FOR CONTRACT NO.: 04-3A9214

INFORMATION HANDOUT

PERMITS

FAA Determination of No Hazard to Air Navigation for Temporary Structure
(2010 AWP 7398 OE and 2010-AWP-7399-OE)
Cal-OSHA Division of Mining and Tunneling Classifications of Underground Works

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Site Investigation Report
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AT&T Specifications
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DRAINAGE/HYDRAULIC INFORMATION

Non-Storm water Information Handout
Storm Water Information Handout

ROUTE: 04-Ala-880-22.6/24.0

Federal Aviation Administration
Air Traffic Airspace Branch, ASW-520
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2010-AWP-7399-OE
Prior Study No.
2010-AWP-5868-OE

Issued Date: 02/25/2011

Stephen Haas
Alameda County Congestion Managment Agency (ACCMA)
1335 Broadway, Suite 220
Oakland, CA 94612

****DETERMINATION OF NO HAZARD TO AIR NAVIGATION FOR TEMPORARY STRUCTURE****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Drilling Rig I-880/Marina Blvd. Overcrossing (Replace)
Location:	San Leandro, CA
Latitude:	37-42-37.76N NAD 83
Longitude:	122-10-02.38W
Heights:	146 feet above ground level (AGL)
	175 feet above mean sea level (AMSL)

This aeronautical study revealed that the temporary structure does exceed obstruction standards but would not be a hazard to air navigation provided the following condition(s), if any, is (are) met:
As a condition to this Determination, the structure is marked and/or lighted in accordance with FAA Advisory circular 70/7460-1 K Change 2, Obstruction Marking and Lighting, flags/red lights - Chapters 3(Marked),4,5(Red),&12.

See attachment for additional condition(s) or information.

It is required that the FAA be notified at least 5 business days prior to the temporary structure being erected and again when the structure is removed from the site. Notification should be made to this office during our core business hours (Monday through Friday, 9:00 a.m. to 3:00 p.m.) via telephone at LAX OEG KAREN MCDONALD @ 310 725-6557 or FTW OEG JOAN TENGOWSKI @ 817 838-1993. Notification is necessary so that aeronautical procedures can be temporarily modified to accommodate the structure. Voicemail messages are not acceptable notice.

NOTIFICATION IS REQUIRED AGAIN VIA TELEPHONE AT LAX OEG KAREN MCDONALD @ 310 725-6557 or FTW OEG JOAN TENGOWSKI @ 817 838-1993 WHEN THE CRANE IS REMOVED FROM THE SITE FOR NOTICE TO AIRMAN (NOTAM) CANCELLATION.

It is required that the manager of OAKLAND AIRPORT @ 510 563-6436 be notified at least 5 business days prior to the temporary structure being erected and again when the structure is removed from the site.

It is required that the manager of OAKLAND ATCT @ 510 273-7418 be notified at least 5 business days prior to the temporary structure being erected and again when the structure is removed from the site. Additionally,

please provide contact information for the onsite operator in the event that Air Traffic Control requires the temporary structure to be lowered immediately.

Any height exceeding 146 feet above ground level (175 feet above mean sea level), will result in a substantial adverse effect and would warrant a Determination of Hazard to Air Navigation.

This determination expires on 08/25/2012 unless extended, revised or terminated by the issuing office.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

This determination is based, in part, on the foregoing description which includes specific coordinates and heights. Any changes in coordinates and/or heights will void this determination. Any future construction or alteration, including increase to heights, requires separate notice to the FAA.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of a structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination did not include an evaluation of the permanent structure associated with the use of this temporary structure. If the permanent structure will exceed Title 14 of the Code of Federal Regulations, part 77.9, a separate aeronautical study and FAA determination is required.

This determination concerns the effect of this temporary structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

Any failure or malfunction that lasts more than thirty (30) minutes and affects a top light or flashing obstruction light, regardless of its position, should be reported immediately to (877) 487-6867 so a Notice to Airmen (NOTAM) can be issued. As soon as the normal operation is restored, notify the same number.

A copy of this determination will be forwarded to the Federal Aviation Administration Flight Procedures Office if the structure is subject to the issuance of a Notice To Airman (NOTAM).

If you have any questions, please contact our office at (310) 725-6557. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2010-AWP-7399-OE

Signature Control No: 133571919-137822740 (TMP)
Karen McDonald
Specialist

Attachment(s)
Additional Information

Case Description
Map(s)

Additional information for ASN 2010-AWP-7399-OE

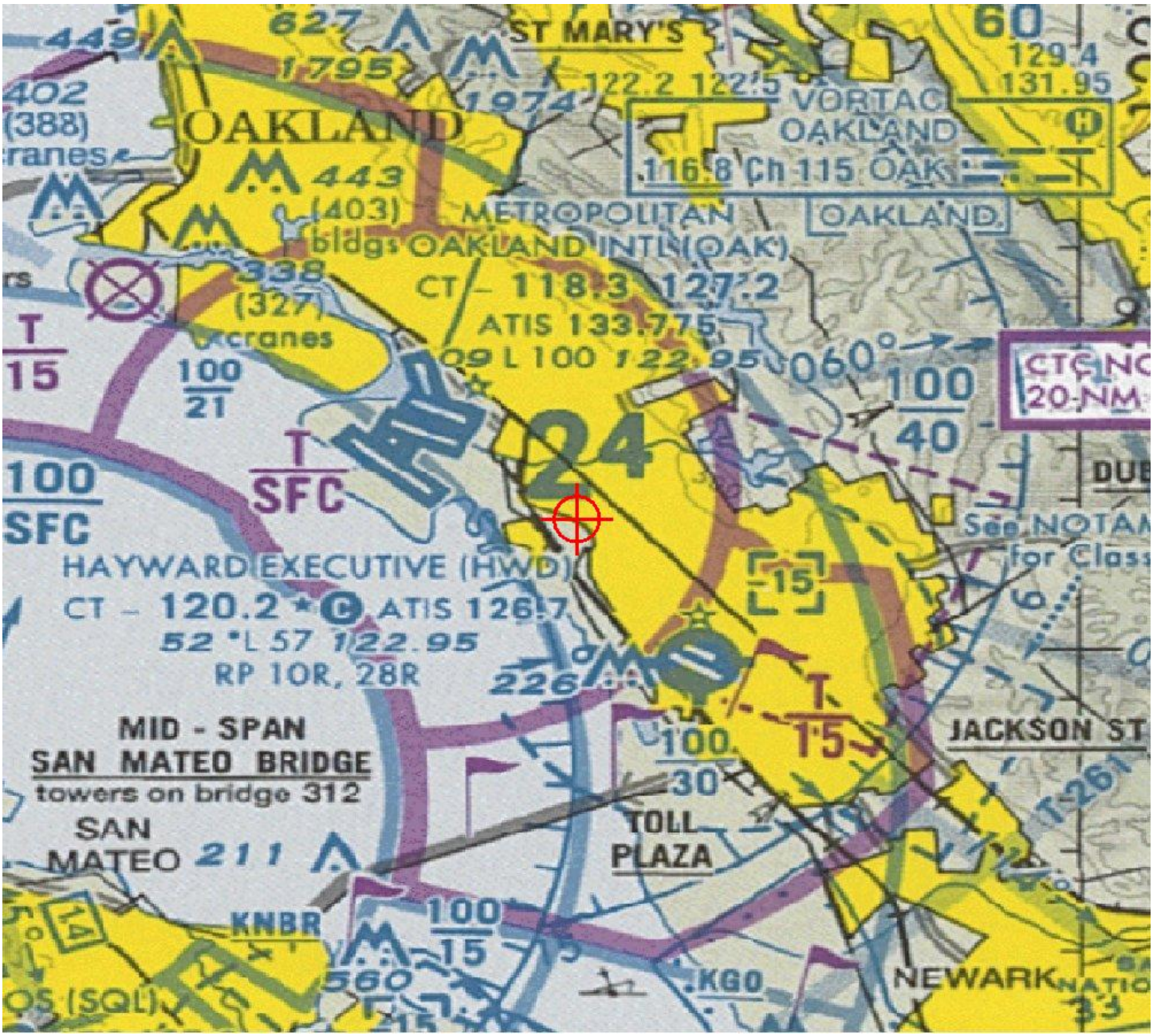
Proposed Drilling Rig has the following IFR effect at Oakland / Metropolitan Oakland Intl (OAK), CA: Raises ILS or LOC RWY 27R LOC MDA from 400 to 480 and Sidestep from 420 to 480 (4D)/440' (2C). The no effect height is 143' MSL. Raises VOR/DME RWY 27L MDA from 420 to 480 (4D)/440' (2C).

POINT OF CONTACT FOR PROJECT IS TIM LEE AT 510 698-6300.

See attached PDF.

Thrasher
Park
Cherry Grove
Park
45
STREET
880
BLVD
20

Sectional Map for ASN 2010-AWP-7399-OE



Federal Aviation Administration
Air Traffic Airspace Branch, ASW-520
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2010-AWP-7398-OE
Prior Study No.
2010-AWP-5867-OE

Issued Date: 02/25/2011

Stephen Haas
Alameda County Congestion Managment Agency (ACCMA)
1335 Broadway, Suite 220
Oakland, CA 94612

****DETERMINATION OF NO HAZARD TO AIR NAVIGATION FOR TEMPORARY STRUCTURE****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Drilling Rig I-880/SR112 Seperation (Davis Street)
Location:	San Leandro, CA
Latitude:	37-43-09.05N NAD 83
Longitude:	122-10-38.52W
Heights:	142 feet above ground level (AGL)
	173 feet above mean sea level (AMSL)

This aeronautical study revealed that the temporary structure does exceed obstruction standards but would not be a hazard to air navigation provided the following condition(s), if any, is (are) met:
As a condition to this Determination, the structure is marked and/or lighted in accordance with FAA Advisory circular 70/7460-1 K Change 2, Obstruction Marking and Lighting, flags/red lights - Chapters 3(Marked),4,5(Red),&12.

See attachment for additional condition(s) or information.

It is required that the FAA be notified at least 5 business days prior to the temporary structure being erected and again when the structure is removed from the site. Notification should be made to this office during our core business hours (Monday through Friday, 9:00 a.m. to 3:00 p.m.) via telephone at LAX OEG KAREN MCDONALD @ 310 725-6557 or FTW OEG JOAN TENGOWSKI @ 817 838-1993. Notification is necessary so that aeronautical procedures can be temporarily modified to accommodate the structure. Voicemail messages are not acceptable notice.

NOTIFICATION IS REQUIRED AGAIN VIA TELEPHONE AT LAX OEG KAREN MCDONALD @ 310 725-6557 or FTW OEG JOAN TENGOWSKI @ 817 838-1993 WHEN THE CRANE IS REMOVED FROM THE SITE FOR NOTICE TO AIRMAN (NOTAM) CANCELLATION.

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It is required that the manager of OAKLAND ATCT @ 510 273-7418 be notified at least 5 business days prior to the temporary structure being erected and again when the structure is removed from the site. Additionally,

please provide contact information for the onsite operator in the event that Air Traffic Control requires the temporary structure to be lowered immediately.

Any height exceeding 142 feet above ground level (173 feet above mean sea level), will result in a substantial adverse effect and would warrant a Determination of Hazard to Air Navigation.

This determination expires on 08/25/2012 unless extended, revised or terminated by the issuing office.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

This determination is based, in part, on the foregoing description which includes specific coordinates and heights. Any changes in coordinates and/or heights will void this determination. Any future construction or alteration, including increase to heights, requires separate notice to the FAA.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of a structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination did not include an evaluation of the permanent structure associated with the use of this temporary structure. If the permanent structure will exceed Title 14 of the Code of Federal Regulations, part 77.9, a separate aeronautical study and FAA determination is required.

This determination concerns the effect of this temporary structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

Any failure or malfunction that lasts more than thirty (30) minutes and affects a top light or flashing obstruction light, regardless of its position, should be reported immediately to (877) 487-6867 so a Notice to Airmen (NOTAM) can be issued. As soon as the normal operation is restored, notify the same number.

A copy of this determination will be forwarded to the Federal Aviation Administration Flight Procedures Office if the structure is subject to the issuance of a Notice To Airman (NOTAM).

If you have any questions, please contact our office at (310) 725-6557. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2010-AWP-7398-OE

Signature Control No: 133571917-137822241 (TMP)
Karen McDonald
Specialist

Attachment(s)
Additional Information

Case Description
Map(s)

Additional information for ASN 2010-AWP-7398-OE

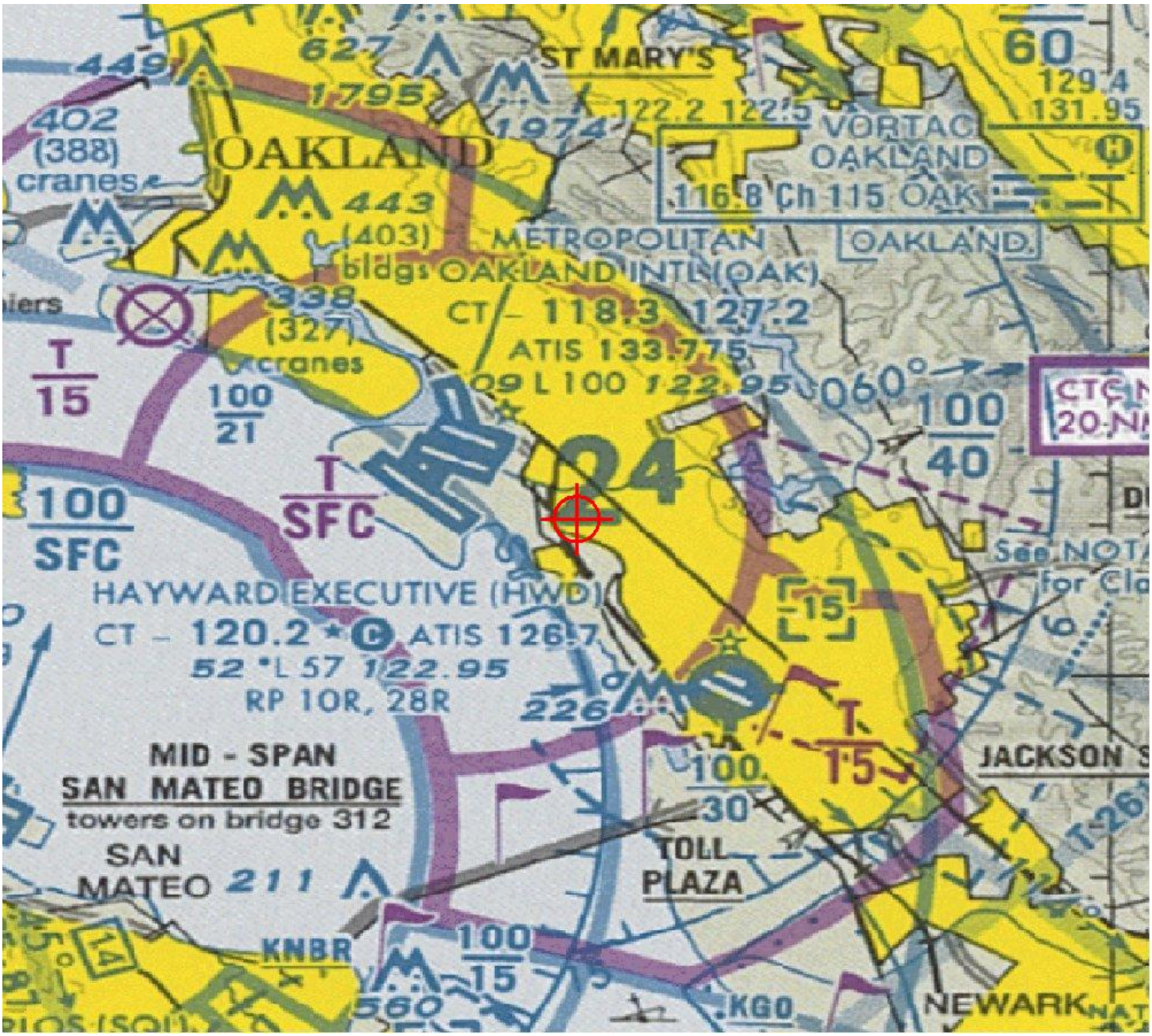
Proposed Drilling Rig has the following IFR effect at Oakland / Metropolitan Oakland Intl (OAK), CA: Raises ILS or LOC RWY 27R LOC MDA from 400 to 480 and Sidestep from 420 to 480 (4D)/440' (2C). The no effect height is 143' MSL. Raises VOR/DME RWY 27L MDA from 420 to 480 (4D)/440' (2C).

POINT OF CONTACT FOR PROJECT IS TIM LEE AT 510 698-6300.

See attached PDF.

FREEWAY
ST.
Cherry Grove
Park
DOOLITTLE
WILLIAMS
30

Sectional Map for ASN 2010-AWP-7398-OE



STATE OF CALIFORNIA EDMUND G. BROWN, JR., Governor

DEPARTMENT OF INDUSTRIAL RELATIONS
DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT
2211 Park Towne Circle, Suite 2
Sacramento, California 95825

Telephone (916) 574-2540
FAX (916) 574-2542

November 15, 2011

WMH Corporation
50 West San Fernando Street, Suite 950
San Jose, CA 95113

Attention: Ben Razeghi (via e-mail: brazeghi@wmhcorporation.com)

Subject: Underground Classification #'s: C058-001-12T thru C064-001-12T

I-880 Southbound HOV Lane Project (Marina Blvd. to Davis St.)

Mr. Razeghi:

The information provided to this office relative to the above project has been reviewed. On the basis of this analysis, Underground Classification of "Potentially Gassy with Special Conditions" has been assigned to the tunnel(s) identified on your submittal. Please retain the original Classification for your records and deliver a true and correct copy of the Classification to the tunnel contractor(s) for posting at the job site.

When the contractor who will be performing the work is selected, please advise them to notify this office to schedule the mandated Prejob Conference with the Division prior to commencing any activity associated with boring of the tunnel(s).

Should you have another bore under construction that is not required to have an Underground Classification (i.e.: less than 30 inches in diameter), please contact the Mining and Tunneling Unit prior to any employee entry of such a space.

If you have any questions on this subject, please contact this office at your earliest convenience.

Sincerely,

Douglas Patterson
Senior Engineer

cc: R. Brockman
File

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

C058-001-12T

CALIFORNIA DEPARTMENT OF TRANSPORTATION
NAME OF TUNNEL OR MINE AND COMPANY NAME

of 111 Grand Avenue, Oakland, CA 94623
MAILING ADDRESS

at I-880 SOUTHBOUND HOV LANE PROJECT (MARINA BLVD. TO DAVIS ST.)
LOCATION

has been classified as ***POTENTIALLY GASSY with Special Conditions***
CLASSIFICATION

as required by the California Labor Code § 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

SPECIAL CONDITIONS

1. A Certified Gas Tester shall perform pre-entry and continuous monitoring of the underground environment to measure Oxygen and detect explosive, flammable, and toxic gasses whenever an employee is working in the underground environment.
2. Mechanical ventilation shall provide for continuous exhaust of fumes and air at any time an employee is working in the underground environment. The primary ventilation fans must be located outside of the underground environment and shall be reversible by a single switch near the fan location.
3. The Division shall be notified immediately if any **Flammable Gas** or **Petroleum Vapor** exceeds 5% of the Lower Explosive Limit.
4. All utilities that may be in conflict with the project shall be identified and physically located (potholed) prior to the start of project operations.

The 30-inch diameter by 181 feet long tunnel bore located beneath Marina Blvd. approximately 100 feet east of the intersection of I-880 and Marina Blvd., San Leandro, Alameda County.

This classification shall be conspicuously posted at the place of employment.

Date November 15, 2011

Douglas Patterson, Senior Engineer

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

C059-001-12T

CALIFORNIA DEPARTMENT OF TRANSPORTATION
NAME OF TUNNEL OR MINE AND COMPANY NAME

of 111 Grand Avenue, Oakland, CA 94623
MAILING ADDRESS

at I-880 SOUTHBOUND HOV LANE PROJECT (MARINA BLVD. TO DAVIS ST.)
LOCATION

has been classified as ***POTENTIALLY GASSY with Special Conditions***
CLASSIFICATION

as required by the California Labor Code § 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

SPECIAL CONDITIONS

1. A Certified Gas Tester shall perform pre-entry and continuous monitoring of the underground environment to measure Oxygen and detect explosive, flammable, and toxic gasses whenever an employee is working in the underground environment.
2. Mechanical ventilation shall provide for continuous exhaust of fumes and air at any time an employee is working in the underground environment. The primary ventilation fans must be located outside of the underground environment and shall be reversible by a single switch near the fan location.
3. The Division shall be notified immediately if any **Flammable Gas** or **Petroleum Vapor** exceeds 5% of the Lower Explosive Limit.
4. All utilities that may be in conflict with the project shall be identified and physically located (potholed) prior to the start of project operations.

The 30-inch diameter by 85 feet long tunnel bore located beneath I-880 approximately 50 feet southeast of the intersection of Williams St. and I-880, San Leandro, Alameda County.

This classification shall be conspicuously posted at the place of employment.

Date November 15, 2011

Douglas Patterson, Senior Engineer

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

C060-001-12T

CALIFORNIA DEPARTMENT OF TRANSPORTATION
NAME OF TUNNEL OR MINE AND COMPANY NAME

of 111 Grand Avenue, Oakland, CA 94623
MAILING ADDRESS

at I-880 SOUTHBOUND HOV LANE PROJECT (MARINA BLVD. TO DAVIS ST.)
LOCATION

has been classified as ***POTENTIALLY GASSY with Special Conditions***
CLASSIFICATION

as required by the California Labor Code § 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

SPECIAL CONDITIONS

1. A Certified Gas Tester shall perform pre-entry and continuous monitoring of the underground environment to measure Oxygen and detect explosive, flammable, and toxic gasses whenever an employee is working in the underground environment.
2. Mechanical ventilation shall provide for continuous exhaust of fumes and air at any time an employee is working in the underground environment. The primary ventilation fans must be located outside of the underground environment and shall be reversible by a single switch near the fan location.
3. The Division shall be notified immediately if any **Flammable Gas** or **Petroleum Vapor** exceeds 5% of the Lower Explosive Limit.
4. All utilities that may be in conflict with the project shall be identified and physically located (potholed) prior to the start of project operations.

The 30-inch diameter by 76 feet long tunnel bore located beneath I-880 approximately 50 feet southeast of the intersection of Williams St. and I-880, San Leandro, Alameda County.

This classification shall be conspicuously posted at the place of employment.

Date November 15, 2011

Douglas Patterson, Senior Engineer

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

C061-001-12T

CALIFORNIA DEPARTMENT OF TRANSPORTATION
NAME OF TUNNEL OR MINE AND COMPANY NAME

of 111 Grand Avenue, Oakland, CA 94623
MAILING ADDRESS

at I-880 SOUTHBOUND HOV LANE PROJECT (MARINA BLVD. TO DAVIS ST.)
LOCATION

has been classified as ***POTENTIALLY GASSY with Special Conditions***
CLASSIFICATION

as required by the California Labor Code § 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

SPECIAL CONDITIONS

1. A Certified Gas Tester shall perform pre-entry and continuous monitoring of the underground environment to measure Oxygen and detect explosive, flammable, and toxic gasses whenever an employee is working in the underground environment.
2. Mechanical ventilation shall provide for continuous exhaust of fumes and air at any time an employee is working in the underground environment. The primary ventilation fans must be located outside of the underground environment and shall be reversible by a single switch near the fan location.
3. The Division shall be notified immediately if any **Flammable Gas** or **Petroleum Vapor** exceeds 5% of the Lower Explosive Limit.
4. All utilities that may be in conflict with the project shall be identified and physically located (potholed) prior to the start of project operations.

The 36-inch diameter by 144 feet long tunnel bore located beneath Davis Street approximately 500 feet east of the intersection of Davis St. and I-880, San Leandro, Alameda County.

This classification shall be conspicuously posted at the place of employment.

Date November 15, 2011

Douglas Patterson, Senior Engineer

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

C062-001-12T

CALIFORNIA DEPARTMENT OF TRANSPORTATION
NAME OF TUNNEL OR MINE AND COMPANY NAME

of 111 Grand Avenue, Oakland, CA 94623
MAILING ADDRESS

at I-880 SOUTHBOUND HOV LANE PROJECT (MARINA BLVD. TO DAVIS ST.)
LOCATION

has been classified as ***POTENTIALLY GASSY with Special Conditions***
CLASSIFICATION

as required by the California Labor Code § 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

SPECIAL CONDITIONS

1. A Certified Gas Tester shall perform pre-entry and continuous monitoring of the underground environment to measure Oxygen and detect explosive, flammable, and toxic gasses whenever an employee is working in the underground environment.
2. Mechanical ventilation shall provide for continuous exhaust of fumes and air at any time an employee is working in the underground environment. The primary ventilation fans must be located outside of the underground environment and shall be reversible by a single switch near the fan location.
3. The Division shall be notified immediately if any **Flammable Gas** or **Petroleum Vapor** exceeds 5% of the Lower Explosive Limit.
4. All utilities that may be in conflict with the project shall be identified and physically located (potholed) prior to the start of project operations.

The 48-inch diameter by 426 feet long tunnel bore located along the south shoulder of Davis Street approximately 500 feet east of the intersection of Davis St. and I-880, San Leandro, Alameda County.

This classification shall be conspicuously posted at the place of employment.

Date November 15, 2011

Douglas Patterson, Senior Engineer

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

C063-001-12T

CALIFORNIA DEPARTMENT OF TRANSPORTATION
NAME OF TUNNEL OR MINE AND COMPANY NAME

of 111 Grand Avenue, Oakland, CA 94623
MAILING ADDRESS

at I-880 SOUTHBOUND HOV LANE PROJECT (MARINA BLVD. TO DAVIS ST.)
LOCATION

has been classified as ***POTENTIALLY GASSY with Special Conditions***
CLASSIFICATION

as required by the California Labor Code § 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

SPECIAL CONDITIONS

1. A Certified Gas Tester shall perform pre-entry and continuous monitoring of the underground environment to measure Oxygen and detect explosive, flammable, and toxic gasses whenever an employee is working in the underground environment.
2. Mechanical ventilation shall provide for continuous exhaust of fumes and air at any time an employee is working in the underground environment. The primary ventilation fans must be located outside of the underground environment and shall be reversible by a single switch near the fan location.
3. The Division shall be notified immediately if any **Flammable Gas** or **Petroleum Vapor** exceeds 5% of the Lower Explosive Limit.
4. All utilities that may be in conflict with the project shall be identified and physically located (potholed) prior to the start of project operations.

The 48-inch diameter by 176 feet long tunnel bore located beneath I-880 approximately 100 feet south of the intersection of Davis St. and I-880, San Leandro, Alameda County.

This classification shall be conspicuously posted at the place of employment.

Date November 15, 2011

Douglas Patterson, Senior Engineer

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

C064-001-12T

CALIFORNIA DEPARTMENT OF TRANSPORTATION
NAME OF TUNNEL OR MINE AND COMPANY NAME

of 111 Grand Avenue, Oakland, CA 94623
MAILING ADDRESS

at I-880 SOUTHBOUND HOV LANE PROJECT (MARINA BLVD. TO DAVIS ST.)
LOCATION

has been classified as ***POTENTIALLY GASSY with Special Conditions***
CLASSIFICATION

as required by the California Labor Code § 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

SPECIAL CONDITIONS

1. A Certified Gas Tester shall perform pre-entry and continuous monitoring of the underground environment to measure Oxygen and detect explosive, flammable, and toxic gasses whenever an employee is working in the underground environment.
2. Mechanical ventilation shall provide for continuous exhaust of fumes and air at any time an employee is working in the underground environment. The primary ventilation fans must be located outside of the underground environment and shall be reversible by a single switch near the fan location.
3. The Division shall be notified immediately if any **Flammable Gas** or **Petroleum Vapor** exceeds 5% of the Lower Explosive Limit.
4. All utilities that may be in conflict with the project shall be identified and physically located (potholed) prior to the start of project operations.

The 60-inch diameter by 115 feet long tunnel bore located beneath I-880 approximately 100 feet south of the intersection of Davis St. and I-880, San Leandro, Alameda County.

This classification shall be conspicuously posted at the place of employment.

Date November 15, 2011

Douglas Patterson, Senior Engineer

GEOTECHNICAL DESIGN & MATERIALS REPORT
ROUTE I-880 SB HOV LANE EXTENSION IMPROVEMENTS
BETWEEN MARINA BLVD. AND
DAVIS STREET INTERCHANGE
ALAMEDA COUNTY, CALIFORNIA
04-ALA-880 22.6/24.0 EA 3A9211

For

WMH CORPORATION
555 12th Street, Suite 1900
Oakland, CA 94607

PARIKH CONSULTANTS, INC.
2360 Qume Drive, Suite A,
San Jose, CA 95131
(408) 452-9000

March 10, 2012 Job No. 206139.GDR

PARIKH
Practicing in the Geosciences

Geotechnical ■
Environmental ■
Materials Testing ■
Construction Inspection ■

WMH Corporation
155 Grand Avenue, Suite 1000
Oakland, CA 94612

Job No.: 206139.GDR
March 10, 2012

Attn: Mr. Timothy Lee

Sub: GEOTECHNICAL DESIGN & MATERIALS REPORT
Route I-880 SB HOV Lane Extension and Other Improvements between Marina Blvd. and Davis Street Interchange, Alameda County, California
04-ALA-880 PM 22.5/24.0, EA 3A9211

Dear Mr. Lee:

Transmitted herewith is the Geotechnical Design & Materials Report (Draft) for the subject project. The report was prepared in accordance with the scope of work outlined in our proposal. The report is for submittal to Caltrans for their review and approval. This report presents the updated pavement design per latest Caltrans comments.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning our findings or conclusions, please feel free to contact this office at (408) 452-9000.

Very truly yours,
PARIKH Consultants, Inc.

Gary Parikh, P.E., G.E.
Project Manager

Attachment: Geotechnical Design & Materials Report

"Approved as to impact on State facilities and conformance with applicable State standards and practices, and the technical oversight were performed as described in the California Department of Transportation A&E Consultant Services Manual."

Caltrans_____

Title_____

Date_____

Caltrans_____

Title_____

Date_____

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GEOTECHNICAL DESIGN & MATERIALS REPORT
ROUTE 880 SB HOV LANE EXTENSION PROJECT
FROM JUST SOUTH OF MARINA BLVD. TO JUST NORTH OF DAVIS STREET
CITY OF SAN LEANDRO, ALAMEDA COUNTY, CALIFORNIA
04-ALA-880 22.6/24.0 EA 3A9211

1. INTRODUCTION

This report presents the results of our geotechnical engineering investigation for the proposed "Route 880 SB HOV Lane Extension Project from must south of Marina Blvd. to just north of Davis Street" in the City of San Leandro, Alameda County, California, hereinafter referred to as "PROJECT". The project includes outside widening of southbound Route 880 and reconstruction of the Davis Street and Marina Boulevard interchanges. The work was performed in general accordance with the scope of work outlined in our proposal to Alameda County Transportation Commission (ACTC). The general location of the project site and its limits are shown on Plate 1, Project Location Map.

This report addresses geotechnical design recommendation for earth retaining system, soundwalls, embankment, corrosion investigation, culverts, and structural pavement sections. The investigation included review of readily available soils and geologic literature pertaining to the site including as-built information and "Log of Test Borings" (LOTB) and pavement as-built data, site reconnaissance, obtaining representative samples and logging soil materials encountered in exploratory borings, performing Cone Penetration Tests (CPT's), laboratory testing of the representative samples, performing engineering analyses, and preparation of this report.

The purpose of this report is to document subsurface geotechnical conditions, provide analyses of anticipated site conditions as they pertain to the project described herein, and to recommend design and construction criteria for the roadway portions of the project. This report also establishes a geotechnical baseline to be used in assessing the existence and scope of changed site conditions, if any. Separate Foundation Reports for the replacement of the existing Marina Blvd. Overcrossing (OC) and Davis Street OC have been submitted separately.

This report is intended for use by the project roadway design engineer, construction personnel, bidders and contractors for information and reference purposes only and should not be construed as project specifications

The purpose of this report is to document subsurface geotechnical conditions, provide analyses of anticipated site conditions as they pertain to the project described herein, and to recommend design and construction criteria for the project. This report also establishes a geotechnical baseline to be used in assessing the existence and scope of changed site conditions, if any.

Due to limitations inherent in geotechnical investigations, it is neither uncommon to encounter unforeseen variations in the soil conditions during construction nor is it practical to determine all such variations during an acceptable program of drilling and sampling for a project of this scope. Such variations, when encountered, generally require additional engineering services to attain a properly constructed project. We, therefore recommend that a contingency fund be provided to accommodate any additional charges resulting from geotechnical engineering technical services that may be required during construction.

2 EXISTING FACILITIES AND PROPOSED IMPROVEMENTS

Existing Facilities

The proposed project site is located in the City of San Leandro, Alameda County from just south of Marina Boulevard (Route 880 "A" Line, Sta. 313+00 to just north of Davis Street ("A" Sta. 385+00). The existing facility for this segment was originally constructed with 0.67 feet thick PCC pavement and has been resurfaced and widened with AC pavement by Caltrans at different times. Route 880 is a north-south connector between Oakland and San Jose. Within the project limits, the freeway is an eight-lane facility with four mixed flow lanes in each direction and shoulders. There is also an auxiliary lane in each direction between the Marina and Davis street ramps. Soundwalls exist along the project corridor on both sides of the freeway. The extent of the proposed project is shown on Plate 1.

The existing bridge structures within the project limits include Marina Boulevard OC, William Street OC, and Davis Street OC. These bridge structures are briefly described below.

- Marina Blvd. OC - The existing bridge is a four-span structure, approximately 255 feet long. The structure was originally built in 1952 and was widened in 1963.
- Williams Street OC - The existing bridge is a two-span structure, approximately 250 feet long. The structure was built in 1994, replacing the old four-span overcrossing built in 1952. The current project does not affect Williams Street OC.
- Davis Street OC - The existing bridge is a seven-span structure, approximately 341 feet long. The structure was originally built in 1952 and was widened in 1971.

Proposed Improvements

The proposed project generally consists of the following design elements:

1. Extend the existing southbound high-occupancy vehicle (HOV) lane from just south of Marina Boulevard to just north of Davis Street;

2. Widen the southbound mainline to the outside to provide the additional width for a standard HOV lane, redelineate the mainline, reconstruct the on-ramp and off-ramps at Davis Street and Marina Blvd. interchanges;

3. Reconstruct bridges over Route 880 at Marina Blvd. and Davis Street to increase the lateral clearance and vertical clearance;

4. Construct Retaining walls and Soundwall at the following locations:

    - Retaining Wall No.1 (Types 1 & 6) – Approximately 1834 feet along southbound Route 880 adjacent to the William Street OC. Typical wall height ranges from 6 feet to 12 feet;
    - Retaining Wall No. 2 (Type 1) – Approximately 420 feet along Route 880 SB on-ramp from Marina Blvd. in the southwest quadrant of the interchange. The wall height ranges from 4 to 12 feet;
    - Retaining Wall No. 3 (Type 1) – Approximately 230 feet along future Davis Street OC approach embankment (north side) on the east side of Route 880. The wall height ranges from 6 to 16 feet;
    - Retaining Wall No. 4 (Type 1) – Approximately 479 feet along future Marina Blvd OC NB off-ramp. The wall height ranges from 6 to 16 feet;
    - Retaining Wall No. SB-1 (Soundwall on Retaining Wall Type 5SW) – Approximately 515 feet along portion of Route 880 SB off-ramp to Davis Street and north side of Davis Street, west of Route 880. The retaining wall height ranges from 6 to 12 feet. The sound wall height ranges from 10 to 12 feet. The existing sound wall will be replaced with the new sound wall on retaining wall.

5. Construct five new cantilever overhead signs.

3. PERTINENT REPORTS AND INVESTIGATION

The following geotechnical investigation report and Caltrans as-built plans were also reviewed to supplement the subsurface soil information for the project:

- PARIKH, November 2006, "Foundation Type Selection Report, I-880 Southbound HOV Lane Widening and Northbound Auxiliary Lane Project, Route 112/880 Separation (Br. No. 33-0168)"
- PARIKH, November 2006, "Foundation Type Selection Report, Route 880 Southbound HOV Lane Widening and Northbound Auxiliary Lane Project, Marina Boulevard Overcrossing (Br. No. 33-0167)"
- Caltrans as-built structural plans for Marina Blvd OC (33-0167) and Route 11/880 Separation (Davis St, 33-0168), as-built roadway plans of 2000 (04-OC7024), 1999 (2134U4), 1998, 1997 (04-123174), 1970 (174364), 1966 (04-292014, 04-602-292021), 1955 (56-14TC21-F), 1952 (53-4TC28), 1950 (51-4TC17), 1949 (O-4TC83F)

4. PHYSICAL SETTING

4.1 Climate

The climate at the project site and the surrounding area is Mediterranean with definite wet and dry seasons. Mild winters, cool summers, small daily temperature ranges and low to medium relative humidity. The temperature at the site typically ranges from 55°F to 73°F in summer and 44°F to 57°F during winter. The average annual rainfall is approximately 22.6 inches per year in the project area; most of the rainfall occurs in the months of October through April.

4.2 Topography and drainage

The topography along the project alignment is relatively flat and decreases from south to north. Some grade differences are noted due to roadway crossing and bridge embankment along the alignment. Route 880 was mostly built at-grade or on fill with approximate Elevation 30 feet between Marina Blvd. and Davis Street OC on Route 880. It is mainly occupied by urban residential/commercial development in the vicinity of the project area. The site drainage is generally by sheet flow towards the southwest, or collected by local drainage systems.

4.3 Man-Made and Natural Features of Engineering and Construction Significance

The subject was considered and was determined to be not significant for the project.

4.4 Regional Geology and Seismicity

The project area is located in the Coast Range Province. The regional structure consists of a complex series of northwest-trending synclines and anticlines with a number of northwest-trending faults.

In the general project area, the geologic unit comprises the Alluvial fan and fluvial deposit deposited during the Holocene period. The deposits generally consist of clay, sand and gravel.

Faults in the vicinity of the project site with a moderate to high potential for surface rupture include the Hayward Fault, Calaveras-Pacines-San Benito Fault, and the San Andreas/N Fault. Significant earthquakes, which have occurred in this area, are generally associated with crustal movements along well-defined active fault zones. A Fault Map, showing the project site location relative to the major active faults in the vicinity, is presented on Plate 4.

5. EXPLORATION

5.1 Drilling and Sampling

Based on the preliminary plans, discussions with the design team, and readily available geotechnical data in the vicinity of the project area, 27 borings were drilled at selected locations to the depths ranging from 5 ft to 100 ft and two Cone Penetration Tests (CPT's) were performed to a depth of 100 feet below the existing ground surface at Marina Blvd and Davis Street sites.

Gregg Drilling & In Situ, Inc. performed the CPT work. The CPTs were conducted using a 60-degree cone pushed into the subsurface. The soil resistance exerted to the tip and side of the cone were recorded and correlated to soil type, classification and strength characteristics.

Selected soil samples were obtained from 2.5-inch I.D. (Modified California, MC) and 1.4-inch I.D. (Standard Penetration Test, SPT) samplers at various depths. The samplers were driven into subsurface soils under the impact of a 140-pound hammer having a free fall of 30 inches. The blow counts are presented on the LOTB in Appendix A. (When correlating

standard penetration data, the blow counts for the Modified California Sampler may be converted to equivalent Standard Penetration Test blow counts by multiplying a factor of 0.65.) The samples were sealed and transported to our laboratory for further evaluation and testing. The field investigation was conducted under the supervision of our field engineer who logged the test borings and prepared the samples for subsequent laboratory testing and evaluation. Table 1 below summarizes the boring program.

TABLE 1 – BORING PROGRAM

Boring/ CPT No.	Station (ft.)	Offset (ft.)	Purpose	Boring Depth (ft)	Approx. Ground Elev. (ft)	Approx. Groundwater Elev. (ft)	Approx. Finish Grade of Widening (ft)
R-1	"A" 314+49	82 Lt.	Pavement	5	30.0	-	29.55
R-2	"A" 320+48	89 Lt.	Pavement	5	30.8	-	30.72
R-3	"A" 324+34	70 Lt.	Pavement	5	30.7	-	30.21
E-4	"MA1" 22+47	111' Rt.	Embankment	30	30.5	8.5	30.22
MR-1	"MA1" 20+67	96' Lt.	Marina Blvd. OC	100	30.0	-	46.48
MR-2	"MA1" 17+10	86' Rt.	Marina Blvd. OC	100	30.0	16.5	25.13
E-5	"MA1" 22+90	126' Lt.	Embankment	30	30.8	7.8	37.92
R-6	"A" 333+88	66' Lt.	Pavement	5	-	-	26.50
RW-7	"A" 341+77	72' Lt.	Retaining Wall	30	30.0	14.0	25.49
R-8/RW-8	"A" 344+42	104' Lt	Retaining Wall	31.5	27.5	10.5	26.04
R-9/RW-9	"A" 347+10	99' Lt.	Retaining Wall	50	26.4	10.4	26.69
R-10/RW-10	"a" 349+97	87' Lt.	Retaining Wall	30	27.6	19.6	27.84
OH-11	"A" 351+40	87' Lt.	Overhead Sign	30	28.5	20.5	28.52
R-12/RW-12	"A" 353+95	87' Lt.	Retaining Wall.	31.5	27.8	19.3	27.91
R-13/OH-13	"A" 365+43	81' Lt.	Overhead Sign	30	30.0	18.0	30.29
R-14	"A" 366+40	82' Lt.	Pavement	5	-	-	30.32
R-15	"A" 369+06	182' Rt.	Pavement	5	-	-	-
R-16	"A" 370+05	417' Rt.	Pavement	5	-	-	-
RW-17	"DA1" 27+40	15' Rt.	Retaining Wall.	30	36.0	22.0	42.95
DV-1	"A" 372+51	81' Rt.	Davis Street OC	100	28.5	-	27.83
DV-2	"A" 373+93	93' Lt.	Davis Street OC	100	28.5	18.5	27.93
R-18/RW-18	"DA1" 21+73	150' Rt.	Embankment	30	31.0	14.0	34.51
R-19/RW-19	"DA1" 19+09	69' Rt.	Embankment	30	29.5	11.5	38.03
R-20	"A" 375+43	410' Lt.	Pavement	5	-	-	-
RW-22	"DL3" 74+65	88' Lt.	Retaining Wall.	50	25.8	12.8	25.69
RW-23	"DL3" 76+36	12' Rt.	Retaining Wall.	30	29.0	17.0	34.59
E-24	"A" 375+16	213' Lt.	Embankment	30	30.5	21.0	29.27
E-25	"A" 376+21	87' Lt.	Embankment	30	26.5	15.0	28.22
R-26	"A" 378+47	143' Lt.	Pavement	5	-	-	-

5.2 Geologic Mapping

The subject was considered and was determined to be not significant for the project.

5.3 Geophysical Studies

The subject was considered and was determined to be not applicable to the project.

5.4 Instrumentation

The subject was considered and was determined to be not applicable to the project.

5.5 Exploration Notes

The Roadway fill material consisting of sandy lean clay and/or clayey sand was typically encountered in the shallow (5 feet) borings. The other (deeper than 5 feet) exploratory borings encountered localized fill, alluvial deposits predominantly consisting of firm to very stiff lean clay with pockets/lenses of loose to medium dense sand.

In general, drilling using the hollow stem auger did not encounter any unusual conditions. No caving of the drilled holes was observed during drilling. However, caving may occur in large diameter drilled holes where the granular soils exist below the water table.

6. GEOTECHNICAL TESTING

6.1 In-Situ Testing

In-situ testing consists of recording blow counts during sampling in the field. The soil samples were obtained during drilling by driving a 2.5-inch I.D. Modified California sampler or a 1.4-inch I.D. Standard Penetration Test (SPT) Sampler into the subsurface soils under the impact of a 140-lb hammer falling through 30 inches. Based on our previous experience, when correlating standard penetration data in similar soils, the blow counts for the Modified California Sampler can be converted to equivalent Standard Penetration Test blow counts by multiplying a factor of 0.65. Based on the average values of the SPT-N values for the soil materials encountered in the field exploration, the subsurface soils are classified generally as firm to very stiff lean clays with pockets/lenses of loose to medium dense sands. The in-situ test results are presented on the LOTB sheets in Appendix A.

6.2 Laboratory Testing

Laboratory tests performed for the study include the following: Laboratory determination of Moisture-Density (California Test Method 226), Atterberg Limits (California Test Method 204), Grain Size Analysis (California Test Method 202), Unconfined Compression Test (California Test Method 221), R-value Test (California Test Method 301), Consolidation Test (California Test Method T219), and Corrosion Test (California Test Method 643). The laboratory test results are included in Appendix B. Laboratory test results for moisture content, unit weight and unconfined compression tests are presented on the LOTB at the appropriate sample depths.

7. GEOTECHNICAL CONDITIONS

7.1 Site Geology

General geologic features pertaining to the site were evaluated by reference to the "Geologic Map and Map Database of the Oakland Metropolitan Area, Alameda, Contra Costa, and San Francisco Counties, California" by R.W. Graymer, 2000 (USGS Map, MF-2342). Based on the geologic map, the site subsoil's consist of Qhaf Alluvial fan and fluvial deposits (Holocene, Qhaf), Basin Deposits (Holocene, Qhb), and Natural Levee Deposits (Holocene, Qhl). A geologic map of the project vicinity is shown on Plate 3.

Qhaf – Alluvial fan and fluvial deposits (Holocene) – Alluvial fan deposits are brown or tan, medium dense to dense, gravely sand or sandy gravel that generally grades upward, to sandy or silty clay.

Qhb – Basin Deposits (Holocene) – Very fine silty clay to clay deposits occupying flat-floored basins at the distal edge of alluvial fans adjacent to the bay mud (Qhbm).

Qhl – Natural Levee Deposits (Holocene) – Loose, moderately to well-sorted sandy or clayey silt grading to sandy or silty clay. Levee deposits border stream channels, usually both banks, and slope away to flatter floodplains and basins.

7.1.1 Lithology

The geological unit present at the project site consists of mainly the alluvial fan and fluvial deposits, basin deposits, and natural levee deposits. The subject was determined to be not applicable for the project.

7.1.2 Structure

The fault that is closest to the project site is Hayward Fault, which is a strike-slip fault. The structures of the geological units such as bedding, folds, fracture, jointing, and foliation were determined to be not applicable for the project.

