## Appendix H
# Preliminary Foundation Report

FUGRO CONSULTANTS, INC.

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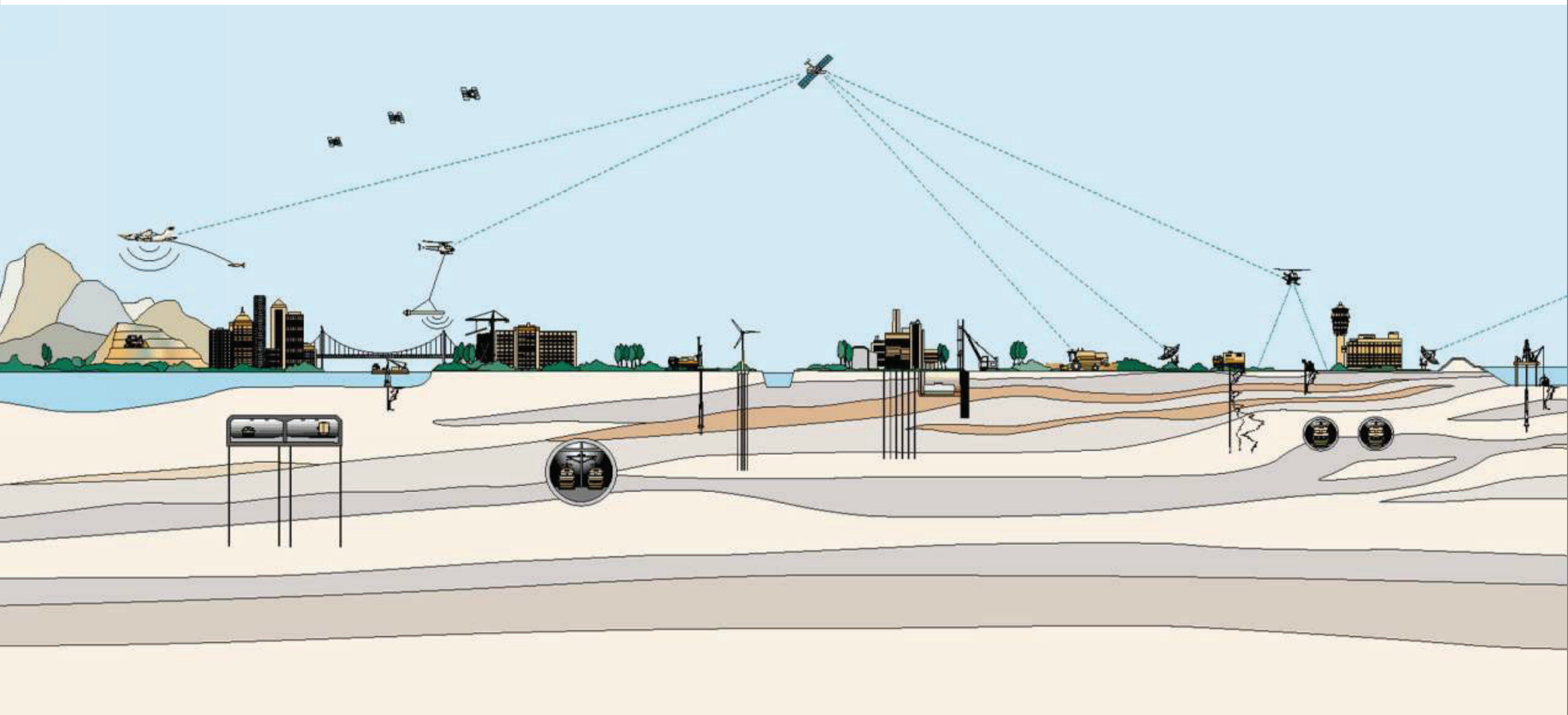
# PRELIMINARY FOUNDATION REPORT SAN FRANCISCO OAKLAND BAY BRIDGE BICYCLE/PEDESTRIAN CONNECTION OAKLAND, CALIFORNIA

Prepared for:
TY Lin International

November 2014
Fugro Project No. 04.72130012



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November 14, 2014
Project No. 04.72130012

TY Lin International
1111 Broadway, Suite 2150
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Attention: Ms. Eva Lillie

Subject: Preliminary Foundation Report, San Francisco Oakland Bay Bridge
Bicycle /Pedestrian Connection
Oakland, California

Dear Ms. Lillie:

Fugro Consultants, Inc. is pleased to present this revised Preliminary Foundation Report (PFR) for the proposed San Francisco Oakland Bay Bridge Bicycle / Pedestrian Connection (Path) Project in Oakland, California. We have updated our report in accordance with the Caltrans reviewer's comments dated October 8, 2014. Our findings, opinions, conclusions and recommendations are based on applicable standards of our profession at the time this report was prepared.

We thank you for the opportunity to be of service to TY Lin International. If you should have any questions or require additional information on this PFR, please call the undersigned at (510) 267-4422.

Sincerely,

FUGRO CONSULTANTS, INC.

Timothy Chi-To Wong, P.E., G.E.
Associate Engineer

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CTW/WAH:afp

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## 1.0 INTRODUCTION

This report presents the results of a preliminary geotechnical study prepared by Fugro for the San Francisco Oakland Bay Bridge Bicycle /Pedestrian Connection (Path) Project in Oakland, California (Vicinity Map, Figure 1). Fugro completed this Preliminary Foundation Report (PFR) on behalf of TY Lin International (TY Lin) and the Gateway Park Working Group, which is composed of nine local, regional, and state agencies including Bay Area Transit Authority (BATA), Caltrans, San Francisco Bay Conservation and Development Commission (BCDC), Alameda County Transportation Commission (CTC), East Bay Regional Park District (EBRPD), City of Oakland, Port of Oakland, East Bay Municipal District (EBMUD) and Association of Bay Area Governments' (ABAG) Bay Trail Project.

The Connection is part of the larger Gateway Park Project (Site Plan, Plate 1a) which encompasses five development areas located near the Oakland-touchdown of the new eastern span of the Bay Bridge. The five development areas are known as Key Point, Port Playground, Windbreak, Bridgeyard, and Radio Beach. These areas along with a sixth area known as Landscaping are presented in a separate report. The Connection project includes of a bicycle /pedestrian path (Class I[1]) divided into five segments. The five segments include an at-grade connection to Mandela Parkway, a separate elevated structure to the east, a West Grand Avenue overcrossing (including a Class III[3] section), a separate elevated structure to the west, and an at-grade connection to the Bay Bridge Trail. Future improvements could include: 1) a gravel parking lot (about 100 parking spaces) west of Wood Street (between 24th Street and West Grand Avenue), 2) landscaping areas, 3) an art statue by Mandela Parkway, and 4) a bike path (Class II[2]) at-grade near the eastern end of the project. These other improvements (including the at-grade connection to Mandela Parkway) will be discussed in the preliminary Geotechnical Design Report (GDR).

## 2.0 PURPOSE AND SCOPE OF USE

The purpose of this PFR is to summarize previous field investigations and subsurface conditions in the project vicinity, evaluate the seismic hazard conditions, make preliminary foundation recommendations, and identify the need for additional geotechnical investigations or studies for the proposed project.

## 3.0 PROPOSED STRUCTURE

Based on the layout plan dated June 5, 2014 (Appendix A), the proposed multi-span bicycle/pedestrian path structures are about 1.14 mile long in total length including the at grade segment which is about 450 feet long. According to TY Lin, the elevated structures (except part of Segment 3) are planned to be supported by Cast-In-Drilled Hole (CIDH) piles that are approximately 6 to 7 feet in diameter. The bicycle/pedestrian path has been divided into the five segments described below from east to west.

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[1] Class I bikeways (bike paths) are separate paths with exclusive right of way for bicycles and pedestrians, with minimal vehicular crossings.

[2] Class II bikeways (bike lanes) are striped lanes on streets, separating bicycles from vehicles, within the road right-of-way.

[3] Class III bikeways (bike routes) are lanes shared with motor vehicles

### 3.1 SEGMENT 1 - AT-GRADE CONNECTION TO MANDELA PARKWAY

Between Mandela Parkway and Campbell Street at West Grand Avenue, the new bicycle/pedestrian path would be a 15-foot wide Class I at-grade path along the south side of West Grand Avenue for approximately 450 feet. A landscape medium will be on the north side of the path to separate the path from vehicular traffic. A Cul-de-sac will be created at Willow Street to prevent vehicular traffic from crossing the new Class I bike path. An emergency vehicle access will be located at the intersection of Campbell Street and West Grand Avenue.

From Mandela Parkway at 20th Street (one block south of West Grand Avenue), there would be Class II bicycle lanes along 20th Street to Wood Street and along Wood Street to 24th Street and the proposed 100-space parking lot on the west side of Wood Street.

### 3.2 SEGMENT 2 - SEPARATE ELEVATED STRUCTURE EAST

From Campbell Street, the Class I path would be continue for approximately 1050 feet as a separate structure along the south side of West Grand Avenue and would begin an elevated ascent similar to West Grand Avenue, crossing at Wood Street. After the Wood Street crossing, the new path would continue on the West Grand Avenue bridge structure (refer to Segment 3 below).

The existing Grand Avenue Alley would be required to be permanently closed to traffic. A pedestrian sidewalk would remain along with the landscaping under the structure. The Grand Avenue Alley is the narrow, one-way street on the south side of Grand Avenue between Mandela Parkway and Wood Street.

### 3.3 SEGMENT 3 - WEST GRAND AVENUE OVERCROSSING

After the Wood Street overcrossing, the Class I path would continue for approximately 780 feet on the West Grand Avenue overcrossing over the frontage road and spur line railroad tracks, under the I-880 freeway structures, and over the Burlington Northern & Santa Fe Railroad (BNSF) and Union Pacific Railroad (UPRR) tracks. The width of the travel lanes and striped medium would be reduced to provide enough width for the bike path, now Class III, using the existing West Grand Avenue roadway structure. After the railroad crossing, the new path continues as a separate structure on the south side of West Grand Avenue (refer to Segment 4).

### 3.4 SEGMENT 4 - SEPARATE ELEVATED STRUCTURE WEST

After the railroad crossing, the Class I path would continue for approximately 3,400 feet as a separate structure on the south side of West Grand Avenue. The bike path would cross over Maritime Street and continue to the touchdown near the Caltrans maintenance facility. The path would descend with a switchback curve to the east of the Caltrans maintenance facility.

Two ramps could also be included with this section after the Class I path is construction, if funding is available. On the east side of Maritime Street, there could be an approximately 700-foot-long ramp extending to Burma Road. On the west side of Maritime Street, there would be an approximately 250-foot-long ramp extending to a roof-top landing and rest stop on the planned Oakland Maritime Support Services building.

### 3.5 SEGMENT 5 - AT-GRADE CONNECTION TO BAY BRIDGE TRAIL

From Segment 4, the Class I path would continue another 350 feet at grade level below the I-880/80 connection lanes and connect to the existing Bay Bridge Trail.

### 3.6 CLASS II BIKE LANES

The project could also include Class II bike paths along surface streets near the east touchdown of the Class I bike path, providing connections to Mandela Parkway and the proposed Wood Street parking lot. The Class II bike lanes would have a width of approximately 5 feet extending along each side of the street and cover approximately 4650 linear feet. The Class II bike paths would be constructed after the Class I bike path if funding is available.

## 4.0 PERTINENT REPORTS

The following reports and drawings prepared by Fugro and other consulting firms are pertinent to this study. No new investigation was performed for this PFR:

- Fugro – Earth Mechanics, 2013, Foundation Report for IERBY Temporary Improvements on Oakland Mole Touchdown, San Francisco-Oakland Bay Bridge East Span Seismic Safety Project, Oakland, California, March 19.
- Berlogar Stevens & Associates, 2012, Updated Master Plan Level Geotechnical Investigation Report, Oakland Army Base, Oakland, California, March 7.
- Fugro – Earth Mechanics, 2003, Final Geotechnical Foundation Report, Oakland Shore Approach Structures, SFOBB East Span Seismic Safety Project, Oakland, California, May 19.
- Earth Tech, 2001, Final Report: Oakland Army Base Utility Study Geotechnical Review, Oakland, California, April.
- Subsurface Consultants, Inc., 1999, Geotechnical Investigation Oakland Harbor Navigation Improvement (-50 Foot) Project, Port of Oakland, Oakland and Alameda, California, February 12.
- Caltrans, 1994, Project Plans for Construction of State Highway in Alameda County in Oakland on Route 880 at West Grand Avenue and on Route 80 from 0.7 Mile West to 1.0 Mile East of San Francisco-Oakland Bay Bridge Toll Plaza (Parts 1 and 2), Contract No. 04-192231.
- Sloan, Doris, 1992, The Yerba Buena Mud: Record of the Last Interglacial Predecessor of San Francisco Bay, California, Geological Society of America Bulletin, vol. 104.
- Rogers/Pacific, Inc., 1991, Final Report to National Science Foundation, Engineering Geologic Site Characterization of the Greater Oakland – Alameda Area, Alameda and San Francisco Counties, California, December 30.

The borings as shown on Plates 1a and 1b are based on the above reference reports and project plans. Plate 1a and 1b present the existing boring and/or Cone Penetration Tests (CPTs) approximate locations for the Gateway Park project and the Connection project, respectively. The boring logs used for the Connection Project are included in Appendix B.

# 5.0 GEOLOGIC AND SEISMOTECTONIC SETTING

## 5.1 REGIONAL GEOLOGY

The site is located in the Coast Ranges geomorphic province, which is characterized by northwest-southeast trending valleys and ridges. These are controlled by folds and faults that resulted from the collision of the Pacific and North American plates and subsequent strike-slip faulting along the San Andreas fault zone. The Bay Area also experienced uplift and faulting in several episodes during late Tertiary time (about 25 to 2 million years ago). This produced a series of northwest-trending valleys and mountain ranges, including the Berkeley Hills, the San Francisco Peninsula, and the intervening San Francisco Bay.

## 5.2 LOCAL GEOLOGY

The Coast Ranges consist of northwest-trending mountain ranges, basins, and narrow valleys generally paralleling major geologic structures and the coastline of California. The San Andreas fault system and the Hayward fault zone, contain active, northwest-trending, strike-slip faults, and to a lesser degree thrust faults which bound the study area.

Bedrock in the project vicinity consists of the late Jurassic and Cretaceous age Franciscan Complex and it is time contemporaneous Great Valley Sequence. The Franciscan Complex is a tectonic mixture of intensely deformed sedimentary, volcanic, and metamorphic rocks including serpentinite, which generally are in faulted contact with the overlying Great Valley Sequence. The San Francisco Bay sits within a broad depression in the Franciscan bedrock resulting from an east-west extension between the San Andreas and the Hayward fault systems. The bedrock surface is estimated to lie at Elevations -400 to -600 feet3 in the study area. The bedrock surface becomes deeper towards the south-southeast and shallower in other directions.

The unconsolidated geologic formations central to this study were deposited on top of the dissected Franciscan bedrock surface during several episodes of significant sea level rise and fall associated with past glaciations. These formations were grouped by Rogers and Figures, (1991), into the following major geologic units (from deepest to shallowest): the Alameda Formation, Old Bay Clay, the San Antonio Formation, Young Bay Mud, and Fill.

The lower Alameda Formation, consisting of continental sediments, was deposited on top of the bedrock surface between 500,000 and 1,000,000 years ago. Depositional environments likely included alluvial fans, lakes, flood plains, streams, and swamps (Rogers and Figures, 1991). Boring logs indicate a mixture of clay, silt, sand, and gravel, with predominantly fine-grained sediments and discontinuous layers of sand and gravel. These sediments are typically oxidized and therefore brown to yellow in color.

Between 400,000 to 500,000 years ago the sea entered the bay and deposition of the upper Alameda Formation began. These sediments were deposited in alluvial, estuarine, and marine environments (Rogers and Figuers,1991). Alameda Formation consists of a mixture of clay, silt, sand, and gravel, with a greater proportion of fine-grained sediments. Sand and gravel units are relatively thin and discontinuous. Sediments include both oxidized alluvial (brown/yellow) and unoxidized (blue/gray/green) marine layers, resulting from a depositional

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[3] Elevations referenced to North American Vertical Datum 1988 (NAVD88)

environment that changed with the rise and fall of the sea level and basin subsidence. Deposition and subsequent erosion of the upper Alameda Formation ceased approximately 125,000 years ago when Old Bay Clay deposition began (Sloan, 1992).

The Old Bay Clay is an unoxidized marine/estuarine unit consisting primarily of gray silty clay with occasional thin, discontinuous sand lenses. It was deposited beginning 115,000 to 125,000 years ago and ending 40,000 to 100,000 years ago during a time when sea level was as high as 20 feet higher than today (Rogers/Pacific, Inc., 1991; Sloan, 1992). The Old Bay Clay forms a relatively continuous layer extending a considerable distance inland from the present shoreline. Erosion of the top of this unit occurred during the Wisconsin glacial period between 90,000 and 11,000 years ago when sea level was considerably lower than at present (Rogers and Figures, 1991).

The San Antonio Formation consists of continental deposits, including the Aeolian Merritt sands and alluvial Posey sands. Deposition of these units occurred in late Wisconsin time when sea level was lower than at present. The top of the San Antonio Formation was subsequently eroded in very late Wisconsin time.

Deposition of the Young Bay Mud has been occurring over the last 10,000 years and continues today. The Young Bay Mud consists of estuarine/marine gray silty clay with minor discontinuous sand lenses.

The Young Bay Mud is overlain by undifferentiated fill that was placed in the late 1800s and throughout the 1900s.

A local geology map is shown on Figure 2.

## 5.3 SEISMOTECTONIC SETTING

The project site is located in the San Francisco Bay Area, which is considered one of the most seismically active regions in the United States. Significant earthquakes have occurred in the Bay Area and are associated with crustal movements along a system of subparallel fault zones that generally trend in a northwesterly direction.

The Coast Ranges tectonic province is bounded on the west by the northwest-trending San Andreas fault system, the primary boundary between the Pacific and North American Plates. The system boundary is represented as a broad region, 100 to 200 km wide, centered on the plate boundary, including much of the Coast Ranges, and is tectonically dominated at present by the dextral horizontal shear caused by the relative motion of the two plates. In the San Francisco Bay region, the plate boundary is a 100-km-wide zone of deformation consisting of several major strike-slip fault zones as shown in Figure 3 including the San Gregorio, San Andreas, Hayward-Rodgers Creek, Calaveras, and Concord-Green Valley faults (USGS, 2006). Table 1 outlines the distance from the site to nearby major faults, their segment length, slip rate, and magnitude.

The last major earthquake on the Hayward fault occurred in 1868 and caused widespread damage throughout much of the East Bay region. This earthquake caused surface rupture from Fremont to as far north as Berkeley. Although the fault rupture was poorly documented, modeling of survey data suggest that the fault moved as far north as Berkeley, and from these data the average amount of horizontal movement along the fault is inferred to be about 1.9 meters (Stover and Coffman, 1993). Small vertical displacements (0.1–0.2 m) have also been estimated (Lienkemper and others, 2002). Based on empirical relationships among earthquake magnitude, fault rupture length, and displacement (Wells and Coppersmith, 1994), a large event on the Hayward fault is capable of generating displacements of at least 10 feet. In addition to coseismic rupture, the Hayward fault is undergoing creep, i.e., it is undergoing continuous aseismic slip. This amounts to about 4 to 6 mm/yr on the Hayward fault in Fremont (Lienkaemper and others, 1997).

**Table 1. Major Active Faults in the Project Vicinity**

| Fault | Distance to Project Site (km) | Slip Rate (mm/yr) | $M_{max}$ | Fault Type |
|---|---|---|---|---|
| North Hayward | 6 | 9 | 7.3 | bi-lateral |
| South Hayward | 17 | 9 | 7.3 | bi-lateral |
| San Andreas - Peninsula | 24 | 17 | 8 | bi-lateral |

In 2008, the Working Group on California Earthquake Probabilities (WGCEP 2007), in conjunction with the United States Geological Survey (USGS), the California Geological Survey (CGS), and the Southern California Earthquake Center (SCEC) published an updated report evaluating the probabilities of significant earthquakes occurring in the Bay Area over the next three decades. The report finds that there is a 63 percent probability that at least one magnitude 6.7 or greater earthquake will occur in the San Francisco Bay region over a 30-year period. This probability is an aggregate value that considers principal Bay Area fault systems and unknown faults (background values).

## 6.0 SITE AND SUBSURFACE CONDITION

### 6.1 SITE CONDITIONS

This linear project area is bound by retail/commercial and industrial properties along Wood Street and West Grand Avenue in its eastern portion and current and former industrial properties of the Oakland Army Base (OAB) and EBMUD wastewater treatment system in its western portion. The site is located in a mixed commercial/industrial and residential areas.

The far eastern limit of the Connection is Mandela Parkway, southwest of the MacArthur Maze. Mandela Parkway is the former location of the Cypress Freeway Structure which collapsed during the 1989 Loma Prieta Earthquake.

West Grand Avenue connects surface streets, such as Mandela Parkway, in Oakland to on and off ramps from the Nimitz Freeway and Interstate-80. West of Campbell Street, West Grand Avenue consists of an elevated roadway that crosses over industrial land occupied by existing Union Pacific Railroad (UPRR) and Burlington Northern Santa Fe (BNSF) Right-of-Ways (ROWs), the former OAB, and Port of Oakland property.

## 6.2 SUBSURFACE CONDITIONS

As previously discussed, the six main geologic units underlying the proposed project area are Fill, Young Bay Mud, the San Antonio Formation, Old Bay Clay, the Alameda Formation, and Franciscan Complex (bedrock). Old borings and wells explored previously encountered the upper five units except the Franciscan bedrock. At some locations, not all of the geologic units are present. The reasons certain units are missing include natural geologic depositional processes, past dredging, and the absence of fill placed offshore.

Based on the review of the available borings from previous investigation, we generated Idealized Soil Profiles F-F’ and G-G’ which are presented on Plates 2a and 2b respectively. It depicts our understanding of the ground surface conditions and the underlying soil types along the Connection alignment. The idealized soil profile represents our interpretation of how the soil (lithological) contacts vary between boring and well locations. Because of the wide spacing of the data points and the natural variations during soil deposition, the actual contact locations may vary. The approximate locations of the borings and wells from previous investigations are shown on the Site and Boring Location Plans (Plates 1a and 1b) and the boring logs are included in Appendix B.

### 6.2.1 Fill (Elevations 10 to -10 feet)

Beginning in the mid-1800s, progressive filling of the natural bay margins occurred in the Port area. The fill was placed at various times and using various filling techniques, including hydraulic filling and end-dumping techniques. The materials used as fill also vary significantly across the project area. The fill materials encountered by the recent borings and wells included various combinations of clay, silt, sand, gravel, and cobbles. The borings indicated the fill ranges from loose to dense. In several areas, loose to medium dense and some occasional dense, fine- to medium-grained sands were encountered below the water table. These loose to medium dense sands are likely hydraulically placed fill with relatively high potential to liquefy in a major earthquake event. The thickness of the fill varies from 5 to 20 feet across the project area.

### 6.2.2 Young Bay Mud (Elevations +5 to -60 feet)

The formation referred to as Young Bay Mud (YBM) consists predominantly of a soft to medium stiff fat clay. The material typically has a high moisture content and a low dry density, and is soft, highly plasticity, and highly compressible. The thickness of the YBM encountered in the boring logs varies from 10 to 60 feet across the project site. There are occasional sand lenses embedded within the Bay Mud but they are discontinuous across the proposed structure alignment.

### 6.2.3 San Antonio Formation (Elevation -10 to -40 feet)

The San Antonio Formation includes fine- to medium-grained estuarine, alluvial, and aeolian sands that contain a varying amount of silt and clay. The Merritt sand is an aeolian deposit that is generally brown or yellow in color, dense to very dense, and ranges from being clean to containing silt and clay. The Posey sand is reworked Merritt sand that tends to be gray/green in color, medium dense, and clayey. The majority of the San Antonio Formation is relatively dense to very dense sand with Standard Penetration Test (SPT) blow counts ranging from 30 to 70. There are a few layers encountered described as medium dense but it is mixed with varying amount of clay. The thickness of the San Antonio Formation encountered in the borings varies from 0 to 20 feet across the project site.

### 6.2.4 Old Bay Clay (Elevations -25' to maximum depth explored)

The Old Bay Clay typically consists of a stiff to hard fat clay that occasionally contains thin lenses of fine-grained sand. The material typically has a lower moisture content, higher density, higher strength, and lower compressibility than the Young Bay Mud. Several historical borings encountered sandy layers within the Old Bay Clay, referred to as Old Bay Deposits. These sandy layers are typically 10 to 15 feet thick and dense to very dense. The bottom of the Old Bay Clay was not encountered in the borings reviewed for this study; however, we estimated the bottom of the Old Bay Clay is at approximate Elevations -75 feet to -100 feet based on the contour map generated from previous investigation by others4.

The Alameda Formation and the bedrock were not encountered in previous borings in the project vicinity.

### 6.2.5 Groundwater Conditions:

Existing data indicate that shallow groundwater in the project area typically varies from Elevation 0 to 3 feet. Based on information provided in the report “Matrix Environmental Services, LLC, Final, Upland Areas of Concern, Feasibility Study, BRAC Parcel 1, Oakland Army Base, dated March 2006”, the tidal influence on the groundwater gradient extends approximately 600 feet inland from the Oakland Harbor; in this area, groundwater flow is expected to be highly variable due to tidal forces. However, the distance of the proposed structure to the Bay is at least 1,000 feet so the tidal force should not significantly impact the groundwater level of the site.

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[4] Information based on report titled “Geotechnical Investigation -50 foot Navigational Improvement Project Port of Oakland, Oakland and Alameda, California”, February 1999.

## 7.0 GEOLOGIC AND SEISMIC HAZARDS

The followings discuss the potential geologic and seismic hazards at the project site:

### 7.1 FAULT RUPTURE

The majority of earthquakes in the Bay Area are associated with the San Andreas Fault and Hayward Fault system. The San Andreas Fault system is a 100-km-wide zone of deformation, which includes multiple northwest-southeast trending strike-slip faults that control the formation of the mountains and valleys of the Coast Ranges Geomorphic Province. As discussed previously, the nearest active fault is the Hayward fault located approximately 6.2 km to the northeast of the site. The structure does not fall within a CGS Fault-Rupture Hazard Zone (Alquist-Priolo Earthquake Fault Zone), as shown on Figure 4. Caltrans (2009) considers a distance of 50 horizontal feet on either side of a field evaluated active fault trace to have a potential for surface fault rupture displacement hazard (SFRDH). Therefore the potential for ground surface rupture is not a design consideration for the proposed structure.

### 7.2 STRONG GROUND SHAKING

Due to the close proximity of the Hayward fault, the project site will be subject to strong ground shaking during future large earthquakes originating on this fault, as well as from other regional faults.

The WGCEP (USGS, 2007) considers the Hayward-Rodgers Creek fault system the most likely source of the next M 6.7 or larger earthquake in the Bay Area, with a 31 percent probability of occurring in the time period 2007 to 2037. Their model also incorporates a scenario where the Hayward fault ruptures along with the Rodgers Creek fault. Rupture of the entire length of both faults would generate a mean maximum earthquake of M 7.3 (USGS, 2007). Rupture of the Rodgers Creek fault and the northern segment of the Hayward fault would generate a maximum event of M 7.1.

### 7.3 LIQUEFACTION

Strong ground shaking caused by large earthquakes can induce ground displacement and/or failure, such as liquefaction, compaction settlement, and slope movement. A site's susceptibility to these hazards relates to the site topography, soil conditions, and depth to groundwater.

Liquefaction is a soil behavior phenomenon whereby sediments temporarily lose shear strength and collapse. This condition is caused by cyclic loading during earthquake shaking that generates high pore-water pressures within the sediments. The soil most susceptible to liquefaction is loose, cohesionless, granular soil below the water table and within about 50 feet of the ground surface. Liquefaction can result in loss of foundation support and settlement of overlying structures, ground subsidence and translation due to lateral spreading, and differential settlement of affected deposits.

The liquefaction susceptibility of the sediments at the project site and its vicinity is mapped by the USGS as "very high" in the vicinity of project site, as shown in Figure 5. Based on our review of the field investigation and laboratory test data, the site is generally underlain by fill consisting of loose to medium dense cohesionless sand (with occasional dense sand) of approximately 5 to 15 feet thick and the depth to groundwater is approximately 2 to 6 feet. Where these deposits are below the water table, there is a high potential for them to liquefy during a major seismic event. There are also some deeper sand layers; there are some thin layers of 1 to 2 feet of medium dense sand layer but the majority of this sand layers tend to be dense and/or cohesive and we judge that they have a relatively low potential to liquefy during a major seismic event.

We used the available information from previous investigations obtained to evaluate the potential for seismically-induced ground surface settlement in the area of the proposed improvements. In accordance with the procedures developed by Tokimatsu and Seed (1987) for estimating volumetric strain of saturated clean sand based on the energy corrected SPT blow count $(N_1)_{60}$ and the cyclic stress ratio (CSR), the settlement at each boring location was estimated. The calculation indicated that the accumulative settlement is on the order of 6 to 10.2 inches based on a moment magnitude Mw of 7.3 and a PGA of 0.62g. The medium dense to dense lower sand layer may be subject to less than 1-inch of settlement. These calculations are provided in the table in Appendix C.

The liquefaction-induced settlements within the surficial fill may induce downdrag loads on deep foundations. Downdrag load on piles should be re-evaluated after completion of future investigations and final design of the Path structure is completed.

Lateral spreading occurs when a layer liquefies at depth and causes horizontal movement or displacement of the overburden mass on sloping ground or toward a free face, such as a stream bank or excavation, or towards an open body of water. Given that the site is generally flat and it is about 1,000 feet from the shoreline of the Bay, we conclude that the potential for lateral spreading is low; however, due to the large lateral extent and depth of liquefiable fill, limited permanent lateral soil displacements may occur. The impact of soil displacements on structures should be evaluated as part of detailed design at a later phase.

### 7.4 LANDSLIDE AND SLOPE FAILURE

Due to the relatively flat topography at the site, landsliding is not considered a hazard.

### 7.5 FLOOD

FEMA flood zone maps (http://www.fema.com) indicate that the project area is located outside the 100-year flood plain. Tsunami, or seismically induced large waves, may be generated by rapid movements on earthquake faults. Studies[5] have been conducted on wave attenuation within San Francisco Bay in the event of a large tsunami, and the project site is within the tsunami inundation line.

Sea level rise issues are addressed in a separate technical memorandum titled “Sea Level Rise Adaptation Revision 3” prepared by CH2M Hill dated February 17, 2014.

### 7.6 SCOUR

Because the existing and proposed structure supports are located outside waterways, scour is not an issue for the proposed structure.

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[5] Information is based on Tsunami Inundation Map for Emergency Planning, Oakland West Quadrangle by California Geological Survey, dated July 31, 2009.

## 7.7 CORROSION

The 2012 Berlogar Stevens & Associates report tested 17 soil samples around the Oakland Army Base for corrosivity testing (Appendix C), and 6 soil samples (H-9, H-16, H-28, H-30, H-56, and T-5) are located near this project location (approximately 260 to 1000 feet away). The classification of these samples, as documented in the report, ranged from “moderately corrosive” to “severely corrosive”. The pH of the soils ranged from 7.4 to 8.2, which does not present corrosion problems for buried iron, steel, mortar-coated steel and reinforced concrete structures. The sulfide ion concentrations reflect none detected with a detected limit of 50 mg/kg. One sample (T-5) was tested to contain chloride ion concentrations more than 300mg/kg, which is sufficient to attack steel embedded in a concrete mortar coating. In addition, an elevated level of sulfate ion concentrations was detected and was determined to be sufficient to damage reinforced concrete structures and cement mortar-coated steel. Therefore, concrete that comes into contact with this soil should use sulfate resistant cement such as Type II, with a maximum water-to-cement ratio of 0.55.

We recommend the corrosion potential of subsurface soils in the vicinity of the proposed improvements be evaluated in accordance with the requirements of Caltrans Memo to Designers 3-1 (July 2008) and ASTM standards during preparation of the future Foundation Report. Specifically, the redox potential, pH, resistivity, chloride, and sulfate will be tested for corrosivity potential to evaluate the effect of corrosion on the proposed improvements.

# 8.0 SEISMIC DESIGN CRITERIA

## 8.1 SEISMIC DESIGN METHODOLOGY

The seismic design methodology adopted for this project is based on the following current Caltrans standards:

1. Seismic Design Criteria (SDC), v 1.7, April 2013;
2. Guidelines for Structures Foundation Reports, v 2.0, updated March 2009;
3. California Seismic Hazard Map (2007); and
4. Caltrans ARS online (v2.3.06).

The new Caltrans procedures for developing the design acceleration response spectrum (ARS) use the envelope of the deterministic and probabilistic spectra, in contrast to the old procedure that used only the deterministic spectrum. The new deterministic spectrum is now adopting two next generation attenuation (NGA) models: an average of Campbell and Bozorgnia (CB) and Chiou and Youngs (CY) attenuation models. The deterministic spectrum is based on the envelope of median spectra corresponding to characteristic earthquakes occurring on all seismic sources in the vicinity of the site. The probabilistic spectrum is defined as the uniform hazard spectrum corresponding to a probability of exceedance of 5% in 50 years (975-year return period) per 2008 USGS hazard maps. In addition, the new procedure also updated the site factor, updated the near fault factor, and includes deep basin effect.

## 8.2 SITE SOIL PROFILE

Boring logs from the field explorations at the project site were reviewed. Shear wave velocity measurements were not made for the previous projects. The representative blow counts and undrained shear strength were used to estimate shear wave velocity based on empirical correlation recommended in Geotechnical Services Design Manual (Caltrans, 2009). The weighted average of the shear wave velocity over the depth of 100 feet was used to determine $V_{s,30}$, which were found in a range of 139 to 248 m/s (Caltrans 2012). However, the site is underlain by more than 10 feet of soft soil (Bay Mud) and is therefore classified as Soil Profile Type E[6] based on the guidelines given in SDC Table B.1.

While some of the surficial fill is potentially liquefiable (Soil Type F), at this preliminary design phase the seismic design spectrum was developed under the simplifying assumption of non-liquefiable material. Additional geotechnical investigations and engineering analyses (e.g. site-specific ground response analyses) should be performed during the preparation for the Foundation Report. However, if the final design of the bridge foundation is relatively deep and the surficial liquefiable fill is confined to be within shallow depth (confirmed by new explorations) such that the site response would not be affected by this liquefiable material, then a code based spectrum may be used instead.

## 8.3 FAULT TYPE AND NEAR-FIELD SPECTRAL ACCELERATIONS

The technical report that accompanies the California Seismic Hazard Map (2007) indicates that the controlling fault is the Hayward fault, which is 6.2 km away from the site. Since the project site is less than 15 km from the nearest active fault, design spectral accelerations should be modified to account for near-fault effects as follows:

| Period (sec) | Increase in Spectral Acceleration (%) |
|---|---|
| <0.5 | 0 |
| 0.5 to 1.0 | 0-20 (determined by linear interpolation) |
| >1.0 | 20 |

This does not include adjustments for bridges with fundamental periods of vibration greater than 1.5 seconds. As the design proceeds, the fundamental period of vibration of the planned structures for this project should be verified with the structural engineer.

---

[6] A soil profile with shear wave velocity vs < 600 ft/s (180 m/s) or any profile with more than 10 ft (3 m) of soft clay, defined as soil with plasticity index PI > 20, water content w ≥ _40 percent, and undrained shear strength su < 500 psf (25 kPa)

## 8.4 DESIGN ACCELERATION RESPONSE SPECTRUM

The Design Acceleration Response Spectrum (ARS) corresponding to Vs,30 = 180 m/s, magnitude of controlling event 7.3, was obtained from ARS online and modified to account for near field effects, as described above. The Design Acceleration Response Spectra is attached as Figure 6, and the spectral values are provided in Table 2. The design ARS curve is the envelope of the deterministic spectrum (Mw = 7.3, R = 6.2 km) and probabilistic spectrum (975-year return period). For the project location, the design spectrum is controlled by the probabilistic spectrum at all structural periods.

**Table 2. Spectral Acceleration Values**

| T (s) | Sa (g) |
|---|---|
| 0.01 | 0.621 |
| 0.05 | 0.866 |
| 0.10 | 1.000 |
| 0.15 | 1.166 |
| 0.20 | 1.300 |
| 0.25 | 1.332 |
| 0.30 | 1.359 |
| 0.40 | 1.328 |
| 0.50 | 1.305 |
| 0.60 | 1.287 |
| 0.70 | 1.278 |
| 0.85 | 1.257 |
| 1.00 | 1.238 |
| 1.20 | 1.120 |
| 1.50 | 0.991 |
| 2.00 | 0.847 |
| 3.00 | 0.544 |
| 4.00 | 0.390 |
| 5.00 | 0.314 |

## 9.0 GEOTECHNICAL RECOMMENDATIONS

On the basis of the results of our preliminary geotechnical study, we conclude that the proposed project is feasible from a geotechnical standpoint. The following sections provide preliminary foundation recommendations for the proposed elevated bike/pedestrian structure.

### 9.1 FOUNDATION ALTERNATIVES

Various foundation alternatives, including isolated shallow foundations as well as deep foundations such as drilled piers and driven piles, were considered to support the proposed structure. The foundation type should be chosen based on structure loading, allowable settlement and economics.

Spread footing foundations are not generally viable unless ground improvement is conducted because of the presence of Bay Mud and potentially liquefiable fill which would lead to total and differential settlements that would exceed the design tolerance. In addition, uplift requirements would likely require very large footings and/or permanent ground anchors. If ground improvement (jet grouting, compaction grouting or cement deep soil mixing) were implemented, shallow foundations could be designed; however, the overall costs would likely be excessive. Therefore, spread footing foundations are not recommended.

Driven precast prestressed concrete piles (PCPS) were also considered for foundation support of the structure. The use of driven piles is sometimes limited due to constructability disadvantages, such as noise and vibration impacts to adjacent structures during installation, as well as difficult driving conditions in dense sands or gravels. Based on the results of the existing subsurface data, the soil layers encountered at the site consists primarily of stiff to very stiff cohesive soils which are not likely to cause any drivability problem for driven piles. Driven piles can be battered at an angle to increase the lateral capacity. In addition, PCPS offer advantages in shallow groundwater and caving soil conditions and also do not produce drill spoils. Based on discussions with TY Lin, PCPS was not selected for this preliminary study; however, this option should be included as a possibility in the environmental documents and should be re-evaluated during final design.

Cast-in-drilled-hole (CIDH) piles have the advantages of easy penetration into dense/hard soil zones, the availability of larger diameters for increased lateral capacity, and adaptability of length to variable subsurface conditions. The presence of shallow groundwater or caving soils can complicate the use of CIDH piles. From the constructability standpoint, CIDH piling rigs are more economical to mobilize than pile driving rigs, can work in limited access conditions, and have significantly lower noise and vibration impacts during pile installation than driving operations. Based on discussions with TY Lin, 6 and 7 feet diameter CIDH piles are currently proposed for support of the Connection structure.

## 9.2 DESIGN SOIL PARAMETERS

Idealized soil profiles with soil stratigraphy and generalized soil engineering parameters are presented in Table 3. This idealized soil profile forms the basis for developing preliminary foundation recommendations for the proposed elevated structure. The proposed CIDH piles will gain primary vertical support through skin friction in the Old Bay Clay. For evaluating axial pile capacity, the skin friction developed within the undocumented fill and Bay Mud was ignored because of the potential for liquefaction of the sands and settlement in the Young Bay Mud. However, these units can be included to resist in short-term lateral loads. While thicker fill exists at some locations along the Connection alignment, thinner fills were used in the idealized profiles because they represent a majority of the alignment and this is considered conservative assuming the piles gain support through the Old Bay Clay. Due to the variability of the location and thickness of the sand, the sand lenses below the Bay Mud and interbedded within Old Bay Clay were conservatively considered assigned Old Bay Clay properties for computing vertical support. The lower sand layer can be included in the detailed design phase when new borings are performed at each foundation location to obtain site-specific information.

Furthermore, to account for the variation of the Bay Mud thickness, two idealized soil profiles were used to bracket the range of subsurface conditions. For other thickness of Bay Mud, the pile capacity can be interpolated linearly. In determining lateral capacity in the event of liquefaction, the fill layer properties were ignored to account for the loss of strength.

**Table 3. Generalized Soil Design Parameters**

| Profile No. | Soil Type | Depth (feet) | Unit Weight (pcf) | Friction Angle (deg) | Shear Strength (psf) |
|---|---|---|---|---|---|
| 1 | Fill | 0-8 | 120 | 28 | 350 (residual, liquefied) |
| | Young Bay Mud | 8-28 | 98 | - | *100 + 10z |
| | Old Bay Clay | 28-110[1] | 115 | - | 1,500 |
| 2 | Fill | 0-6 | 120 | 28 | - |
| | Young Bay Mud | 6-60 | 98 | - | *100 + 10z |
| | Old Bay Clay | 60 -110[1] | 115 | - | 1,500 |

Note 1: The thickness of Old Bay Clay is estimated based on the deepest boring explored. The actual depth could be deeper.

## 9.3 CAST-IN-DRILLED HOLE PILES

As discussed above for this preliminary study, 6 to 7 feet diameter CIDH piles have been selected as the Connector foundation support type. At the time this report was prepared, the design loads were not yet available. Therefore, the proposed pile lengths verses capacities are provided in Figure 7. The final pile data table including design loads and design tip elevations will need to be updated for the Foundation Report once the loading conditions are available and additional geotechnical investigations and analyses are performed. The axial (compression) pile capacities shown in Figure 7 are ultimate values. For preliminary design, the residual strength of the liquefied material is estimated using $N_{160,cs}$ correlations (Seed and Harder 1990). The skin friction due to the non-liquefiable crust using static strength and the liquefied layer using residual strength are used to estimate the downdrag load. The downdrag load is estimated to be about 60 to 70 kips applied to the pile length above the Bay Mud. The downdrag load should disappear once the seismic settlement of this sand layer is complete. This should be re-evaluated when additional boring information is obtained in future design phase to confirm the thickness of the fill and liquefaction potential.

We recommend using a resistance factor of 0.7 and 1.0 for the strength limit state and the extreme limit state, respectively, to calculate the factored nominal resistance in accordance with the Load and Resistance Factor Design (LRFD) methods.

Resistance to lateral loads can be developed by bending of the pile and by soil-pile interaction. The magnitude of the lateral load resistance that can develop depends upon several factors such as the pile size, the physical properties of the surrounding soils, and the structural design of the pile. We used the computer program LPILE plus 5.0 to analyze the individual pile response to the lateral and axial loads with a series of nonlinear springs that are internally generated by the program as a function of user-specified soil properties. In addition, the piles were modeled as free head condition with respect to the two soil profiles including both liquefaction and non-liquefaction conditions. The required depth to provide sufficient lateral capacities is determined by the location of the second zero moment. The lateral loads required producing 1/4 -inch and 1-inch movement at the top of pile are summarized in Table 4. The design tip elevations shown below were estimated only based on the lateral load requirement as information regarding nominal resistance (both compression and tension) are not available at this time.

## Table 4.  Proposed CIDH Pile Data Tables

**For Non-Liquefaction Case:**

| Pile Type | Soil Profile | Nominal Resistance | 1 Inch Deflection | | ¼ Inch Deflection | |
|---|---|---|---|---|---|---|
| | | | Minimum Design Tip Elevation (feet) | Lateral Capacity (kips) | Minimum Design Tip Elevation (feet) | Lateral Capacity (kips) |
| 6-ft CIDH | 1 | N/A | -79 | 178 | -75 | 69 |
| 7-ft CIDH | 1 | N/A | -90 | 225 | -83 | 91 |
| 6-ft CIDH | 2 | N/A | -98 | 172 | -93 | 54 |
| 7-ft CIDH | 2 | N/A | -99 | 220 | -96 | 75 |

**For Liquefaction Case:**

| Pile Type | Soil Profile | Nominal Resistance | 1 Inch Deflection | | ¼ Inch Deflection | |
|---|---|---|---|---|---|---|
| | | | Minimum Design Tip Elevation (feet) | Lateral Capacity (kips) | Minimum Design Tip Elevation (feet) | Lateral Capacity (kips) |
| 6-ft CIDH | 1 | N/A | -92 | 69 | -78 | 37 |
| 7-ft CIDH | 1 | N/A | -97 | 108 | -88 | 55 |
| 6-ft CIDH | 2 | N/A | -96 | 61 | -83 | 27 |
| 7-ft CIDH | 2 | N/A | -99 | 93 | -93 | 38 |

Notes:  1) Assume pile cut off elevation at 0 feet (NAVD 88).

