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Earth Mechanics, Inc.

Geotechnical & Earthquake Engineering

May 31, 2018

EMI Project No. 18-125

TranSystems
6 Hutton Centre Drive, Suite 1250
Santa Ana, CA 92707

Attention: Mr. Andy Cheah, PE

Subject: **District Preliminary Geotechnical Report**
State Route 86/Avenue 50 New Interchange Project
Coachella, California
08-Riv-86, PM R19.2/R21.6
EA No. 08-0C970, Caltrans Project No. 0814000144

Dear Mr. Cheah:

Attached is our District Preliminary Geotechnical Report (DPGR) for the State Route 86/Avenue 50 New Interchange Project in the City of Coachella, California. This report is prepared to support the Project Approval and Environmental Document (PA-ED) phase of the subject project. The report follows the California Department of Transportation (Caltrans) Guidelines for Preparing District Preliminary Geotechnical Reports, Version 1.0 (Caltrans, 2013a).

The recommendations and conclusions provided in this report are based on available as-built subsurface soil information. These conclusions and recommendations are considered preliminary and should be verified in future by conducting additional site-specific geotechnical field investigations, laboratory testing, and engineering analyses.

Please submit this report to City of Coachella, Caltrans, Coachella Valley Association of Governments (CVAG), and any other participating agencies for their review. Responses to their review comments, as well as your comments, will be incorporated into a revised report. We appreciate the opportunity to provide geotechnical services for this project. If you have any questions please do not hesitate to contact us.

Sincerely,
EARTH MECHANICS, INC.

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PRELIMINARY MATERIALS REPORT
STATE ROUTE 86/AVENUE 50 NEW INTERCHANGE PROJECT
COACHELLA, CALIFORNIA
08-RIV-86, PM R19.2/R21.6
EA No. 08-0C970
CALTRANS PROJECT No. 0814000144

Prepared for:

TranSystems
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1.0 INTRODUCTION

This District Preliminary Geotechnical Report (DPGR) has been prepared to provide the preliminary geotechnical information for the purpose of preparing preliminary engineering plans and cost estimates for the proposed State Route 86 (SR-86)/Avenue 50 New Interchange Project in the City of Coachella. Several assumptions have been made in determining the preliminary design information, which require verification during preparation of the Plans, Specifications, and Estimates (PS&E) for the project.

The City of Coachella, in cooperation with the California Department of Transportation (Caltrans) District 8 and Coachella Valley Association of Governments (CVAG), proposes the construction of a new interchange at SR-86 and Avenue 50, approximately 1.1 miles north of the existing Avenue 52 intersection and 1.95 miles south of the existing Dillon Road interchange. The proposed project would convert portion of SR-86 from existing expressway to freeway with a new overcrossing bridge and access ramps. The project location map is presented in Figure 1.

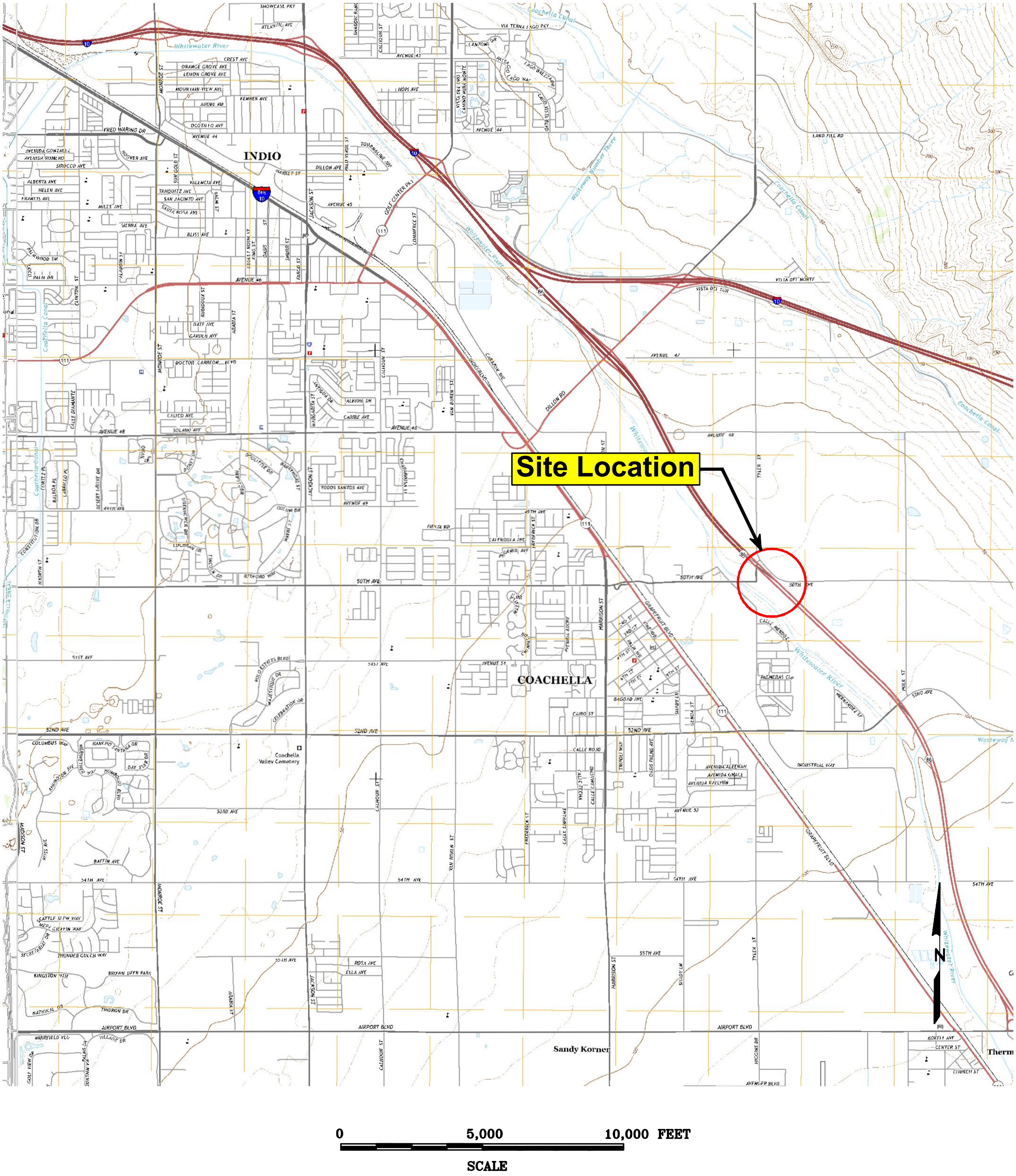
2.0 PERTINENT REPORTS AND INVESTIGATIONS

2.1 Pertinent Previous Reports and Investigations

No previous geotechnical studies were performed specifically for the project improvements described in this report. Subsurface information is obtained from a nearby Overhead Sign Log-Of-Test-Boring (LOTB) sheet (approximately 0.14 mile south of proposed Avenue 50 Overcrossing (OC)), Dillon Road Undercrossing LOTB sheet (approximately 1.95 miles north of proposed Avenue 50 OC), and Wasteway No. 2 Bridge LOTB sheet (approximately 1.41 miles south of proposed Avenue 50 OC). A copy of each of these as-built LOTB sheets is included in Appendix A.

2.2 Related Reports Prepared for the Proposed Improvements

In addition to this District Preliminary Geotechnical Report, a Preliminary Materials Report (EMI, 2018a) and a Structure Preliminary Geotechnical Report (EMI, 2018b) have also been prepared for this project which provides preliminary recommendations for pavement sections and foundation type for Avenue 50 OC, respectively. The Preliminary Materials Report and the Structure Preliminary Geotechnical Report may be referred for additional geotechnical information.



Earth Mechanics, Inc.

Geotechnical and Earthquake Engineering

State Route 86/Avenue 50 New Interchange Project

Project No. 18-125

Date: June 2018

Site Location Map

REFERENCE: USGS, Topographic Map - Indio Quadrangle (2015)

Figure 1

3.0 EXISTING FACILITIES AND PROPOSED IMPROVEMENTS

3.1 Existing Facilities

SR-86 is a north-south State highway facility serving Imperial and Riverside Counties. It begins at State Route 111 (SR-111) near the U.S./Mexico International Border in Imperial County, and extends approximately 91 miles northward (roughly parallel to SR-111) along the western shore of the Salton Sea, terminating at an interchange with Interstate 10 (I-10) in City of Indio. It is a principal route used for distribution of agricultural products as well as local circulations for many of the surrounding areas. The portion of SR-86 within the project limits has been opened to traffic since July 1993, and is a new state highway facility constructed on a new alignment, which runs parallel and easterly to the old SR-86. The facility is a four lane divided expressway that covers approximately 20 miles between Avenue 82 and I-10. SR-86 consists of two 12 foot-wide, mixed-flow lanes in each direction with 5-foot-wide inside and 10-foot-wide outside shoulders. The median width is 92 feet wide, which includes inside shoulders and unpaved area. The right-of-way width is 224 feet with access control on either side. The current SR-86 and Avenue 50 is an at-grade signalized intersection with a dedicated left-turn lane and right-turn lane in the northbound and southbound direction along SR-86.

Avenue 50 is an east/west regional arterial corridor that begins at the Eisenhower Drive intersection in the City of La Quinta. It traverses easterly through Indio and ends at the All American Canal in Coachella. Currently, Avenue 50 is a two-lane roadway within the project limits. Built in 1970, the existing Avenue 50 low water crossing begins immediately east of the Tyler Street intersection, which is stop-sign controlled. The crossing is approximately 700 feet long and consists of two 72-inch diameter corrugated steel pipe culverts across the roadbed at the Coachella Valley Stormwater Channel (CVSC) to convey ordinary low flow waters from north to south. The capacity of these culverts is often exceeded, resulting in roadway flooding during heavy storm events. On the east side of the CVSC, Avenue 50 curves to the north and intersects SR-86 to form a four-leg signalized intersection. The existing travel lanes are 12 feet wide with unpaved outside shoulders.

