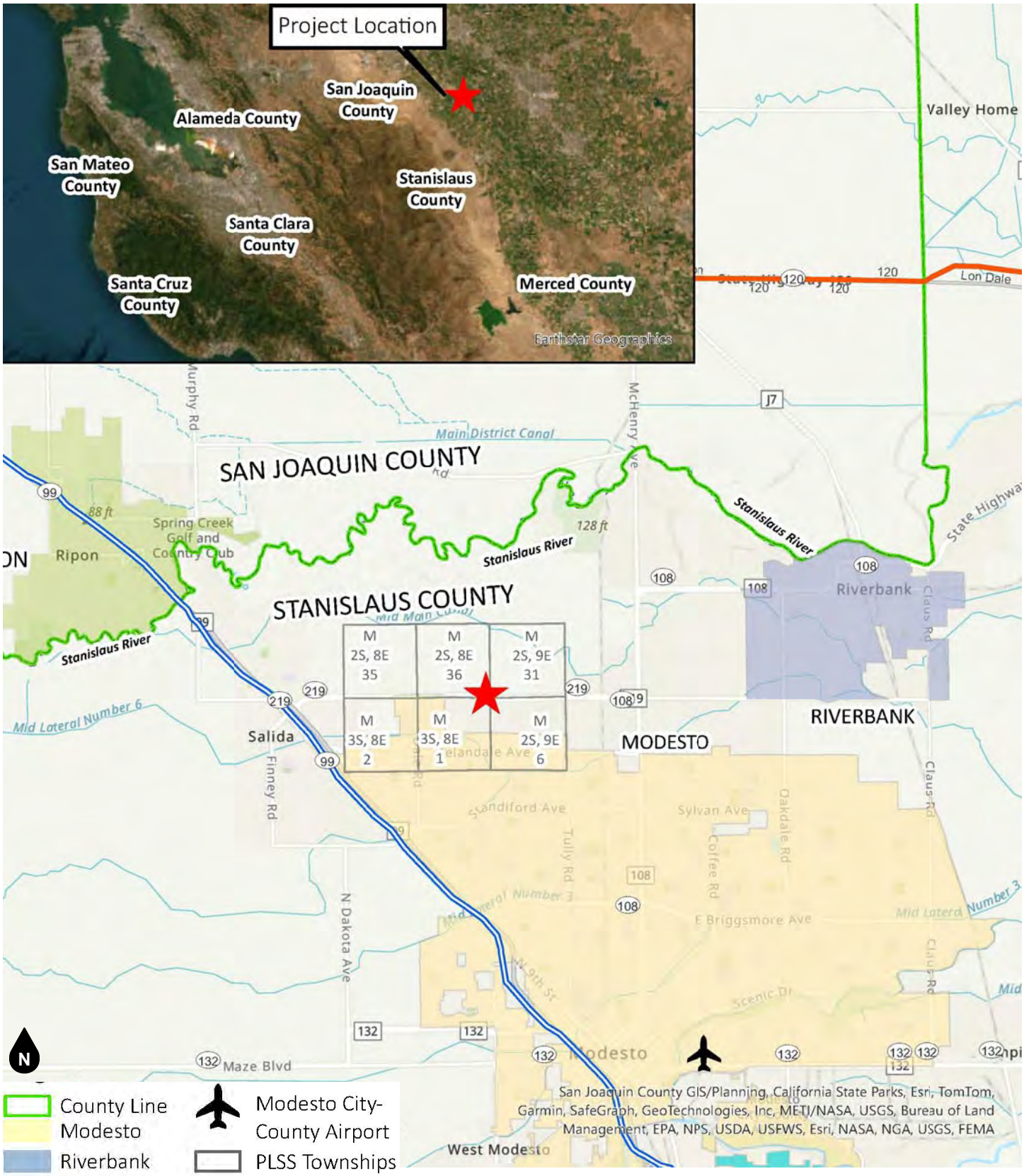


Figure 1
Regional Location Map

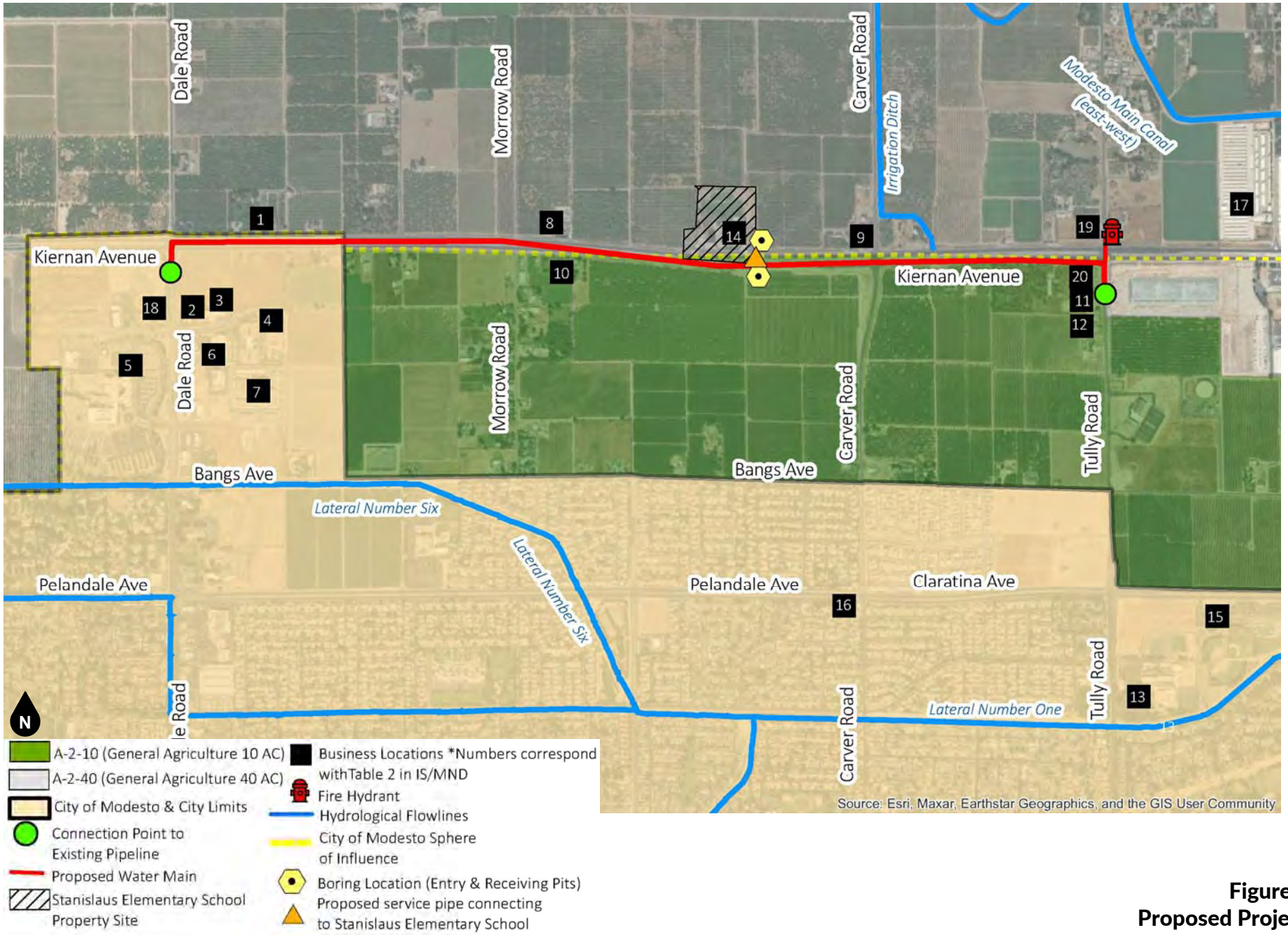


Figure 2
Proposed Project

2. AIR QUALITY ANALYSIS

EXISTING AIR QUALITY CONDITIONS

Local Air Quality

The project is located within the City of Modesto which lies within the San Joaquin Valley Air Basin (SJVAB). The project area is under the jurisdiction of the SJVAPCD. The SJVAB consists of eight counties: Fresno, Kern (western and central), Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare. Air pollution in the SJVAB can be attributed to both human-related (anthropogenic) and natural (non-anthropogenic) activities that produce emissions. Air pollution from significant anthropogenic activities in the SJVAB includes a variety of industrial-based sources as well as on- and off-road mobile sources. Activities that tend to increase mobile activity include increases in population, increases in general traffic activity (including automobiles, trucks, aircraft, and rail), urban sprawl (which will increase commuter driving distances), and general local land management practices as they pertain to modes of commuter transportation. These sources, coupled with geographical and meteorological conditions unique to the area, stimulate the formation of unhealthy air.[5]

The San Joaquin Valley's (SJV) topography and meteorology provide ideal conditions for trapping air pollution for long periods of time and producing harmful levels of air pollutants, including ozone and particulate matter. Low precipitation levels, cloudless days, high temperatures, and light winds during the summer in the SJV are conducive to high ozone levels resulting from the photochemical reaction of nitrogen oxides (NOx) and volatile organic compounds (VOC). Inversion layers in the atmosphere during the winter can trap emissions of directly emitted $PM_{2.5}$ (particulate matter that is 2.5 microns or less in diameter) and $PM_{2.5}$ precursors (such as NOx and sulfur dioxide (SO_2)) within the SJV for several days, accumulating to unhealthy levels. The region also houses the State's major arteries for goods and people movement, I-5 to the west and CA Highway 99 through the Central Valley, thereby attracting a large volume of vehicular traffic. Another compounding factor is the region's historically high rate of population growth compared to other regions of California. Increased population typically results in an even greater increase in vehicle activity and more consumer product use, leading to increased emissions of air pollution, including NOx. In fact, mobile sources account for about 80 percent of the Central Valley's total NOx emissions inventory. Since NOx is a significant precursor for both ozone and $PM_{2.5}$, reducing NOx from mobile sources is critical for progressing the Central Valley towards attainment of ozone and $PM_{2.5}$ standards.[6]

The geography of mountainous areas to the east, west and south, in combination with long summers and relatively short winters, contributes to local climate episodes that prevent the dispersion of pollutants. Transport, as affected by wind flows and inversions, also plays a role in the creation of air pollution.[7]

The temperature and precipitation levels for the City of Modesto are shown below in Table 1. Table 1 shows that July is typically the warmest month and January and December are typically the coolest months. Rainfall in the project area varies considerably depending on the location and season. Almost all the annual rainfall comes from the fringes of mid-latitude storms from late November to early April, with summers being almost completely dry.

[5] San Joaquin Valley Air Pollution Control District, Guidance for Assessing and Mitigating Air Quality Impacts, March 19, 2015. https://ww2.valleyair.org/media/g4nl3p0g/gamaqi.pdf

[6] San Joaquin Valley Air Pollution Control District, Guidance for Assessing and Mitigating Air Quality Impacts, March 19, 2015. https://ww2.valleyair.org/media/g4nl3p0g/gamaqi.pdf

[7] San Joaquin Valley Air Pollution Control District, Guidance for Assessing and Mitigating Air Quality Impacts, March 19, 2015. https://ww2.valleyair.org/media/g4nl3p0g/gamaqi.pdf

Table 1
Local Monthly Climate Data

Descriptor	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg. Max. Temperature	55.1	62.1	68.2	74.2	82.2	89.3	94.2	92.9	87.9	78.3	62.8	55.0
Avg. Min. Temperature	39.3	42.8	45.9	49.0	54.3	59.2	62.4	61.6	58.2	51.9	42.8	39.3
Avg. Total Precipitation (in.)	2.6	2.5	2.0	1.0	0.6	0.2	0.0	0.0	0.2	0.7	1.4	2.1

Source: https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca5738
Data from the Modesto City CO AP, CA station (045738).

Pollutants

Pollutants are generally classified as either criteria pollutants or non-criteria pollutants. Federal ambient air quality standards have been established for criteria pollutants, whereas no ambient standards have been established for non-criteria pollutants. For some criteria pollutants, separate standards have been set for different periods. Most standards have been set to protect public health. For some pollutants, standards have been based on other values (such as protection of crops, protection of materials, or avoidance of nuisance conditions). A summary of federal and state ambient air quality standards is provided in the Regulatory Framework section.

Criteria Pollutants

The criteria pollutants consist of: ozone, nitrogen dioxide, carbon monoxide, sulfur dioxide, lead, and particulate matter. These pollutants can harm your health and the environment, and cause property damage. The Environmental Protection Agency (EPA) calls these pollutants "criteria" air pollutants because it regulates them by developing human health-based and/or environmentally-based criteria for setting permissible levels. The following provides descriptions of each of the criteria pollutants.

Nitrogen Dioxides

Nitrogen Oxides (NOx) is the generic term for a group of highly reactive gases which contain nitrogen and oxygen. While most NOx are colorless and odorless, concentrations of nitrogen dioxide (NO_2) can often be seen as a reddish-brown layer over many urban areas. NOx form when fuel is burned at high temperatures, as in a combustion process. The primary manmade sources of NOx are motor vehicles, electric utilities, and other industrial, commercial, and residential sources that burn fuel. NOx reacts with other pollutants to form, ground-level ozone, nitrate particles, acid aerosols, as well as NO_2, which cause respiratory problems. NOx and the pollutants formed from NOx can be transported over long distances, following the patterns of prevailing winds. Therefore, controlling NOx is often most effective if done from a regional perspective, rather than focusing on the nearest sources.

Ozone

Ozone (O_3) is not usually emitted directly into the air but at ground-level is created by a chemical reaction between NOx and volatile organic compounds (VOC) in the presence of sunlight. Motor vehicle exhaust, industrial emissions, gasoline vapors, chemical solvents as well as natural sources emit NOx and VOC that help form O_3. Ground-level O_3 is the primary constituent of smog. Sunlight and hot weather cause ground-level O_3 to form with the greatest concentrations usually occurring downwind from urban areas. O_3 is subsequently considered a regional pollutant. Ground-level O_3 is a respiratory irritant and an oxidant that increases susceptibility to respiratory infections and can cause substantial damage to vegetation and other materials. Because NOx and VOC are O_3 precursors, the health effects associated with O_3 are also indirect health effects associated with significant levels of NOx and VOC emissions.

Carbon Monoxide

Carbon monoxide (CO) is a colorless, odorless gas that is formed when carbon in fuel is not burned completely. It is a component of motor vehicle exhaust, which contributes about 56 percent of all CO emissions nationwide. In cities, 85 to 95 percent of all CO emissions may come from motor vehicle exhaust. Other sources of CO emissions include industrial processes (such as metals processing and chemical manufacturing), residential wood burning, and natural sources such as forest fires. Woodstoves, gas stoves, cigarette smoke, and unvented gas and kerosene space heaters are indoor sources of CO. The highest levels of CO in the outside air typically occur during the colder months of the year when inversion conditions are more frequent. The air pollution becomes trapped near the ground beneath a layer of warm air. CO is described as having only a local influence because it dissipates quickly. Since CO concentrations are strongly associated with motor vehicle emissions, high CO concentrations generally occur in the immediate vicinity of roadways with high

traffic volumes and traffic congestion, active parking lots, and in automobile tunnels. Areas adjacent to heavily traveled and congested intersections are particularly susceptible to high CO concentrations.

CO is a public health concern because it combines readily with hemoglobin and thus reduces the amount of oxygen transported in the bloodstream. The health threat from lower levels of CO is most serious for those who suffer from heart disease such as angina, clogged arteries, or congestive heart failure. For a person with heart disease, a single exposure to CO at low levels may cause chest pain and reduce that person's ability to exercise; repeated exposures may contribute to other cardiovascular effects. High levels of CO can affect even healthy people. People who breathe high levels of CO can develop vision problems, reduced ability to work or learn, reduced manual dexterity, and difficulty performing complex tasks. At extremely high levels, CO is poisonous and can cause death.

Sulfur Dioxide

Sulfur Oxide (SOx) gases (including sulfur dioxide [SO_2]) are formed when fuel containing sulfur, such as coal and oil is burned, and from the refining of gasoline. SOx dissolve easily in water vapor to form acid and interacts with other gases and particles in the air to form sulfates and other products that can be harmful to people and the environment.

Lead

Lead (Pb) is a metal found naturally in the environment as well as manufactured products. The major sources of lead emissions have historically been motor vehicles and industrial sources. Due to the phase out of leaded gasoline, metal processing is now the primary source of lead emissions to the air. High levels of lead in the air are typically only found near lead smelters, waste incinerators, utilities, and lead-acid battery manufacturers. Exposure of fetuses, infants and children to low levels of lead can adversely affect the development and function of the central nervous system, leading to learning disorders, distractibility, inability to follow simple commands, and lower intelligence quotient. In adults, increased lead levels are associated with increased blood pressure.

Particulate Matter

Particulate matter (PM) is the term for a mixture of solid particles and liquid droplets found in the air. Particulate matter is made up of a number of components including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles. The size of particles is directly linked to their potential for causing health problems. Particles that are less than 10 micrometers in diameter (PM10) are the particles that generally pass through the throat and nose and enter the lungs. Once inhaled, these particles can affect the heart and lungs and cause serious health effects. Particles that are less than 2.5 micrometers in diameter (PM2.5) have been designated as a subset of PM10 due to their increased negative health impacts and its ability to remain suspended in the air longer and travel further.

Reactive Organic Gases (ROG)

Although not a criteria pollutant, reactive organic gases (ROGs), or volatile organic compounds (VOCs), are defined as any compound of carbon—excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate—that participates in atmospheric photochemical reactions. Although there are slight differences in the definition of ROGs and VOCs, the two terms are often used interchangeably. Indoor sources of VOCs include paints, solvents, aerosol sprays, cleansers, tobacco smoke, etc. Outdoor sources of VOCs are from combustion and fuel evaporation. A reduction in VOC emissions reduces certain chemical reactions that contribute to the formulation of O_3. VOCs are transformed into organic aerosols in the atmosphere, which contribute to higher PM10 and lower visibility.

Other Pollutants of Concern

Toxic Air Contaminants (TACs)

In addition to the above-listed criteria pollutants, TACs are another group of pollutants of concern. Sources of TACs include industrial processes such as petroleum refining and chrome plating operations, commercial operations such as gasoline stations and dry cleaners, and motor vehicle exhaust. Cars and trucks release at least forty different TACs. The most important of these TACs, in terms of health risk, are diesel particulates, benzene, formaldehyde, 1,3-butadiene, and acetaldehyde. Public exposure to TACs can result from emissions from normal operations as well as from accidental releases. Health effects of TACs include cancer, birth defects, neurological damage, and death.

TACs are less pervasive in the urban atmosphere than criteria air pollutants, however they are linked to short-term (acute) or long-term (chronic or carcinogenic) adverse human health effects. There are hundreds of different types of TACs with varying degrees of toxicity. Sources of TACs include industrial processes, commercial operations (e.g., gasoline stations and dry cleaners), and motor vehicle exhaust.

According to the 2013 California Almanac of Emissions and Air Quality, the majority of the estimated health risk from TACs can be attributed to relatively few compounds, the most important of which is diesel particulate matter (DPM). Diesel particulate matter is a subset of PM2.5 because the size of diesel particles are typically 2.5 microns and smaller. The identification of diesel particulate matter as a TAC in 1998 led the California Air Resources Board (CARB) to adopt the Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-fueled Engines and Vehicles in September 2000. The plan's goals are a 75-percent reduction in diesel particulate matter by 2010 and an 85-percent reduction by 2020 from the 2000 baseline. Diesel engines emit a complex mixture of air pollutants, composed of gaseous and solid material. The visible emissions in diesel exhaust are known as particulate matter or PM, which includes carbon particles or "soot". Diesel exhaust also contains a variety of harmful gases and over 40 other cancer-causing substances. California's identification of diesel particulate matter as a TAC was based on its potential to cause cancer, premature deaths, and other health problems. Exposure to diesel particulate matter is a health hazard, particularly to children whose lungs are still developing and the elderly who may have other serious health problems. Overall, diesel engine emissions are responsible for the majority of California's potential airborne cancer risk from combustion sources.

Asbestos

Asbestos is listed as a TAC by the ARB and as a Hazardous Air Pollutant by the EPA. Asbestos occurs naturally in mineral formations and crushing or breaking these rocks, through construction or other means, can release asbestiform fibers into the air. Asbestos emissions can result from the sale or use of asbestos-containing materials, road surfacing with such materials, grading activities, and surface mining. The risk of disease is dependent upon the intensity and duration of exposure. When inhaled, asbestos fibers may remain in the lungs and with time may be linked to such diseases as asbestosis, lung cancer, and mesothelioma. The nearest likely locations of naturally occurring asbestos, as identified in the General Location Guide for Ultramafic Rocks in California prepared by the California Division of Mines and Geology, is located Tuolumne County approximately 30 miles northeast of the site. Due to the distance to the nearest natural occurrences of asbestos, the project site is not likely to contain asbestos.

Regulatory Setting

The proposed project is addressed through the efforts of various international, federal, state, regional, and local government agencies. These agencies work jointly, as well as individually, to improve air quality through legislation, regulations, planning, policy-making, education, and a variety of programs. The agencies responsible for improving the air quality are discussed below.

Federal – United States Environmental Protection Agency

The United States Environmental Protection Agency (USEPA) is responsible for setting and enforcing the NAAQS for atmospheric pollutants. It regulates emission sources that are under the exclusive authority of the federal government, such as aircraft, ships, and certain locomotives. The NAAQS pollutants were identified using medical evidence and are shown below in Table 2.

The EPA and the California Air Resource Board (CARB) designate air basins where ambient air quality standards are exceeded as "nonattainment" areas. If standards are met, the area is designated as an "attainment" area. If there is inadequate or inconclusive data to make a definitive attainment designation, they are considered "unclassified." National nonattainment areas are further designated as marginal, moderate, serious, severe, or extreme as a function of deviation from standards. Each standard has a different definition, or 'form' of what constitutes attainment, based on specific air quality statistics. For example, the Federal 8-hour CO standard is not to be exceeded more than once per year; therefore, an area is in attainment of the CO standard if no more than one 8-hour ambient air monitoring values exceeds the threshold per year. In contrast, the Federal annual PM2.5 standard is met if the three-year average of the annual average PM2.5 concentration is less than or equal to the standard. Attainment status is shown in Table 3.

As part of its enforcement responsibilities, the EPA requires each state with federal nonattainment areas to prepare and submit a State Implementation Plan (SIP) that demonstrates the means to attain the national standards. The State Implementation Plan (SIP) must integrate federal, state, and local components and regulations to identify specific measures to reduce pollution, using a combination of performance standards and market-based programs within the timeframe identified in the State Implementation Plan (SIP).

As indicated below in Table 3, the Basin has been designated by the EPA as a non-attainment area for ozone (O_3) and suspended particulates (PM2.5). Currently, the Basin is in attainment with the ambient air quality standards for carbon monoxide (CO), lead, sulfur dioxide (SO_2), suspended particulate matter (PM-10), and nitrogen dioxide (NO_2).

State – California Air Resources Board

The California Air Resources Board (CARB), which is a part of the California Environmental Protection Agency (CalEPA), is responsible for the coordination and administration of both federal and state air pollution control programs within California. In this capacity, the CARB conducts research, sets the CAAQS, compiles emission inventories, develops suggested control measures, provides oversight of local programs, and prepares the State Implementation Plan (SIP). The CAAQS for criteria pollutants are shown in Table 2. In addition, the CARB establishes emission standards for motor vehicles sold in California, consumer products (e.g., hairspray, aerosol paints, and barbeque lighter fluid), and various types of commercial equipment. Furthermore, the motor vehicle emission standards established by CARB include compliance with the Safer Affordable Fuel-Efficient Vehicles (SAFE) Rule, issued by NHTSA and EPA in March 2020 (published on April 30, 2020 and effective after June 29, 2020). The SAFE Rule sets fuel economy and carbon dioxide standards that increase 1.5 percent in stringency each year from model years 2021 through 2026 and apply to both passenger cars and light trucks. CARB also sets fuel specifications to further reduce vehicular emissions.

The San Joaquin Valley has been designated by the CARB as a nonattainment area for ozone, PM10 and PM2.5. Currently, the San Joaquin Valley is in attainment with the ambient air quality standards for CO, lead, SO_2, NO_2, SO_2, vinyl chloride, and sulfates and is unclassified for visibility reducing particles and hydrogen sulfide.

On June 20, 2002, the CARB revised the PM10 annual average standard to 20 $\mu g/m^3$ and established an annual average standard for PM2.5 of 12 $\mu g/m^3$. These standards were approved by the Office of Administrative Law in June 2003 and are now effective.

On December 12, 2008, the CARB adopted Resolution 08-43, which limits NOx, PM10 and PM2.5 emissions from on-road diesel truck fleets that operate in California. On October 12, 2009, Executive Order R-09-010 was adopted that codified Resolution 08-43 into Section 2025, Title 13 of the California Code of Regulations. This regulation requires that by the year 2023 all commercial diesel trucks that operate in California shall meet model year 2010 (Tier 4) or latter emission standards. In the interim period, this regulation provides annual interim targets for fleet owners to meet. This regulation also provides a few exemptions including a once-per-year 3-day pass for trucks registered outside of California.

The CARB is also responsible for regulations pertaining to TACs. The Air Toxics "Hot Spots" Information and Assessment Act (AB 2588, 1987, Connelly) was enacted in 1987 as a means to establish a formal air toxics emission inventory risk quantification program. AB 2588, as amended, establishes a process that requires stationary sources to report the type and quantities of certain substances their facilities routinely release into the South Coast Air Basin. The data is ranked by high, intermediate, and low categories, which are determined by: the potency, toxicity, quantity, volume, and proximity of the facility to nearby receptors.

AB 617 Nonvehicular air pollution: criteria air pollutants and toxic air contaminants

This bill requires the state board to develop a uniform statewide system of annual reporting of emissions of criteria air pollutants and TACs for use by certain categories of stationary sources. The bill requires those stationary sources to report their annual emissions of criteria air pollutants and TACs, as specified. This bill required the state board, by October 1, 2018, to prepare a monitoring plan regarding technologies for monitoring criteria air pollutants and TACs and the need for and benefits of additional community air monitoring systems, as defined. The bill requires the state board to select, based on the monitoring plan, the highest priority locations in the state for the deployment of community air monitoring systems. The bill requires an air district containing a selected location, by July 1, 2019, to deploy a system in the selected location. The bill would authorize the air district to require a stationary source that emits air pollutants in, or that materially affect, the selected location to deploy a fence-line monitoring system, as defined, or other specified real-time, on-site monitoring. The bill authorizes the state board, by January 1, 2020, and annually thereafter, to select additional locations for the deployment of the systems. The bill would require air districts that have deployed a system to provide to the state board air quality data produced by the system. By increasing the duties of air districts, this bill would impose a state-mandated local program. The bill requires the state board to publish the data on its Internet Web site.

Regional

San Joaquin Valley Air Pollution Control District (SJVAPCD)

The SJVAPCD develops rules and regulations, establishes permitting requirements for stationary sources, inspects emission sources, and enforces such measures through educational programs or fines, when necessary. The SJVAPCD is directly responsible for reducing emissions from stationary, mobile, and indirect sources.

The SJVAPCD has developed plans to attain State and Federal standards for ozone and particulate matter. The SJVAPCD's air quality plans include emissions inventories to measure the sources of air pollutants, to evaluate how well different control methods have worked, and to show how air pollution will be reduced. The plans also model and estimate future levels of pollution and make sure that the San Joaquin Valley will meet air quality goals. The SJVAPCD's attainment plans are subject to approval by the SJVAPCD's Governing Board.

SJVAPCD Attainment Plans

Consistent with Clean Air Act requirements, the SJVAPCD has adopted attainment plans that demonstrate how the SJVAPCD will attain and maintain the National Ambient Air Quality Standards. These plans are developed through a public process, formally adopted by the State, and submitted by the Governor's designee

to the US EPA. The Clean Air Act requires EPA to review each plan and any plan revisions and to approve the plan or plan revisions if consistent with the Clean Air Act.

Each attainment plan includes a comprehensive and exhaustive list of regulatory and incentive-based measures to reduce emissions of ozone and particulate matter precursors throughout the Valley. Consistent with the direction of each plan, the Governing Board adopted regulatory measures that, in the majority of cases, exceed the plan commitment for a given source category, especially through the implementation of the Confined Animal Facilities Rule (4570), Phase II of the Stationary Internal Combustion Engines Rule (4702), Stationary Gas Turbines Rule (4703), and multiple rules for Boilers, Steam Generators, and Process Heaters (4306, 4307, 4320).

Many of the rules implemented through the Extreme Ozone Attainment Demonstration Plan and 2007 Ozone Plan, such as the Indirect Source Review (ISR) rule, are the first of their type in the nation, or are deemed the most stringent in the nation. The SJVAPCD's (ISR) Rule bridges the gap between regulations and incentives to maximize reductions while minimizing socioeconomic impacts. The ISR rule requires developers of new development projects to reduce emissions during both the construction and operational phases of the project. SJVAPCD works closely with developers to maximize on-site emissions reductions. However, if developers are not able to fully achieve required reductions through on-site measures, fees may be collected to fund off-site emission reduction projects.

State Implementation Plan

The SJVAPCD's attainment plans are a regional component of the State Implementation Plan (SIP). The SIP includes annual increases in air pollutant emissions resulting from regional growth (including construction-generated emissions) anticipated according to local land use plans (e.g., general plans, regional transportation plans). The SIP also assumes the incremental increase in emissions will be partially offset through the implementation of stationary, area, and indirect source control measures contained within the SIP. The SIP is the State of California's plan for attaining the National Ambient Air Quality Standards (NAAQS). The contents of a typical SIP fall into several categories:

- State-adopted control measures which consists of either rules/regulations or source-specific requirements (e.g., orders and consent decrees);
- State-submitted comprehensive air quality plans, such as attainment plans, maintenance plans, rate of progress plans, and transportation control plans demonstrating how these state regulatory and source-specific controls, in conjunction with federal programs, will bring and/or keep air quality in compliance with federal air quality standards;
- State- submitted "non-regulatory" requirements, such as emission inventories, small business compliance assistance programs; statutes demonstrating legal authority, monitoring networks, etc.); and
- Additional requirements promulgated by EPA (in the absence of a commensurate State provision) to satisfy a mandatory section 110 or part D (Clean Air Act) requirement.

SJVAPCD Rules and Regulations

During construction and operation, the project must comply with applicable rules and regulations. The following are rules that the project may be required to comply with, either directly, or indirectly:

District Rule 4101 Visible Emissions

This rule prohibits the emissions of visible air contaminants to the atmosphere. The rule prohibits the discharge into the atmosphere from any single source of emission, any air contaminant, other than uncombined water vapor, for a period or periods aggregating more than three (3) minutes in any one hour which is as dark or darker in shade as that designated as No. 1 on the Ringelmann Chart.

Rule 4102 Nuisance

The purpose of this rule is to protect the health and safety of the public. The rule prohibits anyone from discharging air contaminants or other materials which cause injury, detriment, nuisance or annoyance to any considerable number of persons or to the public or which endanger the comfort, repose, health or safety of any such person or the public or which cause or have a natural tendency to cause injury or damage to business or property. The provisions of this rule do not apply to odors emanating from agricultural operations in the growing of crops or raising of fowl or animals.

Rule 4601 Architectural Coatings

The purpose of this rule is to limit VOC emissions from architectural coatings by regulating the storage, cleanup, and labeling requirements. Painting Practices: The rule requires that all containers containing architectural coatings (including any volatile material used for thinning or cleanup) be closed when not in use. The rule also sets limits on the number of VOCs in architectural coating and prohibits thinning such that the limits would be exceeded.

Rule 4641, Cutback, Slow Cure, and Emulsified Asphalt, Paving and Maintenance Operations

This rule limits VOC emissions by restricting the application and manufacturing of cutback asphalt[8], slow cure asphalt, or emulsified asphalt.

Rule 4702 Internal Combustion Engines (Certified Equipment for Internal Combustion Engines)

This rule requires stationary engines to meet certain exhaust limits for NOx and CO, but these limits are not applicable to standby engines as long as they are used fewer than 200 hours per year (e.g., for testing during non-emergencies).

District Regulation II (Permits)

District Regulation II (Permits) applies to permitted emission sources and includes rules such as SJVAPCD permit requirements (Rule 2010), New and Modified Stationary Source Review (Rule 2201), and implementation of Emission Reduction Credit Banking (Rule 2301). Many industrial projects and some commercial projects require SJVAPCD permits. Rule 2010 states that "any person who plans to or does operate, construct, alter, or replace any source of emission of air contaminants" must obtain approval of the Air Pollution Control Officer and receive an Authority to Construct and a Permit to Operate. Examples of air contaminant emitting equipment and processes include (but are not limited to) the following:

- Agricultural products processing
- Bulk material handling
- Chemical blending, mixing, manufacturing, storage, etc.
- Combustion equipment (boilers, engines, heaters, incinerators, etc.)
- Metals etching, melting, plating, refining, etc.
- Plastics & fiberglass forming and manufacturing
- Petroleum production, manufacturing, storage, and distribution
- Rock & mineral mining and processing
- Solvent use (degreasing, dry-cleaning, etc.)
- Surface coating and preparation (painting, blasting, etc.)

District Regulation II ensures that stationary source emissions will be reduced or mitigated to below the SJVAPCD's significance thresholds. However, the Lead Agency can, and should, make an exception to this

[8] Cutback asphalt is manufactured by blending asphalt cement with a petroleum solvent.

determination if special circumstances suggest that the emissions from any permitted or exempt source may cause a significant air quality impact. For example, if a source may emit objectionable odors, then odor impacts on nearby receptors should be considered a potentially significant air quality impact.

SJVAPCD implementation of New Source Review (NSR) ensures that there is no net increase in emissions above specified thresholds from New and Modified Stationary Sources for all nonattainment pollutants and their precursors. Furthermore, in general, permitted sources emitting more than the NSR Offset Thresholds for any criteria pollutant must offset all emission increases in excess of the thresholds. However, under certain circumstances, the SJVAPCD may be precluded by state law or other SJVAPCD rule requirements from requiring a stationary source to offset emissions increases.

District Regulation VIII (Fugitive PM10 Prohibition)

The purpose of Regulation VIII (Reg. VIII) is to reduce ambient concentrations of fine particulate matter (PM10) by requiring actions to prevent, reduce or mitigate anthropogenic fugitive dust emissions. Reg. VIII requires property owners, contractors, developers, equipment operators, farmers and public agencies to control fugitive dust emissions from specified outdoor fugitive dust sources, including:

- Construction sites
- Excavation, Demolition, and other earthmoving activities
- Bulk material handling, storage and transport
- Carryout and trackout
- Vacant land
- Paved and unpaved roads
- Unpaved vehicle traffic areas

Regulation VIII specifies the following measures to control fugitive dust:

- Apply water to unpaved surfaces and areas
- Use non-toxic chemical or organic dust suppressants on unpaved roads and traffic areas
- Limit or reduce vehicle speed on unpaved roads and traffic areas
- Maintain areas in a stabilized condition by restricting vehicle access
- Install wind barriers
- During high winds, cease outdoor activities that disturb the soil.
- Keep bulk materials sufficiently wet when handling
- Store and handle materials in a three-sided structure
- When storing bulk materials, apply water to the surface or cover the storage pile with a tarp
- Don't overload haul trucks. Overloaded trucks are likely to spill bulk materials
- Cover haul trucks with a tarp or other suitable cover. Or, wet the top of the load enough to limit visible dust emissions
- Clean the interior of cargo compartments on emptied haul trucks prior to leaving a site
- Prevent trackout by installing a trackout control device
- Clean up trackout at least once a day. If along a busy road or highway, clean up trackout immediately
- Monitor dust-generating activities and implement appropriate measures for maximum dust control

For projects in which construction related activities would disturb equal to or greater than 1-acre of surface area, the SJVAPCD recommends that demonstration of receipt of a SJVAPCD approved Dust Control Plan or Construction Notification form, before issuance of the first grading permit, be made a condition of project approval. It should be noted that although compliance with District Regulation VIII substantially reduces project specific fugitive dust emissions, it may not be sufficient to reduce project specific emissions to less than significant levels. Furthermore, District Regulation VIII does not reduce construction exhaust emissions.

District Rule 9510 (Indirect Source Review)

District Rule 9510 (ISR) is intended to reduce a project's impact on air quality through project design elements or mitigation by payments of applicable off-site mitigation fees. Compliance with Rule 9510 will reduce construction exhaust NOx and PM10 emissions by 20 percent and 45 percent respectively. Compliance with Rule 9510 will reduce operational emissions of NOx and PM10 emissions by 33.3 percent and 50 percent respectively. Individual development projects would be subject to ISR requirements if upon full build-out the project would include or exceed any one of the following:

- 50 dwelling units;
- 2,000 square feet of commercial space;
- 25,000 square feet of light industrial space;
- 100,000 square feet of heavy industrial space;
- 20,000 square feet of medical office space;
- 39,000 square feet of general office space;
- 9,000 square feet of educational space;
- 10,000 square feet of government space;
- 20,000 square feet of recreational space; or
- 9,000 square feet of space not identified above

The ISR rule also applies to any transportation or transit project where construction exhaust emissions equal or exceed two (2.0) tons NOx or two (2.0) tons of PM10.

For projects subject to District Rule 9510, the SJVAPCD recommends that demonstration of compliance with District Rule 9510, including payment of all applicable fees before issuance of the first building permit, be made a condition of project approval.

It should be noted that although compliance with District Rule 9510 substantially reduces project specific impacts on air quality, it may not be sufficient to reduce project specific emissions to less than significant levels.

District Rule 9410 (Employer Based Trip Reduction)

The eTRIP Rule (Rule 9410, Employer Based Trip Reduction), requires larger employers to establish an Employer Trip Reduction Implementation Plan (eTRIP). An eTRIP is a set of measures that encourages employees to use alternative transportation and ridesharing for their morning and evening commutes. Each measure contributes to a workplace where it is easier for employees to choose to use ridesharing or alternative transportation. Through this rule, single-occupancy vehicle trips are reduced, thus reducing emissions of oxides of nitrogen (NOx), volatile organic compounds (VOC) and particulate matter (PM).

Air Quality Guidance Documents

SJVAPCD Guidance for Assessing and Mitigating Air Quality Impacts

As a public agency, the SJVAPCD takes an active part in the intergovernmental review process under CEQA. The SJVAPCD is available to assist governmental agencies and project proponents in understanding how to characterize project-related impacts on air quality and how to reduce or mitigate those impacts. As part of this ongoing effort, the SJVAPCD develops and publishes technical guidance relevant to assessing project specific emissions of criteria pollutants and assessing potential health risks to sensitive receptors. One such document is the Guidance for Assessing and Mitigating Air Quality Impacts which was prepared by the

SJVAPCD in 2015 with the most current updates found at https://ww2.valleyair.org/ceqa. The purpose of this document is to provide technical guidance for the review of air quality impacts from proposed projects within the boundaries of the SJVAPCD. The guide provides SJVAPCD staff uniform procedures for assessing potential air quality impacts of proposed projects and for preparing the air quality section of environmental documents. The guide is intended to be a user-friendly advisory document for use by other agencies, consultants, and project proponents. The Guidance for Assessing and Mitigating Air Quality Impacts and supplemental information is used in this analysis.

Local – City of Modesto

Local jurisdictions, such as the City of Modesto, have the authority and responsibility to reduce air pollution through its police power and decision-making authority. Specifically, the City is responsible for the assessment and mitigation of air emissions resulting from its land use decisions. In accordance with CEQA requirements and the CEQA review process, the City assesses the air quality impacts of new development projects, requires mitigation of potentially significant air quality impacts by conditioning discretionary permits, and monitors and enforces implementation of such mitigation.

In accordance with the CEQA requirements, the City does not, however, have the expertise to develop plans, programs, procedures, and methodologies to ensure that air quality within the City and region will meet federal and state standards. Instead, the City relies on the expertise of the SJVAPCD and utilizes the *SJVAPCD Guidance for Assessing and Mitigating Air Quality Impacts* as the guidance document for the environmental review of plans and development proposals within its jurisdiction.

The City of Modesto General Plan was adopted on March 5, 2019. The policies related to air quality that are applicable to the proposed project from the Environmental Resources, Open Space, and Conservation Element of the Modesto General Plan have been included below.

Policies

a. Implement measures to reduce motor vehicle use and related ozone precursor and PM10 emissions through changes to the transportation infrastructure. Potential measures to be implemented may include those shown in Section V-2 of the Final Master Environmental Impact Report.
b. Implement measures to reduce vehicle use and associated emissions related to existing and future land use development in the City of Modesto. Potential measures to be implemented may include those shown in Section V-2 of the Final Master Environmental Impact Report.
c. Implement measures to reduce emissions associated with energy use by residences and businesses. Potential measures to be implemented may include those shown in Section V-2 of the Draft Master EIR.
d. The City of Modesto recognizes the efforts of the San Joaquin Valley Air Pollution Control District to identify the cumulative transportation and air quality impacts of all General Plan amendments approved during the previous year. This measure is intended to track the effectiveness of current air quality–related programs and guide revision to these programs through periodic review of cumulative air quality impacts in the City.

The following policies are intended to reduce air quality impacts through inter-agency coordination.

e. Work with neighboring jurisdictions and affected agencies to address cross-jurisdictional and regional transportation and air quality issues.
f. Coordinate with other jurisdictions and other regional agencies in the San Joaquin valley to establish parallel air quality programs and implementation measures (trip reduction ordinances, indirect source programs, etc.).
g. Implement measures to reduce emissions associated with future development through the CEQA review process. Section V-2 of the MEIR describes those measures to be implemented, as well as additional measures that may be implemented at the discretion of the City.

h. Consult with the SJVAPCD during CEQA review for discretionary projects with the potential for causing adverse air quality impacts.
i. Consider supporting investment in geographic information system technology.

The following policies are intended to accurately determine and fairly mitigate the local and regional air quality impacts of projects proposed in the City of Modesto.

o. Determine project air quality impacts using analysis methods and significance thresholds recommended by the SJVAPCD.
p. Ensure that identified air quality impacts are consistently and fairly mitigated.
q. Ensure all air quality mitigation measures are feasible, implementable, and cost effective.
r. Identify the cumulative transportation and air quality impacts of all General Plan amendments approved during the previous year.
s. Reduce the air quality impacts of development projects that may be insignificant by themselves, but cumulatively are significant.
t. Encourage innovative mitigation measures to reduce air quality impacts by coordinating with the SJVAPCD, project applicants, and other interested parties.
u. Review of new development shall be coordinated with SJVAPCD staff to ensure all projects subject to the SJVAPCD Rule 9510 (Indirect Source Review) comply fully with the rule. This rule fulfills the SJVAPCD's emission reduction commitments in the PM10 and Ozone Attainment Plans through emission reductions from the construction and use of development projects through design features and onsite measures. Rule 9510 applies to any applicant that seeks to gain a final discretionary approval for a development project, or any portion thereof, which meets certain minimum thresholds.
v. A Construction Health Risk Assessment shall be required on a project-by-project basis if, at the direction of SJVAPCD after applicant consultation, the specific project is considered to have a potentially significant project-level health risk impact, through refined modeling using 2015 OEHHA guidance (or the latest accepted methodology), to identify impacts and, if necessary, include measures determined by SJVAPCD to reduce exposure.
x. Coordinate land use planning to prevent new odor complaints. Consult with SJVAPCD, as necessary, to identify the potential for odor complaints from various existing and planned or proposed land uses and development projects. Prohibit new sources of odors that have the potential to result in frequent odor complaints unless it can be shown that potential odor complaints can be mitigated where feasible. Prohibit sensitive receptors from locating near odor sources where frequent odor complaints would occur, unless it can be shown that potential odor complaints can be mitigated where feasible.

The following policies are consistent with the SJVAPCD Air Quality Guidelines for General Plans and are intended to integrate land use planning, transportation planning, and air quality planning to make the most efficient use of public resources and to create a healthier and more livable environment.

y. Consider air quality when planning the land uses and transportation systems to accommodate the expected growth in this community.
z. All transportation improvement projects to be included in regional transportation plans (RTP, RTIP, CMP, etc.) should be consistent with the air quality goals and policies of the General Plan.
aa. Consult with transit providers to determine project impacts on long-range transit plans and ensure that impacts are mitigated where feasible.
cc. Work with Caltrans and the Regional Transportation Planning Agency to minimize the air quality, mobility, and social impacts of large-scale transportation projects on existing neighborhoods.

The following policies are consistent with the SJVAPCD Air Quality Guidelines for General Plans and are intended to reduce emissions of PM10 and other particulates with local control potential.

jj. Reduce particulate emissions from construction, grading, excavation, and demolition to the maximum extent feasible in accordance with the requirements of SJVAPCD Regulation VIII. Regulation VIII was adopted to reduce the amount of particulate matter suspended in the atmosphere as a result of emissions generated from anthropogenic (man-made) fugitive dust sources.

kk. Require all access roads, driveways, and parking areas serving new commercial and industrial development to be constructed with materials that minimize particulate emissions in accordance with the requirements of SJVAPCD Regulation VIII and are appropriate to the scale and intensity of use.

ll. Reduce PM10 emissions from City–maintained roads to the maximum extent feasible.

The following controls are required to be implemented at all construction sites.

mm. Effectively stabilize dust emissions using water, chemical stabilizer / suppressant, cover with a tarp or other suitable cover or vegetative ground cover, all disturbed areas, including storage piles, which are not being actively utilized for construction purposes.

nn. Effectively stabilize dust emissions using water or chemical stabilizer / suppressant, all onsite unpaved roads and off-site unpaved access roads.

oo. Effectively control fugitive dust emissions utilizing application of water or by presoaking all land clearing, grubbing, scraping, excavation, land leveling, grading, cut & fill, and demolition activities.

pp. Wet all exterior surfaces of buildings that are more than six stories tall during demolition.

qq. When materials are transported off site, cover all materials, or effectively wet them to limit visible dust emissions, and maintain at least six inches of freeboard space from the top of the container.

rr. Limit operations or expeditiously remove the accumulation of mud or dirt from adjacent public streets at the end of each workday (the use of dry rotary brushes is expressly prohibited except where preceded or accompanied by sufficient wetting to limit the visible dust emissions.) (Use of blower devices is expressly forbidden.)

ss. Following the addition of materials to, or the removal of materials from, the surface of outdoor storage piles, effectively stabilize said piles for fugitive dust emissions utilizing sufficient water or chemical stabilizer / suppressant.

tt. Within urban areas, immediately remove trackout when it extends 50 or more feet from the site and at the end of each workday.

uu. Prevent carryout and trackout for any site with 150 or more vehicle trips per day.

The following measures should be implemented at construction sites when required to mitigate significant PM10 impacts (note, these measures are to be implemented in addition to Regulation VIII requirements).

vv. Limit traffic speeds on unpaved roads to 15 mph.

ww. Install sandbags or other erosion control measures to prevent silt runoff to public roadways from sites with a slope greater than one percent (1%).

The following measures are strongly encouraged at construction sites that are large in area, located near sensitive receptors, or which for any other reason warrant additional emissions reductions.

xx. Install wheel washers for all exiting trucks, or wash off all trucks and equipment leaving the site.

yy. Install wind breaks at windward side(s) of construction areas.

zz. Suspend excavation and grading activity when winds exceed 20 mph (regardless of windspeed, an owner/operator must comply with Regulation VIII's 20 percent (20%) opacity limitation).

aaa. Limit the area subject to excavation, grading, and other construction activity at any one time.

Table 2
State and Federal Criteria Pollutant Standards

Air Pollutant	Concentration / Averaging Time		Most Relevant Effects
	California Standards	Federal Primary Standards	
Ozone (O_3)	0.09 ppm/1-hour 0.07 ppm/8-hour	0.070 ppm/8-hour	(a) Decline in pulmonary function and localized lung edema in humans and animals; (b) Risk to public health implied by alterations in pulmonary morphology and host defense in animals; (c) Increased mortality risk; (d) Risk to public health implied by altered connective tissue metabolism and altered pulmonary morphology in animals after long-term exposures and pulmonary function decrements in chronically exposed humans; (e) Vegetation damage; and (f) Property damage.
Carbon Monoxide (CO)	20.0 ppm/1-hour 9.0 ppm/8-hour	35.0 ppm/1-hour 9.0 ppm/8-hour	(a) Aggravation of angina pectoris and other aspects of coronary heart disease; (b) Decreased exercise tolerance in persons with peripheral vascular disease and lung disease; (c) Impairment of central nervous system functions; and (d) Possible increased risk to fetuses.
Nitrogen Dioxide (NO_2)	0.18 ppm/1-hour 0.03 ppm/annual	100 ppb/1-hour 0.053 ppm/annual	(a) Potential to aggravate chronic respiratory disease and respiratory symptoms in sensitive groups; (b) Risk to public health implied by pulmonary and extra-pulmonary biochemical and cellular changes and pulmonary structural changes; and (c) Contribution to atmospheric discoloration.
Sulfur Dioxide (SO_2)	0.25 ppm/1-hour 0.04 ppm/24-hour	75 ppb/1-hour 0.14 ppm/annual	(a) Bronchoconstriction accompanied by symptoms which may include wheezing, shortness of breath and chest tightness, during exercise or physical activity in persons with asthma.
Suspended Particulate Matter (PM_{10})	50 µg/m^3/24-hour 20 µg/m^3/annual	150 µg/m^3/24-hour	(a) Exacerbation of symptoms in sensitive patients with respiratory or cardiovascular disease; (b) Declines in pulmonary function growth in children; (c) Increased risk of premature death from heart or lung diseases in elderly.
Suspended Particulate Matter ($PM_{2.5}$)	12 µg/m^3 / annual	35 µg/m^3/24-hour 9 µg/m^3/annual	
Sulfates	25 µg/m^3/24-hour	No Federal Standards	(a) Decrease in ventilatory function; (b) Aggravation of asthmatic symptoms; (c) Aggravation of cardio-pulmonary disease; (d) Vegetation damage; (e) Degradation of visibility; (f) property damage.
Lead	1.5 µg/m^3/30-day	0.15 µg/m^3/3-month rolling	(a) Learning disabilities; (b) Impairment of blood formation and nerve conduction.
Visibility Reducing Particles	Extinction coefficient of 0.23 per kilometer-visibility of 10 miles or more due to particles when humidity is less than 70 percent.	No Federal Standards	Visibility impairment on days when relative humidity is less than 70 percent.

Source: https://ww2.arb.ca.gov/sites/default/files/2020-07/aaqs2.pdf

Table 3
San Joaquin Valley Attainment Status

Pollutants	Federal Standards[1]	State Standards[2]
Ozone - one hour	Revoked[6]	Nonattainment/Severe
Ozone - eight hour	Nonattainment/Extreme[5]	Nonattainment
PM10	Attainment[3]	Nonattainment
PM2.5	Nonattainment[4]	Nonattainment
Carbon monoxide	Attainment/Unclassified	Attainment/Classified
Nitrogen dioxide	Attainment/Unclassified	Attainment
Sulfur dioxide	Attainment/Unclassified	Attainment
Lead (Particulate)	No Designation/Classification	Attainment
Hydrogen Sulfide	No Federal Standard	Unclassified
Sulfates	No Federal Standard	Attainment
Visibilty Reducing Particles	No Federal Standard	Unclassified
Vinyl Chloride	No Federal Standard	Attainment

Source (Federal and State Status): San Joaquin Valley Air Pollution Control District Ambeint Air Quality Standards and Attainment Status. https://ww2.valleyair.org/air-quality-information/ambient-air-quality-standards-valley-attainmnet-status/

(1) See 40 CFR Part 81

(2) See CCR Title 17 Sections 60200-60210

(3) On September 25, 2008, EPA redesignated the San Joaquin Valley to attainment for the PM10 National Ambient Air Quality Standard (NAAQS) and approved the 2007 PM10 Maintenance Plan.

(4) The Valley is designated nonattainment for the 1997 PM2.5 NAAQS. EPA designated the Valley as nonattainment for the 2006 PM2.5 NAAQS on November 13, 2009 (effective December 14, 2009).

(5) Though the Valley was initially classified as serious nonattainment for the 1997 8-hour ozone standard, EPA approved Valley reclassification to extreme nonattainment in the Federal Register on May 5, 2010 (effective June 4, 2010).

(6) Effective June 15, 2005, the U.S. Environmental Protection Agency (EPA) revoked the federal 1-hour ozone standard, including associated designations and classifications. EPA had previously classified the District as extreme nonattainment for this standard. EPA approved the 2004 Extreme Ozone Attainment Demonstration Plan on March 8, 2010 (effective April 7, 2010). The District Governing Board adopted the 2023 Maintenance Plan and Redesignation Request and submitted to EPA in June of 2023. Although the standard is revoked, anti-backsliding provisions can be terminated upon final approval of the Maintenance Plan from EPA.

MONITORED AIR QUALITY

The air quality at any site is dependent on the regional air quality and local pollutant sources. Regional air quality is determined by the release of pollutants throughout the air basin.

The SJVAPCD, the Air Resources Board, the United States National Park Service, and the Santa Rosa Rancheria in Lemoore operate an extensive air monitoring network to measure progress toward attainment of the NAAQS. Air quality monitoring networks are designed to monitor areas with: high population densities, areas with high pollutant concentrations, areas impacted by major pollutant sources, and areas representative of background concentrations. Some monitors are operated specifically for use in determining attainment status, while others are operated for other purposes, such as for generating daily air quality forecasts. In total, the SJVAPCD utilizes ozone and PM data from over 60 monitors operated at 29 sites in the San Joaquin Valley. All monitors must comply with the pollutant standard for the San Joaquin Valley to be considered as attainment for that standard.

The nearest air monitoring station to the project site is the Modesto Monitoring Station (Modesto Station). The Modesto Station is located approximately 4.89 miles southeast of the project site at 814 14th Street, Modesto. As not all monitoring stations monitor all pollutants, data was also taken from the Turlock – S Minaret Street Monitoring Station (Turlock Station) located approximately 18.21 miles southeast of the project site at 900 S Minaret Street, Turlock. Table 4 presents the monitored pollutant levels from the Modesto and Turlock Stations. However, it should be noted that due to the air monitoring stations' distances from the project site, recorded air pollution levels at the air monitoring station reflect with varying degrees of accuracy, local air quality conditions at the project site.

Table 4 summarizes 2021 through 2023 published monitoring data, which is the most recent 3-year period available. The data shows that during the past few years, the project area has exceeded the ozone standards.

Ozone

During the 2021 to 2023 monitoring period, the State 1-hour concentration standard for ozone was exceeded between one and three days each year at the Modesto Station. The State 8-hour ozone standard has been exceeded between five and 14 days each year over the past three years at the Modesto Station. The Federal 8-hour ozone standard was exceeded between four and 12 days each year over the past three years at the Modesto Station.

Ozone is a secondary pollutant as it is not directly emitted. Ozone is the result of chemical reactions between other pollutants, most importantly hydrocarbons and NO_2, which occur only in the presence of bright sunlight.

Carbon Monoxide

CO is another important pollutant that is due mainly to motor vehicles. The Modesto Station did not record an exceedance of the state or federal 8-hour CO standard for the last three years.

Nitrogen Dioxide

Turlock Station did not record an exceedance of the State or Federal NO_2 standards for the last three years.

Particulate Matter

The State 24-hour concentration standards for PM10 was exceeded between 268 and 59 days each year over the last three years at the Modesto Station. Over the past three years, the Federal 24-hour standards for PM10 were not exceeded at the Modesto Station.

During the 2021 to 2023 monitoring period, the Federal 24-hour standard for PM2.5 was exceeded between three and 20 days each year at the Modesto Station.

According to the EPA, some people are much more sensitive than others to breathing fine particles (PM10 and PM2.5). People with influenza, chronic respiratory and cardiovascular diseases, and the elderly may suffer worsening illness and premature death due to breathing these fine particles. People with bronchitis can expect aggravated symptoms from breathing in fine particles. Children may experience decline in lung function due to breathing in PM10 and PM2.5. Other groups considered sensitive are smokers and people who cannot breathe well through their noses. Exercising athletes are also considered sensitive, because many breathe through their mouths during exercise.

Table 4
Air Quality Monitoring Summary

Pollutant (Standard)[1]		Year		
		2021	2022	2023
Ozone:	Maximum 1-Hour Concentration (ppm)	0.106	0.113	0.099
	Days > CAAQS (0.09 ppm)	**3**	**1**	**1**
	Maximum 8-Hour Concentration (ppm)	0.089	0.086	0.084
	Days > NAAQS (0.070 ppm)	**10**	**4**	**12**
	Days > CAAQS (0.070 ppm)	**11**	**5**	**14**
Carbon Monoxide:	Maximum 8-Hour Concentration (ppm)	*	*	*
	Days > CAAQS (9 ppm)	0	0	0
	Days > NAAQS (9 ppm)	0	0	0
Nitrogen Dioxide:[2]	Maximum 1-Hour Concentration (ppm)	0.040	0.045	0.047
	Days > CAAQS (0.18 ppm)	0	0	0
Inhalable Particulates (PM10):	Maximum 24-Hour Concentration (µg/m^3)	145.7	88.5	97.6
	Days > NAAQS (150 µg/m3)	0	0	0
	Days > CAAQS (50 µg/m3)	**59**	**38**	**26**
	Annual Average (µg/m3)	36.9	32.5	24.0
Ultra-Fine Particulates (PM2.5):	Maximum 24-Hour Concentration (µg/m3)	66.8	53.9	43.2
	Days > NAAQS (35 µg/m3)	**20**	**10**	**3**
	Annual Average (µg/m3)	15	13.3	10.5

Notes:
Source: http://www.arb.ca.gov/adam/topfour/topfour1.php. Data from the Modesto Monitoring Station, unless otherwise noted.
(1) CAAQS = California Ambient Air Quality Standard; NAAQS = National Ambient Air Quality Standard; ppm = parts per million
* Means there was insufficient data available to determine value.
(2) Data taken from the Turlock - S Minaret Street Monitoring Station.

AIR QUALITY STANDARDS

Significance Thresholds

Appendix G of the State CEQA Guidelines

Appendix G of the State CEQA Guidelines states that, where available, the significance criteria established by the applicable air quality management district or air pollution control district may be relied upon to make a significance determination. Pursuant to Appendix G, the project would result in a significant impact related to air quality if it would:

- Conflict with or obstruct the implementation of the applicable air quality plan;
- Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is nonattainment under an applicable federal or state ambient air quality standard;
- Expose sensitive receptors to substantial pollutant concentrations; or
- Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people.

The CEQA Guidelines Section 15064.7 provides the significance criteria established by the applicable air quality management district or air pollution control district, when available, may be relied upon to make determinations of significance. To assess the air quality impact using these five effects per CEQA guidelines, the SJVAPCD has established significance thresholds as stated in the *SJVAPCD Guidance for Assessing and Mitigating Air Quality Impacts*.

The SJVAPCD recommends that the Lead Agencies apply the adopted significance thresholds when evaluating project specific impacts on air quality within the San Joaquin Valley. If the Lead Agency determines the proposed project would exceed San Joaquin Valley Unified Air Pollution Control District Guidance for Assessing and Mitigating Air Quality Impacts March 19, 2015 Page 75 of 125 any of the significance thresholds, then an environmental document should be prepared. However, it is recognized that the final determination of whether a project would have a significant effect on air quality is ultimately within the purview of the Lead Agency pursuant to CEQA Guidelines (CCR §15064(c)).

Regional Air Quality

The significance of the impacts of the emissions from construction, operational non-permitted equipment and activities, and operational permitted equipment and activities are evaluated separately. The thresholds of significance are based on a calendar year basis. For construction emissions, the annual emissions are evaluated on a rolling 12-month period. A project evaluation should characterize emissions associated with the following:

Construction related emissions

- Grading, excavation, road building, and other earth moving activities
- Travel by construction equipment, especially on unpaved surfaces
- Exhaust from construction equipment
- Architectural coatings
- Asphalt paving
- Demolition and renovation of buildings
- Off-road construction equipment

Operational related emissions

- Permitted equipment and activities (Stationary Source Equipment)
- Non-permitted equipment and activities

- Mobile sources (on-site and on-road)
- Non-permitted activities

The SJVAPCD current adopted thresholds of significance for criteria pollutant emissions and their application are identified in Table 5.

Toxic Air Contaminants

The SJVAPCD's current thresholds of significance for toxic air contaminant (TAC) emissions from the operations of both permitted and non-permitted sources are combined and presented below.

- Carcinogens:
  Maximally Exposed Individual risk equals or exceeds 10 in one million

- Non-Carginogens:
  Acute: Hazard Index equals or exceeds 1 for the Maximally Exposed Individual
  Chronic: Hazard Index equals or exceeds 1 for the Maximally Exposed Individual

Carcinogenic (cancer) risk is expressed as cancer cases per one million. Non-carcinogenic (acute and chronic) hazard indices (HI) are expressed as a ratio of expected exposure levels to acceptable exposure levels. The significance of the impacts of TAC emissions from both permitted and non-permitted equipment and activities is evaluated under a single threshold, for example 10 in one million.

Odor Impacts

The *SJVAPCD Guidance for Assessing and Mitigating Air Quality Impacts* states that while offensive odors rarely cause any physical harm, they can be unpleasant, leading to considerable distress among the public and often resulting in citizen complaints to local governments and the SJVAPCD. However, a project should be evaluated to determine the likelihood that the project would result in nuisance odors. Any project with the potential to frequently expose members of the public to objectionable odors should be deemed to have a significant impact. Nuisance odors may be assessed qualitatively taking into consideration project design elements and proximity to off-site receptors that potentially would be exposed to objectionable odors.

Due to the subjective nature of odor impacts, the number of variables that can influence the potential for an odor impact, and the variety of odor sources, there are no quantitative or formulaic methodologies to determine if potential odors would have a significant impact. Rather, projects must be assessed on a case-by-case basis.

Odor impacts on residential areas and other sensitive receptors, such as hospitals, daycare centers, schools, etc., warrant the closest scrutiny, but consideration should also be given to other land uses where people may congregate, such as recreational facilities, worksites, and commercial areas. An analysis of potential odor impacts should be conducted for the following two situations:

- Generators – projects that would potentially generate odorous emissions proposed to locate near existing sensitive receptors or other land uses where people may congregate, and
- Receivers – residential or other sensitive receptor projects or other projects built for the intent of attracting people locating near existing odor sources.

The intensity of an odor source's operations and its proximity to sensitive receptors influences the potential significance of odor emissions. The SJVAPCD has identified some common types of facilities that have been known to produce odors in the San Joaquin Valley Air Basin. These are presented in Table 6.

The Lead Agency should prepare a more detailed analysis for any project that would result in an odor source and sensitive receptors being located closer to one another than the distances indicated in Table 6. When projects trigger the screening level distances in Table 6, the Lead Agency or consultant should contact the SJVAPCD's Compliance Division for information regarding odor complaints.

Existing Odor Sources

For projects involving a new receptor being located near an existing odor source(s), the SJVAPCD's Compliance Division should be contacted. The Compliance Division will provide information on odor complaints logged for the facility(ies) for the previous three years. Because offensive odors rarely cause any physical harm and no requirements for their control are included in state or federal air quality regulations, the SJVAPCD has no rules or standards related to odor emissions, other than its nuisance rule. Any actions related to odors are based on citizen complaints to local governments and the SJVAPCD. Lead Agencies can also make a determination of significance based on a review of SJVAPCD complaint records. For a project located near an existing source of odors, the impact is potentially significant when the project site is at least as close as any other site that has already experienced significant odor problems related to the odor source. Significant odor problems are defined as:

- More than one confirmed complaint per year averaged over a three-year period, or
- Three unconfirmed complaints per year averaged over a three-year period.

An unconfirmed complaint means that either the odor/air contaminant release could not be detected, or the source/facility cannot be determined. Because of the subjective nature of odor impacts and the lack of quantitative or formulaic methodologies, the significance determination of potential odor impacts should be considered on a case-by-case basis.

Table 5
SJVAPCD Air Quality Significance Thresholds

Air Quality Thresholds of Significance - Criteria Pollutants			
		Operational Emissions	
	Construction Emissions	Permitted Equipment and Activities	Non-Permitted Equipment and Activities
Pollutant/Precursor	Emissions (tons/year)	Emissions (tons/year)	Emissions (tons/year)
CO	100	100	100
NOx	10	10	10
ROG	10	10	10
SOx	27	27	27
PM10	15	15	15
PM2.5	15	15	15
Air Quality Thresholds of Significance - Toxic Air Contaminants			
Carcinogens	Maximally Exposed Individual risk equals or exceeds 20 in one million		
Non-Carcinogens	Acute: Hazard Index equals or exceeds 1 for the Maximally Exposed Individual		
	Chronic: Hazard Index equals or exceeds 1 for the Maximally Exposed Individual		

Source: http://www.valleyair.org/transportation/ceqa_idx.htm

Table 6
Screening Levels for Potential Odor Sources

Type of Facility	Distance
Wastewater Treatment Facilities	2 miles
Sanitary Landfill	1 miles
Transfer Station	1 miles
Composting Facility	1 miles
Petroleum Refinery	2 miles
Asphalt Batch Plant	1 mile
Chemical Manufacturing	1 mile
Fiberglass Manufacturing	1 mile
Painting/Coating Operations (e.e. auto body shops)	1 mile
Food Processing Facility	1 mile
Feed Lot/Dairy	1 mile
Rendering Plant	1 mile

Source: San Joaquin Valley Air Pollution Control District Guidance for Assessing and Mitigating Air Quality Impacts (March 19, 2015) https://ww2.valleyair.org/media/g4nl3p0g/gamaqi.pdf.

SHORT-TERM CONSTRUCTION EMISSIONS

Construction activities associated with the proposed project would have the potential to generate air emissions, TAC emissions, and odor impacts. Assumptions for the phasing, duration, and required equipment for the construction of the proposed project were obtained from the project applicant. The project includes the installation of approximately 12,000 linear feet of 12-inch diameter pipe. The entire alignment will be buried underground using open trench construction as well as jack and bore construction to avoid direct impacts to existing utilities and structures. Temporary areas of disturbance as a result of trenching is anticipated to be 6-feet wide and 8-feet deep along the entire 12,000 linear feet of project alignment, approximately 1.64 acres. Jack and bore construction will consist of 5 total pits.[9] Jacking pits are approximately 12-feet wide by 10-feet long by 15-feet deep and receiving pits are approximately 12-feet wide by 24-feet long by 15-feet deep, resulting in approximately 0.03 acres of disturbance. Therefore, the total area of disturbance assumed for construction of the proposed project is approximately 1.67 acres. Per the project applicant, construction equipment is to include: one (1) scraper, five (5) tractors/loaders/backhoes, one (1) off-highway trucks, one (1) plate compactor, one (1) excavator, one (1) other material handling equipment, one (1) paving equipment, one (1) other construction equipment, two (2) pumps, one (1) skid steer loaders, one (1) surfacing equipment, one (1) rubber tired dozer, and one (1) crane. Based on these details and as construction is not anticipated to be phased, to provide a conservative scenario, the entirety of the project has been analyzed as occurring in one construction phase with all proposed equipment in operation simultaneously. It is estimated that the project would include approximately 4,680 cubic yards (CY) of import and 3,348 CY of export. See Appendix B for more details.

The proposed project is anticipated to start construction no sooner than the beginning of fall 2024, taking approximately 11 months to complete, with completion estimated by early fall 2025. The project is anticipated to be operational in 2025.

Methodology

The following provides a discussion of the methodology used to calculate regional construction air emissions for the criteria pollutants. The construction-related regional air quality impacts have been analyzed for both criteria pollutants and GHGs.

Emissions are estimated using the CalEEMod (Version 2022.1.1.28) software, which is a statewide land use emissions computer model designed to provide a uniform platform for government agencies, land use planners, and environmental professionals to quantify potential criteria pollutant and GHG emissions from a variety of land use projects. CalEEMod was developed in collaboration with the air districts of California. Regional data (e.g., emission factors, trip lengths, meteorology, source inventory, etc.) have been provided by the various California air districts to account for local requirements and conditions. The model is considered to be an accurate and comprehensive tool for quantifying air quality and GHG impacts from land use projects throughout California.

Daily regional emissions during construction are forecasted by assuming a conservative estimate of construction activities (i.e., assuming all construction occurs at the earliest feasible date) and applying the mobile source and fugitive dust emissions factors. The input values used in this analysis were adjusted to be project-specific for the construction schedule and the equipment used was based on CalEEMod defaults. The CalEEMod program uses the EMFAC2021 computer program to calculate the emission rates specific for Stanislaus County for construction-related employee vehicle trips and the OFFROAD2017 computer program to calculate emission rates for heavy truck operations. EMFAC2021 and OFFROAD2017 are computer

[9] For modeling purposes, assumptions were made about the location of jacking and receiving pits based on a "worst-case scenario". Under "worst-case" conditions, boring locations are located closest to sensitive receptors adjacent to the project alignment: one (1) along the east side of Dale Road, approximately 150 feet from sensitive receptors; three (3) along the north side of Kiernan Avenue, bordering the southern perimeter of Stanislaus Elementary School, approximately 50 ft from the closest sensitive receptors; and one (1) along the west side of Tully Road, approximately 50 ft from the closest sensitive receptors.

programs generated by CARB that calculates composite emission rates for vehicles. Emission rates are reported by the program in grams per trip and grams per mile or grams per running hour. Daily truck trips and CalEEMod default trip length data were used to assess roadway emissions from truck exhaust. The maximum daily emissions are estimated values for the worst-case day and do not represent the emissions that would occur for every day of project construction. The maximum daily emissions are compared to the SJVAPCD daily regional numeric indicators. Detailed construction equipment lists, construction scheduling, and emission calculations are provided in Appendix B.

The project will be required to comply with existing SJVAPCD rules for the reduction of fugitive dust emissions. District Regulation VIII establishes these procedures. Regulation VIII specifies the following measures to control fugitive dust: apply water to unpaved surfaces and areas, use non-toxic chemical or organic dust suppressants on unpaved roads and traffic areas, limit or reduce vehicle speed on unpaved roads and traffic areas, maintain areas in a stabilized condition by restricting vehicle access, install wind barriers, cease outdoor activities that disturb soil during high winds, keep bulk materials sufficiently wet when handling, store and handle materials in a three-sided structure, apply water to the surface or cover storage pile with a tarp for bulk storage, don't overload trucks, cover haul trucks or wet the top, clean interior of cargo compartments on emptied haul trucks prior to leaving a site, install trackout control devices, and clean up trackout at least once a day. The SJVAPCD has determined that compliance with Regulation VIII and implementation of other control measures presented in their guidance manual[10] constitutes sufficient mitigation to reduce PM_{10} impacts to a level considered less than significant.

For projects in which construction related activities would disturb equal to or greater than 1-acre of surface area, the SJVAPCD recommends that demonstration of receipt of a SJVAPCD approved Dust Control Plan or Construction Notification form, before issuance of the first grading permit, be made a condition of project approval. The project will disturb approximately 1.67 acres and a Dust Control Plan is recommended.

The phases of the construction activities which have been analyzed below for each phase are: (1) site preparation.[11] Details pertaining to the project's construction timing and the type of equipment modeled for each construction phase are available in the CalEEMod output in Appendix B.

Construction-Related Regional Impacts

The construction-related criteria pollutant emissions for the construction of the proposed project are shown below in Table 7. Table 7 shows that none of the analyzed criteria pollutants would exceed the SJVAPCD regional emissions thresholds. Therefore, a less than significant regional air quality impact would occur from construction of the proposed pipeline extension project.

Construction-Related Health Impacts

Regarding health effects related to criteria pollutant emissions, the applicable significance thresholds are established for regional compliance with the state and federal ambient air quality standards, which are intended to protect public health from both acute and long-term health impacts, depending on the potential effects of the pollutant. Because regional emissions of criteria pollutants during construction of the project would be below the applicable thresholds, it would not contribute to long-term health impacts related to nonattainment of the ambient air quality standards. Therefore, significant adverse acute health impacts as a result of project construction are not anticipated.

[10] San Joaquin Valley Air Pollution Control District, Guidance for Assessing and Mitigating Air Quality Impacts, March 19, 2015. https://ww2.valleyair.org/media/g4nl3p0g/gamaqi.pdf

[11] The proposed project is the construction of a water pipeline. As stated in the project description, project construction is not anticipated to be phased and is to occur at approximately 100 feet of pipeline being laid per day for the entirety of the 11 month construction duration. Therefore, to be conservative, it was assumed that all construction activities would occur within one phase, site preparation, and that all anticipated construction equipment would be in operation during the duration of project construction.

Construction-Related Toxic Air Contaminant Impacts

The greatest potential for TAC emissions would be related to diesel particulate emissions associated with heavy equipment operations during construction of the proposed project. According to the Office of Environmental Health Hazard Assessment (OEHHA)[12], health effects from TACs are described in terms of individual cancer risk based on a lifetime (i.e., 30-year) resident exposure duration. Given the temporary and short-term construction schedule (approximately 11 months), the project would not result in a long-term (i.e., lifetime or 30-year) exposure as a result of project construction. Furthermore, construction-based particulate matter (PM) emissions (including diesel exhaust emissions) do not exceed any local or regional thresholds.

The project would comply with the CARB Air Toxics Control Measure that limits diesel powered equipment and vehicle idling to no more than 5 minutes at a location, and the CARB In-Use Off-Road Diesel Vehicle Regulation; compliance with these would minimize emissions of TACs during construction. Therefore, impacts from TACs during construction would be less than significant.

Construction-Related Odor Impacts

Potential sources that may emit odors during construction activities include the application of materials such as asphalt pavement. The objectionable odors that may be produced during the construction process are short-term in nature and the odor emissions are expected to cease upon the drying or hardening of the odor producing materials. Due to the short-term nature and limited amounts of odor producing materials being utilized, no significant impact related to odors would occur during construction of the proposed project. Diesel exhaust and VOCs would be emitted during construction of the project, which are objectionable to some; however, emissions would disperse rapidly from the project site and therefore should not reach an objectionable level at the nearest sensitive receptors.

[12] Office of Environmental Health Hazard Assessment, Air Toxic Hot Spots Program Risk Assessment Guidelines Guidance Manual for Preparation of Health Risk Assessment, February 2015, https://oehha.ca.gov/media/downloads/crnr/2015guidancemanual.pdf.

Table 7
Construction-Related Regional Pollutant Emissions

Activity	Pollutant Emissions (tons/year)					
	ROG	NOx	CO	SO_2	PM10	PM2.5
Maximum Daily Emissions[1]	0.31	2.79	3.15	0.01	0.34	0.20
SJVAPCD Thresholds	10	10	100	27	15	15
Exceeds Thresholds?	No	No	No	No	No	No

Notes:

Source: CalEEMod Version 2022.1.1.28.

(1) Includes both on-site and off-site emissions. On-site PM2.5 and PM-10 emissions show compliance with SJVAPCD Regulation VIII for fugitive dust.

LONG-TERM OPERATIONAL EMISSIONS

The on-going operation of the proposed project would result in a long-term increase in air quality emissions. This increase would be due to emissions from the project-generated operational emissions from the on-going use of the proposed project. The following section provides an analysis of potential long-term air quality impacts due to regional air quality impacts with the on-going operations of the proposed project.

Operations-Related Regional Air Quality Impacts

The potential operations-related air emissions have been discussed below for the criteria pollutants and cumulative impacts.

Operations-Related Criteria Pollutants Analysis

The project is the installation of approximately 12,000 linear feet of 12-inch diameter pipe. To conduct routine inspections and ensure proper long-term maintenance, the long-term operation of the project will require a minimal number of monthly worker trips. Additional staffing needs for long-term operation and maintenance of the proposed project are not anticipated. Therefore, operational emissions associated with the proposed project would be negligible and would not be anticipated to exceed SJVAPCD regional thresholds. Operation of the proposed project would result in a less than significant regional air quality impact.

Operations-Related Local Air Quality Impacts

Project-related air emissions may have the potential to exceed the State and Federal air quality standards in the project vicinity, even though these pollutant emissions may not be significant enough to create a regional impact to the San Joaquin Valley Air Basin (SJVAB). The proposed project has been analyzed for the potential local CO emission impacts from the project-generated vehicular trips and from the potential local air quality impacts from on-site operations. The following analysis analyzes the vehicular CO emissions, local impacts from on-site operations per SJVAPCD methodology, and odor impacts.

Local CO Emission Impacts from Project-Generated Vehicular Trips

Emissions and ambient concentrations of carbon monoxide have decreased greatly in the recent past. These improvements are due largely to the introduction of lower emitting motor vehicles and cleaner burning fuels. The last exceedance of either the state or national CO standard recorded at any of the SJVAB's monitoring stations was in 1991. At present, all areas within the SJVAPCD have attained the federal CO standard and are attainment or unclassified for the state CO standard.

Despite the progress and success in achieving CO standards, localized CO concentrations still warrant concern in the San Joaquin Valley (SJV) and should still be assessed in environmental documents. The reasons for this are twofold. First, state and federal laws require the SJVAB to attain and maintain ambient air quality standards. The SJVAPCD must ensure that increased motor vehicle use and congestion do not nullify the great strides that have been made with respect to ambient concentrations of CO. Secondly, the SJVAPCD must safeguard against localized high concentrations of CO that may expose nearby sensitive receptors that may not be recorded at a given monitoring sites. Because elevated CO concentrations are often localized, heavy traffic volumes and congestion can lead to high levels of CO, or CO "hotspots", while concentrations at the closest air quality monitoring station may be below state and federal standards.

Based on the CO Protocol Analysis developed by the California Department of Transportation (Caltrans), and due to the fact that increased CO concentrations are usually associated with roadways that are congested and with heavy traffic volume, the SJVAPCD has established that preliminary screening can be used to determine with fair certainty that the effect a project has on any given intersection would not result in a CO hotspot. Therefore, the SJVAPCD has established that if neither of the following criteria are met at all

intersections affected by the developmental project, the project will result in no potential to create a violation of the CO standard:

- A traffic study for the project indicates that the Level of Service (LOS) on one or more streets or at one or more intersections in the project vicinity will be reduced to LOS E or F; or
- A traffic study indicates that the project will substantially worsen an already existing LOS F on one or more streets or at more or more intersections in the project vicinity. If either of the above criteria can be associated with any intersection affected by the project, the applicant/consultant would need to conduct a CO analysis to determine a project's significance.

As stated previously, the proposed project is that of the installation of a new water pipeline and additional City staffing needs for the long-term operation and maintenance of the project are not anticipated. The operation of the project is anticipated to include only monthly worker trips in order to conduct routine inspections and ensure proper long-term maintenance. Therefore, as the project operation includes only a negligible amount of monthly maintenance trips, and no traffic study was required or conducted for this project, no CO "hot spot" modeling was performed, and no significant long-term air quality impact is anticipated to local air quality with the on-going use of the proposed project.

Operations-Related Health Impacts

Regarding health effects related to criteria pollutant emissions, the applicable significance thresholds are established for regional compliance with the state and federal ambient air quality standards, which are intended to protect public health from both acute and long-term health impacts, depending on the potential effects of the pollutant. Long-term operation of the proposed project includes only monthly worker for routine inspections and maintenance. Therefore, regional emissions of criteria pollutants during operation of the project would be anticipated to be below the applicable thresholds and would not contribute to long-term health impacts related to nonattainment of the ambient air quality standards. Therefore, significant adverse acute health impacts as a result of project operation are not anticipated.

Operations-Related Odor Impacts

The proposed project is the consolidation of Stanislaus Union School District (SUSD) service area (Water System No. CA5000249) with the City of Modesto, through an extension of water and wastewater services, and the abandonment of the existing Well 02. The proposed project is neither a generator of odor emissions nor is it a sensitive receiver of existing odor emissions. Therefore, per the guidance identified in the *SJVAPCD Guidance for Assessing and Mitigating Air Quality Impacts*, no significant impact related to odors would occur during the on-going operations of the proposed project.

CUMULATIVE AIR QUALITY IMPACTS

There are a number of cumulative projects in the project area that have not yet been built or are currently under construction. Since the timing or sequencing of the cumulative projects is unknown, any quantitative analysis to ascertain daily construction emissions that assumes multiple, concurrent construction projects would be speculative. Further, cumulative projects include local development as well as general growth within the project area. However, as with most developments, the greatest source of emissions is from mobile sources, which travel well out of the local area. Therefore, from an air quality standpoint, the cumulative analysis would extend beyond any local projects and when wind patterns are considered would cover an even larger area.

As stated in the *SJVAPCD Guidance for Assessing and Mitigating Air Quality Impacts*, when assessing whether there is a new significant cumulative effect, the Lead Agency shall consider whether the incremental effects of the project are cumulatively considerable. "Cumulatively considerable" means that the incremental effects of an individual project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects [CCR §15064(h)(1)]. Per CEQA Guidelines §15064(h)(3) a Lead Agency may determine that a project's incremental contribution to a cumulative effect is not cumulatively considerable if the project will comply with the requirements in a previously approved plan or mitigation program, including, but not limited to an air quality attainment or maintenance plan that provides specific requirements that will avoid or substantially lessen the cumulative problem within the geographic area in which the project is located.

Any proposed development project within the jurisdiction of SJVAPCD that would individually have a significant air quality impact would also be considered to have a significant cumulative air quality impact. Therefore, if a project is significant based on the SJVAPCD thresholds of significance for criteria pollutants, then it is also cumulatively significant.

The proposed project does not exceed SJVAPCD air quality thresholds. As a result, the project would result in a less than significant cumulative impact for operational emissions.

3. GLOBAL CLIMATE CHANGE ANALYSIS

EXISTING GREENHOUSE GAS ENVIRONMENT

Constituent gases of the Earth's atmosphere, called atmospheric GHGs, play a critical role in the Earth's radiation amount by trapping infrared radiation emitted from the Earth's surface, which otherwise would have escaped to space. Prominent GHGs contributing to this process include carbon dioxide (CO_2), methane (CH_4), ozone, water vapor, nitrous oxide (N_2O), and chlorofluorocarbons (CFCs). This phenomenon, known as the Greenhouse Effect, is responsible for maintaining a habitable climate. Anthropogenic (caused or produced by humans) emissions of these GHGs in excess of natural ambient concentrations are responsible for the enhancement of the Greenhouse Effect and have led to a trend of unnatural warming of the Earth's natural climate, known as global warming or climate change. Emissions of gases that induce global warming are attributable to human activities associated with industrial/manufacturing, agriculture, utilities, transportation, and residential land uses. Transportation is responsible for 41 percent of the State's GHG emissions, followed by electricity generation. Emissions of CO_2 and nitrous oxide (NOx) are byproducts of fossil fuel combustion. Methane, a potent GHG, results from off-gassing associated with agricultural practices and landfills. Sinks of CO_2, where CO_2 is stored outside of the atmosphere, include uptake by vegetation and dissolution into the ocean. The following provides a description of each of the GHGs and their global warming potential.

Water Vapor

Water vapor is the most abundant, important, and variable GHG in the atmosphere. Water vapor is not considered a pollutant; in the atmosphere it maintains a climate necessary for life. Changes in its concentration are primarily considered a result of climate feedbacks related to the warming of the atmosphere rather than a direct result of industrialization. The feedback loop in which water is involved is critically important to projecting future climate change. As the temperature of the atmosphere rises, more water is evaporated from ground storage (rivers, oceans, reservoirs, soil). Because the air is warmer, the relative humidity can be higher (in essence, the air is able to "hold" more water when it is warmer), leading to more water vapor in the atmosphere. As a GHG, the higher concentration of water vapor is then able to absorb more thermal indirect energy radiated from the Earth, thus further warming the atmosphere. The warmer atmosphere can then hold more water vapor and so on and so on. This is referred to as a "positive feedback loop". The extent to which this positive feedback loop will continue is unknown as there is also dynamics that put the positive feedback loop in check. As an example, when water vapor increases in the atmosphere, more of it will eventually also condense into clouds, which are more able to reflect incoming solar radiation (thus allowing less energy to reach the Earth's surface and heat it up).

Carbon Dioxide (CO_2)

The natural production and absorption of CO_2 is achieved through the terrestrial biosphere and the ocean. However, humankind has altered the natural carbon cycle by burning coal, oil, natural gas, and wood. Since the industrial revolution began in the mid-1700s. Each of these activities has increased in scale and distribution. CO_2 was the first GHG demonstrated to be increasing in atmospheric concentration with the first conclusive measurements being made in the last half of the 20th century. Prior to the industrial revolution, concentrations were fairly stable at 280 parts per million (ppm). The International Panel on Climate Change (IPCC Fifth Assessment Report, 2014) Emissions of CO_2 from fossil fuel combustion and industrial processes contributed about 78% of the total GHG emissions increase from 1970 to 2010, with a similar percentage contribution for the increase during the period 2000 to 2010. Globally, economic and population growth continued to be the most important drivers of increases in CO_2 emissions from fossil fuel combustion. The contribution of population growth between 2000 and 2010 remained roughly identical to the previous three decades, while the contribution of economic growth has risen sharply.

Methane (CH_4)

CH_4 is an extremely effective absorber of radiation, although its atmospheric concentration is less than that of CO_2. Its lifetime in the atmosphere is brief (10 to 12 years), compared to some other GHGs (such as CO_2, N_2O, and Chlorofluorocarbons (CFCs). CH_4 has both natural and anthropogenic sources. It is released as part of the biological processes in low oxygen environments, such as in swamplands or in rice production (at the roots of the plants). Over the last 50 years, human activities such as growing rice, raising cattle, using natural gas, and mining coal have added to the atmospheric concentration of methane. Other anthropocentric sources include fossil-fuel combustion and biomass burning.

Nitrous Oxide (N_2O)

Concentrations of N_2O also began to rise at the beginning of the industrial revolution. In 1998, the global concentration of this GHG was documented at 314 parts per billion (ppb). N_2O is produced by microbial processes in soil and water, including those reactions which occur in fertilizer containing nitrogen. In addition to agricultural sources, some industrial processes (fossil fuel-fired power plants, nylon production, nitric acid production, and vehicle emissions) also contribute to its atmospheric load. It is also commonly used as an aerosol spray propellant, (i.e., in whipped cream bottles, in potato chip bags to keep chips fresh, and in rocket engines and in race cars).

Chlorofluorocarbons (CFC)

CFCs are gases formed synthetically by replacing all hydrogen atoms in methane or ethane (C_2H_6) with chlorine and/or fluorine atoms. CFCs are nontoxic, nonflammable, insoluble, and chemically unreactive in the troposphere (the level of air at the Earth's surface). CFCs have no natural source, but were first synthesized in 1928. It was used for refrigerants, aerosol propellants, and cleaning solvents. Due to the discovery that they are able to destroy stratospheric ozone, a global effort to halt their production was undertaken and in 1989 the European Community agreed to ban CFCs by 2000 and subsequent treaties banned CFCs worldwide by 2010. This effort was extremely successful, and the levels of the major CFCs are now remaining level or declining. However, their long atmospheric lifetimes mean that some of the CFCs will remain in the atmosphere for over 100 years.

Hydrofluorocarbons (HFC)

HFCs are synthetic man-made chemicals that are used as a substitute for CFCs. Out of all the GHGs, they are one of three groups with the highest global warming potential. The HFCs with the largest measured atmospheric abundances are (in order), HFC-23 (CHF_3), HFC-134a (CF_3CH_2F), and HFC-152a (CH_3CHF_2). Prior to 1990, the only significant emissions were HFC-23. HFC-134a use is increasing due to its use as a refrigerant. Concentrations of HFC-23 and HFC-134a in the atmosphere are now about 10 parts per trillion (ppt) each. Concentrations of HFC-152a are about 1 ppt. HFCs are manmade for applications such as automobile air conditioners and refrigerants.

Perfluorocarbons (PFC)

PFCs have stable molecular structures and do not break down through the chemical processes in the lower atmosphere. High-energy ultraviolet rays about 60 kilometers above Earth's surface are able to destroy the compounds. Because of this, PFCs have very long lifetimes, between 10,000 and 50,000 years. Two common PFCs are tetrafluoromethane (CF_4) and hexafluoroethane (C_2F_6). Concentrations of CF_4 in the atmosphere are over 70 ppt. The two main sources of PFCs are primary aluminum production and semiconductor manufacturing.

Sulfur Hexafluoride (SF_6)

SF_6 is an inorganic, odorless, colorless, nontoxic, nonflammable gas. SF_6 has the highest global warming potential of any gas evaluated; 23,900 times that of CO_2. Concentrations in the 1990s were about 4 ppt. Sulfur hexafluoride is used for insulation in electric power transmission and distribution equipment, in the magnesium industry, in semiconductor manufacturing, and as a tracer gas for leak detection.

Aerosols

Aerosols are particles emitted into the air through burning biomass (plant material) and fossil fuels. Aerosols can warm the atmosphere by absorbing and emitting heat and can cool the atmosphere by reflecting light. Cloud formation can also be affected by aerosols. Sulfate aerosols are emitted when fuel containing sulfur is burned. Black carbon (or soot) is emitted during biomass burning due to the incomplete combustion of fossil fuels. Particulate matter regulation has been lowering aerosol concentrations in the United States; however, global concentrations are likely increasing.

Global Warming Potential

The Global Warming Potential (GWP) was developed to allow comparisons of the global warming impacts of different gases. Specifically, it is a measure of how much energy the emissions of 1 ton of a gas will absorb over a given period of time, relative to the emissions of 1 ton of carbon dioxide (CO_2). The larger the GWP, the more that a given gas warms the Earth compared to CO_2 over that time period. The time period usually used for GWPs is 100 years. GWPs provide a common unit of measure, which allows analysts to add up emissions estimates of different gases (e.g., to compile a national GHG inventory), and allows policymakers to compare emissions reduction opportunities across sectors and gases. A summary of the atmospheric lifetime and the global warming potential of selected gases are summarized in Table 8. As shown in Table 8, the global warming potential of GHGs ranges from 1 to 22,800.

Table 8
Global Warming Potentials and Atmospheric Lifetimes

Gas	Atmospheric Lifetime	Global Warming Potential[1] (100 Year Horizon)
Carbon Dioxide (CO_2)	–[2]	1
Methane (CH_4)	12	28-36
Nitrous Oxide (N2O)	114	265-298
Hydrofluorocarbons (HFCs)	1-270	12-14,800
Perfluorocarbons (PFCs)	2,600-50,000	7,390-12,200
Nitrogen trifluoride (NF_3)	740	17,200
Sulfur Hexafluoride (SF_6)	3,200	22,800

Notes:

Source: http://www3.epa.gov/climatechange/ghgemissions/gases.html

(1) Compared to the same quantity of CO_2 emissions.

(2) Carbon dioxide's lifetime is poorly defined because the gas is not destroyed over time, but instead moves among different parts of the ocean–atmosphere–land system. Some of the excess carbon dioxide will be absorbed quickly (for example, by the ocean surface), but some will remain in the atmosphere for thousands of years, due in part to the very slow process by which carbon is transferred to ocean sediments.

GREENHOUSE GAS STANDARDS AND REGULATION

International

Montreal Protocol

In 1988, the United Nations established the Intergovernmental Panel on Climate Change (IPCC) to evaluate the impacts of global climate change and to develop strategies that nations could implement to curtail global climate change. In 1992, the United States joined other countries around the world in signing the United Nations' Framework Convention on Climate Change (UNFCCC) agreement with the goal of controlling GHG emissions. As a result, the Climate Change Action Plan was developed to address the reduction of GHGs in the United States. The plan consists of more than 50 voluntary programs.

Additionally, the Montreal Protocol was originally signed in 1987 and substantially amended in 1990 and 1992. The Montreal Protocol stipulates that the production and consumption of compounds that deplete ozone in the stratosphere—CFCs, halons, carbon tetrachloride, and methyl chloroform—were to be phased out, with the first three by the year 2000 and methyl chloroform by 2005.

The Paris Agreement

The Paris Agreement became effective on November 4, 2016. Thirty days after this date at least 55 Parties to the United Nations Framework Convention on Climate Change (Convention), accounting in total for at least an estimated 55 % of the total global GHG emissions, had deposited their instruments of ratification, acceptance, approval or accession with the Depositary.

The Paris Agreement built upon the Convention and – for the first time – attempted to bring all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so. As such, it charts a new course in the global climate effort.

The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. Additionally, the agreement aims to strengthen the ability of countries to deal with the impacts of climate change. To reach these ambitious goals, appropriate financial flows, a new technology framework and an enhanced capacity building framework will be put in place, thus supporting action by developing countries and the most vulnerable countries, in line with their own national objectives. The Agreement also provides for enhanced transparency of action and support through a more robust transparency framework.

Federal

The USEPA is responsible for implementing federal policy to address GHGs. The federal government administers a wide array of public-private partnerships to reduce the GHG intensity generated in the United States. These programs focus on energy efficiency, renewable energy, methane and other non-CO2 gases, agricultural practices, and implementation of technologies to achieve GHG reductions. The USEPA implements numerous voluntary programs that contribute to the reduction of GHG emissions. These programs (e.g., the ENERGY STAR labeling system for energy-efficient products) play a significant role in encouraging voluntary reductions from large corporations, consumers, industrial and commercial buildings, and many major industrial sectors.

In Massachusetts v. Environmental Protection Agency (Docket No. 05–1120), argued November 29, 2006 and decided April 2, 2007, the U.S. Supreme Court held that not only did the EPA have authority to regulate GHGs, but the EPA's reasons for not regulating this area did not fit the statutory requirements. As such, the

U.S. Supreme Court ruled that the EPA should be required to regulate CO_2 and other GHGs as pollutants under the federal Clean Air Act (CAA).

In response to the FY2008 Consolidations Appropriations Act (H.R. 2764; Public Law 110-161), EPA proposed a rule on March 10, 2009 that requires mandatory reporting of GHG emissions from large sources in the United States. On September 22, 2009, the Final Mandatory Reporting of GHG Rule was signed and published in the Federal Register on October 30, 2009. The rule became effective on December 29, 2009. This rule requires suppliers of fossil fuels or industrial GHGs, manufacturers of vehicles and engines, and facilities that emit 25,000 metric tons or more per year of GHG emissions to submit annual reports to EPA.

On December 7, 2009, the EPA Administrator signed two distinct findings under section 202(a) of the Clean Air Act. One is an endangerment finding that finds concentrations of the six GHGs in the atmosphere threaten the public health and welfare of current and future generations. The other is a cause or contribute finding, that finds emissions from new motor vehicles and new motor vehicle engines contribute to the GHG pollution which threatens public health and welfare. These actions will not themselves impose any requirements on industry or other entities. However, it is a prerequisite to finalizing the EPA's proposed GHG emission standards for light-duty vehicles, which were jointly proposed by the EPA and Department of Transportation on September 15, 2009.

Clean Air Act

In Massachusetts v. Environmental Protection Agency (Docket No. 05–1120), the U.S. Supreme Court held in April of 2007 that the USEPA has statutory authority under Section 202 of the federal Clean Air Act (CAA) to regulate GHGs. The court did not hold that the USEPA was required to regulate GHG emissions; however, it indicated that the agency must decide whether GHGs cause or contribute to air pollution that is reasonably anticipated to endanger public health or welfare. On December 7, 2009, the USEPA Administrator signed two distinct findings regarding GHGs under Section 202(a) of the CAA. The USEPA adopted a Final Endangerment Finding for the six defined GHGs (CO2, CH4, N2O, HFCs, PFCs, and SF6) on December 7, 2009. The Endangerment Finding is required before USEPA can regulate GHG emissions under Section 202(a)(1) of the CAA consistently with the United States Supreme Court decision. The USEPA also adopted a Cause or Contribute Finding in which the USEPA Administrator found that GHG emissions from new motor vehicle and motor vehicle engines are contributing to air pollution, which is endangering public health and welfare. These findings do not, by themselves, impose any requirements on industry or other entities. However, these actions were a prerequisite for implementing GHG emissions standards for vehicles.

Energy Independence Security Act

The Energy Independence and Security Act of 2007 (EISA) facilitates the reduction of national GHG emissions by requiring the following:

- Increasing the supply of alternative fuel sources by setting a mandatory Renewable Fuel Standard (RFS) that requires fuel producers to use at least 36 billion gallons of biofuel in 2022;
- Prescribing or revising standards affecting regional efficiency for heating and cooling products, procedures for new or amended standards, energy conservation, energy efficiency labeling for consumer electronic products, residential boiler efficiency, electric motor efficiency, and home appliances;
- Requiring approximately 25 percent greater efficiency for light bulbs by phasing out incandescent light bulbs between 2012 and 2014; requiring approximately 200 percent greater efficiency for light bulbs, or similar energy savings, by 2020; and
- While superseded by the USEPA and NHTSA actions described above, (i) establishing miles per gallon targets for cars and light trucks and (ii) directing the NHTSA to establish a fuel economy program for medium- and heavy-duty trucks and create a separate fuel economy standard for trucks.

Additional provisions of EISA address energy savings in government and public institutions, promote research for alternative energy, additional research in carbon capture, international energy programs, and the creation of green jobs.[13]

Executive Order 13432

In response to the Massachusetts v. Environmental Protection Agency ruling, the President signed Executive Order 13432 on May 14, 2007, directing the USEPA, along with the Departments of Transportation, Energy, and Agriculture, to initiate a regulatory process that responds to the Supreme Court's decision. Executive Order 13432 was codified into law by the 2009 Omnibus Appropriations Law signed on February 17, 2009. The order sets goals in the areas of energy efficiency, acquisition, renewable energy, toxics reductions, recycling, sustainable buildings, electronics stewardship, fleets, and water conservation. Light-Duty Vehicle GHG and Corporate Average Fuel Economy Standards.

On May 19, 2009, President Obama announced a national policy for fuel efficiency and emissions standards in the United States auto industry. The adopted federal standard applies to passenger cars and light-duty trucks for model years 2012 through 2016. The rule surpasses the prior Corporate Average Fuel Economy standards (CAFE)[14] and requires an average fuel economy standard of 35.5 miles per gallon (mpg) and 250 grams of CO2 per mile by model year 2016, based on USEPA calculation methods. These standards were formally adopted on April 1, 2010. In August 2012, standards were adopted for model year 2017 through 2025 for passenger cars and light-duty trucks. By 2025, vehicles are required to achieve 54.5 mpg (if GHG reductions are achieved exclusively through fuel economy improvements) and 163 grams of CO2 per mile. According to the USEPA, a model year 2025 vehicle would emit one-half of the GHG emissions from a model year 2010 vehicle.[15] In 2017, the USEPA recommended no change to the GHG standards for light-duty vehicles for model years 2022-2025.

Issued by NHTSA and EPA in March 2020 (published on April 30, 2020 and effective after June 29, 2020), the Safer Affordable Fuel-Efficient Vehicles Rule would maintain the CAFE and CO2 standards applicable in model year 2020 for model years 2021 through 2026. The estimated CAFE and CO2 standards for model year 2020 are 43.7 mpg and 204 grams of CO2 per mile for passenger cars and 31.3 mpg and 284 grams of CO2 per mile for light trucks, projecting an overall industry average of 37 mpg, as compared to 46.7 mpg under the standards issued in 2012. This Rule also excludes CO2- equivalent emission improvements associated with air conditioning refrigerants and leakage (and, optionally, offsets for nitrous oxide and methane emissions) after model year 2020.[16]

On May 12, 2021, the National Highway Traffic Safety Administration (NHTSA) published a notice of proposed rulemaking in the Federal Register, proposing to repeal "The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule Part One: One National Program," published Sept. 27, 2019 (SAFE I Rule), in which NHTSA codified regulatory text and made additional pronouncements regarding the preemption of state and local laws related to fuel economy standards. Specifically, this document proposes to fully repeal the regulatory text and appendices promulgated in the SAFE I Rule. In addition, this document proposes to repeal and withdraw the interpretative statements made by the Agency in the SAFE I Rule preamble, including those

[13] A green job, as defined by the United States Department of Labor, is a job in business that produces goods or provides services that benefit the environment or conserve natural resources.

[14] The Corporate Average Fuel Economy standards are regulations in the United States, first enacted by Congress in 1975, to improve the average fuel economy of cars and light trucks. The U.S Department of Transportation has delegated the National Highway Traffic Safety Administration as the regulatory agency for the Corporate Average Fuel Economy standards.

[15] United States Environmental Protection Agency, EPA and NHTSA Set Standards to Reduce Greenhouse Gases and Improve Fuel Economy for Model Years 2017-2025 Cars and Light Trucks, August 2012, https://nepis.epa.gov/Exe/ZyPDF.cgi/P100EZ7C.PDF?Dockey=P100EZ7C.PDF.

[16] National Highway Traffic Safety Administration (NHTSA) and U.S. Environmental Protection Agency (USEPA), 2018. Federal Register / Vol. 83, No. 165 / Friday, August 24, 2018 / Proposed Rules, The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021–2026 Passenger Cars and Light Trucks 2018. Available at: https://www.gpo.gov/fdsys/pkg/FR-2018-08-24/pdf/2018-16820.pdf.

regarding the preemption of particular state Greenhouse Gas (GHG) Emissions standards or Zero Emissions Vehicle (ZEV) mandates. As such, this document proposes to establish a clean slate with respect to NHTSA's regulations and interpretations concerning preemption under the Energy Policy and Conservation Act (EPCA).[17]

In December 2021, the EPA finalized federal GHG emissions standards for passenger cars and light trucks for model years 2023 through 2026. The updated standards will result in avoiding more than 3 billion tons of GHG emissions through 2050. These standards set the light-duty vehicle GHG program on track to provide a strong launch point for the agency's next phase of standards for model year 2027 and beyond.[18] On April 12, 2023, EPA announced new, more ambitious proposed standards to further reduce harmful air pollutant emissions from light-duty and medium-duty vehicles starting with model year 2027. The proposal builds upon EPA's final standards for federal greenhouse gas emissions standards for passenger cars and light trucks for model years 2023 through 2026 and leverages advances in clean car technology to unlock benefits to Americans ranging from reducing climate pollution, to improving public health, to saving drivers money through reduced fuel and maintenance costs. The proposed standards would phase in over model years 2027 through 2032.[19]

State of California

California Air Resources Board

CARB, a part of the CalEPA, is responsible for the coordination and administration of both federal and state air pollution control programs within California. In this capacity, CARB conducts research, sets state ambient air quality standards (CAAQS), compiles emission inventories, develops suggested control measures, and provides oversight of local programs. CARB establishes emissions standards for motor vehicles sold in California, consumer products (such as hairspray, aerosol paints, and barbecue lighter fluid), and various types of commercial equipment. It also sets fuel specifications to further reduce vehicular emissions.

In 2004, the California Air Resources Board (CARB) adopted an Airborne Toxic Control Measure to limit heavy-duty diesel motor vehicle idling in order to reduce public exposure to diesel particulate matter and other TACs (Title 13 California Code of Regulations [CCR], Section 2485). The measure applies to diesel-fueled commercial vehicles with gross vehicle weight ratings greater than 10,000 pounds that are licensed to operate on highways, regardless of where they are registered. This measure generally does not allow diesel-fueled commercial vehicles to idle for more than 5 minutes at any given location with certain exemptions for equipment in which idling is a necessary function such as concrete trucks. While this measure primarily targets diesel particulate matter emissions, it has co-benefits of minimizing GHG emissions from unnecessary truck idling.

In 2008, CARB approved the Truck and Bus regulation to reduce particulate matter and nitrogen oxide emissions from existing diesel vehicles operating in California (13 CCR, Section 2025, subsection (h)). CARB has also promulgated emission standards for off-road diesel construction equipment of greater than 25 horsepower such as bulldozers, loaders, backhoes and forklifts, as well as many other self-propelled off-road diesel vehicles. The regulation, adopted by the CARB on July 26, 2007, aims to reduce emissions by installation of diesel soot filters and encouraging the retirement, replacement, or repower of older, dirtier engines with newer emission-controlled models. While these regulations primarily target reductions in criteria air pollutant emission, they have co-benefits of minimizing GHG emissions due to improved engine efficiencies.

[17] https://www.federalregister.gov/documents/2021/05/12/2021-08758/corporate-average-fuel-economy-cafe-preemption

[18] United States Environmental Protection Agency (EPA), Regulations for Emissions from Vehicles and Engines, Final Rule to Revise Existing National GHG Emissions Standards for Passenger Cars and Light Trucks Through Model Year 2026. https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-revise-existing-national-ghg-emissions

[19] United States Environmental Protection Agency (EPA), Regulations for Emissions from Vehicles and Engines, Proposed Rule: Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles. https://www.epa.gov/regulations-emissions-vehicles-and-engines/proposed-rule-multi-pollutant-emissions-standards-model

The State currently has no regulations that establish ambient air quality standards for GHGs. However, the State has passed laws directing CARB to develop actions to reduce GHG emissions, which are listed below.

Assembly Bill 1493

California Assembly Bill 1493 enacted on July 22, 2002, required the CARB to develop and adopt regulations that reduce GHGs emitted by passenger vehicles and light duty trucks. In 2005, the CARB submitted a "waiver" request to the EPA from a portion of the federal Clean Air Act in order to allow the State to set more stringent tailpipe emission standards for CO_2 and other GHG emissions from passenger vehicles and light duty trucks. On December 19, 2007 the EPA announced that it denied the "waiver" request. On January 21, 2009, CARB submitted a letter to the EPA administrator regarding the State's request to reconsider the waiver denial. The EPA approved the waiver on June 30, 2009. After adopting these initial greenhouse gas standards for passenger vehicles, CARB adopted continuing standards for future model years.

Executive Order S-3-05

The California Governor issued Executive Order S-3-05, GHG Emission, in June 2005, which established the following reduction targets:

- By 2010, California shall reduce GHG emissions to 2000 levels;
- By 2020, California shall reduce GHG emissions to 1990 levels; and
- By 2050, California shall reduce GHG emissions to 80 percent below 1990 levels.

The Executive Order directed the secretary of the CalEPA to coordinate a multi-agency effort to reduce GHG emissions to the target levels. To comply with the Executive Order, the secretary of CalEPA created the California Climate Action Team (CAT), made up of members from various state agencies and commissions. The team released its first report in March 2006. The report proposed to achieve the targets by building on the voluntary actions of businesses, local governments, and communities and through State incentive and regulatory programs.

Assembly Bill 32 (California Health and Safety Code, Division 25.5 – California Global Warming Solutions Act of 2006)

In 2006, the California State Legislature adopted Assembly Bill (AB) 32 (codified in the California Health and Safety Code [HSC], Division 25.5 – California Global Warming Solutions Act of 2006), which focuses on reducing GHG emissions in California to 1990 levels by 2020. HSC Division 25.5 defines GHGs as CO2, CH4, N2O, HFCs, PFCs, and SF6 and represents the first enforceable statewide program to limit emissions of these GHGs from all major industries with penalties for noncompliance. The law further requires that reduction measures be technologically feasible and cost effective. Under HSC Division 25.5, CARB has the primary responsibility for reducing GHG emissions. CARB is required to adopt rules and regulations directing state actions that would achieve GHG emissions reductions equivalent to 1990 statewide levels by 2020.

Senate Bill 32 and Assembly Bill 197

In 2016, the California State Legislature adopted Senate Bill (SB) 32 and its companion bill AB 197, and both were signed by Governor Brown. SB 32 and AB 197 amends HSC Division 25.5 and establishes a new climate pollution reduction target of 40 percent below 1990 levels by 2030 and includes provisions to ensure the benefits of state climate policies reach into disadvantaged communities.

Climate Change Scoping Plan (2008)

A specific requirement of AB 32 was to prepare a Climate Change Scoping Plan for achieving the maximum technologically feasible and cost-effective GHG emission reduction by 2020 (Health and Safety Code section 38561 (h)). CARB developed an AB 32 Scoping Plan that contains strategies to achieve the 2020 emissions cap. The initial Scoping Plan was approved in 2008, and contains a mix of recommended strategies that combined direct regulations, market-based approaches, voluntary measures, policies, and other emission reduction programs calculated to meet the 2020 statewide GHG emission limit and initiate the transformations needed to achieve the State's long-range climate objectives.

As required by HSC Division 25.5, CARB approved the 1990 GHG emissions inventory, thereby establishing the emissions limit for 2020. The 2020 emissions limit was originally set at 427 $MMTCO_2e$ using the GWP values from the IPCC SAR. CARB also projected the state's 2020 GHG emissions under no-action-taken (NAT) conditions – that is, emissions that would occur without any plans, policies, or regulations to reduce GHG emissions. CARB originally used an average of the state's GHG emissions from 2002 through 2004 and projected the 2020 levels at approximately 596 $MMTCO_2e$ (using GWP values from the IPCC SAR). Therefore, under the original projections, the state must reduce its 2020 NAT emissions by 28.4 percent in order to meet the 1990 target of 427 $MMTCO_2e$.

First Update to the Climate Change Scoping Plan (2014)

The First Update to the Scoping Plan was approved by CARB in May 2014 and builds upon the initial Scoping Plan with new strategies and recommendations. In 2014, CARB revised the target using the GWP values from the IPCC AR4 and determined that the 1990 GHG emissions inventory and 2020 GHG emissions limit is 431 $MMTCO_2e$. CARB also updated the State's 2020 NAT emissions estimate to account for the effect of the 2007–2009 economic recession, new estimates for future fuel and energy demand, and the reductions required by regulation that were recently adopted for motor vehicles and renewable energy. CARB's projected statewide 2020 emissions estimate using the GWP values from the IPCC AR4 is 509.4 $MMTCO_2e$.

2017 Climate Change Scoping Plan

In response to the 2030 GHG reduction target, CARB adopted the 2017 Climate Change Scoping Plan at a public meeting held in December 2017. The 2017 Scoping Plan outlines the strategies the State will implement to achieve the 2030 GHG reduction target of 40 percent below 1990 levels. The 2017 Scoping Plan also addresses GHG emissions from natural and working lands of California, including the agriculture and forestry sectors. The 2017 Scoping Plan considered the Scoping Plan Scenario and four alternatives for achieving the required GHG reductions but ultimately selected the Scoping Plan Scenario.

CARB states that the Scoping Plan Scenario "is the best choice to achieve the State's climate and clean air goals."[20] Under the Scoping Plan Scenario, the majority of the reductions would result from the continuation of the Cap-and-Trade regulation. Additional reductions are achieved from electricity sector standards (i.e., utility providers to supply at least 50 percent renewable electricity by 2030), doubling the energy efficiency savings at end uses, additional reductions from the LCFS, implementing the short-lived GHG strategy (e.g., hydrofluorocarbons), and implementing the mobile source strategy and sustainable freight action plan. The alternatives were designed to consider various combinations of these programs, as well as consideration of a carbon tax in the event the Cap-and-Trade regulation is not continued. However, in July 2017, the California Legislature voted to extend the Cap-and-Trade regulation to 2030. Implementing this Scoping Plan will ensure that California's climate actions continue to promote innovation, drive the generation of new jobs, and achieve continued reductions of smog and air toxics. The ambitious approach draws on a decade of successful programs that address the major sources of climate-changing gases in every sector of the economy:

[20] California Air Resources Board, California's 2017 Climate Change Scoping Plan, November 2017, https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf

- More Clean Cars and Trucks: The plan sets out far-reaching programs to incentivize the sale of millions of zero-emission vehicles, drive the deployment of zero-emission trucks, and shift to a cleaner system of handling freight statewide.
- Increased Renewable Energy: California's electric utilities are ahead of schedule meeting the requirement that 33 percent of electricity come from renewable sources by 2020. The Scoping Plan guides utilities to 50 percent renewables, as required under SB 350.
- Slashing Super-Pollutants: The plan calls for a significant cut in super-pollutants such as methane and HFC refrigerants, which are responsible for as much as 40 percent of global warming.
- Cleaner Industry and Electricity: California's renewed cap-and-trade program extends the declining cap on emissions from utilities and industries and the carbon allowance auctions. The auctions will continue to fund investments in clean energy and efficiency, particularly in disadvantaged communities.
- Cleaner Fuels: The Low Carbon Fuel Standard will drive further development of cleaner, renewable transportation fuels to replace fossil fuels.
- Smart Community Planning: Local communities will continue developing plans which will further link transportation and housing policies to create sustainable communities.
- Improved Agriculture and Forests: The Scoping Plan also outlines innovative programs to account for and reduce emissions from agriculture, as well as forests and other natural lands.

The 2017 Scoping Plan also evaluates reductions of smog-causing pollutants through California's climate programs.

2022 Climate Change Scoping Plan

CARB adopted the 2022 Scoping Plan for Achieving Carbon Neutrality on November 16, 2022. The 2022 Scoping Plan lays out the sector-by-sector roadmap for California, the world's fifth largest economy, to achieve carbon neutrality by 2045 or earlier, outlining a technologically feasible, cost-effective, and equity-focused path to achieve the state's climate target. The Plan addresses recent legislation and direction from Governor Newsom and extends and expands upon earlier plans with a target of reducing anthropogenic emissions to 85 percent below 1990 levels by 2045. The plan also takes the unprecedented step of adding carbon neutrality as a science-based guide and touchstone for California's climate work. Specifically, this plan:

- Identifies a path to keep California on track to meet its SB 32 GHG reduction target of at least 40 percent below 1990 emissions by 2030.
- Identifies a technologically feasible, cost-effective path to achieve carbon neutrality by 2045 and a reduction in anthropogenic emissions by 85 percent below 1990 levels.
- Focuses on strategies for reducing California's dependency on petroleum to provide consumers with clean energy options that address climate change, improve air quality, and support economic growth and clean sector jobs.
- Integrates equity and protecting California's most impacted communities as driving principles throughout the document.
- Incorporates the contribution of natural and working lands (NWL) to the state's GHG emissions, as well as their role in achieving carbon neutrality.
- Relies on the most up-to-date science, including the need to deploy all viable tools to address the existential threat that climate change presents, including carbon capture and sequestration, as well as direct air capture.
- Evaluates the substantial health and economic benefits of taking action.
- Identifies key implementation actions to ensure success.

SB 32, Pavley. California Global Warming Solutions Act of 2006

(1) The California Global Warming Solutions Act of 2006 designates the State Air Resources Board as the state agency charged with monitoring and regulating sources of emissions of greenhouse gases. The state

board is required to approve a statewide greenhouse gas emissions limit equivalent to the statewide greenhouse gas emissions level in 1990 to be achieved by 2020 and to adopt rules and regulations in an open public process to achieve the maximum, technologically feasible, and cost-effective greenhouse gas emissions reductions. This bill would require the state board to ensure that statewide greenhouse gas emissions are reduced to 40% below the 1990 level by 2030.

(2) This bill would become operative only if AB 197 of the 2015–16 Regular Session is enacted and becomes effective on or before January 1, 2017. AB 197 requires that the California Air Resources Board, which directs implementation of emission-reduction programs, should target direct reductions at both stationary and mobile sources. AB 197 of the 2015-2016 Regular Session was approved on September 8, 2016.

Senate Bill 1368

Senate Bill 1368 (SB 1368) is the companion Bill of AB 32 and was adopted September, 2006. SB 1368 requires the California Public Utilities Commission (CPUC) to establish a performance standard for baseload generation of GHG emissions by investor-owned utilities by February 1, 2007, and for local publicly owned utilities by June 30, 2007. These standards could not exceed the GHG emissions rate from a baseload combined-cycle, natural gas-fired plant. Furthermore, the legislation states that all electricity provided to the State, including imported electricity, must be generated by plants that meet the standards set by California Public Utilities Commission (CPUC) and California Energy Commission (CEC).

Executive Order S-1-07

Executive Order S-1-07 was issued in 2007 and proclaims that the transportation sector is the main source of GHG emissions in the State, since it generates more than 40 percent of the State's GHG emissions. It establishes a goal to reduce the carbon intensity of transportation fuels sold in the State by at least ten percent by 2020. This Order also directs the CARB to determine whether this Low Carbon Fuel Standard (LCFS) could be adopted as a discrete early-action measure as part of the effort to meet the mandates in AB 32.

On April 23, 2009 CARB approved the proposed regulation to implement the low carbon fuel standard and began implementation on January 1, 2011. The low carbon fuel standard is anticipated to reduce GHG emissions by about 16 MMT per year by 2020. CARB approved some amendments to the LCFS in December 2011, which were implemented on January 1, 2013. In September 2015, the Board approved the re-adoption of the LCFS, which became effective on January 1, 2016, to address procedural deficiencies in the way the original regulation was adopted. In 2018, the Board approved amendments to the regulation, which included strengthening and smoothing the carbon intensity benchmarks through 2030 in-line with California's 2030 GHG emission reduction target enacted through SB 32, adding new crediting opportunities to promote zero emission vehicle adoption, alternative jet fuel, carbon capture and sequestration, and advanced technologies to achieve deep decarbonization in the transportation sector.

The LCFS is designed to encourage the use of cleaner low-carbon transportation fuels in California, encourage the production of those fuels, and therefore, reduce GHG emissions and decrease petroleum dependence in the transportation sector. Separate standards are established for gasoline and diesel fuels and the alternative fuels that can replace each. The standards are "back-loaded", with more reductions required in the last five years, than during the first five years. This schedule allows for the development of advanced fuels that are lower in carbon than today's fuels and the market penetration of plug-in hybrid electric vehicles, battery electric vehicles, fuel cell vehicles, and flexible fuel vehicles. It is anticipated that compliance with the low carbon fuel standard will be based on a combination of both lower carbon fuels and more efficient vehicles.

Reformulated gasoline mixed with corn-derived ethanol at ten percent by volume and low sulfur diesel fuel represent the baseline fuels. Lower carbon fuels may be ethanol, biodiesel, renewable diesel, or blends of these fuels with gasoline or diesel as appropriate. Compressed natural gas and liquefied natural gas also may be low carbon fuels. Hydrogen and electricity, when used in fuel cells or electric vehicles are also considered as low carbon fuels for the low carbon fuel standard.

Senate Bill 97

Senate Bill 97 (SB 97) was adopted August 2007 and acknowledges that climate change is a prominent environmental issue that requires analysis under CEQA. SB 97 directed the Governor's Office of Planning and Research (OPR), which is part of the State Natural Resources Agency, to prepare, develop, and transmit to the CARB guidelines for the feasible mitigation of GHG emissions or the effects of GHG emissions, as required by CEQA, by July 1, 2009. The Natural Resources Agency was required to certify and adopt those guidelines by January 1, 2010.

Pursuant to the requirements of SB 97 as stated above, on December 30, 2009, the Natural Resources Agency adopted amendments to the state CEQA guidelines that address GHG emissions. The CEQA Guidelines Amendments changed 14 sections of the CEQA Guidelines and incorporate GHG language throughout the Guidelines. However, no GHG emissions thresholds of significance were provided and no specific mitigation measures were identified. The GHG emission reduction amendments went into effect on March 18, 2010, and are summarized below:

- Climate action plans and other greenhouse gas reduction plans can be used to determine whether a project has significant impacts, based upon its compliance with the plan.
- Local governments are encouraged to quantify the greenhouse gas emissions of proposed projects, noting that they have the freedom to select the models and methodologies that best meet their needs and circumstances. The section also recommends consideration of several qualitative factors that may be used in the determination of significance, such as the extent to which the given project complies with state, regional, or local GHG reduction plans and policies. OPR does not set or dictate specific thresholds of significance. Consistent with existing CEQA Guidelines, OPR encourages local governments to develop and publish their own thresholds of significance for GHG impacts assessment.
- When creating their own thresholds of significance, local governments may consider the thresholds of significance adopted or recommended by other public agencies, or recommended by experts.
- New amendments include guidelines for determining methods to mitigate the effects of greenhouse gas emissions in Appendix F of the CEQA Guidelines.
- OPR is clear to state that "to qualify as mitigation, specific measures from an existing plan must be identified and incorporated into the project; general compliance with a plan, by itself, is not mitigation".
- OPR's emphasizes the advantages of analyzing GHG impacts on an institutional, programmatic level. OPR therefore approves tiering of environmental analyses and highlights some benefits of such an approach.
- Environmental impact reports (EIRs) must specifically consider a project's energy use and energy efficiency potential.

Senate Bill 100

Senate Bill 100 (SB 100) requires 100 percent of total retail sales of electricity in California to come from eligible renewable energy resources and zero-carbon resources by December 31, 2045. SB 100 was adopted September 2018.

The interim thresholds from prior Senate Bills and Executive Orders would also remain in effect. These include Senate Bill 1078 (SB 1078), which requires retail sellers of electricity, including investor-owned utilities and community choice aggregators, to provide at least 20 percent of their supply from renewable sources by 2017. Senate Bill 107 (SB 107) which changed the target date to 2010. Executive Order S-14-08, which was signed on November 2008 and expanded the State's Renewable Energy Standard to 33 percent renewable energy by 2020. Executive Order S-21-09 directed the CARB to adopt regulations by July 31, 2010 to enforce S-14-08. Senate Bill X1-2 codifies the 33 percent renewable energy requirement by 2020.

Senate Bill 375

Senate Bill 375 (SB 375) was adopted September 2008 and aligns regional transportation planning efforts, regional GHG emission reduction targets, and land use and housing allocation. SB 375 requires Metropolitan Planning Organizations (MPO) to adopt a sustainable communities strategy (SCS) or alternate planning strategy (APS) that will prescribe land use allocation in that MPOs Regional Transportation Plan (RTP). The CARB, in consultation with each MPO, will provide each affected region with reduction targets for GHGs emitted by passenger cars and light trucks in the region for the years 2020 and 2035. These reduction targets will be updated every eight years but can be updated every four years if advancements in emissions technologies affect the reduction strategies to achieve the targets. The CARB is also charged with reviewing each MPO's sustainable communities strategy or alternate planning strategy for consistency with its assigned targets.

The proposed project is located within the SCAG jurisdiction, which has authority to develop the SCS or APS. For the SCAG region, the targets set by the CARB are at eight percent below 2005 per capita GHG emissions levels by 2020 and 19 percent below 2005 per capita GHG emissions levels by 2035. These reduction targets became effective October 2018.

Senate Bill X7-7

Senate Bill X7-7 (SB X7-7), enacted on November 9, 2009, mandates water conservation targets and efficiency improvements for urban and agricultural water suppliers. SB X7-7 requires the Department of Water Resources (DWR) to develop a task force and technical panel to develop alternative best management practices for the water sector. In addition, SB X7-7 required the DWR to develop criteria for baseline uses for residential, commercial, and industrial uses for both indoor and landscaped area uses. The DWR was also required to develop targets and regulations that achieve a statewide 20 percent reduction in water usage.

Assembly Bill 939 and Senate Bill 1374

Assembly Bill 939 (AB 939) requires that each jurisdiction in California to divert at least 50 percent of its waste away from landfills, whether through waste reduction, recycling or other means. Senate Bill 1374 (SB 1374) requires the California Integrated Waste Management Board to adopt a model ordinance by March 1, 2004, suitable for adoption by any local agency to require 50 to 75 percent diversion of construction and demolition of waste materials from landfills.

California Code of Regulations (CCR) Title 24, Part 6

CCR Title 24, Part 6: California's Energy Efficiency Standards for Residential and Nonresidential Buildings (Title 24) were first established in 1978 in response to a legislative mandate to reduce California's energy consumption. The standards are updated periodically to allow consideration and possible incorporation of new energy efficiency technologies and methods. Although it was not originally intended to reduce GHG emissions, electricity production by fossil fuels results in GHG emissions and energy efficient buildings require less electricity. Therefore, increased energy efficiency results in decreased GHG emissions.

The Energy Commission adopted 2008 Standards on April 23, 2008, and Building Standards Commission approved them for publication on September 11, 2008. These updates became effective on August 1, 2009. CalEEMod modeling defaults to 2008 standards. 2013 Standards were approved and have been effective since July 1, 2014. 2016 Standards were adopted January 1, 2017. 2019 standards were published July 1, 2019 and became effective January 1, 2020. All buildings for which an application for a building permit is submitted on or after January 1, 2020 must follow the 2019 standards. The 2016 residential standards were estimated to be approximately 28 percent more efficient than the 2013 standards, whereas the 2019 residential standards are estimated to be approximately 7 percent more efficient than the 2016 standards. Furthermore, once rooftop solar electricity generation is factored in, 2019 residential standards are estimated to be approximately 53 percent more efficient than the 2016 standards. Under the 2019 standards, nonresidential buildings are estimated to be approximately 30 percent more efficient than the 2016 standards.

Energy efficient buildings require less electricity; therefore, increased energy efficiency reduces fossil fuel consumption and decreases GHG emissions.

Per Section 100 Scope, the 2019 Title 24, Part 6 Building Code now requires healthcare facilities, such as assisted living facilities, hospitals, and nursing homes, to meet documentation requirements of Title 24, Part 1 Chapter 7 – Safety Standards for Health Facilities. A healthcare facility is defined as any building or portion thereof licensed pursuant to California Health and Safety Code Division 2, Chapter 1, Section 1204 or Chapter 2, Section 1250.

Section 120.1 Ventilation and Indoor Air Quality included both additions and revisions in the 2019 Code. This section now requires nonresidential and hotel/motel buildings to have air filtration systems that use forced air ducts to supply air to occupiable spaces to have air filters. Further, the air filter efficiency must be either MERV 13 or use a particle size efficiency rating specific in the Energy Code AND be equipped with air filters with a minimum 2-inch depth or minimum 1-inch depth if sized according to the equation 120.1-A. If natural ventilation is to be used the space must also use mechanical unless ventilation openings are either permanently open or controlled to stay open during occupied times. The 2019 version of the Code also completely revised the minimum ventilation requirements including DVC airflow rates within Section 120.1 Table 120.1–A. Table 120.1-A now includes air classification and recirculation limitations, these are based on either the number of occupants or the CFM/ft^2 (cubic feet per minute per square foot), whichever is greater.

Section 120.1 Ventilation and Indoor Air Quality also included additions for high-rise residential buildings. Requirements include that mechanical systems must provide air filters that and that air filters must be MERV 13 or use a particle size efficiency rating specified in the Energy Code. Window operation is no longer a method allowed to meet ventilation requirements, continuous operation of central forced air system handlers used in central fan integrated ventilation system is not a permissible method of providing the dwelling unit ventilation airflow, and central ventilation systems that serve multiple dwelling units must be balanced to provide ventilation airflow to each dwelling unit. In addition, requirements for kitchen range hoods were also provided in the updated Section 120.1.

Per Section 120.1(a) healthcare facilities must be ventilated in accordance with Chapter 4 of the California Mechanical Code and are NOT required to meet the ventilations requirements of Title 24, Part 6.

Section 140.4 Space Conditioning Systems included both additions and revisions within the 2019 Code. The changes provided new requirements for cooling tower efficiency, new chilled water-cooling system requirements, as well as new formulas for calculating allowed fan power. Section 140.4(n) also provide a new exception for mechanical system shut-offs for high-rise multifamily dwelling units, while Section 140.4(o) added new requirements for conditioned supply air being delivered to space with mechanical exhaust.

Section 120.6 Covered Processes added information in regards to adiabatic chiller requirements that included that all condenser fans for air-cooled converseness, evaporative-cooled condensers, adiabatic condensers, gas coolers, air or water fluid coolers or cooling towers must be continuously variable speed, with the speed of all fans serving a common condenser high side controlled in unison .Further, the mid-condensing setpoint must be 70 degrees Fahrenheit for all of the above mentioned systems.

New regulations were also adopted under Section 130.1 Indoor Lighting Controls. These included new exceptions being added for restrooms, the exception for classrooms being removed, as well as exceptions in regard to sunlight provided through skylights and overhangs.

Section 130.2 Outdoor Lighting Controls and Equipment added automatic scheduling controls which included that outdoor lighting power must be reduced by 50 to 90 percent, turn the lighting off during unoccupied times and have at least two scheduling options for each luminaire independent from each other and with a 2-hour override function. Furthermore, motion sensing controls must have the ability to reduce power within 15 minutes of area being vacant and be able to come back on again when occupied. An exception allows for lighting subject to a health or life safety statute, ordinance, or regulation may have a minimum time-out period

longer than 15 minutes or a minimum dimming level above 50% when necessary to comply with the applicable law.

The 2022 Building Energy Efficiency Standards will become effective on January 1, 2023. [21] The core focus of the building standards has been efficiency, but the 2019 Energy Code ventured into onsite generation by requiring solar PV on new homes, providing significant GHG savings. The 2022 update builds off this progress with expanded solar standards and the move to onsite energy storage that will help Californians save on utility bills while bolstering the grid. The 2022 Energy Code update focuses on four key areas in new construction of homes and businesses:

- Encouraging electric heat pump technology and use, which consumes less energy and produces fewer emissions than traditional HVACs and water heaters.
- Establishing electric-ready requirements when natural gas is installed, which positions owners to use cleaner electric heating, cooking and electric vehicle (EV) charging options whenever they choose to adopt those technologies.
- Expanding solar photovoltaic (PV) system and battery storage standards to make clean energy available onsite and complement the state's progress toward a 100 percent clean electricity grid.
- Strengthening ventilation standards to improve indoor air quality.

The 2022 Energy Code affects homes by establishing energy budgets based on efficient heat pumps for space or water heating to encourage builders to install heat pumps over gas-fueled HVAC units; requiring homes to be electric-ready, with dedicated 240-volt outlets and space (with plumbing for water heaters) so electric appliances can eventually replace installed gas appliances; increasing minimum kitchen ventilation requirements so that fans over cooktops have higher airflow or capture efficiency to better exhaust pollution from gas cooking and improve indoor air quality; and allowing exceptions to existing solar PV standards when roof area is not available (such as for smaller homes). In addition, the effect on businesses includes establishing combined solar PV and battery standards for select businesses with systems being sized to maximize onsite use of solar energy and avoid electricity demand during times when the grid must use gas-powered plants; establishing new efficiency standards for commercial greenhouses (primarily cannabis growing); and improving efficiency standards for building envelope, various internal systems, and grid integration equipment, such as demand-responsive controls to buoy grid stability.[22,23]

California Code of Regulations (CCR) Title 24, Part 11 (California Green Building Standards)

On January 12, 2010, the State Building Standards Commission unanimously adopted updates to the California Green Building Standards Code, which went into effect on January 1, 2011. The 2016 version of the California Green Building Standards became effective January 1, 2017.

2016 CALGreen Code: The 2016 residential standards were estimated to be approximately 28 percent more efficient than the 2013 standards. Energy efficient buildings require less electricity; therefore, increased energy efficiency reduces fossil fuel consumption and decreases GHG emissions. During the 2016-2017 fiscal year, the Department of Housing and Community Development (HCD) updated CALGreen through the 2015 Triennial Code Adoption Cycle.

HCD also increased the required construction waste reduction from 50 percent to 65 percent of the total building site waste. This increase aids in meeting CalRecycle's statewide solid waste recycling goal of 75 percent for 2020 as stated in Chapter 476, Statutes of 2011 (AB 341). HCD adopted new regulations requiring recycling areas for multifamily projects of five or more dwelling units. This regulation requires

[21] California Energy Commission (CEC). 2022. Building Energy Efficiency Standards. https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency.

[22] https://www.lightnowblog.com/2021/08/california-energy-commission-adopts-2022-building-energy-efficiency-standards/

[23] State of California Energy Commission. 2022 Building Energy Efficiency Standards Summary. https://www.energy.ca.gov/sites/default/files/2021-08/CEC_2022_EnergyCodeUpdateSummary_ADA.pdf

developers to provide readily accessible areas adequate in size to accommodate containers for depositing, storage and collection of non-hazardous materials (including organic waste) for recycling. This requirement assists businesses that were required as of April 1, 2016, to meet the requirements of Chapter 727, Statutes of 2014 (AB 1826).

HCD adopted new regulations to require information on photovoltaic systems and electric vehicle chargers to be included in operation and maintenance manuals. Currently, CALGreen section 4.410.1 Item 2(a) requires operation and maintenance instructions for equipment and appliances. Photovoltaic systems and electric vehicle chargers are systems that play an important role in many households in California, and their importance is increasing every day. HCD incorporated these two terms in the existing language in order to provide clarity to code users as to additional systems requiring operation and maintenance instructions.

HCD updated the reference to Clean Air Standards of the USEPA applicable to woodstoves and pellet stoves. HCD also adopted a new requirement for woodstoves and pellet stoves to have a permanent label indicating they are certified to meet the emission limits. This requirement provides clarity to the code user and is consistent with the USEPA's New Source Performance Standards. HCD updated the list of standards which can be used for verification of compliance for exterior grade composite wood products. This list now includes four standards from the Canadian Standards Association (CSA): CSA O121, CSA O151, CSA O153 and CSA O325. HCD updated heating and air-conditioning system design references to the ANSI/ACCA 2 Manual J, ANSI/ACCA 1 Manual D, and ANSI/ACCA 3 Manual S to the most recent versions approved by ANSI. HCD adopted a new elective measure for hot water recirculation systems for water conservation. The United States Department of Energy estimates that 3,600 to 12,000 gallons of water per year can be saved by the typical household (with four points of hot water use) if a hot water recirculation system is installed.

2019 CALGreen Code: During the 2019-2020 fiscal year, the Department of Housing and Community Development (HCD) updated CALGreen through the 2019 Triennial Code Adoption Cycle. The 2019 version of the California Green Building Standards became effective January 1, 2020.

HCD modified the best management practices for stormwater pollution prevention adding Section 5.106.2 for projects that disturb one or more acres of land. This section requires projects that disturb one acre or more of land or less than one acre of land but are part of a larger common plan of development or sale must comply with the postconstruction requirement detailed in the applicable National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities issued by the State Water Resources Control Board. The NPDES permits require postconstruction runoff (post-project hydrology) to match the preconstruction runoff pre-project hydrology) with installation of postconstruction stormwater management measures.

HCD added sections 5.106.4.1.3 and 5.106.4.1.5 in regard to bicycle parking. Section 5.106.4.1.3 requires new buildings with tenant spaces that have 10 or more tenant-occupants, provide secure bicycle parking for 5 percent of the tenant-occupant vehicular parking spaces with a minimum of one bicycle parking facility. In addition, Section 5.106.4.1.5 states that acceptable bicycle parking facility for Sections 5.106.4.1.2 through 5.106.4.1.4 shall be convenient from the street and shall meeting one of the following: (1) covered, lockable enclosures with permanently anchored racks for bicycles; (2) lockable bicycle rooms with permanently anchored racks; or (3) lockable, permanently anchored bicycle lockers.

HCD amended section 5.106.5.3.5 allowing future charging spaces to qualify as designated parking for clean air vehicles.

HCD updated section 5.303.3.3 in regard to showerhead flow rates. This update reduced the flow rate to 1.8 GPM.

HCD amended section 5.304.1 for outdoor potable water use in landscape areas and repealed sections 5.304.2 and 5.304.3. The update requires nonresidential developments to comply with a local water efficient landscape ordinance or the current California Department of Water Resource's' Model Water Efficient

Landscape Ordinance (MWELO), whichever is more stringent. Some updates were also made in regard to the outdoor potable water use in landscape areas for public schools and community colleges.

HCD updated Section 5.504.5.3 in regard to the use of MERV filters in mechanically ventilated buildings. This update changed the filter use from MERV 8 to MERV 13. MERV 13 filters are to be installed prior to occupancy, and recommendations for maintenance with filters of the same value shall be included in the operation and maintenance manual.

The 2022 California Green Building Standards Code became effective on January 1, 2023.[24]

In the 2022 version of the Code, HCD amended Section 5.106.5.3 in regard to increasing the EV capable space percentages and adding a new requirement for installed Level 2 DCFC chargers.

HCD under Section 5.106.5.4 added new regulation for electric vehicle charging readiness requirements for new construction of warehouse, grocery stores, and retail stores with planned off-street loading spaces. [25]

However, as this project does not propose any buildings, building efficiency regulations would not be applicable

Executive Order B-30-15

On April 29, 2015, Governor Brown issued Executive Order B-30-15. Therein, the Governor directed the following:

- Established a new interim statewide reduction target to reduce GHG emissions to 40 percent below 1990 levels by 2030.
- Ordered all state agencies with jurisdiction over sources of GHG emissions to implement measures to achieve reductions of GHG emissions to meet the 2030 and 2050 reduction targets.
- Directed CARB to update the Climate Change Scoping Plan to express the 2030 target in terms of million metric tons of carbon dioxide equivalent.

Executive Order B-29-15

Executive Order B-29-15, mandates a statewide 25 percent reduction in potable water usage. EO B-29-15 signed into law on April 1, 2015.

Executive Order B-37-16

Executive Order B-37-16, continuing the State's adopted water reductions, was signed into law on May 9, 2016. The water reductions build off the mandatory 25 percent reduction called for in EO B-29-15.

Executive Order N-79-20

Executive Order N-79-20 Signed in September 2020, Executive Order N-79-20 establishes as a goal that where feasible, all new passenger cars and trucks, as well as all drayage/cargo trucks and off-road vehicles and equipment, sold in California, will be zero-emission by 2035. The executive order sets a similar goal requiring that all medium and heavy-duty vehicles will be zero-emission by 2045 where feasible. It also directs CARB to develop and propose rulemaking for passenger vehicles and trucks, medium-and heavy-duty fleets where feasible, drayage trucks, and off-road vehicles and equipment "requiring increasing volumes" of new zero emission vehicles (ZEVs) "towards the target of 100 percent." The executive order directs the California

[24] California Building Standards Commission (CBSC). 2022. California Green Building Standards. Website: https://codes.iccsafe.org/content/CAGBC2022P1.

[25] https://www.dgs.ca.gov/BSC/Resources/2022-Title-24-California-Code-Changes

Environmental Protection Agency, the California Geologic Energy Management Division (CalGEM), and the California Natural Resources Agency to transition and repurpose oil production facilities with a goal toward meeting carbon neutrality by 2045. Executive Order N-79-20 builds upon the CARB Advanced Clean Trucks regulation, which was adopted by CARB in July 2020.

SBX1 2

Signed into law in April 2011, SBX1 2, requires one-third of the State's electricity to come from renewable sources. The legislation increases California's current 20 percent renewables portfolio standard target in 2010 to a 33 percent renewables portfolio standard by December 31, 2020.

Senate Bill 350

Signed into law October 7, 2015, SB 350 increases California's renewable electricity procurement goal from 33 percent by 2020 to 50 percent by 2030. This will increase the use of Renewables Portfolio Standard (RPS) eligible resources, including solar, wind, biomass, geothermal, and others. In addition, SB 350 requires the state to double statewide energy efficiency savings in electricity and natural gas end uses by 2030. To help ensure these goals are met and the greenhouse gas emission reductions are realized, large utilities will be required to develop and submit Integrated Resource Plans (IRPs). These IRPs will detail how each entity will meet their customers resource needs, reduce greenhouse gas emissions and ramp up the deployment of clean energy resources.

Governor Newsom's September 2022 Climate Legislation

On September 16, 2022, California enacted some of the nation's most aggressive climate measures in history as Governor Gavin Newsom signed a sweeping package of legislation to cut pollution, protect Californians from big polluters, and accelerate the state's transition to clean energy. The Governor partnered with legislative leaders to advance groundbreaking measures to achieve carbon neutrality no later than 2045 and 90 percent clean energy by 2035, establish new setback measures protecting communities from oil drilling, capture carbon pollution from the air, advance nature-based solutions, and more.

Over the next two decades, the California Climate Commitment will:

- Create 4 million new jobs
- Cut air pollution by 60 percent
- Reduce state oil consumption by 91 percent
- Save California $23 billion by avoiding the damages of pollution
- Reduce fossil fuel use in buildings and transportation by 92 percent
- Cut refinery pollution by 94 percent[26]

The following describes a few of the many bills signed in through the Governor's climate package.

Assembly Bill 1279

Establishes a clear, legally binding, and achievable goal for California to achieve statewide carbon neutrality as soon as possible, and no later than 2045, and establishes an 85% emissions reduction target as part of that goal.

[26] https://www.gov.ca.gov/2022/09/16/governor-newsom-signs-sweeping-climate-measures-ushering-in-new-era-of-world-leading-climate-action/

Senate Bill 1137

Establishes a setback distance of 3,200 feet between any new oil well and homes, schools, parks or businesses open to the public. Ensures comprehensive pollution controls for existing oil wells within 3,200 feet of these facilities.

Senate Bill 1020

Creates clean electricity targets of 90 percent by 2035 and 95 percent by 2040 with the intent of advancing the state's trajectory to the existing 100 percent clean electricity retail sales by 2045 goal.

Senate Bill 905

Establishes a clear regulatory framework for carbon removal and carbon capture, utilization and sequestration. Bans the practice of injecting carbon dioxide for the purpose of enhanced oil recovery.

Assembly Bill 1757

Requires the state to develop an achievable carbon removal target for natural and working lands.

Energy Sector and CEQA Guidelines Appendix F

The CEC first adopted Energy Efficiency Standards for Residential and Nonresidential Buildings (CCR, Title 24, Part 6) in 1978 in response to a legislative mandate to reduce energy consumption in the state. Although not originally intended to reduce GHG emissions, increased energy efficiency and reduced consumption of electricity, natural gas, and other fuels would result in fewer GHG emissions from residential and nonresidential buildings subject to the standard. The standards are updated periodically (typically every three years) to allow for the consideration and inclusion of new energy efficiency technologies and methods. The 2016 update to the Energy Efficiency Standards for Residential and Nonresidential Buildings focuses on several key areas to improve the energy efficiency of renovations and addition to existing buildings as well as newly constructed buildings and renovations and additions to existing buildings. The major efficiency improvements to the residential Standards involve improvements for attics, walls, water heating, and lighting, whereas the major efficiency improvements to the nonresidential Standards include alignment with the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 90.1-2013 national standards. Furthermore, the 2016 update required that enforcement agencies determine compliance with CCR, Title 24, Part 6 before issuing building permits for any construction.[27]

Part 11 of the Title 24 Building Energy Efficiency Standards is referred to as the California Green Building Standards (CALGreen) Code. The purpose of the CALGreen Code is to "improve public health, safety and general welfare by enhancing the design and construction of buildings through the use of building concepts having a reduced negative impact or positive environmental impact and encouraging sustainable construction practices in the following categories: (1) Planning and design; (2) Energy efficiency; (3) Water efficiency and conservation; (4) Material conservation and resource efficiency; and (5) Environmental air quality."[28] As of January 1, 2011, the CALGreen Code is mandatory for all new buildings constructed in the state. The CALGreen Code establishes mandatory measures for new residential and non-residential buildings. Such mandatory measures include energy efficiency, water conservation, material conservation, planning and design, and overall environmental quality. The CALGreen Code was most recently updated in 2022 to include new mandatory measures for residential and nonresidential uses; the new measures took effect on January 1, 2023.

[27] California Energy Commission, 2016 Building Energy Efficiency Standards, June 2015, http://www.energy.ca.gov/2015publications/CEC-400-2015-037/CEC-400-2015-037-CMF.pdf

[28] California Building Standards Commission, 2010 California Green Building Standards Code, (2010).

Regional – San Joaquin Valley Air Pollution Control District

The project is within the San Joaquin Valley Air Basin, which is under the jurisdiction of SJVAPCD. The SJVAPCD has *adopted the Guidance for Valley Land-use Agencies in Addressing GHG Emission Impacts for New Projects under CEQA* (December 17, 2009), the *District Policy – Addressing GHG Emission Impacts for Stationary Source Projects Under CEQA When Serving as the Lead Agency* (December 17, 2009), and the *Final Staff Report Addressing Greenhouse Gas Emissions Impacts Under the California Environmental Quality Act* (December 17, 2009).[29]

Per these guidelines, the SJVAPCD has determined the process for evaluating GHG significance is as follows:

- Projects determined to be exempt from the requirements of CEQA would be determined to have a less than significant individual and cumulative impact for GHG emissions and would not require further environmental review, including analysis of project specific GHG emissions. Projects exempt under CEQA would be evaluated consistent with established rules and regulations governing project approval and would not be required to implement BPS.

- Projects complying with an approved GHG emission reduction plan or GHG mitigation program which avoids or substantially reduces GHG emissions within the geographic area in which the project is located would be determined to have a less than significant individual and cumulative impact for GHG emissions. Such plans or programs must be specified in law or approved by the lead agency with jurisdiction over the affected resource and supported by a CEQA compliant environmental review document adopted by the Final Staff Report -Climate Change Action Plan: Addressing GHG Emissions Impacts under CEQA SJVAPCD December 17, 2009, 66 lead agency. Projects complying with an approved GHG emission reduction plan or GHG mitigation program would not be required to implement BPS.

- Projects implementing Best Performance Standards would not require quantification of project specific GHG emissions. Consistent with CEQA Guideline, such projects would be determined to have a less than significant individual and cumulative impact for GHG emissions.

- Projects not implementing Best Performance Standards would require quantification of project specific GHG emissions and demonstration that project specific GHG emissions would be reduced or mitigated by at least 29%, compared to BAU, including GHG emission reductions achieved since the 2002-2004 baseline period. Projects achieving at least a 29% GHG emission reduction compared to BAU, consistent with GHG emission reduction targets established in ARB's AB 32 Scoping Plan, would be determined to have a less than significant individual and cumulative impact for GHG.

- Projects requiring preparation of an Environmental Impact Report would require quantification of project specific GHG emissions. Projects implementing BPS or achieving at least a 29 percent GHG emission reduction compared to BAU would be determined to have a less than significant individual and cumulative impact for GHG.

Local – City of Modesto

The City of Modesto does not currently have a Climate Action Plan (CAP).

[29] https://ww2.valleyair.org/permitting/climate-change-action-plan/

SIGNIFICANCE THRESHOLDS

Appendix G of State CEQA Guidelines

The CEQA Guidelines recommend that a lead agency consider the following when assessing the significance of impacts from GHG emissions on the environment:

- The extent to which the project may increase (or reduce) GHG emissions as compared to the existing environmental setting;
- Whether the project emissions exceed a threshold of significance that the lead agency determines applies to the project;
- The extent to which the project complies with regulations or requirements adopted to implement an adopted statewide, regional, or local plan for the reduction or mitigation of GHG emissions.[30]

Thresholds of Significance for this Project

As shown above, the SJVAPCD does not have an adopted threshold of significance for GHG emissions; however, the SJVAPCD has adopted the *Guidance for Valley Land-use Agencies in Addressing GHG Emission Impacts for New Projects under CEQA* (December 17, 2009) and *District Policy – Addressing GHG Emission Impacts for Stationary Source Projects Under CEQA When Serving as the Lead Agency* (December 17, 2009). As stated in these guidance documents, projects complying with an approved GHG emissions reduction plan or GHG mitigation program which avoids or substantially reduces GHG emissions within the geographic area in which the project is located would be determined to have a less than significant individual and cumulative impact for GHG emissions.

METHODOLOGY

The proposed project is that of the installation of approximately 12,000 linear feet of 12-inch diameter pipe. Therefore, the proposed project has the potential to generate GHG emissions from mobile sources and construction equipment. However, it should be noted that mobile sources were not included in the analysis as additional staffing needs for long-term operation and maintenance of the proposed project are not anticipated and only a minimal number of daily worker trips will be needed for routine inspections and maintenance. Therefore, additional vehicle trips and emissions associated with the operation of the proposed project would be negligible.

CalEEMod Version 2022.1.1.28 was used to calculate the GHG emissions from the construction of the proposed project. The construction-related GHG emissions were included in the analysis and were based on a 30-year amortization rate. The construction related GHG emissions were calculated by CalEEMod and in the manner detailed above in Section 2. The CalEEMod Output is available in Appendix B.

PROJECT GREENHOUSE GAS EMISSIONS

The GHG emissions have been calculated based on the parameters described above. A summary of the results is shown below in Table 9 and the CalEEMod Model run for the proposed project is provided in Appendix B. Table 9 shows that the greenhouse emissions for the proposed project (without credit for any reductions from sustainable design, and/or regulatory requirements) would be 23.1 $MTCO_2e$ (amortized over 30-years) for project construction.

[30] The Governor's Office of Planning and Research recommendations include a requirement that such a plan must be adopted through a public review process and include specific requirements that reduce or mitigate the project's incremental contribution of GHG emissions. If there is substantial evidence that the possible effects of a particular project are still cumulatively considerable, notwithstanding compliance with the adopted regulations or requirements, an EIR must be prepared for the project.

Table 9
Project-Related Greenhouse Gas Emissions

Category	Greenhouse Gas Emissions (Metric Tons/Year)					
	Bio-CO2	NonBio-CO_2	CO_2	CH_4	N_2O	CO_2e
Construction[1,2]	0.00	23.00	23.00	0.00	0.00	23.10
Total Emissions	0.00	23.00	23.00	0.00	0.00	23.10

Notes:

Source: CalEEMod Version 2022.1.1.28 for Opening Year 2025.

(1) Construction GHG emissions CO2e based on a 30-year amortization rate.

Consistency With Applicable Greenhouse Gas Reduction Plans and Policies

The proposed project could have the potential to conflict with any applicable plan, policy or regulation of an agency adopted for the purpose of reducing the emissions of greenhouse gases. The City of Modesto does not currently have a Climate Action Plan (CAP); therefore, the project and its GHG emissions have been compared to the goals of the CARB Scoping Plan.

Scoping Plan

Emission reductions in California alone would not be able to stabilize the concentration of greenhouse gases in the earth's atmosphere. However, California's actions set an example and drive progress towards a reduction in greenhouse gases elsewhere. If other states and countries were to follow California's emission reduction targets, this could avoid medium or higher ranges of global temperature increases. Thus, severe consequences of climate change could also be avoided.

The CARB Board approved a Climate Change Scoping Plan in December 2008. The Scoping Plan outlines the State's strategy to achieve the 2020 greenhouse gas emissions limit. The Scoping Plan "proposes a comprehensive set of actions designed to reduce overall greenhouse gas emissions in California, improve our environment, reduce our dependence on oil, diversify our energy sources, save energy, create new jobs, and enhance public health" (California Air Resources Board 2008). The measures in the Scoping Plan have been in place since 2012.

This Scoping Plan calls for an "ambitious but achievable" reduction in California's greenhouse gas emissions, cutting approximately 30 percent from business-as-usual emission levels projected for 2020, or about 10 percent from today's levels. On a per-capita basis, that means reducing annual emissions of 14 tons of carbon dioxide for every man, woman and child in California down to about 10 tons per person by 2020.

In May 2014, CARB released its *First Update to the Climate Change Scoping Plan* (CARB 2014). This *Update* identifies the next steps for California's leadership on climate change. While California continues on its path to meet the near-term 2020 greenhouse gas limit, it must also set a clear path toward long-term, deep GHG emission reductions. CARB's First Update "lays the foundation for establishing a broad framework for continued emission reductions beyond 2020, on the path to 80 percent below 1990 levels by 2050," and many of the emission reduction strategies recommended by CARB would serve to reduce the Project's post-2020 emissions level to the extent required by applicable by law.

In November 2017, CARB release the 2017 Scoping Plan. This Scoping Plan incorporates, coordinates, and leverages many existing and ongoing efforts and identifies new policies and actions to accomplish the State's climate goals, and includes a description of a suite of specific actions to meet the State's 2030 GHG limit. In addition, Chapter 4 of the Scoping Plan provides a broader description of the many actions and proposals being explored across the sectors, including the natural resources sector, to achieve the State's mid and long-term climate goals.

Guided by legislative direction, the actions identified in the 2017 Scoping Plan reduce overall GHG emissions in California and deliver policy signals that will continue to drive investment and certainty in a low carbon economy. The 2017 Scoping Plan builds upon the successful framework established by the Initial Scoping Plan and First Update, while identifying new, technologically feasible, and cost-effective strategies to ensure that California meets its GHG reduction targets in a way that promotes and rewards innovation, continues to foster economic growth, and delivers improvements to the environment and public health, including in disadvantaged communities. The Plan includes policies to require direct GHG reductions at some of the State's largest stationary sources and mobile sources. These policies include the use of lower GHG fuels, efficiency regulations, and the Cap-and Trade Program, which constrains and reduces emissions at covered sources.

Independent studies confirm CARB's determination that the state's existing and proposed regulatory framework will put the state on a pathway to reduce its GHG emissions level to 40 percent below 1990 levels

by 2030, and to 80 percent below 1990 levels by 2050 if additional appropriate reduction measures are adopted.[31] Even though these studies did not provide an exact regulatory and technological roadmap to achieve the 2030 and 2050 goals, they demonstrated that various combinations of policies could allow the statewide emissions level to remain very low through 2050, suggesting that the combination of new technologies and other regulations not analyzed in the studies would allow the state to meet the 2050 target.

In November of 2022, the CARB released the 2022 Scoping Plan. The 2022 Scoping Plan lays out a path to achieve targets for carbon neutrality and reduce anthropogenic GHG emissions by 85 percent below 1990 levels no later than 2045, as directed by Assembly Bill 1279. The actions and outcomes in the plan will achieve significant reductions in fossil fuel combustion by deploying clean technologies and fuels, further reductions in short-lived climate pollutants, support for sustainable development, increased action on natural and working lands to reduce emissions and sequester carbon, and the capture and storage of carbon. As the latest, 2022 Scoping Plan builds upon previous versions, project consistency with applicable strategies of the 2008, 2017, and 2022 Plan are assessed in Table 10. As shown in Table 10, the project is consistent with the applicable strategies within the Scoping Plan.

Furthermore, at a level of 23.1 $MTCO_2e$ per year, the project's GHG emissions would be in compliance with the reduction goals of the CARB Scoping Plan, AB-32 and SB-32. Furthermore, the project will comply with applicable Green Building Standards and City of Modesto's policies regarding sustainability (as dictated by the City's General Plan). Impacts are considered to be less than significant.

[31] Energy and Environmental Economics (E3). "Summary of the California State Agencies' PATHWAYS Project: Long-term Greenhouse Gas Reduction Scenarios" (April 2015); Greenblatt, Jeffrey, Energy Policy, "Modeling California Impacts on Greenhouse Gas Emissions" (Vol. 78, pp. 158–172). The California Air Resources Board, California Energy Commission, California Public Utilities Commission, and the California Independent System Operator engaged E3 to evaluate the feasibility and cost of a range of potential 2030 targets along the way to the state's goal of reducing GHG emissions to 80 percent below 1990 levels by 2050. With input from the agencies, E3 developed scenarios that explore the potential pace at which emission reductions can be achieved, as well as the mix of technologies and practices deployed. E3 conducted the analysis using its California PATHWAYS model. Enhanced specifically for this study, the model encompasses the entire California economy with detailed representations of the buildings, industry, transportation and electricity sectors. https://www.ethree.com/wp-content/uploads/2017/02/E3_Project_Overview_20150406.pdf

Table 10 (1 of 2)
Project Consistency with CARB Scoping Plan Policies and Meaures

2008 Scoping Plan Measures to Reduce Greenhouse Gas Emissions	Project Compliance with Measure
California Light-Duty Vehicle Greenhouse Gas Standards – Implement adopted standards and planned second phase of the program. Align zero-emission vehicle, alternative and renewable fuel and vehicle technology programs with long-term climate change goals.	No Conflict. These are CARB enforced standards; vehicles that access the project (that are required to comply with the standards) will comply with the strategy.
Energy Efficiency – Maximize energy efficiency building and appliance standards; pursue additional efficiency including new technologies, policy, and implementation mechanisms. Pursue comparable investment in energy efficiency from all retail providers of electricity in California.	No Conflict. The project will be compliant with any applicable portions of the current Title 24 standards.
Low Carbon Fuel Standard – Develop and adopt the Low Carbon Fuel Standard.	No Conflict. These are CARB enforced standards; vehicles that access the project (that are required to comply with the standards) will comply with the strategy.
Vehicle Efficiency Measures – Implement light-duty vehicle efficiency measures.	No Conflict. These are CARB enforced standards; vehicles that access the project (that are required to comply with the standards) will comply with the strategy.
Medium/Heavy-Duty Vehicles – Adopt medium and heavy-duty vehicle efficiency measures.	No Conflict. These are CARB enforced standards; vehicles that access the project (that are required to comply with the standards) will comply with the strategy.
Green Building Strategy – Expand the use of green building practices to reduce the carbon footprint of California's new and existing inventory of buildings.	No Conflict. The California Green Building Standards Code (proposed Part 11, Title 24) was adopted as part of the California Building Standards Code in the CCR. Part 11 establishes voluntary standards, that are mandatory in the 2019 edition of the Code, on planning and design for sustainable site development, energy efficiency (in excess of the California Energy Code requirements), water conservation, material conservation, and internal air contaminants. In addition, the 2022 edition of the Code took effect January 1, 2023. The project is the installation of a water pipeline, however, it project will be subject to any applicable portions of these mandatory standards.
High Global Warming Potential Gases – Adopt measures to reduce high global warming potential gases.	No Conflict. CARB identified five measures that reduce HFC emissions from vehicular and commercial refrigeration systems; vehicles that access the project that are required to comply with the measures will comply with the strategy.
Recycling and Waste – Reduce methane emissions at landfills. Increase waste diversion, composting, and commercial recycling. Move toward zero-waste.	No Conflict. The state is currently developing a regulation to reduce methane emissions from municipal solid waste landfills. The project will be required to comply with local programs, such as City and/or County recycling and waste reduction programs, which comply, with the 75 percent reduction required by 2020 per AB 341.
Water – Continue efficiency programs and use cleaner energy sources to move and treat water.	No Conflict. The project is the installation of a new water pipeline and will comply with all applicable City ordinances and CAL Green requirements.

2017 Scoping Plan Recommended Actions to Reduce Greenhouse Gas Emissions	Project Compliance with Recommended Action
Implement Mobile Source Strategy: Further increase GHG stringency on all light-duty vehicles beyond existing Advanced Clean Car regulations.	No Conflict. These are CARB enforced standards; vehicles that access the project (that are required to comply with the standards) will comply with the strategy.
Implement Mobile Source Strategy: At least 1.5 million zero emission and plug-in hybrid light-duty electric vehicles by 2025 and at least 4.2 million zero emission and plug-in hybrid light-duty electric vehicles by 2030.	No Conflict. These are CARB enforced standards; vehicles that access the project (that are required to comply with the standards) will comply with the strategy.

Table 10 (2 of 2)
Project Consistency with CARB Scoping Plan Policies and Meaures

Implement Mobile Source Strategy: Innovative Clean Transit: Transition to a suite of to-be-determined innovative clean transit options. Assumed 20 percent of new urban buses purchased beginning in 2018 will be zero emission buses with the penetration of zero-emission technology ramped up to 100 percent of new sales in 2030. Also, new natural gas buses, starting in 2018, and diesel buses, starting in 2020, meet the optional heavy-duty low-NOX standard.	No Conflict. These are CARB enforced standards; vehicles that access the project (that are required to comply with the standards) will comply with the strategy.
Implement Mobile Source Strategy: Last Mile Delivery: New regulation that would result in the use of low NOX or cleaner engines and the deployment of increasing numbers of zero-emission trucks primarily for class 3-7 last mile delivery trucks in California. This measure assumes ZEVs comprise 2.5 percent of new Class 3–7 truck sales in local fleets starting in 2020, increasing to 10 percent in 2025 and remaining flat through 2030.	No Conflict. These are CARB enforced standards; vehicles that access the project (that are required to comply with the standards) will comply with the strategy.
Implement SB 350 by 2030: Establish annual targets for statewide energy efficiency savings and demand reduction that will achieve a cumulative doubling of statewide energy efficiency savings in electricity and natural gas end uses by 2030.	No Conflict. The project is the installation of a water pipeline. However the project will be compliant with any applicbale portions of the current Title 24 standards.
By 2019, develop regulations and programs to support organic waste landfill reduction goals in the SLCP and SB 1383.	No Conflict. The project will be required to comply with local programs, such as City and/or County recycling and waste reduction programs,which comply, with the 75 percent reduction required by 2020 per AB 341.

2022 Scoping Plan Priority Key Actions and Recommendations	Project Compliance with Recommended Actions
100 percent of light-duty vehicle sales are ZEVs by 2035.	Not Applicable. This action is in regard to vehicle sales, with an aim to have 100 percent of light-duty vehicle sales be ZEVs by 2035. The proposed project would not interfere with such policymaking.
VMT per capita reduced 25 percent below 2019 levels by 2030 and 30 percent below 2019 levels by 2045.	No Conflict. The Project would not result in an unmitigated impact to VMT. Additional staffing needs for long-term operation and maintenance of the proposed project are not anticipated and only a minimal number of daily worker trips are anticipated to conduct routine inspections and ensure proper long-term maintenance. Therefore, the additional vehicle trips from the existing operations associated with the operation of the proposed project would be minimal.
All electric appliances in new construction beginning 2026 (residential) and 2029 (commercial).	Not Applicable. This action is in regard to residential and commercial appliances and the proposed project is a water pipeline installation project and would not interfere with such policymaking.
For existing residential buildings, 80 percent of appliance sales are electric by 2030 and 100 percent of appliance sales are electric by 2035 (appliances replaced at end of life). For existing commercial buildings, 80 percent of appliance sales are electric by 2030 and 100 percent of appliance sales are electric by 2045 (appliances replaced at end of life)	Not Applicable. This action is in regard to appliance sales and the proposed project is a water pipeline installation project and would not interfere with such policymaking.

Notes:

(1) Source: CARB Scoping Plan (2008, 2017, and 2022)

CUMULATIVE GREENHOUSE GAS IMPACTS

Although the project is expected to emit GHGs, the emission of GHGs by a single project into the atmosphere is not itself necessarily an adverse environmental effect. Rather, it is the increased accumulation of GHG from more than one project and many sources in the atmosphere that may result in global climate change. Therefore, in the case of global climate change, the proximity of the project to other GHG emission generating activities is not directly relevant to the determination of a cumulative impact because climate change is a global condition. According to CAPCOA, "GHG impacts are exclusively cumulative impacts; there are no non-cumulative GHG emission impacts from a climate change perspective."[32] The resultant consequences of that climate change can cause adverse environmental effects. A project's GHG emissions typically would be very small in comparison to state or global GHG emissions and, consequently, they would, in isolation, have no significant direct impact on climate change.

The state has mandated a goal of reducing statewide emissions to 1990 levels by 2020, even though statewide population and commerce are predicted to continue to expand. In order to achieve this goal, CARB is in the process of establishing and implementing regulations to reduce statewide GHG emissions. Consistent with CEQA Guidelines Section 15064h(3),[33] the City, as lead agency, has determined that the project's contribution to cumulative GHG emissions and global climate change would be less than significant if the project is consistent with the applicable regulatory plans and policies to reduce GHG emissions.

As discussed in the Consistency With Applicable Greenhouse Gas Reduction Plans and Policies section above, the project is consistent with the CARB Scoping Plan.

Thus, given the project's consistency with the CARB Scoping Plan, the project would not conflict with any applicable plan, policy, or regulation of an agency adopted for the purpose of reducing the emissions of GHGs. Given this consistency, it is concluded that the project's incremental contribution to greenhouse gas emissions and their effects on climate change would not be cumulatively considerable.

[32] Source: California Air Pollution Control Officers Association, CEQA & Climate change: Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act, (2008).

[33] The State CEQA Guidelines were amended in response to SB 97. In particular, the State CEQA Guidelines were amended to specify that compliance with a GHG emissions reduction program renders a cumulative impact insignificant. Per State CEQA Guidelines Section 15064(h)(3), a project's incremental contribution to a cumulative impact can be found not cumulatively considerable if the project will comply with an approved plan or mitigation program that provides specific requirements that will avoid or substantially lessen the cumulative problem within the geographic area of the project. To qualify, such a plan or program must be specified in law or adopted by the public agency with jurisdiction over the affected resources through a public review process to implement, interpret, or make specific the law enforced or administered by the public agency. Examples of such programs include a "water quality control plan, air quality attainment or maintenance plan, integrated waste management plan, habitat conservation plan, natural community conservation plan, [and] plans or regulations for the reduction of greenhouse gas emissions."

4. NEPA ANALYSIS

FEDERAL CLEAN AIR ACT CONFORMITY

Criteria Pollutant Emissions

Section 176(c) of the Federal Clean Air Act prohibits federal participation in any project that is in conflict with the State Implementation Plan (SIP). Participation includes funding, permitting or other non-direct involvement. Based on the General Conformity requirements (40 CFR Section 93.153), if the total direct and indirect emissions from the proposed project are below the Federal Conformity —de minimus" emissions thresholds, the proposed project would be exempt from performing a comprehensive Air Quality Conformity Analysis and would be considered to be in conformity with the SIP and have less than significant impacts.

Table 11 provides the current General Conformity —de minimus" emissions thresholds in tons per year (tpy) for the San Joaquin Valley Air Basin and the estimated short-term emissions from the proposed project. Table 11 shows that project-related construction emissions would be less than the —de minimus thresholds for all pollutants.

In addition, the project is the installation of approximately 12,000 linear feet of 12-inch diameter pipe. To conduct routine inspections and ensure proper long-term maintenance, the long-term operation of the project will require a minimal number of monthly worker trips. Additional staffing needs for long-term operation and maintenance of the proposed project are not anticipated. Therefore, operational emissions associated with the proposed project would be negligible and would not be anticipated to exceed any of the federal de minimus conformity thresholds.

Greenhouse Gas Emissions

Consistent with section 102(2)(C) of National Environmental Policy Act (NEPA), Federal agencies must disclose and consider the reasonably foreseeable effects of their proposed actions including the extent to which a proposed action would result in reasonably foreseeable GHG emissions that contribute to climate change. The Council on Environmental Quality (CEQ) published their *National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions and Climate Change* in January 2023.[34] The CEQ guidance document assists agencies in analyzing greenhouse gas (GHG) and climate change effects under NEPA.

The CEQ guidance document identifies and explains that the following steps should be taken when analyzing a proposed action's climate change effects under NEPA:

(1) Quantify the reasonably foreseeable GHG emissions (including direct and indirect emissions) of a proposed action, the no action alternative, and any reasonable alternatives.
(2) Disclose and provide context for the GHG emissions and climate impacts associated with a proposed action and alternatives, including by, as relevant, monetizing climate damages using estimates of the SC-GHG, placing emissions in the context of relevant climate action goals and commitments, and providing common equivalents
(3) Analyze reasonable alternatives, including those that would reduce GHG emissions relative to baseline conditions, and identify available mitigation measures to avoid, minimize, or compensate for climate effects.

Although the guidance document sets forth the forementioned steps to analyze a project's greenhouse gas emissions under NEPA, it does not, however, provide a numerical threshold. Code of Federal Regulations Title 40, Chapter 1, Subchapter C, Part 98 includes mandatory greenhouse gas reporting requirements, which

[34] https://www.federalregister.gov/documents/2023/01/09/2023-00158/national-environmental-policy-act-guidance-on-consideration-of-greenhouse-gas-emissions-and-climate

includes a greenhouse gas threshold of 25,000 $MTCO_2e$ per year to assess impacts. Therefore, a threshold of 25,000 $MTCO_2e$ per year was utilized to assess the impacts of the greenhouse gas emissions in relation to NEPA.

Table 12 shows that the total for the proposed project's emissions (without credit for any reductions from sustainable design and/or regulatory requirements) would be 23.1 $MTCO_2e$ per year. Therefore, as shown in Table 12, the proposed project's greenhouse gas emissions do not exceed the threshold of 25,000 $MTCO_2e$ per year.

Based on the federal conformity analysis, the project does not exceed the annual de minimus conformity thresholds and is therefore in conformance with the Clean Air Act.

Table 11
Federal Conformity Analysis and De Minimus Thresholds

Activity	Pollutant Emissions (tons/year)					
	ROG	NOx	CO	SO_2	PM10	PM2.5
De Minimus Threshold[1]	10	100	100	100	100	70
Construction Emissions[2]	0.31	2.79	3.15	0.02	0.34	0.20
Exceeds Thresholds?	No	No	No	No	No	No

Notes:

Source: CalEEMod Version 2022.1.1.28.

(1) Federal General Conformity thresholds obtained from 40 CFR 93.153

(2) Includes both on-site and off-site emissions. On-site PM2.5 and PM-10 emissions show compliance with SJVAPCD Regulation VIII for fugitive dust.

Table 12
Greenhouse Gas Emissions Comparison to Federal Conformity Thresholds

Category	Greenhouse Gas Emissions (Metric Tons/Year)					
	Bio-CO2	NonBio-CO_2	CO_2	CH_4	N_2O	CO_2e
Construction[1,2]	0.00	23.00	23.00	0.00	0.00	23.10
Total Emissions	**0.00**	**23.00**	**23.00**	**0.00**	**0.00**	**23.10**
NEPA GHG Emissions Screening Threshold						25,000
Exceeds Threshold?						No

Notes:

Source: CalEEMod Version 2022.1.1.28.

(1) Construction GHG emissions CO2e based on a 30 year amortization rate.

(2) The proposed project is the installation of a new water pipeline. Therefore, operation of the proposed project includes only a minimal number of monthly worker trips in order to conduct routine inspections and ensure proper long-term maintenance. As operational emissions are anticipated to be negligble and only from monthly maintenance vehilce trips, only construction related GHG emissions have been included in this analysis.

5. ENERGY ANALYSIS

EXISTING CONDITIONS

This section provides an overview of the existing energy conditions in the project area and region.

Overview

California's estimated annual energy use as of 2022 included:

- Approximately 287,220 gigawatt hours of electricity;[35]
- Approximately 2,056,267 million cubic feet of natural gas per year;[36] and
- Approximately 23.2 billion gallons of transportation fuel (for the year 2015).[37]

As of 2021, the year of most recent data currently available by the United States Energy Information Administration (EIA), energy use in California by demand sector was:

- Approximately 41.2 percent transportation;
- Approximately 23.6 percent industrial;
- Approximately 18.2 percent residential; and
- Approximately 17.1 percent commercial.[38]

California's electricity in-state generation system generates approximately 203,257 gigawatt-hours each year. In 2022, California produced approximately 71 percent of the electricity it uses; the rest was imported from the Pacific Northwest (approximately 12 percent) and the U.S. Southwest (approximately 17 percent). Natural gas is the main source for electricity generation at approximately 47.46 percent of the total in-state electric generation system power as shown in Table 13.

A summary of and context for energy consumption and energy demands within the State is presented in "U.S. Energy Information Administration, California State Profile and Energy Estimates, Quick Facts" excerpted below:

- In 2022, California was the seventh-largest producer of crude oil among the 50 states, and, as of January 2022, the state ranked third in crude oil refining capacity.
- California is the largest consumer of jet fuel and second-largest consumer of motor gasoline among the 50 states.
- In 2020, California was the second-largest total energy consumer among the states, but its per capita energy consumption was less than in all but three other states.
- In 2022, renewable resources, including hydroelectric power and small-scale, customer-sited solar power, accounted for 49% of California's in-state electricity generation. Natural gas fueled another 42%. Nuclear power supplied almost all the rest.

[35] California Energy Commission. Energy Almanac. Total Electric Generation. [Online] 2022. https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/2022-total-system-electric-generation.

[36] Natural Gas Consumption by End Use. U.S. Energy Information Administration. [Online] 2022. https://www.eia.gov/dnav/ng/ng_cons_sum_dcu_SCA_a.htm.

[37] California Energy Commission. Revised Transportation Energy Demand Forecast 2018-2030. [Online] 2021. https://www.energy.ca.gov/data-reports/planning-and-forecasting

[38] U.S. Energy Information Administration. California Energy Consumption by End-Use Sector, 2021. California State Profile Overview.[Online] 2023 https://www.eia.gov/state/?sid=CA#tabs-2

- In 2022, California was the fourth-largest electricity producer in the nation. The state was also the nation's third-largest electricity consumer, and additional needed electricity supplies came from out-of-state generators.[39]

As indicated above, California is one of the nation's leading energy-producing states, and California per capita energy use is among the nation's most efficient. Given the nature of the proposed project, the remainder of this discussion will focus on the three sources of energy that are most relevant to the project—namely, electricity and natural gas for building uses, and transportation fuel for vehicle trips associated with the proposed project.

Electricity

Electricity would be provided to the project by Modesto Irrigation District (MID). MID provides electric and irrigation and treats surface water for drinking. The MID electric service area includes the greater Modesto area (north of the Tuolumne River, Waterford, Salida, Mountain House (Northwest of Tracy) and parts of Ripon, Escalon, Oakdale and Riverbank. MID is an independent, publicly owned utility.[40]

Table 14 identifies MID's specific proportional shares of electricity sources in 2022. As shown in Table 14, the 2022 MID Power Mix has renewable energy at 30.1 percent of the overall energy resources, of which solar energy is at 13.9 percent, eligible hydroelectric is at 0.2 percent, and wind is at 16 percent; other energy sources include large hydroelectric at 17.8 percent, natural gas at 13.6 percent, nuclear at 1.8 percent other at 0.1 percent, and unspecified sources at 36.6 percent.

Natural Gas

Natural gas would be provided to the project by Pacific Gas and Electric (PGE). The following summary of natural gas resources and service providers, delivery systems, and associated regulation is excerpted from information provided by the California Public Utilities Commission (CPUC).

The CPUC regulates natural gas utility service for approximately 11 million customers that receive natural gas from Pacific Gas and Electric (PG&E), Southern California Gas (SoCalGas), San Diego Gas & Electric (SDG&E), Southwest Gas, and several smaller investor-owned natural gas utilities. The CPUC also regulates independent storage operators Lodi Gas Storage, Wild Goose Storage, Central Valley Storage and Gill Ranch Storage.

The vast majority of California's natural gas customers are residential and small commercial customers, referred to as "core" customers. Larger volume gas customers, like electric generators and industrial customers, are called "noncore" customers. Although very small in number relative to core customers, noncore customers consume about 65% of the natural gas delivered by the state's natural gas utilities, while core customers consume about 35%.

The PUC regulates the California utilities' natural gas rates and natural gas services, including in-state transportation over the utilities' transmission and distribution pipeline systems, storage, procurement, metering and billing.

Most of the natural gas used in California comes from out-of-state natural gas basins. In 2017, for example, California utility customers received 38% of their natural gas supply from basins located in the U.S. Southwest, 27% from Canada, 27% from the U.S. Rocky Mountain area, and 8% from production located in California."[41]

Transportation Energy Resources

[39] State Profile Overview. [Online] [Cited: April 20, 2023.] https://www.eia.gov/state/?sid=CA#tabs-2

[40] https://www.mid.org/about/default.html

[41] California Public Utilities Commission. Natural Gas and California. http://www.cpuc.ca.gov/natural_gas/

The project would attract additional vehicle trips with resulting consumption of energy resources, predominantly gasoline and diesel fuel. Gasoline (and other vehicle fuels) are commercially provided commodities and would be available to the project patrons and employees via commercial outlets.

The most recent data available shows the transportation sector emits 38 percent of the total greenhouse gases in the state and about 84 percent of smog-forming oxides of nitrogen (NOx).[42,43] About 27 percent of total United States energy consumption in 2022 was for transporting people and goods from one place to another. In 2022, petroleum comprised about 90 percent of all transportation energy use.[44] In 2022, about 135.06 billion gallons (or about 3.22 billion barrels) of finished motor gasoline were consumed in the United States, an average of about 370 million gallons (or about 8.81 million barrels) per day.[45]

REGULATORY BACKGROUND

Federal and state agencies regulate energy use and consumption through various means and programs. On the federal level, the United States Department of Transportation, the United States Department of Energy, and the United States Environmental Protection Agency are three federal agencies with substantial influence over energy policies and programs. On the state level, the PUC and the California Energy Commissions (CEC) are two agencies with authority over different aspects of energy. Relevant federal and state energy-related laws and plans are summarized below.

Federal Regulations

Corporate Average Fuel Economy (CAFE) Standards

First established by the U.S. Congress in 1975, the Corporate Average Fuel Economy (CAFE) standards reduce energy consumption by increasing the fuel economy of cars and light trucks. The National Highway Traffic Safety Administration (NHTSA) and U.S. Environmental Protection Agency (USEPA) jointly administer the CAFE standards. The U.S. Congress has specified that CAFE standards must be set at the "maximum feasible level" with consideration given for: (1) technological feasibility; (2) economic practicality; (3) effect of other standards on fuel economy; and (4) need for the nation to conserve energy.[46]

Issued by NHTSA and EPA in March 2020 (published on April 30, 2020 and effective after June 29, 2020), the Safer Affordable Fuel-Efficient Vehicles Rule would maintain the CAFE and CO2 standards applicable in model year 2020 for model years 2021 through 2026. The estimated CAFE and CO2 standards for model year 2020 are 43.7 mpg and 204 grams of CO2 per mile for passenger cars and 31.3 mpg and 284 grams of CO2 per mile for light trucks, projecting an overall industry average of 37 mpg, as compared to 46.7 mpg under the standards issued in 2012.[47]

On May 12, 2021, the National Highway Traffic Safety Administration (NHTSA) published a notice of proposed rulemaking in the Federal Register, proposing to repeal "The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule Part One: One National Program," published Sept. 27, 2019 (SAFE I Rule), in which NHTSA codified regulatory text and made additional pronouncements regarding the preemption of state and local laws related to fuel economy standards. Specifically, this document proposed to fully repeal the regulatory

[42] CARB. California Greenhouse Gas Emissions Inventory – 2022 Edition. https://ww2.arb.ca.gov/ghg-inventory-data

[43] CARB. 2016 SIP Emission Projection Data. https://www.arb.ca.gov/app/emsinv/2017/emseic1_query.php?F_DIV=-4&F_YR=2012&F_SEASON=A&SP=SIP105ADJ&F_AREA=CA

[44] US Energy Information Administration. Use of Energy in the United States Explained: Energy Use for Transportation. https://www.eia.gov/energyexplained/?page=us_energy_transportation

[45] https://www.eia.gov/tools/faqs/faq.php?id=23&t=10

[46] https://www.nhtsa.gov/lawsregulations/corporate-average-fuel-economy.

[47] National Highway Traffic Safety Administration (NHTSA) and U.S. Environmental Protection Agency (USEPA), 2018. Federal Register / Vol. 83, No. 165 / Friday, August 24, 2018 / Proposed Rules, The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021–2026 Passenger Cars and Light Trucks 2018. Available at: https://www.epa.gov/regulations-emissions-vehicles-and-engines/safer-affordable-fuel-efficient-safe-vehicles-final-rule.

text and appendices promulgated in the SAFE I Rule. In addition, this document proposed to repeal and withdraw the interpretative statements made by the Agency in the SAFE I Rule preamble, including those regarding the preemption of particular state Greenhouse Gas (GHG) Emissions standards or Zero Emissions Vehicle (ZEV) mandates. As such, this document proposed to establish a clean slate with respect to NHTSA's regulations and interpretations concerning preemption under the Energy Policy and Conservation Act (EPCA). This action is effective as of January 28, 2022. [48]

Intermodal Surface transportation Efficiency Act of 1991 (ISTEA)

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) promoted the development of inter-modal transportation systems to maximize mobility as well as address national and local interests in air quality and energy. ISTEA contained factors that Metropolitan Planning Organizations (MPOs) were to address in developing transportation plans and programs, including some energy-related factors. To meet the new ISTEA requirements, MPOs adopted explicit policies defining the social, economic, energy, and environmental values guiding transportation decisions.

The Transportation Equity Act of the 21st Century (TEA-21)

The Transportation Equity Act for the 21st Century (TEA-21) was signed into law in 1998 and builds upon the initiatives established in the ISTEA legislation, discussed above. TEA-21 authorizes highway, highway safety, transit, and other efficient surface transportation programs. TEA-21 continues the program structure established for highways and transit under ISTEA, such as flexibility in the use of funds, emphasis on measures to improve the environment, and focus on a strong planning process as the foundation of good transportation decisions. TEA-21 also provides for investment in research and its application to maximize the performance of the transportation system through, for example, deployment of Intelligent Transportation Systems, to help improve operations and management of transportation systems and vehicle safety.

State Regulations

Integrated Energy Policy Report (IEPR)

Senate Bill 1389 requires the California Energy Commission (CEC) to prepare a biennial integrated energy policy report that assesses major energy trends and issues facing the State's electricity, natural gas, and transportation fuel sectors and provides policy recommendations to conserve resources; protect the environment; ensure reliable, secure, and diverse energy supplies; enhance the state's economy; and protect public health and safety. The Energy Commission prepares these assessments and associated policy recommendations every two years, with updates in alternate years, as part of the Integrated Energy Policy Report.

The 2022 Integrated Energy Policy Report (2022 IEPR) was adopted in February 28, 2023. The 2022 IEPR provides updates on a variety of energy issues facing California. These issues will require action if the state is to meet its climate, energy, air quality, and other environmental goals while maintaining reliability and controlling costs. The 2022 IEPR also discusses the California Energy Commission's equity and environmental justice efforts, its development of a more easily navigable online data platform via the California Energy Planning Library, and an update to the California Energy Demand Forecast. The report also provides information on emerging topics related to energy reliability, western electricity integration, hydrogen, gasoline prices, gas transition, and distributed energy resources.[49]

The 2023 Integrated Energy Policy Report (2023 IEPR) was completed in January 2024. The 2023 IEPR discusses speeding connection of clean resources to the electricity grid, the potential use of clean and

[48] https://www.federalregister.gov/documents/2021/05/12/2021-08758/corporate-average-fuel-economy-cafe-preemption

[49] California Energy Commission. Final 2022 Integrated Energy Policy Report. February 2023. https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2022-integrated-energy-policy-report-update

renewable hydrogen, and the California Energy Demand Forecast to 2040. The report also provides updates on topics such as gas decarbonization, energy efficiency, the Clean Transportation Program, Assembly Bill 1257 (Bocanegra, Chapter 749, Statutes of 2013), and publicly owned utilities' progress toward peak demand reserves and margins.[50]

State of California Energy Plan

The CEC is responsible for preparing the State Energy Plan, which identifies emerging trends related to energy supply, demand, conservation, public health and safety, and the maintenance of a healthy economy. The Plan calls for the state to assist in the transformation of the transportation system to improve air quality, reduce congestion, and increase the efficient use of fuel supplies with the least environmental and energy costs. To further this policy, the plan identifies a number of strategies, including assistance to public agencies and fleet operators and encouragement of urban designs that reduce vehicle miles traveled and accommodate pedestrian and bicycle access.

California Building Standards Code (Title 24)

The California Building Standards Code Title 24 was previously discussed in Section 3 of this report.

California Building Energy Efficiency Standards (Title 24, Part 6)

The California Building Energy Efficiency Standards for Residential and Nonresidential Buildings (California Code of Regulations, Title 24, Part 6) were adopted to ensure that building construction and system design and installation achieve energy efficiency and preserve outdoor and indoor environmental quality. The 2019 Title 24 standards include efficiency improvements to the lighting and efficiency improvements to the non-residential standards include alignment with the American Society of Heating and Air-Conditioning Engineers. For example, window operation is no longer a method allowed to meet ventilation requirements, continuous operation of central forced air system handlers used in central fan integrated ventilation system is not a permissible method of providing the dwelling unit ventilation airflow, and central ventilation systems that serve multiple dwelling units must be balanced to provide ventilation airflow to each dwelling unit. In addition, requirements for kitchen range hoods were also provided in the updated Section 120.1. Ventilation and Indoor Air Quality included both additions and revisions in the 2019 Code. This section now requires nonresidential and hotel/motel buildings to have air filtration systems that use forced air ducts to supply air to occupiable spaces to have air filters. Further, the air filter efficiency must be either MERV 13 or use a particle size efficiency rating specific in the Energy Code AND be equipped with air filters with a minimum 2-inch depth or minimum 1-inch depth if sized according to the equation 120.1-A. If natural ventilation is to be used the space must also use mechanical unless ventilation openings are either permanently open or controlled to stay open during occupied times.

New regulations were also adopted under Section 130.1 Indoor Lighting Controls. These included new exceptions being added for restrooms, the exception for classrooms being removed, as well as exceptions in regard to sunlight provided through skylights and overhangs.

The 2016 residential standards were estimated to be approximately 28 percent more efficient than the 2013 standards, whereas the 2019 residential standards were estimated to be approximately 7 percent more efficient than the 2016 standards. Furthermore, once rooftop solar electricity generation was factored in, 2019 residential standards were estimated to be approximately 53 percent more efficient than the 2016 standards. Under the 2019 standards, nonresidential buildings were estimated to be approximately 30 percent more efficient than the 2016 standards. Energy efficient buildings require less electricity; therefore, increased energy efficiency reduces fossil fuel consumption and decreases greenhouse gas emissions.

[50] California Energy Commission. Final 2023 Integrated Energy Policy Report. January 2024. https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2023-integrated-energy-policy-report

The current California Building Energy Efficiency Standards (Title 24 standards) are the 2022 Building Energy Efficiency Standards became which effective on January 1, 2023. [51] All buildings for which an application for a building permit is submitted on or after January 1, 2022 must follow the 2022 standards. The core focus of the building standards has been efficiency, but the 2019 Energy Code ventured into onsite generation by requiring solar PV on new homes, providing significant GHG savings. The 2022 update builds off this progress with expanded solar standards and the move to onsite energy storage that will help Californians save on utility bills while bolstering the grid. The 2022 Energy Code update focuses on four key areas in new construction of homes and businesses:

- Encouraging electric heat pump technology and use, which consumes less energy and produces fewer emissions than traditional HVACs and water heaters.
- Establishing electric-ready requirements when natural gas is installed, which positions owners to use cleaner electric heating, cooking and electric vehicle (EV) charging options whenever they choose to adopt those technologies.
- Expanding solar photovoltaic (PV) system and battery storage standards to make clean energy available onsite and complement the state's progress toward a 100 percent clean electricity grid.
- Strengthening ventilation standards to improve indoor air quality.

The 2022 Energy Code affects homes by establishing energy budgets based on efficient heat pumps for space or water heating to encourage builders to install heat pumps over gas-fueled HVAC units; requiring homes to be electric-ready, with dedicated 240-volt outlets and space (with plumbing for water heaters) so electric appliances can eventually replace installed gas appliances; increasing minimum kitchen ventilation requirements so that fans over cooktops have higher airflow or capture efficiency to better exhaust pollution from gas cooking and improve indoor air quality; and allowing exceptions to existing solar PV standards when roof area is not available (such as for smaller homes). In addition, the effect on businesses includes establishing combined solar PV and battery standards for select businesses with systems being sized to maximize onsite use of solar energy and avoid electricity demand during times when the grid must use gas-powered plants; establishing new efficiency standards for commercial greenhouses (primarily cannabis growing); and improving efficiency standards for building envelope, various internal systems, and grid integration equipment, such as demand-responsive controls to buoy grid stability.[52,53]

California Building Energy Efficiency Standards (Title 24, Part 11)

The 2019 California Green Building Standards Code (California Code of Regulations, Title 24, Part 11), commonly referred to as the CALGreen Code, went into effect on January 1, 2020. The 2019 CALGreen Code includes mandatory measures for non-residential development related to site development; energy efficiency; water efficiency and conservation; material conservation and resource efficiency; and environmental quality.

As previously discussed in Section 3 of this report, the Department of Housing and Community Development (HCD) updated CALGreen through the 2019 Triennial Code Adoption Cycle. HCD modified the best management practices for stormwater pollution prevention adding Section 5.106.2 for projects that disturb one or more acres of land. This section requires projects that disturb one acre or more of land or less than one acre of land but are part of a larger common plan of development or sale must comply with the postconstruction requirement detailed in the applicable National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities issued by the State Water Resources Control Board. The NPDES permits require postconstruction

[51] California Energy Commission (CEC). 2022. Building Energy Efficiency Standards. https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency.

[52] https://www.lightnowblog.com/2021/08/california-energy-commission-adopts-2022-building-energy-efficiency-standards/

[53] State of California Energy Commission. 2022 Building Energy Efficiency Standards Summary. https://www.energy.ca.gov/sites/default/files/2021-08/CEC_2022_EnergyCodeUpdateSummary_ADA.pdf

runoff (post-project hydrology) to match the preconstruction runoff pre-project hydrology) with installation of postconstruction stormwater management measures.

HCD added sections 5.106.4.1.3 and 5.106.4.1.5 in regard to bicycle parking. Section 5.106.4.1.3 requires new buildings with tenant spaces that have 10 or more tenant-occupants, provide secure bicycle parking for 5 percent of the tenant-occupant vehicular parking spaces with a minimum of one bicycle parking facility. In addition, Section 5.106.4.1.5 states that acceptable bicycle parking facility for Sections 5.106.4.1.2 through 5.106.4.1.4 shall be convenient from the street and shall meeting one of the following: (1) covered, lockable enclosures with permanently anchored racks for bicycles; (2) lockable bicycle rooms with permanently anchored racks; or (3) lockable, permanently anchored bicycle lockers.

HCD amended section 5.106.5.3.5 allowing future charging spaces to qualify as designated parking for clean air vehicles.

HCD updated section 5.303.3.3 in regard to showerhead flow rates. This update reduced the flow rate to 1.8 GPM.

HCD amended section 5.304.1 for outdoor potable water use in landscape areas and repealed sections 5.304.2 and 5.304.3. The update requires nonresidential developments to comply with a local water efficient landscape ordinance or the current California Department of Water Resource's' Model Water Efficient Landscape Ordinance (MWELO), whichever is more stringent. Some updates were also made in regard to the outdoor potable water use in landscape areas for public schools and community colleges.

HCD updated Section 5.504.5.3 in regard to the use of MERV filters in mechanically ventilated buildings. This update changed the filter use from MERV 8 to MERV 13. MERV 13 filters are to be installed prior to occupancy, and recommendations for maintenance with filters of the same value shall be included in the operation and maintenance manual.

The 2022 California Green Building Standards Code became effective on January 1, 2023.[54]

HCD amended Section 5.106.5.3 in regard to increasing the EV capable space percentages and adding a new requirement for installed Level 2 DCFC chargers.

HCD under Section 5.106.5.4 added new regulation for electric vehicle charging readiness requirements for new construction of warehouse, grocery stores, and retail stores with planned off-street loading spaces. [55]

However, as this project does not propose any buildings, building efficiency regulations would not be applicable.

Senate Bill 100

Senate Bill 100 (SB 100) requires 100 percent of total retail sales of electricity in California to come from eligible renewable energy resources and zero-carbon resources by December 31, 2045. SB 100 was adopted September 2018.

The interim thresholds from prior Senate Bills and Executive Orders would also remain in effect. These include Senate Bill 1078 (SB 1078), which requires retail sellers of electricity, including investor-owned utilities and community choice aggregators, to provide at least 20 percent of their supply from renewable sources by 2017. Senate Bill 107 (SB 107) which changed the target date to 2010. Executive Order S-14-08, which was signed on November 2008 and expanded the State's Renewable Energy Standard to 33 percent renewable

[54] California Building Standards Commission (CBSC). 2022. California Green Building Standards. Website: https://codes.iccsafe.org/content/CAGBC2022P1.

[55] https://www.dgs.ca.gov/BSC/Resources/2022-Title-24-California-Code-Changes

energy by 2020. Executive Order S-21-09 directed the CARB to adopt regulations by July 31, 2010 to enforce S-14-08. Senate Bill X1-2 codifies the 33 percent renewable energy requirement by 2020.

Senate Bill 350

As previously discussed in Section 3 of this report, Senate Bill 350 (SB 350) was signed into law October 7, 2015, SB 350 increases California's renewable electricity procurement goal from 33 percent by 2020 to 50 percent by 2030. This will increase the use of Renewables Portfolio Standard (RPS) eligible resources, including solar, wind, biomass, geothermal, and others. In addition, SB 350 requires the state to double statewide energy efficiency savings in electricity and natural gas end uses by 2030. To help ensure these goals are met and the greenhouse gas emission reductions are realized, large utilities will be required to develop and submit Integrated Resource Plans (IRPs). These IRPs will detail how each entity will meet their customers resource needs, reduce greenhouse gas emissions and ramp up the deployment of clean energy resources.

Assembly Bill 32

As discussed in Section 3 of this report, in 2006 the California State Legislature adopted Assembly Bill 32 (AB 32), the California Global Warming Solutions Act of 2006. AB 32 requires CARB, to adopt rules and regulations that would achieve GHG emissions equivalent to statewide levels in 1990 by 2020 through an enforceable statewide emission cap which will be phased in starting in 2012. Emission reductions shall include carbon sequestration projects that would remove carbon from the atmosphere and best management practices that are technologically feasible and cost effective. Please see Section 3 for further detail on AB 32.

Assembly Bill 1493/Pavley Regulations

As discussed in Section 3 of this report, California Assembly Bill 1493 enacted on July 22, 2002, required CARB to develop and adopt regulations that reduce GHGs emitted by passenger vehicles and light duty trucks. In 2005, the CARB submitted a "waiver" request to the EPA from a portion of the federal Clean Air Act in order to allow the State to set more stringent tailpipe emission standards for CO_2 and other GHG emissions from passenger vehicles and light duty trucks. On December 19, 2007 the EPA announced that it denied the "waiver" request. On January 21, 2009, CARB submitted a letter to the EPA administrator regarding the State's request to reconsider the waiver denial. The EPA approved the waiver on June 30, 2009.

Executive Order S-1-07/Low Carbon Fuel Standard

As discussed in Section 3 of this report, Executive Order S-1-07 was issued in 2007 and proclaims that the transportation sector is the main source of GHG emissions in the State, since it generates more than 40 percent of the State's GHG emissions. It establishes a goal to reduce the carbon intensity of transportation fuels sold in the State by at least ten percent by 2020. This Order also directs CARB to determine whether this Low Carbon Fuel Standard (LCFS) could be adopted as a discrete early-action measure as part of the effort to meet the mandates in AB 32.

On April 23, 2009 CARB approved the proposed regulation to implement the low carbon fuel standard. The low carbon fuel standard is anticipated to reduce GHG emissions by about 16 MMT per year by 2020. The low carbon fuel standard is designed to provide a framework that uses market mechanisms to spur the steady introduction of lower carbon fuels. The framework establishes performance standards that fuel producers and importers must meet each year beginning in 2011. Separate standards are established for gasoline and diesel fuels and the alternative fuels that can replace each. The standards are "back-loaded", with more reductions required in the last five years, than during the first five years. This schedule allows for the development of advanced fuels that are lower in carbon than today's fuels and the market penetration of plug-in hybrid electric vehicles, battery electric vehicles, fuel cell vehicles, and flexible fuel vehicles. It is anticipated that compliance with the low carbon fuel standard will be based on a combination of both lower carbon fuels and more efficient vehicles.

Reformulated gasoline mixed with corn-derived ethanol at ten percent by volume and low sulfur diesel fuel represent the baseline fuels. Lower carbon fuels may be ethanol, biodiesel, renewable diesel, or blends of these fuels with gasoline or diesel as appropriate. Compressed natural gas and liquefied natural gas also may be low carbon fuels. Hydrogen and electricity, when used in fuel cells or electric vehicles are also considered as low carbon fuels for the low carbon fuel standard.

California Air Resources Board

CARB's Advanced Clean Cars Program

Closely associated with the Pavley regulations, the Advanced Clean Cars emissions control program was approved by CARB in 2012. The program combines the control of smog, soot, and GHGs with requirements for greater numbers of zero-emission vehicles for model years 2015–2025.15 The components of the Advanced Clean Cars program include the Low-Emission Vehicle (LEV) regulations that reduce criteria pollutants and GHG emissions from light- and medium-duty vehicles, and the Zero-Emission Vehicle (ZEV) regulation, which requires manufacturers to produce an increasing number of pure ZEVs (meaning battery electric and fuel cell electric vehicles), with provisions to also produce plug-in hybrid electric vehicles (PHEV) in the 2018 through 2025 model years.[56]

Airborne Toxic Control Measure to Limit Diesel-Fueled Commercial Motor Vehicle Idling

The Airborne Toxic Control Measure to Limit Diesel-Fueled Commercial Motor Vehicle Idling (Title 13, California Code of Regulations, Division 3, Chapter 10, Section 2435) was adopted to reduce public exposure to diesel particulate matter and other air contaminants by limiting the idling of diesel-fueled commercial motor vehicles. This section applies to diesel-fueled commercial motor vehicles with gross vehicular weight ratings of greater than 10,000 pounds that are or must be licensed for operation on highways. Reducing idling of diesel-fueled commercial motor vehicles reduces the amount of petroleum-based fuel used by the vehicle.