## 9.4 CONSTRUCTION CONSIDERATIONS

Potential construction considerations include:

- The loose cohessionless fill may cave in during installation of the CIDH piles, drilling slurry and/or casing will likely be required.
- Based on the previous investigations, we expect the CIDH piles will encounter groundwater between approximately the Elevations 3 and 0 feet.
- Limited access: the project site is located within urban area and local streets that may require lane closure during construction for the operation of the crane, removing spoil, delivering and installing reinforcing cages, and tremie concrete placement.
- Physical conflicts: potential conflicts with locations of new bridge supports and all existing facilities, such as utilities and adjacent overcrossing foundations.
- Disposal of soil cuttings/excavated materials: in-situ fill material may be contaminated and the handling and disposal should be performed with a Site Mitigation Plan (SMP) that includes health and safety criteria.

## 10.0 ADDITIONAL FIELD INVESTIGATION AND LABORATORY TESTING

As the project advances, we recommend additional geotechnical investigations be performed to characterize the subsurface conditions at the proposed locations of the foundations and verify our preliminary foundation recommendations for the proposed elevated structure. The following additional field investigations are recommended:

- Perform a boring and/or Cone Penetration Test (CPT) advancing 100 feet below the design pile cut-off elevation at each structure support location.
- Perform laboratory tests on recovered soil samples to determine engineering properties, including strength tests, Atterberg limits, sieve analysis, R-value test and corrosivity tests.

At new boring locations, samples should be taken at least at 5-foot depth intervals or at changes in strata. The final sample interval should be based on the materials encountered during drilling and sampling. Drive samples in the alluvium should be taken with either a SPT or Modified California (MC) sampler. Shelby Tubes and Pitcher Barrel samples should be used to collect Bay Mud and Old Bay Clay, respectively. In addition, suspension logging should be performed in selected borings to measure shear wave velocity for seismic design analysis.

At new CPT locations, the CPT probe was advanced using a hydraulic push system mounted in a mobile truck to collect information electronically such as tip resistance, sleeve friction, pore pressure and inclination data at 0.05 m intervals as the sounding was advanced. In addition, the CPT soundings can also include 1) Seismic Cone Penetration Tests (SCPTs) which collect compression and shear wave velocity for evaluation of the Vs30 and 2) Pore Pressure Dissipation Tests (PPDTs) which measure hydrostatic pressure for evaluation of the static groundwater table. The SCPT uses a modified CPT cone that contains a built-in seismometer.

These additional investigations will also allow a confirmation of liquefaction susceptibility and triggering potential, analyses of potential ground deformations and effects on foundation capacity, and design recommendations to accommodate any anticipated consequences of liquefaction.

## 11.0 LIMITATIONS

The opinions, conclusions and recommendations presented herein are based on subsurface information developed by others. The recommendations presented in this report are based on the assumption that the soil and geologic conditions do not deviate substantially from those anticipated by the information contained in the existing logs of test borings. If any variations are encountered during construction, the Geotechnical Professional should be contacted so that supplemental recommendations can be made.

If existing facilities, utilities, soils/bedrock conditions, road/structure distress, slope distress or groundwater/seepage conditions other than those noted in this report are present on the site, then their presence was not known, or was not considered in the preparation of this report. Locating utilities and evaluating potential utility interference is outside the scope of this report. Individuals utilizing this report shall inform Fugro if they are aware of any additional facilities or site conditions so that their presence and impact upon the project (or vice-versa) can be properly evaluated and recommendations modified to address geotechnical issues as necessary.

Specific review and investigation for environmental issues and subsurface environmental contamination will be investigated by Fugro and presented in a separate report if requested.

The opinions and recommendations presented in this report were developed with the standard of care commonly used by other geotechnical professionals practicing at the same time, within the same locality and under the same limitations. No other warranties are included, either expressed or implied, as to the professional advice included in this report.

This report has been prepared for the benefit of TY Lin International and the Gateway Park Working Group. The information contained in this report, including all exhibits and attachments, may not be used by any party other than TY Lin International and the Gateway Park Working Group, without the express written consent of Fugro Consultants Inc.

# 12.0 REFERENCES

California Department of Transportation (Caltrans), 2003 Bridge Design Specification

California Department of Transportation (Caltrans), 2007 Caltrans Deterministic PGA Map

California Department of Transportation (Caltrans), 2011 “California Amendments to AASHTO LRFD Bridge Design Specifications – fifth edition”, November.

California Department of Transportation (Caltrans), 2013a, Caltrans Memo to Designers 3-1 dated August.

California Department of Transportation (Caltrans), 2009, Guidelines for Structures Foundation Reports, Version 2.0, dated March.

California Department of Transportation (Caltrans), 2013, Seismic Design Criteria, Version 1.7, dated April.

California Department of Transportation (Caltrans), 2012, Highway Design Manual dated May.

California Geological Survey, 2009, Tsunami Inundation Map for Emergency Planning, Oakland West Quadrangle by California Geological Survey, dated July.

FEMA, 2009. Digital Flood Insurance Rate Maps (DFIRMS).

Graymer, R.W., 2000, Geologic Map and Map Database of the Oakland Metropolitan Area, Alameda, Contra Costa and San Francisco Counties, California, U.S. Geological Survey, MF-2342, Scale 1:50,000.

Lienkaemper, J.J. and Galehouse, J.S., 1997, Revised long-term creep rates on the Hayward fault, Alameda and Contra Costa Counties: California, U.S. Geological Survey Open-File Report 97-690, 18 p.

Lienkaemper, J.J. Dawson, T.E., Personius, S.F., Seitz, G.G., Reidy, L.M., and Schwartz, D.P. 2002. A Record of Large Earthquakes on the Southern Hayward Fault for the Past 500 Years. Bulletin of the Seismological Society of America, Vol. 92, No. 7, pp. 2637–2658, October 2002

Moss, R.E.S., Seed, R.B., Kayen, R.E., Stewart, J.P., Der Kiureghian, A. and Cetin, K.O., 2006,

O'Neill, M.W. and Reese, L.C., 1999. Drilled Shafts: Construction Procedures and Design Methods, FHWA Report No. IF-99-025, Federal Highway Administration, Washington, D.C

J. David Rogers and Sands H. Figuers, 1991 Engineering Geologic Site Characterization of the Greater Oakland-Alameda Area, Alameda and San Francisco Counties, California. Final Report to the National Science Foundation, Rogers Pacific, Inc., 106 pages

Seed, R.B., K.O., Cetin, R.E.S., Moss, A., Kammerer, J., Wu, J.M., Pestana, M.F., Riemer, R.B., Sancio, J.D., Bray, R.E., Kayen, R.E., Faris, A. (2003), “Recent advances in soil liquefaction engineering: a unified and consistent framework”, Keynote Address, 26th Annual Geotechnical Spring Seminar, Los Angeles Section of the Geo-Institute, American Society of Civil Engineers, H.M.S. Queen Mary, Long Beach, CA.

Sloan, Doris 1992, The Yerba Buena mud record of the last interglacial predecessor of San Francisco Bay California Geological Society of America Bulletin v 104 no 6 p 716 727.

Stover, C.W., and Coffman, J.L., 1993. Seismicity of the United States, 1568-1989 (Revised) U.S. Geological Survey Professional Paper 1527, 1993.

Tokimatsu, K. and H.B. Seed, 1987. Evaluation of settlements in sands due to earthquake shaking, J. Geot. Engrg., 113 (8), 861-878.

Tomlinson, M. J.,1970.The adhesion of piles driven in stiff clay, Construction Industry Research and Information association, Research Report No. 26, London.

USGS, 2007, Earthquake Probabilities in the San Francisco Bay Region: 2007-2037, By Working Group on California Earthquake Probabilities, Open File Report 07-1437.

USGS Probabilistic Seismic Hazard Analysis http://earthquake.usgs.gov/research/hazmaps/

Wells, D. L. and Coppersmith, K.J., 1994 New empirical relationships among magnitude, rupture length, rupture width, rupture area, and surface displacement. Bulletin of the Seismological Society of America August 1994 vol. 84 no. 4 974-1002.

# PLATES

## Legend

- ▼ Fugro 2014 CPT
- ● Fugro 2011 Boring
- ▼ SFOBB CPT
- ● SFOBB Boring
- ● Historical Borings (1946 - 2007)
- ● Army Base Borings
- ● Caltrans Borings
- Cross Section Line

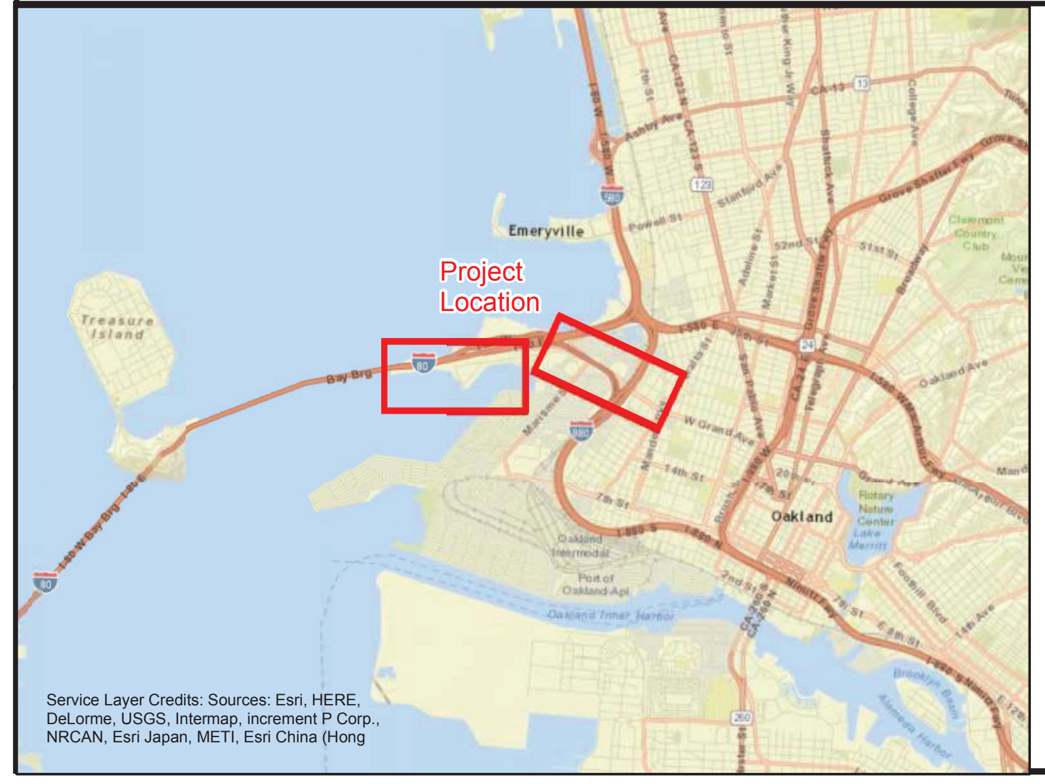
Structures

- 🟥 Existing
- 🟩 Proposed

## Building Index

| Building No. | Name |
|---|---|
| 1 | PG&E Substation |
| 2 | Historical Key Building |
| 3 | Historical Mole Substation |
| 4 | Bay Bridge Elevated Bike Path Structure Connection to Park |
| 5 | 2-288 Span Structure |
| 6 | EBMUD Building @ "The Point" |
| 7 | North Shore Elevated Bike Path on Structure |
| 8 | Mole Substation (PG&E) |
| 9 | Retaining Wall |

| Building No. | Name |
|---|---|
| 10 | Visitor Center |
| 11 | Climbing Wall |
| 12 | Shoreline Protection |
| 13 | EBMUD Crossing Location 1 |
| 14 | IERBYS/Historical Warehouse |
| 15 | Auditorium |
| 16 | EBMUD Crossing Location 2 |
| 17 | EBMUD Crossing Location 3 |
| 18 | Burma Road Elevated Bike Path Structure |



Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong

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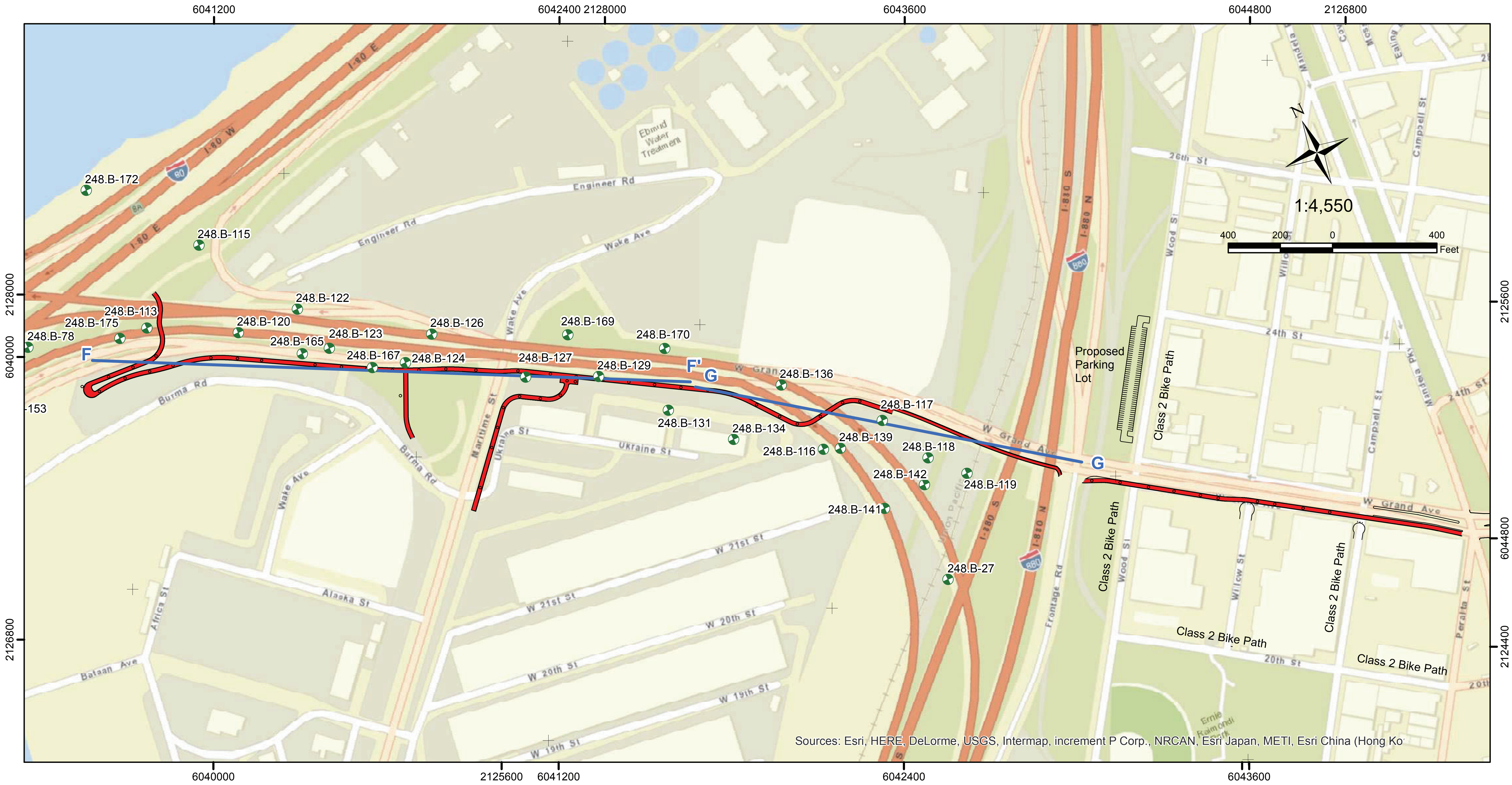
# SITE AND BORING LOCATION PLANS
# GATEWAY PARK

## San Francisco Oakland Bay Bridge Bicycle / Pedestrian Connection, Oakland, California

| NO: | DATE: | DESCRIPTION: | DRAWN: | CHKD: | APPR: |
|---|---|---|---|---|---|
| 1 | Jun 2014 | Exploration and Cross section Location Map | CBD | HS | TW |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

JOB NUMBER: 04.72130012

PLATE.: 1a



Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Ko

**Legend**

| | |
|---|---|
| 🟢 Caltrans Borings | 🟥 Burma Road Elevated Bike Path Structure |
| — Cross Section Line | |

# SITE AND BORING LOCATION PLAN
# THE CONNECTION

San Francisco Oakland Bay Bridge
Bicycle / Pedestrian Connection
Oakland, California

PLATE 1b

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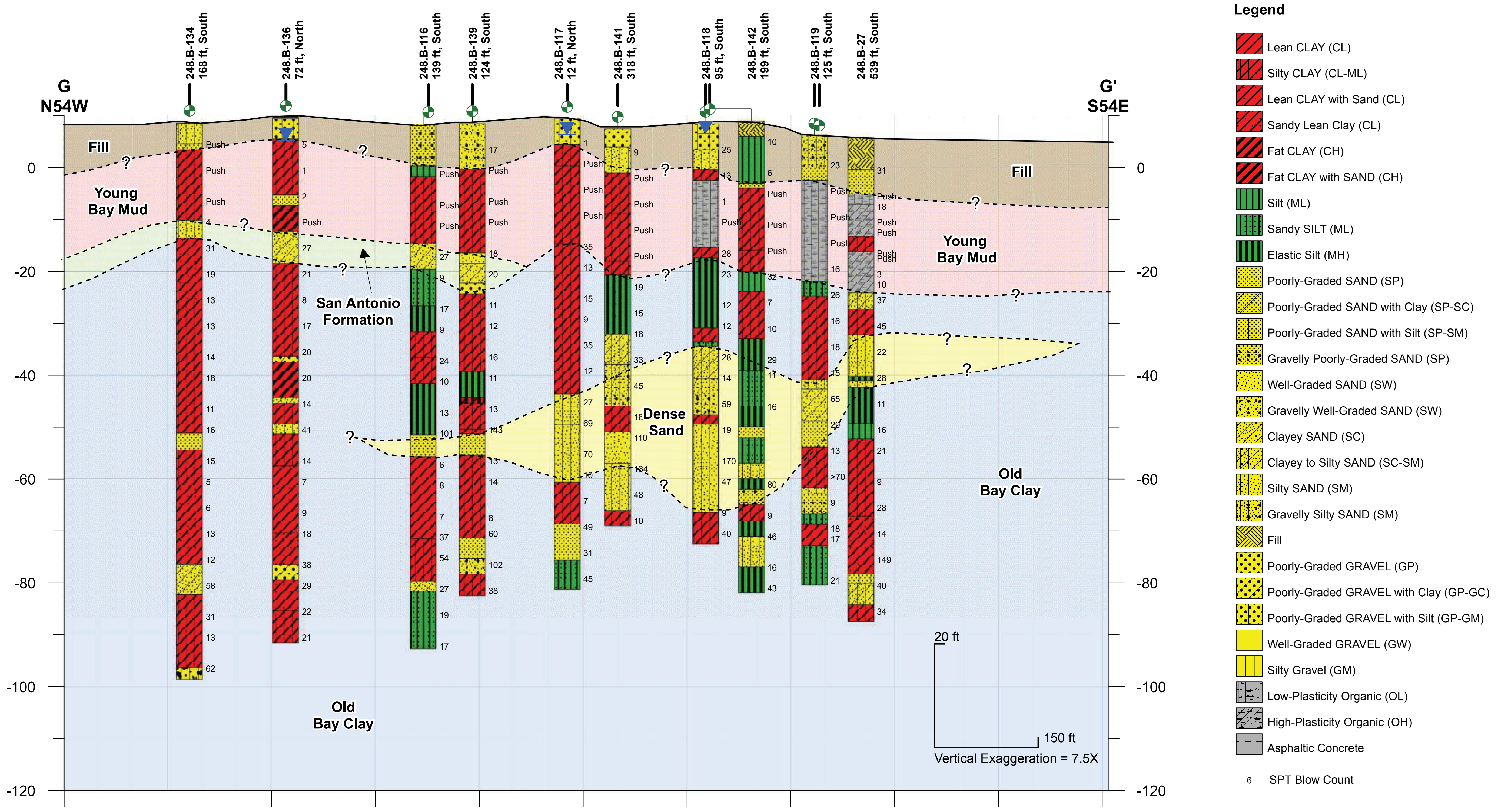

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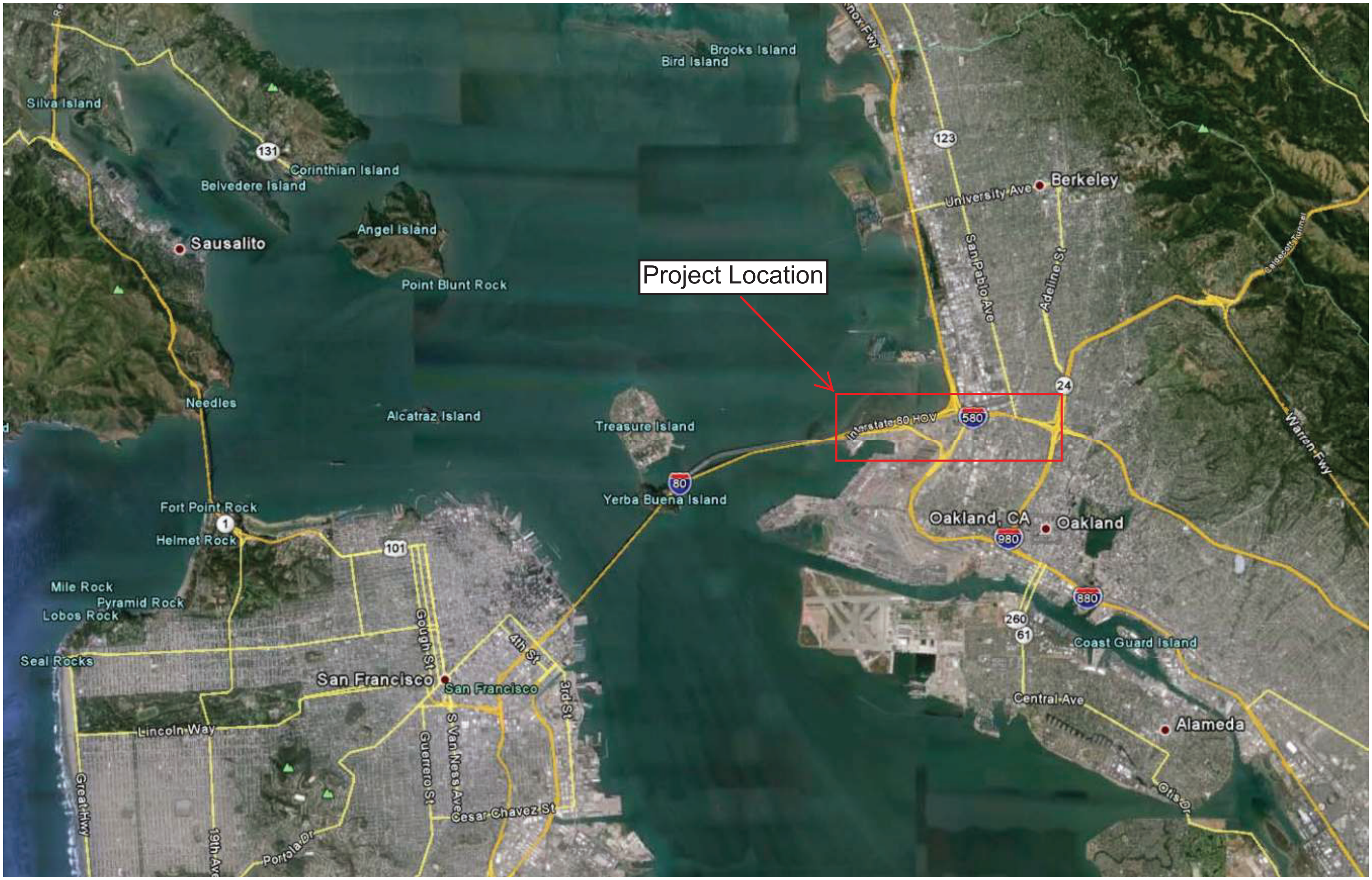
## IDEALIZED SUBSURFACE PROFILE

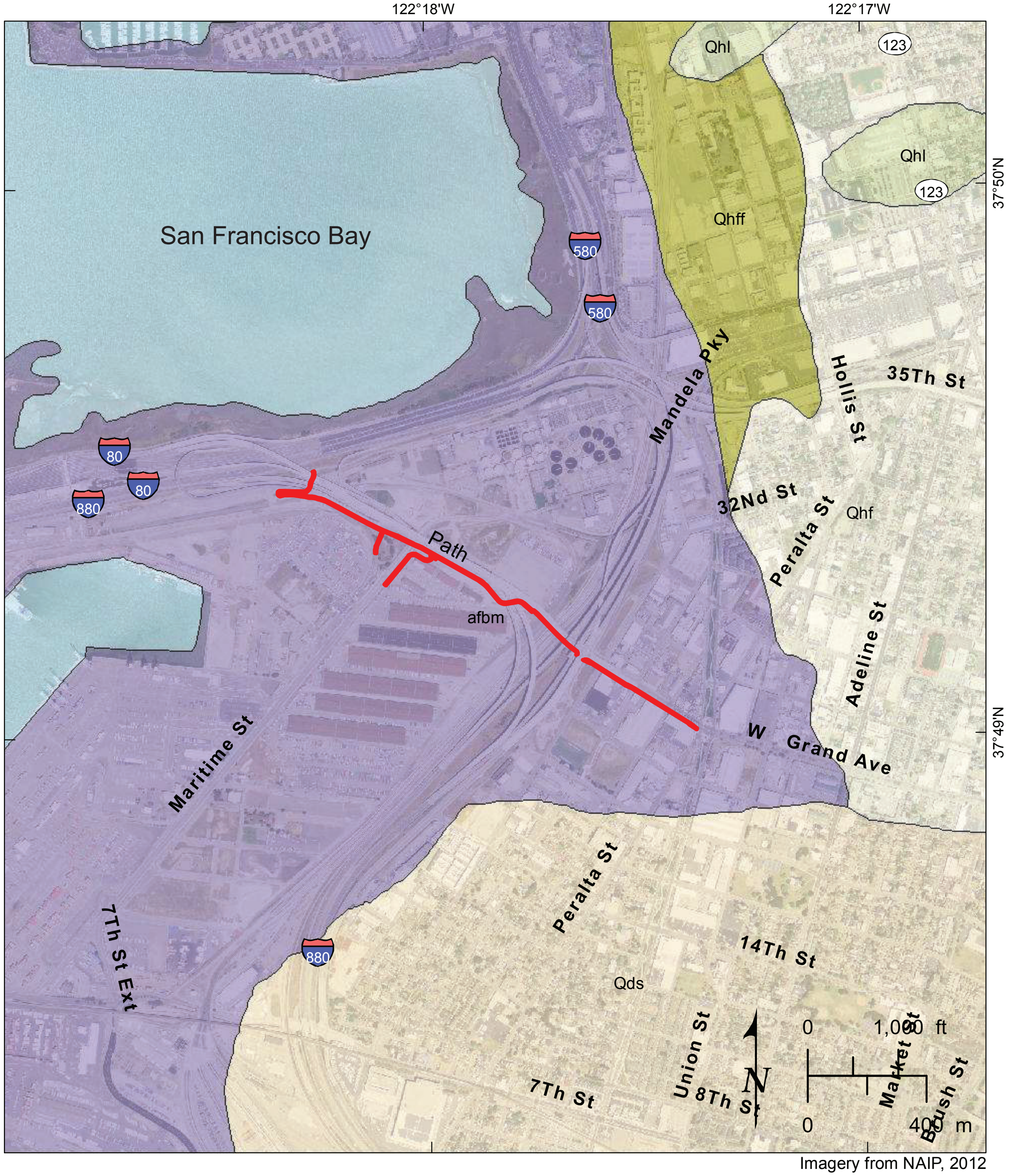
San Francisco Oakland Bay Bridge
Bicycle / Pedestrian Connection
Oakland, California

PLATE 2b

# FIGURES



## Vicinity Map



Imagery from NAIP, 2012

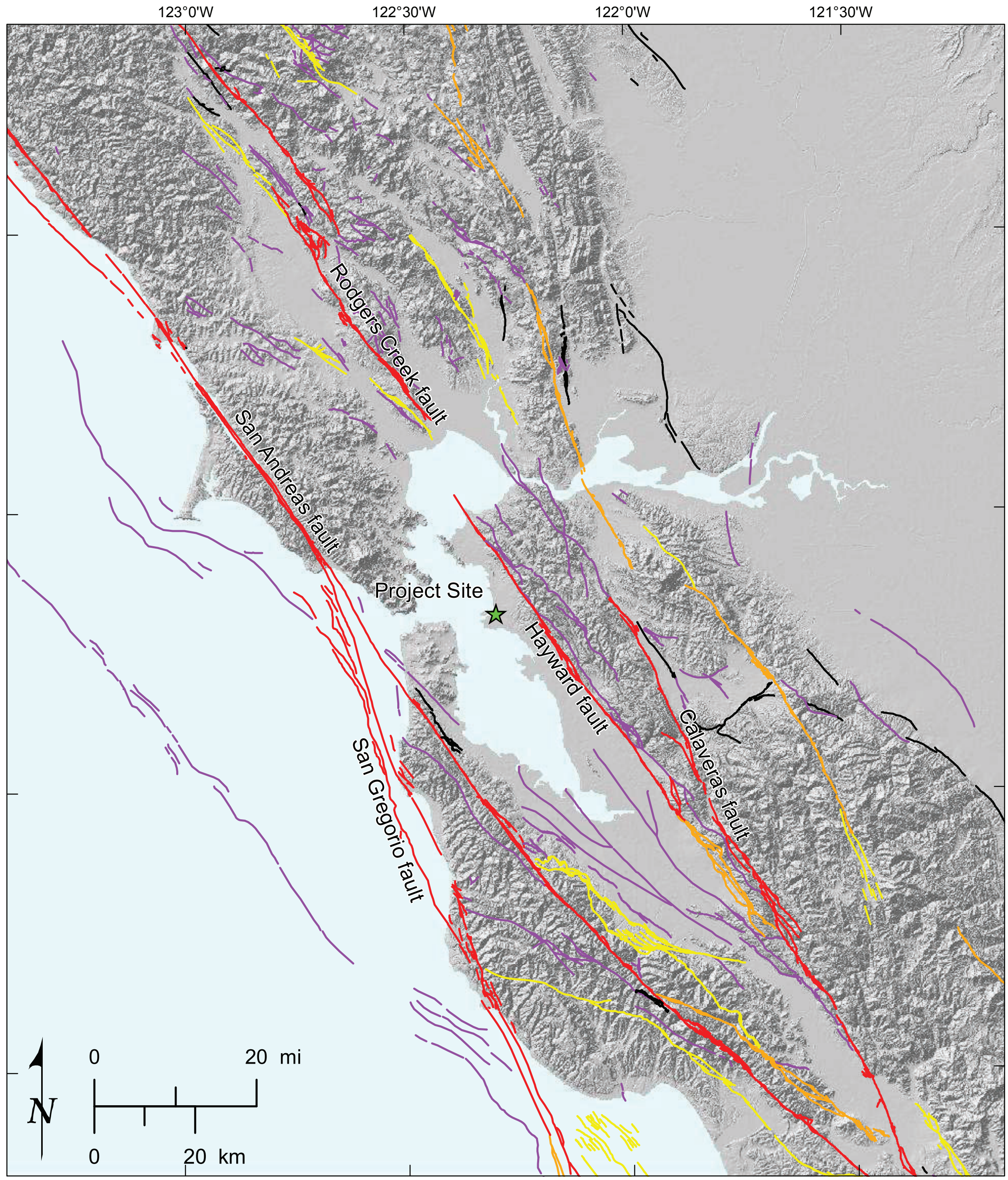
*Quaternary Deposits*
*(Knudsen et al., 2000; USGS OFR 00-444)*

| | |
|---|---|
| afbm | Artificial fill over San Francisco Bay mud |
| Qhff | Fine-grained Holocene alluvial fan deposits |
| Qhf | Holocene alluvial fan deposits |
| Qhl | Holocene alluvial fan levee deposits |
| Qds | Latest Pleistocene to Holocene dune sand |

## Quanternary Geologic Map

San Francisco Oakland Bay Bridge
Bicycle / Pedestrian Connection

FIGURE 2



Reference: U.S. Geological Survey, 2006, Quaternanry fault and fold database,from USGS web site: http//earthquakes.usgs.gov/regional/qfaults/.

*Quaternary Faults (slip rate mm/year)*

- — >5
- — 1-5
- — 0.2-1
- — <0.2
- — Unknown

## Major Active Fault Map

San Francisco Oakland Bay Bridge
Bicycle / Pedestrian Connection

FIGURE 3

Imagery from NAIP, 2012

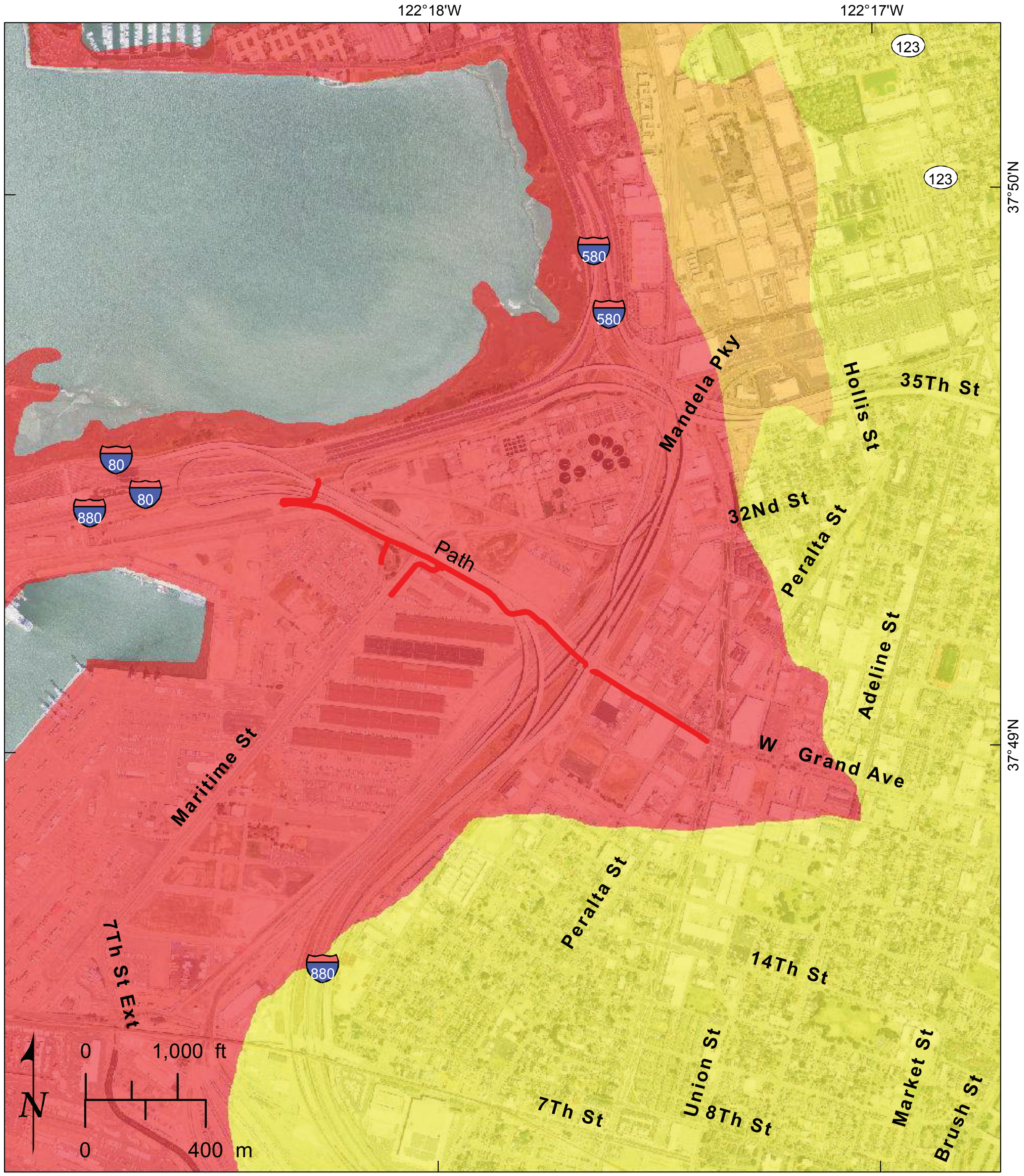
🟥 AP fault zone

**Alquist-Priolo Earthquake Fault Zone**

San Francisco Oakland Bay Bridge

Bicycle / Pedestrian Connection

FIGURE 4



Imagery from NAIP, 2012

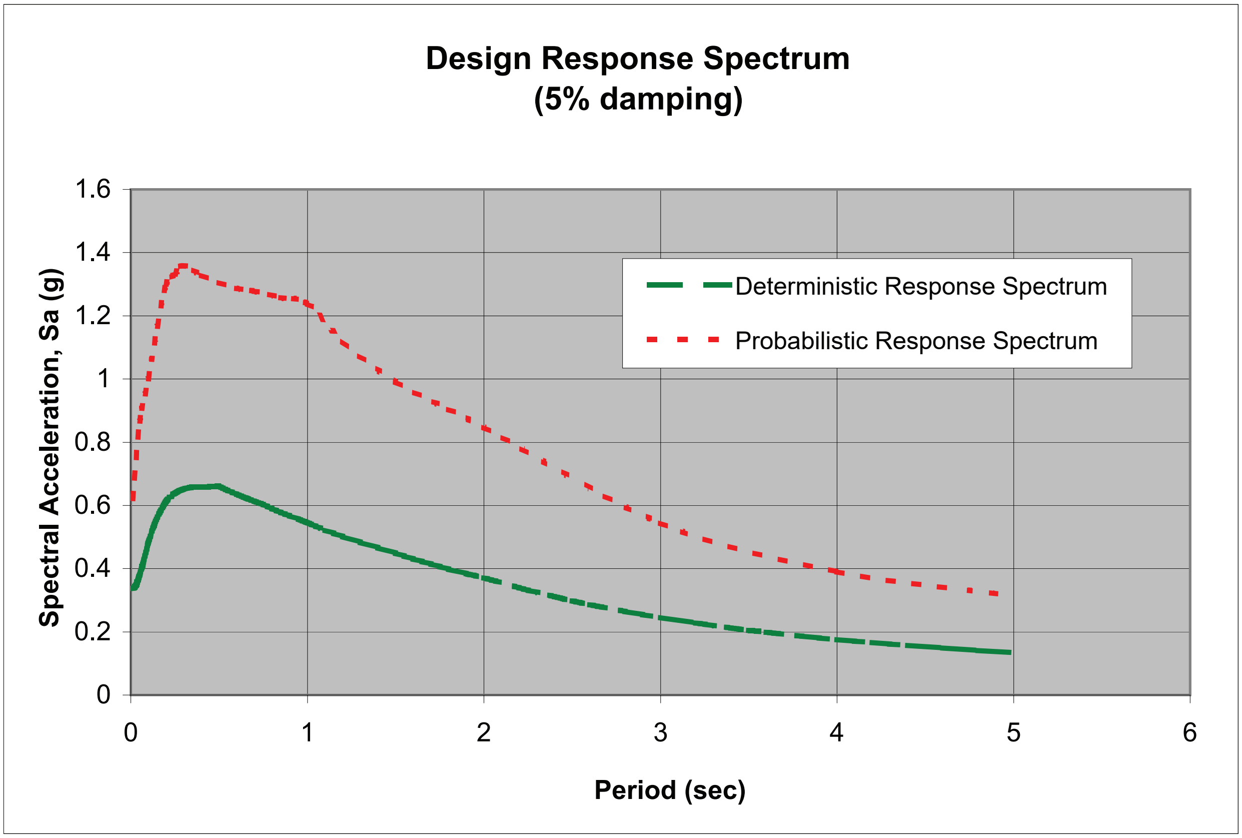
*Liquefaction Susceptibility*
*(Knudsen et al., 2000; USGS OFR 00-444)*

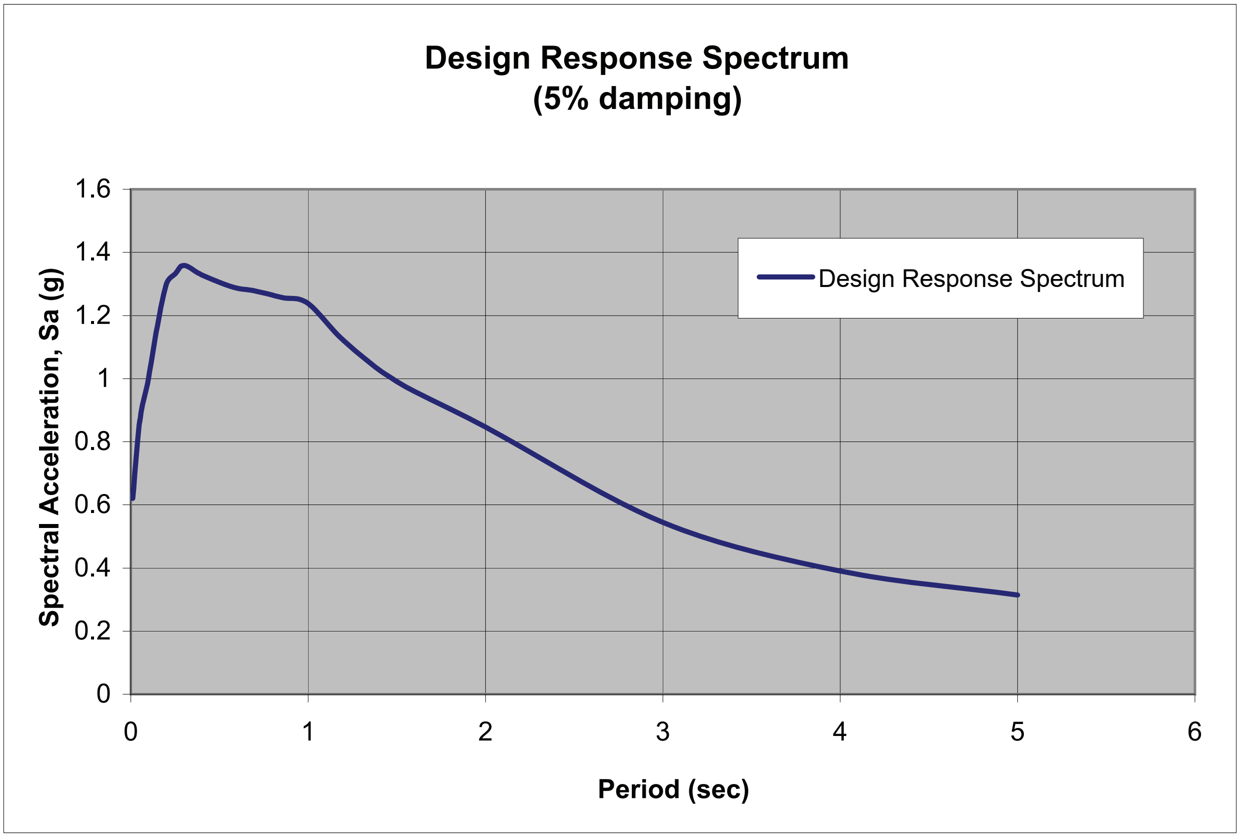
- 🟥 Very High
- 🟧 High
- 🟨 Moderate
- 🟩 Low (not within map extent)
- 🟩 Very Low (not within map extent)