Tyler Street is a two-lane north/south roadway that is segmented/not continuous corridor within the project limits. Immediately north of the existing SR-86/Avenue 50 intersection, Tyler Street terminates and becomes Avenue 50. South of SR-86, Tyler Street restarts at the Avenue 50 intersection, west of the CVSC.

There are currently no sidewalks or bicycle lanes on the roadway within the project limits.

3.2 Proposed Improvements

The proposed improvements include realignment and widening of Avenue 50 from the existing two-lane roadway to a six-lane major arterial, and realignment of Tyler Street on both the east and west sides of SR-86. The project would also improve public safety and mobility by constructing another new bridge spanning over the CVSC, replacing the existing low water crossing, and eliminating flood-related hazards during inclement weather events.

Two viable build alternatives and the No Build Alternative were under consideration for this project. Build Alternative 7 proposes a Modified Type L-9 Partial Cloverleaf that includes a loop on-ramp in the southeast quadrant of the interchange to accommodate the anticipated heavy eastbound-to-northbound movement of morning commute traffic. Build Alternative 8 is similar to Build Alternative 7 with a SB loop on-ramp in the northwest quadrant of the proposed interchange. Both build alternatives share an identical project footprint, and propose the realignment of Avenue 50 and Tyler Street, construction of a two-span structure over the existing State Route 86, construction of a five-span structure over the CVSC, and the addition of signing and traffic signal controls.

4.0 PHYSICAL SETTING

4.1 Climate

The climate of the project region is semi-arid. Weatherbase online tool (www.weatherbase.com) was reviewed for climatic conditions at the project site. A nearby weather station identified as “Coachella, California” (latitude: 33.37N, longitude: 116.10W), located approximately 22 miles south of the proposed SR-86/Avenue 50 Interchange, was reviewed and a summary of climatic data is provided in Table 1.

Table 1. Summary of Climatic Data

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Average High Temperature (°F)	69	73	78	86	93	100	105	104	100	89	78	69
Average Temperature (°F)	53	59	62	69	77	84	91	89	84	73	60	53
Average Low Temperature (°F)	37	42	46	53	60	68	75	73	68	55	44	37
Average Precipitation (in.)	0.4	0.3	0.4	0.1	0.1	0.0	0.1	0.1	0.2	0.1	0.3	0.3

Although freezing occurs occasionally during winter nights, the freezing is generally of short duration (a few hours) and does not commonly result in a “hard” freeze. Snowfall is rare but can occur in the winter months. However, snow is expected to melt the same day. Annual precipitation is about 2.3 inches with most of the rain falling between November and March. Based on the above information, freeze-thaw recommendations are not required.

4.2 Topography and Drainage

Topography: Existing ground elevations along the proposed project ranges between +400 and +430 feet.

Relief in the area is extreme with elevations ranging from below sea level in the central part of the Salton Trough to almost +11,000 feet at Mount San Gorgonio at the northern end of the valley. The nearby Indio Hills rise to elevations of more than +1,650 feet. Although much of the Salton Trough is below sea level, the sea is prevented from encroaching into the Trough by a broad buildup or "delta" of alluvial sediment brought to the head of the Gulf of California by the Colorado River. Presently the southern part of the Trough is occupied by the Salton Sea, a brackish water lake created in 1905 during an attempt to bring irrigation water into the region.

Drainage: The principal drainage in the region is the Whitewater River which drains from the high San Bernardino Mountains and flows southwesterly through the site. Whitewater River is a significant source for stream flow that historically has recharged the Salton Sea and its geologic predecessors (Lake Coahuila). The White Water River is also referred to as the Coachella Valley Stormwater Channel.

4.3 Prior Land Use

The proposed project is located within the City of Coachella, and the project area can be characterized as both semi-urban and agriculturally developed in nature. The area west of SR-86 consists of semi-developed areas of new housing mixed with some rural housing developments while the area east of SR-86 consist mainly of agricultural farmlands. Avenue 50 was extended through the area across White Water River back in the 1980s.

4.4 Man-made and Natural Features of Engineering and Construction Significance

Man-made Features: The major man-made features within the site area includes SR-86 highway consisting of two travel lanes in each direction. Also a low water crossing was constructed through the Coachella Valley Stormwater Channel along Avenue 50 which consists of an embankment with rock slope protection along each side of the embankment. The major utilities in the area consist mainly of overhead lines extending along Avenue 50, SR-86 and Tyler Street. Existing utilities within the project limits will be protected in place or will be relocated in accordance with the project plans. There are no other known significant man-made features within the project limits that will be affected by the proposed project improvements.

Natural Features: The Coachella Valley Stormwater Channel crosses the site and extends parallel with SR-86. No other natural features such as specimen trees or wetlands which require added clearance through retained or steeper cut and fill slopes are present within the project limits.

5.0 GEOLOGY

5.1 Regional Geology

The site is located along the eastern margin of the Coachella Valley. This area comprises the northern part of the Salton Trough physiographic/geologic province. The Salton Trough is a broad, low-elevation depression bounded by mountains of the Peninsular Ranges province on the west and the Eastern Transverse Ranges/Mojave Desert provinces on the east, but is open on the south to the Gulf of California. The eastern mountains comprise the San Bernardino, Little San Bernardino, Orocopia, and Chocolate mountains, and smaller hills such as the Indio Hills and Mecca Hills. The site is located toward the northern end of the Mecca Hills.

5.2 Site Geology

The project site is located in the Coachella Valley portion of the Salton Trough. The project site is located on the western side of the San Andreas Fault zone known as the basin block. The basin block is underlain by deep alluvial, lacustrine and marine deposits which uncomformably overlie basement complex of the Peninsular Ranges.

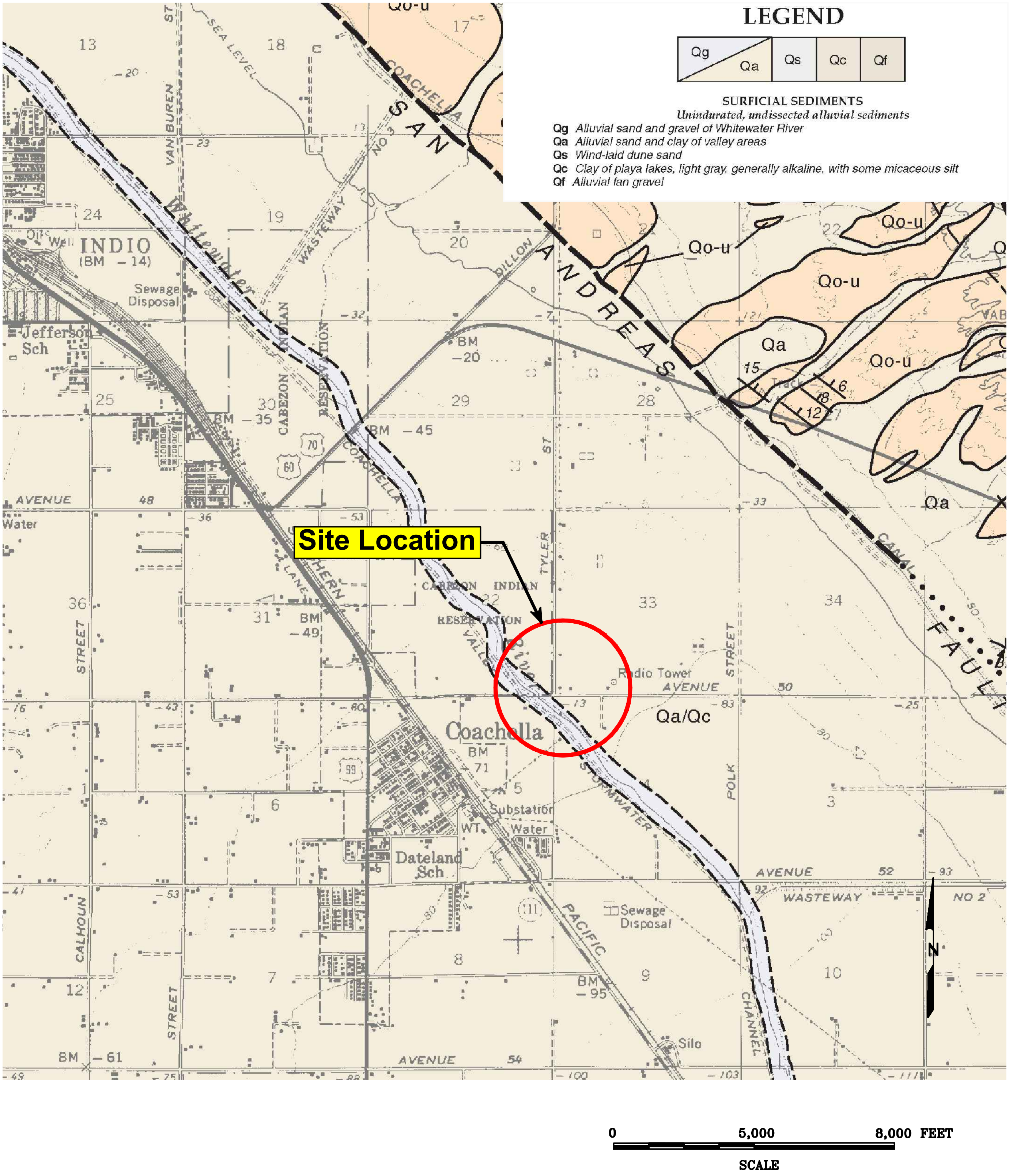
The geologic formations in the area, following the nomenclature of Dibblee (2008) (Figure 2), in descending stratigraphic order are:

- Alluvial Sands and Gravels, Dune Sand (Wind Blown), Lacustrine Clays, Holocene (Qa, Qg, Qs, and Qc);
- Older Alluvial Sand and Gravels, Older Fanglomerate and Conglomerate, Pleistocene (Qoa, Qog, Qo-u, Qo, and Qo-I); and
- Plutonic and Mete-sedimentary Basement Complex – Leucogranites, Quartz Diorite, Granodiorite and Gneiss, Mesozoic to Precambrian, (grd, qd, qdi, gn).

