FOR CONTRACT NO.:04-2640G4

INFORMATION HANDOUT

WATER QUALITY

SAN FRANCISCO BAY REGION,

CIWQS NO. 781744

STORMWATER INFORMATION HANDOUT

PERMITS

UNITED STATES ARMY CORPS OF ENGINEERS

404 PERMIT

AGREEMENTS

CALIFORNIA DEPARTMENT OF FISH AND GAME

NOTIFICATION NO.1600-2012-0139-R3

NATIONAL MARINE FISHERIES SERVICES (Biological Opinion)

UNITED STATES FISH AND WILDLIFE SERVICE (Biological Opinion)

MATERIALS INFORMATION

ASBESTOS LEAD-CCONTAINING PAINT SURVEY REPORT

PROJECT REPORTS

04-2640G1
FOUNDATION REPORT,FOUNDATION RECOMMENDATION, HYDRAULIC REPORT, FOUNDATION REVIEW

04-264061
CORROSION REVIEW, FOUNDATION REPORT, DRIVEABILITY STUDY

04-264064
LOG PILE SHEETS, PILE QUANTITY AND DRIVING RECORD, REVISED PILE DYNAMIC ANALYSIS

04-120374 ORIGINAL BRIDGE DRIVING RECORD

ROUTE: 04-MRN-101, R20.5/R20.9

WATER QUALITY

SAN FRANCISCO BAY REGION,

CIWQS NO. 781744

June 8, 2012
CIWQS Place No. 781744
401 Database No.: 02-21-C0815

Sent via electronic mail--no hard copy to follow

California Department of Transportation
Attn: Mr. Wajahat Nyaz
Wajahat_Nyaz@dot.ca.gov
111 Grand Ave.
Oakland, CA 94612-3717

Subject: Water Quality Certification for the Marin Sonoma Narrows Widening Project, Contract A2, City of Novato, Marin County

Department Project No.: EA 04-2640G1

Dear Mr. Nyaz:

We have reviewed and hereby issue water quality certification to the California Department of Transportation (Department) for the Marin Sonoma Narrows Widening Project, Contract A2 (Project). The Department is seeking an Individual Permit for the Project from the U.S. Army Corps of Engineers pursuant to Section 404 of the Clean Water Act (33 U.S.C. § 1344). As such, the Department has applied to the San Francisco Bay Regional Water Quality Control Board (Water Board) for a Clean Water Act Section 401 water quality certification that the Project will not violate State water quality standards.

Project: The Department is proposing to widen United States Highway 101 (US 101), between Marin County northbound US 101 post-miles 20.5 and 20.9, through the city of Novato as a component of the Marin-Sonoma Narrows HOV Widening Project (MSN). This Project is a subset of the larger MSN project, which the Department has divided into at least seven individual contracts:

- A1, from State Route 37 to just north of Atherton Avenue in Novato. A 401 certification was issued for this project on July 22, 2010;
- A2, the subject of this certification;
- A3, in Novato, between US 101 northbound post-miles 22.1 and 24.1. A 401 certification was issued for this project on June 1, 2012;

- B-1, between Marin County US 101 post-miles 23.3 and 27.6 in the vicinity of Old Redwood Landfill Road. A 401 certification was issued for the project on March 26, 2012;
- B-3, in the vicinity of San Antonio Creek between Marin County US 101 post-miles 27.0 and 27.6, and Sonoma County US 101 post-miles 0.0 and 2.5. The Department intends to submit a 401 certification application in 2013;
- B-2/B-4, between Sonoma County US 101 post-miles 3.4 and 4.1, from the Petaluma Bridge south to the vicinity of Cloud Lane. A 401 certification was issued for the project on March 26, 2012; and
- C-3, between just north of the Petaluma River Bridge and approximately 0.2 miles north of Caulfield Lane, in the City of Petaluma, between US 101 Sonoma post-miles 3.4 and 4.1. A 401 certification was issued for the project on May 17, 2012.

This certification addresses proposed extension of the existing high-occupancy-vehicle lane from the Novato Creek Bridge to the Franklin Overhead by widening into the median in the southbound direction.

Widening of the Novato Creek Bridge would require twelve 24” cast-in-steel-shell piles driven below the ordinary high water mark of Novato Creek and six 14” concrete piles driven above the ordinary high water mark. Pile driving staging would require construction of two temporary work platforms. The two platforms would be formed by either an enclosed fill or trestle structure, both constructed above the ordinary high water mark. Enclosed fill platforms would be built by placing gravel fill within interlocking sheet piles. Trestle platforms would consist of a series of timber pads placed side by side above steel beams supported by steel trestles. Steel trestles would be placed approximately 14 feet apart and consist of horizontal steel beams supported by row of temporary steel piles. Four trestles would be required for each platform and each trestle would require approximately four to five 24” diameter steel pipes.

The Project area drains to Novato Creek, which is tidal through the Project area. Construction is estimated to start on November 1, 2012, and end on November 1, 2013.

Wetland and Water Impacts: Project implementation would result in the permanent fill of approximately 0.001 acres of Novato Creek due to installation of twelve 24” steel piles. Project implementation would also result in permanent impacts to approximately 0.015 acres of emergent wetlands due to covering of the creek and shading of the wetlands.

Construction access would result in temporary impacts to approximately 0.458 acres (659 linear feet) of the Novato Creek bed and banks.

Roadway Pollutant Impacts: Project implementation would result in approximately 0.9 acres of new and 0.2 acres of reworked impervious area. Stormwater runoff from impervious areas may contain hydrocarbons, metals, volatile organic compounds, trash, and sediment at levels that may significantly impact jurisdictional waters if left untreated.

Hydromodification Impacts: Added impervious areas may result in alterations to existing hydrologic regimes, resulting in erosion and/or changes of sediment transport in receiving waters (hydromodification). Because this Project discharges to tidally-influenced receiving waters, potential hydromodification impacts would be insignificant and mitigation is not required.

Mitigation: The Department purchased 0.3 acres of wetland mitigation bank credits from Burdell Ranch Wetland Conservation Bank on December 15, 2010, to mitigate for permanent impacts to approximately 0.25 acres of jurisdictional seasonal freshwater wetlands associated with the MSN C3 and A3 projects. The Department will utilize 0.02 of the 0.05 acre mitigation credit surplus to mitigate for permanent impacts to 0.016 acres of emergent wetlands and Novato Creek.

To mitigate for 0.458 acres of temporary impacts to Novato Creek, the Department shall restore those areas to their original or improved conditions (see condition no. 3).

Roadway Pollutant Mitigation: As mitigation for increased pollutant loads associated with impervious areas, the Department shall provide treatment of stormwater runoff from no less than 1.1 acres of impervious area using one biofiltration swale. The swale shall be located at northbound US 101 post-mile 20.72 and extend between J1R stations 316+25 and 317+50. The swale would be 125 feet long and 16 feet wide.

CEQA Compliance: The Department prepared and approved an Environmental Impact Report for this Project pursuant to the provisions of the California Environmental Quality Act. The Department filed a Notice of Determination on July 27, 2009 (SCH No. 2001042115).

Certification: I hereby issue an order certifying that any discharge from the referenced project will comply with the applicable provisions of sections 301 (Effluent Limitations), 302 (Water Quality Related Effluent Limitations), 303 (Water Quality Standards and Implementation Plans), 306 (National Standards of Performance), and 307 (Toxic and Pretreatment Effluent Standards) of the Clean Water Act, and with other applicable requirements of State law. This discharge is also regulated under State Water Resources Control Board Order No. 2003 - 0017 – DWQ, “General Waste Discharge Requirements for Dredge and Fill Discharges That Have Received State Water Quality Certification” which requires compliance with all conditions of this water quality certification. The following conditions are associated with this certification:

1. As mitigation for increased pollutant loads associated with impervious areas, the Department shall provide treatment of stormwater runoff from no less than 1.1 acres of impervious area using one biofiltration swale. The swale shall be located at northbound US 101 post-mile 20.72 and extend between J1R stations 316+25 and 317+50. The swale shall be installed consistent with the *Roadway Pollutant Mitigation* section of this certification and per the soil specifications in Attachment A of this certification. Any change in swale dimension or placement shall be prohibited without prior acceptance of Water Board staff. The swale shall be maintained regularly to ensure optimal performance;

2. Temporary work platforms shall be placed entirely above the ordinary high water mark of Novato Creek. If an enclosed fill platform is used, the gravel shall be clean and completely removed from the creek channel after use;

3. The Department shall restore the temporarily impacted portions of Novato Creek to pre-project conditions, within the first growing season following cessation of construction activity in the area. Temporarily disturbed areas shall be re-vegetated using only native plant species. The Department shall not cause, through operation of heavy machinery, or any other construction activity, compaction of wetlands or waters. Any compaction of wetlands or waters shall require mitigation. The Department shall submit photo-documentation to the Water Board of the pre- and post-project conditions of temporarily impacted areas no later than three months following completion of Project construction;

4. The Project shall be constructed in conformance with the Project Description described in this certification and certification application materials. Any change in the Project may require modification to the certification and shall be reported to and found acceptable by Water Board staff prior to implementation of the changes;

5. The Department shall adhere to the conditions imposed by the Individual Permit issued to the Department by the U.S. Army Corps of Engineers, to the Streambed Alteration Agreement issued to the Department by the California Department of Fish and Game, the Biological Opinion issued to the Department by the National Marine Fisheries Service on January 26, 2009, and to the Biological Opinion issued to the Department by the U.S. Fish and Wildlife Service on April 1, 2009;

6. Regardless of date, erosion control measures shall be utilized throughout all phases of construction where sediment-laden runoff threatens to enter waters of the State. At no time shall sediment-laden runoff be allowed to enter waters of the State;

7. No fueling, cleaning or maintenance of vehicles or equipment shall take place within jurisdictional waters or within any areas where an accidental discharge to waters of the State may occur;

8. Except as expressly allowed in this Certification, the discharge, or creation of the potential for discharge, to waters of the State of any construction wastes and/or soil materials including cement, fresh concrete, or washings thereof, silts, clay, sand, oil or petroleum products and other organic materials to waters of the State is prohibited;
9. This certification does not allow for the take, or incidental take, of any special status species. The Department shall use the appropriate protocols, as approved by the California Department of Fish and Game and the U.S. Fish and Wildlife Service, to ensure that Project activities do not impact the Beneficial Use of the Preservation of Rare and Endangered Species;

10. The Department shall maintain a copy of this water quality certification at the Project site so as to be available at all times to site operating personnel. It is the responsibility of the Department to assure that all personnel (employees, contractors, and subcontractors) are adequately informed and trained regarding the conditions of this certification;

11. This certification action is subject to modification or revocation upon administrative or judicial review, including review and amendment pursuant to Section 13330 of the California Water Code (CWC) and Section 3867 of Title 23 of the California Code of Regulations(23 CCR);

12. This certification action does not apply to any discharge from any activity involving a hydroelectric facility requiring a Federal Energy Regulatory Commission (FERC) license or an amendment to a FERC license, unless the pertinent certification application was filed pursuant to California Code of Regulations Title 23, Subsection 3855(b) and that application specifically identified that a FERC license or amendment to a FERC license for a hydroelectric facility was being sought; and

13. Certification is conditioned upon total payment of the full fee required in State regulations (23 CCR Section 3833). Water Board staff received full payment of $2475.00 on April 17, 2012.

We anticipate your cooperation in implementing these conditions. However, please be advised that any violation of water quality certification conditions is a violation of State law and subject to administrative civil liability pursuant to California Water Code (CWC) section 13350. Failure to respond, inadequate response, late response, or failure to meet any condition of this certification may subject you to civil liability imposed by the Water Board to a maximum of $5,000 per day per violation or $10 for each gallon of waste discharged in violation of this certification.

Certification condition number 3 is a requirement for information and reports. Any requirement for a report made as a condition to this action is a formal requirement pursuant to CWC section 13267, and failure or refusal to provide, or falsification of such required report is subject to civil liability as described in CWC section 13268.

We anticipate no further action on this request. Should new information come to our attention that indicates a water quality problem with this project, the Water Board may issue Waste Discharge Requirements pursuant to 23 CCR Section 3857.

If you have any question, please contact Brendan Thompson at (510) 622-2506, or via e-mail to BThompson@waterboards.ca.gov.

Sincerely,

Bruce H. Wolfe
Executive Officer

Attachments: A- Biofiltration Swale Soil Specifications

cc (via e-mail):
Mr. Bill Orme SWRCB-DWQ
Ms. Laurie Monarres, USACE
Ms. Jane Hicks, Regulatory Branch, USACE
Ms. Melissa Escaron, CDFG
Ms. Paula Gill, USAC
Mr. Dale Bowyer, Water Board
Mr. Cyrus Vafai, Caltrans
Mr. Hardeep Takhar, Caltrans
Mr. Jason Brush, USEPA

Attachment A

Biofiltration Swale Soil Specifications

10-1.__ IMPORTED BIOFILTRATION SOIL

GENERAL

Summary

This work includes furnishing and placing imported biofiltration soil.

Submittals

Compost: Before mixing compost with sand and topsoil, submit:

1. A Certificate of Compliance from the compost supplier in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.
2. A copy of the compost producer's compost technical data sheet. The compost technical data sheet must include:

    2.1. Laboratory analytical test results
    2.2. List of product ingredients

3. A copy of the compost producers Seal of Testing Assurance certification.

Imported biofiltration soil: Imported biofiltration soil must be accompanied by a Certificate of Compliance, from the soil supplier, in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

Quality Control and Assurance

Saturated hydraulic conductivity for imported biofiltration soil must be at least 5 inches per hour.

MATERIAL

Imported biofiltration soil must be a uniform mixture of sand, compost, and topsoil. Volumetric proportion of the mixture must be: four-parts sand; two-parts compost; one-part topsoil.

Sand

Sand must be free of wood, waste, coating such as clay, stone dust, carbonate, or any other deleterious material. All aggregate passing No. 200 sieve size must be non-plastic. Sand must be graded within the following limits:

Sieve Size	Percentage Passing
3/8"	100
No. 4	90 - 100
No. 8	70 - 100
No. 16	40 - 95
No. 30	15 - 70
No. 40	5 - 55
No. 100	0 - 15
No. 200	0 - 5

Grain size analysis results of the sand component must be performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.

Compost

The compost producer must be fully permitted as specified under the California Integrated Waste Management Board, Local Enforcement Agencies, and any other State and Local Agencies that regulate solid waste facilities. If exempt from State permitting requirements, the composting facility must certify that it follows guidelines and procedures for production of compost meeting the environmental health standards of Title 14, California Code of Regulations, Division 7, Chapter 3.1, Article 7.

The compost producer must be a participant in the United States Composting Council's Seal of Testing Assurance program.

Compost may be derived from any single or mixture of any of the following feedstock materials:

1. Green material consisting of chipped, shredded, or ground vegetation; or clean processed recycled wood products
2. Biosolids
3. Manure
4. Mixed food waste

Compost feedstock materials in a manner that reduces presence of weed seeds, pathogens and deleterious materials as specified under Title 14, California Code of Regulations, Division 7, Chapter 3.1, Article 7, Section 17868.3.

Compost must not be derived from mixed municipal solid waste and must be reasonably free of visible contaminants. Compost must not contain paint, petroleum products, pesticides or any other chemical residues harmful to animal life or plant growth. Compost must not possess objectionable odors.

Metal concentrations in compost must not exceed the maximum metal concentrations listed in Title 14, California Code of Regulations, Division 7, Chapter 3.1, Section 17868.2.

Compost must comply with the following:

Physical and Chemical Requirements

Property	Test Method	Requirement
pH	TMECC 04.11-A Elastometric pH 1:5 Slurry Method pH Units	6.5 - 8.0
Soluble Salts	TMECC 04.10-A Electrical Conductivity 1:5 Slurry Method dS/m (mmhos/cm)	0 - 6.0
Moisture Content	TMECC 03.09-A Total Solids & Moisture at 70 +/- 5 deg C % Wet Weight Basis	30 - 60
Organic Matter Content	TMECC 05.07-A Loss-On-Ignition Organic Matter Method (LOI) % Dry Weight Basis	35 - 75
Maturity	TMECC 05.05-A Germination and Vigor Seed Emergence Seedling Vigor % Relative to Positive Control	 80 or Above 80 or Above
Stability	TMECC 05.08-B Carbon Dioxide Evolution Rate mg CO_2-C/g OM per day	8 or below
Particle Size	TMECC 02.02-B Sample Sieving for Aggregate Size Classification % Dry Weight Basis	Inches % Passing 3 100% 1/2 0 - 95% 1/4 0 - 75% Max. Length 4 inches
Pathogen	TMECC 07.01-B Fecal Coliform Bacteria < 1000 MPN/gram dry wt.	Pass
Pathogen	TMECC 07.01-B Salmonella < 3 MPN/4 grams dry wt.	Pass
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Plastic, Glass and Metal % > 4 mm fraction	Combined Total: < 1.0
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Sharps (Sewing needles, straight pins and hypodermic needles) % > 4 mm fraction	None Detected

NOTE: TMECC refers to "Test Methods for the Examination of Composting and Compost," published by the United States Department of Agriculture and the United States Compost Council (USCC).

Topsoil

Topsoil must be free of wood, waste or other deleterious material. The topsoil texture must be loamy. Overall dry weight percentages must be 60 to 90 percent sand, with less than 20 percent passing the No. 200 sieve, less than 5 percent clay, and no gravel.

CONSTRUCTION

Comply with Section 20-3.02, "Preparation," of the Standard Specifications.

Place imported biofiltration soil in 8 to 12- inch lifts. Do not compact the lifts.

MEASUREMENT AND PAYMENT

Quantity of imported biofiltration soil is measured by the cubic yard.

The contract unit price paid per cubic yard for imported biofiltration soil includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in imported biofiltration soil, complete in place, including testing, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

WATER QUALITY

STORMWATER INFORMATION HANDOUT

Storm Water Information Handout

MARIN SONOMA NARROWS
Marin County, California
Contract A-2
Project ID 0412000514
August 2012

Disclaimer

A “Disclaimer” is required specifying that the information provided in the Storm Water Information Handout is just a guideline and is to be used for information purposes only and should not be considered a sole source document to adhere to the requirements of the new National Pollutant Discharge Elimination System (NPDES) Construction General Permit (CGP), Number CAS000002, adopted on September 2, 2009. The contractor is required to provide water quality monitoring, sampling and implement best management practices (BMPs) based on standard industry operations, field conditions and conditions encountered based on the contractor’s means and methods. The information in this handout is not to be construed in any way as a waiver of the provisions in the CGP. Bidders and contractors are cautioned to make independent investigations and examinations as they deem necessary to satisfy the conditions encountered in performance of work, with respect to the following: sampling and monitoring locations, distribution of watershed areas for sizing of BMPs, and selection of BMPs in order to conform to the requirement of the contract documents and the CGP.

1.1 Intent of this Document

The objectives of this Water Quality Information Handout are: to summarize general water quality information of the Project; to summarize updated requirements per the new Construction General Permit (CGP) adopted on September 2, 2009; to provide general guidelines for contractors to bid on the project; to aid in developing the Storm Water Pollution Prevention Plan (SWPPP) of the project; and to highlight information necessary to file Project Registration Documents (PRDs) to the State Water Resources Control Board via the Stormwater Multi Application Reporting and Tracking System (SMARTS) and file the Notice of Intent at the start of construction.

1.2 Summary of New Requirements

The "National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities" (NPDES Number CAS000002), or CGP, regulates discharges from construction activities within the Project area. The CGP is based on a risk level (RL) permitting approach. The RL is calculated by 1) project sediment risk and 2) receiving water risk. See the risk assessment calculations in Appendix D for details. A risk assessment was done for Marin Sonoma Narrow (MSN) Contract A-2 (Project), and the Project was determined to be **RL 2.** RL 2 projects will be subject to monitoring and sampling requirements, plus Numeric Action Levels (NALs) for pH and turbidity. All projects will have to upload storm water data into SMARTS, such as Notices of Intent (NOIs), SWPPPs, annual reports, and monitoring data.

2 GENERAL PROJECT INFORMATION

2.1 Location

Contract A2 is located on US 101 within the City of Novato, in Marin County. It is approximately 0.4 mile in length, from post-mile (PM) R20.5 to R20.9.

2.2 Major Engineering Features

This project proposes to construct sub-segment A2, of the overall Segment A of the Marin-Sonoma Narrows (MSN) project. The MSN project has a goal of improving US Highway (US) 101 by reducing recurring traffic congestion and minimizing delays throughout the corridor by promoting the use of carpools, vanpools and express buses. The project will also improve the safety of US101 by increasing visibility (sight distance), improving drainage features to address traveled-way flooding, and widening shoulders to current design standards.

The improvements proposed for this segment include widening toward the median along the southbound direction of mainline and the Novato Creek Bridge, to accommodate a 12-foot (ft) lane and 14-ft shoulder. Mainline widening includes the removal and replacement of approximately 5-ft width of existing impervious surface, and placement of approximately 20 feet (ft) of new impervious surface; 3ft of this is for a concrete barrier.

2.2 Watersheds

The project area is located within the Novato watershed. The project watershed is a tidally influenced system.

2.3 Receiving Water Bodies

The project is located in the San Pablo Hydrologic Unit (HU) 206 of the San Pablo Bay Basin, specifically the Novato Hydrologic Sub-area (HSA) 206.2. The receiving water in the vicinity of the project consists of Novato Creek.

2.4 Climate and Rainfall

The general climate of Marin County can be characterized by moderate temperature and precipitation. In the project area, there is a temperature range with high readings occasionally exceeding 100° F and lows sometimes falling several degrees below freezing. Even during the warm period of the year, however, the night temperatures usually drop close to 50° F. Precipitation is concentrated into six months of the winter period with only light amounts of rain reported during the rest of the year. The summer (dry period) is long enough that stored moisture in the soil is depleted. Winds are relatively light most of the year, except for the summer. Sunshine is abundant during the summer over most of the county, except for considerable cloudiness along the immediate coast. The Annual average rainfall within the project limits ranges from approximately 26 inches to 29 inches. The project area terrain consists of gently rolling hills ranging from elevations sea level to approximately 120 ft.

The land use in the project is mainly urban development with the exception of the Petaluma River, which is used for transportation and recreation and Novato Creek, which is used for recreation. The project area is predominately highly urbanized. The roadway is mostly fill with highway lanes out sloped except for super-elevation road section sections through curves. The roadway varies in elevation from 10 feet to 45 feet.

2.5 Soils and Geology

The United States Department of Agriculture, Natural Resources Conservation Service (NRCS) web soil survey was utilized to determine the pertinent hydrologic soil groups (HSGs) for soils within the Project area. These soils within the Project area are classified under HSG D, which suggests that soils within the Project area have a high runoff potential and low infiltration rates.

3 CONSTRUCTION GENERAL PERMIT

To minimize the potential effects of construction runoff on the quality of the receiving water bodies, any construction activity affecting one acre or more must obtain coverage under the CGP. Permit applicants are required to prepare a SWPPP and implement BMPs to reduce construction effects on receiving water quality.

3.1 Risk Assessment

The CGP requirements include a risk assessment to determine the Project's impact risk to receiving water bodies. The risk assessment uses measurements of the Project's potential sediment risk and the sensitivity of the receiving water bodies to sediment to determine the RL of the Project. This Project has a **Low Site Sediment Risk Factor** and a **High Receiving Water Risk Factor** the combined risk is **Level 2.** The risk factors are detailed in the Appendix D.

3.2 Notice of Termination (NOT)

The CGP provides both revised and new requirements for completion and approval of the NOT. The NOT requirements are presented in Section II.D of the new CGP permit "Order." These requirements include demonstrating through photos, computational proof or other "custom methods," such as results of testing and analysis, that the terms of the NOT have been satisfied. While these methods of demonstrating compliance are at the option of the contractor, should the RWQCB determine that the visual photos do not adequately show compliance, further computational efforts may be required. This computational proof is obtained through the use of the Revised Universal Soil Loss Equation 2 (RUSLE2) program.

3.3 Caltrans Forms

The following forms have been developed by the Division of Construction as of 09/2010:

- CEM-2030 “Stormwater Site Inspection Report” Visual inspection monitoring form
- CEM-2034 “Stormwater Best Management Status Report” Identifies BMP types and quantities to be installed on a weekly basis
- CEM-2035 “Stormwater Site Inspection Report Corrective Actions Summary” Describes actions taken for existing BMP failures
- CEM-2045 “Rain Event Action Plan-Highway Construction Phase” REAP to be used during active work phase
- CEM-2046 “Rain Event Action Plan-Plant Establishment Phase” REAP to be used during plant establishment phase
- CEM-2047 “Rain Event Action Plan-Inactive Project” REAP to be used for inactive work phase
- CEM-2090 “Notice of Completion of Construction” Describes efforts to show compliance with NOT requirements

4 RUN-ON DISCHARGES

Run-on discharges are off-site storm water flows that can potentially run onto the site. Run-on discharges should be calculated based on a rainfall intensity for a 2-year, 24-hour event per the PPDG. Based on the Contours, The existing highway is built on fill, so run-on discharges are not anticipated. However, it is the responsibility of the contractor to determine potential run-on based on staging and active and non-active construction work.

5 PROJECT REGISTRATION DOCUMENTS

To obtain permit coverage under the CGP, all dischargers must electronically file PRDs, NOTs, changes of information, sampling and monitoring information, annual reporting, and other compliance documents required by this CGP through the SWRCB's SMARTS. The contractor will have to coordinate these submittals with Caltrans within the timeframe allotted in the contract special provisions and as specified in the permit. SMARTS is found under the following website:
https://smarts.waterboards.ca.gov/smarts/faces/SwSmartsLogin.jsp

PRDs include the following information:

1. Notice of Intent (NOI)
2. Site Map(s) Includes:
   a. The project's surrounding area (vicinity)
   b. Site layout
   c. Construction site boundaries
   d. Drainage areas
   e. Discharge locations
   f. Sampling locations
   g. Areas of soil disturbance (temporary or permanent)
   h. Active areas of soil disturbance (cut or fill)
   i. Locations of all runoff BMPs
   j. Locations of all erosion control BMPs
   k. Locations of all sediment control BMPs
   l. Active Treatment System (ATS) location (if applicable)
   m. Locations of sensitive habitats, watercourses, or other features which are not to be disturbed
   n. Locations of all post-construction BMPs
   o. Locations of storage areas for waste, vehicles, service, loading/unloading of materials, access (entrance/exits) points to construction site, fueling and water storage, water transfer for dust control and compaction practices

3. SWPPPs

4. Risk Assessment

a. The Standard Risk Assessment includes utilization of the following:

i. Receiving water Risk Assessment interactive map

ii. EPA Rainfall Erosivity Factor Calculator Website

iii. Sediment Risk interactive map

iv. Sediment sensitive water bodies list

b. The Site-Specific Risk Assessment includes the completion of the hand calculated R value Risk Calculator

5.1 General Information Included

The following is a list of information included in this Storm Water Information Handout that can be used for the PRDs:

- Vicinity Map
- Risk Assessment

5.2 Storm Water Pollution Prevention Plan

The contractor for the Project is required to prepare a SWPPP because the Project involves disturbing more than 1 ac of soil. The SWPPP must include the following information:

- Active areas of cut and fill
- Areas of soil disturbance (temporary and permanent)
- Locations of storage areas for waste, vehicles, access, etc.
- Locations of all runoff BMPs
- Locations of all erosion control BMPs
- Locations of all sediment control BMPs

5.3 Notice of Intent (NOI)

The NOI must be submitted once the contractor submits the SWPPP. A draft of the NOI is included in Appendix B.

5.4 Site Maps

Registration requirements can be met by the inclusion of the following plans, which can be found in the appendices.

- Sampling Plan (Appendix C)
- Discharge Locations (Subject to changes by the Contractor and approved by the Engineer)
- Sampling locations (Subject to changes by the Contractor and approved by the Engineer)

Appendix A

Vicinity Map

Appendix B

NOI

Appendix C

Sampling Plan

Appendix D

Risk Assessment

PERMITS

UNITED STATES ARMY CORPS OF ENGINEERS

404 PERMIT

DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, U.S. ARMY CORPS OF ENGINEERS
1455 MARKET STREET
SAN FRANCISCO, CALIFORNIA 94103-1398

REPLY TO
ATTENTION OF:

JUN 13 2012

Regulatory Division

SUBJECT: File Number 2001-262140N

Mr. Jeffrey Jensen
California Department of Transportation
111 Grand Avenue
Oakland, California 94623-0660

Dear Mr. Jensen:

Enclosed is your signed copy of a Department of the Army permit (Enclosure 1) to complete phases A2 and A3 of the Marin Sonoma Narrows Project. Phase A2 consists of constructing the southbound (SB) HOV lanes along U.S. 101, including the SB Novato Creek Bridge within the described project reach. Phase A3 consists of widening northbound (NB) U.S. 101 into the median to accommodate an HOV lane and a 10-foot inside and outside shoulder north of the U.S. 101/Atherton interchange in Novato. Phases A2 and A3 of the MSN project extends along U.S. 101 from the Novato Creek Bridge to the Franklin Avenue overhead crossing (approximately 0.5 mile) and from the Atherton Avenue Interchange to near Airport Road in the City of Novato, Sonoma County, California

Please complete the appropriate parts of "Project Status" form (Enclosure 2), and return it to this office as your work progresses. You are responsible for ensuring that the contractor or workers executing the activity authorized herein are knowledgeable of the terms and conditions of this authorization.

Should you have any questions regarding this matter, please call Paula Gill of our Regulatory Division at (415) 503-6776. Please address all correspondence to the Regulatory Division and refer to the File Number at the head of this letter. If you would like to provide comments on our permit review process, please complete the Customer Survey Form available online at http://per2.nwp.usace.army.mil/survey.html.

Sincerely,

Torrey A. DiCiro, P.E., PMP.
Lieutenant Colonel, U.S. Army
Commanding

Enclosures

Copies Furnished (w/encl 1 only):
US CG, Alameda, CA
US EPA, San Francisco, CA
US FWS, Sacramento, CA
US NMFS, Santa Rosa, CA
CA DFG, Yountville, CA
CA RWQCB, Oakland, CA

PROJECT STATUS

Please use the forms below to report the dates when you start and finish the work authorized by the enclosed permit. Also if you suspend work for an extended period of time, use the forms below to report the dates you suspended and resumed work. The second copy is provided for your records. If you find that you cannot complete the work within the time granted by the permit, please apply for a time extension at least one month before your permit expires. If you materially change the plan or scope of the work, it will be necessary for you to submit new drawings and a request for a modification of your permit.

(cut as needed) --

Date:______________

NOTICE OF COMPLETION OF WORK under Department of the Army Permit No., 2001-262140N
TO: District Engineer, US Army Corps of Engineers, Regulatory Division, 1455 Market Street, 16th Floor, San Francisco, CA 94103-1398

In compliance with the conditions of Permit No. 2001-262140N, this is to notify you that work was completed on____________________.

Permittee: Caltrans, Mr. Jeffrey Jensen
Address: 111 Grand Avenue, Oakland, California 94623-0660

(cut as needed) --

Date:______________

NOTICE OF RESUMPTION OF WORK under Department of the Army Permit No. 2001-262140N
TO: District Engineer, US Army Corps of Engineers, Regulatory Division, 1455 Market Street, 16th Floor, San Francisco, CA 94103-1398

In compliance with the conditions of Permit No. 2001-262140N, this is to notify you that work was resumed on ____________________.

Permittee: Caltrans, Mr. Jeffrey Jensen
Address: 111 Grand Avenue, Oakland, California 94623-0660

(cut as needed) --

Date:______________

NOTICE OF SUSPENSION OF WORK under Department of the Army Permit No. 2001-262140N
TO: District Engineer, US Army Corps of Engineers, Regulatory Division, 1455 Market Street, 16th Floor, San Francisco, CA 94103-1398

In compliance with the conditions of Permit No., 2001-262140N, this is to notify you that work was suspended on ____________________.

Permittee: Caltrans, Mr. Jeffrey Jensen
Address: 111 Grand Avenue, Oakland, California 94623-0660

(cut as needed) --

Date:______________

NOTICE OF COMMENCEMENT OF WORK under Department of the Army Permit No. 2001-262140N
TO: District Engineer, US Army Corps of Engineers, Regulatory Division, 1455 Market Street, 16th Floor, San Francisco, CA 94103-1398

In compliance with the conditions of Permit No. 2001-262140N, this is to notify you that work was commenced on ____________________.

Permittee: Caltrans, Mr. Jeffrey Jensen
Address: 111 Grand Avenue, Oakland, California 94623-0660

DEPARTMENT OF THE ARMY PERMIT

PERMITTEE: California Department of Transportation, District 4

PERMIT NO.: SPN-2001-262140 N

ISSUING OFFICE: San Francisco District

NOTE: The term "you" and its derivatives, as used in this permit, means the permittee or any future transferee. The term "this office" refers to the appropriate District or Division office of the Corps of Engineers having jurisdiction over the permitted activity or the appropriate official of that office acting under the authority of the commanding officer.

You are authorized to perform work in accordance with the terms and conditions specified below:

PROJECT DESCRIPTION:

The Marin Sonoma Narrows (MSN) project will construct high-occupancy vehicle (HOV) lanes on United States 101 (U.S. 101) from just south of State Route 37 in the City of Novato to just north of Corona Road in the City of Petaluma. The MSN project will include construction and modification of interchanges as well as the establishment of new frontage roads. Phase A2 will consist of constructing the southbound (SB) HOV lanes along U.S. 101 within the described project reach. Phase A3 consists of widening NB U.S. 101 into the median to accommodate an HOV lane and a 10-foot inside and outside shoulder north of the U.S. 101/Atherton interchange in Novato. Work will include widening of the NB North Novato Overhead Bridge, reconstruction of the median thrie beam barrier, and replacement and extension of culverts and inlets in their current locations, including replacing four culverts to upsized box culvert structures.

Phase A2:

Specific improvements will include extending the existing HOV Lane from the Novato Creek Bridge to the Franklin Overhead and replacing the existing thrie beam barrier with concrete barrier in the median. The Novato Creek Bridge will be widened 23.17-feet in the median to accommodate SB HOV lane and shoulder. The existing gap in the median between the two structures will be closed as a result of the widening. The SB Novato Creek Bridge widening will include installation of 18 piles driven with an impact hammer. Piles will include six Class 200 Alt X Driven piles 14-in by 14-in pile dimensions and twelve 24-inch diameter Cast-in-Steel-Shell (CISS) Piles. A temporary platform (enclosed fill or trestle platform) may be required to complete pile driving of the Class 200 Alt X Driven piles. A catch platform supported on the CISS Piles will be constructed to contain the soil material removed inside the CISS Piles from falling into the creek. Cofferdams may be required. The cofferdams for installation of the Class 200 Alt X Driven piles will be constructed out of interlocking sheet pilings, using a vibratory hammer and an impact hammer if difficult driving is encountered. Coffer dams for the CISS Piles will include 36 inch corrugated steel pipe (CSP) driven vertically using a vibratory hammer at each pile location.

Phase A3:

Specific improvements will include striping, pavement widening and transitions, reconstruction of thrie beam barrier and drainage cross-culvert extensions and upgrades. Cross-culvert upgrades will include replacement of four existing cross-culvert with new (upsized box culvert structures in their current alignment/locations. The remaining existing drainage culverts and inlets within the project limits will receive culvert extensions (outside) or inlet adjustments/locations (inside/median), to account for the outside and inside widening improvements. In a few instances, new inlets (and connecting culverts) are proposed to address the widening improvements and minor grading changes along the median.

All work shall be completed in accordance with the plans and drawings titled "*USACE File #2001-262140N, Marin Sonoma Narrows-Segment A2, June 4, 2012, Figures 1 to 9*", and "*USACE File #2001-262140N, Marin Sonoma Narrows-Segment A3, June 4, 2012, Figures 10 to 19*" provided as enclosure 1.

The project will result in the discharge of fill material into 0.0392 acre of seasonal wetland and 0.0513 acre of other waters of the U.S. Temporary impacts will occur to 0.04 acre of jurisdictional wetlands and 0.0604 acre of jurisdictional waters of the U.S. Discharge of fill material is depicted in drawings titled, "*USACE File # 2001-262140N, Marin Sonoma Narrows- Segments A2 and A3 Impact Maps, June 4, 2012, Figures 1 to 9*" provided as enclosure 2. Permanently impacted jurisdictional seasonal wetlands have been mitigated off site by the purchase of wetland mitigation credits (2 credits, December 2, 1010) from the Burdell Ranch Wetland Conservation Bank.

PROJECT LOCATION: Phases A2 and A3 of the MSN project extend along U.S. 101 from the Novato Creek bridge to the Franklin Avenue overhead crossing (approximately 0.5 mile) and from the Atherton Avenue Interchange to near Airport Road in the City of Novato, Sonoma County, California.

PERMIT CONDITIONS:

GENERAL CONDITIONS:

1. The time limit for completing the work authorized ends on June 15, 2017. If you find that you need more time to complete the authorized activity, submit your request for a time extension to this office for consideration at least one month before the above date is reached.

2. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition 4 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.

3. If you discover any previously unknown historic or archeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of what you have found. We will initiate the Federal and State coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

4. If you sell the property associated with this permit, you must obtain the signature of the new owner in the space provided and forward a copy of the permit to this office to validate the transfer of this authorization.

5. Conditioned water quality certifications have been issued for your project; you must comply with the conditions specified in the certification as special conditions to this permit. For your convenience, copies of the certifications are attached (enclosures 3).

6. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of your permit.

7. You understand and agree that, if future operations by the United States require the removal, relocation or other alteration of the structure or work authorized herein, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, you will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

SPECIAL CONDITIONS:

1. This Corps permit does not authorize you to take a federally listed species. In order to legally take a listed species, you must have a separate authorization under the Endangered Species Act (ESA) (e.g., an ESA Section 10 permit or a Biological Opinion (BO) under ESA Section 7 with "incidental take" provisions with which you must comply). The enclosed U.S. Fish and Wildlife Service (USFWS) BO and letter of concurrence dated April

1, 2009 (enclosure 4), and National Marine Fisheries Service (NOAA-Fisheries) BO dated January 26, 2009 (enclosure 5), contain mandatory terms and conditions to implement the reasonable and prudent measures that are associated with "incidental take" that are also specified in the BOs. Your authorization under this Corps permit is conditional upon your compliance with all of the mandatory terms and conditions associated with incidental take authorized by the attached BOs and letter of concurrence, whose terms and conditions are incorporated by reference in this permit. Failure to comply with the terms and conditions associated with incidental take of the BOs or letter of concurrence, where a 'take' of the listed species occurs, would constitute an unauthorized take and it would also constitute non-compliance with this Corps permit. The USFWS and NOAA-Fisheries are the appropriate authorities to determine compliance with the terms and conditions of their BOs, letter of concurrence, and with the ESA.

2. You shall employ sediment and erosion control best management practices as needed throughout the project area. No objects or fill shall be placed where they can be eroded or washed into drainage systems in the project area. All debris generated as a result of the project, shall be removed from the site and disposed of at an approved location outside of Corps jurisdiction. All project staging and equipment storage areas shall be located away from areas subject to the jurisdiction of the Corps. After construction, any materials used to dewater areas within the creeks shall be removed in their entirety.

3. Within 1-year of initiation of temporary impact to a jurisdictional feature, you shall re-contour the temporarily impacted area and replant it with appropriate soil-stabilizing native species. You shall monitor each re-vegetated area for 5 years. At the end of the fifth year, re-vegetated areas shall provide 75% absolute vegetative cover. In re-vegetated wetlands, over half of the cover must be occupied by hydrophytic plants (having a facultative (FAC) or wetter indicator status). You shall submit a monitoring report for the re-vegetated areas at the end of years 1, 3, and 5. The reports shall include representative photos of the re-vegetated areas. If the cover requirements for the re-vegetated areas are not met, the Corps may require further monitoring, re-vegetation, and/or off-site mitigation.

4. In the event that you are unable to implement the plan described in special condition 3 within 1-year of initiation of temporary impact to a jurisdictional feature, you must purchase credits at a Corps approved mitigation bank to compensate for the temporary impact at a 3:1 ratio. If no approved bank or in-lieu fee is available, you shall propose an alternative mitigation plan to be reviewed and approved by the Corps.

5. You shall comply completely with the conditions established in the *"Memorandum of Agreement Between The Federal Highway Administration and the California State Historic Preservation Officer Regarding Lane Widening of Highway 101, Marin and Sonoma Counties, California"* signed September 11, 2008.

6. If future operations by the United States require the removal, relocation, or other alteration of the work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, you will be required, upon due notice from the U. S Army Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

FURTHER INFORMATION:

1. Congressional Authorities: You have been authorized to undertake the activity described above pursuant to:

(x) Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. Section 403).
(x) Section 404 of the Clean Water Act (33 U.S.C. Section 1344).
( ) Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. Section 1413).

2. Limits of this authorization:

a. This permit does not obviate the need to obtain other Federal, State, or local authorizations required by law.

b. This permit does not grant any property rights or exclusive privileges.

c. This permit does not authorize any injury to the property or rights of others.

d. This permit does not authorize interference with any existing or proposed Federal project.

3. Limits of Federal Liability: In issuing this permit, the Federal Government does not assume any liability for the following:

a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.

b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.

c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.

d. Design or construction deficiencies associated with the permitted work.

e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. Reevaluation of Permit Decision: This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:

a. You fail to comply with the terms and conditions of this permit.

b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate. (See Item 4 above.)

c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 C.F.R. Section 325.7 or enforcement procedures such as those contained in 33 C.F.R. Sections 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measures ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 C.F.R. Section 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. Extensions: General Condition 1 establishes a time limit for the completion of the activity authorized by this permit. Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give favorable consideration to a request for an extension of this time limit.

Your signature below, as permittee, indicates that you accept and agree to comply with the terms and conditions of this permit.

Carrie S. Montero for Jeffrey G. Jensen
(PERMITTEE)

6/12/12
(DATE)

This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.

For
Torrey A. DiCiro, P.E., PMP
Lieutenant Colonel, U.S. Army
District Commander

6/13/12
(DATE)

When the structures or work authorized by this permit are still in existence at the time the property is transferred, the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.

(TRANSFEREE)

(DATE)

AGREEMENTS

CALIFORNIA DEPARTMENT OF FISH AND GAME

NOTIFICATION NO.1600-2012-0139-R3

State of California – The Natural Resources Agency
DEPARTMENT OF FISH AND GAME
Bay Delta Region
7329 Silverado Trail
Napa, CA 94558
(707) 944-5520
www.dfg.ca.gov

***EDMUND G. BROWN JR.**, Governor*
***CHARLTON H. BONHAM,** Director*

June 12, 2012

Mr. Jeffrey G. Jensen
California Department of Transportation
111 Grand Avenue
Oakland, CA 94623

Subject: Final Lake or Streambed Alteration Agreement
Notification No. 1600-2012-0139-R3
Novato Creek

Dear Mr. Jensen:

Enclosed is the final Streambed Alteration Agreement ("Agreement") for Marin Sonoma Narrows HOV Widening Project, Contract A2 ("Project"). Before the Department may issue an Agreement, it must comply with the California Environmental Quality Act ("CEQA"). In this case, the Department, acting as a responsible agency, filed a notice of determination ("NOD") on June 12, 2012, based on information contained in the final Environmental Impact Report the lead agency prepared for the Project.

Under CEQA, filing a NOD starts a 30-day period within which a party may challenge the filing agency's approval of the project. You may begin your project before the 30-day period expires if you have obtained all necessary local, state, and federal permits or other authorizations. However, if you elect to do so, it will be at your own risk.

If you have any questions regarding this matter, please contact Melissa Escaron, Staff Environmental Scientist at (707)339-0334 or mescaron@dfg.ca.gov.

Sincerely,

CJ Weightman

Craig J. Weightman
Acting Environmental Program Manager
Bay Delta Region

cc: Stuart Kirkham
California Department of Transportation

Lieutenant Jones
Warden Thiem
Melissa Escaron

CALIFORNIA DEPARTMENT OF FISH AND GAME
BAY DELTA REGION
7329 SILVERADO TRAIL
NAPA, CALIFORNIA 94558
(707) 944-5520
WWW.DFG.CA.GOV

STREAMBED ALTERATION AGREEMENT
NOTIFICATION NO. 1600-2012-0139-R3
Novato Creek

CALIFORNIA DEPARTMENT OF TRANSPORTATION
MARIN SONOMA NARROWS HOV WIDENING CONTRACT A2

This Streambed Alteration Agreement (Agreement) is entered into between the California Department of Fish and Game (DFG) and California Department of Transportation as represented by Mr. Jeffrey Jensen.

RECITALS

WHEREAS, pursuant to Fish and Game Code (FGC) section 1602, Permittee notified DFG on April 6, 2012 that Permittee intends to complete the project described herein.

WHEREAS, pursuant to FGC section 1603, DFG has determined that the project could substantially adversely affect existing fish or wildlife resources and has included measures in the Agreement necessary to protect those resources.

WHEREAS, Permittee has reviewed the Agreement and accepts its terms and conditions, including the measures to protect fish and wildlife resources.

NOW THEREFORE, Permittee agrees to complete the project in accordance with the Agreement

PROJECT LOCATION

The project is located in Novato Creek at the Interstate 101 bridge crossing, in the County of Marin, State of California.

PROJECT DESCRIPTION

The Project will widen the Novato Creek Bridge into the existing Route 101 median to accommodate a southbound Route 101 High Occupancy Vehicle (HOV) lane widening. The proposed bridge widening will close the gap between the two existing bridges. The superstructure will be a Cast-in-Place concrete structure. The substructure will consist of concrete abutments, anchored by six driven concrete piles. Both proposed abutment sites will be excavated to prepare for the installation of the new abutments. Twelve 24-inch diameter Cast-in-Steel-Shell (CISS) piles will be driven to create new bridge bents. The soils inside the driven shell piles will be removed and the shell piles will then be filled with concrete and rebar. A catch platform will be located on the newly installed CISS piles to store and prevent the soils removed from the inside the steel piles from falling into the creek.

All permanent piles will be driven with an impact hammer. Temporary piles such as sheet piles or trestle piles, if needed, will be installed with an impact or vibratory hammer, or a combination of both. Two temporary fill pads will be constructed by enclosing rock backfill within a box of connected sheet piles, creating work platforms for the pile driving rig. The fill pads will be removed after pile installation. The volume of the fill pads is estimated at 370 cubic yards each. The estimated combined area of the two fill pads is 1865 ft^2. Alternatively, trestles may be built on both banks to provide access to the stream bed for the pile driving rig. The trestles will be made of steel and timbers and each will require four to five 2-inch diameter steel pipe piles driven into the creek banks.

To install the CISS piles, 36-inch corrugated steel piles (CSP) will be driven at each permanent pile location. The CSPs will be used as a coffer dam to allow dewatering and placement of the pile free from the influence of changing water elevations from tidal flows. Water removed from the CSPs will be pumped into Baker Tanks.

A high strength polyethylene soil confinement system will be installed under the bridge to stabilize the steep slopes. The system will be designed to withstand flow velocities of 30 feet/second.

No trees will be removed to accommodate the construction.

PROJECT IMPACTS

Existing fish or wildlife resources the project could substantially adversely affect include:

- riparian habitat, central California coast steelhead migration habitat
- emergent wetland impacts
- aquatic vertebrates
- aquatic invertebrates
- nesting birds

The adverse effects the project could have on the fish or wildlife resources identified above include:

- permanent and temporary loss of natural bed and bank
- change in contour of bed, channel and bank
- debris transport impedance
- loss of natural bed substrate
- change in stream flow
- loss of habitat
- water quality degradation
- short-term release of contaminants
- disruption to nesting birds and other wildlife

MEASURES TO PROTECT FISH AND WILDLIFE RESOURCES

1. Administrative Measures

Permittee shall meet each administrative requirement described below.

1.1 Documentation at Project Site. Permittee shall make the Agreement, any extensions and amendments to the Agreement, and all related notification materials and California Environmental Quality Act (CEQA) documents, readily available at the project site at all times and shall be presented to DFG personnel, or personnel from another state, federal, or local agency upon request.

1.2 Providing Agreement to Persons at Project Site. Permittee shall provide copies of the Agreement and any extensions and amendments to the Agreement to all biological monitors and all supervisory personnel who will be working on the project at the project site on behalf of Permittee, including but not limited to contractors, subcontractors, and inspectors.

1.3 Notification of Conflicting Provisions. Permittee shall notify DFG if Permittee determines or learns that a provision in the Agreement might conflict with a provision imposed on the project by another local, state, or federal agency. In that event, DFG shall contact Permittee to resolve any conflict.

1.4 Project Site Entry. Permittee agrees that DFG personnel may enter the project site at any time with notification to the Resident Engineer to verify compliance with the Agreement.

2. Avoidance and Minimization Measures

To avoid or minimize adverse impacts to fish and wildlife resources identified above, Permittee shall implement each measure listed below.

2.1 Seasonal Work Period. To minimize adverse impacts to fish and wildlife all work described in the project location and description shall be confined to the period of June 15 to October 15. Revegetation work is not confined to this time period.

2.2 Pile Installation. Installation of sheet piles and CSP piles will be conducted at low tide only. Installation of CISS piles within dewatered CSP piles are not restricted to periods of low tide.

2.3 Extension. If the Permittee needs more time to complete the authorized activity within DFG jurisdictional locations as described in the project description, the work period may be extended by submitting a written request to the DFG 1600 Program. The work period extension request shall: 1) describe the extent of work already completed; 2) detail the activities that remain to be completed; 3) detail the time required to complete each of the remaining activities; and 4) provide photographs of both the current work completed and the proposed site for continued work. Work period extensions are issued at the discretion of DFG. DFG will review the written request to work outside of the established work period. DFG reserves the right to require additional measures to protect fish and wildlife resources as a condition for granting the extension. DFG will have ten (10) calendar days to review and respond to the proposed work period extensions. Permittee shall not proceed until written approval has been obtained from DFG.

2.4 Work During Dry Weather Only. The work period for completing the work within the stream zone, shall be restricted to periods of dry weather. No work in the stream zone shall occur during wet weather. For this specific project, wet weather is defined as when there has been ¼ inch of rain, or more, in a 24-hour period. All erosion control measures associated with project activities must be in place prior to the onset of precipitation. After any storm event, the Permittee shall inspect all sites currently under construction and all sites scheduled to begin construction within the next 72 hours for erosion and sediment problems and take corrective action as needed. Seventy-two hour weather forecasts from the National Weather Service shall be consulted and work shall not start back up until runoff ceases and there is less than a 30% forecast for precipitation for the following 24-hour period.

2.5 No Equipment in the Stream. Equipment shall not be operated in wetted areas (including but not limited to ponded, flowing, or wetland areas) without written approval from DFG.

2.6 Qualified Biologist Approval. At least 30-days prior to commencing project activities covered by this Agreement, the Permittee shall submit to DFG, for review and approval, the qualifications for a number of biologist(s) that shall oversee the implementation of the conditions in this Agreement. Project activities covered by this Agreement may not commence unless DFG has approved the proposed biologist(s). At minimum, the DFG approved biologist(s) shall have a combination of academic training and professional experience in biological sciences and related resource management activities.

2.7 Biological Monitor on Site. The Permittee shall designate a person to monitor on-site compliance with all conditions of this Agreement. The monitor shall have received training in special status species identification. The Biological Monitor shall communicate to the Resident Engineer when any activity is not in compliance with this Agreement and the Resident Engineer shall immediately stop the activity that is not in compliance with this Agreement.

2.8 Dewater Work Site. The site shall be dewatered as necessary to provide an adequately dry work area. Any muddy or otherwise contaminated water shall be pumped to a settling tank prior to re-entering the creek. Work site dewatering can be accomplished using pumps and or siphons. NOAA fish screening requirements are required if salmonids may be present.

2.9 Screen Intake: The water diversion intake apparatus shall be screened with a fine mesh screen. The following NOAA fish screening requirements shall be implemented:

2.9.1 A self-cleaning screen shall have at least 2.5 square feet of submerged screen material for each cubic foot per second (450 gallons per minute) of the maximum diversion rate. A screen which is not self -cleaning shall have at least 5 square feet of submerged screen material for each cubic foot per second of the maximum diversion rate. Round openings in the screen shall not exceed 3/32 inch diameter, square openings shall not exceed 3/32 inch measured diagonally, and slotted openings shall not exceed 0.069 inches in width. The screen may be constructed of any rigid woven, perforated, or slotted material that provides water passage while physically excluding fish. Screen material shall provide a minimum of 27% open area, but more open area is better. Stainless steel is recommended to minimize corrosion problems. The screen shall be designed to distribute the flow uniformly over the entire screen area. The screen face generally should be parallel to the flow of the stream. The screen shall be cleaned as frequently as necessary to prevent the approach velocity from exceeding 0.4 feet per second. The screen shall be kept in good repair, and shall be used whenever water is being diverted. Plans shall be provided to DFG which show that all the applicable screening criteria have been met. The applicant is advised to consult with the National Marine Fisheries Service to ensure that all their design criteria are being met.

2.10 Capture and Relocation. Any capture or relocation of aquatic vertebrates shall be conducted in conformance with this condition. The Resident Engineer and Qualified Biologist shall be onsite during dewatering and relocation activities. The Resident Engineer, in consultation with the Qualified Biologist, shall direct all dewatering and relocation activities. Capture and relocation shall be conducted in a manner that minimizes stress and injury to captured animals.

2.10.1 Capture methods may include dip nets. All nets shall be made of a soft braded nylon material that is non abrasive. Mesh sizing shall be matched to species and the life stages likely encountered. Electrofishing shall be used as a last resort and only when appropriate according to the NMFS Guidelines for Electrofishing.

2.10.2 A relocation site shall be identified and the most direct transportation route shall be determined prior to any capture.

2.10.3 Capture and handling of animals shall be minimized. Prior to any capture of animals, an effort shall be made to herd species downstream and out of the work area.

2.10.4 Initial dewatering shall be done at a slow rate (approximately 20 percent of the total depth to be dewatered per hour).

2.10.5 The number of animals captured and moved at any one time shall be limited to the number that can be relocated without stress or injury.

2.10.6 Prior to handling animals, all hands and equipment shall be wetted down with stream water and shall be free of any materials including hand sanitizers, sunscreen or insect repellent. No animals shall be handled with dry hands or dry equipment.

2.10.7 Exclusionary netting or other barriers shall be used to prevent relocated animals from re-entering the dewatered work area.

2.10.8 An aeration system shall be used in any live well or other holding facility. The aerator shall be operating prior to placing animals in it to ensure that sufficient oxygen is present during the adjustment period and to minimize the build-up of toxic carbon dioxide in holding waters. The aeration rate and the number of animals in each holding facility shall be managed such that the dissolved oxygen concentration shall be maintained above 6 ppm.

2.10.9 Water from the local collection site shall be used in live wells or other holding facilities during loading and transport. At no time will chlorinated tap water be used.

2.10.10 Live wells or other holding facilities shall be sufficiently sized to minimize stress.

2.10.11 Water temperatures within any live well or other holding facility shall be kept at or below water temperature at the collection site. Temperatures must be managed in such a way as to minimize stress; for example, floating a sealed bag of ice in each container.

2.10.12 If salmonid species are expected to be present, capture and relocation activities shall not be initiated when and if water temperatures exceed or are expected to exceed 68°F.

2.10.13 All captured salmonids shall be tallied by species.

2.10.14 Dotted smartweed (*Persicaria punctata*) shall not be placed or allowed to enter live wells or holding facilities.

2.10.15 No non-native animals captured shall be returned to the stream or released alive.

2.10.16 Before and after each relocation effort, all equipment shall be sterilized following follow the general gear cleaning protocols in the California Department of Fish and Game Administrative Report 2005-02: Controlling the Spread of New Zealand Mud Snails on Wading Gear (Exhibit A). Note: Formula 409 Disinfectant (50% dilution) has recently changed its formula and is no longer recommended. DFG "Tank Disinfection Protocol" shall also be followed (Exhibit B).

2.10.17 Capture and Relocation Results. Permittee shall submit a report of capture and relocation activities to DFG within 30-days after relocation activities have been completed. The report shall include: species encountered, capture methods; methods used for handling, stress minimization, equipment cleaning and disinfection; sizes of holding facilities; descriptions of relocation sites; number by species of all captured salmonids; and all instances of mortality and injury.

2.11 Qualified Biologist to Check Dewatered Area. The Qualified Biologist shall check daily for stranded aquatic life as the water level in the dewatering area drops and until dewatering facilities are removed. All stranded native aquatic vertebrates in the dewatered areas shall be immediately relocated to the nearest suitable habitat.

2.12 Limit Disturbance to Vegetation. Disturbance or removal of vegetation shall not exceed the minimum necessary to complete operations.

2.13 Environmentally Sensitive Area fencing. The perimeter of the work site shall be adequately fenced to prevent damage to adjacent riparian habitat. No work activities shall occur outside the perimeter.

2.14 Stabilize Disturbed Areas. All exposed/disturbed areas within the project site shall be stabilized to the greatest extent possible. Erosion control measures such as silt fences, straw hay bales, gravel or rock lined ditches, water check bars, and broadcasted straw shall be used wherever silt laden water has the potential to leave the work site and enter State waters. Modifications, repairs and improvements to erosion control measures shall be made whenever it is needed. At no time shall silt laden runoff be allowed to enter the stream or directed to where it may enter a water body. Materials containing monofilament or plastic netting shall not be used.

2.15 Concrete. Concrete shall be excluded from surface water for a period of 30-days after it is poured/sprayed. During that time the concrete shall be kept moist and runoff from the concrete shall not be allowed to enter any water body. Commercial sealants may be applied to the concrete surface where difficulty in excluding flow for a long period may occur. If sealant is used, water shall be excluded from the site until the sealant is cured. If groundwater comes into contact with fresh concrete, it shall be prevented from flowing towards surface water.

2.16 Nesting Bird Surveys. To protect nesting birds, no project activities shall occur from February 15 through August 31 unless nesting bird surveys have been completed by a qualified biologist. To prevent nest abandonment, a qualified biologist shall survey within 500 feet of the proposed Project for nesting birds. If nests are found within the Project site or 500 feet from the Project then the qualified biologist shall establish a 50-foot buffer radius for nests of non-raptor bird species or a 300-foot buffer radius for raptor nests. The Qualified Biologist shall monitor the nesting birds and shall increase the buffer if the Qualified Biologist determines the birds are showing signs of unusual or distressed behavior by Project activities. To prevent encroachment, the established buffer(s) shall be clearly marked by high visibility material. The established buffer(s) shall remain in effect until the young have fledged or the nest has been abandoned as confirmed by the qualified biologist. Surveys shall be conducted during periods of peak activity (early morning, dusk) and shall be of sufficient duration to observe movement patterns. Identified nests shall be reported to DFG. The buffer area shall be fenced off from work activities and avoided until the young have fledged, as determined by a qualified biologist. Active nests found within the vicinity of the project area shall be monitored by the qualified biologist during all work activities to monitor bird behavior. Permittee shall perform at least two hours of pre-construction monitoring of the nest to characterize "normal" bird behavior. During work, should birds indicate unusual or distressed behavior that could be indicative of future nest abandonment, the biologist shall stop work immediately and consult DFG on how to proceed.

2.17 Wildlife Encounters. If any wildlife is encountered during the course of project activities, said wildlife shall be allowed to leave the area unharmed and on their own volition.

2.18 Agreement Does Not Authorize Take of Listed Species. The Permittee shall comply with all applicable state and federal laws, including the California and Federal Endangered Species Act. This Agreement does not authorize the take of any state or federally endangered listed species. Liability for any take or incidental take of such species remains the responsibility of the Permittee for the duration of the project. Any unauthorized take of listed species may result in prosecution and nullification of the Agreement.

2.19 Equipment Storage and Maintenance. Staging and storage areas for equipment, materials, fuels, lubricants and solvents, shall be located outside of the creek channel and banks. Stationary equipment such as motors, pumps, generators, compressors and welders, located within or adjacent to the creek shall be positioned over drip pans. Any equipment or vehicles driven and/or operated within or adjacent to the stream must be checked and maintained daily, to prevent leaks of materials that if introduced to water could be deleterious to aquatic life.

2.20 Equipment and materials within tree drip line. No heavy equipment, vehicular traffic, or storage piles of any construction materials shall be permitted within the drip line of any preserved tree.

2.21 Refueling of equipment. Refueling of construction equipment and vehicles shall not occur within 50 feet of any water body, or anywhere that spilled fuel could drain to a water body. Tarps or similar material shall be placed underneath the construction equipment and vehicles, when refueling, to capture incidental spillage of fuels. Equipment and vehicles operating in the project area shall be checked and maintained daily to prevent leaks of fuels, lubricants, or other liquids.

2.22 No trees shall be removed.

3. Compensatory Measures

To compensate for adverse impacts to fish and wildlife resources identified above that cannot be avoided or minimized, Permittee shall implement each measure listed below.

3.1 Creek Impacts. At least 30-days prior to construction, Permittee shall submit a plan identifying an offsite mitigation location to DFG for review and approval. The mitigation plan shall mitigate permanent stream impacts at a minimum of a 3:1 ratio. Permanent impacts are estimated to be 23 linear feet and 4581 square feet, accordingly, permanent mitigation will be at least 69 linear feet and 13,743 square feet.

3.2 Emergent Wetland. Prior to commencement of construction, Permittee shall offset 212 linear feet and 639 square feet of emergent wetland impacts through the purchase of 2 wetland credits at Burdell Ranch Wetland Conservation Bank in Marin County, California. Permittee shall provide the final Bill of Sale for the 2 wetland credits to DFG prior to commencement of construction.

CONTACT INFORMATION

Any communication that Permittee or DFG submits to the other shall be in writing and any communication or documentation shall be delivered to the address below by U.S. mail, fax, or email, or to such other address as Permittee or DFG specifies by written notice to the other.

To Permittee:

Jeffrey G. Jensen, California Department of Transportation
111 Grand Ave.
Oakland, Ca 94623
Fax: 510.622.8729
Email: jeffrey_jensen@dot.ca.gov

To DFG:

Department of Fish and Game
Bay Delta Region
7329 Silverado Trail
Napa, California 94558
Attn: Lake and Streambed Alteration Program – Melissa Escaron
Notification #1600-2012- 0139-R3
Fax (707) 944-5553

mescaron@dfg.ca.gov

LIABILITY

Permittee shall be solely liable for any violations of the Agreement, whether committed by Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents or contractors and subcontractors, to complete the project or any activity related to it that the Agreement authorizes.

This Agreement does not constitute DFG's endorsement of, or require Permittee to proceed with the project. The decision to proceed with the project is Permittee's alone.

SUSPENSION AND REVOCATION

DFG may suspend or revoke in its entirety the Agreement if it determines that Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, is not in compliance with the Agreement.

Before DFG suspends or revokes the Agreement, it shall provide Permittee written notice by certified or registered mail that it intends to suspend or revoke. The notice shall state the reason(s) for the proposed suspension or revocation, provide Permittee an opportunity to correct any deficiency before DFG suspends or revokes the Agreement, and include instructions to Permittee, if necessary, including but not limited to a directive to immediately cease the specific activity or activities that caused DFG to issue the notice.

ENFORCEMENT

Nothing in the Agreement precludes DFG from pursuing an enforcement action against Permittee instead of, or in addition to, suspending or revoking the Agreement.

Nothing in the Agreement limits or otherwise affects DFG's enforcement authority or that of its enforcement personnel.

OTHER LEGAL OBLIGATIONS

This Agreement does not relieve Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, from obtaining any other permits or authorizations that might be required under other federal, state, or local laws or regulations before beginning the project or an activity related to it.

This Agreement does not relieve Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, from complying with other applicable statutes in the FGC including, but not limited to, FGC sections 2050 et seq. (threatened and endangered species), 3503 (bird nests and eggs), 3503.5 (birds of prey), 5650 (water pollution), 5652 (refuse disposal into water), 5901 (fish passage), 5937 (sufficient water for fish), and 5948 (obstruction of stream).

Nothing in the Agreement authorizes Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, to trespass.

AMENDMENT

DFG may amend the Agreement at any time during its term if DFG determines the amendment is necessary to protect an existing fish or wildlife resource.

Permittee may amend the Agreement at any time during its term, provided the amendment is mutually agreed to in writing by DFG and Permittee. To request an amendment, Permittee shall submit to DFG a completed DFG "Request to Amend Lake or Streambed Alteration" form and include with the completed form payment of the corresponding amendment fee identified in DFG's current fee schedule (see Cal. Code Regs., tit. 14, § 699.5).

TRANSFER AND ASSIGNMENT

This Agreement may not be transferred or assigned to another entity, and any purported transfer or assignment of the Agreement to another entity shall not be valid or effective, unless the transfer or assignment is requested by Permittee in writing, as specified below, and thereafter DFG approves the transfer or assignment in writing.

The transfer or assignment of the Agreement to another entity shall constitute a minor amendment, and therefore to request a transfer or assignment, Permittee shall submit to DFG a completed DFG "Request to Amend Lake or Streambed Alteration" form and include with the completed form payment of the minor amendment fee identified in DFG's current fee schedule (see Cal. Code Regs., tit. 14, § 699.5).

EXTENSIONS

In accordance with FGC section 1605(b), Permittee may request one extension of the Agreement, provided the request is made prior to the expiration of the Agreement's term. To request an extension, Permittee shall submit to DFG a completed DFG

"Request to Extend Lake or Streambed Alteration" form and include with the completed form payment of the extension fee identified in DFG's current fee schedule (see Cal. Code Regs., tit. 14, § 699.5). DFG shall process the extension request in accordance with FGC 1605(b) through (e).

If Permittee fails to submit a request to extend the Agreement prior to its expiration, Permittee must submit a new notification and notification fee before beginning or continuing the project the Agreement covers (Fish & G. Code, § 1605, subd. (f)).

EFFECTIVE DATE

The Agreement becomes effective on the date of DFG's signature, which shall be: 1) after Permittee's signature; 2) after DFG complies with all applicable requirements under the California Environmental Quality Act (CEQA); and 3) after payment of the applicable FGC section 711.4 filing fee listed at http://www.dfg.ca.gov/habcon/ceqa/ceqa_changes.html.

TERM

This Agreement shall expire on December 31, 2015, unless it is terminated or extended before then. All provisions in the Agreement shall remain in force throughout its term. Permittee shall remain responsible for implementing any provisions specified herein to protect fish and wildlife resources after the Agreement expires or is terminated, as FGC section 1605(a)(2) requires.

AUTHORITY

If the person signing the Agreement (signatory) is doing so as a representative of Permittee, the signatory hereby acknowledges that he or she is doing so on Permittee's behalf and represents and warrants that he or she has the authority to legally bind Permittee to the provisions herein.

AUTHORIZATION

This Agreement authorizes only the project described herein. If Permittee begins or completes a project different from the project the Agreement authorizes, Permittee may be subject to civil or criminal prosecution for failing to notify DFG in accordance with FGC section 1602.

CONCURRENCE

The undersigned accepts and agrees to comply with all provisions contained herein.

FOR CALIFORNIA DEPARTMENT OF TRANSPORTATION

Jeffrey G. Jensen Signed for.
Office Chief

6/6/12
Date

FOR DEPARTMENT OF FISH AND GAME

CJ Weightman
Craig J Weightman
Acting Environmental Program Manager

6/12/12
Date

Prepared by: Melissa Escaron
Staff Environmental Scientist

Date Sent: May 23, 2012
Revision Sent: June 5, 2012

FOR DEPARTMENT USE ONLY				
Date Received	Amount Received	Amount Due	Date Complete	Notification No.
5/4/12	$ 482.75	$		1600-2012-0139-3

CK# 1000354778 Treasurer County of Marin

Escaron Thiem Jones

STATE OF CALIFORNIA
DEPARTMENT OF FISH AND GAME

NOTIFICATION OF LAKE OR STREAMBED ALTERATION

Complete EACH field, unless otherwise indicated, following the enclosed instructions and submit ALL required enclosures. Attach additional pages, if necessary.

Fish & Game
MAY 04 2012
Yountville

1. APPLICANT PROPOSING PROJECT

Name	Jeffrey Jensen		
Business/Agency	Caltrans, District 4, Oakland		
Street Address	111 Grand Ave		
City, State, Zip	Oakland, CA 94612		
Telephone	(510) 622-8729	Fax	(510) 286-6374
Email	jeffrey_jensen@dot.ca.gov		

2. CONTACT PERSON (*Complete only if different from applicant*)

Name	Stuart Kirkham		
Street Address	111 Grand Ave		
City, State, Zip	Oakland, CA 94612		
Telephone	(510) 286-5602	Fax	(510) 286-6374
Email	stuart_kirkham@dot.ca.gov		

3. PROPERTY OWNER (*Complete only if different from applicant*)

Name			
Street Address			
City, State, Zip			
Telephone		Fax	
Email			

4. PROJECT NAME AND AGREEMENT TERM

A. Project Name	Marin-Sonoma Narrows HOV Widening Project Contract A2, EA 04-2640G1
B. Agreement Term Requested	☑ Regular (*5 years or less*) ☐ Long-term (*greater than 5 years*)

C. Project Term		D. Seasonal Work Period		E. Number of Work Days
Beginning (*year*)	Ending (*year*)	Start Date (*month/day*)	End Date (*month/day*)	
2012	2013	11/01	11/30	120.00

NOTIFICATION OF LAKE OR STREAMBED ALTERATION

5. AGREEMENT TYPE

Check the applicable box. If box B, C, D, or E is checked, complete the specified attachment.		
A.	☑ Standard *(Most construction projects, excluding the categories listed below)*	
B.	☐ Gravel/Sand/Rock Extraction (*Attachment A*)	*Mine I.D. Number:* ______
C.	☐ Timber Harvesting (*Attachment B*)	THP *Number:* ______
D.	☐ Water Diversion/Extraction/Impoundment (*Attachment C*)	*SWRCB Number:* ______
E.	☐ Routine Maintenance (*Attachment D*)	
F.	☐ DFG Fisheries Restoration Grant Program (FRGP)	*FRGP Contract Number:* ______
G.	☐ Master	
H.	☐ Master Timber Harvesting	

6. FEES

Please see the current fee schedule to determine the appropriate notification fee. Itemize each project's estimated cost and corresponding fee. ***Note: The Department may not process this notification until the correct fee has been received.***

	A. Project	B. Project Cost	C. Project Fee
1	Marin-Sonoma Narrows HOV Widening Project Contract A2, EA 04-2640G1	$5,000,000.00	$4,482.75
2			
3			
4			
5			
		D. Base Fee *(if applicable)*	
		E. TOTAL FEE ENCLOSED	$4,482.75

7. PRIOR NOTIFICATION OR ORDER

A. Has a notification previously been submitted to, or a Lake or Streambed Alteration Agreement previously been issued by, the Department for the project described in this notification?

☐ Yes (*Provide the information below*) ☑ No

Applicant: ______ Notification Number: ______ Date: ______

B. Is this notification being submitted in response to an order, notice, or other directive ("order") by a court or administrative agency (including the Department)?

☑ No ☐ Yes (*Enclose a copy of the order, notice, or other directive. If the directive is not in writing, identify the person who directed the applicant to submit this notification and the agency he or she represents, and describe the circumstances relating to the order.*)

☐ *Continued on additional page(s)*

NOTIFICATION OF LAKE OR STREAMBED ALTERATION

8. PROJECT LOCATION

A. Address or description of project location.
(*Include a map that marks the location of the project with a reference to the nearest city or town, and provide driving directions from a major road or highway*)

The project is located on southbound US 101 in the City of Novato, on an approximate 0.3-mile strip from 200-ft south of the existing Novato Creek bridge north to the Franklin Avenue overhead crossing. Refer to Figure 1 of the attached supplement.

From Yountville, take SR29 south to SR12/121. Continue westward, following SR 121 south to SR37. Go west on SR37, then take US 101 past the Rowland Blvd. interchange, entering the project area.

☑ *Continued on additional page(s)*

B. River, stream, or lake affected by the project.	Novato Creek
C. What water body is the river, stream, or lake tributary to?	San Pablo Bay
D. Is the river or stream segment affected by the project listed in the state or federal Wild and Scenic Rivers Acts?	☐ Yes ☑ No ☐ Unknown
E. County	Marin

F. USGS 7.5 Minute Quad Map Name	G. Township	H. Range	I. Section	J. ¼ Section
Novato	03N	06W	18	

☐ *Continued on additional page(s)*

K. Meridian (*check one*) ☐ Humboldt ☑ Mt. Diablo ☐ San Bernardino

L. Assessor's Parcel Number(s)

The project is strictly located within Caltrans' Right of Way. Use of existing Marin County Flood Control District access roads may occur from parcels with APN 15317050; 15317034

☐ *Continued on additional page(s)*

M. Coordinates (*If available, provide at least latitude/longitude or UTM coordinates and check appropriate boxes)*

Latitude/Longitude	*Latitude:* 38.097 N	*Longitude:* 122.562 W	
	☐ Degrees/Minutes/Seconds	☑ Decimal Degrees	☐ Decimal Minutes
UTM	*Easting:* 538425.88	*Northing:* 4216634.546	☑ Zone 10 ☐ Zone 11
Datum used for Latitude/Longitude or UTM	☐ NAD 27	☑ NAD 83 or WGS 84	

9. PROJECT CATEGORY AND WORK TYPE *(Check each box that applies)*

PROJECT CATEGORY	NEW CONSTRUCTION	REPLACE EXISTING STRUCTURE	REPAIR/MAINTAIN EXISTING STRUCTURE
Bank stabilization – bioengineering/recontouring	☐	☐	☐
Bank stabilization – rip-rap/retaining wall/gabion	☐	☐	☐
Boat dock/pier	☐	☐	☐
Boat ramp	☐	☐	☐
Bridge	☑	☐	☐
Channel clearing/vegetation management	☐	☐	☐
Culvert	☐	☐	☐
Debris basin	☐	☐	☐
Dam	☐	☐	☐
Diversion structure – weir or pump intake	☐	☐	☐
Filling of wetland, river, stream, or lake	☑	☐	☐
Geotechnical survey	☐	☐	☐
Habitat enhancement – revegetation/mitigation	☐	☐	☐
Levee	☐	☐	☐
Low water crossing	☐	☐	☐
Road/trail	■	☑	☐
Sediment removal – pond, stream, or marina	☐	☐	☐
Storm drain outfall structure	☐	☐	☐
Temporary stream crossing	☐	☐	☐
Utility crossing : Horizontal Directional Drilling	☐	☐	☐
Jack/bore	☐	☐	☐
Open trench	☐	☐	☐
Other *(specify)*:	☐	☐	☐

10. PROJECT DESCRIPTION

A. Describe the project in detail. Photographs of the project location and immediate surrounding area should be included.

- Include any structures (e.g., rip-rap, culverts, or channel clearing) that will be placed, built, or completed in or near the stream, river, or lake.
- Specify the type and volume of materials that will be used.
- If water will be diverted or drafted, specify the purpose or use.

Enclose diagrams, drawings, plans, and/or maps that provide all of the following: site specific construction details; the dimensions of each structure and/or extent of each activity in the bed, channel, bank or floodplain; an overview of the entire project area (i.e., "bird's-eye view") showing the location of each structure and/or activity, significant area features, and where the equipment/machinery will enter and exit the project area.

Contract A-2 proposes to widen the existing unpaved median in the southbound direction of Route 101 in the City of Novato in Marin County. This project will extend the existing HOV lane from the Novato Creek Bridge to the Franklin Overhead and replace the existing thrie beam barrier with concrete barrier in the median. The Novato Creek Bridge (Bridge Number 27-0089L) will be widened 23.17-ft in the median to accommodate the southbound HOV lane and shoulder. The existing gap in the median between the two structures will be closed as a result of the widening.

The proposed bridge foundation consists of:

1. Abutment 1: Class 200 Alt X Driven Concrete Piles. Total 3 piles. Pile dimension is approximately 14-in x 14-in.
2. Bent 2 to Bent 5: 24-in diameter x 0.5-in thick Cast-in-Steel-Shell (CISS) Piles, CISS Piles are driven, the soil inside the steel pipe is removed and filled with concrete and bar reinforcing steel. 3 piles per bent for a total of 12 Piles.
3. Abutment 6: Class 200 Alt X Driven Piles. Total 3 piles. Pile dimension is approximately 14-in x 14-in.

The abutment area will be excavated to the bottom of footing elevation prior to driving the Class 200 Alt X Concrete Piles. Upon completion of the reinforcing steel placement, the forming work will be completed and secured to allow for concrete placement. The abutment diaphragm is 2.5-ft thick (footing width similar) and the length is approximately 25.5-ft. The calculated volume of Structure Excavation is approximately 20 CY each at Abut 1 and Abut 5. Structure backfill is approximately 14 CY at each abutment.

The CISS Piles at the bents will occupy a footprint area of approximately 38-ft2 and approximately 95-CY of soil will be removed from inside the CISS Piles. A catch platform supported on the CISS Piles will be constructed to contain the soil material removed inside the CISS Piles from falling into the creek.

☑ *Continued on additional page(s)*

B. Specify the equipment and machinery that will be used to complete the project.

Excavators, cranes, pile drivers, bulldozers, earth movers, compaction equipment, front loader, dump truck, back hoe, paver, graders, mixers.

☐ *Continued on additional page(s)*

C. Will water be present during the proposed work period (specified in box 4.D) in the stream, river, or lake (specified in box 8.B).	☑ Yes ☐ No (*Skip to box 11*)
D. Will the proposed project require work in the wetted portion of the channel?	☑ Yes (*Enclose a plan to divert water around work site*) ☐ No

11. PROJECT IMPACTS

A. Describe impacts to the bed, channel, and bank of the river, stream, or lake, and the associated riparian habitat. Specify the dimensions of the modifications in length (linear feet) and area (square feet or acres) and the type and volume of material (cubic yards) that will be moved, displaced, or otherwise disturbed, if applicable.

Twelve 24-in CISS piles will be installed in Novato Creek, resulting in a permanent loss of 37.7 square feet (0.001 acres) of channel bottom. 95 cubic yards of soil are anticipated to be removed from inside the CISS piles. Excavation of the abutments occurs at the top of bank, resulting in minor encroachment into 25 feet of the north and south banks of Novato Creek. Abutment fill does not result in permanent loss of stream channel or impede the flow of the creek.

☑ *Continued on additional page(s)*

B. Will the project affect any vegetation? ☑ Yes (*Complete the tables below*) ☐ No

Vegetation Type	Temporary Impact	Permanent Impact
Emergent Wetland	Linear feet: ____ Total area: ____	Linear feet: 211.6 ft Total area: 639 sq ft (0.015 ac)
	Linear feet: ____ Total area: ____	Linear feet: ____ Total area: ____

Tree Species	Number of Trees to be Removed	Trunk Diameter (range)
No tree removal		

☑ *Continued on additional page(s)*

C. Are any special status animal or plant species, or habitat that could support such species, known to be present on or near the project site?

☑ Yes (*List each species and/or describe the habitat below*) ☐ No ☐ Unknown

Potential Salt Marsh Harvest Mouse habitat, Central California Coast Steelhead migration habitat

☑ *Continued on additional page(s)*

D. Identify the source(s) of information that supports a “yes” or “no” answer above in Box 11.C.

USFWS Biological Opinion (81420-2008-F-1619-4); NMFS Biological Opinion (2007/08320).

☑ *Continued on additional page(s)*

E. Has a biological study been completed for the project site?

☑ Yes (*Enclose the biological study*) ☐ No

Note: A biological assessment or study may be required to evaluate potential project impacts on biological resources.

F. Has a hydrological study been completed for the project or project site?

☑ Yes (*Enclose the hydrological study*) ☐ No

Note: A hydrological study or other information on site hydraulics (e.g., flows, channel characteristics, and/or flood recurrence intervals) may be required to evaluate potential project impacts on hydrology.

12. MEASURES TO PROTECT FISH, WILDIFE, AND PLANT RESOURCES

A. Describe the techniques that will be used to prevent sediment from entering watercourses during and after construction.

Best management practices (BMPs) will be used as temporary erosion control during construction and will consist of fiber rolls, concrete wash outs, soil binder, temporary cover for stock piles, and construction entrances/exits to avoid vehicle tracking. Permanent erosion control will consist of rolled erosion control netting, compost blanket, and hydroseed at the embankment of Novato Creek

☑ *Continued on additional page(s)*

B. Describe project avoidance and/or minimization measures to protect fish, wildlife, and plant resources.

The following avoidance and minimization measures will be employed in order to avoid take of listed plants and animals and minimize harm to their habitats.

- To avoid take of SMHM and avoid loss of potential habitat for SMHM and Sebastopol meadowfoam, the wetlands in the east and north quadrants of the US 101 crossing of Novato Creek are identified as ESAs on the project plans and delineated with high-visibility Temporary Fence (Type ESA).
- Work within the banks of Novato Creek will be limited to June 15 – October 15 of any given year to avoid take of CCCS.
- To the maximum extent practicable, sheet piles and CISS piles will be installed when tides are low.

☑ *Continued on additional page(s)*

C. Describe any project mitigation and/or compensation measures to protect fish, wildlife, and plant resources.

All temporarily disturbed areas will be contoured and graded and revegetated to resemble preconstruction conditions to the maximum extent practicable.

Wetland mitigation credits from the Burdell Wetland Mitigation Bank will be used to offset the permanent loss of the emergent wetlands lining Novato Creek. Excess credits purchased from the Burdell Wetland Mitigation Bank used to offset the loss of wetlands from MSN A1 are sufficient to offset the impacts from A2. A copy of the A1 wetland mitigation credit purchase agreement from the Burdell Wetland Mitigation Bank is provided as Attachment 7.

☑ *Continued on additional page(s)*

13. PERMITS

List any local, state, and federal permits required for the project and check the corresponding box(es). Enclose a copy of each permit that has been issued.

A. Biological Opinions (USFWS; NMFS) ☐ Applied ☑ Issued

B. Clean Water Act Section 404 Individual Permit (USACE) ☑ Applied ☐ Issued

C. Clean Water Act Section 401 Water Quality Certification (RWQCB) ☑ Applied ☐ Issued

D. Unknown whether ☐ local, ☐ state, or ☐ federal permit is needed for the project. (*Check each box that applies*)

☑ *Continued on additional page(s)*

14. ENVIRONMENTAL REVIEW

A. Has a draft or final document been prepared for the project pursuant to the California Environmental Quality Act (CEQA), National Environmental Protection Act (NEPA), California Endangered Species Act (CESA) and/or federal Endangered Species Act (ESA)?

☑ Yes (*Check the box for each CEQA, NEPA, CESA, and ESA document that has been prepared and enclose a copy of each*)

☐ No (*Check the box for each CEQA, NEPA, CESA, and ESA document listed below that will be or is being prepared*)

☐ Notice of Exemption	☐ Mitigated Negative Declaration	☑ NEPA document (*type*): EIS
☐ Initial Study	☑ Environmental Impact Report	☐ CESA document (*type*):
☐ Negative Declaration	☑ Notice of Determination (*Enclose*)	☑ ESA document (*type*): BO
☐ THP/ NTMP	☐ Mitigation, Monitoring, Reporting Plan	

B. State Clearinghouse Number (*if applicable*)	2001042115
C. Has a CEQA lead agency been determined?	☑ Yes (*Complete boxes D, E, and F*) ☐ No (*Skip to box 14.G*)
D. CEQA Lead Agency	Caltrans, District 4
E. Contact Person	Yolanda Rivas
F. Telephone Number	(510) 286-6216

G. If the project described in this notification is part of a larger project or plan, briefly describe that larger project or plan.

Caltrans proposes to construct a roadway widening and high occupancy vehicle (HOV) lane project (referred to as Marin Sonoma Narrows or MSN) on U.S. 101 just south of SR 37 in the City of Novato (Marin County) to just north of the Corona Road in the City of Petaluma (Sonoma County). The MSN Project extends from postmile (PM) 18.6 and PM 27.6 in Marin County, and between PM 0.0 and PM 7.1 in Sonoma County. The proposed MSN A2 Contract project is one of seven independently funded contracts/phases.

☐ *Continued on additional page(s)*

H. Has an environmental filing fee (Fish and Game Code section 711.4) been paid?

☑ Yes (*Enclose proof of payment*) ☐ No (*Briefly explain below the reason a filing fee has not been paid*)

See Attachment 1 (CD-ROM) for the Filing of Notice of Determination including the environmental filing fee proof of payment.

Note: If a filing fee is required, the Department may not finalize a Lake or Streambed Alteration Agreement until the filing fee is paid.

15. SITE INSPECTION

Check one box only.

☐ In the event the Department determines that a site inspection is necessary, I hereby authorize a Department representative to enter the property where the project described in this notification will take place at any reasonable time, and hereby certify that I am authorized to grant the Department such entry.

☑ I request the Department to first contact (*insert name*) Stuart Kirkham at (*insert telephone number*) (510) 286-5602 to schedule a date and time to enter the property where the project described in this notification will take place. I understand that this may delay the Department's determination as to whether a Lake or Streambed Alteration Agreement is required and/or the Department's issuance of a draft agreement pursuant to this notification.

16. DIGITAL FORMAT

Is any of the information included as part of the notification available in digital format (i.e., CD, DVD, etc.)?

☑ Yes (Please enclose the information via digital media with the completed notification form)

☐ No

17. SIGNATURE

I hereby certify that to the best of my knowledge the information in this notification is true and correct and that I am authorized to sign this notification as, or on behalf of, the applicant. I understand that if any information in this notification is found to be untrue or incorrect, the Department may suspend processing this notification or suspend or revoke any draft or final Lake or Streambed Alteration Agreement issued pursuant to this notification. I understand also that if any information in this notification is found to be untrue or incorrect and the project described in this notification has already begun, I and/or the applicant may be subject to civil or criminal prosecution. I understand that this notification applies only to the project(s) described herein and that I and/or the applicant may be subject to civil or criminal prosecution for undertaking any project not described herein unless the Department has been separately notified of that project in accordance with Fish and Game Code section 1602 or 1611.

Carles Montero for Jeffrey G. Jensen
Signature of Applicant or Applicant's Authorized Representative

4/27/12
Date

CARLES MONTERO
Print Name

NOTICE OF DETERMINATION

TO: Office of Planning and Research
Post Office Box 3044
Sacramento, California 95812-3044

FROM: California Department of Fish and Game
Bay Delta Region
7329 Silveerado Trail
Napa, California 94558

SUBJECT: Filing of Notice of Determination in compliance with Section 21108 or 21152 of the Public Resources Code

PROJECT TITLE: Marin Sonoma Narrows HOV Widening Project

STATE CLEARINGHOUSE NUMBER: 2001042115

LEAD AGENCY: California Department of Transportation
CONTACT: Melanie Brent, (510) 286-5621

RESPONSIBLE AGENCY: California Department of Fish and Game
CONTACT: Melissa Escaron, Staff Environmental Scientist, (707) 339-0334

PROJECT DESCRIPTION / LOCATION: The California Department of Transportation (Caltrans) proposes to widen the Novato Creek Bridge into the existing Route 101 median to accommodate a southbound Route 101 High Occupancy Vehicle (HOV) lane widening. The proposed bridge widening will close the gap between the two existing bridges. The superstructure will be a Cast-in-Place concrete structure. The substructure will consist of concrete abutments, anchored by six driven concrete piles. The California Department of Fish and Game is executing a Lake and Streambed Alteration Agreement Number 1600-2012-0139-3 pursuant to Section 1602 of the Fish and Game Code to the project Applicant, Jeffrey Jensen/California Department of Transportation.

This is to advise that the California Department of Fish and Game as a Responsible Agency approved the project described above on June 12, 2012, and has made the following determinations regarding the above described project pursuant to section 15096 (i).

1. The project will not have a significant effect on the environment.
2. An EIR was prepared for this project pursuant to the provisions of CEQA.
3. Mitigation measures were made a condition of the approval of the project.
4. A Statement of Overriding Considerations was not adopted for this project.
5. Findings were not made pursuant to the provisions of CEQA.

This is to certify that a copy of the Environmental Impact Report prepared for this project is available to the general public and may be reviewed at: http://www.dot.ca.gov/dist4/envdocs.htm.

CJ Weightman

Craig J. Weightman
Acting Environmental Program Manager
Bay Delta Region

Date Received for Filing:________________________

AGREEMENTS

NATIONAL MARINE FISHERIES SERVICES (Biological Opinion)

AGREEMENTS

UNITED STATES FISH AND WILDLIFE SERVICE (Biological Opinion)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

IN REPLY REFER TO:
81420-2008-F-1619-4

APR 0 1 2009

Mr. Walter C. Waidelich Jr.
Federal Highway Administration
U. S. Department of Transportation
650 Capitol Mall, Suite 4-100
Sacramento, California 95814

Subject: Biological Opinion for the State Route 101 Marin-Sonoma Narrows High Occupancy Vehicle Widening Project, Marin and Sonoma Counties, California (Caltrans EA 264000) on the Threatened California Red-legged Frog and the Endangered Salt Marsh Harvest Mouse

Dear Mr. Waidelich:

This is in response to your June 18, 2008, request for formal consultation with the U.S. Fish and Wildlife Service (Service) on the proposed State Route 101 Marin-Sonoma Narrows High Occupancy Vehicle Widening Project, Marin and Sonoma Counties, California. Your request was received in this office via an electronic mail message on June 24, 2008, and included the request for formal consultation on the threatened California red-legged frog (*Rana aurora draytonii*) and the endangered salt marsh harvest mouse (*Reithrodontomys raviventris*). This document represents the Service's biological opinion on the effects of the proposed action on this listed species. This document is issued under the authority of the Endangered Species Act of 1973, as amended (16 U.S.C. § 1531 *et seq.*)(Act).

Protocol level surveys have not been completed in the action area due to scheduling issues and access problems for the soft bird's beak (*Cordylanthus mollis* ssp. *mollis*), endangered Baker's larkspur (*Delphinium bakeri*), endangered Sonoma alopecurus (*Alopecurus aequalis* var. *sonomensis*), endangered showy Indian clover (*Trifolium amoenum*), and endangered Contra Costa goldfields (*Lasthenia conjugens*). Suitable habitat is located within the action area for all of these listed plants. At this time, based on the preliminary and incomplete information provided to the Service, we concur that the proposed project may affect, but is not likely to adversely affect these five listed plant species. At a meeting with the Service on June 5, 2008, and in a letter to the Service dated June 18, 2008, the Federal Highway Administration (FHWA) stated that they will complete protocol level surveys within the action area for all of these listed species prior to groundbreaking and reinitiate consultation pursuant to section 7 if any or all of these taxa are found, with the understanding that the presence of any or all of these plants could lead to additional conservation measures that will be determined in conjunction with the Service, project delays, project redesign, or other significant effects on the State Route 101 Marin Sonoma Narrows project.

Based on our current knowledge regarding their distribution we have determined the proposed action is not likely to adversely affect the endangered Sebastopol meadowfoam (*Limnanthes vinculans*, endangered Sonoma County Distinct Population Segment of the California tiger salamander (*Ambystoma californiense*), or the endangered California clapper rail (*Rallus longirostris obsoletus*) due to lack of appropriate habitat in the action area.

This biological opinion is based on: (1) May 2008 Biological Assessment; (2) June 19, 2008, field review; (3) additional project information provided by the California Department of Transportation (Caltrans) on August 27, 2008; (4) miscellaneous correspondence and electronic mail concerning the proposed action between the Service and Caltrans, the Transportation Authority of Marin, and the Sonoma County Transportation Authority; and (5) other information available to the Service.

Consultation History

April 21, 2008 — The Service received a letter dated April 17, 2008, regarding a tentative meeting agenda and information on a proposed Least Environmentally Damaging Preferred Alternative for the Marin-Sonoma Narrows Project.

June 2, 2008 — The Service received a letter dated May 30, 2008, providing a summary of the May 7, 2008, meeting to discuss the proposed Least Environmentally Damaging Preferred Alternative for the Marin-Sonoma Narrows Project.

June 5, 2008 — The Service received an advance copy of the Biological Assessment for the proposed State Route 101 Marin-Sonoma Narrows High Occupancy Vehicle (HOV) Widening Project, Marin and Sonoma Counties, California, at a meeting with the FHWA and Caltrans. In the Biological Assessment, Caltrans determined that the proposed project *is likely to adversely affect* Burke's goldfields, Sonoma alopecurus, Contra Costa goldfields, Sebastopol meadowfoam, California red-legged frog, and the salt marsh harvest mouse; but *will not affect* the soft bird's beak, showy Indian clover, California tiger salamander, or the California clapper rail. The Service recommended that FHWA and Caltrans revise their current determinations to a *no effect* for the Sebastopol meadowfoam and a *may affect, not likely to adversely affect* for the five remaining listed plant species given their commitment to reinitiate consultation following completion of protocol surveys for these species within suitable habitat within the action area prior to construction. The Service also recommended that FHWA/Caltrans consider the presence of upland and aquatic habitat for California red-legged frog on the east side of State Route 101. This was based on the existing east-west connectivity provided by culverts and bridge crossings under State Route 101, particularly in Segment B. During the meeting Caltrans requested that the biological opinion first be issued as a draft for their review.

June 19, 2008 The Service attended a field review of the project with Caltrans, the Transportation Authority of Marin (TAM), the Sonoma County Transportation Authority (SCTA), and their consultants. Following the field review, the Service met with Caltrans, TAM, and SCTA to summarize the information requests that arose during the visit. The information requests were primarily associated with the need for more complete project description for activities at creek and river crossings.

June 24, 2008 The Service received a letter dated June 18, 2008, from the Federal Highway Administration (FHWA) requesting formal consultation for the proposed State Route 101 Marin-Sonoma Narrows High Occupancy Vehicle (HOV) Widening Project, Marin and Sonoma Counties, California. The letter was received via an electronic mail message. In the letter, FHWA requested formal consultation on the threatened California red-legged frog, the endangered salt marsh harvest mouse, and seven listed plants. It was noted in the letter that FHWA was requesting formal consultation on seven listed plants due to their incomplete plant surveys of the action area. FHWA also outlined their plan to reinitiate consultation on the individual listed plants following the completion of additional protocol plant surveys within the action area prior to ground disturbing activities.

June 25, 2008 The Service sent FHWA a request for additional information to adequately review the determination of the effects of the project on listed species (Service File: 81420-2008-I-1619-1). The information requested primarily focused on the need for additional project description information, particularly for those activities associated with drainage crossings. Other issues of particular focus included: the effects to salt marsh harvest mouse potential habitat under the Petaluma River Bridge; the acknowledgement of California red-legged frog habitat on the east side of State Route 101 in Segment B; the potential for California red-legged frog to occur in the more urban drainages of Segments A and C; appropriate compensation ratios to offset effects; and the previously mentioned recommended listed plant species determinations.

August 7, 2008	The Service received additional information dated August 5, 2008, from Caltrans in response to the June 25, 2008, information request and questions asked during the June 19, 2008, field visit. Of note, the Caltrans letter revised the California red-legged frog effects acreage to 206.94 acres (203.78 acres of permanent effects and 3.16 acres of temporary effects) and FHWA and Caltrans revised their effects determination for the Sebastopol meadowfoam to "no effect." Caltrans also revised their determination for soft bird's beak, Baker's larkspur, Sonoma alopecurus, and Contra Costa goldfields to a "may affect, not likely to adversely affect." Caltrans committed to completing protocol level surveys for these four listed plants within the action area prior to construction. FHWA will reinitiate consultation with the Service if a listed species is found in the action area or could otherwise be affected by the project.
August 13, 2008	The Service received a revised project description from Caltrans developed for the formal consultation process with the National Marine Fisheries Service via an electronic mail message.
August 27, 2008	The Service received a revised a complete project description from Caltrans via an electronic mail message.
August 29, 2008	The Service issued a draft biological opinion (file # 81420-2008-F-1619-2).
September 16, 2008	The Service met with FHWA, Caltrans, TAM, and SCTA to discuss the draft biological opinion.
September 19, 2008	The Service received additional project information, comments on the draft biological opinion, and September 16, 2008, meeting notes from Caltrans via an electronic mail message.
September 24, 2008	The Service received elevation contours for action area near the Petaluma Bridge from Caltrans via an electronic mail message.
September 26, 2008	The Service received comments on the draft biological opinion from FHWA.
October 9, 2008	The Service met representatives from Caltrans and CDFG to discuss the proposed geotechnical borings for the Petaluma Bridge portion of the proposed action.
December 2, 2008	The Service received project description information from Caltrans for the proposed geotechnical borings for the Petaluma Bridge portion of the

proposed action via an electronic mail message. A hardcopy of the information was received on December 3, 2008.

December 10, 2008 The Service received an electronic message from Caltrans outlining the proposed compensation language for the biological assessment. The statement proposed the fulfillment of appropriate California red-legged frog compensation through either purchase of credits at a conservation bank, establishment of a conservation easement, or fee title habitat acquisition. As stated in the message, a conservation easement would include a management plan and endowment. Caltrans referenced the Lawson's Landing property as a potential site for compensation through purchase on a conservation easement.

December 11, 2008 The Service received additional project description information from FHWA for the proposed geotechnical borings for the Petaluma Bridge portion of the proposed action and other outstanding Service information requests via an electronic mail message.

December 15, 2008 The Service received a map depicting the mean high water limits in the Petaluma River Bridge portion of the action area attached to an electronic mail message. This map was sent in response to the Service's request for information regarding available upland refuge for the salt marsh harvest mouse during high water events.