**Liquefaction Susceptibility in the Project Vicinity**

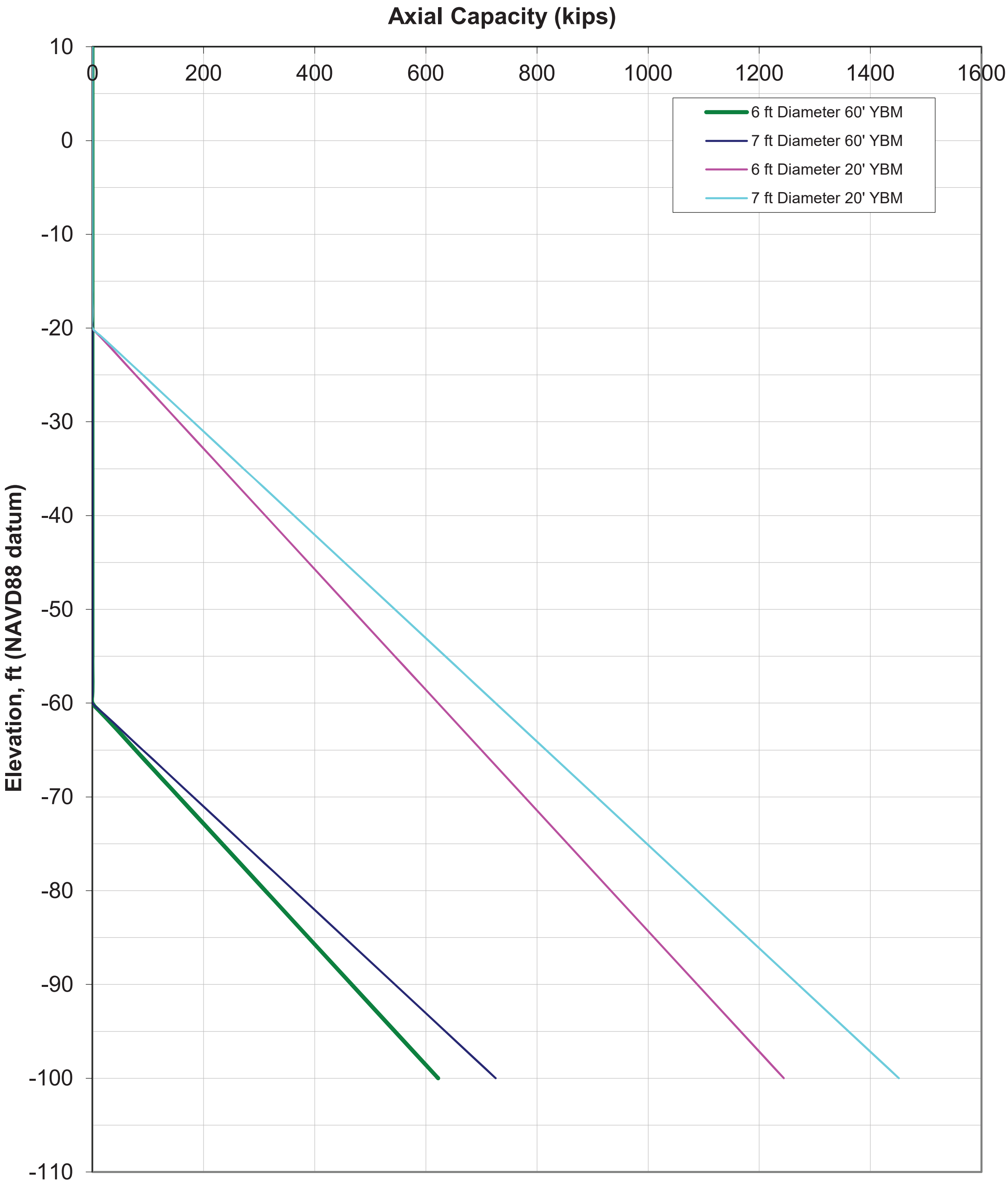
San Francisco Oakland Bay Bridge
Bicycle / Pedestrian Connection

FIGURE 5





**Recommended Acceleration Response Spectrum**



## Gateway Park - The Connection
## Cast-In-Drilled Holes (CIDH) Piles Ultimate Capacity

FIGURE 7

# APPENDIX A

# PROJECT LAYOUT PLANS

Drawing: P:\320142.00 Gateway Park\CADD\00 Shts\S-LINK-XXX-C-L001-50sc.dwg

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

CONSULTANT FUNCTIONAL SUPERVISOR

CALCULATED-DESIGNED BY

CHECKED BY

REVISED BY

UNDERGROUND SERVICE ALERT
CALL BEFORE YOU DIG
1-800-227-2600

| Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS |
|---|---|---|---|---|---|
|  |  |  |  |  |  |

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
No.
Exp.
CIVIL
STATE OF CALIFORNIA

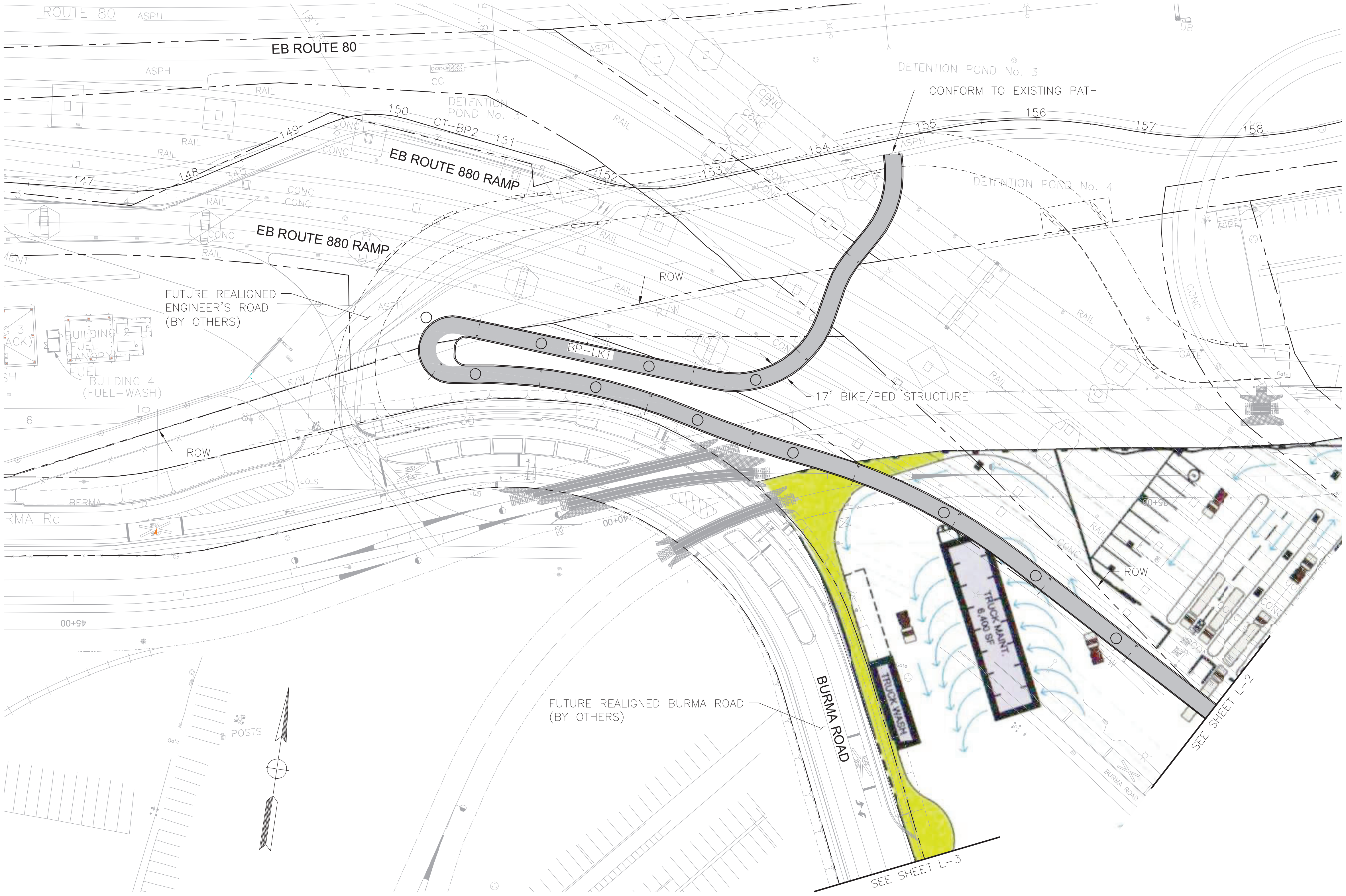
*THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.*

BAY AREA TOLL AUTHORITY
101 EIGHT STREET
OAKLAND, CALIFORNIA 94607

T.Y. LIN INTERNATIONAL
1111 BROADWAY, SUITE 2150
OAKLAND, CALIFORNIA 94607

NOTES:

1. XXXXXXXXXXXXXXX
2. XXXXXXXXXXXXXXX



50' 0' 100' 150'
SCALE: 1" = 50'

## LAYOUT

Scale: 1"=50'

# PRELIMINARY PLAN

L-1

LAST REVISION 06-05-14

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

EA XX-XXXXX

| Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS |
|---|---|---|---|---|---|
| | | | | | |

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
No.
Exp.
CIVIL
STATE OF CALIFORNIA

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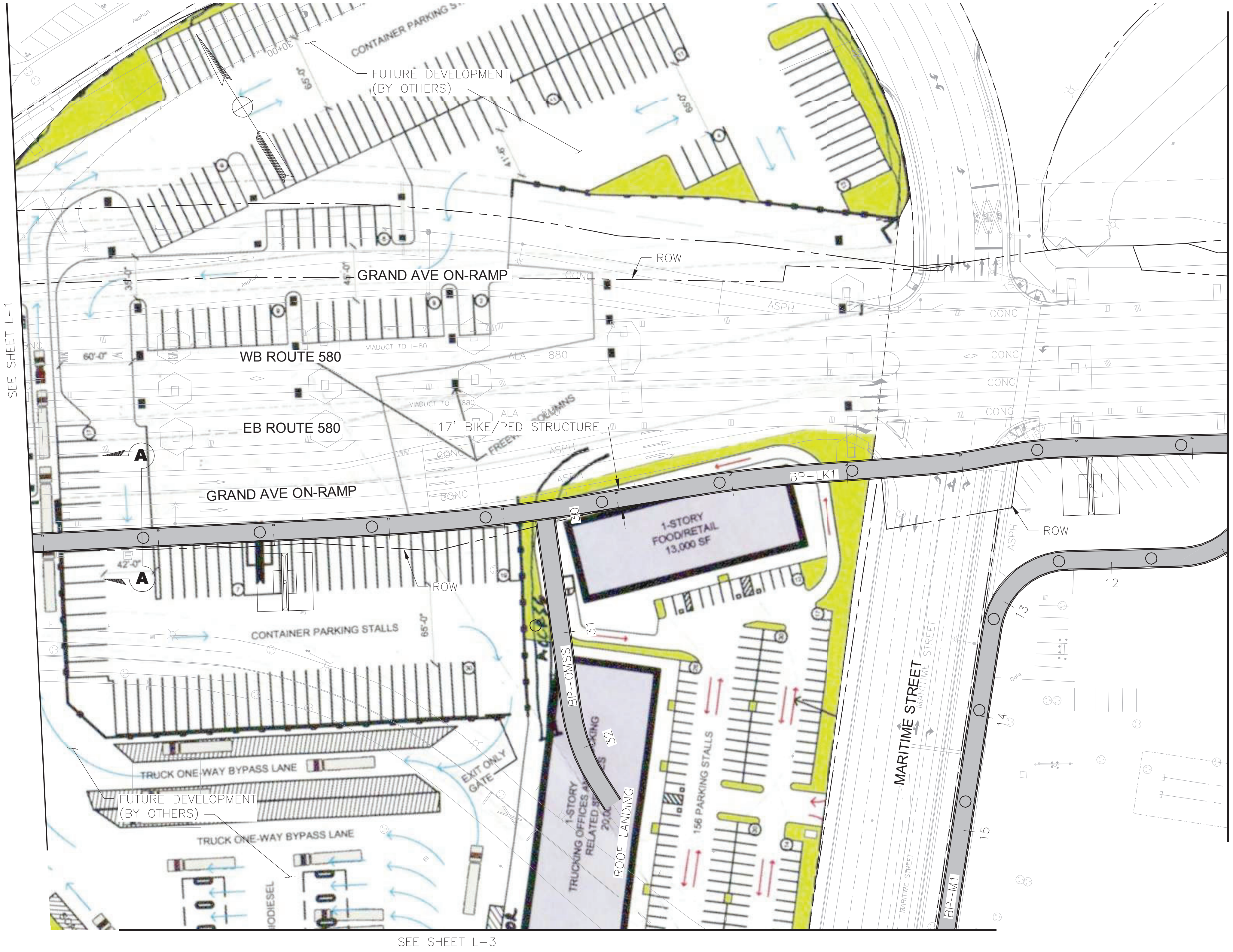
BAY AREA TOLL AUTHORITY
101 EIGHT STREET
OAKLAND, CALIFORNIA 94607

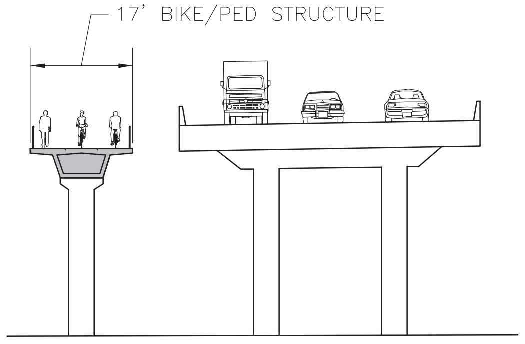
T.Y. LIN INTERNATIONAL
1111 BROADWAY, SUITE 2150
OAKLAND, CALIFORNIA 94607

UNDERGROUND SERVICE ALERT
CALL BEFORE YOU DIG
1-800-227-2600

NOTES:

1. XXXXXXXXXXXXXXX
2. XXXXXXXXXXXXXXX





**PROPOSED SECTION A-A**

NTS

50' 0' 100' 150'

SCALE: 1" = 50'

## LAYOUT

Scale: 1"=50'

# PRELIMINARY PLAN

L-2

LAST REVISION
06-05-14

RELATIVE BORDER SCALE IS IN INCHES
0 1 2 3

EA XX-XXXXX

Drawing: P:\320142.00 Gateway Park\CADD\00 Shts\S-LINK-XXX-C-L002-50sc.dwg

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR

CALCULATED-DESIGNED BY

CHECKED BY

REVISED BY

| Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS |
|---|---|---|---|---|---|
| | | | | | |

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1-800-227-2600

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
No.
Exp.
CIVIL
STATE OF CALIFORNIA

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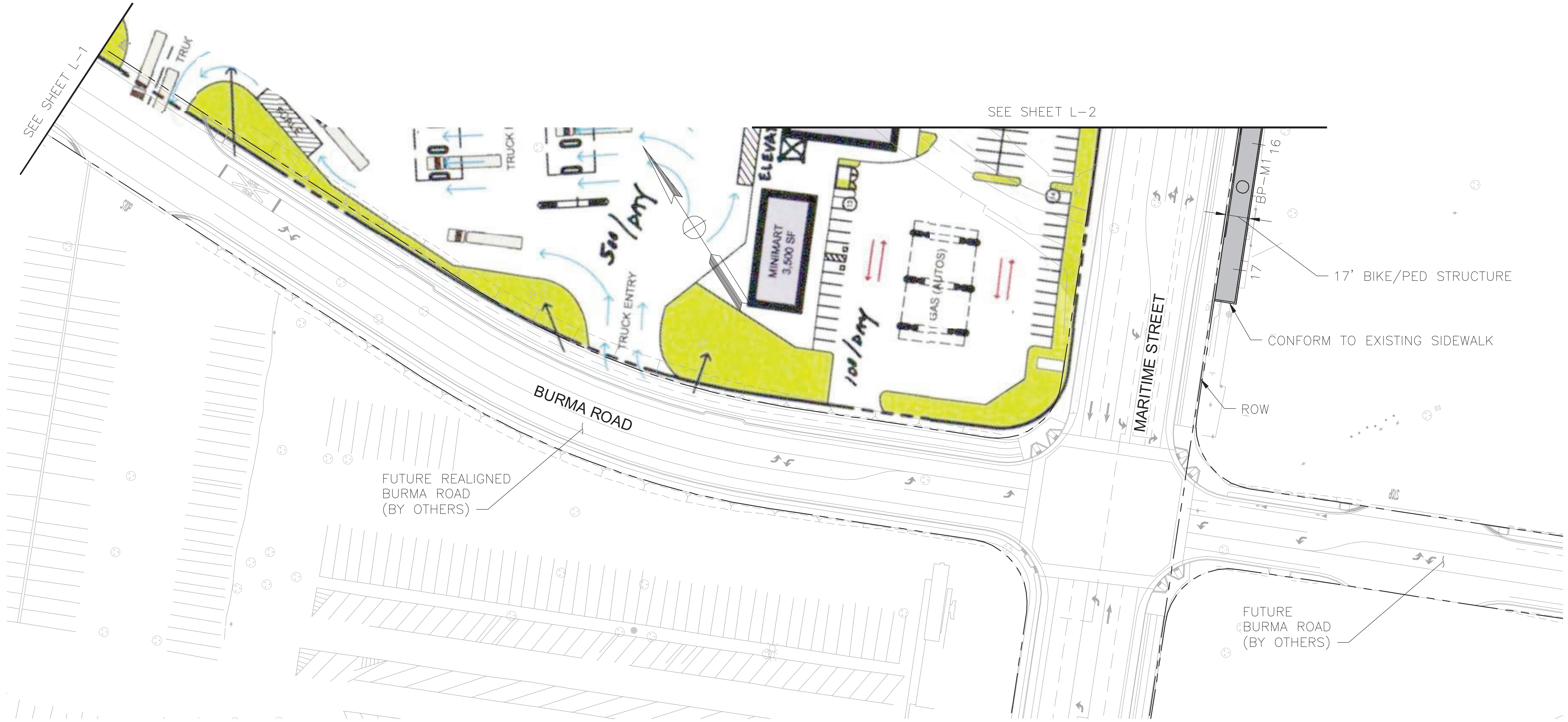
101 EIGHT STREET
OAKLAND, CALIFORNIA 94607

T.Y. LIN INTERNATIONAL
1111 BROADWAY, SUITE 2150
OAKLAND, CALIFORNIA 94607

NOTES:

1. XXXXXXXXXXXXXXX
2. XXXXXXXXXXXXXXX



50' 0' 100' 150'
SCALE: 1" = 50'

## LAYOUT

Scale: 1"=50'

# PRELIMINARY PLAN

L-3

LAST REVISION 06-05-14

REVISED BY

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CONSULTANT FUNCTIONAL SUPERVISOR

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

Drawing: P:\320142.00 Gateway Park\CADD\00 Shts\S-LINK-XXX-C-L003-50sc.dwg

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

EA XX-XXXXX

Drawing: P:\320142.00 Gateway Park\CADD\00 Shts\S-LINK-XXX-C-L004-50sc.dwg

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| Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS |
|---|---|---|---|---|---|
| | | | | | |

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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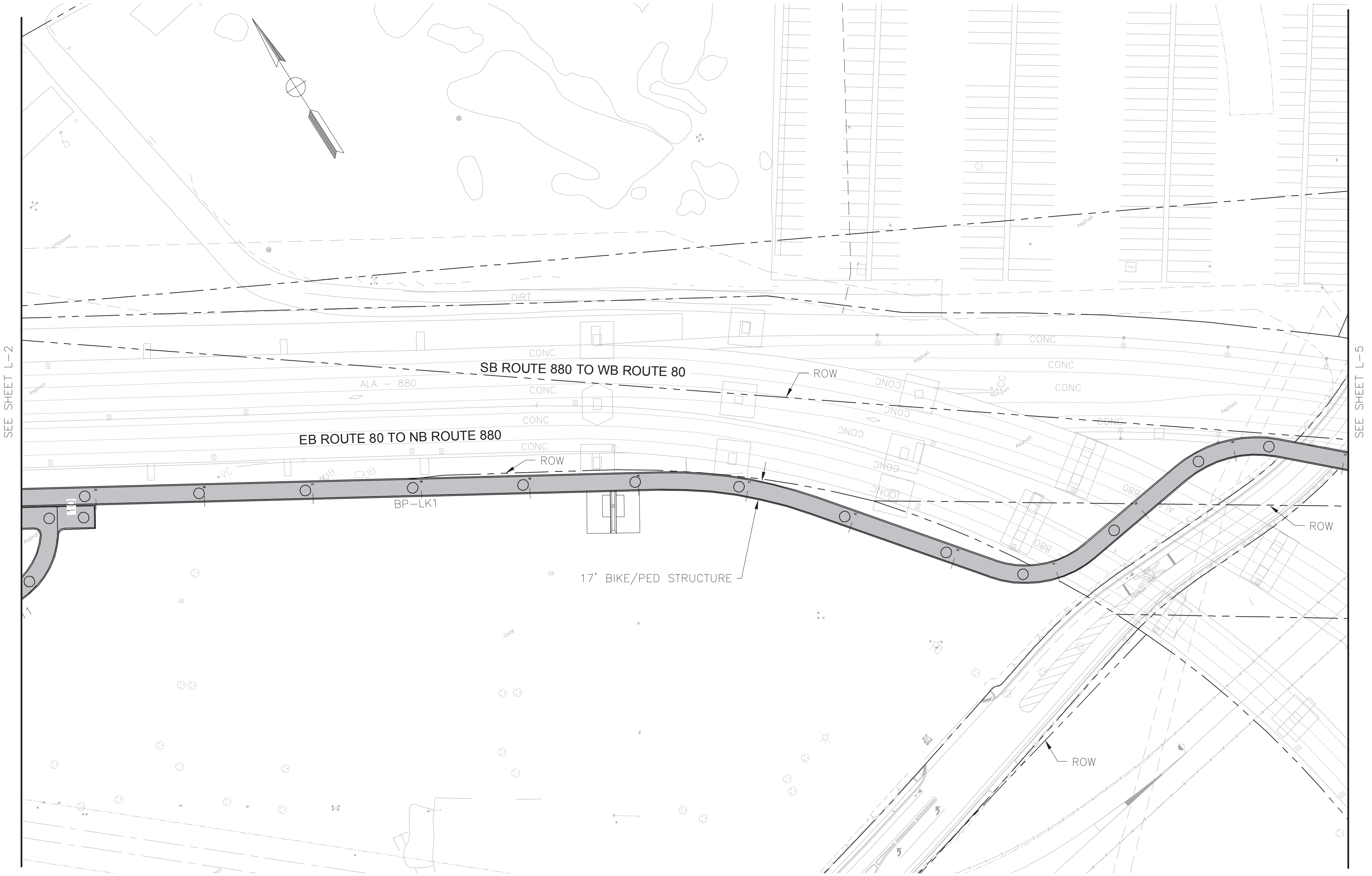
REGISTERED PROFESSIONAL ENGINEER
No.
Exp.
CIVIL
STATE OF CALIFORNIA

BAY AREA TOLL AUTHORITY
101 EIGHT STREET
OAKLAND, CALIFORNIA 94607

T.Y. LIN INTERNATIONAL
1111 BROADWAY, SUITE 2150
OAKLAND, CALIFORNIA 94607

NOTES:

1. XXXXXXXXXXXXXXX
2. XXXXXXXXXXXXXXX



50' 0' 100' 150'
SCALE: 1" = 50'

## LAYOUT

Scale: 1"=50'

# PRELIMINARY PLAN

L-4

LAST REVISION
06-05-14

RELATIVE BORDER SCALE IS IN INCHES
0 1 2 3

EA XX-XXXXX

Drawing: P:\320142.00 Gateway Park\CADD\00 Shts\S-LINK-XXX-C-L005-50sc.dwg

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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| | | | |

UNDERGROUND SERVICE ALERT

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1-800-227-2600

| Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS |
|---|---|---|---|---|---|
| | | | | | |

REGISTERED CIVIL ENGINEER DATE

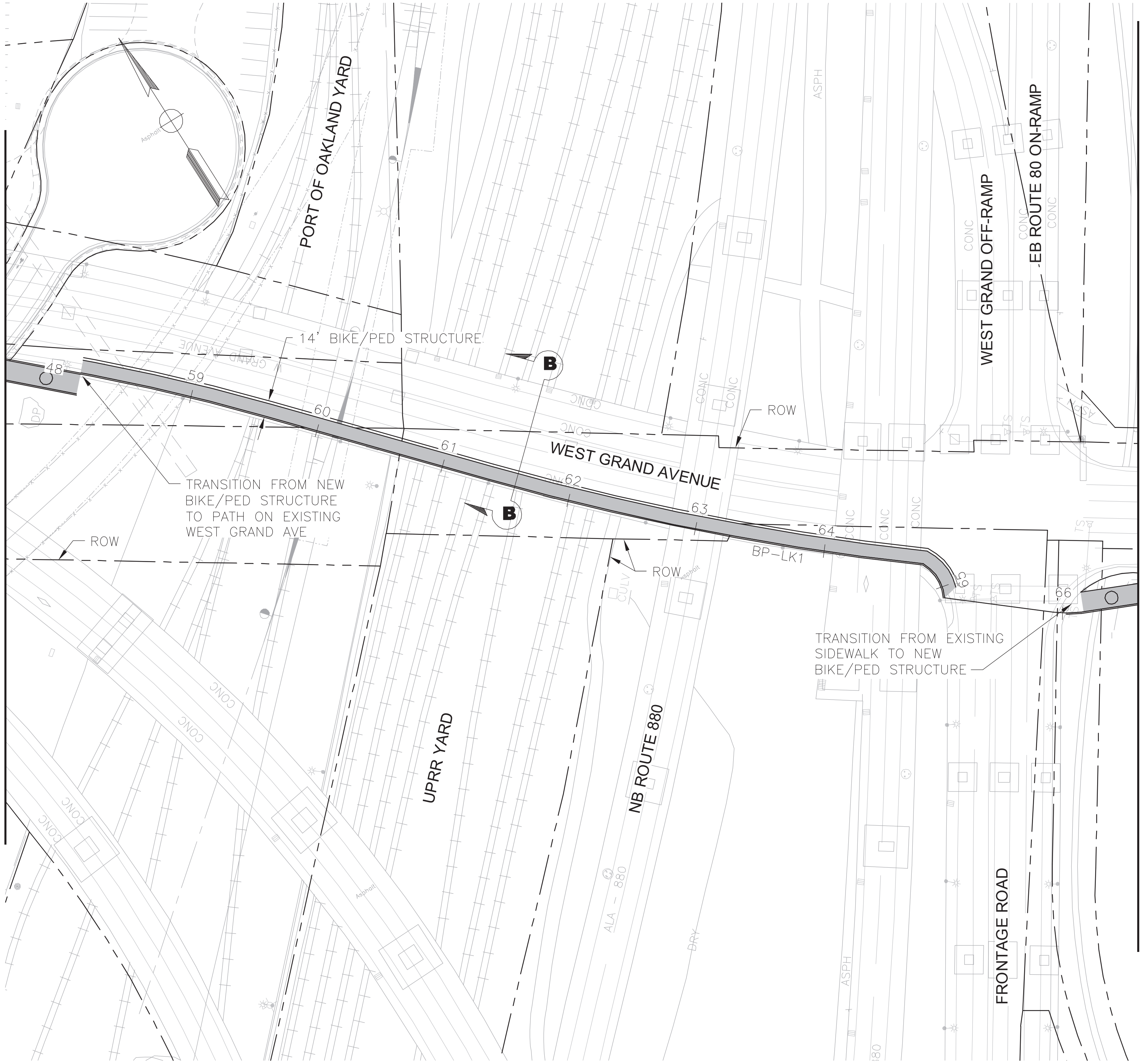
PLANS APPROVAL DATE

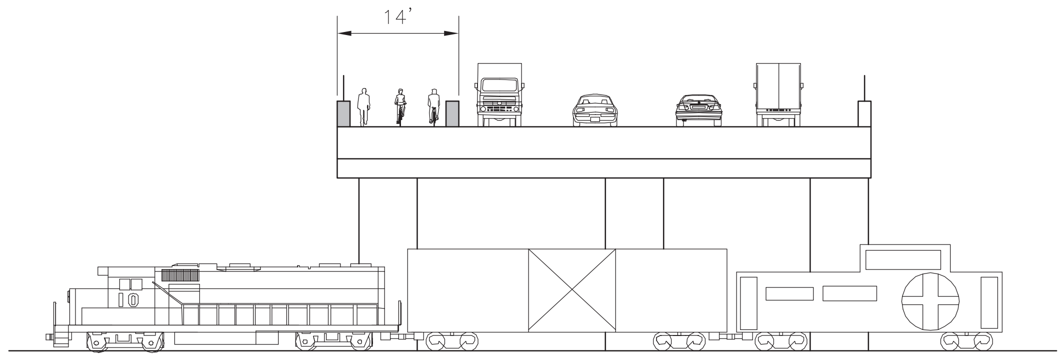
BAY AREA TOLL AUTHORITY
101 EIGHT STREET
OAKLAND, CALIFORNIA 94607

T.Y. LIN INTERNATIONAL
1111 BROADWAY, SUITE 2150
OAKLAND, CALIFORNIA 94607

NOTES:

1. XXXXXXXXXXXXXXX
2. XXXXXXXXXXXXXXX





**PROPOSED SECTION B-B**

NTS

50' 0' 100' 150'

SCALE: 1" = 50'

## LAYOUT

Scale: 1"=50'

# PRELIMINARY PLAN

L-5

LAST REVISION 06-05-14

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

EA XX-XXXXX

| Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS |
|---|---|---|---|---|---|
| | | | | | |

UNDERGROUND SERVICE ALERT
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1-800-227-2600

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

No. ____
Exp. ____
CIVIL

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101 EIGHT STREET
OAKLAND, CALIFORNIA 94607

T.Y. LIN INTERNATIONAL
1111 BROADWAY, SUITE 2150
OAKLAND, CALIFORNIA 94607

NOTES:

1. XXXXXXXXXXXXXXX
2. XXXXXXXXXXXXXXX

**PROPOSED SECTION C-C**
NTS

LAYOUT
Scale: 1"=50'

# PRELIMINARY PLAN

L-6

Drawing: P:\320142.00 Gateway Park\CADD\00 Shts\S-LINK-XXX-C-L006-50sc.dwg

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

CONSULTANT FUNCTIONAL SUPERVISOR | CALCULATED-DESIGNED BY | CHECKED BY | REVISED BY

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

EA XX-XXXXX

LAST REVISION 06-05-14

| Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS |
|---|---|---|---|---|---|
| | | | | | |

UNDERGROUND SERVICE ALERT
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1-800-227-2600

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

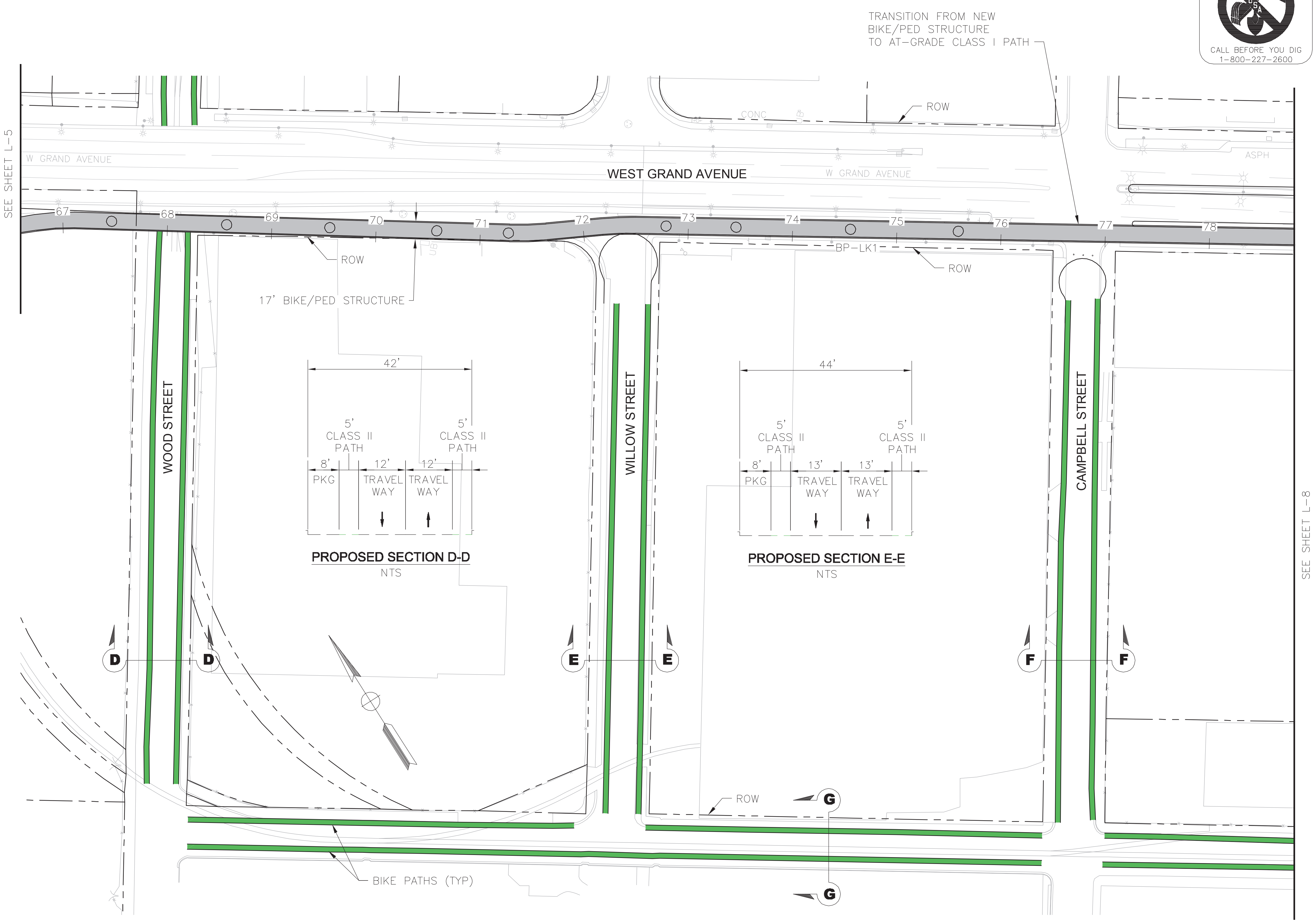
REGISTERED PROFESSIONAL ENGINEER
No.
Exp.
CIVIL
STATE OF CALIFORNIA

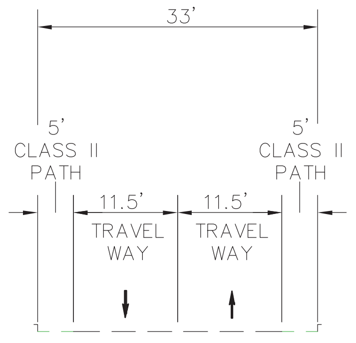
BAY AREA TOLL AUTHORITY
101 EIGHT STREET
OAKLAND, CALIFORNIA 94607

T.Y. LIN INTERNATIONAL
1111 BROADWAY, SUITE 2150
OAKLAND, CALIFORNIA 94607

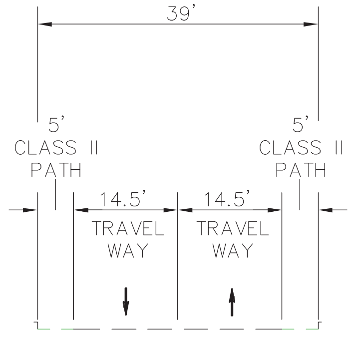
NOTES:

1. XXXXXXXXXXXXXXX
2. XXXXXXXXXXXXXXX





PROPOSED SECTION F-F
NTS



PROPOSED SECTION G-G
NTS

50' 0' 100' 150'
SCALE: 1" = 50'

## LAYOUT

Scale: 1"=50'

# PRELIMINARY PLAN

L-7

LAST REVISION
06-05-14

REVISED BY

CALCULATED-DESIGNED BY

CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

Drawing: P:\320142.00 Gateway Park\CADD\00 Shts\S-LINK-XXX-C-L007-50sc.dwg

RELATIVE BORDER SCALE IS IN INCHES
0 1 2 3

EA XX-XXXXX

| Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS |
|---|---|---|---|---|---|
| | | | | | |

UNDERGROUND SERVICE ALERT
CALL BEFORE YOU DIG
1-800-227-2600

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
No.
Exp.
CIVIL
STATE OF CALIFORNIA

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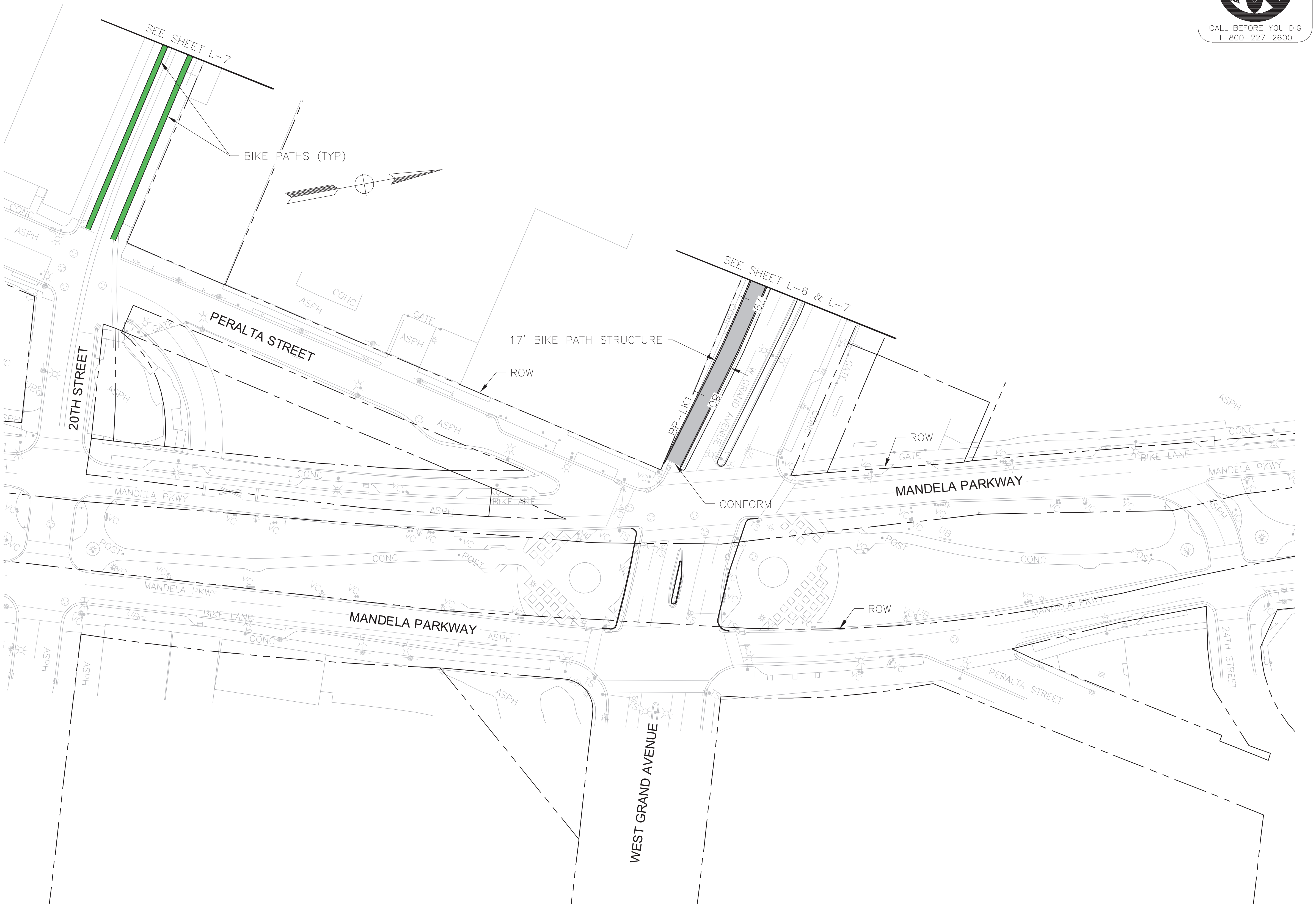
101 EIGHT STREET
OAKLAND, CALIFORNIA 94607

T.Y. LIN INTERNATIONAL
1111 BROADWAY, SUITE 2150
OAKLAND, CALIFORNIA 94607

NOTES:

1. XXXXXXXXXXXXXXX
2. XXXXXXXXXXXXXXX



50' 0' 100' 150'
SCALE: 1" = 50'

## LAYOUT

Scale: 1"=50'

# PRELIMINARY PLAN

L-8

Drawing: P:\320142.00 Gateway Park\CADD\00 Shts\S-LINK-XXX-C-L008-50sc.dwg

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR

CALCULATED-DESIGNED BY

CHECKED BY

REVISED BY

LAST REVISION
06-05-14

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

EA XX-XXXXX

# APPENDIX B

# BORING LOGS FROM PREVIOUS INVESTIGATIONS

| DIST. | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 04 | Ala | 880 | 34.3/35.0 | 888 | 940 |

R.C. Wilhelms
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST
R.C. WILHELMS
No. 560
Exp. 6-30-94
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

3-13-95
PLANS APPROVAL DATE

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

## AS BUILT

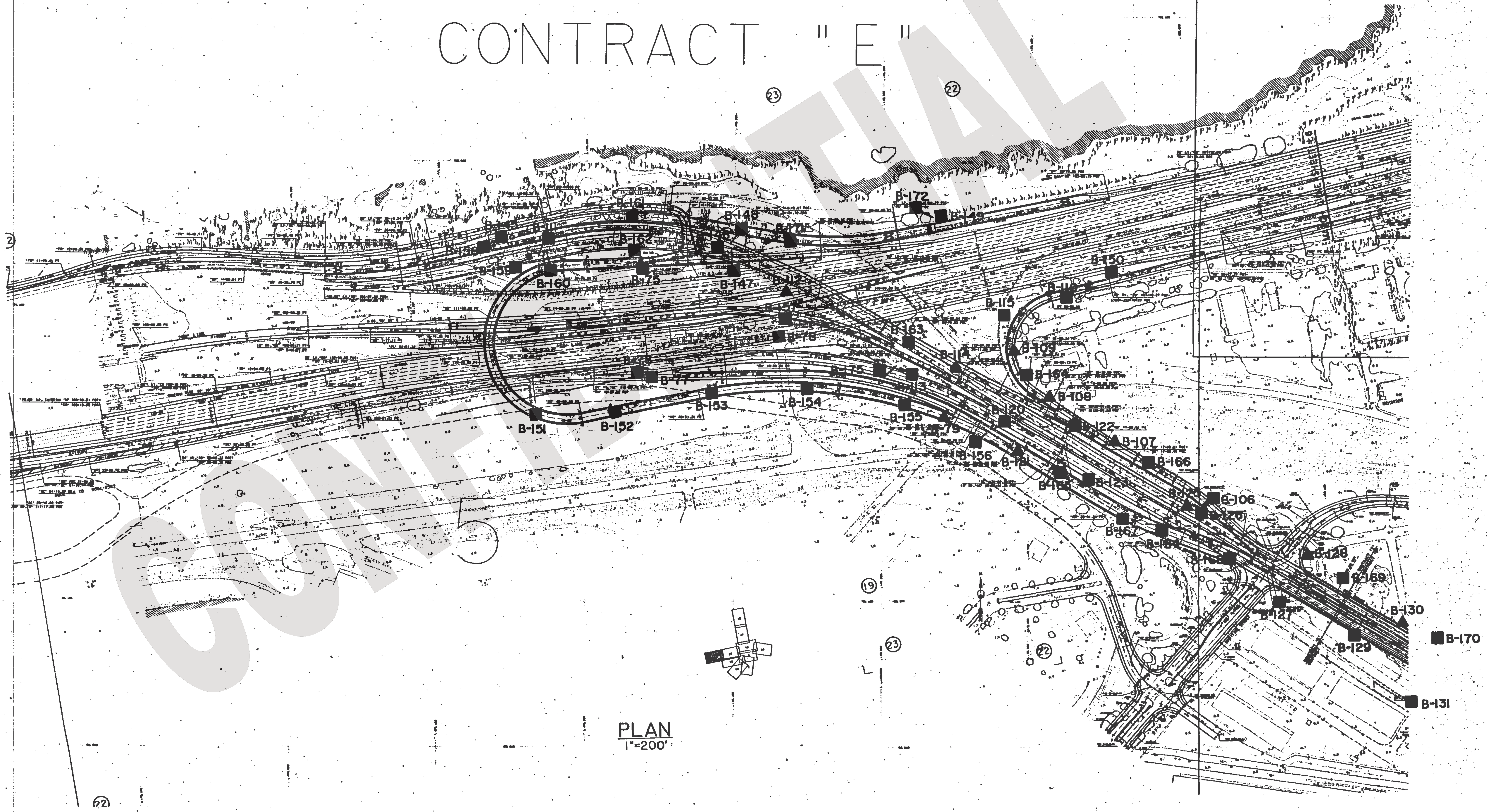
CORRECTIONS BY S. WHIPPLE
CONTRACT NO. 04192244
DATE 01-28-98
NO AS-BUILT CHANGES M.F. 4-16-98

## BENCH MARK

BM AB-1036 EL.=5.92'
P.K. NAIL W/C.T. SHINER AT NORTHERLY END OF A.C. PATH LEADING AWAY (NORTHERLY) S.P.R.R. DEPOT (16TH & WOOD ST.) APPROX. OPPOSITE FROM 20TH STREET.

BM AB-441 EL.=5.33'
P.K. NAIL AND SHINER 0.04 BELOW A.C. PAVEMENT NEAR ℄ INTERSECTION OF WOOD AND 20TH STREET.