7.1.3 Existing Slope Stability

The slopes at the project site consist of man-made embankment slope at the existing bridges abutments and the interchanges. No other major slopes are present within the project limits. These existing slopes have gradient of 2(H): 1(V) and flatter and are covered with vegetations and generally appear to be in good condition.

7.2 Subsurface Soil Conditions

Based on the boring data and as-built LOTBs, the subsurface soil conditions at the project site generally consist of the following:

General Location	Reference Borings	Subsurface Soil Conditions
Marina Blvd./I-880 interchange	MR-1, MR-2, E-4, E-5	Stiff to very stiff lean clays with pockets/lenses of loose to dense sands/soft to firm lean clays
Between Marina Blvd. and Davis Street	RW-7 thru RW-10, OH-11, RW-12, OH-13. As-built B-1 (Williams St OC)	Firm to very stiff lean clays with occasional pockets/lenses of loose to medium dense sands/gravels
Davis Street/I-880 interchange	DV-1, DV-2, RW-17-RW-19, RW-22, RW-23, E-24, E-25, As-built LOTB of Davis St	Firm to hard lean clays underlain by interbedded layers of loose to medium dense sand and firm to stiff clays

The near-surface material consists of existing roadway fill which is generally sandy clay and/or clayey sand with gravel. Detailed descriptions of the materials encountered in the exploratory borings are presented in the LOTB in Appendix A “Log of Test Borings”. It should be noted that these descriptions and related information depict subsurface conditions

only at the locations indicated and on the particular date noted on the LOTB. Because of the variability from place to place within soil/rock in general, subsurface soil conditions at other locations may differ from conditions occurring at the locations explored. The abrupt stratum changes shown on the logs may be gradational and relatively minor changes in soil types within a stratum may not be noted due to field limitations. Also, the passage of time may result in a change in the soil conditions at the locations due to environmental changes.

7.3 Water

7.3.1 Surface Water

The terrain at the project site gently slopes towards the south, and the surface water /drainage sheet flows towards the south.

7.3.1.1 Scour

The subject was determined to be not applicable for the roadway project.

7.3.1.2 Erosion

The existing slopes have established landscaping to help control erosion. The subject was determined to be not applicable for the project.

7.3.2 Groundwater

Groundwater was encountered in some of the borings during field exploration in June 2008. The boring numbers, station and offset, approximate ground elevations and approximate groundwater elevations are summarized in Table 1. Majority of the groundwater level was encountered between Elev. 10 feet and Elev. 20 feet).

It is anticipated that groundwater level will vary with the passage of time due to seasonal groundwater fluctuations, surface and subsurface flow, and ground surface run-off as well as other environment factors that may not be present at the time of our investigation.

7.4 Project Site Seismicity

7.4.1 Ground Motions

The project is located in a seismically active part of northern California. Many faults in the San Francisco Bay Area are capable of producing earthquakes that may cause strong ground shaking at the site. The attached Fault Map (Plate 4) presents the locations of the fault systems relative to the project site.

The maximum magnitude (M_{max}) for some of the major faults in the area in accordance with Caltrans 2007 Deterministic PGA map and Fault Database are summarized in Table 2 below.

TABLE 2 - EARTHQUAKE DATA

Fault	Estimated Closest Distance to the Project Area (miles)	M_{max}
Hayward Fault Zone (Northern Section; strike-slip)	2.2	7.3
Calaveras Fault Zone (Northern Calaveras Section; strike-slip)	10.6	7.4
San Andreas Fault Zone (Peninsula Section; strike-slip)	16.5	7.9
Silver Creek Fault (Reverse)	11.9	7.1

7.4.2 Ground Rupture

Since no active faults pass through the project site, the potential for fault rupture is low.

8. GEOTECHNICAL ANALYSIS AND DESIGN

8.1 Dynamic Analysis

8.1.1 Parameter Selection

Caltrans has recently released the 2009 Seismic Design Criteria. Seismic design of bridge structures type-selected after September 30, 2009 will follow the 2009 criteria. Bridge structures type-selected prior to September 30, 2009 may follow Seismic Design Criteria v. 1.4 (June 2006). The two bridge structures of the project (Davis St OC and Marina Blvd OC) went through type selection process in June

2009, and these two structures have been designed in accordance with Seismic Design Criteria v. 1.4 (June 2006).

Based on the available boring information in the vicinity of the project site, the subsurface soil conditions at the project site generally matches the criteria for Soil Type D, as per Caltrans Seismic Design Criteria (Version 1.4, June 2006). Based on Caltrans Seismic Design Criteria and the above information, the seismic design criteria are as follows:

1. Governing Fault = Hayward Fault (strike-slip; Mw=7.5)
2. Closest Distance to Fault = 2.2 miles
3. PBA = 0.6 g
4. Design ARS Curve = Caltrans Seismic Design Criteria June 2006 Version 1.4 Figure B.7 for Soil Type D with (1) 20% increase of spectral accelerations (S_a) for structural periods ≥ 1 sec. (2) No change in S_a for structural periods ≤ 0.5 sec. and (3) Linear interpolation of S_a for structural periods between 0.5 sec. and 1 sec.

A copy of the ARS Design Curve is included on Plate No. 5 of this report.

8.1.2 Analysis

The project is for roadway widening along Route 880 and structure replacements at Davis Street OC and Marina Blvd OC. Retaining walls are planned for cut for roadway widening, new embankment at the bridge approaches, and ramp widening to accommodate raised grades at the interchanges. No specific seismic analyses are required for Caltrans standard retaining walls.

8.1.3 Liquefaction Potential

Liquefaction is a phenomenon in which saturated cohesionless soils are subject to a temporary but essentially total loss of shear strength under the reversing, cyclic shear stresses associated with earthquake shaking. Submerged cohesionless sands and silts of low relative density are the type of soils, which usually are susceptible to liquefaction. Clays are generally not susceptible to liquefaction.

Based on the field boring logs, CPT and available data, the majority of the soils encountered during our investigation are mainly firm to very stiff lean/fat clay and medium dense to very dense clayey sand. Generally, the liquefaction potential at the proposed project site is considered to be relatively low. We do not anticipate global failure due to these conditions. Localized settlement is anticipated to be small and considered insignificant for the roadway project.

A layer of loose to medium dense sand/silty sand was encountered at approximate Elev. -1 to -8 feet (depth of 29 feet to 36 feet bgs) at Davis St OC as indicated in the exploration data of 2008. To further evaluate the liquefaction potential, we have also referenced the as-built LOTB of Davis St OC (Route 112/17 Separation, #33-0168). Based on as-built Borings B-3 (1967) and B-7 (1951), the materials within the zone also include stiff clays and compact to dense sand. It appears that some of the relatively loose to medium dense sand layers/lenses could be isolated, but still subject to triggering of liquefaction and lose strength. We have considered liquefaction potential of the zone in foundation design of the Davis St OC.

In our opinion, the liquefaction potential within the project site is generally relatively low to moderate. Based on the evaluation, the impact of the post-liquefaction settlement on the roadway should be relatively small because:

- The potential liquefiable zone is deep and also contains stiff clays and compact to dense sand (non-liquefiable).
- The potentially liquefiable soil layers are generally covered by predominantly cohesive soils, which tend to serve as a “soil mat” and should reduce the potential impact of liquefaction.
- The post-liquefaction settlement probably would be random and localized and could spread out over some distance/area.

For a roadway project, we do not see a need to implement a mitigation program.

8.2 Cuts and Excavations

Cuts and excavations will be for pavement construction, roadway widening, structure foundations, and installation of underground storm drain culverts and public utilities.

8.2.1 Stability

Based on information provided by the designer, the proposed roadway widening requires cut into existing sloping ground along southbound Route 880 between approximately "A" Sta. 335+75 to 355+80). This is from north of Marina Blvd to north of Williams Street OC. The existing slope is at approximately 2H:1V and in stable condition. A portion of the cut will be retained by Retaining Wall No. 1. Use of temporary shoring will be required to construct portions of this retaining wall due to close proximity of existing building structures near the top of the cut. Due to the physical constraints of the project site, temporary shoring may also be required for structure foundations, and installation of underground storm drain culverts and public utilities

8.2.2 Rippability

Based on the investigation, rippability does not appear to be a concern for construction.

8.2.3 Grading Factor

Source of the fill may include the fill generated from the cuts (as long as the on-site native soil meets the project specifications) planned for the project. Fill may also be imported from outside borrow sources. The source of borrow is unknown at the time of report preparation. Based on previous experience, for preliminary estimate, a grading factor of 0.9 may be assumed for import materials.

8.3 Embankments

Embankments are required at the abutments for the proposed modification of Davis Street and Marina Blvd Interchanges. Based on information provided, a maximum embankment height on the order of 25 feet is proposed. At both Davis Street and Marina Blvd, the new approach embankments will abut existing embankments. At Marina Blvd, the approach embankments will have side slopes (2H:1V or flatter) similar to existing condition. At Davis Street, in addition to side slopes (2H:1V or flatter), the embankment in the northeast quadrant will be retained by Retaining Wall No. 3.

The boring data indicates that the subsurface soil conditions generally consist of firm to stiff clay in the upper 30 feet overlying sand layer and more stiff clays at depth. The clay layers were considered in the settlement analysis. The evaluation of the consolidation settlements under the new fill was based on the consolidation test results, understanding of the consolidation behavior of the clay and empirical correlations in the literatures. Based on the results of the settlement analyses, the consolidation settlements are estimated to be on the order of 2.7 inches at Davis Street and 3 inches Marina Blvd, respectively. Majority of settlements are in the overconsolidated/elastic range. A 30-day settlement period is recommended for ground adjustment under the 25-foot embankment.

Although up to 25 ft of embankment is proposed, the new embankment would abut the existing approach fill and on top of exiting side slopes. Also, the site subsoils consist of upper clay layer with shear strength over 1 ksf per the boring data. Since fill placement and compacting still take time, a normal earthwork sequence, say, limit to approx. 2 feet of new fill placement per day may suffice. We do not see a need to further break the embankment construction into two stages.

It is recommended that settlement platforms be installed and settlement be monitored per California Test 112. As a common practice, this is typically handled by the project Resident Engineer. It is recommended that a minimum of 3 to 4 settlement platforms be installed per abutment since earthwork and construction equipment tend to destroy some platforms during fill placement.

8.4 Earth Retaining System

Due to right-of-way and other geometric constraints, the project will require construction of five retaining walls (one will support a soundwall). Information of approximate wall locations, length and maximum wall heights provided by the designer are summarized in Table 3 below. The subsurface soil conditions and design considerations of each of the retaining walls are discussed below. For the project, the wall design is based on Caltrans 2006 standard plans. Calculations of bearing capacities of the walls are attached in Appendix C of the report.

TABLE 3 - SUMMARY OF PROPOSED RETAINING WALLS

Wall No.	Approximate Wall Location	Max. Wall Design Height (ft)	Approx. Length (ft)	Proposed Wall Type
RW No. 1	Along SB I-880, north of Marina Blvd to north of Williams St OC (Approx. "A" Sta. 339+20 to 357+30)	12	1834	Types 1 & 6
RW No. 2	Along I-880 SB on-ramp from Marina Blvd, (Approx. "ML1" Sta. 27+50 to 31+45)	12	420	Type 1
RW No. 3	Along Davis St OC east approach embankment in the northeast quadrant of the interchange (Approx. Sta. "DA1" 24+95 to 27+24	16	230	Type 1
RW No. 4	I-880 NB diagonal off-ramp to Marina Blvd (Approx. "MR1" Sta. 26+53 to "MA1" 25+00	16	479	Type 1
RW SB-1	I-880 SB off-ramp and Davis St. (retaining wall with masonry block; soundwall) (Approx. " DA1" 16+50 to "DL3" 76+90)	12	515	Types 5SW & 5SWB

Retaining Wall No. 1 (Types 1 and 6)

The wall is to retain the cut due to outside widening of I-880 SB between north of Marina Blvd and north of Williams St OC ("I-880 Line", Sta. 339+20 to 357+30 approx.) The wall height varies from 6 feet to 12 feet. The elevation at the bottom of footing generally varies from Elev. 21 to 25 feet. At "A" Sta. 340+00, 346+20 & 353+50, there are standard overhead signs mounted on the wall. Based on the boring data and soil strength, we have subdivided the wall into two segments: "A" Sta. 339+20 to 347+20 and "A" Sta. 347+20 to "A" Sta. 357+30.

Sta. 339+20 to 347+20 Approx. The reference boring data include RW-7, RW-8 and RW-9. The maximum wall height in this segment is 12 feet. The subsurface soil material generally consists of firm to stiff clays. Existing grade is at Elev. 26 to 34 feet. Groundwater was encountered at Elev. 10 to 14 feet in 2008.

Based on the boring data at the anticipated footing subgrade, the recommended allowable bearing capacity is 2500 psf. For standard Type 1 wall height up to 10 feet, the allowable bearing capacity is adequate for the foundation demand. For wall over 10 feet, it is recommended that the footing subgrade be over excavated and replaced with lean concrete base to improve the footing subgrade. The over excavation and replacement should extend 3.5 feet below the footing subgrade level and 1 foot beyond the footing width/dimension. At "A" Sta. 340+00 and 346+00, sign structures will be mounted on the wall per Caltrans standard details.

Sta. 347+20 to 355+75 Approx. The reference boring data include RW-10, OH-11, RW-12 and as-built B-1 (Williams St OC #33-169, Caltrans 1989). The maximum wall height in this segment is 12 feet for the planned CHP enforcement area. The subsurface soil material generally consists of firm clays near the footing level. Existing grade is at Elev. 32 to 38 feet. Groundwater was encountered at Elev. 19 to 20 feet in 2008.

Based on the boring data at the anticipated footing subgrade, the recommended allowable bearing capacity is 2000 psf. For wall height of 8 feet and above, it is recommended that the footing subgrade be over-excavated and replace with lean concrete base to improve the footing subgrade. The over-excavation and replacement should also extend 1 foot beyond the footing width/dimension. For planned wall heights of 8, 10 and 12 feet, the recommended footing subgrade improvements are 2 feet (for wall height of 8 & 10 feet), and 3.5 feet (for wall height of 12 feet). At "A" Sta. 353+00, a sign structure will be mounted on the wall per Caltrans standard details.

As the 12-foot high wall straddles the above two segments, it is recommended that the 12-foot high wall receive 3.5 feet of footing subgrade improvements consisting of over-excavation and replace with lean concrete base.

Retaining Wall No. 2 (Type 1)

The wall is to retain the I-880 SB on-ramp from Marina Boulevard in the southwest quadrant of the interchange. The reference boring data include MR-2 (Parikh 2008) and as-built Borings B-2 (Caltrans 1962) and No. 1 (Caltrans 1950). The wall height varies from 4 to 12 feet. The elevation at the bottom of the footing is generally at Elev. 27 feet. Based on the boring data, the near-surface soil is generally stiff clay. At about Elev. 22 feet, there appears to be a 6-foot thick layer of firm clay (at Elev. 22 to 16 feet). Groundwater was encountered at Elev. 16.5 feet. This weak layer governs foundation design of Wall No. 2. We have verified the available bearing capacity assuming a two-layer system using the approach outlined in NAVFAC DM 7.2.

Based on the evaluation, footing subgrade improvement is recommended for wall height over 8 feet. For wall height of 8 feet, the native soil is capable of supporting the footing toe pressure demand of 2.2 ksf, and standard Type 1 wall (Caltrans 2006 standard plans) is feasible at the location. For wall heights of 10 and 12 feet where the footing demand increases to 2.5 and 2.8 ksf, over-excavation and replace with 2 and 3 feet of lean concrete

base, respectively, is recommended for foundation support.

Retaining Wall No. 3 (Type 1)

The wall is to retain the Davis Street OC east approach embankment in the northeast quadrant of the interchange. The reference boring data include RW-17, DV-1 and as-built LOTB of Route 112/880 Separation (#33-168). The wall height varies from 6 to 16 feet. The elevation at the bottom of the footing generally varies from Elev. 32.1 to 37 feet. The footing is in existing compacted fill/embankment over native stiff clay mixed with silty sand layer. Groundwater was encountered at Elev. 22 feet in the borings.

Based on the boring data at the anticipated footing subgrade, the recommended allowable bearing capacity is 2500 psf. For wall height of 14 and 16 feet, it is recommended that the footing subgrade be over-excavated and replaced with lean concrete base to improve the footing subgrade. The over-excavation and replacement should also extend 1 foot beyond the footing width/dimension. For the planned wall heights of 14 and 16 feet, the recommended footing subgrade improvements are 3 and 3.5 feet, respectively.

Retaining Wall No. 4 (Type 1)

The wall is to retain the I-880 NB Diagonal Off-Ramp to Eastbound Marina Blvd. in the southeast quadrant of the interchange. The reference boring data include E-4. The wall height varies from 6 to 16 feet. The elevation at the bottom of the footing generally varies from Elev. 26.6 to 29 feet. The footing is predominantly in native stiff soil. Groundwater was encountered at Elev. 8.5 feet.

Based on the boring data, the recommended allowable bearing capacity is 3800 psf, which exceeds the foundation demand (3500 psf) of the proposed Type 1 wall (wall height up to 16 feet & Case I loading) per 2006 standard plans. Therefore, the proposed Type 1wall is feasible.

Retaining Wall RW SB-1 (Type 5SW and 5SWB)

The wall is to retain a portion of the I-880 SB off-ramp and Davis Street widening. The reference boring data include RW-22 and RW-23. The wall height varies from 6 to 12 feet. The wall supports a soundwall on top and is immediately adjacent to an existing soundwall

(to be removed). The elevation of the bottom of the footing generally varies from Elev. 21.2 to 26.4 feet. The footing is in native stiff clay mixed with gravel. Groundwater was encountered at Elev. 13 to 17 feet in the borings.

Based on the boring data at the anticipated footing subgrade, the recommended available ultimate bearing capacity is 7700 psf. For standard Type 5SW or 5SWB wall height up to 6 feet, the available ultimate bearing capacity is adequate for the foundation demand. For wall heights over 6 feet, it is recommended that the footing subgrade be over-excavated and replaced with lean concrete base to improve the footing subgrade. The over-excavation and replacement should also extend 1 foot beyond the footing width/dimension. For planned wall heights of 8, 10 and 12 feet, the recommended footing subgrade improvements are 2 feet (for wall heights of 8 and 10 feet), and 3.5 feet (for wall height of 12 feet).

In addition, since the RW SB-1 is next to an existing soundwall (on piles), it is recommended that "slot" construction be adopted for the wall footing and subgrade improvements in order to reduce impact on existing soundwall prior to its removal.

8.5 Corrosion Investigation

During our investigation, fourteen corrosion tests were performed through out the project limit. The corrosion investigation for this project was performed in general accordance with the provisions of California Test Method 643. Representative native soil sample at the anticipated pipe subgrade were obtained for corrosion tests. A summary of the corrosion test results is presented in Table 4.

TABLE 4 - SUMMARY OF CORROSION TEST RESULTS

Sample No.	Depth (ft)	Resistivity (ohm-cm)	pH	Sulfate (ppm)	Chloride (ppm)
E-4 #2	4.5	1930	6.91	133.4	38.1
RW-7 #3	9.5	1180	7.16	23.6	13.8
RW-9 #2	4.5	2170	7.15	20.3	15.6
OH-11 #2	4.5	2170	6.71	24.8	10.3
OH-13 #2	4.5	830	6.18	214.9	19.6
RW-17 #2	4.5	1960	6.74	1.4	6.1
RW-23 #2	4.5	960	5.86	12.0	8.6
E-24 #2	4.5	2220	6.03	61.1	15.6
OH-28 #3	9.5	1100	6.95	51.4	11.8
RW-30 #2	4.5	960	7.40	102.1	22.7

Sample No.	Depth (ft)	Resistivity (ohm-cm)	pH	Sulfate (ppm)	Chloride (ppm)
RW-31 #3	9.5	1210	7.39	34.5	7.9
RW-33 #4	16.0	1150	7.97	236.1	70.6
RW-35 #3	9.5	590	7.13	117.2	21.2
OH-39 #3	9.5	1690	7.41	27.8	15.1

Corrosion test results indicate that the subsurface soil is generally non- corrosive according to Caltrans guidelines. Standard reinforced concrete pipe design is suitable with Type IP (MS) modified cement or Type II Modified cement, minimum required as per Caltrans Bridge Design Specifications (Section 8.22).

Based on the test results obtained, corrosion analyses were carried out using Caltrans ALTPIPE program. The "ALTPIPE" data indicate that, for corrugated steel pipes the recommended pipe thickness is typically between 0.052" & 0.064" . For aluminum pipes, the recommended pipe thickness is 0.06 ". Plastic pipes are allowable. Reinforced concrete pipes should have steel cover of 0.75" to 1", 5 sacks of cement and 10% of water.
A copy of the "ALTPIPE" analyses results is included in Appendix C.

8.6 Pipe Jacking

Per information provided by the designer, the drainage system includes pipe jacking at different locations. The planned jacking lengths vary from 65 to 240 feet. Installation of culverts by jacking is proposed at the following locations:

TABLE 5 - SUMMARY OF PIPE JACKING LOCATIONS

Culvert ID	Location	Diameter (in.)	Jacked Length (ft)	Minimum Cover (ft)
38b	Marina Blvd. crossing, east side of interchange. (Sheet D-2)	24	240	5
15z and 15ab	I-880 crossing, south of Williams St. OC (Sheet D-4)	24	82 and 76	5
37d	Davis St. crossing, east side of interchange (Sheet D-7)	36	144	12
37f and 37h	I-880 crossing, south of Davis St. (Sheet D-7)	48	425 and 176	5
37j	SB I-880 diagonal on-ramp from Davis St. (Sheet D-7)	60	65	7

Per boring data, the jacking operation is anticipated to encounter the upper stiff clays of the native soil. Based on the boring data, groundwater appears to be below the planned invert elevation. It may be prudent to assume "Potentially Gassy" for the site per OSHA's classification.

The bore-and-jack operation requires construction of jacking and receiving pits that should be shored. If groundwater is encountered after excavating the jacking and receiving pits, temporary, controlled dewatering should be implemented to maintain reasonably dry working conditions. The contractor should satisfy himself with the prevailing conditions and obtain additional information if needed to design the required dewatering method. Developing and implementing an effective dewatering program should be the contractor's responsibility. The dewatering system should prevent pumping soil fines with the discharge water.

The work should conform to applicable provisions of Section 65-1.05 of Caltrans Standard Specifications. It is the contractor's responsibility to select the equipment, to determine the jacking force, and to protect the existing developments for the jacking operation. We recommend the following:

- Bentonite slurry may be used as a lubricant during the jacking operation. The lubricant slurry should not be allowed to advance ahead of the pipe.
- The annular space around the outside of the pipe shall be cement grouted upon completion of the jacking operation.
- Settlement hubs should be placed across the jacking lines prior to commencement of the operation. The hubs should be placed and monitored prior to and during the entire operation.

Lateral Design. It is anticipated that the shoring system may consist of sheet piles for the jacking and receiving pits. Lateral earth pressures for internally braced shoring system are presented on Apparent Lateral Earth Pressures for Shoring, Plate 6. Additional lateral load due to relevant traffic and construction operations should be included for design. The lateral load may be assumed at 40% of the total vertical surcharge load. For passive design, an equivalent fluid pressure of 350 pcf may be used with a maximum passive resistance of 3500 psf below the base of excavation. A minimum FS of 1.5 is recommended. The contractor should provide his design-build system for the shoring work. It is the contractor's responsibility to select the type of shoring system, the design, and the performance of the system.

The pressure exerted by the reaction block on the surrounding soils should not exceed a horizontal bearing capacity of 2000 psf. The reaction block should be properly designed to uniformly distribute the jacking thrust to the jacking pit shoring system.

8.7 Minor Structure Foundations

8.7.1 Overhead Sign Structures

Based on information provided by the designer, there are six overhead signs planned for the project. The sign locations, types, and relevant boring information are shown below.

TABLE 6 - SUMMARY OF OVERHEAD SIGN STRUCTURES

Sign No.	Approx. Location	Type	Relevant Boring Information	Standard Foundation
C	"MR2" Sta. 27+15	Post Type IX	Boring E-4: stiff clay	5' dia. CIDH
F	"A" Sta. 330+90	N/A	Boring MR-2: firm to stiff clay	bridge mounted
I	"A" Sta. 340+00	Post Type VIII	Boring RW-7: stiff clay	wall mounted
K	"A" Sta. 346+20	Post Type 24 NPS	Boring RW-8: firm to stiff clay	wall mounted
M	"A" Sta. 353+50	Post Type VIII	Boring RW-12: firm clay	wall mounted
Q	"DL3" Sta. 79+90	Post Type IX	Boring E-25: stiff clay & med sand	5' dia. CIDH

Based on the boring information, it is feasible to use standard CIDH foundations for Sign Nos. C and Q per Caltrans standard sign plans. Sign No. F will be mounted on the bridge, and Sign Nos. J, K and M will be mounted on Wall No. 1 following Caltrans standard details, which show sign pedestal integrated into the wall stem with robust reinforcement.

Construction Considerations. Caltrans standard specifications and standard special provisions (SSP) for "Cast-in-Place Concrete Piling" should be used for the construction of CIDH piles. It is expected that groundwater will be encountered during construction, and "dry" condition as per the standard specifications Section 49-4 could not be maintained.

Vertical inspection pipes for acceptance testing should be provided in all CIDH piles that are 24 inches in diameter or larger, except when the holes are dry or when the holes are dewatered without the use of temporary casing to control groundwater. The acceptance test should include Gamma-Gamma Logging and may also include crosshole sonic logging. Gamma-Gamma Logging should be performed in accordance with California Test 233 Standard (CT233) to check the homogeneity of CIDH piles. CT233 defines pile rejection criteria based on the statistical principles of mean and three standard deviations to analyze the homogeneity of a pile. Anomalies detected should be evaluated by the designer for their significance and potential impact on design and to see if mitigation plans are required. Details of the acceptance testing and Gamma-Gamma Logging are contained in Caltrans SSP and CT233.

The site appears to be predominantly clayey soil; however, local variation including presence of sand/gravel layers and lenses is not unusual. Due to the presence of groundwater, raveling or caving is expected which may require additional drilling and cleaning effort and may increase the concrete volume for the piles. It is prudent to make the contractor aware of these conditions so that he takes appropriate steps to comply with the standards and maintain the integrity of the CIDH piles. The use of temporary steel casing should be anticipated at all times to maintain the integrity of the piles. Prior to construction, the qualifications and previous work experience of the potential sub-contractors should be reviewed. The intent is to help select qualified contractors to reduce construction issues.

All piles excavations should be observed by the geotechnical engineer or regulatory agency prior to the placement of reinforcement and concrete so that if conditions differ from those anticipated, appropriate recommendations can be made.

9. STRUCTURAL PAVEMENT SECTIONS

R-value tests were conducted on representative samples collected at subgrade level. The test results are summarized in Table 7.

TABLE 7 - SUMMARY OF R-VALUE TEST RESULTS
ROUTE 880 SB HOV LANE EXTENSION ALA 880-PM 22.6/24.0

Boring No.	Station & Offset (ft.)	Date Drilled	Description	R-Value
R-1	"A" Line 314+49 82 Lt.	06/09/08	Clayey Sand	48
R-2	"A" Line 320+48 89 Lt.	06/09/08	Silty Gravel	82
R-3	"A" Line 324+34 70 Lt.	06/09/08	Lean Clay with Gravel	*
R-6	"A" Line 333+88 66' Lt.	06/09/08	Sandy Lean Clay	*
R-8	"A" Line 344+42 104' Lt	06/11/08	Clayey Sand	48
R-9	"A" Line 347+10 99' Lt.	06/11/08	Sandy Lean Clay with Gravel	*
R-10	"A" Line 349+97 87' Lt.	06/11/08	Clayey Gravel	68
R-12	"A" Line 353+95 87' Lt.	06/10/08	Gravelly Lean Clay	*
R-13	"A" Line 365+43 81' Lt.	06/10/08	Sandy Lean Clay with Gravel	*
R-14	"A" Line 366+63 82' Lt.	06/09/08	Clayey Sand	58
R-15	"A" Line 369+06 182' Rt.	06/09/08	Sandy Lean Clay	16
R-16	"A" Line 370+05 417' Rt.	06/09/08	Sandy Lean Clay	*
R-18	"DA1" Line 21+92 112' Rt.	06/10/08	Clayey Sand	37
R-19	"DA1" Line 19+15 79' Rt.	06/10/08	Lean Clay with Gravel	*
R-20	"A" Line 375+43 749' Lt.	06/09/08	Clayey Sand	44
R-26	"A" Line 378+47 143' Lt.	06/09/08	Sandy Lean Clay	21
R-27	"A" Line 383+13 81' Lt.	06/09/08	Sandy Lean Clay with Gravel	*

*The pavement subgrade consists of imported roadbed material that contains substantial amount of sand and gravel. A screening process was performed first. Some of the bulk samples did not have R-value tests done because they are similar or contain more sand and gravel that will yield higher R-values. We still list these sample locations in the table to show that we have verified the material along the alignment.

As-built Pavement Sections

Existing Median Structural Section. Based on review of available as-built roadway plans, the existing I-880 median structural section and adjacent mainline structural section within the limits of the Project are summarized in a memorandum, dated September 23, 2010, prepared by the designer. This memorandum is attached in Appendix D of the report. The available as-built plans are also attached in Appendix D. The available as-built information includes roadway plans of 1950 through 2002. The chronology of the pavement improvements and evolvements including the median shoulder over the years is summarized in a table in the memorandum. The existing median structural section is also shown in Figure A of the memorandum.

In general, the as-built plans suggest a 3-foot wide concrete curb (located 3 feet from the centerline of I-880), installed as part of the original median construction, remains in place and has been buried by several layers of AC under subsequent contracts. During deflection testing (CHEC, March 2010), concrete was found in the cores performed by CHEC, reinforcing the fact that the curb is still in place. It was noted that the depth and make-up of the pavement section at the buried concrete curb location is the same as the mainline except that the mainline has a layer of CTB where the shoulder has AS.

Existing Structural Sections along Travel Lanes. The existing structural sections along travel lanes have been presented on the Typical Cross Sections (descriptions shown on Sheet X-1) in the plan set based on the as-built data. The sections typically consist of 0.10' OGAC, 0.15' RAC-G and 0.10' OGAC on the top over variable AC, CTPB and AS. ATPB drainage layer was noted in the sections along the following locations: "A" Sta. 313+00 to 325+03, "A" Sta. 356+18 to 370+49, and existing ramps at Marina Blvd interchange.

As-Built Plans. As-built data (Roadway plans) showing the existing structural pavement sections obtained from Caltrans, including Contract No. 04-OC7024 (11/14/2002), Contract No. 04-213404 (12/27/1999), Contract No. 04-174364 (8/1970, Document No. 40001996), Contract No. 04-292024 (3/1996, Document No. 40000001), Contract No. 04-123174 (11/29/1995 & 12/19/1997), Contract No. 04-292014 (undated, Document No. 40000761), Contract No. 56-14TC21-F (undated, Documented No. 40000760), and Contracted No. 51-4TC17 (undated, Document No. 40000759) are attached in Appendix D of the report.

<u>Findings and Recommendations</u>

- **ATPB, Edge Drains & Underdrains**. According to Highway Design Manual (HDM) 633.1, the general guideline is to use rigid pavement when TI is over 15. The design TI for mainline is 16.5. For the project, however, the as-built sections contain ATPB layer, and the design has to continue the ATPB layer and connect to new edge drain on the outside. Based on communication with Caltrans, the project design is using flexible pavement, and the existing ATPB layer will be extended to the outside with edge drain.

  New underdrain installation is recommended at I-880 SB off-ramp to WB Marina Blvd. (Sheet X-9) where the new pavement is in cut near the toe of slopes. Per our understanding, the existing underdrain along SB "A" Sta. 353+00 to 356+18 will be removed. The drainage from the opposite side of travel lanes will be handled by the wall

drainage of the planned Retaining Wall No. 1.

- **Design R-Value & Subgrade Enhancement Geotextile**. According to HDM 614.5, the use of SEG on weak subgrade can raise the effective R-value to 20. Based on the laboratory R-value test data obtained (Table 7), majority of lab data (12 out of 14) show R-value greater than 20; the only two tests show R-value of 14 and 16. Therefore, with the use of SEG, we recommend that the design R-value be raised to 20. The recommended R-value for design is 20. According to Caltrans Subgrade Enhancement Geotextiles Guide (April 28, 2009), it is recommended that the requirements for SEG conform to Stabilization Application (STAB), Class B2 of the guide. Based on the R-value test data and boring information, it is recommended that SEG be applied to the following segment of the mainline: Between Sta. 365+00 and Sta. 385+00. For the ramps, SEG is only needed in the gore areas per Caltrans comment.

- **Atterberg Limits.** Plasticity Index (PI) data are presented in Appendix B of the report. Based on the data points at shallow depths (2 to 5 ft depths, relevant to pavement design), we found that majority of the PI are in the range of 15 to 20. The PI data per se, however, should not be construed to imply significant expansive clay condition for pavement design. The Atterberg Limits test is performed in accordance with ASTM D4318, and the specimen is processed to remove any material retained on No. 40 sieve. Therefore, the effect of gravel and sand (coarser than No. 40 sieve) only manifests in the R-value tests. For pure "clays" with such PI's and no presence of sand/gravel, the R-values would have been much lower, probably similar to that shown in HDM 623.1A (7/1/08). Majority portion of the Route 880 widening subgrade soils contain substantial amount of sand and gravel (imported material for roadway prism construction through the years), and therefore many R-values tested are over 20. Some segments of the subgrade soil tend to be more clayey (with less granular material) that showed R-values lower than 20. Per current HDM guidelines, the material with R-value less than 20 is still considered relatively poor and weak. Therefore, a layer of SEG for separation and stabilization is recommended for these segments (Sta. 365+00 to 385+00, and ramp gore areas).

- **Southbound Median Shoulder**. For the median shoulder widening, the Memorandum (9/23/10; attached in Appendix D) indicates that the existing Lane No. 1 already encroaches into the portion of structural section where the buried curb is located. The proposed Lane No. 1 will also encroach into this area. At no location will the proposed

Lane No. 1 encroach within 3 feet of the I-880 centerline (i.e., between the buried curb and the median barrier).

Based on discussion and coordination meeting with Caltrans, it was agreed to adopt the rehabilitation strategy to mill and overlay the southbound shoulder to the depths specified in CHEC's report but over a width of 5 feet. The 5-foot zone includes an additional one-foot on either side of the buried concrete curb. Per CHEC's analysis, the recommendations for the existing median shoulder are to mill and overlay for a depth of between 3 inches and 5.5 inches, depending on the location within the project limit. It was noted that the agreed upon strategy would also apply to the north contract using the mill/overlay depths specified in CHEC's report. CHEC's report is attached in Appendix D for information.

- **Use of RHMA & HMA (OG).** The existing section contains OGAC and RAC-G on top. The current project will also use rubberized HMA (RHMA-G). Caltrans indicated that it is preferable to use RHMA-G of the same thickness to match the existing RAC-G since future rehab projects could be required within the project limits. To address the concern of low temperature for RHMA paving, it is our understanding that based on work staging and traffic handling, all the RHMA work can be done behind K-rail during day light hours and that would help to control the temperature. Open graded friction course (OGFC, now named HMA (OG)) will be used as final overlay and to match as-built condition. The median pavement rehab work should be done during the same stage of construction that the final 0.1 ft mill/overlay is done.

  Per Caltrans comment, the asphalt binder for the HMA (OG) should be PG 58-34 PM since it has to be placed over RHMA-G.

- **20-Year Flexible Pavement Design & Design Alternatives**. Per Caltrans comments, we have updated the Pavement Design Alternatives. The Design TIs are 16.5 and 12 for mainline and ramps, respectively. For comparison, we have considered the following options:

  (1) Flexible Option 1 – HMA, LCB & AS,
  (2) Flexible Option 2 – HMA, LCB & Lime Treated Subbase,
  (3) Flexible Option 3 – Full Depth HMA, and
  (4) Rigid Option – JPCP.

These options are presented in Tables 8 & 9 with remarks. In addition to Tables 8 & 9, additional relevant structural sections recommended for various design conditions are presented in the following text of this section.

For Rigid Option, the native subgrade (with 10<R<40) fits Type II soil of HDM Table 623.1A, and the design can directly follow Table 623.1E. However, there are ATPB layers in the existing pavement sections. Matching the new ATPB with the existing ATPB is complicated with the use of JPCP sections. Per HDM Table 623.1E footnote, the ATPB layer should be placed between the surface JPCP and the base. This causes issues and complicated connections between the ATPB. This Rigid Option may not be desirable.

To do lime treatment on a busy highway for the narrow outside widening is not suitable. In our experience, the pulverizing/mixing blade of the equipment (majority of them on the market in construction practice) cannot cover edge-to-edge/lane-to-lane treatment. There are zones, which may be formed by existing travel lane/traffic and physical limitations that the treatment would be difficult to be effectively executed. We have seen this being construction QA/QC issues in a recent project. In addition, the lime treatment operation could render the area an "open trench" next to a busy travel lane for several days due to spreading, mixing, mellowing, etc. This could pose a safety issue for the existing traffic.

For pavement type selection on existing adjacent lanes, we believe it is best to provide continuity of existing pavement type; this also ensures consistency in maintenance operations (HDM 616). The existing pavement along the outside lane consists of AC, ATPB, CTB & AS. Therefore, the listed Option 1 (HMA, ATPB, LCB & AS) appears to be best-suited.

- Based on information provided, ramps and cross street structural sections will be designed for TI of 12 in accordance with HDM Table 613.5A. Rigid pavement is not proposed at ramp termini since the TI is not greater than 12. A TI of 9 (3-year duration) will be used for ramps and cross street detour sections. Per our understanding, calculations supporting the use of TI = 9 for temporary detour were reviewed and verified by Caltrans Highway Operations. Detour pavement is not required on the mainline.

Pavement Design Alternatives
Route 880 SB HOV Lane Extension, Ala 880-PM 22.6/24.0

TABLE 8 - Pavement Alternatives - Mainline Widening (TI = 16.5)

Flexible Option 1 (HMA, LCB & AS)	**Flexible Option 2 (HMA, LCB & LTS)**	**Flexible Option 3 (Full Depth HMA)**	**Rigid Option (JPCP)**
0.10’ HMA (OG) 0.15’ RHMA-G 0.75’ HMA (Type A) 0.25’ ATPB 0.60’ LCB 1.30’ AS	0.10’ HMA (OG) 0.15’ RHMA-G 0.75’ HMA (Type A) 0.25’ ATPB 0.50’ LCB 1.50’ LTS (Lime Treated Subbase)	0.10’ HMA (OG) 0.15’ RHMA-G 0.75’ HMA 0.25’ ATPB 1.00’ HMA 0.50’ AB (Cl. 2)	0.10’HMA (OG) 1.10’ JPCP 0.25’ ATPB 0.50’ LCB 0.70’ AS
Remarks: -Use Subgrade Enhance. Geotextile between Sta. “A” 365+00 and 385+00 of mainline and ramp gore area.	**Remarks**:	**Remarks**: -Use 0.50’ AB (Cl.2) below pavement -Use Subgrade Enhance. Geotextile between Sta. “A: 365+00 and 385+00 of mainline and ramp gore area.	**Remarks**: Per HDM Table 623.1E footnote, the ATPB layer is between the JPCP and the base. This causes issues and complicated connection between the new and as-built ATPB.

TABLE 9 - Pavement Alternatives - Ramp (TI = 12)

Flexible Option 1 (HMA, LCB & AS)	**Flexible Option 2 (HMA, LCB & LTS)**	**Flexible Option 3 (Full Depth HMA)**	**Rigid Option (JPCP)**
0.60’ HMA (Type A) 0.65’ LCB 0.90’ AS	0.55’ HMA 0.35’ LCB 1.50’ LTS (Lime Treated Subbase)	1.50’ HMA 0.50’ AB (Cl. 2) over SEG	0.85’ JPCP 0.40’ LCB 0.60’ AS
Remarks: -Use Subgrade Enhance. Geotextile at ramp gore area. -For area where the existing underdrain system is replaced, a 1.00’ Cl. 3 Permeable material should be placed below the AS.	**Remarks**:	**Remarks**: -Use 0.50’ AB (Cl.2) below pavement -Use Subgrade Enhance. Geotextile at ramp gore area.	**Remarks**: This option is provided for reference and cost comparison by prime designer.

Note: Additional structural sections are presented in the text of the report.

For the City cross streets (TI = 12), the following pavement section is recommended (**Structural Section No. 4**):

- 0.65’ HMA, 0.90’ AB (Cl. 3), 0.95’ AS (Cl. 4) or 1.45’ Full Depth HMA

For temporary detour (TI = 9), the following pavement section is recommended:

- 0.45’ HMA, 0.75’ AB (Cl. 3), 0.80’ AS (Cl. 4) or 1.10’ Full Depth HMA

- For mainline widening without ATPB & edge drain, the following pavement section is recommended (**Structural Section No. 5**):
  - 0.10' HMA(OG), 0.15' RHMA-G, 1.00' HMA(A), 0.60' LCB, 1.30' AS (Cl 4)

- For the ramps area, where the existing underdrain system is replaced, the following pavement section is recommended (**Structural Section No. 7**):
  - 0.60' HMA (Type A), 0.65' LCB, 0.90 Cl 4 AS, 1.00' Cl 3 Permeable material (Blanket)

- To repair the depression areas in the mainline pavement under the existing Marina Boulevard and Davis Street Overcrossings, it is recommended that the existing pavement be grinded to min. 0.10' and the depressions areas filled with HMA leveling (0.1' to 0.3') over Geosynthetic Pavement Interlayer (GPI) and then paved over with 0.10’ HMA (OG) (**Structural Section No. 9**).

  The recommended minimum HMA thickness is 0.10’ for HMA over a cold planed surface prior to the placement of GPI. Per subsection 39-1.09D, “GPI,” of the latest amendment to the 2006 standard specifications, the minimum HMA thickness over the GPI should be 0.12’. For areas away from the bridge structures, GPI is not used, and these areas will be cold planed and build up with 0.10’ HMA (OG) on top (**Structural Section No. 3**).

- For mainline median pavement reconstruction where the new bridge bent footings are constructed, the following pavement section is recommended (**Structural Sections No. 10 & 11**):
  - 0.10' HMA (OG), 0.65’ HMA (Type A), 0.65' LCB, 1.00' AS (Cl 4). Between Sta. "A" 371+87 and 373+66, use Subgrade Enhanced Geotextile

- To expedite the pavement construction in the areas with limited windows for road closures and time constraints, use of rapid strength concrete base as a substitute for lean

concrete base in the pavement sections is recommended (**Structural Sections No. 12 & 14**).

- For sidewalk and median island paving, the following section is recommended (**Structural Section No. 8**):
  - 0.33' minor concrete (miscellaneous construction) and 0.50' Cl 3AB

- The designer has indicated that at the conform limit of approaches to new overcrossings, the existing pavement is within 0 to 0.3' of the finish grade. The existing pavement will be overlaid (cold planed and build up) to match the new grade (**Structural Section No. 13**).

- The recommended minimum R-value for Class 3 Aggregate Base (AB) is 78 and for Class 4 Aggregate Subbase (AS) is 50 per Caltrans 2006 standard specifications. Fill material to be placed within 4 feet of the finish pavement subgrade should have a minimum R-value of 20.

A set of the proposed Typical Cross Sections (Sheets X-1 thru X-13) together with median construction details (C-29 & C-30) at Marina Blvd and Davis Street Overcrossings is attached in Appendix D.

10. MATERIAL SOURCES

There are several commercial sources of asphalt, concrete, and aggregate products in the vicinity of the project area. Some of the available commercial suppliers in the vicinity of the project site are listed in the following table.

TABLE 10 - SOURCES OF ASPHALT AND AGGREGATE MATERIAL

Source	Location	Approx. Haul Dist. (One way, miles)
Sierra Concrete	9819 Pearmain St, Oakland, CA	1.0
Quick Mix Concrete & Pumping	754 Castro Street, San Leandro, CA	3.7
Central Concrete Supply Co.	1844 W Winton Ave, Hayward, CA	10.5

11. MATERIAL DISPOSAL

Majority of the project will require fill/imported borrow material for the proposed project. The Aerially Deposited Lead (ADL) material (Type Y-1) may be used in permanent

embankment provided that they are covered under pavement or with a minimum of 2 feet of clean soil cover.

The materials generated by removal of base and surfacing and from removal of temporary HMA pavement are acceptable to be used as embankment material provided that they meet the requirements of standard specifications and have a minimum R-value of 20 if they are to be placed within 4 feet of the finished pavement subgrade. The excavated asphalt concrete and concrete pavement, if broken down to 3-inch particles, are acceptable to be used in embankments. Chunks and large size cracked PCC (larger than 3 inches) should not be used in embankments.

12. CONSTRUCTION CONSIDERATIONS

12.1 Construction Advisories

The sections are written primarily for the engineer responsible for the preparation of plans and specifications. Since these sections identify potential construction issues related to the project, it may also be of use to the Agency's representatives involved in monitoring of construction activity. The field investigation performed by us primarily addresses design issues and was not planned specifically to identify construction issues.

The project site is located along the existing I-880 and the city streets. Therefore, traffic control is required to maintain traffic flow along I-880 and the respective city streets. Several underground utilities exist at the site. The contractor should verify the utility lines, be aware of the existing conditions and plan the construction activities accordingly.

In our opinion, conventional equipment may be used to excavate the on-site soil materials. The materials to be excavated may consist of firm to very stiff clays with varying amounts of medium dense to dense sand and gravel. Localized subgrade pumping may be encountered during earthwork construction depending on the weather, moisture condition of the subsurface soils, and surface drainage conditions. Equipment mobility may also be difficult if the subgrade is wet. In which case, the subgrade soils may require reworking, aeration, or over-excavation and replacing with dry granular fill to facilitate earthwork construction. It is possible that unknown old buried utilities or abandoned structures, concrete rubble etc. are located along the alignment. It might require special equipment and additional efforts to remove these buried objects.

Prospective contractors for the project must evaluate construction-related issues on the basis of their own knowledge and experience in the local area, on the basis of similar projects in other localities, or on the basis of field investigation on the site performed by them, taking into account their proposed construction methods and procedures. In addition, construction activities related to excavation and lateral earth support must conform to safety requirements of OSHA and other applicable municipal and Stage regulatory agencies.