December 22, 2008 The Service issued a second draft of the biological opinion (file # 81420-2008-F-1619-3).

December 22, 2008 The Service issued a second draft of the biological opinion (file # 81420-2008-F-1619-3).

December 10, 2009 The Service received comments from Caltrans regarding the second draft of the biological opinion. The comments were attached to an electronic mail message as an undated letter that represented the consolidated comments of the SCTA, TAM, FHWA, and Caltrans.

March 5, 2009 The Service met with Caltrans and FHWA to discuss the second draft of the biological opinion (file # 81420-2008-F-1619-3).

March 27, 2009 The Service received additional information from Caltrans regarding proposed project scheduling and compensation phasing via an electronic message. The correspondence also included language related to contractor actions and compliance with the Act.

March 31, 2009 — The Service received project description revisions and requested terms and conditions revisions from Caltrans via an electronic mail message.

BIOLOGICAL OPINION

Description of the Proposed Action

FHWA and Caltrans propose to construct HOV lanes on State Route 101 from just south of State Route 37 in the City of Novato to just north of Corona Road in the City of Petaluma. These transportation improvements also will include construction and modification of interchanges as well as the establishment of a new frontage road. According to Caltrans, the project is intended to reduce congestion and improve mobility while providing an incentive for commuters to use buses, carpools, or vanpools for peak period travel, and to improve freeway operations including providing safe access to and from State Route 101. The project will be referred to in the remainder of this biological opinion as the Marin-Sonoma Narrows Project.

Caltrans is in the process of developing bridge designs for the Marin-Sonoma Narrows Project and not all of the project description has been fully developed. According to the May 2008, Biological Assessment, additional design engineering will be completed for Segments B and C when funding becomes available for those segments. FHWA will reinitiate consultation with the Service if the action is subsequently modified in a manner that causes an effect to the listed species that was not considered in this project description.

Construction Schedule and Funding

The proposed project is divided into three project segments (A, B, and C) that are further divided into sub-segments (such as A1 and B2). The overall project will be completed in two primary construction phases. Construction Phase 1 will include segments A1, B2, and B3. Construction Phase 2 will include all remaining project segments.

Construction in Phase 1 is scheduled to begin in Fiscal Year 2010/2011 (between July 1, 2010, and June 30, 2011). Construction in Phase 2 is scheduled to begin in Fiscal Year 2014/2015 (between July 1, 2014, and June 30, 2015).

The activities associated with the sub-segments are described as follows:

1. A1 consists of constructing approximately 1.5 miles of the southbound HOV lane between State Route 37 and Rowland Boulevard in Novato (Segment A), and approximately 4 miles of the northbound HOV lane between State Route 37 and Atherton Avenue in Segments A and B.

2. B1 consists of converting the existing Redwood Landfill overcrossing to a full interchange, including the construction of associated frontage roads in Segment B.

3. B2 consists of constructing a new Petaluma Boulevard South interchange including associated frontage roads in Segment B.

4. B3 is fully funded as well and consists of constructing a new mainline bridge at San Antonio Creek in Segment B. This segment would shift US-101 traffic to the west and allow the existing highway to be converted to a frontage road.

5. B4, not yet fully funded, would replace the Petaluma River bridges in Segment B and northbound State Route 116 bridge in Segment C. The southbound State Route 116 bridge, also in Segment C, would be widened as part of this phase.

Additional sub-phases are contemplated and will be defined and advanced as funding is identified.

Two upland and two aquatic geotechnical investigation bores under the Petaluma River Bridge will likely occur prior to construction of the three project segments. The bores are expected to be completed in approximately one week. Scheduling will be weather dependent to avoid boring activities and access of equipment in and out of the action area during rain and when the ground is wet. Additional borings will be accessed from the State Route 101 median and performed in areas that are not identified as listed species habitat or having the potential to adversely affect listed species.

Project Components

Caltrans has divided the approximately 16.1 mile long Marin-Sonoma Narrows Project into three segments, based on the activities occurring in each distinct segment and the construction schedule. The segments are labeled from south to north as A, B, and C. Segments A and C consist of the existing freeway in the cities of Novato and Petaluma, respectively. Segment B is the existing expressway between the two cities. The project activities are discussed by segment as follows. Caltrans has characterized the planned activities in each segment as those that will and will not affect aquatic habitat for listed species.

Segment A

<u>HOV Lane Construction</u>. The existing Segment A includes the existing State Route 101 roadway from State Route 101/State Route 37 Interchange and north of the Atherton Avenue Interchange through the City of Novato. The existing Segment A roadway consists of six 12-foot wide lanes (three in each direction) with 10 foot outside shoulders and 5 foot inside shoulders. The existing non-paved median between the opposite lanes of travel vary in width from 28 to 45 feet and include a double thrie-beam barrier.

According to Caltrans, the majority of the existing drainage features in the existing roadway right-of-way will remain with only minor modifications due to a lack of drainage issues.

Caltrans proposes to widen the Segment A roadway by adding a new HOV lane to each direction of travel. These new 12 foot lanes will be added to the median and will separated by a concrete barrier and varying-width inside shoulders. The new median width from the start of the project to the Atherton Avenue interchange will vary between 22 to 28 feet and will be paved. The median between the Atherton Avenue interchange and Olompali State Historic Park will vary between 28 to 44 feet with 10 foot minimum paved shoulders with the remainder unpaved.

To construct the HOV lanes, heavy equipment would be used to excavate the existing material to sub-grade for the proposed structural section. Excavated material would be tested for the presence of aerially deposited lead (ADL) and if high levels are found, Caltrans would require that the material be handled in compliance with state and federal requirements. According to an August 5, 2008 letter from Caltrans, recycled roadbed material will only be placed on areas that are classified as permanently disturbed by project activities, including material that will be used as fill or base material under the roadway. Material that exceeds the threshold for re-use would be hauled off-site to a Service-approved and/or Type 1 facility. Existing soil under the existing roadway will be used as fill. Temporary impact areas will not have stockpiles.

According to their August 5, 2008 letter, Caltrans would not place any stockpiles of material containing ADL near any sources of run-off. The contractor will place and cover stockpiles of ADL material on 0.33 millimeter thickness plastic sheeting. These stockpiles would not be placed in environmentally sensitive areas and in addition to be covered with plastic, they piles would be surrounded by either hay bales or wattles to protect them from runoff.

Dump or haul trucks would transport borrow and aggregate materials for placement and compaction. Water trucks would spray water on excavated material to maintain control of dust. Sub-base and base material would be compacted and leveled using vibratory rollers and other standard compacting equipment. Aggregate material would be placed in multiple lifts set at a maximum depth of 0.5 feet. The concrete median barrier would be placed via a concrete slip form machine. Asphalt concrete material would be hauled onto the site, and the asphalt would then be spread with a paving machine and rolled with a roller for compaction.

Sub-Grade Correction at the Rowland Interchange. According to Caltrans the existing sub-grade at the Rowland Interchange is failing due to poor soil conditions created by soft clay (Bay Mud) that is not able to support the existing roadbed.

Caltrans plans to remove 11 feet of existing fill and replace it with a lightweight fill material to stabilize the roadbed.

Caltrans will correct the sub-grade with a two-stage construction operation. Temporary lanes would be constructed to the outside of the mainline and traffic would be shifted. These new temporary lanes would require a temporary realignment of the northbound onramp at the Rowland Interchange. Once traffic is shifted, one half of the mainline would be dug out with excavation equipment and temporary retaining walls would be put in place to shore the excavation. Lightweight fill material would be placed 0.5 foot lifts and compacted with rollers. After the sub-grade has been reached and compacted, base and sub-base aggregates would be trucked and placed in 0.5 foot lifts and compacted with rollers. Asphalt concrete (AC) material would be hauled onto the site and the asphalt will then be spread with an AC paving machine and rolled with a roller for compaction. After the first stage is complete, traffic would be moved over to the median and the same process would be repeated for the outside lanes and shoulders. After the existing fill has been replaced, centerline and roadway edges would be re-striped.

Roadway Resurfacing and Striping. Caltrans plans to repair deteriorated localized sections of the existing pavement and put down an overlay on all of the existing six lanes of pavement to prevent reflective cracking and extend the service life of the roadway by 20 years. The centerline and roadway edges would be re-striped following rehabilitation.

Damaged roadway would be removed with a grinder or excavation equipment. The excavated material would be recycled and reused as embankment material for the fill section, or removed off-site. The dig-out areas would be patched with material and overlayed and striped during the rehabilitation process.

Culvert Improvements. According to Caltrans, the existing roadway drainage is conveyed by a depressed median to drainage inlets at low points in the median. There are thirty-five cross culverts that convey storm water to swales along the outside which then drain to adjacent water courses.

Caltrans proposes to replace the depressed median with new HOV lanes, shoulders, and a median barrier. The new roadway would sheet flow drainage towards the outside shoulders, away from the median. Through mainline horizontal curves when sheet flow drainage is directed towards the median due to super elevation, 27 existing drainage inlets would be reconfigured at the median. Cross culverts that are not needed would be abandoned in place and plugged. Caltrans determined that some of the cross culverts would need to be replaced due to deterioration or the need for a larger culvert.

After new cross-culvert construction has been completed, repaving methodology will be similar to those described for roadway rehabilitation. Existing cross culverts that are to be abandoned would be capped with concrete at each end or filled with either a concrete slurry or sand.

California Highway Patrol (CHP) Pullouts, HOV Bypass Lanes, Ramp Metering. The addition of HOV Lanes would require the addition of HOV bypass lanes, CHP pullouts and ramp metering.

Caltrans proposes to widen existing on-ramps for HOV bypass lanes, CHP pullouts, and install ramp-metering infrastructure at all four of the existing interchanges in Segment A (State Route 37, Rowland, DeLong, and Atherton). An additional 12 foot lane would be added to the interchange ramps. The CHP pull outs would be 15 feet wide and 100 feet long. The length of the bypass lane will vary by ramp and all on-ramps within the action area would have HOV bypass lanes, CHP pullouts, and ramp-metering infrastructure.

The ramp widening would consist of importing fill material and placing in multiple lifts set at a maximum depth of 0.5 feet. The fill material would then be compacted between lifts until the sub-grade depth is met. Dump or haul trucks would transport aggregate materials for placement and compaction. Asphalt concrete material would be hauled to the site and then spread with an AC paving machine and rolled with a roller for compaction. Before AC is placed, electrical conduit would be trenched and placed for the ramp metering system infrastructure.

Sound Walls. Caltrans plans to erect sound walls at four locations within Segment A. The combined length of the four walls will be 4,770 feet.

The sound wall locations would be cleared and bulldozed to meet finished grade for the sound wall footing. The foundation type would depend on soil type. After the foundation is complete, a pile cap would be formed up with wood forming, steel would be placed within the cap, and concrete would be poured to complete the pile cap. If the sound wall is within 30 feet of the edge of travel way, the sound wall is required to be placed on a concrete protective barrier. Once the pile cap or the concrete barrier is in place, the concrete masonry blocks would be set and mortared to the top of the barrier or pile cap until the wall is complete.

Retaining Walls. Caltrans plans to construct retaining walls to reduce the widening needed to construct additional lanes at three existing ramps (the State Route 101/State Route 37 Southbound Connector, the DeLong Southbound On-Ramp, and the South of Rowland Southbound On-Ramp).

The retaining wall locations would be cleared and excavated with excavation equipment to reach grade for the retaining wall footing. Once grade is met, the footing would be formed, steel would be placed and the concrete would then be poured for the footing.

After the footing is poured, the same process would be used to build the stem wall. After the wall is complete, the excavated material would be backfilled and compacted.

In instances where a retaining wall is included in the design as a means of reducing the project footprint in the vicinity of sensitive resources, the following construction techniques and equipment will be used:

1. Retaining walls with spread footings: This work involves excavating through the existing shoulder backing to the substrate below using excavators and/or backhoes. The retaining walls would be constructed before the shoulder widening takes place and may involve the use of a crane from the roadway.

2. Retaining walls with pile foundations: This work involves constructing a retaining wall foundation which could include driven concrete or steel piles, cast-in-drilled-hole (CIDH) piles, or cast-in-steel shell (CISS) piles. If CIDH or CISS piles are used, a drill auger would be used to remove soil at the piles location.

3. Mechanically Stabilized Earth (MSE) retaining walls: This work involves constructing a retaining wall without a foundation. Precast concrete panels would be placed at the bottom of the wall to create the wall face. Reinforcing steel would connect to the wall panels and extend behind the wall. Fill would be placed in layers on top of the reinforcing steel and compacted in place. This procedure would be repeated until the wall is built up to the elevation of the highway.

If subsurface water is encountered during the drilling or excavation, the excavation will be de-watered under the direction of their Best Managmeent Practices (BMPs) of the Storm Water Pollution Prevention Plan (SWPPP). Residues may include aerially deposited lead material. If the residue exceeds the level of lead standards, the material would be deposited off-site at an approved location.

Structures. According to Caltrans, roadway widening would require modification to existing structures such as railing, sound walls, deck treatment, and bridges. Caltrans describes the proposed bridge work as follows.

> *Novato Creek Bridge*. There are two existing Novato Creek Bridges that are only wide enough to accommodate the three lanes of north or southbound traffic plus 5 foot inside shoulders and 8 to 10 foot outside shoulders. Both of the existing 192 foot long structures were built in 1974 and consist of a five-span continuous reinforced concrete T-beam superstructures on 18 inch +/- octagonal pre-stressed concrete pile bents (total 44 octagonal bent piles) and diaphragm type abutments on reinforced concrete piles.

Caltrans proposes to widen and connect the Novato Creek Bridges in the median to allow for the two HOV lanes and 10 foot shoulders. It is also proposed to replace the existing bridge barriers with current standard barriers. The widening of the existing bridges would include the construction of a new cast-in-place reinforced concrete T-beam superstructure, including new concrete bent caps and abutments. The substructure would consist of Class 140 driven pre-cast concrete piles at the abutments and driven CISS piles at the bents. The location and bearing for the new abutments and bents would match with the alignments of the existing abutments and bents. It is anticipated that four-2 foot diameter new CISS piles would be required per bent for a total of 16 piles for the 4 bents.

Caltrans would widen the Novato Creek Bridges by constructing and connecting the right and left parallel bridge structures to the median side of each of the existing bridge structures and closing the median gap. The existing bridge barrier would be replaced with current standard barriers. A portion of the existing overhang in the median would be removed. Access to the existing channel would be required for construction. (In Phase A1, the existing northbound structure would be widened to provide for the northbound HOV lane and shoulders. The complete widening and the ultimate connection of the northbound and southbound structures will not be completed until a future project phase.)

The construction of the CISS piles would likely include driving down the steel pipe pile into ground, removing the soil inside the steel pile, inserting bar reinforcing steel (rebar cages) into the steel pipe and filling the remaining void inside the steel pipe with concrete using a concrete pump truck. The piles would extend into the superstructure.

Existing pilings that need to be removed during construction or demolition (e.g. those in conflict with new bridge or falsework) would be removed by commonly practiced methods. These include pulling by crane or through use of vibratory methods. It may also be possible that some existing pilings can be left in place and cut off below ground.

According to Caltrans, temporary supports also known as falsework would be required to construct the superstructure. The falsework is used to support construction loads such as bar reinforcing steel, wet concrete and live loads (construction crew, equipment, etc). According to Caltrans, the falsework system usually consists of a series of falsework bents placed in the creek at certain intervals with steel beams (falsework stringers) spanning across the falsework bents. Plywood deckings are then placed between the steel beams to allow for the placement of bar reinforcing steel and forming/constructing the superstructure. The falsework bents may be constructed using braced steel or timber posts supported on timber pads placed on top of existing ground or supported on timber or steel piles driven into the ground depending on the bearing capacity of the soil. Falsework piles may be completely removed or cut below the ground elevation and left in place.

Types of hammers used in piling installation would conform to Caltrans Standard Specifications (49-1.05). Impact hammers would be steam, hydraulic, air or diesel hammers sufficient to drive piles at a penetrations rate of not less than 1/8 inches per blow at the specified nominal resistance. Vibratory hammers would not be used for installation of permanent piles unless shown on the plans or specified in the special provisions. Caltrans might use vibratory hammers to install shoring, coffer dam or falsework piles unless otherwise restricted in the Contract Special Provisions or as listed in permits.

Once the falsework is complete the reinforced concrete T-beam superstructure would be constructed. After completion of the structure, all temporary falsework material would be removed, the creek banks would be stabilized and erosion control BMP's would be placed.

The Novato Creek Bridge work will be located approximately 28 meters east of potential salt marsh harvest mouse habitat. In their August 5, 2008 letter, Caltrans maintained that the bridge work will be accessed from the opposite side of the existing bridge and this pickleweed habitat would be effectively avoided.

Storm Water Quality Systems and Construction Site BMPs. The proposed project would incorporate bio-filtration strips, swales, and Austin sand filters to receive storm water discharges from the highway or other impervious surfaces. The project will also likely include off-site storm water treatment.

Bio-filtration strips would be located at the base of fill slopes and graded to flow perpendicular to the mainline. Bio-filtration swales would also be located at the base of fill slope and convey water parallel with the main line. Swales would be a graded trapezoidal channel with side slopes of 4:1 or flatter.

Bio-filtration strips and swales have the same means of construction. A backhoe and excavator would be used to excavate and set grade for the channel. After the channel is graded, it would be planted with a vegetative species that has filtration properties.

An Austin sand filter is a two-chamber device with the first chamber used to settle out larger sediment and meter flow into the second chamber. The second chamber is a sand media filter that removes the finer particulates from the influent. The treated effluent is then discharged back into the drainage system.

Construction Site BMPs. To maintain water quality during construction, Caltrans would implement BMPs to reduce unnecessary water quality impacts. The following methods and practices would be implemented:

1. Earth dikes/drainage swales and lined ditches
2. Outlet protection/velocity dissipation devices
3. Check dams
4. Silt fencing with maintenance openings
5. Fiber rolls
6. Concrete washouts
7. Drainage inlet protection
8. Construction entrance/exit protection

Staging Locations. Staging locations would be used for temporary storage of heavy construction equipment and construction materials, equipment maintenance shops, stockpile areas, and field offices. The primary staging area in Segment A would be located within the interchange at the South Novato overcrossing. According the Caltrans project description, areas that are located within the State Right-of-Way and quantified as within the project area of effect may also be used, subject to approval of the contractor submitted SWPPP. Contractors may independently seek off-site staging locations. Off-site staging locations will be subject to the requirements of resource agencies and permits will be the responsibility of the contractor.

Segment B

Nonstandard Shoulders, Vertical and Horizontal Curves. The existing State Route 101 roadway in Segment B is a four-lane expressway with two 12 foot wide lanes in each direction. Most of the existing roadway in this segment does not meet current horizontal alignment, vertical profile and sight distance requirements for the 70 mile per hour corridor design speed. The shoulders are variable width, with the outside shoulders varying from 5 to 8 feet and the inside shoulders varying from 2 to 4 feet. The non-paved median varies in width from 11 to 51 feet and contains a double thrie-beam barrier.

Caltrans plans to improve the Segment B roadway design by upgrading the existing nonstandard shoulders, constructing a HOV lane in each direction, and bringing vertical and horizontal curves to current standards. The proposed project design would include 10 foot shoulders with a concrete median barrier. Nonstandard vertical and horizontal curves would be brought to current standards to meet stopping sight distance requirements. Within the concrete medians, Type S barriers for wildlife crossing would be installed every 20 feet and Type M wildlife crossings would be installed every 0.25 miles. Type S barriers are a type 60 concrete barrier with a 6 inch diameter opening at the base of the barrier for small animal passage. Type M wildlife crossings are a type 60 concrete barrier with a 2-foot break in the barrier, with the break protected by a thrie-beam guard rail to deflect vehicle traffic.

Caltrans proposes to realign the roadway mainline to correct vertical and horizontal curves throughout Segment B.

The proposed horizontal alignment would shift from the existing alignment throughout Segment B to correct nonstandard curves. Approximately 75% of the existing alignment would be reconstructed with a new structural section. The additional 25% of Segment B would utilize the existing roadway alignment and would be widened in the median for HOV lanes and shoulders.

According to Caltrans, the proposed vertical alignment would correct nonstandard curves. The locations of the profile corrections are from approximately 229 feet south of the Redwood Landfill OC to approximately 3280 feet north of the OC; from approximately 656 feet south of San Antonio Creek to Gambini Road, and from South Kastania Road to the Petaluma River Bridge. Through these areas the proposed profile would shift the new roadway up to 28 feet above or up to 24 feet below the existing roadway.

Due to the rolling terrain in Segment B, Caltrans will use two methods for the construction of the proposed roadway realignment. When the alignment is shifted through a hillside, material would be cut from the hillside until finished grade is met. Typical equipment to be used for this method would include excavators, bulldozers, earth movers, and compaction equipment. Excess fill cut from other locations within the project would be used in areas where the roadway needs to be built up. This material would either be hauled in by trucks for long hauls, or from earth moving equipment for short hauls. Once the fill material is hauled in, it will be placed in multiple lifts set at a maximum depth of 0.5 feet. Fill material would then be compacted between lifts until the sub-grade depth is met. Dump or haul trucks would then transport aggregate materials for placement and compaction. Asphalt concrete material will be hauled to the site and then spread with an AC paving machine and rolled with a roller for compaction.

Upgrade Expressway to Freeway with the Addition of Frontage Roads. Residents, ranches, and other land uses are only directly accessible off of State Route 101 in Segment B. There are currently 31 driveways and seven at-grade intersections that connect directly to State Route 101. Also in Segment B there is no other north-south bicycle passage other than on the shoulder of State Route 101. These conditions make the State Route 101 through Segment B an expressway rather than a freeway. Caltrans proposes to upgrade Segment B to a freeway by constructing off-ramps to new frontage roads. Local access and bicycle traffic will be moved to frontage roads or a dedicated bicycle and pedestrian facility.

Therefore the proposed project will convert the existing expressway in Segment B to an access-controlled freeway. Converting the existing expressway would require reconfiguring the existing Landfill Overcrossing into an interchange, reconfiguring the Petaluma Boulevard South interchange, and building a frontage road system to maintain access to intersecting roadways and adjacent parcels, as well as replacing bicycle and pedestrian access. Bicycle access will be moved to frontage roads or a dedicated bicycle and pedestrian facility.

As previously described, due to the rolling terrain in Segment B, Caltrans will use two methods for the construction of the proposed roadway realignment. When the alignment is shifted through a hillside, material would be cut from the hillside until finished grade is met. Typical equipment to be used for this method would include excavators, bulldozers, earth movers, and compaction equipment. Excess fill cut from other locations within the project would be used in areas where the roadway needs to be built up. This material would either be hauled in by dump trucks for long hauls, or from earth moving equipment for short hauls. Once the fill material is hauled in, it will be placed in multiple lifts set at a maximum depth of 0.5 feet. Fill material would then be compacted between lifts until the sub-grade depth is met. Dump or haul trucks would then transport aggregate materials for placement and compaction. Asphalt concrete material will be hauled to the site and then spread with an AC paving machine and rolled with a roller for compaction.

Culvert Improvements. As described for Segment A, existing drainage in Segment B is conveyed by a depressed median to drainage inlets at low points in the median. Cross culverts convey the storm water to swales along the outside which drain to adjacent water courses.

The roadway realignment would replace the depressed median with new HOV lanes, shoulders, and a median barrier. These improvements would cause the sheet flow to drainage towards the outside shoulders, away from the median. Through mainline horizontal curves, where sheet flow drainage is directed towards the median due to super elevation, existing drainage inlets would be reconfigured at the median. Cross culverts that are no longer needed would be abandoned in place.

Caltrans determined that the majority of culverts are still in a state of good repair and function adequately. Some systems will require replacement due to deteriorated conditions or resizing to handle additional flow.

As described for culvert work in Segment A, Caltrans determined that some of the cross culverts would need to be replaced due to deterioration or the need for a larger culvert.

Caltrans plans to abandon unneeded culverts in place. The extension of existing box culverts may require accessing creeks.

According to an August 5, 2008 Caltrans letter, Caltrans is considering adding cross culverts, where feasible, in Segment B specifically to provide wildlife passage under State Route 101.

After new cross-culvert construction has been completed, repaving methodology will be similar to those described for roadway rehabilitation. Existing cross culverts that are to be abandoned would be capped with concrete at each end and filled with either a concrete slurry or sand.

Recurring Flooding and Culvert Improvements. Caltrans plans to replace or upgrade the majority of the drainage facilities through Segment B due to their age, capacity or condition. There are two locations, San Antonio Creek and Gunn Lane, where roadway flooding has been a problem.

Caltrans plans to realign and raise the road profile through San Antonio Creek and near Gunn Lane to alleviate recurring flooding and replace the majority of the existing culvert systems due to the proposed realignment or deteriorated condition. Cross culverts would be sized to pass design-year flows with a minimum diameter of 24 inches for maintenance and approximately 79 new cross culverts will be added.
Caltrans plans to address the flooding issue by building a fill section with a higher profile through the area. This would be constructed using the previously described methods for constructing nonstandard shoulders, vertical and horizontal curves. During construction of the new fill sections, cross-culverts would be placed as the fill section is being built. Existing drainage systems that only require extensions or reconfigurations would be installed as previously described for Segment A.

Retaining Walls. Caltrans plans to construct retaining walls to avoid a historic residence near Kastania Road, trees on the new frontage road at the Landfill Interchange, and salt marsh harvest mouse habitat near the northbound off-ramp at the Petaluma Boulevard, South Interchange.

The retaining walls near Kastania Road and the Landfill Interchange locations would be one of the three types described for Segment A.

The retaining wall near the Landfill Interchange would be a soil nail or tieback retaining structure. Soil would be excavated from the top of the wall down approximately 5 to 10 feet to the first tieback or soil nail location. Horizontal drill equipment would drill holes along the length of the wall and a post tensioned tieback tendons or soil nails would be installed and grouted in place. If post tensioned tiebacks are used, a reinforced concrete whaler would be constructed at the tieback location horizontally across the wall. Tendons would be post tensioned and locked against the concrete whaler. In either case, reinforcing steel would be placed in front of the excavation and shotcrete would be placed against the excavated hillside. If soil nails are used, they would be locked against steel plates. The hillside would then be excavated to the next tieback or soil nail location and the process would be repeated to reach the bottom of the wall. A reinforced concrete or shotcrete facing would then be constructed to complete the wall.

Utility Relocations. The project design in Segment B would require a significant number of intricate utility relocations. According to Caltrans, the exact location and condition of the existing facilities would not be determined until positive location (potholing) work has been completed. As the designs of these relocations proceed, the remaining service life of the existing individual facilities would be calculated and a cost/benefit analysis would be performed to determine the feasibility of their retention. If retention appears to be the preferred alternative, encroachment exceptions would be requested on a case-by-case basis. Otherwise, the utility will be relocated at a location within the project footprint. Depending on the nature of the utility relocations, FHWA may reinitiate Section 7 consultation to address any additional effects to listed species not described in this biological opinion.

Structures. The proposed project includes modifications to several bridges. Of these, the San Antonio Creek Bridge (mainline), San Antonio Creek Bridge (frontage road), and the Petaluma River Bridge all cross over bodies of water, and are discussed below. Although bridge designs have not been determined, Caltrans stated in their August 5, 2008, letter that the described action area is based on the alternative with the largest footprint.

San Antonio Creek Bridge (mainline). The existing San Antonio Creek Bridges are located within an area of recurring flooding. The new San Antonio Creek Bridge would be built on a realigned portion of State Route 101, west of the existing highway, with a raised profile. The bridge is proposed as a cast-in-place concrete pre-stressed box girder with reinforced concrete bent caps and abutments. The existing northbound structure would be used for a new frontage road creek crossing and the southbound structure would be removed.

Two structure alternatives are proposed for the new bridge. Alternative 1 is a five-span structure, 634.8 feet long by 115.2 feet wide, with 4 columns per bent for a total of 16 columns for the 4 bents. Alternative 2 is a three-span structure, 428.1 feet long by 115.2 feet wide, with 4 columns per bent for a total of 8 columns for the two bents. The bridge layout for Alternative 1 and Alternative 2 are similar except that Alternative 2 includes a Mechanically Stabilized Earth (MSE) wall at abutment 1 which would result in a shorter bridge. The substructure would consist of reinforced concrete columns and abutments supported on a concrete pile cap with driven pre-cast concrete piles. The column size is expected to be approximately 5.5 feet in diameter. Each column footing size is approximately 22 by 22 by 6 feet deep. There would be approximately 25 piles per column footing. The dimensions of the pre-cast concrete pile are approximately 1.24 x 1.24 feet.

It is anticipated that the construction footprint would extend 50feet beyond each side of the edge of bridge deck. Access to the existing channel would be required for construction.

To construct the new bridge, soil at the abutment locations would be re-graded to raise the profile. If Bridge Alternative 2 is selected, the MSE wall would be constructed as the profile is raised at Abutment 1. After the profile is raised at the abutment locations, the precast concrete piles would be driven into the ground. A reinforced concrete footing would be constructed on top of the piles. Then, a reinforced concrete abutment would be constructed on the pile cap.

The contractor would excavate soil at the column footing locations. If water is anticipated at the footing elevations, cofferdams consisting of driven sheet pilings would be construction around the perimeter of the footings. If needed, cofferdams would be approximately 32 by 32 feet per column footing. After cofferdams are placed, soil would be excavated to the footing elevation. The column footing piles would then be driven with an impact hammer. If water is encountered, it would be pumped from the cofferdam to trucks or a sediment basin permitted by the Water Quality Control Board. A lean concrete seal course might be placed to minimize water intrusion. Reinforced concrete pile caps and columns would be constructed at each column footing.

To construct the new superstructure, temporary supports also known as falsework would be required. The falsework is used to support construction loads such as bar reinforcing steel, wet concrete and live loads (construction crew, equipment, etc.). The falsework system usually consists of a series of falsework bents placed at certain intervals with steel beams spanning across the falsework bents. Plywood decking is then placed between the steel beams to allow for the placement of bar reinforcing steel and forming/constructing the superstructure. The falsework bents might be constructed using steel or braced timber posts supported on timber pads which have been placed on top of existing ground or steel piles that have been driven into the ground depending on the bearing capacity of the soil. Once the falsework is complete the reinforced concrete box girder superstructure would be constructed. After completion of the structure, all temporary cofferdam and falsework material would be removed, the creek banks would be stabilized and erosion control BMP's would be placed. Falsework piles may be completely removed or cut below the ground elevation and left in place.

Bridge removal work would consist of breaking and removing the existing concrete structure. Over land, the bridge would be dropped in sections onto filter fabric or similar material and removed. Over the creek, the contractor would use approved BMP's to protect the creek from falling debris.

San Antonio Creek Bridge (frontage road). The existing historic San Antonio Creek Bridge on San Antonio Road is approximately 101 feet long and 23 feet wide. According to Caltrans the existing structure is not wide enough to provide two new12 foot-wide lanes and 5 foot wide shoulders and the historic nature of the structure does not allow it to be widened. Therefore Caltrans plans to build a new bridge to cross San Antonio Creek. The existing structure will be re-striped for a one-way bridge and a bike lane.

Two structure alternatives are proposed for the new San Antonio Creek bridge. Alternative 1 is proposed as a cast-in-place concrete slab with reinforced concrete bent caps and abutments. This seven-span bridge is approximately 227.5 feet long and 42 feet wide. The substructure would consist of Class 140 driven precast concrete piles at the abutments and driven cast-in-steel shell piles at the bents. Caltrans anticipates that five 2-foot diameter new CISS piles will be required per pier for a total of thirty for the 6-piers. Alternative 2 is proposed as a cast-in-place concrete pre-stressed box girder with reinforced concrete bent caps and abutments. This new two-span bridge would be approximately 235 feet long and 42 feet wide. The substructure would consist of reinforced concrete columns (total two) approximately 4 feet in diameter and abutments that are supported on a concrete pile cap with driven pre-cast concrete piles. The size of the column footings is approximately 28 by 28 by 6 feet. Each column footing would have approximately 25 driven piles. The size of each pile is approximately 15 x 15 inches.

Caltrans anticipates that the area required for construction activities would extend 50 feet beyond each side of the edge of bridge deck. Access to the existing channel would be required for construction.

To construct the new bridge, soil at the abutment locations would be re-graded to raise the profile. After the profile is raised at the abutment locations, the precast concrete piles would be driven into the ground. A reinforced concrete footing would be constructed on top of the piles. Then, a reinforced concrete abutment would be placed on the pile cap.

If Alternative 1 is selected, the contractor would drive CISS piles into the ground at column locations. The soil inside the steel shells would be drilled out, a reinforcing steel cage would be placed inside the shell, and concrete would be placed by a pump. The foundation piles would be extended as columns into the deck slab.

If Alternative 2 is selected, the contractor would excavate soil at the column footing locations. If water is anticipated at the footing elevations, cofferdams consisting of driven sheet pilings would be construction around the perimeter of the footings. If needed, cofferdams would be approximately 38 by 38 feet per column footing. After cofferdams are placed, soil would be excavated to the footing elevation. The column footing CISS piles would then be driven with an impact hammer. If water is encountered, it would be pumped from the cofferdam to trucks or a sediment basin permitted by the Water Quality Control Board. A lean concrete seal course might be used to minimize water intrusion. The soil inside the steel shells will be dug out, a reinforcing steel cage would be placed inside the shell, and concrete would be placed by a pump. Reinforced concrete pile caps and columns would be constructed at each column footing.

To construct the superstructure, temporary supports also known as falsework would be required. The falsework would be used to support construction loads such as bar reinforcing steel, wet concrete and live loads (construction crew, equipment, etc). According to Caltrans, the falsework system usually consists of a series of falsework bents placed at certain intervals with steel beams spanning across the falsework bents. Plywood decking is then placed between the steel beams to allow for the placement of bar reinforcing steel and forming/constructing of the superstructure. The falsework bents might be constructed using steel or timber posts supported on timber pads which have been placed on top of existing ground or on timber or steel piles that have been driven into ground depending on the bearing capacity of the soil. Access to the existing channel would be required for pile driving, pile cap construction and falsework construction. Once the falsework is complete the reinforced concrete slab or box girder superstructure would be installed. After completion of the structure, all temporary cofferdam and falsework material would be removed, the creek banks would be stabilized and erosion control BMP's would be installed. Falsework piles may be completely removed or cut below the ground elevation and left in place.

Petaluma River Bridge. The existing Petaluma River Bridge on State Route 101 consists of two separate structures, each 885 feet long and 31 feet wide. The bridges were built in 1955.

Due to the age of the existing structures and the costs associated with bringing them up to current standards, it is proposed to replace the two existing bridges with a single bridge. There is an existing fender system protecting the bridge bents at each side of the waterway. This fender system would be removed during construction in order to facilitate bridge construction work. The new bridge would increase the span over the waterway to 210 feet long and the new Pier 3 would be located above the waterway limit. A new bridge fender system would likely be required for Pier 4 even though it would be located closer to the north bank.

Caltrans has proposed two structure alternatives for the new bridge. Both alternatives would include construction of an 855 foot long and 115 foot wide, five-span bridge. Alternative 1 would consist of a reinforced concrete box girder superstructure. Alternative 2 would consist of a Precast/Pre-stressed Concrete Bulb "T" girder superstructure. The substructure for both alternatives consists of reinforced concrete column piers supported on spread footings or on pile caps with either cast-in-drilled hole (CIDH) or cast-in-steel shell (CISS) pilings. Both alternatives would include between 3 to 5 columns per pier for a total of between 12 to 20 columns for the 4 piers. The size of the individual column footings would be approximately 35 by 28 by 7 feet deep. Caltrans anticipates that each column footing would consist of between twenty-five to forty 18-inch to 30-inch diameter CIDH or CISS pilings for each of the twelve to twenty columns.

Geotechnical investigation will be needed prior to construction of the new Petaluma River Bridge. The purpose of the investigation is to characterize the subsurface conditions and to evaluate engineering properties of the soils and/or rock for the design development of the replacement of the Petaluma River Bridge. As part of the geotechnical investigation for the proposed improvements of Segment B4 of the Marin Sonoma Narrows project, four borings, ranging from 50 to 100 feet in depth, are planned to investigate the bents of the proposed Petaluma River Bridge Replacement located north of the Petaluma River. Two of the bore sites will be located in the designated temporary staging areas and the other two will be located in the Petaluma River. Additional borings will be accessed from the State Route 101 median and performed in areas that are not identified as listed species habitat or having the potential to adversely affect listed species.
The drilling will be completed using a track-mounted drill rig, a truck-mounted drill rig, or a potable drill rig may be used to access the slopes along the east side of the freeway between the Petaluma River Bridge and the 101/116 Separation and Overhead, and the banks of the Petaluma River. A skid-mounted drill rig attached to a sectional barge will be used to explore the bent on the river bank and in the river. Drilling will be completed using rotary wash methods; the size of the borehole will be about 5 inches in diameter.

Prior to the start of the field investigation Underground Service Alert (USA) will be contacted at least 48 hours before the start of work to clear underground utilities. All boring locations will also be cleared utilizing the services of a private underground utility locator. Some locations may require that the boring first be advanced using a hand auger to a depth of at least 3 feet to check for underground utilities, and then be advanced with the drill rig.

Boring permits are required by County of Sonoma, Department of Health Services, Environmental Health Division, for completion of the borings. The permit applications will be processed by consultant, URS. The borings will be completed during daylight hours. Traffic control will be provided during drilling pursuant to Caltrans standards and as specified in the encroachment permit. A traffic control specialty contractor will be retained to provide traffic control for other borings, where required.

Sampling in the borings will be completed at 5-foot intervals or closer intervals at changes in material type as the drilling progresses. Caltrans anticipates that the majority of the sampling will be completed using a Standard Penetration Test (SPT) or Modified California (MC) sampler. If soft cohesive soils are encountered thin-walled Shelby tube samples will also be obtained.

All soil cuttings generated during the drilling of the borings will be placed in drums and stored at an offsite location designated by Caltrans. The soil cuttings in the drums will be sampled for waste characterization (approximately 1 sample for 3 drums) and disposed of at the nearest non-hazardous waste landfill following reception of the analytical testing results and acceptance of the materials for disposal. If analytical results indicate that the soil cuttings cannot be disposed of at the nearest non-hazardous landfill further testing and analysis may be required to dispose of the drums of soil at an appropriate facility.

Waste associated with the drilling operation such as drilling fluid, material containers, and personal trash will be placed in drums or containers and moved offsite for proper disposal.

All drilling equipment and vehicles will access the drill locations using an existing designated road/path. Access will be confined to this designated route to minimize effects to adjacent pickleweed habitat for the salt marsh harvest mouse.

The two upland borings (R-08-005 and R-08-006) will be explored by using a track mounted rig. The exploration for the two borings in the Petaluma River (R-08-005A and R-08-005B) is planned using a skid-mounted CME 45 rotary drill rig attached to a sectional barge that would be floated to the proposed locations at appropriate high tide levels. The remaining proposed borings will be explored with a truck-mounted rotary drill rig.

For rotary drilling, a one-ton service truck equipped with a water tank will support the drill rig. In general, the drill rig will access the site at the beginning the job and be parked over night until drilling is complete. On the other hand, the service truck will access the site in the morning at the beginning of each shift of drilling and leave the site at the end of the day to refill for the next day. It will leave the site during the day only if the drill hole requires more water for the drilling fluid mixture. The service truck will also be used to transport drill waste containers and soil cutting drums.

The new Petaluma River Bridge would be constructed in three stages. During Stage 1, the middle portion of the new bridge would be built in between the two existing structures and the existing median barriers would be removed. During Stage 2, the existing southbound structure would be removed for the new bridge construction. During stage 3, the northbound structure would be removed to allow for the construction of the final portion of the new bridge. Pile driving for the column footings will occur year-round. Other construction activities that will occur year-round on land include: bridge demolition, vegetation clearing and planting, and road construction for site access, removal of existing piles, falsework removal and cleanup, and concrete pouring (which may involve some work over water using appropriately sealed forms).

Access to the existing channel would be required for construction. The contractor would access the north bank of the river from State Route 116 along the east side of State Route 101. The contractor would access the south bank of the river from Petaluma Boulevard South. Piers 2 and 5 are located above the banks of the Petaluma River. Pier 3 is located on land at the edge of the south bank the river. Pier 4 is located in the river, adjacent to the north bank. Caltrans anticipates that the contractor would need to construct a trestle bridge to gain access to Pier 4 and to gain access to the north side of Pier 3. The trestle would also need to be extended around the existing piers for demolition of the existing bridge and towards the center of the channel for falsework, temporary erection tower, and temporary fender pile installation. A navigational opening would be maintained for mariners on the Petaluma River. The size of the opening would be negotiated and subject to approval of the U.S. Coast Guard. At the north and south sides of the opening a temporary fender system consisting of driven piles and steel and timber barriers would be placed to protect the falsework and/or erection towers from being hit from a vessel. The contractor would drive piles in the river and place a timber deck on the pilings to create a work platform or trestle above the river. The maximum trestle size is estimated at 1000 by 36 feet. Trestle and temporary fender piles would be either steel H-piles or steel pipe piles. Pipe would be approximately 20 to 24 inches in diameter. Piles would initially be driven with a vibratory hammer. Bearing would be confirmed with an impact hammer. Caltrans anticipates that a maximum of 300 temporary trestle and fender piles would be needed. Trestle and fender piles would be between 20 to 45 feet deep and would be installed between June 15 and October 31 of any year. Caltrans estimates that the contractor would install approximately 2 to 10 trestle and/or fender piles per day. Trestle and fender piles would be installed on approximately 20 to 75 days over a three year period. When an impact hammer is used to confirm bearing, each pile would receive approximately 5 to 20 strikes. If required for noise reduction, trestle piles would be driven inside a double walled isolation casing when an impact hammer is used.

Cofferdams consisting of sheet pilings will then be installed around the perimeter of Piers 3 and 4 footings. It is anticipated that one large cofferdam approximately 135 by 38 feet would be installed per pier location. Cofferdams might also be used at Piers 2 and 4, if ground water is anticipated. Four additional cofferdams approximately 39 by 22 feet would be used during demolition of the existing column footings in the river. Cofferdams would be constructed of interlocking sheet pilings, which would be driven by a vibratory hammer. If difficult driving is encountered, an impact hammer might be used for the final few feet of installation. Cofferdams would be installed between June 15 and October 31 of any year.

According to the August 5, 2008, Caltrans letter an existing ditch that contains pickleweed and acts as a connector between two pickleweed areas on the east and west sides of the existing Petaluma River Bridges. Caltrans would construct a new bridge pier and footing at the site of the existing ditch. A new ditch would be constructed slightly south of the existing ditch to maintain flow regimes during construction. The new ditch would be culverted for three years so construction equipment can access the area to construct the new pier and footing. Once construction is complete, Caltrans would restore the ditch, which will include removing the culvert and grading it to mimic the current ditch, including the same elevation, topography, and vegetation. This will be done in order to encourage the pickleweed to self-propagate as it has in the existing ditch.

The pickleweed removal would be the first order of work at the Petaluma River Bridge, prior to any heavy equipment being brought onto the site. The pickleweed will be removed by hand and the area is expected to be re-vegetated based on previous pickleweed propagation information. Caltrans makes this assumption based on other projects such as the Guadalcanal Tidal Marsh Restoration Project on State Route 37 in Solano County where a levee was breached and pickleweed self-propagated within several years.

Additionally, the construction access road would require an approximate 25-foot long temporary culvert in the vicinity of the SMART railroad bridge. Currently drainage traverses into the Petaluma River via an open ditch that contains some pickleweed. This culvert will also be in place for approximately 3-years, during construction. At the conclusion of construction, the culvert will be removed and the ditch will be restored to pre-construction conditions

Caltrans has developed minimization and avoidance measures to address potential adverse effects to listed salmonids and will implement those measures according to the separate biological opinion issued by National Marine Fisheries.

After cofferdams are completed and cleared of salmonid issues by the fisheries biologist, the contractor would install permanent foundation piles and the soil would be excavated to the footing elevation. If final design indicates CIDH piles, the contractor would likely use temporary steel casings at pile locations to help prevent caving and control water. CIDH piles would be constructed by drilling holes to the pile tips. Slurry would also likely be placed in the holes to control water and prevent caving. Once drilling is complete, a reinforcing steel cage would be placed in the hole and concrete would be pumped to the bottom of the hole, displacing the slurry, which would be pumped into holding tanks. If final design indicates CISS piles, Caltrans anticipates that the contractor would initially drive the piles with a vibratory hammer and complete driving into bedrock with an impact hammer. Piles at Piers 3 and 4 are estimated to be between 30 to 50 feet long and each pile will receive between 200 to 600 strikes. Piles will extend to bedrock and the contractor would likely install between 2 to 20 CISS piles per day. The contractor would likely be driving piles at Piers 3 and 4 with an impact hammer for up to 60 days over an 18 month period. CISS would be installed year round from completed trestle and cofferdams. If required for noise reduction, bubble curtains would be used around CISS piles, inside of cofferdams at Piers 3 and 4, when driving with an impact hammer. After piles are driven, soil would be excavated from inside the pile shells by drilling. Slurry would likely be pumped inside the shells to displace water. A reinforcing steel cage would be placed inside the shell, and structural concrete would be pumped to the bottom of the shell, displacing the slurry. Slurry would be pumped to holding tanks.

After piles are constructed, a seal course of lean concrete would likely be placed at the bottom of the footing to prevent water intrusion. Water would be pumped from the cofferdam into a baker tanks or a sediment basin permitted by the Water Quality Control Board. Then, a reinforced concrete footing cap and columns would be constructed on top of the pilings.

To construct the superstructure, temporary supports also known as falsework would be required for Alternative 1 and temporary erection towers would be needed for Alternative 2. The falsework would be used to support construction loads such as bar reinforcing steel, wet concrete and live loads (construction crew, equipment, etc). According to Caltrans, the falsework system usually consists of a series of falsework bents placed at certain intervals with steel beams spanning across the falsework bents. Plywood decking is then placed between the steel beams to allow for the placement of bar reinforcing steel and forming/constructing the superstructure. The falsework bents might be constructed using steel or timber posts supported on timber pads which have been placed on top of existing ground or on timber or steel piles that have been driven into ground depending on the bearing capacity of the soil. Temporary erection towers are needed to provide temporary support and a work platform for splicing precast concrete bulb T-

Girders. Erection towers would be supported by piles driven in the water. Steel and/or timber posts, beams, and lateral supports would complete the tower to the bottom of the superstructure elevation. Falsework or temporary erection piles would be either steel H-piles or steel pipe piles. The pipe would be approximately 20 to 24 inches in diameter. Piles would initially be driven with a vibratory hammer. Bearing would be confirmed with an impact hammer. It is estimated that a maximum of 160 falsework or temporary erection piles would need to be driven in Petaluma River. Falsework or temporary erection piles would be between 20 to 45 feet deep and would be installed between June 15 and October 31 of any year. Caltrans estimates that the contractor would install approximately 2 to 20 falsework or temporary erection piles per day. Trestle piles would be installed on approximately 20 to 80 days over a three year period. When an impact hammer is used to confirm bearing, each pile would receive approximately 5 to 20 strikes. If required for noise reduction, falsework or temporary erection piles would be driven inside a double walled isolation casing when an impact hammer is used.

After the completion of the Stage 1 bridge construction, the existing northbound bridge would be removed. After the completion of the Stage 2 bridge construction, the existing southbound bridge would be removed. For the portion of the structure over the waterway, the structure would likely be removed by saw cutting between precast concrete girders and then using crane(s) to lift the girders out of place. Subject to the engineer's approval, the crane(s) would likely be located at the adjacent spans of the bridge or barge cranes would be utilized to remove the girders. Bridge removal protective cover, if necessary, would be attached to the existing bridge soffit/bents. Cofferdams of approximately 39 feet long by 22 feet wide each (total 4) would be required for the removal of the existing columns and/or spread footings at Pier 5 and Pier 6. Access would be gained by using the temporary trestle.

For bridge demolition work on non-waterway areas, the columns would likely be tipped over and demolished on ground or on protective ground cover such as crane mats etc. Existing footings in water and on banks would be removed to a required minimum elevation or distance below original ground.

After completion of the new bridge, all temporary cofferdam, temporary fender system, temporary erection tower, and falsework material would be removed. Piles would be removed by vibrating and/or pulling the piles with a crane. Alternatively, the piles may be cut at an elevation specified by the U.S. Coast Guard and left in place below existing grade. A new permanent pier protective system consisting of either a closed fill system or a fender system of driven piles and barriers would be placed to protect the new bridge Pier 4. The permanent fenders would consist of approximately 60 driven piles. Piles would be made of steel pipe, steel H, or timber. Pipe would be approximately 20 to 24 inches in diameter. Piles would initially be driven with a vibratory hammer. Bearing would be confirmed with an impact hammer. Permanent fender piles would be between 20 to 45 feet deep and would be installed between June 15 and October 31 of any year. It is estimated that the contractor would install approximately 2 to 20 permanent fender piles per day. Permanent piles would be installed during approximately 3 to 15 days over a three year period. When an impact hammer is used to confirm bearing, each pile would receive approximately 5 to 20 strikes. If required for noise reduction, permanent fender piles would be driven inside a double walled isolation casing when an impact hammer is used.

The creek banks would then be stabilized and erosion control BMP's would be implemented.

Storm Water Quality Systems and Construction Site BMPs. The proposed project would incorporate bio-filtration strips and swales to receive storm water discharges from the highway or other impervious surfaces. The project would also likely include off-site storm water treatment.

The Segment B on-site storm water treatment would include bio-filtration strips, bio-filtration swales, and Austin sand filters. The installation of these features were discussed in the Segment A project description.

Construction Site BMPs. To maintain water quality during construction, Caltrans would implement BMPs to reduce unnecessary water quality impacts. The following methods and practices would be implemented:

1. Earth Dikes/Drainage Swales and Lined Ditches
2. Outlet Protection/Velocity Dissipation Devices
3. Check Dams
4. Silt Fencing with Maintenance Openings
5. Fiber Rolls
6. Concrete Washouts
7. Drainage Inlet Protection
8. Construction Entrance/Exit Protection

Staging Locations. Caltrans would use staging locations for temporary storage of heavy construction equipment and construction materials, equipment maintenance shops, stockpile areas, and field offices. The primary staging areas in Segment B would be located within the new interchange at the Sanitary Landfill Road (Station 1405-1409), at the new interchange off of Kastania Road (Station 2039-2045), and below and along the sides of the Petaluma River Bridge (Station 2053-2055). Caltrans proposes areas that are located within the State Right-of-Way and quantified as within the project area of effect, subject to approval of the contractor submitted SWPPP. Contractors may independently seek off-site staging locations. Off- site staging locations will be subject to the requirements of resource agencies and permits will be the responsibility of the contractor.

Segment C

HOV Lane Construction. The existing State Route 101 Segment C roadway travels through the City of Petaluma. This segment is classified as a freeway, and includes two 12 foot lanes in each direction, 10 foot outside shoulders and 5 foot inside shoulders. The majority of existing curves in Segment C meet current horizontal alignment, vertical profile and sight distance requirements for the 70 mile per hour corridor design speed with the exception of the Petaluma Overhead. The existing Petaluma Overhead vertical profile is nonstandard and would be brought to current standards with this project. The non-paved median varies in width from 28 to 35 feet and contains a double thrie-beam barrier. The majority of the drainage facilities through Segment C can be utilized with only minor modifications and no historical drainage issues or recurring flooding has been documented.

In Segment C, Caltrans proposes to add a 12 foot wide HOV lane in each direction between south of the Lakeville Highway/State Route 116 Interchange and north of the Corona Road Overcrossing. The new roadway would be separated by a concrete barrier and would include 10 foot-wide inside shoulders. The majority of the widening would be in the median, with some outside widening. The roadway would be reconstructed at the approaches to the North Petaluma Overhead to correct the existing nonstandard vertical alignment. The proposed profile would be a new roadway located up to 17 feet above the existing roadway.

The HOV roadway construction would be completed as described for Segment A.

Vertical Curve Correction at the Petaluma Overhead. Caltrans plans to reconstruct the vertical profile through the Petaluma Overhead to achieve standard specification and replace the structure. The work would be completed in three stages. The first stage would consist of constructing the median portion of the overhead and fill the section leading up to both sides of the structure. Temporary retaining walls would be set in place for the fill section and imported material would be trucked in and placed in 0.5 foot lifts. Each lift would be spread and compacted with grading compacting equipment. The structural section would then be placed and compacted using the same methodology as described for HOV construction. Once the median is constructed, northbound traffic would be shifted to the median, and the same process would be used to construct the northbound portion of the vertical curve correction. Finally, northbound traffic would be moved to the new northbound lanes and southbound traffic would be shifted to the median for construction of the southbound lanes.

Roadway Resurfacing and Striping. Roadway resurfacing and striping for Segment C would use the same methodology as that described for Segment A.

Culvert Improvements. As described for the previous segments existing roadway drainage in Segment C is conveyed by a depressed median to drainage inlets at low points in the median. Segment C includes fifteen cross culverts that convey storm water to swales along the outside of the roadway which drain to adjacent water courses.

Caltrans would replace the depressed median with new HOV lanes, shoulders, and a median barrier. These improvements would result in sheet flow drainage towards the outside shoulders, away from the median. Sixteen existing drainage wells will be reconfigured at the median in Segment C. Cross culverts that are no longer needed would be abandoned in place and plugged. Caltrans has determined that most of the existing culverts are adequate but some would require replacement due to deterioration and improper sizing.

The construction methods for removing, installing, and extending culverts are as described for Segment A.

CHP Pullouts, HOV Bypass Lanes, and Ramp Metering. The addition of CHP pullouts, HOV bypass lanes, and ramp metering in Segment C will be similar to the methodology described for Segment A. These features will be added Landfill, Petaluma Boulevard South, State Route 116/Lakeville, and East Washington interchanges.

Sound Walls. Caltrans will construct new sound walls at four locations within Segment C. These locations include Ponderosa Drive to East Washington, North of Lynch Creek, Napa Drive to Corona Road, and East Washington to north of Lynch Creek. The combined length of the new walls would be approximately 12,230 feet.

Retaining Walls. Caltrans plans to construct three retaining walls for structural reasons in Segment C. The walls will be located north on both sides of the Petaluma Bridge and from McGregor Avenue Drive to East Washington. The combined length of the retaining walls in Segment C would be 3,635 feet long and will vary between 4 and 7 feet high. The walls will be constructed as described in Segment A.

Structures. Six bridges would be modified for the widening and include the structures at Route 101/116, Caulfield Lane, East Washington Street, Washington Creek, Lynch Creek, and North Petaluma. Only the two creek crossings are further described as follows.

Washington Creek Bridge. The existing 67 foot-long Washington Creek Bridges accommodate two 12 foot-wide lanes of traffic and one 2 foot-wide inside shoulder and a 4 foot-wide outside shoulder in each direction.

Caltrans plans to widen both bridges in order to add the 12 foot wide HOV lane along with 10 foot-wide shoulders and HOV bypass. The existing twin bridges will be widened by connecting the right and left bridges and matching the existing structures to make a total width of 139.8 feet. It is also proposed that the existing bridge barriers with current standard barriers be replaced.

Access to the existing channel would be required for construction. Widening would involve the construction of a new cast-in-place reinforced concrete slab superstructure including new concrete bent caps and abutments. The substructure would consist of class 140 driven steel shell piles approximately 1.2 feet in diameter at the abutments and piers. Caltrans anticipates that there would be 11 new driven steel shell piles (pier columns) per pier for a total of 22 for the two piers. The piles would extend into the superstructure.

The Washington Creek Bridge would be constructed using the same methods described for Segment B.

Lynch Creek Bridge. The two Lynch Creek Bridges are only wide enough to accommodate two 12 foot wide lanes along with 2 foot wide inside shoulders and 4 foot wide outside shoulders. Both of the existing bridges were built in 1955 and consist of a three-span continuous reinforced concrete slab superstructure on reinforced concrete pile bents and reinforced concrete "U" open abutments.

As with the Washington Creek Bridge, Caltrans plans to widen the Lynch Creek Bridges to accommodate an additional 12 foot-wide HOV lane, 10 foot wide shoulders, and a ramp taper. Caltrans also plans to replace the existing bridge barriers with current standard barriers.

Access to the existing channel would be required for construction. Caltrans would widen the Lynch Creek Bridge by constructing and connecting parallel bridge structures to the median side of each of the existing bridge structures and closing the median gap as well as constructing and connecting a parallel bridge structure to the northbound side of the existing bridge. Caltrans would construct the widened portions of the bridge similar to the existing structure so that the widened portions match the existing structure in strength, durability, and flexibility.

Caltrans also plans to construct a sound wall on a bridge barrier on the southbound side of the structure. According to Caltrans, the widening of the existing bridge would require the construction of new a cast-in-place reinforced concrete slab superstructure including new concrete bent caps and abutments. The substructure consists of Class 140 (12 by 12 inch) driven precast concrete piles

Caltrans anticipates that there would be 10 new driven precast concrete piles (pier columns) per pier for a total of 20 piles for the 2 piers. The piles would extend into the superstructure.

The location and bearing for the new abutments and bents would match with the alignments of the existing abutments and bents. The use of falsework and erosion control BMPs would be similar to that used for the other bridges in this project.

Storm Water Quality Systems and Construction Site BMPs. Segment C would use the same BMPs as described for Segment B.

Construction Site BMPs. Segment C would use the same BMPs as described for Segment B.

Staging Locations. Caltrans would use staging locations for temporary storage of heavy construction equipment and construction materials, equipment maintenance shops, stockpile areas, and field offices. The primary staging areas in Segment C would be located within the State Route 116 Interchange. Caltrans proposes to use areas that are located within the State Right-of-Way and quantified as within the project area of effect, subject to approval of the contractor submitted SWPPP. Contractors may independently seek off-site staging locations. Off- site staging locations will be subject to the requirements of resource agencies and permits will be the responsibility of the contractor.

Construction Site Restoration

Caltrans plans to restore areas of temporary ground disturbances, including storage and staging areas, and temporary roads. These areas will be re-contoured, if appropriate, and revegetated with seeds and/or cuttings of appropriate plant species to promote restoration of the area to pre-project conditions. Caltrans defines areas of "temporary" disturbance to be any area that is disturbed during the project, but that after project completion will not be subject to further disturbance and has the potential to be revegetated. Caltrans will be developing a restoration plan that will be submitted to the Service for comment prior to initial ground breaking. According to Caltrans, to the maximum extent practicable (i.e., presence of natural lands), topsoil will be removed, cached, and returned to the site according to successful restoration protocols. Loss of soil from run-off or erosion will be prevented with straw bales, straw wattles, or similar means provided they do not entangle, block escape or dispersal routes of listed animal species.

Proposed Avoidance and Minimization Measures

According to the May 2008 Biological Assessment and the revised project description provided by Caltrans on August 27, 2008, FHWA/Caltrans propose to avoid, minimize, and compensate for effects to listed species by implementing the following measures:

Federally Listed Plants

If listed plants may be affected by the project, Caltrans will implement the following:

1. Minor design modifications will be made to avoid effects to listed plant species.

2. Any area where federally listed plants and/or populations have been observed within the temporary work area will be designated an Environmentally Sensitive Area and marked in the field with orange construction fencing.

3. The location of all Environmentally Sensitive Area's will be shown on project construction drawings and noted for monitoring during construction.

4. Preconstruction botanical surveys will be conducted prior to construction during the appropriate time of year (during spring and early summer), by qualified botanists familiar with the regional flora, and will follow Service, California Department of Fish and Game, and CNPS approved protocols.

California Red-Legged Frog

1. To compensate for the potential effects to 203.78 acres of California red-legged frog habitat Caltrans and FHWA will provide compensation at a 1:1 ratio totaling approximately (203.78 acres). This compensation, which is being provided pursuant to CEQA/NEPA and FHWA policies on mitigating effects to natural lands, and which is incorporated as part of the project description, will be achieved using a combination of the following:

    a. Purchasing credits at a resource agency approved mitigation bank servicing the action area;

    b. Purchasing conservation easements at or as close to the project site as practical within Marin and/or Sonoma Counties;

    c. Purchasing fee title and preserving the land for California red-legged frog at or as close to the project site as practical within Marin and/or Sonoma Counties.

Compensation may be provided by Caltrans itself or to the extent feasible with the assistance of a state or local partner such as a park or open space district or a resource conservation district. Compensation for California red-legged frog will be provided before or concurrent with the project effects to California red-legged frog for each project Construction Phase.

2. A Service-approved biologist(s) will be designated for the construction phase activities in Segment B and Segment C that will affect California red-legged frog habitat. The qualified biologist(s) will be on-site during specific construction activities for each construction phase work in potential California red-legged frog habitat. The qualifications of the biologist(s) will be presented to the Service for review and written approval prior to ground-breaking at the project site. The biologist(s) will coordinate through the Resident Engineer, to stop any work that may result in take of the California red-legged frog. If work is stopped, the biologist(s) will notify the Service by telephone and electronic mail within one (1) working day. The Service contact will be Chris Nagano, Division Chief, Endangered Species Program at the Sacramento Field Office at telephone (916) 414-6600.

3. The Resident Engineer will halt work and immediately contact the Service-approved project biologist(s) and the Service in the event that a California red-legged frog gains access to a construction zone. The Resident Engineer will suspend construction activities in the immediate construction zone within Segment B and Segment C for each specific project phase that may affect California red-legged frog habitat until the animal leaves the site voluntarily or is removed by the biologist(s) to a release site using Service-approved handling techniques.

4. All construction supervisory personnel for each specific project phase within Segment B and Segment C that are working in areas of potential endangered species habitat will attend an environmental education program delivered by the Service approved biologist prior to working on the project site. The program will include an explanation as how to best avoid the accidental take of California red-legged frogs. The Service approved biologist(s) will conduct a training session that would be scheduled as a mandatory informational field meeting by the Caltrans Resident Engineer for all construction contractor supervisory personnel. The field meeting will include topics on species identification, life history, descriptions, and habitat requirements during various life stages. Emphasis will be placed on the importance of the habitat and life stage requirements within the context of project maps showing areas where minimization and avoidance measures are being implemented. The program will include an explanation of appropriate federal and state laws protecting endangered species as well as the importance of compliance with Caltrans and various resource agency conditions.

5. To minimize temporary disturbances in areas of potential California red-legged frog habitat, project related vehicle traffic within Segment B and Segment C for construction phases with potential California red-legged frog habitat will be restricted to established roads, construction areas, and other designated areas. These areas also should be included in pre-construction surveys and, to the maximum extent practicable, should be established in locations disturbed by previous activities to prevent further adverse effects. Project related vehicles will observe a 20-mile per hour speed limit within Segment B and Segment C for construction phases with potential California red-legged frog habitat, except on County roads, and State and Federal highways. Off-road traffic outside of designated action areas of Segment B and Segment C for construction phases with potential California red-legged frog habitat will be prohibited.

6. Dust control measures will be implemented within Segment B and Segment C for construction phases with potential California red-legged frog habitat, consisting of regular truck watering of constriction access areas and disturbed soil areas with the use of organic soil stabilizers to minimize airborne dust and soil particles generated from graded areas. Regular truck watering will be a requirement of the construction contract. In addition, for disturbed soil areas, an organic tackifier to control dust emissions blowing off of the right-of-way or out of the construction area during construction will be included in the contract special provisions. Watering guildelines for dewatering will be established to avoid any excessive run-off that may flow into contiguous areas. Any material stockpiles will be watered, sprayed with tackifier or covered, to minimize dust production and wind erosion.

7. Project employees will be provided with written guidance governing vehicle use, speed limits on unpaved roads, fire prevention, and other hazards.

8. To eliminate an attraction to predators of the California red-legged frog, all food-related trash items such as wrappers, cans, bottles, and food scraps will be disposed of in closed containers and removed at least once a day from the action area.

9. To avoid injury or death of a California red-legged frog, no firearms will be allowed in the action area except for those carried by authorized security personnel, or local, State, or Federal law enforcement officials.

10. To prevent harassment, injury or mortality of a California red-legged frog or destruction of their refuge, project personnel will not be permitted to have dogs or cats in the action area.

11. Use of rodenticides and herbicides in the action area will be used in such a manner to prevent primary or secondary poisoning of a California red-legged frog and the depletion of vegetation on which they depend. All uses of such compounds will observe label and other restrictions mandated by the U.S. Environmental Protection Agency, California Department of Food and Agriculture, and other appropriate State and Federal regulations, as well as additional project-related restrictions deemed necessary by the Service or the California Department of Fish and Game.

12. Dedicated fueling and refueling practices will be designated as part of the approved SWPPP. Dedicated fueling areas will be protected from storm water run-on and run-off and will be located at least 50 feet from downslope drainage facilities and water courses. Fueling must be performed on level-grade areas. On site fueling will only be used where it is impractical to send vechicles and equipment off-site for fueling. When fueling must occur on-site, the contractor will designate an area to be used subject to the approval of the Resident Engineer, representing Caltrans. Drip pans or absorbent pads will be used during on-site vehicle and equipment fueling.

13. All grindings and asphaltic-concrete waste will be stored within previously disturbed areas absent of California red-legged frog habitat and at a minimum of 150 feet from any downstream riparian habitat, aquatic habitat, culvert, or drainage feature.

14. For each specific project phase within Segment B and Segment C, and to the extent practicable, areas outside of the construction zones containing suitable habitat for the California red-legged frog will be delineated with high visibility temporary fencing at least 4 feet in height, flagging, or other barrier to prevent encroachment of construction personnel and equipment onto sensitive areas during construction activities. The fencing will be removed only when all construction equipment is removed from the site. No project activities will occur outside the delineated project construction area.

15. If requested, before, during, or upon completion of ground breaking and construction activities, Caltrans will allow access by Service personnel to the action area to inspect project effects to California red-legged frogs and their habitats. Due to safety concerns, Caltrans requests that Service staff check in with the Resident Engineer prior to accessing the construction site.

16. For work on each construction phase within Segment B and Segment C that may affect California red-legged frog habitat, a Service-approved biologist(s) will be on-site to monitor the initial ground disturbance activities for the road construction. The biologist(s) will perform a clearance survey immediately prior

to the initial ground disturbance. Safety permitting, the Service-approved biologist(s) will investigate areas of disturbed soil for signs of listed species within thirty (30) minutes following the initial disturbance of that given area.

17. To prevent inadvertent entrapment of California red-legged frogs during work within construction Phase B4, all excavated, steep-walled holes or trenches more than 2 feet deep will be covered at the close of each working day by plywood or similar materials. Alternatively, an additional 4-foot high vertical barrier, independent of exclusionary fences, may be used to further prevent the inadvertent entrapment of California red-legged frogs. If it is not feasible to cover an excavation or provide an additional 4-foot high vertical barrier, independent of exclusionary fences, one or more escape ramps constructed of earth fill or wooden planks will be installed. Before such holes or trenches are filled, they must be thoroughly inspected for trapped animals. If at any time a trapped listed animal is discovered, the on-site biologist will immediately place escape ramps or other appropriate structures to allow the animal to escape, or the Service will be contacted by telephone for guidance. The Service will be notified of the incident by telephone and electronic mail within one working day.

18. Plastic mono-filament netting (erosion control matting) or similar material will not be used at the project site because California red-legged frogs may become entangled or trapped in it. Acceptable substitutes include coconut coir matting or tackified hydroseeding compounds.

19. Injured California red-legged frogs will be cared for by a licensed veterinarian or other qualified person such as the on-site biologist; dead individuals must be placed in a sealed plastic bag with the date, time, location of discovery, and the name of the person who found the animal; the carcass should be kept in a freezer; and held in a secure location. The Service and the California Department of Fish and Game will be notified within one (1) working day of the discovery of death or injury to a California red-legged frog that occurs due to project related activities or is observed at the project site. Notification will include the date, time, and location of the incident or of the finding of a dead or injured animal clearly indicated on a USGS 7.5 minute quadrangle and other maps at a finer scale, as requested by the Service, and any other pertinent information. The Service contacts are Chris Nagano, Division Chief, Endangered Species Program at the Sacramento Fish and Wildlife Office (916/414-6600), and Dan Crum, Resident Agent-in-Charge of the Service's Law Enforcement Division at 916/414-6660. The California Department of Fish and Game contact is Mr. Scott Wilson at telephone (707) 944-5563. Sightings of any listed or sensitive animal species should be reported to the California Natural Diversity Database of the California Department of Fish and Game

20. Caltrans will submit post-construction compliance reports for each Segment B and Segment C construction phase with potential California red-legged frog habitat, prepared by the on-site biologist, to the Service within sixty (60) calendar days following completion of each phase with potential California red-legged frog habitat or within sixty calendar days of any break in construction activity lasting more than sixty calendar days. This report will detail (1) dates that construction occurred; (2) pertinent information concerning the success of the project in implementing avoidance and minimization measures for listed species; (3) an explanation of failure to meet such measures, if any; (4) known project effects on California red-legged frogs, if any; (5) occurrences of incidental take of any of these species; (6) documentation of employee environmental education; and (7) other pertinent information. The reports will be addressed to the Deputy Assistant Field Supervisor of the Endangered Species Program, Sacramento Field Office of the Service.

Salt Marsh Harvest Mouse

Caltrans stated in their August 5, 2008 letter that the following measures would be implemented during activities associated with the Petaluma Bridge. Caltrans will avoid potential salt marsh harvest mouse habitat adjacent to the action area at other locations.

1. Caltrans will begin restoration of all salt marsh harvest mouse pickleweed and upland habitat associated with the action area to baseline or better conditions following the completion of construction at the Petaluma River Bridge. Successful establishment of baseline or better salt marsh harvest mouse pickleweed habitat should be achieved within three years.

2. A Service and the California Department of Fish and Game approved biologist will be designated for construction activities for Construction Phase B4. The qualified biologist(s) will be on-site during specific construction activities for each project activity that may have adverse effects to the salt marsh harvest mouse. The qualifications of the biologist(s) will be presented to the Service and the California Department of Fish and Game for review and written approval prior to ground-breaking at the project site. The biologist(s) will coordinate through the Resident Engineer, to stop any work that may result in take of these listed animal species. If work is stopped, the biologist(s) will notify the Service and the California Department of Fish and Game by telephone and electronic mail within one working day. The Service contact will be Chris Nagano, Division Chief, Endangered Species Program at the Sacramento Field Office at telephone (916) 414-6600. The California Department of Fish and Game contact is Mr. Scott Wilson at (707) 944-5563.

3. The Resident Engineer will halt work and immediately contact the Service and California Department of Fish and Game approved biologist and the Service and the California Department of Fish and Game in the event that a salt marsh harvest mouse gains access to a construction zone. The Resident Engineer will suspend construction activities in the immediate construction zone for work in Construction Phase B4 that could have adverse effects to the salt marsh harvest mouse until the animal leaves the site voluntarily.

4. All supervisory construction personnel for Construction Phase B4 that are working in areas of potential endangered species habitat will attend an environmental education program delivered by the Service and California Department of Fish and Game approved biologist prior to working on the project site. The program will include an explanation as how to best avoid the accidental take of salt marsh harvest mouse. The Service and California Department of Fish and Game approved biologist(s) will conduct a training session that would be scheduled as a mandatory informational field meeting by the Caltrans Resident Engineer for all construction contractor supervisory personnel. The field meeting will include topics on species identification, life history, descriptions, and habitat requirements during various life stages. Emphasis will be placed on the importance of the habitat and life stage requirements within the context of project maps showing areas where minimization and avoidance measures are being implemented. The program will include an explanation of appropriate federal and state laws protecting endangered species as well as the importance of compliance with Caltrans and various resource agency conditions.

5. To minimize temporary disturbances for work in areas of potential salt marsh harvest mouse habitat, project related vehicle traffic within Construction Phase B4 will be restricted to established roads, construction areas, and other designated areas. These areas also should be included in preconstruction surveys and, to the maximum extent practicable, should be established in locations disturbed by previous activities to prevent further adverse effects. Project related vehicles will observe a 20-mile per hour speed limit within Construction Phase B4, except on County roads, and State and Federal highways. Off-road traffic outside of designated action areas within Construction Phases B2 and B4 will be prohibited.

6. Dust control measures will be implemented within Construction Phase B4, consisting of regular truck watering of constriction access areas and disturbed soil areas with the use of organic soil stabilizers to minimize airborne dust and soil particles generated from graded areas. Regular truck watering will be a requirement of the construction contract. In addition, for disturbed soil areas, an organic tackifier to control dust emissions blowing off of the right-of-way or out of the construction area during construction will be included in the contract special provisions. Watering guildelines for dewatering will be established to

avoid any excessive run-off that may flow into contiguous areas. Any material stockpiles will be watered, sprayed with tackifier or covered, to minimize dust production and wind erosion.

7. Project employees will be provided with written guidance governing vehicle use, speed limits on unpaved roads, fire prevention, and other hazards.

8. To eliminate an attraction to predators of the salt marsh harvest mouse, all food-related trash items such as wrappers, cans, bottles, and food scraps will be disposed of in closed containers and removed at least once a day from the action area.

9. To avoid injury or death of the salt marsh harvest mouse, no firearms will be allowed in the action area except for those carried by authorized security personnel, or local, State, or Federal law enforcement officials.

10. To prevent harassment, injury or mortality of a salt marsh harvest mouse or destruction of their refuge/nesting areas by dogs or cats, project personnel will not be permitted to have dogs or cats in the action area.

11. Rodenticides and herbicides in the action area will be used in such a manner to prevent primary or secondary poisoning of salt marsh harvest mouse and the depletion of vegetation on which they depend. All uses of such compounds will observe label and other restrictions mandated by the U.S. Environmental Protection Agency, California Department of Food and Agriculture, and other appropriate State and Federal regulations, as well as additional project-related restrictions deemed necessary by the Service or the California Department of Fish and Game.

12. Dedicated fueling and refueling practices will be designated as part of the approved SWPPP. Dedicated fueling areas will be protected from storm water run-on and run-off and will be located at least 50 feet from downstream drainage facilities and water courses. Fueling must be performed on level-grade areas. On site fueling will only be used where it is impractical to send vechicles and equipment off-site for fueling. When fueling must occur on-site, the contractor will designate an area to be used subject to the approval of the Resident Engineer, representing Caltrans. Drip pans or absorbent pads will be used during on-site vehicle and equipment fueling.

13. All grindings and asphaltic-concrete waste will be stored within previously disturbed areas absent of salt marsh harvest mouse habitat and at a minimum of 150 feet from any downslope riparian habitat, aquatic habitat, culvert, or drainage feature.

14. To minimize or avoid the loss of individual salt marsh harvest mice from construction activities in the Petaluma River area, pickleweed vegetation will be hand-removed. Following removal, a special 2-foot high fence consisting of plastic sheeting will be placed 20 feet from the boundaries of construction areas in and adjacent to the pickleweed areas after the vegetation is removed. The fence will be held in place with 2-inch wide and 3-foot long stakes and will be buried in a 6 to 8 inch deep trench to prevent mice from pushing under the fence. These methods will occur with the approval of and in coordination with the California Department of Fish and Game.

15. Prior to commencing construction work for Contract Phase B4 that can have adverse effects to salt marsh harvest mouse, and to the extent practicable, areas outside of the construction zones containing suitable habitat for salt marsh harvest mouse will be delineated with high visibility temporary fencing at least 4 feet in height, flagging, or other barrier to prevent encroachment of construction personnel and equipment onto sensitive areas during construction. The fencing will be removed only when all construction equipment is removed from the site. Actions within the action area will be limited to vehicle and equipment operation on existing roads. No construction activities will occur outside the delineated project construction area.

16. Caltrans will minimize effects on potential habitat at Location 4 by restricting construction to within 100 feet of the existing Caltrans ROW. The closest potential habitat for salt marsh harvest mouse was found approximately 150 feet from the existing Caltrans ROW.

17. If requested, before, during, or upon completion of ground breaking and construction activities, Caltrans will allow access by the Service and/or California Department of Fish and Game personnel to the project site to inspect project effects to the salt marsh harvest mouse and their habitats. Due to safety concerns, Caltrans requests that Service staff check in with the Resident Engineer prior to accessing the construction site.

18. For work within Construction Phase B4 that could have adverse effects to salt marsh harvest mouse, a Service and California Department of Fish and Game approved biologist will be on-site to monitor the initial ground disturbance activities for the road construction. The biologist will perform a clearance survey immediately prior to the initial ground disturbance. Safety permitting, the Service and California Department of Fish and Game approved biologist(s) will investigate areas of disturbed soil for signs of listed species within thirty (30) minutes following the initial disturbance of that given area.

19. To prevent inadvertent entrapment of salt marsh harvest mouse during construction, all excavated, steep-walled holes or trenches more than 2 feet deep will be covered at the close of each working day by plywood or similar materials. Alternatively, an additional 2-foot high vertical barrier, independent of exclusionary fences, may be used to further prevent the inadvertent entrapment of salt marsh harvest mice. If it is not feasible to cover an excavation or provide an additional 2-foot high vertical barrier, independent of exclusionary fences, one or more escape ramps constructed of earth fill or wooden planks will be installed. Before such holes or trenches are filled, they must be thoroughly inspected for trapped animals. If at any time a trapped listed animal is discovered, the on-site biologist will immediately place escape ramps or other appropriate structures to allow the animal to escape, or the Service and/or California Department of Fish and Game will be contacted by telephone for guidance. The Service will be notified of the incident by telephone and electronic mail within one working day.

20. Injured salt marsh harvest mice will be cared for by a licensed veterinarian or other qualified person such as the on-site biologist; dead individuals must be placed in a sealed plastic bag in which a piece of paper is placed that contains the date, time, location of discovery, and the name of the person who found the animal; the carcass should be kept in a freezer; and held in a secure location. The Service and the California Department of Fish and Game will be notified within one (1) working day of the discovery of death or injury to a salt marsh harvest mouse that occurs due to project related activities or is observed at the project site. Notification will include the date, time, and location of the incident or of the finding of a dead or injured animal clearly indicated on a USGS 7.5 minute quadrangle and other maps at a finer scale, as requested by the Service, and any other pertinent information. The Service contacts are Chris Nagano, Division Chief, Endangered Species Program at the Sacramento Fish and Wildlife Office (916/414-6600), and Dan Crum, Resident Agent-in-Charge of the Service's Law Enforcement Division at 916/414-6660. The California Department of Fish and Game contact is Mr. Scott Wilson at telephone (707) 944-5563. Sightings of any listed or sensitive animal species should be reported to the California Natural Diversity Database of the California Department of Fish and Game.

21. Caltrans will submit a post-construction compliance report for Construction Phase B4 prepared by the on-site biologist to the Service within sixty (60) calendar days following completion of Construction Phase B4 or within sixty (60) calendar days of any break in construction activity lasting more than sixty calendar days. This report will detail (1) dates that construction occurred; (2) pertinent information concerning the success of the project in implementing avoidance and minimization measures for listed species; (3) an explanation of failure to meet such measures, if any; (4) known project effects on the salt marsh harvest mouse, if any; (5) occurrences of incidental take of this listed species; (6) documentation

of employee environmental education; and (7) other pertinent information. The report will be addressed to the Deputy Assistant Field Supervisor of the Endangered Species Program.

According to the revised project description received by the Service on December 2, 2008, Caltrans plans to implement the following measures during the geotechnical investigation activities associated with construction of the Petaluma Bridge.

1. When accessing the designated temporary staging area, located between the north bank of Petaluma River and the toe of the north approach embankment, a qualified biologist will monitor the site access path taken by the drilling equipment. Along the access path near any salt marsh harvest mouse habitat designated by the biologists, plywood boards (4 feet by 8 feet) will be placed to temporarily form a pathway for the drilling equipment. A steel plate will be used to provide temporary crossing platform of a drainage ditch.

2. Maintain all vehicles and drill rigs will be inspected frequently and maintained to repair leaks.

3. Drip pans or drop cloths will be used to catch drips and spills. Drain and replace motor oil, radiator coolant, or other fluid will be conducted off site. All spent fluids will be collected, stored in labeled separate containers, and recycled whenever possible. All fuels, oils and lubricants will be kept within secondary containment.

4. Perform major maintenance, repair jobs and vehicle and equipment washing will be performed off-site when feasible, or in designated and controlled areas on-site.

5. Vehicles will be washed at an appropriate off-site facility. If equipment must be washed on-site, water will be prevented from entering the storm drain or open channel. Use of soaps, solvents, degreasers, or steam cleaning equipment will be prohibited. Wash water will be directed to an area that will not flow to any storm drain inlets or open channels.

6. Vehicles and heavy equipment will be refueled in one designated location on the site and spills will be cleaned up immediately.

7. A biological monitor will hold daily tail gate meeting prior to start of drilling activities.

8. Plastic sheeting or visqueen will be placed over the drill site to catch spills and drips of drilling fluids.

9. Straw waddle will be placed on top of visqueen to form a temporary dike surrounding the drill hole and circulation tub to contain spills.

10. Absorbents will be made available to clean up any leaks or spills.

Action Area

The action area is defined in 50 CFR § 402.02, as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." For the proposed action, the action area includes all lands associated with the approximately 786.402 acre project footprint and roads (except for County roads, and State and Federal highways) and other areas accessed by project vehicles.

Status of the Species and Environmental Baseline

California Red-Legged Frog

The California red-legged frog was listed as a threatened species on May 23, 1996 (Service 1996). Please refer to the final rule and the *Recovery Plan for the California Red-Legged Frog (Rana aurora draytonii)* (Service 2002) for additional information on this species.

This threatened species is the largest native frog in the western United States (Wright and Wright 1949), ranging from 1.5 to 5.1 inches in length (Stebbins 2003). The abdomen and hind legs of adults are largely red, while the back is characterized by small black flecks and larger irregular dark blotches with indistinct outlines on a brown, gray, olive, or reddish background color. Dorsal spots usually have lighter centers (Stebbins 2003) and dorsolateral folds are prominent on the back. Larvae (tadpoles) range from 0.6 to 3.1 inches in length, and the background color of the body is dark brown and yellow with darker spots (Storer 1925).

Red-legged frogs have paired vocal sacs and vocalize in air (Hayes and Krempels 1986). Female frogs deposit egg masses on emergent vegetation, allowing the egg mass floats on the surface of the water (Hayes and Miyamoto 1984). Red-legged frogs breed from November through March with earlier breeding records occurring in southern localities (Storer 1925). Individuals occurring in coastal drainages are active year-round (Jennings *et al.* 1992), whereas those found in interior sites are normally less active during the cold season.

The historic range of the red-legged frog extended coastally from the vicinity of Elk Creek in Mendocino County, California, and inland from the vicinity of Redding, Shasta County, California, southward to northwestern Baja California, Mexico (Fellers 2005; Jennings and Hayes 1985; Hayes and Krempels 1986). The species historically was documented in 46 counties but the taxa now remains in 238 streams or drainages within 23 counties. This represents a loss of 70 percent of its former range (Service 2002). Red-legged frogs are still locally abundant within portions of the San Francisco Bay area and the central coast. Within the remaining distribution of the species, only isolated populations have been documented in the Sierra Nevada, northern Coast, and northern Transverse Ranges. This listed amphibian is believed to be extirpated from the southern Transverse and Peninsular ranges, but is still present in Baja California, Mexico (California Department of Fish and Game 2004).

Adult California red-legged frogs prefer dense, shrubby or emergent riparian vegetation closely associated with deep (>2.3 feet), still, or slow-moving water (Hayes and Jennings 1988). However, frogs also have been found in ephemeral creeks and drainages and in ponds that may or may not have riparian vegetation. The largest densities of red-legged frogs currently are associated with deep pools with dense stands of overhanging willows (*Salix* species) and an intermixed fringe of cattails (*Typha latifolia*) (Jennings 1988). Red-legged frogs disperse upstream and downstream of their breeding habitat to forage and seek sheltering habitat.

California red-legged frogs also can be found in disturbed areas such as channelized creeks and drainage ditches in urban and agricultural areas. An adult California red-legged frog recently was observed in a shallow isolated pool on North Slough Creek in the American Canyon area of Napa County (Christine Gaber/PG&E personal communication with Chris Nagano/Service on October 22, 2008). This frog location was surrounded by vineyard development. Another adult California red-legged frog was observed under debris in an unpaved parking lot in a heavily industrial area of Burlingame (Patrick Kobernus communication with Michelle Havens on October 16, 2008). This Burlingame frog was likely utilizing a nearby drainage ditch. Caltrans has also discovered California red-legged frog adults, tadpoles, and egg masses within a storm drainage system within a major cloverleaf intersection of Millbrae Avenue and State Route 101 in a heavily developed area of San Mateo County (Caltrans 2007). California red-legged frog has the potential to persist in disturbed areas as long as they provide at least one or more of their life history requirements.

According to Feller and Kleeman (2007), non-breeding dry season habitat includes several characteristics: 1) sufficient moisture to allow the frogs to survive throughout the non-breeding season that may be up to 11 months long ; 2) sufficient cover to moderate temperatures during the warmest and coldest times of the year; and 3) protection (e.g., deep pools in a stream, or complex cover such as root masses or thick vegetation) from predators such as hawks and owls, herons, and small carnivores.

During other parts of the year, habitat includes nearly any area within 1-2 miles of a breeding site that stays moist and cool through the summer (Fellers 2005). According to Fellers (2005), this can include vegetated areas with coyote bush (*Baccharis pilularis*), California blackberry thickets (*Rubus ursinus*), and root masses associated with willow (*Salix* species) and California bay trees (*Umbellularia californica*). Sometimes the non-breeding habitat used by red-legged frogs is extremely limited in size. For example, non-breeding red-legged frogs have been found in a 6-foot wide coyote bush thicket growing along a tiny intermittent creek surrounded by heavily grazed grassland (Fellers 2005). Sheltering habitat for red-legged frogs is potentially all aquatic, riparian, and upland areas within the range of the species and includes any landscape features that provide cover, such as existing animal burrows, boulders or rocks, organic debris such as downed trees or logs, and industrial debris. Agricultural features such as drains, watering troughs, spring boxes, abandoned sheds, or hay stacks may also be used. Incised stream channels with portions narrower and depths greater than 18 inches also may provide important summer sheltering habitat. Accessibility to sheltering habitat is essential for the survival of red-legged frogs within a watershed, and can be a factor limiting frog population numbers and survival.

Red-legged frogs do not have a distinct breeding migration (Fellers 2005). Adult frogs are often associated with permanent bodies of water. Some frogs remain at breeding sites all year while others disperse. Dispersal distances are typically less than 0.5 mile (0.8 kilometers), with records of a few individuals moving up to 1-2 miles (Fellers 2005). Movements are typically along riparian corridors, but some individuals, especially on rainy nights, move directly from one site to another through normally inhospitable habitats, such as heavily grazed pastures or oak-grassland savannas (Fellers 2005). Dispersing frogs in northern Santa Cruz County traveled distances from 0.25 miles to more than 2 miles without apparent regard to topography, vegetation type, or riparian corridors (Bulger *et al.* 2003). Fellers and Kleeman (2007) and Bulger et al. (2003) found that California red-legged frog migration corridors can be less "pristine" (e.g., closely grazed fields, plowed agricultural lands) than breeding or non-breeding habitats. Bulger *et al.* (2003) observed that this listed ranid did not avoid or prefer any landscape feature or vegetation type. They tracked individuals that crossed agricultural land, including recently tilled fields and areas with mature crops. The threats facing migrating California red-legged frogs during their movements include being run over by vehicles on roads (Gibbs 1998; Vos and Chardon 1998), degradation of habitat (Vos and Stumpel 1995; Findlay and Houlahan 1997; Gibbs 1998), predation (Gibbs 1998), and dessication (Rothermel and Semlistch 2002; Mazerolle and Desrochers 2003).

Egg masses contain about 2,000 to 5,000 moderate sized (0.08 to 0.11 inches in diameter), dark reddish brown eggs and are typically attached to vertical emergent vegetation, such as bulrushes (*Scirpus* species) or cattails (Jennings *et al.* 1992). Red-legged frogs are often prolific breeders, laying their eggs during or shortly after large rainfall events in late winter and early spring (Hayes and Miyamoto 1984). Eggs hatch in 6 to 14 days (Jennings 1988). In coastal lagoons, the most significant mortality factor in the pre-hatching stage is water salinity (Jennings *et al.* 1992). Eggs exposed to salinity levels greater than 4.5 parts per thousand results in 100 percent mortality (Jennings and Hayes 1990). Increased siltation during the breeding season can cause asphyxiation of eggs and small larvae. Larvae undergo metamorphosis 3.5 to 7 months after hatching (Storer 1925; Wright and Wright 1949; Jennings and Hayes 1990). Of the various life stages, larvae probably experience the highest mortality rates, with less than 1 percent of eggs laid reaching metamorphosis (Jennings *et al.* 1992). Sexual maturity normally is reached at 3 to 4 years of age (Storer 1925; Jennings and Hayes 1985). Red-legged frogs may live 8 to 10 years (Jennings *et al.* 1992). Populations of red-legged frogs fluctuate from year to year. When conditions are favorable red-legged frogs can experience extremely high rates of reproduction and thus produce large numbers of dispersing young and a concomitant increase in the number of occupied sites. In contrast, red-legged frogs may temporarily disappear from an area when conditions are stressful (e.g., drought).

The diet of red-legged frogs is highly variable. Hayes and Tennant (1985) found invertebrates to be the most common food items. According to their data, vertebrates, such as Pacific tree frogs and California mice (*Peromyscus californicus*) represent over half the prey mass eaten by larger frogs (Hayes and Tennant 1985). Hayes and Tennant (1985) found juvenile frogs to be active diurnally and nocturnally, whereas adult frogs were largely nocturnal. The diet of red-legged frogs is not well studied, but their diet is likely similar to other ranid frogs that feed on algae, diatoms, and detritus by grazing on the surface of rocks and vegetation (Fellers 2005; Kupferberg 1996a, 1996b).

Several researchers in central California have noted the decline and eventual local disappearance of California and northern red-legged frogs in systems supporting bullfrogs (Jennings and Hayes 1990; Twedt 1993), red swamp crayfish (*Procambarus clarkii*), signal crayfish (*Pacifastacus leniusculus*), and several species of warm water fish including sunfish (*Lepomis* species), goldfish (*Carassius auratus*), common carp (*Cyprinus carpio*), and mosquitofish (L. Hunt, in litt. 1993; S. Barry, in litt. 1992; S. Sweet, in litt. 1993). Habitat loss, non-native species introduction, and urban encroachment are the primary factors that have adversely affected the red-legged frog throughout its range.

Several researchers in central California have noted the decline and eventual disappearance of red-legged frog populations once bullfrogs became established at the same site (L. Hunt, in litt. 1993; S. Barry, in litt. 1992; S. Sweet, in litt. 1993). This has been attributed to predation, competition, and reproduction interference. Twedt (1993) documented bullfrog predation of juvenile northern red-legged frogs (*Rana aurora aurora*), and suggested that bullfrogs could prey on subadult northern red-legged frogs as well. Bullfrogs may also have a competitive advantage over red-legged frogs. For instance, bullfrogs are larger and possess more generalized food habits (Bury and Whelan 1984). In addition, bullfrogs have an extended breeding season (Storer 1933) during which an individual female can produce as many as 20,000 eggs (Emlen 1977). Further more, bullfrog larvae are unpalatable to predatory fish (Kruse and Francis 1977). Bullfrogs also interfere with red-legged frog reproduction. Both California and northern red-legged frogs have been observed in amplexus (mounted on) with both male and female bullfrogs (Jennings and Hayes 1990; Twedt 1993; M. Jennings, in litt.1993; R. Stebbins in litt. 1993). Thus bullfrogs are able to prey upon and out-compete red-legged frogs, especially in sub-optimal habitat.

The urbanization of land within and adjacent to red-legged frog habitat has also adversely affected red-legged frogs. These declines are attributed to channelization of riparian areas, enclosure of the channels by urban development that blocks red-legged frog dispersal, and the introduction of predatory fishes and bullfrogs. The conversion and isolation of perennial pool habitats resulting from urbanization is an ongoing impact to red-legged frogs.

The California red-legged frog may be susceptible to many of the same pathogens, fungi, water mold, bacteria, and viruses have been known to adversely affect tiger salamander species or other amphibians. As with the California tiger salamander, Chytridiomycosis and ranaviruses may be a particular developing concern for California red-legged frog populations. Mao *et al.* (1999 cited in Fellers 2005) reported northern red-legged frogs infected with an iridovirus, which was also presented in sympatric three-spined sticklebacks (*Gasterosteus aculeatus*) in northwestern California. Ingles (1932a, 1932b, and 1933 cited in Fellers 2005) reported four species of trematodes from red-legged frogs, but he later synonymized two of them (found them to be the same as the other two). Nonnative species, such as bullfrogs and nonnative tiger salamanders, are both located within the range of the California red-legged frog and have been identified as potential carriers of these diseases. Human activities can facilitate the spread of disease by encouraging the further introduction of non-native carriers and by acting as carriers themselves (i.e. contaminated boots or fishing equipment). Human activities can also introduce stress by other means, such as habitat fragmentation, that results in red-legged frogs being more susceptible to the effects of disease. Disease will likely become a growing threat because of the relatively small, fragmented remaining California red-legged frog breeding sites, the many stresses on these sites due to habitat losses and alterations, translocation of infected animals, and the many other potential disease-enhancing anthropogenic changes which have occurred both inside and outside the species' range.

The recovery plan for red-legged frogs identifies eight Recovery Units (Service 2002). The establishment of these Recovery Units is based on the Recovery Team's determination that various regional areas of the species' range are essential to its survival and recovery. The status of the red-legged frog will be considered within the smaller scale of Recovery Units as opposed to the overall range. These Recovery Units are delineated by major watershed boundaries as defined by U.S. Geological Survey hydrologic units and the limits of the range of the California red-legged frog. The goal of the draft recovery plan is to protect the long-term viability of all extant populations within each Recovery Unit. Within each Recovery Unit, core areas have been delineated and represent contiguous areas of moderate to high red-legged frog densities that are relatively free of exotic species such as bullfrogs. The goal of designating core areas is to protect metapopulations that, combined with suitable dispersal habitat, will allow for the long term viability within existing populations. This management strategy will allow for the recolonization of habitat within and adjacent to core areas that are naturally subjected to periodic localized extinctions, thus assuring the long-term survival and recovery of red-legged frogs. The Marin-Sonoma Narrows Project is within Recovery Unit 3 (North Coast and North San Francisco Bay) (Service 2002).

Project Segments A and C cross through urbanized area with little potential upland red-legged frog habitat but with urban creek crossing that include degraded riparian habitat and non-native predators of this animal. Although urban, Washington and Lynch creeks in Segment C have well developed riparian cover within their confines and provide habitat for California red-legged frogs.

The habitat in and surrounding the action area of Segment B is rural and characterized by rolling oak grasslands and creeks with well-developed riparian systems. The development in Segment B is primarily limited to several large ranches and the dominate land use is cattle grazing. Based on the habitat conditions it appears likely that there is suitable upland and aquatic red-legged frog habitat throughout Segment B. According to Caltrans assessment, potential California red-legged frog habitat on both sides of the roadway that would be affected in Segment B amounts to 206.94 acres. Therefore, the Service has determined it is reasonable to conclude the California red-legged frog inhabits and has the potential to be encountered within 206.94 acres of the action area, based on the biology and ecology of the species, and the presence of suitable habitat.

Salt Marsh Harvest Mouse

The salt marsh harvest mouse was federally listed as endangered in 1970 (Service 1970). Critical habitat has not been proposed or designated. A detailed account of the taxonomy, ecology, and biology of the salt marsh harvest mouse is presented in the *Salt Marsh Harvest Mouse & California Clapper Rail Recovery Plan* (Service 1984) (Recovery Plan) and the references cited therein. The salt marsh harvest mouse is a Fully Protected Species under California law (See California Fish and Game Code Section 4700).

The salt marsh harvest mouse is a rodent endemic to the salt and brackish marshes of the San Francisco Bay Estuary and adjacent tidally influenced areas. The salt marsh harvest mouse closely resembles the western harvest mouse (*R. megalotis*). The salt marsh harvest mouse typically weighs about 0.35 ounce, has a head and body length ranging from 2.7-2.9 inches, a tail length ranging from 2.6-3.2 inches, and a hind foot length of 0.7 inch (Fisler 1965). As stated in the recovery plan, the salt marsh harvest mouse, when compared to the western harvest mouse, have darker ears, belly and back, and a slightly thicker, less pointed and unicolored tail. The salt marsh harvest mouse is further distinguished taxonomically into the northern and southern subspecies, *R. raviventris halicoetes* and *R. raviventris raviventris*, respectively. Of the two subspecies, *R. r. halicoetes* more closely resembles *R. megalotis*, and can be difficult to differentiate in the field; body color and color of ventral hairs as well as the thickness and shape of the tail have been used to distinguish the two.

The salt marsh harvest mouse has evolved to a life in tidal marshes. Specifically, they have evolved to depend mainly on dense pickleweed as their primary cover and food source. However, salt marsh harvest mice may utilize a broader source of food and cover which includes saltgrass (*Distichlis spicata*) and other vegetation typically found in the salt and brackish marshes of this region. In natural systems, salt marsh harvest mice can be found in the middle tidal marsh and upland transition zones. Upland refugia is an essential habitat component during high tide events. Salt marsh harvest mice are highly dependent on cover, and open areas as small as 33 feet wide may act as barriers to movement (Shellhammer 1978, as cited in Service 1984). The salt marsh harvest mouse does not burrow. It has been noted that the northern subspecies may build nests of loose grasses.