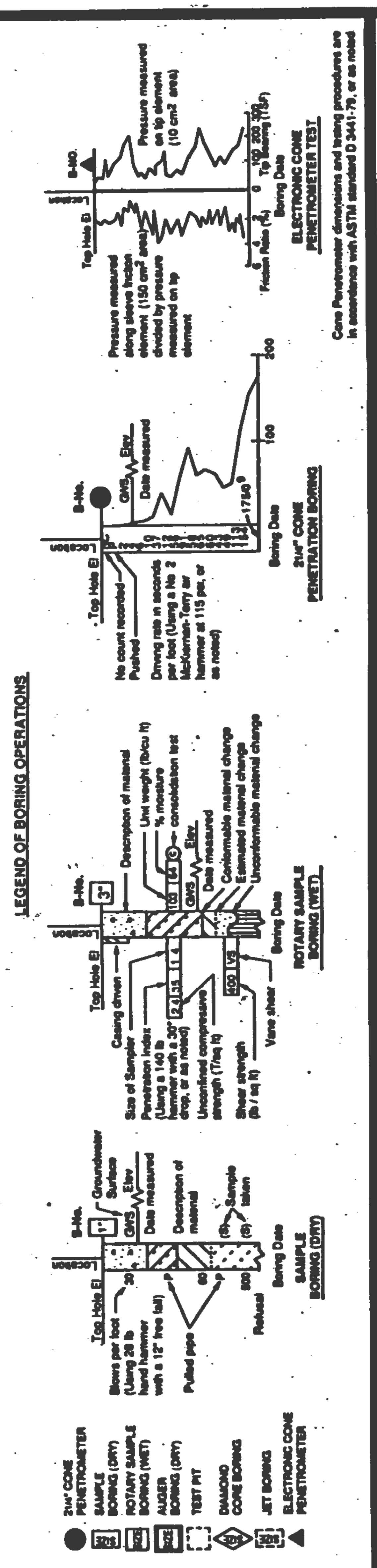
BM AB-420 EL.=39.64'
P.K. NAIL W/ SHINER AT NORTHEASTERLY SIDE OF ABANDONED WOOD BRIDGE OVER S.P.R.R. TRACKS. 1200' NORTHERLY OF WEST GRAND AVE. AT END OF WAKE AVE.



PLAN
1"=200'

CONTRACT "E"

### LEGEND OF BORING OPERATIONS



- ● 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 material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

OFFICE OF TRANSPORTATION MATERIALS & RESEARCH
ENGINEERING GEOLOGY BRANCH
DRAWN BY K. WAHL 5-92
CHECKED BY
FIELD INVESTIGATION BY: M. WILLIAN

State of CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN

BRIDGE NO. 33-612 E
POST MILE

PORT OF OAKLAND CONN. VIADUCT
LOG OF TEST BORINGS 1 OF 20

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3
CU 04
EA 192231
DISREGARD PRINTS BEARING EARLIER REVISION DATES →
REVISION DATES (PRELIMINARY STAGE ONLY)
SHEET 68 OF 101

TL 6051 REV. 3/90

| DIST. | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET NO | TOTAL SHEETS |
|---|---|---|---|---|---|
| 04 | Ala | 880, 80 | 34.4,<br>1.3/3.0 | 557 | 1412 |

R.C. Wilhelms
CERTIFIED ENGINEERING GEOLOGIST

R.C. WILHELMS
No. 560
Exp. 6-30-94
CERTIFIED ENGINEERING GEOLOGIST

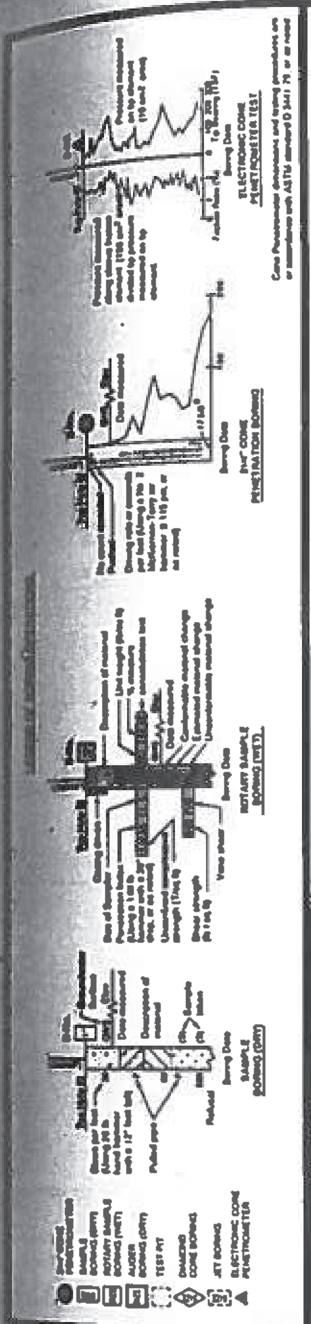
6-13-94
PLANS APPROVAL DATE

## BENCH MARK

BM:AB-1036 EL.=5.92
P.K. NAIL W/C.T. SHINER AT NORTHERLY END OF A.C. PATH LEADING AWAY (NORTHERLY) S.P.R.R. DEPOT (16TH & WOOD ST.) APPROX. OPPOSITE FROM 20TH STREET.

BM:AB-441 EL.=5.33'
P.K. NAIL AND SHINER 0.04 BELOW A.C. PAVEMENT NEAR ₵ INTERSECTION OF WOOD AND 20TH STREET.

BM:AB-420 EL.=39.64
P.K. NAIL W/ SHINER AT NORTHEASTERLY SIDE OF ABANDONED WOOD BRIDGE OVER S.P.R.R. TRACKS. 1200' NORTHERLY OF WEST GRAND AVE AT END OF WAKE AVE.



According to the Standard Penetration Test

| Penetration Index (Blows / Ft) | Granular | Cohesive |
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| +70 | Very dense | Very hard |

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

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

PLAN
1" = 200

CONTRACT "E"

| OFFICE OF TRANSPORTATION MATERIALS & RESEARCH | ENGINEERING GEOLOGY BRANCH | FIELD INVESTIGATION BY |
|---|---|---|
| DRAWN BY | IRMA GAMARRA 5/92 | M. WILLIAN |
| CHECKED BY | | |

State of
CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN

BRIDGE NO.
33-612 E
POST MILE

PORT OF OAKLAND CONN. VIADUCT
LOG OF TEST BORINGS 2 OF 20

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04
EA 19223I

DISREGARD PRINTS BEARING EARLIER REVISION DATES

[redacted]

SHEET OF
116 148

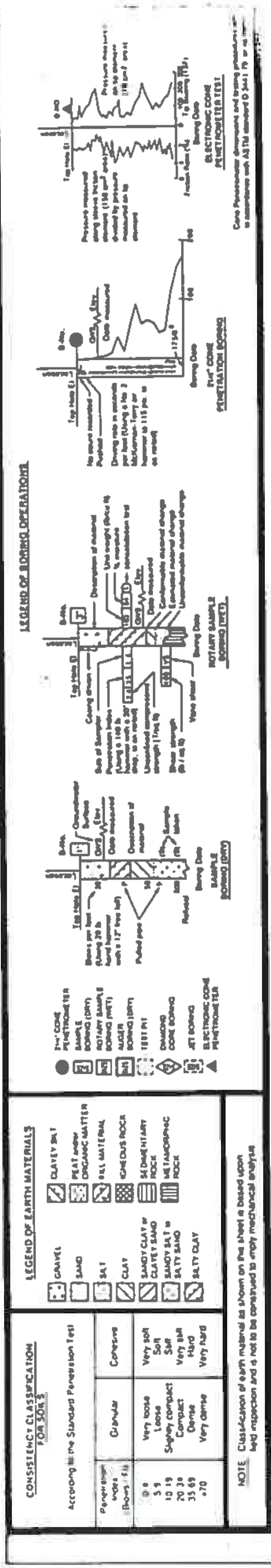
240. B-11
· B-78

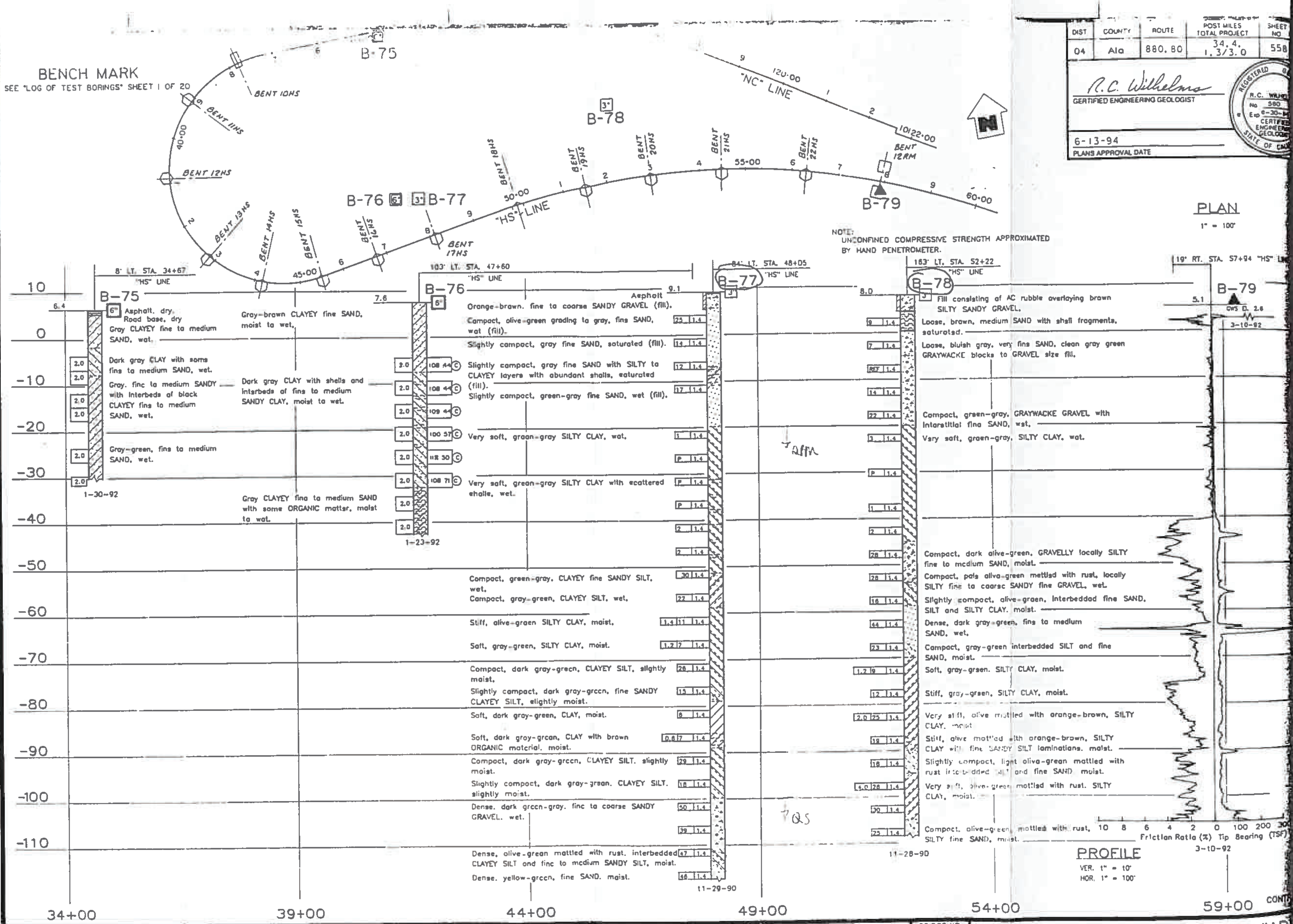
| DIST | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET NO |
|---|---|---|---|---|
| 04 | Ala | 880, 80 | 34.4.<br>1.3/3.0 | 558 |

R.C. Wilhelms
CERTIFIED ENGINEERING GEOLOGIST

R.C. No 580 Exp 6-30-

6-13-94
PLANS APPROVAL DATE





| | | | | | |
|---|---|---|---|---|---|
| OFFICE OF TRANSPORTATION MATERIALS & RESEARCH | ENGINEERING GEOLOGY BRANCH | FIELD INVESTIGATION BY: M. WILLIAM | State of CALIFORNIA DEPARTMENT OF TRANSPORTATION | DIVISION OF STRUCTURES STRUCTURE DESIGN | BRIDGE NO. 33-612 E |
| DRAWN BY | | | | CU 04 | POST MILE |
| CHECKED BY | | | | EA 192231 | |

PORT OF OAKLAND CONN. VIAD
LOG OF TEST BORINGS 3

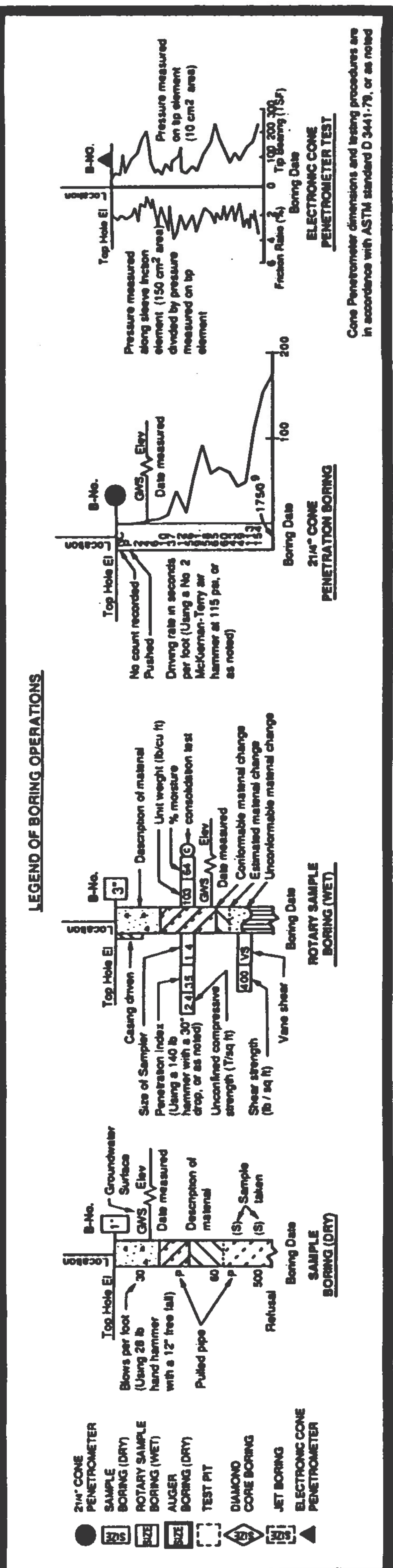
DISREGARD PRINTS BEARING EARLIER REVISION DATES
REVISION DATES (PRELIMINARY STAGE ONLY)
INCHES 0 1 2 3

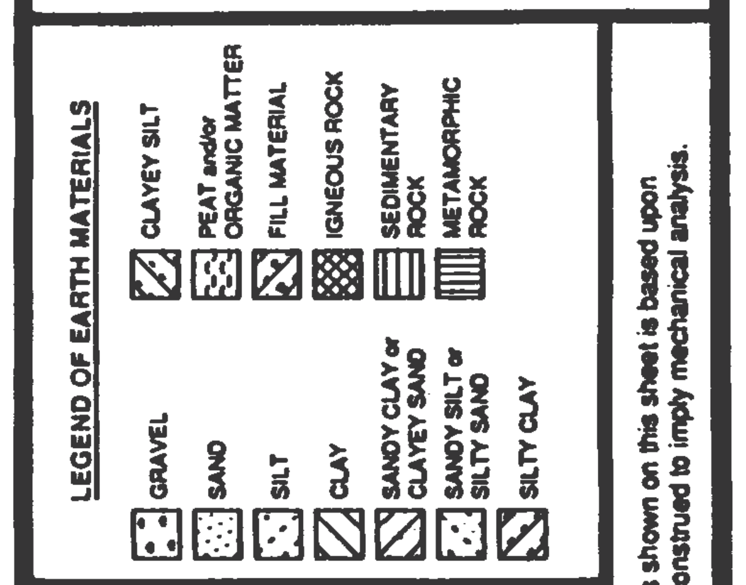
| DIST. | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 04 | Ala | 880 | 34.3/35.0 | 891 | 940 |

R.C. Wilhelms
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST R.C. WILHELMS No. 560 Exp. 6-30-94 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

3-13-95
PLANS APPROVAL DATE

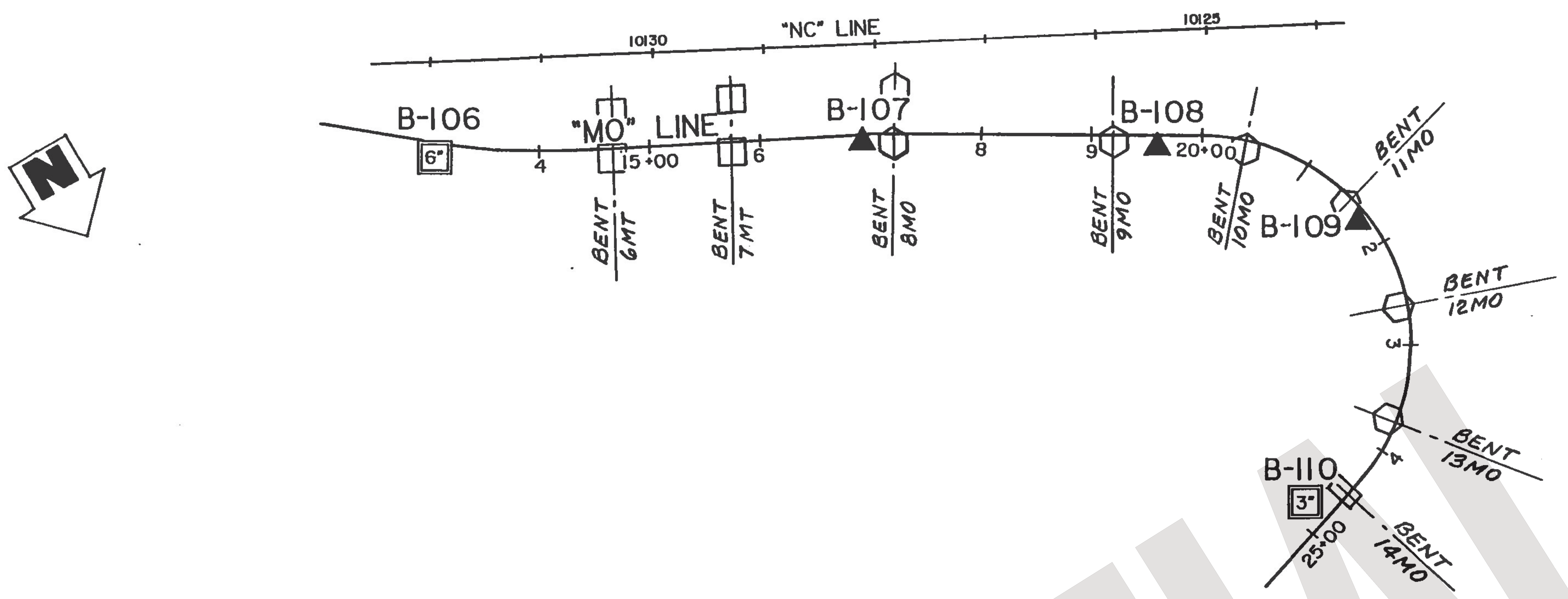




CONSISTENCY CLASSIFICATION FOR SOILS
According to the Standard Penetration Test

| 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 material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

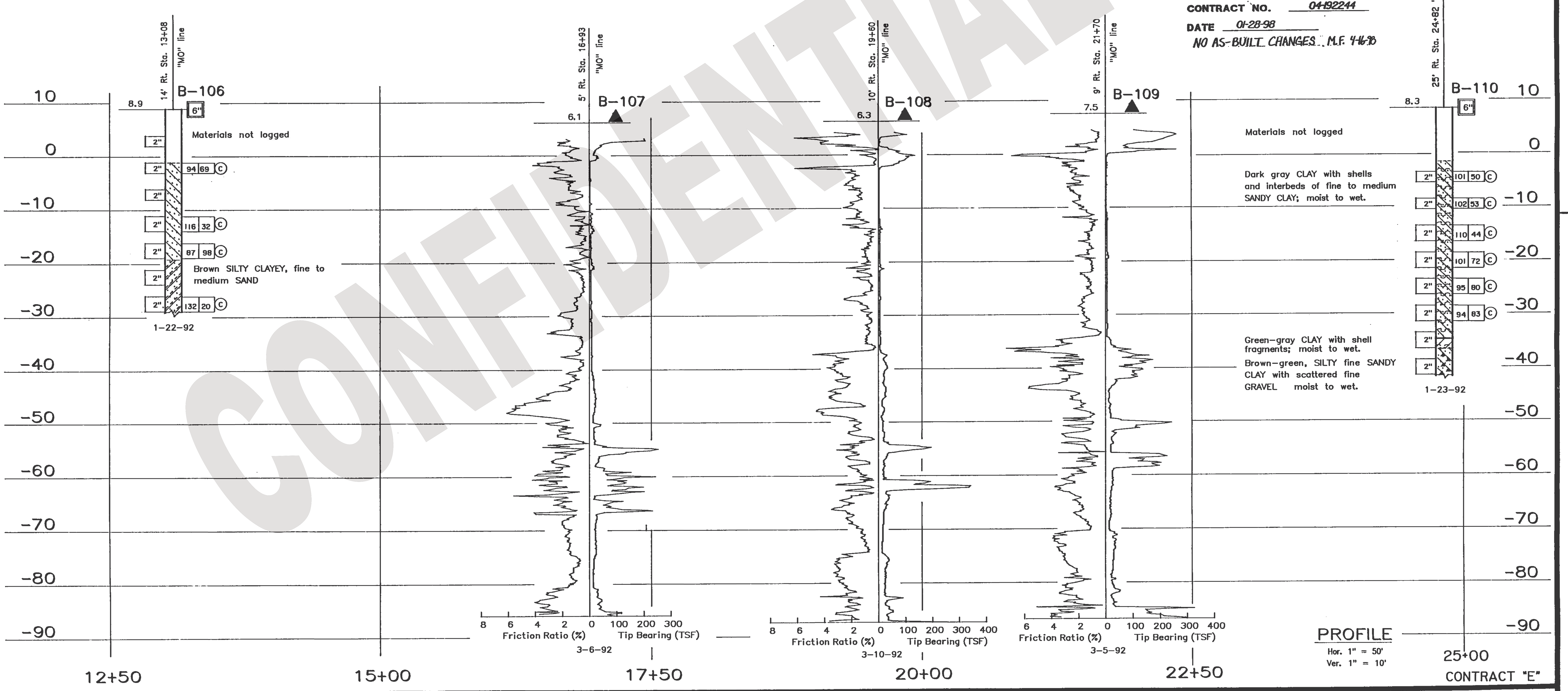


BENCH MARK
SEE "LOG OF TEST BORINGS 1 OF 20

PLAN
1" = 100'

## AS BUILT

CORRECTIONS BY S. WHIPPLE
CONTRACT NO. 04-192244
DATE 01-28-98
NO AS-BUILT CHANGES M.F. 4-16-98



PROFILE
Hor. 1" = 50'
Ver. 1" = 10'

| OFFICE OF TRANSPORTATION MATERIALS & RESEARCH | ENGINEERING GEOLOGY BRANCH | FIELD INVESTIGATION BY: |
|---|---|---|
| DRAWN BY | IRMA GAMARRA 5/92 | M. WILLIAN |
| CHECKED BY | | |

State of
CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN

BRIDGE NO. 33-612 E
POST MILE

PORT OF OAKLAND CONN. VIADUCT
LOG OF TEST BORINGS 4 OF 20

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04
EA 192231

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 71 OF 101

TL 6051 REV. 3/90

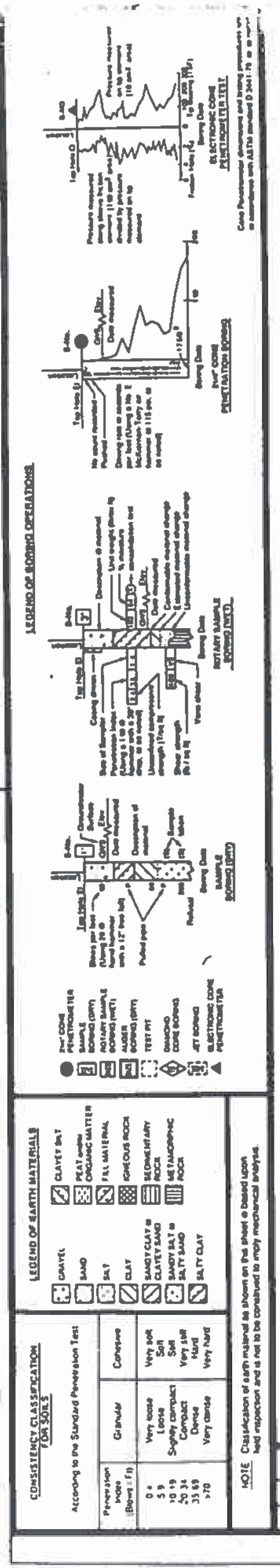
248.B-113

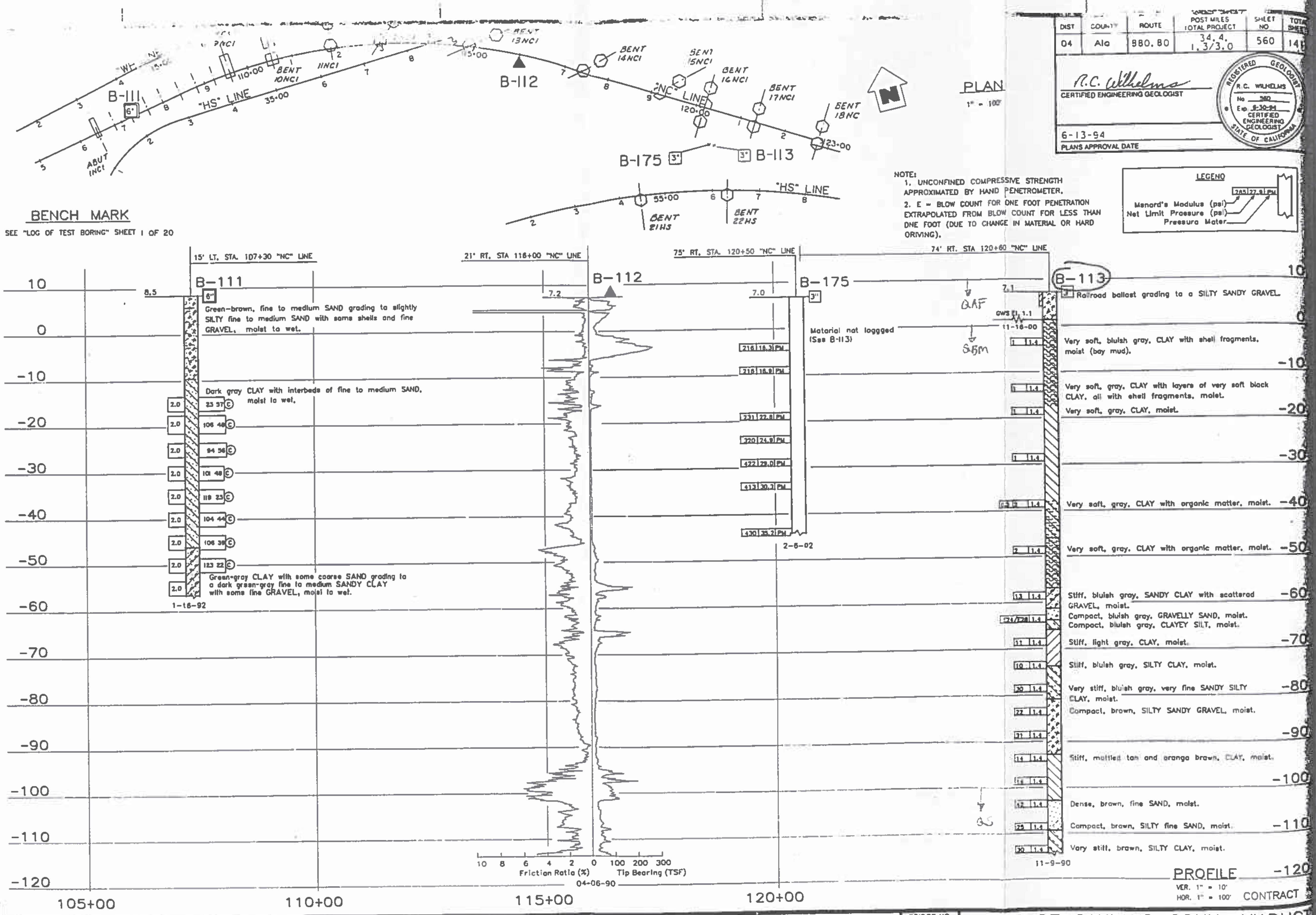
| DIST | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET NO | TOTAL SHEETS |
|---|---|---|---|---|---|
| 04 | Ala | 880, 80 | 34.4,<br>1.3/3.0 | 560 | 14 |

R.C. Wilhelms
CERTIFIED ENGINEERING GEOLOGIST

R.C. WILHELMS No 560 Exp. 6-30-94

6-13-94
PLANS APPROVAL DATE





NOTE:
1. UNCONFINED COMPRESSIVE STRENGTH APPROXIMATED BY HAND PENETROMETER.
2. E = BLOW COUNT FOR ONE FOOT PENETRATION EXTRAPOLATED FROM BLOW COUNT FOR LESS THAN ONE FOOT (DUE TO CHANGE IN MATERIAL OR HARD DRIVING).

LEGEND
Menard's Modulus (psi)
Net Limit Pressure (psi)
Pressure Meter

CONTRACT

OFFICE OF TRANSPORTATION MATERIALS & RESEARCH
ENGINEERING GEOLOGY BRANCH
DRAWN BY K. KAHL 5-92
CHECKED BY
FIELD INVESTIGATION BY: M. WILLIAN

State of
CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN

BRIDGE NO. 33-612 E
POST MILE

# PORT OF OAKLAND CONN. VIADUCT

# LOG OF TEST BORINGS 5 OF 2

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3
CU 04
EA 192231
DISREGARD PRINTS BEARING EARLIER REVISION DATES
REVISION DATES (PRELIMINARY STAGE ONLY)
SHEET 119

| DIST. | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET NO | TOTAL SHEETS |
|---|---|---|---|---|---|
| 04 | Ala | 880, 80 | 34.4, .1, 3/3.0 | 561 | 1412 |

R.C. Wilhelms
CERTIFIED ENGINEERING GEOLOGIST

R.C. WILHELMS No. 360 Exp. 6-30-94

6-13-94
PLANS APPROVAL DATE

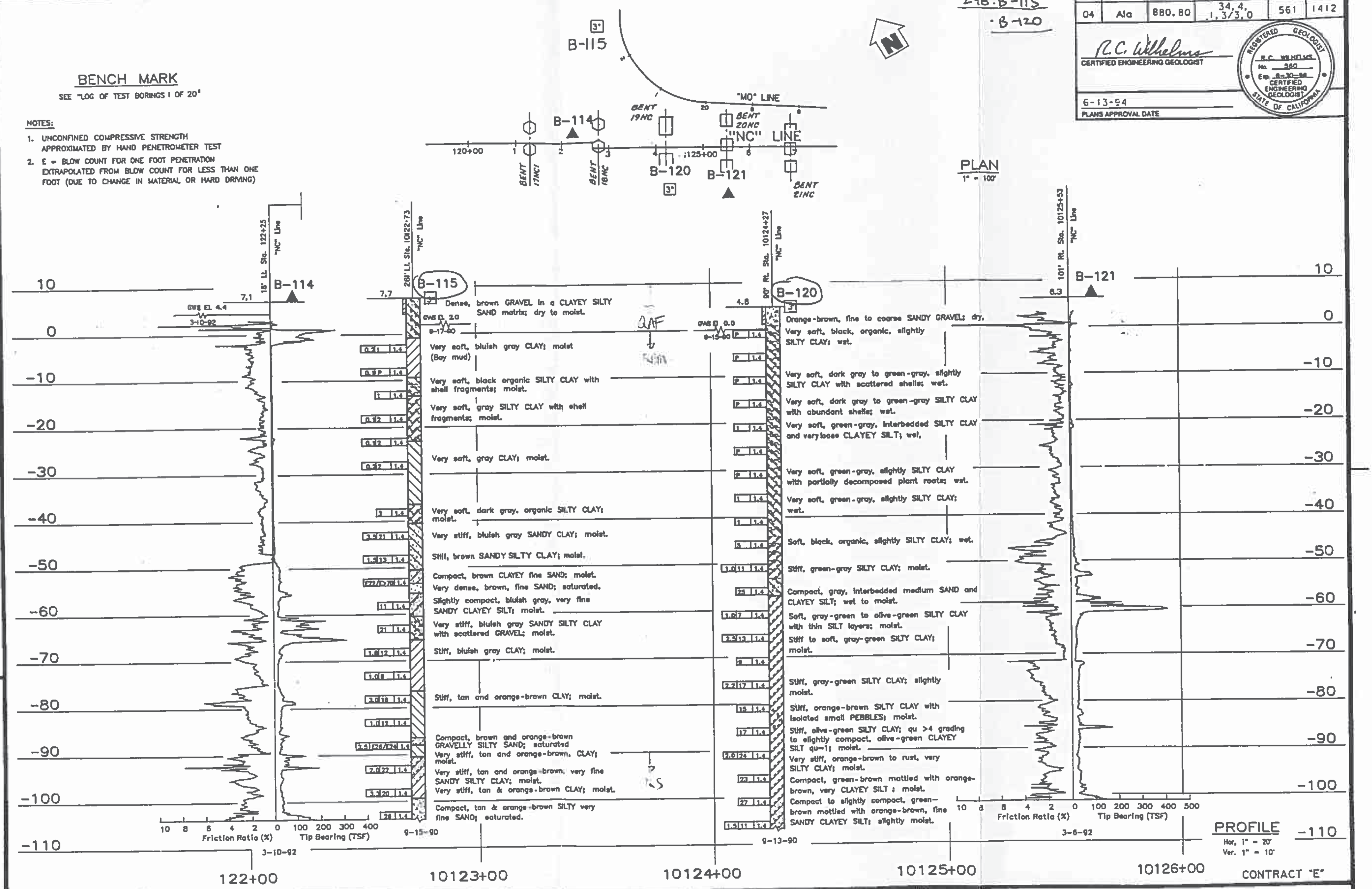
248.B-115
·B-120

## BENCH MARK

SEE "LOG OF TEST BORINGS 1 OF 20"

NOTES:

1. UNCONFINED COMPRESSIVE STRENGTH APPROXIMATED BY HAND PENETROMETER TEST
2. £ = BLOW COUNT FOR ONE FOOT PENETRATION EXTRAPOLATED FROM BLOW COUNT FOR LESS THAN ONE FOOT (DUE TO CHANGE IN MATERIAL OR HARD DRIVING)



**B-115**

- Dense, brown GRAVEL in a CLAYEY SILTY SAND matrix; dry to moist.
- Very soft, bluish gray CLAY; moist (Bay mud)
- Very soft, black organic SILTY CLAY with shell fragments; moist.
- Very soft, gray SILTY CLAY with shell fragments; moist.
- Very soft, gray CLAY; moist.
- Very soft, dark gray, organic SILTY CLAY; moist.
- Very stiff, bluish gray SANDY CLAY; moist.
- Still, brown SANDY SILTY CLAY; moist.
- Compact, brown CLAYEY fine SAND; moist.
- Very dense, brown, fine SAND; saturated.
- Slightly compact, bluish gray, very fine SANDY CLAYEY SILT; moist.
- Very stiff, bluish gray SANDY SILTY CLAY with scattered GRAVEL; moist.
- Stiff, bluish gray CLAY; moist.
- Stiff, tan and orange-brown CLAY; moist.
- Compact, brown and orange-brown GRAVELLY SILTY SAND; saturated
- Very stiff, tan and orange-brown, CLAY; moist.
- Very stiff, tan and orange-brown, very fine SANDY SILTY CLAY; moist.
- Very stiff, tan & orange-brown CLAY; moist.
- Compact, tan & orange-brown SILTY very fine SANO; saturated.

**B-120**

- Orange-brown, fine to coarse SANDY GRAVEL; dry.
- Very soft, black, organic, slightly SILTY CLAY; wet.
- Very soft, dark gray to green-gray, slightly SILTY CLAY with scattered shells; wet.
- Very soft, dark gray to green-gray SILTY CLAY with abundant shells; wet.
- Very soft, green-gray, interbedded SILTY CLAY and very loose CLAYEY SILT; wet.
- Very soft, green-gray, slightly SILTY CLAY with partially decomposed plant roots; wet.
- Very soft, green-gray, slightly SILTY CLAY; wet.
- Soft, black, organic, slightly SILTY CLAY; wet.
- Stiff, green-gray SILTY CLAY; moist.
- Compact, gray, interbedded medium SAND and CLAYEY SILT; wet to moist.
- Soft, gray-green to olive-green SILTY CLAY with thin SILT layers; moist.
- Stiff to soft, gray-green SILTY CLAY; moist.
- Stiff, gray-green SILTY CLAY; slightly moist.
- Stiff, orange-brown SILTY CLAY with isolated small PEBBLES; moist.
- Stiff, olive-green SILTY CLAY; qu >4 grading to slightly compact, olive-green CLAYEY SILT qu=1; moist.
- Very stiff, orange-brown to rust, very SILTY CLAY; moist.
- Compact, green-brown mottled with orange-brown, very CLAYEY SILT ; moist.
- Compact to slightly compact, green-brown mottled with orange-brown, fine SANDY CLAYEY SILT; slightly moist.

PROFILE
Hor. 1" = 20'
Ver. 1" = 10'

CONTRACT "E"

| OFFICE OF TRANSPORTATION MATERIALS & RESEARCH | ENGINEERING GEOLOGY BRANCH | FIELD INVESTIGATION BY: | State of CALIFORNIA. DEPARTMENT OF TRANSPORTATION | DIVISION OF STRUCTURES STRUCTURE DESIGN | BRIDGE NO. 33-612 E POST MILE |
|---|---|---|---|---|---|
| DRAWN BY IRMA CAMARRA 5/92 | | M. WILLIAN | | | |
| CHECKED BY | | | | | |

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04
EA 192231

DISREGA EARLIER

# PORT OF OAKLAND CONN. VIADUCT
## LOG OF TEST BORINGS 6 OF 20

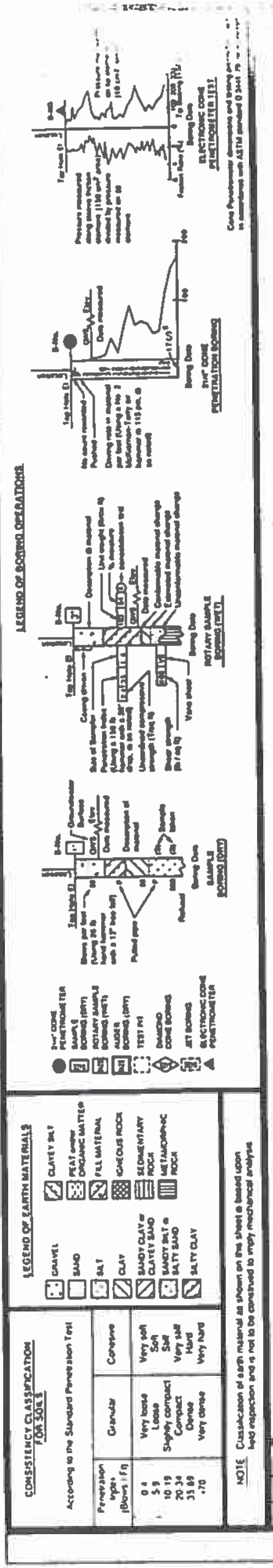
| SHEET | |
|---|---|
| 120 | 148 |

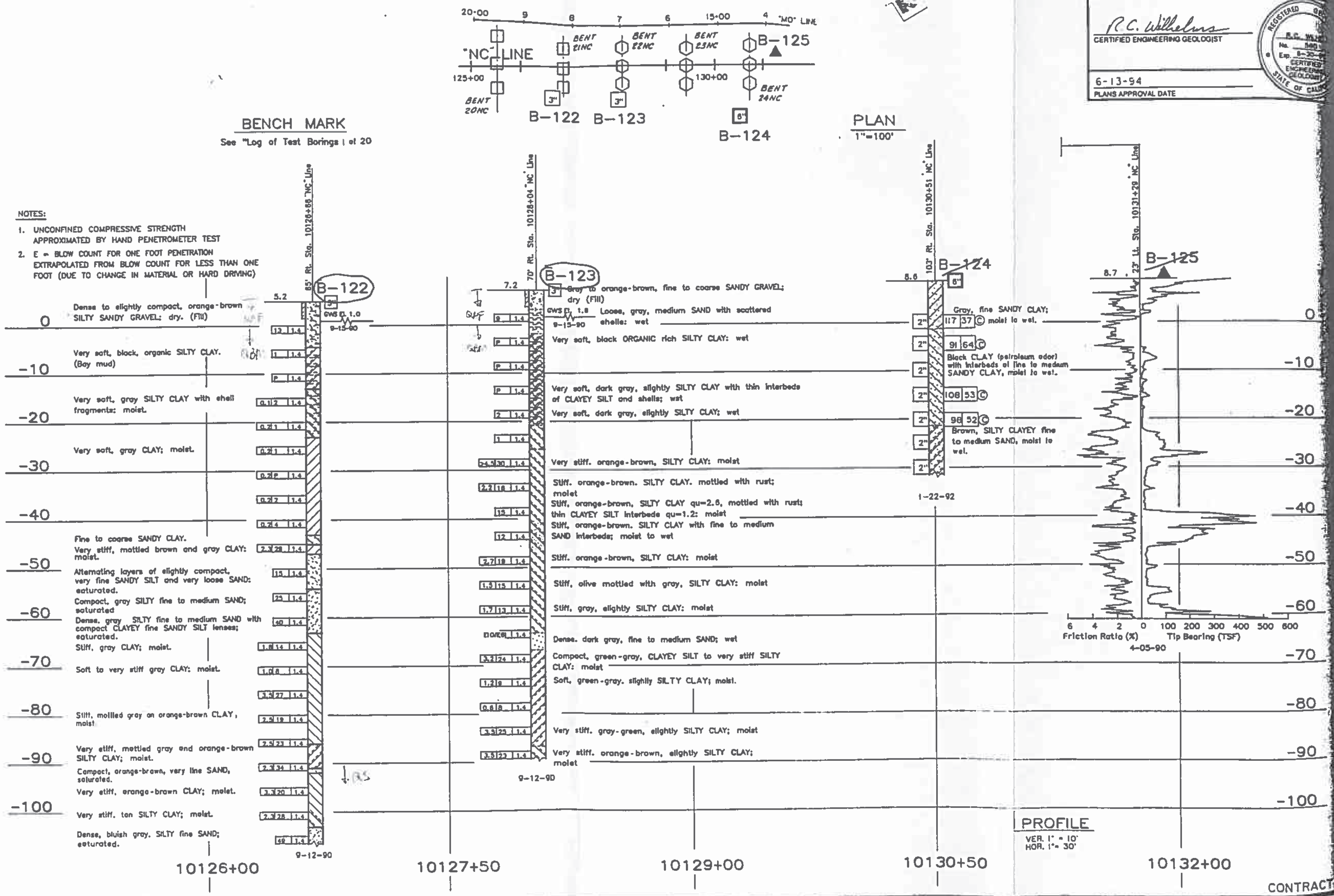
248 · B-122
· B-123

| DIST | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET NO. |
|---|---|---|---|---|
| 04 | Ala | 880, 80 | 34.4,<br>1.3/3.0 | 562 |

R.C. Wilhelms
CERTIFIED ENGINEERING GEOLOGIST

6-13-94
PLANS APPROVAL DATE





NOTES:

1. UNCONFINED COMPRESSIVE STRENGTH APPROXIMATED BY HAND PENETROMETER TEST
2. E = BLOW COUNT FOR ONE FOOT PENETRATION EXTRAPOLATED FROM BLOW COUNT FOR LESS THAN ONE FOOT (DUE TO CHANGE IN MATERIAL OR HARD DRIVING)

**B-122**

Dense to slightly compact, orange-brown SILTY SANDY GRAVEL: dry. (Fill)

Very soft, black, organic SILTY CLAY. (Bay mud)

Very soft, gray SILTY CLAY with shell fragments: moist.

Very soft, gray CLAY; moist.

Fine to coarse SANDY CLAY.