Regulation to Reduce Emissions of Diesel Particulate Matter, Oxides of Nitrogen, and other Criteria Pollutants, form In-Use Heavy-Duty Diesel-Fueled Vehicles

The Regulation to Reduce Emissions of Diesel Particulate Matter, Oxides of Nitrogen and other Criteria Pollutants, from In-Use Heavy-Duty Diesel-Fueled Vehicles (Title 13, California Code of Regulations, Division 3, Chapter 1, Section 2025) was adopted to reduce emissions of diesel particulate matter, oxides of nitrogen (NOX) and other criteria pollutants from in-use diesel-fueled vehicles. This regulation is phased, with full implementation by 2023. The regulation aims to reduce emissions by requiring the installation of diesel soot filters and encouraging the retirement, replacement, or repower of older, dirtier engines with newer emission-controlled models. The newer emission-controlled models would use petroleum-based fuel in a more efficient manner.

Sustainable Communities Strategy

The Sustainable Communities and Climate Protection Act of 2008, or Senate Bill 375 (SB 375), coordinates land use planning, regional transportation plans, and funding priorities to help California meet the GHG reduction mandates established in AB 32.

As previously stated in Section 3 of this report, Senate Bill 375 (SB 375) was adopted September 2008 and aligns regional transportation planning efforts, regional GHG emission reduction targets, and land use and housing allocation. SB 375 requires Metropolitan Planning Organizations (MPO) to adopt a sustainable communities strategy (SCS) or alternate planning strategy (APS) that will prescribe land use allocation in that MPOs Regional Transportation Plan (RTP). CARB, in consultation with each MPO, will provide each affected region with reduction targets for GHGs emitted by passenger cars and light trucks in the region for the years

[56] California Air Resources Board, California's Advanced Clean Cars Program, January 18, 2017. www.arb.ca.gov/msprog/acc/acc.htm.

2020 and 2035. These reduction targets will be updated every eight years but can be updated every four years if advancements in emissions technologies affect the reduction strategies to achieve the targets. CARB is also charged with reviewing each MPO's sustainable communities strategy or alternate planning strategy for consistency with its assigned targets.

PROJECT ENERGY DEMANDS AND ENERGY EFFICIENCY MEASURES

Evaluation Criteria

In compliance with Appendix G of the State CEQA Guidelines, this report analyzes the project's anticipated energy use to determine if the project would:

- Result in potentially significant environmental impact due to wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation; or
- Conflict with or obstruct a state or local plan for renewable energy or energy efficiency.

In addition, Appendix F of the State CEQA Guidelines states that the means of achieving the goal of energy conservation includes the following:

- Decreasing overall per capita energy consumption;
- Decreasing reliance on fossil fuels such as coal, natural gas and oil; and
- Increasing reliance on renewable energy sources.

Methodology

Information from the CalEEMod 2022.1.1.28 Output contained in Appendix B, utilized for air quality and greenhouse gas analyses in Sections 2 and 3 of this report, were also utilized for this analysis. The CalEEMod outputs detail project related construction equipment, transportation energy demands, and facility energy demands.

Construction Energy Demands

The construction is anticipated to occur no sooner than the beginning of fall 2024 and conclude in the beginning of fall 2025, lasting approximately 11 months, and be completed in one phase. The staging of construction vehicles and equipment will be located inside existing public right-of-way, adjacent parcels, and a portion of the Stanislaus Elementary School parking lot and will depend on the portion of the alignment under construction. The approximately 11-month schedule is relatively short, and the estimated area of disturbance during project construction is approximately 1.67 acres.[57]

Construction Equipment Electricity Usage Estimates

As stated previously, Electrical service will be provided by Modesto Irrigation District. The focus within this section is the energy implications of the construction process, specifically the power cost from on-site electricity consumption during construction of the proposed project. Based on the 2021 National Construction Estimator, Richard Pray (2021),[58] the typical power cost per 1,000 square feet of building construction per month is estimated to be $2.37. The project includes construction of an approximately 12,000 linear foot pipeline extension. Therefore, the project does not include the construction of buildings.

[57] Temporary areas of disturbance as a result of trenching is anticipated to be 4-feet wide and 8-feet deep along the entire approximately 12,000 linear feet of project alignment, approximately 1.1 acres. Jack and bore construction will consist of 5 total pits. Jacking pits are approximately 12-feet wide by 10-feet long by 15-feet deep and receiving pits are approximately 12-feet wide by 24-feet long by 15-feet deep, resulting in approximately 0.03 acres of disturbance. Therefore, the total area of disturbance assumed for the proposed project is approximately 1.13 acres.

[58] Pray, Richard. 2021 National Construction Estimator. Carlsbad : Craftsman Book Company, 2021.

Construction Equipment Fuel Estimates

Fuel consumed by construction equipment would be the primary energy resource expended over the course of project construction. Fuel consumed by construction equipment was evaluated with the following assumptions:

- Construction schedule of 11 months
- All construction equipment was assumed to run on diesel fuel
- Typical daily use of 8 hours, with some equipment operating from ~7 hours
- Aggregate fuel consumption rate for all equipment was estimated at 18.5 hp-hr/gallon (from CARB's 2017 Emissions Factors Tables and fuel consumption rate factors as shown in Table D-21 of the Moyer Guidelines: (https://www.arb.ca.gov/msprog/moyer/guidelines/2017gl/2017_gl_appendix_d.pdf).
- Diesel fuel would be the responsibility of the equipment operators/contractors and would be sources within the region.
- Project construction represents a "single-event" for diesel fuel demand and would not require on-going or permanent commitment of diesel fuel resources during long term operation.

Using the CalEEMod data input for the air quality and greenhouse gas analyses (Sections 2 and 3 of this report), the project's construction phase would consume electricity and fossil fuels as a single energy demand, that is, once construction is completed their use would cease. CARB's 2017 Emissions Factors Tables show that on average, aggregate fuel consumption (gasoline and diesel fuel) would be approximately 18.5 hp-hr-gal. Table 15 shows the results of the analysis of construction equipment.

As presented in Table 15, project construction, would consume an estimated 105,782 gallons of diesel fuel. As stated previously, project construction would represent a "single-event" diesel fuel demand and would not require on-going or permanent commitment of diesel fuel resources for this purpose.

Construction Worker Fuel Estimates

It is assumed that construction worker trips are from light duty autos (LDA), light duty truck 1 (LDT1), and light duty truck 2 (LDT2) at a mix of 25 percent/50 percent/25 percent, respectively, along area roadways.[59] With respect to estimated VMT, the construction worker trips would generate an estimated 82,944 VMT. Data regarding project related construction worker trips were based on CalEEMod 2022.1.1.28 model defaults.

Vehicle fuel efficiencies for construction workers were estimated in the air quality and greenhouse gas analyses (Sections 2 and 3 of this report) using information generated using CARB's 2021 EMFAC model (see Appendix B for details). An aggregate fuel efficiency of 26.2 miles per gallon (mpg) was used to calculate vehicle miles traveled for construction worker trips. Table 16 shows that an estimated 3,167 gallons of fuel would be consumed for construction worker trips.

Construction Vendor/Hauling Fuel Estimates

Tables 17 and 18 show the estimated fuel consumption for vendor and hauling during building construction. With respect to estimated VMT, the vendor and hauling trips would generate an estimated 15,154 VMT. Data regarding project related construction worker trips were based on CalEEMod 2022.1.1.28 model defaults.

For the architectural coatings it is assumed that the contractors would be responsible for bringing coatings and equipment with them in their light duty vehicles. Therefore, vendors delivering construction material or

[59] CalEEMod User's Guide Appendix C (April 2022) states that construction work trips are made by a fleet consisting of 25 percent light-duty auto (or passenger car), 50 percent light-duty truck type 1 (LDT1), and 25 percent light duty truck type 2 (LDT2).

hauling debris from the site during project construction would use medium to heavy duty vehicles with an average fuel consumption of 7.9 mpg for medium heavy-duty trucks and 6.05 mpg for heavy heavy-duty trucks (see Appendix B for details).[60] Tables 17 and 18 show that an estimated 2,429 gallons of fuel would be consumed for vendor and hauling trips.

Construction Energy Efficiency/Conservation Measures

Construction equipment used over the approximately eleven-month construction phase would conform to CARB regulations and California emissions standards and is evidence of related fuel efficiencies. There are no unusual project characteristics or construction processes that would require the use of equipment that would be more energy intensive than is used for comparable activities; or equipment that would not conform to current emissions standards (and related fuel efficiencies). Equipment employed in the construction of the project would therefore not result in inefficient wasteful, or unnecessary consumption of fuel.

The project would utilize construction contractors which practice compliance with applicable CARB regulation regarding retrofitting, repowering, or replacement of diesel off-road construction equipment. Additionally, CARB has adopted the Airborne Toxic Control Measure to limit heavy-duty diesel motor vehicle idling in order to reduce public exposure to diesel particulate matter and other Toxic Air Contaminants. Compliance with these measures would result in a more efficient use of construction-related energy and would minimize or eliminate wasteful or unnecessary consumption of energy. Idling restrictions and the use of newer engines and equipment would result in less fuel combustion and energy consumption.

Additionally, as required by California Code of Regulations Title 13, Motor Vehicles, section 2449(d)(3) Idling, limits idling times of construction vehicles to no more than five minutes, thereby minimizing or eliminating unnecessary and wasteful consumption of fuel due to unproductive idling of construction equipment. Enforcement of idling limitations is realized through periodic site inspections conducted by County building officials, and/or in response to citizen complaints.

Therefore, as the project's construction is required to comply with CARB regulations and does not include the need of construction processes that would require the use of equipment that is more energy efficient, the proposed project annual construction related fuel consumption would not be considered significant.

Operational Energy Demands

Energy consumption in support of or related to project operations would include transportation energy demands (energy consumed by employee and patron vehicles accessing the project site) and facilities energy demands (energy consumed by building operations and site maintenance activities).

Transportation and Operational Fuel Consumption

As stated previously, additional staffing needs for long-term operation and maintenance of the proposed project are not expected. However, a minimal number of daily worker trips are anticipated to conduct routine inspections and ensure proper long-term maintenance. Therefore, the increase in project generated trips is minimal and the project's transportation and operational energy consumption would not be considered inefficient, wasteful, or otherwise unnecessary.

[60] CalEEMod User's Guide Appendix C (April 2022) states that vendor trips are made by a fleet consisting of 50 percent medium trucks (MHDT) and 50 percent heavy trucks (HHDT) and that hauling and onsite truck trips are made by a fleet consisting of 100 percent HHDT.

Facility Energy Demands (Electricity and Natural Gas)

In 2022, the non-residential sector of the County of Stanislaus consumed approximately 3,219 million kWh of electricity and approximately 141 million therms of gas. [61,62] The project is the installation of approximately 12,000 linear feet of 12-inch diameter pipe and, therefore, project operation would not require any additional consumption of energy or natural gas. Furthermore, any potential energy demands of the proposed project would be comparable to other water distribution projects of similar scale and configuration. Therefore, the project facilities' energy demands, and energy consumption would not be considered inefficient, wasteful, or otherwise unnecessary.

RENEWABLE ENERGY AND ENERGY EFFICIENCY PLAN CONSISTENCY

Regarding federal transportation regulations, the project site is located in an already developed area. Access to/from the project site is from existing roads. These roads are already in place so the project would not interfere with, nor otherwise obstruct intermodal transportation plans or projects that may be proposed pursuant to the ISTEA.

Regarding Pavley (AB 1493) regulations, an individual project does not have the ability to comply or conflict with these regulations because they are intended for agencies and their adoption of procedures and protocols for reporting and certifying GHG emission reductions from mobile sources. The vehicles associated with the proposed project would be required to comply with federal and state fuel efficiency standards; however, as stated previously the project requires a minimal number of vehicle trips during operation.

Regarding the State's Renewable Energy Portfolio Standards, as applicable, the project would be required to meet or exceed the energy standards established in the California Green Building Standards Code, Title 24, Part 11 (CALGreen). CALGreen Standards require that new buildings reduce water consumption, employ building commissioning to increase building system efficiencies, divert construction waste from landfills, and install low pollutant-emitting finish materials.

As shown in Section 3 above, the proposed project would be consistent with the applicable goals of the CARB Scoping Plan.

CONCLUSIONS

As supported by the preceding analyses, project construction would not result in the inefficient, wasteful or unnecessary consumption of energy. The proposed project does not include any unusual project characteristics or construction processes that would require the use of equipment that would be more energy intensive than is used for comparable activities and is a water supply infrastructure project that is not proposing any additional features that would require a larger energy demand than other projects of similar scale and configuration. The energy demands of the project are anticipated to be accommodated within the context of available resources and energy delivery systems. The project would therefore not cause or result in the need for additional energy producing or transmission facilities. The project would not engage in wasteful or inefficient uses of energy and aims to achieve energy conservations goals within the State of California. Notwithstanding, the project proposes a water supply infrastructure project and will not have any long-term effects on an energy provider's future energy development or future energy conservation strategies.

[61] California Energy Commission, Electricity Consumption by County. https://ecdms.energy.ca.gov/elecbycounty.aspx

[62] California Energy Commission, Gas Consumption by County. http://ecdms.energy.ca.gov/gasbycounty.aspx

Table 13
Total Electricity System Power (California 2022)

Fuel Type	California In-State Generation (GWh)	Percent of California In-State Generation	Northwest Imports (GWh)	Southwest Imports (GWh)	Total Imports (GWh)	Total California Energy Mix (GWh)	Total California Power Mix
Coal	273	0.13%	181	5,716	5,897	6,170	2.15%
Natural Gas	96,457	47.46%	44	7,994	8,038	104,495	36.38%
Oil	65	0.03%	-	-	-	65	0.02%
Other (Waste Heat/Petroleum Coke)	315	0.15%	-	-	-	315	0.11%
Unspecified Sources of Power	-	0.00%	12,485	7,943	20,428	20,428	7.11%
Total Thermal and Unspecified	97,110	47.78%	12,710	21,653	34,363	121,473	45.77%
Nuclear	17,627	8.67%	397	8,342	8,739	26,366	9.18%
Large Hydro	14,607	7.19%	10,803	1,118	11,921	26,528	9.24%
Renewables	73,913	36.37%	10,270	18,668	28,940	131,853	35.81%
Biomass	5,366	2.64%	771	25	797	6,162	2.15%
Geothermal	11,110	5.47%	253	2,048	2,301	13,412	4.67%
Small Hydro	3,005	1.48%	211	13	225	32,230	1.12%
Solar	40,494	19.92%	231	8,225	8,456	48,950	17.04%
Wind	13,938	6.86%	8,804	8,357	17,161	31,099	10.83%
Total Non-GHG and Renewables	106,147	52.22%	21,471	28,129	49,599	155,747	54.23%
Total Energy	203,257	100%	34,180	49,782	83,962	287,220	100%

Notes:

(1) Source: California Energy Commission. 2022 Total System Electric Generation. hhttps://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/2022-total-system-electric-generation

Table 14
MID 2022 Power Content Mix

Energy Resources	2022 MID Power Mix
Eligible Renewable	30.1%
Biomass & Biowaste	0%
Geothermal	0%
Eligible Hydroelectric	0.2%
Solar	13.9%
Wind	16%
Coal	0.0%
Large Hydroelectric	17.8%
Natural Gas	13.6%
Nuclear	1.8%
Other	0.1%
Unspecified Sources of power*	36.6%
Total	100%

Notes:

(1) https://www.mid.org/about/newsroom/currents/documents/2022%20PCL.pdf

* Unspecified sources of power means electricity from transactions that are not traceable to specific generation sources.

Table 15
Construction Equipment Fuel Consumption Estimates

Phase[1]	Number of Days	Offroad Equipment Type[2]	Amount	Usage Hours	Horse Power	Load Factor	HP hrs/day	Total Fuel Consumption (gal diesel fuel)[3]
Site Preparation	240	Rubber Tired Dozers	1	7	367	0.40	1,028	13,331
	240	Tractors/Loaders/Backhoes	5	8	84	0.37	1,243	16,128
	240	Scrapers	1	8	423	0.48	1,624	21,072
	240	Off-Highway Trucks	1	8	376	0.38	1,143	14,829
	240	Plate Compactors	1	8	8	0.43	28	357
	240	Excavators	1	8	36	0.38	109	1,420
	240	Other Material Handling Equipment	1	8	93	0.40	298	3,861
	240	Paving Equipment	1	8	89	0.36	256	3,325
	240	Other Construction Equipment	1	8	82	0.42	276	3,574
	240	Pumps	2	8	11	0.74	130	1,690
	240	Skid Steer Loaders	1	8	71	0.37	210	2,726
	240	Surfacing Equipment	1	8	399	0.30	958	12,423
	240	Cranes	1	8	367	0.29	851	11,046
CONSTRUCTION FUEL DEMAND (gallons of diesel fuel)								105,782

Notes:

(1) Construction of the proposed project is not anticipated to be phased. Therefore, to provide a conservative scenario, the entirety of the project has been analyzed as occurring in one construction phase with all proposed equipment in operation simultaneously.

(2) Per the project applicant, construction equipment is to include: one (1) scraper, five (5) tractors/ loaders/ backhoes, one (1) off-highway trucks, one (1) plate compactor, one (1) excavator, one (1) other material handling equipment, one (1) paving equipment, one (1) other construction equipment, two (2) pumps, one (1) skid steer loaders, one (1) surfacing equipment, one (1) rubber tired dozer, and one (1) crane.

(3) Using Carl Moyer Guidelines Table D-21 Fuel consumption rate factors (bhp-hr/gal) for engines less than 750 hp. (Source: https://www.arb.ca.gov/msprog/moyer/guidelines/2017gl/2017_gl_appendix_d.pdf)

Table 16
Construction Worker Fuel Consumption Estimates

Phase	Number of Days	Worker Trips/Day	Trip Length (miles)	Vehicle Miles Traveled	Average Vehicle Fuel Economy (mpg)	Estimated Fuel Consumption (gallons)
Site Preparation	240	32	10.8	82,944	26.2	3,167
Total Construction Worker Fuel Consumption						3,167

Notes:

(1) Assumptions for the worker trip length and vehicle miles traveled are consistent with CalEEMod 2022.1.1.28 defaults.

(2) Per CalEEMod User's Guide Appendix C (April 2022), CalEEMod assumes that construction work trips are made by a fleet consisting of 25 percent light-duty auto (or passenger car), 50 percent light-duty truck type 1 (LDT1), and 25 percent light duty truck type 2 (LDT2).

Table 17
Construction Vendor Fuel Consumption Estimates (MHD & HHD Trucks)

Phase	Number of Days	Vendor Trips/Day	Trip Length (miles)	Vehicle Miles Traveled	Average Vehicle Fuel Economy (mpg)	Estimated Fuel Consumption (gallons)
Site Preparation	240	2	7.17	3,442	7.0	493
Total Construction Vendor Fuel Consumption						493

Notes:

(1) Assumptions for the vendor trip length and vehicle miles traveled are consistent with CalEEMod 2022.1.1.28 defaults.

(2) Per CalEEMod User's Guide Appendix C (April 2022), CalEEMod assumes vendor trips are made by a fleet consisting of 50 percent medium trucks (MHDT) and 50 percent heavy trucks (HHDT).

Table 18
Construction Hauling Fuel Consumption Estimates (HHD Trucks)

Phase	Number of Days	Hauling Trips/Day	Trip Length (miles)	Vehicle Miles Traveled	Average Vehicle Fuel Economy (mpg)	Estimated Fuel Consumption (gallons)
Site Preparation	240	2.44	20	11,712	6.1	1,936
Total Construction Hauling Fuel Consumption						1,936

Notes:

(1) Assumptions for the hauling trip length and vehicle miles traveled are consistent with CalEEMod 2022.1.28 defaults.

6. EMISSIONS REDUCTION MEASURES

CONSTRUCTION MEASURES

Adherence to SJVAPCD Regulation VIII is required.

No construction mitigation measures are required. However, SJVAPCD recommends that, as a condition of project approval, projects in which construction related activities would disturb equal to or greater than 1-acre of surface area include a SJVAPCD approved Dust Control Plan or Construction Notification form before issuance of the first grading permit. The project will disturb approximately 1.67 acres. Therefore, it is recommended that a Dust Control Plan or Construction Notification form be completed for the proposed project.

OPERATIONAL MEASURES

No operational measures are required.

7. REFERENCES

California Air Resources Board

2008 Resolution 08-43

2008 Recommended Approaches for Setting Interim Significance Thresholds for Greenhouse Gases under the California Environmental Quality Act

2008 Climate Change Scoping Plan, a framework for change.

2011 Supplement to the AB 32 Scoping Plan Functional Equivalent Document

2013 Almanac of Emissions and Air Quality.
Source: https://www.arb.ca.gov/aqd/almanac/almanac13/almanac13.htm

2014 First Update to the Climate Change Scoping Plan, Building on the Framework Pursuant to AB32, the California Global Warming Solutions Act of 2006. May.

2017 California's 2017 Climate Change Scoping Plan. November.

2022 2022 Scoping Plan for Achieving Carbon Neutrality. November 16.

City of Modesto

2019 General Plan 2040. March 5.

Governor's Office of Planning and Research

2008 CEQA and Climate: Addressing Climate Change Through California Environmental Quality Act (CEQA) Review

2018 CEQA Guideline Sections to be Added or Amended

Intergovernmental Panel on Climate Change (IPCC)

2014 IPCC Fifth Assessment Report, Climate Change 2014: Synthesis Report

Office of Environmental Health Hazard Assessment

2015 Air Toxics Hot Spots Program Risk Assessment Guidelines

San Joaquin Valley Air Pollution Control District

2000 Environmental Review Guidelines. August.

2009 Final Staff Report Addressing Greenhouse Gas Emissions Impacts Under the California Environmental Quality Act. December 17.

2015 Guidance for Assessing and Mitigating Air Quality Impacts. March 15.

U.S. Environmental Protection Agency (EPA)

2017 Understanding Global Warming Potentials
(Source: https://www.epa.gov/ghgemissions/understanding-global-warming-potentials)

U.S. Geological Survey

2011 Reported Historic Asbestos Mines, Historic Asbestos Prospects, and Other Natural Occurrences of Asbestos in California

APPENDICES

Appendix A Glossary

Appendix B CalEEMod Model Detailed Report and EMFAC Data

APPENDIX A

GLOSSARY

AQMP	Air Quality Management Plan
BACT	Best Available Control Technologies
CAAQS	California Ambient Air Quality Standards
CalEPA	California Environmental Protection Agency
CARB	California Air Resources Board
CCAA	California Clean Air Act
CCAR	California Climate Action Registry
CEQA	California Environmental Quality Act
CFCs	Chlorofluorocarbons
CH_4	Methane
CNG	Compressed natural gas
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
DPM	Diesel particulate matter
EPA	U.S. Environmental Protection Agency
GHG	Greenhouse gas
GWP	Global warming potential
HIDPM	Hazard Index Diesel Particulate Matter
HFCs	Hydrofluorocarbons
IPCC	International Panel on Climate Change
LCFS	Low Carbon Fuel Standard
LST	Localized Significance Thresholds
$MTCO_2e$	Metric tons of carbon dioxide equivalent
$MMTCO_2e$	Million metric tons of carbon dioxide equivalent
MPO	Metropolitan Planning Organization
NAAQS	National Ambient Air Quality Standards
NOx	Nitrogen Oxides
NO_2	Nitrogen dioxide
N_2O	Nitrous oxide
O_3	Ozone
OPR	Governor's Office of Planning and Research
PFCs	Perfluorocarbons
PM	Particle matter
PM10	Particles that are less than 10 micrometers in diameter
PM2.5	Particles that are less than 2.5 micrometers in diameter
PMI	Point of maximum impact
PPM	Parts per million
PPB	Parts per billion
RTIP	Regional Transportation Improvement Plan
RTP	Regional Transportation Plan
SJVAPCD	San Joaquin Valley Air Pollution Control District
SF_6	Sulfur hexafluoride
SIP	State Implementation Plan
SOx	Sulfur Oxides
TAC	Toxic air contaminants
VOC	Volatile organic compounds

APPENDIX B

CALEEMOD MODEL DETAILED REPORT AND EMFAC DATA

19689 Stanislaus Elementary School 1,2,3-TCP Mitigation - CONSTRUCTION ANALYSIS ONLY Detailed Report

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1. Basic Project Information

1.1. Basic Project Information

Data Field	Value
Project Name	19689 Stanislaus Elementary School 1,2,3-TCP Mitigation - CONSTRUCTION ANALYSIS ONLY
Construction Start Date	9/1/2024
Lead Agency	City of Modesto
Land Use Scale	Project/site
Analysis Level for Defaults	County
Windspeed (m/s)	3.10
Precipitation (days)	25.4
Location	37.711112524016144, -121.02856621462826
County	Stanislaus
City	Unincorporated
Air District	San Joaquin Valley APCD
Air Basin	San Joaquin Valley
TAZ	2201
EDFZ	15
Electric Utility	Modesto Irrigation District
Gas Utility	Pacific Gas & Electric
App Version	2022.1.1.28

1.2. Land Use Types

Land Use Subtype	Size	Unit	Lot Acreage	Building Area (sq ft)	Landscape Area (sq ft)	Special Landscape Area (sq ft)	Population	Description

Other Asphalt Surfaces	1.67	Acre	1.67	0.00	0.00	—	—	Project is a ~12,000 linear ft pipeline. Temporary disturbance area of 6ft wide x 8 ft deep for entire 12,000 linear feet or ~1.64 acres. Five jack & bore pits totaling ~0.03 acres of disturbance. Total project disturbance is ~1.67 acres.

1.3. User-Selected Emission Reduction Measures by Emissions Sector

No measures selected

2. Emissions Summary

2.1. Construction Emissions Compared Against Thresholds

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Un/Mit.	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	4.48	41.3	43.4	0.09	1.72	2.95	4.67	1.58	1.27	2.85	—	10,025	10,025	0.41	0.12	1.68	10,073
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	4.46	41.3	43.0	0.09	1.72	2.95	4.67	1.58	1.27	2.85	—	9,996	9,996	0.41	0.12	0.04	10,042
Average Daily (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	1.72	15.3	17.3	0.04	0.61	1.23	1.84	0.56	0.53	1.09	—	4,166	4,166	0.17	0.05	0.28	4,185
Annual (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Unmit.	0.31	2.79	3.15	0.01	0.11	0.22	0.34	0.10	0.10	0.20	—	690	690	0.03	0.01	0.05	693

2.2. Construction Emissions by Year, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2024	4.48	41.3	43.4	0.09	1.72	2.95	4.67	1.58	1.27	2.85	—	10,025	10,025	0.41	0.12	1.68	10,073
2025	4.14	36.6	41.8	0.09	1.46	2.95	4.41	1.35	1.27	2.61	—	10,015	10,015	0.40	0.12	1.58	10,063
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2024	4.46	41.3	43.0	0.09	1.72	2.95	4.67	1.58	1.27	2.85	—	9,996	9,996	0.41	0.12	0.04	10,042
2025	4.12	36.7	41.4	0.09	1.46	2.95	4.41	1.35	1.27	2.61	—	9,987	9,987	0.40	0.12	0.04	10,033
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2024	1.06	9.86	10.3	0.02	0.41	0.70	1.11	0.38	0.30	0.68	—	2,388	2,388	0.10	0.03	0.17	2,399
2025	1.72	15.3	17.3	0.04	0.61	1.23	1.84	0.56	0.53	1.09	—	4,166	4,166	0.17	0.05	0.28	4,185
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2024	0.19	1.80	1.87	< 0.005	0.07	0.13	0.20	0.07	0.06	0.12	—	395	395	0.02	< 0.005	0.03	397
2025	0.31	2.79	3.15	0.01	0.11	0.22	0.34	0.10	0.10	0.20	—	690	690	0.03	0.01	0.05	693

3. Construction Emissions Details

3.1. Site Preparation (2024) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	4.26	40.9	41.5	0.09	1.71	—	1.71	1.58	—	1.58	—	9,537	9,537	0.39	0.08	—	9,570
Dust From Material Movement	—	—	—	—	—	2.65	2.65	—	1.19	1.19	—	—	—	—	—	—	—
Architectural Coatings	0.06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	4.26	40.9	41.5	0.09	1.71	—	1.71	1.58	—	1.58	—	9,537	9,537	0.39	0.08	—	9,570
Dust From Material Movement	—	—	—	—	—	2.65	2.65	—	1.19	1.19	—	—	—	—	—	—	—
Architectural Coatings	0.06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.02	9.76	9.90	0.02	0.41	—	0.41	0.38	—	0.38	—	2,277	2,277	0.09	0.02	—	2,285
Dust From Material Movement	—	—	—	—	—	0.63	0.63	—	0.29	0.29	—	—	—	—	—	—	—

Architectural	0.01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.19	1.78	1.81	< 0.005	0.07	—	0.07	0.07	—	0.07	—	377	377	0.02	< 0.005	—	378
Dust From Material Movement	—	—	—	—	—	0.12	0.12	—	0.05	0.05	—	—	—	—	—	—	—
Architectural Coatings	< 0.005	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.16	0.10	1.88	0.00	0.00	0.24	0.24	0.00	0.06	0.06	—	268	268	0.01	0.01	1.14	272
Vendor	< 0.005	0.06	0.02	< 0.005	< 0.005	0.01	0.01	< 0.005	< 0.005	< 0.005	—	46.1	46.1	< 0.005	0.01	0.12	48.3
Hauling	< 0.005	0.22	0.05	< 0.005	< 0.005	0.05	0.05	< 0.005	0.01	0.02	—	174	174	< 0.005	0.03	0.42	183
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.14	0.13	1.44	0.00	0.00	0.24	0.24	0.00	0.06	0.06	—	239	239	0.02	0.01	0.03	242
Vendor	< 0.005	0.07	0.02	< 0.005	< 0.005	0.01	0.01	< 0.005	< 0.005	< 0.005	—	46.1	46.1	< 0.005	0.01	< 0.005	48.2
Hauling	< 0.005	0.23	0.05	< 0.005	< 0.005	0.05	0.05	< 0.005	0.01	0.02	—	174	174	< 0.005	0.03	0.01	182
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.03	0.03	0.36	0.00	0.00	0.06	0.06	0.00	0.01	0.01	—	58.7	58.7	< 0.005	< 0.005	0.12	59.7
Vendor	< 0.005	0.02	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	11.0	11.0	< 0.005	< 0.005	0.01	11.5
Hauling	< 0.005	0.05	0.01	< 0.005	< 0.005	0.01	0.01	< 0.005	< 0.005	< 0.005	—	41.5	41.5	< 0.005	0.01	0.04	43.5

Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01	0.01	0.06	0.00	0.00	0.01	0.01	0.00	< 0.005	< 0.005	—	9.72	9.72	< 0.005	< 0.005	0.02	9.88
Vendor	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	1.82	1.82	< 0.005	< 0.005	< 0.005	1.91
Hauling	< 0.005	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	6.87	6.87	< 0.005	< 0.005	0.01	7.21

3.3. Site Preparation (2025) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	3.93	36.3	40.0	0.09	1.46	—	1.46	1.34	—	1.34	—	9,537	9,537	0.39	0.08	—	9,570
Dust From Material Movement	—	—	—	—	—	2.65	2.65	—	1.19	1.19	—	—	—	—	—	—	—
Architectural Coatings	0.06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	3.93	36.3	40.0	0.09	1.46	—	1.46	1.34	—	1.34	—	9,537	9,537	0.39	0.08	—	9,570
Dust From Material Movement	—	—	—	—	—	2.65	2.65	—	1.19	1.19	—	—	—	—	—	—	—

Architectural Coatings	0.06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.64	15.1	16.7	0.04	0.61	—	0.61	0.56	—	0.56	—	3,975	3,975	0.16	0.03	—	3,989
Dust From Material Movement	—	—	—	—	—	1.10	1.10	—	0.50	0.50	—	—	—	—	—	—	—
Architectural Coatings	0.02	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.30	2.76	3.04	0.01	0.11	—	0.11	0.10	—	0.10	—	658	658	0.03	0.01	—	660
Dust From Material Movement	—	—	—	—	—	0.20	0.20	—	0.09	0.09	—	—	—	—	—	—	—
Architectural Coatings	< 0.005	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.15	0.09	1.73	0.00	0.00	0.24	0.24	0.00	0.06	0.06	—	262	262	0.01	0.01	1.05	266
Vendor	< 0.005	0.06	0.02	< 0.005	< 0.005	0.01	0.01	< 0.005	< 0.005	< 0.005	—	45.3	45.3	< 0.005	0.01	0.12	47.4

Hauling	< 0.005	0.21	0.05	< 0.005	< 0.005	0.05	0.05	< 0.005	0.01	0.02	—	171	171	< 0.005	0.03	0.41	179
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.13	0.12	1.32	0.00	0.00	0.24	0.24	0.00	0.06	0.06	—	234	234	0.01	0.01	0.03	237
Vendor	< 0.005	0.07	0.02	< 0.005	< 0.005	0.01	0.01	< 0.005	< 0.005	< 0.005	—	45.3	45.3	< 0.005	0.01	< 0.005	47.3
Hauling	< 0.005	0.22	0.05	< 0.005	< 0.005	0.05	0.05	< 0.005	0.01	0.02	—	171	171	< 0.005	0.03	0.01	179
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.06	0.04	0.57	0.00	0.00	0.10	0.10	0.00	0.02	0.02	—	100	100	< 0.005	< 0.005	0.19	102
Vendor	< 0.005	0.03	0.01	< 0.005	< 0.005	< 0.005	0.01	< 0.005	< 0.005	< 0.005	—	18.9	18.9	< 0.005	< 0.005	0.02	19.7
Hauling	< 0.005	0.09	0.02	< 0.005	< 0.005	0.02	0.02	< 0.005	0.01	0.01	—	71.1	71.1	< 0.005	0.01	0.07	74.5
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01	0.01	0.10	0.00	0.00	0.02	0.02	0.00	< 0.005	< 0.005	—	16.6	16.6	< 0.005	< 0.005	0.03	16.9
Vendor	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	3.13	3.13	< 0.005	< 0.005	< 0.005	3.27
Hauling	< 0.005	0.02	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	11.8	11.8	< 0.005	< 0.005	0.01	12.3

4. Operations Emissions Details

4.10. Soil Carbon Accumulation By Vegetation Type

4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Vegetation	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.2. Above and Belowground Carbon Accumulation by Land Use Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Species	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

5. Activity Data

5.1. Construction Schedule

Phase Name	Phase Type	Start Date	End Date	Days Per Week	Work Days per Phase	Phase Description
Site Preparation	Site Preparation	9/1/2024	8/1/2025	5.00	240	—

5.2. Off-Road Equipment

5.2.1. Unmitigated

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Site Preparation	Rubber Tired Dozers	Diesel	Average	1.00	7.00	367	0.40
Site Preparation	Tractors/Loaders/Backhoes	Diesel	Average	5.00	8.00	84.0	0.37
Site Preparation	Scrapers	Diesel	Average	1.00	8.00	423	0.48
Site Preparation	Off-Highway Trucks	Diesel	Average	1.00	8.00	376	0.38
Site Preparation	Plate Compactors	Diesel	Average	1.00	8.00	8.00	0.43
Site Preparation	Excavators	Diesel	Average	1.00	8.00	36.0	0.38
Site Preparation	Other Material Handling Equipment	Diesel	Average	1.00	8.00	93.0	0.40
Site Preparation	Paving Equipment	Diesel	Average	1.00	8.00	89.0	0.36
Site Preparation	Other Construction Equipment	Diesel	Average	1.00	8.00	82.0	0.42
Site Preparation	Pumps	Diesel	Average	2.00	8.00	11.0	0.74
Site Preparation	Skid Steer Loaders	Diesel	Average	1.00	8.00	71.0	0.37
Site Preparation	Surfacing Equipment	Diesel	Average	1.00	8.00	399	0.30
Site Preparation	Cranes	Diesel	Average	1.00	8.00	367	0.29

5.3. Construction Vehicles

5.3.1. Unmitigated

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Site Preparation	—	—	—	—
Site Preparation	Worker	32.0	10.8	LDA,LDT1,LDT2
Site Preparation	Vendor	2.00	7.17	HHDT,MHDT
Site Preparation	Hauling	2.44	20.0	HHDT
Site Preparation	Onsite truck	—	—	HHDT

5.4. Vehicles

5.4.1. Construction Vehicle Control Strategies

Control Strategies Applied	PM10 Reduction	PM2.5 Reduction
Water unpaved roads twice daily	55%	55%
Limit vehicle speeds on unpaved roads to 25 mph	44%	44%

5.5. Architectural Coatings

Phase Name	Residential Interior Area Coated (sq ft)	Residential Exterior Area Coated (sq ft)	Non-Residential Interior Area Coated (sq ft)	Non-Residential Exterior Area Coated (sq ft)	Parking Area Coated (sq ft)
Site Preparation	0.00	0.00	0.00	0.00	2,880

5.6. Dust Mitigation

5.6.1. Construction Earthmoving Activities

Phase Name	Material Imported (Cubic Yards)	Material Exported (Cubic Yards)	Acres Graded (acres)	Material Demolished (sq. ft.)	Acres Paved (acres)
Site Preparation	4,680	3,348	345	0.00	—

5.6.2. Construction Earthmoving Control Strategies

Control Strategies Applied	Frequency (per day)	PM10 Reduction	PM2.5 Reduction

Water Exposed Area	2	61%	61%

5.7. Construction Paving

Land Use	Area Paved (acres)	% Asphalt
Other Asphalt Surfaces	1.67	100%

5.8. Construction Electricity Consumption and Emissions Factors

kWh per Year and Emission Factor (lb/MWh)

Year	kWh per Year	CO2	CH4	N2O
2024	0.00	478	0.03	< 0.005
2025	0.00	478	0.03	< 0.005

5.18. Vegetation

5.18.1. Land Use Change

5.18.1.1. Unmitigated

Vegetation Land Use Type	Vegetation Soil Type	Initial Acres	Final Acres

5.18.1. Biomass Cover Type

5.18.1.1. Unmitigated

Biomass Cover Type	Initial Acres	Final Acres

5.18.2. Sequestration

5.18.2.1. Unmitigated

Tree Type	Number	Electricity Saved (kWh/year)	Natural Gas Saved (btu/year)

6. Climate Risk Detailed Report

6.1. Climate Risk Summary

Cal-Adapt midcentury 2040–2059 average projections for four hazards are reported below for your project location. These are under Representation Concentration Pathway (RCP) 8.5 which assumes GHG emissions will continue to rise strongly through 2050 and then plateau around 2100.

Climate Hazard	Result for Project Location	Unit
Temperature and Extreme Heat	21.4	annual days of extreme heat
Extreme Precipitation	1.80	annual days with precipitation above 20 mm
Sea Level Rise	—	meters of inundation depth
Wildfire	0.00	annual hectares burned

Temperature and Extreme Heat data are for grid cell in which your project are located. The projection is based on the 98th historical percentile of daily maximum/minimum temperatures from observed historical data (32 climate model ensemble from Cal-Adapt, 2040–2059 average under RCP 8.5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Extreme Precipitation data are for the grid cell in which your project are located. The threshold of 20 mm is equivalent to about ¾ an inch of rain, which would be light to moderate rainfall if received over a full day or heavy rain if received over a period of 2 to 4 hours. Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Sea Level Rise data are for the grid cell in which your project are located. The projections are from Radke et al. (2017), as reported in Cal-Adapt (Radke et al., 2017, CEC-500-2017-008), and consider inundation location and depth for the San Francisco Bay, the Sacramento-San Joaquin River Delta and California coast resulting different increments of sea level rise coupled with extreme storm events. Users may select from four scenarios to view the range in potential inundation depth for the grid cell. The four scenarios are: No rise, 0.5 meter, 1.0 meter, 1.41 meters
Wildfire data are for the grid cell in which your project are located. The projections are from UC Davis, as reported in Cal-Adapt (2040–2059 average under RCP 8.5), and consider historical data of climate, vegetation, population density, and large (> 400 ha) fire history. Users may select from four model simulations to view the range in potential wildfire probabilities for the grid cell. The four simulations make different assumptions about expected rainfall and temperature are: Warmer/drier (HadGEM2-ES), Cooler/wetter (CNRM-CM5), Average conditions (CanESM2), Range of different rainfall and temperature possibilities (MIROC5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.

6.2. Initial Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	N/A	N/A	N/A	N/A
Wildfire	N/A	N/A	N/A	N/A
Flooding	N/A	N/A	N/A	N/A
Drought	N/A	N/A	N/A	N/A
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores do not include implementation of climate risk reduction measures.

6.3. Adjusted Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	N/A	N/A	N/A	N/A
Wildfire	N/A	N/A	N/A	N/A
Flooding	N/A	N/A	N/A	N/A
Drought	N/A	N/A	N/A	N/A
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores include implementation of climate risk reduction measures.

6.4. Climate Risk Reduction Measures

7. Health and Equity Details

7.1. CalEnviroScreen 4.0 Scores

The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Exposure Indicators	—
AQ-Ozone	66.8

AQ-PM	54.5
AQ-DPM	19.6
Drinking Water	97.8
Lead Risk Housing	41.1
Pesticides	93.0
Toxic Releases	46.1
Traffic	26.3
Effect Indicators	—
CleanUp Sites	0.00
Groundwater	2.11
Haz Waste Facilities/Generators	3.64
Impaired Water Bodies	0.00
Solid Waste	0.00
Sensitive Population	—
Asthma	51.1
Cardio-vascular	37.6
Low Birth Weights	10.1
Socioeconomic Factor Indicators	—
Education	49.8
Housing	40.3
Linguistic	53.9
Poverty	60.6
Unemployment	52.5

7.2. Healthy Places Index Scores

The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Economic	—

Above Poverty	41.44745284
Employed	56.93571154
Median HI	43.02579238
Education	—
Bachelor's or higher	35.41639933
High school enrollment	100
Preschool enrollment	9.444373155
Transportation	—
Auto Access	53.75336841
Active commuting	10.714744
Social	—
2-parent households	75.23418452
Voting	45.28422944
Neighborhood	—
Alcohol availability	54.77993071
Park access	58.37289876
Retail density	37.14872321
Supermarket access	57.12819197
Tree canopy	67.72744771
Housing	—
Homeownership	38.44475812
Housing habitability	47.76081098
Low-inc homeowner severe housing cost burden	50.37854485
Low-inc renter severe housing cost burden	73.36070833
Uncrowded housing	34.15886052
Health Outcomes	—
Insured adults	34.59514949
Arthritis	20.9

Asthma ER Admissions	49.1
High Blood Pressure	30.8
Cancer (excluding skin)	40.8
Asthma	21.6
Coronary Heart Disease	31.2
Chronic Obstructive Pulmonary Disease	17.9
Diagnosed Diabetes	41.8
Life Expectancy at Birth	11.6
Cognitively Disabled	28.0
Physically Disabled	32.1
Heart Attack ER Admissions	49.4
Mental Health Not Good	29.3
Chronic Kidney Disease	35.4
Obesity	23.9
Pedestrian Injuries	50.1
Physical Health Not Good	33.1
Stroke	29.9
Health Risk Behaviors	—
Binge Drinking	48.9
Current Smoker	23.5
No Leisure Time for Physical Activity	39.0
Climate Change Exposures	—
Wildfire Risk	0.0
SLR Inundation Area	0.0
Children	10.6
Elderly	64.7
English Speaking	56.4
Foreign-born	36.4

Outdoor Workers	32.7
Climate Change Adaptive Capacity	—
Impervious Surface Cover	33.4
Traffic Density	27.7
Traffic Access	0.0
Other Indices	—
Hardship	63.6
Other Decision Support	—
2016 Voting	48.7

7.3. Overall Health & Equity Scores

Metric	Result for Project Census Tract
CalEnviroScreen 4.0 Score for Project Location (a)	38.0
Healthy Places Index Score for Project Location (b)	41.0
Project Located in a Designated Disadvantaged Community (Senate Bill 535)	No
Project Located in a Low-Income Community (Assembly Bill 1550)	No
Project Located in a Community Air Protection Program Community (Assembly Bill 617)	No

a: The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.
b: The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

7.4. Health & Equity Measures

No Health & Equity Measures selected.

7.5. Evaluation Scorecard

Health & Equity Evaluation Scorecard not completed.

7.6. Health & Equity Custom Measures

No Health & Equity Custom Measures created.

8. User Changes to Default Data

Screen	Justification
Construction: Construction Phases	Construction anticipated to begin Fall 2024 and be completed by Fall 2025, taking ~11 months to complete. Therefore, assumed a start date of early September 2024 ending early August 2025. As stated in Projet Description, project is not anticipated to be phased & contractor will lay ~100 ft of pipeline per day.
Construction: Off-Road Equipment	Per project description equipment to include: 1-scraper, 5-tractors/loaders/backhoes, 1-off-highway truck, 1-plate compactor, 1-excavator, 1-other material handling equipment, 1-paving equipment, 1-other construction equipment, 2-pumps, 1-skid steer loader, 1-surfacing equipment, 1-rubber tired dozer, & 1-crane. To be conservative, it was assumed that all construction equipment would be in operation during the duration of project construction. Project to include ~3,348 CY export & ~4,680 CY import.
Construction: Trips and VMT	Per Project Description, up to 16 construction workers working per day, which results in ~32 one-way trips per day. To be conservative, 2 vendor trips added to account for water trucks.
Construction: Architectural Coatings	Traffic coating would occur in roadway where pipeline is being installed. Pipeline is 12,000 LF x 4 ft wide which equals a potential for up to 48,000 sf in roadway ROW. Per CalEEMod User's Guide (2022) Appendix C Section 4.8, CalEEMod assumes ~6% of parking lot areas will be coated. Therefore, ~2,880 sf assumed for potential coating for roadway areas.

Source: EMFAC2021 (v1.0.2) Emissions Inventory
Region Type: Air Basin
Region: San Joaquin Valley
Calendar Year: 2024
Season: Annual
Vehicle Classification: EMFAC2007 Categories
Units: miles/day for CVMT and EVMT, trips/day for Trips, kWh/day for Energy Consumption, tons/day for Emissions, 1000 gallons/day for Fuel Consumption

Region	Calendar Year	Vehicle Category	Model Year	Speed	Fuel	Population	Trips	Energy Consumption	Fuel Consumption	Fuel Consumption	Total Fuel Consumption	Total VMT	Total VMT	Miles Per Gallon	Vehicle Class
San Joaquin Valley	2024	HHDT	Aggregate	Aggregate	Gasoline	14.26923503	285.4989	0	0.208856287	208.8562873	1853178.413	705.1751657	11208126.26	**6.05**	**HHDT**
San Joaquin Valley	2024	HHDT	Aggregate	Aggregate	Diesel	75540.42982	1311827	0	1832.446977	1832446.977		11080187.54			
San Joaquin Valley	2024	HHDT	Aggregate	Aggregate	Electricity	212.263297	3559.011	46923.73868	0	0		25610.0205			
San Joaquin Valley	2024	HHDT	Aggregate	Aggregate	Natural Gas	1559.052033	13418.38	0	20.52257967	20522.57967		101623.5225			
San Joaquin Valley	2024	LDA	Aggregate	Aggregate	Gasoline	1396040.642	6460217	0	1879.142372	1879142.372	1910877.745	55651025.96	60215384.7	**31.51**	**LDA**
San Joaquin Valley	2024	LDA	Aggregate	Aggregate	Diesel	3574.544528	15178.67	0	2.56390661	2563.90661		112884.9583			
San Joaquin Valley	2024	LDA	Aggregate	Aggregate	Electricity	56530.82162	283590.1	1044501.358	0	0		2705383.603			
San Joaquin Valley	2024	LDA	Aggregate	Aggregate	Plug-in Hybrid	36607.58071	151372.3	264938.2613	29.17146597	29171.46597		1746090.185			
San Joaquin Valley	2024	LDT1	Aggregate	Aggregate	Gasoline	132549.9964	568365.8	0	177.1498941	177149.8941	177295.2602	4330431.678	4346098.934	**24.51**	**LDT1**
San Joaquin Valley	2024	LDT1	Aggregate	Aggregate	Diesel	70.12019936	201.4517	0	0.035743248	35.74324775		897.8907497			
San Joaquin Valley	2024	LDT1	Aggregate	Aggregate	Electricity	162.1298891	800.9995	2897.681935	0	0		7505.343227			
San Joaquin Valley	2024	LDT1	Aggregate	Aggregate	Plug-in Hybrid	139.537005	576.9855	1210.906009	0.109622843	109.6228427		7264.022186			
San Joaquin Valley	2024	LDT2	Aggregate	Aggregate	Gasoline	627210.9415	2907658	0	1032.721557	1032721.557	1038442.923	24738370.26	25151792.29	**24.22**	**LDT2**
San Joaquin Valley	2024	LDT2	Aggregate	Aggregate	Diesel	1735.202254	8281.607	0	2.195003587	2195.003587		74255.90809			
San Joaquin Valley	2024	LDT2	Aggregate	Aggregate	Electricity	3211.923975	16415.56	44992.87026	0	0		116536.9221			
San Joaquin Valley	2024	LDT2	Aggregate	Aggregate	Plug-in Hybrid	4455.774394	18424.63	35711.20912	3.526362907	3526.362907		222629.1991			
San Joaquin Valley	2024	LHDT1	Aggregate	Aggregate	Gasoline	61035.20702	909333.6	0	231.5879776	231587.9776	364615.1665	2183997.723	4295909.202	**11.78**	**LHDT1**
San Joaquin Valley	2024	LHDT1	Aggregate	Aggregate	Diesel	58964.19692	741695.4	0	133.0271889	133027.1889		2101668.864			
San Joaquin Valley	2024	LHDT1	Aggregate	Aggregate	Electricity	136.6778687	1909.303	6662.793509	0	0		10242.615			
San Joaquin Valley	2024	LHDT2	Aggregate	Aggregate	Gasoline	9690.581586	144375.2	0	40.4212088	40421.2088	102414.741	338996.5257	1150157.856	**11.23**	**LHDT2**
San Joaquin Valley	2024	LHDT2	Aggregate	Aggregate	Diesel	22034.0548	277160.7	0	61.99353223	61993.53223		808649.4788			
San Joaquin Valley	2024	LHDT2	Aggregate	Aggregate	Electricity	35.37650647	468.2778	1607.510525	0	0		2511.85159			
San Joaquin Valley	2024	MCY	Aggregate	Aggregate	Gasoline	72131.45693	144262.9	0	9.662809904	9662.809904	9662.809904	397968.797	397968.797	**41.19**	**MCY**
San Joaquin Valley	2024	MDV	Aggregate	Aggregate	Gasoline	603341.7501	2720908	0	1115.375628	1115375.628	1132266.797	21447403.32	22086040.56	**19.51**	**MDV**
San Joaquin Valley	2024	MDV	Aggregate	Aggregate	Diesel	9136.287951	42317.49	0	14.22000987	14220.00987		349976.2265			
San Joaquin Valley	2024	MDV	Aggregate	Aggregate	Electricity	3563.058628	18203.02	49844.84223	0	0		129104.1106			
San Joaquin Valley	2024	MDV	Aggregate	Aggregate	Plug-in Hybrid	3361.829524	13901.17	24569.64142	2.671159153	2671.159153		159556.9045			
San Joaquin Valley	2024	MH	Aggregate	Aggregate	Gasoline	8368.221093	837.1568	0	16.64893506	16648.93506	20398.43966	73441.61156	108727.0967	**5.33**	**MH**
San Joaquin Valley	2024	MH	Aggregate	Aggregate	Diesel	4046.860917	404.6861	0	3.749504597	3749.504597		35285.48513			
San Joaquin Valley	2024	MHDT	Aggregate	Aggregate	Gasoline	4102.384281	82080.5	0	49.54614262	49546.14262	248592.3107	232785.3097	1963841.913	**7.90**	**MHDT**
San Joaquin Valley	2024	MHDT	Aggregate	Aggregate	Diesel	35629.61693	427304.9	0	196.3595694	196359.5694		1706105.994			
San Joaquin Valley	2024	MHDT	Aggregate	Aggregate	Electricity	105.3935739	1334.617	6566.449551	0	0		5970.977911			
San Joaquin Valley	2024	MHDT	Aggregate	Aggregate	Natural Gas	358.0916483	2773.915	0	2.686598731	2686.598731		18979.63179			
San Joaquin Valley	2024	OBUS	Aggregate	Aggregate	Gasoline	1293.408525	25878.52	0	13.68661197	13686.61197	21790.1299	65025.8265	119780.7772	**5.50**	**OBUS**
San Joaquin Valley	2024	OBUS	Aggregate	Aggregate	Diesel	694.8682592	8946.252	0	7.99908921	7999.08921		53775.81972			
San Joaquin Valley	2024	OBUS	Aggregate	Aggregate	Electricity	2.098518815	41.98716	239.8267442	0	0		216.2366432			
San Joaquin Valley	2024	OBUS	Aggregate	Aggregate	Natural Gas	13.05684082	116.2059	0	0.104428721	104.428721		762.8943354			
San Joaquin Valley	2024	SBUS	Aggregate	Aggregate	Gasoline	1103.053416	4412.214	0	6.838528214	6838.528214	20698.91048	67587.25208	173519.2719	**8.38**	**SBUS**
San Joaquin Valley	2024	SBUS	Aggregate	Aggregate	Diesel	3904.184742	56532.6	0	10.65785774	10657.85774		87343.2412			
San Joaquin Valley	2024	SBUS	Aggregate	Aggregate	Electricity	11.90280977	160.2921	341.1750972	0	0		323.8628191			
San Joaquin Valley	2024	SBUS	Aggregate	Aggregate	Natural Gas	724.3049401	10487.94	0	3.202524526	3202.524526		18264.91575			
San Joaquin Valley	2024	UBUS	Aggregate	Aggregate	Gasoline	323.2416707	1292.967	0	4.368511345	4368.511345	15987.84296	22139.35711	106366.3689	**6.65**	**UBUS**
San Joaquin Valley	2024	UBUS	Aggregate	Aggregate	Diesel	235.9037236	943.6149	0	2.434681385	2434.681385		22916.36038			
San Joaquin Valley	2024	UBUS	Aggregate	Aggregate	Electricity	30.74245853	122.9698	3180.789994	0	0		1824.244126			
San Joaquin Valley	2024	UBUS	Aggregate	Aggregate	Natural Gas	562.7442454	2250.977	0	9.184650232	9184.650232		59486.40732			



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APPENDIX B

Biological Resources (ELMT 2023)

October 5, 2024

ARDURRA
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SUBJECT: Biological Resources Assessment for the Proposed Stanislaus Elementary School 1, 2, 3-TCP Mitigation Project Located in Stanislaus County, California

Introduction

This report contains the findings of ELMT Consulting's (ELMT) biological resources assessment for Stanislaus Elementary School 1, 2, 3-TCP Mitigation Project (project, project site), located in Stanislaus County, California. The habitat assessment was conducted by biologist Jacob H. Lloyd Davies on December 5, 2023, to document baseline conditions and assess the potential for special-status[1] plant and wildlife species to occur within the project site that could pose a constraint to implementation of the proposed project. Special attention was given to the suitability of the project site to support special-status plant and wildlife species identified by the California Department of Fish and Wildlife's (CDFW) California Natural Diversity Database (CNDDB), and other electronic databases as potentially occurring in the general vicinity of the project. Additionally, the report also addresses resources protected under the Migratory Bird Treaty Act (MBTA) and California Fish and Game Code (FGC), federal Clean Water Act (CWA) regulated by the United States Army Corps of Engineers (Corps) and Regional Water Quality Control Board (Regional Board) respectively, and Section 1602 of the FGC administered by CDFW.

Project Location

The proposed project site is generally located north and east of State Route 99, south of the Stanislaus River, and west of State Route 108 in unincorporated Stanislaus County, California. The project is located approximately 0.5 miles north of the City Limits of Modesto, within part of Modesto's approved Sphere of Influence (SOI), and also within the Study Area of the City's Water Master Plan. Specifically, the project occupies an east/west oriented right-of-way alignment, within Kiernan Avenue, between Sections 1 (Township 3 South, Range 8 East) and 36 (Township 2 South, Range 8 East), and Sections 6 (Township 3 South, Range 9 East) and 31 (Township 2 South, Range 9 East) Mt. Diablo Base and Meridian. The alignment continues briefly south before terminating on Dale Road at the western end and continues briefly both south and north along Tully Road before terminating at the eastern end. Refer to Exhibits 1-3 in Attachment A.

Project Description

The proposed Project is the consolidation of Stanislaus Union School District (SUSD) service area (Water

1 As used in this report, "special-status" refers to plant and wildlife species that are federally and State listed, proposed, or candidates; plant species that have been designated with a California Native Plant Society Rare Plant Rank; wildlife species that are designated by the CDFW as fully protected, species of special concern, or watch list species; and specially protected natural vegetation communities as designated by the CDFW.

System No. CA5000249) with the City of Modesto, through an extension of water and wastewater services, and the abandonment of the existing Well 02. Stanislaus Elementary School is one of six schools located within SUSD (five (5) elementary schools; one (1) junior high school); however, Stanislaus Elementary School is the only school currently being serviced by Water System No. CA5000249 since it is the only school within the district located outside of Modesto's Water System and City Limits.

Proposed Water Improvements

Water improvements will construct a total of approximately 12,000 linear feet of 12-inch potable water pipeline along Tully Road; Kieran Avenue; and Dale Road. See *Table 4: Project Alignment*. The pipeline will extend from the existing dead-end 12- inch potable water main along Tully Road, approximately 700 feet south from the Tully Road and Kieran Avenue intersection. From the existing connection point, the potable water pipeline will continue north towards Keiran Avenue, then west towards Dale Road along Kieran Avenue. The Project Alignment will terminate along Dale Road and connect with the existing dead-end 12- inch potable water main, approximately 570 feet from the Dale Road and Keiran Avenue intersection.

Due to the connection to two existing dead-end 12-inch pipelines along Tully Road and Dale Road, the proposed water improvements will meet fire flow requirements (33 psi at 4,000 gpm); meet the City's operational and performance criteria; and result in high pipeline turnover rates which benefit water quality within the distribution system. The entire alignment will be buried underground using open trench construction as well as jack and bore construction to avoid direct impacts to existing utilities and structures. Temporary areas of disturbance as a result of trenching is anticipated to be 4-feet wide and 8-feet deep along the entire 12,000 linear feet of Project Alignment, approximately 1.1 acres. Jack and bore construction will consist of 5 total pits[2]. Jacking pits are approximately 12-ft wide by 10-ft long by 15-ft deep and receiving pits that are approximately 12-ft wide by 24-ft long x 15-ft deep, resulting in approximately 0.03 acres of disturbance. As a result, earthwork quantities are approximately 3,348 cubic yards (CY) of export and 4,680 CY of import.

One service lateral will be located near the southwestern corner of the Stanislaus Elementary School property line. Following the installation of the Project Alignment, the abandonment of the existing Well 02 will occur. Abandonment and permanent sealing of SUSD Well 02 will occur in accordance with requirements set forth by the City of Modesto's Director of Utilities and Environmental Resources Department of Stanislaus County.

Methodology

A literature review and records search were conducted to determine which special-status biological resources have the potential to occur on or within the general vicinity of the project site. In addition to the literature review, a general habitat assessment or field investigation of the project site was conducted to document existing conditions and assess the potential for special-status biological resources to occur within the project site.

2 For the purposes of noise, air quality/GHG, and traffic modeling, assumptions to were made about the location of jacking and receiving pits based on a "worst-case scenario". Under "worst-case" conditions, boring locations are located closest to sensitive receptors adjacent to the Project Alignment: one (1) along the east side of Dale Road, approximately 150 feet from sensitive receptors; three (3) along the north side of Kiernan Avenue, bordering the southern perimeter of Stanislaus Elementary School, approximately 50 ft from the closest sensitive receptors; and one (1) along the west side of Tully Road, approximately 50 ft from the closest sensitive receptors.

Literature Review

Prior to conducting the field investigation, a literature review and records search was conducted for special-status biological resources potentially occurring on or within the vicinity of the project site. Previously recorded occurrences of special-status plant and wildlife species and their proximity to the project site were determined through a query of the CDFW's QuickView Tool in the Biogeographic Information and Observation System (BIOS), CNDDB Rarefind 5, the California Native Plant Society's (CNPS) Electronic Inventory of Rare and Endangered Vascular Plants of California, Calflora Database, compendia of special-status species published by CDFW, and the United States Fish and Wildlife Service (USFWS) species listings.

All available reports, survey results, and literature detailing the biological resources previously observed on or within the vicinity of the project site were reviewed to understand existing site conditions and note the extent of any disturbances that have occurred within the project site that would otherwise limit the distribution of special-status biological resources. Standard field guides and texts were reviewed for specific habitat requirements of special-status and non-special-status biological resources, as well as the following resources:

- Google Earth Pro historic aerial imagery (1985-2024);
- United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS), Soil Survey[3];
- USFWS Critical Habitat designations for Threatened and Endangered Species; and
- USFWS Endangered Species Profiles.

The literature review provided a baseline from which to inventory the biological resources potentially occurring within the project site. The CNDDB database was used, in conjunction with ArcGIS software, to locate the nearest recorded occurrences of special-status species and determine the distance from the project site.

Field Investigation

Following the literature review, biologist Jacob H. Lloyd Davies inventoried and evaluated the condition of the habitat within a 200-foot buffer around the project site, where applicable, on December 5, 2023. Plant communities and land cover types identified on aerial photographs during the literature review were verified by walking meandering transects throughout the project site. In addition, aerial photography was reviewed prior to the site investigation to locate potential natural corridors and linkages that may support the movement of wildlife through the area. These areas identified on aerial photography were then walked during the field investigation.

Soil Series Assessment

On-site and adjoining soils were researched prior to the field investigation using the USDA NRCS Soil Survey for Stanislaus County, California. In addition, a review of the local geological conditions and historical aerial photographs was conducted to assess the ecological changes that the project site has

3 A soil series is defined as a group of soils with similar profiles developed from similar parent materials under comparable climatic and vegetation conditions. These profiles include major horizons with similar thickness, arrangement, and other important characteristics, which may promote favorable conditions for certain biological resources.

undergone.

Plant Communities

Plant communities were mapped using 7.5-minute USGS topographic base maps and aerial photography. The plant communities were classified in accordance with Sawyer, Keeler-Wolf and Evens (2009), delineated on an aerial photograph, and then digitized into GIS Arcview. The Arcview application was used to compute the area of each plant community and/or land cover type in acres.

Plants

Common plant species observed during the field investigation were identified by visual characteristics and morphology in the field and recorded in a field notebook. Unusual and less-familiar plants were photographed in the field and identified in the laboratory using taxonomic guides. Taxonomic nomenclature used in this study follows the 2012 Jepson Manual (Hickman 2012). In this report, scientific names are provided immediately following common names of plant species (first reference only).

Wildlife

Wildlife species detected during the field investigation by sight, calls, tracks, scat, or other sign were recorded during surveys in a field notebook. Field guides used to assist with identification of wildlife species during the survey included The Sibley Field Guide to the Birds of Western North America (Sibley 2003), A Field Guide to Western Reptiles and Amphibians (Stebbins 2003), and A Field Guide to Mammals of North America (Reid 2006). Although common names of wildlife species are well standardized, scientific names are provided immediately following common names in this report (first reference only).

Jurisdictional Drainages and Wetlands

Aerial photography was reviewed prior to conducting a field investigation in order to locate and inspect any potential natural drainage features, ponded areas, or water bodies that may fall under the jurisdiction of the United States Army Corps of Engineers (Corps), Regional Water Quality Control Board (Regional Board), or CDFW. In general, surface drainage features indicated as blue-line streams on USGS maps that are observed or expected to exhibit evidence of flow are considered potential riparian/riverine habitat and are also subject to state and federal regulatory jurisdiction. In addition, ELMT reviewed jurisdictional waters information through examining historical aerial photographs to gain an understanding of the impact of land-use on natural drainage patterns in the area. The USFWS National Wetland Inventory (NWI) and Environmental Protection Agency (EPA) Water Program "My Waters" data layers were also reviewed to determine whether any hydrologic features and wetland areas have been documented on or within the vicinity of the project site.

Existing Site Conditions

The proposed project site occurs in an area dominated by agricultural land uses on the northern periphery of the City of Modesto. The site is bounded primarily by active agriculture, with scattered commercial, residential, and institutional developments present. The proposed project will be limited to existing developed roads and thoroughfares in the public right-of-way. No natural plant communities are present within or adjacent to the project site.

Topography and Soils

The project site is generally flat with no areas of topographic variability and occurs at an average elevation of approximately 93 feet above mean sea level. Based on the NRCS USDA Web Soil Survey, the project site is historically underlain by Dinuba fine sandy loam (0 to 1 percent slopes, MLRA 17), Hanford fine sandy loam (0 to 1 percent slopes, moderately deep over silt), Hanford sandy loam (0 to 3 percent slopes), and Hanford sandy loam (0 to 1 percent slopes, moderately deep over silt). Refer to Exhibit 4, *Soils*, in Attachment A. Soils on-site have been disturbed and compacted by historic and ongoing land uses and on-site and surrounding development.

Vegetation

Due to historic and ongoing land uses, no natural plant communities are supported within or adjacent to the project site. All project activities are to take place within public right-of-way that supports existing paved roads and associated spaces and infrastructure. The site supports two (2) land cover types that would be classified as disturbed and developed. (refer to Exhibit 4, *Vegetation and Land Cover Types*, in Attachment A). Refer to Attachment B, *Site Photographs*, for representative site photographs.

The majority of the project site supports developed land in the form of paved roads and related infrastructure. Developed areas are generally devoid of vegetation or may support scattered weedy/early successional plant species that are well-adapted to establishing in such conditions. Disturbed land supported by the project site occurs adjacent to existing roads and typically consists of earthen substrates that were installed in association with flood control measures. Such features range from roadside ditches to shallow medians with flowlines that were installed below the grade of adjacent roads, and often support storm drain inlets. These areas are routinely subject to weed abatement regimes to maintain flood control integrity. Disturbed land supported by the project site is generally barren or minimally vegetated with weedy/early successional species. Common plant species observed on-site during the field investigation include black mustard (*Brassica nigra*), morning glory (*Calystegia occidentalis*), yellow starthistle (*Centaurea melitensis*), mustard (*Hirschfeldia incana*), telegraph weed (*Heterotheca grandiflora*), cheese weed (*Malva parviflora*), and Russian thistle (*Salsola tragus*).

Wildlife

Plant communities provide foraging habitat, nesting/denning sites, and shelter from adverse weather or predation. This section provides a discussion of those wildlife species that were observed or are expected to occur within the project site. The discussion is to be used as a general reference and is limited by the season, time of day, and weather conditions in which the field investigation was conducted. Wildlife detections were based on calls, songs, scat, tracks, burrows, and direct observation. The project site provides moderate habitat for wildlife species, especially those adapted to a high degree of anthropogenic disturbances and development.

Fish

No fish or hydrogeomorphic features (e.g., perennial creeks, ponds, lakes, reservoirs) that would provide suitable habitat for fish were observed on or within the vicinity of the site. Therefore, no fish are expected to occur and are presumed absent.

Amphibians

No amphibians or hydrogeomorphic features (e.g., perennial creeks, ponds, lakes, reservoirs) that would provide suitable habitat for amphibian species were observed on or within the vicinity of the site. Therefore, no amphibians are expected to occur.

Reptiles

No reptiles or suitable habitat for reptiles were observed within the project site. Limited habitat for local reptiles is present adjacent to the roadways that support the project site, but no such area occurs adjacent to boundaries of the project site itself. Therefore, no reptiles are expected to occur.

Birds

The project site itself does not support suitable foraging or nesting habitat for local avian species beyond perching opportunities; however, the agriculture, development, and ornamental landscaping that occurs in the surrounding area provide suitable foraging and nesting habitat for resident and migratory bird species adapted to routine disturbance and development. Bird species detected during the field investigation include Cooper's hawk (*Accipiter cooperii*), California scrub-jay (*Aphelocoma california*), red-tailed hawk (*Buteo jamaicensis*), killdeer (*Charadrius vociferans*), yellow-rumped warbler (*Setophaga coronate*), European starling (*Sturnus vulgaris*), and white-crowned sparrow (*Zonotrichia leucophrys*).

Mammals

The project site itself does not support suitable foraging or cover habitat for local mammalian species; however, mammals may occur incidentally while foraging in adjacent areas. No mammalian species were detected during the field investigation. Common mammalian species that may be expected to occur include coyote (*Canis latrans*), opossum (*Didelphis virginiana*), and raccoon (*Procyon lotor*). In addition, local bat species such as western red bat (*Lasiurus frantzii*) that are adapted to routine disturbance may utilize surrounding agriculture and ornamental landscaping for roosting purposes.

Nesting Birds

No active nests or birds displaying nesting behavior were observed during the field survey, which was conducted outside the normal breeding season. No suitable nesting opportunities or habitats occur within the project site itself, but surrounding agriculture and ornamental landscaping provide viable nesting habitat for year-round and seasonal avian residents, as well as migrating songbirds that could occur in the area that are adapted to routine disturbance. In addition, suitable nesting opportunities for raptors occur throughout adjacent areas, and disturbed land surrounding the site has the potential to provide suitable nesting opportunities for ground-nesting species such as killdeer, which was observed in adjacent disturbed land.

Nesting birds are protected pursuant to the Migratory Bird Treaty Act (MBTA) and California Fish and Game Code (Sections 3503, 3503.5, 3511, and 3513 prohibit the take, possession, or destruction of birds, their nests or eggs). If construction occurs between February 1st and August 31st, a pre-construction clearance survey for nesting birds should be conducted within three (3) days of the start of any vegetation removal or ground disturbing activities to ensure that no nesting birds will be disturbed during construction.

Migratory Corridors and Linkages

Habitat linkages provide connections between larger habitat areas that are separated by development. Wildlife corridors are similar to linkages but provide specific opportunities for animals to disperse or migrate between areas. A corridor can be defined as a linear landscape feature of sufficient width to allow animal movement between two comparatively undisturbed habitat fragments. Adequate cover is essential for a corridor to function as a wildlife movement area. It is possible for a habitat corridor to be adequate for one species yet still inadequate for others. Wildlife corridors are features that allow for the dispersal, seasonal migration, breeding, and foraging of a variety of wildlife species. Additionally, open space can provide a buffer against both human disturbance and natural fluctuations in resources.

The proposed project has not been mapped as occurring within any recognized wildlife corridor or linkage. As mapped by CDFW, the nearest mapped wildlife corridor to the site occurs approximately 1.75 miles to the north within and along the Stanislaus River, beyond existing development and active agriculture. No impacts to any mapped wildlife corridors will occur from project implementation. The site does occur in proximity to a variety of land uses that provide movement and stopover opportunities for local wildlife; however, project activities will be confined to developed land and no impacts to suitable migratory or stopover habitat are expected to occur.

Jurisdictional Areas

There are three key agencies that regulate activities within inland streams, wetlands, and riparian areas in California. The Corps Regulatory Branch regulates discharge of dredge or fill materials into "waters of the United States" pursuant to Section 404 of the Clean Water Act (CWA) and Section 10 of the Rivers and Harbors Act. Of the State agencies, the CDFW regulates alterations to streambed and bank under Fish and Wildlife Code Sections 1600 et seq., and the Regional Board regulates discharges into surface waters pursuant to Section 401 of the CWA and the California Porter-Cologne Water Quality Control Act.

The USFWS NWI and the USGS National Hydrography Dataset were reviewed to determine if any blueline streams or riverine resources have been documented within or immediately surrounding the project site. Based on this review, no blueline streams or riverine resources occur within the project site. However, one (1) riverine resource is mapped as occurring roughly adjacent to a portion of Kiernan Avenue; however, this feature occurs outside of the limits of disturbance for the project and no impacts to this feature will occur. In addition, several blueline streams and riverine resources are also mapped in the surrounding area, all of which correlate to a network of canals that support irrigation for local agriculture.

No impacts to Corps, Regional Board, or CDFW jurisdictional features will occur from project implementation, and regulatory approvals will not be required.

Special-Status Biological Resources

The CNDDB Rarefind 5 and the CNPS Electronic Inventory of Rare and Endangered Vascular Plants of California were queried for reported locations of special-status plant and wildlife species as well as special-status natural plant communities in the Salida USGS 7.5-minute quadrangles. Both quadrangles were queried due to the proximity of the project site to quadrangle boundaries. The habitat assessment evaluated the conditions of the habitat(s) within the boundaries of the project site to determine if the existing plant communities, at the time of the survey, have the potential to provide suitable habitat(s) for special-status plant and wildlife species.

The literature search identified twenty-four (24) special-status wildlife species, as having potential to occur within the Salida USGS 7.5-minute quadrangle. No special-status plant species or special-status plant communities are recorded within the Salida quadrangle. Special-status wildlife species were evaluated for their potential to occur within the project site based on habitat requirements, availability and quality of suitable habitat, and known distributions. Species determined to have the potential to occur within the general vicinity of the project site is presented in Attachment D*: Potentially Occurring Special-Status Biological Resources*.

Special-Status Plants

According to the CNDDB and CNPS, no special-status plant species have been recorded in the Salida quadrangle (refer to Attachment D). No special-status plant species were observed on-site during the habitat assessment. The project site and surrounding area have been subject to decades of anthropogenic disturbances including full development of the site and adjacent areas. These disturbances have reduced the suitability of the habitat to support special-status plant species known to occur in the general vicinity of the project site. Based on habitat requirements for specific special-status plant species and the availability and quality of habitats needed by each species, it was determined that the project site does not provide suitable habitat for special-status plant species. No focused surveys are recommended.

Special-Status Wildlife

According to the CNDDB, twenty-four (24) special-status wildlife species have been reported in the Salida quadrangle (refer to Attachment D). No special-status wildlife species reported within the Salida quadrangle were observed during the habitat assessment. One (1) special-status wildlife species not included in the Salida quadrangle, Cooper's hawk (a California Watch List Species), was observed foraging nearby. The project site has supported developed land for several decades and no longer supports suitable habitats for special-status species. Cooper's hawk is only expected to occur on-site incidentally while foraging due to the lack of suitable nesting opportunities, but suitable nesting opportunities do occur in proximity to the site.

However, active agricultural dominates the surrounding area, which often provides suitable foraging habitat for local and migratory species. Based on habitat requirements for specific species and the availability and quality of on-site and adjacent habitats, it was determined that the proposed project site has a low potential to support Swainson's hawk (*Buteo swainsoni*; State Threatened species). It was further determined that the site does not provide suitable habitat for the remaining special-status species known to occur in the vicinity and all are presumed to be absent. Swainson's hawk and Cooper's hawk are only expected to occur on-site incidentally while foraging due to the lack of suitable nesting opportunities, but suitable nesting opportunities do occur in proximity to the site.

With the completion of a pre-construction nesting bird clearance survey, no significant impacts to special-status avian species will occur. Due to listing status and known occurrence in the vicinity of the site, the potential of the project site to support coastal Swainson's hawk is discussed in further detail below.

Swainson's Hawk

The Swainson's hawk (*Buteo swainsoni*) is listed as a California state threatened species under the California Endangered Species Act. It is not listed as threatened or endangered under the federal Endangered Species Act. It spends most of the year in the western United States extending into southwest

Canada and south to west Texas. Foraging habitat includes dry land and irrigated pasture, alfalfa, fallow fields, low-growing row or field crops, new orchards, and cereal grain crops. Gophers dominate the prey base of agriculturally based pairs while Swainson's hawks nesting in natural desert habitats consume a wider variety of prey species. Other prey includes small reptiles, large insects, small birds, and other small mammals like mice and ground squirrels.

Breeding begins in March and April. Central Valley Swainson's hawks are known to nest in agricultural areas or prairies within scattered groves of trees. This species prefers to nest in tall trees such as oaks, aspens, cottonwoods, conifers, and ornamental trees which may surround open agricultural fields and pastures where they feed. These hawks are mostly monogamous, and a breeding pair may return to a previous nesting site. When the nest is complete, the female lays 2 to 4 pale bluish white eggs, usually with brown flecks. The male usually helps the female during the incubation period, which can last for 35 days. Swainson's hawk chicks hatch between March and July and begin to fly approximately 43 days after hatching. However, young Swainson's hawks may remain with their parents until the fall migration. Most of California's Central Valley Swainson's hawk population migrates in Mexico, Central America, and South America, but a small percentage remains in the Central Valley to overwinter.

It is estimated that 95% of California's Swainson's hawk population resides in the Central Valley. Historically, breeding pairs of Swainson's hawks are said to have been over 17,000. However, these numbers declined drastically to an estimated 375 pairs in California in 1980. Species decline has been largely attributed to habitat loss, pesticide poisoning, and poaching. However, the species has made a steady recovery since 1980 and the number of breeding pairs is estimated to be over 18,000 in California. Although much of their natural habitat has been lost, the Swainson's hawk has shown to be a fairly adaptable species, and many populations have been successful in novel agricultural settings.

Swainson's hawk was not observed during the field investigation. While perching opportunities are present along the existing roadways, no suitable foraging or nesting habitat is present onsite. However, suitable foraging habitat is present in the active agriculture that occurs in the surrounding area. Therefore, the project site was determined to have a low potential to support Swainson's hawk, although only incidentally during foraging.

Special-Status Plant Communities

According to the CNDDB, no special-status plant communities have been reported in the Salida USGS 7.5-minute quadrangle. No special-status plant communities or natural plant communities of any kind were observed during the field investigation. Therefore, no special-status plant communities will be impacted by implementation of the proposed project.

Critical Habitats

Under the federal Endangered Species Act, "Critical Habitat" is designated at the time of listing of a species or within one year of listing. Critical Habitat refers to specific areas within the geographical range of a species at the time it is listed that include the physical or biological features that are essential to the survival and eventual recovery of that species. Maintenance of these physical and biological features requires special management considerations or protection, regardless of whether individuals or the species are present or not. All federal agencies are required to consult with the USFWS regarding activities they authorize, fund, or permit which may affect a federally listed species or its designated Critical Habitat. The purpose of the

consultation is to ensure that projects will not jeopardize the continued existence of the listed species or adversely modify or destroy its designated Critical Habitat. The designation of Critical Habitat does not affect private landowners, unless a project they are proposing is on federal lands, uses federal funds, or requires federal authorization or permits (e.g., funding from the Federal Highways Administration or a Clean Water Act Permit from the United States Army Corps of Engineers). If there is a federal nexus, then the federal agency that is responsible for providing the funding or permit would consult with the USFWS.

The project site is not located within federally designated Critical Habitat. The nearest Critical Habitat designation is located approximately 7 miles to the southeast for conservancy fairy shrimp (*Branchinecta conservation*). Refer to Exhibit 5, *Critical Habitat*, in Attachment A. Therefore, no impacts to federally designated Critical Habitat will occur from implementation of the proposed project.

Stanislaus County General Plan

The Conservation/Open Space Element of the Stanislaus County General Plan is a framework designed to safeguard and manage the natural resources and open spaces located within the County. It encompasses the identification and mapping of key natural resources, including wildlife habitats, water bodies, and agricultural lands. The plan outlines strategies for sustainable resource management, prioritizing environmental protection with policies to maintain water and air quality and control pollution. A significant focus is placed on preserving open spaces for ecological values, including zoning regulations that support conservation and designating areas specifically for this purpose. Additionally, the plan emphasizes public access to these spaces to ensure sustainability and recreational opportunities and ongoing monitoring and adaptive management to address evolving environmental challenges.

The project site does not occur within or adjacent to any areas designated for conservation. Therefore, project implementation will not result in impacts to areas covered under the Conservation/Open Space Element of the Stanislaus County General Plan.

Conclusion

Based on the literature review and field investigation, and existing site conditions discussed in this report, implementation of the project will have no significant impacts on federally or State listed species known to occur in the general vicinity of the project site. Additionally, the project will have no effect on designated Critical Habitat, since there is no federal nexus, or regional wildlife corridors/linkages because none exist within the area. No jurisdictional drainage and/or wetland features were observed on the project site during the field investigation. No further surveys are recommended. With completion of the recommendations provided below, no impacts to year-round, seasonal, or special-status avian residents or special-status species will occur from implementation of the proposed project.

Recommendations

Migratory Bird Treaty Act and Fish and Game Code

Nesting birds are protected pursuant to the Migratory Bird Treaty Act (MBTA) and California Fish and Game Code (Sections 3503, 3503.5, 3511, and 3513 prohibit the take, possession, or destruction of birds, their nests or eggs). In order to protect migratory bird species, a nesting bird clearance survey should be conducted prior to any ground disturbance or vegetation removal activities that may disrupt the birds during the nesting season.

If construction occurs between February 1st and August 31st, a pre-construction clearance survey for nesting birds should be conducted within three (3) days of the start of any vegetation removal or ground disturbing activities to ensure that no nesting birds will be disturbed during construction. The biologist conducting the clearance survey should document a negative survey with a brief letter report indicating that no impacts to active avian nests will occur. If an active avian nest is discovered during the pre-construction clearance survey, construction activities should stay outside of a no-disturbance buffer. The size of the no-disturbance buffer will be determined by the wildlife biologist and will depend on the level of noise and/or surrounding anthropogenic disturbances, line of sight between the nest and the construction activity, type and duration of construction activity, ambient noise, species habituation, and topographical barriers. These factors will be evaluated on a case-by-case basis when developing buffer distances. Limits of construction to avoid an active nest will be established in the field with flagging, fencing, or other appropriate barriers; and construction personnel will be instructed on the sensitivity of nest areas. A biological monitor should be present to delineate the boundaries of the buffer area and to monitor the active nest to ensure that nesting behavior is not adversely affected by the construction activity. Once the young have fledged and left the nest, or the nest otherwise becomes inactive under natural conditions, construction activities within the buffer area can occur.

Please do not hesitate to contact Travis McGill at (909) 816-1646 or travismcgill@elmtconsulting.com should you have any questions.

Sincerely,



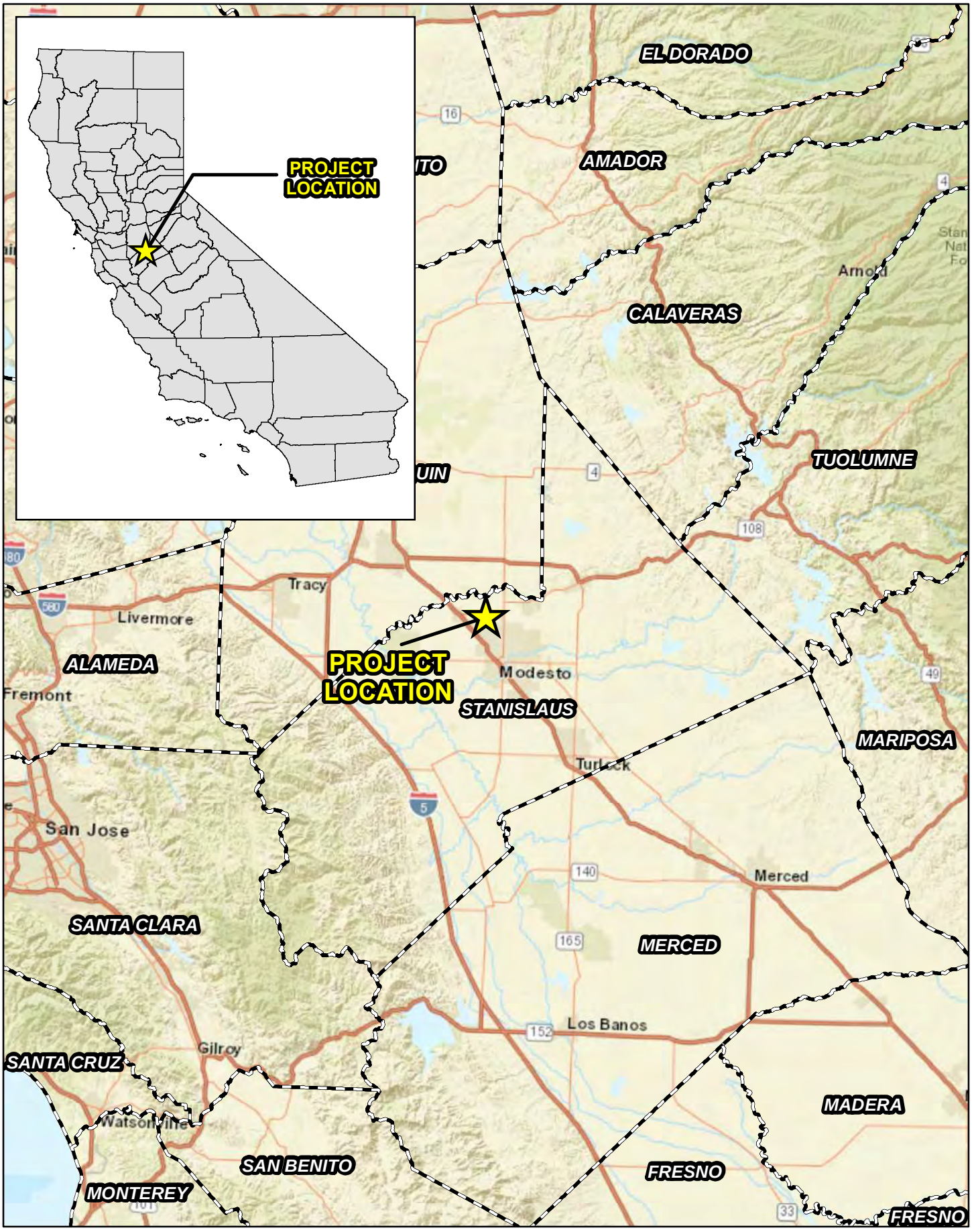
Travis J. McGill
Senior Biologist/Director

Attachments:

A. *Project Exhibits*
B. *Site Plan*
C. *Site Photographs*
D. *Potentially Occurring Special-Status Biological Resources*
E. *Regulations*
F. *IPaC Species List*

Attachment A

Project Exhibits



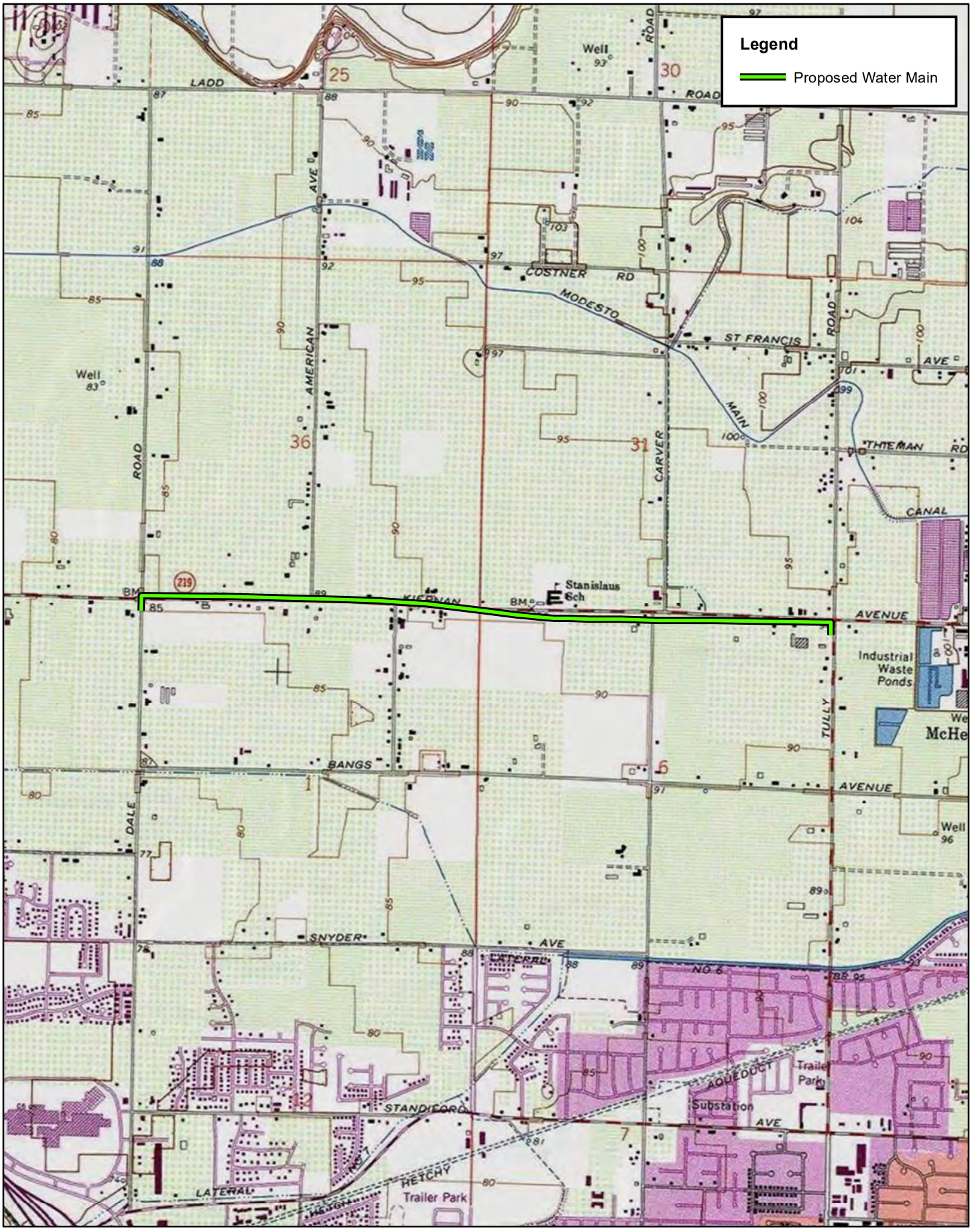
0 5 10 20 Miles

Source: World Street Map, Stanislaus County

Stanislaus Elemetary School 1, 2, 3-TCP Mitigation Project

Regional Vicinity

Exhibit 1



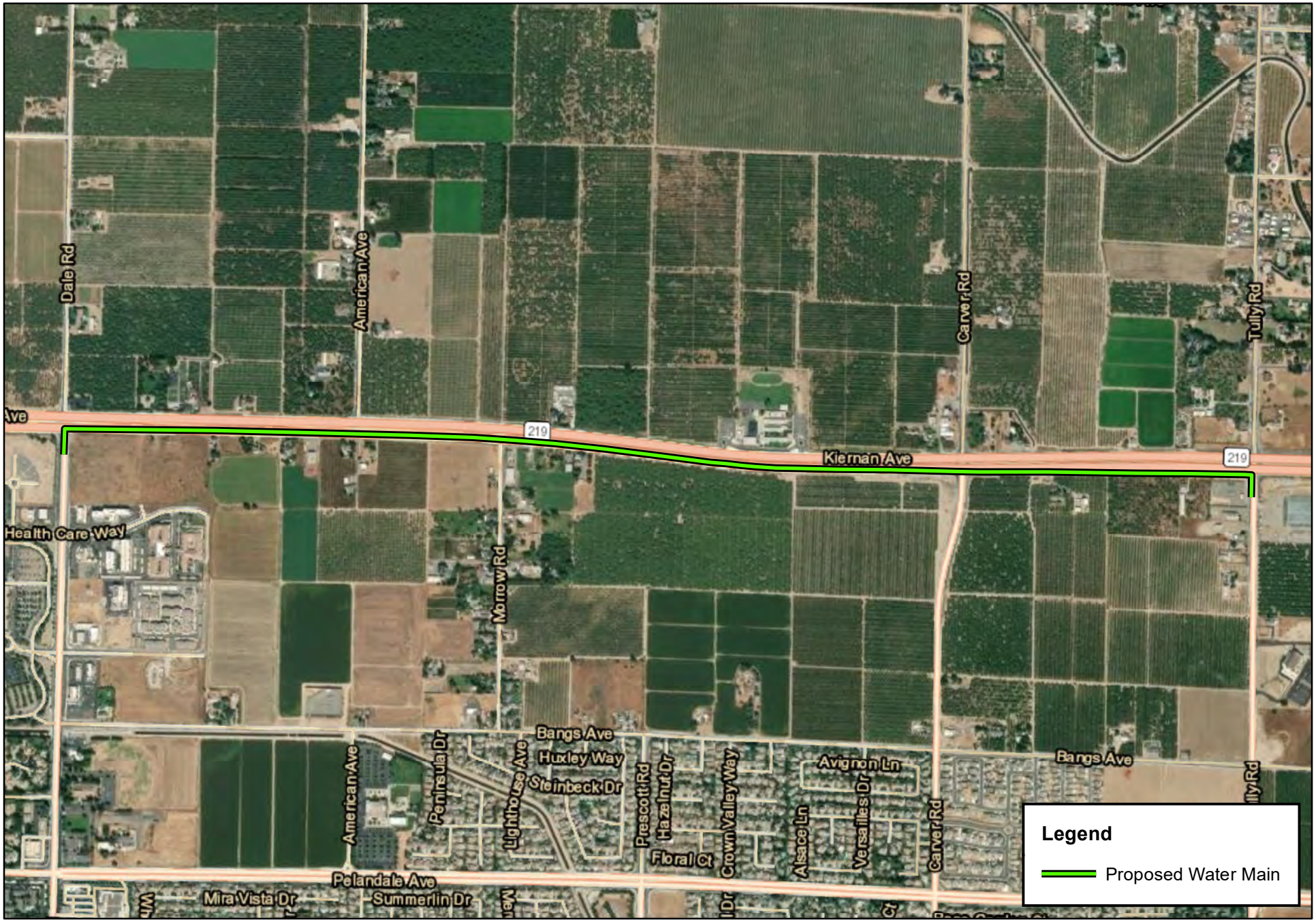
0 1,000 2,000 4,000 Feet

Source: USA Topographic Map, Stanislaus County

Stanislaus Elemetary School 1, 2, 3-TCP Mitigation Project

Site Vicinity

Exhibit 2



ELMT CONSULTING

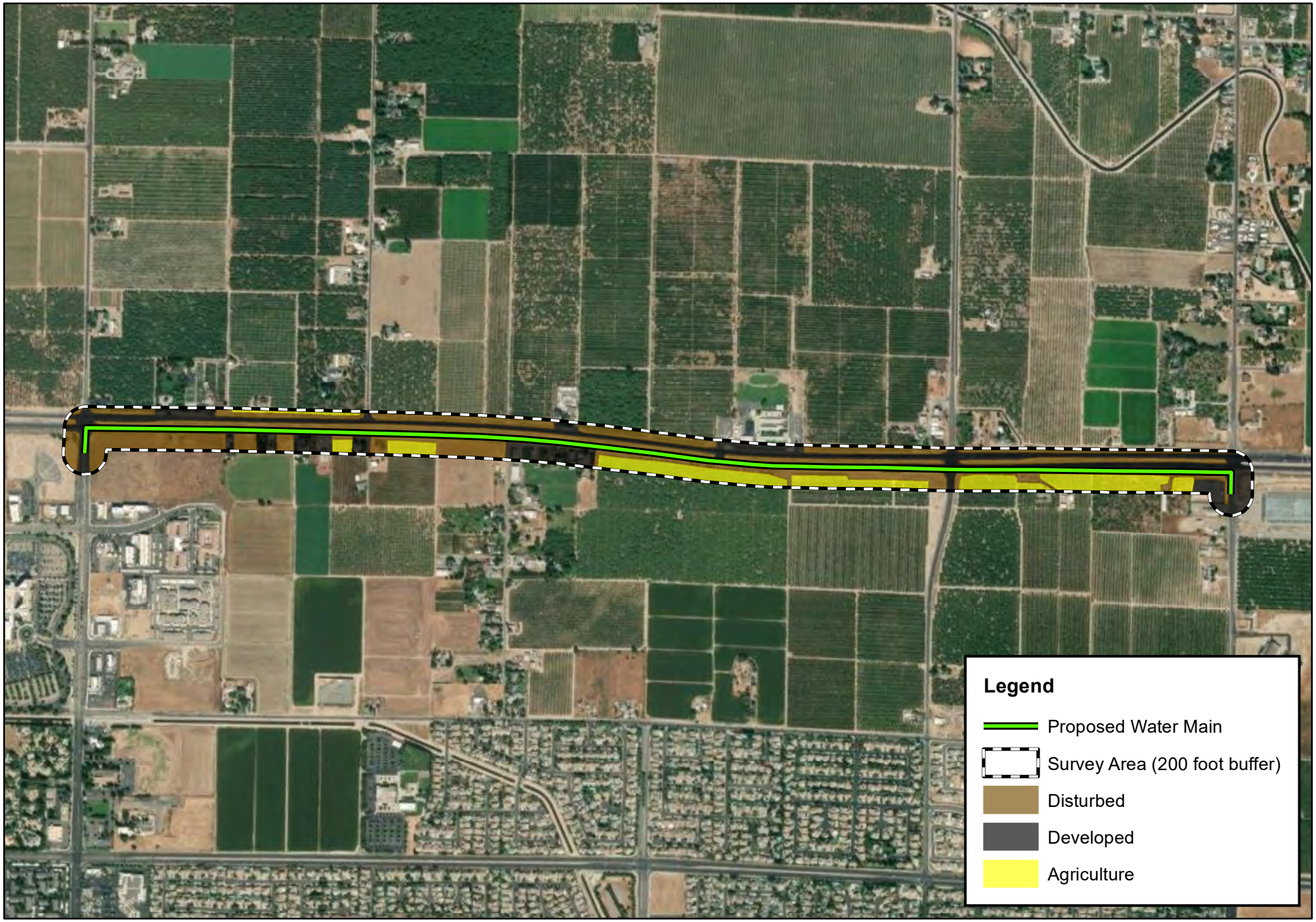
0 1,250 2,500 5,000 Feet

Source: ESRI Aerial Imagery, Stanislaus County

Stanislaus Elemetary School 1, 2, 3-TCP Mitigation Project

Project Site

Exhibit 3



ELMT CONSULTING

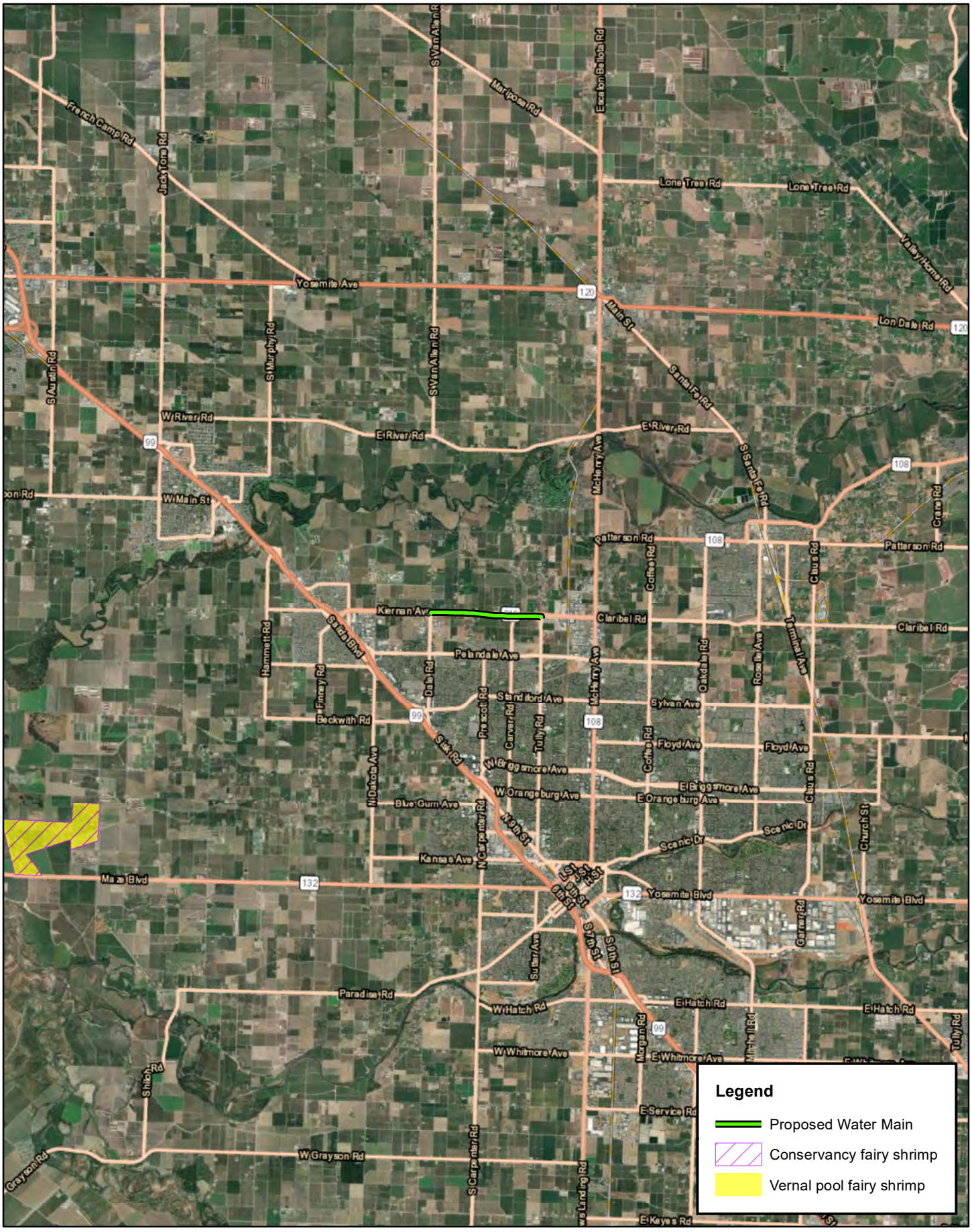
0 1,250 2,500 5,000 Feet

Source: ESRI Aerial Imagery, Stanislaus County

Stanislaus Elemetary School 1, 2, 3-TCP Mitigation Project

Vegetation and Land Cover Types

Exhibit 4



Stanislaus Elemetary School 1, 2, 3-TCP Mitigation Project

Critical Habitat

Source: ESRI Aerial Imagery, USFWS Critical Habitat, Stanislaus County

Exhibit 5

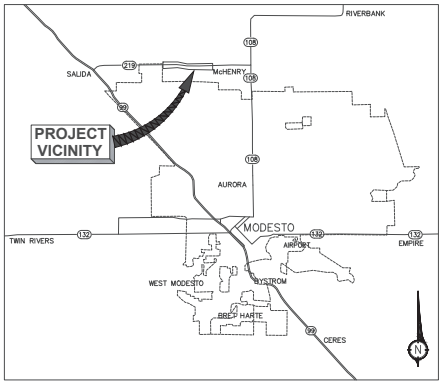
Attachment B

Site Plan

CITY OF MODESTO

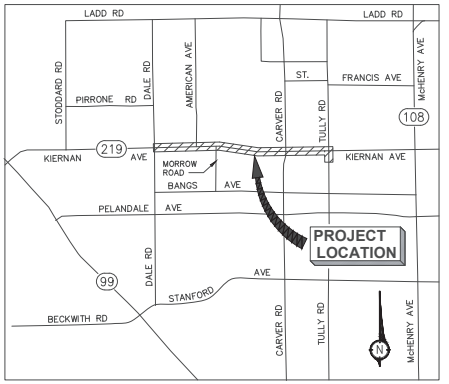
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN



VICINITY MAP
NTS

MODESTO
CALIFORNIA



LOCATION/INDEX MAP
NTS

DECLARATION OF RESPONSIBLE CHARGE

I HEREBY DECLARE THAT I AM THE ENGINEER OF WORK FOR THIS PROJECT, THAT I HAVE EXERCISED RESPONSIBLE CHARGE OVER DESIGN OF THIS PROJECT AS DEFINED IN SECTION 6703 OF THE BUSINESS AND PROFESSIONS CODE, AND THAT THE DESIGN IS CONSISTENT WITH CURRENT STANDARDS.

I UNDERSTAND THAT THE CHECK OF PROJECT DRAWINGS AND SPECIFICATIONS OF EASTERN MUNICIPAL WATER DISTRICT IS CONFINED TO A REVIEW ONLY AND DOES NOT RELIEVE ME, AS ENGINEER OF WORK, OF MY RESPONSIBILITIES FOR PROJECT DESIGN.

00/00/2024

DOLORES SALGADO R.C.E. 067536 DATE

ABBREVIATIONS

AC	ASPHALT	PGE	PACIFIC GAS & ELECTRIC
BL	BIKE LANE	R/W	RIGHT-OF-WAY
BD	BRASS DISC	SLBX	STREET LIGHT BOX
C	CONCRETE	S/W	SIDEWALK
CB	CATCH BASIN	SD	STORM DRAIN
CO	CLEANOUT	SDCB	STORM DRAIN CATCH BASIN
CONC	CONCRETE	SDCO	STORM DRAIN CLEANOUT
D/W	DRIVEWAY	SDI	STORM DRAIN DRAIN INLET
EB	EASTBOUND	SDMH	STORM DRAIN MANHOLE
ELEC	ELECTRIC	SHLD	SHOULDER
ELEV	ELEVATION	SP	SIGNAL POLE
EOP	EDGE OF PAVEMENT	SS	SANITARY SEWER
FH	FIRE HYDRANT	SSCO	SANITARY SEWER CLEANOUT
FL	FLOWLINE	SSMH	SANITARY SEWER MANHOLE
GB	GRADEBREAK	TC	TOP OF CURB
GM	GAS METER	TELE	TELECOMMUNICATION
G	GROUND	TRANS	TRANSFORMER
GR	GRATE	TSBX	TRAFFIC SIGNAL BOX
GV	GAS VALVE	UTIL	UTILITY
INV	INVERT	VLT/VLTS	VAULT/VAULTS
IRR	IRRIGATION	W	WATER
LN	LANE	WB	WESTBOUND
JP	JOINT UTILITY POLE	WM	WATER METER
MH	MANHOLE	WV	WATER VALVE
MTR	METER	x123.45	SPOT ELEVATION
PBMH	PACIFIC BELL MANHOLE		

UNDERGROUND UTILITY NOTE

UNDERGROUND UTILITIES SHOWN HEREON ARE A COMBINATION OF TOPOGRAPHIC SURVEY DATA OF PHYSICAL SURFACE STRUCTURES AND PREEXISTING MARKINGS. NO PG&E, AT&T, PACIFIC BELL OR OTHER UNDERGROUND DRY UTILITIES WERE MARKED AT TIME OF SURVEY OTHER THAN SHOWN HEREON. GIULIANI & KULL, INC. MAKES NO GUARANTEE AS TO THE ACCURACY OF REPRESENTED LOCATION OF UNDERGROUND GAS, ELECTRIC, TELECOMMUNICATIONS OR OTHER DRY UTILITIES. CALL 811 FOR UTILITY MARKING BEFORE CONSTRUCTION.

ALL UNDERGROUND UTILITY LINES SHOWN PER THE PLANS FURNISHED BY THE RESPECTIVE UTILITY COMPANIES. CONTRACTOR SHALL CONTACT UNDERGROUND SERVICE ALERT (USA) AT 811 TO VERIFY THE UTILITIES ON SITE BEFORE COMMENCING CONSTRUCTION. CONTRACTOR SHALL REQUEST HIGH PRESSURE STANDBY FROM SOCAL GAS DURING CONSTRUCTION NEAR EXISTING HIGH PRESSURE GAS LINE.

SYMBOL LEGEND

E	UNDERGROUND ELECTRICAL
T	UNDERGROUND TELECOMMUNICATIONS
OH	OVERHEAD UTILITY LINE
E	UNDERGROUND JOINT UTILITY
G	UNDERGROUND GAS LINE
SD	STORM DRAIN LINE
SS	SANITARY SEWER LINE
W	WATER LINE
IRR	IRRIGATION PIPELINE
	STREET RIGHT-OF-WAY LINE
	SECTION LINE
	SURFACE UTILITY STRUCTURE W/ TYPE
	MANHOLE W/ TYPE
	STORM DRAIN INLET
	STORM DRAIN CATCH BASIN
	FIRE HYDRANT
	WATER VALVE
	POLE MOUNTED STREET LIGHT
	TRAFFIC SIGNAL LIGHT
	UTILITY POLE
	MAILBOX
	STREET SIGN
	FOUND SURVEY MONUMENT IN WELL

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2	G-2	GENERAL NOTES
3	G-3	KEY MAP
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5	C-2	PLAN & PROFILE STA 22+00 TO 34+00
6	C-3	PLAN & PROFILE STA 34+00 TO 46+00
7	C-4	PLAN & PROFILE STA 46+00 TO 58+00
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12	C-9	PLAN & PROFILE STA 106+00 TO 118+00
13	C-10	PLAN & PROFILE STA 118+00 TO 122+92.65
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15	CD-2	DETAILS AND CONNECTIONS
16	CD-3	DETAILS AND CONNECTIONS
17	CD-4	DETAILS AND CONNECTIONS
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19	TCP-2	TRAFFIC CONTROL PLAN PHASE 1 FROM STA 10+00 TO 21+70
20	TCP-3	TRAFFIC CONTROL PLAN PHASE 2 FROM STA 21+70 TO 34+00
21	TCP-4	PLAN & PROFILE PHASE 3 FROM STA 21+70 TO 34+00
22	TCP-5	TRAFFIC CONTROL PLAN PHASE 4 FROM STA 34+00 TO 67+90
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24	TCP-7	TRAFFIC CONTROL PLAN PHASE 5 FROM STA 67+90 TO 83+00
25	TCP-8	TRAFFIC CONTROL PLAN PHASE 6 FROM STA 67+90 TO 83+00
26	TCP-9	TRAFFIC CONTROL PLAN PHASE 7 FROM STA 83+00 TO 89+70
27	TCP-10	TRAFFIC CONTROL PLAN PHASE 10 FROM STA 89+50 TO 90+40
28	TCP-11	TRAFFIC CONTROL PLAN PHASE 10 FROM STA 89+50 TO 90+40
29	TCP-12	DETOUR PLAN
30	TCP-13	DETOUR PLAN
31	TCP-14	TRAFFIC CONTROL PLAN PHASE 11 FROM STA 90+40 TO 91+50
32	TCP-15	TRAFFIC CONTROL PLAN PHASE 8 FROM STA 91+20 TO 112+00
33	TCP-16	TRAFFIC CONTROL PLAN PHASE 8 FROM STA 91+20 TO 112+00
34	TCP-17	TRAFFIC CONTROL PLAN PHASE 9 FROM STA 112+00 TO 116+00
35	TCP-18	TRAFFIC CONTROL PLAN PHASE 12 FROM STA 15+00 TO 16+70
36	TCP-19	DETOUR PLAN
37	TCP-20	DETOUR PLAN
38	TCP-21	TRAFFIC CONTROL PLAN PHASE 13 FROM STA 16+70 TO 17+30
39	TCP-22	TRAFFIC CONTROL PLAN PHASE 14 FROM STA 17+30 TO 22+83

60% SUBMITTAL – NOT FOR CONSTRUCTION

DIGALERT
DIAL TOLL FREE 811
AT LEAST TWO DAYS BEFORE YOU DIG
UNDERGROUND SERVICE ALERT OF SOUTHERN CALIFORNIA

REVISIONS				
NO.	DATE	INITIAL	DESCRIPTION	APPROVED / DATE

DESIGNED: DRAWN: CHECKED:

ARDURRA
9100 Ming Avenue, Suite 202
Bakersfield, California 93309
(661) 529-2190
www.Ardurra.com

DOLORES SALGADO No. C067536 CIVIL STATE OF CALIFORNIA

MODESTO CALIFORNIA

CITY OF MODESTO APPROVED BY:

DIRECTOR OF ENGINEERING DATE

REFERENCES

CITY OF MODESTO

PROJECT MANAGER DATE

APPROVALS

	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

	DATE
DESIGNED:	
DRAWN:	
TRACED:	
CHECKED:	
SUBMITTED:	
SCALE: NA	

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

TITLE SHEET

I.D.	
S.A.	
W.O.	
C.O.	
COORD.	
SHT.	OF XX
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AGENCY CONTACTS:

1. THE LOCATION OF THE EXISTING UNDERGROUND STRUCTURES AND UTILITIES HAVE BEEN LOCATED IN THE FIELD OR OBTAINED FROM AVAILABLE RECORDS. CONTRACTOR SHALL ASSUME THE SOLE RESPONSIBILITY FOR DETERMINING OR CONFIRMING THE EXACT LOCATION OF THESE FACILITIES AND PROTECTING SAME FROM DAMAGE.

2. CONTRACTOR SHALL NOTIFY AND COORDINATE ALL RELATED WORK WITH THE FOLLOWING AGENCIES. AGENCIES PROVIDED BELOW ARE FOR REFERENCE ONLY. IT IS THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE AND CONFIRM UTILITIES AND CONTACTS:

CITY OF MODESTO
(CONSTRUCTION ADMINISTRATION)
1010 TENTH STREET
MODESTO, CA 95353
PHONE: (209) 577-5452
FAX: (209) 577-4302

CITY OF MODESTO (TRAFFIC)
CONTACT: JAMES ASHBY
PHONE: (209) 571-5116

CITY OF MODESTO (WATER)
CONTACT: JEFF DANIELS
PHONE: (209) 342-4585
FAX: (209) 577-4983

CITY OF MODESTO (WASTEWATER)
CONTACT: ROBERT ENGLENT
PHONE: (209) 577-6222
FAX: (209) 491-4390

CITY OF MODESTO (STORM WATER)
CONTACT: BOB EUSEBIO
PHONE: (209) 577-6239
FAX: (209) 491-4390

PACIFIC GAS & ELECTRIC COMPANY
1524 N. CARPENTER ROAD
MODESTO, CA 95351
CONTACT: DAVE LOOMIS
PHONE: (209) 576-6606
FAX: (209) 576-6618

AT&T
1116 M STREET, ROOM 200
MODESTO, CA 95354
CONTACT: ROBERT KNECHT
PHONE: (209) 578-7037

STANISLAUS COUNTY
DEPARTMENT OF PUBLIC WORKS
1010 TENTH STREET
MODESTO, CA 95353
CONTACT: CHRIS BRADY
PHONE: (209) 525-4130

MODESTO IRRIGATION DISTRICT
(IRRIGATION)
1231 ELEVENTH STREET
MODESTO, CA 95354
CONTACT: SEYLIN SAVY
PHONE: (209) 557-1351

MODESTO IRRIGATION DISTRICT
(ELECTRICAL)
CONTACT: WEB KARAM
PHONE: (209) 526-7427

COMCAST
6505 TAM O'SHANTER DRIVE
STOCKTON, CA 95210
CONTACT: KRIS COOK
PHONE: (209) 329-4743

LEVEL 3 COMMUNICATIONS
1025 EL DORADO BLVD
BROOMFIELD, CO 80021
CONTACT: MATHEW PRINK
PHONE: (720) 888-2639

3. CONTRACTOR SHALL PROVIDE HAND WRITTEN NOTICES TO EACH OWNER AND/OR RESIDENT OF PROPERTY LOCATED ADJACENT TO THE JOB SITE, 2 WEEKS, 1 WEEK, AND 24 HOURS PRIOR TO THE START OF WORK.

4. PER TITLE 8 CALIFORNIA ADMINISTRATION CODE SECTION 1540 (A) (1) OF THE CONSTRUCTION SAFETY ORDERS ISSUED BY THE OCCUPATION SAFETY AND HEALTH STANDARDS BOARD PURSUANT TO THE CALIFORNIA OCCUPATIONS SAFETY AND HEALTH ACT OF 1973 AS AMENDED:

1) PRIOR TO OPENING ANY EXCAVATION, EFFORT SHALL BE MADE TO DETERMINE WHETHER UNDERGROUND INSTALLATIONS, I.E. SEWER, WATER, FUEL, ELECTRIC LINES, ETC., WILL BE ENCOUNTERED AND IF SO, WHERE SUCH UNDERGROUND INSTALLATIONS ARE LOCATED. WHEN THE EXCAVATION APPROACHED THE APPROXIMATE OF SUCH INSTALLATION, THE EXACT LOCATION SHALL BE DETERMINED BY CAREFUL PROBING OR HAND DIGGING, AND, WHEN IT IS UNCOVERED ADEQUATE PROTECTION SHALL BE PROVIDED FOR THE EXISTING INSTALLATION. ALL KNOWN OWNERS OF UNDERGROUND FACILITIES IN THE AREA CONCERNED SHALL BE ADVISED OF PROPOSED WORK AT LEAST 48 HOURS PRIOR TO THE START OF ACTUAL EXCAVATION.

5. PROVIDE AND MAINTAIN ON SITE A SPECIAL PERMIT FROM CAL-OSHA FOR ALL UTILITY TRENCHES 5' OR MORE IN DEPTH.

6. CONTRACTOR MUST COMPLY WITH THE TRENCHING AND EXCAVATION REQUIREMENTS OF 29 CFR 1926.651 AND 1926.652 AND ALL CAL-OSHA REQUIREMENTS.

WATER NOTES:

1. ALL WATER IMPROVEMENTS SHALL CONFORM TO THE CITY OF MODESTO STANDARD SPECIFICATIONS.

2. CONTRACTOR TO PROTECT EXISTING WATER IMPROVEMENTS, WHICH MAY INCLUDE (BUT NOT LIMITED TO) EXISTING WATER LINES, THRUST BLOCKS, VALVES, FIRE HYDRANTS AND LATERALS.

3. WATER SERVICE SHALL BE MAINTAINED AT ALL TIMES DURING CONSTRUCTION.

4. AFTER NEW WATER MAIN INSTALLATION IS COMPLETED, ALL EXISTING WATER LINES ARE TO REMAIN IN SERVICE UNTIL ABANDONED. CONTRACTOR WILL ABANDON IN PLACE EXISTING WATER LINES AND FIRE HYDRANTS AS SHOWN ON THESE PLANS.

5. ALL VALVES, TEES AND CROSSES TO BE FLANGED TO THEIR RESPECTIVE FITTINGS.

6. 6-INCH AND 8-INCH WATER MAINS SHALL UTILIZE GATE VALVES. 12-INCH WATER MAINS SHALL UTILIZE BUTTERFLY VALVES, UNLESS NOTED OTHERWISE. FOR ALL BUTTERFLY VALVES, THE OPERATING NUT SHALL BE LOCATED TOWARD THE NEAREST PROPERTY LINE.

7. ALL VALVE STEMS MUST BE BROUGHT TO A MAXIMUM OF FOUR FEET BELOW FINISH GRADE WITH STAINLESS STEEL STEM EXTENSION UNITS.

8. ANY WATER VALVE BOXES IN DIRT OR UNPAVED AREAS SHALL BE INSTALLED 2 INCHES ABOVE GRADE AND HAVE 10-INCH CONCRETE ENCASEMENT POURED TO GRADE (NO AC) AS PER CITY OF MODESTO STANDARD SPECIFICATIONS.

9. WHEN NEW WATER MAIN CROSSING AND EXISTING WATER MAIN ARE AT THE SAME DEPTH, THE NEW WATER MAIN SHALL DIP BELOW EXISTING WATER MAIN.

10. RESTRAINED JOINTS AND THRUST BLOCKS SHALL BE PROVIDED AT ALL REQUIRED LOCATIONS ON WATER LINES IN ACCORDANCE WITH THE CITY OF MODESTO STANDARD SPECIFICATIONS AND DETAILS.

11. CONTRACTOR SHALL FURNISH AND INSTALL 6-INCH FIRE HYDRANT ASSEMBLY PER CITY OF MODESTO STANDARD SPECIFICATIONS WHERE INDICATED ON THE PLANS. ALL FIRE HYDRANTS SHALL BE PLACED IN ACCORDANCE WITH CITY OF MODESTO STANDARD DETAIL NO. 631. ALL PROPOSED FIRE HYDRANT ASSEMBLY IMPROVEMENTS SHALL CONFORM ALSO TO THE REQUIREMENTS OF THE STANISLAUS CONSOLIDATED FIRE PROTECTION DISTRICT.

12. CONTRACTOR SHALL INSTALL TRACER WIRE PER CITY OF MODESTO STANDARD SPECIFICATIONS.

13. ALL WATER SERVICES SHALL BE 1-INCH MINIMUM. WATER SERVICES SHALL BE CONNECTED TO WATER MAINS PER CITY OF MODESTO STANDARD SPECIFICATIONS.

14. ALL WATER LINES SHALL BE PRESSURE TESTED, DISINFECTED, FLUSHED AND TESTED FOR BACTERIA IN CONFORMANCE WITH CITY OF MODESTO STANDARD SPECIFICATIONS.

15. ALL NEW WATER VALVE BOXES ON KIERNAN AVENUE AND TULLY ROAD ARE TO BE "MARK V" HEAVY TRAFFIC VALVE BOX.

16. CONTRACTOR TO INSTALL WET BARREL HYDRANT CHECK VALVE AT ALL FIRE HYDRANTS.

SANITARY SEWER AND STORM DRAIN NOTES:

1. CONTRACTOR TO PROTECT EXISTING SEWER AND STORM DRAIN IMPROVEMENTS, WHICH MAY INCLUDE (BUT NOT LIMITED TO) EXISTING SEWER LINES, MANHOLES, CLEANOUTS, AND LATERALS, EXISTING STORM DRAIN LINES, MANHOLES, CATCH BASINS AND ROCK WELLS.

STORMWATER POLLULTION PREVENTION PLAN (SWPPP) NOTES:

1. CONTRACTOR SHALL COMPLY WITH THE REQUIREMENTS OF THE STATE WATER RESOURCES CONTROL BOARD (SWRCB), RWQCB, CALIFORNIA ADMINISTRATIVE CODE, 2022 CALIFORNIA GREEN BUILDING STANDARDS CODE SECTION 5.

2. CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES (BMP) TO ELIMINATE OR MINIMIZE POLLUTION DISCHARGE CAUSED BY CONSTRUCTION ACTIVITIES.

MONUMENT PRESERVATION NOTES:

1. MONUMENT PRESERVATION WILL BE PERFORMED BY THE CITY OF MODESTO SURVEY DEPARTMENT IN ACCORDANCE WITH SECTION 8771 OF THE CALIFORNIA PROFESSIONAL LAND SURVEYOR'S ACT. KNOWN SURVEY MONUMENTS AFFECTED BY CONSTRUCTION WILL BE LOCATED AND REFERENCED UNDER THE DIRECTION OF A LICENSED LAND SURVEYOR AND A CORNER RECORD OR RECORD OF SURVEY SHALL BE FILED WITH THE COUNTY SURVEYOR.

2. THE CITY OF MODESTO HAS ATTEMPTED TO LOCATE ALL EXISTING MONUMENTS, HOWEVER IF ANY UNKNOWN MONUMENTS ARE DISCOVERED DURING THE TIME OF CONSTRUCTION, THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE CITY OF MODESTO CONSTRUCTION INSPECTOR AND SENIOR LAND SURVEYOR.

3. THE CONTRACTOR SHALL USE CAUTION WHEN WORKING NEAR EXISTING MONUMENTS. THE CONTRACTOR SHALL BEAR ALL COSTS OF A RE-SURVEY, REPLACEMENT OF CORNERS, MAPPING AND RECORDING FEES WHICH MAY BE REQUIRED AS A RESULT OF UNNECESSARY LOSS OR DISTURBANCE OF MONUMENTATION DURING THE COURSE OF WORK.

4. PRIOR TO COMMENCEMENT OF ANY CONSTRUCTION ON THIS SITE, IT IS ADVISED THAT ALL INVOLVED PARTIES REVIEW SECTION 8771 AND 8725 OF THE BUSINESS AND PROFESSIONS CODE AND SECTION 605 OF THE CALIFORNIA PENAL CODE TO ENSURE THAT MONUMENT PRESERVATION HAS BEEN PROPERLY ADDRESSED.

VERTICAL DATUM:

NAME: "Y 1387"

DESCRIPTION: A STAINLESS STEEL ROD IN WELL

ELEVATION: 103.31', NAVD88, GEOID18

LOCATION: LOCATED ON THE EAST SIDE OF STATE HIGHWAY 108 (MCHENRY AVENUE), 0.06 MILES NORTH OF STATE HIGHWAY 219 (KIERNAN AVENUE)

HORIZONTAL DATUM:

1. ALL COORDINATES, BEARINGS, AND DISTANCES ARE BASED ON THE CITY OF MODESTO GPS CONTROL NETWORK, AS SHOWN ON THE AMENDED CITY OF MODESTO RECORD OF SURVEY FILED IN BOOK 22 OF SURVEYS AT PAGE 51, STANISLAUS COUNTY RECORDS. SAID DATUM IS A 1992 ADJUSTMENT OF THE NORTH AMERICAN DATUM OF 1983, (NAD83-1992).

2. TOPO ALL POINTS WITH CONVENTIONAL METHODS.

CALTRANS AND TRAFFIC NOTES:

1. ALL WORK SHALL BE IN ACCORDANCE WITH 2018 CALTRANS STANDARD PLANS AND SPECIFICATIONS, LATEST EDITION OF MUTCD AND CALIFORNIA SUPPLEMENT.

2. TEMPORARY STRIPING SHALL BE PAINT AND TEMPORARY PAVEMENT MARKERS.

3. CONTRACTOR SHALL RESTORE PERMANENT PAVEMENT MARKINGS AND STRIPING (THERMOPLASTIC) WITHIN 30 CALENDAR DAYS AFTER LAST TRAFFIC DISRUPTION.

4. UNLESS OTHERWISE SPECIFIED, ALL TEMPORARY WARNING SIGNS SHALL HAVE BLACK LEGEND ON ORANGE BACKGROUND.

5. SEE MUTCD STANDARD APPLICATION 20 FOR DETOUR SIGNAGE LOCATIONS.

6. SEE CALTRANS STANDARD DETAIL T13 FOR SIGNS REQUIRED FOR LANE CLOSURE AND FLAGGING.

7. ALL CONES USED FOR LANE CLOSURES DURING HOURS OF DARKNESS SHALL BE FITTED WITH RETROFLECTIVE BANDS (OR SLEEVES) AS SPECIFIED IN CALTRANS STANDARD SPECIFICATIONS.

8. CONTRACTOR SHALL CALL IN ALL LANE CLOSURES WITHIN CALTRANS RIGHT-OF-WAY TO THE TRAFFIC MANAGEMENT CENTER (TMC) WHEN THE CLOSURE BEGINS (10-97) ENDS (10-98) OR IS CANCELED (10-22). THE TMC CAN BE REACHED 24 HOURS A DAY, SEVEN DAYS A WEEK. (209) 948-7556 OR (209) 948-7551.

9. FIELD CONDITIONS MAY WARRANT MODIFICATION TO THE TRAFFIC HANDLING PLANS. ANY MODIFICATION IS SUBJECT TO CALTRANS APPROVAL.

10. THE POSTED SPEED LIMIT MAY BE REDUCED BY A MAXIMUM OF 10 MPH, WITH CALTRANS APPROVAL. CONTRACTOR SHALL BE RESPONSIBLE FOR INSTALLATION OF APPROPRIATE SIGNAGE (NOT SHOWN ON THE PLANS).

11. CONTRACTOR SHALL PRESERVE ALL SURFACE AND SUBSURFACE FACILITIES IN THE WORK ARE.

12. CONTRACTOR SHALL NOTIFY CALTRANS REPRESENTATIVE PRIOR TO STARTING WORK.

13. CONTRACTOR SHALL REVIEW AND ABIDE BY APPROVED TRAFFIC CONTROL PLANS LOCATED IN PROJECT SPECIFICATIONS FOR EACH SEGMENT OF WORK DURING CONSTRUCTION.

14. NO TRENCH IS ALLOWED TO REMAIN OPEN AFTER THE LANE OR ADJACENT LANE ARE OPENED TO TRAFFIC. ALL TRENCHES SHALL BE COVERED BY A STEEL PLATE AS REQUIRED BY THE LATEST CALTRANS ENCROACHMENT PERMIT MANUAL CHAPTER 600.

15. CONTRACTOR SHALL OBTAIN ENCROACHMENT PERMIT FROM CALTRANS PRIOR TO THE START OF ANY WORK AND BEAR ANY AND ALL COSTS ASSOCIATED WITH SECURING, MAINTAINING, OR IMPLEMENTING THESE PERMITS.

16. THE LOCATION OF UNDERGROUND UTILITIES WAS TAKEN FROM THE RECORDS OF THE CONTROLLING AGENCIES AND FROM LIMITED POTHOLING. NO RESPONSIBILITY FOR THEIR ACCURACY IS ASSUMED BY THE ENGINEER AND/OR THE CONTROLLING AGENCIES. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY THE EXISTENCE AND/OR LOCATION OF ALL UNDERGROUND UTILITIES PRIOR TO THE COMMENCEMENT OF CONSTRUCTION. CONTRACTOR SHALL TAKE PRECAUTIONARY MEASURES TO PROTECT THESE UTILITIES. CONTRACTOR SHALL DO NO EXCAVATION UNTIL THE UTILITY COMPANIES HAVE BEEN NOTIFIED AND HAVE BEEN GIVEN THE OPPORTUNITY TO MARK THEIR FACILITIES IN THE FIELD.

17. ALL LINES INDICATED TO BE ABANDONED DURING CONSTRUCTION SHALL BE REMOVED OR PLUGGED OR COMPLETELY FILLED WITH CONTROLLED DENSITY FILL (CDF) AT ALL OPEN ENDS PER CALTRANS SECTION 15---2.05C AND ALSO PER CITY OF MODESTO STANDARDS. CONTRACTOR SHALL SUBMIT AND ABANDONMENT PLAN PRIOR TO ANY ABANDONMENT WORK.

18. GROUND SURFACES (GS) SHOWN ARE APPROXIMATE, NO ADDITIONAL COMPENSATION WILL BE MADE FOR INACCURATE OR IMPRECISE DEPICTIONS OF GROUND SURFACES.

19. EXISTING CURB, GUTTER, AND SIDEWALK WITHIN THE PROJECT LIMITS THAT ARE DAMAGED OR DISPLACED DURING CONSTRUCTION, EVEN THOUGH THEY WERE NOT TO BE REMOVED, SHALL BE REPAIRED OR REPLACED PER CALTRANS STANDARDS ON KIERNAN AVENUE AND TULLY ROAD AND PER STANISLAUS COUNTY DETAILS ON OTHER STREETS.

23. CONTRACTOR SHALL COORDINATE WITH CALTRANS TRAFFIC MANAGEMENT DIVISION TO REPROGRAM SIGNALS DURING CONSTRUCTION. TRAFFIC LOOPS SHALL BE RESTORED 4 HOURS.

24. EXISTING TRAFFIC LOOPS TO BE PROTECTED IN PLACE. IF DAMAGED, REPAIR IN-KIND PER CALTRANS STANDARDS.

25. CALTRANS IS NOT A MEMBER OF UNDERGROUND SERVICES ALERT (USA) LOCATING SERVICE. CONTRACTOR SHALL COORDINATE WITH CALTRANS FOR FIELD LOCATING EXISTING UNDERGROUND ELECTRICAL AND SIGNAL CONDUITS AND SIGNAL TIMING CHANGES.

26. CONTACT CALTRANS AT (209) 610-9987 FOR ALL CALTRANS ELECTRICAL COORDINATION.

27. EXISTING CALTRANS ELECTRICAL CONDUIT, TO BE PROTECTED IN PLACE. IF DAMAGED, THE CONTRACTOR IS RESPONSIBLE FOR INSTALLING NEW ELECTRICAL CONDUIT RUNS, IN ITS ENTIRETY. REPAIR WILL NOT BE ALLOWED. COORDINATE WITH CALTRANS FOR NEW INSTALLATIONS, IF DAMAGED.

28. CONTRACTOR SHALL REPLACE PAVEMENT MARKINGS AND STRIPING DAMAGED DUE TO CONSTRUCTION.

29. THIS PLAN INDICATES EXISTING STRIPING, ALL STRIPING AND PAVEMENT MARKINGS SHALL BE REPLACED IN KIND. NO GUARANTEES ARE GIVEN OR IMPLIED AS TO DESIGN ADEQUACY OR SAFETY OF EXISTING STRIPING.

30. CONTRACTOR SHALL PROVIDE AND INSTALL ALL TEMPORARY AND PERMANENT STRIPING AND PAVEMENT MARKINGS.

31. ALL STRIPING, PAVEMENT MARKINGS, AND LEGENDS SHALL BE THERMOPLASTIC, UNLESS OTHERWISE NOTED.

32. WHERE PORTIONS OF THERMOPLASTIC PAVEMENT ARROW, CROSSWALK LIMIT LINE, OR LEGEND (SINGLE LETTER) ARE DAMAGED DUE TO CONSTRUCTION, ENTIRE ARROW, LIMIT LINE, CROSSWALK OR FULL LETTER SHALL BE GROUND OFF AND REAPPLIED.

33. STRIPING DAMAGED DURING CONSTRUCTION SHALL BE REPLACED PER CALTRANS DETAIL REGARDLESS OF CONDITION PRIOR TO CONSTRUCTION.

34. ALL WORK ON KIERNAN AVENUE IS TO BE PERFORMED DURING DAYTIME WORK HOURS (8:30AM-5:00PM).

GENERAL NOTES:

1. USED MATERIAL, REJECTS, MISFITS, OR SECONDS, ETC. ARE NOT ACCEPTABLE FOR USE ON CITY OF MODESTO FACILITIES.

2. CONTRACTOR SHALL FIELD VERIFY THE HORIZONTAL AND VERTICAL LOCATIONS OF ALL EXISTING FACILITIES PRIOR TO COMMENCING WORK. CALL UNDERGROUND SERVICE ALERT (USA) AT 8-1-1 AT LEAST 48 HOURS IN ADVANCE AT (800) 642-2444 OR (800) 277-2600. CONTRACTOR SHALL MAKE ENGINEER AWARE OF ANY DISCREPANCIES.

3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR POTHOLING AT ALL CROSSING EXISTING UTILITIES AND SENDING THE FINDINGS AS A "POTHOLING INFORMATION TABLE" SUBMITTAL TO THE ENGINEER A MINIMUM OF 15 WORKING DAYS PRIOR TO COMMENCING ANY WORK.

4. THE POTHOLE SUBMITTAL SHALL INCLUDE THE FOLLOWING INFORMATION:
   A) MINIMUM COVER OVER EXISTING PIPE
   B) OUTSIDE DIAMETER OF PIPE
   C) TYPE/MATERIAL OF PIPE
   D) ASPHALT CONCRETE THICKNESS
   E) AGGREGATE BASE THICKNESS

5. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF ANY DEVIATION FROM THE PLANS ENCOUNTERED IN THE FIELD PRIOR TO TRENCHING. THE CONTRACTOR SHALL WAIT FOR WRITTEN CONFIRMATION THAT THE DEVIATION HAS BEEN RESOLVED PRIOR TO CONTINUING WORK.

6. ALL EXISTING UNDERGROUND FACILITIES MAY NOT BE SHOWN. CONTRACTOR SHALL TAKE PRECAUTIONARY MEASURES TO PROTECT THESE UTILITIES. CONTRACTOR SHALL DO NO EXCAVATION UNTIL ALL UTILITY COMPANIES HAVE BEEN NOTIFIED AND HAVE BEEN THE OPPORTUNITY TO MARK FACILITIES IN THE FIELD.

7. PRIOR TO TRENCHING FOR ANY SEWER, WATER, OR STORM DRAIN PIPE, CONTRACTOR SHALL VERIFY, IN THE FIELD, THE SIZE AND LOCATION OF THE EXISTING PIPE AT THE POINT OF CONNECTION. ANY DEVIATION FROM THE PLANS SHALL BE RESOLVED BY THE ENGINEER PRIOR TO TRENCHING.

8. CONTRACTOR IS RESPONSIBLE FOR VERIFYING LOCATION, PROTECTING, AND SUPPORTING ALL EXISTING UTILITIES SERVICES TO INDIVIDUAL PARCELS.

9. ALL NUTS, BOLTS, AND WASHERS USED TO SECURE UNDERGROUND FITTINGS SHALL BE STAINLESS STEEL. AFTER INSTALLATION, ALL STEEL HARDWARE SHALL BE COATED WITH A RUST PREVENTATIVE, WRAPPED WITH 4 MIL POLYETHYLENE SHEETING, AND SECURE WITH PVC TAPE.

10. THRUST RESTRAINTS TO BE PROVIDED AT ALL PIPELINE BENDS, WHETHER OR NOT SHOWN ON THE PLANS.

11. ALL CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH APPLICABLE HEALTH AND SAFETY LAWS OF THE STATE OF CALIFORNIA AND CAL/OSHA STANDARDS.

12. CONTRACTOR IS RESPONSIBLE FOR THE REPAIR OF ALL PIPELINE CRACKS, WHICH DEVELOP DURING CONSTRUCTION OF IMPROVEMENTS AFFECTING EXISTING FACILITIES.

13. CONTRACTOR WILL BE RESPONSIBLE FOR IN-KIND REPLACEMENT OF ALL CURB, GUTTER AND SIDEWALK DAMAGED DURING THE COURSE OF CONSTRUCTION.

14. ALL EXCESS MATERIAL AND/OR DEBRIS SHALL BE REMOVED UPON COMPLETION OF INSTALLATION.

15. CONTRACTOR SHALL CONTROL DUST AT ALL TIMES DURING CONSTRUCTION AS REQUIRED BY THE REGIONAL AIR QUALITY CONTROL BOARD.

16. FOR ALL PROJECTS REGARDLESS OF SIZE, CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES TO ELIMINATE OR MINIMIZE POLLUTION DISCHARGE CAUSED BY CONSTRUCTION.

17. IF IMPACTED BY PROPOSED IMPROVEMENTS, RESTORE STREET STRIPING IN ITS ENTIRETY, WHICH MAY INCLUDE STOP BARS, CENTERLINE STRIPING OR MARKERS, CROSSWALKS AND ALL OTHER EXISTING MARKINGS.

18. IF IMPACTED BY PROPOSED IMPROVEMENTS, RESTORE SIGNAGE, WHICH MAY INCLUDE STOP SIGNS, SPEED LIMIT SIGNS AND ALL OTHER EXISTING SIGNAGE.

19. WHENEVER PAVEMENT IS BROKEN OR CUT IN THE INSTALLATION OF THE WORK COVERED IN THESE PLANS, THE PAVEMENT SHALL BE REPLACED, AFTER PROPER BACKFILLING, WITH PAVEMENT MATERIALS EQUAL TO OR BETTER THAN THE MATERIALS USED IN THE ORIGINAL PAVING PER CALTRANS AND STANISLAUS COUNTY STANDARDS.

20. MANHOLES, VALVE, CLEANOUTS, MONUMENT WELLS, ETC. SHALL BE BROUGHT TO FINISH GRADE BY THE CONTRACTOR AFTER THE FINAL PAVING COURSE IS PLACED.

21. CONTRACTOR SHALL ASSUME ALL WORK WITHIN CALTRANS RIGHT-OF-WAY ON KIERNAN AVENUE TO BE PERFORMED DURING THE DAYTIME WORK HOURS (8:30 AM-5:00 PM), AS DETERMINED BY CALTRANS.

22. PAINT CURBS 15' EACH SIDE OF HYDRANT (TOTAL 30' CENTERED WITH HYDRANT) AT NEW HYDRANT LOCATIONS PER CITY STANDARDS.

23. WHERE EXISTING ROAD STRIPING AND/OR REFLECTORS ARE DAMAGED DUE TO TRENCHING WORK ASSOCIATED WITH THIS PROJECT, REPAIR OR REPLACE DAMAGED MATERIAL AS REQUIRED TO MATCH EXISTING CONDITIONS PRIOR TO CONSTRUCTION.

CORROSION PROTECTION NOTES:

1. ALL BURIED FLANGE ISOLATION KITS SHALL BE WAX TAPE COATED.

2. PROVIDE FULL TIME INSPECTION FOR FIELD APPLIED COATINGS AT ALL PIPE JOINTS, FOR INSULATING FLANGE KIT INSTALLATIONS, AND FOR COATINGS ON ALL IN LINE APPURTENANCES.

3. PROVIDE ALL BURIED VALVES, FLANGES, COUPLINGS, AND ADAPTORS, 3-PART WAX TAPE COATING SYSTEM PER AWWA C-217 WITH PLASTIC OUTER WRAP. ADDITIONALLY ALL BURIED INSULATING FLANGES SHALL BE WAX TAPE COATED. NO BARE METALLIC SURFACE SHALL BE IN DIRECT CONTACT WITH THE SOIL.

SHUTDOWN NOTES:

1. CONTRACTOR SHALL ASSUME THE EXISTING VALVES AT BOTH CONNECTION LOCATIONS MAY NOT CLOSE FULLY WITHOUT LEAKING.

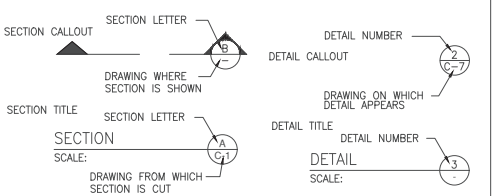
2. THE CONTRACTOR SHALL PROVIDE THE CITY WITH 4 WEEKS, 48 HOURS, AND 24HR ADVANCE NOTICE FOR WATER SHUTDOWNS. SUCH NOTICE SHALL INCLUDE THE CONTRACTOR'S SHUTDOWN PLAN WHICH SHALL INCLUDE A DEWATERING PLAN, PROPOSED VALVE CLOSURES, MATERIAL LISTS FOR CONNECTIONS, SCHEDULE AND DURATION FOR EACH SHUTDOWN, WATER SERVICES AFFECTED, AND ANY OTHER INFORMATION REQUESTED BY THE CITY. THE SHUTDOWN PLAN SHALL BE SUBMITTED TO THE CITY AND SHALL BE SUBJECT TO THE APPROVAL OF THE CITY.

3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING VOLUME OF WATER AND PROVIDING ACTUAL VOLUMES, SUPPORTING CALCULATIONS, AND MANAGING SAID WATER ACCORDINGLY.

4. CONTRACTOR SHALL LEGALLY DISPOSE OF THE WATER. CONTRACTOR SHALL MAKE ALL ARRANGEMENTS TO FULLY CONTAIN, DECHLORINATE, DISPOSE OF THE WATER AS NECESSARY, AND ALL COSTS INCLUDED IN THE CONTRACTOR'S BID.

5. WHERE RESIDENTS WILL EXPERIENCE WATER SERVICE SHUTDOWN, ADVANCE NOTIFICATION VIA DOOR HANGERS SHALL BE POSTED BY THE CONTRACTOR 24-HOUR IN ADVANCE. SHUTDOWN PLAN SHALL INCLUDE ADDRESSES OF AFFECTED RESIDENTS.

SECTION AND DETAIL IDENTIFICATION SYSTEM



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REVISIONS					
NO.	DATE	INITIAL	DESCRIPTION	APPROVED / DATE	
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9100 Ming Avenue, Suite 202
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(661) 529-2190
www.Ardurra.com

REGISTERED PROFESSIONAL ENGINEER DOLORES SALCEDO No. C067536 CIVIL STATE OF CALIFORNIA

MODESTO CALIFORNIA

CITY OF MODESTO
APPROVED BY:
DIRECTOR OF ENGINEERING DATE
REFERENCES

CITY OF MODESTO
PROJECT MANAGER DATE
APPROVALS

	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

	DATE
DESIGNED:	
DRAWN:	
TRACED:	
CHECKED:	
SUBMITTED:	
SCALE: NA	

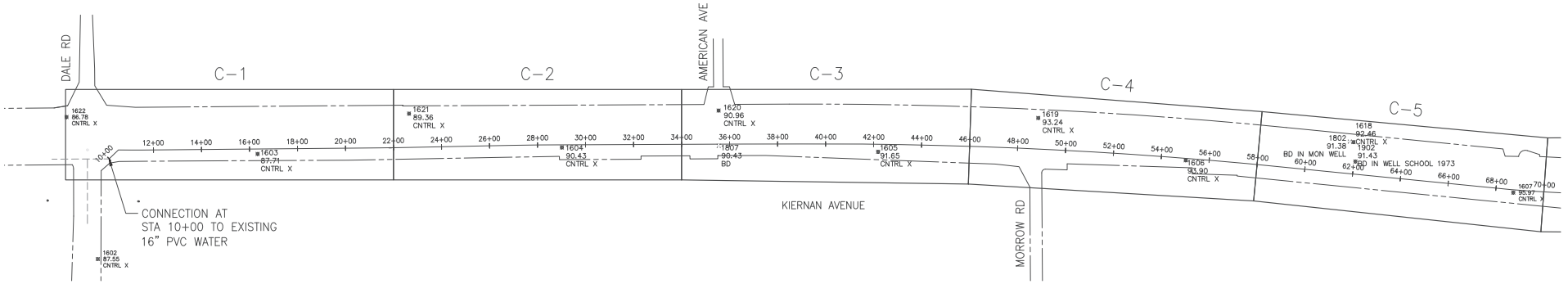
CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

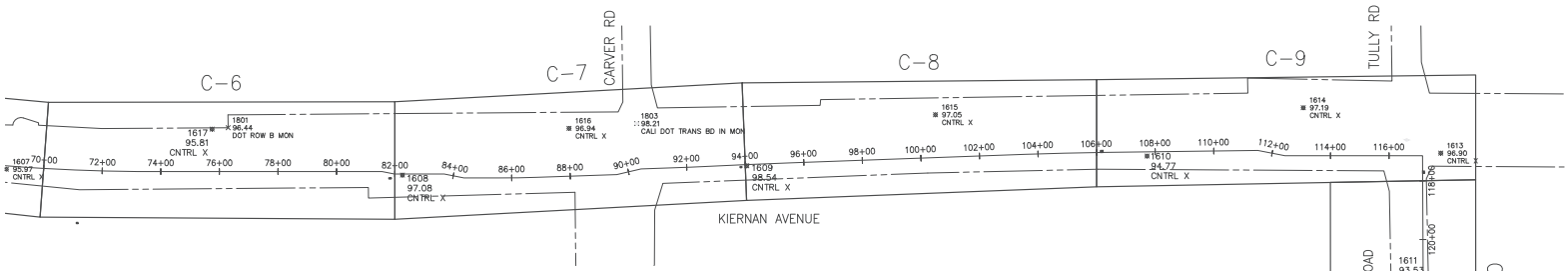
GENERAL NOTES

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KEY MAP



KEY MAP

Point Table				
Point #	Northing	Easting	Elevation	Description
1601	2080915.45	6402491.73	85.98	CNTRL X
1602	2081461.45	6402572.63	87.55	CNTRL X
1603	2081899.24	6403238.12	87.71	CNTRL X
1604	2081926.14	6404505.76	90.43	CNTRL X
1605	2081908.19	6405823.02	91.65	CNTRL X
1606	2081872.69	6407104.29	93.90	CNTRL X
1607	2081738.22	6408468.93	95.97	CNTRL X
1608	2081718.28	6409820.86	97.08	CNTRL X
1609	2081750.19	6410996.31	98.54	CNTRL X
1610	2081783.36	6412362.53	94.77	CNTRL X
1611	2081328.77	6413220.22	93.53	CNTRL X
1612	2080788.54	6413290.04	94.88	CNTRL X
1613	2081793.09	6413365.06	96.90	CNTRL X
1614	2081947.98	6412895.72	97.19	CNTRL X
1615	2081924.03	6411640.14	97.05	CNTRL X

Point Table				
Point #	Northing	Easting	Elevation	Description
1616	2081877.69	6410389.44	96.94	CNTRL X
1617	2081875.00	6409171.12	95.81	CNTRL X
1618	2081948.47	6407803.33	92.46	CNTRL X
1619	2082049.00	6406490.06	93.24	CNTRL X
1620	2082080.05	6405158.56	90.96	CNTRL X

Point Table				
Point #	Northing	Easting	Elevation	Description
1621	2082067.25	6403868.84	89.36	CNTRL X
1622	2082052.89	6402442.24	86.78	CNTRL X
1801	2081879.70	6409225.98	96.44	DOT ROW B MON
1802	2081950.75	6407787.74	91.38	BD IN MON WELL
1803	2081893.90	6410620.64	98.21	CALI DOT TRANS BD IN MON
1807	2081932.90	6405158.82	90.43	BD
1902	2081867.58	6407811.09	91.43	BD IN WELL SCHOOL 1973

SURVEY

ARDURRA, 9100 MING AVE, SUITE 202, BAKERSFIELD, CA 93309 DATED DECEMBER 11, 2023

BASIS OF BEARING

BEARINGS SHOWN HEREON ARE BASED UPON THE CALIFORNIA COORDINATE SYSTEM OF 1983, NAD 83–2011 (EPOCH 2010.00), ZONE 3.

BENCHMARK

ELEVATIONS ARE BASED ON THE NATIONAL GEODETIC SURVEY (NGS) BENCHMARK "Y 1387", A STAINLESS STEEL ROD IN WELL LOCATED ON THE EAST SIDE OF STATE HIGHWAY 108 (MCHENRY AVENUE), 0.06 MILES NORTH OF STATE HIGHWAY 219 (KIERNAN AVENUE). ELEVATION = 103.37', NAVD88, GEOID18.

GENERAL NOTES

1. *DISTANCES ARE EXPRESSED IN FEET AND DECIMALS THEREOF.*
2. *POINTS FOUND OR SET ARE SO NOTED. ALL OTHER POINTS ARE FOR REFERENCE ONLY.*
3. *THIS IS NOT AN ALTA SURVEY. NOT ALL ENTITLEMENTS OR ENCUMBRANCES ARE NECESSARILY SHOWN.*

1" = 200'
100 0 200

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MODESTO CALIFORNIA

CITY OF MODESTO
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REFERENCES

CITY OF MODESTO

PROJECT MANAGER DATE

APPROVALS

	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

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SCALE: 1' = 200'	

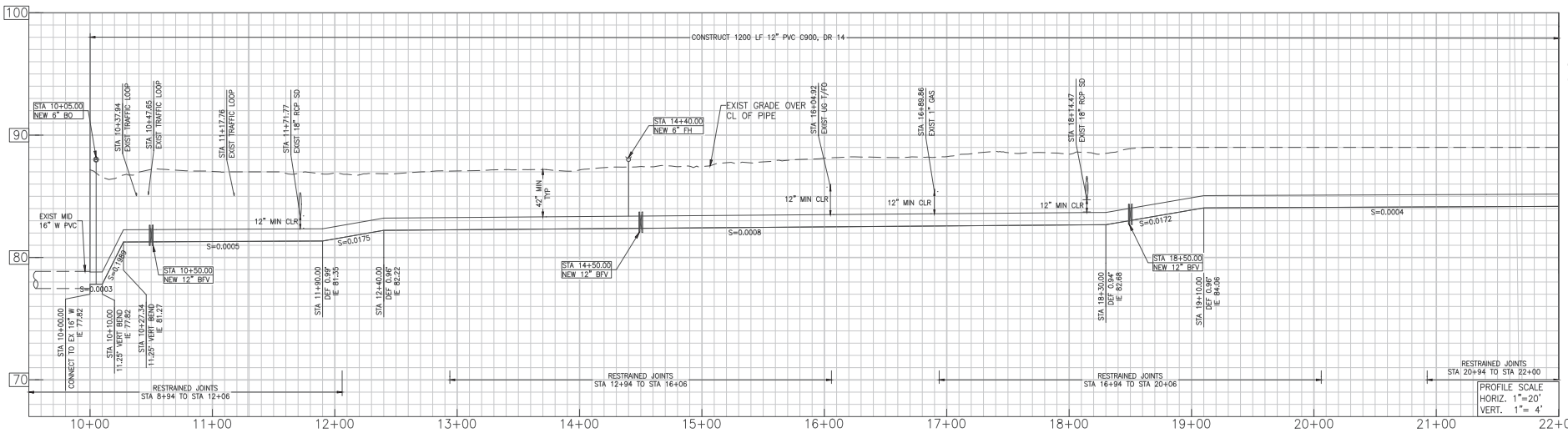
CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

KEY MAP

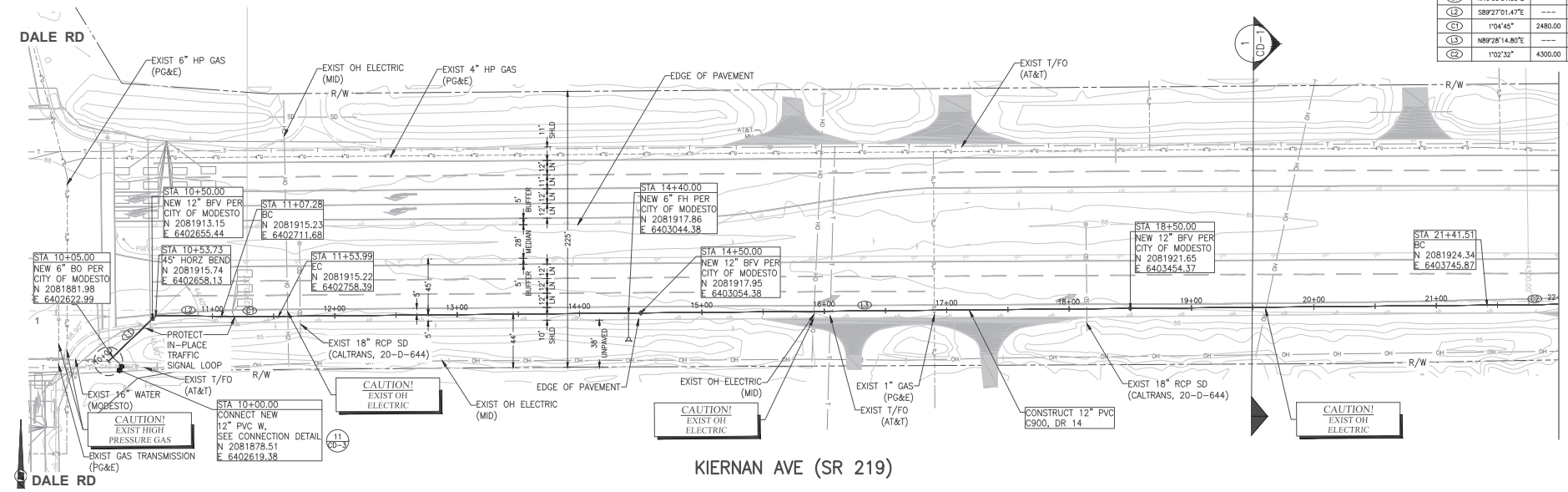
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PROFILE

DATA TABLE – 12IN WATER				
NUMBER	BEARING/DELTA	RADIUS	LENGTH	TANGENT
L1	N46°08'51.35"E	---	53.73	---
L2	S89°27'01.47"E	---	53.54	---
C1	1°04'45"	2480.00	46.71	23.36
L3	N89°28'14.80"E	---	987.52	---
C2	1°02'32"	4300.00	78.21	39.11



PLAN

1" = 40'

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CITY OF MODESTO
PROJECT MANAGER DATE

APPROVALS	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

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SUBMITTED:	
SCALE: 1' = 40'	

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

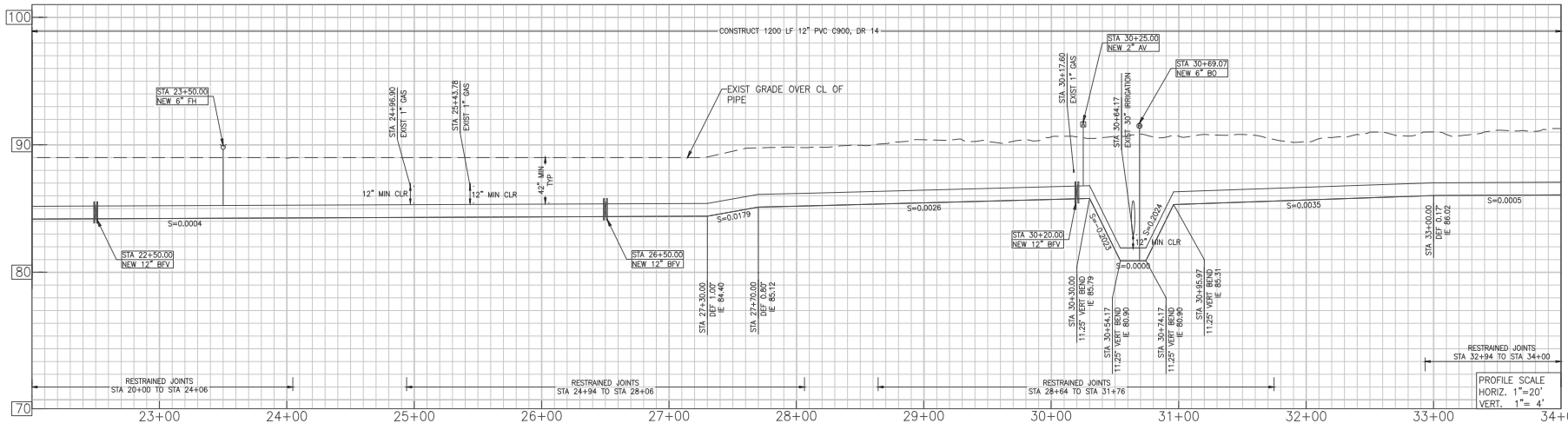
KIERNAN AVENUE 12-INCH WATER MAIN

PLAN & PROFILE
STA 10+00 TO STA 22+00

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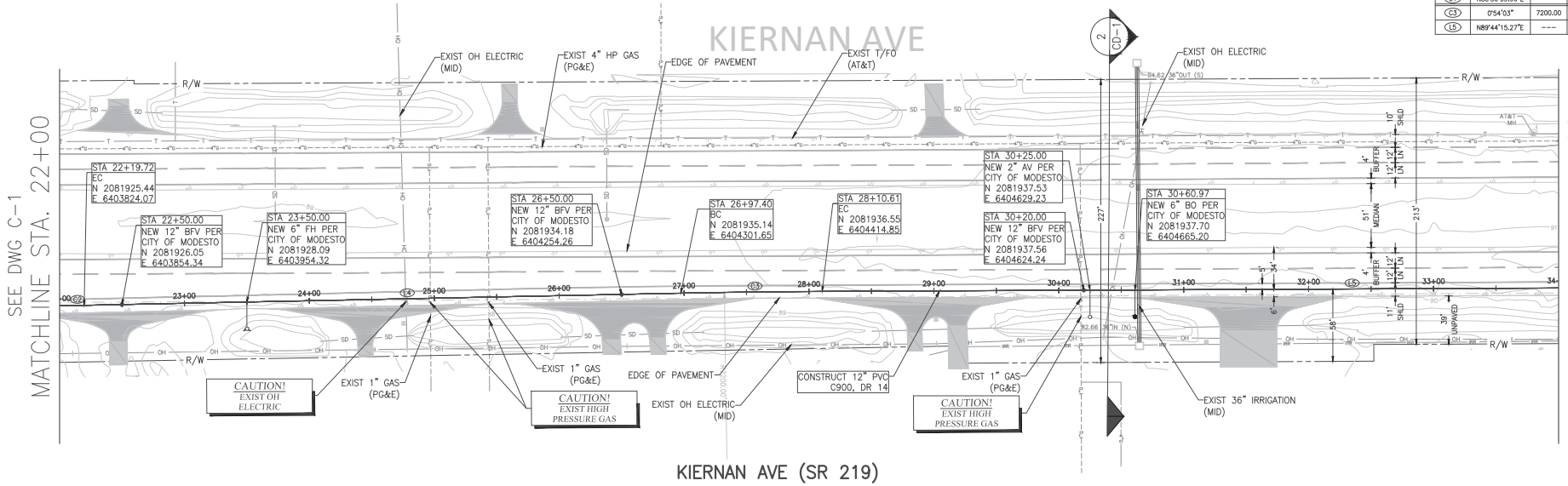
C-1

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PROFILE

DATA TABLE – 12IN WATER				
NUMBER	BEARING/DELTA	RADIUS	LENGTH	TANGENT
C2	1°02'32"	4300.00	78.21	39.11
L4	N88°50'09.96"E	---	477.68	---
C3	0°54'03"	7200.00	113.21	56.60
L5	N89°44'15.27"E	---	848.69	---



PLAN

1" = 40'

60% SUBMITTAL – NOT FOR CONSTRUCTION

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PROJECT MANAGER DATE

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PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

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CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

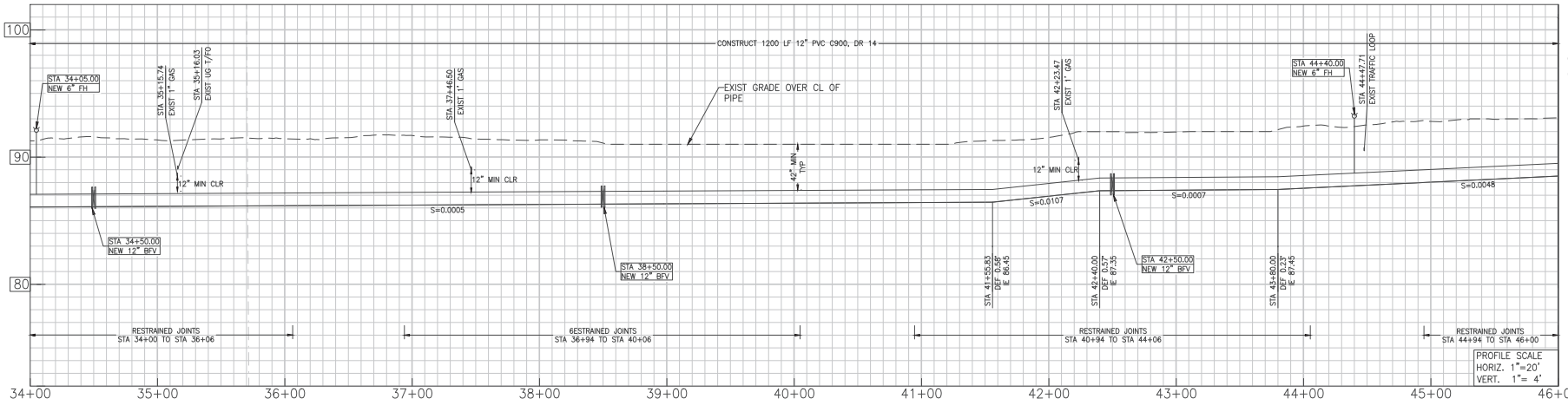
KIERNAN AVENUE 12-INCH WATER MAIN

PLAN & PROFILE
STA 22+00 TO STA 34+00

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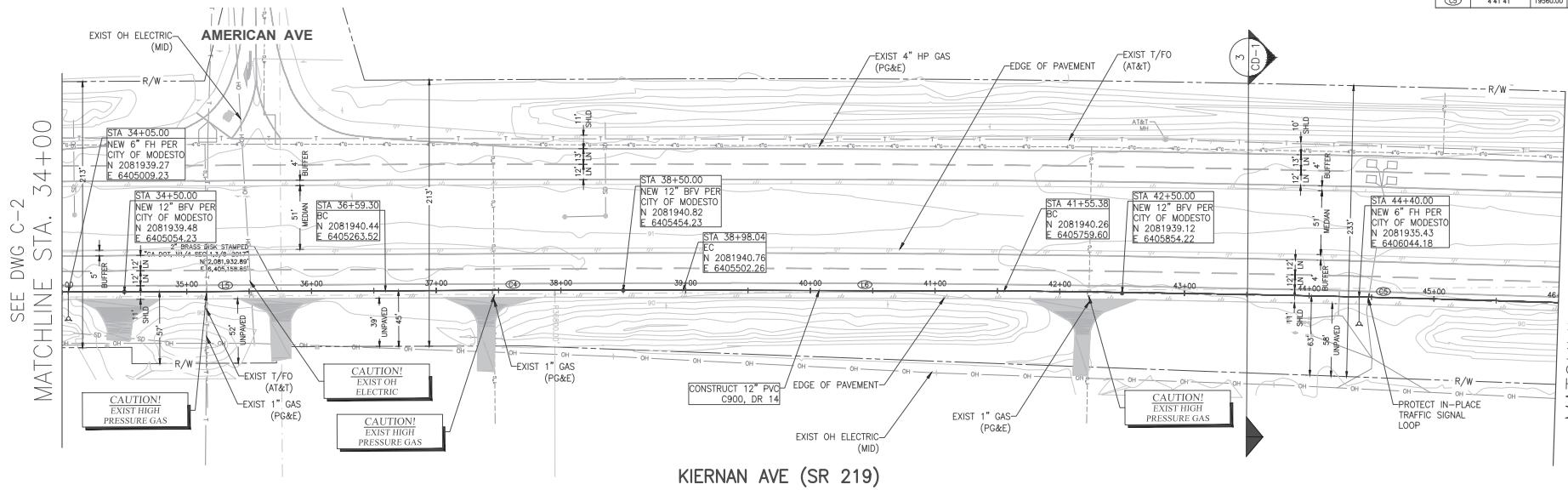
C-2

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PROFILE

DATA TABLE – 12IN WATER				
NUMBER	BEARING/DELTA	RADIUS	LENGTH	TANGENT
L5	N89°44'15.27"E	---	848.69	---
C4	0°22'18"	36800.00	238.74	119.37
L6	S89°53'23.24"E	---	257.34	---
C5	4°41'41"	19560.00	1602.68	801.79



PLAN

1" = 40'

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MODESTO CALIFORNIA

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PROJECT MANAGER DATE
APPROVALS: PROJECT ENGINEER, INSPECTION, WATER OPERATIONS, MAINTENANCE — INITIAL / DATE

DESIGNED: DRAWN: CHECKED: TRACED: SUBMITTED: DATE
SCALE: 1' = 40'

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

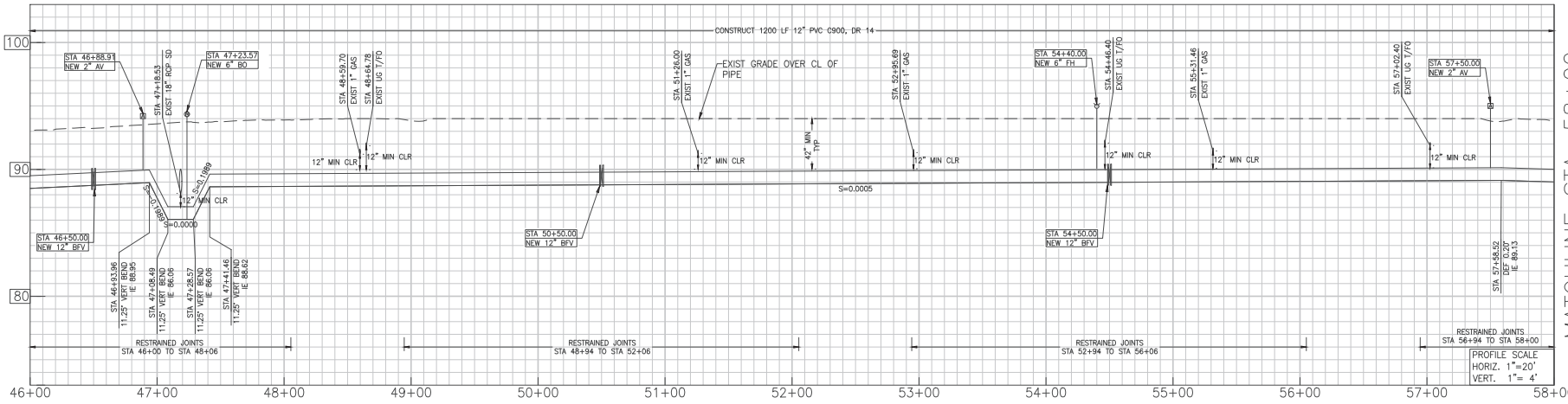
KIERNAN AVENUE 12-INCH WATER MAIN

PLAN & PROFILE
STA 34+00 TO STA 46+00

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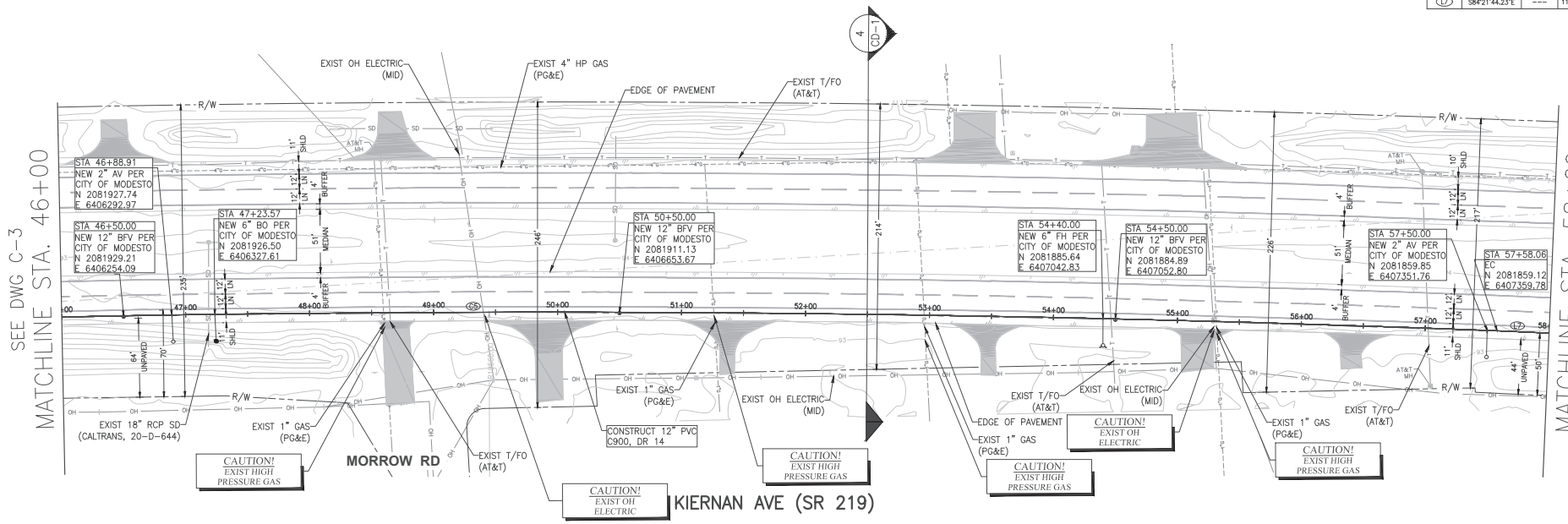
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PROFILE

DATA TABLE – 12IN WATER				
NUMBER	BEARING/DELTA	RADIUS	LENGTH	TANGENT
(S5)	4°41'41"	19560.00	1602.68	801.79
(L7)	S84°21'44.23"E	---	1103.30	---



PLAN

1" = 40'

60% SUBMITTAL – NOT FOR CONSTRUCTION

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CITY OF MODESTO
PROJECT MANAGER DATE

APPROVALS	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

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CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

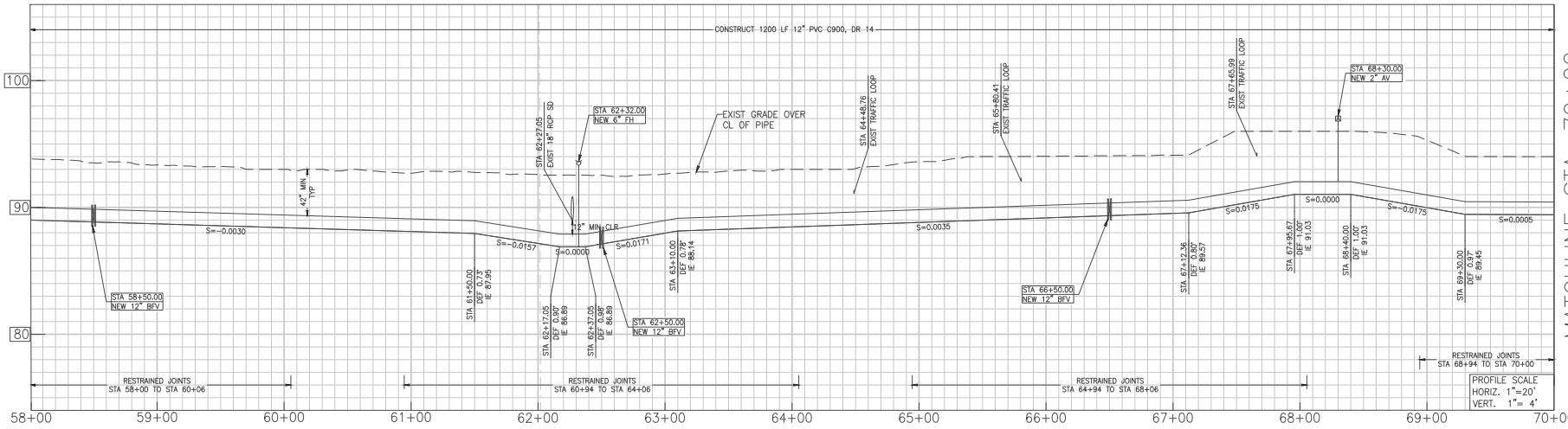
KIERNAN AVENUE 12-INCH WATER MAIN

PLAN & PROFILE
STA 46+00 TO STA 58+00

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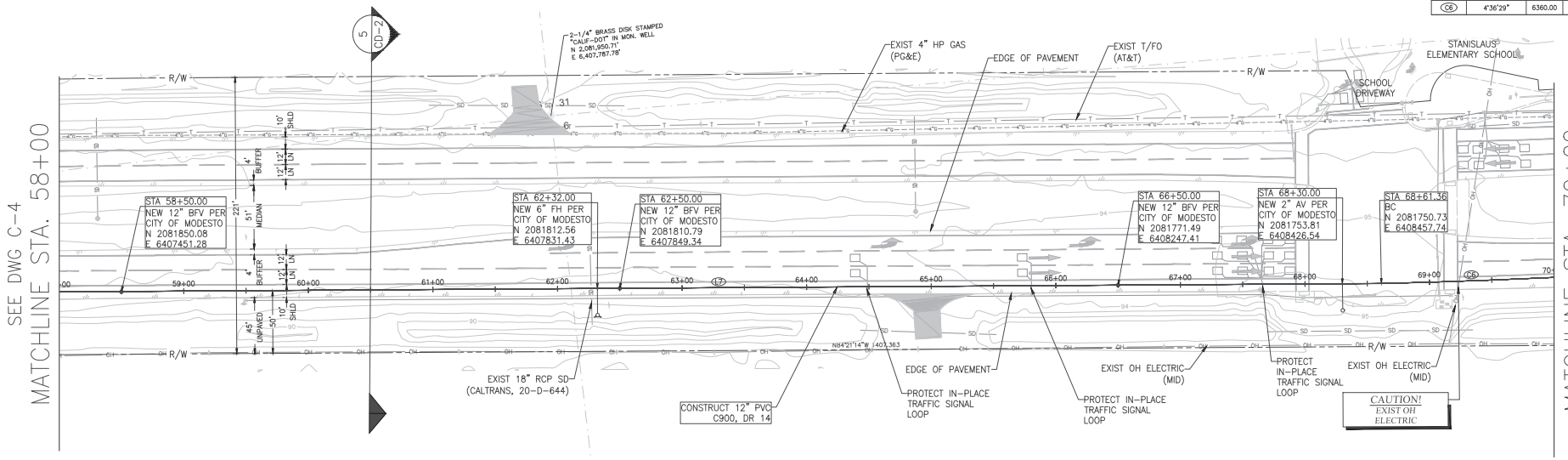
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PROFILE

DATA TABLE – 12IN WATER				
NUMBER	BEARING/DELTA	RADIUS	LENGTH	TANGENT
L7	S84°21'44.23"E	---	1103.30	---
C6	4°36'29"	6360.00	511.50	255.89



KIERNAN AVE (SR 219)

PLAN

1" = 40'
20 0 40

60% SUBMITTAL – NOT FOR CONSTRUCTION

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REGISTERED PROFESSIONAL ENGINEER CHRISTOPHER J. CARGILL No. C067536 CIVIL STATE OF CALIFORNIA

MODESTO CALIFORNIA

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PROJECT MANAGER DATE

APPROVALS	INITIAL	DATE
PROJECT ENGINEER		
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WATER OPERATIONS		
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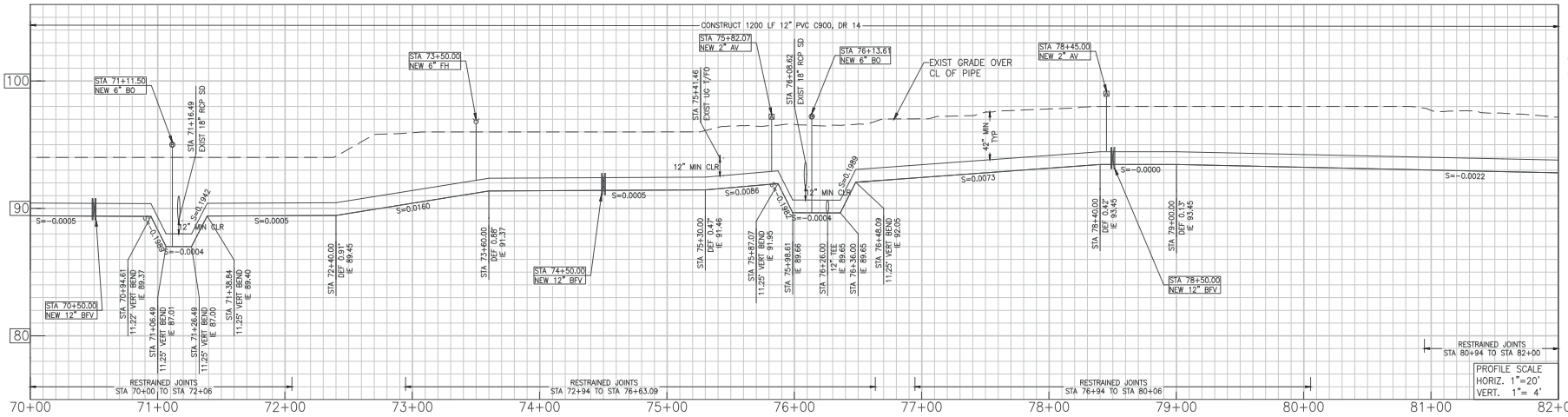
CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

PLAN & PROFILE
STA 58+00 TO STA 70+00

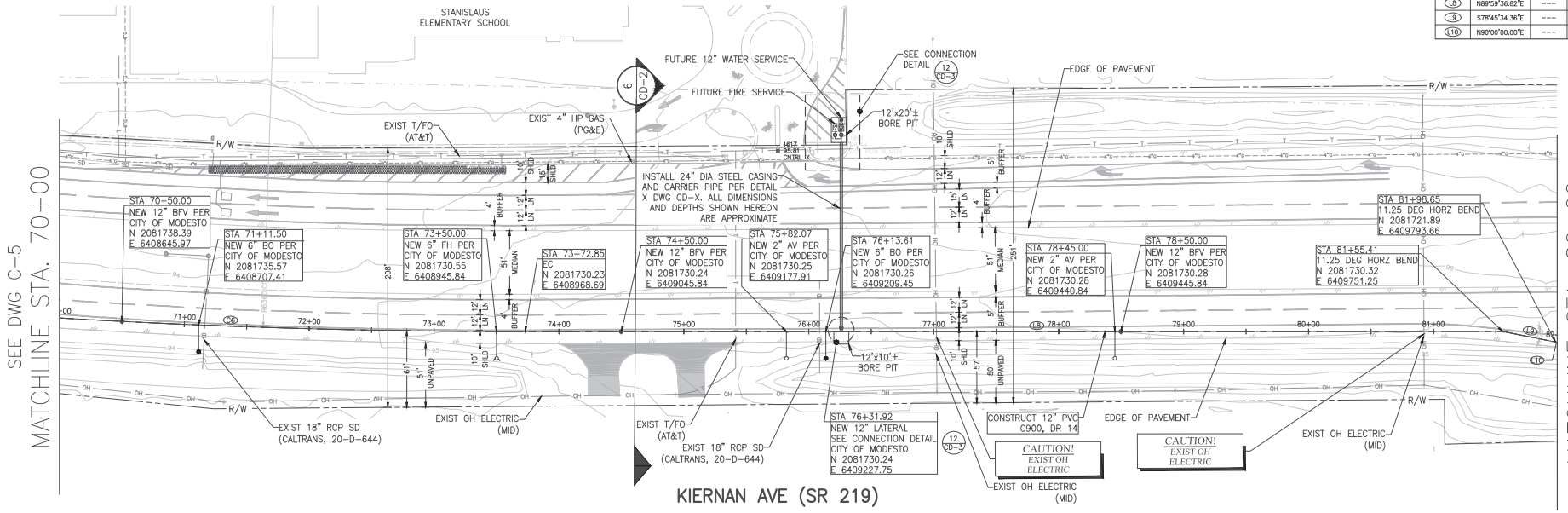
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PROFILE

DATA TABLE – 12IN WATER				
NUMBER	BEARING/DELTA	RADIUS	LENGTH	TANGENT
C6	4°36'29"	6360.00	511.50	255.89
L8	N89°59'36.82"E	---	782.56	---
L9	S78°45'34.36"E	---	43.24	---
L10	N90°00'00.00"E	---	169.69	---



PLAN

1" = 40'

60% SUBMITTAL – NOT FOR CONSTRUCTION

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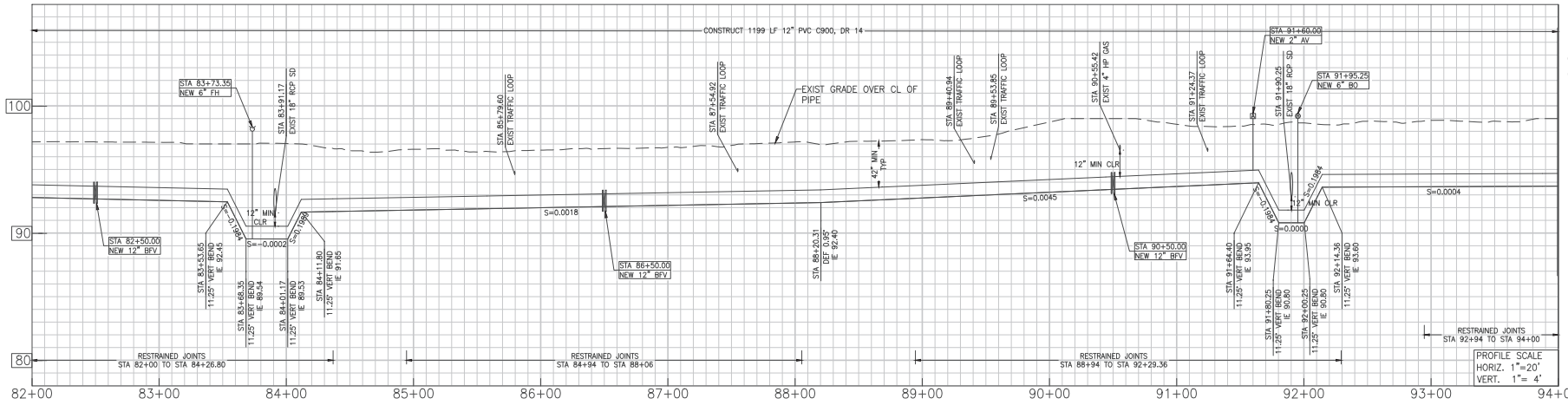
CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

PLAN & PROFILE
STA 70+00 TO STA 82+00

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SHT.	OF XX
	C-6

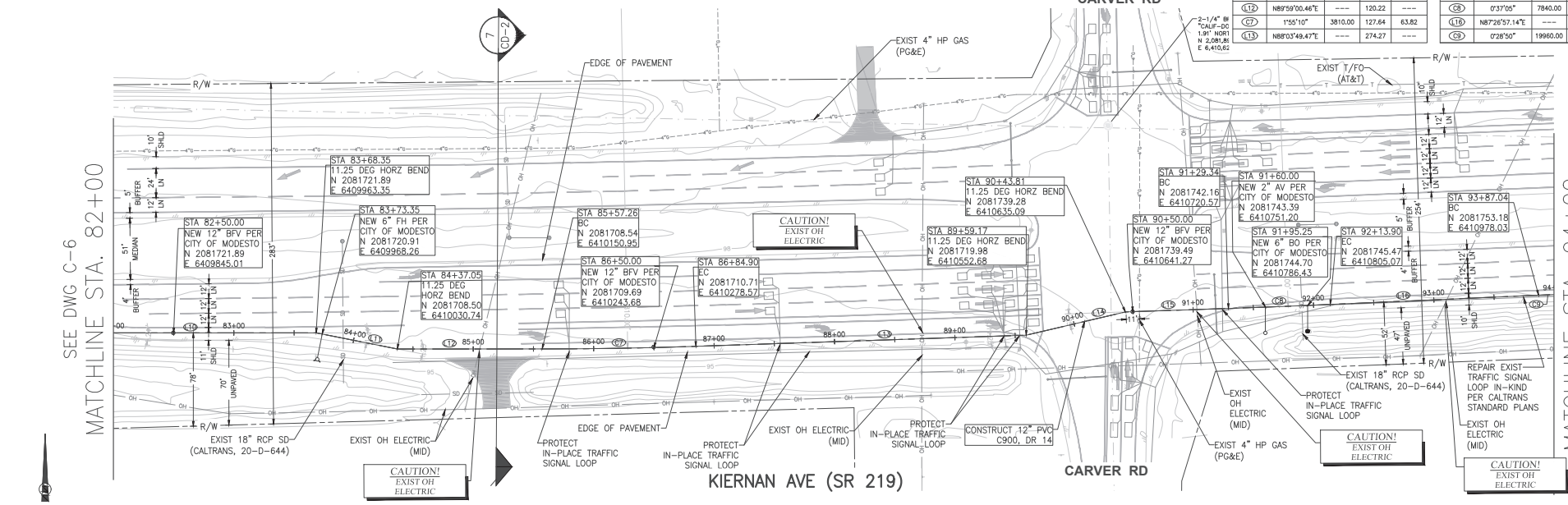
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PROFILE

DATA TABLE – 12IN WATER				
NUMBER	BEARING/DELTA	RADIUS	LENGTH	TANGENT
L10	N90°00'00.00"E	---	169.69	---
L11	S78°45'45.76"E	---	68.70	---
L12	N89°59'00.46"E	---	120.22	---
C7	1°55'10"	3810.00	127.64	63.82
L13	N88°03'49.47"E	---	274.27	---

DATA TABLE – 12IN WATER				
NUMBER	BEARING/DELTA	RADIUS	LENGTH	TANGENT
L14	N76°49'01.16"E	---	84.64	---
L15	N88°04'02.20"E	---	85.53	---
C8	0°37'05"	7840.00	84.57	42.28
L16	N87°26'57.14"E	---	173.14	---
C9	0°28'50"	19960.00	167.43	83.71



PLAN

60% SUBMITTAL – NOT FOR CONSTRUCTION

DIAL TOLL FREE 811
AT LEAST TWO DAYS BEFORE YOU DIG
UNDERGROUND SERVICE ALERT OF SOUTHERN CALIFORNIA

REVISIONS				
NO.	DATE	INITIAL	DESCRIPTION	APPROVED / DATE

DESIGNED: DRAWN: CHECKED:

ARDURRA
9100 Ming Avenue, Suite 202
Bakersfield, California 93309
(661) 529-2190
www.Ardurra.com

REGISTERED PROFESSIONAL ENGINEER CHRISTOPHER J. CARGO No. C067536 CIVIL STATE OF CALIFORNIA

MODESTO CALIFORNIA

CITY OF MODESTO APPROVED BY:
DIRECTOR OF ENGINEERING DATE
REFERENCES

CITY OF MODESTO
PROJECT MANAGER DATE

APPROVALS	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

	DATE
DESIGNED:	
DRAWN:	
TRACED:	
CHECKED:	
SUBMITTED:	
SCALE: 1' = 40'	

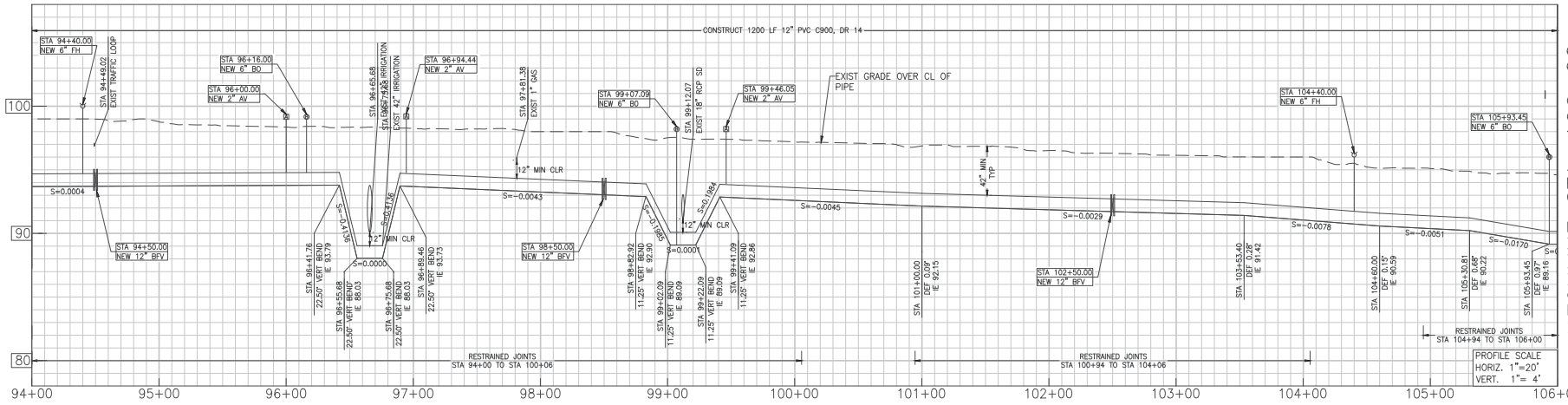
CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

PLAN & PROFILE
STA 82+00 TO STA 94+00

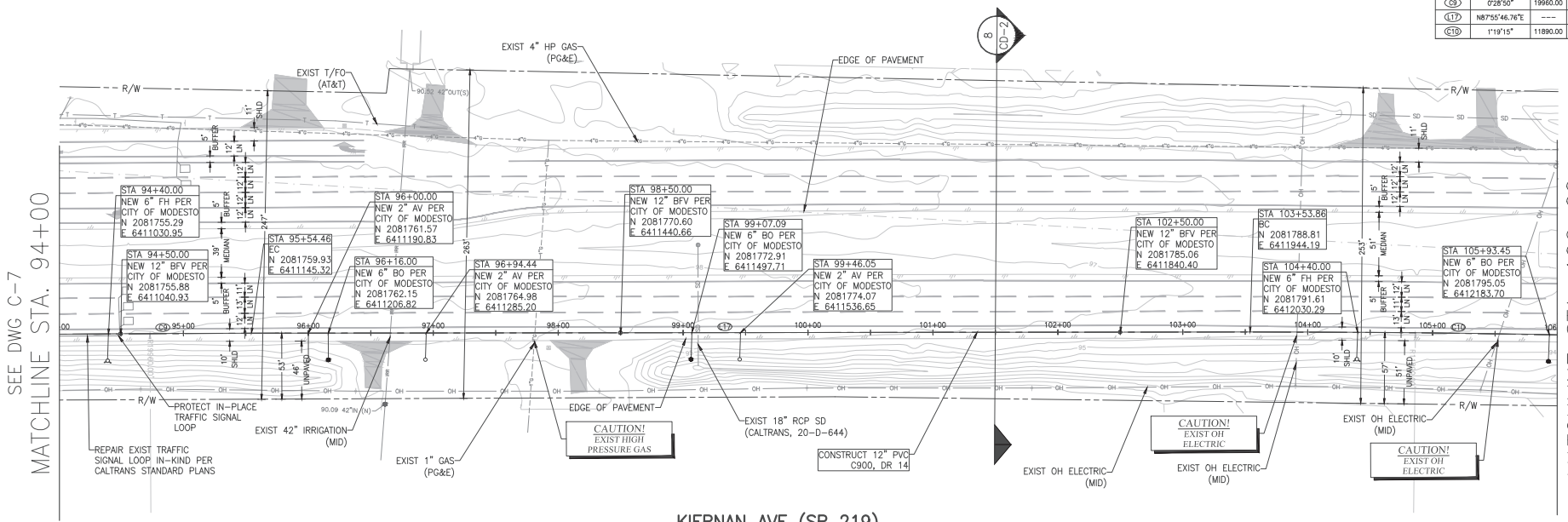
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COORD.	
SHT.	OF XX
	C-7

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PROFILE

DATA TABLE – 12IN WATER				
NUMBER	BEARING/DELTA	RADIUS	LENGTH	TANGENT
C9	0°28'50"	19960.00	167.43	83.71
L17	N87°55'46.76"E	---	799.39	---
C10	1°19'15"	11890.00	274.12	137.07



KIERNAN AVE (SR 219)

PLAN

1" = 40'

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CITY OF MODESTO
PROJECT MANAGER DATE

APPROVALS	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

	DATE
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SUBMITTED:	
SCALE: 1' = 40'	

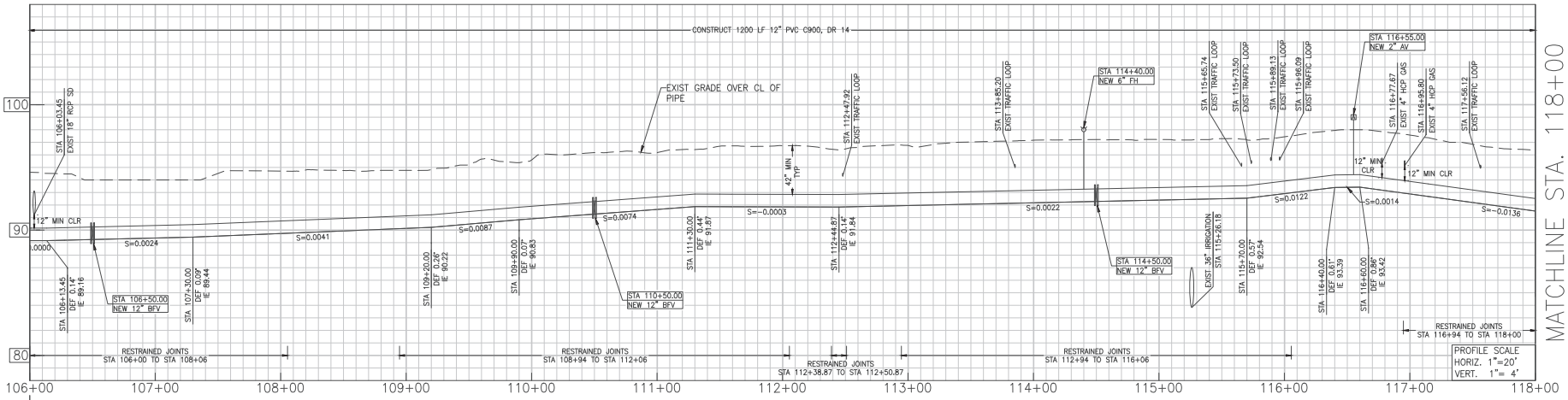
CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