12.2 Construction Consideration that Influence Specifications

The contractor should verify the conditions of the existing utility lines. These locations should not be used for stockpiling of borrow materials. Any utility conflicts with proposed construction should also be reviewed prior to construction.

12.3 Construction Monitoring and Instrumentation

The construction monitoring and instrumentation subject was considered and was determined to be not significant for the project.

12.4 Hazardous Waste Considerations

The project environmental study report should be referred to for further details about any potential hazardous materials within the project site.

12.5 Differing Site Conditions

The soil conditions described in this report are based on available boring data. It should be noted that these borings depict subsurface conditions only at the locations drilled. Because of the variability from place to place within soils in general, and the nature of geologic depositions, subsurface soil conditions could change between the explored locations.
Early communication should be made between the Resident Engineer, the Contractor and the Geotechnical Engineer as soon as conditions that differ from those established in this report are recognized by any of the parties. Additional recommendations could be provided if such conditions arise.

13. RECOMMENDATIONS AND SPECIFICATIONS

13.1 Summary of Recommendations

If the designer has questions or concerns with any of these recommendations, or, if conditions are found to be different during construction, the Geotechnical Engineer who prepared this report should be contacted. Additional fieldwork, analysis or changes in recommendations may be required. These services may be provided under a separate authorization, as necessary. A concise summary of the geotechnical recommendations is presented below:

- Design peak bedrock acceleration (PBA) = 0.6 g. Design peak ground acceleration (PGA) refers to Plate No. 5 (SDC 1.4). (Ref.: Section 7.4)
- The boring/CPT data indicates that the subsurface soil conditions at the project site generally consists of mainly firm to very stiff lean clays with pockets/ lenses/layers of loose to medium dense sands/gravels. Subsurface soil conditions consist of interbedded layers of firm to very stiff lean clays and loose to medium dense sands/gravels were also encountered in some of the soil borings/CPTs. Groundwater was encountered at the depths between 8 feet and 23 feet. The impact of liquefaction potential to this roadway-widening project is considered relatively low. The impact of liquefaction potential on the pile capacity analyses should be addressed in the Foundation Investigation Report (Ref.: Section 8.1.3)
- Retaining Walls (Ref.: Section 8.4)
- Pavement Sections for widening (Ref: Section 9)

13.2 Recommended Materials Specifications

13.2.1 Standard Specifications

Unless otherwise stated in the special provisions, all materials specifications should conform to Caltrans Standard Specifications, May 2006 edition, including but not limited to the following: Earthwork, Structure Backfill, Pervious Backfill Material, Reinforcing Geofabric, Thermoplastic Pipes, Hot-Mixed Asphalt, Aggregate Base and Aggregate Subbase, Cement Treated Base, etc. Note that there are most-current specifications included in the “Amendments to the Standard Specifications dated

May 2006" – last revised/issued on November 21, 2011. The entire Section 90, "Portland Cement Concrete" was replaced on this date.

13.2.2 Special Provisions

The project design follows Caltrans 2006 standard plans and specifications. The standard specifications should be augmented with relevant and current standard special provisions.

Imported Borrow:

Imported material should be in accordance with the specifications set forth in Caltrans Section 19. In particular, for new embankment/roadway construction, the material placed within 4 feet of the finish pavement subgrade should meet the following requirements:

1. Free of organic or other deleterious materials.
2. An R-value of no less than 20.

Surplus material from the northerly segment of I-880 HOV lane widening project (Contract No. 04-3A9224) can be used in the embankment construction of this project.

Aggregate Base: Aggregate Base (Class 3) shall conform to the grading specified in the table below for the special provisions. It shall also be clean and free from organic matter and other deleterious substances. The percentage composition by weight of Class 3 aggregate base shall conform to the following grading as determined by California Test Method No. 202.

Gradation Requirement (Percent Passing ¾" Maximum)

Sieve Sizes	Operating Range	Contract Compliance
1":	100	100
¾"	90 – 100	87 – 100
No. 4	35 – 60	30 – 65
No. 30	10 – 30	5 – 35
No. 200	2 – 11	0 – 14

Gradation Requirement (Percent Passing 1 ½" Maximum)

Sieve Sizes	Operating Range	Contract Compliance
2"	100	100
1 ½"	90 – 100	87 – 100
1"	------	------
¾"	50 – 85	45 – 90
No. 4	25 – 45	20 – 50
No. 30	10 – 25	6 – 29
No. 200	2 – 11	0 – 14

Aggregate Base (Class 3) shall also conform to the quality requirements given on the following table:

Quality Requirements

California Test Method	Operating Range	Contract Compliance
Sand Equivalent (217)	25 min	22 Min.
Resistance (R-value) (301)	-	78 Min.
Durability Index	-	35 Min.

Aggregate Subbase: Aggregate Subbase (Class 4) shall conform to the provisions in Section 25 of the Standard Specifications and to these Special Provisions.

Aggregate Subbase (Class 4) shall be clean and free from organic matter and other deleterious substances. The percentage composition by weight of Class 4 aggregate subbase shall conform to the following grading as determined by California Test Method No. 202.

Gradation Requirement (Percent Passing)

Sieve Sizes	Operating Range	Contract Compliance
2 1/2 "	100	100
No. 4	30 - 65	25 – 70
No. 200	0 - 15	0 - 18

Aggregate Subbase (Class 4) shall also conform to the quality requirements given on the following table:

Quality Requirements

California Test Method	Operating Range	Contract Compliance
Sand Equivalent (217)	21 Min.	18 Min.
Resistance (R-value) (301)	50	50 Min.

14. INVESTIGATION LIMITATIONS

Our services consist of professional opinions and recommendations made in accordance with generally accepted geotechnical engineering principles and practices and are based on our field exploration and the assumption that the soil conditions do not deviate from observed conditions. No warranty, expressed or implied, of merchantability or fitness, is made or intended in connection with our work or by the furnishing of oral or written reports or findings. The scope of our services did not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in structures, soil, surface water, groundwater or air, below or around this site. Unanticipated soil conditions are commonly encountered and cannot be fully determined by taking soil samples and excavating test borings; different soil conditions may require that additional expenditures be made during construction to attain a properly constructed project. Some contingency fund is thus recommended to accommodate these possible extra costs.

This report has been prepared for the proposed “Route 880 SB HOV Lane Extension and Other Improvements between Marina Blvd. and Davis Street Interchange” as described earlier, to assist the engineer in the design of this project. In the event any changes in the design or location of the facilities are planned, or if any variations or undesirable conditions are encountered during construction, our findings and recommendations shall not be considered valid unless the changes or variations are reviewed and our recommendations modified or approved by us in writing.

This report is issued with the understanding that it is the designer's responsibility to ensure that the information and recommendations contained herein are incorporated into the project and that necessary steps are also taken to see that the recommendations are carried out in the field.

The findings in this report are valid as of the present date. However, changes in the soil conditions can occur with the passage of time, whether they are due to natural processes or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur, whether they result from legislation or from the broadening of knowledge. Accordingly, the findings in this report might be invalidated, wholly or partially, by changes outside of our control.

Respectfully submitted,
PARIKH CONSULTANTS, INC.

Y. David Wang, Ph.D., P.E. C52911
Senior Engineer

REGISTERED PROFESSIONAL ENGINEER
GAURANG R. PARIKH
No. 666
EXP. 12-31-13
GEOTECHNICAL
STATE OF CALIFORNIA

Gary Parikh, G.E. 666
Project Manager

S:/ONGOING PROJECTS/2006/206139.GDR (WMH)/GDMR FINAL

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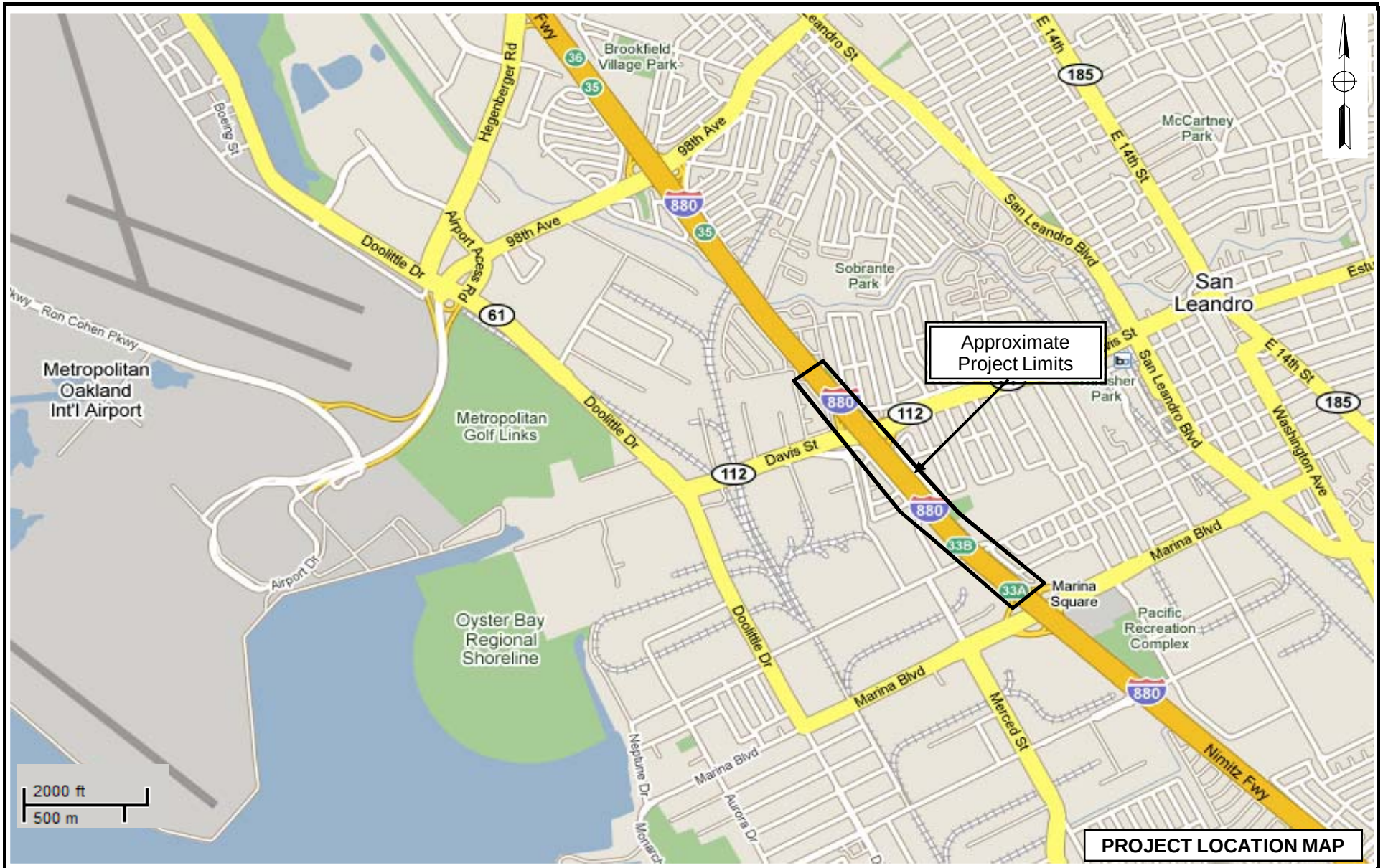
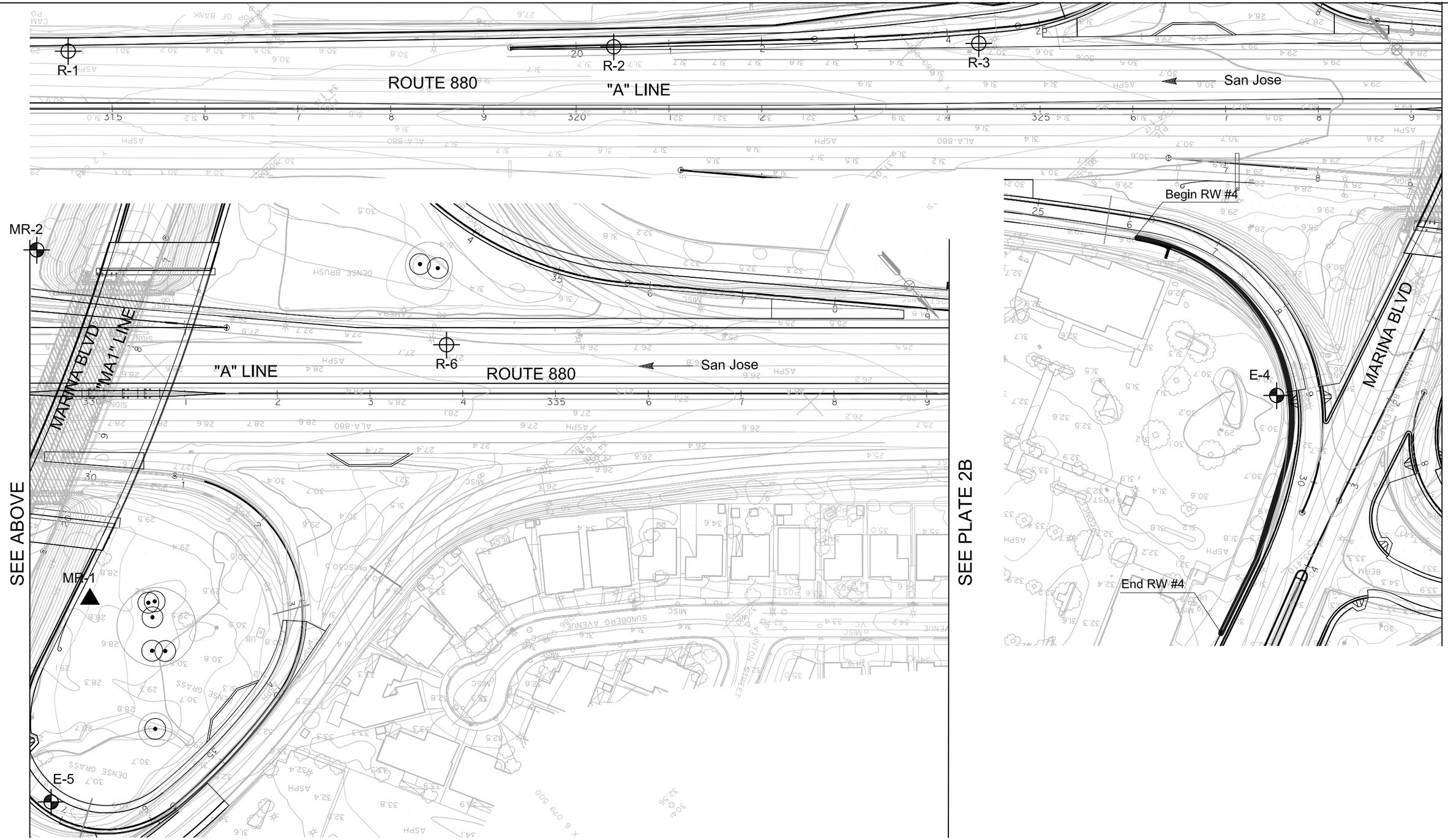


PROJECT LOCATION MAP

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS TESTING

I-880 SB HOV LANE EXTENSION AND OTHER IMPROVEMENTS
BETWEEN MARINA BLVD AND DAVIS STREET INTERCHANGE
ALAMEDA COUNTY, CALIFORNIA

JOB NO.: 206139.GDR	PLATE NO.: 1



LEGEND

E-4 — Approx. Boring Location

R-1 — Approx. R-Value Boring Location

MR-1 — Approx. Cone Penetration Test Location

SCALE 1 inch = 100 feet

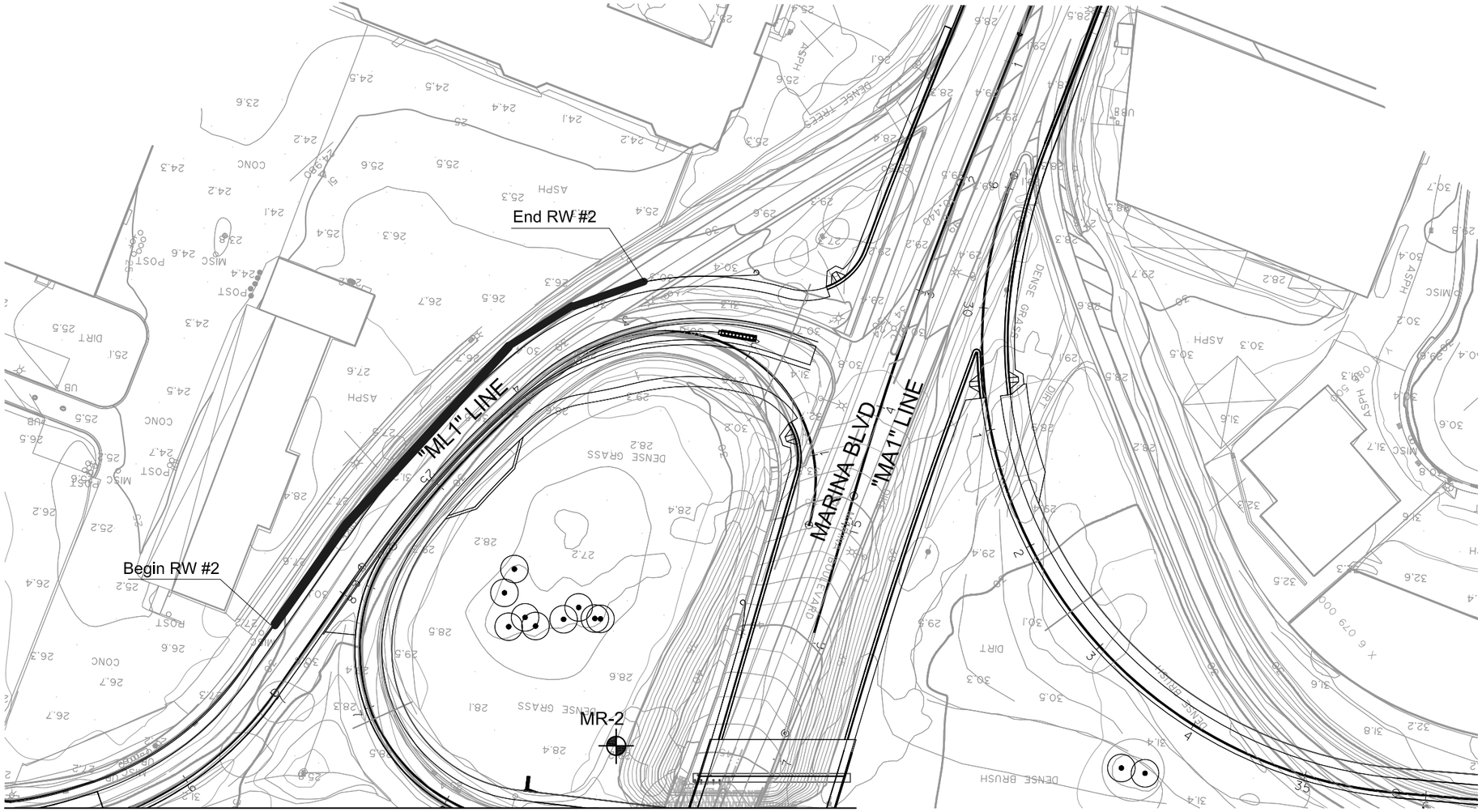
Note: All units are in feet unless otherwise specified
Reference Map was provided by WMH Corporation

SITE PLAN

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

I-880 SB HOV LANE EXTENSION AND OTHER IMPROVEMENTS
MARINA BLVD TO DAVIS STREET INTERCHANGE
ALAMEDA COUNTY, CALIFORNIA

JOB NO.: 206139.GDR | PLATE NO: 2A



SEE PLATE 2A

SITE PLAN

LEGEND

E-4 — Approx. Boring Location

R-1 — Approx. R-Value Boring Location

MR-1 — Approx. Cone Penetration Test Location

SCALE 1 inch = 100 feet

Note: All units are in feet unless otherwise specified
Reference Map was provided by WMH Corporation

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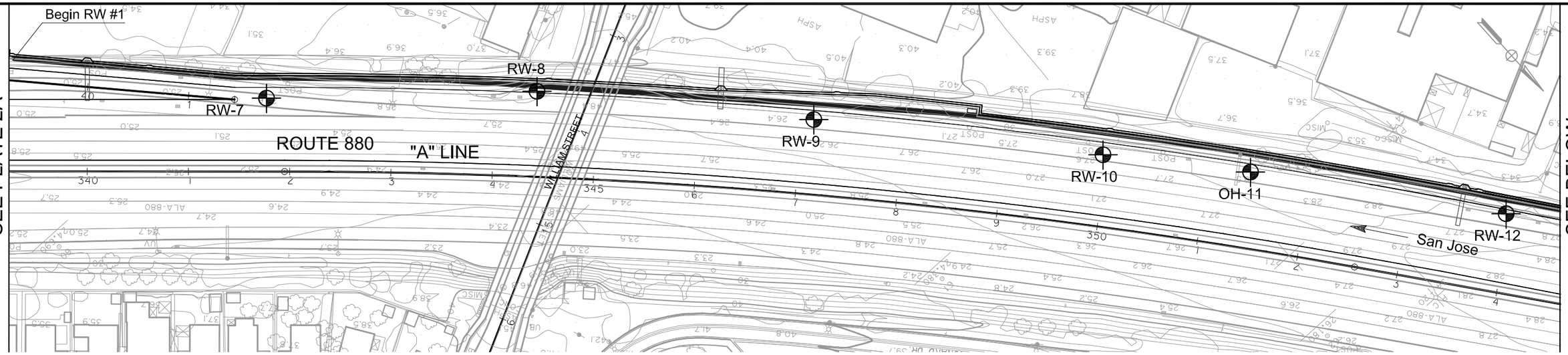
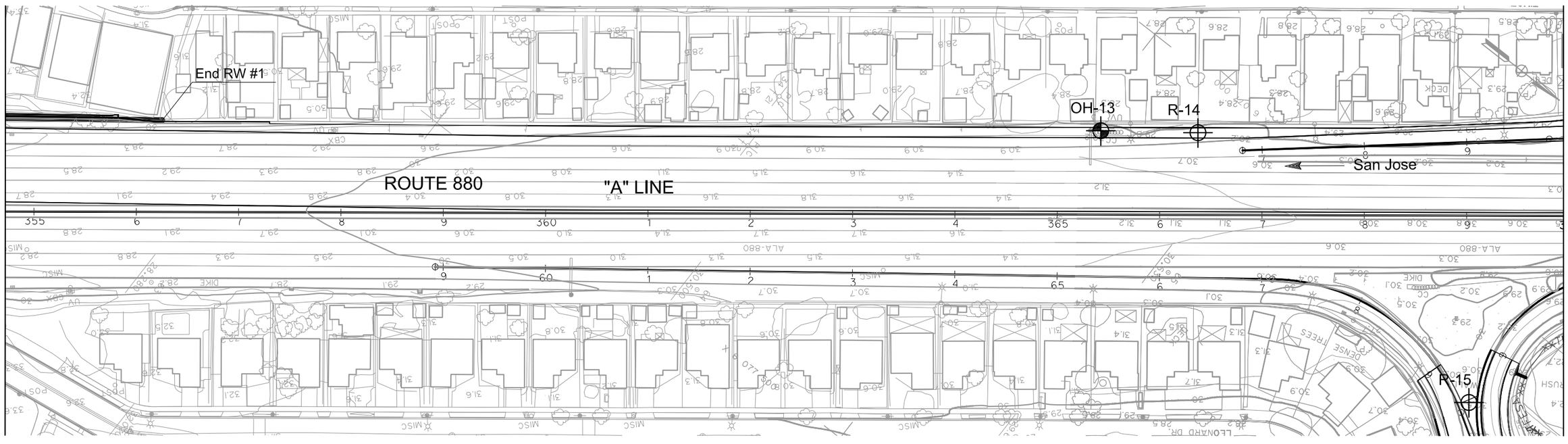
I-880 SB HOV LANE EXTENSION AND OTHER IMPROVEMENTS
MARINA BLVD TO DAVIS STREET INTERCHANGE
ALAMEDA COUNTY, CALIFORNIA

JOB NO.: 206139.GDR

PLATE NO: 2B





LEGEND

OH-11 — Approx. Boring Location

R-7 — Approx. R-Value Boring Location

SCALE 1 inch = 100 feet

Note: All units are in feet unless otherwise specified
Reference Map was provided by WMH Corporation

SITE PLAN

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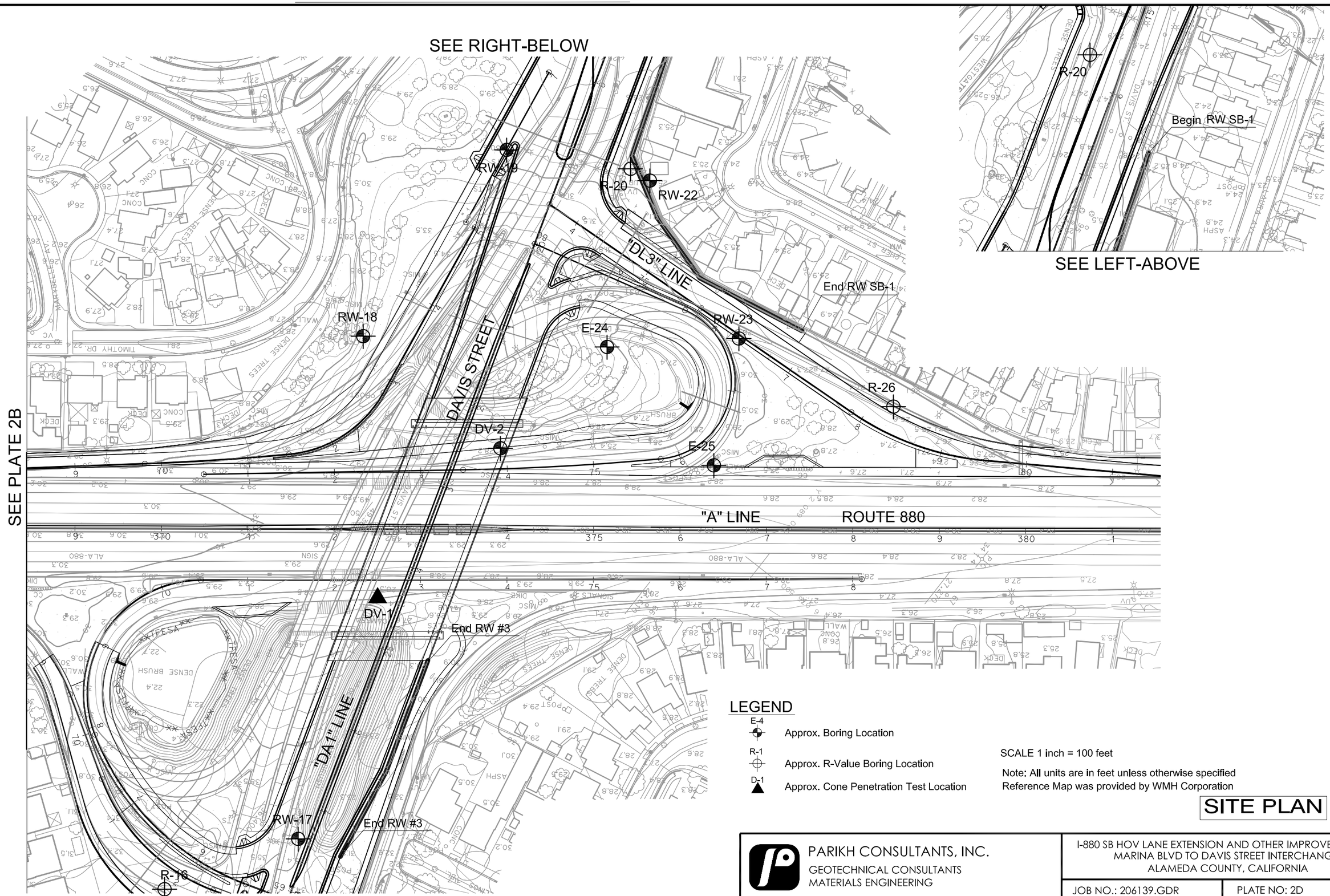
MATERIALS ENGINEERING

I-880 SB HOV LANE EXTENSION AND OTHER IMPROVEMENTS
MARINA BLVD TO DAVIS STREET INTERCHANGE
ALAMEDA COUNTY, CALIFORNIA

JOB NO.: 206139.GDR | PLATE NO: 2C



LEGEND

E-4 — Approx. Boring Location

R-1 — Approx. R-Value Boring Location

D-1 — Approx. Cone Penetration Test Location

SCALE 1 inch = 100 feet

Note: All units are in feet unless otherwise specified
Reference Map was provided by WMH Corporation

SITE PLAN

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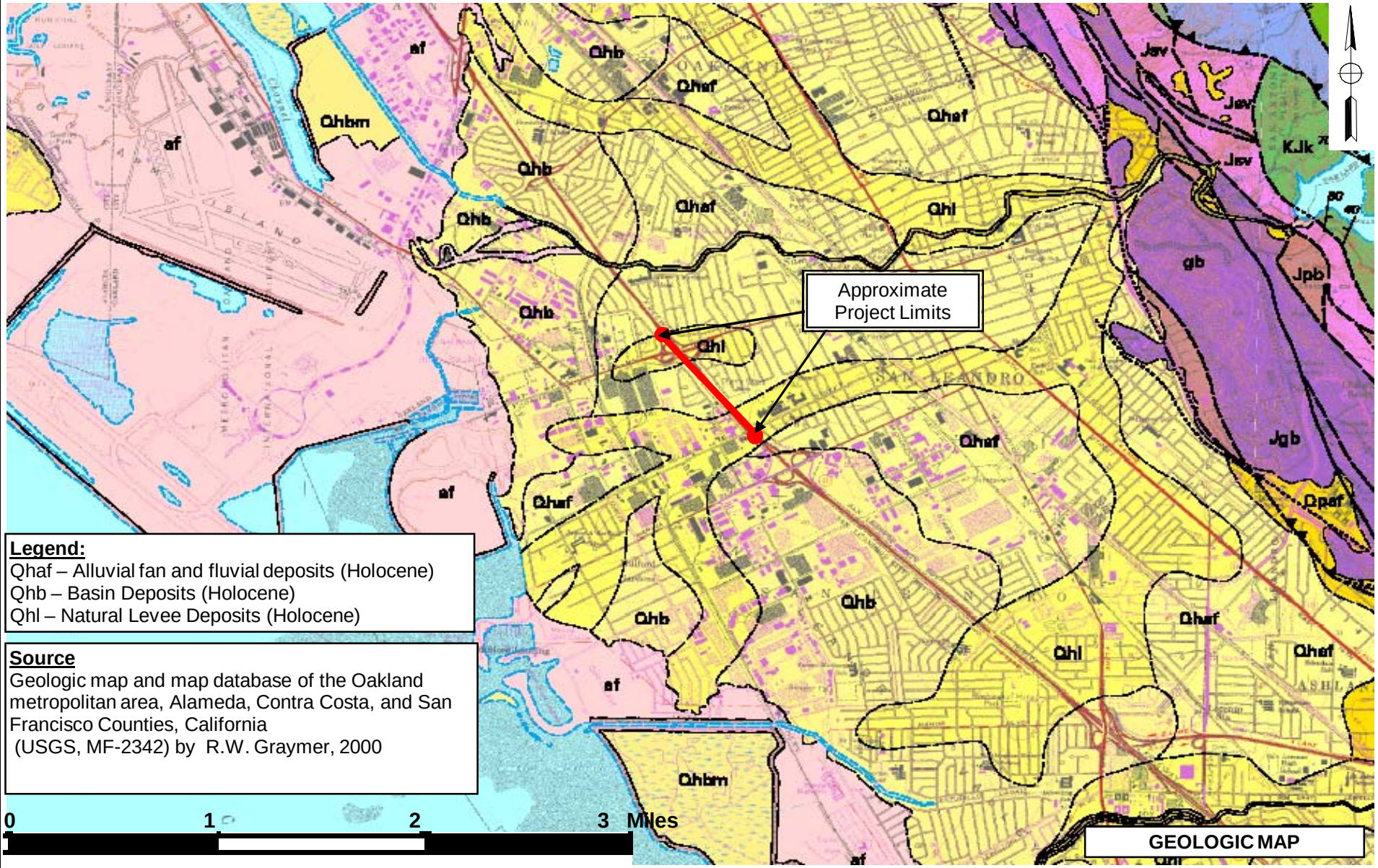
I-880 SB HOV LANE EXTENSION AND OTHER IMPROVEMENTS
MARINA BLVD TO DAVIS STREET INTERCHANGE
ALAMEDA COUNTY, CALIFORNIA

JOB NO.: 206139.GDR | PLATE NO: 2D



Legend:
Qhaf – Alluvial fan and fluvial deposits (Holocene)
Qhb – Basin Deposits (Holocene)
Qhl – Natural Levee Deposits (Holocene)

Source
Geologic map and map database of the Oakland metropolitan area, Alameda, Contra Costa, and San Francisco Counties, California
(USGS, MF-2342) by R.W. Graymer, 2000

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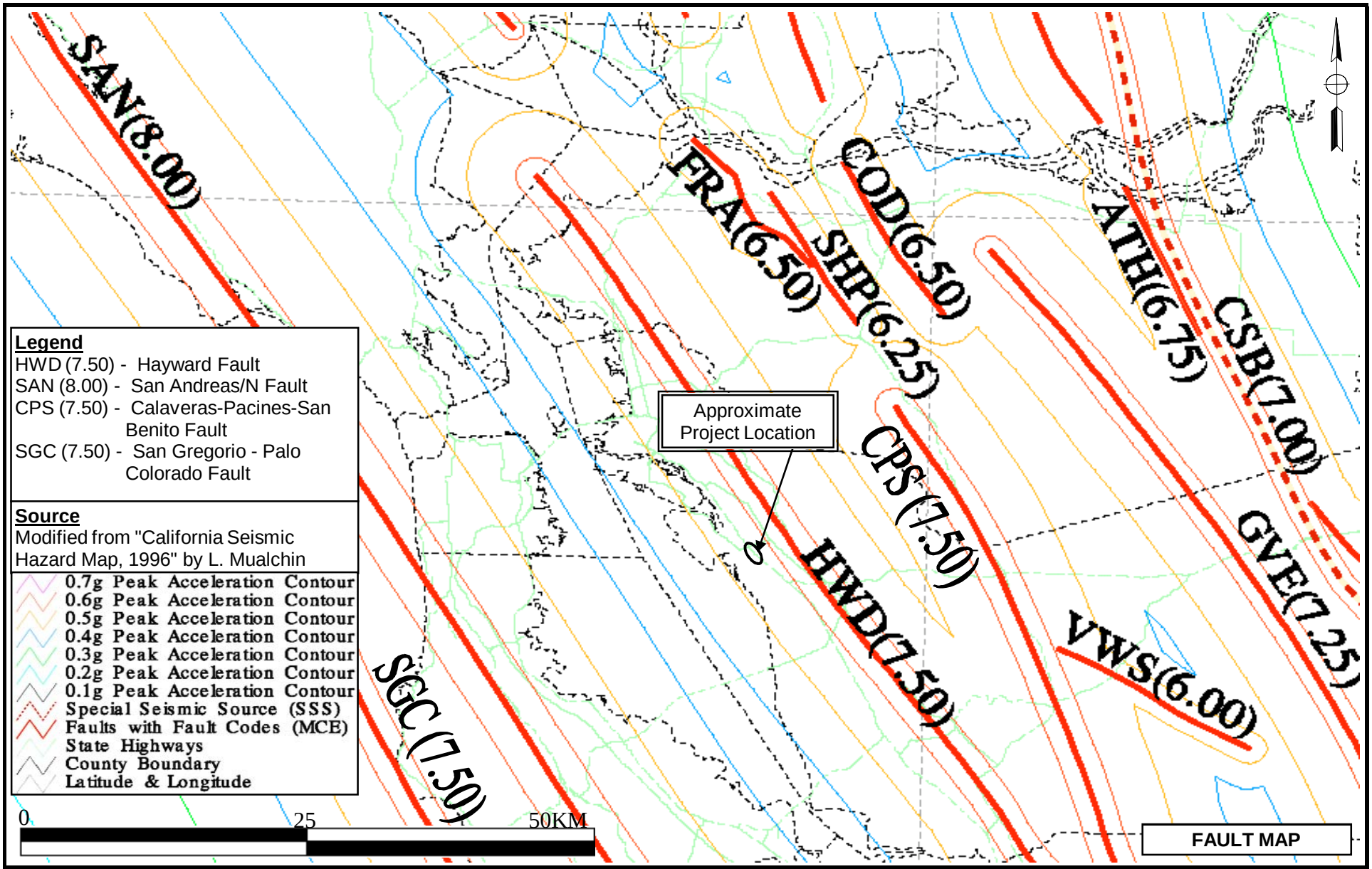
GEOTECHNICAL CONSULTANTS
MATERIALS TESTING

I-880 SB HOV LANE EXTENSION AND OTHER IMPROVEMENTS
BETWEEN MARINA BLVD AND DAVIS STREET INTERCHANGE
ALAMEDA COUNTY, CALIFORNIA

JOB NO.: 206139.GDR

PLATE NO.: 3



FAULT MAP

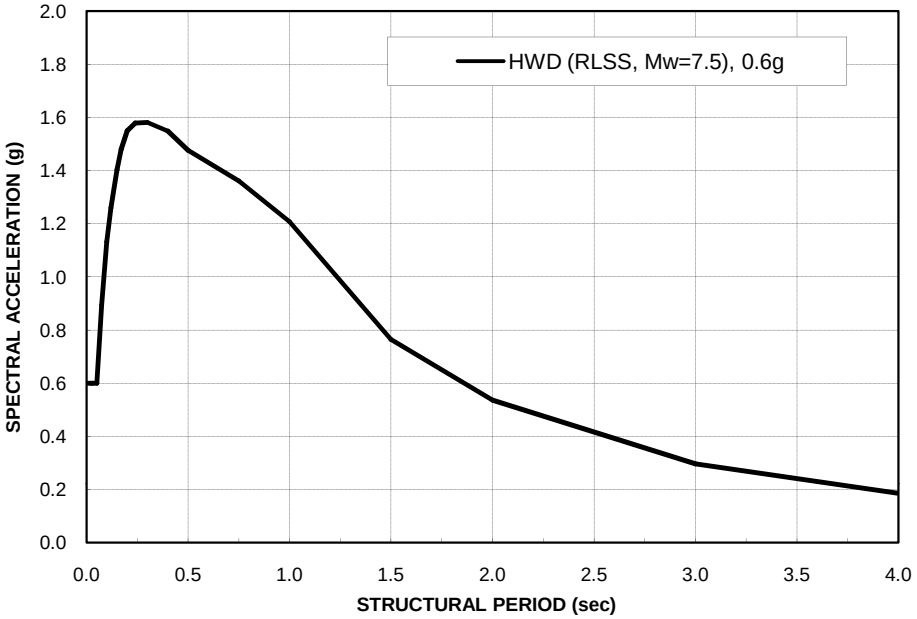
PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS TESTING

I-880 SB HOV LANE EXTENSION AND OTHER IMPROVEMENTS BETWEEN MARINA BLVD AND DAVIS STREET INTERCHANGE ALAMEDA COUNTY, CALIFORNIA

JOB NO.: 206139.GDR

PLATE NO.: 4

ARS DESIGN CURVE
ROUTE 880 SB IMPROVEMENTS
ALAMEDA COUNTY, CALIFORNIA



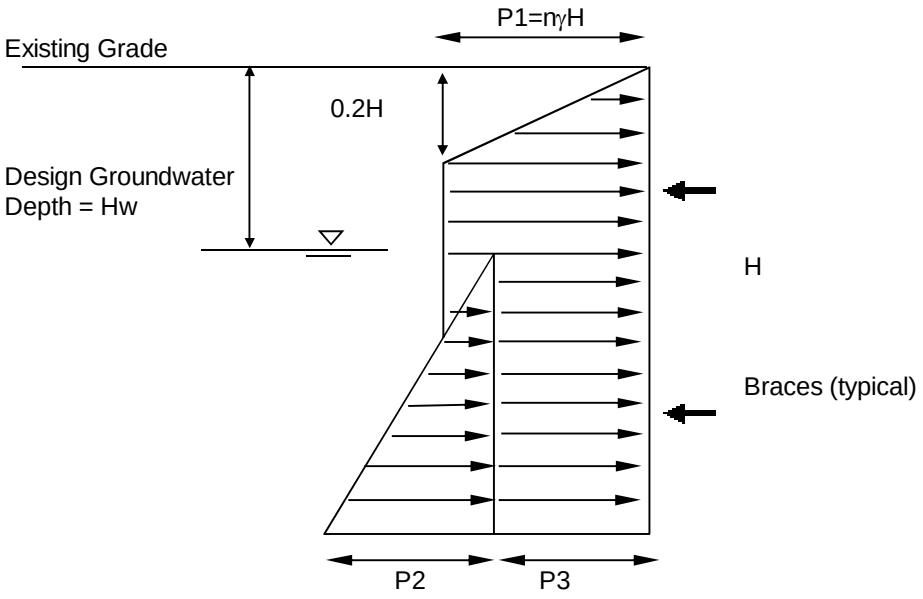
Spectral Data

Period (sec)	Spectral Accel. (g)
0.010	0.600
0.020	0.600
0.030	0.600
0.050	0.600
0.075	0.893
0.100	1.132
0.120	1.259
0.150	1.403
0.170	1.480
0.200	1.550
0.240	1.578
0.300	1.581
0.400	1.548
0.500	1.477
0.750	1.360
1.000	1.207
1.500	0.765
2.000	0.536
3.000	0.296
4.000	0.186

Caltrans SDC (v 1.4, June 2006), Figure B.8,
Governing Fault: Hayward Fault
Fault Distance = 3.87 km (2.32 miles)
(Mw = 7.5, Soil Profile Type D, PBA = 0.6g)

Notes:
(A) PBA was obtained by using Sadigh Attenuation Relationship
(B) The following modifications were then applied for near-fault effects:
(1) No change of Sa for structural periods $\leq$ 0.5 sec
(2) 20% increase of Sa for structural periods > 1 sec
(3) Linear interpolation for structural periods between 0.5 and 1 sec

APPARENT LATERAL EARTH PRESSURE DIAGRAM



H = Excavation Depth in feet
P1 = nγH = 0.3(125)H = 37.5H psf
P2 = 62.4 (H-Hw) psf
P3 = n(γHw + γ'(H - Hw)) psf

γ = 125 pcf (Total Unit Weight)
γ' = 65 pcf (Buoyant Unit Weight)

1. The pressure diagram is based on average soil and groundwater conditions.
2. Lateral earth pressure should be checked where conditions are different.
3. All surcharge loads due to railroad and construction operation should be added for designing the shoring system.

APPARENT LATERAL EARTH PRESSURE DIAGRAM

PARIKH
Practicing in the Geosciences

I-880 SB HOV LANE EXTENSION BETWEEN MARINA BLVD AND DAVIS STREET INTERCHANGES ALAMEDA COUNTY, CALIFORNIA

JOB NO.: 206139.GDR	PLATE No. 6

APPENDIX A

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	ALA	880	22.6/24.0		

GEOTECHNICAL PROFESSIONAL — DATE 3/7/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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OAKLAND, CA 94612

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SAN JOSE, CA 95131

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

CONSISTENCY OF COHESIVE SOILS

Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

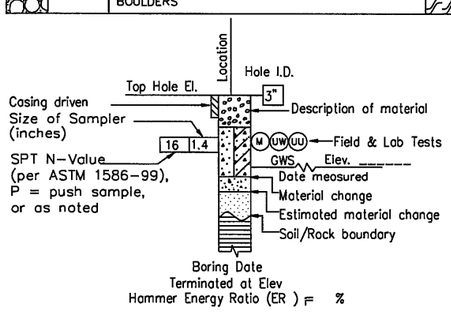
PLASTICITY OF FINE-GRAINED SOILS

Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

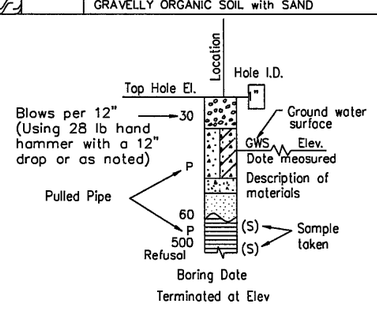
BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
□	O	Other

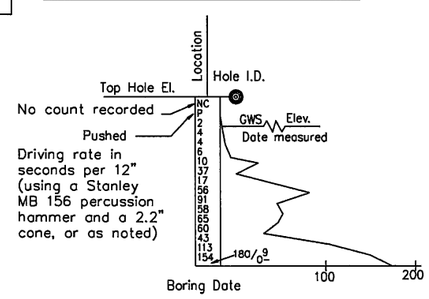
Note: Size in inches.