As described by Fisler (1965), male salt marsh harvest mice are reproductively active from April through September, but may appear active throughout the year. Females are reproductively active from March to November, and have a mean litter size of approximately four offspring.

The historic range of the species included tidal marshes within the San Francisco and San Pablo bays, east to the Collinsville-Antioch areas. Agriculture and urbanization has claimed much of the former historic tidal marshes, resulting in a 79 percent reduction in the amount of tidal marshes in these areas (Goals Project 1999). At present, the distribution of the northern subspecies occurs along Suisun and San Pablo Bays north of Point Pinole in Contra Costa County and Point Pedro in Marin County. The southern subspecies is found in marshes in Corte Madera, Richmond, and South San Francisco Bay mostly south of the San Mateo Bridge (Highway 92).

The preservation and growth of existing populations of the salt marsh harvest mouse is considered important to assuring the survival of this species. The Recovery Plan identifies essential habitat areas to be preserved or restored throughout the Estuary to meet the recovery objectives for this species. No essential habitat for the salt marsh harvest mouse is identified within the action area in the Recovery Plan.

Although no surveys for salt marsh harvest mice have been conducted within the action area, pickleweed-vegetated tidal wetlands and other potential habitat areas of suitable for the salt marsh harvest mouse occur within the action area at the Petaluma Bridge crossing. Salt marsh harvest mice have been detected in tidal marshes approximately 0.5 mile downstream of the Petaluma Bridge portion of the action area. Given that the salt marsh harvest mouse recovery plan identified four essential habitat areas on the Petaluma River and the species is known throughout the Petaluma Marsh Wildlife Area downstream of the Petaluma Bridge it is likely that salt marsh harvest mice would be found in pickleweed habitat throughout the tidally influenced portions of the Petaluma River system. As noted in the May 2008 Biological Assessment, California Department of Fish and Game biologist Fred Botti stated that the listed mouse may use the pickleweed habitat at the Petaluma Bridge crossing for migration or dispersal. Therefore, given the biology and ecology of this animal, the presence of occupied habitat in other nearby tidal marshes, and recent records, the salt marsh harvest mouse is likely to inhabit the action area.

Effects of the Proposed Action

California Red-Legged Frog

The proposed project could have adverse effects on the threatened California red-legged frog through mortality, injury, harassment, and harm of individual juveniles and adults. According to the August 5, 2008, Caltrans letter, the proposed actions will adversely affect 206.94 acres of California red-legged frog habitat. According to Caltrans, the affects amount to 203.78 acres of permanent effects and 3.16 acres of temporary effects associated with the creation of bioswales.

The proposed project likely will result in adverse effects to the feeding, resting, aestivation, movement, and other essential behaviors of the California red-legged frog. It will result in the loss and degradation of habitat. The primary east-west habitat connectivity in Segment B is at the existing bridge spanned creek crossings. The bridge widening at these locations is unlikely to present any barriers to those movement corridors. Construction and maintenance of properly sized and located culverts likely will minimize this adverse effect of the threatened California red-legged frog (see Rodriguez *et al.* 1996; Yanes *et al.* 1905).

Construction activities associated with the proposed project would remove vegetation and other materials necessary for cover and aestivation, fill or crush burrows or crevices, and potentially reduce the prey base for the California red-legged frog. Because this listed amphibian uses small mammal burrows and soil crevices for shelter, individuals may be crushed, buried, or otherwise injured during construction activities. California red-legged frogs also may be run over by construction equipment or other vehicles accessing the construction areas. Disturbance caused by construction activities may cause frogs to disperse into areas of unsuitable habitat, increase the risk of predation or other sources of mortality. Siltation, fill, or spill of petroleum products or other chemicals could cause loss of prey items in or adjacent to the project area. Construction activities are likely to result in the direct disturbance, displacement, injury, and/or morality of California red-legged frogs. Individuals likely are to be killed or injured by construction equipment or other vehicles accessing the construction site. There is a likelihood of direct injury or mortality to the animal from injury or death due to pet cats or dogs owned by construction related personnel, poisoning by pesticides, injury or death due to predators attracted to food or trash at the site, and harassment from night-lighting, noise, and vibration. Implementation of certain types of erosion control materials, such as plastic netting, could result in the entanglement and death of California red-legged frogs within these materials due to exposure or predators (Bartin and Kinkead 2005; Stuart *et al.* 2001). Disturbance from construction activities may also cause individuals to move into or across areas of unsuitable habitat where they may be prone to higher rates of mortality from vehicles and predation.

Range-wide habitat loss, fragmentation, and degradation from multiple factors are the primary threats to the California red-legged frog (Service 1996, 2004). Loss of natural lands continues to occur further reducing the habitat available for this listed animal. However, the amount of historical and current habitat loss directly attributable to road loss has not been calculated, but the effect of habitat fragmentation on the California red-legged frog is significant. Fragmentation can reduce access to habitat as well as habitat suitability, increase mortality of animals that are moving between habitat patches due to increased risk of predation, and disrupt movements, dispersal, and gene flow. As barriers to movement for the California red-legged frog, roads create smaller patches of habitat and increase patch isolation. Smaller populations of animals are at greater risk of extinction by chance from demographic, genetic, and environmental stochastic events (Wilcox and Murphy 1985; Schoener and Spiller 1992). Isolated populations also have a higher chance of extinction without the demographic and genetic input of immigrants and a lower chance of colonization after extinction (Lande 1988; Sjogren-Gulve 1994).

The short term temporal effect will occur when suitable habitat is lost when riparian and other vegetation vegetation is removed for construction of the highway, and also due to the improved ability of predators to hunt the listed amphibian. Hilty and Merender (2004) found that, in contrast to native species, non-native mammalian predators were more active in narrow and denuded riparian corridors and in large expanses of agricultural land (vineyards) far from core habitat. The increased width of the highway along with higher numbers of vehicles and speed of the cars and trucks likely will discourage or prevent movement by the California red-legged frog.

The necessity of moving between multiple habitats and breeding ponds means that many amphibian species, such as the California red-legged frog are especially vulnerable to roads in the landscape. Van Gelder (1973) and Cooke (1995) have examined the effect of roads on amphibians; and found that because of their activity patterns, population structure, and preferred habitats, aquatic breeding amphibians are more vulnerable to traffic mortality than some other species.

Fahrig *et al.* (1995) found that high traffic two-lane paved roads had a much larger effect on frog abundance than low traffic two-lane roads. Mortality rates for anurans on high traffic roads are higher than on low traffic roads (Hels and Buchwald 2001). Vos and Chardon (1998) found a significant negative effect of road density on the occupation probability of ponds by the moor frog (*Rana arvalis*) in the Netherlands. In addition, incidences of very large numbers of road-killed frogs are well documented (e.g., Asley and Robinson 1996), and studies have shown strong population level effects of traffic density (Carr and Fahrig 2001) and high traffic roads on these amphibians (Van Gelder 1973; Vos and Chardon 1998). Most studies regularly count road kills from slow moving vehicles (Hansen 1982; Rosen and Lowe 1994; Drews 1995; Mallick *et al.* 1998) or by foot (Munguira and Thomas 1992). These studies assume that every victim is observed, which may be true for large conspicuous mammals, but it certainly is not true for small animals, such as the California red-legged frog. Amphibians appear especially vulnerable to traffic mortality because they readily attempt to cross roads, are slow-moving and small, and thus can not easily be avoided by drivers (Carr and Fahrig 2001).

The direction and type of habitat used by dispersing animals is especially important in fragmented environments (Forys and Humphrey 1996). Models of habitat patch geometry predict that individual animals will exit patches at more "permeable" areas (Buechner 1987; Stamps *et al.* 1987). A landscape corridor may increase the patch-edge permeability by extending patch habitat (La Polla and Barrett 1993), and allow individuals to move from one patch to another. The geometric and habitat features that constitute a "corridor" must be determined from the perspective of the animal (Forys and Humphrey 1996).

State Route 101 from Navato to Petaluma is a formidable barrier to California red-legged frog and general wildlife movement. There are existing bridge and culvert crossings that have the potential to provide wildlife passage under State Route 101. As part of the project, Caltrans plans to upsize the diameter of approximately 36 culvert pipes and one reinforced concrete box (RCB). These replacements will include the installation of two 18-inch pipes, twenty 24-inch pipes, six 30-inch pipes, one 36-inch pipe, two 42-inch pipes, one 43-inch pipe and a 6 foot by 3 foot RCB. In addition, Caltrans will install approximately 41 new culvert pipes, including one new 7 foot by 7 foot cattle pass. These new structures include five 18-inch pipes, fifteen 24-inch pipes, four 30-inch pipes, three 36-inch pipes, one 42-inch pipe, and two 48-inch double pipes. There are also existing crossing structures in Segment B that are not subject to project alteration. Those include two 7- to 10-foot high cattle crossings and eight 2- to 7-foot high RCBs.

The project will provide more opportunity for wildlife passage under State Route 101, however, it is doubtful if frogs will use long corregated culverts across a 80-foot or wider roadway that are not day-lighted, do not have a natural bottom, and do not have regular maintenance to prevent filling with sediment and debris. The dimension of the tunnels is considered one of the most important variables in the design of passage ways for vertebrates (Yanes *et al.* 1995; Rodriguez *et al.* 1996); although no studies have determined a minimum width for the California red-legged frog, passages made for other small vertebrates, such as salamanders, must be wide and tall enough to enable animals to clearly see to the opposite end of the culvert, or there is lighting along the culvert provided by overhead grates. Ng *et al.* (2004) note that culverts typically are installed to accommodate water flow, the installation of such passage ways solely for listed species and wildlife, especially across major roadways, is justified if no other passages or crossings exist and there is suitable habitat. It is also important that the crossing attract target listed species and wildlife; fencing or other measures be incorporated into a wildlife crossing to guide animals to the preferred crossing; the crossing be placed strategically to enhance habitat connectivity; and that the adjacent land use be conducive to long-term habitat protection (Portland State University 2003). The culverts, RCBs, and cattle crossings proposed by Caltrans may not adequately minimize the reduction or elimination of the movement of the California red-legged frog. The long term viability of any designated wildlife crossing is questionable unless crossing locations and the habitat on both sides of the crossing are permanently set aside as open space or have a conservation easement or some other designation that limits development. In addition, hog wire apparently will not be placed on the bottom one foot of the highway perimeter fence to deter frogs from entering the roadway and guide them towards safe crossings. The culverts may not be high enough to allow the animals to see through them to the other side of the roadway, improper placement in areas where the animals will not use them, and the uncertainty of maintenance and silt removal at drainage-associated crossings could eliminate their potential use by the frogs. The lack of hog wire will result in individuals crossing the roadway where they are more likely to be killed by vehicles.

Larger culverts, e.g. at least 72 inches tall, grates placed midway on the culvert to allow lighting to encourage the animals to use them, placement in areas where the animals are moving through, and appropriate, maintenance and silt removal, and the use of properly sized hog wire along the bottom of the highway perimeter fence to guide the California red-legged frog to the culverts, RCBs, and cattle crossings should increase the potential for these animals to move across the State Route 101 right-of-way in areas other than the bridged creek crossings.

Road studies suggest that properly designed passage can significantly reduce wildlife, including frog mortality (Dodd *et al.* 2004). The Town of Amherst in the State of Massachusetts installed two culverts with guiding fences to facilitate spotted salamander (*Ambystoma maculatum*) migration from their wintering burrows during the spring. Before the placement of these culverts under Henry Street, a two-lane street, salamander mortality was high. After installation, approximately 75.9% of animals that reached the tunnel entrances successfully passed through them (Jackson 1996).

The installation of a concrete median will present a definitive barrier to California red-legged frog movement over the road. Within the concrete medians, Caltrans plans to install Type S barriers for wildlife crossing every 20 feet and Type M wildlife crossings would be installed every 0.25 miles. Type S barriers are a type 60 concrete barrier with a 6 inch diameter opening at the base of the barrier for small animal passage. Type M wildlife crossings are a type 60 concrete barrier with a 2-foot break in the barrier, with the break protected by a thrie-beam guard rail to deflect vehicle traffic. Given the amount of traffic on State Route 101 it is unlikely that frogs will be able to successfully cross the road even if they do manage to find these openings.

Though the intent of wildlife culverts and crossings are to ensure safe passage of listed species and wildlife, they are also a benefit to human safety (Aleshire 2007; Ruediger and DiGiorgio undated; Sherwood 2007). Deer-automobile collisions, estimated by the Insurance Information Institute to occur at a rate of 500,000 per year, result in over $1 billion worth of vehicular damages, 29,000 human injuries, and 200 human fatalities each year (Cornell University). Insurance company, State Farm estimates that there were more than 1.2 million claims for damage in crashes with animals during the last half of 2007 and the first half of 2008 (Highway Loss Data Institute 2008). Although most animal strikes do not result in human injury, human deaths resulting from animal collision is increasing (Highway Loss Data Institute 2008). Culverts large enough to accommodate species such as deer (*Odocoileus* species) and mountain lion (*Felis concolor*), while maintaining substrates for the California red-legged frog and smaller wildlife, could reduce roadway collisions for a variety of species. For example, wildlife crossings of the Trans-Canada Highway in Canada's Banff National Park have reduced wildlife road mortality by 80%, and as much as 96% for ungulates (Robbins 2003).

Because their habitats have been fragmented, many endangered and threatened species exist as metapopulations (Verboom and Apeldom 1990; Verboom *et al.* 1991). A metapopulation is a collection of spatially discrete subpopulations that are connected by the dispersal movements of the individuals (Levins 1970; Hanski 1991). For metapopulations of listed species, a prerequisite to recovery is determining if unoccupied habitat patches are vacant due to the attributes of the habitat patch (food, cover, and patch area) or due to patch context (distance of the patch to other patches and distance of the patch to other features). Subpopulations on patches with higher quality food and cover are more likely to persist because they can support more individuals. Large populations have less of a chance of extinction due to stochastic events (Gilpin and Soule 1986). Similarly, small patches will support fewer individuals, increasing the rate of extinction. Patches that are near occupied patches are more likely to be recolonized when local extinction occurs and may benefit from emigration of individuals via the "rescue" effect (Hanski 1982; Gotelli 1991; Holt 1993; Fahrig and Merriam 1985). For the metapopulation to persist, the rate of patches being colonized must exceed the rate of patches going extinct (Levins 1970). If some subpopulations go extinct regardless of patch context, recovery actions should be placed on patch attributes. Patches could be managed to increase the availability of food and/or cover. Movements and dispersal corridors likely are critical to California red-legged frog population dynamics, particularly because the animals likely currently persist as metapopulations with disjunct population centers. Movement and dispersal corridors are important for alleviating over-crowding and intraspecific competition, and also they are important for facilitating the recolonization of areas where the animal has been extirpated. Movement between population centers maintains gene flow and reduced genetic isolation. Genetically isolated populations are at greater risk of deleterious genetic effects such as inbreeding, genetic drift, and founder effects. The survival of wildlife species in fragmented habitats may ultimately depend on their ability to move among patches to access necessary resources, retain genetic diversity, and maintain reproductive capacity within populations (Hilty and Merenlender 2004; Petit *et al.* 1995; Buza *et al.* 2000).

Most metapopulation or meta-population-like models of patchy populations do not directly include the effects of dispersal mortality on population dynamics (Hanski 1994; With and Crist 1995; Lindenmayer and Possingham 1996). Based on these models, it has become a widely held notion that more vagile species have a higher tolerance to habitat loss and fragmentation than less vagile species. But models that include dispersal mortality predict exactly the opposite: more vagile species should be more vulnerable to habitat loss and fragmentation becase they are more susceptible to dispersal mortality (Fahrig 1998; Casagrandi and Gatto 1999). This prediction is supported by Gibbs (1998), who examined the presence-absence of five amphibian species across a gradient of habitat loss. He found that species with low dispersal rates are better able than more vagile species top persist in landscapes with low habitat cover. Gibbs (1998) postulated that the land between habitat serves as a demographic "drain" for many amphibians. Furthermore, Bonnet *et al.* (1999) found that snake species that use frequent long-distance movements have higher mortality rates than do sedentary species.

The construction activities at the proposed project could result in the introduction of chemical contaminants to the site. Substances used in road building materials or could leach out or wash out of the soil into adjacent habitat. Vehicles may leak hazardous substances such as motor oil and antifreeze. A variety of substances could be introduced during accidental spills of materials. Such spills can result from leaks in vehicles, small containers falling off vehicles, or from accidents resulting in whole loads being spilled. Large spills may be partially or completely mitigated by clean-up efforts, depending on the substance. California red-legged frogs using these areas could be exposed to any contaminants that are present at the site. Exposure pathways could include inhalation, dermal contact, direct ingestion, or ingestion of contaminated soil or plants. Exposure to contaminants could cause short- or long-term morbidity, possibly resulting in reduced productivity or mortality. Carcinogenic substances could cause genetic damage resulting in sterility, reduced productivity, or reduced fitness among progeny. Little information is available on the effects of contaminants on the California red-legged frog. The effects may be difficult to detect. Morbidity or mortality likely would occur after the animals had left the contaminated site, and more subtle effects such as genetic damage could only be detected through intensive study and monitoring.

Preconstruction surveys and the relocation of individual red-legged frogs may reduce injury or mortality. However, the capturing and handling of red-legged frogs to remove them from a work area may result in the harassment, mortality or injury of individuals. Stress, injury, and mortality may occur as a result of improper handling, containment, and transport of individuals. Death and injury of individual red-legged frogs could occur at the time of relocation or later in time subsequent to their release. Although survivorship for translocated red-legged frogs has not been estimated, survivorship of translocated wildlife, in general, is lower because of intraspecific competition, lack of familiarity with the location of potential breeding, feeding, and sheltering habitats, risk of contracting disease in foreign environment, and increased risk of predation. Improper handling, containment, or transport of individuals would be reduced or prevented by use of a Service-approved biologist, by limiting the duration of handling, limited the distance of translocation, and requiring the proper transport.

Biologists, construction workers, and construction equipment working in different areas and with different species may transmit diseases by introducing contaminated equipment. The chance of a disease being introduced into a new area is greater today than in the past due to the increasing occurrences of disease throughout amphibian populations in California and the United States. It is possible that chytrid fungus may exacerbate the effects of other diseases on amphibians or increase the sensitivity of the amphibian to environmental changes (e.g., water pH) that reduce normal immune response capabilities (Bosch *et al.* 2001). Implementation of the "Declining Amphibian Populations Task Force Fieldwork Code of Practice" during any aquatic survey activity will likely prevent transfer of diseases through contaminated equipment or clothing.

Construction of roads can facilitate the invasion and establishment by species not native to the area (Gelbard and Belnap 2003) or are native and are better competitors than the California red-legged frog, such as the bullfrog, that could feed on or compete with, the listed amphibian or its food sources. Disturbance and alteration of habitat adjacent to roads may create favorable conditions for non-native plants and animals. These exotic species can spread along roadsides and then into adjacent habitat. Non-native animals may use modified habitats adjacent to road to disperse into California red-legged frog habitat. These animals could compete with the listed ranid for resources such as food or cover, or directly injure or kill the amphibians. Non-native plants and animals may reduce habitat quality for the threatened frog, and reduce the productivity or the local carrying capacity for the animals. Introductions of non-native species could cause California red-legged frogs to alter behavioral patterns by avoiding or abandoning areas near road.

Disturbed areas adjacent to roads provide favorable habitat conditions for a number of non-native plant species. Some of these taxa are aggressively invasive and they can alter natural communities and potentially affect habitat quality. A problematic species within the range of the California red-legged frog is yellow star thistle (*Centaurea melitensis*). Dense stands of this plant can form along roadsides and then spread into adjacent habitat. This plant displaces native vegetation, competes with native plants for resources, and it may be difficult for the animals to move through due the plant's numerous sharp spines. Other species that may disperse along roads and invade adjacent riparian habitats include mustards (*Brassica* species) and Russian thistle (*Salsola tragus*) (Tellman 1997). Disturbed soils and reduced competition from native plants are some of the conditions that facilitate invasion along roads by non-native plant species.

Negative effects to wildlife populations from roads may extend some distance from the actual road, as the proposed project. The phenomenon can result from any of the effects already described in this biological opinion, such as vehicle-related mortality, habitat degradation, and invasive exotic species. Forman and Deblinger (1998) described the area affected as the "road effect" zone. Along a 4-lane road in Massachusetts, they determined that this zone extend for an average of approximately 980 feet to either side of the road for an average total zone width of approximately 1970 feet. However, in places they detected an effect > 0.6 mile from the road. Rudolph *et al* (1999) detected reduced snake abundance up to 2790 feet from roads in Texas. They estimated snake abundance out to 2790 feet, so the effect may have been greater. Extrapolating to a landscape scale, they concluded the effect of roads on snake populations in Texas likely was significant, given that approximately 79% of the land area of the Lone Star State is within 1640 feet of a road. The "road-zone" effects can be subtle. Van der Zandt *et al.* (1980) reported that lapwings (*Vanellus vanellus*) and black-tailed godwits (*Limosa limosa*) feeding at 1575 feet-6560 feet from roads were disturbed by passing vehicles. The heart rate, metabolic rate and energy expenditure of female bighorn sheep (*Ovis canadensis*) increases near roads (MacArthur *et al.* 1979). Trombulak and Frossell (2000) described another type of "road-zone' effect. Heavy metal concentrations from vehicle exhaust were greatest within 66 feet of roads, by elevated levels of metals in both soil and plants were detected at 660 feet of roads. The "road-zone" apparently varies with habitat type and traffic volume. Based on responses by birds, Forman (2000) estimated the effect zone along primary roads of 1000 feet in woodlands, 1197 feet in grasslands, and 2657 feet) in natural lands near urban areas. Along secondary roads with lower traffic volumes, the effect zone was 656 feet. The "road zone" and the California red-legged frog have not been adequately investigated.

The proposed compensation for the effects to 203.78 acres of California red-legged frog habitat will likely be beneficial to this listed species in Marin and/or Sonoma Counties. Caltrans proposes expenditure of the funds to purchase California red-legged frog credits at a Service-approved approved conservation bank, establishment of a Service-approved conservation easement, or obtaining fee title to habitat acquisition.

Caltrans is entertaining the possibility of obtaining a conservation easement at the Lawson's Landing property at Dillon Beach in Marin County. Lawson's Landing property is approximately 940 acres, and is one of the few areas remaining in coastal California with an active dune system that is not under permanent conservation status. The site supports a high proportion of dune slack wetlands with breeding habitat for the California red-legged frog. It has the largest expanse of native coastal scrub vegetation on paleodunes north of Monterey. The beach supports one of the largest wintering populations for the threatened western snowy plover (*Charadrius alexandrinus nivosus*) between San Francisco and the northern end of their range in Washington State. The endangered Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*) has been documented in the past as well as the endangered Tidestrom's lupine (*Lupinus tidestromii*) and the potential exists to repatriate these species for their recovery. The dunes and wetlands host numerous other special status plants and invertebrates that are adapted to shifting sands and coastal wetlands. The site not only offers important biological resources, but geological interest, as well as stunning scenic resources. The area contains important habitat for the California red-legged frog, as well as other listed species. Not all of the Lawson's Landing property provides habitat for the California red-legged frog but the establishment of a conservation easement on the California red-legged frog habitat within the Lawson's Landing property likely will provide benefits to several listed species, as well as native wildlife.
There are also several ranchers in Marin and Sonoma Counties that would be willing to sell conservation easements on their land that would allow them to maintain ecologically sustainable grazing while providing in-perpetuity management for the California red-legged frog. Conservation easements would be especially valuable for this listed frog in areas of designated or proposed California red-legged frog critical habitat.

Salt Marsh Harvest Mouse

Construction and other work activities at the Petaluma River Bridge crossing would permanently eliminate about 0.05 acres of pickleweed-vegetated habitat currently available for salt marsh harvest mice. Construction and other work activities in and around the pickleweed habitat near the Petaluma River Bridge crossing could affect individual salt marsh harvest mice through increased disturbance and habitat destruction. Increased levels of disturbance to salt marsh harvest mice would result from noise and vibrations from equipment and other work activities. Operation of equipment and associated loss of habitat would result in displacement of salt marsh harvest mice from protective cover and their territories/home ranges (through noise and vibrations) and/or direct injury or mortality (through crushing). These disturbances likely would disrupt normal behavior patterns of breeding, foraging, sheltering, and dispersal, and likely result in the displacement of salt marsh harvest mice from their territory/home range in the areas where their habitat is destroyed. Displaced salt marsh harvest mice may have to compete for resources in occupied habitat, and may be more vulnerable to predators. Female salt marsh harvest mice are reproductively active from March through November (Fisler 1965), so disturbance during this period could result in abandonment or failure of their litter. Thus, displaced salt marsh harvest mice may suffer from increased predation, competition, mortality, and reduced reproductive success.

Salt marsh harvest mice could be harmed if the habitat area affected by the proposed action is colonized by non-native, invasive plant species. The proposed action could result in the invasion of non-native plant species in the habitat area off the Petaluma River and subsequently into adjacent habitat areas for the salt marsh harvest mouse and California clapper rail. If established in these habitat areas, these non-native plant species could limit the habitat value of these areas for salt marsh harvest mice and California clapper rails by out competing and preventing or limiting the establishment of native wetland plant species. Successful removal of non-native, invasive plant species could prevent, or at least severely reduce the establishment of these undesirable species and ensure that current habitat values are reestablished or increased.

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Numerous non-Federal activities continue to negatively affect the California red-legged frog in Marin and Sonoma Counties. Habitats are lost or degraded as a result of road and utility construction and maintenance, overgrazing, agricultural expansion, and water irrigation and storage projects that may not be funded, permitted, or constructed by a Federal agency. Other threats include contamination, poisoning, increased predation, and competition from non-native species associated with human development. Small private actions that may impact listed species, such as conversion of land, small mammal population control, mosquito control, and residential development, may occur without consultation with or authorization by the Service or the California Department of Fish and Game pursuant to their respectively Endangered Species Act.

As urban development continues, it will likely adversely affect upland areas that serve as dispersal and aestivation habitat for red-legged frogs. Continued development and maintenance of roadways to serve expanding urban areas may further fragment and isolate populations of red-legged frogs from other nearby populations. Increased predation associated with domesticated pets or feral animals generally accompanies urban expansion. As urban development encroaches on rural areas, the need increases for mosquito abatement programs that may introduce exotic fish into ponds used for breeding by red-legged frogs, thus impacting the reproductive success of this species.

Increased levels of vehicles and increased vehicle speeds could lead to an increased mortality level for the California red-legged frog. The cumulative local development will result in temporary and permanent habitat fragmentation. The results of fragmentation are inhibition of genetic exchange between populations and impediments to recolonization of habitats from which populations have been extirpated. Small, isolated populations are substantially more vulnerable to stochastic events (e.g., aberrant weather patterns, fluctuations in availability of food) and may exhibit reduced adaptability to environmental (natural or anthropogenic) changes.

There is a continued demand for new housing and commercial development in Marin and Sonoma Counties and other road and development projects have been recently completed or are planned along the State Route 1, State Route 12, State Route 101, and State Route 116. These developments and further infill will eliminate the habitat connectivity between listed species habitat remaining habitat in the action area vicinity and the local region. Development of adjacent wildlife habitat will continue to result in the loss of not only breeding, resting, and foraging habitat, but the loss of dispersal corridors between breeding populations, thereby further isolating and fragmenting wildlife populations. Additionally, development of small reservoirs or water bodies, such as golf course hazards, and water diversions may occur which may pose further threats such as disruption of dispersal corridors for terrestrial species, and competition or predation from with non-native species such as bullfrogs for aquatic species.

Cumulative effects to the California red-legged frog include continuing and future conversion of suitable breeding, foraging, sheltering, and dispersal habitat resulting from urban development. Additional urbanization can result in road widening and increased traffic on roads that bisect habitat, thereby increasing road-kill while reducing in size and further fragmenting remaining habitats.

Cattle-grazing is a common land use practice in rural Marin and Sonoma Counties. Overgrazing results in degradation and loss of riparian vegetation, increased water temperatures, streambank and upland erosion, and decreased water quality in streams. Livestock operations may also degrade water quality with pesticides and nutrient contamination. However, light to moderate livestock grazing is generally thought to be compatible with continued successful use of rangelands by the red-legged frog and other listed species, provided the grazed areas do not also have intensive burrowing rodent control efforts (T. Jones, in litt. 1993; Shaffer et al. 1993). The shorter vegetation associated with grazed areas may make the habitat more suitable for ground squirrels whose burrows are utilized by red-legged frogs. Rodent control in rural areas in Marin and Sonoma Counties could contribute to the decline of red-legged frogs in the region, as well as other sensitive species that utilize burrows created by burrowing rodents.

Agricultural development, impoundments, and irrigation can reduce stream flows, resulting in the loss of aquatic habitat during the summer for red-legged frogs. Discing is a common practice on agricultural lands which can result in substantial losses of upland habitat for red-legged frogs. Significant conversion of rural, undeveloped land to agricultural land, particularly vineyards, is currently occurring in Sonoma County, resulting in loss of upland habitat for listed species. California red-legged frogs likely are exposed to a variety of pesticides and other chemicals throughout their ranges. This amphibian species could also die from starvation due to the loss of their prey base. Hydrocarbon and other contamination from oil production and road runoff; the application of numerous chemicals for roadside maintenance; urban/suburban landscape maintenance; and rodent and vector control programs may all have negative effects on red-legged frog populations. In addition, red-legged frogs may be harmed through increased road kill due to the construction and use of new roads and increased traffic in the overall region and collection by amphibian enthusiast and others.

Further habitat fragmentation; additional non-native species introduction; translocation of infected individuals, and increased access to aquatic habitat could facilitate or increase the spread of amphibian diseases within the range of the California red-legged frog. The global mass extinction of amphibians primarily due to chytrid fungus continues to be of significant concern (Norris 2007; Skerratt *et al* 2007).

The global average temperature has risen by approximately 0.6 degrees centigrade during the 20th Century (International Panel on Climate Change 2001, 2007; Adger et al 2007). There is an international scientific consensus that most of the warming observed has been caused by human activities (International Panel on Climate Change 2001, 2007; Adger et al. 2007), and that it is "very likely" that it is largely due to increasing concentrations of greenhouse gases (carbon dioxide, methane, nitrous oxide, and others) in the global atmosphere from burning fossil fuels and other human activities (Cayan et al. 2005, EPA Global Warming webpage http://yosemite. epa.gov; Adger et al. 2007). Eleven of the twelve years between 1995 and 2006 rank among the twelve warmest years since global temperatures began in 1850 (Adger et al. 2007). The warming trend over the last fifty years is nearly twice that for the last 100 years (Adger et al. 2007). Looking forward, under a high emissions scenario, the International Panel on Climate Change estimates that global temperatures will rise another four degrees centigrade by the end of this Century; even under a low emissions growth scenario, the International Panel on Climate Change estimates that the global temperature will go up another 1.8 degrees centigrade (International Panel on Climate Change 2001).

The increase in global average temperatures affects certain areas more than others. The western United States, in general, is experiencing more warming than the rest of the Nation, with the 11 western states averaging 1.7 degrees Fahrenheit warmer temperatures than this region's average over the 20th Century (Saunders et al. 2008). California, in particular, will suffer significant consequences as a result of global warming (California Climate Action Team 2006). In California, reduced snowpack will cause more winter flooding and summer drought, as well as higher temperatures in lakes and coastal areas. The incidence of wildfires in the Golden State also will increase and the amount of increase is highly dependent upon the extent of global warming. No less certain than the fact of global warming itself is the fact that global warming, unchecked, will harm biodiversity generally and cause the extinction of large numbers of species. If the global mean temperatures exceed a warming of two to three degrees centigrade above pre-industrial levels, twenty to thirty percent of plant and animal species will face an increasingly high risk of extinction (International Panel on Climate Change 2001, 2007).

The mechanisms by which global warming may push already imperiled species closer or over the edge of extinction are multiple. Global warming increases the frequency of extreme weather events, such as heat waves, droughts, and storms (International Panel on Climate Change 2001, 2007; California Climate Action Team 2006; Lenihan et al. 2003). Extreme events, in turn may cause mass mortality of individuals and significantly contribute to determining which species will remain or occur in natural habitats. As the global climate warms, terrestrial habitats are moving northward and upward, but in the future, range contractions are more likely than simple northward or upslope shifts. Ongoing global climate change (Anonymous 2007; Inkley et al. 2004; Adger et al. 2007; Kanter 2007) likely imperils the California red-legged frog and the resources necessary for its survival. Since climate change threatens to disrupt annual weather patterns, it may result in a loss of their habitats and/or prey, and/or increased numbers of their predators, parasites, and diseases. Where populations are isolated, a changing climate may result in local extinction, with range shifts precluded by lack of habitat.

Numerous activities continue to eliminate habitats of salt marsh harvest mice. Habitat loss and degradation affecting this species continues as a result of urbanization, freshwater urban run-off, and contaminant inputs. Salt marsh harvest mice are also affected by increased predation associated with human development, and disturbance of breeding and foraging behavior. All of these non-Federal activities are expected to continue to adversely affect listed species considered in this opinion within the action area.

INCIDENTAL TAKE STATEMENT

Section 9(a)(1) of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened fish and wildlife species without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are non-discretionary, and must be implemented by FHWA so that they become binding conditions of any grant or permit issued to FHWA as appropriate, in order for the exemption in section 7(o)(2) to apply. FHWA has a continuing duty to regulate the activity covered by this Incidental Take Statement. If FHWA (1) fails to require Caltrans to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

Amount or Extent of Take

The Service anticipates that incidental take of the California red-legged frog will be difficult to detect because when California red-legged frogs are not in their breeding ponds, they inhabit the burrows of ground squirrels or other rodents; they may be difficult to locate due to their cryptic appearance and behavior; the juvenile and adult animals may be located a distance from the breeding ponds; the migrations occur on a limited period during rainy nights in the fall, winter, or spring; and the finding of an injured or dead individual is unlikely because of their relatively small body size. Recent project monitoring suggests that California red-legged frogs are difficult to find during preconstruction clearance surveys that include excavation of potential upland salamander refugia in close proximity to breeding ponds and other aquatic habitat. Losses of California red-legged frogs may also be difficult to quantify due to seasonal fluctuations in their numbers, random environmental events, changes in water regime at their breeding ponds, or additional environmental disturbances. Due to the difficulty in quantifying the number of California red-legged frogs that will be taken as a result of the proposed action, the Service is quantifying take incidental to the project as all of the California red-legged frogs inhabiting or utilizing the 206.94 acres of habitat identified within Segment B and Washington Creek and Lynch Creek in Segment C. The incidental take is expected to be in the form of harm, harassment, injury, and mortality to adult California red-legged frogs from habitat loss/degradation, construction-related disturbance, and capture and relocation.

The Service anticipates incidental take of the salt marsh harvest mouse will be difficult to detect or quantify because of the variable, unknown size of any resident population over time, and the difficulty of finding killed or injured small mammals. The level of take of salt marsh harvest mice can be anticipated by the loss of available habitat. The Service considers the number of salt marsh harvest mice subject to harassment from noise and vibrations to be impracticable to estimate. Upon implementation of the Reasonable and Prudent Measures, incidental take associated with the proposed project in the form of harm, and harassment of the salt marsh harvest mouse caused by habitat loss and construction activities will become exempt from the prohibitions described under section 9 of the Act.

Upon implementation of the following reasonable and prudent measures incidental take associated with the proposed action described above for the California red-legged frog and salt marsh harvest mouse will become exempt from the prohibitions described under section 9 of the Act.

Effect of the Take

The Service determined that this level of anticipated take is not likely to result in jeopardy to the California red-legged frog or the salt marsh harvest mouse. There is no designated or proposed critical habitat for the listed frog in the action area and critical habitat has not been designated for the salt marsh harvest mouse.

Reasonable and Prudent Measures

The following reasonable and prudent measures are necessary and appropriate to minimize the effect of the proposed action on the California red-legged frog and the salt marsh harvest mouse. FHWA will be responsible for compliance with these measures which they will entrust Caltrans to implement:

1. FHWA will ensure the conservation measures in the project description as described in the May 2008, Biological Assessment, the August 27, 2008 revised project description, and this biological opinion will be implemented.

2. FHWA will ensure adverse effects to the California red-legged frog and the salt marsh harvest mouse will be minimized.

3. FHWA will ensure their compliance with this biological opinion.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, with implementation under the direction of Caltrans, FHWA shall ensure compliance with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are nondiscretionary.

1. The following Terms and Conditions implement Reasonable and Prudent Measure one (1):

    a. FHWA shall minimize the potential for harm, harassment, or killing of federally listed wildlife species resulting from project related activities by implementation of the conservation measures as described in the May 2008, Biological Assessment, the August 27, 2008 revised project description, and appearing in the *Project Description* of this biological opinion.

    b. FHWA/Caltrans shall include Special Provisions that include the Conservation Measures and the Terms and Conditions of this biological opinion in the solicitation for bid information. In addition, Caltrans shall educate and inform contractors involved in the project as to the requirements of the biological opinion.

    c. Caltrans and FHWA have proposed to provide 1:1 compensation for the effects to 203.78 acres of California red-legged frog habitat. Acceptable compensation shall be satisfied through in-perpetuity preservation of high quality red-legged frog habitat consisting of a breeding and/or significant dispersal habitat between breeding populations or a biological equivalent site similar to Lawson's Landing through purchase of bank credits and/or acquisition of a conservation easement or fee title. Purchase of the site shall be reviewed and approved by the Service.

If a compensation bank is proposed in lieu of acquisition it shall be a Service-approved bank.

An approved ecologically-based conservation easement shall include restricted public access, a management plan, and an in-perpetuity endowment or other permanent non-wasting management fund based on a property analysis. The management plan shall include a description of the site, management needs (e.g. grazing plan, non-native vegetation and animal control, etc), when the management activities should be implemented, how often and to what level monitoring of the site shall occur, and a action/contingency plan to address potential management issues.

Proposed habitat acquisition shall also be accompanied by a Service-approved conservation easement that shall include restricted public access, a management plan, and an in-perpetuity endowment based on a property analysis.

Caltrans will demonstrate measurable progress in proving the Service approved compensation prior to initiating construction in Segment B in Phase 1, not no later than initiating construction on Phase 2.

d. Wildlife crossings established in Segment B shall be reviewed and approved by the Service.

e. FHWA/Caltrans shall prepare a relocation plan for moving California red-legged frogs that will be submitted to the Service for review and approval at least thirty (30) calendar days prior to the date of groundbreaking.

2. The following Terms and Conditions implement Reasonable and Prudent Measure two (2):

a. The Resident Engineer or their designee shall be responsible for implementing the conservation measures and Terms and Conditions of this biological opinion and shall be the point of contact for the project. The Resident Engineer or their designee shall maintain a copy of this biological opinion onsite whenever construction is taking place. Their name and telephone number shall be provided to the Service at least thirty (30) calendar days prior to groundbreaking at the project. Prior to ground breaking, the Resident Engineer must submit a letter to the Service verifying that they posses a copy of this biological opinion and have read the Terms and Conditions.

b. The Caltrans biologist shall have oversight over implementation of all the Terms and Conditions in this biological opinion, and shall have the authority to stop project activities, through communication with the Resident Engineer or their designee, if any of the requirements associated with these Terms and Conditions are not being fulfilled. If biologist/construction liaison has requested a stop work due to take of any of the listed species the Service and the California Department of Fish and Game will be notified within one (1) working day via email or telephone.

c. Only Service-approved biologist(s) who are familiar with the biology and ecology of the California red-legged frog shall capture or handle this listed species.

d. To control erosion during and after implementation of the project, the applicant will implement erosion control BMPs. Erosion control measures and BMPs, which retain soil or sediment, runoff from dust control, and hazardous materials on the construction site and prevent these from entering aquatic habitat, will be placed, monitored, and maintained throughout the construction operations. These measures and BMPs may include, but are not limited to, silt fencing, sterile hay bales, vegetative strips, hydroseeding, and temporary sediment disposal.

e. Nets or bare hands may be used to capture California red-legged frogs. Service-approved biologists will not use soaps, oils, creams, lotions, repellents, or solvents of any sort on their hands within two hours before and during periods when they are capturing and relocating red-legged frogs. To avoid transferring disease or pathogens between aquatic habitats during the course of surveys or handling of red-legged frogs, Service-approved biologists will follow the Declining Amphibian Populations Task Force's "Code of Practice." Service-approved biologists will limit the duration of handling and captivity of red-legged frogs. While in captivity, individual frogs shall be kept in a cool, moist, aerated environment, such as a bucket containing a damp sponge. Containers used for holding or transporting adults shall not contain any standing water. California red-legged frogs should not be moved outside their functional population in order to reduce translocation stress and the spread of disease.

f. Biologists shall take precautions to prevent introduction of amphibian diseases to the action area by disinfecting equipment and clothing as directed in the October 2003, California tiger salamander survey protocol titled, Interim Guidance on Site Assessment and Field Surveys for Determining Presence or a Negative Finding of the California Tiger Salamander and the recommended equipment decontamination procedures within the Service's California Red-Legged Frog Survey Guidance. Both items are available at the Service's Sacramento office website (http://www.fws.gov/sacramento/es/protocol.htm). Disinfecting equipment and clothing is especially important when biologists are coming to the action area to handle salamanders or frogs after working in other aquatic habitats.

g. All California red-legged frogs encountered in the action area should be relocated to a Service-approved location. The relocation site must be approved for the Marin Sonoma Narrows Project prior to ground breaking.

h. An outline of the employee environmental awareness program shall be submitted to the Deputy Assistant Field Supervisor of the Endangered Species Program at the Sacramento Fish and Wildlife Office within twenty (20) working days prior to the start of construction. Documentation of the training, including individual signed affidavits, will be kept of file and available on request.

i. Permanent and temporary disturbances and other types of project-related disturbance to the habitats of the California red-legged frog and the salt marsh harvest mouse shall be minimized to the maximum extent practicable by Caltrans. To minimize temporary disturbances, all project-related vehicle traffic shall be restricted to established roads, construction areas, and other designated areas. These areas also should be included in pre-construction surveys and, to the maximum extent possible, should be established in locations disturbed by previous activities to prevent further adverse effects.

j. Areas disturbed by project activities will be recontoured to pre-project conditions and reseeded with an appropriate erosion-control mixture. The seed mixture will include appropriate native grasses and forbs. Areas that will be subjected to ongoing maintenance are not areas of temporary effects even if they are restored within one year following the initial disturbance.

k. Construction activities shall not occur adjacent to the pickleweed wetland on the north side of the Petaluma River during high tide events of eight feet or greater (as determined by NAVD88 vertical datum) when salt marsh harvest mice might seek refuge outside of the adjacent inundated tidal marsh. Activities shall not resume until the water level has dropped below the eight foot NAVD88 elevation.

3. The following Terms and Conditions implement Reasonable and Prudent Measure three (3):

a. The following shall be implemented for staging, storage sites, vehicle parking, and access associated with the project:

1. Caltrans shall require as part of the construction contract that all contractors comply with the Act in the performance of the work as described in the project description of this biological opinion and conducted within the action area.

2. If a staging, storage, access, or vehicle parking area that is in compliance with the Act is not available, the agency with jurisdiction and the contractor would be responsible for compliance with the Act.

c. Caltrans shall report to the Service any information about take or suspected take of listed wildlife species not authorized by this biological opinion. Caltrans must notify the Service via electronic mail and telephone within 24 hours of receiving such information. Notification must include the date, time, location of the incident or of the finding of a dead or injured animal, and photographs of the specific animal. The individual animal shall be preserved, as appropriate, and held in a secure location until instructions are received from the Service regarding the disposition of the specimen or the Service takes custody of the specimen. The Service contacts are Chris Nagano, Division Chief, Endangered Species Program, Sacramento Fish and Wildlife Office at (916) 414-6600, and Resident Agent-in-Charge Dan Crum of the Service's Law Enforcement Division at (916) 414-6660.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities that can be implemented to further the purposes of the Act, such as preservation of endangered species habitat, implementation of recovery actions, or development of information and data bases.

The Service requests notification of the implementation of any conservation recommendations in order to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats. We propose the following conservation recommendations:

1. FHWA, Caltrans, Transportation Authority of Marin, and Sonoma County Transportation Authority should assist the Service in implementing recovery actions identified in the *Recovery Plan for the California Red-legged Frog* (Service 2002).

2. Caltrans should consider participating in the planning for a regional habitat conservation plan for the California red-legged frog, salt marsh harvest mouse, other listed species, and sensitive species.

3. FHWA, Caltrans, Transportation Authority of Marin, and Sonoma County Transportation Authority should consider establishing functioning preservation and creation conservation banking systems to further the conservation of the California red-legged frog, salt marsh harvest mouse, and other listed species. Such banking systems also could possibly be utilized for other required mitigation (i.e., seasonal wetlands, riparian habitats, etc.) where

appropriate. Efforts should be made to preserve habitat along roadways in association with wildlife crossings.

4. Roadways can constitute a major barrier to critical wildlife movement. Therefore, FHWA, Caltans, Transportation Authority of Marin, and Sonoma County Transportation Authority should incorporate culverts, tunnels, or bridges on highways and other roadways that allow safe passage by California red-legged frog, other listed animals, and wildlife. Photographs, plans, and other information in to the biological assessments if "wildlife friendly" crossings are incorporated into projects. Efforts should be made to establish upland culverts designed specifically for wildlife movement rather than accommodations for hydrology. Transportation agencies should also acknowledge the value of enhancing human safety by providing safe passage for wildlife in their early project design.

5. FHWA and Caltrans should continue to pursue multifaceted compensation packages such as the one developed for the proposed U.S. Interstate 580/Isabel Avenue Interchange Construction Project on future formal consultations with the Service.

6. Caltrans should continue to develop and implement their Early Statewide Biological Mitigation Planning Project that has been developed by the University of California at Davis, Road Ecology Center through Caltrans funding.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed and/or proposed species or their habitats, the Service requests notification of the implementation of these recommendations.

REINITIATION--CLOSING STATEMENT

This concludes formal consultation on the proposed State Route 101 Marin-Sonoma Narrows HOV Widening Project, Marin and Sonoma Counties, California. As provided in 50 CFR §402.16 and in the terms and conditions of this biological opinion, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the final project design exceeds the described action area in the May 2008 Biological Assessment; (2) the amount or extent of incidental take is exceeded; (3) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (4) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (5) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

If you have questions concerning this opinion on the proposed State Route 101 Marin-Sonoma Narrows HOV Widening Project, Marin and Sonoma Counties, California, please contact John Cleckler or Ryan Olah at the letterhead address or at (916) 414-6600.

Sincerely,

for Susan K. Moore
Field Supervisor

cc:
Larry Vinzant, Cesar Perez, Federal Highway Administration, Sacramento, California
Dale Jones, California Department of Transportation, Sacramento, California
Jim Richards, John Yeakel, Kevin Melanephy, California Department of Transportation, Oakland, California
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Scott Wilson, Melissa Escaron, California Department of Fish and Game, Yountville, California
Guy Preston, Preston Engineering Management Consulting, Ashland, Oregon
Bill Gamlen, Transportation Authority of Marin, San Rafael, California
John Maitland, Seana Gause, Sonoma County Transportation Authority, Santa Rosa, California

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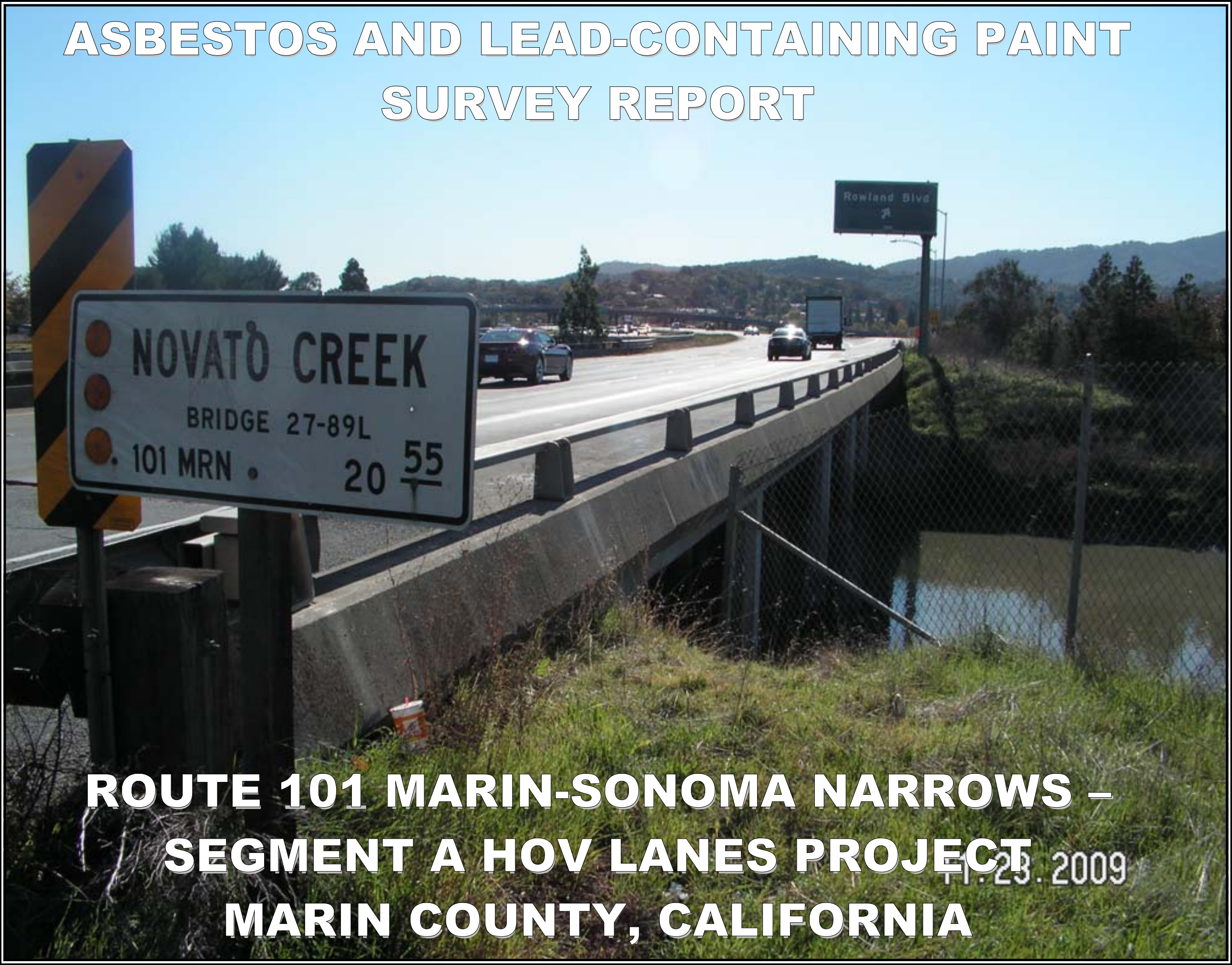
MATERIALS INFORMATION

ASBESTOS LEAD-CONTAINING PAINT SURVEY REPORT

ASBESTOS AND LEAD-CONTAINING PAINT SURVEY REPORT



ROUTE 101 MARIN-SONOMA NARROWS – SEGMENT A HOV LANES PROJECT
MARIN COUNTY, CALIFORNIA

PREPARED FOR:
CALTRANS DISTRICT 4
111 GRAND AVENUE, MS8C
OAKLAND, CALIFORNIA 94612

PREPARED BY:
GEOCON CONSULTANTS, INC.
6671 BRISA STREET
LIVERMORE, CALIFORNIA 94550

GEOCON PROJECT NO. E8435-06-40
CALTRANS EA 04-264061

FEBRUARY 2010

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ASBESTOS AND LEAD-CONTAINING PAINT SURVEY REPORT

REPORT LIMITATIONS

This asbestos and lead-containing paint (LCP) survey was conducted in conformance with generally accepted standards of practice for identifying and evaluating asbestos and LCP in structures. Due to the nature of structure surveys, asbestos and LCP use, and laboratory analytical limitations, some asbestos or LCP in the structures may not have been identified. Structure spaces such as cavities, crawlspaces, and pipe chases may have been concealed to our investigator. Previous structure renovation work may have concealed or covered spaces or materials, or may have partially demolished materials and left debris in inaccessible areas. Additionally, renovation activities may have partially replaced asbestos with indistinguishable non-asbestos materials. Asbestos or LCP may exist in areas of the structures not accessible or sampled in conjunction with this Task Order.

During renovation or demolition operations, suspect materials may be uncovered which are different from those accessible for sampling during this assessment. Personnel in charge of renovation/demolition should be alerted to note materials uncovered during such activities that differ substantially from those included in this or previous assessment reports. If suspect materials are found, additional sampling and analysis should be performed to determine if the materials contain asbestos or lead.

This report has been prepared exclusively for the State of California Department of Transportation (Caltrans) District 4. The information contained herein is only valid as of the date of the report, and will require an update to reflect additional information obtained.

This report is not a comprehensive site characterization and should not be construed as such. The findings as presented in this report are predicated on the results of the limited sampling and laboratory testing performed. In addition, the information obtained is not intended to address potential impacts related to sources other than those specified herein. Therefore, the report should be deemed conclusive with respect to only the information obtained. We make no warranty, express or implied, with respect to the content of this report or any subsequent reports, correspondence or consultation. Geocon strived to perform the services summarized herein in accordance with the local standard of care in the geographic region at the time the services were rendered.

The contents of this report reflect the views of the authors who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the State of California or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

GEOCON CONSULTANTS, INC

Chris Giuntoli, CAC
Senior Project Scientist

David Watts, CAC
Senior Project Scientist

CALIFORNIA DEPARTMENT OF TRANSPORTATION – DISTRICT 4
OFFICE OF ENVIRONMENTAL ENGINEERING

Reviewed By:	Recommended by:	Approved By:
Ms. Nandini Vishwanath Task Order Manager	Chris Wilson, P.E. District Branch Chief	Allen Baradar, P.E., REA District Office Chief

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Dan Kocher 408.934.7010 408.934.7015 fax sanleandrolab@emsl.com	EMSL Analytical, Inc. 2235 Polvorosa Avenue San Leandro, CA 94577 (*Geocon Subcontractor*)	Asbestos Analysis

EXECUTIVE SUMMARY

This asbestos and lead-containing paint (LCP) survey report for the Marin Sonoma Narrows (MSN) – Segment A High Occupancy Vehicle (HOV) Lanes Project was prepared by Geocon Consultants, Inc., under California Department of Transportation (Caltrans) Contract No. 04A2912 and Task Order 40 (TO-40), under EA 04-264061. This work was conducted between Highway 101 Post Mile (PM) 18.6 and PM 22.2 in Marin County, California. We performed an asbestos and LCP survey on the following bridges at the project location:

- Novato Creek Bridge (Bridge No. 27-0089R),
- Franklin Avenue Overhead (OH) (Bridge No. 27-0090R and 27-0090L), and
- Olive Avenue Undercrossing (UC) (Bridge No. 27-0092R).

The project location is depicted on the Vicinity Map, Figure 1, and Site Plan, Figure 2. Caltrans has requested an investigation at the project location to provide data regarding the presence of asbestos and LCP at the bridges prior to roadway widening activities.

This report documents the investigation sampling methods and laboratory analytical data. The primary objective of our survey was to determine and quantify asbestos and LCP at the project location prior to renovation or demolition activities. The information obtained from this investigation will be used by Caltrans to coordinate proposed renovation or demolition activities, determine appropriate abatement/disposal costs, and identify health and safety concerns during improvements.

The field investigation was performed on November 23, 2009. The following field activities were performed during asbestos and LCP sampling efforts:

- Collected 14 bulk suspect asbestos samples at the project location;
- Collected one suspect LCP sample at the project location; and
- Transported samples to Caltrans-approved, California-certified environmental laboratories.

Samples were collected from locations as shown on the Site Plan, Figure 2. Suspect asbestos and LCP sample identification numbers are presented in Tables 1 and 2, respectively. Materials represented by the samples collected are presented in the Site Photographs.

Bulk suspect asbestos samples were collected after first wetting the material with a light mist of water. The samples were then cut from the substrate and transferred to labeled containers and sealed. Fourteen suspect materials were identified during the survey (see Table 1). Sampling locations were distributed throughout the homogeneous areas (spaces where the material was observed).

We relinquished bulk samples for asbestos analysis using standard chain-of-custody documentation. Asbestos content was determined using EPA Test Method 600/R-93/116 for polarized light microscopy (PLM). We requested laboratory analyses to be within a 5-day turn-around-time.

The bulk paint sample was collected using techniques presented in U.S. Department of Housing and Urban Development (HUD) guidelines. One paint system was identified during the survey (see Table 2).

> *It was not Geocon's intent during this inspection to conduct an evaluation of lead-based paint hazards in accordance with HUD guidelines. HUD protocol generally requires a very extensive sampling strategy that includes sampling of paint on each surface type.*

We relinquished the bulk paint sample for lead analysis using standard chain-of-custody documentation. Total lead content was determined using EPA Test Method 6010B. We requested laboratory analysis to be within a 5-day turn-around-time.

Chrysotile asbestos at a concentration of 85% was detected in samples representing nonfriable asbestos sheet packing used as barrier rail shims on the Novato Creek Bridge (Bridge 27-0089R), the Franklin Avenue OH (Bridges 27-0090R and L), and the Olive Avenue OC (Bridge 27-0092R). We were not able to quantify the amount of barrier rail shim material due to safety concerns (i.e., traffic). No asbestos was detected in samples of the remaining suspect materials collected. A summary of the analytical laboratory test results for asbestos is presented in Table 1. Reproductions of the laboratory report and chain-of-custody documentation are presented in Appendix A.

The laboratory analyses for lead paint indicated a bulk sample representing intact multi-layer graffiti abatement paint used on the Franklin Avenue OH (Bridge No. 27-0090R) exhibited a total lead concentration of 5.0 milligrams per kilogram. Painted surfaces were not observed on the Novato Creek Bridge or the Olive Avenue OC. Our paint sample laboratory result is summarized in Table 2. Reproductions of the lead laboratory report and chain-of-custody documentation are presented in Appendix A.

We provide the following conclusions and recommendations based on the results of our investigation.

NESHAP regulations do not require that asbestos-containing sheet packing used in barrier rail systems on Bridges 27-0089R, 27-0090R, 27-0090L, and 27-0092R (a Category I nonfriable/nonhazardous material) identified during our survey be removed prior to demolition or treated as hazardous waste. However, the disturbance of the material is still covered by the Cal/OSHA asbestos standard (Title 8, CCR Section 1529). We recommend that a licensed contractor registered with Cal/OSHA for asbestos-related work perform activities that would disturb the asbestos-containing material. Contractors are responsible for informing the landfill of the contractor's intent to dispose of asbestos-containing waste. Some landfills may require additional waste characterization. Contractors are responsible for segregating and characterizing waste streams prior to disposal.

In accordance with Bay Area Air Quality Management District (BAAQMD) Regulation 11, Rule 2, written notification is required ten working days prior to commencement of *any* demolition activity (whether asbestos is present or not). In accordance with Title 8, CCR 341.9, written notification to the nearest Cal/OSHA district office is required at least 24 hours prior to certain asbestos-related work.

Geocon recommends that all paints at the project location (graffiti, graffiti abatement, signage, traffic striping, etc.) be treated as lead-containing for purposes of determining the applicability of the Cal/OSHA lead standard during any future maintenance, renovation, or demolition activities. This recommendation is based on the LCP sample result and the fact that lead was a common ingredient of paints manufactured before 1978 and is still an ingredient of some industrial paints. In accordance with Title 8, CCR, Section 1532.1(p), written notification to the nearest Cal/OSHA district office is required at least 24 hours prior to certain lead-related work.

ASBESTOS AND LEAD-CONTAINING PAINT SURVEY REPORT

1.0 INTRODUCTION

This asbestos and lead-containing paint (LCP) survey report for the Marin Sonoma Narrows (MSN) – Segment A High Occupancy Vehicle (HOV) Lanes Project was prepared by Geocon Consultants, Inc., under California Department of Transportation (Caltrans) Contract No. 04A2912 and Task Order 40 (TO-40), under EA 04-264061. This work was conducted between Highway 101 Post Mile (PM) 18.6 and PM 22.2 in Marin County, California. This report documents the investigation sampling methods and laboratory analytical data.

1.1 Site Description and Proposed Improvements

We performed an asbestos and LCP survey on the following bridges at the project location:

- Novato Creek Bridge (Bridge No. 27-0089R),
- Franklin Avenue Overhead (OH) (Bridge No. 27-0090R and 27-0090L), and
- Olive Avenue Undercrossing (UC) (Bridge No. 27-0092R).

The project location is depicted on the Vicinity Map, Figure 1, and Site Plan, Figure 2. Caltrans has requested an investigation at the project location to provide data regarding the presence of asbestos and LCP prior to roadway widening activities.

1.2 Purpose

This report documents the investigation sampling methods and laboratory analytical data. The primary objective of our survey was to determine and quantify asbestos and LCP at the project location prior to roadway widening activities. The information obtained from this investigation will be used by Caltrans to coordinate proposed renovation or demolition activities, determine appropriate abatement/disposal costs, and identify health and safety concerns during improvements.

2.0 BACKGROUND

The *Code of Federal Regulations (CFR),* 40 CFR 61, Subpart M, National Emissions Standards for Hazardous Air Pollutants (NESHAP) and Federal Occupational Safety and Health Administration (FED OSHA) classify asbestos-containing material (ACM) as any material or product that contains *greater than* 1% asbestos. Nonfriable ACM is classified by NESHAP as either Category I or Category II material defined as follows:

- **Category I** – asbestos-containing packings, gaskets, resilient floor coverings, and asphalt roofing products.
- **Category II** – all remaining types of nonfriable asbestos-containing material not included in Category I that when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.

Regulated asbestos-containing material (RACM), a hazardous waste when friable, is classified as any manufactured material that contains *greater than* 1% asbestos by dry weight *and* is:

- Friable; or
- Category I material that has become friable; or
- Category I material that has been subjected to sanding, grinding, cutting, or abrading; or
- Category II nonfriable material that has a high probability of becoming crumbled, pulverized, or reduced to a powder during demolition or renovation activities.

Activities that disturb materials containing *any* amount of asbestos are subject to certain requirements of the Cal/OSHA asbestos standard contained in Title 8, CCR Section 1529. Typically, removal or disturbance of more than 100 square feet of material containing more than 0.1% asbestos must be performed by a registered asbestos abatement contractor, but associated waste labeling is not required if the material contains 1% or less asbestos. When the asbestos content of a material exceeds 1%, virtually all requirements of the standard become effective.

Materials containing more than 1% asbestos are also subject to NESHAP regulations (40 CFR Part 61, Subpart M). RACM (friable ACM and nonfriable ACM that will become friable during demolition operations) must be removed from structures prior to demolition. Certain nonfriable ACM and materials containing 1% or less asbestos may remain in structures during demolition; however, there are waste handling/disposal issues and Cal/OSHA work requirements that must be followed. Contractors are responsible for segregating and characterizing waste streams prior to disposal.

With respect to potential worker exposure, notification, and registration requirements, Cal/OSHA defines asbestos-containing construction material (ACCM) as construction material that contains more than 0.1% asbestos (Title 8, CCR 341.6).

2.2 Lead Paint

Construction activities (including demolition) that disturb materials or paints containing *any* amount of lead are subject to certain requirements of the Cal/OSHA lead standard contained in Title 8, CCR, Section 1532.1. Deteriorated paint is defined by Title 17, CCR, Division 1, Chapter 8, §35022 as a surface coating that is cracking, chalking, flaking, chipping, peeling, non-intact, failed, or otherwise separating from a component. Demolition of a deteriorated LCP component would require waste characterization and appropriate disposal. Most landfill facilities and recyclers currently accept intact LCP on a component; however, contractors are responsible for segregating and characterizing waste streams prior to disposal.

For a solid waste containing lead, the waste is classified as California hazardous when: 1) the total lead content equals or exceeds the respective Total Threshold Limit Concentration (TTLC) of 1,000 milligrams per kilogram (mg/kg); or 2) the soluble lead content equals or exceeds the respective Soluble Threshold Limit Concentration (STLC) of 5 milligrams per liter (mg/l) based on the standard Waste Extraction Test (WET). A waste has the potential for exceeding the lead STLC when the waste's total lead content is greater than or equal to ten times the respective STLC value since the WET uses a 1:10 dilution ratio. Hence, when total lead is detected at a concentration greater than or equal to 50 mg/kg, and assuming that 100 percent of the total lead is soluble, soluble lead analysis is required. Lead-containing waste is classified as "Resource, Conservation, and Recovery Act" (RCRA) hazardous, or Federal hazardous, when the soluble lead content equals or exceeds the Federal regulatory level of 5 mg/l based on the Toxicity Characteristic Leaching Procedure (TCLP).

The above regulatory criteria are based on chemical concentrations. Wastes may also be classified as hazardous based on other criteria such as ignitability; however, for the purposes of this investigation, toxicity (i.e., lead concentrations) is the primary factor considered for waste classification since waste generated during the construction activities would not likely warrant testing for ignitability or other criteria. Waste that is classified as either California hazardous or RCRA hazardous requires management as a hazardous waste.

Potential hazards exist to workers who remove or cut through LCP coatings during demolition. Dust containing hazardous concentrations of lead may be generated during scraping or cutting materials coated with LCP. Torching of these materials may produce lead oxide fumes. Therefore, air monitoring and/or respiratory protection may be required during the demolition of materials coated with LCP. Guidelines regarding regulatory provisions for construction work where workers may be exposed to lead are presented in the Title 8, CCR, Section 1532.1.

2.3 Architectural Drawings and Previous Survey Activities

Architectural drawings and previous survey reports for the project were not available for our review.

3.0 SCOPE OF SERVICES

The following scope of services was performed:

3.1 Pre-Field Activities

- Retained the services of EMSL, Inc. (EMSL), a Caltrans-approved laboratory accredited by the National Voluntary Laboratory Accreditation Program (NVLAP), to perform the asbestos analyses.
- Retained the services of Advance Technology Laboratories, Inc. (ATL), a Caltrans-approved laboratory, to perform the lead paint analysis.

3.2 Field Activities

Mr. Chris Giuntoli, a California-certified Asbestos Consultant (CAC), Certification No. 02-3163 (expiration June 18, 2010), and Certified Lead Paint Inspector with the California Department of Public Health (DPH), Certification No. I-5502 (expiration June 14, 2010) performed the asbestos and LCP survey on November 23, 2009. Fourteen bulk samples of suspect ACM were collected. One bulk sample of suspect LCP was collected.

4.0 INVESTIGATIVE METHODS

4.1 Asbestos

Bulk suspect asbestos samples were collected after first wetting the material with a light mist of water. The samples were then cut from the substrate and transferred to labeled containers and sealed. We observed eight suspect materials during the survey (see Table 1). Sampling locations were distributed throughout the homogeneous areas (spaces where the material was observed).

We relinquished bulk samples for asbestos analysis using standard chain-of-custody documentation. Asbestos content was determined using EPA Test Method 600/R-93/116 for polarized light microscopy (PLM). We requested laboratory analyses to be within a 5-day turn-around-time.

4.2 Lead Paint

The bulk paint sample was collected using techniques presented in U.S. Department of Housing and Urban Development (HUD) guidelines. One paint system was identified during the survey (see Table 2).

> *It was <u>not</u> Geocon's intent during this inspection to conduct an evaluation of lead-based paint hazards in accordance with HUD guidelines. HUD protocol generally requires a very extensive sampling strategy that includes sampling of paint on each surface type.*

We relinquished the bulk paint sample for lead analysis using standard chain-of-custody documentation. Total lead content was determined using EPA Test Method 6010B. We requested laboratory analysis to be within a 5-day turn-around-time.

5.0 INVESTIGATIVE RESULTS

5.1 Asbestos

Chrysotile asbestos at a concentration of 85% was detected in samples representing nonfriable asbestos sheet packing used as barrier rail shims on the Novato Creek Bridge (Bridge 27-0089R), the Franklin Avenue OH (Bridges 27-0090R and L), and the Olive Avenue OC (Bridge 27-0092R). We were not able to quantify the amount of barrier rail shim material due to safety concerns (i.e., traffic).

No asbestos was detected in samples of the remaining suspect materials collected. A summary of the analytical laboratory test results for asbestos is presented in Table 1. Reproductions of the laboratory report and chain-of-custody documentation are presented in Appendix A.

5.2 Lead Paint

The laboratory analyses for lead paint indicated the bulk sample representing intact multi-layer graffiti abatement paint used on the Franklin Avenue OH (Bridge No. 27-0090R) exhibited a total lead concentration of 5.0 mg/kg.

Painted surfaces were not observed on the Novato Creek Bridge or the Olive Avenue OC.

Our paint sample laboratory result is summarized in Table 2. Reproductions of the lead laboratory report and chain-of-custody documentation are presented in Appendix A.

6.0 CONCLUSIONS

6.1 Asbestos

NESHAP regulations do not require that asbestos-containing sheet packing used in barrier rail systems on Bridges 27-0089R, 27-0090R, 27-0090L, and 27-0092R (a Category I nonfriable/nonhazardous material) identified during our survey be removed prior to demolition or treated as hazardous waste. However, the disturbance of the material is still covered by the Cal/OSHA asbestos standard (Title 8, CCR Section 1529). We recommend that a licensed contractor registered with Cal/OSHA for asbestos-related work perform activities that would disturb the asbestos-containing material. Contractors are responsible for informing the landfill of the contractor's intent to dispose of asbestos-containing waste. Some landfills may require additional waste characterization. Contractors are responsible for segregating and characterizing waste streams prior to disposal.

In accordance with Bay Area Air Quality Management District (BAAQMD) Regulation 11, Rule 2, written notification is required ten working days prior to commencement of *any* demolition activity (whether asbestos is present or not). In accordance with Title 8, CCR 341.9, written notification to the nearest Cal/OSHA district office is required at least 24 hours prior to certain asbestos-related work.

6.2 Lead Paint

Geocon recommends that all paints at the project location (graffiti, graffiti abatement, signage, traffic striping, etc.) be treated as lead-containing for purposes of determining the applicability of the Cal/OSHA lead standard during any future maintenance, renovation, or demolition activities. This recommendation is based on the LCP sample result and the fact that lead was a common ingredient of paints manufactured before 1978 and is still an ingredient of some industrial paints. In accordance with Title 8, CCR, Section 1532.1(p), written notification to the nearest Cal/OSHA district office is required at least 24 hours prior to certain lead-related work. The LCP identified during our survey would not be considered a California or Federal hazardous waste based on lead content.

TABLE 1
SUMMARY OF ANALYTICAL LABORATORY TEST RESULTS - ASBESTOS
ROUTE 101 MARIN-SONOMA NARROWS - SEGMENT A
MARIN COUNTY, CALIFORNIA

Polarized Light Microscopy (PLM) - EPA Test Method 600/R-93/116

Sample ID	Description of Suspect Material	Approximate Quantity	Friable	Site Photo	Asbestos Content
89R-1A 89R-1B	Novato Creek Bridge (Bridge 27-0089R) guard rail shim	Unable to safely quantify	No	2	85% 85%
89R-2A	Novato Creek Bridge (Bridge 27-0089R) black drain pipe	NA	NA	3	ND ND
90R-1A	Franklin Avenue Overhead (Bridge 27-0090R) guard rail shim	Unable to safely quantify	No	8	85%
90R-2A 90R-2B	Franklin Avenue Overhead (Bridge 27-0090R) brown fiberboard	NA	NA	9	ND ND
90L-1A 90L-1B	Franklin Avenue Overhead (Bridge 27-0090L) guard rail shim	Unable to safely quantify	No	14	85% 85%
90R-2A 90R-2B	Franklin Avenue Overhead (Bridge 27-0090L) brown fiberboard	NA	NA	15	ND ND
92R-1A 92R-1B	Olive Avenue Undercrossing (Bridge 27-0092R) guard rail shim	Unable to safely quantify	No	19	85% 85%
92R-2A 92R-2B	Olive Avenue Undercrossing (Bridge 27-0092R) brown fiberboard	NA	NA	20	ND ND

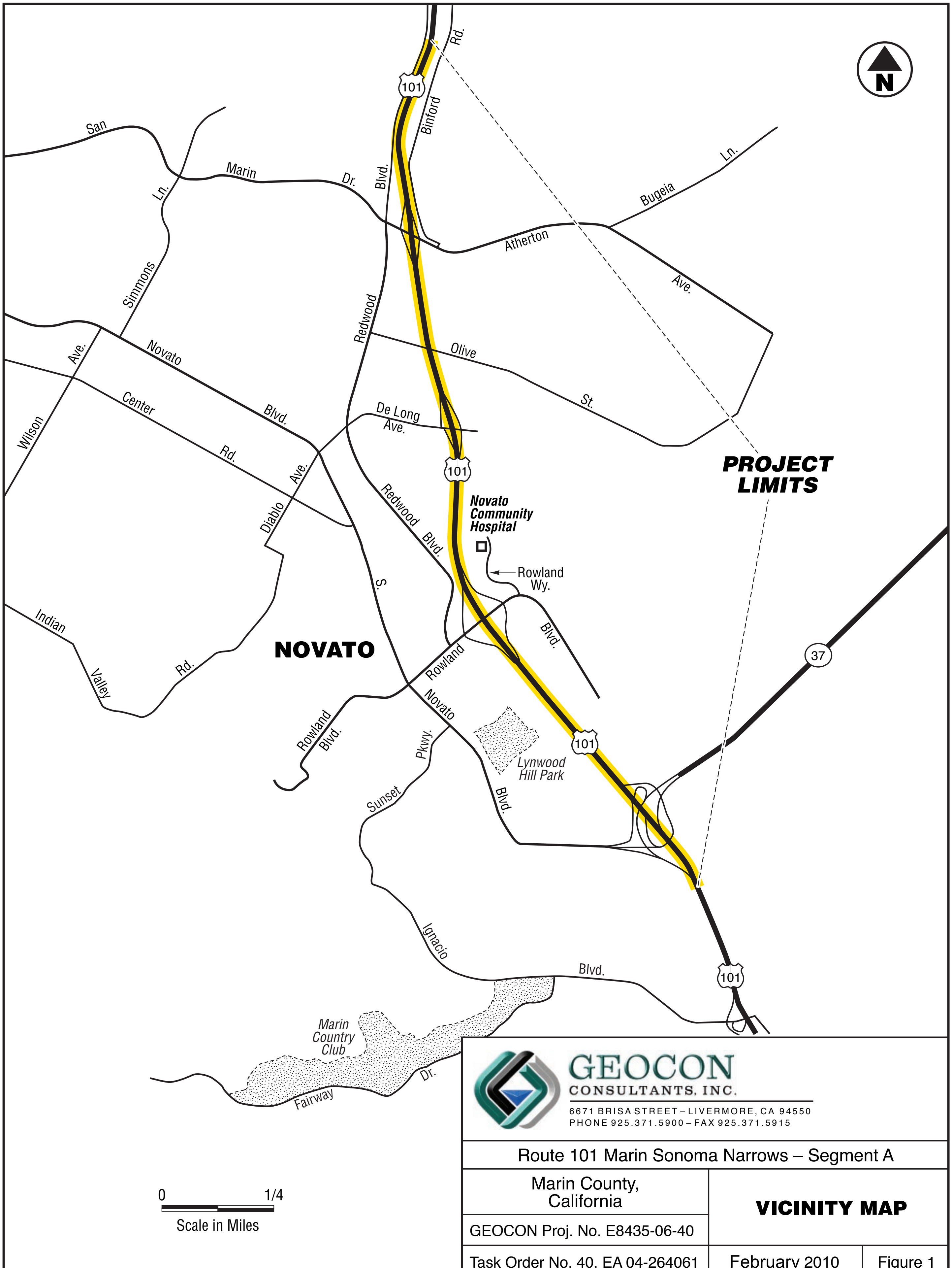
Notes:
NA = Not applicable
ND = No asbestos fibers detected

TABLE 2
SUMMARY OF ANALYTICAL LABORATORY TEST RESULTS - PAINT
ROUTE 101 MARIN-SONOMA NARROWS - SEGMENT A
MARIN COUNTY, CALIFORNIA

Total Lead

Bridge No.	Sample No.	Paint Description	Approximate Quantity Peeling/Flaking	Site Photo	Total Lead (mg/kg)
27-0090R	90R-P1A	White graffiti abatement paint	Intact	12	5.0

Notes:
mg/kg = milligrams per kilogram (EPA Test Method 6010)



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Route 101 Marin Sonoma Narrows – Segment A

Marin County,
California

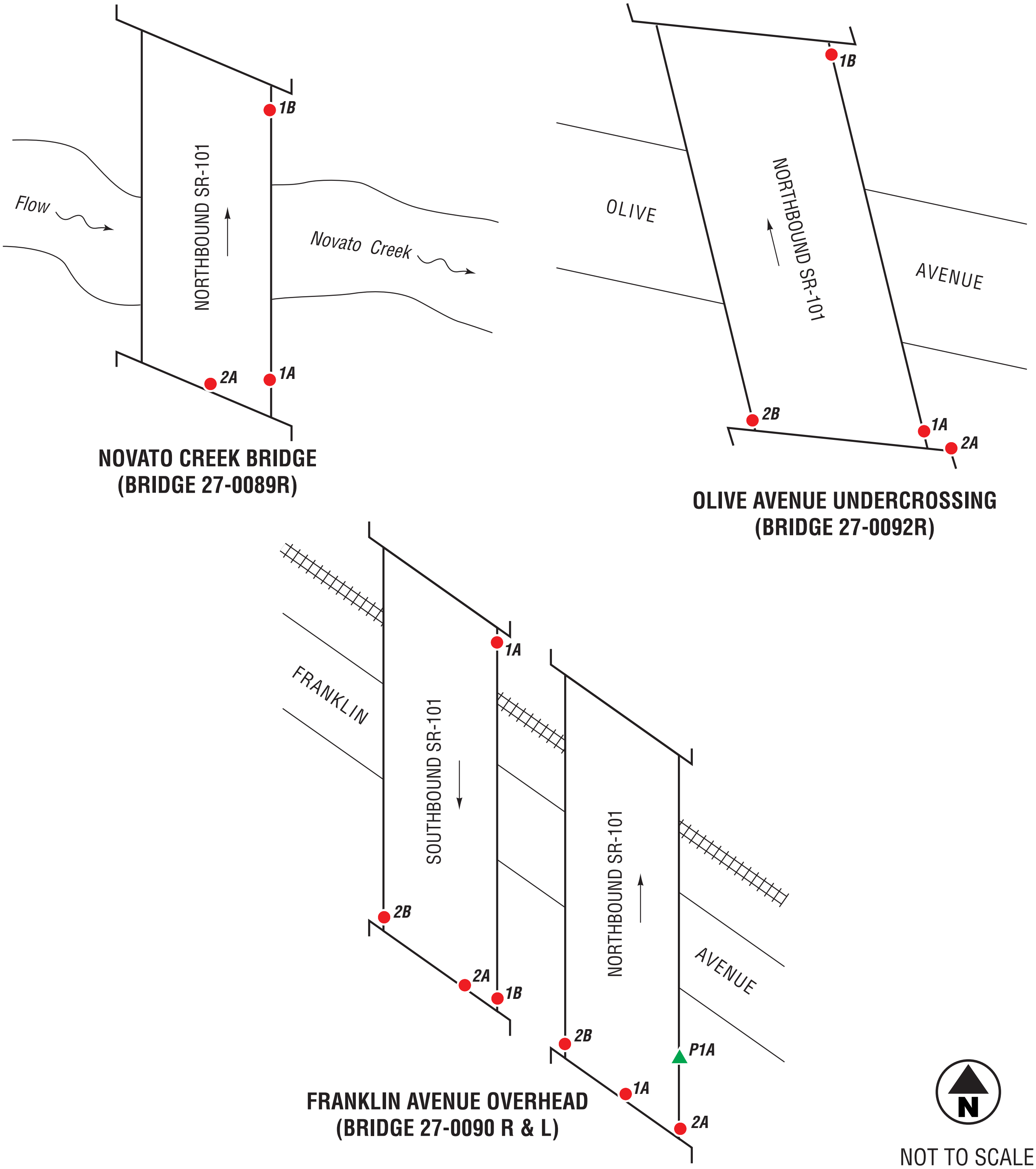
VICINITY MAP

GEOCON Proj. No. E8435-06-40

Task Order No. 40, EA 04-264061

February 2010

Figure 1



LEGEND:

- ● Approximate Asbestos Sample Location
- ▲ Approximate Paint Sample Location

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Route 101 Marin Sonoma Narrows – Segment A		
Marin County, California	SITE PLAN	
GEOCON Proj. No. E8435-06-40		
Task Order No. 40, EA 04-264061	February 2010	Figure 2

Photo 1 – Novato Creek Bridge, northbound SR 101 (Bridge No. 27-0089R)

Photo 2 – Bridge No. 27-0089R asbestos-containing guard rail shim

Photo 3 – Bridge No. 27-0089R black drain pipe

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PHOTOGRAPHS 1, 2, & 3		
Route 101 Marin-Sonoma Narrows – Segment A Project Marin County, California		
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Photo 4 – Bridge No. 27-0089R north deck joint (no suspect materials)

Photo 5 – Bridge No. 27-0089R south deck joint (no suspect materials)

Photo 6 – Bridge No. 27-0089R underside

Photo 7 – Franklin Avenue Overhead (Bridge No. 27-0090R)

Photo 8 – Bridge No. 27-0090R asbestos-containing guard rail shim

Photo 9 – Bridge No. 27-0090R brown fiberboard at bridge abutments

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PHOTOGRAPHS 7, 8, & 9		
Route 101 Marin-Sonoma Narrows – Segment A Project Marin County, California		
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Photo 10 – Bridge No. 27-0090R typical deck joint (no suspect materials)

Photo 11 – Bridge No. 27-0090R underside

Photo 12 – Bridge No. 27-0090R intact graffiti abatement paint

Photo 13 – Franklin Avenue Overhead (Bridge No. 27-0090L)

Photo 14 – Bridge No. 27-0090L asbestos-containing guard rail shim

Photo 15 – Bridge No. 27-0090L brown fiberboard at bridge abutments

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PHOTOGRAPHS 13, 14, & 15		
Route 101 Marin-Sonoma Narrows – Segment A Project Marin County, California		
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Photo 16 – Bridge No. 27-0090L typical deck joint (no suspect materials)

Photo 17 – Bridge No. 27-0090L underside

Photo 18 – Olive Avenue Undercrossing (Bridge No. 27-0092R)

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Photo 19 – Bridge No. 27-0092R asbestos-containing guard rail shim

Photo 20 – Bridge No. 27-0092R brown fiberboard

Photo 21 – Bridge No. 27-0092R north deck joint (no suspect material)

Photo 22 - Bridge No. 27-0092R south deck joint (no suspect material)

Photo 23 – Bridge No. 27-0092R underside

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PHOTOGRAPHS 22 & 23		
Route 101 Marin-Sonoma Narrows – Segment A Project Marin County, California		
E8435-06-40	Task Order No. 40	February 2010

APPENDIX A

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Project: **E8435-06-40**

Customer ID: GECN21
Customer PO: E8435-06-40
Received: 11/25/09 9:00 AM
EMSL Order: 090909587

EMSL Proj: E8435-06-**
Analysis Date: 11/30/2009

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos % Fibrous	Non-Asbestos % Non-Fibrous	Asbestos % Type
89R-1A-Rail Shim *090909587-0001*	Rail shim	Gray Fibrous Homogeneous		15% Non-fibrous (other)	**85% Chrysotile**
89R-1B-Rail Shim *090909587-0002*	Rail shim	Gray Fibrous Homogeneous		15% Non-fibrous (other)	**85% Chrysotile**
89R-2A-Drain Pipe *090909587-0003*	Black drain pipe	Black Fibrous Homogeneous	95% Cellulose	5% Non-fibrous (other)	**None Detected**
90R-1A-Rail Shim *090909587-0004*	Rail shim	Gray Fibrous Homogeneous		15% Non-fibrous (other)	**85% Chrysotile**
90R-2A-Fiber Board *090909587-0005*	Brown fiber board	Brown Fibrous Homogeneous	95% Cellulose	5% Non-fibrous (other)	**None Detected**
90R-2B-Fiber Board *090909587-0006*	Brown fiber board	Brown Fibrous Homogeneous	95% Cellulose	5% Non-fibrous (other)	**None Detected**
90L-1A-Rail Shim *090909587-0007*	Rail shim	Gray Fibrous Homogeneous		15% Non-fibrous (other)	**85% Chrysotile**

Analyst(s)

Grant Mays (14)

Baojia Ke, Laboratory Manager
or other approved signatory

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Project: **E8435-06-40**

Customer ID: GECN21
Customer PO: E8435-06-40
Received: 11/25/09 9:00 AM
EMSL Order: 090909587

EMSL Proj: E8435-06-**
Analysis Date: 11/30/2009

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos %	Fibrous	%	Non-Fibrous	Asbestos % Type
90L-1B-Rail Shim *090909587-0008*	Rail shim	Gray Fibrous Homogeneous			15%	Non-fibrous (other)	**85% Chrysotile**
90L-2A-Fiber Board *090909587-0009*	Brown fiber board	Brown Fibrous Homogeneous	95%	Cellulose	5%	Non-fibrous (other)	**None Detected**
90L-2B-Fiber Board *090909587-0010*	Brown fiber board	Brown Fibrous Homogeneous	95%	Cellulose	5%	Non-fibrous (other)	**None Detected**
92R-1A-Rail Shim *090909587-0011*	Rail shim	Gray Fibrous Homogeneous			15%	Non-fibrous (other)	**85% Chrysotile**
92R-1B-Rail Shim *090909587-0012*	Rail shim	Gray Fibrous Homogeneous			15%	Non-fibrous (other)	**85% Chrysotile**
92R-2A-Fiber Board *090909587-0013*	Brown fiber board	Brown Fibrous Homogeneous	95%	Cellulose	5%	Non-fibrous (other)	**None Detected**
92R-2B-Fiber Board *090909587-0014*	Brown fiber board	Brown Fibrous Homogeneous	95%	Cellulose	5%	Non-fibrous (other)	**None Detected**

Analyst(s)

Grant Mays (14)

Baojia Ke, Laboratory Manager
or other approved signatory

090909587

090909587

EMSL ANALYTICAL, INC.

EMSL – San Leandro ◆ 2235 Polvorosa Ave, Suite 230, San Leandro, CA 94577

(888) 455-3675 ◆ Phone (510) 895-3675 ◆ Fax (510) 895-3680 ◆ sanleandrolab@emsl.com

EMSL Rep: DAN KOCHER
Company: GEOCON
Contact: CHRIS GIUNTOLI
Address: 6671 BRISA ST
City & State: LIVERMORE, CA **Zip** 94550
Phone: 925-371-5900
☒ **Email Results** GIUNTOLI@GEOCONINC.COM
Project Name or Number: E8435-06-40

Third Party Billing **requires written authorization from third party*
EMSL-Bill to:
Contact:
Address:
City & State: **Zip**
Fax:
☐ **Fax results**
Purchase Order Number:

TURNAROUND TIME

☐ 3 Hours	☐ 6 Hours	☐ 24 Hours	☐ 48 Hours	☐ 72 Hours	☒ 5 Days	☐ 10 Days

SAMPLE MATRIX

☐ Air	☒ Bulk	☐ Soil	☐ Wipe	☐ Micro-Vac	☐ Drinking Water	☐ Wastewater	☐ Chips	☐ Other

ASBESTOS ANALYSIS

PCM - Air
☐ NIOSH 7400 (A) Issue 2: August 1994
☐ OSHA w/ Time Weighted Average

TEM AIR
☐ AHERA 40 CFR, Part 763 Subpart E
☐ NIOSH 7402 Issue 2
☐ EPA Level II

PLM - Bulk
☒ EPA 600/R-93/116
☐ **+ Add Gravimetric Reduction (EPA NOB)**
PLM CARB 435 Level: ☐ A (0.25%) ☐ B (0.1%)
☐ NIOSH 9002
☐ EPA Point Count (400 Points)
☐ **+ Add Gravimetric Reduction (EPA NOB)**
☐ EPA Point Count (1,000 Points)
☐ **+ Add Gravimetric Reduction (EPA NOB)**
☐ Standard Addition Point Count

SOILS
PLM CARB 435 Level: ☐ A (0.25%) ☐ B (0.1%)
TEM CARB 435 Level: ☐ B (0.1%) ☐ C (0.01%) ☐ D (0.001%) ☐ E (0.0005%) ☐ F (0.0001%)
☐ EMSL MSD 9000 Method fibers/gram
☐ Superfund EPA 540-R097-028 (dust generation)
EPA Protocol ☐ Qualitative ☐ Quantitative

TEM BULK
☐ TEM EPA NOB, EPA 600/R-93/116 Section 2.5.5.1 (TEM % by VAE)
☐ Chatfield SOP-1988-02
☐ TEM EPA 600/R-93/116 Section 2.5.5.2 (TEM % by Mass)

TEM MICROVAC
☐ ASTM D 5755 (Quantitative)

TEM WIPE
☐ ASTM D-6480 (Quantitative)

TEM WATER
☐ EPA 100.2 (≥10 microns)
☐ Modified EPA 100.2 (≥ 0.5 microns)
OTHER:

LEAD ANALYSIS

Flame Atomic Absorption
☐ Wipe, SW846-7420 ☐ ASTM ☐ non ASTM
☐ Soil, SW846-7420
☐ Air, NIOSH 7082
☐ Chips, SW846-7420 or AOAC 5.009 (974.02)
☐ Wastewater, SW 846-7420

☐ TCLP LEAD SW846-1311/7420

Graphite Furnace Atomic Absorption
☐ Air, NIOSH 7105
☐ Wastewater, SW846-7421
☐ Soil, SW846-7421
☐ Drinking Water, EPA 239.2

ICP – Inductively Coupled Plasma
☐ Wipe, SW846-6010 ☐ ASTM ☐ non ASTM
☐ Soil, SW846-6010
☐ Air, NIOSH 7300

MATERIALS ANALYSIS

☐ Particle Identification
☐ Full Particle Identification
☐ Dust Mites and Insect Fragments
☐ Particle Size & Distribution
☐ Product Comparison
☐ Paint Characterization
☐ Failure Analysis
☐ Corrosion Analysis
☐ Glove Box Containment Study
☐ Petrographic Examination of Concrete
☐ Portland Cement in Workplace Atmospheres (OSHA ID-143)
☐ Man Made Vitrous Fibers – MMVF's
☐ Synthetic Fiber Identification
☐ Other:

MICROBIAL ANALYSIS

Air Samples
☐ Mold & Fungi by Air O Cell
☐ Mold & Fungi by Agar Plate count & id
☐ Bacterial Count and Gram Stain
☐ Bacterial Count and Identification

Water Samples
☐ Total Coliforms, Fecal Coliforms
☐ Escherichia Coli, Fecal Streptococcus
☐ Legionella
☐ Salmonella
☐ Giardia and Cryptosporidium

Wipe and Bulk Samples
☐ Mold & Fungi – Direct Examination
☐ Mold & Fungi – (Culture follow up to direct examination if necessary)
☐ Mold & Fungi – Culture (Count & ID)
☐ Mold & Fungi – Culture (Count only)
☐ Bacterial Count & Gram Stain
☐ Bacterial Count & Identification (3 most prominent types)
☐ Other:

IAQ ANALYSIS

☐ Nuisance Dust (NIOSH 0500 & 0600)
☐ Airborne Dust (PM10, TSP)
☐ Silica Analysis by XRD ☐ NIOSH 7500
☐ HVAC Efficiency
☐ Carbon Black
☐ Airborne Oil Mist
☐ Other:

Relinquished:	[signature]	Date:	11/24/09	Time:	1700
Received:	[signature]	Date:	11/25/09	Time:	0900 Fd
Relinquished:		Date:		Time:	
Received:		Date:		Time:	

090909587

EMSL ANALYTICAL, INC.

EMSL – San Leandro ◆ 2235 Polvorosa Ave, Suite 230, San Leandro, CA 94577

	SAMPLE NUMBER	SAMPLE DESCRIPTION	LOCATION	VOLUME Air (L) Area (Inches sq.)
1	89R-1A	RAIL SHIM		
2	89R-1B	↓		
3	89R-2A	BLACK DRAIN PIPE		
4	90R-1A	RAILSHIM		
5	90R-2A	BROWN FIBER BOARD		
6	90R-2B	↓		
7	90L-1A	RAILSHIM		
8	90L-1B	↓		
9	90L-2A	BROWN FIBER BOARD		
10	90L-2B	↓		
11	92R-1A	RAILSHIM		
12	92R-1B	↓		
13	92R-2A	BROWN FIBER BOARD		
14	92R-2B	↓		
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				

Client Sample # (S) ______ - ______

TOTAL SAMPLE # ______

Relinquished: ______ Date: ______ Time: ______
Received: Alanry Date: 4/25/09 Time: 0900
Relinquished: ______ Date: ______ Time: ______
Received: ______ Date: ______ Time: ______

December 03, 2009

Chris Giuntoli
Geocon Consultants, Inc.
6671 Brisa Street
Livermore, CA 94550
TEL: (925) 371-5900
FAX: (925) 371-5915

ELAP No.: 1838
NELAP No.: 02107CA
NEVADA.: CA-401
CSDLAC No.: 10196

Workorder No.: 108842

RE: MSN-SEGMENTA, E8435-06-40

Attention: Chris Giuntoli

Enclosed are the results for sample(s) received on November 25, 2009 by Advanced Technology Laboratories . The sample(s) are tested for the parameters as indicated in the enclosed chain of custody in accordance with the applicable laboratory certifications.

Thank you for the opportunity to service the needs of your company.

Please feel free to call me at (562)989-4045 if I can be of further assistance to your company.

Sincerely,

Eddie F. Rodriguez
Laboratory Director

Advanced Technology Laboratories

ANALYTICAL RESULTS

Print Date: *03-Dec-09*

CLIENT:	Geocon Consultants, Inc.	**Client Sample ID:**	90R-P1A
Lab Order:	108842	**Collection Date:**	11/24/2009
Project:	MSN-SEGMENTA, E8435-06-40	**Matrix:**	PAINT CHIPS
Lab ID:	108842-001A		

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
ICP METALS						
	EPA 3050B			**EPA 6010B**		
RunID: ICP8_091201H	QC Batch: 60171			PrepDate:	12/1/2009	Analyst: **CL**
Lead	5.0	2.0		mg/Kg	1	12/2/2009 11:49 AM

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	ND	Not Detected at the Reporting Limit
S	Spike/Surrogate outside of limits due to matrix interference		Results are wet unless otherwise specified
DO	Surrogate Diluted Out		

Advanced Technology Laboratories

3275 Walnut Avenue, Signal Hill, CA 90755 Tel: 562. 989.4045 Fax: 562.989.4040

CLIENT: Geocon Consultants, Inc.
Work Order: 108842
Project: MSN-SEGMENTA, E8435-06-40

ANALYTICAL QC SUMMARY REPORT

TestCode: 6010_S

Sample ID: **MB-60171** SampType: **MBLK** TestCode: **6010_S** Units: **mg/Kg** Prep Date: **12/1/2009** RunNo: **115597**
Client ID: **PBS** Batch ID: **60171** TestNo: **EPA 6010B** **EPA 3050B** Analysis Date: **12/1/2009** SeqNo: **1833867**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	ND	1.0									

Sample ID: **LCS-60171** SampType: **LCS** TestCode: **6010_S** Units: **mg/Kg** Prep Date: **12/1/2009** RunNo: **115597**
Client ID: **LCSS** Batch ID: **60171** TestNo: **EPA 6010B** **EPA 3050B** Analysis Date: **12/1/2009** SeqNo: **1833868**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	51.616	1.0	50.00	0	103	80	120				

Sample ID: **108843-002ADUP** SampType: **DUP** TestCode: **6010_S** Units: **mg/Kg** Prep Date: **12/1/2009** RunNo: **115597**
Client ID: **ZZZZZZ** Batch ID: **60171** TestNo: **EPA 6010B** **EPA 3050B** Analysis Date: **12/1/2009** SeqNo: **1833879**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	7.041	1.0						6.977	0.915	20	

Sample ID: **108843-002AMS** SampType: **MS** TestCode: **6010_S** Units: **mg/Kg** Prep Date: **12/1/2009** RunNo: **115597**
Client ID: **ZZZZZZ** Batch ID: **60171** TestNo: **EPA 6010B** **EPA 3050B** Analysis Date: **12/1/2009** SeqNo: **1833880**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	114.115	1.0	125.0	6.977	85.7	33	120				

Sample ID: **108843-002AMSD** SampType: **MSD** TestCode: **6010_S** Units: **mg/Kg** Prep Date: **12/1/2009** RunNo: **115597**
Client ID: **ZZZZZZ** Batch ID: **60171** TestNo: **EPA 6010B** **EPA 3050B** Analysis Date: **12/1/2009** SeqNo: **1833881**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	109.874	1.0	125.0	6.977	82.3	33	120	114.1	3.79	20	

Qualifiers:

- B Analyte detected in the associated Method Blank
- ND Not Detected at the Reporting Limit
- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits
- Calculations are based on raw values
- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

CHAIN OF CUSTODY RECORD

Advanced Technology Laboratories
3275 Walnut Avenue
Signal Hill, CA 90755
(562) 989-4045 • Fax (562) 989-4040

FOR LABORATORY USE ONLY:

P.O.#:

Logged By: [signature] Date: 11/25/09

Method of Transport: Client ☐ ATL ☐ CA OverN ☐ FEDEX ☐ Other: GSO

Sample Condition Upon Receipt: 4.4

1. CHILLED Y ☑ N ☐
2. HEADSPACE (VOA) Y ☐ N ☐ NA
3. CONTAINER INTACT Y ☑ N ☐
4. SEALED Y ☐ N ☑
5. # OF SPLS MATCH COC Y ☑ N ☐
6. PRESERVED Y ☐ N ☑

Client: GEOCON CONSULTANTS, INC.
Attn: CHRIS GIUNTOLI
Address: 6671 Brisa Street
City: Livemore State: CA Zip Code: 94550
TEL: (925) 371-5900
FAX: (925) 371-5915

Project Name: MSN-SEGMENT A Project #: E8435-06-40
Sampler: (Printed Name) C GIUNTOLI (Signature) [signature]

Relinquished by: (Signature and Printed Name)	Date:	Time:	Received by: (Signature and Printed Name)	Date:	Time:
[signature]	11/24/09	1630	[signature]	11/25/09	10:10

I hereby authorize ATL to perform the work indicated below:
Project Mgr /Submitter: C GIUNTOLI (Print Name) 11/24/09 (Date) [signature] (Signature)

Send Report To: Attn: Co: SAME AS ABOVE Address City State Zip

Bill To: Attn: Co: SAME AS ABOVE Address City State Zip

Special Instructions/Comments: SOLUBLE LEAD MAY BE REQUESTED BASED ON TOTAL LEAD RESULTS

Sample/Records - Archival & Disposal
Unless otherwise requested by client, all samples will be disposed 45 days after receipt and records will be disposed 1 year after submittal of final report.