PLAN & PROFILE
STA 94+00 TO STA 106+00

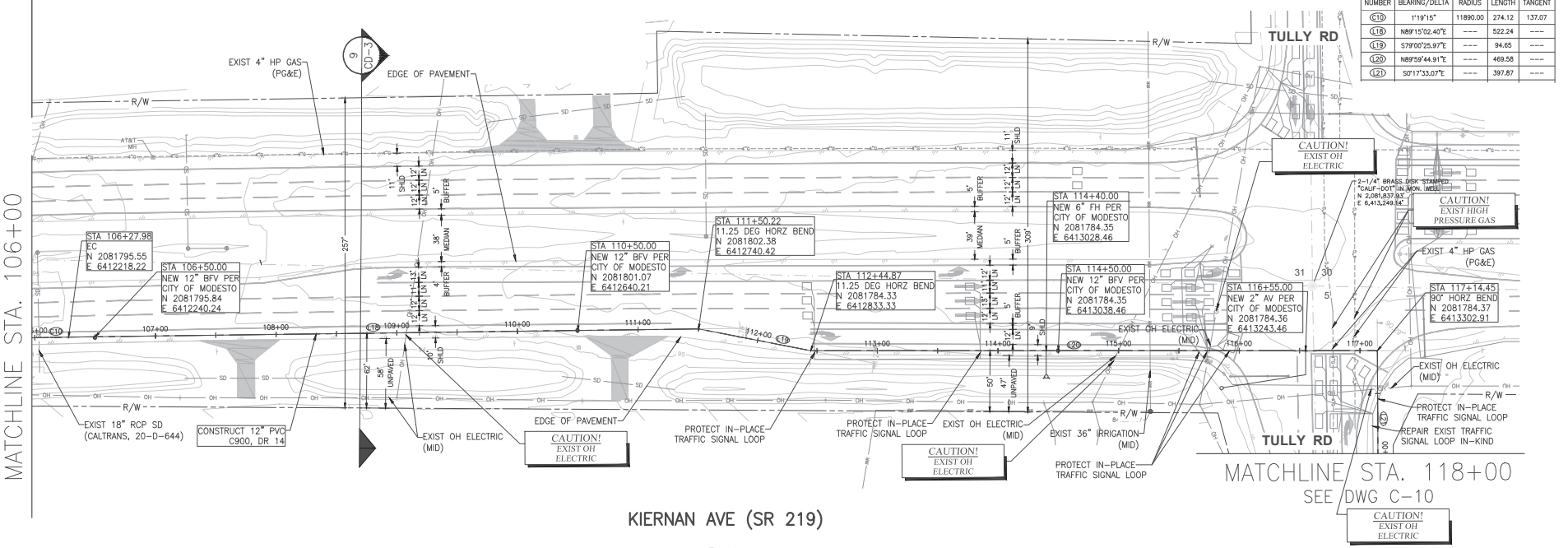
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COORD.	
SHT.	OF XX
	C-8

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PROFILE

DATA TABLE – 12IN WATER				
NUMBER	BEARING/DELTA	RADIUS	LENGTH	TANGENT
C10	1°19'15"	11890.00	274.12	137.07
L18	N89°15'02.40"E	---	522.24	---
L19	S79°00'25.97"E	---	94.65	---
L20	N89°59'44.91"E	---	469.58	---
L21	S0°17'33.07"E	---	397.87	---



PLAN

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PROJECT MANAGER DATE

APPROVALS	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

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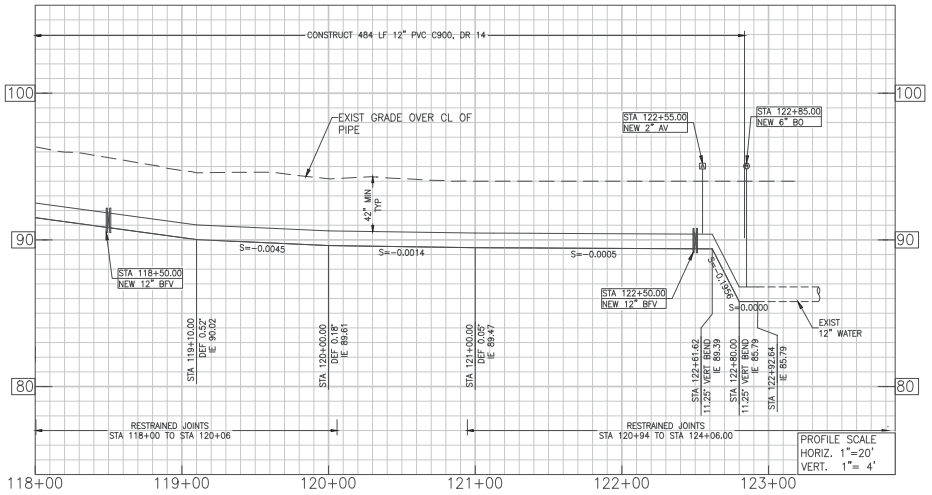
CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

PLAN & PROFILE
STA 106+00 TO STA 118+00

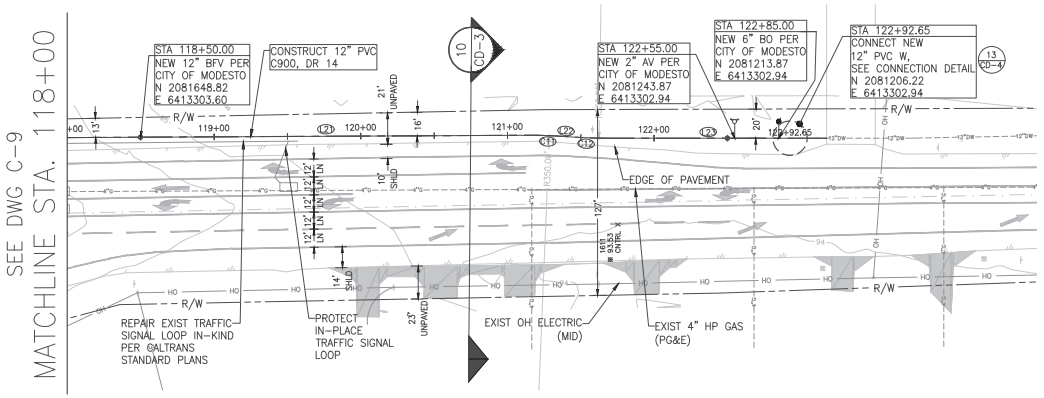
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COORD.	
SHT.	OF XX
	C-9

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PROFILE

DATA TABLE – 12IN WATER				
NUMBER	BEARING/DELTA	RADIUS	LENGTH	TANGENT
L21	S0°17'33.07"E	---	397.87	---
C11	4°05'44"	350.00	25.02	12.51
L22	S3°48'11.11"W	---	7.07	---
C12	3°48'11"	350.00	23.23	11.62



TULLY RD

PLAN

60% SUBMITTAL – NOT FOR CONSTRUCTION

1" = 40'
20 0 40

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CITY OF MODESTO
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DIRECTOR OF ENGINEERING DATE

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CITY OF MODESTO

PROJECT MANAGER DATE

APPROVALS

	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

	DATE
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TRACED:	
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SUBMITTED:	
SCALE:	1' = 40'

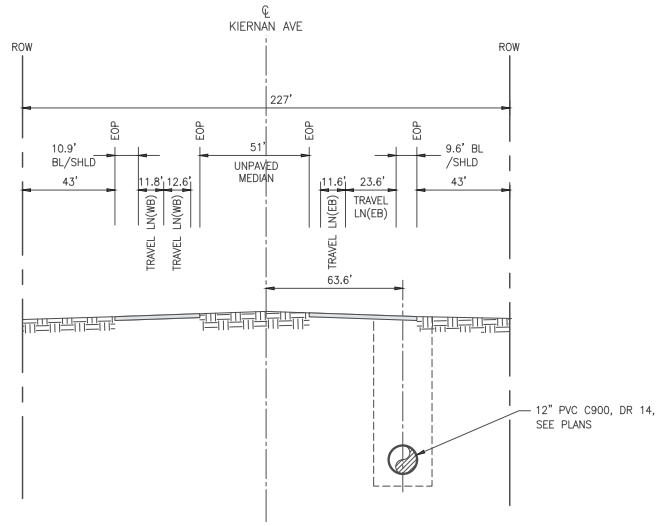
CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

PLAN & PROFILE
STA 118+00 TO STA 122+92.64

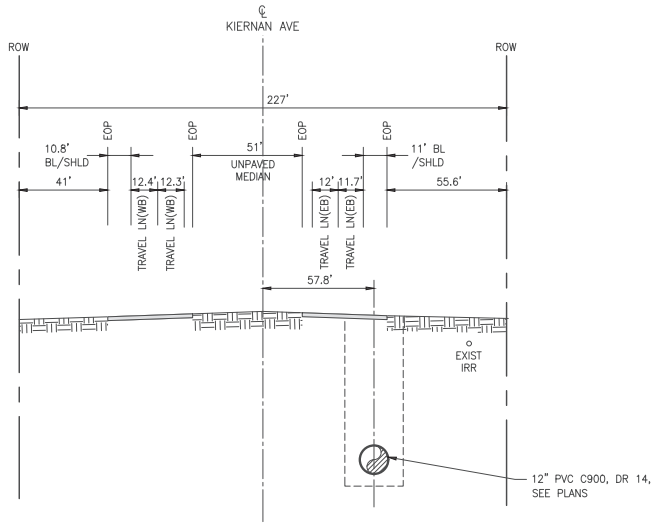
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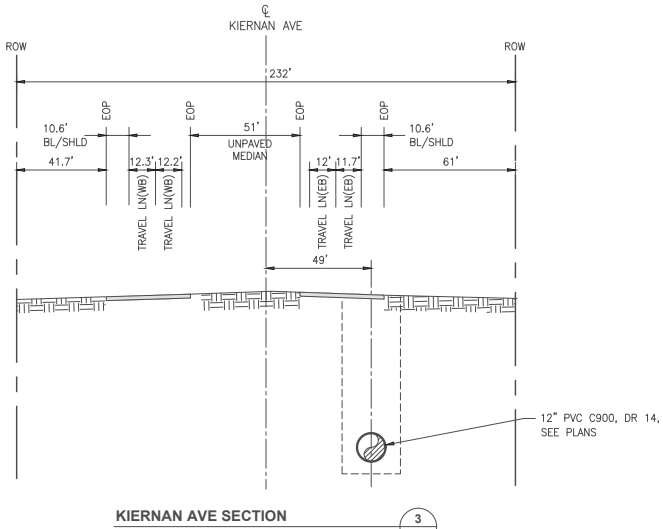
KIERNAN AVE SECTION 1 C-1

SCALE: NTS



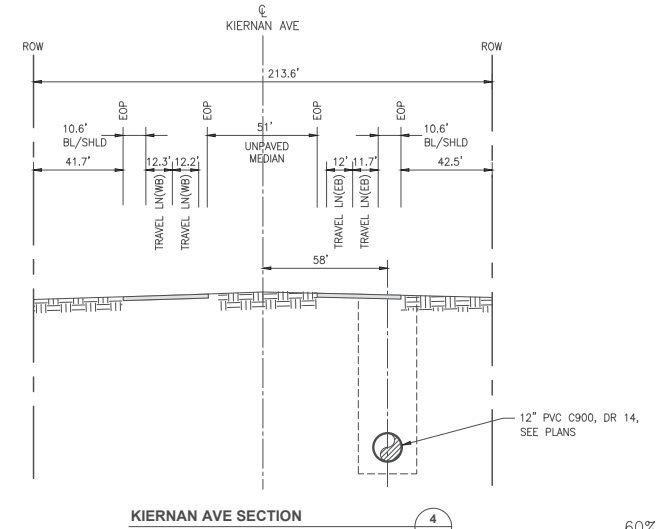
KIERNAN AVE SECTION 2 C-2

SCALE: NTS



KIERNAN AVE SECTION 3 C-3

SCALE: NTS



KIERNAN AVE SECTION 4 C-4

SCALE: NTS

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PROJECT MANAGER DATE

APPROVALS

	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

	DATE
DESIGNED:	
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SCALE: NA	

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

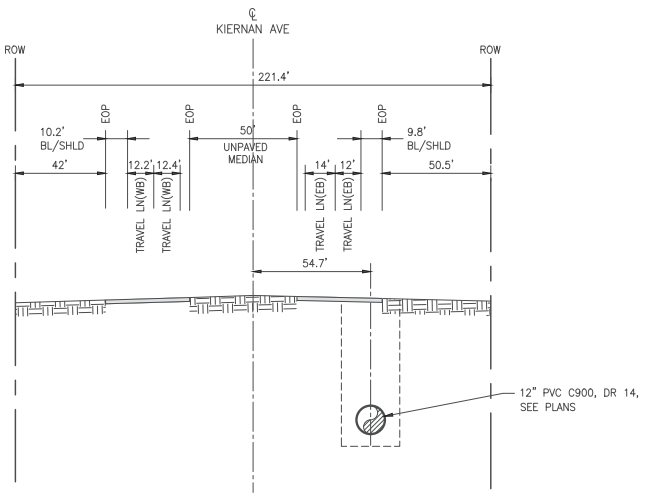
KIERNAN AVENUE 12-INCH WATER MAIN

DETAILS AND CONNECTIONS

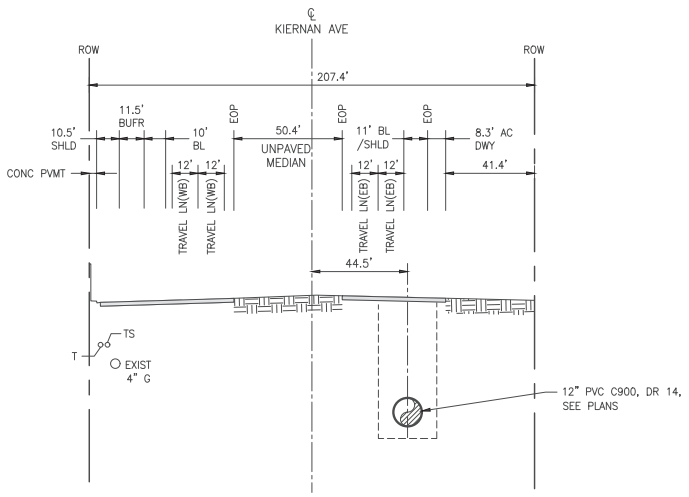
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W.O.	
C.O.	
COORD.	
SHT.	OF XX

CD-1

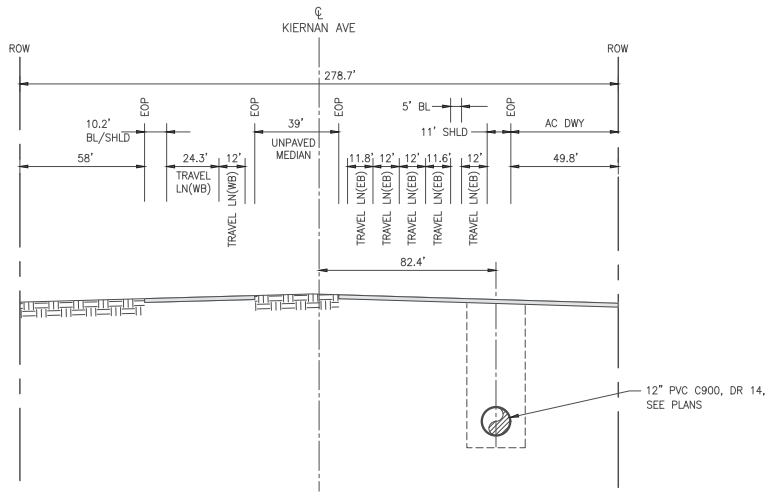
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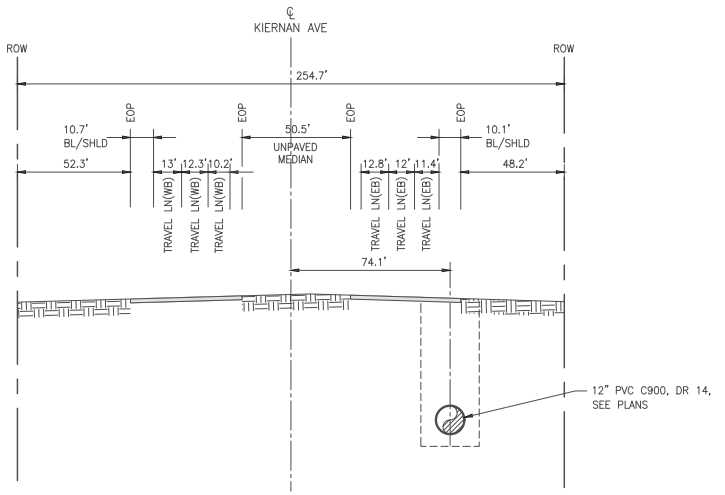
KIERNAN AVE SECTION — SCALE: NTS — 5 / C-5



KIERNAN AVE SECTION — SCALE: NTS — 6 / C-6



KIERNAN AVE SECTION — SCALE: NTS — 7 / C-7



KIERNAN AVE SECTION — SCALE: NTS — 8 / C-8

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MODESTO CALIFORNIA

CITY OF MODESTO
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REFERENCES

CITY OF MODESTO
PROJECT MANAGER DATE

APPROVALS

	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

	DATE
DESIGNED:	
DRAWN:	
TRACED:	
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SCALE: NA	

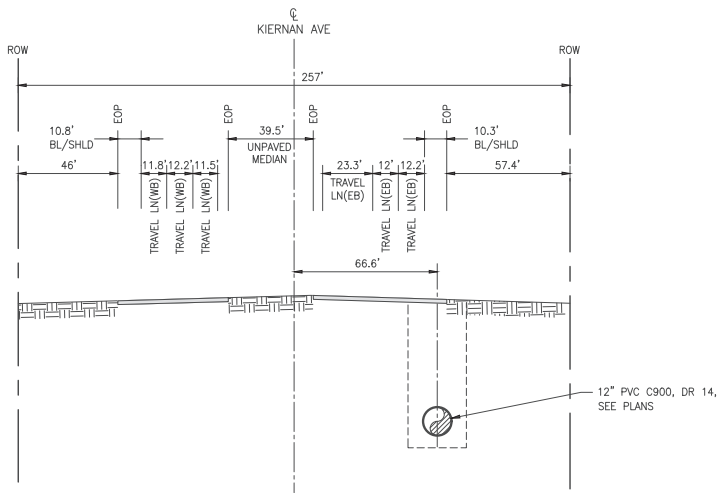
CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

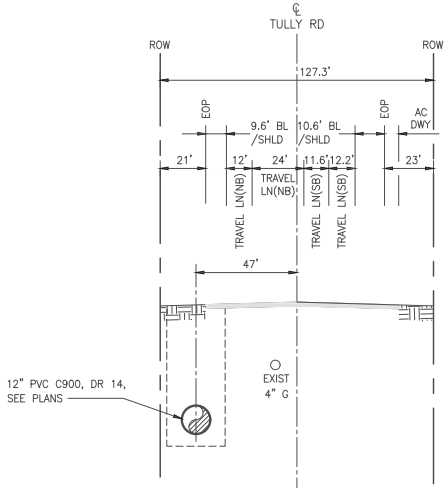
DETAILS AND CONNECTIONS

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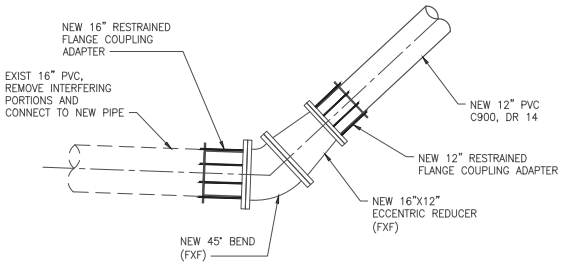
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KIERNAN AVE SECTION
SCALE: NTS
9
C-9



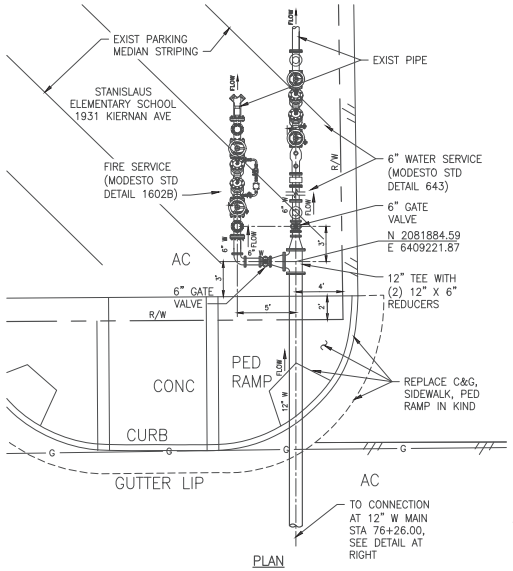
TULLY RD SECTION
SCALE: NTS
10
C-10



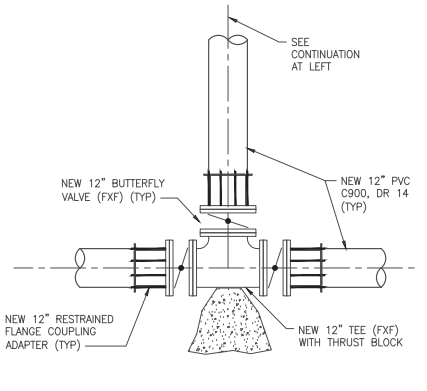
NOTES:

1. CONTRACTOR SHALL EXPOSE EXISTING PIPE, LOCATE JOINTS AND RESTRAIN TO LENGTH SHOWN ON DWG C-1.

CONNECTION DETAIL
SCALE: NTS
11
C-1



CONNECTION DETAIL
SCALE: NTS
12
C-6



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DIGALERT
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STATE OF CALIFORNIA

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CITY OF MODESTO
PROJECT MANAGER DATE

APPROVALS	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

	DATE
DESIGNED:	
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SCALE: NA	

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

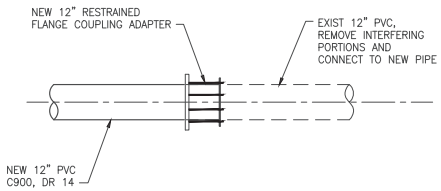
DETAILS AND CONNECTIONS

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SHT.	OF XX
CD-3	

t:\Projects\SHE (0207)\0002.01 TO#1 Stanislaus 123-TO#1 Mitigation\CADD\CD-1_CD-5.dwg 03/14/2024 15:43

NOTES:

1. CONTRACTOR SHALL EXPOSE EXISTING PIPE, LOCATE JOINTS AND RESTRAIN TO LENGTH SHOWN ON DWG C-1.



CONNECTION DETAIL
SCALE: NTS

13
C-10

60% SUBMITTAL –
NOT FOR CONSTRUCTION

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REVISIONS				
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STATE OF CALIFORNIA

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CALIFORNIA

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PROJECT MANAGER DATE

APPROVALS

	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

	DATE
DESIGNED:	
DRAWN:	
TRACED:	
CHECKED:	
SUBMITTED:	

SCALE: NA

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

DETAILS AND CONNECTIONS

I.D.	
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COORD.	
SHT.	OF XX

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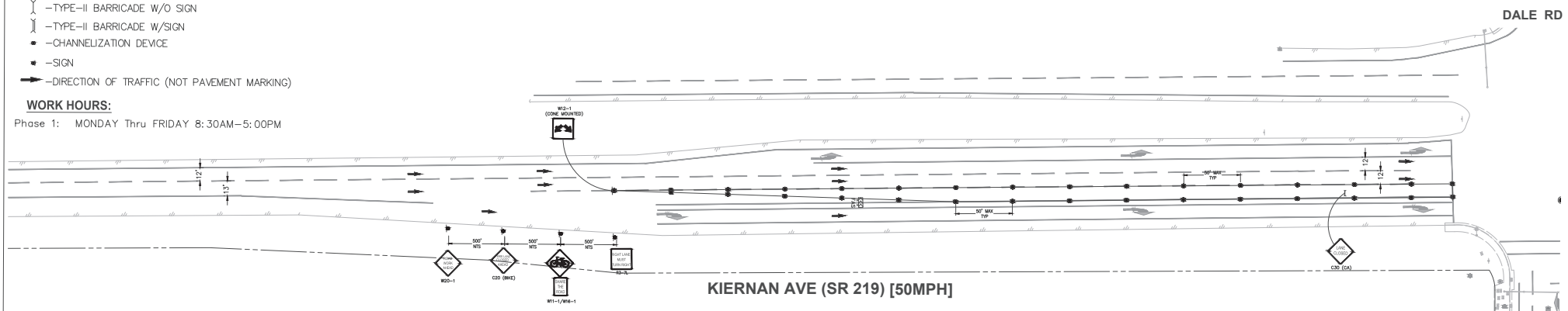
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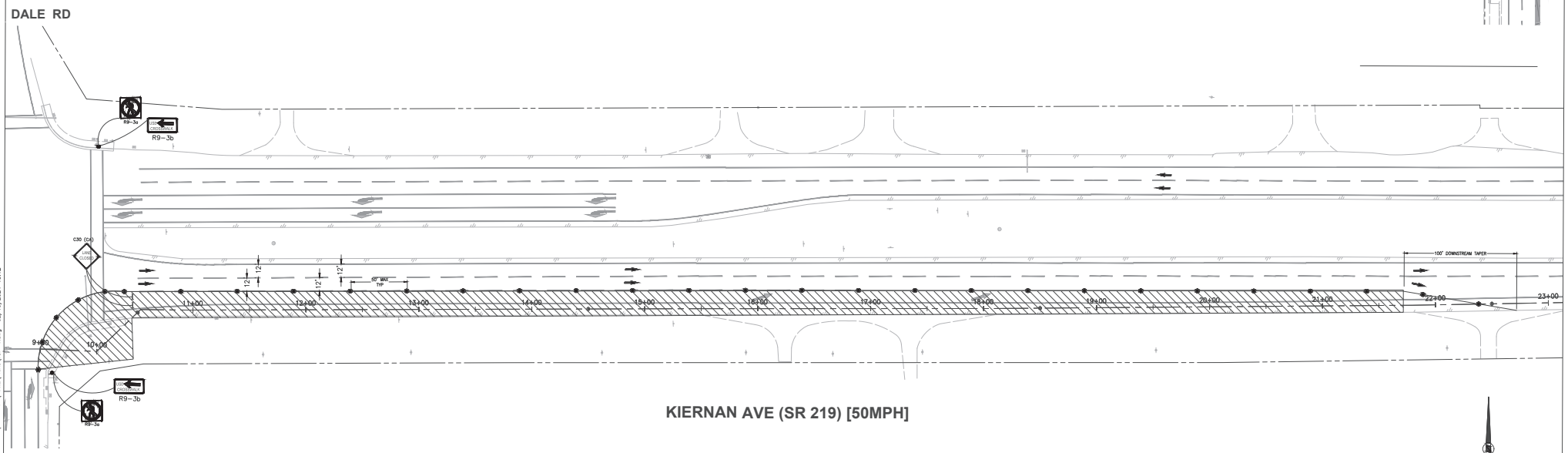
LEGEND:

- TS — TRAFFIC SIGNAL
- — WORK AREA LIMITS
- — FLASHING ARROW SIGN (FAS)
- — TYPE–III BARRICADE W/SIGN
- — TYPE–II BARRICADE W/O SIGN
- — TYPE–II BARRICADE W/SIGN
- — CHANNELIZATION DEVICE
- — SIGN
- — DIRECTION OF TRAFFIC (NOT PAVEMENT MARKING)

WORK HOURS:

Phase 1: MONDAY Thru FRIDAY 8:30AM–5:00PM





PLAN

1" = 40'

20 0 40

P:\Projects\City of Modesto\Stanislaus County Water Pipeline TCP\PS&E\Plans\TCP-1.dwg 02/19/2024 15:12

DIGALERT — DIAL TOLL FREE 811 — AT LEAST TWO DAYS BEFORE YOU DIG — UNDERGROUND SERVICE ALERT OF SOUTHERN CALIFORNIA

REVISIONS				
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REGISTERED PROFESSIONAL ENGINEER — MARK B. LEWIS — No. 1637 — TRAFFIC — STATE OF CALIFORNIA

MODESTO CALIFORNIA

CITY OF MODESTO APPROVED BY:

DIRECTOR OF ENGINEERING DATE

REFERENCES

CITY OF MODESTO

PROJECT MANAGER DATE

APPROVALS		INITIAL	DATE
	PROJECT ENGINEER		
	INSPECTION		
	WATER OPERATIONS		
	MAINTENANCE		

	DATE
DESIGNED:	
DRAWN:	
TRACED:	
CHECKED:	
SUBMITTED:	
SCALE: 1' = 40'	

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

TRAFFIC CONTROL PLAN
PHASE 1 FROM STA 10++ TO STA 21+70

I.D.	
S.A.	
W.O.	
C.O.	
COORD.	
SHT.	OF XX

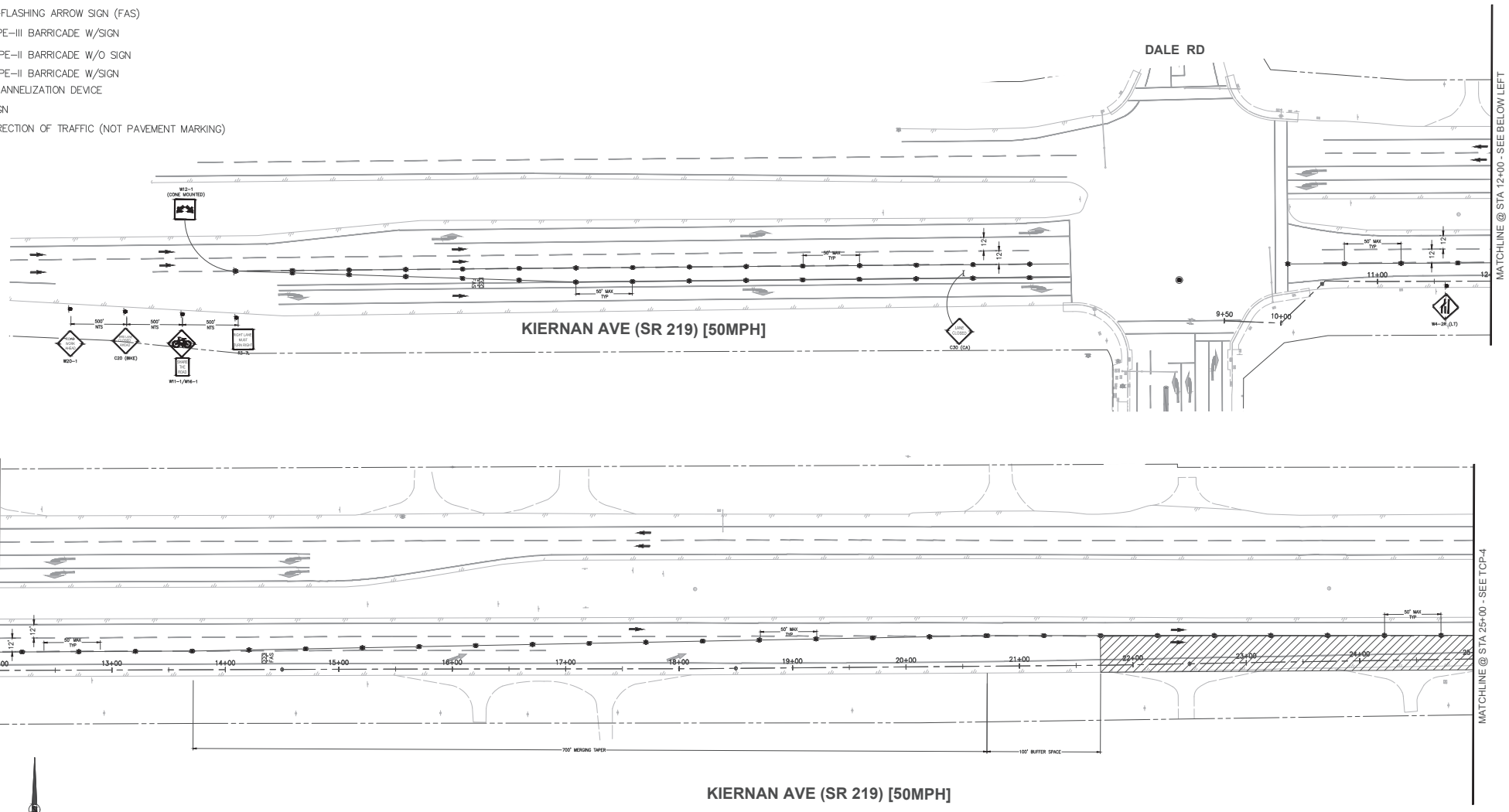
TCP-2

LEGEND:

- TS —TRAFFIC SIGNAL
- —WORK AREA LIMITS
- —FLASHING ARROW SIGN (FAS)
- —TYPE–III BARRICADE W/SIGN
- —TYPE–II BARRICADE W/O SIGN
- —TYPE–II BARRICADE W/SIGN
- —CHANNELIZATION DEVICE
- —SIGN
- —DIRECTION OF TRAFFIC (NOT PAVEMENT MARKING)

WORK HOURS:

Phase 2: MONDAY Thru FRIDAY 8:30AM–5:00PM



1" = 40'

20 0 40

PLAN

DIGALERT — DIAL TOLL FREE 811 — AT LEAST TWO DAYS BEFORE YOU DIG — UNDERGROUND SERVICE ALERT OF SOUTHERN CALIFORNIA

REVISIONS				
NO.	DATE	INITIAL	DESCRIPTION	APPROVED / DATE

DESIGNED: DRAWN: CHECKED:

ARDURRA
9100 Ming Avenue, Suite 202
Bakersfield, California 93309
(661) 529-2190
www.Ardurra.com

REGISTERED PROFESSIONAL ENGINEER — MARK B. LEWIS — No. 1637 — TRAFFIC — STATE OF CALIFORNIA

CITY OF MODESTO

CITY OF MODESTO APPROVED BY:

DIRECTOR OF ENGINEERING DATE

REFERENCES

CITY OF MODESTO

PROJECT MANAGER DATE

APPROVALS

	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

	DATE
DESIGNED:	
DRAWN:	
TRACED:	
CHECKED:	
SUBMITTED:	
SCALE: 1' = 40'	

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

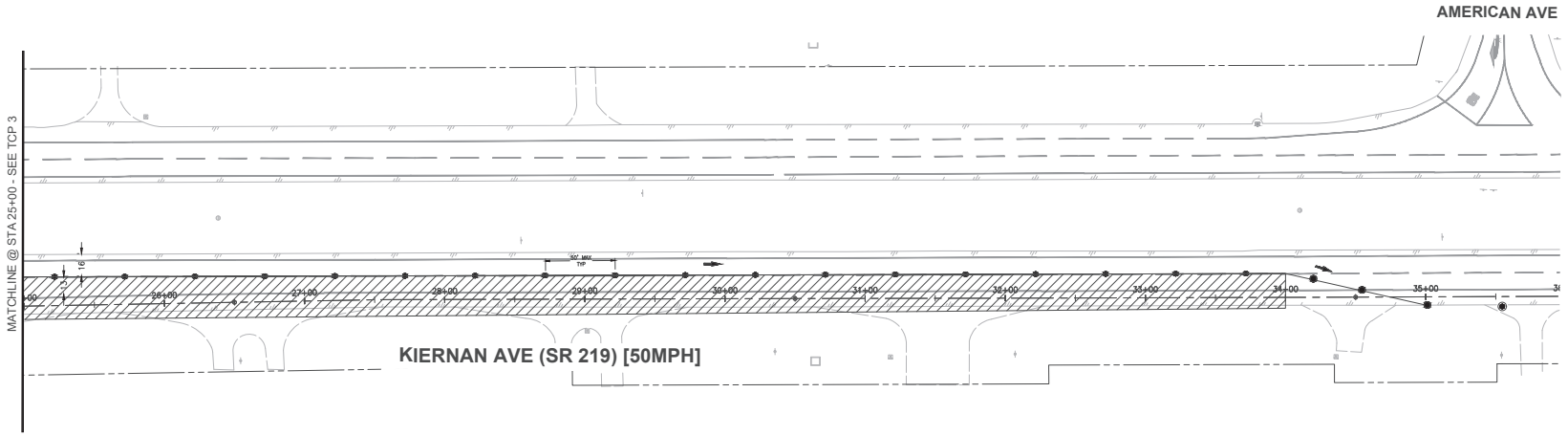
KIERNAN AVENUE 12-INCH WATER MAIN

TRAFFIC CONTROL PLAN
PHASE 2- FROM STA 21+70 TO STA 34+00

I.D.
S.A.
W.O.
C.O.
COORD.
SHT. OF XX

TCP-3

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LEGEND:

- (TS) – TRAFFIC SIGNAL
- – WORK AREA LIMITS
- – FLASHING ARROW SIGN (FAS)
- – TYPE–III BARRICADE W/SIGN
- – TYPE–II BARRICADE W/O SIGN
- – TYPE–II BARRICADE W/SIGN
- – CHANNELIZATION DEVICE
- – SIGN
- – DIRECTION OF TRAFFIC (NOT PAVEMENT MARKING)

WORK HOURS:

Phase 3: MONDAY Thru FRIDAY 8:30AM–5:00PM

1" = 40'
20 0 40

DIGALERT
DIAL TOLL FREE 811
AT LEAST TWO DAYS BEFORE YOU DIG
UNDERGROUND SERVICE ALERT OF SOUTHERN CALIFORNIA

REVISIONS

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REGISTERED PROFESSIONAL ENGINEER – TRAFFIC – No. 1637 – STATE OF CALIFORNIA

MODESTO CALIFORNIA

CITY OF MODESTO
APPROVED BY:
DIRECTOR OF ENGINEERING DATE

REFERENCES

CITY OF MODESTO

PROJECT MANAGER DATE

APPROVALS

	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

	DATE
DESIGNED:	
DRAWN:	
TRACED:	
CHECKED:	
SUBMITTED:	

SCALE: 1' = 40'

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

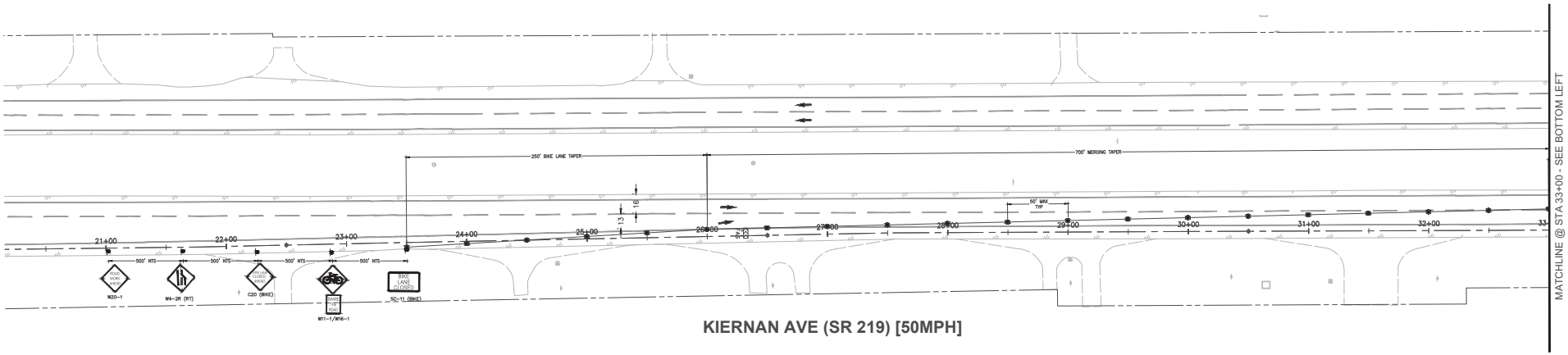
KIERNAN AVENUE 12-INCH WATER MAIN

PLAN & PROFILE
PHASE 3 FROM STA 21+70 TO STA 34+00

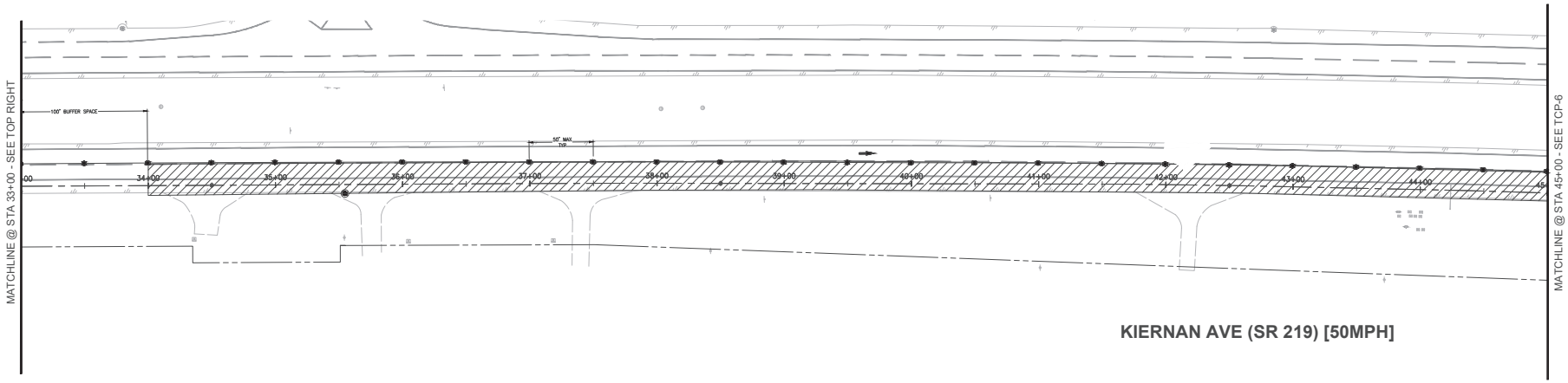
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S.A.	
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COORD.	
SHT.	OF XX

TCP-4

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KIERNAN AVE (SR 219) [50MPH]



KIERNAN AVE (SR 219) [50MPH]

LEGEND:

- TS —TRAFFIC SIGNAL
- —WORK AREA LIMITS
- —FLASHING ARROW SIGN (FAS)
- —TYPE–III BARRICADE W/SIGN
- —TYPE–II BARRICADE W/O SIGN
- —TYPE–II BARRICADE W/SIGN
- —CHANNELIZATION DEVICE
- —SIGN
- —DIRECTION OF TRAFFIC (NOT PAVEMENT MARKING)

WORK HOURS:

Phase 1: MONDAY Thru FRIDAY 8:30AM–5:00PM

1" = 40'

20 0 40

PLAN

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DIAL TOLL FREE 811
AT LEAST TWO DAYS BEFORE YOU DIG
UNDERGROUND SERVICE ALERT OF SOUTHERN CALIFORNIA

REVISIONS				
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DESIGNED: DRAWN: CHECKED:

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REGISTERED PROFESSIONAL ENGINEER — WAYNE B. LEWIS — No. 1637 — TRAFFIC — STATE OF CALIFORNIA

CITY OF MODESTO
APPROVED BY:
DIRECTOR OF ENGINEERING DATE
REFERENCES

CITY OF MODESTO
PROJECT MANAGER DATE

APPROVALS	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

	DATE
DESIGNED:	
DRAWN:	
TRACED:	
CHECKED:	
SUBMITTED:	

SCALE: 1' = 40'

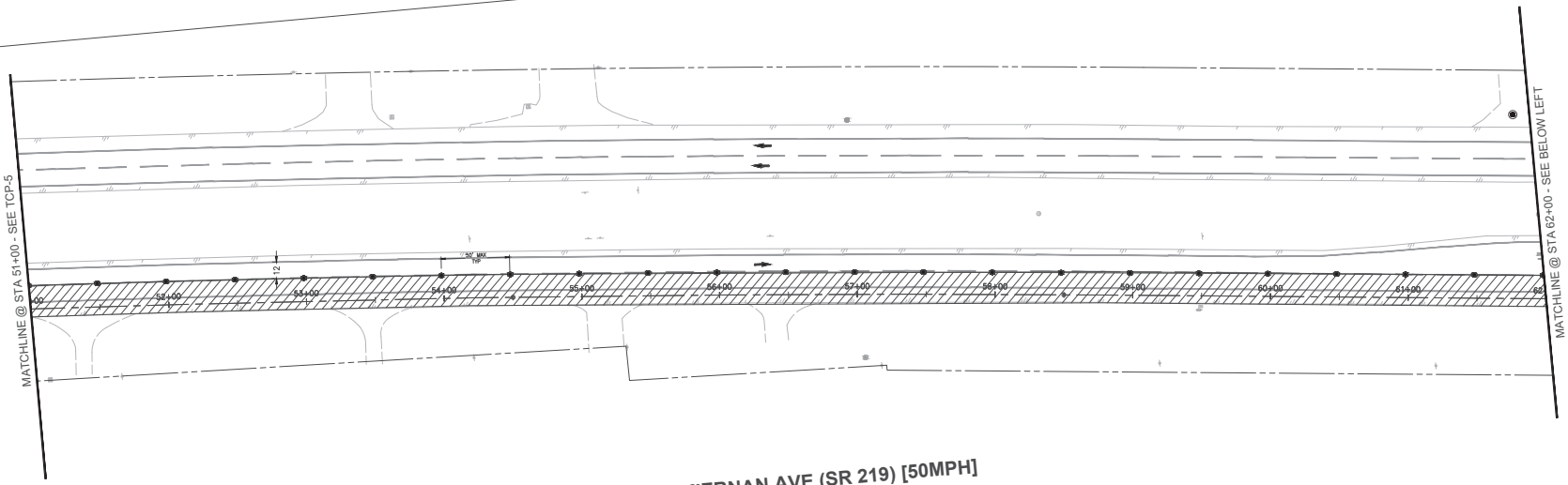
CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

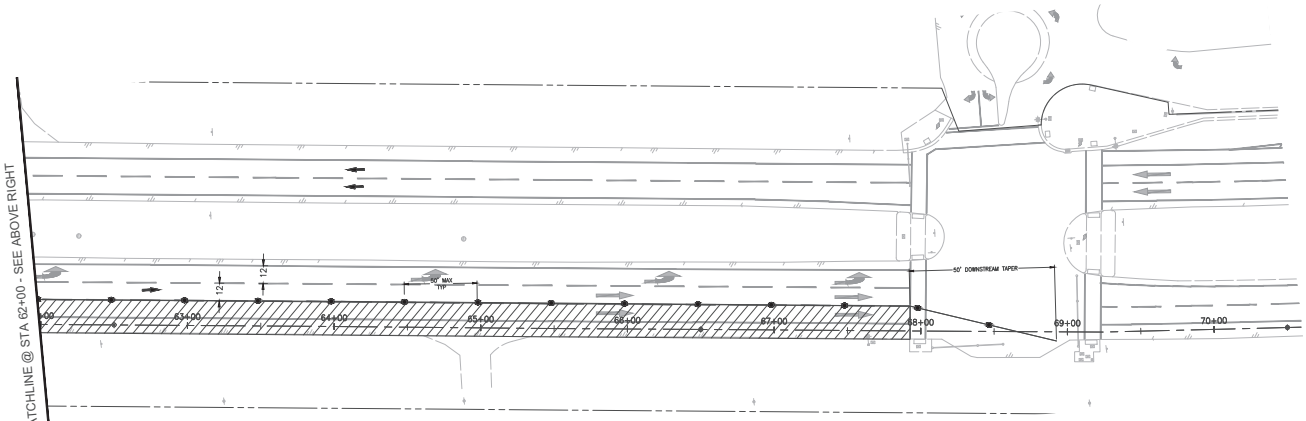
TRAFFIC CONTROL PLAN
PHASE 4 FROM STA 34+00 TO STA 67+90

I.D.	
S.A.	
W.O.	
C.O.	
COORD.	
SHT.	OF XX

TCP-5



KIERNAN AVE (SR 219) [50MPH]



KIERNAN AVE (SR 219) [50MPH]

LEGEND:

- TS – TRAFFIC SIGNAL
- – WORK AREA LIMITS
- – FLASHING ARROW SIGN (FAS)
- – TYPE–III BARRICADE W/SIGN
- – TYPE–II BARRICADE W/O SIGN
- – TYPE–II BARRICADE W/SIGN
- – CHANNELIZATION DEVICE
- – SIGN
- – DIRECTION OF TRAFFIC (NOT PAVEMENT MARKING)

WORK HOURS:

Phase 4: MONDAY Thru FRIDAY 8:30AM–5:00PM

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1" = 40'
20 0 40

DIGALERT
DIAL TOLL FREE 811
AT LEAST TWO DAYS BEFORE YOU DIG
UNDERGROUND SERVICE ALERT OF SOUTHERN CALIFORNIA

NO.	DATE	INITIAL	REVISIONS DESCRIPTION	APPROVED / DATE

DESIGNED: DRAWN: CHECKED:

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REGISTERED PROFESSIONAL ENGINEER
WAYNE B. LEWIS
No. 1637
CIVIL
STATE OF CALIFORNIA

MODESTO CALIFORNIA

CITY OF MODESTO
APPROVED BY:
DIRECTOR OF ENGINEERING DATE

REFERENCES

CITY OF MODESTO

APPROVALS

	PROJECT MANAGER	INITIAL	DATE
	PROJECT ENGINEER		
	INSPECTION		
	WATER OPERATIONS		
	MAINTENANCE		

	DATE
DESIGNED:	
DRAWN:	
TRACED:	
CHECKED:	
SUBMITTED:	
SCALE:	1' = 40'

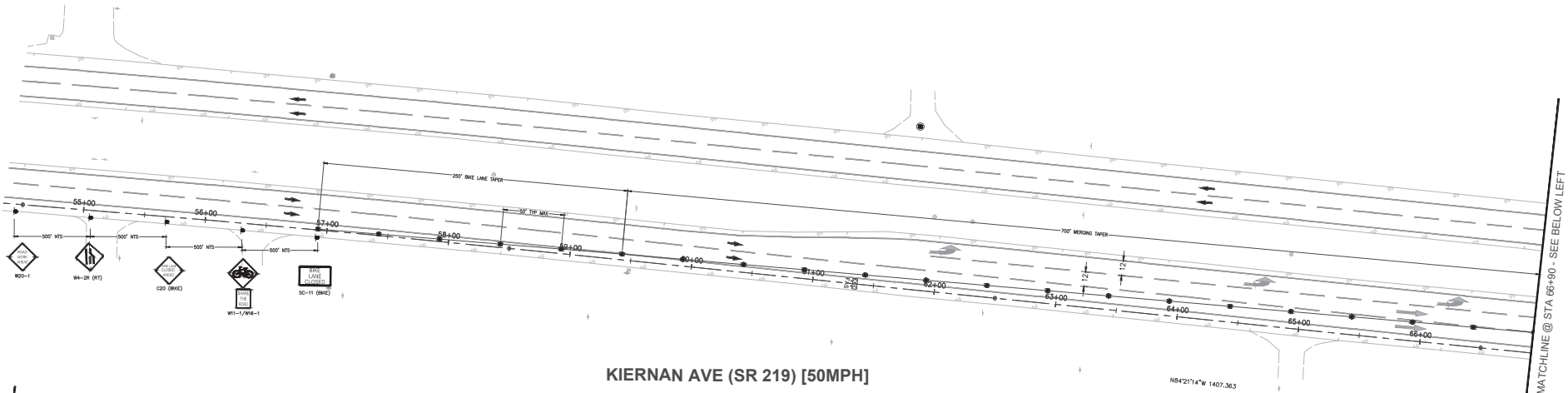
CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

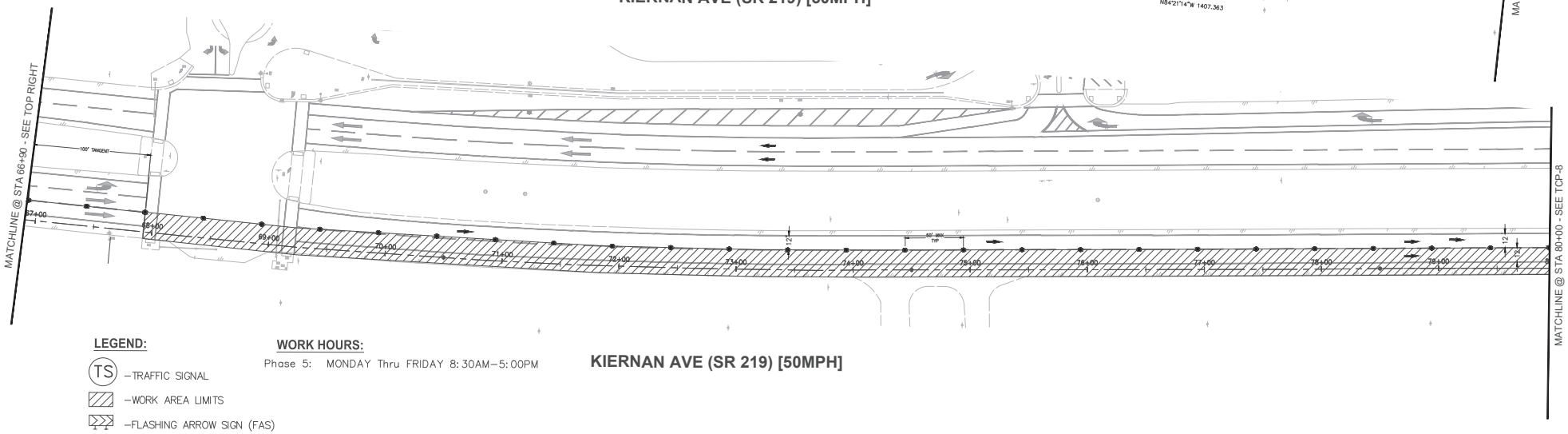
TRAFFIC CONTROL PLAN
PHASE 4 FROM STA 34+00 TO STA 67+90

I.D.	
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W.O.	
C.Y.	
COORD.	
SHT.	OF

TCP-4



KIERNAN AVE (SR 219) [50MPH]



KIERNAN AVE (SR 219) [50MPH]

LEGEND:

- (TS) –TRAFFIC SIGNAL
- –WORK AREA LIMITS
- –FLASHING ARROW SIGN (FAS)
- –TYPE–III BARRICADE W/SIGN
- –TYPE–II BARRICADE W/O SIGN
- –TYPE–II BARRICADE W/SIGN
- –CHANNELIZATION DEVICE
- –SIGN
- –DIRECTION OF TRAFFIC (NOT PAVEMENT MARKING)

WORK HOURS:

Phase 5: MONDAY Thru FRIDAY 8:30AM–5:00PM

1" = 40'
20 0 40

DIGALERT — DIAL TOLL FREE 811 — AT LEAST TWO DAYS BEFORE YOU DIG — UNDERGROUND SERVICE ALERT OF SOUTHERN CALIFORNIA

REVISIONS				
NO.	DATE	INITIAL	DESCRIPTION	APPROVED / DATE
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REGISTERED PROFESSIONAL ENGINEER — MARK B. LEWIS — No. 1637 — TRAFFIC — STATE OF CALIFORNIA

CITY OF MODESTO

CITY OF MODESTO
APPROVED BY:
DIRECTOR OF ENGINEERING DATE

REFERENCES

CITY OF MODESTO

PROJECT MANAGER DATE

APPROVALS

	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

	DATE
DESIGNED:	
DRAWN:	
TRACED:	
CHECKED:	
SUBMITTED:	
SCALE: 1' = 40'	

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

TRAFFIC CONTROL PLAN
PHASE 5 FROM STA 67+90 TO STA 83+00

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TCP-7

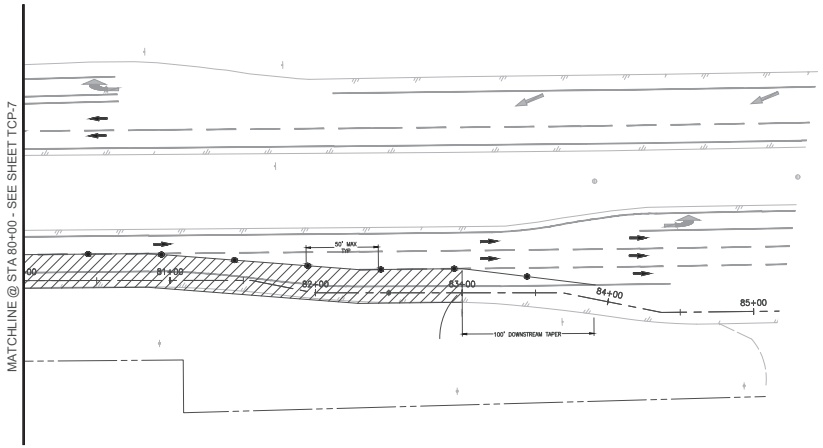
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LEGEND:

- TS —TRAFFIC SIGNAL
- —WORK AREA LIMITS
- —FLASHING ARROW SIGN (FAS)
- —TYPE–III BARRICADE W/SIGN
- —TYPE–II BARRICADE W/O SIGN
- —TYPE–II BARRICADE W/SIGN
- —CHANNELIZATION DEVICE
- —SIGN
- —DIRECTION OF TRAFFIC (NOT PAVEMENT MARKING)

WORK HOURS:

Phase 6: MONDAY Thru FRIDAY 8:30AM–5:00PM



KIERNAN AVE (SR 219) [50MPH]

1" = 40'
20 0 40

DIGALERT — DIAL TOLL FREE 811 — AT LEAST TWO DAYS BEFORE YOU DIG — UNDERGROUND SERVICE ALERT OF SOUTHERN CALIFORNIA

REVISIONS				
NO.	DATE	INITIAL	DESCRIPTION	APPROVED / DATE

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REGISTERED PROFESSIONAL ENGINEER — WAYNE B. LEWIS — No. 1637 — TRAFFIC — STATE OF CALIFORNIA

CITY OF MODESTO
APPROVED BY:
DIRECTOR OF ENGINEERING DATE
REFERENCES

CITY OF MODESTO
PROJECT MANAGER DATE

APPROVALS		INITIAL	DATE
	PROJECT ENGINEER		
	INSPECTION		
	WATER OPERATIONS		
	MAINTENANCE		

	DATE
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SUBMITTED:	
SCALE: 1' = 40'	

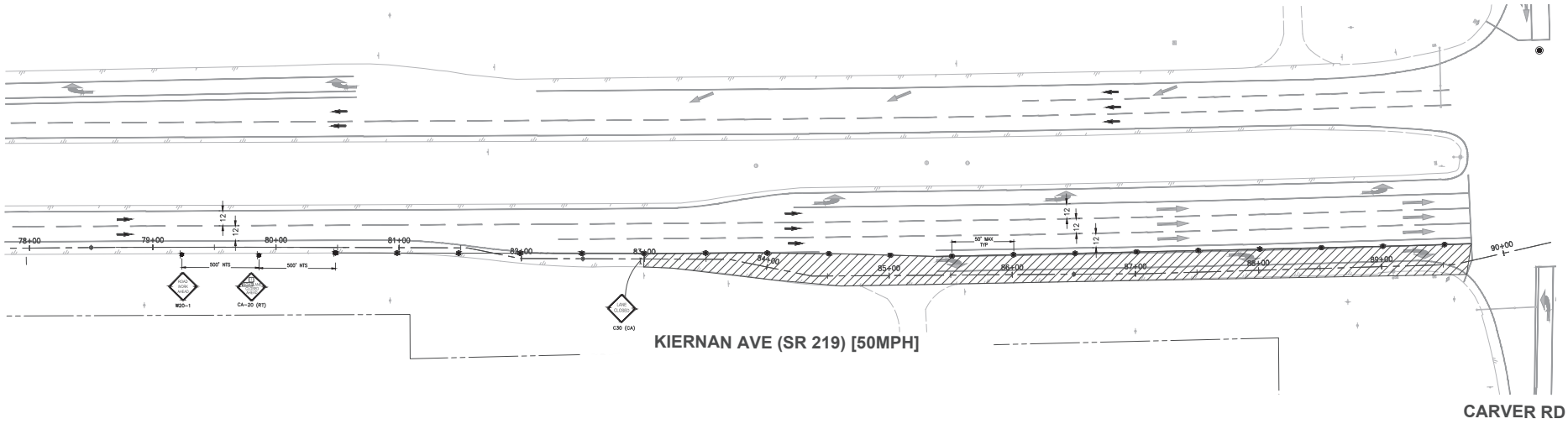
CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

TRAFFIC CONTROL PLAN
PHASE 6 FROM STA 67+90 TO STA 83+00

I.D.	
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W.O.	
C.O.	
COORD.	
SHT.	OF XX
TCP-8	

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LEGEND:

- (TS) –TRAFFIC SIGNAL
- –WORK AREA LIMITS
- –FLASHING ARROW SIGN (FAS)
- –TYPE–III BARRICADE W/SIGN
- –TYPE–II BARRICADE W/O SIGN
- –TYPE–II BARRICADE W/SIGN
- –CHANNELIZATION DEVICE
- –SIGN
- –DIRECTION OF TRAFFIC (NOT PAVEMENT MARKING)

WORK HOURS:

Phase 7: MONDAY Thru FRIDAY 8:30AM–5:00PM

1" = 40'
20 0 40

DIGALERT — DIAL TOLL FREE 811 — AT LEAST TWO DAYS BEFORE YOU DIG — UNDERGROUND SERVICE ALERT OF SOUTHERN CALIFORNIA

REVISIONS

NO.	DATE	INITIAL	DESCRIPTION	APPROVED / DATE

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THE MODESTO CALIFORNIA

CITY OF MODESTO
APPROVED BY:
DIRECTOR OF ENGINEERING DATE

REFERENCES

CITY OF MODESTO
PROJECT MANAGER DATE

APPROVALS

	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

	DATE
DESIGNED:	
DRAWN:	
TRACED:	
CHECKED:	
SUBMITTED:	
SCALE: 1' = 40'	

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

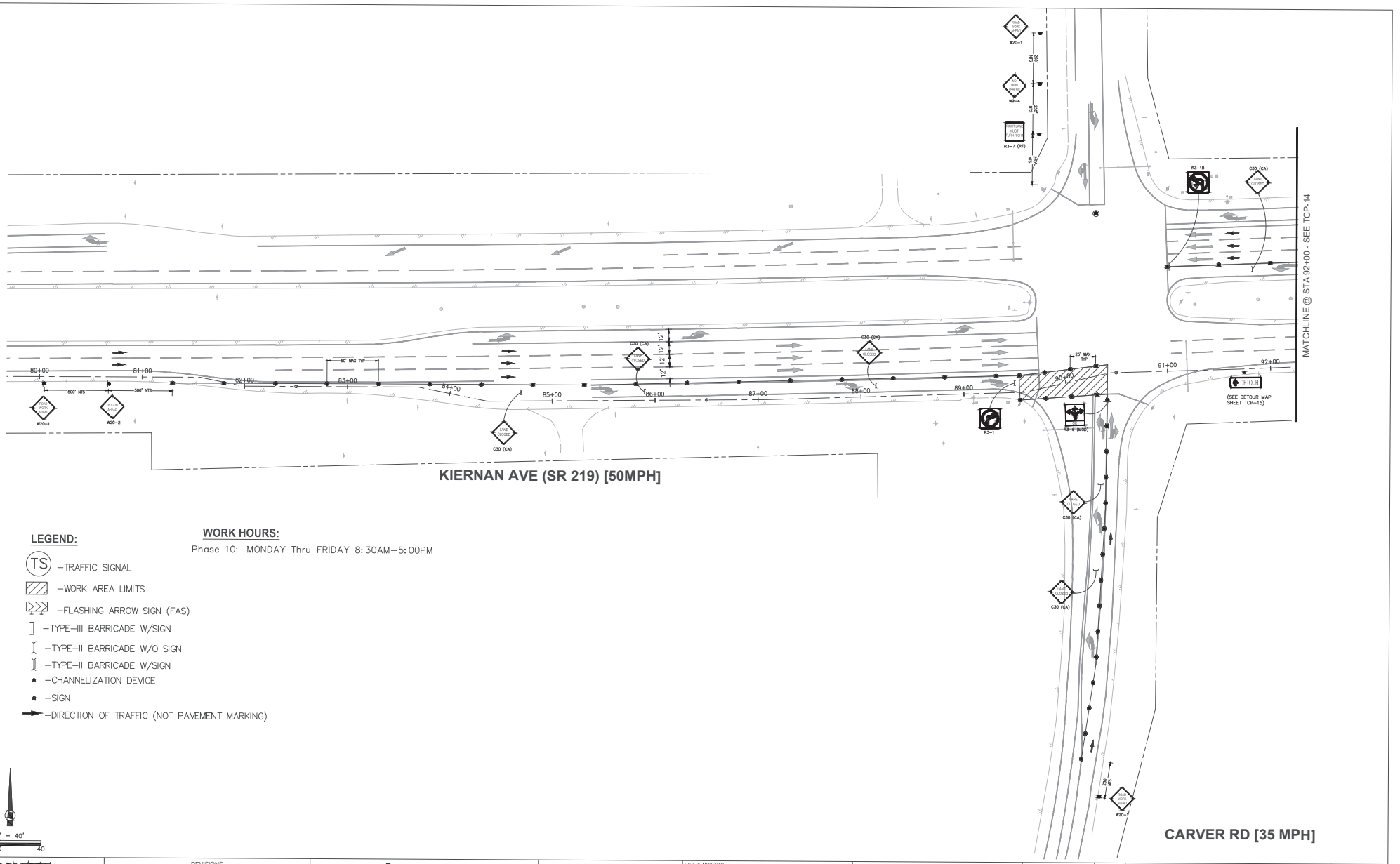
KIERNAN AVENUE 12-INCH WATER MAIN

TRAFFIC CONTROL PLAN
PHASE 7 FROM STA 83+00 TO STA 89+70

I.D.
S.A.
W.O.
C.O.
COORD.
SHT. OF XX

TCP-9

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LEGEND:

- TS —TRAFFIC SIGNAL
- —WORK AREA LIMITS
- —FLASHING ARROW SIGN (FAS)
- —TYPE–III BARRICADE W/SIGN
- —TYPE–II BARRICADE W/O SIGN
- —TYPE–II BARRICADE W/SIGN
- —CHANNELIZATION DEVICE
- —SIGN
- —DIRECTION OF TRAFFIC (NOT PAVEMENT MARKING)

WORK HOURS:

Phase 10: MONDAY Thru FRIDAY 8:30AM–5:00PM

1" = 40'
20 0 40

DIGALERT DIAL TOLL FREE 811 AT LEAST TWO DAYS BEFORE YOU DIG
UNDERGROUND SERVICE ALERT OF SOUTHERN CALIFORNIA

REVISIONS				
NO.	DATE	INITIAL	DESCRIPTION	APPROVED / DATE

DESIGNED: DRAWN: CHECKED:

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www.Ardurra.com

REGISTERED PROFESSIONAL ENGINEER MARK S. LEWIS No. 1637 TRAFFIC STATE OF CALIFORNIA

CITY OF MODESTO
APPROVED BY:
DIRECTOR OF ENGINEERING DATE
REFERENCES

CITY OF MODESTO
PROJECT MANAGER DATE

APPROVALS		INITIAL	DATE
	PROJECT ENGINEER		
	INSPECTION		
	WATER OPERATIONS		
	MAINTENANCE		

	DATE
DESIGNED:	
DRAWN:	
TRACED:	
CHECKED:	
SUBMITTED:	
SCALE: 1' = 40'	

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

TRAFFIC CONTROL PLAN
PHASE 10 FROM STA 89+50 TO STA 90+40

I.D.	
S.A.	
W.O.	
C.O.	
COORD.	
SHT.	OF XX

TCP-10

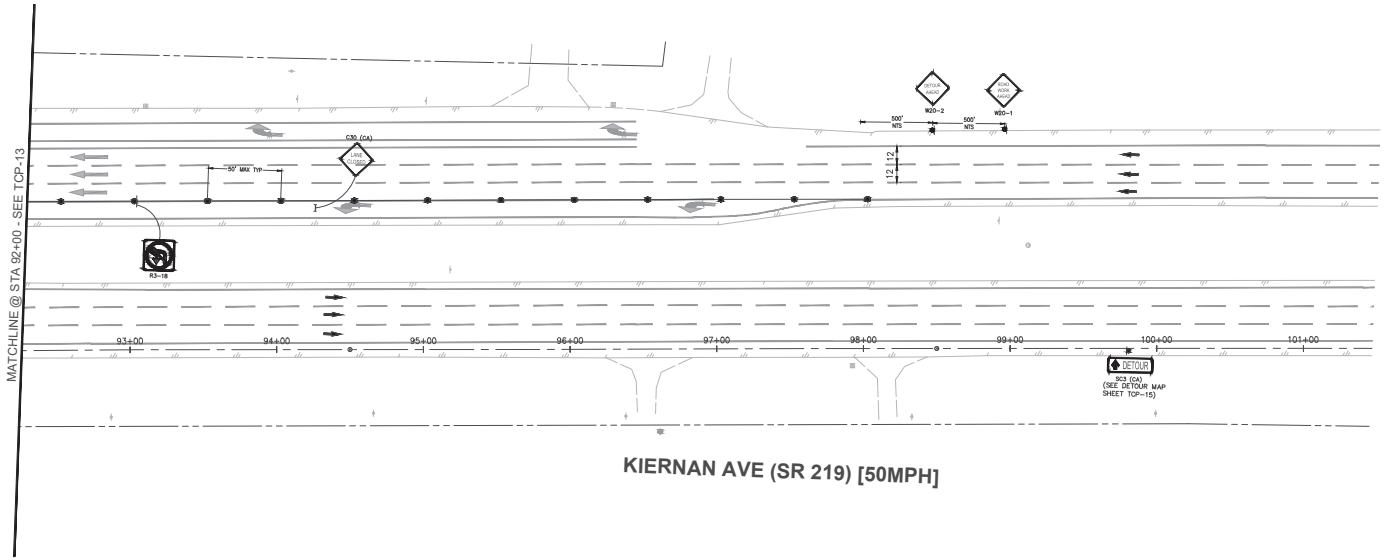
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LEGEND:

- (TS) –TRAFFIC SIGNAL
- –WORK AREA LIMITS
- –FLASHING ARROW SIGN (FAS)
- –TYPE–III BARRICADE W/SIGN
- –TYPE–II BARRICADE W/O SIGN
- –TYPE–II BARRICADE W/SIGN
- –CHANNELIZATION DEVICE
- –SIGN
- –DIRECTION OF TRAFFIC (NOT PAVEMENT MARKING)

WORK HOURS:

Phase 10: MONDAY Thru FRIDAY 8:30AM–5:00PM



KIERNAN AVE (SR 219) [50MPH]

1" = 40'
20 0 40

DIGALERT
DIAL TOLL FREE 811
AT LEAST TWO DAYS BEFORE YOU DIG
UNDERGROUND SERVICE ALERT OF SOUTHERN CALIFORNIA

REVISIONS				
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REGISTERED PROFESSIONAL ENGINEER
MARK B. LEWIS
No. 1637
STATE OF CALIFORNIA

MODESTO CALIFORNIA

CITY OF MODESTO
APPROVED BY:
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CITY OF MODESTO
PROJECT MANAGER DATE

APPROVALS

	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

	DATE
DESIGNED:	
DRAWN:	
TRACED:	
CHECKED:	
SUBMITTED:	
SCALE: 1" = 40'	

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

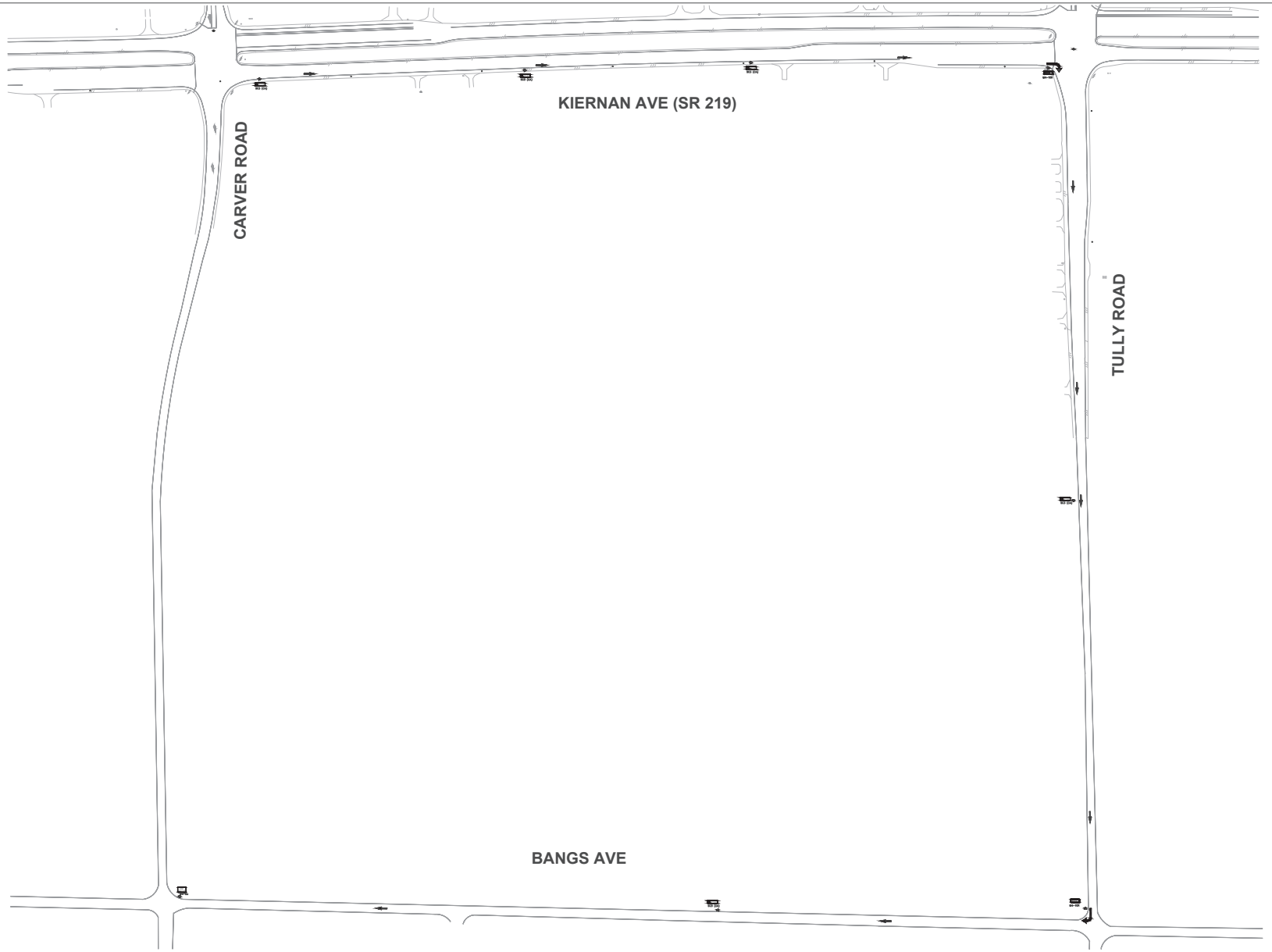
KIERNAN AVENUE 12-INCH WATER MAIN

TRAFFIC CONTROL PLAN
PHASE 10 FROM STA 89+50 TO STA 90+40

I.D.	
S.A.	
W.O.	
C.O.	
COORD.	
SHT.	OF XX

TCP-11

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DIGALERT
DIAL TOLL FREE
811
AT LEAST TWO DAYS BEFORE YOU DIG
UNDERGROUND SERVICE ALERT OF SOUTHERN CALIFORNIA

REVISIONS				
NO.	DATE	INITIAL	DESCRIPTION	APPROVED / DATE
DESIGNED:		DRAWN:	CHECKED:	

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REGISTERED PROFESSIONAL ENGINEER
MARK B. LEWIS
No. 1637
TRAFFIC
STATE OF CALIFORNIA

CITY OF MODESTO
APPROVED BY:

DIRECTOR OF ENGINEERING DATE

REFERENCES

CITY OF MODESTO

PROJECT MANAGER DATE

APPROVALS

	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

	DATE
DESIGNED:	
DRAWN:	
TRACED:	
CHECKED:	
SUBMITTED:	

SCALE: NTS

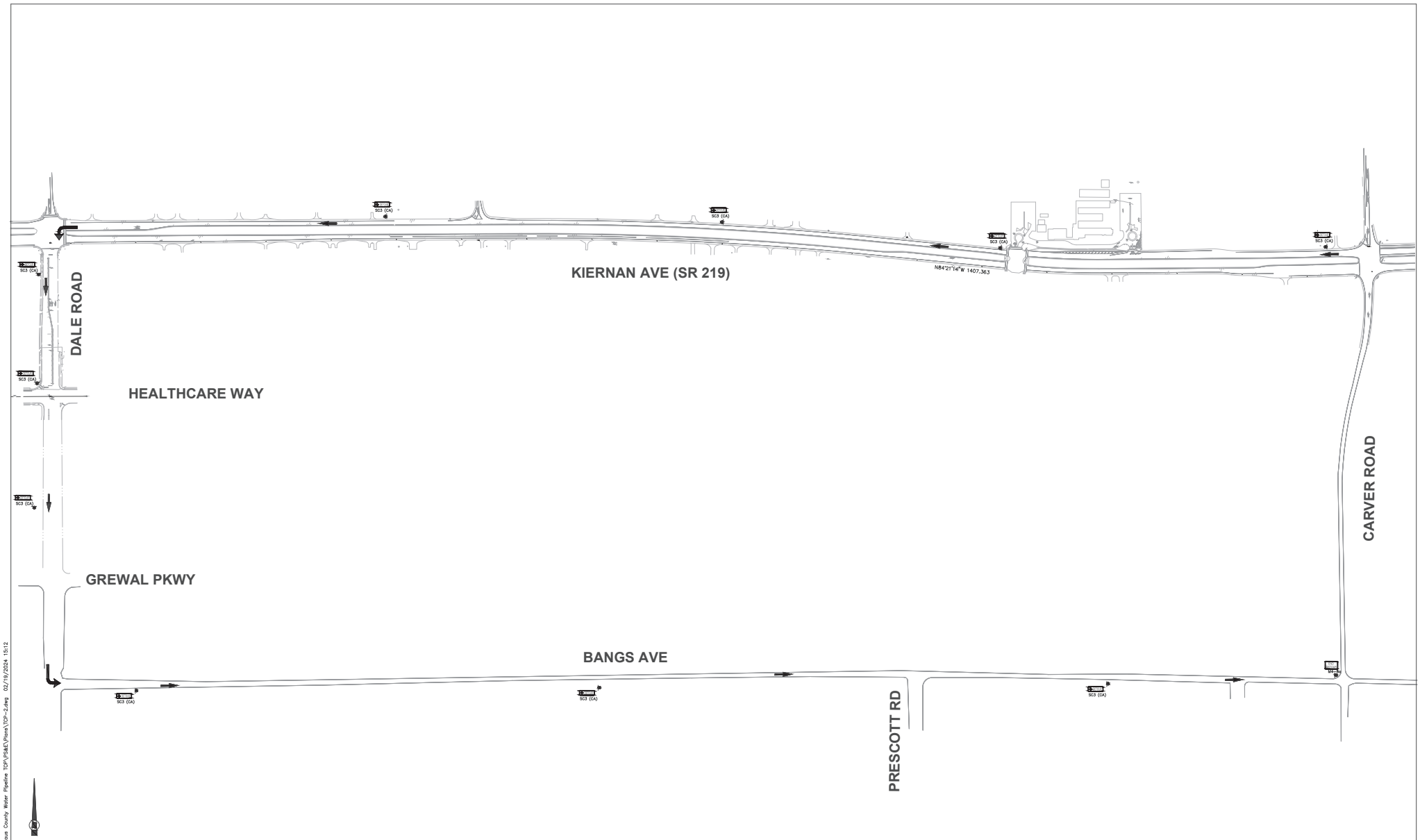
CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

DETOUR PLAN

I.D.	
S.A.	
W.O.	
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811
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UNDERGROUND SERVICE ALERT OF SOUTHERN CALIFORNIA

REVISIONS				
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(661) 529-2190
www.Ardurra.com

REGISTERED PROFESSIONAL ENGINEER
WAYNE B. LEWIS
No. 1637
TRAFFIC
STATE OF CALIFORNIA

CITY OF MODESTO
CALIFORNIA

CITY OF MODESTO
APPROVED BY:

DIRECTOR OF ENGINEERING DATE

REFERENCES

CITY OF MODESTO

PROJECT MANAGER DATE

APPROVALS

	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

	DATE
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TRACED:	
CHECKED:	
SUBMITTED:	

SCALE: NTS

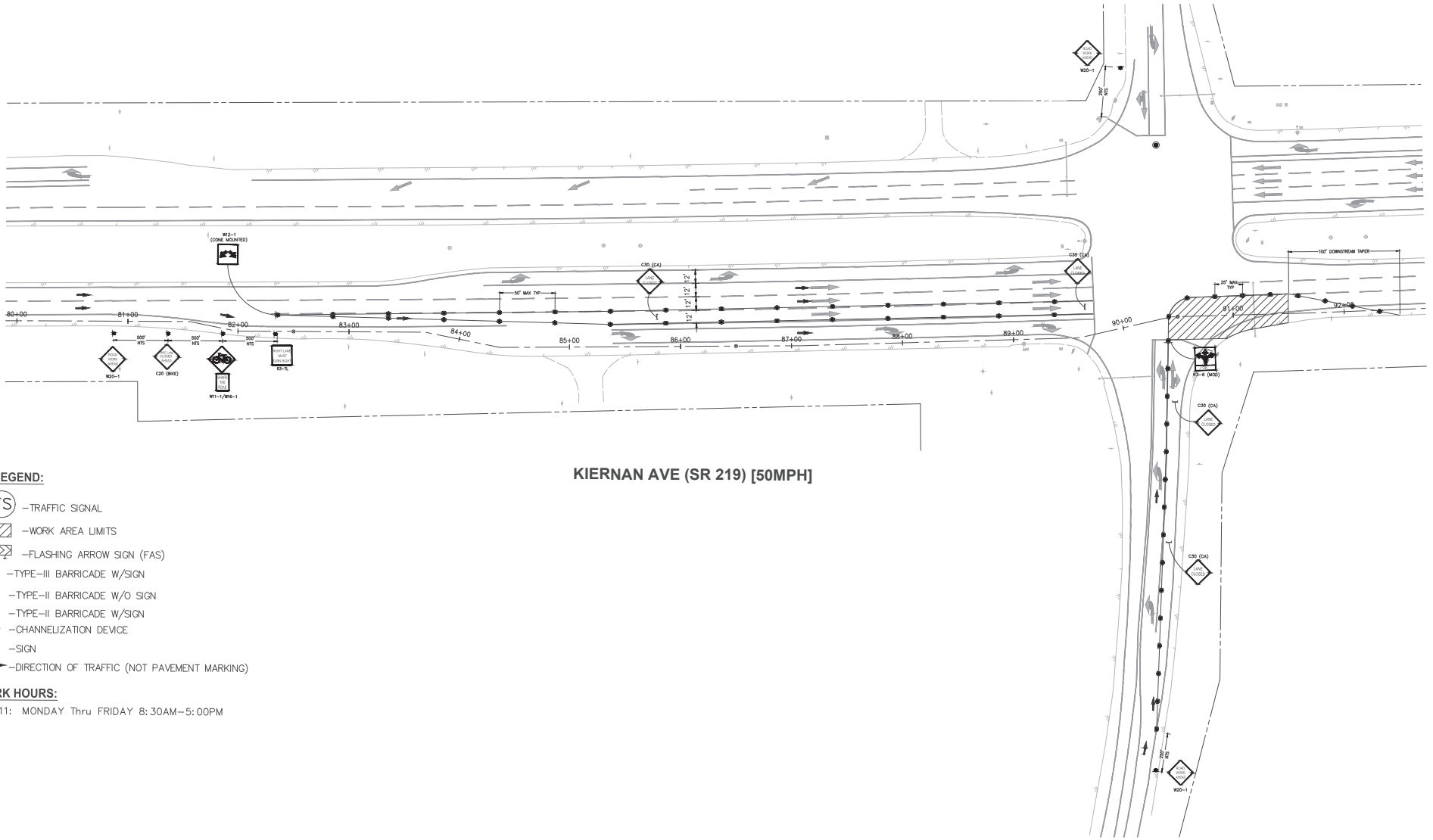
CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

DETOUR PLAN

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TCP-13



LEGEND:

- (TS) –TRAFFIC SIGNAL
- –WORK AREA LIMITS
- –FLASHING ARROW SIGN (FAS)
- –TYPE–III BARRICADE W/SIGN
- –TYPE–II BARRICADE W/O SIGN
- –TYPE–II BARRICADE W/SIGN
- –CHANNELIZATION DEVICE
- –SIGN
- –DIRECTION OF TRAFFIC (NOT PAVEMENT MARKING)

WORK HOURS:

Phase 11: MONDAY Thru FRIDAY 8:30AM–5:00PM

1" = 40'
20 0 40

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REFERENCES

CITY OF MODESTO
PROJECT MANAGER DATE

APPROVALS		INITIAL	DATE
	PROJECT ENGINEER		
	INSPECTION		
	WATER OPERATIONS		
	MAINTENANCE		

	DATE
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DRAWN:	
TRACED:	
CHECKED:	
SUBMITTED:	
SCALE: 1' = 40'	

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

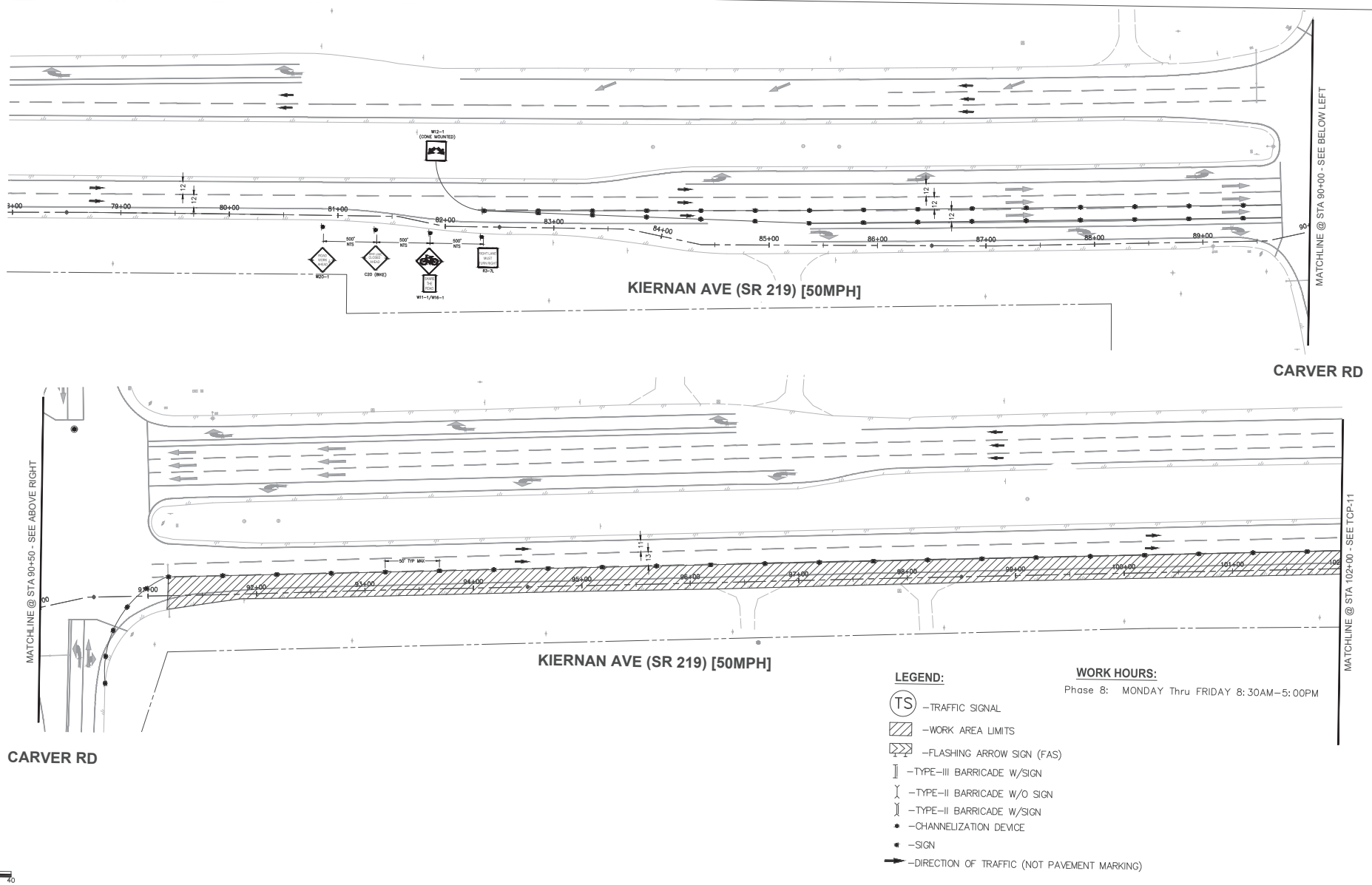
KIERNAN AVENUE 12-INCH WATER MAIN

TRAFFIC CONTROL PLAN
PHASE 11 FROM STA 90+40 TO STA 91+50

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LEGEND:

- TS —TRAFFIC SIGNAL
- —WORK AREA LIMITS
- —FLASHING ARROW SIGN (FAS)
- —TYPE-III BARRICADE W/SIGN
- —TYPE-II BARRICADE W/O SIGN
- —TYPE-II BARRICADE W/SIGN
- —CHANNELIZATION DEVICE
- —SIGN
- —DIRECTION OF TRAFFIC (NOT PAVEMENT MARKING)

WORK HOURS:

Phase 8: MONDAY Thru FRIDAY 8:30AM–5:00PM

1" = 40'
20 0 40

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STATE OF CALIFORNIA

MODESTO CALIFORNIA

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REFERENCES

CITY OF MODESTO
PROJECT MANAGER DATE

APPROVALS

	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

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TRACED:	
CHECKED:	
SUBMITTED:	
SCALE: 1' = 40'	

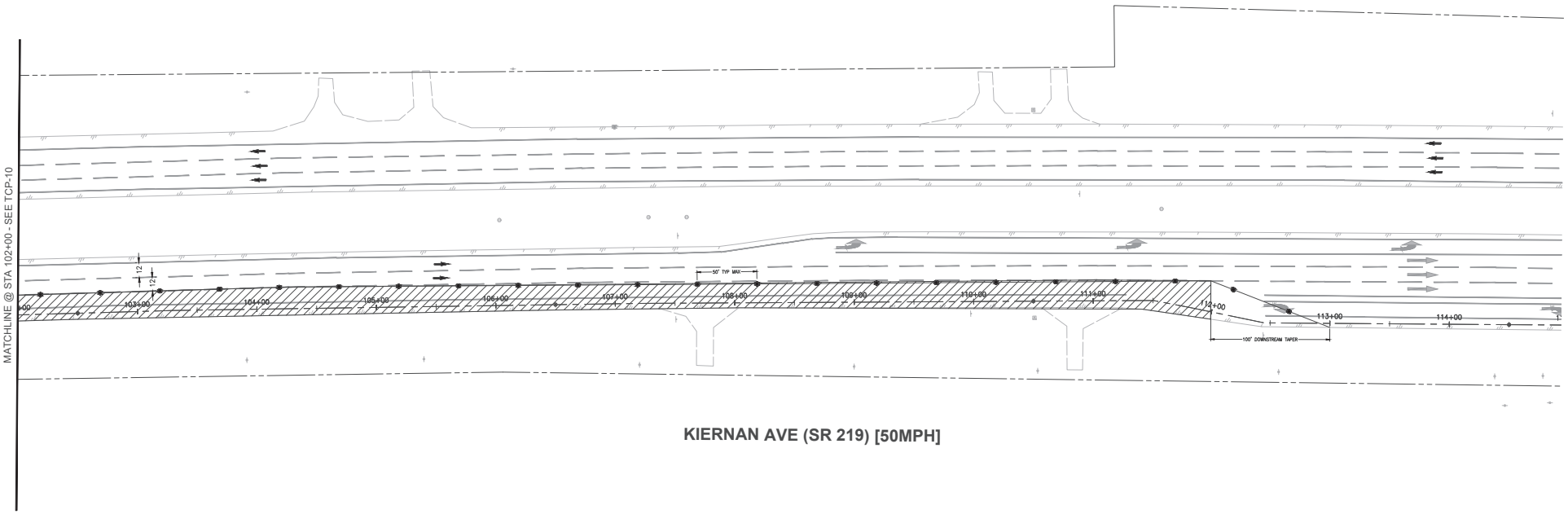
CITY OF MODESTO
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KIERNAN AVENUE 12-INCH WATER MAIN

TRAFFIC CONTROL PLAN
PHASE 8 FROM STA 91+20 TO STA 112+00

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TCP-15



KIERNAN AVE (SR 219) [50MPH]

WORK HOURS:

Phase 8: MONDAY Thru FRIDAY 8:30AM–5:00PM

LEGEND:

- (TS) –TRAFFIC SIGNAL
- –WORK AREA LIMITS
- –FLASHING ARROW SIGN (FAS)
- –TYPE–III BARRICADE W/SIGN
- –TYPE–II BARRICADE W/O SIGN
- –TYPE–II BARRICADE W/SIGN
- –CHANNELIZATION DEVICE
- –SIGN
- –DIRECTION OF TRAFFIC (NOT PAVEMENT MARKING)

1" = 40'
20 0 40

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CITY OF MODESTO
PROJECT MANAGER DATE

APPROVALS		INITIAL	DATE
	PROJECT ENGINEER		
	INSPECTION		
	WATER OPERATIONS		
	MAINTENANCE		

	DATE
DESIGNED:	
DRAWN:	
TRACED:	
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SCALE: 1' = 40'

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

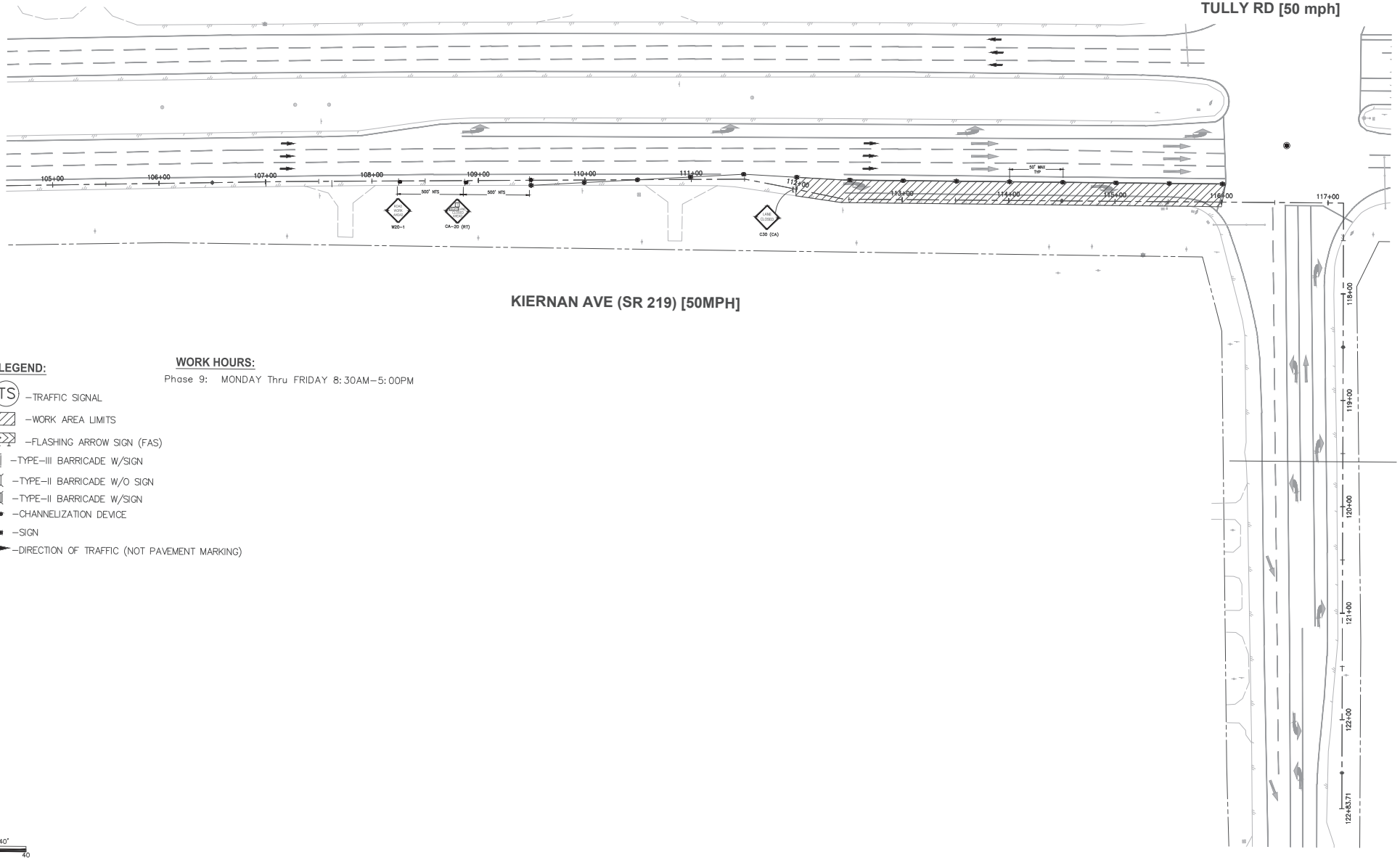
KIERNAN AVENUE 12-INCH WATER MAIN

TRAFFIC CONTROL PLAN
PHASE 8 FROM STA 91+20 TO STA 112+00

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TCP-16

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LEGEND:

- (TS) –TRAFFIC SIGNAL
- –WORK AREA LIMITS
- –FLASHING ARROW SIGN (FAS)
- –TYPE–III BARRICADE W/SIGN
- –TYPE–II BARRICADE W/O SIGN
- –TYPE–II BARRICADE W/SIGN
- –CHANNELIZATION DEVICE
- –SIGN
- –DIRECTION OF TRAFFIC (NOT PAVEMENT MARKING)

WORK HOURS:

Phase 9: MONDAY Thru FRIDAY 8:30AM–5:00PM

1" = 40'
20 0 40

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REVISIONS				
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CITY OF MODESTO
PROJECT MANAGER DATE

APPROVALS		INITIAL	DATE
	PROJECT ENGINEER		
	INSPECTION		
	WATER OPERATIONS		
	MAINTENANCE		

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SUBMITTED:	

SCALE: 1' = 40'

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

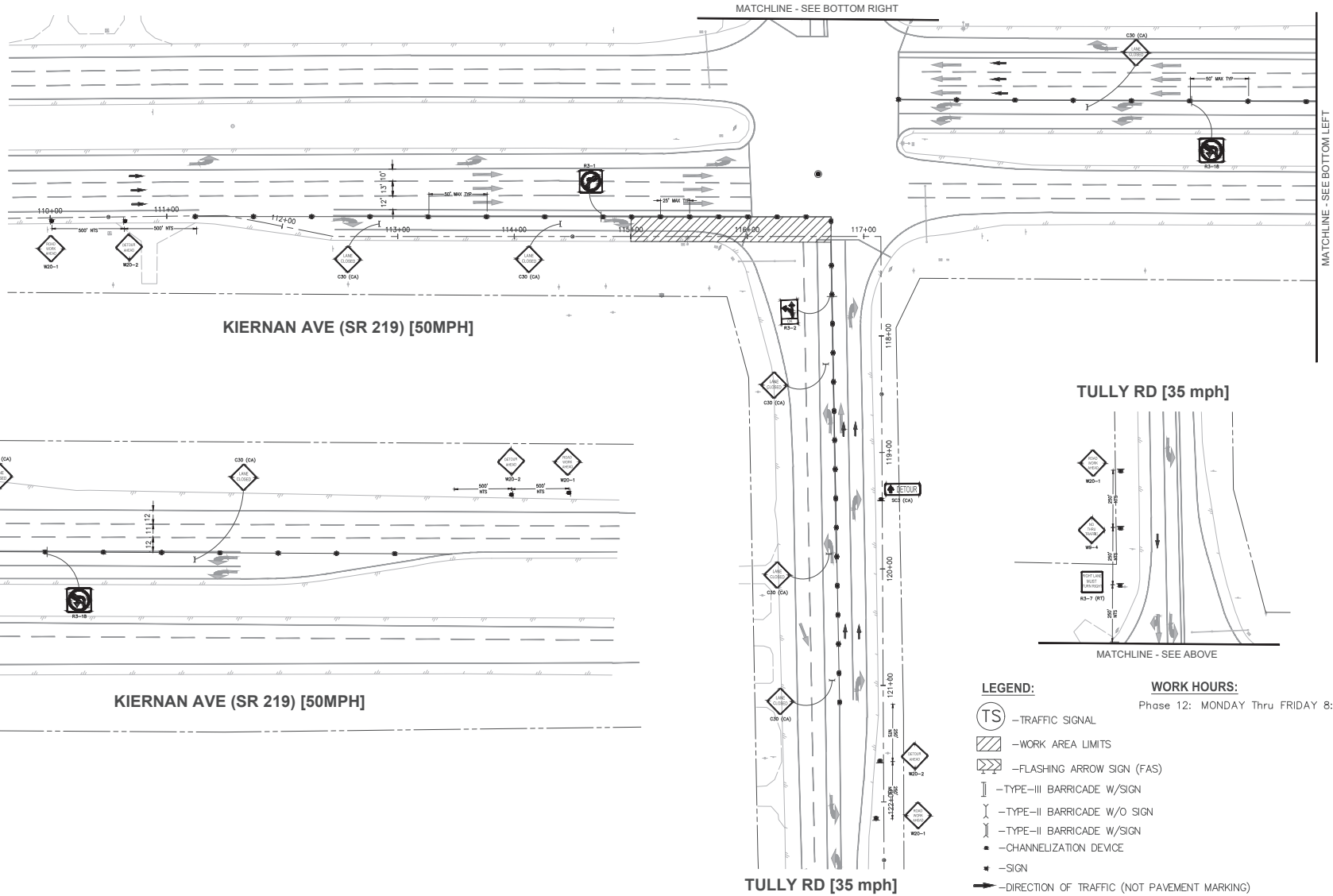
KIERNAN AVENUE 12-INCH WATER MAIN

TRAFFIC CONTROL PLAN
PHASE 9 FROM STA 112+00 TO STA 116+00

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TCP-17

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LEGEND:

- TS —TRAFFIC SIGNAL
- —WORK AREA LIMITS
- —FLASHING ARROW SIGN (FAS)
- —TYPE–III BARRICADE W/SIGN
- —TYPE–II BARRICADE W/O SIGN
- —TYPE–II BARRICADE W/SIGN
- —CHANNELIZATION DEVICE
- —SIGN
- —DIRECTION OF TRAFFIC (NOT PAVEMENT MARKING)

WORK HOURS:

Phase 12: MONDAY Thru FRIDAY 8:30AM–5:00PM

1" = 40'
20 0 40

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CITY OF MODESTO
PROJECT MANAGER DATE

APPROVALS	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

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CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

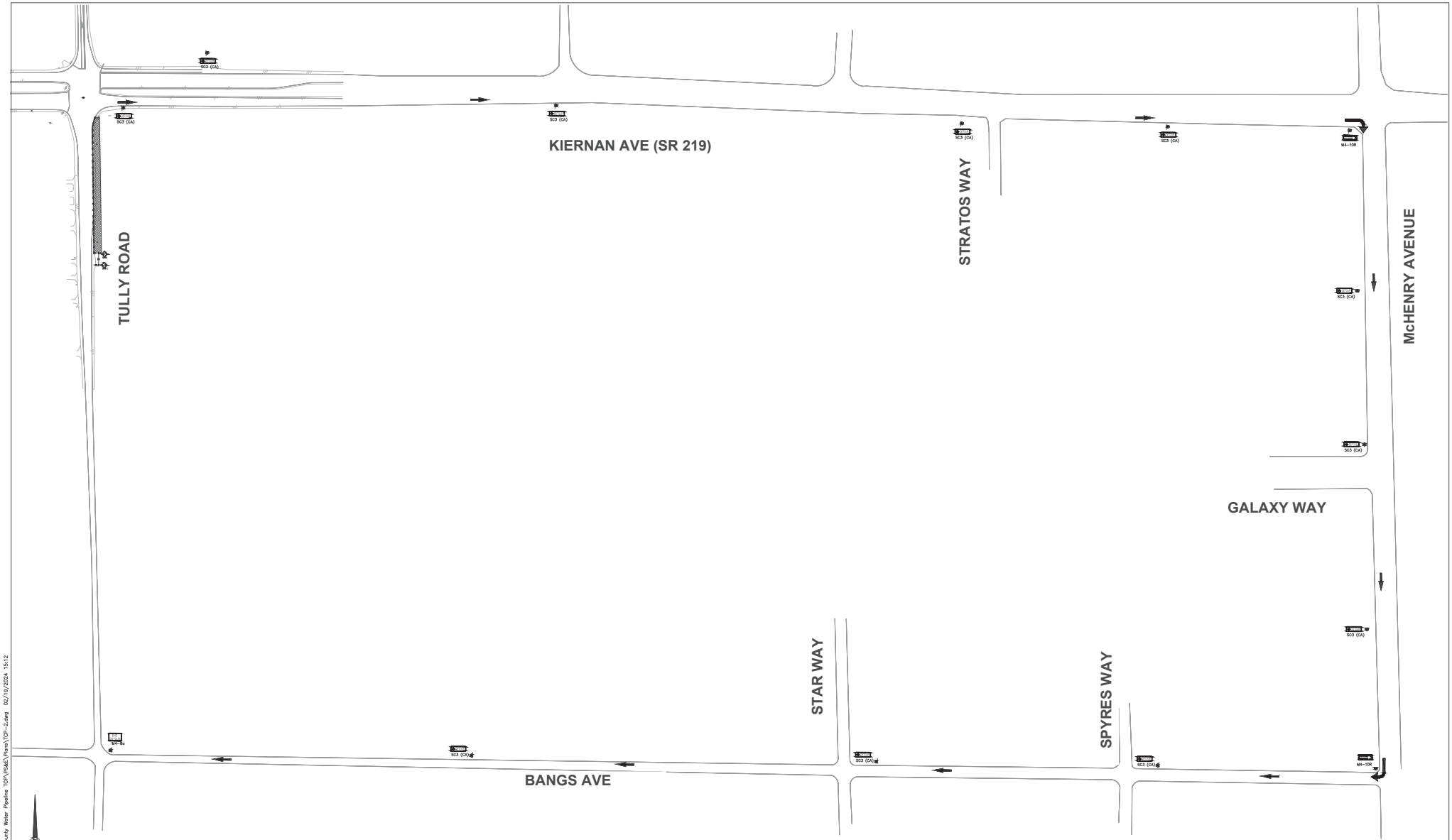
KIERNAN AVENUE 12-INCH WATER MAIN

TRAFFIC CONTROL PLAN
PHASE 12 FROM STA 15+00 TO STA 16+70

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CITY OF MODESTO

PROJECT MANAGER DATE

APPROVALS

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INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

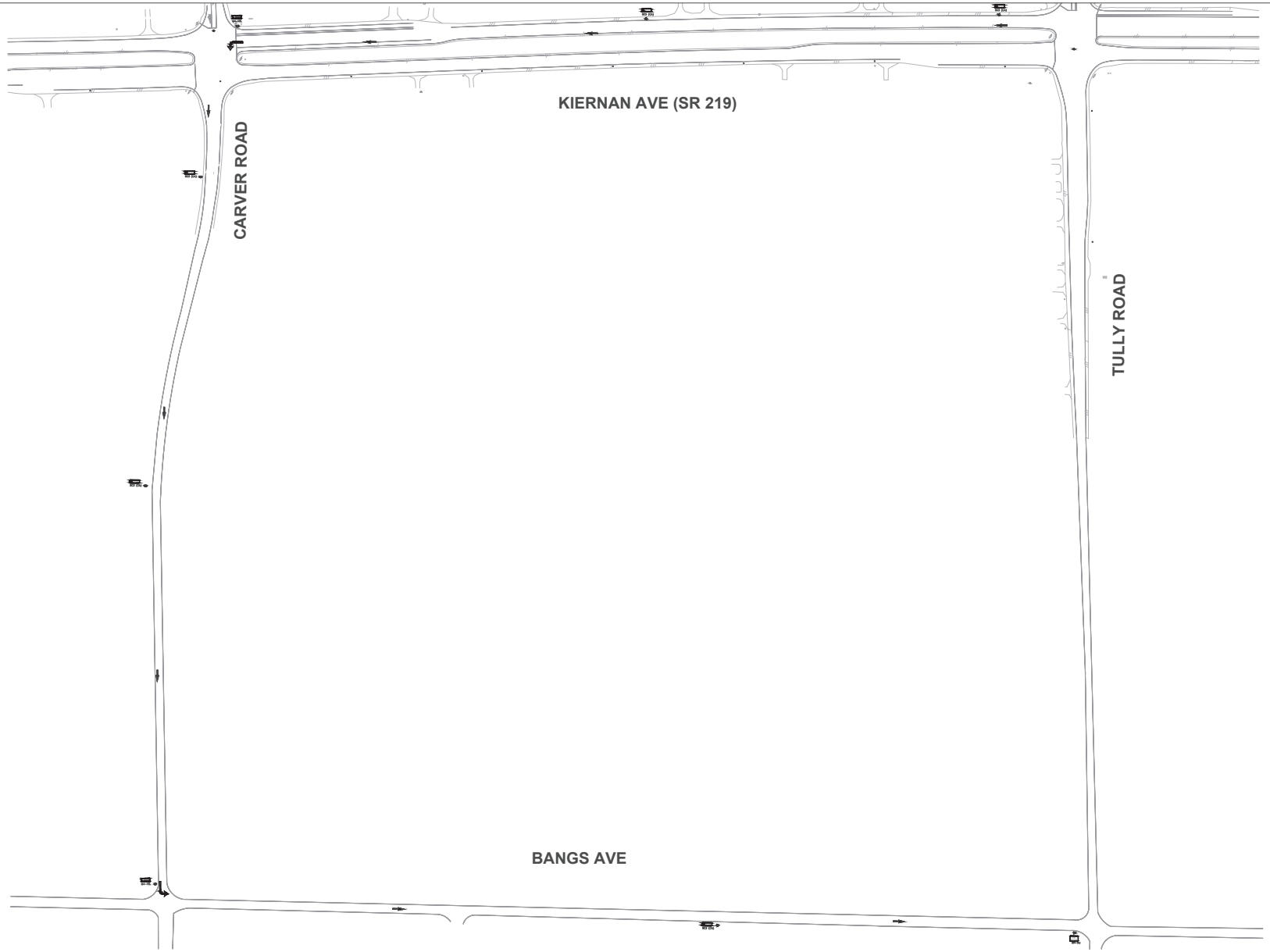
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SCALE: NTS	

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

DETOUR PLAN

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PROJECT MANAGER DATE

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PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

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CHECKED:	
SUBMITTED:	

SCALE: NTS

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

DETOUR PLAN

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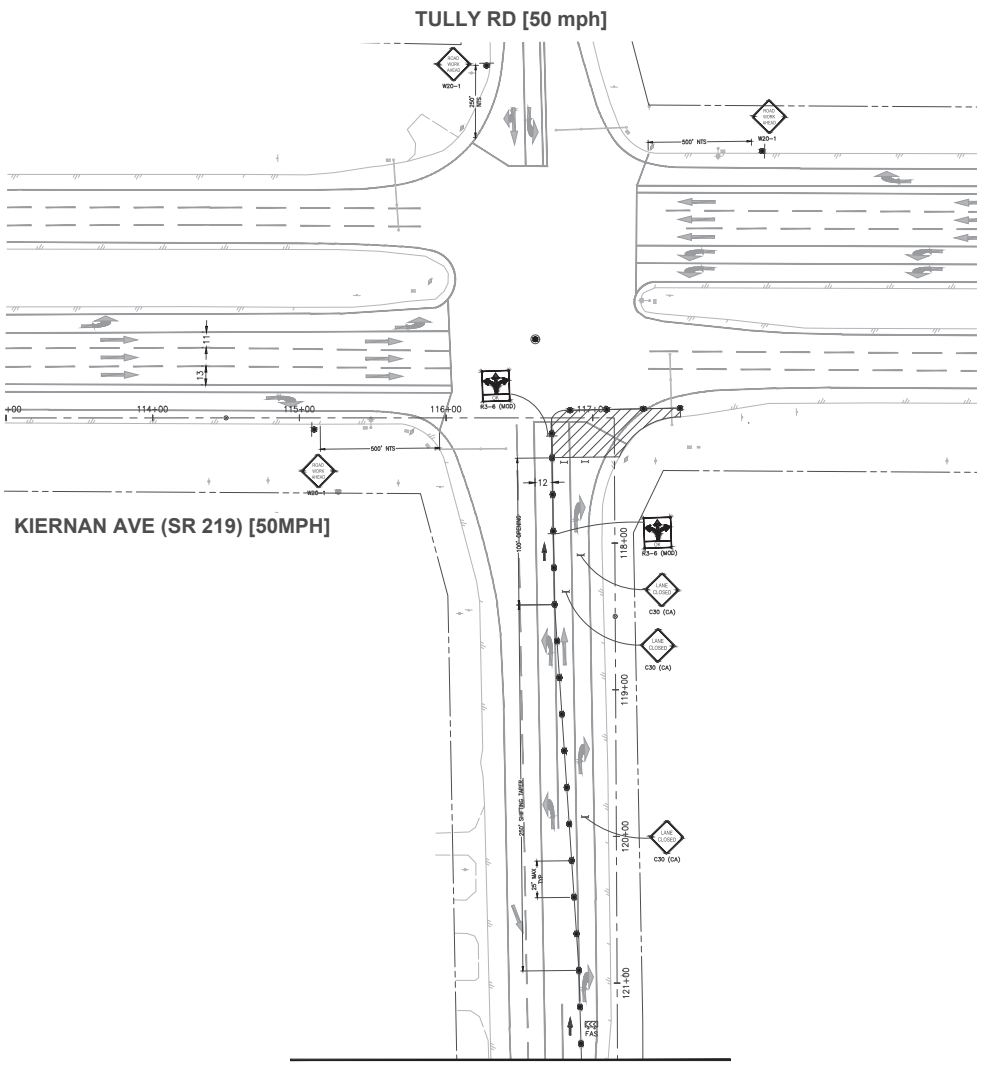
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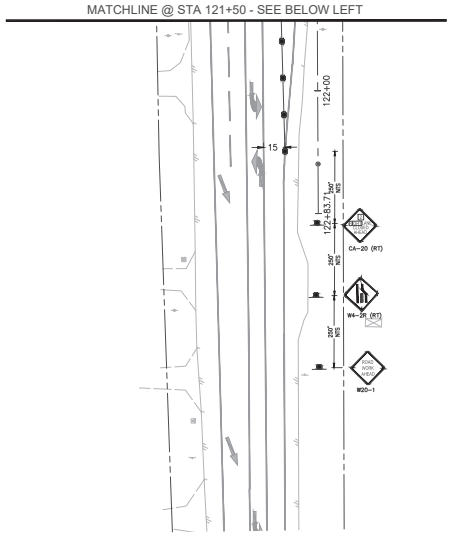
LEGEND:

- TS – TRAFFIC SIGNAL
- – WORK AREA LIMITS
- – FLASHING ARROW SIGN (FAS)
- – TYPE–III BARRICADE W/SIGN
- – TYPE–II BARRICADE W/O SIGN
- – TYPE–II BARRICADE W/SIGN
- – CHANNELIZATION DEVICE
- – SIGN
- – DIRECTION OF TRAFFIC (NOT PAVEMENT MARKING)

WORK HOURS:

Phase 13: MONDAY Thru FRIDAY 8:30AM–5:00PM





1" = 40'

20 0 40

DIGALERT — DIAL TOLL FREE 811 — AT LEAST TWO DAYS BEFORE YOU DIG — UNDERGROUND SERVICE ALERT OF SOUTHERN CALIFORNIA

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PROJECT MANAGER DATE

APPROVALS

	INITIAL	DATE
PROJECT ENGINEER		
INSPECTION		
WATER OPERATIONS		
MAINTENANCE		

	DATE
DESIGNED:	
DRAWN:	
TRACED:	
CHECKED:	
SUBMITTED:	
SCALE: 1' = 40'	

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

TRAFFIC CONTROL PLAN
PHASE 13 FROM STA 16+70 TO STA 17+30

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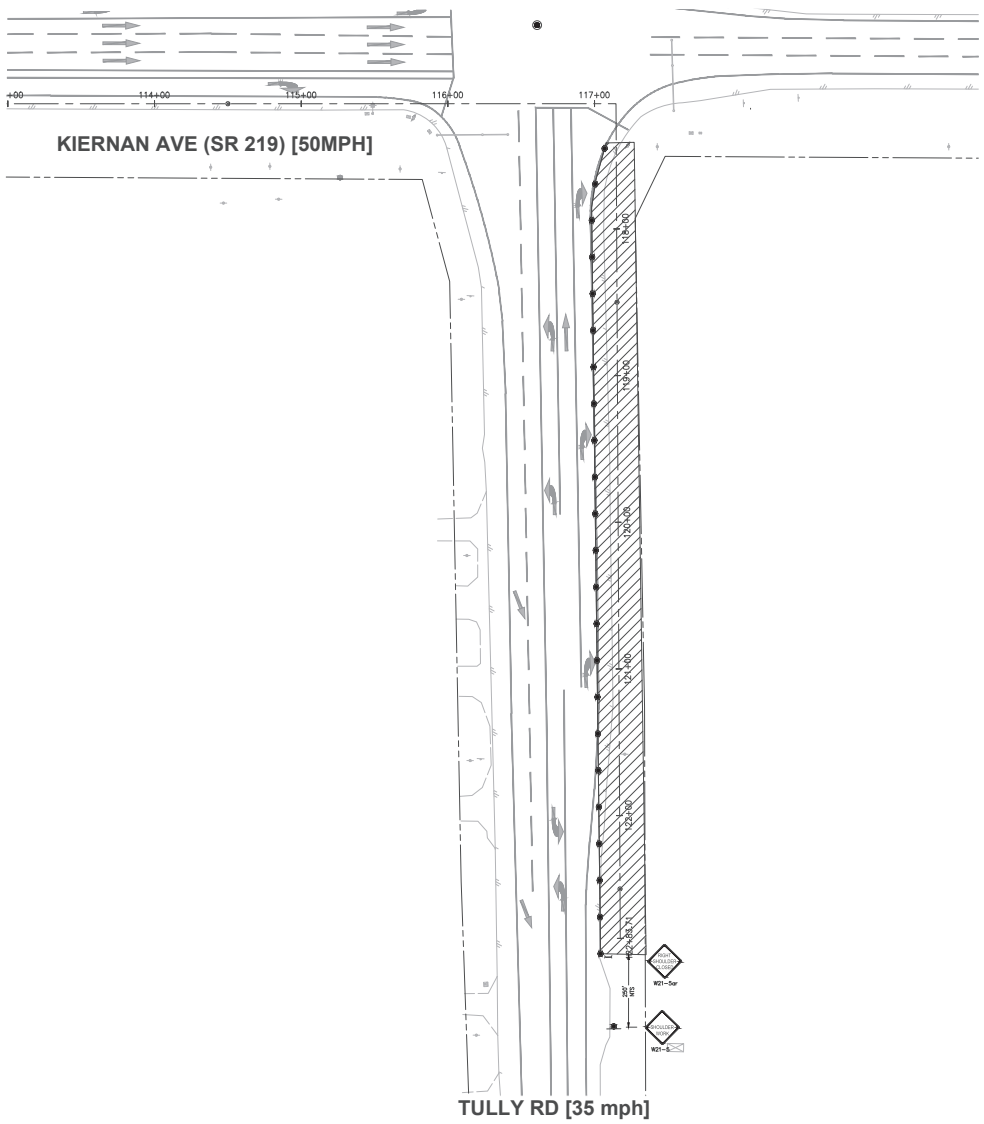
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LEGEND:

- TS —TRAFFIC SIGNAL
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- —TYPE–III BARRICADE W/SIGN
- —TYPE–II BARRICADE W/O SIGN
- —TYPE–II BARRICADE W/SIGN
- —CHANNELIZATION DEVICE
- —SIGN
- —DIRECTION OF TRAFFIC (NOT PAVEMENT MARKING)

WORK HOURS:

Phase 13: MONDAY Thru FRIDAY 8:30AM–5:00PM



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1" = 40'

20 0 40

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WATER OPERATIONS		
MAINTENANCE		

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CHECKED:	
SUBMITTED:	

SCALE: 1' = 40'

CITY OF MODESTO
STANISLAUS COUNTY, CALIFORNIA

KIERNAN AVENUE 12-INCH WATER MAIN

TRAFFIC CONTROL PLAN
PHASE 14 FROM STA 17+30 TO STA 22+83

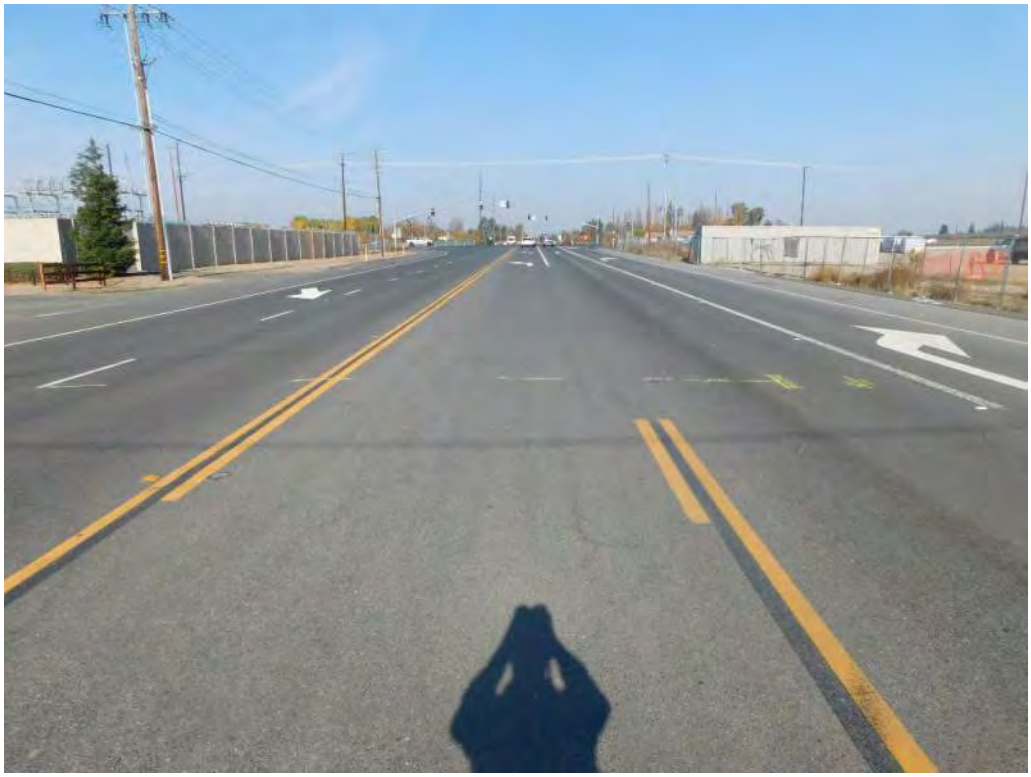
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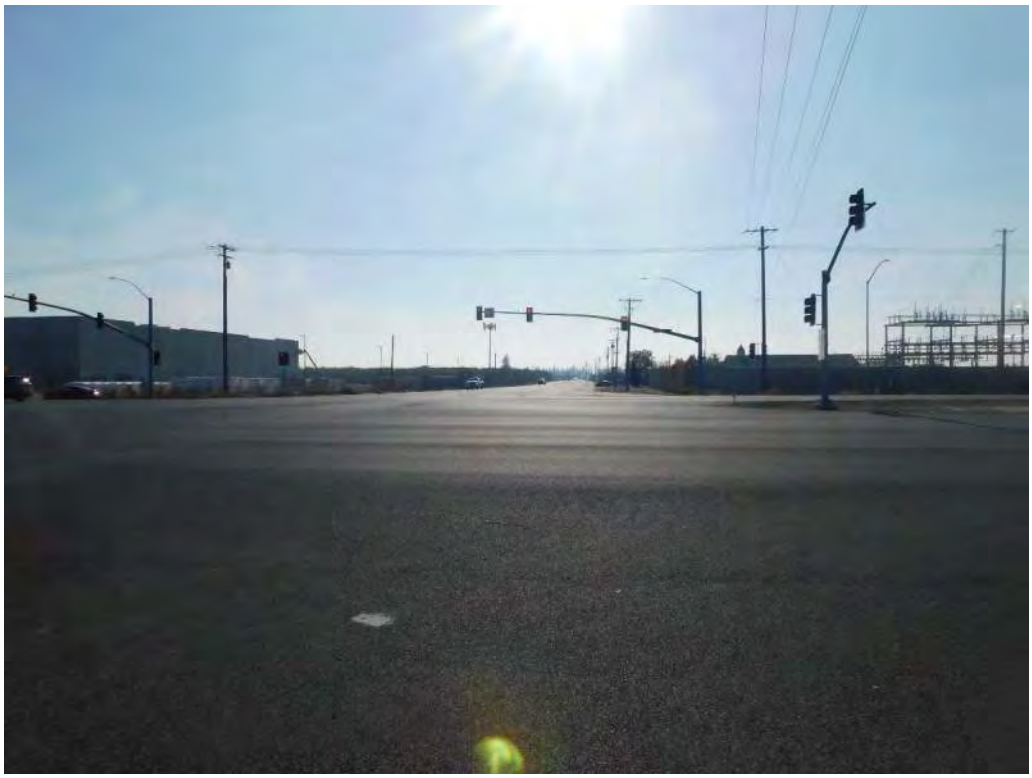
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Attachment C

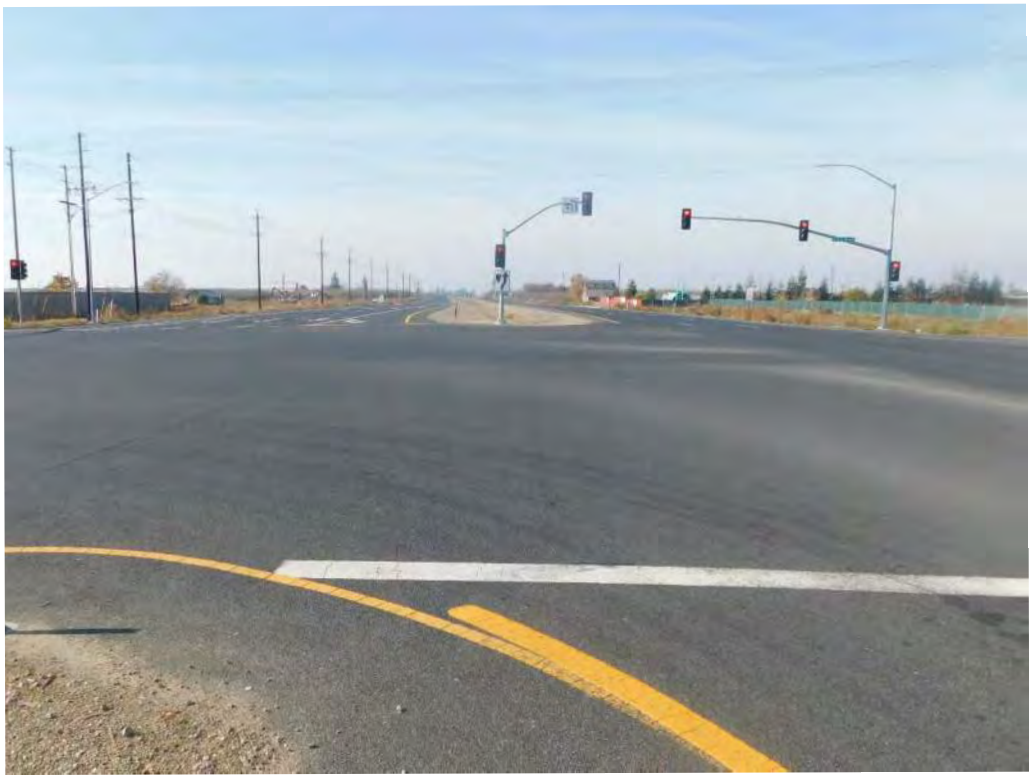
Site Photographs



Photograph 1: Looking north along the proposed alignment from the terminus on Tully Road.



Photograph 2: From the northern side of the intersection of Kiernan Road and Tully Road looking south along the proposed alignment.



Photograph 3: From the eastern side of the intersection of Kiernan Road and Tully Road looking west along the proposed alignment.



Photograph 4: From the entrance to Stanislaus Elementary School looking east along the proposed alignment.



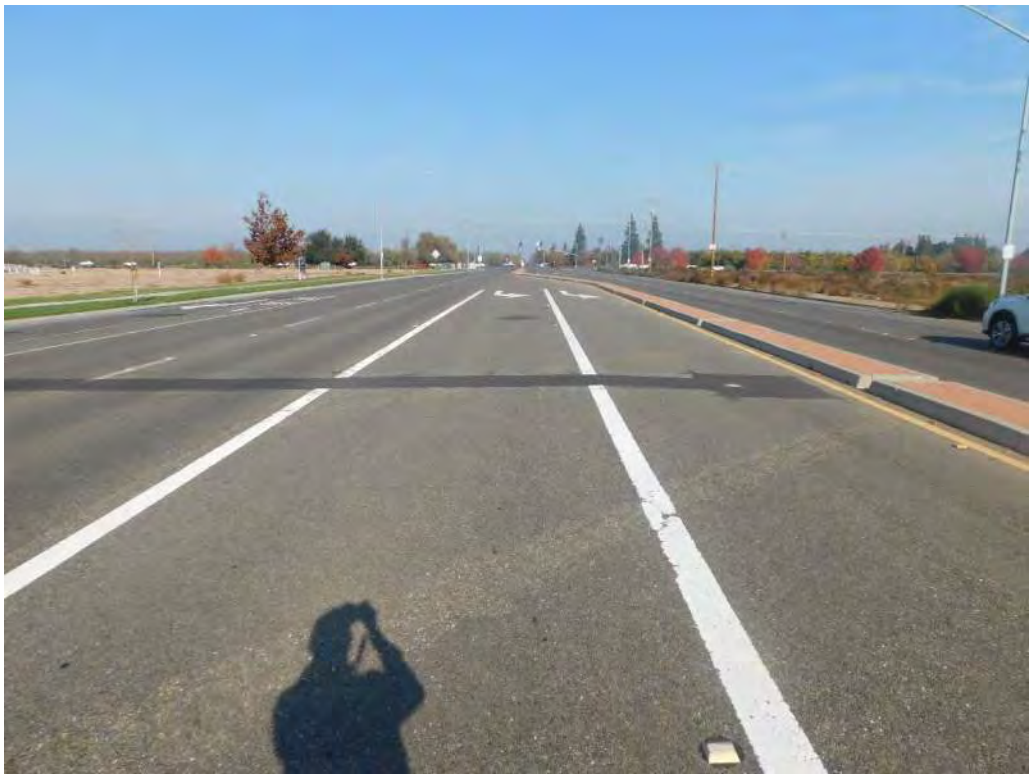
Photograph 5: From the middle of Kiernan Road in front of Stanislaus Elementary School looking west along the proposed alignment.



Photograph 6: From the northwest corner of the intersection of Kiernan Road and Dale Road looking east-southeast along the proposed alignment.



Photograph 7: From the northwest corner of the intersection of Kiernan Road and Dale Road looking south-southeast along the proposed alignment.



Photograph 8: Looking north along the proposed alignment from the terminus on Dale Road.

Attachment D

Potentially Occurring Special-Status Biological Resources

Potentially Occurring Sensitive Biological Resources

Scientific Name Common Name	**Status**	**Habitat**	**Observed On-site**	**Potential to Occur**
SPECIAL-STATUS WILDLIFE SPECIES				
***Acipenser medirostris* pop. 1** green sturgeon- southern DPS	Fed: **THR** CA: None	Generally found in the San Joaquin and Delta River systems. Spawn primarily in the upper mainstem of the Sacramento River but can also be found spawning in the Yuba and Feather Rivers. Remain in freshwater for a few years, then migrate to saltwater to feed, grow, and mature. Adults enter San Francisco Bay between mid-February and early May and migrate upstream to spawn. Congregate in bays and estuaries in Washington, Oregon, and California in the summer and fall, and northern Vancouver Island, B.C. in the winter and spring.	No	**Presumed Absent** There is no suitable habitat present within or adjacent to the project site.
Actinemys marmorata Northwestern pond turtle	Fed: Proposed THR CA: None	Inhabits a variety of aquatic environments, primarily in the western United States and northern Baja California, Mexico. Their preferred habitats include slow-moving freshwater bodies such as ponds, lakes, marshes, and streams with abundant vegetation and basking sites. These turtles are often found in areas with muddy or sandy bottoms, where aquatic plants thrive, providing both food and cover. They rely on open, sunny spots for basking to regulate their body temperature but also need nearby hiding places like logs, overhanging banks, or dense vegetation for protection from predators. Terrestrial environments near water are equally important for nesting and overwintering, as females lay their eggs in well-drained, open soil away from aquatic habitats. This species thrives in areas with a balance of aquatic and terrestrial features.	No	**Presumed Absent** There is no suitable habitat present within or adjacent to the project site.
Agelaius tricolor tricolored blackbird	Fed: None CA: **THR**; SSC	Range is limited to the coastal areas of the Pacific coast of North America, from Northern California to upper Baja California. Can be found in a wide variety of habitat including annual grasslands, wet and dry vernal pools and other seasonal wetlands, agricultural fields, cattle feedlots, and dairies. Occasionally forage in riparian scrub habitats along marsh borders. Basic habitat requirements for breeding include open accessible water, protected nesting substrate (freshwater marsh dominated by cattails, willows, and bulrushes [*Schoenoplectus* sp.]), and either flooded or thorny or spiny vegetation and suitable foraging space providing adequate insect prey.	No	**Presumed Absent** There is no suitable habitat present within or adjacent to the project site.
***Ambystoma californiense* pop. 1** California tiger salamander-central California DPS	Fed: **THR** CA: **THR;** WL	Can be found in annual grasslands and oak woodlands with hot, dry summers and cool, rainy winters. Reside underground throughout most of the year in abandoned small mammal burrows. Require ephemeral pools for breeding.	No	**Presumed Absent** There is no suitable habitat present within or adjacent to the project site.

Scientific Name Common Name	**Status**	**Habitat**	**Observed On-site**	**Potential to Occur**
Bombus caliginosus obscure bumble bee	Fed: None CA: None	Colonial species found along the western coast between British Columbia, Canada, and California. Inhabits native grasslands, coastal scrub, and open woodland with high flowering plant diversity and successional flower availability. This species typically nests underground, often utilizing abandoned rodent burrows, and prefers well-drained soils that are easy to excavate for nesting.	No	**Presumed Absent** There is no suitable habitat present within or adjacent to the project site.
Bombus crotchii Crotch bumble bee	Fed: None CA: CE	Colonial species that lives almost exclusively from coastal California east towards the Sierra-Cascade Crest and can be found uncommonly in western Nevada and south through Baja California. Inhabits grassland and scrub habitats in hotter and drier climates than most other bumblebee species and is only capable of tolerating a narrow range of climatic conditions. This species usually nests underground, often in abandoned rodent dens.	No	**Presumed Absent** There is no suitable habitat present within or adjacent to the project site.
Bombus pensylvanicus American bumble bee	Fed: None CA: None	Prefers farmlands, meadows, grasslands, and open fields. Nests below grass or underground. Feeds on pollen of a wide variety of flowering plants including vetches, clovers, goldenrods, and many crop species.	No	**Presumed Absent** There is no suitable habitat present within or adjacent to the project site.
Branchinecta lynchi Vernal pool fairy shrimp	Fed: **THR** CA: None	Associated with vernal pools. Can be found in association with other ephemeral habits including alkali pools, seasonal drainages, stock ponds, vernal swales, and rock outcrops.	No	**Presumed Absent** There is no suitable habitat present within or adjacent to the project site.
Buteo swainsoni Swainson's hawk	Fed: None CA: **THR**	Typical habitat is open desert, grassland, or cropland containing scattered, large trees or small groves. Breeds in stands with few trees in juniper-sage flats, riparian areas, and in oak savannah in the Central Valley. Forages in adjacent grassland or suitable grain or alfalfa fields or livestock pastures.	No	**Low** Suitable perching opportunities are present within the project site and suitable foraging habitat is present in the surrounding area. No suitable nesting opportunities are present. This species is only expected to occur on-site incidentally while foraging nearby.

Scientific Name Common Name	**Status**	**Habitat**	**Observed On-site**	**Potential to Occur**
Danaus plexippus Monarch butterfly	Fed: Candidate CA: None	Wide range of habitats due to its migratory nature. Monarchs are found in open fields, meadows, prairies, and along roadsides where milkweed plants grow, which are crucial for egg-laying and caterpillar development. In their summer breeding grounds, they prefer areas rich in nectar-producing flowers, such as wildflowers, and warm climates that support their growth. During migration, monarchs often stop in coastal areas, forests, and urban gardens. Their overwintering habitat, however, is more specialized: in North America, they gather in dense fir and pine forests in the mountains of central Mexico, seeking cool, humid microclimates that help them conserve energy. These diverse habitats, both in breeding and overwintering, are vital to the monarch's survival.	No	**Presumed Absent** There is no suitable habitat present within or adjacent to the project site.
Desmocerus californicus dimorphus valley elderberry longhorn beetle	Fed: **THR** CA: None	Found only within the valley floor and lower foothill region within riparian and foothill oak communities in the Central Valley, of California. Dependent on elderberry as host plant.	No	**Presumed Absent** There is no suitable habitat present within or adjacent to the project site.
Entosphenus tridentatus pacific lamprey	Fed: None CA: SSC	Spend most of their lives in freshwater streams before entering the ocean as adults. Young lamprey burrow in muddy bottoms of backwater pools and eddies. Spawn in medium and large-sized, low-gradient rivers and streams.	No	**Presumed Absent** There is no suitable habitat present within or adjacent to the project site.
Hysterocarpus traskii traskii Sacramento-San Joaquin tule perch	Fed: None CA: None	Found in deep waters of low-elevation lakes, streams, and estuarine environments. Require cool, well-oxygenated water. Occupy deep pools with complex vegetative cover.	No	**Presumed Absent** There is no suitable habitat present within or adjacent to the project site.
Lavinia exilicauda exilicauda Sacramento hitch	Fed: None CA: SSC	Inhabits warm, lowland waters, including clear streams, turbid sloughs, lakes, and reservoirs. Generally found in pools or runs among aquatic vegetation associated with streams.	No	**Presumed Absent** There is no suitable habitat present within or adjacent to the project site.

Scientific Name Common Name	**Status**	**Habitat**	**Observed On-site**	**Potential to Occur**
Lepidurus packardi Vernal pool tadpole shrimp	Fed: **END** CA: SSC	Is an aquatic crustacean that inhabits temporary freshwater environments, particularly seasonal vernal pools in California's Central Valley. These pools form during the rainy season and are characterized by shallow, ephemeral water bodies that dry up during the warmer months. Tadpole shrimp are well-adapted to these unpredictable conditions, thriving in pools with muddy or clay-rich substrates. They rely on the short-lived nature of these pools, which limits predation by fish and other aquatic predators. The species is typically found in areas where the pools have little to no vegetation, though algae and microorganisms serve as their primary food sources.	No	**Presumed Absent** There is no suitable habitat present within or adjacent to the project site.
Lytta moesta moestan blister beetle	Fed: None CA: None	General habitat appears to be grasslands and vernal pools, but details are lacking. Adults are thought to feed primarily on legumes in the genera Lupinus and Trifolium, but have also been documented feeding on non-native Erodium species. Juveniles are thought to parasitize solitary bee species.	No	**Presumed Absent** There is no suitable habitat present within or adjacent to the project site.
Mustela frenata xanthogenys San Joaquin long-tailed weasel	Fed: None CA: None	Occurs in woodlands, thickets, and open areas such as farmland, usually near a water source. Uses abandoned mammal burrows to den, preferably under stumps or beneath rock piles.	No	**Presumed Absent** There is no suitable habitat present within or adjacent to the project site.
Mylopharodon conocephalus hardhead	Fed: None CA: SSC	Found at low to mid-elevations in relatively undisturbed large stream habitat with high water clarity. Limited to well-oxygenated streams and reservoir surface waters. Common in small aggregations in pools and runs during the day. Primarily bottom-feed but can feed on drifting material and insects at the water's surface.	No	**Presumed Absent** There is no suitable habitat present within or adjacent to the project site.
Oncorhynchus mykiss irideus pop. 11 steelhead – central valley DPS	Fed: **THR** CA: None	Occurs primarily in tailwaters of dammed rivers, undammed creeks and four hatchery-supported systems of Battle Creek, and the Feather, American, and Mokelumne Rivers.	No	**Presumed Absent** There is no suitable habitat present within or adjacent to the project site.
Oncorhynchus tshawytscha pop. 13 Chinook salmon-central valley fall/late fall-run ESU	Fed: None CA: SSC	Spend early life growing and feeding in freshwater streams, estuaries, and associated wetlands. Adults live in coastal oceanic areas. This population includes naturally spawned spring-run individuals, originating from the Sacramento River and its tributaries, as well as the Feather River Hatchery program.	No	**Presumed Absent** There is no suitable habitat present within or adjacent to the project site.

Scientific Name Common Name	**Status**	**Habitat**	**Observed On-site**	**Potential to Occur**
Phrynosoma blainvillii coast horned lizard	Fed: None CA: SSC	Occurs in a wide variety of vegetation types including coastal sage scrub, annual grassland, chaparral, oak woodland, riparian woodland and coniferous forest. In inland areas, this species is restricted to areas with pockets of open microhabitat, created by disturbance (i.e. fire, floods, roads, grazing, fire breaks). The key elements of such habitats are loose, fine soils with a high sand fraction; an abundance of native ants or other insects; and open areas with limited overstory for basking and low, but relatively dense shrubs for refuge.	No	**Presumed Absent** There is no suitable habitat present within or adjacent to the project site.
Pogonichthys macrolepidotus Sacramento splittail	Fed: None CA: SSC	Primarily inhabits slow-moving or still waters, such as lakes, large rivers, and reservoirs. Dense aquatic vegetation is required to provide shelter, breeding grounds, and forage. Capable of tolerating a range of turbidity and temperature variations, but prefer clearer, warmer waters. Often found in deeper waters with substrates composed of mud, sand, or gravel.	No	**Presumed Absent** There is no suitable habitat present within or adjacent to the project site.
Rhaphiomidas trochilus San Joaquin Valley giant flower-loving fly	Fed: None CA: None	Inhabits arid or semi-arid environments such as deserts and scrublands characterized by low vegetation and open spaces. Adapted to high temperatures and low humidity. Presumed to be a generalist nectivore preferring large, brightly colored flowers. Larvae likely develop in sandy soils.	No	**Presumed Absent** There is no suitable habitat present within or adjacent to the project site.
Spea hammondii Western spadefoot	Fed: Proposed THR CA: SSC	Prefers open areas with sandy or gravelly soils, in a variety of habitats including mixed woodlands, grasslands, coastal sage scrub, chaparral, sandy washed, lowlands, river floodplains, alluvial fans, playas, alkali flats, foothills, and mountains. Rainpools which do not contain bullfrogs, fish, or crayfish are necessary for breeding.	No	**Presumed Absent** There is no suitable habitat present within or adjacent to the project site.

U.S. Fish and Wildlife Service (Fed) - Federal
END- Federal Endangered
THR- Federal Threatened
CE- Candidate for listing under the Federal Endangered Species Act

California Department of Fish and Wildlife (CA) - California
END- California Endangered
THR- California Threatened
CE- Candidate for listing under the California Endangered Species Act
FP- California Fully Protected
SSC- Species of Special Concern
WL- Watch List

California Native Plant Society (CNPS)
California Rare Plant Rank
1B Plants Rare, Threatened, or Endangered in California and Elsewhere
2B Plants Rare, Threatened, or Endangered in California, But More Common Elsewhere
3 Plants About Which More Information is Needed – A Review List
4 Plants of Limited Distribution – A Watch List

CNPS Threat Ranks
0.1- Seriously threatened in California
0.2- Moderately threatened in California
0.3- Not very threatened in California

Attachment E

Regulations

Special status species are native species that have been afforded special legal or management protection because of concern for their continued existence. There are several categories of protection at both federal and state levels, depending on the magnitude of threat to continued existence and existing knowledge of population levels.

Federal Regulations

Endangered Species Act of 1973

Federally listed threatened and endangered species and their habitats are protected under provisions of the Federal Endangered Species Act (ESA). Section 9 of the ESA prohibits "take" of threatened or endangered species. "Take" under the ESA is defined as to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any of the specifically enumerated conduct." The presence of any federally threatened or endangered species that are in a project area generally imposes severe constraints on development, particularly if development would result in "take" of the species or its habitat. Under the regulations of the ESA, the United States Fish and Wildlife Service (USFWS) may authorize "take" when it is incidental to, but not the purpose of, an otherwise lawful act.

Critical Habitat is designated for the survival and recovery of species listed as threatened or endangered under the ESA. Critical Habitat includes those areas occupied by the species, in which are found physical and biological features that are essential to the conservation of an ESA listed species and which may require special management considerations or protection. Critical Habitat may also include unoccupied habitat if it is determined that the unoccupied habitat is essential for the conservation of the species.

Whenever federal agencies authorize, fund, or carry out actions that may adversely modify or destroy Critical Habitat, they must consult with USFWS under Section 7 of the ESA. The designation of Critical Habitat does not affect private landowners, unless a project they are proposing uses federal funds, or requires federal authorization or permits (e.g., funding from the Federal Highway Administration or a permit from the U.S. Army Corps of Engineers (Corps)).

If USFWS determines that Critical Habitat will be adversely modified or destroyed from a proposed action, the USFWS will develop reasonable and prudent alternatives in cooperation with the federal institution to ensure the purpose of the proposed action can be achieved without loss of Critical Habitat. If the action is not likely to adversely modify or destroy Critical Habitat, USFWS will include a statement in its biological opinion concerning any incidental take that may be authorized and specify terms and conditions to ensure the agency is in compliance with the opinion.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) (16 U.S. Government Code [USC] 703) makes it unlawful to pursue, capture, kill, possess, or attempt to do the same to any migratory bird or part, nest, or egg of any such bird listed in wildlife protection treaties between the United States, Great Britain, Mexico, Japan, and the countries of the former Soviet Union, and authorizes the U.S. Secretary of the Interior to protect and regulate the taking of migratory birds. It establishes seasons and bag limits for hunted species and protects migratory birds, their occupied nests, and their eggs (16 USC 703; 50 CFR 10, 21).

The MBTA covers the taking of any nests or eggs of migratory birds, except as allowed by permit pursuant to 50 CFR, Part 21. Disturbances causing nest abandonment and/or loss of reproductive effort (i.e., killing or abandonment of eggs or young) may also be considered "take." This regulation seeks to protect migratory birds and active nests.

In 1972, the MBTA was amended to include protection for migratory birds of prey (e.g., raptors). Six families of raptors occurring in North America were included in the amendment: Accipitridae (kites, hawks, and eagles); Cathartidae (New World vultures); Falconidae (falcons and caracaras); Pandionidae (ospreys); Strigidae (typical owls); and Tytonidae (barn owls). The provisions of the 1972 amendment to the MBTA protects all species and subspecies of the families listed above. The MBTA protects over 800 species including geese, ducks, shorebirds, raptors, songbirds and many relatively common species.

State Regulations

California Environmental Quality Act (CEQA)

The California Environmental Quality Act (CEQA) provides for the protection of the environment within the State of California by establishing State policy to prevent significant, avoidable damage to the environment through the use of alternatives or mitigation measures for projects. It applies to actions directly undertaken, financed, or permitted by State lead agencies. If a project is determined to be subject to CEQA, the lead agency will be required to conduct an Initial Study (IS); if the IS determines that the project may have significant impacts on the environment, the lead agency will subsequently be required to write an Environmental Impact Report (EIR). A finding of non-significant effects will require either a Negative Declaration or a Mitigated Negative Declaration instead of an EIR. Section 15380 of the CEQA Guidelines independently defines "endangered" and "rare" species separately from the definitions of the California Endangered Species Act (CESA). Under CEQA, "endangered" species of plants or animals are defined as those whose survival and reproduction in the wild are in immediate jeopardy, while "rare" species are defined as those who are in such low numbers that they could become endangered if their environment worsens.

California Endangered Species Act (CESA)

In addition to federal laws, the state of California implements the CESA which is enforced by CDFW. The CESA program maintains a separate listing of species beyond the FESA, although the provisions of each act are similar.

State-listed threatened and endangered species are protected under provisions of the CESA. Activities that may result in "take" of individuals (defined in CESA as; "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill") are regulated by CDFW. Habitat degradation or modification is not included in the definition of "take" under CESA. Nonetheless, CDFW has interpreted "take" to include the destruction of nesting, denning, or foraging habitat necessary to maintain a viable breeding population of protected species.

The State of California considers an endangered species as one whose prospects of survival and reproduction are in immediate jeopardy. A threatened species is considered as one present in such small numbers throughout its range that it is likely to become an endangered species in the near future in the

absence of special protection or management. A rare species is one that is considered present in such small numbers throughout its range that it may become endangered if its present environment worsens. State threatened and endangered species are fully protected against take, as defined above.

The CDFW has also produced a species of special concern list to serve as a species watch list. Species on this list are either of limited distribution or their habitats have been reduced substantially, such that a threat to their populations may be imminent. Species of special concern may receive special attention during environmental review, but they do not have formal statutory protection. At the federal level, USFWS also uses the label species of concern, as an informal term that refers to species which might be in need of concentrated conservation actions. As the Species of Concern designated by USFWS do not receive formal legal protection, the use of the term does not necessarily ensure that the species will be proposed for listing as a threatened or endangered species.

Fish and Game Code

Fish and Game Code Sections 3503, 3503.5, 3511, and 3513 are applicable to natural resource management. For example, Section 3503 of the Code makes it unlawful to destroy any birds' nest or any birds' eggs that are protected under the MBTA. Further, any birds in the orders Falconiformes or Strigiformes (Birds of Prey, such as hawks, eagles, and owls) are protected under Section 3503.5 of the Fish and Game Code which makes it unlawful to take, possess, or destroy their nest or eggs. A consultation with CDFW may be required prior to the removal of any bird of prey nest that may occur on a project site. Section 3511 of the Fish and Game Code lists fully protected bird species, where the CDFW is unable to authorize the issuance of permits or licenses to take these species. Pertinent species that are State fully protected by the State include golden eagle (*Aquila chrysaetos*) and white-tailed kite (*Elanus leucurus*). Section 3513 of the Fish and Game Code makes it unlawful to take or possess any migratory nongame bird as designated in the MBTA or any part of such migratory nongame bird except as provided by rules and regulations adopted by the Secretary of the Interior under provisions of the MBTA.

Native Plant Protection Act

Sections 1900–1913 of the Fish and Game Code were developed to preserve, protect, and enhance Rare and Endangered plants in the state of California. The act requires all state agencies to use their authority to carry out programs to conserve Endangered and Rare native plants. Provisions of the Native Plant Protection Act prohibit the taking of listed plants from the wild and require notification of the CDFW at least ten days in advance of any change in land use which would adversely impact listed plants. This allows the CDFW to salvage listed plant species that would otherwise be destroyed.

California Native Plant Society Rare and Endangered Plant Species

Vascular plants listed as rare or endangered by the CNPS, but which have no designated status under FESA or CESA are defined as follows:

California Rare Plant Rank

1A- Plants Presumed Extirpated in California and either Rare or Extinct Elsewhere

1B- Plants Rare, Threatened, or Endangered in California and Elsewhere

2A- Plants Presumed Extirpated in California, But More Common Elsewhere

2B- Plants Rare, Threatened, or Endangered in California, But More Common Elsewhere

3- Plants about Which More Information is Needed - A Review List

4- Plants of Limited Distribution - A Watch List

Threat Ranks

.1- Seriously threatened in California (over 80% of occurrences threatened / high degree and immediacy of threat)

.2- Moderately threatened in California (20-80% occurrences threatened / moderate degree and immediacy of threat)

.3- Not very threatened in California (<20% of occurrences threatened / low degree and immediacy of threat or no current threats known).

(A)

There are three key agencies that regulate activities within inland streams, wetlands, and riparian areas in California. The Corps Regulatory Branch regulates activities pursuant to Section 404 of the Federal Clean Water Act (CWA) and Section 10 of the Rivers and Harbors Act. Of the State agencies, the CDFG regulates activities under the Fish and Game Code Section 1600-1616, and the Regional Board regulates activities pursuant to Section 401 of the CWA and the California Porter-Cologne Water Quality Control Act.

Federal Regulations

Section 404 of the Clean Water Act

In accordance with the Revised Definition of "Waters of the United States"; Conforming (September 8, 2023), "waters of the United Sates" are defined as follows:

(a) ***Waters of the United States*** means:

(1) Waters which are:
(i) Currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;
(ii) The territorial seas; or
(iii) Interstate waters;

(2) Impoundments of waters otherwise defined as waters of the United States under this definition, other than impoundments of waters identified under paragraph (a)(5) of this section;

(3) Tributaries of waters identified in paragraph (a)(1) or (2) of this section that are relatively permanent, standing or continuously flowing bodies of water;

(4) Wetlands adjacent to the following waters:
(i) Waters identified in paragraph (a)(1) of this section; or
(ii) Relatively permanent, standing or continuously flowing bodies of water identified in paragraph (a)(2) or (a)(3) of this section and with a continuous surface connection to those waters;

(5) Intrastate lakes and ponds not identified in paragraphs (a)(1) through (4) of this section that are relatively permanent, standing or continuously flowing bodies of water with a continuous surface connection to the waters identified in paragraph (a)(1) or (a)(3) of this section

(b) The following are not "waters of the United States" even where they otherwise meet the terms of paragraphs (a)(2) through (5) of this section:

(1) Waste treatment systems, including treatment ponds or lagoons, designed to meet the requirements of the Clean Water Act;

(2) Prior converted cropland designated by the Secretary of Agriculture. The exclusion would cease upon a change of use, which means that the area is no longer available for the production of agricultural commodities. Notwithstanding the determination of an area's status as prior converted

cropland by any other Federal agency, for the purposes of the Clean Water Act, the final authority regarding Clean Water Act jurisdiction remains with EPA;

(3) Ditches (including roadside ditches) excavated wholly in and draining only dry land and that do not carry a relatively permanent flow of water;

(4) Artificially irrigated areas that would revert to dry land if the irrigation ceased;
(5) Artificial lakes or ponds created by excavating or diking dry land to collect and retain water and which are used exclusively for such purposes as stock watering, irrigation, settling basins, or rice growing;
(6) Artificial reflecting or swimming pools or other small ornamental bodies of water created by excavating or diking dry land to retain water for primarily aesthetic reasons;

(7) Waterfilled depressions created in dry land incidental to construction activity and pits excavated in dry land for the purpose of obtaining fill, sand, or gravel unless and until the construction or excavation operation is abandoned and the resulting body of water meets the definition of waters of the United States; and

(8) Swales and erosional features (*e.g.*, gullies, small washes) characterized by low volume, infrequent, or short duration flow.

(c) In this section, the following definitions apply:

(1) ***Wetlands*** means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

(2) ***Adjacent*** means having a continuous surface connection

(3) ***High tide line*** means the line of intersection of the land with the water's surface at the maximum height reached by a rising tide. The high tide line may be determined, in the absence of actual data, by a line of oil or scum along shore objects, a more or less continuous deposit of fine shell or debris on the foreshore or berm, other physical markings or characteristics, vegetation lines, tidal gages, or other suitable means that delineate the general height reached by a rising tide. The line encompasses spring high tides and other high tides that occur with periodic frequency but does not include storm surges in which there is a departure from the normal or predicted reach of the tide due to the piling up of water against a coast by strong winds such as those accompanying a hurricane or other intense storm.

(4) ***Ordinary high water mark*** means that line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

(5) ***Tidal waters*** means those waters that rise and fall in a predictable and measurable rhythm or cycle due to the gravitational pulls of the moon and sun. Tidal waters end where the rise and fall of the water surface can no longer be practically measured in a predictable rhythm due to masking by hydrologic, wind, or other effects.

Section 401 of the Clean Water Act

Pursuant to Section 401 of the CWA, any applicant for a federal license or permit to conduct any activity which may result in any discharge to waters of the United States must provide certification from the State or Indian tribe in which the discharge originates. This certification provides for the protection of the physical, chemical, and biological integrity of waters, addresses impacts to water quality that may result from issuance of federal permits, and helps insure that federal actions will not violate water quality standards of the State or Indian tribe. In California, there are nine Regional Water Quality Control Boards (Regional Board) that issue or deny certification for discharges to waters of the United States and waters of the State, including wetlands, within their geographical jurisdiction. The State Water Resources Control Board assumed this responsibility when a project has the potential to result in the discharge to waters within multiple Regional Boards.

State Regulations

Fish and Game Code

Fish and Game Code Sections 1600 et. seq. establishes a fee-based process to ensure that projects conducted in and around lakes, rivers, or streams do not adversely impact fish and wildlife resources, or, when adverse impacts cannot be avoided, ensures that adequate mitigation and/or compensation is provided.

Fish and Game Code Section 1602 requires any person, state, or local governmental agency or public utility to notify the CDFW before beginning any activity that will do one or more of the following:

(1) substantially obstruct or divert the natural flow of a river, stream, or lake;
(2) substantially change or use any material from the bed, channel, or bank of a river, stream, or lake; or
(3) deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it can pass into a river, stream, or lake.

Fish and Game Code Section 1602 applies to all perennial, intermittent, and ephemeral rivers, streams, and lakes in the State. CDFW's regulatory authority extends to include riparian habitat (including wetlands) supported by a river, stream, or lake regardless of the presence or absence of hydric soils and saturated soil conditions. Generally, the CDFW takes jurisdiction to the top of bank of the stream or to the outer limit of the adjacent riparian vegetation (outer drip line), whichever is greater. Notification is generally required for any project that will take place in or in the vicinity of a river, stream, lake, or their tributaries. This includes rivers or streams that flow at least periodically or permanently through a bed or channel with banks that support fish or other aquatic life and watercourses having a surface or subsurface flow that support or have supported riparian vegetation. A Section 1602 Streambed Alteration Agreement would be required if impacts to identified CDFW jurisdictional areas occur.

Porter Cologne Act

The California *Porter-Cologne Water Quality Control Act* gives the State very broad authority to regulate waters of the State, which are defined as any surface water or groundwater, including saline waters. The Porter-Cologne Act has become an important tool in the post SWANCC and Rapanos regulatory environment, with respect to the state's authority over isolated and insignificant waters. Generally, any person proposing to discharge waste into a water body that could affect its water quality must file a Report of Waste Discharge in the event that there is no Section 404/401 nexus. Although "waste" is partially defined as any waste substance associated with human habitation, the Regional Board also interprets this to include fill discharged into water bodies.

Attachment F

IPaC Species List

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish And Wildlife Office
Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846
Phone: (916) 414-6600 Fax: (916) 414-6713

In Reply Refer To: 10/08/2024 18:25:37 UTC
Project Code: 2025-0003344
Project Name: Stanislaus Elementary School 1, 2, 3=TCP Mitigation Project

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)

(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

https://www.fws.gov/sites/default/files/documents/endangered-species-consultation-handbook.pdf

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts, see https://www.fws.gov/program/migratory-bird-permit/what-we-do.

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures, see https://www.fws.gov/library/collections/threats-birds.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/partner/council-conservation-migratory-birds.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Sacramento Fish And Wildlife Office
Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846
(916) 414-6600

PROJECT SUMMARY

Project Code: 2025-0003344
Project Name: Stanislaus Elementary School 1, 2, 3=TCP Mitigation Project
Project Type: Water Supply Facility - Maintenance / Modification
Project Description: The proposed Project is the consolidation of Stanislaus Union School District (SUSD) service area (Water System No. CA5000249) with the City of Modesto, through an extension of water and wastewater services, and the abandonment of the existing Well 02. Stanislaus Elementary School is one of six schools located within SUSD (five (5) elementary schools; one (1) junior high school); however, Stanislaus Elementary School is the only school currently being serviced by Water System No. CA5000249 since it is the only school within the district located outside of Modesto's Water System and City Limits.

Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@37.7112583,-121.03155615601807,14z



Counties: Stanislaus County, California

ENDANGERED SPECIES ACT SPECIES

There is a total of 7 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

REPTILES

NAME	STATUS
Northwestern Pond Turtle *Actinemys marmorata* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1111	Proposed Threatened

AMPHIBIANS

NAME	STATUS
California Tiger Salamander *Ambystoma californiense* Population: U.S.A. (Central CA DPS) There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/2076	Threatened
Western Spadefoot *Spea hammondii* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/5425	Proposed Threatened

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate
Valley Elderberry Longhorn Beetle *Desmocerus californicus dimorphus* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/7850	Threatened

CRUSTACEANS

NAME	STATUS
Vernal Pool Fairy Shrimp *Branchinecta lynchi* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/498	Threatened
Vernal Pool Tadpole Shrimp *Lepidurus packardi* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/2246	Endangered

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

IPAC USER CONTACT INFORMATION

Agency: ELMT Consulting
Name: Travis McGill
Address: 2201 N. Grand Ave. #10098
City: Santa Ana
State: CA
Zip: 92711
Email travismcgill@elmtconsulting.com
Phone: 7147165050

APPENDIX C

Historic Property Identification Report (BCR 2024) and Cultural/ Archaeological/Tribal/ Paleontological Resources Report (BCR Consulting 2023)

HISTORIC PROPERTY IDENTIFICATION REPORT

Stanislaus Elementary School 1, 2, 3-TCP Mitigation Project
Modesto and Unincorporated Stanislaus County, California

FOR PUBLIC REVIEW

Prepared for:

Lori Trottier
Ardurra
3737 Birch Street, Suite 250
Newport Beach, California 92660

Prepared by:

David Brunzell, M.A., RPA
Contributions by Joseph Orozco, M.A., RPA and Timothy Blood, M.S.
BCR Consulting LLC
Claremont, California 91711

Project No. ARD2302

Data Base Information:

Type of Study: Cultural Resources Assessment
Resources Recorded: None
Keywords: Stanislaus County, Modesto, Stanislaus School
USGS Quadrangle: 7.5-minute *Salida, California* (1987)

BCRCONSULTING LLC

October 7, 2024

SUMMARY OF FINDINGS

BCR Consulting LLC (BCR Consulting) is under contract to Ardurra to conduct a Historic Property Identification Report (HPIR) of the Stanislaus Elementary 1, 2, 3-TCP Mitigation Project (the undertaking, or project) located in the City of Modesto and unincorporated portions of Stanislaus County, California. The work is being performed pursuant to Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended (Section 106) based on *Guidelines for Applicants and their Consultants on Preparing HPIRs for the Clean and Drinking Water State Revolving Fund (SRF) Programs* (State Water Board 2024). A cultural resources records search, additional research, field survey, Sacred Lands File Search with the Native American Heritage Commission (NAHC), and Tribal and Additional Consulting Party Coordination as required were conducted for the effort. The records search revealed that 11 cultural resource studies have taken place resulting in 13 cultural resources recorded within a one-half mile radius of the project. Four studies have taken place within the project, and no cultural resources have been identified within its boundaries.

During the field survey, BCR Consulting archaeologists did not identify any cultural resources within the project area. Based on these results, BCR Consulting recommends that the undertaking as proposed will not result in an adverse effect to any historical properties under Section 106 of the NHPA. No further cultural resource work or monitoring is recommended.

While the current study has not indicated sensitivity for buried cultural resources within the project alignment, ground disturbing activities always have the potential to reveal buried deposits not observed on the surface during previous surveys. Prior to the initiation of ground-disturbing activities, field personnel should be alerted to the possibility of buried prehistoric or historic cultural deposits. In the event that field personnel encounter buried cultural materials, work in the immediate vicinity of the find should cease and a qualified archaeologist should be retained to assess the significance of the find. The qualified archaeologist shall have the authority to stop or divert construction excavation as necessary. If the qualified archaeologist finds that any cultural resources present meet eligibility requirements for listing on the National Register, plans for the treatment, evaluation, and mitigation of impacts to the find will need to be developed. Prehistoric or historic cultural materials that may be encountered during ground-disturbing activities include:

- historic artifacts such as glass bottles and fragments, cans, nails, ceramic and pottery fragments, and other metal objects;
- historic structural or building foundations, walkways, cisterns, pipes, privies, and other structural elements;
- prehistoric flaked-stone artifacts and debitage (waste material), consisting of obsidian, basalt, and or cryptocrystalline silicates;
- groundstone artifacts, including mortars, pestles, and grinding slabs;
- dark, greasy soil that may be associated with charcoal, ash, bone, shell, flaked stone, groundstone, and fire affected rocks.

Findings were negative during the Sacred Lands File search with the NAHC. BCR Consulting conducted Tribal and Additional Consulting Party Coordination as required. During this task BCR Consulting sent letters to tribes and the local historical society with the undertaking description, map, and contact information. The State Water Board-provided Applicant Template was used for tribal notification letters and the historical society was emailed. Follow-up phone calls were completed on September 11, 2024. The results of the Sacred Lands File search, and the Tribal and Additional Party Coordination correspondence and tracking table are provided in Appendix B.

If human remains are encountered during the undertaking, State Health and Safety Code Section 7050.5 states that no further disturbance shall occur until the County Coroner has made a determination of origin and disposition pursuant to Public Resources Code Section 5097.98. The County Coroner must be notified of the find immediately. If the remains are determined to be prehistoric, the Coroner will notify the Native American Heritage Commission (NAHC), which will determine and notify a Most Likely Descendant (MLD). With the permission of the landowner or his/her authorized representative, the MLD may inspect the site of the discovery. The MLD shall complete the inspection within 48 hours of notification by the NAHC.

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INTRODUCTION

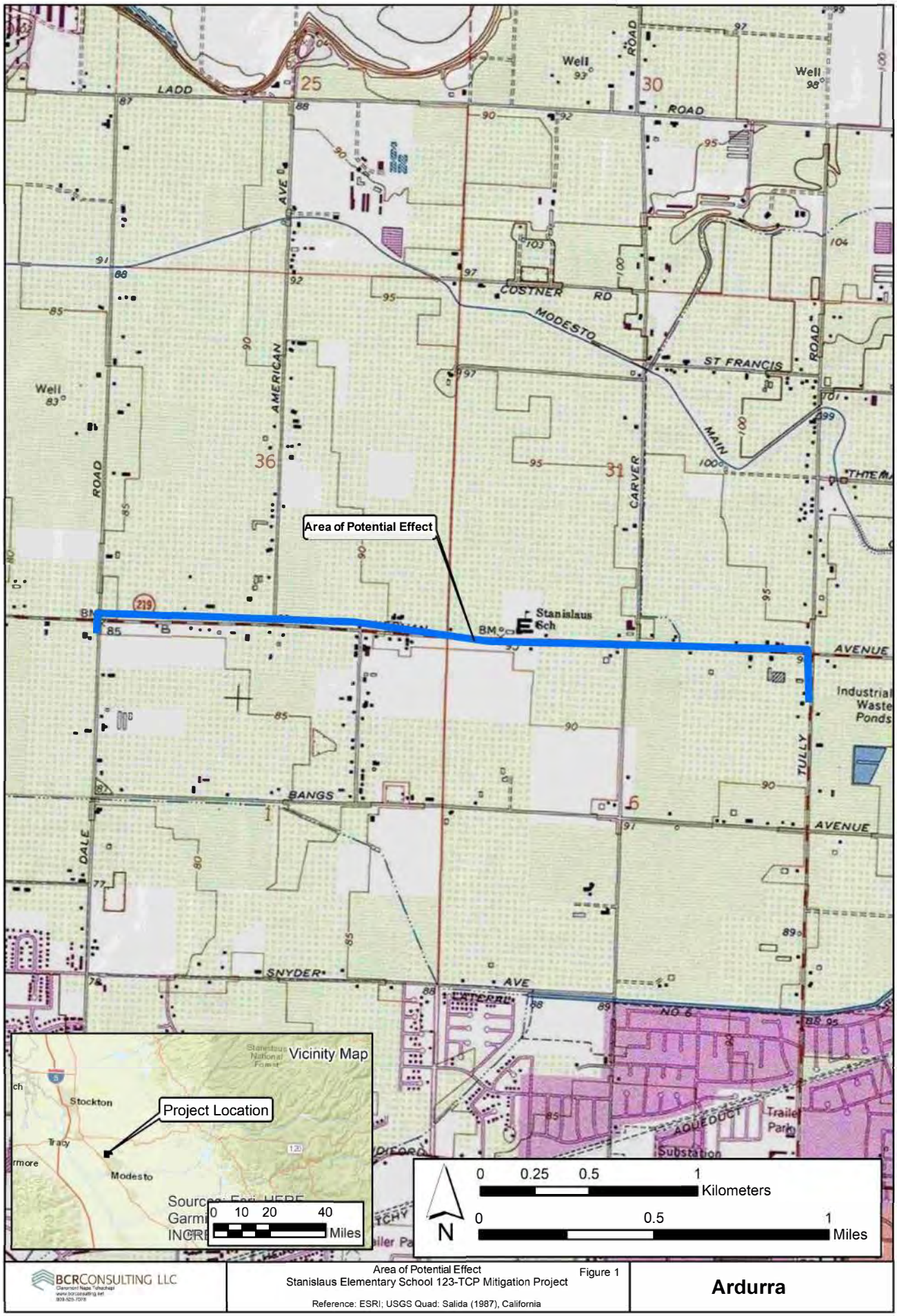
BCR Consulting LLC (BCR Consulting) is under contract to Ardurra to conduct a Historic Property Identification Report (HPIR) of the Stanislaus Elementary 1, 2, 3-TCP Mitigation Project (the project) in the City of Modesto and unincorporated Stanislaus County, California. The work is being performed pursuant to Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended (Section 106) based on *Guidelines for Applicants and their Consultants on Preparing HPIRs for the Clean and Drinking Water State Revolving Fund (SRF) Programs* (State Water Board 2024). A cultural resources records search, additional research, field survey, Sacred Lands File Search with the Native American Heritage Commission (NAHC), and Tribal and Additional Consulting Party Coordination as required were conducted for the effort.

Area of Potential Effects and Undertaking/Project

The Area of Potential Effects (APE) occupies an east/west oriented alignment between Sections 1 (Township 3 South, Range 8 East) and 36 (Township 2 South, Range 8 East), and Sections 6 (Township 3 South, Range 9 East) and 31 (Township 2 South, Range 9 East) Mt. Diablo Base and Meridian. The alignment continues briefly south before terminating on Dale Road at the western end and continues briefly south before terminating on Tully Road at the eastern end. It is depicted on the United States Geological Survey (USGS) *Salida, California* (1987) 7.5-minute topographic quadrangle in Figure 1 and in aerial view with cultural resource locations in confidential Appendix D. The undertaking will include the installation of a 12-inch diameter water line within the Kiernan Avenue right-of-way to connect the City of Modesto's water service to the Stanislaus Elementary School Property, and a fire hydrant at the northeast corner of the intersection of Kiernan Avenue and Tully Road. It will also provide a service connection of the City of Modesto's potable water system in Dale Road and in Tully Road to the proposed water main being installed in Kiernan Avenue. Open trenching will occupy 11,897 linear feet by six feet in width and eight feet in depth. A maximum of 10 jack and bore locations (five jacking pits and five receiving pits) will be excavated within the linear alignment to avoid impacts to existing utilities and structures. The jacking pits will be 12 feet wide, 10 feet long, and 15 feet deep and the receiving pits will be 12 feet wide by 24 feet long, and 15 feet deep. Above ground installations are not anticipated. The horizontal surface disturbance will equal approximately 73,442 square feet (approximately 1.68 acres) at a maximum depth of 15 feet below the surface.

Regulatory Setting

Section 106 of the National Historic Preservation Act. The NHPA establishes the federal government policy on historic preservation and the programs, including the National Register, through which this policy is implemented. Under the NHPA, significant cultural resources (referred to as historic properties) include any prehistoric or historic district, site, building, structure, or object included in, or determined eligible for inclusion in, the National Register. Historic properties also include resources determined to be National Historic Landmarks. National Historic Landmarks are nationally significant historic places designated by the Secretary of the Interior because they possess exceptional value or quality in illustrating or interpreting United States heritage. A property is considered historically significant if it meets one of the National Register criteria and retains sufficient historic



BCR CONSULTING LLC

Area of Potential Effect
Stanislaus Elementary School 123-TCP Mitigation Project

Figure 1

Reference: ESRI; USGS Quad: Salida (1987), California

Ardurra

integrity to convey its significance. This act also established the Advisory Council on Historic Preservation, an independent agency responsible for implementing Section 106 of NHPA by developing procedures to protect cultural resources included in, or eligible for inclusion in, the National Register. Regulations are published in 36 C.F.R. Parts 60, 63, and 800.

National Historic Preservation Act Implementing Regulations (36 Code of Federal Regulations § 800). Section 106 of the NHPA requires that effects on historic properties be taken into consideration in any federal undertaking. The process has five steps: (1) initiating the Section 106 process, (2) identifying historic properties, (3) assessing adverse effects, (4) resolving adverse effects, and (5) implementing stipulations in an agreement document. The implementing regulations for Section 106 are at 36 C.F.R. Part 800. Section 106 affords the Advisory Council on Historic Preservation and the State Historic Preservation Officer (SHPO), as well as other consulting parties, a reasonable opportunity to comment on any undertaking that would adversely affect historic properties. SHPOs administer the national historic preservation program at the state level, review National Register nominations, maintain data on historic properties that have been identified but not yet nominated, and consult with federal agencies during Section 106 review.

National Register of Historic Places Eligibility (Section 106). Eligibility for the National Register rests on two factors: significance and integrity. In order to be eligible for inclusion in the National Register, a property must meet one or more of the significance criteria listed below (36 C.F.R. § 60.4) and retain integrity:

- Criterion A—Association with “events that have made a significant contribution to the broad patterns of our history.”
- Criterion B—Association with “the lives of persons significant in our past.”
- Criterion C—Resources “that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction.”
- Criterion D—Resources “that have yielded, or may be likely to yield, information important to history or prehistory.”

The National Register bulletin entitled *How to Apply the National Register Criteria for Evaluation* states that in order for a property to qualify for listing in the National Register, it must meet at least one of the National Register criteria by: (1) being associated with an important historic context, and (2) retaining historic integrity of those features necessary to convey its significance (National Park Service 1997). The historic context of a resource will define the theme(s), geographical limits, and period of significance by which to evaluate a resource’s significance (National Park Service 1997:7). Generally, cultural properties must be 50 years of age or more to be eligible for listing in the National Register. According to the National Park Service (1997:2), “properties that have achieved significance within the past 50 years shall not be considered eligible” unless such properties are “of exceptional importance.”

In addition to being significant under one or more of these criteria, National Register eligibility (as well as California Register of Historical Resources [California Register]

eligibility, as described below) requires that a resource retain sufficient integrity to convey its significance. Integrity is evaluated through consideration of characteristics that existed during a resource's period of significance. Integrity is evaluated with regard to the retention of seven elements:

- Location—The place where the resource was constructed
- Design—The combination of elements that create the form, plans, space, structure, and style of the resource
- Setting—The physical environment of the resource, including the landscape and spatial relationship of the buildings
- Materials—The physical elements that were combined or deposited during a particular period of time and in a particular pattern of configuration to form the resource
- Workmanship—The physical evidence of the crafts of a particular culture or people during any given period of history
- Feeling—The resource's expression of the aesthetic or historic sense of a particular period of time
- Association—The direct link between an important historic event or person and a resource

The NHPA allows properties of traditional religious and cultural importance to a Native American tribe to be eligible for National Register inclusion (Section 101(d)(6)(A)). Additionally, a broader range of traditional cultural properties is also considered and may be eligible for or listed in the National Register. Traditional cultural properties are places associated with the cultural practices or beliefs of a living community that are rooted in that community's history and that may be eligible because of their association with cultural practices or beliefs of living communities that are rooted in that community's history and are important in maintaining the continuing cultural identity of the community. In the National Register programs, culture is understood to mean the traditions, beliefs, practices, lifeways, arts, crafts, and social institutions of any community, be it an Indian tribe, a local ethnic group, or the nation as a whole (Parker and King 1998).

NHPA Section 106 Native American Consultation. Section 106 of the NHPA requires tribal consultation in all steps of the process when a federal agency project or effort may affect historic properties that are either located on tribal lands, or when any Native American tribe or Native Hawaiian organization attaches religious or cultural significance to the historic property, regardless of the property's location (U.S. General Services Administration 2022).

NATURAL SETTING

The elevation of the project alignment ranges from approximately 86 to 95 feet above mean sea level (AMSL). The property has been subject to disturbances related to road construction and maintenance, drainage infrastructure, and agricultural activities. Local geologic units include alluvial Quaternary deposits of the Pleistocene Modesto Formation (Rapp et al. 1977). These deposits do not appear to be a source of prehistoric tool materials. The region is characterized by a Mediterranean climate with relatively dry summers and mild winters. Annual rainfall averages approximately 14.06 inches, and

typically occurs in the form of fall and winter storms and showers. The nearest local fresh water source is the Stanislaus River, which flows from west to east approximately two miles north of the project site (USGS 1987). Very little native vegetation remains locally intact due to intensive agricultural and other developments. Historically, Valley Grassland and Oak Woodland communities dominated local vegetation. Signature native and non-native species associated with each habitat are summarized below in Table A (see also Williams et al. 2009: 375, 453). For prehistoric use of many of the local native species see Lightfoot and Parrish 2009.

Table A. Local Vegetation Communities

Habitat	Plant Species	Animal Species
Valley Grassland	Beardless Wildrye, Blue Wildrye, Deergrass, Foothill Bluegrass, Needlegrass, Three-Awn Grass, Baby Blue-Eyes, Big Tarweed, Blue Dicks, California Jewelflower, California Poppy, Clover, Goldfields, Lupine, Mariposa Lily, Pitgland Tarweeed, Purple Owl's Clover, Tidytips, Wild Onion	Burrow Owl, Ferruginous Hawk, Horned Lark, Long-Billed Curlew, Northern Harrier, Sandhill Crane, Swainson's Hawk, Western Kingbird, Western Meadowlark, American Badger, California Ground Squirrel, California Pocket Mouse, Cottontail Rabbit, Giant Kangaroo Rat, Heermann's Kangaroo Rat, Pronghorn Antelope, Kit Fox, Tule Elk, Pocket Gopher, Leopard Lizard, Gopher Snake, Rattlesnake
Oak Woodland	Black Oak, Blue Oak, Buckeye, California Bay, Canyon Live Oak, Coast Live Oak, Engelmann Oak, Interior Live Oak, Oregon Oak, Valley Oak, Coffeeberry, Toyon, Blue Dicks	Mule deer, Western Grey Squirrel, Deer Mouse, Wood Rat, Northern Flicker, Scrub Jay, Ash-throated Flycatcher, Western Kingbird, White-breasted Nuthatch.

CULTURAL SETTING

Prehistory

Similar to most of western North America, human groups commenced regional settlement between 9,000-11,500 years before present. Humans proliferated globally during this era due to gradual environmental warming that marked the close of the last ice age. Changes in settlement patterns and subsistence focus are widely cited as adaptations to the new conditions and have been organized into a number of chronological frameworks for the region (see Moratto 1984; Heizer 1978; and others).

Ethnography

The project sites are situated within the traditional boundaries of the Northern Valley Yokuts. This prehistoric population depended heavily on the San Joaquin River and its connecting sloughs and rivers for sustenance and transportation. Little ethnographic information is available for the local Northern Valley Yokuts, due to missionization and disease soon after European contact, and to the influx of miners in the 1850s (Wallace 1978:462). Trade routes and rights to riverine resources allowed the Northern Valley Yokuts to reap the benefits of the numerous perennial water sources allowing local populations to pursue a sedentary lifestyle in an otherwise arid climate. Prehistorically, such sedentism often coincides with a village-style residential model in which residential bases remain the same or seasonal, while specialized procurement parties are deployed to more remote areas to collect specialized resources (Binford 1980, Thomas 1983). This village model has been locally supported by early ethnographers, who considered Yokuts unique in California for forming "true tribes" and for developing an unparalleled array of dialects (Kroeber 1925:474).

History

The first Europeans to establish contact with the Yokuts were Spanish troops led by Captain Don Pedro Fages in pursuit of deserters. Father Francisco Garces also travelled through the San Joaquin Valley searching for an overland route from Yuma to Monterey. During his travels, Garces noted positive interactions with locals (see Smith 1939, Bailey 1984). The Mexican era (1821-1848) saw little notable cultural exchange between Mexicans and Yokuts, although an 1833 malaria epidemic devastated the local native population (Wallace 1978:460). The American era, punctuated by California's annexation into the United States in 1848, resulted in overwhelming Anglo settlement which disrupted local Yokut influence. Mining and ranching represented the early historical focus of the San Joaquin Valley, although abundant natural water, a mild climate, and arable land soon led to the successful development of agriculture. The resulting diversion of local water and escalating land values transformed the physical and economic character of the area and has allowed it to remain one of the world's most productive agricultural regions to this day (Preston 1981).

Salida. The project site is near the unincorporated rural community known as Salida, north of Modesto on Highway 99. The original settlement was known as Murphy's Ferry, established and operated by John Murphy from 1867 until the arrival of the Central Pacific Railroad in 1870. A year later Murphy built a warehouse and a sidetrack was installed for shipping grain. This was called Murphy's Switch. In 1875, the community was granted a post office, but a new name had to be chosen because there already was a Murphy's post office in Calaveras County. A Spanish word, "Salida", meaning exit, was chosen and this implied that the new town was "near the water", it being the closest town to the south bank of the Stanislaus River (Stanislaus County 2020).

Modesto. Modesto was founded in 1870, shortly after the establishment of the railroad connecting Sacramento to Los Angeles. A co-founder of Central Pacific Railroad suggested it be named after their banking associate William C. Ralston, who refused the honor. A railroad employee was overheard in Spanish calling Ralston a modest man, and thus the name Modesto came to reflect his modesty. The population exceeded 1,000 residents in 1884, and 4,500 by the turn of the twentieth century. The region became a major grower and supplier of foodstuffs for allied forces during World War II. In the following decades, Modesto's population would continue to grow by about two percent annually, surpassing 100,000 in 1980 and eventually 200,000 by 2001 (Modesto Irrigation District 1987).

PERSONNEL

David Brunzell, M.A., RPA acted as the Project Manager and Principal Investigator, provided project oversight, and authored the technical report with contributions from BCR Consulting Project Manager Joseph Orozco, M.A., RPA and BCR Consulting Archaeological Crew Chief Timothy Blood, M.S. Central California Information Center (CCIC) staff completed the cultural resources records search through its archive at California State University, Stanislaus. Doug Kazmier, B.A. PGC, completed the field survey.

METHODS

This work was completed pursuant to Section 106 of the NHPA, based on *Guidelines for Applicants and their Consultants on Preparing HPIRs for the Clean and Drinking Water State Revolving Fund (SRF) Programs* (State Water Board 2024). The pedestrian cultural resources survey was intended to locate and document previously recorded or new cultural resources, including archaeological sites, features, isolates, and historic-period buildings, that exceed 45 years in age within defined project boundaries. The project site was inspected using 15 meter transect intervals on either side of the alignment. This study is intended to determine whether cultural resources are located within the project alignment, whether any cultural resources are significant pursuant to the above-referenced regulations and standards, and to develop specific mitigation measures that will address potential impacts to existing or potential resources. Tasks pursued to achieve that end include:

- Cultural resources records search to review any studies conducted and the resulting cultural resources recorded within a one half-mile radius of the project alignment
- Systematic pedestrian survey of the entire project alignment
- Development of recommendations and mitigation measures following Section 106

Research

Records Search. An archaeological records search was conducted by the CCIC on November 7, 2023. This included a review of all recorded historic and prehistoric cultural resources, as well as a review of known cultural resources, and survey and excavation reports generated from projects located within one half-mile of the project alignment. In addition, a review was conducted of the National Register of Historic Places (National Register), the California Register of Historical Resources (California Register), and documents and inventories from the California Office of Historic Preservation including the lists of California Historical Landmarks, California Points of Historical Interest, Listing of National Register Properties, and the Built Environment Resources Directory (BERD).

Field Survey

An intensive-level cultural resources field survey of the project alignment was conducted on December 10th, 2023. The survey was conducted by walking parallel transects spaced approximately 15 meters apart along both sides of the project alignment. Digital photographs were taken at various points within the project alignment. These included overviews as well as detailed photographs of all cultural resources. Cultural resources were recorded per the California OHP *Instructions for Recording Historical Resources* in the field using:

- Hand-held Global Positioning systems for mapping purposes
- Digital photography of all cultural resources (see Appendix C).

RESULTS

Research

Records Search. Data from the CCIC revealed that 11 cultural resource studies have taken place resulting in 13 cultural resources recorded within a one half-mile radius of the undertaking. Four of these studies have taken place within the project alignment, and no resources have been previously recorded within its boundaries. The records search results are summarized in Table B. Bibliographic details and records search maps are provided in Confidential Appendix A.

Table B. Cultural Resources and Reports Within One-Half Mile of the Undertaking

USGS 7.5 Min Quad	Cultural Resources Within One Half-Mile of Undertaking	Studies Within One-Half Mile
Salida, California (1987)	P-50-0075: MID Lateral No. 6 (0.5 Miles SSE) P-50-1918: Bangs #1 (0.35 Miles SW) P-50-1925: Chappell Ditch (Adjacent North) P-50-2002: Modesto Main/La Grange MID Old Canal (0.25 Miles N) P-50-2024: Fluence Property (0.3 Miles E) P-50-2025: 5024 Tunson Rd., Modesto (0.3 Miles E) P-50-2026: 907 Kiernan Rd. (SR 219), Modesto (0.3 Miles E) P-50-2165: Essa Property (Adjacent W) P-50-2166: Kumar Property (0.2 Miles N) P-50-2167: Harrell Property (0.2 Miles N) P-50-2259: 10-STA-219 EA (Adjacent S) P-50-2260: 1348 Kiernan Ave. (Adjacent S) P-50-2301: 1349 Bangs Ave. (0.4 Miles S)	ST-3697*, 3879, 4054*, 4749, 4829, 5470, 5900, 6306, 7244*, 7725, 8007*

*Occurred Within Project Area

Field Survey

During the field survey Mr. Kazmier carefully inspected the entirety of the project alignment for both prehistoric and historic-period cultural resources. No cultural resources (including prehistoric or historic archaeological or historic architectural resources) were identified during the field survey. The project alignment has been subject to severe disturbances related to the construction and maintenance of roads, drainage and other infrastructure, as well as agricultural activities and the dumping of modern refuse. Sediments included sandy silt, and vegetation within the alignment was dominated by seasonal grasses affording surface visibility that varied between 80 and 100 percent within unpaved portions of the project alignment.

RECOMMENDATIONS

During the research and field survey, BCR Consulting archaeologists identified no cultural resources (including historic-period or prehistoric archaeological sites and historic-period architectural resources) within the project alignment. Based on these results, BCR Consulting recommends that development of the project site would not result in an adverse effect to any historic properties under Section 106 of the NHPA. No further cultural resource work or monitoring is recommended.

While the current study has not indicated sensitivity for buried cultural resources within the project alignment, ground disturbing activities always have the potential to reveal buried deposits not observed on the surface during previous surveys. Prior to the initiation of ground-disturbing activities, field personnel should be alerted to the possibility of buried prehistoric or historic cultural deposits. In the event that field personnel encounter buried cultural materials, work in the immediate vicinity of the find should cease and a qualified archaeologist should be retained to assess the significance of the find. The qualified archaeologist shall have the authority to stop or divert construction excavation as necessary. If the qualified archaeologist finds that any cultural resources present meet eligibility requirements for listing on the National Register, plans for the treatment, evaluation, and mitigation of impacts to the find will need to be developed. Prehistoric or historic cultural materials that may be encountered during ground-disturbing activities include:

- historic artifacts such as glass bottles and fragments, cans, nails, ceramic and pottery fragments, and other metal objects;
- historic structural or building foundations, walkways, cisterns, pipes, privies, and other structural elements;
- prehistoric flaked-stone artifacts and debitage (waste material), consisting of obsidian, basalt, and or cryptocrystalline silicates;
- groundstone artifacts, including mortars, pestles, and grinding slabs;
- dark, greasy soil that may be associated with charcoal, ash, bone, shell, flaked stone, groundstone, and fire affected rocks.

Findings were negative during the Sacred Lands File search with the NAHC. BCR Consulting conducted Tribal and Additional Consulting Party Coordination as required. During this task BCR Consulting sent letters to tribes and the local historical society with the undertaking description, map, and contact information. The State Water Board-provided Applicant Template was used for tribal notification letters and the historical society was emailed. Follow-up phone calls were completed on September 11, 2024. The results of the Sacred Lands File search, and the Tribal and Additional Party Coordination correspondence and tracking table are provided in Appendix B.

If human remains are encountered during the undertaking, State Health and Safety Code Section 7050.5 states that no disturbance shall occur until the County Coroner has made a determination of origin and disposition pursuant to Public Resources Code Section 5097.98. The County Coroner must be notified of the find immediately. If the remains are determined to be prehistoric, the Coroner will notify the Native American Heritage Commission (NAHC), which will determine and notify a Most Likely Descendant (MLD). With the permission of the landowner or his/her authorized representative, the MLD may inspect the site of the discovery. The MLD shall complete the inspection within 48 hours of notification by the NAHC.

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APPENDIX A (CONFIDENTIAL)

RECORDS SEARCH RESULTS

PROVIDED UNDER SEPARTE COVER

APPENDIX B

NAHC, TRIBAL, AND ADDITIONAL CONSULTING PARTY COORDINATION

Sacred Lands File & Native American Contacts List Request

Native American Heritage Commission
1550 Harbor Blvd, Suite 100
West Sacramento, CA 95691
916-373-3710
916-373-5471 – Fax
nahc@nahc.ca.gov

Information Below is Required for a Sacred Lands File Search

Project: Stanislaus Elementary School 123-TCP Mitigation Project (ARD2302)

County: Stanislaus County

USGS Quadrangle Name: Salida (1987), California

Township: 2S, 3S **Range:** 8E, 9E **Section(s):** 35 & 36 (8E), 06 & 31 (9E)

Company/Firm/Agency: BCR Consulting, LLC

Street Address: 505 W 8th Street

City: Claremont **Zip:** 91711

Phone: 909-525-7078

Fax:

Email: bcrllc2008@gmail.com

Project Description: Development project.

NATIVE AMERICAN HERITAGE COMMISSION

CHAIRPERSON
Reginald Pagaling
Chumash

VICE-CHAIRPERSON
Buffy McQuillen
Yokayo Pomo, Yuki, Nomlaki

SECRETARY
Sara Dutschke
Miwok

PARLIAMENTARIAN
Wayne Nelson
Luiseño

COMMISSIONER
Isaac Bojorquez
Ohlone-Costanoan

COMMISSIONER
Stanley Rodriguez
Kumeyaay

COMMISSIONER
Laurena Bolden
Serrano

COMMISSIONER
Reid Milanovich
Cahuilla

COMMISSIONER
Vacant

EXECUTIVE SECRETARY
Raymond C. Hitchcock
Miwok, Nisenan

NAHC HEADQUARTERS
1550 Harbor Boulevard
Suite 100
West Sacramento,
California 95691
(916) 373-3710

November 29, 2023

Joseph Orozco
BCR Consulting, LLC

Via Email to: bcrllc2008@gmail.com

Re: Stanislaus Elementary School 123-TCP Mitigation (ARD2302) Project, Stanislaus County

Dear Mr. Orozco:

A record search of the Native American Heritage Commission (NAHC) Sacred Lands File (SLF) was completed for the information you have submitted for the above referenced project. The results were negative. However, the absence of specific site information in the SLF does not indicate the absence of cultural resources in any project area. Other sources of cultural resources should also be contacted for information regarding known and recorded sites.

Attached is a list of Native American tribes who may also have knowledge of cultural resources in the project area. This list should provide a starting place in locating areas of potential adverse impact within the proposed project area. I suggest you contact all of those indicated; if they cannot supply information, they might recommend others with specific knowledge. By contacting all those listed, your organization will be better able to respond to claims of failure to consult with the appropriate tribe. If a response has not been received within two weeks of notification, the Commission requests that you follow-up with a telephone call or email to ensure that the project information has been received.

If you receive notification of change of addresses and phone numbers from tribes, please notify me. With your assistance, we can assure that our lists contain current information.

If you have any questions or need additional information, please contact me at my email address: Pricilla.Torres-Fuentes@nahc.ca.gov.

Sincerely,

Pricilla Torres-Fuentes

Pricilla Torres-Fuentes
Cultural Resources Analyst

Attachment

Native American Heritage Commission
Native American Contact List
Stanislaus County
11/29/2023

County	Tribe Name	Fed (F) Non-Fed (N)	Contact Person	Contact Address	Phone #	Email Address	Cultural Affiliation
Stanislaus	Calaveras Band of Mi-Wuk Indians	N	Gloria Grimes, Chairperson	P.O. Box 899 West Point, CA, 95255	(209) 419-5675	calaverasband.miwukindians@gmail.com	Mi-wuk
	Calaveras Band of Mi-Wuk Indians - Grimes	N	Debra Grimes, Cultural Resources Specialist	P.O. Box 1015 West Point, CA, 95255	(209) 470-8688	calaverasmiwukpreservation@gmail.com	Mi-wuk
	California Valley Miwok Tribe	F	AKA Sheep Rancheria of Me-Wuk Indians of CA,	P.O. Box 395 West Point, CA, 95255	(209) 293-4179	l.ewilson@yahoo.com	Miwok
	California Valley Miwok Tribe	F	,	14807 Avenida Central La Grange, CA, 95329	(209) 931-4567		Miwok
	Confederated Villages of Lisjan Nation	N	Corrina Gould, Chairperson	10926 Edes Avenue Oakland, CA, 94603	(510) 575-8408	cvltribe@gmail.com	Bay Miwok Ohlone Delta Yokut
	Confederated Villages of Lisjan Nation	N	Deja Gould, Language Program Manager	10926 Edes Ave Oakland, CA, 94603	(510) 575-8408	cvltribe@gmail.com	Bay Miwok Ohlone Delta Yokut
	Confederated Villages of Lisjan Nation	N	Cheyenne Gould, Tribal Cultural Resource Manager	10926 Edes Ave Oakland, CA, 94603	(510) 575-8408	cvltribe@gmail.com	Bay Miwok Ohlone Delta Yokut

Native American Heritage Commission
Native American Contact List
Stanislaus County
11/29/2023

North Valley Yokuts Tribe	N	John Murga, Tribal Historian	P.O. Box 717 Linden, CA, 95236	(209) 479-0546	johnmurga824@gmail.com	Costanoan Northern Valley Yokut
North Valley Yokuts Tribe	N	Jessica Murga, Tribal Secretary	990 N. Fine Rd Linden, CA, 95236	(209) 401-6250		Costanoan Northern Valley Yokut
North Valley Yokuts Tribe	N	Timothy Perez, Tribal Compliance Officer	P.O. Box 717 Linden, CA, 95236	(209) 662-2788	huskanam@gmail.com	Costanoan Northern Valley Yokut
North Valley Yokuts Tribe	N	Erolinda Perez, Tribal Administrator	P.O. Box 717 Linden, CA, 95236	(209) 649-3155	arr0604w@verizon.net	Costanoan Northern Valley Yokut
Southern Sierra Miwuk Nation	N	Sandra Chapman, Chairperson	P.O. Box 186 Mariposa, CA, 95338	(559) 580-7871	sandra47roy@gmail.com	Miwok Northern Valley Yokut Paiute
Tule River Indian Tribe	F	Neil Peyron, Chairperson	P.O. Box 589 Porterville, CA, 93258	(559) 781-4271	neil.peyron@tulerivertribe-nsn.gov	Yokut
Tule River Indian Tribe	F	Joey Garfield, Tribal Archaeologist	P. O. Box 589 Porterville, CA, 93258	(559) 783-8892	joey.garfield@tulerivertribe-nsn.gov	Yokut
Tule River Indian Tribe	F	Kerri Vera, Environmental Department	P. O. Box 589 Porterville, CA, 93258	(559) 783-8892	kerri.vera@tulerivertribe-nsn.gov	Yokut

Native American Heritage Commission
Native American Contact List
Stanislaus County
11/29/2023

Wilton Rancheria	F	Cultural Preservation Department,	9728 Kent Street Elk Grove, CA, 95624	(916) 683-6000	cpd@wiltonrancheria-nsn.gov	Miwok
Wilton Rancheria	F	Dahlton Brown, Executive Director of Administration	9728 Kent Street Elk Grove, CA, 95624	(916) 683-6000	dbrown@wiltonrancheria-nsn.gov	Miwok
Wilton Rancheria	F	Herbert Griffin, Executive Director of Cultural Preservation	9728 Kent Street Elk Grove, CA, 95624	(916) 683-6000	hgriffin@wiltonrancheria-nsn.gov	Miwok
Wuksachi Indian Tribe/Eshom Valley Band	N	Kenneth Woodrow, Chairperson	1179 Rock Haven Ct. Salinas, CA, 93906	(831) 443-9702	kwood8934@aol.com	Foothill Yokut Mono

This list is current only as of the date of this document. Distribution of this list does not relieve any person of statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resource Section 5097.98 of the Public Resources Code.