The central part of the Salton Trough is underlain by thick Holocene to Pleistocene deposits of clay, silt, sand, and gravel deposited during a long history of alternating desert, lake, and marine environments. The area contained a shallow tropical sea as recently as early Pliocene time (3-4 million years ago). After the sea retreated, the Trough was occasionally the site of large lakes such as Lake Borrego in late Pliocene time, Lake Brawley in Pleistocene time, and Lake Cahuila (Coahuila) in Holocene time. Lake Cahuila is estimated to have begun to recede in the year 1676 (+/- 35 years). Windblown sand covers much of the floor of Coachella Valley as thin sand sheets and local dunes.

5.3 Soils

According to United States Department of Agriculture (USDA, 2016) web soil survey, the area along Coachella Valley Stormwater Channel is underlain by Fluvents (Fe) with the remainder of the project site is immediately underlain by Indio very fine sandy loam (Db). The Fluvents soil fall under National Resources Conservation Service (NRCS) hydrologic soil group A as it is considered to be well drained to excessively drained while having high infiltration rates/water transmission rates while the Indio very fine sandy loam falls under hydrologic soil group B as it is considered to be moderately well drained while having moderate infiltration rates.



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Regional Geologic Map

Reference: Dibblee, 2008

Figure 2

5.4 Faulting and Seismicity

The site is located in seismically active southern California and is subject to shaking from both local and distant earthquakes (Figure 3). The nearest substantial local sources of earthquakes are provided in Table 2 along with their fault ID, fault type and their maximum earthquake magnitude according to the Caltrans Fault Database (Merriam, 2012). The site to fault distances and deterministic Peak Ground Accelerations (PGA) were determined using Caltrans ARS Online V2.3.09 (2018).

Table 2. Fault Data

Fault	Fault ID	Fault Type	Maximum Earthquake Magnitude	Approx. Distance from Site to Fault (miles)	PGA
San Andreas (Coachella) Rev	372	SS	7.9	1.8	0.522
Mecca Hills Fault	377	SS	6.8	4.9	0.421
San Andreas (San Bernardino S)	325	SS	7.9	8.1	0.332
San Andreas (San Bernardino N)	294	SS	7.4	10.1	0.258
San Jacinto (Anza)	362	SS	7.7	22.6	0.164
Note: SS = Strike Slip.					

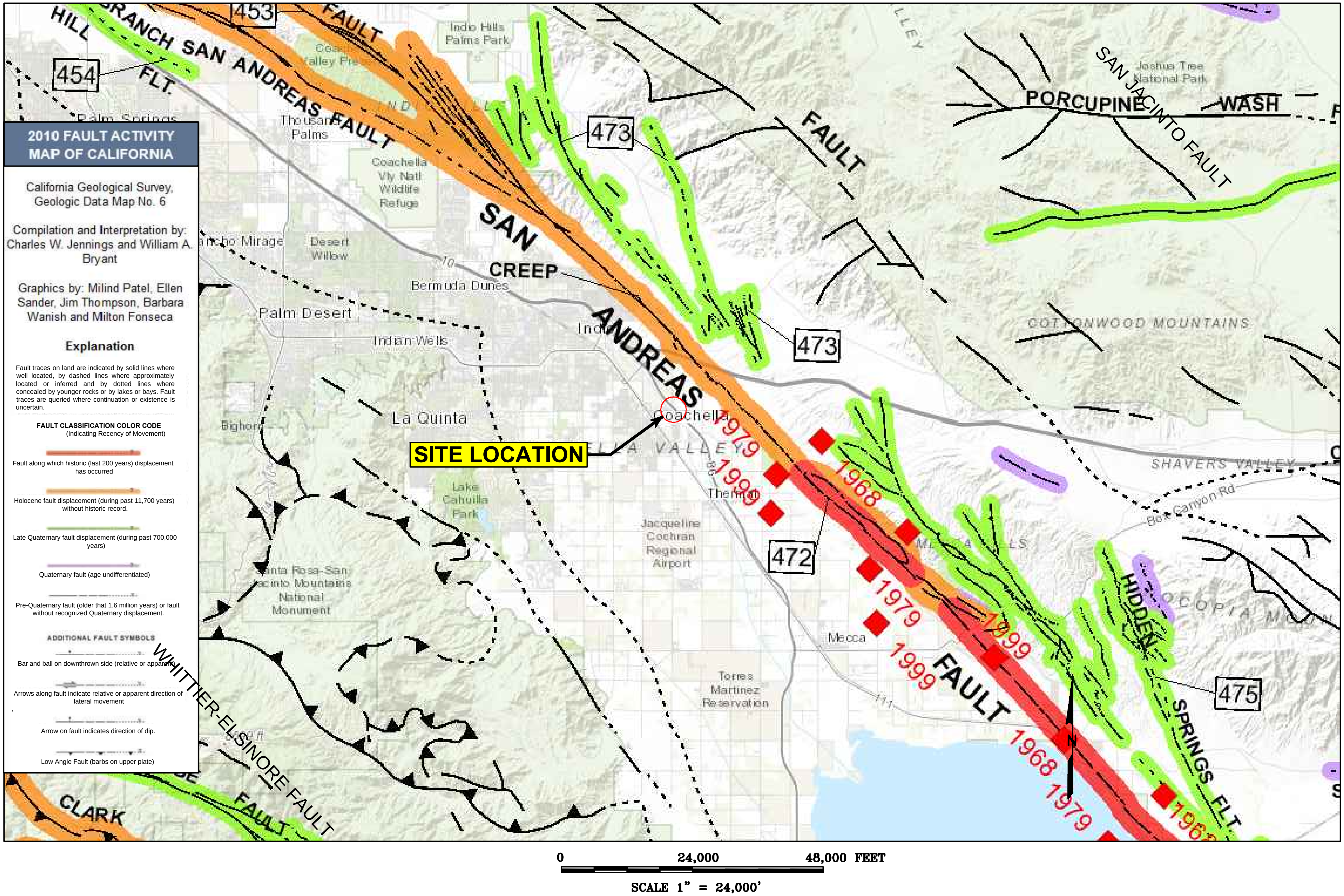
The preliminary PGA for the project site was determined using the Caltrans ARS Online website and the small-strain shear wave velocity for the upper 100 feet (V_{s30}) estimated from the information presented in the as-built LOTB sheets included in Appendix A and the SPT correlations provided in the Methodology for Developing Design Response Spectrum for Use in Seismic Design Recommendations (Caltrans, 2012). The key parameters for determining the preliminary PGA are listed in Table 3.

Table 3. Key Parameters for Determining Preliminary PGA

Site Coordinates	Latitude = 33.6853 degrees	Longitude = -116.1614 degrees
Shear Wave Velocity, V_{s30}	935 feet/sec (285 m/sec)	

The probabilistic response spectrum controls the preliminary PGA, and the resulting design magnitude (M) is 7.1 and the preliminary PGA is 0.952g. The design magnitude and the preliminary PGA will be updated following the field investigation based on a V_{s30} estimated from site specific borings.

Ground Rupture: No major faults traverse through the project site. The California Division of Mines and Geology has not identified Alquist-Priolo Fault Zones through the site. Therefore, the risk of ground surface rupture and related hazards at the project site are expected to be low. According to Caltrans Memo To Designers 20-10 (Caltrans, 2013c), since the project site does not fall within an Alquist-Priolo Earthquakes Fault Zone or within 1,000 feet of an unzoned fault that is Holocene or younger in age, further fault studies will not be needed (Figure 4).



2010 FAULT ACTIVITY MAP OF CALIFORNIA

California Geological Survey, Geologic Data Map No. 6

Compilation and Interpretation by: Charles W. Jennings and William A. Bryant

Graphics by: Milind Patel, Ellen Sander, Jim Thompson, Barbara Wanish and Milton Fonseca

Explanation

Fault traces on land are indicated by solid lines where well located, by dashed lines where approximately located or inferred and by dotted lines where concealed by younger rocks or by lakes or bays. Fault traces are queried where continuation or existence is uncertain.

FAULT CLASSIFICATION COLOR CODE
(Indicating Recency of Movement)

🟥 Fault along which historic (last 200 years) displacement has occurred

🟧 Holocene fault displacement (during past 11,700 years) without historic record.

🟩 Late Quaternary fault displacement (during past 700,000 years)

🟪 Quaternary fault (age undifferentiated)

— Pre-Quaternary fault (older that 1.6 million years) or fault without recognized Quaternary displacement.

ADDITIONAL FAULT SYMBOLS

Bar and ball on downthrown side (relative or apparent).

Arrows along fault indicate relative or apparent direction of lateral movement

Arrow on fault indicates direction of dip.

Low Angle Fault (barbs on upper plate)