Storage Fees (applies when storage is requested):
- Sample : $2.00 / sample / mo (after 45 days)
- Records : $1.00 / ATL workorder / mo (after 1 year)

Circle or Add Analysis(es) Requested: 8081A (Pesticides), 8082 (PCB), 8260B (Volatiles), 8270C (BNA), 6010B (Total Metal), 8015B (GRO) / BTEX, 8015B (DRO), 8021 (BTEX), TITLE 22 / CAM 17 (6010 / 7000), TOTAL LEAD

SPECIFY APPROPRIATE MATRIX: SOIL, WATER, GROUND WATER, WASTEWATER, PAINT CHIPS

QA/QC: RTNE ☐ CT ☒ SWRCB ☐ Logcode OTHER

ITEM	LAB USE ONLY: Batch #: Lab No.	Sample I.D. / Location	Date	Time	TOTAL LEAD	PAINT CHIPS	TAT	Container(s) #	Type	PRESERVATION	REMARKS
	108842-001	90R-P1 A	11/24/09		X	X	E	1	PT		

• TAT starts 8 a.m. following day if samples received after 3 p.m.

TAT: A= Overnight ≤ 24 hr B= Emergency Next workday C= Critical 2 Workdays D= Urgent 3 Workdays E= Routine 7 Workdays

Container Types: T=Tube V=VOA L=Liter P=Pint J=Jar B=Tedlar G=Glass P=Plastic M=Metal

Preservatives: H=Hcl N=HNO_3 S=H_2SO_4 C=4°C Z=Zn(AC)$_2$ O=NaOH T=$Na_2S_2O_3$

DISTRIBUTION: **White** with report, **Yellow** to folder, **Pink** to submitter.

MATERIALS INFORMATION

04-2640G1

Reissued Supplemental FOUNDATION REPORT for the Novato Creek Bridge (Southbound) Widening dated March 30, 2012 (4 pages)

Reissued FOUNDATION RECOMMENDATION for the Novato Creek Bridge (Southbound) Widening dated March 26, 2012 (9 pages)

Final HYDRAULIC REPORT - Novato Creek dated October 22, 2010.

FOUNDATION REVIEW - Novato Creek Bridge dated April 19, 2012 and April 26, 2012.

Memorandum

Flex your power!
Be energy efficient!

To: MS. OFELIA ALCANTARA
Chief
Office of Bridge Design – West
Structure Design

Date: March 30, 2012

Attention: K. Low

File: 04-MRN-101, PM 18.6/22.3
04-2640G1
Novato Creek Bridge Widening
Bridge No. 27-0089 R/L

From: JOHN C. MOORE
Transportation Engineer
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

M. Momenzadeh
MAHMOOD MOMENZADEH
Chief, Branch C
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

Subject: Reissued Supplemental Foundation Report (FR) for the Novato Creek Bridge (Southbound) Widening

This memo serves as a supplemental foundation report (FR) and is an update to the Novato Creek (Southbound) Widening Report, dated March 26, 2012, and addresses structural design questions regarding edits for special provisions. CISS Piles 24-inches in diameter are planned for installation at the Novato Creek Bridge Widening.

Because the 24-inch diameter CISS Pile has a diameter greater than 18-inches, a Pile Dynamic Analysis (PDA) test is recommended for one pile in Bent 3 of the Novato Creek Bridge Widening, in order to verify nominal resistance. Pile driving acceptance criteria shall be developed from the PDA test results for the hammer system selected by the Contractor and approved by the Engineer according to the nominal driving resistance shown in the Pile Data Table. The specifications for piling should include the following statements:

GENERAL

All piles shall be clearly marked along their entire length in one-foot increments with more prominent markings every 5-feet. Markings shall be made by white paint 2-inches in width. Markings shall be accurately placed on the pile using a tape measure that is at least 100-feet in length, insuring that the intended measurement is true at the bottom of the pile. Markings shall be visible from all directions and shall indicate cumulative length from the pile toe.

DRIVING SYSTEM SUBMITTAL

Prior to installing driven piling, the Contractor shall provide a driving system submittal, including drivability analysis, in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings" of the Standard Specifications. A submittal shall be made for each control location shown below. All proposed driving systems (i.e., each hammer that may be brought onto the site) shall be included in the submittal.

Bridge Number	Control Location
27-0089R/L	Bent 3

The driving system submittal shall contain an analysis showing that the proposed driving systems will install piling to the specified tip elevation and specified bearing. Driving systems shall generate sufficient energy to drive the piles with stresses not more than 95% of the specified yield strength of the steel pile or unfilled steel shell. Submittals shall include the following:

A. Complete description of soil parameters used, including soil quake and damping coefficients, skin friction distribution, and ratio of shaft resistance to nominal compression resistance, assumptions made regarding the formation of soil plugs, and assumptions made regarding drilling through the center of open ended steel shells.

B. List of all hammer operation parameters assumed in the analysis, including fuel settings, stroke limitations, and hammer efficiency.

C. Drivability studies that are based on wave equation analysis using a computer program that has been approved by the Engineer. Drivability studies shall model the Contractor's proposed driving systems, including the hammers, capblocks, and pile cushions, as well as determine driving resistance and pile stresses for assumed site conditions. Separate analyses shall be completed at elevations above the specified tip elevations where difficult driving is anticipated. Studies shall include plots for a range of pile compression capacities above and below the nominal compression resistance shown on the plans. Plots shall include the following:

1. Pile compressive stress versus blows per foot.

2. Pile tensile stress versus blows per foot.

3. Nominal compression resistance versus blows per foot.

When the drivability analysis hammers indicate that open ended pipe pile and steel shell penetration rates are less than one foot per 200 blows and the driving stresses will exceed 80 percent of the specified yield strength of the pipe and steel shell, the study shall include assumptions for drilling through the center of open ended pipe piles and steel shells.

D. Completed "Pile and Driving Data Form" included in these special provisions.

The driving system submittal shall be signed and stamped by a professional engineer registered as a Civil Engineer in the State of California and include the attached "Pile and Driving Data Form" completed for each hammer and driving system. The Contractor shall allow the Engineer 20 working days to review a driving system submittal. Should the Engineer fail to complete his review within the time allowance, and if, in the opinion of the Engineer, the Contractor's controlling operation is delayed or interfered with by reason of delay in conformance with the provisions in Section 8-1.09, "Right-of-Way Delays" of the Standard Specifications.

The Contractor shall use the driving system and installation methods described in the approved driving system submittal for a given control location. Any change in hammers from those submitted and approved by the Engineer shall also meet the requirements for driving systems submittals. Revised and new driving system submittals shall be approved by the Engineer prior to using corresponding driving systems on production piling. The Contractor shall allow the Engineer 20 working days to review each revised and each new driving system submittal after a complete set, as determined by the Engineer, has been received.

Approval of pile driving equipment will not relieve the Contractor of his responsibility to drive piling, free of damage, to the specified penetration.

DYNAMIC MONITORING

The Contractor shall drill and tap holes at opposite sides of the pile at about two pile diameters from the top and set anchors for the PDA instrument.

The recommendations contained in this supplementary foundation report are based on specific project information regarding structure type and location. If any conceptual changes are made during final project design, the Office of Geotechnical Design – West, Design Branch C should review those changes to determine if these foundation recommendations are still applicable. Any questions regarding the above recommendations should be directed to the attention of John Moore at (510) 622-8742 or Mahmood Momenzadeh at (510) 286-5732.

c: MMomenzadeh, TJPokrywka, SRajendra, Archive

JMoore/JM

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MS. OFELIA ALCANTARA
Chief
Office of Bridge Design – West
Structure Design

Date: March 26, 2012

Attention: K. Low

File: 04-MRN-101, PM 18.6/22.3
04-2640G1
Novato Creek Bridge Widening
Bridge No. 27-0089 R/L

From: JOHN C. MOORE JM
Transportation Engineer
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

MAHMOOD MOMENZADEH JM for MM
Chief, Branch C
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

Subject: Reissued Foundation Recommendations for the Novato Creek Bridge (Southbound) Widening

Note: This memo was originally submitted March 8th, 2011. Any changes are highlighted in bold font. The original memo was based on the results of our subsurface investigation. This revised memo includes the original memo in addition to the revised Pile Data Table (see Table 5) based on the pile driving records obtained from the construction of the northbound widening.

This memo in conjunction with our Foundation Report (FR) for the Novato Creek Bridge (Northbound) Widening, dated October 26, 2009, serves as foundation recommendations for the Novato Creek Bridge (Southbound) Widening.

The project site is located on Highway 101, in Marin County, at post mile 20.6. Based on as-built plans, the Novato Creek Bridge was built between the years of 1971 and 1975. The bridge has five spans and carries three lanes of traffic. It is planned to widen the Novato Creek Bridge OH (Bridge No. 27-89 R/L), specifically the Southbound (Left) Median. This proposed widening is one of three bridges to be widened, for the Marin-Sonoma Narrows, Segment 'A' project.

The Office of Bridge Design – West, Structure Design, furnished foundation design data and column loads, for columns 1 through 3, on January 27, 2011. Loads for Column 1 bents reflect governing loads higher than those of columns 2 and 3, and will be used as the design loads in this memo for all three columns. Design loads for abutments 1 and 6, and column 1, and their corresponding pile data are presented in the following tables:

Table No. 1 – Foundation Design Data for Southbound Median Widening

Foundation Design Data									
Support No.	Design Method	Pile Type	Finished Grade Elevation (ft)	Bottom of Footing (ft)	Cut-off Elevation (ft)	Pile Cap Size (ft)		Permissible Settlement under Service Load (in)	Number of Piles per Support
						B	L		
Abut 1	WSD	Class 200 Alt "X"	N/A	9.6	9.85	N/A	N/A	1"	3
Bent 2	LRFD	24" Diam. x ½" Thick CISS Pile	5	5	17±	N/A	N/A	1"	1
Bent 3	LRFD	24" Diam. x ½" Thick CISS Pile	1	1	17±	N/A	N/A	1"	1
Bent 4	LRFD	24" Diam. x ½" Thick CISS Pile	1	1	17.5±	N/A	N/A	1"	1
Bent 5	LRFD	24" Diam. x ½" Thick CISS Pile	6.5	6.5	17.5±	N/A	N/A	1"	1
Abut 6	WSD	Class 200 Alt "X"	N/A	10.6	10.85	N/A	N/A	1"	3

Note: 24" Diameter CISS Piles at the Bents are Pile Extensions. There are two Pile Extensions per Bent. Each Pile Extension is considered as a "Support".

Table No. 2 – Foundation Design Loads for Southbound Median Widening

Foundation Design Loads											
Support No.	Service – I Limit State (kips)			Strength Limit State (Controlling Group, kips)				Extreme Event Limit State (Controlling Group, kips)			
	Total Load		Permanent Loads	Compression		Tension		Compression		Tension	
	Per Support	Max Per Pile	Per Support	Per Support	Max Per Pile	Per Support	Max Per Pile	Per Support	Max Per Pile	Per Support	Max Per Pile
Abut 1	305	102	165	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bent 2*	258	258	141	383	383	0	0	208	208	53	53
Bent 3*	234	234	125	347	347	0	0	197	197	65	65
Bent 4*	234	234	125	347	347	0	0	195	195	63	63
Bent 5*	257	257	140	382	382	0	0	202	202	52	52
Abut 6	305	102	165	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Bent loads provided are per Pile Extension.

Table No. 3 – Abutment Foundation Pile Data for Southbound Median Widening

Abutment Foundation Design Recommendations									
Support Location	Pile Type	Cut-off Elevation	Service-I Limit State Load (kips) per Support		Service-I Limit State Total Load (kips) per pile (Compression)	Nominal Resistance (kips)	Design Tip Elevation (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance Required (kips)
			Total	Permanent					
Abut 1	Class 200 Alt "X"	10	305	165	102	204	-47 (a) -14 (b) -51 (c)	-51	400
Abut 6	Class 200 Alt "X"	11	305	165	102	204	-50 (a) -13 (b) -58 (c)	-58	400

<u>*Notes:*</u>

1) *Design tip elevations for **Abutments** are controlled by: (a) Compression, (b) Settlement, and (c) Extreme Event I.*

2) *For Extreme Event I, 276 kips of downdrag per pile has been added to the compression load.*

3) <u>*Lateral loading should be checked by Structures Design.*</u>

4) *The Specified Tip Elevation can be raised not more than 5-ft. if the nominal driving resistance is achieved.*

5) *Use the Nominal Driving Resistance value of 400 kips for the Gates formula.*

Table No. 4 – Bent Foundation Pile Data for Southbound Median Widening

Bent Foundations Design Recommendation											
Support Location	Pile Type	Cut-off Elevation (ft)	Service-I Limit State Load per Support (kips)	Total Permissible Support Settlement (inches)	Required Factored Nominal Resistance (kips)				Design Tip Elevation (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance Required (kips)
					Strength Event		Extreme Event I				
					Comp. (ϕ=0.7)	Tension (ϕ=0.7)	Comp. (ϕ=1)	Tension (ϕ=1)			
Bent 2	24" Diam. CISS Pile	17±	141	1"	383	-	408	53	-63(a-I) -62(a-II) -14(c)	-63	550
Bent 3	24" Diam. CISS Pile	17±	125	1"	347	-	397	65	-63(a-I) -62(a-II) -13(c)	-63	550
Bent 4	24" Diam. CISS Pile	17.5±	125	1"	347	-	395	63	-63(a-I) -62(a-II) -13(c)	-63	550
Bent 5	24" Diam. CISS Pile	17.5±	140	1"	382	-	402	52	-63(a-I) -62(a-II) -14(c)	-63	550

Notes:

1) *Design tip elevations for* ***Bents*** *are controlled by: (a-I) Compression (Strength Limit), (a-II) Compression (Extreme Event I), and (c) Settlement.*

2) *Because CISS piles are founded in rock, settlement under service loads does not govern. Lateral loading should be checked by Structures Design.*

3) *For Extreme Event I, 200 kips of downdrag per pile has been added to the compression load.*

Table No. 5 – Pile Data Table for Novato Creek Bridge (Southbound) Widening

Pile Data Table						
Location	Pile Type	Nominal Resistance (kips)		Design Tip Elevations (ft.)	Specified Tip Elevation (ft.)	Nominal Driving Resistance (kips)
		Compression	Tension			
Abut 1	Class 200 Alt "X"	205	0	-51 (a) -14 (b)	-51	400
Bent 2	CISS NPS 24x0.75	550	30	-63 (a) -14 (b)	-63	550
Bent 3	CISS NPS 24x0.75	500	30	-63 (a) -14(b)	-63	550
Bent 4	CISS NPS 24x0.75	500	30	-63 (a) -14(b)	-63	550
Bent 5	CISS NPS 24x0.75	550	20	-63 (a) -14 (b)	-63	550
Abut 6	Class 200 Alt "X"	205	0	-58 (a) -13 (b)	-58	400

Notes:

1) *Design tip elevations for* ***Abutments*** *are controlled by: (a) Compression and (b) Settlement.*

2) *Design tip elevations for* ***Bents*** *are controlled by: (a) Compression and (b) Settlement.*

3) *Design tip elevations for Lateral Load (c) to be provided by Designer.*

4) *Design tip elevations for tension were not reported for bents because they were very insignificant.*

Comparison of pile data shown in Table 5 of this memo with respect to Table 10 of our FR, dated October 26, 2009, indicates small changes in the specified pile tip elevations for all piles in the northbound and southbound bents. Therefore, we recommend that pile tips and driving resistances specified for the northbound widening piles be used for the entire project to minimize variations of the pile driving requirements.

An additional Pile Drivability Study was conducted on January 20th, 2011, by the Foundation Testing Branch, to determine the efficacy of using a 0.5-inch pipe wall thickness in lieu of the originally intended 0.75-inch pipe pile wall thickness for the Novato Creek Bridge bents. The study found that a 0.5-inch pipe pile wall thickness could be used. Please contact the Foundation Testing Branch for a copy of this report.

On March 16, 2012, this office was asked by The Office of Bridge Design – West, Structure Design, to review/revise the specified tip elevations in Table No. 5 (above) based on pile driving records for the northbound widening of Novato Creek Bridge. The revised Table No. 5 is shown on the following page:

Revised Table No. 5 – Pile Data Table for Novato Creek Bridge (Southbound) Widening

Pile Data Table						
Location	Pile Type	Nominal Resistance (kips)		Design Tip* Elevations (ft.)	Specified Tip** Elevation (ft.)	Nominal Driving Resistance (kips)
		Compression	Tension			
Abut 1	Class 200 Alt "X"	340	0	-51 (a) -14 (b)	-50	400
Bent 2	CISS NPS 24x0.75	550	30	-63 (a) -14 (b)	-52	680
Bent 3	CISS NPS 24x0.75	500	30	-63 (a) -14(b)	-59	680
Bent 4	CISS NPS 24x0.75	500	30	-63 (a) -14(b)	-62	680
Bent 5	CISS NPS 24x0.75	550	20	-63 (a) -14 (b)	-65	680
Abut 6	Class 200 Alt "X"	340	0	-58 (a) -13 (b)	-58	400

Notes:

**Design pile tip elevations are based on the results of our investigation and analysis.*
***Specified tip elevations have been revised based on the pile driving records for the northbound widening.*

1) *Design tip elevations for* ***Abutments*** *are controlled by: (a) Compression and (b) Settlement.*
2) *Design tip elevations for* ***Bents*** *are controlled by: (a) Compression and (b) Settlement.*
3) *Design tip elevations for Lateral Load (c) to be provided by Designer.*
4) *Design tip elevations for tension were not reported for bents because they were very insignificant.*
5) *Drive* ***Bent 2*** *piles to the specified tip elevation of -52 but, fabricate Bent 2 piles with an additional 5-feet of length in the case that nominal driving resistance is not met.*
6) *All piles must be driven to specified tip to achieve desired embedment into non-liquefiable material.*

In our initial Pile Data Table we specified a nominal driving resistance of 550 kips for Bents 2 through 5. Since we have subsequently revised the specified tip elevations of the piles for the southbound widening based on pile driving records for the northbound widening, we have adjusted the nominal driving resistance back to 680 kips to eliminate confusion. Because of this switch, the valid question of "if during driving will the specified tip elevations be reduced if a nominal driving resistance of 550 kips is achieved versus 680 kips?" arises. The short answer is 'yes, they could be shortened under normal conditions' but, our case assumes a high probability of liquefaction occurring, and our intention is to insure that the piles are driven to the specified tip elevations listed in Table No. 5 to achieve a desired embedment in non-liquefiable material. So, in summary, for our case only, the order of importance for this bridge is "specified tip elevation" first and "nominal driving resistance" second.

Because material above weathered rock is subject to liquefaction, the specified pile tip elevations include our recommendation to drive piles at least 8 to 10-ft. into intermediate geologic material, i.e. weathered rock, to provide sufficient fixity during seismic loading. Based on pile driving analyses the required embedment depth is also fixed in weathered rock at almost the same elevations as what we determined for sufficient fixity to counter the effects of liquefaction would be. Therefore, the specified pile tip elevations as required have been established for the northbound site using a rated hammer energy of 66,000 ft-lbs.

The recommendations contained in this report are based on specific project information regarding structure type and location. If any conceptual changes are made during final project design, the Office of Geotechnical Design – West, Design Branch C should review those changes to determine if these foundation recommendations are still applicable. Any questions regarding the above recommendations should be directed to the attention of John Moore at (510) 622-8742 or Mahmood Momenzadeh at (510) 286-5732.

c: MMomenzadeh, TJPokrywka, SRajendra, Archive

JMoore/JM

REGISTERED PROFESSIONAL ENGINEER
JOHN C. MOORE
No. C61792
Exp. 6/30/13
CIVIL
STATE OF CALIFORNIA

State of California Department of Transportation Structure Hydraulics

DIVISION OF STRUCTURES
FINAL HYDRAULIC REPORT

Novato Creek

Located about 1 mile north of State Route 37 on US Route 101 over Novato Creek in the City of Novato in Marin County, and part of the Marin-Sonoma Narrows project, Phase A2

JOB:

Novato Creek, EA 04-2640G1

LOCATION:

Bridge No. 27-0089L; 04-MRN-101- PM 20.5

WRITTEN BY:

Tony Nedwick

DATE:

October 22, 2010

Hydrology/Hydraulics Report

General:

It is proposed to widen the existing reinforced concrete T-beam structure at Novato Creek on US Route 101 in the city of Novato in Marin County. The proposed median widening is only for the Left structure. The structure crosses Novato Creek roughly parallel to the right structure with a bridge skew of approximately 20.7°. Hydraulic skew is negligible.

Keng Mun Low, Structure Design Branch 8, provided draft versions of the General Plans for two alternatives, both with revision dates of 08-26-10. Preliminary Investigations-North had previously provided the Caice file based on a September 2008 survey of the site. The draft versions of the General Plans indicate that only the Left structure will be widened as part of this project. The widening is only proposed for the median. Both alternatives share similar design aspects, including using 2-foot diameter Cast in Steel Shell (CISS) concrete piles. It is proposed to add 3 piles per bent in line with the existing piles. While one alternative proposes a Cast-in-Place (CIP), concrete T-beam structure with a Structural Depth of 2'-6", the other alternative proposes a CIP voided slab with a drop cap and a structural Depth of 1'-11". There is no hydraulic skew at the structure.

All elevations in this report are based on the survey data provided by Preliminary Investigations-North and the preliminary design information provided by Structure Design. The Vertical Datum is NAVD 88, with a vertical transformation of 2.7 feet above the NGVD 1929 elevations used for As-builts for the existing structure.

Basin:

At the bridge, Novato Creek drains approximately 25.4 square miles. The watershed is located on the eastern-side of the coastal range, between Big Rock Ridge and San Pablo Bay. The upper Novato creek flows into Stafford Lake. Stafford Dam is operated primarily for water supply purposes, with no flood control pool. Watershed elevations range from approximately 1900 feet at the higher elevations to approximately 2.2 feet at the site. The channel in the vicinity of the site is dredged on a regular basis to maintain the current capacity. According to Hannah Lee of the Marin County Flood Control and Water Conservation District, there are no pending plans to increase channel capacity in the vicinity of the structure.

Channel slope was estimated at 0.1% in the immediate vicinity of the project, with steeper slope occurring upstream from the site. The channel is periodically dredged and graded to sustain the design capacity. Manning's roughness coefficient was estimated at approximately 0.030 in the vicinity of the project site.

Discharge:

Various sources were looked at to determine the applicable flow rates for the 50-year and 100-year events. These sources included the latest FEMA Flood Insurance Study for the City of Novato, dated September 29, 1989, FEMA Letter of Map Revisions (LOMR), USGS stream gage data and the Marin County Flood Control and Water Conservation District. For Novato Creek just upstream of the project site the 50-year event flow rate is 5,140 cfs while the 100-year flow rate is 6,230 cfs.

The channel capacity upstream of the bridge site can only handle approximately 5,140 cfs; any additional discharge will overtop the levees and flood the surrounding area. This additional discharge flows to the south of the bridge where it then crosses Route 101 at the Rowland Blvd interchange. The frequency of the channel capacity is considered to be a 50-year event.

Stage/Velocity/Tidal:

The proposed bridge site was modeled using the data provided by Structures Design, Preliminary Investigations-North, historical Bridge Inspection Reports, FEMA Flood Insurance Study for the City of Novato and HECRAS version 3.1 water flow analysis software. The analysis was used to estimate the water surface elevation, velocity and other hydraulic parameters as well as correlate the analysis with other data. Water Surface Elevation for the Design Flood Discharge of 5,140 cfs is 13.2 feet (NAVD 88). The proposed Minimum Soffit Elevation for the structure is 15.2 feet. Currently, the Water Surface Elevation for the Base Flood discharge is the same as the Design Flood, 13.2 feet.

Velocity is provided for use in sizing bank protection around abutments and embankments if desired by the district. The average velocity of the channel at the proposed bridge sites during the Design Discharge event is 3.2 fps.

The Novato Creek channel at the project site is subject to tidal flows. According to the FEMA Flood Insurance Study, the 100-year Stillwater Tidal Elevation at Petaluma Point on San Pablo Bay is 9.2 feet (NAVD 88). The 10-year Stillwater Tidal Elevation is 8.7 feet. These tidal elevations are assumed to be applicable at the project site.

Streambed:

In the vicinity of the structure the channel is relatively straight with an average channel slope of 0.1 %. According to the Log of Test Borings for the existing structure, the streambed is comprised of silt, silty clay, clayey silt, sand and some underlying gravel. These materials are susceptible to scour. The channel is dredged to maintain design capacity on semi-regular schedule, currently a four-year cycle.

Drift:

There have been a few previous Bridge Inspection Reports noting minor debris at the columns. There was no report of debris causing any scour concerns.

Scour:

The existing structure is not considered to be scour critical, with an NBIS 113 code of 5. Local Pier Scour due to the 2-foot diameter columns is estimated at 4.8 feet. There is no history of degradation, however the channel is dredged on a regular basis to maintain the channel capacity.

Summary Information for Bridge Designer:

The following table is a summary of key design parameters based on the hydrology and hydraulic analysis performed for these structures. The minimum soffit elevation for the structure was determined by using the water surface elevation at channel capacity of 5,140 cfs.

Novato Creek
Br. No. 27-0089 L
04-MRN-101-R20.5
EA 04-2640G1
October 22, 2010

Hydrologic Summary Novato Creek, 27-0089L		
Drainage Area: 25.4 mi^2		
	Design Flood	**Base Flood**
Frequency	50-year	100 year
Discharge	5,140 cfs	5,140 cfs*
Water Surface Elevation at Bridge	13.2 ft	13.2 ft*
Flood plain data are based upon information available when the plans were prepared and are shown to meet federal requirements. The accuracy of said information is not warranted by the State and interested or affected parties should make their own investigation.		

Minimum Soffit Elevation	**15.2 ft**
Tidal Elevation, 10-year	**8.7 ft**
Tidal Elevation, 100-year	**9.2 ft**
Scour Depth, 2-foot diameter columns	**4.8 ft below channel invert**
Scour Elevation, 2-foot dia. columns	**- 3.8 ft at Bent 3 and Bent 4**

* Flows greater than the upstream channel capacity of 5,140 cfs, will result in the same water surface elevations and flow rates at the bridge site.

All elevations given are referenced to the data provided by Structures Design and Preliminary Investigations-North, using the NAVD 88 vertical datum.

This report has been prepared under my direction as the professional engineer in responsible charge of the work, in accordance with the provisions of the Professional Engineers Act of the State of California.

REGISTERED PROFESSIONAL ENGINEER
ANTHONY NEDWICK
No. C60368
Exp. 06/30/2012
CIVIL
STATE OF CALIFORNIA

Engineer – report prepared by Tony Nedwick	
Registration Number: C60368	Date: October 22, 2010

FOUNDATION REVIEW

DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES

To: **Structure Design**

1. Design
2. R.E. Pending File
3. Specifications & Estimates
4. File

Geotechnical Services

1. GD - North ; South ; West
2. GS File Room

Date: 4/19/12 ; 4/26/12

Novato Creek Br.
Structure Name

04 - MRN - 101 - R20.51
District County Route ~~km~~ Post mi

District Project Development
District Project Engineer

04 - 2640G1 27 - 0089
E.A. Number Structure Number

Foundation Report By: J. Moore Dated: 3/26/12 ; 3/30/12

Reviewed By: K.M. Low (SD) R. Price (GS)

General Plan Dated: 2/16/12 ; 4/23/12 Foundation Plan Dated: 1/14/11

☐ No changes. ☑ The following changes are necessary.

Due to changes in "Driving System Submittal" spec, pile driving stresses shall not exceed 90% of specified yield strength.

FOUNDATION CHECKLIST

✓ Pile Types and Design Loads	✓ Footing Elevations, Design Loads, and Locations	✓ Effect of Fills on Abutments and Bents
✓ Pile Lengths	✓ Seismic Data	✓ Fill Surcharge
✓ Predrilling	✓ Location of Adjacent Structures and Utilities	✓ Approach Paving Slabs
✓ Pile Load Test	✓ Stability of Cuts or Fills	✓ Scour
✓ Substitution of H Piles For Concrete Piles ☐ Yes ☑ No	✓ Fill Time Delay	✓ Ground Water
		✓ Tremie Seals/Type D Excavation

Structure Design Bridge Design Branch No. 8 Geotechnical Services

Rev. 06/02

MATERIALS INFORMATION

04-264061

CORROSION REVIEW - Novato Creek Bridge No. 27-0089R Widening Project dated May 5, 2010 (2 pages)

FOUNDATION REPORT for the Novato Creek Bridge Widening dated October 26, 2009, including Appendix:

A. Soil/Rock Profiles,
B. Liquefaction Analyses,
C. Laboratory Tests and,
D. Pile Drivability Study.

DRIVEABILITY STUDYof 0.5-inch CISS pile for Novato Creek Br (Widen) dated January 20, 2011 (24 pages).

Memorandum

Flex your power!
Be energy efficient!

To: KENG M. LOW
Senior Bridge Engineer
DES-SD

Date: May, 5 2010

File: 04-MRN-101
04-264061
Novato Creek Bridge
Widening Br. No. 27-0089R

From: ROB REIS RAR
Senior Materials & Research Engineer
Corrosion Technology Branch
Office of Structural Materials

Subject: Corrosion Review – Novato Creek Bridge No. 27-0089R Widening Project

I have completed my corrosion review of the proposed widening of the Novato Creek Bridge (Bridge No. 27-0089R). Information that I used for my review included the Draft Foundation Recommendations prepared for the project (dated May 7, 2009) and discussions with you.

BACKGROUND

The project site is located on Highway 101 in Marin County. The existing Novato Creek Bridges consists of right and left structures. The existing bridges were built between the years of 1971 and 1975. The proposed project includes widening the right bridge (Bridge No. 27-0089R). The Office of Geotechnical Design-West provided the Draft Foundation Recommendations that I reviewed for the project.

Precast concrete piles are proposed at the bridge widening abutments. CISS piles are proposed at other locations.

CORROSION REVIEW

The Foundation Report included a detailed description of the geology of the area and corrosion test results of soil samples.

Corrosion testing was performed on five soil samples obtained from three separate borings. Initial soil resistivity and pH testing was performed at the Caltrans' District 04 Materials Lab. Additional testing for chlorides and sulfates was performed as required, based on the results of soil resistivity tests (when soil resistivity was less than 1000 ohm-cm). Chloride and sulfate testing was performed on two of the samples. The additional testing for chlorides and sulfates was performed at the Caltrans' Transportation Laboratory in Sacramento.

Based on the corrosion testing, the controlling corrosion parameter (indicating a corrosive condition) for design is the chloride concentration of 2440 ppm observed at Boring location R-08-004.

Corrosion parameters at other boring locations indicate non-corrosive conditions.

Since the region of corrosive soil is limited at the site, it is prudent to apply corrosion mitigation measures at specific locations (e.g., Abutment 6 at the vicinity of the corrosive soil) as a cost savings measure.

RECOMMENDATIONS

The following recommendations use the value of 2440 ppm chlorides obtained from boring location, R-08-004 as the controlling corrosion parameter. In addition, since the region of corrosive soil is limited at the site, corrosion mitigation measures were applied only to the area affected by the corrosive soil.

- Precast concrete piles at Abutment 6 will be in contact with corrosive soils as identified by sampling Boring R-08-004. Precast piles at Abutment 6 should be designed in accordance with BDS, Table 8.22.1 "Minimum Concrete Cover (inches) for 75-year Design Life", using the column of "Corrosive soil below the MLLW level", with a chloride concentration of 500 to 5000 ppm. This measure allows the standard 2 inches of concrete cover, but has additional requirements for supplementary cementitious materials.
- Supplementary cementitious requirements are listed in SSP S8-C04 "Corrosion Control for Portland Cement Concrete". In accordance with BDS, Table 8.22.1, the exposure condition of the piles, and the controlling corrosion parameter of 2440 ppm, Paragraph 5 of SSPS8-C04 is required for the precast concrete piles at Abutment 6.
- No special corrosion mitigations measures are needed at Abutment 1. Corrosive soils do not exist at the Abutment 1 location.
- No special corrosion mitigation measures are required for the CISS steel shells at Bents 2 through 5. Corrosive soils do not exist at Bents 2 through 5.
- No special corrosion mitigation measures are needed for concrete in-fill of any proposed CISS piles at Bents 2 through 5.

Please let me know if you have any additional questions.

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MS. OFELIA ALCANTARA
Chief
Office of Bridge Design – West
Structure Design

Date: October 26, 2009

Attention: K. Low

File: 04-MRN-101, PM 18.6/22.3
04-264061
Novato Creek Bridge Widening
Bridge No. 27-0089 R/L

From: JOHN C. MOORE JM
Transportation Engineer
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

MM
MAHMOOD MOMENZADEH
Chief, Branch C
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

Subject: Foundation Report for the Novato Creek Bridge Widening

INTRODUCTION

This Foundation Report (FR) documents site geology and subsurface conditions, provides analyses of site conditions as they pertain to the project, and recommends geotechnical input for foundation design.

To accomplish the above stated purpose, the following tasks were conducted:

- Field reconnaissance to observe and document site conditions
- Review of geologic open-files and as-built foundation plans
- Site subsurface investigation
- Engineering analyses for foundation design

PROJECT DESCRIPTION

The project site is located on Highway 101, in Marin County, at post mile 20.6. Based on as-built plans, the Novato Creek Bridge was built between the years of 1971 and 1975.

The bridge has five spans and carries three lanes of traffic. It is planned to widen the Novato Creek Bridge OH (Bridge No. 27-89 R/L), specifically the Northbound (Right) Median. This proposed widening is one of three bridges to be widened, for the Marin-Sonoma Narrows, Segment 'A' project. **Please note that all elevations listed in this report are referenced with respect to the North American Vertical Datum of 1988 (NAVD 88), unless otherwise noted.**

SITE GEOLOGY AND SUBSURFACE CONDITIONS

Regional Setting and Area Geology

The project is located within the California Coast Range geomorphic province; a series of northwest-trending mountain ranges separated by parallel valleys. The boundaries between ranges and valleys are generally defined by faults dividing the harder, more resistant rocks, from the weaker, less resistant rocks. The orientation of these valleys and ranges is controlled by the regional tectonics – specifically the San Andreas Fault system.

The oldest known basement rocks are part of the Franciscan Formation, a complex assemblage of sedimentary, metamorphic and igneous rocks of Jurassic and Cretaceous ages that have been faulted, folded, sheared, and heated to varying degrees. Overlying the Franciscan Formation are Pliocene-age, marine sediments of the Wilson Grove Formation, and Pliocene-age volcanics of the Sonoma Group. Structural deformation of the Sonoma Group rocks during the Late Pliocene formed the hills and valleys in the region. Sand, silt, and gravel eroded from the surrounding hills and deposited in the valleys forming the Plio-Pleistocene Glen Ellen Formation. After which another period of structural deformation occurred, forming the present landscape.

Site Geology

Foundation materials underlying Novato Creek Bridge consist of two geologic units at the surface: artificial fill (levee fill) and artificial fill (over bay mud)(Geologic Map of the Novato Quadrangle, Marin and Sonoma Counties, California, a Digital Database, California Geological Survey [CGS], 2002). Borings drilled at the site indicate Bay Mud occurs at shallow depths (5 ft. to 30 ft.) and overlies mixed alluvial/colluvial sediments. Artificial fill (levee fill) occurs as abutment foundation material. Weak, intensely weathered, and sheared rock occurs at depths of about 65 feet below the ground surface at abutment #1 and bents 2 through 5, and at about 80 feet below the ground surface at abutment #6.

Site Specific Subsurface Conditions based on As-Built Contract No. 04-120373

The initial subsurface investigation; Contract No. 04-120373, for the construction of the Novato Creek Bridge was conducted by the Bridge Department Geology Section in November 1968 and June 1969. **Please note that elevations listed under this heading are based on the National Geodetic Vertical Datum of 1929 (NGVD29), unless otherwise noted.** The investigation consisted of two rotary borings (B-1 and B-4) and two penetration borings (B-2 and B-3). The original ground elevations for the two rotary borings ranged from 5.2 feet to 6.0 feet and terminated at elevations ranging from –50 feet to –70 feet. Based on this as-built log of test borings (LOTB's), the site is underlain by an approximately 5- to 6-foot thick layer of Levee (engineered) fill consisting of a loose mixture of clay, silt, and sand. Underlying the clay/silt/sand mixture is a layer of soft silty clay with coarse sand and fine gravel, approximately 20-feet in thickness (Bay Mud). Below the Bay Mud is a layer of silt with fine sands ranging in thickness from 15 to 20-feet. Following the silt/sand mixture is Sandstone in various descending stages of decomposition and weathering.

The as-built LOTB indicated that groundwater was encountered during the investigation at elevations ranging between –1.5 and –0.5 feet.

Current Field Investigation and Subsurface Conditions

The Office of Geotechnical Design-West conducted a subsurface investigation for the Marin-Sonoma Narrows Segment 'A' project during the months of October, November, and December 2008, and January 2009. Table No. 1 lists borings associated with the Novato Creek Bridge widening, each boring's approximate northing, easting, alignment/stationing, elevation, and depth:

Table No. 1 – Boring Summary

Northbound Median Widening			
	Abutment #1	Bents 2, 3, 4, & 5	Abutment #6
Boring	R-08-002	R-08-003	R-08-004
Northing (ft.)	2228215.5	2228394.2	2228447.0
Easting (ft.)	5968438.2	5968413.2	5968412.8
Alignment/Stationing	Centerline of 'J1' @ 305+20	Centerline of 'J1' @ 307+02	7.5 feet right of 'J1' @ 307+56
Elevation (ft.)	18.0	7.0	20.0
Depth (ft.)	80.0	100.0	101.5

The subsurface investigation for the Novato Creek Bridge consisted of three mud rotary borings. Borings R-08-002, R-08-003, and R-08-004 were drilled for the northbound median widening; Boring R-08-001 was eliminated due to tidal fluctuations at Novato Creek. The mud rotary borings were advanced using a self-casing wire line drilling method to depths shown in the tables above. Borings R-08-002 and R-08-003 were drilled using a CS2000 Track mounted drill rig with an automatic hammer. Boring R-08-004 was drilled using a CS2000 Truck mounted drill rig with an automatic hammer. Sampling was performed using a Standard Penetration Test (SPT) sampler at five-foot intervals as well as continuous coring in all borings. Selected soil samples were collected and submitted for laboratory testing. Logs of Test Borings (LOTB's) are currently being drafted and will be provided separate of this report.

TOPOGRAPHY

The project sits at the mouth of the Novato Valley, a northwest/southeast trending valley containing Novato Creek. Novato Valley opens to the southeast to the reclaimed tidal flats that separate it from northern San Francisco Bay. Small, isolated hills of resistant bedrock rise from the lower lying reclaimed tidal areas. The Novato Creek Bridge spans Novato Creek, which flows southeast through reclaimed tidal flats. Abutments are elevated above Novato Creek and founded on a continuous levee that rises approximately 15’ above the creek. Elevations are relatively flat, ranging from about 18 ft at the southeast corner of Abutment 1 to 20 ft. at the northwest corner of Abutment 6.

PERTINENT SOIL CONDITIONS OR GEOLOGIC HAZARDS

There are no known geologic hazards at the project site. Franciscan Formation mélange is found at depths greater than 65-ft. (Elev.-47.5 ft.) for Abutment #1 and Bents #2 through #5, and at 80-ft. (Elev.-62 ft.) for Abutment #6. While no hard rock was encountered in the borings at the site, hard to very hard rock could be encountered during pile installation.

PROJECT SITE SOILS

Abutments 1 and 6 are founded on engineered fill (levee fill) that is approximately 15 to 20 feet deep. Soils found below the fill sections consist of a mixture of very soft-to-soft organic silty clay, and dense fine to coarse sand with gravel. These soils extend to depths of 65 feet below the ground surface for Abutment #1 and Bents #2 through #5, and 80-ft. below the ground surface for Abutment #6. This mixture of material was likely deposited by regular flooding of Novato Creek as well as tidal fluctuations.

PROJECT SITE ROCKS

Rocks found at the project site are predominantly sheared argillite (shale) with minor serpentine and sandstone of the Franciscan Formation mélange. As recovered in the borings the unit is sheared, very intensely weathered to decomposed, weak, and soft. The color is a consistent dark gray with occasional blue green areas indicating minor serpentine. The sheared and weathered nature of the rock creates a mixture of angular rock fragments in a plastic, moist, clayey matrix.

GROUNDWATER

Groundwater is typically not measured during drilling because each boring was drilled using the mud rotary wash method. However, drilling fluid/groundwater in Boring R-08-002 was allowed to equalize for five days after drilling (November 2008) and then measured, indicating groundwater to be approximately 19.0-ft. below the ground surface. Boring R-08-003 was allowed to equalize for seven days after drilling (November 2008) and then measured, indicating groundwater to be approximately 4.2-ft. below the ground surface. Boring R-08-004 was measured the same day it was drilled, indicating groundwater to be approximately 18.8-ft. below the ground surface. It should be noted that groundwater levels are affected by tidal fluctuations and changes in precipitation.

SCOUR

The following information listed in Table 2 below, has been summarized by and taken directly from the Division of Structures Final Hydraulic Report for Novato Creek, dated December 9, 2009.

Table No. 2 – Hydrologic Summary

Hydrologic Summary Novato Creek, 27-0089R		
Drainage Area: 25.4 mi^2		
Frequency	**Design Flood**	**Base Flood**
	50-year	100-year
Discharge	5,140 cfs	5,140 cfs
Water Surface Elevation at Bridge	13.2 ft.	13.2 ft.
Minimum Soffit Elevation	**15.2 ft.**	
Tidal Elevation, 10-year	**8.7 ft.**	
Tidal Elevation, 100-year	**9.2 ft.**	
Scour Depth, 2-foot diameter columns	**4.8 ft. below channel invert**	
Scour Elevation, 2-foot diameter columns	**-3.8 ft. at Bent 3 and Bent 4**	

According to the report "the existing structure is not considered to be scour critical", and therefore scour was not considered in pile foundation design.

CORROSIVITY

As part of our study, five soil/rock samples were collected from three borings and sent to Caltrans' District 04 Laboratory for corrosion analyses. Corrosion test results are shown in Table No. 4 below:

Table No. 3 – Corrosion Test Results

Boring	Sample No.	Depth	Resistivity (Ω-Cm)	pH	Sulfates ppm	Chlorides ppm
R-08-004	3417-1P	75-80	216	7.2	328	2440
N/A	3417-2P	Water sample from Novato Creek	4500	6.9	N/A	N/A
R-08-002	3417-3P	15-16.5	1700	7.8	N/A	N/A
R-08-003	3417-4P	35-36.5	710	7.8	180	510
R-08-004	3417-5P	20-21.5	2250	8.0	N/A	N/A

Caltrans specifications require further testing (for sulfates and chlorides) if resistivity is indicated to be less than 1000 Ω-cm or if the pH is indicated to be less than 5.5. If further testing is required, samples are sent to Caltrans' Sacramento Laboratory for further corrosion analyses. Two of the samples listed (Nos. 3417-1P and 3417-4P) above, were sent to Sacramento for further testing and were found to be corrosive. Please contact Caltrans' Corrosion Technology Branch for further direction.

SEISMICITY/LIQUEFACTION POTENTIAL

Hossain Salimi of the Office of Geotechnical Design West will provide preliminary seismic recommendations for this structure.

Analyses for liquefaction potential for the abutments and bents were conducted using methods outlined in the book "Soil Liquefaction During Earthquakes", by I.M. Idriss and R.W. Boulanger, 2008. Please refer to the attached analyses for each boring in the appendix.

Based on the results of these analyses the potential for liquefaction at this site is high.

In each boring, where low blowcounts were recorded, either sand or clay samples were recovered using Shelby Tubes and/or a standard split spoon sampler. Mechanical Analysis, Atterberg Limits, and Hydrometer tests were performed on the samples. The samples were classified as having either sand-like or clay-like behavior using one or all of the following criteria for clay-like behavior:

Plasticity Index, PI ≥ 7
Hydrometer, $5\mu > 15\%$ of material passing

If a sample was classified as being clay-like, it was excluded as having liquefaction potential. All other samples and associated blowcounts were analyzed for liquefaction potential

Based on our geotechnical investigation for the Novato Creek Bridge, we have determined that a liquefiable zone, variable in thickness, exists between elevations –27 and –42-feet at Abutment #1, -25 to –48-feet for Bents 2 through 5, and –6 to –10 feet and –20 to –25 feet for Abutment #6. It has been found that this may result in a downdrag force that could result in the structural (compression) capacity of the piles being exceeded for the existing and proposed bridges.

The thickness of this liquefiable zone is based on our liquefaction analysis for Borings R-08-002 and R-08-003. Boring R-08-004 was not included in the detailed determination of liquefiable zone because of a lack of concurrent SPT/Shelby tube sampling in Boring R-08-004. Two Cone Penetration Tests (CPT's) were also performed – one near each proposed abutment – to supplement our borings. Please refer to the liquefaction analyses attached in the appendix.

Our findings indicated that post liquefiable ground settlement of approximately 4 to 5-inches will occur at abutment 1, 5.0 to 7.0-inches at Bent 5, and 2.5 to 3-inches at Abutment 6. In addition, due to the estimated downdrag load demand, the calculated pile tip load deformation at the abutments and the bents indicated that piles at the abutments move about 1.7-inches whereas those at the bents may move about 6-inches, inducing a differential settlement of about 4-inches between an abutment and adjacent bents.

The downdrag loads due to seismically induced ground settlement is estimated to be 200 kips for 24-in. diameter CISS piles located at the bents and 276 kips for Class 200 Alternative 'X' piles located at the abutments.

The above information was brought to the attention of the Office of Structural Design and the Office of Earthquake Engineering through meetings and correspondence, regarding liquefaction impacts and remediation measures for the existing bridge as well as the proposed structure. Based on the analysis by Structures Design using the above information, the bridge will experience significant damage but will not collapse in a design safety level earthquake event. Our office was informed by the Office of Structural Design, that the Novato Creek Bridge has been designated as an "Ordinary" bridge, as opposed to an "Important" bridge, which are both defined in Caltrans' Memo to Designers 20-1, January 1999. Based on the memo, the bridge has been designed for, with respect to a Functional-Evaluation Ground Motion, an immediate service level and a repairable damage level. With respect to a Safety-Evaluation Ground Motion, the bridge has been designed for a limited level of service and a significant damage level. Because the Novato Creek Bridge has been designated as ordinary, the costs for liquefaction remediation according to the Office of Earthquake Engineering may be prohibitive.

AS-BUILT FOUNDATION DATA

Based on the as-built plans, the existing foundation information is as follows in Table No. 4 below:

Table No. 4 - Existing Foundation Conditions

		NGVD 1929		NAVD 1988**	
Support Location	Foundation Type	Bottom of Footing Elevation (ft.)	Average Pile Tip Elevation (ft.)	Bottom of Footing Elevation (ft.)	Average Pile Tip Elevation (ft.)
Abutment 1R	Class 70, Alternative 'X' Driven Piles	7.0	-50.2	9.7	-47.5
Abutment 1L	Class 70, Alternative 'X' Driven Piles	9.0	-50.2	11.7	-47.5
Bent 2R	18-in. diameter Octagonal Prestressed	N/A	-45.8	N/A	-43.1
Bent 2L	18-in. diameter Octagonal Prestressed	N/A	-49.3	N/A	-46.6
Bent 3R	18-in. diameter Octagonal Prestressed	N/A	-51.1	N/A	-48.4
Bent 3L	18-in. diameter Octagonal Prestressed	N/A	-54.6	N/A	-51.9
Bent 4R	18-in. diameter Octagonal Prestressed	N/A	-50.7	N/A	-48.0
Bent 4L	18-in. diameter Octagonal Prestressed	N/A	-54.9	N/A	-52.2
Bent 5R	18-in. diameter Octagonal Prestressed	N/A	-51.6	N/A	-48.9
Bent 5L	18-in. diameter Octagonal Prestressed	N/A	-59.0	N/A	-56.3
Abutment 6R	Class 70, Alternative 'X' Driven Piles	8.0	-60.2	10.7	-57.5
Abutment 6L	Class 70, Alternative 'X' Driven Piles	10.0	-60.2	12.7	-57.5

Design pile loading at bents and abutments is 70 tons (140 kips). ** - Elevations adjusted to NAVD 88.

FOUNDATION TYPE RECOMMENDATIONS

After discussions with the Office of Structure Design, it was initially determined that the foundations for the Novato Creek Bridge would consist of 24-in. diameter CISS piles for Bents 2 through 5 and Class 200 Alternative "X", Standard Plan piles for abutments 1 and 6. Table Nos. 5, 6, and 7 list respectively, the Scour Data, Foundation Design Data, and Foundation Design Loads provided to our office by Structure Design for the median widening:

Table No. 5 – Scour Data for Northbound Median Widening

Scour Data		
Support No.	Long Term (Degradation and Contraction) Scour Elevation (ft)	Short Term (Local) Scour Depth (ft)
Abut 1	N/A	N/A
Bent 2	N/A	N/A
Bent 3	N/A	4.8
Bent 4	N/A	4.8
Bent 5	N/A	N/A
Abut 6	N/A	N/A

Table No. 6 – Foundation Design Data for Northbound Median Widening

Foundation Design Data									
Support No.	Design Method	Pile Type	Finished Grade Elevation (ft)	Bottom of Footing (ft)	Cut-off Elevation (ft)	Pile Cap Size (ft)		Permissible Settlement under Service Load (in)	Number of Piles per Support
						B	L		
Abut 1	WSD	Class 200 Alt "X"	N/A	9.6	10	N/A	N/A	1"	2
Bent 2	LRFD	24" Diam. CISS Pile	5	N/A	17±	N/A	N/A	1"	1
Bent 3	LRFD	24" Diam. CISS Pile	2	N/A	17±	N/A	N/A	1"	1
Bent 4	LRFD	24" Diam. CISS Pile	2	N/A	17.5±	N/A	N/A	1"	1
Bent 5	LRFD	24" Diam. CISS Pile	6	N/A	17.5±	N/A	N/A	1"	1
Abut 6	WSD	Class 200 Alt "X"	N/A	10.6	11	N/A	N/A	1"	2

Note: 24" Diameter CISS Piles at the Bents are Pile Extensions. There are two Pile Extensions per Bent. Each Pile Extension is considered as a "Support".

Table No. 7 – Foundation Design Loads for Northbound Median Widening

Foundation Design Loads											
Support No.	Service – I Limit State (kips)			Strength Limit State (Controlling Group, kips)				Extreme Event Limit State (Controlling Group, kips)			
	Total Load		Permanent Loads	Compression		Tension		Compression		Tension	
	Per Support	Max Per Pile	Per Support	Per Support	Max Per Pile	Per Support	Max Per Pile	Per Support	Max Per Pile	Per Support	Max Per Pile
Abut 1	237	119	124	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bent 2*	304	N/A	114	472	472	-	-	192	192	23	23
Bent 3*	282	N/A	104	438	438	-	-	185	185	26	26
Bent 4*	282	N/A	104	438	438	-	-	169	169	24	24
Bent 5*	303	N/A	114	472	472	-	-	176	176	14	14
Abut 6	237	119	124	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Bent loads provided are per Pile Extension.

Based on the provided foundation design data, Class 200 Alternative 'X' piles to support the abutments were analyzed to meet WSD loads and the estimated additional downdrag load. CISS Piles, 24-inches in diameter, to support the Bents were analyzed to meet LRFD loads and the additional estimated downdrag load. According to the current boring data, the site subsurface conditions consist of materials categorized under FHWA 1999 criteria for cohesive and cohesionless soils, and weak to strong rocks as shown in the attached Appendix A, Soil/Rock Profiles. These materials, with engineering properties estimated from field and laboratory tests results, were used to analyze proposed driven and CISS piles' axial capacity in compression and tension using the computer program APILE Plus Version 4.0. Table Nos. 8 and 9 below; summarizes Axial Pile Data for driven piles under WSD conditions and CISS pile foundations under Service, Strength, and Extreme Limit State conditions, respectively. It is recommended that the length of the soil plug for CISS piles be maintained to not less than three pile diameters. This data should be checked against specified pile type for design lateral loads. We understand that lateral load – deformation analysis will be performed by Structures Design.

Table No. 8 – Abutment Foundation Pile Data for Northbound Median Widening

Abutment Foundation Design Recommendations									
Support Location	Pile Type	Cut-off Elevation	Service-I Limit State Load (kips) per Support		Service-I Limit State Total Load (kips) per pile (Compression)	Nominal Resistance (kips)	Design Tip Elevation (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance Required (kips)
			Total	Permanent					
Abut 1	Class 200 Alt "X"	10	237	124	119	240	-47 (a) -12 (b) -51 (c)	-51	400
Abut 6	Class 200 Alt "X"	11	237	124	119	240	-50 (a) -11 (b) -58 (c)	-58	400

<u>*Notes:*</u>

1) *Design tip elevations for **Abutments** are controlled by: (a) Compression,(b) Settlement, and (c) Extreme Event I.*

2) *For Extreme Event I, 276 kips of downdrag per pile has been added to the compression load.*

3) <u>*Lateral loading should be checked by Structures Design.*</u>

4) *The Specified Tip Elevation can be raised not more than 5-ft. if the nominal driving resistance is achieved.*
5) *Use the Nominal Driving Resistance value of 400 kips for the Gates formula.*

Table No. 9 – Bent Foundation Pile Data for Northbound Median Widening

Bent Foundations Design Recommendation											
			Service-I Limit State Load per Support (kips)	Total Permissible Support Settlement (inches)	Required Factored Nominal Resistance (kips)				Design Tip Elevation (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance Required (kips)
					Strength Event		Extreme Event I				
Support Location	Pile Type	Cut-off Elevation (ft)			Comp. (ϕ=0.7)	Tension (ϕ=0.7)	Comp. (ϕ=1)	Tension (ϕ=1			
Bent 2	24" Diam. CISS Pile	17±	114	1"	472	-	392	23	-65(a-I) -64(a-II) -13(c)	-65	680
Bent 3	24" Diam. CISS Pile	17±	104	1"	438	-	385	26	-65(a-I) -64(a-II) -12(c)	-65	680
Bent 4	24" Diam. CISS Pile	17.5±	104	1"	438	-	369	24	-65(a-I) -64(a-II) -12(c)	-65	680
Bent 5	24" Diam. CISS Pile	17.5±	114	1"	472	-	376	14	-65(a-I) -64(a-II) -13(c)	-65	680

Notes:

1) *Design tip elevations for **Bents** are controlled by: (a-I) Compression (Strength Limit), (a-II)Compression (Extreme Event I), and (c) Settlement.*

2) *Because CISS piles are founded in rock, settlement under service loads does not govern. Lateral loading should be checked by Structures Design.*

3) *For Extreme Event I, 200 kips of downdrag per pile has been added to the compression load.*

The final pile data table to be included on the plans should be as shown in Table No. 10 below:

Table No. 10 – Pile Data Table for Novato Creek Bridge Widening

Pile Data Table							
Location	Pile Type	Nominal Resistance (kips)		Design Tip Elevations (ft.)	Specified Tip Elevation (ft.)	Nominal Driving Resistance (kips)
		Compression	Tension			
Abut 1	Class 200 Alt "X"	240	0	-51 (a) -12 (b)	-51	400
Bent 2	CISS NPS 24x0.75	680	30	-65 (a) -13 (b)	-65	680
Bent 3	CISS NPS 24x0.75	630	30	-65 (a) -12(b)	-65	680
Bent 4	CISS NPS 24x0.75	630	30	-65 (a) -12(b)	-65	680
Bent 5	CISS NPS 24x0.75	680	20	-58 (a) -13 (b)	-65	680
Abut 6	Class 200 Alt "X"	240	0	-58 (a) -11 (b)	-58	400

Notes:

1) *Design tip elevations for **Abutments** are controlled by: (a) Compression and (b) Settlement.*

2) *Design tip elevations for **Bents** are controlled by: (a) Compression and (b) Settlement.*

3) *Design tip elevations for Lateral Load (c) to be provided by Designer.*

4) *Design tip elevations for tension were not reported for bents because they were very insignificant.*

Table No. 11 below provides the Group Efficiency Factors (GEF's) to be used for driven piles in cohesionless material:

Table No. 11 – Group Efficiency Factors

Pile Spacing	GEF
2.5 D	0.65
3.0 D	0.77
3.5 D	0.88
4.0 D	1.00

'D' in Table No. 10 represents pile diameter. However, we recommend to use no reduction factor (GEF = 1.0) provided that a minimum pile spacing of 2.5 D be used and a minimum 6-inch compacted gravel pad be placed on prepared subgrade below the pile cap to enhance/ensure that the pile cap has firm contact with native ground. For gravel pad material, use ¾-inch Maximum Class II aggregate base as specified in Section 26: Aggregate Bases, of the most current Caltrans Standard Specification Manual. Ensure material is compacted to 95% relative compaction.

CONSTRUCTION CONSIDERATIONS

The Contractor should review all LOTB's (when they become available) and laboratory test results attached to this report.

Pile driving for each pile installation can be terminated if refusal is attained within 5-feet of the specified tip elevation. Drive each pile to its specified tip elevation if refusal is not attained within 5-feet of the specified tip elevation.

If, during driving to specified tip elevation, piles have not achieved their required capacity, piles should be allowed to set for a minimum time period of 48-hours and then restruck.

A Pile Drivability Study for the bents has been performed for the Novato Creek Bridge, of which the final report was submitted on September 1, 2009. A copy of this report is attached to this memo and is located in the appendix.

DISCLAIMER AND CONTACT INFORMATION

The recommendations contained in this report are based on specific project information regarding structure type and location. If any conceptual changes are made during final project design, the Office of Geotechnical Design – West, Design Branch C should review those changes to determine if these foundation recommendations are still applicable. Any questions regarding the above recommendations should be directed to the attention of John Moore at (510) 622-8742 or Mahmood Momenzadeh at (510) 286-5732.

c: MMomenzadeh, TJPokrywka, Daily File, Route File, Translab File

JMoore/JM

REGISTERED PROFESSIONAL ENGINEER
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No. C61792
Exp. 6/30/2011
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STATE OF CALIFORNIA

APPENDIX

SOIL/ROCK PROFILES

LIQUEFACTION ANALYSES

LABORATORY TESTS

PILE DRIVABILITY STUDY

AXIALLY LOADING PILE ANALYSIS PROGRAM - APILEplus

Abt 1, Novato Creek Bridge

DESIGNER : TN-JM

DATE : 04/24/2009

PILE PROPERTIES :

PERIMETER OF PILE WITH NONCIRCULAR SECTION	= 48.00	IN.
TIP AREA OF PILE WITH NONCIRCULAR SECTION	= 1.00	SQF
OUTSIDE DIAMETER OF CIRCULAR PILE	= 0.00	IN.
INTERNAL DIAMETER OF CIRCULAR PILE	= 0.00	IN.
PILE LENGTH	= 76.00	FT.
MODULUS OF ELASTICITY	= 0.290E+07	PSI

LENGTH OF SURFACE SECTION WITH ZERO SKIN FRICTION = 8.00 FT.
INCREMENT OF PILE LENGTH USED IN COMPUTATION = 1.00 FT.

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	1.00	120.00	34.00	0.01
8.00	SAND	1.00	120.00	34.00	0.01
8.00	SAND	1.00	120.00	35.00	20.00
19.00	SAND	1.00	120.00	35.00	20.00
19.00	SAND	1.00	57.60	34.00	20.00
30.00	SAND	1.00	57.60	34.00	20.00
30.00	CLAY	0.00	57.60	0.00	0.00
40.00	CLAY	0.00	57.60	0.00	0.00
40.00	SAND	1.00	57.60	8.00	8.00
45.00	SAND	1.00	57.60	8.00	8.00
45.00	SAND	1.00	57.60	3.00	8.00
50.00	SAND	1.00	57.60	3.00	8.00
50.00	SAND	1.00	57.60	5.00	8.00
60.00	SAND	1.00	57.60	5.00	8.00
60.00	SAND	1.00	57.60	10.00	8.00
62.50	SAND	1.00	57.60	10.00	8.00
62.50	SAND	1.00	67.60	44.00	50.00
80.00	SAND	1.00	67.60	44.00	50.00

AXIALLY LOADING PILE ANALYSIS PROGRAM - APILEplus

Bent 3, Novato Creek Bridge

DESIGNER : TN

DATE : 04/24/09

PILE PROPERTIES :

PERIMETER OF PILE WITH NONCIRCULAR SECTION	=	0.00 IN.
TIP AREA OF PILE WITH NONCIRCULAR SECTION	=	1.59 SQF
OUTSIDE DIAMETER OF CIRCULAR PILE	=	24.00 IN.
INTERNAL DIAMETER OF CIRCULAR PILE	=	23.00 IN.
PILE LENGTH	=	80.00 FT.
MODULUS OF ELASTICITY	=	0.290E+08 PSI

LENGTH OF SURFACE SECTION WITH ZERO SKIN FRICTION	=	3.00 FT.
INCREMENT OF PILE LENGTH USED IN COMPUTATION	=	1.00 FT.

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	CLAY	0.00	120.00	0.00	0.00
4.20	CLAY	0.00	120.00	0.00	0.00
4.20	CLAY	0.00	57.60	0.00	0.00
13.60	CLAY	0.00	57.60	0.00	0.00
13.60	CLAY	0.00	57.60	0.00	0.00
17.00	CLAY	0.00	57.60	0.00	0.00
17.00	SAND	1.00	57.60	7.00	8.00
18.50	SAND	1.00	57.60	7.00	8.00
18.50	CLAY	0.00	57.60	0.00	0.00
30.00	CLAY	0.00	57.60	0.00	0.00
30.00	SAND	1.00	57.60	13.00	8.00
40.00	SAND	1.00	57.60	13.00	8.00
40.00	SAND	1.00	57.60	8.00	8.00
55.00	SAND	1.00	57.60	8.00	8.00
55.00	SAND	1.00	67.60	38.00	40.00
65.00	SAND	1.00	67.60	38.00	40.00
65.00	CLAY	0.00	77.60	0.00	0.00
84.00	CLAY	0.00	77.60	0.00	0.00

AXIALLY LOADING PILE ANALYSIS PROGRAM - APILEplus
VERSION 4.0 - (C) COPYRIGHT ENSOFT, INC., 1987-2004.

Bent 3, Novato Creek Bridge

DESIGNER : TN

DATE : 04/24/09

PILE PROPERTIES :

PERIMETER OF PILE WITH NONCIRCULAR SECTION	=	0.00 IN.
TIP AREA OF PILE WITH NONCIRCULAR SECTION	=	1.59 SQF
OUTSIDE DIAMETER OF CIRCULAR PILE	=	24.00 IN.
INTERNAL DIAMETER OF CIRCULAR PILE	=	23.00 IN.
PILE LENGTH	=	76.00 FT.
MODULUS OF ELASTICITY	=	0.290E+08 PSI

LENGTH OF SURFACE SECTION WITH ZERO SKIN FRICTION = 3.00 FT.
INCREMENT OF PILE LENGTH USED IN COMPUTATION = 1.00 FT.

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	CLAY	0.00	120.00	0.00	0.00
4.20	CLAY	0.00	120.00	0.00	0.00
4.20	CLAY	0.00	57.60	0.00	0.00
13.60	CLAY	0.00	57.60	0.00	0.00
13.60	CLAY	0.00	57.60	0.00	0.00
17.00	CLAY	0.00	57.60	0.00	0.00
17.00	SAND	1.00	57.60	31.00	20.00
18.50	SAND	1.00	57.60	31.00	20.00
18.50	CLAY	0.00	57.60	0.00	0.00
30.00	CLAY	0.00	57.60	0.00	0.00
30.00	SAND	1.00	57.60	32.00	20.00
40.00	SAND	1.00	57.60	32.00	20.00
40.00	SAND	1.00	57.60	32.00	20.00
55.00	SAND	1.00	57.60	32.00	20.00
55.00	SAND	1.00	67.60	38.00	40.00
65.00	SAND	1.00	67.60	38.00	40.00
65.00	CLAY	0.00	77.60	0.00	0.00
80.00	CLAY	0.00	77.60	0.00	0.00

Boring R-08-002

Input Parameters:

Peak Ground Acceleration (g) =	0.350		
Earthquake Magnitude, M =	7		
	English Units	Metric Units	
Top of Borehole Elevation (ft.) =	18	5.5	m
Water Table Depth (ft.) =	19.0	5.8	m
Borehole Depth (ft.) =	80	24.4	m
Average γ above water table (lbs./ft.^{3}) =	120	18.9	kN/m^3
Average γ below water table (lbs./ft.^{3}) =	120	18.9	kN/m^3
Borehole Diameter (in.) =	4	101.6	mm

Requires correction for sampler liners (YES/NO): NO

Rod lengths assumed equal to the depth plus 1.5 m (for above ground extension)

						Clay Criteria																						
SPT sample number	Depth (ft.)	Elevation (ft.)	Depth (m)	Measured N	Soil Type (USCS)	Plasticity Index, PI, (PI > 7)	Hydrometer, 5μ (0.005mm), (>15% passing 5μ)	Flag "Clay" "Unsaturated" "Unreliable"	Fines Content (%)	Energy Ratio, ER (%)	C_E	C_B	C_R	C_S	N_{60}	σ_{vc} (kPa)	σ_{vc}' (kPa)	C_N	$(N_1)_{60}$	ΔN for fines content	$(N_1)_{60\text{-}CS}$	Stress Reduction Coefficient, r_d	CSR	MSF for Sand	K_σ for Sand	CRR for M=7.5 & σ_{vc}' = 1 atm	CRR	Fator of Safety	Depth (ft.)
1	**5**	13	1.5	21	SC			Unsaturated		84	1.40	1	0.80	1.00	23.5	29	29	1.51	35.5	0.0	35.46	0.99	0.226	1.14	1.10	1.223	n.a.	n.a.	**5**
2	**10**	8	3.0	20	SC			Unsaturated		84	1.40	1	0.85	1.00	23.8	57	57	1.23	29.3	0.0	29.30	0.97	0.222	1.14	1.10	0.444	n.a.	n.a.	**10**
3	**15**	3	4.6	33	SC			Unsaturated		84	1.40	1	0.95	1.00	43.9	86	86	1.04	45.8	0.0	45.77	0.95	0.217	1.14	1.05	2.000	n.a.	n.a.	**15**
4	**20**	-2	6.1	20	SC			Unsaturated		84	1.40	1	0.95	1.00	26.6	115	112	0.96	25.5	0.0	25.54	0.93	0.217	1.14	0.98	0.303	n.a.	n.a.	**20**
5	**25**	-7	7.6	19	SC					84	1.40	1	0.95	1.00	25.3	144	126	0.91	23.1	0.0	23.08	0.90	0.235	1.14	0.97	0.251	0.277	1.18	**25**
6	**30**	-12	9.1	6	SC	15		Clay		84	1.40	1	1.00	1.00	8.4	172	139	0.92	n.a.	n.a.	n.a.	0.88	0.247	1.14	0.90	n.a.	n.a.	n.a.	**30**
7	**37**	-19	11.3	7	CL	19	40.5	Clay	96	84	1.40	1	1.00	1.00	9.8	213	159	0.89	n.a.	n.a.	n.a.	0.84	0.256	1.14	0.87	n.a.	n.a.	n.a.	**37**
8	**42**	-24	12.8	12	SC	5	25.6	Clay	30	84	1.40	1	1.00	1.00	16.8	241	173	0.87	n.a.	n.a.	n.a.	0.81	0.258	1.14	0.84	n.a.	n.a.	n.a.	**42**
9	**45**	-27	13.7	2	SC		17.2	Clay	41	84	1.40	1	1.00	1.00	2.8	259	181	0.86	n.a.	n.a.	n.a.	0.79	0.259	1.14	0.83	n.a.	n.a.	n.a.	**45**
10	**50**	-32	15.2	6	SM		13.3		29	84	1.40	1	1.00	1.00	8.4	287	195	0.71	5.9	5.3	11.27	0.77	0.258	1.14	0.94	0.127	0.136	0.53	**50**
11	**60**	-42	18.3	20	SM	13				84	1.40	1	1.00	1.00	28.0	345	222	0.71	19.8	0.0	19.75	0.71	0.252	1.14	0.90	0.203	0.207	0.82	**60**
12	**65**	-47	19.8	59	ROCK					84	1.40	1	1.00	1.00	82.6	373	236	0.80	66.1	0.0	66.07	0.69	0.248	1.14	0.75	2.000	1.711	2.00	**65**
	90																												**90**
	100																												**100**

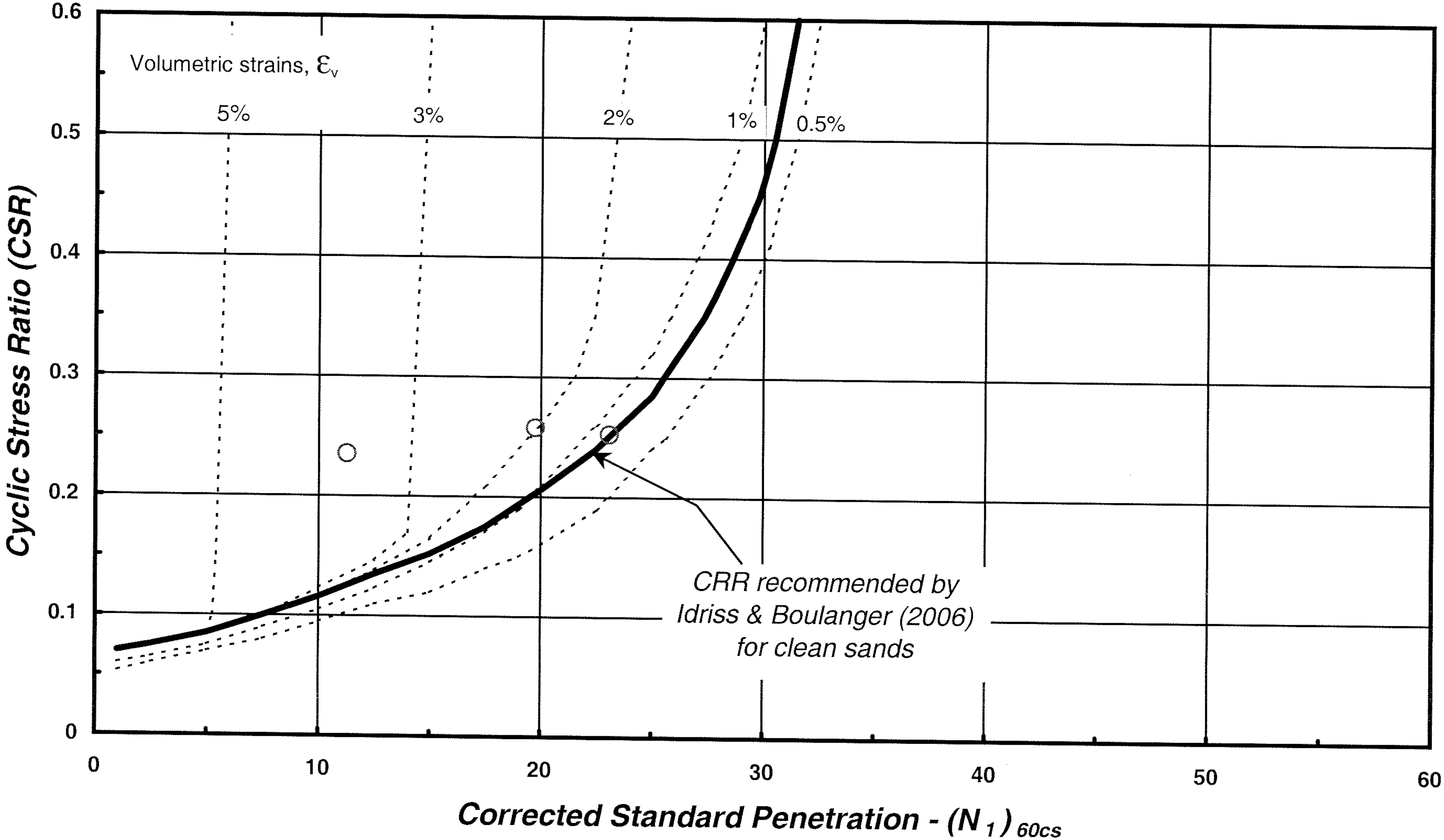
Soil Boring Profile

	X	Depth	Soil Type
Soil Type Depth 0	0	0	CLAYEY SAND
	2	0	
Soil Type Depth 1	0	30	Lean CLAY
	2	30	
Soil Type Depth 2	0	45	CLAYEY SAND
	2	45	
Soil Type Depth 3	0	50	SILTY SAND
	2	50	
Soil Type Depth 4	0	65	ROCK
	2	65	
Borehole Depth	0	80	
	2	80	

Water Table Depth

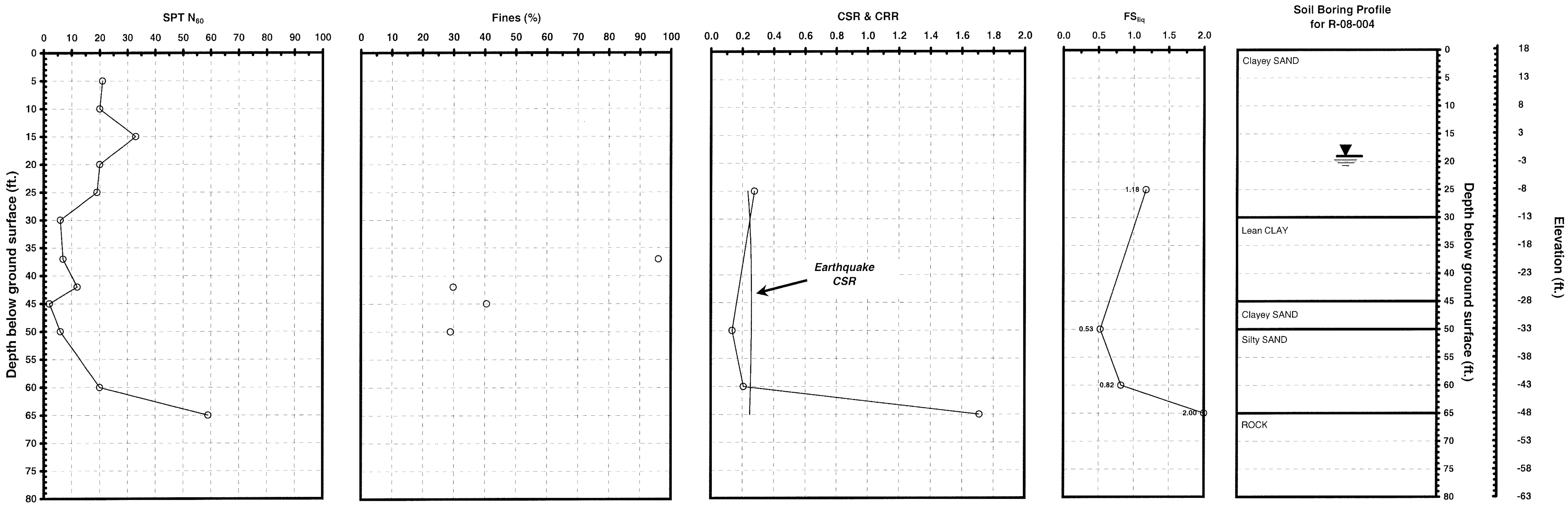
X	Y
1	19
1.25	19

Liquefaction Analysis for Boring R-08-002



SPT-based Liquefaction Correlation for Clean Sands with M=7.5 and σ'_{vc} =1atm, showing computed variation of volumetric strains during reconsolidaton

Liquefaction Triggering Analysis for Boring R-08-002



Boring R-08-003

Input Parameters:

Peak Ground Acceleration (g) =	0.350		
Earthquake Magnitude, M =	7		
	English Units	Metric Units	
Top of Borehole Elevation (ft.) =	6.8	2.1	m
Water Table Depth (ft.) =	4.2	1.3	m
Borehole Depth (ft.) =	100	30.5	m
Average γ above water table (lbs./ft.^{3}) =	120	18.9	kN/m^3
Average γ below water table (lbs./ft.^{3}) =	120	18.9	kN/m^3
Borehole Diameter (in.) =	4	101.6	mm

Requires correction for sampler liners (YES/NO): NO

Rod lengths assumed equal to the depth plus 1.5 m (for above ground extension)

						Clay Criteria																							
SPT sample number	Depth (ft.)	Elevation (ft.)	Depth (m)	Measured N	Soil Type (USCS)	Plasticity Index, PI, (PI > 7)	Hydrometer, 5μ (0.005mm), (>15% passing 5μ)	Flag "Clay" "Unsaturated" "Unreliable"	Fines Content (%)	Energy Ratio, ER (%)	C_E	C_B	C_R	C_S	N_{60}	σ_{vc} (kPa)	σ_{vc}' (kPa)	C_N	$(N_1)_{60}$	ΔN for fines content	$(N_1)_{60\text{-}CS}$	Stress Reduction Coefficient, r_d	CSR	MSF for Sand	K_σ for Sand	CRR for M=7.5 & σ_{vc}' = 1 atm	CRR	Fator of Safety	Depth (ft.)
1	**7**	-0.2	2.1	1	CL	65	70.9	Clay		84	1.40	1	0.80	1.00	1.1	40	32	1.35	n.a.	n.a.	n.a.	0.98	0.283	1.14	1.10	n.a.	n.a.	n.a.	**7**
2	**17**	-10.2	5.2	8	SC	12	11.1	Clay	23	84	1.40	1	0.95	1.00	10.6	98	59	1.15	n.a.	n.a.	n.a.	0.94	0.353	1.14	1.10	n.a.	n.a.	n.a.	**17**
3	**25**	-18.2	7.6	6	SC	12	29	Clay	60	84	1.40	1	0.95	1.00	8.0	144	81	1.06	n.a.	n.a.	n.a.	0.90	0.363	1.14	1.06	n.a.	n.a.	n.a.	**25**
4	**32**	-25.2	9.8	18	SW	7	8.8			84	1.40	1	1.00	1.00	25.2	184	101	1.00	25.2	0.0	25.23	0.87	0.360	1.14	1.00	0.295	0.337	0.94	**32**
5	**35**	-28.2	10.7	16	SW					84	1.40	1	1.00	1.00	22.4	201	109	0.97	21.7	0.0	21.68	0.85	0.357	1.14	0.99	0.228	0.258	0.72	**35**
6	**40**	-33.2	12.2	11	SC		8.9		25	84	1.40	1	1.00	1.00	15.4	230	123	0.92	14.1	5.1	19.18	0.82	0.350	1.14	0.97	0.196	0.218	0.62	**40**
7	**45**	-38.2	13.7	14	ML					84	1.40	1	1.00	1.00	19.6	259	137	0.87	17.0	0.0	17.02	0.79	0.342	1.14	0.96	0.174	0.192	0.56	**45**
8	**50**	-43.2	15.2	15	ML					84	1.40	1	1.00	1.00	21.0	287	150	0.83	17.5	0.0	17.47	0.77	0.333	1.14	0.95	0.178	0.194	0.58	**50**
9	**55**	-48.2	16.8	30	ML		5.1		18	84	1.40	1	1.00	1.00	42.0	316	164	0.87	36.4	4.1	40.48	0.74	0.324	1.14	0.86	2.000	1.955	2.00	**55**
10	**60**	-53.2	18.3	34	GM					84	1.40	1	1.00	1.00	47.6	345	178	0.85	40.2	0.0	40.24	0.71	0.315	1.14	0.83	2.000	1.901	2.00	**60**
11	**70**	-63.2	21.3	81	ROCK					84	1.40	1	1.00	1.00	113.4	402	205	0.83	94.1	0.0	94.07	0.67	0.297	1.14	0.79	2.000	1.804	2.00	**70**
	80	-73.2	24.4																										**80**
	90	-83.2	27.4																										**90**
	100	-93.2	30.5																										**100**

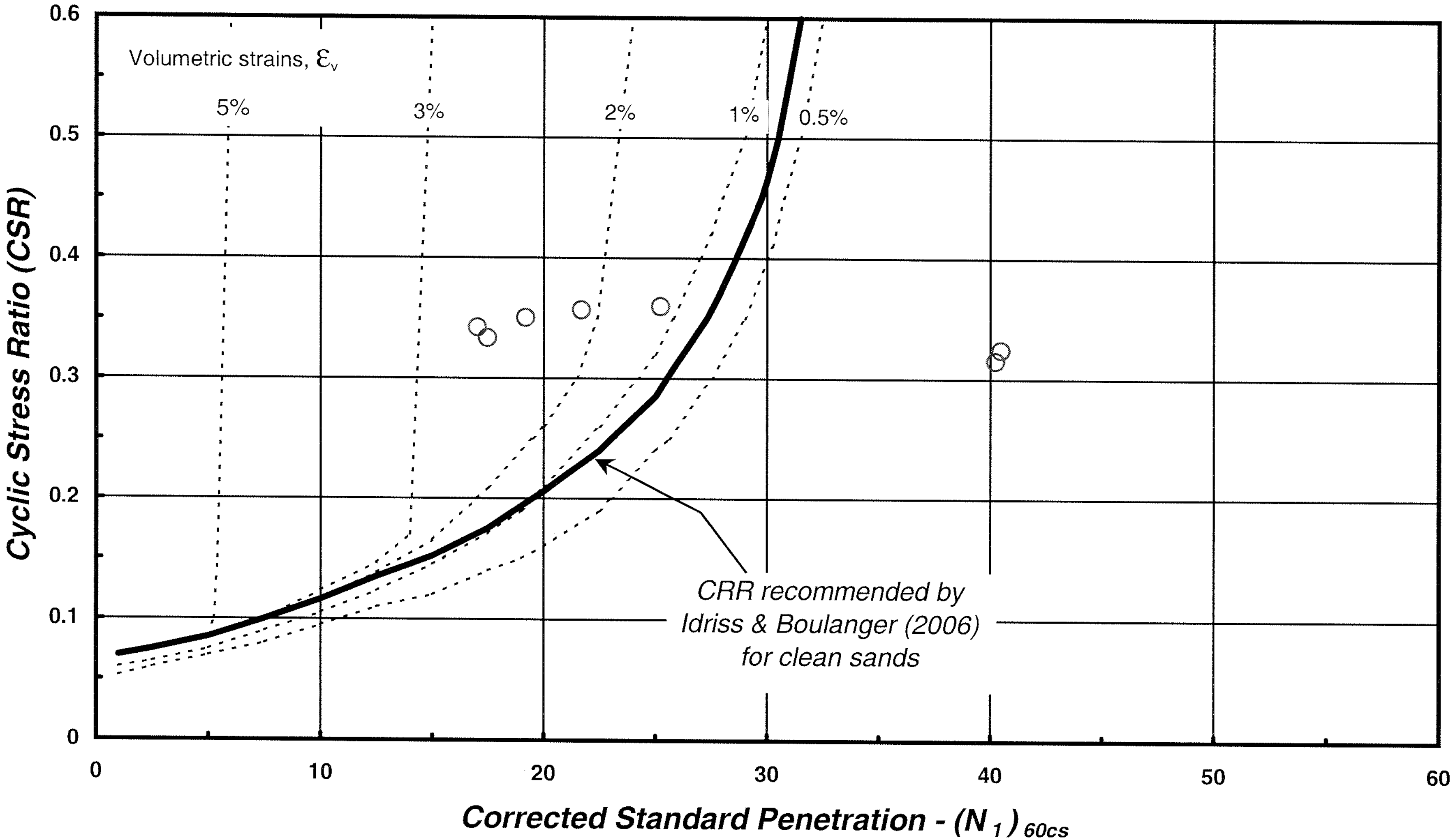
Soil Boring Profile

	X	Depth	Soil Type
Soil Type Depth 0	0	0	Lean CLAY
	2	0	
Soil Type Depth 1	0	9	Fat CLAY
	2	9	
Soil Type Depth 2	0	17	CLAYEY SAND
	2	17	
Soil Type Depth 3	0	32	Well-graded SAND with GRAVE
	2	32	
Soil Type Depth 4	0	40	CLAYEY SAND
	2	40	
Soil Type Depth 5	0	45	SILT
	2	45	
Soil Type Depth 6	0	60	SILTY GRAVEL
	2	60	
Soil Type Depth 7	0	65	ROCK
	2	65	
Borehole Depth	0	100	
	2	100	

Water Table Depth

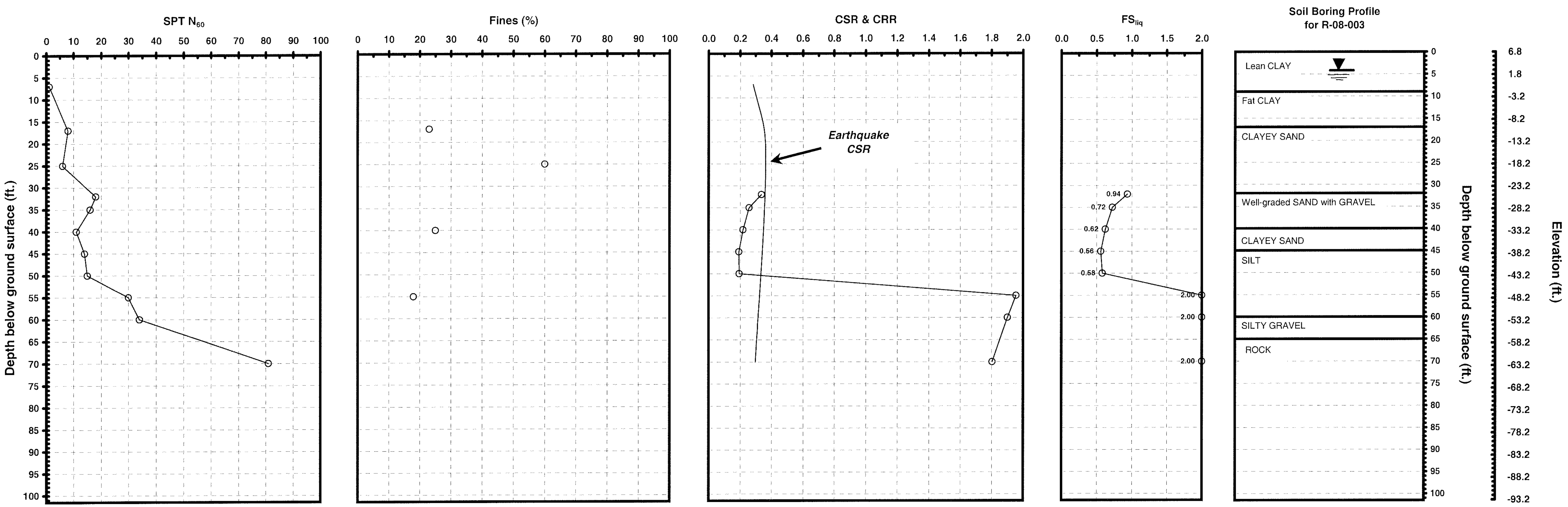
X	Y
1	4.2
1.25	4.2

Liquefaction Analysis for Boring R-08-003

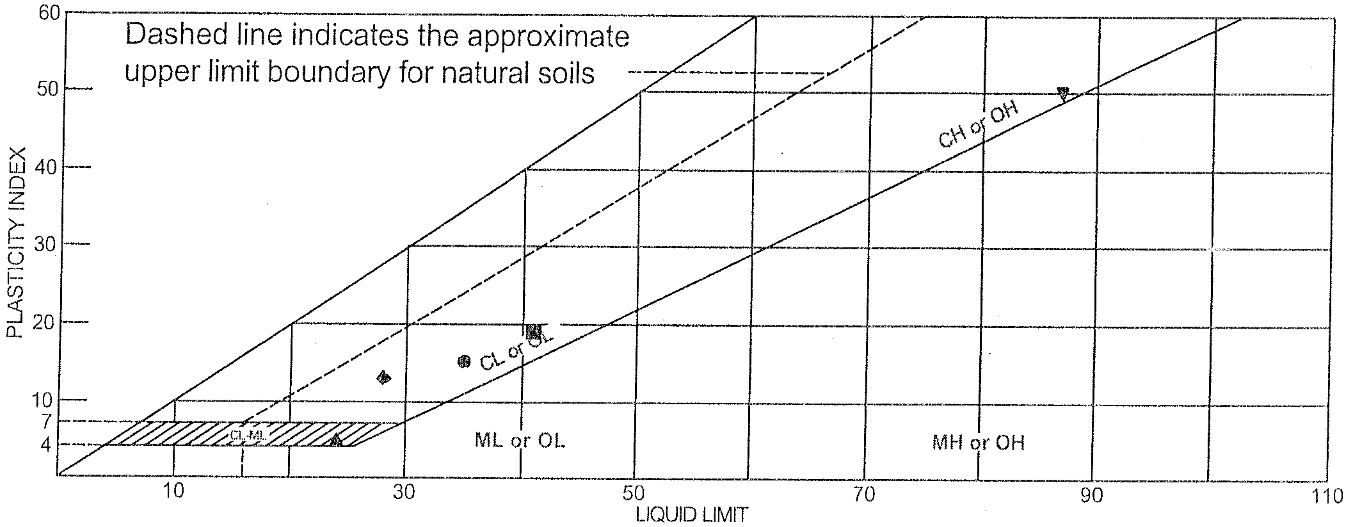


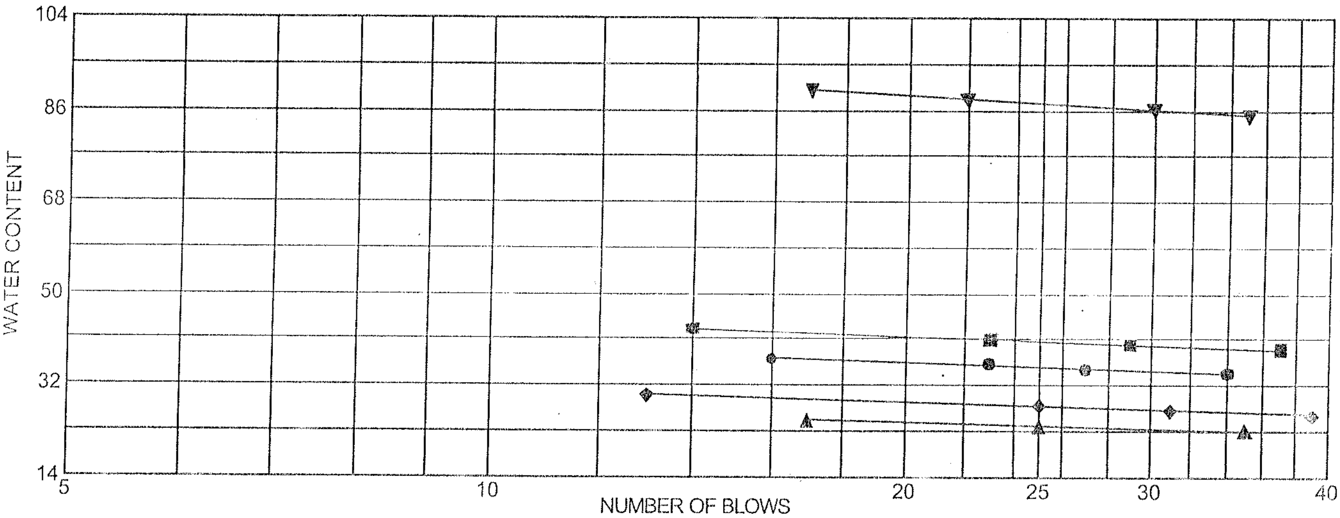
SPT-based Liquefaction Correlation for Clean Sands with M=7.5 and σ'_{vc} =1atm, showing computed variation of volumetric strains during reconsolidaton

Liquefaction Triggering Analysis for Boring R-08-003



LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Gray Sandy Lean CLAY	35	20	15			
■	Gray Lean CLAY	41	22	19	100.0	96.0	CL
▲	Gray Sandy Silty CLAY	24	19	5	98.2	50.0	CL-ML
◆	Mottled Grayish Brown Lean Clayey SAND	28	15	13			
▼	Gray Fat CLAY	87	37	50			

Project No. 603-013 **Client:** PB

Project: Marin-Sonoma Narrows - 04-264061

● **Source:** R-08-002 **Elev./Depth:** 30-31.5'

■ **Source:** R-08-002 **Elev./Depth:** 35-37'

▲ **Source:** R-08-002 **Elev./Depth:** 40-42'

◆ **Source:** R-08-002 **Elev./Depth:** 60-61.5'

▼ **Source:** R-08-003 **Elev./Depth:** 6.5-8.5'

Remarks:

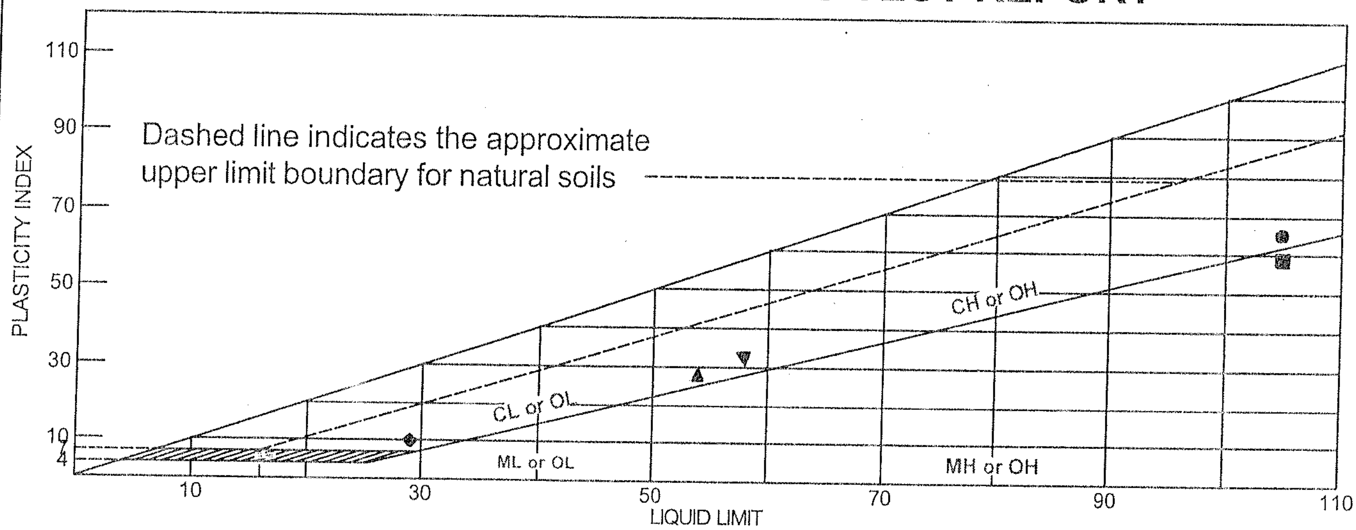
●
■
▲
◆
▼

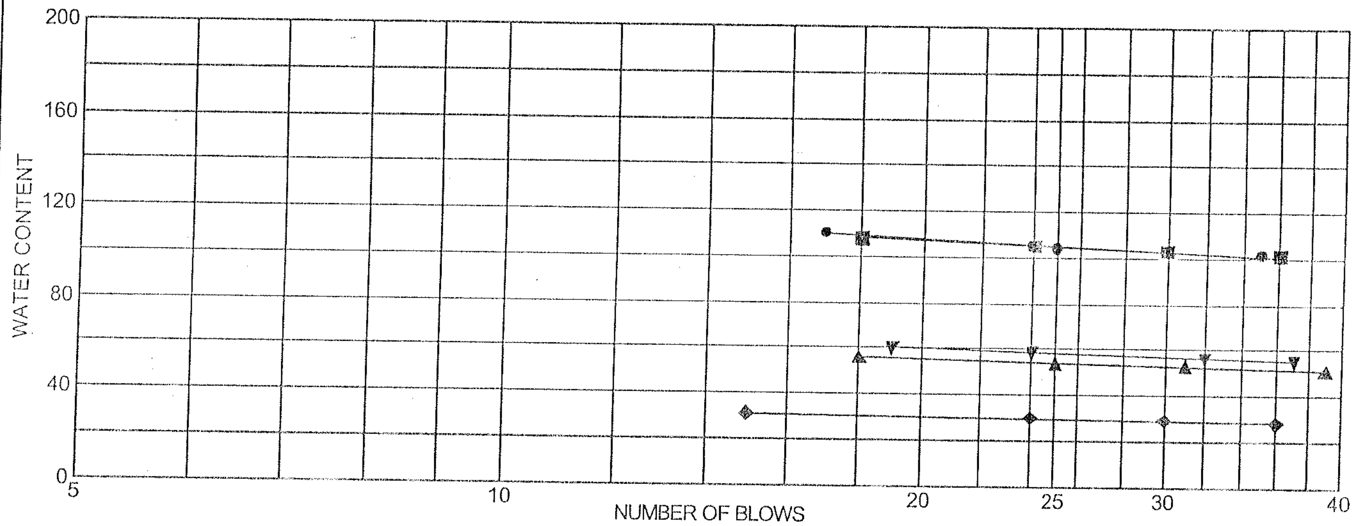
LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Gray Fat CLAY	105	40	65	88.7	88.3	CH
■	Gray Fat CLAY	105	46	59			
▲	Gray Fat CLAY	54	26	28	99.7	95.1	CH
◆	Gray Lean Clayey SAND w/ Gravel	29	19	10	38.2	23.3	SC
▼	Dark Gray Fat CLAY	58	26	32			