This list is only applicable for contacting local Native Americans with regard to cultural resources assessment for the proposed Stanislaus Elementary School 123-TCP Mitigation (ARD2302) Project, Stanislaus County.

Gmail

Joseph Orozco <josepho@bcrcllc.com>

BCR Tribal Scoping for the Stanislaus Elementary School 123-TCP Mitigation Project

5 messages

Joseph Orozco <josepho@bcrcllc.com> Tue, Sep 10, 2024 at 2:33 PM
To: Joseph Orozco <josephorozco513@gmail.com>
Bcc: "Calaverasband.miwukindians@gmail.com" <Calaverasband.miwukindians@gmail.com>, "CalaverasMiwukPreservation@gmail.com" <CalaverasMiwukPreservation@gmail.com>, l.ewilson@yahoo.com, "cvltribe@gmail.com" <cvltribe@gmail.com>, "johnmurga824@gmail.com" <johnmurga824@gmail.com>, "huskanam@gmail.com" <huskanam@gmail.com>, "arr0604w@verizon.net" <arr0604w@verizon.net>, "Sandra47roy@gmail.com" <Sandra47roy@gmail.com>, neilpeyron@tulerivertribensn.gov, joey.garfield@tulerivertribensn.gov, kerri.vera@tulerivertribensn.gov, cpd@wiltonrancheria-nsn.gov, dbrown@wiltonrancheria-nsn.gov, "hgriffin@wiltonrancheria-nsn.gov" <hgriffin@wiltonrancheria-nsn.gov>, kwood8934@aol.com

The City of Modesto Public Works and Stanislaus County are proposing improvements to water and sewer alignments for Stanislaus Elementary School as part of the Stanislaus Elementary School 1, 2, 3-TCP Mitigation Project (Project). The project proposes to extend potable water from the City of Modesto, and the installation of new sewer mains. The Project is located within the City of Modesto (City) and in portions of unincorporated Stanislaus County (County). The area of potential effects (APE) is within the Salida, California (1987) 7.5' United States Geographical Survey (USGS) topographic quadrangle. The APE occupies an east/west oriented alignment between Sections 1 (Township 3 South, Range 8 East) and 36 (Township 2 South, Range 8 East), and Sections 6 (Township 3 South, Range 9 East) and 31 (Township 2 South, Range 9 East), Mt. Diablo Base and Meridian (Figure 1).

Work on the project would include open trench construction as well as jack and bore construction for the installment of the entire project alignment. A total of 11,897 linear feet of project alignment consisting of approximately 1.1 acres will be trenched. Disturbances related to trench work are anticipated to be four-feet wide and eight-feet deep. Jack and bore construction will consist of not more than a total of five jack and bore locations, each including two pits, one entry (jacking), and one exit pit. Jacking pits are approximately 12-feet wide by 10-feet long by 15-feet deep and receiving pits are approximately 12-feet wide by 204-feet long by 15-feet deep, resulting in approximately 0.03 acres of disturbance. Earthwork quantities are approximately 3,348 cubic yards of export and 4,680 cubic yards of imported soil is anticipated.

The City may apply for State Revolving Fund (SRF) Program funding from the California State Water Resources Control Board (State Water Board) to assist in financing the Project. The SRF Program is partially funded by the United States Environmental Protection Agency (USEPA). The State Water Board, Division of Financial Assistance, administers the SRF Program pursuant to 40 Code of Federal Regulations Part 35. Issuance of SRF Program funding by the State Water Board is considered equivalent to a federal action, thereby necessitating compliance with Section 106 of the National Historic Preservation Act (Section 106). The USEPA has delegated certain responsibilities under Section 106 to the State Water Board.

In anticipation of potentially applying for SRF Program funding, and as part of the environmental compliance for the project, your Tribe has been identified as one that might attach religious and cultural significance to historic properties in the APE. We are seeking your assistance with the identification of sites of religious and cultural significance. Your participation in the early identification of cultural resources will ensure their consideration during the project planning phase. We welcome your recommendations regarding appropriate management or treatment of resources that occur within the project area. Please note that this outreach does not constitute consultation as required under Section 106. The State Water Board will initiate consultation with your Tribe if the Project may receive SRF

Program funding.

If you have questions, need additional information, or wish to comment, please contact me at the address provided below, or call me at 909-455-8531 or email at josepho@bcrcllc.com.

Joseph Orozco, M.A., RPA
Project Manager/Archaeologist

BCR Consulting LLC
1274 North Yale Avenuef
Claremont, CA 91711
(909) 455-8531
www.bcrconsulting.net



ARD2302_Fig1.jpg
1012K

Mail Delivery Subsystem <mailer-daemon@googlemail.com> Tue, Sep 10, 2024 at 2:34 PM
To: josepho@bcrcllc.com

Address not found

Your message wasn't delivered to **kerri.vera@tulerivertribensn.gov** because the domain tulerivertribensn.gov couldn't be found. Check for typos or unnecessary spaces and try again.

LEARN MORE

The response was:

```
DNS Error: DNS type 'mx' lookup of tulerivertribensn.gov responded with code NXDOMAIN Domain name not found: tulerivertribensn.gov For more information, go to https://support.google.com/mail/?p=BadRcptDomain
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Final-Recipient: rfc822; kerri.vera@tulerivertribensn.gov
Action: failed
Status: 5.1.2
Diagnostic-Code: smtp; DNS Error: DNS type 'mx' lookup of tulerivertribensn.gov responded with code NXDOMAIN Domain name not found: tulerivertribensn.gov For more information, go to https://support.google.com/mail/?p=BadRcptDomain
Last-Attempt-Date: Tue, 10 Sep 2024 14:34:12 -0700 (PDT)

---------- Forwarded message ----------
From: Joseph Orozco <josepho@bcrcllc.com>
To: Joseph Orozco <josephorozco513@gmail.com>
Cc:
Bcc: kerri.vera@tulerivertribensn.gov
Date: Tue, 10 Sep 2024 14:33:59 -0700
Subject: BCR Tribal Scoping for the Stanislaus Elementary School 123-TCP Mitigation Project
----- Message truncated -----

Mail Delivery Subsystem <mailer-daemon@googlemail.com> Tue, Sep 10, 2024 at 2:34 PM
To: josepho@bcrcllc.com



Address not found

Your message wasn't delivered to **joey.garfield@tulerivertribensn.gov** because the domain tulerivertribensn.gov couldn't be found. Check for typos or unnecessary spaces and try again.

LEARN MORE

The response was:

```
DNS Error: DNS type 'mx' lookup of tulerivertribensn.gov responded with code NXDOMAIN Domain name not found: tulerivertribensn.gov For more information, go to https://support.google.com/mail/?p=BadRcptDomain
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Final-Recipient: rfc822; joey.garfield@tulerivertribensn.gov
Action: failed
Status: 5.1.2
Diagnostic-Code: smtp; DNS Error: DNS type 'mx' lookup of tulerivertribensn.gov responded with code NXDOMAIN Domain name not found: tulerivertribensn.gov For more information, go to https://support.google.com/mail/?p=BadRcptDomain
Last-Attempt-Date: Tue, 10 Sep 2024 14:34:12 -0700 (PDT)

---------- Forwarded message ----------

From: Joseph Orozco <josepho@bcrcllc.com>
To: Joseph Orozco <josephorozco513@gmail.com>
Cc:
Bcc: joey.garfield@tulerivertribensn.gov
Date: Tue, 10 Sep 2024 14:33:59 -0700
Subject: BCR Tribal Scoping for the Stanislaus Elementary School 123-TCP Mitigation Project
----- Message truncated -----

Mail Delivery Subsystem <mailer-daemon@googlemail.com> Tue, Sep 10, 2024 at 2:34 PM
To: josepho@bcrcllc.com



Address not found

Your message wasn't delivered to **neilpeyron@tulerivertribensn.gov** because the domain tulerivertribensn.gov couldn't be found. Check for typos or unnecessary spaces and try again.

LEARN MORE

The response was:

DNS Error: DNS type 'mx' lookup of tulerivertribensn.gov responded with code NXDOMAIN Domain name not found: tulerivertribensn.gov For more information, go to https://support.google.com/mail/?p=BadRcptDomain

Final-Recipient: rfc822; neilpeyron@tulerivertribensn.gov
Action: failed
Status: 5.1.2
Diagnostic-Code: smtp; DNS Error: DNS type 'mx' lookup of tulerivertribensn.gov responded with code NXDOMAIN Domain name not found: tulerivertribensn.gov For more information, go to https://support.google.com/mail/?p=BadRcptDomain
Last-Attempt-Date: Tue, 10 Sep 2024 14:34:12 -0700 (PDT)

---------- Forwarded message ----------
From: Joseph Orozco <josepho@bcrcllc.com>
To: Joseph Orozco <josephorozco513@gmail.com>
Cc:
Bcc: neilpeyron@tulerivertribensn.gov
Date: Tue, 10 Sep 2024 14:33:59 -0700
Subject: BCR Tribal Scoping for the Stanislaus Elementary School 123-TCP Mitigation Project
----- Message truncated -----

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postmaster@wiltonrancheria-nsn.gov <postmaster@wiltonrancheria- Tue, Sep 10, 2024 at 2:34 PM

nsn.gov>
To: josepho@bcrcllc.com

Delivery has failed to these recipients or groups:

dbrown@wiltonrancheria-nsn.gov

The recipient's mailbox is full and can't accept messages now. Please try resending your message later, or contact the recipient directly.

Diagnostic information for administrators:

Generating server: PH7PR10MB6353.namprd10.prod.outlook.com

dbrown@wiltonrancheria-nsn.gov
Remote server returned '554 5.2.2 mailbox full; STOREDRV.Deliver.Exception:QuotaExceededException.
MapiExceptionShutoffQuotaExceeded; Failed to process message due to a permanent exception with message
[BeginDiagnosticData]The process failed to get the correct properties. 1.84300:01000000, 1.84300:02000000,
1.84300:9F000000, 1.84300:A1000000, 1.84300:01000000, 1.84300:08000000, 1.116652:9A000000,
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7.29832:000000800C0000000F010480, 4.45884:DD040000, 4.29880:DD040000, 4.59420:DD040000, 7.40840:
010000000000010C7A000100, 8.45434:ECEB1FA29AC8704FAD383A15C79D009B7A000100, 1.46798:04000000,
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0.100684:00000000, 4.70028:DD040000, 1.52466:01000000, 0.60402:5C000000, 1.52466:01000000[
EndDiagnosticData] [Stage: CreateMessage]'

Original message headers:

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Received: from CH0PR03CA0331.namprd03.prod.outlook.com (2603:10b6:610:11a::22)
 by PH7PR10MB6353.namprd10.prod.outlook.com (2603:10b6:510:1b4::7) with
 Microsoft SMTP Server (version=TLS1_2,
 cipher=TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384) id 15.20.7939.14; Tue, 10 Sep
 2024 21:34:13 +0000
Received: from CH1PEPF0000A34C.namprd04.prod.outlook.com
 (2603:10b6:610:11a:cafe::60) by CH0PR03CA0331.outlook.office365.com
 (2603:10b6:610:11a::22) with Microsoft SMTP Server (version=TLS1_2,
 cipher=TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384) id 15.20.7939.24 via Frontend
 Transport; Tue, 10 Sep 2024 21:34:13 +0000
Authentication-Results: spf=pass (sender IP is 209.85.218.49)
 smtp.mailfrom=bcrcllc.com; dkim=pass (signature was verified)
 header.d=bcrcllc.com;dmarc=bestguesspass action=none
 header.from=bcrcllc.com;compauth=pass reason=109
Received-SPF: Pass (protection.outlook.com: domain of bcrcllc.com designates
 209.85.218.49 as permitted sender) receiver=protection.outlook.com;
 client-ip=209.85.218.49; helo=mail-ej1-f49.google.com; pr=C
```

```
Received: from mail-ej1-f49.google.com (209.85.218.49) by
 CH1PEPF0000A34C.mail.protection.outlook.com (10.167.244.6) with Microsoft
 SMTP Server (version=TLS1_3, cipher=TLS_AES_256_GCM_SHA384) id 15.20.7918.13
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Date: Tue, 10 Sep 2024 14:33:59 -0700
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 Mitigation Project
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Content-Type: multipart/mixed; boundary="00000000000046f0a80621caa266"
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---------- Forwarded message ----------
From: Joseph Orozco <josepho@bcrcllc.com>
To: Joseph Orozco <josephorozco513@gmail.com>
Cc:
Bcc: dbrown@wiltonrancheria-nsn.gov
Date: Tue, 10 Sep 2024 14:33:59 -0700
Subject: BCR Tribal Scoping for the Stanislaus Elementary School 123-TCP Mitigation Project

You don't often get email from josepho@bcrcllc.com. Learn why this is important

The City of Modesto Public Works and Stanislaus County are proposing improvements to water and sewer alignments for Stanislaus Elementary School as part of the Stanislaus Elementary School 1, 2, 3-TCP Mitigation Project (Project). The project proposes to extend potable water from the City of Modesto, and the installation of new sewer mains. The Project is located within the City of Modesto (City) and in portions of unincorporated Stanislaus County (County). The area of potential effects (APE) is within the Salida, California (1987) 7.5' United States Geographical Survey (USGS) topographic quadrangle. The APE occupies an east/west oriented alignment between Sections 1 (Township 3 South, Range 8 East) and 36 (Township 2 South, Range 8 East), and Sections 6 (Township 3 South, Range 9 East) and 31 (Township 2 South, Range 9 East), Mt. Diablo Base and Meridian (Figure 1).

Work on the project would include open trench construction as well as jack and bore construction for the installment of the entire project alignment. A total of 11,897 linear feet of project alignment consisting of approximately 1.1 acres will be trenched. Disturbances related to trench work are anticipated to be four-feet wide and eight-feet deep. Jack and bore construction will consist of not more than a total of five jack and bore locations, each including two pits, one entry (jacking), and one exit pit. Jacking pits are approximately 12-feet wide by 10-feet long by 15-feet deep and receiving pits are approximately 12-feet wide by 204-feet long by 15-feet deep, resulting in approximately 0.03 acres of disturbance. Earthwork quantities are approximately 3,348 cubic yards of export and 4,680 cubic yards of imported soil is anticipated.

The City may apply for State Revolving Fund (SRF) Program funding from the California State Water Resources Control Board (State Water Board) to assist in financing the Project. The SRF Program is partially funded by the United States Environmental Protection Agency (USEPA). The State Water Board, Division of Financial Assistance, administers the SRF Program pursuant to 40 Code of Federal Regulations Part 35. Issuance of SRF Program funding by the State Water Board is considered equivalent to a federal action, thereby necessitating compliance with Section 106 of the National Historic Preservation Act (Section 106). The USEPA has delegated certain responsibilities under Section 106 to the State Water Board.

In anticipation of potentially applying for SRF Program funding, and as part of the environmental compliance for the project, your Tribe has been identified as one that might attach religious and cultural significance to historic properties in the APE. We are seeking your assistance with the identification of sites of religious and cultural significance. Your participation in the early identification of cultural resources will ensure their consideration during the project planning phase. We welcome your recommendations regarding appropriate management or treatment of resources that occur within the project area. Please note that this outreach does not constitute consultation as required under Section 106. The State Water Board will initiate consultation with your Tribe if the Project may receive SRF Program funding.

If you have questions, need additional information, or wish to comment, please contact me at the address provided below, or call me at 909-455-8531 or email at josepho@bcrcllc.com.

Joseph Orozco, M.A., RPA
Project Manager/Archaeologist

BCR Consulting LLC
1274 North Yale Avenuef
Claremont, CA 91711
(909) 455-8531

www.bcrconsulting.net



ARD2302_Fig1.jpg
1012K

Gmail

Joseph Orozco <josepho@bcrcllc.com>

BCR Tribal Scoping for the Stanislaus Elementary School 123-TCP Mitigation Project

2 messages

Joseph Orozco <josepho@bcrcllc.com> Tue, Sep 10, 2024 at 2:42 PM
To: Joseph Orozco <josepho@bcrcllc.com>
Bcc: neil.peyron@tulerivertribe-nsn.gov, joey.garfield@tulerivertribe-nsn.gov, kerri.vera@tulerivertribe-nsn.gov

The City of Modesto Public Works and Stanislaus County are proposing improvements to water and sewer alignments for Stanislaus Elementary School as part of the Stanislaus Elementary School 1, 2, 3-TCP Mitigation Project (Project). The project proposes to extend potable water from the City of Modesto, and the installation of new sewer mains. The Project is located within the City of Modesto (City) and in portions of unincorporated Stanislaus County (County). The area of potential effects (APE) is within the Salida, California (1987) 7.5' United States Geographical Survey (USGS) topographic quadrangle. The APE occupies an east/west oriented alignment between Sections 1 (Township 3 South, Range 8 East) and 36 (Township 2 South, Range 8 East), and Sections 6 (Township 3 South, Range 9 East) and 31 (Township 2 South, Range 9 East), Mt. Diablo Base and Meridian (Figure 1).

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If you have questions, need additional information, or wish to comment, please contact me at the address provided below, or call me at 909-455-8531 or email at josepho@bcrcllc.com.

Joseph Orozco, M.A., RPA
Project Manager/Archaeologist

BCR Consulting LLC
1274 North Yale Avenue
Claremont, CA 91711
(909) 455-8531
www.bcrconsulting.net

Mail Delivery Subsystem <mailer-daemon@googlemail.com> Tue, Sep 10, 2024 at 2:42 PM
To: josepho@bcrcllc.com



Message blocked

Your message to **joey.garfield@tulerivertribe-nsn.gov** has been blocked. See technical details below for more information.

The response from the remote server was:

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550 permanent failure for one or more recipients (joey.garfield@tulerivertribe-nsn.gov:550 5.4.1
Recipient address rejected: Access denied. [CH1PEPF0000AD7E.namprd04.p...)
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Action: failed
Status: 4.4.2
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server for the domain tulerivertribe-nsn.gov.)
Diagnostic-Code: smtp; 550 permanent failure for one or more recipients (joey.garfield@tulerivertribe-nsn.gov:550
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Last-Attempt-Date: Tue, 10 Sep 2024 14:42:55 -0700 (PDT)

---------- Forwarded message ----------
From: Joseph Orozco <josepho@bcrcllc.com>
To: Joseph Orozco <josepho@bcrcllc.com>
Cc:
Bcc: joey.garfield@tulerivertribe-nsn.gov
Date: Tue, 10 Sep 2024 14:42:41 -0700
Subject: BCR Tribal Scoping for the Stanislaus Elementary School 123-TCP Mitigation Project
----- Message truncated -----

Tracking Table for Section 106 Tribal and Additional Party Coordination Correspondence for the Stanislaus Elementary School 123-TCP Mitigation Project, City of Modesto and Unincorporated Stanislaus County, California

Native American Heritage Commission replied to BCR Consulting Request on November 29, 2023. Results of Sacred Land File Search were negative and recommended that the entities below be contacted.

Group Affiliation	Individual Contacted	Letter Email Date	Follow-Up Phone Calls and Responses
Calaveras Band of Mi-Wuk Indians	Gloria Grimes, Chairperson	9/10/2024	Ms. Grimes was called on September 11, 2024. The phone number provided by the NAHC is no longer in service.
Calaveras Band of Mi-Wuk Indians - Grimes	Debra Grimes, Cultural Resources Specialist	9/10/2024	Ms. Grimes was contacted by phone on September 11, 2024. The voicemail box was full and BCR was unable to leave a voicemail.
California Valley Miwok Tribe	AKA Sheep Rancheria of Me-Wuk Indians of CA	9/10/2024	A voicemail was left on September 11, 2024, and as of October 7, 2024, no one has responded.
Confederated Villages of Lisjan Nation	Corrina Gould, Chairperson	9/10/2024	Lucy Gill responded by email and stated that the project is not in traditional Lisjan Territory. They will defer to affiliated tribes.
Confederated Villages of Lisjan Nation	Deja Gould, Language Program Manager	9/10/2024	Lucy Gill responded by email and stated that the project is not in traditional Lisjan Territory. They will defer to affiliated tribes.
Confederated Villages of Lisjan Nation	Cheyenne Gould, Tribal Cultural Resource Manager	9/10/2024	Lucy Gill responded by email and stated that the project is not in traditional Lisjan Territory. They will defer to affiliated tribes.
North Valley Yokuts Tribe	John Murga, Tribal Historian	9/10/2024	A voicemail was left on September 11, 2024. No call has been returned as of October 7, 2024.
North Valley Yokuts Tribe	Jessica Murga, Tribal Secretary	No email was listed	A voicemail was left on September 11, 2024. No call has been returned as of October 7, 2024.
North Valley Yokuts Tribe	Timothy Perez, Tribal Compliance Officer	9/10/2024	A voicemail was left on September 11, 2024. No call has been returned as of October 7, 2024.
North Valley Yokuts Tribe	Erolinda Perez, Tribal Administrator	9/10/2024	A voicemail was left on September 11, 2024. No call has been returned as of October 7, 2024.
Southern Sierra Miwuk Nation	Sandra Chapman, Chairperson	9/10/2024	A phone call was attempted on September 11, but the call hangs up automatically.
Tule River Indian Tribe	Neil Peyron, Chairperson	9/10/2024	A voicemail was left on September 11, 2024. No call has been returned as of October 7, 2024.
Tule River Indian Tribe	Joey Garfield, Tribal	9/10/2024	A phone call was attempted on September 11, 2024. There

Group Affiliation	Individual Contacted	Letter Email Date	Follow-Up Phone Calls and Responses
	Archaeologist		was no answer or voicemail option.
Tule River Indian Tribe	Kerri Vera, Environmental Dept.	9/10/2024	A phone call was attempted on September 11, 2024. There was no answer or voicemail option.
Wilton Rancheria	Cultural Preservation Dept.	9/10/2024	A voicemail was left on September 11, 2024. No call has been returned as of October 7, 2024.
Wilton Rancheria	Dahlton Brown, Executive Director of Administration	9/10/2024	A voicemail was left on September 11, 2024. No call has been returned as of October 7, 2024.
Wilton Rancheria	Herbert Griffin, Executive Director of Cultural Preservation	9/10/2024	A voicemail was left on September 11, 2024. No call has been returned as of October 7, 2024.
Wuksachi Indian Tribe/Eshom Valley Band	Kenneth Woodrow, Chairperson	9/10/2024	A phone call was attempted on September 11, 2024. There was no answer.

McHenry Museum

McHenry Museum	info@mchenrymuseum.org	10/7/2024	A voicemail was left on September 11, 2024. No call has been returned as of October 7, 2024.

Gmail

Joseph Orozco <josepho@bcrcllc.com>

BCR Tribal Scoping for the Stanislaus Elementary School 123-TCP Mitigation Project

Lisjan Nation <cvltribe@gmail.com> Tue, Sep 24, 2024 at 8:00 PM
To: Joseph Orozco <josepho@bcrcllc.com>

Joseph,

Thank you for your email. This project does not land in our traditional territory. We will defer to any affiliated Tribal Nations.

'Uni (Respectfully),

Lucy Gill, Cultural Resource Manager II
Confederated Villages of Lisjan Nation

[Quoted text hidden]

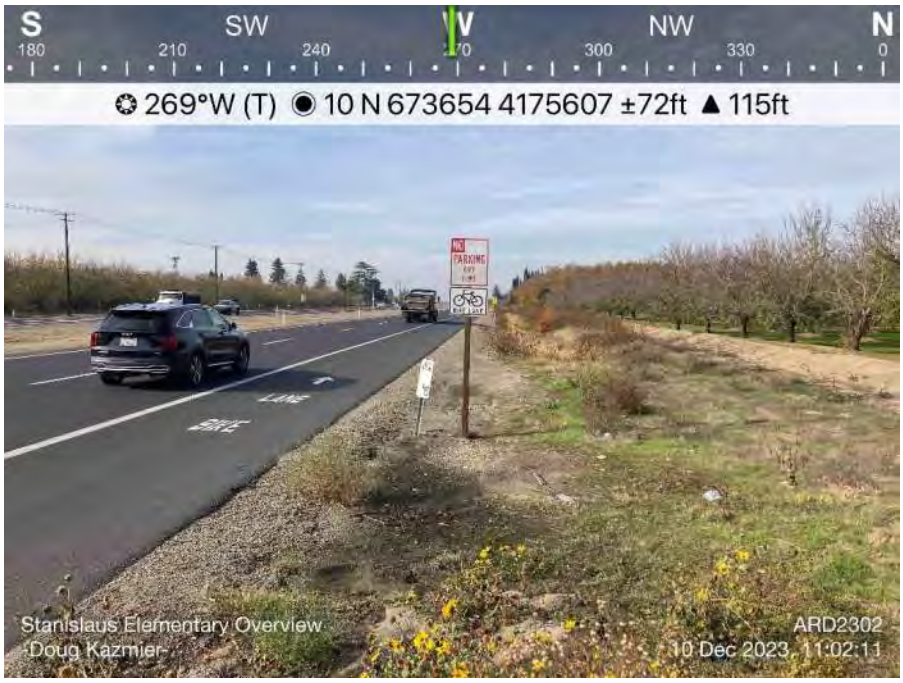
APPENDIX C

PHOTOGRAPHS


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184°S (T) 10 N 675138 4175347 ±13ft 98ft
Tully Road Overview
-Doug Kazmier-
ARD2302
10 Dec 2023, 10:44:31


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252°W (T) 10 N 674987 4175666 ±13ft 85ft
Kiernan Overview
-Doug Kazmier-
ARD2302
10 Dec 2023, 10:50:11


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98°E (T) 10 N 673706 4175601 ±29ft ▲114ft
Stanislaus Elementary Overview
-Doug Kazmier-
ARD2302
10 Dec 2023, 10:56:13


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Stanislaus Elementary Overview
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ARD2302
10 Dec 2023, 11:02:11


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263°W (T) 10 N 672429 4175624 ±26ft 122ft
Kiernan Overview
-Doug Kazmier-
ARD2302
10 Dec 2023, 11:06:33


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Kiernan & Dale Overview
-Doug Kazmier-
ARD2302
10 Dec 2023, 11:14:32

APPENDIX D (CONFIDENTIAL)

APE AERIAL VIEW WITH CULTURAL RESOURCES LOCATIONS

PROVIDED UPON REQUEST UNDER SEPARATE COVER

CULTURAL RESOURCES ASSESSMENT

Stanislaus Elementary School 1, 2, 3-TCP Mitigation Project
Modesto and Unincorporated Stanislaus County, California

Prepared for:

Lori Trottier
Ardurra
3737 Birch Street, Suite 250
Newport Beach, California 92660

Prepared by:

David Brunzell, M.A., RPA
Contributions by Doug Kazmier, B.A., PGC, and Nicholas Shepetuk, B.A.
BCR Consulting LLC
Claremont, California 91711

Project No. ARD2302

Data Base Information:

Type of Study: Cultural Resources Assessment
Resources Recorded: None
Keywords: Stanislaus County, Modesto, Stanislaus School
USGS Quadrangle: 7.5-minute *Salida, California* (1987)

BCRCONSULTING LLC

December 14, 2023

MANAGEMENT SUMMARY

BCR Consulting LLC (BCR Consulting) is under contract to Ardurra to conduct a Cultural Resources Assessment of the Stanislaus Elementary 1, 2, 3-TCP Mitigation Project (the project) located in the City of Modesto and unincorporated portions of Stanislaus County, California. The work is being performed pursuant to the California Environmental Quality Act (CEQA). A cultural resources records search, additional research, field survey, Sacred Lands File Search with the Native American Heritage Commission (NAHC), and paleontological overview were conducted for the effort. The records search revealed that 11 cultural resource studies have taken place resulting in 13 cultural resources recorded within a one-half mile radius of the project alignment. Four studies have taken place within the project alignment, and no cultural resources have been identified within its boundaries.

During the field survey, BCR Consulting archaeologists did not identify any cultural resources within the project area. Based on these results, BCR Consulting recommends that the project as proposed will not result in an adverse effect to any historical resources under CEQA. No further cultural resource work or monitoring is recommended.

While the current study has not indicated sensitivity for buried cultural resources within the project alignment, ground disturbing activities always have the potential to reveal buried deposits not observed on the surface during previous surveys. Prior to the initiation of ground-disturbing activities, field personnel should be alerted to the possibility of buried prehistoric or historic cultural deposits. In the event that field personnel encounter buried cultural materials, work in the immediate vicinity of the find should cease and a qualified archaeologist should be retained to assess the significance of the find. The qualified archaeologist shall have the authority to stop or divert construction excavation as necessary. If the qualified archaeologist finds that any cultural resources present meet eligibility requirements for listing on the California Register or the National Register, plans for the treatment, evaluation, and mitigation of impacts to the find will need to be developed. Prehistoric or historic cultural materials that may be encountered during ground-disturbing activities include:

- historic artifacts such as glass bottles and fragments, cans, nails, ceramic and pottery fragments, and other metal objects;
- historic structural or building foundations, walkways, cisterns, pipes, privies, and other structural elements;
- prehistoric flaked-stone artifacts and debitage (waste material), consisting of obsidian, basalt, and or cryptocrystalline silicates;
- groundstone artifacts, including mortars, pestles, and grinding slabs;
- dark, greasy soil that may be associated with charcoal, ash, bone, shell, flaked stone, groundstone, and fire affected rocks.

Findings were negative during the Sacred Lands File search with the NAHC. The results of the Sacred Lands File search are provided in Appendix B. Assembly Bill (AB) 52 Native American Consultation will be initiated by the SSJID. Therefore, the results are not included in this report. However, report results may be shared with participating tribes as necessary. The Legislature added requirements regarding tribal cultural resources for CEQA in Assembly Bill 52 (AB 52) that took effect July 1, 2015. AB 52 requires consultation with

California Native American tribes and consideration of tribal cultural resources in the CEQA process. By including tribal cultural resources early in the CEQA process, the legislature intended to ensure that local and Tribal governments, public agencies, and project proponents would have information available, early in the project planning process, to identify and address potential adverse impacts to tribal cultural resources. By taking this proactive approach, the legislature also intended to reduce the potential for delay and conflicts in the environmental review process. To help determine whether a project may have such an effect, the Public Resources Code requires a lead agency to consult with any California Native American tribe that requests consultation and is traditionally and culturally affiliated with the geographic area of a Proposed Project. The SSJID would initiate and carry out the required AB52 Native American Consultation, although this report may be used during the consultation process and BCR Consulting staff is available to answer questions and address concerns as necessary.

According to CEQA Guidelines, projects subject to CEQA must determine whether the project would "directly or indirectly destroy a unique paleontological resource". The Paleontological Overview provided in Appendix D has recommended that:

> The geologic units underlying the project area are mapped as alluvial deposits dating from the Quaternary - specifically, the Pleistocene Modesto Formation (Rapp et al. 1977, A mineral land classification study of the Stanislaus River area, San Joaquin and Stanislaus counties, California). Quaternary alluvial units are considered to be fossiliferous and highly paleontologically sensitive. The Western Science Center does not have any fossil localities within the project area nor within a one-mile radius. However, Quaternary alluvial units throughout California have produced large quantities of fossils, such as the extensive collection from Diamond Valley Lake housed at Western Science Center.
>
> Any fossil specimens recovered from the project would be scientifically significant. Excavation activity associated with the development of the project area would impact the paleontologically sensitive Quaternary units, and it is the recommendation of the Western Science Center that a paleontological resource mitigation program be put in place to monitor, salvage, and curate any recovered fossils from the study area.

If human remains are encountered during the undertaking, State Health and Safety Code Section 7050.5 states that no further disturbance shall occur until the County Coroner has made a determination of origin and disposition pursuant to Public Resources Code Section 5097.98. The County Coroner must be notified of the find immediately. If the remains are determined to be prehistoric, the Coroner will notify the Native American Heritage Commission (NAHC), which will determine and notify a Most Likely Descendant (MLD). With the permission of the landowner or his/her authorized representative, the MLD may inspect the site of the discovery. The MLD shall complete the inspection within 48 hours of notification by the NAHC.

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B: NAHC SACRED LANDS FILE SEARCH
C: PHOTOGRAPHS
D: PALEONTOLOGICAL OVERVIEW

INTRODUCTION

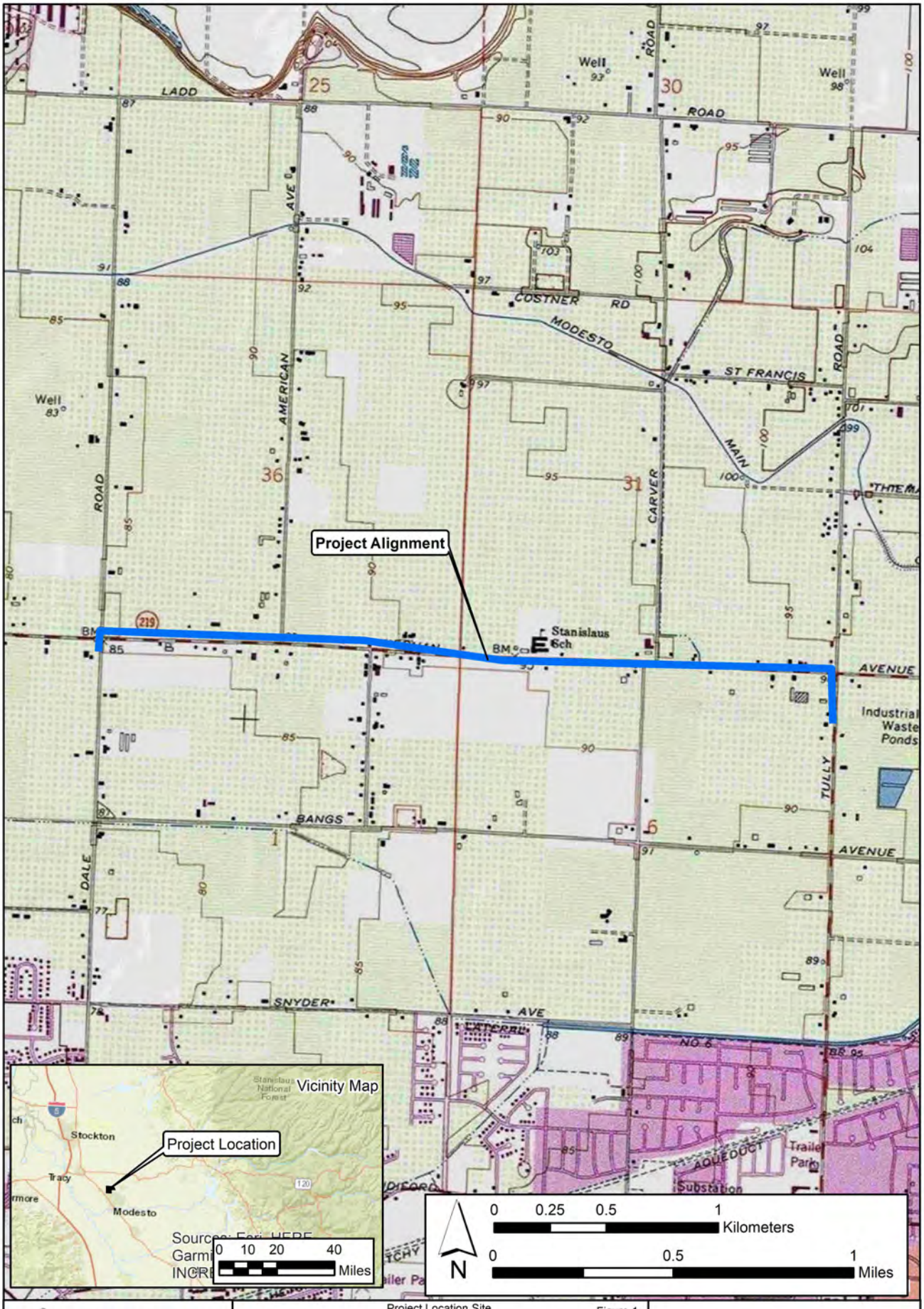
BCR Consulting LLC (BCR Consulting) is under contract to Ardurra to conduct a Cultural Resources Assessment of the Stanislaus Elementary 1, 2, 3-TCP Mitigation Project (the project) in the City of Modesto and unincorporated Stanislaus County, California. The work is being performed pursuant to the California Environmental Quality Act (CEQA). Tasks completed for the scope of work include a cultural resource records search, additional research, intensive pedestrian cultural resource survey, Sacred Lands File search with the Native American Heritage Commission, and paleontological resources overview. The project site occupies an east/west oriented alignment between Sections 1 (Township 3 South, Range 8 East) and 36 (Township 2 South, Range 8 East), and Sections 6 (Township 3 South, Range 9 East) and 31 (Township 2 South, Range 9 East) Mt. Diablo Base and Meridian. The alignment continues briefly south before terminating on Dale Road at the western end and continues briefly south before terminating on Tully Road at the eastern end. It is depicted on the United States Geological Survey (USGS) *Salida, California* (1987) 7.5-minute topographic quadrangle (Figure 1).

Regulatory Setting

The California Environmental Quality Act. CEQA applies to all discretionary projects undertaken or subject to approval by the state's public agencies (California Code of Regulations 14(3), § 15002(i)). Under CEQA, "A project with an effect that may cause a substantial adverse change in the significance of a historical resource is a project that may have a significant effect on the environment" (Cal. Code Regs. tit. 14(3), § 15064.5(b)). State CEQA Guidelines section 15064.5(a) defines a "historical resource" as a resource that meets one or more of the following criteria:

- Listed in, or eligible for listing in, the California Register of Historical Resources (California Register)
- Listed in a local register of historical resources (as defined at Cal. Public Res. Code § 5020.1(k))
- Identified as significant in a historical resource survey meeting the requirements of § 5024.1(g) of the Cal. Public Res. Code
- Determined to be a historical resource by a project's lead agency (Cal. Code Regs. tit. 14(3), § 15064.5(a))

A historical resource consists of "Any object, building, structure, site, area, place, record, or manuscript which a lead agency determines to be historically significant or significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, military, or cultural annals of California…Generally, a resource shall be considered by the lead agency to be 'historically significant' if the resource meets the criteria for listing in the California Register of Historical Resources" (Cal. Code Regs. tit. 14(3), § 15064.5(a)(3)). The significance of a historical resource is impaired when a project demolishes or materially alters in an adverse manner those physical characteristics of a historical resource that convey its historical significance and that justify its eligibility for the California Register. If an impact on a historical or archaeological resource is significant, CEQA requires feasible measures to minimize the impact (State CEQA Guidelines § 15126.4 (a)(1)). Mitigation of



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Claremont Napa Tehachapi
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Project Location Site
Stanislaus Elementary School 123-TCP Mitigation Project
Figure 1

Reference: ESRI; USGS Quad: Salida (1987), California

Ardurra

significant impacts must lessen or eliminate the physical impact that the project will have on the resource.

Section 5024.1 of the Cal. Public Res. Code established the California Register. Generally, resource is considered by the lead agency to be "historically significant" if the resource meets the criteria for listing in the California Register (Cal. Code Regs. tit. 14(3), § 15064.5(a)(3)). The eligibility criteria for the California Register are similar to those of the National Register of Historic Places (National Register), and a resource that meets one or more of the eligibility criteria of the National Register will be eligible for the California Register.

The California Register program encourages public recognition and protection of resources of architectural, historical, archaeological, and cultural significance, identifies historical resources for state and local planning purposes, determines eligibility for state historic preservation grant funding and affords certain protections under CEQA. Criteria for Designation:

1. Associated with events that have made a significant contribution to the broad patterns of local or regional history or the cultural heritage of California or the United States.
2. Associated with the lives of persons important to local, California or national history.
3. Embodies the distinctive characteristics of a type, period, region or method of construction or represents the work of a master or possesses high artistic values.
4. Has yielded, or has the potential to yield, information important to the prehistory or history of the local area, California or the nation.

In addition to meeting one or more of the above criteria, the California Register requires that sufficient time has passed since a resource's period of significance to "obtain a scholarly perspective on the events or individuals associated with the resources." (CCR 4852 [d][2]). Fifty years is normally considered sufficient time for a potential historical resource, and in order that the evaluation remain valid for a minimum of five years after the date of this report, all resources older than 45 years (i.e. resources from the "historic-period") will be evaluated for California Register listing eligibility, or CEQA significance. The California Register also requires that a resource possess integrity. This is defined as the ability for the resource to convey its significance through seven aspects: location, setting, design, materials, workmanship, feeling, and association.

Finally, CEQA requires that significant effects on unique archaeological resources be considered and addressed. CEQA defines a unique archaeological resource as any archaeological artifact, object, or site about which it can be clearly demonstrated that, without merely adding to the current body of knowledge, there is a high probability that it meets any of the following criteria:

1. Contains information needed to answer important scientific research questions and there is a demonstrable public interest in that information.

2. Has a special and particular quality such as being the oldest of its type or the best available example of its type.
3. Is directly associated with a scientifically recognized important prehistoric or historic event or person.

CEQA Guidelines Section 15064.5 Appendix G includes significance criteria relative to archaeological and historical resources. These have been utilized as thresholds of significance here, and a project would have a significant environmental impact if it would:

a) cause a substantial adverse change in the significance of a historical resource as defined in section 10564.5;
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to Section 10564.5;
c) Disturb any human remains, including those interred outside of formal cemeteries.

Tribal Cultural Resources. The Legislature added requirements regarding tribal cultural resources for CEQA in Assembly Bill 52 (AB 52) that took effect July 1, 2015. AB 52 requires consultation with California Native American tribes and consideration of tribal cultural resources in the CEQA process. By including tribal cultural resources early in the CEQA process, the legislature intended to ensure that local and Tribal governments, public agencies, and project proponents would have information available, early in the project planning process, to identify and address potential adverse impacts to tribal cultural resources. By taking this proactive approach, the legislature also intended to reduce the potential for delay and conflicts in the environmental review process. To help determine whether a project may have such an effect, the Public Resources Code requires a lead agency to consult with any California Native American tribe that requests consultation and is traditionally and culturally affiliated with the geographic area of a Proposed Project. Since the City will initiate and carry out the required AB52 Native American Consultation, the results of the consultation are not provided in this report. However, this report may be used during the consultation process, and BCR Consulting staff are available to answer questions and address comments as necessary.

Paleontological Resources. CEQA provides guidance relative to significant impacts on paleontological resources, indicating that a project would have a significant impact on paleontological resources if it disturbs or destroys a unique paleontological resource or site or unique geologic feature. Section 5097.5 of the California Public Resources Code specifies that any unauthorized removal of paleontological remains is a misdemeanor. Further, California Penal Code Section 622.5 sets the penalties for damage or removal of paleontological resources. CEQA documentation prepared for projects would be required to analyze paleontological resources as a condition of the CEQA process to disclose potential impacts. Please note that as of January 2018 paleontological resources are considered in the geological rather than cultural category. Therefore, paleontological resources are not summarized in the body of this report. A paleontological overview completed by the Western Science Center is provided as Appendix D.

NATURAL SETTING

The elevation of the project alignment ranges from approximately 86 to 95 feet above mean sea level (AMSL). The property has been subject to disturbances related to road construction and maintenance, drainage infrastructure, and agricultural activities. Local geologic units include alluvial Quaternary deposits of the Pleistocene Modesto Formation (see Appendix D). These deposits do not appear to be a source of prehistoric tool materials. The region is characterized by a Mediterranean climate with relatively dry summers and mild winters. Annual rainfall averages approximately 14.06 inches, and typically occurs in the form of fall and winter storms and showers. The nearest local fresh water source is the Stanislaus River, which flows from west to east approximately two miles north of the project site (USGS 1987). Very little native vegetation remains locally intact due to intensive agricultural and other developments. Historically, Valley Grassland and Oak Woodland communities dominated local vegetation. Signature native and non-native species associated with each habitat are summarized below in Table A (see also Williams et al. 2009: 375, 453). For prehistoric use of many of the local native species see Lightfoot and Parrish 2009.

Table A. Local Vegetation Communities

Habitat	Plant Species	Animal Species
Valley Grassland	Beardless Wildrye, Blue Wildrye, Deergrass, Foothill Bluegrass, Needlegrass, Three-Awn Grass, Baby Blue-Eyes, Big Tarweed, Blue Dicks, California Jewelflower, California Poppy, Clover, Goldfields, Lupine, Mariposa Lily, Pitgland Tarweeed, Purple Owl's Clover, Tidytips, Wild Onion	Burrow Owl, Ferruginous Hawk, Horned Lark, Long-Billed Curlew, Northern Harrier, Sandhill Crane, Swainson's Hawk, Western Kingbird, Western Meadowlark, American Badger, California Ground Squirrel, California Pocket Mouse, Cottontail Rabbit, Giant Kangaroo Rat, Heermann's Kangaroo Rat, Pronghorn Antelope, Kit Fox, Tule Elk, Pocket Gopher, Leopard Lizard, Gopher Snake, Rattlesnake
Oak Woodland	Black Oak, Blue Oak, Buckeye, California Bay, Canyon Live Oak, Coast Live Oak, Engelmann Oak, Interior Live Oak, Oregon Oak, Valley Oak, Coffeeberry, Toyon, Blue Dicks	Mule deer, Western Grey Squirrel, Deer Mouse, Wood Rat, Northern Flicker, Scrub Jay, Ash-throated Flycatcher, Western Kingbird, White-breasted Nuthatch.

CULTURAL SETTING

Prehistory

Similar to most of western North America, human groups commenced regional settlement between 9,000-11,500 years before present. Humans proliferated globally during this era due to gradual environmental warming that marked the close of the last ice age. Changes in settlement patterns and subsistence focus are widely cited as adaptations to the new conditions and have been organized into a number of chronological frameworks for the region (see Moratto 1984; Heizer 1978; and others).

Ethnography

The project sites are situated within the traditional boundaries of the Northern Valley Yokuts. This prehistoric population depended heavily on the San Joaquin River and its connecting sloughs and rivers for sustenance and transportation. Little ethnographic information is available for the local Northern Valley Yokuts, due to missionization and disease soon after

European contact, and to the influx of miners in the 1850s (Wallace 1978:462). Trade routes and rights to riverine resources allowed the Northern Valley Yokuts to reap the benefits of the numerous perennial water sources allowing local populations to pursue a sedentary lifestyle in an otherwise arid climate. Prehistorically, such sedentism often coincides with a village-style residential model in which residential bases remain the same or seasonal, while specialized procurement parties are deployed to more remote areas to collect specialized resources (Binford 1980, Thomas 1983). This village model has been locally supported by early ethnographers, who considered Yokuts unique in California for forming "true tribes" and for developing an unparalleled array of dialects (Kroeber 1925:474).

History

The first Europeans to establish contact with the Yokuts were Spanish troops led by Captain Don Pedro Fages in pursuit of deserters. Father Francisco Garces also travelled through the San Joaquin Valley searching for an overland route from Yuma to Monterey. During his travels, Garces noted positive interactions with locals (see Smith 1939, Bailey 1984). The Mexican era (1821-1848) saw little notable cultural exchange between Mexicans and Yokuts, although an 1833 malaria epidemic devastated the local native population (Wallace 1978:460). The American era, punctuated by California's annexation into the United States in 1848, resulted in overwhelming Anglo settlement which disrupted local Yokut influence. Mining and ranching represented the early historical focus of the San Joaquin Valley, although abundant natural water, a mild climate, and arable land soon led to the successful development of agriculture. The resulting diversion of local water and escalating land values transformed the physical and economic character of the area, and has allowed it to remain one of the world's most productive agricultural regions to this day (Preston 1981).

Salida. The project site is near the unincorporated rural community known as Salida, north of Modesto on Highway 99. The original settlement was known as Murphy's Ferry, established and operated by John Murphy from 1867 until the arrival of the Central Pacific Railroad in 1870. A year later Murphy built a warehouse and a sidetrack was installed for shipping grain. This was called Murphy's Switch. In 1875, the community was granted a post office, but a new name had to be chosen because there already was a Murphy's post office in Calaveras County. A Spanish word, "Salida", meaning exit, was chosen and this implied that the new town was "near the water", it being the closest town to the south bank of the Stanislaus River (Stanislaus County 2020).

Modesto. Modesto was founded in 1870, shortly after the establishment of the railroad connecting Sacramento to Los Angeles. A co-founder of Central Pacific Railroad suggested it be named after their banking associate William C. Ralston, who refused the honor. A railroad employee was overheard in Spanish calling Ralston a modest man, and thus the name Modesto came to reflect his modesty. The population exceeded 1,000 residents in 1884, and 4,500 by the turn of the twentieth century. The region became a major grower and supplier of foodstuffs for allied forces during World War II. In the following decades, Modesto's population would continue to grow by about two percent annually, surpassing 100,000 in 1980 and eventually 200,000 by 2001 (Modesto Irrigation District 1987).

PERSONNEL

David Brunzell, M.A., RPA acted as the Project Manager and Principal Investigator, provided project oversight, and authored the technical report with contributions from BCR Consulting Staff Archaeologist Doug Kazmier, B.A., PGC and BCR Consulting Archaeological Crew Chief Nicholas Shepetuk, B.A. Central California Information Center (CCIC) staff completed the cultural resources records search through its archive at California State University, Stanislaus. Mr. Kazmier completed the field survey.

METHODS

This work was completed pursuant to CEQA, the Public Resources Code (PRC) Chapter 2.6, Section 21083.2, and California Code of Regulations (CCR) Title 14, Chapter 3, Article 5, Section 15064.5. The pedestrian cultural resources survey was intended to locate and document previously recorded or new cultural resources, including archaeological sites, features, isolates, and historic-period buildings, that exceed 45 years in age within defined project boundaries. The project site was inspected using 15 meter transect intervals on either side of the alignment.

This study is intended to determine whether cultural resources are located within the project alignment, whether any cultural resources are significant pursuant to the above-referenced regulations and standards, and to develop specific mitigation measures that will address potential impacts to existing or potential resources. Tasks pursued to achieve that end include:

- Cultural resources records search to review any studies conducted and the resulting cultural resources recorded within a one half-mile radius of the project alignment
- Systematic pedestrian survey of the entire project alignment
- Development of recommendations and mitigation measures following CEQA
- Vertebrate paleontology resources report through Professional Paleontologists of the Western Science Center in Hemet, California.

Research

Records Search. An archaeological records search was conducted by the CCIC on November 7, 2023. This included a review of all recorded historic and prehistoric cultural resources, as well as a review of known cultural resources, and survey and excavation reports generated from projects located within one half-mile of the project alignment. In addition, a review was conducted of the National Register of Historic Places (National Register), the California Register of Historical Resources (California Register), and documents and inventories from the California Office of Historic Preservation including the lists of California Historical Landmarks, California Points of Historical Interest, Listing of National Register Properties, and the Built Environment Resources Directory (BERD).

Field Survey

An intensive-level cultural resources field survey of the project alignment was conducted on December 10th, 2023. The survey was conducted by walking parallel transects spaced approximately 15 meters apart along both sides of the project alignment. Digital

photographs were taken at various points within the project alignment. These included overviews as well as detail photographs of all cultural resources. Cultural resources were recorded per the California OHP *Instructions for Recording Historical Resources* in the field using:

- Hand-held Global Positioning systems for mapping purposes
- Digital photography of all cultural resources (see Appendix C).

RESULTS

Research

Records Search. Data from the CCIC revealed that 11 cultural resource studies have taken place resulting in 13 cultural resources recorded within a one half-mile radius of the project alignment. Four of these studies has taken place within the project alignment, and no resources have been previously recorded within its boundaries. The records search results are summarized in Table B. Bibliographic details and records search maps are provided in Confidential Appendix A.

Table B. Cultural Resources and Reports Within One-Half Mile of the Project Alignment

USGS 7.5 Min Quad	Cultural Resources Within One Half-Mile of Project Alignment	Studies Within One-Half Mile
Salida, California (1987)	P-50-0075: MID Lateral No. 6 (0.5 Miles SSE) P-50-1918: Bangs #1 (0.35 Miles SW) P-50-1925: Chappell Ditch (Adjacent North) P-50-2002: Modesto Main/La Grange MID Old Canal (0.25 Miles N) P-50-2024: Fluence Property (0.3 Miles E) P-50-2025: 5024 Tunson Rd., Modesto (0.3 Miles E) P-50-2026: 907 Kiernan Rd. (SR 219), Modesto (0.3 Miles E) P-50-2165: Essa Property (Adjacent W) P-50-2166: Kumar Property (0.2 Miles N) P-50-2167: Harrell Property (0.2 Miles N) P-50-2259: 10-STA-219 EA (Adjacent S) P-50-2260: 1348 Kiernan Ave. (Adjacent S) P-50-2301: 1349 Bangs Ave. (0.4 Miles S)	ST-3697*, 3879, 4054*, 4749, 4829, 5470, 5900, 6306, 7244*, 7725, 8007*

*Occurred Within Project Area

Field Survey

During the field survey Mr. Kazmier carefully inspected the entirety of the project alignment for both prehistoric and historic-period cultural resources. No cultural resources (including prehistoric or historic archaeological or historic architectural resources) were identified during the field survey. The project alignment has been subject to severe disturbances related to the construction and maintenance of roads, drainage and other infrastructure, as well as agricultural activities and the dumping of modern refuse. Sediments included sandy silt, and vegetation within the alignment was dominated by seasonal grasses affording surface visibility that varied between 80 and 100 percent within unpaved portions of the project alignment.

RECOMMENDATIONS

During the research and field survey, BCR Consulting archaeologists identified no cultural resources (including historic or prehistoric archaeological sites and historic architectural resources) within the project alignment. Based on these results, BCR Consulting recommends that development of the project site would not result in an adverse effect to any historical resources under CEQA. No further cultural resource work or monitoring is recommended.

While the current study has not indicated sensitivity for buried cultural resources within the project alignment, ground disturbing activities always have the potential to reveal buried deposits not observed on the surface during previous surveys. Prior to the initiation of ground-disturbing activities, field personnel should be alerted to the possibility of buried prehistoric or historic cultural deposits. In the event that field personnel encounter buried cultural materials, work in the immediate vicinity of the find should cease and a qualified archaeologist should be retained to assess the significance of the find. The qualified archaeologist shall have the authority to stop or divert construction excavation as necessary. If the qualified archaeologist finds that any cultural resources present meet eligibility requirements for listing on the California Register or the National Register, plans for the treatment, evaluation, and mitigation of impacts to the find will need to be developed. Prehistoric or historic cultural materials that may be encountered during ground-disturbing activities include:

- historic artifacts such as glass bottles and fragments, cans, nails, ceramic and pottery fragments, and other metal objects;
- historic structural or building foundations, walkways, cisterns, pipes, privies, and other structural elements;
- prehistoric flaked-stone artifacts and debitage (waste material), consisting of obsidian, basalt, and or cryptocrystalline silicates;
- groundstone artifacts, including mortars, pestles, and grinding slabs;
- dark, greasy soil that may be associated with charcoal, ash, bone, shell, flaked stone, groundstone, and fire affected rocks.

Findings were negative during the Sacred Lands File search with the NAHC. The results of the Sacred Lands File search are provided in Appendix B. Assembly Bill (AB) 52 Native American Consultation will be initiated by the SSJID. Therefore, the results are not included in this report. However, report results may be shared with participating tribes as necessary.

The Legislature added requirements regarding tribal cultural resources for CEQA in Assembly Bill 52 (AB 52) that took effect July 1, 2015. AB 52 requires consultation with California Native American tribes and consideration of tribal cultural resources in the CEQA process. By including tribal cultural resources early in the CEQA process, the legislature intended to ensure that local and Tribal governments, public agencies, and project proponents would have information available, early in the project planning process, to identify and address potential adverse impacts to tribal cultural resources. By taking this proactive approach, the legislature also intended to reduce the potential for delay and conflicts in the environmental review process. To help determine whether a project may

have such an effect, the Public Resources Code requires a lead agency to consult with any California Native American tribe that requests consultation and is traditionally and culturally affiliated with the geographic area of a Proposed Project. The County would initiate and carry out the required AB52 Native American Consultation, although this report may be used during the consultation process and BCR Consulting staff is available to answer questions and address concerns as necessary.

According to CEQA Guidelines, projects subject to CEQA must determine whether the project would "directly or indirectly destroy a unique paleontological resource". The Paleontological Overview provided in Appendix D has recommended that:

> The geologic units underlying the project area are mapped as alluvial deposits dating from the Quaternary - specifically, the Pleistocene Modesto Formation (Rapp et al. 1977, A mineral land classification study of the Stanislaus River area, San Joaquin and Stanislaus counties, California). Quaternary alluvial units are considered to be fossiliferous and highly paleontologically sensitive. The Western Science Center does not have any fossil localities within the project area nor within a one-mile radius. However, Quaternary alluvial units throughout California have produced large quantities of fossils, such as the extensive collection from Diamond Valley Lake housed at Western Science Center.
>
> Any fossil specimens recovered from the project would be scientifically significant. Excavation activity associated with the development of the project area would impact the paleontologically sensitive Quaternary units, and it is the recommendation of the Western Science Center that a paleontological resource mitigation program be put in place to monitor, salvage, and curate any recovered fossils from the study area.

If human remains are encountered during the undertaking, State Health and Safety Code Section 7050.5 states that no disturbance shall occur until the County Coroner has made a determination of origin and disposition pursuant to Public Resources Code Section 5097.98. The County Coroner must be notified of the find immediately. If the remains are determined to be prehistoric, the Coroner will notify the Native American Heritage Commission (NAHC), which will determine and notify a Most Likely Descendant (MLD). With the permission of the landowner or his/her authorized representative, the MLD may inspect the site of the discovery. The MLD shall complete the inspection within 48 hours of notification by the NAHC.

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APPENDIX A

CONFIDENTIAL RECORDS SEARCH MAPS AND BIBLIOGRAPHY

PROVIDED UNDER SEPARATE COVER UPON REQUEST

APPENDIX B

NATIVE AMERICAN HERITAGE COMMISSION SACRED LANDS FILE SEARCH

NATIVE AMERICAN HERITAGE COMMISSION

CHAIRPERSON
Reginald Pagaling
Chumash

VICE-CHAIRPERSON
Buffy McQuillen
Yokayo Pomo, Yuki, Nomlaki

SECRETARY
Sara Dutschke
Miwok

PARLIAMENTARIAN
Wayne Nelson
Luiseño

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Isaac Bojorquez
Ohlone-Costanoan

COMMISSIONER
Stanley Rodriguez
Kumeyaay

COMMISSIONER
Laurena Bolden
Serrano

COMMISSIONER
Reid Milanovich
Cahuilla

COMMISSIONER
Vacant

EXECUTIVE SECRETARY
Raymond C. Hitchcock
Miwok, Nisenan

NAHC HEADQUARTERS
1550 Harbor Boulevard
Suite 100
West Sacramento,
California 95691
(916) 373-3710

November 29, 2023

Joseph Orozco
BCR Consulting, LLC

Via Email to: bcrllc2008@gmail.com

Re: Stanislaus Elementary School 123-TCP Mitigation (ARD2302) Project, Stanislaus County

Dear Mr. Orozco:

A record search of the Native American Heritage Commission (NAHC) Sacred Lands File (SLF) was completed for the information you have submitted for the above referenced project. The results were negative. However, the absence of specific site information in the SLF does not indicate the absence of cultural resources in any project area. Other sources of cultural resources should also be contacted for information regarding known and recorded sites.

Attached is a list of Native American tribes who may also have knowledge of cultural resources in the project area. This list should provide a starting place in locating areas of potential adverse impact within the proposed project area. I suggest you contact all of those indicated; if they cannot supply information, they might recommend others with specific knowledge. By contacting all those listed, your organization will be better able to respond to claims of failure to consult with the appropriate tribe. If a response has not been received within two weeks of notification, the Commission requests that you follow-up with a telephone call or email to ensure that the project information has been received.

If you receive notification of change of addresses and phone numbers from tribes, please notify me. With your assistance, we can assure that our lists contain current information.

If you have any questions or need additional information, please contact me at my email address: Pricilla.Torres-Fuentes@nahc.ca.gov.

Sincerely,

Pricilla Torres-Fuentes

Pricilla Torres-Fuentes
Cultural Resources Analyst

Attachment

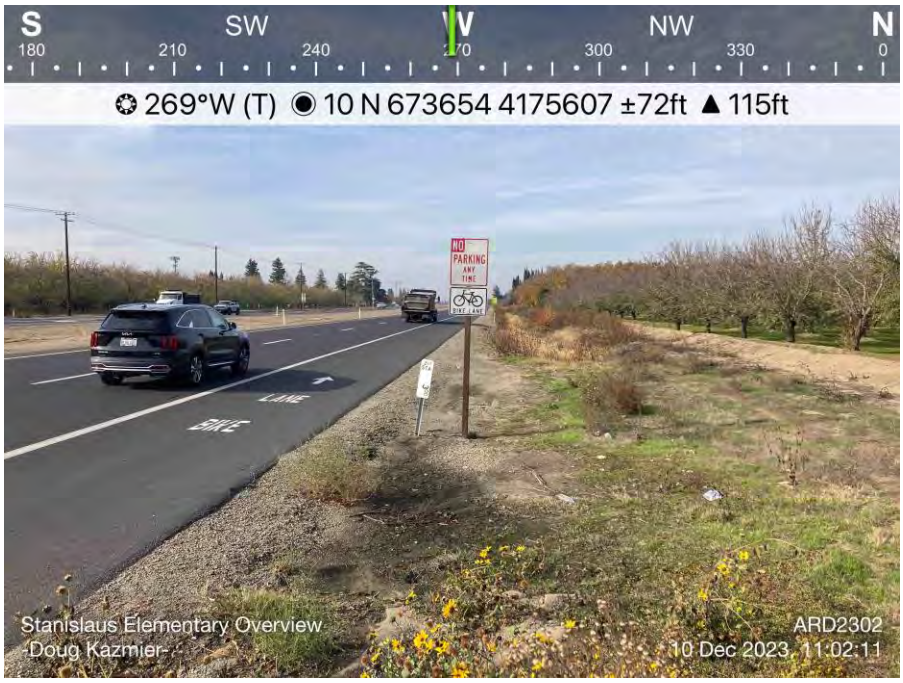
APPENDIX C

PHOTOGRAPHS


E SE S SW W
90 120 150 180 210 240 270
184°S (T) 10 N 675138 4175347 ±13ft 98ft
Tully Road Overview
-Doug Kazmier-
ARD2302
10 Dec 2023, 10:44:31


S SW W NW
180 210 240 270 300 330
252°W (T) 10 N 674987 4175666 ±13ft 85ft
Kiernan Overview
-Doug Kazmier-
ARD2302
10 Dec 2023, 10:50:11


NE
E
SE
S
30
60
90
120
150
180
98°E (T) 10 N 673706 4175601 ±29ft 114ft
Stanislaus Elementary Overview
-Doug Kazmier-
ARD2302
10 Dec 2023, 10:56:13


S
SW
W
NW
N
180
210
240
300
330
0
269°W (T) 10 N 673654 4175607 ±72ft 115ft
NO PARKING ANY TIME
BIKE
LANE
Stanislaus Elementary Overview
-Doug Kazmier-
ARD2302
10 Dec 2023, 11:02:11


S
SW
W
NW
180
210
240
270
300
330
263°W (T) 10 N 672429 4175624 ±26ft 122ft
Kiernan Overview
-Doug Kazmier-
ARD2302
10 Dec 2023, 11:06:33


W
N
NE
E
SE
330
0
30
60
90
120
51°NE (T) 10 N 671856 4175504 ±32ft 106ft
Kiernan & Dale Overview
-Doug Kazmier-
ARD2302
10 Dec 2023, 11:14:32

APPENDIX D

PALEONTOLOGICAL OVERVIEW

WESTERN SCIENCE CENTER

November 20, 2023

BCR Consulting LLC
Joseph Orozco
909-525-7078

Dear Mr. Orozco,

This letter presents the results of a record search conducted for the Stanislaus Elementary School 123-TCP Mitigation Project (ARD2302) in Modesto, Stanislaus County, California, on the *Salida* USGS 7.5 minute quadrangle.

The geologic units underlying the project area are mapped as alluvial deposits dating from the Quaternary - specifically, the Pleistocene Modesto Formation (Rapp et al. 1977, *A mineral land classification study of the Stanislaus River area, San Joaquin and Stanislaus counties, California*). Quaternary alluvial units are considered to be fossiliferous and highly paleontologically sensitive. The Western Science Center does not have any fossil localities within the project area nor within a one-mile radius. However, Quaternary alluvial units throughout California have produced large quantities of fossils, such as the extensive collection from Diamond Valley Lake housed at Western Science Center.

Any fossil specimens recovered from the project would be scientifically significant. Excavation activity associated with the development of the project area would impact the paleontologically sensitive Quaternary units, and it is the recommendation of the Western Science Center that a paleontological resource mitigation program be put in place to monitor, salvage, and curate any recovered fossils from the study area.

If you have any questions, or would like further information, please feel free to contact me at amcdonald@westerncentermuseum.org

Sincerely,

Andrew McDonald

Andrew McDonald, PhD
Curator

Stanislaus Elementary School Project

Project Area + 1 mile radius

Legend

Q: Quaternary alluvium and marine deposits (Pliocene to Holocene)

Del Rio

Ladd Rd

Ladd Rd

Ladd Rd

Stoddard Rd

Kiernan Ave

Kiernan Ave

McHenry

Salida

Salida Blvd

Dale Rd

Tully Rd

Bangs Ave

Bangs Ave

Pelandale Ave

Pelandale Ave

Pelandale Ave

Claribel Rd

Coffee Rd

Claratina Ave

Claratina Ave

Mable Ave

Oakdale Rd

Toomes Rd

Bacon Rd

Murphy Rd

Finney Rd

Carver Rd

Standiford Ave

Standiford Ave

Sylvan Ave

W Rumble Rd

W Rumble Rd

E Rumble Rd

Floyd Ave

Floyd Ave

North Dakota Ave

Beckwith Rd

Pirrone Rd

99

99

219

219

108

108

108

N

1 mi

Survey Google Earth

Image Landsat / Copernicus

APPENDIX D

Soils and Geotechnical (Universal Engineering Services, 2023)

UNIVERSAL
ENGINEERING SCIENCES

Geotechnical Engineering and Geologic Hazards Investigation
STANISLAUS ELEMENTARY REPLACEMENT SCHOOL
1931 Kiernan Road
Modesto, California

Prepared for:

Stanislaus Union School District

2410 Janna Avenue

Modesto, California 95350

Prepared by:

3410 West Hammer Lane Suite F, Stockton, CA 95219

Date: June 1, 2023

Project No. 4730.2300008.0016

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Appendix C CPT Data

Appendix D Liquefaction Analysis

1. INTRODUCTION

We have completed a geotechnical engineering and geologic hazards report for the proposed replacement school project for Stanislaus Elementary School in Modesto, California.

The purpose of our study has been to prepare this geotechnical engineering and geologic hazards report for the proposed new replacement campus Stanislaus Elementary School campus in Modesto, California. As part of this study, we have explored the existing soil and groundwater conditions in the location of the proposed new buildings and have provided geotechnical and geologic hazards conclusions and recommendations for the design and construction of the proposed improvements.

Our study has been performed in general accordance with our Geotechnical Engineering and Geologic Hazards Services Proposal to the Stanislaus Union School District, dated March 6, 2023, as authorized by Mr. Jason Gales on March 17, 2023. This report represents the results of our study.

2. SCOPE OF WORK

Our scope of work included the following:

1. Site reconnaissance;
2. Review of United States Geological Survey (USGS) topographic maps, aerial photographs and available groundwater data;
3. Review of geologic maps and fault maps;
4. Review of seismic activity within 100 kilometers (62 miles) of the site;
5. Subsurface exploration, including the drilling and sampling of four Cone Penetrometer Test borings to depths of approximately 18½ to 50 feet below the existing ground surface (BGS), and six auger borings to depths of approximately 15 to 16½ feet BGS.
6. Bulk sampling of near-surface soils;
7. Laboratory testing of selected soil samples;
8. Engineering and geologic analyses; and,
9. Preparation of this report.

2.1. Figures and Attachments

The following figures are included with this report:

Table 1: Figures

Figure	Title	Figure	Title
1	Vicinity Map	7	Epicenter Map
2	Site Plan	8 - 13	Logs of Soil Borings
3	USGS Topographic Map	14	Unified Soil Classification System
4	Geologic Map	15	FEMA Flood Map
5	Geologic Cross Section	16	Dam Inundation Map
6	Fault Map		

Appended to this report are:

- General information regarding project concepts, exploratory methods used during our field investigation and laboratory test results (Appendix A).
- A list of references cited (Appendix B).
- Logs of the CPT soundings (Appendix C).
- Results of Liquefaction Analysis (Appendix D)

2.2. Proposed Development

We understand the project will consist of the design and construction of a new school consisting of eight new classroom buildings (denoted as Buildings A through H on the *Stanislaus Elementary School Replacement School* plans*,* prepared by California Design West Architects, Inc.) and a cafeteria building (nine buildings total). We understand the new buildings will be single-story, slab-on-grade structures and will each cover about 960 to 7860 square feet in plan area. Associated improvements will consist of a new asphalt concrete parking areas, exterior concrete flatwork, and underground utilities.

Grading plans are not yet available; however, based on the existing site topography, we anticipate excavations and fills on the order of about one to two feet will be required for development of the proposed improvements.

3. FINDINGS

3.1. Site Description

The building site is located at 1931 Kiernan Road in Modesto, California (Figure 1), north of the existing Stanislaus Elementary School Campus. The property is identified as Stanislaus County Assessor's Parcel Number (APN) 004-068-008-000. The building site is bounded to the north by orchards; to the east by a orchards; to the south by Kiernan Avenue, beyond which is orchards; and west by more orchards.

The existing school campus consist of several single-story, slab-on-grade building structures, asphalt concrete parking and hardcourt areas, exterior concrete flatwork, and landscaping consisting of natural turf grass and trees. The north end of the campus contains a natural turf playfields and football/soccer field surrounded by a gravel-covered track. The south and east ends of the campus are surrounded by a masonry sound wall and the north and west ends of the campus are surrounded by chain-link fencing.

At the time of our field exploration on April 7 and 22, the existing school campus resides on the south side of the parcel. The location of the new proposed campus is situated on the north side of the parcel and situated around the existing track and field.

The topography of the site is generally flat with an average surface elevation of about +90 feet relative to the North American Vertical Datum of 1998 based on review of the USGS 7.5 Minute Topographic Map of the Salida Quadrangle, California, dated 2021.

3.2. Historical Aerial Photographic Review

We reviewed historical aerial photographs and historic topographic maps. Available photographs reviewed were taken in the years 1957, 1967, 1968, 1982, 1985, 1993, 2002 through 2006, 2009 through 2022. Our historical review of the project site and adjacent land is based completely on the historic maps and aerial photography from the aforementioned years.

The Stanislaus school appears on the USGS 7.5 minute Topographic Map of the Salida Quadrangle dated 1915. Aerial photographs taken in 1957 show the five main school structures closest to Kiernan Road. The paved parking lots and soundwall do not appear to be present yet at the site. Aerial photographs taken in 1967 and 1968 reveal tennis courts to be present on the western side of the site. Aerial

photographs taken in 1982 reveal what appears to be a rectangular hardcourt situated on the eastern side of the site. Photographs taken in 1993 do not contain the hardcourt seen in the 1982 photograph and also reveal the eastern parking lot has been completed.

Aerial photographs taken from 2002 through 2011 reveal the site remains relatively the same. Aerial photographs taken in 2012 reveal the track to be present on the north side of the campus. The site remains relatively unchanged in 2013 according to the aerial photographs.

Aerial photographs taken in 2014 reveal the western parking lot has been added to the school campus in addition to the early stages of the soundwall currently present on the south side of the campus adjacent to Kiernan Avenue. Aerial photographs in 2015 reveal the soundwall has been completed. The site remains relatively unchanged until aerial photographs taking in 2019 reveal a building addition on the north side of the campus buildings. The site appears to have remained relatively unchanged between 2019 and the time of our field explorations.

3.3. General Site Geology

The site is located within the Great Valley geomorphic province of California, a 500-mile, northwest-trending structural trough, generally constrained to the west by the Coast Ranges and to the east by the foothills of the Sierra Nevada Range (Norris and Webb, 1990). The Sierra Nevada and the Great Valley provinces are part of the Sierra Nevada microplate, an element of the broad Pacific-North American plate boundary. The Great Valley consists of two valleys lying end-to-end, with the Sacramento Valley to the north and the San Joaquin Valley to the south.

The San Joaquin Valley has been filled to its present elevations with thick sequences of sediment derived from both marine and terrestrial sources. The sedimentary deposits range in thickness from relatively thin deposits along the eastern valley edge to more than 25,000 feet in the south-central portion of the Great Valley (Norris and Webb, 1990). The sedimentary geologic formations of the Great Valley Province vary in age from Jurassic to Quaternary, with the older deposits being primarily marine in origin. The overall thickness of alluvium beneath the school campus is approximately 850 meters (2,800 feet) (Bartow, 1985). Younger sediments are continentally derived and were typically deposited in lacustrine, fluvial, and alluvial environments with their primary source being the Sierra Nevada Range. The campus is located in the northern part of the San Joaquin Valley, approximately 3 kilometers south of the Stanislaus River.

According to the USGS Geologic Map of the San Francisco-San Jose Quadrangle (Wagner, 1991; Marchand & Harden, 1978), the project site is underlain by the Quaternary-aged Modesto Formation Qm. The geologic materials that comprise the Modesto Formation are primarily sands, silts and gravels. The mapped geology was found to be consistent with the subsurface soil conditions encountered within our soil borings performed at the site.

A copy of a portion of the 1991 San Francisco-San Jose Quadrangle is provided as Figure 4. Two geologic cross sections are included in this report as Figures 5A and 5B.

3.4. Faulting

No indication of surface rupture or fault-related surface disturbance was observed at the site during our site reconnaissance or review of aerial photographs. The site is not located within a designated Alquist-Priolo Earthquake Fault Zone (Parrish, 2018). The nearest Alquist-Priolo Earthquake Fault Zones have been established around the Greenville Fault located about 55 miles (about 52 kilometers) west of the site. This fault and its associated fault zone are comprised of northwest-southeast trending faults.

The Interactive Fault Activity Map of California at https://maps.conservation.ca.gov/cgs/fam/, shows the Quaternary sections of the Vernalis Fault, the late Quaternary-aged San Joaquin Fault, and the Quaternary-aged Black Butte Fault located about 13, 18, and 19 miles west of the site respectively. These faults do not have recognized displacement in Holocene time (11,700 years) and are not identified as an Alquist-Priolo Earthquake Fault Rupture Hazard Zone by the CGS. This is consistent with our opinion.

Using local geologic maps, and the USGS and California Geological Survey (CGS) 2010 Quaternary fault and fold database for the United States, accessed on March 22, 2023, from website: https://earthquake.usgs.gov/cfusion/hazfaults_2008_search/query_main.cfm and the Revised 2002 California Probabilistic Seismic Hazard Maps (Cao, 2003), we have prepared Table 2 containing faults and fault systems within 100 kilometers (about 62 miles) of the site that are considered capable of producing earthquakes with a moment magnitude (MW) of 6.5 or greater. A fault map is presented as Figure 6. The nearest of these faults are associated with the Great Valley 7 fault, located 28.8 kilometers (17.9 miles) west of the site.

Table 2: Fault Systems within 100 Kilometers of the Subject Site

Fault Name	Distance		Maximum Earthquake Magnitude (Mw)
	Miles	Kilometers	
Great Valley 7	17.9	28.8	6.9
Stockton Fault	20.0	32.2	n/a
Great Valley 8	20.5	33.0	6.8
Greenville Connected	31.6	51.0	7.0
Ortigalita	33.5	54.0	7.1
Great Valley 9	42.0	67.8	6.8
Mount Diablo Thrust	43.5	70.2	6.7
Calaveras;CN+CC+CS	45.5	73.4	7.0
Calaveras;CC+CS	45.5	73.4	6.5
Calaveras;CC	45.5	73.4	6.4
Calaveras;CN+CC	45.5	73.4	7.0
Calaveras;CN	46.3	74.6	6.9
Hayward-Rodgers Creek;RC+HN+HS	48.4	78.1	7.3
Hayward-Rodgers Creek;HS	48.4	78.1	6.8
Hayward-Rodgers Creek;HN+HS	48.4	78.1	7.0
Great Valley 5, Pittsburg Kirby Hills	49.3	79.5	6.7
Green Valley Connected	54.1	87.3	6.8
Calaveras;CS	55.3	89.2	5.8
Monte Vista-Shannon	56.4	90.9	6.5
Quien Sabe	57.3	92.3	6.6

3.5. Coseismic Ground Deformation

The California State Legislature passed the Seismic Hazards Mapping Act (SHMA) in 1990 (Public Resources Code Division 2, Chapter 7.8) following the earthquake damage caused by the 1987 Whittier Narrows and 1989 Loma Prieta earthquakes. The purpose of the SHMA is to protect public safety from the effects of strong ground shaking, liquefaction, landslides, or other ground failure, and other hazards caused by earthquakes (California Geological Survey [CGS] SP117). The building site is not mapped

within any seismic hazard zones and there are no published maps available on the CGS website that cover the building site.

3.6. Historic Seismicity

Seismological data regarding significant historical earthquakes affecting the site was obtained using the USGS Earthquake Catalog (USGS, https://earthquake.usgs.gov/earthquakes/search/). A search radius of 100 kilometers (62 miles) was specified for this analysis. A historic earthquake epicenter map is presented as Figure 7. According to the Emergency Operations Plan prepared by Stanislaus County in November 2021, the County has the potential to receive a range of ground shaking equivalent to Modified Mercalli Intensity Scale (MMIS) VI to X. The eastern half of the county is estimated to expect a MMIS of VI to VII, the western half is expected to receive a MMIS of VII to VIII, and the areas surrounding the City of Newman can expect a shaking intensity up to X MMIS. Based on this, the City of Modesto would likely expect a maximum MMIS of VI to VII.

According to the tabulated data, the most intense earthquake ground shaking within 100 kilometers of the site resulted from a MR (Richter Scale Magnitude) 6.5 earthquake on July 1, 1911, with an epicenter located approximately 85.3 kilometers (53 miles) southwest of the site.

The closest earthquake to the site is indicated to be an MR 2.5 earthquake that occurred on December 23, 1985, with an epicenter located approximately 10.8 kilometers (6.7 miles) northwest of the site. Other notable events include a February 2, 1979, 3.5 magnitude earthquake with an epicenter located 14.6 kilometers (9.1 miles) southwest of the site.

3.7. Subsurface Soil Conditions

Six exploratory borings (D1 through D6) and four CPT soundings (CPT1 through CPT4) were performed on April 7, 2023 and April 22, 2023, respectively, at the approximate locations shown on the attached Site Plan presented as Figure 2.

The borings consisted of predominantly silty sand with interbedded layers of silt from the ground surface to about 16½ feet below the existing ground surface.

The CPT sounding data revealed silty sand to depths of approximately 22 feet below the existing ground surface. From approximately 22 to 50 feet bgs sand was encountered at CPT-03.

For specific information regarding the soil conditions at a specific location, please refer to the Logs of Soil Borings (Figures 8 through 13) and the CPT data displayed in Appendix C.

3.8. Groundwater

Groundwater was not encountered within the borings drilled on April 7, 2023 to the explored 15 to 16½ foot depths. However, groundwater was measured in CPT sounding number CPT-03 on April 22, 2023 at a depth of about 40 feet below the ground surface.

To supplement the groundwater data, we reviewed available groundwater data published by the California Department of Water Resources (DWR) from a monitoring well (377188N1210179W001) located about 0.6 miles northeast of the site. . Ground surface elevation at the well is indicated to be about +102 feet (NAVD 88) which is approximately 10 feet higher than the site elevation. Groundwater measurements were recorded from July 1971 through November 2011. Historic high groundwater was encountered at an elevation of approximately +82 feet (NAVD 88) in November of 1980 which corresponds to a depth of 11 feet BGS. Historic low groundwater was encountered at approximately +31 feet (NAVD 88) in March 1963 which corresponds to a depth of about 68 feet BGS. Regional geologic references from the early part of the 20th century are typically used for “historic high” groundwater elevations. In the area of the site vicinity, these records indicate an elevation of +91 feet above sea level, or approximately 11 feet BGS (Mendenhall, et.al., 1916).

We also reviewed available groundwater information at the DWR *Sustainable Groundwater Management Act Data Viewer* website. The data viewer website shows groundwater elevations for the Central Valley of California based on groundwater level data collected from wells monitored by the DWR. Based on review of available groundwater level contour maps, dated Spring of 2018 through Spring of 2022, groundwater at the campus has fluctuated from about 40 to 60 feet below existing grades.

4. CONCLUSIONS

4.1. Seismic Site Class

Shear wave velocities were obtained from the upper 50 feet below the ground surface at the CPT locations. The average shear wave velocities within the upper 50 feet for CPT-01, CPT-03, and CPT-04 were determined in accordance with Chapter 20 of American Society of Civil Engineers (ASCE) 7-16. The average shear wave velocities for each CPT are shown in Table 3.

Table 3: Average Shear Wave Velocities

CPT Number	Average Shear Wave Velocity (ft/s)
CPT-01	689
CPT-03	1102.66
CPT-04	699

Based on Table 20.3-1 of ASCE 7-16, a seismic Site Class D applies to sites with average shear wave velocities between 600 to 1200 fps for the upper 100 feet of the ground surface. Assuming the soils from a depth of 50 to 100 feet have at least the same average shear wave velocity as the CPT soundings, which in our opinion is a reasonable assumption based on site geology, the soils at this site can be designated as site Class D in determining seismic design forces for this project in accordance with Table 20.3-1 of ASCE 7-16 and the 2022 CBC.

4.2. 2022 CBC/ASCE 7-16 Seismic Design Criteria

The 2022 California Building Code (CBC) currently references the ASCE Standard 7-16 for seismic design. The seismic design parameters provided in Table 4 were developed based on a Site Classification D, and the latitude and longitude for the site using the web interface developed by ASCE (https://asce7hazardtool.online/). Since S1 is greater than 0.2g, the coefficient values Fv, SM1, and SD1 presented in Table 2 below are valid for this project, provided the requirements in Exception Note No. 2 in Section 11.4.8 of ASCE 7-16 apply. If not, a site-specific ground motion hazard analysis is required. Based on our experience with similar structures, we anticipate the exception will be met. However, this should be verified by the project structural engineer.

Table 4: 2022 CBC/ASCE 7-16 Seismic Design Parameters

Latitude: 37.7130° N Longitude: 121.0278° W	ASCE 7-16 Table/Figure	2022 CBC Table/Figure	Factor/Coefficient	Value
0.2-second Period MCE	Figure 22-1	Figure 1613.2.1(1)	S_S	0.676 g
1.0-second Period MCE	Figure 22-2	Figure 1613.2.1(3)	S1	0.268 g
Soil Class	Table 20.3-1	Section 1613.2.2	Site Class	D
Site Coefficient	Table 11.4-1	Table 1613.2.3(1)	F_a	1.259
Site Coefficient	Table 11.4-2	Table 1613.2.3(2)	F_v	2.064*
Adjusted MCE Spectral Response Parameters	Equation 11.4-1	Equation 16-20	S_{MS}	0.851 g
	Equation 11.4-2	Equation 16-21	S_{M1}	0.553 g*
Design Spectral Acceleration Parameters	Equation 11.4-3	Equation 16-22	S_{DS}	0.567 g
	Equation 11.4-4	Equation 16-23	S_{D1}	0.369 g*
Seismic Design Category	Table 11.6-1	Table 1613.2.5(1)	Risk Category I-IV	D
	Table 11.6-2	Table 1613.2.5(2)	Risk Category IV	D

Notes: MCE = Maximum Considered Earthquake
g = gravity
* = The value is valid since the requirements in Exception Note No. 2 in Section 11.4.8 of ASCE 7-16 are met.

4.3. Liquefaction Potential

Liquefaction is a soil strength and stiffness loss phenomenon that typically occurs in loose, saturated cohesionless soils exposed to strong ground shaking during earthquakes. Hazards to buildings associated with liquefaction include bearing capacity failure, lateral spreading, and differential settlement of soils below foundations, which can contribute to structural damage or collapse.

The results of the subsurface exploration at the site, performed on April 7 and 22, 2023, revealed the underlying soils generally consist relatively dense silts and sands extending to the explored depths of 15 to 50½ feet BGS. Our review of available recent groundwater data for the area indicates historic high

groundwater levels at 11 feet BGS. Groundwater was encountered at CPT-033 at 40 feet BGS during this study.

A liquefaction analysis to determine factors of safety against liquefaction was performed for the soil and groundwater conditions encountered at CPT-01, CPT-02, CPT-03, and CPT-04 during our field explorations.

4.4. Seismic Settlement Analysis and Results

We performed a liquefaction analysis of data obtained from CPT-01, CPT-02, CPT-03, and CPT-04 using the groundwater depth encountered during field operations and a historic high groundwater level of 11 feet below the ground surface during a seismic event. The analysis was performed using soil liquefaction assessment software Cliq (Version 3.4.1.4) developed by GeoLogismiki. The software utilizes data collected from CPT soundings to determine factors of safety against liquefaction for varying earthquake input energies and uses the results of the National Center for Earthquake Engineering Research (NCEER) liquefaction evaluation methods summarized by Youd, et al (2001). Input values were obtained using the results of the CPT soundings referenced above.

A peak ground acceleration (PGA_M) of 0.37 g was used in the liquefaction analysis based on Equation 11.8-1 of ASCE 7-16. A mode magnitude earthquake of 6.25 was used for this analysis using the 2014 USGS National Seismic Hazard Mapping Project (NSHMP) Probabilistic Seismic Hazard Analysis (PSHA) Interactive Deaggregation web site.

Liquefaction potential at the site also was evaluated based on the Liquefaction Potential Index (LPI). The LPI is a measure of the liquefaction potential based on an analysis of the entire vertical soil profile, and not just discrete layers (Iwasaki, 1986; Toprak and Holzer, 2003). Factors taken into consideration for the LPI calculations include: thickness of the liquefied layer; proximity of the liquefied layer to the surface; and, the factor of safety. The LPI ranges from 0 to 100 with the value zero representing no liquefaction potential. Surface manifestations of liquefaction occur at LPI ≥ 5. The LPI and calculated seismic settlements for the soil conditions at CPT-01 through CPT-04 are summarized in Table 5, indicating a low potential for liquefaction during the design seismic event (mode magnitude earthquake of 6.25 and a PGA of 0.37 g).

Table 5: Liquefaction Analysis Results Summary

CPT No.	Liquefaction Potential Index	Calculated Seismic Settlement (inches)
CPT-01	0.63	0.39
CPT-02	0.00	0.00
CPT-03	0.02	0.18
CPT-04	0.00	0.00

The results of the liquefaction analysis at the CPT locations using Cliq indicate calculated seismic settlements between 0.00 and 0.39 inches at CPT-01 through CPT-04, as presented in Table 5. Worst-case differential seismic induced settlement across 50 feet, or the shortest dimension of the structure, whichever is less, is estimated to be about ½ inch. These estimates of post-liquefaction seismic settlements represent free-field ground settlement, not settlement of the proposed structure. The presence of non-liquefiable soil layers overlying and interbedded within the liquefiable layers will likely mitigate the impact of seismically induced settlement at the ground surface.

Given the results of our analysis performed for this investigation, the risk of seismic induced settlements is low.

Based on the results of our analysis, it is our opinion that the potential for loss of bearing capacity (strength) beneath the prepared building pad is very low and does not need to be further mitigated in the design of the structure, provided the recommendations of this report are incorporated into the design of the building addition.

Copies of the output files for the liquefaction analysis, including the results of the 2014 USGS NSHMP PSHA Interactive Deaggregation, are provided in Appendix D.

4.5. Seismic Hazards

No active or potentially active faults are known to underlie the site based on the published geologic maps or aerial photographs that we reviewed. The site is not located within an Alquist-Priolo Earthquake Fault Zone, and we observed no surface evidence of faulting during our site reconnaissance.

Therefore, it is our opinion that ground rupture at the site resulting from seismic activity is unlikely. The site is not located within a seismic hazard zone pursuant to the Seismic Hazard Zone Mapping Act.

4.6. Volcanic Hazards

The building site is not located within a volcanic hazard zone (e.g., pyroclastic flow, volcanic debris flow, lava flow, bas surge, tephra, etc.) associated with potential volcanic eruptions of Mt. Shasta, Clear Lake, Lassen Peak or the Mono Lake - Long Valley Volcanic areas (Miller, 1989). Therefore, the risk to the site associated with volcanic hazards is very low.

4.7. Landslides

Based on a visual observation of the project site and review of topographic data, the site surface generally is found to be flat. Also, review of the Stanislaus County Emergency Operations Plan (SC EOP, 11, 2021) indicates that landslide hazards within Stanislaus County are typically restrained to the eastern and western edges of Stanislaus County within the foothills of the Coast Ranges and the Sierras. Based on the above information, it is our opinion that the potential for landslides is highly unlikely, provided the recommendations presented in this report for site grading and compaction are carefully followed.

4.8. Flood Hazards

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map for Stanislaus, California, (Community-Panel Numbers 06099C0310E, September 26, 2008), the entire campus is located within ZONE X defined as “Area of Minimal Flood Hazard.” The FEMA flood map for the site vicinity is presented in Figure 15 of this report.

4.9. Dam Inundation

The Stanislaus County Emergency Operations Plan (Stanislaus County, 2021) identifies three dams that have high damage potential should they fail: Don Pedro Reservoir, New Melones Dam, and New Exchequer Dam. We also reviewed the Dam Breach Inundation Data provided by the California Department of Water Resources Division of Dam Safety, March 2021. Our review indicates that the site does lie within the potential inundation area associated with the failure of the Don Pedro Dam (see Figure 16).

4.10. Tsunamis and Seiches

The publicly available "Tsunami Inundation" maps developed by the CGS do not cover the site. Given that the site is not located near a coastal region or near a large body of standing water, we consider the occurrence of tsunamis or seiches to be very unlikely.

4.11. Subsidence and Hydrocollapse

Subsidence occurs when a large land area settles due to extensive withdrawal of groundwater, oil, natural gas or oxidation of peat. Based on our subsurface exploration, the soil at the project site generally consists of silty sand and sandy silt layers to the explored depths of approximately 50 feet BGS.

DWR has mapped the entire Central Valley of California as having potential (low to high) for future land subsidence; however, DWR indicates the mapping is intended to be advisory only to assist state and local agencies in defining areas of potential subsidence that may require additional study (DWR, 2014).

Based on the subsurface conditions encountered at the site, it is our opinion that settlement at the site due to subsidence is unlikely, provided the recommendations of this report are followed.

4.12. Naturally Occurring Asbestos (NOA)

Review of A General Location Guide for Ultramafic Rocks in California - Areas More Likely to Contain Naturally Occurring Asbestos, CGS Open-File Report 2000-19 (Churchill and Hill, 2000) indicate the site is not underlain by ultramafic rocks likely to contain asbestos. This is consistent with our observations.

4.13. Radon-222 Gas

Radon is a naturally occurring radioactive gas that is produced from the radioactive decay of uranium and thorium, most abundant in coastal marine sedimentary rocks and granitic and felsic volcanic rocks. Geologic Controls on the Distribution of Radon in California (Churchill, 2003) identified Stanislaus County as an area containing common indicators of naturally occurring radon gas.

According to the Environmental Protection Agency's Map of Radon Zones, the project site is located within Zone 3, meaning the site has a predicted average indoor radon screening level below 2 picocuries per liter (pCi/L) of air. Therefore, there is a low potential for radon gas at the site.

4.14. Bearing Capacity

Relatively loose soils were encountered in the upper two to three feet at the site. In our opinion, these loose soils are not considered capable of providing adequate or uniform support for the planned buildings in their current condition without experiencing significant total and/or differential static settlements, which can potentially result in structural damage. The relatively dense soils underlying the loose near-surface soils are considered capable of supporting the anticipated loads associated with the planned buildings.

In our opinion, over-excavation, processing and compaction of the near-surface soils within the planned building pad areas will be necessary to adequately support the proposed buildings. Specific recommendations for shallow foundations supported on over-excavated/re-compacted building pads are provided in this report.

Engineered fill that is properly placed and compacted as recommended in this report will be capable of supporting the proposed structures.

4.15. Soil Expansion Potential

The soil conditions encountered at the boring locations consist of sandy silt and silty sand soils. Laboratory tests performed on a sample of near-surface soil indicate the sample was non-plastic (Plasticity Index [PI]=0) when subjected to Atterberg Limits tests in accordance with American Society of Testing and Materials (ASTM) D4318 test method (Figure A1). Testing of a representative sample of the near surface soil revealed the soils are not expansive (Expansion Index [EI]=0) when tested in accordance with STM D4829 test method (see Figure A2).

Based on the laboratory test results and the soil conditions encountered at the boring and CPT locations, mitigation measures for expansive soils are not considered necessary at this site.

4.16. Pavement Subgrade Quality

Laboratory test results indicate the near-surface soils are good quality materials for support of asphalt concrete pavements. Laboratory tests indicate that the near-surface soils possess a Resistance ("R") value of 44 and 53 when tested in accordance with California Test 301. The results of the R-value tests are presented in Figure A3.

Based on the R-value obtained at the site, our experience with similar soil conditions, and to account for variable soil conditions at the site, for design purposes we used an R-value of 40 to calculate the various pavement sections.

4.17. On-site Soil Suitability for Use in Fill Construction

The on-site soils encountered in our borings and CPTs are considered suitable for use in engineered fill construction, provided these materials do not contain rubble, rubbish, significant organic concentrations, and are at a workable moisture content appropriate for compaction. Imported materials, if necessary, should be granular and approved by our office prior to importing the materials to the site.

Existing pavements and flatwork (asphalt concrete and/or concrete), if any, within areas to be demolished may be broken up and pulverized for use as fill. Asphalt and Portland cement concrete rubble may be used as fill provided it is processed into fragments less than three inches in largest dimension, is mixed with soil to form a compactable mixture, and is approved by the District.

4.18. Excavation Conditions

The surface and near-surface soils at the site should be readily excavatable with conventional earthmoving and trenching equipment. Relatively stiff/dense and variably cemented soils were encountered within the explored 15- to 50-foot depths of the borings and CPTs and may require increased effort or larger equipment to excavate where encountered. However, our experience has shown that excavators and contractors with experience in the area are capable of excavating at the site.

Based on our borings and CPTs, excavations associated with building foundations, shallow trenches for utilities, and other excavations less than five feet deep associated with the proposed construction, should stand vertically for short periods of time (i.e., less than one day) required for construction, unless saturated and/or disturbed soils are encountered. These unstable conditions may result in caving or sloughing; therefore, the contractor should be prepared to brace or shore the excavations, if necessary.

Excavations or trenches exceeding five feet in depth that will be entered by workers should be sloped, braced or shored to conform to current Occupational Safety and Health Administration (OSHA) requirements. The contractor must provide an adequately constructed and braced shoring system in accordance with federal, state and local safety regulations for individuals working in an excavation that may expose them to the danger of moving ground.

Temporarily sloped excavations should be constructed no steeper than a one horizontal to one vertical (1H:1V) inclination. Temporary slopes likely will stand at this inclination for the short-term duration of construction, provided significant pockets of loose and/or saturated granular soils are not encountered. Flatter slopes would be required if these conditions are encountered.

Excavated materials should not be stockpiled directly adjacent to an open excavation to prevent surcharge loading of the excavation sidewalls. Excessive truck and equipment traffic should be avoided near excavations. If material is stored or heavy equipment is stationed and/or operated near an excavation, a shoring system must be designed to resist the additional pressure due to the superimposed loads.

4.19. Groundwater Effect on Development and Seasonal Water

Available data indicates recent groundwater levels are at a depth of at least 40 feet below the existing ground surface. Therefore, groundwater should not adversely affect construction of the project. However, during the winter and spring months, infiltrating surface run-off water will create saturated surface soil conditions due to the impervious nature of the underlying shallow, cemented soils.

It is probable that grading operations attempted following the onset of winter rains and prior to prolonged drying periods will be hampered by high soil moisture contents.

Soils beneath existing pavements and structures will likely be at an elevated moisture content regardless of the time of year and will require drying before compaction or use as fill. Such soils, intended for use as engineered fill, will require a prolonged period of dry weather and/or considerable aeration to reach a moisture content suitable for proper compaction.

4.20. Soil Corrosion Potential

Two soil samples were tested to determine resistivity, pH, chloride, and sulfate concentrations to help evaluate the potential for corrosive attack upon reinforced concrete and buried metal. The results of the corrosivity test is summarized in Table 6. Copies of the corrosion potential test results performed by Sunland Analytical are presented on Figure A5 and A6.

Table 6: Soil Corrosivity Testing Results

Analyte	Test Method	D1 @ (0'-5')	D6 @ (0'-5')
pH	CA DOT 643 Modified*	7.64	6.93
Minimum Resistivity	CA DOT 643 Modified*	1,550 Ω-cm	3,430 Ω-cm
Chloride	CA DOT 422	9.7 ppm	1.6 ppm
Sulfate	CA DOT 417	29.7 ppm	2.6 ppm

* = Small cell method; Ω-cm = Ohm-centimeters; ppm = Parts per million

The California Department of Transportation Corrosion and Structural Concrete Field Investigation Branch, 2021 Corrosion Guidelines (Version 3.2), considers a site to be corrosive to foundation elements if one or more of the following conditions exists for the representative soil and/or water samples taken: has a chloride concentration greater than or equal to 500 ppm, sulfate concentration greater than or equal to 1500 ppm, or the pH is 5.5 or less. Based on this criterion, the on-site soils tested are not considered corrosive to steel reinforcement properly embedded within Portland cement concrete (PCC).

Table 19.3.1.1 – Exposure Categories and Classes, of American Concrete Institute (ACI) 318-19, Section 19.3 – Concrete Design and Durability Requirements, as referenced in Section 1904.1 of the 2022 CBC, indicates the severity of sulfate exposure for the sample tested is Exposure Class S0 (water-soluble sulfate concentration in contact with concrete is low and injurious sulfate attack is not a concern). The project structural engineer should evaluate the requirements of ACI 318-19 and determine their applicability to the site.

Universal Engineering Sciences are not corrosion engineers. Therefore, if it is desired to further define the soil corrosion potential at the site, a corrosion engineer should be consulted.

5. RECOMMENDATIONS

5.1. General

The recommendations in this report are based on assumed excavations and fills on the order of about one to two feet for the development of the site. We consider it essential that our office review grading and structural foundation plans to verify the applicability of the following recommendations, to verify that the intent of our recommendations has been incorporated into the construction documents, and to provide supplemental recommendations, if necessary.

The recommendations presented below are appropriate for typical construction in the late spring through fall months. The on-site soils likely will be saturated by rainfall in the winter and early spring months and will not be compactable without drying by aeration or chemical treatment. Should the construction schedule require work to continue during the wet months, additional recommendations can be provided, as conditions dictate.

Site preparation should be accomplished in accordance with the provisions of this report. A representative of the Geotechnical Engineer should be present during all earthwork operations to evaluate compliance with the recommendations included in this report. The Geotechnical Engineer of Record referenced herein is the Geotechnical Engineer that is retained to provide geotechnical engineering observation and testing services during construction.

5.2. Site Clearing

Prior to site grading, construction areas should be cleared of existing structures including all foundations, flatwork, asphalt concrete pavements, rubble, deleterious debris, if any, and any other surface and subsurface items designated for removal to expose undisturbed firm and stable native soils. Where practical, the clearing should extend a minimum of five feet beyond the limits of the proposed structural areas of the site. Existing underground utilities to be abandoned should be completely removed, including existing trench backfill.

Depressions resulting from removal of underground structures (e.g., foundations, utilities, etc.) should be cleaned of loose soil and properly backfilled in accordance with the recommendations of this report.

Following clearing operations, any remaining surface vegetation and organically contaminated topsoil should be removed by stripping. Strippings may be stockpiled for later use or disposed of off-site. Strippings should not be used in general fill construction, but may be used in non-structural areas, provided they are kept at least five feet from structural areas, moisture conditioned and compacted.

Discing of the organics into the surface soils may be a suitable alternate to stripping, depending on the condition and quantity of the organics at the time of grading. The decision to utilize discing in lieu of stripping should be made by the field representative of the Geotechnical Engineer at the time of earthwork construction. Discing operations, if approved, should be observed by the Geotechnical Engineer's representative and be continuous until the organics are adequately mixed into the surface soils to provide a compactable mixture of soil containing minor amounts of organic matter. Pockets or concentrations of organics will not be allowed.

Due to the relatively shallow hardpan soils encountered across the site, grading operations will likely be hampered by high soil moisture contents. In addition, soils excavated during utility trench construction and soils at the bottom of the utility trenches are anticipated to have moisture contents significantly above optimum moisture content. Subgrade soils and excavated soils with high moisture contents will require considerable aeration to reach a moisture content that will permit the specified degree of compaction to be achieved. Aeration may include deep ripping to the top of the hardpan, mixing wetter soils with drier soils onsite, and/or windrows to dry the existing subgrade soils to a compactable moisture content. The contractor should anticipate wet and unstable subgrade soils and the project schedule should allow for adequate drying of the subgrade to achieve compactable moisture contents.

Existing pavements and flatwork (asphalt concrete and concrete) that are not incorporated into the new design should be broken up and removed from the site. Alternatively, pulverized asphalt and Portland cement concrete rubble may be used as fill provided it is processed into fragments less than three inches in largest dimension, is mixed with soil or aggregate base to form a compactable mixture, and its use is approved by the Owner.

Where encountered, any loose, soft or saturated soils should be cleaned out to firm native soil and backfilled with engineered fill in accordance with the recommendations in this report. It is important that the Geotechnical Engineer's representative be present for a sufficient time during clearing operations to verify adequate removal of the surface and subsurface items, as well as the proper backfilling of resulting excavations.

5.3. Subgrade Preparation

Based on the soil conditions encountered at the borings and CPTs performed at the site, we conclude the existing near-surface soils at the site are not considered suitable for shallow foundation support of the planned buildings unless the subgrade soils are improved (i.e., over-excavated and recompacted). The intent of these subgrade improvement alternatives is to provide adequate and uniform support for the planned buildings and building additions to reduce static settlements at the site.

Following site clearing activities, the building pad areas should be over-excavated to a depth of at least three feet below existing grades or one foot below the bottom of the foundations, whichever is deeper. The over-excavation should extend at least five feet beyond the edge of exterior foundations or the building footprints, whichever is greater. Any debris exposed by the required over-excavation should be removed and the resulting excavations should be restored to grade with engineered fill placed and compacted in accordance with the recommendations in this report. The lateral extents of the required over-excavation should be clearly marked on the final grading plans. The Geotechnical Engineer should be given the opportunity to review the final grading plan to determine if the intent of the over-excavation recommendation has been properly incorporated.

Following over-excavation operations, the upper 12 inches of the exposed subgrade soils should be scarified, moisture conditioned to at least the optimum moisture content, and compacted to at least 90 percent of the ASTM D1557 maximum dry density. Difficulty in achieving the recommended compaction may require the use of a layer of geogrid reinforcement (Tensar BX1100, Tensar TX140, Mirafi 5XT, or equivalent) placed directly on the exposed subgrade. Overlap of the geogrid reinforcement should be performed in accordance with the manufacturer's recommendations. The geogrid, if required, should be covered with at least a six-inch-thick lift of Caltrans Class 2 aggregate base and the aggregate base should be uniformly compacted to at least 90 percent of the ASTM D1557 maximum dry density at no less than the optimum moisture content. Recycled aggregate base is acceptable for use. The resulting over-excavations following scarification and recompaction and/or a geogrid stabilized bottom should be

restored with engineered fill placed and compacted in accordance with Engineered Fill Construction section of this report.

Please note that the ground improvement recommendations provided above are not necessary within areas designated for exterior flatwork (at least five feet outside of the building pad areas) nor pavement areas. Any other surfaces to receive fill outside of the building pad areas, achieved by excavation or remain at grade, should be scarified to a depth of at least 12 inches, thoroughly moisture conditioned to at least the optimum moisture content and uniformly compacted to at least 90 percent of the ASTM D1557 maximum dry density. The upper six inches of the final pavement subgrade should be compacted to at least 95 percent.

Compaction of all subgrade soils should be performed using a heavy, self-propelled, sheepsfoot compactor capable of achieving the required compaction and must be performed in the presence of the Geotechnical Engineer's representative who will evaluate the performance of subgrade under compactive load. Difficulty in achieving subgrade compaction may be an indication of loose, soft or unstable soil conditions that could require additional excavation. If these conditions exist, additional subgrade stabilization recommendations may be required at the time of construction.

Difficulty in achieving subgrade compaction or unusual soil instability may be indications of loose soils associated with past subsurface items. Should these conditions exist, the materials should be excavated to check for subsurface structures and the excavations backfilled with engineered fill. We recommend construction bid documents contain a unit price (price per cubic yard) for additional excavation due to unstable wet soil or the presence of unsuitable materials and replacement with engineered fill.

5.4. Engineered Fill Construction

On-site soils are considered suitable for use in engineered fill construction, if they do not contain significant concentrations of organic materials, rubble debris, or particles greater than three inches in maximum dimension. Imported fill materials, if required, should be granular materials with a Plasticity Index of 15 or less; an Expansion Index of 20 or less; an organic content less than four percent; do not contain particles greater than three inches in maximum dimension, and be within a compactable moisture content.

Imported fill should be observed and approved by the Geotechnical Engineer at least three business days prior to being transported to the site. Also, if import fills are required (other than aggregate base), the contractor must provide appropriate documentation that the import is clean of known contamination per Department of Toxic Substances Control (DTSC) and within acceptable corrosion limits.

Engineered fill should be placed in lifts not exceeding six inches in compacted thickness with each lift being uniformly moisture conditioned to at least the optimum moisture content and compacted to not less than 90 percent of the maximum dry density per ASTM D1557. The upper six inches of final pavement subgrades should be uniformly compacted to at least 95 percent relative compaction at a moisture content of at least the optimum moisture content, regardless of whether final grade is established by excavation, engineered fill or left at grade.

Permanent excavation and fill slopes should be constructed no steeper than two horizontal to one vertical (2H:1V) and should be vegetated as soon as practical following grading to minimize erosion. As a minimum, the following erosion control measures should be considered: placement of straw bale sediment barriers or construction of silt filter fences in areas where surface run-off may be concentrated. Slopes should be over-built and cutback to design grades and inclinations. The final decision of erosion control measures should be made by the Project Stormwater Pollution Prevention Plan Engineer.

All earthwork operations should be accomplished in accordance with the recommendations contained within this report. We recommend the Geotechnical Engineer's representative be present on a regular basis during all earthwork operations to observe and test the engineered fill and to verify compliance with the recommendations of this report and the project plans and specifications.

5.5. Utility Trench Backfill

Utility trench backfill should be mechanically compacted as engineered fill in accordance with the following recommendations. Bedding and initial backfill around and over the pipe should conform to the pipe manufacturers recommendations for the pipe materials selected and applicable sections of the governing agency standards.

We recommend that native, on-site soil be used as trench backfill. Utility trench backfill should be placed in thin lifts, thoroughly moisture conditioned to at least the optimum moisture content, and compacted to at least 90 percent of the maximum dry density as determined by ASTM D1557. Within the upper six inches of pavement subgrade soil compaction of untreated soils should be increased to at least 95 percent relative compaction at no less than the optimum moisture content. The lift thickness will depend on the type of compaction equipment used to backfill utility trenches.

We recommend that all underground utility trenches aligned nearly parallel with new foundations be at least three feet from the outer edge of foundations, wherever possible. Trenches should not encroach into the zone extending outward at a one horizontal to one vertical (1H:1V) inclination below the bottom of foundations. The intent of these recommendations is to prevent loss of both lateral and vertical support of foundations, resulting in possible settlement.

5.6. Foundations

Based on the subsurface conditions encountered at the boring and CPT locations, the foundations may consist of shallow spread foundations on an improved subgrade. Fence posts, canopies, light standards and other ancillary structures that will proportionally support more lateral loading than axial loading may be supported upon a deep foundation system consisting of drilled, cast-in-place reinforced concrete piers (drilled piers). Therefore, our recommendations for shallow spread foundations on an improved subgrade and drilled pier recommendations are provided below.

The buildings may be supported on a conventional shallow foundation system with an interior slab-on-grade floor, provided the building pad areas are over-excavated and constructed in accordance with the recommendations included in the Subgrade Preparation section of this report. Below we have provided recommendations for conventional shallow foundations supported on an over-excavated building pad. The Geotechnical Engineer should be given the opportunity to review final grading plans and foundation plans to determine if the intent of our recommendations has been properly implemented into those documents.

5.6.1 Conventional Shallow Foundations on Over-Excavated Building Pads

The planned buildings may be supported upon a continuous perimeter foundation with continuous and/or isolated interior spread foundations embedded at least 18 inches below lowest adjacent soil

grade, provided the subgrade has been prepared in accordance with the Subgrade Preparation and Engineered Fill Construction sections of this report. Lowest soil grade is defined as either the adjacent exterior soil grade or the soil subgrade beneath the building, whichever is lower. Continuous foundations should maintain a minimum width of 12 inches and isolated spread foundations should be at least 24 inches in plan dimension.

Foundations constructed as described above may be sized utilizing a net allowable bearing capacity of 3000 pounds per square foot (psf) for dead plus live loads. This value may be increased by 1/3 to include wind or seismic forces. The weight of foundation concrete extending below the lowest adjacent soil grade may be disregarded in sizing computations.

The project structural engineer should determine the final dimensions and structural reinforcement of the foundations.

Resistance to lateral foundation displacement may be computed using an allowable friction factor of 0.35 which may be multiplied by the effective vertical load on each foundation.

Additional lateral resistance may be computed using an allowable passive earth pressure of 300 psf per foot of depth. These two modes of resistance should not be added unless the frictional value is reduced by 50 percent since full mobilization of these resistances typically occurs at different degrees of horizontal movement.

We estimate total static settlement for shallow footing foundations using the recommended maximum net allowable bearing pressure presented above, should be less than ¾ inch. Static differential settlements are estimated to be about one-half (½) the total settlement. These settlement estimates are based on the available boring information, our experience with similar structures and soil conditions, and field verification of suitable bearing soils by our firm during foundation construction.

5.6.2 Drilled Piers

Drilled, cast-in-place piers (drilled piers) may be used to support the proposed structures. Drilled piers should be at least 24 inches in diameter and extend to at least five feet below the existing ground surface. Drilled piers may be sized utilizing a maximum allowable vertical bearing capacity of 4000 psf

or an allowable skin friction of 300 psf for dead plus live loads, which may be applied over the surface of the pier extending deeper than 12 inches below grade. Those values may be increased by one-third to include short-term wind or seismic forces. The weight of foundation concrete below grade may be disregarded in sizing computations.

We recommend that adjacent piers be constructed no closer than three pier diameters apart, as measured between centers of the piers. Drilled pier foundations should be structurally isolated from any adjacent concrete flatwork by a felt strip or similar material.

Uplift resistance of the pier foundations may be computed assuming the following resisting forces, where applicable: 1) the unit weight of foundation concrete (150 pound per cubic foot); and, 2) uplift resistance of 300 psf applied over the shaft area of the pier. Increased uplift resistance can be achieved by increasing the diameter of the pier or increasing the depth of the embedment depth.

Sizing of drilled piers to resist lateral loads can be evaluated using Section 1807A.3.2 of the 2022 CBC. An allowable value of 250 pcf for lateral bearing as defined in Table 1806A.2 of the CBC may be used for the coefficients S_1 and S_3 for the nonconstrained and constrained conditions, respectively. Per Section 1806A.1 of the 2022 CBC, an increase of 1/3 is permitted when using the alternate load combinations in Section 1605A.3.2 that include wind or earthquake loads. The upper 12 inches of the subgrade should be neglected unless the drilled pier is surrounded by at least three feet of concrete on all sides.

Lateral resistance of drilled piers can also be evaluated by determining the shear, moment and deflection of the pier using a computer model of the pier and soil (i.e., LPILE). Such an analysis is beyond the current scope of this evaluation and can be accomplished after the dimensions of the piers and loading conditions are known, if desired.

The bottom of the pier excavations should be free of loose or disturbed soils prior to placement of the concrete. Cleaning of the bearing surface may be done mechanically with the belling bucket, but should be verified by the geotechnical engineer prior to concrete placement.

Reinforcement and concrete should be placed in the pier excavations as soon as possible after excavation is completed to reduce the potential of sidewall caving into the excavations.

To reduce lateral movement of the drilled shafts, it is necessary to place the concrete for the drilled shafts in intimate contact with the surrounding soil. Any voids or enlargements in the shafts due to over-excavation or temporary casing installation shall be filled with concrete at the time the shaft concrete is placed.

If the drilled piers are constructed in the "dry" (with dry being less than two inches of water at the base of the excavation), the concrete may be placed by the free-fall method, using a short hopper or back-chute to direct the concrete flow out of the truck into a vertical stream of flowing concrete with a relatively small diameter. The stream should be directed to avoid hitting the sides of the excavation or any reinforcing cages. For the free-fall method of concrete placement, we recommend the concrete mix be designed with a slump of five to seven inches.

In general, we anticipate the drilled pier excavations will be relatively dry for pier excavations. However, perched groundwater may be encountered depending on the time of year when the piers are excavated. Where perched groundwater will not be controlled such that more than six inches of water accumulates at the bottom of the pier excavation and after it is confirmed that the excess water cannot be removed from the caisson excavation by bailing or with pumps, concrete should be placed using a tremie. For concrete placed using the tremie method, a slump of six to eight inches, and a maximum aggregate size of ¾-inch is recommended. The required slump should be obtained by using plasticizers or water-reducing agents. Addition of water on-site to establish the recommended slump should not be allowed.

When extracting temporary casings or tremie methods from the excavation, care should be taken to maintain a head of concrete to prevent infiltration of water and soil into the shaft area. The head of concrete should always be greater than the head of water trapped outside the pier or tremie, taking into account the differences in unit weights of concrete and water.

We estimate total settlement for drilled pier foundations using the recommended maximum net allowable bearing pressure and allowable capacities presented above, will be less than one inch. Differential settlements may be as much as the total settlement between individual pier elements. The settlement estimates are based on the available soil information, our experience with similar structures and soil conditions, and field verification of suitable bearing soils during foundation construction.

5.7. Interior Floor Slab Support

Interior concrete slab-on-grade floors can be supported upon the soil subgrade prepared in accordance with the recommendations in this report and maintained in that condition (at least the optimum moisture content). Interior concrete slab-on-grade floors should be at least four inches thick and contain reinforcement for crack control. Final reinforcement and joint spacing should be determined by the project structural engineer. Proper and consistent location of the reinforcement near mid-slab is essential to its performance. The risk of uncontrolled shrinkage cracking is increased if the reinforcement is not properly located within the slab.

Floor slabs should be underlain by a layer of free-draining crushed rock, serving as a deterrent to migration of capillary moisture. The crushed rock layer should be between four and six inches thick and graded such that 100 percent passes a one-inch sieve and no appreciable amount passes a No. 4 sieve. Additional moisture protection may be provided by placing a vapor retarder membrane (at least 10-mils thick) directly over the crushed rock. The membrane should meet or exceed the minimum specifications as outlined in ASTM E1745 and be installed in strict conformance with the manufacturer's recommendations.

Floor slab construction over the past 30 years or more has included placement of a thin layer of sand or pea gravel over the vapor retarder membrane. The intent of the sand or pea gravel is to aid in the proper curing of the slab concrete and to protect the membrane prior to concrete placement. However, debate over excessive moisture vapor emissions from floor slabs includes concern for water trapped within the sand or pea gravel. Therefore, we consider the use of the sand or pea gravel layer as optional and not required from a geotechnical perspective. The concrete curing benefits should be weighed against efforts to reduce slab moisture vapor transmission.

The recommendations presented above are intended to mitigate any significant soils-related cracking of the slab-on-grade floors. More important to the performance and appearance of a Portland cement concrete slab is the quality of the concrete, the workmanship of the concrete contractor, the curing techniques utilized, and the spacing of control joints.

5.8. Floor Slab Moisture Penetration Resistance

It is considered likely that floor slab subgrade soils will become wet to near saturated at some time during the life of structures. This is a certainty when slabs are constructed during the wet seasons, or when constantly wet ground or poor drainage conditions exist adjacent to structures. For this reason, it should be assumed that interior slabs intended for moisture-sensitive floor coverings or materials, require protection against moisture or moisture vapor penetration. Standard practice includes the gravel/crushed rock and vapor retarder as suggested above. However, the gravel/crushed rock and plastic membrane offer only a limited, first line of defense against soil-related moisture; they do not moisture-proof the slab. Recommendations contained in this report concerning foundation and floor slab design are presented as minimum requirements, only from the geotechnical engineering standpoint.

It is emphasized that the use of gravel/crushed rock and plastic membrane below the slab will not "moisture proof" the slab, nor does it assure that slab moisture transmission levels will be low enough to prevent damage to floor coverings or other building components. If increased protection against moisture vapor penetration of slabs is desired, a concrete moisture protection specialist should be consulted. The design team should consider all available measures for slab moisture protection. It is commonly accepted that maintaining the lowest practical water-cement ratio in the slab concrete is one of the most effective ways to reduce future moisture vapor penetration of the completed slabs.

5.9. Exterior Flatwork Construction

Soil subgrades supporting exterior concrete flatwork (i.e., sidewalks, courtyards, etc.) should be brought to at least the optimum moisture content and uniformly compacted to at least 90 percent of the ASTM D1557 maximum dry density prior to the placement of the aggregate base.

Exterior concrete flatwork should be at least four inches thick in pedestrian traffic areas and underlain by at least four inches of aggregate base compacted to at least 90 percent of the ASTM D1557 maximum dry density. Exterior concrete flatwork that will support occasional vehicular traffic should be at least six inches thick and underlain by at least six inches of aggregate base compacted to at least 95 percent of the ASTM D1557 maximum dry density.

Proper moisture conditioning of the subgrade soils is considered important to the performance of exterior flatwork. Expansion joints should be provided to allow for minor vertical movement of the flatwork. Exterior flatwork should be constructed independent of the perimeter building foundation and isolated column foundations by the placement of a layer of felt material between the flatwork and the foundation.

Consideration should be given to thickening the edges of exterior flatwork to at least twice the slab thickness. Flatwork reinforcement for crack control, if desired, should be determined by the structural engineer.

Our recommendations are intended to reduce the effects of variable soil subgrade conditions in exterior concrete flatwork areas. However, some seasonal movement of exterior flatwork should be anticipated where flatwork is adjacent to landscape areas.

Areas adjacent to new exterior flatwork should be landscaped to maintain more uniform soil moisture conditions adjacent to and beneath flatwork. We recommend final landscaping plans not allow fallow ground adjacent to exterior concrete flatwork.

Practices recommended by the Portland Cement Association (PCA) for proper placement, curing, joint depth and spacing, construction, and placement of concrete should be followed during exterior concrete flatwork construction.

5.10. Pavement Design

The following pavement sections have been calculated based on an R-value of 40 and the procedures contained within Chapters 600 to 670 of the California Highway Design Manual, 6th edition, utilizing design Traffic Indices (TIs) considered appropriate for the proposed improvements. The project Civil Engineer should determine the appropriate TI based on anticipated traffic conditions. New pavements should match adjacent pavement sections or be constructed in accordance with the pavement sections in Table 7 below, whichever is greater.

Table 7: Pavement Design Alternatives

Traffic Index (TI)	Pavement Use	Pavement Subgrades R-value = 40	
		Type A Asphalt Concrete (inches)	Class 2 Aggregate Base (inches)
4.5	Automobile Parking	2½*	4.0
6.0	Entry-Exit Drives, Truck Traffic, and Fire Lanes	3	7.0
		3½*	6.0

Notes: * = Asphalt concrete thickness includes Caltrans factor of safety.

We emphasize that the performance of pavements is critically dependent upon uniform and adequate compaction of the soil subgrade, as well as all engineered fill and utility trench backfill within the limits of the pavements. Pavement subgrade preparation (i.e., scarification, moisture conditioning and compaction), should be performed after underground utility construction is completed and just prior to aggregate base placement. The upper six inches of pavement subgrade soils should be compacted to at least 95 percent relative compaction at no less than the optimum moisture content (ASTM D1557).

Pavement subgrades should be proof-rolled with a fully-loaded, water truck prior to placement of aggregate base to identify soft/unstable areas that may require removal and re-compaction. All aggregate base should be compacted to at least 95 percent of the ASTM D1557 maximum dry density. Materials quality and construction of the structural section should conform to the applicable provisions of the Caltrans Standard Specifications, latest editions.

In the summer heat, high axle loads coupled with shear stresses induced by sharply turning tire movements can lead to failure in asphalt concrete pavements. Therefore, we recommend that consideration be given to using PCC pavements in areas subjected to concentrated heavy wheel loading, such as entry driveways and in front of trash enclosures. The PCC pavements should be at least six inches of PCC pavement, supported on at least four inches of compacted Class 2 aggregate base over the prepared subgrade.

Efficient drainage of all surface water to avoid infiltration and saturation of the supporting aggregate base and subgrade soils is important to pavement performance. Weep holes could be provided at drainage inlets, located at the subgrade/base interface, to allow accumulated water to drain from beneath the pavements. Consideration should be given to using full-depth curbs between landscaped areas and pavements to serve as a cut-off for water that could migrate into the pavement base materials or subgrade soils.

It has been our experience that pavement failures may occur where a non-uniform or disturbed subgrade soil condition is created. Subgrade disturbances can result if pavement subgrade preparation is performed prior to underground utility construction and/or if a significant time period passes between subgrade preparation and placement of aggregate base. Therefore, we recommend that final pavement subgrade preparation (i.e., scarification, moisture conditioning, and compaction) be performed just prior to aggregate base placement.

We suggest considering the use of full depth curbs where pavements abut landscaping. The curbs should extend to at least the surface of the soil subgrade. Weep holes also could be provided at storm drain drop inlets, located at the subgrade-base interface, to allow water to drain from beneath the pavements.

5.11. Site Drainage

Final site grading should be accomplished to provide positive drainage of surface water away from the buildings and prevent ponding of water adjacent to foundations, slabs, or pavements. Subgrades adjacent to buildings should be sloped away from foundations at a minimum two percent gradient for at least 10 feet, where possible.

We recommend connecting all roof drains to solid PVC pipes which are connected to available drainage features to convey water away from the structures, or discharging the drains onto paved, or hard surfaces that slope away from the foundations. Discharging or ponding of surface water should not be allowed adjacent to buildings, exterior flatwork or onto slope surfaces. Landscape berms, if planned, should not be constructed in such a manner as to promote drainage toward buildings.

5.12. Geotechnical Engineering Observation and Testing During Construction

Site preparation should be accomplished in accordance with the recommendations of this report. Representatives of the Geotechnical Engineer should be present during site preparation and all grading operations to observe and test the fill to verify compliance with our recommendations and the project specifications.

Section 1809.5.8 Compacted Fill Material of the 2022 CBC requires that the geotechnical engineering report provide a number and frequency of field compaction tests to determine compliance with the recommended minimum compaction. Many factors can affect the number of tests that should be performed during the course of construction, such as soil type, soil moisture, season of the year and contractor operations/performance. Therefore, it is crucial that the actual number and frequency of testing be determined by the Geotechnical Engineer during construction based on their observations, site conditions, and construction conditions encountered.

The Geotechnical Engineer of Record (GEOR) for construction shall be retained by the Owner to provide consulting services during construction and whose representatives shall perform required testing and inspection during construction. In the event that our firm is not retained to provide geotechnical engineering observation and testing services during construction, the Geotechnical Engineer retained to provide these services must indicate in writing that they agree with the recommendations of this report, or prepare supplemental recommendations as necessary. A final report by the Geotechnical Engineer of Record retained to provide construction testing services should be prepared upon completion of the project.

5.13. Additional Services

We recommend that our firm be retained to review the final plans and specifications to determine if the intent of our recommendations has been implemented in those documents. We would be pleased to submit a proposal to provide these services upon request.

6. LIMITATIONS

Our recommendations are based upon the information provided regarding the proposed construction, combined with our analysis of site conditions revealed by the field exploration and laboratory testing programs. We have used prudent engineering and geologic judgment based upon the information provided and the data generated from our investigation. This report has been prepared in substantial compliance with generally accepted geotechnical engineering practices that exist in the area of the project at the time the report was prepared. No warranty, either express or implied, is provided.

If the proposed construction is modified or relocated or, if it is found during construction that subsurface conditions differ from those we encountered at our boring locations, we should be afforded the opportunity to review the new information or changed conditions to determine if our conclusions and recommendations must be modified.

We emphasize that this report is applicable only to the proposed construction and the investigated site. This report should not be utilized for construction on any other site. This report is considered valid for the proposed construction for a period of two years following the date of this report. If construction has not started within two years, we must re-evaluate the recommendations of this report and update the report, if necessary.

Universal Engineering Sciences

Abigail M. Heagy
Staff Geologist

Matthew S. Moyneur
Senior Engineer

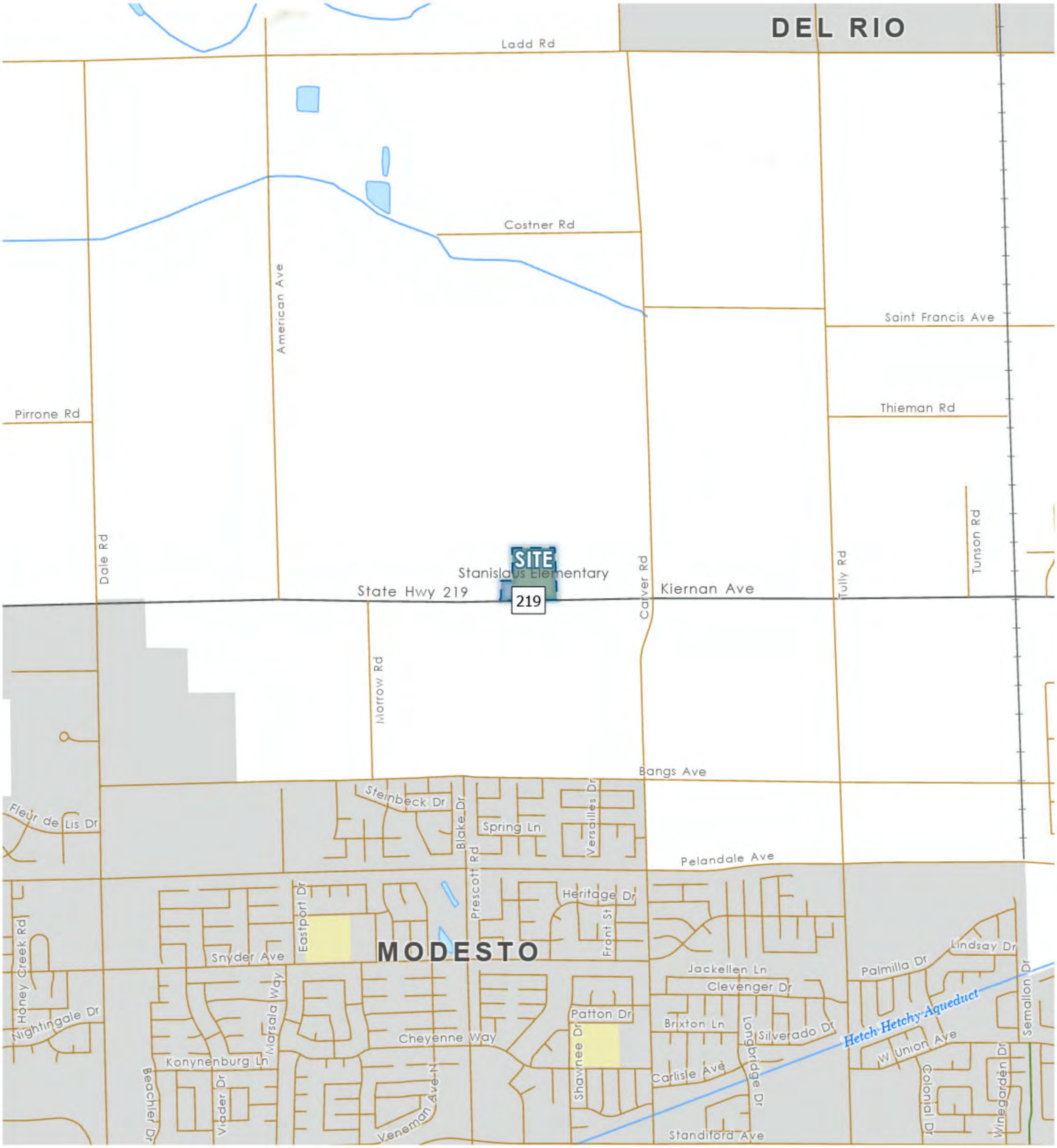
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FIGURES



Spatial Data provided by Esri, NOAA, and USGS.
Projection: NAD 1983 2011 StatePlane California II FIPS 0402 Ft US

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VICINITY MAP

STANISLAUS ELEMENTARY REPLACEMENT SCHOOL

Modesto, California

FIGURE	1
DRAWN BY	AMH
CHECKED BY	JRY
PROJECT MGR	MSM
DATE	04/2023
4730.2300008.0016	



B-B' Approximate CPT Locations

A-A' Approximate Boring Locations

N

0 75 150

Feet

Adapted from Site Plan provided by RGM Kramer and drawn by Design California West

Aerial imagery provided by Esri.
Projection: NAD 1983 2011 StatePlane California II FIPS 0402 Ft US

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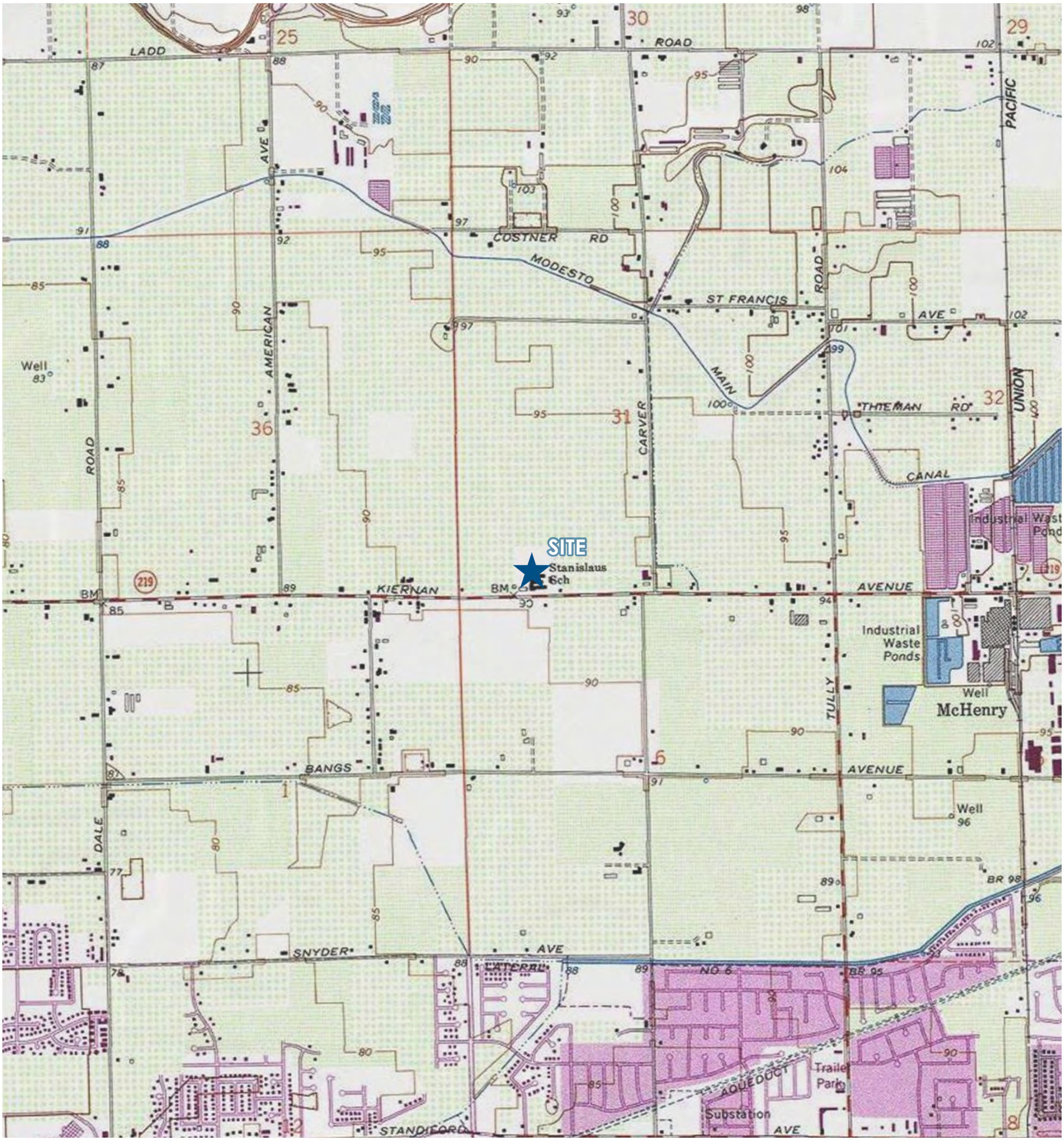
SITE PLAN

STANISLAUS ELEMENTARY REPLACEMENT SCHOOL

Modesto, California

FIGURE	2
DRAWN BY	AMH
CHECKED BY	JRY
PROJECT MGR	MSM
DATE	05/2023

4730.2300008.0016



Approximate Site Location

N

0 1,000 2,000

Feet

Topographic Basemap Adapted from the USGS 7.5' Digital Map Series
Projection: NAD 1983 2011 StatePlane California II FIPS 0402 Ft US

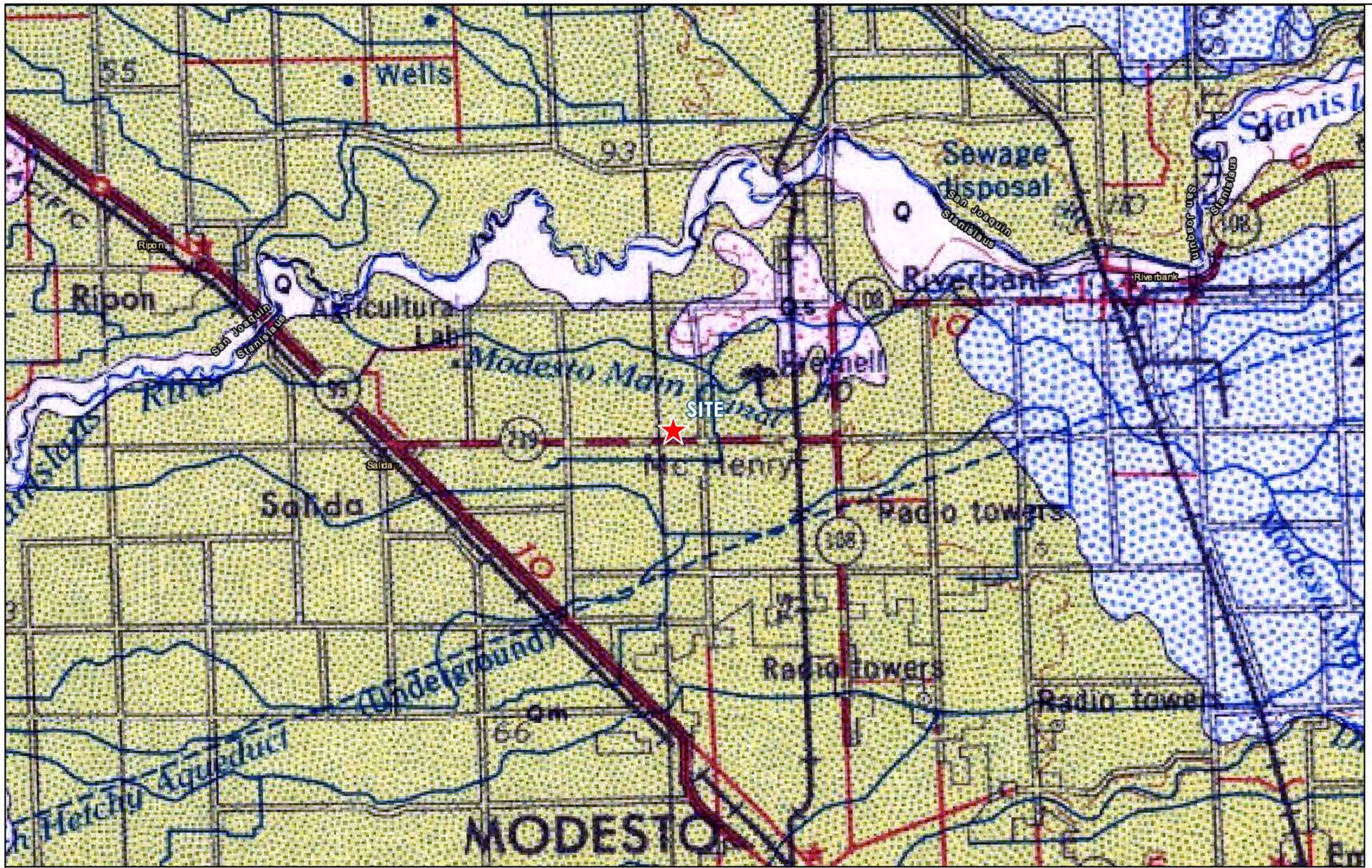
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TOPOGRAPHIC MAP

STANISLAUS ELEMENTARY REPLACEMENT SCHOOL

Modesto, California

FIGURE	3
DRAWN BY	AMH
CHECKED BY	JRY
PROJECT MGR	MSM
DATE	04/2023
4730.2300008.0016	



ABBREVIATED EXPLANATION

Approximate Stratigraphic relationships only; see Geologic Map Explanation for more accurate age determinations and unit descriptions

Q	Alluvium
Qs	Dune Sand
Qm	Modesto Formation
Qr	Riverbank Formation

★ Approximate Site Location

N

0 5,000 10,000
Feet

Adapted from the California Division of Mines and Geology Geologic Map of the San Francisco-San Jose Quadrangle, Wagner et. al. 1991
Aerial imagery provided by Esri.
Projection: NAD 1983 StatePlane California II FIPS 0402 FT US

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GEOLOGIC MAP

STANISLAUS ELEMENTARY REPLACEMENT SCHOOL

Modesto, California

FIGURE	4
DRAWN BY	AMH
CHECKED BY	JRY
PROJECT MGR	MSM
DATE	03/2023
4730.2300008.0016	

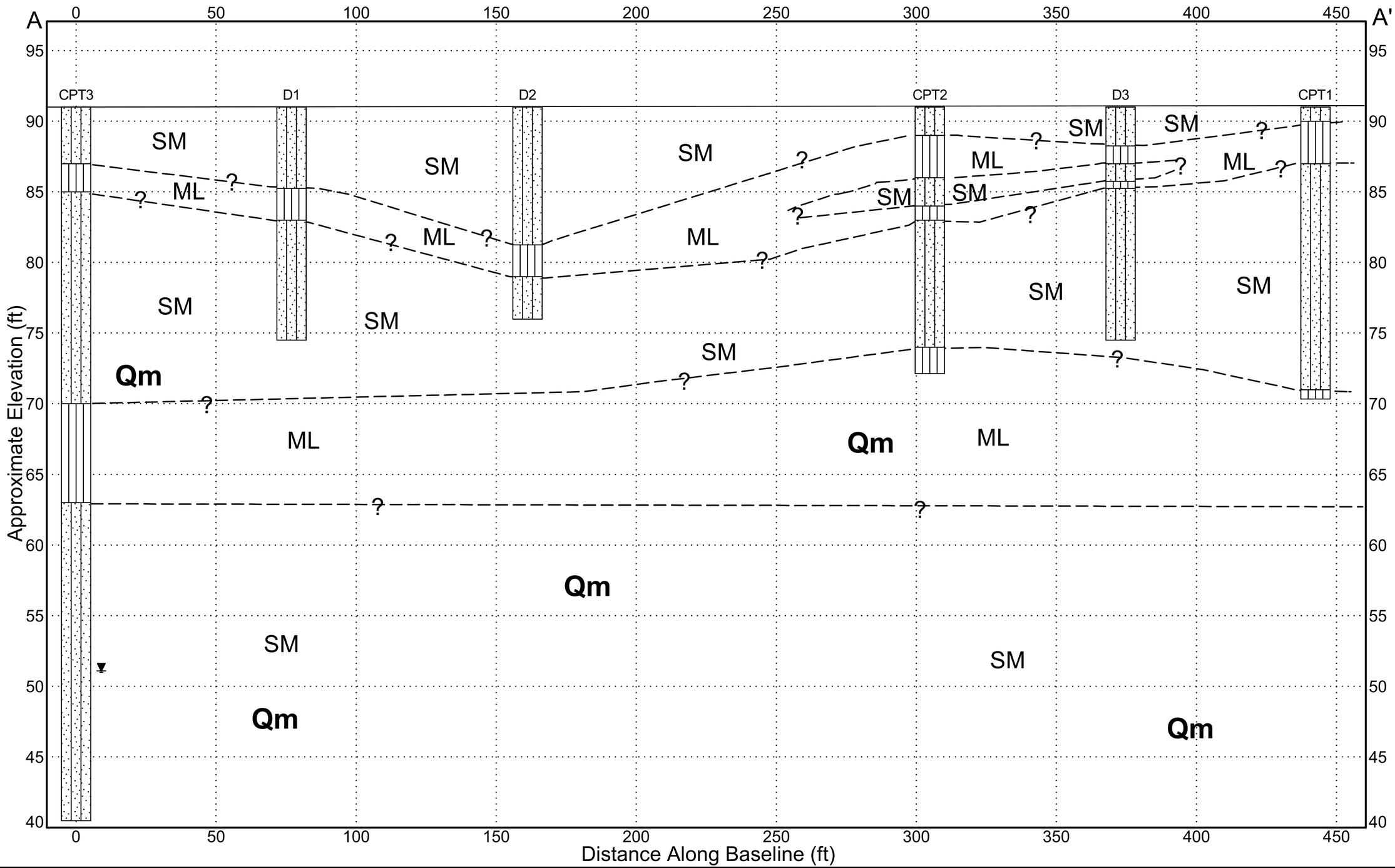
Universal Engineering Sciences
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West Sacramento, California 95691

GEOLOGIC CROSS SECTION
FIGURE 5A

PROJECT NAME Stanislaus Elementary Replacement School

PROJECT NUMBER 4730.2300008.0016

PROJECT LOCATION Modesto, California



EXPLANATION

The above layers are interpreted to be part of the Modesto Formation (Qm).
Geologic Contacts are considered approximate based on subsurface boring data.
Elevations, depths and locations are approximate.

(XX) = Dominant soil types and symbols (USCS shorthand after ASTM D2487-5)*.
*Detailed soil boring logs and descriptions available in Figures 8 through 13.
▼ = Approximate ground water elevation encountered during drilling.

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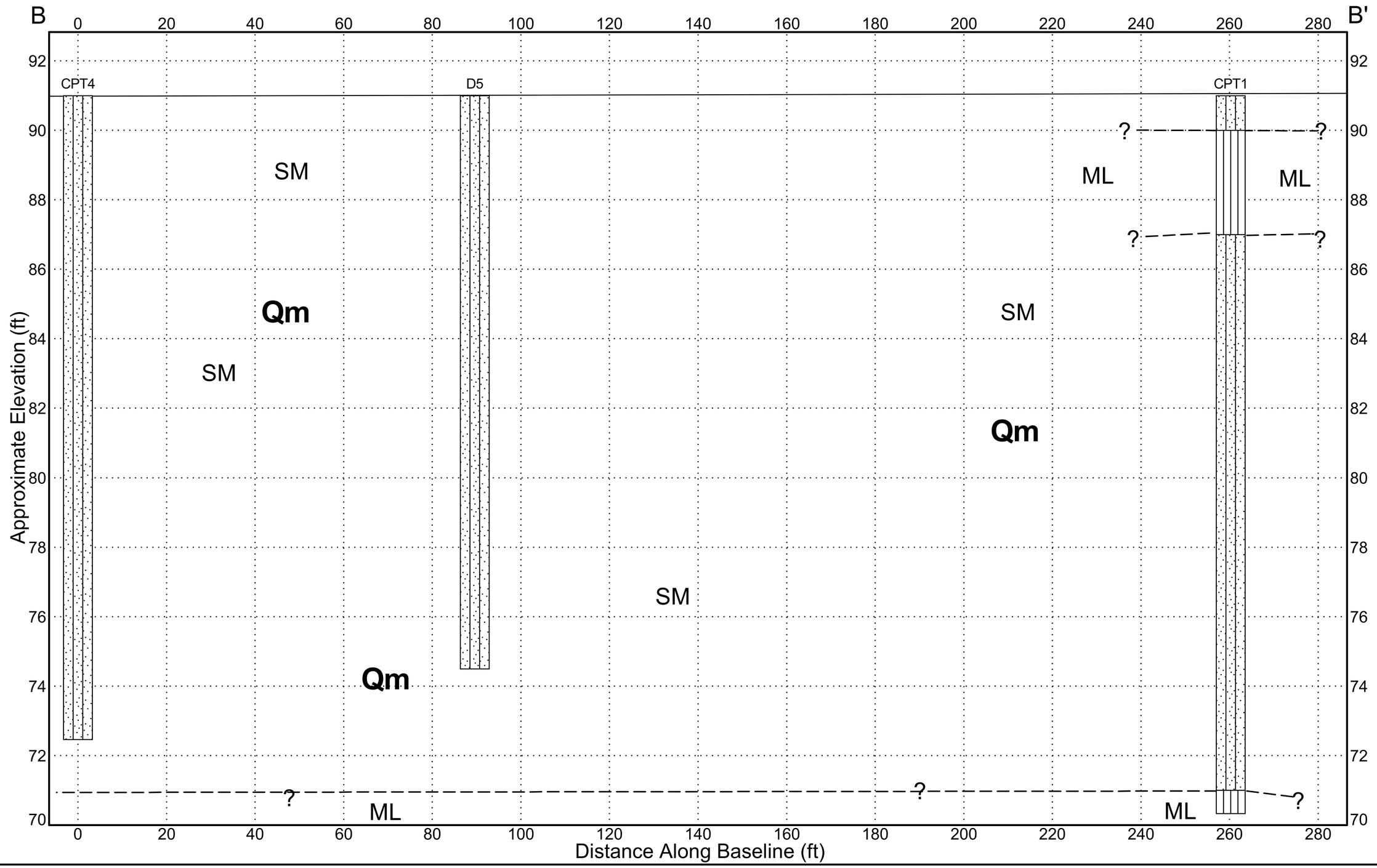
Universal Engineering Sciences
3050 Industrial Boulevard
West Sacramento, California 95691

GEOLOGIC CROSS SECTION
FIGURE 5B

PROJECT NAME Stanislaus Elementary Replacement School

PROJECT NUMBER 4730.2300008.0016

PROJECT LOCATION Modesto, California

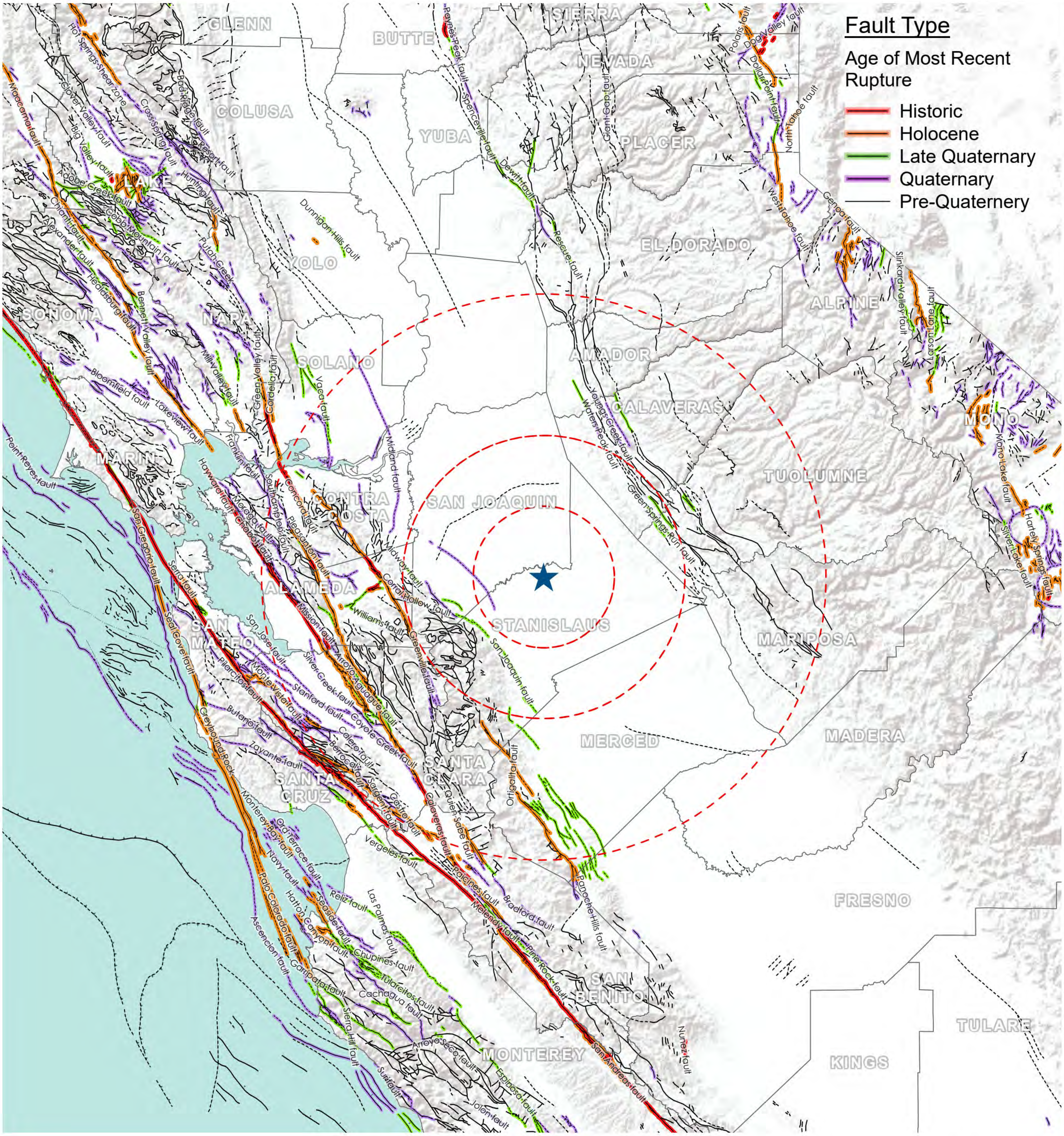


EXPLANATION

The above layers are interpreted to be part of the Modesto Formation (Qm).
Geologic Contacts are considered approximate based on subsurface boring data.
Elevations, depths and locations are approximate.

(XX) = Dominant soil types and symbols (USCS shorthand after ASTM D2487-5)*.
*Detailed soil boring logs and descriptions available in Figures 8 through 13.
▼ = Approximate ground water elevation encountered during drilling.

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Fault locations adapted from the Fault activity Map
of California (C.W. Jennings, 2010).
Basemap data provided by Esri and State of California.
Projection: NAD 1983 2011 California Teale Albers

★ Approximate Project Location

N

0 40
Kilometers

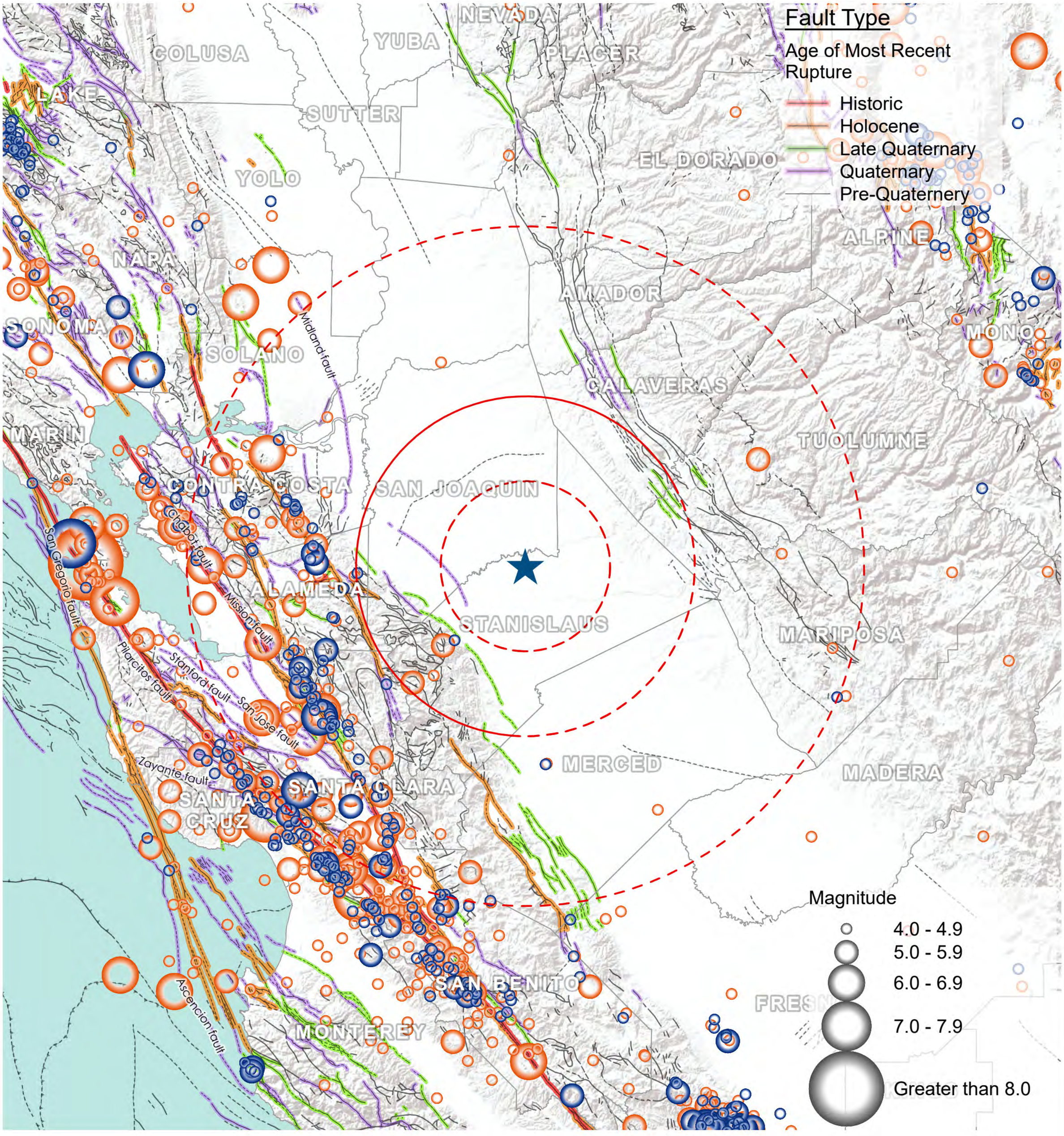
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FAULT ACTIVITY MAP

STANISLAUS ELEMENTARY REPLACEMENT SCHOOL

Modesto, California

FIGURE	6
DRAWN BY	AMH
CHECKED BY	JRY
PROJECT MGR	MSM
DATE	04/2023
4730.2300008.0016	



Epicenters from EQ Search 12/2016, and USGS 2016.
Fault locations adapted from the Fault activity Map of California (C.W. Jennings, 2010).
Basemap data provided by Esri and State of California.
Projection: NAD 1983 2011 California Teale Albers

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EPICENTER MAP

STANISLAUS ELEMENTARY REPLACEMENT SCHOOL

Modesto, California

FIGURE	7
DRAWN BY	AMH
CHECKED BY	JRY
PROJECT MGR	MSM
DATE	04/2023
4730.2300008.0016	

Project: Stanislaus Elementary Replacement School
Project Location: Modesto, California
Project Number: 4730.2300008.0016

LOG OF SOIL BORING D1

Sheet 1 of 1

Date(s) Drilled	**4/7/23**	Logged By	**AMH**	Checked By	**MSM**
Drilling Method	**Solid Flight Auger**	Drilling Contractor	**V&W Drilling**	Total Depth of Drill Hole	**16.5 feet**
Drill Rig Type	**CME 75**	Diameter(s) of Hole, inches	**6"**	Approx. Surface Elevation, ft WGS84	**91.0**
Groundwater Depth [Elevation], feet	**Groundwater Not Encountered**	Sampling Method(s)	**2.0" Modified California with 6-inch sleeve**	Drill Hole Backfill	**Neat Cement**
Remarks	**Bulk @ 0'-5'** **Qm: Modesto Formation**			Driving Method and Drop	**140lb auto. hammer with 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE NUMBER	NUMBER OF BLOWS	TEST DATA: MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
			Reddish brown, moist, loose, silty fine-to-coarse SAND (SM)						
90	1								
	2				Bulk@0'-5 D1-1I	6	8.7	105	FC= 29.2%
	3								
	4								
	5								
			with trace fine gravel						
85	6		Grayish brown with orange mottling, moist, dense, sandy SILT (ML)		D1-2I	45	28.6	80	
	7								
	8		Yellowish brown, moist, medium dense, fine-to-medium SAND (SM) with silt						
	9								
	10								
80	11				D1-3I	12	8.0	88	
	12								
	13								
	14								
	15								
75	16		same with increasing fines content		D1-4I	23	4.9	95	
			Boring terminated at approximately 16½ feet below the existing ground surface. No Groundwater encountered.						

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FIGURE 8

Project: Stanislaus Elementary Replacement School
Project Location: Modesto, California
Project Number: 4730.2300008.0016

LOG OF SOIL BORING D2

Sheet 1 of 1

Date(s) Drilled	**4/7/23**	Logged By	**AMH**	Checked By	**MSM**
Drilling Method	**Solid Flight Auger**	Drilling Contractor	**V&W Drilling**	Total Depth of Drill Hole	**15.0 feet**
Drill Rig Type	**CME 75**	Diameter(s) of Hole, inches	**6"**	Approx. Surface Elevation, ft WGS84	**91.0**
Groundwater Depth [Elevation], feet	**Groundwater Not Encountered**	Sampling Method(s)	**2.0" Modified California with 6-inch sleeve**	Drill Hole Backfill	**Neat Cement**
Remarks	**Bulk @ 0'-5'** **Qm: Modesto Formation**			Driving Method and Drop	**140lb auto. hammer with 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE NUMBER	NUMBER OF BLOWS	TEST DATA: MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
90	1		Brown, moist, very loose, silty fine SAND (SM)						
	2				D2-1I Bulk@0'-5'	4	8.2	97	
	3								
	4		reddish brown, silty fine-to-coarse sand		D2-2I	6			
85	5								
	6								
	7								
	8								
	9				D2-3I	21	34.2	81	
80	10		Grayish brown, moist, medium dense, sandy SILT (ML)						
	11								
	12		Grayish yellow, moist, very dense, silty fine-to-coarse SAND (SM)						
	13								
	14				D2-4I	45	5.4	96	
	15		Boring terminated at approximately 15 feet below the existing ground surface. No groundwater encountered.						

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FIGURE 9

Project: Stanislaus Elementary Replacement School
Project Location: Modesto, California
Project Number: 4730.2300008.0016

LOG OF SOIL BORING D3

Sheet 1 of 1

Date(s) Drilled	**4/7/23**	Logged By	**AMH**	Checked By	**MSM**
Drilling Method	**Solid Flight Auger**	Drilling Contractor	**V&W Drilling**	Total Depth of Drill Hole	**16.5 feet**
Drill Rig Type	**CME 75**	Diameter(s) of Hole, inches	**6"**	Approx. Surface Elevation, ft WGS84	**91.0**
Groundwater Depth [Elevation], feet	**Groundwater Not Encountered**	Sampling Method(s)	**2.0" Modified California with 6-inch sleeve**	Drill Hole Backfill	**Neat Cement**
Remarks	**Bulk @ 0'-5'** **Qm: Modesto Formation**			Driving Method and Drop	**140lb auto. hammer with 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE NUMBER	NUMBER OF BLOWS	TEST DATA: MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
	0		Brown, moist, silty fine SAND (SM)						
90	1								
	2				Bulk@0'-5				
	3		Gray with orange mottling, moist, medium dense, slightly cemented SILT (ML) with calcification		D3-1I	33	7.2	89	
	4		Brown, moist, medium dense, silty fine SAND (SM)						
	5		Olive gray, moist, medium dense, sandy silt (ML)						
85	6		Grayish brown, moist, medium dense, silty fine SAND (SM)		D3-2I	28	8.3	102	
	7								
	8								
	9								
	10								
80	11		yellowish brown		D3-3I	25	5.1	95	
	12								
	13								
	14								
	15								
75	16		fine to coarse		D3-4I	15	5.1	94	
			Boring terminated at approximately 16½ feet below the existing ground surface. No groundwater encountered.						

BORING LOG 4730.2300008.0016 - STANISLAUS ES.GPJ WKA.GDT 6/1/23 2:51 PM

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FIGURE 10

Project: Stanislaus Elementary Replacement School
Project Location: Modesto, California
Project Number: 4730.2300008.0016

LOG OF SOIL BORING D4

Sheet 1 of 1

Date(s) Drilled	**4/7/23**	Logged By	**AMH**	Checked By	**MSM**
Drilling Method	**Solid Flight Auger**	Drilling Contractor	**V&W Drilling**	Total Depth of Drill Hole	**15.0 feet**
Drill Rig Type	**CME 75**	Diameter(s) of Hole, inches	**6"**	Approx. Surface Elevation, ft WGS84	**91.0**
Groundwater Depth [Elevation], feet	**Groundwater Not Encountered**	Sampling Method(s)	**2.0" Modified California with 6-inch sleeve**	Drill Hole Backfill	**Neat Cement**
Remarks	**Bulk @ 0'-5'** **Qm: Modesto Formation**			Driving Method and Drop	**140lb auto. hammer with 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE NUMBER	NUMBER OF BLOWS	TEST DATA: MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
90	1		Brown, moist, loose, sandy SILT (ML) with observed voids in sample						
	2				D4-1I Bulk@0'-5'	5	13.3	95	
	3								
	4		light greyish brown; medium dense; increased sand content		D4-2I	21	14.6	99	
	5								
85	6								
	7		Brown, moist, silty CLAY (CL)						
	8								
	9		Olive brown with orange mottling, moist, very dense, fine sandy SILT (ML)		D4-3I	64	30.5	88	FC= 80.3%
	10								
80	11		Yellow to grayish brown, moist, medium dense, silty fine-to-medium SAND (SM)						
	12								
	13								
	14				D4-4I	31	7.2	94	
	15		Boring terminated at approximately 15 feet below the existing ground surface. No groundwater encountered.						

BORING LOG 4730.2300008.0016 - STANISLAUS ES.GPJ WKA.GDT 6/1/23 2:51 PM

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FIGURE 11

Project: Stanislaus Elementary Replacement School
Project Location: Modesto, California
Project Number: 4730.2300008.0016

LOG OF SOIL BORING D5

Sheet 1 of 1

Date(s) Drilled	**4/7/23**	Logged By	**AMH**	Checked By	**MSM**
Drilling Method	**Solid Flight Auger**	Drilling Contractor	**V&W Drilling**	Total Depth of Drill Hole	**16.5 feet**
Drill Rig Type	**CME 75**	Diameter(s) of Hole, inches	**6"**	Approx. Surface Elevation, ft WGS84	**91.0**
Groundwater Depth [Elevation], feet	**Groundwater Not Encountered**	Sampling Method(s)	**2.0" Modified California with 6-inch sleeve**	Drill Hole Backfill	**Neat Cement**
Remarks	**Bulk @ 0'-5' Qm: Modesto Formation**			Driving Method and Drop	**140lb auto. hammer with 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE NUMBER	NUMBER OF BLOWS	TEST DATA: MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
90	1		Brown, moist, very loose, silty fine to medium sand (SM)						
	2				Bulk@0'-5 D5-1I	2			FC= 40.8 %
	3								
	4								
	5								
85	6		yellowish brown to greyish brown with orange mottling; loose		D5-2I	8	13.7	96	
	7								
	8								
	9								
	10		Reddish brown, moist, medium dense, silty fine to medium SAND (SP-SM) with silt		D5-3I	22	5.1	94	FC=4.7%
80	11								
	12								
	13								
	14								
	15								
75	16		light yellowish brown to gray		D5-4I	24	12.1	90	
			Boring terminated at approximately 16½ feet below the existing ground surface. No Groundwater encountered.						

BORING LOG 4730.2300008.0016 - STANISLAUS ES.GPJ WKA.GDT 6/1/23 2:51 PM

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FIGURE 12

Project: Stanislaus Elementary Replacement School
Project Location: Modesto, California
Project Number: 4730.2300008.0016

LOG OF SOIL BORING D6

Sheet 1 of 1

Date(s) Drilled	**4/7/23**	Logged By	**AMH**	Checked By	**MSM**
Drilling Method	**Solid Flight Auger**	Drilling Contractor	**V&W Drilling**	Total Depth of Drill Hole	**16.5 feet**
Drill Rig Type	**CME 75**	Diameter(s) of Hole, inches	**6"**	Approx. Surface Elevation, ft WGS84	**91.0**
Groundwater Depth [Elevation], feet	**Groundwater Not Encountered**	Sampling Method(s)	**2.0" Modified California with 6-inch sleeve**	Drill Hole Backfill	**Neat Cement**
Remarks	**Bulk @ 0'-5' Qm: Modesto Formation**			Driving Method and Drop	**140lb auto. hammer with 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE NUMBER	NUMBER OF BLOWS	TEST DATA: MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
	0		Brown, moist, very loose, silty fine to medium SAND (SM)						
90	1								
	2				Bulk@0'-5 D6-1I	2	8.0	100	
	3								
	4								
	5		loose; yellowish brown						
85	6				D6-2I	7	7.5	102	
	7								
	8								
	9								
	10		yellowish orange; fine-to-coarse; medium dense						
80	11				D6-3I	14	9.2	87	
	12								
	13								
	14								
	15								
75	16				D6-4I	19	11.3	91	
			Boring terminated at approximately 16½ feet below the existing ground surface. No Groundwater encountered.						

BORING LOG 4730.2300008.0016 - STANISLAUS ES.GPJ WKA.GDT 6/1/23 2:51 PM

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FIGURE 13

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D2487)

MAJOR DIVISIONS		USCS[4]	CODE	CHARACTERISTICS
COARSE GRAINED SOILS (More than 50% of soil > no. 200 sieve size)	GRAVELS[1] (More than 50% of coarse fraction > no. 4 sieve size)	GW		Well-graded gravels or gravel - sand mixtures, trace or no fines
		GP		Poorly graded gravels or gravel - sand mixtures, trace or no fines
		GM		Silty gravels, gravel - sand - silt mixtures, containing little to some fines[2]
		GC		Clayey gravels, gravel - sand - clay mixtures, containing little to some fines[2]
	SANDS[1] (50% or more of coarse fraction < no. 4 sieve size)	SW		Well-graded sands or sand - gravel mixtures, trace or no fines
		SP		Poorly graded sands or sand - gravel mixtures, trace or no fines
		SM		Silty sands, sand - gravel - silt mixtures, containing little to some fines[2]
		SC		Clayey sands, sand - gravel - clay mixtures, containing little to some fines[2]
FINE GRAINED SOILS (50% or more of soil < no. 200 sieve size)	SILTS & CLAYS LL < 50	ML		Inorganic silts, gravely silts, and sandy silts that are non-plastic or with low plasticity
		CL		Inorganic lean clays, gravelly lean clays, sandy lean clays of low to medium plasticity[3]
		OL		Organic silts, organic lean clays, and organic silty clays
	SILTS & CLAYS LL ≥ 50	MH		Inorganic elastic silts, gravelly elastic silts, and sandy elastic silts
		CH		Inorganic fat clays, gravelly fat clays, sandy fat clays of medium to high plasticity
		OH		Organic fat clays, gravelly fat clays, sandy fat clays of medium to high plasticity
HIGHLY ORGANIC SOILS		PT		Peat
ROCK		RX		Rocks, weathered to fresh
FILL		FILL		Artificially placed fill material

OTHER SYMBOLS

= Drive Sample: 2-1/2" O.D. Modified California sampler

= Drive Sampler: no recovery

= SPT Sampler

= Initial Water Level

= Final Water Level

= Estimated or gradational material change line

= Observed material change line

Laboratory Tests

CR = Corrosion
PI = Plasticity Index
EI = Expansion Index
UCC = Unconfined Compression Test (TSF)
TR = Triaxial Compression Test
GR = Gradational Analysis (Sieve/Hydro)
FC = Wash (Fines Content)
PP = Pocket Penetrometer Test (TSF)
PID = Photo Ionization Detector Test (PPM)
RV = Resistance ("R") Value

REF = Refusal (>50 blows in 6 inches)

GRAIN SIZE CLASSIFICATION

CLASSIFICATION	RANGE OF GRAIN SIZES	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDERS (b)	Above 12"	Above 300
COBBLES (c)	12" to 3"	300 to 75
GRAVEL (g) coarse fine	3" to No. 4 3" to 3/4" 3/4" to No. 4	75 to 4.75 75 to 19 19 to 4.75
SAND coarse medium fine	No. 4 to No. 200 No. 4 to No. 10 No. 10 to No. 40 No. 40 to No. 200	4.75 to 0.075 4.75 to 2.00 2.00 to 0.425 0.425 to 0.075
SILT & CLAY	Below No. 200	Below 0.075

Trace - Less than 5 percent
Few - 5 to 10 percent
Little - 15 to 25 percent
Some - 35 to 45 percent
Mostly - 50 to 100 percent

* Percents as given in ASTM D2488

NOTES:

1. Coarse grained soils containing 5% to 12% fines, use dual classification symbol (ex. SP-SM).
2. If fines classify as CL-ML (4<PI<7), use dual symbol (ex. SC-SM).
3. Silty Clays, use dual symbol (CL-ML).
4. Borderline soils with uncertain classification list both classifications (ex. CL/ML).

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UNIFIED SOIL CLASSIFICATION SYSTEM

STANISLAUS ELEMENTARY REPLACEMENT SCHOOL

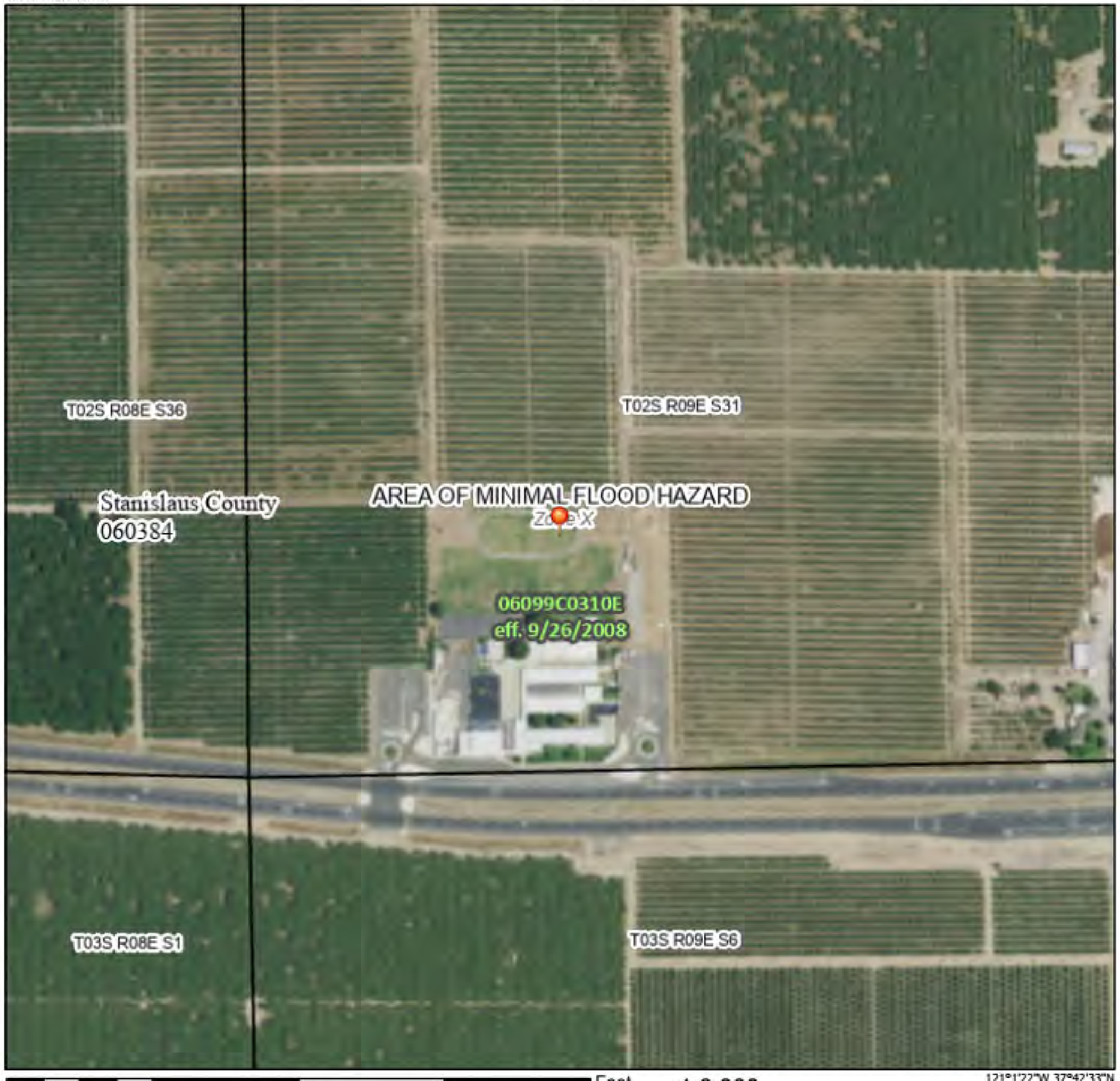
Modesto, California

FIGURE	14
DRAWN BY	AMH
CHECKED BY	JRY
PROJECT MGR	MSM
DATE	05/2023
4730.2300008.0016	

National Flood Hazard Layer FIRMette

FEMA

121°2'W 37°43'1"N



Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

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
- 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 3/24/2023 at 3:05 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.

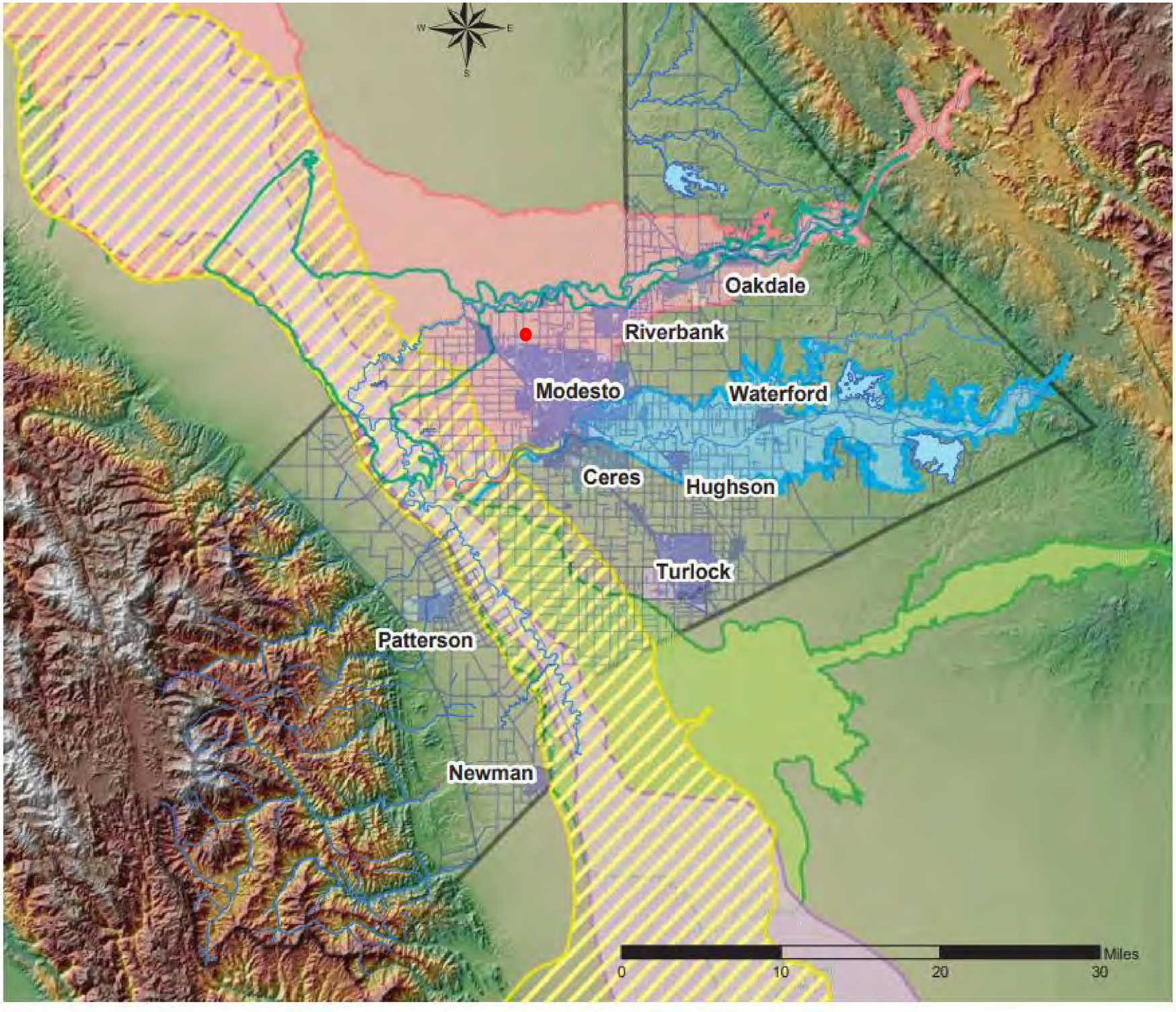
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FEMA FLOOD MAP

STANISLAUS ELEMENTARY REPLACEMENT SCHOOL

Modesto, California

FIGURE	15
DRAWN BY	AMH
CHECKED BY	JRY
PROJECT MGR	MSM
DATE	04/2023
4730.2300008.0016	



Map Legend:

- Lakes
- Rivers
- Streams
- Roads

Dam Inundation Areas

Dam Name

- Don Pedro
- Exchequer
- New Melones
- San Luis
- Pine Flat
- Tulloch

Map displays Stanislaus County with Dam Inundation Areas of regional dams.

Prepared by:
Stanislaus County
Public Works - GIS
November, 2009

● Approximate Site Location

Projection: NAD 1983 2011 StatePlane California III FIPS 0403 Ft US

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DAM INUNDATION MAP

STANISLAUS ELEMENTARY REPLACEMENT SCHOOL

Modesto, California

FIGURE	16
DRAWN BY	AMH
CHECKED BY	JRY
PROJECT MGR	MSM
DATE	05/2023
UES NO.	4730.2300008.0016

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APPENDIX A

General Project Information, Laboratory Testing and Results

3050 Industrial Boulevard, West Sacramento, CA 95691
p. 916.372.1434 | teamues.com

APPENDIX A

Project No. 4730.2300008.0016

A. GENERAL INFORMATION

The performance of a geotechnical engineering and geologic hazards study for the proposed Stanislaus elementary replacement school in Modesto, California, was authorized by Mr. Jason gales with Stanislaus union school district, on march 17, 2023. Authorization was for a study as described in our proposal letter dated march 6, 2023, sent to our client, Stanislaus union school district, whose mailing address 2410 Janna Avenue in Modesto, California 95350.

In performing this investigation, we made reference to the *Stanislaus Elementary School Replacement School* plans, prepared by California Design West Architects, Inc.

B. FIELD EXPLORATION

Between April 7, 2023 and on April 22, 2023, six borings were drilled and sampled to depths of about 15 to 16½ feet below existing site grades by utilizing a CME-75 truck-mounted drilling rig equipped with six-inch-diameter, solid-stem helical augers provided by V&W Drilling of Galt, California. Soil samples were recovered from the borings at various intervals with a 2½-inch outside diameter (O.D.), two-inch inside diameter (I.D.), modified California split-spoon sampler. The sampler was driven by an automatic 140-pound hammer freely falling 30 inches. The number of blows of the hammer required to drive the 18-inch-long samplers each six-inch interval were recorded. The sum of the blows required to drive the sampler the lower 12-inch interval is designated the penetration resistance or "blow count" for that particular drive.

The modified California samples were retained in two-inch diameter by six-inch long, thin-walled brass tubes contained within the sampler. After recovery, the field representative visually classified the soil recovered in the tubes and plastic bags. After the samples were classified, the ends of the tubes and plastic bags were sealed to preserve the natural moisture contents. After recovery, the field representative visually classified the soil recovered in the tubes. After the samples were classified, the ends of the tubes were sealed to preserve the natural moisture contents. Additionally, bulk samples were collected and sealed to preserve the natural moisture contents.

Pocket penetrometer testing was performed during drilling operations on select cohesive soil samples obtained at the boring locations. In pocket penetrometer testing, the unconfined compressive strength of a cohesive soil sample is estimated by measuring the resistance of the

sample to penetration of a relatively small, calibrated, spring-loaded cylinder. The maximum capacity of the penetrometer is 4.5 tons per square-foot (tsf). The unconfined compressive strength estimated from pocket penetrometer testing on the select cohesive soil samples is included on the boring logs at the depth the sample tested was obtained. The approximate undrained shear strength of the samples tested is one-half of the unconfined compressive strength.

The Logs of Soil Borings , Figures 9 through 15, contain descriptions of the soils encountered at each boring location. A boring legend explaining the Unified Soil Classification System and the symbols used on the logs is contained in Figure 16.

Four CPT soundings were completed on April 22, 2023 and were advanced at a rate of about two centimeters per second using a 10-square-centimeter cone penetrometer at the locations shown in Figure 2. The CPTs were advanced by using a 25-ton, truck-mounted CPT rig provided by Middle Earth Geo Testing, Inc. of Hayward, California. The CPT soundings was advanced to a penetration depths of about 18 to 50 feet below existing grades. Data was collected from the CPTs at approximate depth intervals of five centimeters (or about two inches), with shear wave velocity measurements obtained at approximately five-foot intervals on three of the four CPTs.

The Logs of CPTs are included in Appendix C.

C. LABORATORY TESTING

Selected soil samples were tested to determine natural moisture content (ASTM D4643). The results of these tests are included on the boring logs at the depth each sample was obtained.

One sample of near-surface soil was tested to determine the Atterberg Limits (ASTM D4318). The test results are presented in Figure A1.

One representative samples of the near-surface soil was subjected to Expansion Index testing (ASTM D4829); the results of these tests are presented in Figures A2.

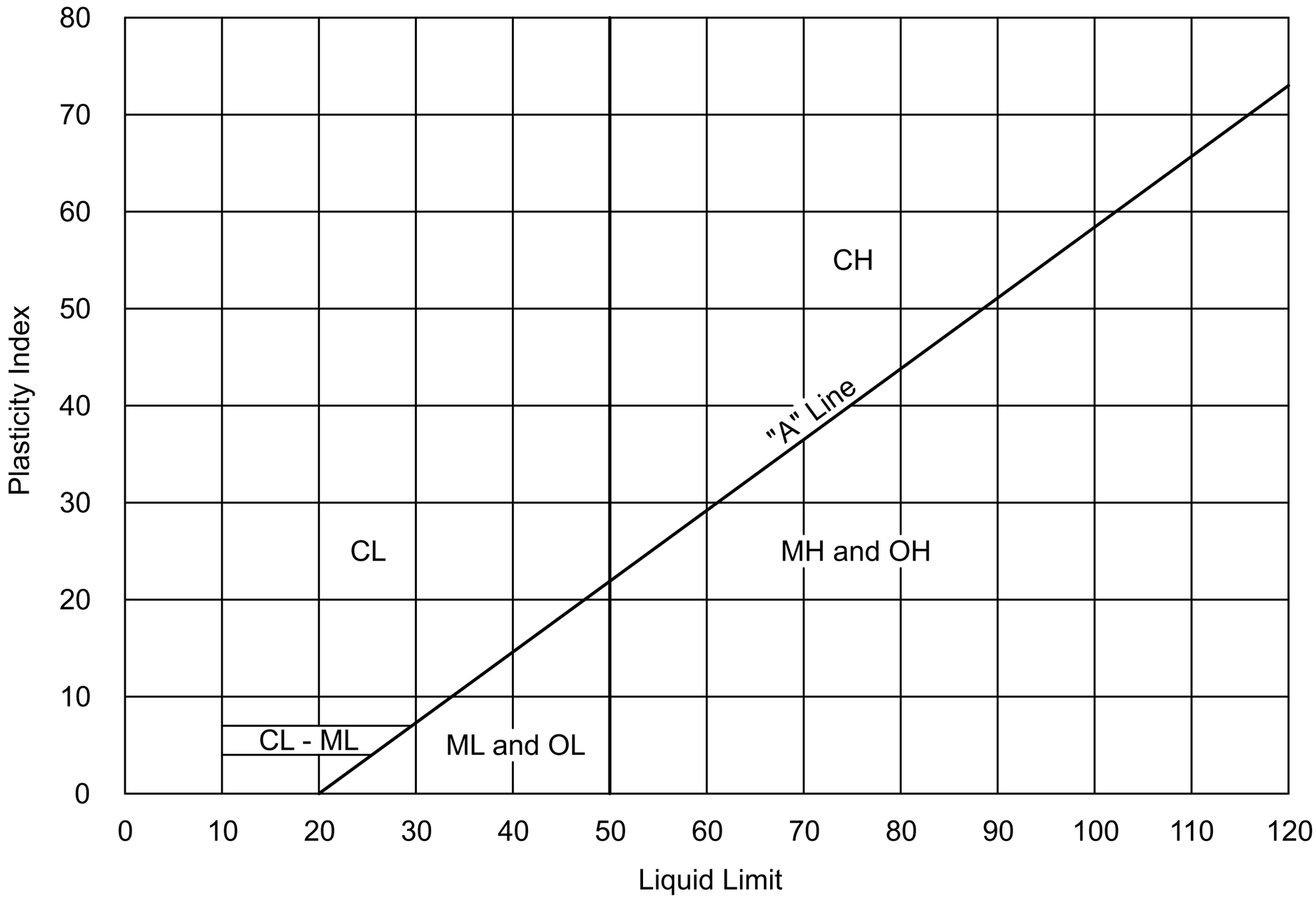
Two bulk samples of anticipated pavement subgrade soil were subjected to Resistance-value ("R-value") testing in accordance with California Test 301. The results of the R-value test, which were used in the pavement design, are presented in Figures A3.

One sample of sub-surface soil were subjected to Triaxial Shear Strength Testing (ASTM D4767). The results of these tests are presented in Figures A4.

Two samples of near-surface soil were submitted to Sunland Analytical in Rancho Cordova, California, for corrosivity testing in accordance with California Test (CT) No. 643 (Modified Small Cell), CT 417, and CT 422M. Copies of the analytical results are presented in Figures A5 and A6.

ATTERBERG LIMITS

ASTM D4318



KEY SYMBOL	LOCATION	SAMPLE DEPTH	NATURAL WATER CONTENT (%)	ATTERBERG LIMITS		PASSING No. 200 SIEVE (%)	UNIFIED SOIL CLASSIFI-CATION SYMBOL
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		
●	D4	0’-5.0’	---	NP	NP	---	ML

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ATTERBERG LIMITS

STANISLAUS ELEMENTARY REPLACEMENT SCHOOL

Modesto, California

FIGURE	A1
DRAWN BY	AMH
CHECKED BY	JRY
PROJECT MGR	MSM
DATE	05/2023
4730.2300008.0016	

EXPANSION INDEX TEST RESULTS

ASTM D4829

MATERIAL DESCRIPTION: Brown, sandy SILT (ML)

LOCATION: D4 @ 0'-5'

Sample Depth	Pre-Test Moisture (%)	Post-Test Moisture (%)	Dry Density (pcf)	Expansion Index
0’ - 5’	8.6	13.4	116.2	**0**

CLASSIFICATION OF EXPANSIVE SOIL *

EXPANSION INDEX	POTENTIAL EXPANSION
0 - 20	**Very Low**
21 - 50	Low
51 - 90	Medium
91 - 130	High
Above 130	Very High

* From ASTM D4829, Table 1

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EXPANSION INDEX

STANISLAUS ELEMENTARY REPLACEMENT SCHOOL

Modesto, California

FIGURE	A2
DRAWN BY	AMH
CHECKED BY	JRY
PROJECT MGR	MSM
DATE	05/2023
4710.2300008.0016	

RESISTANCE VALUE TEST RESULTS

(California Test 301)

MATERIAL DESCRIPTION: Reddish brown, silty fine SAND (SM)

LOCATION: D1 (0’ - 5’)

Specimen No.	Dry Unit Weight (pcf)	Moisture @ Compaction (%)	Exudation Pressure (psi)	Expansion (dial, inches x 1000)	Expansion (psf)	R Value
1	133	8.6	296	0	0	52
2	134	7.8	545	5	22	75
3	134	8.9	228	0	0	38

R-Value at 300 psi exudation pressure = 53

MATERIAL DESCRIPTION: Brown, silty fine to medium SAND (SM)

LOCATION: D6 (0’ - 5’)

Specimen No.	Dry Unit Weight (pcf)	Moisture @ Compaction (%)	Exudation Pressure (psi)	Expansion (dial, inches x 1000)	Expansion (psf)	R Value
1	130	8.2	466	0	0	66
2	129	9.4	204	0	0	13
3	130	8.6	337	0	0	54

R-Value at 300 psi exudation pressure = 44

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RESISTANCE VALUE TEST RESULTS

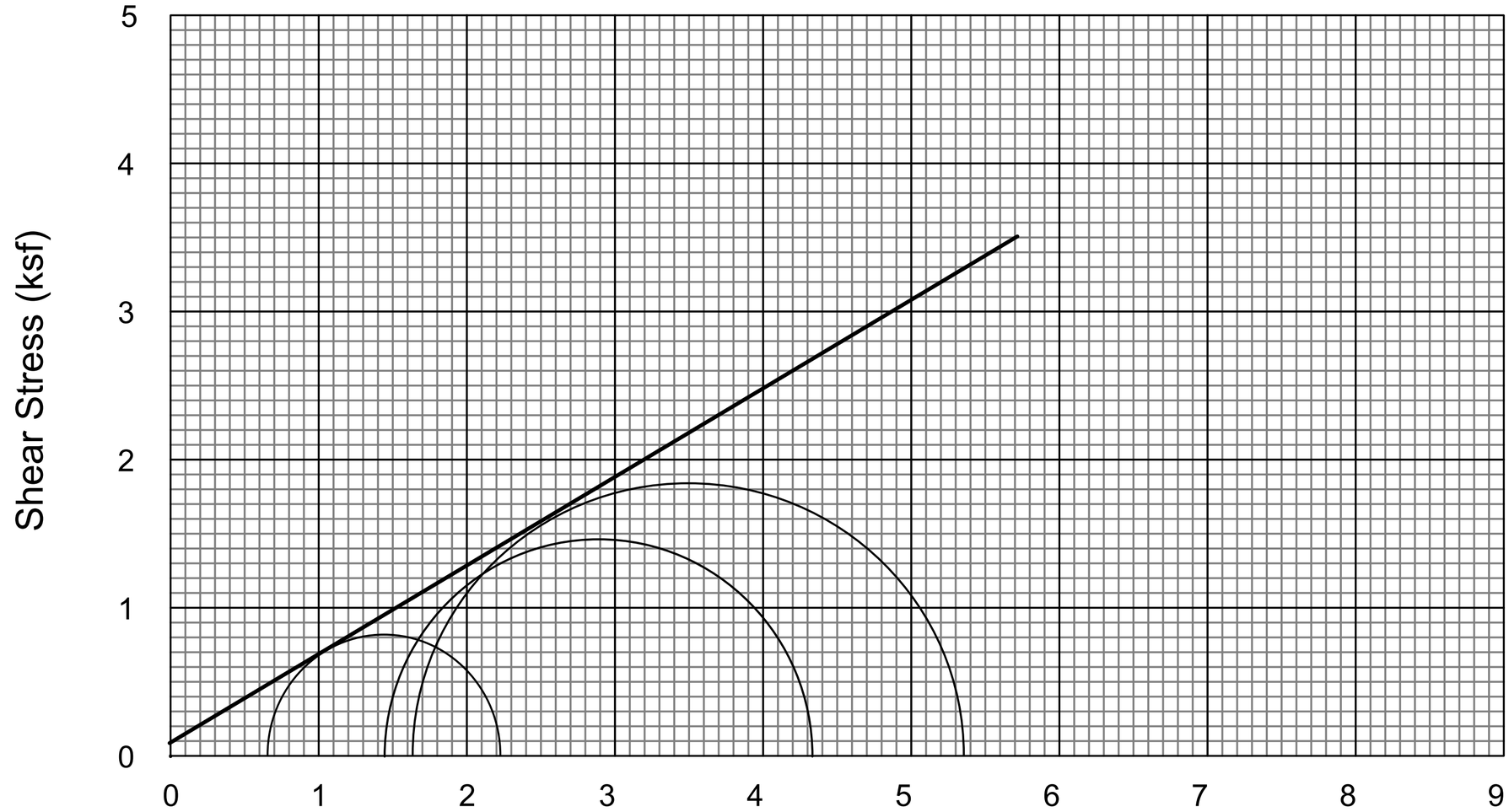
STANISLAUS ELEMENTARY REPLACEMENT SCHOOL

Modesto, California

FIGURE	A3
DRAWN BY	AMH
CHECKED BY	JRY
PROJECT MGR	MSM
DATE	05/2023
4730.2300008.0016	

TRIAXIAL COMPRESSION TEST

ASTM D4767



SAMPLE NO. : D2-2I

SAMPLE CONDITION : Undisturbed

SAMPLE DESCRIPTION : Brown, silty fine SAND (SM)

DRY DENSITY (PCF) : 108.32
INITIAL MOISTURE (%) : 10.39
FINAL MOISTURE (%) : 52.2

ANGLE OF INTERNAL FRICTION (ø) : 30°
COHESION (PSF) : 102.24

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TRIAXIAL COMPRESSION TEST RESULTS

STANISLAUS ELEMENTARY REPLACEMENT SCHOOL

Modesto, California

FIGURE	A4
DRAWN BY	AMH
CHECKED BY	JRY
PROJECT MGR	MSM
DATE	05/2023
4730.2300008.0016	

Sunland Analytical

11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 04/19/2023
Date Submitted 04/12/2023

To: Abigail Heagy
Wallace-Kuhl & Assoc.
3050 Industrial Blvd
West Sacramento, CA 95691

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 4730.2300008.0016 Site ID : D6E 0-5FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 89344-185453.