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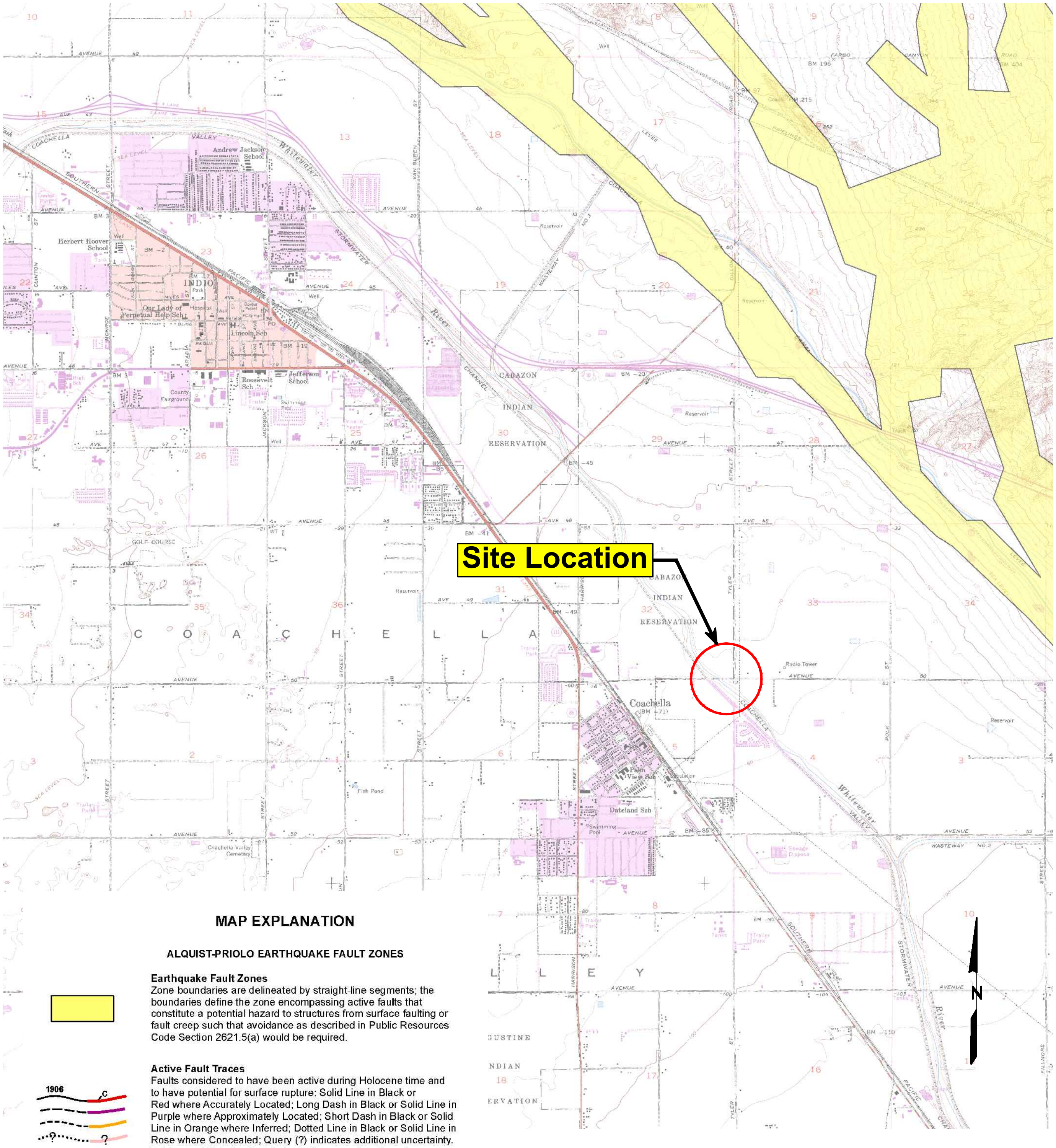
REGIONAL FAULT MAP

Figure 3



MAP EXPLANATION

ALQUIST-PRIOLO EARTHQUAKE FAULT ZONES

🟨 **Earthquake Fault Zones**
Zone boundaries are delineated by straight-line segments; the boundaries define the zone encompassing active faults that constitute a potential hazard to structures from surface faulting or fault creep such that avoidance as described in Public Resources Code Section 2621.5(a) would be required.

Active Fault Traces
Faults considered to have been active during Holocene time and to have potential for surface rupture: Solid Line in Black or Red where Accurately Located; Long Dash in Black or Solid Line in Purple where Approximately Located; Short Dash in Black or Solid Line in Orange where Inferred; Dotted Line in Black or Solid Line in Rose where Concealed; Query (?) indicates additional uncertainty. Evidence of historic offset indicated by year of earthquake-associated event or C for displacement caused by fault creep.

1906 C
? ?

0 5,000 10,000 FEET

SCALE

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

State Route 86/Avenue 50 New Interchange Project

Project No. 18-125 | Date: June 2018

AP Fault Map

Reference: CGS, 2015, Earthquake Zones of Required Investigation Indio Quadrangle

Figure 3

Seismicity: The site region is within the tectonically active southern California. In spite of the active tectonic regime, earthquakes in the Coachella Valley region within historical times (i.e., the past couple hundred years) have been infrequent and of smaller magnitudes. Historic earthquakes affecting the Salton Trough region have ranged up to the magnitude 7.8 Fort Tejon earthquake of 1857. Other notable earthquakes include the Laguna Salada earthquakes of 1892 and 1934 (M>7, 7.1 and 6.7), the 1915 Cerro Prieto earthquakes (M6.0, 7.1), the 1992 Landers earthquake (M7.3), the 1999 Hector Mine earthquake (M7.1) and the 2010 Baja California earthquake (M7.2).

The nearby San Andreas fault, which trends northwest-southeast for about 1,000 kilometers from the Gulf of California to the Cape Mendocino area of northern California. The San Andreas fault is very complex at the northern end of the Coachella Valley, but the various faults merge south of the project area and the fault is much simpler and linear to the south where it disappears into the Salton Sea (Jennings, 2010). Although the San Andreas fault has been historically active north of the Salton Trough, there have been no large earthquakes or surface ruptures on the Coachella segment in historical time, and little direct evidence for major young prehistoric events.

As the San Andreas extends southeasterly through the San Bernardino area, it changes orientation and splits into several branches, is intermingled with several thrust faults, and may even lose continuity. This zone of complex faulting is commonly referred to as San Bernardino tectonic knot. The San Andreas fault south of the San Bernardino Mountains has not experienced a large earthquake in historic time. In the northern Coachella Valley, the fault comprises the Garnet Hill, Banning, and Mission Creek branches, and several other smaller faults. These branches merge near the southern end of the Indio Hills and the fault continues as a narrow, if not a single fault, to Bombay Beach at the Salton Sea where it disappears. Seismicity at the southern end of the Salton Sea in the Brawley area suggests that the San Andreas fault steps westward to link up with the Imperial fault and continues into the Gulf of California (Dillon and Ehlig, 1993).

The most recent surface-rupturing earthquake on the Mission Creek segment of the San Andreas fault likely occurred in the 1600s. Prior events occurred in about A.D. 825, 982, 1231, 1502 based on trenching at the Thousand Palms Oasis (Fumal et al., 2002). These data indicate that the average repeat time of surface-rupturing earthquakes on the southern San Andreas fault is about 215 +/- 25 years, but this average may be misleading because the inter-event time ranged from as short as a few decades to as long as 400 years (Fumal et al., 2002).

6.0 GEOTECHNICAL CONDITIONS

6.1 Subsurface Soil Conditions

As mentioned in Section 2.1, as-built LOTB sheets of a nearby Overhead Sign, Dillon Road Undercrossing, and Wasteway No. 2 Bridge were reviewed. The boring and groundwater information extracted from these as-built LOTB sheets are listed in Table 4. As shown on the as-built LOTB sheets of the Overhead Sign and Dillon Road Undercrossing, 500 feet was added to the original NGVD29 elevations. This 500 feet was not added to the elevations in the Wasteway No. 2 Bridge as-built LOTB sheet; however, there is a note suggesting to add 500 feet to the elevations provided in the LOTB sheet. As a result, EMI added 500 feet to the elevations shown on the Wasteway No. 2 Bridge as-built LOTB sheet when developing the idealized soil profile presented in Table 5.

Table 4. Boring Information from Available As-Built LOTB Sheets

Date of Boring/s	Number and Type of As-Built Boring/s	Approx. Top of Boring Elevation/s (feet)	Approx. Bottom of Boring Elevation/s (feet)	Approx. Groundwater Elevation (feet)
Overhead Sign				
November 2017	1 Hollow-Stem Auger Boring	+421.6	+375.1	+392.6
Dillon Road Undercrossing				
February to March 1990	3 Hollow-Stem Auger Borings	+452 to +483	+386 to +427	+432.0 to +436.5
November to December 1989	1 Hollow-Stem Auger Boring 1 Cone Penetrometer	+454 to +456	+366 to +375	+432.0
Wasteway No. 2 Bridge				
March 1990	1 Hollow-Stem Auger Boring	+410	+346	+386.0
December 1989	2 Cone Penetrometer	+413 to +414	+329 to +331	NA

The available subsurface information indicates that the site soils are composed of a mixture of soft to hard silt and clay with medium dense to very dense sand and silty sand. The idealized soil profile is presented in Table 5.

Table 5. Idealized Soil Profile

Approximate Elevation (feet)	Predominant Soil Type
+422 to +410	Loose Silty Sand
+410 to +375	Soft to Hard Silt and Clay
+375 to +346	Medium Dense to Very Dense Silty Sand and Sand

6.2 Groundwater Conditions

As shown in Table 4, groundwater at Dillon Road Undercrossing is between elevations +432 and +437, groundwater at Wasteway No. 2 Bridge is around elevation +386, and groundwater at the nearby Overhead Sign is around +393 feet. The California Statewide Groundwater Elevation Monitoring (CASGEM) Online System was reviewed for additional groundwater level readings in the vicinity of the project site. However, no active wells were located within 1 mile from the project site. The Geotracker website (http://geotracker.waterboards.ca.gov/) shows several groundwater monitoring wells in the vicinity, and the closest well (Well ID SL20703104) is located about 0.8 mile west of the proposed bridge site. The highest groundwater measurements from 2006 to 2017 obtained from this well show a gradual decline in elevation from +402 to +397 feet between 2006 and 2013, followed by a nearly constant elevation of about +398 feet between 2013 and 2017.

Since Dillon Road Undercrossing and Wasteway No. 2 Bridge are located outside the project vicinity, less emphasis was placed on groundwater data from those as-built LOTB sheets. Instead, more emphasis was placed on the groundwater data collected from the Overhead Sign LOTB sheet and the nearby Geotracker monitoring well. As a result, a preliminary design groundwater table was placed at an elevation of +398 feet (approximately 29 feet below SR-86 roadway grade at the proposed Avenue 50 OC) for preliminary liquefaction analysis and foundation evaluation. Groundwater elevation used for final design will be determined when site specific field investigation is completed during the PS&E phase.

6.3 Erosion

The project area is composed of relatively flat terrain. However, the side slopes of the Coachella Valley Stormwater Channel are at generally mild inclination, and are covered with sparse vegetation. Surficial soils on existing slopes within the project limits are mostly sandy soils and are susceptible to erosion. Erosion of the existing slope faces was observed to be minimal to moderate.

6.4 Seismic Hazards

Liquefaction Potential: Preliminary liquefaction analysis was performed using the procedures outlined by Seed et al. (1983) and updated by NCEER (1997) and Youd et al. (2001), and SPT blowcounts and soil descriptions shown on the attached LOTB sheets. Results of the analyses show that liquefaction potential does not exist at the site. This conclusion will be confirmed using additional site-specific soil borings, CPT soundings, and groundwater data to be obtained later during the PS&E phase.