Very stiff, mottled brown and gray CLAY: moist.

Alternating layers of slightly compact, very fine SANDY SILT and very loose SAND: saturated.

Compact, gray SILTY fine to medium SAND; saturated

Dense, gray SILTY fine to medium SAND with compact CLAYEY fine SANDY SILT lenses; saturated.

Stiff, gray CLAY; moist.

Soft to very stiff gray CLAY: moist.

Stiff, mottled gray an orange-brown CLAY, moist

Very stiff, mottled gray and orange-brown SILTY CLAY; moist.

Compact, orange-brown, very fine SAND, saturated.

Very stiff, orange-brown CLAY; moist.

Very stiff, tan SILTY CLAY; moist.

Dense, bluish gray, SILTY fine SAND; saturated.

**B-123**

~~Gray to~~ orange-brown, fine to coarse SANDY GRAVEL; dry (Fill)

Loose, gray, medium SAND with scattered shells: wet

Very soft, black ORGANIC rich SILTY CLAY: wet

Very soft, dark gray, slightly SILTY CLAY with thin interbeds of CLAYEY SILT and shells; wet

Very soft, dark gray, slightly SILTY CLAY; wet

Very stiff, orange-brown, SILTY CLAY: moist

Stiff, orange-brown, SILTY CLAY, mottled with rust; moist

Stiff, orange-brown, SILTY CLAY qu=2.6, mottled with rust; thin CLAYEY SILT interbeds qu=1.2: moist

Stiff, orange-brown, SILTY CLAY with fine to medium SAND interbeds; moist to wet

Stiff, orange-brown, SILTY CLAY: moist

Stiff, olive mottled with gray, SILTY CLAY: moist

Stiff, gray, slightly SILTY CLAY: moist

Dense, dark gray, fine to medium SAND; wet

Compact, green-gray, CLAYEY SILT to very stiff SILTY CLAY: moist

Soft, green-gray, slightly SILTY CLAY; moist.

Very stiff, gray-green, slightly SILTY CLAY; moist

Very stiff, orange-brown, slightly SILTY CLAY; moist

**B-124**

Gray, fine SANDY CLAY; moist to wet.

Black CLAY (petroleum odor) with interbeds of fine to medium SANDY CLAY, moist to wet.

Brown, SILTY CLAYEY fine to medium SAND, moist to wet.

CONTRACT

| OFFICE OF TRANSPORTATION MATERIALS & RESEARCH | ENGINEERING GEOLOGY BRANCH | FIELD INVESTIGATION BY: |
|---|---|---|
| DRAWN BY | ED FONG 5-92 | M. WILLIAN |
| CHECKED BY | | |

State of
CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN

BRIDGE NO. 33-612 E
POST MILE

PORT OF OAKLAND CONN. VIADU
LOG OF TEST BORINGS 7 OF

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04
EA 192231

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

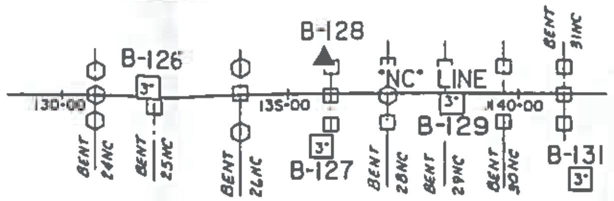
| DIST | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET NO | TOTAL SHEETS |
|---|---|---|---|---|---|
| 04 | Ala | 880, 80 | 34.4, .1.3/3.0 | 563 | 1412 |

R.C. Wilhelms
CERTIFIED ENGINEERING GEOLOGIST

R.C. WILHELMS No. 560 Exp. 9-30-94

6-13-94
PLANS APPROVAL DATE

248 . B-126
· B-127
· B-128
· B-129
· B-131

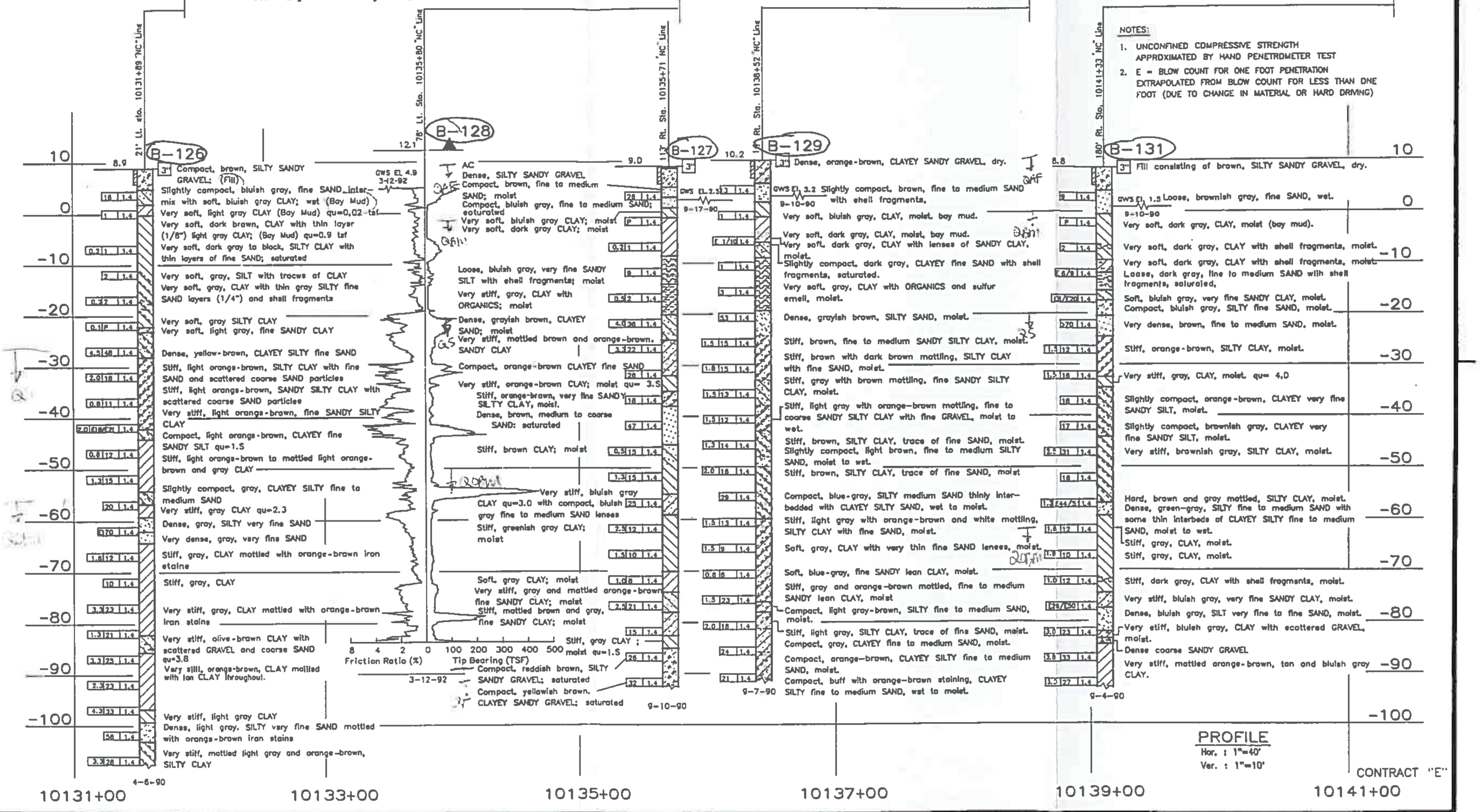


PLAN
1"=200'

BENCH MARK
See " Log of Test Borings 1 of 20 "

NOTES:

1. UNCONFINED COMPRESSIVE STRENGTH APPROXIMATED BY HAND PENETROMETER TEST
2. E = BLOW COUNT FOR ONE FOOT PENETRATION EXTRAPOLATED FROM BLOW COUNT FOR LESS THAN ONE FOOT (DUE TO CHANGE IN MATERIAL OR HARD DRIVING)



**B-126**

Compact, brown, SILTY SANDY GRAVEL: (Fill)
Slightly compact, bluish gray, fine SAND inter-mix with soft, bluish gray CLAY; wet (Bay Mud)
Very soft, light gray CLAY (Bay Mud) qu=0.02 tsf
Very soft, dark brown, CLAY with thin layer (1/8") light gray CLAY; (Bay Mud) qu=0.9 tsf
Very soft, dark gray to black, SILTY CLAY with thin layers of fine SAND; saturated
Very soft, gray, SILT with tracws of CLAY
Very soft, gray, CLAY with thin gray SILTY fine SAND layers (1/4") and shell fragments
Very soft, gray SILTY CLAY
Very soft, light gray, fine SANDY CLAY
Dense, yellow-brown, CLAYEY SILTY fine SAND
Stiff, light orange-brown, SILTY CLAY with fine SAND and scattered coarse SAND particles
Stiff, light orange-brown, SANDY SILTY CLAY with scattered coarse SAND particles
Very stiff, light orange-brown, fine SANDY SILTY CLAY
Compact, light orange-brown, CLAYEY fine SANDY SILT qu=1.5
Stiff, light orange-brown to mottled light orange-brown and gray CLAY
Slightly compact, gray, CLAYEY SILTY fine to medium SAND
Very stiff, gray CLAY qu=2.3
Dense, gray, SILTY very fine SAND
Very dense, gray, very fine SAND
Stiff, gray, CLAY mottled with orange-brown iron stains
Stiff, gray, CLAY
Very stiff, gray, CLAY mottled with orange-brown iron stains
Very stiff, olive-brown CLAY with scattered GRAVEL and coarse SAND qu=3.8
Very stiff, orange-brown, CLAY mottled with tan CLAY throughout.
Very stiff, light gray CLAY
Dense, light gray, SILTY very fine SAND mottled with orange-brown iron stains
Very stiff, mottled light gray and orange-brown, SILTY CLAY

**B-128**

AC
Dense, SILTY SANDY GRAVEL
Compact, brown, fine to medium SAND; moist
Compact, bluish gray, fine to medium SAND; saturated
Very soft, bluish gray CLAY; moist
Very soft, dark gray CLAY; moist
Loose, bluish gray, very fine SANDY SILT with shell fragments; moist
Very stiff, gray, CLAY with ORGANICS; moist
Dense, grayish brown, CLAYEY SAND; moist
Very stiff, mottled brown and orange-brown, SANDY CLAY
Compact, orange-brown CLAYEY fine SAND
Very stiff, orange-brown CLAY; moist qu= 3.5
Stiff, orange-brown, very fine SANDY SILTY CLAY, moist.
Dense, brown, medium to coarse SAND: saturated
Stiff, brown CLAY; moist
Very stiff, bluish gray CLAY qu=3.0 with compact, bluish gray fine to medium SAND lenses
Stiff, greenish gray CLAY; moist
Soft, gray CLAY; moist
Very stiff, gray and mottled orange-brown fine SANDY CLAY; moist
Stiff, mottled brown and gray, fine SANDY CLAY; moist
Stiff, gray CLAY ; moist qu=1.5
Compact, reddish brown, SILTY SANDY GRAVEL; saturated
Compact, yellowish brown, CLAYEY SANDY GRAVEL; saturated

**B-129**

Dense, orange-brown, CLAYEY SANDY GRAVEL, dry.
Slightly compact, brown, fine to medium SAND with shell fragments.
Very soft, bluish gray, CLAY, moist. bay mud.
Very soft, dark gray, CLAY, moist, bay mud.
Very soft, dark gray, CLAY with lenses of SANDY CLAY, moist.
Slightly compact, dark gray, CLAYEY fine SAND with shell fragments, saturated.
Very soft, gray, CLAY with ORGANICS and sulfur smell, moist.
Dense, grayish brown, SILTY SAND, moist.
Stiff, brown, fine to medium SANDY SILTY CLAY, moist.
Stiff, brown with dark brown mottling, SILTY CLAY with fine SAND, moist.
Stiff, gray with brown mottling, fine SANDY SILTY CLAY, moist.
Stiff, light gray with orange-brown mottling, fine to coarse SANDY SILTY CLAY with fine GRAVEL, moist to wet.
Stiff, brown, SILTY CLAY, trace of fine SAND, moist.
Slightly compact, light brown, fine to medium SILTY SAND, moist to wet.
Stiff, brown, SILTY CLAY, trace of fine SAND, moist
Compact, blue-gray, SILTY medium SAND thinly inter-bedded with CLAYEY SILTY SAND, wet to moist.
Stiff, light gray with orange-brown and white mottling, SILTY CLAY with fine SAND, moist.
Soft, gray, CLAY with very thin fine SAND lenses, moist.
Soft, blue-gray, fine SANDY lean CLAY, moist.
Stiff, gray and orange-brown mottled, fine to medium SANDY lean CLAY, moist
Compact, light gray-brown, SILTY fine to medium SAND, moist.
Stiff, light gray, SILTY CLAY, trace of fine SAND, moist.
Compact, gray, CLAYEY fine to medium SAND, moist.
Compact, orange-brown, CLAYEY SILTY fine to medium SAND, moist.
Compact, buff with orange-brown staining, CLAYEY SILTY fine to medium SAND, wet to moist.

**B-131**

Fill consisting of brown, SILTY SANDY GRAVEL, dry.
Loose, brownish gray, fine SAND, wet.
Very soft, dark gray, CLAY, moist (bay mud).
Very soft, dark gray, CLAY with shell fragments, moist.
Very soft, dark gray, CLAY with shell fragments, moist.
Loose, dark gray, fine to medium SAND with shell fragments, saturated.
Soft, bluish gray, very fine SANDY CLAY, moist.
Compact, bluish gray, SILTY fine SAND, moist.
Very dense, brown, fine to medium SAND, moist.
Stiff, orange-brown, SILTY CLAY, moist.
Very stiff, gray, CLAY, moist. qu= 4.0
Slightly compact, orange-brown, CLAYEY very fine SANDY SILT, moist.
Slightly compact, brownish gray, CLAYEY very fine SANDY SILT, moist.
Very stiff, brownish gray, SILTY CLAY, moist.
Hard, brown and gray mottled, SILTY CLAY, moist.
Dense, green-gray, SILTY fine to medium SAND with some thin interbeds of CLAYEY SILTY fine to medium SAND, moist to wet.
Stiff, gray, CLAY, moist.
Stiff, gray, CLAY, moist.
Stiff, dark gray, CLAY with shell fragments, moist.
Very stiff, bluish gray, very fine SANDY CLAY, moist.
Dense, bluish gray, SILT very fine to fine SAND, moist.
Very stiff, bluish gray, CLAY with scattered GRAVEL, moist.
Dense coarse SANDY GRAVEL
Very stiff, mottled orange-brown, tan and bluish gray CLAY.

PROFILE
Hor. : 1"=40'
Ver. : 1"=10'

CONTRACT "E"

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

| | | | | | |
|---|---|---|---|---|---|
| DIVISION OF NEW TECHNOLOGY, MATERIALS AND RESEARCH | OFFICE OF ENGINEERING GEOLOGY | FIELD INVESTIGATION BY | State of CALIFORNIA DEPARTMENT OF TRANSPORTATION | DIVISION OF STRUCTURES STRUCTURE DESIGN | BRIDGE NO. 33-612 E |
| DRAWN BY ED FONG 5-92 | | M. WILLIAN | | | POST MILE |
| CHECKED BY | | | | | |

PORT OF OAKLAND CONN. VIADUCT
LOG OF TEST BORINGS 8 OF 20

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3
CU 04
EA 192231
DISREGARD PRINTS BEARING EARLIER REVISION DATES
REVISION DATES (PRELIMINARY STAGE ONLY)
122 148

248 B-158
· ~~B-159~~
· B-160

| DIST | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET NO | TOTAL SHEETS |
|---|---|---|---|---|---|
| 04 | Ala | 880, 80 | 34.4,<br>1.3/3.0 | 569 | 1412 |

GEOTECHNICAL PROFESSIONAL

6-13-94
PLANS APPROVAL DATE

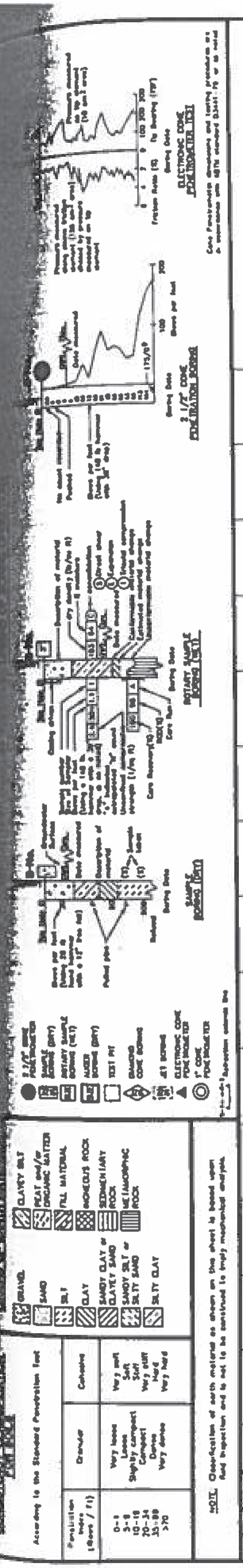
H. R. TABER
No. 817
EXP. 12-31-92

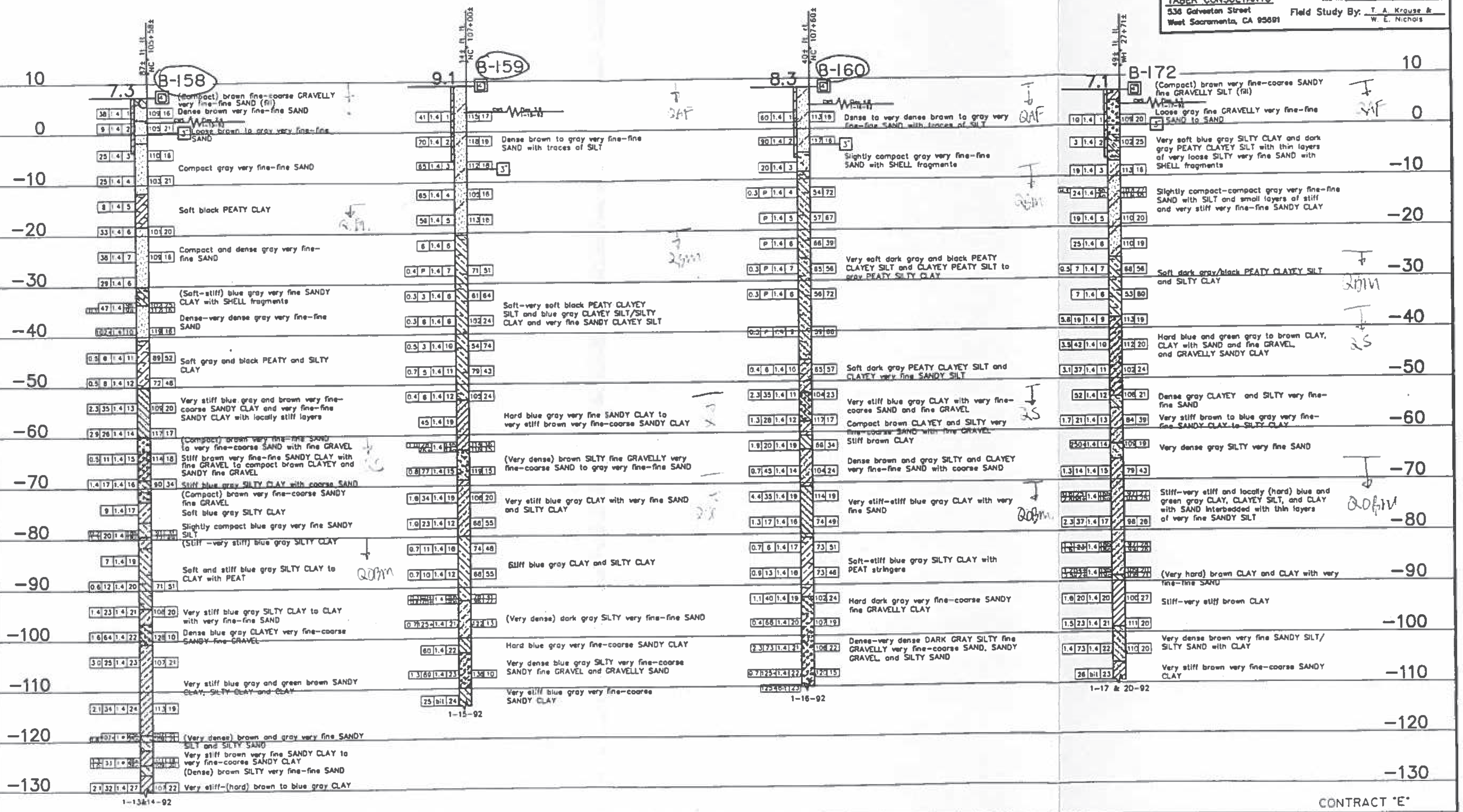
**TABER CONSULTANTS**
536 Galveston Street
West Sacramento, CA 95691

JOB No. 1P1/388/72.019

Field Study By: T. A. Krause & W. E. Nichols

FOR PLAN VIEW, SEE SHEET 1 OF 20





CONTRACT "E"

ENGINEERING GEOLOGY BRANCH - TRANSPORTATION LABORATORY

DRAWN BY M D R 1/92
CHECKED BY T A K & W E N 2/92

PROJECT ENGINEER

Prepared for the State of
CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN

BRIDGE NO. 33-612 E
POST MILE

PORT OF OAKLAND CONN. VIADUCT

## LOG OF TEST BORINGS 14 OF 20

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04
EA 192231

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 5/15/92

SHEET 128 OF 148

| DIST. | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 04 | Ala | 880 | 34.3/35.0 | 902 | 940 |

H. R. Taber
GEOTECHNICAL PROFESSIONAL

3-13-95
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER H. R. TABER No. 817 EXP. 12-31-92 GEOTECHNICAL STATE OF CALIFORNIA

**TABER CONSULTANTS**
536 Galveston Street
West Sacramento, CA 95691

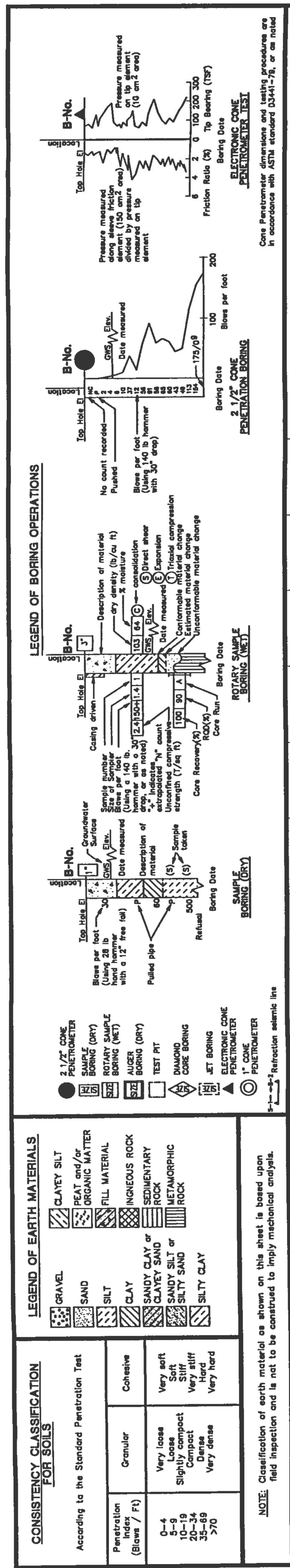
JOB No. 1P1/388/72.019
Field Study By: T. A. Krause & W. E. Nichols

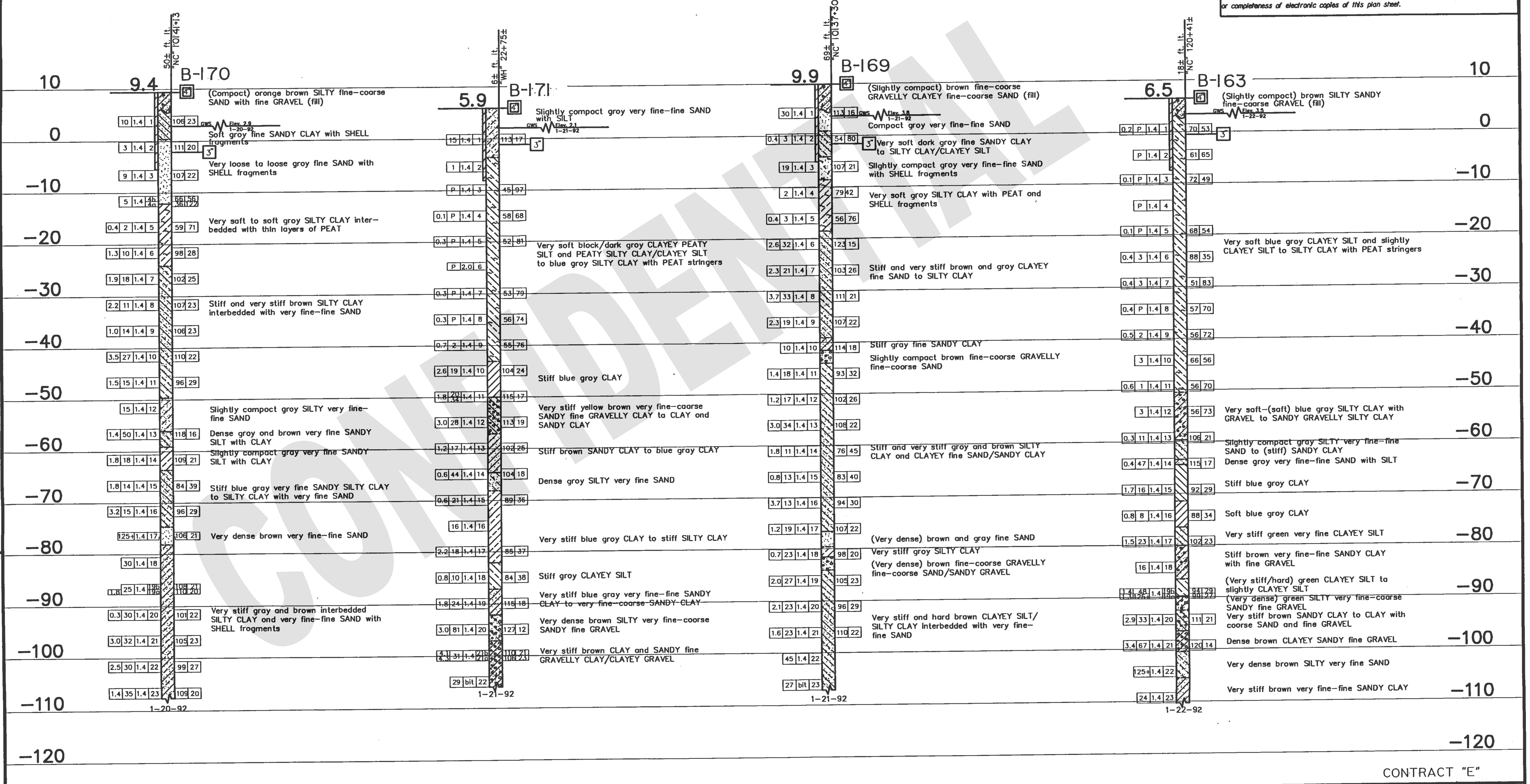
*The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.*

# AS BUILT

CORRECTIONS BY S. WHIPPLE
CONTRACT NO. 04-192244
DATE 01-28-98
NO AS-BUILT CHANGES M.F. 4-16-98

FOR PLAN VIEW, SEE SHEET 1 OF 20





CONTRACT "E"

ENGINEERING GEOLOGY BRANCH - TRANSPORTATION LABORATORY

| DRAWN BY | M.D.R. 1/92 |
|---|---|
| CHECKED BY | T.A.K. & W.E.N. 2/92 |

, PROJECT ENGINEER

Prepared for the State of
CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN

BRIDGE NO. 33-612 E
POST MILE

PORT OF OAKLAND CONN. VIADUCT

## LOG OF TEST BORINGS 15 OF 20

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04
EA 192231

DISREGARD PRINTS BEARING EARLIER REVISION DATES 5/5/92

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 82 OF 101

IL 6052 REV. 4/89   2/92 138872B.DWG 70

| DIST. | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 04 | Ala | 880 | 34.3/35.0 | 903 | 940 |

H. R. Taber
GEOTECHNICAL PROFESSIONAL

3-13-95
PLANS APPROVAL DATE

H. R. TABER No. 817 EXP. 12-31-92

TABER CONSULTANTS
536 Galveston Street
West Sacramento, CA 95691

JOB No. 1P1/388/72.019

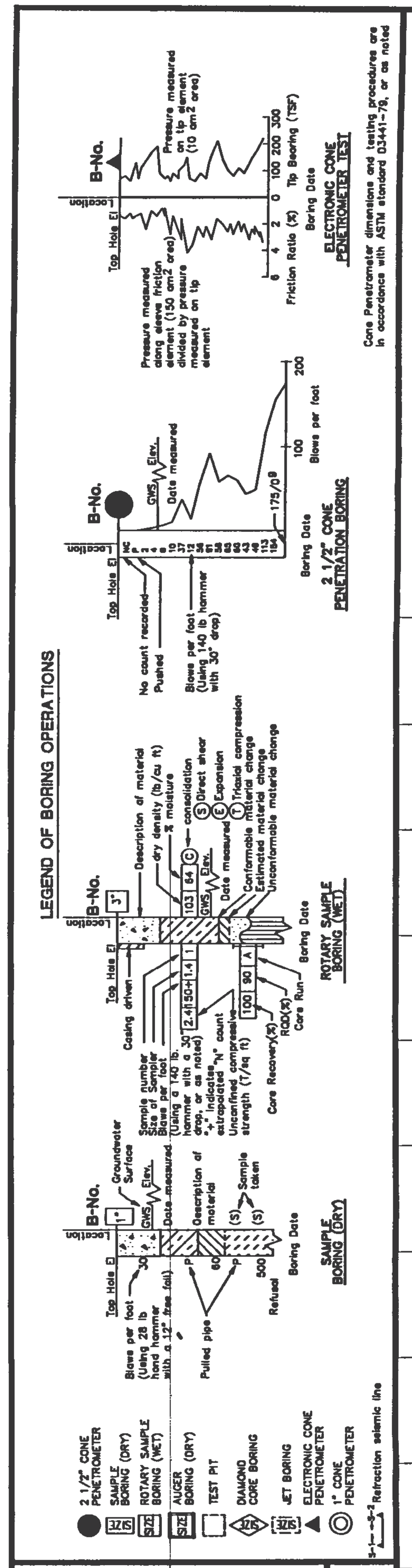
Field Study By: T. A. Krause & W. E. Nichols

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

# AS BUILT

CORRECTIONS BY S. WHIPPLE
CONTRACT NO. 04-192244
DATE 01-28-98
NO AS-BUILT CHANGES M.F. 4-16-98

FOR PLAN VIEW, SEE SHEET 1 OF 20



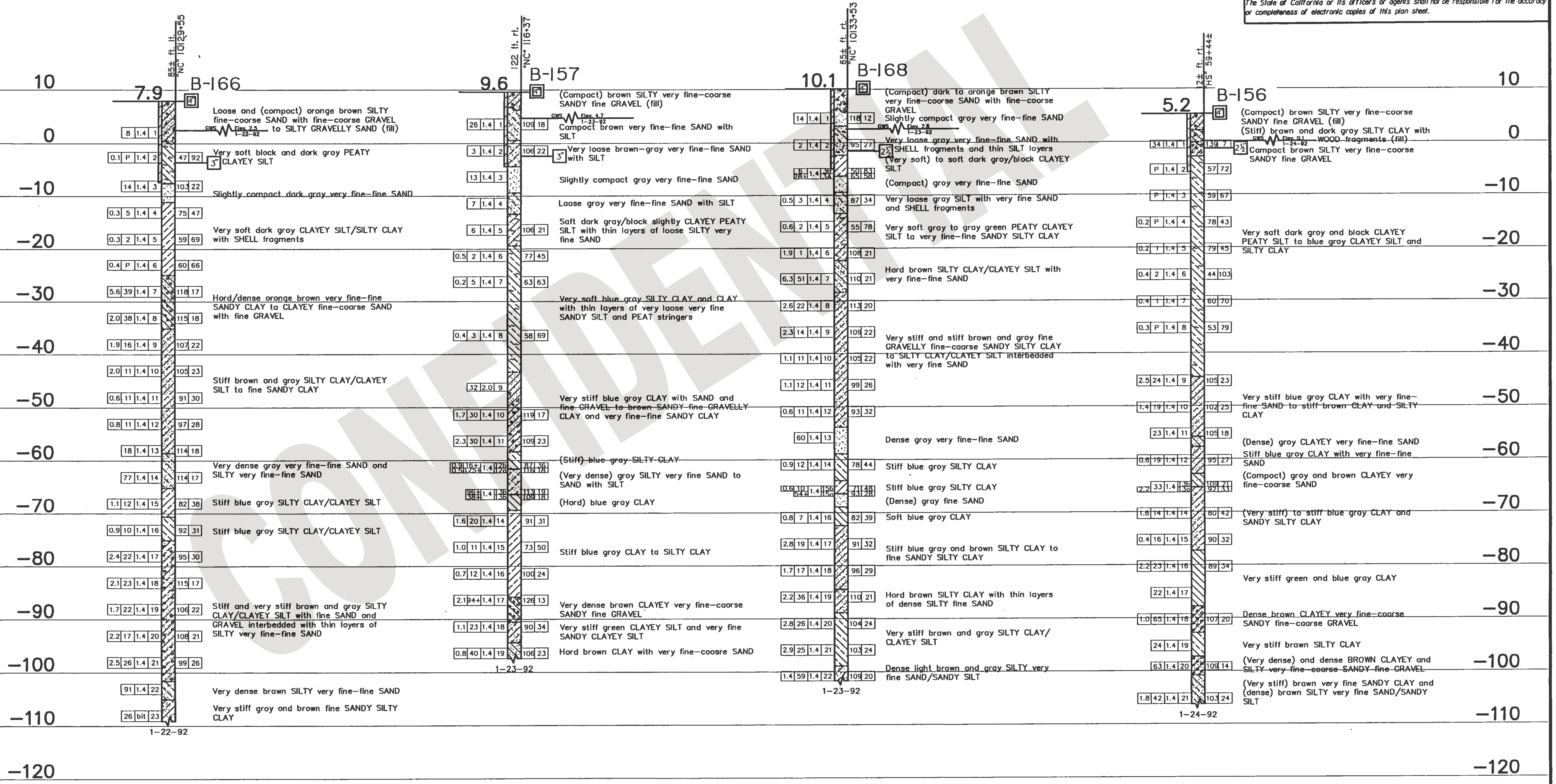
LEGEND OF EARTH MATERIALS

GRAVEL, SAND, SILT, CLAY, SANDY CLAY or CLAYEY SAND, 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 |
| 35–49 | Dense | Hard |
| >70 | Very dense | Very hard |

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



CONTRACT "E"

ENGINEERING GEOLOGY BRANCH - TRANSPORTATION LABORATORY

| | | |
|---|---|---|
| DRAWN BY | M.D.R. 1/92 | |
| CHECKED BY | T.A.K. & W.E.N. 2/92 | |

PROJECT ENGINEER

Prepared for the State of
**CALIFORNIA**
**DEPARTMENT OF TRANSPORTATION**

DIVISION OF STRUCTURES
STRUCTURE DESIGN

BRIDGE NO. 33-612 E
POST MILE

PORT OF OAKLAND CONN. VIADUCT

## LOG OF TEST BORINGS 16 OF 20

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04
EA 192231

DISREGARD PRINTS BEARING EARLIER REVISION DATES 5/5/92

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 83 OF 101

IL 6052 REV. 4/89   2/92 138872C.DWG 70

| DIST. | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 04 | Ala | 880 | 34.3/35.0 | 904 | 940 |

H R Taber
**GEOTECHNICAL PROFESSIONAL**

3-13-95
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER H. R. TABER No. 817 EXP. 12-31-92 GEOTECHNICAL STATE OF CALIFORNIA

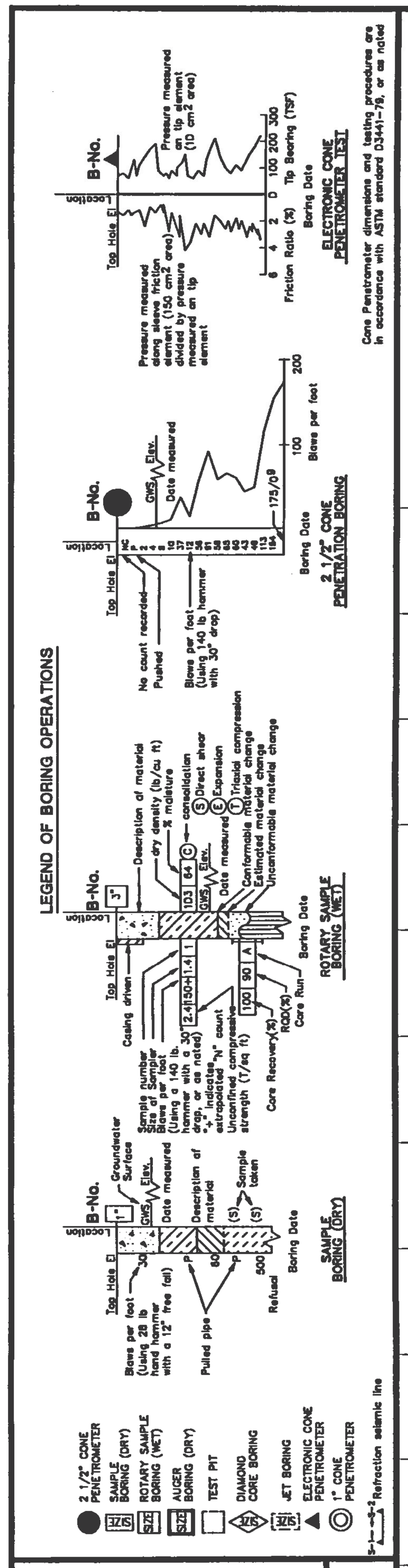
**TABER CONSULTANTS**
**536 Galveston Street**
**West Sacramento, CA 95691**

JOB No. 1P1/388/72.019
**Field Study By:** T. A. Krause & W. E. Nichols

FOR PLAN VIEW, SEE SHEET 1 OF 20

# AS BUILT

**CORRECTIONS BY** *S. WHIPPLE*
**CONTRACT NO.** *04-192244*
**DATE** *01-28-98*
*NO AS-BUILT CHANGES .. M.F. 4-16-98*



**LEGEND OF EARTH MATERIALS**

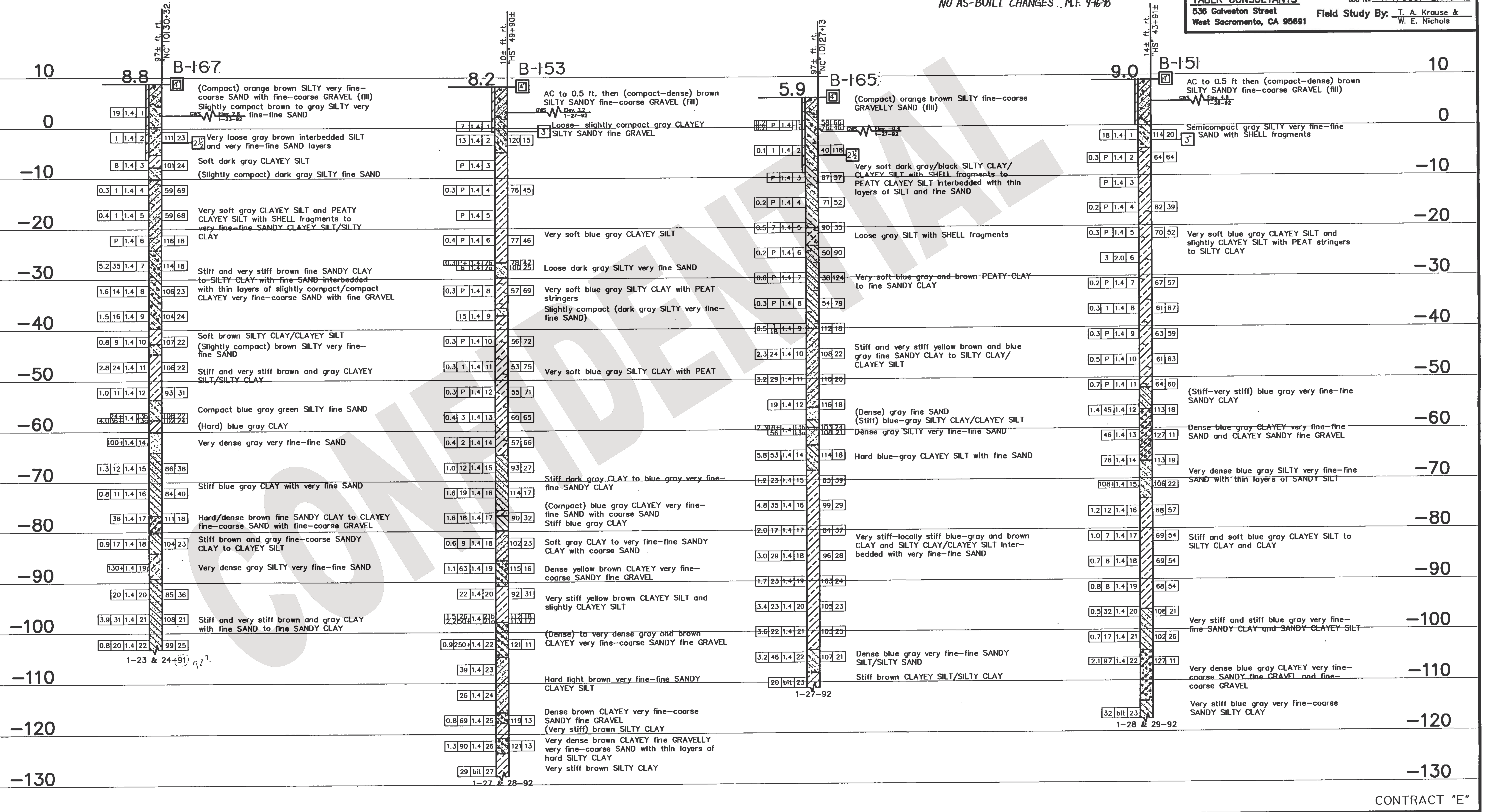
- ▨ GRAVEL
- ▨ SAND
- ▨ SILT
- ▨ CLAY
- ▨ SANDY CLAY or CLAYEY SAND
- ▨ SANDY SILT or SILTY SAND
- ▨ SILTY CLAY
- ▨ CLAYEY SILT
- ▨ PEAT and/or ORGANIC MATTER
- ▨ FILL MATERIAL
- ▨ INGNEOUS ROCK
- ▨ SEDIMENTARY ROCK
- ▨ METAMORPHIC ROCK

**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 material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.



**B-167**

(Compact) orange brown SILTY very fine-coarse SAND with fine-coarse GRAVEL (fill)
Slightly compact brown to gray SILTY very fine-fine SAND
Very loose gray brown interbedded SILT and very fine-fine SAND layers
Soft dark gray CLAYEY SILT
(Slightly compact) dark gray SILTY fine SAND
Very soft gray CLAYEY SILT and PEATY CLAYEY SILT with SHELL fragments to very fine-fine SANDY CLAYEY SILT/SILTY CLAY
Stiff and very stiff brown fine SANDY CLAY to SILTY CLAY with fine SAND interbedded with thin layers of slightly compact/compact CLAYEY very fine-coarse SAND with fine GRAVEL
Soft brown SILTY CLAY/CLAYEY SILT
(Slightly compact) brown SILTY very fine-fine SAND
Stiff and very stiff brown and gray CLAYEY SILT/SILTY CLAY
Compact blue gray green SILTY fine SAND
(Hard) blue gray CLAY
Very dense gray very fine-fine SAND
Stiff blue gray CLAY with very fine SAND
Hard/dense brown fine SANDY CLAY to CLAYEY fine-coarse SAND with fine-coarse GRAVEL
Stiff brown and gray fine-coarse SANDY CLAY to CLAYEY SILT
Very dense gray SILTY very fine-fine SAND
Stiff and very stiff brown and gray CLAY with fine SAND to fine SANDY CLAY