EVALUATION FOR SOIL CORROSION

Soil pH	6.93	
Minimum Resistivity	3.43 ohm-cm (x1000)	
Chloride	1.6 ppm	00.00016 %
Sulfate	2.6 ppm	00.00026 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

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CORROSION TEST RESULTS

STANISLAUS ELEMENTARY REPLACEMENT SCHOOL

Modesto, California

FIGURE	A5
DRAWN BY	AMH
CHECKED BY	JRY
PROJECT MGR	MSM
DATE	05/2023
4730.2300008.0016	

Sunland Analytical

11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 04/19/2023
Date Submitted 04/12/2023

To: Abigail Heagy
Wallace-Kuhl & Assoc.
3050 Industrial Blvd
West Sacramento, CA 95691

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 4730.2300008.0016 Site ID : D1E 0-5FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 89344-185454.

EVALUATION FOR SOIL CORROSION

Soil pH	7.64	
Minimum Resistivity	1.55 ohm-cm (x1000)	
Chloride	9.7 ppm	00.00097 %
Sulfate	29.7 ppm	00.00297 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

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CORROSION TEST RESULTS

STANISLAUS ELEMENTARY REPLACEMENT SCHOOL

Modesto, California

FIGURE	A6
DRAWN BY	AMH
CHECKED BY	JRY
PROJECT MGR	MSM
DATE	05/2023
4730.2300008.0016	

APPENDIX B: REFERENCES

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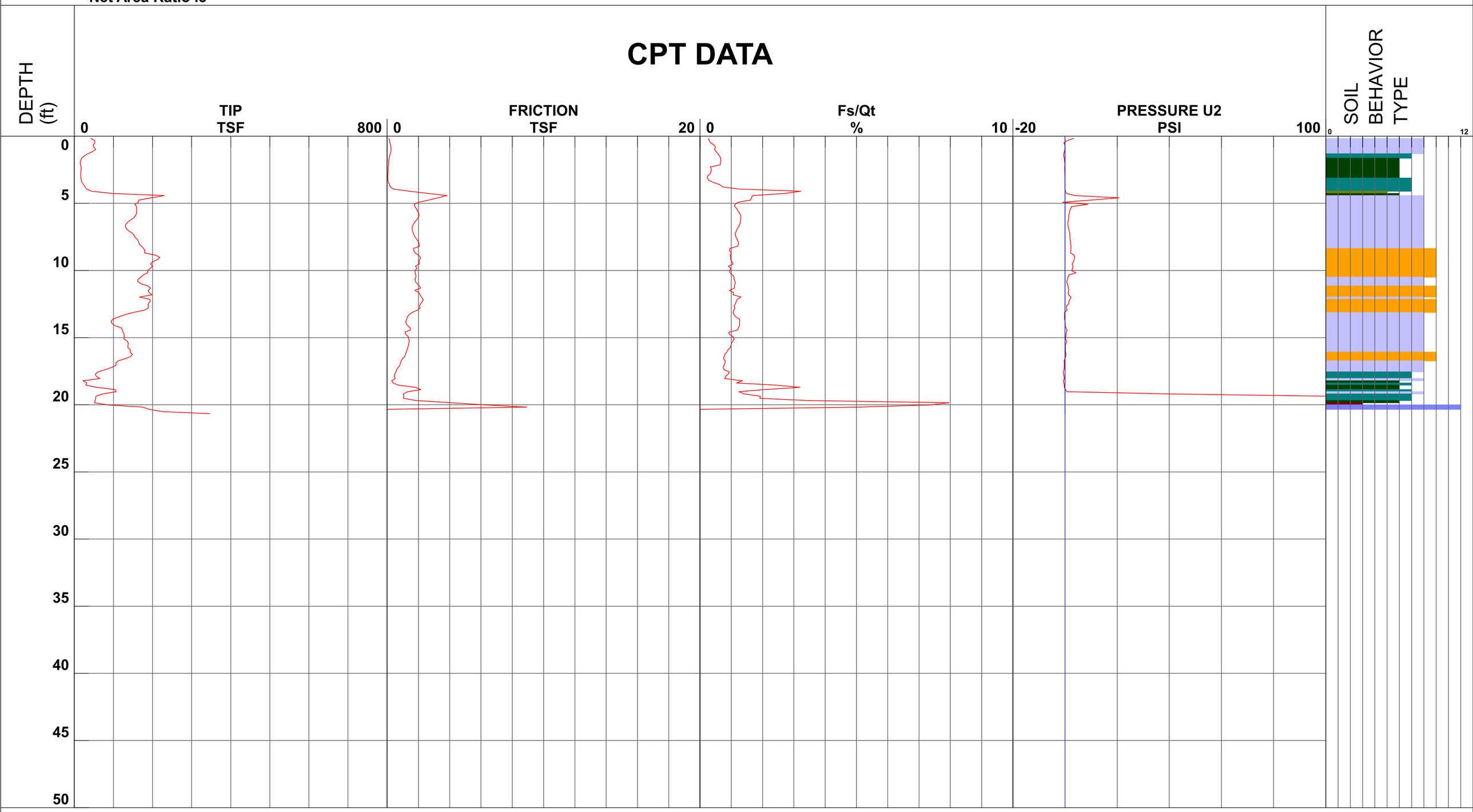
APPENDIX C: CPT LOGS

Universal Engineering

Project	Stanislaus Elementary School	Operator	AJ-IM	Filename	SDF(645).cpt
Job Number	4730.2300008.0016	Cone Number	DDG1587	GPS	
Hole Number	CPT-01	Date and Time	4/22/2023 8:58:45 AM	Maximum Depth	20.67 ft
EST GW Depth During Test		40.00 ft			

Net Area Ratio .8

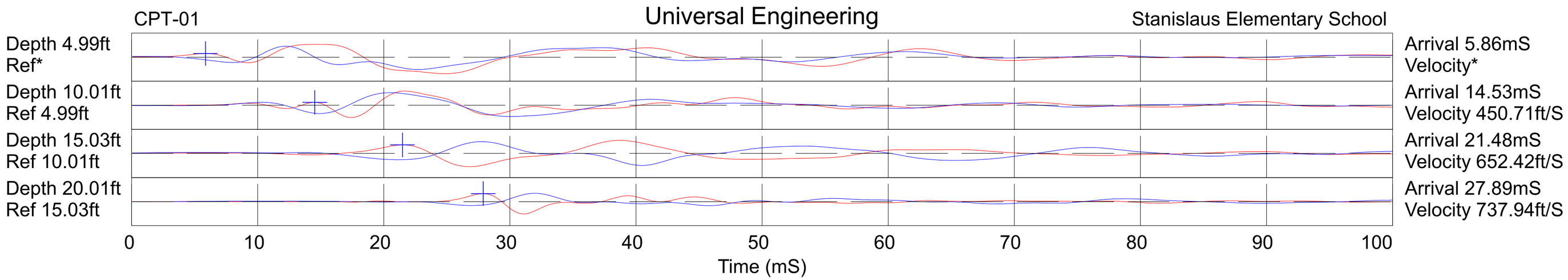
CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Cone Size 15cm squared

S*Soil behavior type and SPT based on data from UBC-1983



Hammer to Rod String Distance (ft): 5.83
* = Not Determined

COMMENT:

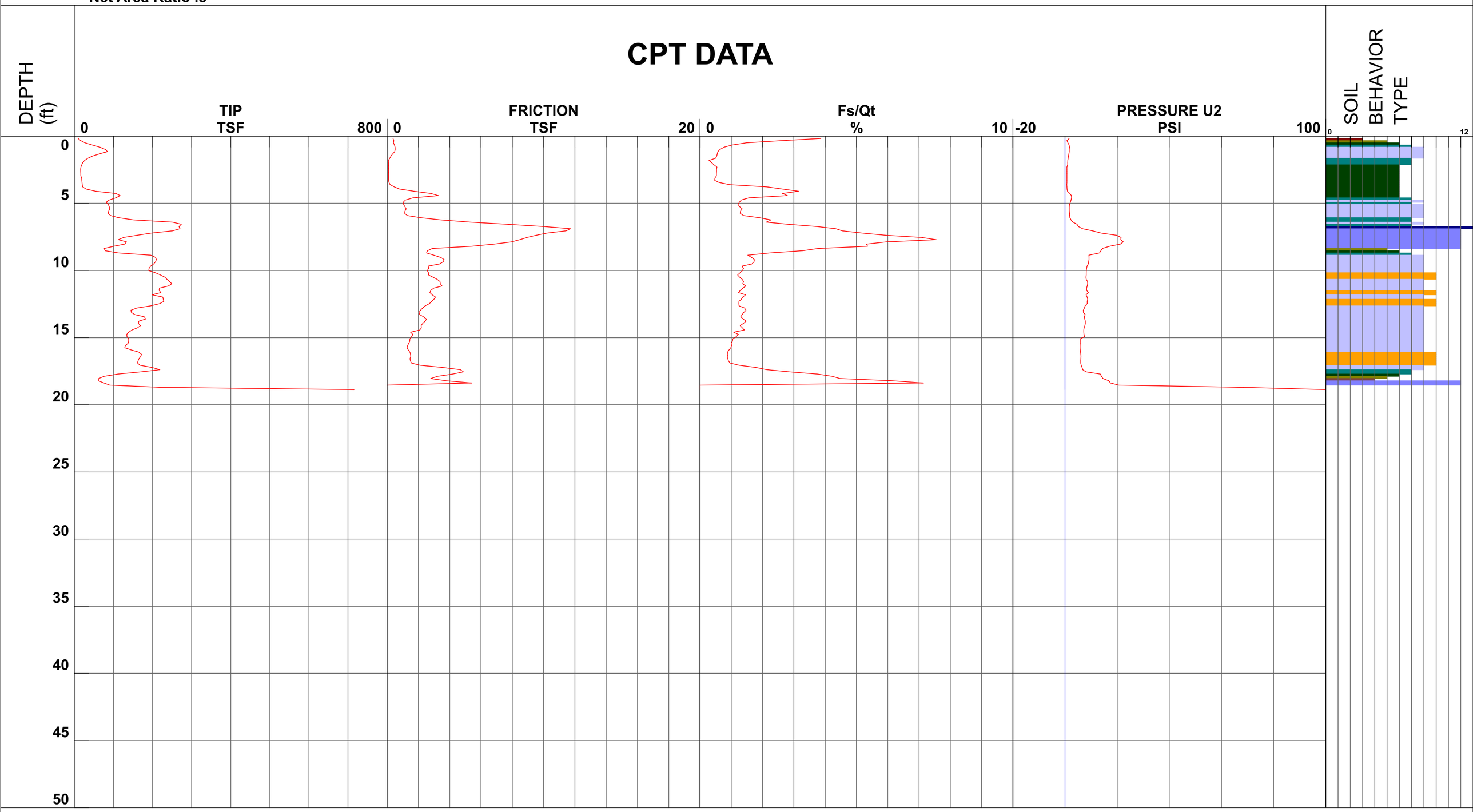
Middle Earth
Geo Testing Inc.

Universal Engineering

Project	Stanislaus Elementary School	Operator	AJ-IM	Filename	SDF(648).cpt
Job Number	4730.2300008.0016	Cone Number	DDG1587	GPS	
Hole Number	CPT-02	Date and Time	4/22/2023 11:29:22 AM	Maximum Depth	18.86 ft
EST GW Depth During Test		40.00 ft			

Net Area Ratio .8

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Cone Size 15cm squared

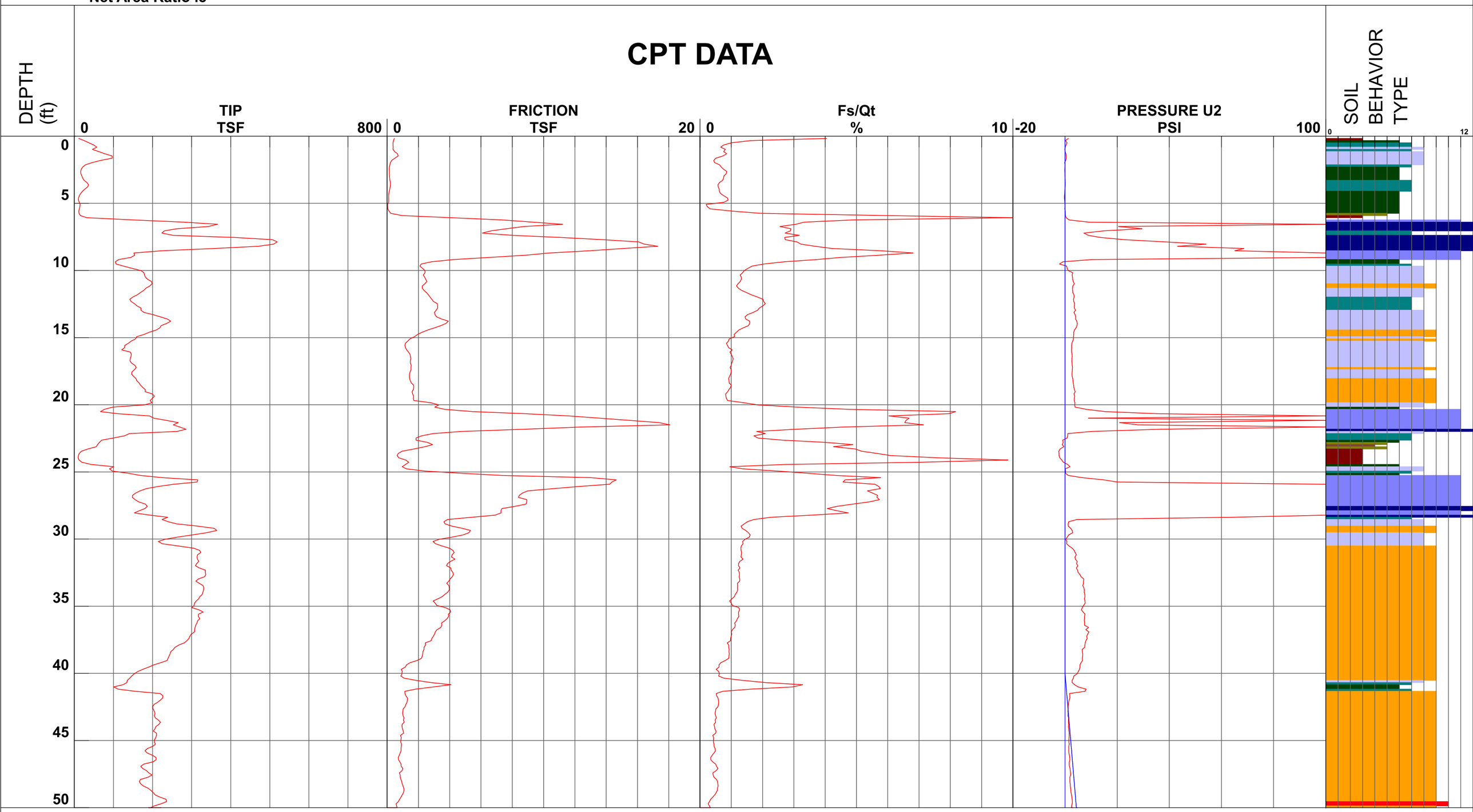
S*Soil behavior type and SPT based on data from UBC-1983

Universal Engineering

Project	Stanislaus Elementary School	Operator	AJ-IM	Filename	SDF(646).cpt
Job Number	4730.2300008.0016	Cone Number	DDG1587	GPS	
Hole Number	CPT-03	Date and Time	4/22/2023 9:45:45 AM	Maximum Depth	50.52 ft
EST GW Depth During Test		40.00 ft			

Net Area Ratio .8

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

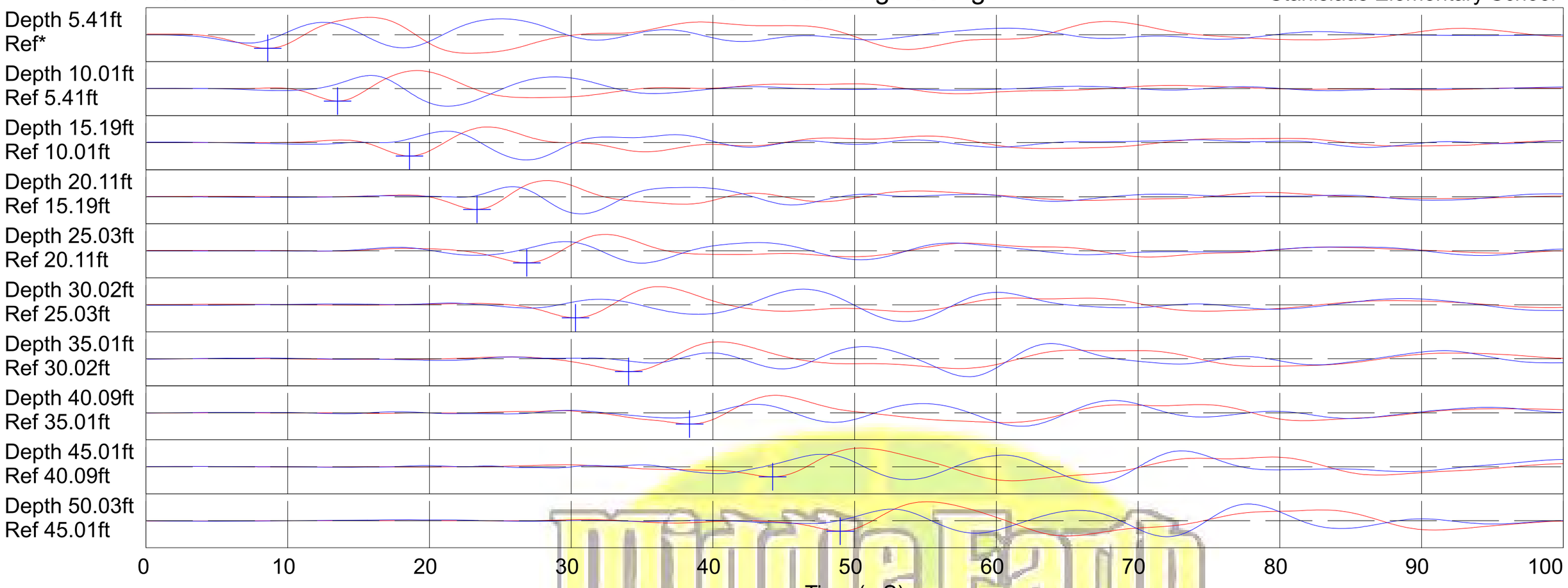
Cone Size 15cm squared

S*Soil behavior type and SPT based on data from UBC-1983

CPT-03

Universal Engineering

Stanislaus Elementary School



Hammer to Rod String Distance (ft): 5.83

* = Not Determined

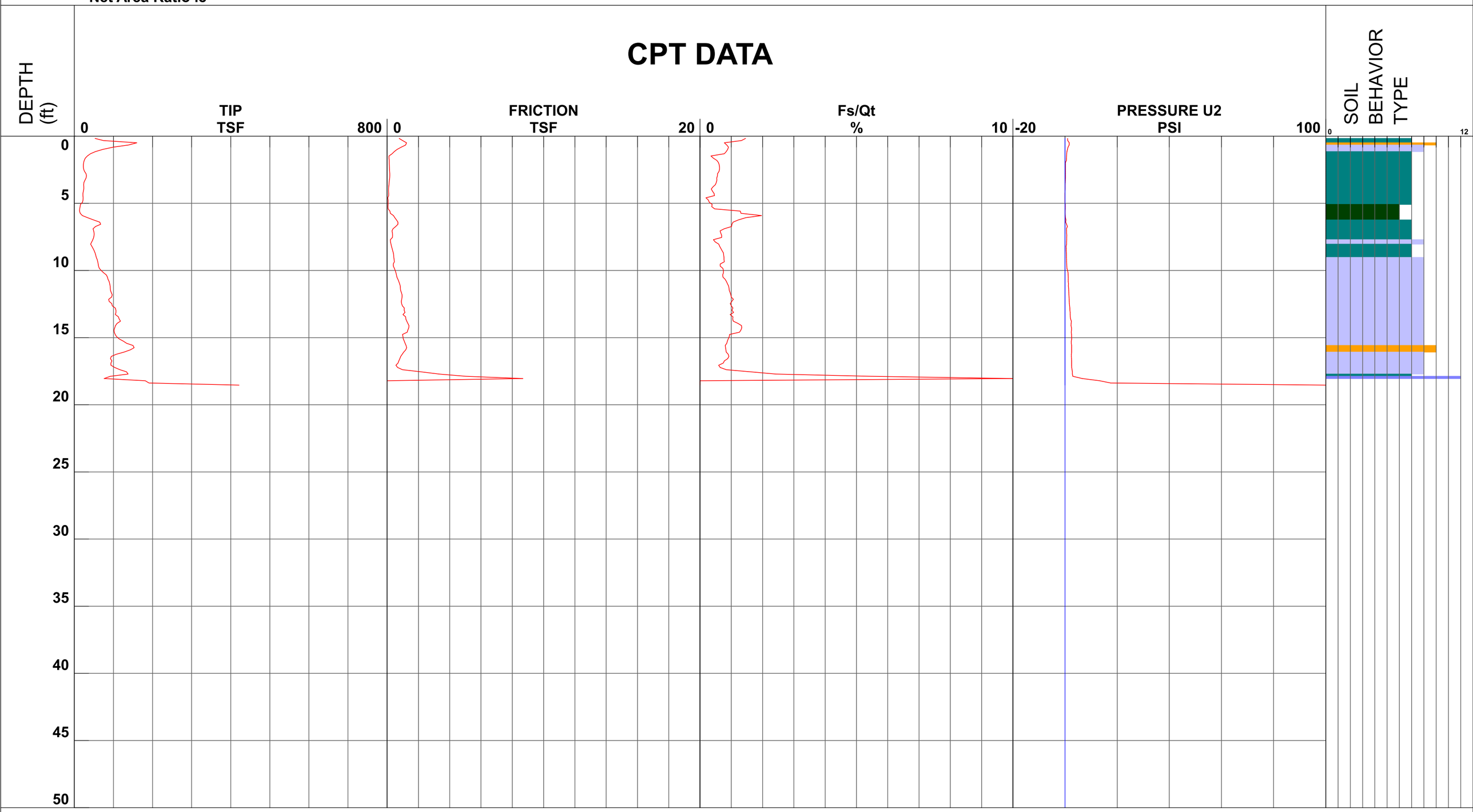
COMMENT:

Universal Engineering

Project	Stanislaus Elementary School	Operator	AJ-IM	Filename	SDF(647).cpt
Job Number	4730.2300008.0016	Cone Number	DDG1587	GPS	
Hole Number	CPT-04	Date and Time	4/22/2023 10:50:25 AM	Maximum Depth	18.54 ft
EST GW Depth During Test		40.00 ft			

Net Area Ratio .8

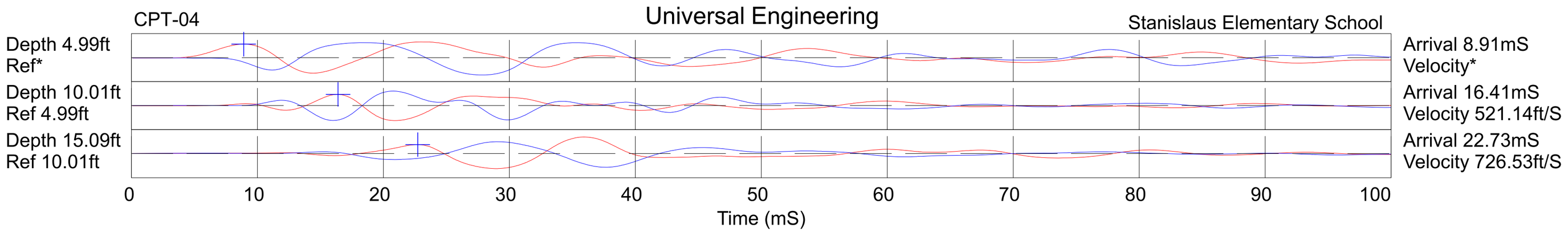
CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Cone Size 15cm squared

S*Soil behavior type and SPT based on data from UBC-1983



Hammer to Rod String Distance (ft): 5.83
* = Not Determined

COMMENT:

Middle Earth
Geo Testing Inc.

APPENDIX D: LIQUEFACTION ANALYSIS

3050 Industrial Boulevard, West Sacramento, CA 95691
p. 916.372.1434 | teamues.com

Universal Engineering Sciences

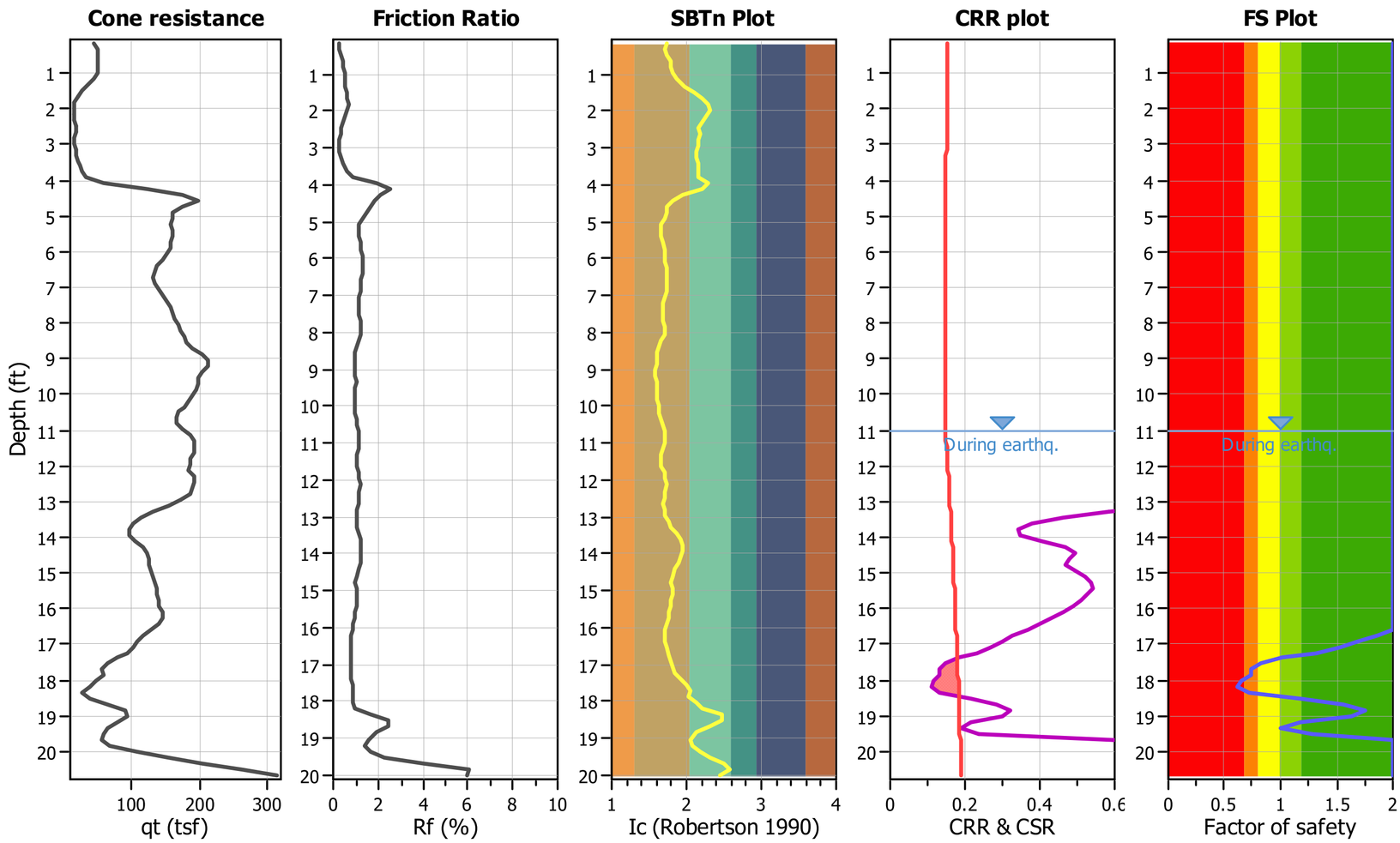
LIQUEFACTION ANALYSIS REPORT

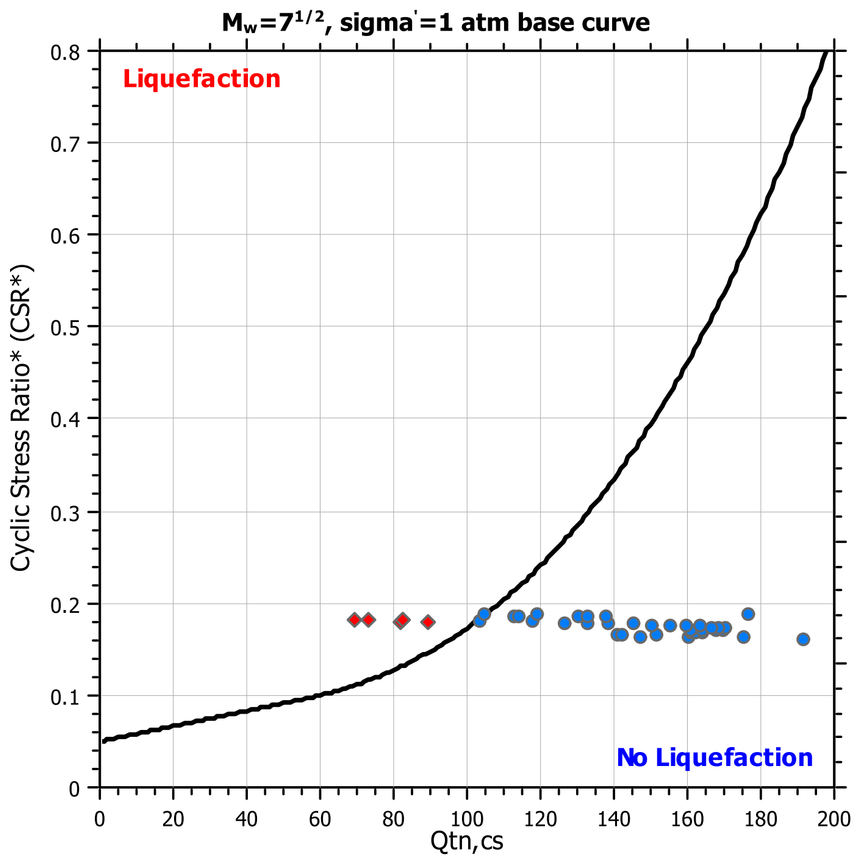
Project title : Stanislaus Elementary Replacement School **Location : Modesto, California**

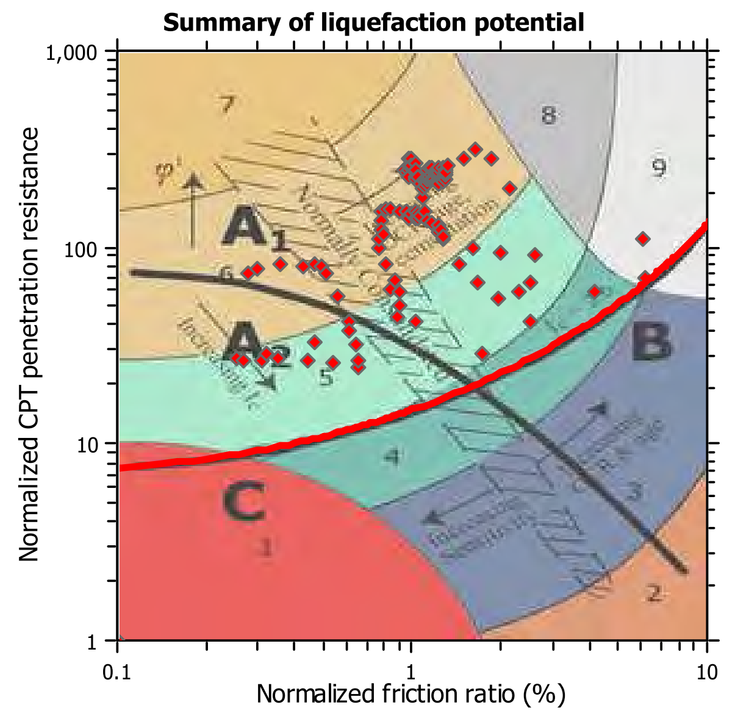
CPT file : CPT-01

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	11.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	11.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.25	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.37	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

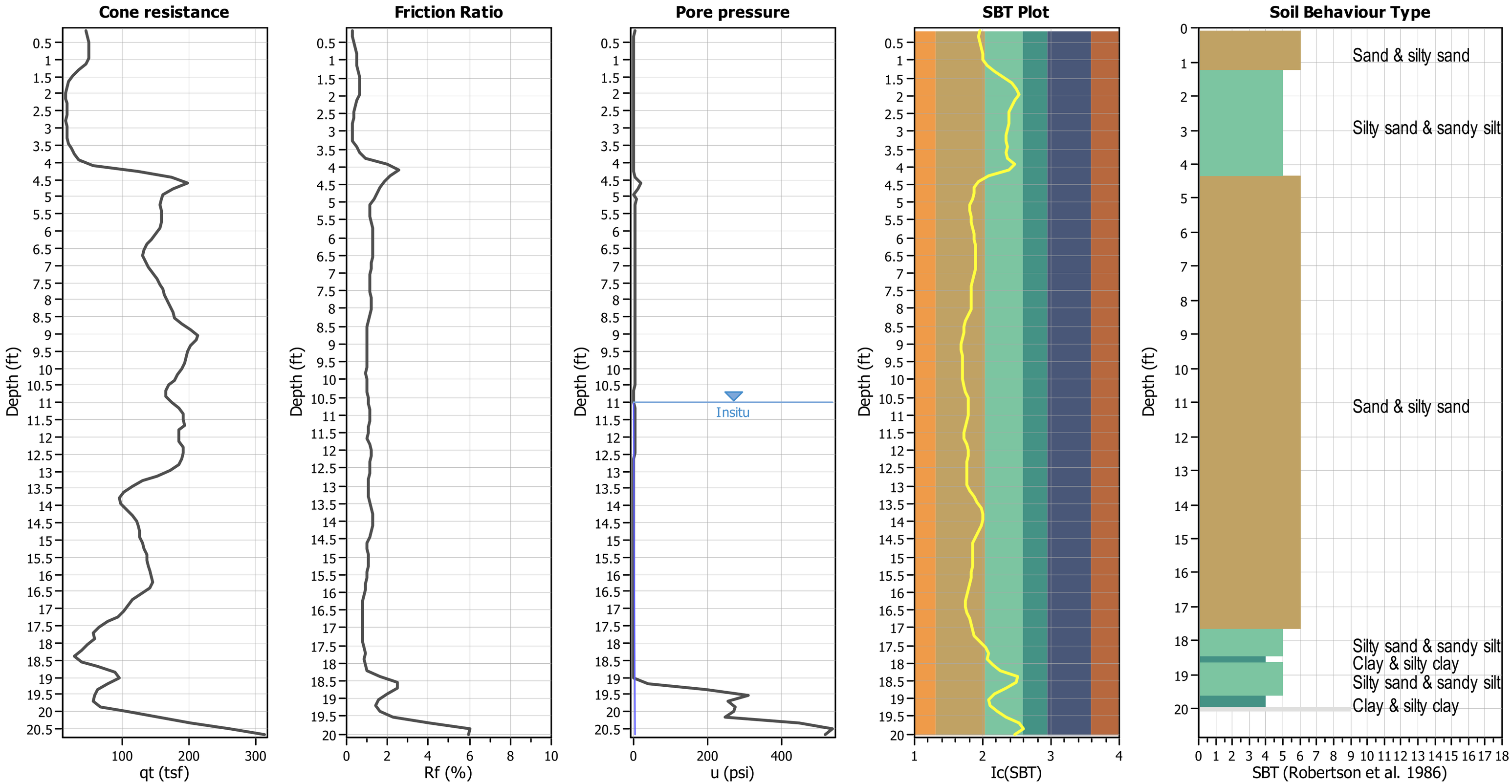






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



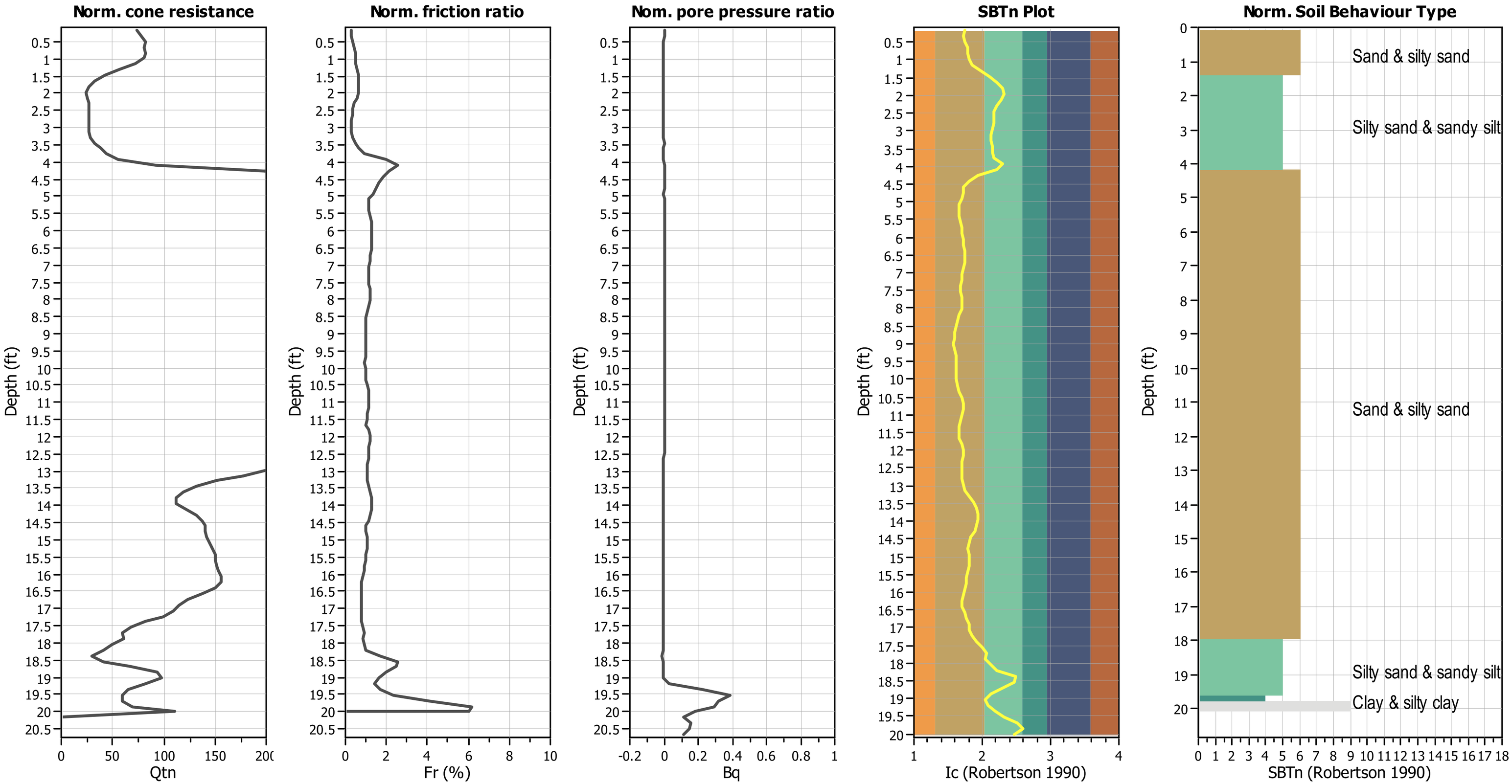
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



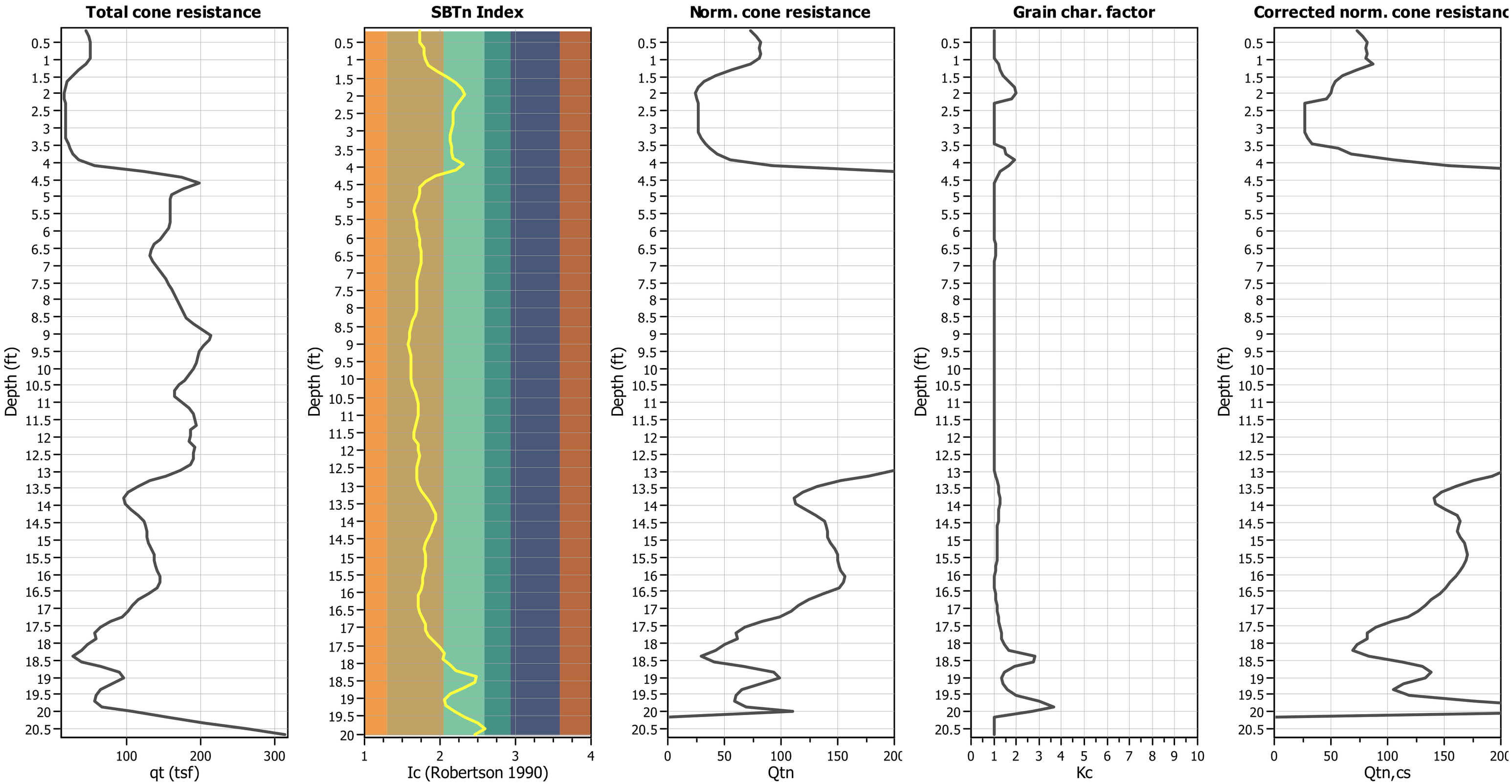
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

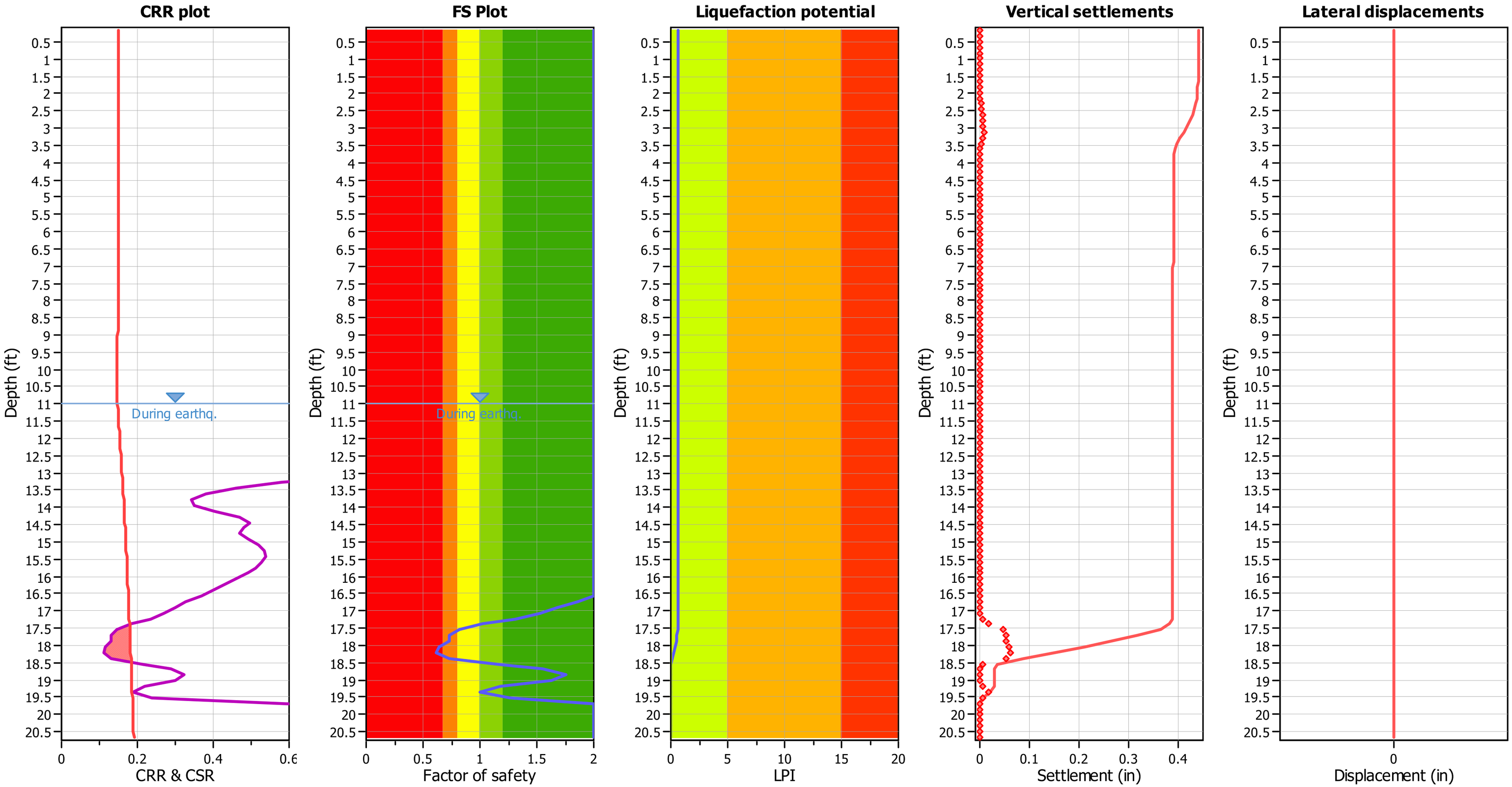
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

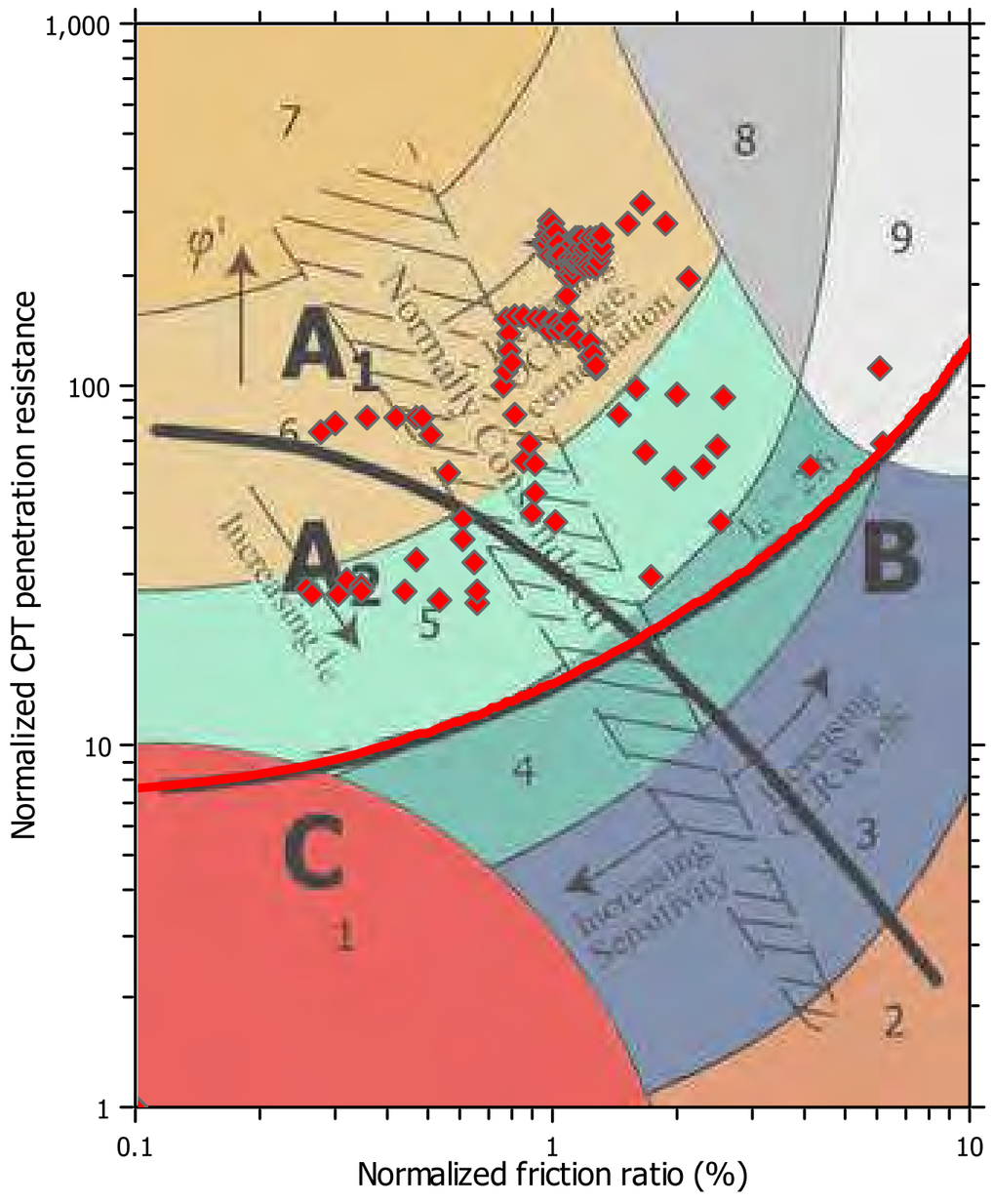
F.S. color scheme

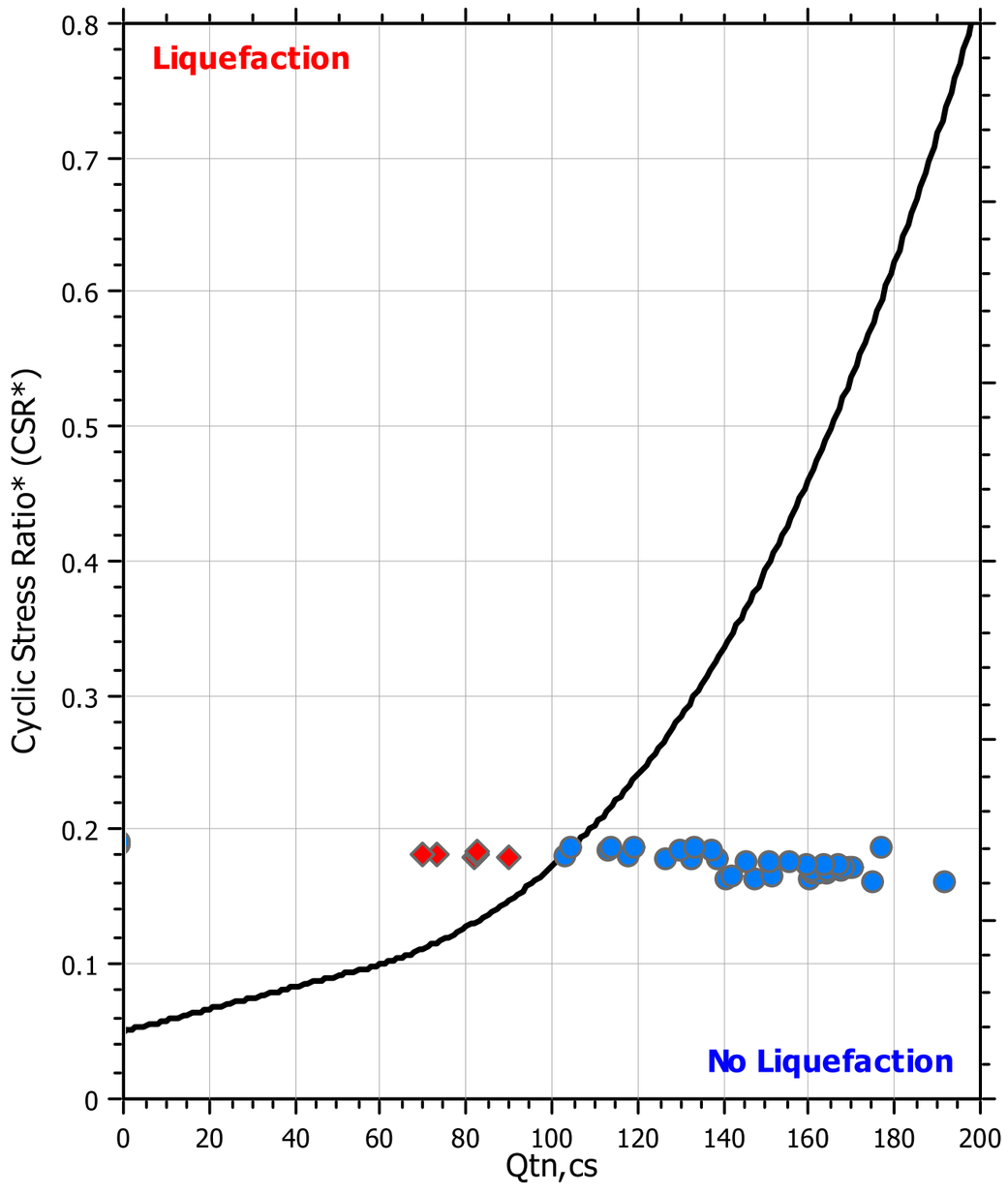
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

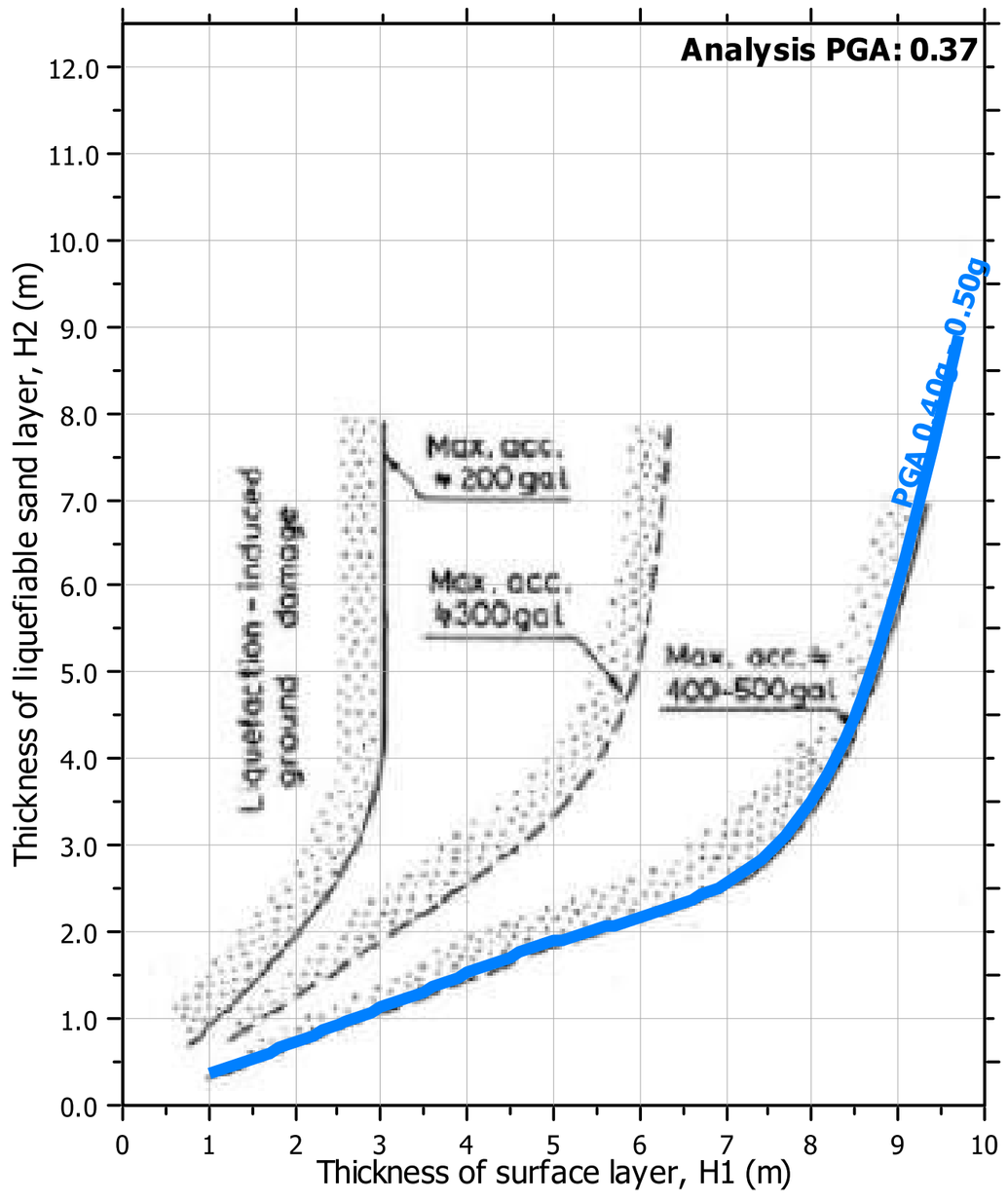
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



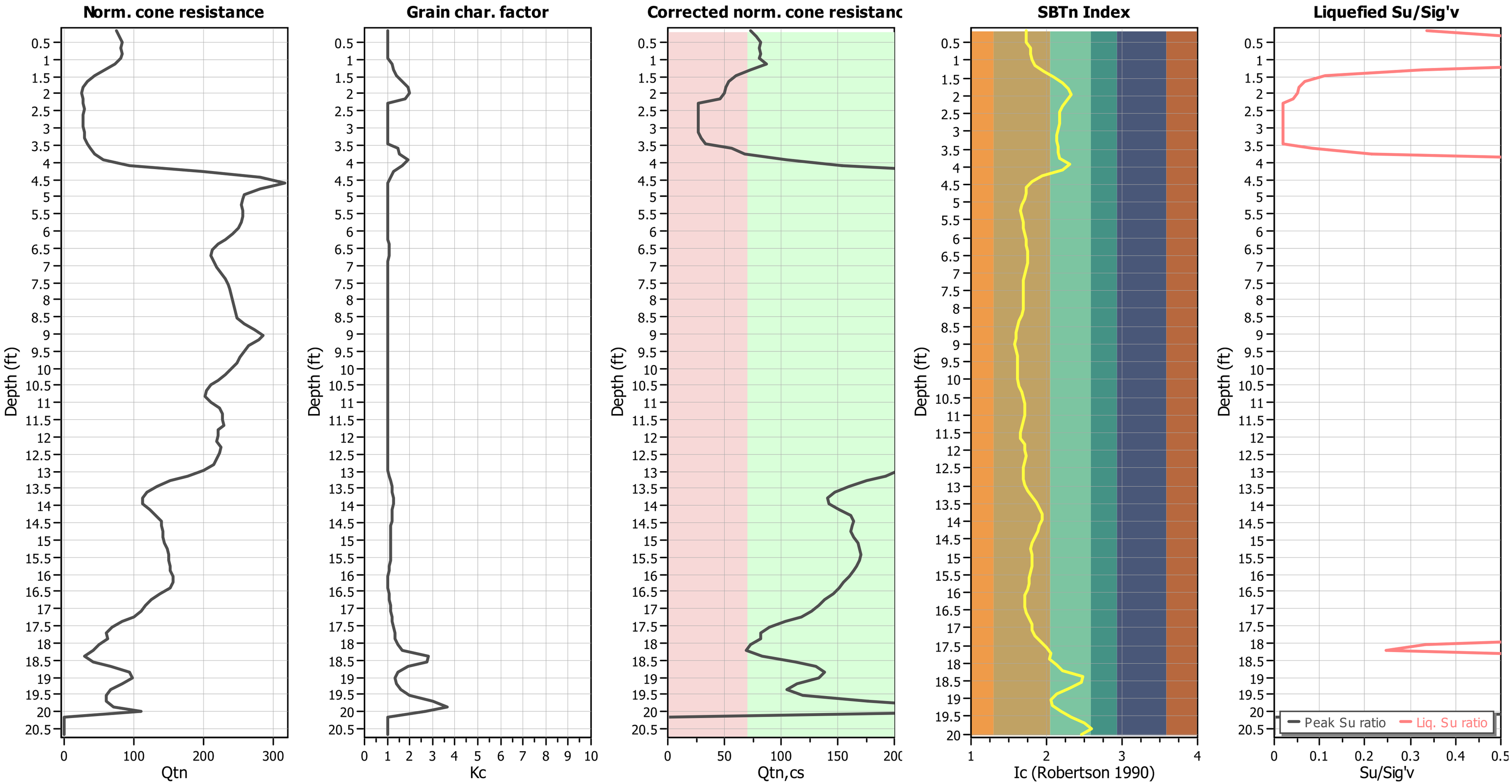




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

:: Field input data ::

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
1	0.16	42.54	0.11	3.27	5.00	104.47
2	0.33	51.74	0.15	0.78	5.00	105.75
3	0.49	52.55	0.18	-0.45	5.00	107.39
4	0.66	48.28	0.22	-0.08	5.00	108.51
5	0.82	49.66	0.24	-0.02	5.00	109.38
6	0.98	54.86	0.25	-0.05	5.00	109.58
7	1.15	46.59	0.24	-0.29	9.35	108.84
8	1.31	34.71	0.20	-0.47	12.14	107.15
9	1.48	25.20	0.16	-0.53	15.82	104.88
10	1.64	19.30	0.13	-0.33	19.52	102.69
11	1.80	16.10	0.11	-0.20	22.28	100.99
12	1.97	14.73	0.10	-0.11	23.35	100.23
13	2.13	15.70	0.10	-0.06	21.44	99.00
14	2.30	17.58	0.06	-0.14	5.00	98.11
15	2.46	17.32	0.06	-0.15	5.00	96.59
16	2.62	16.94	0.06	-0.09	5.00	96.43
17	2.79	16.62	0.05	-0.11	5.00	95.29
18	2.95	16.12	0.04	-0.07	5.00	94.27
19	3.12	17.11	0.04	-0.04	5.00	94.23
20	3.28	18.11	0.05	-0.02	5.00	96.48
21	3.44	19.47	0.08	0.00	5.00	100.45
22	3.61	24.03	0.15	-0.02	17.23	103.79
23	3.77	27.31	0.20	-0.03	18.02	108.03
24	3.94	31.19	0.38	-0.01	22.51	115.96
25	4.10	44.37	1.43	0.12	19.69	123.05
26	4.27	97.31	2.64	0.60	11.44	129.12
27	4.43	229.69	3.83	3.85	8.24	131.47
28	4.59	197.29	3.25	20.72	6.75	131.78
29	4.76	165.09	2.66	10.14	6.69	129.97
30	4.92	164.01	2.00	-0.93	6.26	128.20
31	5.09	154.84	1.73	8.76	5.47	127.08
32	5.25	159.34	1.77	2.42	5.44	126.89
33	5.41	159.26	1.88	2.15	5.56	127.18
34	5.58	159.36	1.93	1.79	5.84	127.51
35	5.74	159.05	2.02	1.69	6.07	127.69
36	5.91	156.71	2.04	1.41	6.31	127.72
37	6.07	152.36	1.99	1.43	6.53	127.47
38	6.23	144.17	1.88	1.28	6.75	127.01
39	6.40	137.02	1.76	1.12	6.96	126.47
40	6.56	131.78	1.68	1.12	7.04	126.01
41	6.73	130.44	1.61	1.26	6.92	125.73
42	6.89	133.24	1.59	1.36	6.66	125.69
43	7.05	139.19	1.62	1.56	6.33	125.89
44	7.22	148.02	1.67	1.80	6.06	126.21
45	7.38	153.36	1.73	1.91	5.93	126.55
46	7.55	155.53	1.80	1.91	5.95	126.97
47	7.71	161.69	1.92	1.99	6.05	127.40
48	7.87	164.84	2.02	2.10	6.12	127.76

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
49	8.04	166.24	2.04	2.10	6.08	127.98
50	8.20	172.04	2.06	2.32	5.56	127.64
51	8.37	177.65	1.69	2.23	5.01	127.27
52	8.53	180.76	1.71	2.26	4.64	126.95
53	8.69	179.74	1.80	2.08	4.45	127.52
54	8.86	208.07	2.01	3.49	4.25	128.24
55	9.02	219.10	2.15	3.60	4.02	128.71
56	9.19	213.26	2.08	3.50	4.22	128.72
57	9.35	200.01	2.04	3.24	4.58	128.52
58	9.51	195.03	2.06	2.75	4.60	128.14
59	9.68	200.19	1.81	3.02	4.62	127.95
60	9.84	194.15	1.91	2.92	4.52	127.55
61	10.01	187.98	1.78	2.57	4.77	127.47
62	10.17	187.48	1.79	4.20	5.07	127.30
63	10.33	176.40	1.83	1.56	5.52	127.30
64	10.50	170.03	1.84	1.10	6.06	127.16
65	10.66	163.02	1.77	0.97	6.41	127.06
66	10.83	161.56	1.81	0.67	6.50	127.16
67	10.99	171.28	1.92	0.92	6.29	127.67
68	11.15	188.63	2.07	1.16	5.96	128.22
69	11.32	194.54	2.14	1.27	5.49	128.13
70	11.48	189.37	1.77	1.43	5.44	128.09
71	11.65	191.10	2.03	1.20	5.35	128.07
72	11.81	198.96	2.11	1.34	6.19	128.47
73	11.98	166.61	2.19	2.28	6.42	128.78
74	12.14	192.92	2.30	1.84	6.67	128.92
75	12.30	194.30	2.25	1.44	6.20	128.97
76	12.47	189.25	2.15	1.49	6.08	128.68
77	12.63	188.84	2.06	0.56	6.06	128.50
78	12.80	189.62	2.11	0.60	6.09	128.20
79	12.96	178.93	1.94	0.77	6.44	127.45
80	13.12	150.91	1.59	-0.18	7.10	126.20
81	13.29	130.39	1.42	-0.16	8.15	124.81
82	13.45	114.12	1.29	-0.19	9.50	123.88
83	13.62	99.40	1.25	-0.18	10.72	123.19
84	13.78	94.20	1.20	-0.01	11.49	122.87
85	13.94	95.97	1.21	0.06	11.42	123.01
86	14.11	103.42	1.31	0.08	10.70	123.75
87	14.27	120.37	1.48	0.41	10.03	124.43
88	14.44	122.80	1.48	0.84	8.96	124.29
89	14.60	124.88	1.14	0.52	8.30	123.84
90	14.76	127.55	1.21	0.34	7.94	123.60
91	14.93	127.54	1.34	0.32	8.29	124.08
92	15.09	126.86	1.39	0.14	8.36	124.51
93	15.26	135.65	1.42	0.65	8.11	124.66
94	15.42	138.21	1.39	0.35	7.77	124.67
95	15.58	137.30	1.36	0.13	7.61	124.51
96	15.75	137.03	1.32	0.12	7.30	124.33

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
97	15.91	143.74	1.28	0.15	6.96	124.09
98	16.08	142.36	1.22	0.15	6.46	123.88
99	16.24	148.31	1.18	0.38	6.23	123.58
100	16.40	144.80	1.13	0.26	6.20	122.98
101	16.57	130.04	0.97	-0.04	6.79	122.13
102	16.73	112.23	0.90	-0.35	7.57	121.17
103	16.90	106.03	0.85	-0.30	8.14	120.58
104	17.06	106.80	0.82	-0.23	8.39	119.84
105	17.22	95.33	0.70	-0.31	9.03	118.82
106	17.39	78.78	0.60	-0.37	10.84	117.48
107	17.55	60.94	0.57	-0.74	13.11	116.13
108	17.72	54.09	0.49	-0.57	14.65	115.15
109	17.88	55.79	0.46	-0.38	13.96	114.94
110	18.04	65.59	0.52	-0.28	16.63	113.44
111	18.21	21.98	0.30	-0.64	19.71	112.50
112	18.37	32.12	0.37	-0.46	29.77	112.75
113	18.54	29.58	0.71	-0.26	28.99	119.01
114	18.70	56.87	1.82	-0.25	22.77	123.67
115	18.86	104.68	2.15	0.15	16.92	125.39
116	19.03	106.92	1.32	0.67	14.40	124.35
117	19.19	72.84	1.03	39.90	15.27	121.90
118	19.36	55.38	1.07	196.98	18.86	120.72
119	19.52	54.58	1.04	312.47	23.19	122.17
120	19.69	53.44	1.83	255.05	30.79	126.32
121	19.85	51.67	4.11	276.25	34.74	130.78
122	20.01	84.53	6.24	273.27	28.85	135.29
123	20.18	174.29	8.92	247.61	N/A	87.36
124	20.34	192.10	-268745.54	449.76	N/A	87.36
125	20.51	224.52	-268745.54	540.18	N/A	87.36
126	20.67	346.68	-268745.54	520.94	N/A	87.36

Abbreviations

Depth: Depth from free surface, at which CPT was performed (ft)
q_c: Measured cone resistance (tsf)
f_s: Sleeve friction resistance (tsf)
u: Pore pressure (tsf)
Fines content: Percentage of fines in soil (%)
Unit weight: Bulk soil unit weight (pcf)

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data ::

Point ID	Depth (ft)	σ_v (tsf)	u_0 (tsf)	σ_v' (tsf)	r_d	CSR	MSF	CSR_{eq}	K_σ	User FS	CSR^*	Belongs to transition
1	0.16	0.01	0.00	0.01	1.00	0.241	1.59	0.151	1.00	1.00	2.000	No
2	0.33	0.02	0.00	0.02	1.00	0.241	1.59	0.151	1.00	1.00	2.000	No
3	0.49	0.03	0.00	0.03	1.00	0.241	1.59	0.151	1.00	1.00	2.000	No
4	0.66	0.03	0.00	0.03	1.00	0.241	1.59	0.151	1.00	1.00	2.000	No
5	0.82	0.04	0.00	0.04	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
6	0.98	0.05	0.00	0.05	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
7	1.15	0.06	0.00	0.06	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
8	1.31	0.07	0.00	0.07	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
9	1.48	0.08	0.00	0.08	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
10	1.64	0.09	0.00	0.09	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
11	1.80	0.10	0.00	0.10	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
12	1.97	0.10	0.00	0.10	1.00	0.240	1.59	0.150	1.00	1.00	2.000	No
13	2.13	0.11	0.00	0.11	1.00	0.240	1.59	0.150	1.00	1.00	2.000	No
14	2.30	0.12	0.00	0.12	1.00	0.240	1.59	0.150	1.00	1.00	2.000	No
15	2.46	0.13	0.00	0.13	1.00	0.240	1.59	0.150	1.00	1.00	2.000	No
16	2.62	0.14	0.00	0.14	1.00	0.240	1.59	0.150	1.00	1.00	2.000	No
17	2.79	0.14	0.00	0.14	1.00	0.239	1.59	0.150	1.00	1.00	2.000	No
18	2.95	0.15	0.00	0.15	1.00	0.239	1.59	0.150	1.00	1.00	2.000	No
19	3.12	0.16	0.00	0.16	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
20	3.28	0.17	0.00	0.17	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
21	3.44	0.18	0.00	0.18	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
22	3.61	0.18	0.00	0.18	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
23	3.77	0.19	0.00	0.19	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
24	3.94	0.20	0.00	0.20	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
25	4.10	0.21	0.00	0.21	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
26	4.27	0.22	0.00	0.22	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
27	4.43	0.23	0.00	0.23	0.99	0.238	1.59	0.150	1.00	1.00	2.000	No
28	4.59	0.24	0.00	0.24	0.99	0.238	1.59	0.150	1.00	1.00	2.000	No
29	4.76	0.26	0.00	0.26	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
30	4.92	0.27	0.00	0.27	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
31	5.09	0.28	0.00	0.28	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
32	5.25	0.29	0.00	0.29	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
33	5.41	0.30	0.00	0.30	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
34	5.58	0.31	0.00	0.31	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
35	5.74	0.32	0.00	0.32	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
36	5.91	0.33	0.00	0.33	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
37	6.07	0.34	0.00	0.34	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
38	6.23	0.35	0.00	0.35	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
39	6.40	0.36	0.00	0.36	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
40	6.56	0.37	0.00	0.37	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
41	6.73	0.38	0.00	0.38	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
42	6.89	0.39	0.00	0.39	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
43	7.05	0.40	0.00	0.40	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
44	7.22	0.41	0.00	0.41	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
45	7.38	0.42	0.00	0.42	0.98	0.237	1.59	0.149	1.00	1.00	2.000	No
46	7.55	0.43	0.00	0.43	0.98	0.237	1.59	0.149	1.00	1.00	2.000	No
47	7.71	0.44	0.00	0.44	0.98	0.237	1.59	0.148	1.00	1.00	2.000	No
48	7.87	0.45	0.00	0.45	0.98	0.237	1.59	0.148	1.00	1.00	2.000	No

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data :: (continued)

Point ID	Depth (ft)	σ_v (tsf)	u_0 (tsf)	σ_v' (tsf)	r_d	CSR	MSF	CSR_{eq}	K_σ	User FS	CSR^*	Belongs to transition
49	8.04	0.46	0.00	0.46	0.98	0.237	1.59	0.148	1.00	1.00	2.000	No
50	8.20	0.47	0.00	0.47	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
51	8.37	0.48	0.00	0.48	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
52	8.53	0.50	0.00	0.50	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
53	8.69	0.51	0.00	0.51	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
54	8.86	0.52	0.00	0.52	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
55	9.02	0.53	0.00	0.53	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
56	9.19	0.54	0.00	0.54	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
57	9.35	0.55	0.00	0.55	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
58	9.51	0.56	0.00	0.56	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
59	9.68	0.57	0.00	0.57	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
60	9.84	0.58	0.00	0.58	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
61	10.01	0.59	0.00	0.59	0.98	0.235	1.59	0.148	1.00	1.00	2.000	No
62	10.17	0.60	0.00	0.60	0.98	0.235	1.59	0.148	1.00	1.00	2.000	No
63	10.33	0.61	0.00	0.61	0.98	0.235	1.59	0.148	1.00	1.00	2.000	No
64	10.50	0.62	0.00	0.62	0.98	0.235	1.59	0.148	1.00	1.00	2.000	No
65	10.66	0.63	0.00	0.63	0.98	0.235	1.59	0.147	1.00	1.00	2.000	No
66	10.83	0.64	0.00	0.64	0.98	0.235	1.59	0.147	1.00	1.00	2.000	No
67	10.99	0.65	0.00	0.65	0.98	0.235	1.59	0.147	1.00	1.00	2.000	No
68	11.15	0.66	0.00	0.66	0.98	0.237	1.59	0.148	1.00	1.00	0.148	No
69	11.32	0.67	0.01	0.66	0.98	0.238	1.59	0.149	1.00	1.00	0.149	No
70	11.48	0.68	0.02	0.67	0.98	0.240	1.59	0.151	1.00	1.00	0.151	No
71	11.65	0.69	0.02	0.67	0.98	0.242	1.59	0.152	1.00	1.00	0.152	No
72	11.81	0.70	0.03	0.68	0.98	0.243	1.59	0.153	1.00	1.00	0.153	No
73	11.98	0.72	0.03	0.68	0.97	0.245	1.59	0.154	1.00	1.00	0.154	No
74	12.14	0.73	0.04	0.69	0.97	0.246	1.59	0.155	1.00	1.00	0.155	No
75	12.30	0.74	0.04	0.70	0.97	0.248	1.59	0.156	1.00	1.00	0.156	No
76	12.47	0.75	0.05	0.70	0.97	0.250	1.59	0.157	1.00	1.00	0.157	No
77	12.63	0.76	0.05	0.71	0.97	0.251	1.59	0.157	1.00	1.00	0.157	No
78	12.80	0.77	0.06	0.71	0.97	0.252	1.59	0.158	1.00	1.00	0.158	No
79	12.96	0.78	0.06	0.72	0.97	0.254	1.59	0.159	1.00	1.00	0.159	No
80	13.12	0.79	0.07	0.72	0.97	0.255	1.59	0.160	1.00	1.00	0.160	No
81	13.29	0.80	0.07	0.73	0.97	0.257	1.59	0.161	1.00	1.00	0.161	No
82	13.45	0.81	0.08	0.73	0.97	0.258	1.59	0.162	1.00	1.00	0.162	No
83	13.62	0.82	0.08	0.74	0.97	0.259	1.59	0.163	1.00	1.00	0.163	No
84	13.78	0.83	0.09	0.74	0.97	0.261	1.59	0.164	1.00	1.00	0.164	No
85	13.94	0.84	0.09	0.75	0.97	0.262	1.59	0.164	1.00	1.00	0.164	No
86	14.11	0.85	0.10	0.75	0.97	0.263	1.59	0.165	1.00	1.00	0.165	No
87	14.27	0.86	0.10	0.76	0.97	0.265	1.59	0.166	1.00	1.00	0.166	No
88	14.44	0.87	0.11	0.76	0.97	0.266	1.59	0.167	1.00	1.00	0.167	No
89	14.60	0.88	0.11	0.77	0.97	0.267	1.59	0.168	1.00	1.00	0.168	No
90	14.76	0.89	0.12	0.77	0.97	0.268	1.59	0.168	1.00	1.00	0.168	No
91	14.93	0.90	0.12	0.78	0.97	0.270	1.59	0.169	1.00	1.00	0.169	No
92	15.09	0.91	0.13	0.78	0.97	0.271	1.59	0.170	1.00	1.00	0.170	No
93	15.26	0.92	0.13	0.79	0.97	0.272	1.59	0.171	1.00	1.00	0.171	No
94	15.42	0.93	0.14	0.79	0.97	0.273	1.59	0.171	1.00	1.00	0.171	No
95	15.58	0.94	0.14	0.80	0.97	0.274	1.59	0.172	1.00	1.00	0.172	No
96	15.75	0.95	0.15	0.80	0.97	0.275	1.59	0.173	1.00	1.00	0.173	No

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data :: (continued)

Point ID	Depth (ft)	σ_v (tsf)	u_0 (tsf)	σ_v' (tsf)	r_d	CSR	MSF	CSR_{eq}	K_σ	User FS	CSR^*	Belongs to transition
97	15.91	0.96	0.15	0.81	0.97	0.277	1.59	0.173	1.00	1.00	0.173	No
98	16.08	0.97	0.16	0.81	0.97	0.278	1.59	0.174	1.00	1.00	0.174	No
99	16.24	0.98	0.16	0.82	0.97	0.279	1.59	0.175	1.00	1.00	0.175	No
100	16.40	0.99	0.17	0.82	0.97	0.280	1.59	0.175	1.00	1.00	0.175	No
101	16.57	1.00	0.17	0.83	0.97	0.281	1.59	0.176	1.00	1.00	0.176	No
102	16.73	1.01	0.18	0.83	0.96	0.282	1.59	0.177	1.00	1.00	0.177	No
103	16.90	1.02	0.18	0.84	0.96	0.283	1.59	0.177	1.00	1.00	0.177	No
104	17.06	1.03	0.19	0.84	0.96	0.284	1.59	0.178	1.00	1.00	0.178	No
105	17.22	1.04	0.19	0.85	0.96	0.285	1.59	0.179	1.00	1.00	0.179	No
106	17.39	1.05	0.20	0.85	0.96	0.286	1.59	0.179	1.00	1.00	0.179	No
107	17.55	1.06	0.20	0.86	0.96	0.287	1.59	0.180	1.00	1.00	0.180	No
108	17.72	1.07	0.21	0.86	0.96	0.288	1.59	0.181	1.00	1.00	0.181	No
109	17.88	1.08	0.21	0.87	0.96	0.289	1.59	0.181	1.00	1.00	0.181	No
110	18.04	1.09	0.22	0.87	0.96	0.290	1.59	0.182	1.00	1.00	0.182	No
111	18.21	1.10	0.22	0.87	0.96	0.291	1.59	0.182	1.00	1.00	0.182	No
112	18.37	1.11	0.23	0.88	0.96	0.292	1.59	0.183	1.00	1.00	0.183	No
113	18.54	1.12	0.24	0.88	0.96	0.293	1.59	0.184	1.00	1.00	0.184	No
114	18.70	1.13	0.24	0.89	0.96	0.293	1.59	0.184	1.00	1.00	0.184	No
115	18.86	1.14	0.25	0.89	0.96	0.294	1.59	0.185	1.00	1.00	0.185	No
116	19.03	1.15	0.25	0.90	0.96	0.295	1.59	0.185	1.00	1.00	0.185	No
117	19.19	1.16	0.26	0.90	0.96	0.296	1.59	0.186	1.00	1.00	0.186	No
118	19.36	1.17	0.26	0.91	0.96	0.297	1.59	0.186	1.00	1.00	0.186	No
119	19.52	1.18	0.27	0.91	0.96	0.298	1.59	0.187	1.00	1.00	0.187	No
120	19.69	1.19	0.27	0.92	0.96	0.298	1.59	0.187	1.00	1.00	0.187	No
121	19.85	1.20	0.28	0.92	0.96	0.299	1.59	0.188	1.00	1.00	0.188	No
122	20.01	1.21	0.28	0.93	0.96	0.300	1.59	0.188	1.00	1.00	0.188	No
123	20.18	1.22	0.29	0.93	0.96	0.301	1.59	0.189	1.00	1.00	0.189	No
124	20.34	1.22	0.29	0.93	0.96	0.302	1.59	0.189	1.00	1.00	0.189	No
125	20.51	1.23	0.30	0.93	0.96	0.303	1.59	0.190	1.00	1.00	0.190	No
126	20.67	1.24	0.30	0.94	0.96	0.304	1.59	0.190	1.00	1.00	0.190	No

Abbreviations

Depth: Depth from free surface, at which CPT was performed (ft)
σ_v: Total overburden pressure at test point (tsf)
u_0: Water pressure at test point (tsf)
σ_v': Effective overburden pressure based on GWT during earthquake (tsf)
r_d: Nonlinear shear mass factor
CSR: Cyclic Stress Ratio
MSF: Magnitude Scaling Factor
CSR_{eq}: CSR adjusted for M=7.5
K_σ: Effective overburden stress factor
CSR^*: CSR fully adjusted

:: Cyclic Resistance Ratio (CRR) calculation data ::

Point ID	Depth (ft)	q_t (tsf)	I_c	Fr (%)	n	Q_{tn}	K_c	$Q_{tn,cs}$	$CRR_{7.5}$	Belongs to trans. layer	Clay-like behaviour	FS
1	0.16	45.64	1.74	0.28	0.53	73.32	1.00	73.32	4.000	No	No	2.00
2	0.33	48.96	1.72	0.30	0.52	78.64	1.00	78.64	4.000	No	No	2.00
3	0.49	50.86	1.74	0.36	0.53	81.67	1.00	81.67	4.000	No	No	2.00
4	0.66	50.16	1.78	0.42	0.54	80.54	1.00	80.54	4.000	No	No	2.00
5	0.82	50.94	1.79	0.47	0.55	81.77	1.00	81.77	4.000	No	No	2.00
6	0.98	50.37	1.81	0.49	0.55	80.84	1.00	80.84	4.000	No	No	2.00
7	1.15	45.38	1.86	0.51	0.56	72.81	1.21	87.76	4.000	No	No	2.00
8	1.31	35.49	1.97	0.56	0.60	56.91	1.28	73.06	4.000	No	No	2.00
9	1.48	26.40	2.10	0.61	0.64	42.29	1.42	60.01	4.000	No	No	2.00
10	1.64	20.20	2.22	0.65	0.67	32.31	1.65	53.44	4.000	No	No	2.00
11	1.80	16.71	2.29	0.66	0.70	26.69	1.90	50.72	4.000	No	No	2.00
12	1.97	15.51	2.32	0.66	0.70	24.75	2.01	49.78	4.000	No	No	2.00
13	2.13	16.00	2.27	0.53	0.69	25.53	1.82	46.45	4.000	No	No	2.00
14	2.30	16.86	2.22	0.44	0.67	26.90	1.00	26.90	4.000	No	No	2.00
15	2.46	17.28	2.17	0.35	0.66	27.55	1.00	27.55	4.000	No	No	2.00
16	2.62	16.96	2.18	0.35	0.66	27.03	1.00	27.03	4.000	No	No	2.00
17	2.79	16.56	2.17	0.31	0.66	26.37	1.00	26.37	4.000	No	No	2.00
18	2.95	16.62	2.15	0.27	0.65	26.45	1.00	26.45	4.000	No	No	2.00
19	3.12	17.11	2.13	0.26	0.65	27.24	1.00	27.24	4.000	No	No	2.00
20	3.28	18.23	2.13	0.32	0.65	29.02	1.00	29.02	4.000	No	No	2.00
21	3.44	20.54	2.15	0.47	0.65	32.72	1.00	32.72	4.000	No	No	2.00
22	3.61	23.61	2.15	0.61	0.65	37.63	1.50	56.29	4.000	No	No	2.00
23	3.77	27.51	2.17	0.89	0.66	43.89	1.55	67.85	4.000	No	No	2.00
24	3.94	34.29	2.30	1.97	0.70	54.77	1.92	105.34	4.000	No	No	2.00
25	4.10	57.63	2.22	2.59	0.67	92.25	1.67	153.83	4.000	No	No	2.00
26	4.27	123.81	1.94	2.13	0.59	198.57	1.26	251.16	4.000	No	No	2.00
27	4.43	174.89	1.81	1.86	0.55	280.60	1.16	325.27	4.000	No	No	2.00
28	4.59	197.52	1.73	1.65	0.53	316.96	1.05	334.24	4.000	No	No	2.00
29	4.76	175.61	1.73	1.50	0.53	281.73	1.05	295.59	4.000	No	No	2.00
30	4.92	161.40	1.71	1.32	0.52	258.88	1.00	259.57	4.000	No	No	2.00
31	5.09	159.44	1.66	1.15	0.51	255.72	1.00	255.72	4.000	No	No	2.00
32	5.25	157.88	1.66	1.14	0.51	253.19	1.00	253.19	4.000	No	No	2.00
33	5.41	159.35	1.67	1.17	0.51	255.54	1.00	255.54	4.000	No	No	2.00
34	5.58	159.25	1.69	1.22	0.51	255.36	1.00	255.36	4.000	No	No	2.00
35	5.74	158.39	1.70	1.26	0.52	253.97	1.00	253.97	4.000	No	No	2.00
36	5.91	156.06	1.71	1.30	0.52	250.20	1.01	252.21	4.000	No	No	2.00
37	6.07	151.10	1.72	1.31	0.52	242.22	1.03	250.06	4.000	No	No	2.00
38	6.23	144.54	1.73	1.30	0.53	231.66	1.05	244.26	4.000	No	No	2.00
39	6.40	137.67	1.74	1.29	0.53	220.62	1.07	236.93	4.000	No	No	2.00
40	6.56	133.10	1.75	1.27	0.53	213.24	1.08	230.36	4.000	No	No	2.00
41	6.73	131.84	1.74	1.24	0.53	211.20	1.07	226.01	4.000	No	No	2.00
42	6.89	134.31	1.73	1.20	0.53	213.83	1.05	223.61	4.000	No	No	2.00
43	7.05	140.17	1.71	1.16	0.52	219.09	1.01	221.51	4.000	No	No	2.00
44	7.22	146.88	1.70	1.14	0.52	225.67	1.00	225.67	4.000	No	No	2.00
45	7.38	152.33	1.69	1.14	0.52	230.62	1.00	230.62	4.000	No	No	2.00
46	7.55	156.89	1.69	1.16	0.52	234.63	1.00	234.63	4.000	No	No	2.00
47	7.71	160.71	1.70	1.19	0.52	237.76	1.00	237.76	4.000	No	No	2.00
48	7.87	164.29	1.70	1.22	0.52	240.34	1.00	240.34	4.000	No	No	2.00

:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)

Point ID	Depth (ft)	q_t (tsf)	I_c	Fr (%)	n	Q_{tn}	K_c	$Q_{tn,cs}$	$CRR_{7.5}$	Belongs to trans. layer	Clay-like behaviour	FS
49	8.04	167.74	1.70	1.22	0.52	242.40	1.00	242.40	4.000	No	No	2.00
50	8.20	172.01	1.67	1.12	0.51	244.03	1.00	244.03	4.000	No	No	2.00
51	8.37	176.85	1.64	1.03	0.50	246.30	1.00	246.30	4.000	No	No	2.00
52	8.53	179.41	1.62	0.97	0.50	247.22	1.00	247.22	4.000	No	No	2.00
53	8.69	189.56	1.61	0.97	0.50	258.51	1.00	258.51	4.000	No	No	2.00
54	8.86	202.35	1.59	0.98	0.50	273.15	1.00	273.15	4.000	No	No	2.00
55	9.02	213.53	1.58	0.98	0.50	285.37	1.00	285.37	4.000	No	No	2.00
56	9.19	210.84	1.59	0.99	0.50	278.97	1.00	278.97	4.000	No	No	2.00
57	9.35	202.81	1.61	1.02	0.50	265.71	1.00	265.71	4.000	No	No	2.00
58	9.51	198.45	1.61	1.00	0.50	257.51	1.00	257.51	4.000	No	No	2.00
59	9.68	196.50	1.62	0.98	0.50	252.59	1.00	252.59	4.000	No	No	2.00
60	9.84	194.15	1.61	0.95	0.50	247.28	1.00	247.28	4.000	No	No	2.00
61	10.01	189.92	1.62	0.96	0.50	239.71	1.00	239.71	4.000	No	No	2.00
62	10.17	183.99	1.64	0.98	0.50	230.25	1.00	230.25	4.000	No	No	2.00
63	10.33	178.00	1.67	1.03	0.51	221.78	1.00	221.78	4.000	No	No	2.00
64	10.50	169.84	1.70	1.07	0.52	210.67	1.00	210.67	4.000	No	No	2.00
65	10.66	164.88	1.72	1.10	0.52	203.32	1.02	207.24	4.000	No	No	2.00
66	10.83	165.30	1.72	1.11	0.52	202.24	1.03	208.32	4.000	No	No	2.00
67	10.99	173.83	1.71	1.12	0.52	210.57	1.01	211.83	4.000	No	No	2.00
68	11.15	184.83	1.69	1.11	0.52	222.35	1.00	222.35	4.000	No	No	2.00
69	11.32	190.86	1.67	1.05	0.51	227.89	1.00	227.89	4.000	No	No	2.00
70	11.48	191.69	1.66	1.04	0.51	227.82	1.00	227.82	4.000	No	No	2.00
71	11.65	193.16	1.66	1.02	0.51	228.47	1.00	228.47	4.000	No	No	2.00
72	11.81	185.58	1.70	1.14	0.52	219.89	1.00	219.89	4.000	No	No	2.00
73	11.98	186.19	1.72	1.19	0.52	220.04	1.02	224.76	4.000	No	No	2.00
74	12.14	184.64	1.73	1.22	0.53	217.64	1.05	227.91	4.000	No	No	2.00
75	12.30	192.18	1.70	1.17	0.52	224.93	1.00	224.93	4.000	No	No	2.00
76	12.47	190.81	1.70	1.13	0.52	222.23	1.00	222.23	4.000	No	No	2.00
77	12.63	189.25	1.70	1.12	0.52	219.49	1.00	219.49	4.000	No	No	2.00
78	12.80	185.81	1.70	1.10	0.52	214.66	1.00	214.66	4.000	No	No	2.00
79	12.96	173.16	1.72	1.09	0.52	199.64	1.02	204.25	4.000	No	No	2.00
80	13.12	153.41	1.75	1.08	0.53	176.76	1.09	191.91	0.737	No	No	2.00
81	13.29	131.81	1.80	1.09	0.55	152.02	1.15	175.47	0.582	No	No	2.00
82	13.45	114.63	1.86	1.16	0.57	132.47	1.21	160.33	0.463	No	No	2.00
83	13.62	102.57	1.91	1.23	0.58	118.62	1.25	147.77	0.380	No	No	2.00
84	13.78	96.52	1.94	1.27	0.59	111.49	1.27	141.18	0.342	No	No	2.00
85	13.94	97.87	1.94	1.28	0.59	112.56	1.26	142.32	0.348	No	No	2.00
86	14.11	106.59	1.91	1.26	0.58	121.83	1.25	151.72	0.405	No	No	2.00
87	14.27	115.54	1.88	1.24	0.57	131.24	1.23	160.97	0.468	No	No	2.00
88	14.44	122.69	1.84	1.12	0.56	138.25	1.19	164.64	0.495	No	No	2.00
89	14.60	125.08	1.81	1.03	0.55	140.03	1.16	162.72	0.481	No	No	2.00
90	14.76	126.66	1.79	0.98	0.55	141.07	1.14	161.24	0.470	No	No	2.00
91	14.93	127.32	1.81	1.04	0.55	141.50	1.16	164.35	0.493	No	No	2.00
92	15.09	130.02	1.81	1.07	0.55	144.04	1.17	167.84	0.520	No	No	2.00
93	15.26	133.58	1.80	1.05	0.55	147.32	1.15	169.78	0.535	No	No	2.00
94	15.42	137.06	1.78	1.02	0.54	150.43	1.13	170.42	0.540	No	No	2.00
95	15.58	137.51	1.78	0.99	0.54	150.30	1.12	168.73	0.527	No	No	2.00
96	15.75	139.36	1.76	0.95	0.54	151.61	1.10	166.93	0.513	No	No	2.00

:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)

Point ID	Depth (ft)	q_t (tsf)	I_c	Fr (%)	n	Q_{tn}	K_c	$Q_{tn,cs}$	$CRR_{7.5}$	Belongs to trans. layer	Clay-like behaviour	FS
97	15.91	141.05	1.74	0.91	0.53	152.72	1.07	164.02	0.490	No	No	2.00
98	16.08	144.81	1.72	0.85	0.52	155.98	1.03	159.96	0.461	No	No	2.00
99	16.24	145.16	1.71	0.81	0.52	155.70	1.00	155.70	0.431	No	No	2.00
100	16.40	141.06	1.70	0.78	0.52	150.76	1.00	150.76	0.399	No	No	2.00
101	16.57	129.02	1.74	0.78	0.53	137.69	1.06	145.77	0.368	No	No	2.00
102	16.73	116.10	1.77	0.79	0.54	123.74	1.12	138.61	0.328	No	No	1.85
103	16.90	108.35	1.80	0.80	0.55	115.26	1.15	133.02	0.299	No	No	1.68
104	17.06	102.72	1.81	0.78	0.55	108.95	1.17	127.09	0.271	No	No	1.52
105	17.22	93.64	1.84	0.76	0.56	99.10	1.19	118.27	0.234	No	No	1.31
106	17.39	78.35	1.92	0.81	0.58	82.90	1.25	103.55	0.183	No	No	1.02
107	17.55	64.60	2.01	0.87	0.61	68.32	1.31	89.65	0.147	No	No	0.82
108	17.72	56.93	2.06	0.91	0.63	60.09	1.37	82.14	0.132	No	No	0.73
109	17.88	58.48	2.04	0.85	0.62	61.46	1.34	82.40	0.132	No	No	0.73
110	18.04	47.78	2.13	0.91	0.65	50.10	1.46	73.22	0.117	No	No	0.64
111	18.21	39.89	2.22	1.02	0.67	41.73	1.67	69.64	0.111	No	No	0.61
112	18.37	27.89	2.48	1.73	0.75	29.13	2.84	82.73	0.133	No	No	0.73
113	18.54	39.52	2.46	2.52	0.75	41.57	2.73	113.30	0.215	No	No	1.17
114	18.70	63.71	2.31	2.50	0.70	66.91	1.95	130.48	0.287	No	No	1.56
115	18.86	89.49	2.14	2.00	0.65	93.27	1.48	137.85	0.324	No	No	1.75
116	19.03	95.01	2.05	1.60	0.62	98.31	1.36	133.41	0.301	No	No	1.63
117	19.19	79.52	2.08	1.45	0.63	81.92	1.39	114.16	0.218	No	No	1.18
118	19.36	63.57	2.20	1.67	0.67	65.36	1.60	104.86	0.187	No	No	1.01
119	19.52	58.14	2.32	2.31	0.70	59.77	1.99	119.20	0.238	No	No	1.27
120	19.69	57.28	2.50	4.15	0.76	59.09	3.00	177.01	0.596	No	No	2.00
121	19.85	67.08	2.59	6.16	0.78	69.32	3.64	252.56	4.000	No	No	2.00
122	20.01	107.33	2.46	6.05	0.75	110.53	2.71	299.11	4.000	No	No	2.00
123	20.18	154.97	N/A	-58260.96	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
124	20.34	202.91	N/A	-88831.09	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
125	20.51	261.68	N/A	-103183.84	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
126	20.67	313.55	N/A	-86050.53	1.00	-1.00	1.00	N/A	4.000	No	No	2.00

Abbreviations

Depth: Depth from free surface, at which CPT was performed (ft)
q_t: Total cone resistance
I_c: Soil behavior type index
Fr: Normalized friction ratio (%)
n: Stress exponent
Q_{tn}: Normalized cone resistance
K_c: Cone resistance correction factor due to fines
$Q_{tn,cs}$: Normalized and adjusted cone resistance
$CRR_{7.5}$: Cyclic resistance ratio for M_w=7.5
FS: Factor of safety against soil liquefaction

:: Liquefaction Potential Index calculation data ::

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
0.16	2.00	0.00	0.00	0.16	0.00	0.33	2.00	0.00	0.00	0.16	0.00
0.49	2.00	0.00	0.00	0.16	0.00	0.66	2.00	0.00	0.00	0.16	0.00
0.82	2.00	0.00	0.00	0.16	0.00	0.98	2.00	0.00	0.00	0.16	0.00
1.15	2.00	0.00	0.00	0.16	0.00	1.31	2.00	0.00	0.00	0.16	0.00
1.48	2.00	0.00	0.00	0.16	0.00	1.64	2.00	0.00	0.00	0.16	0.00
1.80	2.00	0.00	0.00	0.16	0.00	1.97	2.00	0.00	0.00	0.16	0.00
2.13	2.00	0.00	0.00	0.16	0.00	2.30	2.00	0.00	0.00	0.16	0.00
2.46	2.00	0.00	0.00	0.16	0.00	2.62	2.00	0.00	0.00	0.16	0.00
2.79	2.00	0.00	0.00	0.16	0.00	2.95	2.00	0.00	0.00	0.16	0.00
3.12	2.00	0.00	0.00	0.16	0.00	3.28	2.00	0.00	0.00	0.16	0.00
3.44	2.00	0.00	0.00	0.16	0.00	3.61	2.00	0.00	0.00	0.16	0.00
3.77	2.00	0.00	0.00	0.16	0.00	3.94	2.00	0.00	0.00	0.16	0.00
4.10	2.00	0.00	0.00	0.16	0.00	4.27	2.00	0.00	0.00	0.16	0.00
4.43	2.00	0.00	0.00	0.16	0.00	4.59	2.00	0.00	0.00	0.16	0.00
4.76	2.00	0.00	0.00	0.16	0.00	4.92	2.00	0.00	0.00	0.16	0.00
5.09	2.00	0.00	0.00	0.16	0.00	5.25	2.00	0.00	0.00	0.16	0.00
5.41	2.00	0.00	0.00	0.16	0.00	5.58	2.00	0.00	0.00	0.16	0.00
5.74	2.00	0.00	0.00	0.16	0.00	5.91	2.00	0.00	0.00	0.16	0.00
6.07	2.00	0.00	0.00	0.16	0.00	6.23	2.00	0.00	0.00	0.16	0.00
6.40	2.00	0.00	0.00	0.16	0.00	6.56	2.00	0.00	0.00	0.16	0.00
6.73	2.00	0.00	0.00	0.16	0.00	6.89	2.00	0.00	0.00	0.16	0.00
7.05	2.00	0.00	0.00	0.16	0.00	7.22	2.00	0.00	0.00	0.16	0.00
7.38	2.00	0.00	0.00	0.16	0.00	7.55	2.00	0.00	0.00	0.16	0.00
7.71	2.00	0.00	0.00	0.16	0.00	7.87	2.00	0.00	0.00	0.16	0.00
8.04	2.00	0.00	0.00	0.16	0.00	8.20	2.00	0.00	0.00	0.16	0.00
8.37	2.00	0.00	0.00	0.16	0.00	8.53	2.00	0.00	0.00	0.16	0.00
8.69	2.00	0.00	0.00	0.16	0.00	8.86	2.00	0.00	0.00	0.16	0.00
9.02	2.00	0.00	0.00	0.16	0.00	9.19	2.00	0.00	0.00	0.16	0.00
9.35	2.00	0.00	0.00	0.16	0.00	9.51	2.00	0.00	0.00	0.16	0.00
9.68	2.00	0.00	0.00	0.16	0.00	9.84	2.00	0.00	0.00	0.16	0.00
10.01	2.00	0.00	0.00	0.16	0.00	10.17	2.00	0.00	0.00	0.16	0.00
10.33	2.00	0.00	0.00	0.16	0.00	10.50	2.00	0.00	0.00	0.16	0.00
10.66	2.00	0.00	0.00	0.16	0.00	10.83	2.00	0.00	0.00	0.16	0.00
10.99	2.00	0.00	0.00	0.16	0.00	11.15	2.00	0.00	0.00	0.16	0.00
11.32	2.00	0.00	0.00	0.16	0.00	11.48	2.00	0.00	0.00	0.16	0.00
11.65	2.00	0.00	0.00	0.16	0.00	11.81	2.00	0.00	0.00	0.16	0.00
11.98	2.00	0.00	0.00	0.16	0.00	12.14	2.00	0.00	0.00	0.16	0.00
12.30	2.00	0.00	0.00	0.16	0.00	12.47	2.00	0.00	0.00	0.16	0.00
12.63	2.00	0.00	0.00	0.16	0.00	12.80	2.00	0.00	0.00	0.16	0.00
12.96	2.00	0.00	0.00	0.16	0.00	13.12	2.00	0.00	0.00	0.16	0.00
13.29	2.00	0.00	0.00	0.16	0.00	13.45	2.00	0.00	0.00	0.16	0.00
13.62	2.00	0.00	0.00	0.16	0.00	13.78	2.00	0.00	0.00	0.16	0.00
13.94	2.00	0.00	0.00	0.16	0.00	14.11	2.00	0.00	0.00	0.16	0.00
14.27	2.00	0.00	0.00	0.16	0.00	14.44	2.00	0.00	0.00	0.16	0.00
14.60	2.00	0.00	0.00	0.16	0.00	14.76	2.00	0.00	0.00	0.16	0.00
14.93	2.00	0.00	0.00	0.16	0.00	15.09	2.00	0.00	0.00	0.16	0.00
15.26	2.00	0.00	0.00	0.16	0.00	15.42	2.00	0.00	0.00	0.16	0.00
15.58	2.00	0.00	0.00	0.16	0.00	15.75	2.00	0.00	0.00	0.16	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
15.91	2.00	0.00	0.00	0.16	0.00	16.08	2.00	0.00	0.00	0.16	0.00
16.24	2.00	0.00	0.00	0.16	0.00	16.40	2.00	0.00	0.00	0.16	0.00
16.57	2.00	0.00	0.00	0.16	0.00	16.73	1.85	0.00	0.00	0.16	0.00
16.90	1.68	0.00	0.00	0.16	0.00	17.06	1.52	0.00	0.00	0.16	0.00
17.22	1.31	0.00	0.00	0.16	0.00	17.39	1.02	0.00	0.00	0.16	0.00
17.55	0.82	0.18	1.91	0.16	0.07	17.72	0.73	0.27	1.06	0.16	0.10
17.88	0.73	0.27	1.06	0.16	0.10	18.04	0.64	0.36	0.72	0.16	0.13
18.21	0.61	0.39	0.65	0.16	0.14	18.37	0.73	0.27	1.04	0.16	0.10
18.54	1.17	0.00	0.00	0.16	0.00	18.70	1.56	0.00	0.00	0.16	0.00
18.86	1.75	0.00	0.00	0.16	0.00	19.03	1.63	0.00	0.00	0.16	0.00
19.19	1.18	0.00	0.00	0.16	0.00	19.36	1.01	0.00	0.00	0.16	0.00
19.52	1.27	0.00	0.00	0.16	0.00	19.69	2.00	0.00	0.00	0.16	0.00
19.85	2.00	0.00	0.00	0.16	0.00	20.01	2.00	0.00	0.00	0.16	0.00
20.18	2.00	0.00	0.00	0.16	0.00	20.34	2.00	0.00	0.00	0.16	0.00
20.51	2.00	0.00	0.00	0.16	0.00	20.67	2.00	0.00	0.00	0.16	0.00

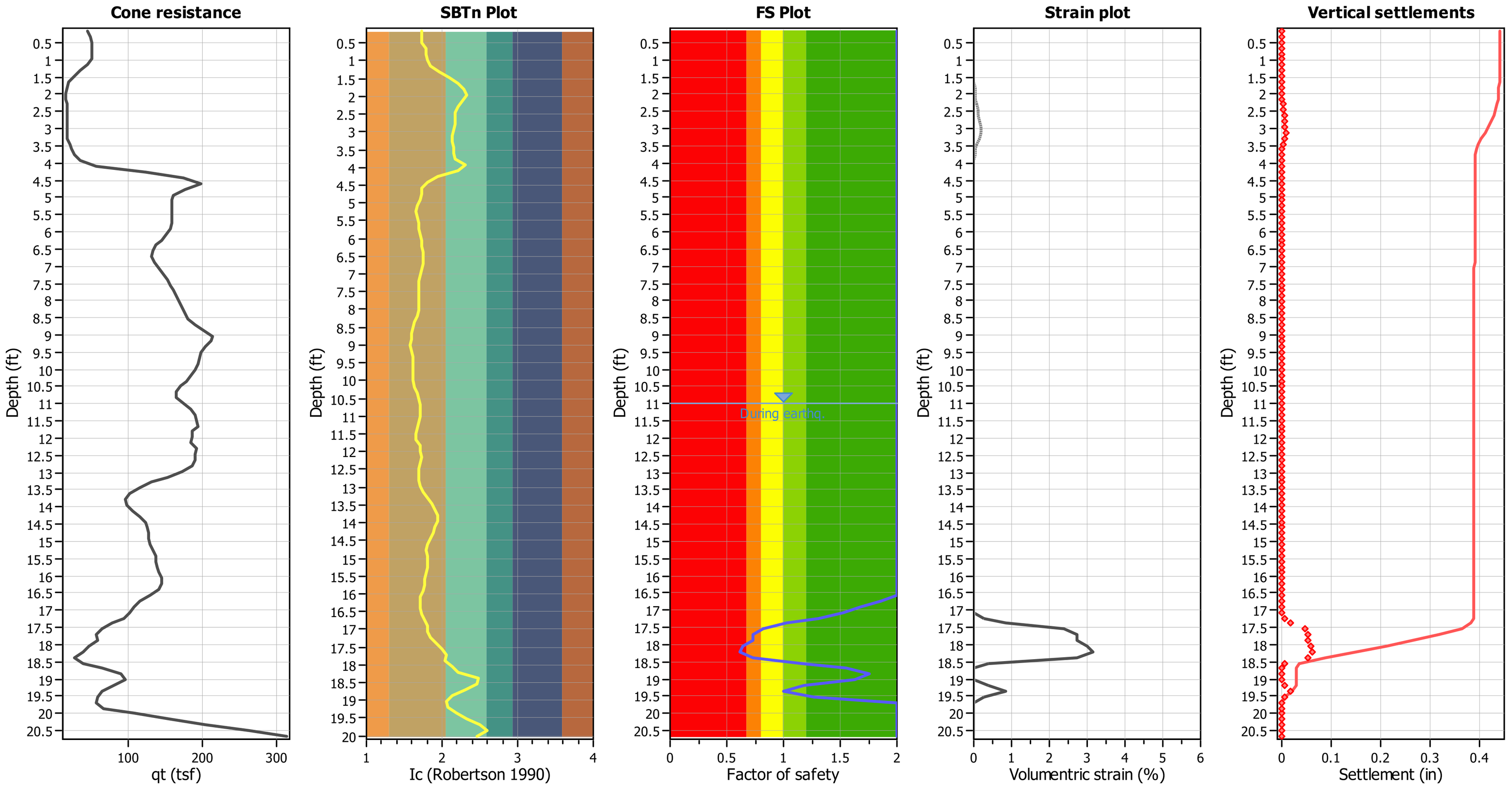
Overall liquefaction potential: 0.63

LPI = 0.00 - Liquefaction risk very low
LPI between 0.00 and 5.00 - Liquefaction risk low
LPI between 5.00 and 15.00 - Liquefaction risk high
LPI > 15.00 - Liquefaction risk very high

Abbreviations

FS: Calculated factor of safety for test point
F_L: 1 - FS
w_z: Function value of the extend of soil liquefaction according to depth
d_z: Layer thickness (ft)
LPI: Liquefaction potential index value for test point

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement of dry sands ::

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
0.16	1.74	73.32	1.00	73.32	14	370	0.15	0.001	0.00	5.81	0.00	0.000
0.33	1.72	78.64	1.00	78.64	15	390	0.15	0.001	0.00	5.81	0.00	0.000
0.49	1.74	81.67	1.00	81.67	15	414	0.15	0.002	0.00	5.81	0.00	0.000
0.66	1.78	80.54	1.00	80.54	15	429	0.15	0.002	0.00	5.81	0.00	0.000
0.82	1.79	81.77	1.00	81.77	16	444	0.15	0.003	0.00	5.81	0.00	0.000
0.98	1.81	80.84	1.00	80.84	16	447	0.15	0.003	0.00	5.81	0.00	0.000
1.15	1.86	72.81	1.21	87.76	17	428	0.15	0.004	0.01	5.81	0.00	0.000
1.31	1.97	56.91	1.28	73.06	15	386	0.15	0.006	0.01	5.81	0.01	0.000
1.48	2.10	42.29	1.42	60.01	13	338	0.15	0.008	0.01	5.81	0.01	0.000
1.64	2.22	32.31	1.65	53.44	12	299	0.15	0.012	0.02	5.81	0.01	0.001
1.80	2.29	26.69	1.90	50.72	12	273	0.15	0.017	0.03	5.81	0.02	0.001
1.97	2.32	24.75	2.01	49.78	12	262	0.15	0.021	0.04	5.81	0.03	0.001
2.13	2.27	25.53	1.82	46.45	11	254	0.15	0.026	0.05	5.81	0.04	0.001
2.30	2.22	26.90	1.00	26.90	6	249	0.15	0.030	0.13	5.81	0.08	0.003
2.46	2.17	27.55	1.00	27.55	6	240	0.15	0.038	0.16	5.81	0.10	0.004
2.62	2.18	27.03	1.00	27.03	6	238	0.15	0.043	0.18	5.81	0.12	0.005
2.79	2.17	26.37	1.00	26.37	6	230	0.15	0.054	0.24	5.81	0.15	0.006
2.95	2.15	26.45	1.00	26.45	6	225	0.15	0.065	0.29	5.81	0.19	0.007
3.12	2.13	27.24	1.00	27.24	6	226	0.15	0.071	0.30	5.81	0.20	0.008
3.28	2.13	29.02	1.00	29.02	6	242	0.15	0.061	0.24	5.81	0.16	0.006
3.44	2.15	32.72	1.00	32.72	7	278	0.15	0.043	0.15	5.81	0.10	0.004
3.61	2.15	37.63	1.50	56.29	12	319	0.15	0.032	0.06	5.81	0.04	0.001
3.77	2.17	43.89	1.55	67.85	15	384	0.15	0.022	0.03	5.81	0.02	0.001
3.94	2.30	54.77	1.92	105.34	25	564	0.15	0.012	0.01	5.81	0.01	0.000
4.10	2.22	92.25	1.67	153.83	35	860	0.15	0.007	0.00	5.81	0.00	0.000
4.27	1.94	198.57	1.26	251.16	51	1302	0.15	0.005	0.00	5.81	0.00	0.000
4.43	1.81	280.60	1.16	325.27	63	1547	0.15	0.004	0.00	5.81	0.00	0.000
4.59	1.73	316.96	1.05	334.24	63	1593	0.15	0.004	0.00	5.81	0.00	0.000
4.76	1.73	281.73	1.05	295.59	56	1411	0.15	0.005	0.00	5.81	0.00	0.000
4.92	1.71	258.88	1.00	259.57	49	1260	0.15	0.006	0.00	5.81	0.00	0.000
5.09	1.66	255.72	1.00	255.72	47	1179	0.15	0.006	0.00	5.81	0.00	0.000
5.25	1.66	253.19	1.00	253.19	47	1165	0.15	0.007	0.00	5.81	0.00	0.000
5.41	1.67	255.54	1.00	255.54	47	1186	0.15	0.007	0.00	5.81	0.00	0.000
5.58	1.69	255.36	1.00	255.36	47	1208	0.15	0.007	0.00	5.81	0.00	0.000
5.74	1.70	253.97	1.00	253.97	47	1221	0.15	0.007	0.00	5.81	0.00	0.000
5.91	1.71	250.20	1.01	252.21	47	1222	0.15	0.007	0.00	5.81	0.00	0.000
6.07	1.72	242.22	1.03	250.06	47	1200	0.15	0.008	0.00	5.81	0.00	0.000
6.23	1.73	231.66	1.05	244.26	46	1164	0.15	0.008	0.00	5.81	0.00	0.000
6.40	1.74	220.62	1.07	236.93	45	1124	0.15	0.009	0.00	5.81	0.00	0.000
6.56	1.75	213.24	1.08	230.36	44	1092	0.15	0.010	0.00	5.81	0.00	0.000
6.73	1.74	211.20	1.07	226.01	43	1073	0.15	0.010	0.00	5.81	0.00	0.000
6.89	1.73	213.83	1.05	223.61	42	1075	0.15	0.010	0.00	5.81	0.00	0.000
7.05	1.71	219.09	1.01	221.51	41	1099	0.15	0.010	0.00	5.81	0.00	0.000
7.22	1.70	225.67	1.00	225.67	42	1131	0.15	0.010	0.00	5.81	0.00	0.000
7.38	1.69	230.62	1.00	230.62	43	1162	0.15	0.010	0.00	5.81	0.00	0.000
7.55	1.69	234.63	1.00	234.63	44	1199	0.15	0.010	0.00	5.81	0.00	0.000
7.71	1.70	237.76	1.00	237.76	44	1236	0.15	0.010	0.00	5.81	0.00	0.000
7.87	1.70	240.34	1.00	240.34	45	1269	0.15	0.010	0.00	5.81	0.00	0.000

:: Post-earthquake settlement of dry sands :: (continued)

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
8.04	1.70	242.40	1.00	242.40	45	1293	0.15	0.010	0.00	5.81	0.00	0.000
8.20	1.67	244.03	1.00	244.03	45	1279	0.15	0.010	0.00	5.81	0.00	0.000
8.37	1.64	246.30	1.00	246.30	45	1264	0.15	0.011	0.00	5.81	0.00	0.000
8.53	1.62	247.22	1.00	247.22	45	1247	0.15	0.011	0.00	5.81	0.00	0.000
8.69	1.61	258.51	1.00	258.51	47	1299	0.15	0.011	0.00	5.81	0.00	0.000
8.86	1.59	273.15	1.00	273.15	49	1366	0.15	0.010	0.00	5.81	0.00	0.000
9.02	1.58	285.37	1.00	285.37	51	1415	0.15	0.010	0.00	5.81	0.00	0.000
9.19	1.59	278.97	1.00	278.97	50	1419	0.15	0.010	0.00	5.81	0.00	0.000
9.35	1.61	265.71	1.00	265.71	48	1404	0.15	0.011	0.00	5.81	0.00	0.000
9.51	1.61	257.51	1.00	257.51	47	1375	0.15	0.011	0.00	5.81	0.00	0.000
9.68	1.62	252.59	1.00	252.59	46	1364	0.15	0.012	0.00	5.81	0.00	0.000
9.84	1.61	247.28	1.00	247.28	45	1337	0.15	0.012	0.00	5.81	0.00	0.000
10.01	1.62	239.71	1.00	239.71	44	1333	0.15	0.013	0.00	5.81	0.00	0.000
10.17	1.64	230.25	1.00	230.25	42	1320	0.15	0.013	0.01	5.81	0.00	0.000
10.33	1.67	221.78	1.00	221.78	41	1319	0.15	0.013	0.01	5.81	0.00	0.000
10.50	1.70	210.67	1.00	210.67	39	1306	0.15	0.014	0.01	5.81	0.00	0.000
10.66	1.72	203.32	1.02	207.24	39	1297	0.15	0.014	0.01	5.81	0.00	0.000
10.83	1.72	202.24	1.03	208.32	39	1309	0.15	0.014	0.01	5.81	0.00	0.000
10.99	1.71	210.57	1.01	211.83	40	1357	0.15	0.014	0.01	5.81	0.00	0.000

Total estimated settlement: 0.05

Abbreviations

Q_{tn}: Equivalent clean sand normalized cone resistance
K_c: Fines correction factor
$Q_{tn,cs}$: Post-liquefaction volumentric strain
G_{max}: Small strain shear modulus
CSR: Soil cyclic stress ratio
γ: Cyclic shear strain
$e_{vol(15)}$: Volumetric strain after 15 cycles
N_c: Equivalent number of cycles
e_v: Volumetric strain
Settle.: Calculated settlement

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
11.15	222.35	2.00	0.00	1.00	0.00	11.32	227.89	2.00	0.00	1.00	0.00
11.48	227.82	2.00	0.00	1.00	0.00	11.65	228.47	2.00	0.00	1.00	0.00
11.81	219.89	2.00	0.00	1.00	0.00	11.98	224.76	2.00	0.00	1.00	0.00
12.14	227.91	2.00	0.00	1.00	0.00	12.30	224.93	2.00	0.00	1.00	0.00
12.47	222.23	2.00	0.00	1.00	0.00	12.63	219.49	2.00	0.00	1.00	0.00
12.80	214.66	2.00	0.00	1.00	0.00	12.96	204.25	2.00	0.00	1.00	0.00
13.12	191.91	2.00	0.00	1.00	0.00	13.29	175.47	2.00	0.00	1.00	0.00
13.45	160.33	2.00	0.00	1.00	0.00	13.62	147.77	2.00	0.00	1.00	0.00
13.78	141.18	2.00	0.00	1.00	0.00	13.94	142.32	2.00	0.00	1.00	0.00
14.11	151.72	2.00	0.00	1.00	0.00	14.27	160.97	2.00	0.00	1.00	0.00
14.44	164.64	2.00	0.00	1.00	0.00	14.60	162.72	2.00	0.00	1.00	0.00
14.76	161.24	2.00	0.00	1.00	0.00	14.93	164.35	2.00	0.00	1.00	0.00
15.09	167.84	2.00	0.00	1.00	0.00	15.26	169.78	2.00	0.00	1.00	0.00
15.42	170.42	2.00	0.00	1.00	0.00	15.58	168.73	2.00	0.00	1.00	0.00
15.75	166.93	2.00	0.00	1.00	0.00	15.91	164.02	2.00	0.00	1.00	0.00
16.08	159.96	2.00	0.00	1.00	0.00	16.24	155.70	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
16.40	150.76	2.00	0.00	1.00	0.00	16.57	145.77	2.00	0.00	1.00	0.00
16.73	138.61	1.85	0.00	1.00	0.00	16.90	133.02	1.68	0.00	1.00	0.00
17.06	127.09	1.52	0.00	1.00	0.00	17.22	118.27	1.31	0.26	1.00	0.01
17.39	103.55	1.02	0.86	1.00	0.02	17.55	89.65	0.82	2.38	1.00	0.05
17.72	82.14	0.73	2.75	1.00	0.05	17.88	82.40	0.73	2.74	1.00	0.05
18.04	73.22	0.64	3.02	1.00	0.06	18.21	69.64	0.61	3.14	1.00	0.06
18.37	82.73	0.73	2.73	1.00	0.05	18.54	113.30	1.17	0.37	1.00	0.01
18.70	130.48	1.56	0.00	1.00	0.00	18.86	137.85	1.75	0.00	1.00	0.00
19.03	133.41	1.63	0.00	1.00	0.00	19.19	114.16	1.18	0.37	1.00	0.01
19.36	104.86	1.01	0.85	1.00	0.02	19.52	119.20	1.27	0.26	1.00	0.01
19.69	177.01	2.00	0.00	1.00	0.00	19.85	252.56	2.00	0.00	1.00	0.00
20.01	299.11	2.00	0.00	1.00	0.00	20.18	-1.00	2.00	0.00	1.00	0.00
20.34	-1.00	2.00	0.00	1.00	0.00	20.51	-1.00	2.00	0.00	1.00	0.00
20.67	-1.00	2.00	0.00	1.00	0.00						

Total estimated settlement: 0.39

Abbreviations

$Q_{tn,cs}$:	Equivalent clean sand normalized cone resistance
FS:	Factor of safety against liquefaction
e_v (%):	Post-liquefaction volumentric strain
DF:	e_v depth weighting factor
Settlement:	Calculated settlement

:: Strength loss calculation (Robertson (2009) ::

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
0.16	45.64	73.32	1.00	73.32	1.74	0.34	0.69
0.33	48.96	78.64	1.00	78.64	1.72	0.52	0.70
0.49	50.86	81.67	1.00	81.67	1.74	0.67	0.71
0.66	50.16	80.54	1.00	80.54	1.78	0.61	0.71
0.82	50.94	81.77	1.00	81.77	1.79	0.68	0.71
0.98	50.37	80.84	1.00	80.84	1.81	0.63	0.71
1.15	45.38	72.81	1.21	87.76	1.86	0.72	0.72
1.31	35.49	56.91	1.28	73.06	1.97	0.33	0.69
1.48	26.40	42.29	1.42	60.01	2.10	0.11	0.66
1.64	20.20	32.31	1.65	53.44	2.22	0.07	0.64
1.80	16.71	26.69	1.90	50.72	2.29	0.06	0.63
1.97	15.51	24.75	2.01	49.78	2.32	0.05	0.62
2.13	16.00	25.53	1.82	46.45	2.27	0.04	0.62
2.30	16.86	26.90	1.00	26.90	2.22	0.02	0.62
2.46	17.28	27.55	1.00	27.55	2.17	0.02	0.62
2.62	16.96	27.03	1.00	27.03	2.18	0.02	0.62
2.79	16.56	26.37	1.00	26.37	2.17	0.02	0.62
2.95	16.62	26.45	1.00	26.45	2.15	0.02	0.62
3.12	17.11	27.24	1.00	27.24	2.13	0.02	0.62
3.28	18.23	29.02	1.00	29.02	2.13	0.02	0.62
3.44	20.54	32.72	1.00	32.72	2.15	0.02	0.62
3.61	23.61	37.63	1.50	56.29	2.15	0.08	0.65
3.77	27.51	43.89	1.55	67.85	2.17	0.21	0.68
3.94	34.29	54.77	1.92	105.34	2.30	0.76	0.76
4.10	57.63	92.25	1.67	153.83	2.22	0.83	0.83
4.27	123.81	198.57	1.26	251.16	1.94	0.94	0.94
4.43	174.89	280.60	1.16	325.27	1.81	1.00	1.00
4.59	197.52	316.96	1.05	334.24	1.73	1.00	1.00
4.76	175.61	281.73	1.05	295.59	1.73	0.97	0.97
4.92	161.40	258.88	1.00	259.57	1.71	0.94	0.94
5.09	159.44	255.72	1.00	255.72	1.66	0.94	0.94
5.25	157.88	253.19	1.00	253.19	1.66	0.94	0.94
5.41	159.35	255.54	1.00	255.54	1.67	0.94	0.94
5.58	159.25	255.36	1.00	255.36	1.69	0.94	0.94
5.74	158.39	253.97	1.00	253.97	1.70	0.94	0.94
5.91	156.06	250.20	1.01	252.21	1.71	0.94	0.94
6.07	151.10	242.22	1.03	250.06	1.72	0.94	0.94
6.23	144.54	231.66	1.05	244.26	1.73	0.93	0.93
6.40	137.67	220.62	1.07	236.93	1.74	0.92	0.92
6.56	133.10	213.24	1.08	230.36	1.75	0.92	0.92
6.73	131.84	211.20	1.07	226.01	1.74	0.91	0.91
6.89	134.31	213.83	1.05	223.61	1.73	0.91	0.91
7.05	140.17	219.09	1.01	221.51	1.71	0.91	0.91
7.22	146.88	225.67	1.00	225.67	1.70	0.91	0.91
7.38	152.33	230.62	1.00	230.62	1.69	0.92	0.92
7.55	156.89	234.63	1.00	234.63	1.69	0.92	0.92
7.71	160.71	237.76	1.00	237.76	1.70	0.92	0.92
7.87	164.29	240.34	1.00	240.34	1.70	0.93	0.93

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
8.04	167.74	242.40	1.00	242.40	1.70	0.93	0.93
8.20	172.01	244.03	1.00	244.03	1.67	0.93	0.93
8.37	176.85	246.30	1.00	246.30	1.64	0.93	0.93
8.53	179.41	247.22	1.00	247.22	1.62	0.93	0.93
8.69	189.56	258.51	1.00	258.51	1.61	0.94	0.94
8.86	202.35	273.15	1.00	273.15	1.59	0.96	0.96
9.02	213.53	285.37	1.00	285.37	1.58	0.97	0.97
9.19	210.84	278.97	1.00	278.97	1.59	0.96	0.96
9.35	202.81	265.71	1.00	265.71	1.61	0.95	0.95
9.51	198.45	257.51	1.00	257.51	1.61	0.94	0.94
9.68	196.50	252.59	1.00	252.59	1.62	0.94	0.94
9.84	194.15	247.28	1.00	247.28	1.61	0.93	0.93
10.01	189.92	239.71	1.00	239.71	1.62	0.93	0.93
10.17	183.99	230.25	1.00	230.25	1.64	0.92	0.92
10.33	178.00	221.78	1.00	221.78	1.67	0.91	0.91
10.50	169.84	210.67	1.00	210.67	1.70	0.90	0.90
10.66	164.88	203.32	1.02	207.24	1.72	0.89	0.89
10.83	165.30	202.24	1.03	208.32	1.72	0.90	0.90
10.99	173.83	210.57	1.01	211.83	1.71	0.90	0.90
11.15	184.83	222.35	1.00	222.35	1.69	0.91	0.91
11.32	190.86	227.89	1.00	227.89	1.67	0.92	0.92
11.48	191.69	227.82	1.00	227.82	1.66	0.92	0.92
11.65	193.16	228.47	1.00	228.47	1.66	0.92	0.92
11.81	185.58	219.89	1.00	219.89	1.70	0.91	0.91
11.98	186.19	220.04	1.02	224.76	1.72	0.91	0.91
12.14	184.64	217.64	1.05	227.91	1.73	0.92	0.92
12.30	192.18	224.93	1.00	224.93	1.70	0.91	0.91
12.47	190.81	222.23	1.00	222.23	1.70	0.91	0.91
12.63	189.25	219.49	1.00	219.49	1.70	0.91	0.91
12.80	185.81	214.66	1.00	214.66	1.70	0.90	0.90
12.96	173.16	199.64	1.02	204.25	1.72	0.89	0.89
13.12	153.41	176.76	1.09	191.91	1.75	0.88	0.88
13.29	131.81	152.02	1.15	175.47	1.80	0.86	0.86
13.45	114.63	132.47	1.21	160.33	1.86	0.84	0.84
13.62	102.57	118.62	1.25	147.77	1.91	0.82	0.82
13.78	96.52	111.49	1.27	141.18	1.94	0.81	0.81
13.94	97.87	112.56	1.26	142.32	1.94	0.82	0.82
14.11	106.59	121.83	1.25	151.72	1.91	0.83	0.83
14.27	115.54	131.24	1.23	160.97	1.88	0.84	0.84
14.44	122.69	138.25	1.19	164.64	1.84	0.85	0.85
14.60	125.08	140.03	1.16	162.72	1.81	0.84	0.84
14.76	126.66	141.07	1.14	161.24	1.79	0.84	0.84
14.93	127.32	141.50	1.16	164.35	1.81	0.85	0.85
15.09	130.02	144.04	1.17	167.84	1.81	0.85	0.85
15.26	133.58	147.32	1.15	169.78	1.80	0.85	0.85
15.42	137.06	150.43	1.13	170.42	1.78	0.85	0.85
15.58	137.51	150.30	1.12	168.73	1.78	0.85	0.85
15.75	139.36	151.61	1.10	166.93	1.76	0.85	0.85

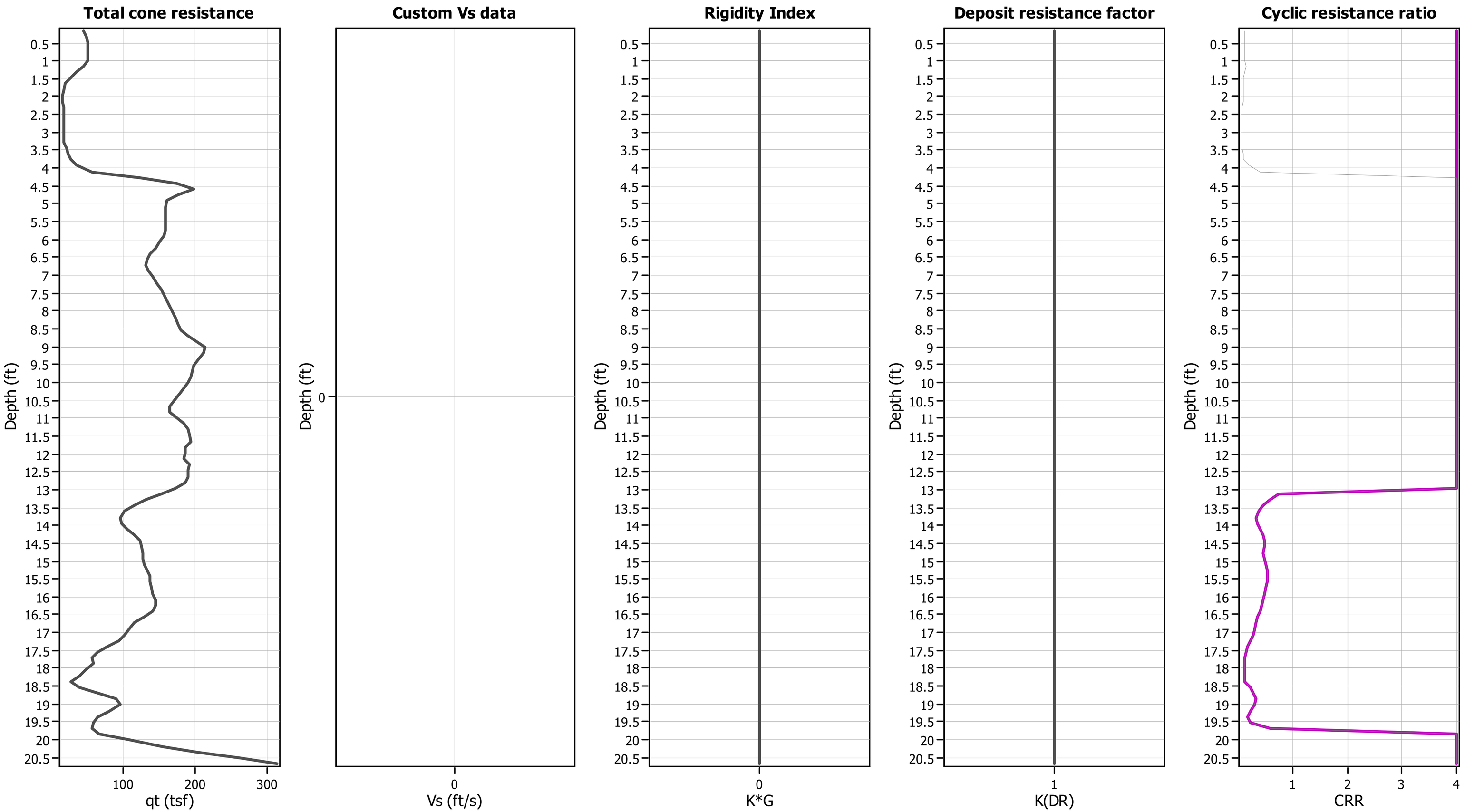
:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
15.91	141.05	152.72	1.07	164.02	1.74	0.85	0.85
16.08	144.81	155.98	1.03	159.96	1.72	0.84	0.84
16.24	145.16	155.70	1.00	155.70	1.71	0.83	0.83
16.40	141.06	150.76	1.00	150.76	1.70	0.83	0.83
16.57	129.02	137.69	1.06	145.77	1.74	0.82	0.82
16.73	116.10	123.74	1.12	138.61	1.77	0.81	0.81
16.90	108.35	115.26	1.15	133.02	1.80	0.80	0.80
17.06	102.72	108.95	1.17	127.09	1.81	0.79	0.79
17.22	93.64	99.10	1.19	118.27	1.84	0.78	0.78
17.39	78.35	82.90	1.25	103.55	1.92	0.75	0.75
17.55	64.60	68.32	1.31	89.65	2.01	0.73	0.73
17.72	56.93	60.09	1.37	82.14	2.06	0.70	0.71
17.88	58.48	61.46	1.34	82.40	2.04	0.71	0.71
18.04	47.78	50.10	1.46	73.22	2.13	0.33	0.69
18.21	39.89	41.73	1.67	69.64	2.22	0.25	0.68
18.37	27.89	29.13	2.84	82.73	2.48	0.71	0.71
18.54	39.52	41.57	2.73	113.30	2.46	0.77	0.77
18.70	63.71	66.91	1.95	130.48	2.31	0.80	0.80
18.86	89.49	93.27	1.48	137.85	2.14	0.81	0.81
19.03	95.01	98.31	1.36	133.41	2.05	0.80	0.80
19.19	79.52	81.92	1.39	114.16	2.08	0.77	0.77
19.36	63.57	65.36	1.60	104.86	2.20	0.76	0.76
19.52	58.14	59.77	1.99	119.20	2.32	0.78	0.78
19.69	57.28	59.09	3.00	177.01	2.50	0.86	0.86
19.85	67.08	69.32	3.64	252.56	2.59	0.94	0.94
20.01	107.33	110.53	2.71	299.11	2.46	0.98	0.98
20.18	154.97	-1.00	1.00	-1.00	-1.00	0.00	0.00
20.34	202.91	-1.00	1.00	-1.00	-1.00	0.00	0.00
20.51	261.68	-1.00	1.00	-1.00	-1.00	0.00	0.00
20.67	313.55	-1.00	1.00	-1.00	-1.00	0.00	0.00

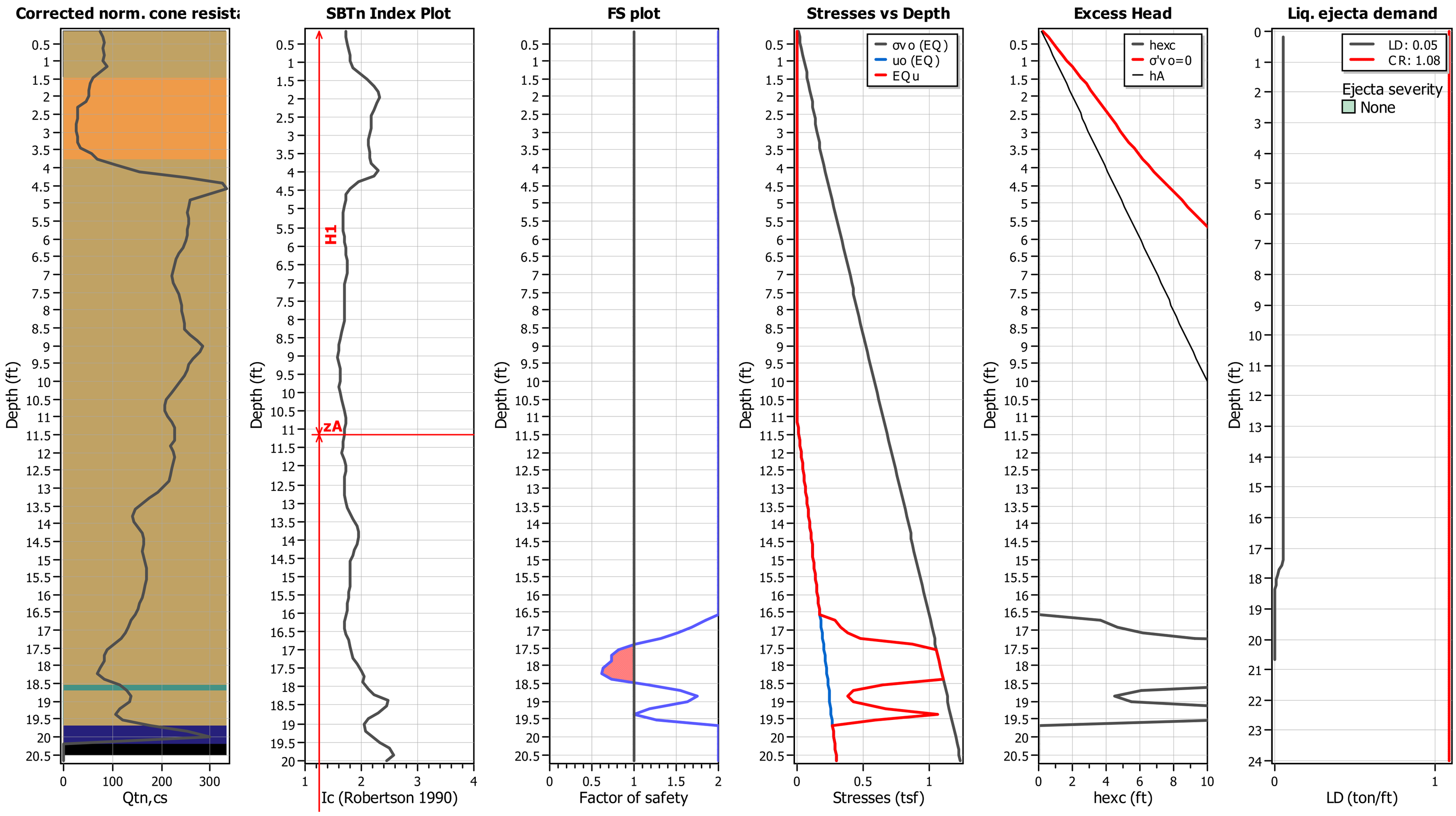
Abbreviations

q_t: Total cone resistance
K_c: Cone resistance correction factor due to fines
$Q_{tn,cs}$: Adjusted and corrected cone resistance due to fines
I_c: Soil behavior type index
$S_{u(liq)}/\sigma'_v$: Calculated liquefied undrained strength ratio
$S_{u(peak)}/\sigma'_v$: Calculated peak undrained strength ratio

Aging Calculation Estimation



Ejecta Severity Estimation



Universal Engineering Sciences

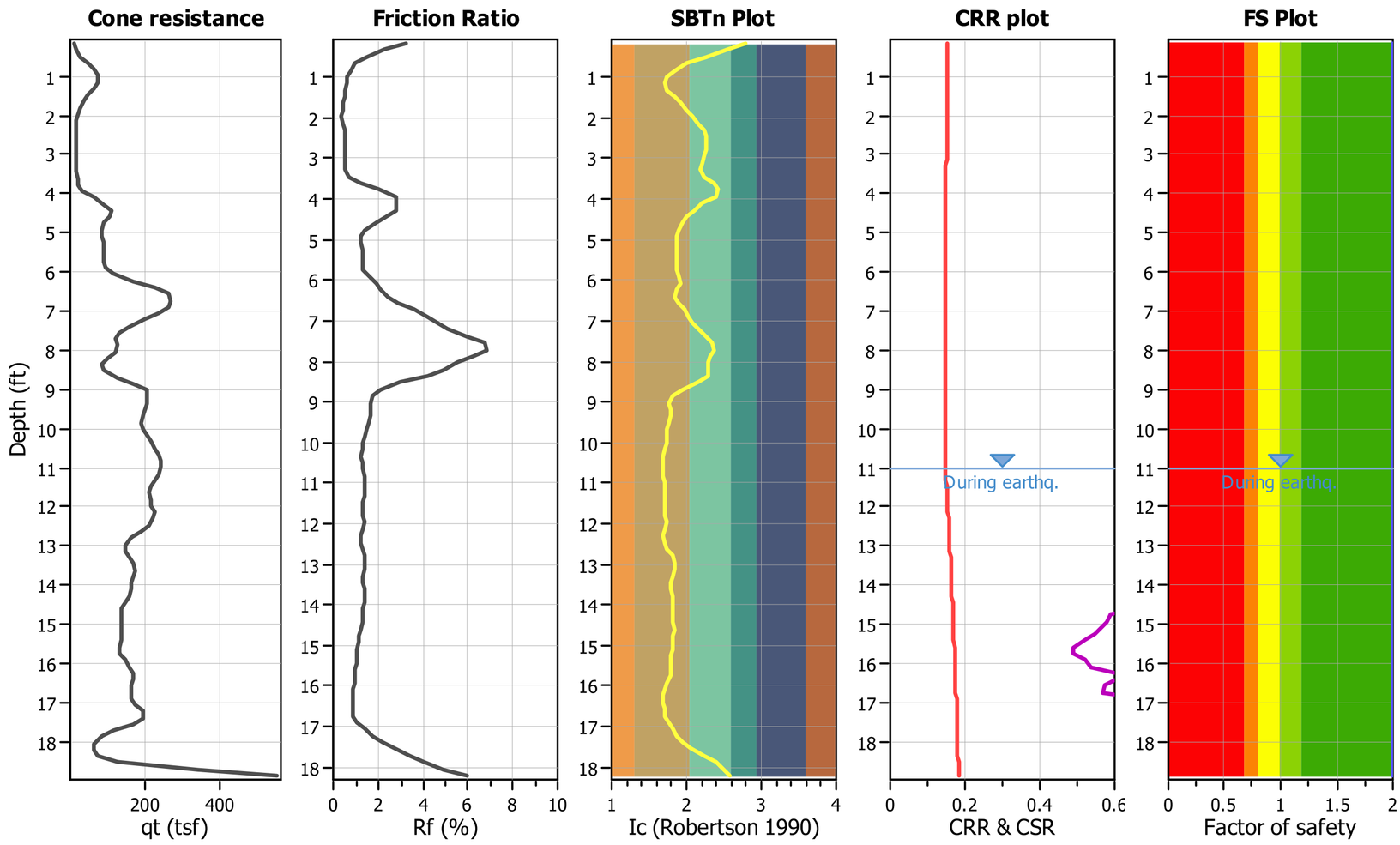
LIQUEFACTION ANALYSIS REPORT

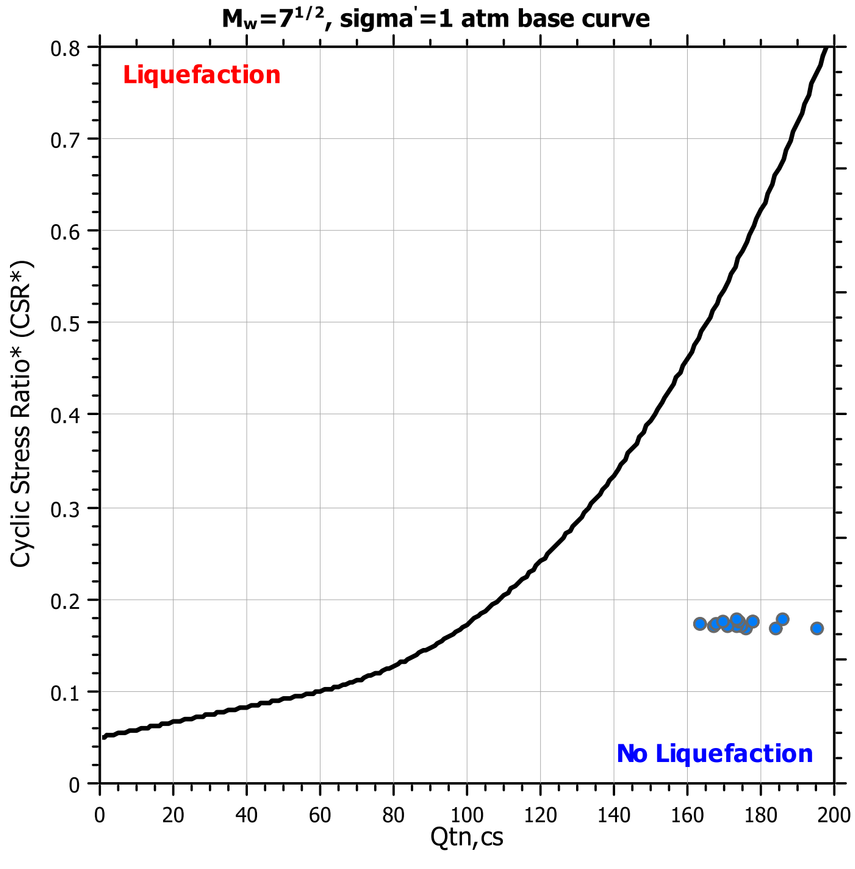
Project title : Stanislaus Elementary Replacement School **Location : Modesto, California**

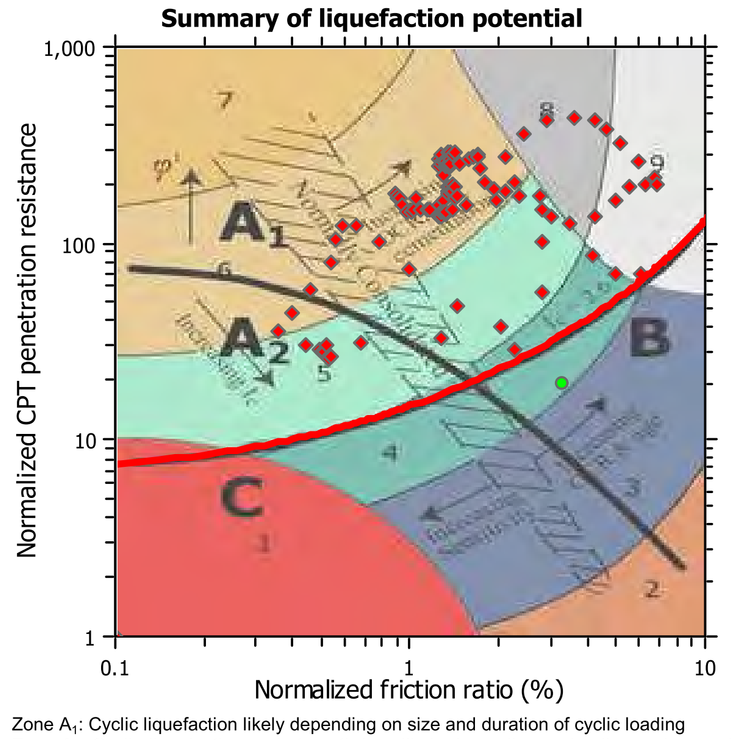
CPT file : CPT-02

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	11.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	11.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.25	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.37	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

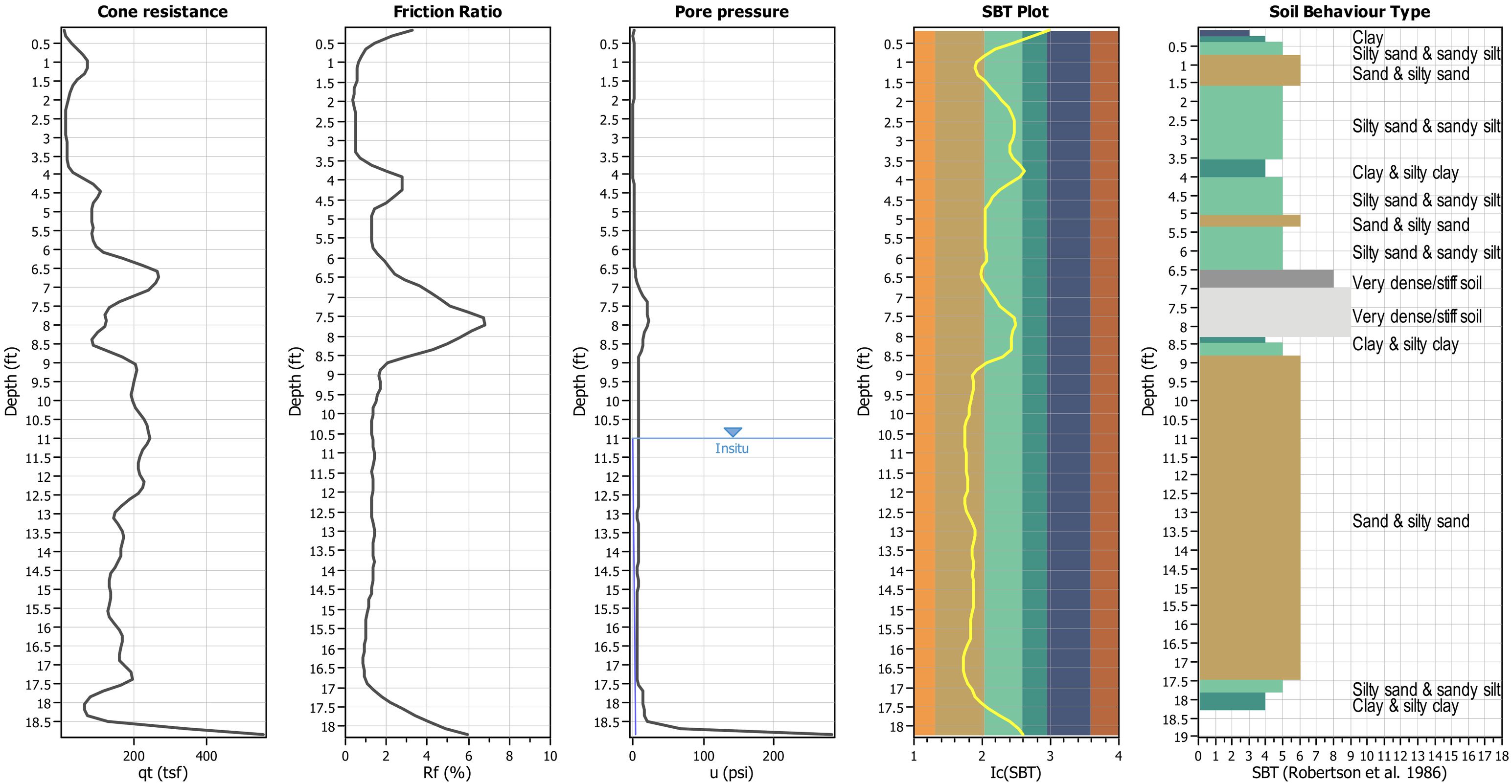






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



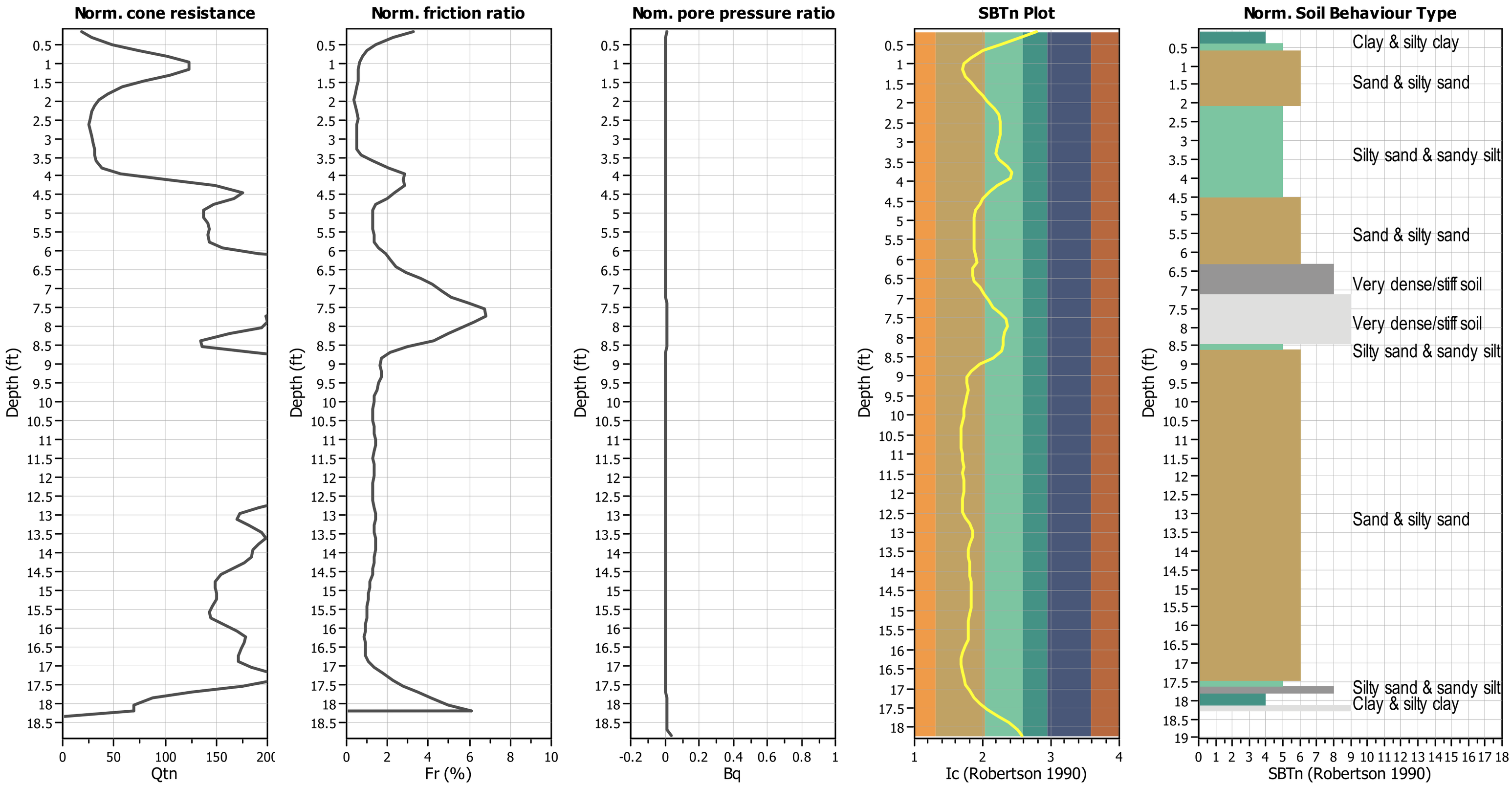
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



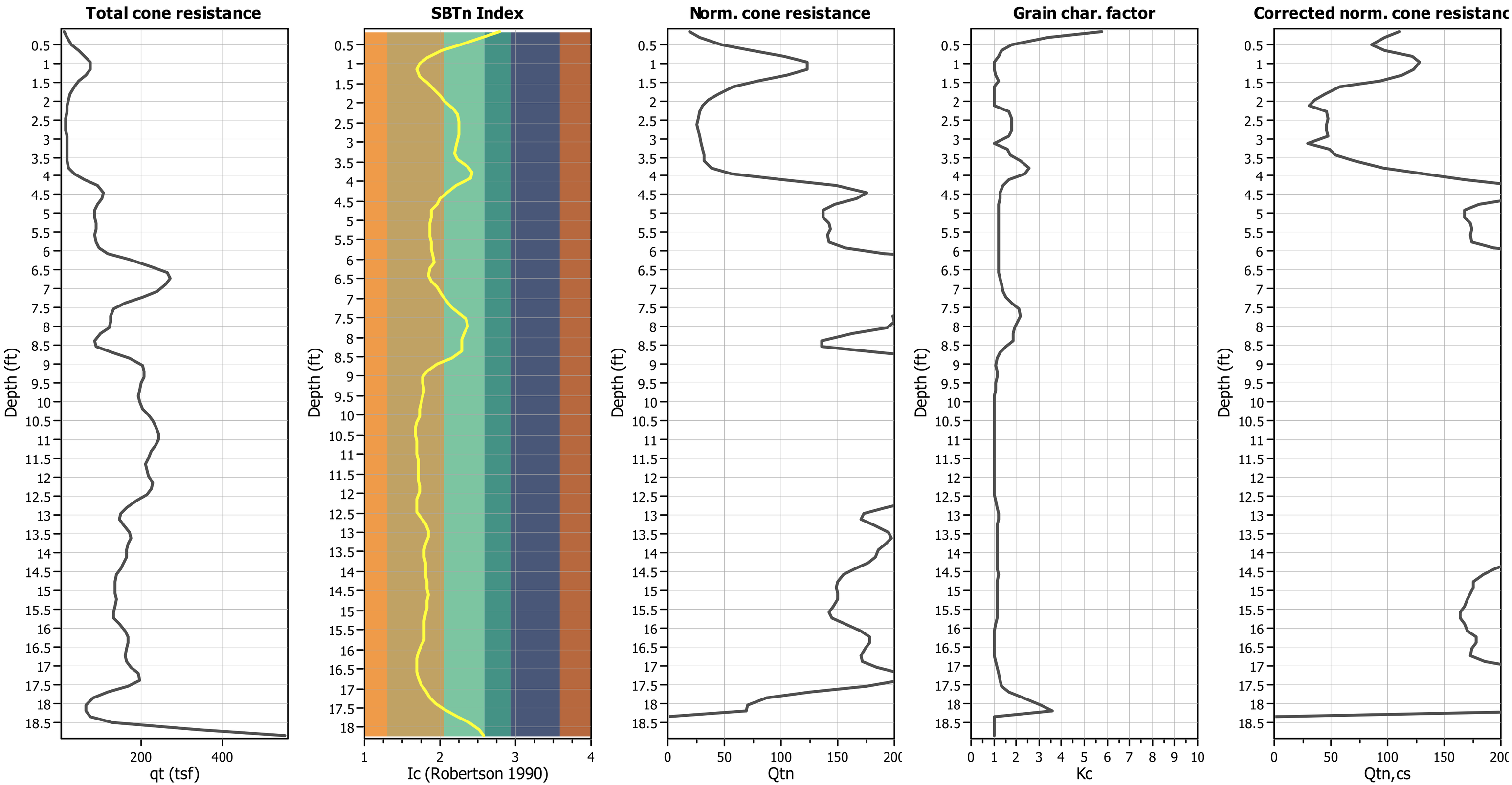
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

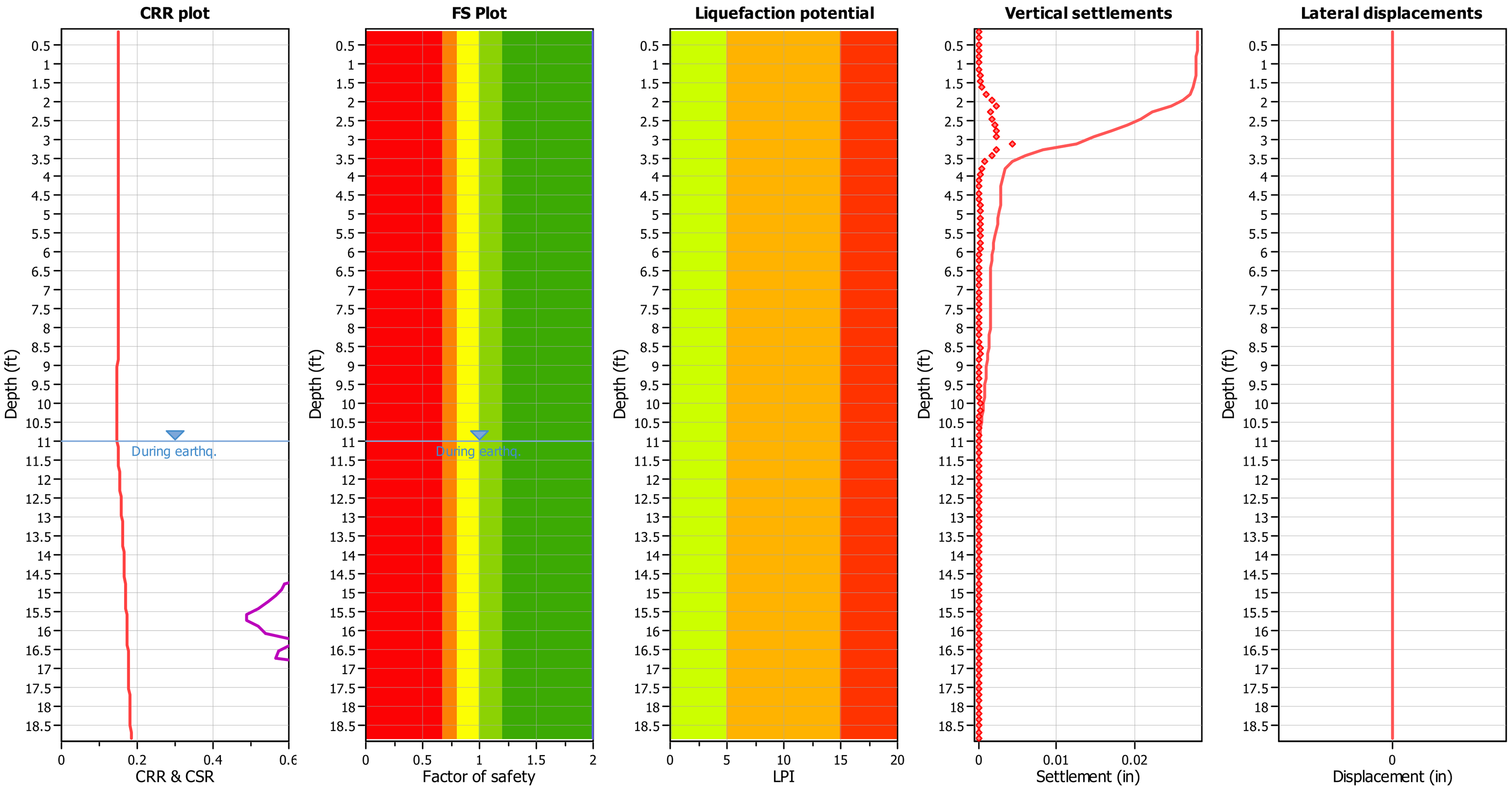
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

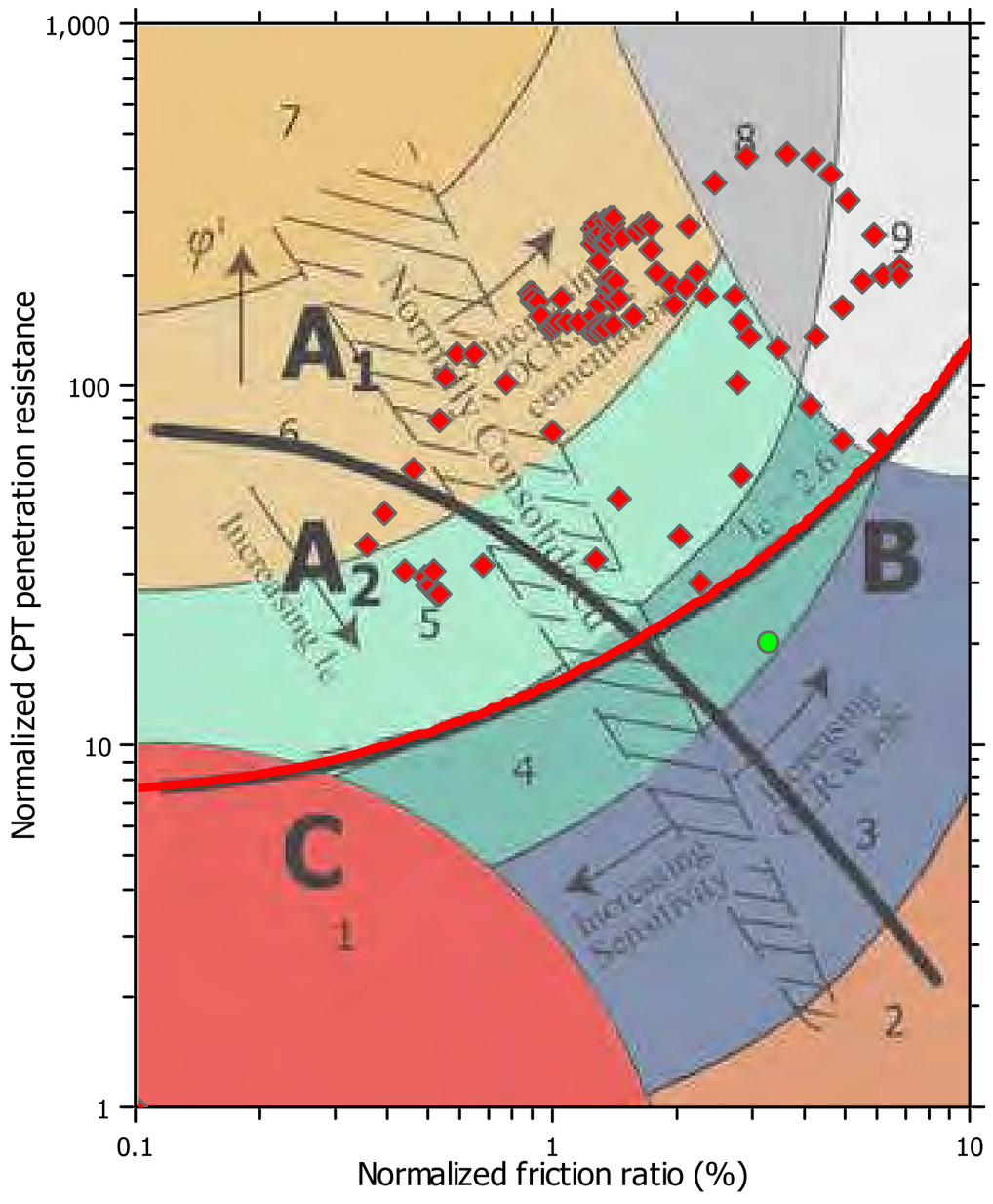
F.S. color scheme

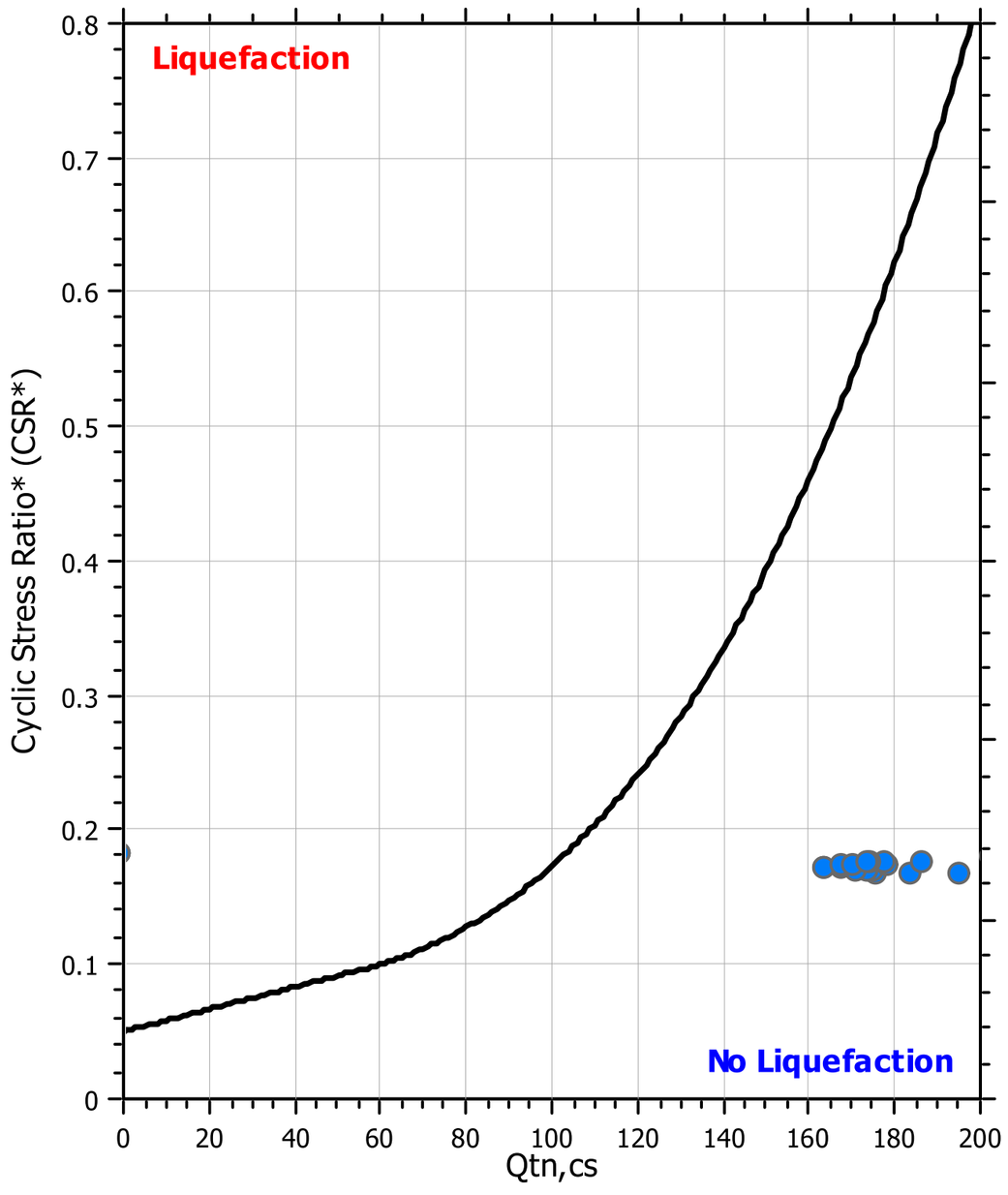
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

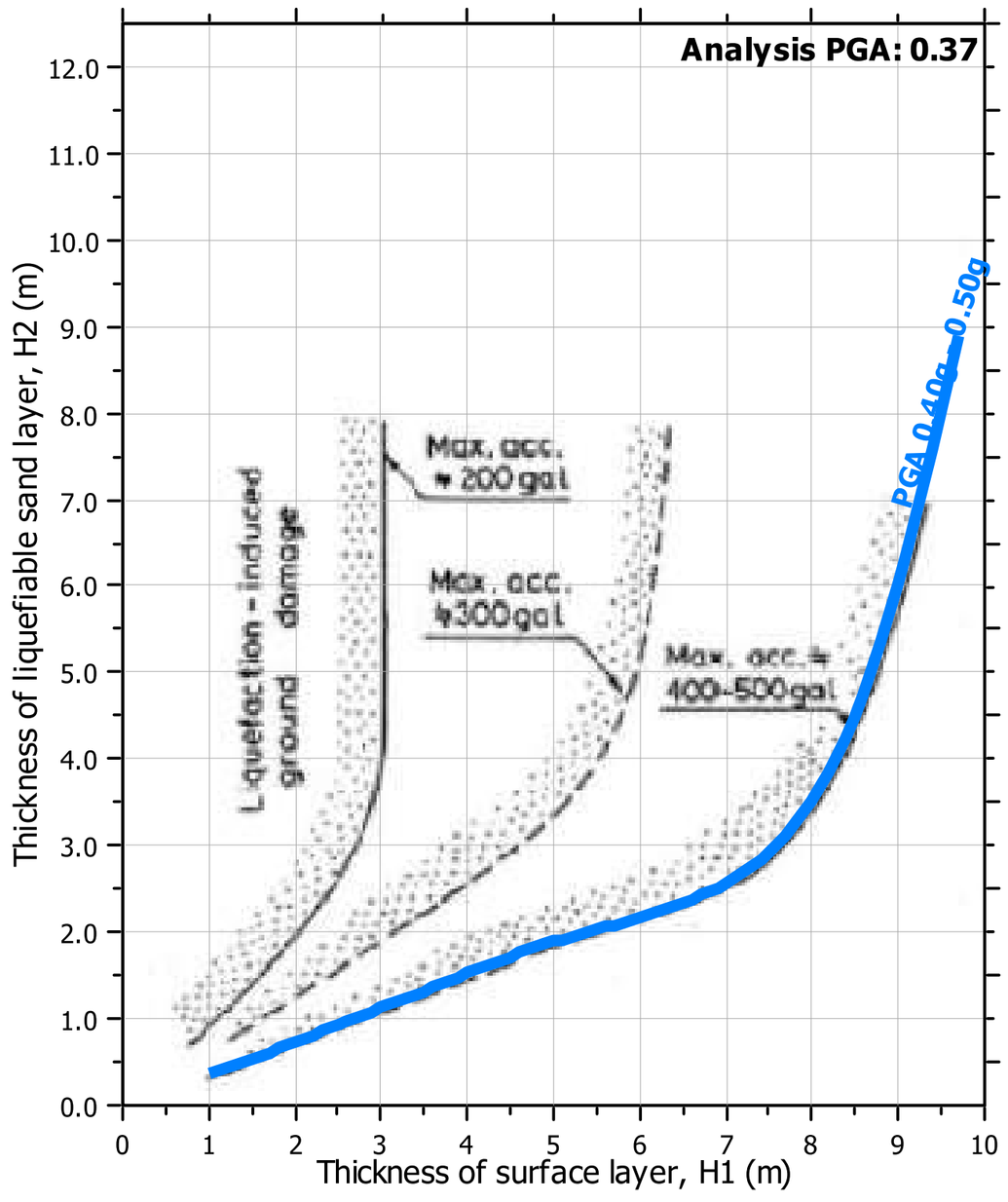
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



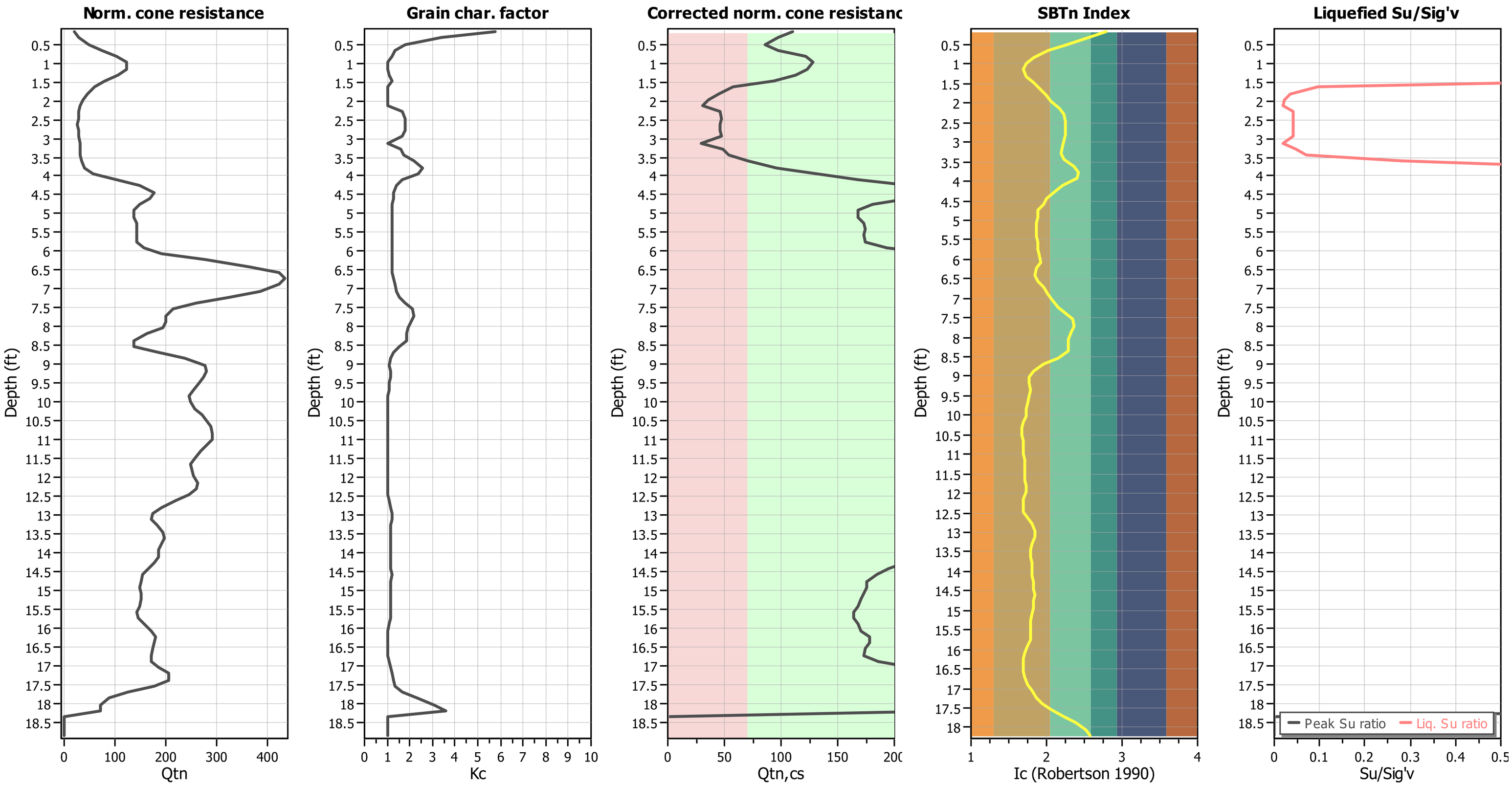




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

:: Field input data ::

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
1	0.16	9.68	0.37	1.58	45.67	109.45
2	0.33	16.32	0.43	0.71	33.29	110.62
3	0.49	27.31	0.41	1.11	21.08	112.46
4	0.66	46.09	0.47	1.58	13.21	113.94
5	0.82	65.42	0.50	1.72	8.89	115.25
6	0.98	79.24	0.51	1.61	6.60	115.75
7	1.15	84.63	0.48	1.60	6.11	115.02
8	1.31	65.51	0.36	1.49	6.86	113.11
9	1.48	47.18	0.25	1.32	8.90	109.99
10	1.64	35.03	0.17	1.18	5.00	105.93
11	1.80	26.49	0.07	1.07	5.00	102.23
12	1.97	21.75	0.08	1.03	5.00	99.34
13	2.13	18.91	0.08	0.99	5.00	99.44
14	2.30	16.85	0.09	0.72	19.93	99.37
15	2.46	16.32	0.09	0.72	21.02	99.30
16	2.62	16.34	0.09	0.72	21.03	99.18
17	2.79	16.59	0.09	0.72	20.91	99.25
18	2.95	16.75	0.09	0.72	20.05	99.48
19	3.12	18.78	0.09	0.71	5.00	99.69
20	3.28	19.35	0.09	0.71	18.77	100.64
21	3.44	19.76	0.12	0.71	20.23	102.83
22	3.61	20.18	0.19	0.70	24.89	107.66
23	3.77	21.36	0.46	0.70	27.63	112.61
24	3.94	29.97	0.79	0.76	26.28	118.83
25	4.10	54.20	1.71	0.94	19.55	124.55
26	4.27	106.37	2.80	1.82	16.24	128.28
27	4.43	117.12	3.27	2.44	13.15	128.65
28	4.59	105.96	1.66	2.53	11.89	126.79
29	4.76	89.10	1.17	2.31	10.04	123.13
30	4.92	81.39	1.02	2.05	9.84	121.71
31	5.09	86.87	1.05	1.74	9.74	121.63
32	5.25	89.45	1.13	1.85	9.66	122.14
33	5.41	90.52	1.22	1.88	9.78	122.33
34	5.58	88.00	1.14	1.86	9.89	122.28
35	5.74	86.79	1.11	1.74	9.92	122.44
36	5.91	92.73	1.29	1.74	10.48	124.48
37	6.07	112.94	2.14	1.89	10.83	127.99
38	6.23	151.60	3.44	2.31	9.39	132.26
39	6.40	250.92	5.32	3.02	9.16	135.93
40	6.56	273.82	7.68	4.59	9.97	137.28
41	6.73	267.69	9.99	5.12	12.01	137.28
42	6.89	270.32	11.73	6.73	13.72	137.28
43	7.05	251.23	11.43	10.56	15.35	137.28
44	7.22	196.99	10.21	13.84	17.51	137.28
45	7.38	159.71	9.51	19.82	20.96	137.28
46	7.55	126.43	8.95	21.48	24.29	137.28
47	7.71	112.44	8.49	21.39	24.98	137.28
48	7.87	133.67	7.96	22.31	23.58	137.04

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
49	8.04	128.44	6.83	21.20	22.29	135.92
50	8.20	100.86	5.40	17.05	22.17	133.39
51	8.37	76.51	2.89	14.36	21.89	130.54
52	8.53	78.60	2.58	13.76	17.66	128.39
53	8.69	112.73	2.51	13.25	11.74	129.37
54	8.86	195.42	2.98	9.13	8.62	130.80
55	9.02	207.95	3.42	9.19	7.41	132.09
56	9.19	209.66	3.64	9.20	7.63	132.57
57	9.35	207.95	3.58	9.07	7.73	132.49
58	9.51	202.61	3.35	8.90	7.36	131.69
59	9.68	195.35	2.62	8.46	7.06	130.88
60	9.84	191.12	2.65	8.23	6.75	130.13
61	10.01	189.92	2.57	8.19	6.59	130.20
62	10.17	206.81	2.65	8.14	6.09	130.31
63	10.33	219.93	2.64	8.13	5.70	130.80
64	10.50	231.43	2.93	8.03	5.65	131.37
65	10.66	236.89	3.19	8.14	5.83	132.04
66	10.83	242.94	3.38	8.63	5.89	132.46
67	10.99	249.36	3.40	8.69	6.08	132.70
68	11.15	240.48	3.51	8.53	6.23	132.32
69	11.32	217.90	2.98	8.23	6.38	131.74
70	11.48	216.93	2.79	8.32	6.17	131.03
71	11.65	221.38	2.73	8.92	6.46	130.87
72	11.81	198.26	2.88	8.11	6.53	131.17
73	11.98	226.49	3.09	8.47	6.64	131.42
74	12.14	227.62	3.00	8.67	6.12	131.49
75	12.30	228.68	2.84	8.53	6.00	131.14
76	12.47	218.22	2.70	8.49	6.15	130.51
77	12.63	194.98	2.43	7.72	7.01	129.70
78	12.80	160.32	2.28	7.46	8.19	128.78
79	12.96	144.77	2.13	7.01	9.17	128.09
80	13.12	145.71	2.04	7.06	9.15	127.83
81	13.29	154.47	2.08	7.74	8.41	128.24
82	13.45	179.11	2.33	7.43	7.97	128.94
83	13.62	182.31	2.52	7.55	8.08	129.36
84	13.78	165.12	2.43	7.78	8.43	129.23
85	13.94	163.84	2.27	7.76	8.45	128.81
86	14.11	169.41	2.18	7.60	8.32	128.53
87	14.27	161.33	2.19	7.31	8.59	128.24
88	14.44	147.56	2.09	7.18	8.72	127.27
89	14.60	139.09	1.50	7.17	8.93	126.40
90	14.76	133.96	1.65	7.28	8.65	125.55
91	14.93	134.92	1.56	7.41	8.62	125.49
92	15.09	139.00	1.46	5.82	8.19	125.19
93	15.26	139.23	1.45	5.82	7.86	124.89
94	15.42	137.71	1.38	5.83	7.95	124.60
95	15.58	130.24	1.31	5.79	8.03	124.22
96	15.75	129.20	1.27	5.77	7.78	124.22

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
97	15.91	144.93	1.35	5.83	7.00	124.66
98	16.08	164.71	1.45	5.98	6.24	125.29
99	16.24	171.64	1.50	6.07	5.89	125.68
100	16.40	169.87	1.51	6.11	5.91	125.71
101	16.57	165.37	1.46	6.07	6.11	125.64
102	16.73	162.95	1.48	6.02	6.37	125.66
103	16.90	161.47	1.55	6.04	7.10	126.64
104	17.06	168.05	2.10	6.20	8.44	129.31
105	17.22	199.03	3.57	6.53	9.72	132.20
106	17.39	219.00	4.68	6.81	11.65	133.95
107	17.55	170.68	4.88	8.04	14.75	133.90
108	17.72	111.60	4.19	13.54	19.99	132.27
109	17.88	76.51	3.23	13.98	25.88	130.03
110	18.04	62.26	2.79	14.55	31.19	129.18
111	18.21	61.45	3.78	16.75	34.44	130.65
112	18.37	75.94	5.42	17.44	N/A	87.36
113	18.54	90.56	-268745.56	20.61	N/A	87.36
114	18.70	222.19	-268745.56	68.36	N/A	87.36
115	18.86	715.51	-268745.56	281.64	N/A	87.36

Abbreviations

Depth:	Depth from free surface, at which CPT was performed (ft)
q_c:	Measured cone resistance (tsf)
f_s:	Sleeve friction resistance (tsf)
u:	Pore pressure (tsf)
Fines content:	Percentage of fines in soil (%)
Unit weight:	Bulk soil unit weight (pcf)

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data ::

Point ID	Depth (ft)	σ_v (tsf)	u_0 (tsf)	σ_v' (tsf)	r_d	CSR	MSF	CSR_{eq}	K_σ	User FS	CSR^*	Belongs to transition
1	0.16	0.01	0.00	0.01	1.00	0.241	1.59	0.151	1.00	1.00	2.000	No
2	0.33	0.02	0.00	0.02	1.00	0.241	1.59	0.151	1.00	1.00	2.000	No
3	0.49	0.03	0.00	0.03	1.00	0.241	1.59	0.151	1.00	1.00	2.000	No
4	0.66	0.04	0.00	0.04	1.00	0.241	1.59	0.151	1.00	1.00	2.000	No
5	0.82	0.05	0.00	0.05	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
6	0.98	0.06	0.00	0.06	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
7	1.15	0.07	0.00	0.07	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
8	1.31	0.07	0.00	0.07	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
9	1.48	0.08	0.00	0.08	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
10	1.64	0.09	0.00	0.09	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
11	1.80	0.10	0.00	0.10	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
12	1.97	0.11	0.00	0.11	1.00	0.240	1.59	0.150	1.00	1.00	2.000	No
13	2.13	0.12	0.00	0.12	1.00	0.240	1.59	0.150	1.00	1.00	2.000	No
14	2.30	0.12	0.00	0.12	1.00	0.240	1.59	0.150	1.00	1.00	2.000	No
15	2.46	0.13	0.00	0.13	1.00	0.240	1.59	0.150	1.00	1.00	2.000	No
16	2.62	0.14	0.00	0.14	1.00	0.240	1.59	0.150	1.00	1.00	2.000	No
17	2.79	0.15	0.00	0.15	1.00	0.239	1.59	0.150	1.00	1.00	2.000	No
18	2.95	0.16	0.00	0.16	1.00	0.239	1.59	0.150	1.00	1.00	2.000	No
19	3.12	0.17	0.00	0.17	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
20	3.28	0.17	0.00	0.17	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
21	3.44	0.18	0.00	0.18	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
22	3.61	0.19	0.00	0.19	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
23	3.77	0.20	0.00	0.20	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
24	3.94	0.21	0.00	0.21	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
25	4.10	0.22	0.00	0.22	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
26	4.27	0.23	0.00	0.23	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
27	4.43	0.24	0.00	0.24	0.99	0.238	1.59	0.150	1.00	1.00	2.000	No
28	4.59	0.25	0.00	0.25	0.99	0.238	1.59	0.150	1.00	1.00	2.000	No
29	4.76	0.26	0.00	0.26	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
30	4.92	0.27	0.00	0.27	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
31	5.09	0.28	0.00	0.28	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
32	5.25	0.29	0.00	0.29	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
33	5.41	0.30	0.00	0.30	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
34	5.58	0.31	0.00	0.31	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
35	5.74	0.32	0.00	0.32	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
36	5.91	0.33	0.00	0.33	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
37	6.07	0.34	0.00	0.34	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
38	6.23	0.35	0.00	0.35	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
39	6.40	0.36	0.00	0.36	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
40	6.56	0.38	0.00	0.38	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
41	6.73	0.39	0.00	0.39	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
42	6.89	0.40	0.00	0.40	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
43	7.05	0.41	0.00	0.41	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
44	7.22	0.42	0.00	0.42	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
45	7.38	0.43	0.00	0.43	0.98	0.237	1.59	0.149	1.00	1.00	2.000	No
46	7.55	0.44	0.00	0.44	0.98	0.237	1.59	0.149	1.00	1.00	2.000	No
47	7.71	0.45	0.00	0.45	0.98	0.237	1.59	0.148	1.00	1.00	2.000	No
48	7.87	0.47	0.00	0.47	0.98	0.237	1.59	0.148	1.00	1.00	2.000	No

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data :: (continued)

Point ID	Depth (ft)	σ_v (tsf)	u_0 (tsf)	σ_v' (tsf)	r_d	CSR	MSF	CSR_{eq}	K_σ	User FS	CSR^*	Belongs to transition
49	8.04	0.48	0.00	0.48	0.98	0.237	1.59	0.148	1.00	1.00	2.000	No
50	8.20	0.49	0.00	0.49	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
51	8.37	0.50	0.00	0.50	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
52	8.53	0.51	0.00	0.51	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
53	8.69	0.52	0.00	0.52	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
54	8.86	0.53	0.00	0.53	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
55	9.02	0.54	0.00	0.54	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
56	9.19	0.55	0.00	0.55	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
57	9.35	0.56	0.00	0.56	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
58	9.51	0.57	0.00	0.57	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
59	9.68	0.58	0.00	0.58	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
60	9.84	0.60	0.00	0.60	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
61	10.01	0.61	0.00	0.61	0.98	0.235	1.59	0.148	1.00	1.00	2.000	No
62	10.17	0.62	0.00	0.62	0.98	0.235	1.59	0.148	1.00	1.00	2.000	No
63	10.33	0.63	0.00	0.63	0.98	0.235	1.59	0.148	1.00	1.00	2.000	No
64	10.50	0.64	0.00	0.64	0.98	0.235	1.59	0.148	1.00	1.00	2.000	No
65	10.66	0.65	0.00	0.65	0.98	0.235	1.59	0.147	1.00	1.00	2.000	No
66	10.83	0.66	0.00	0.66	0.98	0.235	1.59	0.147	1.00	1.00	2.000	No
67	10.99	0.67	0.00	0.67	0.98	0.235	1.59	0.147	1.00	1.00	2.000	No
68	11.15	0.68	0.00	0.68	0.98	0.237	1.59	0.148	1.00	1.00	0.148	No
69	11.32	0.69	0.01	0.68	0.98	0.238	1.59	0.149	1.00	1.00	0.149	No
70	11.48	0.70	0.02	0.69	0.98	0.240	1.59	0.150	1.00	1.00	0.150	No
71	11.65	0.71	0.02	0.69	0.98	0.241	1.59	0.151	1.00	1.00	0.151	No
72	11.81	0.72	0.03	0.70	0.98	0.243	1.59	0.152	1.00	1.00	0.152	No
73	11.98	0.74	0.03	0.71	0.97	0.245	1.59	0.153	1.00	1.00	0.153	No
74	12.14	0.75	0.04	0.71	0.97	0.246	1.59	0.154	1.00	1.00	0.154	No
75	12.30	0.76	0.04	0.72	0.97	0.248	1.59	0.155	1.00	1.00	0.155	No
76	12.47	0.77	0.05	0.72	0.97	0.249	1.59	0.156	1.00	1.00	0.156	No
77	12.63	0.78	0.05	0.73	0.97	0.251	1.59	0.157	1.00	1.00	0.157	No
78	12.80	0.79	0.06	0.73	0.97	0.252	1.59	0.158	1.00	1.00	0.158	No
79	12.96	0.80	0.06	0.74	0.97	0.253	1.59	0.159	1.00	1.00	0.159	No
80	13.12	0.81	0.07	0.74	0.97	0.255	1.59	0.160	1.00	1.00	0.160	No
81	13.29	0.82	0.07	0.75	0.97	0.256	1.59	0.161	1.00	1.00	0.161	No
82	13.45	0.83	0.08	0.75	0.97	0.257	1.59	0.161	1.00	1.00	0.161	No
83	13.62	0.84	0.08	0.76	0.97	0.259	1.59	0.162	1.00	1.00	0.162	No
84	13.78	0.85	0.09	0.77	0.97	0.260	1.59	0.163	1.00	1.00	0.163	No
85	13.94	0.86	0.09	0.77	0.97	0.261	1.59	0.164	1.00	1.00	0.164	No
86	14.11	0.87	0.10	0.78	0.97	0.263	1.59	0.165	1.00	1.00	0.165	No
87	14.27	0.88	0.10	0.78	0.97	0.264	1.59	0.165	1.00	1.00	0.165	No
88	14.44	0.89	0.11	0.79	0.97	0.265	1.59	0.166	1.00	1.00	0.166	No
89	14.60	0.90	0.11	0.79	0.97	0.266	1.59	0.167	1.00	1.00	0.167	No
90	14.76	0.92	0.12	0.80	0.97	0.267	1.59	0.168	1.00	1.00	0.168	No
91	14.93	0.93	0.12	0.80	0.97	0.269	1.59	0.168	1.00	1.00	0.168	No
92	15.09	0.94	0.13	0.81	0.97	0.270	1.59	0.169	1.00	1.00	0.169	No
93	15.26	0.95	0.13	0.81	0.97	0.271	1.59	0.170	1.00	1.00	0.170	No
94	15.42	0.96	0.14	0.82	0.97	0.272	1.59	0.171	1.00	1.00	0.171	No
95	15.58	0.97	0.14	0.82	0.97	0.273	1.59	0.171	1.00	1.00	0.171	No
96	15.75	0.98	0.15	0.83	0.97	0.274	1.59	0.172	1.00	1.00	0.172	No

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data :: (continued)