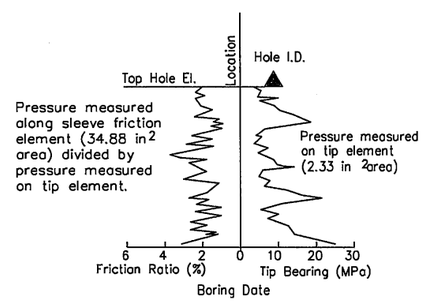
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

SOIL LEGEND

DESIGN OVERSIGHT	DRAWN BY L. TRAN	L. BHANGOO/G. TRIPATHI FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	D. WANG PROJECT ENGINEER	BRIDGE NO.
SIGN OFF DATE	CHECKED BY D. WANG	DATE: JUNE 2008			POST MILES 22.5/24.0

I-880 SB HOV LANE EXTENSION AND OTHER IMPROVEMENTS BETWEEN MARINA BLVD. TO DAVIS STREET INTERCHANGE

LOG OF TEST BORINGS — 1 OF 10

OGS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 06-01-09)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04248
EA 3A9201

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES 9/22/09 3/7/12 — SHEET — OF

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	ALA	880	22.6/24.0	----	----

GEOTECHNICAL PROFESSIONAL — DATE 3/7/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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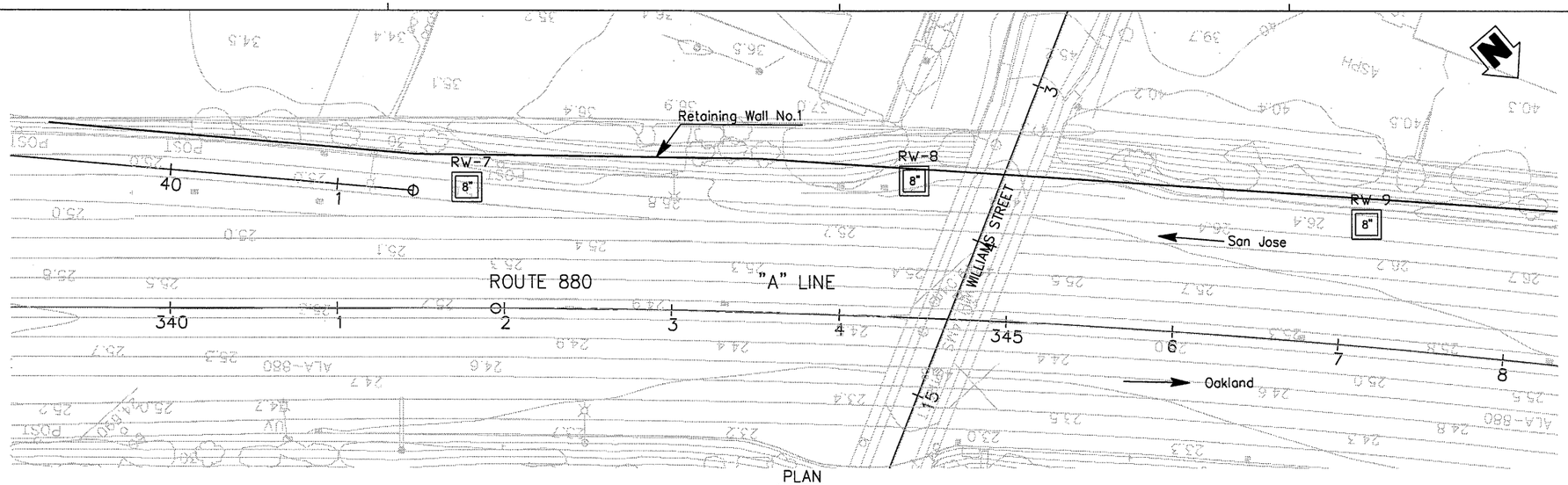
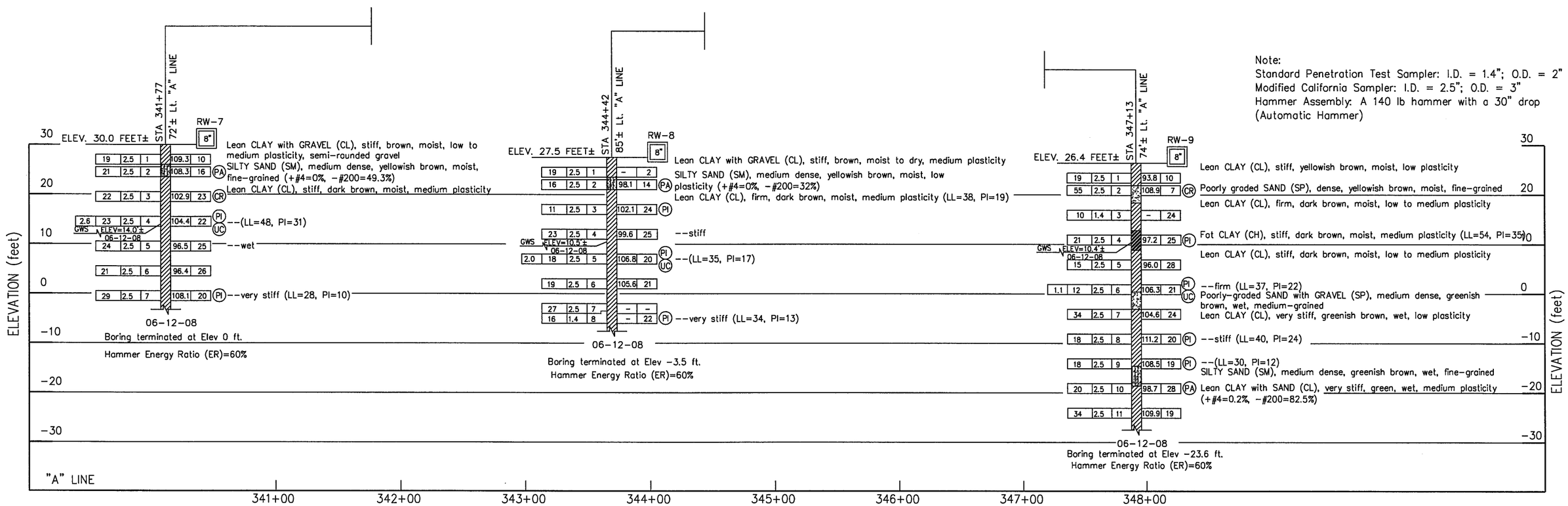


PLAN
1"=40'

Note:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)



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

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT	DRAWN BY L. TRAN	L. BHANGOO/G. TRIPATHI FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	D. WANG PROJECT ENGINEER	BRIDGE NO.
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I-880 SB HOV LANE EXTENSION AND OTHER IMPROVEMENTS BETWEEN MARINA BLVD. TO DAVIS STREET INTERCHANGE

LOG OF TEST BORINGS 2 OF 10

OGS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 06-01-09)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

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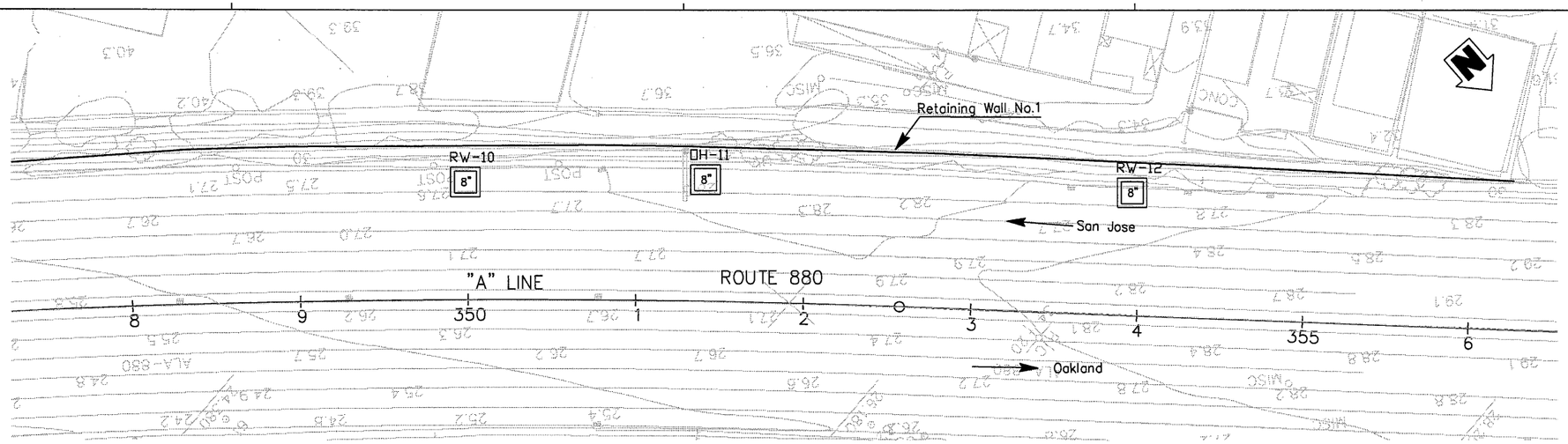

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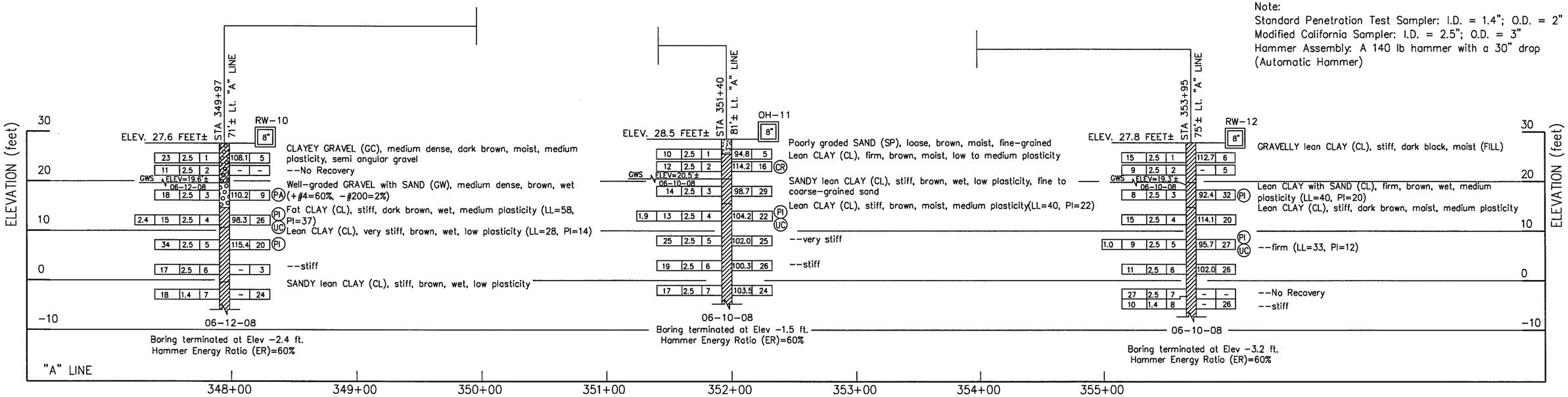

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SIGN OFF DATE	CHECKED BY	D. WANG	FIELD INVESTIGATION BY: DATE: JUNE 2008	PROJECT ENGINEER	POST MILES 22.5/24.0

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

I-880 SB HOV LANE EXTENSION AND OTHER IMPROVEMENTS BETWEEN MARINA BLVD. TO DAVIS STREET INTERCHANGE

LOG OF TEST BORINGS 3 OF 10

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ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

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EA 3A9201

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES 9/22/08 3/7/12 — SHEET OF

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DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	ALA	880	22.6/24.0		

GEOTECHNICAL PROFESSIONAL — DATE 3/7/12

PLANS APPROVAL DATE

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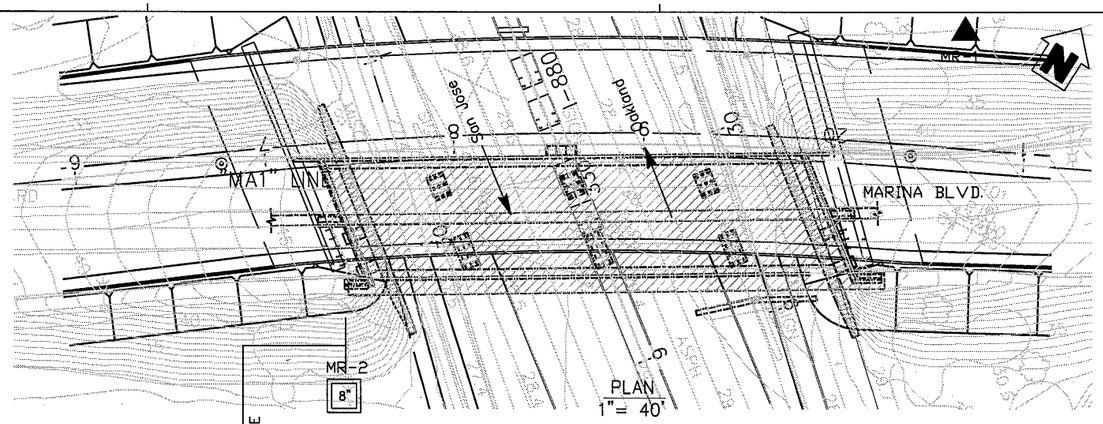

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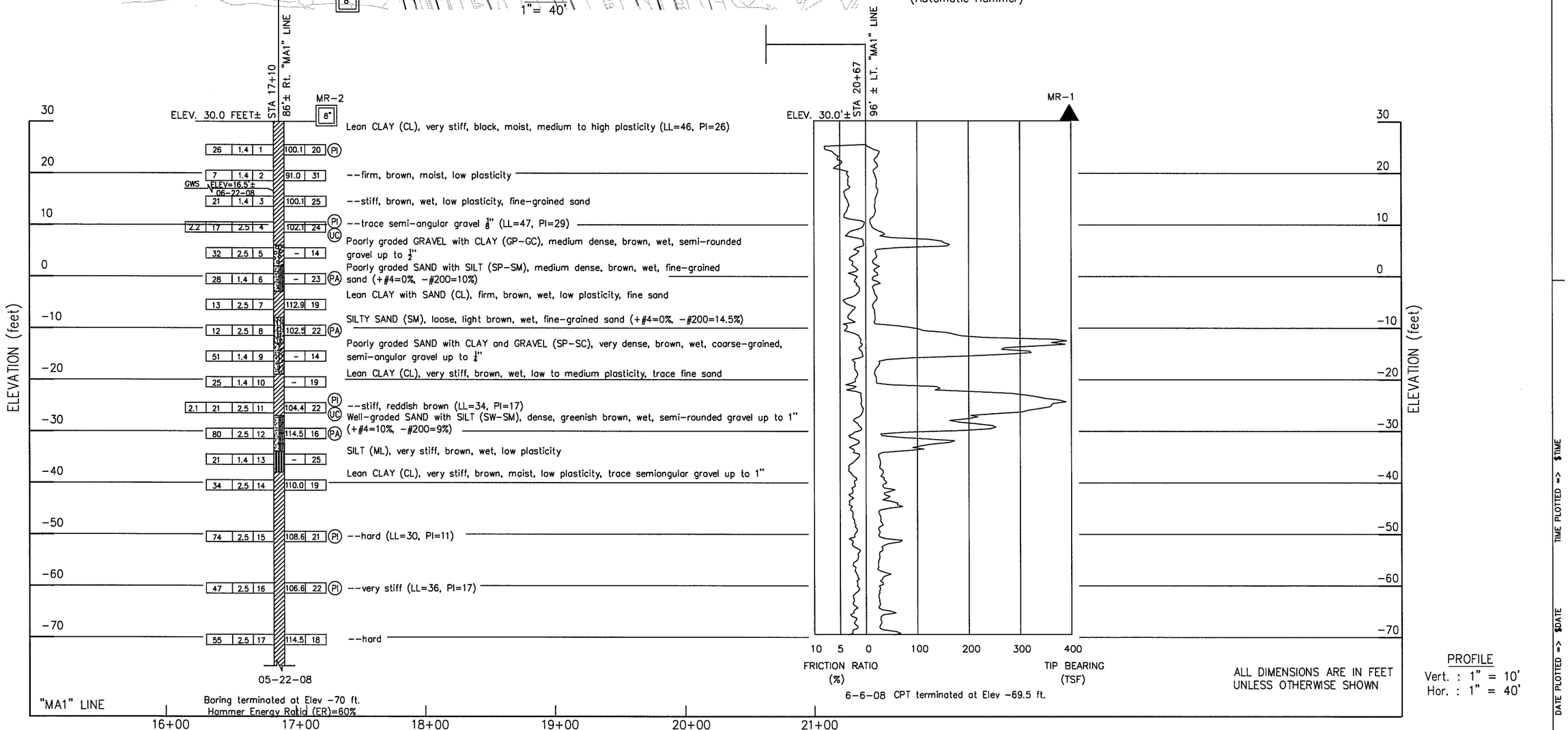

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PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

DESIGN OVERSIGHT	DRAWN BY	L. TRAN	L. BHANGOO/G. TRIPATHI — FIELD INVESTIGATION BY:
SIGN OFF DATE	CHECKED BY	D. WANG	DATE: JUNE 2008

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

D. WANG — PROJECT ENGINEER

BRIDGE NO.

POST MILES 22.5/24.0

I-880 SB HOV LANE EXTENSION AND OTHER IMPROVEMENTS BETWEEN MARINA BLVD. TO DAVIS STREET INTERCHANGE

LOG OF TEST BORINGS 4 OF 10

CU 04248
EA 3A9201

OGS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 06-01-09)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES 3/22/13 3/7/12 — SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	ALA	880	22.6/24.0	----	----

GEOTECHNICAL PROFESSIONAL — 3/7/12 DATE

PLANS APPROVAL DATE

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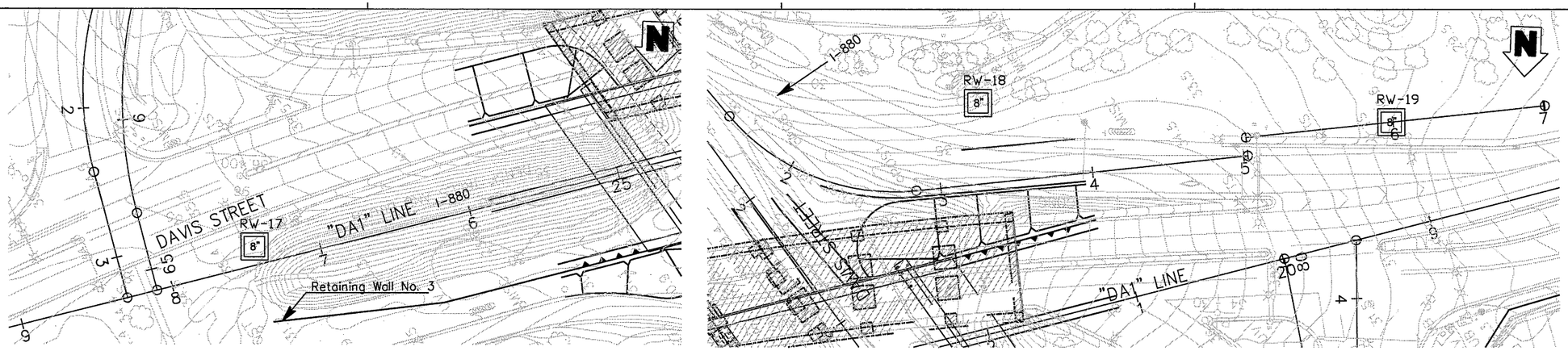
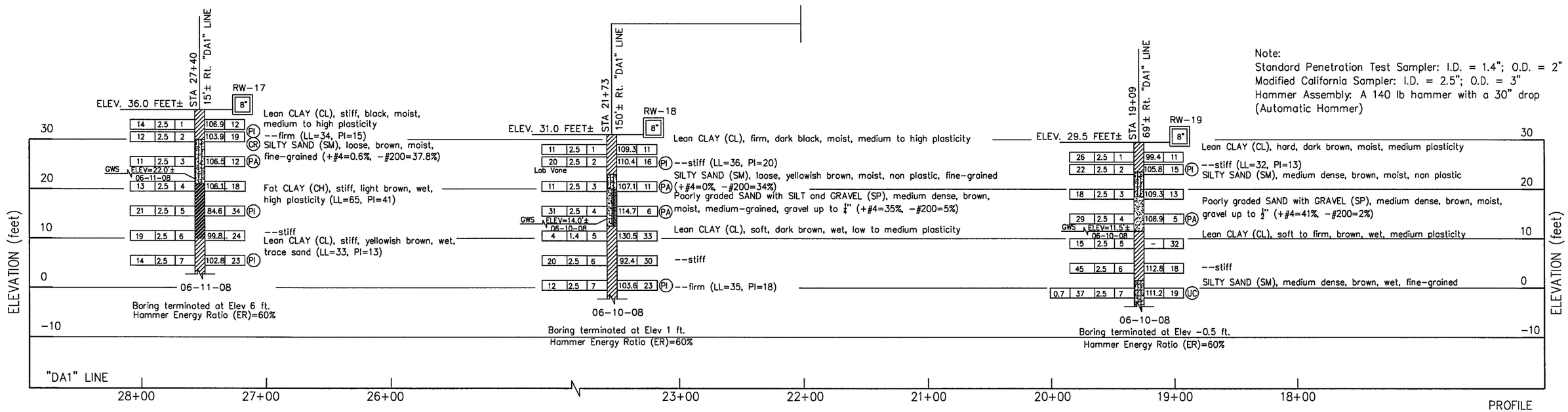


PLAN
1"=40'



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SIGN OFF DATE	CHECKED BY	D. WANG	FIELD INVESTIGATION BY: DATE: JUNE 2008		PROJECT ENGINEER

BRIDGE NO.

POST MILES 22.5/24.0

I-880 SB HOV LANE EXTENSION AND OTHER IMPROVEMENTS BETWEEN MARINA BLVD. TO DAVIS STREET INTERCHANGE

LOG OF TEST BORINGS 5 OF 10

CU 04248
EA 3A9201

OGS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 06-01-09)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES 3/22/10 3/7/12 — SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	ALA	880	22.6/24.0	----	----

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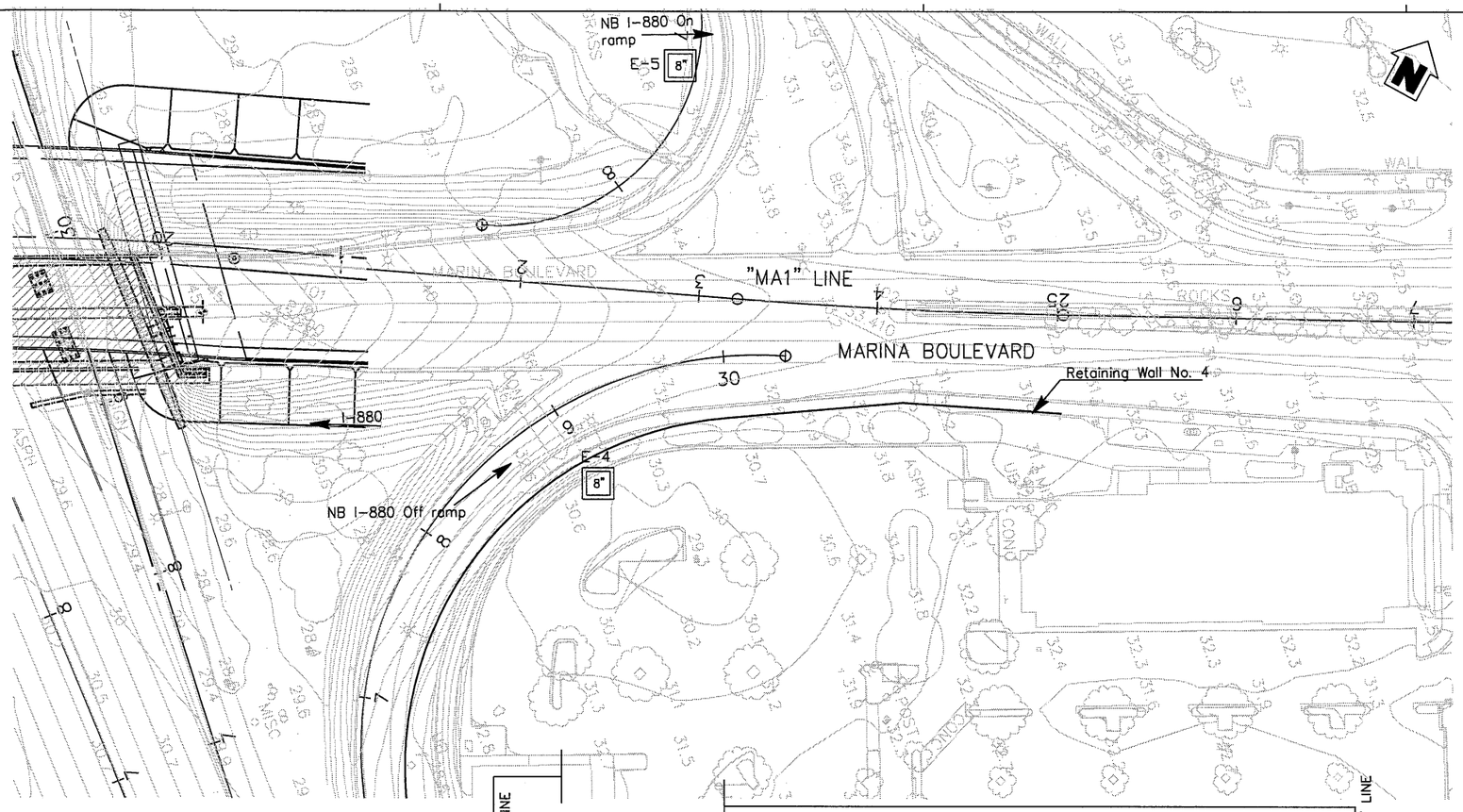

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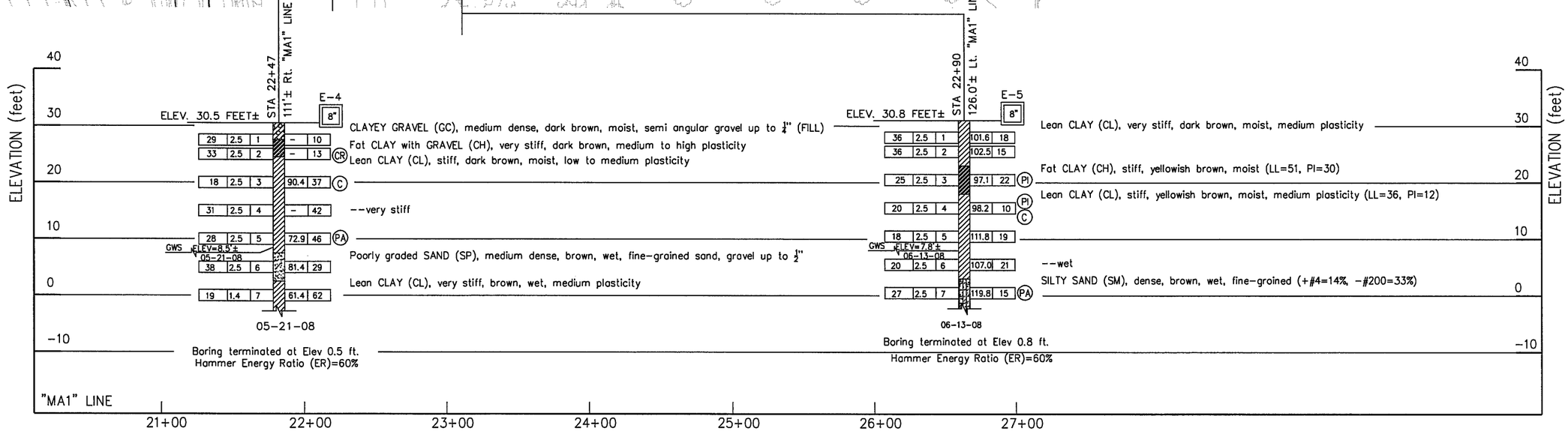

PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

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DESIGN OVERSIGHT	DRAWN BY	L. TRAN	L. BHANGOO/G. TRIPATHI	D. WANG	BRIDGE NO.
SIGN OFF DATE	CHECKED BY	D. WANG	FIELD INVESTIGATION BY: DATE: JUNE 2008	PROJECT ENGINEER	POST MILES 22.5/24.0

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I-880 SB HOV LANE EXTENSION AND OTHER IMPROVEMENTS BETWEEN MARINA BLVD. TO DAVIS STREET INTERCHANGE

LOG OF TEST BORINGS 6 OF 10

OGS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 06-01-09)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES — 9/22/09 3/7/12

REVISION DATES | SHEET | OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	ALA	880	22.6/24.0	----	----

GEOTECHNICAL PROFESSIONAL — DATE 3/7/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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ACTC
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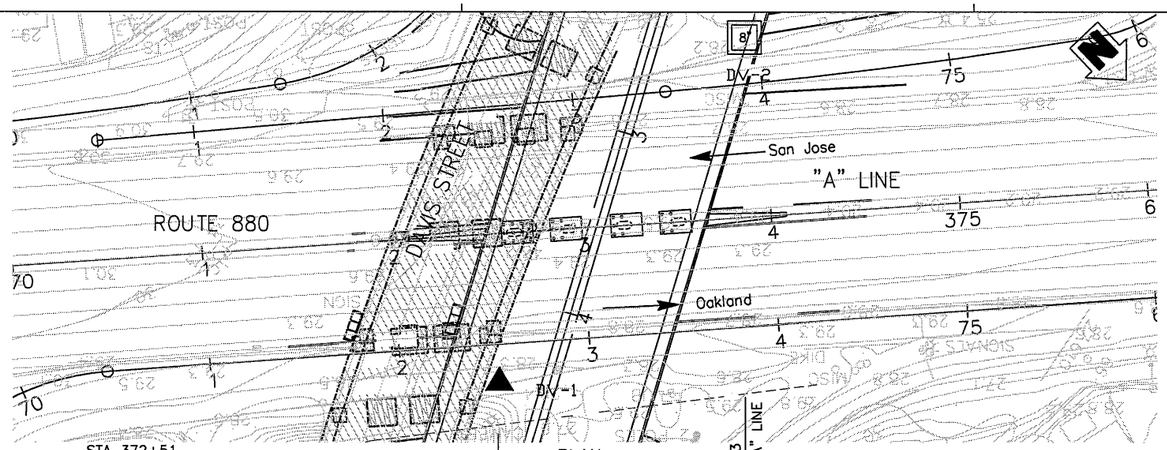
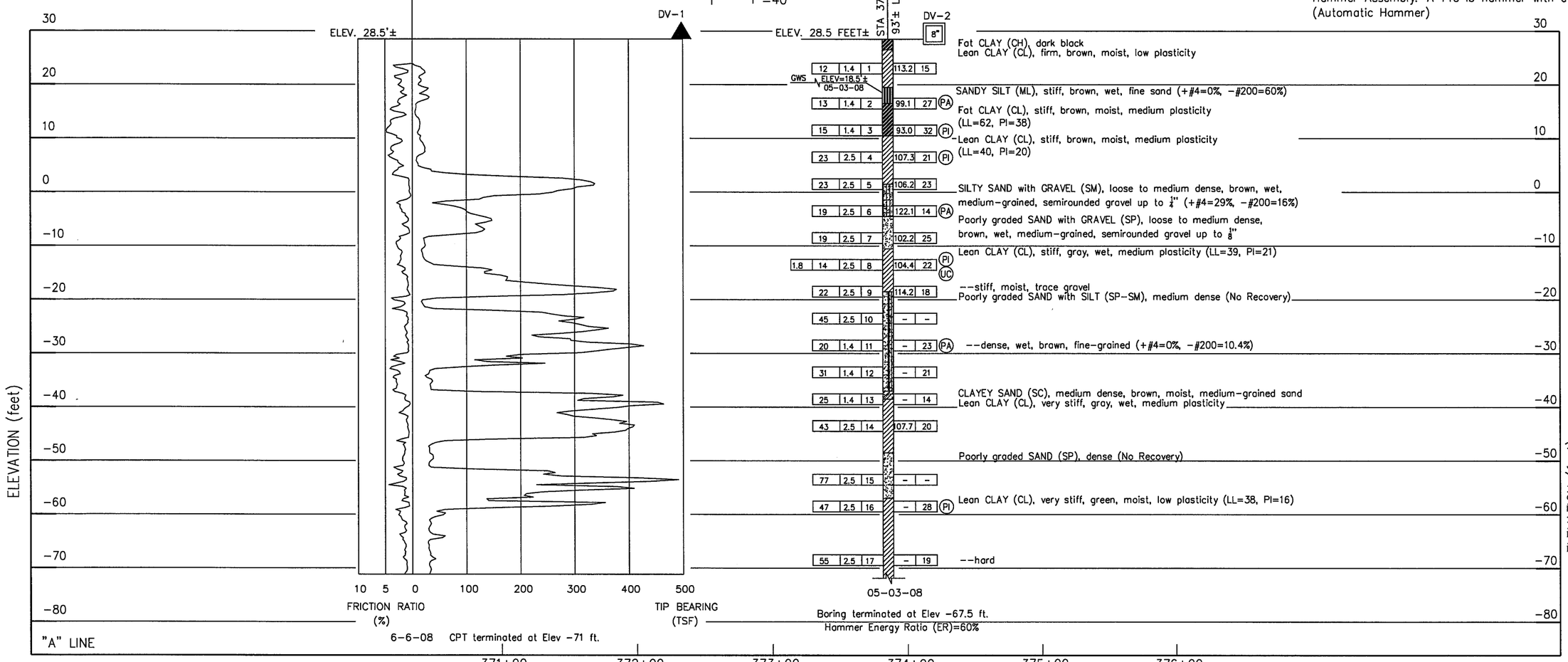
OAKLAND, CA 94612

PARIKH CONSULTANTS, INC.
2360 QUME DRIVE, SUITE A
SAN JOSE, CA 95131



PLAN
1"=40'

Note:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)



ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

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

DESIGN OVERSIGHT	DRAWN BY	L. TRAN	L. BHANGOO/G. TRIPATHI FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	D. WANG PROJECT ENGINEER
SIGN OFF DATE	CHECKED BY	D. WANG	DATE: JUNE 2008		

BRIDGE NO. — POST MILES 22.5/24.0

I-880 SB HOV LANE EXTENSION AND OTHER IMPROVEMENTS BETWEEN MARINA BLVD. TO DAVIS STREET INTERCHANGE

LOG OF TEST BORINGS 7 OF 10

CU 04248
EA 3A9201

OGS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 06-01-09)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 3/22/10 3/7/12

REVISION DATES — SHEET — OF

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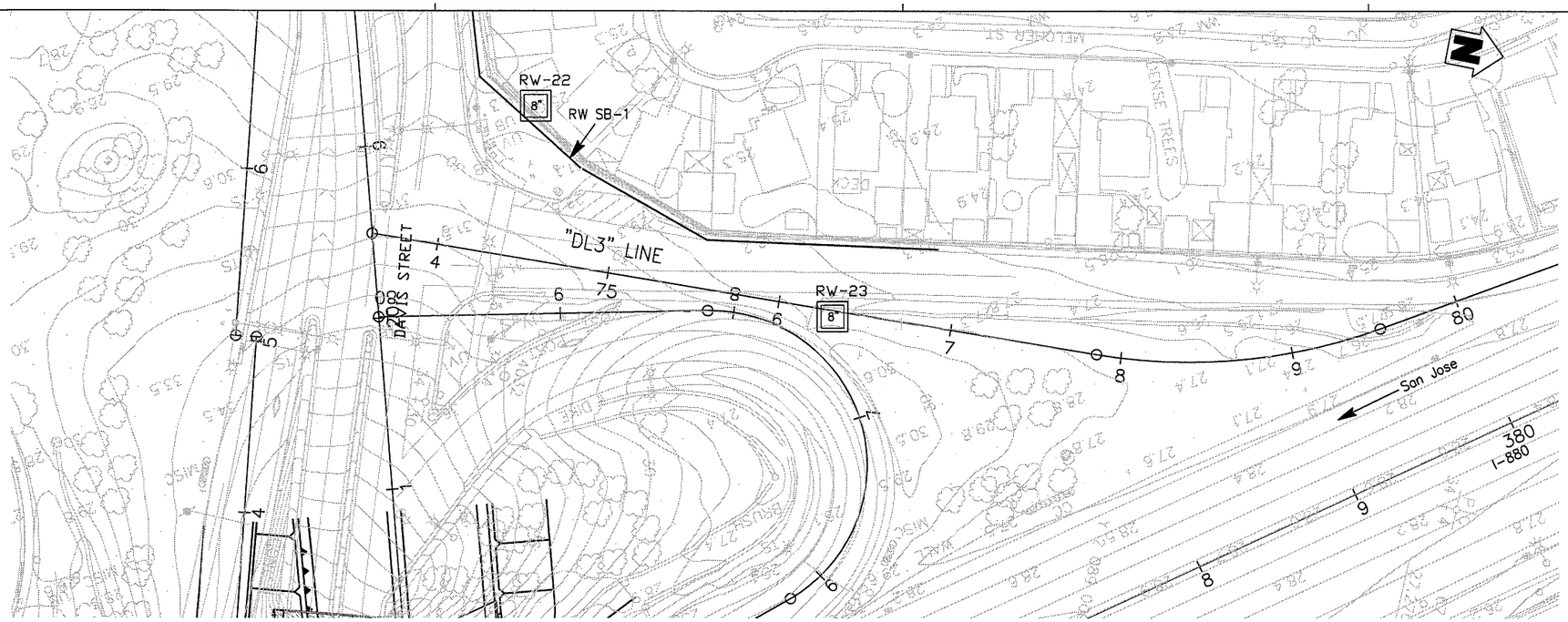

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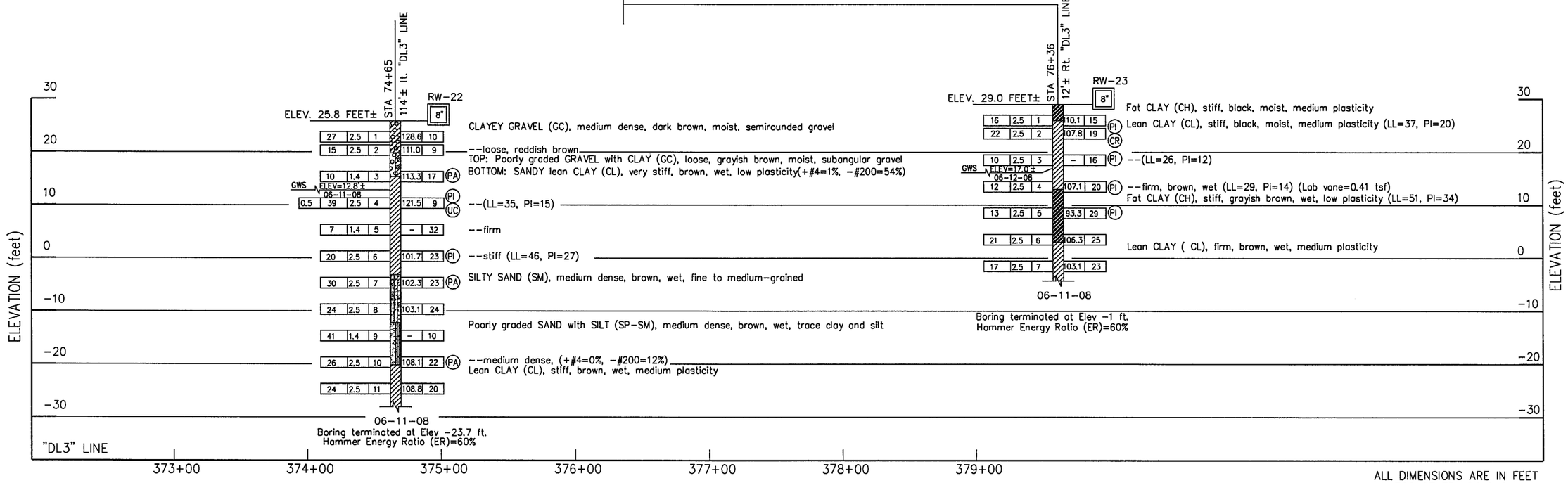

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BRIDGE NO. — POST MILES 22.5/24.0

I-880 SB HOV LANE EXTENSION AND OTHER IMPROVEMENTS BETWEEN MARINA BLVD. TO DAVIS STREET INTERCHANGE

LOG OF TEST BORINGS 8 OF 10

CU 04248
EA 3A9201

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES 9/22/09 3/7/12 — SHEET — OF

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USERNAME => $USER — DATE PLOTTED => $DATE — TIME PLOTTED => $TIME

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GEOTECHNICAL PROFESSIONAL — 3/7/12 DATE

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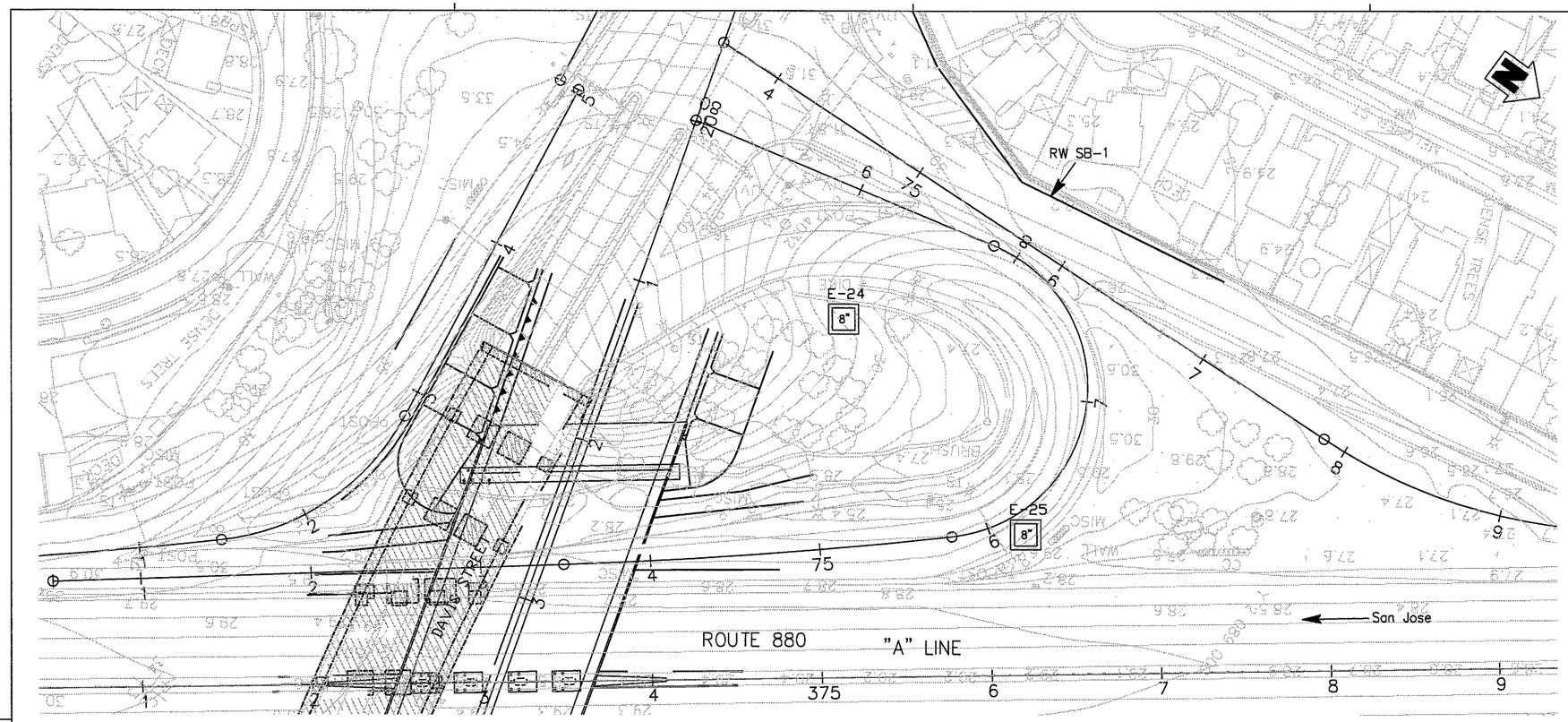

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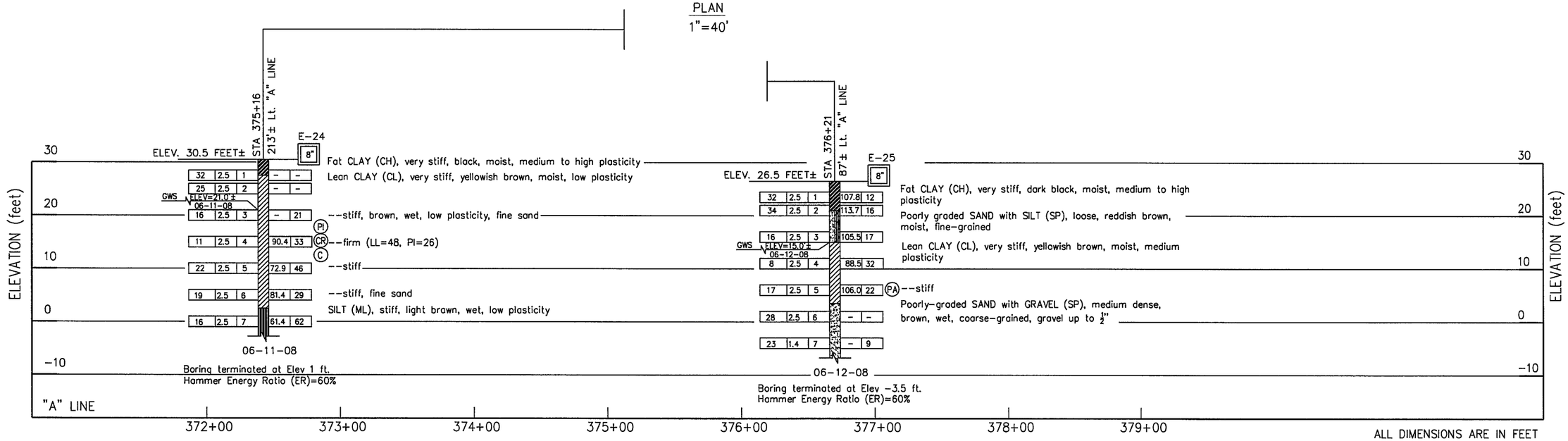

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LOG OF TEST BORINGS 9 OF 10

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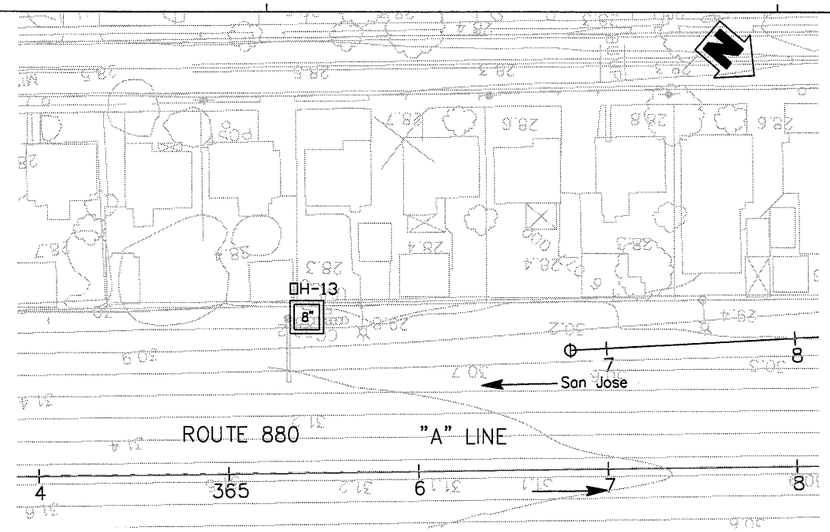

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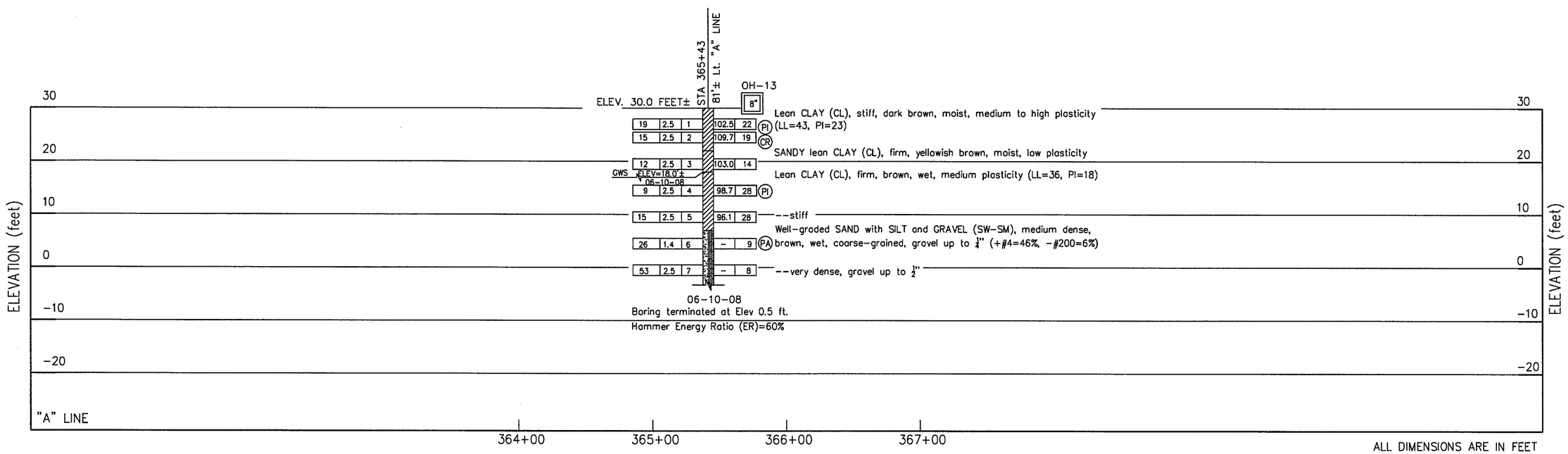

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SIGN OFF DATE	CHECKED BY	D. WANG	FIELD INVESTIGATION BY: DATE: JUNE 2008		PROJECT ENGINEER

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I-880 SB HOV LANE EXTENSION AND OTHER IMPROVEMENTS BETWEEN MARINA BLVD. TO DAVIS STREET INTERCHANGE

LOG OF TEST BORINGS 10 OF 10

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REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

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GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Trioxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potentiol (ASTM D 4546)
- (TV) Pocket Tarvone
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Trioxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

CONSISTENCY OF COHESIVE SOILS

Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

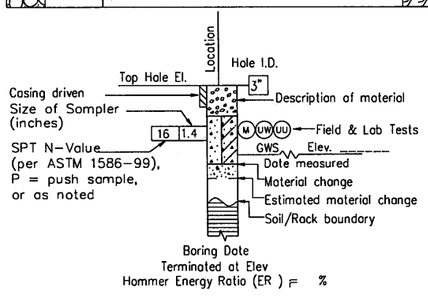
PLASTICITY OF FINE-GRAINED SOILS

Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

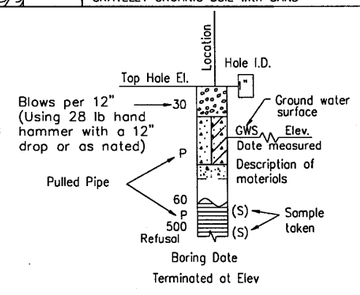
BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetrotion Test (ASTM D 5778-95)
□	O	Other

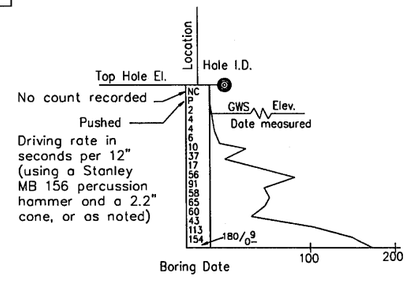
Note: Size in inches.