Project No. 603-013 **Client:** PB

Project: Marin-Sonoma Narrows - 04-264061

● **Source:** R-08-003 **Elev./Depth:** 8.5-10.5'
■ **Source:** R-08-003 **Elev./Depth:** 10.5-12'
▲ **Source:** R-08-003 **Elev./Depth:** 15-16.5'
◆ **Source:** R-08-003 **Elev./Depth:** 16.5-18'
▼ **Source:** R-08-003 **Elev./Depth:** 20-21.5'

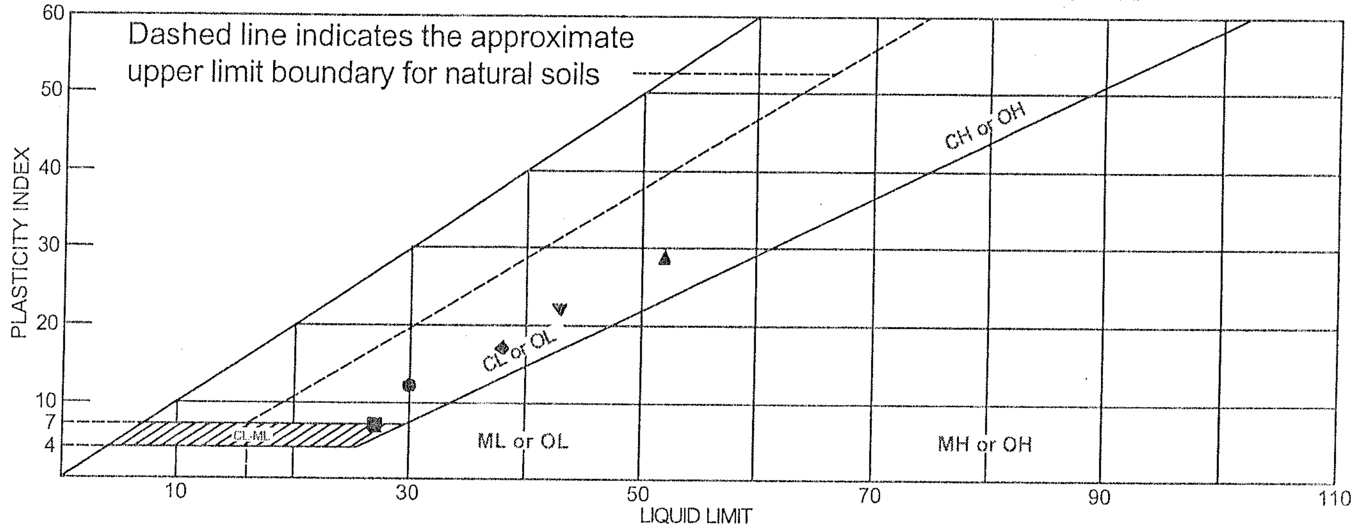
Remarks:
●
■
▲
◆
▼

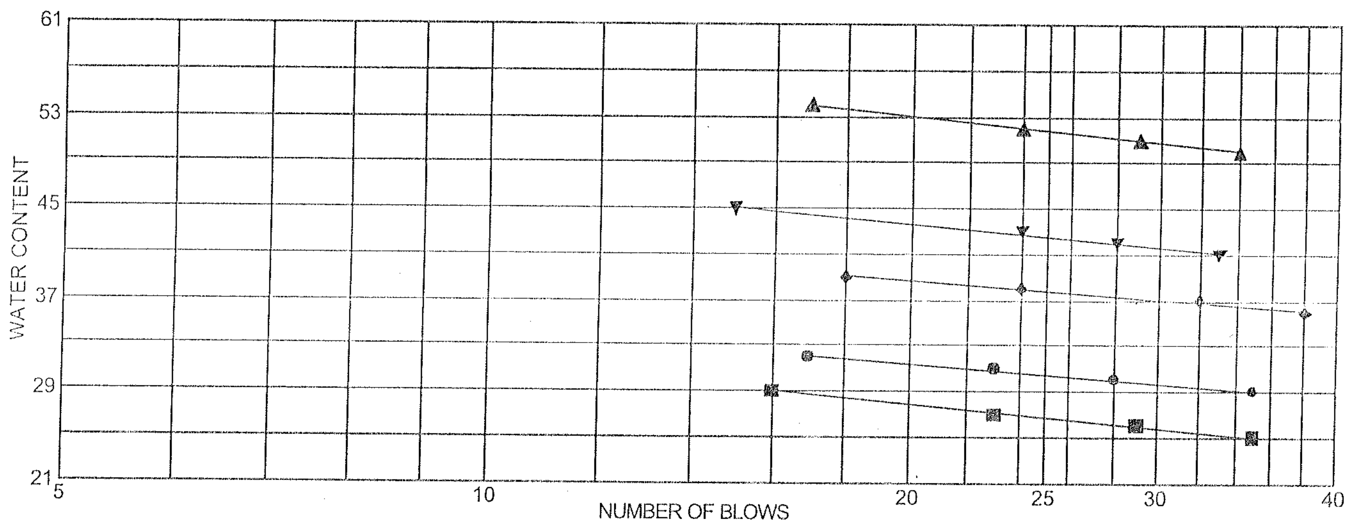
LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Dark Gray Sandy Lean CLAY	30	18	12	88.6	59.7	CL
■	Gray Silty, Clayey SAND	27	20	7	28.2	15.0	SC-SM
▲	Brown Fat CLAY	52	23	29			
◆	Gray & Olive Lean CLAY	38	21	17			
▼	Gray Lean CLAY	43	21	22	96.7	86.0	CL

Project No. 603-013 **Client:** PB

Project: Marin-Sonoma Narrows - 04-264061

● **Source:** R-08-003 **Elev./Depth:** 25-26.5'
■ **Source:** R-08-003 **Elev./Depth:** 30-31.5'
▲ **Source:** R-08-003 **Elev./Depth:** 45-46.5'
◆ **Source:** R-08-003 **Elev./Depth:** 50-51.5'
▼ **Source:** R-08-004 **Elev./Depth:** 35-37'

Remarks:
●
■
▲
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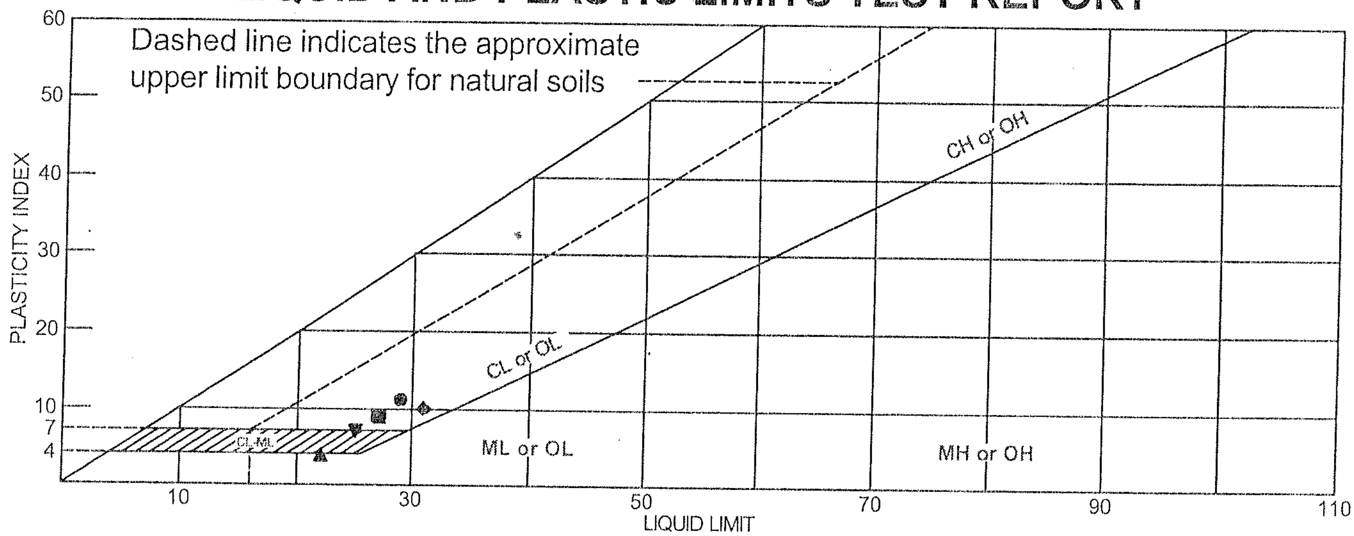
▼

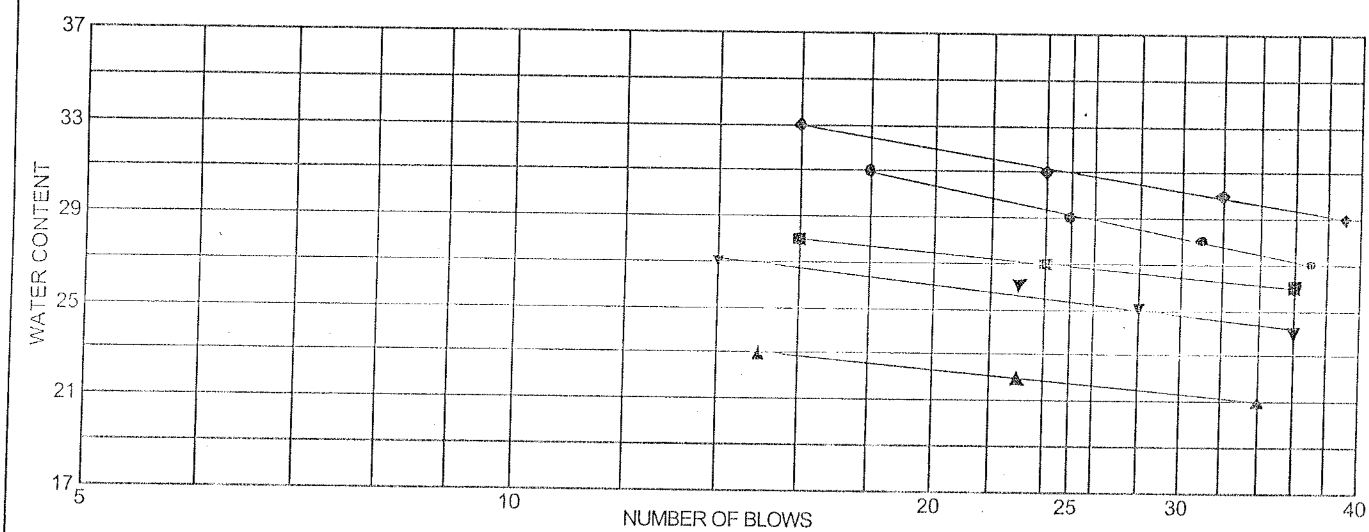
LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Gray Lean Clayey SAND	29	18	11	61.1	40.4	SC
■	Gray Lean Clayey SAND	27	18	9	71.5	43.9	SC
▲	Gray Silty, Clayey SAND	22	18	4	43.0	20.1	SC-SM
◆	Brown Sandy Lean CLAY	31	21	10	99.9	63.0	CL
▼	Brown Silty, Clayey SAND, trace Gravel	25	18	7			

Project No. 603-013 **Client:** PB

Project: Marin-Sonoma Narrows - 04-264061

● **Source:** R-08-004 **Elev./Depth:** 40-41.5'

■ **Source:** R-08-004 **Elev./Depth:** 45-46.5'

▲ **Source:** R-08-004 **Elev./Depth:** 50-52'

◆ **Source:** R-08-004 **Elev./Depth:** 60-62'

▼ **Source:** R-08-006A **Elev./Depth:** 30'

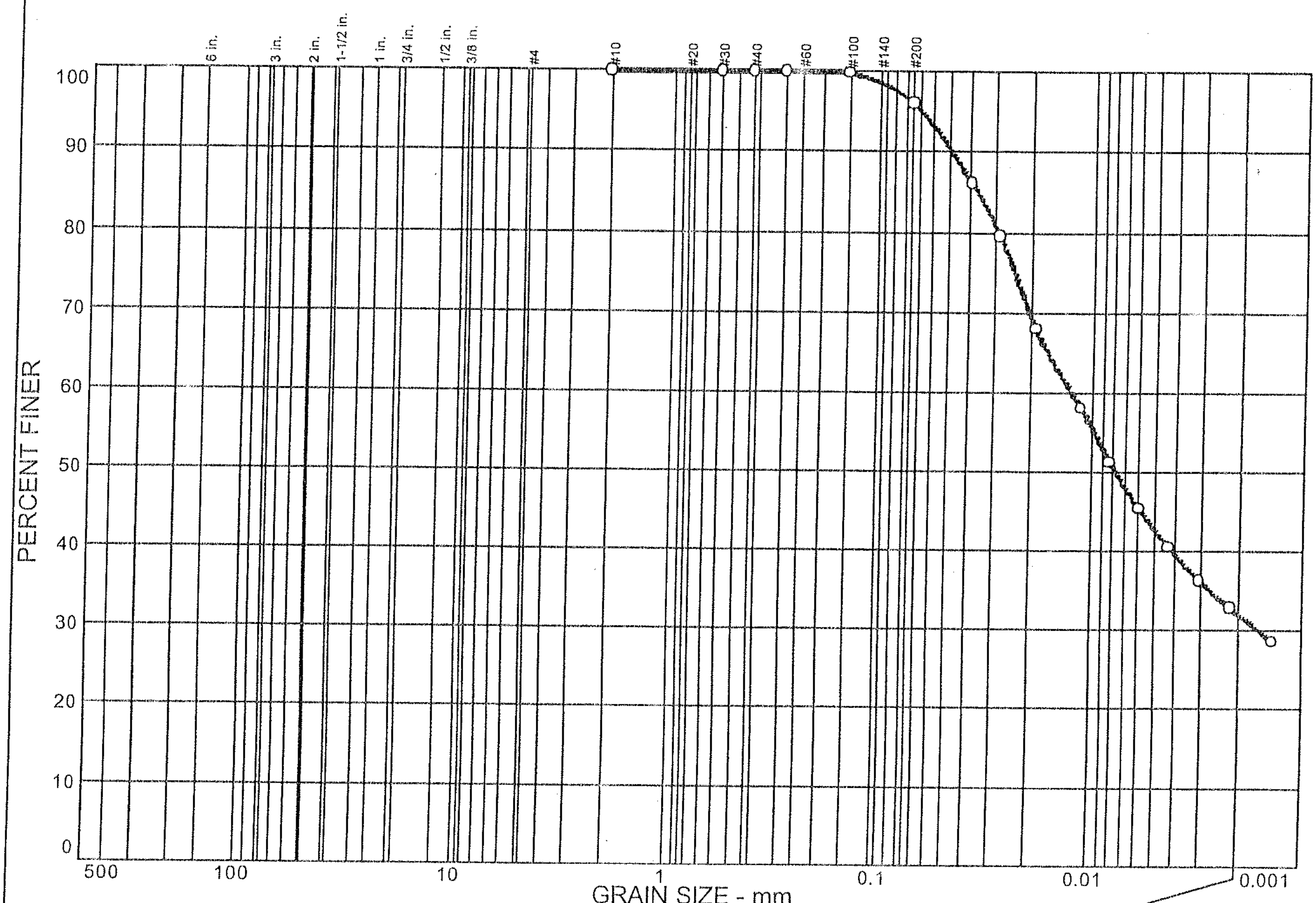
Remarks:
●
■
▲
◆
▼

LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	4.0	63.9	32.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#30	100.0		
#40	100.0		
#50	100.0		
#100	99.8		
#200	96.0		
0.0390 mm.	86.0		
0.0285 mm.	79.5		
0.0190 mm.	68.0		
0.0114 mm.	58.0		
0.0083 mm.	51.2		
0.0060 mm.	45.4		
0.0043 mm.	40.5		
0.0031 mm.	36.3		
0.0022 mm.	32.9		
0.0014 mm.	28.6		

* (no specification provided)

Soil Description

Gray Lean CLAY

Atterberg Limits

PL= 22 LL= 41 PI= 19

Coefficients

D_{85}= 0.0369 D_{60}= 0.0127 D_{50}= 0.0078
D_{30}= 0.0016 D_{15}= D_{10}=
C_u= C_c=

Classification

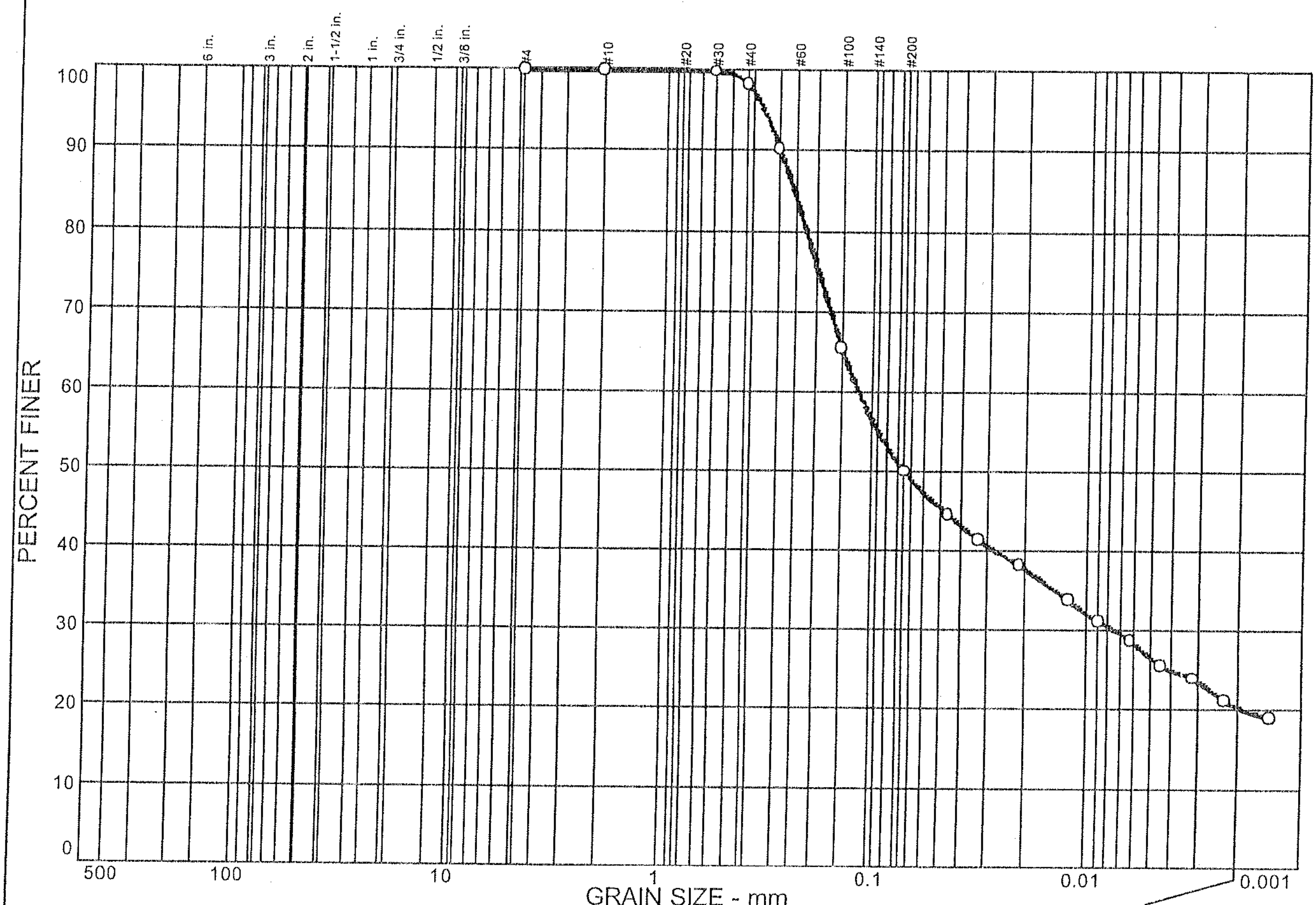
USCS= CL AASHTO=

Remarks

Sample No.: Source of Sample: R-08-002 Date:
Location: Elev./Depth: 35-37'

COOPER TESTING LABORATORY	Client: PB Project: Marin-Sonoma Narrows - 04-264061 Project No: 603-013 Figure

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	50.0	29.6	20.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#30	99.8		
#40	98.2		
#50	90.3		
#100	65.4		
#200	50.0		
0.0461 mm.	44.6		
0.0330 mm.	41.4		
0.0211 mm.	38.2		
0.0123 mm.	33.8		
0.0088 mm.	31.1		
0.0063 mm.	28.8		
0.0045 mm.	25.6		
0.0032 mm.	24.0		
0.0023 mm.	21.2		
0.0014 mm.	19.0		

* (no specification provided)

Soil Description

Gray Sandy Silty CLAY

Atterberg Limits

PL= 19 LL= 24 PI= 5

Coefficients

D_{85}= 0.256 D_{60}= 0.125 D_{50}= 0.0750
D_{30}= 0.0074 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL-ML AASHTO=

Remarks

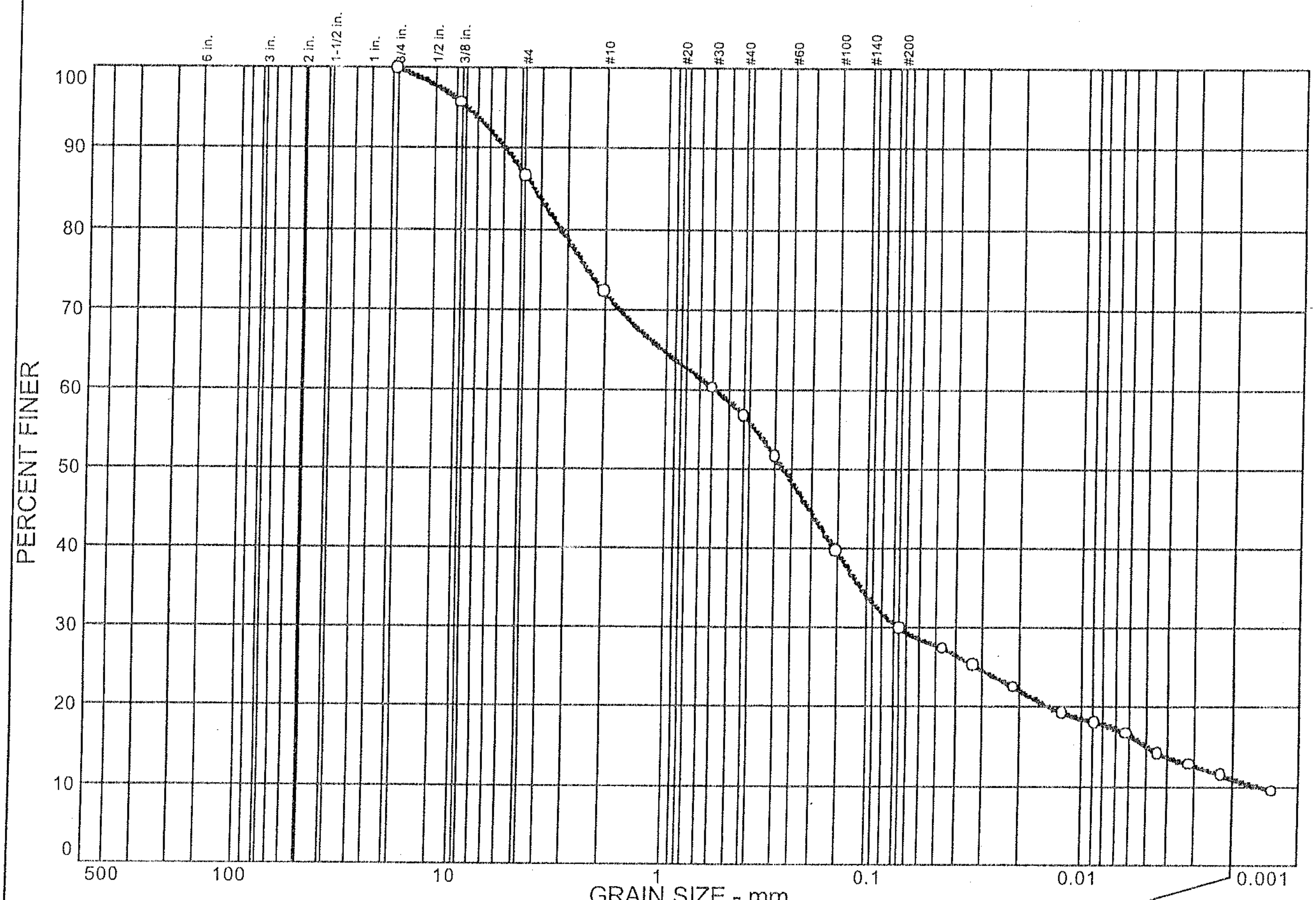
Sample No.: Source of Sample: R-08-002 Date:
Location: Elev./Depth: 40-42'

COOPER TESTING LABORATORY

Client: PB
Project: Marin-Sonoma Narrows - 04-264061

Project No: 603-013 Figure

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	13.4	56.7	19.0	10.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
3/8 in.	95.7		
#4	86.6		
#10	72.2		
#30	60.2		
#40	56.7		
#50	51.5		
#100	39.6		
#200	29.9		
0.0461 mm.	27.4		
0.0329 mm.	25.3		
0.0211 mm.	22.5		
0.0123 mm.	19.3		
0.0087 mm.	18.1		
0.0062 mm.	16.7		
0.0044 mm.	14.2		
0.0032 mm.	12.8		
0.0022 mm.	11.4		
0.0013 mm.	9.4		

* (no specification provided)

Soil Description

Gray Clayey SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 4.31 D_{60}= 0.586 D_{50}= 0.274
D_{30}= 0.0759 D_{15}= 0.0050 D_{10}= 0.0016
C_u= 375.55 C_c= 6.29

Classification

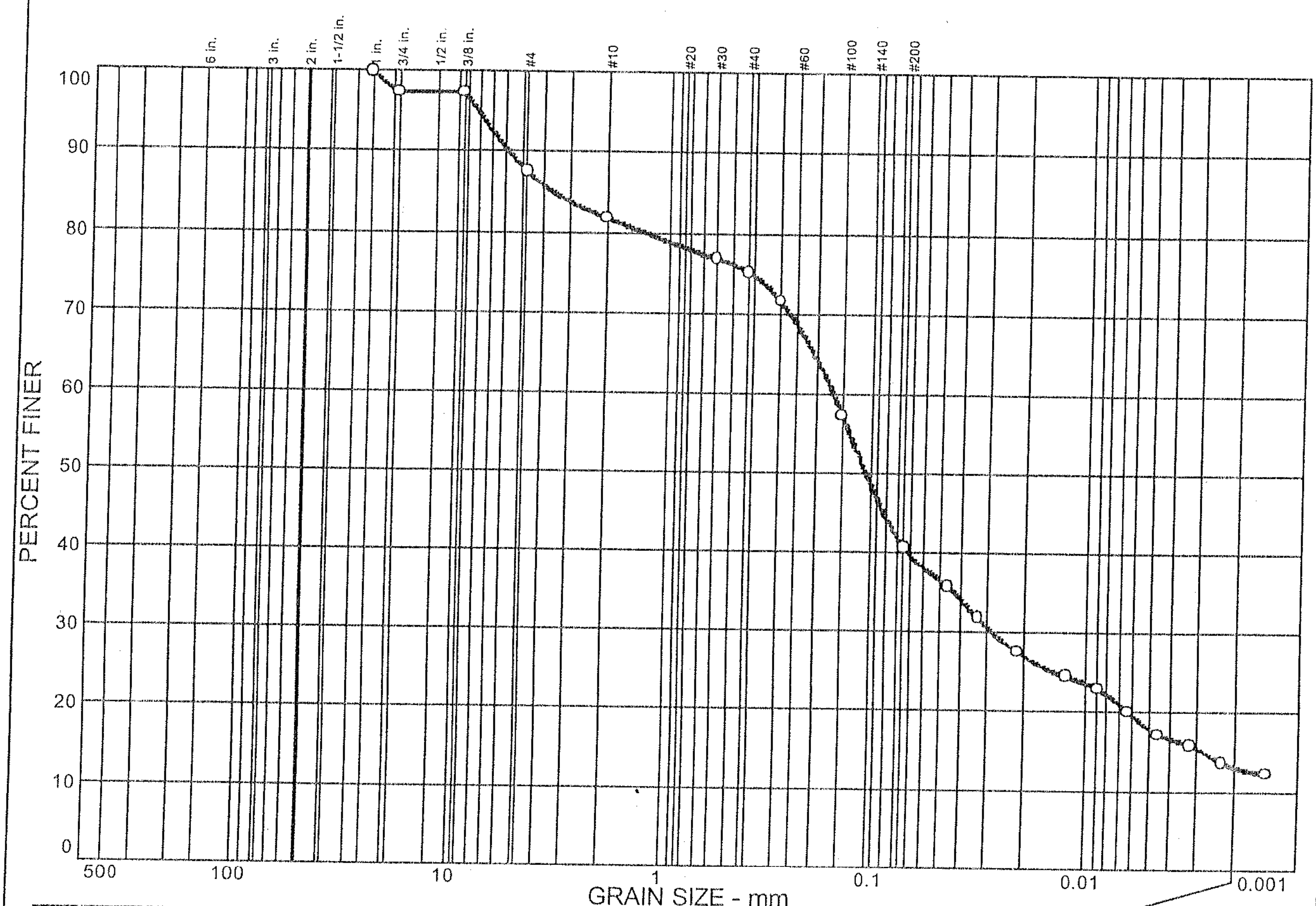
USCS= AASHTO=

Remarks

Sample No.: Source of Sample: R-08-002 Date:
Location: Elev./Depth: 42-43.5'

COOPER TESTING LABORATORY	Client: PB Project: Marin-Sonoma Narrows - 04-264061 Project No: 603-013 Figure

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	12.5	46.9	27.5	13.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
3/4 in.	97.4		
3/8 in.	97.4		
#4	87.5		
#10	81.8		
#30	76.8		
#40	75.2		
#50	71.6		
#100	57.3		
#200	40.6		
0.0460 mm.	35.8		
0.0332 mm.	31.8		
0.0214 mm.	27.6		
0.0125 mm.	24.5		
0.0089 mm.	23.0		
0.0063 mm.	20.1		
0.0045 mm.	17.2		
0.0032 mm.	15.9		
0.0023 mm.	13.7		
0.0014 mm.	12.3		

* (no specification provided)

Soil Description

Gray Clayey SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 3.60 D_{60}= 0.167 D_{50}= 0.114
D_{30}= 0.0282 D_{15}= 0.0028 D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

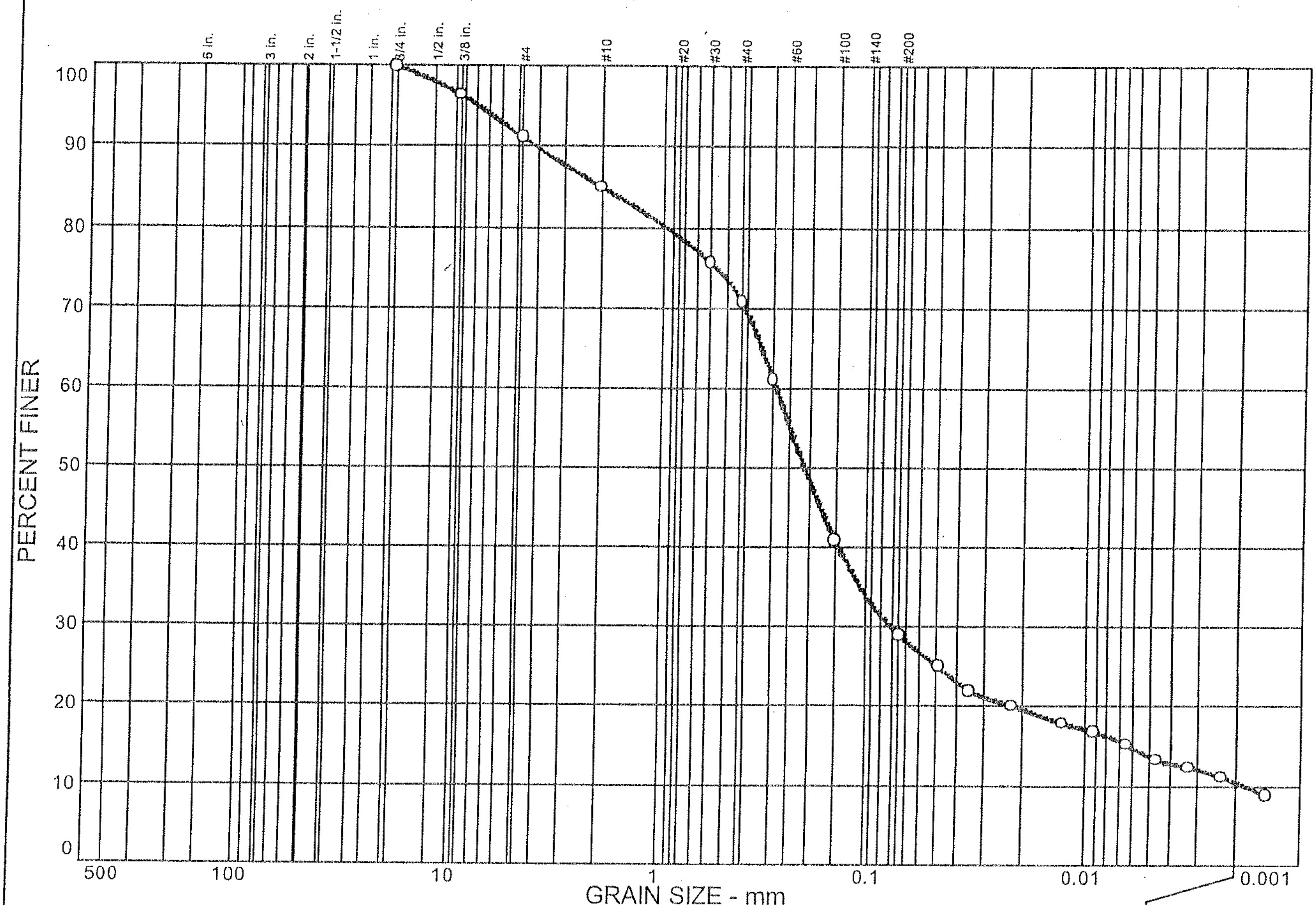
Remarks

Sample No.: Source of Sample: R-08-002 Date:
Location: Elev./Depth: 45-46.5'

COOPER TESTING LABORATORY

Client: PB
Project: Marin-Sonoma Narrows - 04-264061
Project No: 603-013 Figure

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	8.9	62.1	18.6	10.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
3/8 in.	96.4		
#4	91.1		
#10	85.0		
#30	75.6		
#40	70.7		
#50	61.0		
#100	40.8		
#200	29.0		
0.0488 mm.	25.0		
0.0349 mm.	22.0		
0.0222 mm.	20.1		
0.0129 mm.	17.9		
0.0091 mm.	16.8		
0.0065 mm.	15.2		
0.0046 mm.	13.3		
0.0033 mm.	12.3		
0.0023 mm.	11.1		
0.0014 mm.	8.8		

* (no specification provided)

Soil Description

Gray Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 2.00 D_{60}= 0.291 D_{50}= 0.210
D_{30}= 0.0818 D_{15}= 0.0063 D_{10}= 0.0018
C_u= 158.73 C_c= 12.57

Classification

USCS= AASHTO=

Remarks

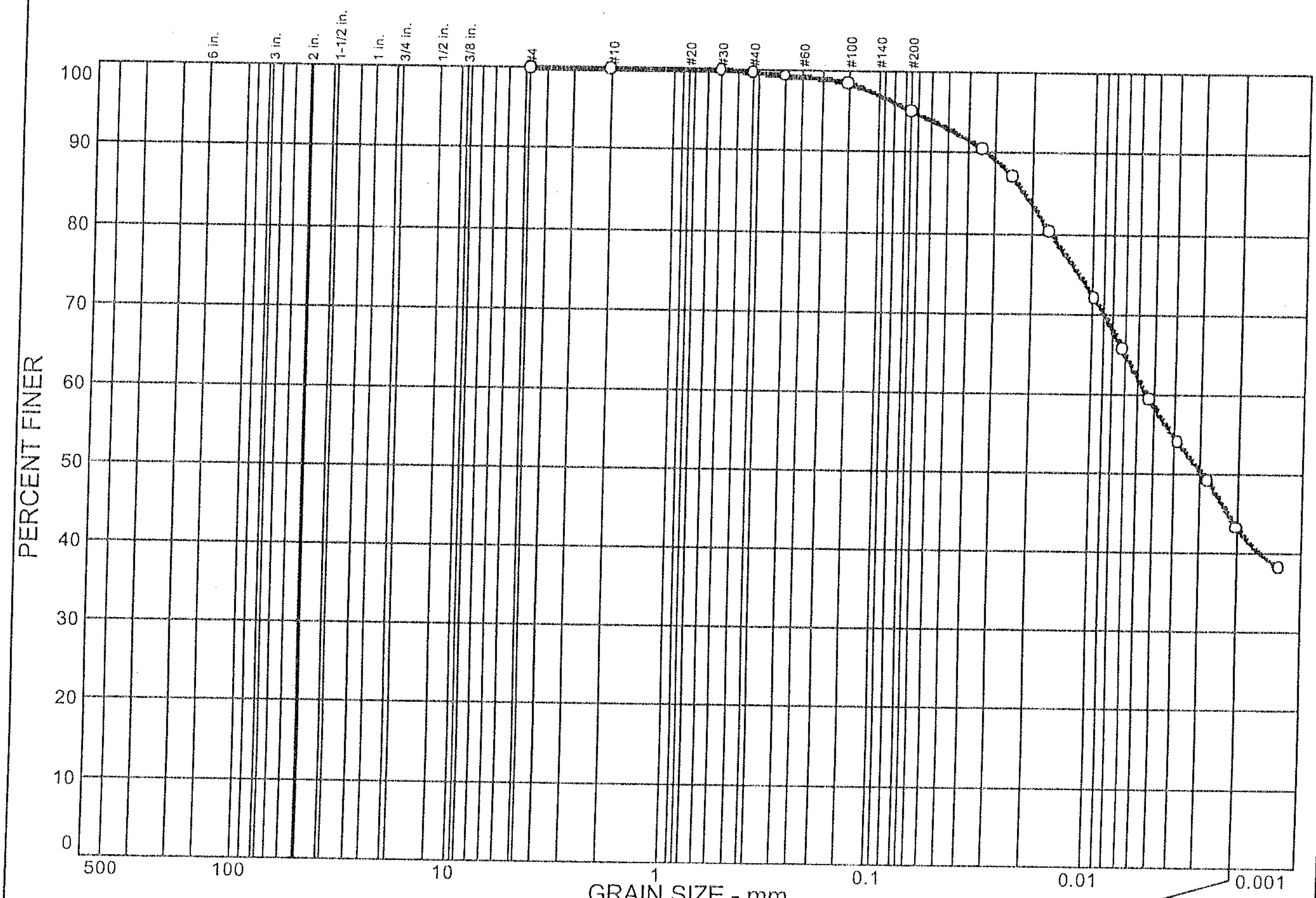
Sample No.: Source of Sample: R-08-002 Date:
Location: Elev./Depth: 50-51.5'

COOPER TESTING LABORATORY

Client: PB
Project: Marin-Sonoma Narrows - 04-264061

Project No: 603-013 Figure

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	4.9	51.9	43.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#30	99.9		
#40	99.7		
#50	99.3		
#100	98.5		
#200	95.1		
0.0341 mm.	90.4		
0.0247 mm.	87.0		
0.0164 mm.	80.3		
0.0099 mm.	72.0		
0.0072 mm.	65.7		
0.0053 mm.	59.4		
0.0038 mm.	54.0		
0.0028 mm.	49.1		
0.0020 mm.	43.2		
0.0013 mm.	38.2		

* (no specification provided)

Soil Description

Gray Fat CLAY

Atterberg Limits

PL= 26 LL= 54 PI= 28

Coefficients

D_{85}= 0.0216 D_{60}= 0.0055 D_{50}= 0.0029
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

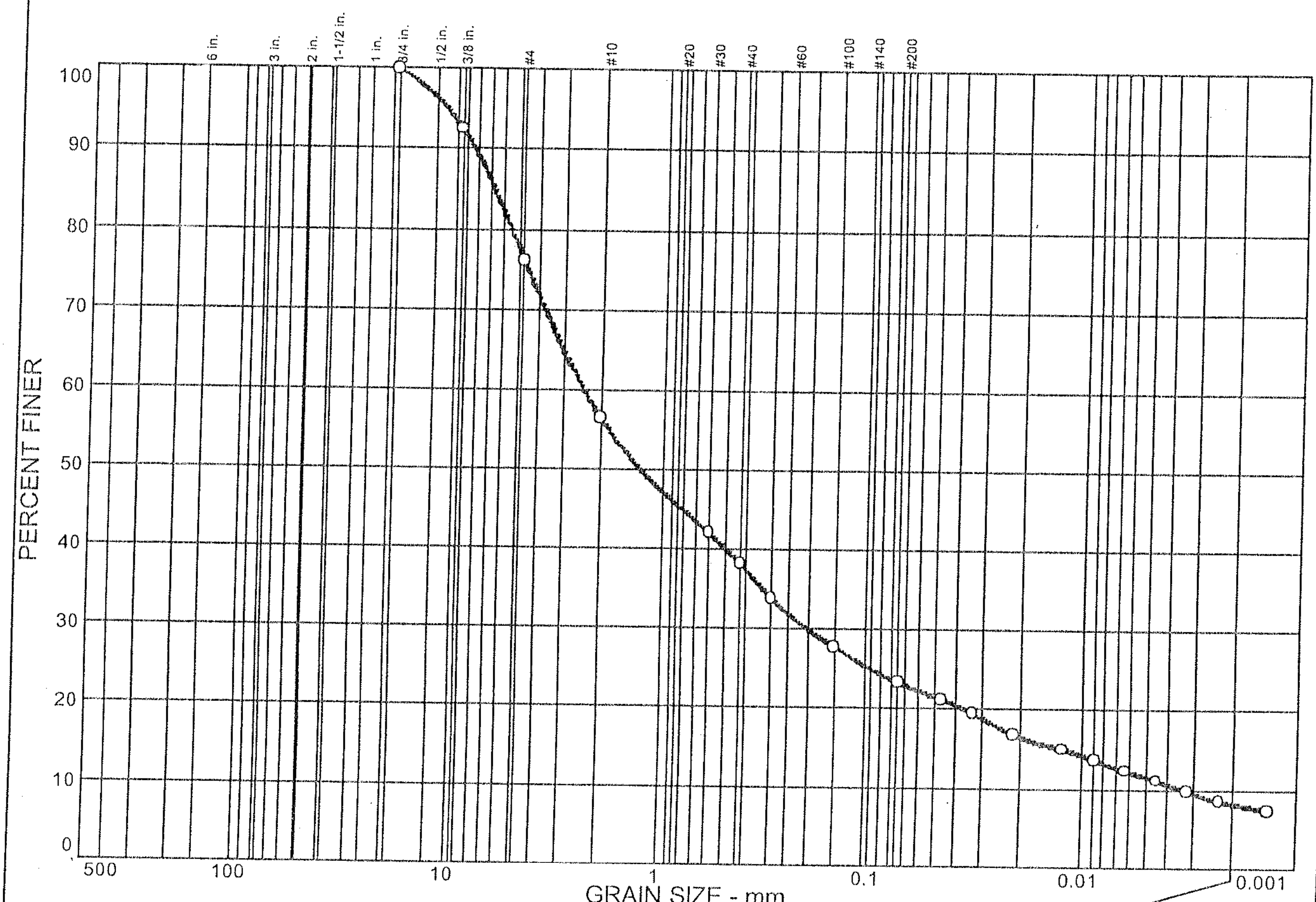
Remarks

Sample No.: Source of Sample: R-08-003 Date:
Location: Elev./Depth: 15-16.5'

COOPER TESTING LABORATORY

Client: PB
Project: Marin-Sonoma Narrows - 04-264061
Project No: 603-013 Figure

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	23.9	52.8	15.2	8.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
3/8 in.	92.5		
#4	76.1		
#10	56.4		
#30	42.0		
#40	38.2		
#50	33.9		
#100	27.8		
#200	23.3		
0.0464 mm.	21.2		
0.0332 mm.	19.5		
0.0214 mm.	16.8		
0.0125 mm.	15.0		
0.0089 mm.	13.7		
0.0063 mm.	12.3		
0.0045 mm.	11.1		
0.0032 mm.	9.7		
0.0023 mm.	8.5		
0.0014 mm.	7.4		

* (no specification provided)

Soil Description

Gray Lean Clayey SAND w/ Gravel

Atterberg Limits

PL= 18 LL= 30 PI= 12

Coefficients

D_{85}= 6.71 D_{60}= 2.42 D_{50}= 1.29
D_{30}= 0.200 D_{15}= 0.0125 D_{10}= 0.0035
C_u= 697.36 C_c= 4.78

Classification

USCS= SC AASHTO=

Remarks

Sample No.:
Location:

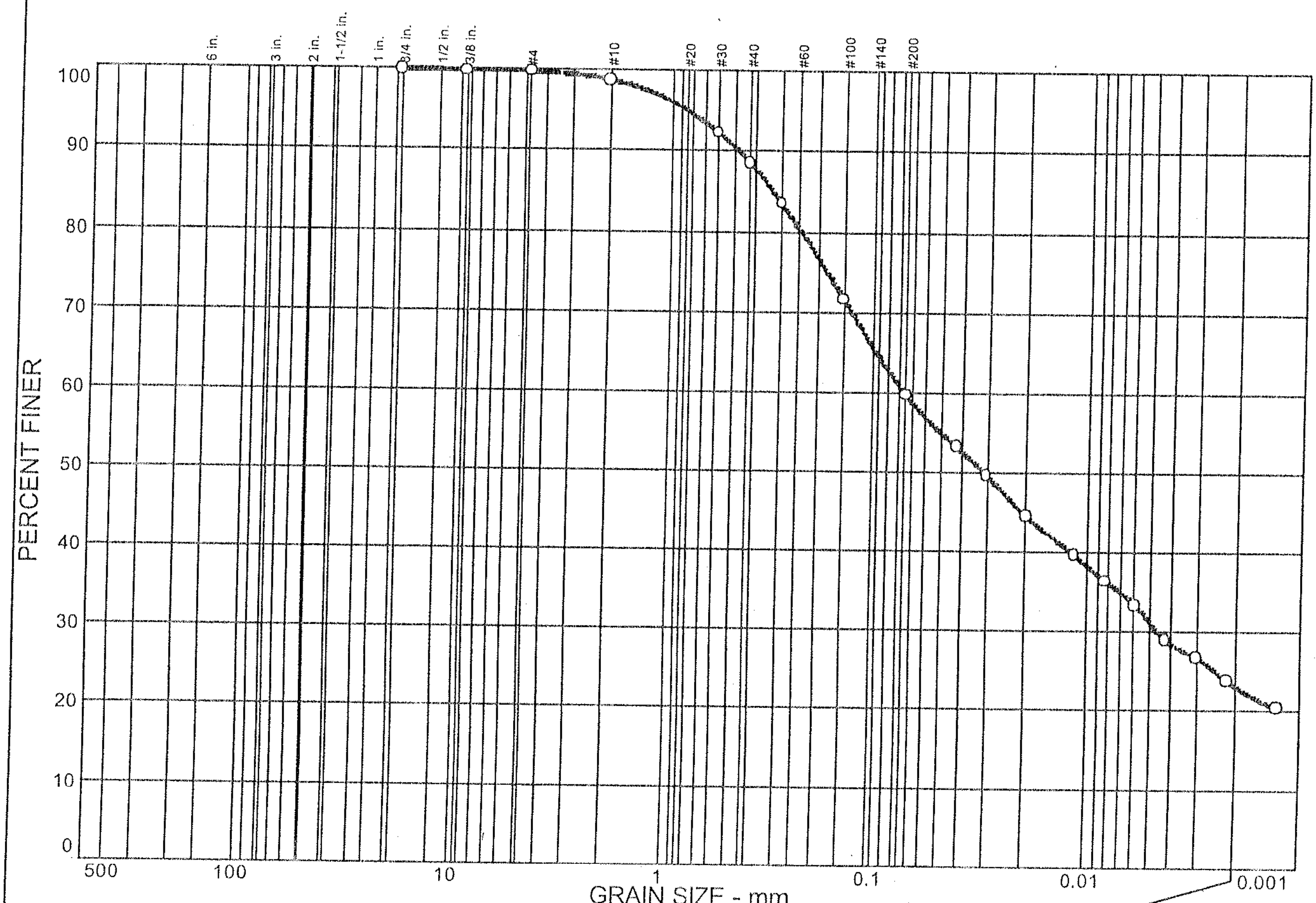
Source of Sample: R-08-003

Date:
Elev./Depth: 16.5-18'

COOPER TESTING LABORATORY

Client: PB
Project: Marin-Sonoma Narrows - 04-264061
Project No: 603-013 Figure

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.2	40.1	36.6	23.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
3/8 in.	99.8		
#4	99.8		
#10	98.8		
#30	92.3		
#40	88.6		
#50	83.5		
#100	71.6		
#200	59.7		
0.0425 mm.	53.2		
0.0306 mm.	49.7		
0.0198 mm.	44.5		
0.0116 mm.	39.7		
0.0083 mm.	36.4		
0.0059 mm.	33.4		
0.0043 mm.	29.0		
0.0030 mm.	26.8		
0.0022 mm.	23.8		
0.0013 mm.	20.4		

* (no specification provided)

Soil Description

Dark Gray Sandy Lean CLAY

Atterberg Limits

PL= 18 LL= 30 PI= 12

Coefficients

D_{85}= 0.330 D_{60}= 0.0766 D_{50}= 0.0314
D_{30}= 0.0046 D_{15}= D_{10}=
C_u= C_c=

Classification

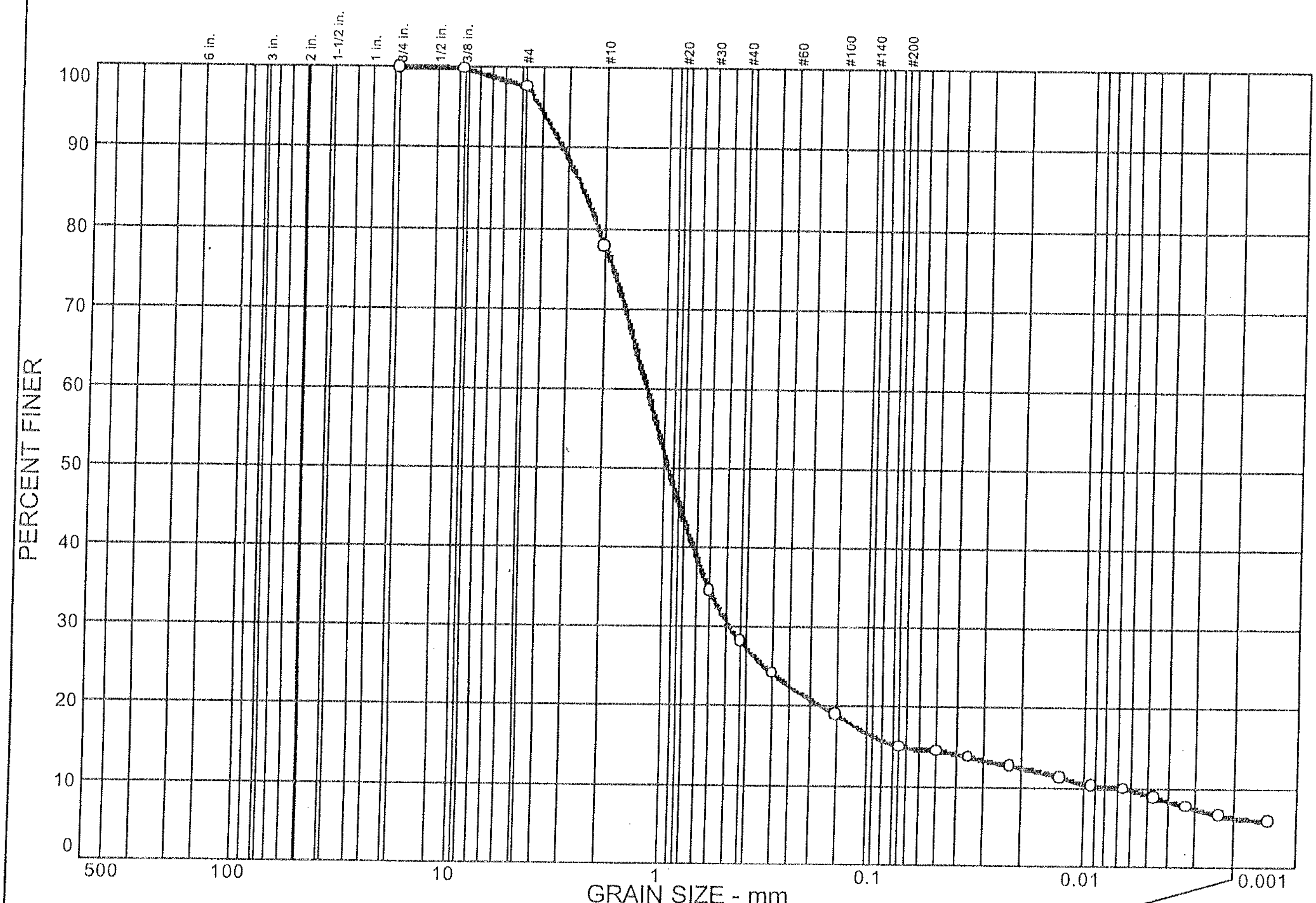
USCS= CL AASHTO=

Remarks

Sample No.: Source of Sample: R-08-003 Date:
Location: Elev./Depth: 25-26.5'

COOPER TESTING LABORATORY	Client: PB Project: Marin-Sonoma Narrows - 04-264061 Project No: 603-013 Figure

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	2.4	82.6	8.7	6.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
3/8 in.	99.8		
#4	97.6		
#10	77.9		
#30	34.5		
#40	28.2		
#50	24.2		
#100	19.0		
#200	15.0		
0.0498 mm.	14.5		
0.0353 mm.	13.8		
0.0225 mm.	12.7		
0.0130 mm.	11.3		
0.0093 mm.	10.2		
0.0066 mm.	9.9		
0.0047 mm.	8.8		
0.0033 mm.	7.7		
0.0023 mm.	6.6		
0.0014 mm.	5.8		

* (no specification provided)

Soil Description

Gray Silty, Clayey SAND

Atterberg Limits

PL= 20 LL= 27 PI= 7

Coefficients

D_{85}= 2.57 D_{60}= 1.24 D_{50}= 0.964
D_{30}= 0.479 D_{15}= 0.0750 D_{10}= 0.0071
C_u= 173.97 C_c= 26.00

Classification

USCS= SC-SM AASHTO=

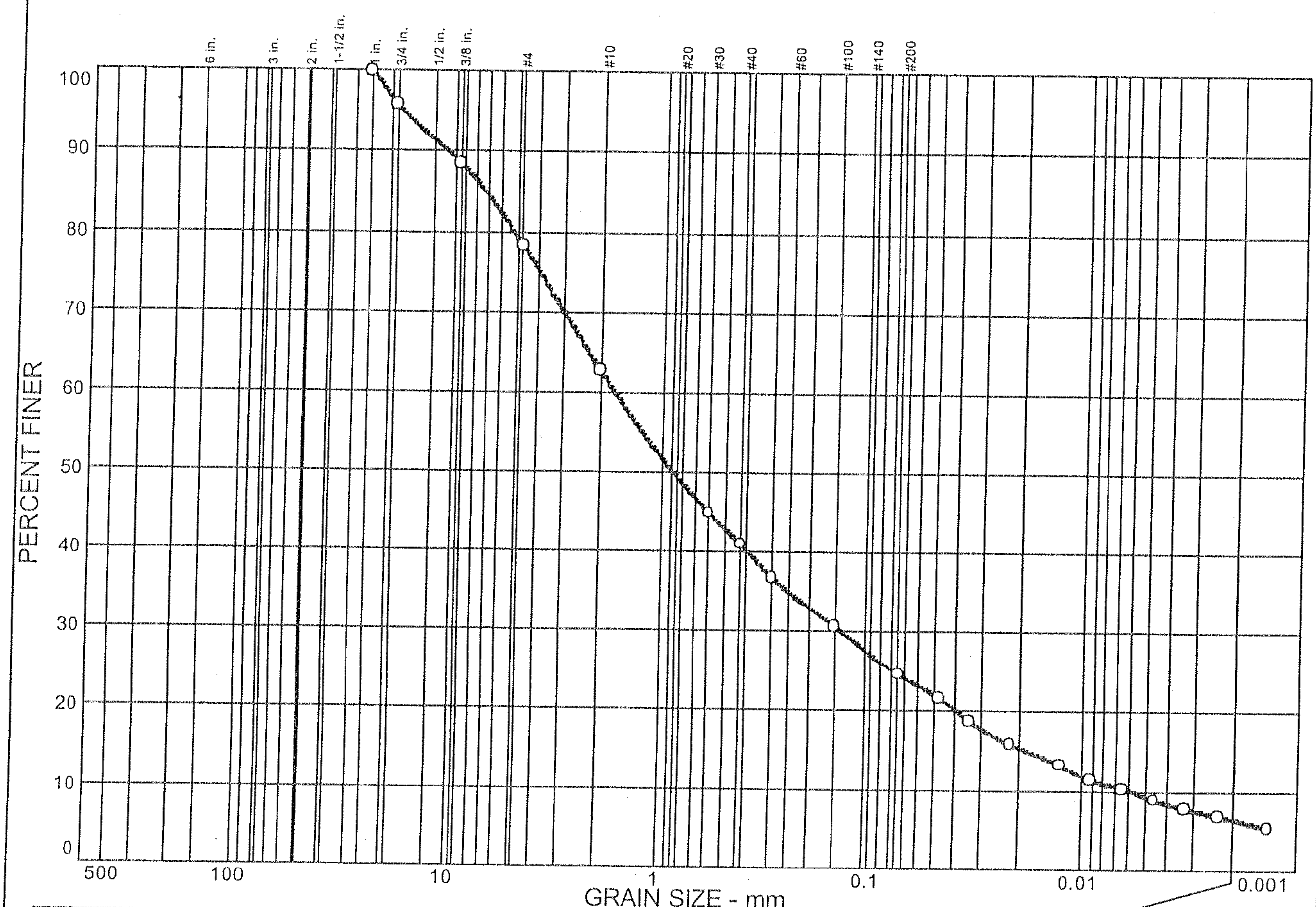
Remarks

Sample No.: Source of Sample: R-08-003 Date:
Location: Elev./Depth: 30-31.5'

COOPER TESTING LABORATORY

Client: PB
Project: Marin-Sonoma Narrows - 04-264061
Project No: 603-013 Figure

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	21.7	53.6	18.2	6.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
3/4 in.	95.8		
3/8 in.	88.6		
#4	78.3		
#10	62.7		
#30	44.9		
#40	41.0		
#50	36.8		
#100	30.7		
#200	24.7		
0.0475 mm.	21.7		
0.0342 mm.	18.8		
0.0220 mm.	15.8		
0.0129 mm.	13.3		
0.0091 mm.	11.4		
0.0065 mm.	10.3		
0.0046 mm.	8.9		
0.0033 mm.	7.8		
0.0023 mm.	6.9		
0.0014 mm.	5.3		

* (no specification provided)

Soil Description

Olive Clayey SAND w/ Gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 7.21 D_{60}= 1.71 D_{50}= 0.896
D_{30}= 0.138 D_{15}= 0.0185 D_{10}= 0.0060
C_u= 285.32 C_c= 1.87

Classification

USCS= AASHTO=

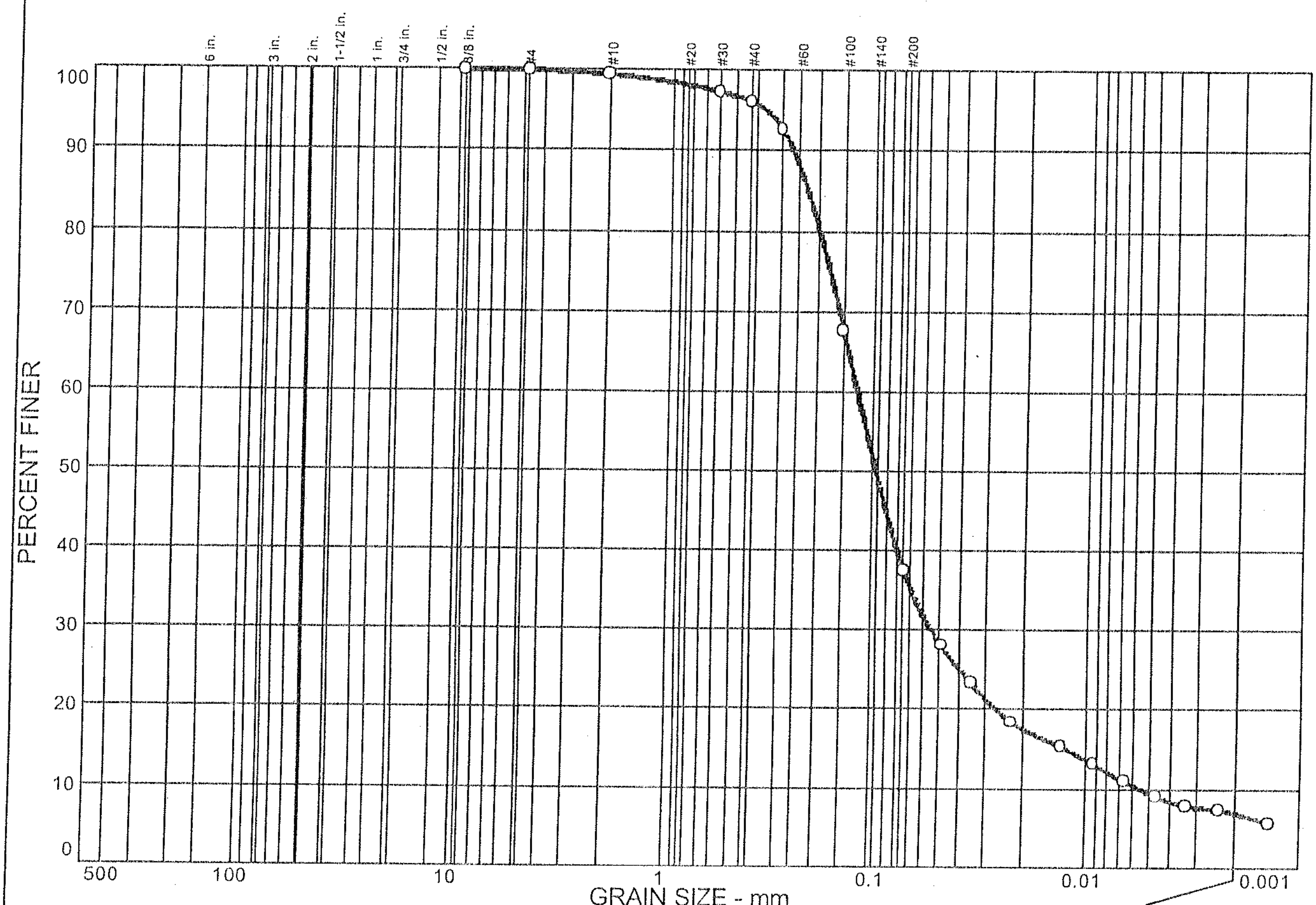
Remarks

Sample No.: Source of Sample: R-08-003 Date:
Location: Elev./Depth: 40-41.5'

COOPER TESTING LABORATORY

Client: PB
Project: Marin-Sonoma Narrows - 04-264061
Project No: 603-013 Figure

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.1	62.5	30.5	6.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8 in.	100.0		
#4	99.9		
#10	99.4		
#30	97.3		
#40	96.1		
#50	92.7		
#100	67.6		
#200	37.4		
0.0488 mm.	28.1		
0.0351 mm.	23.3		
0.0226 mm.	18.4		
0.0132 mm.	15.3		
0.0093 mm.	13.1		
0.0066 mm.	10.9		
0.0047 mm.	9.1		
0.0033 mm.	7.8		
0.0024 mm.	7.3		
0.0014 mm.	5.6		

* (no specification provided)

Soil Description

Dark Yellowish Brown Silty SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.226 D_{60}= 0.128 D_{50}= 0.104
D_{30}= 0.0547 D_{15}= 0.0125 D_{10}= 0.0056
C_u= 22.76 C_c= 4.15

Classification

USCS= AASHTO=

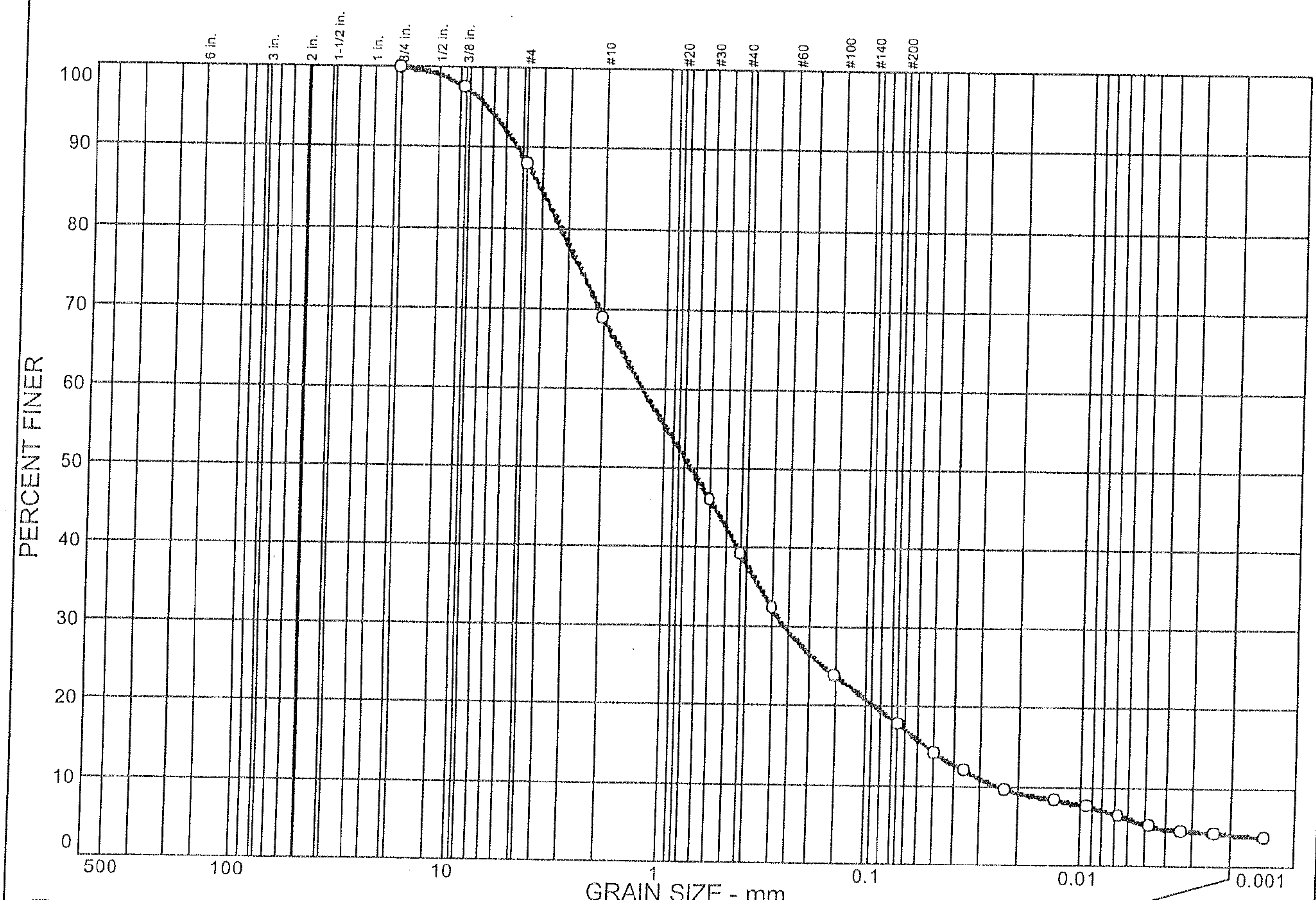
Remarks

Sample No.: Source of Sample: R-08-003 Date:
Location: Elev./Depth: 52-53'

COOPER TESTING LABORATORY

Client: PB
Project: Marin-Sonoma Narrows - 04-264061
Project No: 603-013 Figure

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	12.0	70.2	13.7	4.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
3/8 in.	97.5		
#4	88.0		
#10	68.9		
#30	45.9		
#40	39.2		
#50	32.3		
#100	23.9		
#200	17.8		
0.0496 mm.	14.2		
0.0356 mm.	11.9		
0.0228 mm.	9.6		
0.0132 mm.	8.3		
0.0094 mm.	7.5		
0.0067 mm.	6.4		
0.0048 mm.	5.1		
0.0034 mm.	4.5		
0.0024 mm.	4.2		
0.0014 mm.	3.7		

* (no specification provided)

Soil Description

Brown Clayey SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 4.09 D_{60}= 1.29 D_{50}= 0.750
D_{30}= 0.260 D_{15}= 0.0548 D_{10}= 0.0251
C_u= 51.37 C_c= 2.09

Classification

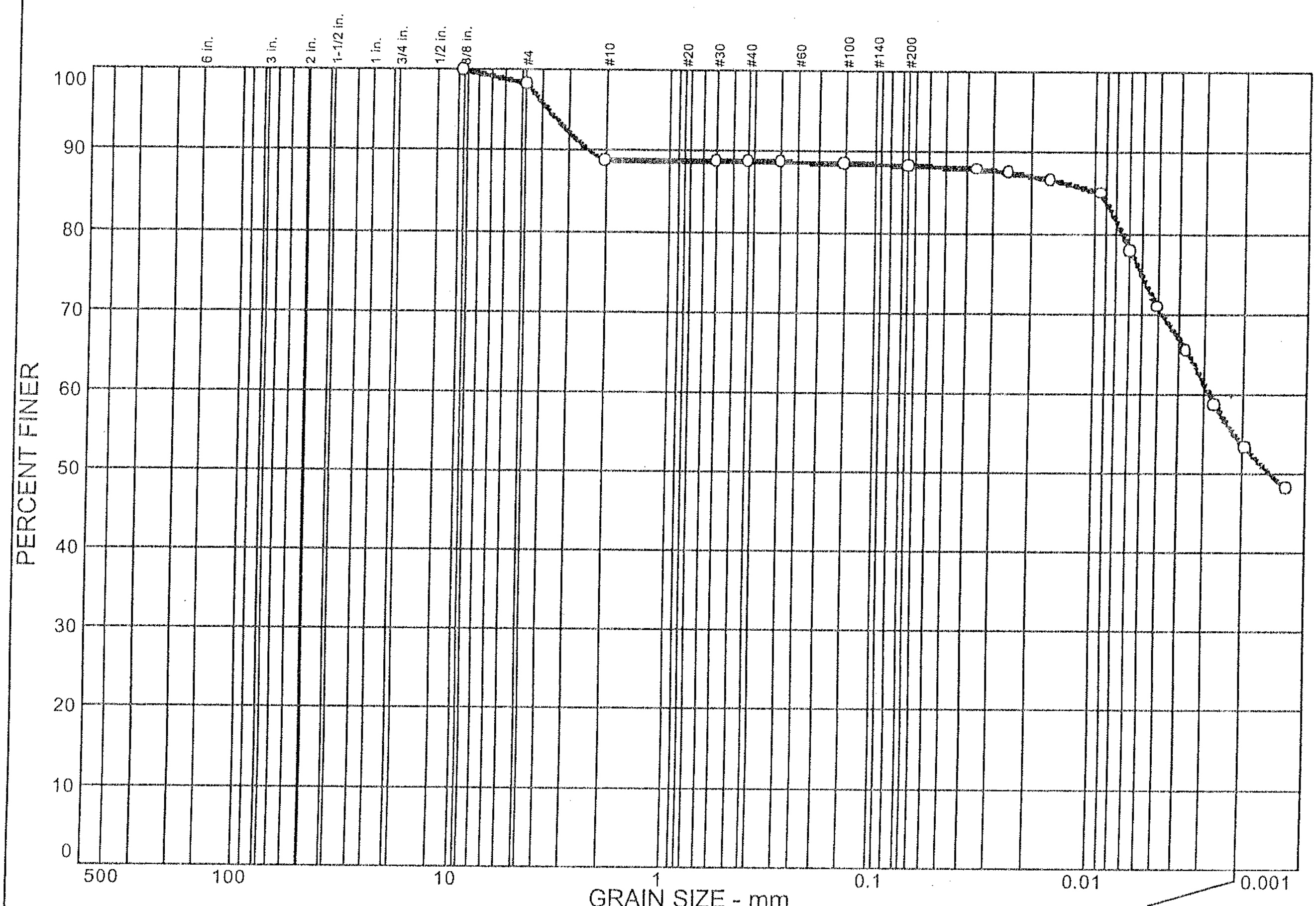
USCS= AASHTO=

Remarks

Sample No.: Source of Sample: R-08-003 Date:
Location: Elev./Depth: 53-54'

COOPER TESTING LABORATORY	Client: PB Project: Marin-Sonoma Narrows - 04-264061 Project No: 603-013 Figure

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	1.7	10.0	34.6	53.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8 in.	100.0		
#4	98.3		
#10	88.7		
#30	88.7		
#40	88.7		
#50	88.7		
#100	88.5		
#200	88.3		
0.0358 mm.	87.9		
0.0254 mm.	87.5		
0.0161 mm.	86.6		
0.0094 mm.	85.0		
0.0069 mm.	77.9		
0.0051 mm.	70.9		
0.0037 mm.	65.5		
0.0027 mm.	58.7		
0.0019 mm.	53.3		
0.0012 mm.	48.1		

* (no specification provided)

Soil Description

Gray Fat CLAY

Atterberg Limits

PL= 40 LL= 105 PI= 65

Coefficients

D_{85}= 0.0094 D_{60}= 0.0028 D_{50}= 0.0015
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

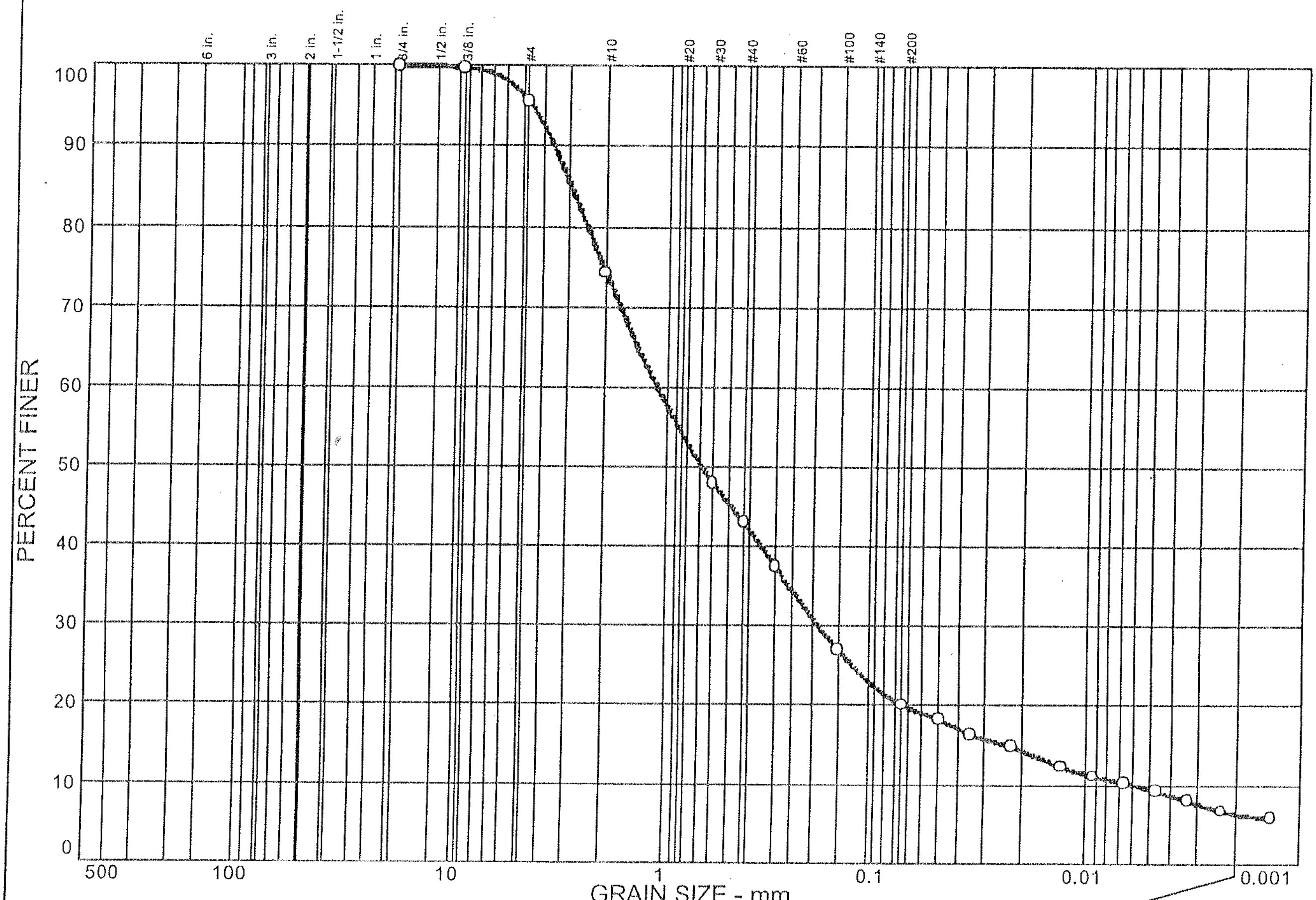
Remarks

Sample No.: Source of Sample: R-08-003 Date:
Location: Elev./Depth: 8.5-10.5'

COOPER TESTING LABORATORY

Client: PB
Project: Marin-Sonoma Narrows - 04-264061
Project No: 603-013 Figure

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	4.4	75.5	13.8	6.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
3/8 in.	99.7		
#4	95.6		
#10	74.3		
#30	48.0		
#40	43.0		
#50	37.5		
#100	27.0		
#200	20.1		
0.0492 mm.	18.2		
0.0351 mm.	16.4		
0.0224 mm.	14.8		
0.0131 mm.	12.3		
0.0093 mm.	11.1		
0.0066 mm.	10.2		
0.0047 mm.	9.2		
0.0033 mm.	8.0		
0.0023 mm.	6.7		
0.0014 mm.	5.8		

* (no specification provided)

Soil Description

Gray Silty, Clayey SAND

Atterberg Limits

PL= 18 LL= 22 PI= 4

Coefficients

D_{85}= 2.93 D_{60}= 1.13 D_{50}= 0.679
D_{30}= 0.186 D_{15}= 0.0236 D_{10}= 0.0061
C_u= 184.28 C_c= 4.97

Classification

USCS= SC-SM AASHTO=

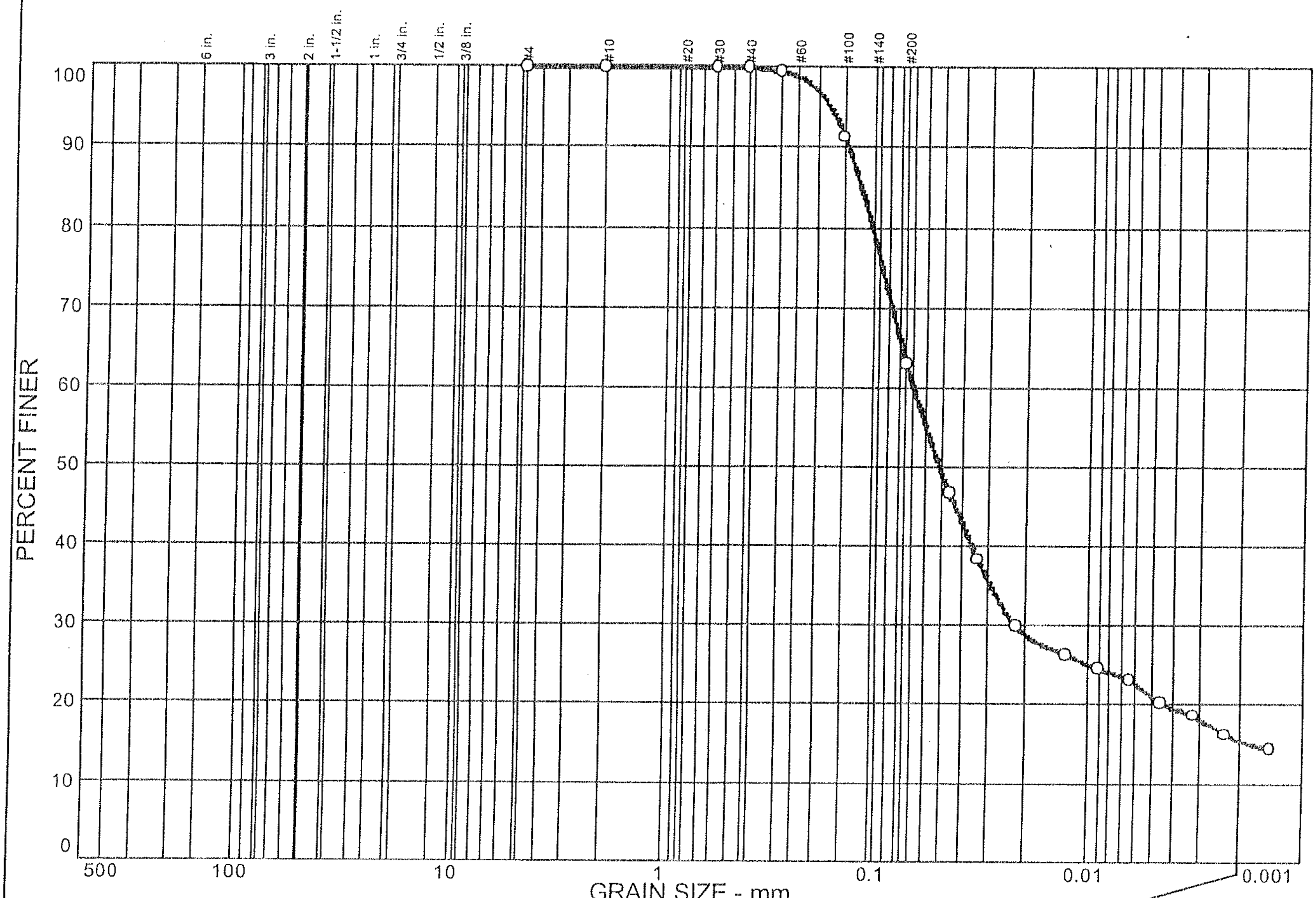
Remarks

Sample No.: Source of Sample: R-08-004 Date:
Location: Elev./Depth: 50-52'

COOPER TESTING LABORATORY

Client: PB
Project: Marin-Sonoma Narrows - 04-264061
Project No: 603-013 Figure

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	37.0	47.6	15.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#30	100.0		
#40	99.9		
#50	99.4		
#100	91.3		
#200	63.0		
0.0459 mm.	46.7		
0.0335 mm.	38.3		
0.0218 mm.	29.9		
0.0127 mm.	26.3		
0.0090 mm.	24.5		
0.0064 mm.	23.1		
0.0046 mm.	20.2		
0.0032 mm.	18.6		
0.0023 mm.	16.2		
0.0014 mm.	14.4		

* (no specification provided)

Soil Description

Brown Sandy Lean CLAY

Atterberg Limits

PL= 21 LL= 31 PI= 10

Coefficients

D_{85}= 0.125 D_{60}= 0.0694 D_{50}= 0.0514
D_{30}= 0.0220 D_{15}= 0.0018 D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

Sample No.: Source of Sample: R-08-004 Date:
Location: Elev./Depth: 60-62'

COOPER TESTING LABORATORY

Client: PB
Project: Marin-Sonoma Narrows - 04-264061
Project No: 603-013 Figure

Memorandum

Flex your power!
Be energy efficient!

To: MAHMOOD MOMENZADEH
Chief, Branch C
Office of Geotechnical Design West

Attn: Mahmood Momenzadeh

Date: September 1, 2009

File: 04-MRN-101-PM18.6/22.3
04-264061
Novato Creek Br. (Widen)
Bridge No. 27-89 R/L

From: **DEPARTMENT OF TRANSPORTATION**
Division of Engineering Services
Geotechnical Services - MS 5

Subject: Driveability Study

Attached is a revised report summarizing results of driveability analyses performed by this Office for the proposed 24" diameter pipe piles at Bent 3 of the above-referenced project.

If you have any questions or comments regarding this report, please contact Jason D. Wahleithner, P.E. at (916) 227-1059.

BRIAN LIEBICH, P.E.
Senior Transportation Engineer
Foundation Testing Branch

Attachments

JDW/jdw

FOUNDATION TESTING BRANCH

September 1, 2009

04-MRN-101

04-264061

Novato Creek Bridge Widening
Bridge No. 27-89 R/L

Revised Driveability Study

September 1, 2009

Project Information

04-MRN-101-PM 18.6/22.3
04-264061
Novato Creek Br. (Widen)
Bridge No. 27-89R/L

Subject

Driveability Study

Introduction

This Office has performed a set of pile driveability analyses for the proposed installation of 24-inch diameter, ¾-inch wall, steel pipe piles, at the location of Bent 3 of the above-referenced project.

Description of Piling

The driveability study was performed for the proposed installation of 24-inch diameter, ¾-inch wall, steel pipe piles at the Novato Creek Bridge Widening project. Minimum steel yield strength of 45 ksi was specified in the information submitted to this Office. This places the maximum allowable compressive stress during driving at 0.95*45 = 42.75 ksi. This Office was requested to analyze both the open-ended and closed-ended pile conditions.

The pile type, nominal resistance in compression, pile cut-off and design tip elevations for the subject piles were provided by John Moore of OGDW. Table I presents the submitted piling information that was used in the driving analyses.

Table I. Piling Information

Support Location	Pile Type (1)	Pile Cut-off Elevation (1) (ft)	Soil Surface Elevation (1) (ft)	Pipe Pile Tip Elevation (1) (ft)	Analyzed Pile Penetration Length (ft)
Bent 3	24"x ¾" steel pipe	17.0	6.8	-69.0	75.8

(1) Information provided by J. Moore based on Table 9 of Draft Foundation Report dated 5/7/09.

Subsurface Conditions and Soil Resistance Parameters

According to the soil profile included in the Draft Foundation Report dated May 7, 2009, the foundation materials at the site consist of layers of very soft to soft organic silty clay and dense fine to coarse sand with gravel. Soils are underlain by shale and sandstone bedrock. The soil profile used in the WEAP analysis is included in Appendix A. This profile separates the geology into 11 different layers that are based on Boring R-08-003 provided by OGDW. For the 11th layer, identified as bedrock, the WEAP analysis requires a set of unit skin friction and toe resistance values. The first set of values used in the original WEAP analysis was 2.6 ksf and 291 ksf for the unit skin and toe resistance, respectively. The revised WEAP analysis includes a second and third set of unit skin and toe resistance values provided by OGDW as alternatives to the values used in the original report. These alternative values, along with the original values used in the 1st Analysis, are summarized in Table II below. A separate WEAP analysis was performed using each of the three sets of unit skin and toe resistance values.

Table II: Bedrock (Soil Layer No. 11) Properties

WEAP Analysis	Unit Skin Resistance	Unit Toe Resistance
1st Analysis	2.6 ksf	291 ksf
2nd Analysis	2.4 ksf	250 ksf
3rd Analysis	2.0 ksf	200 ksf

Each WEAP analysis used four basic soil model parameters to describe the dynamic soil behavior (soil behavior during piledriving). These parameters include shaft quake, toe quake, shaft damping, and toe damping. Soil model parameters used to describe the dynamic soil behavior are included in Table III.

Table III: Soil Resistance Parameters

Parameter Type	Quake	Damping
Shaft (Non-Cohesive Layers)	0.10-inch	0.05 s/ft
Shaft (Cohesive Layers)	0.10-inch	0.20 s/ft
Toe (Displacement Piles)[1]	0.20-inch.	0.15 s/ft
Toe (Non-Displacement Piles)	0.10-inch.	0.15 s/ft

[1] Displacement piles are closed-ended piles or open-ended piles that plug during driving.

Pile Driving Resistance

To install a driven pile, the pile must overcome resistance to penetration developed by the soil. The driving resistance will determine the size of the required pile driving hammer and the stress magnitude imparted to the steel pile by the driving system. As such, an estimate of driving resistance is necessary to perform a driveability study when investigating the potential for pile damage due to steel overstressing during driving. Driving resistance can be related to static axial capacity using set-up and relaxation factors applied to various layers of soil that the pile penetrates. Several methods are available to estimate pile static axial capacity and thereby driving resistance. These methods will generally determine a range of axial capacities for a given pile penetration. To be conservative, pile tip elevation may be based on lower estimates of static capacity, but higher capacity estimates are generally used for the driveability analysis.

The maximum initial driving resistance at Bent 3 predicted by GRLWEAP in the 1st Analysis, based on the soil profile included in the Draft Foundation Report, is estimated at approximately 622 kips for the open-ended pile condition and 1426 kips for the closed-ended pile condition. The GRLWEAP estimated driving resistance for the open-ended pile condition is approximately

92% of required nominal driving resistance (677 kips) stated in the Draft Foundation Report. The GRLWEAP estimates rely upon the following assumptions:

- The anticipated driving resistance includes the resistance contributions of approximately 82% from skin friction (Qs); and 18% from end bearing (Qp) for the open-ended pile condition. Percentage distributions are based on GRLWEAP output. The open-ended pile condition assumes no plugging, which may not be valid.

- The anticipated driving resistance includes the resistance contributions of approximately 36% from skin friction (Qs); and 64% from end bearing (Qp) for the closed-ended pile condition. Percentage distributions are based on GRLWEAP output.

- The piles will be driven in approximately 40' lengths with 24 hour splicing delays, and associated setup, between each 40' length.

The maximum initial driving resistances at Bent 3 predicted by GRLWEAP in the 2nd and 3rd Analyses, based on the soil profile included in the Draft Foundation Report and the OGDW recommendations for the unit skin and toe resistance values of the bedrock, are summarized in the Table IV below. This includes assumptions regarding resistance distributions for the open and closed end conditions for each analysis.

Table IV: WEAP Predicted Driving Resistances (by Analysis)

WEAP Analysis	Pile End Condition	Max. Predicted Driving Resistance	Skin Friction Contribution	End Bearing Contribution
1st Analysis	Open	622 kips	82%	18%
	Closed	1426 kips	36%	64%
2nd Analysis	Open	587 kips	84%	16%
	Closed	1277 kips	38%	62%
3rd Analysis	Open	527 kips	86%	14%
	Closed	1079 kips	42%	58%

Description of Pile Driving Systems

This study involved modeling the performance of four selected driving systems to reflect the range of rated energies possibly appropriate for the installation of the 24-inch diameter steel pipe piles for the two pile conditions: open-ended and closed-ended.

The analyses were performed using GRLWEAP™ recommended default parameters. For each hammer, the analysis was performed with the hammer operating at maximum stroke for determining driving-behavior stresses imparted to the steel pile. The analysis performed for each hammer was utilized to demonstrate the predicted blow counts and corresponding maximum compressive stresses expected during pile driving. Standard configurations for the hammer driving systems and related components were based upon information published in GRLWEAP™ literature and database. The hammer characteristics are listed in Table V.

Table V: Summary of Hammer Systems at Bent 3

Hammer Manufacturer	APE	PILECO	DELMAG	APE
Hammer Model	D36-42	D46-42	D62-42	D80-42
Hammer Type	OED	OED	OED	OED
Rated Energy (kip-ft)	89.30	107.48	152.45	198.45
Ram Weight (kips)	7.938	10.143	13.660	17.640
Maximum Stroke (ft)	13.08	13.10	12.71	13.08

Note: OED= Open End Diesel

Discussion of Results

For the 1st Analysis, tables and charts depicting predicted relationships between driving resistances and driving stresses versus blow counts for each of the hammers with the pile in the open and closed-ended condition are included in Appendix B and C, respectively. Printouts and charts for the 2nd and 3rd Analysis are presented in Appendix D through G. All three analyses results for the four hammers with the pile in both the open-ended and closed-ended condition are summarized in Table VI through VIII below.

Table VI: Summary of Results for 1st Analysis

Hammer Manufacturer/ Model	Pile End Condition[1]	Estimated Maximum Driving Resistance (kips)	Estimated Max. Compressive Stress (ksi)	Estimated Ending Blow Count (Blows/ft)	At Stroke (ft)
APE / D36-42	Open	622	23.6	43	8.1
PILECO / D46-42			26.4	33	8.2
DELMAG / D62-42			29.4	27	8.2
APE / D80-42			32.9	18	8.0
APE / D36-42	Closed	1426	26.5	769 [2]	9.5
PILECO / D46-42			29.6	252 [2]	9.5
DELMAG / D62-42			35.8	117 [2]	10.7
APE / D80-42			38.4	80	9.9

(1) 24" x 3/4" Steel pipe pile, Fy = 45 ksi

(2) Exceeds maximum allowable blow count (96 blows per foot) based on minimum penetration of 1/8" per blow as required by Standard Specification 49-1.05.

Table VII: Summary of Results for 2nd Analysis

Hammer Manufacturer/ Model	Pile End Condition[1]	Estimated Maximum Driving Resistance (kips)	Estimated Max. Compressive Stress (ksi)	Estimated Ending Blow Count (Blows/ft)	At Stroke (ft)
APE / D36-42	Open	587	23.4	39	8.0
PILECO / D46-42			26.1	30	8.1
DELMAG / D62-42			29.1	25	8.1
APE / D80-42			32.4	17	7.9
APE / D36-42	Closed	1277	26.1	312 [2]	9.3
PILECO / D46-42			29.1	156 [2]	9.3
DELMAG / D62-42			35.2	86	10.5
APE / D80-42			37.7	58	9.6

(1) 24" x 3/4" Steel pipe pile, Fy = 45 ksi

(2) Exceeds maximum allowable blow count (96 blows per foot) based on minimum penetration of 1/8" per blow as required by Standard Specification 49-1.05.

Table VIII: Summary of Results for 3rd Analysis

Hammer Manufacturer/ Model	Pile End Condition[1]	Estimated Maximum Driving Resistance (kips)	Estimated Max. Compressive Stress (ksi)	Estimated Ending Blow Count (Blows/ft)	At Stroke (ft)
APE / D36-42	Open	527	23.0	33	7.9
PILECO / D46-42			25.9	26	7.9
DELMAG / D62-42			28.7	22	7.9
APE / D80-42			31.7	14	7.6
APE / D36-42	Closed	1079	25.4	149 [2]	9.0
PILECO / D46-42			28.4	93	9.0
DELMAG / D62-42			34.2	57	10.1
APE / D80-42			36.3	39	9.1

(1) 24" x 3/4" Steel pipe pile, Fy = 45 ksi

(2) Exceeds maximum allowable blow count (96 blows per foot) based on minimum penetration of 1/8" per blow as required by Standard Specification 49-1.05.

The GRLWEAP™ wave equation program is a one-dimensional analysis and does not consider buckling or bending of the pile due to non-uniform blows or localized stresses at the pile tip, which may occur during pile driving. Also, it has been observed in the field that significantly harder or softer driving could occur than the GRLWEAP™ predictions.