Point ID	Depth (ft)	σ_v (tsf)	u_0 (tsf)	σ_v' (tsf)	r_d	CSR	MSF	CSR_{eq}	K_σ	User FS	CSR^*	Belongs to transition
97	15.91	0.99	0.15	0.83	0.97	0.275	1.59	0.173	1.00	1.00	0.173	No
98	16.08	1.00	0.16	0.84	0.97	0.276	1.59	0.173	1.00	1.00	0.173	No
99	16.24	1.01	0.16	0.84	0.97	0.277	1.59	0.174	1.00	1.00	0.174	No
100	16.40	1.02	0.17	0.85	0.97	0.278	1.59	0.175	1.00	1.00	0.175	No
101	16.57	1.03	0.17	0.85	0.97	0.279	1.59	0.175	1.00	1.00	0.175	No
102	16.73	1.04	0.18	0.86	0.96	0.280	1.59	0.176	1.00	1.00	0.176	No
103	16.90	1.05	0.18	0.86	0.96	0.281	1.59	0.176	1.00	1.00	0.176	No
104	17.06	1.06	0.19	0.87	0.96	0.282	1.59	0.177	1.00	1.00	0.177	No
105	17.22	1.07	0.19	0.88	0.96	0.283	1.59	0.178	1.00	1.00	0.178	No
106	17.39	1.08	0.20	0.88	0.96	0.284	1.59	0.178	1.00	1.00	0.178	No
107	17.55	1.09	0.20	0.89	0.96	0.285	1.59	0.179	1.00	1.00	0.179	No
108	17.72	1.10	0.21	0.89	0.96	0.286	1.59	0.179	1.00	1.00	0.179	No
109	17.88	1.11	0.21	0.90	0.96	0.287	1.59	0.180	1.00	1.00	0.180	No
110	18.04	1.12	0.22	0.90	0.96	0.288	1.59	0.180	1.00	1.00	0.180	No
111	18.21	1.13	0.22	0.91	0.96	0.288	1.59	0.181	1.00	1.00	0.181	No
112	18.37	1.14	0.23	0.91	0.96	0.289	1.59	0.182	1.00	1.00	0.182	No
113	18.54	1.15	0.24	0.91	0.96	0.290	1.59	0.182	1.00	1.00	0.182	No
114	18.70	1.16	0.24	0.92	0.96	0.291	1.59	0.183	1.00	1.00	0.183	No
115	18.86	1.16	0.25	0.92	0.96	0.293	1.59	0.183	1.00	1.00	0.183	No

Abbreviations

Depth: Depth from free surface, at which CPT was performed (ft)
σ_v: Total overburden pressure at test point (tsf)
u_0: Water pressure at test point (tsf)
σ_v': Effective overburden pressure based on GWT during earthquake (tsf)
r_d: Nonlinear shear mass factor
CSR: Cyclic Stress Ratio
MSF: Magnitude Scaling Factor
CSR_{eq}: CSR adjusted for M=7.5
K_σ: Effective overburden stress factor
CSR^*: CSR fully adjusted

:: Cyclic Resistance Ratio (CRR) calculation data ::

Point ID	Depth (ft)	q_t (tsf)	I_c	Fr (%)	n	Q_{tn}	K_c	$Q_{tn,cs}$	$CRR_{7.5}$	Belongs to trans. layer	Clay-like behaviour	FS
1	0.16	11.91	2.79	3.29	0.85	19.12	5.78	110.55	4.000	No	Yes	2.00
2	0.33	17.78	2.56	2.26	0.78	28.54	3.40	96.97	4.000	No	No	2.00
3	0.49	29.92	2.26	1.45	0.69	48.03	1.79	85.78	4.000	No	No	2.00
4	0.66	46.29	2.01	0.99	0.61	74.32	1.32	97.76	4.000	No	No	2.00
5	0.82	63.61	1.84	0.78	0.56	102.12	1.19	121.35	4.000	No	No	2.00
6	0.98	76.45	1.73	0.65	0.53	122.74	1.04	127.69	4.000	No	No	2.00
7	1.15	76.48	1.70	0.59	0.52	122.78	1.00	122.78	4.000	No	No	2.00
8	1.31	65.79	1.74	0.56	0.53	105.59	1.06	112.44	4.000	No	No	2.00
9	1.48	49.26	1.84	0.53	0.56	79.01	1.19	93.91	4.000	No	No	2.00
10	1.64	36.25	1.92	0.46	0.58	58.09	1.00	58.09	4.000	No	No	2.00
11	1.80	27.77	2.00	0.40	0.61	44.46	1.00	44.46	4.000	No	No	2.00
12	1.97	22.40	2.07	0.36	0.63	35.81	1.00	35.81	4.000	No	No	2.00
13	2.13	19.18	2.17	0.45	0.66	30.63	1.00	30.63	4.000	No	No	2.00
14	2.30	17.37	2.23	0.50	0.68	27.71	1.69	46.74	4.000	No	No	2.00
15	2.46	16.51	2.26	0.54	0.69	26.32	1.78	46.85	4.000	No	No	2.00
16	2.62	16.43	2.26	0.53	0.69	26.17	1.78	46.63	4.000	No	No	2.00
17	2.79	16.57	2.26	0.53	0.68	26.39	1.77	46.73	4.000	No	No	2.00
18	2.95	17.38	2.23	0.51	0.68	27.68	1.70	46.95	4.000	No	No	2.00
19	3.12	18.30	2.20	0.49	0.67	29.14	1.00	29.14	4.000	No	No	2.00
20	3.28	19.30	2.19	0.52	0.67	30.74	1.60	49.10	4.000	No	No	2.00
21	3.44	19.77	2.24	0.68	0.68	31.47	1.71	53.86	4.000	No	No	2.00
22	3.61	20.44	2.36	1.26	0.72	32.54	2.19	71.12	4.000	No	No	2.00
23	3.77	23.85	2.43	2.02	0.74	37.99	2.53	96.29	4.000	No	No	2.00
24	3.94	35.19	2.40	2.81	0.73	56.20	2.36	132.46	4.000	No	No	2.00
25	4.10	63.53	2.22	2.79	0.67	101.72	1.66	168.46	4.000	No	No	2.00
26	4.27	92.59	2.11	2.81	0.64	148.39	1.44	213.73	4.000	No	No	2.00
27	4.43	109.85	2.01	2.35	0.61	176.10	1.31	231.32	4.000	No	No	2.00
28	4.59	104.10	1.96	1.96	0.60	166.84	1.28	213.03	4.000	No	No	2.00
29	4.76	92.19	1.89	1.40	0.57	147.69	1.23	181.21	4.000	No	No	2.00
30	4.92	85.82	1.88	1.27	0.57	137.44	1.22	167.81	4.000	No	No	2.00
31	5.09	85.93	1.87	1.25	0.57	137.61	1.22	167.58	4.000	No	No	2.00
32	5.25	88.97	1.87	1.28	0.57	142.48	1.22	173.17	4.000	No	No	2.00
33	5.41	89.35	1.87	1.31	0.57	143.07	1.22	174.42	4.000	No	No	2.00
34	5.58	88.47	1.88	1.31	0.57	141.63	1.22	173.15	4.000	No	No	2.00
35	5.74	89.20	1.88	1.33	0.57	142.80	1.22	174.69	4.000	No	No	2.00
36	5.91	97.51	1.90	1.56	0.58	156.14	1.24	193.52	4.000	No	No	2.00
37	6.07	119.12	1.92	1.93	0.58	190.83	1.25	238.31	4.000	No	No	2.00
38	6.23	171.85	1.86	2.12	0.57	275.54	1.21	332.47	4.000	No	No	2.00
39	6.40	225.49	1.85	2.43	0.56	361.70	1.20	433.41	4.000	No	No	2.00
40	6.56	264.20	1.88	2.90	0.57	423.88	1.22	519.19	4.000	No	No	2.00
41	6.73	270.69	1.96	3.63	0.60	434.28	1.28	555.88	4.000	No	No	2.00
42	6.89	263.18	2.03	4.20	0.62	422.20	1.33	562.45	4.000	No	No	2.00
43	7.05	239.66	2.08	4.65	0.63	384.39	1.40	537.11	4.000	No	No	2.00
44	7.22	202.85	2.15	5.13	0.65	325.24	1.51	492.08	4.000	No	No	2.00
45	7.38	161.31	2.26	5.94	0.69	258.47	1.78	458.92	4.000	No	No	2.00
46	7.55	133.16	2.35	6.77	0.71	213.23	2.12	451.21	4.000	No	No	2.00
47	7.71	124.49	2.36	6.83	0.72	199.29	2.20	437.61	4.000	No	No	2.00
48	7.87	125.16	2.33	6.22	0.71	200.34	2.04	407.97	4.000	No	No	2.00

:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)

Point ID	Depth (ft)	q_t (tsf)	I_c	Fr (%)	n	Q_{tn}	K_c	$Q_{tn,cs}$	$CRR_{7.5}$	Belongs to trans. layer	Clay-like behaviour	FS
49	8.04	121.28	2.29	5.57	0.70	194.09	1.90	369.08	4.000	No	No	2.00
50	8.20	102.19	2.29	4.95	0.70	163.39	1.89	308.77	4.000	No	No	2.00
51	8.37	85.54	2.28	4.26	0.69	135.34	1.86	252.04	4.000	No	No	2.00
52	8.53	89.48	2.16	2.99	0.66	135.84	1.52	206.77	4.000	No	No	2.00
53	8.69	129.09	1.95	2.09	0.59	185.41	1.27	235.98	4.000	No	No	2.00
54	8.86	172.18	1.82	1.73	0.55	237.91	1.18	279.97	4.000	No	No	2.00
55	9.02	204.48	1.77	1.64	0.54	276.32	1.11	306.45	4.000	No	No	2.00
56	9.19	208.65	1.78	1.71	0.54	279.54	1.12	314.18	4.000	No	No	2.00
57	9.35	206.87	1.78	1.71	0.54	274.49	1.13	310.37	4.000	No	No	2.00
58	9.51	202.10	1.76	1.58	0.54	264.50	1.11	292.45	4.000	No	No	2.00
59	9.68	196.48	1.75	1.47	0.53	253.90	1.08	274.76	4.000	No	No	2.00
60	9.84	192.25	1.73	1.36	0.53	245.34	1.05	258.68	4.000	No	No	2.00
61	10.01	196.07	1.72	1.34	0.53	247.55	1.04	257.22	4.000	No	No	2.00
62	10.17	205.67	1.70	1.28	0.52	256.24	1.00	256.24	4.000	No	No	2.00
63	10.33	219.51	1.68	1.25	0.51	270.19	1.00	270.19	4.000	No	No	2.00
64	10.50	229.53	1.67	1.28	0.51	279.98	1.00	279.98	4.000	No	No	2.00
65	10.66	237.20	1.68	1.34	0.51	287.29	1.00	287.29	4.000	No	No	2.00
66	10.83	243.18	1.69	1.37	0.51	292.19	1.00	292.19	4.000	No	No	2.00
67	10.99	244.38	1.70	1.41	0.52	291.55	1.00	291.55	4.000	No	No	2.00
68	11.15	236.04	1.71	1.40	0.52	280.57	1.00	280.57	4.000	No	No	2.00
69	11.32	225.22	1.71	1.38	0.52	266.77	1.02	271.03	4.000	No	No	2.00
70	11.48	218.86	1.70	1.30	0.52	257.72	1.00	257.72	4.000	No	No	2.00
71	11.65	212.31	1.72	1.32	0.52	249.40	1.03	255.71	4.000	No	No	2.00
72	11.81	215.50	1.72	1.35	0.52	252.20	1.03	260.57	4.000	No	No	2.00
73	11.98	217.58	1.73	1.38	0.53	253.73	1.04	264.97	4.000	No	No	2.00
74	12.14	227.72	1.70	1.31	0.52	263.60	1.00	263.60	4.000	No	No	2.00
75	12.30	224.97	1.69	1.27	0.52	259.13	1.00	259.13	4.000	No	No	2.00
76	12.47	214.08	1.70	1.25	0.52	245.78	1.00	245.78	4.000	No	No	2.00
77	12.63	191.29	1.75	1.30	0.53	219.74	1.08	236.94	4.000	No	No	2.00
78	12.80	166.80	1.80	1.37	0.55	191.92	1.16	221.98	4.000	No	No	2.00
79	12.96	150.37	1.85	1.44	0.56	173.05	1.20	207.43	4.000	No	No	2.00
80	13.12	148.42	1.85	1.41	0.56	170.07	1.20	203.74	4.000	No	No	2.00
81	13.29	159.87	1.81	1.35	0.55	181.87	1.17	212.28	4.000	No	No	2.00
82	13.45	172.07	1.79	1.35	0.55	194.64	1.14	222.84	4.000	No	No	2.00
83	13.62	175.63	1.80	1.39	0.55	197.97	1.15	227.76	4.000	No	No	2.00
84	13.78	170.54	1.81	1.42	0.55	191.75	1.17	223.97	4.000	No	No	2.00
85	13.94	166.24	1.82	1.39	0.55	186.16	1.17	217.66	4.000	No	No	2.00
86	14.11	164.97	1.81	1.35	0.55	183.91	1.16	213.93	4.000	No	No	2.00
87	14.27	159.54	1.82	1.35	0.55	177.34	1.18	208.50	4.000	No	No	2.00
88	14.44	149.43	1.83	1.30	0.56	165.49	1.18	195.50	0.775	No	No	2.00
89	14.60	140.31	1.84	1.25	0.56	154.86	1.19	184.22	0.661	No	No	2.00
90	14.76	136.10	1.82	1.16	0.56	149.47	1.18	176.13	0.588	No	No	2.00
91	14.93	136.06	1.82	1.15	0.55	148.86	1.18	175.21	0.580	No	No	2.00
92	15.09	137.81	1.80	1.09	0.55	150.00	1.16	173.50	0.566	No	No	2.00
93	15.26	138.73	1.79	1.03	0.54	150.30	1.14	171.13	0.546	No	No	2.00
94	15.42	135.81	1.79	1.02	0.55	146.65	1.14	167.70	0.519	No	No	2.00
95	15.58	132.47	1.80	1.00	0.55	142.56	1.15	163.65	0.488	No	No	2.00
96	15.75	134.87	1.78	0.98	0.54	144.55	1.13	163.87	0.489	No	No	2.00

:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)

Point ID	Depth (ft)	q_t (tsf)	I_c	Fr (%)	n	Q_{tn}	K_c	$Q_{tn,cs}$	$CRR_{7.5}$	Belongs to trans. layer	Clay-like behaviour	FS
97	15.91	146.37	1.75	0.93	0.53	155.99	1.08	167.98	0.521	No	No	2.00
98	16.08	160.51	1.71	0.90	0.52	170.13	1.00	170.20	0.538	No	No	2.00
99	16.24	168.83	1.69	0.89	0.51	178.19	1.00	178.19	0.606	No	No	2.00
100	16.40	169.05	1.69	0.89	0.51	177.86	1.00	177.86	0.603	No	No	2.00
101	16.57	166.15	1.70	0.90	0.52	174.36	1.00	174.36	0.573	No	No	2.00
102	16.73	163.35	1.71	0.92	0.52	171.01	1.02	173.62	0.567	No	No	2.00
103	16.90	164.24	1.75	1.05	0.53	171.77	1.09	186.46	0.683	No	No	2.00
104	17.06	176.27	1.81	1.37	0.55	184.49	1.17	215.63	4.000	No	No	2.00
105	17.22	195.45	1.87	1.78	0.57	204.60	1.22	249.03	4.000	No	No	2.00
106	17.39	196.34	1.95	2.24	0.59	205.62	1.27	261.24	4.000	No	No	2.00
107	17.55	167.23	2.06	2.76	0.63	175.32	1.37	240.44	4.000	No	No	2.00
108	17.72	119.77	2.23	3.45	0.68	125.77	1.69	212.80	4.000	No	No	2.00
109	17.88	83.66	2.39	4.12	0.72	87.79	2.31	202.54	4.000	No	No	2.00
110	18.04	66.95	2.51	4.96	0.76	70.12	3.06	214.37	4.000	No	No	2.00
111	18.21	66.78	2.58	6.09	0.78	69.82	3.59	250.78	4.000	No	No	2.00
112	18.37	76.24	N/A	-119276.09	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
113	18.54	130.07	N/A	-138969.28	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
114	18.70	344.53	N/A	-78266.15	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
115	18.86	554.10	N/A	-48603.14	1.00	-1.00	1.00	N/A	4.000	No	No	2.00

Abbreviations

Depth: Depth from free surface, at which CPT was performed (ft)
q_t: Total cone resistance
I_c: Soil behavior type index
Fr: Normalized friction ratio (%)
n: Stress exponent
Q_{tn}: Normalized cone resistance
K_c: Cone resistance correction factor due to fines
$Q_{tn,cs}$: Normalized and adjusted cone resistance
$CRR_{7.5}$: Cyclic resistance ratio for M_w=7.5
FS: Factor of safety against soil liquefaction

:: Liquefaction Potential Index calculation data ::

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
0.16	2.00	0.00	0.00	0.16	0.00	0.33	2.00	0.00	0.00	0.16	0.00
0.49	2.00	0.00	0.00	0.16	0.00	0.66	2.00	0.00	0.00	0.16	0.00
0.82	2.00	0.00	0.00	0.16	0.00	0.98	2.00	0.00	0.00	0.16	0.00
1.15	2.00	0.00	0.00	0.16	0.00	1.31	2.00	0.00	0.00	0.16	0.00
1.48	2.00	0.00	0.00	0.16	0.00	1.64	2.00	0.00	0.00	0.16	0.00
1.80	2.00	0.00	0.00	0.16	0.00	1.97	2.00	0.00	0.00	0.16	0.00
2.13	2.00	0.00	0.00	0.16	0.00	2.30	2.00	0.00	0.00	0.16	0.00
2.46	2.00	0.00	0.00	0.16	0.00	2.62	2.00	0.00	0.00	0.16	0.00
2.79	2.00	0.00	0.00	0.16	0.00	2.95	2.00	0.00	0.00	0.16	0.00
3.12	2.00	0.00	0.00	0.16	0.00	3.28	2.00	0.00	0.00	0.16	0.00
3.44	2.00	0.00	0.00	0.16	0.00	3.61	2.00	0.00	0.00	0.16	0.00
3.77	2.00	0.00	0.00	0.16	0.00	3.94	2.00	0.00	0.00	0.16	0.00
4.10	2.00	0.00	0.00	0.16	0.00	4.27	2.00	0.00	0.00	0.16	0.00
4.43	2.00	0.00	0.00	0.16	0.00	4.59	2.00	0.00	0.00	0.16	0.00
4.76	2.00	0.00	0.00	0.16	0.00	4.92	2.00	0.00	0.00	0.16	0.00
5.09	2.00	0.00	0.00	0.16	0.00	5.25	2.00	0.00	0.00	0.16	0.00
5.41	2.00	0.00	0.00	0.16	0.00	5.58	2.00	0.00	0.00	0.16	0.00
5.74	2.00	0.00	0.00	0.16	0.00	5.91	2.00	0.00	0.00	0.16	0.00
6.07	2.00	0.00	0.00	0.16	0.00	6.23	2.00	0.00	0.00	0.16	0.00
6.40	2.00	0.00	0.00	0.16	0.00	6.56	2.00	0.00	0.00	0.16	0.00
6.73	2.00	0.00	0.00	0.16	0.00	6.89	2.00	0.00	0.00	0.16	0.00
7.05	2.00	0.00	0.00	0.16	0.00	7.22	2.00	0.00	0.00	0.16	0.00
7.38	2.00	0.00	0.00	0.16	0.00	7.55	2.00	0.00	0.00	0.16	0.00
7.71	2.00	0.00	0.00	0.16	0.00	7.87	2.00	0.00	0.00	0.16	0.00
8.04	2.00	0.00	0.00	0.16	0.00	8.20	2.00	0.00	0.00	0.16	0.00
8.37	2.00	0.00	0.00	0.16	0.00	8.53	2.00	0.00	0.00	0.16	0.00
8.69	2.00	0.00	0.00	0.16	0.00	8.86	2.00	0.00	0.00	0.16	0.00
9.02	2.00	0.00	0.00	0.16	0.00	9.19	2.00	0.00	0.00	0.16	0.00
9.35	2.00	0.00	0.00	0.16	0.00	9.51	2.00	0.00	0.00	0.16	0.00
9.68	2.00	0.00	0.00	0.16	0.00	9.84	2.00	0.00	0.00	0.16	0.00
10.01	2.00	0.00	0.00	0.16	0.00	10.17	2.00	0.00	0.00	0.16	0.00
10.33	2.00	0.00	0.00	0.16	0.00	10.50	2.00	0.00	0.00	0.16	0.00
10.66	2.00	0.00	0.00	0.16	0.00	10.83	2.00	0.00	0.00	0.16	0.00
10.99	2.00	0.00	0.00	0.16	0.00	11.15	2.00	0.00	0.00	0.16	0.00
11.32	2.00	0.00	0.00	0.16	0.00	11.48	2.00	0.00	0.00	0.16	0.00
11.65	2.00	0.00	0.00	0.16	0.00	11.81	2.00	0.00	0.00	0.16	0.00
11.98	2.00	0.00	0.00	0.16	0.00	12.14	2.00	0.00	0.00	0.16	0.00
12.30	2.00	0.00	0.00	0.16	0.00	12.47	2.00	0.00	0.00	0.16	0.00
12.63	2.00	0.00	0.00	0.16	0.00	12.80	2.00	0.00	0.00	0.16	0.00
12.96	2.00	0.00	0.00	0.16	0.00	13.12	2.00	0.00	0.00	0.16	0.00
13.29	2.00	0.00	0.00	0.16	0.00	13.45	2.00	0.00	0.00	0.16	0.00
13.62	2.00	0.00	0.00	0.16	0.00	13.78	2.00	0.00	0.00	0.16	0.00
13.94	2.00	0.00	0.00	0.16	0.00	14.11	2.00	0.00	0.00	0.16	0.00
14.27	2.00	0.00	0.00	0.16	0.00	14.44	2.00	0.00	0.00	0.16	0.00
14.60	2.00	0.00	0.00	0.16	0.00	14.76	2.00	0.00	0.00	0.16	0.00
14.93	2.00	0.00	0.00	0.16	0.00	15.09	2.00	0.00	0.00	0.16	0.00
15.26	2.00	0.00	0.00	0.16	0.00	15.42	2.00	0.00	0.00	0.16	0.00
15.58	2.00	0.00	0.00	0.16	0.00	15.75	2.00	0.00	0.00	0.16	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
15.91	2.00	0.00	0.00	0.16	0.00	16.08	2.00	0.00	0.00	0.16	0.00
16.24	2.00	0.00	0.00	0.16	0.00	16.40	2.00	0.00	0.00	0.16	0.00
16.57	2.00	0.00	0.00	0.16	0.00	16.73	2.00	0.00	0.00	0.16	0.00
16.90	2.00	0.00	0.00	0.16	0.00	17.06	2.00	0.00	0.00	0.16	0.00
17.22	2.00	0.00	0.00	0.16	0.00	17.39	2.00	0.00	0.00	0.16	0.00
17.55	2.00	0.00	0.00	0.16	0.00	17.72	2.00	0.00	0.00	0.16	0.00
17.88	2.00	0.00	0.00	0.16	0.00	18.04	2.00	0.00	0.00	0.16	0.00
18.21	2.00	0.00	0.00	0.16	0.00	18.37	2.00	0.00	0.00	0.16	0.00
18.54	2.00	0.00	0.00	0.16	0.00	18.70	2.00	0.00	0.00	0.16	0.00
18.86	2.00	0.00	0.00	0.16	0.00						

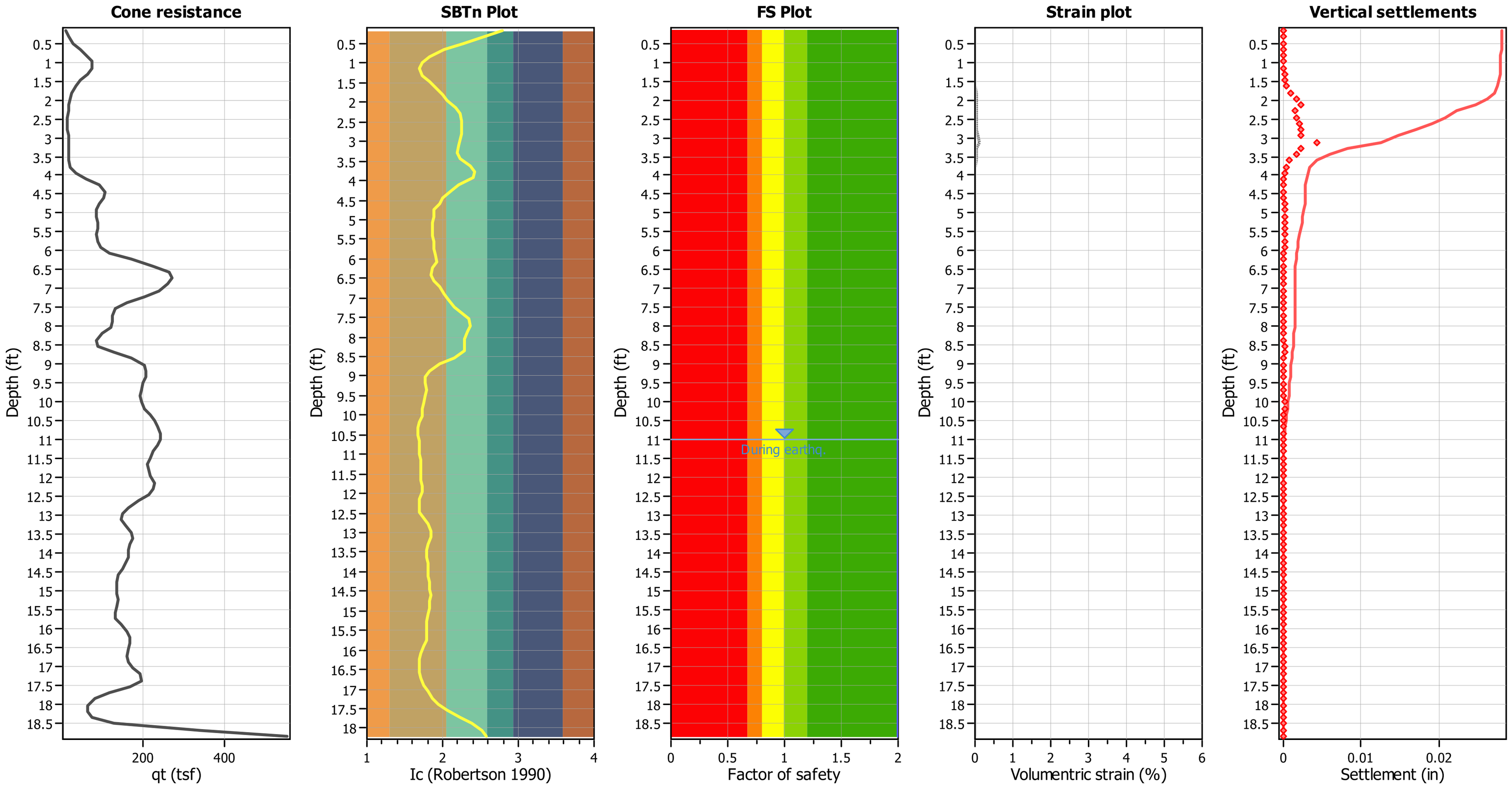
Overall liquefaction potential: 0.00

LPI = 0.00 - Liquefaction risk very low
LPI between 0.00 and 5.00 - Liquefaction risk low
LPI between 5.00 and 15.00 - Liquefaction risk high
LPI > 15.00 - Liquefaction risk very high

Abbreviations

FS: Calculated factor of safety for test point
F_L: 1 - FS
w_z: Function value of the extend of soil liquefaction according to depth
d_z: Layer thickness (ft)
LPI: Liquefaction potential index value for test point

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement of dry sands ::

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
0.16	2.79	19.12	5.78	110.55	0	0	0.15	0.000	0.00	0.00	0.00	0.000
0.33	2.56	28.54	3.40	96.97	26	407	0.15	0.001	0.00	5.81	0.00	0.000
0.49	2.26	48.03	1.79	85.78	20	471	0.15	0.002	0.00	5.81	0.00	0.000
0.66	2.01	74.32	1.32	97.76	20	530	0.15	0.002	0.00	5.81	0.00	0.000
0.82	1.84	102.12	1.19	121.35	24	585	0.15	0.002	0.00	5.81	0.00	0.000
0.98	1.73	122.74	1.04	127.69	24	611	0.15	0.002	0.00	5.81	0.00	0.000
1.15	1.70	122.78	1.00	122.78	23	592	0.15	0.003	0.00	5.81	0.00	0.000
1.31	1.74	105.59	1.06	112.44	21	535	0.15	0.004	0.00	5.81	0.00	0.000
1.48	1.84	79.01	1.19	93.91	18	452	0.15	0.006	0.01	5.81	0.00	0.000
1.64	1.92	58.09	1.00	58.09	12	371	0.15	0.009	0.02	5.81	0.01	0.000
1.80	2.00	44.46	1.00	44.46	9	313	0.15	0.013	0.03	5.81	0.02	0.001
1.97	2.07	35.81	1.00	35.81	8	275	0.15	0.020	0.06	5.81	0.04	0.002
2.13	2.17	30.63	1.00	30.63	7	266	0.15	0.024	0.09	5.81	0.06	0.002
2.30	2.23	27.71	1.69	46.74	11	261	0.15	0.029	0.06	5.81	0.04	0.002
2.46	2.26	26.32	1.78	46.85	11	257	0.15	0.033	0.07	5.81	0.05	0.002
2.62	2.26	26.17	1.78	46.63	11	256	0.15	0.037	0.08	5.81	0.05	0.002
2.79	2.26	26.39	1.77	46.73	11	257	0.15	0.041	0.09	5.81	0.06	0.002
2.95	2.23	27.68	1.70	46.95	11	261	0.15	0.043	0.09	5.81	0.06	0.002
3.12	2.20	29.14	1.00	29.14	7	266	0.15	0.044	0.17	5.81	0.11	0.004
3.28	2.19	30.74	1.60	49.10	11	277	0.15	0.043	0.09	5.81	0.06	0.002
3.44	2.24	31.47	1.71	53.86	12	299	0.15	0.037	0.07	5.81	0.04	0.002
3.61	2.36	32.54	2.19	71.12	17	363	0.15	0.025	0.03	5.81	0.02	0.001
3.77	2.43	37.99	2.53	96.29	24	461	0.15	0.016	0.01	5.81	0.01	0.000
3.94	2.40	56.20	2.36	132.46	33	655	0.15	0.010	0.01	5.81	0.00	0.000
4.10	2.22	101.72	1.66	168.46	38	943	0.15	0.007	0.00	5.81	0.00	0.000
4.27	2.11	148.39	1.44	213.73	47	1209	0.15	0.005	0.00	5.81	0.00	0.000
4.43	2.01	176.10	1.31	231.32	48	1253	0.15	0.005	0.00	5.81	0.00	0.000
4.59	1.96	166.84	1.28	213.03	44	1118	0.15	0.006	0.00	5.81	0.00	0.000
4.76	1.89	147.69	1.23	181.21	36	901	0.15	0.008	0.00	5.81	0.00	0.000
4.92	1.88	137.44	1.22	167.81	33	829	0.15	0.010	0.01	5.81	0.00	0.000
5.09	1.87	137.61	1.22	167.58	33	825	0.15	0.010	0.01	5.81	0.00	0.000
5.25	1.87	142.48	1.22	173.17	34	851	0.15	0.010	0.01	5.81	0.00	0.000
5.41	1.87	143.07	1.22	174.42	35	860	0.15	0.010	0.01	5.81	0.00	0.000
5.58	1.88	141.63	1.22	173.15	34	857	0.15	0.011	0.01	5.81	0.00	0.000
5.74	1.88	142.80	1.22	174.69	35	865	0.15	0.011	0.01	5.81	0.00	0.000
5.91	1.90	156.14	1.24	193.52	39	975	0.15	0.010	0.00	5.81	0.00	0.000
6.07	1.92	190.83	1.25	238.31	48	1213	0.15	0.008	0.00	5.81	0.00	0.000
6.23	1.86	275.54	1.21	332.47	66	1622	0.15	0.006	0.00	5.81	0.00	0.000
6.40	1.85	361.70	1.20	433.41	85	2101	0.15	0.004	0.00	5.81	0.00	0.000
6.56	1.88	423.88	1.22	519.19	103	2575	0.15	0.004	0.00	5.81	0.00	0.000
6.73	1.96	434.28	1.28	555.88	114	2927	0.15	0.003	0.00	5.81	0.00	0.000
6.89	2.03	422.20	1.33	562.45	118	3084	0.15	0.003	0.00	5.81	0.00	0.000
7.05	2.08	384.39	1.40	537.11	116	3017	0.15	0.003	0.00	5.81	0.00	0.000
7.22	2.15	325.24	1.51	492.08	109	2790	0.15	0.004	0.00	5.81	0.00	0.000
7.38	2.26	258.47	1.78	458.92	106	2524	0.15	0.004	0.00	5.81	0.00	0.000
7.55	2.35	213.23	2.12	451.21	108	2332	0.15	0.005	0.00	5.81	0.00	0.000
7.71	2.36	199.29	2.20	437.61	106	2229	0.15	0.005	0.00	5.81	0.00	0.000
7.87	2.33	200.34	2.04	407.97	97	2141	0.15	0.006	0.00	5.81	0.00	0.000

:: Post-earthquake settlement of dry sands :: (continued)

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
8.04	2.29	194.09	1.90	369.08	87	1985	0.15	0.006	0.00	5.81	0.00	0.000
8.20	2.29	163.39	1.89	308.77	72	1665	0.15	0.008	0.00	5.81	0.00	0.000
8.37	2.28	135.34	1.86	252.04	59	1378	0.15	0.010	0.00	5.81	0.00	0.000
8.53	2.16	135.84	1.52	206.77	46	1233	0.15	0.012	0.00	5.81	0.00	0.000
8.69	1.95	185.41	1.27	235.98	48	1374	0.15	0.011	0.00	5.81	0.00	0.000
8.86	1.82	237.91	1.18	279.97	55	1554	0.15	0.009	0.00	5.81	0.00	0.000
9.02	1.77	276.32	1.11	306.45	59	1717	0.15	0.008	0.00	5.81	0.00	0.000
9.19	1.78	279.54	1.12	314.18	60	1776	0.15	0.008	0.00	5.81	0.00	0.000
9.35	1.78	274.49	1.13	310.37	60	1772	0.15	0.008	0.00	5.81	0.00	0.000
9.51	1.76	264.50	1.11	292.45	56	1692	0.15	0.009	0.00	5.81	0.00	0.000
9.68	1.75	253.90	1.08	274.76	52	1614	0.15	0.010	0.00	5.81	0.00	0.000
9.84	1.73	245.34	1.05	258.68	49	1548	0.15	0.011	0.00	5.81	0.00	0.000
10.01	1.72	247.55	1.04	257.22	48	1563	0.15	0.011	0.00	5.81	0.00	0.000
10.17	1.70	256.24	1.00	256.24	48	1586	0.15	0.011	0.00	5.81	0.00	0.000
10.33	1.68	270.19	1.00	270.19	50	1648	0.15	0.010	0.00	5.81	0.00	0.000
10.50	1.67	279.98	1.00	279.98	52	1717	0.15	0.010	0.00	5.81	0.00	0.000
10.66	1.68	287.29	1.00	287.29	53	1797	0.15	0.010	0.00	5.81	0.00	0.000
10.83	1.69	292.19	1.00	292.19	54	1851	0.15	0.010	0.00	5.81	0.00	0.000
10.99	1.70	291.55	1.00	291.55	54	1883	0.15	0.009	0.00	5.81	0.00	0.000

Total estimated settlement: 0.03

Abbreviations

Q_{tn}: Equivalent clean sand normalized cone resistance
K_c: Fines correction factor
$Q_{tn,cs}$: Post-liquefaction volumentric strain
G_{max}: Small strain shear modulus
CSR: Soil cyclic stress ratio
γ: Cyclic shear strain
$e_{vol(15)}$: Volumetric strain after 15 cycles
N_c: Equivalent number of cycles
e_v: Volumetric strain
Settle.: Calculated settlement

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
11.15	280.57	2.00	0.00	1.00	0.00	11.32	271.03	2.00	0.00	1.00	0.00
11.48	257.72	2.00	0.00	1.00	0.00	11.65	255.71	2.00	0.00	1.00	0.00
11.81	260.57	2.00	0.00	1.00	0.00	11.98	264.97	2.00	0.00	1.00	0.00
12.14	263.60	2.00	0.00	1.00	0.00	12.30	259.13	2.00	0.00	1.00	0.00
12.47	245.78	2.00	0.00	1.00	0.00	12.63	236.94	2.00	0.00	1.00	0.00
12.80	221.98	2.00	0.00	1.00	0.00	12.96	207.43	2.00	0.00	1.00	0.00
13.12	203.74	2.00	0.00	1.00	0.00	13.29	212.28	2.00	0.00	1.00	0.00
13.45	222.84	2.00	0.00	1.00	0.00	13.62	227.76	2.00	0.00	1.00	0.00
13.78	223.97	2.00	0.00	1.00	0.00	13.94	217.66	2.00	0.00	1.00	0.00
14.11	213.93	2.00	0.00	1.00	0.00	14.27	208.50	2.00	0.00	1.00	0.00
14.44	195.50	2.00	0.00	1.00	0.00	14.60	184.22	2.00	0.00	1.00	0.00
14.76	176.13	2.00	0.00	1.00	0.00	14.93	175.21	2.00	0.00	1.00	0.00
15.09	173.50	2.00	0.00	1.00	0.00	15.26	171.13	2.00	0.00	1.00	0.00
15.42	167.70	2.00	0.00	1.00	0.00	15.58	163.65	2.00	0.00	1.00	0.00
15.75	163.87	2.00	0.00	1.00	0.00	15.91	167.98	2.00	0.00	1.00	0.00
16.08	170.20	2.00	0.00	1.00	0.00	16.24	178.19	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
16.40	177.86	2.00	0.00	1.00	0.00	16.57	174.36	2.00	0.00	1.00	0.00
16.73	173.62	2.00	0.00	1.00	0.00	16.90	186.46	2.00	0.00	1.00	0.00
17.06	215.63	2.00	0.00	1.00	0.00	17.22	249.03	2.00	0.00	1.00	0.00
17.39	261.24	2.00	0.00	1.00	0.00	17.55	240.44	2.00	0.00	1.00	0.00
17.72	212.80	2.00	0.00	1.00	0.00	17.88	202.54	2.00	0.00	1.00	0.00
18.04	214.37	2.00	0.00	1.00	0.00	18.21	250.78	2.00	0.00	1.00	0.00
18.37	-1.00	2.00	0.00	1.00	0.00	18.54	-1.00	2.00	0.00	1.00	0.00
18.70	-1.00	2.00	0.00	1.00	0.00	18.86	-1.00	2.00	0.00	1.00	0.00

Total estimated settlement: 0.00

Abbreviations

$Q_{tn,cs}$: Equivalent clean sand normalized cone resistance
FS: Factor of safety against liquefaction
e_v (%): Post-liquefaction volumentric strain
DF: e_v depth weighting factor
Settlement: Calculated settlement

:: Strength loss calculation (Robertson (2009) ::

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
0.16	11.91	19.12	5.78	110.55	2.79	0.77	0.77
0.33	17.78	28.54	3.40	96.97	2.56	0.74	0.74
0.49	29.92	48.03	1.79	85.78	2.26	0.72	0.72
0.66	46.29	74.32	1.32	97.76	2.01	0.74	0.74
0.82	63.61	102.12	1.19	121.35	1.84	0.78	0.78
0.98	76.45	122.74	1.04	127.69	1.73	0.79	0.79
1.15	76.48	122.78	1.00	122.78	1.70	0.79	0.79
1.31	65.79	105.59	1.06	112.44	1.74	0.77	0.77
1.48	49.26	79.01	1.19	93.91	1.84	0.74	0.74
1.64	36.25	58.09	1.00	58.09	1.92	0.10	0.65
1.80	27.77	44.46	1.00	44.46	2.00	0.04	0.62
1.97	22.40	35.81	1.00	35.81	2.07	0.02	0.62
2.13	19.18	30.63	1.00	30.63	2.17	0.02	0.62
2.30	17.37	27.71	1.69	46.74	2.23	0.04	0.62
2.46	16.51	26.32	1.78	46.85	2.26	0.04	0.62
2.62	16.43	26.17	1.78	46.63	2.26	0.04	0.62
2.79	16.57	26.39	1.77	46.73	2.26	0.04	0.62
2.95	17.38	27.68	1.70	46.95	2.23	0.04	0.62
3.12	18.30	29.14	1.00	29.14	2.20	0.02	0.62
3.28	19.30	30.74	1.60	49.10	2.19	0.05	0.62
3.44	19.77	31.47	1.71	53.86	2.24	0.07	0.64
3.61	20.44	32.54	2.19	71.12	2.36	0.28	0.69
3.77	23.85	37.99	2.53	96.29	2.43	0.74	0.74
3.94	35.19	56.20	2.36	132.46	2.40	0.80	0.80
4.10	63.53	101.72	1.66	168.46	2.22	0.85	0.85
4.27	92.59	148.39	1.44	213.73	2.11	0.90	0.90
4.43	109.85	176.10	1.31	231.32	2.01	0.92	0.92
4.59	104.10	166.84	1.28	213.03	1.96	0.90	0.90
4.76	92.19	147.69	1.23	181.21	1.89	0.87	0.87
4.92	85.82	137.44	1.22	167.81	1.88	0.85	0.85
5.09	85.93	137.61	1.22	167.58	1.87	0.85	0.85
5.25	88.97	142.48	1.22	173.17	1.87	0.86	0.86
5.41	89.35	143.07	1.22	174.42	1.87	0.86	0.86
5.58	88.47	141.63	1.22	173.15	1.88	0.86	0.86
5.74	89.20	142.80	1.22	174.69	1.88	0.86	0.86
5.91	97.51	156.14	1.24	193.52	1.90	0.88	0.88
6.07	119.12	190.83	1.25	238.31	1.92	0.93	0.93
6.23	171.85	275.54	1.21	332.47	1.86	1.00	1.00
6.40	225.49	361.70	1.20	433.41	1.85	1.07	1.07
6.56	264.20	423.88	1.22	519.19	1.88	1.12	1.12
6.73	270.69	434.28	1.28	555.88	1.96	1.13	1.13
6.89	263.18	422.20	1.33	562.45	2.03	1.14	1.14
7.05	239.66	384.39	1.40	537.11	2.08	1.12	1.12
7.22	202.85	325.24	1.51	492.08	2.15	1.10	1.10
7.38	161.31	258.47	1.78	458.92	2.26	1.08	1.08
7.55	133.16	213.23	2.12	451.21	2.35	1.08	1.08
7.71	124.49	199.29	2.20	437.61	2.36	1.07	1.07
7.87	125.16	200.34	2.04	407.97	2.33	1.05	1.05

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
8.04	121.28	194.09	1.90	369.08	2.29	1.03	1.03
8.20	102.19	163.39	1.89	308.77	2.29	0.98	0.98
8.37	85.54	135.34	1.86	252.04	2.28	0.94	0.94
8.53	89.48	135.84	1.52	206.77	2.16	0.89	0.89
8.69	129.09	185.41	1.27	235.98	1.95	0.92	0.92
8.86	172.18	237.91	1.18	279.97	1.82	0.96	0.96
9.02	204.48	276.32	1.11	306.45	1.77	0.98	0.98
9.19	208.65	279.54	1.12	314.18	1.78	0.99	0.99
9.35	206.87	274.49	1.13	310.37	1.78	0.99	0.99
9.51	202.10	264.50	1.11	292.45	1.76	0.97	0.97
9.68	196.48	253.90	1.08	274.76	1.75	0.96	0.96
9.84	192.25	245.34	1.05	258.68	1.73	0.94	0.94
10.01	196.07	247.55	1.04	257.22	1.72	0.94	0.94
10.17	205.67	256.24	1.00	256.24	1.70	0.94	0.94
10.33	219.51	270.19	1.00	270.19	1.68	0.95	0.95
10.50	229.53	279.98	1.00	279.98	1.67	0.96	0.96
10.66	237.20	287.29	1.00	287.29	1.68	0.97	0.97
10.83	243.18	292.19	1.00	292.19	1.69	0.97	0.97
10.99	244.38	291.55	1.00	291.55	1.70	0.97	0.97
11.15	236.04	280.57	1.00	280.57	1.71	0.96	0.96
11.32	225.22	266.77	1.02	271.03	1.71	0.95	0.95
11.48	218.86	257.72	1.00	257.72	1.70	0.94	0.94
11.65	212.31	249.40	1.03	255.71	1.72	0.94	0.94
11.81	215.50	252.20	1.03	260.57	1.72	0.95	0.95
11.98	217.58	253.73	1.04	264.97	1.73	0.95	0.95
12.14	227.72	263.60	1.00	263.60	1.70	0.95	0.95
12.30	224.97	259.13	1.00	259.13	1.69	0.94	0.94
12.47	214.08	245.78	1.00	245.78	1.70	0.93	0.93
12.63	191.29	219.74	1.08	236.94	1.75	0.92	0.92
12.80	166.80	191.92	1.16	221.98	1.80	0.91	0.91
12.96	150.37	173.05	1.20	207.43	1.85	0.89	0.89
13.12	148.42	170.07	1.20	203.74	1.85	0.89	0.89
13.29	159.87	181.87	1.17	212.28	1.81	0.90	0.90
13.45	172.07	194.64	1.14	222.84	1.79	0.91	0.91
13.62	175.63	197.97	1.15	227.76	1.80	0.92	0.92
13.78	170.54	191.75	1.17	223.97	1.81	0.91	0.91
13.94	166.24	186.16	1.17	217.66	1.82	0.91	0.91
14.11	164.97	183.91	1.16	213.93	1.81	0.90	0.90
14.27	159.54	177.34	1.18	208.50	1.82	0.90	0.90
14.44	149.43	165.49	1.18	195.50	1.83	0.88	0.88
14.60	140.31	154.86	1.19	184.22	1.84	0.87	0.87
14.76	136.10	149.47	1.18	176.13	1.82	0.86	0.86
14.93	136.06	148.86	1.18	175.21	1.82	0.86	0.86
15.09	137.81	150.00	1.16	173.50	1.80	0.86	0.86
15.26	138.73	150.30	1.14	171.13	1.79	0.85	0.85
15.42	135.81	146.65	1.14	167.70	1.79	0.85	0.85
15.58	132.47	142.56	1.15	163.65	1.80	0.84	0.84
15.75	134.87	144.55	1.13	163.87	1.78	0.84	0.84

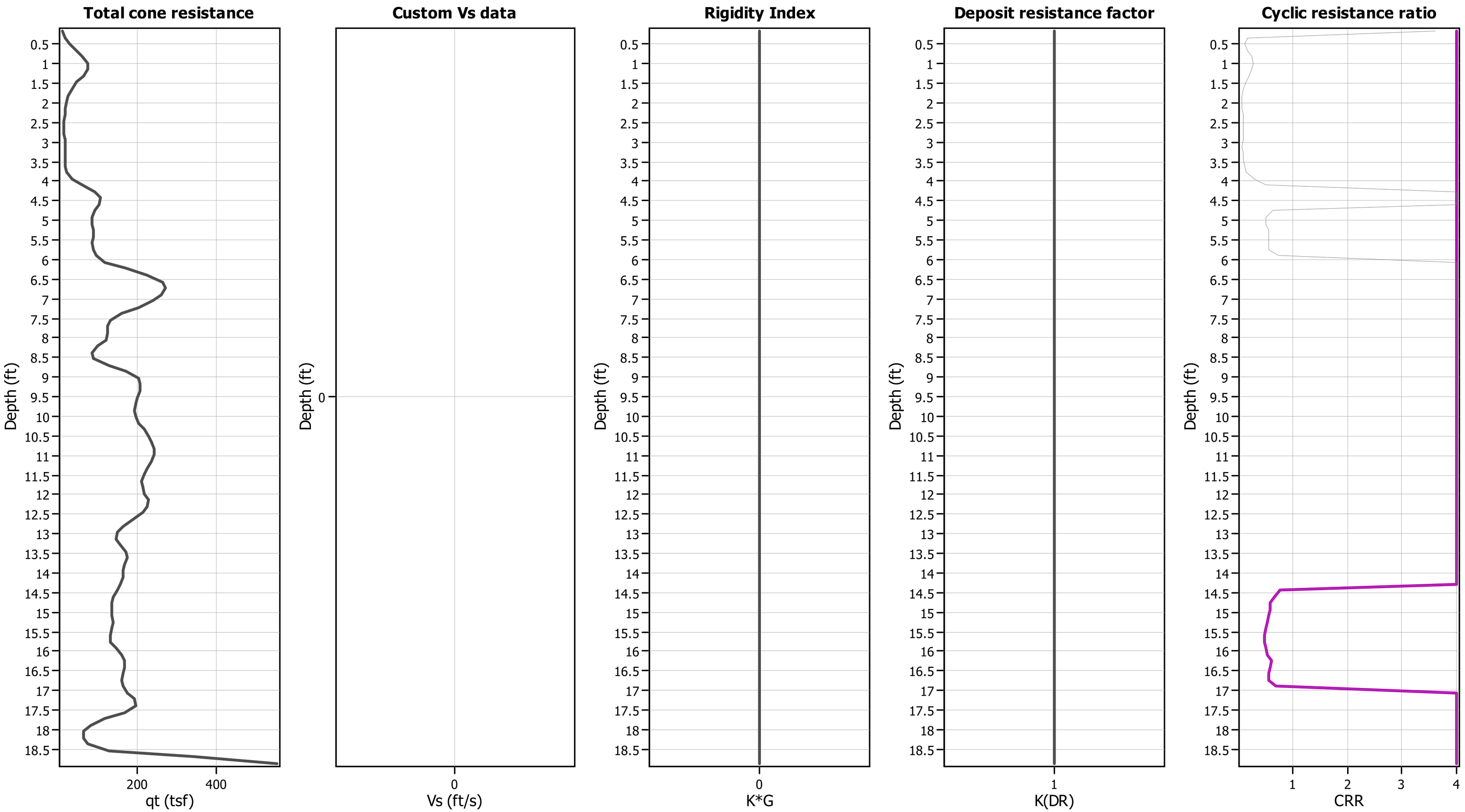
:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
15.91	146.37	155.99	1.08	167.98	1.75	0.85	0.85
16.08	160.51	170.13	1.00	170.20	1.71	0.85	0.85
16.24	168.83	178.19	1.00	178.19	1.69	0.86	0.86
16.40	169.05	177.86	1.00	177.86	1.69	0.86	0.86
16.57	166.15	174.36	1.00	174.36	1.70	0.86	0.86
16.73	163.35	171.01	1.02	173.62	1.71	0.86	0.86
16.90	164.24	171.77	1.09	186.46	1.75	0.87	0.87
17.06	176.27	184.49	1.17	215.63	1.81	0.90	0.90
17.22	195.45	204.60	1.22	249.03	1.87	0.94	0.94
17.39	196.34	205.62	1.27	261.24	1.95	0.95	0.95
17.55	167.23	175.32	1.37	240.44	2.06	0.93	0.93
17.72	119.77	125.77	1.69	212.80	2.23	0.90	0.90
17.88	83.66	87.79	2.31	202.54	2.39	0.89	0.89
18.04	66.95	70.12	3.06	214.37	2.51	0.90	0.90
18.21	66.78	69.82	3.59	250.78	2.58	0.94	0.94
18.37	76.24	-1.00	1.00	-1.00	-1.00	0.00	0.00
18.54	130.07	-1.00	1.00	-1.00	-1.00	0.00	0.00
18.70	344.53	-1.00	1.00	-1.00	-1.00	0.00	0.00
18.86	554.10	-1.00	1.00	-1.00	-1.00	0.00	0.00

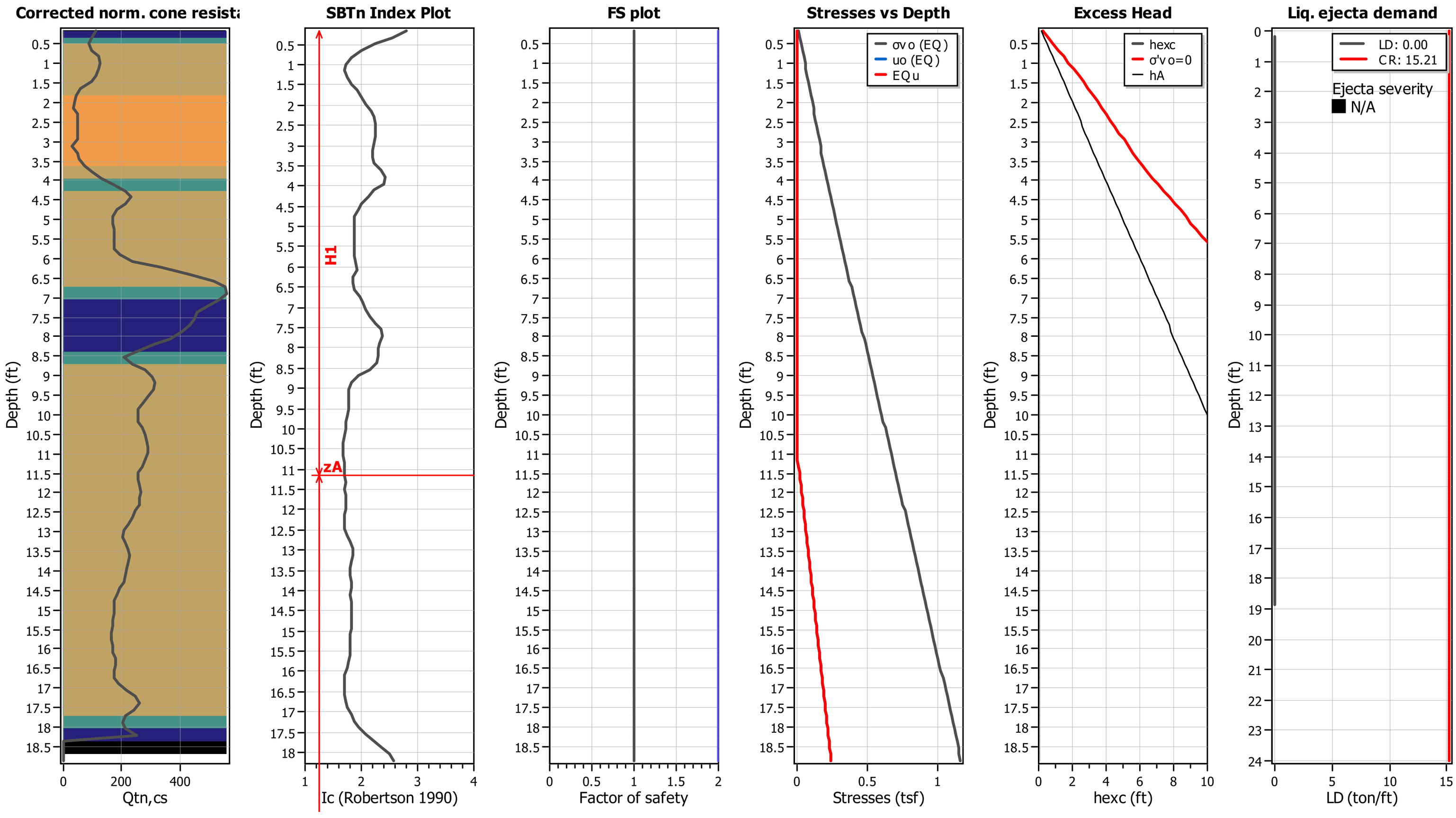
Abbreviations

q_t: Total cone resistance
K_c: Cone resistance correction factor due to fines
$Q_{tn,cs}$: Adjusted and corrected cone resistance due to fines
I_c: Soil behavior type index
$S_{u(liq)}/\sigma'_v$: Calculated liquefied undrained strength ratio
$S_{u(peak)}/\sigma'_v$: Calculated peak undrained strength ratio

Aging Calculation Estimation



Ejecta Severity Estimation



Universal Engineering Sciences

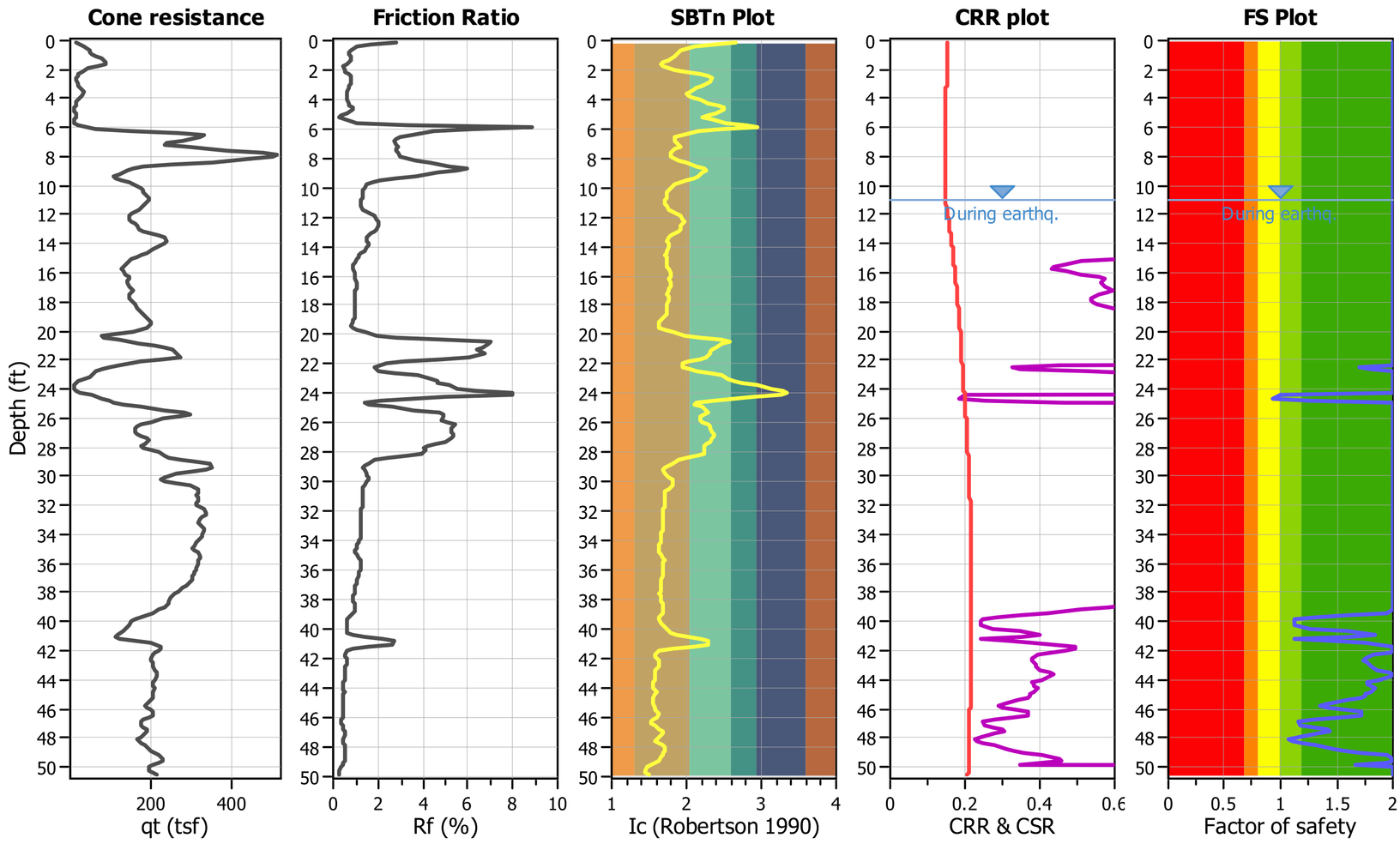
LIQUEFACTION ANALYSIS REPORT

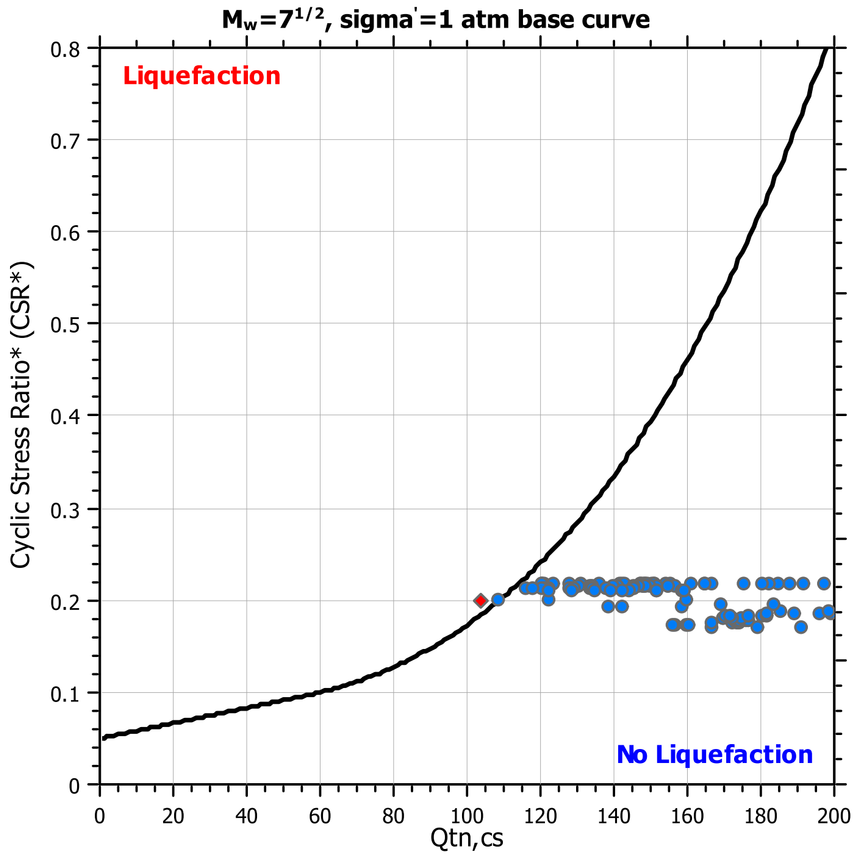
Project title : Stanislaus Elementary Replacement School **Location : Modesto, California**

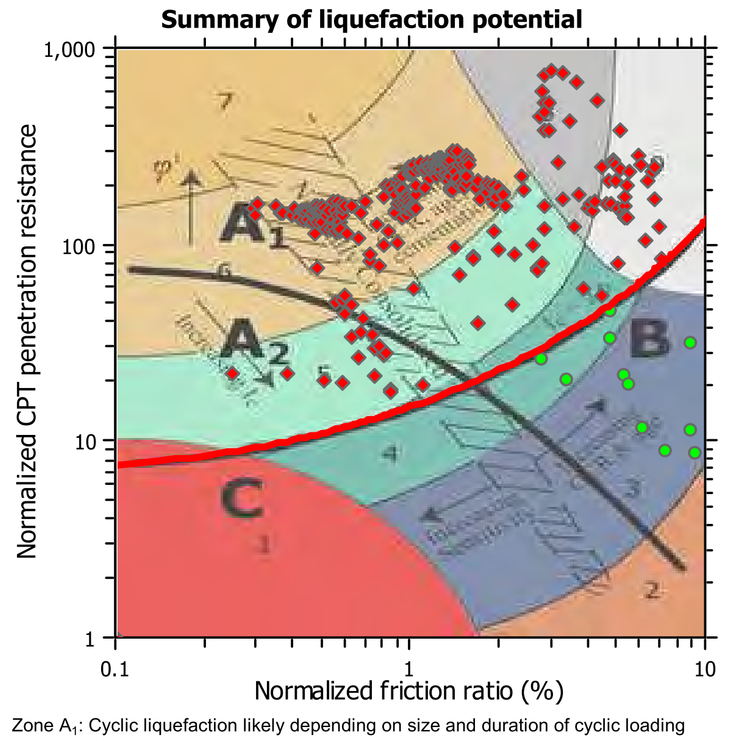
CPT file : CPT-03

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	11.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	11.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.25	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.37	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

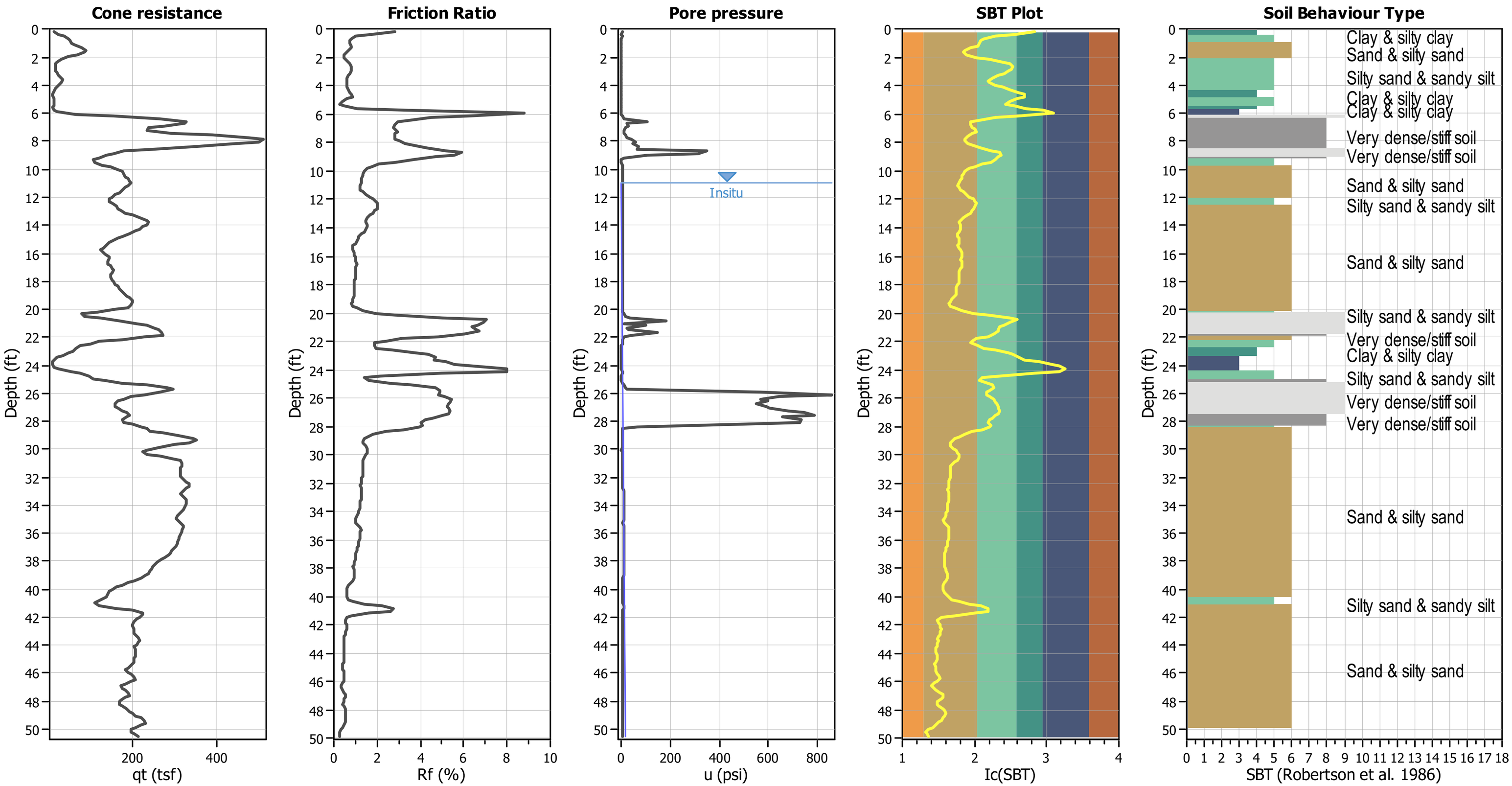






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



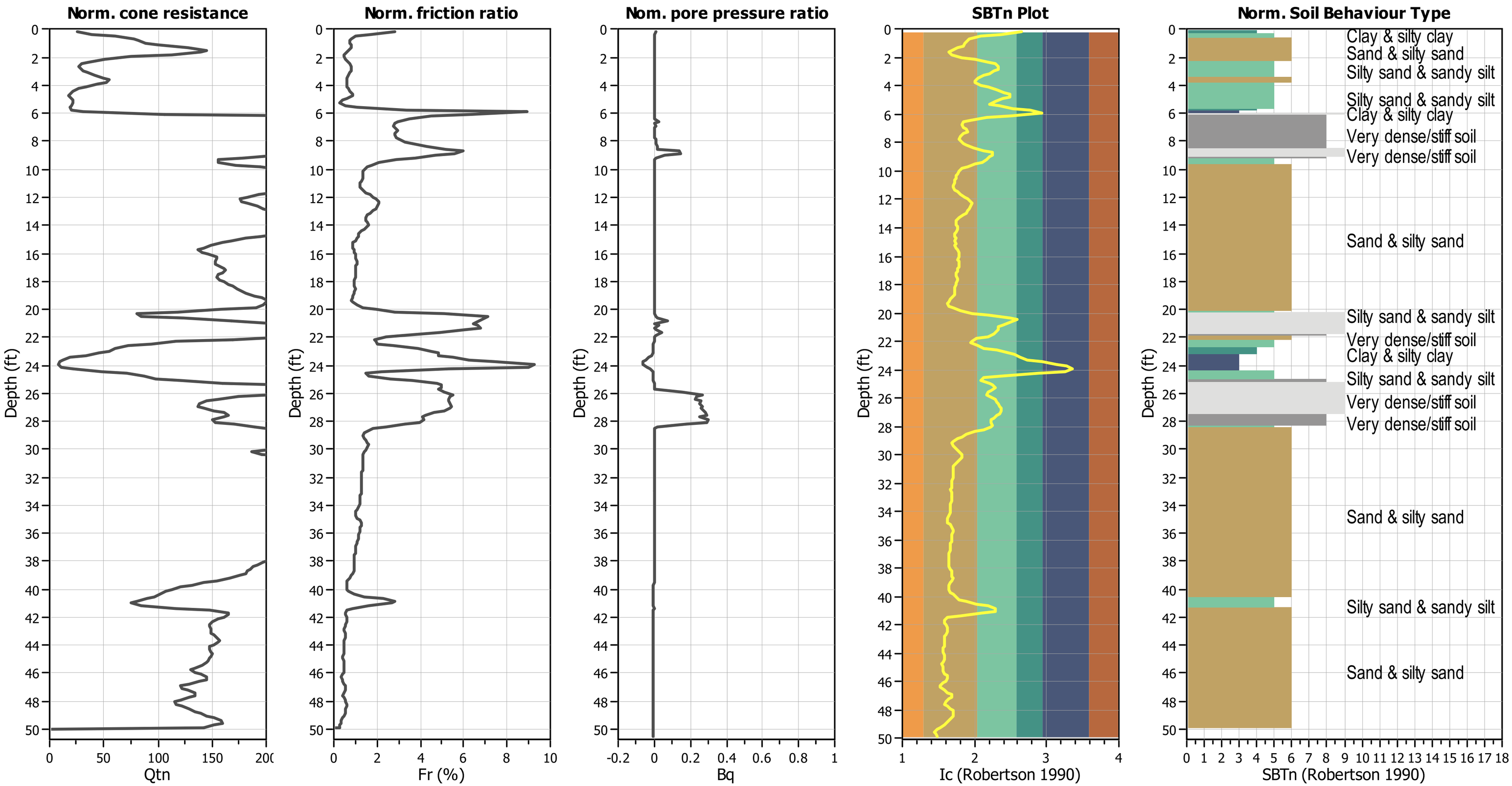
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



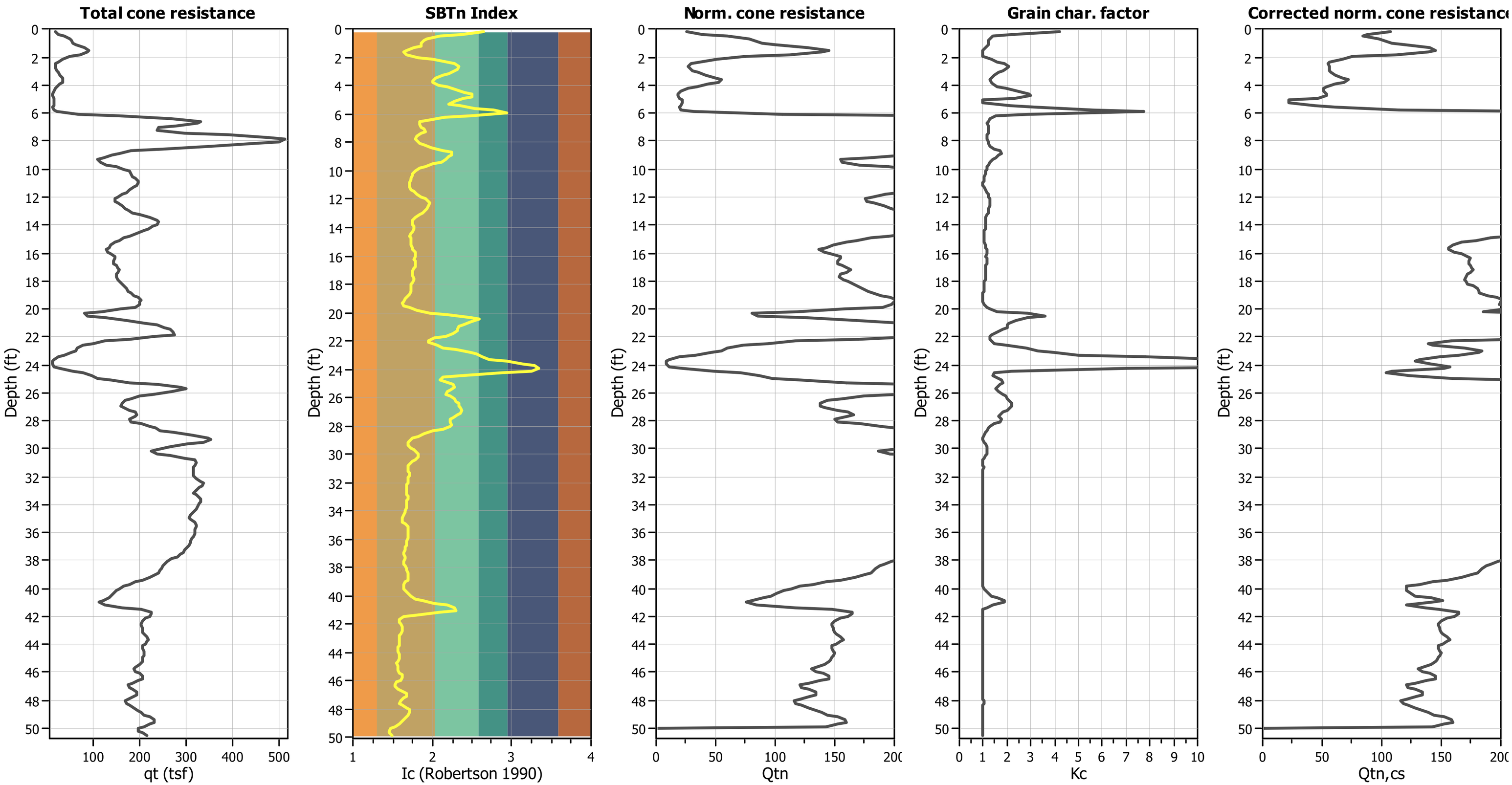
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

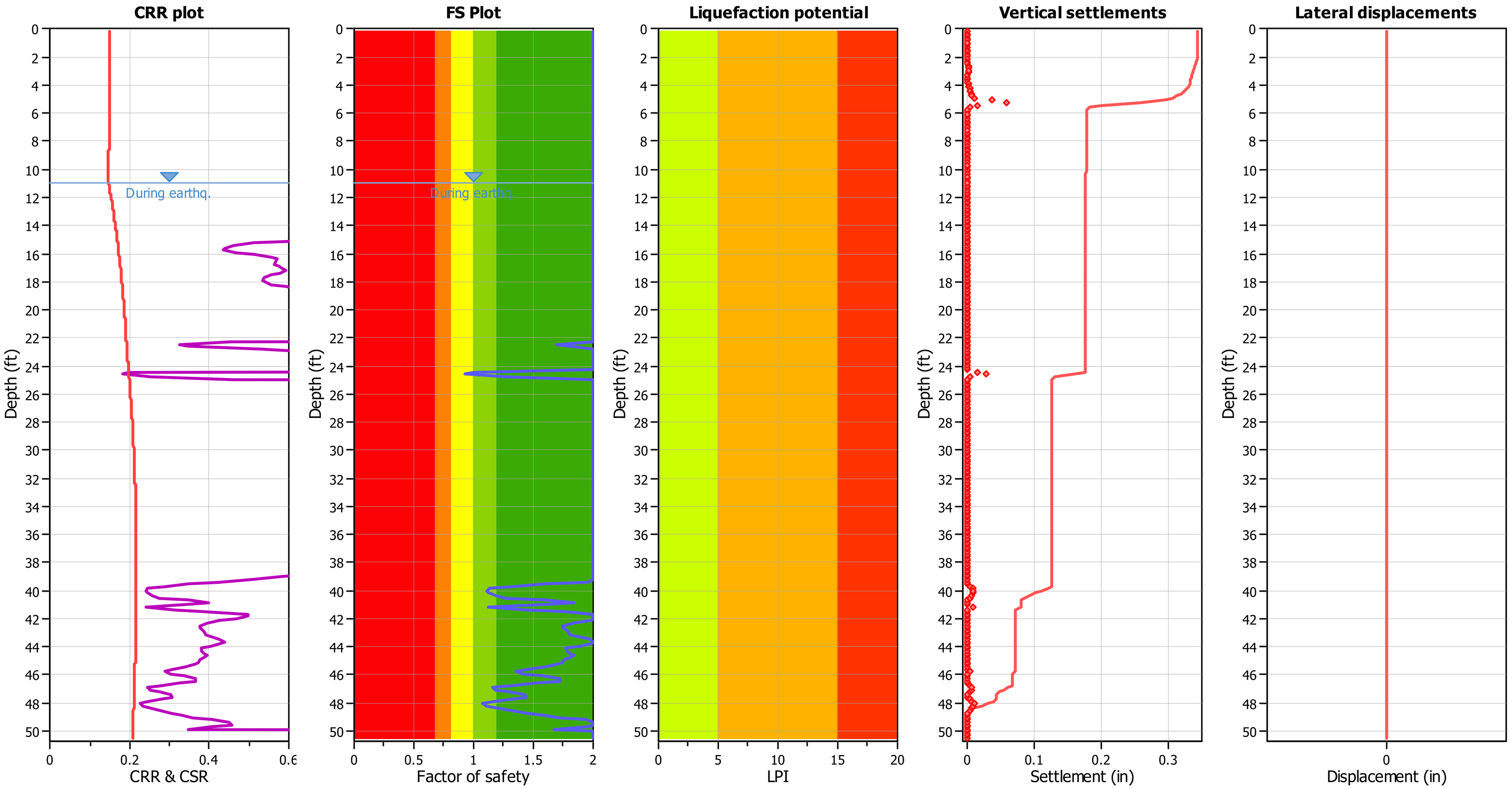
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

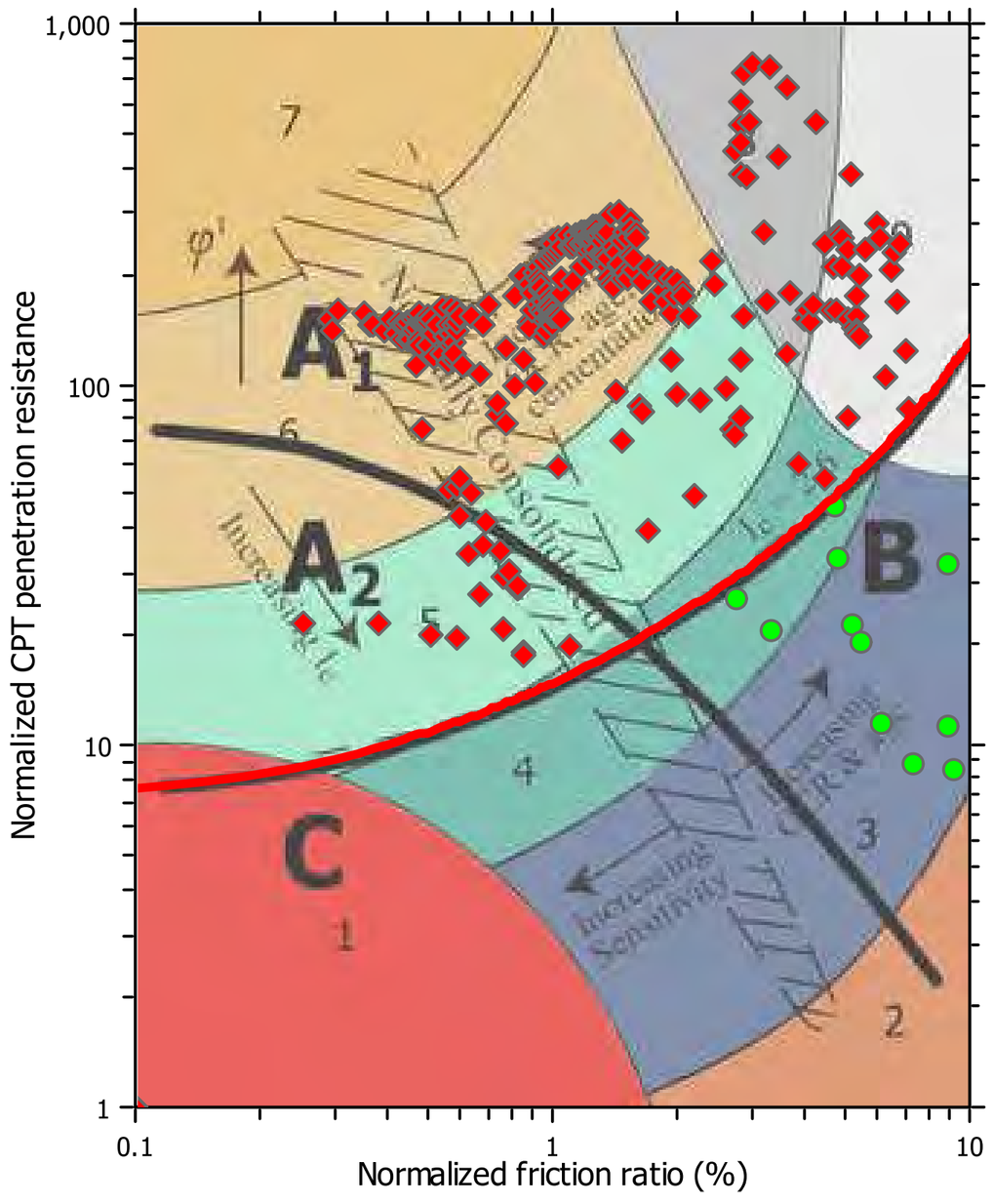
F.S. color scheme

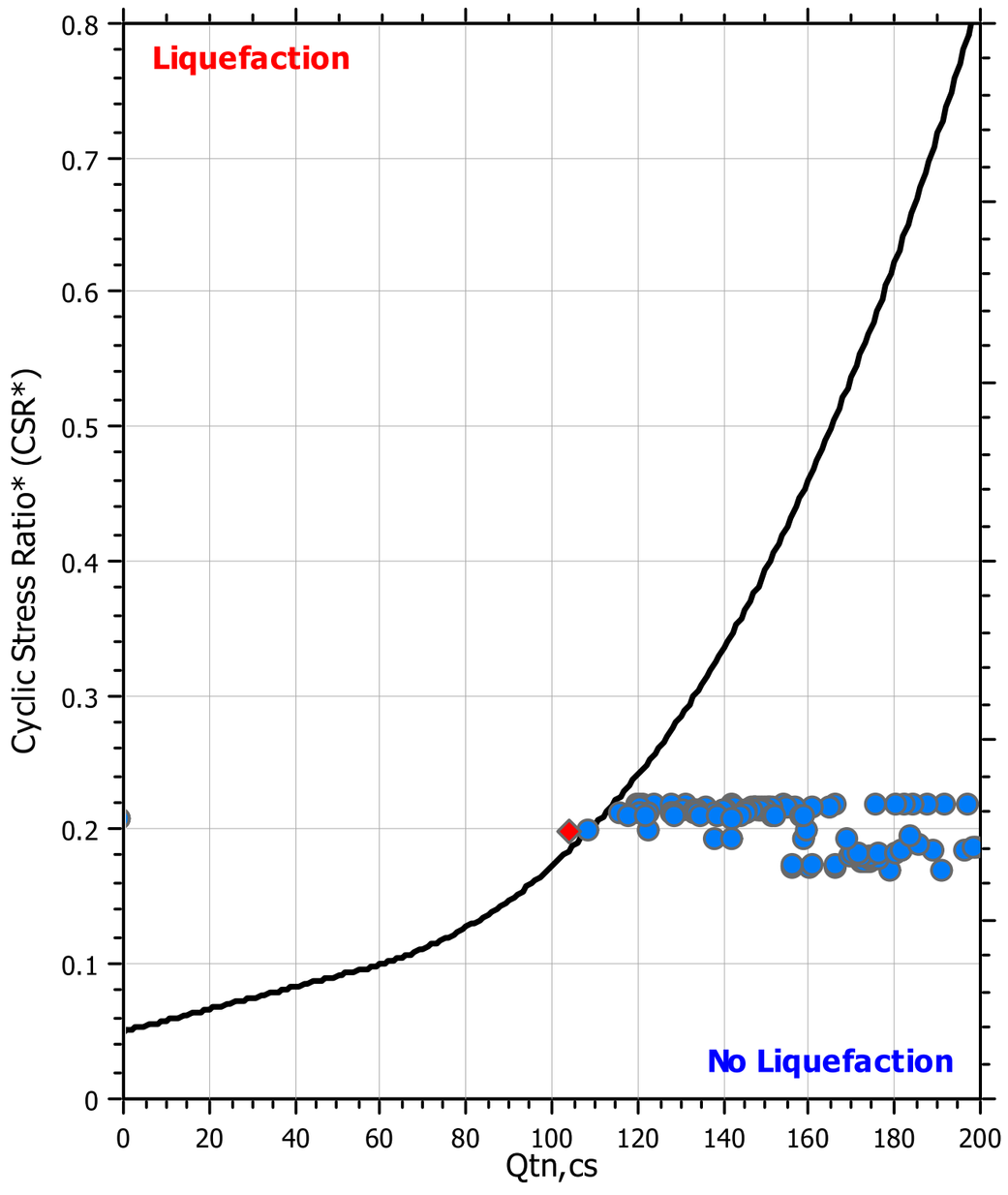
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

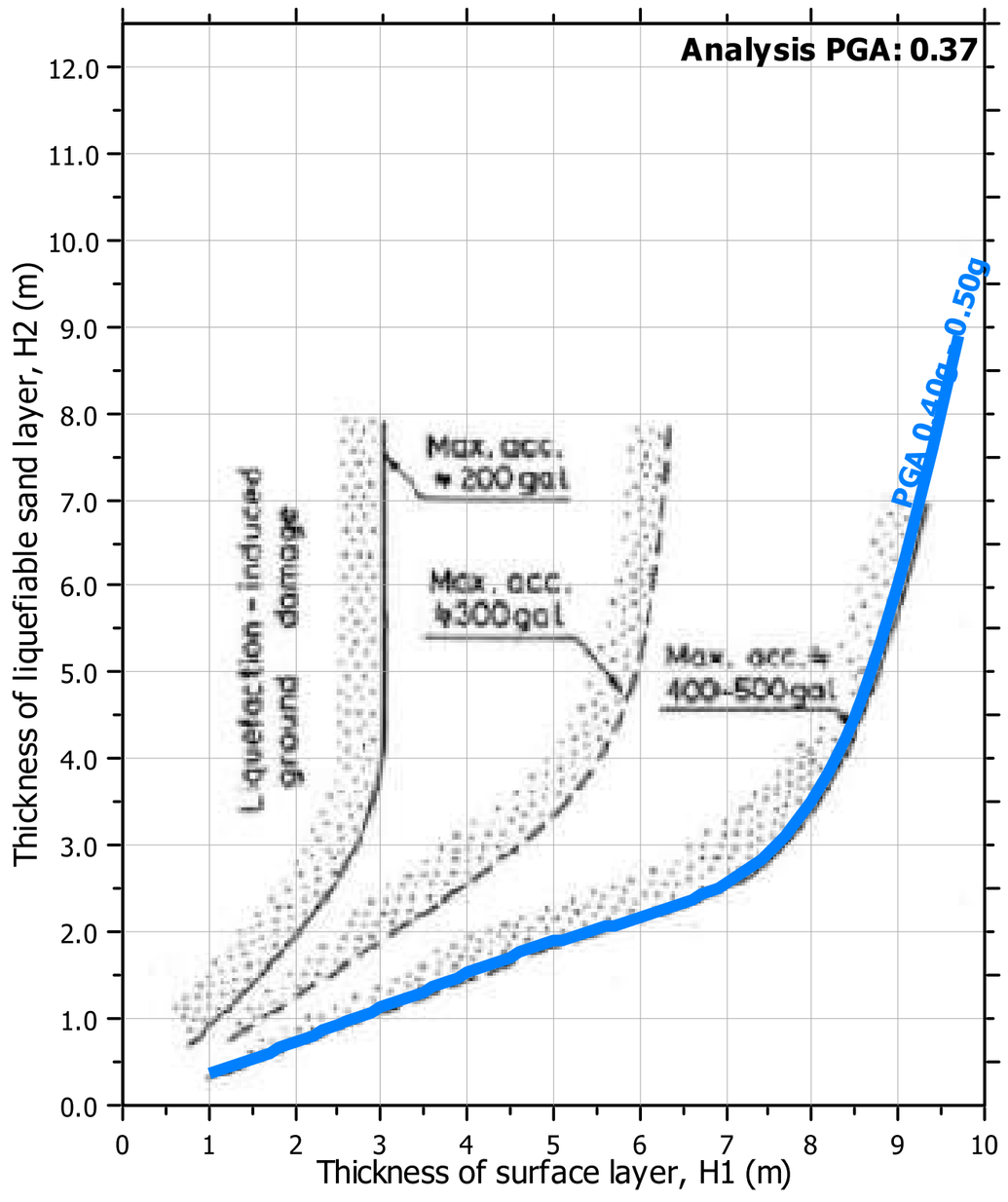
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



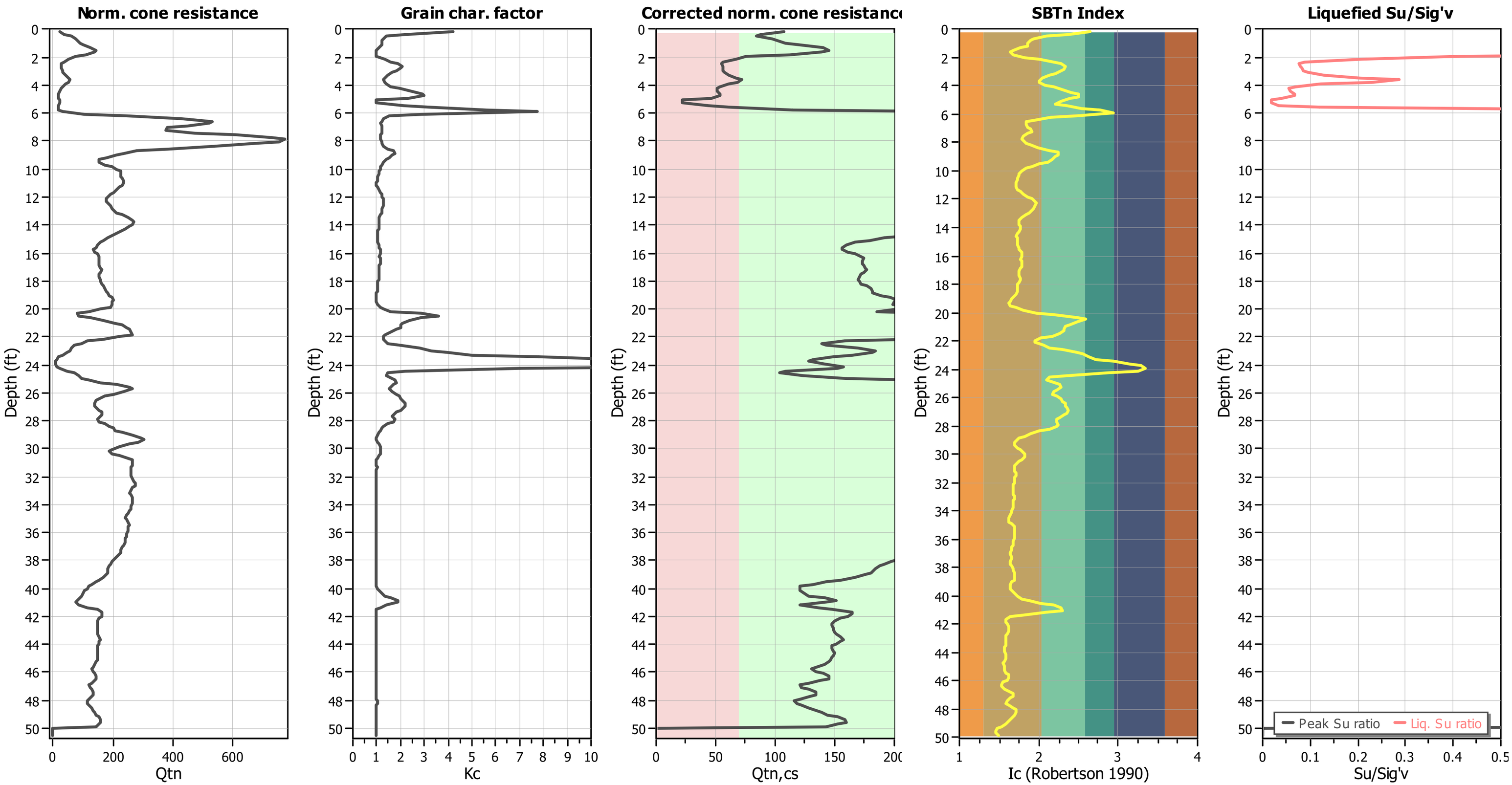




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

:: Field input data ::

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
1	0.16	11.47	0.46	1.29	37.95	111.08
2	0.33	24.72	0.40	0.18	25.17	111.63
3	0.49	37.37	0.38	0.75	15.68	112.10
4	0.66	49.59	0.37	0.38	11.20	112.58
5	0.82	57.79	0.38	0.07	10.31	112.69
6	0.98	46.13	0.37	-0.12	9.64	113.51
7	1.15	62.70	0.47	0.03	9.30	115.30
8	1.31	77.72	0.66	0.34	7.30	117.37
9	1.48	96.91	0.71	0.42	5.75	117.75
10	1.64	96.90	0.49	0.49	5.14	116.04
11	1.80	67.11	0.29	0.24	5.00	112.54
12	1.97	46.05	0.21	-0.14	5.00	108.87
13	2.13	28.65	0.18	0.01	13.18	106.13
14	2.30	21.44	0.14	-0.06	18.43	104.07
15	2.46	17.54	0.13	-0.12	21.92	102.94
16	2.62	16.38	0.14	-0.10	23.74	102.69
17	2.79	16.99	0.14	-0.06	23.29	103.05
18	2.95	19.29	0.15	-0.01	21.63	103.62
19	3.12	21.49	0.16	0.01	19.51	104.55
20	3.28	25.09	0.18	0.03	16.80	105.73
21	3.44	32.04	0.20	0.07	14.25	106.79
22	3.61	36.49	0.21	0.09	12.88	107.22
23	3.77	34.21	0.20	0.05	13.33	106.67
24	3.94	27.16	0.17	-0.06	15.37	105.12
25	4.10	20.82	0.13	-0.10	18.63	103.02
26	4.27	16.36	0.11	-0.13	22.53	101.03
27	4.43	12.88	0.10	-0.21	26.81	99.76
28	4.59	11.04	0.10	-0.23	30.33	99.15
29	4.76	10.80	0.10	-0.18	30.58	99.07
30	4.92	12.49	0.10	-0.10	25.89	97.34
31	5.09	14.66	0.03	-0.04	5.00	95.04
32	5.25	14.30	0.03	-0.07	5.00	92.03
33	5.41	12.95	0.04	-0.09	24.58	96.39
34	5.58	11.38	0.12	0.09	32.02	101.49
35	5.74	12.06	0.23	0.12	44.75	110.42
36	5.91	15.80	0.95	0.18	54.22	121.64
37	6.07	31.60	4.06	0.44	29.89	130.86
38	6.23	150.80	7.36	1.56	17.67	136.71
39	6.40	280.51	9.33	9.14	11.71	137.28
40	6.56	366.38	11.22	107.12	9.18	137.28
41	6.73	342.47	8.74	20.50	8.88	137.28
42	6.89	262.06	7.62	29.54	9.26	137.28
43	7.05	230.21	6.64	14.85	10.25	137.28
44	7.22	223.77	6.08	7.21	10.62	137.28
45	7.38	252.32	8.01	8.90	9.30	137.28
46	7.55	409.38	11.08	13.52	8.24	137.28
47	7.71	506.82	13.80	22.77	7.74	137.28
48	7.87	518.80	16.07	38.45	8.04	137.28

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
49	8.04	509.50	16.44	54.06	8.99	137.28
50	8.20	471.12	17.30	43.15	10.26	137.28
51	8.37	357.19	15.08	68.57	12.86	137.28
52	8.53	224.86	12.97	65.13	16.72	137.28
53	8.69	152.44	10.38	346.32	20.39	137.28
54	8.86	154.84	8.87	314.76	20.75	137.28
55	9.02	144.88	6.53	107.14	19.42	136.07
56	9.19	113.63	4.23	10.26	17.92	133.04
57	9.35	105.04	2.83	-0.78	16.05	129.93
58	9.51	106.69	2.17	-2.14	13.06	128.10
59	9.68	126.30	2.10	0.64	10.64	127.79
60	9.84	148.26	2.27	0.82	8.85	128.42
61	10.01	170.60	2.41	1.20	7.84	129.04
62	10.17	178.19	2.43	2.98	7.20	129.24
63	10.33	179.63	2.31	2.76	6.99	129.28
64	10.50	181.92	2.40	2.86	6.88	129.36
65	10.66	187.48	2.47	2.88	6.76	129.67
66	10.83	197.38	2.54	3.13	6.47	129.75
67	10.99	198.97	2.41	3.55	6.22	129.55
68	11.15	192.88	2.25	3.00	6.26	129.19
69	11.32	183.63	2.24	2.85	6.66	129.04
70	11.48	177.70	2.35	2.89	7.45	129.21
71	11.65	168.98	2.51	3.00	8.38	129.49
72	11.81	161.03	2.64	3.44	9.53	129.73
73	11.98	149.56	2.74	3.46	10.71	129.90
74	12.14	141.91	2.86	3.23	11.58	130.08
75	12.30	144.99	2.95	3.32	11.91	130.49
76	12.47	153.56	3.21	3.69	11.66	130.88
77	12.63	160.45	3.23	3.60	11.13	131.23
78	12.80	170.16	3.23	3.58	10.60	131.26
79	12.96	170.51	3.14	4.03	9.96	131.19
80	13.12	178.27	3.02	3.44	9.06	131.20
81	13.29	200.91	3.06	3.87	7.99	131.42
82	13.45	219.79	3.16	4.10	7.18	132.01
83	13.62	238.14	3.48	4.08	6.97	132.79
84	13.78	246.70	3.91	4.49	7.09	133.25
85	13.94	236.41	3.76	4.70	7.35	133.17
86	14.11	222.11	3.43	4.56	7.28	132.45
87	14.27	218.62	3.02	4.26	6.98	131.47
88	14.44	209.80	2.60	3.63	6.64	130.31
89	14.60	191.77	2.23	3.33	6.53	129.07
90	14.76	178.31	1.94	3.33	6.79	127.88
91	14.93	159.75	1.76	3.27	6.78	126.68
92	15.09	156.44	1.46	3.24	6.86	125.57
93	15.26	145.36	1.32	2.94	6.64	124.43
94	15.42	138.27	1.17	2.62	6.95	123.65
95	15.58	128.83	1.13	2.53	7.25	123.25
96	15.75	128.41	1.18	2.55	7.96	123.31

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
97	15.91	121.11	1.25	2.45	7.90	123.87
98	16.08	143.19	1.37	2.52	7.81	124.51
99	16.24	145.88	1.46	2.68	7.47	125.08
100	16.40	145.08	1.49	2.72	7.70	125.32
101	16.57	142.91	1.51	2.63	7.86	125.33
102	16.73	142.39	1.48	2.61	7.83	125.32
103	16.90	146.13	1.48	2.67	7.56	125.43
104	17.06	154.48	1.54	2.75	7.20	125.59
105	17.22	158.44	1.53	2.85	7.08	125.70
106	17.39	153.55	1.52	2.80	7.18	125.54
107	17.55	147.63	1.47	2.76	7.40	125.31
108	17.72	146.44	1.43	2.68	7.35	125.14
109	17.88	151.17	1.43	2.75	7.07	125.14
110	18.04	157.33	1.43	2.92	6.80	125.29
111	18.21	159.89	1.48	3.04	6.62	125.57
112	18.37	165.59	1.55	3.17	6.67	126.04
113	18.54	169.21	1.69	3.29	6.61	126.46
114	18.70	175.00	1.71	3.40	6.41	126.71
115	18.86	181.53	1.67	3.59	6.06	126.63
116	19.03	181.26	1.60	3.89	5.50	126.64
117	19.19	199.50	1.64	3.43	5.10	126.77
118	19.36	204.94	1.69	3.73	4.88	126.96
119	19.52	199.43	1.68	3.52	5.06	127.04
120	19.69	193.99	1.71	3.53	6.31	128.46
121	19.85	198.26	2.80	3.82	8.24	130.08
122	20.01	179.83	3.30	3.71	12.14	130.79
123	20.18	98.35	3.05	3.85	18.35	130.74
124	20.34	77.00	3.68	8.12	29.86	131.24
125	20.51	66.77	5.46	15.32	34.54	134.20
126	20.67	110.81	8.82	35.27	29.90	137.28
127	20.83	192.48	11.62	183.49	26.23	137.28
128	21.00	203.18	13.58	8.96	23.74	137.28
129	21.16	235.57	15.51	99.83	23.31	137.28
130	21.33	265.79	17.40	20.94	23.14	137.28
131	21.49	253.18	18.08	27.95	21.34	137.28
132	21.65	269.52	12.47	147.38	18.28	137.28
133	21.82	285.55	8.80	36.98	13.44	137.28
134	21.98	262.54	4.75	10.15	11.84	136.01
135	22.15	141.06	2.94	1.07	11.43	131.64
136	22.31	128.41	2.21	1.08	14.49	128.20
137	22.47	99.93	1.84	0.77	16.90	126.44
138	22.64	70.27	1.85	-0.93	22.76	126.30
139	22.80	64.10	2.58	-0.66	29.60	126.98
140	22.97	59.53	2.91	-1.05	32.80	127.34
141	23.13	56.46	2.41	-0.49	36.54	126.06
142	23.29	34.62	1.72	-1.88	41.93	122.89
143	23.46	18.41	0.95	-2.42	54.55	118.67
144	23.62	12.62	0.71	-2.31	68.40	114.76

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
145	23.79	10.58	0.64	-2.32	79.27	113.47
146	23.95	9.69	0.74	-2.04	85.24	114.93
147	24.11	12.07	1.19	-1.23	76.99	117.37
148	24.28	19.61	1.38	-0.64	51.25	119.74
149	24.44	43.42	1.18	1.05	25.17	121.19
150	24.61	101.01	0.96	1.92	16.84	121.75
151	24.77	89.84	1.23	0.11	15.69	124.55
152	24.93	97.25	2.42	0.23	19.28	129.27
153	25.10	138.60	4.79	0.22	20.93	133.77
154	25.26	168.61	7.31	1.22	21.85	137.28
155	25.43	225.43	13.03	6.52	20.02	137.28
156	25.59	316.13	14.65	14.87	18.61	137.28
157	25.75	314.24	14.37	19.98	18.16	137.28
158	25.92	254.68	14.23	566.24	19.56	137.28
159	26.08	214.60	12.26	858.54	21.76	137.28
160	26.25	184.64	10.65	644.02	22.72	137.28
161	26.41	168.12	8.99	565.58	23.59	137.28
162	26.57	156.85	8.65	595.18	24.17	137.28
163	26.74	148.96	8.45	549.25	24.83	137.28
164	26.90	148.36	8.39	591.95	25.08	137.28
165	27.07	155.61	8.93	602.49	24.50	137.28
166	27.23	164.86	8.92	682.77	23.14	137.28
167	27.40	182.00	8.88	745.78	21.40	137.28
168	27.56	186.79	8.18	787.88	20.05	137.28
169	27.72	180.56	7.34	657.38	19.80	137.28
170	27.89	166.54	7.27	733.30	20.66	137.28
171	28.05	153.69	7.28	729.35	19.98	137.28
172	28.22	194.12	6.90	510.06	16.72	136.94
173	28.38	238.65	5.40	63.85	13.05	135.77
174	28.54	224.14	3.86	4.54	10.16	134.25
175	28.71	240.11	3.63	1.39	8.63	133.29
176	28.87	261.80	3.71	1.19	7.26	133.75
177	29.04	314.91	4.13	1.25	6.30	134.80
178	29.20	357.70	4.81	2.17	5.90	135.94
179	29.36	364.38	5.33	2.76	6.14	136.53
180	29.53	338.76	5.22	2.92	6.81	136.43
181	29.69	302.33	4.86	1.41	7.57	135.58
182	29.86	263.41	4.14	0.85	8.19	134.24
183	30.02	232.05	3.34	0.26	8.52	132.71
184	30.18	215.05	2.93	0.72	8.53	131.79
185	30.35	224.68	3.09	0.58	8.01	132.05
186	30.51	265.61	3.51	1.52	7.19	133.11
187	30.68	305.44	3.99	2.78	6.47	134.12
188	30.84	320.77	4.21	3.50	6.16	134.74
189	31.00	323.40	4.28	3.90	6.13	134.86
190	31.17	315.18	4.15	4.31	6.18	134.79
191	31.33	313.93	4.11	3.82	6.33	134.80
192	31.50	314.96	4.34	3.98	6.25	134.75

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
193	31.66	318.43	4.05	4.64	6.13	134.60
194	31.82	313.17	3.86	4.44	5.92	134.25
195	31.99	309.53	3.80	4.86	5.93	134.27
196	32.15	319.70	4.07	4.37	5.80	134.47
197	32.32	335.25	4.09	4.79	5.72	134.78
198	32.48	335.08	4.20	4.99	5.63	134.91
199	32.64	336.15	4.24	5.66	5.71	134.95
200	32.81	332.86	4.17	6.19	5.83	134.80
201	32.97	317.06	4.02	7.24	5.99	134.56
202	33.14	310.87	3.94	7.09	5.97	134.31
203	33.30	319.67	3.81	7.08	5.80	134.30
204	33.46	329.45	3.95	6.81	5.58	134.37
205	33.63	331.08	3.97	7.21	5.55	134.50
206	33.79	330.55	3.97	7.40	5.52	134.44
207	33.96	328.66	3.86	7.37	5.43	134.25
208	34.12	327.04	3.69	7.56	5.30	133.94
209	34.28	321.08	3.52	7.64	5.09	133.48
210	34.45	317.92	3.24	7.43	4.84	132.90
211	34.61	311.75	2.94	7.63	4.75	132.52
212	34.78	307.33	3.08	7.69	4.85	132.45
213	34.94	306.53	3.18	7.14	5.47	133.01
214	35.10	300.33	3.71	6.63	5.90	133.71
215	35.27	318.96	4.03	6.30	6.12	134.33
216	35.43	329.67	4.05	6.93	6.02	134.50
217	35.60	317.79	3.91	7.68	5.99	134.43
218	35.76	317.31	3.93	7.51	5.99	134.27
219	35.93	320.77	3.83	7.43	5.90	134.12
220	36.09	315.41	3.67	7.38	5.70	133.81
221	36.25	313.64	3.48	7.52	5.64	133.56
222	36.42	310.61	3.50	7.49	5.59	133.37
223	36.58	309.01	3.43	9.01	5.50	133.15
224	36.75	307.79	3.19	7.96	5.30	132.83
225	36.91	307.35	3.08	9.16	5.18	132.50
226	37.07	299.14	3.03	8.66	5.19	132.28
227	37.24	295.36	2.95	8.32	5.23	132.06
228	37.40	293.17	2.86	8.48	5.24	131.84
229	37.57	287.98	2.81	8.00	5.08	131.35
230	37.73	280.98	2.44	7.76	5.14	130.89
231	37.89	267.01	2.45	7.61	5.22	130.36
232	38.06	257.57	2.36	7.55	5.58	130.20
233	38.22	252.99	2.36	6.61	5.77	129.97
234	38.39	246.69	2.29	6.62	5.92	129.85
235	38.55	244.84	2.28	6.82	6.01	129.69
236	38.71	242.26	2.25	6.73	6.06	129.58
237	38.88	239.75	2.20	6.65	5.87	129.14
238	39.04	237.35	1.92	6.70	5.49	128.14
239	39.21	221.90	1.48	6.19	5.10	126.62
240	39.37	203.60	1.23	5.75	5.03	125.13

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
241	39.53	190.42	1.16	5.73	5.15	123.76
242	39.70	175.25	0.91	5.48	5.62	122.96
243	39.86	162.50	0.97	5.05	6.13	122.25
244	40.03	153.36	0.94	4.63	6.83	122.02
245	40.19	146.70	0.87	3.35	7.65	122.19
246	40.35	141.86	1.08	3.21	9.90	124.05
247	40.52	135.59	1.84	2.77	13.57	127.02
248	40.68	134.27	2.82	2.73	18.51	130.00
249	40.85	124.51	4.08	3.63	22.06	130.65
250	41.01	100.16	2.96	5.03	22.27	129.70
251	41.17	112.45	1.80	8.09	16.01	126.96
252	41.34	156.00	1.14	7.72	8.42	124.95
253	41.50	219.42	1.14	1.77	4.91	124.28
254	41.67	226.61	1.20	1.81	4.00	124.88
255	41.83	225.89	1.30	1.85	4.17	125.18
256	41.99	219.89	1.30	1.57	4.47	125.26
257	42.16	212.79	1.26	1.37	4.71	124.98
258	42.32	203.89	1.19	1.28	4.86	124.61
259	42.49	200.56	1.15	1.20	4.75	124.05
260	42.65	201.32	1.02	1.19	4.51	123.64
261	42.81	204.30	1.01	1.10	4.21	123.29
262	42.98	206.49	0.99	1.13	4.16	123.30
263	43.14	204.52	1.02	1.11	4.22	123.47
264	43.31	207.09	1.07	1.36	4.16	123.61
265	43.47	214.43	1.04	1.33	4.02	123.84
266	43.64	220.22	1.09	1.30	3.74	123.60
267	43.80	216.26	0.96	1.40	3.74	123.39
268	43.96	208.60	0.96	1.30	3.80	123.05
269	44.13	206.35	0.97	1.41	4.13	123.18
270	44.29	202.25	1.03	1.51	4.24	123.41
271	44.46	210.08	1.05	1.57	4.02	123.14
272	44.62	210.29	0.85	1.57	3.76	122.83
273	44.78	208.16	0.90	1.55	3.61	122.35
274	44.95	205.16	0.88	1.51	3.73	122.37
275	45.11	204.47	0.87	1.52	3.77	122.42
276	45.28	207.69	0.92	1.60	3.88	122.45
277	45.44	200.65	0.90	1.44	4.21	122.45
278	45.60	186.78	0.89	1.42	4.64	122.26
279	45.77	180.78	0.89	1.39	4.80	122.01
280	45.93	186.63	0.83	1.52	4.38	121.72
281	46.10	199.77	0.77	1.66	3.65	121.30
282	46.26	208.73	0.72	1.77	3.16	121.04
283	46.42	209.29	0.72	1.82	3.21	121.18
284	46.59	201.35	0.82	1.64	3.94	121.60
285	46.75	177.91	0.89	1.59	4.91	121.93
286	46.92	169.91	0.90	1.69	5.81	122.32
287	47.08	174.61	1.00	1.91	5.77	122.50
288	47.24	184.54	0.95	1.99	5.14	122.30

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
289	47.41	190.66	0.78	2.07	4.44	121.94
290	47.57	198.66	0.83	2.13	4.22	121.64
291	47.74	188.25	0.84	1.89	4.78	121.85
292	47.90	169.06	0.89	1.84	5.62	121.98
293	48.06	166.36	0.93	1.87	6.30	122.22
294	48.23	169.49	0.96	1.96	6.34	122.59
295	48.39	176.86	1.02	2.01	6.04	123.00
296	48.56	188.63	1.06	2.15	5.65	123.38
297	48.72	195.62	1.07	2.22	5.19	123.54
298	48.88	201.74	1.04	2.31	4.74	123.41
299	49.05	206.62	0.97	2.46	4.11	123.04
300	49.21	218.89	0.89	2.59	3.30	122.52
301	49.38	234.99	0.80	2.76	2.60	121.90
302	49.54	236.22	0.72	2.83	2.16	120.90
303	49.70	222.69	0.58	2.76	2.26	120.11
304	49.87	204.80	0.61	2.54	2.68	119.65
305	50.03	194.71	0.64	2.48	N/A	87.36
306	50.20	189.73	-268745.54	2.58	N/A	87.36
307	50.36	203.01	-268745.54	2.77	N/A	87.36
308	50.52	222.19	-268745.54	3.03	N/A	87.36

Abbreviations

Depth:	Depth from free surface, at which CPT was performed (ft)
q_c:	Measured cone resistance (tsf)
f_s:	Sleeve friction resistance (tsf)
u:	Pore pressure (tsf)
Fines content:	Percentage of fines in soil (%)
Unit weight:	Bulk soil unit weight (pcf)

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data ::

Point ID	Depth (ft)	σ_v (tsf)	u_0 (tsf)	σ_v' (tsf)	r_d	CSR	MSF	CSR_{eq}	K_σ	User FS	CSR^*	Belongs to transition
1	0.16	0.01	0.00	0.01	1.00	0.241	1.59	0.151	1.00	1.00	2.000	No
2	0.33	0.02	0.00	0.02	1.00	0.241	1.59	0.151	1.00	1.00	2.000	No
3	0.49	0.03	0.00	0.03	1.00	0.241	1.59	0.151	1.00	1.00	2.000	No
4	0.66	0.04	0.00	0.04	1.00	0.241	1.59	0.151	1.00	1.00	2.000	No
5	0.82	0.05	0.00	0.05	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
6	0.98	0.06	0.00	0.06	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
7	1.15	0.06	0.00	0.06	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
8	1.31	0.07	0.00	0.07	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
9	1.48	0.08	0.00	0.08	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
10	1.64	0.09	0.00	0.09	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
11	1.80	0.10	0.00	0.10	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
12	1.97	0.11	0.00	0.11	1.00	0.240	1.59	0.150	1.00	1.00	2.000	No
13	2.13	0.12	0.00	0.12	1.00	0.240	1.59	0.150	1.00	1.00	2.000	No
14	2.30	0.13	0.00	0.13	1.00	0.240	1.59	0.150	1.00	1.00	2.000	No
15	2.46	0.14	0.00	0.14	1.00	0.240	1.59	0.150	1.00	1.00	2.000	No
16	2.62	0.15	0.00	0.15	1.00	0.240	1.59	0.150	1.00	1.00	2.000	No
17	2.79	0.15	0.00	0.15	1.00	0.239	1.59	0.150	1.00	1.00	2.000	No
18	2.95	0.16	0.00	0.16	1.00	0.239	1.59	0.150	1.00	1.00	2.000	No
19	3.12	0.17	0.00	0.17	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
20	3.28	0.18	0.00	0.18	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
21	3.44	0.19	0.00	0.19	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
22	3.61	0.20	0.00	0.20	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
23	3.77	0.21	0.00	0.21	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
24	3.94	0.21	0.00	0.21	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
25	4.10	0.22	0.00	0.22	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
26	4.27	0.23	0.00	0.23	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
27	4.43	0.24	0.00	0.24	0.99	0.238	1.59	0.150	1.00	1.00	2.000	No
28	4.59	0.25	0.00	0.25	0.99	0.238	1.59	0.150	1.00	1.00	2.000	No
29	4.76	0.26	0.00	0.26	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
30	4.92	0.26	0.00	0.26	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
31	5.09	0.27	0.00	0.27	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
32	5.25	0.28	0.00	0.28	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
33	5.41	0.29	0.00	0.29	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
34	5.58	0.30	0.00	0.30	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
35	5.74	0.30	0.00	0.30	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
36	5.91	0.31	0.00	0.31	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
37	6.07	0.33	0.00	0.33	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
38	6.23	0.34	0.00	0.34	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
39	6.40	0.35	0.00	0.35	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
40	6.56	0.36	0.00	0.36	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
41	6.73	0.37	0.00	0.37	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
42	6.89	0.38	0.00	0.38	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
43	7.05	0.39	0.00	0.39	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
44	7.22	0.40	0.00	0.40	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
45	7.38	0.42	0.00	0.42	0.98	0.237	1.59	0.149	1.00	1.00	2.000	No
46	7.55	0.43	0.00	0.43	0.98	0.237	1.59	0.149	1.00	1.00	2.000	No
47	7.71	0.44	0.00	0.44	0.98	0.237	1.59	0.148	1.00	1.00	2.000	No
48	7.87	0.45	0.00	0.45	0.98	0.237	1.59	0.148	1.00	1.00	2.000	No

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data :: (continued)

Point ID	Depth (ft)	σ_v (tsf)	u_0 (tsf)	σ_v' (tsf)	r_d	CSR	MSF	CSR_{eq}	K_σ	User FS	CSR^*	Belongs to transition
49	8.04	0.46	0.00	0.46	0.98	0.237	1.59	0.148	1.00	1.00	2.000	No
50	8.20	0.47	0.00	0.47	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
51	8.37	0.48	0.00	0.48	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
52	8.53	0.49	0.00	0.49	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
53	8.69	0.51	0.00	0.51	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
54	8.86	0.52	0.00	0.52	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
55	9.02	0.53	0.00	0.53	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
56	9.19	0.54	0.00	0.54	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
57	9.35	0.55	0.00	0.55	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
58	9.51	0.56	0.00	0.56	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
59	9.68	0.57	0.00	0.57	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
60	9.84	0.58	0.00	0.58	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
61	10.01	0.59	0.00	0.59	0.98	0.235	1.59	0.148	1.00	1.00	2.000	No
62	10.17	0.60	0.00	0.60	0.98	0.235	1.59	0.148	1.00	1.00	2.000	No
63	10.33	0.61	0.00	0.61	0.98	0.235	1.59	0.148	1.00	1.00	2.000	No
64	10.50	0.62	0.00	0.62	0.98	0.235	1.59	0.148	1.00	1.00	2.000	No
65	10.66	0.63	0.00	0.63	0.98	0.235	1.59	0.147	1.00	1.00	2.000	No
66	10.83	0.64	0.00	0.64	0.98	0.235	1.59	0.147	1.00	1.00	2.000	No
67	10.99	0.66	0.00	0.66	0.98	0.235	1.59	0.147	1.00	1.00	2.000	No
68	11.15	0.67	0.00	0.66	0.98	0.237	1.59	0.148	1.00	1.00	0.148	No
69	11.32	0.68	0.01	0.67	0.98	0.238	1.59	0.149	1.00	1.00	0.149	No
70	11.48	0.69	0.02	0.67	0.98	0.240	1.59	0.151	1.00	1.00	0.151	No
71	11.65	0.70	0.02	0.68	0.98	0.242	1.59	0.152	1.00	1.00	0.152	No
72	11.81	0.71	0.03	0.68	0.98	0.243	1.59	0.153	1.00	1.00	0.153	No
73	11.98	0.72	0.03	0.69	0.97	0.245	1.59	0.154	1.00	1.00	0.154	No
74	12.14	0.73	0.04	0.69	0.97	0.246	1.59	0.155	1.00	1.00	0.155	No
75	12.30	0.74	0.04	0.70	0.97	0.248	1.59	0.156	1.00	1.00	0.156	No
76	12.47	0.75	0.05	0.71	0.97	0.249	1.59	0.156	1.00	1.00	0.156	No
77	12.63	0.76	0.05	0.71	0.97	0.251	1.59	0.157	1.00	1.00	0.157	No
78	12.80	0.77	0.06	0.72	0.97	0.252	1.59	0.158	1.00	1.00	0.158	No
79	12.96	0.78	0.06	0.72	0.97	0.254	1.59	0.159	1.00	1.00	0.159	No
80	13.12	0.79	0.07	0.73	0.97	0.255	1.59	0.160	1.00	1.00	0.160	No
81	13.29	0.80	0.07	0.73	0.97	0.257	1.59	0.161	1.00	1.00	0.161	No
82	13.45	0.82	0.08	0.74	0.97	0.258	1.59	0.162	1.00	1.00	0.162	No
83	13.62	0.83	0.08	0.75	0.97	0.259	1.59	0.163	1.00	1.00	0.163	No
84	13.78	0.84	0.09	0.75	0.97	0.261	1.59	0.163	1.00	1.00	0.163	No
85	13.94	0.85	0.09	0.76	0.97	0.262	1.59	0.164	1.00	1.00	0.164	No
86	14.11	0.86	0.10	0.76	0.97	0.263	1.59	0.165	1.00	1.00	0.165	No
87	14.27	0.87	0.10	0.77	0.97	0.264	1.59	0.166	1.00	1.00	0.166	No
88	14.44	0.88	0.11	0.77	0.97	0.266	1.59	0.167	1.00	1.00	0.167	No
89	14.60	0.89	0.11	0.78	0.97	0.267	1.59	0.167	1.00	1.00	0.167	No
90	14.76	0.90	0.12	0.78	0.97	0.268	1.59	0.168	1.00	1.00	0.168	No
91	14.93	0.91	0.12	0.79	0.97	0.269	1.59	0.169	1.00	1.00	0.169	No
92	15.09	0.92	0.13	0.79	0.97	0.270	1.59	0.170	1.00	1.00	0.170	No
93	15.26	0.93	0.13	0.80	0.97	0.271	1.59	0.170	1.00	1.00	0.170	No
94	15.42	0.94	0.14	0.81	0.97	0.273	1.59	0.171	1.00	1.00	0.171	No
95	15.58	0.95	0.14	0.81	0.97	0.274	1.59	0.172	1.00	1.00	0.172	No
96	15.75	0.96	0.15	0.82	0.97	0.275	1.59	0.172	1.00	1.00	0.172	No

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data :: (continued)

Point ID	Depth (ft)	σ_v (tsf)	u_0 (tsf)	σ_v' (tsf)	r_d	CSR	MSF	CSR_{eq}	K_σ	User FS	CSR^*	Belongs to transition
97	15.91	0.97	0.15	0.82	0.97	0.276	1.59	0.173	1.00	1.00	0.173	No
98	16.08	0.98	0.16	0.83	0.97	0.277	1.59	0.174	1.00	1.00	0.174	No
99	16.24	0.99	0.16	0.83	0.97	0.278	1.59	0.174	1.00	1.00	0.174	No
100	16.40	1.00	0.17	0.84	0.97	0.279	1.59	0.175	1.00	1.00	0.175	No
101	16.57	1.01	0.17	0.84	0.97	0.280	1.59	0.176	1.00	1.00	0.176	No
102	16.73	1.02	0.18	0.85	0.96	0.281	1.59	0.176	1.00	1.00	0.176	No
103	16.90	1.03	0.18	0.85	0.96	0.282	1.59	0.177	1.00	1.00	0.177	No
104	17.06	1.05	0.19	0.86	0.96	0.283	1.59	0.178	1.00	1.00	0.178	No
105	17.22	1.06	0.19	0.86	0.96	0.284	1.59	0.178	1.00	1.00	0.178	No
106	17.39	1.07	0.20	0.87	0.96	0.285	1.59	0.179	1.00	1.00	0.179	No
107	17.55	1.08	0.20	0.87	0.96	0.286	1.59	0.179	1.00	1.00	0.179	No
108	17.72	1.09	0.21	0.88	0.96	0.287	1.59	0.180	1.00	1.00	0.180	No
109	17.88	1.10	0.21	0.88	0.96	0.288	1.59	0.180	1.00	1.00	0.180	No
110	18.04	1.11	0.22	0.89	0.96	0.289	1.59	0.181	1.00	1.00	0.181	No
111	18.21	1.12	0.22	0.89	0.96	0.289	1.59	0.182	1.00	1.00	0.182	No
112	18.37	1.13	0.23	0.90	0.96	0.290	1.59	0.182	1.00	1.00	0.182	No
113	18.54	1.14	0.24	0.90	0.96	0.291	1.59	0.183	1.00	1.00	0.183	No
114	18.70	1.15	0.24	0.91	0.96	0.292	1.59	0.183	1.00	1.00	0.183	No
115	18.86	1.16	0.25	0.91	0.96	0.293	1.59	0.184	1.00	1.00	0.184	No
116	19.03	1.17	0.25	0.92	0.96	0.294	1.59	0.184	1.00	1.00	0.184	No
117	19.19	1.18	0.26	0.92	0.96	0.294	1.59	0.185	1.00	1.00	0.185	No
118	19.36	1.19	0.26	0.93	0.96	0.295	1.59	0.185	1.00	1.00	0.185	No
119	19.52	1.20	0.27	0.93	0.96	0.296	1.59	0.186	1.00	1.00	0.186	No
120	19.69	1.21	0.27	0.94	0.96	0.297	1.59	0.186	1.00	1.00	0.186	No
121	19.85	1.22	0.28	0.95	0.96	0.297	1.59	0.187	1.00	1.00	0.187	No
122	20.01	1.23	0.28	0.95	0.96	0.298	1.59	0.187	1.00	1.00	0.187	No
123	20.18	1.24	0.29	0.96	0.96	0.299	1.59	0.187	1.00	1.00	0.187	No
124	20.34	1.25	0.29	0.96	0.96	0.300	1.59	0.188	1.00	1.00	0.188	No
125	20.51	1.26	0.30	0.97	0.96	0.300	1.59	0.188	1.00	1.00	0.188	No
126	20.67	1.28	0.30	0.97	0.96	0.301	1.59	0.189	1.00	1.00	0.189	No
127	20.83	1.29	0.31	0.98	0.95	0.301	1.59	0.189	1.00	1.00	0.189	No
128	21.00	1.30	0.31	0.99	0.95	0.302	1.59	0.189	1.00	1.00	0.189	No
129	21.16	1.31	0.32	0.99	0.95	0.303	1.59	0.190	1.00	1.00	0.190	No
130	21.33	1.32	0.32	1.00	0.95	0.303	1.59	0.190	1.00	1.00	0.190	No
131	21.49	1.33	0.33	1.01	0.95	0.304	1.59	0.191	1.00	1.00	0.191	No
132	21.65	1.34	0.33	1.01	0.95	0.304	1.59	0.191	1.00	1.00	0.191	No
133	21.82	1.35	0.34	1.02	0.95	0.305	1.59	0.191	1.00	1.00	0.191	No
134	21.98	1.37	0.34	1.02	0.95	0.305	1.59	0.192	1.00	1.00	0.192	No
135	22.15	1.38	0.35	1.03	0.95	0.306	1.59	0.192	1.00	1.00	0.192	No
136	22.31	1.39	0.35	1.03	0.95	0.307	1.59	0.192	1.00	1.00	0.192	No
137	22.47	1.40	0.36	1.04	0.95	0.307	1.59	0.193	1.00	1.00	0.193	No
138	22.64	1.41	0.36	1.04	0.95	0.308	1.59	0.193	1.00	1.00	0.193	No
139	22.80	1.42	0.37	1.05	0.95	0.308	1.59	0.193	1.00	1.00	0.193	No
140	22.97	1.43	0.37	1.06	0.95	0.309	1.59	0.194	1.00	1.00	0.194	No
141	23.13	1.44	0.38	1.06	0.95	0.309	1.59	0.194	1.00	1.00	0.194	No
142	23.29	1.45	0.38	1.07	0.95	0.310	1.59	0.194	1.00	1.00	0.195	No
143	23.46	1.46	0.39	1.07	0.95	0.310	1.59	0.195	1.00	1.00	0.195	No
144	23.62	1.47	0.39	1.07	0.95	0.311	1.59	0.195	1.00	1.00	0.196	No

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data :: (continued)

Point ID	Depth (ft)	σ_v (tsf)	u_0 (tsf)	σ_v' (tsf)	r_d	CSR	MSF	CSR_{eq}	K_σ	User FS	CSR^*	Belongs to transition
145	23.79	1.48	0.40	1.08	0.95	0.312	1.59	0.195	1.00	1.00	0.196	No
146	23.95	1.49	0.40	1.08	0.95	0.312	1.59	0.196	1.00	1.00	0.197	No
147	24.11	1.50	0.41	1.09	0.94	0.313	1.59	0.196	0.99	1.00	0.197	No
148	24.28	1.51	0.41	1.09	0.94	0.313	1.59	0.196	0.99	1.00	0.198	No
149	24.44	1.52	0.42	1.10	0.94	0.314	1.59	0.197	0.99	1.00	0.198	No
150	24.61	1.53	0.42	1.10	0.94	0.314	1.59	0.197	0.99	1.00	0.199	No
151	24.77	1.54	0.43	1.11	0.94	0.315	1.59	0.197	0.99	1.00	0.199	No
152	24.93	1.55	0.43	1.11	0.94	0.315	1.59	0.198	0.99	1.00	0.200	No
153	25.10	1.56	0.44	1.12	0.94	0.315	1.59	0.198	0.99	1.00	0.200	No
154	25.26	1.57	0.44	1.12	0.94	0.316	1.59	0.198	0.99	1.00	0.201	No
155	25.43	1.58	0.45	1.13	0.94	0.316	1.59	0.198	0.99	1.00	0.201	No
156	25.59	1.59	0.46	1.14	0.94	0.316	1.59	0.199	0.99	1.00	0.201	No
157	25.75	1.60	0.46	1.14	0.94	0.317	1.59	0.199	0.98	1.00	0.202	No
158	25.92	1.61	0.47	1.15	0.94	0.317	1.59	0.199	0.98	1.00	0.202	No
159	26.08	1.63	0.47	1.16	0.94	0.317	1.59	0.199	0.98	1.00	0.203	No
160	26.25	1.64	0.48	1.16	0.94	0.318	1.59	0.199	0.98	1.00	0.203	No
161	26.41	1.65	0.48	1.17	0.94	0.318	1.59	0.199	0.98	1.00	0.203	No
162	26.57	1.66	0.49	1.17	0.94	0.318	1.59	0.200	0.98	1.00	0.204	No
163	26.74	1.67	0.49	1.18	0.94	0.319	1.59	0.200	0.98	1.00	0.204	No
164	26.90	1.68	0.50	1.19	0.93	0.319	1.59	0.200	0.98	1.00	0.205	No
165	27.07	1.69	0.50	1.19	0.93	0.319	1.59	0.200	0.98	1.00	0.205	No
166	27.23	1.70	0.51	1.20	0.93	0.319	1.59	0.200	0.98	1.00	0.205	No
167	27.40	1.72	0.51	1.20	0.93	0.320	1.59	0.200	0.97	1.00	0.206	No
168	27.56	1.73	0.52	1.21	0.93	0.320	1.59	0.201	0.97	1.00	0.206	No
169	27.72	1.74	0.52	1.22	0.93	0.320	1.59	0.201	0.97	1.00	0.206	No
170	27.89	1.75	0.53	1.22	0.93	0.320	1.59	0.201	0.97	1.00	0.207	No
171	28.05	1.76	0.53	1.23	0.93	0.320	1.59	0.201	0.97	1.00	0.207	No
172	28.22	1.77	0.54	1.24	0.93	0.321	1.59	0.201	0.97	1.00	0.207	No
173	28.38	1.78	0.54	1.24	0.93	0.321	1.59	0.201	0.97	1.00	0.208	No
174	28.54	1.79	0.55	1.25	0.93	0.321	1.59	0.201	0.97	1.00	0.208	No
175	28.71	1.81	0.55	1.25	0.93	0.321	1.59	0.201	0.97	1.00	0.208	No
176	28.87	1.82	0.56	1.26	0.93	0.321	1.59	0.202	0.97	1.00	0.209	No
177	29.04	1.83	0.56	1.26	0.93	0.322	1.59	0.202	0.96	1.00	0.209	No
178	29.20	1.84	0.57	1.27	0.92	0.322	1.59	0.202	0.96	1.00	0.209	No
179	29.36	1.85	0.57	1.28	0.92	0.322	1.59	0.202	0.96	1.00	0.210	No
180	29.53	1.86	0.58	1.28	0.92	0.322	1.59	0.202	0.96	1.00	0.210	No
181	29.69	1.87	0.58	1.29	0.92	0.322	1.59	0.202	0.96	1.00	0.210	No
182	29.86	1.88	0.59	1.29	0.92	0.322	1.59	0.202	0.96	1.00	0.210	No
183	30.02	1.89	0.59	1.30	0.92	0.322	1.59	0.202	0.96	1.00	0.211	No
184	30.18	1.90	0.60	1.31	0.92	0.323	1.59	0.202	0.96	1.00	0.211	No
185	30.35	1.92	0.60	1.31	0.92	0.323	1.59	0.202	0.96	1.00	0.211	No
186	30.51	1.93	0.61	1.32	0.92	0.323	1.59	0.202	0.96	1.00	0.212	No
187	30.68	1.94	0.61	1.32	0.92	0.323	1.59	0.203	0.96	1.00	0.212	No
188	30.84	1.95	0.62	1.33	0.92	0.323	1.59	0.203	0.96	1.00	0.212	No
189	31.00	1.96	0.62	1.34	0.92	0.323	1.59	0.203	0.95	1.00	0.212	No
190	31.17	1.97	0.63	1.34	0.91	0.323	1.59	0.203	0.95	1.00	0.213	No
191	31.33	1.98	0.63	1.35	0.91	0.323	1.59	0.203	0.95	1.00	0.213	No
192	31.50	1.99	0.64	1.35	0.91	0.323	1.59	0.203	0.95	1.00	0.213	No

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data :: (continued)

Point ID	Depth (ft)	σ_v (tsf)	u_0 (tsf)	σ_v' (tsf)	r_d	CSR	MSF	CSR_{eq}	K_σ	User FS	CSR^*	Belongs to transition
193	31.66	2.00	0.64	1.36	0.91	0.323	1.59	0.203	0.95	1.00	0.213	No
194	31.82	2.01	0.65	1.37	0.91	0.323	1.59	0.203	0.95	1.00	0.213	No
195	31.99	2.03	0.65	1.37	0.91	0.323	1.59	0.203	0.95	1.00	0.214	No
196	32.15	2.04	0.66	1.38	0.91	0.323	1.59	0.203	0.95	1.00	0.214	No
197	32.32	2.05	0.67	1.38	0.91	0.323	1.59	0.203	0.95	1.00	0.214	No
198	32.48	2.06	0.67	1.39	0.91	0.323	1.59	0.203	0.95	1.00	0.214	No
199	32.64	2.07	0.68	1.39	0.91	0.323	1.59	0.203	0.95	1.00	0.214	No
200	32.81	2.08	0.68	1.40	0.90	0.323	1.59	0.203	0.95	1.00	0.215	No
201	32.97	2.09	0.69	1.41	0.90	0.323	1.59	0.203	0.94	1.00	0.215	No
202	33.14	2.10	0.69	1.41	0.90	0.323	1.59	0.203	0.94	1.00	0.215	No
203	33.30	2.11	0.70	1.42	0.90	0.323	1.59	0.203	0.94	1.00	0.215	No
204	33.46	2.13	0.70	1.42	0.90	0.323	1.59	0.203	0.94	1.00	0.215	No
205	33.63	2.14	0.71	1.43	0.90	0.323	1.59	0.203	0.94	1.00	0.215	No
206	33.79	2.15	0.71	1.44	0.90	0.323	1.59	0.203	0.94	1.00	0.215	No
207	33.96	2.16	0.72	1.44	0.90	0.323	1.59	0.203	0.94	1.00	0.216	No
208	34.12	2.17	0.72	1.45	0.90	0.323	1.59	0.203	0.94	1.00	0.216	No
209	34.28	2.18	0.73	1.45	0.90	0.323	1.59	0.203	0.94	1.00	0.216	No
210	34.45	2.19	0.73	1.46	0.89	0.323	1.59	0.203	0.94	1.00	0.216	No
211	34.61	2.20	0.74	1.47	0.89	0.323	1.59	0.203	0.94	1.00	0.216	No
212	34.78	2.21	0.74	1.47	0.89	0.323	1.59	0.202	0.94	1.00	0.216	No
213	34.94	2.22	0.75	1.48	0.89	0.323	1.59	0.202	0.94	1.00	0.216	No
214	35.10	2.23	0.75	1.48	0.89	0.323	1.59	0.202	0.93	1.00	0.216	No
215	35.27	2.25	0.76	1.49	0.89	0.322	1.59	0.202	0.93	1.00	0.217	No
216	35.43	2.26	0.76	1.49	0.89	0.322	1.59	0.202	0.93	1.00	0.217	No
217	35.60	2.27	0.77	1.50	0.89	0.322	1.59	0.202	0.93	1.00	0.217	No
218	35.76	2.28	0.77	1.51	0.89	0.322	1.59	0.202	0.93	1.00	0.217	No
219	35.93	2.29	0.78	1.51	0.88	0.322	1.59	0.202	0.93	1.00	0.217	No
220	36.09	2.30	0.78	1.52	0.88	0.322	1.59	0.202	0.93	1.00	0.217	No
221	36.25	2.31	0.79	1.52	0.88	0.322	1.59	0.202	0.93	1.00	0.217	No
222	36.42	2.32	0.79	1.53	0.88	0.321	1.59	0.202	0.93	1.00	0.217	No
223	36.58	2.33	0.80	1.54	0.88	0.321	1.59	0.202	0.93	1.00	0.217	No
224	36.75	2.34	0.80	1.54	0.88	0.321	1.59	0.201	0.93	1.00	0.217	No
225	36.91	2.36	0.81	1.55	0.88	0.321	1.59	0.201	0.93	1.00	0.217	No
226	37.07	2.37	0.81	1.55	0.88	0.321	1.59	0.201	0.93	1.00	0.217	No
227	37.24	2.38	0.82	1.56	0.87	0.321	1.59	0.201	0.93	1.00	0.217	No
228	37.40	2.39	0.82	1.56	0.87	0.320	1.59	0.201	0.92	1.00	0.217	No
229	37.57	2.40	0.83	1.57	0.87	0.320	1.59	0.201	0.92	1.00	0.217	No
230	37.73	2.41	0.83	1.58	0.87	0.320	1.59	0.201	0.92	1.00	0.217	No
231	37.89	2.42	0.84	1.58	0.87	0.320	1.59	0.201	0.92	1.00	0.217	No
232	38.06	2.43	0.84	1.59	0.87	0.320	1.59	0.201	0.92	1.00	0.217	No
233	38.22	2.44	0.85	1.59	0.87	0.319	1.59	0.200	0.92	1.00	0.217	No
234	38.39	2.45	0.85	1.60	0.86	0.319	1.59	0.200	0.92	1.00	0.217	No
235	38.55	2.46	0.86	1.60	0.86	0.319	1.59	0.200	0.92	1.00	0.217	No
236	38.71	2.47	0.86	1.61	0.86	0.319	1.59	0.200	0.92	1.00	0.217	No
237	38.88	2.48	0.87	1.61	0.86	0.319	1.59	0.200	0.92	1.00	0.217	No
238	39.04	2.49	0.87	1.62	0.86	0.318	1.59	0.200	0.92	1.00	0.217	No
239	39.21	2.50	0.88	1.62	0.86	0.318	1.59	0.200	0.92	1.00	0.217	No
240	39.37	2.52	0.89	1.63	0.86	0.318	1.59	0.199	0.92	1.00	0.217	No

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data :: (continued)

Point ID	Depth (ft)	σ_v (tsf)	u_0 (tsf)	σ_v' (tsf)	r_d	CSR	MSF	CSR_{eq}	K_σ	User FS	CSR^*	Belongs to transition
241	39.53	2.53	0.89	1.63	0.86	0.318	1.59	0.199	0.92	1.00	0.217	No
242	39.70	2.54	0.90	1.64	0.85	0.317	1.59	0.199	0.92	1.00	0.217	No
243	39.86	2.55	0.90	1.64	0.85	0.317	1.59	0.199	0.92	1.00	0.217	No
244	40.03	2.56	0.91	1.65	0.85	0.317	1.59	0.199	0.92	1.00	0.217	No
245	40.19	2.57	0.91	1.65	0.85	0.317	1.59	0.199	0.91	1.00	0.217	No
246	40.35	2.58	0.92	1.66	0.85	0.316	1.59	0.198	0.91	1.00	0.217	No
247	40.52	2.59	0.92	1.66	0.85	0.316	1.59	0.198	0.91	1.00	0.217	No
248	40.68	2.60	0.93	1.67	0.84	0.316	1.59	0.198	0.91	1.00	0.217	No
249	40.85	2.61	0.93	1.68	0.84	0.316	1.59	0.198	0.91	1.00	0.217	No
250	41.01	2.62	0.94	1.68	0.84	0.315	1.59	0.198	0.91	1.00	0.217	No
251	41.17	2.63	0.94	1.69	0.84	0.315	1.59	0.198	0.91	1.00	0.217	No
252	41.34	2.64	0.95	1.69	0.84	0.315	1.59	0.197	0.91	1.00	0.217	No
253	41.50	2.65	0.95	1.70	0.84	0.314	1.59	0.197	0.91	1.00	0.217	No
254	41.67	2.66	0.96	1.70	0.84	0.314	1.59	0.197	0.91	1.00	0.217	No
255	41.83	2.67	0.96	1.71	0.83	0.314	1.59	0.197	0.91	1.00	0.217	No
256	41.99	2.68	0.97	1.71	0.83	0.313	1.59	0.197	0.91	1.00	0.216	No
257	42.16	2.69	0.97	1.72	0.83	0.313	1.59	0.196	0.91	1.00	0.216	No
258	42.32	2.70	0.98	1.72	0.83	0.313	1.59	0.196	0.91	1.00	0.216	No
259	42.49	2.71	0.98	1.73	0.83	0.312	1.59	0.196	0.91	1.00	0.216	No
260	42.65	2.72	0.99	1.73	0.83	0.312	1.59	0.196	0.91	1.00	0.216	No
261	42.81	2.73	0.99	1.74	0.83	0.312	1.59	0.196	0.91	1.00	0.216	No
262	42.98	2.74	1.00	1.74	0.82	0.311	1.59	0.195	0.91	1.00	0.216	No
263	43.14	2.75	1.00	1.75	0.82	0.311	1.59	0.195	0.90	1.00	0.216	No
264	43.31	2.76	1.01	1.75	0.82	0.311	1.59	0.195	0.90	1.00	0.216	No
265	43.47	2.77	1.01	1.76	0.82	0.310	1.59	0.195	0.90	1.00	0.215	No
266	43.64	2.78	1.02	1.76	0.82	0.310	1.59	0.194	0.90	1.00	0.215	No
267	43.80	2.79	1.02	1.77	0.82	0.310	1.59	0.194	0.90	1.00	0.215	No
268	43.96	2.80	1.03	1.77	0.81	0.309	1.59	0.194	0.90	1.00	0.215	No
269	44.13	2.81	1.03	1.78	0.81	0.309	1.59	0.194	0.90	1.00	0.215	No
270	44.29	2.82	1.04	1.78	0.81	0.309	1.59	0.194	0.90	1.00	0.215	No
271	44.46	2.83	1.04	1.79	0.81	0.308	1.59	0.193	0.90	1.00	0.215	No
272	44.62	2.84	1.05	1.79	0.81	0.308	1.59	0.193	0.90	1.00	0.215	No
273	44.78	2.85	1.05	1.80	0.81	0.307	1.59	0.193	0.90	1.00	0.214	No
274	44.95	2.86	1.06	1.80	0.80	0.307	1.59	0.193	0.90	1.00	0.214	No
275	45.11	2.87	1.06	1.81	0.80	0.307	1.59	0.192	0.90	1.00	0.214	No
276	45.28	2.88	1.07	1.81	0.80	0.306	1.59	0.192	0.90	1.00	0.214	No
277	45.44	2.89	1.07	1.82	0.80	0.306	1.59	0.192	0.90	1.00	0.214	No
278	45.60	2.90	1.08	1.82	0.80	0.305	1.59	0.192	0.90	1.00	0.214	No
279	45.77	2.91	1.08	1.83	0.80	0.305	1.59	0.191	0.90	1.00	0.213	No
280	45.93	2.92	1.09	1.83	0.79	0.305	1.59	0.191	0.90	1.00	0.213	No
281	46.10	2.93	1.09	1.84	0.79	0.304	1.59	0.191	0.90	1.00	0.213	No
282	46.26	2.94	1.10	1.84	0.79	0.304	1.59	0.191	0.90	1.00	0.213	No
283	46.42	2.95	1.11	1.85	0.79	0.303	1.59	0.190	0.89	1.00	0.213	No
284	46.59	2.96	1.11	1.85	0.79	0.303	1.59	0.190	0.89	1.00	0.213	No
285	46.75	2.97	1.12	1.86	0.79	0.303	1.59	0.190	0.89	1.00	0.212	No
286	46.92	2.98	1.12	1.86	0.78	0.302	1.59	0.190	0.89	1.00	0.212	No
287	47.08	2.99	1.13	1.87	0.78	0.302	1.59	0.189	0.89	1.00	0.212	No
288	47.24	3.00	1.13	1.87	0.78	0.301	1.59	0.189	0.89	1.00	0.212	No

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data :: (continued)

Point ID	Depth (ft)	σ_v (tsf)	u_0 (tsf)	σ_v' (tsf)	r_d	CSR	MSF	CSR_{eq}	K_σ	User FS	CSR^*	Belongs to transition
289	47.41	3.01	1.14	1.88	0.78	0.301	1.59	0.189	0.89	1.00	0.212	No
290	47.57	3.02	1.14	1.88	0.78	0.300	1.59	0.188	0.89	1.00	0.211	No
291	47.74	3.03	1.15	1.89	0.78	0.300	1.59	0.188	0.89	1.00	0.211	No
292	47.90	3.04	1.15	1.89	0.77	0.300	1.59	0.188	0.89	1.00	0.211	No
293	48.06	3.05	1.16	1.90	0.77	0.299	1.59	0.188	0.89	1.00	0.211	No
294	48.23	3.06	1.16	1.90	0.77	0.299	1.59	0.187	0.89	1.00	0.211	No
295	48.39	3.07	1.17	1.91	0.77	0.298	1.59	0.187	0.89	1.00	0.210	No
296	48.56	3.08	1.17	1.91	0.77	0.298	1.59	0.187	0.89	1.00	0.210	No
297	48.72	3.09	1.18	1.92	0.77	0.297	1.59	0.187	0.89	1.00	0.210	No
298	48.88	3.10	1.18	1.92	0.76	0.297	1.59	0.186	0.89	1.00	0.210	No
299	49.05	3.11	1.19	1.93	0.76	0.296	1.59	0.186	0.89	1.00	0.210	No
300	49.21	3.12	1.19	1.93	0.76	0.296	1.59	0.186	0.89	1.00	0.209	No
301	49.38	3.13	1.20	1.94	0.76	0.296	1.59	0.185	0.89	1.00	0.209	No
302	49.54	3.14	1.20	1.94	0.76	0.295	1.59	0.185	0.89	1.00	0.209	No
303	49.70	3.15	1.21	1.94	0.76	0.295	1.59	0.185	0.89	1.00	0.209	No
304	49.87	3.16	1.21	1.95	0.75	0.294	1.59	0.185	0.88	1.00	0.209	No
305	50.03	3.17	1.22	1.95	0.75	0.294	1.59	0.184	0.88	1.00	0.208	No
306	50.20	3.18	1.22	1.95	0.75	0.294	1.59	0.184	0.88	1.00	0.208	No
307	50.36	3.18	1.23	1.96	0.75	0.293	1.59	0.184	0.88	1.00	0.208	No
308	50.52	3.19	1.23	1.96	0.75	0.293	1.59	0.184	0.88	1.00	0.208	No

Abbreviations

Depth: Depth from free surface, at which CPT was performed (ft)
σ_v: Total overburden pressure at test point (tsf)
u_0: Water pressure at test point (tsf)
σ_v': Effective overburden pressure based on GWT during earthquake (tsf)
r_d: Nonlinear shear mass factor
CSR: Cyclic Stress Ratio
MSF: Magnitude Scaling Factor
CSR_{eq}: CSR adjusted for M=7.5
K_σ: Effective overburden stress factor
CSR^*: CSR fully adjusted

:: Cyclic Resistance Ratio (CRR) calculation data ::

Point ID	Depth (ft)	q_t (tsf)	I_c	Fr (%)	n	Q_{tn}	K_c	$Q_{tn,cs}$	$CRR_{7.5}$	Belongs to trans. layer	Clay-like behaviour	FS
1	0.16	15.90	2.65	2.79	0.80	25.53	4.22	107.83	4.000	No	Yes	2.00
2	0.33	24.53	2.37	1.69	0.72	39.38	2.22	87.37	4.000	No	No	2.00
3	0.49	37.23	2.10	1.03	0.64	59.78	1.41	84.43	4.000	No	No	2.00
4	0.66	48.26	1.93	0.78	0.59	77.47	1.26	97.51	4.000	No	No	2.00
5	0.82	51.17	1.90	0.73	0.58	82.14	1.23	101.42	4.000	No	No	2.00
6	0.98	55.54	1.87	0.74	0.57	89.14	1.21	108.29	4.000	No	No	2.00
7	1.15	62.18	1.85	0.81	0.56	99.80	1.20	120.09	4.000	No	No	2.00
8	1.31	79.11	1.76	0.78	0.54	126.98	1.10	139.86	4.000	No	No	2.00
9	1.48	90.51	1.68	0.68	0.51	145.29	1.00	145.29	4.000	No	No	2.00
10	1.64	86.98	1.65	0.57	0.50	139.59	1.00	139.59	4.000	No	No	2.00
11	1.80	70.02	1.68	0.47	0.51	112.34	1.00	112.34	4.000	No	No	2.00
12	1.97	47.27	1.83	0.48	0.56	75.77	1.00	75.77	4.000	No	No	2.00
13	2.13	32.05	2.01	0.56	0.61	51.29	1.31	67.42	4.000	No	No	2.00
14	2.30	22.54	2.18	0.68	0.66	36.01	1.57	56.65	4.000	No	No	2.00
15	2.46	18.45	2.28	0.76	0.69	29.43	1.87	54.88	4.000	No	No	2.00
16	2.62	16.97	2.33	0.82	0.71	27.03	2.05	55.51	4.000	No	No	2.00
17	2.79	17.55	2.32	0.82	0.70	27.95	2.00	56.04	4.000	No	No	2.00
18	2.95	19.26	2.28	0.79	0.69	30.68	1.84	56.36	4.000	No	No	2.00
19	3.12	21.96	2.22	0.75	0.67	35.00	1.65	57.88	4.000	No	No	2.00
20	3.28	26.21	2.13	0.70	0.65	41.81	1.47	61.50	4.000	No	No	2.00
21	3.44	31.21	2.05	0.64	0.62	49.84	1.35	67.35	4.000	No	No	2.00
22	3.61	34.25	2.00	0.60	0.61	54.71	1.31	71.41	4.000	No	No	2.00
23	3.77	32.62	2.01	0.59	0.61	52.08	1.32	68.71	4.000	No	No	2.00
24	3.94	27.40	2.09	0.60	0.63	43.67	1.40	61.07	4.000	No	No	2.00
25	4.10	21.45	2.19	0.63	0.66	34.10	1.59	54.13	4.000	No	No	2.00
26	4.27	16.69	2.30	0.67	0.70	26.44	1.93	50.90	4.000	No	No	2.00
27	4.43	13.43	2.41	0.76	0.73	21.18	2.43	51.37	4.000	No	No	2.00
28	4.59	11.57	2.49	0.85	0.76	18.19	2.92	53.20	4.000	No	No	2.00
29	4.76	11.44	2.50	0.86	0.76	17.97	2.96	53.26	4.000	No	No	2.00
30	4.92	12.65	2.39	0.59	0.72	19.90	2.31	45.93	4.000	No	No	2.00
31	5.09	13.82	2.28	0.38	0.69	21.76	1.00	21.76	4.000	No	No	2.00
32	5.25	13.97	2.22	0.25	0.67	21.99	1.00	21.99	4.000	No	No	2.00
33	5.41	12.87	2.35	0.51	0.71	20.22	2.15	43.46	4.000	No	No	2.00
34	5.58	12.13	2.53	1.11	0.77	19.01	3.19	60.63	4.000	No	No	2.00
35	5.74	13.08	2.78	3.39	0.84	20.53	5.59	114.66	4.000	No	Yes	2.00
36	5.91	19.82	2.94	8.96	0.89	31.34	7.73	242.35	4.000	No	Yes	2.00
37	6.07	66.08	2.48	6.27	0.75	105.64	2.86	301.90	4.000	No	No	2.00
38	6.23	154.36	2.16	4.49	0.66	247.45	1.52	376.87	4.000	No	No	2.00
39	6.40	266.46	1.95	3.50	0.59	427.55	1.27	543.83	4.000	No	No	2.00
40	6.56	330.44	1.85	2.96	0.56	530.32	1.20	635.84	4.000	No	No	2.00
41	6.73	324.39	1.83	2.84	0.56	520.58	1.19	618.28	4.000	No	No	2.00
42	6.89	278.56	1.85	2.76	0.56	446.93	1.20	537.19	4.000	No	No	2.00
43	7.05	238.93	1.89	2.84	0.58	383.24	1.23	472.47	4.000	No	No	2.00
44	7.22	235.58	1.91	2.94	0.58	377.85	1.24	469.76	4.000	No	No	2.00
45	7.38	295.30	1.85	2.84	0.56	472.23	1.20	568.33	4.000	No	No	2.00
46	7.55	389.72	1.81	2.82	0.55	606.15	1.16	702.58	4.000	No	No	2.00
47	7.71	478.70	1.78	2.85	0.54	729.52	1.13	825.20	4.000	No	No	2.00
48	7.87	512.26	1.80	3.02	0.55	772.87	1.15	887.77	4.000	No	No	2.00

:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)

Point ID	Depth (ft)	q_t (tsf)	I_c	Fr (%)	n	Q_{tn}	K_c	$Q_{tn,cs}$	$CRR_{7.5}$	Belongs to trans. layer	Clay-like behaviour	FS
49	8.04	500.46	1.84	3.32	0.56	752.95	1.19	897.41	4.000	No	No	2.00
50	8.20	446.73	1.89	3.65	0.58	671.86	1.23	828.46	4.000	No	No	2.00
51	8.37	351.90	2.00	4.30	0.61	534.65	1.30	697.41	4.000	No	No	2.00
52	8.53	247.13	2.13	5.19	0.65	381.44	1.47	559.40	4.000	No	No	2.00
53	8.69	180.87	2.24	5.96	0.68	281.74	1.72	485.96	4.000	No	No	2.00
54	8.86	154.41	2.25	5.59	0.68	237.35	1.76	416.95	4.000	No	No	2.00
55	9.02	139.86	2.21	4.70	0.67	210.10	1.65	345.96	4.000	No	No	2.00
56	9.19	121.74	2.17	3.74	0.66	178.64	1.54	274.94	4.000	No	No	2.00
57	9.35	108.49	2.11	2.85	0.64	155.24	1.43	222.07	4.000	No	No	2.00
58	9.51	112.67	2.00	2.11	0.61	156.11	1.31	204.59	4.000	No	No	2.00
59	9.68	127.08	1.91	1.72	0.58	171.19	1.24	212.91	4.000	No	No	2.00
60	9.84	148.40	1.83	1.53	0.56	195.20	1.19	231.63	4.000	No	No	2.00
61	10.01	165.71	1.79	1.43	0.54	214.10	1.14	243.51	4.000	No	No	2.00
62	10.17	176.17	1.76	1.36	0.53	224.28	1.09	245.23	4.000	No	No	2.00
63	10.33	179.95	1.75	1.33	0.53	226.59	1.08	243.94	4.000	No	No	2.00
64	10.50	183.05	1.74	1.31	0.53	228.18	1.07	243.39	4.000	No	No	2.00
65	10.66	188.97	1.73	1.31	0.53	233.25	1.06	246.13	4.000	No	No	2.00
66	10.83	194.65	1.72	1.27	0.52	237.65	1.03	243.79	4.000	No	No	2.00
67	10.99	196.45	1.71	1.22	0.52	237.36	1.00	237.36	4.000	No	No	2.00
68	11.15	191.87	1.71	1.20	0.52	230.80	1.00	231.31	4.000	No	No	2.00
69	11.32	184.78	1.73	1.24	0.53	221.92	1.05	232.14	4.000	No	No	2.00
70	11.48	176.81	1.77	1.35	0.54	212.53	1.11	236.30	4.000	No	No	2.00
71	11.65	169.28	1.81	1.48	0.55	203.74	1.17	237.55	4.000	No	No	2.00
72	11.81	159.90	1.86	1.65	0.57	192.83	1.21	233.54	4.000	No	No	2.00
73	11.98	150.88	1.91	1.83	0.58	182.21	1.25	226.94	4.000	No	No	2.00
74	12.14	145.53	1.95	1.97	0.59	175.66	1.27	222.83	4.000	No	No	2.00
75	12.30	146.87	1.96	2.06	0.60	176.72	1.28	225.76	4.000	No	No	2.00
76	12.47	153.05	1.95	2.05	0.59	183.09	1.27	232.64	4.000	No	No	2.00
77	12.63	161.44	1.93	2.00	0.59	191.77	1.26	241.01	4.000	No	No	2.00
78	12.80	167.09	1.91	1.92	0.58	197.09	1.24	244.90	4.000	No	No	2.00
79	12.96	173.03	1.88	1.82	0.57	202.57	1.22	248.07	4.000	No	No	2.00
80	13.12	183.28	1.84	1.68	0.56	212.72	1.19	254.18	4.000	No	No	2.00
81	13.29	199.71	1.79	1.55	0.55	229.61	1.15	263.09	4.000	No	No	2.00
82	13.45	219.67	1.75	1.48	0.53	250.52	1.09	273.52	4.000	No	No	2.00
83	13.62	234.94	1.74	1.50	0.53	266.57	1.07	286.43	4.000	No	No	2.00
84	13.78	240.48	1.75	1.55	0.53	271.92	1.08	294.94	4.000	No	No	2.00
85	13.94	235.14	1.76	1.58	0.54	265.10	1.10	292.87	4.000	No	No	2.00
86	14.11	225.78	1.76	1.51	0.54	253.38	1.10	278.70	4.000	No	No	2.00
87	14.27	216.90	1.74	1.40	0.53	242.05	1.08	260.26	4.000	No	No	2.00
88	14.44	206.78	1.73	1.27	0.53	229.45	1.04	239.57	4.000	No	No	2.00
89	14.60	193.34	1.72	1.17	0.52	213.55	1.03	220.50	4.000	No	No	2.00
90	14.76	176.65	1.74	1.13	0.53	194.56	1.06	205.97	4.000	No	No	2.00
91	14.93	164.88	1.73	1.05	0.53	180.86	1.06	191.30	0.731	No	No	2.00
92	15.09	153.89	1.74	0.99	0.53	168.21	1.06	179.13	0.615	No	No	2.00
93	15.26	146.73	1.73	0.90	0.53	159.63	1.04	166.72	0.511	No	No	2.00
94	15.42	137.52	1.74	0.88	0.53	149.24	1.07	160.15	0.462	No	No	2.00
95	15.58	131.87	1.76	0.88	0.54	142.75	1.10	156.66	0.438	No	No	2.00
96	15.75	126.15	1.79	0.95	0.55	136.42	1.14	156.10	0.434	No	No	2.00

:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)

Point ID	Depth (ft)	q_t (tsf)	I_c	Fr (%)	n	Q_{tn}	K_c	$Q_{tn,cs}$	$CRR_{7.5}$	Belongs to trans. layer	Clay-like behaviour	FS
97	15.91	130.94	1.79	0.97	0.54	141.12	1.14	160.93	0.468	No	No	2.00
98	16.08	136.76	1.79	1.00	0.54	146.89	1.14	166.73	0.511	No	No	2.00
99	16.24	144.75	1.77	1.00	0.54	154.81	1.11	172.40	0.557	No	No	2.00
100	16.40	144.66	1.78	1.04	0.54	154.31	1.13	174.19	0.571	No	No	2.00
101	16.57	143.50	1.79	1.05	0.54	152.63	1.14	173.70	0.567	No	No	2.00
102	16.73	143.85	1.79	1.04	0.54	152.47	1.14	173.31	0.564	No	No	2.00
103	16.90	147.70	1.77	1.02	0.54	155.92	1.12	174.55	0.575	No	No	2.00
104	17.06	153.06	1.76	1.00	0.53	160.89	1.09	175.97	0.587	No	No	2.00
105	17.22	155.53	1.75	0.99	0.53	162.91	1.08	176.60	0.592	No	No	2.00
106	17.39	153.25	1.75	0.99	0.53	160.03	1.09	174.80	0.577	No	No	2.00
107	17.55	149.25	1.77	0.99	0.54	155.42	1.11	172.27	0.555	No	No	2.00
108	17.72	148.45	1.76	0.98	0.54	154.06	1.11	170.24	0.539	No	No	2.00
109	17.88	151.69	1.75	0.95	0.53	156.82	1.08	169.80	0.535	No	No	2.00
110	18.04	156.17	1.74	0.93	0.53	160.86	1.06	170.40	0.540	No	No	2.00
111	18.21	160.98	1.73	0.93	0.53	165.25	1.04	172.14	0.554	No	No	2.00
112	18.37	164.94	1.73	0.96	0.53	168.84	1.05	176.78	0.594	No	No	2.00
113	18.54	169.98	1.73	0.98	0.53	173.46	1.04	180.54	0.627	No	No	2.00
114	18.70	175.30	1.72	0.97	0.52	178.28	1.02	181.83	0.639	No	No	2.00
115	18.86	179.32	1.70	0.93	0.52	181.69	1.00	181.69	0.638	No	No	2.00
116	19.03	187.48	1.67	0.88	0.51	189.20	1.00	189.20	0.710	No	No	2.00
117	19.19	195.29	1.64	0.85	0.50	196.35	1.00	196.35	0.784	No	No	2.00
118	19.36	201.35	1.63	0.83	0.50	201.86	1.00	201.86	4.000	No	No	2.00
119	19.52	199.51	1.64	0.85	0.50	199.44	1.00	199.44	0.818	No	No	2.00
120	19.69	197.28	1.71	1.05	0.52	197.10	1.01	198.67	0.809	No	No	2.00
121	19.85	190.75	1.81	1.37	0.55	190.55	1.16	220.82	4.000	No	No	2.00
122	20.01	158.87	1.97	1.93	0.60	158.81	1.28	203.88	4.000	No	No	2.00
123	20.18	118.47	2.18	2.85	0.66	118.43	1.57	185.69	0.675	No	No	2.00
124	20.34	80.84	2.48	5.10	0.75	80.78	2.85	230.58	4.000	No	No	2.00
125	20.51	85.14	2.58	7.13	0.78	84.97	3.61	306.74	4.000	No	No	2.00
126	20.67	124.47	2.48	7.01	0.75	123.89	2.86	354.34	4.000	No	No	2.00
127	20.83	169.91	2.40	6.72	0.73	168.44	2.35	396.01	4.000	No	No	2.00
128	21.00	211.81	2.33	6.45	0.71	209.05	2.05	429.35	4.000	No	No	2.00
129	21.16	235.47	2.32	6.62	0.70	231.46	2.01	464.42	4.000	No	No	2.00
130	21.33	252.23	2.32	6.77	0.70	246.92	1.99	491.17	4.000	No	No	2.00
131	21.49	263.77	2.27	6.09	0.69	256.96	1.81	465.12	4.000	No	No	2.00
132	21.65	270.43	2.18	4.87	0.66	262.06	1.56	409.70	4.000	No	No	2.00
133	21.82	273.47	2.02	3.19	0.61	263.44	1.32	348.47	4.000	No	No	2.00
134	21.98	229.95	1.96	2.41	0.60	220.36	1.28	281.08	4.000	No	No	2.00
135	22.15	177.40	1.94	1.88	0.59	169.11	1.26	213.87	4.000	No	No	2.00
136	22.31	123.15	2.06	1.91	0.62	116.71	1.36	158.83	0.453	No	No	2.00
137	22.47	99.54	2.14	2.00	0.65	93.82	1.48	138.52	0.327	No	No	1.70
138	22.64	78.10	2.31	2.73	0.70	73.12	1.95	142.53	0.349	No	No	1.81
139	22.80	64.62	2.48	3.87	0.75	60.07	2.82	169.12	0.530	No	No	2.00
140	22.97	60.02	2.55	4.49	0.77	55.48	3.32	183.99	0.659	No	No	2.00
141	23.13	50.19	2.62	4.81	0.80	45.98	3.96	182.28	3.600	No	Yes	2.00
142	23.29	36.47	2.73	4.83	0.83	32.90	5.00	164.56	3.600	No	Yes	2.00
143	23.46	21.85	2.94	5.53	0.89	19.08	7.81	149.06	3.600	No	Yes	2.00
144	23.62	13.84	3.14	6.22	1.00	11.51	11.42	131.44	3.600	No	Yes	2.00

:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)

Point ID	Depth (ft)	q_t (tsf)	I_c	Fr (%)	n	Q_{tn}	K_c	$Q_{tn,cs}$	$CRR_{7.5}$	Belongs to trans. layer	Clay-like behaviour	FS
145	23.79	10.93	3.28	7.38	1.00	8.76	14.62	128.16	3.600	No	Yes	2.00
146	23.95	10.75	3.35	9.24	1.00	8.55	16.53	141.43	3.600	No	Yes	2.00
147	24.11	13.77	3.25	8.97	1.00	11.28	13.92	157.11	3.600	No	Yes	2.00
148	24.28	25.03	2.89	5.30	0.87	21.62	7.03	152.01	3.600	No	Yes	2.00
149	24.44	54.69	2.37	2.20	0.72	48.96	2.22	108.66	0.199	No	No	1.01
150	24.61	78.11	2.13	1.47	0.65	70.49	1.47	103.85	0.184	No	No	0.93
151	24.77	96.05	2.10	1.63	0.64	86.78	1.41	122.62	0.251	No	No	1.26
152	24.93	108.57	2.21	2.63	0.67	97.79	1.64	159.97	0.461	No	No	2.00
153	25.10	134.83	2.26	3.63	0.68	121.26	1.77	214.92	4.000	No	No	2.00
154	25.26	177.59	2.28	4.76	0.69	159.47	1.86	296.34	4.000	No	No	2.00
155	25.43	236.83	2.23	4.96	0.68	212.55	1.69	360.15	4.000	No	No	2.00
156	25.59	285.46	2.19	4.94	0.66	255.77	1.59	405.73	4.000	No	No	2.00
157	25.75	297.90	2.17	4.87	0.66	266.10	1.55	413.71	4.000	No	No	2.00
158	25.92	268.11	2.22	5.11	0.67	238.24	1.66	394.78	4.000	No	No	2.00
159	26.08	227.90	2.28	5.47	0.69	201.23	1.85	372.06	4.000	No	No	2.00
160	26.25	199.05	2.31	5.39	0.70	174.79	1.94	339.93	4.000	No	No	2.00
161	26.41	178.53	2.33	5.33	0.71	155.93	2.04	317.62	4.000	No	No	2.00
162	26.57	166.19	2.34	5.29	0.71	144.43	2.10	303.68	4.000	No	No	2.00
163	26.74	159.72	2.36	5.38	0.72	138.16	2.18	301.04	4.000	No	No	2.00
164	26.90	159.35	2.37	5.45	0.72	137.28	2.21	303.18	4.000	No	No	2.00
165	27.07	165.29	2.35	5.35	0.71	141.99	2.14	303.77	4.000	No	No	2.00
166	27.23	177.24	2.32	5.08	0.70	152.00	1.99	302.36	4.000	No	No	2.00
167	27.40	188.52	2.27	4.64	0.69	161.47	1.82	293.16	4.000	No	No	2.00
168	27.56	193.63	2.23	4.24	0.68	165.56	1.70	280.84	4.000	No	No	2.00
169	27.72	188.42	2.22	4.07	0.68	160.55	1.68	269.17	4.000	No	No	2.00
170	27.89	177.11	2.25	4.16	0.68	150.14	1.75	262.55	4.000	No	No	2.00
171	28.05	180.92	2.23	3.99	0.68	153.00	1.69	258.74	4.000	No	No	2.00
172	28.22	201.74	2.13	3.26	0.65	170.99	1.47	250.77	4.000	No	No	2.00
173	28.38	221.75	2.00	2.45	0.61	188.63	1.31	247.17	4.000	No	No	2.00
174	28.54	234.64	1.89	1.84	0.58	200.21	1.23	246.34	4.000	No	No	2.00
175	28.71	242.05	1.82	1.55	0.56	206.72	1.18	243.34	4.000	No	No	2.00
176	28.87	272.29	1.76	1.41	0.54	232.92	1.10	255.83	4.000	No	No	2.00
177	29.04	311.49	1.71	1.36	0.52	266.69	1.01	268.66	4.000	No	No	2.00
178	29.20	345.69	1.69	1.38	0.51	295.75	1.00	295.75	4.000	No	No	2.00
179	29.36	353.65	1.70	1.46	0.52	301.63	1.00	301.63	4.000	No	No	2.00
180	29.53	335.19	1.74	1.54	0.53	284.51	1.06	301.67	4.000	No	No	2.00
181	29.69	301.52	1.77	1.58	0.54	254.56	1.12	285.24	4.000	No	No	2.00
182	29.86	265.94	1.80	1.56	0.55	223.38	1.16	258.33	4.000	No	No	2.00
183	30.02	236.85	1.82	1.48	0.55	198.08	1.17	232.22	4.000	No	No	2.00
184	30.18	223.94	1.82	1.41	0.55	186.73	1.17	218.98	4.000	No	No	2.00
185	30.35	235.13	1.79	1.36	0.55	195.96	1.15	224.77	4.000	No	No	2.00
186	30.51	265.27	1.76	1.34	0.53	221.32	1.09	241.90	4.000	No	No	2.00
187	30.68	297.31	1.72	1.32	0.52	248.26	1.03	254.84	4.000	No	No	2.00
188	30.84	316.58	1.70	1.32	0.52	264.13	1.00	264.13	4.000	No	No	2.00
189	31.00	319.84	1.70	1.33	0.52	266.26	1.00	266.26	4.000	No	No	2.00
190	31.17	317.56	1.70	1.32	0.52	263.69	1.00	263.69	4.000	No	No	2.00
191	31.33	314.75	1.71	1.34	0.52	260.59	1.01	263.28	4.000	No	No	2.00
192	31.50	315.83	1.71	1.33	0.52	260.96	1.00	261.25	4.000	No	No	2.00

:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)

Point ID	Depth (ft)	q_t (tsf)	I_c	Fr (%)	n	Q_{tn}	K_c	$Q_{tn,cs}$	$CRR_{7.5}$	Belongs to trans. layer	Clay-like behaviour	FS
193	31.66	315.58	1.70	1.30	0.52	260.27	1.00	260.27	4.000	No	No	2.00
194	31.82	313.78	1.69	1.25	0.51	258.42	1.00	258.42	4.000	No	No	2.00
195	31.99	314.20	1.69	1.25	0.51	258.18	1.00	258.18	4.000	No	No	2.00
196	32.15	321.56	1.68	1.25	0.51	263.82	1.00	263.82	4.000	No	No	2.00
197	32.32	330.08	1.68	1.26	0.51	270.34	1.00	270.34	4.000	No	No	2.00
198	32.48	335.57	1.67	1.25	0.51	274.37	1.00	274.37	4.000	No	No	2.00
199	32.64	334.78	1.68	1.26	0.51	273.01	1.00	273.01	4.000	No	No	2.00
200	32.81	328.78	1.68	1.27	0.51	267.35	1.00	267.35	4.000	No	No	2.00
201	32.97	320.36	1.69	1.27	0.52	259.70	1.00	259.70	4.000	No	No	2.00
202	33.14	315.97	1.69	1.25	0.52	255.57	1.00	255.57	4.000	No	No	2.00
203	33.30	320.10	1.68	1.23	0.51	258.59	1.00	258.59	4.000	No	No	2.00
204	33.46	326.83	1.67	1.20	0.51	263.77	1.00	263.77	4.000	No	No	2.00
205	33.63	330.46	1.67	1.21	0.51	266.19	1.00	266.19	4.000	No	No	2.00
206	33.79	330.20	1.67	1.20	0.51	265.45	1.00	265.45	4.000	No	No	2.00
207	33.96	328.86	1.66	1.18	0.51	263.93	1.00	263.93	4.000	No	No	2.00
208	34.12	325.70	1.66	1.14	0.50	261.01	1.00	261.01	4.000	No	No	2.00
209	34.28	322.12	1.64	1.09	0.50	257.89	1.00	257.89	4.000	No	No	2.00
210	34.45	317.03	1.63	1.03	0.50	253.35	1.00	253.35	4.000	No	No	2.00
211	34.61	312.44	1.62	0.99	0.50	249.16	1.00	249.16	4.000	No	No	2.00
212	34.78	308.65	1.63	1.00	0.50	245.62	1.00	245.62	4.000	No	No	2.00
213	34.94	304.83	1.66	1.10	0.51	241.48	1.00	241.48	4.000	No	No	2.00
214	35.10	308.70	1.69	1.19	0.51	243.48	1.00	243.48	4.000	No	No	2.00
215	35.27	316.41	1.70	1.25	0.52	248.80	1.00	248.80	4.000	No	No	2.00
216	35.43	322.24	1.69	1.25	0.52	253.02	1.00	253.02	4.000	No	No	2.00
217	35.60	321.70	1.69	1.24	0.52	252.10	1.00	252.10	4.000	No	No	2.00
218	35.76	318.73	1.69	1.23	0.52	249.25	1.00	249.25	4.000	No	No	2.00
219	35.93	317.94	1.69	1.21	0.51	248.25	1.00	248.25	4.000	No	No	2.00
220	36.09	316.71	1.68	1.16	0.51	247.07	1.00	247.07	4.000	No	No	2.00
221	36.25	313.32	1.67	1.14	0.51	244.01	1.00	244.01	4.000	No	No	2.00
222	36.42	311.20	1.67	1.12	0.51	241.94	1.00	241.94	4.000	No	No	2.00
223	36.58	309.25	1.67	1.10	0.51	240.08	1.00	240.08	4.000	No	No	2.00
224	36.75	308.18	1.65	1.06	0.50	239.08	1.00	239.08	4.000	No	No	2.00
225	36.91	304.89	1.65	1.02	0.50	236.24	1.00	236.24	4.000	No	No	2.00
226	37.07	300.74	1.65	1.01	0.50	232.54	1.00	232.54	4.000	No	No	2.00
227	37.24	296.01	1.65	1.00	0.50	228.36	1.00	228.36	4.000	No	No	2.00
228	37.40	292.29	1.65	0.99	0.50	225.04	1.00	225.04	4.000	No	No	2.00
229	37.57	287.49	1.64	0.95	0.50	221.14	1.00	221.14	4.000	No	No	2.00
230	37.73	278.77	1.65	0.93	0.50	213.90	1.00	213.90	4.000	No	No	2.00
231	37.89	268.63	1.65	0.91	0.50	205.55	1.00	205.55	4.000	No	No	2.00
232	38.06	259.29	1.67	0.93	0.51	197.51	1.00	197.51	0.797	No	No	2.00
233	38.22	252.52	1.68	0.93	0.51	191.70	1.00	191.70	0.735	No	No	2.00
234	38.39	248.27	1.69	0.94	0.51	187.92	1.00	187.92	0.697	No	No	2.00
235	38.55	244.70	1.69	0.94	0.52	184.73	1.00	184.73	0.666	No	No	2.00
236	38.71	242.38	1.70	0.94	0.52	182.58	1.00	182.58	0.646	No	No	2.00
237	38.88	239.88	1.69	0.89	0.51	180.59	1.00	180.59	0.628	No	No	2.00
238	39.04	233.09	1.67	0.81	0.51	175.58	1.00	175.58	0.583	No	No	2.00
239	39.21	221.04	1.64	0.71	0.50	166.59	1.00	166.59	0.510	No	No	2.00
240	39.37	205.39	1.64	0.64	0.50	154.48	1.00	154.48	0.423	No	No	1.95

:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)

Point ID	Depth (ft)	q_t (tsf)	I_c	Fr (%)	n	Q_{tn}	K_c	$Q_{tn,cs}$	$CRR_{7.5}$	Belongs to trans. layer	Clay-like behaviour	FS
241	39.53	189.84	1.65	0.59	0.50	142.29	1.00	142.29	0.348	No	No	1.60
242	39.70	176.13	1.67	0.58	0.51	131.22	1.00	131.22	0.290	No	No	1.33
243	39.86	163.78	1.70	0.58	0.52	121.23	1.00	121.23	0.246	No	No	1.13
244	40.03	154.25	1.74	0.61	0.53	113.33	1.06	120.42	0.242	No	No	1.12
245	40.19	147.36	1.78	0.67	0.54	107.43	1.13	120.89	0.244	No	No	1.12
246	40.35	141.43	1.88	0.91	0.57	101.45	1.22	124.04	0.257	No	No	1.19
247	40.52	137.28	2.02	1.42	0.61	96.33	1.33	127.86	0.274	No	No	1.26
248	40.68	131.50	2.19	2.26	0.66	89.97	1.58	142.07	0.347	No	No	1.60
249	40.85	119.70	2.29	2.81	0.69	80.41	1.88	151.01	0.400	No	No	1.84
250	41.01	112.45	2.29	2.68	0.70	75.19	1.90	142.83	0.351	No	No	1.62
251	41.17	122.97	2.11	1.63	0.64	84.38	1.43	120.56	0.243	No	No	1.12
252	41.34	162.71	1.81	0.85	0.55	116.73	1.17	136.31	0.316	No	No	1.46
253	41.50	200.73	1.63	0.59	0.50	147.82	1.00	147.82	0.380	No	No	1.76
254	41.67	224.00	1.58	0.55	0.50	164.92	1.00	164.92	0.497	No	No	2.00
255	41.83	224.15	1.59	0.57	0.50	164.78	1.00	164.78	0.496	No	No	2.00
256	41.99	219.55	1.61	0.59	0.50	161.10	1.00	161.10	0.469	No	No	2.00
257	42.16	212.21	1.62	0.60	0.50	155.41	1.00	155.41	0.429	No	No	1.98
258	42.32	205.76	1.63	0.59	0.50	150.40	1.00	150.40	0.396	No	No	1.83
259	42.49	201.94	1.62	0.56	0.50	147.34	1.00	147.34	0.377	No	No	1.75
260	42.65	202.08	1.61	0.53	0.50	147.22	1.00	147.22	0.377	No	No	1.74
261	42.81	204.05	1.59	0.50	0.50	148.46	1.00	148.46	0.384	No	No	1.78
262	42.98	205.12	1.59	0.50	0.50	149.03	1.00	149.03	0.388	No	No	1.80
263	43.14	206.05	1.59	0.51	0.50	149.49	1.00	149.49	0.391	No	No	1.81
264	43.31	208.70	1.59	0.51	0.50	151.21	1.00	151.21	0.402	No	No	1.86
265	43.47	213.93	1.58	0.51	0.50	154.83	1.00	154.83	0.425	No	No	1.97
266	43.64	216.99	1.56	0.48	0.50	156.84	1.00	156.84	0.439	No	No	2.00
267	43.80	215.04	1.56	0.47	0.50	155.19	1.00	155.19	0.428	No	No	1.99
268	43.96	210.42	1.56	0.46	0.50	151.59	1.00	151.59	0.404	No	No	1.88
269	44.13	205.75	1.59	0.49	0.50	147.96	1.00	147.96	0.381	No	No	1.77
270	44.29	206.25	1.59	0.50	0.50	148.11	1.00	148.11	0.382	No	No	1.78
271	44.46	207.56	1.58	0.48	0.50	148.85	1.00	148.85	0.387	No	No	1.80
272	44.62	209.53	1.56	0.45	0.50	150.07	1.00	150.07	0.394	No	No	1.84
273	44.78	207.89	1.55	0.43	0.50	148.67	1.00	148.67	0.386	No	No	1.80
274	44.95	205.96	1.56	0.44	0.50	147.05	1.00	147.05	0.376	No	No	1.75
275	45.11	205.80	1.56	0.44	0.50	146.73	1.00	146.73	0.374	No	No	1.75
276	45.28	204.29	1.57	0.45	0.50	145.44	1.00	145.44	0.366	No	No	1.71
277	45.44	198.40	1.59	0.46	0.50	140.98	1.00	140.98	0.341	No	No	1.59
278	45.60	189.43	1.62	0.48	0.50	134.32	1.00	134.32	0.305	No	No	1.43
279	45.77	184.75	1.63	0.48	0.50	130.77	1.00	130.77	0.288	No	No	1.35
280	45.93	189.08	1.60	0.45	0.50	133.70	1.00	133.70	0.302	No	No	1.42
281	46.10	198.40	1.56	0.40	0.50	140.20	1.00	140.20	0.336	No	No	1.58
282	46.26	205.96	1.52	0.36	0.50	145.43	1.00	145.43	0.366	No	No	1.72
283	46.42	206.48	1.53	0.37	0.50	145.61	1.00	145.61	0.367	No	No	1.73
284	46.59	196.21	1.57	0.42	0.50	138.07	1.00	138.07	0.325	No	No	1.53
285	46.75	183.08	1.63	0.48	0.50	128.51	1.00	128.51	0.277	No	No	1.31
286	46.92	174.17	1.68	0.54	0.51	121.08	1.00	121.08	0.245	No	No	1.15
287	47.08	176.38	1.68	0.55	0.51	122.52	1.00	122.52	0.251	No	No	1.18
288	47.24	183.30	1.65	0.51	0.50	127.99	1.00	127.99	0.275	No	No	1.30

:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)

Point ID	Depth (ft)	q_t (tsf)	I_c	Fr (%)	n	Q_{tn}	K_c	$Q_{tn,cs}$	$CRR_{7.5}$	Belongs to trans. layer	Clay-like behaviour	FS
289	47.41	191.32	1.60	0.45	0.50	133.65	1.00	133.65	0.302	No	No	1.43
290	47.57	192.55	1.59	0.43	0.50	134.35	1.00	134.35	0.306	No	No	1.44
291	47.74	185.35	1.62	0.47	0.50	129.07	1.00	129.07	0.280	No	No	1.33
292	47.90	174.58	1.67	0.52	0.51	120.58	1.00	120.58	0.243	No	No	1.15
293	48.06	168.33	1.71	0.56	0.52	115.29	1.01	116.09	0.225	No	No	1.07
294	48.23	170.93	1.71	0.58	0.52	116.88	1.01	118.33	0.234	No	No	1.11
295	48.39	178.35	1.70	0.58	0.52	122.23	1.00	122.23	0.250	No	No	1.19
296	48.56	187.06	1.67	0.57	0.51	128.60	1.00	128.60	0.278	No	No	1.32
297	48.72	195.36	1.65	0.55	0.50	134.83	1.00	134.83	0.308	No	No	1.47
298	48.88	201.36	1.62	0.52	0.50	139.08	1.00	139.08	0.330	No	No	1.57
299	49.05	209.12	1.58	0.47	0.50	144.33	1.00	144.33	0.360	No	No	1.72
300	49.21	220.20	1.53	0.41	0.50	151.89	1.00	151.89	0.406	No	No	1.94
301	49.38	230.07	1.48	0.35	0.50	158.59	1.00	158.59	0.451	No	No	2.00
302	49.54	231.34	1.45	0.31	0.50	159.27	1.00	159.27	0.456	No	No	2.00
303	49.70	221.27	1.46	0.29	0.50	152.06	1.00	152.06	0.407	No	No	1.95
304	49.87	207.44	1.49	0.30	0.50	142.23	1.00	142.23	0.348	No	No	1.67
305	50.03	196.45	N/A	-46348.13	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
306	50.20	195.85	N/A	-92986.08	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
307	50.36	205.01	N/A	-133154.29	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
308	50.52	215.84	N/A	-126382.34	1.00	-1.00	1.00	N/A	4.000	No	No	2.00

Abbreviations

Depth: Depth from free surface, at which CPT was performed (ft)
q_t: Total cone resistance
I_c: Soil behavior type index
Fr: Normalized friction ratio (%)
n: Stress exponent
Q_{tn}: Normalized cone resistance
K_c: Cone resistance correction factor due to fines
$Q_{tn,cs}$: Normalized and adjusted cone resistance
$CRR_{7.5}$: Cyclic resistance ratio for M_w=7.5
FS: Factor of safety against soil liquefaction

:: Liquefaction Potential Index calculation data ::

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
0.16	2.00	0.00	0.00	0.16	0.00	0.33	2.00	0.00	0.00	0.16	0.00
0.49	2.00	0.00	0.00	0.16	0.00	0.66	2.00	0.00	0.00	0.16	0.00
0.82	2.00	0.00	0.00	0.16	0.00	0.98	2.00	0.00	0.00	0.16	0.00
1.15	2.00	0.00	0.00	0.16	0.00	1.31	2.00	0.00	0.00	0.16	0.00
1.48	2.00	0.00	0.00	0.16	0.00	1.64	2.00	0.00	0.00	0.16	0.00
1.80	2.00	0.00	0.00	0.16	0.00	1.97	2.00	0.00	0.00	0.16	0.00
2.13	2.00	0.00	0.00	0.16	0.00	2.30	2.00	0.00	0.00	0.16	0.00
2.46	2.00	0.00	0.00	0.16	0.00	2.62	2.00	0.00	0.00	0.16	0.00
2.79	2.00	0.00	0.00	0.16	0.00	2.95	2.00	0.00	0.00	0.16	0.00
3.12	2.00	0.00	0.00	0.16	0.00	3.28	2.00	0.00	0.00	0.16	0.00
3.44	2.00	0.00	0.00	0.16	0.00	3.61	2.00	0.00	0.00	0.16	0.00
3.77	2.00	0.00	0.00	0.16	0.00	3.94	2.00	0.00	0.00	0.16	0.00
4.10	2.00	0.00	0.00	0.16	0.00	4.27	2.00	0.00	0.00	0.16	0.00
4.43	2.00	0.00	0.00	0.16	0.00	4.59	2.00	0.00	0.00	0.16	0.00
4.76	2.00	0.00	0.00	0.16	0.00	4.92	2.00	0.00	0.00	0.16	0.00
5.09	2.00	0.00	0.00	0.16	0.00	5.25	2.00	0.00	0.00	0.16	0.00
5.41	2.00	0.00	0.00	0.16	0.00	5.58	2.00	0.00	0.00	0.16	0.00
5.74	2.00	0.00	0.00	0.16	0.00	5.91	2.00	0.00	0.00	0.16	0.00
6.07	2.00	0.00	0.00	0.16	0.00	6.23	2.00	0.00	0.00	0.16	0.00
6.40	2.00	0.00	0.00	0.16	0.00	6.56	2.00	0.00	0.00	0.16	0.00
6.73	2.00	0.00	0.00	0.16	0.00	6.89	2.00	0.00	0.00	0.16	0.00
7.05	2.00	0.00	0.00	0.16	0.00	7.22	2.00	0.00	0.00	0.16	0.00
7.38	2.00	0.00	0.00	0.16	0.00	7.55	2.00	0.00	0.00	0.16	0.00
7.71	2.00	0.00	0.00	0.16	0.00	7.87	2.00	0.00	0.00	0.16	0.00
8.04	2.00	0.00	0.00	0.16	0.00	8.20	2.00	0.00	0.00	0.16	0.00
8.37	2.00	0.00	0.00	0.16	0.00	8.53	2.00	0.00	0.00	0.16	0.00
8.69	2.00	0.00	0.00	0.16	0.00	8.86	2.00	0.00	0.00	0.16	0.00
9.02	2.00	0.00	0.00	0.16	0.00	9.19	2.00	0.00	0.00	0.16	0.00
9.35	2.00	0.00	0.00	0.16	0.00	9.51	2.00	0.00	0.00	0.16	0.00
9.68	2.00	0.00	0.00	0.16	0.00	9.84	2.00	0.00	0.00	0.16	0.00
10.01	2.00	0.00	0.00	0.16	0.00	10.17	2.00	0.00	0.00	0.16	0.00
10.33	2.00	0.00	0.00	0.16	0.00	10.50	2.00	0.00	0.00	0.16	0.00
10.66	2.00	0.00	0.00	0.16	0.00	10.83	2.00	0.00	0.00	0.16	0.00
10.99	2.00	0.00	0.00	0.16	0.00	11.15	2.00	0.00	0.00	0.16	0.00
11.32	2.00	0.00	0.00	0.16	0.00	11.48	2.00	0.00	0.00	0.16	0.00
11.65	2.00	0.00	0.00	0.16	0.00	11.81	2.00	0.00	0.00	0.16	0.00
11.98	2.00	0.00	0.00	0.16	0.00	12.14	2.00	0.00	0.00	0.16	0.00
12.30	2.00	0.00	0.00	0.16	0.00	12.47	2.00	0.00	0.00	0.16	0.00
12.63	2.00	0.00	0.00	0.16	0.00	12.80	2.00	0.00	0.00	0.16	0.00
12.96	2.00	0.00	0.00	0.16	0.00	13.12	2.00	0.00	0.00	0.16	0.00
13.29	2.00	0.00	0.00	0.16	0.00	13.45	2.00	0.00	0.00	0.16	0.00
13.62	2.00	0.00	0.00	0.16	0.00	13.78	2.00	0.00	0.00	0.16	0.00
13.94	2.00	0.00	0.00	0.16	0.00	14.11	2.00	0.00	0.00	0.16	0.00
14.27	2.00	0.00	0.00	0.16	0.00	14.44	2.00	0.00	0.00	0.16	0.00
14.60	2.00	0.00	0.00	0.16	0.00	14.76	2.00	0.00	0.00	0.16	0.00
14.93	2.00	0.00	0.00	0.16	0.00	15.09	2.00	0.00	0.00	0.16	0.00
15.26	2.00	0.00	0.00	0.16	0.00	15.42	2.00	0.00	0.00	0.16	0.00
15.58	2.00	0.00	0.00	0.16	0.00	15.75	2.00	0.00	0.00	0.16	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
15.91	2.00	0.00	0.00	0.16	0.00	16.08	2.00	0.00	0.00	0.16	0.00
16.24	2.00	0.00	0.00	0.16	0.00	16.40	2.00	0.00	0.00	0.16	0.00
16.57	2.00	0.00	0.00	0.16	0.00	16.73	2.00	0.00	0.00	0.16	0.00
16.90	2.00	0.00	0.00	0.16	0.00	17.06	2.00	0.00	0.00	0.16	0.00
17.22	2.00	0.00	0.00	0.16	0.00	17.39	2.00	0.00	0.00	0.16	0.00
17.55	2.00	0.00	0.00	0.16	0.00	17.72	2.00	0.00	0.00	0.16	0.00
17.88	2.00	0.00	0.00	0.16	0.00	18.04	2.00	0.00	0.00	0.16	0.00
18.21	2.00	0.00	0.00	0.16	0.00	18.37	2.00	0.00	0.00	0.16	0.00
18.54	2.00	0.00	0.00	0.16	0.00	18.70	2.00	0.00	0.00	0.16	0.00
18.86	2.00	0.00	0.00	0.16	0.00	19.03	2.00	0.00	0.00	0.16	0.00
19.19	2.00	0.00	0.00	0.16	0.00	19.36	2.00	0.00	0.00	0.16	0.00
19.52	2.00	0.00	0.00	0.16	0.00	19.69	2.00	0.00	0.00	0.16	0.00
19.85	2.00	0.00	0.00	0.16	0.00	20.01	2.00	0.00	0.00	0.16	0.00
20.18	2.00	0.00	0.00	0.16	0.00	20.34	2.00	0.00	0.00	0.16	0.00
20.51	2.00	0.00	0.00	0.16	0.00	20.67	2.00	0.00	0.00	0.16	0.00
20.83	2.00	0.00	0.00	0.16	0.00	21.00	2.00	0.00	0.00	0.16	0.00
21.16	2.00	0.00	0.00	0.16	0.00	21.33	2.00	0.00	0.00	0.16	0.00
21.49	2.00	0.00	0.00	0.16	0.00	21.65	2.00	0.00	0.00	0.16	0.00
21.82	2.00	0.00	0.00	0.16	0.00	21.98	2.00	0.00	0.00	0.16	0.00
22.15	2.00	0.00	0.00	0.16	0.00	22.31	2.00	0.00	0.00	0.16	0.00
22.47	1.70	0.00	0.00	0.16	0.00	22.64	1.81	0.00	0.00	0.16	0.00
22.80	2.00	0.00	0.00	0.16	0.00	22.97	2.00	0.00	0.00	0.16	0.00
23.13	2.00	0.00	0.00	0.16	0.00	23.29	2.00	0.00	0.00	0.16	0.00
23.46	2.00	0.00	0.00	0.16	0.00	23.62	2.00	0.00	0.00	0.16	0.00
23.79	2.00	0.00	0.00	0.16	0.00	23.95	2.00	0.00	0.00	0.16	0.00
24.11	2.00	0.00	0.00	0.16	0.00	24.28	2.00	0.00	0.00	0.16	0.00
24.44	1.01	0.00	0.00	0.16	0.00	24.61	0.93	0.07	13.48	0.16	0.02
24.77	1.26	0.00	0.00	0.16	0.00	24.93	2.00	0.00	0.00	0.16	0.00
25.10	2.00	0.00	0.00	0.16	0.00	25.26	2.00	0.00	0.00	0.16	0.00
25.43	2.00	0.00	0.00	0.16	0.00	25.59	2.00	0.00	0.00	0.16	0.00
25.75	2.00	0.00	0.00	0.16	0.00	25.92	2.00	0.00	0.00	0.16	0.00
26.08	2.00	0.00	0.00	0.16	0.00	26.25	2.00	0.00	0.00	0.16	0.00
26.41	2.00	0.00	0.00	0.16	0.00	26.57	2.00	0.00	0.00	0.16	0.00
26.74	2.00	0.00	0.00	0.16	0.00	26.90	2.00	0.00	0.00	0.16	0.00
27.07	2.00	0.00	0.00	0.16	0.00	27.23	2.00	0.00	0.00	0.16	0.00
27.40	2.00	0.00	0.00	0.16	0.00	27.56	2.00	0.00	0.00	0.16	0.00
27.72	2.00	0.00	0.00	0.16	0.00	27.89	2.00	0.00	0.00	0.16	0.00
28.05	2.00	0.00	0.00	0.16	0.00	28.22	2.00	0.00	0.00	0.16	0.00
28.38	2.00	0.00	0.00	0.16	0.00	28.54	2.00	0.00	0.00	0.16	0.00
28.71	2.00	0.00	0.00	0.16	0.00	28.87	2.00	0.00	0.00	0.16	0.00
29.04	2.00	0.00	0.00	0.16	0.00	29.20	2.00	0.00	0.00	0.16	0.00
29.36	2.00	0.00	0.00	0.16	0.00	29.53	2.00	0.00	0.00	0.16	0.00
29.69	2.00	0.00	0.00	0.16	0.00	29.86	2.00	0.00	0.00	0.16	0.00
30.02	2.00	0.00	0.00	0.16	0.00	30.18	2.00	0.00	0.00	0.16	0.00
30.35	2.00	0.00	0.00	0.16	0.00	30.51	2.00	0.00	0.00	0.16	0.00
30.68	2.00	0.00	0.00	0.16	0.00	30.84	2.00	0.00	0.00	0.16	0.00
31.00	2.00	0.00	0.00	0.16	0.00	31.17	2.00	0.00	0.00	0.16	0.00
31.33	2.00	0.00	0.00	0.16	0.00	31.50	2.00	0.00	0.00	0.16	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
31.66	2.00	0.00	0.00	0.16	0.00	31.82	2.00	0.00	0.00	0.16	0.00
31.99	2.00	0.00	0.00	0.16	0.00	32.15	2.00	0.00	0.00	0.16	0.00
32.32	2.00	0.00	0.00	0.16	0.00	32.48	2.00	0.00	0.00	0.16	0.00
32.64	2.00	0.00	0.00	0.16	0.00	32.81	2.00	0.00	0.00	0.16	0.00
32.97	2.00	0.00	0.00	0.16	0.00	33.14	2.00	0.00	0.00	0.16	0.00
33.30	2.00	0.00	0.00	0.16	0.00	33.46	2.00	0.00	0.00	0.16	0.00
33.63	2.00	0.00	0.00	0.16	0.00	33.79	2.00	0.00	0.00	0.16	0.00
33.96	2.00	0.00	0.00	0.16	0.00	34.12	2.00	0.00	0.00	0.16	0.00
34.28	2.00	0.00	0.00	0.16	0.00	34.45	2.00	0.00	0.00	0.16	0.00
34.61	2.00	0.00	0.00	0.16	0.00	34.78	2.00	0.00	0.00	0.16	0.00
34.94	2.00	0.00	0.00	0.16	0.00	35.10	2.00	0.00	0.00	0.16	0.00
35.27	2.00	0.00	0.00	0.16	0.00	35.43	2.00	0.00	0.00	0.16	0.00
35.60	2.00	0.00	0.00	0.16	0.00	35.76	2.00	0.00	0.00	0.16	0.00
35.93	2.00	0.00	0.00	0.16	0.00	36.09	2.00	0.00	0.00	0.16	0.00
36.25	2.00	0.00	0.00	0.16	0.00	36.42	2.00	0.00	0.00	0.16	0.00
36.58	2.00	0.00	0.00	0.16	0.00	36.75	2.00	0.00	0.00	0.16	0.00
36.91	2.00	0.00	0.00	0.16	0.00	37.07	2.00	0.00	0.00	0.16	0.00
37.24	2.00	0.00	0.00	0.16	0.00	37.40	2.00	0.00	0.00	0.16	0.00
37.57	2.00	0.00	0.00	0.16	0.00	37.73	2.00	0.00	0.00	0.16	0.00
37.89	2.00	0.00	0.00	0.16	0.00	38.06	2.00	0.00	0.00	0.16	0.00
38.22	2.00	0.00	0.00	0.16	0.00	38.39	2.00	0.00	0.00	0.16	0.00
38.55	2.00	0.00	0.00	0.16	0.00	38.71	2.00	0.00	0.00	0.16	0.00
38.88	2.00	0.00	0.00	0.16	0.00	39.04	2.00	0.00	0.00	0.16	0.00
39.21	2.00	0.00	0.00	0.16	0.00	39.37	1.95	0.00	0.00	0.16	0.00
39.53	1.60	0.00	0.00	0.16	0.00	39.70	1.33	0.00	0.00	0.16	0.00
39.86	1.13	0.00	0.00	0.16	0.00	40.03	1.12	0.00	0.00	0.16	0.00
40.19	1.12	0.00	0.00	0.16	0.00	40.35	1.19	0.00	0.00	0.16	0.00
40.52	1.26	0.00	0.00	0.16	0.00	40.68	1.60	0.00	0.00	0.16	0.00
40.85	1.84	0.00	0.00	0.16	0.00	41.01	1.62	0.00	0.00	0.16	0.00
41.17	1.12	0.00	0.00	0.16	0.00	41.34	1.46	0.00	0.00	0.16	0.00
41.50	1.76	0.00	0.00	0.16	0.00	41.67	2.00	0.00	0.00	0.16	0.00
41.83	2.00	0.00	0.00	0.16	0.00	41.99	2.00	0.00	0.00	0.16	0.00
42.16	1.98	0.00	0.00	0.16	0.00	42.32	1.83	0.00	0.00	0.16	0.00
42.49	1.75	0.00	0.00	0.16	0.00	42.65	1.74	0.00	0.00	0.16	0.00
42.81	1.78	0.00	0.00	0.16	0.00	42.98	1.80	0.00	0.00	0.16	0.00
43.14	1.81	0.00	0.00	0.16	0.00	43.31	1.86	0.00	0.00	0.16	0.00
43.47	1.97	0.00	0.00	0.16	0.00	43.64	2.00	0.00	0.00	0.16	0.00
43.80	1.99	0.00	0.00	0.16	0.00	43.96	1.88	0.00	0.00	0.16	0.00
44.13	1.77	0.00	0.00	0.16	0.00	44.29	1.78	0.00	0.00	0.16	0.00
44.46	1.80	0.00	0.00	0.16	0.00	44.62	1.84	0.00	0.00	0.16	0.00
44.78	1.80	0.00	0.00	0.16	0.00	44.95	1.75	0.00	0.00	0.16	0.00
45.11	1.75	0.00	0.00	0.16	0.00	45.28	1.71	0.00	0.00	0.16	0.00
45.44	1.59	0.00	0.00	0.16	0.00	45.60	1.43	0.00	0.00	0.16	0.00
45.77	1.35	0.00	0.00	0.16	0.00	45.93	1.42	0.00	0.00	0.16	0.00
46.10	1.58	0.00	0.00	0.16	0.00	46.26	1.72	0.00	0.00	0.16	0.00
46.42	1.73	0.00	0.00	0.16	0.00	46.59	1.53	0.00	0.00	0.16	0.00
46.75	1.31	0.00	0.00	0.16	0.00	46.92	1.15	0.00	0.00	0.16	0.00
47.08	1.18	0.00	0.00	0.16	0.00	47.24	1.30	0.00	0.00	0.16	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
47.41	1.43	0.00	0.00	0.16	0.00	47.57	1.44	0.00	0.00	0.16	0.00
47.74	1.33	0.00	0.00	0.16	0.00	47.90	1.15	0.00	0.00	0.16	0.00
48.06	1.07	0.00	0.00	0.16	0.00	48.23	1.11	0.00	0.00	0.16	0.00
48.39	1.19	0.00	0.00	0.16	0.00	48.56	1.32	0.00	0.00	0.16	0.00
48.72	1.47	0.00	0.00	0.16	0.00	48.88	1.57	0.00	0.00	0.16	0.00
49.05	1.72	0.00	0.00	0.16	0.00	49.21	1.94	0.00	0.00	0.16	0.00
49.38	2.00	0.00	0.00	0.16	0.00	49.54	2.00	0.00	0.00	0.16	0.00
49.70	1.95	0.00	0.00	0.16	0.00	49.87	1.67	0.00	0.00	0.16	0.00
50.03	2.00	0.00	0.00	0.16	0.00	50.20	2.00	0.00	0.00	0.16	0.00
50.36	2.00	0.00	0.00	0.16	0.00	50.52	2.00	0.00	0.00	0.16	0.00