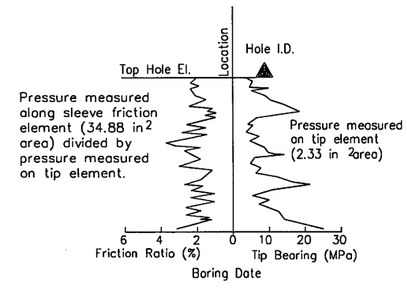
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

SOIL LEGEND

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BRIDGE NO.

POST MILES 22.6/24.0

RETAINING WALL NO. 1

LOG OF TEST BORINGS

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ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

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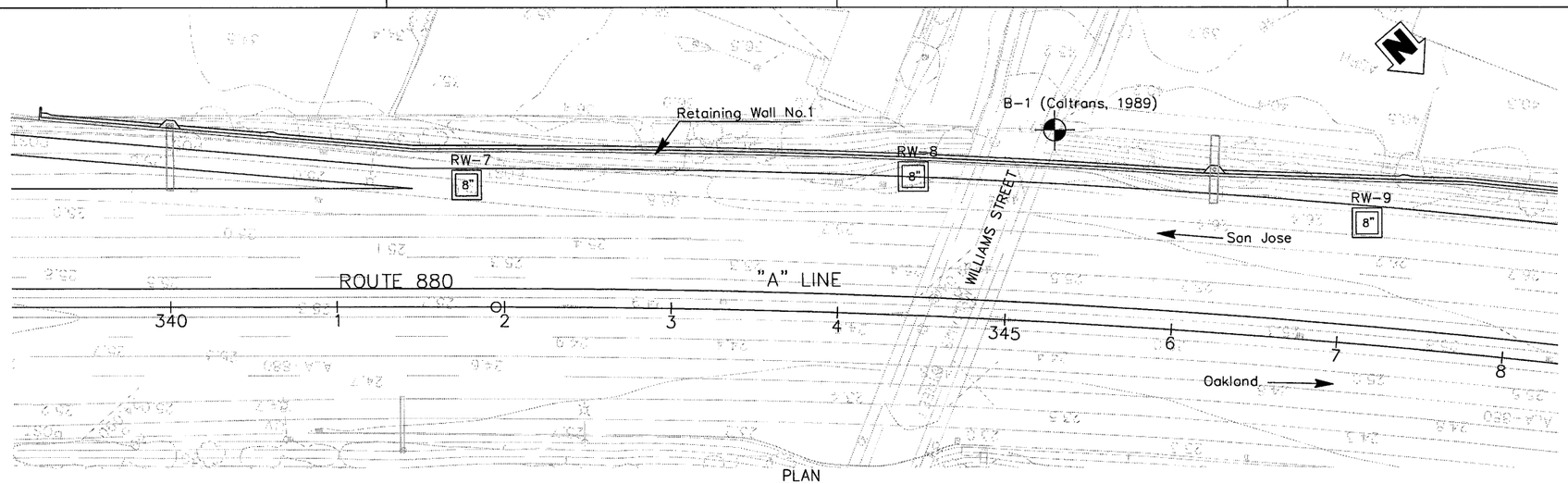

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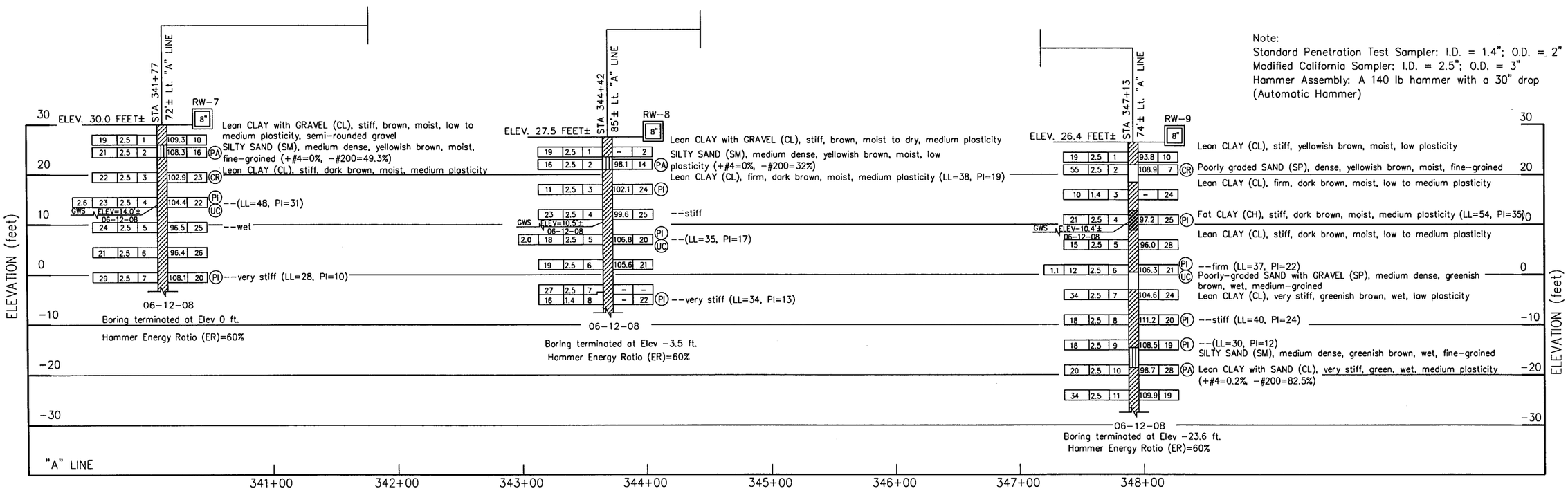

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GEOTECHNICAL PROFESSIONAL — DATE 3/7/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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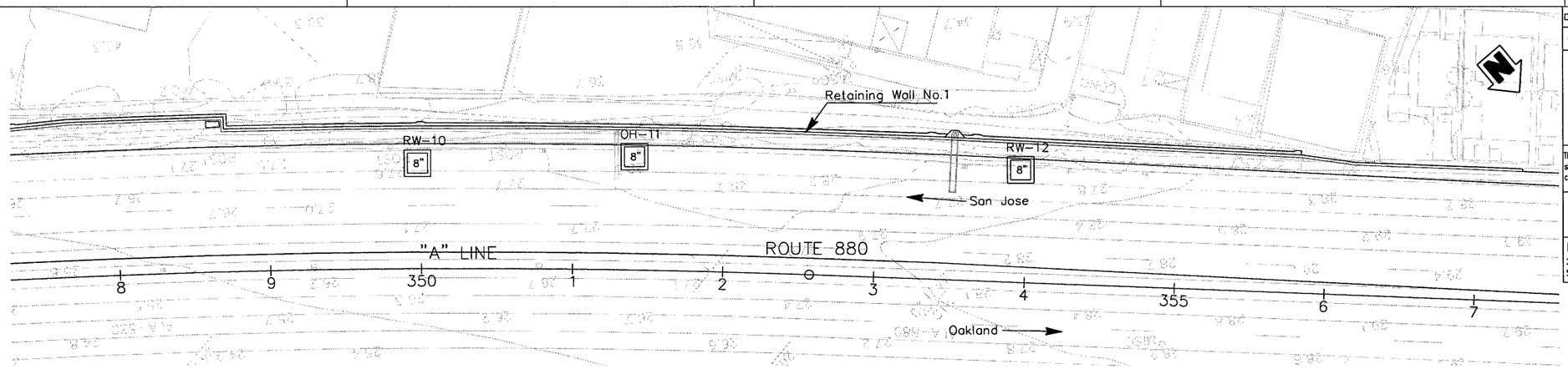
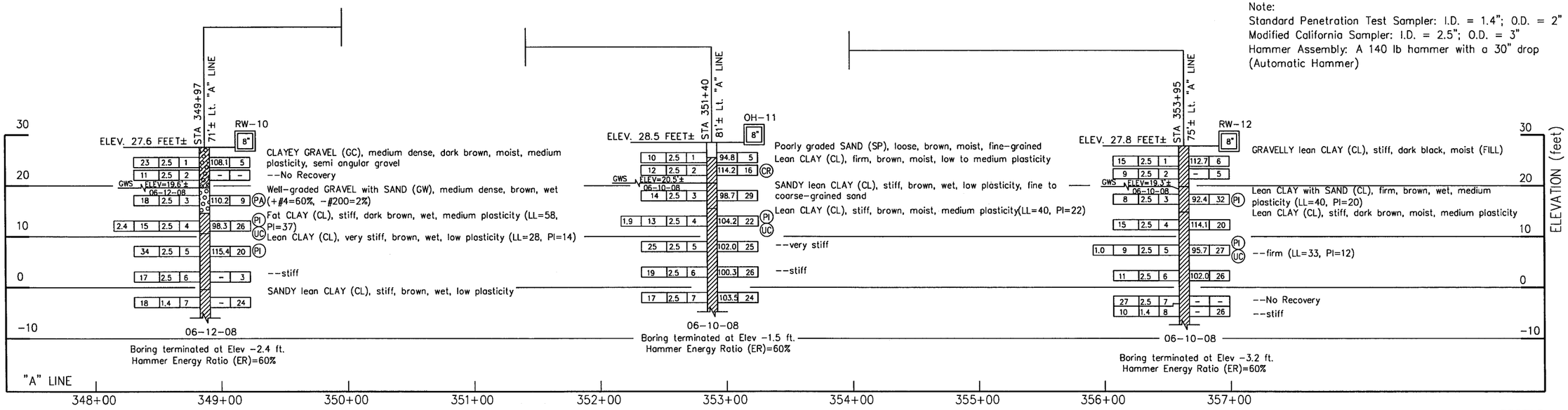
ACTC
1333 BROADWAY, SUITE 220
OAKLAND, CA 94612

PARIKH CONSULTANTS, INC.
2360 QUME DRIVE, SUITE A
SAN JOSE, CA 95131



PLAN
1"=40'

Note:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)



ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

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

DESIGN OVERSIGHT	DRAWN BY	L. TRAN	L. BHANGOO/G. TRIPATHI	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	D. WANG
SIGN OFF DATE	CHECKED BY	D. WANG	FIELD INVESTIGATION BY: DATE: JUNE 2008		PROJECT ENGINEER

BRIDGE NO.
POST MILES 22.6/24.0

RETAINING WALL NO. 1
LOG OF TEST BORINGS

OGS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 06-01-09)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04248
EA 3A9211

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 9/22/10 4/20/11 3/7/12

SHEET OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	880	20.3/23.8	284	354

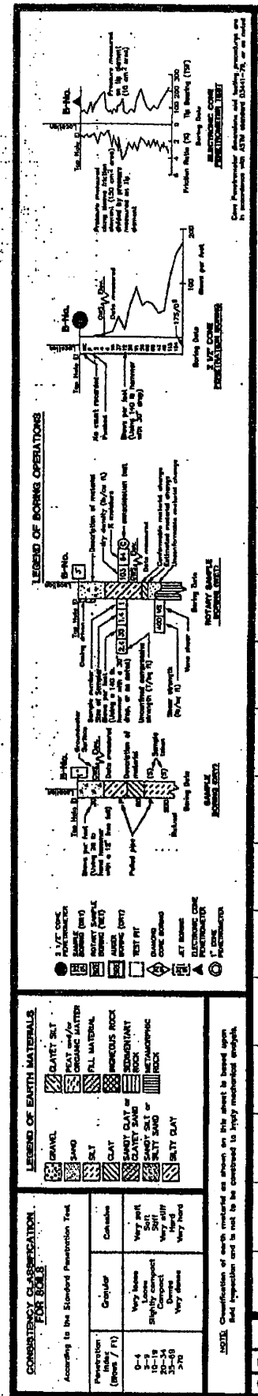
H. R. Taber
CERTIFIED ENGINEERING GEOLOGIST

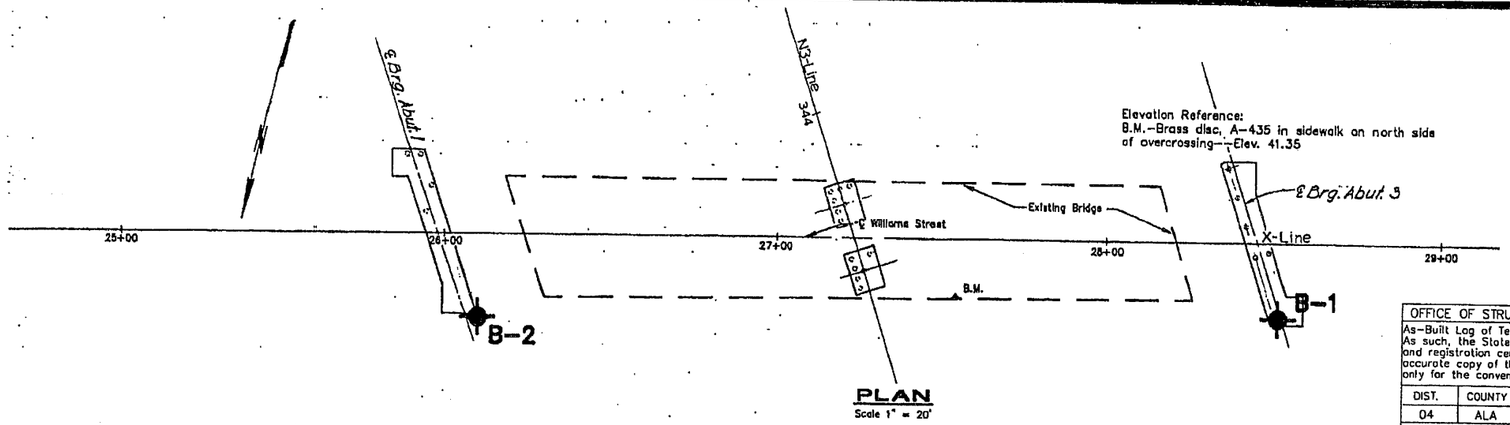
8-26-91
PLANS APPROVAL DATE

REGISTERED GEOLOGIST — H. R. TABER — No. 12 — Exp. 6-30-90 — CERTIFIED ENGINEERING GEOLOGIST — STATE OF CALIFORNIA

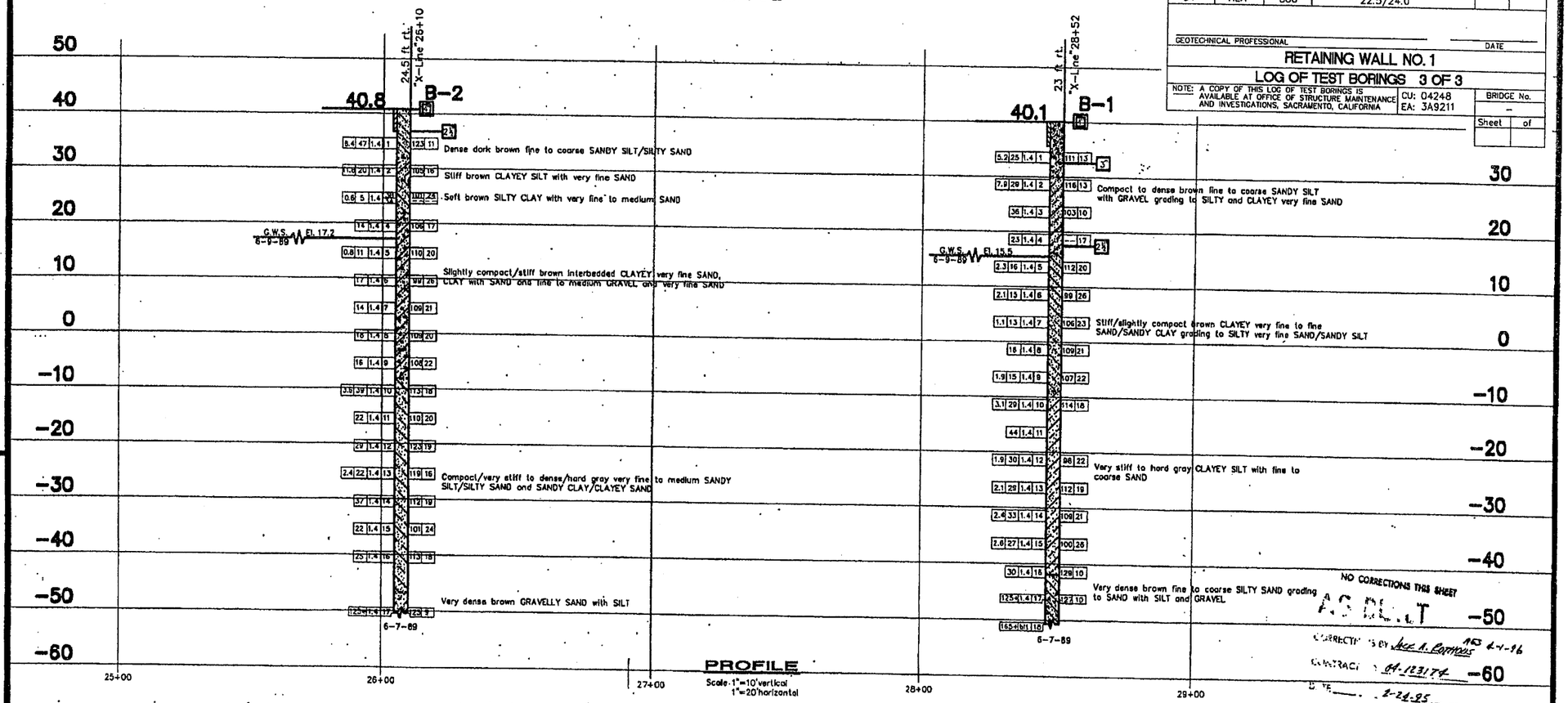
TABER CONSULTANTS
636 Galveston Street
West Sacramento, CA 95691

JOB No. 1P1/388/72-12
Field Study By: E. A. SHEDD





PLAN
Scale 1" = 20'



PROFILE
Scale 1"=10' vertical
1"=20' horizontal

OFFICE OF STRUCTURE FOUNDATIONS – ENGINEERING SERVICE CENTER

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILE–TOTAL PROJECT	Sheet No.	Total Sheets
04	ALA	880	22.5/24.0		

GEOTECHNICAL PROFESSIONAL — DATE

RETAINING WALL NO. 1

LOG OF TEST BORINGS 3 OF 3

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 04248
EA: 3A9211

BRIDGE No. –
Sheet of

NO CORRECTIONS THIS SHEET
AS BUILT
CORRECTIONS BY Jack A. Barnhart 4-1-96
CONTRACT 04-123174
DATE 2-28-95

ENGINEERING GEOLOGY BRANCH - TRANSPORTATION LABORATORY

DRAWN BY M.D.R. 7-89
CHECKED BY E.A.S. 7-89

PROJECT ENGINEER

PREPARED FOR: State of CALIFORNIA DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES 2
STRUCTURE DESIGN

BRIDGE NO. 33-169
POST MILE 23.1

WILLIAMS STREET OVERCROSSING
LOG OF TEST BORINGS

Scale: As shown

TL 6092 REV. 4/89

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04173
EA 123171

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 15 OF 16

ClibPDF - www.fastio.com

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	880	22.6/24.0		

GEOTECHNICAL PROFESSIONAL — 3/7/12 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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2360 QUME DRIVE, SUITE A
SAN JOSE, CA 95131

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

(C)	Consolidation (ASTM D 2435)
(CL)	Collapse Potential (ASTM D 5333)
(CP)	Compaction Curve (CTM 216)
(CR)	Corrosivity Testing (CTM 643, CTM 422, CTM 417)
(CU)	Consolidated Undrained Triaxial (ASTM D 4767)
(DS)	Direct Shear (ASTM D 3080)
(EI)	Expansion Index (ASTM D 4829)
(M)	Moisture Content (ASTM D 2216)
(OC)	Organic Content-% (ASTM D 2974)
(P)	Permeability (CTM 220)
(PA)	Particle Size Analysis (ASTM D 422)
(PI)	Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
(PL)	Point Load Index (ASTM D 5731)
(PM)	Pressure Meter
(PP)	Pocket Penetrometer
(R)	R-Value (CTM 301)
(SE)	Sand Equivalent (CTM 217)
(SG)	Specific Gravity (AASHTO T 100)
(SL)	Shrinkage Limit (ASTM D 427)
(SW)	Swell Potential (ASTM D 4546)
(TV)	Pocket Torvane
(UC)	Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
(UU)	Unconsolidated Undrained Triaxial (ASTM D 2850)
(UW)	Unit Weight (ASTM D 4767)
(VS)	Vane Shear (AASHTO T 223)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 – 4
Loose	5 – 10
Medium Dense	11 – 30
Dense	31 – 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

CONSISTENCY OF COHESIVE SOILS

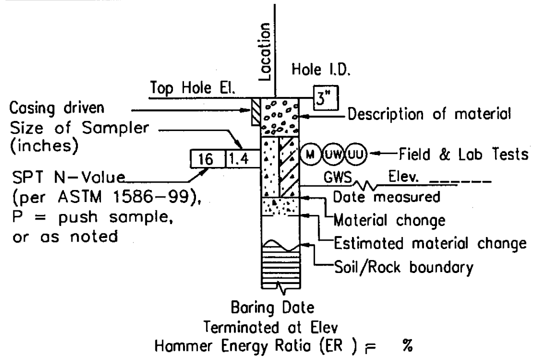
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

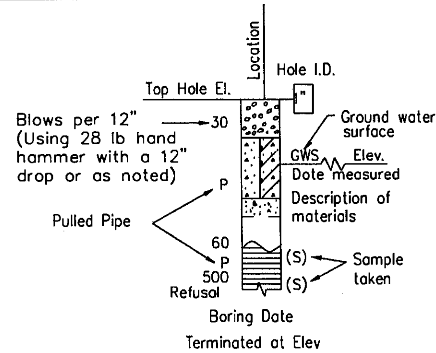
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

BOREHOLE IDENTIFICATION

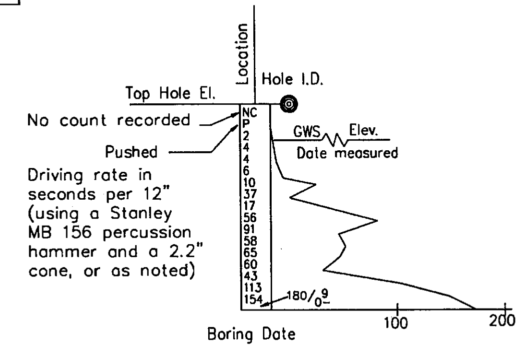
Symbol	Hole Type	Description
[Size]	A	Auger Boring
[Size]	R P	Rotary drilled boring Rotary percussion boring (air)
◇ Size	R	Rotary drilled diamond core
[Size]	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
□	O	Other
Note: Size in inches.		



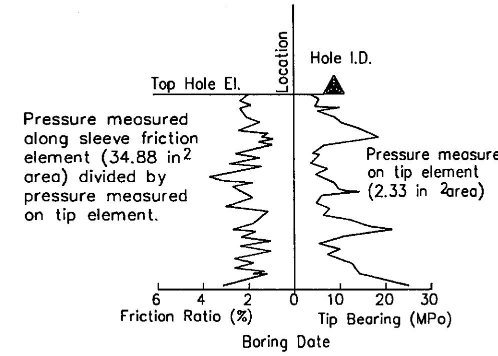
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

SOIL LEGEND

DESIGN OVERSIGHT	DRAWN BY	L. TRAN	L. BHANGOO/G. TRIPATHI FIELD INVESTIGATION BY:
SIGN OFF DATE	CHECKED BY	D. WANG	DATE: JUNE 2008

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

D. WANG
PROJECT ENGINEER

BRIDGE NO.

POST MILES 22.6/24.0

RETAINING WALL NO. 2
LOG OF TEST BORINGS

OGS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 06-01-09)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04248
EA 3A9211

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 9/22/09, 4/20/11, 10/24/11, 3/7/12

SHEET OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	880	22.6/24.0		

GEOTECHNICAL PROFESSIONAL — DATE 3/7/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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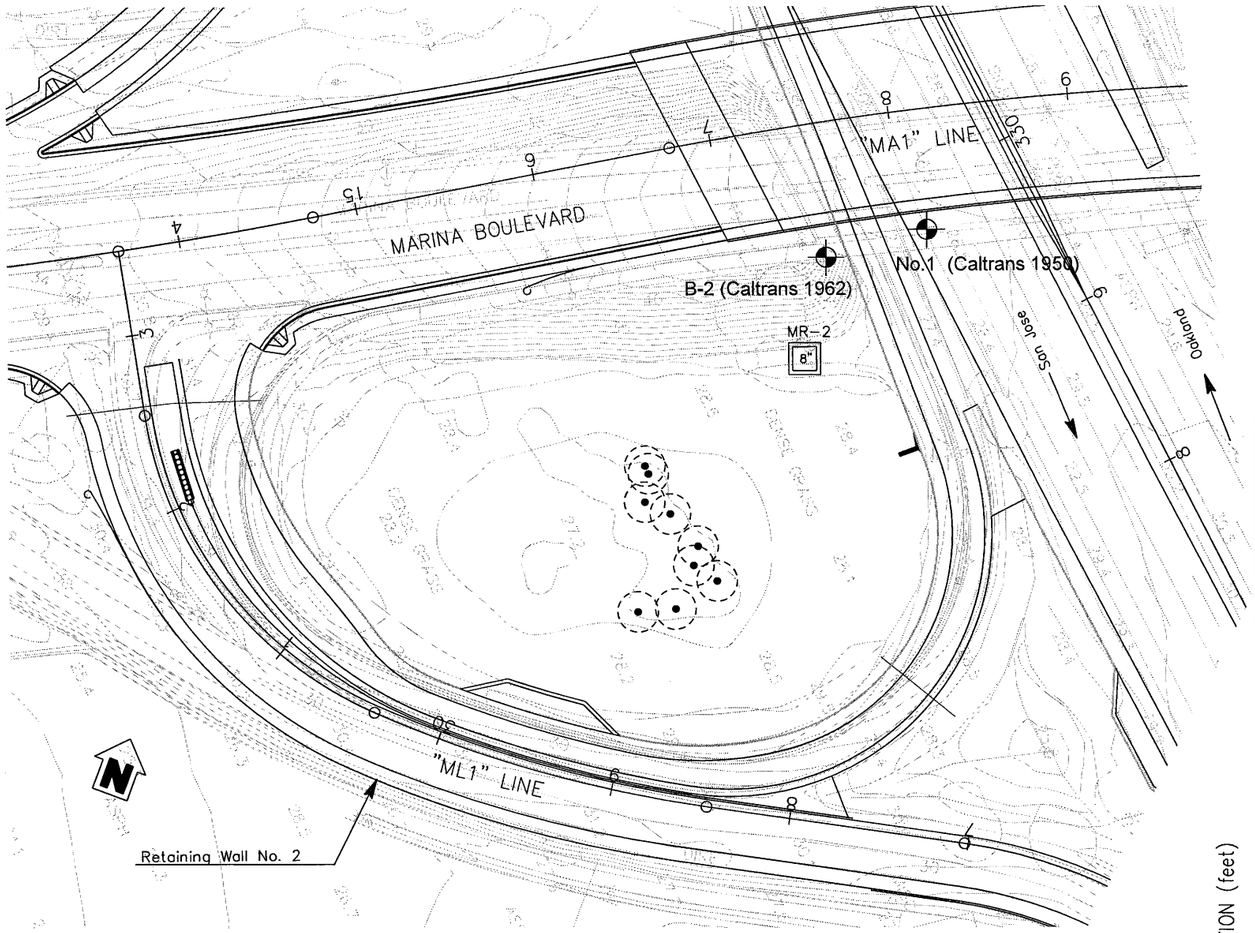

PLAN
1"=40'

Note:
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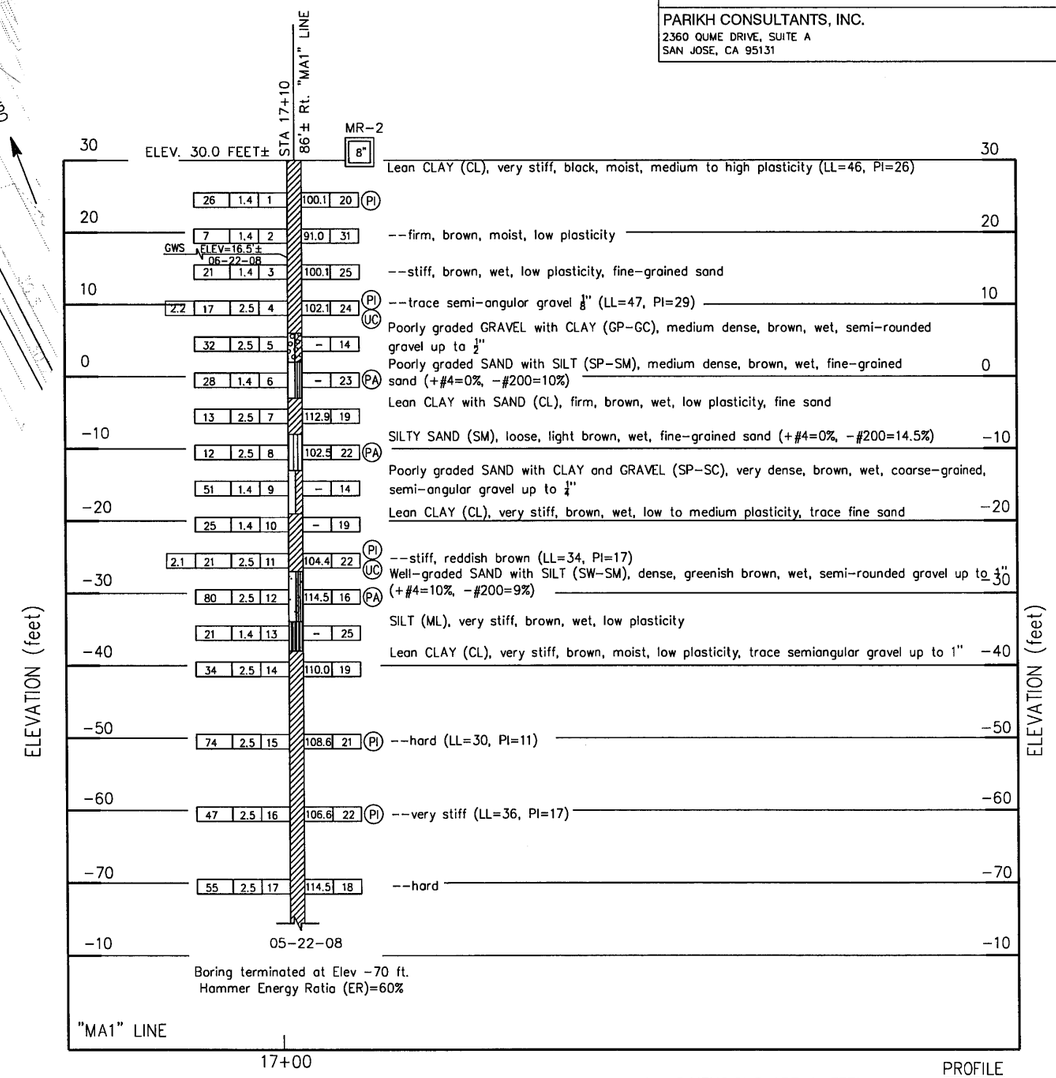

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

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

DESIGN OVERSIGHT	DRAWN BY	L. TRAN	L. BHANGOO/G. TRIPATHI	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	D. WANG
SIGN OFF DATE	CHECKED BY	D. WANG	FIELD INVESTIGATION BY: DATE: JUNE 2008		PROJECT ENGINEER

BRIDGE NO.
POST MILES 22.6/24.0

RETAINING WALL NO. 2

LOG OF TEST BORINGS 1 OF 3

CU 04248
EA 3A9211

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES 9/22/10 4/28/11 10/24/11 3/7/12 — SHEET — OF

OGS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 05-01-09)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

FILE => $REQUEST

USERNAME => $USER — DATE PLOTTED => $DATE — TIME PLOTTED => $TIME

DIST NO	STATE	PROJ NO	YEAR	NO	SHEETS
2	CAL.			143	174

DIST	COUNTY	ROUTE	SECTION	SHEET No.	TOTAL SHEETS
IV	Ala	880	6	2	8

Stewart M. Kelly
August 21, 1950

OFFICE OF STRUCTURE FOUNDATIONS — ENGINEERING SERVICE CENTER

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DIST.	COUNTY	ROUTE	POST MILE–TOTAL PROJECT	Sheet No.	Total Sheets
04	Ala	880	22.6/24.0		

GEOTECHNICAL PROFESSIONAL — DATE: 04/20/11

RETAINING WALL NO. 2

LOG OF TEST BORINGS 2 OF 3

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

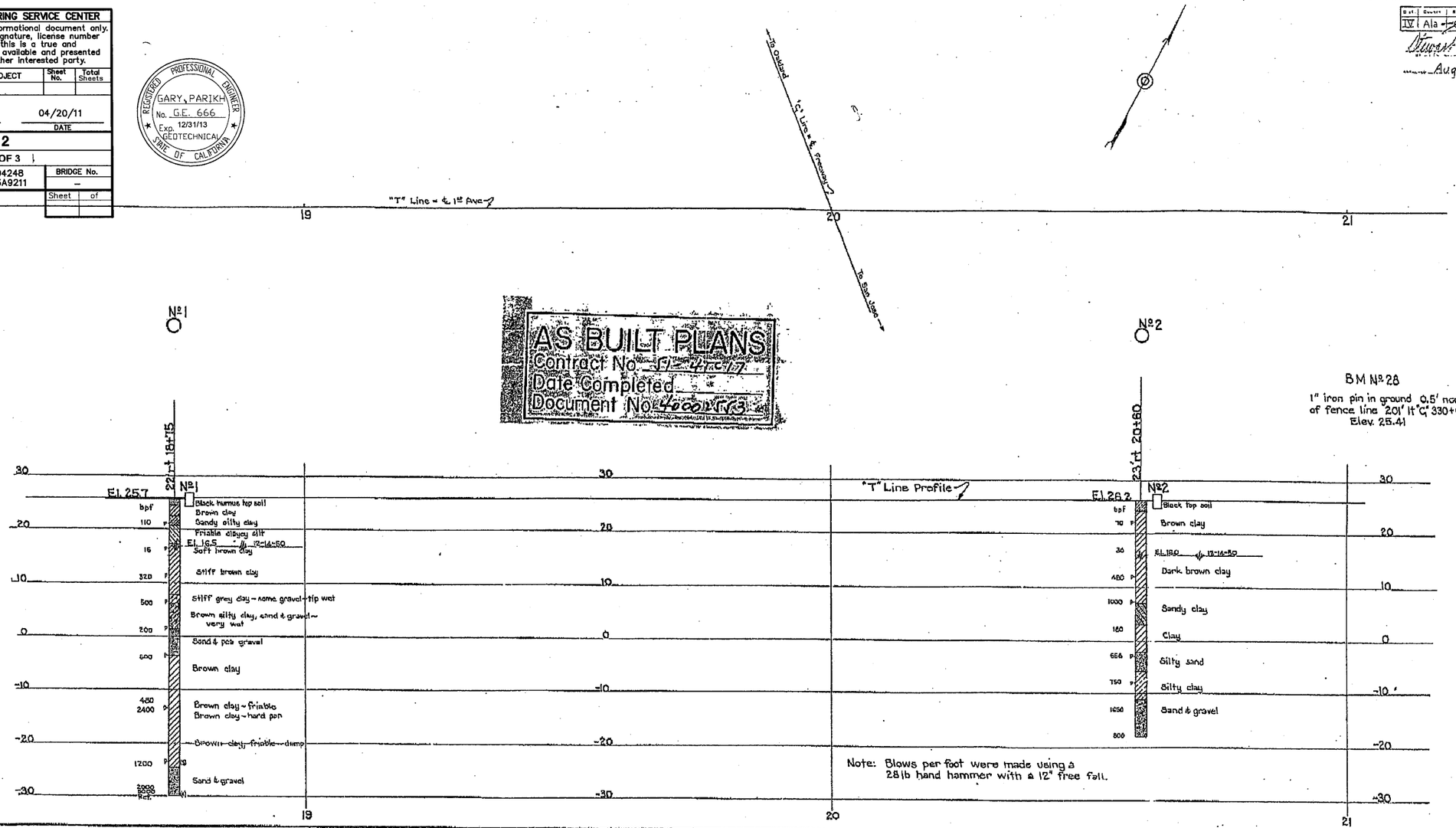
CU: 04248
EA: 3A9211

BRIDGE No. —

Sheet ___ of ___

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

AS BUILT PLANS
Contract No. 51-4C17
Date Completed
Document No. 4000017-3



CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

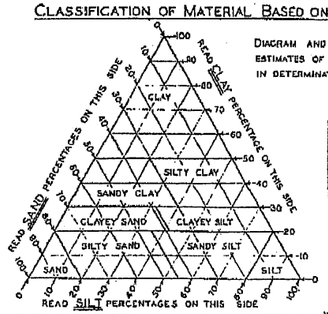


DIAGRAM AND TABLE SHOWING THE BASIS FOR ESTIMATES OF GRADE SIZE DISTRIBUTION USED IN DETERMINATION OF CLASS NAMES.

GROUPING USED IN TRIANGULAR CLASSIFICATION			
CLASS NAME	PERCENTAGE OF SIZES PRESENT		
	SAND	SILT	CLAY
SAND	80–100	0–20	0–20
SILTY SAND	45–80	0–55	0–20
SANDY SILT	0–45	55–80	0–20
SILT	0–20	80–100	0–20
CLAYEY SAND	45–80	0–42	20–30
CLAYEY SILT	0–38	52–80	20–30
SANDY CLAY	30–70	0–40	30–50
SILTY CLAY	0–30	20–70	30–50
CLAY	0–50	0–30	50–100

IF GRAVEL IS PRESENT IN APPRECIABLE AMOUNTS THE TERM "GRAVELLY" MAY BE ADDED TO THE CLASS NAME, VIZ. "GRAVELLY SAND". THE TERMS "COARSE", "MEDIUM" AND "FINE" WHEN USED TO DESCRIBE GRAVEL, SAND AND SILT REFER TO STANDARD GRADE SIZE LIMITS.

LEGEND OF BORING OPERATIONS

- PLAN OF ANY BORING
- 1" SAMPLER BORING
- ROTARY WASH BORING
- 1" CLOSED SAMPLER DRIVEN
- CORE BORING
- 2½" PENETROMETER DRIVEN
- 2" SAMPLER BORING
- 2"×0.5" AUGER BORING
- 6"×20" AUGER BORING
- CASING DRIVEN
- JET BORING
- (S) SAMPLE TAKEN

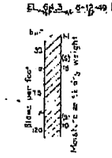
THE APPROPRIATE BORING SYMBOLS DESIGNATING THE METHOD OF OPERATION ARE SHOWN AT THE UPPER RIGHT-HAND CORNER OF THE RESPECTIVE BORING. WHERE TOOL CHANGES WERE MADE DURING THE BORING OPERATION SYMBOLS ARE SHOWN AT THE POINT OF CHANGE.

LEGEND OF EARTH MATERIALS

- GRAVEL ~ G
- SAND ~ S
- SILT ~ SI
- CLAY ~ C
- SILTY SAND ~ SI S
- CLAYEY SAND ~ C S
- SANDY SILT ~ S SI
- CLAYEY SILT ~ C SI
- SANDY CLAY ~ SC
- SILTY CLAY ~ SI C
- PEAT and/or ORGANIC CLAY ~ O
- SANDSTONE ~ SS
- SHALE ~ SH
- BROKEN ROCK (FRAGMENTS) ~ BR
- ROCK ~ R

ABBREVIATIONS

EL. 69.4	ELEVATION OF GROUND AT TEST HOLE
bpf	BLOWS PER FOOT ~ (SEE NOTE ABOVE)
P	PULLED PIPE
M	MOISTURE AS % DRY WEIGHT
EL. 68.3 ⊥ 8-12-49	ELEVATION OF GROUND WATER AND DATE



NOTES

THE CONTRACTOR'S ATTENTION IS DIRECTED TO SECTION 2, ARTICLE (c) OF THE STANDARD SPECIFICATIONS AND TO THE SPECIAL PROVISIONS ACCOMPANYING THIS SET OF PLANS.

CLASSIFICATION OF EARTH MATERIAL AS SHOWN ON THIS SHEET IS BASED UPON FIELD INSPECTION AND IS NOT TO BE CONSTRUED TO IMPLY MECHANICAL ANALYSIS.