General

It should be noted that all driving output data generated by the GRLWEAP™ Program presumes uniform hammer blows, with leads and hammer perfectly aligned. The analyses do not consider the effects of eccentric blows, malfunctioning hammers, or Contractor-selected reduction in fuel setting for Diesel hammers. Some Diesel hammers may exhibit operating efficiencies significantly lower than the theoretical 80% used in the analyses, subject to condition and maintenance states. The analyses also do not consider higher stresses, which could be induced by bending, non-axial hammer alignment, or high local stress concentrations, and therefore should be considered as minimum values. Local pile damage can occur at the pile tip due to highly localized pile stresses caused by non-uniform resistance from sloping rock, boulders, cobbles, or obstructions, even if the calculated average axial stresses are within the allowable limits. These stresses cannot be predicted by wave equation analysis. The analysis results are only valid for the assumptions noted in the above sections and the soil profile input provided.

Conclusions and Recommendations

1st Analysis

Based upon the results of the 1st driveability analysis using the submitted information from the Geotechnical Designer, the following has been concluded:

- APE D36-42, PILECO D46-42, DELMAG D62-42, and APE D80-42 diesel impact hammers are capable of driving the 24-inch diameter open-ended steel pipe pile at 0.75-inch wall thickness without exceeding the maximum allowable blow count limit of 96 blows/ft (1/8" blow per foot) and without exceeding the maximum compressive stress of 42.75 ksi. This assumes no plugging occurs in the open-ended pile condition.

- Only the APE D80-42 diesel impact hammer is capable of driving the 24-inch diameter closed-end steel pipe pile at 0.75-inch wall thickness without exceeding the maximum allowable blow count limit of 96 blows/ft (1/8" blow per foot).

2nd Analysis

Based upon the results of the 2nd driveability analyses using the submitted information from the Geotechnical Designer, the following has been concluded:

- APE D36-42, PILECO D46-42, DELMAG D62-42, and APE D80-42 diesel impact hammers are capable of driving the 24-inch diameter open-ended steel pipe pile at 0.75-inch wall thickness without exceeding the maximum allowable blow count limit of 96 blows/ft (1/8" blow per foot) and without exceeding the maximum compressive stress of 42.75 ksi. This assumes no plugging occurs in the open-ended pile condition.

- Only the DELMAG D62-42, and APE D80-42 diesel impact hammers are capable of driving the 24-inch diameter closed-end steel pipe pile at 0.75-inch wall thickness without exceeding the maximum allowable blow count limit of 96 blows/ft (1/8" blow per foot).

3rd Analysis

Based upon the results of the driveability analyses using the submitted information from the Geotechnical Designer, the following has been concluded:

- APE D36-42, PILECO D46-42, DELMAG D62-42, and APE D80-42 diesel impact hammers are capable of driving the 24-inch diameter open-ended steel pipe pile at 0.75-inch wall thickness without exceeding the maximum allowable blow count limit of 96 blows/ft (1/8" blow per foot) and without exceeding the maximum compressive stress of 42.75 ksi. This assumes no plugging occurs in the open-ended pile condition.

- Only the PILECO D46-42, DELMAG D62-42, and APE D80-42 diesel impact hammers are capable of driving the 24-inch diameter closed-end steel pipe pile at 0.75-inch wall thickness without exceeding the maximum allowable blow count limit of 96 blows/ft (1/8" blow per foot).

General

- Steel pipe piles smaller than 30-inch in diameter may plug during driving into bearing layers. If plugging occurs, the driving stresses and blow counts will be similar to those predicted by the closed-end pipe pile analyses.

- The WEAP analysis cannot model and predict high local stress concentrations that may occur at the pile tip when driving in rock due to highly localized pile stresses caused by non-uniform resistance from sloping rock, boulders, or cobbles. Additional measures such as driving tips, driving shoes, and/or thicker pipe wall section may need to be considered when specifying piles driven into rock.

- A pile driving system submittal for this project is necessary upon hammer(s) selection. The driving system submittal must contain a driveability analysis showing that the proposed driving system will install all the piles to the specified tip elevations at acceptable rates of penetration without overstressing the piles.

If you have any questions or comments pertaining to this report, please contact Jason D. Wahleithner, P.E. at (916) 227-1059.

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JASON D. WAHLEITHNER, P.E.
Transportation Engineer, Civil
Foundation Testing Branch
Office of Geotechnical Support

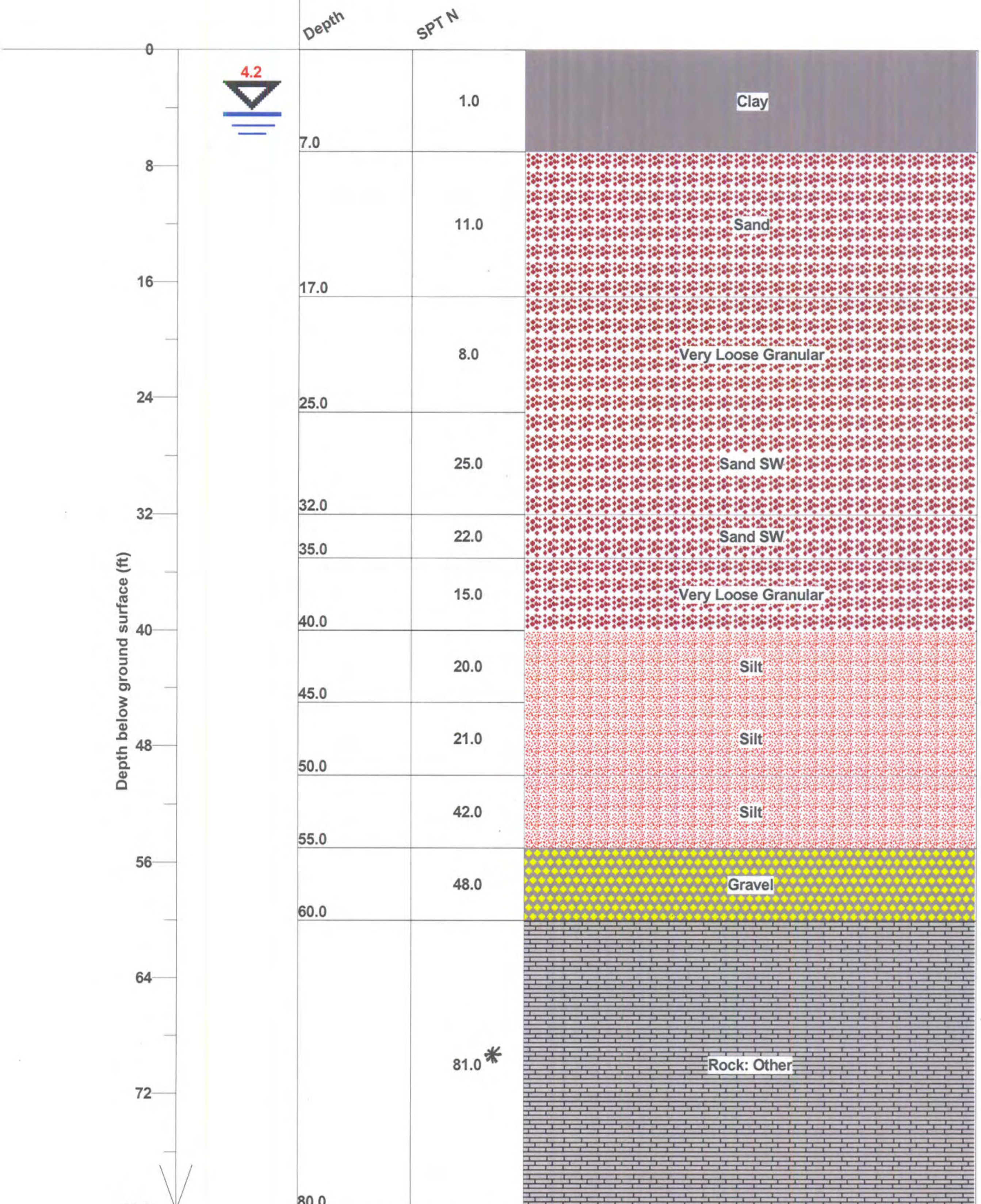
APPENDIX A

SOIL PROFILE

FROM

WEAP ANALYSIS

WEAP Analysis Soil Profile



* Unit skin Friction and Toe Resistance Values Used In Lieu of SPTN in Determining Driving Resistance: (See Table II: Bedrock (Soil Layer No. 11) Properties)

APPENDIX B

DRIVEABILITY ANALYSIS CHARTS

FOR

OPEN-ENDED PILE CONDITION

1ST ANALYSIS

California D.O.T. Geotechnical Services
Br. 27-89 APE D36-42 OE Pipe Analysis 1

Aug 31 2009
GRLWEAP(TM) Version 2005

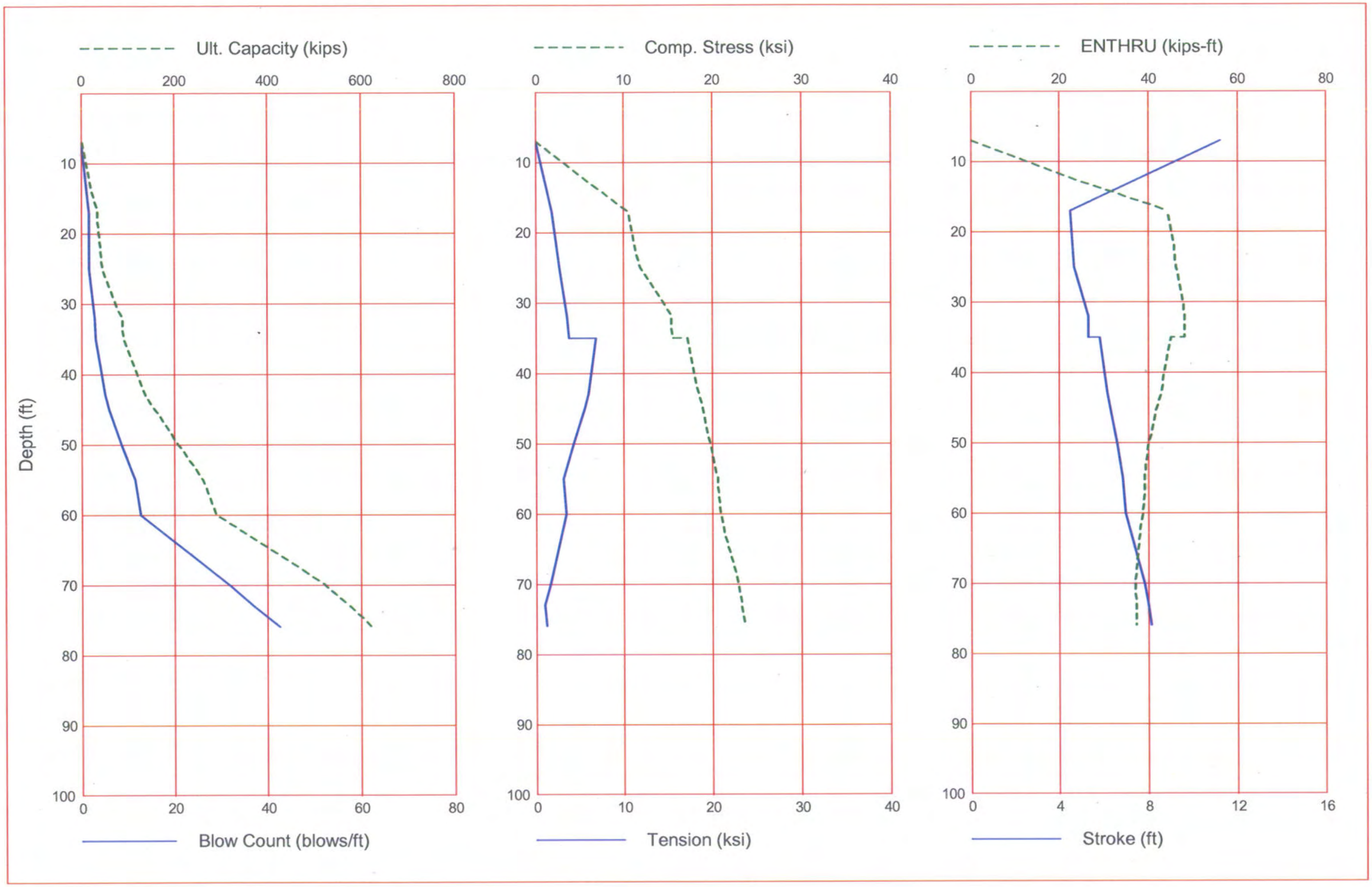
Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	4.0	3.5	0.4	0.0	0.000	0.000	11.25	0.0
17.0	35.6	18.1	17.5	1.8	10.558	-1.885	4.52	44.2
25.0	45.0	32.3	12.7	1.8	11.847	-2.753	4.69	46.2
32.0	87.8	48.1	39.7	3.0	15.446	-3.528	5.32	48.1
35.0	91.0	56.0	35.0	3.1	15.526	-3.740	5.33	48.0
35.0	91.0	56.0	35.0	3.1	17.238	-6.890	5.83	45.1
43.0	137.6	95.8	41.9	5.1	18.502	-5.987	6.16	42.9
43.0	137.6	95.8	41.9	5.1	18.502	-5.987	6.16	42.9
45.0	157.0	113.4	43.6	6.0	18.935	-5.589	6.28	41.9
45.0	157.0	113.4	43.6	6.0	18.935	-5.589	6.28	41.9
50.0	208.4	160.7	47.7	8.6	19.826	-4.371	6.58	40.1
55.0	260.2	212.5	47.7	11.5	20.632	-3.191	6.86	39.1
60.0	288.3	250.1	38.1	12.7	20.931	-3.514	6.97	38.8
70.0	524.2	413.5	110.7	31.9	23.012	-1.658	7.84	37.1
73.0	573.2	462.5	110.7	36.9	23.314	-1.005	7.98	37.3
76.0	622.2	511.5	110.7	42.6	23.616	-1.217	8.13	37.3

Total Continuous Driving Time 16.00 minutes; Total Number of Blows 685

California D.O.T. Geotechnical Services | Aug 31 2009

Br. 27-89 APE D36-42 OE Pipe Analysis 1 | Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 | GRLWEAP(TM) Version 2005



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	4.0	3.5	0.4	0.0	0.000	0.000	11.25	0.0
17.0	35.6	18.1	17.5	1.2	9.285	-1.502	4.07	65.1
25.0	45.0	32.3	12.7	1.3	10.952	-1.891	4.21	65.0
32.0	87.8	48.1	39.7	2.4	16.025	-3.505	4.93	63.5
35.0	91.0	56.0	35.0	2.4	16.173	-3.770	4.93	63.4
35.0	91.0	56.0	35.0	2.3	18.215	-7.088	5.43	61.5
40.0	94.5	70.7	23.8	2.3	18.247	-7.414	5.43	61.7
43.0	137.6	95.8	41.9	3.9	19.949	-6.541	5.83	56.6
45.0	157.0	113.4	43.6	4.6	20.521	-6.173	5.99	55.4
45.0	157.0	113.4	43.6	4.6	20.521	-6.173	5.99	55.4
50.0	208.4	160.7	47.7	6.7	21.730	-5.111	6.36	53.3
55.0	260.2	212.5	47.7	8.9	22.658	-3.856	6.68	51.6
60.0	288.3	250.1	38.1	9.7	23.032	-4.039	6.82	50.9
70.0	524.2	413.5	110.7	25.3	25.756	-0.814	7.91	48.2
73.0	573.2	462.5	110.7	28.8	26.058	-0.419	8.04	48.2
76.0	622.2	511.5	110.7	32.7	26.375	-0.322	8.18	48.2

Total Continuous Driving Time 12.00 minutes; Total Number of Blows 526

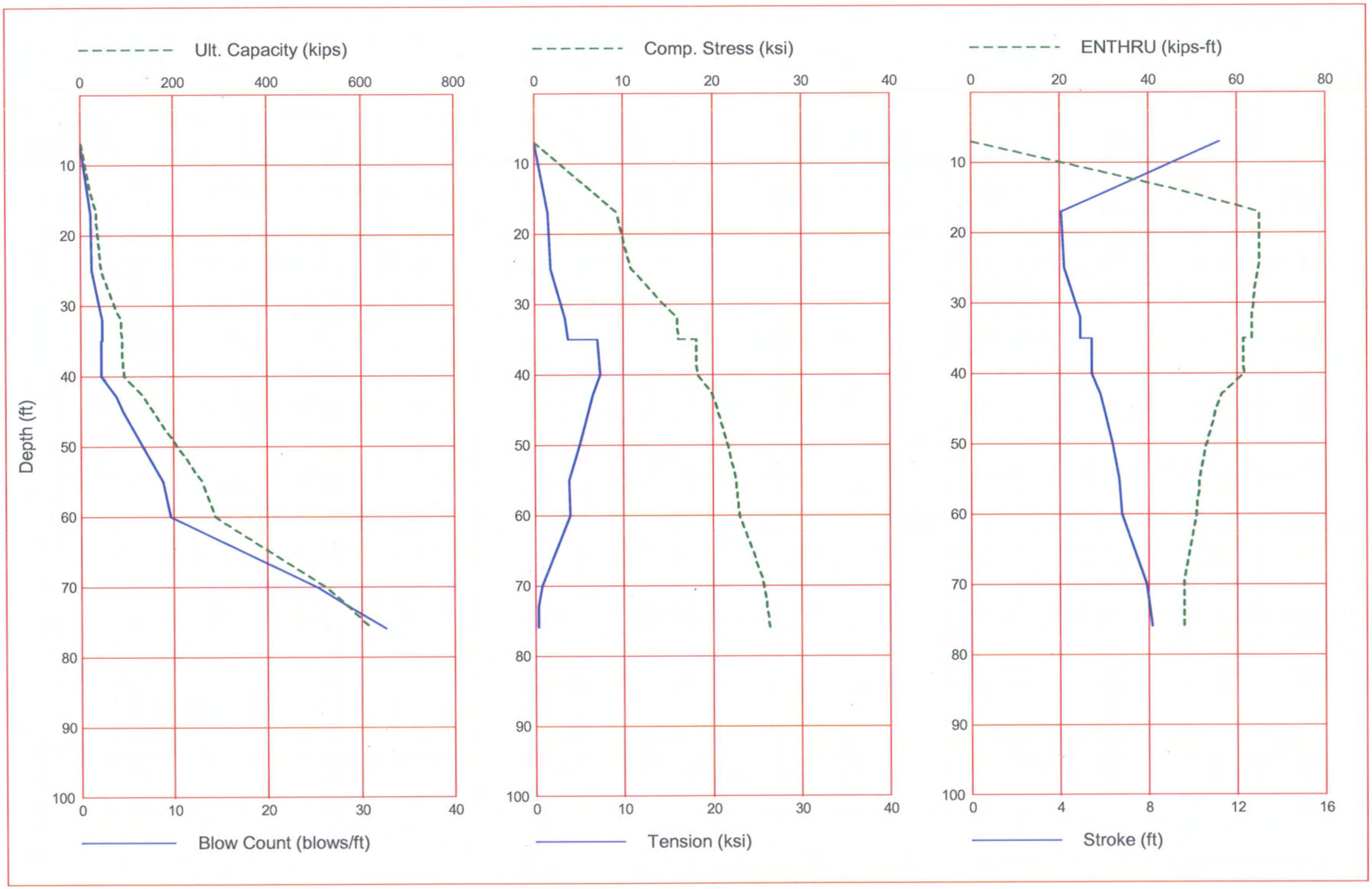
California D.O.T. Geotechnical Services

Aug 31 2009

Br. 27-89 PILECO D46-42 OEP Analysis 1

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



California D.O.T. Geotechnical Services
Br. 27-89 DELMAG D62-42 OEP Analysis 1

Aug 31 2009
GRLWEAP(TM) Version 2005

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	4.0	3.5	0.4	0.0	0.000	0.000	11.16	0.0
17.0	35.6	18.1	17.5	-1.0	0.000	0.000	0.00	0.0
25.0	45.0	32.3	12.7	-1.0	0.000	0.000	0.00	0.0
32.0	87.8	48.1	39.7	1.8	15.707	-2.892	4.41	86.5
35.0	91.0	56.0	35.0	1.8	15.875	-3.078	4.42	86.4
35.0	91.0	56.0	35.0	1.7	17.862	-5.990	4.80	83.8
40.0	94.5	70.7	23.8	1.7	17.883	-6.278	4.79	83.9
43.0	137.6	95.8	41.9	2.9	20.529	-6.089	5.30	76.4
45.0	157.0	113.4	43.6	3.4	21.438	-5.851	5.52	74.9
45.0	157.0	113.4	43.6	3.4	21.438	-5.851	5.52	74.9
50.0	208.4	160.7	47.7	5.0	22.803	-4.734	5.88	69.7
55.0	260.2	212.5	47.7	6.7	24.131	-3.699	6.28	67.0
60.0	288.3	250.1	38.1	7.4	24.599	-3.878	6.43	66.0
70.0	524.2	413.5	110.7	20.9	28.636	-0.076	7.87	59.8
73.0	573.2	462.5	110.7	24.0	28.946	0.000	8.00	58.5
76.0	622.2	511.5	110.7	26.7	29.415	0.000	8.18	58.5

Total Continuous Driving Time 9.00 minutes; Total Number of Blows 403

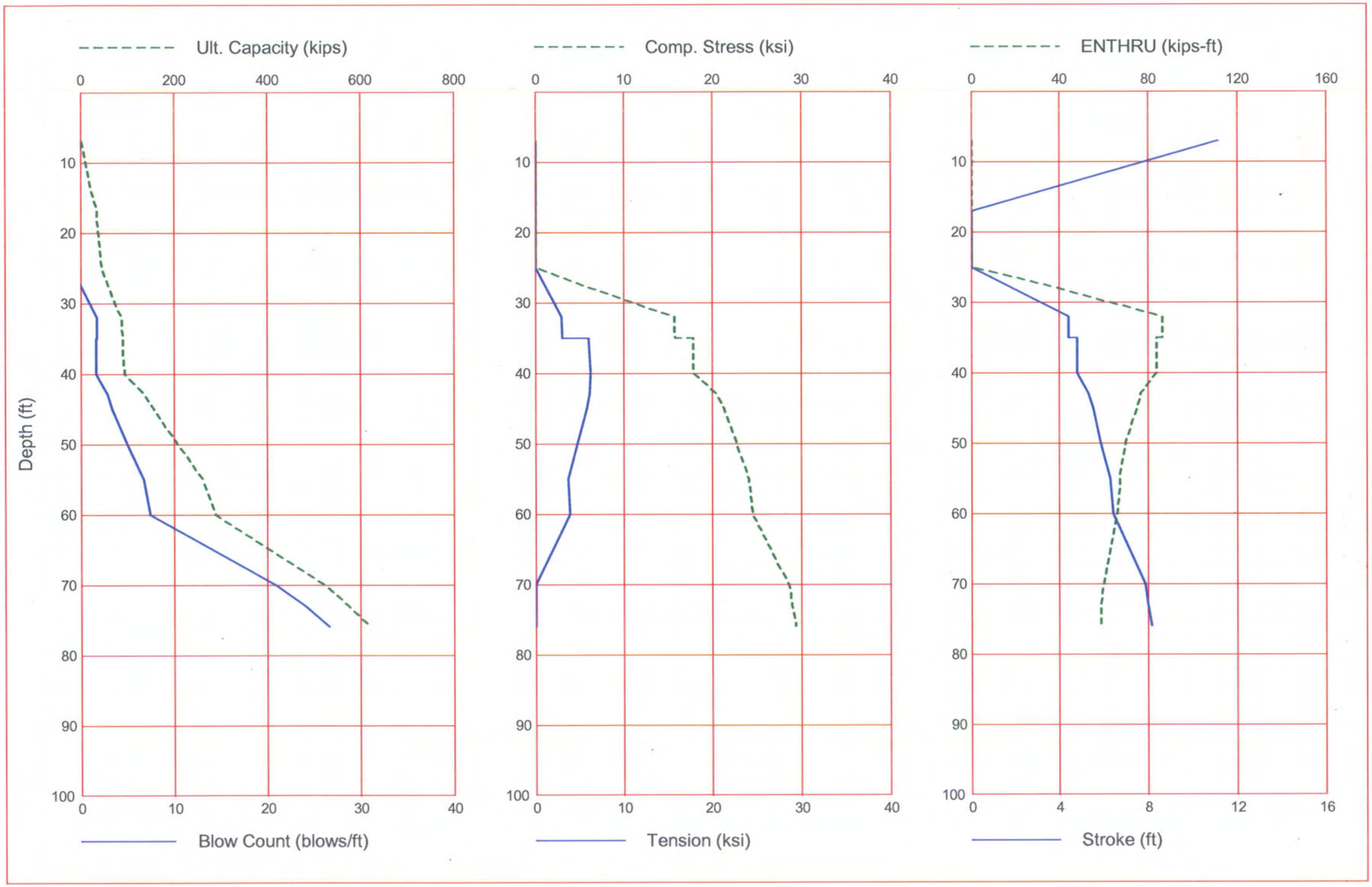
California D.O.T. Geotechnical Services

Aug 31 2009

Br. 27-89 DELMAG D62-42 OEP Analysis 1

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	4.0	3.5	0.4	0.0	0.000	0.000	11.25	0.0
17.0	35.6	18.1	17.5	-1.0	0.000	0.000	0.00	0.0
25.0	45.0	32.3	12.7	-1.0	0.000	0.000	0.00	0.0
32.0	87.8	48.1	39.7	-1.0	0.000	0.000	0.00	0.0
35.0	91.0	56.0	35.0	-1.0	0.000	0.000	0.00	0.0
35.0	91.0	56.0	35.0	1.3	15.536	-2.811	4.54	119.7
40.0	94.5	70.7	23.8	1.2	15.677	-2.970	4.54	120.3
43.0	137.6	95.8	41.9	2.1	20.101	-3.183	5.01	110.0
45.0	157.0	113.4	43.6	2.5	21.442	-3.319	5.21	107.1
45.0	157.0	113.4	43.6	2.5	21.442	-3.319	5.21	107.1
50.0	208.4	160.7	47.7	3.5	23.771	-2.729	5.60	100.5
55.0	260.2	212.5	47.7	4.7	25.557	-2.574	5.97	96.5
60.0	288.3	250.1	38.1	5.1	25.993	-3.795	6.07	94.5
70.0	524.2	413.5	110.7	13.7	31.531	-0.058	7.57	84.3
73.0	573.2	462.5	110.7	16.1	32.149	0.000	7.78	83.0
76.0	622.2	511.5	110.7	18.2	32.859	0.000	8.00	82.1

Total Continuous Driving Time 6.00 minutes; Total Number of Blows 266

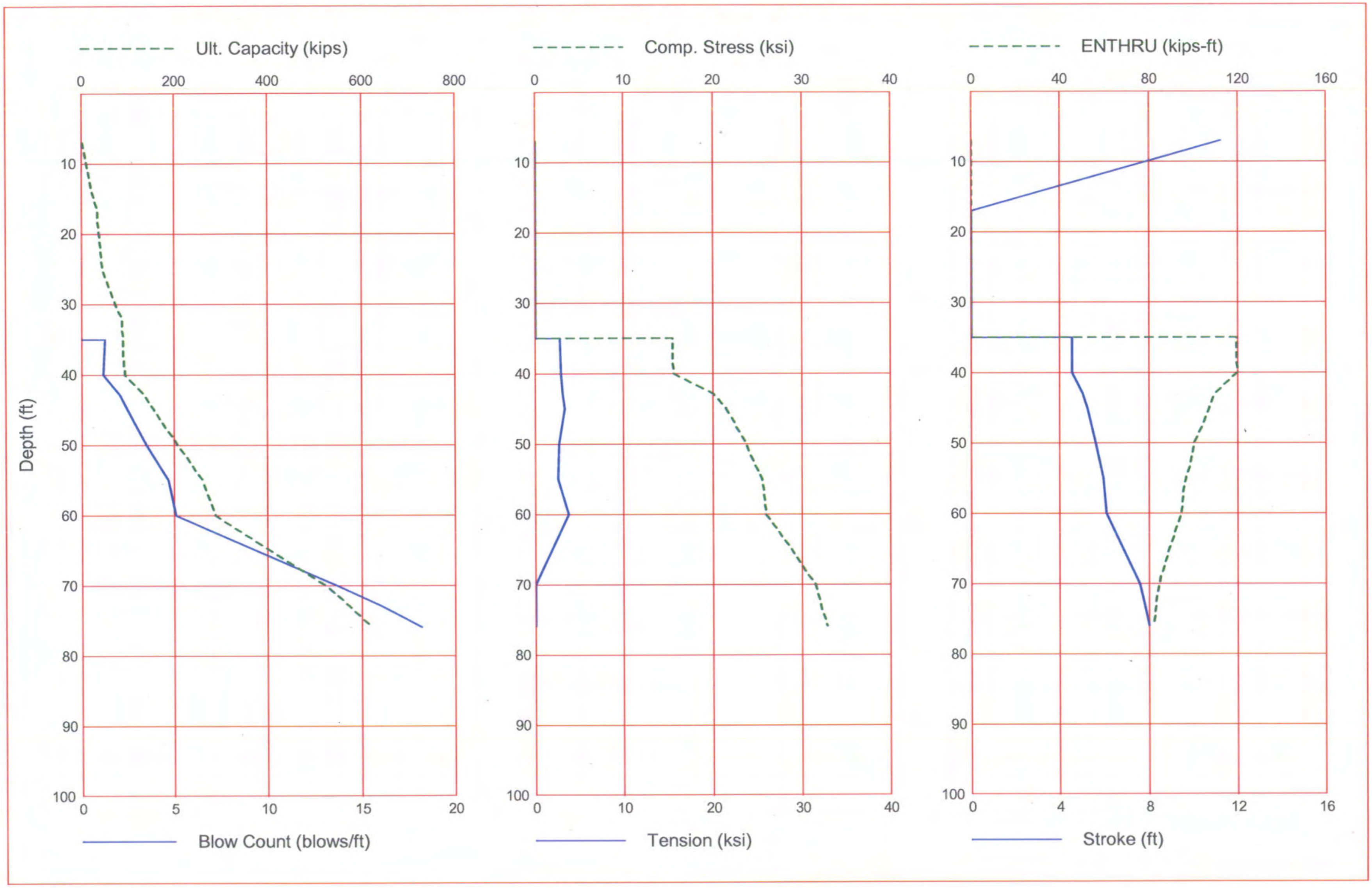
California D.O.T. Geotechnical Services

Aug 31 2009

Br. 27-89 APE D80-42 OEP Analysis 1

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



APPENDIX C

DRIVEABILITY ANALYSIS CHARTS

FOR

CLOSED-ENDED PILE CONDITION

1ST ANALYSIS

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	7.1	3.5	3.5	0.0	0.000	0.000	11.25	0.0
17.0	162.5	18.1	144.4	7.7	18.542	-0.464	6.13	41.8
25.0	137.3	32.3	105.0	5.9	17.739	-1.708	5.92	43.5
32.0	376.2	48.1	328.1	21.0	22.291	-0.402	7.50	38.0
35.0	344.7	56.0	288.7	18.8	21.688	-0.278	7.27	37.9
35.0	344.7	56.0	288.7	18.6	21.962	-1.476	7.34	39.0
43.0	441.6	95.8	345.8	25.7	22.713	-1.408	7.64	38.6
43.0	441.6	95.8	345.8	25.7	22.713	-1.408	7.64	38.6
45.0	473.7	113.4	360.2	27.7	22.899	-1.462	7.72	38.5
45.0	473.7	113.4	360.2	27.7	22.899	-1.462	7.72	38.5
50.0	554.4	160.7	393.7	33.5	23.344	-2.109	7.92	38.7
55.0	606.2	212.5	393.7	37.8	23.637	-2.392	8.04	38.8
60.0	565.1	250.1	314.9	33.6	23.189	-2.214	7.88	38.0
70.0	1327.7	413.5	914.2	317.5	26.454	-5.341	9.36	43.9
73.0	1376.7	462.5	914.2	450.4	26.528	-5.338	9.42	43.9
76.0	1425.7	511.5	914.2	768.5	26.542	-5.018	9.46	43.7

Total Continuous Driving Time 145.00 minutes; Total Number of Blows 5720

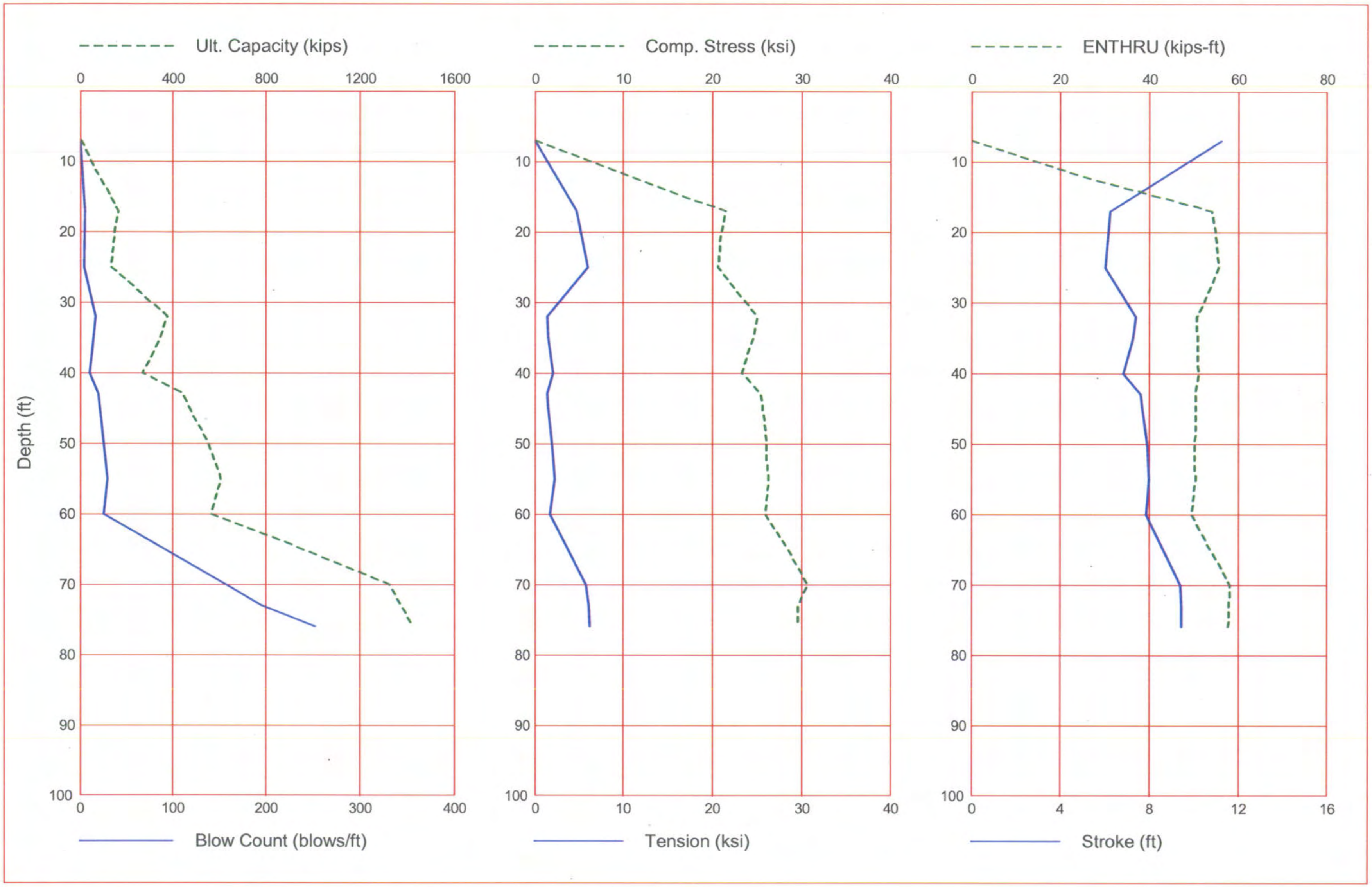
Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	7.1	3.5	3.5	0.0	0.000	0.000	11.25	0.0
17.0	162.5	18.1	144.4	5.8	21.447	-4.758	6.27	54.1
25.0	137.3	32.3	105.0	4.5	20.667	-6.035	6.05	55.6
32.0	376.2	48.1	328.1	16.3	24.961	-1.474	7.41	50.7
35.0	344.7	56.0	288.7	14.3	24.591	-1.529	7.28	50.9
40.0	267.5	70.7	196.8	10.3	23.272	-2.034	6.84	51.1
43.0	441.6	95.8	345.8	19.9	25.472	-1.469	7.62	50.5
43.0	441.6	95.8	345.8	19.9	25.472	-1.469	7.62	50.5
45.0	473.7	113.4	360.3	21.9	25.688	-1.553	7.72	50.4
45.0	473.7	113.4	360.3	21.9	25.688	-1.553	7.72	50.4
50.0	554.4	160.7	393.7	26.3	26.126	-1.928	7.90	50.3
55.0	606.2	212.5	393.7	29.4	26.343	-2.297	8.00	50.4
60.0	565.1	250.1	314.9	26.2	25.965	-1.805	7.87	49.5
70.0	1327.7	413.5	914.2	157.7	30.617	-5.795	9.40	58.1
73.0	1376.7	462.5	914.2	194.8	29.643	-6.155	9.43	58.0
76.0	1425.7	511.5	914.2	252.2	29.595	-6.219	9.45	57.8

Total Continuous Driving Time 72.00 minutes; Total Number of Blows 2856

California D.O.T. Geotechnical Services | Aug 31 2009

Br. 27-89 PILECO D46-42 CEP Analysis 1 | Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 | GRLWEAP(TM) Version 2005



California D.O.T. Geotechnical Services
Br. 27-89 DELMAG D62-42 CEP Analysis 1

Aug 31 2009
GRLWEAP(TM) Version 2005

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	7.1	3.5	3.5	0.0	0.000	0.000	11.25	0.0
17.0	162.5	18.1	144.4	4.1	22.914	-1.550	5.94	83.9
25.0	137.3	32.3	105.0	3.2	21.461	-2.759	5.58	87.8
32.0	376.2	48.1	328.1	11.8	28.772	0.000	7.88	71.4
35.0	344.7	56.0	288.7	10.3	28.047	0.000	7.65	72.9
35.0	344.7	56.0	288.7	9.9	28.342	-0.634	7.64	73.7
40.0	267.5	70.7	196.8	6.9	26.444	-1.397	7.02	76.5
43.0	441.6	95.8	345.8	13.6	29.575	-0.360	8.11	71.5
45.0	473.7	113.4	360.2	14.9	29.916	-0.435	8.25	71.2
45.0	473.7	113.4	360.2	14.9	29.916	-0.435	8.25	71.2
50.0	554.4	160.7	393.7	18.4	30.723	-0.199	8.56	70.4
55.0	606.2	212.5	393.7	20.7	31.031	-0.118	8.71	70.0
60.0	565.1	250.1	314.9	18.6	30.618	-0.456	8.58	70.0
70.0	1327.7	413.5	914.2	86.7	37.733	-3.274	10.63	81.3
73.0	1376.7	462.5	914.2	100.5	35.798	-3.052	10.67	80.8
76.0	1425.7	511.5	914.2	117.4	35.818	-2.844	10.72	80.6

Total Continuous Driving Time 43.00 minutes; Total Number of Blows 1649

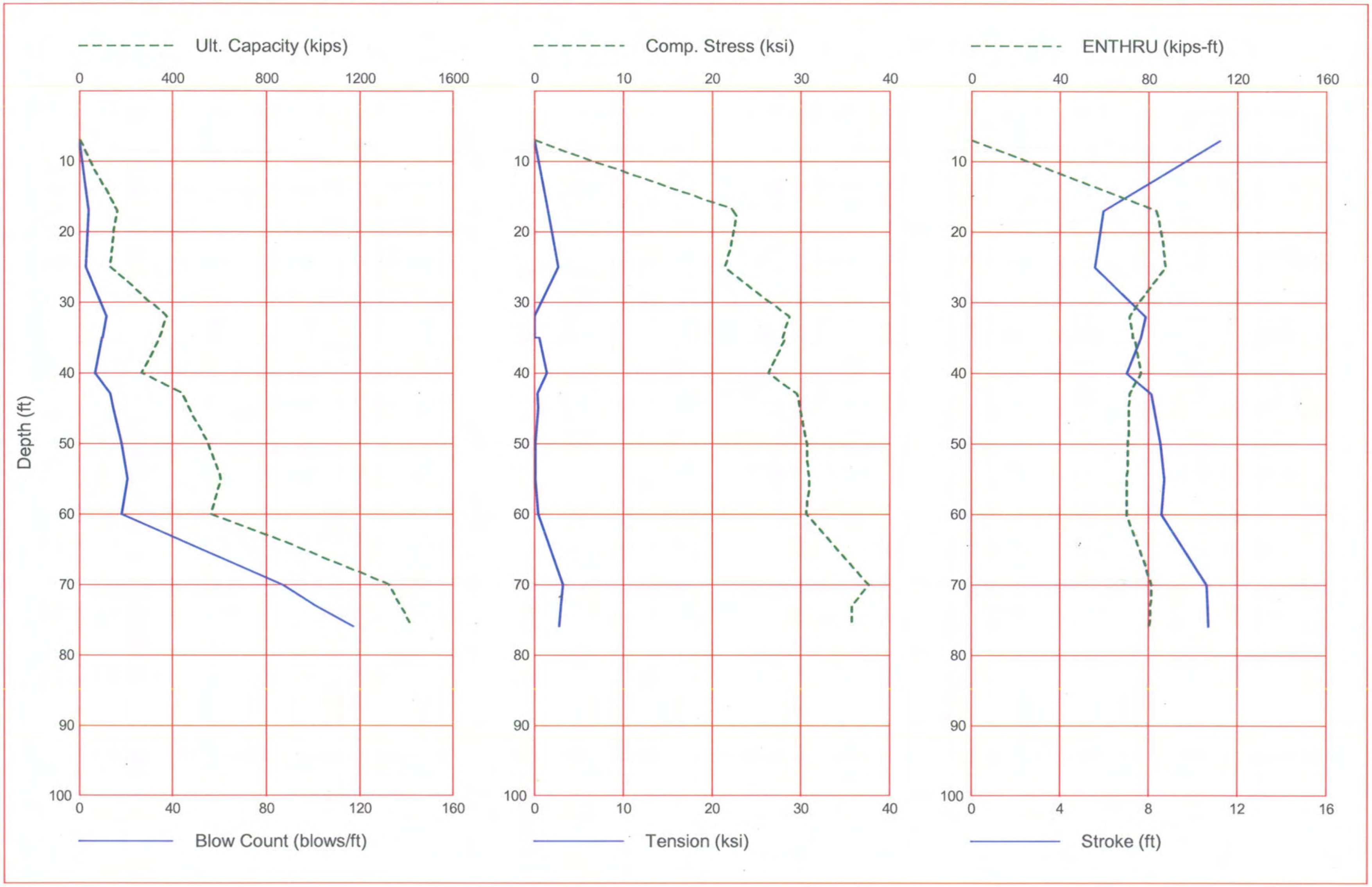
California D.O.T. Geotechnical Services

Aug 31 2009

Br. 27-89 DELMAG D62-42 CEP Analysis 1

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



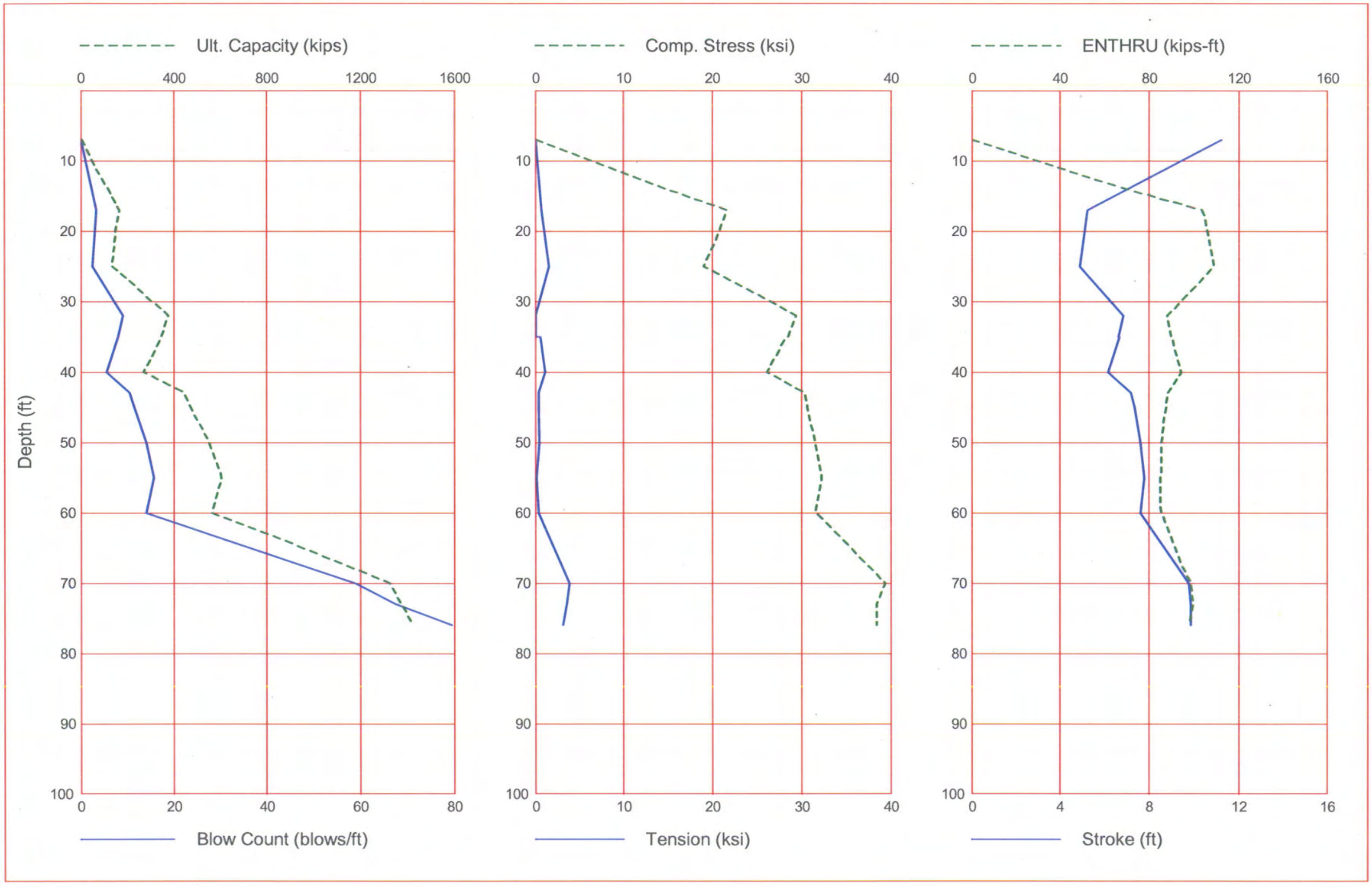
Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	7.1	3.5	3.5	0.0	0.000	0.000	11.25	0.0
17.0	162.5	18.1	144.4	3.3	21.657	-0.679	5.24	104.4
25.0	137.3	32.3	105.0	2.6	19.059	-1.566	4.89	108.9
32.0	376.2	48.1	328.1	9.1	29.392	0.000	6.86	87.9
35.0	344.7	56.0	288.7	8.0	28.500	-0.009	6.64	89.6
35.0	344.7	56.0	288.7	7.9	28.346	-0.597	6.69	90.3
40.0	267.5	70.7	196.8	5.5	26.210	-1.094	6.15	94.3
43.0	441.6	95.8	345.8	10.4	30.325	-0.397	7.21	88.4
45.0	473.7	113.4	360.2	11.4	30.703	-0.404	7.34	87.6
45.0	473.7	113.4	360.2	11.4	30.703	-0.404	7.34	87.6
50.0	554.4	160.7	393.7	14.1	31.631	-0.496	7.61	85.7
55.0	606.2	212.5	393.7	15.7	32.221	-0.207	7.77	85.3
60.0	565.1	250.1	314.9	14.0	31.633	-0.409	7.60	85.5
70.0	1327.7	413.5	914.2	59.1	39.430	-3.933	9.79	98.8
73.0	1376.7	462.5	914.2	67.5	38.503	-3.616	9.88	99.5
76.0	1425.7	511.5	914.2	79.5	38.435	-3.162	9.86	98.5

Total Continuous Driving Time 29.00 minutes; Total Number of Blows 1174

California D.O.T. Geotechnical Services | | Aug 31 2009

Br. 27-89 APE D80-42 CEP Analysis 1 | Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 | GRLWEAP(TM) Version 2005



APPENDIX D

DRIVEABILITY ANALYSIS CHARTS

FOR

OPEN-ENDED PILE CONDITION

2^{ND} ANALYSIS

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	4.0	3.5	0.4	0.0	0.000	0.000	11.25	0.0
17.0	35.6	18.1	17.5	1.8	10.558	-1.885	4.52	44.2
25.0	45.0	32.3	12.7	1.8	11.847	-2.753	4.69	46.2
32.0	87.8	48.1	39.7	3.0	15.446	-3.528	5.32	48.1
35.0	91.0	56.0	35.0	3.1	15.526	-3.740	5.33	48.0
35.0	91.0	56.0	35.0	3.1	17.238	-6.890	5.83	45.1
43.0	137.6	95.8	41.9	5.1	18.502	-5.987	6.16	42.9
43.0	137.6	95.8	41.9	5.1	18.502	-5.987	6.16	42.9
45.0	157.0	113.4	43.6	6.0	18.935	-5.589	6.28	41.9
45.0	157.0	113.4	43.6	6.0	18.935	-5.589	6.28	41.9
50.0	208.4	160.7	47.7	8.6	19.826	-4.371	6.58	40.1
55.0	260.2	212.5	47.7	11.5	20.632	-3.191	6.86	39.1
60.0	288.3	250.1	38.1	12.7	20.931	-3.514	6.97	38.8
70.0	496.0	400.9	95.1	29.6	22.873	-1.639	7.78	36.8
73.0	541.2	446.1	95.1	33.8	23.105	-1.349	7.90	36.9
76.0	586.5	491.4	95.1	38.7	23.362	-0.823	8.02	36.9

Total Continuous Driving Time 15.00 minutes; Total Number of Blows 656

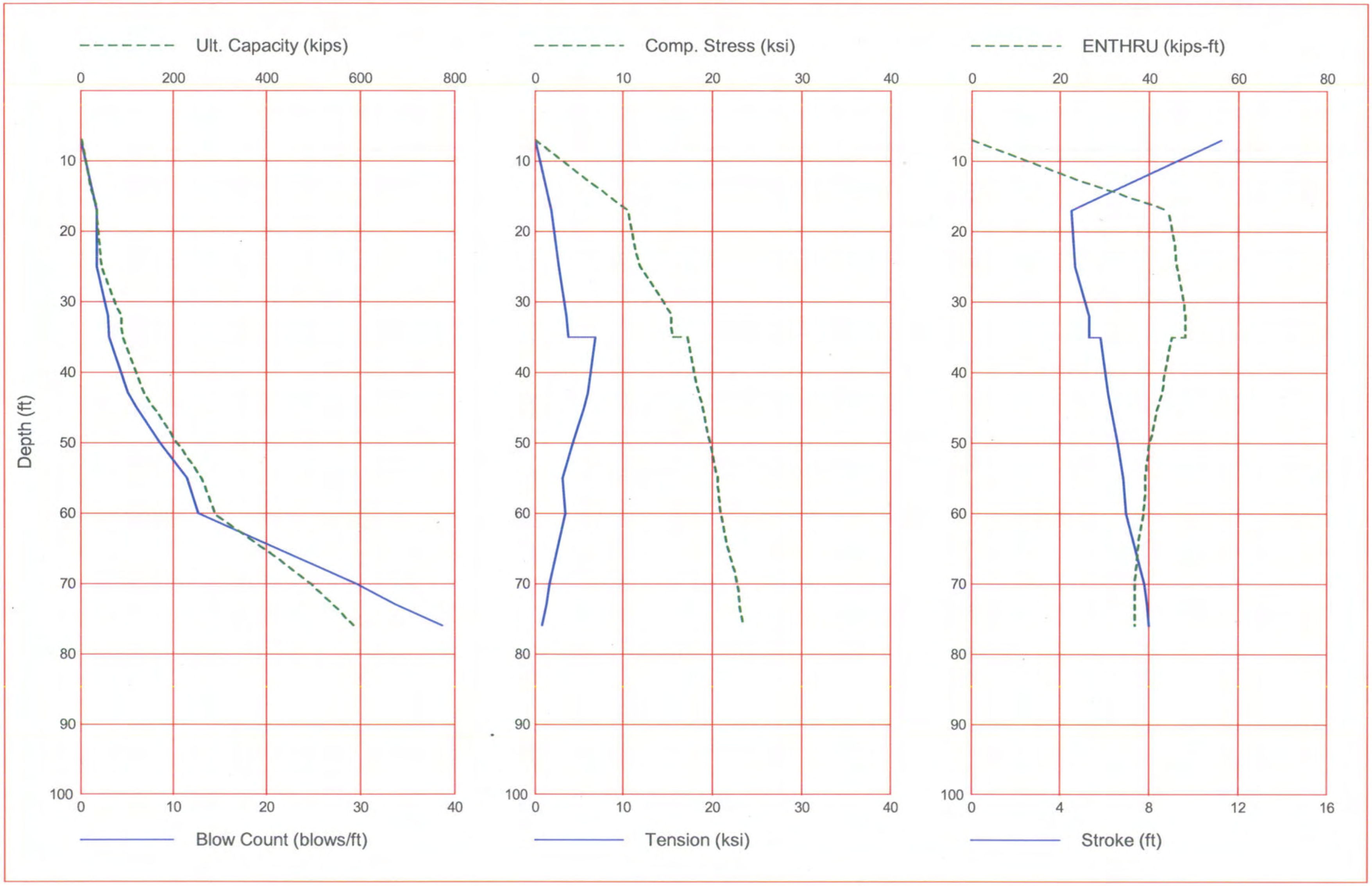
California D.O.T. Geotechnical Services

Aug 31 2009

Br. 27-89 APE D36-42 OE Pipe Analysis 2

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	4.0	3.5	0.4	0.0	0.000	0.000	11.25	0.0
17.0	35.6	18.1	17.5	1.2	9.285	-1.502	4.07	65.1
25.0	45.0	32.3	12.7	1.3	10.952	-1.891	4.21	65.0
32.0	87.8	48.1	39.7	2.4	16.025	-3.505	4.93	63.5
35.0	91.0	56.0	35.0	2.4	16.173	-3.770	4.93	63.4
35.0	91.0	56.0	35.0	2.3	18.215	-7.088	5.43	61.5
40.0	94.5	70.7	23.8	2.3	18.247	-7.414	5.43	61.7
43.0	137.6	95.8	41.9	3.9	19.949	-6.541	5.83	56.6
45.0	157.0	113.4	43.6	4.6	20.521	-6.173	5.99	55.4
45.0	157.0	113.4	43.6	4.6	20.521	-6.173	5.99	55.4
50.0	208.4	160.7	47.7	6.7	21.730	-5.111	6.36	53.3
55.0	260.2	212.5	47.7	8.9	22.658	-3.856	6.68	51.6
60.0	288.3	250.1	38.1	9.7	23.032	-4.039	6.82	50.9
70.0	496.0	400.9	95.1	23.7	25.583	-1.360	7.84	48.4
73.0	541.2	446.1	95.1	26.6	25.855	-0.534	7.97	47.8
76.0	586.5	491.4	95.1	29.9	26.149	-0.256	8.09	47.9

Total Continuous Driving Time 11.00 minutes; Total Number of Blows 505

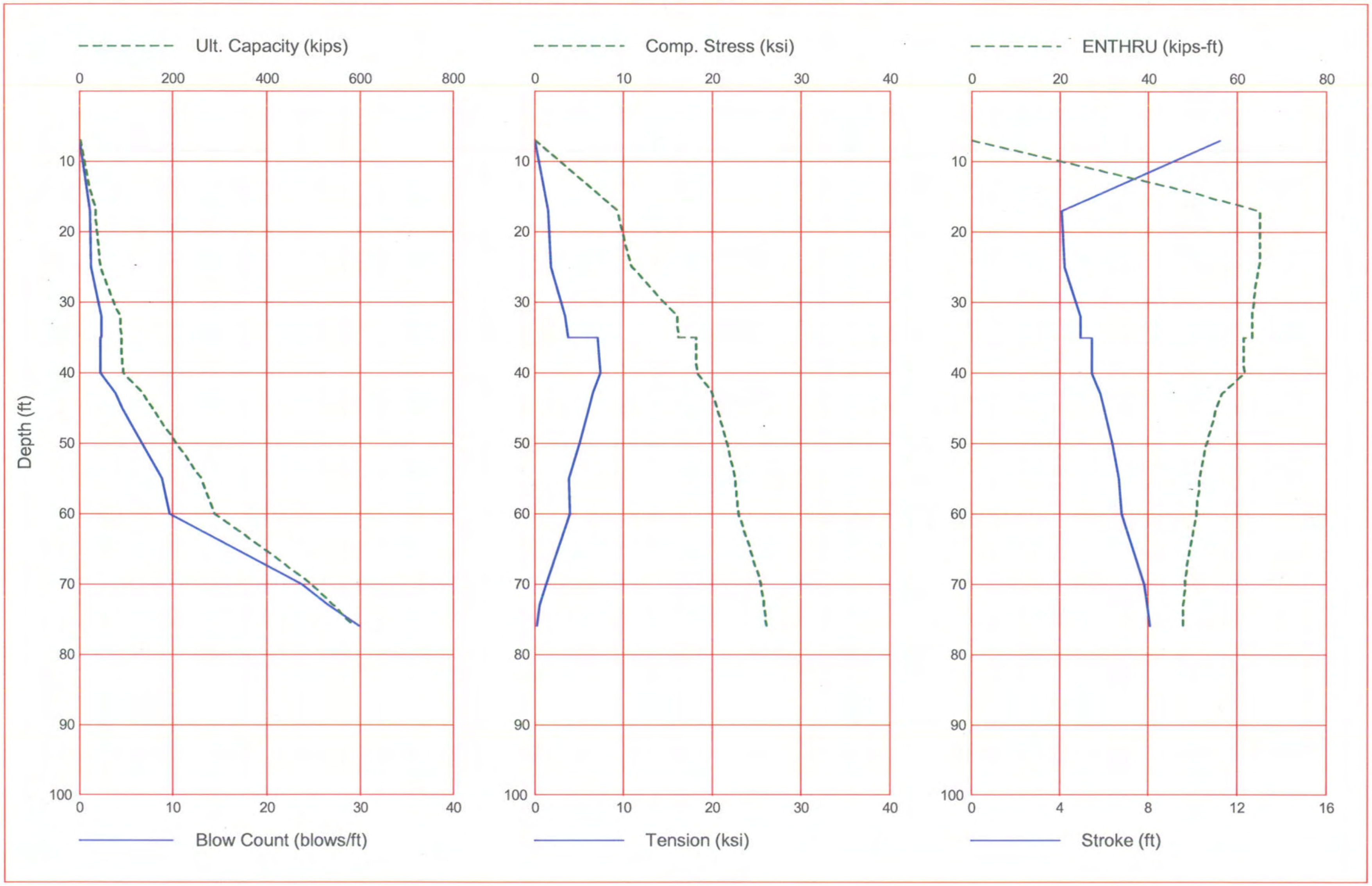
California D.O.T. Geotechnical Services

Aug 31 2009

Br. 27-89 PILECO D46-42 OEP Analysis 2

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



California D.O.T. Geotechnical Services
Br. 27-89 DELMAG D62-42 OEP Analysis 2

Aug 31 2009
GRLWEAP(TM) Version 2005

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	4.0	3.5	0.4	0.0	0.000	0.000	11.16	0.0
17.0	35.6	18.1	17.5	-1.0	0.000	0.000	0.00	0.0
25.0	45.0	32.3	12.7	-1.0	0.000	0.000	0.00	0.0
32.0	87.8	48.1	39.7	1.8	15.707	-2.892	4.41	86.5
35.0	91.0	56.0	35.0	1.8	15.875	-3.078	4.42	86.4
35.0	91.0	56.0	35.0	1.7	17.862	-5.990	4.80	83.8
40.0	94.5	70.7	23.8	1.7	17.883	-6.278	4.79	83.9
43.0	137.6	95.8	41.9	2.9	20.529	-6.089	5.30	76.4
45.0	157.0	113.4	43.6	3.4	21.438	-5.851	5.52	74.9
45.0	157.0	113.4	43.6	3.4	21.438	-5.851	5.52	74.9
50.0	208.4	160.7	47.7	5.0	22.803	-4.734	5.88	69.7
55.0	260.2	212.5	47.7	6.7	24.131	-3.699	6.28	67.0
60.0	288.3	250.1	38.1	7.4	24.599	-3.878	6.43	66.0
70.0	496.0	400.9	95.1	19.1	28.246	-0.177	7.74	60.1
73.0	541.2	446.1	95.1	22.3	28.837	0.000	7.96	59.3
76.0	586.5	491.4	95.1	24.8	29.109	0.000	8.07	58.2

Total Continuous Driving Time 9.00 minutes; Total Number of Blows 384

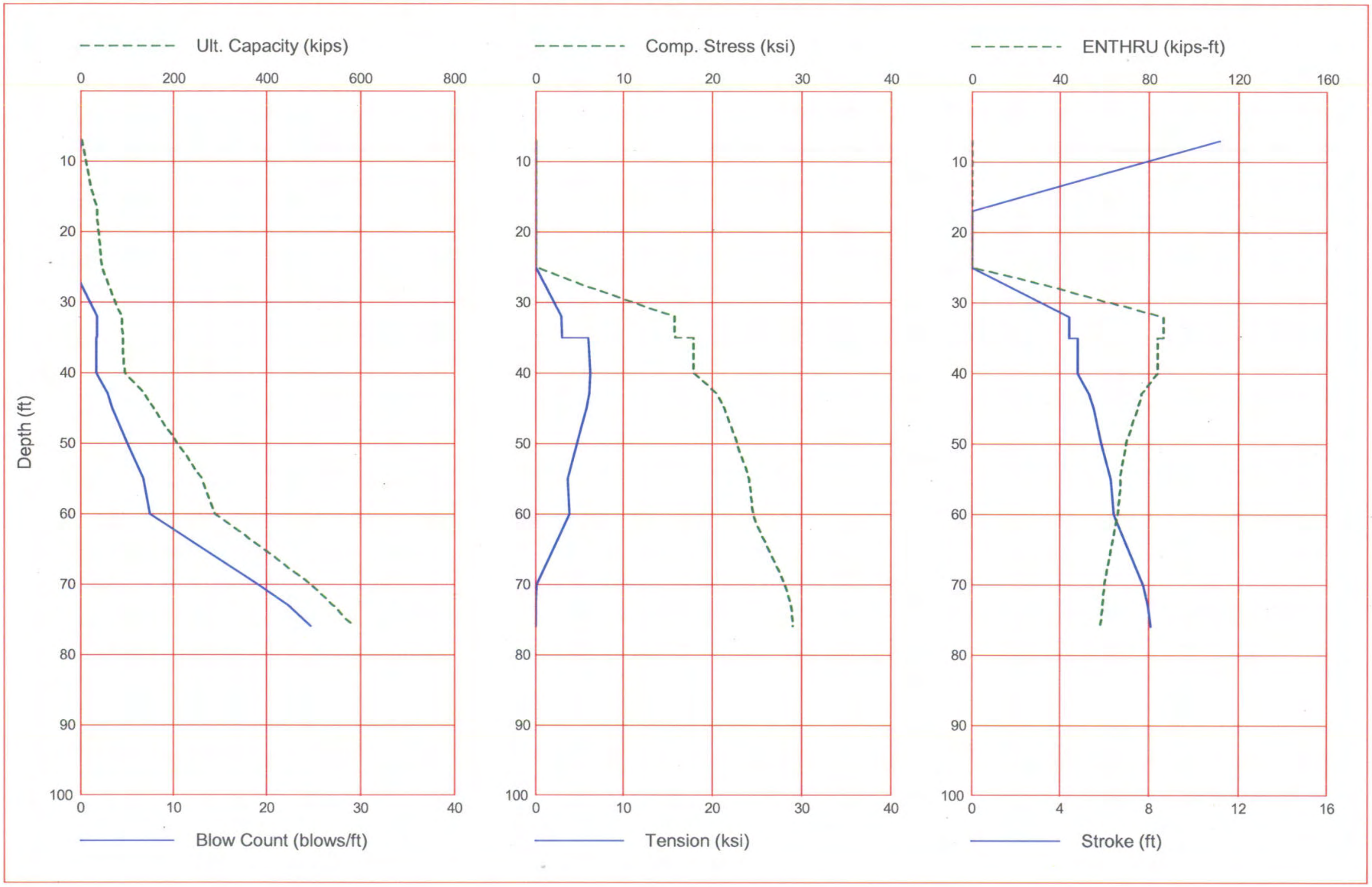
California D.O.T. Geotechnical Services

Aug 31 2009

Br. 27-89 DELMAG D62-42 OEP Analysis 2

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



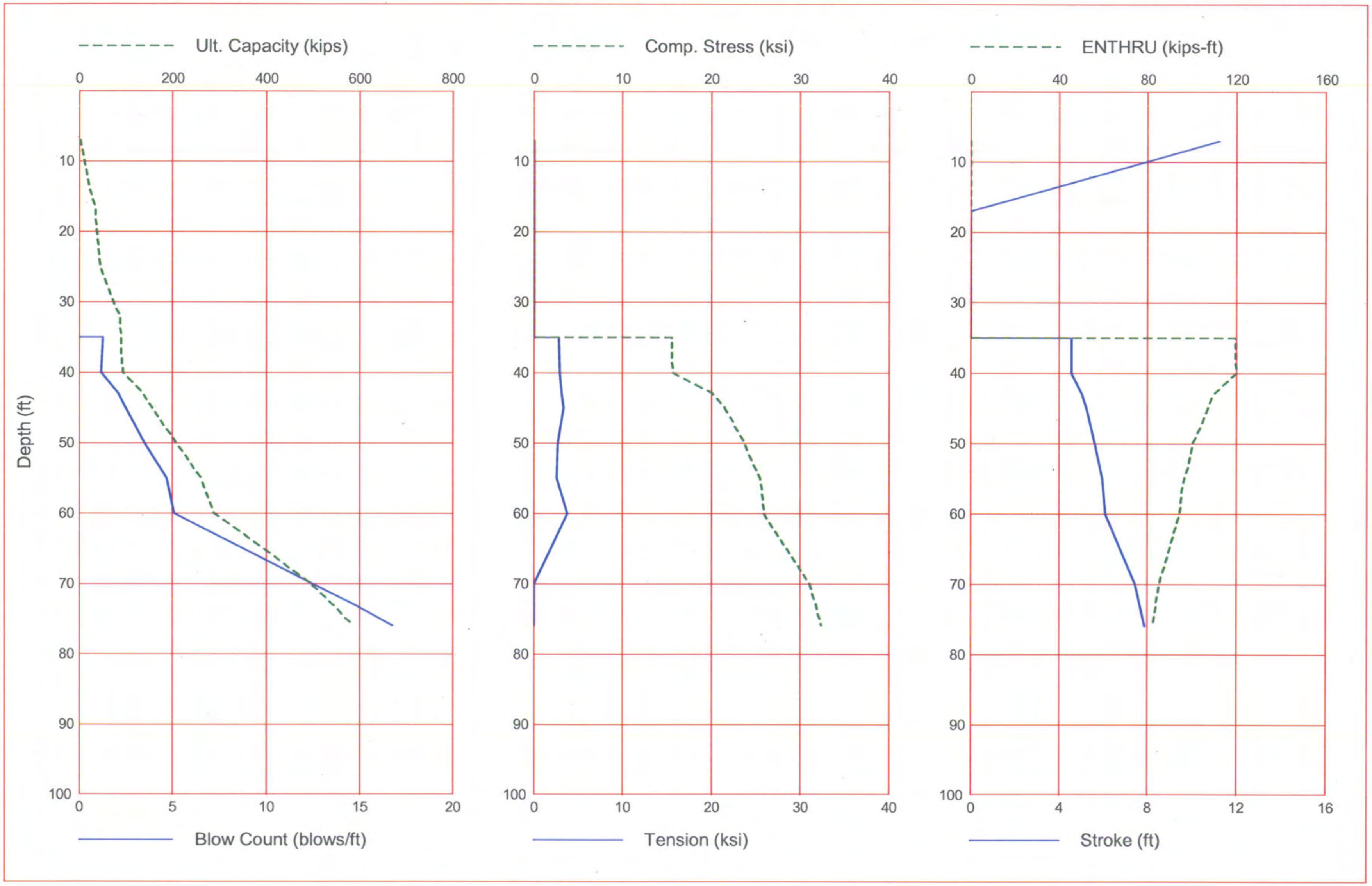
Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	4.0	3.5	0.4	0.0	0.000	0.000	11.25	0.0
17.0	35.6	18.1	17.5	-1.0	0.000	0.000	0.00	0.0
25.0	45.0	32.3	12.7	-1.0	0.000	0.000	0.00	0.0
32.0	87.8	48.1	39.7	-1.0	0.000	0.000	0.00	0.0
35.0	91.0	56.0	35.0	-1.0	0.000	0.000	0.00	0.0
35.0	91.0	56.0	35.0	1.3	15.536	-2.811	4.54	119.7
40.0	94.5	70.7	23.8	1.2	15.677	-2.970	4.54	120.3
43.0	137.6	95.8	41.9	2.1	20.101	-3.183	5.01	110.0
45.0	157.0	113.4	43.6	2.5	21.442	-3.319	5.21	107.1
45.0	157.0	113.4	43.6	2.5	21.442	-3.319	5.21	107.1
50.0	208.4	160.7	47.7	3.5	23.771	-2.729	5.60	100.5
55.0	260.2	212.5	47.7	4.7	25.557	-2.574	5.97	96.5
60.0	288.3	250.1	38.1	5.1	25.993	-3.795	6.07	94.5
70.0	496.0	400.9	95.1	12.5	31.129	-0.022	7.45	85.1
73.0	541.2	446.1	95.1	14.7	31.838	0.000	7.66	83.8
76.0	586.5	491.4	95.1	16.8	32.439	0.000	7.86	82.6

Total Continuous Driving Time 6.00 minutes; Total Number of Blows 252

California D.O.T. Geotechnical Services Aug 31 2009

Br. 27-89 APE D80-42 OEP Analysis 2 Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 GRLWEAP(TM) Version 2005



APPENDIX E

DRIVEABILITY ANALYSIS CHARTS

FOR

CLOSED-ENDED PILE CONDITION

2ND ANALYSIS

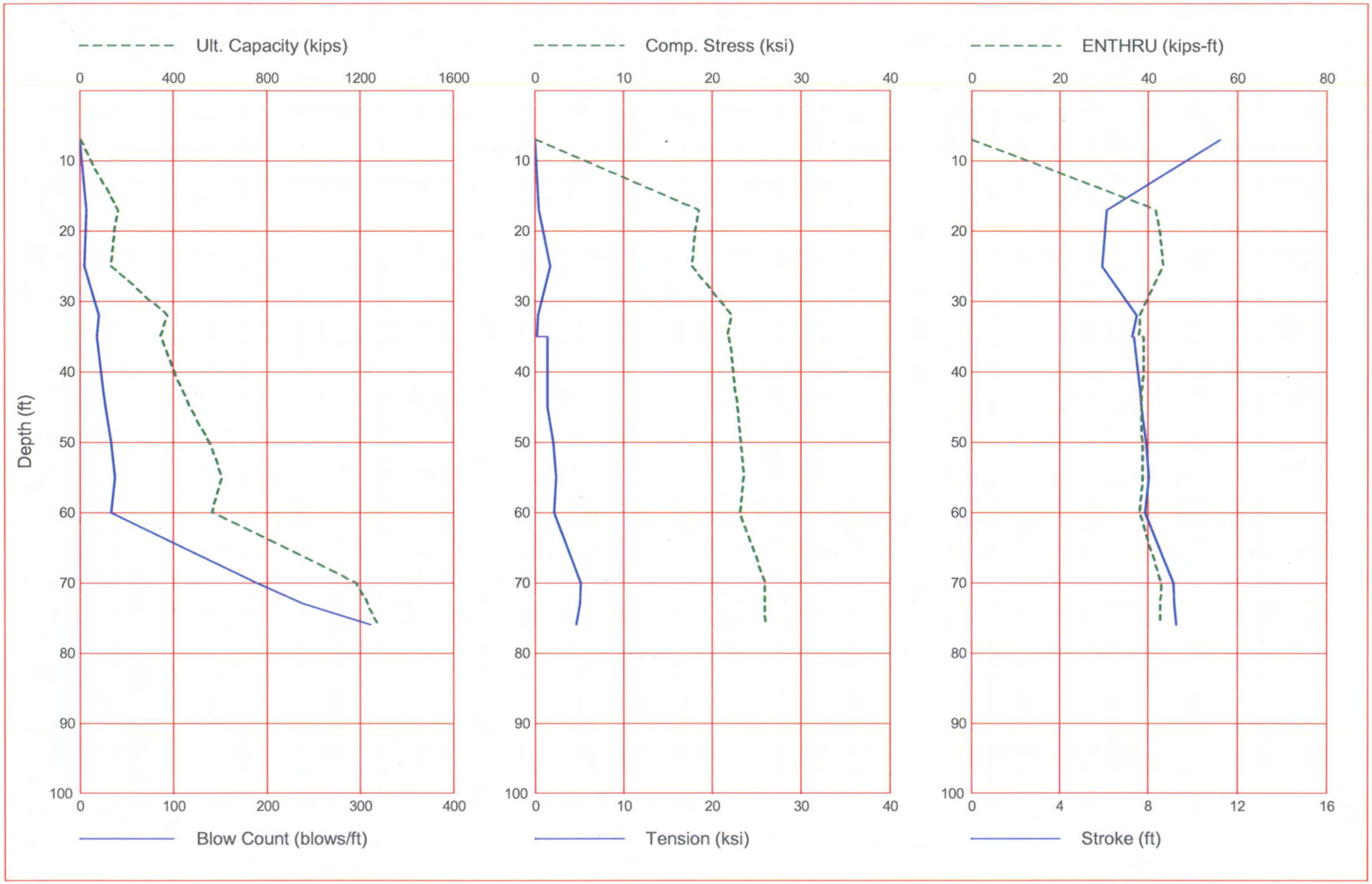
Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	7.1	3.5	3.5	0.0	0.000	0.000	11.25	0.0
17.0	162.5	18.1	144.4	7.7	18.542	-0.464	6.13	41.8
25.0	137.3	32.3	105.0	5.9	17.739	-1.708	5.92	43.5
32.0	376.2	48.1	328.1	21.0	22.291	-0.402	7.50	38.0
35.0	344.7	56.0	288.7	18.8	21.688	-0.278	7.27	37.9
35.0	344.7	56.0	288.7	18.6	21.962	-1.476	7.34	39.0
43.0	441.6	95.8	345.8	25.7	22.713	-1.408	7.64	38.6
43.0	441.6	95.8	345.8	25.7	22.713	-1.408	7.64	38.6
45.0	473.7	113.4	360.2	27.7	22.899	-1.462	7.72	38.5
45.0	473.7	113.4	360.2	27.7	22.899	-1.462	7.72	38.5
50.0	554.4	160.7	393.7	33.5	23.344	-2.109	7.92	38.7
55.0	606.2	212.5	393.7	37.8	23.637	-2.392	8.04	38.8
60.0	565.1	250.1	314.9	33.6	23.189	-2.214	7.88	38.0
70.0	1186.3	400.9	785.4	188.9	25.975	-5.193	9.15	43.0
73.0	1231.5	446.1	785.4	238.0	26.001	-5.043	9.20	42.8
76.0	1276.8	491.4	785.4	311.5	26.073	-4.613	9.26	42.7

Total Continuous Driving Time 88.00 minutes; Total Number of Blows 3561

California D.O.T. Geotechnical Services | Aug 31 2009

Br. 27-89 APE D36-42 CE Pipe Analysis 2 | Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 | GRLWEAP(TM) Version 2005



California D.O.T. Geotechnical Services
Br. 27-89 PILECO D46-42 CEP Analysis 2

Aug 31 2009
GRLWEAP(TM) Version 2005

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	7.1	3.5	3.5	0.0	0.000	0.000	11.25	0.0
17.0	162.5	18.1	144.4	5.8	21.447	-4.758	6.27	54.1
25.0	137.3	32.3	105.0	4.5	20.667	-6.035	6.05	55.6
32.0	376.2	48.1	328.1	16.3	24.961	-1.474	7.41	50.7
35.0	344.7	56.0	288.7	14.3	24.591	-1.529	7.28	50.9
40.0	267.5	70.7	196.8	10.3	23.272	-2.034	6.84	51.1
43.0	441.6	95.8	345.8	19.9	25.472	-1.469	7.62	50.5
43.0	441.6	95.8	345.8	19.9	25.472	-1.469	7.62	50.5
45.0	473.7	113.4	360.3	21.9	25.688	-1.553	7.72	50.4
45.0	473.7	113.4	360.3	21.9	25.688	-1.553	7.72	50.4
50.0	554.4	160.7	393.7	26.3	26.126	-1.928	7.90	50.3
55.0	606.2	212.5	393.7	29.4	26.343	-2.297	8.00	50.4
60.0	565.1	250.1	314.9	26.2	25.965	-1.805	7.87	49.5
70.0	1186.3	400.9	785.4	110.8	29.037	-5.315	9.21	56.8
73.0	1231.5	446.1	785.4	130.1	29.100	-5.530	9.25	56.7
76.0	1276.8	491.4	785.4	155.8	29.126	-5.599	9.28	56.6

Total Continuous Driving Time 55.00 minutes; Total Number of Blows 2212

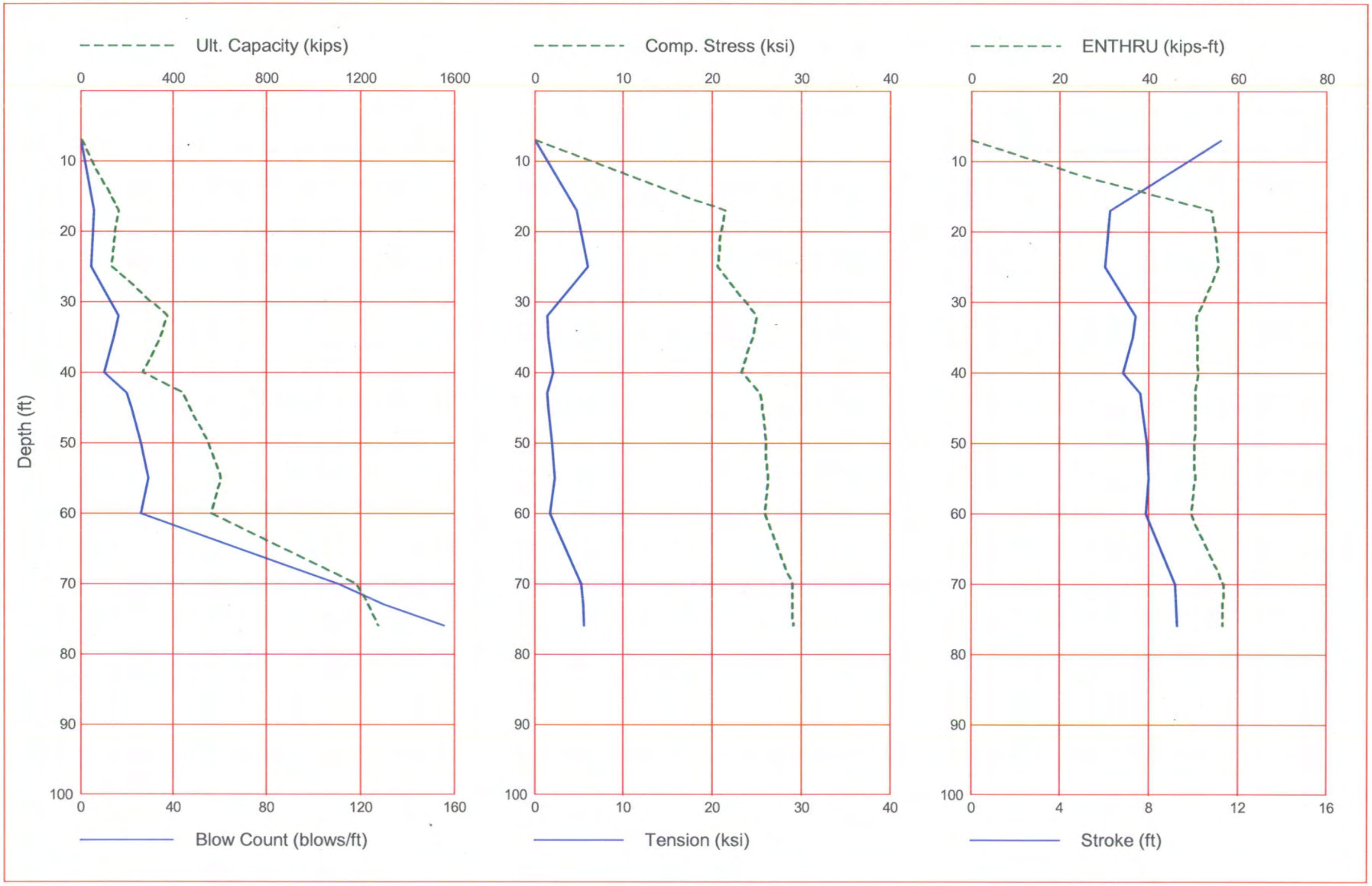
California D.O.T. Geotechnical Services

Aug 31 2009

Br. 27-89 PILECO D46-42 CEP Analysis 2

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	7.1	3.5	3.5	0.0	0.000	0.000	11.25	0.0
17.0	162.5	18.1	144.4	4.1	22.914	-1.550	5.94	83.9
25.0	137.3	32.3	105.0	3.2	21.461	-2.759	5.58	87.8
32.0	376.2	48.1	328.1	11.8	28.772	0.000	7.88	71.4
35.0	344.7	56.0	288.7	10.3	28.047	0.000	7.65	72.9
35.0	344.7	56.0	288.7	9.9	28.342	-0.634	7.64	73.7
40.0	267.5	70.7	196.8	6.9	26.444	-1.397	7.02	76.5
43.0	441.6	95.8	345.8	13.6	29.575	-0.360	8.11	71.5
45.0	473.7	113.4	360.2	14.9	29.916	-0.435	8.25	71.2
45.0	473.7	113.4	360.2	14.9	29.916	-0.435	8.25	71.2
50.0	554.4	160.7	393.7	18.4	30.723	-0.199	8.56	70.4
55.0	606.2	212.5	393.7	20.7	31.031	-0.118	8.71	70.0
60.0	565.1	250.1	314.9	18.6	30.618	-0.456	8.58	70.0
70.0	1186.3	400.9	785.4	67.1	35.382	-2.848	10.38	79.1
73.0	1231.5	446.1	785.4	75.6	35.188	-2.416	10.44	78.9
76.0	1276.8	491.4	785.4	85.7	35.212	-2.280	10.48	78.7

Total Continuous Driving Time 36.00 minutes; Total Number of Blows 1399

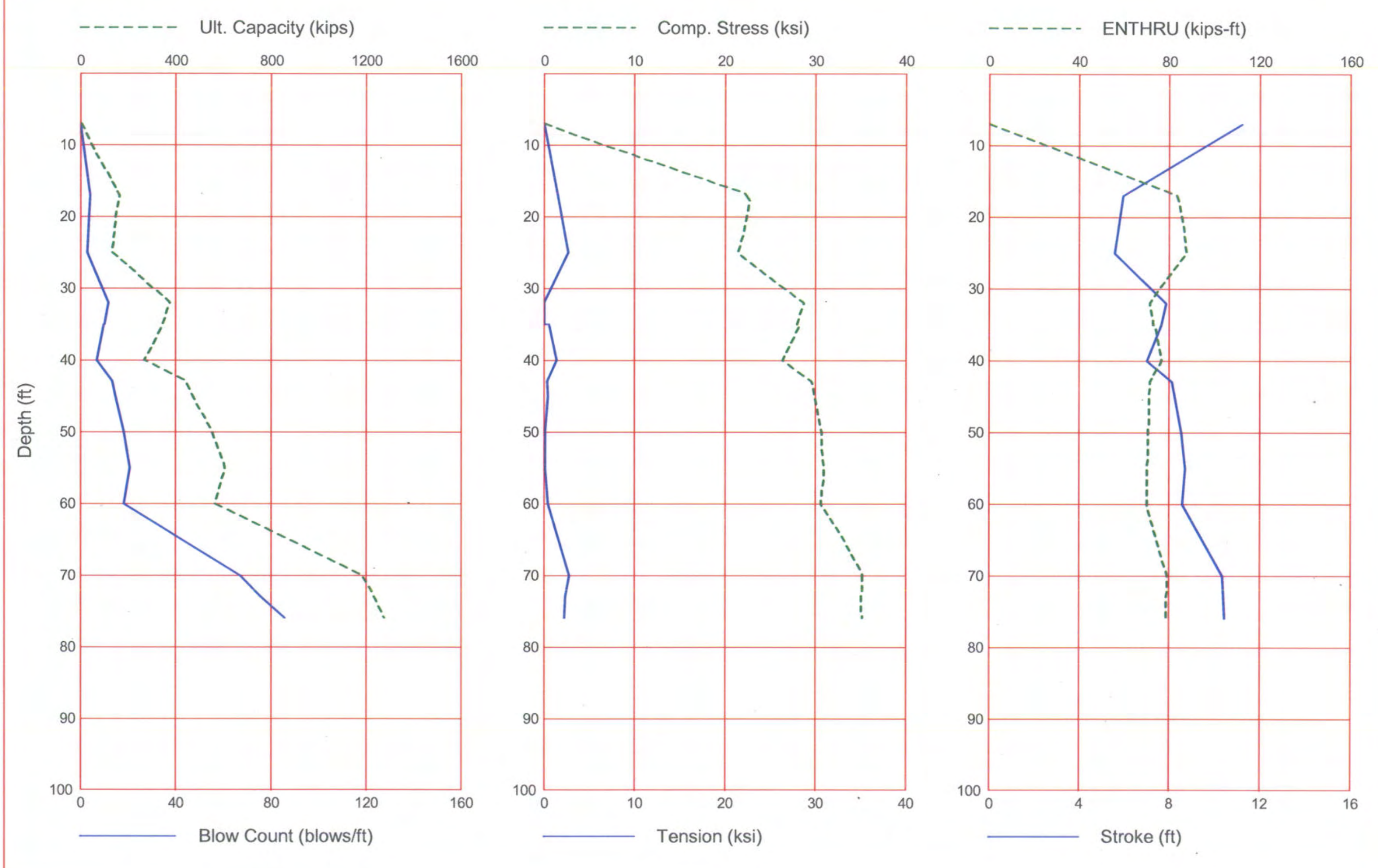
California D.O.T. Geotechnical Services

Aug 31 2009

Br. 27-89 DELMAG D62-42 CEP Analysis 2

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



California D.O.T. Geotechnical Services
Br. 27-89 APE D80-42 CEP Analysis 2

Aug 31 2009
GRLWEAP(TM) Version 2005

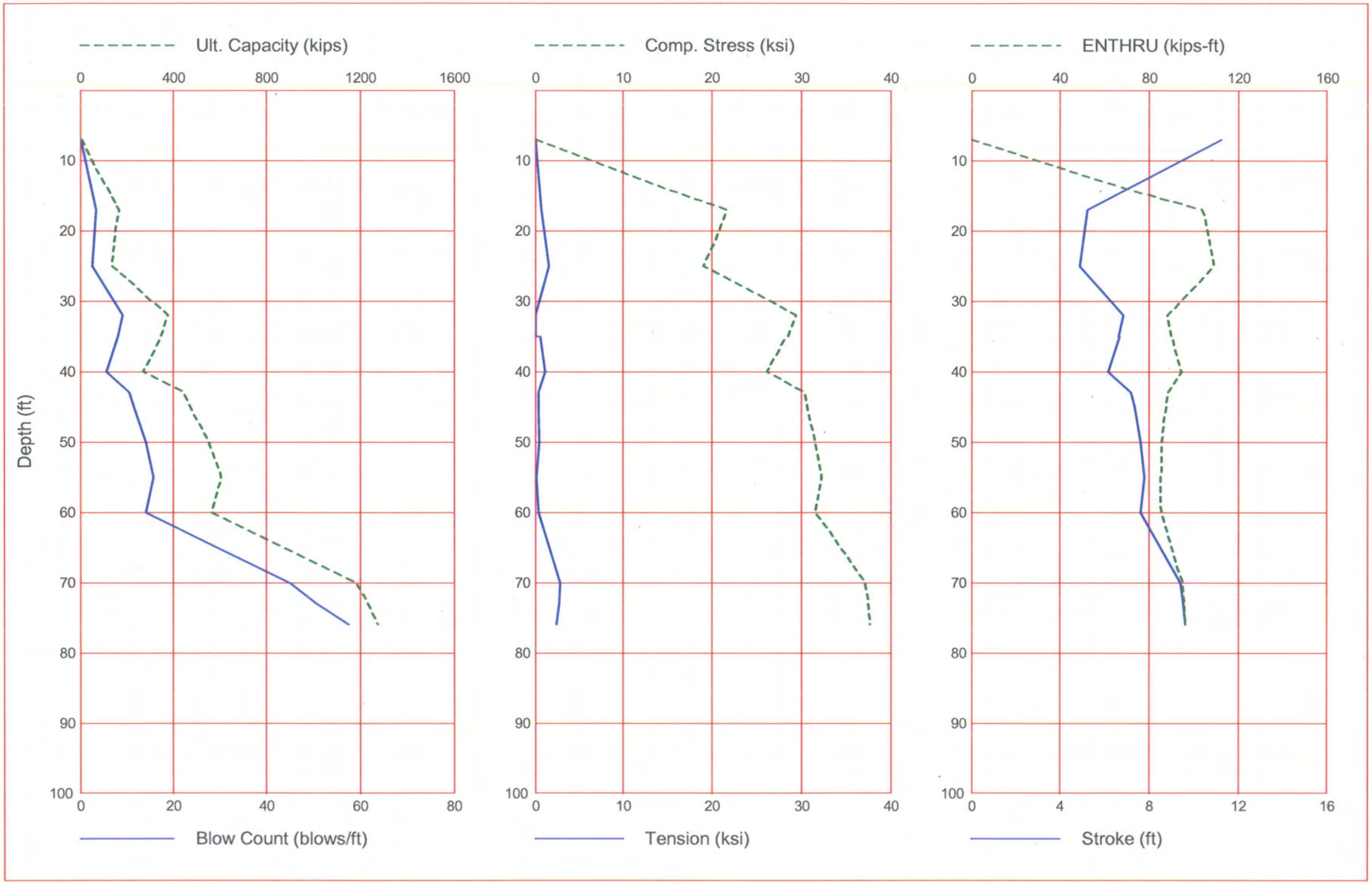
Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	7.1	3.5	3.5	0.0	0.000	0.000	11.25	0.0
17.0	162.5	18.1	144.4	3.3	21.657	-0.679	5.24	104.4
25.0	137.3	32.3	105.0	2.6	19.059	-1.566	4.89	108.9
32.0	376.2	48.1	328.1	9.1	29.392	0.000	6.86	87.9
35.0	344.7	56.0	288.7	8.0	28.500	-0.009	6.64	89.6
35.0	344.7	56.0	288.7	7.9	28.346	-0.597	6.69	90.3
40.0	267.5	70.7	196.8	5.5	26.210	-1.094	6.15	94.3
43.0	441.6	95.8	345.8	10.4	30.325	-0.397	7.21	88.4
45.0	473.7	113.4	360.2	11.4	30.703	-0.404	7.34	87.6
45.0	473.7	113.4	360.2	11.4	30.703	-0.404	7.34	87.6
50.0	554.4	160.7	393.7	14.1	31.631	-0.496	7.61	85.7
55.0	606.2	212.5	393.7	15.7	32.221	-0.207	7.77	85.3
60.0	565.1	250.1	314.9	14.0	31.633	-0.409	7.60	85.5
70.0	1186.3	400.9	785.4	45.1	37.208	-2.825	9.41	95.0
73.0	1231.5	446.1	785.4	50.8	37.473	-2.696	9.52	95.8
76.0	1276.8	491.4	785.4	57.7	37.703	-2.380	9.63	96.1

Total Continuous Driving Time 25.00 minutes; Total Number of Blows 1000

California D.O.T. Geotechnical Services — Aug 31 2009

Br. 27-89 APE D80-42 CEP Analysis 2 — Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 — GRLWEAP(TM) Version 2005



APPENDIX F

DRIVEABILITY ANALYSIS CHARTS
FOR
OPEN-ENDED PILE CONDITION

3RD ANALYSIS

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	4.0	3.5	0.4	0.0	0.000	0.000	11.25	0.0
17.0	35.6	18.1	17.5	1.8	10.558	-1.885	4.52	44.2
25.0	45.0	32.3	12.7	1.8	11.847	-2.753	4.69	46.2
32.0	87.8	48.1	39.7	3.0	15.446	-3.528	5.32	48.1
35.0	91.0	56.0	35.0	3.1	15.526	-3.740	5.33	48.0
35.0	91.0	56.0	35.0	3.1	17.238	-6.890	5.83	45.1
43.0	137.6	95.8	41.9	5.1	18.502	-5.987	6.16	42.9
43.0	137.6	95.8	41.9	5.1	18.502	-5.987	6.16	42.9
45.0	157.0	113.4	43.6	6.0	18.935	-5.589	6.28	41.9
45.0	157.0	113.4	43.6	6.0	18.935	-5.589	6.28	41.9
50.0	208.4	160.7	47.7	8.6	19.826	-4.371	6.58	40.1
55.0	260.2	212.5	47.7	11.5	20.632	-3.191	6.86	39.1
60.0	288.3	250.1	38.1	12.7	20.931	-3.514	6.97	38.8
70.0	451.9	375.8	76.1	26.2	22.623	-1.501	7.66	37.1
73.0	489.5	413.5	76.1	29.3	22.814	-1.650	7.77	36.5
76.0	527.2	451.2	76.1	32.6	23.055	-1.252	7.89	36.6

Total Continuous Driving Time 14.00 minutes; Total Number of Blows 610

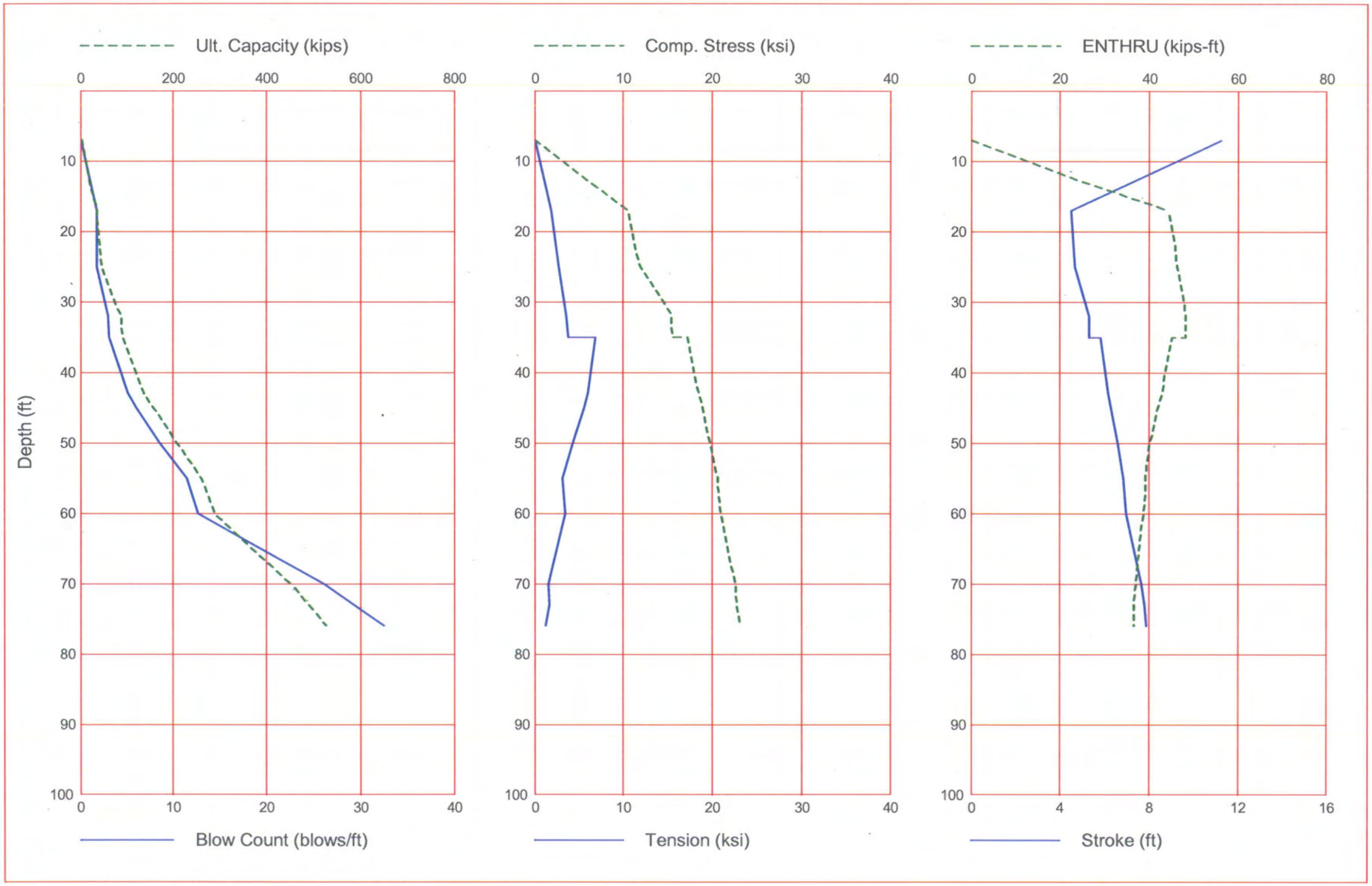
California D.O.T. Geotechnical Services

Aug 31 2009

Br. 27-89 APE D36-42 OE Pipe Analysis 3

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	4.0	3.5	0.4	0.0	0.000	0.000	11.25	0.0
17.0	35.6	18.1	17.5	1.2	9.285	-1.502	4.07	65.1
25.0	45.0	32.3	12.7	1.3	10.952	-1.891	4.21	65.0
32.0	87.8	48.1	39.7	2.4	16.025	-3.505	4.93	63.5
35.0	91.0	56.0	35.0	2.4	16.173	-3.770	4.93	63.4
35.0	91.0	56.0	35.0	2.3	18.215	-7.088	5.43	61.5
40.0	94.5	70.7	23.8	2.3	18.247	-7.414	5.43	61.7
43.0	137.6	95.8	41.9	3.9	19.949	-6.541	5.83	56.6
45.0	157.0	113.4	43.6	4.6	20.521	-6.173	5.99	55.4
45.0	157.0	113.4	43.6	4.6	20.521	-6.173	5.99	55.4
50.0	208.4	160.7	47.7	6.7	21.730	-5.111	6.36	53.3
55.0	260.2	212.5	47.7	8.9	22.658	-3.856	6.68	51.6
60.0	288.3	250.1	38.1	9.7	23.032	-4.039	6.82	50.9
70.0	451.9	375.8	76.1	21.0	25.230	-2.123	7.69	48.8
73.0	489.5	413.5	76.1	23.5	25.540	-1.543	7.84	48.2
76.0	527.2	451.2	76.1	25.9	25.756	-0.891	7.94	47.4