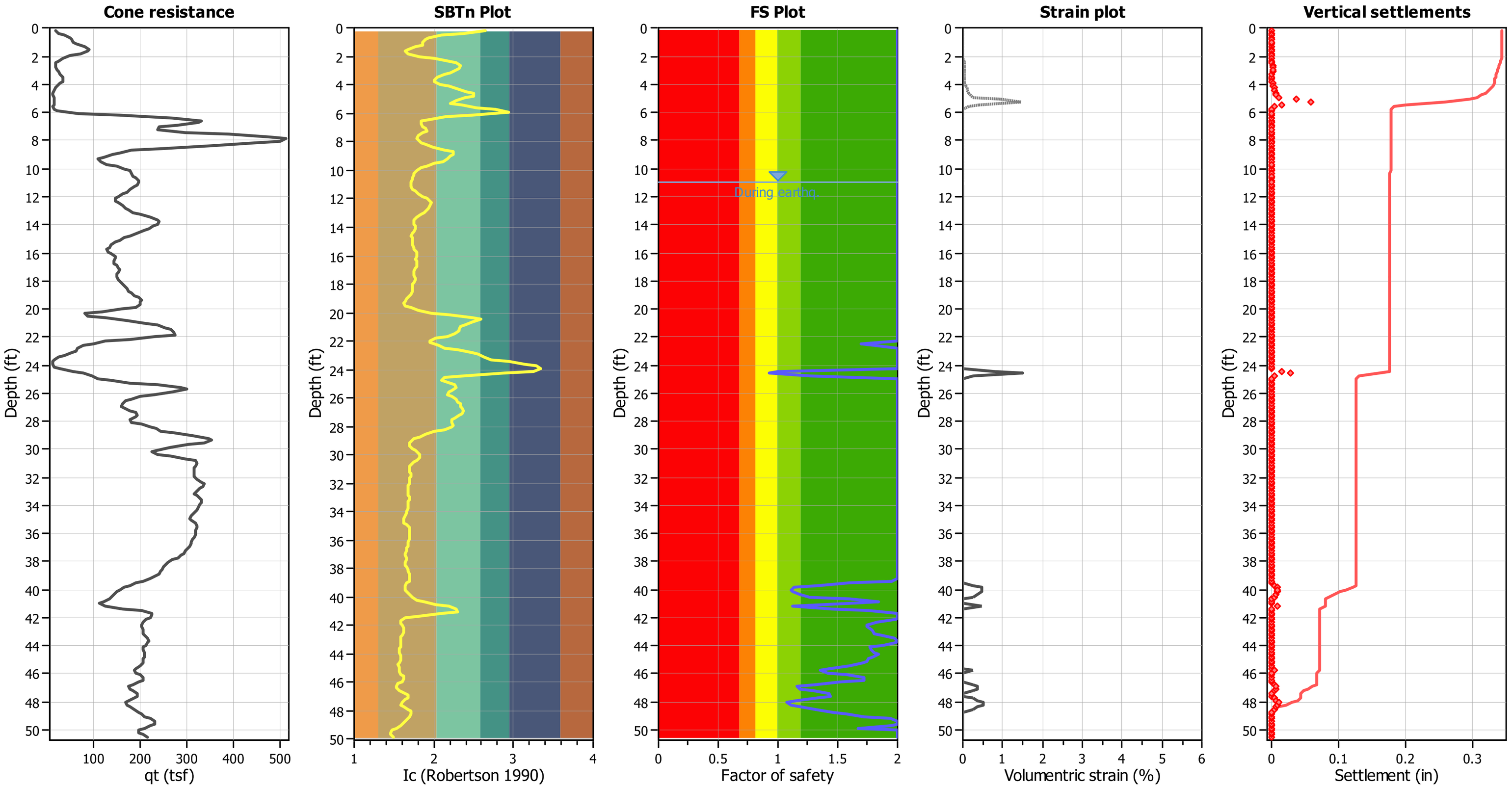
Overall liquefaction potential: 0.02

LPI = 0.00 - Liquefaction risk very low
LPI between 0.00 and 5.00 - Liquefaction risk low
LPI between 5.00 and 15.00 - Liquefaction risk high
LPI > 15.00 - Liquefaction risk very high

Abbreviations

FS: Calculated factor of safety for test point
F_L: 1 - FS
w_z: Function value of the extend of soil liquefaction according to depth
d_z: Layer thickness (ft)
LPI: Liquefaction potential index value for test point

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement of dry sands ::

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
0.16	2.65	25.53	4.22	107.83	0	0	0.15	0.000	0.00	0.00	0.00	0.000
0.33	2.37	39.38	2.22	87.37	21	443	0.15	0.001	0.00	5.81	0.00	0.000
0.49	2.10	59.78	1.41	84.43	18	476	0.15	0.002	0.00	5.81	0.00	0.000
0.66	1.93	77.47	1.26	97.51	20	502	0.15	0.002	0.00	5.81	0.00	0.000
0.82	1.90	82.14	1.23	101.42	20	508	0.15	0.003	0.00	5.81	0.00	0.000
0.98	1.87	89.14	1.21	108.29	21	532	0.15	0.003	0.00	5.81	0.00	0.000
1.15	1.85	99.80	1.20	120.09	24	584	0.15	0.003	0.00	5.81	0.00	0.000
1.31	1.76	126.98	1.10	139.86	27	661	0.15	0.003	0.00	5.81	0.00	0.000
1.48	1.68	145.29	1.00	145.29	27	683	0.15	0.003	0.00	5.81	0.00	0.000
1.64	1.65	139.59	1.00	139.59	26	629	0.15	0.004	0.00	5.81	0.00	0.000
1.80	1.68	112.34	1.00	112.34	21	527	0.15	0.006	0.01	5.81	0.00	0.000
1.97	1.83	75.77	1.00	75.77	15	431	0.15	0.009	0.01	5.81	0.01	0.000
2.13	2.01	51.29	1.31	67.42	14	366	0.15	0.013	0.02	5.81	0.01	0.001
2.30	2.18	36.01	1.57	56.65	13	320	0.15	0.018	0.03	5.81	0.02	0.001
2.46	2.28	29.43	1.87	54.88	13	297	0.15	0.024	0.04	5.81	0.03	0.001
2.62	2.33	27.03	2.05	55.51	13	290	0.15	0.028	0.05	5.81	0.03	0.001
2.79	2.32	27.95	2.00	56.04	13	296	0.15	0.029	0.05	5.81	0.03	0.001
2.95	2.28	30.68	1.84	56.36	13	307	0.15	0.029	0.05	5.81	0.03	0.001
3.12	2.22	35.00	1.65	57.88	13	324	0.15	0.027	0.05	5.81	0.03	0.001
3.28	2.13	41.81	1.47	61.50	13	349	0.15	0.025	0.04	5.81	0.03	0.001
3.44	2.05	49.84	1.35	67.35	14	373	0.15	0.023	0.03	5.81	0.02	0.001
3.61	2.00	54.71	1.31	71.41	15	385	0.15	0.023	0.03	5.81	0.02	0.001
3.77	2.01	52.08	1.32	68.71	14	374	0.15	0.026	0.04	5.81	0.03	0.001
3.94	2.09	43.67	1.40	61.07	13	343	0.15	0.034	0.06	5.81	0.04	0.001
4.10	2.19	34.10	1.59	54.13	12	305	0.15	0.050	0.09	5.81	0.06	0.002
4.27	2.30	26.44	1.93	50.90	12	273	0.15	0.078	0.14	5.81	0.09	0.004
4.43	2.41	21.18	2.43	51.37	13	251	0.15	0.114	0.20	5.81	0.13	0.005
4.59	2.49	18.19	2.92	53.20	14	239	0.15	0.149	0.23	5.81	0.15	0.006
4.76	2.50	17.97	2.96	53.26	14	238	0.15	0.164	0.26	5.81	0.17	0.007
4.92	2.39	19.90	2.31	45.93	11	229	0.15	0.208	0.42	5.81	0.27	0.011
5.09	2.28	21.76	1.00	21.76	5	218	0.15	0.281	1.46	5.81	0.95	0.037
5.25	2.22	21.99	1.00	21.99	5	204	0.15	0.429	2.27	5.81	1.48	0.058
5.41	2.35	20.22	2.15	43.46	10	223	0.15	0.290	0.63	5.81	0.41	0.016
5.58	2.53	19.01	3.19	60.63	16	262	0.15	0.151	0.20	5.81	0.13	0.005
5.74	2.78	20.53	5.59	114.66	0	0	0.15	0.000	0.00	0.00	0.00	0.000
5.91	2.94	31.34	7.73	242.35	0	0	0.15	0.000	0.00	0.00	0.00	0.000
6.07	2.48	105.64	2.86	301.90	77	1371	0.15	0.006	0.00	5.81	0.00	0.000
6.23	2.16	247.45	1.52	376.87	84	2136	0.15	0.004	0.00	5.81	0.00	0.000
6.40	1.95	427.55	1.27	543.83	111	2840	0.15	0.003	0.00	5.81	0.00	0.000
6.56	1.85	530.32	1.20	635.84	125	3084	0.15	0.003	0.00	5.81	0.00	0.000
6.73	1.83	520.58	1.19	618.28	121	2977	0.15	0.003	0.00	5.81	0.00	0.000
6.89	1.85	446.93	1.20	537.19	106	2611	0.15	0.004	0.00	5.81	0.00	0.000
7.05	1.89	383.24	1.23	472.47	94	2362	0.15	0.004	0.00	5.81	0.00	0.000
7.22	1.91	377.85	1.24	469.76	94	2376	0.15	0.004	0.00	5.81	0.00	0.000
7.38	1.85	472.23	1.20	568.33	112	2775	0.15	0.004	0.00	5.81	0.00	0.000
7.55	1.81	606.15	1.16	702.58	136	3448	0.15	0.003	0.00	5.81	0.00	0.000
7.71	1.78	729.52	1.13	825.20	158	4111	0.15	0.003	0.00	5.81	0.00	0.000
7.87	1.80	772.87	1.15	887.77	171	4479	0.15	0.002	0.00	5.81	0.00	0.000

:: Post-earthquake settlement of dry sands :: (continued)

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
8.04	1.84	752.95	1.19	897.41	176	4622	0.15	0.002	0.00	5.81	0.00	0.000
8.20	1.89	671.86	1.23	828.46	166	4422	0.15	0.003	0.00	5.81	0.00	0.000
8.37	2.00	534.65	1.30	697.41	145	3964	0.15	0.003	0.00	5.81	0.00	0.000
8.53	2.13	381.44	1.47	559.40	123	3293	0.15	0.004	0.00	5.81	0.00	0.000
8.69	2.24	281.74	1.72	485.96	111	2771	0.15	0.005	0.00	5.81	0.00	0.000
8.86	2.25	237.35	1.76	416.95	96	2396	0.15	0.006	0.00	5.81	0.00	0.000
9.02	2.21	210.10	1.65	345.96	78	2066	0.15	0.007	0.00	5.81	0.00	0.000
9.19	2.17	178.64	1.54	274.94	61	1697	0.15	0.008	0.00	5.81	0.00	0.000
9.35	2.11	155.24	1.43	222.07	48	1402	0.15	0.011	0.00	5.81	0.00	0.000
9.51	2.00	156.11	1.31	204.59	43	1276	0.15	0.012	0.01	5.81	0.00	0.000
9.68	1.91	171.19	1.24	212.91	43	1279	0.15	0.013	0.01	5.81	0.00	0.000
9.84	1.83	195.20	1.19	231.63	45	1356	0.15	0.012	0.00	5.81	0.00	0.000
10.01	1.79	214.10	1.14	243.51	47	1428	0.15	0.012	0.00	5.81	0.00	0.000
10.17	1.76	224.28	1.09	245.23	47	1459	0.15	0.011	0.00	5.81	0.00	0.000
10.33	1.75	226.59	1.08	243.94	46	1471	0.15	0.012	0.00	5.81	0.00	0.000
10.50	1.74	228.18	1.07	243.39	46	1486	0.15	0.012	0.00	5.81	0.00	0.000
10.66	1.73	233.25	1.06	246.13	46	1522	0.15	0.011	0.00	5.81	0.00	0.000
10.83	1.72	237.65	1.03	243.79	46	1538	0.15	0.012	0.00	5.81	0.00	0.000
10.99	1.71	237.36	1.00	237.36	44	1527	0.15	0.012	0.00	5.81	0.00	0.000

Total estimated settlement: 0.17

Abbreviations

Q_{tn}: Equivalent clean sand normalized cone resistance
K_c: Fines correction factor
$Q_{tn,cs}$: Post-liquefaction volumentric strain
G_{max}: Small strain shear modulus
CSR: Soil cyclic stress ratio
γ: Cyclic shear strain
$e_{vol(15)}$: Volumetric strain after 15 cycles
N_c: Equivalent number of cycles
e_v: Volumetric strain
Settle.: Calculated settlement

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
11.15	231.31	2.00	0.00	1.00	0.00	11.32	232.14	2.00	0.00	1.00	0.00
11.48	236.30	2.00	0.00	1.00	0.00	11.65	237.55	2.00	0.00	1.00	0.00
11.81	233.54	2.00	0.00	1.00	0.00	11.98	226.94	2.00	0.00	1.00	0.00
12.14	222.83	2.00	0.00	1.00	0.00	12.30	225.76	2.00	0.00	1.00	0.00
12.47	232.64	2.00	0.00	1.00	0.00	12.63	241.01	2.00	0.00	1.00	0.00
12.80	244.90	2.00	0.00	1.00	0.00	12.96	248.07	2.00	0.00	1.00	0.00
13.12	254.18	2.00	0.00	1.00	0.00	13.29	263.09	2.00	0.00	1.00	0.00
13.45	273.52	2.00	0.00	1.00	0.00	13.62	286.43	2.00	0.00	1.00	0.00
13.78	294.94	2.00	0.00	1.00	0.00	13.94	292.87	2.00	0.00	1.00	0.00
14.11	278.70	2.00	0.00	1.00	0.00	14.27	260.26	2.00	0.00	1.00	0.00
14.44	239.57	2.00	0.00	1.00	0.00	14.60	220.50	2.00	0.00	1.00	0.00
14.76	205.97	2.00	0.00	1.00	0.00	14.93	191.30	2.00	0.00	1.00	0.00
15.09	179.13	2.00	0.00	1.00	0.00	15.26	166.72	2.00	0.00	1.00	0.00
15.42	160.15	2.00	0.00	1.00	0.00	15.58	156.66	2.00	0.00	1.00	0.00
15.75	156.10	2.00	0.00	1.00	0.00	15.91	160.93	2.00	0.00	1.00	0.00
16.08	166.73	2.00	0.00	1.00	0.00	16.24	172.40	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
16.40	174.19	2.00	0.00	1.00	0.00	16.57	173.70	2.00	0.00	1.00	0.00
16.73	173.31	2.00	0.00	1.00	0.00	16.90	174.55	2.00	0.00	1.00	0.00
17.06	175.97	2.00	0.00	1.00	0.00	17.22	176.60	2.00	0.00	1.00	0.00
17.39	174.80	2.00	0.00	1.00	0.00	17.55	172.27	2.00	0.00	1.00	0.00
17.72	170.24	2.00	0.00	1.00	0.00	17.88	169.80	2.00	0.00	1.00	0.00
18.04	170.40	2.00	0.00	1.00	0.00	18.21	172.14	2.00	0.00	1.00	0.00
18.37	176.78	2.00	0.00	1.00	0.00	18.54	180.54	2.00	0.00	1.00	0.00
18.70	181.83	2.00	0.00	1.00	0.00	18.86	181.69	2.00	0.00	1.00	0.00
19.03	189.20	2.00	0.00	1.00	0.00	19.19	196.35	2.00	0.00	1.00	0.00
19.36	201.86	2.00	0.00	1.00	0.00	19.52	199.44	2.00	0.00	1.00	0.00
19.69	198.67	2.00	0.00	1.00	0.00	19.85	220.82	2.00	0.00	1.00	0.00
20.01	203.88	2.00	0.00	1.00	0.00	20.18	185.69	2.00	0.00	1.00	0.00
20.34	230.58	2.00	0.00	1.00	0.00	20.51	306.74	2.00	0.00	1.00	0.00
20.67	354.34	2.00	0.00	1.00	0.00	20.83	396.01	2.00	0.00	1.00	0.00
21.00	429.35	2.00	0.00	1.00	0.00	21.16	464.42	2.00	0.00	1.00	0.00
21.33	491.17	2.00	0.00	1.00	0.00	21.49	465.12	2.00	0.00	1.00	0.00
21.65	409.70	2.00	0.00	1.00	0.00	21.82	348.47	2.00	0.00	1.00	0.00
21.98	281.08	2.00	0.00	1.00	0.00	22.15	213.87	2.00	0.00	1.00	0.00
22.31	158.83	2.00	0.00	1.00	0.00	22.47	138.52	1.70	0.00	1.00	0.00
22.64	142.53	1.81	0.00	1.00	0.00	22.80	169.12	2.00	0.00	1.00	0.00
22.97	183.99	2.00	0.00	1.00	0.00	23.13	182.28	2.00	0.00	1.00	0.00
23.29	164.56	2.00	0.00	1.00	0.00	23.46	149.06	2.00	0.00	1.00	0.00
23.62	131.44	2.00	0.00	1.00	0.00	23.79	128.16	2.00	0.00	1.00	0.00
23.95	141.43	2.00	0.00	1.00	0.00	24.11	157.11	2.00	0.00	1.00	0.00
24.28	152.01	2.00	0.00	1.00	0.00	24.44	108.66	1.01	0.82	1.00	0.02
24.61	103.85	0.93	1.48	1.00	0.03	24.77	122.62	1.26	0.25	1.00	0.00
24.93	159.97	2.00	0.00	1.00	0.00	25.10	214.92	2.00	0.00	1.00	0.00
25.26	296.34	2.00	0.00	1.00	0.00	25.43	360.15	2.00	0.00	1.00	0.00
25.59	405.73	2.00	0.00	1.00	0.00	25.75	413.71	2.00	0.00	1.00	0.00
25.92	394.78	2.00	0.00	1.00	0.00	26.08	372.06	2.00	0.00	1.00	0.00
26.25	339.93	2.00	0.00	1.00	0.00	26.41	317.62	2.00	0.00	1.00	0.00
26.57	303.68	2.00	0.00	1.00	0.00	26.74	301.04	2.00	0.00	1.00	0.00
26.90	303.18	2.00	0.00	1.00	0.00	27.07	303.77	2.00	0.00	1.00	0.00
27.23	302.36	2.00	0.00	1.00	0.00	27.40	293.16	2.00	0.00	1.00	0.00
27.56	280.84	2.00	0.00	1.00	0.00	27.72	269.17	2.00	0.00	1.00	0.00
27.89	262.55	2.00	0.00	1.00	0.00	28.05	258.74	2.00	0.00	1.00	0.00
28.22	250.77	2.00	0.00	1.00	0.00	28.38	247.17	2.00	0.00	1.00	0.00
28.54	246.34	2.00	0.00	1.00	0.00	28.71	243.34	2.00	0.00	1.00	0.00
28.87	255.83	2.00	0.00	1.00	0.00	29.04	268.66	2.00	0.00	1.00	0.00
29.20	295.75	2.00	0.00	1.00	0.00	29.36	301.63	2.00	0.00	1.00	0.00
29.53	301.67	2.00	0.00	1.00	0.00	29.69	285.24	2.00	0.00	1.00	0.00
29.86	258.33	2.00	0.00	1.00	0.00	30.02	232.22	2.00	0.00	1.00	0.00
30.18	218.98	2.00	0.00	1.00	0.00	30.35	224.77	2.00	0.00	1.00	0.00
30.51	241.90	2.00	0.00	1.00	0.00	30.68	254.84	2.00	0.00	1.00	0.00
30.84	264.13	2.00	0.00	1.00	0.00	31.00	266.26	2.00	0.00	1.00	0.00
31.17	263.69	2.00	0.00	1.00	0.00	31.33	263.28	2.00	0.00	1.00	0.00
31.50	261.25	2.00	0.00	1.00	0.00	31.66	260.27	2.00	0.00	1.00	0.00
31.82	258.42	2.00	0.00	1.00	0.00	31.99	258.18	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
32.15	263.82	2.00	0.00	1.00	0.00	32.32	270.34	2.00	0.00	1.00	0.00
32.48	274.37	2.00	0.00	1.00	0.00	32.64	273.01	2.00	0.00	1.00	0.00
32.81	267.35	2.00	0.00	1.00	0.00	32.97	259.70	2.00	0.00	1.00	0.00
33.14	255.57	2.00	0.00	1.00	0.00	33.30	258.59	2.00	0.00	1.00	0.00
33.46	263.77	2.00	0.00	1.00	0.00	33.63	266.19	2.00	0.00	1.00	0.00
33.79	265.45	2.00	0.00	1.00	0.00	33.96	263.93	2.00	0.00	1.00	0.00
34.12	261.01	2.00	0.00	1.00	0.00	34.28	257.89	2.00	0.00	1.00	0.00
34.45	253.35	2.00	0.00	1.00	0.00	34.61	249.16	2.00	0.00	1.00	0.00
34.78	245.62	2.00	0.00	1.00	0.00	34.94	241.48	2.00	0.00	1.00	0.00
35.10	243.48	2.00	0.00	1.00	0.00	35.27	248.80	2.00	0.00	1.00	0.00
35.43	253.02	2.00	0.00	1.00	0.00	35.60	252.10	2.00	0.00	1.00	0.00
35.76	249.25	2.00	0.00	1.00	0.00	35.93	248.25	2.00	0.00	1.00	0.00
36.09	247.07	2.00	0.00	1.00	0.00	36.25	244.01	2.00	0.00	1.00	0.00
36.42	241.94	2.00	0.00	1.00	0.00	36.58	240.08	2.00	0.00	1.00	0.00
36.75	239.08	2.00	0.00	1.00	0.00	36.91	236.24	2.00	0.00	1.00	0.00
37.07	232.54	2.00	0.00	1.00	0.00	37.24	228.36	2.00	0.00	1.00	0.00
37.40	225.04	2.00	0.00	1.00	0.00	37.57	221.14	2.00	0.00	1.00	0.00
37.73	213.90	2.00	0.00	1.00	0.00	37.89	205.55	2.00	0.00	1.00	0.00
38.06	197.51	2.00	0.00	1.00	0.00	38.22	191.70	2.00	0.00	1.00	0.00
38.39	187.92	2.00	0.00	1.00	0.00	38.55	184.73	2.00	0.00	1.00	0.00
38.71	182.58	2.00	0.00	1.00	0.00	38.88	180.59	2.00	0.00	1.00	0.00
39.04	175.58	2.00	0.00	1.00	0.00	39.21	166.59	2.00	0.00	1.00	0.00
39.37	154.48	1.95	0.00	1.00	0.00	39.53	142.29	1.60	0.00	1.00	0.00
39.70	131.22	1.33	0.24	1.00	0.00	39.86	121.23	1.13	0.49	1.00	0.01
40.03	120.42	1.12	0.49	1.00	0.01	40.19	120.89	1.12	0.49	1.00	0.01
40.35	124.04	1.19	0.35	1.00	0.01	40.52	127.86	1.26	0.24	1.00	0.00
40.68	142.07	1.60	0.00	1.00	0.00	40.85	151.01	1.84	0.00	1.00	0.00
41.01	142.83	1.62	0.00	1.00	0.00	41.17	120.56	1.12	0.49	1.00	0.01
41.34	136.31	1.46	0.00	1.00	0.00	41.50	147.82	1.76	0.00	1.00	0.00
41.67	164.92	2.00	0.00	1.00	0.00	41.83	164.78	2.00	0.00	1.00	0.00
41.99	161.10	2.00	0.00	1.00	0.00	42.16	155.41	1.98	0.00	1.00	0.00
42.32	150.40	1.83	0.00	1.00	0.00	42.49	147.34	1.75	0.00	1.00	0.00
42.65	147.22	1.74	0.00	1.00	0.00	42.81	148.46	1.78	0.00	1.00	0.00
42.98	149.03	1.80	0.00	1.00	0.00	43.14	149.49	1.81	0.00	1.00	0.00
43.31	151.21	1.86	0.00	1.00	0.00	43.47	154.83	1.97	0.00	1.00	0.00
43.64	156.84	2.00	0.00	1.00	0.00	43.80	155.19	1.99	0.00	1.00	0.00
43.96	151.59	1.88	0.00	1.00	0.00	44.13	147.96	1.77	0.00	1.00	0.00
44.29	148.11	1.78	0.00	1.00	0.00	44.46	148.85	1.80	0.00	1.00	0.00
44.62	150.07	1.84	0.00	1.00	0.00	44.78	148.67	1.80	0.00	1.00	0.00
44.95	147.05	1.75	0.00	1.00	0.00	45.11	146.73	1.75	0.00	1.00	0.00
45.28	145.44	1.71	0.00	1.00	0.00	45.44	140.98	1.59	0.00	1.00	0.00
45.60	134.32	1.43	0.00	1.00	0.00	45.77	130.77	1.35	0.24	1.00	0.00
45.93	133.70	1.42	0.00	1.00	0.00	46.10	140.20	1.58	0.00	1.00	0.00
46.26	145.43	1.72	0.00	1.00	0.00	46.42	145.61	1.73	0.00	1.00	0.00
46.59	138.07	1.53	0.00	1.00	0.00	46.75	128.51	1.31	0.24	1.00	0.00
46.92	121.08	1.15	0.35	1.00	0.01	47.08	122.52	1.18	0.35	1.00	0.01
47.24	127.99	1.30	0.24	1.00	0.00	47.41	133.65	1.43	0.00	1.00	0.00
47.57	134.35	1.44	0.00	1.00	0.00	47.74	129.07	1.33	0.24	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
47.90	120.58	1.15	0.36	1.00	0.01	48.06	116.09	1.07	0.50	1.00	0.01
48.23	118.33	1.11	0.49	1.00	0.01	48.39	122.23	1.19	0.35	1.00	0.01
48.56	128.60	1.32	0.24	1.00	0.00	48.72	134.83	1.47	0.00	1.00	0.00
48.88	139.08	1.57	0.00	1.00	0.00	49.05	144.33	1.72	0.00	1.00	0.00
49.21	151.89	1.94	0.00	1.00	0.00	49.38	158.59	2.00	0.00	1.00	0.00
49.54	159.27	2.00	0.00	1.00	0.00	49.70	152.06	1.95	0.00	1.00	0.00
49.87	142.23	1.67	0.00	1.00	0.00	50.03	-1.00	2.00	0.00	1.00	0.00
50.20	-1.00	2.00	0.00	1.00	0.00	50.36	-1.00	2.00	0.00	1.00	0.00
50.52	-1.00	2.00	0.00	1.00	0.00						

Total estimated settlement: 0.18

Abbreviations

$Q_{tn,cs}$: Equivalent clean sand normalized cone resistance
FS: Factor of safety against liquefaction
e_v (%): Post-liquefaction volumentric strain
DF: e_v depth weighting factor
Settlement: Calculated settlement

:: Strength loss calculation (Robertson (2009) ::

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
0.16	15.90	25.53	4.22	107.83	2.65	0.76	0.76
0.33	24.53	39.38	2.22	87.37	2.37	0.72	0.72
0.49	37.23	59.78	1.41	84.43	2.10	0.72	0.72
0.66	48.26	77.47	1.26	97.51	1.93	0.74	0.74
0.82	51.17	82.14	1.23	101.42	1.90	0.75	0.75
0.98	55.54	89.14	1.21	108.29	1.87	0.76	0.76
1.15	62.18	99.80	1.20	120.09	1.85	0.78	0.78
1.31	79.11	126.98	1.10	139.86	1.76	0.81	0.81
1.48	90.51	145.29	1.00	145.29	1.68	0.82	0.82
1.64	86.98	139.59	1.00	139.59	1.65	0.81	0.81
1.80	70.02	112.34	1.00	112.34	1.68	0.77	0.77
1.97	47.27	75.77	1.00	75.77	1.83	0.41	0.70
2.13	32.05	51.29	1.31	67.42	2.01	0.21	0.68
2.30	22.54	36.01	1.57	56.65	2.18	0.09	0.65
2.46	18.45	29.43	1.87	54.88	2.28	0.08	0.64
2.62	16.97	27.03	2.05	55.51	2.33	0.08	0.64
2.79	17.55	27.95	2.00	56.04	2.32	0.08	0.64
2.95	19.26	30.68	1.84	56.36	2.28	0.08	0.65
3.12	21.96	35.00	1.65	57.88	2.22	0.10	0.65
3.28	26.21	41.81	1.47	61.50	2.13	0.13	0.66
3.44	31.21	49.84	1.35	67.35	2.05	0.20	0.68
3.61	34.25	54.71	1.31	71.41	2.00	0.29	0.69
3.77	32.62	52.08	1.32	68.71	2.01	0.23	0.68
3.94	27.40	43.67	1.40	61.07	2.09	0.12	0.66
4.10	21.45	34.10	1.59	54.13	2.19	0.07	0.64
4.27	16.69	26.44	1.93	50.90	2.30	0.06	0.63
4.43	13.43	21.18	2.43	51.37	2.41	0.06	0.63
4.59	11.57	18.19	2.92	53.20	2.49	0.07	0.64
4.76	11.44	17.97	2.96	53.26	2.50	0.07	0.64
4.92	12.65	19.90	2.31	45.93	2.39	0.04	0.62
5.09	13.82	21.76	1.00	21.76	2.28	0.02	0.62
5.25	13.97	21.99	1.00	21.99	2.22	0.02	0.62
5.41	12.87	20.22	2.15	43.46	2.35	0.03	0.62
5.58	12.13	19.01	3.19	60.63	2.53	0.12	0.66
5.74	13.08	20.53	5.59	114.66	2.78	0.77	0.77
5.91	19.82	31.34	7.73	242.35	2.94	0.93	0.93
6.07	66.08	105.64	2.86	301.90	2.48	0.98	0.98
6.23	154.36	247.45	1.52	376.87	2.16	1.03	1.03
6.40	266.46	427.55	1.27	543.83	1.95	1.13	1.13
6.56	330.44	530.32	1.20	635.84	1.85	1.17	1.17
6.73	324.39	520.58	1.19	618.28	1.83	1.16	1.16
6.89	278.56	446.93	1.20	537.19	1.85	1.12	1.12
7.05	238.93	383.24	1.23	472.47	1.89	1.09	1.09
7.22	235.58	377.85	1.24	469.76	1.91	1.09	1.09
7.38	295.30	472.23	1.20	568.33	1.85	1.14	1.14
7.55	389.72	606.15	1.16	702.58	1.81	1.20	1.20
7.71	478.70	729.52	1.13	825.20	1.78	1.25	1.25
7.87	512.26	772.87	1.15	887.77	1.80	1.27	1.27

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
8.04	500.46	752.95	1.19	897.41	1.84	1.28	1.28
8.20	446.73	671.86	1.23	828.46	1.89	1.25	1.25
8.37	351.90	534.65	1.30	697.41	2.00	1.20	1.20
8.53	247.13	381.44	1.47	559.40	2.13	1.14	1.14
8.69	180.87	281.74	1.72	485.96	2.24	1.10	1.10
8.86	154.41	237.35	1.76	416.95	2.25	1.06	1.06
9.02	139.86	210.10	1.65	345.96	2.21	1.01	1.01
9.19	121.74	178.64	1.54	274.94	2.17	0.96	0.96
9.35	108.49	155.24	1.43	222.07	2.11	0.91	0.91
9.51	112.67	156.11	1.31	204.59	2.00	0.89	0.89
9.68	127.08	171.19	1.24	212.91	1.91	0.90	0.90
9.84	148.40	195.20	1.19	231.63	1.83	0.92	0.92
10.01	165.71	214.10	1.14	243.51	1.79	0.93	0.93
10.17	176.17	224.28	1.09	245.23	1.76	0.93	0.93
10.33	179.95	226.59	1.08	243.94	1.75	0.93	0.93
10.50	183.05	228.18	1.07	243.39	1.74	0.93	0.93
10.66	188.97	233.25	1.06	246.13	1.73	0.93	0.93
10.83	194.65	237.65	1.03	243.79	1.72	0.93	0.93
10.99	196.45	237.36	1.00	237.36	1.71	0.92	0.92
11.15	191.87	230.80	1.00	231.31	1.71	0.92	0.92
11.32	184.78	221.92	1.05	232.14	1.73	0.92	0.92
11.48	176.81	212.53	1.11	236.30	1.77	0.92	0.92
11.65	169.28	203.74	1.17	237.55	1.81	0.92	0.92
11.81	159.90	192.83	1.21	233.54	1.86	0.92	0.92
11.98	150.88	182.21	1.25	226.94	1.91	0.91	0.91
12.14	145.53	175.66	1.27	222.83	1.95	0.91	0.91
12.30	146.87	176.72	1.28	225.76	1.96	0.91	0.91
12.47	153.05	183.09	1.27	232.64	1.95	0.92	0.92
12.63	161.44	191.77	1.26	241.01	1.93	0.93	0.93
12.80	167.09	197.09	1.24	244.90	1.91	0.93	0.93
12.96	173.03	202.57	1.22	248.07	1.88	0.93	0.93
13.12	183.28	212.72	1.19	254.18	1.84	0.94	0.94
13.29	199.71	229.61	1.15	263.09	1.79	0.95	0.95
13.45	219.67	250.52	1.09	273.52	1.75	0.96	0.96
13.62	234.94	266.57	1.07	286.43	1.74	0.97	0.97
13.78	240.48	271.92	1.08	294.94	1.75	0.97	0.97
13.94	235.14	265.10	1.10	292.87	1.76	0.97	0.97
14.11	225.78	253.38	1.10	278.70	1.76	0.96	0.96
14.27	216.90	242.05	1.08	260.26	1.74	0.94	0.94
14.44	206.78	229.45	1.04	239.57	1.73	0.93	0.93
14.60	193.34	213.55	1.03	220.50	1.72	0.91	0.91
14.76	176.65	194.56	1.06	205.97	1.74	0.89	0.89
14.93	164.88	180.86	1.06	191.30	1.73	0.88	0.88
15.09	153.89	168.21	1.06	179.13	1.74	0.86	0.86
15.26	146.73	159.63	1.04	166.72	1.73	0.85	0.85
15.42	137.52	149.24	1.07	160.15	1.74	0.84	0.84
15.58	131.87	142.75	1.10	156.66	1.76	0.84	0.84
15.75	126.15	136.42	1.14	156.10	1.79	0.84	0.84

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
15.91	130.94	141.12	1.14	160.93	1.79	0.84	0.84
16.08	136.76	146.89	1.14	166.73	1.79	0.85	0.85
16.24	144.75	154.81	1.11	172.40	1.77	0.86	0.86
16.40	144.66	154.31	1.13	174.19	1.78	0.86	0.86
16.57	143.50	152.63	1.14	173.70	1.79	0.86	0.86
16.73	143.85	152.47	1.14	173.31	1.79	0.86	0.86
16.90	147.70	155.92	1.12	174.55	1.77	0.86	0.86
17.06	153.06	160.89	1.09	175.97	1.76	0.86	0.86
17.22	155.53	162.91	1.08	176.60	1.75	0.86	0.86
17.39	153.25	160.03	1.09	174.80	1.75	0.86	0.86
17.55	149.25	155.42	1.11	172.27	1.77	0.86	0.86
17.72	148.45	154.06	1.11	170.24	1.76	0.85	0.85
17.88	151.69	156.82	1.08	169.80	1.75	0.85	0.85
18.04	156.17	160.86	1.06	170.40	1.74	0.85	0.85
18.21	160.98	165.25	1.04	172.14	1.73	0.86	0.86
18.37	164.94	168.84	1.05	176.78	1.73	0.86	0.86
18.54	169.98	173.46	1.04	180.54	1.73	0.87	0.87
18.70	175.30	178.28	1.02	181.83	1.72	0.87	0.87
18.86	179.32	181.69	1.00	181.69	1.70	0.87	0.87
19.03	187.48	189.20	1.00	189.20	1.67	0.88	0.88
19.19	195.29	196.35	1.00	196.35	1.64	0.88	0.88
19.36	201.35	201.86	1.00	201.86	1.63	0.89	0.89
19.52	199.51	199.44	1.00	199.44	1.64	0.89	0.89
19.69	197.28	197.10	1.01	198.67	1.71	0.89	0.89
19.85	190.75	190.55	1.16	220.82	1.81	0.91	0.91
20.01	158.87	158.81	1.28	203.88	1.97	0.89	0.89
20.18	118.47	118.43	1.57	185.69	2.18	0.87	0.87
20.34	80.84	80.78	2.85	230.58	2.48	0.92	0.92
20.51	85.14	84.97	3.61	306.74	2.58	0.98	0.98
20.67	124.47	123.89	2.86	354.34	2.48	1.02	1.02
20.83	169.91	168.44	2.35	396.01	2.40	1.05	1.05
21.00	211.81	209.05	2.05	429.35	2.33	1.07	1.07
21.16	235.47	231.46	2.01	464.42	2.32	1.09	1.09
21.33	252.23	246.92	1.99	491.17	2.32	1.10	1.10
21.49	263.77	256.96	1.81	465.12	2.27	1.09	1.09
21.65	270.43	262.06	1.56	409.70	2.18	1.05	1.05
21.82	273.47	263.44	1.32	348.47	2.02	1.01	1.01
21.98	229.95	220.36	1.28	281.08	1.96	0.96	0.96
22.15	177.40	169.11	1.26	213.87	1.94	0.90	0.90
22.31	123.15	116.71	1.36	158.83	2.06	0.84	0.84
22.47	99.54	93.82	1.48	138.52	2.14	0.81	0.81
22.64	78.10	73.12	1.95	142.53	2.31	0.82	0.82
22.80	64.62	60.07	2.82	169.12	2.48	0.85	0.85
22.97	60.02	55.48	3.32	183.99	2.55	0.87	0.87
23.13	50.19	45.98	3.96	182.28	2.62	0.87	0.87
23.29	36.47	32.90	5.00	164.56	2.73	0.85	0.85
23.46	21.85	19.08	7.81	149.06	2.94	0.83	0.83
23.62	13.84	11.51	11.42	131.44	3.14	0.66	0.82

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
23.79	10.93	8.76	14.62	128.16	3.28	0.60	0.63
23.95	10.75	8.55	16.53	141.43	3.35	0.68	0.61
24.11	13.77	11.28	13.92	157.11	3.25	1.09	0.81
24.28	25.03	21.62	7.03	152.01	2.89	0.83	0.83
24.44	54.69	48.96	2.22	108.66	2.37	0.76	0.76
24.61	78.11	70.49	1.47	103.85	2.13	0.76	0.76
24.77	96.05	86.78	1.41	122.62	2.10	0.79	0.79
24.93	108.57	97.79	1.64	159.97	2.21	0.84	0.84
25.10	134.83	121.26	1.77	214.92	2.26	0.90	0.90
25.26	177.59	159.47	1.86	296.34	2.28	0.97	0.97
25.43	236.83	212.55	1.69	360.15	2.23	1.02	1.02
25.59	285.46	255.77	1.59	405.73	2.19	1.05	1.05
25.75	297.90	266.10	1.55	413.71	2.17	1.06	1.06
25.92	268.11	238.24	1.66	394.78	2.22	1.04	1.04
26.08	227.90	201.23	1.85	372.06	2.28	1.03	1.03
26.25	199.05	174.79	1.94	339.93	2.31	1.01	1.01
26.41	178.53	155.93	2.04	317.62	2.33	0.99	0.99
26.57	166.19	144.43	2.10	303.68	2.34	0.98	0.98
26.74	159.72	138.16	2.18	301.04	2.36	0.98	0.98
26.90	159.35	137.28	2.21	303.18	2.37	0.98	0.98
27.07	165.29	141.99	2.14	303.77	2.35	0.98	0.98
27.23	177.24	152.00	1.99	302.36	2.32	0.98	0.98
27.40	188.52	161.47	1.82	293.16	2.27	0.97	0.97
27.56	193.63	165.56	1.70	280.84	2.23	0.96	0.96
27.72	188.42	160.55	1.68	269.17	2.22	0.95	0.95
27.89	177.11	150.14	1.75	262.55	2.25	0.95	0.95
28.05	180.92	153.00	1.69	258.74	2.23	0.94	0.94
28.22	201.74	170.99	1.47	250.77	2.13	0.94	0.94
28.38	221.75	188.63	1.31	247.17	2.00	0.93	0.93
28.54	234.64	200.21	1.23	246.34	1.89	0.93	0.93
28.71	242.05	206.72	1.18	243.34	1.82	0.93	0.93
28.87	272.29	232.92	1.10	255.83	1.76	0.94	0.94
29.04	311.49	266.69	1.01	268.66	1.71	0.95	0.95
29.20	345.69	295.75	1.00	295.75	1.69	0.97	0.97
29.36	353.65	301.63	1.00	301.63	1.70	0.98	0.98
29.53	335.19	284.51	1.06	301.67	1.74	0.98	0.98
29.69	301.52	254.56	1.12	285.24	1.77	0.97	0.97
29.86	265.94	223.38	1.16	258.33	1.80	0.94	0.94
30.02	236.85	198.08	1.17	232.22	1.82	0.92	0.92
30.18	223.94	186.73	1.17	218.98	1.82	0.91	0.91
30.35	235.13	195.96	1.15	224.77	1.79	0.91	0.91
30.51	265.27	221.32	1.09	241.90	1.76	0.93	0.93
30.68	297.31	248.26	1.03	254.84	1.72	0.94	0.94
30.84	316.58	264.13	1.00	264.13	1.70	0.95	0.95
31.00	319.84	266.26	1.00	266.26	1.70	0.95	0.95
31.17	317.56	263.69	1.00	263.69	1.70	0.95	0.95
31.33	314.75	260.59	1.01	263.28	1.71	0.95	0.95
31.50	315.83	260.96	1.00	261.25	1.71	0.95	0.95

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
31.66	315.58	260.27	1.00	260.27	1.70	0.95	0.95
31.82	313.78	258.42	1.00	258.42	1.69	0.94	0.94
31.99	314.20	258.18	1.00	258.18	1.69	0.94	0.94
32.15	321.56	263.82	1.00	263.82	1.68	0.95	0.95
32.32	330.08	270.34	1.00	270.34	1.68	0.95	0.95
32.48	335.57	274.37	1.00	274.37	1.67	0.96	0.96
32.64	334.78	273.01	1.00	273.01	1.68	0.96	0.96
32.81	328.78	267.35	1.00	267.35	1.68	0.95	0.95
32.97	320.36	259.70	1.00	259.70	1.69	0.94	0.94
33.14	315.97	255.57	1.00	255.57	1.69	0.94	0.94
33.30	320.10	258.59	1.00	258.59	1.68	0.94	0.94
33.46	326.83	263.77	1.00	263.77	1.67	0.95	0.95
33.63	330.46	266.19	1.00	266.19	1.67	0.95	0.95
33.79	330.20	265.45	1.00	265.45	1.67	0.95	0.95
33.96	328.86	263.93	1.00	263.93	1.66	0.95	0.95
34.12	325.70	261.01	1.00	261.01	1.66	0.95	0.95
34.28	322.12	257.89	1.00	257.89	1.64	0.94	0.94
34.45	317.03	253.35	1.00	253.35	1.63	0.94	0.94
34.61	312.44	249.16	1.00	249.16	1.62	0.94	0.94
34.78	308.65	245.62	1.00	245.62	1.63	0.93	0.93
34.94	304.83	241.48	1.00	241.48	1.66	0.93	0.93
35.10	308.70	243.48	1.00	243.48	1.69	0.93	0.93
35.27	316.41	248.80	1.00	248.80	1.70	0.93	0.93
35.43	322.24	253.02	1.00	253.02	1.69	0.94	0.94
35.60	321.70	252.10	1.00	252.10	1.69	0.94	0.94
35.76	318.73	249.25	1.00	249.25	1.69	0.94	0.94
35.93	317.94	248.25	1.00	248.25	1.69	0.93	0.93
36.09	316.71	247.07	1.00	247.07	1.68	0.93	0.93
36.25	313.32	244.01	1.00	244.01	1.67	0.93	0.93
36.42	311.20	241.94	1.00	241.94	1.67	0.93	0.93
36.58	309.25	240.08	1.00	240.08	1.67	0.93	0.93
36.75	308.18	239.08	1.00	239.08	1.65	0.93	0.93
36.91	304.89	236.24	1.00	236.24	1.65	0.92	0.92
37.07	300.74	232.54	1.00	232.54	1.65	0.92	0.92
37.24	296.01	228.36	1.00	228.36	1.65	0.92	0.92
37.40	292.29	225.04	1.00	225.04	1.65	0.91	0.91
37.57	287.49	221.14	1.00	221.14	1.64	0.91	0.91
37.73	278.77	213.90	1.00	213.90	1.65	0.90	0.90
37.89	268.63	205.55	1.00	205.55	1.65	0.89	0.89
38.06	259.29	197.51	1.00	197.51	1.67	0.88	0.88
38.22	252.52	191.70	1.00	191.70	1.68	0.88	0.88
38.39	248.27	187.92	1.00	187.92	1.69	0.87	0.87
38.55	244.70	184.73	1.00	184.73	1.69	0.87	0.87
38.71	242.38	182.58	1.00	182.58	1.70	0.87	0.87
38.88	239.88	180.59	1.00	180.59	1.69	0.87	0.87
39.04	233.09	175.58	1.00	175.58	1.67	0.86	0.86
39.21	221.04	166.59	1.00	166.59	1.64	0.85	0.85
39.37	205.39	154.48	1.00	154.48	1.64	0.83	0.83

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
39.53	189.84	142.29	1.00	142.29	1.65	0.82	0.82
39.70	176.13	131.22	1.00	131.22	1.67	0.80	0.80
39.86	163.78	121.23	1.00	121.23	1.70	0.78	0.78
40.03	154.25	113.33	1.06	120.42	1.74	0.78	0.78
40.19	147.36	107.43	1.13	120.89	1.78	0.78	0.78
40.35	141.43	101.45	1.22	124.04	1.88	0.79	0.79
40.52	137.28	96.33	1.33	127.86	2.02	0.80	0.80
40.68	131.50	89.97	1.58	142.07	2.19	0.82	0.82
40.85	119.70	80.41	1.88	151.01	2.29	0.83	0.83
41.01	112.45	75.19	1.90	142.83	2.29	0.82	0.82
41.17	122.97	84.38	1.43	120.56	2.11	0.78	0.78
41.34	162.71	116.73	1.17	136.31	1.81	0.81	0.81
41.50	200.73	147.82	1.00	147.82	1.63	0.82	0.82
41.67	224.00	164.92	1.00	164.92	1.58	0.85	0.85
41.83	224.15	164.78	1.00	164.78	1.59	0.85	0.85
41.99	219.55	161.10	1.00	161.10	1.61	0.84	0.84
42.16	212.21	155.41	1.00	155.41	1.62	0.83	0.83
42.32	205.76	150.40	1.00	150.40	1.63	0.83	0.83
42.49	201.94	147.34	1.00	147.34	1.62	0.82	0.82
42.65	202.08	147.22	1.00	147.22	1.61	0.82	0.82
42.81	204.05	148.46	1.00	148.46	1.59	0.82	0.82
42.98	205.12	149.03	1.00	149.03	1.59	0.83	0.83
43.14	206.05	149.49	1.00	149.49	1.59	0.83	0.83
43.31	208.70	151.21	1.00	151.21	1.59	0.83	0.83
43.47	213.93	154.83	1.00	154.83	1.58	0.83	0.83
43.64	216.99	156.84	1.00	156.84	1.56	0.84	0.84
43.80	215.04	155.19	1.00	155.19	1.56	0.83	0.83
43.96	210.42	151.59	1.00	151.59	1.56	0.83	0.83
44.13	205.75	147.96	1.00	147.96	1.59	0.82	0.82
44.29	206.25	148.11	1.00	148.11	1.59	0.82	0.82
44.46	207.56	148.85	1.00	148.85	1.58	0.83	0.83
44.62	209.53	150.07	1.00	150.07	1.56	0.83	0.83
44.78	207.89	148.67	1.00	148.67	1.55	0.83	0.83
44.95	205.96	147.05	1.00	147.05	1.56	0.82	0.82
45.11	205.80	146.73	1.00	146.73	1.56	0.82	0.82
45.28	204.29	145.44	1.00	145.44	1.57	0.82	0.82
45.44	198.40	140.98	1.00	140.98	1.59	0.81	0.81
45.60	189.43	134.32	1.00	134.32	1.62	0.80	0.80
45.77	184.75	130.77	1.00	130.77	1.63	0.80	0.80
45.93	189.08	133.70	1.00	133.70	1.60	0.80	0.80
46.10	198.40	140.20	1.00	140.20	1.56	0.81	0.81
46.26	205.96	145.43	1.00	145.43	1.52	0.82	0.82
46.42	206.48	145.61	1.00	145.61	1.53	0.82	0.82
46.59	196.21	138.07	1.00	138.07	1.57	0.81	0.81
46.75	183.08	128.51	1.00	128.51	1.63	0.80	0.80
46.92	174.17	121.08	1.00	121.08	1.68	0.78	0.78
47.08	176.38	122.52	1.00	122.52	1.68	0.79	0.79
47.24	183.30	127.99	1.00	127.99	1.65	0.80	0.80

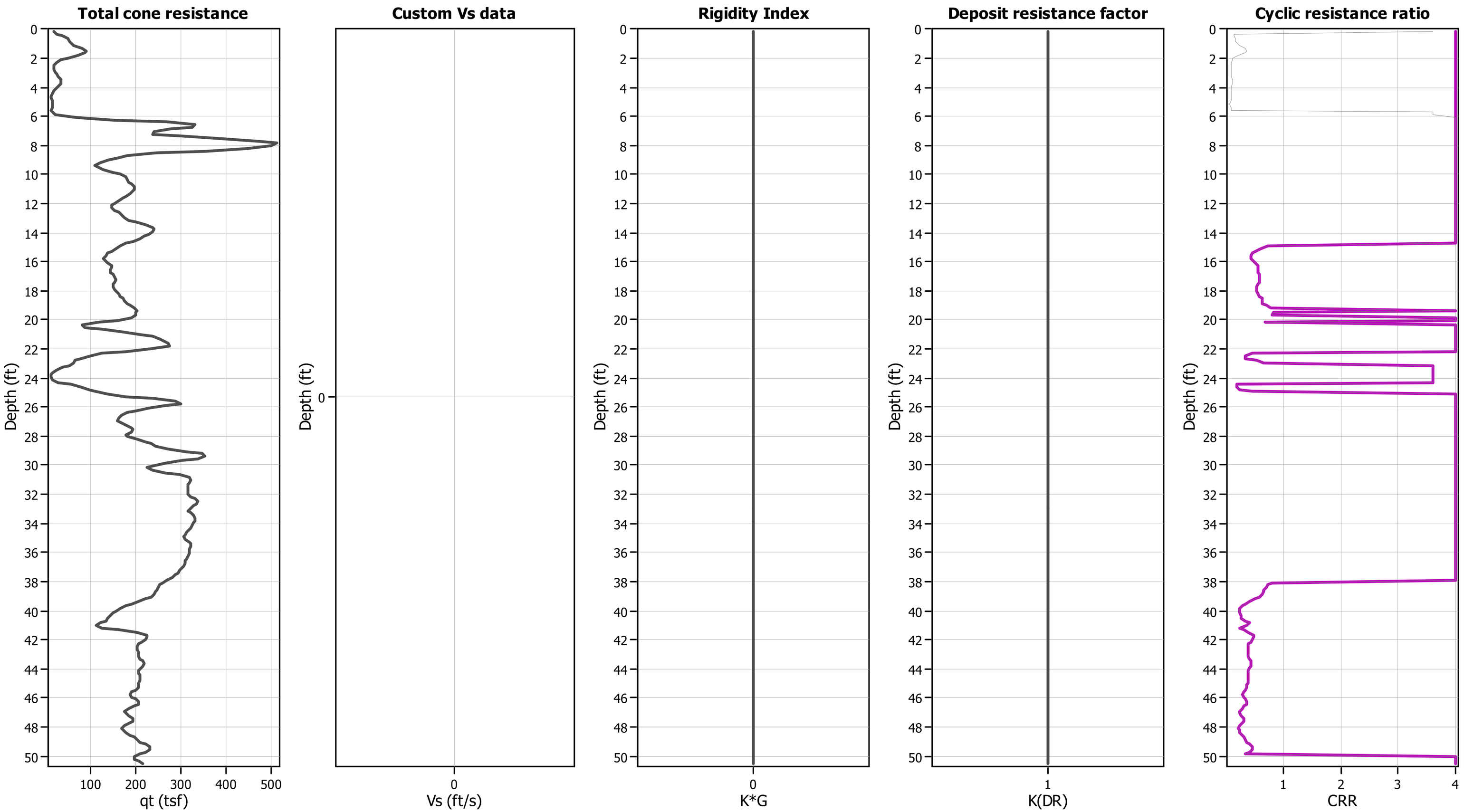
:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
47.41	191.32	133.65	1.00	133.65	1.60	0.80	0.80
47.57	192.55	134.35	1.00	134.35	1.59	0.80	0.80
47.74	185.35	129.07	1.00	129.07	1.62	0.80	0.80
47.90	174.58	120.58	1.00	120.58	1.67	0.78	0.78
48.06	168.33	115.29	1.01	116.09	1.71	0.78	0.78
48.23	170.93	116.88	1.01	118.33	1.71	0.78	0.78
48.39	178.35	122.23	1.00	122.23	1.70	0.79	0.79
48.56	187.06	128.60	1.00	128.60	1.67	0.80	0.80
48.72	195.36	134.83	1.00	134.83	1.65	0.81	0.81
48.88	201.36	139.08	1.00	139.08	1.62	0.81	0.81
49.05	209.12	144.33	1.00	144.33	1.58	0.82	0.82
49.21	220.20	151.89	1.00	151.89	1.53	0.83	0.83
49.38	230.07	158.59	1.00	158.59	1.48	0.84	0.84
49.54	231.34	159.27	1.00	159.27	1.45	0.84	0.84
49.70	221.27	152.06	1.00	152.06	1.46	0.83	0.83
49.87	207.44	142.23	1.00	142.23	1.49	0.82	0.82
50.03	196.45	-1.00	1.00	-1.00	-1.00	0.00	0.00
50.20	195.85	-1.00	1.00	-1.00	-1.00	0.00	0.00
50.36	205.01	-1.00	1.00	-1.00	-1.00	0.00	0.00
50.52	215.84	-1.00	1.00	-1.00	-1.00	0.00	0.00

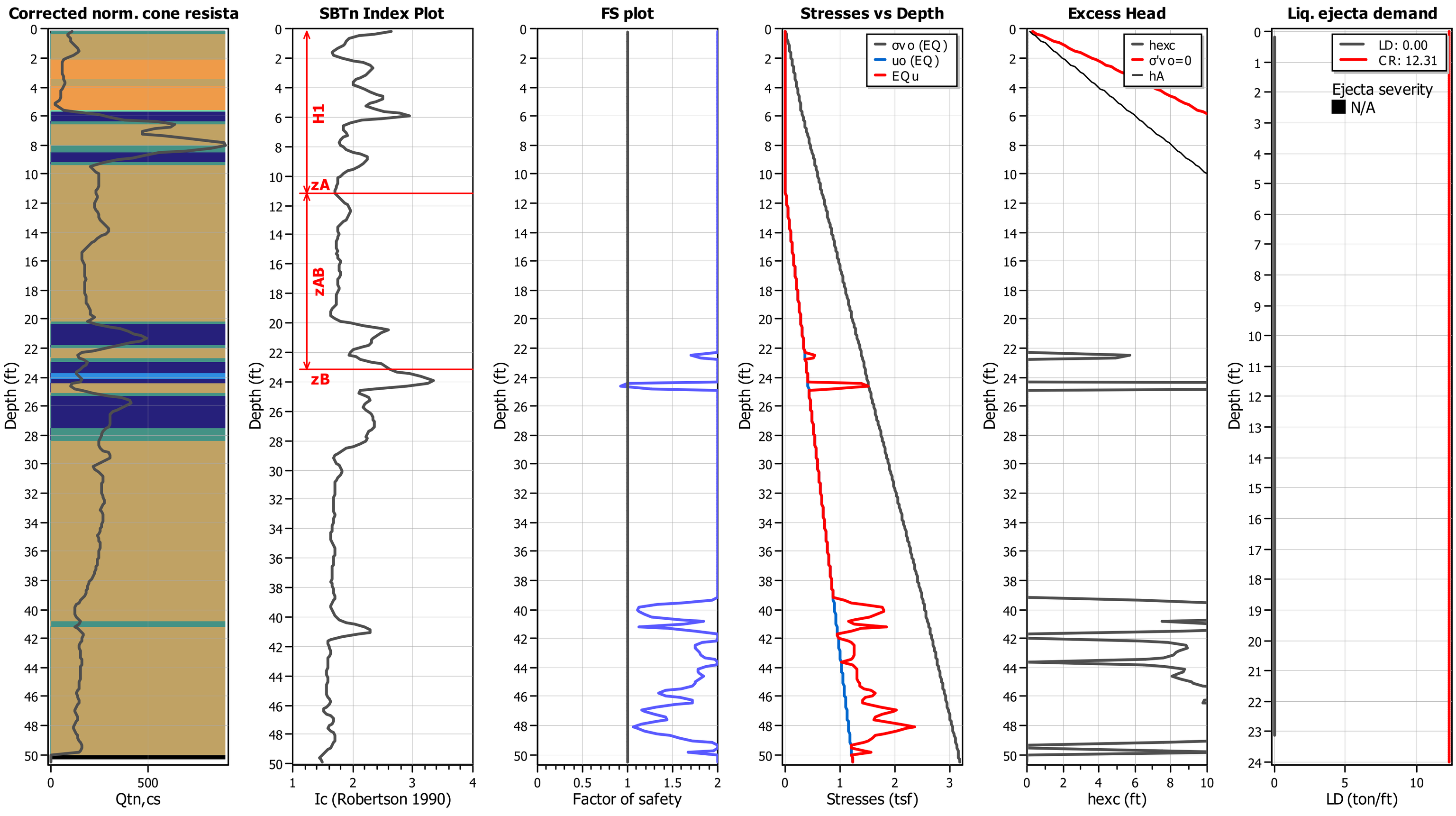
Abbreviations

q_t: Total cone resistance
K_c: Cone resistance correction factor due to fines
$Q_{tn,cs}$: Adjusted and corrected cone resistance due to fines
I_c: Soil behavior type index
$S_{u(liq)}/\sigma'_v$: Calculated liquefied undrained strength ratio
$S_{u(peak)}/\sigma'_v$: Calculated peak undrained strength ratio

Aging Calculation Estimation



Ejecta Severity Estimation



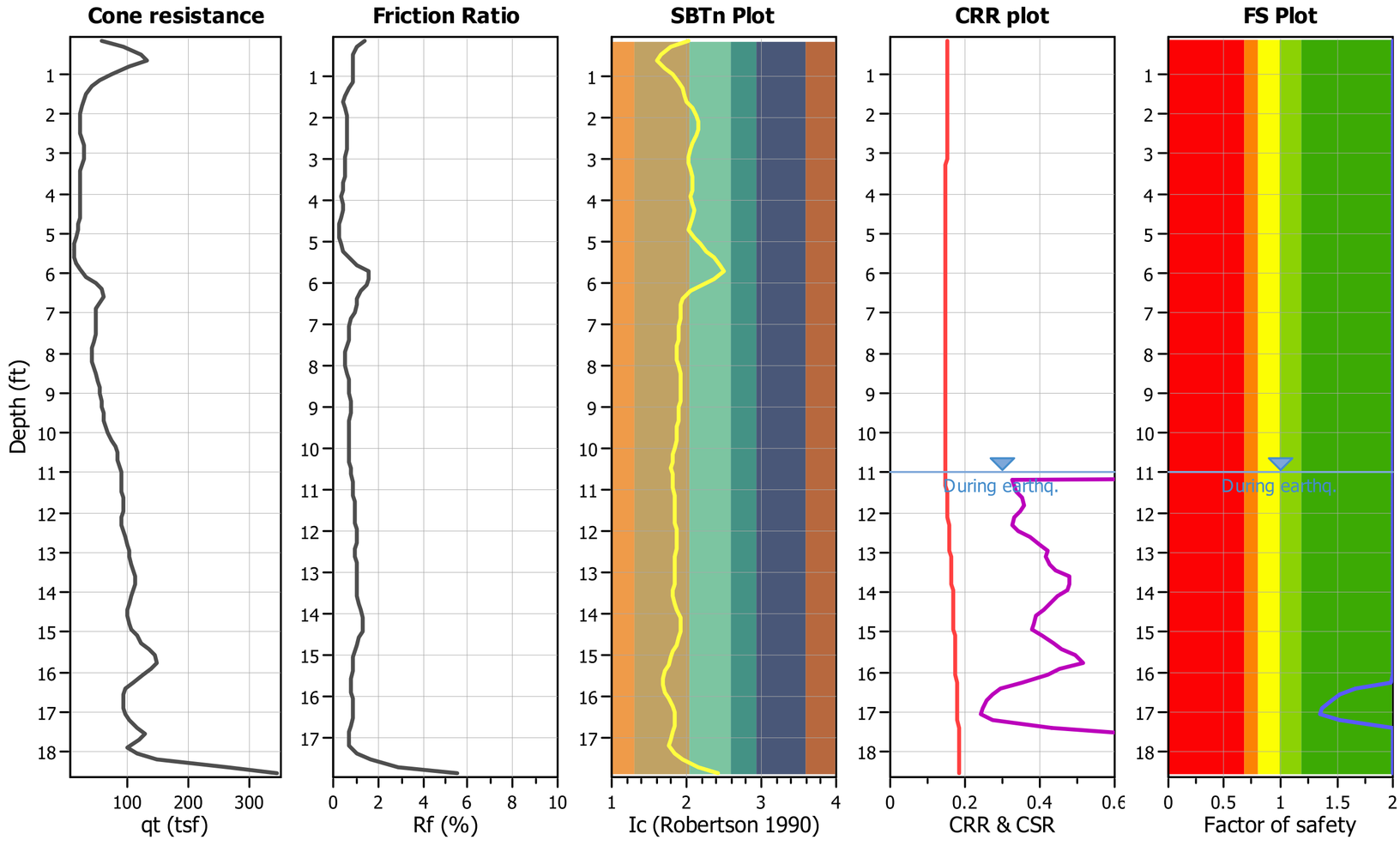
LIQUEFACTION ANALYSIS REPORT

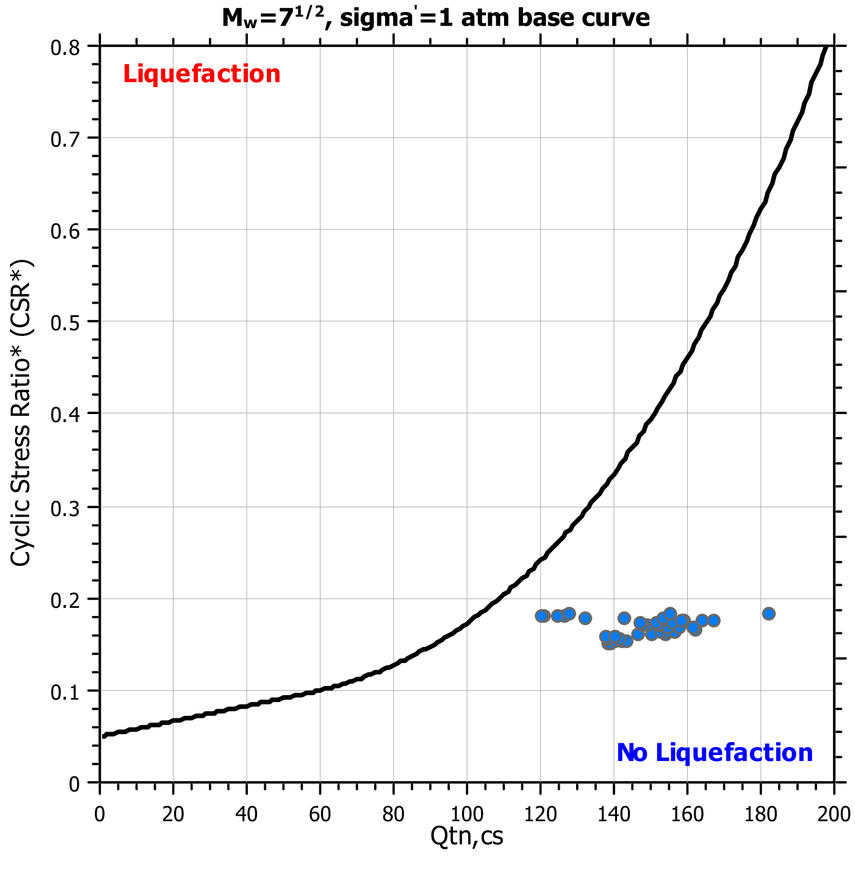
Project title : Stanislaus Elementary Replacement School **Location : Modesto, California**

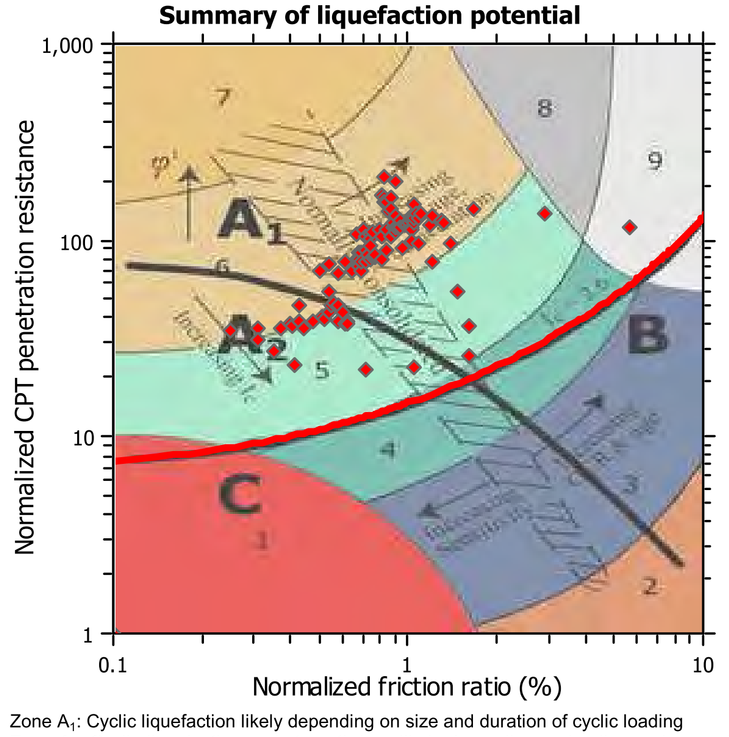
CPT file : CPT-04

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	11.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	11.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.25	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.37	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

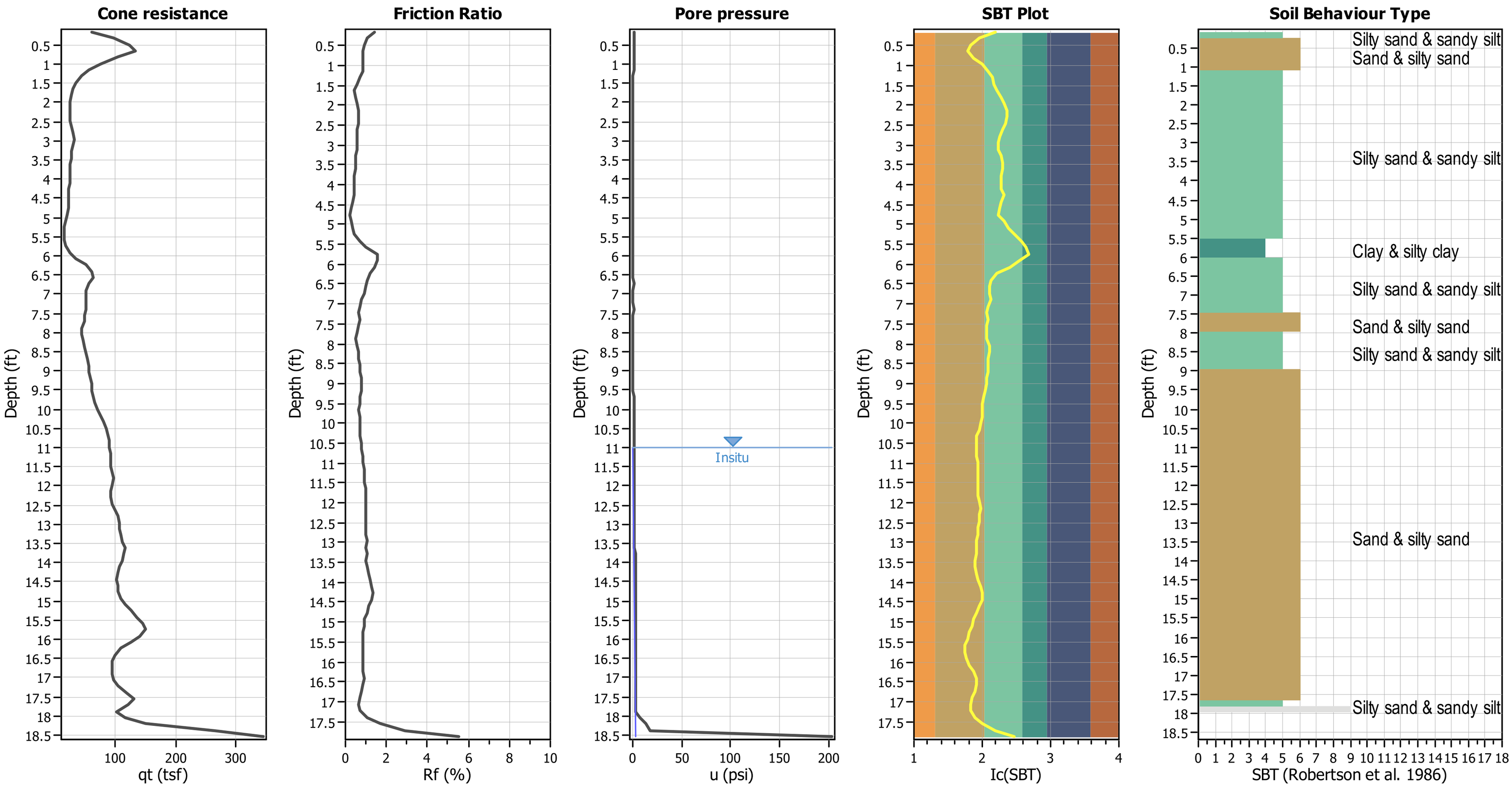






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



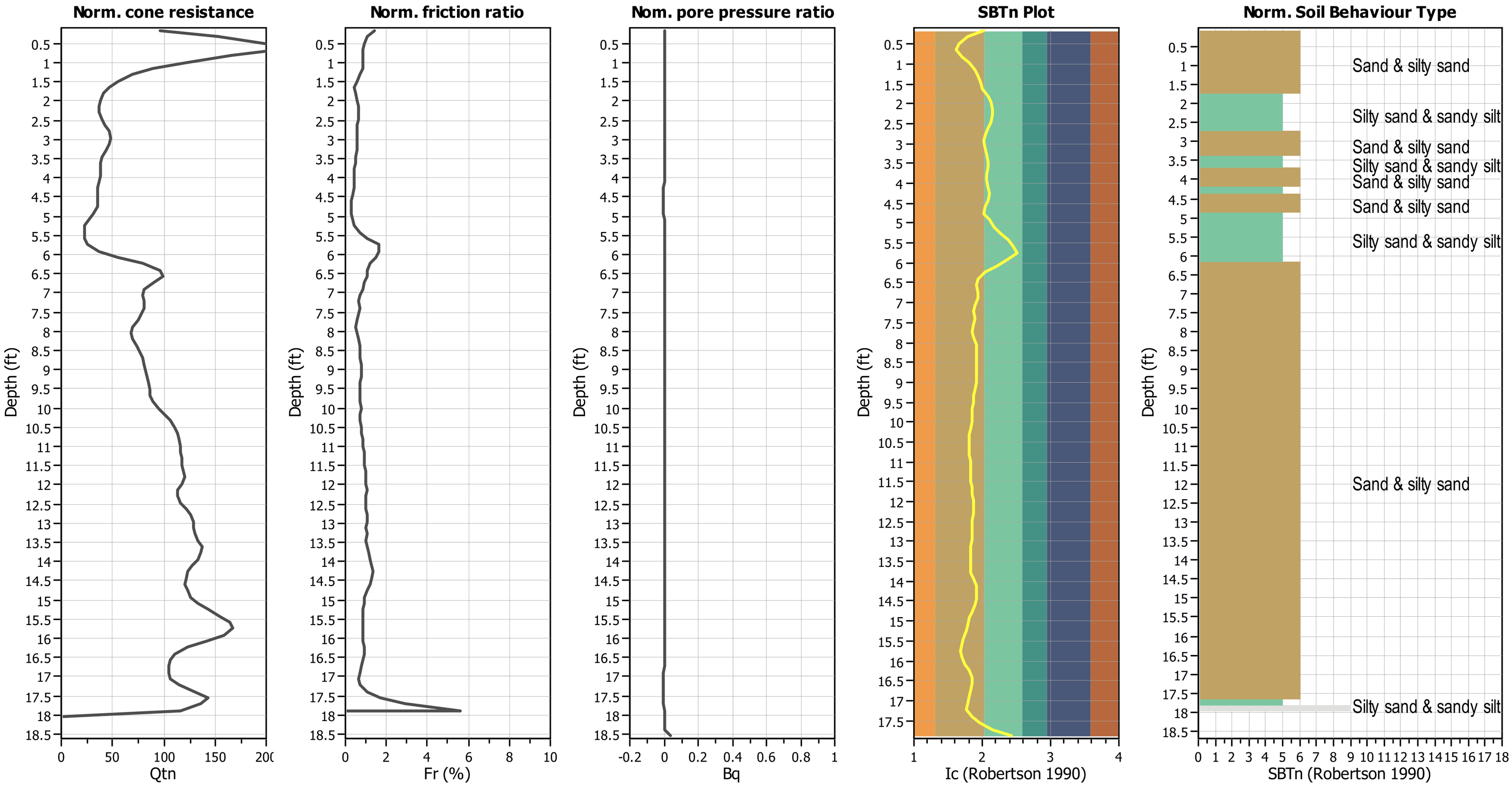
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



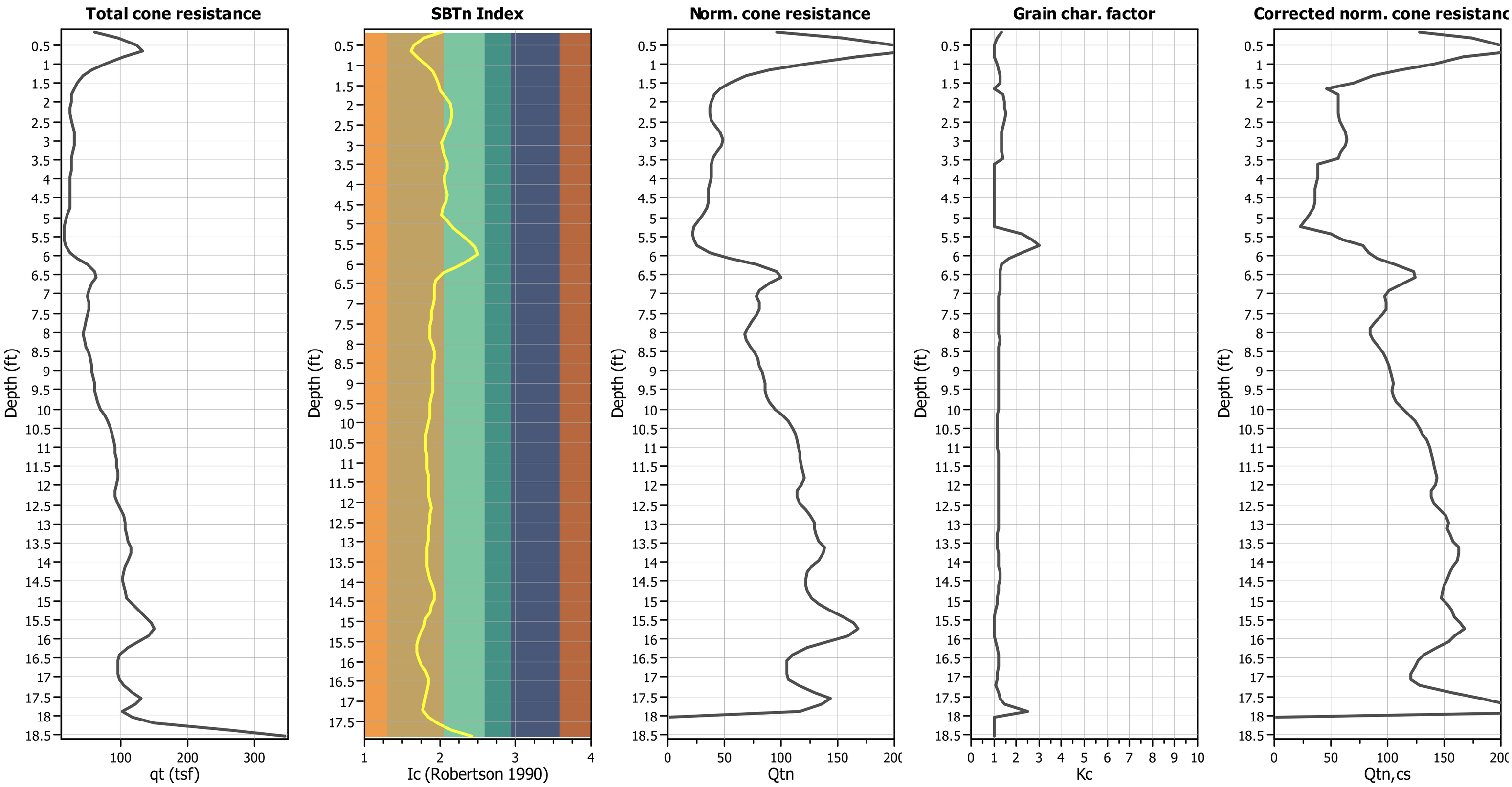
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

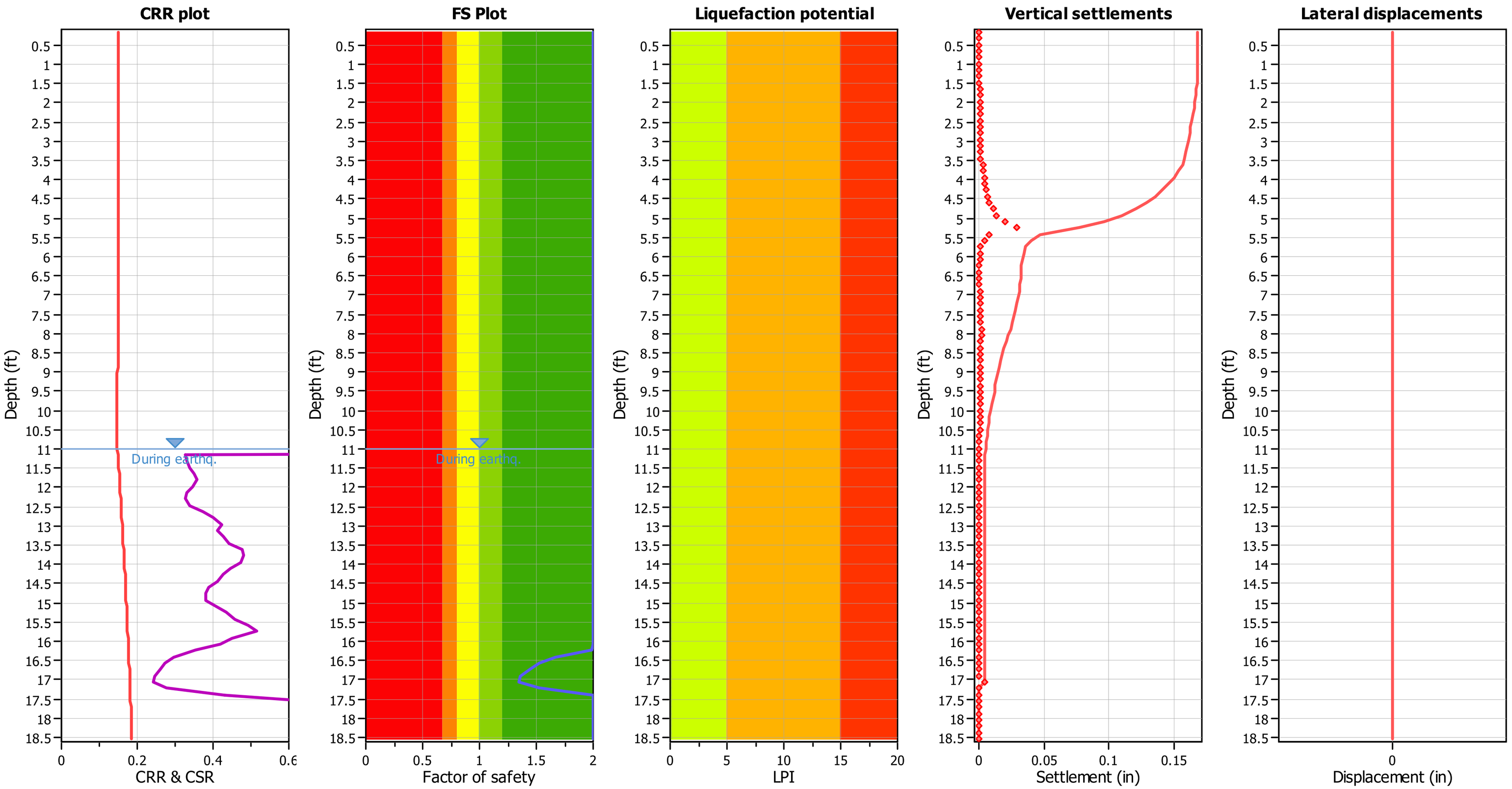
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

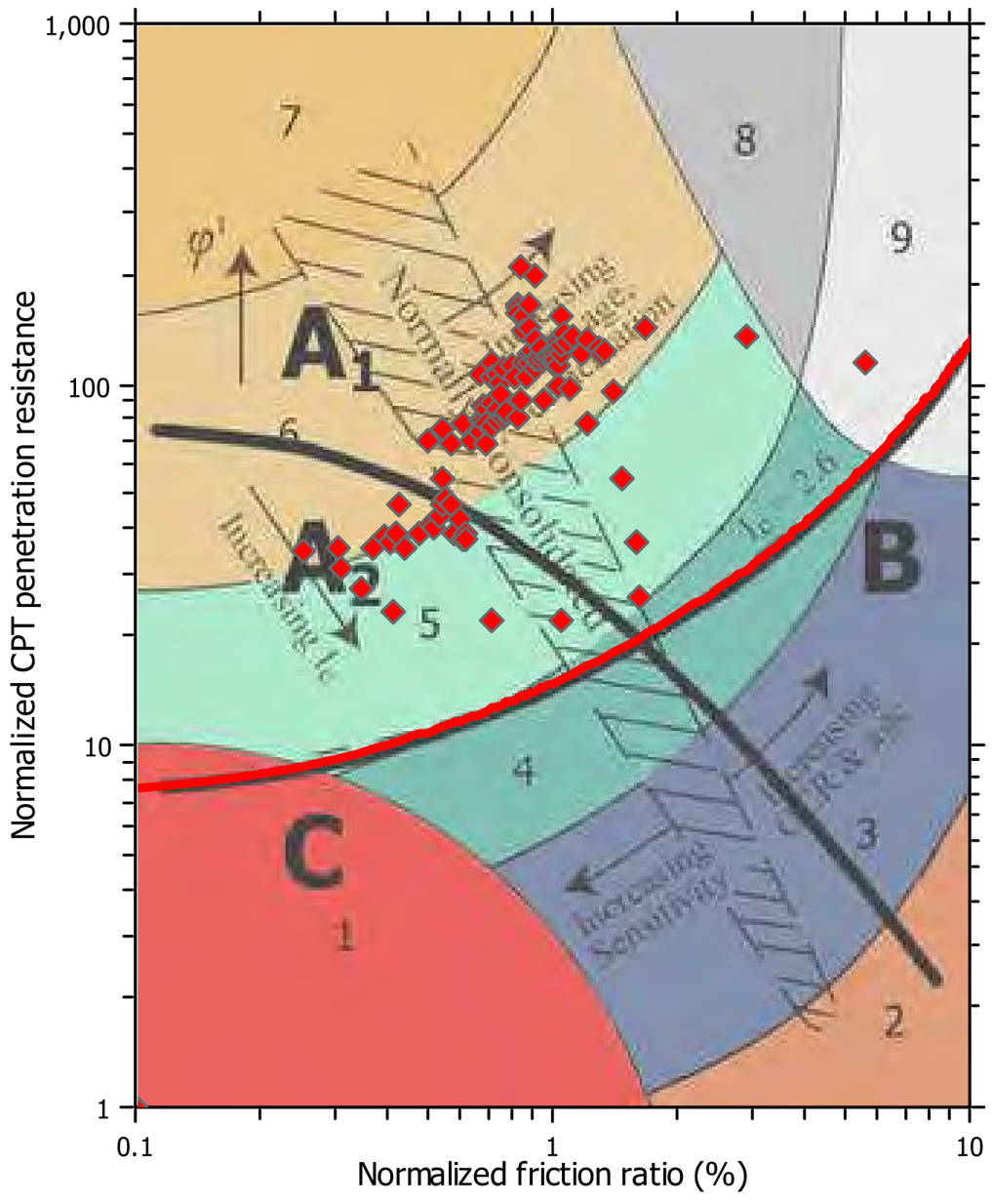
F.S. color scheme

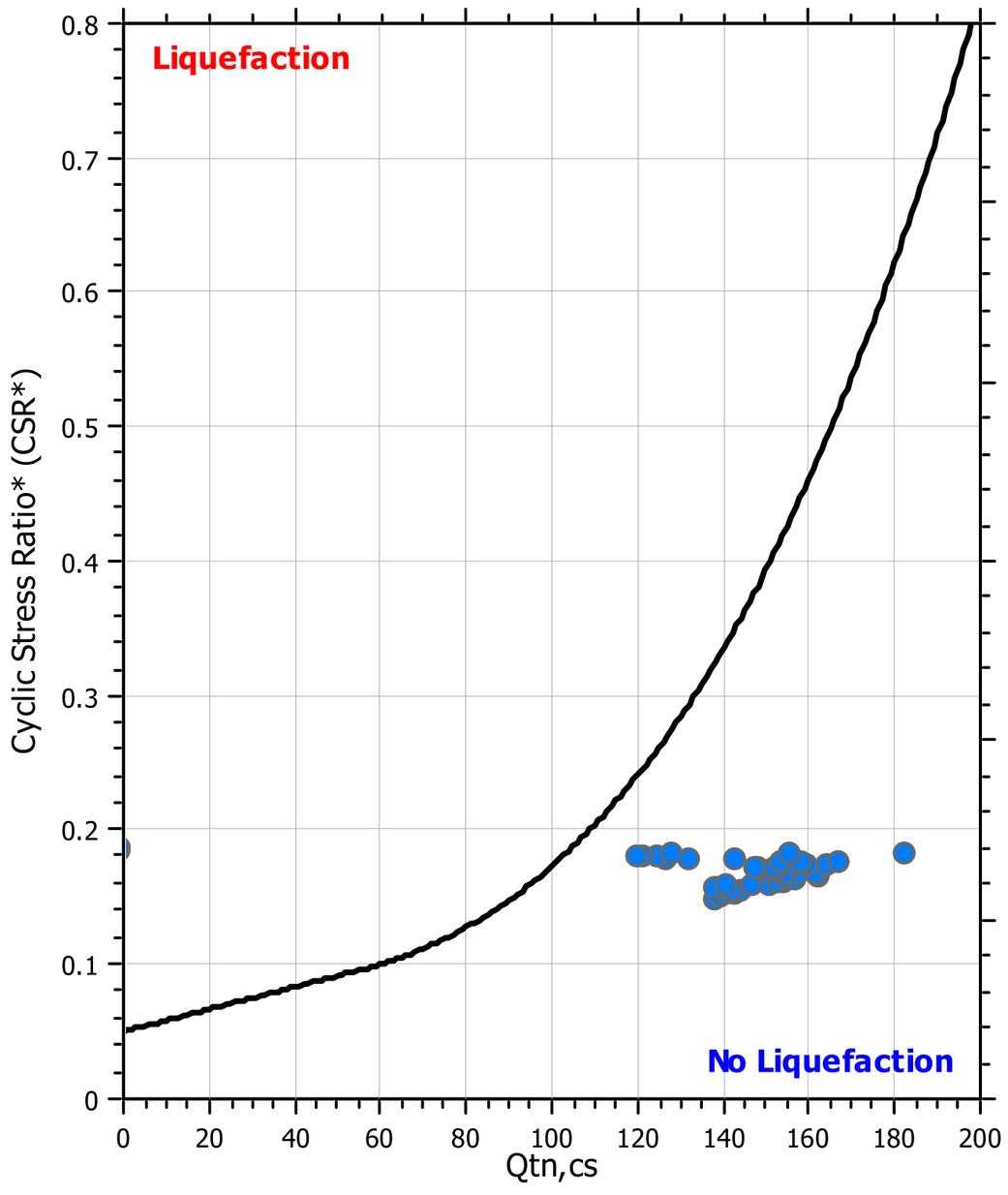
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

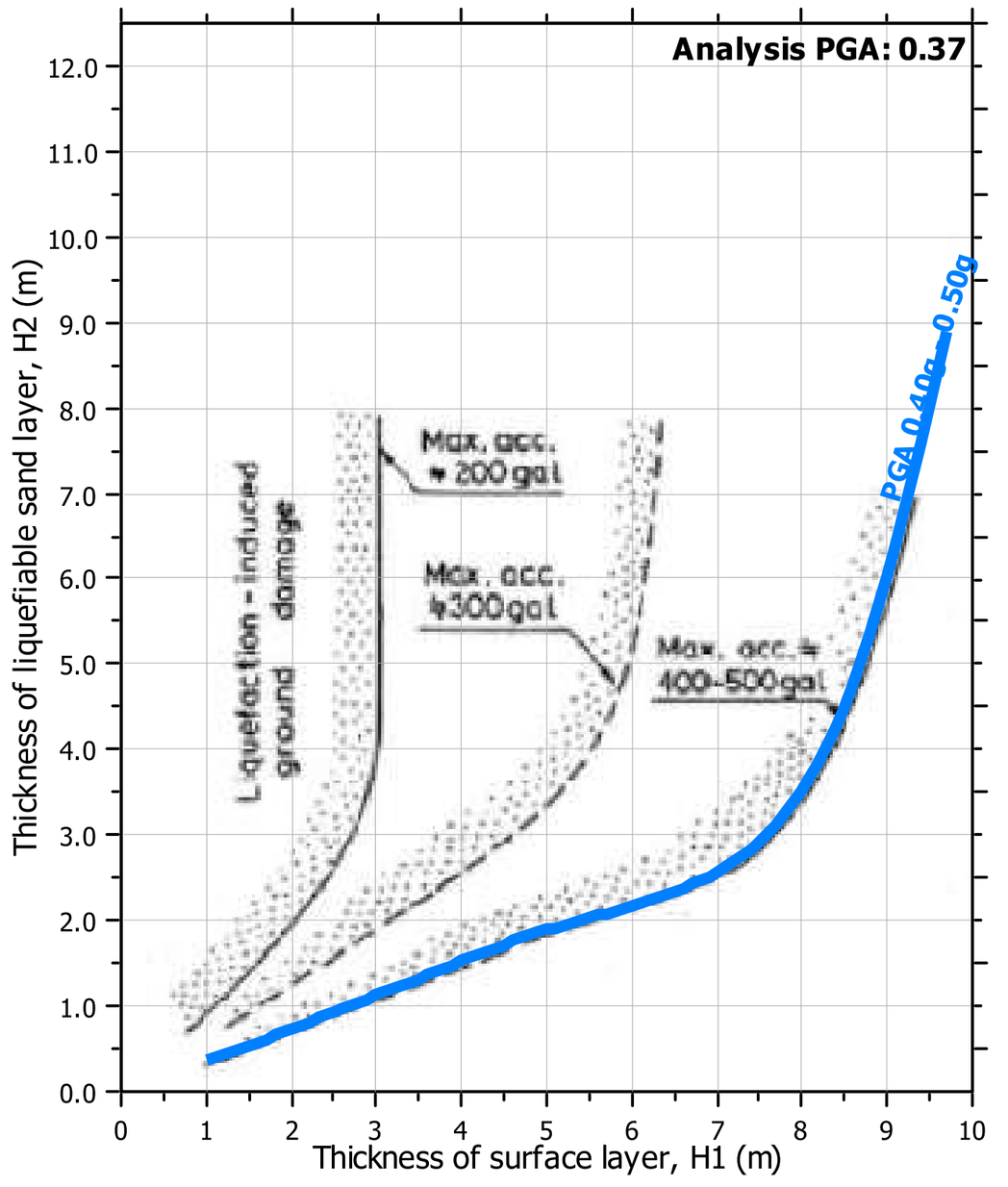
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



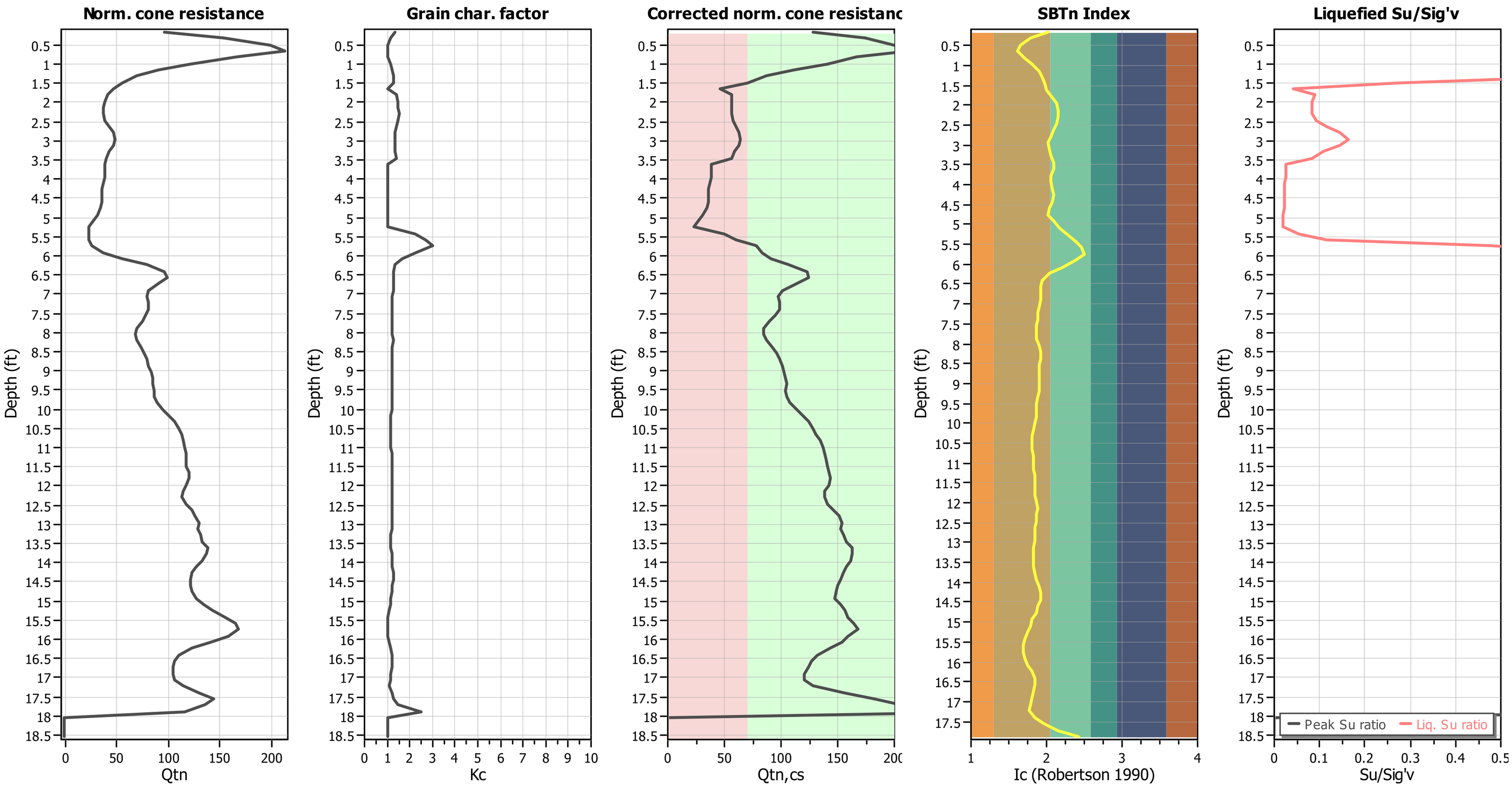




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.25	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.37	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

:: Field input data ::

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
1	0.16	52.93	0.77	0.98	13.44	118.99
2	0.33	74.38	0.98	1.01	7.76	121.37
3	0.49	159.72	1.24	1.62	5.43	122.96
4	0.66	138.46	1.18	1.58	4.60	122.95
5	0.82	99.76	0.90	1.13	6.24	120.91
6	0.98	72.92	0.64	0.92	8.36	117.85
7	1.15	54.07	0.45	0.72	10.38	114.60
8	1.31	41.35	0.32	0.64	11.51	110.55
9	1.48	33.57	0.12	0.57	12.29	106.57
10	1.64	28.01	0.12	0.53	5.00	103.21
11	1.80	25.35	0.14	0.50	15.10	103.33
12	1.97	23.68	0.14	0.19	16.59	103.59
13	2.13	23.20	0.14	0.18	17.33	103.63
14	2.30	22.96	0.14	0.17	17.41	103.83
15	2.46	24.02	0.15	0.16	16.84	104.22
16	2.62	26.39	0.16	0.16	15.54	104.84
17	2.79	29.94	0.17	0.16	14.36	105.39
18	2.95	31.10	0.17	0.15	13.71	105.52
19	3.12	30.04	0.16	0.14	13.99	105.09
20	3.28	27.00	0.14	0.10	14.73	104.16
21	3.44	24.46	0.13	0.07	15.48	103.21
22	3.61	23.94	0.12	0.06	5.00	102.22
23	3.77	24.32	0.10	0.04	5.00	101.31
24	3.94	24.16	0.09	0.03	5.00	100.63
25	4.10	22.99	0.09	0.01	5.00	100.55
26	4.27	22.15	0.10	-0.03	5.00	100.86
27	4.43	22.08	0.10	-0.04	5.00	99.51
28	4.59	22.57	0.04	-0.04	5.00	98.17
29	4.76	22.24	0.06	-0.06	5.00	96.49
30	4.92	20.87	0.06	-0.07	5.00	96.94
31	5.09	15.63	0.06	0.09	5.00	96.49
32	5.25	14.94	0.06	0.08	5.00	96.26
33	5.41	13.80	0.06	0.07	25.53	99.79
34	5.58	13.67	0.18	0.05	28.73	102.71
35	5.74	15.33	0.20	0.06	30.71	107.24
36	5.91	20.49	0.40	0.08	25.48	110.60
37	6.07	33.91	0.50	0.18	19.57	113.82
38	6.23	48.93	0.60	0.33	14.15	115.97
39	6.40	65.27	0.69	0.27	11.54	117.22
40	6.56	67.34	0.69	0.63	10.91	117.09
41	6.73	54.26	0.55	0.88	11.16	115.54
42	6.89	48.07	0.37	0.55	11.15	113.34
43	7.05	49.44	0.32	0.61	10.36	111.92
44	7.22	50.74	0.34	0.60	9.97	111.80
45	7.38	50.73	0.35	0.68	10.12	111.98
46	7.55	49.40	0.34	0.65	9.67	110.89
47	7.71	47.27	0.20	0.64	9.43	109.59
48	7.87	44.43	0.21	0.62	9.65	108.50

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
49	8.04	41.59	0.25	0.61	10.54	109.28
50	8.20	44.66	0.28	0.42	10.95	110.33
51	8.37	48.10	0.32	0.47	10.77	111.37
52	8.53	50.95	0.36	0.49	10.70	112.34
53	8.69	53.06	0.40	0.52	10.67	113.06
54	8.86	54.75	0.41	0.54	10.66	113.57
55	9.02	56.16	0.43	0.56	10.53	113.95
56	9.19	58.48	0.45	0.58	10.42	114.30
57	9.35	59.93	0.46	0.61	9.99	114.16
58	9.51	61.00	0.39	0.65	9.61	113.93
59	9.68	61.98	0.40	0.69	9.41	114.00
60	9.84	63.97	0.47	0.73	9.43	114.78
61	10.01	69.09	0.52	0.96	9.28	115.73
62	10.17	74.60	0.56	1.13	8.72	116.51
63	10.33	81.79	0.59	1.17	8.28	117.13
64	10.50	84.79	0.62	1.21	8.14	117.76
65	10.66	86.28	0.69	1.21	8.29	118.41
66	10.83	88.89	0.75	1.26	8.52	119.05
67	10.99	90.61	0.80	1.31	8.70	119.56
68	11.15	91.48	0.84	1.31	8.84	119.89
69	11.32	91.88	0.85	1.38	8.94	120.11
70	11.48	92.49	0.86	1.40	9.00	120.34
71	11.65	94.34	0.91	1.44	9.03	120.66
72	11.81	96.93	0.95	1.49	9.12	120.92
73	11.98	95.34	0.95	1.53	9.52	120.94
74	12.14	87.87	0.94	1.57	9.82	120.74
75	12.30	89.22	0.90	1.62	9.78	120.68
76	12.47	95.79	0.93	1.65	9.44	120.85
77	12.63	97.09	0.97	1.75	9.17	121.48
78	12.80	104.73	1.10	1.83	9.06	121.95
79	12.96	106.52	1.09	1.91	9.02	122.41
80	13.12	106.55	1.14	1.96	8.86	122.21
81	13.29	105.09	1.01	1.97	8.82	122.48
82	13.45	112.80	1.19	2.01	8.63	122.66
83	13.62	114.59	1.20	2.15	8.59	123.26
84	13.78	118.21	1.25	2.42	8.98	123.51
85	13.94	109.43	1.33	2.36	9.72	123.82
86	14.11	105.42	1.40	2.33	10.61	123.93
87	14.27	103.50	1.38	2.46	11.01	123.88
88	14.44	101.58	1.33	2.45	11.00	123.65
89	14.60	102.18	1.29	2.41	10.25	122.90
90	14.76	104.49	0.98	2.47	9.37	122.28
91	14.93	108.29	1.01	2.53	8.39	121.78
92	15.09	114.66	1.03	2.59	7.84	122.20
93	15.26	125.30	1.09	2.39	7.24	122.68
94	15.42	133.75	1.15	2.39	6.49	123.29
95	15.58	150.09	1.21	2.49	6.01	123.76
96	15.75	153.02	1.25	2.56	5.84	123.90

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
97	15.91	143.43	1.19	2.55	6.24	123.47
98	16.08	127.22	1.06	2.49	7.14	122.57
99	16.24	106.96	0.96	2.42	8.30	121.47
100	16.40	94.31	0.87	2.42	9.27	120.54
101	16.57	92.59	0.82	2.45	9.28	119.83
102	16.73	96.32	0.75	2.51	8.91	119.29
103	16.90	93.64	0.69	2.54	8.20	118.41
104	17.06	93.78	0.56	2.54	7.70	118.16
105	17.22	103.28	0.67	2.58	7.50	119.37
106	17.39	116.86	0.98	2.70	9.18	123.66
107	17.55	133.70	2.16	2.83	11.72	127.76
108	17.72	137.56	3.33	2.82	17.40	131.16
109	17.88	92.18	5.04	3.02	27.22	134.26
110	18.04	76.29	8.68	6.61	N/A	87.36
111	18.21	181.51	-268745.57	13.32	N/A	87.36
112	18.37	190.91	-268745.57	17.48	N/A	87.36
113	18.54	421.22	-268745.57	203.05	N/A	87.36

Abbreviations

Depth:	Depth from free surface, at which CPT was performed (ft)
q_c:	Measured cone resistance (tsf)
f_s:	Sleeve friction resistance (tsf)
u:	Pore pressure (tsf)
Fines content:	Percentage of fines in soil (%)
Unit weight:	Bulk soil unit weight (pcf)

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data ::

Point ID	Depth (ft)	σ_v (tsf)	u_0 (tsf)	σ_v' (tsf)	r_d	CSR	MSF	CSR_{eq}	K_σ	User FS	CSR^*	Belongs to transition
1	0.16	0.01	0.00	0.01	1.00	0.241	1.59	0.151	1.00	1.00	2.000	No
2	0.33	0.02	0.00	0.02	1.00	0.241	1.59	0.151	1.00	1.00	2.000	No
3	0.49	0.03	0.00	0.03	1.00	0.241	1.59	0.151	1.00	1.00	2.000	No
4	0.66	0.04	0.00	0.04	1.00	0.241	1.59	0.151	1.00	1.00	2.000	No
5	0.82	0.05	0.00	0.05	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
6	0.98	0.06	0.00	0.06	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
7	1.15	0.07	0.00	0.07	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
8	1.31	0.08	0.00	0.08	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
9	1.48	0.09	0.00	0.09	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
10	1.64	0.10	0.00	0.10	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
11	1.80	0.10	0.00	0.10	1.00	0.240	1.59	0.151	1.00	1.00	2.000	No
12	1.97	0.11	0.00	0.11	1.00	0.240	1.59	0.150	1.00	1.00	2.000	No
13	2.13	0.12	0.00	0.12	1.00	0.240	1.59	0.150	1.00	1.00	2.000	No
14	2.30	0.13	0.00	0.13	1.00	0.240	1.59	0.150	1.00	1.00	2.000	No
15	2.46	0.14	0.00	0.14	1.00	0.240	1.59	0.150	1.00	1.00	2.000	No
16	2.62	0.15	0.00	0.15	1.00	0.240	1.59	0.150	1.00	1.00	2.000	No
17	2.79	0.15	0.00	0.15	1.00	0.239	1.59	0.150	1.00	1.00	2.000	No
18	2.95	0.16	0.00	0.16	1.00	0.239	1.59	0.150	1.00	1.00	2.000	No
19	3.12	0.17	0.00	0.17	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
20	3.28	0.18	0.00	0.18	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
21	3.44	0.19	0.00	0.19	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
22	3.61	0.20	0.00	0.20	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
23	3.77	0.21	0.00	0.21	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
24	3.94	0.21	0.00	0.21	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
25	4.10	0.22	0.00	0.22	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
26	4.27	0.23	0.00	0.23	0.99	0.239	1.59	0.150	1.00	1.00	2.000	No
27	4.43	0.24	0.00	0.24	0.99	0.238	1.59	0.150	1.00	1.00	2.000	No
28	4.59	0.25	0.00	0.25	0.99	0.238	1.59	0.150	1.00	1.00	2.000	No
29	4.76	0.25	0.00	0.25	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
30	4.92	0.26	0.00	0.26	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
31	5.09	0.27	0.00	0.27	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
32	5.25	0.28	0.00	0.28	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
33	5.41	0.29	0.00	0.29	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
34	5.58	0.30	0.00	0.30	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
35	5.74	0.30	0.00	0.30	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
36	5.91	0.31	0.00	0.31	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
37	6.07	0.32	0.00	0.32	0.99	0.238	1.59	0.149	1.00	1.00	2.000	No
38	6.23	0.33	0.00	0.33	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
39	6.40	0.34	0.00	0.34	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
40	6.56	0.35	0.00	0.35	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
41	6.73	0.36	0.00	0.36	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
42	6.89	0.37	0.00	0.37	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
43	7.05	0.38	0.00	0.38	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
44	7.22	0.39	0.00	0.39	0.99	0.237	1.59	0.149	1.00	1.00	2.000	No
45	7.38	0.40	0.00	0.40	0.98	0.237	1.59	0.149	1.00	1.00	2.000	No
46	7.55	0.41	0.00	0.41	0.98	0.237	1.59	0.149	1.00	1.00	2.000	No
47	7.71	0.42	0.00	0.42	0.98	0.237	1.59	0.148	1.00	1.00	2.000	No
48	7.87	0.42	0.00	0.42	0.98	0.237	1.59	0.148	1.00	1.00	2.000	No

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data :: (continued)

Point ID	Depth (ft)	σ_v (tsf)	u_0 (tsf)	σ_v' (tsf)	r_d	CSR	MSF	CSR_{eq}	K_σ	User FS	CSR^*	Belongs to transition
49	8.04	0.43	0.00	0.43	0.98	0.237	1.59	0.148	1.00	1.00	2.000	No
50	8.20	0.44	0.00	0.44	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
51	8.37	0.45	0.00	0.45	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
52	8.53	0.46	0.00	0.46	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
53	8.69	0.47	0.00	0.47	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
54	8.86	0.48	0.00	0.48	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
55	9.02	0.49	0.00	0.49	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
56	9.19	0.50	0.00	0.50	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
57	9.35	0.51	0.00	0.51	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
58	9.51	0.52	0.00	0.52	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
59	9.68	0.53	0.00	0.53	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
60	9.84	0.54	0.00	0.54	0.98	0.236	1.59	0.148	1.00	1.00	2.000	No
61	10.01	0.55	0.00	0.55	0.98	0.235	1.59	0.148	1.00	1.00	2.000	No
62	10.17	0.55	0.00	0.55	0.98	0.235	1.59	0.148	1.00	1.00	2.000	No
63	10.33	0.56	0.00	0.56	0.98	0.235	1.59	0.148	1.00	1.00	2.000	No
64	10.50	0.57	0.00	0.57	0.98	0.235	1.59	0.148	1.00	1.00	2.000	No
65	10.66	0.58	0.00	0.58	0.98	0.235	1.59	0.147	1.00	1.00	2.000	No
66	10.83	0.59	0.00	0.59	0.98	0.235	1.59	0.147	1.00	1.00	2.000	No
67	10.99	0.60	0.00	0.60	0.98	0.235	1.59	0.147	1.00	1.00	2.000	No
68	11.15	0.61	0.00	0.61	0.98	0.237	1.59	0.149	1.00	1.00	0.149	No
69	11.32	0.62	0.01	0.61	0.98	0.239	1.59	0.150	1.00	1.00	0.150	No
70	11.48	0.63	0.02	0.62	0.98	0.240	1.59	0.151	1.00	1.00	0.151	No
71	11.65	0.64	0.02	0.62	0.98	0.242	1.59	0.152	1.00	1.00	0.152	No
72	11.81	0.65	0.03	0.63	0.98	0.244	1.59	0.153	1.00	1.00	0.153	No
73	11.98	0.66	0.03	0.63	0.97	0.246	1.59	0.154	1.00	1.00	0.154	No
74	12.14	0.67	0.04	0.64	0.97	0.247	1.59	0.155	1.00	1.00	0.155	No
75	12.30	0.68	0.04	0.64	0.97	0.249	1.59	0.156	1.00	1.00	0.156	No
76	12.47	0.69	0.05	0.65	0.97	0.251	1.59	0.157	1.00	1.00	0.157	No
77	12.63	0.70	0.05	0.65	0.97	0.252	1.59	0.158	1.00	1.00	0.158	No
78	12.80	0.71	0.06	0.66	0.97	0.254	1.59	0.159	1.00	1.00	0.159	No
79	12.96	0.72	0.06	0.66	0.97	0.256	1.59	0.160	1.00	1.00	0.160	No
80	13.12	0.73	0.07	0.67	0.97	0.257	1.59	0.161	1.00	1.00	0.161	No
81	13.29	0.74	0.07	0.67	0.97	0.259	1.59	0.162	1.00	1.00	0.162	No
82	13.45	0.75	0.08	0.68	0.97	0.260	1.59	0.163	1.00	1.00	0.163	No
83	13.62	0.76	0.08	0.68	0.97	0.262	1.59	0.164	1.00	1.00	0.164	No
84	13.78	0.77	0.09	0.69	0.97	0.263	1.59	0.165	1.00	1.00	0.165	No
85	13.94	0.78	0.09	0.69	0.97	0.265	1.59	0.166	1.00	1.00	0.166	No
86	14.11	0.79	0.10	0.70	0.97	0.266	1.59	0.167	1.00	1.00	0.167	No
87	14.27	0.80	0.10	0.70	0.97	0.267	1.59	0.168	1.00	1.00	0.168	No
88	14.44	0.81	0.11	0.71	0.97	0.269	1.59	0.169	1.00	1.00	0.169	No
89	14.60	0.82	0.11	0.71	0.97	0.270	1.59	0.169	1.00	1.00	0.169	No
90	14.76	0.83	0.12	0.72	0.97	0.271	1.59	0.170	1.00	1.00	0.170	No
91	14.93	0.84	0.12	0.72	0.97	0.273	1.59	0.171	1.00	1.00	0.171	No
92	15.09	0.85	0.13	0.73	0.97	0.274	1.59	0.172	1.00	1.00	0.172	No
93	15.26	0.86	0.13	0.73	0.97	0.275	1.59	0.173	1.00	1.00	0.173	No
94	15.42	0.87	0.14	0.74	0.97	0.276	1.59	0.173	1.00	1.00	0.173	No
95	15.58	0.88	0.14	0.74	0.97	0.278	1.59	0.174	1.00	1.00	0.174	No
96	15.75	0.89	0.15	0.75	0.97	0.279	1.59	0.175	1.00	1.00	0.175	No

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data :: (continued)

Point ID	Depth (ft)	σ_v (tsf)	u_0 (tsf)	σ_v' (tsf)	r_d	CSR	MSF	CSR_{eq}	K_σ	User FS	CSR^*	Belongs to transition
97	15.91	0.90	0.15	0.75	0.97	0.280	1.59	0.176	1.00	1.00	0.176	No
98	16.08	0.91	0.16	0.76	0.97	0.281	1.59	0.176	1.00	1.00	0.176	No
99	16.24	0.92	0.16	0.76	0.97	0.282	1.59	0.177	1.00	1.00	0.177	No
100	16.40	0.93	0.17	0.77	0.97	0.283	1.59	0.178	1.00	1.00	0.178	No
101	16.57	0.94	0.17	0.77	0.97	0.284	1.59	0.178	1.00	1.00	0.178	No
102	16.73	0.95	0.18	0.77	0.96	0.286	1.59	0.179	1.00	1.00	0.179	No
103	16.90	0.96	0.18	0.78	0.96	0.287	1.59	0.180	1.00	1.00	0.180	No
104	17.06	0.97	0.19	0.78	0.96	0.288	1.59	0.181	1.00	1.00	0.181	No
105	17.22	0.98	0.19	0.79	0.96	0.289	1.59	0.181	1.00	1.00	0.181	No
106	17.39	0.99	0.20	0.79	0.96	0.290	1.59	0.182	1.00	1.00	0.182	No
107	17.55	1.00	0.20	0.80	0.96	0.291	1.59	0.182	1.00	1.00	0.182	No
108	17.72	1.01	0.21	0.80	0.96	0.292	1.59	0.183	1.00	1.00	0.183	No
109	17.88	1.02	0.21	0.81	0.96	0.293	1.59	0.184	1.00	1.00	0.184	No
110	18.04	1.03	0.22	0.81	0.96	0.294	1.59	0.184	1.00	1.00	0.184	No
111	18.21	1.04	0.22	0.81	0.96	0.295	1.59	0.185	1.00	1.00	0.185	No
112	18.37	1.05	0.23	0.82	0.96	0.296	1.59	0.186	1.00	1.00	0.186	No
113	18.54	1.05	0.24	0.82	0.96	0.297	1.59	0.187	1.00	1.00	0.187	No

Abbreviations

Depth: Depth from free surface, at which CPT was performed (ft)
σ_v: Total overburden pressure at test point (tsf)
u_0: Water pressure at test point (tsf)
σ_v': Effective overburden pressure based on GWT during earthquake (tsf)
r_d: Nonlinear shear mass factor
CSR: Cyclic Stress Ratio
MSF: Magnitude Scaling Factor
CSR_{eq}: CSR adjusted for M=7.5
K_σ: Effective overburden stress factor
CSR^*: CSR fully adjusted

:: Cyclic Resistance Ratio (CRR) calculation data ::

Point ID	Depth (ft)	q_t (tsf)	I_c	Fr (%)	n	Q_{tn}	K_c	$Q_{tn,cs}$	$CRR_{7.5}$	Belongs to trans. layer	Clay-like behaviour	FS
1	0.16	60.09	2.02	1.40	0.61	96.53	1.32	127.69	4.000	No	No	2.00
2	0.33	95.69	1.78	1.04	0.54	153.71	1.13	174.07	4.000	No	No	2.00
3	0.49	124.21	1.66	0.91	0.51	199.51	1.00	199.51	4.000	No	No	2.00
4	0.66	132.67	1.61	0.84	0.50	213.08	1.00	213.08	4.000	No	No	2.00
5	0.82	103.73	1.71	0.88	0.52	166.57	1.00	166.62	4.000	No	No	2.00
6	0.98	75.60	1.81	0.88	0.55	121.36	1.16	141.35	4.000	No	No	2.00
7	1.15	56.12	1.90	0.84	0.58	90.06	1.24	111.37	4.000	No	No	2.00
8	1.31	43.01	1.95	0.69	0.59	68.97	1.27	87.37	4.000	No	No	2.00
9	1.48	34.32	1.98	0.54	0.60	55.00	1.29	70.84	4.000	No	No	2.00
10	1.64	28.99	1.99	0.43	0.61	46.42	1.00	46.42	4.000	No	No	2.00
11	1.80	25.69	2.08	0.51	0.63	41.10	1.39	56.97	4.000	No	No	2.00
12	1.97	24.08	2.13	0.58	0.65	38.51	1.46	56.20	4.000	No	No	2.00
13	2.13	23.28	2.15	0.61	0.65	37.21	1.50	55.89	4.000	No	No	2.00
14	2.30	23.39	2.15	0.62	0.65	37.38	1.51	56.33	4.000	No	No	2.00
15	2.46	24.46	2.13	0.62	0.65	39.08	1.47	57.56	4.000	No	No	2.00
16	2.62	26.79	2.09	0.60	0.64	42.80	1.41	60.17	4.000	No	No	2.00
17	2.79	29.15	2.05	0.57	0.62	46.58	1.36	63.16	4.000	No	No	2.00
18	2.95	30.36	2.03	0.55	0.62	48.52	1.33	64.63	4.000	No	No	2.00
19	3.12	29.39	2.04	0.55	0.62	46.93	1.34	62.97	4.000	No	No	2.00
20	3.28	27.17	2.06	0.53	0.63	43.36	1.37	59.43	4.000	No	No	2.00
21	3.44	25.14	2.09	0.52	0.63	40.08	1.40	56.24	4.000	No	No	2.00
22	3.61	24.24	2.09	0.48	0.63	38.63	1.00	38.63	4.000	No	No	2.00
23	3.77	24.14	2.07	0.42	0.63	38.45	1.00	38.45	4.000	No	No	2.00
24	3.94	23.82	2.06	0.39	0.63	37.93	1.00	37.93	4.000	No	No	2.00
25	4.10	23.10	2.08	0.41	0.63	36.76	1.00	36.76	4.000	No	No	2.00
26	4.27	22.41	2.10	0.44	0.64	35.63	1.00	35.63	4.000	No	No	2.00
27	4.43	22.27	2.08	0.37	0.63	35.39	1.00	35.39	4.000	No	No	2.00
28	4.59	22.30	2.05	0.31	0.62	35.43	1.00	35.43	4.000	No	No	2.00
29	4.76	21.89	2.03	0.25	0.62	34.76	1.00	34.76	4.000	No	No	2.00
30	4.92	19.58	2.10	0.31	0.64	31.03	1.00	31.03	4.000	No	No	2.00
31	5.09	17.14	2.18	0.35	0.66	27.11	1.00	27.11	4.000	No	No	2.00
32	5.25	14.79	2.26	0.41	0.69	23.32	1.00	23.32	4.000	No	No	2.00
33	5.41	14.14	2.38	0.71	0.72	22.25	2.26	50.37	4.000	No	No	2.00
34	5.58	14.27	2.46	1.05	0.74	22.45	2.69	60.37	4.000	No	No	2.00
35	5.74	16.50	2.50	1.60	0.76	26.02	2.98	77.60	4.000	No	No	2.00
36	5.91	23.24	2.38	1.60	0.72	36.84	2.26	83.16	4.000	No	No	2.00
37	6.07	34.44	2.22	1.46	0.67	54.82	1.66	90.91	4.000	No	No	2.00
38	6.23	49.37	2.04	1.21	0.62	78.79	1.35	106.19	4.000	No	No	2.00
39	6.40	60.52	1.95	1.09	0.59	96.69	1.27	122.56	4.000	No	No	2.00
40	6.56	62.30	1.92	1.03	0.58	99.53	1.25	124.50	4.000	No	No	2.00
41	6.73	56.57	1.93	0.95	0.59	90.31	1.26	113.56	4.000	No	No	2.00
42	6.89	50.60	1.93	0.82	0.59	80.70	1.26	101.45	4.000	No	No	2.00
43	7.05	49.43	1.90	0.70	0.58	78.80	1.24	97.40	4.000	No	No	2.00
44	7.22	50.31	1.88	0.67	0.57	80.21	1.22	98.25	4.000	No	No	2.00
45	7.38	50.30	1.89	0.69	0.57	80.17	1.23	98.55	4.000	No	No	2.00
46	7.55	49.14	1.87	0.61	0.57	78.30	1.22	95.17	4.000	No	No	2.00
47	7.71	47.04	1.86	0.54	0.57	74.78	1.21	90.33	4.000	No	No	2.00
48	7.87	44.44	1.87	0.50	0.57	69.94	1.22	84.98	4.000	No	No	2.00

:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)

Point ID	Depth (ft)	q_t (tsf)	I_c	Fr (%)	n	Q_{tn}	K_c	$Q_{tn,cs}$	$CRR_{7.5}$	Belongs to trans. layer	Clay-like behaviour	FS
49	8.04	43.57	1.91	0.58	0.58	68.42	1.24	84.91	4.000	No	No	2.00
50	8.20	44.79	1.92	0.64	0.59	69.81	1.25	87.39	4.000	No	No	2.00
51	8.37	47.91	1.92	0.67	0.58	73.69	1.25	91.89	4.000	No	No	2.00
52	8.53	50.71	1.91	0.71	0.58	77.06	1.25	95.98	4.000	No	No	2.00
53	8.69	52.93	1.91	0.74	0.58	79.50	1.24	98.94	4.000	No	No	2.00
54	8.86	54.66	1.91	0.76	0.58	81.18	1.24	101.00	4.000	No	No	2.00
55	9.02	56.47	1.91	0.77	0.58	82.85	1.24	102.78	4.000	No	No	2.00
56	9.19	58.20	1.90	0.78	0.58	84.32	1.24	104.37	4.000	No	No	2.00
57	9.35	59.81	1.88	0.73	0.57	85.38	1.23	104.62	4.000	No	No	2.00
58	9.51	60.98	1.87	0.69	0.57	85.85	1.21	104.20	4.000	No	No	2.00
59	9.68	62.33	1.86	0.68	0.57	86.71	1.21	104.68	4.000	No	No	2.00
60	9.84	65.03	1.86	0.71	0.57	89.59	1.21	108.22	4.000	No	No	2.00
61	10.01	69.24	1.85	0.75	0.56	94.36	1.20	113.49	4.000	No	No	2.00
62	10.17	75.18	1.83	0.74	0.56	101.02	1.18	119.33	4.000	No	No	2.00
63	10.33	80.41	1.81	0.74	0.55	106.65	1.16	123.83	4.000	No	No	2.00
64	10.50	84.31	1.80	0.76	0.55	110.67	1.15	127.68	4.000	No	No	2.00
65	10.66	86.67	1.81	0.80	0.55	112.88	1.16	131.12	4.000	No	No	2.00
66	10.83	88.61	1.82	0.85	0.55	114.58	1.17	134.35	4.000	No	No	2.00
67	10.99	90.34	1.83	0.88	0.56	115.93	1.18	136.85	4.000	No	No	2.00
68	11.15	91.34	1.83	0.91	0.56	116.78	1.19	138.50	0.327	No	No	2.00
69	11.32	91.97	1.84	0.93	0.56	117.16	1.19	139.44	0.332	No	No	2.00
70	11.48	92.93	1.84	0.95	0.56	117.92	1.19	140.61	0.339	No	No	2.00
71	11.65	94.61	1.84	0.97	0.56	119.57	1.19	142.72	0.350	No	No	2.00
72	11.81	95.56	1.85	0.99	0.56	120.32	1.20	144.02	0.358	No	No	2.00
73	11.98	93.40	1.86	1.02	0.57	117.39	1.21	142.15	0.347	No	No	2.00
74	12.14	90.83	1.88	1.03	0.57	113.86	1.22	138.96	0.330	No	No	2.00
75	12.30	90.98	1.87	1.02	0.57	113.52	1.22	138.38	0.326	No	No	2.00
76	12.47	94.06	1.86	1.00	0.57	116.62	1.21	140.89	0.340	No	No	2.00
77	12.63	99.23	1.85	1.01	0.56	122.34	1.20	146.66	0.373	No	No	2.00
78	12.80	102.81	1.84	1.03	0.56	126.15	1.19	150.70	0.398	No	No	2.00
79	12.96	105.96	1.84	1.05	0.56	129.45	1.19	154.45	0.423	No	No	2.00
80	13.12	106.08	1.83	1.03	0.56	128.93	1.19	153.05	0.413	No	No	2.00
81	13.29	108.17	1.83	1.04	0.56	130.91	1.19	155.19	0.428	No	No	2.00
82	13.45	110.85	1.82	1.03	0.56	133.46	1.18	157.15	0.441	No	No	2.00
83	13.62	115.23	1.82	1.06	0.55	138.14	1.18	162.37	0.478	No	No	2.00
84	13.78	114.11	1.84	1.11	0.56	136.54	1.19	162.72	0.481	No	No	2.00
85	13.94	111.05	1.87	1.20	0.57	132.85	1.22	161.72	0.473	No	No	2.00
86	14.11	106.15	1.91	1.30	0.58	127.00	1.24	157.83	0.446	No	No	2.00
87	14.27	103.53	1.93	1.33	0.59	123.57	1.25	154.88	0.426	No	No	2.00
88	14.44	102.45	1.92	1.31	0.59	121.74	1.25	152.56	0.410	No	No	2.00
89	14.60	102.79	1.89	1.18	0.58	121.18	1.23	149.41	0.390	No	No	2.00
90	14.76	105.02	1.86	1.05	0.56	122.80	1.21	148.08	0.382	No	No	2.00
91	14.93	109.19	1.81	0.93	0.55	126.55	1.17	147.60	0.379	No	No	2.00
92	15.09	116.12	1.79	0.91	0.54	133.76	1.14	152.12	0.407	No	No	2.00
93	15.26	124.61	1.76	0.88	0.54	142.60	1.10	156.40	0.436	No	No	2.00
94	15.42	136.42	1.72	0.85	0.52	154.98	1.03	159.43	0.457	No	No	2.00
95	15.58	145.66	1.69	0.83	0.52	164.49	1.00	164.49	0.494	No	No	2.00
96	15.75	148.88	1.69	0.82	0.51	167.41	1.00	167.41	0.516	No	No	2.00

:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)

Point ID	Depth (ft)	q_t (tsf)	I_c	Fr (%)	n	Q_{tn}	K_c	$Q_{tn,cs}$	$CRR_{7.5}$	Belongs to trans. layer	Clay-like behaviour	FS
97	15.91	141.26	1.71	0.83	0.52	158.57	1.00	158.57	0.451	No	No	2.00
98	16.08	125.91	1.75	0.86	0.53	141.39	1.09	153.91	0.419	No	No	2.00
99	16.24	109.53	1.81	0.89	0.55	123.12	1.16	143.07	0.352	No	No	1.99
100	16.40	97.99	1.85	0.91	0.56	110.11	1.20	132.37	0.296	No	No	1.66
101	16.57	94.44	1.85	0.87	0.56	105.72	1.20	127.15	0.271	No	No	1.52
102	16.73	94.22	1.84	0.81	0.56	104.93	1.19	124.73	0.260	No	No	1.45
103	16.90	94.62	1.80	0.71	0.55	104.71	1.16	121.14	0.245	No	No	1.36
104	17.06	96.94	1.78	0.67	0.54	106.72	1.13	120.44	0.242	No	No	1.34
105	17.22	104.68	1.77	0.71	0.54	114.85	1.12	128.12	0.276	No	No	1.52
106	17.39	117.98	1.85	1.09	0.56	130.00	1.20	155.90	0.432	No	No	2.00
107	17.55	129.41	1.95	1.68	0.59	143.42	1.27	182.45	0.645	No	No	2.00
108	17.72	121.19	2.15	2.92	0.65	135.86	1.51	204.66	4.000	No	No	2.00
109	17.88	102.07	2.42	5.62	0.73	116.16	2.48	288.00	4.000	No	No	2.00
110	18.04	116.77	N/A	-77397.05	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
111	18.21	149.75	N/A	-120475.91	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
112	18.37	265.67	N/A	-101558.16	1.00	-1.00	1.00	N/A	4.000	No	No	2.00
113	18.54	346.48	N/A	-77800.78	1.00	-1.00	1.00	N/A	4.000	No	No	2.00

Abbreviations

Depth: Depth from free surface, at which CPT was performed (ft)
q_t: Total cone resistance
I_c: Soil behavior type index
Fr: Normalized friction ratio (%)
n: Stress exponent
Q_{tn}: Normalized cone resistance
K_c: Cone resistance correction factor due to fines
$Q_{tn,cs}$: Normalized and adjusted cone resistance
$CRR_{7.5}$: Cyclic resistance ratio for M_w=7.5
FS: Factor of safety against soil liquefaction

:: Liquefaction Potential Index calculation data ::

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
0.16	2.00	0.00	0.00	0.16	0.00	0.33	2.00	0.00	0.00	0.16	0.00
0.49	2.00	0.00	0.00	0.16	0.00	0.66	2.00	0.00	0.00	0.16	0.00
0.82	2.00	0.00	0.00	0.16	0.00	0.98	2.00	0.00	0.00	0.16	0.00
1.15	2.00	0.00	0.00	0.16	0.00	1.31	2.00	0.00	0.00	0.16	0.00
1.48	2.00	0.00	0.00	0.16	0.00	1.64	2.00	0.00	0.00	0.16	0.00
1.80	2.00	0.00	0.00	0.16	0.00	1.97	2.00	0.00	0.00	0.16	0.00
2.13	2.00	0.00	0.00	0.16	0.00	2.30	2.00	0.00	0.00	0.16	0.00
2.46	2.00	0.00	0.00	0.16	0.00	2.62	2.00	0.00	0.00	0.16	0.00
2.79	2.00	0.00	0.00	0.16	0.00	2.95	2.00	0.00	0.00	0.16	0.00
3.12	2.00	0.00	0.00	0.16	0.00	3.28	2.00	0.00	0.00	0.16	0.00
3.44	2.00	0.00	0.00	0.16	0.00	3.61	2.00	0.00	0.00	0.16	0.00
3.77	2.00	0.00	0.00	0.16	0.00	3.94	2.00	0.00	0.00	0.16	0.00
4.10	2.00	0.00	0.00	0.16	0.00	4.27	2.00	0.00	0.00	0.16	0.00
4.43	2.00	0.00	0.00	0.16	0.00	4.59	2.00	0.00	0.00	0.16	0.00
4.76	2.00	0.00	0.00	0.16	0.00	4.92	2.00	0.00	0.00	0.16	0.00
5.09	2.00	0.00	0.00	0.16	0.00	5.25	2.00	0.00	0.00	0.16	0.00
5.41	2.00	0.00	0.00	0.16	0.00	5.58	2.00	0.00	0.00	0.16	0.00
5.74	2.00	0.00	0.00	0.16	0.00	5.91	2.00	0.00	0.00	0.16	0.00
6.07	2.00	0.00	0.00	0.16	0.00	6.23	2.00	0.00	0.00	0.16	0.00
6.40	2.00	0.00	0.00	0.16	0.00	6.56	2.00	0.00	0.00	0.16	0.00
6.73	2.00	0.00	0.00	0.16	0.00	6.89	2.00	0.00	0.00	0.16	0.00
7.05	2.00	0.00	0.00	0.16	0.00	7.22	2.00	0.00	0.00	0.16	0.00
7.38	2.00	0.00	0.00	0.16	0.00	7.55	2.00	0.00	0.00	0.16	0.00
7.71	2.00	0.00	0.00	0.16	0.00	7.87	2.00	0.00	0.00	0.16	0.00
8.04	2.00	0.00	0.00	0.16	0.00	8.20	2.00	0.00	0.00	0.16	0.00
8.37	2.00	0.00	0.00	0.16	0.00	8.53	2.00	0.00	0.00	0.16	0.00
8.69	2.00	0.00	0.00	0.16	0.00	8.86	2.00	0.00	0.00	0.16	0.00
9.02	2.00	0.00	0.00	0.16	0.00	9.19	2.00	0.00	0.00	0.16	0.00
9.35	2.00	0.00	0.00	0.16	0.00	9.51	2.00	0.00	0.00	0.16	0.00
9.68	2.00	0.00	0.00	0.16	0.00	9.84	2.00	0.00	0.00	0.16	0.00
10.01	2.00	0.00	0.00	0.16	0.00	10.17	2.00	0.00	0.00	0.16	0.00
10.33	2.00	0.00	0.00	0.16	0.00	10.50	2.00	0.00	0.00	0.16	0.00
10.66	2.00	0.00	0.00	0.16	0.00	10.83	2.00	0.00	0.00	0.16	0.00
10.99	2.00	0.00	0.00	0.16	0.00	11.15	2.00	0.00	0.00	0.16	0.00
11.32	2.00	0.00	0.00	0.16	0.00	11.48	2.00	0.00	0.00	0.16	0.00
11.65	2.00	0.00	0.00	0.16	0.00	11.81	2.00	0.00	0.00	0.16	0.00
11.98	2.00	0.00	0.00	0.16	0.00	12.14	2.00	0.00	0.00	0.16	0.00
12.30	2.00	0.00	0.00	0.16	0.00	12.47	2.00	0.00	0.00	0.16	0.00
12.63	2.00	0.00	0.00	0.16	0.00	12.80	2.00	0.00	0.00	0.16	0.00
12.96	2.00	0.00	0.00	0.16	0.00	13.12	2.00	0.00	0.00	0.16	0.00
13.29	2.00	0.00	0.00	0.16	0.00	13.45	2.00	0.00	0.00	0.16	0.00
13.62	2.00	0.00	0.00	0.16	0.00	13.78	2.00	0.00	0.00	0.16	0.00
13.94	2.00	0.00	0.00	0.16	0.00	14.11	2.00	0.00	0.00	0.16	0.00
14.27	2.00	0.00	0.00	0.16	0.00	14.44	2.00	0.00	0.00	0.16	0.00
14.60	2.00	0.00	0.00	0.16	0.00	14.76	2.00	0.00	0.00	0.16	0.00
14.93	2.00	0.00	0.00	0.16	0.00	15.09	2.00	0.00	0.00	0.16	0.00
15.26	2.00	0.00	0.00	0.16	0.00	15.42	2.00	0.00	0.00	0.16	0.00
15.58	2.00	0.00	0.00	0.16	0.00	15.75	2.00	0.00	0.00	0.16	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
15.91	2.00	0.00	0.00	0.16	0.00	16.08	2.00	0.00	0.00	0.16	0.00
16.24	1.99	0.00	0.00	0.16	0.00	16.40	1.66	0.00	0.00	0.16	0.00
16.57	1.52	0.00	0.00	0.16	0.00	16.73	1.45	0.00	0.00	0.16	0.00
16.90	1.36	0.00	0.00	0.16	0.00	17.06	1.34	0.00	0.00	0.16	0.00
17.22	1.52	0.00	0.00	0.16	0.00	17.39	2.00	0.00	0.00	0.16	0.00
17.55	2.00	0.00	0.00	0.16	0.00	17.72	2.00	0.00	0.00	0.16	0.00
17.88	2.00	0.00	0.00	0.16	0.00	18.04	2.00	0.00	0.00	0.16	0.00
18.21	2.00	0.00	0.00	0.16	0.00	18.37	2.00	0.00	0.00	0.16	0.00
18.54	2.00	0.00	0.00	0.16	0.00						

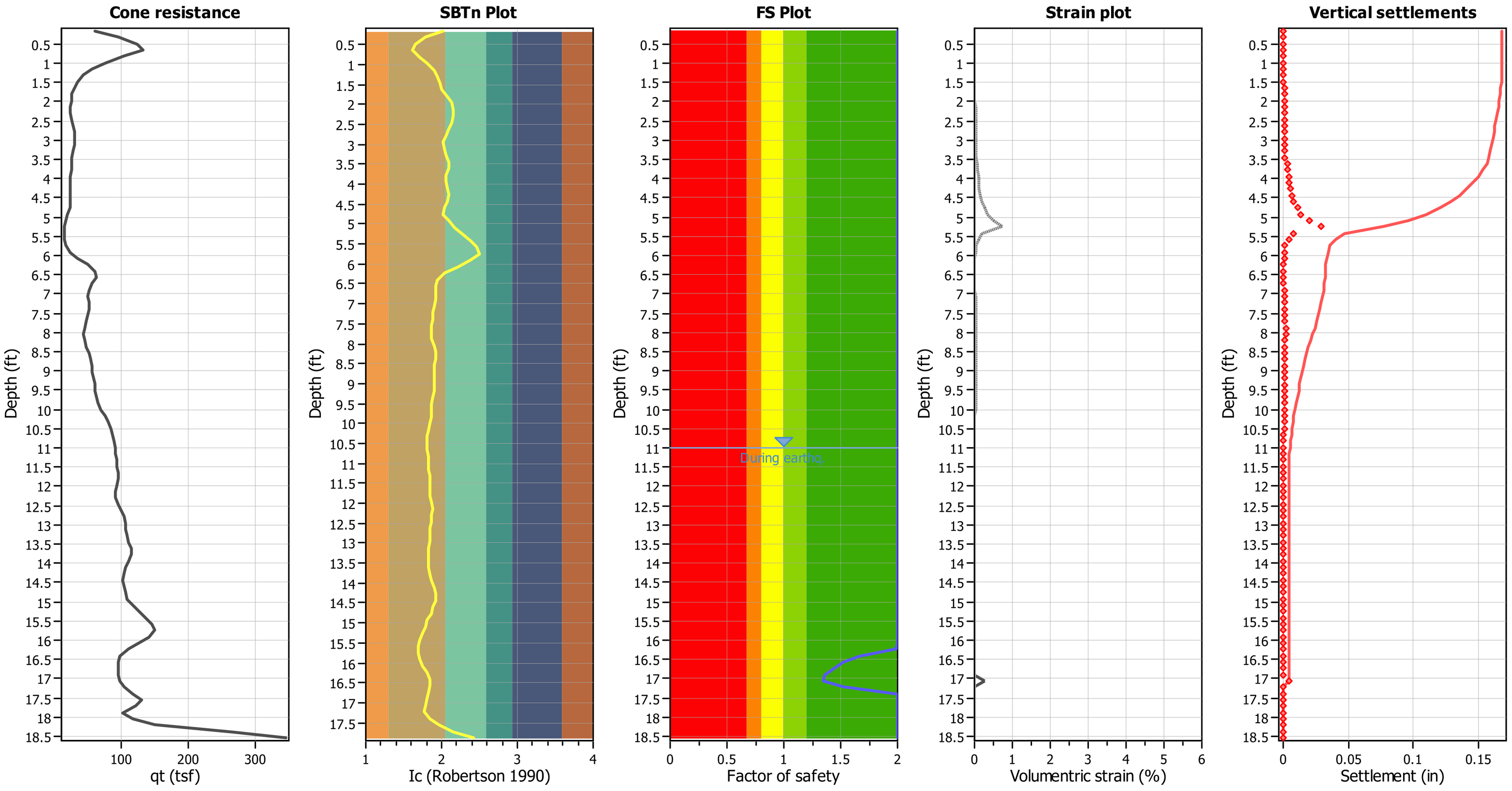
Overall liquefaction potential: 0.00

LPI = 0.00 - Liquefaction risk very low
LPI between 0.00 and 5.00 - Liquefaction risk low
LPI between 5.00 and 15.00 - Liquefaction risk high
LPI > 15.00 - Liquefaction risk very high

Abbreviations

FS: Calculated factor of safety for test point
F_L: 1 - FS
w_z: Function value of the extend of soil liquefaction according to depth
d_z: Layer thickness (ft)
LPI: Liquefaction potential index value for test point

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement of dry sands ::

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
0.16	2.02	96.53	1.32	127.69	27	696	0.15	0.000	0.00	5.81	0.00	0.000
0.33	1.78	153.71	1.13	174.07	33	823	0.15	0.001	0.00	5.81	0.00	0.000
0.49	1.66	199.51	1.00	199.51	37	917	0.15	0.001	0.00	5.81	0.00	0.000
0.66	1.61	213.08	1.00	213.08	39	922	0.15	0.001	0.00	5.81	0.00	0.000
0.82	1.71	166.57	1.00	166.62	31	810	0.15	0.002	0.00	5.81	0.00	0.000
0.98	1.81	121.36	1.16	141.35	27	673	0.15	0.002	0.00	5.81	0.00	0.000
1.15	1.90	90.06	1.24	111.37	22	559	0.15	0.004	0.00	5.81	0.00	0.000
1.31	1.95	68.97	1.27	87.37	18	454	0.15	0.005	0.01	5.81	0.00	0.000
1.48	1.98	55.00	1.29	70.84	15	376	0.15	0.008	0.01	5.81	0.01	0.000
1.64	1.99	46.42	1.00	46.42	10	325	0.15	0.012	0.03	5.81	0.02	0.001
1.80	2.08	41.10	1.39	56.97	12	319	0.15	0.013	0.02	5.81	0.02	0.001
1.97	2.13	38.51	1.46	56.20	12	318	0.15	0.015	0.03	5.81	0.02	0.001
2.13	2.15	37.21	1.50	55.89	12	317	0.15	0.017	0.03	5.81	0.02	0.001
2.30	2.15	37.38	1.51	56.33	12	319	0.15	0.018	0.03	5.81	0.02	0.001
2.46	2.13	39.08	1.47	57.56	13	326	0.15	0.019	0.03	5.81	0.02	0.001
2.62	2.09	42.80	1.41	60.17	13	339	0.15	0.020	0.03	5.81	0.02	0.001
2.79	2.05	46.58	1.36	63.16	13	350	0.15	0.020	0.03	5.81	0.02	0.001
2.95	2.03	48.52	1.33	64.63	14	354	0.15	0.021	0.03	5.81	0.02	0.001
3.12	2.04	46.93	1.34	62.97	13	347	0.15	0.024	0.04	5.81	0.03	0.001
3.28	2.06	43.36	1.37	59.43	13	331	0.15	0.028	0.05	5.81	0.03	0.001
3.44	2.09	40.08	1.40	56.24	12	316	0.15	0.034	0.06	5.81	0.04	0.002
3.61	2.09	38.63	1.00	38.63	8	304	0.15	0.041	0.12	5.81	0.08	0.003
3.77	2.07	38.45	1.00	38.45	8	295	0.15	0.048	0.14	5.81	0.09	0.004
3.94	2.06	37.93	1.00	37.93	8	288	0.15	0.056	0.16	5.81	0.11	0.004
4.10	2.08	36.76	1.00	36.76	8	286	0.15	0.061	0.19	5.81	0.12	0.005
4.27	2.10	35.63	1.00	35.63	8	287	0.15	0.065	0.20	5.81	0.13	0.005
4.43	2.08	35.39	1.00	35.39	8	275	0.15	0.080	0.26	5.81	0.17	0.007
4.59	2.05	35.43	1.00	35.43	8	265	0.15	0.098	0.32	5.81	0.21	0.008
4.76	2.03	34.76	1.00	34.76	7	253	0.15	0.125	0.42	5.81	0.27	0.011
4.92	2.10	31.03	1.00	31.03	7	249	0.15	0.143	0.53	5.81	0.35	0.014
5.09	2.18	27.11	1.00	27.11	6	239	0.15	0.184	0.77	5.81	0.50	0.020
5.25	2.26	23.32	1.00	23.32	5	229	0.15	0.237	1.14	5.81	0.74	0.029
5.41	2.38	22.25	2.26	50.37	12	253	0.15	0.163	0.29	5.81	0.19	0.008
5.58	2.46	22.45	2.69	60.37	15	282	0.15	0.113	0.16	5.81	0.10	0.004
5.74	2.50	26.02	2.98	77.60	20	346	0.15	0.060	0.06	5.81	0.04	0.002
5.91	2.38	36.84	2.26	83.16	20	419	0.15	0.038	0.04	5.81	0.02	0.001
6.07	2.22	54.82	1.66	90.91	21	509	0.15	0.026	0.03	5.81	0.02	0.001
6.23	2.04	78.79	1.35	106.19	22	587	0.15	0.021	0.02	5.81	0.01	0.000
6.40	1.95	96.69	1.27	122.56	25	637	0.15	0.019	0.01	5.81	0.01	0.000
6.56	1.92	99.53	1.25	124.50	25	635	0.15	0.020	0.01	5.81	0.01	0.000
6.73	1.93	90.31	1.26	113.56	23	584	0.15	0.023	0.02	5.81	0.01	0.001
6.89	1.93	80.70	1.26	101.45	21	521	0.15	0.030	0.03	5.81	0.02	0.001
7.05	1.90	78.80	1.24	97.40	20	489	0.15	0.036	0.04	5.81	0.02	0.001
7.22	1.88	80.21	1.22	98.25	20	487	0.15	0.037	0.04	5.81	0.03	0.001
7.38	1.89	80.17	1.23	98.55	20	491	0.15	0.038	0.04	5.81	0.03	0.001
7.55	1.87	78.30	1.22	95.17	19	468	0.15	0.044	0.05	5.81	0.03	0.001
7.71	1.86	74.78	1.21	90.33	18	442	0.15	0.053	0.06	5.81	0.04	0.002
7.87	1.87	69.94	1.22	84.98	17	422	0.15	0.061	0.08	5.81	0.05	0.002

:: Post-earthquake settlement of dry sands :: (continued)

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
8.04	1.91	68.42	1.24	84.91	17	434	0.15	0.059	0.07	5.81	0.05	0.002
8.20	1.92	69.81	1.25	87.39	18	456	0.15	0.054	0.06	5.81	0.04	0.002
8.37	1.92	73.69	1.25	91.89	19	483	0.15	0.048	0.05	5.81	0.03	0.001
8.53	1.91	77.06	1.25	95.98	19	510	0.15	0.044	0.05	5.81	0.03	0.001
8.69	1.91	79.50	1.24	98.94	20	531	0.15	0.041	0.04	5.81	0.03	0.001
8.86	1.91	81.18	1.24	101.00	20	548	0.15	0.039	0.04	5.81	0.03	0.001
9.02	1.91	82.85	1.24	102.78	21	563	0.15	0.038	0.04	5.81	0.02	0.001
9.19	1.90	84.32	1.24	104.37	21	577	0.15	0.038	0.04	5.81	0.02	0.001
9.35	1.88	85.38	1.23	104.62	21	579	0.15	0.038	0.04	5.81	0.02	0.001
9.51	1.87	85.85	1.21	104.20	21	579	0.15	0.039	0.04	5.81	0.02	0.001
9.68	1.86	86.71	1.21	104.68	21	585	0.15	0.039	0.04	5.81	0.02	0.001
9.84	1.86	89.59	1.21	108.22	21	611	0.15	0.037	0.03	5.81	0.02	0.001
10.01	1.85	94.36	1.20	113.49	22	646	0.15	0.034	0.03	5.81	0.02	0.001
10.17	1.83	101.02	1.18	119.33	23	680	0.15	0.032	0.03	5.81	0.02	0.001
10.33	1.81	106.65	1.16	123.83	24	709	0.15	0.030	0.02	5.81	0.02	0.001
10.50	1.80	110.67	1.15	127.68	25	737	0.15	0.029	0.02	5.81	0.01	0.001
10.66	1.81	112.88	1.16	131.12	25	765	0.15	0.027	0.02	5.81	0.01	0.001
10.83	1.82	114.58	1.17	134.35	26	792	0.15	0.026	0.02	5.81	0.01	0.000
10.99	1.83	115.93	1.18	136.85	27	816	0.15	0.026	0.02	5.81	0.01	0.000

Total estimated settlement: 0.16

Abbreviations

Q_{tn}: Equivalent clean sand normalized cone resistance
K_c: Fines correction factor
$Q_{tn,cs}$: Post-liquefaction volumentric strain
G_{max}: Small strain shear modulus
CSR: Soil cyclic stress ratio
γ: Cyclic shear strain
$e_{vol(15)}$: Volumetric strain after 15 cycles
N_c: Equivalent number of cycles
e_v: Volumetric strain
Settle.: Calculated settlement

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
11.15	138.50	2.00	0.00	1.00	0.00	11.32	139.44	2.00	0.00	1.00	0.00
11.48	140.61	2.00	0.00	1.00	0.00	11.65	142.72	2.00	0.00	1.00	0.00
11.81	144.02	2.00	0.00	1.00	0.00	11.98	142.15	2.00	0.00	1.00	0.00
12.14	138.96	2.00	0.00	1.00	0.00	12.30	138.38	2.00	0.00	1.00	0.00
12.47	140.89	2.00	0.00	1.00	0.00	12.63	146.66	2.00	0.00	1.00	0.00
12.80	150.70	2.00	0.00	1.00	0.00	12.96	154.45	2.00	0.00	1.00	0.00
13.12	153.05	2.00	0.00	1.00	0.00	13.29	155.19	2.00	0.00	1.00	0.00
13.45	157.15	2.00	0.00	1.00	0.00	13.62	162.37	2.00	0.00	1.00	0.00
13.78	162.72	2.00	0.00	1.00	0.00	13.94	161.72	2.00	0.00	1.00	0.00
14.11	157.83	2.00	0.00	1.00	0.00	14.27	154.88	2.00	0.00	1.00	0.00
14.44	152.56	2.00	0.00	1.00	0.00	14.60	149.41	2.00	0.00	1.00	0.00
14.76	148.08	2.00	0.00	1.00	0.00	14.93	147.60	2.00	0.00	1.00	0.00
15.09	152.12	2.00	0.00	1.00	0.00	15.26	156.40	2.00	0.00	1.00	0.00
15.42	159.43	2.00	0.00	1.00	0.00	15.58	164.49	2.00	0.00	1.00	0.00
15.75	167.41	2.00	0.00	1.00	0.00	15.91	158.57	2.00	0.00	1.00	0.00
16.08	153.91	2.00	0.00	1.00	0.00	16.24	143.07	1.99	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
16.40	132.37	1.66	0.00	1.00	0.00	16.57	127.15	1.52	0.00	1.00	0.00
16.73	124.73	1.45	0.00	1.00	0.00	16.90	121.14	1.36	0.00	1.00	0.00
17.06	120.44	1.34	0.25	1.00	0.00	17.22	128.12	1.52	0.00	1.00	0.00
17.39	155.90	2.00	0.00	1.00	0.00	17.55	182.45	2.00	0.00	1.00	0.00
17.72	204.66	2.00	0.00	1.00	0.00	17.88	288.00	2.00	0.00	1.00	0.00
18.04	-1.00	2.00	0.00	1.00	0.00	18.21	-1.00	2.00	0.00	1.00	0.00
18.37	-1.00	2.00	0.00	1.00	0.00	18.54	-1.00	2.00	0.00	1.00	0.00

Total estimated settlement: 0.00

Abbreviations

$Q_{tn,cs}$: Equivalent clean sand normalized cone resistance
FS: Factor of safety against liquefaction
e_v (%): Post-liquefaction volumentric strain
DF: e_v depth weighting factor
Settlement: Calculated settlement

:: Strength loss calculation (Robertson (2009) ::

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
0.16	60.09	96.53	1.32	127.69	2.02	0.79	0.79
0.33	95.69	153.71	1.13	174.07	1.78	0.86	0.86
0.49	124.21	199.51	1.00	199.51	1.66	0.89	0.89
0.66	132.67	213.08	1.00	213.08	1.61	0.90	0.90
0.82	103.73	166.57	1.00	166.62	1.71	0.85	0.85
0.98	75.60	121.36	1.16	141.35	1.81	0.82	0.82
1.15	56.12	90.06	1.24	111.37	1.90	0.77	0.77
1.31	43.01	68.97	1.27	87.37	1.95	0.72	0.72
1.48	34.32	55.00	1.29	70.84	1.98	0.27	0.69
1.64	28.99	46.42	1.00	46.42	1.99	0.04	0.62
1.80	25.69	41.10	1.39	56.97	2.08	0.09	0.65
1.97	24.08	38.51	1.46	56.20	2.13	0.08	0.65
2.13	23.28	37.21	1.50	55.89	2.15	0.08	0.64
2.30	23.39	37.38	1.51	56.33	2.15	0.08	0.65
2.46	24.46	39.08	1.47	57.56	2.13	0.09	0.65
2.62	26.79	42.80	1.41	60.17	2.09	0.11	0.66
2.79	29.15	46.58	1.36	63.16	2.05	0.15	0.67
2.95	30.36	48.52	1.33	64.63	2.03	0.16	0.67
3.12	29.39	46.93	1.34	62.97	2.04	0.14	0.66
3.28	27.17	43.36	1.37	59.43	2.06	0.11	0.65
3.44	25.14	40.08	1.40	56.24	2.09	0.08	0.65
3.61	24.24	38.63	1.00	38.63	2.09	0.03	0.62
3.77	24.14	38.45	1.00	38.45	2.07	0.03	0.62
3.94	23.82	37.93	1.00	37.93	2.06	0.02	0.62
4.10	23.10	36.76	1.00	36.76	2.08	0.02	0.62
4.27	22.41	35.63	1.00	35.63	2.10	0.02	0.62
4.43	22.27	35.39	1.00	35.39	2.08	0.02	0.62
4.59	22.30	35.43	1.00	35.43	2.05	0.02	0.62
4.76	21.89	34.76	1.00	34.76	2.03	0.02	0.62
4.92	19.58	31.03	1.00	31.03	2.10	0.02	0.62
5.09	17.14	27.11	1.00	27.11	2.18	0.02	0.62
5.25	14.79	23.32	1.00	23.32	2.26	0.02	0.62
5.41	14.14	22.25	2.26	50.37	2.38	0.05	0.63
5.58	14.27	22.45	2.69	60.37	2.46	0.12	0.66
5.74	16.50	26.02	2.98	77.60	2.50	0.48	0.70
5.91	23.24	36.84	2.26	83.16	2.38	0.71	0.71
6.07	34.44	54.82	1.66	90.91	2.22	0.73	0.73
6.23	49.37	78.79	1.35	106.19	2.04	0.76	0.76
6.40	60.52	96.69	1.27	122.56	1.95	0.79	0.79
6.56	62.30	99.53	1.25	124.50	1.92	0.79	0.79
6.73	56.57	90.31	1.26	113.56	1.93	0.77	0.77
6.89	50.60	80.70	1.26	101.45	1.93	0.75	0.75
7.05	49.43	78.80	1.24	97.40	1.90	0.74	0.74
7.22	50.31	80.21	1.22	98.25	1.88	0.74	0.74
7.38	50.30	80.17	1.23	98.55	1.89	0.75	0.75
7.55	49.14	78.30	1.22	95.17	1.87	0.74	0.74
7.71	47.04	74.78	1.21	90.33	1.86	0.73	0.73
7.87	44.44	69.94	1.22	84.98	1.87	0.72	0.72

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
8.04	43.57	68.42	1.24	84.91	1.91	0.72	0.72
8.20	44.79	69.81	1.25	87.39	1.92	0.72	0.72
8.37	47.91	73.69	1.25	91.89	1.92	0.73	0.73
8.53	50.71	77.06	1.25	95.98	1.91	0.74	0.74
8.69	52.93	79.50	1.24	98.94	1.91	0.75	0.75
8.86	54.66	81.18	1.24	101.00	1.91	0.75	0.75
9.02	56.47	82.85	1.24	102.78	1.91	0.75	0.75
9.19	58.20	84.32	1.24	104.37	1.90	0.76	0.76
9.35	59.81	85.38	1.23	104.62	1.88	0.76	0.76
9.51	60.98	85.85	1.21	104.20	1.87	0.76	0.76
9.68	62.33	86.71	1.21	104.68	1.86	0.76	0.76
9.84	65.03	89.59	1.21	108.22	1.86	0.76	0.76
10.01	69.24	94.36	1.20	113.49	1.85	0.77	0.77
10.17	75.18	101.02	1.18	119.33	1.83	0.78	0.78
10.33	80.41	106.65	1.16	123.83	1.81	0.79	0.79
10.50	84.31	110.67	1.15	127.68	1.80	0.79	0.79
10.66	86.67	112.88	1.16	131.12	1.81	0.80	0.80
10.83	88.61	114.58	1.17	134.35	1.82	0.80	0.80
10.99	90.34	115.93	1.18	136.85	1.83	0.81	0.81
11.15	91.34	116.78	1.19	138.50	1.83	0.81	0.81
11.32	91.97	117.16	1.19	139.44	1.84	0.81	0.81
11.48	92.93	117.92	1.19	140.61	1.84	0.81	0.81
11.65	94.61	119.57	1.19	142.72	1.84	0.82	0.82
11.81	95.56	120.32	1.20	144.02	1.85	0.82	0.82
11.98	93.40	117.39	1.21	142.15	1.86	0.82	0.82
12.14	90.83	113.86	1.22	138.96	1.88	0.81	0.81
12.30	90.98	113.52	1.22	138.38	1.87	0.81	0.81
12.47	94.06	116.62	1.21	140.89	1.86	0.81	0.81
12.63	99.23	122.34	1.20	146.66	1.85	0.82	0.82
12.80	102.81	126.15	1.19	150.70	1.84	0.83	0.83
12.96	105.96	129.45	1.19	154.45	1.84	0.83	0.83
13.12	106.08	128.93	1.19	153.05	1.83	0.83	0.83
13.29	108.17	130.91	1.19	155.19	1.83	0.83	0.83
13.45	110.85	133.46	1.18	157.15	1.82	0.84	0.84
13.62	115.23	138.14	1.18	162.37	1.82	0.84	0.84
13.78	114.11	136.54	1.19	162.72	1.84	0.84	0.84
13.94	111.05	132.85	1.22	161.72	1.87	0.84	0.84
14.11	106.15	127.00	1.24	157.83	1.91	0.84	0.84
14.27	103.53	123.57	1.25	154.88	1.93	0.83	0.83
14.44	102.45	121.74	1.25	152.56	1.92	0.83	0.83
14.60	102.79	121.18	1.23	149.41	1.89	0.83	0.83
14.76	105.02	122.80	1.21	148.08	1.86	0.82	0.82
14.93	109.19	126.55	1.17	147.60	1.81	0.82	0.82
15.09	116.12	133.76	1.14	152.12	1.79	0.83	0.83
15.26	124.61	142.60	1.10	156.40	1.76	0.84	0.84
15.42	136.42	154.98	1.03	159.43	1.72	0.84	0.84
15.58	145.66	164.49	1.00	164.49	1.69	0.85	0.85
15.75	148.88	167.41	1.00	167.41	1.69	0.85	0.85

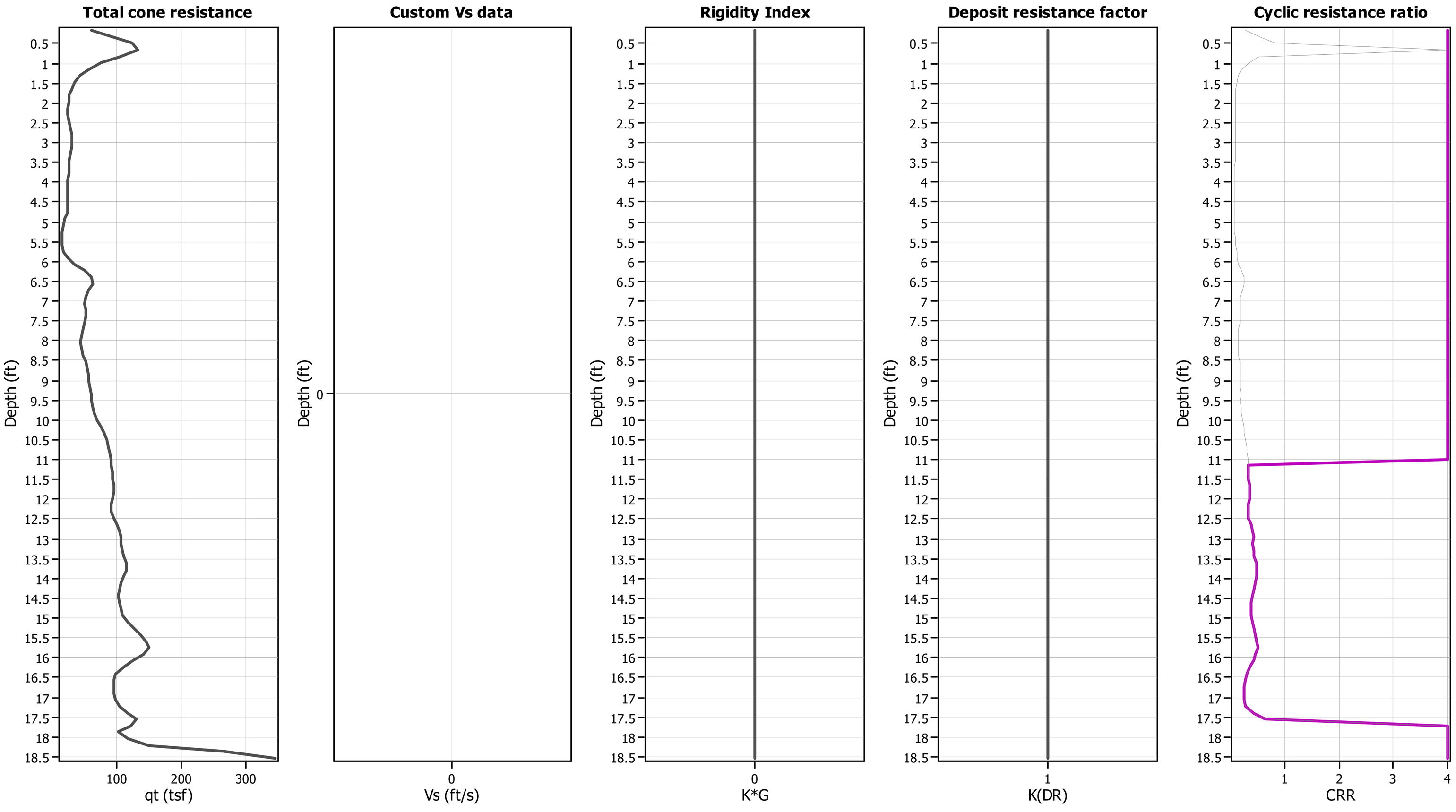
:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
15.91	141.26	158.57	1.00	158.57	1.71	0.84	0.84
16.08	125.91	141.39	1.09	153.91	1.75	0.83	0.83
16.24	109.53	123.12	1.16	143.07	1.81	0.82	0.82
16.40	97.99	110.11	1.20	132.37	1.85	0.80	0.80
16.57	94.44	105.72	1.20	127.15	1.85	0.79	0.79
16.73	94.22	104.93	1.19	124.73	1.84	0.79	0.79
16.90	94.62	104.71	1.16	121.14	1.80	0.78	0.78
17.06	96.94	106.72	1.13	120.44	1.78	0.78	0.78
17.22	104.68	114.85	1.12	128.12	1.77	0.80	0.80
17.39	117.98	130.00	1.20	155.90	1.85	0.83	0.83
17.55	129.41	143.42	1.27	182.45	1.95	0.87	0.87
17.72	121.19	135.86	1.51	204.66	2.15	0.89	0.89
17.88	102.07	116.16	2.48	288.00	2.42	0.97	0.97
18.04	116.77	-1.00	1.00	-1.00	-1.00	0.00	0.00
18.21	149.75	-1.00	1.00	-1.00	-1.00	0.00	0.00
18.37	265.67	-1.00	1.00	-1.00	-1.00	0.00	0.00
18.54	346.48	-1.00	1.00	-1.00	-1.00	0.00	0.00

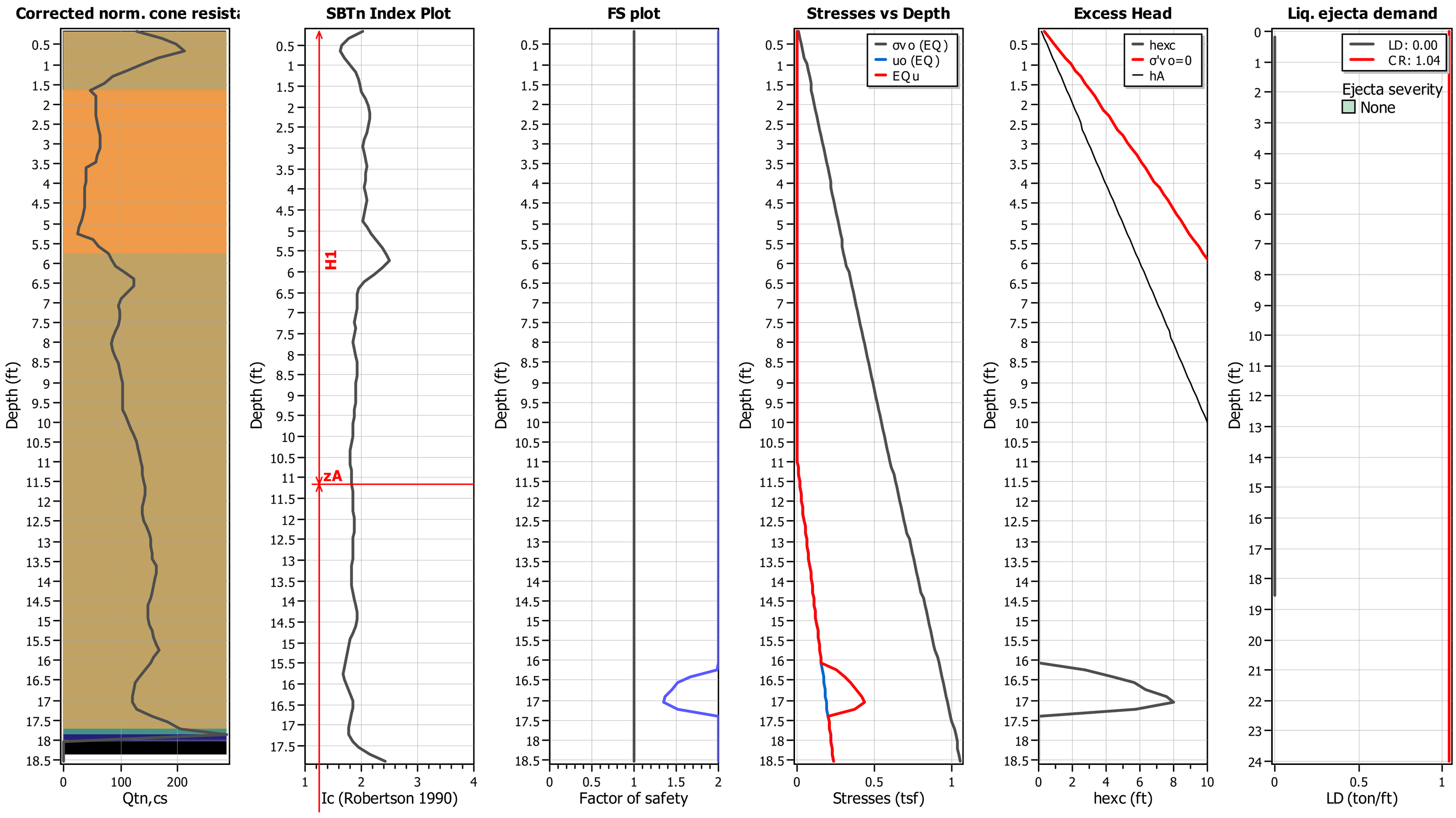
Abbreviations

q_t: Total cone resistance
K_c: Cone resistance correction factor due to fines
$Q_{tn,cs}$: Adjusted and corrected cone resistance due to fines
I_c: Soil behavior type index
$S_{u(liq)}/\sigma'_v$: Calculated liquefied undrained strength ratio
$S_{u(peak)}/\sigma'_v$: Calculated peak undrained strength ratio

Aging Calculation Estimation



Ejecta Severity Estimation



U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Please also see the new USGS Earthquake Hazard Toolbox for access to the most recent NSHMs for the conterminous U.S. and Hawaii.

Input

Edition

Dynamic: Conterminous U.S. 2014 (u…

Spectral Period

Peak Ground Acceleration

Latitude

Decimal degrees

37.713

Time Horizon

Return period in years

2475

Longitude

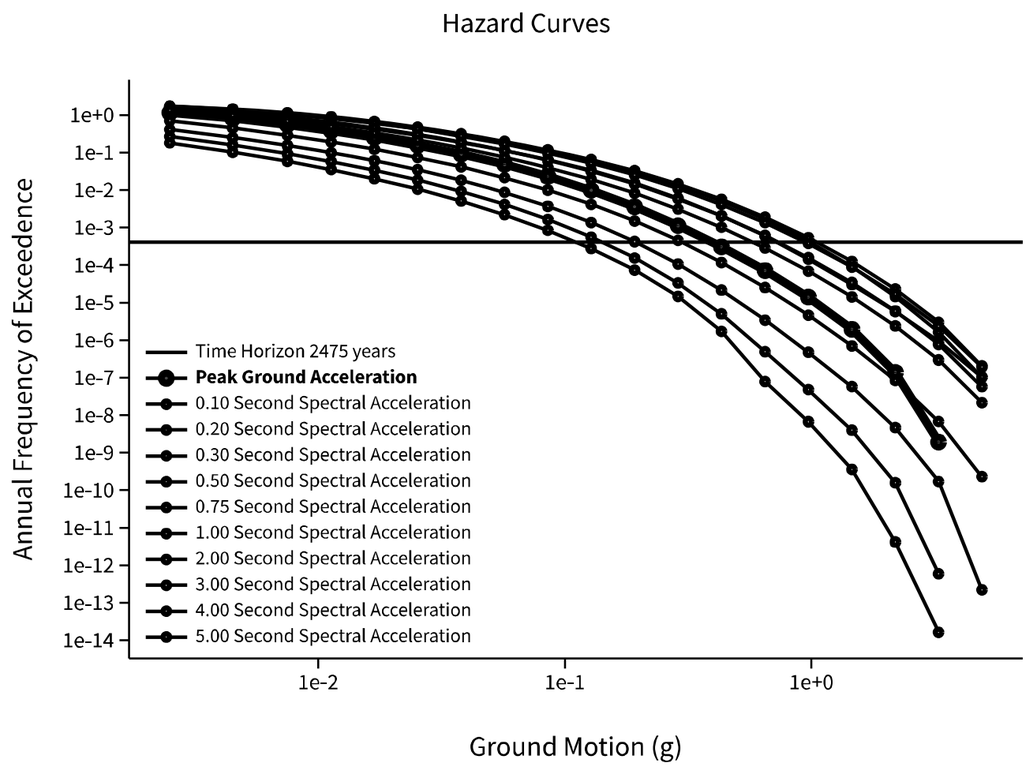
Decimal degrees, negative values for western longitudes

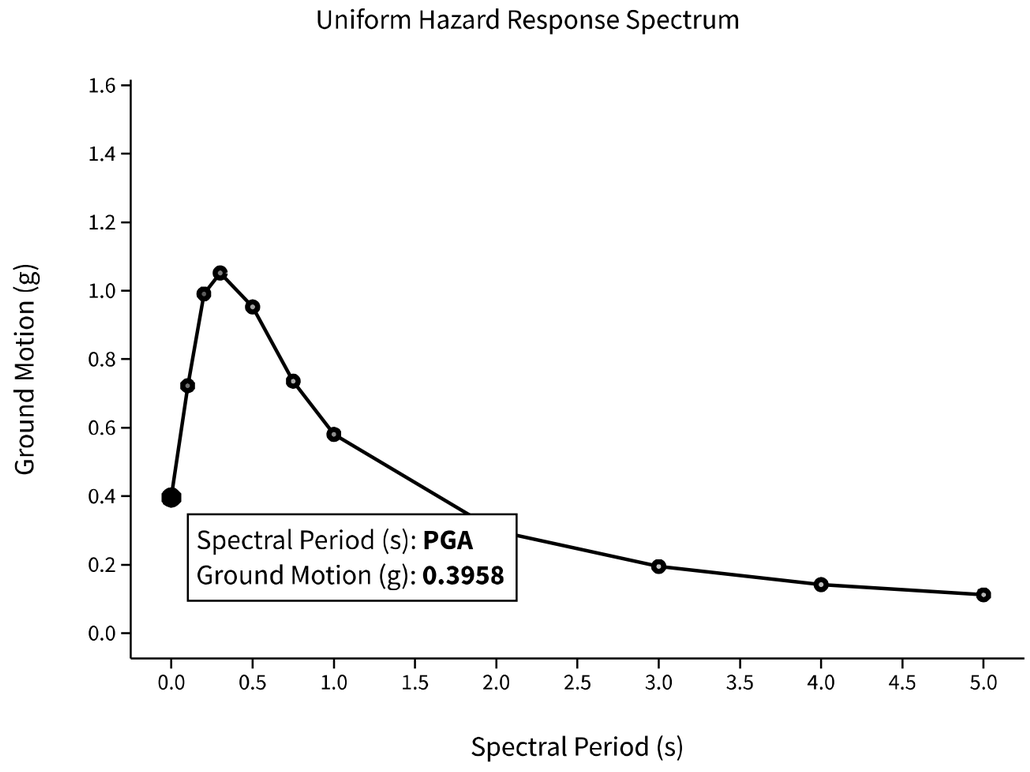
-121.0278

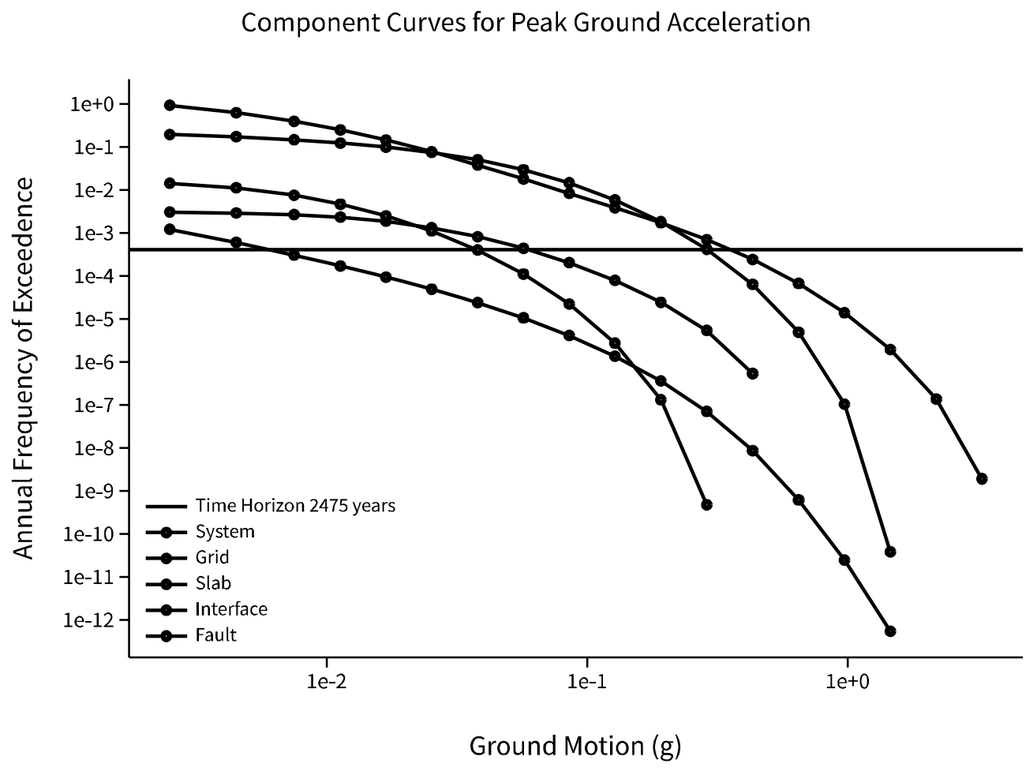
Site Class

259 m/s (Site class D)

Hazard Curve





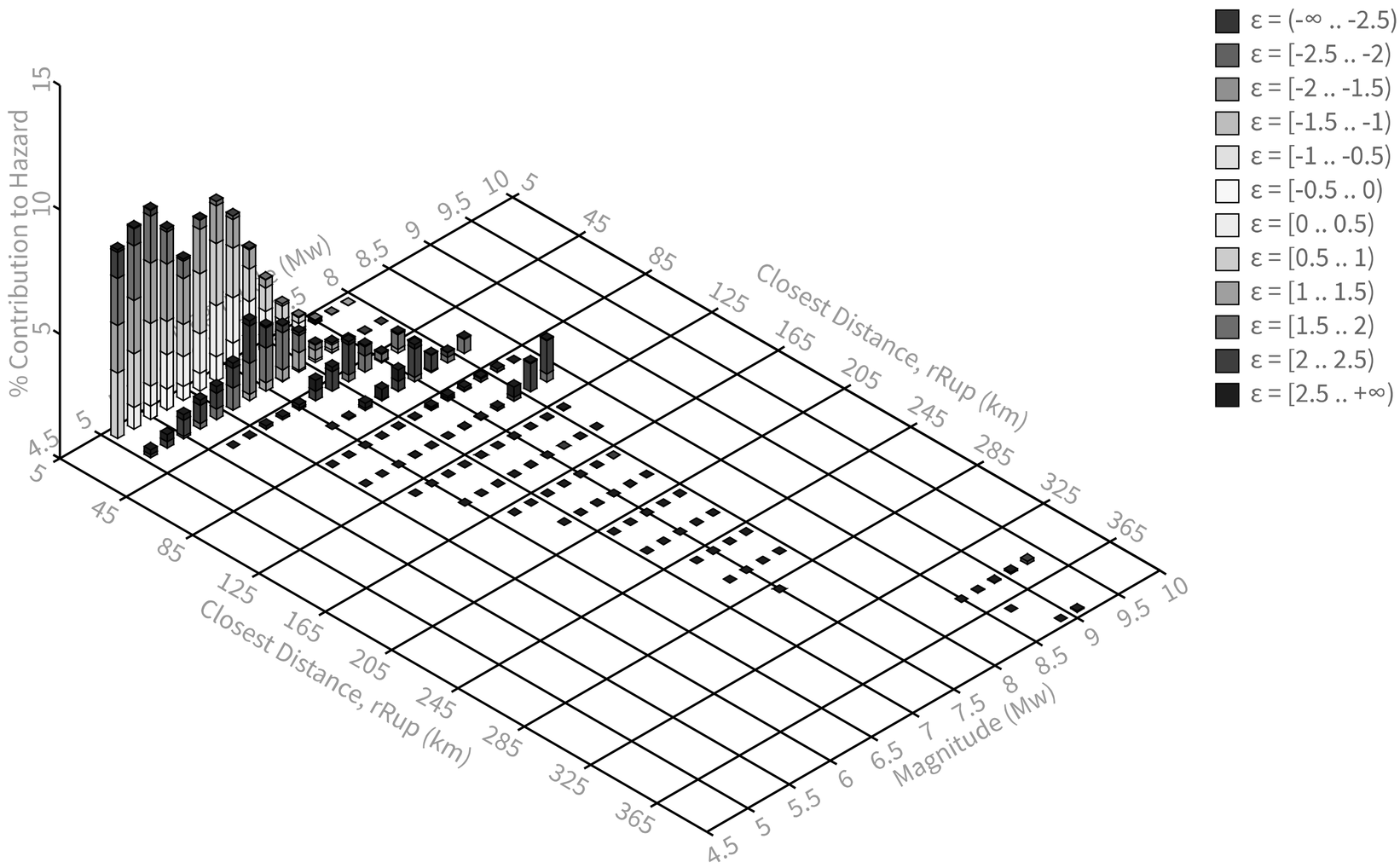


View Raw Data

Deaggregation

Component

Total


% Contribution to Hazard
15
10
5
Closest Distance, rRup (km)
5
45
85
125
165
205
245
285
325
365
Magnitude (Mw)
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
10
ε = (-∞ .. -2.5)
ε = [-2.5 .. -2)
ε = [-2 .. -1.5)
ε = [-1.5 .. -1)
ε = [-1 .. -0.5)
ε = [-0.5 .. 0)
ε = [0 .. 0.5)
ε = [0.5 .. 1)
ε = [1 .. 1.5)
ε = [1.5 .. 2)
ε = [2 .. 2.5)
ε = [2.5 .. +∞)

Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.39584581 g

Recovered targets

Return period: 2831.1555 yrs
Exceedance rate: 0.00035321268 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.18 %

Mean (over all sources)

m: 6.25
r: 23.63 km
ε_0: 1.26 σ

Mode (largest m–r bin)

m: 5.5
r: 10.16 km
ε_0: 1.03 σ
Contribution: 8.42 %

Mode (largest m–r–ε_0 bin)

m: 5.1
r: 5.64 km
ε_0: 0.82 σ
Contribution: 2.62 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
UC33brAvg_FM31 (opt)	Grid							40.34
PointSourceFinite: -121.028, 37.735		5.60	5.67	0.38	121.028°W	37.735°N	0.00	3.98
PointSourceFinite: -121.028, 37.735		5.60	5.67	0.38	121.028°W	37.735°N	0.00	3.98
PointSourceFinite: -121.028, 37.771		7.88	5.77	0.68	121.028°W	37.771°N	0.00	3.19
PointSourceFinite: -121.028, 37.771		7.88	5.77	0.68	121.028°W	37.771°N	0.00	3.19
PointSourceFinite: -121.028, 37.816		11.31	5.93	1.02	121.028°W	37.816°N	0.00	2.07
PointSourceFinite: -121.028, 37.816		11.31	5.93	1.02	121.028°W	37.816°N	0.00	2.07
PointSourceFinite: -121.028, 37.843		13.52	6.03	1.19	121.028°W	37.843°N	0.00	1.55
PointSourceFinite: -121.028, 37.843		13.52	6.03	1.19	121.028°W	37.843°N	0.00	1.55
PointSourceFinite: -121.028, 37.798		9.90	5.87	0.90	121.028°W	37.798°N	0.00	1.26
PointSourceFinite: -121.028, 37.798		9.90	5.87	0.90	121.028°W	37.798°N	0.00	1.26
PointSourceFinite: -121.028, 37.825		12.04	5.96	1.08	121.028°W	37.825°N	0.00	1.17
PointSourceFinite: -121.028, 37.825		12.04	5.96	1.08	121.028°W	37.825°N	0.00	1.17
PointSourceFinite: -121.028, 37.852		14.26	6.06	1.24	121.028°W	37.852°N	0.00	1.03
PointSourceFinite: -121.028, 37.852		14.26	6.06	1.24	121.028°W	37.852°N	0.00	1.03
UC33brAvg_FM32 (opt)	Grid							40.29
PointSourceFinite: -121.028, 37.735		5.60	5.67	0.38	121.028°W	37.735°N	0.00	3.98
PointSourceFinite: -121.028, 37.735		5.60	5.67	0.38	121.028°W	37.735°N	0.00	3.98
PointSourceFinite: -121.028, 37.771		7.88	5.77	0.68	121.028°W	37.771°N	0.00	3.19
PointSourceFinite: -121.028, 37.771		7.88	5.77	0.68	121.028°W	37.771°N	0.00	3.19
PointSourceFinite: -121.028, 37.816		11.32	5.93	1.02	121.028°W	37.816°N	0.00	2.07
PointSourceFinite: -121.028, 37.816		11.32	5.93	1.02	121.028°W	37.816°N	0.00	2.07
PointSourceFinite: -121.028, 37.843		13.52	6.03	1.19	121.028°W	37.843°N	0.00	1.55
PointSourceFinite: -121.028, 37.843		13.52	6.03	1.19	121.028°W	37.843°N	0.00	1.55
PointSourceFinite: -121.028, 37.798		9.90	5.87	0.90	121.028°W	37.798°N	0.00	1.25
PointSourceFinite: -121.028, 37.798		9.90	5.87	0.90	121.028°W	37.798°N	0.00	1.25
PointSourceFinite: -121.028, 37.825		12.04	5.96	1.08	121.028°W	37.825°N	0.00	1.16
PointSourceFinite: -121.028, 37.825		12.04	5.96	1.08	121.028°W	37.825°N	0.00	1.16
PointSourceFinite: -121.028, 37.852		14.26	6.06	1.25	121.028°W	37.852°N	0.00	1.03
PointSourceFinite: -121.028, 37.852		14.26	6.06	1.25	121.028°W	37.852°N	0.00	1.03
UC33brAvg_FM32	System							10.00
Greenville (No) [0]		50.45	7.20	2.03	121.537°W	37.510°N	243.46	2.23
Calaveras (Central) [6]		72.27	7.58	2.28	121.694°W	37.315°N	233.22	1.64
San Andreas (Santa Cruz Mts) [3]		100.57	8.16	2.24	121.766°W	37.025°N	220.69	1.61
Great Valley 07 (Orestimba) [7]		33.77	6.60	1.88	121.319°W	37.527°N	231.22	1.41
UC33brAvg_FM31	System							9.09
Greenville (No) [0]		50.47	7.18	2.07	121.535°W	37.511°N	243.48	1.63
Calaveras (Central) [6]		72.27	7.57	2.29	121.694°W	37.315°N	233.22	1.59
San Andreas (Santa Cruz Mts) [3]		100.57	8.16	2.23	121.766°W	37.025°N	220.69	1.59
Great Valley 07 (Orestimba) [7]		33.77	6.61	1.87	121.319°W	37.527°N	231.22	1.43

APPENDIX E

Noise Study (Ganddini 2023)

STANISLAUS ELEMENTARY SCHOOL 1,2,3-TCP MITIGATION NOISE IMPACT ANALYSIS

City of Modesto

December 14, 2023

gandhi

Traffic Engineering ● Transportation Planning ● Parking ● Noise & Vibration
Air Quality ● Global Climate Change ● Health Risk Assessment

STANISLAUS ELEMENTARY SCHOOL
1,2,3-TCP MITIGATION
NOISE IMPACT ANALYSIS

City of Modesto

December 14, 2023

prepared by
Roma Stromberg, INCE, MS
Catherine Howe, MS

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Santa Ana, California 92705
(714) 795-3100 | ganddini.com

Project No. 19689

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EXECUTIVE SUMMARY

The proposed project is located within northwest unincorporated Stanislaus County in central San Joaquin Valley, "Central Valley." The Project is approximately 0.5 miles north from the City Limits of Modesto, within Modesto's Sphere of Influence (SOI). The Project will be constructed in public-right-of-way either within or adjacent to paved streets to the north of the Kiernan/ Carver North Comprehensive Planning District (CPD), and north of the City Limits of Modesto.

The proposed Project is the consolidation of Stanislaus Union School District (SUSD) service area (Water System No. CA5000249) with the City of Modesto, through an extension of water and wastewater services, and the abandonment of the existing Well 02. Stanislaus Elementary School is one of six schools located within SUSD (five (5) elementary schools; one (1) junior high school); however, Stanislaus Elementary School is the only school currently being serviced by Water System No. CA5000249 since it is the only school within the district located outside of Modesto's Water System and City Limits.

Due to presence of 1,2,3-TCP in Well 02, the Stanislaus Elementary School's water system needs additional water services. Therefore, the intended outcome of the proposed Project is the following:

- Provide Stanislaus Elementary School with a source of drinking water that meets water quality standards; Provide sufficient hydraulic capacity to meet 4,000 gallons per minute (gpm) fire flow requirements while maintaining a 20-pounds per square inch (psi) residual pressure at the school; build a Project that is consistent with the City's 2019 Water Master Plan (WMP) identified future improvements.

- To achieve these objectives, the Project proposes to extend the City of Modesto's Water and Wastewater systems to the school and stop the extraction of contaminated groundwater from Well 02.

On-Site Construction Noise

Noise Ordinance Compliance
Although most construction activity is expected to occur during the allowed hours as provided above, jack and bore activities may occur outside of those hours. This would be a significant impact and mitigation is required, unless otherwise authorized by Building Commissioner.

Analysis in Light of FTA Standards
As shown in Table 7, construction noise will range between 82 and 98 dBA dBA, L_{eq}. Project construction noise may exceed the FTA noise threshold of 80 dBA L_{eq} for an 8-hour period at residential and noise-sensitive outdoor areas. Although FTA standards only apply to residential land uses, impacts to commercial land uses, schools and parks were also considered.

Construction noise levels at the retail uses near the jack and bore site near the intersection of Dale Road and Kiernan Avenue may reach up to 82.5 dBA L_{eq}. Retail land uses are not considered sensitive. Therefore, this impact is less than significant and no mitigation is required.