Seismically-Induced Settlement: Since the liquefaction potential does not exist at the site, liquefaction induced (seismic) settlement of onsite soils is anticipated to be negligible. However, this conclusion will need to be confirmed using site specific soil borings to be performed later during the PS&E phase. If soil liquefaction and associated seismically-induced settlement is confirmed, then foundation design will incorporate the effects of seismically-induced settlement.

Seismic Slope Instability: The project area is composed of relatively flat terrain. Since liquefaction of the in-situ soils is not anticipated, lateral spreading is not a design concern. Slope stability will be assessed during the PS&E phase and using final layout and profile sheets when they become available.

6.5 Slope Stability

The topography in the project site is flat without any major natural slopes. Therefore, landslide potential is considered low.

6.6 Excavation Characteristics

Excavations are anticipated to be performed within existing artificial fill and alluvium. These on-site materials can be excavated using conventional heavy-duty earth-moving equipment and the materials are not expected to pose a rippability problem.

6.7 Embankments

The project area is composed of relatively flat terrain. No major stability or settlement issues were observed during the aerial site reconnaissance.

6.8 Volumetric Stability of Embankments and Subgrade Materials

The available subsurface information indicates that site soils are composed of predominately sand, silt, and clay. The sandy soils are primarily sand and silty sand which are not expected to be expansive. The silty and clayey soils consist of clayey silt, sandy silt, and lean clay; the corresponding expansion potential is considered to be moderate. Currently, there is insufficient data to evaluate the onsite soil collapse potential. Therefore, both soil expansion and collapse potential should be evaluated during PS&E using the site-specific borings and soil laboratory tests.

7.0 HAZARDOUS WASTE POTENTIAL

Evaluating the presence and concentration of hazardous contaminants is beyond EMI’s scope of work and therefore is not addressed in this report. EMI has assumed that no hazardous or contaminated materials exist within the project area; therefore, no hazardous waste considerations are provided. If for any reason hazardous or toxic materials are believed to exist within the project area, an environmental consultant should be retained.

8.0 PRELIMINARY RECOMMENDATIONS AND CONCLUSIONS

8.1 Future Explorations and Investigations

EMI recommends a site specific geotechnical field investigation for the proposed project improvements, during the final design phase of the project. The field investigation will be conducted in an effort to determine the feasibility and potential construction issues that could be encountered. The locations and depths of the borings should be selected once the design alternative has been finalized.

Samples recovered during the field investigation will be transported to the laboratory for testing. All of the soil samples will be visually classified. Additional samples will be selected for moisture content/density tests, sieve analysis, #200 wash, Atterberg limits, sand equivalents, corrosion, consolidation, UU triaxial, direct shear, R-value and compaction tests. Other laboratory tests may be required depending upon the nature of the soils encountered during the investigation.

8.2 Embankments

Based on the preliminary plans, the majority of the fill placement is located at the Avenue 50 approach embankments and along the on- and off-ramps. The proposed major fill embankments are provided in Table 6 with the estimated settlement. The settlement magnitude provided below will be confirmed using the final design profile, site-specific soil borings, and laboratory test results to be performed later during the PS&E phase.

Table 6. Major Embankments and Estimated Settlement

Location	Approx. Maximum Height of Fill (feet)	Estimated Settlement (inches)
Avenue 50	29	3.0
Southbound On- and Off- Ramps	25	2.75
Northbound Direct On-Ramp	28	3.0
Northbound Off-Ramp, Northbound Loop On-Ramp, and Tyler Street North	22	2.5

Topic 304 of the Caltrans Highway Design Manual (Caltrans, 2017) advises that for new construction, widening, or where slopes are otherwise being modified, embankment (fill) slopes should be constructed at an inclination of 4H:1V or flatter. In locations where there is insufficient room for embankment side slopes of 4H:1V, slopes with a maximum inclination of 2H:1V can be constructed; however, if the 2H:1V slopes are within the Caltrans right-of-way, they will require a design exception.

The proposed embankments will be sloped at 4H:1V or flatter. Fill embankments should be globally stable for a maximum slope gradient of 2H:1V or flatter. Fill slopes with a gradient of 2H:1V or flatter should be surficially stable. In all cases, proper maintenance with erosion protection and drainage control in accordance with Section 21 of Caltrans Standard Specifications (2015) are also recommended.

Stability of fill embankments will be evaluated during the final design phase using the subsurface information collected from the site specific borings.

8.3 Excavations

Based on the preliminary plans, there are no major excavations (greater than 5 feet) in the project. Temporary cuts may be required in areas where drainage improvements and footings are proposed. Temporary excavations, including temporary shoring, necessary to construct the footings or culverts will need to be designed by the contractor for local and global stability.

Based on the available nearby subsurface information, it is anticipated that excavations can be made using heavy duty excavation equipment without requiring extensive rock excavation techniques, i.e. drilling, jack-hammering and blasting.

8.4 Retaining Wall Alternatives

Based on the preliminary plans, a Type 1 retaining wall is proposed between the southbound SR-86 and southbound off-ramp. Since preliminary PGA is greater than 0.6g, Caltrans standard plan Type 1 retaining walls will need to be checked and modified (if necessary) to accommodate the higher PGA. A MSE wall is proposed in the northeast quadrant of Avenue 50 and Tyler Street. The MSE bearing stresses published in Caltrans BDA 3-8 (2013b) are not applicable because preliminary PGA is greater than 0.6g. A “special” design will be required for the MSE walls, if used, to account for the relatively high PGA at the project site.

8.5 Groundwater Control

Groundwater is not expected be encountered during bridge footing and roadway embankment construction. Should groundwater be encountered during footing construction, it should be controlled in accordance with Section 19-3.03B(5) of the Caltrans Standard Specification (2015). Any seepage or groundwater removed from an excavation should be tested and disposed of in compliance with all applicable local, state and federal requirements.

9.0 LIMITATIONS

This District Preliminary Geotechnical Report is intended for use by TranSystems, City of Coachella, Caltrans, and Coachella Valley Association of Governments (CVAG) for the proposed SR-86/Avenue 50 New Interchange Project. This report is based on the project as described herein and the available as built subsurface information. The earth materials and subsurface conditions described in the as-built exploratory borings are presumed to be representative of the project site; however, subsurface conditions and characteristics of earth materials between borings can vary. This report should be used for planning and preliminary cost estimating purpose only. This report is not intended for final design.

The data, opinions, and recommendations contained herein are applicable to the specific design elements and locations which are the subject of this report. Data, opinions, and recommendations herein have no applicability to any other design elements or to any other locations, and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of EMI.

Services performed by EMI were conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, expressed or implied, and no warranty or guarantee is included or intended.

10.0 REFERENCES

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APPENDIX A

AS-BUILT LOTB SHEETS OF NEARBY STRUCTURES

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	086			

5-03-18
REGISTERED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Nadeem Srour
No. GE 2801
Exp. 12-31-19
GEOTECHNICAL
STATE OF CALIFORNIA

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of scanned copies of this plan sheet.

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, & Presentation Manual (2010 Edition).

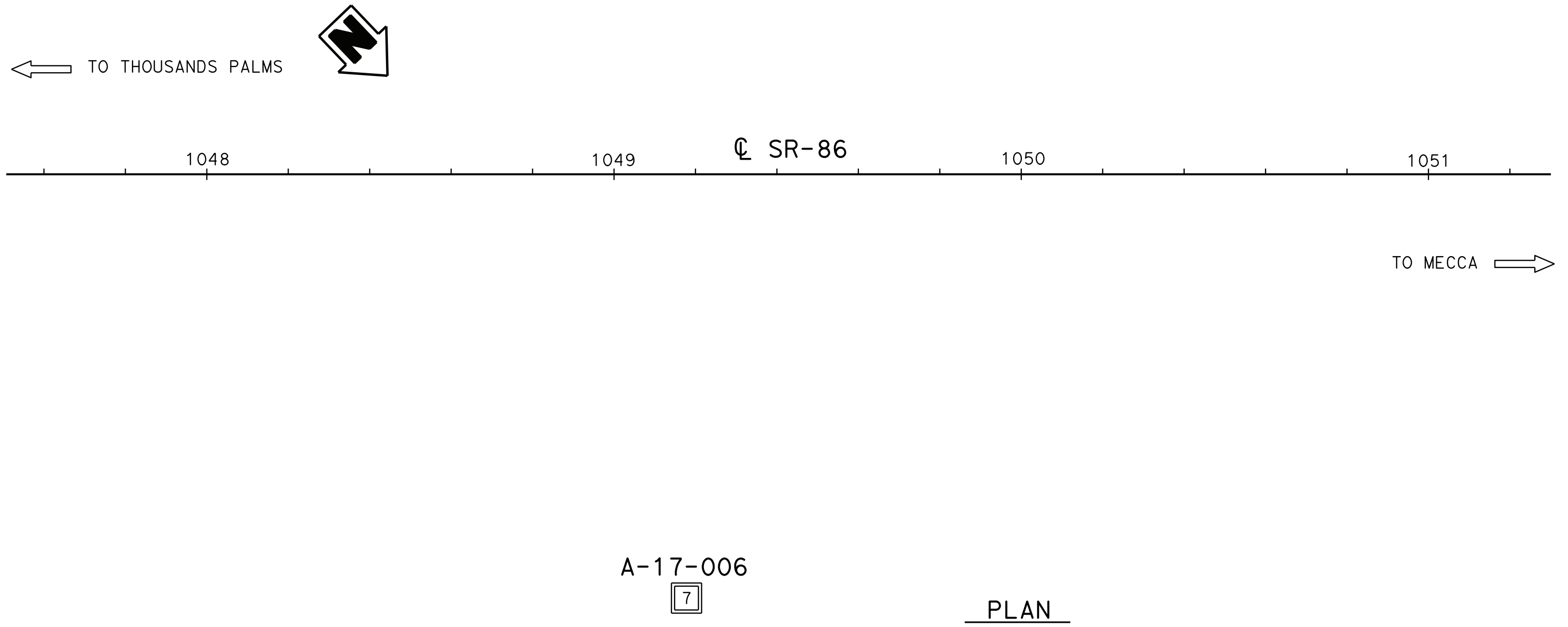
See 2015 Standard Plans A10F and A10G for Soil Legend, and A10H for Rock Legend.