Total Continuous Driving Time 11.00 minutes; Total Number of Blows 472

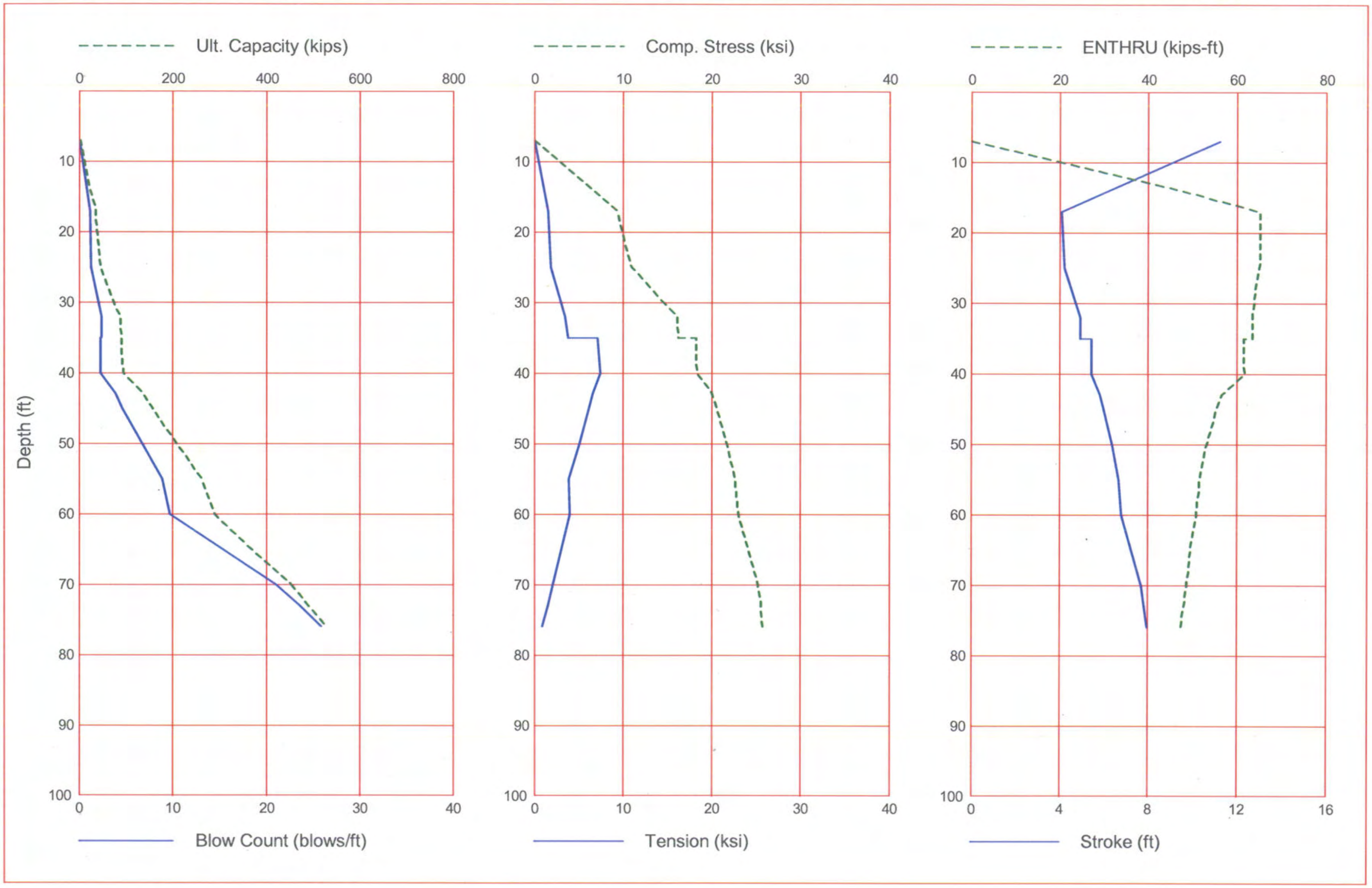
California D.O.T. Geotechnical Services

Aug 31 2009

Br. 27-89 PILECO D46-42 OEP Analysis 3

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



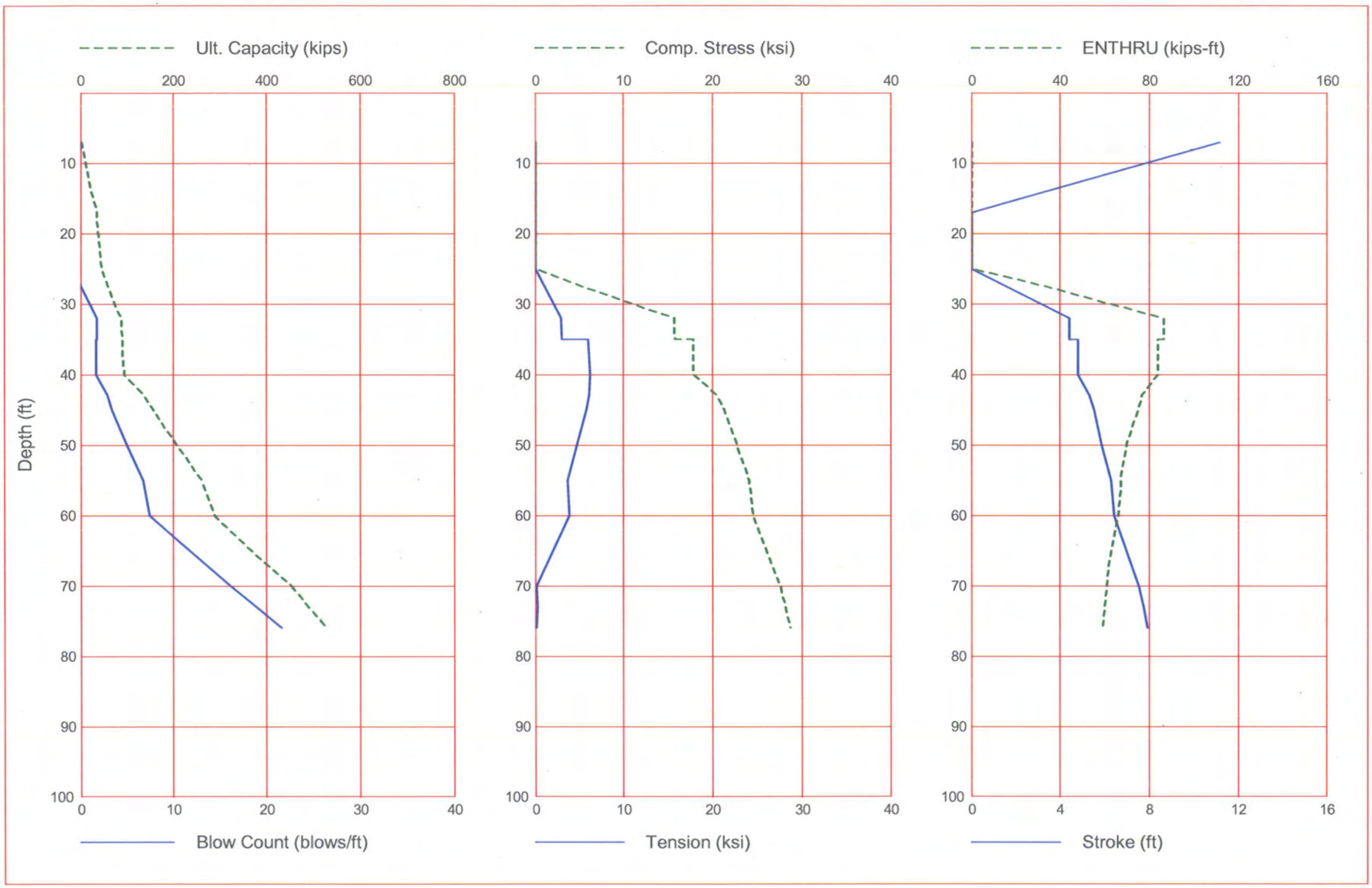
Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	4.0	3.5	0.4	0.0	0.000	0.000	11.16	0.0
17.0	35.6	18.1	17.5	-1.0	0.000	0.000	0.00	0.0
25.0	45.0	32.3	12.7	-1.0	0.000	0.000	0.00	0.0
32.0	87.8	48.1	39.7	1.8	15.707	-2.892	4.41	86.5
35.0	91.0	56.0	35.0	1.8	15.875	-3.078	4.42	86.4
35.0	91.0	56.0	35.0	1.7	17.862	-5.990	4.80	83.8
40.0	94.5	70.7	23.8	1.7	17.883	-6.278	4.79	83.9
43.0	137.6	95.8	41.9	2.9	20.529	-6.089	5.30	76.4
45.0	157.0	113.4	43.6	3.4	21.438	-5.851	5.52	74.9
45.0	157.0	113.4	43.6	3.4	21.438	-5.851	5.52	74.9
50.0	208.4	160.7	47.7	5.0	22.803	-4.734	5.88	69.7
55.0	260.2	212.5	47.7	6.7	24.131	-3.699	6.28	67.0
60.0	288.3	250.1	38.1	7.4	24.599	-3.878	6.43	66.0
70.0	451.9	375.8	76.1	16.2	27.700	-0.177	7.53	60.7
73.0	489.5	413.5	76.1	18.9	28.197	-0.281	7.73	59.8
76.0	527.2	451.2	76.1	21.6	28.699	-0.146	7.93	59.2

Total Continuous Driving Time 8.00 minutes; Total Number of Blows 350

California D.O.T. Geotechnical Services Aug 31 2009

Br. 27-89 DELMAG D62-42 OEP Analysis 3 Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 GRLWEAP(TM) Version 2005



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	4.0	3.5	0.4	0.0	0.000	0.000	11.25	0.0
17.0	35.6	18.1	17.5	-1.0	0.000	0.000	0.00	0.0
25.0	45.0	32.3	12.7	-1.0	0.000	0.000	0.00	0.0
32.0	87.8	48.1	39.7	-1.0	0.000	0.000	0.00	0.0
35.0	91.0	56.0	35.0	-1.0	0.000	0.000	0.00	0.0
35.0	91.0	56.0	35.0	1.3	15.536	-2.811	4.54	119.7
40.0	94.5	70.7	23.8	1.2	15.677	-2.970	4.54	120.3
43.0	137.6	95.8	41.9	2.1	20.101	-3.183	5.01	110.0
45.0	157.0	113.4	43.6	2.5	21.442	-3.319	5.21	107.1
45.0	157.0	113.4	43.6	2.5	21.442	-3.319	5.21	107.1
50.0	208.4	160.7	47.7	3.5	23.771	-2.729	5.60	100.5
55.0	260.2	212.5	47.7	4.7	25.557	-2.574	5.97	96.5
60.0	288.3	250.1	38.1	5.1	25.993	-3.795	6.07	94.5
70.0	451.9	375.8	76.1	10.7	30.421	0.000	7.24	86.4
73.0	489.5	413.5	76.1	12.3	31.080	0.000	7.44	84.8
76.0	527.2	451.2	76.1	14.2	31.666	-0.058	7.62	83.5

Total Continuous Driving Time 5.00 minutes; Total Number of Blows 229

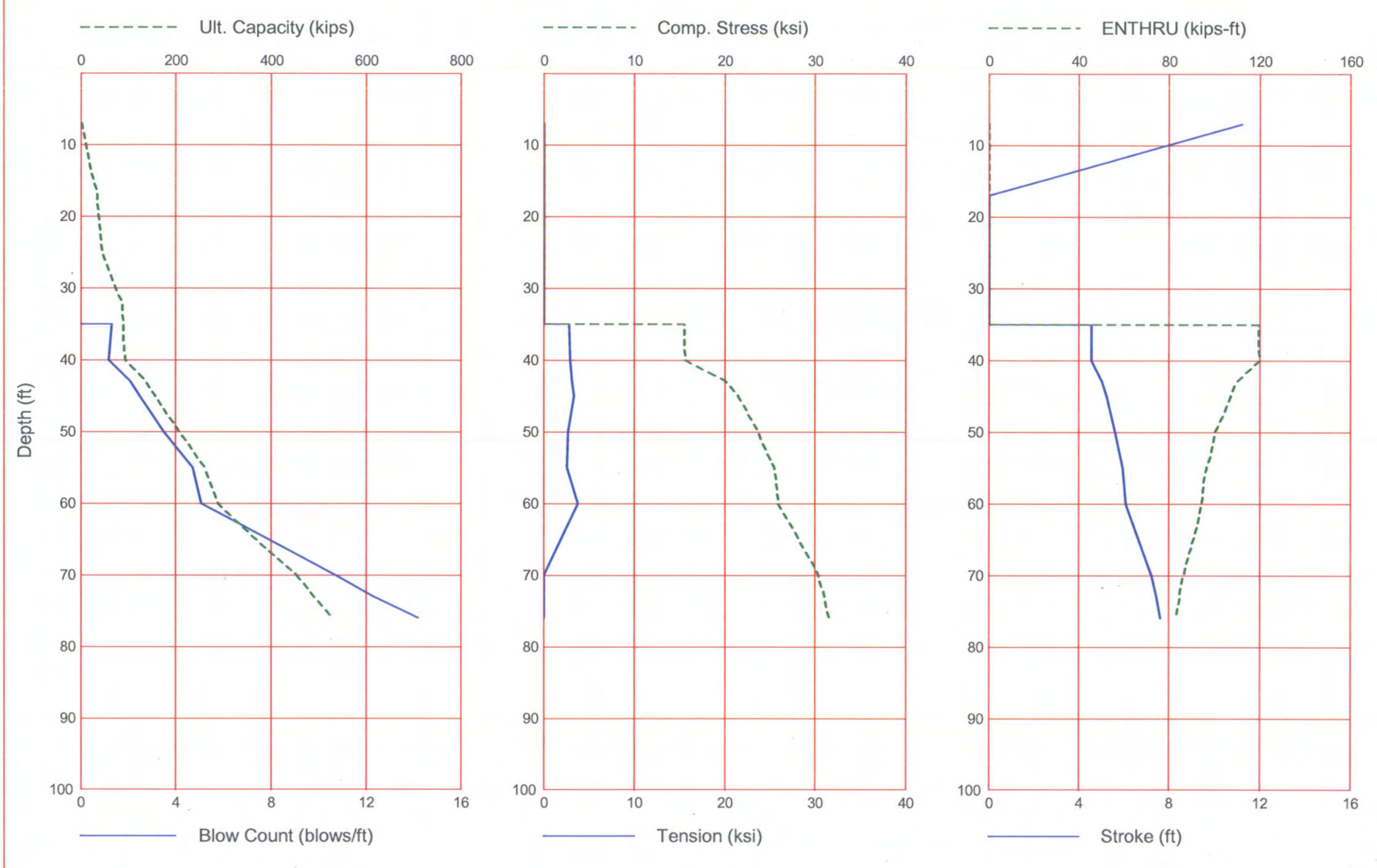
California D.O.T. Geotechnical Services

Aug 31 2009

Br. 27-89 APE D80-42 OEP Analysis 3

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



APPENDIX G

DRIVEABILITY ANALYSIS CHARTS

FOR

CLOSED-ENDED PILE CONDITION

3RD ANALYSIS

California D.O.T. Geotechnical Services
Br. 27-89 APE D36-42 CE Pipe Analysis 3

Aug 31 2009
GRLWEAP(TM) Version 2005

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	7.1	3.5	3.5	0.0	0.000	0.000	11.25	0.0
17.0	162.5	18.1	144.4	7.7	18.542	-0.464	6.13	41.8
25.0	137.3	32.3	105.0	5.9	17.739	-1.708	5.92	43.5
32.0	376.2	48.1	328.1	21.0	22.291	-0.402	7.50	38.0
35.0	344.7	56.0	288.7	18.8	21.688	-0.278	7.27	37.9
35.0	344.7	56.0	288.7	18.6	21.962	-1.476	7.34	39.0
43.0	441.6	95.8	345.8	25.7	22.713	-1.408	7.64	38.6
43.0	441.6	95.8	345.8	25.7	22.713	-1.408	7.64	38.6
45.0	473.7	113.4	360.2	27.7	22.899	-1.462	7.72	38.5
45.0	473.7	113.4	360.2	27.7	22.899	-1.462	7.72	38.5
50.0	554.4	160.7	393.7	33.5	23.344	-2.109	7.92	38.7
55.0	606.2	212.5	393.7	37.8	23.637	-2.392	8.04	38.8
60.0	565.1	250.1	314.9	33.6	23.189	-2.214	7.88	38.0
70.0	1004.1	375.8	628.3	112.4	25.227	-4.723	8.83	41.4
73.0	1041.8	413.5	628.3	129.3	25.316	-4.650	8.90	41.3
76.0	1079.5	451.2	628.3	149.3	25.446	-4.050	8.97	41.4

Total Continuous Driving Time 61.00 minutes; Total Number of Blows 2496

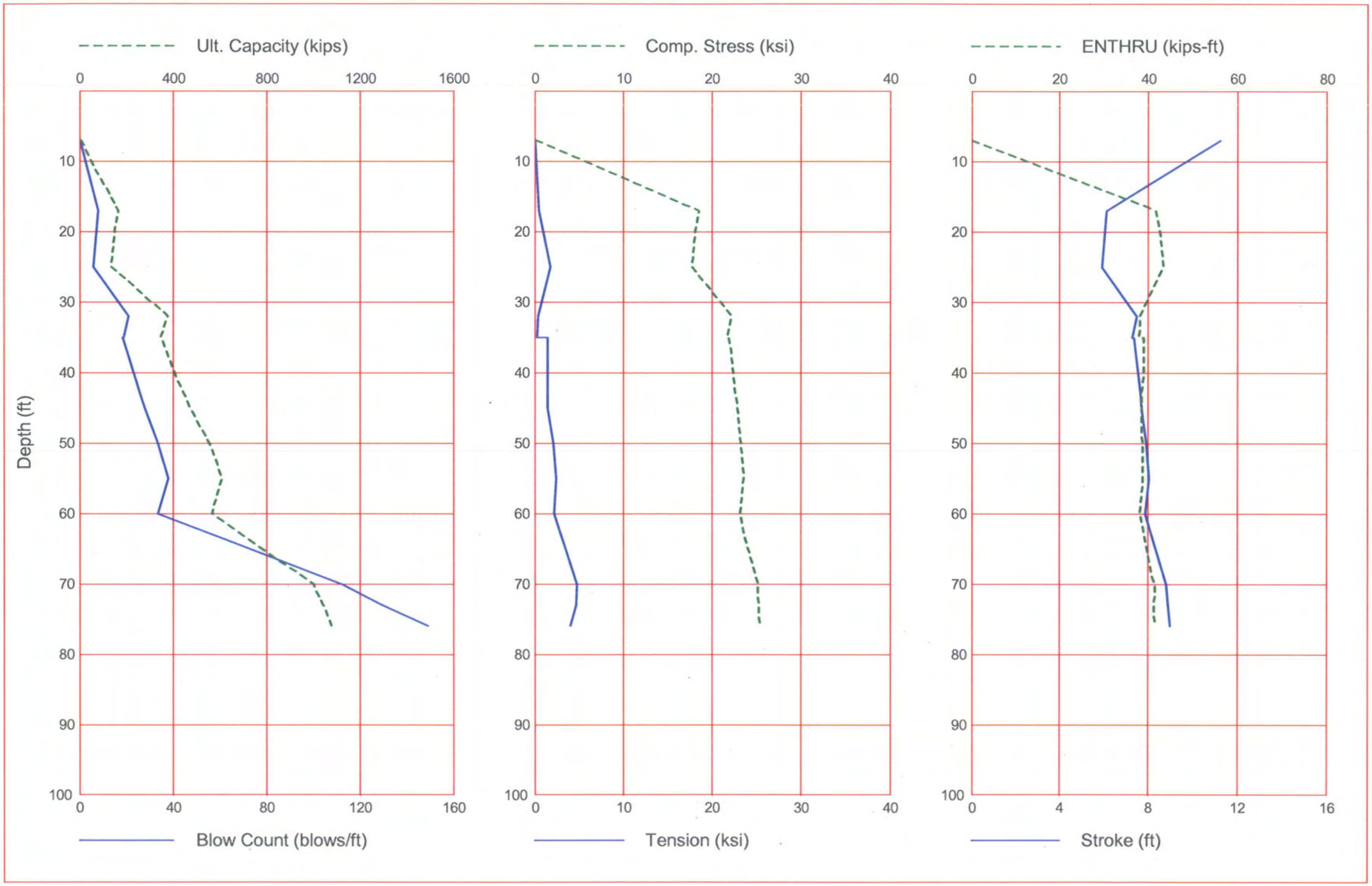
California D.O.T. Geotechnical Services

Aug 31 2009

Br. 27-89 APE D36-42 CE Pipe Analysis 3

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	7.1	3.5	3.5	0.0	0.000	0.000	11.25	0.0
17.0	162.5	18.1	144.4	5.8	21.447	-4.758	6.27	54.1
25.0	137.3	32.3	105.0	4.5	20.667	-6.035	6.05	55.6
32.0	376.2	48.1	328.1	16.3	24.961	-1.474	7.41	50.7
35.0	344.7	56.0	288.7	14.3	24.591	-1.529	7.28	50.9
40.0	267.5	70.7	196.8	10.3	23.272	-2.034	6.84	51.1
43.0	441.6	95.8	345.8	19.9	25.472	-1.469	7.62	50.5
43.0	441.6	95.8	345.8	19.9	25.472	-1.469	7.62	50.5
45.0	473.7	113.4	360.3	21.9	25.688	-1.553	7.72	50.4
45.0	473.7	113.4	360.3	21.9	25.688	-1.553	7.72	50.4
50.0	554.4	160.7	393.7	26.3	26.126	-1.928	7.90	50.3
55.0	606.2	212.5	393.7	29.4	26.343	-2.297	8.00	50.4
60.0	565.1	250.1	314.9	26.2	25.965	-1.805	7.87	49.5
70.0	1004.1	375.8	628.3	73.6	28.224	-4.753	8.88	54.6
73.0	1041.8	413.5	628.3	82.2	28.334	-4.817	8.94	54.7
76.0	1079.5	451.2	628.3	92.5	28.435	-4.749	9.01	54.8

Total Continuous Driving Time 42.00 minutes; Total Number of Blows 1732

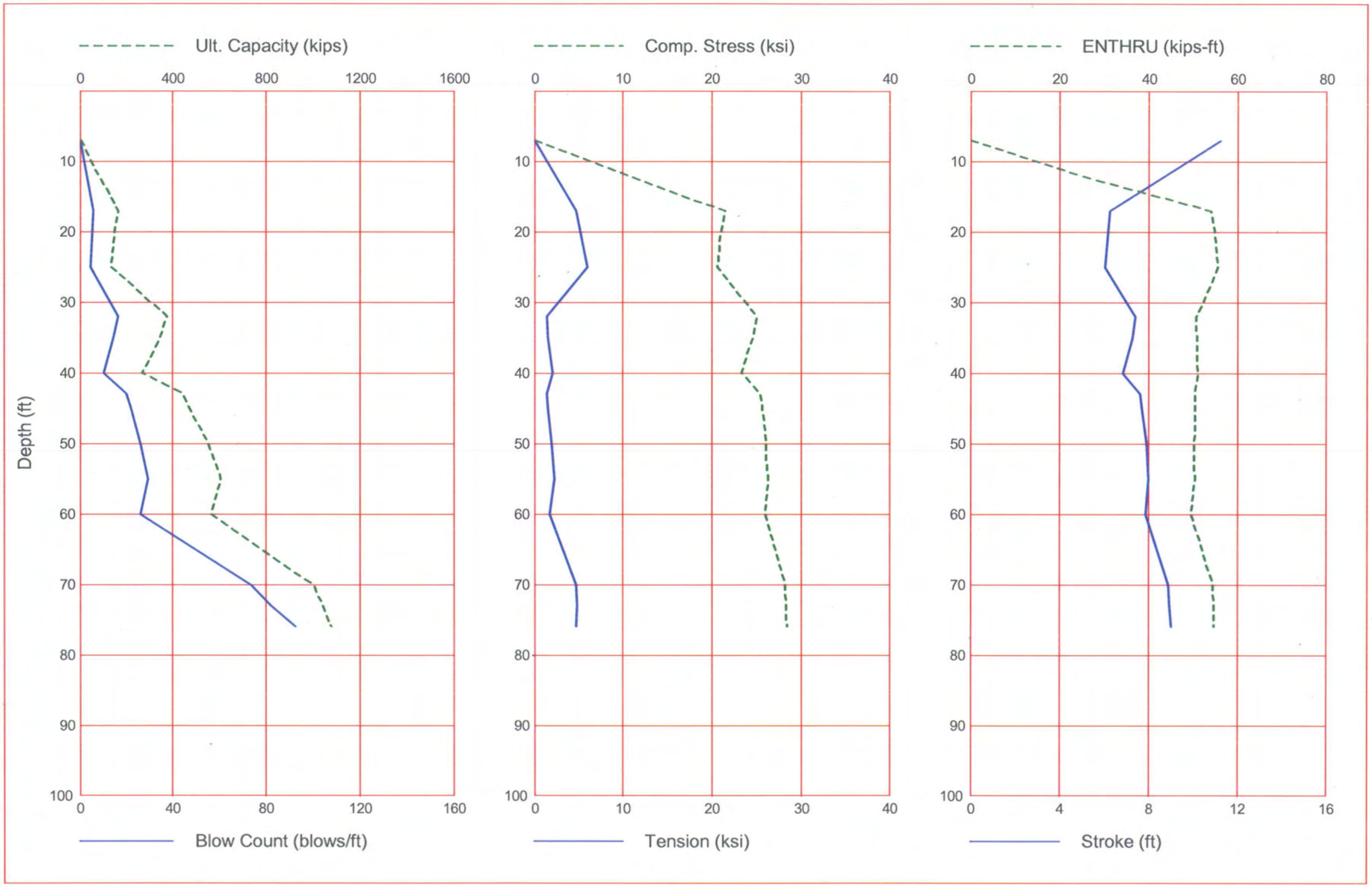
California D.O.T. Geotechnical Services

Aug 31 2009

Br. 27-89 PILECO D46-42 CEP Analysis 3

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



California D.O.T. Geotechnical Services
Br. 27-89 DELMAG D62-42 CEP Analysis 3

Aug 31 2009
GRLWEAP(TM) Version 2005

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	7.1	3.5	3.5	0.0	0.000	0.000	11.25	0.0
17.0	162.5	18.1	144.4	4.1	22.914	-1.550	5.94	83.9
25.0	137.3	32.3	105.0	3.2	21.461	-2.759	5.58	87.8
32.0	376.2	48.1	328.1	11.8	28.772	0.000	7.88	71.4
35.0	344.7	56.0	288.7	10.3	28.047	0.000	7.65	72.9
35.0	344.7	56.0	288.7	9.9	28.342	-0.634	7.64	73.7
40.0	267.5	70.7	196.8	6.9	26.444	-1.397	7.02	76.5
43.0	441.6	95.8	345.8	13.6	29.575	-0.360	8.11	71.5
45.0	473.7	113.4	360.2	14.9	29.916	-0.435	8.25	71.2
45.0	473.7	113.4	360.2	14.9	29.916	-0.435	8.25	71.2
50.0	554.4	160.7	393.7	18.4	30.723	-0.199	8.56	70.4
55.0	606.2	212.5	393.7	20.7	31.031	-0.118	8.71	70.0
60.0	565.1	250.1	314.9	18.6	30.618	-0.456	8.58	70.0
70.0	1004.1	375.8	628.3	46.9	33.846	-1.972	9.94	75.8
73.0	1041.8	413.5	628.3	51.7	34.052	-1.885	10.03	75.7
76.0	1079.5	451.2	628.3	56.9	34.197	-1.820	10.10	75.7

Total Continuous Driving Time 29.00 minutes; Total Number of Blows 1154

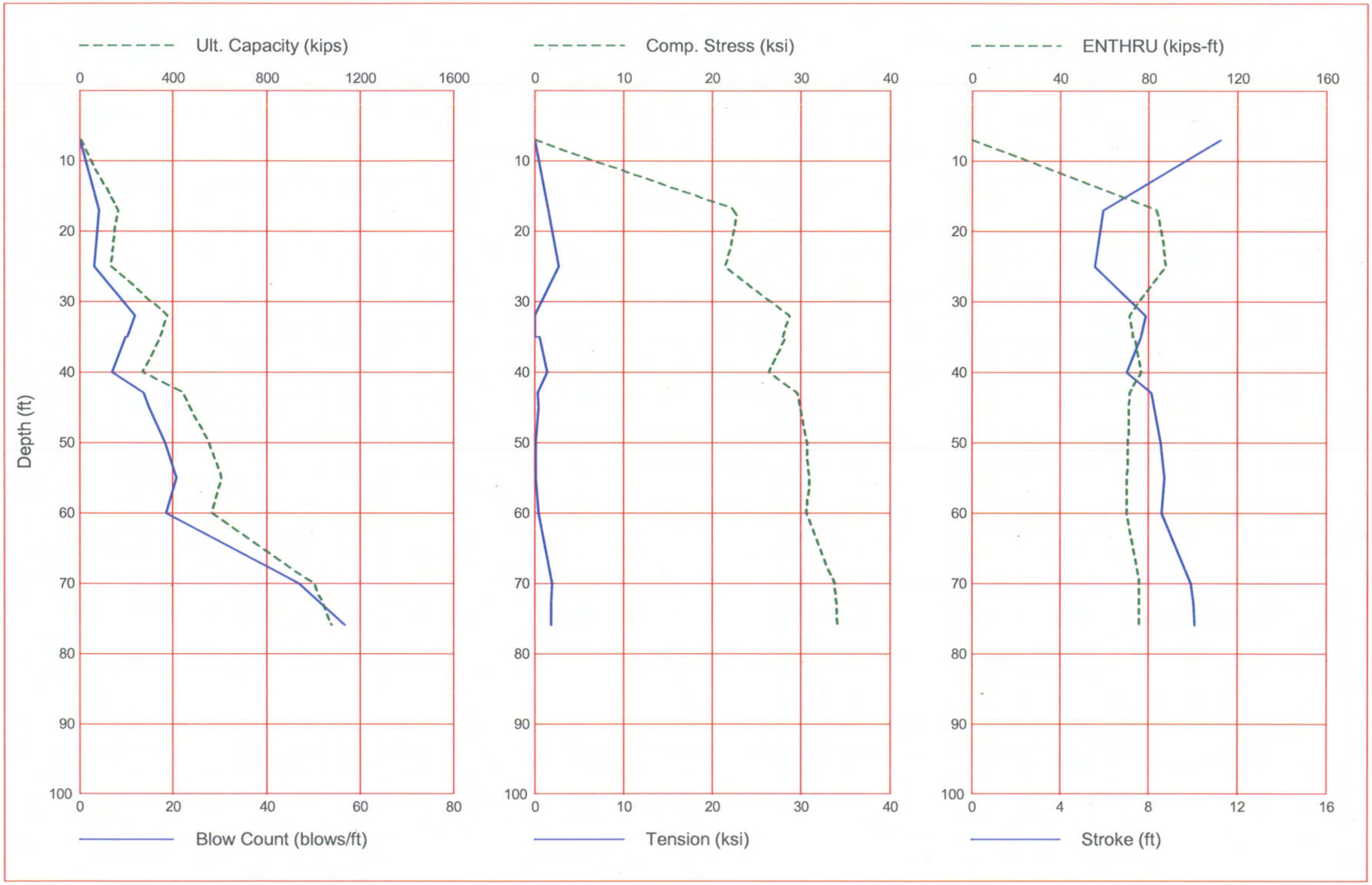
California D.O.T. Geotechnical Services

Aug 31 2009

Br. 27-89 DELMAG D62-42 CEP Analysis 3

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



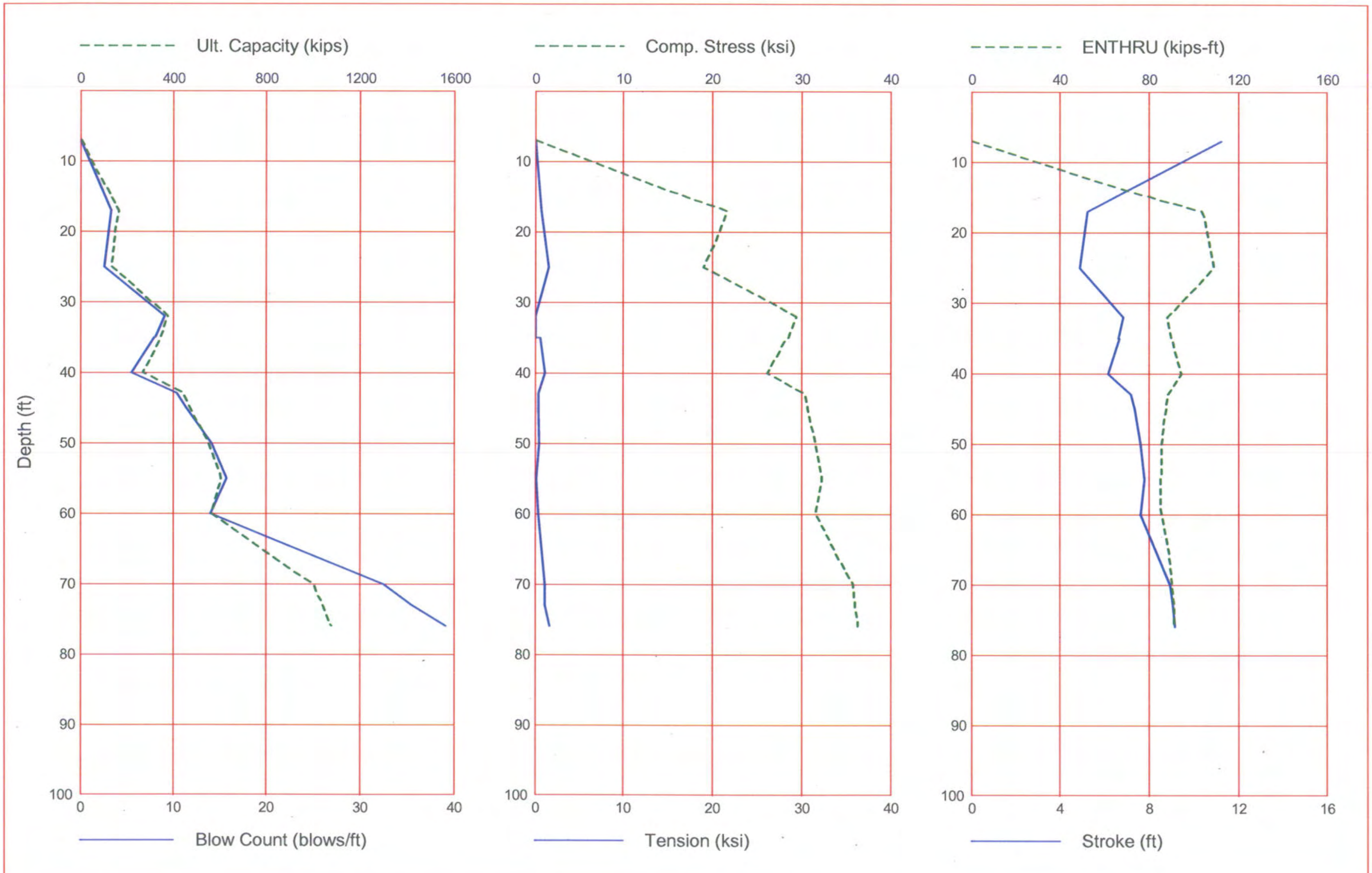
Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	7.1	3.5	3.5	0.0	0.000	0.000	11.25	0.0
17.0	162.5	18.1	144.4	3.3	21.657	-0.679	5.24	104.4
25.0	137.3	32.3	105.0	2.6	19.059	-1.566	4.89	108.9
32.0	376.2	48.1	328.1	9.1	29.392	0.000	6.86	87.9
35.0	344.7	56.0	288.7	8.0	28.500	-0.009	6.64	89.6
35.0	344.7	56.0	288.7	7.9	28.346	-0.597	6.69	90.3
40.0	267.5	70.7	196.8	5.5	26.210	-1.094	6.15	94.3
43.0	441.6	95.8	345.8	10.4	30.325	-0.397	7.21	88.4
45.0	473.7	113.4	360.2	11.4	30.703	-0.404	7.34	87.6
45.0	473.7	113.4	360.2	11.4	30.703	-0.404	7.34	87.6
50.0	554.4	160.7	393.7	14.1	31.631	-0.496	7.61	85.7
55.0	606.2	212.5	393.7	15.7	32.221	-0.207	7.77	85.3
60.0	565.1	250.1	314.9	14.0	31.633	-0.409	7.60	85.5
70.0	1004.1	375.8	628.3	32.6	35.784	-1.069	8.94	90.1
73.0	1041.8	413.5	628.3	35.5	36.046	-1.091	9.05	90.9
76.0	1079.5	451.2	628.3	39.1	36.295	-1.641	9.14	91.1

Total Continuous Driving Time 20.00 minutes; Total Number of Blows 844

California D.O.T. Geotechnical Services Aug 31 2009

Br. 27-89 APE D80-42 CEP Analysis 3 Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 GRLWEAP(TM) Version 2005



State of California Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MAHMOOD MOMENZADEH
Chief, Branch C
Office of Geotechnical Design West

Attn: Mahmood Momenzadeh

Date: January 20, 2011

File: 04-MRN-101-PM18.6/22.3
04-264061
Novato Creek Br. (Widen)
Bridge No. 27-89 R/L

From: **DEPARTMENT OF TRANSPORTATION**
Division of Engineering Services
Geotechnical Services - MS 5

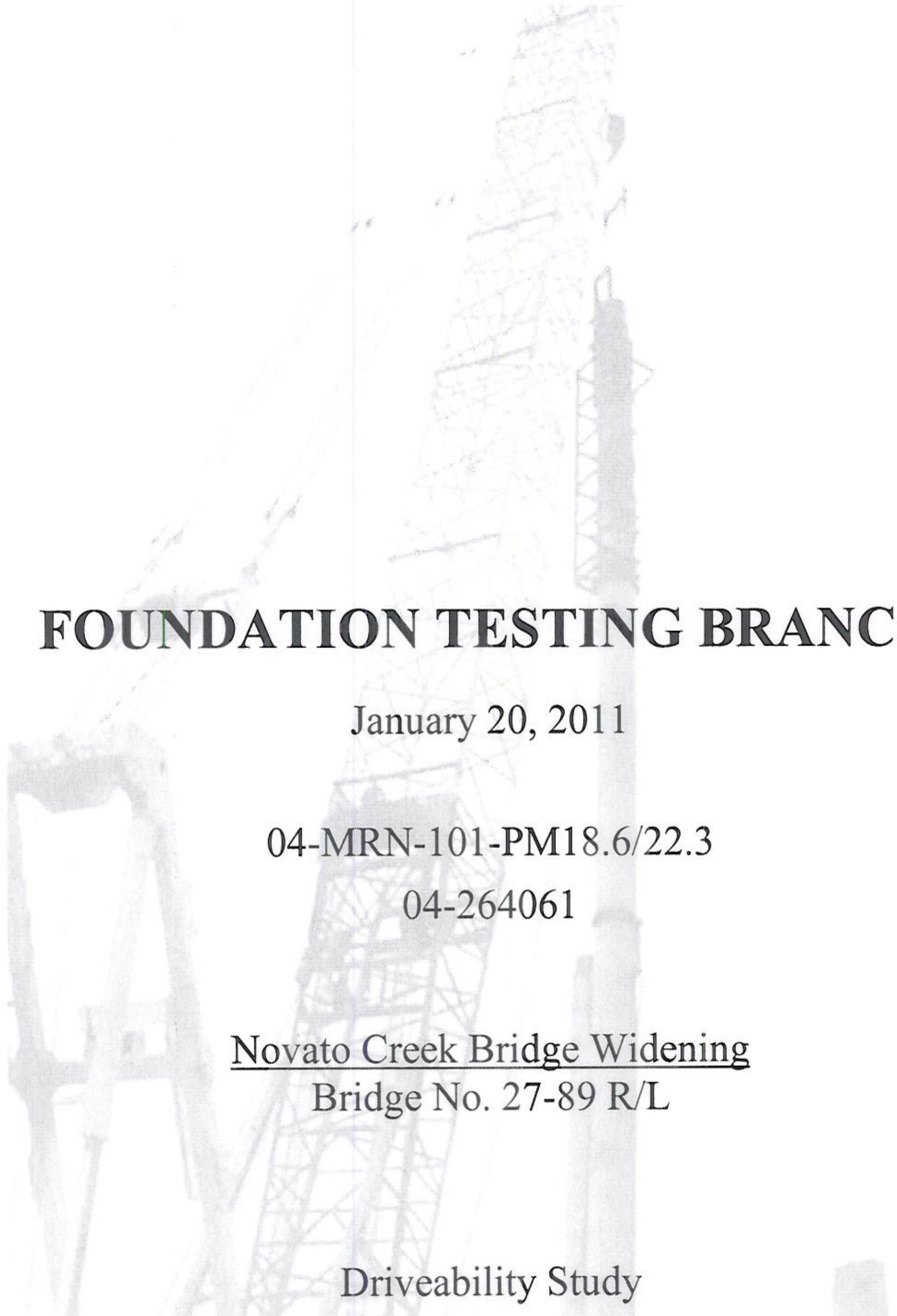
Subject: Driveability Study

Attached is a report summarizing results of driveability analyses performed by this Office for the proposed 24-inch diameter and 0.5-inch thick pipe piles at Bent 3 of the above-referenced project.

If you have any questions or comments regarding this report, please contact Tejinderjit Singh, P.E. at (916) 227-1052.

FOR: BRIAN LIEBICH, P.E.
Senior Transportation Engineer
Foundation Testing Branch

TJ/tj



FOUNDATION TESTING BRANCH

January 20, 2011

04-MRN-101-PM18.6/22.3

04-264061

<u>Novato Creek Bridge Widening</u>

Bridge No. 27-89 R/L

Driveability Study

January 20, 2011

Project Information

04-MRN-101-PM 18.6/22.3
04-264061
Novato Creek Br. (Widen)
Bridge No. 27-89R/L

Subject

Driveability Study

Introduction

This Office has performed a pile driveability analyses for the proposed installation of 24-inch diameter, 0.5-inch wall thickness steel pipe piles at the location of Bent 3 of the Novato Creek Bridge Widening project. The minimum yield strength of the steel was specified to be 45 ksi, according to the information submitted to this Office. As a result, maximum allowable compressive stress during driving is 95% of 45 ksi or 42.75 ksi. This Office analyzed the driven piling for both the open-ended and closed-ended pile conditions. A previous driveability study was conducted by this Office for this project examining 0.75-inch wall thickness piles.

The pile information for the subject piles were provided by John Moore of OGDW for original 0.75-inch thick pile driveability study. This Office used all the same information for 0.5-inch wall pipe pile analyses. Table I presents the piling information that was used in the driving analysis.

Table I. Piling Information

Support Location	Pile Type	Pile Cut-off Elevation (ft)	Soil Surface Elevation (ft)	Pipe Pile Tip Elevation (ft)	Analyzed Pile Penetration Length (ft)
Bent 3	24"x 1/2" steel pipe	17.0	6.8	-69.0	75.8

Pile Driving Resistance

To install a driven pile, the pile must overcome resistance to penetration developed by the soil. The driving resistance will determine the size of the required pile driving hammer and the stress magnitude imparted to the steel pile by the driving system. As such, an estimate of driving resistance is necessary to perform a driveability study when investigating the potential for pile damage due to steel overstressing during driving. Driving resistance can be related to static axial capacity using set-up and relaxation factors applied to various layers of soil that the pile penetrates. Several methods are available to estimate pile static axial capacity and thereby driving resistance. These methods will generally determine a range of axial capacities for a given pile penetration. To be conservative, pile tip elevation may be based on lower estimates of static capacity, but higher capacity estimates are generally used for the driveability analysis.

The maximum initial driving resistance at Bent 3 predicted by GRLWEAP in the analysis, is estimated at approximately 576 kips for the open-ended pile condition and 1730 kips for the closed-ended pile condition. The anticipated driving resistance includes the resistance contributions of approximately 82% from skin friction (Qs); and 18% from end bearing (Qp) for the open-ended pile condition. Percentage distributions are based on GRLWEAP output. The open-ended pile condition assumes no plugging, which may not be valid. The anticipated driving resistance includes the resistance contributions of approximately 27% from skin friction (Qs); and 73% from end bearing (Qp) for the closed-ended pile condition. Percentage distributions are based on GRLWEAP output.

Description of Pile Driving Systems

This study involved modeling the performance of four selected driving systems to reflect the range of rated energies appropriate for the installation of the 24-inch diameter steel pipe piles for the two pile conditions: open-ended and closed-ended.

The analyses were performed using GRLWEAP™ recommended soil hammer parameters. For each hammer, the analysis was performed with the hammer operating at maximum stroke for determining driving-behavior stresses imparted to the steel pile. The analysis performed for each hammer was utilized to demonstrate the predicted blow counts and corresponding maximum compressive stresses expected during pile driving. Standard configurations for the hammer driving systems and related components were based upon information published in GRLWEAP™ literature and database. The hammer characteristics are listed in Table II.

Table II: Summary of Hammer Systems at Bent 3

Hammer Manufacturer	APE	PILECO	DELMAG	APE
Hammer Model	D36-42	D46-42	D62-42	D80-42
Hammer Type	OED	OED	OED	OED
Rated Energy (kip-ft)	89.30	107.48	152.45	198.45
Ram Weight (kips)	7.938	10.143	13.660	17.640
Maximum Stroke (ft)	13.08	13.10	12.71	13.08

Note: OED= Open End Diesel

Discussion of Results

The results for the analysis, tables and charts depicting predicted relationships between driving resistances and driving stresses versus blow counts for each of the hammers with the pile in the open-ended and closed-ended conditions are included in Appendix A and B, respectively.

GRLWEAP™ wave equation program is a one-dimensional analysis and does not consider buckling or bending of the pile due to non-uniform blows or localized stresses at the pile tip, which may occur during pile driving. Also, it has been observed in the field that significantly harder or softer driving could occur than the GRLWEAP™ predictions.

It should be noted that all driving output data generated by the GRLWEAP™ Program presumes uniform hammer blows, with leads and hammer perfectly aligned. The analyses do not consider the effects of eccentric blows, malfunctioning hammers, or Contractor-selected reduction in fuel setting for Diesel hammers. Some Diesel hammers may exhibit operating efficiencies significantly lower than the theoretical 80% used in the analyses, subject to condition and maintenance states. The analyses also do not consider higher stresses, which could be induced by bending, non-axial hammer alignment, or high local stress concentrations, and therefore should be considered as minimum values. Local pile damage can occur at the pile tip due to highly localized pile stresses caused by non-uniform resistance from sloping rock, boulders, cobbles, or obstructions, even if the calculated average axial stresses are within the allowable limits. These stresses cannot be predicted by wave equation analysis.

Conclusions and Recommendations

Based upon the results of the driveability the following has been concluded:

- APE D36-42, PILECO D46-42, DELMAG D62-42, and APE D80-42 diesel impact hammers are capable of driving the 24-inch diameter open-ended steel pipe pile at 0.5-inch wall thickness without exceeding the maximum allowable blow count limit of 96 blows/ft (1/8" blow per foot) and without exceeding the maximum compressive stress of 42.75 ksi. This assumes no plugging occurs in the open-ended pile condition.

- None of the hammers is capable of driving the 24-inch diameter, 0.5-inch wall thickness piles at an acceptable stress and penetration rate, if the pile plugs during driving.

If you have any questions or comments pertaining to this report, please contact Tejinderjit Singh, P.E. at (916) 227-1052.

Tejinderjit Singh 1/20/11

REGISTERED PROFESSIONAL ENGINEER
TEJINDERJIT SINGH
No. 75524
Exp. 6/30/2012
CIVIL
STATE OF CALIFORNIA

Tejinderjit Singh, P.E.
Transportation Engineer, Civil
Foundation Testing Branch
Office of Geotechnical Support

Caltrans

APPENDIX A

DRIVEABILITY ANALYSIS CHARTS

FOR

OPEN-ENDED PILE CONDITION

California D.O.T. Geotechnical Services
Br. 27-89 APE D36-42 OE

Jan 20 2011
GRLWEAP(TM) Version 2005

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	4.0	3.7	0.3	0.0	0.000	0.000	11.25	0.0
32.0	67.8	66.1	1.7	3.2	17.584	-3.315	5.46	46.6
35.0	95.9	78.0	17.9	4.4	18.954	-2.807	5.70	44.6
32.0	67.8	66.1	1.7	3.2	17.584	-3.315	5.46	46.6
39.0	115.4	95.5	19.9	5.2	19.617	-2.635	5.83	43.7
45.0	148.1	125.2	22.9	6.6	20.397	-2.156	6.03	42.3
57.0	225.9	197.0	28.9	9.8	21.845	-2.440	6.45	40.6
60.0	280.1	228.8	51.2	13.1	22.683	-2.700	6.72	40.0
65.0	337.0	285.8	51.2	16.2	23.203	-3.319	6.94	39.6
70.0	469.2	366.7	102.5	23.6	24.191	-1.131	7.29	38.7
72.0	503.7	401.2	102.5	25.8	24.371	-0.969	7.39	38.9
74.0	539.4	436.9	102.5	28.3	24.588	-0.902	7.48	39.1
76.0	576.3	473.8	102.5	31.0	25.034	-1.164	7.65	39.6

Total Continuous Driving Time 13.00 minutes; Total Number of Blows 572

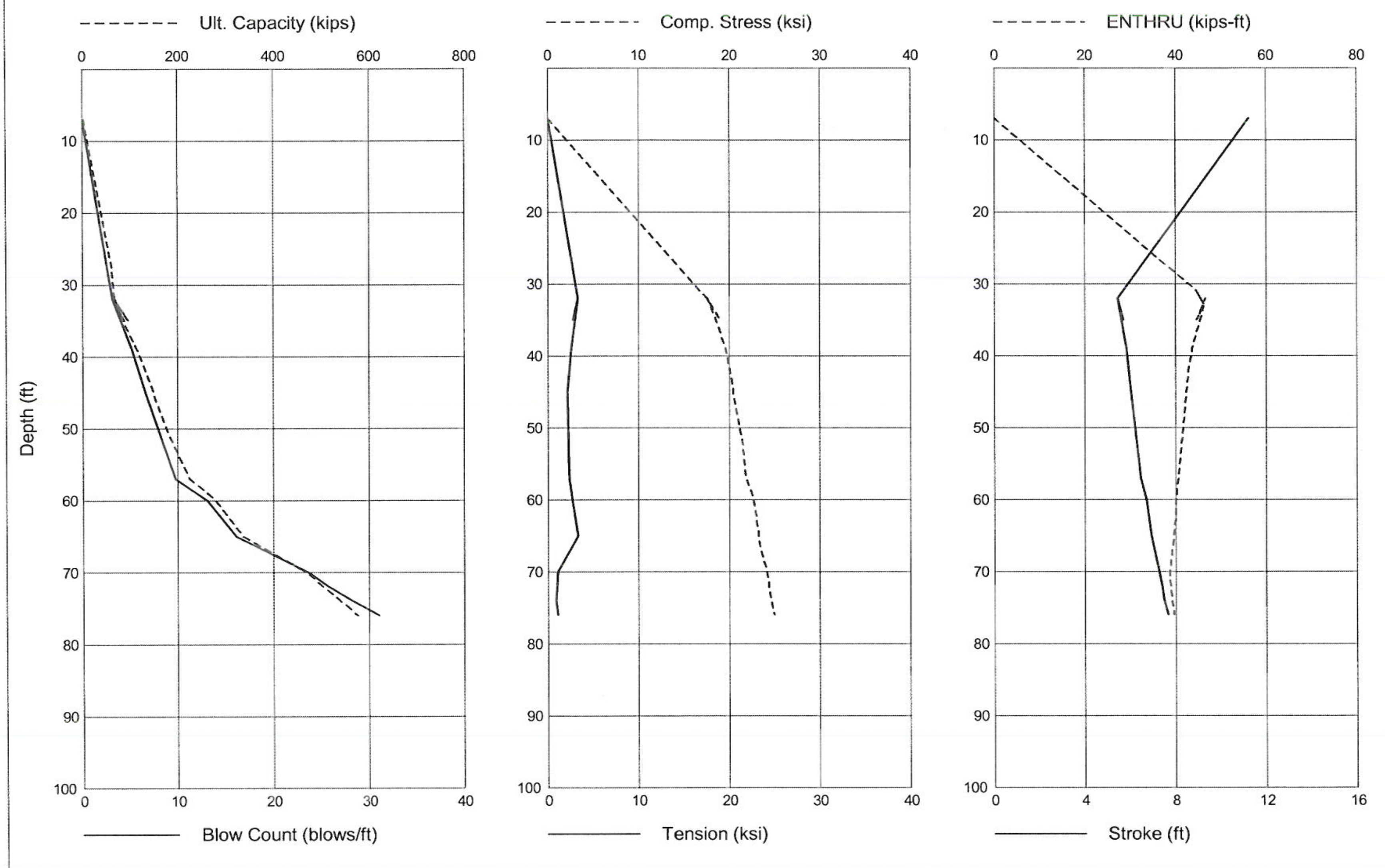
California D.O.T. Geotechnical Services

Jan 20 2011

Br. 27-89 APE D36-42 OE

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	4.0	3.7	0.3	0.0	0.000	0.000	10.60	0.0
32.0	67.8	66.1	1.7	2.7	19.099	-3.489	4.82	57.0
35.0	95.9	78.0	17.9	3.8	21.185	-3.532	5.11	53.9
32.0	67.8	66.1	1.7	2.7	19.099	-3.489	4.82	57.0
39.0	115.4	95.5	19.9	4.4	22.240	-3.747	5.26	52.4
45.0	148.1	125.2	22.9	5.5	23.667	-3.740	5.55	51.5
57.0	225.9	197.0	28.9	8.4	25.584	-3.099	6.00	48.3
60.0	280.1	228.8	51.3	10.9	26.789	-2.249	6.31	47.8
65.0	337.0	285.8	51.3	13.6	27.609	-2.764	6.57	47.4
70.0	469.2	366.7	102.5	21.1	29.338	-1.024	7.10	46.5
72.0	503.7	401.2	102.5	22.8	29.520	-0.781	7.19	46.4
74.0	539.4	436.9	102.5	24.8	29.761	-0.299	7.27	46.4
76.0	576.3	473.8	102.5	26.9	30.051	0.000	7.37	46.7

Total Continuous Driving Time 11.00 minutes; Total Number of Blows 493

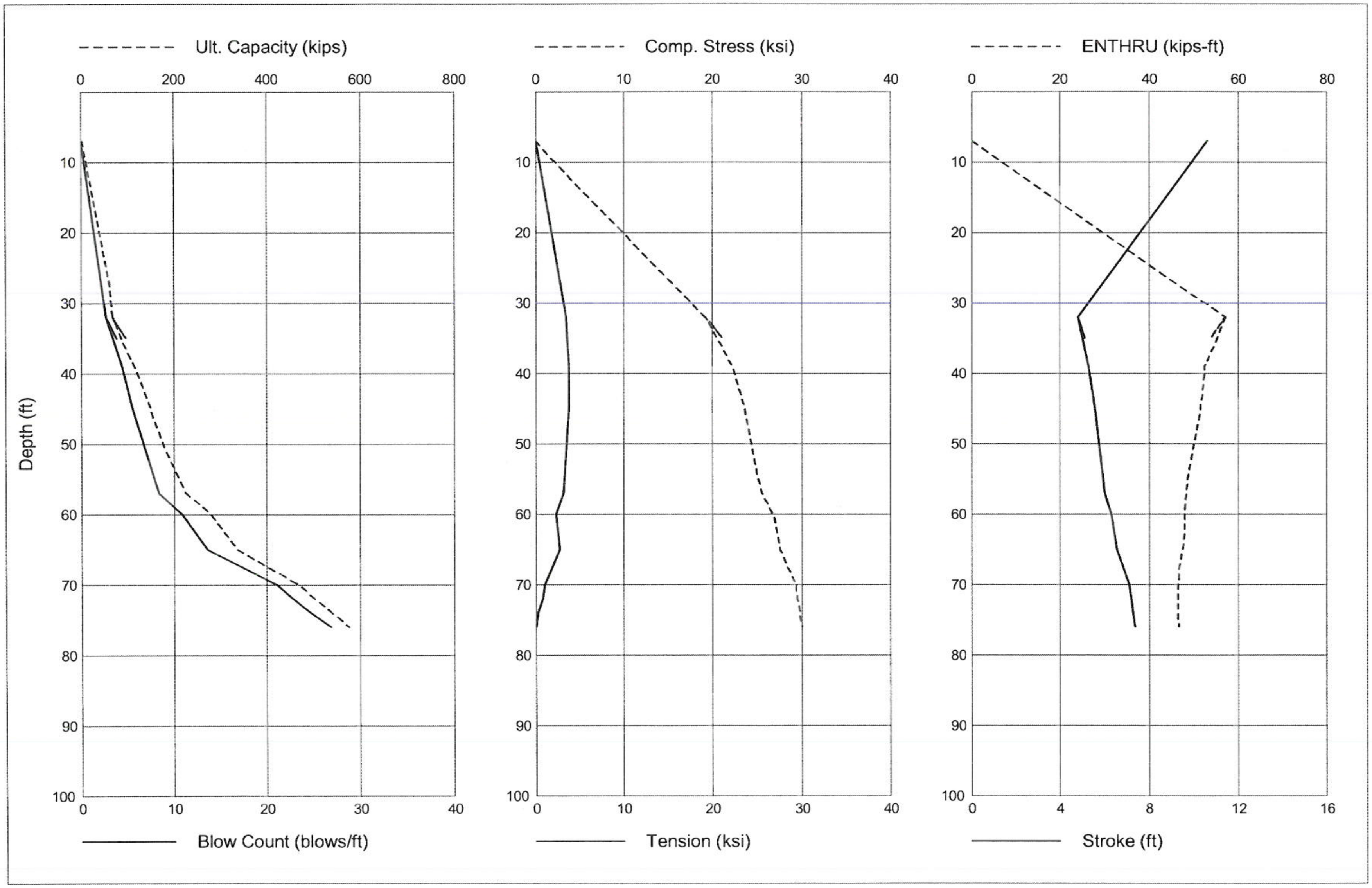
California D.O.T. Geotechnical Services

Jan 19 2011

Br. 27-89 PILECO D46-42 OE

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



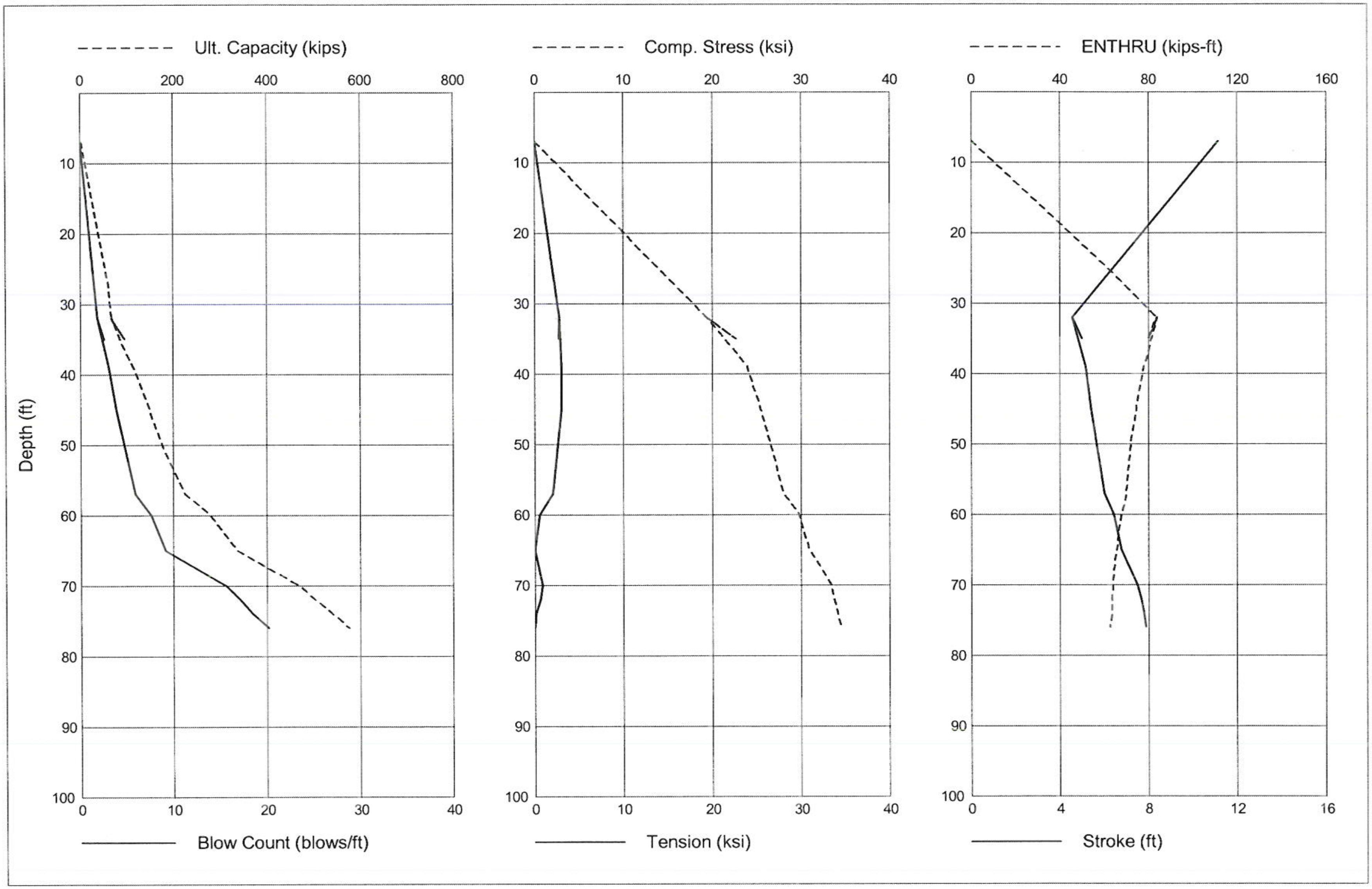
Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	4.0	3.7	0.3	0.0	0.000	0.000	11.16	0.0
32.0	67.8	66.1	1.7	1.9	19.323	-2.874	4.53	84.0
35.0	95.9	78.0	17.9	2.6	22.647	-2.709	4.97	80.0
32.0	67.8	66.1	1.7	1.9	19.323	-2.874	4.53	84.0
39.0	115.4	95.5	19.9	3.1	23.942	-3.021	5.15	77.7
45.0	148.1	125.2	22.9	3.9	25.476	-3.027	5.41	74.5
57.0	225.9	197.0	28.9	5.9	28.108	-2.084	6.00	69.9
60.0	280.1	228.8	51.2	7.6	29.807	-0.557	6.42	67.5
65.0	337.0	285.8	51.2	9.2	31.009	0.000	6.78	65.7
70.0	469.2	366.7	102.5	15.6	33.402	-0.905	7.49	63.9
72.0	503.7	401.2	102.5	17.2	33.769	-0.700	7.65	63.4
74.0	539.4	436.9	102.5	18.5	34.215	-0.209	7.80	63.5
76.0	576.3	473.8	102.5	20.2	34.561	0.000	7.87	62.4

Total Continuous Driving Time 8.00 minutes; Total Number of Blows 353

California D.O.T. Geotechnical Services | Jan 19 2011

Br. 27-89 DELMAG D62-42 OE | Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 | GRLWEAP(TM) Version 2005



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	4.0	3.7	0.3	0.0	0.000	0.000	11.25	0.0
32.0	67.8	66.1	1.7	1.4	15.421	-0.906	4.38	121.4
35.0	95.9	78.0	17.9	1.9	18.991	-2.475	4.72	114.3
32.0	67.8	66.1	1.7	1.4	15.421	-0.906	4.38	121.4
39.0	115.4	95.5	19.9	2.2	20.815	-2.426	4.86	110.4
45.0	148.1	125.2	22.9	2.8	23.436	-2.609	5.13	106.4
57.0	225.9	197.0	28.9	4.2	27.058	-2.171	5.64	99.2
60.0	280.1	228.8	51.3	5.5	28.890	-0.938	6.00	96.0
65.0	337.0	285.8	51.3	6.5	29.959	-0.005	6.26	93.0
70.0	469.2	366.7	102.5	10.1	32.798	-1.008	6.94	89.8
72.0	503.7	401.2	102.5	11.1	33.482	-0.770	7.15	90.2
74.0	539.4	436.9	102.5	12.1	33.784	-0.694	7.24	89.1
76.0	576.3	473.8	102.5	13.1	34.188	-0.526	7.33	88.2

Total Continuous Driving Time 5.00 minutes; Total Number of Blows 242

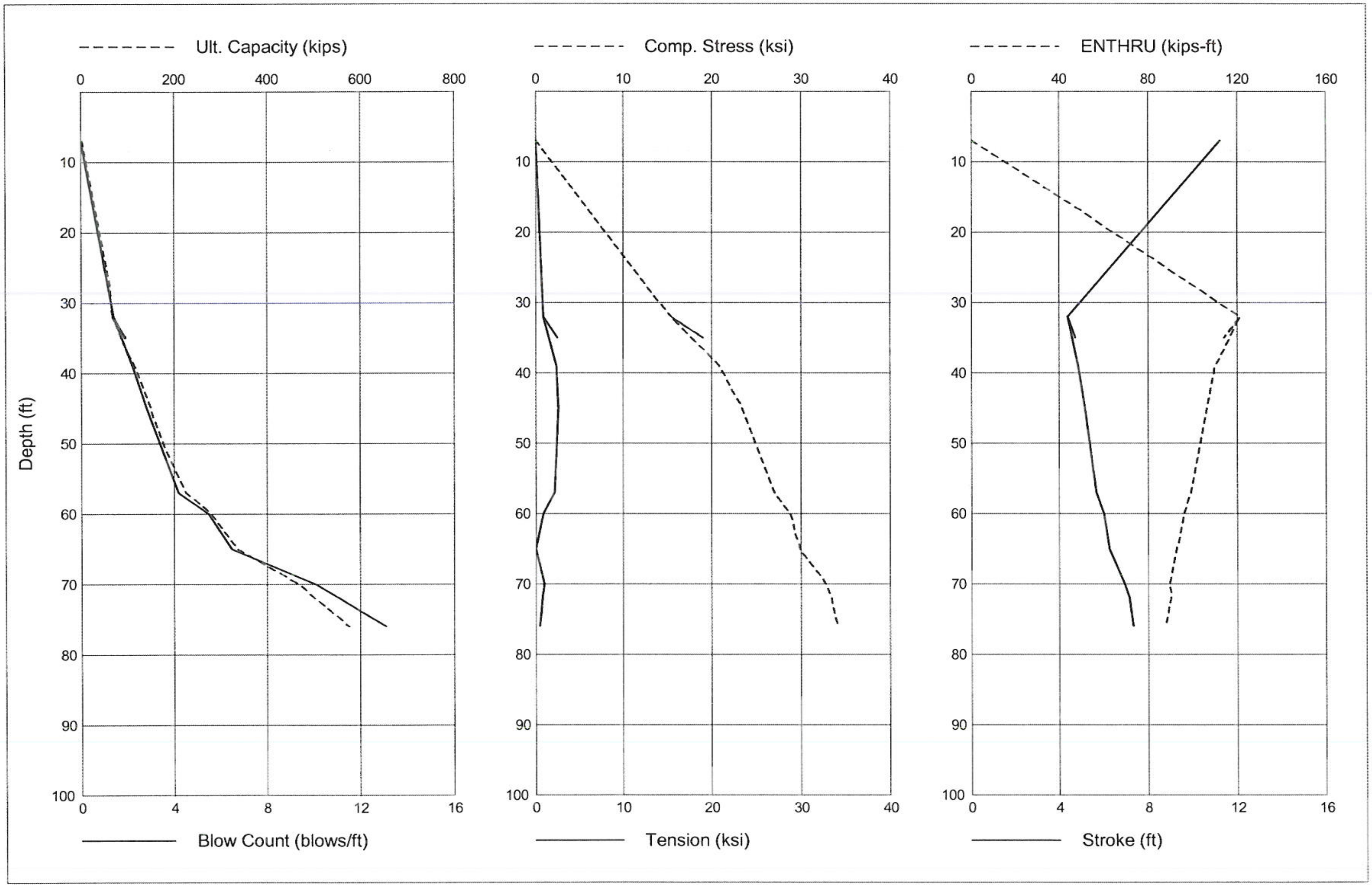
California D.O.T. Geotechnical Services

Jan 19 2011

Br. 27-89 APE D80-42 OE

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



APPENDIX B

DRIVEABILITY ANALYSIS CHARTS

FOR

CLOSED-ENDED PILE CONDITION

California D.O.T. Geotechnical Services
Br. 27-89 APE D36-42 CE

Jan 19 2011
GRLWEAP(TM) Version 2005

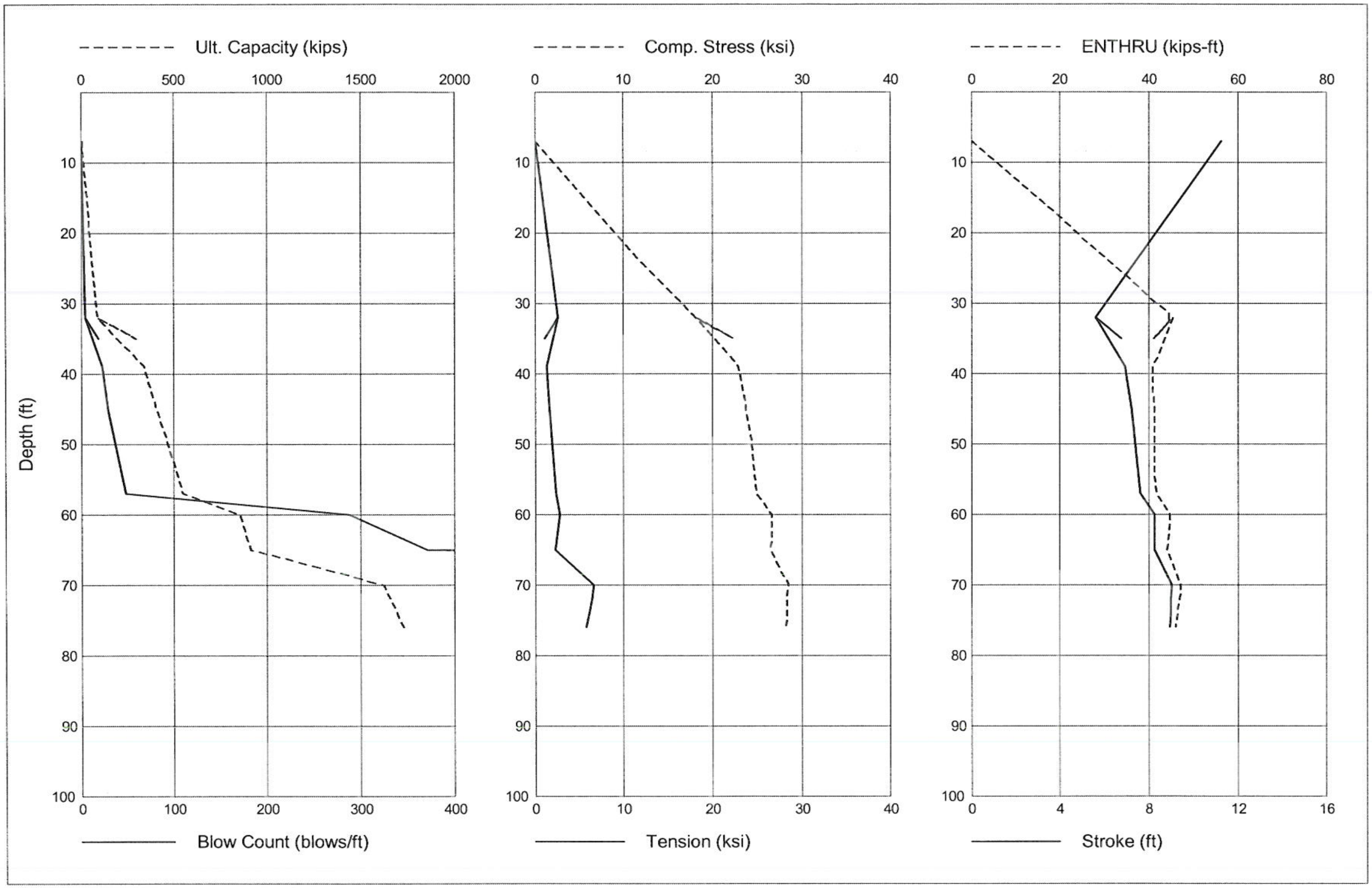
Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	7.2	3.7	3.5	0.0	0.000	0.000	11.25	0.0
32.0	87.1	66.1	21.0	4.2	18.132	-2.582	5.60	45.4
35.0	297.8	78.0	219.8	19.2	22.345	-1.089	6.77	41.0
32.0	87.1	66.1	21.0	4.2	18.132	-2.582	5.60	45.4
39.0	339.7	95.5	244.3	22.7	22.890	-1.378	6.93	40.9
45.0	406.1	125.2	280.9	29.3	23.749	-1.661	7.22	41.3
57.0	551.2	197.0	354.2	48.4	24.903	-2.383	7.62	41.7
60.0	857.2	228.8	628.3	288.3	26.580	-2.819	8.26	44.6
65.0	914.1	285.8	628.3	371.0	26.474	-2.338	8.24	44.1
70.0	1623.3	366.7	1256.6	9999.0	28.534	-6.699	9.02	47.1
72.0	1657.8	401.2	1256.6	9999.0	28.354	-6.489	8.99	46.8
74.0	1693.5	436.9	1256.6	9999.0	28.270	-6.155	8.96	46.4
76.0	1730.4	473.8	1256.6	9999.0	28.224	-5.865	8.93	46.0

Refusal occurred; no driving time output possible

California D.O.T. Geotechnical Services | Jan 19 2011

Br. 27-89 APE D36-42 CE | Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 | GRLWEAP(TM) Version 2005



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	7.2	3.7	3.5	0.0	0.000	0.000	11.16	0.0
32.0	87.1	66.1	21.0	2.5	20.917	-1.612	4.80	80.6
35.0	297.8	78.0	219.8	11.0	30.371	0.000	6.82	67.6
32.0	87.1	66.1	21.0	2.5	20.917	-1.612	4.80	80.6
39.0	339.7	95.5	244.3	13.1	31.324	0.000	7.03	66.8
45.0	406.1	125.2	280.9	16.6	32.396	0.000	7.31	65.9
57.0	551.2	197.0	354.2	26.4	34.427	0.000	7.91	66.4
60.0	857.2	228.8	628.3	82.7	38.136	0.000	9.02	73.4
65.0	914.1	285.8	628.3	96.4	38.143	0.000	9.05	73.1
70.0	1623.3	366.7	1256.6	9999.0	42.311	-1.407	10.17	81.0
72.0	1657.8	401.2	1256.6	9999.0	40.992	-1.303	10.00	79.2
74.0	1693.5	436.9	1256.6	9999.0	41.002	-1.137	10.03	79.1
76.0	1730.4	473.8	1256.6	9999.0	40.803	-0.930	9.95	78.0

Refusal occurred; no driving time output possible

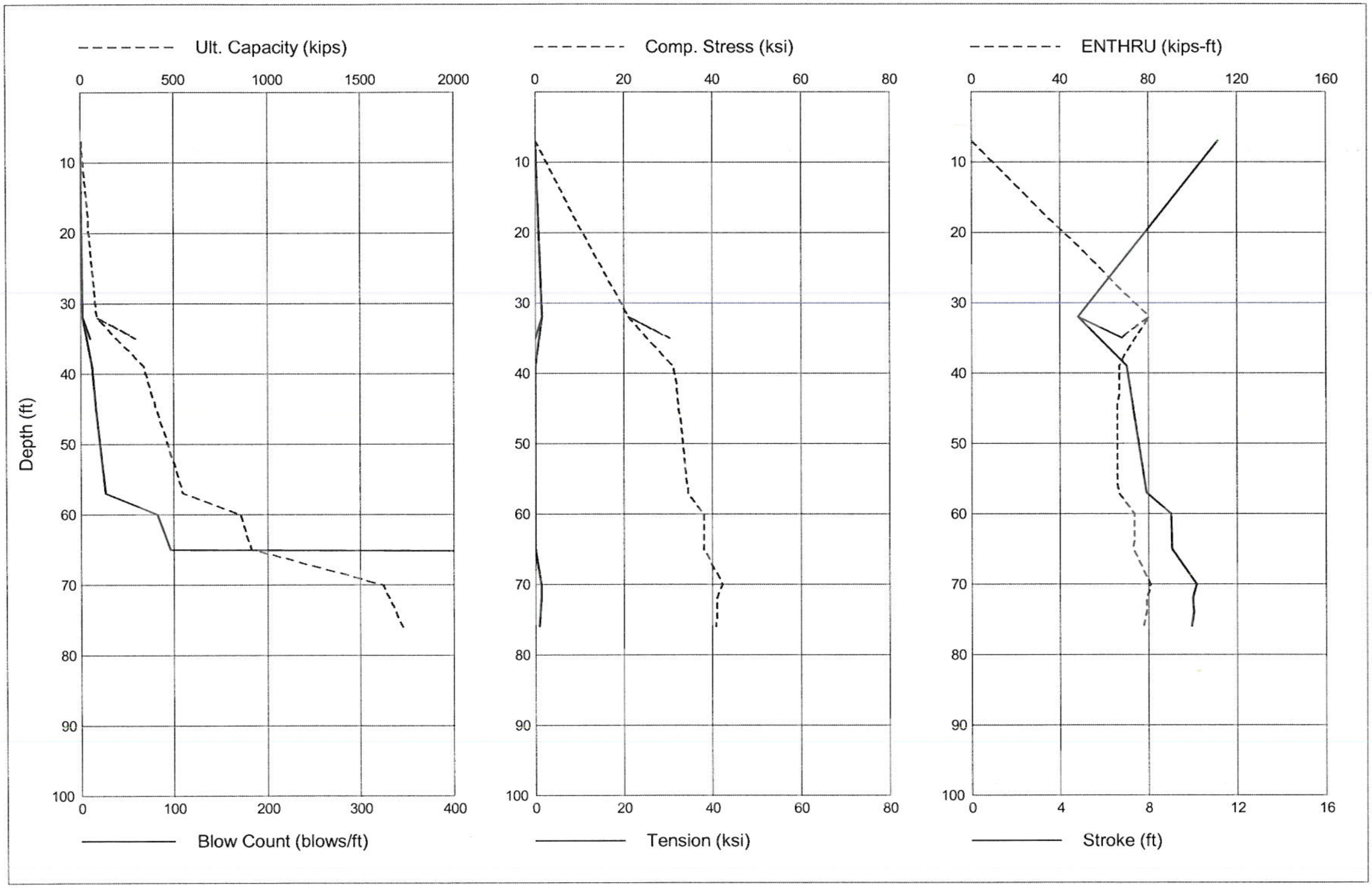
California D.O.T. Geotechnical Services

Jan 19 2011

Br. 27-89 DELMAG D62-42 CE

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	7.2	3.7	3.5	0.0	0.000	0.000	10.60	0.0
32.0	87.1	66.1	21.0	3.5	20.019	-2.799	4.99	54.8
35.0	297.8	78.0	219.8	16.2	26.908	-0.453	6.54	49.2
32.0	87.1	66.1	21.0	3.5	20.019	-2.799	4.99	54.8
39.0	339.7	95.5	244.3	19.2	27.641	-0.760	6.71	49.0
45.0	406.1	125.2	280.9	24.8	28.523	-0.967	6.94	49.0
57.0	551.2	197.0	354.2	41.1	29.873	-0.935	7.32	49.0
60.0	857.2	228.8	628.3	167.4	32.354	-1.078	8.09	54.2
65.0	914.1	285.8	628.3	189.1	32.192	-0.700	8.07	53.5
70.0	1623.3	366.7	1256.6	9999.0	34.793	-4.082	8.91	58.3
72.0	1657.8	401.2	1256.6	9999.0	34.542	-3.458	8.86	57.7
74.0	1693.5	436.9	1256.6	9999.0	34.366	-3.051	8.82	57.1
76.0	1730.4	473.8	1256.6	9999.0	34.279	-2.592	8.78	56.5

Refusal occurred; no driving time output possible

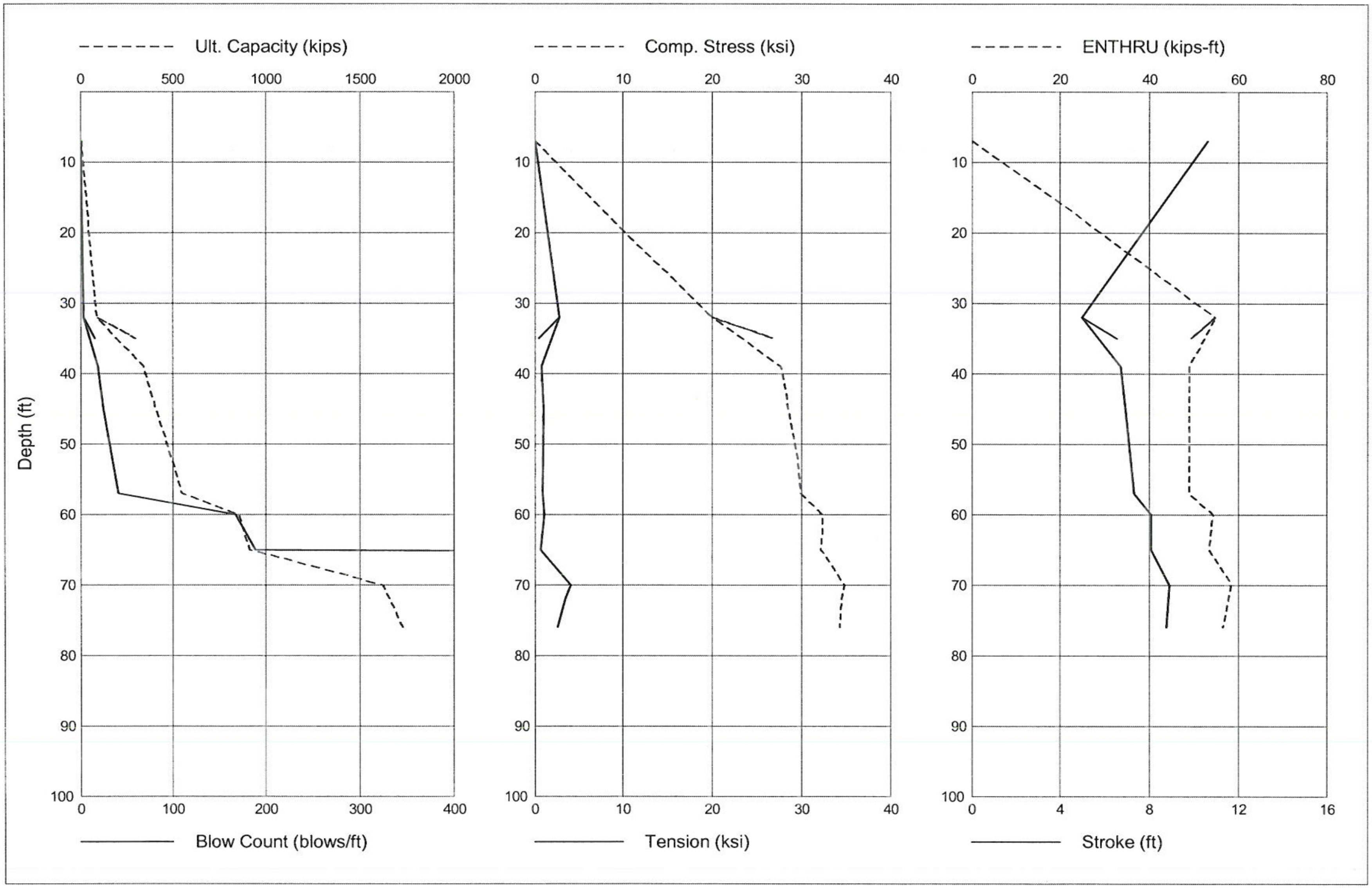
California D.O.T. Geotechnical Services

Jan 19 2011

Br. 27-89 PILECO D46-42 CE

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

GRLWEAP(TM) Version 2005



California D.O.T. Geotechnical Services
Br. 27-89 APE D80-42 CE

Jan 19 2011
GRLWEAP(TM) Version 2005

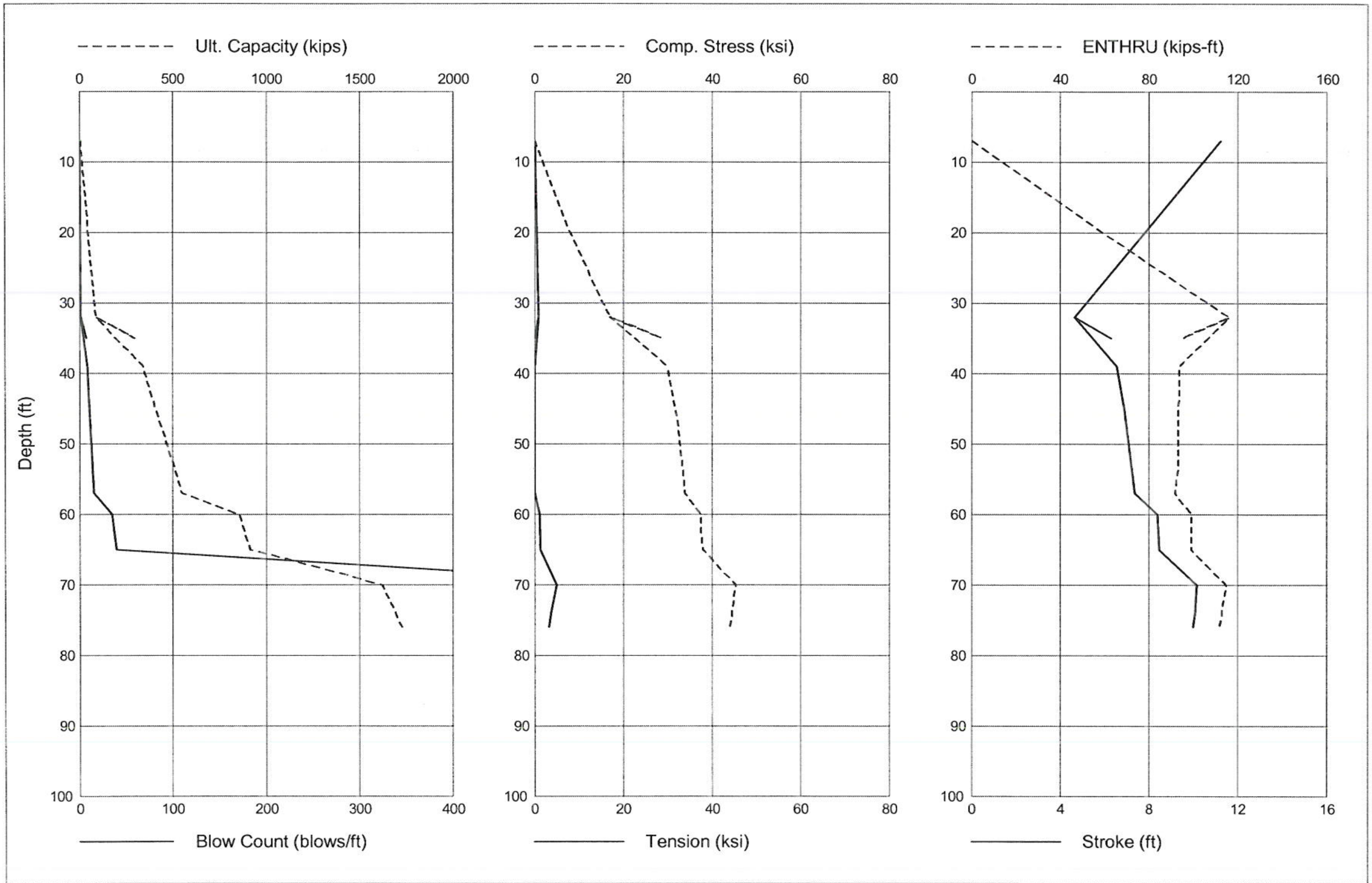
Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
7.0	7.2	3.7	3.5	0.0	0.000	0.000	11.25	0.0
32.0	87.1	66.1	21.0	1.8	16.967	-1.003	4.61	116.3
35.0	297.8	78.0	219.8	7.4	28.427	0.000	6.30	94.9
32.0	87.1	66.1	21.0	1.8	16.967	-1.003	4.61	116.3
39.0	339.7	95.5	244.3	8.6	29.770	0.000	6.54	93.8
45.0	406.1	125.2	280.9	10.5	31.608	0.000	6.88	93.1
57.0	551.2	197.0	354.2	15.3	33.764	0.000	7.35	91.8
60.0	857.2	228.8	628.3	34.6	37.537	-1.267	8.37	99.0
65.0	914.1	285.8	628.3	40.4	37.857	-1.403	8.47	99.1
70.0	1623.3	366.7	1256.6	646.8	45.422	-4.929	10.17	114.8
72.0	1657.8	401.2	1256.6	791.7	44.984	-4.404	10.13	113.9
74.0	1693.5	436.9	1256.6	1021.2	44.546	-3.839	10.07	113.0
76.0	1730.4	473.8	1256.6	1550.9	43.988	-3.337	10.00	111.8

Total Continuous Driving Time 216.00 minutes; Total Number of Blows 8075

California D.O.T. Geotechnical Services Jan 19 2011

Br. 27-89 APE D80-42 CE Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 GRLWEAP(TM) Version 2005



MATERIALS INFORMATION

04-264064

LOG PILE SHEETS (12 pages)

PILE QUANTITY AND DRIVING RECORD (Driven Piles) (6 pages)

REVISED PILE DYNAMIC ANALYSIS and Pile Field Acceptance Criteria: Pile 1 at Bent 3 dated October 10, 2011 (13 pages)

DEPARTMENT OF TRANSPORTATION

LOG PILE SHEET

DH-OS C79 (REV. 03/2009)

JOB STAMP

04-264064

Sheet No.

Bridge No. *Navato Cr Rt* Abut No. *1* Footing *9.6* Pile No. *1*

Hammer Make *Delmag* Model *30-32* E = *62700* ft-lbs

Reference Point HI Elevation ft

Total Length of Pile *67.850* ft Pile I.D. *Class 200 Alt X* Final Top of Pile EL *(+10.850)* ft

Date Driven *October 6, 2011* Inspected by *RR*

Penetration (ft)	Tip EL (ft)	Blows/ft
1.00	+8.60	
2.00	+7.60	
3.00	+6.60	
4.00	+5.60	
5.00	+4.60	
6.00	+3.60	5
7.00	+2.60	3
8.00	+1.60	3
9.00	+0.60	3
10.00	-0.40	3
11.00	-1.40	3
12.00	-2.40	3
13.00	-3.40	4
14.00	-4.40	5
15.00	-5.40	4
16.00	-6.40	5
17.00	-7.40	4
18.00	-8.40	4
19.00	-9.40	4
20.00	-10.40	4
21.00	-11.40	4
22.00	-12.40	5
23.00	-13.40	4
24.00	-14.40	4
25.00	-15.40	5
26.00	-16.40	5
27.00	-17.40	5
28.00	-18.40	5
29.00	-19.40	6
30.00	-20.40	5
31.00	-21.40	5
32.00	-22.40	5
33.00	-23.40	6
34.00	-24.40	10
35.00	-25.40	10
36.00	-26.40	10
37.00	-27.40	8
38.00	-28.40	7
39.00	-29.40	8
40.00	-30.40	7
41.00	-31.40	7
42.00	-32.40	6
43.00	-33.40	6
44.00	-34.40	6
45.00	-35.40	7
46.00	-36.40	8
47.00	-37.40	10
48.00	-38.40	9
49.00	-39.40	11
50.00	-40.40	11
51.00	-41.40	12
52.00	-42.40	14
53.00	-43.40	18
54.00	-44.40	32
55.00	-45.40	40
56.00	-46.40	48
57.00	-47.40	50
58.00	-48.40	51
59.00	-49.40	81
60.00	-50.40	100
61.00	-51.40	
62.00	-52.40	
63.00	-53.40	
64.00	-54.40	
65.00	-55.40	
66.00	-56.40	
67.00	-57.40	
68.00	-58.40	
69.00	-59.40	
70.00	-60.40	
71.00	-61.40	
72.00	-62.40	
73.00	-63.40	

DEPARTMENT OF TRANSPORTATION

LOG PILE SHEET

DH-OS C79 (REV. 03/2009)

JOB STAMP

04-264064

Sheet No.

Bridge No. *Novato Cr Rt* Abut No. *1* Footing *9.6* Pile No. *2*

Hammer Make *Delmag* Model *30-32* E = *62700* ft-lbs

Reference Point HI Elevation ft

Total Length of Pile *67.850* ft Pile I.D. *Class 200 Alt X* Final Top of Pile EL *(+10.850)* ft

Date Driven *October 6, 2011* Inspected by *RR*

Penetration (ft)	Tip EL (ft)	Blows/ft
1.00	+8.60	
2.00	+7.60	
3.00	+6.60	
4.00	+5.60	
5.00	+4.60	
6.00	+3.60	
7.00	+2.60	
8.00	+1.60	
9.00	+0.60	
10.00	-0.40	
11.00	-1.40	2
12.00	-2.40	6
13.00	-3.40	4
14.00	-4.40	5
15.00	-5.40	5
16.00	-6.40	5
17.00	-7.40	5
18.00	-8.40	5
19.00	-9.40	5
20.00	-10.40	5
21.00	-11.40	6
22.00	-12.40	6
23.00	-13.40	5
24.00	-14.40	5
25.00	-15.40	5
26.00	-16.40	5
27.00	-17.40	5
28.00	-18.40	5
29.00	-19.40	4
30.00	-20.40	5
31.00	-21.40	5
32.00	-22.40	8
33.00	-23.40	12
34.00	-24.40	12
35.00	-25.40	10
36.00	-26.40	8
37.00	-27.40	9
38.00	-28.40	7
39.00	-29.40	7
40.00	-30.40	6
41.00	-31.40	5
42.00	-32.40	5
43.00	-33.40	5
44.00	-34.40	5
45.00	-35.40	6
46.00	-36.40	10
47.00	-37.40	14
48.00	-38.40	15
49.00	-39.40	15
50.00	-40.40	13
51.00	-41.40	14
52.00	-42.40	14
53.00	-43.40	23
54.00	-44.40	35
55.00	-45.40	48
56.00	-46.40	50
57.00	-47.40	63
58.00	-48.40	100
59.00	-49.40	
60.00	-50.40	
61.00	-51.40	
62.00	-52.40	
63.00	-53.40	
64.00	-54.40	
65.00	-55.40	
66.00	-56.40	
67.00	-57.40	
68.00	-58.40	
69.00	-59.40	
70.00	-60.40	
71.00	-61.40	
72.00	-62.40	
73.00	-63.40	

Penetration (ft)	Tip EL (ft)	Blows/ft

DEPARTMENT OF TRANSPORTATION

LOG PILE SHEET

DH-OS C79 (REV. 03/2009)

JOB STAMP

04-264064

Sheet No.