See Pile Driving Log

MICROFILMED

BRIDGE DEPARTMENT

STATE OF CALIFORNIA — DEPARTMENT OF PUBLIC WORKS — DIVISION OF HIGHWAYS

FIRST AVE. OVERCROSSING
LOG OF TEST BORINGS

SCALE: 1" = 10'
BRIDGE No. 33-187
FILE NO
DRAWING NO. C-23395-2

OFFICE OF STRUCTURE FOUNDATIONS — ENGINEERING SERVICE CENTER

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILE–TOTAL PROJECT	Sheet No.	Total Sheets
04	Ala	880	22.6/24.0	–	

GEOTECHNICAL PROFESSIONAL — DATE 04/20/11

RETAINING WALL NO. 2

LOG OF TEST BORINGS 3 OF 3

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 04248
EA: 3A9211

BRIDGE No. –

Sheet of

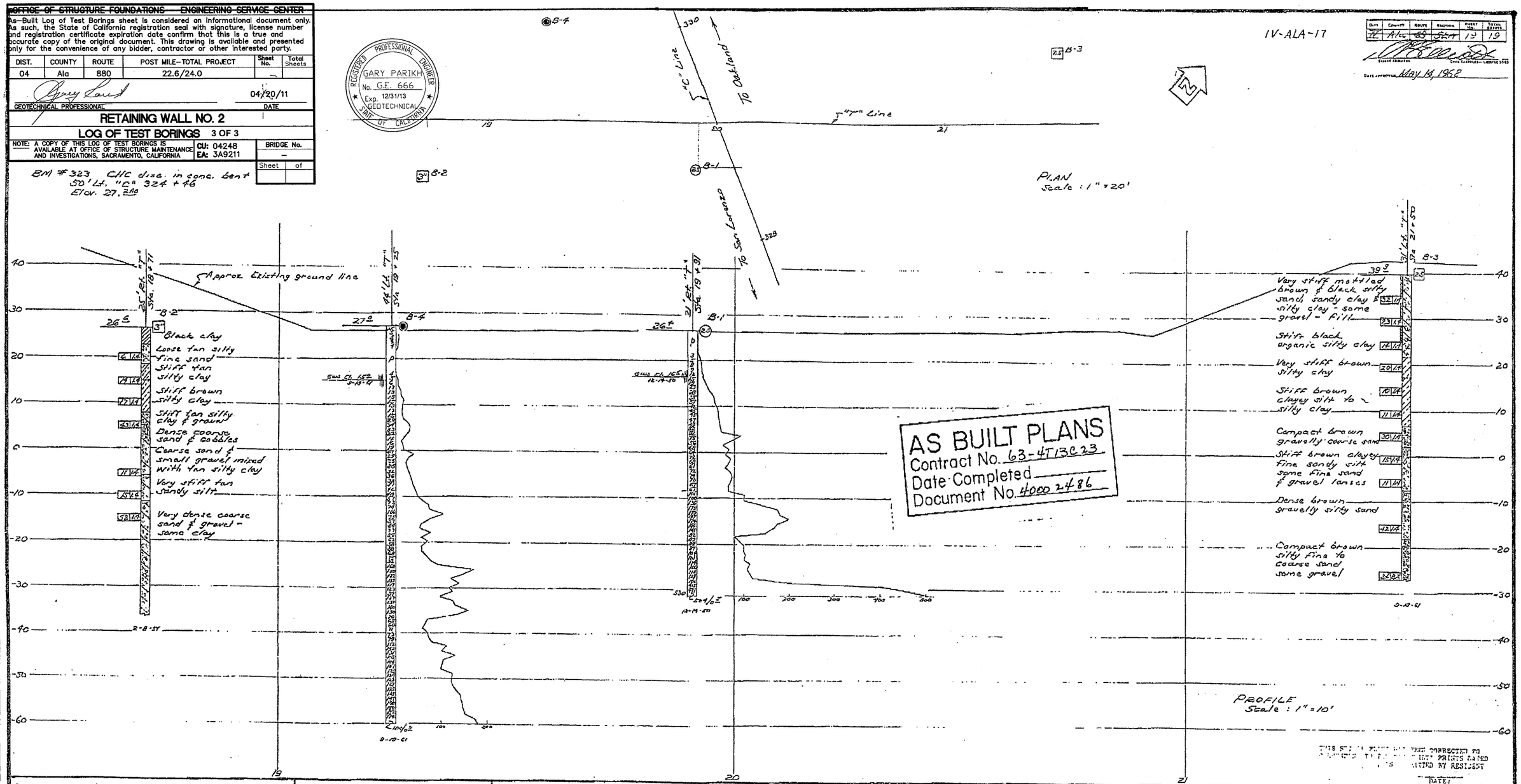
REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

IV-ALA-17

Dist.	County	Route	Section	Sheet No.	Total Sheets
04	Ala	880	Stat	19	19

Date approved May 14, 1962

BM #323 CHC disc. in conc. bent 50' Lt. "C" 324 + 46 Elev. 27.288



CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

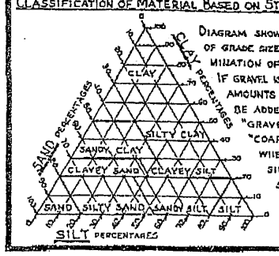


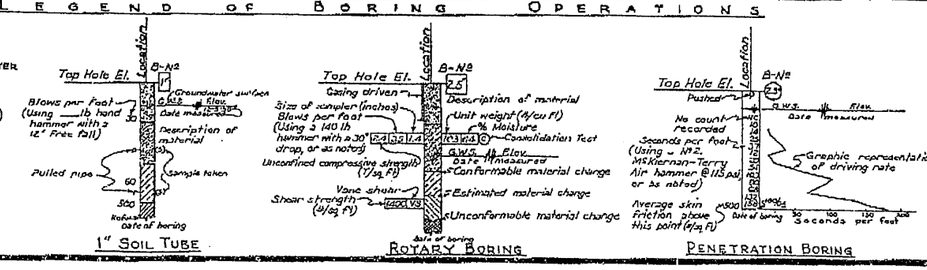
DIAGRAM SHOWING THE BASIS FOR ESTIMATES OF GRADE SIZE DISTRIBUTION USED IN DETERMINATION OF CLASS NAMES. IF GRAVEL IS PRESENT IN APPRECIABLE AMOUNTS THE TERM "GRAVELLY" MAY BE ADDED TO THE CLASS NAME, VIZ. "GRAVELLY SAND." THE TERMS "COARSE," "MEDIUM" AND "FINE" WHEN USED TO DESCRIBE SAND, SILT AND GRAVEL REFER TO STANDARD GRADE SIZE LIMITS.

LEGEND OF EARTH MATERIALS

- GRAVEL
- SAND
- SILT
- CLAY
- SANDY CLAY OR CLAYEY SAND
- SANDY SILT OR SILTY SAND
- SILTY CLAY OR CLAYEY SILT
- PEAT AND/OR ORGANIC MATTER
- FILL MATERIAL
- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

LEGEND OF BORING OPERATIONS

- PENETROMETER
- 2¼" CONE PENETROMETER
- SAMPLER BORING (DRY)
- ROTARY BORING (WET)
- AUGER BORING (DRY)
- JET BORING
- CORE BORING
- TEST PIT



NOTE

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

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

Marina Blvd. OC.
~~FIRST AVENUE OC~~

LOG OF TEST BORINGS

SCALE	BRIDGE	FILE	DRAWING
As Noted	33-167		C-33167-19

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	880	22.6/24.0		

GEOTECHNICAL PROFESSIONAL 3/7/12 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER GARY PARIKH No. G.E. 666 Exp. 12/31/13 GEOTECHNICAL STATE OF CALIFORNIA

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ACTC
1333 BROADWAY, SUITE 220
OAKLAND, CA 94612

PARIKH CONSULTANTS, INC.
2360 QUME DRIVE, SUITE A
SAN JOSE, CA 95131

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

CONSISTENCY OF COHESIVE SOILS

Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

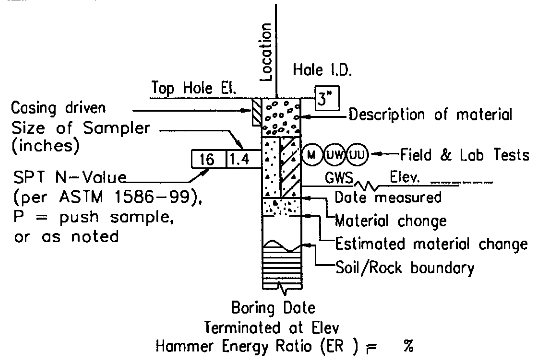
PLASTICITY OF FINE-GRAINED SOILS

Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

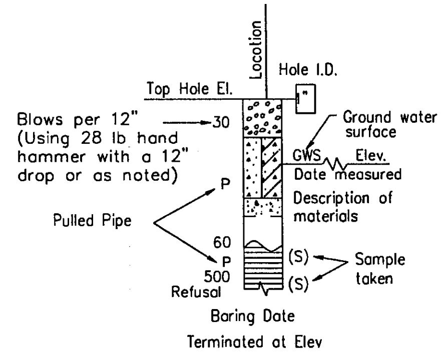
BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size (square, double border)	A	Auger Boring
Size (square)	R P	Rotary drilled boring Rotary percussion boring (air)
Size (diamond)	R	Rotary drilled diamond core
Size (rectangle)	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
□	O	Other

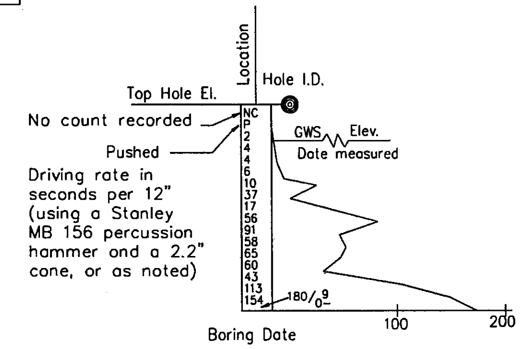
Note: Size in inches.



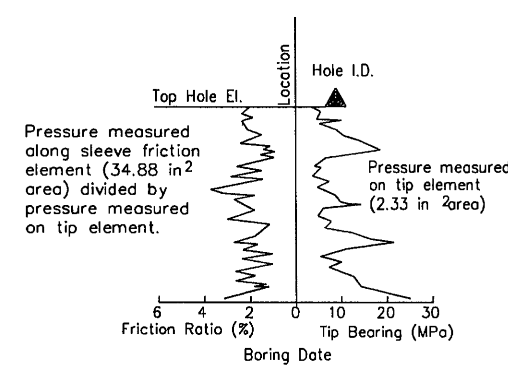
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

SOIL LEGEND

DESIGN OVERSIGHT	DRAWN BY	L. TRAN	L. BHANGOO/G. TRIPATHI FIELD INVESTIGATION BY:
SIGN OFF DATE	CHECKED BY	D. WANG	DATE: JUNE 2008

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

D. WANG
PROJECT ENGINEER

BRIDGE NO.

POST MILES 22.6/24.0

RETAINING WALL NO. 3
LOG OF TEST BORINGS

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	880	22.6/24.0		

GEOTECHNICAL PROFESSIONAL — DATE 3/7/12

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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ACTC
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2360 QUME DRIVE, SUITE A
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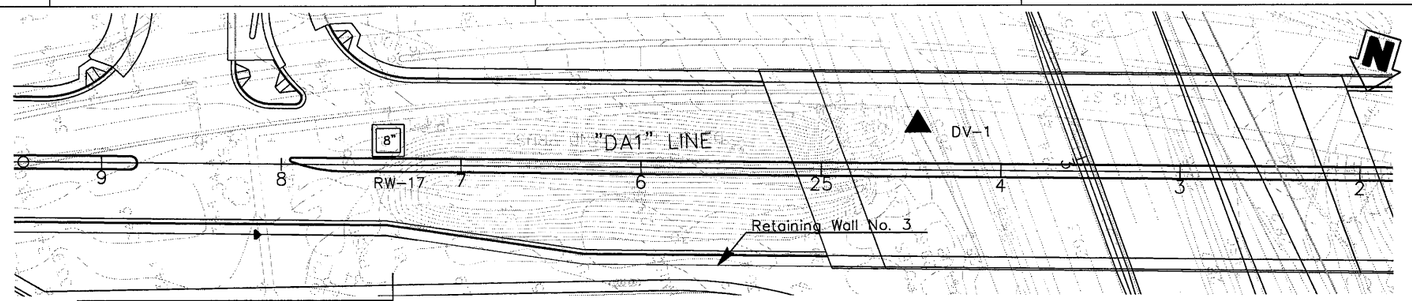

PLAN
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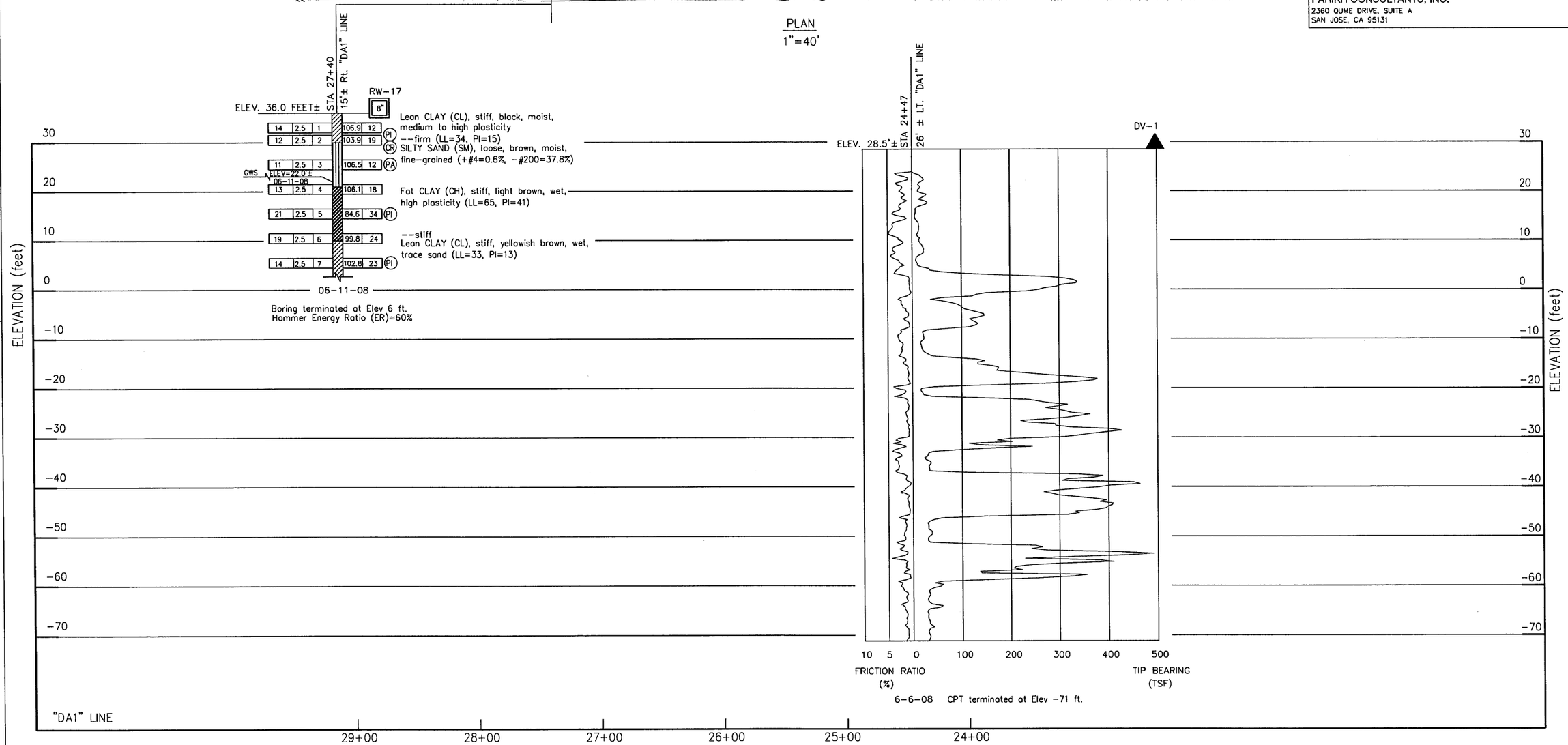

DESIGN OVERSIGHT	DRAWN BY	L. TRAN	L. BHANGOO/G. TRIPATHI	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	D. WANG
SIGN OFF DATE	CHECKED BY	D. WANG	FIELD INVESTIGATION BY: DATE: JUNE 2008		PROJECT ENGINEER

BRIDGE NO. — POST MILES 22.6/24.0

RETAINING WALL NO. 3

LOG OF TEST BORINGS

1 OF 2

OGS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 06-01-09)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04248
EA 3A9211

FILE => $REQUEST

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES 9/22/09 4/28/11 3/7/12 — SHEET — OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Note:
The As-Built Log of Test Boring sheets were used to prepare the geotechnical report.

10-24-94
TO ACCOMPANY PLANS DATED

DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	112,580	0.511.4, 32.3/37.8	29	66

GEOTECHNICAL PROFESSIONAL
-14-94
PLANS APPROVAL DATE
PSC ASSOCIATES, INC.
200 BLOSSOM LANE
MT. VIEW, CA. 94041

REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA — GEOTECHNICAL

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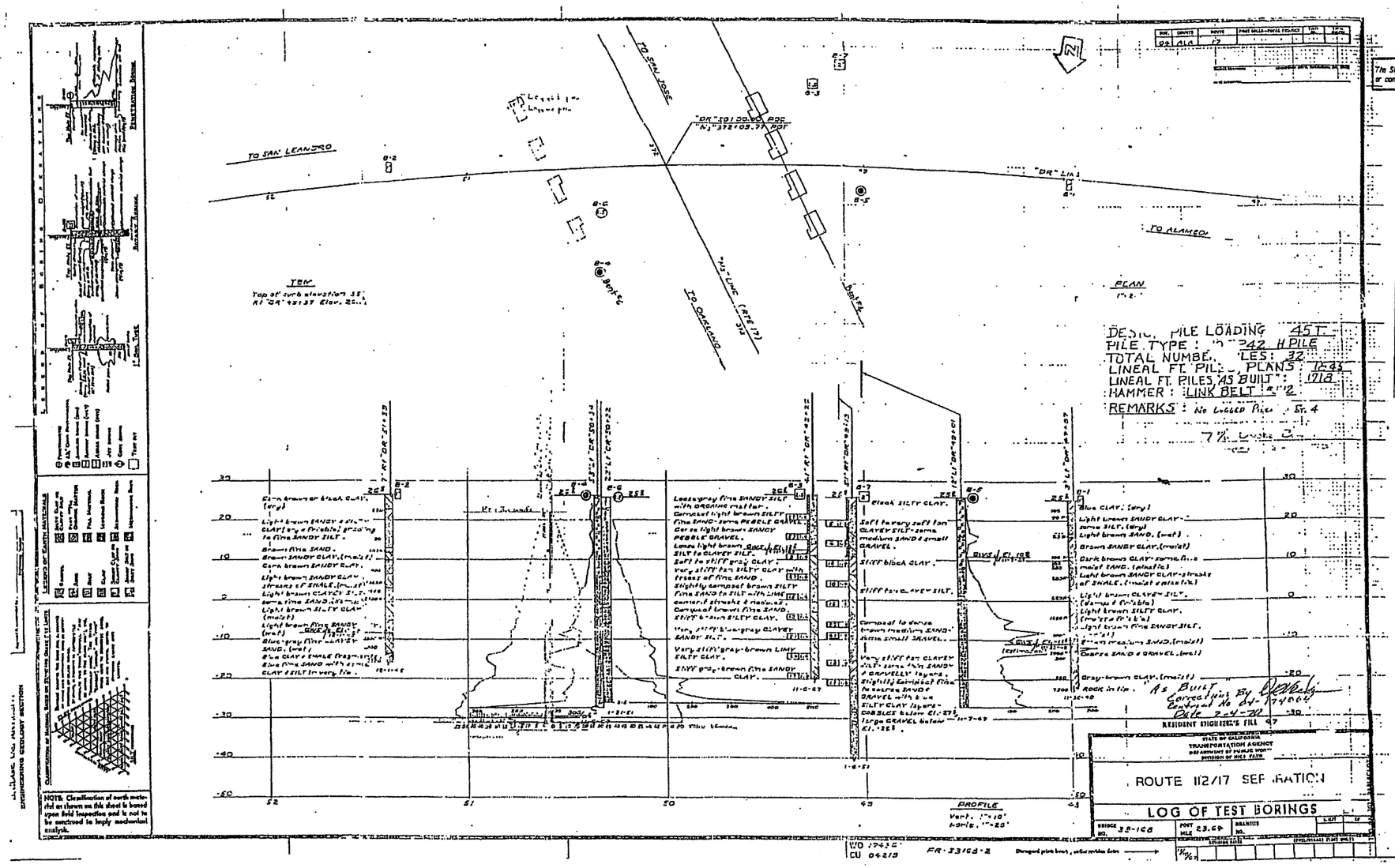

OFFICE OF STRUCTURE FOUNDATIONS – ENGINEERING SERVICE CENTER

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04	ALA	880	22.5/24.0		

GEOTECHNICAL PROFESSIONAL — DATE

RETAINING WALL NO. 3

LOG OF TEST BORINGS 2 OF 2

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CU: 0424B
EA: 3A9211

BRIDGE No. –
Sheet of

NO AS BUILT CHANGES

AS BUILT

CORRECTIONS BY
CONTRACT NO.
DATE

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL

DE AKINSANYA
ICH OVERSIGHT 9/24/94
K OFF DATE

NOTE:
ADDITIONAL AS-BUILT FOUNDATION DATA MAY BE AVAILABLE AT THE DIVISION OF NEW TECHNOLOGY, MATERIALS AND RESEARCH 5900 FOLSOM BOULEVARD, SACRAMENTO, CALIFORNIA 95819

DESIGN	G.P. KENNING	CHECKED	T.M GOOLKASIAN
DETAILS	N.H. VILLEGAS	CHECKED	S.F. WADE
QUANTITIES	T. FENG	CHECKED	G.P. KENNING

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

T.M. GOOLKASIAN
PROJECT ENGINEER

CU 04
EA 140101

BRIDGE NO. 33-168
POST MILE 0.47

EARTHQUAKE RETROFIT PROJECT NO. 90

ROUTE 112/880 SEPARATION

AS-BUILT LOG OF TEST BORINGS

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 11/16/87 5/11/94 3/15/94

SHEET 9 OF 9

ClibPDF - www.fastio.com

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
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- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

CONSISTENCY OF COHESIVE SOILS

Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

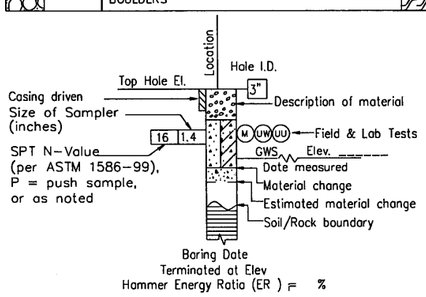
PLASTICITY OF FINE-GRAINED SOILS

Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

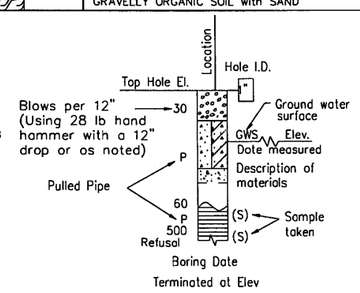
BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
□	O	Other

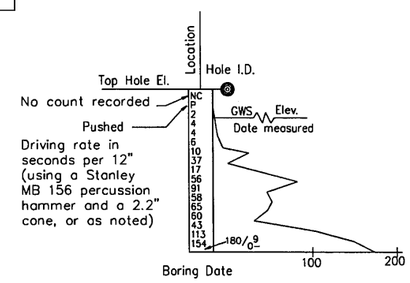
Note: Size in inches.



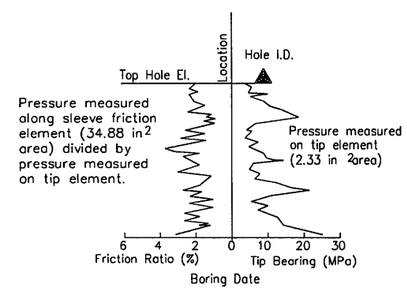
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

SOIL LEGEND

DESIGN OVERSIGHT	DRAWN BY L. TRAN	L. BHANGOO/G. TRIPATHI FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	D. WANG PROJECT ENGINEER	BRIDGE NO.
SIGN OFF DATE	CHECKED BY D. WANG	DATE: JUNE 2008			POST MILES 22.6/24.0

RETAINING WALL SB-1

LOG OF TEST BORINGS

OGS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 06-01-09)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04248
EA 3A9211

FILE => $REQUEST

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES 9/22/08 1/28/11 3/7/12 — SHEET — OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	880	22.6/24.0		

GEOTECHNICAL PROFESSIONAL — DATE 3/7/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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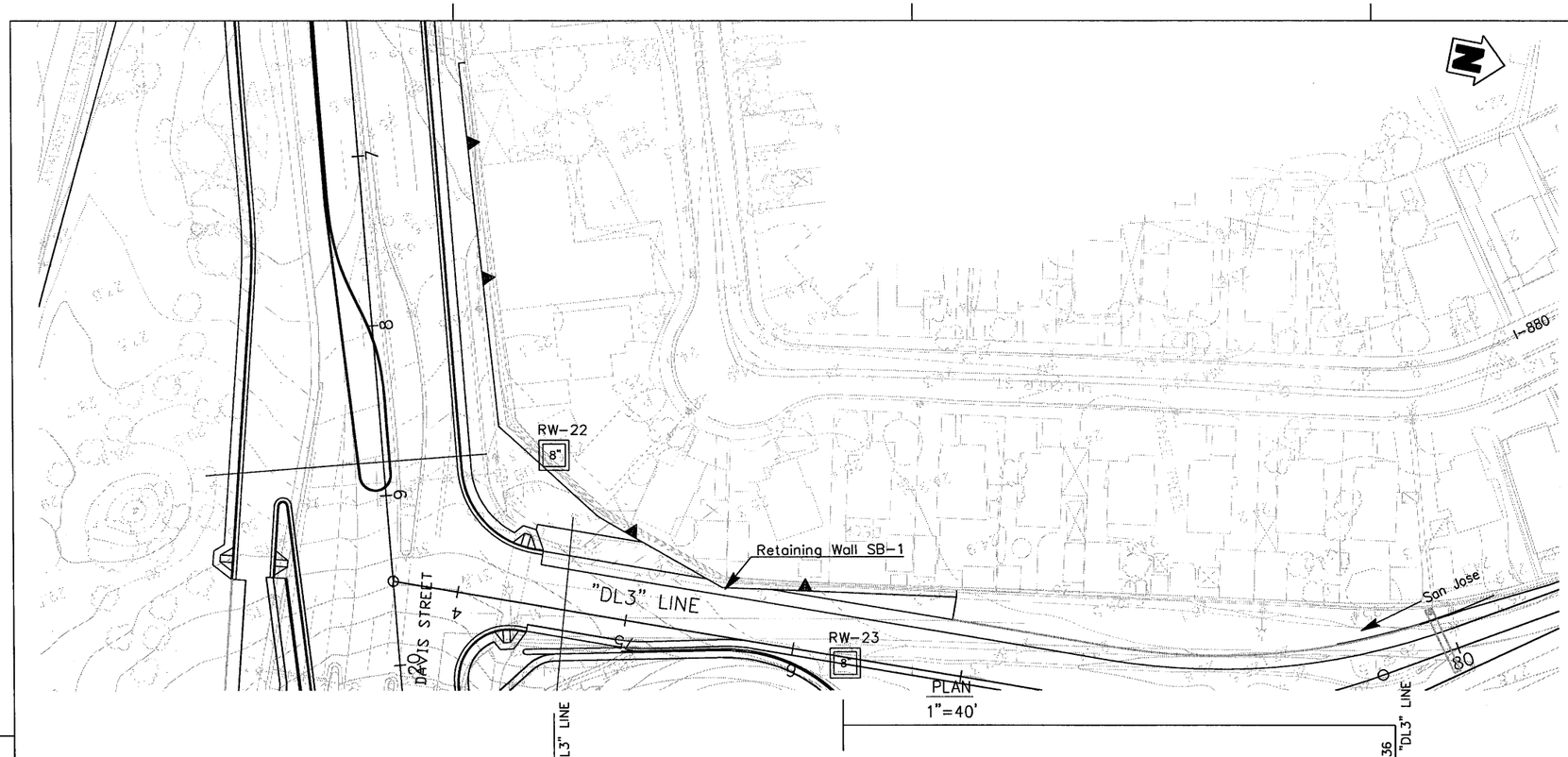
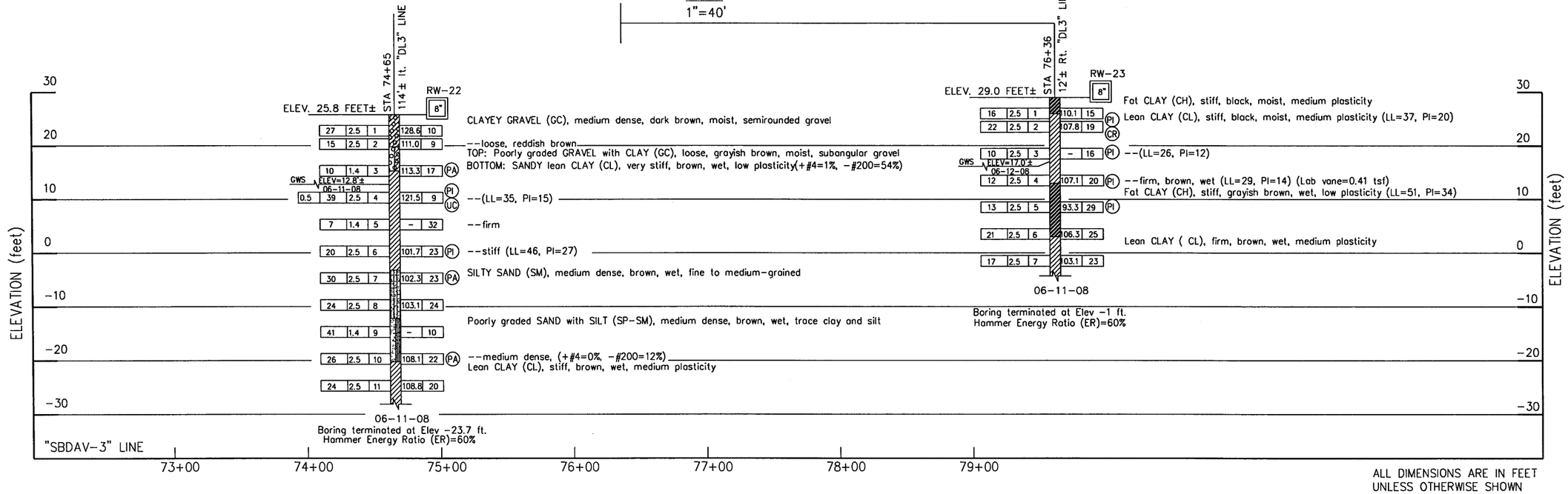


Note:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop
(Automatic Hammer)



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

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT	DRAWN BY L. TRAN	L. BHANGOO/G. TRIPATHI	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	D. WANG	BRIDGE NO.
SIGN OFF DATE	CHECKED BY D. WANG	FIELD INVESTIGATION BY: DATE: JUNE 2008		PROJECT ENGINEER	POST MILES 22.6/24.0

RETAINING WALL SB-1
LOG OF TEST BORINGS

OGS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 06-01-09)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04248
EA 3A9211

FILE => $REQUEST

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 9/22/09 4/28/11 3/7/12

SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	880	22.6/24.0		

GEOTECHNICAL PROFESSIONAL — DATE 3/7/12

PLANS APPROVAL DATE

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GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

CONSISTENCY OF COHESIVE SOILS

Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

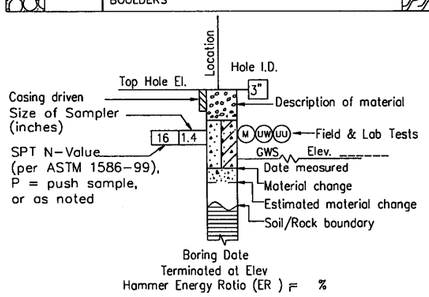
PLASTICITY OF FINE-GRAINED SOILS

Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

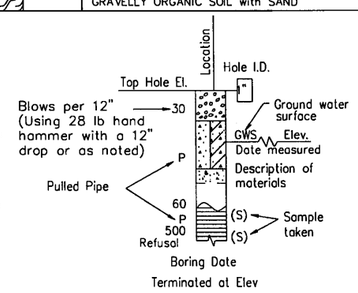
BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
□	O	Other

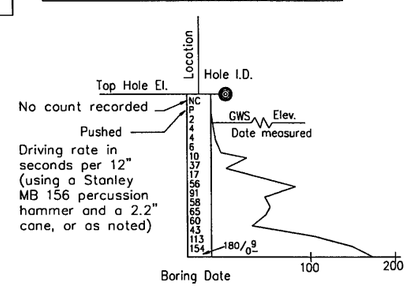
Note: Size in inches.



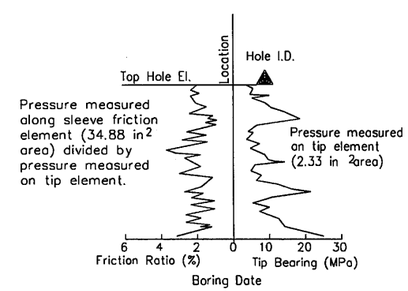
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

SOIL LEGEND

DESIGN OVERSIGHT	DRAWN BY	L. TRAN	L. BHANGOO/G. TRIPATHI FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	D. WANG PROJECT ENGINEER
SIGN OFF DATE	CHECKED BY	D. WANG	DATE: JUNE 2008		

BRIDGE NO.
POST MILES 22.6/24.0

RETAINING WALL NO. 4

LOG OF TEST BORINGS

CU 04248
EA 3A9211

OGS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 06-01-09)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES 9/22/08 4/28/11 3/7/12

REVISION DATES — SHEET — OF

FILE => $REQUEST

USERNAME => $USER — DATE PLOTTED => $DATE — TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	880	22.6/24.0		

GEOTECHNICAL PROFESSIONAL — DATE 3/7/12

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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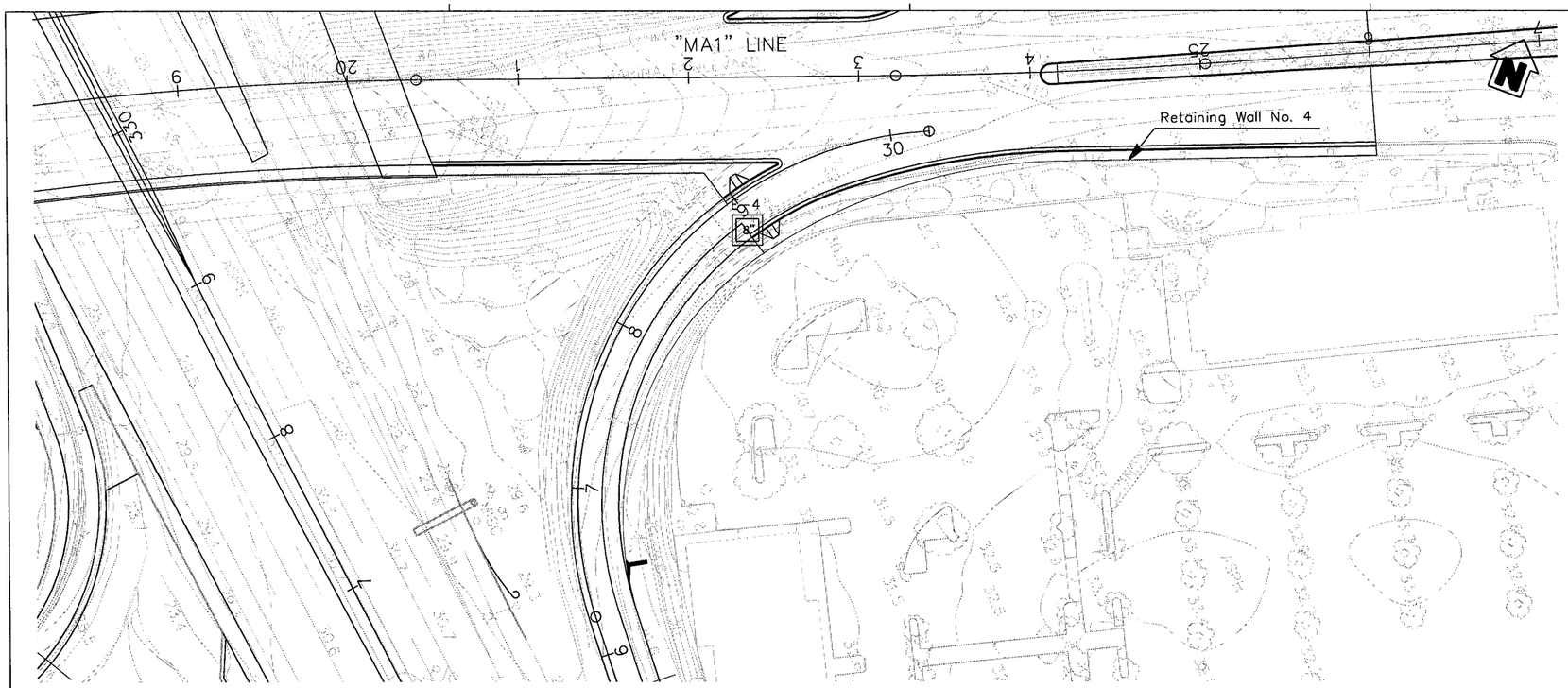
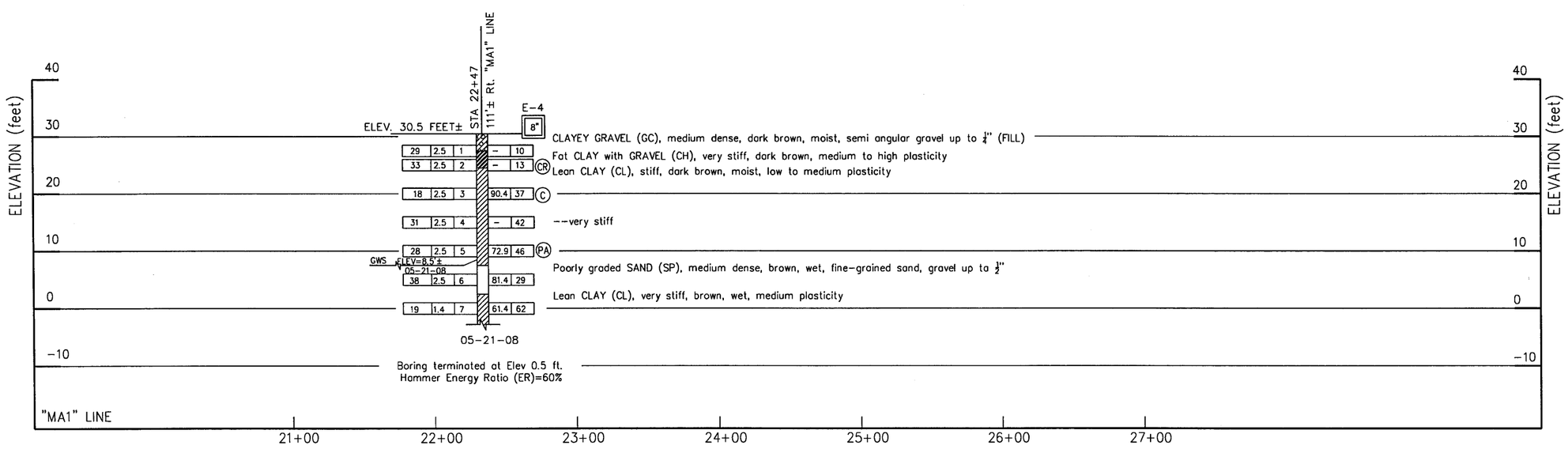
SAN JOSE, CA 95131



PLAN
1"=40'

Note:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop
(Automatic Hammer)



ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

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

DESIGN OVERSIGHT	DRAWN BY L. TRAN	L. BHANGOO/G. TRIPATHI FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	D. WANG PROJECT ENGINEER	BRIDGE NO. / POST MILES 22.6/24.0 — RETAINING WALL NO. 4
SIGN OFF DATE	CHECKED BY D. WANG	DATE: JUNE 2008			LOG OF TEST BORINGS
OGS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 06-01-09)	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3			CU 04248 EA 3A9211	DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES 9/22/08 4/28/11 3/1/12 — SHEET — OF

APPENDIX B

APPENDIX B

LABORATORY TESTS

Classification Tests
The field classification of the samples was visually verified in the laboratory according to the Unified Soil Classification System. The results are presented in “Log of Test Borings”, Appendix A.

Moisture-Density
The natural moisture contents and dry unit weights were determined for selected undisturbed samples of the soils in general accordance with ASTM Test Method D 2216-92. This information was used to classify and correlate the soils. The results are presented at the appropriate depths on the "Log of Test Borings", Appendix A.

Atterberg Limits
The Atterberg Limits were determined for selected samples of the fine-grained materials. These results were used to classify the soils, as well as to obtain an indication of the effective strength characteristics and expansion potential with variations in moisture content. The Atterberg Limits were determined in general accordance with ASTM Test Method D 4318-93. The results of these tests are presented on Plate B-2A thru Plate B-2C, “Plasticity Chart”.

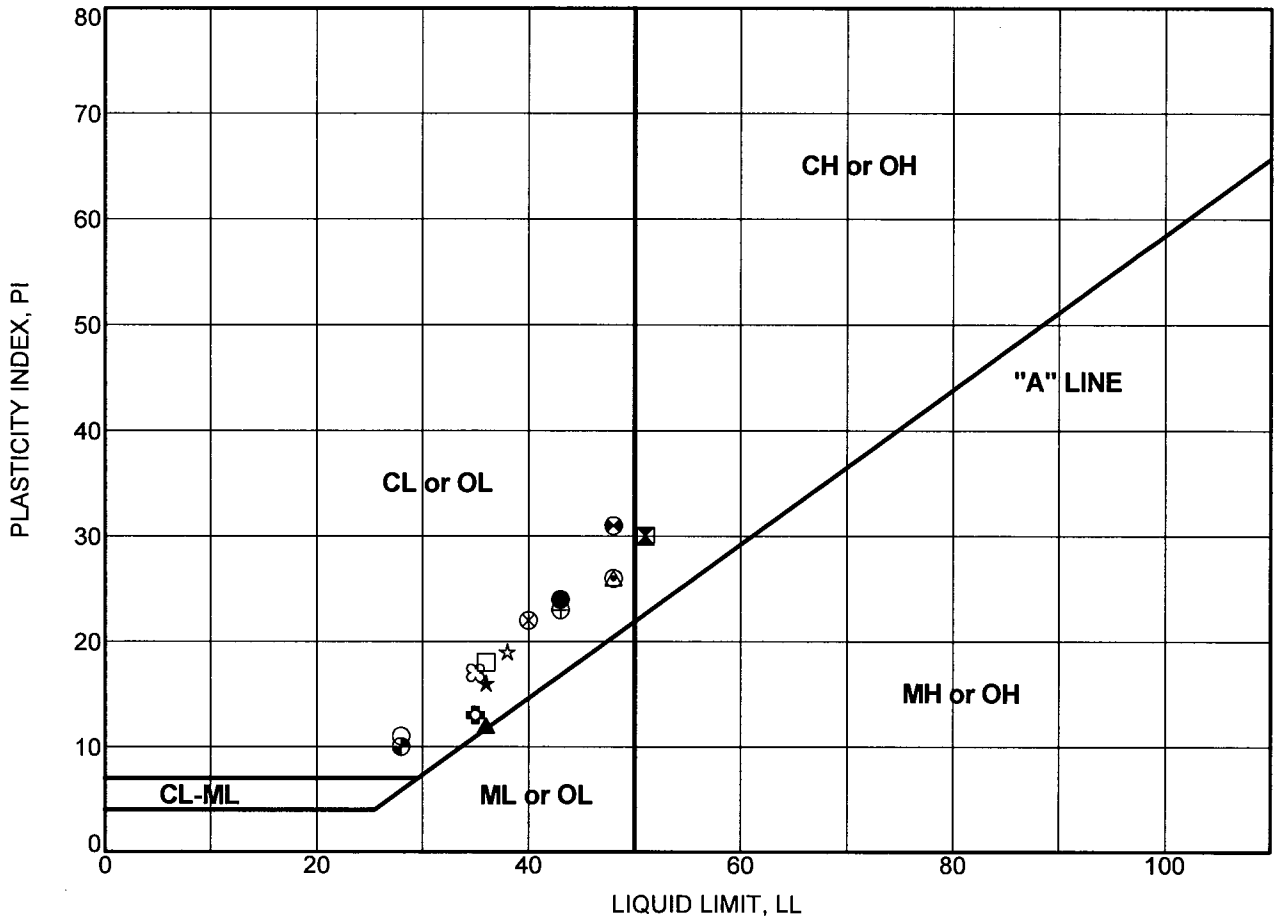
Grain Size Classification
Grain size classification tests (ASTM Test Method D422-63) were performed on selected samples of granular soil to aid in the classification. The results are presented on Plate B-3A and Plate B-3D, “Grain Size Distribution Curves”.

Unconfined Compression Tests
Strength tests were performed on selected undisturbed samples using unconfined compression machine. Unconfined compression tests were performed in general accordance with ASTM Test Method D 2166-91. The results are presented on “Log of Test Borings”, Appendix A.

Corrosion Tests
Corrosion tests were performed on selected samples to determine the corrosion potential of the soils. The pH and minimum resistively tests were performed according to California Test Method 643. The tests were performed by Sunland Analytical. The test results are presented on Plate B-4A thru Plate B-4H.

Consolidation Tests
Consolidation tests (California Test Method T219) were performed on two selected undisturbed samples. The test results are presented on Plates B-5A thru B-5I.

R-value Tests
R-value tests were performed on representative bulk samples for pavement design. The tests were performed according to California Test Method 301. The test results are presented on Plates B-6A and B-6I.