BENCH MARK

(P#600) RIV SR86
SET 1" IP WITH RED PLASTIC PLUG
"CALTRANS RP" FLUSH
N 2 192 723.77
E 6 589 024.98
Elev 425.37'

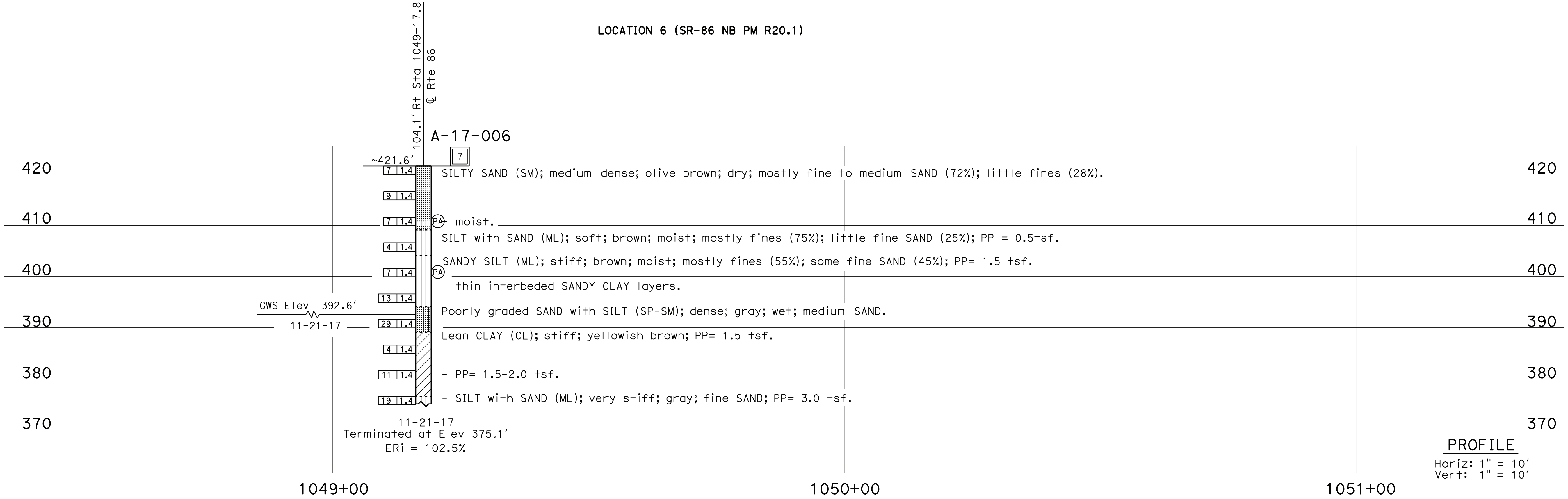
P#601
SET 1" IP WITH RED PLASTIC PLUG
"CALTRANS RP" FLUSH
N 2 192 422.21
E 6 589 340.74
Elev 423.77'

Datum
NAD83 ZONE 6 (1991.35) US FEET
ELEVATIONS ARE NGVD29 +500 FEET.



PLAN
1" = 20'

LOCATION 6 (SR-86 NB PM R20.1)



SILTY SAND (SM); medium dense; olive brown; dry; mostly fine to medium SAND (72%); little fines (28%).

- moist.

SILT with SAND (ML); soft; brown; moist; mostly fines (75%); little fine SAND (25%); PP = 0.5tsf.

SANDY SILT (ML); stiff; brown; moist; mostly fines (55%); some fine SAND (45%); PP= 1.5 tsf.

- thin interbeded SANDY CLAY layers.

Poorly graded SAND with SILT (SP-SM); dense; gray; wet; medium SAND.

Lean CLAY (CL); stiff; yellowish brown; PP= 1.5 tsf.

- PP= 1.5-2.0 tsf.

- SILT with SAND (ML); very stiff; gray; fine SAND; PP= 3.0 tsf.

11-21-17
Terminated at Elev 375.1'
ERi = 102.5%

PROFILE
Horiz: 1" = 10'
Vert: 1" = 10'

ENGINEERING SERVICES		GEOTECHNICAL SERVICES
FUNCTIONAL SUPERVISOR NAME: T. Lam	DRAWN BY: F. Nguyen CHECKED BY: K. Barker	FIELD INVESTIGATION BY: N. Srour

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS
0 1 2 3

STATE OF
CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES
STRUCTURE DESIGN
DESIGN BRANCH X

BRIDGE NO.
N/A
POST MILE
R20.1

SIX OVERHEAD SIGNS IN VARIOUS LOCATIONS IN RIVERSIDE COUNTY

LOG OF TEST BORINGS 6 OF 6

UNIT: 3650
PROJECT NUMBER & PHASE: 08150000591
CONTRACT NO.: 08-1F9204

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES			SHEET	OF
~~02-26-18~~	~~04-03-18~~	04-17-18	X	X

FILE => 6ohsigns-6of 6.dgn

USERNAME => s128198 DATE PLOTTED => 03-MAY-2018 TIME PLOTTED => 14:45

DILLOG.DGN 10/16/90

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	Riv	86	R15.2/R22.5	142	157

S Stuart Williams Jr

REGISTERED ENGINEER-GEOTECHNICAL

12-2-91

PLANS APPROVAL DATE

S. Stuart Williams
No. GE 896
Exp. 12/31/92
GEOTECHNICAL

CH2M HILL
2510 RED HILL AVE, SUITE A
SANTA ANA, CALIFORNIA 92705

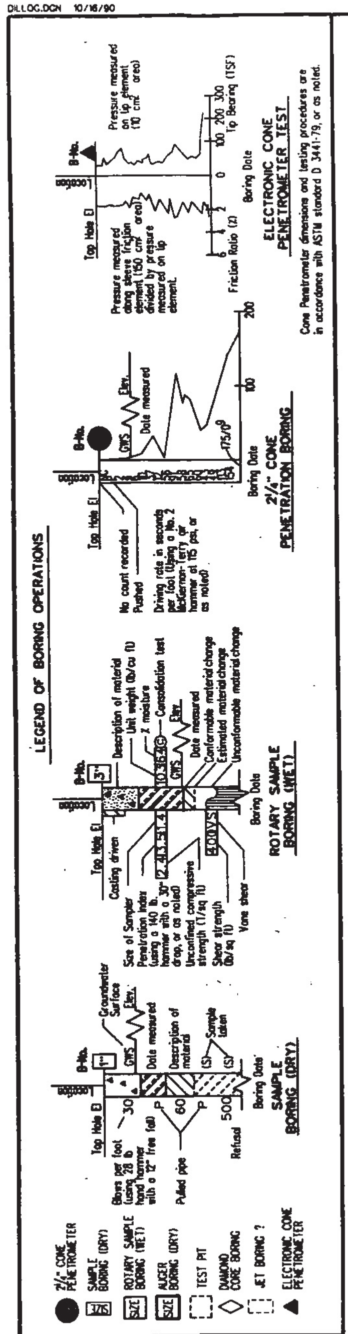
NOTES:

1. THE BORING LOGS AND RELATED INFORMATION REPRESENT THE OPINION OF THE GEOTECHNICAL ENGINEER AS TO THE CHARACTER OF THE MATERIALS AT THE LOCATIONS SHOWN. SOIL AND GROUNDWATER CONDITIONS BETWEEN ADJACENT TEST HOLES AND AT OTHER LOCATIONS MAY DIFFER FROM THOSE SHOWN. GROUNDWATER CONDITIONS MAY CHANGE WITH PASSAGE OF TIME.
2. AUGER BORINGS WERE DRILLED WITH A MOBIL B61 DRILL RIG. ELECTRIC CONE PENETROMETER TESTS WERE CONDUCTED IN ACCORDANCE WITH ASTM D 3441-86.
3. TEST BORING ELEVATIONS ARE APPROXIMATE AND ARE INTERPOLATED BASED ON TOPOGRAPHIC BASE SHEET MAPPING PREPARED FOR THIS PROJECT. TEST BORING ELEVATIONS ARE IN FEET AND ARE REFERENCED TO THE PROJECT DATUM.
4. DETAILED BORING LOGS ARE INCLUDED IN THE JUNE 1990 GEOTECHNICAL BRIDGE FOUNDATION REPORT PREPARED BY CH2M HILL, FILE NO. LA028117.DL11.
5. TEST BORING LOCATIONS WERE DETERMINED IN THE FIELD BASED ON READING AUTOMOBILE ODOMETER MEASUREMENTS, AND TAPING AND PACING FROM MAPPED SITE FEATURES. THE LOCATIONS OF THE EXPLORATIONS SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE MEASUREMENT METHODS USED.
6. BASIS OF BEARINGS IS CALIFORNIA STATE PLANE COORDINATE SYSTEM OF 1927, ZONE 6.

BENCHMARK	DESCRIPTION	ELEVATION
86-21.8 1986	A 2¼" CDOT DISK IN 2" IP ON THE E SIDE OF THE E LEVEE RD. FROM THE LOCKED GATE OF THE LEVEE RD AT DILLON RD GO S ON ROAD 0.6 MI TO MON PLP SET 1.5 NWLY FROM STATION.	453.07'

7. ELEVATIONS SHOWN ARE BASED UPON USC & GS DATUM OF 1929, NGS ADJUSTMENT OF 1978. SEA LEVEL + 500 FEET.

LEGEND OF BORING OPERATIONS



Cone Penetrometer dimensions and testing procedures are in accordance with ASTM standard D 3441-79, or as noted.