**B-153**

AC to 0.5 ft. then (compact-dense) brown SILTY SANDY fine-coarse GRAVEL (fill)
Loose- slightly compact gray CLAYEY SILTY SANDY fine GRAVEL
Very soft blue gray CLAYEY SILT
Loose dark gray SILTY very fine SAND
Very soft blue gray SILTY CLAY with PEAT stringers
Slightly compact (dark gray SILTY very fine-fine SAND)
Very soft blue gray SILTY CLAY with PEAT
Stiff dark gray CLAY to blue gray very fine-fine SANDY CLAY
(Compact) blue gray CLAYEY very fine-fine SAND with coarse SAND
Stiff blue gray CLAY
Soft gray CLAY to very fine-fine SANDY CLAY with coarse SAND
Dense yellow brown CLAYEY very fine-coarse SANDY fine GRAVEL
Very stiff yellow brown CLAYEY SILT and slightly CLAYEY SILT
(Dense) to very dense gray and brown CLAYEY very fine-coarse SANDY fine GRAVEL
Hard light brown very fine-fine SANDY CLAYEY SILT
Dense brown CLAYEY very fine-coarse SANDY fine GRAVEL
(Very stiff) brown SILTY CLAY
Very dense brown CLAYEY fine GRAVELLY very fine-coarse SAND with thin layers of hard SILTY CLAY
Very stiff brown SILTY CLAY

**B-165**

(Compact) orange brown SILTY fine-coarse GRAVELLY SAND (fill)
Very soft dark gray/black SILTY CLAY/CLAYEY SILT with SHELL fragments to PEATY CLAYEY SILT interbedded with thin layers of SILT and fine SAND
Loose gray SILT with SHELL fragments
Very soft blue gray and brown PEATY CLAY to fine SANDY CLAY
Stiff and very stiff yellow brown and blue gray fine SANDY CLAY to SILTY CLAY/CLAYEY SILT
(Dense) gray fine SAND
(Stiff) blue-gray SILTY CLAY/CLAYEY SILT
Dense gray SILTY very fine-fine SAND
Hard blue-gray CLAYEY SILT with fine SAND
Very stiff-locally stiff blue-gray and brown CLAY and SILTY CLAY/CLAYEY SILT inter-bedded with very fine-fine SAND
Dense blue gray very fine-fine SANDY SILT/SILTY SAND
Stiff brown CLAYEY SILT/SILTY CLAY

**B-151**

AC to 0.5 ft then (compact-dense) brown SILTY SANDY fine-coarse GRAVEL (fill)
Semicompact gray SILTY very fine-fine SAND with SHELL fragments
Very soft blue gray CLAYEY SILT and slightly CLAYEY SILT with PEAT stringers to SILTY CLAY
(Stiff-very stiff) blue gray very fine-fine SANDY CLAY
Dense blue gray CLAYEY very fine-fine SAND and CLAYEY SANDY fine GRAVEL
Very dense blue gray SILTY very fine-fine SAND with thin layers of SANDY SILT
Stiff and soft blue gray CLAYEY SILT to SILTY CLAY and CLAY
Very stiff and stiff blue gray very fine-fine SANDY CLAY and SANDY CLAYEY SILT
Very dense blue gray CLAYEY very fine-coarse SANDY fine GRAVEL and fine-coarse GRAVEL
Very stiff blue gray very fine-coarse SANDY SILTY CLAY

CONTRACT "E"

**ENGINEERING GEOLOGY BRANCH - TRANSPORTATION LABORATORY**

DRAWN BY M.D.R. 1/92
CHECKED BY T.A.K. & W.E.N. 2/92

______________, PROJECT ENGINEER

Prepared for the
State of
**CALIFORNIA**
**DEPARTMENT OF TRANSPORTATION**

**DIVISION OF STRUCTURES**
**STRUCTURE DESIGN**

BRIDGE NO.
POST MILE

# LOG OF TEST BORINGS 17 OF 20

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04
EA 192231

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 5/5/92

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 84 OF 101

| DIST. | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 04 | Ala | 880 | 34.3/35.0 | 905 | 940 |

H. R. Taber
GEOTECHNICAL PROFESSIONAL

3-13-95
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER H. R. TABER No. 817 EXP. 12-31-92 GEOTECHNICAL STATE OF CALIFORNIA

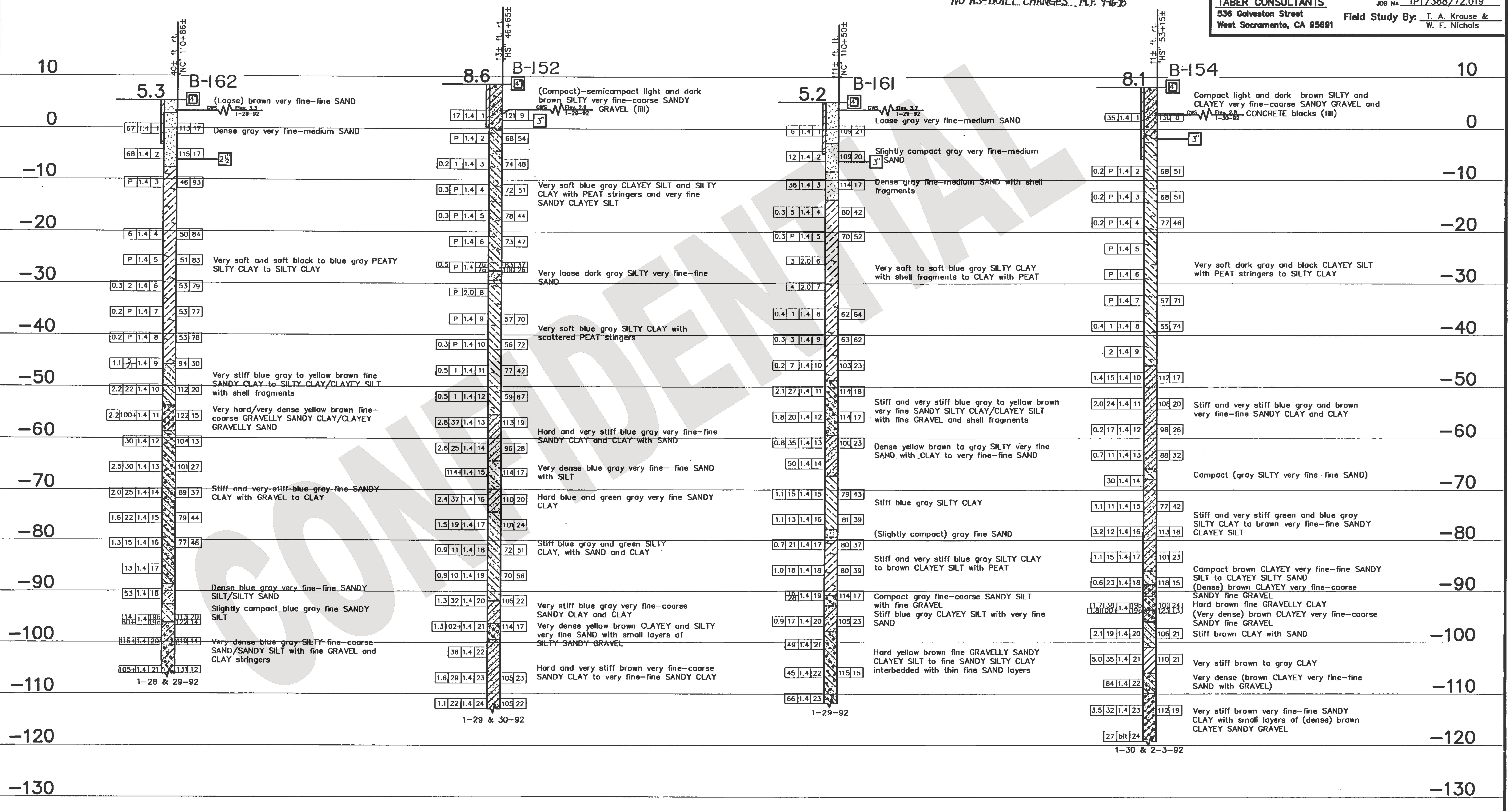
**TABER CONSULTANTS**
536 Galveston Street
West Sacramento, CA 95691

JOB No. 1P1/388/72.019
Field Study By: T. A. Krause & W. E. Nichals

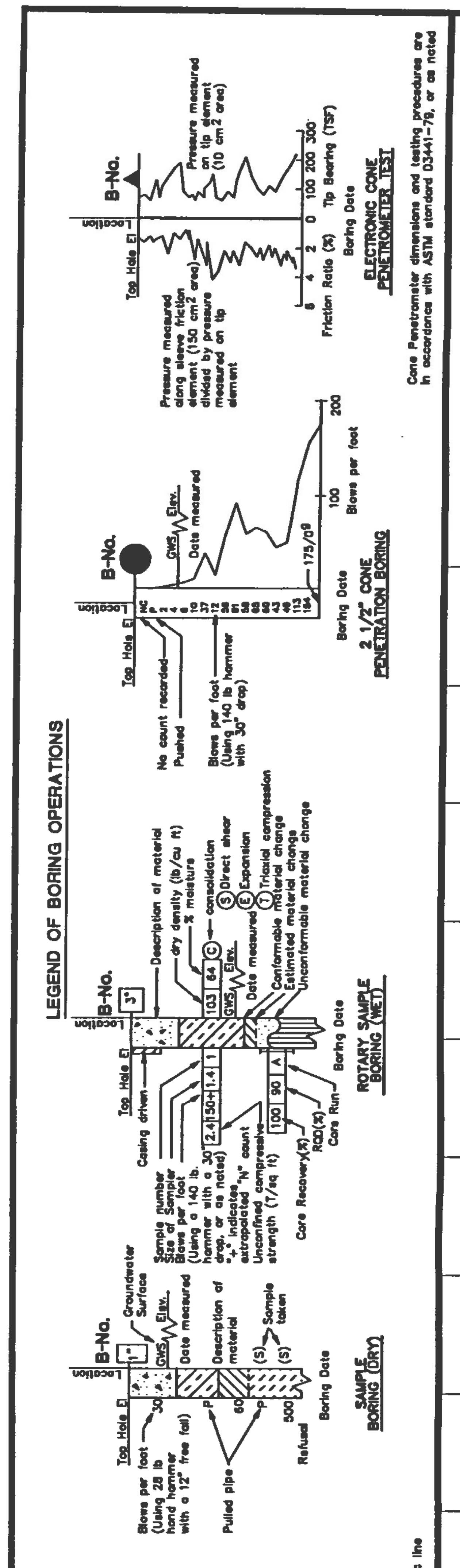
# AS BUILT

CORRECTIONS BY S. WHIPPLE
CONTRACT NO. 04-192244
DATE 01-28-98
NO AS-BUILT CHANGES M.F. 4-16-98

FOR PLAN VIEW, SEE SHEET 1 OF 20



CONTRACT "E"



● 2 1/2" CONE PENETROMETER
▭ SAMPLE BORING (DRY)
▭ ROTARY SAMPLE BORING (WET)
▭ AUGER BORING (DRY)
☐ TEST PIT
◇ DIAMOND CORE BORING
▭ JET BORING
▲ ELECTRONIC CONE PENETROMETER
◎ 1" CONE PENETROMETER
Refraction seismic line

## LEGEND OF EARTH MATERIALS

| | |
|---|---|
| GRAVEL | CLAYEY SILT |
| SAND | PEAT and/or ORGANIC MATTER |
| SILT | FILL MATERIAL |
| CLAY | INGNEOUS ROCK |
| SANDY CLAY or CLAYEY SAND | SEDIMENTARY ROCK |
| SANDY SILT or SILTY SAND | METAMORPHIC ROCK |
| SILTY CLAY | |

## CONSISTENCY CLASSIFICATION FOR SOILS

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| >70 | Very dense | Very hard |

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

**ENGINEERING GEOLOGY BRANCH - TRANSPORTATION LABORATORY**

| | |
|---|---|
| DRAWN BY | M.D.R. 1/92 |
| CHECKED BY | T.A.K. & W.E.N. 2/92 |

________, PROJECT ENGINEER

Prepared for the State of
**CALIFORNIA**
**DEPARTMENT OF TRANSPORTATION**

DIVISION OF STRUCTURES
**STRUCTURE DESIGN**

BRIDGE NO. 33-612 E
POST MILE

PORT OF OAKLAND CONN. VIADUCT

# LOG OF TEST BORINGS 18 OF 20

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04
EA 192231

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 5/5/92

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET B5 OF 101

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| DIST. | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 04 | Ala | 880 | 34.3/35.0 | 906 | 940 |

H. R. Taber
GEOTECHNICAL PROFESSIONAL

3-13-95
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER H. R. TABER No. 817 EXP. 12-31-92 GEOTECHNICAL STATE OF CALIFORNIA

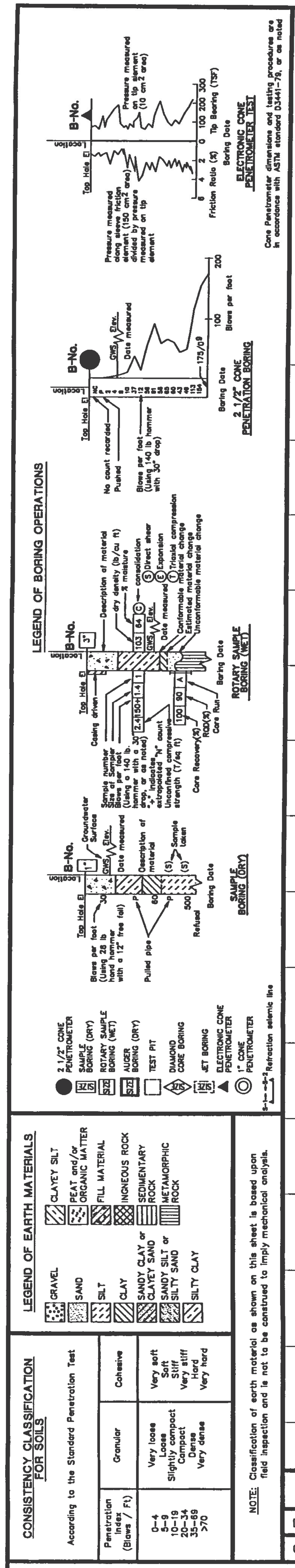
**TABER CONSULTANTS**
536 Galveston Street
West Sacramento, CA 95691

JOB No. 1P1/388/72.019
Field Study By: T. A. Krause & W. E. Nichols

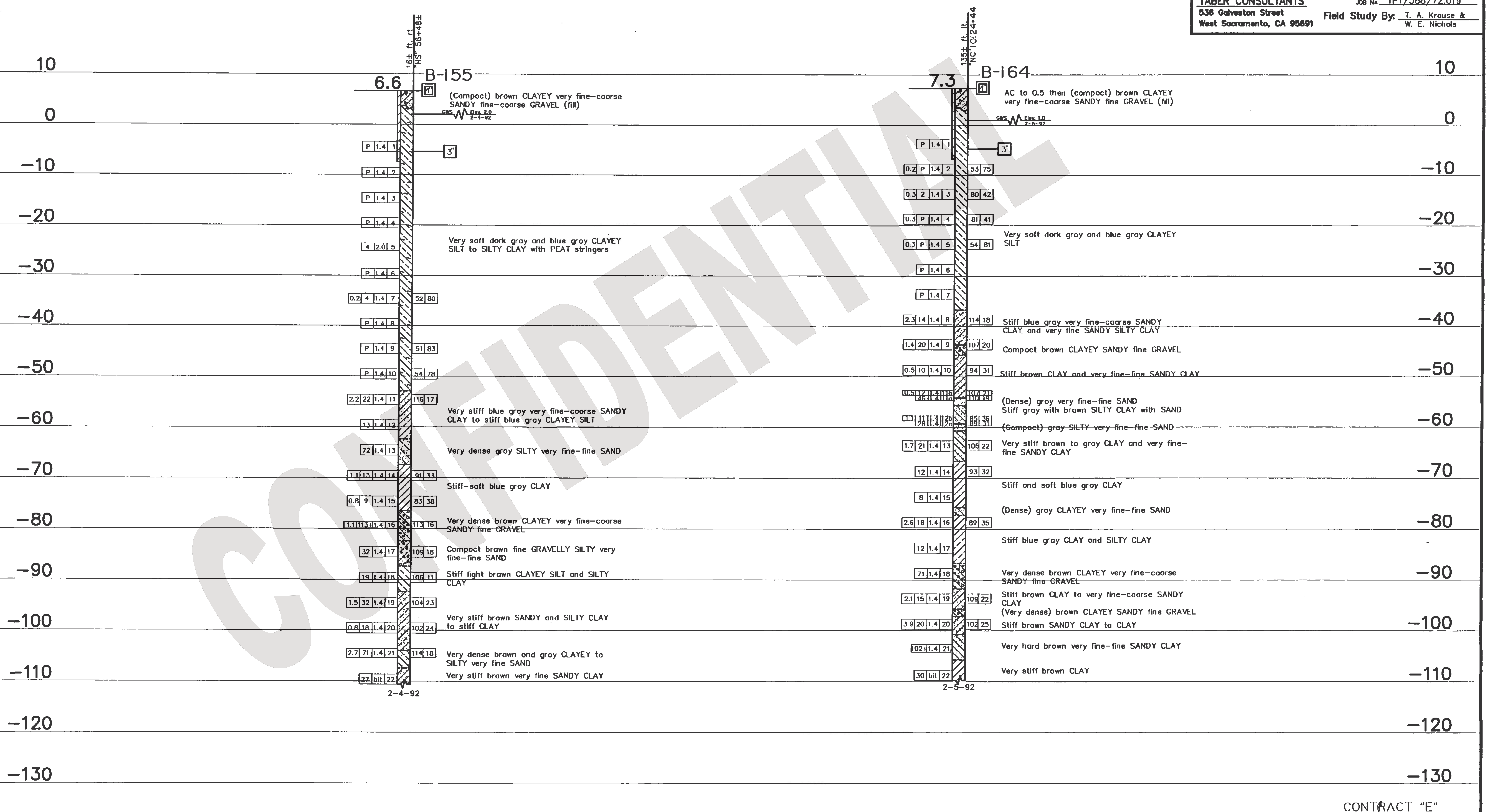
# AS BUILT

CORRECTIONS BY S. WHIPPLE
CONTRACT NO. 04-192244
DATE 01-28-98
NO AS-BUILT CHANGES M.F. 4-16-98

FOR PLAN VIEW, SEE SHEET 1 OF 20



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



CONTRACT "E"

**ENGINEERING GEOLOGY BRANCH - TRANSPORTATION LABORATORY**

| | |
|---|---|
| DRAWN BY | M.D.R. 1/92 |
| CHECKED BY | T.A.K. & W.E.N. 2/92 |

______________, PROJECT ENGINEER

Prepared for the
State of
**CALIFORNIA**
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
**STRUCTURE DESIGN**

BRIDGE NO. 33-612 E
POST MILE

PORT OF OAKLAND CONN. VIADUCT

## LOG OF TEST BORINGS 19 OF 20

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

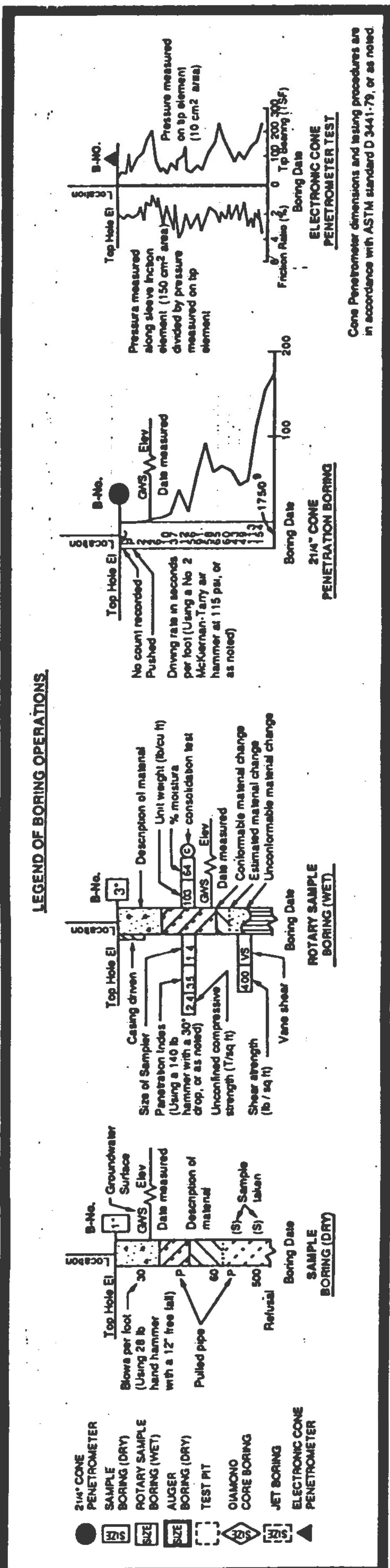
CU 04
EA 192231

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 5/5/92

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 86 OF 101

TL 6052 REV. 4/89    2/92 138872F.DWG 708



## 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 | |

## CONSISTENCY 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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| 10-19 | Slightly compact | Stiff |
| 20-34 | Compact | Very stiff |
| 35-69 | Dense | Hard |
| >70 | Very dense | Very hard |

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

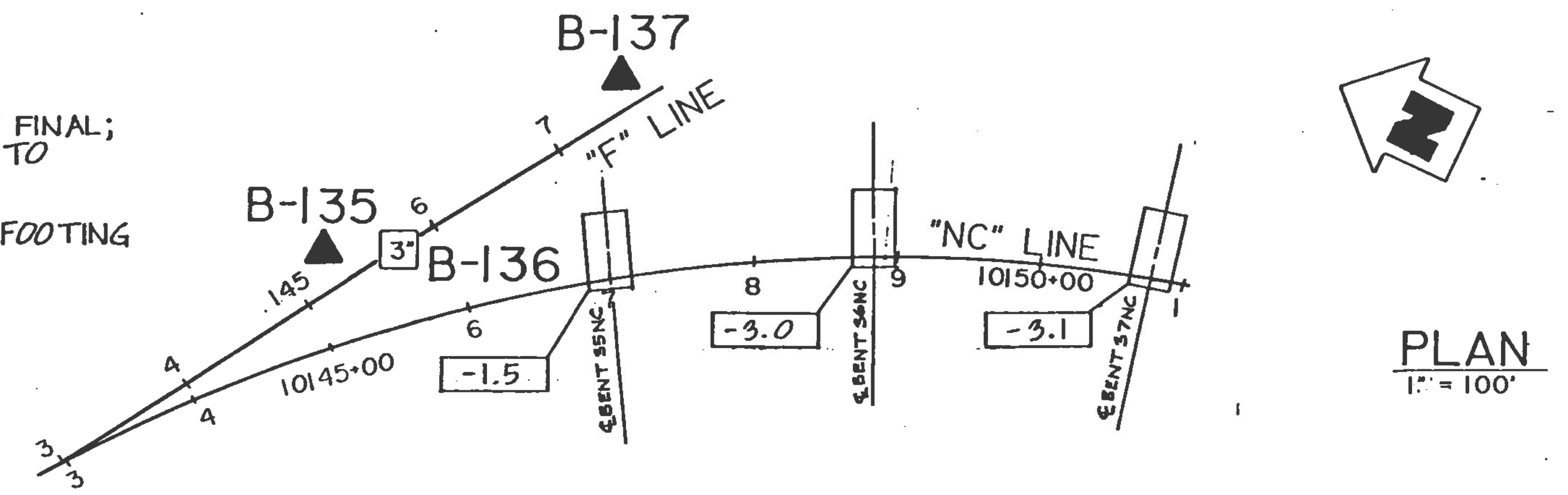
BENCH MARK

SEE "LOG OF TEST BORING" SHEET 1 OF 14

NOTES:

THIS ALIGNMENT MAY NOT BE FINAL; FOR FINAL ALIGNMENT REFER TO FOUNDATION PLANS

-1.5 INDICATES BOTTOM OF FOOTING ELEVATION



| DIST. | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 04 | Ala | 880 | 34.3/35.0 | 1021 | 1046 |

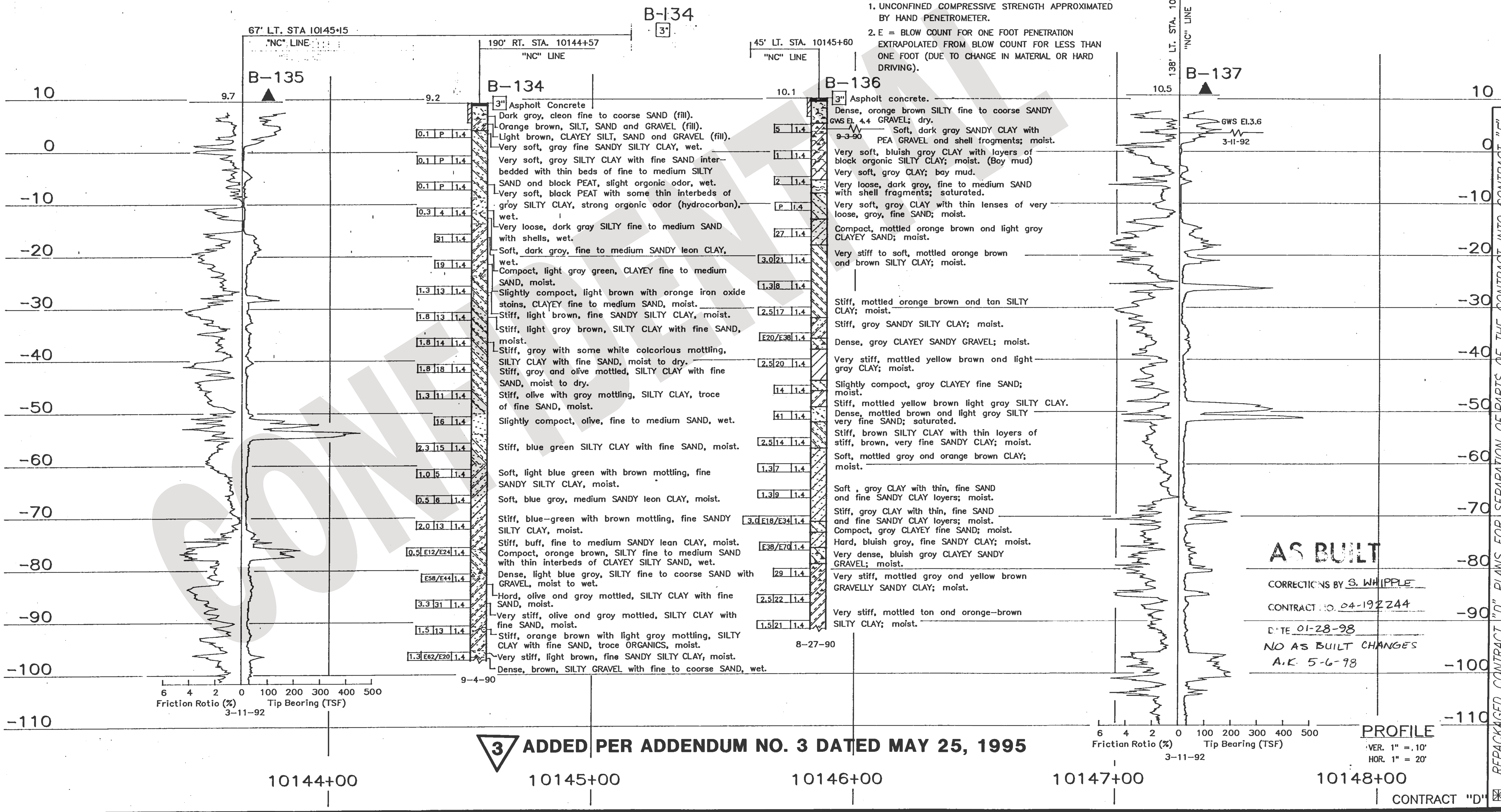
R.C. Wilhelms
CERTIFIED ENGINEERING GEOLOGIST

R.C. WILHELMS
No. 560
Exp. 6-30-94

3-13-95
PLANS APPROVAL DATE

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

NOTES:
1. UNCONFINED COMPRESSIVE STRENGTH APPROXIMATED BY HAND PENETROMETER.
2. E = BLOW COUNT FOR ONE FOOT PENETRATION EXTRAPOLATED FROM BLOW COUNT FOR LESS THAN ONE FOOT (DUE TO CHANGE IN MATERIAL OR HARD DRIVING).



B-134

3" Asphalt Concrete
Dark groy, cleon fine to coorse SAND (fill).
Orange brown, SILT, SAND and GRAVEL (fill).
Light brown, CLAYEY SILT, SAND ond GRAVEL (fill).
Very soft, gray fine SANDY SILTY CLAY, wet.
Very soft, groy SILTY CLAY with fine SAND interbedded with thin beds of fine to medium SILTY SAND ond block PEAT, slight orgonic odor, wet.
Very soft, black PEAT with some thin interbeds of groy SILTY CLAY, strong orgonic odor (hydrocorban), wet.
Very loose, dork gray SILTY fine to medium SAND with shells, wet.
Soft, dark groy, fine to medium SANDY leon CLAY, wet.
Compoct, light gray green, CLAYEY fine to medium SAND, moist.
Slightly compoct, light brown with orange iron oxide stoins, CLAYEY fine to medium SAND, moist.
Stiff, light brown, fine SANDY SILTY CLAY, moist.
Stiff, light groy brown, SILTY CLAY with fine SAND, moist.
Stiff, groy with some white colcorious mottling, SILTY CLAY with fine SAND, moist to dry.
Stiff, groy and olive mottled, SILTY CLAY with fine SAND, moist to dry.
Stiff, olive with groy mottling, SILTY CLAY, troce of fine SAND, moist.
Slightly compoct, olive, fine to medium SAND, wet.
Stiff, blue green SILTY CLAY with fine SAND, moist.
Soft, light blue green with brown mottling, fine SANDY SILTY CLAY, moist.
Soft, blue groy, medium SANDY leon CLAY, moist.
Stiff, blue-green with brown mottling, fine SANDY SILTY CLAY, moist.
Stiff, buff, fine to medium SANDY lean CLAY, moist.
Compoct, orange brown, SILTY fine to medium SAND with thin interbeds of CLAYEY SILTY SAND, wet.
Dense, light blue groy, SILTY fine to coorse SAND with GRAVEL, moist to wet.
Hord, olive ond groy mottled, SILTY CLAY with fine SAND, moist.
Very stiff, olive ond groy mottled, SILTY CLAY with fine SAND, moist.
Stiff, orange brown with light groy mottling, SILTY CLAY with fine SAND, troce ORGANICS, moist.
Very stiff, light brown, fine SANDY SILTY CLAY, moist.
Dense, brown, SILTY GRAVEL with fine to coorse SAND, wet.

B-136

3" Aspholt concrete.
Dense, oronge brown SILTY fine to coorse SANDY GRAVEL; dry.
Soft, dark gray SANDY CLAY with PEA GRAVEL ond shell frogments; maist.
Very soft, bluish groy CLAY with layers of block orgonic SILTY CLAY; moist. (Boy mud)
Very soft, groy CLAY; bay mud.
Very loose, dark groy, fine to medium SAND with shell fragments; saturated.
Very soft, groy CLAY with thin lenses of very loose, groy, fine SAND; moist.
Compact, mottled oronge brown ond light groy CLAYEY SAND; maist.
Very stiff to soft, mottled oronge brown ond brown SILTY CLAY; moist.
Stiff, mottled oronge brown ond tan SILTY CLAY; moist.
Stiff, groy SANDY SILTY CLAY; maist.
Dense, groy CLAYEY SANDY GRAVEL; moist.
Very stiff, mattled yellow brawn ond light gray CLAY; moist.
Slightly compoct, groy CLAYEY fine SAND; moist.
Stiff, mottled yellow brown light gray SILTY CLAY.
Dense, mottled brown ond light groy SILTY very fine SAND; saturated.
Stiff, brown SILTY CLAY with thin loyers of stiff, brown, very fine SANDY CLAY; moist.
Soft, mottled groy ond orange brown CLAY; moist.
Saft , groy CLAY with thin, fine SAND ond fine SANDY CLAY loyers; moist.
Stiff, groy CLAY with thin, fine SAND and fine SANDY CLAY loyers; moist.
Compoct, groy CLAYEY fine SAND; moist.
Hard, bluish groy, fine SANDY CLAY; moist.
Very dense, bluish groy CLAYEY SANDY GRAVEL; moist.
Very stiff, mottled groy ond yellow brown GRAVELLY SANDY CLAY; moist.
Very stiff, mottled ton ond oronge-brown SILTY CLAY; moist.

AS BUILT
CORRECTIONS BY S. WHIPPLE
CONTRACT NO. 04-192244
DATE 01-28-98
NO AS BUILT CHANGES
A.K. 5-6-98

3 ADDED PER ADDENDUM NO. 3 DATED MAY 25, 1995

REPACKAGED CONTRACT "D" PLANS FOR SEPARATION OF PARTS OF THE CONTRACT INTO CONTRACT "F"

CONTRACT "D"

| OFFICE OF TRANSPORTATION MATERIALS & RESEARCH | ENGINEERING GEOLOGY BRANCH | FIELD INVESTIGATION BY: |
|---|---|---|
| DRAWN BY K. WAHL 5-92 | | M. WILLIAN |
| CHECKED BY | | |

State of CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN

BRIDGE NO. 33-612 E
POST MILE

# PORT OF OAKLAND CONN. VIADUCT
# LOG OF TEST BORINGS 3 OF 14

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04
EA 192281

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

| SHEET | OF |
|---|---|
| ~~141~~ | ~~166~~ |
| 81 | 106 |

TL 6051 REV. 3/90 90 58358

| DIST. | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 04 | Ala | 880 | 34.3/35.0 | 1022 | 1046 |

R.C. Wilhelms
CERTIFIED ENGINEERING GEOLOGIST

3-13-95
PLANS APPROVAL DATE

REGISTERED GEOLOGIST R.C. WILHELMS No. 560 Exp. 6-30-94

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NOTES:
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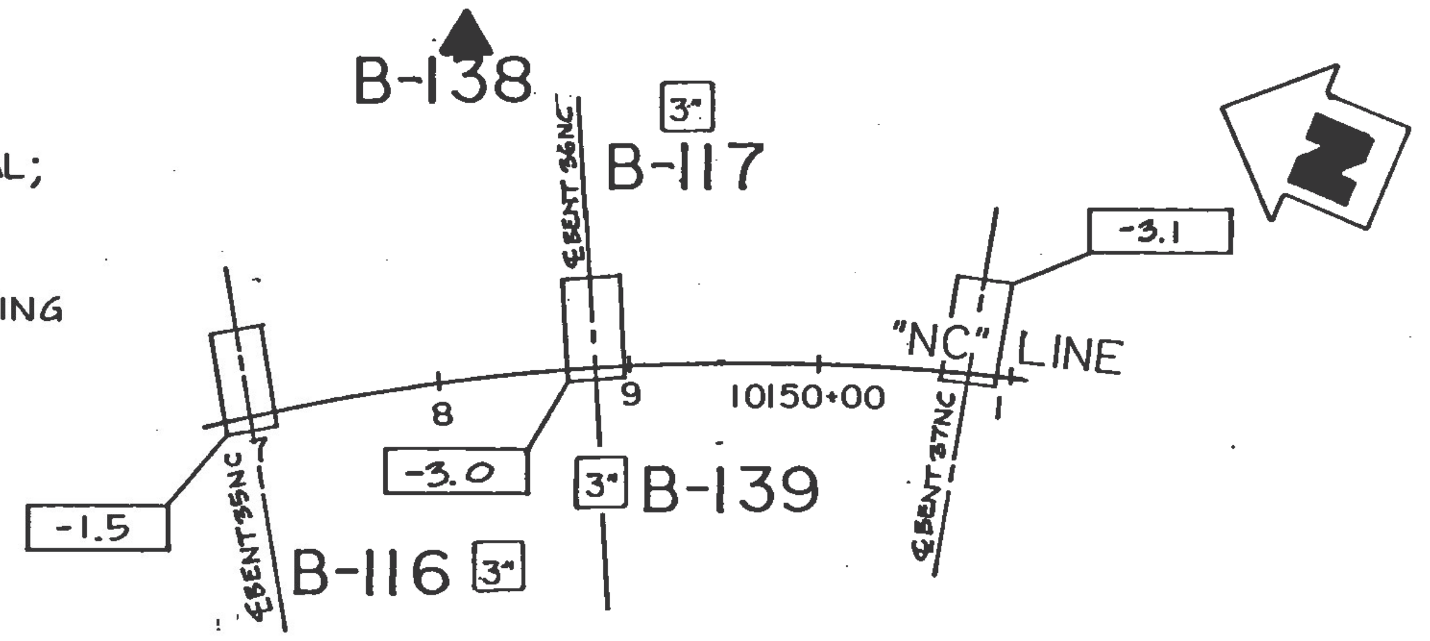
-1.5 INDICATES BOTTOM OF FOOTING ELEVATION

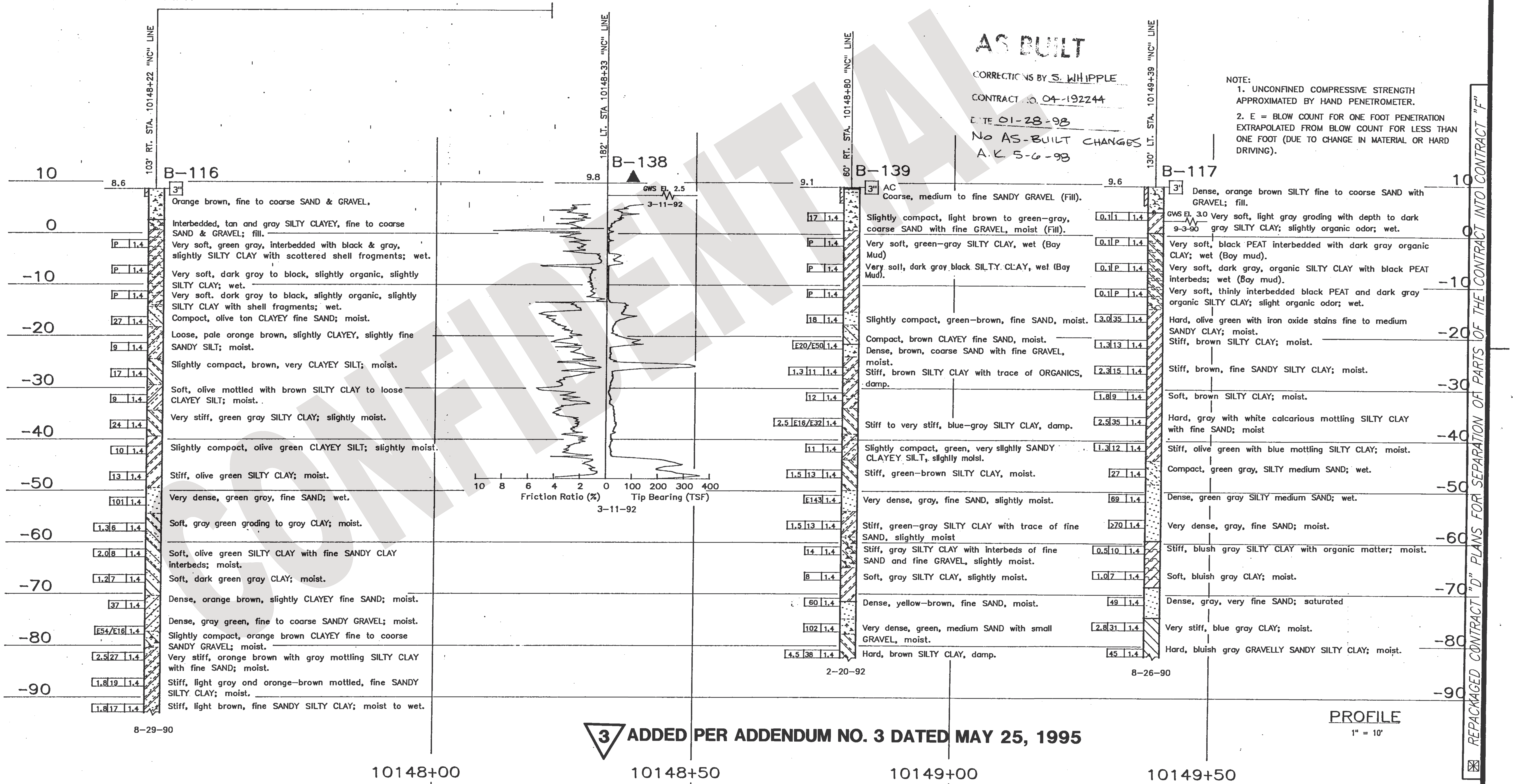


PLAN
1" = 100'

BENCH MARK
SEE "LOG OF TEST BORING" SHEET 1 OF 14

AS BUILT
CORRECTIONS BY S. WHIPPLE
CONTRACT NO. 04-192244
DATE 01-28-98
No AS-BUILT CHANGES
A.K. 5-6-98

NOTE:
1. UNCONFINED COMPRESSIVE STRENGTH APPROXIMATED BY HAND PENETROMETER.
2. E = BLOW COUNT FOR ONE FOOT PENETRATION EXTRAPOLATED FROM BLOW COUNT FOR LESS THAN ONE FOOT (DUE TO CHANGE IN MATERIAL OR HARD DRIVING).