PLASTICITY CHART

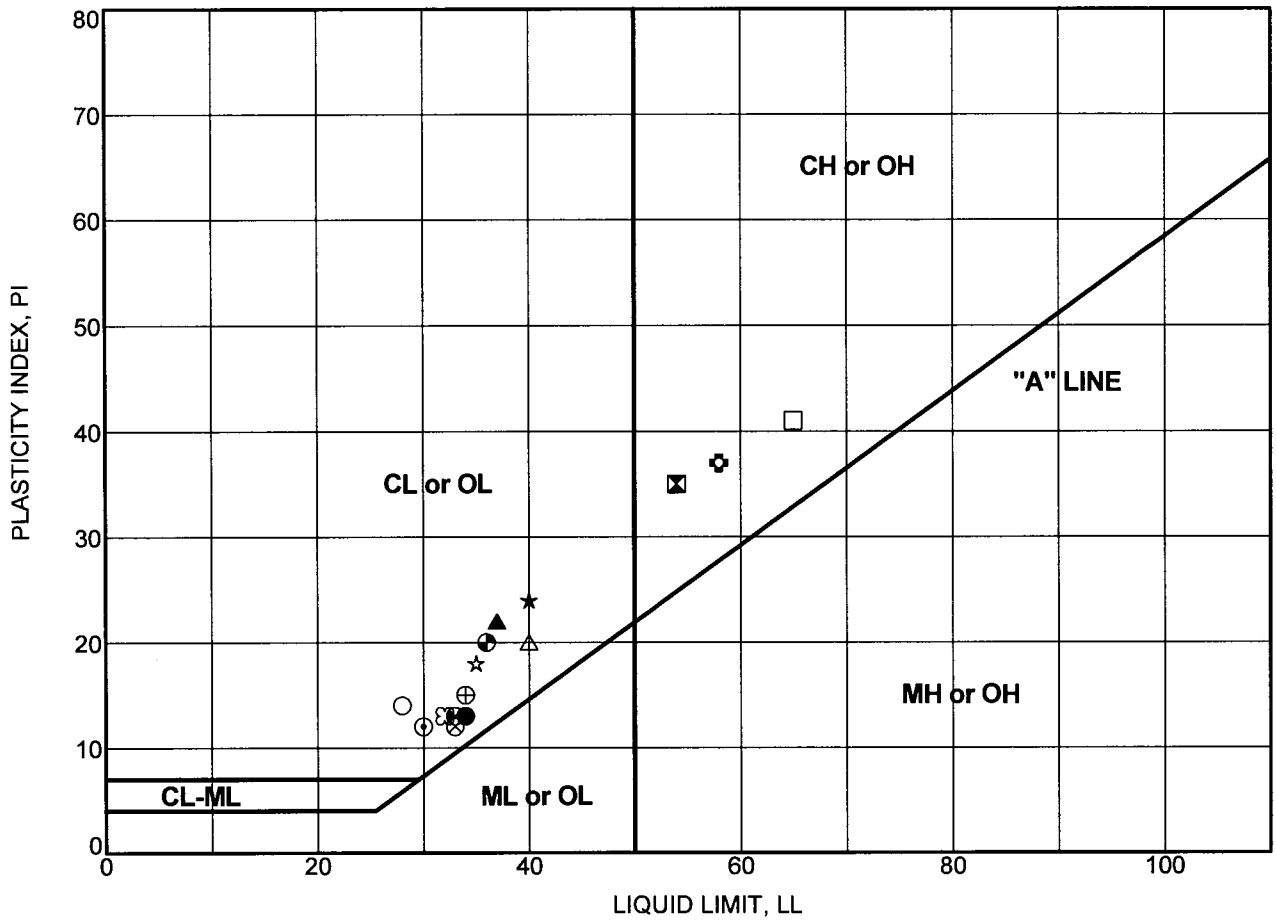
Boring Number	Sample Number	Depth (feet)	Test Symbol	Moisture Content (%)	LL	PL	PI	Description
E-04	MC-3	9.5	●	37	43	19	24	LEAN CLAY (CL)
E-05	MC-3	9.5	⊠	22	51	21	30	FAT CLAY (CH)
E-05	MC-4	14.5	▲	10	36	24	12	LEAN CLAY (CL)
E-24	MC-1	2.0	★	15	36	20	16	LEAN CLAY (CL)
E-24	MC-4	14.5	⊙	33	48	22	26	LEAN CLAY (CL)
E-24	MC-7	29.5	✿	25	35	22	13	LEAN CLAY (CL)
E-25	MC-1	2.0	○	12	28	17	11	LEAN CLAY (CL)
E-25	MC-4	14.5	△	32	48	22	26	LEAN CLAY (CL)
OH-11	MC-4	14.5	⊗	22	40	18	22	LEAN CLAY (CL)
OH-13	MC-1	2.0	⊕	22	43	20	23	LEAN CLAY (CL)
OH-13	MC-4	14.5	□	28	36	18	18	LEAN CLAY (CL)
RW-07	MC-4	14.5	⊛	22	48	17	31	LEAN CLAY (CL)
RW-07	MC-7	29.5	◕	20	28	18	10	LEAN CLAY (CL)
RW-08	MC-3	9.5	☆	24	38	19	19	LEAN CLAY (CL)
RW-08	MC-5	19.5	⌘	20	35	18	17	LEAN CLAY (CL)

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

RTE 880 SB HOV LANE EXT. (MARINA BLVD. TO DAVIS STREET IC)
ALAMEDA COUNTY, CALIFORNIA

JOB NO: 206139.GDR

PLATE NO: B-2A



PLASTICITY CHART

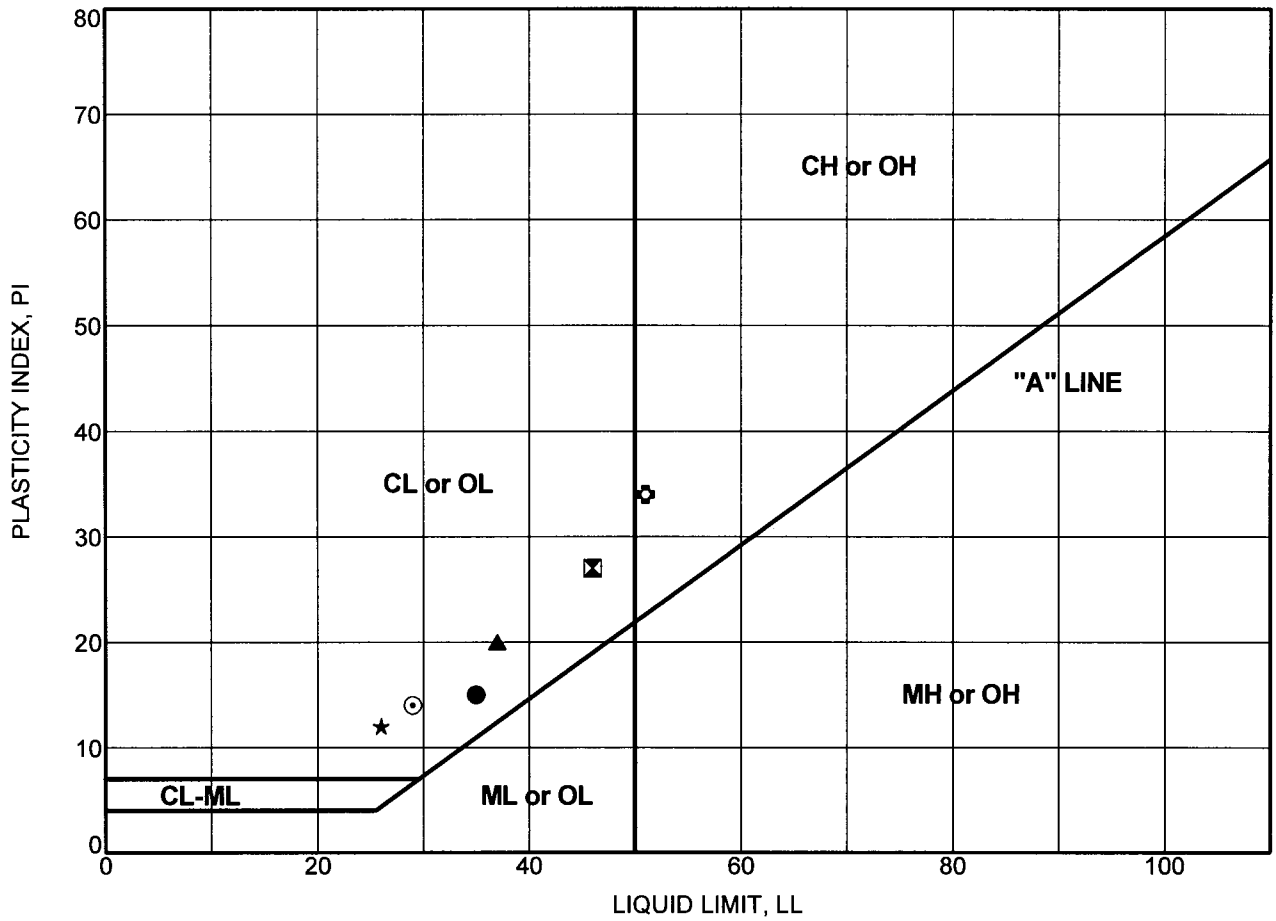
Boring Number	Sample Number	Depth (feet)	Test Symbol	Moisture Content (%)	LL	PL	PI	Description
RW-08	SPT-7	31.0	●	22	34	21	13	LEAN CLAY (CL)
RW-09	MC-4	14.5	⊠	25	54	19	35	FAT CLAY (CH)
RW-09	MC-6	24.5	▲	21	37	15	22	LEAN CLAY (CL)
RW-09	MC-8	34.5	★	20	40	16	24	LEAN CLAY (CL)
RW-09	MC-9	39.5	⊙	19	30	18	12	LEAN CLAY (CL)
RW-10	MC-4	14.5	✿	26	58	21	37	FAT CLAY (CH)
RW-10	MC-5	19.5	○	20	28	14	14	LEAN CLAY (CL)
RW-12	MC-3	9.5	△	32	40	20	20	LEAN CLAY (CL)
RW-12	MC-5	19.5	⊗	27	33	21	12	LEAN CLAY (CL)
RW-17	MC-2	4.5	⊕	19	34	19	15	LEAN CLAY (CL)
RW-17	MC-5	19.5	□	34	65	24	41	FAT CLAY (CH)
RW-17	MC-7	28.5	⊛	23	33	20	13	LEAN CLAY (CL)
RW-18	MC-2	4.5	◕	16	36	16	20	LEAN CLAY (CL)
RW-18	MC-7	29.5	☆	23	35	17	18	LEAN CLAY (CL)
RW-19	MC-2	4.5	⊠	15	32	19	13	LEAN CLAY (CL)

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

RTE 880 SB HOV LANE EXT. (MARINA BLVD. TO DAVIS STREET IC)
ALAMEDA COUNTY, CALIFORNIA

JOB NO: 206139.GDR

PLATE NO: B-2B



PLASTICITY CHART

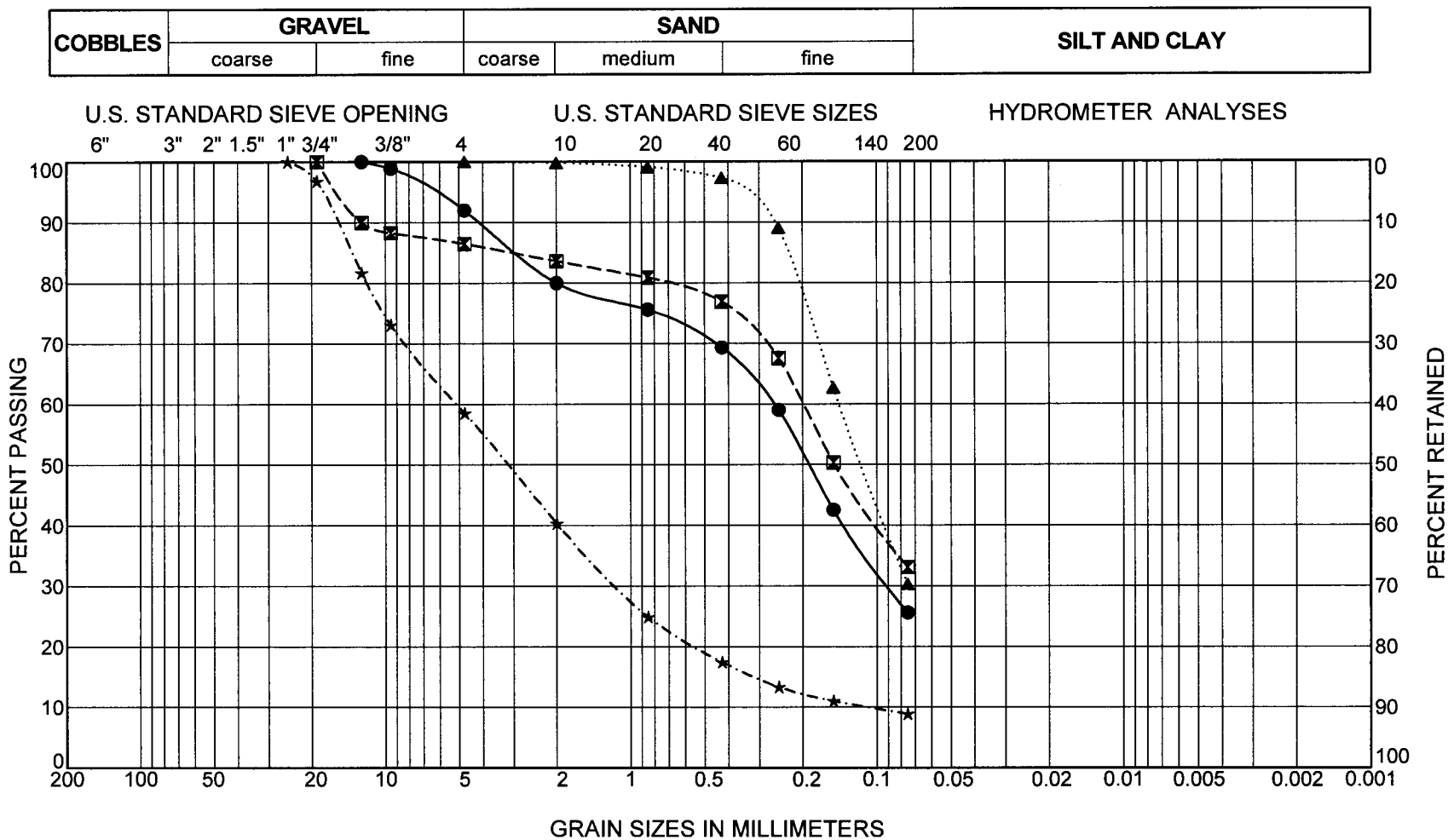
Boring Number	Sample Number	Depth (feet)	Test Symbol	Moisture Content (%)	LL	PL	PI	Description
RW-22	MC-4	14.5	●	9	35	20	15	LEAN CLAY (CL)
RW-22	MC-6	24.5	⊠	23	46	19	27	LEAN CLAY (CL)
RW-23	MC-2	4.5	▲	19	37	17	20	LEAN CLAY (CL)
RW-23	MC-3	9.5	★	16	26	14	12	LEAN CLAY (CL)
RW-23	MC-4	14.5	⊙	20	29	15	14	LEAN CLAY (CL)
RW-23	MC-5	19.5	✿	29	51	17	34	FAT CLAY (CH)

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

RTE 880 SB HOV LANE EXT. (MARINA BLVD. TO DAVIS STREET IC)
ALAMEDA COUNTY, CALIFORNIA

JOB NO: 206139.GDR | PLATE NO: B-2C

GRAIN SIZE DISTRIBUTION CURVES



Boring Number	Sample Number	Depth (feet)	Symbol	LL	PI	Description
E-04	MC-6	24.5	●			CLAYEY SAND (SC)
E-05	MC-7	29.5	⊠			SILTY SAND (SM)
E-25	MC-3	9.5	▲			SILTY SAND (SM)
E-25	SPT-7	29.5	★			WELL-GRADED SAND WITH SILT AND GRAVEL (SW-SM)

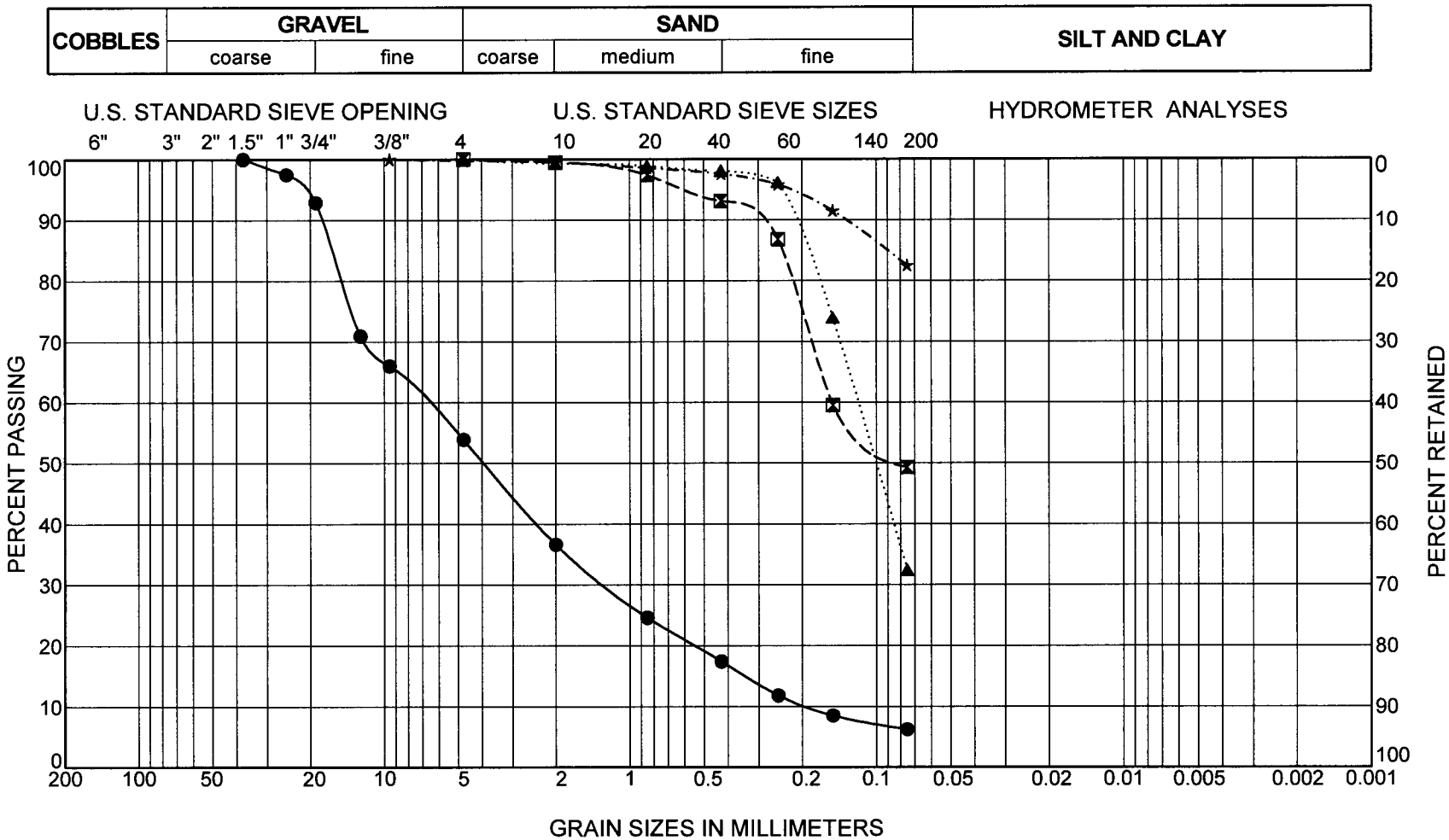
PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

RTE 880 SB HOV LANE EXT. (MARINA BLVD. TO DAVIS STREET IC)
ALAMEDA COUNTY, CALIFORNIA

JOB NO: 206139.GDR

PLATE NO: B-3A

GRAIN SIZE DISTRIBUTION CURVES



Boring Number	Sample Number	Depth (feet)	Symbol	LL	PI	Description
OH-13	SPT-6	24.5	●			WELL-GRADED SAND WITH SILT AND GRAVEL (SW-SM)
RW-07	MC-2	4.5	⊠			SILTY SAND (SM)
RW-08	MC-2	4.5	▲			SILTY SAND (SM)
RW-09	MC-11	49.5	★			LEAN CLAY WITH SAND (CL)

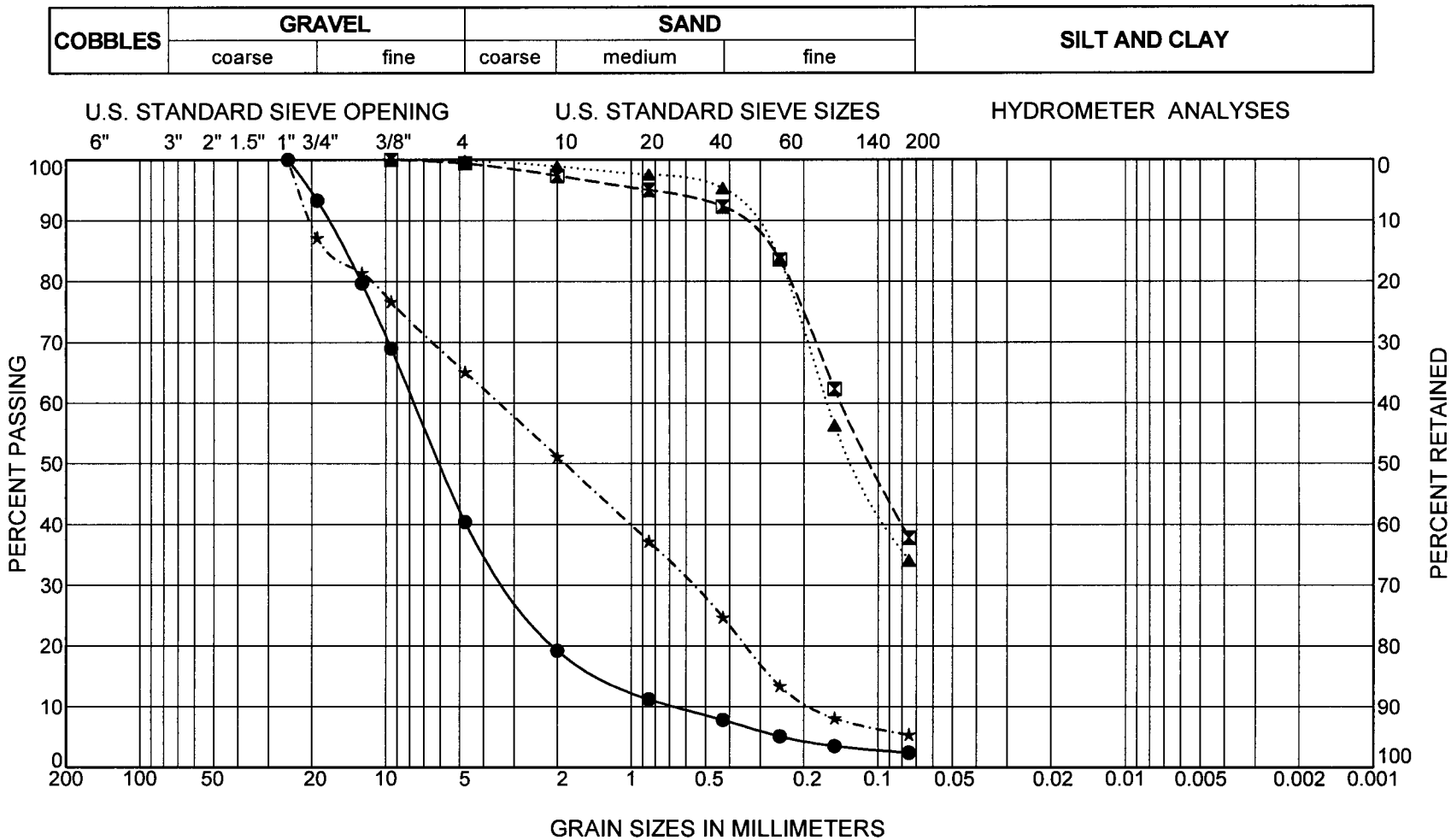
PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

RTE 880 SB HOV LANE EXT. (MARINA BLVD. TO DAVIS STREET IC)
ALAMEDA COUNTY, CALIFORNIA

JOB NO: 206139.GDR

PLATE NO: B-3B

GRAIN SIZE DISTRIBUTION CURVES



Boring Number	Sample Number	Depth (feet)	Symbol	LL	PI	Description
RW-10	MC-3	9.5	●			WELL-GRADED GRAVEL WITH SAND (GW)
RW-17	MC-3	9.5	⊠			SILTY SAND (SM)
RW-18	MC-3	9.5	▲			SILTY SAND (SM)
RW-18	MC-4	14.5	★			POORLY-GRADED SAND WITH SILT AND GRAVEL (SP-SM)

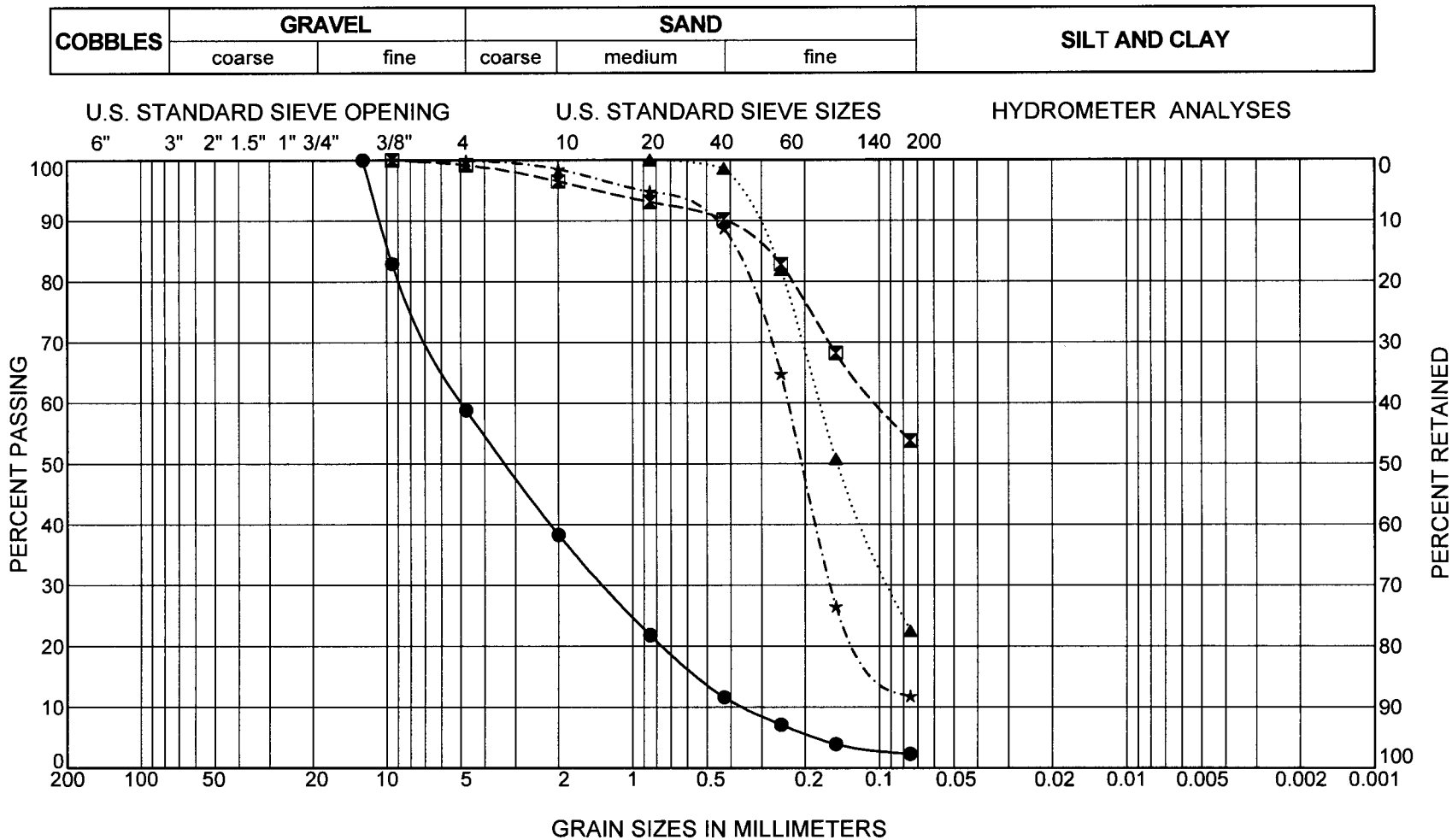
PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

RTE 880 SB HOV LANE EXT. (MARINA BLVD. TO DAVIS STREET IC)
ALAMEDA COUNTY, CALIFORNIA

JOB NO: 206139.GDR

PLATE NO: B-3C

GRAIN SIZE DISTRIBUTION CURVES



Boring Number	Sample Number	Depth (feet)	Symbol	LL	PI	Description
RW-19	MC-4	14.5	●			POORLY-GRADED SAND WITH GRAVEL (SP)
RW-22	MC-3	9.5	⊠			SANDY LEAN CLAY (CL)
RW-22	MC-7	29.5	▲			SILTY SAND (SM)
RW-22	MC-10	44.5	★			POORLY-GRADED SAND WITH SILT (SP-SM)

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

RTE 880 SB HOV LANE EXT. (MARINA BLVD. TO DAVIS STREET IC)
ALAMEDA COUNTY, CALIFORNIA

JOB NO: 206139.GDR

PLATE NO: B-3D

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 08/27/2008
Date Submitted 08/20/2008

To: Prav Dayah
Parikh Consultants, Inc.
356 S. Milpitas Blvd.
Milpitas, CA 95035

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager RH

The reported analysis was requested for the following location:
Location : 206139.GDR I-880 Site ID : E4#2@4.5'.
Thank you for your business.

* For future reference to this analysis please use SUN # 54220-108793.

EVALUATION FOR SOIL CORROSION

Soil pH	6.91	
Minimum Resistivity	1.93 ohm-cm (x1000)	
Chloride	38.1 ppm	00.00381 %
Sulfate	133.4 ppm	00.01334 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical
11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 08/06/2008
Date Submitted 08/01/2008

To: Prav Dayah
Parikh Consultants, Inc.
356 S. Milpitas Blvd.
Milpitas, CA 95035

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 206139.GDR/ I-880 Site ID : RW-7 #3 @ 9.5'.
Thank you for your business.

* For future reference to this analysis please use SUN # 54032-108390.

EVALUATION FOR SOIL CORROSION

Soil pH	7.16	
Minimum Resistivity	1.18 ohm-cm (x1000)	
Chloride	13.8 ppm	00.00138 %
Sulfate	23.6 ppm	00.00236 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical
11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 08/06/2008
Date Submitted 08/01/2008

To: Prav Dayah
Parikh Consultants, Inc.
356 S. Milpitas Blvd.
Milpitas, CA 95035

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 206139.GDR/ I-880 Site ID : RW-9 #2 @ 4.5'.
Thank you for your business.

* For future reference to this analysis please use SUN # 54032-108391.

EVALUATION FOR SOIL CORROSION

Soil pH	7.15		
Minimum Resistivity	2.17 ohm-cm (x1000)		
Chloride	15.6 ppm	00.00156	%
Sulfate	20.3 ppm	00.00203	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 08/27/2008
Date Submitted 08/20/2008

To: Prav Dayah
Parikh Consultants, Inc.
356 S. Milpitas Blvd.
Milpitas, CA 95035

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 206139.GDR I-880 Site ID : OH-11#2@4.5'.
Thank you for your business.

* For future reference to this analysis please use SUN # 54220-108794.

EVALUATION FOR SOIL CORROSION

Soil pH	6.71	
Minimum Resistivity	2.17 ohm-cm (x1000)	
Chloride	10.3 ppm	00.00103 %
Sulfate	24.8 ppm	00.00248 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 08/27/2008
Date Submitted 08/20/2008

To: Prav Dayah
Parikh Consultants, Inc.
356 S. Milpitas Blvd.
Milpitas, CA 95035

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager RH

The reported analysis was requested for the following location:
Location : 206139.GDR I-880 Site ID : OH-13#2@4.5'.
Thank you for your business.

* For future reference to this analysis please use SUN # 54220-108795.

EVALUATION FOR SOIL CORROSION

Soil pH	6.18	
Minimum Resistivity	0.83 ohm-cm (x1000)	
Chloride	19.6 ppm	00.00196 %
Sulfate	214.9 ppm	00.02149 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical
11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 08/06/2008
Date Submitted 08/01/2008

To: Prav Dayah
Parikh Consultants, Inc.
356 S. Milpitas Blvd.
Milpitas, CA 95035

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 206139.GDR/ I-880 Site ID : RW-17 #2 @ 4.5'.
Thank you for your business.

* For future reference to this analysis please use SUN # 54032-108392.

EVALUATION FOR SOIL CORROSION

Soil pH	6.74		
Minimum Resistivity	1.96 ohm-cm (x1000)		
Chloride	6.1 ppm	00.00061	%
Sulfate	1.4 ppm	00.00014	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 07/18/2008
Date Submitted 07/14/2008

To: Prav Dayah
Parikh Consultants, Inc.
356 S. Milpitas Blvd.
Milpitas, CA 95035

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 206139-GDR/ I-880 Site ID : RW23#2 @ 4.5'.
Thank you for your business.

* For future reference to this analysis please use SUN # 53807-107956.

EVALUATION FOR SOIL CORROSION

Soil pH	5.86		
Minimum Resistivity	0.96 ohm-cm (x1000)		
Chloride	8.6 ppm	00.00086	%
Sulfate	12.0 ppm	00.00120	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 08/27/2008
Date Submitted 08/20/2008

To: Prav Dayah
Parikh Consultants, Inc.
356 S. Milpitas Blvd.
Milpitas, CA 95035

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 206139.GDR I-880 Site ID : E24#2@4.5'.
Thank you for your business.

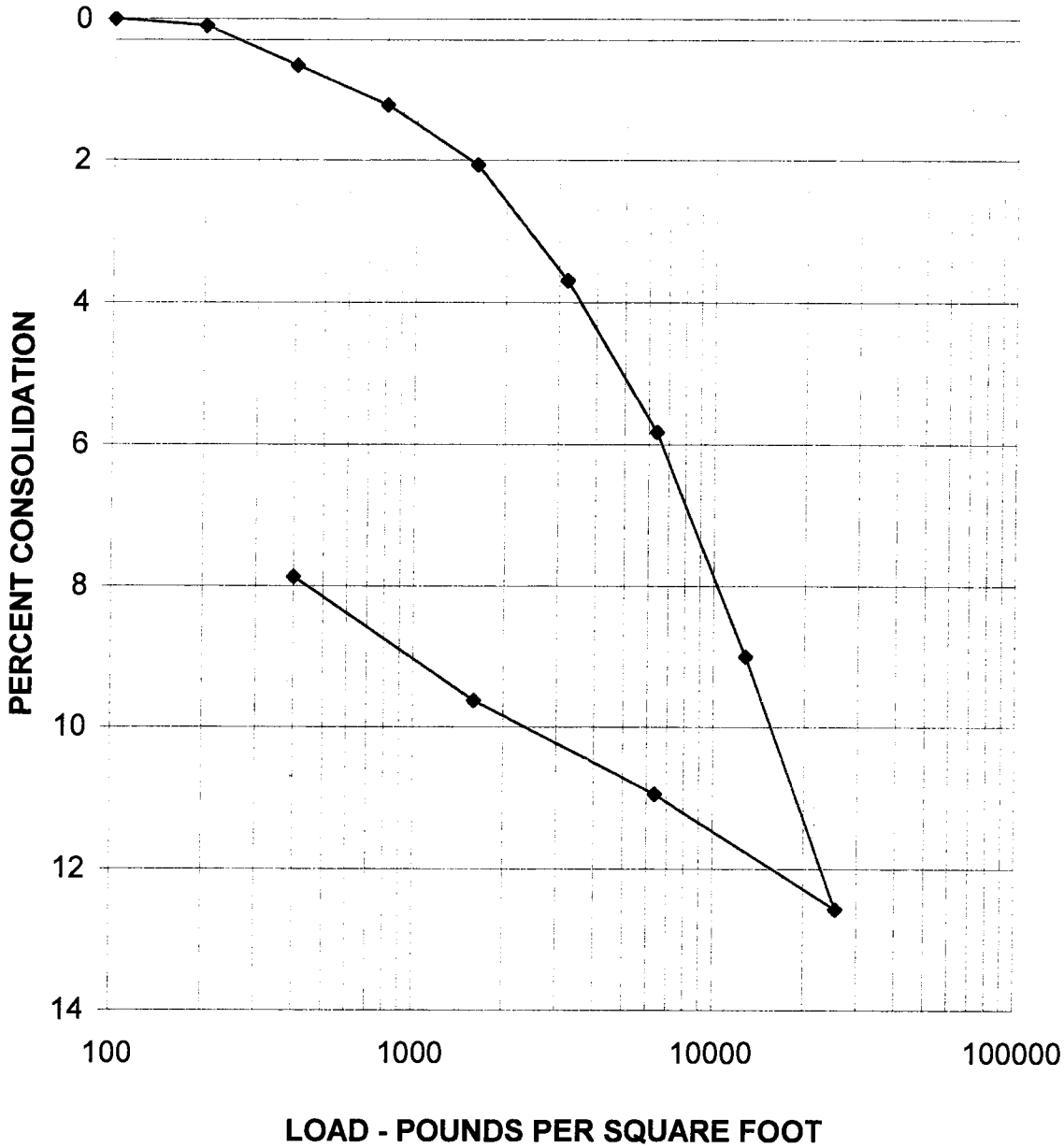
* For future reference to this analysis please use SUN # 54220-108792.

EVALUATION FOR SOIL CORROSION

Soil pH	6.03		
Minimum Resistivity	2.22 ohm-cm (x1000)		
Chloride	15.6 ppm	00.00156	%
Sulfate	61.1 ppm	00.00611	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

CONSOLIDATION TEST RESULTS



	MOISTURE CONTENT %	DRY DENSITY PCF	HEIGHT (INCHES)	DIAMETER (INCHES)
INITIAL	37.2	90.4	1.0000	2.416
FINAL	28.4	98.1	0.9213	2.416

BORING NO.	E-4	SAMPLE NO.	3	ELEV. OR DEPTH	9.5'
DESCRIPTION	Lean clay, brown				

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

I-880 SB HOV Lane Extension
R & M

DATE	JOB NO:
9/12/08	206139.GDR

Reported by: Prav Dayah

PLATE NO: B-5A

CONSOLIDATION TEST - TIME CURVE

JOB #: 206139.GDR

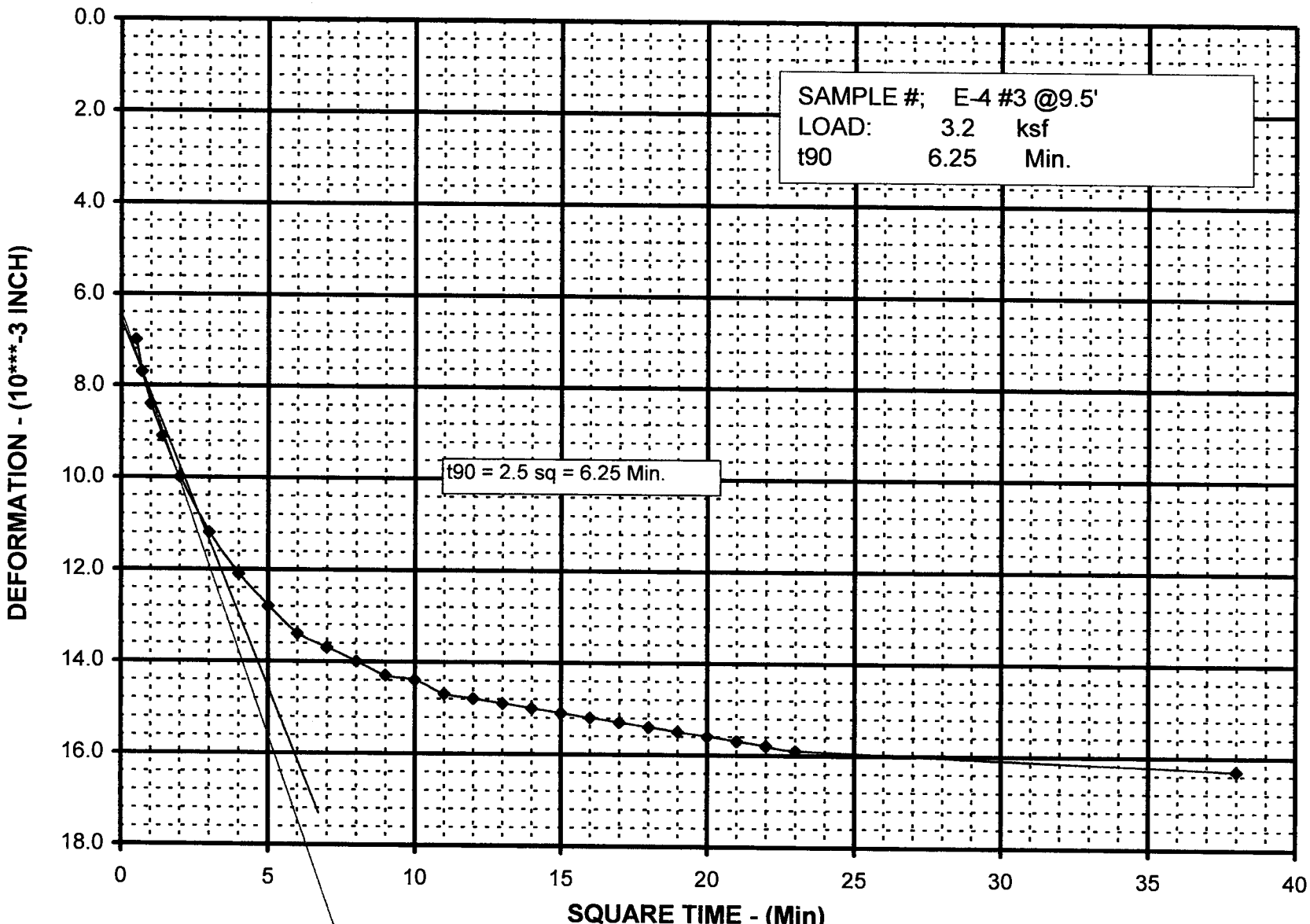


PLATE NO: B-5B

CONSOLIDATION TEST - TIME CURVE

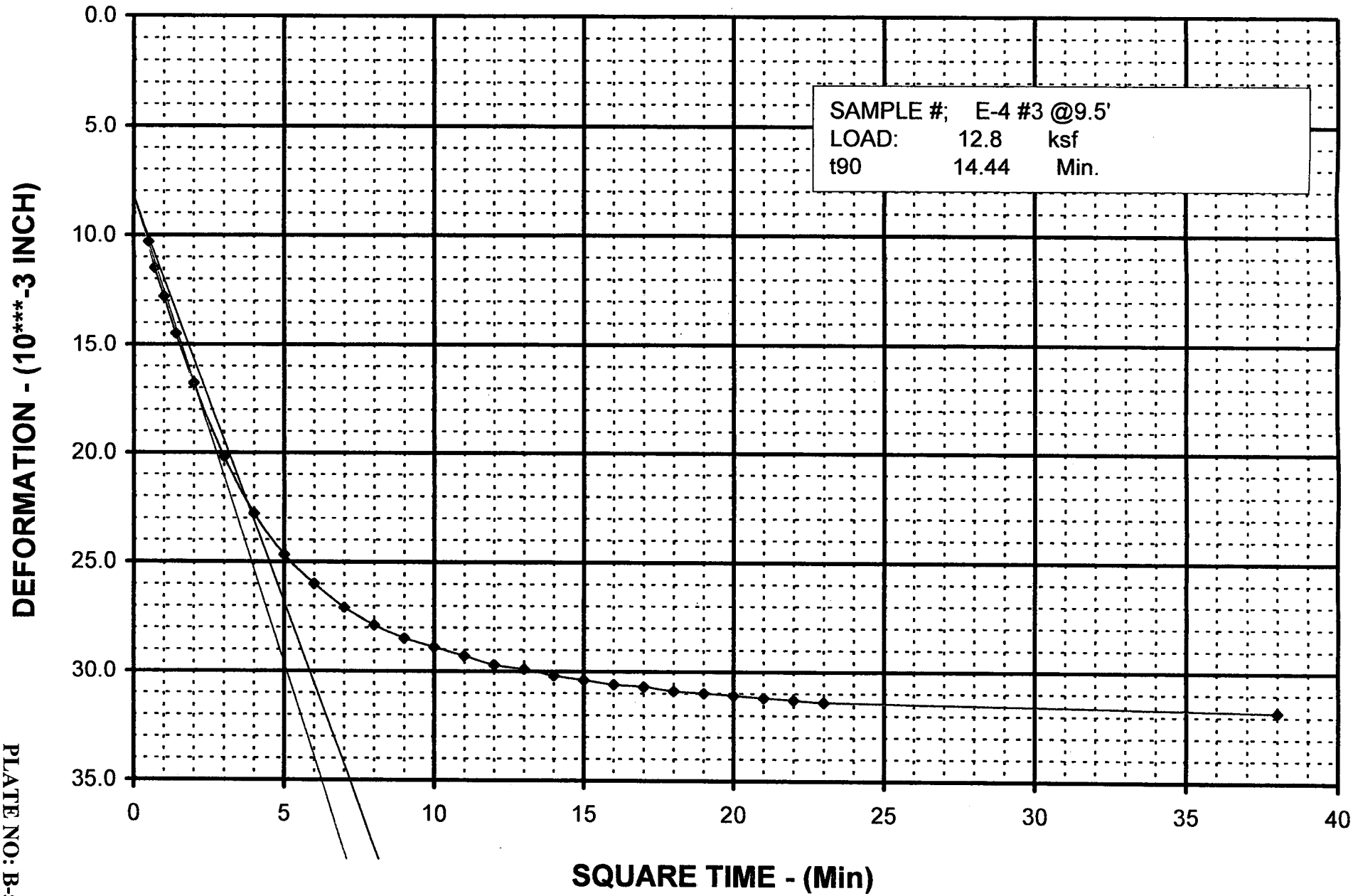
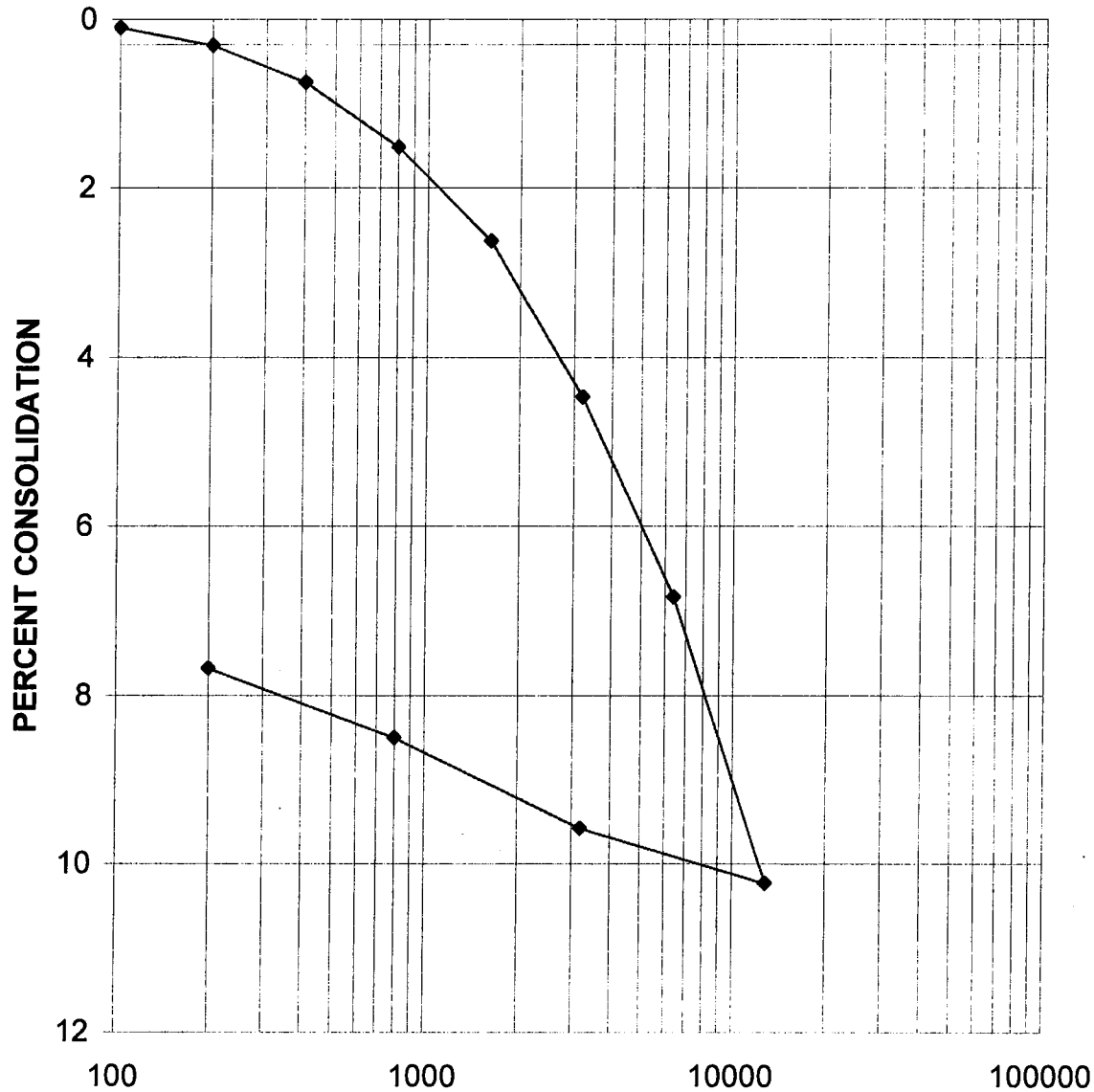