● 2¼" CONE PENETROMETER
▭ SAMPLE BORING (DRY)
▭ ROTARY SAMPLE BORING (WET)
▭ AUGER BORING (DRY)
⬚ TEST PIT
◇ DIAMOND CORE BORING
⬚ JET BORING ?
▲ ELECTRONIC CONE PENETROMETER

LEGEND OF EARTH MATERIALS

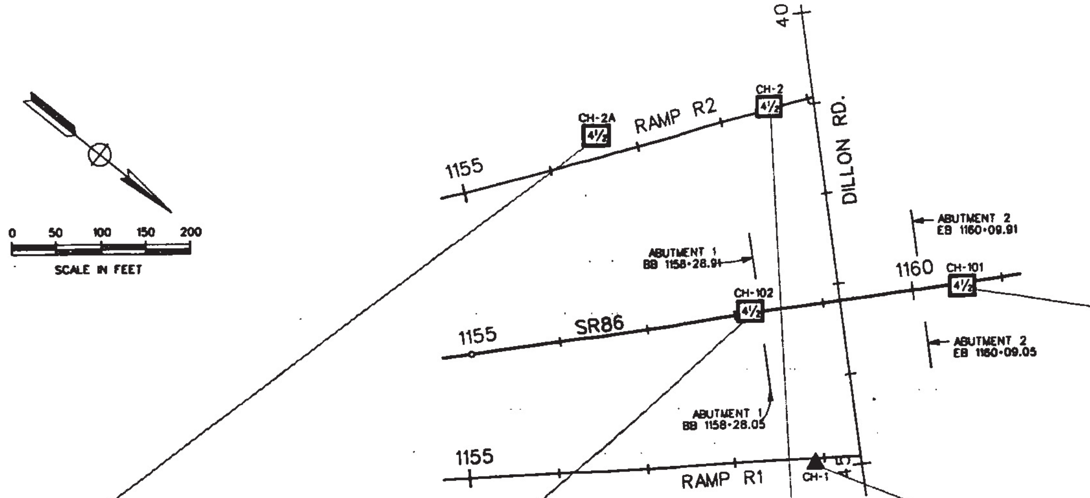
▨ GRAVEL
▨ SAND
▨ SILT
▨ CLAY
▨ SANDY CLAY OR CLAYEY SAND
▨ SANDY SILT OR SILTY SAND
▨ SILTY CLAY
▨ CLAYEY SILT
▨ PEAT and/or ORGANIC MATTER
▨ FILL MATERIAL
▨ IGNEOUS ROCK
▨ SEDIMENTARY ROCK
▨ METAMORPHIC ROCK

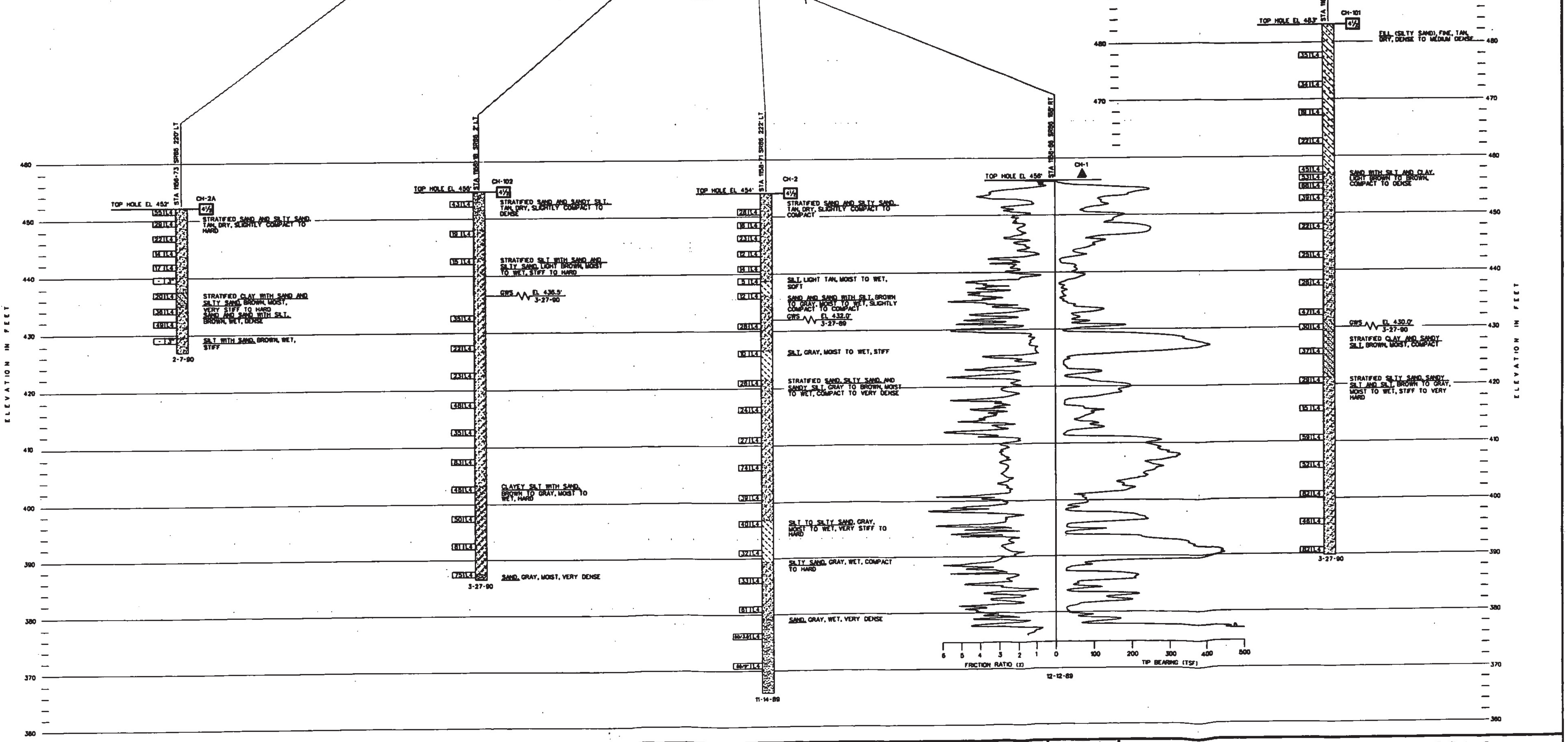
CONSISTENCY CLASSIFICATION FOR SOILS

According to the Standard Penetration Test

Penetration Index (Blows / Ft)	Granular	Cohesive
0-4	Very loose	Very soft
5-9	Loose	Soft
10-19	Slightly compact	Stiff
20-34	Compact	Very stiff
35-69	Dense	Hard
>70	Very dense	Very hard

NOTE: Classification of earth materials shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.





E M Simon

CALTRANS STRUCTURES PROJECT REVIEWER

sign off Date 8/28/91

~~REGISTERED CIVIL ENGINEER NO.~~

DRAWN BY R. MUNOZ

CHECKED BY E.M. SMITH

E.M. SMITH, PROJECT ENGINEER

FIELD INVESTIGATOR

APPROVAL RECOMMENDED BY

L. PERKO

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

0 1 2 3

K. CORDTZ

PROJECT ENGINEER

CU 11208
EA 179821

BRIDGE NO.
56-760 R/L
POST MILE

DISREGARD PRINTS BEARING EARLIER REVISION DATES

DILLON ROAD UNDERCROSSING

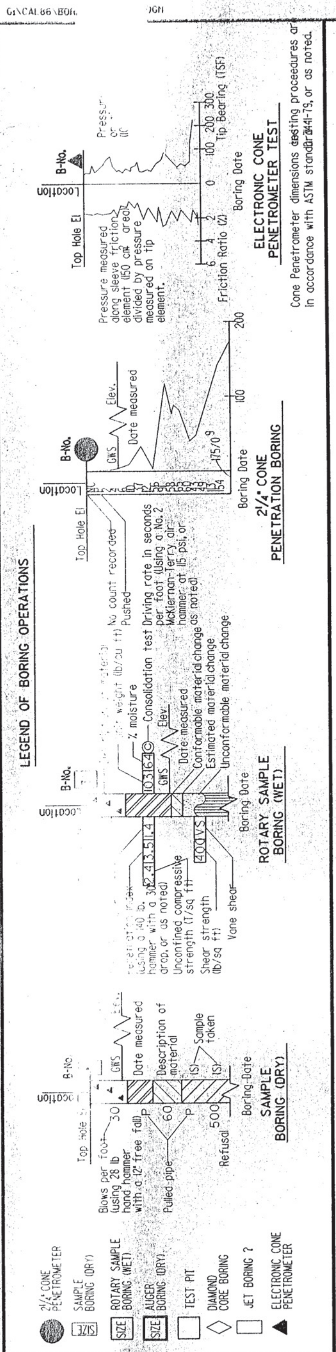
LOG OF TEST BORINGS

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET	OF
12	12

G:\CAL86\BOR [illegible] DGN

LEGEND OF BORING OPERATIONS



Cone Penetrometer dimensions and testing proceedures are in accordance with ASTM standard D3441-79, or as noted.