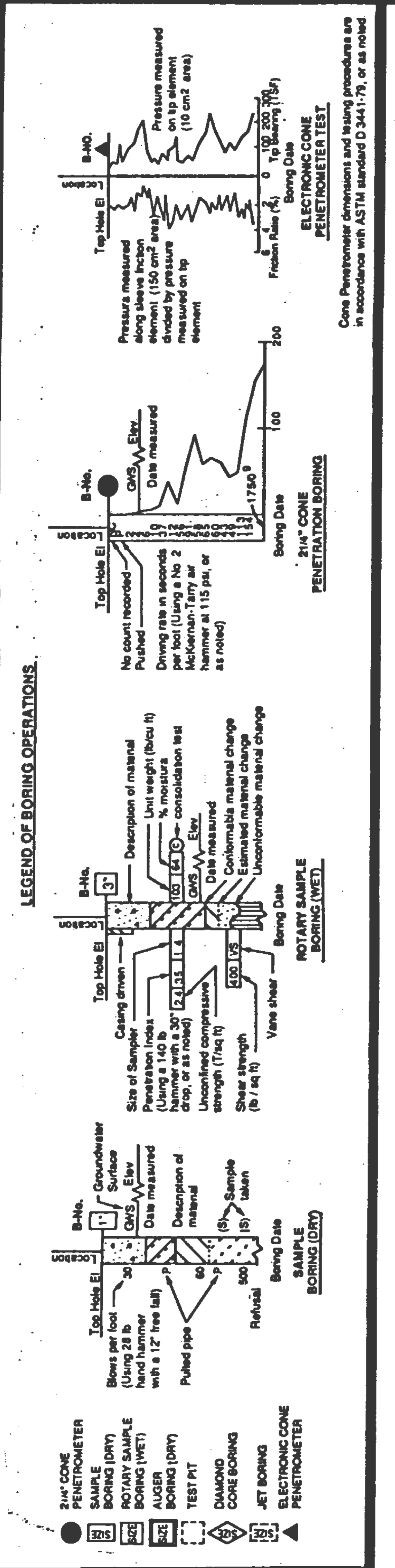


PROFILE
1" = 10'

3 ADDED PER ADDENDUM NO. 3 DATED MAY 25, 1995

REPACKAGED CONTRACT "D" PLANS FOR SEPARATION OF PARTS OF THE CONTRACT INTO CONTRACT "F"

CONTRACT "D"



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 |
| SILTY SAND or SANDY SILT | METAMORPHIC ROCK |
| SILTY CLAY | |

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 material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

OFFICE OF TRANSPORTATION MATERIALS & RESEARCH — ENGINEERING GEOLOGY BRANCH

DRAWN BY K. WAHL 5-92
CHECKED BY

FIELD INVESTIGATION BY:
M. WILLIAN

State of CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN

BRIDGE NO. 33-612 E
POST MILE

PORT OF OAKLAND CONN. VIADUCT
LOG OF TEST BORINGS 4 OF 14

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04
EA 192281

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET ~~142~~ 82 OF ~~166~~ 106

TL 6051 REV. 3/90

| DIST. | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 04 | Ala | 880 | 34.3/35.0 | 1023 | 1046 |

R.C. Wilhelms
CERTIFIED ENGINEERING GEOLOGIST

R.C. WILHELMS
No. 560
Exp. 6-30-94

3-13-95
PLANS APPROVAL DATE

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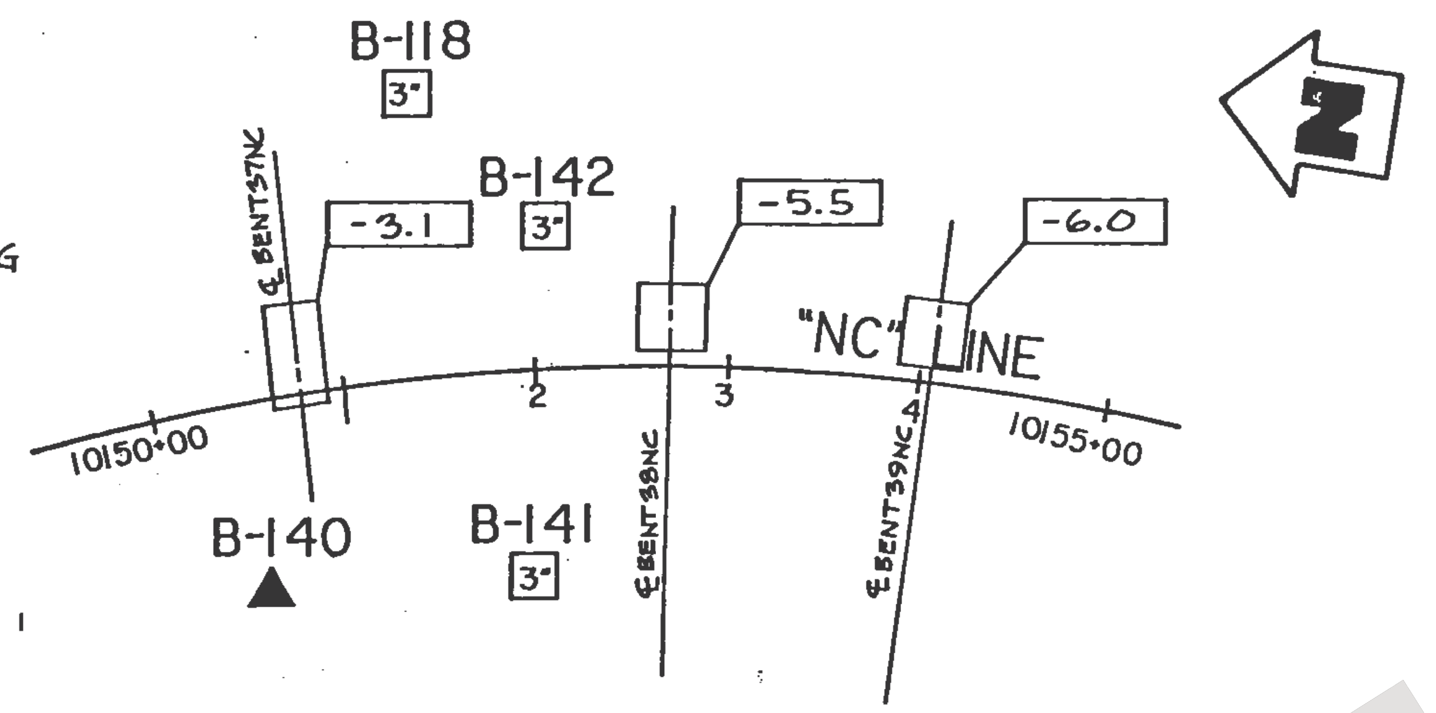
NOTES:
THIS ALIGNMENT MAY NOT BE FINAL; FOR FINAL ALIGNMENT REFER TO FOUNDATION PLANS
-3.1 INDICATES BOTTOM OF FOOTING ELEVATION

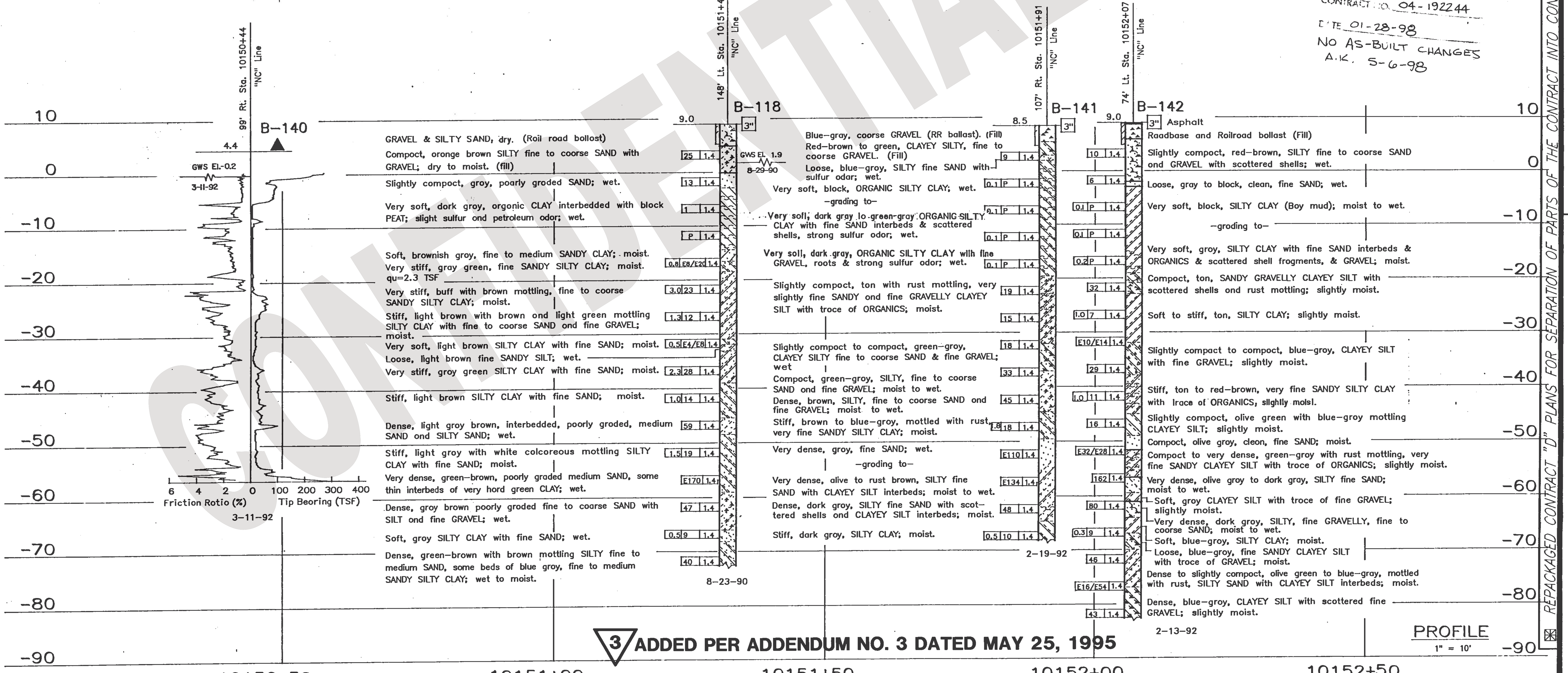


PLAN
1" = 100'

BENCH MARK
SEE "LOG OF TEST BORINGS 1 OF 14

NOTES:
1. UNCONFINED COMPRESSIVE STRENGTH APPROXIMATED BY HAND PENETROMETER TEST
2. E = BLOW COUNT FOR ONE FOOT PENETRATION EXTRAPOLATED FROM BLOW COUNT FOR LESS THAN ONE FOOT (DUE TO CHANGE IN MATERIAL OR HARD DRIVING)

AS BUILT
CORRECTIONS BY S. WHIPPLE
CONTRACT NO. 04-192244
DATE 01-28-98
NO AS-BUILT CHANGES
A.K. 5-6-98



B-118:

GRAVEL & SILTY SAND, dry. (Roil road bollost)

Compoct, oronge brown SILTY fine to coorse SAND with GRAVEL; dry to moist. (fill)

Slightly compoct, groy, poorly groded SAND; wet.

Very soft, dork groy, orgonic CLAY interbedded with block PEAT; slight sulfur ond petroleum odor; wet.

Soft, brownish groy, fine to medium SANDY CLAY; moist.

Very stiff, gray green, fine SANDY SILTY CLAY; moist. qu=2.3 TSF

Very stiff, buff with brown mottling, fine to coorse SANDY SILTY CLAY; moist.

Stiff, light brown with brown ond light green mottling SILTY CLAY with fine to coorse SAND ond fine GRAVEL; moist.

Very soft, light brown SILTY CLAY with fine SAND; moist.

Loose, light brown fine SANDY SILT; wet.

Very stiff, groy green SILTY CLAY with fine SAND; moist.

Stiff, light brown SILTY CLAY with fine SAND; moist.

Dense, light groy brown, interbedded, poorly groded, medium SAND ond SILTY SAND; wet.

Stiff, light groy with white colcoreous mottling SILTY CLAY with fine SAND; moist.

Very dense, green-brown, poorly graded medium SAND, some thin interbeds of very hord green CLAY; wet.

Dense, groy brown poorly groded fine to coarse SAND with SILT ond fine GRAVEL; wet.

Soft, groy SILTY CLAY with fine SAND; wet.

Dense, green-brown with brown mottling SILTY fine to medium SAND, some beds of blue groy, fine to medium SANDY SILTY CLAY; wet to moist.

| | | |
|---|---|---|
| | 25 | 1.4 |
| | 13 | 1.4 |
| | 1 | 1.4 |
| | P | 1.4 |
| 0.8 | E8/E20 | 1.4 |
| 3.0 | 23 | 1.4 |
| 1.3 | 12 | 1.4 |
| 0.5 | E4/E8 | 1.4 |
| 2.3 | 28 | 1.4 |
| 1.0 | 14 | 1.4 |
| | 59 | 1.4 |
| 1.5 | 19 | 1.4 |
| | E170 | 1.4 |
| | 47 | 1.4 |
| 0.5 | 9 | 1.4 |
| | 40 | 1.4 |

B-141:

Blue-gray, coorse GRAVEL (RR ballast). (Fill)

Red-brown to green, CLAYEY SILTY, fine to coorse GRAVEL. (Fill)

Loose, blue-groy, SILTY fine SAND with sulfur odar; wet.

Very soft, block, ORGANIC SILTY CLAY; wet.

—grading to—

Very soft, dark gray to green-gray ORGANIC SILTY CLAY with fine SAND interbeds & scattered shells, strong sulfur odor; wet.

Very soft, dark gray, ORGANIC SILTY CLAY with fine GRAVEL, roots & strong sulfur odor; wet.

Slightly compoct, ton with rust mottling, very slightly fine SANDY ond fine GRAVELLY CLAYEY SILT with troce of ORGANICS; moist.

Slightly compoct to compact, green-groy, CLAYEY SILTY fine to coorse SAND & fine GRAVEL; wet

Compoct, green-groy, SILTY, fine to coorse SAND ond fine GRAVEL; moist to wet.

Dense, brown, SILTY, fine to coorse SAND ond fine GRAVEL; moist to wet.

Stiff, brown to blue-groy, mottled with rust, very fine SANDY SILTY CLAY; moist.

Very dense, groy, fine SAND; wet.

—groding to—

Very dense, alive to rust brown, SILTY fine SAND with CLAYEY SILT interbeds; moist to wet.

Dense, dork groy, SILTY fine SAND with scottered shells ond CLAYEY SILT interbeds; moist.

Stiff, dark groy, SILTY CLAY; moist.

| | | |
|---|---|---|
| | 9 | 1.4 |
| 0.1 | P | 1.4 |
| 0.1 | P | 1.4 |
| 0.1 | P | 1.4 |
| 0.1 | P | 1.4 |
| | 19 | 1.4 |
| | 15 | 1.4 |
| | 18 | 1.4 |
| | 33 | 1.4 |
| | 45 | 1.4 |
| 1.8 | 18 | 1.4 |
| | E110 | 1.4 |
| | E134 | 1.4 |
| | 48 | 1.4 |
| 0.5 | 10 | 1.4 |

B-142:

Asphalt

Raadbase and Roilroad bollast (Fill)

Slightly compoct, red-brown, SILTY fine to coorse SAND ond GRAVEL with scottered shells; wet.

Loose, gray to block, clean, fine SAND; wet.

Very soft, block, SILTY CLAY (Boy mud); moist to wet.

—groding to—

Very soft, groy, SILTY CLAY with fine SAND interbeds & ORGANICS & scattered shell frogments, & GRAVEL; moist.

Compoct, ton, SANDY GRAVELLY CLAYEY SILT with scottered shells ond rust mottling; slightly moist.

Soft to stiff, ton, SILTY CLAY; slightly maist.

Slightly compact to compoct, blue-groy, CLAYEY SILT with fine GRAVEL; slightly moist.

Stiff, ton to red-brown, very fine SANDY SILTY CLAY with trace of ORGANICS, slightly moist.

Slightly compoct, olive green with blue-groy mottling CLAYEY SILT; slightly moist.

Compoct, olive groy, cleon, fine SAND; moist.

Compoct to very dense, green-groy with rust mottling, very fine SANDY CLAYEY SILT with troce of ORGANICS; slightly moist.

Very dense, olive groy to dork gray, SILTY fine SAND; moist to wet.

Soft, groy CLAYEY SILT with troce of fine GRAVEL; slightly moist.

Very dense, dork groy, SILTY, fine GRAVELLY, fine to coorse SAND; moist to wet.

Soft, blue-groy, SILTY CLAY; moist.

Loose, blue-groy, fine SANDY CLAYEY SILT with troce of GRAVEL; moist.

Dense to slightly compoct, olive green to blue-gray, mottled with rust, SILTY SAND with CLAYEY SILT interbeds; moist.

Dense, blue-groy, CLAYEY SILT with scottered fine GRAVEL; slightly moist.

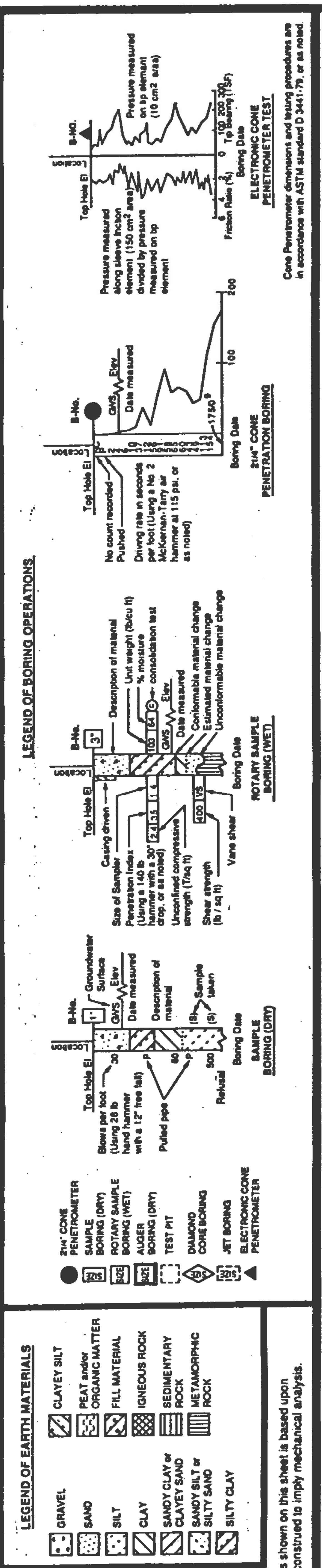
| | | |
|---|---|---|
| | 10 | 1.4 |
| | 6 | 1.4 |
| 0.1 | P | 1.4 |
| 0.1 | P | 1.4 |
| 0.2 | P | 1.4 |
| | 32 | 1.4 |
| 1.0 | 7 | 1.4 |
| | E10/E14 | 1.4 |
| | 29 | 1.4 |
| 1.0 | 11 | 1.4 |
| | 16 | 1.4 |
| | E32/E28 | 1.4 |
| | 162 | 1.4 |
| | 80 | 1.4 |
| 0.3 | 9 | 1.4 |
| | 46 | 1.4 |
| | E16/E54 | 1.4 |
| | 43 | 1.4 |

3 ADDED PER ADDENDUM NO. 3 DATED MAY 25, 1995

PROFILE
1" = 10'

CONTRACT "D"

REPACKAGED CONTRACT "D" PLANS FOR SEPARATION OF PARTS OF THE CONTRACT INTO CONTRACT "F"



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| 10-19 | Slightly compact | Stiff |
| 20-34 | Compact | Very stiff |
| 35-69 | Dense | Hard |
| >70 | Very dense | Very hard |

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

| | | |
|---|---|---|
| OFFICE OF TRANSPORTATION MATERIALS & RESEARCH | ENGINEERING GEOLOGY BRANCH | FIELD INVESTIGATION BY: M. WILLIAN |
| DRAWN BY | IRMA GAMARRA 5/92 | |
| CHECKED BY | | |

State of
CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN

BRIDGE NO. 33-612 E
POST MILE

# PORT OF OAKLAND CONN. VIADUCT
## LOG OF TEST BORINGS 5 OF 14

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04
EA 192281

DISREGARD PRINTS BEARING EARLIER REVISION DATES
REVISION DATES (PRELIMINARY STAGE ONLY)

| SHEET | OF |
|---|---|
| ~~143~~ | ~~166~~ |
| 83 | 106 |

TL 6051 REV 3/90

| DIST. | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 04 | Ala | 880 | 34.3/35.0 | 1024 | 1046 |

R.C. Wilhelms
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST R.C. WILHELMS No. 560 Exp. 6-30-94 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

3-13-95
PLANS APPROVAL DATE

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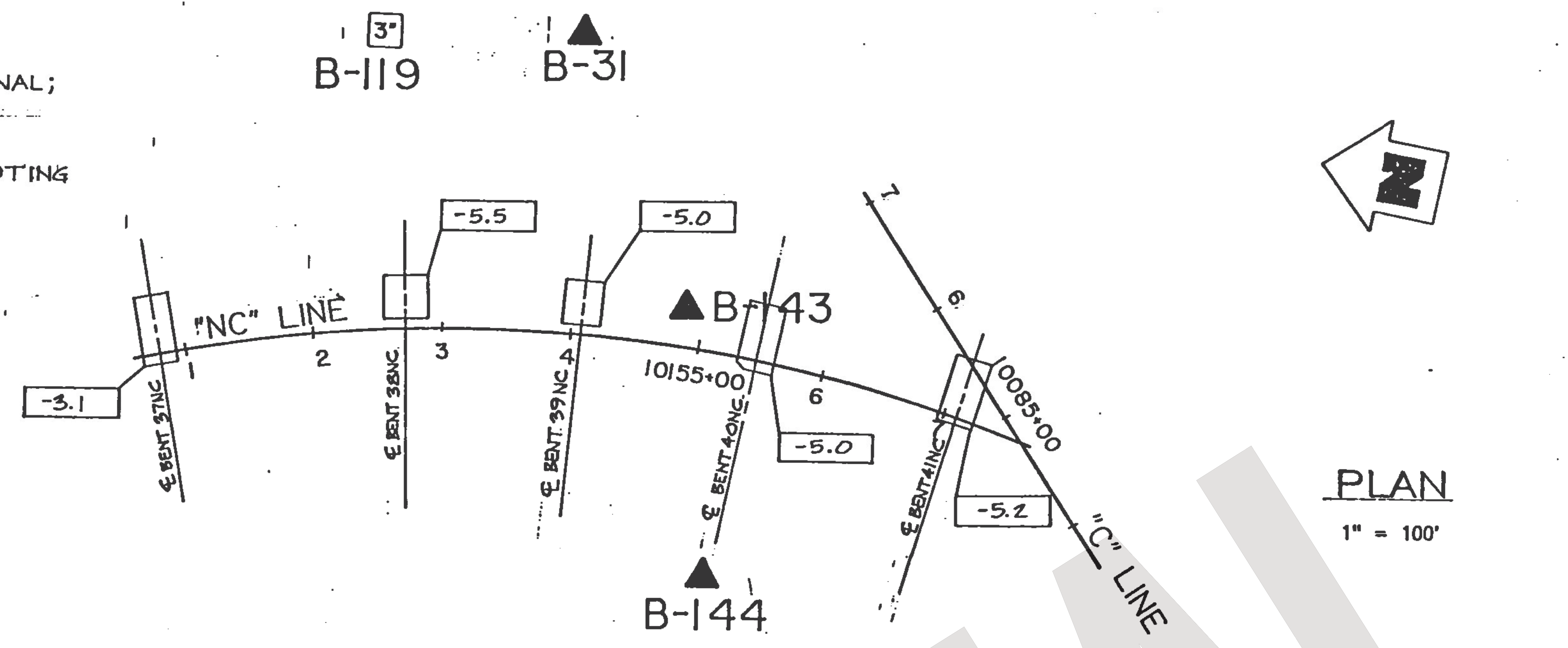
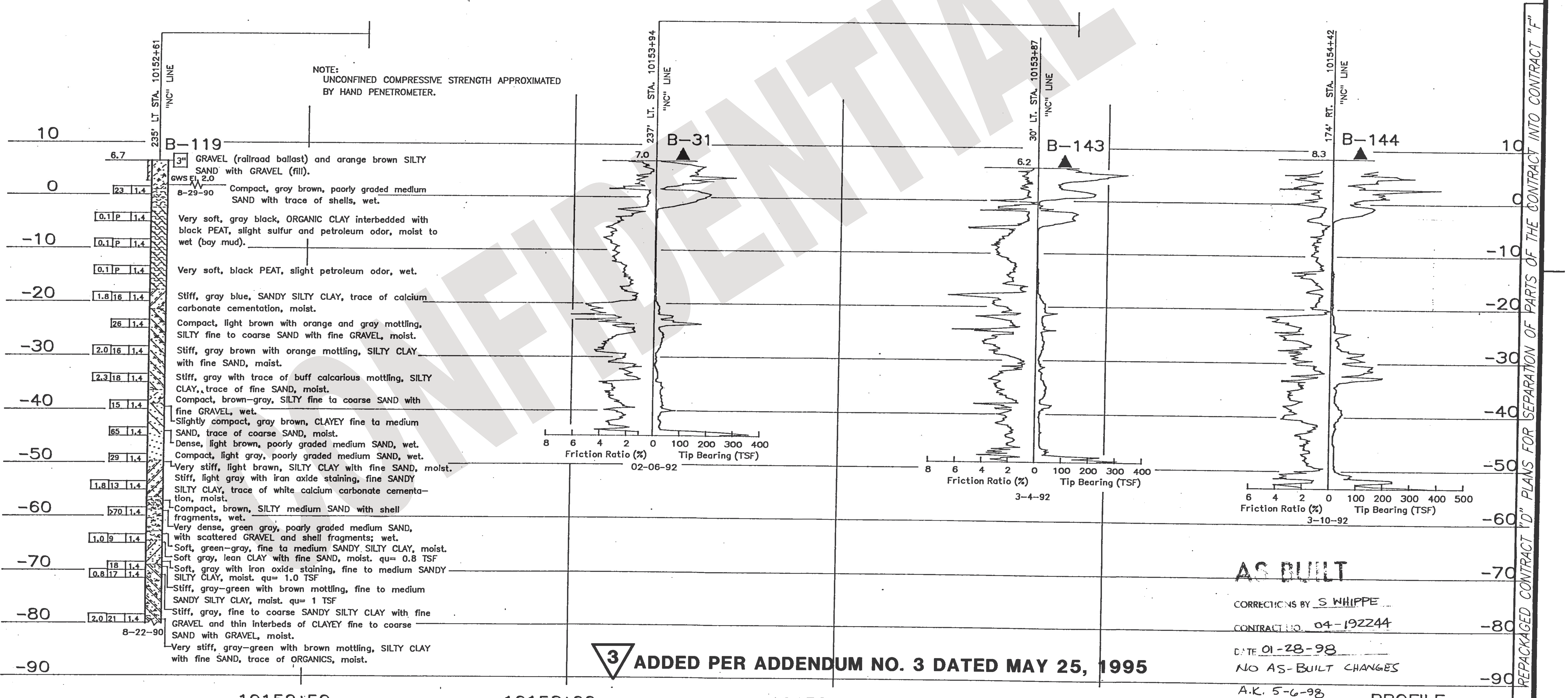


PLAN
1" = 100'

BENCH MARK
SEE "LOG OF TEST BORING" SHEET 1 OF 14

NOTE:
UNCONFINED COMPRESSIVE STRENGTH APPROXIMATED BY HAND PENETROMETER.



3" GRAVEL (railraad ballast) and orange brown SILTY SAND with GRAVEL (fill).

Compact, groy brown, paorly graded medium SAND with trace of shells, wet.

Very soft, gray black, ORGANIC CLAY interbedded with black PEAT, slight sulfur and petroleum odor, moist to wet (bay mud).

Very soft, black PEAT, slight petroleum odor, wet.

Stiff, gray blue, SANDY SILTY CLAY, trace of calcium carbonate cementation, moist.

Compact, light brown with orange and gray mottling, SILTY fine to coarse SAND with fine GRAVEL, moist.

Stiff, gray brown with orange mottling, SILTY CLAY with fine SAND, maist.

Stiff, gray with trace of buff calcarious mottling, SILTY CLAY,, trace of fine SAND, moist.

Compact, brown-gray, SILTY fine ta coarse SAND with fine GRAVEL, wet.

Slightly compact, gray brown, CLAYEY fine ta medium SAND, trace of coarse SAND, moist.

Dense, light brown, poorly graded medium SAND, wet.

Compact, light gray, poorly graded medium SAND, wet.

Very stiff, light brawn, SILTY CLAY with fine SAND, moist.

Stiff, light gray with iran axide staining, fine SANDY SILTY CLAY, trace of white calcium carbonate cementation, moist.

Compact, brown, SILTY medium SAND with shell fragments, wet.

Very dense, green gray, poorly graded medium SAND, with scattered GRAVEL and shell fragments; wet.

Soft, green-gray, fine ta medium SANDY SILTY CLAY, moist.

Soft gray, lean CLAY with fine SAND, moist. qu= 0.8 TSF

Soft, gray with iron oxide staining, fine to medium SANDY SILTY CLAY, moist. qu= 1.0 TSF

Stiff, gray-green with brown mottling, fine to medium SANDY SILTY CLAY, maist. qu= 1 TSF

Stiff, gray, fine to coarse SANDY SILTY CLAY with fine GRAVEL and thin interbeds of CLAYEY fine to coarse SAND with GRAVEL, moist.

Very stiff, gray-green with brown mottling, SILTY CLAY with fine SAND, trace of ORGANICS, moist.

3 ADDED PER ADDENDUM NO. 3 DATED MAY 25, 1995

AS BUILT
CORRECTIONS BY S WHIPPE
CONTRACT NO. 04-192244
DATE 01-28-98
NO AS-BUILT CHANGES
A.K. 5-6-98

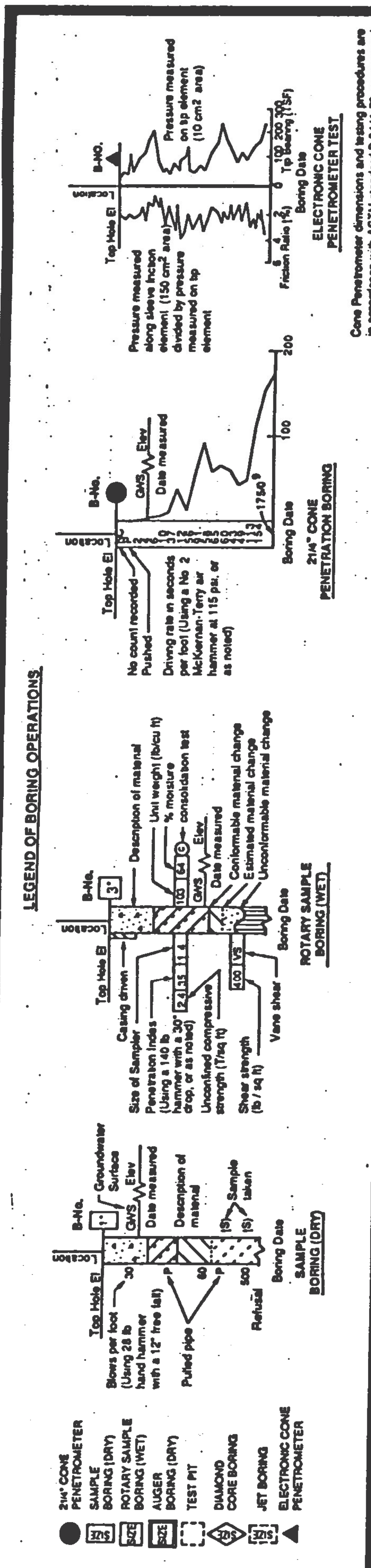
10152+50
10153+00
10153+50
10154+00

PROFILE
1" = 10'

CONTRACT "D".

*REPACKAGED CONTRACT "D" PLANS FOR SEPARATION OF PARTS OF THE CONTRACT INTO CONTRACT "F"*

LEGEND OF BORING OPERATIONS



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

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

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According to the Standard Penetration Test

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ENGINEERING GEOLOGY BRANCH
DRAWN BY K. WAHL 5-92
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STRUCTURE DESIGN

BRIDGE NO.
33-612 E
POST MILE

# PORT OF OAKLAND CONN. VIADUCT
## LOG OF TEST BORINGS 6 OF 14

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04
EA 192281

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

| SHEET | OF |
|---|---|
| ~~144~~ | ~~166~~ |
| 84 | 106 |

| DIST. | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
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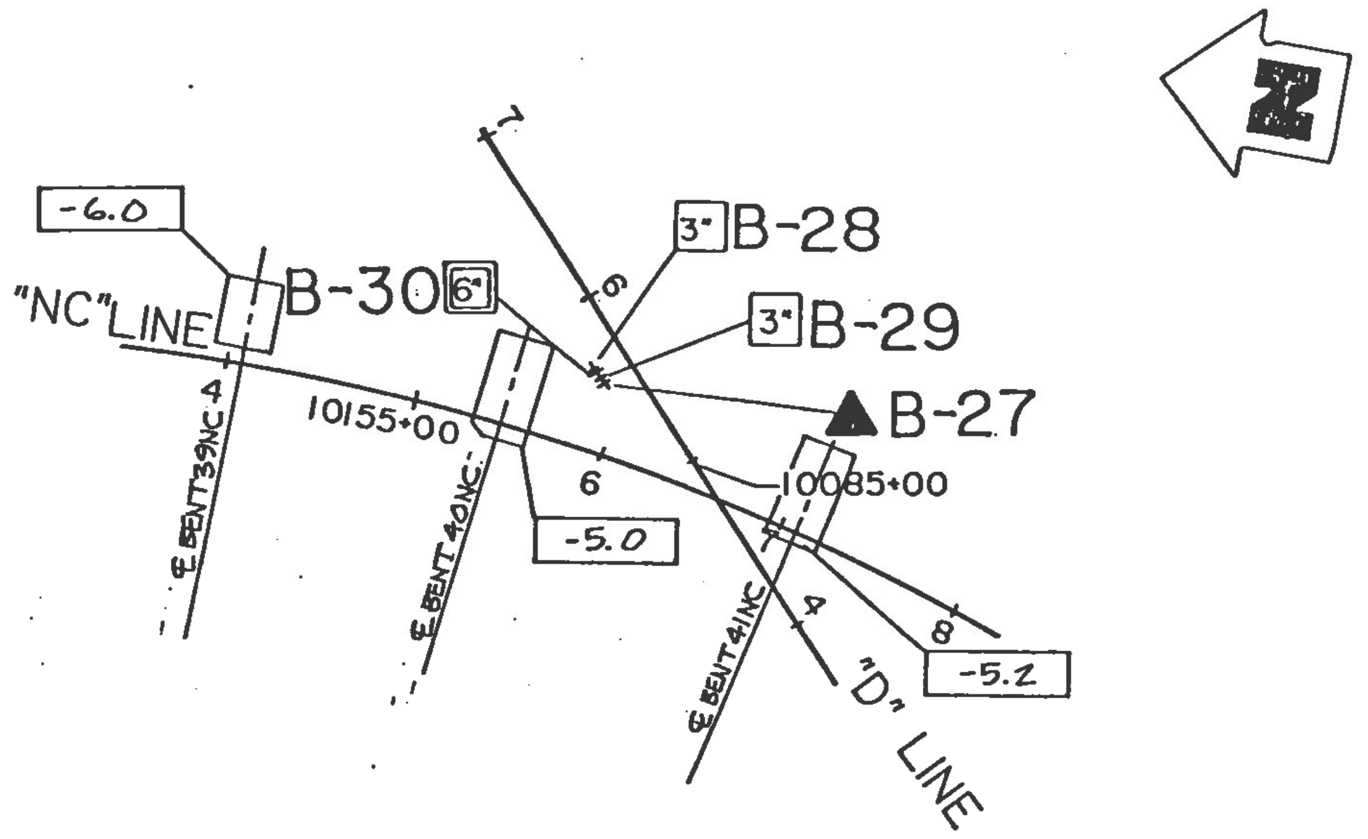
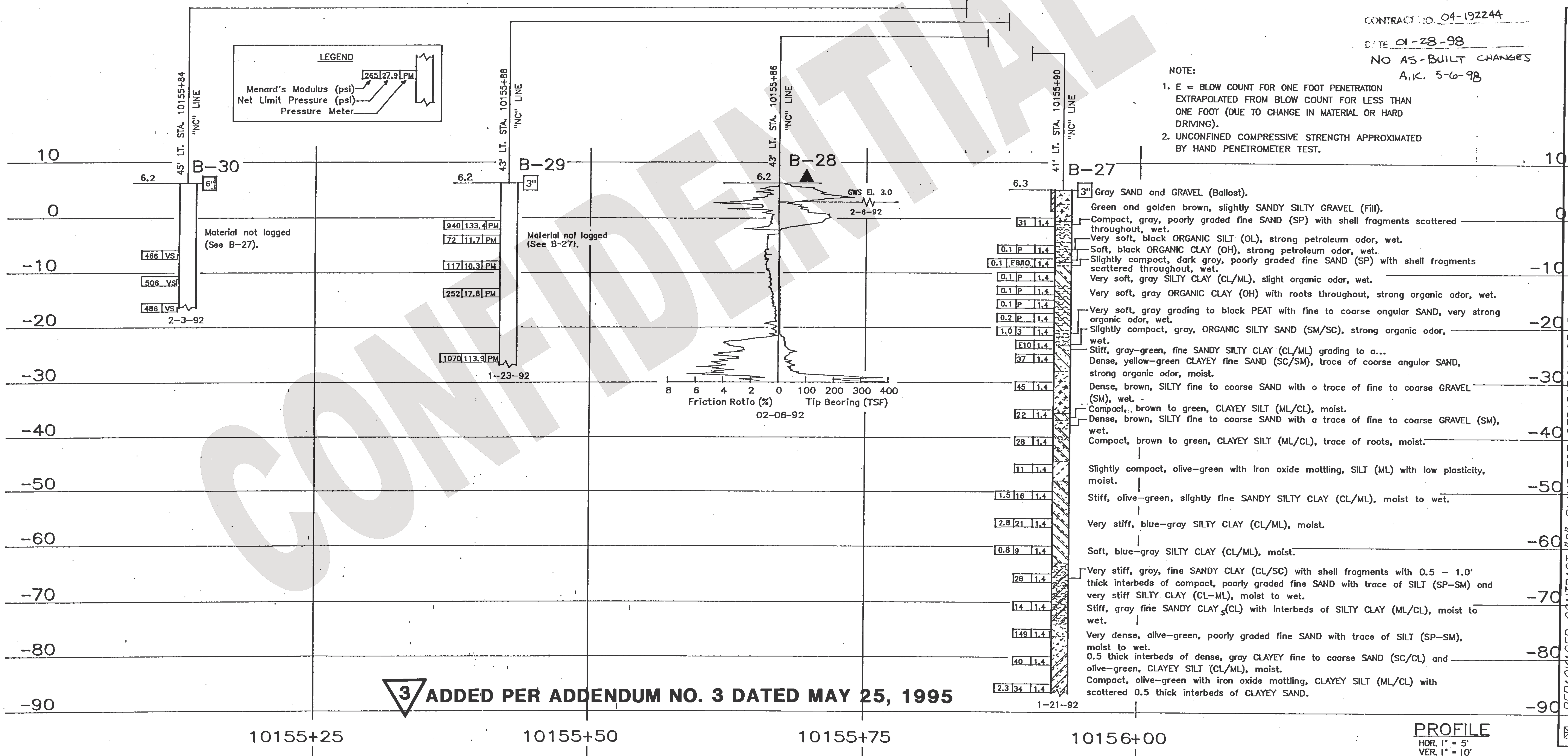
-5.0 INDICATES BOTTOM OF FOOTING ELEVATION



PLAN
1" = 100'

BENCH MARK
SEE "LOG OF TEST BORING" SHEET 1 OF 14

AS BUILT
CORRECTIONS BY S. WHIPPLE
CONTRACT NO. 04-192244
DATE 01-28-98
NO AS-BUILT CHANGES
A.K. 5-6-98



NOTE:

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B-27

Gray SAND ond GRAVEL (Ballost).

Green ond golden brown, slightly SANDY SILTY GRAVEL (Fill).

Compact, gray, poorly graded fine SAND (SP) with shell fragments scattered throughout, wet.

Very soft, black ORGANIC SILT (OL), strong petroleum odor, wet.

Soft, black ORGANIC CLAY (OH), strong petroleum odor, wet.

Slightly compoct, dark groy, poorly graded fine SAND (SP) with shell frogments scattered throughout, wet.

Very soft, gray SILTY CLAY (CL/ML), slight organic odar, wet.

Very soft, gray ORGANIC CLAY (OH) with roots throughout, strong organic odor, wet.

Very soft, gray groding to block PEAT with fine to coarse ongular SAND, very strong organic odor, wet.

Slightly compact, gray, ORGANIC SILTY SAND (SM/SC), strong organic odor, wet.

Stiff, gray-green, fine SANDY SILTY CLAY (CL/ML) grading to a...

Dense, yellow-green CLAYEY fine SAND (SC/SM), troce of coorse angulor SAND, strong organic odor, moist.

Dense, brown, SILTY fine to coorse SAND with o troce of fine to coarse GRAVEL (SM), wet.

Compact, brown to green, CLAYEY SILT (ML/CL), moist.

Dense, brown, SILTY fine to coarse SAND with a trace of fine to coarse GRAVEL (SM), wet.

Compoct, brown to green, CLAYEY SILT (ML/CL), trace of roots, moist.

Slightly compoct, olive-green with iron oxide mottling, SILT (ML) with low plasticity, moist.

Stiff, olive-green, slightly fine SANDY SILTY CLAY (CL/ML), moist to wet.

Very stiff, blue-gray SILTY CLAY (CL/ML), moist.

Soft, blue-gray SILTY CLAY (CL/ML), moist.

Very stiff, groy, fine SANDY CLAY (CL/SC) with shell frogments with 0.5 – 1.0' thick interbeds of compact, poorly graded fine SAND with trace of SILT (SP-SM) ond very stiff SILTY CLAY (CL-ML), moist to wet.

Stiff, gray fine SANDY CLAY$_s$(CL) with interbeds of SILTY CLAY (ML/CL), moist to wet.

Very dense, alive-green, poorly graded fine SAND with trace of SILT (SP-SM), moist to wet.

0.5 thick interbeds of dense, gray CLAYEY fine to caarse SAND (SC/CL) and olive-green, CLAYEY SILT (CL/ML), moist.

Compact, olive-green with iron oxide mottling, CLAYEY SILT (ML/CL) with scottered 0.5 thick interbeds of CLAYEY SAND.