Bridge No. Navato Cr Rt Bent No. 2 Footing 27.5 Ft Pile No. 1

Hammer Make Delmag Model 30-32 E = 66000 ft-lbs

Reference Point HI Elevation ft

Total Length of Pile 82.250 ft Pile I.D. 24' CISS Final Top of Pile EL (+17.250) ft

Date Driven October 4, 2011 Inspected by RR

Penetration (ft)	Tip EL (ft)	Blows/ft
1.00	+7.00	
2.00	+6.00	
3.00	+5.00	
4.00	+4.00	
5.00	+3.00	
6.00	+2.00	
7.00	+1.00	
8.00	+0.00	
9.00	-1.00	
10.00	-2.00	
11.00	-3.00	
12.00	-4.00	
13.00	-5.00	
14.00	-6.00	
15.00	-7.00	
16.00	-8.00	
17.00	-9.00	
18.00	-10.00	
19.00	-11.00	
20.00	-12.00	
21.00	-13.00	
22.00	-14.00	
23.00	-15.00	
24.00	-16.00	
25.00	-17.00	
26.00	-18.00	
27.00	-19.00	
28.00	-20.00	2
29.00	-21.00	1
30.00	-22.00	1
31.00	-23.00	1
32.00	-24.00	1
33.00	-25.00	5
34.00	-26.00	6
35.00	-27.00	3
36.00	-28.00	3
37.00	-29.00	3
38.00	-30.00	2
39.00	-31.00	3
40.00	-32.00	3
41.00	-33.00	2
42.00	-34.00	2
43.00	-35.00	2

Penetration (ft)	Tip EL (ft)	Blows/ft
44.00	-36.00	3
45.00	-37.00	5
46.00	-38.00	5
47.00	-39.00	7
48.00	-40.00	8
49.00	-41.00	8
50.00	-42.00	6
51.00	-43.00	6
52.00	-44.00	11
53.00	-45.00	20
54.00	-46.00	27
55.00	-47.00	30
56.00	-48.00	38
57.00	-49.00	47
58.00	-50.00	60
59.00	-51.00	78
60.00	-52.00	92
61.00	-53.00	168
62.00	-54.00	
63.00	-55.00	
64.00	-56.00	
65.00	-57.00	
66.00	-58.00	
67.00	-59.00	
68.00	-60.00	
69.00	-61.00	
70.00	-62.00	
71.00	-63.00	
72.00	-64.00	
73.00	-65.00	

Penetration (ft)	Tip EL (ft)	Blows/ft

DEPARTMENT OF TRANSPORTATION

LOG PILE SHEET

DH-OS C79 (REV. 03/2009)

JOB STAMP

04-264064

Sheet No.

Bridge No. *Navato Cr Rt* Bent No. *2* Footing *27.5 Ft* Pile No. *2*

Hammer Make *Delmag* Model *30-32* E = *66000* ft-lbs

Reference Point HI Elevation ft

Total Length of Pile *82.250* ft Pile I.D. *24' CISS* Final Top of Pile EL *(-7.250)* ft

Date Driven *October 18, 2011* Inspected by *RR*

Penetration (ft)	Tip EL (ft)	Blows/ft
1.00	+7.00	
2.00	+6.00	
3.00	+5.00	
4.00	+4.00	
5.00	+3.00	
6.00	+2.00	
7.00	+1.00	
8.00	+0.00	
9.00	-1.00	
10.00	-2.00	
11.00	-3.00	
12.00	-4.00	
13.00	-5.00	
14.00	-6.00	
15.00	-7.00	
16.00	-8.00	
17.00	-9.00	
18.00	-10.00	
19.00	-11.00	
20.00	-12.00	
21.00	-13.00	
22.00	-14.00	
23.00	-15.00	
24.00	-16.00	
25.00	-17.00	
26.00	-18.00	
27.00	-19.00	
28.00	-20.00	
29.00	-21.00	
30.00	-22.00	1
31.00	-23.00	1
32.00	-24.00	1
33.00	-25.00	2
34.00	-26.00	2
35.00	-27.00	4
36.00	-28.00	4
37.00	-29.00	5
38.00	-30.00	4
39.00	-31.00	3
40.00	-32.00	2
41.00	-33.00	3
42.00	-34.00	3
43.00	-35.00	3
44.00	-36.00	5
45.00	-37.00	6
46.00	-38.00	8
47.00	-39.00	8
48.00	-40.00	8
49.00	-41.00	8
50.00	-42.00	9
51.00	-43.00	13
52.00	-44.00	15
53.00	-45.00	31
54.00	-46.00	44
55.00	-47.00	51
56.00	-48.00	71
57.00	-49.00	81
58.00	-50.00	92
59.00	-51.00	116
60.00	-52.00	171
61.00	-53.00	
62.00	-54.00	
63.00	-55.00	
64.00	-56.00	
65.00	-57.00	
66.00	-58.00	
67.00	-59.00	
68.00	-60.00	
69.00	-61.00	
70.00	-62.00	
71.00	-63.00	
72.00	-64.00	
73.00	-65.00	

Penetration (ft)	Tip EL (ft)	Blows/ft

DEPARTMENT OF TRANSPORTATION

LOG PILE SHEET

DH-OS C79 (REV. 03/2009)

JOB STAMP

04-264064

Sheet No.

Bridge No. Navato Cr Rt Bent No. 3 Footing 27.5 Ft Pile No. 1

Hammer Make Delmag Model 30-32 E = 66000 ft-lbs

Reference Point HI Elevation ft

Total Length of Pile 82.250 ft Pile I.D. 24' CISS Final Top of Pile EL (+17.250) ft

Date Driven October 4, 2011 Inspected by RR

Penetration (ft)	Tip EL (ft)	Blows/ft	Penetration (ft)	Tip EL (ft)	Blows/ft	Penetration (ft)	Tip EL (ft)	Blows/ft
1.00	+7.00		44.00	-36.00	8			
2.00	+6.00		45.00	-37.00	10			
3.00	+5.00		46.00	-38.00	10			
4.00	+4.00		47.00	-39.00	11			
5.00	+3.00		48.00	-40.00	11			
6.00	+2.00		49.00	-41.00	13			
7.00	+1.00		50.00	-42.00	10			
8.00	+0.00		51.00	-43.00	13			
9.00	-1.00		52.00	-44.00	13			
10.00	-2.00		53.00	-45.00	13			
11.00	-3.00		54.00	-46.00	19			
12.00	-4.00		55.00	-47.00	18			
13.00	-5.00		56.00	-48.00	15			
14.00	-6.00		57.00	-49.00	15			
15.00	-7.00		58.00	-50.00	15			
16.00	-8.00		59.00	-51.00	18			
17.00	-9.00		60.00	-52.00	16			
18.00	-10.00		61.00	-53.00	16			
19.00	-11.00		62.00	-54.00	17			
20.00	-12.00		63.00	-55.00	20			
21.00	-13.00		64.00	-56.00	30			
22.00	-14.00		65.00	-57.00	51			
23.00	-15.00		66.00	-58.00	72			
24.00	-16.00		67.00	-59.00	131			
25.00	-17.00		68.00	-60.00	178			
26.00	-18.00		69.00	-61.00				
27.00	-19.00		70.00	-62.00				
28.00	-20.00		71.00	-63.00				
29.00	-21.00	1	72.00	-64.00				
30.00	-22.00	2	73.00	-65.00				
31.00	-23.00	2						
32.00	-24.00	5						
33.00	-25.00	8						
34.00	-26.00	7						
35.00	-27.00	9						
36.00	-28.00	8						
37.00	-29.00	9						
38.00	-30.00	9						
39.00	-31.00	8						
40.00	-32.00	10						
41.00	-33.00	14						
42.00	-34.00	10						
43.00	-35.00	8						

DEPARTMENT OF TRANSPORTATION

LOG PILE SHEET

DH-OS C79 (REV. 03/2009)

JOB STAMP

04-264064

Sheet No.

Bridge No. *Navato Cr Rt* Bent No. *3* Footing *27.5 Ft* Pile No. *2*

Hammer Make *Delmag* Model *30-32* E = *66000* ft-lbs

Reference Point HI Elevation ft

Total Length of Pile *82,250* ft Pile I.D. *24' CISS* Final Top of Pile EL *(+17,250)* ft

Date Driven *October 4, 2011* Inspected by *RR*

Penetration (ft)	Tip EL (ft)	Blows/ft
1.00	+7.00	
2.00	+6.00	
3.00	+5.00	
4.00	+4.00	
5.00	+3.00	
6.00	+2.00	
7.00	+1.00	
8.00	+0.00	
9.00	-1.00	
10.00	-2.00	
11.00	-3.00	
12.00	-4.00	
13.00	-5.00	
14.00	-6.00	
15.00	-7.00	
16.00	-8.00	
17.00	-9.00	
18.00	-10.00	
19.00	-11.00	
20.00	-12.00	
21.00	-13.00	
22.00	-14.00	
23.00	-15.00	
24.00	-16.00	
25.00	-17.00	
26.00	-18.00	
27.00	-19.00	
28.00	-20.00	
29.00	-21.00	
30.00	-22.00	
31.00	-23.00	2
32.00	-24.00	5
33.00	-25.00	7
34.00	-26.00	8
35.00	-27.00	8
36.00	-28.00	7
37.00	-29.00	7
38.00	-30.00	7
39.00	-31.00	7
40.00	-32.00	8
41.00	-33.00	5
42.00	-34.00	8
43.00	-35.00	7

Penetration (ft)	Tip EL (ft)	Blows/ft
44.00	-36.00	7
45.00	-37.00	9
46.00	-38.00	9
47.00	-39.00	10
48.00	-40.00	15
49.00	-41.00	13
50.00	-42.00	12
51.00	-43.00	13
52.00	-44.00	13
53.00	-45.00	12
54.00	-46.00	13
55.00	-47.00	14
56.00	-48.00	13
57.00	-49.00	15
58.00	-50.00	14
59.00	-51.00	16
60.00	-52.00	17
61.00	-53.00	16
62.00	-54.00	21
63.00	-55.00	32
64.00	-56.00	40
65.00	-57.00	57
66.00	-58.00	54
67.00	-59.00	88
68.00	-60.00	82
69.00	-61.00	80
70.00	-62.00	
71.00	-63.00	
72.00	-64.00	
73.00	-65.00	

Penetration (ft)	Tip EL (ft)	Blows/ft

DEPARTMENT OF TRANSPORTATION

LOG PILE SHEET

DH-OS C79 (REV. 03/2009)

JOB STAMP

04-264064

Sheet No.

Bridge No. *Navato Cr Rt* Bent No. *4* Footing *27.5 Ft* Pile No. *1*

Hammer Make *Delmag* Model *30-32* E = *66000* ft-lbs

Reference Point HI Elevation ft

Total Length of Pile *82.250* ft Pile I.D. *24' CISS* Final Top of Pile EL *(+17.250)* ft

Date Driven *October 10, 2011* Inspected by *RR*

Penetration (ft)	Tip EL (ft)	Blows/ft	Penetration (ft)	Tip EL (ft)	Blows/ft	Penetration (ft)	Tip EL (ft)	Blows/ft
1.00	+7.00		44.00	-36.00	6			
2.00	+6.00		45.00	-37.00	8			
3.00	+5.00		46.00	-38.00	9			
4.00	+4.00		47.00	-39.00	10			
5.00	+3.00		48.00	-40.00	10			
6.00	+2.00		49.00	-41.00	12			
7.00	+1.00		50.00	-42.00	11			
8.00	+0.00		51.00	-43.00	9			
9.00	-1.00		52.00	-44.00	11			
10.00	-2.00		53.00	-45.00	11			
11.00	-3.00		54.00	-46.00	10			
12.00	-4.00		55.00	-47.00	8			
13.00	-5.00		56.00	-48.00	9			
14.00	-6.00		57.00	-49.00	9			
15.00	-7.00		58.00	-50.00	9			
16.00	-8.00		59.00	-51.00	9			
17.00	-9.00		60.00	-52.00	9			
18.00	-10.00		61.00	-53.00	10			
19.00	-11.00		62.00	-54.00	10			
20.00	-12.00		63.00	-55.00	12			
21.00	-13.00		64.00	-56.00	13			
22.00	-14.00		65.00	-57.00	13			
23.00	-15.00		66.00	-58.00	13			
24.00	-16.00		67.00	-59.00	26			
25.00	-17.00		68.00	-60.00	36			
26.00	-18.00		69.00	-61.00	63			
27.00	-19.00		70.00	-62.00	91			
28.00	-20.00	3	71.00	-63.00	61	For 6"		
29.00	-21.00	3	72.00	-64.00				
30.00	-22.00	3	73.00	-65.00				
31.00	-23.00	6						
32.00	-24.00	7						
33.00	-25.00	7						
34.00	-26.00	5						
35.00	-27.00	5						
36.00	-28.00	3						
37.00	-29.00	3						
38.00	-30.00	3						
39.00	-31.00	3						
40.00	-32.00	3						
41.00	-33.00	4						
42.00	-34.00	5						
43.00	-35.00	6						

DEPARTMENT OF TRANSPORTATION

LOG PILE SHEET

DH-OS C79 (REV. 03/2009)

JOB STAMP

04-264064

Sheet No.

Bridge No. *Navato Cr Rt* Bent No. *4* Footing *27.5 Ft* Pile No. *2*

Hammer Make *Delmag* Model *30-32* E = *66000* ft-lbs

Reference Point HI Elevation ft

Total Length of Pile *82.250* ft Pile I.D. *24' CISS* Final Top of Pile EL *(+17.250)* ft

Date Driven *October 7, 2011* Inspected by *RR*

Penetration (ft)	Tip EL (ft)	Blows/ft
1.00	+7.00	
2.00	+6.00	
3.00	+5.00	
4.00	+4.00	
5.00	+3.00	
6.00	+2.00	
7.00	+1.00	
8.00	+0.00	
9.00	-1.00	
10.00	-2.00	
11.00	-3.00	
12.00	-4.00	
13.00	-5.00	
14.00	-6.00	
15.00	-7.00	
16.00	-8.00	
17.00	-9.00	
18.00	-10.00	
19.00	-11.00	
20.00	-12.00	
21.00	-13.00	
22.00	-14.00	
23.00	-15.00	
24.00	-16.00	
25.00	-17.00	1
26.00	-18.00	1
27.00	-19.00	1
28.00	-20.00	3
29.00	-21.00	3
30.00	-22.00	3
31.00	-23.00	6
32.00	-24.00	7
33.00	-25.00	7
34.00	-26.00	5
35.00	-27.00	5
36.00	-28.00	3
37.00	-29.00	3
38.00	-30.00	3
39.00	-31.00	3
40.00	-32.00	3
41.00	-33.00	4
42.00	-34.00	5
43.00	-35.00	6

Penetration (ft)	Tip EL (ft)	Blows/ft
44.00	-36.00	6
45.00	-37.00	8
46.00	-38.00	9
47.00	-39.00	10
48.00	-40.00	10
49.00	-41.00	12
50.00	-42.00	11
51.00	-43.00	9
52.00	-44.00	11
53.00	-45.00	11
54.00	-46.00	10
55.00	-47.00	8
56.00	-48.00	9
57.00	-49.00	9
58.00	-50.00	9
59.00	-51.00	9
60.00	-52.00	9
61.00	-53.00	11
62.00	-54.00	12
63.00	-55.00	12
64.00	-56.00	13
65.00	-57.00	15
66.00	-58.00	18
67.00	-59.00	26
68.00	-60.00	36
69.00	-61.00	63
70.00	-62.00	91
71.00	-63.00	120
72.00	-64.00	
73.00	-65.00	

Penetration (ft)	Tip EL (ft)	Blows/ft

DEPARTMENT OF TRANSPORTATION

LOG PILE SHEET

DH-OS C79 (REV. 03/2009)

JOB STAMP

04-264064

Sheet No.

Bridge No. *Navato Cr Rt* Bent No. *5* Footing *27.5 Ft* Pile No. *1*

Hammer Make *Delmag* Model *30-32* E = *66000* ft-lbs

Reference Point HI Elevation ft

Total Length of Pile *82.250* ft Pile I.D. *24' CISS* Final Top of Pile EL *(+17.250)* ft

Date Driven *October 10, 2011* Inspected by *RR*

Penetration (ft)	Tip EL (ft)	Blows/ft
1.00	+7.00	
2.00	+6.00	
3.00	+5.00	
4.00	+4.00	
5.00	+3.00	
6.00	+2.00	
7.00	+1.00	
8.00	+0.00	
9.00	-1.00	
10.00	-2.00	
11.00	-3.00	
12.00	-4.00	
13.00	-5.00	
14.00	-6.00	
15.00	-7.00	
16.00	-8.00	
17.00	-9.00	
18.00	-10.00	
19.00	-11.00	
20.00	-12.00	
21.00	-13.00	
22.00	-14.00	
23.00	-15.00	1
24.00	-16.00	1
25.00	-17.00	2
26.00	-18.00	5
27.00	-19.00	7
28.00	-20.00	7
29.00	-21.00	8
30.00	-22.00	7
31.00	-23.00	7
32.00	-24.00	6
33.00	-25.00	7
34.00	-26.00	8
35.00	-27.00	8
36.00	-28.00	9
37.00	-29.00	8
38.00	-30.00	8
39.00	-31.00	7
40.00	-32.00	7
41.00	-33.00	6
42.00	-34.00	7
43.00	-35.00	7
44.00	-36.00	10
45.00	-37.00	10
46.00	-38.00	11
47.00	-39.00	14
48.00	-40.00	11
49.00	-41.00	11
50.00	-42.00	8
51.00	-43.00	9
52.00	-44.00	10
53.00	-45.00	9
54.00	-46.00	9
55.00	-47.00	10
56.00	-48.00	12
57.00	-49.00	11
58.00	-50.00	13
59.00	-51.00	18
60.00	-52.00	17
61.00	-53.00	20
62.00	-54.00	31
63.00	-55.00	22
64.00	-56.00	23
65.00	-57.00	22
66.00	-58.00	20
67.00	-59.00	21
68.00	-60.00	31
69.00	-61.00	27
70.00	-62.00	26
71.00	-63.00	33
72.00	-64.00	43
73.00	-65.00	53

DEPARTMENT OF TRANSPORTATION

LOG PILE SHEET

DH-OS C79 (REV. 03/2009)

JOB STAMP

04-264064

Sheet No.

Bridge No. *Navato Cr Rt* Bent No. *5* Footing *27.5 Ft* Pile No. *2*

Hammer Make *Delmag* Model *30-32* E = *66000* ft-lbs

Reference Point HI Elevation ft

Total Length of Pile *82.250* ft Pile I.D. *24' CISS* Final Top of Pile EL *(+17.250)* ft

Date Driven *October 10, 2011* Inspected by *RR*

Penetration (ft)	Tip EL (ft)	Blows/ft
1.00	+7.00	
2.00	+6.00	
3.00	+5.00	
4.00	+4.00	
5.00	+3.00	
6.00	+2.00	
7.00	+1.00	
8.00	+0.00	
9.00	-1.00	
10.00	-2.00	
11.00	-3.00	
12.00	-4.00	
13.00	-5.00	
14.00	-6.00	
15.00	-7.00	
16.00	-8.00	
17.00	-9.00	
18.00	-10.00	
19.00	-11.00	
20.00	-12.00	
21.00	-13.00	
22.00	-14.00	1
23.00	-15.00	1
24.00	-16.00	2
25.00	-17.00	2
26.00	-18.00	2
27.00	-19.00	2
28.00	-20.00	2
29.00	-21.00	2
30.00	-22.00	2
31.00	-23.00	5
32.00	-24.00	8
33.00	-25.00	10
34.00	-26.00	10
35.00	-27.00	8
36.00	-28.00	9
37.00	-29.00	9
38.00	-30.00	9
39.00	-31.00	5
40.00	-32.00	6
41.00	-33.00	6
42.00	-34.00	7
43.00	-35.00	7
44.00	-36.00	7
45.00	-37.00	7
46.00	-38.00	9
47.00	-39.00	10
48.00	-40.00	9
49.00	-41.00	8
50.00	-42.00	7
51.00	-43.00	8
52.00	-44.00	8
53.00	-45.00	8
54.00	-46.00	9
55.00	-47.00	9
56.00	-48.00	8
57.00	-49.00	10
58.00	-50.00	11
59.00	-51.00	11
60.00	-52.00	12
61.00	-53.00	16
62.00	-54.00	15
63.00	-55.00	16
64.00	-56.00	20
65.00	-57.00	18
66.00	-58.00	18
67.00	-59.00	20
68.00	-60.00	25
69.00	-61.00	28
70.00	-62.00	25
71.00	-63.00	21
72.00	-64.00	32
73.00	-65.00	41

DEPARTMENT OF TRANSPORTATION

LOG PILE SHEET

DH-OS C79 (REV. 03/2009)

JOB STAMP

04-264064

Sheet No.

Bridge No. *Navato Cr Rt* Abut No. *6* Footing *27.5 Ft* Pile No. *1*

Hammer Make *Delmag* Model *30-32* E = *62700* ft-lbs

Reference Point HI Elevation ft

Total Length of Pile *68.850* ft Pile I.D. *Class 200 Alt X* Final Top of Pile EL *(+10.850)* ft

Date Driven *October 10, 2011* Inspected by *RR*

Penetration (ft)	Tip EL (ft)	Blows/ft
1.00	+9.60	
2.00	+8.60	
3.00	+7.60	
4.00	+6.60	
5.00	+5.60	
6.00	+4.60	
7.00	+3.60	
8.00	+2.60	
9.00	+1.60	
10.00	+0.60	
11.00	-0.40	
12.00	-1.40	
13.00	-2.40	
14.00	-3.40	
15.00	-4.40	
16.00	-5.40	
17.00	-6.40	
18.00	-7.40	
19.00	-8.40	
20.00	-9.40	2
21.00	-10.40	2
22.00	-11.40	2
23.00	-12.40	
24.00	-13.40	
25.00	-14.40	
26.00	-15.40	
27.00	-16.40	
28.00	-17.40	
29.00	-18.40	5
30.00	-19.40	9
31.00	-20.40	16
32.00	-21.40	16
33.00	-22.40	15
34.00	-23.40	17
35.00	-24.40	18
36.00	-25.40	21
37.00	-26.40	20
38.00	-27.40	17
39.00	-28.40	16
40.00	-29.40	15
41.00	-30.40	17
42.00	-31.40	16
43.00	-32.40	16

Penetration (ft)	Tip EL (ft)	Blows/ft
44.00	-33.40	14
45.00	-34.40	14
46.00	-35.40	16
47.00	-36.40	17
48.00	-37.40	17
49.00	-38.40	16
50.00	-39.40	15
51.00	-40.40	14
52.00	-41.40	9
53.00	-42.40	13
54.00	-43.40	14
55.00	-44.40	12
56.00	-45.40	20
57.00	-46.40	28
58.00	-47.40	29
59.00	-48.40	24
60.00	-49.40	24
61.00	-50.40	35
62.00	-51.40	27
63.00	-52.40	24
64.00	-53.40	24
65.00	-54.40	20
66.00	-55.40	30
67.00	-56.40	33
68.00	-57.40	38
69.00	-58.40	30
70.00	-59.40	
71.00	-60.40	
72.00	-61.40	
73.00	-62.40	

Penetration (ft)	Tip EL (ft)	Blows/ft

DEPARTMENT OF TRANSPORTATION
LOG PILE SHEET
DH-OS C79 (REV. 03/2009)

JOB STAMP

04-264064

Sheet No.

Bridge No. *Navato Cr Rt* Abut No. *6* Footing *27.5 Ft* Pile No. *2*

Hammer Make *Delmag* Model *30-32* E = *62700* ft-lbs

Reference Point HI Elevation ft

Total Length of Pile *68.850* ft Pile I.D. *Class 200 Alt X* Final Top of Pile EL *(+10.850)* ft

Date Driven *October 10, 2011* Inspected by *RR*

Penetration (ft)	Tip EL (ft)	Blows/ft
1.00	+9.60	
2.00	+8.60	
3.00	+7.60	
4.00	+6.60	
5.00	+5.60	
6.00	+4.60	
7.00	+3.60	
8.00	+2.60	
9.00	+1.60	
10.00	+0.60	
11.00	-0.40	
12.00	-1.40	
13.00	-2.40	
14.00	-3.40	
15.00	-4.40	
16.00	-5.40	
17.00	-6.40	
18.00	-7.40	
19.00	-8.40	
20.00	-9.40	
21.00	-10.40	
22.00	-11.40	
23.00	-12.40	3
24.00	-13.40	3
25.00	-14.40	3
26.00	-15.40	4
27.00	-16.40	3
28.00	-17.40	3
29.00	-18.40	3
30.00	-19.40	3
31.00	-20.40	3
32.00	-21.40	3
33.00	-22.40	4
34.00	-23.40	7
35.00	-24.40	7
36.00	-25.40	7
37.00	-26.40	7
38.00	-27.40	6
39.00	-28.40	6
40.00	-29.40	5
41.00	-30.40	6
42.00	-31.40	7
43.00	-32.40	7

Penetration (ft)	Tip EL (ft)	Blows/ft
44.00	-33.40	7
45.00	-34.40	9
46.00	-35.40	11
47.00	-36.40	11
48.00	-37.40	12
49.00	-38.40	12
50.00	-39.40	18
51.00	-40.40	15
52.00	-41.40	11
53.00	-42.40	11
54.00	-43.40	12
55.00	-44.40	15
56.00	-45.40	25
57.00	-46.40	37
58.00	-47.40	40
59.00	-48.40	37
60.00	-49.40	40
61.00	-50.40	39
62.00	-51.40	29
63.00	-52.40	35
64.00	-53.40	36
65.00	-54.40	37
66.00	-55.40	39
67.00	-56.40	35
68.00	-57.40	37
69.00	-58.40	49
70.00	-59.40	
71.00	-60.40	
72.00	-61.40	
73.00	-62.40	

Penetration (ft)	Tip EL (ft)	Blows/ft

DEPARTMENT OF TRANSPORTATION

PILE QUANTITY & DRIVING RECORD
(DRIVEN PILES)

Form DC-SC78 (REV. 8/81)

JOB STAMP
04-264064

SHEET NO. 48

BRIDGE NO: 27-0089R

ITEM DESCRIPT Class 200 Alt X PILING

BRIDGE NAME Novato creek

TYPE PILE USED

ABUT OR BENT NO. 1 FTG FTG TYPE BOTTOM FTG ELEV.

HAMMER MAKE Delmag MODEL 30-32 E= 66,000 # ft ft

DESIGN BRNG. ~~660~~ 340 REQUIRED BRNG. ~~680~~ 400 BLOW/FT AT REQUIRED BRNG. ~~46~~

PILE DRIVING INSPECTED BY Richard Rosenberg PILE QUANTITY CALC BY RR DATE 10/6/11

PILE CONCRETE PLACING INSP. BY PILE QUANTITY CHECK BY JC DATE 10/24/11

PILE NO.	DATE PILE DRIVEN	BLOWS PER FOOT	DATE PILE CONCRETE PLACED	(1) SPEC. TOP OF PILE ELEV.	(2) SPEC. TIP ELEV.	(3) LENGTH IN LEADS	(4) LENGTH OF CUT-OFF	(5) ACTUAL LENGTH IN GROUND (3-4)	(6) ACTUAL TIP ELEV. (1-5)	(7) PAY LENGTH * SEE NOTE BELOW	REMARKS	PRE DRILL HOLE DEPTH	LENGTH OF RE-BAR REQ.
1	10/6/11	100		9.85	-58	67.85	8	50	-50.4				
2	10/6/11	100		9.85	-58	67.85	10	48	-48.4				

SHEET TOTALS	ITEM NO. EA.	ITEM NO L.F.	FILE CATEGORY 48

* THE PAY LENGTH IS THE ACTUAL LENGTH IN THE GROUND, EXCEPT THAT NO PAY WILL BE MADE FOR THAT LENGTH OF PILE DRIVEN BELOW THE ELEVATION WHERE SPECIFIED TIP AND/OR SPECIFIED BEARING (WHICHEVER IS LOWER) WAS OBTAINED. ALSO, WHEN STEEL PILES ARE SUBSTITUTED FOR CLASS 45-1, 45-2, OR 70 PILING, THE LOWER LIMIT FOR PAYMENT WILL BE NO LOWER THAN THE SPECIFIED TIP ELEVATION.

DEPARTMENT OF TRANSPORTATION

PILE QUANTITY & DRIVING RECORD
(~~DRIVEN PILES~~)

Form DC-SC78 (REV. 8/81)

JOB STAMP: 04-264064

SHEET NO. 48

BRIDGE NO. 27-0089R

ITEM DESCRIPT CISS PILING

BRIDGE NAME Novato Creek Bridge

TYPE PILE USED 24" CISS Pile

ABUT OR BENT NO. Bent 2 FTG ______ FTG TYPE ______ BOTTOM FTG ELEV. 10.6

HAMMER MAKE Del Mag MODEL D 30-32 E= 66,000 @ 10 ft stroke

DESIGN BRNG. 680 Kps REQUIRED BRNG. 680 Kps BLOW/FT AT REQUIRED BRNG. 48

PILE DRIVING INSPECTED BY Richard Rosenberg PILE QUANTITY CALC BY RR DATE 10-4-11

PILE CONCRETE PLACING INSP. BY ______ PILE QUANTITY CHECK BY ______ DATE ______

PILE NO.	DATE PILE DRIVEN	BLOWS PER FOOT	DATE PILE CONCRETE PLACED	(1) SPEC. TOP OF PILE ELEV.	(2) SPEC. TIP ELEV.	(3) LENGTH IN LEADS	(4) LENGTH OF CUT-OFF	(5) ACTUAL LENGTH IN GROUND (3-4)	(6) ACTUAL TIP ELEV. (1-5)	(7) PAY LENGTH * SEE NOTE BELOW	REMARKS	PRE DRILL HOLE DEPTH	LENGTH OF RE-BAR REQ.
1	11-4-11	168		17.25	-65	80'	11.43		-53		Top of Pile 28.68 after Driving		
2	11-4-11	171		17.25	-65	80'	10.43		-52		Top of Pile 27.68		

SHEET TOTALS ITEM NO. 100 0 EA. ITEM NO 107 658 L.F. FILE CATEGORY 48

* THE PAY LENGTH IS THE ACTUAL LENGTH IN THE GROUND, EXCEPT THAT NO PAY WILL BE MADE FOR THAT LENGTH OF PILE DRIVEN BELOW THE ELEVATION WHERE SPECIFIED TIP AND/OR SPECIFIED BEARING (WHICHEVER IS LOWER) WAS OBTAINED. ALSO, WHEN STEEL PILES ARE SUBSTITUTED FOR CLASS 45-1 45-Z, OR 70 PILING, THE LOWER LIMIT FOR PAYMENT WILL BE NO LOWER THAN THE SPECIFIED TIP ELEVATION.

DEPARTMENT OF TRANSPORTATION

PILE QUANTITY & DRIVING RECORD
(DRIVEN PILES)

Form DC-SC78 (REV. 8/81)

JOB STAMP 04-264064

SHEET NO. 48

BRIDGE NO. 27-0089R ITEM DESCRIPT CISS PILING

BRIDGE NAME Novato Creek Bridge TYPE PILE USED 24" CISS Pile

ABUT OR BENT NO. Bent 3 FTG FTG TYPE Pile Ext BOTTOM FTG ELEV -65

HAMMER MAKE Del Mag MODEL D30-32 E= 66000 @ 10'

DESIGN BRNG. 630 Kips REQUIRED BRNG. 680 Kips BLOW/FT AT REQUIRED BRNG. 48

PILE DRIVING INSPECTED BY Richard Rosenberg PILE QUANTITY CALC BY RR DATE 10-4-11

PILE CONCRETE PLACING INSP. BY PILE QUANTITY CHECK BY DATE

PILE NO.	DATE PILE DRIVEN	BLOWS PER FOOT	DATE PILE CONCRETE PLACED	(1) SPEC. TOP OF PILE ELEV.	(2) SPEC. TIP ELEV.	(3) LENGTH IN LEADS	(4) LENGTH OF CUT-OFF	(5) ACTUAL LENGTH IN GROUND (3-4)	(6) ACTUAL TIP ELEV. (1-5)	(7) PAY LENGTH * SEE NOTE BELOW	REMARKS	PRE DRILL HOLE DEPTH	LENGTH OF RE-BAR REQ.
1	10/4/11	128		17.25	-65	82'6"	5.01	77-6"	-60		Top of Pile 21.73 After Driving		
2	10/4/11	80		17.25	-65	82'6"	3.84	78-8	-61		Top of Pile 21.48		

SHEET TOTALS ITEM NO. 106 0 EA. ITEM NO 107 658 L.F. FILE CATEGORY 48

* THE PAY LENGTH IS THE ACTUAL LENGTH IN THE GROUND, EXCEPT THAT NO PAY WILL BE MADE FOR THAT LENGTH OF PILE DRIVEN BELOW THE ELEVATION WHERE SPECIFIED TIP AND/OR SPECIFIED BEARING (WHICHEVER IS LOWER) WAS OBTAINED. ALSO, WHEN STEEL PILES ARE SUBSTITUTED FOR CLASS 45-1 45-2, OR 70 PILING, THE LOWER LIMIT FOR PAYMENT WILL BE NO LOWER THAN THE SPECIFIED TIP ELEVATION.

DEPARTMENT OF TRANSPORTATION

PILE QUANTITY & DRIVING RECORD
(DRIVEN ~~PILES~~)

Form DC-SC78 (REV. 8/81)

JOB STAMP: 04-264064

SHEET NO. 48

BRIDGE NO. 27-0089R

ITEM DESCRIPT CISS PILING

BRIDGE NAME Novato Creek Bridge

TYPE PILE USED 24" CISS Pile

ABUT OR BENT NO. Bent 4 FTG ______ FTG TYPE ______ BOTTOM FTG ELEV -65

HAMMER MAKE Del Mag MODEL 32-30 E= 66 000 x 10'

DESIGN BRNG. 630 REQUIRED BRNG. 630 BLOW/FT AT REQUIRED BRNG. 48

PILE DRIVING INSPECTED BY R Rosaly PILE QUANTITY CALC BY ______ DATE ______

PILE CONCRETE PLACING INSP. BY ______ PILE QUANTITY CHECK BY ______ DATE ______

PILE NO.	DATE PILE DRIVEN	BLOWS PER FOOT	DATE PILE CONCRETE PLACED	(1) SPEC. TOP OF PILE ELEV.	(2) SPEC. TIP ELEV.	(3) LENGTH IN LEADS	(4) LENGTH OF CUT-OFF	(5) ACTUAL LENGTH IN GROUND (3-4)	(6) ACTUAL TIP ELEV. (1-5)	(7) PAY LENGTH * SEE NOTE BELOW	REMARKS	PRE DRILL HOLE DEPTH	LENGTH OF RE-BAR REQ.
1	10/10/11			17.25	-65	82'1"	3	80	~~[illegible]~~		Top of Pile 20.36 after driving		
2	10/7/11	120		17.25	-65	82'6"	2	80	-63.58		Top of Pile 18.88		

SHEET TOTALS | ITEM NO. 106 8 EA. | ITEM NO 107 658 L.F. | FILE CATEGORY 48

* THE PAY LENGTH IS THE ACTUAL LENGTH IN THE GROUND, EXCEPT THAT NO PAY WILL BE MADE FOR THAT LENGTH OF PILE DRIVEN BELOW THE ELEVATION WHERE SPECIFIED TIP AND/OR SPECIFIED BEARING (WHICHEVER IS LOWER) WAS OBTAINED. ALSO, WHEN STEEL PILES ARE SUBSTITUTED FOR CLASS 45-1 45-2, OR 70 PILING, THE LOWER LIMIT FOR PAYMENT WILL BE NO LOWER THAN THE SPECIFIED TIP ELEVATION.

DEPARTMENT OF TRANSPORTATION

PILE QUANTITY & DRIVING RECORD (~~DRIVEN PILES~~)

Form DC-SC78 (REV. 8/81)

JOB STAMP: 04-264064

SHEET NO. 48

BRIDGE NO. 27-0089R

ITEM DESCRIPT CISS PILING

BRIDGE NAME Novato Creek Bridge

TYPE PILE USED 24" CISS Pile

ABUT OR BENT NO. Bent 5 FTG ______ FTG TYPE ______ BOTTOM FTG ELEV. ______

HAMMER MAKE Del Mag MODEL 32-30 E= 66,000 e 10'

DESIGN BRNG. 680 REQUIRED BRNG. 680 BLOW/FT AT REQUIRED BRNG. 62

PILE DRIVING INSPECTED BY R Rosenly PILE QUANTITY CALC BY ______ DATE ______

PILE CONCRETE PLACING INSP. BY ______ PILE QUANTITY CHECK BY ______ DATE ______

PILE NO.	DATE PILE DRIVEN	BLOWS PER FOOT	DATE PILE CONCRETE PLACED	(1) SPEC. TOP OF PILE ELEV.	(2) SPEC. TIP ELEV.	(3) LENGTH IN LEADS	(4) LENGTH OF CUT-OFF	(5) ACTUAL LENGTH IN GROUND (3-4)	(6) ACTUAL TIP ELEV. (1-5)	(7) PAY LENGTH * SEE NOTE BELOW	REMARKS	PRE DRILL HOLE DEPTH	LENGTH OF RE-BAR REQ.
1	10/10/11	51	10/10/11	17.25	-65	82'6"	.75		18		Top of Pile 18.0 after driving		
2	10/10/11	43	10/10/11	17.25	-65	82'6"	.33		17.58		Top of Pile 17.58		

SHEET TOTALS | ITEM NO. 100 8 EA. | ITEM NO 107 658 L.F. | FILE CATEGORY 48

* THE PAY LENGTH IS THE ACTUAL LENGTH IN THE GROUND, EXCEPT THAT NO PAY WILL BE MADE FOR THAT LENGTH OF PILE DRIVEN BELOW THE ELEVATION WHERE SPECIFIED TIP AND/OR SPECIFIED BEARING (WHICHEVER IS LOWER) WAS OBTAINED. ALSO, WHEN STEEL PILES ARE SUBSTITUTED FOR CLASS 45-1, 45-2, OR 70 PILING, THE LOWER LIMIT FOR PAYMENT WILL BE NO LOWER THAN THE SPECIFIED TIP ELEVATION.

DEPARTMENT OF TRANSPORTATION

PILE QUANTITY & DRIVING RECORD (DRIVEN PILES)

Form DC-SC78 (REV. 8/81)

JOB STAMP: 04-264064

SHEET NO. 48

BRIDGE NO. 27-0089R

ITEM DESCRIPT ~~CISS~~ Precast Concrete PILING

BRIDGE NAME Novato Creek Bridge

TYPE PILE USED ~~24" CISS Pile~~ Class 200 Alt. X

ABUT OR BENT NO. Abut 6 FTG ______ FTG TYPE ______ BOTTOM FTG ELEV. 10.6 FT.

HAMMER MAKE Del Mag MODEL 32-30 E= 62,700

DESIGN BRNG. 340 REQUIRED BRNG. 400 BLOW/FT AT REQUIRED BRNG. 12

PILE DRIVING INSPECTED BY Richard Reany PILE QUANTITY CALC BY RR DATE 10/10/11

PILE CONCRETE PLACING INSP. BY ______ PILE QUANTITY CHECK BY ______ DATE ______

PILE NO.	DATE PILE DRIVEN	BLOWS PER FOOT	DATE PILE CONCRETE PLACED	(1) SPEC. TOP OF PILE ELEV.	(2) SPEC. TIP ELEV.	(3) LENGTH IN LEADS	(4) LENGTH OF CUT-OFF	(5) ACTUAL LENGTH IN GROUND (3-4)	(6) ACTUAL TIP ELEV. (1-5)	(7) PAY LENGTH * SEE NOTE BELOW	REMARKS	PRE DRILL HOLE DEPTH	LENGTH OF RE-BAR REQ.
1	10/10/11	1-38		10.85	-58	68	0	68	-58	68			
2	10/10/11	1-49		10.85	-58	68	0	68	-58	68			

SHEET TOTALS — ITEM NO. 104 4 EA. — ITEM NO 103 274 L.F. — FILE CATEGORY 48

* THE PAY LENGTH IS THE ACTUAL LENGTH IN THE GROUND, EXCEPT THAT NO PAY WILL BE MADE FOR THAT LENGTH OF PILE DRIVEN BELOW THE ELEVATION WHERE SPECIFIED TIP AND/OR SPECIFIED BEARING (WHICHEVER IS LOWER) WAS OBTAINED. ALSO, WHEN STEEL PILES ARE SUBSTITUTED FOR CLASS 45-1 45-2, OR 70 PILING, THE LOWER LIMIT FOR PAYMENT WILL BE NO LOWER THAN THE SPECIFIED TIP ELEVATION.

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: LONG LY
Structure Representative
Novato Creek Bridge Project

Date: October 10, 2011

File: 04-MRN-101- 18.6/R22.3
04-264064
Novato Creek Bridge
(Widen)
Br. No. 27-0089R

From: **DEPARTMENT OF TRANSPORTATION**
Division of Engineering Services
Geotechnical Services - MS 5

Subject: Revised Pile Dynamic Analysis and Pile Field Acceptance Criteria: Pile 1 at Bent 3

Attached is a report from this Office containing the revised Pile Dynamic Analysis and Pile Field Acceptance Criteria for Pile 1 at Bent 3 of the above-referenced project. This replaces the report from this Office dated October 7, 2011. The revision is necessary due to information received on October 10, 2011 regarding a change in pile thickness from the bid documents.

If you have any questions or comments regarding this report, please contact Michael K. Harris, P.E. at (916) 227-1058.

for BRIAN LIEBICH, P.E.
Senior Transportation Engineer
Foundation Testing Branch

Attachment

c: R. Stott - SC (Email)
B. Alsamman - SC (Email)
J. Moore - OGDW (Email)
K. Low - SD (Email)
Geodog

MKH:mkh

FOUNDATION TESTING BRANCH

October 10, 2011

04-MRN-101-18.6/R22.3
04-264064
Novato Creek Bridge (Widen)
Bridge Number 27-0089R

Revised Pile Dynamic Monitoring, Analysis and Field Acceptance Criteria:

Pile 1 at Bent 3

October 10, 2011

Project Information

04-MRN-101-18.6/R22.3
04-264064
Novato Creek Bridge (Widen)
Bridge Number 27-0089R

Subject

Revised Pile Dynamic Analysis and Pile Field Acceptance Criteria: Pile 1 at Bent 3

Introduction

This report presents the results of Pile Dynamic Analysis (PDA) performed on one steel pipe pile installed at Bent 3 of the above-referenced project. Additionally, this report presents pile field acceptance criteria for NPS 24 x 0.50 CISS piles of the Novato Creek Bridge (Widen) Project. (Pile thickness was modified from 0.75 in by addendum.) This report replaces the subject report issued by this Office on October 7, 2011.

A site location map is provided for reference in Appendix A. The pile at Bent 3 is a production pile and will be incorporated into the structure. Pile 1 is the first driven pile at Bent 3 and is intended to be representative of the remaining production piles at the Novato Creek Bridge (Widen) foundation. The criteria detailed herein are designed to provide compressive pile acceptance criteria based on wave equation analysis of the behavior of the first pile during installation.

Foundation Description

The Novato Creek Bridge (Widen) Project includes the installation of two (2) plumb NPS 24 x 0.50 CISS piles at each of four (4) bent foundations of the bridge structure. The minimum specified nominal driving resistance for the bent piles at Novato Creek Bridge is 680 kips. All bent piles are specified to be installed to a tip elevation of -65.0 feet, controlled by compression. The required tip elevation for lateral demand is -61.0 feet.

Subsurface Conditions

Stratigraphy at the Novato Creek Bridge Bent 3 can be characterized by Geotechnical Borings R-08-002 (October 30, 2008) and R-08-003 (October 28/29, 2008). The site stratigraphy generally consists of layers of very soft to soft organic silty clay and dense fine to coarse sand with gravel. Soils are underlain by shale bedrock. For a complete description of the subsurface conditions, please view the Log of Test Borings included in the Construction Plans. A Case Damping Factor of 0.70 was used for the PDA monitoring and analysis.

Pile Installation Summary

Initial driving of Pile 1 at Bent 3 took place on October 4, 2011 utilizing a Delmag D30-32 Diesel hammer system. The NPS 24 x 0.50 pile was installed within a shallow corrugated metal pipe section placed in the creek bottom as a fish protector. This spiral-welded pipe pile was 82.7' in length, with internal 1.5' x 0.5" tip protection welded in. Installation of the pile was monitored within the last 30 feet of drive. Hammer refusal was experienced prior to reaching specified tip elevation, and Structure Construction decided to end driving at the tip elevation controlled by lateral demand (-61.0 feet). The restrike scheduled for the following day was cancelled.

Pile Dynamic Monitoring and Analysis

The Contractor utilized a Delmag D30-32 hammer to drive Pile 1 to final tip elevation. According to Structure Construction, the requirement for a driving system submittal was waived for this project due to extenuating circumstances. Apparently piles must be installed in the creek not later than October 15, 2011, and the current drilling contractor is the second one since contract award. Manufacturer's published specifications of the Delmag D30-32 Diesel hammer, as available in the GRLWEAP Hammer Database File, are shown in Table I.

Table I: Hammer Characteristics*

Hammer	Rated Energy	Ram Weight	Max. Stroke
Delmag D30-32	75.44 kip-ft	6.60 kips	13.73 ft

* Source: GRLWEAP Hammer Database File.

Pile Dynamic Analysis (PDA) monitoring was performed on Pile 1 at Bent 3 within the last 25 feet of driving to revised tip elevation, utilizing a Pile Driving Analyzer® Model PAX, Serial No. 3707L, manufactured by Pile Dynamics Inc. Elevation information is based on information provided by Structure Construction and PDA monitoring. Two wireless strain sensor and accelerometer pairs were used to monitor the pile driving. All sensors were mounted on the outer surface of the pile at about 4.30 ft below top of pile. Sensor attachment was aided by the use of a torque wrench to set the fasteners.

Pile 1 was monitored during initial drive from a starting tip elevation of approximately -32.8 feet to an ending tip elevation of approximately -61.0 feet. The hammer was operated at maximum fuel setting. Driving was stopped at a tip elevation of approximately -59.8 feet, after excessively high blow count was observed. PDA monitoring was conducted continuously until this point of the installation. Driving was resumed suddenly by the Contractor, and approximately 4-5 blows were not recorded while PDA was being taken off standby mode. PDA monitoring then resumed continuously until tip elevation of approximately -61.0 feet was reached.

Measured strains and accelerations induced in the pile as a result of driving were used to determine various engineering parameters of interest. Some of the more significant attributes derived for each hammer blow include the maximum energy transferred from the hammer to the pile, maximum pile compressive stresses, and the blow count. Plots depicting these parameters as a function of penetration depth are presented in Appendix B. The results for Pile 1 are summarized in Table III.

Table III. PDA Monitoring Results: Pile 1 at Bent 3

Approx Elevation of Pile Tip at Start of Monitoring Start of Initial Drive End of Drive	 -32.8 ft -61.0 ft
Transferred Energy (EMX) End of Initial Drive	40.8 kip-ft
Peak Maximum Average Compressive Stress (CSX)	35.8 ksi
Peak Maximum Individual Compressive Stress (CSI)	39.5 ksi
Approx Blow Counts at End of PDA Monitoring	120 b/ft

Pile 1

Pile 1 at Bent 3 of the Novato Creek Bridge (Widen) Project appears to have been driven without observed damage while being monitored by Pile Dynamic Analysis during initial drive. The compressive pile driving stresses measured by PDA did not exceed the allowable stresses within the pile. The maximum compressive stress (CSI) recorded at either sensor was observed as 39.5 ksi during the driving event. This represents about 92% of the maximum allowable 42.75 ksi.

During initial driving of Pile 1 at Bent 3, it was observed that the peak resistance to driving (as indicated by several factors: CSI, CSX, Maximum Transferred Energy) appeared to occur at or near end of drive. The estimated capacity of Pile 1 was computed at Blow Number 766 of a total of 772 recorded blows, using the CAse Pile Wave Analysis Program (CAPWAP® Version 2006) software program and was generated from dynamic data obtained while monitoring the pile at an approximate penetration depth of about 65.8 ft (elev. -60.9 ft). The individual blow record was selected from among the highest-energy blows at end of drive detected by the pile driving analyzer during the installation of the pile. CAPWAP® estimated the capacity of Pile 1 at an approximate tip elevation of -60.9 ft (about 0.1 ft below the tip elevation controlled by lateral demand) to be roughly 1047 kips, which is 154% of the specified nominal driving resistance. The observed blow count at Blow Number 766 was 120 blows/ft.

Due to the high blow count observed during driving of Pile 1 and the high apparent driving resistance obtained, a decision was made by Structure Construction to end driving at the tip elevation determined by lateral demand, which is 4.0 feet above the specified tip elevation. The specified elevation is controlled by compressive demand, which is 680 kips nominal driving resistance. The PDA-indicated driving resistance was approximately 1050 to 1060 kips near end of drive, which correlates well to the CAPWAP® estimated capacity of 1047 kips. The decision was also made to cancel the restrike.

Pile Field Acceptance Criteria

Under normally encountered conditions during test pile installation and Pile Dynamic Monitoring, data collected during dynamic monitoring is utilized to produce a relationship between hammer blow counts and pile ultimate capacity. The normally encountered conditions reflect a pile driving event in which the pile moves somewhat proportionally in response to hammer force.

In the case of Pile 1 at Bent 3, the pile shell began shifting to greater end-bearing at an approximate tip elevation of -53.8 ft, suggesting a transition from open-end to plugged condition. The pile encountered a layer of high driving resistance at blow count exceeding 96 blows/ft at approximate tip elevation of -58.8 ft and beyond, with excess compressive capacity. All the other steel shells to be driven in this control group will be considered to have similar excess capacity, when driven into the geotechnical layer resulting in noticeably higher blow counts. Pile 1 at Bent 3 exhibited compressive capacity in excess of the required nominal driving resistance for the control group pile shells, and accomplished this at a shallower tip elevation than that specified for the control group pile shells. Consequently, driven tip elevations of each of the control group piles could be considered acceptable at shallower tip elevations than specified, up to that required for lateral demand, providing similar driving resistances are met. This condition of acceptability has been acknowledged by Mr. Jeffrey Kress, Senior Bridge Engineer, and the Structural Designer, Mr. Kang Low, and eliminates the need for bearing acceptance criteria curves for the control group.

Pile driveability is highly dependent upon soil characteristics; hammer alignment, pile length, pile handling, and adherence to the specifications and industry-accepted driving practices, so engineering judgment should be exercised when applying this information to other piles driven at the site.

Recommendations

This Office recommends the release of all piles in the pile control zone associated with Pile 1 at Bent 3 for construction, namely Bents 2-5. The steel shells are to be installed to the specified tip elevations if excessive blow counts (over 96 blows/ft) are not observed. If excessive blow counts are observed prior to achieving specified tip elevation, pile tips may be requested to be raised up to but no higher than elevation -61.0 feet, as determined by lateral demand. If this elevation cannot be achieved with the Delmag D30-32 hammer, the Contractor may need to propose use of a driving system with greater energy output. In this case, consultation with the Structural and/or Geotechnical Designer is recommended. If the hammer is modified, or if a different hammer is utilized, additional Pile Dynamic Analysis should be performed to verify dynamic characteristics. In order to impart maximum energy to the pile and limit the potential for pile damage, pile and hammer alignment must be properly maintained.

If you have any questions or comments regarding this report, please call Michael K. Harris, P.E. at (916) 227-1058.

10/10/11

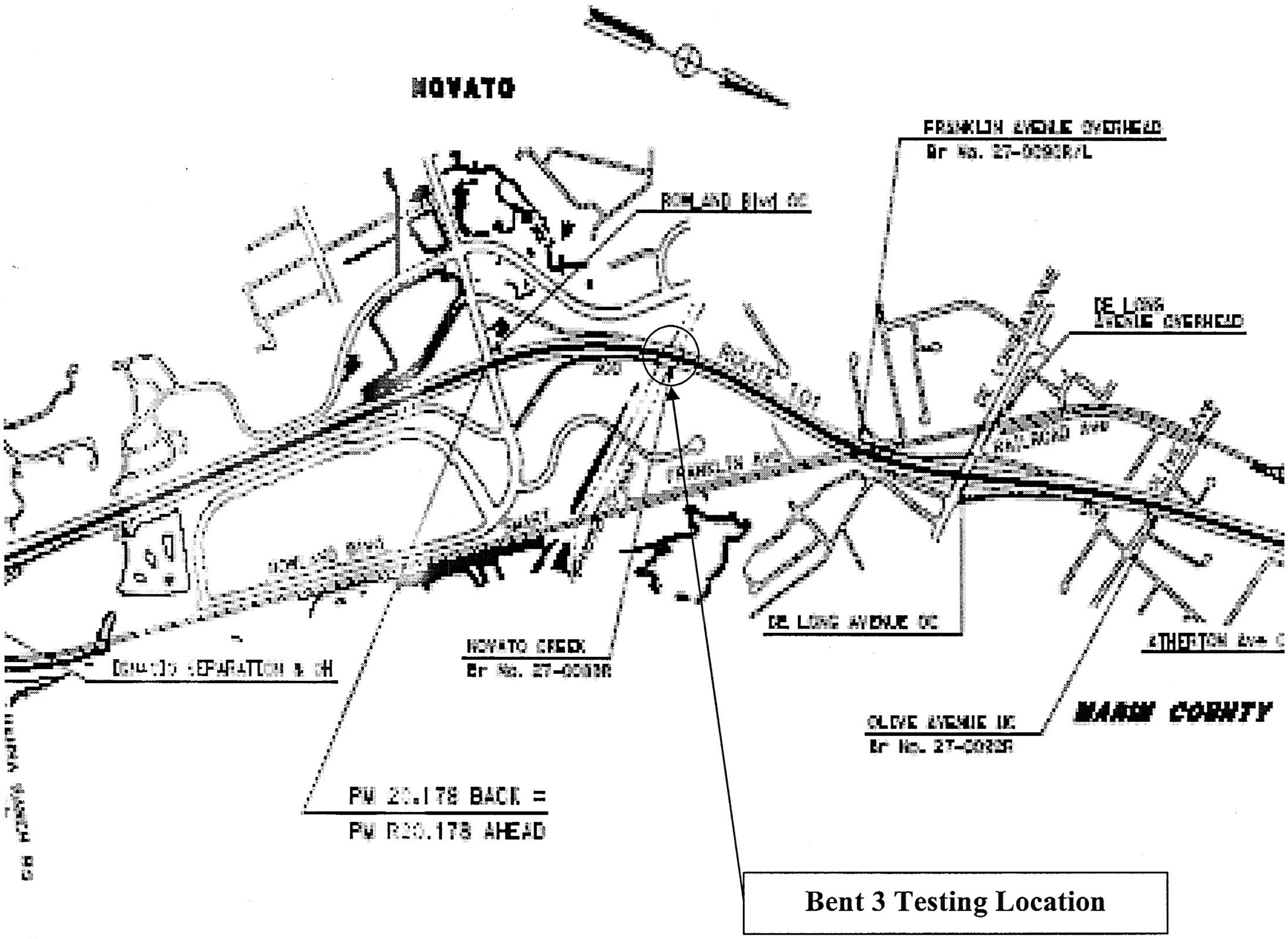
MICHAEL K. HARRIS, P.E.
Transportation Engineer, Civil
Foundation Testing Branch
Office of Geotechnical Support

REGISTERED PROFESSIONAL ENGINEER
MICHAEL KELVIN
HARRIS
No. C 27924
EXP. 3/13/12
CIVIL
STATE OF CALIFORNIA

Caltrans

APPENDIX A

LOCATION MAPS

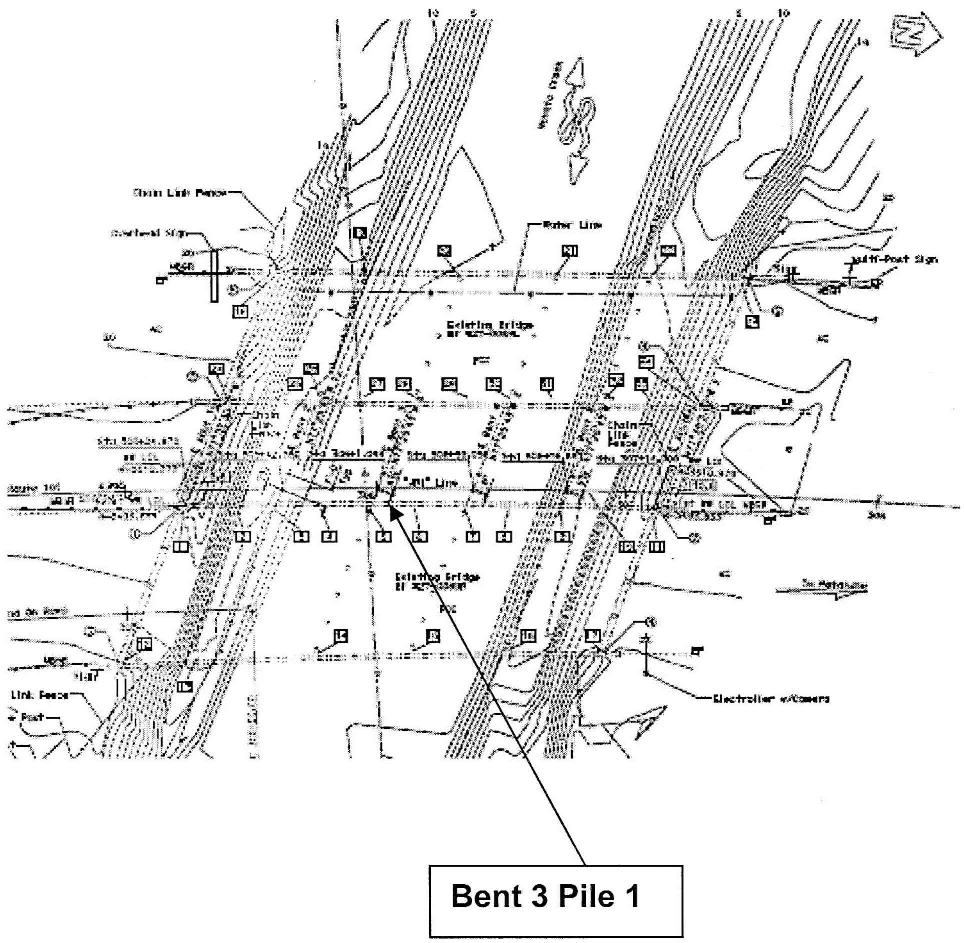


GENERAL SITE LOCATION MAP
Novato Creek Bridge (Widen)
Bent 3 Pile 1 PDA-Monitored Drive

Bridge No. 27-0089R
Contract No. 04-264064
04-MRN-101-18.6/R22.3

NPS 24 x 0.50 Steel Pipe Pile
Installed: 10/4/2011

Caltrans



TESTING LOCATION MAP
Novato Creek Bridge (Widen)
Bent 3 Pile 1 PDA-Monitored Drive

Bridge No. 27-0089R
Contract No. 04-264064
04-MRN-101-18.6/R22.3

NPS 24 x 0.50 Steel Pipe Pile
Installed: 10/4/2011

APPENDIX B

PILE DYNAMIC ANALYSIS

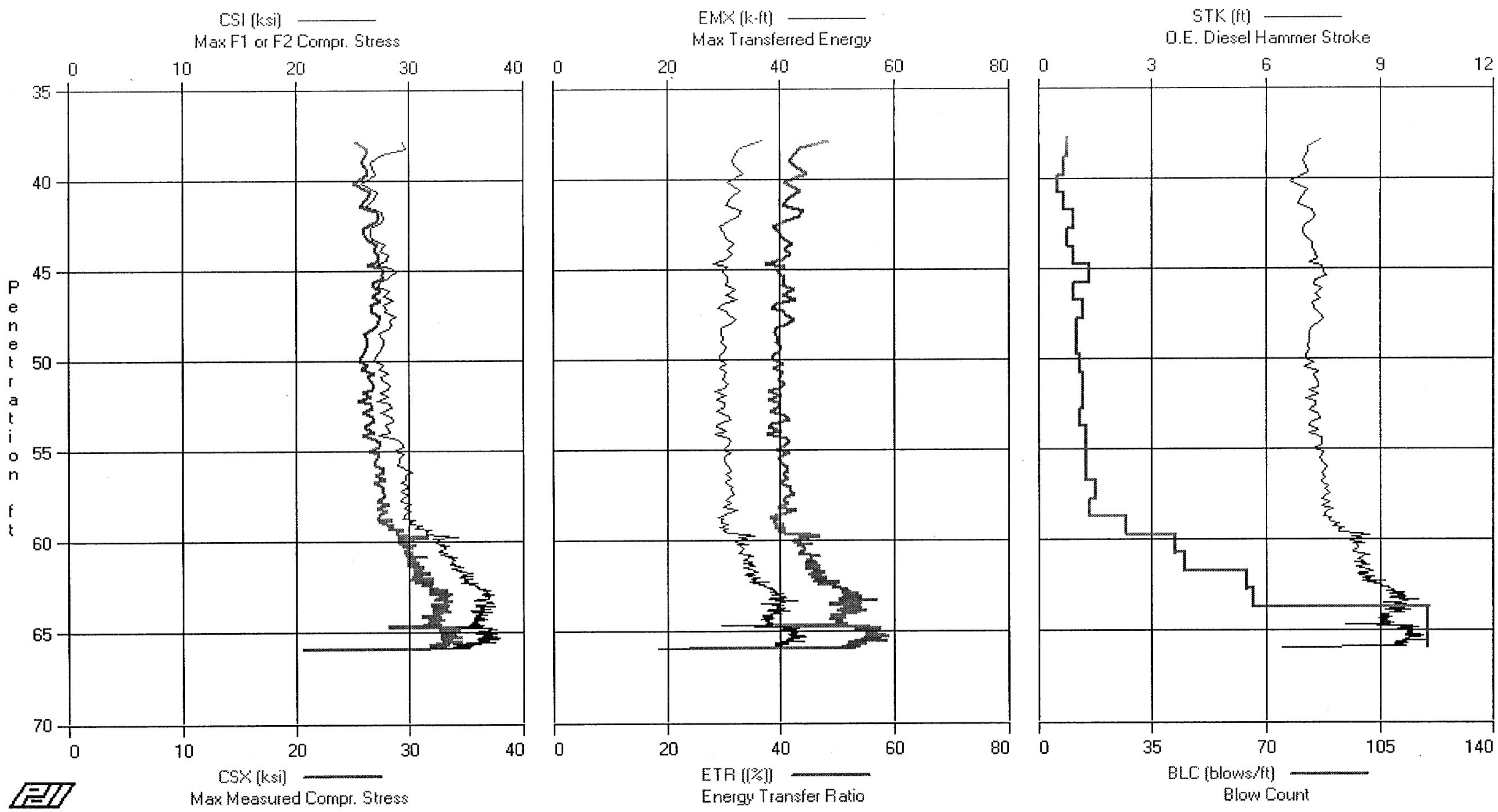
NOVATO CREWEK BRIDGE (WIDEN), BRIDGE NO. 27-0089R: BENT 3 PILE 1
INSTALLATION DRIVE: 10/4/2011, 37.7 FT TO 65.9 FT MONITORED PENETRATION DEPTH; ENGLISH UNITS
DELMAG D30-32 HAMMER

California D.O.T. - Case Method Results

PDIPLOT Ver. 2010.2 - Printed: 10-Oct-2011

Test date: 4-Oct-2011

NOVATO CR. BR. 2011 - TEST PILE_4



Caltrans

MATERIALS INFORMATION

04-120374 ORIGINAL BRIDGE DRIVING RECORD

#27-89R/L

STATE OF CALIFORNIA
DIVISION OF HIGHWAYS
BRIDGE DEPARTMENT

PILE LAYOUT SHEET

JOB STAMP
04-Mrn-101-18.2/23.3 EMP-U-001-1(7)
04-120374(505) 0.9 mi S of Rte 37/101
sep to 1.2 mi N of Atherton Ave

BRIDGE Novato Cr. (Lt) CALC. BY CSF ~~BENT OR~~ ABUT. NO. 1 & 6 SHEET

FOOTING NO. OR TYPE CHECK BY JV FOOTING

HAMMER TYPE Delmag D-36 NUMBER OF PILES 4+4 DESIGN LOAD 70 tons

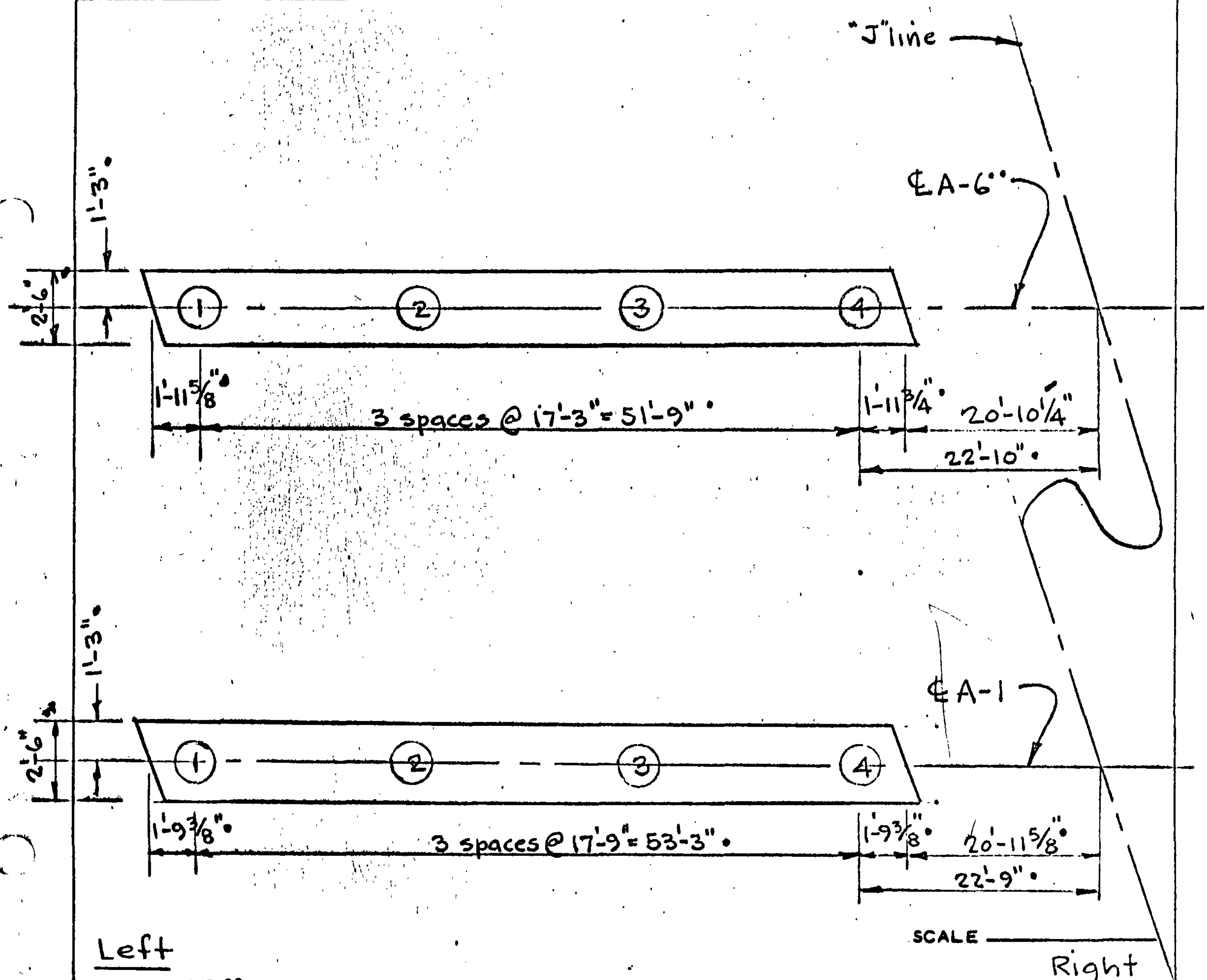
BLOWS PER FT. AT BEARING 13 SPEC. TIP ELEV. varies EST. TIP ELEV. varies

AS BUILT PILE LENGTH - MIN. LENGTH STEEL CAGE N/A

MAXIMUM: — MIN. LENGTH IN LEADS varies

MINIMUM: — MAX. DEPTH DRILLED HOLE 0

AVERAGE: A-1 59'; A-6 70'



SCALE

FORM H-BD C 80

STATE OF CALIFORNIA
DIVISION OF HIGHWAYS
BRIDGE DEPARTMENT

PILE QUANTITY AND DRIVING RECORD

JOB STAMP
04-Mrn-101-18.2/23.3 EMP-U-001-1(7)
04-120374(505) 0.9 mi S of Rte 37/101
sep to 1.2 mi N of Atherton Ave

BRIDGE Novato Cr. (L) FTG. TYPE ____ CALC. BY JV DATE 3-30-72 SHEET 48-71-18

~~BENT OR~~ ABUT. NO. 1 & 6 FOOTING ______ CHECKED BY CJF DATE 4-18-72 ITEM 71 PILING

DATE	PILE NO.	BRG. VAL. TONS	BLWS PER L. FT.	DATE POURED	ELEVATIONS TIP	ELEVATIONS TOP (FOR PAY)	MEAS. LENGTH	LENGTHS IN LEADS	LENGTHS CUT OFF-EXT. +	PAY LENGTH	REMARKS
Abut 1 (Left Br.)											
5-25	1		9/38		-50²	9.3		59.50		59.50	ALL 4 PILES LEFT HIGH DUE TO SOFT DRIVING. Note: all [illegible] 5-29-73 are OK ✓
5-25	2		7/32					59.50		59.50	
5-25	3		7/35					59.50		59.50	
5-25	4		8/32		-50²	9.3		59.50		59.50	
Abut 6 (Left Br.)											
5-24	1		30		-60²	10.3		70.50		70.50	7² to 8² fall Logged
5-24	2		24					70.50		70.50	7² to 8² fall
5-24	3		31					70.50		70.50	
5-24	4		38		-60²	10.3		70.50		70.50	

N.C
5-29-73

INSPECTOR: H. CONRAD SHEET TOTAL 520.00 ✓

JCJF

FORM H-80 C 78

5

STATE OF CALIFORNIA
DIVISION OF HIGHWAYS
BRID E DEPARTMENT

PILE LAYOUT SHEET

JOB STAMP
04-Mrn-101-18.2/23.3 EMP-U-001-1(7)
04-120374(505) 0.9 mi S of Rte 37/101
sep to 1.2 mi N of Atherton Ave

BRIDGE Novato Cr. (Lt.) CALC. BY CSF BENT ~~OR ABUT~~. NO. 2-5 SHEET

FOOTING NO. OR TYPE CHECK BY JV FOOTING

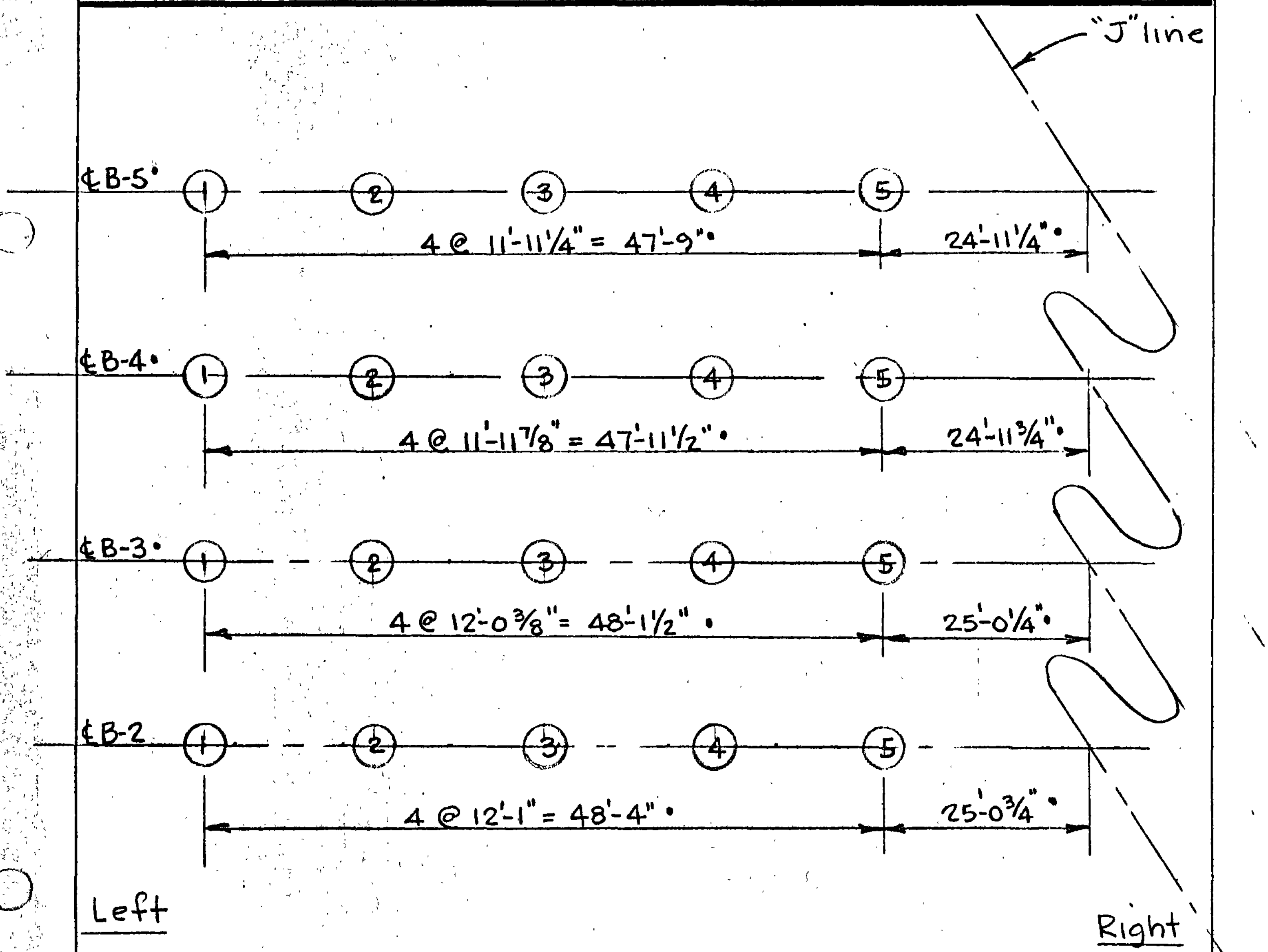
HAMMER TYPE Delmag D-36 NUMBER OF PILES 5+5+5+5 DESIGN LOAD 70 tons

BLOWS PER FT. AT BEARING 13 SPEC. TIP ELEV. varies EST. TIP ELEV. varies

AS BUILT PILE LENGTH –

MAXIMUM: 77²
MINIMUM: 63³
AVERAGE: 70²

MIN. LENGTH STEEL CAGE N/A
MIN. LENGTH IN LEADS varies
MAX. DEPTH DRILLED HOLE Ø



SCALE

FORM H-BD C 80

5

STATE OF CALIFORNIA
DIVISION OF HIGHWAYS
BRIDGE DEPARTMENT

PILE QUANTITY AND DRIVING RECORD

JOB STAMP
04-Mrn-101-18.2/23.3 EMP-U-001-1(7)
04-120374(505) 0.9 mi S of Rte 37/101
sep to 1.2 mi N of Atherton Ave

BRIDGE Novato Cr. (L) FTG. TYPE ____ CALC. BY CSF DATE 3-1-71 SHEET 48-72-1

BENT ~~OR ABUT~~. NO. 2 ~ 5 FOOTING ____ CHECKED BY RWT DATE 5-6-73 ITEM 72 PILING

DATE	PILE NO.	BRG. VAL. TONS	BLWS PER L. FT.	DATE POURED	ELEVATIONS TIP	ELEVATIONS TOP (FOR PAY)	MEAS. LENGTH	LENGTHS IN LEADS	LENGTHS CUT OFF- EXT. +	PAY LENGTH	REMARKS
Bent	2	(Left Br.)									
5-29	1		16		-50^{3}	16.20		66^{50}		66.50	
5-29	2		16		-50^{0}	15.8		65^{75}		65.75	6^{5} drop
5-29	3		25		-48^{8}	15.5		64^{25}		64.25	
5-29	4		16		-49^{1}	15.1		64^{17}		64.17	
5-30	5		20		-48^{5}	14.8		63^{25}		63.25	
Bent	3	(Left Br.)									
5-23	1		32		-55^{6}	16.4		72^{0}		72.00	
5-23	2		36		-55^{0}	16.0		71^{0}		71.00	
5-23	3		20		-53^{8}	15.7		69^{5}		69.50	
5-23	4		14		-54^{2}	15.3		69^{5}		69.50	6½' fall *
5-23	5		12		-54^{5}	15.0		69^{5}		69.50	6½' fall *
Bent	4	(Left Br.)									
5-2[illegible]	1		26		-55^{4}	16.6		72^{0}		72.00	
5-[illegible]	2		[illegible]		-55^{8}	16.2		72^{0}		72.00	Logged
5-23	3		17		-55^{1}	15.9		71^{0}		71.00	
5-23	4		42		-54^{0}	15.5		69^{5}		69.50	
5-2[illegible]	5		36		$-54^{[illegible]}$	15.1		69^{5}		69.50	
Bent	5	(Left Br.)									
5-30	1		50		-60^{2}	16.8		77^{00}		77.00	6^{5} to 7^{0} drop
5-30	2		56		-60^{1}	16.4		76^{50}		76.50	
5-30	3		48		-59^{2}	16.1		75^{25}		75.25	
5-29	4		40		-58^{1}	15.7		73^{75}		73.75	
5-29	5		42		-57^{2}	15.3		72^{50}		72.50	Log 6^{5} to 7^{0} drop
*	BECAUSE OF PILE TAKEUP ON ALL REDRIVE PILES (SEE RIGHT BRIDGE)										
	WILL ACCEPT THESE 2 PILES.										

INSPECTOR: R. JESPERSON, H. CONRAD   SHEET TOTAL 1404^{4} ✓

JWF

FORM H-80 C 78

STATE OF CALIFORNIA
DIVISION OF HIGHWAYS
BRIDGE DEPARTMENT

PILE LAYOUT SHEET

JOB STAMP: 04-Mrn-101-18.2/23.3 EMP-U-001-1(7)
04-120374(505) 0.9 mi S of Rte 37/101
sep to 1.2 mi N of Atherton Ave

BRIDGE Novato Cr. (Rt) CALC. BY CSF ~~BENT OR~~ ABUT. NO. 1 & 6 Rt. SHEET

FOOTING NO. OR TYPE CHECK BY JV FOOTING

HAMMER TYPE Delmag D-36 NUMBER OF PILES 5+5 DESIGN LOAD 70 tons

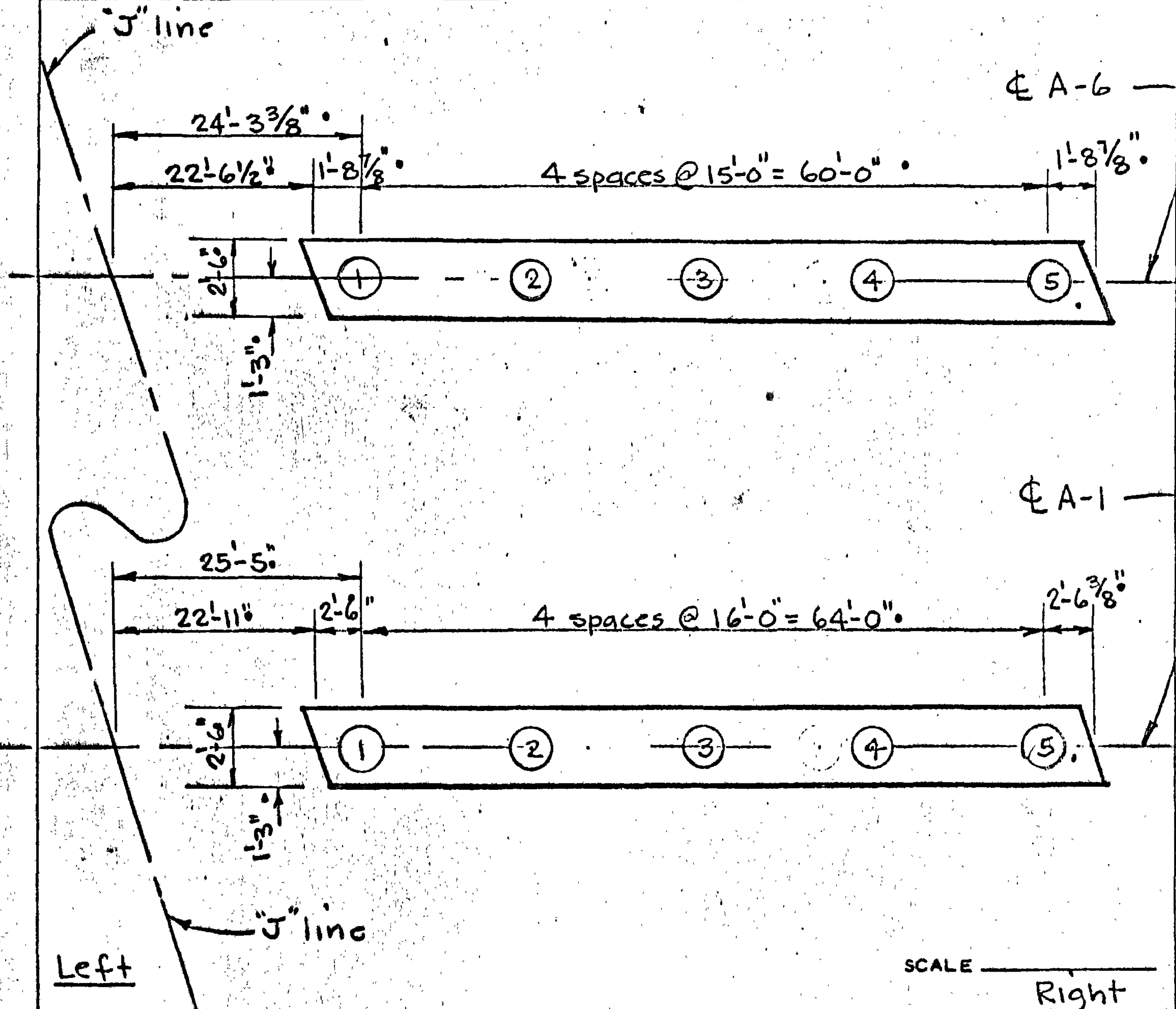
BLOWS PER FT. AT BEARING 13 SPEC. TIP ELEV. varies EST. TIP ELEV. varies

AS BUILT PILE LENGTH - MIN. LENGTH STEEL CAGE N/A

MAXIMUM: MIN. LENGTH IN LEADS varies

MINIMUM: MAX. DEPTH DRILLED HOLE

AVERAGE: A-1 52.5 ; A-6 58.5



Left

SCALE

Right

FORM H-BD C 60

5

STATE OF CALIFORNIA
DIVISION OF HIGHWAYS
BRIDGE DEPARTMENT

PILE QUANTITY AND DRIVING RECORD

JOB STAMP: 04-Mrn-101-18.2/23.3 EMP-U-001-1(7)
04-120374(505) 0.9 mi S of Rte 37/101
sep to 1.2 mi N of Atherton Ave

BRIDGE Novato Cr. (R) FTG. TYPE ____ CALC. BY CSF DATE 3-1-72 SHEET 48-71-19

~~BENT OR~~ ABUT. NO. 1 & 6 FOOTING ____ CHECKED BY JV DATE 4-18-72 ITEM 71. PILING

DATE	PILE NO.	BRG. VAL. TONS	BLWS PER L. FT.	DATE POURED	ELEVATIONS TIP	ELEVATIONS TOP (FOR PAY)	MEAS. LENGTH	LENGTHS IN LEADS	LENGTHS CUT OFF-EXT. +	PAY LENGTH	REMARKS
Abut. 1 (Right Br.)											
5-25	1		8/30		$-45^{\underline{2}}$	7.3		52.50		52.50	1º HIGH REDRIVE
5-25	2		10/35					52.50		52.50	LOG 1º HIGH REDRIVE
5-25	3		10/22					52.50		52.50	1º HIGH REDRIVE
5-25	4		3/25					52.50		52.50	1º High Redrive
5-25	5		3/30		$-45^{\underline{2}}$	7.3		52.50		52.50	1º High Redrive
										NOTE:	
										all Redrive on Tues.	
										May 29 were OK. HC.	
Abut. 6 (Right Br.)											
5-24	1		24		$-50^{\underline{2}}$	8.3		58.50		58.50	
5-24	2		9/35					58.50		58.50	1º High REDRIVE
5-24	3		8/35					58.50		58.50	1º HIGH REDRIVE
5-24	4		8/35					58.50		58.50	1º HIGH REDRIVE
5-24	5		19		$-50^{\underline{2}}$	8.3		58.50		58.50	
									NOTE: all redrives on		
									Wed. May 30 were OK.		
									(35 Blows per foot) HC.		

INSPECTOR: H. CONRAD SHEET TOTAL 555.00 ✓

JCMF

FORM H-BD C 78

5

STATE OF CALIFORNIA
DIVISION OF HIGHWAYS
BRIDGE DEPARTMENT

PILE LAYOUT SHEET

JOB STAMP
04-Mrn-101-18.2/23.3 EMP-U-001-1(7)
04-120374(505) 0.9 mi S of Rte 37/101
sep to 1.2 mi N of Atherton Ave

BRIDGE Novato Cr. (Rt) CALC. BY CSF BENT ~~OR ABUT~~. NO. 2-5 Rt. SHEET

FOOTING NO. OR TYPE CHECK BY JV FOOTING

HAMMER TYPE Delmag D-36 NUMBER OF PILES 6+6+6+6 DESIGN LOAD 70 tons

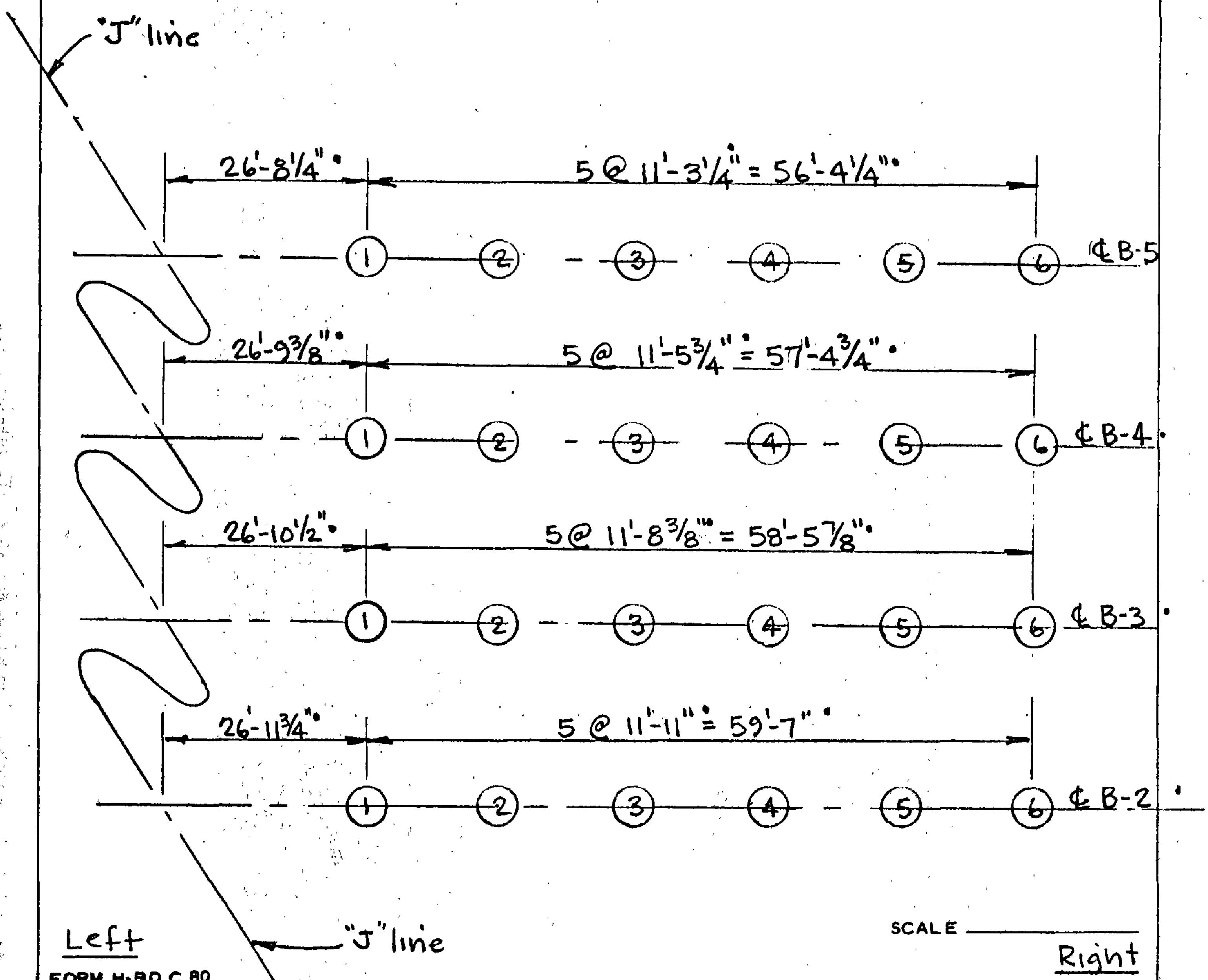
BLOWS PER FT. AT BEARING 13 SPEC. TIP ELEV. varies EST. TIP ELEV. varies

AS BUILT PILE LENGTH – MIN. LENGTH STEEL CAGE N/A

MAXIMUM: 67 5 MIN. LENGTH IN LEADS varies

MINIMUM: 57 8 MAX. DEPTH DRILLED HOLE ~~0~~

AVERAGE: 63 2



Left

SCALE

Right

FORM H-BD C 80

5

STATE OF CALIFORNIA
DIVISION OF HIGHWAYS
BRIDGE DEPARTMENT

PILE QUANTITY AND DRIVING RECORD

JOB STAMP

04-Mrn-101-18.2/23.3 EMP-U-001-1(7)
04-120374(505) 0.9 mi S of Rte 37/101
sep to 1.2 mi N of Atherton Ave

BRIDGE Novato Cr. (R) FTG. TYPE ____ CALC. BY CSF DATE 3-1-72 SHEET 48-72-2

BENT ~~OR ABUT~~. NO. 2-5 FOOTING ____ CHECKED BY RWT DATE 3-6-73 ITEM 72 PILING

DATE	PILE NO.	BRG. VAL. TONS	BLWS PER L. FT.	DATE POURED	ELEVATIONS TIP	ELEVATIONS TOP (FOR PAY)	MEAS. LENGTH	LENGTHS IN LEADS	LENGTHS CUT OFF- EXT. +	PAY LENGTH	REMARKS	Spec Ti
Bent	2		(Right Br.)									
5-29	1		34		-47.0	14.8		61.00		61.00		-17
5-29	2		30		-45.9	13.56		59.50		59.50		-[illegible]
5-25	3		17		-46.0	13.23		59.25		59.25		-[illegible]
5-25	4		17		-44.9	12.89		57.75		57.75	7'-7½ Drop	-[illegible]
5-25	5		17		-45.2	12.56		57.75		57.75	6½'-7' Drop	-[illegible]
..25	6		18		-45.6	12.12		57.75		57.75		-[illegible]
Bent	3		(Right Br.)									
5-23	1		18/44		-52.3	14.12		66.5		66.50	[illegible]	-52
5-24	2		17		-52.7	13.78		66.5		66.50	7' drop	-51
5-24	3		23		-51.0	13.45		64.5		64.50	6½-7' drop	-51
5-24	4		21		-50.7	13.01		63.75		63.75		-50
5-24	5		32		-49.5	12.78		62.75		62.75		-50
5-24	6		40		-50.4	12.34		62.75		62.75	LOG 6½ to 6½ DROP	-50
Bent	4		(Right Br.)									
5-23	1		22		-52.1	14.34		66.5		66.50	6'-6.5' drop	-52
5-24	2		14		-51.0	~~13.9~~ 14.8		65.00		65.00		-51
5-24	3		13/35		-51.3	13.67		65.00		65.00	REDRIVE 1.2 Redrive on 5-25-73 ✡ OK	-51
5-24	4		15		-49.9	13.34		63.25		63.25		-[illegible]
5-24	5		16		-49.8	~~12.9~~ 13.0		62.75		62.75	6' drop	-50
5-24	6		19		-50.1	12.67		62.75		62.75		-50
Bent	5		(Right Br.)						✡ REDRIVE OF PILE #3 WAS OK WILL ACCEPT PILE #2, #4 & #5			
5-29	1		20		-52.7	14.56		67.33		67.33	6½'-7' drop	-53
5-29	2		22		-53.3	14.12		67.50		67.50		-53
5-29	3		11/55		-51.9	13.89		65.75		65.75	REDRIVE 1.0 *	-52
5-29	4		11		-50.7	13.56		64.25		64.25		-51
5-29	5		27		-50.1	13.12		63.25		63.25	6' drop	-50
5-29	6		20		-50.6	12.89		63.50		63.50	6' drop	-50
									* Redrive of Pile was OK WILL ALSO ACCEPT PILE #4		HC 5-30	

INSPECTOR: R. JESPERSON, H. CONRAD

SHEET TOTAL 1516.6 ✓

JCF

FORM H-80 C 78

STATE OF CALIFORNIA
DIVISION OF HIGHWAYS
BRIDGE DEPARTMENT

LOG PILE SHEET

JOB STAMP
04-Mrn-101-18.2/23.3 EMP-U-001-1(7)
04-120374(505) 0.9 mi S of Rte 37/101
sep to 1.2 mi N of Atherton Ave

BRIDGE Novato Creek Br. PILE NUMBER 1 SHEET

BENT OR ABUT. NO. 6 Lt. FOOTING

70.50' LONG
INSP. = H. CONRAD

FOOT	BLOWS / FT.
18	PRE DRILL
36	PUSH
	2
38	2
	2
40	3
	3
42	3
	2
44	3
	4
46	6
	12
48	13
	13
50	14
	13
52	8
	8
54	9
	10
56	12
	12
58	18
	24
60	29
	30
62	28

FOOT	BLOWS / FT.
63	27
64	25
	25
66	23
	24
68	30
	30
70	

FOOT	BLOWS / FT.

FORM H-80 C 79

STATE OF CALIFORNIA
DIVISION OF HIGHWAYS
BRIDGE DEPARTMENT

LOG PILE SHEET

JOB STAMP
04-Mrn-101-18.2/23.3 EMP-U-001-1(7)
04-120374(505) 0.9 mi S of Rte 37/101
sep to 1.2 mi N of Atherton Ave

BRIDGE Novato Cr. PILE NUMBER 2 SHEET 1

BENT OR ABUT. NO. 8-4 FOOTING

INSP. = H. CONRAD

BENT 4 Lt. Br.
PILE 2

FOOT	BLOWS / FT.
[illegible]	
38	2
39	2
40	3
41	3
42	6
[illegible]	8
[illegible]	10
45	14
46	12
47	11
48	11
49	8
50	9
51	9
52	8
53	10
54	12
55	12
56	12
57	18
58	17
59	24
60	28
61	
62	

BENT 5 Lt. Br.
PILE 5

FOOT	BLOWS / FT.
32	PUSH
	2
34	2
	2
36	2
	2
38	4
	4
40	6
	7
42	6
	7
44	8
	12
46	26
	26
48	31
	36
50	38
	38
52	30
	28
54	23
	23
56	26
	28
58	32
	28

FOOT	BLOWS / FT.
60	28
	32
62	34
	41
64	42
66	

✓

FORM H-80 C 79

STATE OF CALIFORNIA
DIVISION OF HIGHWAYS
BRIDGE DEPARTMENT

LOG PILE SHEET

JOB STAMP
04-Mrn-101-18.2/23.3 EMP-U-001-1(7)
04-120374(505) 0.9 mi S of Rte 37/101
sep to 1.2 mi N of Atherton Ave

SHEET ______

BRIDGE Novato Cr. Rt. Br. PILE NUMBER ______

INSP. = H. CONRAD

BENT OR ABUT. NO. ______ FOOTING ______

Bent 3 Pile 6

FOOT	BLOWS/FT.
30	PUSH
	3
32	6
	5
34	6
	7
36	6
	5
38	6
	7
40	5
	10
42	20
	23
44	24
	27
46	23
	22
48	22
	24
50	27
	27
52	30
	35
54	40
56	

PILE LENGTH = 62.75'

Abut. 1 Pile 2

FOOT	BLOWS/FT.
22	PUSH
	1
24	1
	2
26	1
	1
28	2
	1
30	2
	1
32	1
	2
34	2
	6
36	9
	7
38	6
	6
40	5
	4
42	4
	5
44	7
	10
46	9
	10
48	9
49	10

PILE LENGTH = 52.50'

FOOT	BLOWS/FT.