●	2¼" CONE PENETROMETER
SIZE	SAMPLE BORING (DRY)
SIZE	ROTARY SAMPLE BORING (WET)
SIZE	AUGER BORING (DRY)
☐	TEST PIT
◇	DIAMOND CORE BORING
☐	JET BORING ?
▲	ELECTRONIC CONE PENETROMETER

LEGEND OF EARTH MATERIALS

▨	GRAVEL	▨	CLAYEY SILT
▨	SAND	▨	PEAT and/or ORGANIC MATTER
▨	SILT	▨	FILL MATERIAL
▨	CLAY	▨	IGNEOUS ROCK
▨	SANDY CLAY OR CLAYEY SAND	▨	SEDIMENTARY ROCK
▨	SANDY SILT OR SILTY SAND	▨	METAMORPHIC ROCK
▨	SILTY CLAY		

CLASSIFICATION FOR SOILS

According to the Standard Penetration Test

Penetration Index (Blows / Ft)	Granular	Cohesive
0-4	Very loose	Very soft
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NOTE: Classification of earth materials shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

NOTES:

1. THE BORING LOGS AND RELATED INFORMATION REPRESENT THE OPINION OF THE GEOTECHNICAL ENGINEER AS TO THE CHARACTER OF THE MATERIALS AT THE LOCATIONS SHOWN. SOIL AND GROUNDWATER CONDITIONS BETWEEN ADJACENT TEST HOLES AND AT OTHER LOCATIONS MAY DIFFER FROM THOSE SHOWN. GROUNDWATER CONDITIONS MAY CHANGE WITH PASSAGE OF TIME. ALL LOCATIONS AND ELEVATIONS ARE APPROXIMATE.
2. AUGER BORINGS WERE DRILLED WITH A MOBIL B61 DRILL RIG. ELECTRIC CONE PENETROMETER TESTS WERE CONDUCTED IN ACCORDANCE WITH ASTM D 3441-86.
3. ELEVATIONS ARE BASED ON TOPOGRAPHIC BASE SHEET MAPPING PREPARED FOR THIS PROJECT. TEST BORING ELEVATIONS ARE IN FEET AND ARE REFERENCED TO MEAN SEA LEVEL DATUM.
4. DETAILED BORING LOGS ARE INCLUDED IN THE JUNE 1990 GEOTECHNICAL BRIDGE FOUNDATION REPORT PREPARED BY CH2M HILL. FILE NO. LA028117.D1.11

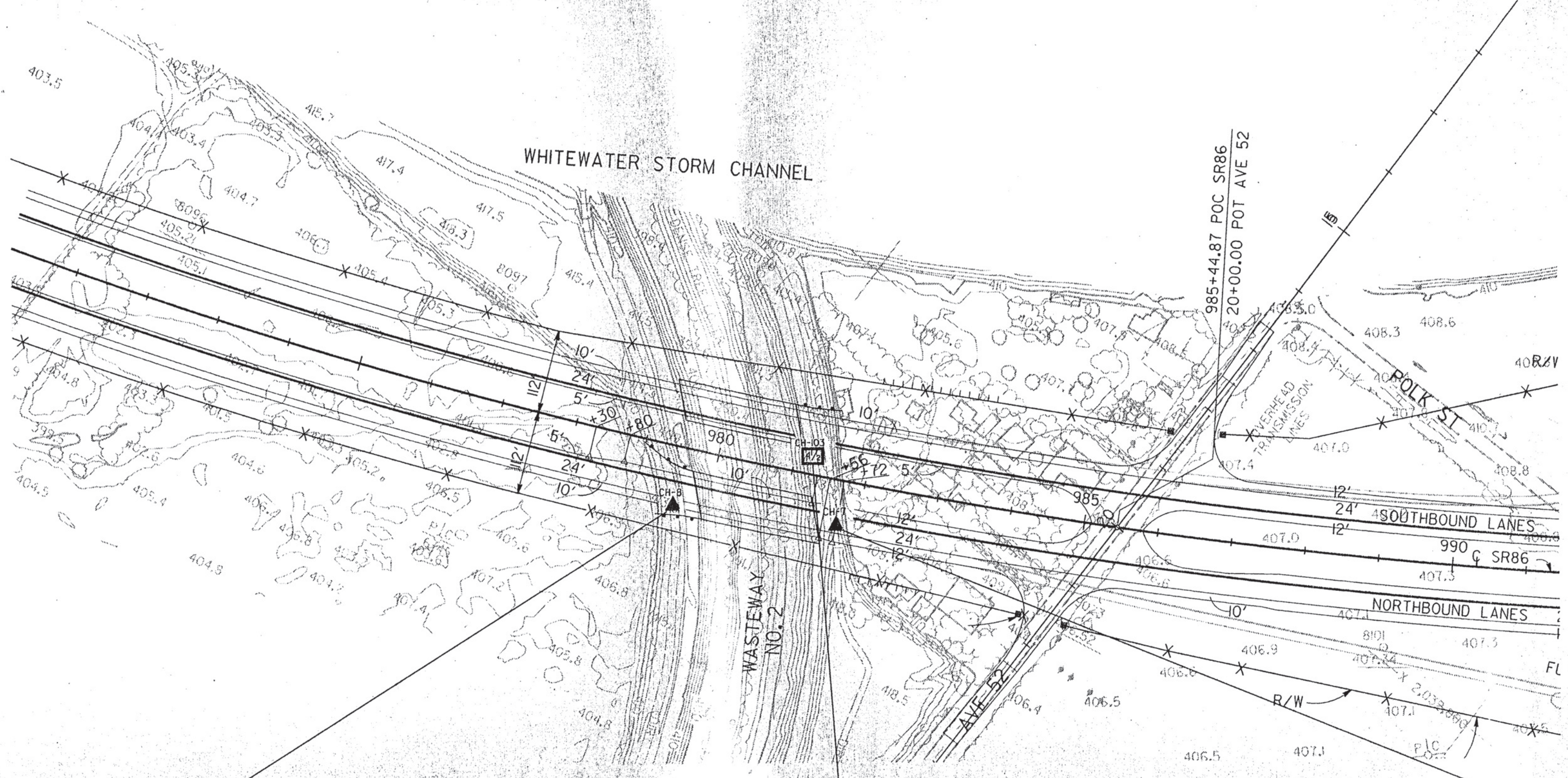
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	RIV	86			

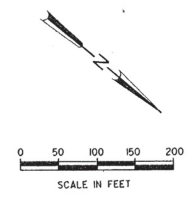
REGISTERED ENGINEER-GEOTECHNICAL

PLANS APPROVAL DATE

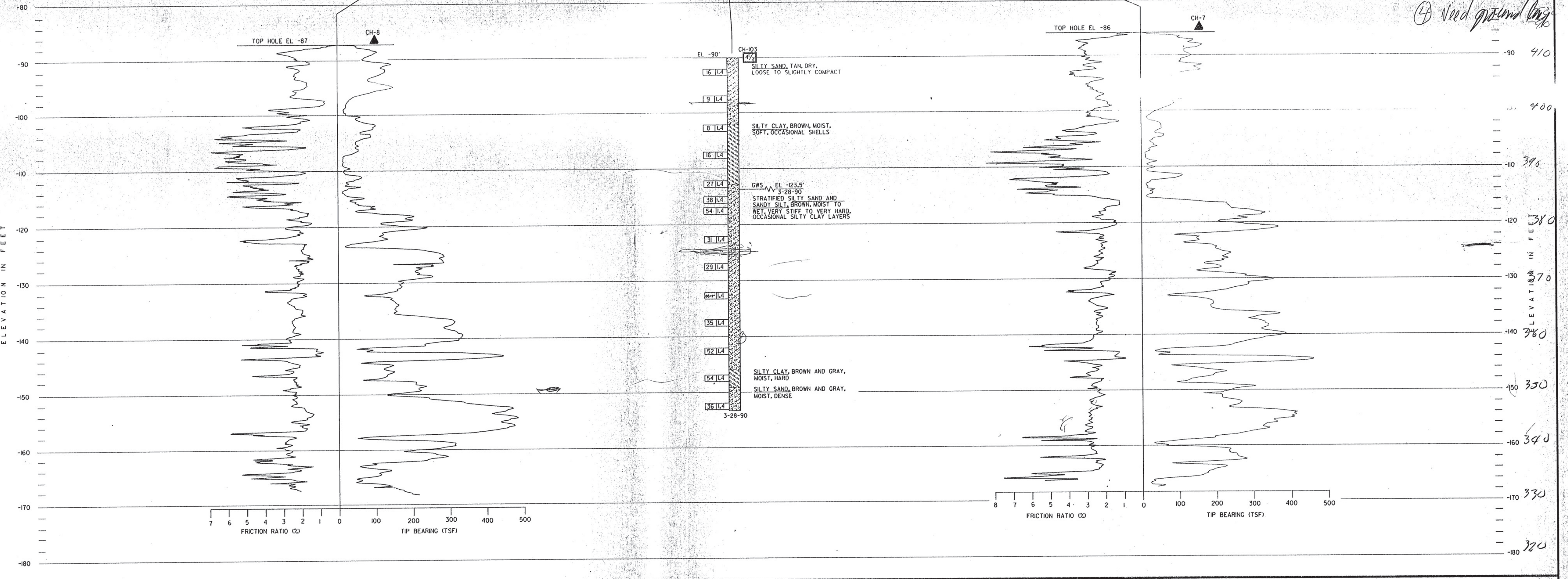
S. Stuart Williams
No. GE 896
Exp. 12/31/92
GEOTECHNICAL

CH2M HILL
2510 RED HILL AVE, SUITE A
SANTA ANA, CALIFORNIA 92705





① Station & offset FOR Boring
② Add 500' to top hole ELEVATIONS
③ Bench Mark LOC.
④ Need ground line



CH-103
EL -90'
4½

16	1.4
9	1.4
8	1.4
16	1.4
27	1.4
38	1.4
54	1.4
31	1.4
29	1.4
88/5"	1.4
35	1.4
52	1.4
54	1.4
36	1.4

SILTY SAND, TAN, DRY, LOOSE TO SLIGHTLY COMPACT

SILTY CLAY, BROWN, MOIST, SOFT, OCCASIONAL SHELLS

GWS EL -123.5' 3-28-90

STRATIFIED SILTY SAND AND SANDY SILT, BROWN, MOIST TO WET, VERY STIFF TO VERY HARD, OCCASIONAL SILTY CLAY LAYERS

SILTY CLAY, BROWN AND GRAY, MOIST, HARD

SILTY SAND, BROWN AND GRAY, MOIST, DENSE

3-28-90

CALTRANS STRUCTURES PROJECT REVIEWER REGISTERED CIVIL ENGINEER NO.	DRAWN BY	M. REICHERT	E. M. SMITH FIELD INVESTIGATOR	APPROVAL RECOMMENDED BY L. PERKO	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PROJECT ENGINEER REGISTERED CIVIL ENGINEER NO.
	CHECKED BY	E. M. SMITH	REGISTRATION NO.	REGISTRATION NO. CE 44359	0 1 2 3	CU EA

BRIDGE NO. 56-759 R/L	WASTEWAY NO. 2 BRIDGE
POST MILE	FIGURE 2 - LOG OF TEST BORINGS

DISREGARD PRINTS BEARING EARLIER REVISION DATES	REVISION DATES (PRELIMINARY STAGE ONLY)	SHEET	OF
		15	15