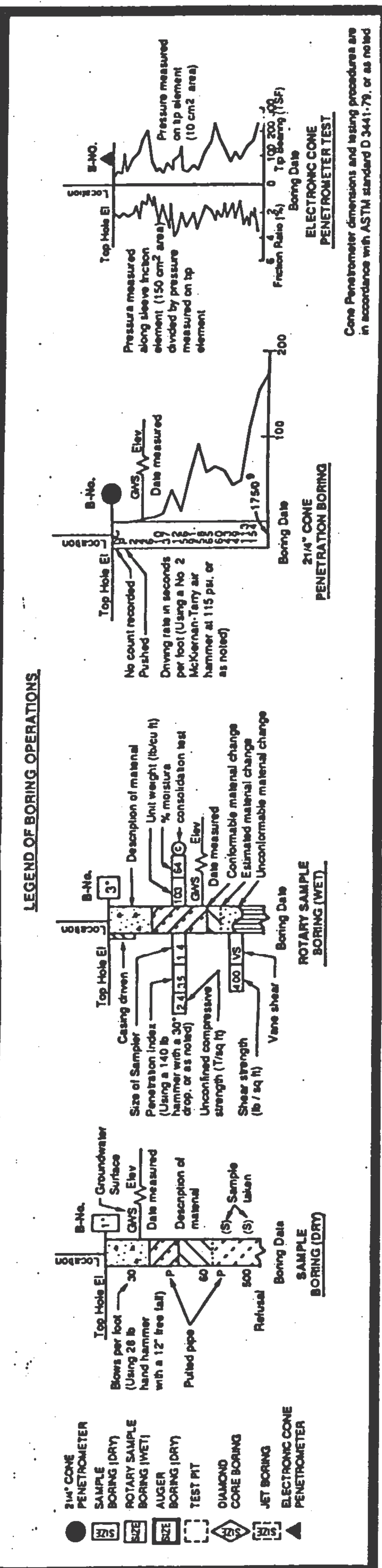
3 ADDED PER ADDENDUM NO. 3 DATED MAY 25, 1995

PROFILE
HOR. 1" = 5'
VER. 1" = 10'

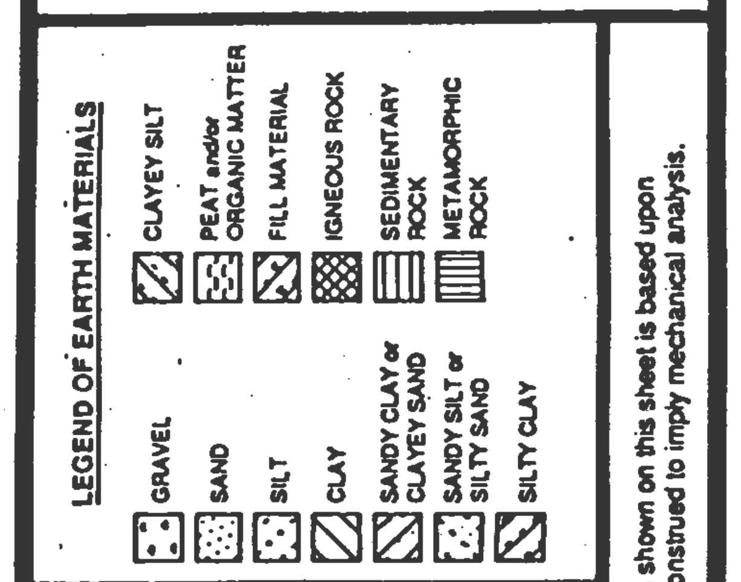
CONTRACT "D"

REPACKAGED CONTRACT "D" PLANS FOR SEPARATION OF PARTS OF THE CONTRACT INTO CONTRACT "F"

LEGEND OF BORING OPERATIONS



LEGEND OF EARTH MATERIALS



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PORT OF OAKLAND CONN. VIADUCT
LOG OF TEST BORINGS 7 OF 14

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04
EA 192281

DISREGARD PRINTS BEARING EARLIER REVISION DATES
REVISION DATES (PRELIMINARY STAGE ONLY)

| SHEET | OF |
|---|---|
| ~~145~~ | ~~166~~ |
| 85 | 106 |

TL 6051 REV. 3/90

# APPENDIX C

# LIQUEFACTION SETTLEMENT

# Liquefaction Evaluation

## Seed et al. (2003) Procedure

Earthquake Magnitude M = 7.50 (MCE)
Peak Ground Acceleration: 0.62 (g)
Vs,40 = 591 (fps)
MSF (Seed et, al., 2003) = 1.00

| Boring ID | USCS class from boring log | Depth to Sample (ft) | Layer Thickness (ft) | GS Elev | $\gamma_m$ (pcf) | Blows foot, N | Sampler code | % finer than No200 | USCS class lab | PI | GWT Elev. Ft | Assigned Class. | Sample Elev. (ft) | $\sigma_v$, psf | $\sigma_v'$, psf | Sampler Correction | Rod Length, m | CR | FC, % | $C_N$ | ER | $N_{1,60}$ | Capped FC | $C_{Fines}$ | $(N_1)_{60cs}$ | f | Kσ | CRR | Rd | CSR | CSR* | $FS_L$ | $FS_L < 1$ | $P_L$ | Liquefaction Susceptibility | Below GWT | Assessment |  | $FS_L$ | $P_L$ |  | Lookup Num | Vol. Strain (%) | Settlement (inches) | PI | Final Enginering Judgment | Liquefied Layer Thickness (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B-165 | SP | 10.0 | 5.00 | 5.4 | 120 | 1 | SPT | 10 | SP |  | -0.6 | SP | -5 | 1200 | 950 | 1.1 | 4.6 | 0.85 | 10 | 1.45 | 75 | 2 | 10 | 1.33 | 2 | 0.61 | 1.00 | 0.048 | 0.96 | 0.491 | 0.491 | 0.1 | Yes | 1.00 | Yes | Yes | Yes |  | 0.1 | 1.0 |  | 249 | 10.00 | 6.0 |  | Yes | 5 |
| B-165 | CL | 15.0 | 5.00 | 5.4 | 98 | 1 | SPT | 40 | CL |  | -0.6 | CL | -10 | 1690 | 1128 | 1.1 | 6.1 | 0.95 | 40 | 1.33 | 75 | 2 | 35 | 2.15 | 4 | 0.62 | 1.00 | 0.051 | 0.93 | 0.562 | 0.562 | 0.1 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 20.0 | 5.00 | 5.4 | 98 | 0 | SPT | 40 | CL |  | -0.6 | CL | -15 | 2180 | 1306 | 1.1 | 7.6 | 0.95 | 40 | 1.24 | 75 | 0 | 35 | 0.00 | 0 | 0.60 | 1.00 | 0.042 | 0.88 | 0.595 | 0.595 | 0.1 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 25.0 | 5.00 | 5.4 | 98 | 0 | SPT | 40 | CL |  | -0.6 | CL | -20 | 2670 | 1484 | 1.1 | 9.1 | 0.95 | 40 | 1.16 | 75 | 0 | 35 | 0.00 | 0 | 0.60 | 1.00 | 0.041 | 0.83 | 0.600 | 0.600 | 0.1 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 30.0 | 5.00 | 5.4 | 98 | 7 | SPT | 40 | CL |  | -0.6 | CL | -25 | 3160 | 1662 | 1.1 | 10.7 | 1.00 | 40 | 1.10 | 75 | 11 | 35 | 1.31 | 14 | 0.67 | 1.00 | 0.098 | 0.76 | 0.585 | 0.585 | 0.2 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 35.0 | 5.00 | 5.4 | 98 | 0 | SPT | 40 | CL |  | -0.6 | CL | -30 | 3650 | 1840 | 1.1 | 12.2 | 1.00 | 40 | 1.04 | 75 | 0 | 35 | 0.00 | 0 | 0.60 | 1.00 | 0.038 | 0.70 | 0.560 | 0.560 | 0.1 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 40.0 | 5.00 | 5.4 | 98 | 0 | SPT | 40 | CL |  | -0.6 | CL | -35 | 3920 | 1798 | 1.1 | 13.7 | 1.00 | 40 | 1.05 | 75 | 0 | 35 | 0.00 | 0 | 0.60 | 1.00 | 0.039 | 0.65 | 0.569 | 0.569 | 0.1 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 45.0 | 4.50 | 5.4 | 98 | 0 | SPT | 40 | CL |  | -0.6 | CL | -40 | 4410 | 1976 | 1.1 | 15.2 | 1.00 | 40 | 1.01 | 75 | 0 | 35 | 0.00 | 0 | 0.60 | 1.00 | 0.038 | 0.61 | 0.545 | 0.545 | 0.1 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 49.0 | 2.50 | 5.4 | 98 | 1 | SPT | 40 | CL |  | -0.6 | CL | -44 | 4802 | 2119 | 1.1 | 16.5 | 1.00 | 40 | 0.97 | 75 | 1 | 35 | 2.45 | 3 | 0.62 | 1.00 | 0.041 | 0.58 | 0.532 | 0.532 | 0.1 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 50.0 | 3.00 | 5.4 | 115 | 18 | SPT | 40 | CL |  | -0.6 | CL | -45 | 5750 | 3004 | 1.1 | 16.8 | 1.00 | 40 | 0.82 | 76 | 20 | 35 | 1.23 | 25 | 0.73 | 0.91 | 0.193 | 0.58 | 0.446 | 0.490 | 0.4 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 55.0 | 5.00 | 5.4 | 115 | 24 | SPT | 40 | CL |  | -0.6 | CL | -50 | 6325 | 3267 | 1.1 | 18.3 | 1.00 | 40 | 0.78 | 77 | 27 | 35 | 1.21 | 32 | 0.76 | 0.90 | 0.317 | 0.56 | 0.436 | 0.483 | 0.7 | Yes | 0.60 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 60.0 | 5.00 | 5.4 | 115 | 29 | SPT | 40 | CL |  | -0.6 | CL | -55 | 6900 | 3530 | 1.1 | 19.8 | 1.00 | 40 | 0.75 | 78 | 31 | 35 | 1.20 | 37 | 0.79 | 0.90 | 0.464 | 0.55 | 0.430 | 0.480 | 1.1 |  | 0.04 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 65.0 | 4.50 | 5.4 | 125 | 19 | SPT | 5 | CL |  | -0.6 | CL | -60 | 8125 | 4443 | 1.1 | 21.3 | 1.00 | 5 | 0.67 | 79 | 18 | 5 | 1.03 | 19 | 0.70 | 0.80 | 0.111 | 0.54 | 0.397 | 0.497 | 0.3 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 69.0 | 2.50 | 5.4 | 115 | 8 | SPT | 40 | CL |  | -0.6 | CL | -64 | 7935 | 4004 | 1.1 | 22.6 | 1.00 | 40 | 0.71 | 80 | 8 | 35 | 1.35 | 11 | 0.66 | 0.80 | 0.063 | 0.54 | 0.430 | 0.536 | 0.1 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 70.0 | 3.00 | 5.4 | 115 | 56 | SPT | 40 | CL |  | -0.6 | CL | -65 | 8050 | 4056 | 1.1 | 22.9 | 1.00 | 40 | 0.70 | 81 | 58 | 35 | 1.17 | 68 | 0.80 | 0.88 | 0.600 | 0.54 | 0.431 | 0.491 | 1.4 |  | 0.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 75.0 | 5.00 | 5.4 | 115 | 53 | SPT | 40 | CL |  | -0.6 | CL | -70 | 8625 | 4319 | 1.1 | 24.4 | 1.00 | 40 | 0.68 | 82 | 54 | 35 | 1.17 | 64 | 0.80 | 0.87 | 0.600 | 0.54 | 0.433 | 0.500 | 1.4 |  | 0.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 80.0 | 5.00 | 5.4 | 115 | 23 | SPT | 40 | CL |  | -0.6 | CL | -75 | 9200 | 4582 | 1.1 | 25.9 | 1.00 | 40 | 0.66 | 83 | 23 | 35 | 1.22 | 28 | 0.74 | 0.82 | 0.216 | 0.54 | 0.436 | 0.532 | 0.5 | Yes | 0.98 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 85.0 | 5.00 | 5.4 | 115 | 35 | SPT | 40 | CL |  | -0.6 | CL | -80 | 9775 | 4845 | 1.1 | 27.4 | 1.00 | 40 | 0.64 | 84 | 35 | 35 | 1.19 | 41 | 0.80 | 0.85 | 0.570 | 0.54 | 0.438 | 0.517 | 1.3 |  | 0.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 90.0 | 5.00 | 5.4 | 115 | 17 | SPT | 40 | CL |  | -0.6 | CL | -85 | 10350 | 5108 | 1.1 | 29.0 | 1.00 | 40 | 0.63 | 85 | 17 | 35 | 1.25 | 21 | 0.70 | 0.77 | 0.120 | 0.54 | 0.440 | 0.571 | 0.3 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 95.0 | 5.00 | 5.4 | 115 | 29 | SPT | 40 | CL |  | -0.6 | CL | -90 | 10925 | 5371 | 1.1 | 30.5 | 1.00 | 40 | 0.61 | 86 | 28 | 35 | 1.20 | 34 | 0.77 | 0.81 | 0.311 | 0.54 | 0.441 | 0.548 | 0.7 | Yes | 0.65 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 100.0 | 5.00 | 5.4 | 115 | 23 | SPT | 40 | CL |  | -0.6 | CL | -95 | 11500 | 5634 | 1.1 | 32.0 | 1.00 | 40 | 0.60 | 87 | 22 | 35 | 1.22 | 27 | 0.73 | 0.77 | 0.183 | 0.54 | 0.443 | 0.575 | 0.4 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 105.0 | 5.00 | 5.4 | 115 | 23 | SPT | 40 | CL |  | 0.4 | CL | -100 | 12075 | 5835 | 1.1 | 33.5 | 1.00 | 40 | 0.59 | 88 | 22 | 35 | 1.22 | 27 | 0.73 | 0.76 | 0.179 | 0.54 | 0.449 | 0.589 | 0.4 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 110.0 | 5.00 | 5.4 | 115 | 22 | SPT | 40 | CL |  | 1.4 | CL | -105 | 12650 | 6036 | 1.1 | 35.1 | 1.00 | 40 | 0.58 | 89 | 21 | 35 | 1.22 | 25 | 0.73 | 0.75 | 0.162 | 0.54 | 0.455 | 0.606 | 0.4 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 115.0 | 3.00 | 5.4 | 115 | 46 | SPT | 40 | CL |  | 2.4 | CL | -110 | 13225 | 6236 | 1.1 | 36.6 | 1.00 | 40 | 0.57 | 90 | 43 | 35 | 1.18 | 51 | 0.80 | 0.81 | 0.600 | 0.54 | 0.460 | 0.571 | 1.3 |  | 0.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 116.0 | 0.75 | 5.4 | 115 | 20 | SPT | 40 | CL |  | 3.4 | CL | -111 | 13340 | 6226 | 1.1 | 36.9 | 1.00 | 40 | 0.57 | 91 | 19 | 35 | 1.23 | 23 | 0.72 | 0.74 | 0.138 | 0.54 | 0.465 | 0.631 | 0.3 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-165 | CL | 116.5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 37.0 | 1.00 |  |  |  |  |  |  |  |  |  |  | 0.54 |  |  |  |  |  | Yes | **Estimated Settlement of Entire Boring Depth (inches) =** |  |  |  |  |  |  |  | **6.0** |  | **Total=** | **5.0** |

<u>Final Enginering Judgment is based on:</u>

1.N160cs: if N160cs>35, no liquification problem

2.Induced settlement: if induced settlement is limited and the liquefied layer is deep, no liquefication problem

Note:

The high groundwater table is assumed if there is any change of the groundwater due to the use of peremable paver, assume a 2 feet increase to be conservative

# Liquefaction Evaluation

## Seed et al. (2003) Procedure

Earthquake Magnitude M = 7.50 (MCE)
Peak Ground Acceleration: 0.62 (g)
Vs,40 = 591 (fps)
MSF (Seed et, al., 2003) = 1.00

| Boring ID | USCS class from boring log | Depth to Sample (ft) | Layer Thickness (ft) | GS Elev | $\gamma_m$ (pcf) | Blows foot, N | Sampler code | % finer than No200 | USCS class lab | PI | GWT Elev. Ft | Assigned Class. | Sample Elev. (ft) | $\sigma_v$, psf | $\sigma_v'$, psf | Sampler Correction | Rod Length, m | CR | FC, % | $C_N$ | ER | $N_{1,60}$ | Capped FC | $C_{Fines}$ | $(N_1)_{60cs}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B-167 | SP-SM | 7.0 | 9.50 | 8.8 | 120 | 19 | SPT | 10 | SP-SM |  | 2.6 | SP-SM | 2 | 840 | 790 | 1.1 | 3.7 | 0.80 | 10 | 1.59 | 75 | 33 | 10 | 1.06 | 35 |
| B-167 | ML | 12.0 | 5.50 | 8.8 | 120 | 1 | SPT | 10 | ML |  | 2.6 | ML | -3 | 1440 | 1078 | 1.1 | 5.2 | 0.85 | 10 | 1.36 | 75 | 2 | 10 | 1.35 | 2 |
| B-167 | SM | 18.0 | 5.00 | 8.8 | 120 | 8 | SPT | 10 | SM |  | 2.6 | SM | -9 | 2160 | 1424 | 1.1 | 7.0 | 0.95 | 10 | 1.19 | 75 | 12 | 10 | 1.08 | 13 |
| B-167 | CL | 22.0 | 5.00 | 8.8 | 98 | 1 | SPT | 40 | CL |  | 2.6 | CL | -13 | 2552 | 1566 | 1.1 | 8.2 | 0.95 | 40 | 1.13 | 75 | 1 | 35 | 2.33 | 3 |
| B-167 | CL | 28.0 | 5.00 | 8.8 | 98 | 1 | SPT | 40 | CL |  | 2.6 | CL | -19 | 3140 | 1780 | 1.1 | 10.1 | 1.00 | 40 | 1.06 | 75 | 1 | 35 | 2.34 | 3 |
| B-167 | CL | 32.0 | 5.00 | 8.8 | 98 | 0 | SPT | 40 | CL |  | 2.6 | CL | -23 | 3532 | 1922 | 1.1 | 11.3 | 1.00 | 40 | 1.02 | 75 | 0 | 35 | 0.00 | 0 |
| B-167 | CL | 38.0 | 5.00 | 8.8 | 115 | 35 | SPT | 40 | CL |  | 2.6 | CL | -29 | 4370 | 2386 | 1.1 | 13.1 | 1.00 | 40 | 0.92 | 75 | 44 | 35 | 1.18 | 52 |
| B-167 | CL | 42.0 | 5.00 | 8.8 | 115 | 14 | SPT | 40 | CL |  | 2.6 | CL | -33 | 4830 | 2596 | 1.1 | 14.3 | 1.00 | 40 | 0.88 | 75 | 17 | 35 | 1.24 | 21 |
| B-167 | CL | 48.0 | 5.00 | 8.8 | 115 | 16 | SPT | 40 | CL |  | 2.6 | CL | -39 | 5520 | 2912 | 1.1 | 16.2 | 1.00 | 40 | 0.83 | 75 | 18 | 35 | 1.24 | 23 |
| B-167 | CL | 52.0 | 5.00 | 8.8 | 115 | 9 | SPT | 40 | CL |  | 2.6 | CL | -43 | 5980 | 3122 | 1.1 | 17.4 | 1.00 | 40 | 0.80 | 76 | 10 | 35 | 1.31 | 13 |
| B-167 | CL | 58.0 | 5.00 | 8.8 | 115 | 24 | SPT | 40 | CL |  | 2.6 | CL | -49 | 6670 | 3438 | 1.1 | 19.2 | 1.00 | 40 | 0.76 | 77 | 26 | 35 | 1.21 | 31 |
| B-167 | CL | 62.0 | 4.00 | 8.8 | 115 | 11 | SPT | 40 | CL |  | 2.6 | CL | -53 | 7130 | 3648 | 1.1 | 20.4 | 1.00 | 40 | 0.74 | 78 | 12 | 35 | 1.29 | 15 |
| B-167 | SP | 66.0 | 5.00 | 8.8 | 125 | 60 | SPT | 5 | SP |  | 2.6 | SP | -57 | 8250 | 4518 | 1.1 | 21.6 | 1.00 | 5 | 0.67 | 79 | 58 | 5 | 1.02 | 59 |
| B-167 | CL | 72.0 | 5.50 | 8.8 | 115 | 100 | SPT | 40 | CL |  | 2.6 | CL | -63 | 8280 | 4174 | 1.1 | 23.5 | 1.00 | 40 | 0.69 | 80 | 102 | 35 | 1.16 | 117 |
| B-167 | CL | 77.0 | 5.00 | 8.8 | 115 | 12 | SPT | 40 | CL |  | 2.6 | CL | -68 | 8855 | 4437 | 1.1 | 25.0 | 1.00 | 40 | 0.67 | 81 | 12 | 35 | 1.29 | 15 |
| B-167 | CL | 82.0 | 7.50 | 8.8 | 115 | 11 | SPT | 40 | CL |  | 2.6 | CL | -73 | 9430 | 4700 | 1.1 | 26.5 | 1.00 | 40 | 0.65 | 82 | 11 | 35 | 1.30 | 14 |
| B-167 | CL | 92.0 | 7.50 | 8.8 | 115 | 17 | SPT | 40 | CL |  | 2.6 | CL | -83 | 10580 | 5226 | 1.1 | 29.6 | 1.00 | 40 | 0.62 | 83 | 16 | 35 | 1.25 | 20 |
| B-167 | CL | 97.0 | 5.00 | 8.8 | 115 | 130 | SPT | 40 | CL |  | 2.6 | CL | -88 | 11155 | 5489 | 1.1 | 31.1 | 1.00 | 40 | 0.60 | 84 | 121 | 35 | 1.15 | 140 |
| B-167 | CL | 102.0 | 5.50 | 8.8 | 115 | 20 | SPT | 40 | CL |  | 2.6 | CL | -93 | 11730 | 5752 | 1.1 | 32.6 | 1.00 | 40 | 0.59 | 85 | 18 | 35 | 1.24 | 23 |
| B-167 | CL | 108.0 | 5.00 | 8.8 | 115 | 31 | SPT | 40 | CL |  | 2.6 | CL | -99 | 12420 | 6068 | 1.1 | 34.4 | 1.00 | 40 | 0.57 | 86 | 28 | 35 | 1.20 | 34 |
| B-167 | CL | 112.0 | 2.40 | 8.8 | 115 | 31 | SPT | 40 | CL |  | 2.6 | CL | -103 | 12880 | 6278 | 1.1 | 35.7 | 1.00 | 40 | 0.56 | 87 | 28 | 35 | 1.20 | 34 |
| B-167 | CL | 112.8 |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 35.9 | 1.00 |  |  |  |  |  |  |  |

| Boring ID | Depth to Sample (ft) | f | $K_\sigma$ | CRR | Rd | CSR | CSR* | $FS_L$ | $FS_L$ < 1 | $P_L$ | Liquefaction Susceptibility | Below GWT | Assessment |  | $FS_L$ | $P_L$ |  | Lookup Num | Vol. Strain (%) | Settlement (inches) | PI | Final Enginering Judgment | Liquefied Layer Thickness (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B-167 | 7.0 | 0.78 | 1.00 | 0.594 | 0.98 | 0.420 | 0.419 | 1.4 |  | 0.00 | Yes | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-167 | 12.0 | 0.61 | 1.00 | 0.046 | 0.95 | 0.513 | 0.513 | 0.1 | Yes | 1.00 | Yes | Yes | Yes |  | 0.1 | 1.0 |  | 251 | 10.00 | 6.6 |  | Yes | 5.5 |
| B-167 | 18.0 | 0.67 | 1.00 | 0.099 | 0.90 | 0.553 | 0.553 | 0.2 | Yes | 1.00 | Yes | Yes | Yes |  | 0.2 | 1.0 |  | 1355 | 3.47 | 2.1 |  | Yes | 5 |
| B-167 | 22.0 | 0.62 | 1.00 | 0.046 | 0.86 | 0.567 | 0.567 | 0.1 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-167 | 28.0 | 0.62 | 1.00 | 0.044 | 0.79 | 0.561 | 0.561 | 0.1 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-167 | 32.0 | 0.60 | 1.00 | 0.038 | 0.74 | 0.546 | 0.546 | 0.1 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-167 | 38.0 | 0.80 | 0.98 | 0.600 | 0.67 | 0.493 | 0.505 | 1.2 |  | 0.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-167 | 42.0 | 0.71 | 0.94 | 0.148 | 0.63 | 0.472 | 0.501 | 0.3 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-167 | 48.0 | 0.71 | 0.91 | 0.161 | 0.59 | 0.449 | 0.492 | 0.4 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-167 | 52.0 | 0.67 | 0.88 | 0.078 | 0.57 | 0.439 | 0.500 | 0.2 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-167 | 58.0 | 0.76 | 0.89 | 0.295 | 0.55 | 0.430 | 0.484 | 0.7 | Yes | 0.70 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-167 | 62.0 | 0.68 | 0.84 | 0.086 | 0.54 | 0.427 | 0.510 | 0.2 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-167 | 66.0 | 0.80 | 0.86 | 0.600 | 0.54 | 0.396 | 0.461 | 1.5 |  | 0.00 | Yes | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-167 | 72.0 | 0.80 | 0.87 | 0.600 | 0.54 | 0.431 | 0.493 | 2.0 |  | 0.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-167 | 77.0 | 0.68 | 0.79 | 0.084 | 0.54 | 0.433 | 0.550 | 0.2 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-167 | 82.0 | 0.67 | 0.77 | 0.075 | 0.54 | 0.436 | 0.567 | 0.2 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-167 | 92.0 | 0.70 | 0.76 | 0.113 | 0.54 | 0.439 | 0.576 | 0.3 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-167 | 97.0 | 0.80 | 0.83 | 0.600 | 0.54 | 0.441 | 0.534 | 2.0 |  | 0.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-167 | 102.0 | 0.71 | 0.75 | 0.135 | 0.54 | 0.443 | 0.589 | 0.3 | Yes | 1.00 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-167 | 108.0 | 0.77 | 0.78 | 0.305 | 0.54 | 0.444 | 0.567 | 0.7 | Yes | 0.70 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-167 | 112.0 | 0.77 | 0.78 | 0.298 | 0.54 | 0.445 | 0.573 | 0.7 | Yes | 0.74 | No | Yes | No |  | - | - |  |  |  |  |  | No | 0 |
| B-167 | 112.8 |  |  |  | 0.54 |  |  |  |  |  | Yes | Estimated Settlement of Entire Boring Depth (inches) = |  |  |  |  |  |  |  | 8.7 |  | Total= | 10.5 |

Final Enginering Judgment is based on:

1.N160cs: if N160cs>35, no liquification problem

2.Induced settlement: if induced settlement is limited and the liquefied layer is deep, no liquefication problem

Note:

The high groundwater table is assumed if there is any change of the groundwater due to the use of peremable paver, assume a 2 feet increase to be conservative

# Liquefaction Evaluation

## Seed et al. (2003) Procedure

Earthquake Magnitude M = 7.50 (MCE)
Peak Ground Acceleration: 0.62 (g)
Vs,40 = 591 (fps)
MSF (Seed et, al., 2003) = 1.00

| Boring ID | USCS class from boring log | Depth to Sample (ft) | Layer Thickness (ft) | GS Elev | $\gamma_m$ (pcf) | Blows foot, N | Sampler code | % finer than No200 | USCS class lab | PI | GWT Elev. Ft | Assigned Class. | Sample Elev. (ft) | $\sigma_v$, psf | $\sigma_v'$, psf | Sampler Correction | Rod Length, m | CR | FC, % | $C_N$ | ER | $N_{1,60}$ | Capped FC | $C_{Fines}$ | $(N_1)_{60cs}$ | f | Kσ | CRR | Rd | CSR | CSR* | $FS_L$ | $FS_L$ < 1 | $P_L$ | Liquefaction Susceptibility | Below GWT | Assessment | | $FS_L$ | $P_L$ | | Lookup Num | Vol. Strain (%) | Settlement (inches) | PI | Final Enginering Judgment | Liquefied Layer Thickness (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B-127 | SP | 7.0 | 9.00 | 8.5 | 120 | 26 | SPT | 10 | SP | | 2 | SP | 2 | 840 | 809 | 1.1 | 3.7 | 0.80 | 10 | 1.57 | 75 | 45 | 10 | 1.05 | 47 | 0.80 | 1.00 | 0.600 | 0.98 | 0.410 | 0.410 | 1.5 | | 0.00 | Yes | Yes | No | | - | - | | | | | | No | 0 |
| B-127 | CL | 11.0 | 6.00 | 8.5 | 98 | 0 | SPT | 40 | CL | | 2 | CL | -3 | 1232 | 951 | 1.1 | 4.9 | 0.85 | 40 | 1.45 | 75 | 0 | 35 | 0.00 | 0 | 0.60 | 1.00 | 0.046 | 0.96 | 0.500 | 0.500 | 0.1 | Yes | 1.00 | No | Yes | No | | - | - | | | | | | No | 0 |
| B-127 | CL | 19.0 | 5.50 | 8.5 | 98 | 1 | SPT | 40 | CL | | 2 | CL | -11 | 2016 | 1236 | 1.1 | 7.3 | 0.95 | 40 | 1.27 | 75 | 2 | 35 | 2.19 | 4 | 0.62 | 1.00 | 0.050 | 0.89 | 0.588 | 0.588 | 0.1 | Yes | 1.00 | No | Yes | No | | - | - | | | | | | No | 0 |
| B-127 | CL | 22.0 | 5.00 | 8.5 | 98 | 9 | SPT | 40 | CL | | 2 | CL | -14 | 2310 | 1343 | 1.1 | 8.2 | 0.95 | 40 | 1.22 | 75 | 14 | 35 | 1.26 | 18 | 0.69 | 1.00 | 0.143 | 0.86 | 0.598 | 0.598 | 0.2 | Yes | 1.00 | No | Yes | No | | - | - | | | | | | No | 0 |
| B-127 | CL | 29.0 | 5.00 | 8.5 | 98 | 2 | SPT | 40 | CL | | 2 | CL | -21 | 2996 | 1592 | 1.1 | 10.4 | 1.00 | 40 | 1.12 | 75 | 3 | 35 | 1.71 | 5 | 0.63 | 1.00 | 0.052 | 0.78 | 0.589 | 0.589 | 0.1 | Yes | 1.00 | No | Yes | No | | - | - | | | | | | No | 0 |
| B-127 | SP-SM | 32.0 | 3.50 | 8.5 | 120 | 36 | SPT | 10 | SP-SM | | 2 | SP-SM | -24 | 3356 | 1765 | 1.1 | 11.3 | 1.00 | 10 | 1.06 | 75 | 53 | 10 | 1.05 | 55 | 0.80 | 1.00 | 0.600 | 0.74 | 0.566 | 0.565 | 1.1 | | 0.00 | Yes | Yes | No | | - | - | | | | | | No | 0 |
| B-127 | CL | 36.0 | 5.00 | 8.5 | 120 | 22 | SPT | 10 | CL | | 2 | CL | -28 | 4320 | 2479 | 1.1 | 12.5 | 1.00 | 10 | 0.90 | 75 | 27 | 10 | 1.06 | 29 | 0.74 | 0.96 | 0.269 | 0.69 | 0.484 | 0.504 | 0.6 | Yes | 0.97 | No | Yes | No | | - | - | | | | | | No | 0 |
| B-127 | SP-SM | 42.0 | 5.00 | 8.5 | 120 | 26 | SPT | 10 | SP-SM | | 2 | SP-SM | -34 | 5040 | 2825 | 1.1 | 14.3 | 1.00 | 10 | 0.84 | 75 | 30 | 10 | 1.06 | 32 | 0.76 | 0.93 | 0.326 | 0.63 | 0.453 | 0.485 | 0.7 | Yes | 0.72 | Yes | Yes | Yes | | 0.7 | 0.7 | | 3249 | 0.97 | 0.6 | | Yes | 5 |
| B-127 | CL | 46.0 | 5.00 | 8.5 | 115 | 18 | SPT | 40 | CL | | 2 | CL | -38 | 5290 | 2825 | 1.1 | 15.5 | 1.00 | 40 | 0.84 | 75 | 21 | 35 | 1.22 | 25 | 0.73 | 0.92 | 0.203 | 0.60 | 0.453 | 0.490 | 0.4 | Yes | 1.00 | No | Yes | No | | - | - | | | | | | No | 0 |
| B-127 | CL | 52.0 | 6.00 | 8.5 | 115 | 47 | SPT | 40 | CL | | 2 | CL | -44 | 5980 | 3141 | 1.1 | 17.4 | 1.00 | 40 | 0.80 | 76 | 52 | 35 | 1.17 | 61 | 0.80 | 0.92 | 0.600 | 0.57 | 0.437 | 0.472 | 1.4 | | 0.00 | No | Yes | No | | - | - | | | | | | No | 0 |
| B-127 | CL | 58.0 | 5.00 | 8.5 | 125 | 15 | SPT | 5 | CL | | 2 | CL | -50 | 7250 | 4036 | 1.1 | 19.2 | 1.00 | 5 | 0.70 | 77 | 15 | 5 | 1.04 | 15 | 0.68 | 0.81 | 0.087 | 0.55 | 0.398 | 0.491 | 0.2 | Yes | 1.00 | No | Yes | No | | - | - | | | | | | No | 0 |
| B-127 | CL | 62.0 | 5.00 | 8.5 | 125 | 15 | SPT | 5 | CL | | 2 | CL | -54 | 7750 | 4287 | 1.1 | 20.4 | 1.00 | 5 | 0.68 | 78 | 15 | 5 | 1.04 | 15 | 0.68 | 0.80 | 0.083 | 0.54 | 0.395 | 0.497 | 0.2 | Yes | 1.00 | No | Yes | No | | - | - | | | | | | No | 0 |
| B-127 | CL | 68.0 | 5.00 | 8.5 | 115 | 25 | SPT | 40 | CL | | 2 | CL | -60 | 7820 | 3982 | 1.1 | 22.3 | 1.00 | 40 | 0.71 | 79 | 26 | 35 | 1.21 | 31 | 0.76 | 0.86 | 0.279 | 0.54 | 0.426 | 0.498 | 0.7 | Yes | 0.78 | No | Yes | No | | - | - | | | | | | No | 0 |
| B-127 | CL | 72.0 | 5.00 | 8.5 | 115 | 12 | SPT | 40 | CL | | 2 | CL | -64 | 8280 | 4193 | 1.1 | 23.5 | 1.00 | 40 | 0.69 | 80 | 12 | 35 | 1.28 | 16 | 0.68 | 0.80 | 0.087 | 0.54 | 0.429 | 0.534 | 0.2 | Yes | 1.00 | No | Yes | No | | - | - | | | | | | No | 0 |
| B-127 | CL | 78.0 | 5.00 | 8.5 | 115 | 10 | SPT | 40 | CL | | 2 | CL | -70 | 8970 | 4508 | 1.1 | 25.3 | 1.00 | 40 | 0.67 | 81 | 10 | 35 | 1.32 | 13 | 0.67 | 0.78 | 0.070 | 0.54 | 0.432 | 0.556 | 0.2 | Yes | 1.00 | No | Yes | No | | - | - | | | | | | No | 0 |
| B-127 | CL | 82.0 | 5.00 | 8.5 | 115 | 8 | SPT | 40 | CL | | 2 | CL | -74 | 9430 | 4719 | 1.1 | 26.5 | 1.00 | 40 | 0.65 | 82 | 8 | 35 | 1.36 | 11 | 0.65 | 0.76 | 0.058 | 0.54 | 0.434 | 0.573 | 0.1 | Yes | 1.00 | No | Yes | No | | - | - | | | | | | No | 0 |
| B-127 | CL | 88.0 | 5.00 | 8.5 | 115 | 21 | SPT | 40 | CL | | 2 | CL | -80 | 10120 | 5034 | 1.1 | 28.3 | 1.00 | 40 | 0.63 | 83 | 20 | 35 | 1.23 | 25 | 0.72 | 0.79 | 0.163 | 0.54 | 0.436 | 0.554 | 0.4 | Yes | 1.00 | No | Yes | No | | - | - | | | | | | No | 0 |
| B-127 | CL | 92.0 | 4.50 | 8.5 | 115 | 15 | SPT | 40 | CL | | 2 | CL | -84 | 10580 | 5245 | 1.1 | 29.6 | 1.00 | 40 | 0.62 | 84 | 14 | 35 | 1.26 | 18 | 0.69 | 0.75 | 0.098 | 0.54 | 0.438 | 0.580 | 0.2 | Yes | 1.00 | No | Yes | No | | - | - | | | | | | No | 0 |
| B-127 | CL | 97.0 | 4.50 | 8.5 | 115 | 26 | SPT | 40 | CL | | 2 | CL | -89 | 11155 | 5508 | 1.1 | 31.1 | 1.00 | 40 | 0.60 | 85 | 24 | 35 | 1.21 | 30 | 0.75 | 0.79 | 0.229 | 0.54 | 0.440 | 0.559 | 0.5 | Yes | 0.97 | No | Yes | No | | - | - | | | | | | No | 0 |
| B-127 | CL | 101.0 | 2.20 | 8.5 | 115 | 32 | SPT | 40 | CL | | 2 | CL | -93 | 11615 | 5718 | 1.1 | 32.3 | 1.00 | 40 | 0.59 | 86 | 30 | 35 | 1.20 | 36 | 0.78 | 0.80 | 0.361 | 0.54 | 0.441 | 0.549 | 0.8 | Yes | 0.36 | No | Yes | No | | - | - | | | | | | No | 0 |
| B-127 | CL | 101.4 | | | | | | | | | | | | | | | 32.4 | 1.00 | | | | | | | | | | | 0.54 | | | | | | Yes | **Estimated Settlement of Entire Boring Depth (inches) =** | | | | | | | | **0.6** | | **Total=** | **5.0** |

Final Enginering Judgment is based on:

1.N160cs: if N160cs>35, no liquification problem

2.Induced settlement: if induced settlement is limited and the liquefied layer is deep, no liquefication problem

Note:

The high groundwater table is assumed if there is any change of the groundwater due to the use of peremable paver, assume a 2 feet increase to be conservative

# APPENDIX D

# CORROSION TEST RESULTS BY OTHERS

Job No. 3362.200
Oakland Army Base
Oakland, California

## SUMMARY OF CORROSIVITY TEST RESULTS

| Sample I.D. | Redox (mV) | pH | Resistivity (100% Saturation) (ohms-cm) | | Sulfide (mg/kg) | Chloride (mg/kg) | Sulfate (mg/kg) |
|---|---|---|---|---|---|---|---|
| H-6 @ 1.5' - 2.0' | 480 | 8.2 | 1,300 | Corrosive | N.D. | 91 | 77 |
| H-9 @ 3.0' - 3.5' | 470 | 8.1 | 5,900 | Moderately Corrosive | N.D. | N.D. | N.D. |
| H-16 @ 6.0' - 6.5' | 460 | 7.7 | 1,700 | Corrosive | N.D. | 58 | 71 |
| H-17 @ 2.5' - 3.0' | 460 | 8.2 | 2,500 | Moderately Corrosive | N.D. | 32 | 94 |
| H-23 @ 3.5' - 4.0' | 460 | 7.9 | 240 | Severely Corrosive | N.D. | 1,500 | 230 |
| H-28 @ 2.0' - 2.5' | 470 | 7.4 | 2,300 | Moderately Corrosive | N.D. | 96 | 44 |
| H-30 @ 6.0' - 6.5' | 460 | 8.1 | 1,900 | Corrosive | N.D. | 25 | 25 |
| H-37 @ 4.5' - 5.0' | 460 | 7.4 | 3,000 | Moderately Corrosive | N.D. | N.D. | 110 |
| H-47 @ 2.5' - 3.0' | 450 | 7.8 | 5,800 | Moderately Corrosive | N.D. | 24 | 43 |
| H-49 @ 1.5' - 2.0' | 450 | 7.5 | 4,300 | Moderately Corrosive | N.D. | N.D. | 17 |
| H-55 @ 2.5' - 3.0' | 450 | 7.4 | 5,000 | Moderately Corrosive | N.D. | N.D. | 48 |
| H-56 @ 2.5' - 3.0' | 440 | 7.6 | 7,000 | Moderately Corrosive | N.D. | N.D. | 23 |
| H-63 @ 5.0' - 5.5' | 450 | 7.9 | 17,000 | Mildly Corrosive | N.D. | N.D. | N.D. |
| H-69 @ 4.0' - 4.5' | 430 | 8.2 | 3,000 | Moderately Corrosive | N.D. | 33 | 44 |
| T-5 @ 9.0' - 9.5' | 270 | 8.2 | 220 | Severely Corrosive | N.D. | 2,800 | 210 |
| T-11 @ 20.0' - 21.5' | 440 | 8.2 | 290 | Severely Corrosive | N.D. | 1,600 | 230 |
| T-15 @ 20.0 - 20.5' | 400 | 8.4 | 160 | Severely Corrosive | N.D. | 2,100 | 77 |

N.D. = None Detected

California State Certified Laboratory No. 2153

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

5 October 2011

Job No.1109179
Cust. No.10598

Mr. Steve Tsang
Berlogar Stevens & Associates
5587 Sunol Blvd.
Pleasanton, CA 94566

Subject: Project No.: 3362.200
Project Name: Oakland Army Base
Corrosivity Analysis – ASTM Test Methods with Brief Evaluation

Dear Mr. Tsang:

Pursuant to your request, CERCO Analytical has analyzed the soil samples submitted on September 26, 2011. Based on the analytical results, a brief corrosivity evaluation is enclosed for your consideration.

Based upon the resistivity measurements, Sample No.005 is classified as "severely corrosive", Samples No.001, No.003 and No.007 are classified as "corrosive" and Samples No.002, No.004 and No.006 are samples are classified as "moderately corrosive". All buried iron, steel, cast iron, ductile iron, galvanized steel and dielectric coated steel or iron should be properly protected against corrosion depending upon the critical nature of the structure. All buried metallic pressure piping such as ductile iron firewater pipelines should be protected against corrosion.

The chloride ion concentrations range from none detected to 1,500 mg/kg. Because the chloride ion concentrations are greater than 300 mg/kg, they are determined to be sufficient to attack steel embedded in a concrete mortar coating.

The sulfate ion concentrations ranged from none detected to 240 mg/kg and are determined to be sufficient to damage reinforced concrete structures and cement mortar-coated steel at these locations. Therefore, concrete that comes into contact with this soil should use sulfate resistant cement such as Type II, with a maximum water-to-cement ratio of 0.55.

The sulfide ion concentrations reflect none detected with a detected limit of 50 mg/kg.

The pH of the soils ranged from 7.4 to 8.2, which does not present corrosion problems for buried iron, steel, mortar-coated steel and reinforced concrete structures.

The redox potentials range from 460 to 480-mV, which are indicative of aerobic soil conditions.

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

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

Very truly yours,
**CERCO ANALYTICAL, INC.**

Cheryl McMillen for

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

JDH/jdl
Enclosure

California State Certified Laboratory No. 2153

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| | |
|---|---|
| Client: | Berlogar Stevens & Associates |
| Client's Project No.: | 3362.200 |
| Client's Project Name: | Oakland Army Base |
| Date Sampled: | Not Indicated |
| Date Received: | 26-Sep-11 |
| Matrix: | Soil |
| Authorization: | Signed Chain of Custody |

Date of Report: 5-Oct-2011

| Job/Sample No. | Sample I.D. | Redox (mV) | pH | Conductivity (umhos/cm)* | Resistivity (100% Saturation) (ohms-cm) | Sulfide (mg/kg)* | Chloride (mg/kg)* | Sulfate (mg/kg)* |
|---|---|---|---|---|---|---|---|---|
| 1109179-001 | H6 @ 1.5'-2.0' | 480 | 8.2 | - | 1,300 | N.D. | 91 | 77 |
| 1109179-002 | H9 @ 3.0'-3.5' | 470 | 8.1 | - | 5,900 | N.D. | N.D. | N.D. |
| 1109179-003 | H16 @ 6.0'-6.5' | 460 | 7.7 | - | 1,700 | N.D. | 58 | 71 |
| 1109179-004 | H17 @ 2.5'-3.0' | 460 | 8.2 | - | 2,500 | N.D. | 32 | 94 |
| 1109179-005 | H23 @ 3.5'-4.0' | 460 | 7.9 | - | 240 | N.D. | 1,500 | 230 |
| 1109179-006 | H28 @ 2.0'-2.5 | 470 | 7.4 | - | 2,300 | N.D. | 96 | 44 |
| 1109179-007 | H30 @ 6.0'-6.5' | 460 | 8.1 | - | 1,900 | N.D. | 25 | 25 |
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|---|---|---|---|---|---|---|---|
| Method: | ASTM D1498 | ASTM D4972 | ASTM D1125M | ASTM G57 | ASTM D4658M | ASTM D4327 | ASTM D4327 |
| Detection Limit: | - | - | 10 | - | 50 | 15 | 15 |
| Date Analyzed: | 4-Oct-2011 | 4-Oct-2011 | - | 29-Sep-2011 | 30-Sep-2011 | 3-Oct-2011 | 3-Oct-2011 |

Cheryl McMillen
Laboratory Director

* Results Reported on "As Received" Basis

N.D. - None Detected

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

California State Certified Laboratory No. 2153

CERCO
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20 October 2011

Job No.1110100
Cust. No.10598

Mr. Steve Tsang
Berlogar Stevens & Associates
5587 Sunol Blvd.
Pleasanton, CA 94566

Subject: Project No.: 3362.200
Project Name: Oakland Army Base
Corrosivity Analysis – ASTM Test Methods with Brief Evaluation

Dear Mr. Tsang:

Pursuant to your request, CERCO Analytical has analyzed the soil samples submitted on October 12, 2011. Based on the analytical results, a brief corrosivity evaluation is enclosed for your consideration.

The following classifications are based upon the resistivity measurement:

**Severely Corrosive**

Sample No.008
Sample No.009
Sample No.010

**Moderately Corrosive**

Sample No.001
Sample No.002
Sample No.003
Sample No.004
Sample No.005
Sample No.007

**Mildly Corrosive**

Sample No.006

All buried iron, steel, cast iron, ductile iron, galvanized steel and dielectric coated steel or iron should be properly protected against corrosion depending upon the critical nature of the structure. All buried metallic pressure piping such as ductile iron firewater pipelines should be protected against corrosion.

The chloride ion concentrations range from none detected to 2,800 mg/kg. Because the chloride ion concentrations are more than 300 mg/kg, they are determined to be sufficient to attack steel embedded in a concrete mortar coating.

The sulfate ion concentrations ranged from none detected to 230 mg/kg and are determined to be sufficient to damage reinforced concrete structures and cement mortar-coated steel at these locations. Therefore, concrete that comes into contact with this soil should use sulfate resistant cement such as Type II, with a maximum water-to-cement ratio of 0.55.

The sulfide ion concentrations reflect none detected with a detection limit of 50 mg/kg.

The pH of the soils ranged from 7.4 to 8.4, which does not present corrosion problems for buried iron, steel, mortar-coated steel and reinforced concrete structures.

The redox potentials ranged from 270 to 460-mV. Sample No.008 is indicative of potentially "slightly corrosive" soils resulting from anaerobic soil conditions, and the remaining samples are indicative of aerobic soil conditions.

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

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

Very truly yours,
**CERCO ANALYTICAL, INC.**

Cheryl McMillen for

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

JDH/jdl

Enclosure

California State Certified Laboratory No. 2153

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| | |
|---|---|
| Client: | Berlogar Stevens & Associates |
| Client's Project No.: | 3362.200 |
| Client's Project Name: | Oakland Army Base |
| Date Sampled: | Not Indicated |
| Date Received: | 12-Oct-11 |
| Matrix: | Soil |
| Authorization: | Signed Chain of Custody |

Date of Report: 21-Oct-2011

| Job/Sample No. | Sample I.D. | Redox (mV) | pH | Conductivity (umhos/cm)* | Resistivity (100% Saturation) (ohms-cm) | Sulfide (mg/kg)* | Chloride (mg/kg)* | Sulfate (mg/kg)* |
|---|---|---|---|---|---|---|---|---|
| 1110100-001 | H-37, 4.5-5.0' | 460 | 7.4 | - | 3,000 | N.D. | N.D. | 110 |
| 1110100-002 | H-47, 2.5-3.0' | 450 | 7.8 | - | 5,800 | N.D. | 24 | 43 |
| 1110100-003 | H-49, 1.5-2.0' | 450 | 7.5 | - | 4,300 | N.D. | N.D. | 17 |
| 1110100-004 | H-55, 2.5-3.0' | 450 | 7.4 | - | 5,000 | N.D. | N.D. | 48 |
| 1110100-005 | H-56, 2.5-3.0' | 440 | 7.6 | - | 7,000 | N.D. | N.D. | 23 |
| 1110100-006 | H-63, 5.0-5.5' | 450 | 7.9 | - | 17,000 | N.D. | N.D. | N.D. |
| 1110100-007 | H-69, 4.0-4.5' | 430 | 8.2 | - | 3,000 | N.D. | 33 | 44 |
| 1110100-008 | T-5, 9.0-9.5' | 270 | 8.2 | - | 220 | N.D. | 2,800 | 210 |
| 1110100-009 | T-11, 20.0-21.5' | 440 | 8.2 | - | 290 | N.D. | 1,600 | 230 |
| 1110100-010 | T-15, 20.0-20.5' | 400 | 8.4 | - | 160 | N.D. | 2,100 | 77 |
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|---|---|---|---|---|---|---|---|
| Method: | ASTM D1498 | ASTM D4972 | ASTM D1125M | ASTM G57 | ASTM D4658M | ASTM D4327 | ASTM D4327 |
| Detection Limit: | - | - | 10 | - | 50 | 15 | 15 |
| Date Analyzed: | 18-Oct-2011 | 17-Oct-2011 | - | 14-Oct-2011 | 17-Oct-2011 | 17-Oct-2011 &<br>19-Oct-2011 | 17-Oct-2011 |

Cheryl McMillen

Cheryl McMillen
Laboratory Director

* Results Reported on "As Received" Basis

N.D. - None Detected

[1] Detection limit is elevated to 75 mg/kg due to dilution

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