Construction noise levels at the Elementary School may reach up to 92.0 dBA L_{eq} at a distance of 50 feet on school grounds. This impact would be significant and mitigation is required.

Construction noise levels at single-family homes near Tully Road and Kiernan Avenue may reach up to 92.0 dBA L_{eq} at a distance of 50 feet on school grounds. This impact would be significant and mitigation is required.

Construction noise along the pipeline alignment at residential land uses could reach up to 97.7 dBA L_{eq}. This impact would be significant and mitigation is required.

Required Construction Noise Mitigation Measures

In addition to the previously mentioned Best Management Practices (BMPs), the following construction noise impacts must be implemented in order for impacts to be considered less than significant.

1. During all project site excavation and grading on-site, construction contractors shall equip all construction equipment, fixed or mobile, with properly operating and maintained mufflers, consistent with manufacturer standards.

2. The contractor shall place all stationary construction equipment so that emitted noise is directed away from the noise sensitive receptors nearest the project site. One-inch plywood or acoustical blankets capable of achieving a reduction level of at least 10 dB shall be used to keep equipment noise from exceeding the 80 dBA noise level standard.

3. Equipment shall be shut off and not left to idle when not in use.

4. Whenever possible, electric power will be used in lieu of internal combustion engine power.

5. The contractor shall locate equipment staging in areas that will create the greatest distance between construction-related noise/vibration sources and sensitive receptors nearest the project site during all project construction.

6. Jackhammers, pneumatic equipment, and all other portable stationary noise sources shall be shielded, and noise shall be directed away from sensitive receptors.

7. The project proponent shall mandate that the construction contractor prohibit the use of music or sound amplification on the project site during construction.

8. The construction contractor shall limit haul truck deliveries to the same hours specified for construction equipment.

9. The quietest equipment available will be utilized when feasible; and,

10. Haul routes that affect the fewest number of people will be utilized whenever possible.

Off-Site Construction Noise (Construction Vehicle Trips)

The addition of project construction-related vehicle trips is not expected to result in a noticeable change in noise levels (less than 1 dB). Project impacts related to project construction related vehicle trips would be less than significant. No mitigation is required.

Groundborne Vibration

The closest structures to the proposed construction activities include single family residential structures as close as 25 feet. Plate compactors are the most vibratory equipment that may be used near an existing structure. The peak particle velocity (PPV) per square foot associated with these vibratory plates is 0.21 at a distance of 25 feet. They are not, however, expected to be utilized within 25 feet of an existing structure. Other equipment anticipated to be used during project construction generate lower PPV. Therefore, groundborne vibration generated by project construction would not exceed the levels necessary to cause architectural damage. Use of plate compactors would not exceed the threshold for annoyance due to vibration (PPV of 0.4 in/sec) at residential receptors along the project route. This impact would be less than significant. No mitigation is required.

The most substantial sources of groundborne vibration during post-construction project operations will include the movement of passenger vehicles and trucks on paved and generally smooth surfaces. Loaded trucks generally have a PPV of 0.076 at a distance of 25 feet (Caltrans 2020), which is a substantially lower PPV than that of a vibratory roller (0.210 in/sec PPV at 25 feet). Therefore, groundborne vibration levels generated by project operation would not exceed those modeled for project construction.

Impacts related to groundborne vibration would be less than significant. No mitigation is required.

Air Traffic Impacts

There are no airports within two miles of the project site. The project would not result in any impacts related to airport or aircraft noise. No mitigation is required.

1. INTRODUCTION

This section describes the purpose of this study and introduces the proposed project.

PURPOSE AND OBJECTIVES

The purpose of this study is to provide an assessment of the noise impacts associated with construction of the proposed Stanislaus Elementary School 1,2,3-TCP Mitigation project and to identify mitigation measures that may be necessary to reduce those impacts. The noise issues related to the proposed construction and long-term operation have been evaluated in light of applicable federal, state and local policies, including those of the City of Modesto, in the context of the California Environmental Quality Act (CEQA).

Although this is a technical report, effort has been made to write the report clearly and concisely. A list of acronyms and glossary are provided in Appendix A and Appendix B of this report to assist the reader with technical terms related to noise analysis.

PROJECT LOCATION

The proposed project is located within northwest unincorporated Stanislaus County in central San Joaquin Valley, "Central Valley." The Project is approximately 0.5 miles north from the City Limits of Modesto, within Modesto's Sphere of Influence (SOI). The Project will be constructed in public-right-of-way either within or adjacent to paved streets to the north of the Kiernan/ Carver North Comprehensive Planning District (CPD), and north of the City Limits of Modesto. The Project proposes a lateral extending from the proposed water main within the street to the Stanislaus Elementary School Property (APN 004-068-008) for water delivery to the existing school facility. The Project also proposes water mains within public rights-of-way for Dale Road; Kieran Avenue; Carver Road; and Tully Road, which is referred to as the "Project Site" for CEQA analysis and as summarized as follows:

Public ROW	Length (LF[1])	Direction of Pipeline Construction	Lat/Long; Elevation	Area of Disturbance
Tully Road	~ 700 ft	**North** from existing "dead-end" connection point	**Beginning of proposed alignment**: Latitude 37.710473 °N/Longitude 121.013059°W; 22-25 ft AMSL	**Open Trenching**: 6-ft x 8-ft for 12,000 linear feet **Jack and Bore Pits**: ***5 Jacking Pits:*** 12-ft wide x 10-ft long x 15-ft deep ***5 Receiving Pits:*** 12-ft wide x 24-ft long x 15-ft deep
Kieran Avenue	~ 10,730 ft	**West** from Tully Road and Kieran Avenue intersection.	---	
Dale Road	~570 ft	**South** from Kiernan Avenue and Dale Road intersection to existing "dead-end" connection point.	**End of Proposed Alignment**: Latitude 37.710636 °N/Longitude -121.050073°W; 22-25 ft AMSL	

Reference: See Figure 2A: Water Improvements Local Vicinity Map
Notes: 1) LF= Linear Feet
2) Average dimensions of trenching are 6-feet wide by 8-feet deep.
3) AMSL= Above Mean Sea Level

The project's location is shown on Figures 1 and 2.

PROJECT DESCRIPTION

The proposed Project is the consolidation of Stanislaus Union School District (SUSD) service area (Water System No. CA5000249) with the City of Modesto, through an extension of water and wastewater services, and the abandonment of the existing Well 02. Stanislaus Elementary School is one of six schools located within SUSD (five (5) elementary schools; one (1) junior high school); however, Stanislaus Elementary School is the only school currently being serviced by Water System No. CA5000249 since it is the only school within the district located outside of Modesto's Water System and City Limits.

Proposed Water Improvements

Water improvements will construct a total of approximately 12,000 linear feet of 12-inch potable water pipeline along Tully Road; Kieran Avenue; and Dale Road. The pipeline will extend from the existing dead-end 12-inch potable water main along Tully Road, approximately 700 feet south from the Tully Road and Kieran Avenue intersection. From the existing connection point, the potable water pipeline will continue north towards Keiran Avenue, then west towards Dale Road along Kieran Avenue. The Project Alignment will terminate along Dale Road and connect with the existing dead-end 12-inch potable water main, approximately 570 feet from the Dale Road and Keiran Avenue intersection.

Due to the connection to two existing dead-end 12-inch pipelines along Tully Road and Dale Road, the proposed water improvements will meet fire flow requirements (33 psi at 4,000 gpm); meet the City's operational and performance criteria; and result in high pipeline turnover rates which benefit water quality within the distribution system. The entire alignment will be buried underground using open trench construction as well as jack and bore construction to avoid direct impacts to existing utilities and structures. Temporary areas of disturbance as a result of trenching is anticipated to be 4-feet wide and 8-feet deep along the entire 12,000 linear feet of Project Alignment, approximately 1.1 acres. Jack and bore construction will consist of 5 total pits[1]. Jacking pits are approximately 12-ft wide by 10-ft long by 15-ft deep and receiving pits that are approximately 12-ft wide by 24-ft long x 15-ft deep, resulting in approximately 0.03 acres of disturbance. As a result, earthwork quantities are approximately 3,348 cubic yards (CY) of export and 4,680 CY of import.

One service lateral will be located near the southwestern corner of the Stanislaus Elementary School property line. Following the installation of the Project Alignment, the abandonment of the existing Well 02 will occur. Abandonment and permanent sealing of SUSD Well 02 will occur in accordance with requirements set forth by the City of Modesto's Director of Utilities and Environmental Resources Department of Stanislaus County.

Project Objectives

Due to presence of 1,2,3-TCP in Well 02, the Stanislaus Elementary School's water system needs additional water services. Therefore, the intended outcome of the proposed Project is the following:

- Provide Stanislaus Elementary School with a source of drinking water that meets water quality standards; Provide sufficient hydraulic capacity to meet 4,000 gallons per minute (gpm) fire flow requirements while maintaining a 20-pounds per square inch (psi) residual pressure at the school; build a Project that is consistent with the City's 2019 Water Master Plan (WMP) identified future improvements.
- To achieve these objectives, the Project proposes to extend the City of Modesto's Water and Wastewater systems to the school and stop the extraction of contaminated groundwater from Well 02.

Project Elements

Construction Activities

Project construction is anticipated to begin in fall of 2024 and conclude in fall of 2025, lasting for approximately eleven months. Construction activities will occur between 7:30 AM and 4:30 PM, Monday through Friday; weekend work will be avoided when feasible, however, weekend or night work might occur

[1] For the purposes of noise, air quality/GHG, and traffic modeling, assumptions were made about the location of jacking and receiving pits based on a "worst-case scenario". Under "worst-case" conditions, boring locations are located closest to sensitive receptors adjacent to the Project Alignment: one (1) along the east side of Dale Road, approximately 150 feet from sensitive receptors; three (3) along the north side of Kiernan Avenue, bordering the southern perimeter of Stanislaus Elementary School, approximately 50 ft from the closest sensitive receptors; and one (1) along the west side of Tully Road, approximately 50 ft from the closest sensitive receptors.

to accommodate traffic. The installation rate of the water and sewer mains are expected to average 100 feet per day.

Construction activities will involve approximately six to eight crew members[2] at any one time for a total of 16 people on the job. Crew members will get to the construction site utilizing personal vehicles, approximately 16 vehicles at any one time, accessing the construction site via local roadways (Carver Road, Dale Road, etc.) or regional transportation routes (State Route (SR) 99; SR 219 (Kiernan Avenue); SR 108). Personal vehicles will be parked along the public right-of-way, adjacent to the Project Alignments within the roadway, shoulder or the streets, or in a designated laydown yard on the Stanislaus Elementary School property. Temporary fencing will be constructed around each work area to secure construction sites and prevent theft/ vandalism that has the potential to occur overnight, concluding daily construction activities. In addition to fencing, active construction will either be backfilled or covered with trench plates at the end of each day. Water for construction and potable water during construction activities will be supplied by the City of Modesto's water system.

Construction Equipment

During Project implementation, construction activities will involve the utilization of various diesel-powered equipment along various locations of the Project Alignment for the duration of Project construction. Potential equipment on-site during construction includes one (1) scraper, five (5) tractors/ loaders/ backhoes, one (1) off-highway trucks, one (1) plate compactor, one (1) excavator, one (1) other material handling equipment, one (1) paving equipment, one (1) other construction equipment, two (2) pumps, one (1) skid steer loaders, one (1) surfacing equipment, one (1) rubber tiered dozer, and one (1) crane. During temporary Project construction, equipment will be kept at a designated laydown yard or the Project contractor's own facilities.

Staging

Staging areas will be located inside existing public right-of-way along various locations of the Project Alignment or on adjacent parcels. These staging locations will depend on the portion of the alignment under construction. Staging will also be located within a portion of the Stanislaus Elementary School parking lot.

Schedule and Phasing

The Project Construction is not anticipated to be phased. As mentioned above, the contractor will lay approximately 100 feet of pipeline per day for approximately eight months until the entire Project Alignment has been implemented. Utility potholing and determining locations of existing "dead-end" connections will occur prior to open trench construction and excavation.

Long-Term Operations and Maintenance

The proposed Project Alignment is anticipated to be operational for 50 or more years upon initial construction. The City will operate and manage the potable water conveyance pipeline to Stanislaus Elementary School, serving approximately 360 students and staff. The City of Modesto does not anticipate additional staffing needs for long-term operation and maintenance of the proposed Project. Monthly worker trips over the lifetime of the proposed Project will be required to conduct routine inspections and ensure proper long-term maintenance. Since a portion of the proposed Project will occur within the CALTRANS right-of-way (Kiernan Avenue), the City will establish a long-term maintenance agreement with CALTRANS pursuant to a parallel encroachment policy exception for an arterial.

[2] The number of construction crew members is an assumption based on the scale of the proposed Project and type of infrastructure being implemented.

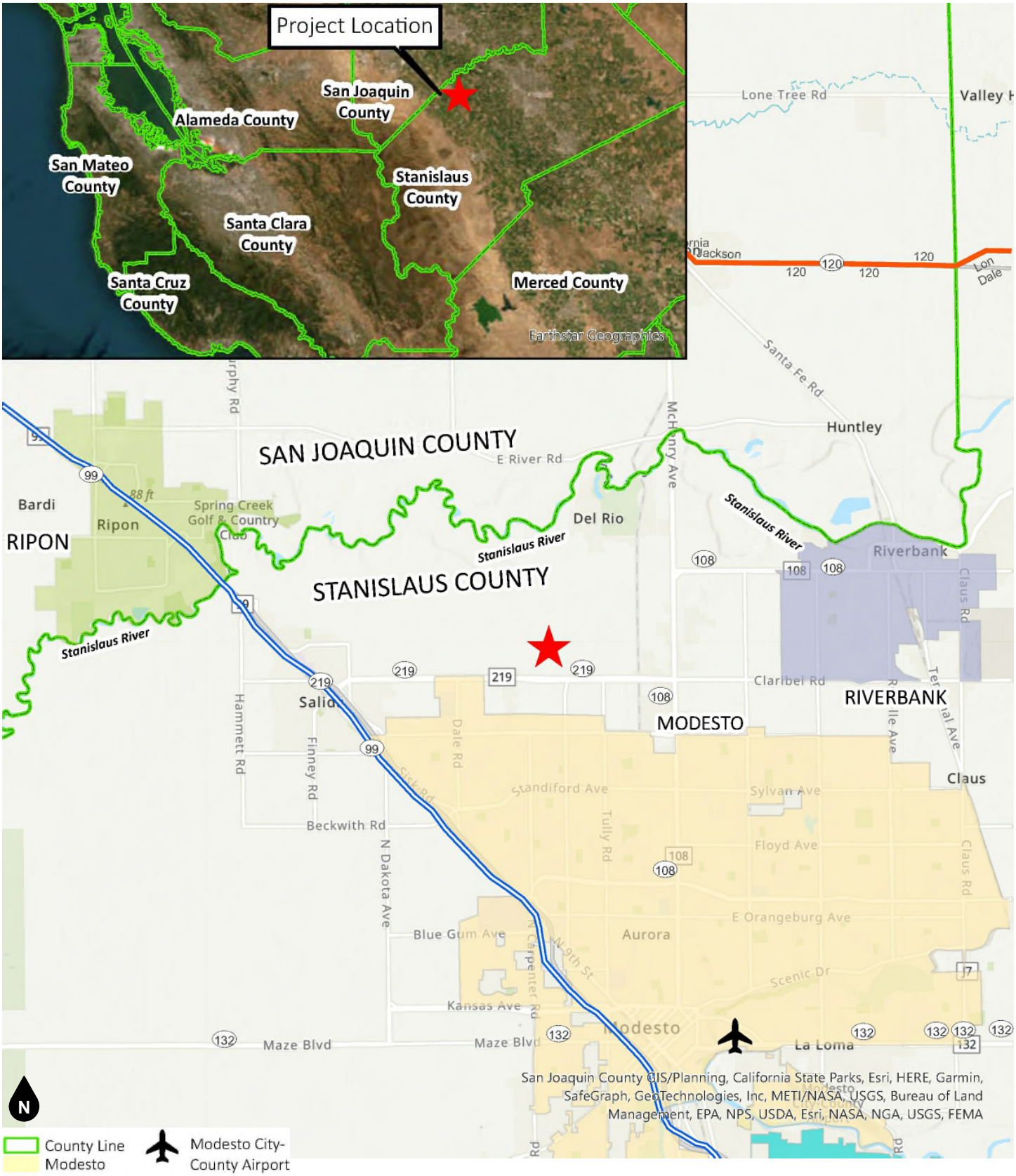


Figure 1
Regional Location Map

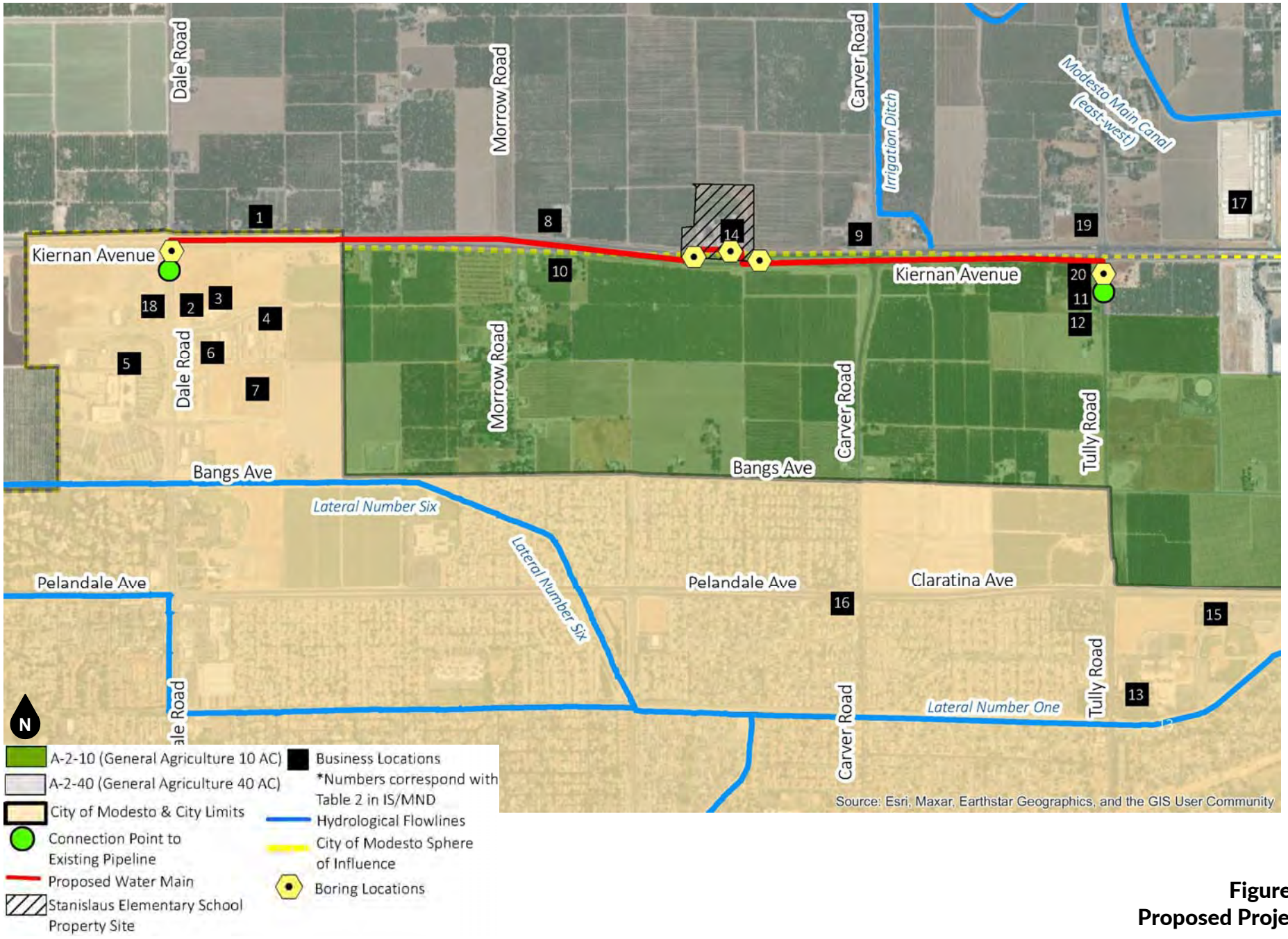


Figure 2
Proposed Project

2. NOISE FUNDAMENTALS

This section provides an overview of key noise concepts.

NOISE FUNDAMENTALS

Sound is a pressure wave created by a moving or vibrating source that travels through an elastic medium such as air. Noise is defined as unwanted or objectionable sound. The effects of noise on people can include general annoyance, interference with speech communication, sleep disturbance, and in extreme circumstances, hearing impairment.

Commonly used noise terms are presented in Appendix B. The unit of measurement used to describe a noise level is the decibel (dB). The human ear is not equally sensitive to all frequencies within the sound spectrum. Therefore, the "A-weighted" noise scale, which weights the frequencies to which humans are sensitive, is used for measurements. Noise levels using A-weighted measurements are written dB(A) or dBA.

From the noise source to the receiver, noise changes both in level and frequency spectrum. The most obvious is the decrease in noise as the distance from the source increases. The manner in which noise reduces with distance depends on whether the source is a point or line source as well as ground absorption, atmospheric effects and refraction, and shielding by natural and manmade features. Sound from point sources, such as air conditioning condensers, radiates uniformly outward as it travels away from the source in a spherical pattern. The noise drop-off rate associated with this geometric spreading is 6 dBA per each doubling of the distance (dBA/DD). Transportation noise sources such as roadways are typically analyzed as line sources, since at any given moment the receiver may be impacted by noise from multiple vehicles at various locations along the roadway. Because of the geometry of a line source, the noise drop-off rate associated with the geometric spreading of a line source is 3 dBA/DD.

Decibels are measured on a logarithmic scale, which quantifies sound intensity in a manner similar to the Richter scale used for earthquake magnitudes. Thus, a doubling of the energy of a noise source, such as a doubled traffic volume, would increase the noise levels by 3 dBA; halving of the energy would result in a 3 dBA decrease. Figure 3 shows the relationship of various noise levels to commonly experienced noise events.

Average noise levels over a period of minutes or hours are usually expressed as dBA Leq, or the equivalent noise level for that period of time. For example, $Leq_{(3\text{-}hr)}$ would represent a 3-hour average. When no period is specified, a one-hour average is assumed.

Noise standards for land use compatibility are stated in terms of the Community Noise Equivalent Level (CNEL) and the Day-Night Average Noise Level (DNL). CNEL is a 24-hour weighted average measure of community noise. CNEL is obtained by adding five decibels to sound levels in the evening (7:00 PM to 10:00 PM), and by adding ten decibels to sound levels at night (10:00 PM to 7:00 AM). This weighting accounts for the increased human sensitivity to noise during the evening and nighttime hours. DNL is a very similar 24-hour average measure that weighs only the nighttime hours.

It is widely accepted that the average healthy ear can barely perceive changes of 3 dBA; that a change of 5 dBA is readily perceptible, and that an increase (decrease) of 10 dBA sounds twice (half) as loud. This definition is recommended by the California Department of Transportation's Technical Noise Supplement to the Traffic Noise Analysis Protocol (2013).

VIBRATION FUNDAMENTALS

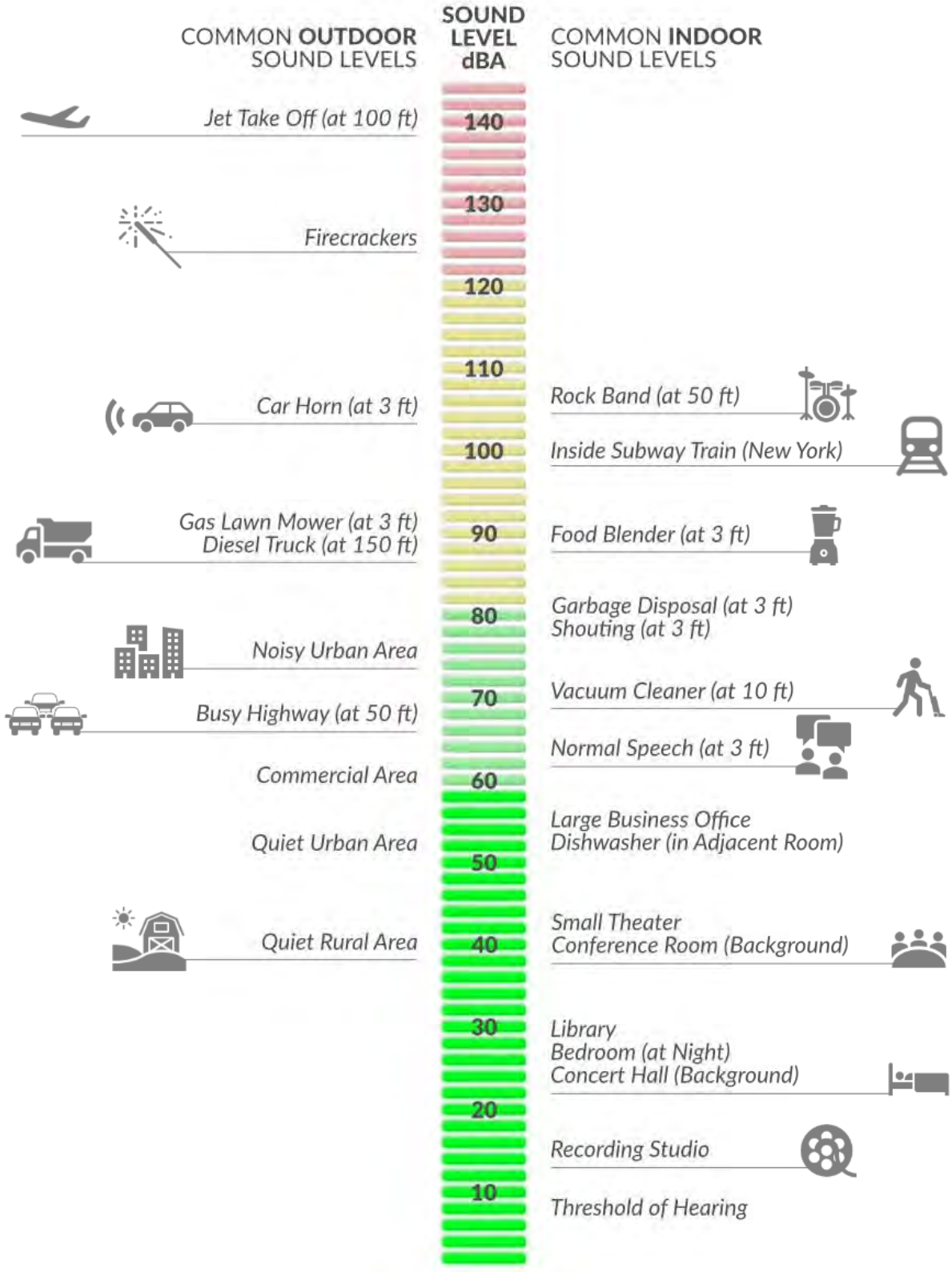
The way in which vibration is transmitted through the earth is called propagation. Propagation of earthborn vibrations is complicated and difficult to predict because of the endless variations in the soil through which waves travel. There are three main types of vibration propagation: surface, compression and shear waves.

Surface waves, or Rayleigh waves, travel along the ground's surface. These waves carry most of their energy along an expanding circular wave front, similar to ripples produced by throwing a rock into a pool of water. Compression waves, or P-waves, are body waves that carry their energy along an expanding spherical wave front. The particle motion in these waves is longitudinal (i.e., in a "push-pull" fashion). P-waves are analogous to airborne sound waves. Shear waves, or S-waves, are also body waves that carry energy along an expanding spherical wave front. However, unlike P-waves, the particle motion is transverse or "side-to-side and perpendicular to the direction of propagation".

As vibration waves propagate from a source, the energy is spread over an ever-increasing area such that the energy level striking a given point is reduced with the distance from the energy source. This geometric spreading loss is inversely proportional to the square of the distance. Wave energy is also reduced with distance as a result of material damping in the form of internal friction, soil layering, and void spaces. The amount of attenuation provided by material damping varies with soil type and condition as well as the frequency of the wave.

Vibration amplitudes are usually expressed as either peak particle velocity (PPV) or the root mean square (RMS) velocity. The PPV is defined as the maximum instantaneous peak of the vibration signal in inches per second. The RMS of a signal is the average of the squared amplitude of the signal in vibration decibels (VdB), ref one micro-inch per second. The Federal Railroad Administration uses the abbreviation "VdB" for vibration decibels to reduce the potential for confusion with sound decibel.

PPV is appropriate for evaluating the potential of building damage and VdB is commonly used to evaluate human response. Decibel notation acts to compress the range of numbers required in measuring vibration. Similar to the noise descriptors, L_{eq} and L_{max} can be used to describe the average vibration and the maximum vibration level observed during a single vibration measurement interval. The threshold of perception for human response is approximately 65 VdB; however, human response to vibration is not usually substantial unless the vibration exceeds 70 VdB. Vibration tolerance limits for sensitive instruments such as magnetic resonance imaging (MRI) or electron microscopes could be much lower than the human vibration perception threshold.



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Based on Policy & Guidance from Federal Aviation Administration

Figure 3
A-Weighted Comparative Sound Levels

3. EXISTING NOISE ENVIRONMENT

This section describes the existing noise setting in the project vicinity.

EXISTING LAND USES AND SENSITIVE RECEPTORS

The State of California defines sensitive receptors as those land uses that require serenity or are otherwise adversely affected by noise events or conditions. Schools, libraries, churches, hospitals, single and multiple-family residential, including transient lodging, motels and hotel uses make up the majority of these areas. Furthermore, the City of Modesto General Plan states that noise sensitive land uses include residences, hospitals, parks, churches, and schools.

The surrounding land uses are primarily agricultural fields and urban commercial uses as shown below.

	Land Use	Stanislaus County General Plan	City of Modesto General Plan	Zoning
Project Location	County and City Right-of-Way; Stanislaus Elementary School	General Agriculture (Deciduous Fruits and Nuts)	Village Residential (VR)-Keiran/ Carver North Comprehensive Planning District	AG-40
North	Large-scale agriculture	General Agriculture (Deciduous Fruits and Nuts, Field Crops)	Village Residential (VR)	AG-40
South	Large-scale agriculture; Kaiser Permanente Modesto Medical Center	Community Commercial; Urban Vacant; Urban Industrial; General Agriculture (Pasture, Deciduous Fruits and Nuts)	Village Residential (VR); Business Park (BP); Mixed Use (MU)	AG 10; Modesto
East	Large-scale agriculture	General Agriculture (Deciduous Fruits and Nuts, Field Crops)	Business Park (BP)	AG-40
West	Large-scale agriculture	General Agriculture (Deciduous Fruits and Nuts)	Business Park (BP)	AG-40

Source: (1) Stanislaus County GIS, Updated May 2023. (2) Modesto General Plan EIR, 2019.

Existing sensitive land uses in the project area that may be affected by project noise include the existing residential, school, and transient lodging uses located adjacent or near Kiernan Avenue between Tully Road to Dale Road.

AMBIENT NOISE MEASUREMENTS

An American National Standards Institute (ANSI Section S1.4 2014 Class 1) Larson Davis model LxT sound level meter was used to document existing ambient noise levels. In order to document existing ambient noise levels in the project area, five (5) 15-minute daytime noise measurements were taken between 1:00 PM and 3:52 PM on December 5, 2023. In addition, one (1) long-term 24-hour noise measurement were also taken from December 5, 2023, to December 6, 2023. Field worksheets and noise measurement output data are included in Appendix C.

As shown in Figure 4, the noise meter was placed at the following locations:

- NM1: represents the existing noise environment of the commercial and transient lodging uses located along and/or near Dale Road (4800 Dale Road, Modesto).The noise meter was placed just northeast of the commercial use along the eastern side of Dale Road.

- NM2: represents the existing noise environment of the single-family residential use located along the southern side of Kiernan Avenue near Morrow Road (2224 Kiernan Avenue, Modesto). The noise meter was placed just north of the residence along the southern side of Kiernan Avenue.

- NM3: represents the existing noise environment of the single-family residential use located along the southern side of Kiernan Avenue near Tully Road (1348 Kiernan Avenue, Modesto). The noise meter was placed just north of the residence along the southern side of Kiernan Avenue.

- NM4: represents the existing noise environment of the single-family residential and commercial use located along the northern side of Kiernan Avenue near Carver Road (1601 Kiernan Avenue, Modesto). The noise meter was placed just south of the residential and commercial use along the northern side of Kiernan Avenue.

- NM5: represents the existing noise environment of the school use located to the north of Kiernan Avenue (1931 Kiernan Avenue, Modesto). The noise meter was placed just west of the residence along the northern side of Kiernan Avenue.

- LTNM1: represents the existing noise environment of the surrounding area of the project site. The noise meter was placed near the residential use at 5143 American Avenue, Modesto just west of America Avenue.

Table 1 provides a summary of the short-term ambient noise data. Table 2 provides hourly interval ambient noise data from the long-term noise measurements. Measured short-term ambient noise levels ranged between 62.6 and 72.9 dBA L_{eq}. Long-term hourly noise measurement ambient noise levels ranged from 43.6 to 59.8 dBA L_{eq}. The dominant noise source in the project vicinity was vehicle traffic associated with Dale Road, Kiernan Avenue, Tully Road, Carver Road, American Avenue, and other surrounding roadways.

Table 1
Short-Term Noise Measurement Summary (dBA)

Site Location	Time Started	Leq	Lmax	Lmin	L(2)	L(8)	L(25)	L(50)
NM1	1:00 PM	62.6	81.8	46.5	69.7	63.6	60.1	56.3
NM2	1:46 PM	72.9	83.7	42.8	79.9	77.9	74.3	68.5
NM3	2:23 PM	72.8	85.7	58.6	80.5	77.1	73.0	69.4
NM4	3:03 PM	68.7	80.3	42.5	76.1	73.3	69.7	65.8
NM5	3:37 PM	71.8	81.8	49.7	77.9	76.6	73.5	69.3

Notes:
(1) See Figure 5 for noise measurement locations. Each noise measurement was performed over a 15-minute duration.
(2) Noise measurements performed on December 5, 2023.

Table 2
Long-Term Noise Measurement Summary (LTNM1) (dBA)

24-Hour Ambient Noise[1,2]								
Hourly Measurements	Time Started	Leq	Lmax	Lmin	L(2)	L(8)	L(25)	L(50)
Overall Summary	5:00 PM	52.9	90.6	32.8	57.5	53.9	50.6	47.1
1	5:00 PM	55.1	81.4	37.1	62.7	54.6	50.8	48.3
2	6:00 PM	51.7	71.6	39.4	57.7	53.8	51.2	48.7
3	7:00 PM	50.8	73.2	40.1	55.2	52.9	50.5	48.3
4	8:00 PM	49.4	70.7	40.1	54.7	51.8	49.6	48
5	9:00 PM	49.2	57.6	39.4	55.1	52.8	50.4	47.8
6	10:00 PM	48.6	68.1	37.6	55.5	51.8	48.9	46.5
7	11:00 PM	48.0	73.3	34.4	53.1	49.9	47.2	44.5
8	12:00 AM	45.2	57.7	33.7	51.6	49.1	46.1	43.5
9	1:00 AM	43.6	57.6	33.2	50.3	47.2	44.3	41.7
10	2:00 AM	44.9	60.4	32.8	51.5	48.8	45.7	42.7
11	3:00 AM	48.3	59.6	36.7	53.9	51.7	49.3	46.9
12	4:00 AM	50.1	66.8	41.8	55.4	53.4	50.9	48.8
13	5:00 AM	52.1	61.1	44.8	56.8	55.1	53.1	51.3
14	6:00 AM	53.2	71.3	46.5	57.4	55.5	53.4	51.8
15	7:00 AM	55.7	74.4	48.5	63	56.6	55.1	53.6
16	8:00 AM	59.8	90.6	44.9	64.5	55.8	53.5	51.8
17	9:00 AM	52.8	80.3	43.3	56.3	51.1	48.9	47.1
18	10:00 AM	49.7	74.0	38.5	55	47.3	45.4	43.8
19	11:00 AM	47.8	73.8	36.4	53.6	45.5	42.6	41.2
20	12:00 PM	49.2	73.6	37.0	56	44	42	40.8
21	1:00 PM	52.7	76.9	37.6	60.5	48.5	45.5	43.4
22	2:00 PM	52.7	75.9	40.0	62.1	51.8	48.5	46.5
23	3:00 PM	55.0	79.1	37.5	64.3	54.8	51.6	45.6
24	4:00 PM	58.8	80.7	44.5	70.5	56.6	53.4	51.6
CNEL	57.1							

Notes:

(1) See Figure 5 for noise measurement locations. Noise measurement was performed over a 24-hour duration.

(2) Noise measurement performed from December 5, 2023 to December 6, 2023.



Legend

NM 1 Noise Measurement Location

ST NM Short-Term Noise Measurement

LT NM Long-Term Noise Measurement

Figure 4
Noise Measurement Location Map

4. REGULATORY SETTING

This section documents the regulatory framework and applicable noise standards.

FEDERAL REGULATION

Federal Noise Control Act of 1972

The U.S. Environmental Protection Agency (EPA) Office of Noise Abatement and Control was originally established to coordinate federal noise control activities. After its inception, EPA's Office of Noise Abatement and Control issued the Federal Noise Control Act of 1972, establishing programs and guidelines to identify and address the effects of noise on public health, welfare, and the environment. In response, the EPA published Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety (Levels of Environmental Noise). The Levels of Environmental Noise recommended that the Ldn should not exceed 55 dBA outdoors or 45 dBA indoors to prevent significant activity interference and annoyance in noise-sensitive areas.

In addition, the Levels of Environmental Noise identified five (5) dBA as an "adequate margin of safety" for a noise level increase relative to a baseline noise exposure level of 55 dBA Ldn (i.e., there would not be a noticeable increase in adverse community reaction with an increase of five dBA or less from this baseline level). The EPA did not promote these findings as universal standards or regulatory goals with mandatory applicability to all communities, but rather as advisory exposure levels below which there would be no risk to a community from any health or welfare effect of noise.

In 1981, EPA administrators determined that subjective issues such as noise would be better addressed at lower levels of government. Consequently, in 1982 responsibilities for regulating noise control policies were transferred to State and local governments. However, noise control guidelines and regulations contained in EPA rulings in prior years remain in place by designated Federal agencies, allowing more individualized control for specific issues by designated Federal, State, and local government agencies.

STATE REGULATIONS

State of California General Plan Guidelines 2017

Though not adopted by law, the State of California General Plan Guidelines 2017, published by the California Governor's Office of Planning and Research (OPR) (OPR Guidelines), provides guidance for the compatibility of projects within areas of specific noise exposure. The OPR Guidelines identify the suitability of various types of construction relative to a range of outdoor noise levels and provide each local community some flexibility in setting local noise standards that allow for the variability in community preferences. Findings presented in the Levels of Environmental Noise Document (EPA 1974) influenced the recommendations of the OPR Guidelines, most importantly in the choice of noise exposure metrics (i.e., Ldn or CNEL) and in the upper limits for the normally acceptable outdoor exposure of noise-sensitive uses.

The OPR Guidelines include a Noise and Land Use Compatibility Matrix which identifies acceptable and unacceptable community noise exposure limits for various land use categories. Where the "normally acceptable" range is used, it is defined as the highest noise level that should be considered for the construction of the buildings which do not incorporate any special acoustical treatment or noise mitigation. The "conditionally acceptable" or "normally unacceptable" ranges include conditions calling for detailed acoustical study prior to the construction or operation of the proposed project.

LOCAL REGULATIONS

City of Modesto General Plan

The City of Modesto General Plan Chapter VII – Environmental Resources and Open Space contains noise related policies which apply to the proposed project. Applicable policies are presented below.

Policies

a. Construction activities are to comply with Modesto Municipal Code Title 4, Chapter 9.
b. Implement noise-reducing construction practices as conditions of approval where substantial construction-related noise impacts would be likely to occur, such as with extended periods of pile driving, or where construction is expected to continue or where sensitive receptors would be affected by construction noise. Conditions of approval may include, but are not limited to:
    - Require construction equipment, including air compressors and pneumatic equipment to have properly maintained mufflers;
    - Require impact tools to be equipped with shrouds or shields;
    - Require that the quietest equipment available be used; and,
    - Require selection of haul routes that affect the fewest number of people.
e. Incorporate construction practices and acoustic treatment in new residential construction to reduce typical indoor noise levels to 45 dB. Developers of residential buildings within the 65 dBA contours shown in the General Plan Master EIR shall demonstrate that interior noise has been reduced to 45 dB. Other types of development should be protected against noise intrusion at least to the levels indicated on Table 3.
f. At noise-sensitive land uses, increases in noise should not exceed 3 dBA where any other noise threshold or standard would be exceeded, and/or 5 dBA where noise levels would otherwise fall within acceptable limits, for the existing conditions scenario as compared to the buildout scenario.
g. Additional study and/or mitigation for outdoor recreation areas will be required if:
    a. For single-family dwellings, noise exceeds 65 dBA Ldn in one or more backyards;
    b. For multi-family dwellings, noise exceeds 65 dBA Ldn at common recreation areas, such as swimming pools or play areas or at private patios and balconies; or,
    c. For other uses, noise exceeds the level considered "conditionally acceptable"
h. Limit trucking to specific routes, times, and speeds that avoid or minimize adverse effec receptors.
n. For construction activities involving high-powered vibratory tools or pile driving within 200 feet of an existing structure, demonstrate that project construction would not exceed the Caltrans construction vibration thresholds to ensure that no damage to sensitive structures would occur.

City of Modesto Municipal Code

The City of Modesto Municipal Code addresses noise regulations and standards in Chapter 9 Noise Regulations. The standards applicable to the proposed project have been presented below:

Section 4-9.103 - Enumeration.

The following specific acts, subject to the exemptions provided in Section 4-9.104, are declared to be public nuisances in violation of Section 4-9.102, namely:

a) The loud and raucous discharge into the open air of the steam of any steam equipment or exhaust from any stationary internal-combustion engine;

b) The loud and raucous operation or use of any of the following before 7:00 AM or after 9:00 PM daily (except Saturday and Sunday and state or federal holidays, when the prohibited time shall be before 9:00 AM and after 9:00 PM):

(1) A hammer, or any other device or implement used to pound or strike an object.
(2) An impact wrench or other tool or equipment powered by compressed air.
(3) A hand-powered saw.
(4) Any tool or piece of equipment powered by an internal-combustion engine such as, but not limited to, chain saw, backpack blower, and lawn mower. Except as included in subsection (a)(6), motor vehicles, powered by an internal-combustion engine and subject to the California Vehicle Code, are excluded from this prohibition.
(5) Any electrically powered (whether by alternating current electricity or by direct current electricity) tool or piece of equipment used for cutting, drilling, or shaping wood, plastic, metal, or other materials or objects, such as, but not limited to, a saw, drill, lathe or router.
(6) Any of the following: heavy equipment (such as but not limited to bulldozer, steam shovel, road grader, back hoe), ground drilling and boring equipment (such as but not limited to derrick or dredge), hydraulic crane, and boom equipment, portable power generator or pump, pavement equipment (such as but not limited to pneumatic hammer, pavement breaker, tamper, compacting equipment), pile-driving equipment, vibrating roller, sand blaster, gunite machine, trencher, concrete truck and hot kettle pump.
(7) Any construction, demolition, excavation, erection, alteration, or repair activity.

In the case of urgent necessity and in the interest of public health and safety, the Chief Building Official may issue a permit for exemption from the requirements within subsection (b) of this section. Such period shall not exceed three (3) working days in length while the emergency continues but may be renewed for successive periods of three (3) days or less while the emergency continues. The Chief Building Official may limit such permit as to time of use and/or permitted action, depending upon the nature of the emergency and the type of action requested.

IMPACT CRITERIA BORROWED FROM OTHER AGENCIES

California Department of Transportation

The City of Modesto has not established specific criteria related to groundborne vibration. Therefore, for the purposes of this analysis impact criteria established in the Caltrans *Transportation and Construction Vibration Guidance Manual* (Caltrans, 2020) will be utilized to assess project impacts related to groundborne vibration. The Caltrans manual provides informational content that supplements previous publications with improved knowledge and information relating to groundborne transportation- and construction-induced vibrations.

Table 5 and Table 5 show the guideline criteria for potential damage and annoyance resulting from groundborne vibration. As shown in Table 4, these guidelines recommend that the threshold at which there is a risk of architectural damage is a peak particle velocity (PPV) of 0.25 inches/second (in/sec) for historic buildings, PPV of 0.3 in/sec at older residential structures, and a PPV of 0.5 in/sec at new residential structures and modern commercial/industrial buildings. Table 5 shows that a PPV of 0.4 in/sec is the threshold at which groundborne vibration becomes severe in regard to annoyance (Caltrans, 2020).

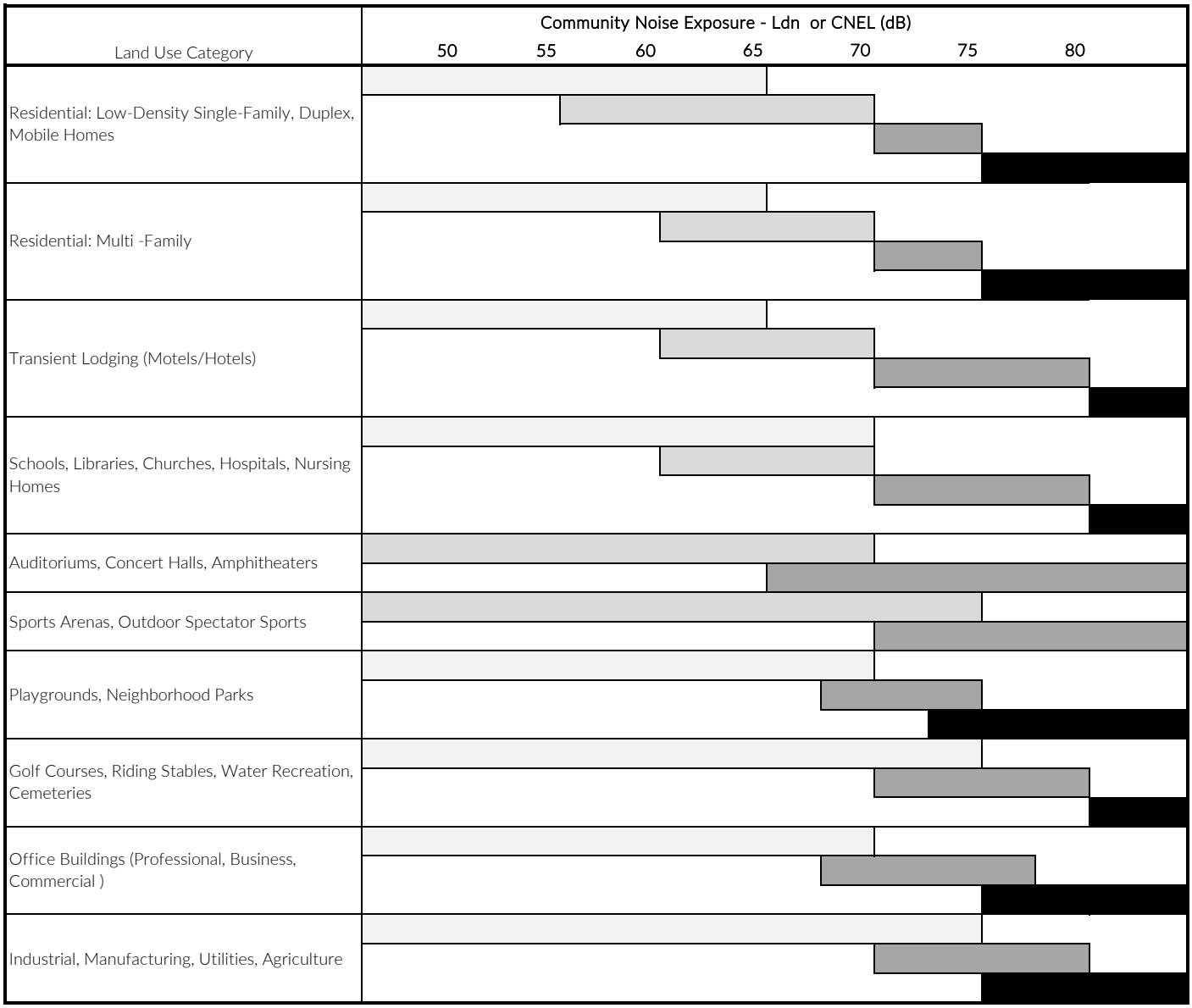
Federal Transit Administration

As discussed above, the City of Modesto General Plan Noise Element includes policies that when implemented will minimize construction noise, and the City Ordinance limits the allowed hours for loud raucous construction noise. For discussion purposes and in an effort to minimize construction noise, project related construction impacts in this report are also discussed in light of the Federal Transit Administration (FTA) construction noise criteria[3] below.

- Project construction noise would be considered significant if it exceeds 80 dBA L_{eq} for an 8-hour period at residential and noise-sensitive outdoor areas.

[3] Federal Transit Administration Transit Noise and Vibration Impact Assessment Manual. Sept. 2018

Table 3
Noise Compatibility Matrix



Normally Acceptable:	Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements
Conditionally Acceptable:	New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features are included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning, will normally suffice.
Normally Unacceptable:	New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and noise insulation features included in the design.
Clearly Unacceptable:	New construction or development generally should not be undertaken.

Notes:

(1) Source: City of Modesto General Plan, Table VII-2, March 2019.

Table 4
Guideline Vibration Damage Potential Threshold Criteria

Structure Condition	Maximum PPV (in/sec)	
	Transient Sources[1]	Continuous/Frequent Intermittent Sources[1]
Extremely fragile historic buildings, ruins, ancient monuments	0.12	0.08
Fragile buildings	0.2	0.1
Historic and some old buildings	0.5	0.25
Older residential structures	0.5	0.3
New residential structures	1.0	0.5
Modern industrial/commercial buildings	2.0	0.5

Source: California Department of Transportation. Transportation and Construction Vibration Guidance Manual, Chapter 7 Table 19, April 2020.

Notes:

(1) Transient sources create a single isolated vibration event, such as blasting or drop balls. Continuous/frequent intermittent sources include impact pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.

Table 5
Guideline Vibration Annoyance Potential Criteria

Human Response	Maximum PPV (in/sec)	
	Transient Sources	Continuous/Frequent Intermittent Sources
Barely perceptible	0.04	0.01
Distinctly perceptible	0.25	0.04
Strongly perceptible	0.9	0.10
Severe	2.0	0.4

Source: California Department of Transportation. Transportation and Construction Vibration Guidance Manual, Chapter 7 Table 20, April 2020.

Notes:

(1) Transient sources create a single isolated vibration event, such as blasting or drop balls. Continuous/frequent intermittent sources include impact pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.

5. ANALYTICAL METHODOLOGY AND MODEL PARAMETERS

This section discusses the analysis methodologies used to assess noise impacts.

CONSTRUCTION NOISE MODELING

Construction noise associated with the proposed project was calculated at the sensitive receptor locations, utilizing methodology presented in the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (2018) together with several key construction parameters including: distance to each sensitive receiver, equipment usage, percent usage factor, and baseline parameters for the project site. The equipment used to calculate the construction noise levels for each phase were based on the assumptions provided by the project applicant as well as the CalEEMod modeling provided in the Air Quality, Global Climate Change, and Energy Impact Analysis prepared for the proposed project (Ganddini Group Inc., 2023). For construction noise purposes, the distance measured from the project site to sensitive receptors was assumed to be the acoustical center of the construction work area to the property line of residential properties with existing residential buildings. Sound emission levels associated with typical construction equipment as well as typical usage factors provided in Table 6 were utilized for modeling purposes. Construction noise assumptions and worksheets are provided in Appendix D.

MOBILE SOURCE NOISE MODELING

Noise from vehicular traffic was projected using a computer program that replicates the FHWA Traffic Noise Prediction Model (FHWA-RD-77-108). The FHWA model arrives at the predicted noise level through a series of adjustments to the Reference Energy Mean Emission Level (REMEL). Key model parameters and REMEL adjustments are presented below:

- Roadway classification (e.g., freeway, major arterial, arterial, secondary, collector, etc.)
- Roadway Active Width (distance between the center of the outer most travel lanes on each side of the roadway)
- Average Daily Traffic Volumes (ADT), Travel Speeds, Percentages of automobiles, medium trucks, and heavy trucks
- Roadway grade and angle of view
- Site Conditions (e.g. soft vs. hard)
- Percentage of total ADT which flows each hour throughout a 24-hour period.

The traffic noise calculation worksheets are included in Appendix E.

Table 6 (1 of 2)
CA/T Equipment Noise Emissions and Acoustical Usage Factor Database

Equipment Description	Impact Device?	Acoustical Use Factor (%)	Spec. Lmax @ 50ft (dBA, slow)	Actual Measured Lmax @ 50ft (dBA, slow)	No. of Actual Data Samples (Count)
All Other Equipment > 5 HP	No	50	85	-N/A-	0
Auger Drill Rig	No	20	85	84	36
Backhoe	No	40	80	78	372
Bar Bender	No	20	80	-N/A-	0
Blasting	Yes	-N/A-	94	-N/A-	0
Boring Jack Power Unit	No	50	80	83	1
Chain Saw	No	20	85	84	46
Clam Shovel (dropping)	Yes	20	93	87	4
Compactor (ground)	No	20	80	83	57
Compressor (air)	No	40	80	78	18
Concrete Batch Plant	No	15	83	-N/A-	0
Concrete Mixer Truck	No	40	85	79	40
Concrete Pump Truck	No	20	82	81	30
Concrete Saw	No	20	90	90	55
Crane	No	16	85	81	405
Dozer	No	40	85	82	55
Drill Rig Truck	No	20	84	79	22
Drum Mixer	No	50	80	80	1
Dump Truck	No	40	84	76	31
Excavator	No	40	85	81	170
Flat Bed Truck	No	40	84	74	4
Forklift[2,3]	No	50	n/a	61	n/a
Front End Loader	No	40	80	79	96
Generator	No	50	82	81	19
Generator (<25KVA, VMS signs)	No	50	70	73	74
Gradall	No	40	85	83	70
Grader	No	40	85	-N/A-	0
Grapple (on backhoe)	No	40	85	87	1
Horizontal Boring Hydr. Jack	No	25	80	82	6
Hydra Break Ram	Yes	10	90	-N/A-	0
Impact Pile Driver	Yes	20	95	101	11
Jackhammer	Yes	20	85	89	133
Man Lift	No	20	85	75	23
Mounted Impact hammer (hoe ram)	Yes	20	90	90	212
Pavement Scarafier	No	20	85	90	2
Paver	No	50	85	77	9
Pickup Truck	No	50	85	77	9
Paving Equipment	No	50	85	77	9
Pneumatic Tools	No	50	85	85	90

Table 6 (2 of 2)
CA/T Equipment Noise Emissions and Acoustical Usage Factor Database

Equipment Description	Impact Device?	Acoustical Use Factor (%)	Spec. Lmax @ 50ft (dBA, slow)	Actual Measured Lmax @ 50ft (dBA, slow)	No. of Actual Data Samples (Count)
Pumps	No	50	77	81	17
Refrigerator Unit	No	100	82	73	3
Rivit Buster/chipping gun	Yes	20	85	79	19
Rock Drill	No	20	85	81	3
Roller	No	20	85	80	16
Sand Blasting (Single Nozzle)	No	20	85	96	9
Scraper	No	40	85	84	12
Shears (on backhoe)	No	40	85	96	5
Slurry Plant	No	100	78	78	1
Slurry Trenching Machine	No	50	82	80	75
Soil Mix Drill Rig	No	50	80	-N/A-	0
Tractor	No	40	84	-N/A-	0
Vacuum Excavator (Vac-truck)	No	40	85	85	149
Vacuum Street Sweeper	No	10	80	82	19
Ventilation Fan	No	100	85	79	13
Vibrating Hopper	No	50	85	87	1
Vibratory Concrete Mixer	No	20	80	80	1
Vibratory Pile Driver	No	20	95	101	44
Warning Horn	No	5	85	83	12
Welder/Torch	No	40	73	74	5

Notes:

(1) Source: FHWA Roadway Construction Noise Model User's Guide January 2006.

(2) Warehouse & Forklift Noise Exposure - NoiseTesting.info Carl Stautins, November 4, 2014 http://www.noisetesting.info/blog/carl-strautins/page-3/

(3) Data provided Leq as measured at the operator. Sound Level at 50 feet is calculated using Inverse Square Law.

6. IMPACT ANALYSIS

This section analyzes the significance of project-related noise and groundborne vibration impacts relative to standards established by the City of Modesto and other applicable agencies in the context of CEQA. Appendix G of the California Environmental Quality Act Guidelines (Title 14, Division 6, Chapter 3 of the California Code of Regulations) includes an environmental checklist that identifies issues upon which findings of significance should be made. The CEQA Environmental Checklist Appendix G, XIII. Noise, requires determination if the project would result in:

a) *Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?*

b) *Generation of excessive groundborne vibration or groundborne noise levels?*

c) *For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the area to excessive noise levels?*

NOISE IMPACTS

Would the project result in:

a) *Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?*

Finding: Less Than Significant With Mitigation

In relation to the Environmental Checklist noise issue "a", applicable standards established by the City of Modesto can be categorized into the following areas:

- Construction Noise
- Mobile Source Noise (Construction

Construction Noise - Onsite

Construction noise sources are also regulated within Section 4-9.103(b)(7) of the City of Modesto's Municipal Code which prohibits the loud and raucous operation or use of construction equipment outside of the hours between the hours of 7:00 AM and 9:00 PM daily except on Saturday, Sunday, and state or federal holidays in which the hours are to be between 9:00 AM and 9:00 PM. In the case of urgent necessity and in the interest of public health and safety, the Chief Building Official may issue a permit for exemption from the requirements within subsection (b) of this section. Such period shall not exceed three (3) working days in length while the emergency continues but may be renewed for successive periods of three (3) days or less while the emergency continues. The Chief Building Official may limit such permit as to time of use and/or permitted action, depending upon the nature of the emergency and the type of action requested.
Accordingly, the project would result in a significant impact if:

- Loud and raucous noise caused by project construction occurs outside the hours of 7:00 AM and 9:00 PM daily or outside the hours of 9:00 AM and 9:00 PM on Saturday, Sunday, and state or federal holidays unless otherwise permitted by the Chief Building Official.

In an effort to minimize construction noise and to develop appropriate mitigation, construction noise has also been analyzed in light of Federal Transit Administration (FTA) construction noise criteria[4].

The project would result in a significant impact if:

- Project construction noise exceeds 80 dBA L_{eq} for an 8-hour period at residential and noise-sensitive outdoor areas.

Sensitive Receptors

Land uses adjacent to and nearby the pipeline route and were evaluated in regards to construction noise.

Construction Noise Modeling and Findings

Noise Ordinance Compliance
Although most construction activity is expected to occur during the allowed hours as provided above, jack and bore activities may occur outside of those hours. This would be a significant impact and mitigation is required, unless otherwise authorized by Building Commissioner.

Analysis in Light of FTA Standards
Project construction noise levels at nearby sensitive receptors were calculated using FTA methodology (see Section 5). The equipment assumptions provided by Stanislaus Elementary School 1,2,3-TCP Air Quality; Greenhouse Gas, & Energy Report (Ganddini 2023) were applied. Construction noise modeling worksheets for each phase are provided in Appendix D. Anticipated noise levels during each construction phase are presented in Table 7.

Typical pipeline site preparation and installation will involve the utilization of various diesel-powered equipment along various location of the Project Alignment for the duration of Project construction. Potential equipment to be utilized during typical pipeline installation is expected to entail the use of one (1) scraper, five (5) tractors/ loaders/ backhoes, one (1) off-highway trucks, one (1) plate compactor, one (1) excavator, one (1) other material handling equipment, one (1) paving equipment, one (1) other construction equipment, two (2) pumps, one (1) skid steer loaders, one (1) surfacing equipment, one (1) rubber tired dozer, and one (1) crane. Construction noise along the pipeline route that do not include jack and boring were evaluated using these assumptions.

In addition to typical pipeline installation methods, jack and bore construction methods will also be used at several locations. For the purposes of this analysis, assumptions to were made about the location of jacking and receiving pits based on a "worst-case scenario". Under "worst-case" conditions, boring locations are assumed to be located closest to sensitive receptors adjacent to the Project Alignment: one (1) along the east side of Dale Road, approximately 150 feet from sensitive receptors; three (3) along the north side of Kiernan Avenue, bordering the southern perimeter of Stanislaus Elementary School, approximately 50 ft from the closest sensitive receptors; and one (1) along the west side of Tully Road, approximately 50 ft from the closest sensitive receptors (See Figure 2A).

As shown in Table 7, construction noise will range between 82 and 98 dBA dBA, L_{eq}. Because the exact location of the pipeline within the road right of way or adjacent property is not known at this time, conservative assumptions were used. For example, there are existing single-family adjacent to the pipeline route. Because the construction noise standards apply at the property line, the worst-case scenario was assumed to be 25 feet. Project construction noise will exceed the FTA noise threshold of 80 dBA L_{eq} for an 8-hour period at residential and noise-sensitive outdoor areas. Although FTA standards only apply to residential land uses, impacts to commercial land uses, schools and parks were also considered.

[4] Federal Transit Administration Transit Noise and Vibration Impact Assessment Manual. Sept. 2018

Construction noise levels at the retail uses near the jack and bore site near the intersection of Dale Road and Kiernan Avenue may reach up to 82.5 dBA L_{eq}. Retail land uses are not considered sensitive. Therefore, this impact is less than significant and no mitigation is required.

Construction noise levels at the Elementary School may reach up to 92.0 dBA L_{eq} at a distance of 50 feet on school grounds. This impact would be significant and mitigation is required.

Construction noise levels at single-family homes near Tully Road and Kiernan Avenue may reach up to 92.0 dBA L_{eq} at a distance of 50 feet on school grounds. This impact would be significant and mitigation is required.

Construction noise along the pipeline alignment at residential land uses could reach up to 97.7 dBA L_{eq}. This impact would be significant and mitigation is required.

Required Construction Noise Mitigation Measures

In addition to the previously mentioned Best Management Practices (BMPs), the following construction noise impacts must be implemented in order for impacts to be considered less than significant.

1. During all project site excavation and grading on-site, construction contractors shall equip all construction equipment, fixed or mobile, with properly operating and maintained mufflers, consistent with manufacturer standards.

2. The contractor shall place all stationary construction equipment so that emitted noise is directed away from the noise sensitive receptors nearest the project site. One-inch plywood or acoustical blankets capable of achieving a reduction level of at least 10 dB shall be used to keep equipment noise from exceeding the 80 dBA noise level standard.

3. Equipment shall be shut off and not left to idle when not in use.

4. Whenever possible, electric power will be used in lieu of internal combustion engine power.

5. The contractor shall locate equipment staging in areas that will create the greatest distance between construction-related noise/vibration sources and sensitive receptors nearest the project site during all project construction.

6. Jackhammers, pneumatic equipment, and all other portable stationary noise sources shall be shielded, and noise shall be directed away from sensitive receptors.

7. The project proponent shall mandate that the construction contractor prohibit the use of music or sound amplification on the project site during construction.

8. The construction contractor shall limit haul truck deliveries to the same hours specified for construction equipment.

9. The quietest equipment available will be utilized when feasible; and,

10. Haul routes that affect the fewest number of people will be utilized whenever possible.

Construction Noise (Offsite)

Based on the City of Modesto General Plan noise source standards, the noise level criteria of 45 dBA CNEL for interior noise and 65 dBA CNEL for exterior noise apply to sensitive receptors in the vicinity of the project site (Table 3). Also, it is widely accepted that the average healthy human ear can barely perceive changes of 3 dBA in an outdoor environment and that a change of 5 dBA is readily perceptible.[5] Accordingly, and as stated in the City's General Plan Chapter VII – Environmental Resources and Open Space under noise policy g (see Section 4 above), the project would result in a significant impact if the addition of project trips on surrounding roadways causes noise levels to increase by:

- 5 dBA in residential areas where the existing ambient noise level is within the City standards shown in Table 3; or,
- 3 dBA in residential areas where the existing ambient noise level exceeds the City standards shown in Table 3).

Roadway noise levels were calculated for land uses adjacent to Kiernan Avenue in the project vicinity based on the FHWA Traffic Noise Prediction Model methodology. As shown in the CalEEMod output files provided in the Air Quality, Global Climate Change, and Energy Impact Analysis prepared for the proposed project (Ganddini Group Inc., 2023), the greatest number of construction-related vehicle trips per day would be a maximum of up to approximately 37 vehicle trips per day (32 for worker trips, 2 for vendor trips, and 2.44 for hauling trips). The most recent traffic count for Kiernan Avenue along the project alignment is approximately 14,200 average daily trips (ADT)[6]. Roadway noise levels were calculated for the following scenarios:

- *Existing (without Project)*: This scenario refers to the existing year traffic noise conditions.
- *Existing Plus Project Construction*: This scenario refers to the existing year plus project construction traffic noise conditions.

Modeling results show that the existing noise level along Kiernan Avenue is 73.4 dBA CNEL and the existing plus project noise level would be 73.5 dBA CNEL. The proposed project would result in a noise increase of less than one decibel and impacts would be less than significant. No mitigation measures are required. FHWA Traffic Noise Prediction Model calculation worksheets are provided in Appendix E.

GROUNDBORNE VIBRATION IMPACTS

Would the project result in:

b) Generation of excessive groundborne vibration or groundborne noise levels?

Finding: Less Than Significant

In relation to the Environmental Checklist noise issue "b", the City of Modesto General Plan states that for construction activities involving high-powered vibratory tools or pile driving within 200 feet of an existing structure, demonstrate that project construction would not exceed the Caltrans construction vibration thresholds to ensure that no damage to sensitive structures would occur. Therefore, per the City's General Plan, groundborne vibration impacts are based on guidance from the *Transportation and Construction Vibration Guidance Manual* (California Department of Transportation, 2020) (see Regulatory Setting section). Accordingly, the project would result in a significant impact if:

[5] California Department of Transportation's Technical Noise Supplement to the Traffic Noise Analysis Protocol (2013).

[6] Caltrans Traffic Census Program, Truck Traffic: Annual Average Daily Truck Traffic (2021 AADT Truck), 2023 https://dot.ca.gov/programs/traffic-operations/census. Total of 14,200 average daily vehicle trips with a calculated vehicle mix of 91 percent autos, 4.05 percent medium trucks, and 4.95 percent heavy trucks for Kiernan Avenue (State Route 219). See Appendix E for further details.

- Groundborne vibration levels generated by the project have the potential to cause architectural damage at nearby buildings by exceeding the following PPV:
    - 0.08 in/sec at extremely fragile historic buildings, ruins, ancient monuments
    - 0.10 in/sec at fragile buildings
    - 0.25 in/sec at historic and some old buildings
    - 0.30 in/sec at older residential structures
    - 0.50 in/sec at new residential structures and modern industrial/commercial buildings.
- Groundborne vibration levels generated by the project have the potential to cause severe annoyance to people living or working in nearby buildings by exceeding a PPV of 0.4 in/sec.

Groundborne vibration modeling worksheets are provided in Appendix F.

The closest structures to the proposed construction activities include single family residential structures as close as 25 feet. Plate compactors are the most vibratory equipment that may be used near an existing structure. The peak particle velocity (PPV) per square foot associated with these vibratory plates is 0.21 at a distance of 25 feet (see Table 8). They are not, however, expected to be utilized within 25 feet of an existing structure. Other equipment anticipated to be used during project construction generate lower PPV. Therefore, groundborne vibration generated by project construction would not exceed the levels necessary to cause architectural damage. Use of plate compactors would not exceed the threshold for annoyance due to vibration (PPV of 0.4 in/sec) at residential receptors along the project route. This impact would be less than significant. No mitigation is required.

The most substantial sources of groundborne vibration during post-construction project operations will include the movement of passenger vehicles and trucks on paved and generally smooth surfaces. Loaded trucks generally have a PPV of 0.076 at a distance of 25 feet (Caltrans 2020), which is a substantially lower PPV than that of a vibratory roller (0.210 in/sec PPV at 25 feet). Therefore, groundborne vibration levels generated by project operation would not exceed those modeled for project construction.

Impacts related to groundborne vibration would be less than significant. No mitigation is required.

AIR TRAFFIC IMPACTS

Would the project result in:

c) *For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the area to excessive noise levels?*

Finding: No Impact

The closest airport to the project site is the Modesto City-County Airport located approximately 6 miles to the southeast of the project site. The proposed project is that of the installation of approximately 12,000 linear feet of 12-inch potable water pipeline along Tully Road; Kieran Avenue; and Dale Road. Therefore, due to both the nature of the proposed project and the distance to the nearest airport, the proposed project would not expose people residing or working in the area to excessive noise levels. There is no impact, and no mitigation is required.

Table 7
Construction Noise Levels by Location (dBA Leq)

Location		Noise Level at Nearest Receptor (dBA Leq)	Distance to Nearest Sensitive Receptor
East of Dale Road	Site Prep, Pipe Installation and Jack & Bore	82.5	150
North of Kiernen Ave	Site Prep, Pipe Installation and Jack & Bore	92.0	50
W of Tully Road	Site Prep, Pipe Installation and Jack & Bore	92.0	50
Adjacent to Road ROW	Site Prep and Pipeline Installation	97.7	25

Table 8
Construction Equipment Vibration Source Levels

Equipment		PPV at 25 ft, in/sec	Approximate Lv* at 25 ft
Pile Driver (impact)	upper range	1.518	112
	typical	0.644	104
Pile Driver (sonic)	upper range	0.734	105
	typical	0.170	93
clam shovel drop (slurry wall)		0.202	94
Hydromill (slurry wall)	in soil	0.008	66
	in rock	0.017	75
Vibratory Roller		0.210	94
Hoe Ram		0.089	87
Large Bulldozer		0.089	87
Caisson Drilling		0.089	87
Loaded Trucks		0.076	86
Jackhammer		0.035	79
Small Bulldozer		0.003	58

Source: Federal Transit Administration: Transit Noise and Vibration Impact Assessment Manual, 2018.
*RMS velocity in decibels, VdB re 1 micro-in/sec

7. REFERENCES

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APPENDICES

Appendix A List of Acronyms
Appendix B Glossary
Appendix C Noise Measurement Field Worksheets
Appendix D Construction Noise Modeling
Appendix E FHWA Traffic Noise Model Worksheets
Appendix F Groundborne Vibration Worksheets

APPENDIX A

LIST OF ACRONYMS

Term	Definition
ADT	Average Daily Traffic
ANSI	American National Standard Institute
CEQA	California Environmental Quality Act
CNEL	Community Noise Equivalent Level
D/E/N	Day / Evening / Night
dB	Decibel
dBA or dB(A)	Decibel "A-Weighted"
dBA/DD	Decibel per Double Distance
dBA Leq	Average Noise Level over a Period of Time
EPA	Environmental Protection Agency
FHWA	Federal Highway Administration
L_{02},L_{08},L_{50},L_{90}	A-weighted Noise Levels at 2 percent, 8 percent, 50 percent, and 90 percent, respectively, of the time period
DNL	Day-Night Average Noise Level
$Leq_{(x)}$	Equivalent Noise Level for '"x" period of time
Leq	Equivalent Noise Level
L_{max}	Maximum Level of Noise (measured using a sound level meter)
L_{min}	Minimum Level of Noise (measured using a sound level meter)
Lp	Sound pressure level
LOS C	Level of Service C
Lw	Sound Power Level
OPR	California Governor's Office of Planning and Research
PPV	Peak Particle Velocities
RCNM	Road Construction Noise Model
REMEL	Reference Energy Mean Emission Level
RMS	Root Mean Square

APPENDIX B

GLOSSARY

Term	Definition
Ambient Noise Level	The all-encompassing noise environment associated with a given environment, at a specified time, usually a composite of sound from many sources, at many directions, near and far, in which usually no particular sound is dominant.
A-Weighted Sound Level, dBA	The sound level obtained by use of A-weighting. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear.
CNEL	Community Noise Equivalent Level. CNEL is a weighted 24-hour noise level that is obtained by adding five decibels to sound levels in the evening (7:00 PM to 10:00 PM), and by adding ten decibels to sound levels at night (10:00 PM to 7:00 AM). This weighting accounts for the increased human sensitivity to noise during the evening and nighttime hours.
Decibel, dB	A logarithmic unit of noise level measurement that relates the energy of a noise source to that of a constant reference level; the number of decibels is 10 times the logarithm (to the base 10) of this ratio.
DNL, Ldn	Day Night Level. The DNL, or Ldn is a weighted 24-hour noise level that is obtained by adding ten decibels to sound levels at night (10:00 PM to 7:00 AM). This weighting accounts for the increased human sensitivity to noise during the nighttime hours.
Equivalent Continuous Noise Level, Leq	A level of steady state sound that in a stated time period, and a stated location, has the same A-weighted sound energy as the time-varying sound.
Fast/Slow Meter Response	The fast and slow meter responses are different settings on a sound level meter. The fast response setting takes a measurement every 100 milliseconds, while a slow setting takes one every second.
Frequency, Hertz	In a function periodic in time, the number of times that the quantity repeats itself in one second (i.e., the number of cycles per second).
L_{02}, L_{08}, L_{50}, L_{90}	The A-weighted noise levels that are equaled or exceeded by a fluctuating sound level, 2 percent, 8 percent, 50 percent, and 90 percent of a stated time period, respectively.
L_{max}, L_{min}	Lmax is the RMS (root mean squared) maximum level of a noise source or environment measured on a sound level meter, during a designated time interval, using fast meter response. Lmin is the minimum level.
Offensive/ Offending/Intrusive Noise	The noise that intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of sound depends on its amplitude, duration, frequency, and time of occurrence, and tonal information content as well as the prevailing ambient noise level.
Root Mean Square (RMS)	A measure of the magnitude of a varying noise source quantity. The name derives from the calculation of the square root of the mean of the squares of the values. It can be calculated from either a series of lone values or a continuous varying function.

APPENDIX C

NOISE MEASUREMENT FIELD WORKSHEETS

Noise Measurement
Field Data

Project Name: Stanislaus Elementary School 1,2,3-TCP Mitigation Project, City of Modesto **Date:** December 5, 2023

Project #: 19689

Noise Measurement #: NM1 Run Time: 15 minutes (1 x 15 minutes) **Technician:** Ian Edward Gallagher

Nearest Address or Cross Street: 4800 Dale Road, Modesto, CA 95356

Site Description (Type of Existing Land Use and any other notable features): Measurement Site: Just northwest of the commercial use at 4800 Dale Road and east of Dale Road. Adjacent: Dale Rd (running N-S) ~80' to west, Kiernan Ave (running E-W) ~600' to north, & Healthcare Way (running E-W) ~300' to south. Vacant land to the north and northeast, commercial use to the south, and transient lodging use to the southeast.

Weather: High cloud, filtered sunshine. Sunset 4:45 PM. **Settings:** SLOW FAST

Temperature: 62 deg F **Wind:** 5 mph **Humidity:** 66% **Terrain:** Flat

Start Time: 1:00 PM **End Time:** 1:15 PM **Run Time:**

Leq: 62.6 dB **Primary Noise Source:** Traffic noise from the 249 vehicles passing microphone on Dale Rd during 15 min

Lmax 81.8 dB measurement. Traffic noise from vehicles on other roads.

L2 69.7 dB **Secondary Noise Sources:** General city ambiance, overhead air traffic. Some bird song.

L8 63.6 dB

L25 60.1 dB

L50 56.3 dB

NOISE METER:	SoundTrack LXT Class 1	**CALIBRATOR:**	Larson Davis CA 250
MAKE:	Larson Davis	**MAKE:**	Larson Davis
MODEL:	LXT1	**MODEL:**	CA 250
SERIAL NUMBER:	3099	**SERIAL NUMBER:**	2723
FACTORY CALIBRATION DATE:	11/17/2021	**FACTORY CALIBRATION DATE:**	11/18/2021
FIELD CALIBRATION DATE:	12/5/2023		

Noise Measurement
Field Data

PHOTOS:



NM1 looking NNW towards Dale Road & Kiernan Avenue intersection (~580').



NM1 looking SSE towards commercial building, 4800 Dale Road, Modesto (~100').

Summary	
File Name on Meter	LxT_Data.367.s
File Name on PC	LxT_0003099-20231205 130057-LxT_Data.367.ldbin
Serial Number	0003099
Model	SoundTrack LxT®
Firmware Version	2.404
User	Ian Edward Gallagher
Location	NM1 37°42'34.67"N 121° 2'58.90"W
Job Description	15 minute noise measurement (1 x 15 minutes)
Note	Ganddini Project# 19689 Stanislaus Elementary School 1,2,3-TCP Mitigation Project, City of Modesto.

Measurement	
Start	2023-12-05 13:00:57
Stop	2023-12-05 13:15:57
Duration	00:15:00.0
Run Time	00:15:00.0
Pause	00:00:00.0
Pre-Calibration	2023-12-05 12:48:01
Post-Calibration	None

Overall Settings	
RMS Weight	A Weighting
Peak Weight	A Weighting
Detector	Slow
Preamplifier	PRMLxT1L
Microphone Correction	Off
Integration Method	Linear
OBA Range	Normal
OBA Bandwidth	1/1 and 1/3
OBA Frequency Weighting	C Weighting
OBA Max Spectrum	At LMax
Overload	122.7 dB

Results				
LA_{eq}	62.6			
LAE	92.1			
EA	181.058	µPa²h		
EA8	5.794	mPa²h		
EA40	28.969	mPa²h		
$LA_{peak\ (max)}$	2023-12-05 13:11:11	93.0 dB		
LAS_{max}	2023-12-05 13:11:11	81.8 dB		
LAS_{min}	2023-12-05 13:12:55	46.5 dB		

		Statistics	
LC_{eq}	68.8 dB	**LA2.00**	69.7 dB
LA_{eq}	62.6 dB	**LA8.00**	63.6 dB
LC_{eq} - LA_{eq}	6.3 dB	**LA25.00**	60.1 dB
LAI_{eq}	64.9 dB	**LA50.00**	56.3 dB
LA_{eq}	62.6 dB	**LA66.60**	53.9 dB
LAI_{eq} - LA_{eq}	2.3 dB	**LA90.00**	49.9 dB
Overload Count	0		

Measurement Report

Report Summary

Meter's File Name	LxT_Data.367.s	Computer's File Name	LxT_0003099-20231205 130057-LxT_Data.3
Meter	LxT1 0003099		
Firmware	2.404		
User	Ian Edward Gallagher	Location	NM1 37°42'34.67"N 121° 2'58.90"
Job Description	15 minute noise measurement (1 x 15 minutes)		
Note	Ganddini Project# 19689 Stanislaus Elementary School 1,2,3-TCP Mitigation Project, City of Modesto.		
Start Time	2023-12-05 13:00:57	Duration	0:15:00.0
End Time	2023-12-05 13:15:57	Run Time	0:15:00.0
		Pause Time	0:00:00.0

Results

Overall Metrics

LA_{eq}	62.6 dB		
LAE	92.1 dB	SEA	--- dB
EA	181.1 µPa²h	LAFTM5	66.9 dB
EA8	5.8 mPa²h		
EA40	29.0 mPa²h		
LA_{peak}	93.0 dB	2023-12-05 13:11:11	
LAS_{max}	81.8 dB	2023-12-05 13:11:11	
LAS_{min}	46.5 dB	2023-12-05 13:12:55	
LA_{eq}	62.6 dB		
LC_{eq}	68.8 dB	LC_{eq} - LA_{eq}	6.3 dB
LAI_{eq}	64.9 dB	LAI_{eq} - LA_{eq}	2.3 dB

Exceedances

	Count	Duration
LAS > 65.0 dB	7	0:00:56.7
LAS > 85.0 dB	0	0:00:00.0
LApeak > 135.0 dB	0	0:00:00.0
LApeak > 137.0 dB	0	0:00:00.0
LApeak > 140.0 dB	0	0:00:00.0

Community Noise

LDN	LDay	LNight
--- dB	--- dB	0.0 dB

LDEN	LDay	LEve	LNight
--- dB	--- dB	--- dB	--- dB

Any Data

	A		C		Z	
	Level	Time Stamp	Level	Time Stamp	Level	Time Stamp
L_{eq}	62.6 dB		68.8 dB		--- dB	
$L_{S(max)}$	81.8 dB	2023-12-05 13:11:11	--- dB		--- dB	
$L_{S(min)}$	46.5 dB	2023-12-05 13:12:55	--- dB		--- dB	
$L_{Peak(max)}$	93.0 dB	2023-12-05 13:11:11	--- dB		--- dB	

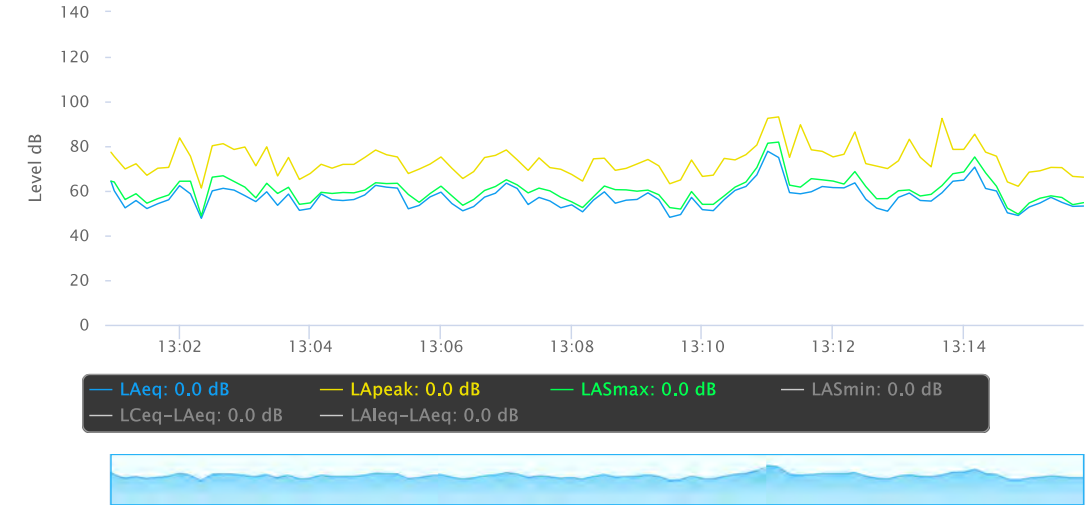
Overloads

Count	Duration	OBA Count	OBA Duration
0	0:00:00.0	0	0:00:00.0

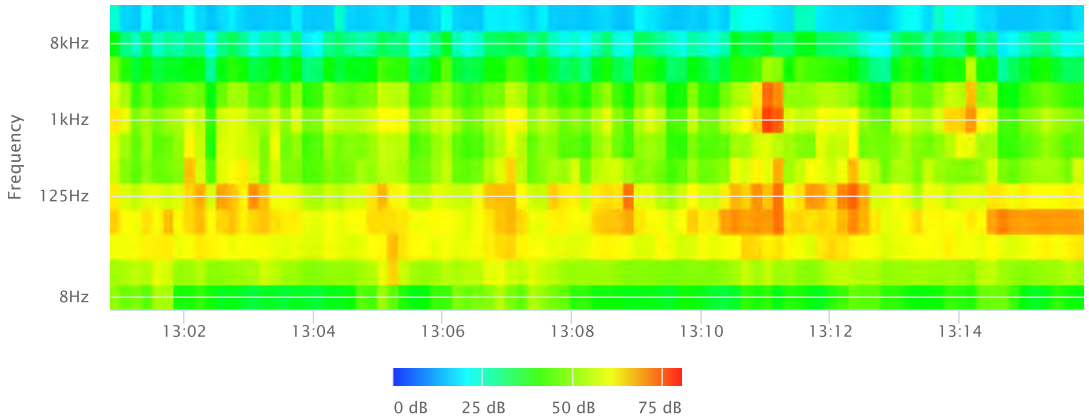
Statistics

LAS 2.0	69.7 dB
LAS 8.0	63.6 dB
LAS 25.0	60.1 dB
LAS 50.0	56.3 dB
LAS 66.6	53.9 dB
LAS 90.0	49.9 dB

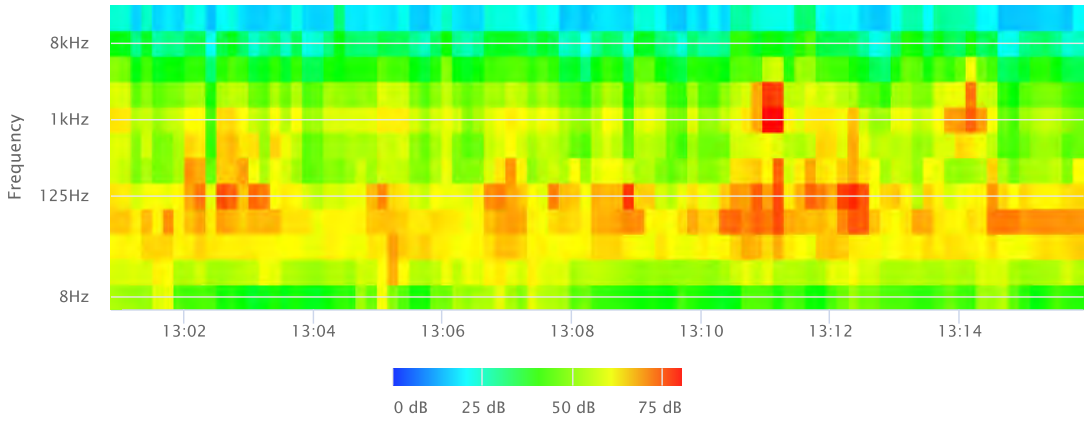
Time History



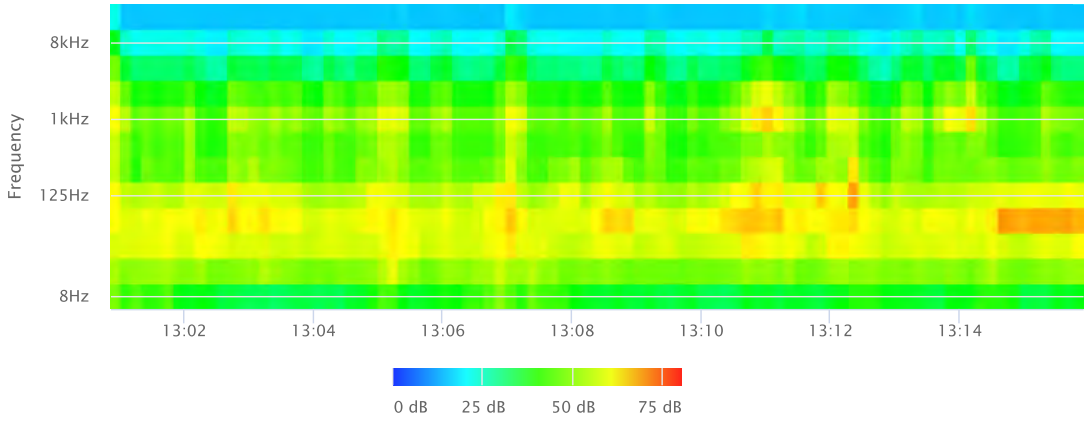
OBA 1/1 Leq



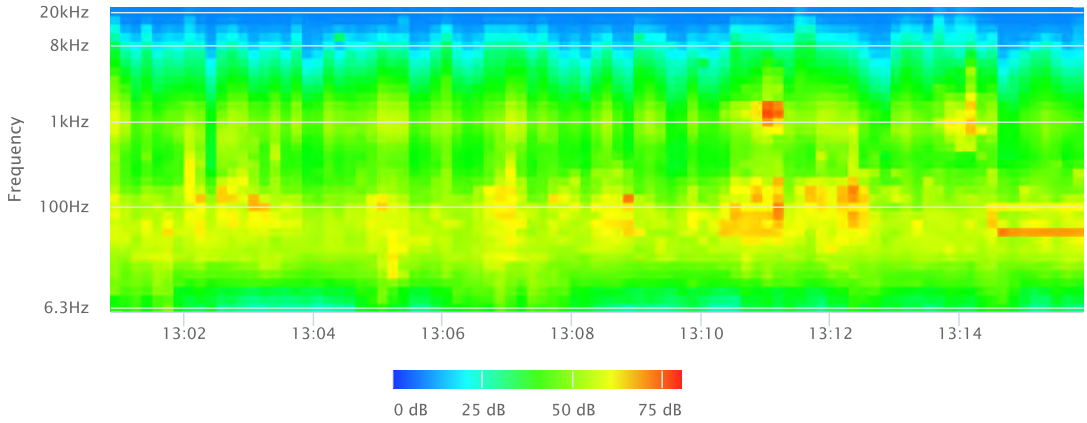
OBA 1/1 Lmax



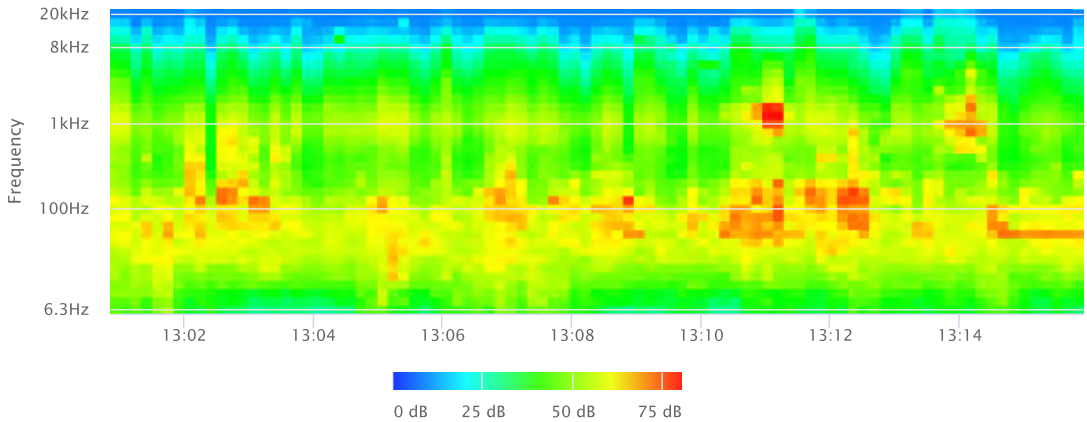
OBA 1/1 Lmin



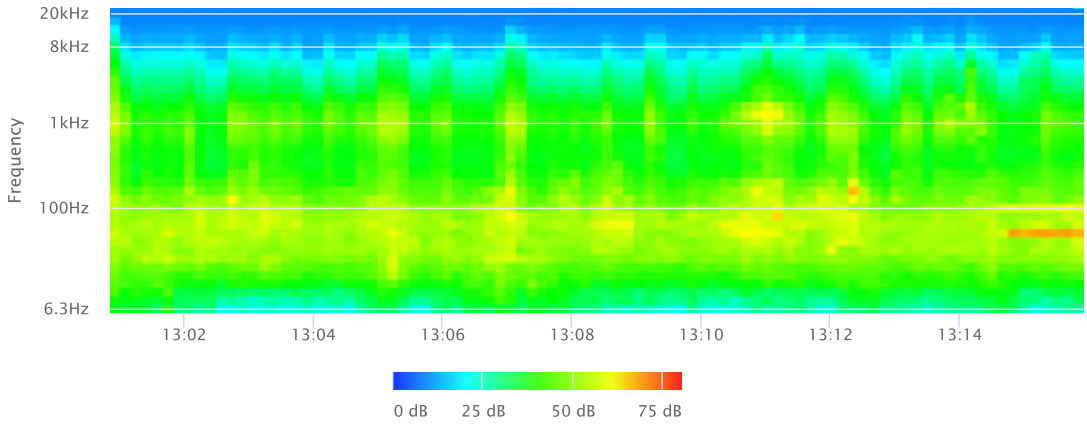
OBA 1/3 Leq



OBA 1/3 Lmax



OBA 1/3 Lmin


20kHz
8kHz
1kHz
100Hz
6.3Hz
Frequency
13:02
13:04
13:06
13:08
13:10
13:12
13:14
0 dB
25 dB
50 dB
75 dB

Noise Measurement
Field Data

Project Name: Stanislaus Elementary School 1,2,3-TCP Mitigation Project, City of Modesto **Date:** December 5, 2023

Project #: 19689

Noise Measurement #: NM2 Run Time: 15 minutes (1 x 15 minutes) **Technician:** Ian Edward Gallagher

Nearest Address or Cross Street: 2224 Kiernan Avenue, Modesto, CA 95356

Site Description (Type of Existing Land Use and any other notable features): Measurement Site: Just north of the residence at 2224 Kiernan Avenue and just south of Kiernan Avenue. Adjacent: Kiernan Ave (running E-W) just north with residential, commercial, and agricultural uses further north and residential uses to south.

Weather: High cloud, filtered sunshine. Sunset 4:45 PM. **Settings:** SLOW FAST

Temperature: 62 deg F **Wind:** 5 mph **Humidity:** 66% **Terrain:** Flat

Start Time: 1:46 PM **End Time:** 2:01 PM **Run Time:**

Leq: 72.9 dB

Lmax 83.7 dB

L2 79.9 dB

L8 77.9 dB

L25 74.3 dB

L50 68.5 dB

Primary Noise Source: Traffic noise from the 358 vehicles passing microphone on Kiernan Ave during 15 min measurement. Traffic ambiance from vehicles on other roads.

Secondary Noise Sources: Occasional overhead air traffic. Bird song.

NOISE METER:	SoundTrack LXT Class 1	**CALIBRATOR:**	Larson Davis CA 250
MAKE:	Larson Davis	**MAKE:**	Larson Davis
MODEL:	LXT1	**MODEL:**	CA 250
SERIAL NUMBER:	3099	**SERIAL NUMBER:**	2723
FACTORY CALIBRATION DATE:	11/17/2021	**FACTORY CALIBRATION DATE:**	11/18/2021
FIELD CALIBRATION DATE:	12/5/2023		

Noise Measurement
Field Data

PHOTOS:



NM2 looking across Kiernan Avenue towards residence 2207 Kiernan Ave, Modesto.



NM2 looking S towards frontyard of residence 2224 Kiernan Ave, Modesto.

Summary	
File Name on Meter	LxT_Data.369.s
File Name on PC	LxT_0003099-20231205 134604-LxT_Data.369.ldbin
Serial Number	0003099
Model	SoundTrack LxT®
Firmware Version	2.404
User	Ian Edward Gallagher
Location	NM2 37°42'40.21"N 121° 2'5.68"W
Job Description	15 minute noise measurement (1 x 15 minutes)
Note	Ganddini Project# 19689 Stanislaus Elementary School 1,2,3-TCP Mitigation Project, City of Modesto.

Measurement	
Start	2023-12-05 13:46:04
Stop	2023-12-05 14:01:04
Duration	00:15:00.0
Run Time	00:15:00.0
Pause	00:00:00.0
Pre-Calibration	2023-12-05 13:43:52
Post-Calibration	None

Overall Settings	
RMS Weight	A Weighting
Peak Weight	A Weighting
Detector	Slow
Preamplifier	PRMLxT1L
Microphone Correction	Off
Integration Method	Linear
OBA Range	Normal
OBA Bandwidth	1/1 and 1/3
OBA Frequency Weighting	C Weighting
OBA Max Spectrum	At LMax
Overload	122.8 dB

Results		
LA_{eq}	72.9	
LAE	102.4	
EA	1.928	mPa^2h
EA8	61.709	mPa^2h
EA40	308.546	mPa^2h
$LA_{peak\ (max)}$	2023-12-05 13:52:11	97.9 dB
LAS_{max}	2023-12-05 13:52:11	83.7 dB
LAS_{min}	2023-12-05 13:51:25	42.8 dB

		Statistics	
LC_{eq}	76.9 dB		
LA_{eq}	72.9 dB	**LA2.00**	79.9 dB
LC_{eq} - LA_{eq}	4.1 dB	**LA8.00**	77.9 dB
LAI_{eq}	74.1 dB	**LA25.00**	74.3 dB
LA_{eq}	72.9 dB	**LA50.00**	68.5 dB
LAI_{eq} - LA_{eq}	1.2 dB	**LA66.60**	64.4 dB
Overload Count	0		

Measurement Report

Report Summary

Meter's File Name	LxT_Data.369.s	Computer's File Name	LxT_0003099-20231205 134604-LxT_Data.3
Meter	LxT1 0003099		
Firmware	2.404		
User	Ian Edward Gallagher	Location	NM2 37°42'40.21"N 121° 2'5.68"\
Job Description	15 minute noise measurement (1 x 15 minutes)		
Note	Ganddini Project# 19689 Stanislaus Elementary School 1,2,3-TCP Mitigation Project, City of Modesto.		
Start Time	2023-12-05 13:46:04	Duration	0:15:00.0
End Time	2023-12-05 14:01:04	Run Time	0:15:00.0
Pause Time	0:00:00.0		

Results

Overall Metrics

LA_{eq}	72.9 dB		
LAE	102.4 dB	SEA	--- dB
EA	1.9 mPa²h	LAFTM5	76.7 dB
EA8	61.7 mPa²h		
EA40	308.5 mPa²h		
LA_{peak}	97.9 dB	2023-12-05 13:52:11	
LAS_{max}	83.7 dB	2023-12-05 13:52:11	
LAS_{min}	42.8 dB	2023-12-05 13:51:25	
LA_{eq}	72.9 dB		
LC_{eq}	76.9 dB	LC_{eq} - LA_{eq}	4.1 dB
LAI_{eq}	74.1 dB	LAI_{eq} - LA_{eq}	1.2 dB

Exceedances

	Count	Duration
LAS > 65.0 dB	26	0:10:23.2
LAS > 85.0 dB	0	0:00:00.0
LApeak > 135.0 dB	0	0:00:00.0
LApeak > 137.0 dB	0	0:00:00.0
LApeak > 140.0 dB	0	0:00:00.0

Community Noise

LDN	LDay	LNight
--- dB	--- dB	0.0 dB

LDEN	LDay	LEve	LNight
--- dB	--- dB	--- dB	--- dB

Any Data

	A		C		Z	
	Level	Time Stamp	Level	Time Stamp	Level	Time Stamp
L_{eq}	72.9 dB		76.9 dB		--- dB	
$LS_{(max)}$	83.7 dB	2023-12-05 13:52:11	--- dB		--- dB	
$LS_{(min)}$	42.8 dB	2023-12-05 13:51:25	--- dB		--- dB	
$L_{Peak(max)}$	97.9 dB	2023-12-05 13:52:11	--- dB		--- dB	

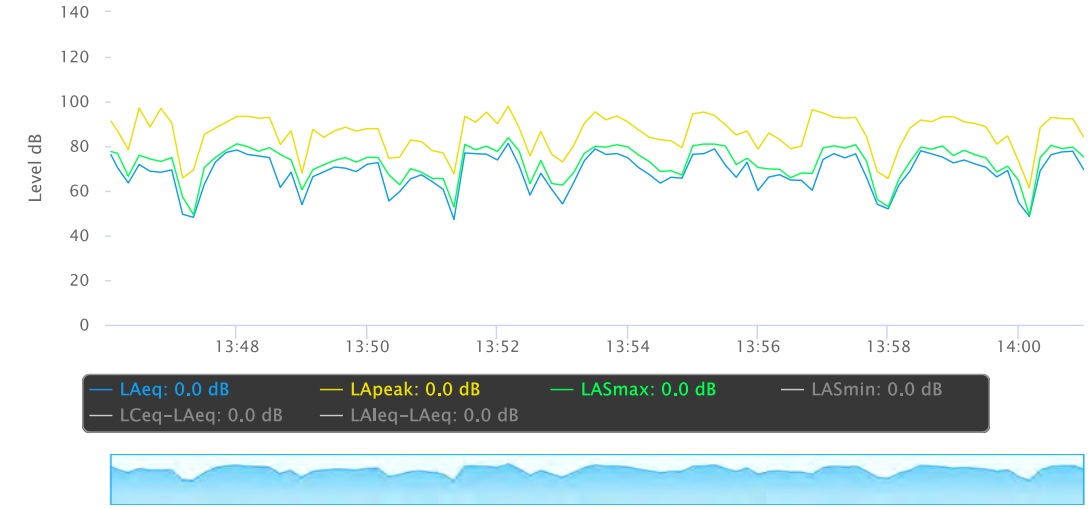
Overloads

Count	Duration	OBA Count	OBA Duration
0	0:00:00.0	0	0:00:00.0

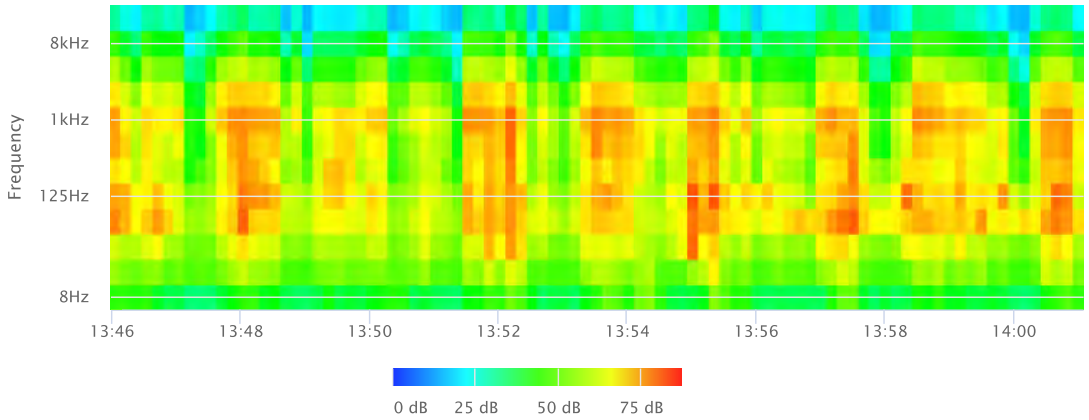
Statistics

LAS 2.0	79.9 dB
LAS 8.0	77.9 dB
LAS 25.0	74.3 dB
LAS 50.0	68.5 dB
LAS 66.6	64.4 dB
LAS 90.0	52.9 dB

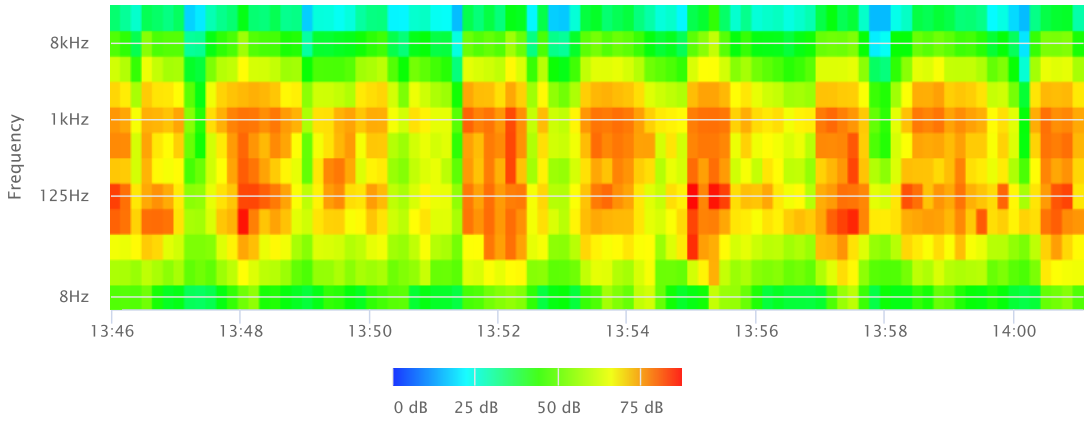
Time History



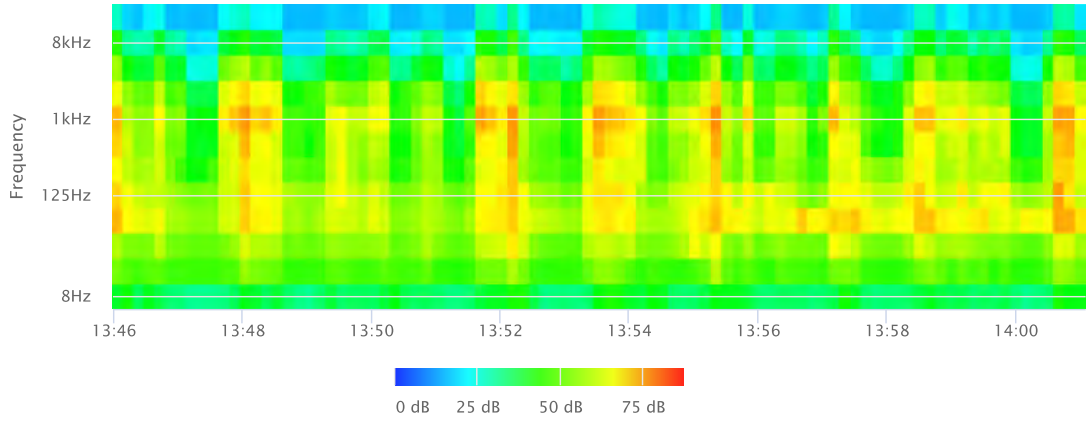
OBA 1/1 Leq



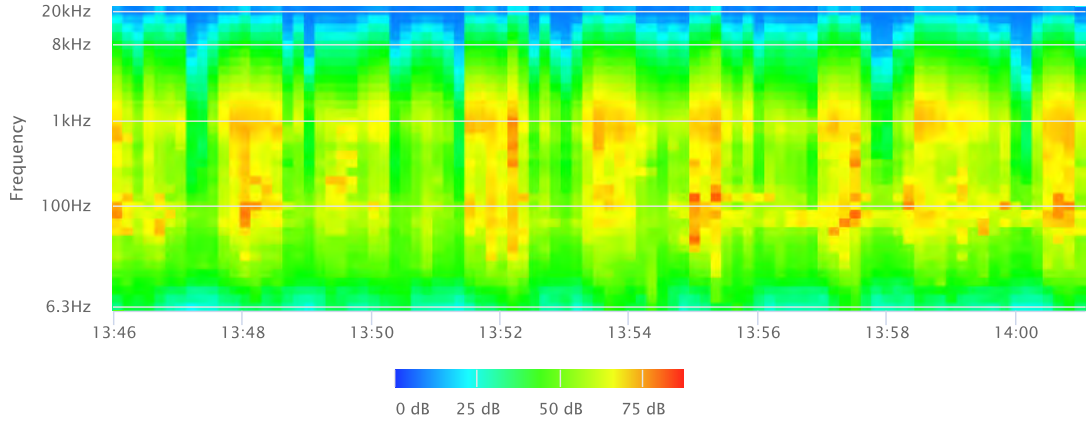
OBA 1/1 Lmax



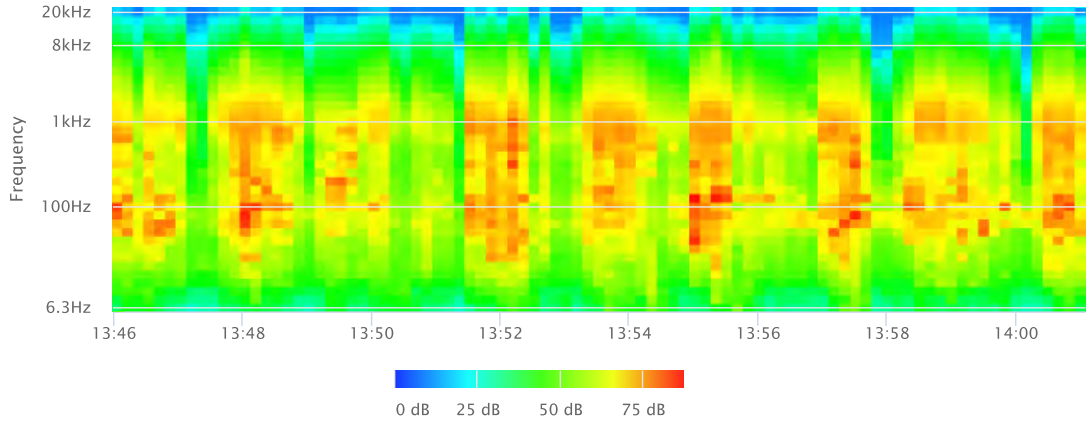
OBA 1/1 Lmin



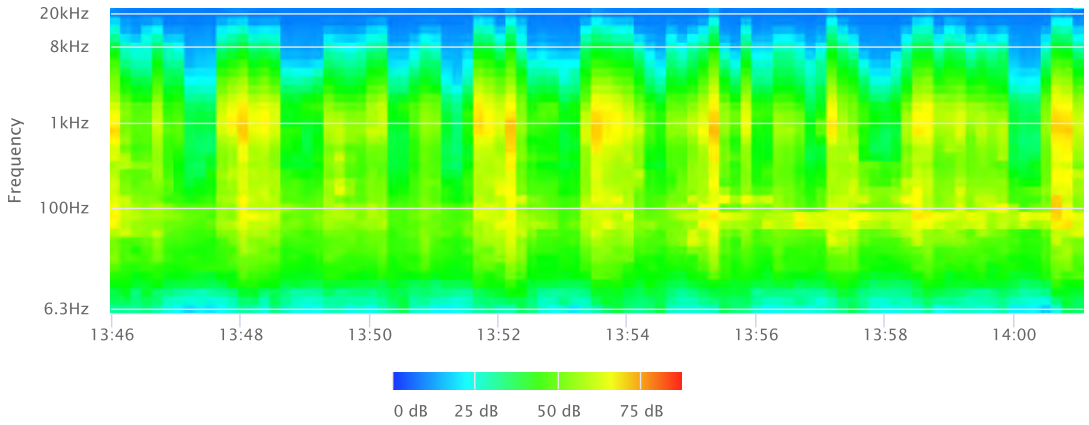
OBA 1/3 Leq



OBA 1/3 Lmax



OBA 1/3 Lmin


20kHz
8kHz
1kHz
100Hz
6.3Hz
Frequency
13:46
13:48
13:50
13:52
13:54
13:56
13:58
14:00
0 dB
25 dB
50 dB
75 dB

Noise Measurement
Field Data

Project Name: Stanislaus Elementary School 1,2,3-TCP Mitigation Project, City of Modesto **Date:** December 5, 2023

Project #: 19689

Noise Measurement #: NM3 Run Time: 15 minutes (1 x 15 minutes) **Technician:** Ian Edward Gallagher

Nearest Address or Cross Street: 1348 Kiernan Avenue, Modesto, CA 95356

Site Description (Type of Existing Land Use and any other notable features): Measurement Site: Just north of the residence at 1348 Kiernan Avenue and just south of Kiernan Avenue. Adjacent: Kiernan Ave (running E-W) just north & Tully Rd (running N-S) ~580' east of NM3. Heavy machinery in operation at 1348 Kiernan Ave just south of NM3. Residential, agricultural uses, and commercial uses throughout surrounding area.

Weather: High cloud, filtered sunshine. Sunset 4:45 PM. **Settings:** SLOW FAST

Temperature: 62 deg F **Wind:** 5 mph **Humidity:** 66% **Terrain:** Flat

Start Time: 2:23 PM **End Time:** 2:38 PM **Run Time:**

Leq: 72.8 dB

Lmax 85.7 dB

L2 80.5 dB

L8 77.1 dB

L25 73.0 dB

L50 69.4 dB

Primary Noise Source: Traffic noise from the 435 vehicles passing microphone on Kiernan Ave during 15 min measurement. Traffic noise from vehicles on Tully Rd.

Secondary Noise Sources: Occasional overhead air traffic. Bird song. Dirt moving machinery in operation in frontyard of residence 1348 Kiernan Ave.

NOISE METER:	SoundTrack LXT Class 1	**CALIBRATOR:**	Larson Davis CA 250
MAKE:	Larson Davis	**MAKE:**	Larson Davis
MODEL:	LXT1	**MODEL:**	CA 250
SERIAL NUMBER:	3099	**SERIAL NUMBER:**	2723
FACTORY CALIBRATION DATE:	11/17/2021	**FACTORY CALIBRATION DATE:**	11/18/2021
FIELD CALIBRATION DATE:	12/5/2023		

Noise Measurement
Field Data

PHOTOS:



NM3 looking across Kiernan Avenue towards residence 1379 Kiernan Ave, Modesto.



NM3 looking SE towards frontyard of residence 1348 Kiernan Ave, Modesto.

Summary	
File Name on Meter	LxT_Data.370.s
File Name on PC	LxT_0003099-20231205 142331-LxT_Data.370.ldbin
Serial Number	0003099
Model	SoundTrack LxT®
Firmware Version	2.404
User	Ian Edward Gallagher
Location	NM3 37°42'39.47"N 121° 0'54.76"W
Job Description	15 minute noise measurement (1 x 15 minutes)
Note	Ganddini Project# 19689 Stanislaus Elementary School 1,2,3-TCP Mitigation Project, City of Modesto.

Measurement	
Start	2023-12-05 14:23:31
Stop	2023-12-05 14:38:31
Duration	00:15:00.0
Run Time	00:15:00.0
Pause	00:00:00.0
Pre-Calibration	2023-12-05 14:23:14
Post-Calibration	None

Overall Settings	
RMS Weight	A Weighting
Peak Weight	A Weighting
Detector	Slow
Preamplifier	PRMLxT1L
Microphone Correction	Off
Integration Method	Linear
OBA Range	Normal
OBA Bandwidth	1/1 and 1/3
OBA Frequency Weighting	C Weighting
OBA Max Spectrum	At LMax
Overload	122.7 dB

Results				
LA_{eq}	72.8			
LAE	102.4			
EA	1.919	mPa^2h		
EA8	61.412	mPa^2h		
EA40	307.063	mPa^2h		
$LA_{peak\ (max)}$	2023-12-05 14:27:19	103.7	dB	
LAS_{max}	2023-12-05 14:27:20	85.7	dB	
LAS_{min}	2023-12-05 14:36:51	58.6	dB	

			Statistics	
LC_{eq}	77.7	dB	**LA2.00**	80.5 dB
LA_{eq}	72.8	dB	**LA8.00**	77.1 dB
LC_{eq} - LA_{eq}	4.8	dB	**LA25.00**	73.0 dB
LAI_{eq}	74.0	dB	**LA50.00**	69.4 dB
LA_{eq}	72.8	dB	**LA66.60**	67.4 dB
LAI_{eq} - LA_{eq}	1.1	dB	**LA90.00**	63.1 dB
Overload Count	0			

Measurement Report

Report Summary

Meter's File Name	LxT_Data.370.s	Computer's File Name	LxT_0003099-20231205 142331-LxT_Data.3
Meter	LxT1 0003099		
Firmware	2.404		
User	Ian Edward Gallagher	Location	NM3 37°42'39.47"N 121° 0'54.76"
Job Description	15 minute noise measurement (1 x 15 minutes)		
Note	Ganddini Project# 19689 Stanislaus Elementary School 1,2,3-TCP Mitigation Project, City of Modesto.		
Start Time	2023-12-05 14:23:31	Duration	0:15:00.0
End Time	2023-12-05 14:38:31	Run Time	0:15:00.0
Pause Time	0:00:00.0		

Results

Overall Metrics

LA_{eq}	72.8 dB		
LAE	102.4 dB	SEA	--- dB
EA	1.9 mPa²h	LAFTM5	76.5 dB
EA8	61.4 mPa²h		
EA40	307.1 mPa²h		
LA_{peak}	103.7 dB	2023-12-05 14:27:19	
LAS_{max}	85.7 dB	2023-12-05 14:27:20	
LAS_{min}	58.6 dB	2023-12-05 14:36:51	
LA_{eq}	72.8 dB		
LC_{eq}	77.7 dB	LC_{eq} - LA_{eq}	4.8 dB
LAI_{eq}	74.0 dB	LAI_{eq} - LA_{eq}	1.1 dB

Exceedances

	Count	Duration
LAS > 65.0 dB	8	0:12:58.4
LAS > 85.0 dB	1	0:00:01.8
LApeak > 135.0 dB	0	0:00:00.0
LApeak > 137.0 dB	0	0:00:00.0
LApeak > 140.0 dB	0	0:00:00.0

Community Noise

LDN	LDay	LNight
--- dB	--- dB	0.0 dB

LDEN	LDay	LEve	LNight
--- dB	--- dB	--- dB	--- dB

Any Data

	A		C		Z	
	Level	Time Stamp	Level	Time Stamp	Level	Time Stamp
L_{eq}	72.8 dB		77.7 dB		--- dB	
$LS_{(max)}$	85.7 dB	2023-12-05 14:27:20	--- dB		--- dB	
$LS_{(min)}$	58.6 dB	2023-12-05 14:36:51	--- dB		--- dB	
$L_{Peak(max)}$	103.7 dB	2023-12-05 14:27:19	--- dB		--- dB	

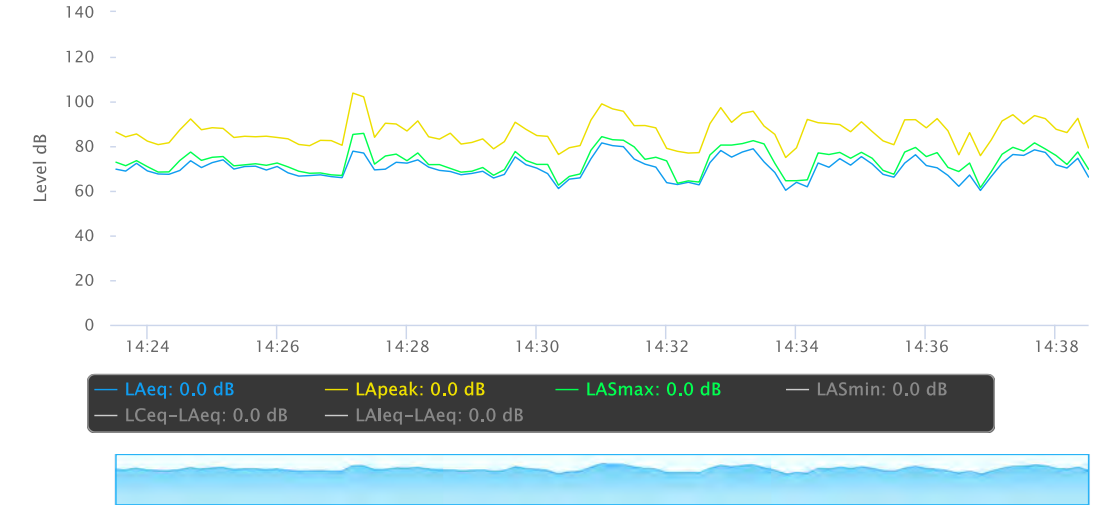
Overloads

Count	Duration	OBA Count	OBA Duration
0	0:00:00.0	0	0:00:00.0

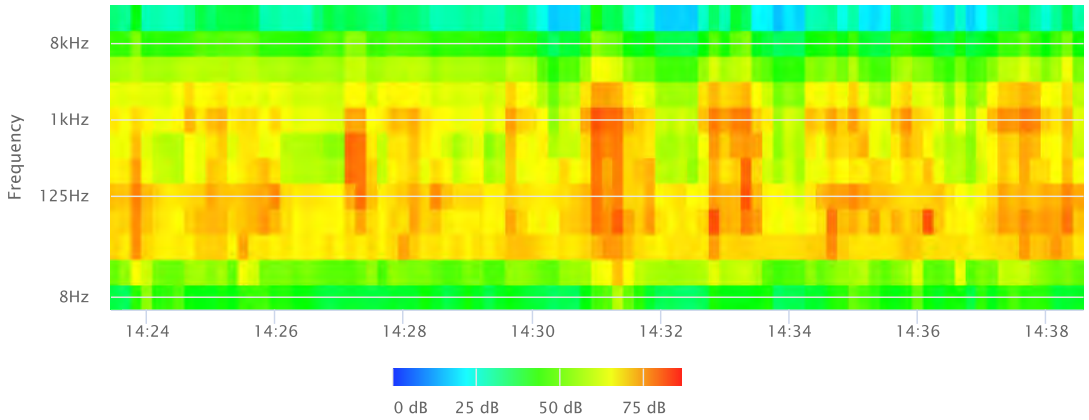
Statistics

LAS 2.0	80.5 dB
LAS 8.0	77.1 dB
LAS 25.0	73.0 dB
LAS 50.0	69.4 dB
LAS 66.6	67.4 dB
LAS 90.0	63.1 dB

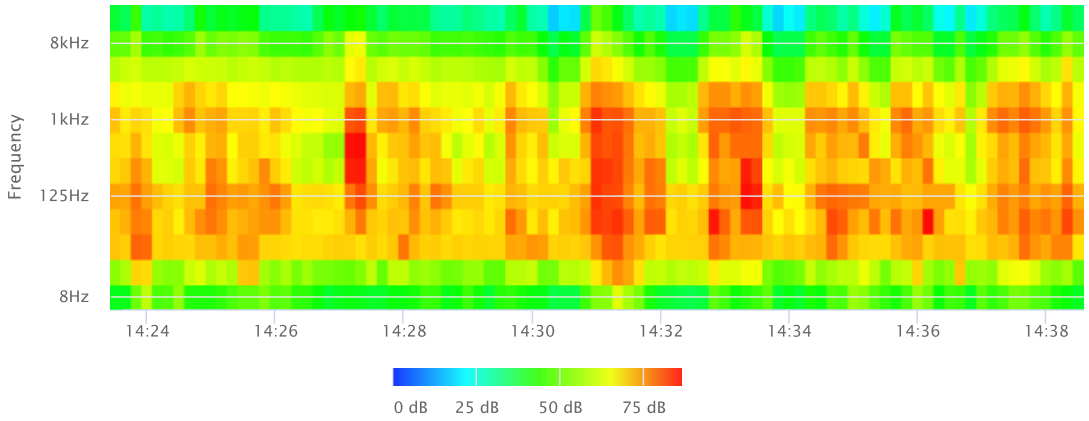
Time History



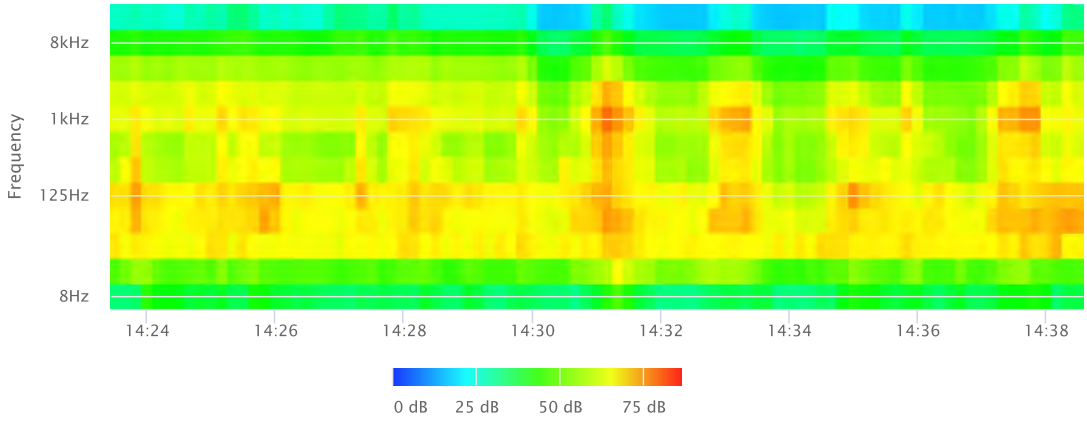
OBA 1/1 Leq



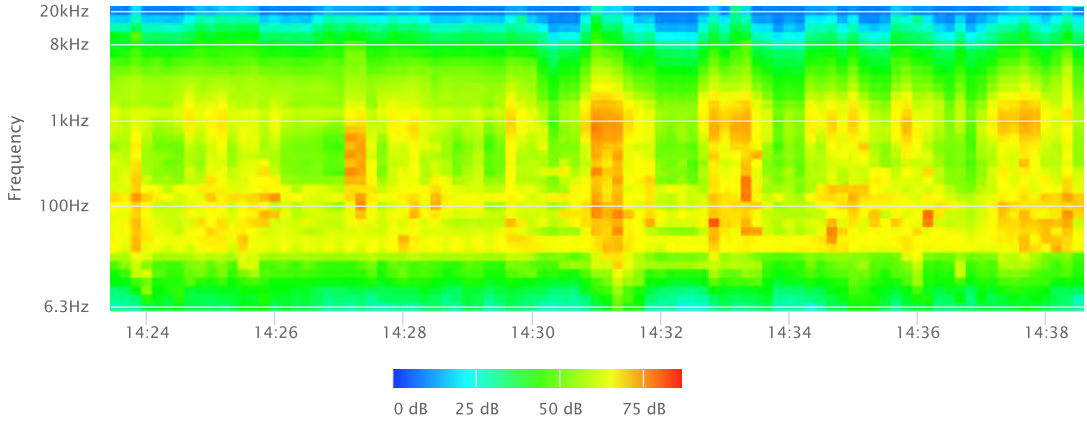
OBA 1/1 Lmax



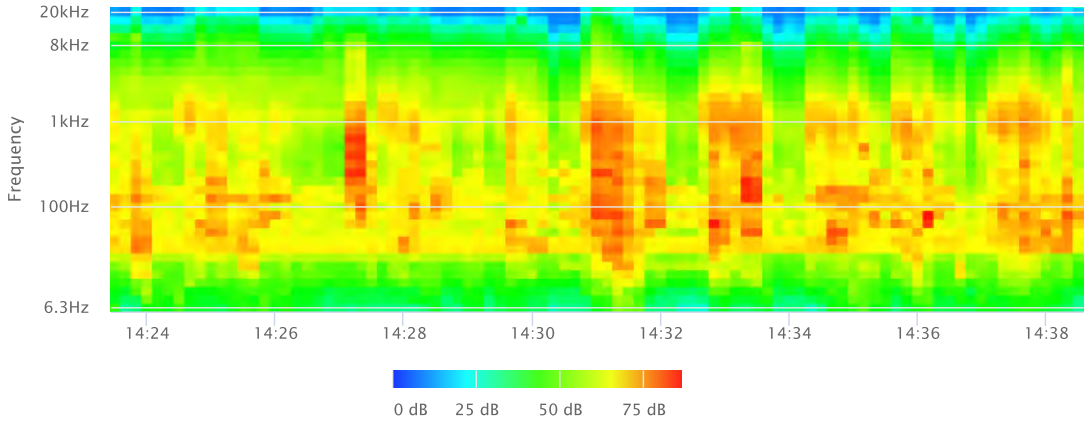
OBA 1/1 Lmin



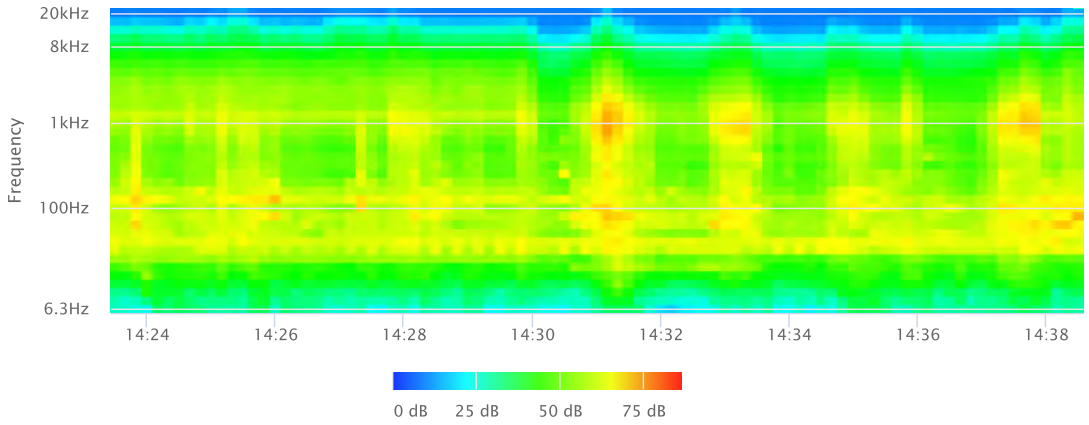
OBA 1/3 Leq



OBA 1/3 Lmax



OBA 1/3 Lmin


20kHz
8kHz
1kHz
100Hz
6.3Hz
Frequency
14:24
14:26
14:28
14:30
14:32
14:34
14:36
14:38
0 dB
25 dB
50 dB
75 dB

Noise Measurement
Field Data

Project Name: Stanislaus Elementary School 1,2,3-TCP Mitigation Project, City of Modesto **Date:** December 5, 2023

Project #: 19689

Noise Measurement #: NM4 Run Time: 15 minutes (1 x 15 minutes) **Technician:** Ian Edward Gallagher

Nearest Address or Cross Street: 1601 Kiernan Avenue, Modesto, CA 95356

Site Description (Type of Existing Land Use and any other notable features): Measurement Site: Just southeast of residential/commercial use at 1601 Kiernan Avenue and just north of Kiernan Avenue. Adjacent: Kiernan Ave (running E-W) just south & Carver Rd (running N-S) ~590' west. Residential/commercial use to north (dog kennel with no barking dogs). Residential and agricultural land throughout surrounding area.

Weather: High cloud, filtered sunshine. Sunset 4:45 PM. **Settings:** SLOW FAST

Temperature: 62 deg F **Wind:** 5 mph **Humidity:** 66% **Terrain:** Flat

Start Time: 3:03 PM **End Time:** 3:18 PM **Run Time:**

Leq: 68.7 dB **Primary Noise Source:** Traffic noise from the 447 vehicles passing microphone on Kiernan Ave during 15

Lmax 80.3 dB min measurement. Traffic noise from vehicles on Carver Rd.

L2 76.1 dB **Secondary Noise Sources:** Occasional overhead air traffic. Bird song. No dog kennel noise (no barking).

L8 73.3 dB

L25 69.7 dB

L50 65.8 dB

NOISE METER:	SoundTrack LXT Class 1	**CALIBRATOR:**	Larson Davis CA 250
MAKE:	Larson Davis	**MAKE:**	Larson Davis
MODEL:	LXT1	**MODEL:**	CA 250
SERIAL NUMBER:	3099	**SERIAL NUMBER:**	2723
FACTORY CALIBRATION DATE:	11/17/2021	**FACTORY CALIBRATION DATE:**	11/18/2021
FIELD CALIBRATION DATE:	12/5/2023		

Noise Measurement
Field Data

PHOTOS:



NM4 looking W down Kiernan Ave. Carver Rd & Kiernan Ave intersection (~600' WSW) & residence (with dog kennel business) 1601 Kiernan Ave on right of image (no barking dogs at time of measurement).



NM4 looking ESE across Kiernan Avenue.

Summary	
File Name on Meter	LxT_Data.371.s
File Name on PC	LxT_0003099-20231205 150358-LxT_Data.371.ldbin
Serial Number	0003099
Model	SoundTrack LxT®
Firmware Version	2.404
User	Ian Edward Gallagher
Location	NM4 37°42'41.40"N 121° 1'12.08"W
Job Description	15 minute noise measurement (1 x 15 minutes)
Note	Ganddini Project# 19689 Stanislaus Elementary School 1,2,3-TCP Mitigation Project, City of Modesto.

Measurement	
Start	2023-12-05 15:03:58
Stop	2023-12-05 15:18:58
Duration	00:15:00.0
Run Time	00:15:00.0
Pause	00:00:00.0
Pre-Calibration	2023-12-05 15:03:29
Post-Calibration	None

Overall Settings	
RMS Weight	A Weighting
Peak Weight	A Weighting
Detector	Slow
Preamplifier	PRMLxT1L
Microphone Correction	Off
Integration Method	Linear
OBA Range	Normal
OBA Bandwidth	1/1 and 1/3
OBA Frequency Weighting	C Weighting
OBA Max Spectrum	At LMax
Overload	122.7 dB

Results			
LA_{eq}	68.7		
LAE	98.3		
EA	749.099	µPa²h	
EA8	23.971	mPa²h	
EA40	119.856	mPa²h	
$LA_{peak\ (max)}$	2023-12-05 15:17:15	95.6	dB
LAS_{max}	2023-12-05 15:04:14	80.3	dB
LAS_{min}	2023-12-05 15:14:54	42.5	dB

		Statistics	
LC_{eq}	74.5 dB	**LA2.00**	76.1 dB
LA_{eq}	68.7 dB	**LA8.00**	73.3 dB
LC_{eq} - LA_{eq}	5.8 dB	**LA25.00**	69.7 dB
LAI_{eq}	69.7 dB	**LA50.00**	65.8 dB
LA_{eq}	68.7 dB	**LA66.60**	62.8 dB
LAI_{eq} - LA_{eq}	1.0 dB	**LA90.00**	52.6 dB
Overload Count	0		

Measurement Report

Report Summary

Meter's File Name	LxT_Data.371.s	Computer's File Name	LxT_0003099-20231205 150358-LxT_Data.3
Meter	LxT1 0003099		
Firmware	2.404		
User	Ian Edward Gallagher	Location	NM4 37°42'41.40"N 121° 1'12.08"
Job Description	15 minute noise measurement (1 x 15 minutes)		
Note	Ganddini Project# 19689 Stanislaus Elementary School 1,2,3-TCP Mitigation Project, City of Modesto.		
Start Time	2023-12-05 15:03:58	Duration	0:15:00.0
End Time	2023-12-05 15:18:58	Run Time	0:15:00.0
		Pause Time	0:00:00.0

Results

Overall Metrics

LA_{eq}	68.7 dB		
LAE	98.3 dB	SEA	--- dB
EA	749.1 µPa²h	LAFTM5	72.1 dB
EA8	24.0 mPa²h		
EA40	119.9 mPa²h		
LA_{peak}	95.6 dB	2023-12-05 15:17:15	
LAS_{max}	80.3 dB	2023-12-05 15:04:14	
LAS_{min}	42.5 dB	2023-12-05 15:14:54	
LA_{eq}	68.7 dB		
LC_{eq}	74.5 dB	LC_{eq} - LA_{eq}	5.8 dB
LAI_{eq}	69.7 dB	LAI_{eq} - LA_{eq}	1.0 dB

Exceedances

	Count	Duration
LAS > 65.0 dB	25	0:09:18.8
LAS > 85.0 dB	0	0:00:00.0
LApeak > 135.0 dB	0	0:00:00.0
LApeak > 137.0 dB	0	0:00:00.0
LApeak > 140.0 dB	0	0:00:00.0

Community Noise

LDN	LDay	LNight
--- dB	--- dB	0.0 dB

LDEN	LDay	LEve	LNight
--- dB	--- dB	--- dB	--- dB

Any Data

	A		C		Z	
	Level	Time Stamp	Level	Time Stamp	Level	Time Stamp
L_{eq}	68.7 dB		74.5 dB		--- dB	
$LS_{(max)}$	80.3 dB	2023-12-05 15:04:14	--- dB		--- dB	
$LS_{(min)}$	42.5 dB	2023-12-05 15:14:54	--- dB		--- dB	
$L_{Peak(max)}$	95.6 dB	2023-12-05 15:17:15	--- dB		--- dB	

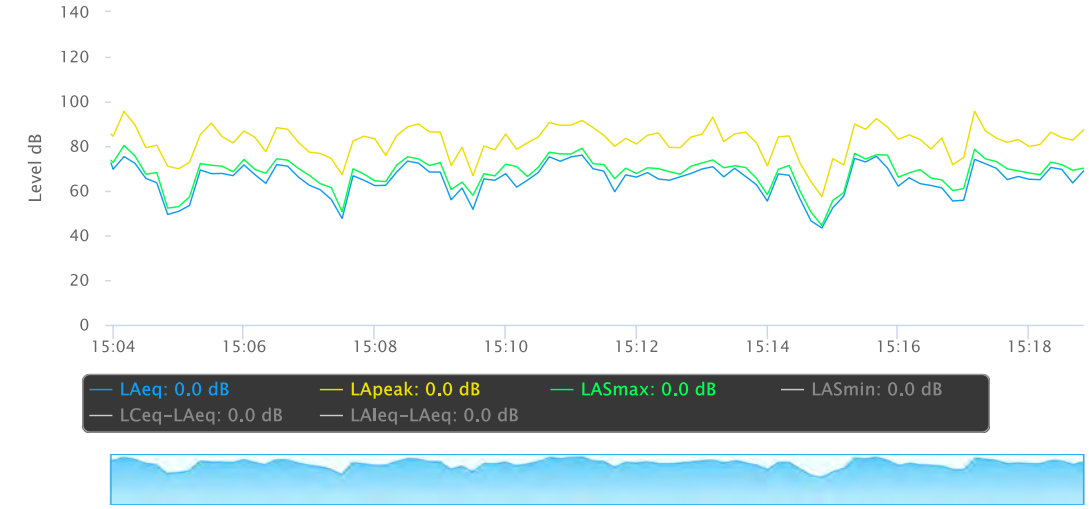
Overloads

Count	Duration	OBA Count	OBA Duration
0	0:00:00.0	0	0:00:00.0

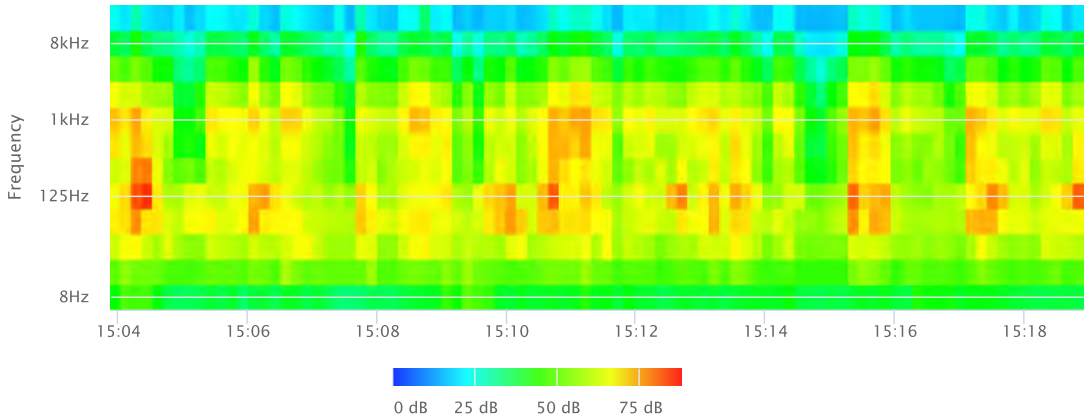
Statistics

LAS 2.0	76.1 dB
LAS 8.0	73.3 dB
LAS 25.0	69.7 dB
LAS 50.0	65.8 dB
LAS 66.6	62.8 dB
LAS 90.0	52.6 dB

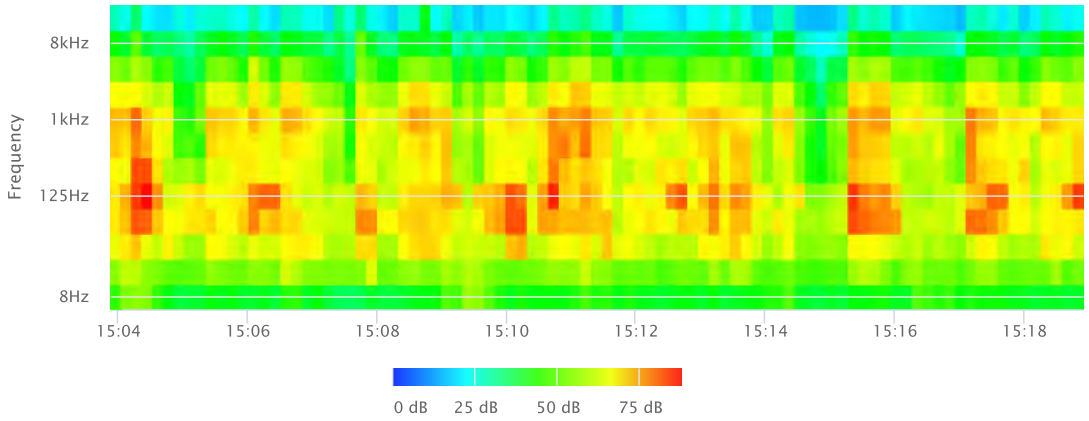
Time History



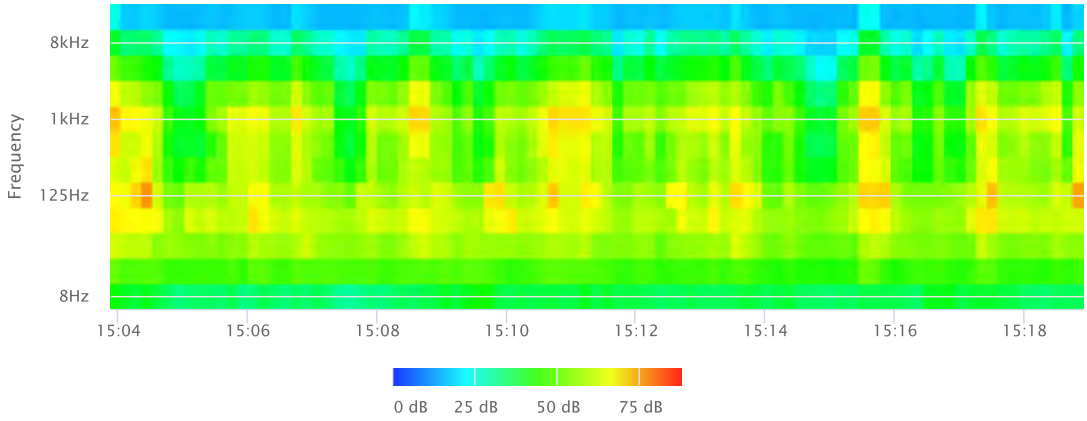
OBA 1/1 Leq



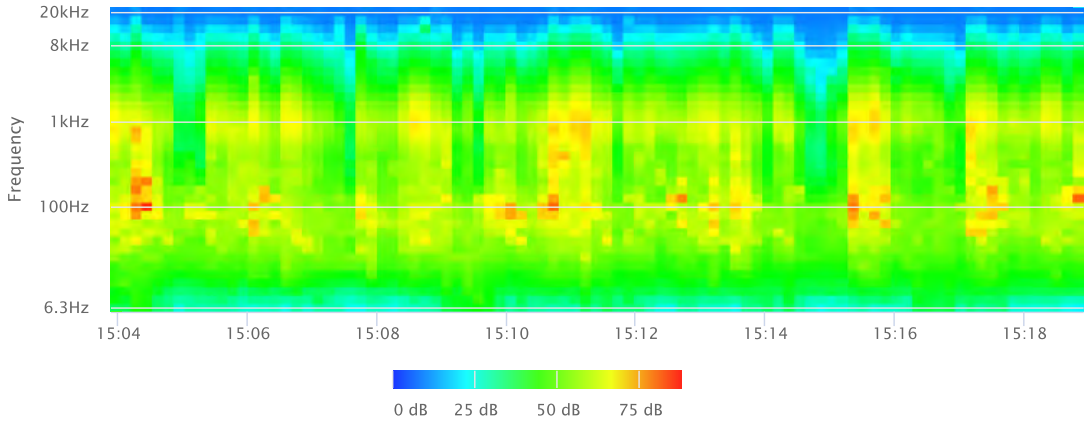
OBA 1/1 Lmax



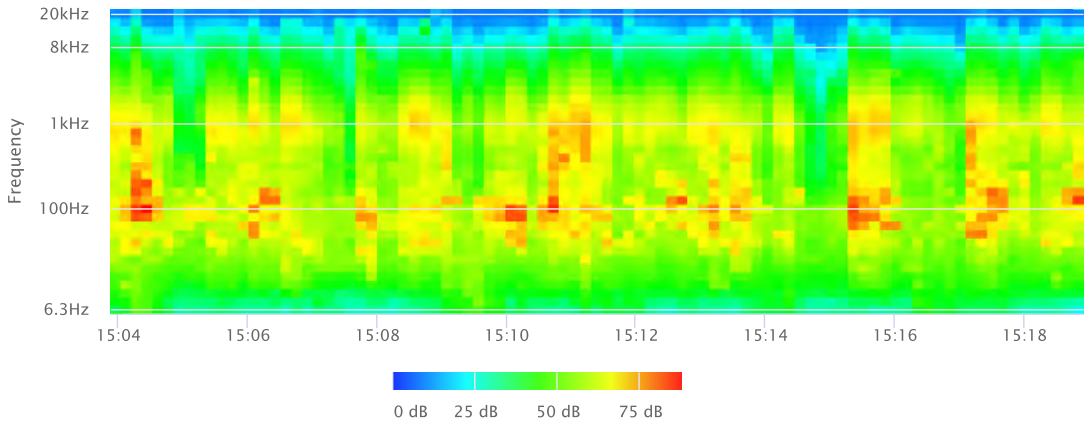
OBA 1/1 Lmin



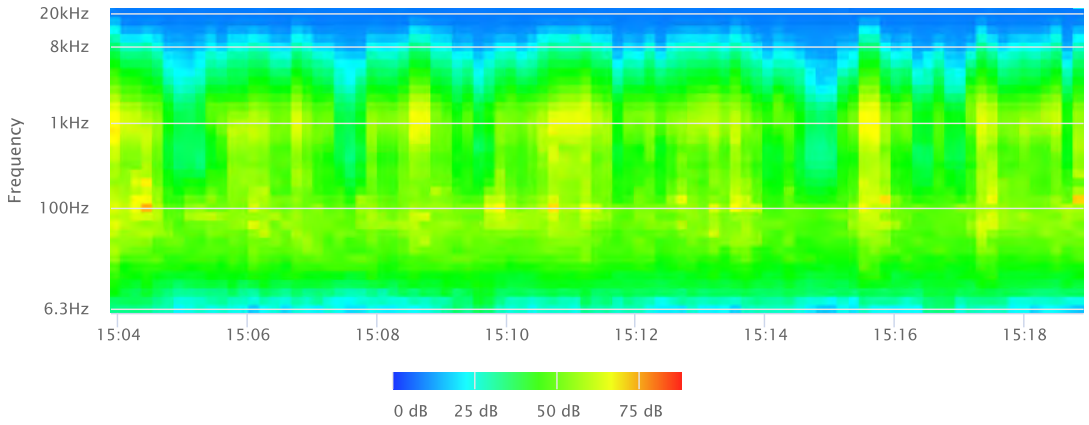
OBA 1/3 Leq



OBA 1/3 Lmax



OBA 1/3 Lmin


20kHz
8kHz
1kHz
100Hz
6.3Hz
Frequency
15:04
15:06
15:08
15:10
15:12
15:14
15:16
15:18
0 dB
25 dB
50 dB
75 dB

Noise Measurement
Field Data

Project Name: Stanislaus Elementary School 1,2,3-TCP Mitigation Project, City of Modesto **Date:** December 5, 2023

Project #: 19689

Noise Measurement #: NM5 Run Time: 15 minutes (1 x 15 minutes) **Technician:** Ian Edward Gallagher

Nearest Address or Cross Street: 1931 Kiernan Avenue, Modesto, CA 95356

Site Description (Type of Existing Land Use and any other notable features): Measurement Site: Just west of Stanislaus Elementary school and north of Kiernan Avenue. Adjacent: Kiernan Ave (running E-W) just south & Carver Rd (running N-S) ~2,200' to east. Elementary school just east, agricultural lands to north and west, and to south just past Kiernan Avenue.

Weather: High cloud, filtered sunshine. Sunset 4:45 PM. **Settings:** SLOW FAST

Temperature: 62 deg F **Wind:** 5 mph **Humidity:** 66% **Terrain:** Flat

Start Time: 3:37 PM **End Time:** 3:52 PM **Run Time:**

Leq:	71.8	dB
Lmax	81.8	dB
L2	77.9	dB
L8	76.6	dB
L25	73.5	dB
L50	69.3	dB

Primary Noise Source: Traffic noise from the 453 vehicles passing microphone on Kiernan Ave during 15 min measurement. Traffic ambiance from vehicles on Carver Rd ~2,200' E of NM5.

Secondary Noise Sources: Occasional overhead air traffic. Bird song. No school yard ambiance from children attending elementary school just E of NM5.

NOISE METER:	SoundTrack LXT Class 1	**CALIBRATOR:**	Larson Davis CA 250
MAKE:	Larson Davis	**MAKE:**	Larson Davis
MODEL:	LXT1	**MODEL:**	CA 250
SERIAL NUMBER:	3099	**SERIAL NUMBER:**	2723
FACTORY CALIBRATION DATE:	11/17/2021	**FACTORY CALIBRATION DATE:**	11/18/2021
FIELD CALIBRATION DATE:	12/5/2023		

Noise Measurement
Field Data

PHOTOS:



NM5 looking east at Kiernan Ave intersection with school parking lot, to an elementary school.



NM5 looking W down Kiernan Ave away from elementary school.

Summary	
File Name on Meter	LxT_Data.372.s
File Name on PC	LxT_0003099-20231205 153747-LxT_Data.372.ldbin
Serial Number	0003099
Model	SoundTrack LxT®
Firmware Version	2.404
User	Ian Edward Gallagher
Location	NM5 37°42'40.88"N 121° 1'47.71"W
Job Description	15 minute noise measurement (1 x 15 minutes)
Note	Ganddini Project# 19689 Stanislaus Elementary School 1,2,3-TCP Mitigation Project, City of Modesto.

Measurement	
Start	2023-12-05 15:37:47
Stop	2023-12-05 15:52:47
Duration	00:15:00.0
Run Time	00:15:00.0
Pause	00:00:00.0
Pre-Calibration	2023-12-05 15:37:22
Post-Calibration	None

Overall Settings	
RMS Weight	A Weighting
Peak Weight	A Weighting
Detector	Slow
Preamplifier	PRMLxT1L
Microphone Correction	Off
Integration Method	Linear
OBA Range	Normal
OBA Bandwidth	1/1 and 1/3
OBA Frequency Weighting	C Weighting
OBA Max Spectrum	At LMax
Overload	122.7 dB

Results				
LA_{eq}	71.8			
LAE	101.4			
EA	1.523	mPa^2h		
EA8	48.745	mPa^2h		
EA40	243.726	mPa^2h		
$LA_{peak\ (max)}$	2023-12-05 15:43:48	94.9 dB		
LAS_{max}	2023-12-05 15:43:49	81.8 dB		
LAS_{min}	2023-12-05 15:45:26	49.7 dB		

		Statistics	
LC_{eq}	76.4 dB	**LA2.00**	77.9 dB
LA_{eq}	71.8 dB	**LA8.00**	76.6 dB
LC_{eq} - LA_{eq}	4.6 dB	**LA25.00**	73.5 dB
LAI_{eq}	72.5 dB	**LA50.00**	69.3 dB
LA_{eq}	71.8 dB	**LA66.60**	65.7 dB
LAI_{eq} - LA_{eq}	0.7 dB	**LA90.00**	59.2 dB
Overload Count	0		

Measurement Report

Report Summary

Meter's File Name	LxT_Data.372.s	Computer's File Name	LxT_0003099-20231205 153747-LxT_Data.3
Meter	LxT1 0003099		
Firmware	2.404		
User	Ian Edward Gallagher	Location	NM5 37°42'40.88"N 121° 1'47.71"
Job Description	15 minute noise measurement (1 x 15 minutes)		
Note	Ganddini Project# 19689 Stanislaus Elementary School 1,2,3-TCP Mitigation Project, City of Modesto.		
Start Time	2023-12-05 15:37:47	Duration	0:15:00.0
End Time	2023-12-05 15:52:47	Run Time	0:15:00.0
Pause Time	0:00:00.0		

Results

Overall Metrics

LA_{eq}	71.8 dB		
LAE	101.4 dB	SEA	--- dB
EA	1.5 mPa²h	LAFTM5	74.5 dB
EA8	48.7 mPa²h		
EA40	243.7 mPa²h		
LA_{peak}	94.9 dB	2023-12-05 15:43:48	
LAS_{max}	81.8 dB	2023-12-05 15:43:49	
LAS_{min}	49.7 dB	2023-12-05 15:45:26	
LA_{eq}	71.8 dB		
LC_{eq}	76.4 dB	LC_{eq} - LA_{eq}	4.6 dB
LAI_{eq}	72.5 dB	LAI_{eq} - LA_{eq}	0.7 dB

Exceedances

	Count	Duration
LAS > 65.0 dB	16	0:11:29.1
LAS > 85.0 dB	0	0:00:00.0
LApeak > 135.0 dB	0	0:00:00.0
LApeak > 137.0 dB	0	0:00:00.0
LApeak > 140.0 dB	0	0:00:00.0

Community Noise

LDN	LDay	LNight
--- dB	--- dB	0.0 dB

LDEN	LDay	LEve	LNight
--- dB	--- dB	--- dB	--- dB

Any Data

	A		C		Z	
	Level	Time Stamp	Level	Time Stamp	Level	Time Stamp
L_{eq}	71.8 dB		76.4 dB		--- dB	
$LS_{(max)}$	81.8 dB	2023-12-05 15:43:49	--- dB		--- dB	
$LS_{(min)}$	49.7 dB	2023-12-05 15:45:26	--- dB		--- dB	
$L_{Peak(max)}$	94.9 dB	2023-12-05 15:43:48	--- dB		--- dB	

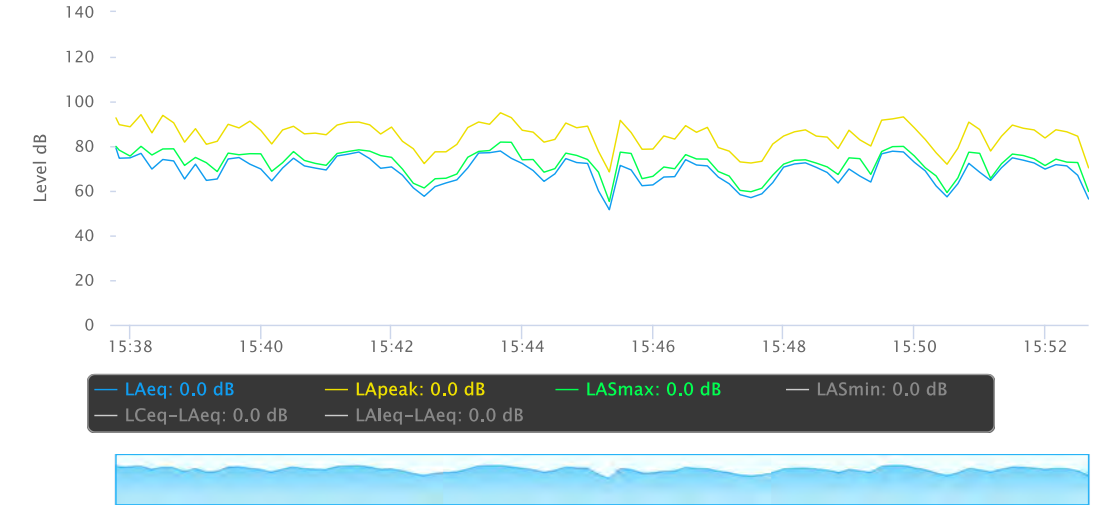
Overloads

Count	Duration	OBA Count	OBA Duration
0	0:00:00.0	0	0:00:00.0

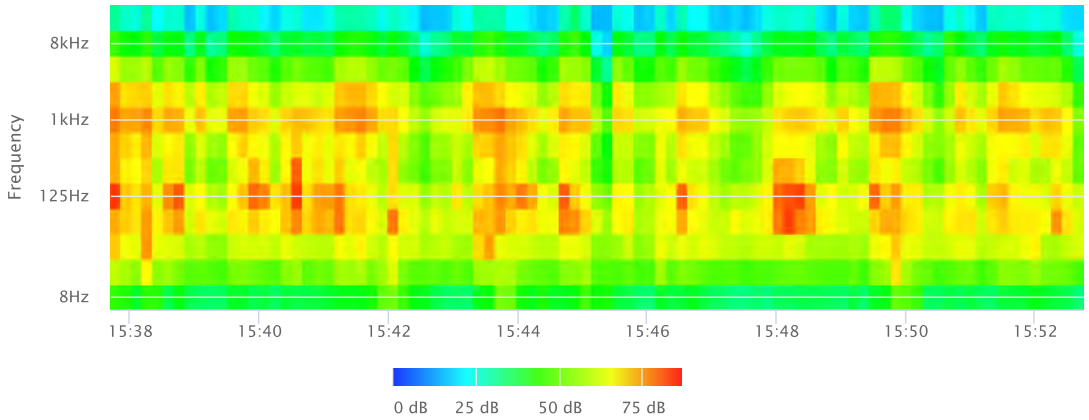
Statistics

LAS 2.0	77.9 dB
LAS 8.0	76.6 dB
LAS 25.0	73.5 dB
LAS 50.0	69.3 dB
LAS 66.6	65.7 dB
LAS 90.0	59.2 dB

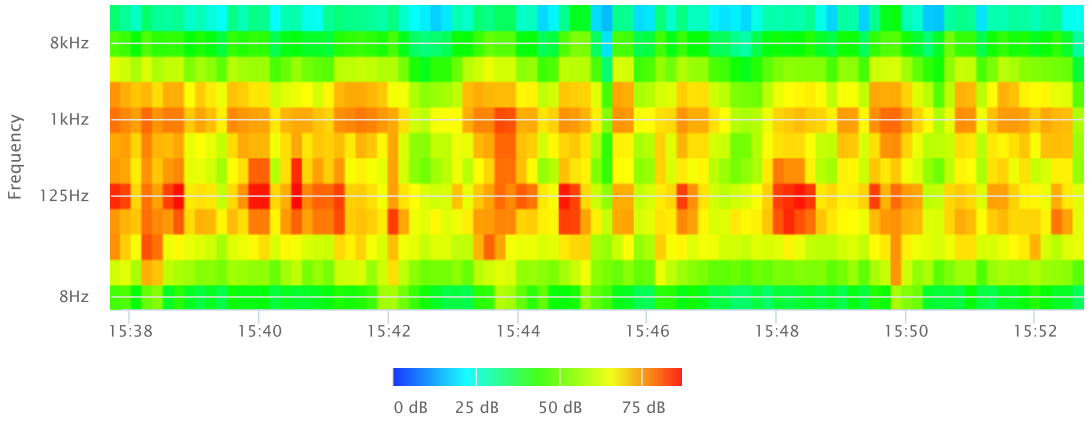
Time History



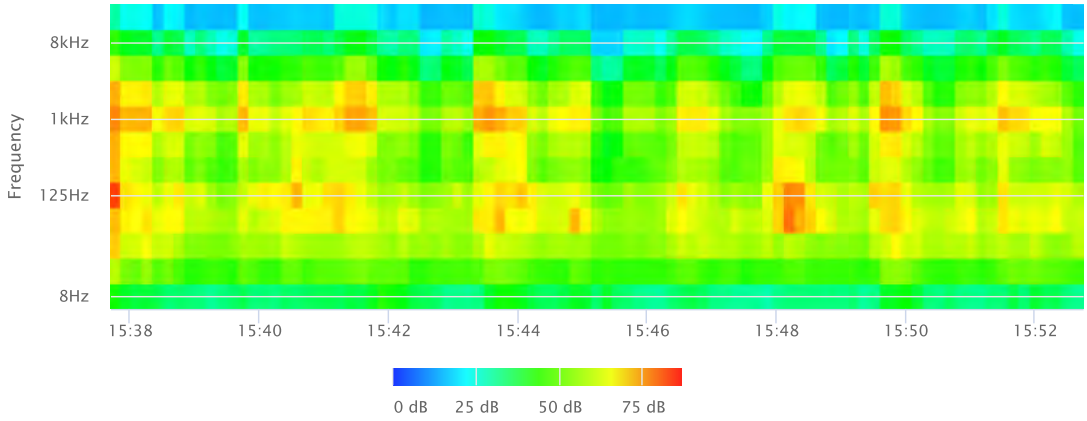
OBA 1/1 Leq



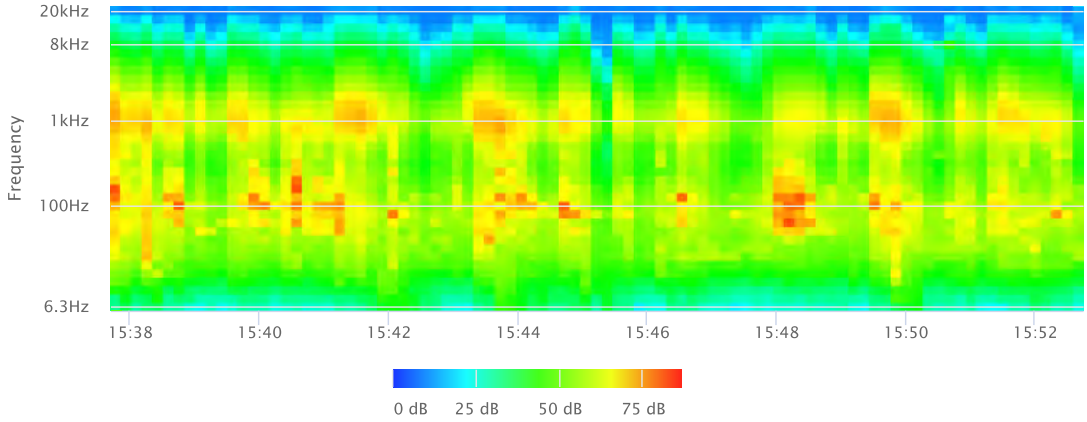
OBA 1/1 Lmax



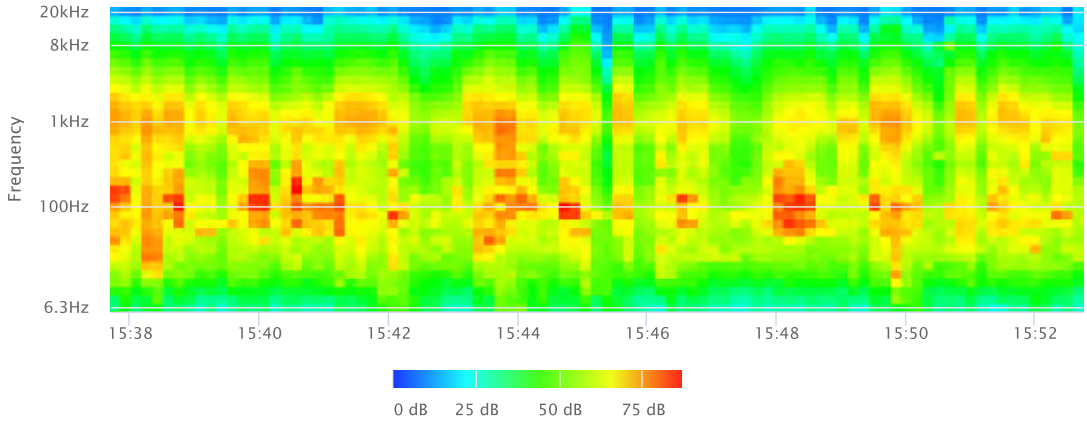
OBA 1/1 Lmin



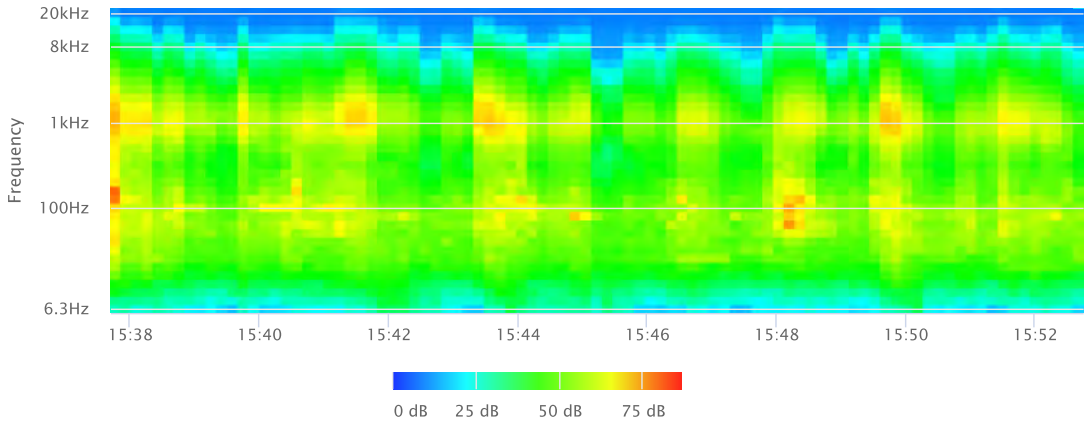
OBA 1/3 Leq



OBA 1/3 Lmax



OBA 1/3 Lmin


20kHz
8kHz
1kHz
100Hz
6.3Hz
Frequency
15:38
15:40
15:42
15:44
15:46
15:48
15:50
15:52
0 dB
25 dB
50 dB
75 dB

Noise Measurement
Field Data

Project Name: Stanislaus Elementary School 1,2,3-TCP Mitigation Project, City of Modesto **Date:** December 5-6, 2023

Project #: 19689

Noise Measurement #: LTNM1 Run Time: 24 hours (24 x 1 hours) **Technician:** Ian Edward Gallagher

Nearest Address or Cross Street: 5143 American Avenue, Modesto, CA 95356

Site Description (Type of Existing Land Use and any other notable features): Measurement Site: Just west of the residential use at 5143 American Avenue and east of American Avenue. Adjacent: Kiernan Ave (running E-W) ~1,050' S & American Ave (running N-S) adjacent to east. Residential and agricultural uses surrounding.

Weather: Clouding over, some rain. Sunset/rise 4:45 PM/ 7:04AM **Settings:** SLOW FAST

Temperature: 45-63 deg F **Wind:** 0-5 mph **Humidity:** 66-80% **Terrain:** Flat

Start Time: 5:00 PM **End Time:** 5:00 PM **Run Time:**

Leq: 52.9 dB

Lmax 90.6 dB

L2 57.5 dB

L8 53.9 dB

L25 50.6 dB

L50 47.1 dB

Primary Noise Source: Traffic noise from vehicles passing microphone on American Ave during 24 hour measurement. Traffic ambiance from vehicles traveling on Kiernan Ave.

Secondary Noise Sources: Occasional overhead air traffic. Bird song and tractor work being done in fields by day. Some residential ambiance.

NOISE METER:	SoundTrack LXT Class 1	**CALIBRATOR:**	Larson Davis CA 250
MAKE:	Larson Davis	**MAKE:**	Larson Davis
MODEL:	LXT1	**MODEL:**	CA 250
SERIAL NUMBER:	3099	**SERIAL NUMBER:**	2723
FACTORY CALIBRATION DATE:	11/17/2021	**FACTORY CALIBRATION DATE:**	11/18/2021
FIELD CALIBRATION DATE:	12/5/2023		

Noise Measurement
Field Data

PHOTOS:



LTNM1 looking S at microphone placed in tree. Frontyard to residence 5143 American Avenue, Modesto on the right & American Avenue on the left of image.



LTNM1 aerial view showing location of LTNM1 microphone relative to surrounding area.

Summary	
File Name on Meter	LxT_Data.373.s
File Name on PC	LxT_0003099-20231205 170000-LxT_Data.373.ldbin
Serial Number	0003099
Model	SoundTrack LxT®
Firmware Version	2.404
User	Ian Edward Gallagher
Location	LTNM1 37°42'52.50"N 121° 2'28.25"W
Job Description	24 hour noise measurement (24 x 1 hours)
Note	Ganddini Project# 19689 Stanislaus Elementary School 1,2,3-TCP 1,2,3-TCP Mitigation Project, City of Modesto.

Measurement	
Start	2023-12-05 17:00:00
Stop	2023-12-06 17:00:00
Duration	24:00:00.0
Run Time	24:00:00.0
Pause	00:00:00.0
Pre-Calibration	2023-12-05 16:30:46
Post-Calibration	None

Overall Settings	
RMS Weight	A Weighting
Peak Weight	A Weighting
Detector	Slow
Preamplifier	PRMLxT2
Microphone Correction	Off
Integration Method	Linear
OBA Range	Normal
OBA Bandwidth	1/1 and 1/3
OBA Frequency Weighting	A Weighting
OBA Max Spectrum	Bin Max
Overload	122.6 dB

Results		
LA_{eq}	52.9	
LAE	102.3	
EA	1.887	mPa^2h
EA8	628.986	μPa^2h
EA40	3.145	mPa^2h
$LA_{peak\ (max)}$	2023-12-06 08:50:53	106.7 dB
LAS_{max}	2023-12-06 08:50:54	90.6 dB
LAS_{min}	2023-12-06 02:10:26	32.8 dB

		Statistics	
LC_{eq}	63.1 dB	**LA2.00**	57.5 dB
LA_{eq}	52.9 dB	**LA8.00**	53.9 dB
LC_{eq} - LA_{eq}	10.2 dB	**LA25.00**	50.6 dB
LAI_{eq}	56.2 dB	**LA50.00**	47.1 dB
LA_{eq}	52.9 dB	**LA90.00**	40.7 dB
LAI_{eq} - LA_{eq}	3.3 dB	**LA99.00**	36.4 dB
Overload Count	0		

Measurement Report

Report Summary

Meter's File Name	LxT_Data.373.s	Computer's File Name	LxT_0003099-20231205 170000-LxT_Data.3
Meter	LxT1 0003099		
Firmware	2.404		
User	Ian Edward Gallagher	Location	LTNM1 37°42'52.50"N 121° 2'28.2
Job Description	24 hour noise measurement (24 x 1 hours)		
Note	Ganddini Project# 19689 Stanislaus Elementary School 1,2,3-TCP Mitigation Project, City of Modesto.		
Start Time	2023-12-05 17:00:00	Duration	24:00:00.0
End Time	2023-12-06 17:00:00	Run Time	24:00:00.0
Pause Time	0:00:00.0		

Results

Overall Metrics

LA_{eq}	52.9 dB		
LAE	102.3 dB	SEA	--- dB
EA	1.9 mPa²h	LAFTM5	59.1 dB
EA8	629.0 µPa²h		
EA40	3.1 mPa²h		
LA_{peak}	106.7 dB	2023-12-06 08:50:53	
LAS_{max}	90.6 dB	2023-12-06 08:50:54	
LAS_{min}	32.8 dB	2023-12-06 02:10:26	
LA_{eq}	52.9 dB		
LC_{eq}	63.1 dB	LC_{eq} - LA_{eq}	10.2 dB
LAI_{eq}	56.2 dB	LAI_{eq} - LA_{eq}	3.3 dB

Exceedances

	Count	Duration
LAS > 65.0 dB	202	0:12:31.6
LAS > 85.0 dB	1	0:00:03.1
LApeak > 135.0 dB	0	0:00:00.0
LApeak > 137.0 dB	0	0:00:00.0
LApeak > 140.0 dB	0	0:00:00.0

Community Noise

LDN	LDay	LNight
--- dB	--- dB	0.0 dB

LDEN	LDay	LEve	LNight
--- dB	--- dB	--- dB	--- dB

Any Data

	A		C		Z	
	Level	Time Stamp	Level	Time Stamp	Level	Time Stamp
L_{eq}	52.9 dB		63.1 dB		--- dB	
$LS_{(max)}$	90.6 dB	2023-12-06 08:50:54	--- dB		--- dB	
$LS_{(min)}$	32.8 dB	2023-12-06 02:10:26	--- dB		--- dB	
$L_{Peak(max)}$	106.7 dB	2023-12-06 08:50:53	--- dB		--- dB	

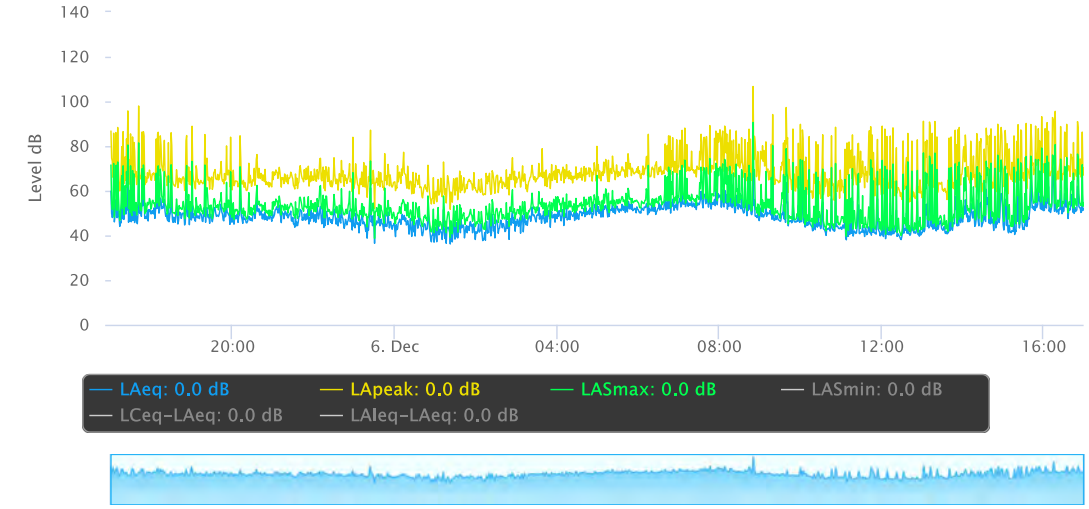
Overloads

Count	Duration	OBA Count	OBA Duration
0	0:00:00.0	0	0:00:00.0

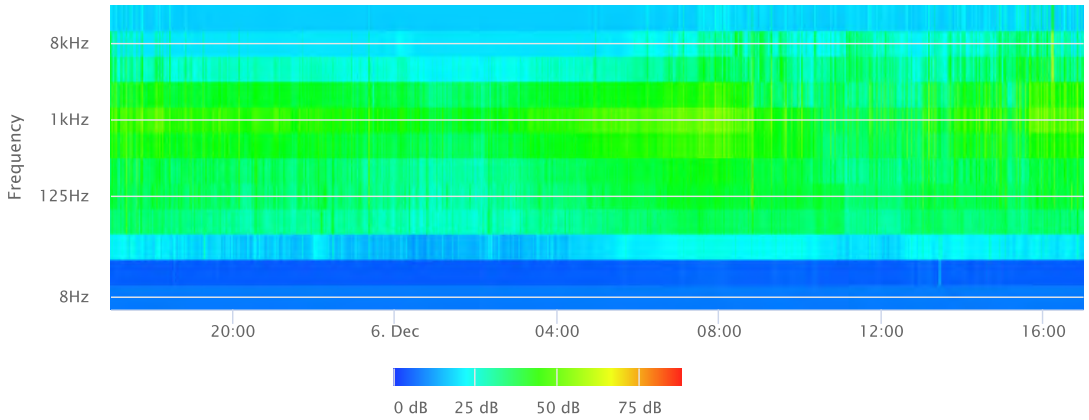
Statistics

LAS 2.0	57.5 dB
LAS 8.0	53.9 dB
LAS 25.0	50.6 dB
LAS 50.0	47.1 dB
LAS 90.0	40.7 dB
LAS 99.0	36.4 dB

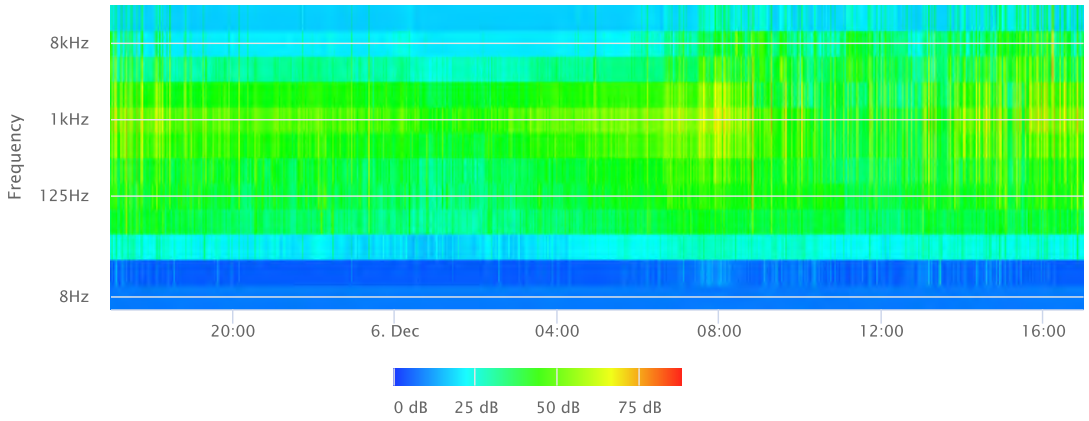
Time History



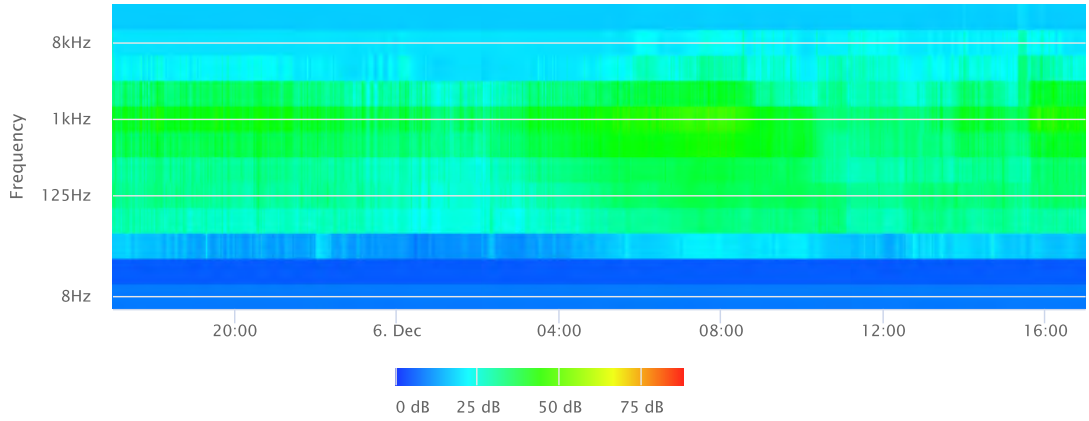
OBA 1/1 Leq



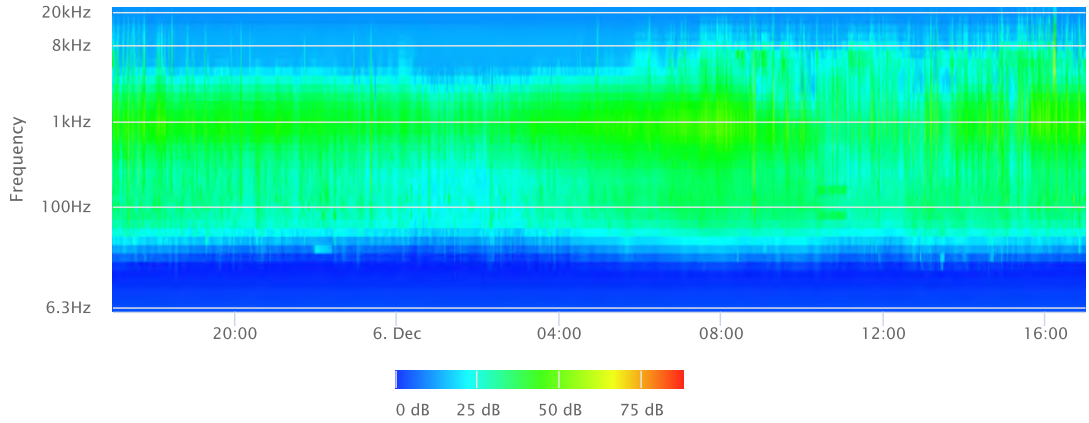
OBA 1/1 Lmax



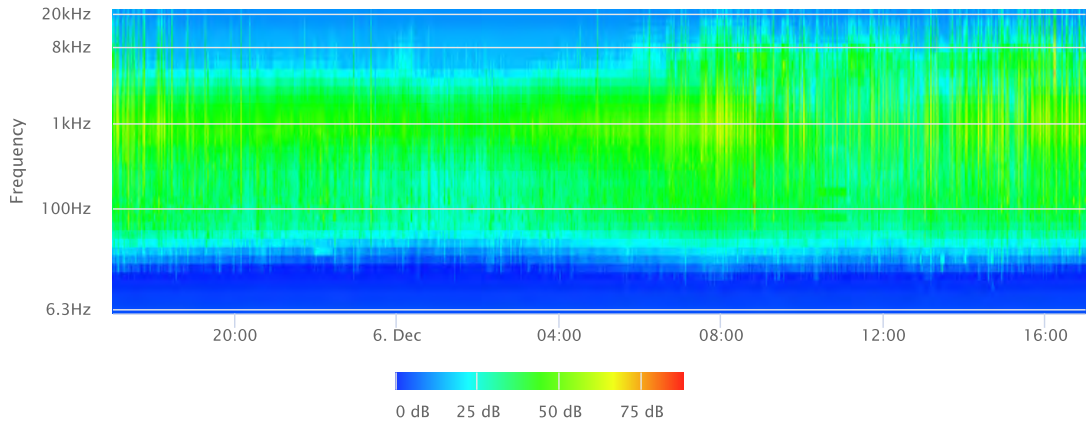
OBA 1/1 Lmin



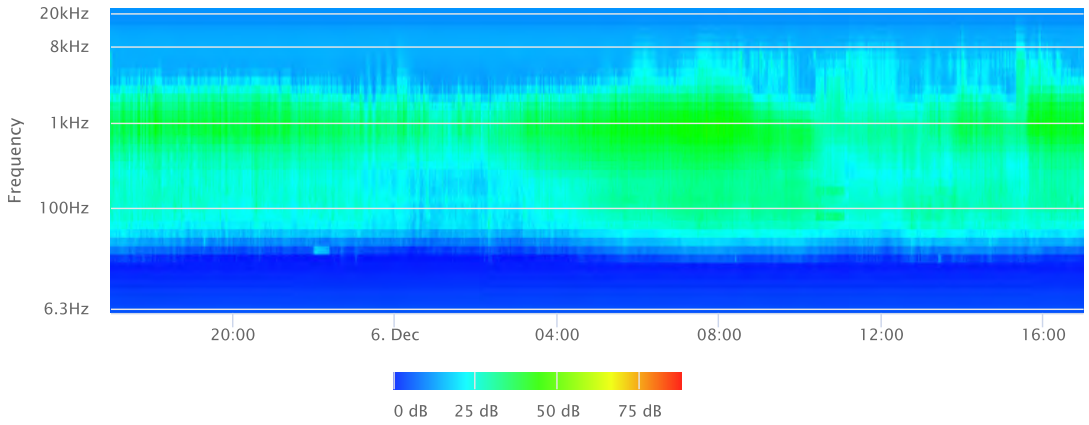
OBA 1/3 Leq



OBA 1/3 Lmax



OBA 1/3 Lmin


20kHz
8kHz
1kHz
100Hz
6.3Hz
Frequency
20:00
6. Dec
04:00
08:00
12:00
16:00

0 dB
25 dB
50 dB
75 dB

APPENDIX D

CONSTRUCTION NOISE MODELING

Construction Analysis for Stanislaus Elementary School - E of Dale

Construction Phase Equipment Item	# of Items	Item Lmax at 50 feet, dBA [1]	Distance to Receptor [3]	Item Usage Percent	Usage Factor	Dist. Correction dB	Usage Adj. dB	Receptor Item Lmax, dBA	Receptor Item Leq, dBA
Site Preparation, Pipline Installation and Jack and Bore									
Scraper	1	81	150	50	0.50	-9.5	-3.0	71.5	68.4
Tractors/Loaders/Backhoes/Skid Steer	6	84	150	40	2.40	-9.5	3.8	74.5	78.3
Off Highway Truck (concrete pump truck)	1	82	150	20	0.20	-9.5	-7.0	72.5	65.5
Plate Compactor	1	80	150	20	0.20	-9.5	-7.0	70.5	63.5
Excavator	1	85	150	40	0.40	-9.5	-4.0	75.5	71.5
Other material handling (Vibratory Concrete Mixer)	1	80	150	20	0.20	-9.5	-7.0	70.5	63.5
Paving equipment (Paver)	1	85	150	50	0.50	-9.5	-3.0	75.5	72.4
Other construction (Horizontal Boring Jack)	1	82	150	25	0.25	-9.5	-6.0	72.5	66.4
Pumps	2	77	150	50	1.00	-9.5	0.0	67.5	67.5
Surfacing equipment (Pavement Scarifier)	1	90	150	20	0.20	-9.5	-7.0	80.5	73.5
Rubber Tired Dozers	1	85	150	40	0.40	-9.5	-4.0	75.5	71.5
Crane	1	85	150	16	0.16	-9.5	-8.0	75.5	67.5
Jack and Bore	1	83	150	50	0.50	-9.5	-3.0	73.5	70.4
								Log Sum	82.5

Notes:

(1) Source: Referenced noise levels from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (September 2018) and the FHWA Roadway Construction Noise Model User's Guide (January 2006).

(2) Source: SoundPLAN reference list.

(3) Distance to receptor calculated from center of site. Construction noise projected from the center of the project site to nearest sensitive use (property line).

Construction Analysis for Stanislaus Elementary School - N of Kiernen

Construction Phase Equipment Item	# of Items	Item Lmax at 50 feet, dBA [1]	Distance to Receptor [3]	Item Usage Percent	Usage Factor	Dist. Correction dB	Usage Adj. dB	Receptor Item Lmax, dBA	Receptor Item Leq, dBA
Site Preparation, Pipline Installation and Jack and Bore									
Scraper	1	81	50	50	0.50	0.0	-3.0	81.0	78.0
Tractors/Loaders/Backhoes/Skid Steer	6	84	50	40	2.40	0.0	3.8	84.0	87.8
Off Highway Truck (concrete pump truck)	1	82	50	20	0.20	0.0	-7.0	82.0	75.0
Plate Compactor	1	80	50	20	0.20	0.0	-7.0	80.0	73.0
Excavator	1	85	50	40	0.40	0.0	-4.0	85.0	81.0
Other material handling (Vibratory Concrete Mixer)	1	80	50	20	0.20	0.0	-7.0	80.0	73.0
Paving equipment (Paver)	1	85	50	50	0.50	0.0	-3.0	85.0	82.0
Other construction (Horizontal Boring Jack)	1	82	50	25	0.25	0.0	-6.0	82.0	76.0
Pumps	2	77	50	50	1.00	0.0	0.0	77.0	77.0
Surfacing equipment (Pavement Scarifier)	1	90	50	20	0.20	0.0	-7.0	90.0	83.0
Rubber Tired Dozers	1	85	50	40	0.40	0.0	-4.0	85.0	81.0
Crane	1	85	50	16	0.16	0.0	-8.0	85.0	77.0
Jack and Bore	1	83	50	50	0.50	0.0	-3.0	83.0	80.0
								Log Sum	92.0

Notes:

(1) Source: Referenced noise levels from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (September 2018) and the FHWA Roadway Construction Noise Model User's Guide (January 2006).

(2) Source: SoundPLAN reference list.

(3) Distance to receptor calculated from center of site. Construction noise projected from the center of the project site to nearest sensitive use (property line).

Construction Analysis for Stanislaus Elementary School - W of Tully

Construction Phase Equipment Item	# of Items	Item Lmax at 50 feet, dBA [1]	Distance to Receptor [3]	Item Usage Percent	Usage Factor	Dist. Correction dB	Usage Adj. dB	Receptor Item Lmax, dBA	Receptor Item Leq, dBA
Site Preparation, Pipline Installation and Jack and Bore									
Scraper	1	81	50	50	0.50	0.0	-3.0	81.0	78.0
Tractors/Loaders/Backhoes/Skid Steer	6	84	50	40	2.40	0.0	3.8	84.0	87.8
Off Highway Truck (concrete pump truck)	1	82	50	20	0.20	0.0	-7.0	82.0	75.0
Plate Compactor	1	80	50	20	0.20	0.0	-7.0	80.0	73.0
Excavator	1	85	50	40	0.40	0.0	-4.0	85.0	81.0
Other material handling (Vibratory Concrete Mixer)	1	80	50	20	0.20	0.0	-7.0	80.0	73.0
Paving equipment (Paver)	1	85	50	50	0.50	0.0	-3.0	85.0	82.0
Other construction (Horizontal Boring Jack)	1	82	50	25	0.25	0.0	-6.0	82.0	76.0
Pumps	2	77	50	50	1.00	0.0	0.0	77.0	77.0
Surfacing equipment (Pavement Scarifier)	1	90	50	20	0.20	0.0	-7.0	90.0	83.0
Rubber Tired Dozers	1	85	50	40	0.40	0.0	-4.0	85.0	81.0
Crane	1	85	50	16	0.16	0.0	-8.0	85.0	77.0
Jack and Bore	1	83	50	50	0.50	0.0	-3.0	83.0	80.0
								Log Sum	92.0

Notes:

(1) Source: Referenced noise levels from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (September 2018) and the FHWA Roadway Construction Noise Model User's Guide (January 2006).

(2) Source: SoundPLAN reference list.

(3) Distance to receptor calculated from center of site. Construction noise projected from the center of the project site to nearest sensitive use (property line).

Construction Analysis for Stanislaus Elementary School - Adjacent to Alignment

Construction Phase Equipment Item	# of Items	Item Lmax at 50 feet, dBA [1]	Distance to Receptor [3]	Item Usage Percent	Usage Factor	Dist. Correction dB	Usage Adj. dB	Receptor Item Lmax, dBA	Receptor Item Leq, dBA
Site Preparation, Pipline Installation and Jack and Bore									
Scraper	1	81	25	50	0.50	6.0	-3.0	87.0	84.0
Tractors/Loaders/Backhoes/Skid Steer	6	84	25	40	2.40	6.0	3.8	90.0	93.8
Off Highway Truck (concrete pump truck)	1	82	25	20	0.20	6.0	-7.0	88.0	81.0
Plate Compactor	1	80	25	20	0.20	6.0	-7.0	86.0	79.0
Excavator	1	85	25	40	0.40	6.0	-4.0	91.0	87.0
Other material handling (Vibratory Concrete Mixer)	1	80	25	20	0.20	6.0	-7.0	86.0	79.0
Paving equipment (Paver)	1	85	25	50	0.50	6.0	-3.0	91.0	88.0
Other construction (Horizontal Boring Jack)	1	82	25	25	0.25	6.0	-6.0	88.0	82.0
Pumps	2	77	25	50	1.00	6.0	0.0	83.0	83.0
Surfacing equipment (Pavement Scarifier)	1	90	25	20	0.20	6.0	-7.0	96.0	89.0
Rubber Tired Dozers	1	85	25	40	0.40	6.0	-4.0	91.0	87.0
Crane	1	85	25	16	0.16	6.0	-8.0	91.0	83.1
								Log Sum	97.7

Notes:

(1) Source: Referenced noise levels from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (September 2018) and the FHWA Roadway Construction Noise Model User's Guide (January 2006).

(2) Source: SoundPLAN reference list.

(3) Distance to receptor calculated from center of site. Construction noise projected from the center of the project site to nearest sensitive use (property line).

APPENDIX E

FHWA TRAFFIC NOISE MODEL WORKSHEETS

FHWA Traffic Noise Prediction Model FHWA-RD-77-108

Existing Traffic Noise

Project: **19689 Stanislaus Elementary School 1,2,3-TCP Mitigation**

Road: **Kiernan Avenue**

Segment: **In vicinity of project site**

	DAYTIME			EVENING			NIGHTTIME			ADT	14200.00
	AUTOS	M.TRUCKS	H.TRUCKS	AUTOS	M.TRUCKS	H.TRUCKS	AUTOS	M.TRUCKS	H.TRUCKS	SPEED	50.00
										DISTANCE	75.00
INPUT PARAMETERS											
Vehicles per hour	813.66	23.44	27.71	601.30	4.16	12.68	150.61	31.25	36.94	% A	91
Speed in MPH	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00		
Left angle	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00		
Right angle	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	% MT	4.05
NOISE CALCULATIONS											
Reference levels	71.12	78.79	83.02	71.12	78.79	83.02	71.12	78.79	83.02	% HT	4.95
ADJUSTMENTS											
Flow	21.81	6.40	7.13	20.50	-1.10	3.73	14.48	7.65	8.38		
Distance	-1.83	-1.83	-1.83	-1.83	-1.83	-1.83	-1.83	-1.83	-1.83	LEFT	-90.00
Finite Roadway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	RIGHT	90.00
Barrier	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	CNEL	73.44
Constant	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	DAY LEQ	68.39
LEQ	66.10	58.37	63.32	64.78	50.86	59.92	58.77	59.62	64.57	Day hour	89.00
										Absorbtive?	no
	DAY LEQ	68.39		EVENING LEQ	66.14		NIGHT LEQ	66.56		Use hour?	no
										GRADE dB	0.00
		CNEL	**73.44**								

FHWA Traffic Noise Prediction Model FHWA-RD-77-108

Existing Plus Project Traffic Noise

Project: **19689 Stanislaus Elementary School 1,2,3-TCP Mitigation**

Road: **Kiernan Avenue**

Segment: **In vicinity of project site**

	DAYTIME			EVENING			NIGHTTIME			ADT	14237.00
	AUTOS	M.TRUCKS	H.TRUCKS	AUTOS	M.TRUCKS	H.TRUCKS	AUTOS	M.TRUCKS	H.TRUCKS	SPEED	50.00
										DISTANCE	75.00
INPUT PARAMETERS											
Vehicles per hour	815.78	23.50	27.78	602.87	4.17	12.71	151.01	31.33	37.04	% A	91.00
Speed in MPH	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00		
Left angle	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00		
Right angle	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	% MT	4.05
NOISE CALCULATIONS											
Reference levels	71.12	78.79	83.02	71.12	78.79	83.02	71.12	78.79	83.02	% HT	4.95
ADJUSTMENTS											
Flow	21.82	6.42	7.14	20.51	-1.09	3.75	14.49	7.66	8.39		
Distance	-1.83	-1.83	-1.83	-1.83	-1.83	-1.83	-1.83	-1.83	-1.83	LEFT	-90.00
Finite Roadway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	RIGHT	90.00
Barrier	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	CNEL	73.45
Constant	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	DAY LEQ	68.40
LEQ	66.11	58.38	63.33	64.80	50.87	59.93	58.78	59.63	64.58	Day hour	89.00
										Absorbtive?	no
	DAY LEQ	68.40		EVENING LEQ	66.15		NIGHT LEQ	66.57		Use hour?	no
										GRADE dB	0.00
		CNEL	**73.45**								

RTE	RTE_SFX	DIST	CNTY	PM_PFX	POSTMILE	PM_SFX	LEG	DESCRIPTION	VEHICLE_AADT_TOTAL	TOT_TRK_AADT	TRK_PERCENT_TOT	TRK_2_AXLE	TRK_2_AXLE_PCT	TRK_3_AXLE	TRK_3_AXLE_PCT	TRK_4_AXLE	TRK_4_AXLE_PCT	TRK_5_AXLE	TRK_5_AXLE_PCT	EAL	EST_YEAR	EST_CODE
219		10	STA		4.858		B	JCT. RTE. 108	14200	1278	9.00	281	22.00	243	19.00	102	8.00	652	51.00	272	1	E

Source: https://dot.ca.gov/programs/traffic-operations/census

	Autos	Medium	Heavy	Total
Total Vehicle Trips	12,922	575	703	14,200
Percent of Trips	91.00	4.05	4.95	100.00

APPENDIX F

GROUNDBORNE VIBRATION WORKSHEETS

GROUNDBORNE VIBRATION ANALYSIS			
Project:	19689 Stanislaus Elementary School		Date: 12/14/23
Source:	Vibratory Roller		
Scenario:	Unmitigated		
Location:	Single Family Residential		
Address:			
PPV = PPVref(25/D)^n (in/sec)			
INPUT			
Equipment Type =	1	Vibratory Roller	INPUT SECTION IN GREEN
PPVref =	0.21	Reference PPV (in/sec) at 25 ft.	
D =	25.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	
Note: Based on reference equations from the Transportation and Construction Vibration Guidance Manual, California Department of Transportation, April 2020, pg 37.			
RESULTS			
PPV =	0.004	IN/SEC	OUTPUT IN BLUE



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