PLATE NO: B-5C

CONSOLIDATION TEST RESULTS



LOAD - POUNDS PER SQUARE FOOT

	MOISTURE CONTENT %	DRY DENSITY PCF	HEIGHT (INCHES)	DIAMETER (INCHES)
INITIAL	9.7	98.2	1.0000	2.416
FINAL	22.8	106.3	0.9232	2.416

BORING NO.	E-5	SAMPLE NO.	4	ELEV. OR DEPTH	14.5'
DESCRIPTION	Lean clay, yellowish brown				

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

I-880 SB HOV Lane Extension
R & M

DATE	JOB NO:
8/5/08	206139.GDR

Reported by: Prav Dayah

PLATE NO: B-5D

CONSOLIDATION TEST - TIME CURVE

JOB #: 206139.GDR

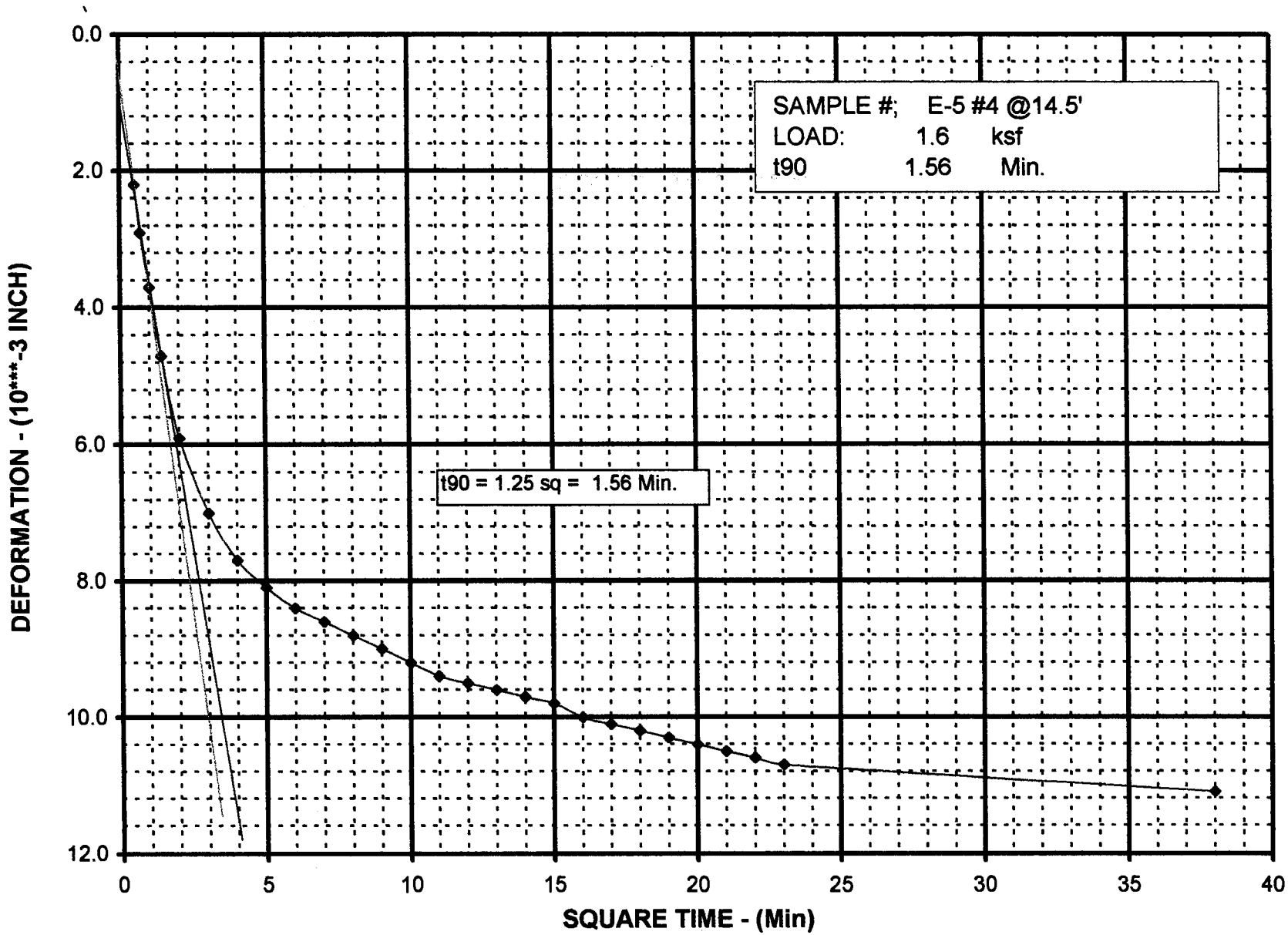


PLATE NO: B-5E

CONSOLIDATION TEST - TIME CURVE

JOB #: 206139.GDR

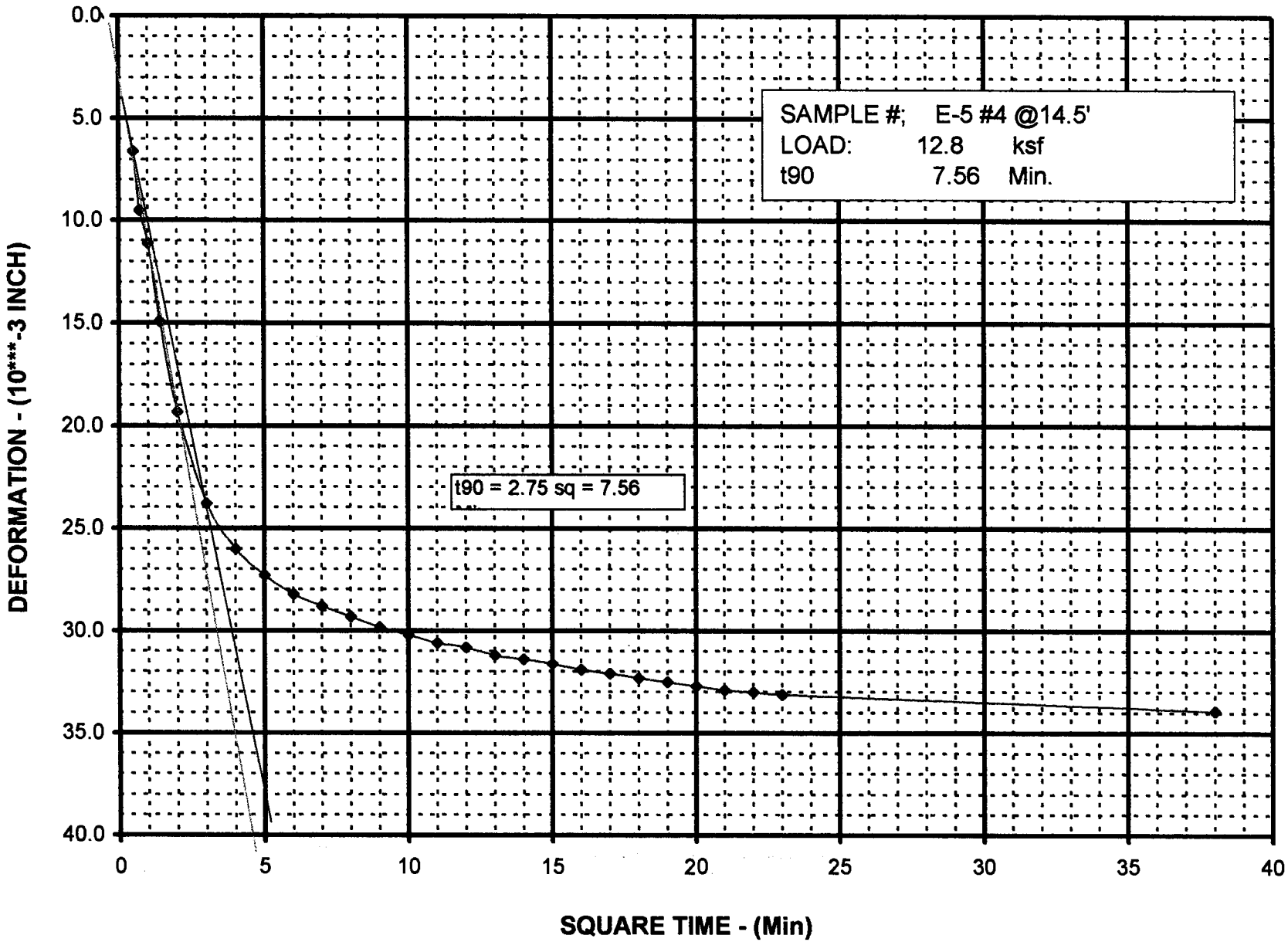
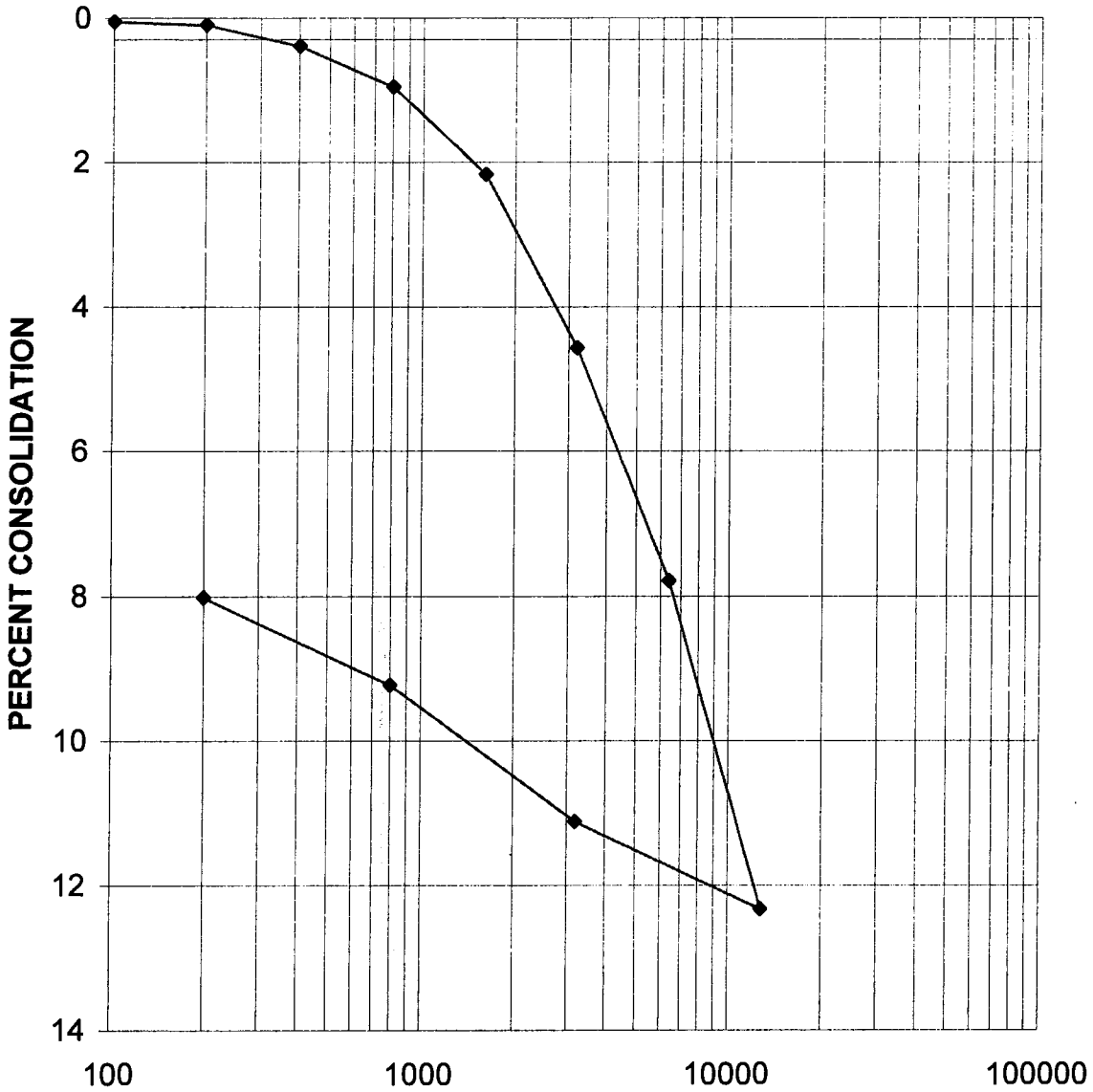


PLATE NO: B-5F

CONSOLIDATION TEST RESULTS



	MOISTURE CONTENT %	DRY DENSITY PCF	HEIGHT (INCHES)	DIAMETER (INCHES)
INITIAL	32.6	90.4	1.0000	2.416
FINAL	28.4	98.3	0.9198	2.416

BORING NO.	E-24	SAMPLE NO.	4	ELEV. OR DEPTH	14.5'
DESCRIPTION	Lean clay, yellowish brown				

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

I-880 SB HOV Lane Extension
R & M

DATE	JOB NO:
8/5/08	206139.GDR

Reported by: Prav Dayah

PLATE NO: B-5G

CONSOLIDATION TEST - TIME CURVE

JOB #: 206139.GDR

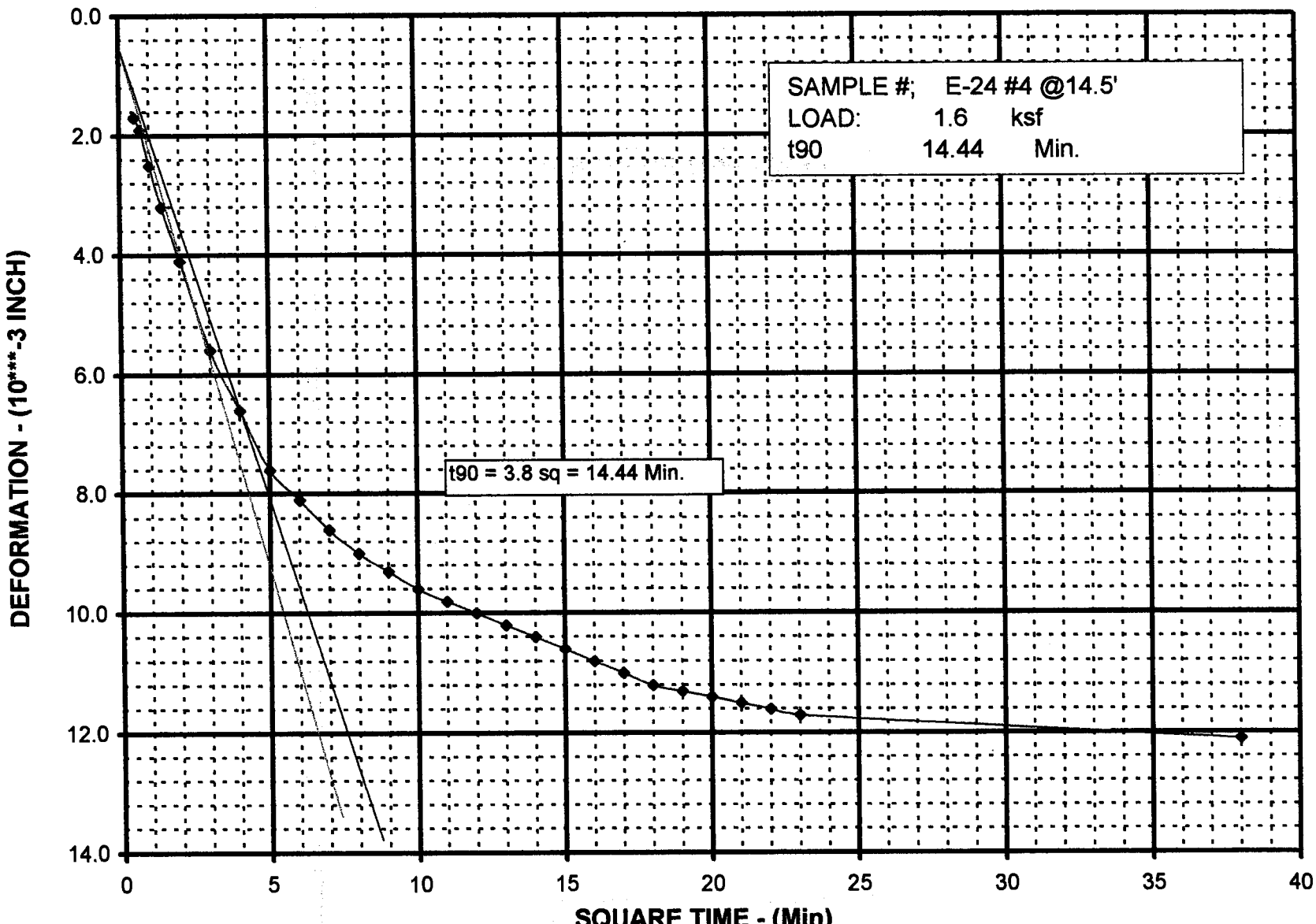


PLATE NO: B-5H

CONSOLIDATION TEST - TIME CURVE

JOB #: 206139.GDR

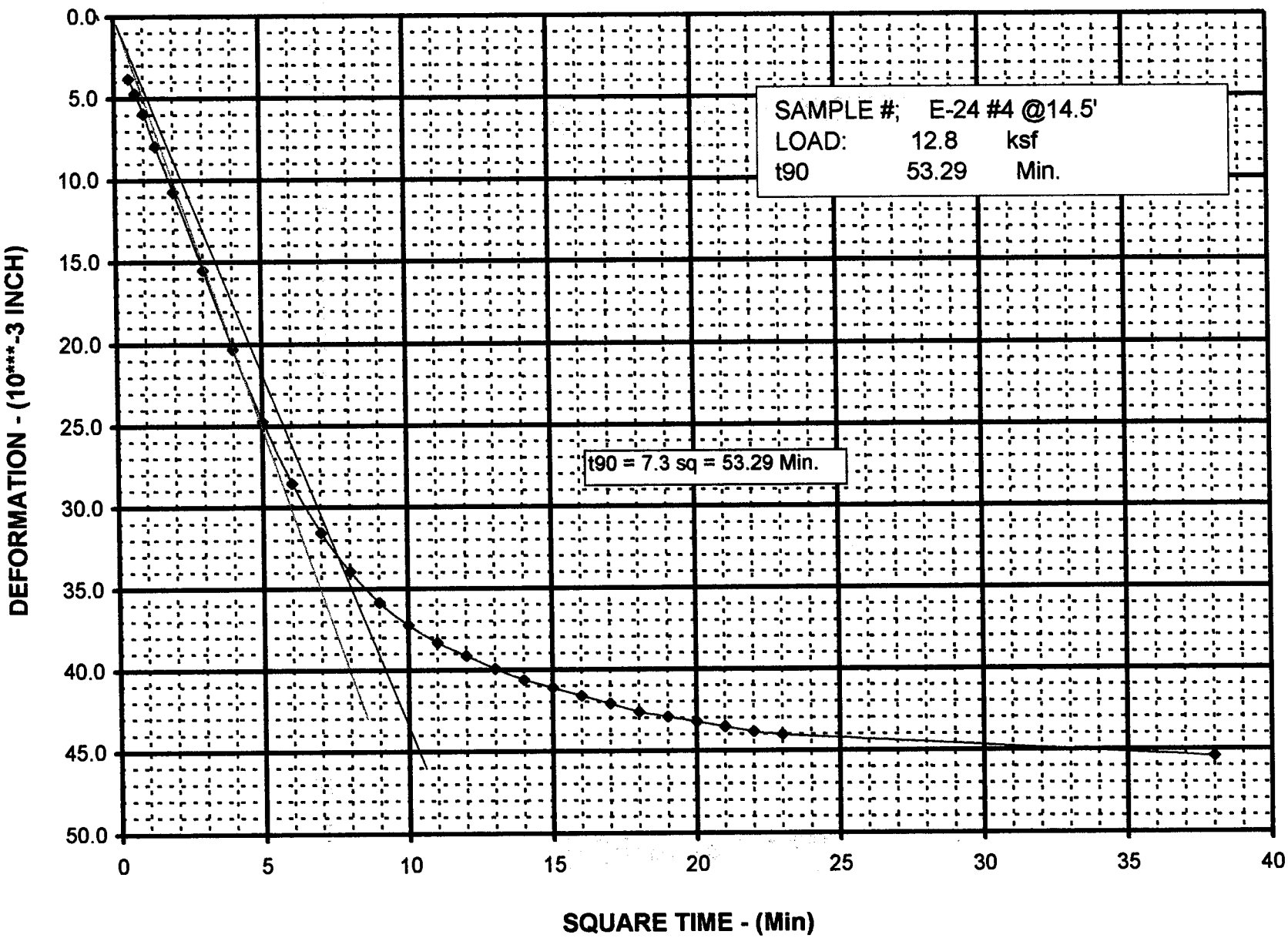
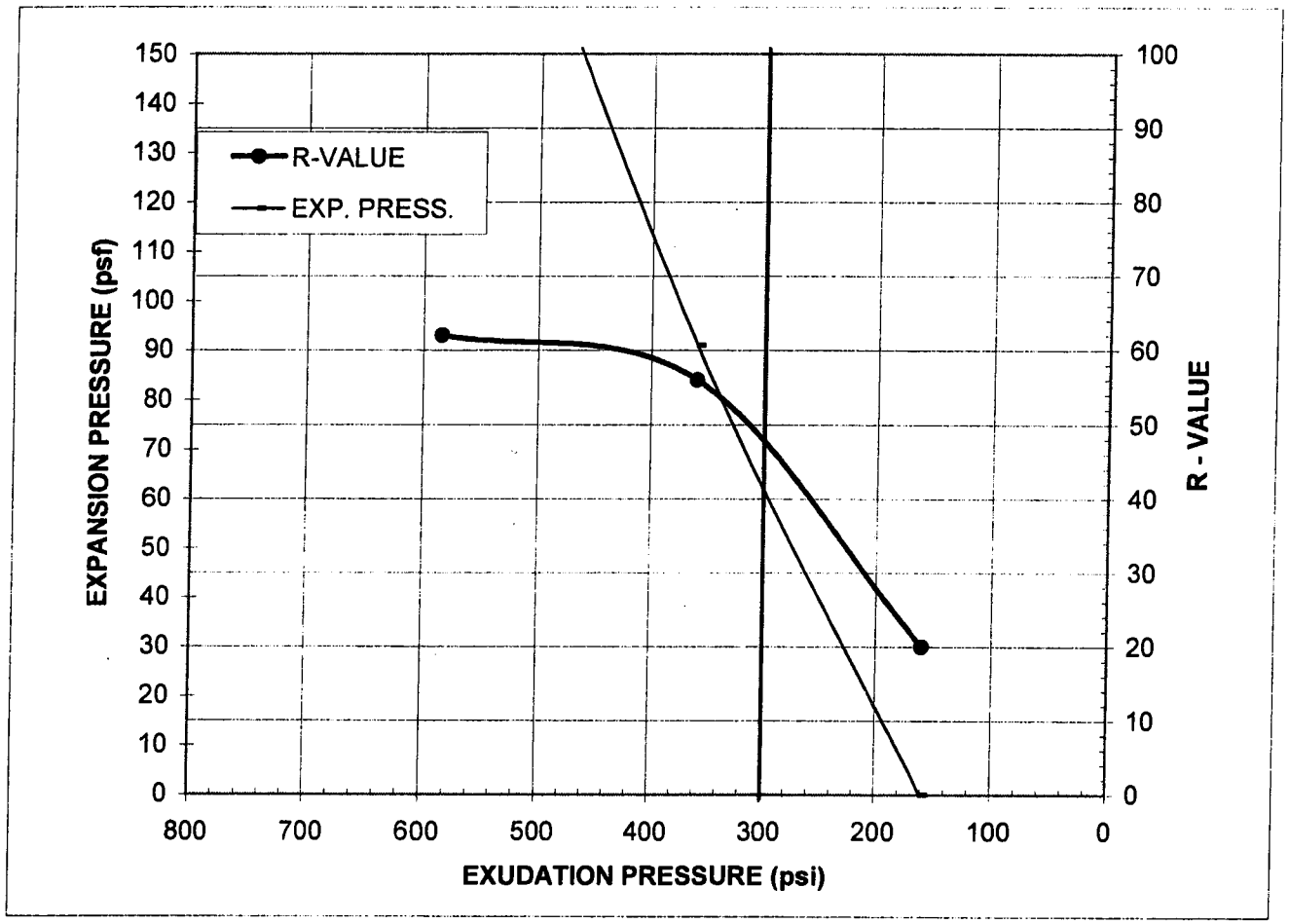


PLATE NO: B-5I

R-VALUE REPORT

Parikh Consultants, Inc. **ASTM D2844 or CTM 301** (408) 945-1011

Project Name:	I-880 SB - HOV Lane Ext. from Hegenberger to Marina Rd	Date:	7/28/08
Client:	Rajappan & Mayer	Project #:	206139.GDR
Sample #:	R-1 Depth: 0' - 5'	Lab #:	M722
Location / Source:	Onsite / Native	Sample Date:	
Material :	Clayey sands, brown	Sampled By:	



Specimen No.	A	B	C
Exudation Pressure, psi	160	359	584
Expansion Pressure, psf	0	91	221
R-Value	20	56	62
Moisture Content at Test, %	15.5	13.7	12.7
Dry Density at Test, pcf	113.7	116.8	118.8

R-Value @ 300 psi Exudation Pressure = 48

Expansion Pressure @300 psi Exudation, psf = **62**

Minimum R-Value Requirement:

Comments:

Report By: Prav Dayah

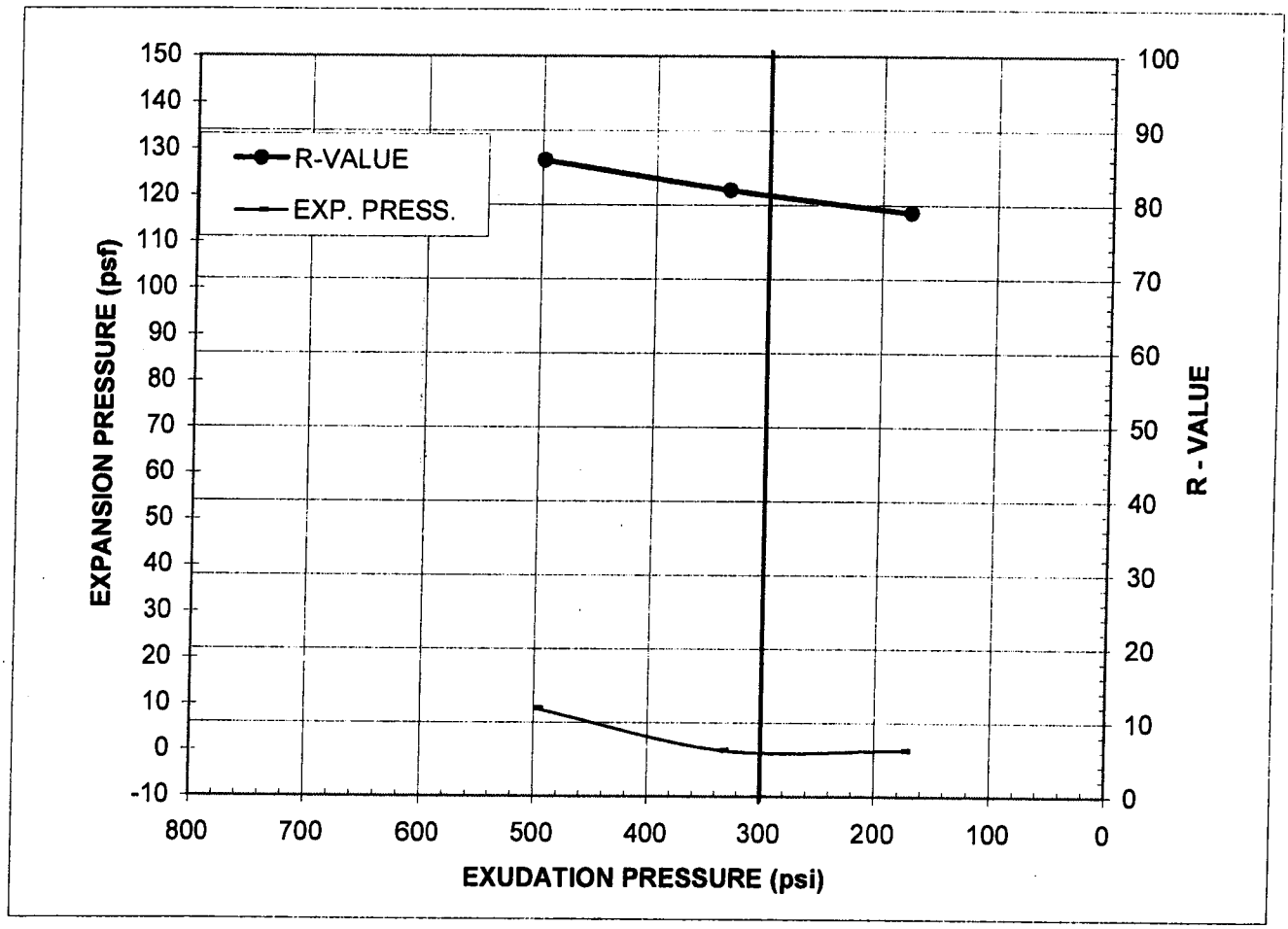
RVALUE with calcs pdp

PLATE NO: B-6A

R-VALUE REPORT

Parikh Consultants, Inc. ASTM D2844 or CTM 301 (408) 945-1011

Project Name:	I-880 SB - HOV Lane Ext. from Hegenberger to Marina Rd	Date:	7/28/08
Client:	Rajappan & Mayer	Project #:	206139.GDR
Sample #: R-2	Depth: 0' - 5'	Lab #:	M722
Location / Source:	Onsite / Native	Sample Date:	
Material :	Silty gravel,brown	Sampled By:	



Specimen No.	A	B	C
Exudation Pressure, psi	175	334	498
Expansion Pressure, psf	0	0	9
R-Value	79	82	86
Moisture Content at Test, %	16.1	15.8	15.7
Dry Density at Test, pcf	110.8	111.8	112.4

R-Value @ 300 psi Exudation Pressure = 82

Expansion Pressure @300 psi Exudation, psf = **0**

Minimum R-Value Requirement:

Comments:

Report By: Prav Dayah

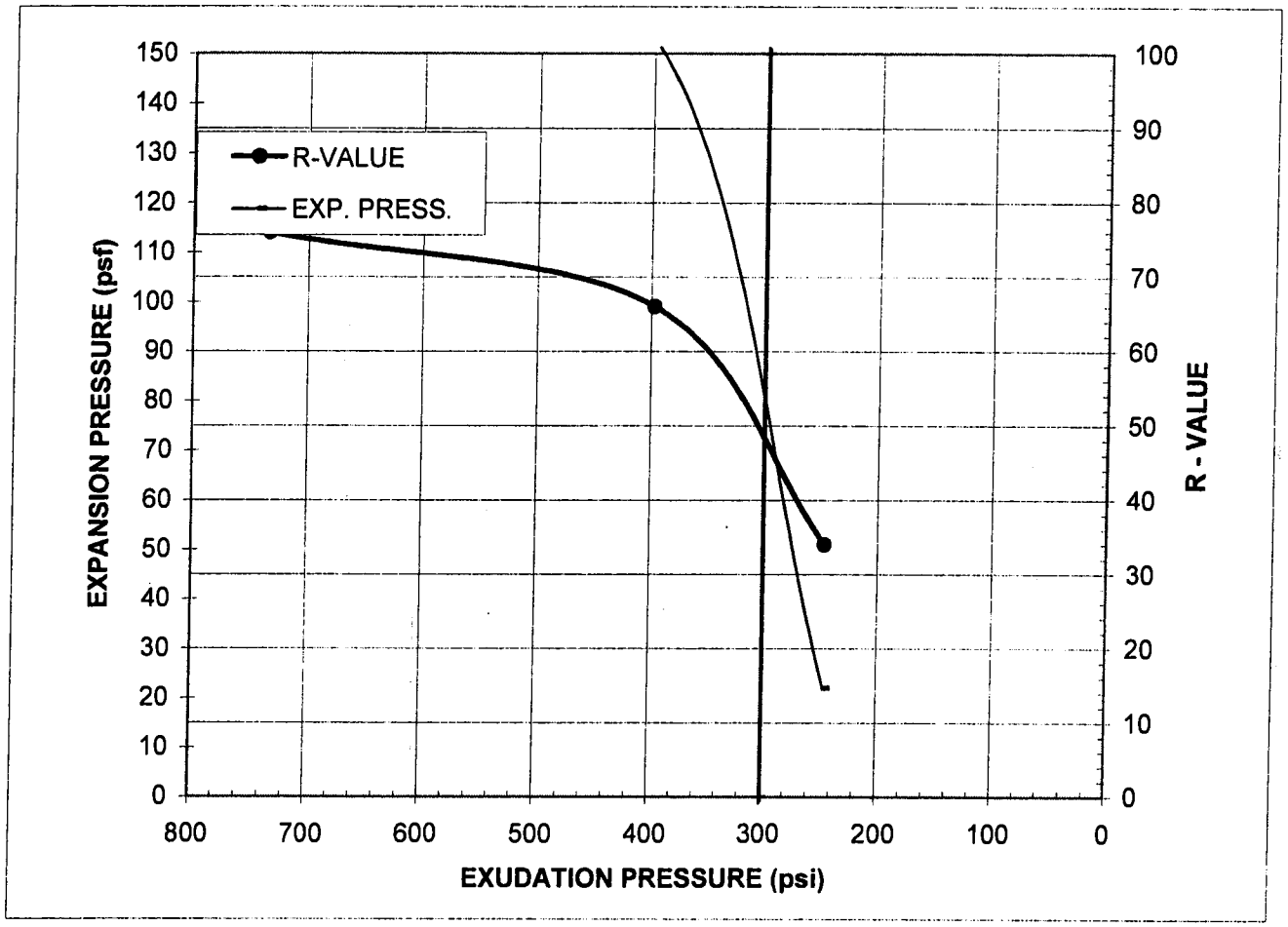
RVALUE with calcs pdp

PLATE NO: B-6B

R-VALUE REPORT

Parikh Consultants, Inc. ASTM D2844 or CTM 301 (408) 945-1011

Project Name:	I-880 SB - HOV Lane Ext. from Hegenberger to Marina Rd	Date:	7/28/08
Client:	Rajappan & Mayer	Project #:	206139.GDR
Sample #: R-8	Depth: 0' - 5'	Lab #:	M722
Location / Source:	Onsite / Native	Sample Date:	
Material :	Clayey sands, brown	Sampled By:	



Specimen No.	A	B	C
Exudation Pressure, psi	246	397	734
Expansion Pressure, psf	22	152	191
R-Value	34	66	76
Moisture Content at Test, %	10.4	9.5	8.9
Dry Density at Test, pcf	123.8	125.6	126.8

R-Value @ 300 psi Exudation Pressure = 48

Expansion Pressure @300 psi Exudation, psf = **80**

Minimum R-Value Requirement:

Comments:

Report By: Prav Dayah

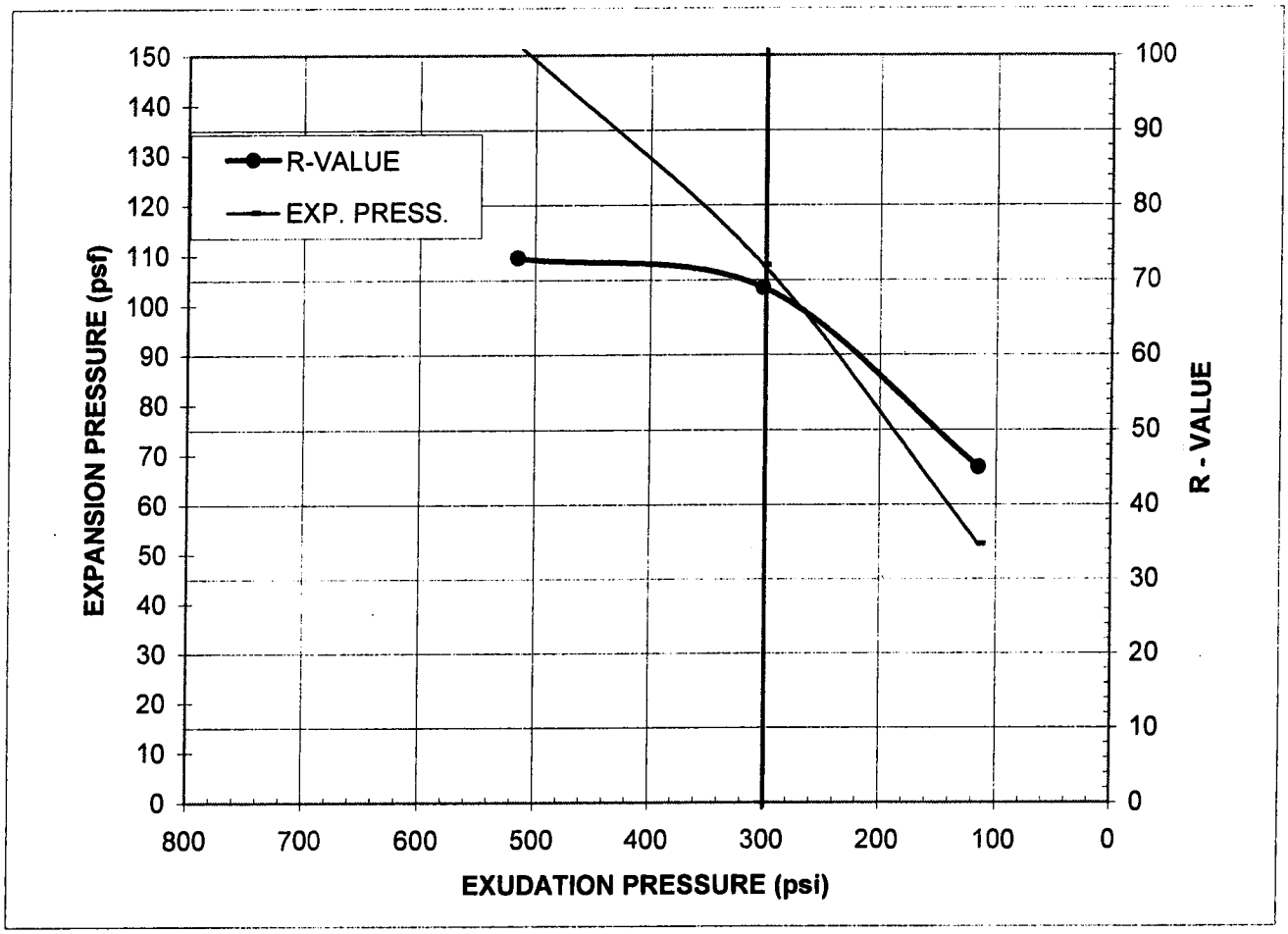
RVALUE with calcs pdp

PLATE NO: B-6C

R-VALUE REPORT

Parikh Consultants, Inc. | ASTM D2844 or CTM 301 | (408) 945-1011

Project Name:	I-880 SB - HOV Lane Ext. from Hegenberger to Marina Rd	Date:	7/28/08
Client:	Rajappan & Mayer	Project #:	206139.GDR
Sample #:	R-10 Depth: 0' - 5'	Lab #:	M722
Location / Source:	Onsite / Native	Sample Date:	
Material :	Clayey gravel,brown	Sampled By:	



Specimen No.	A	B	C
Exudation Pressure, psi	115	302	515
Expansion Pressure, psf	52	108	152
R-Value	45	69	73
Moisture Content at Test, %	11.1	10.3	9.4
Dry Density at Test, pcf	120.4	123.4	124.8

R-Value @ 300 psi Exudation Pressure = 68

Expansion Pressure @300 psi Exudation, psf = **110**

Minimum R-Value Requirement:

Comments:

Report By: Prav Dayah

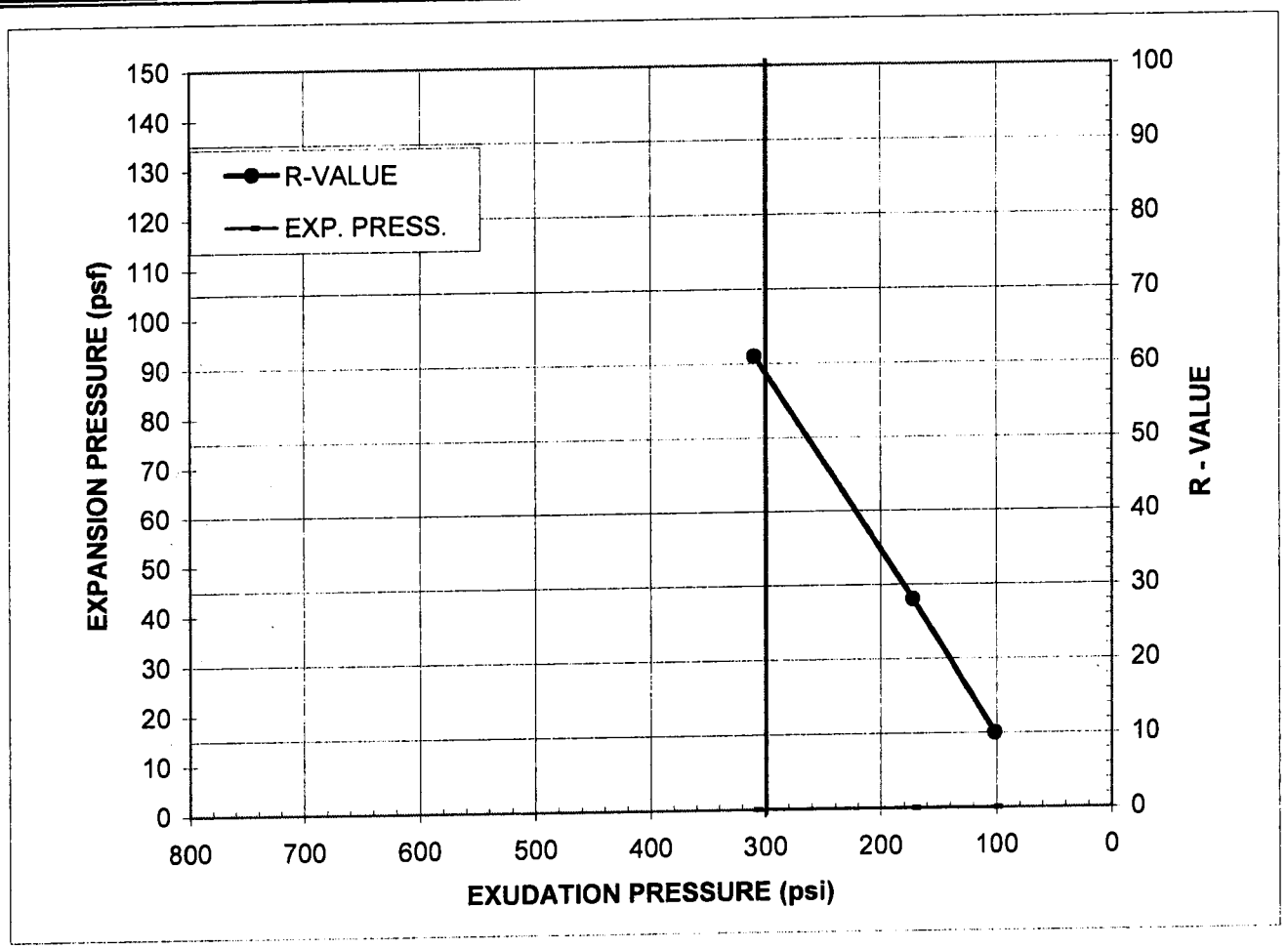
RVALUE with calcs pdp

PLATE NO: B-6D

R-VALUE REPORT

Parikh Consultants, Inc. **ASTM D2844 or CTM 301** (408) 945-1011

Project Name:	I-880 SB - HOV Lane Ext. from Hegenberger to Marina Rd	Date:	7/28/08
Client:	Rajappan & Mayer	Project #:	206139.GDR
Sample #:	R-14 Depth: 0' - 5'	Lab #:	M722
Location / Source:	Onsite / Native	Sample Date:	
Material :	Clayey sands, dark brown	Sampled By:	



Specimen No.	A	B	C
Exudation Pressure, psi	101	172	309
Expansion Pressure, psf	0	0	0
R-Value	10	28	61
Moisture Content at Test, %	15.2	13.3	11.9
Dry Density at Test, pcf	114.1	118.5	120.9

R-Value @ 300 psi Exudation Pressure = **58**

Expansion Pressure @300 psi Exudation, psf = **0**

Minimum R-Value Requirement:

Comments:

Report By: Prav Dayah

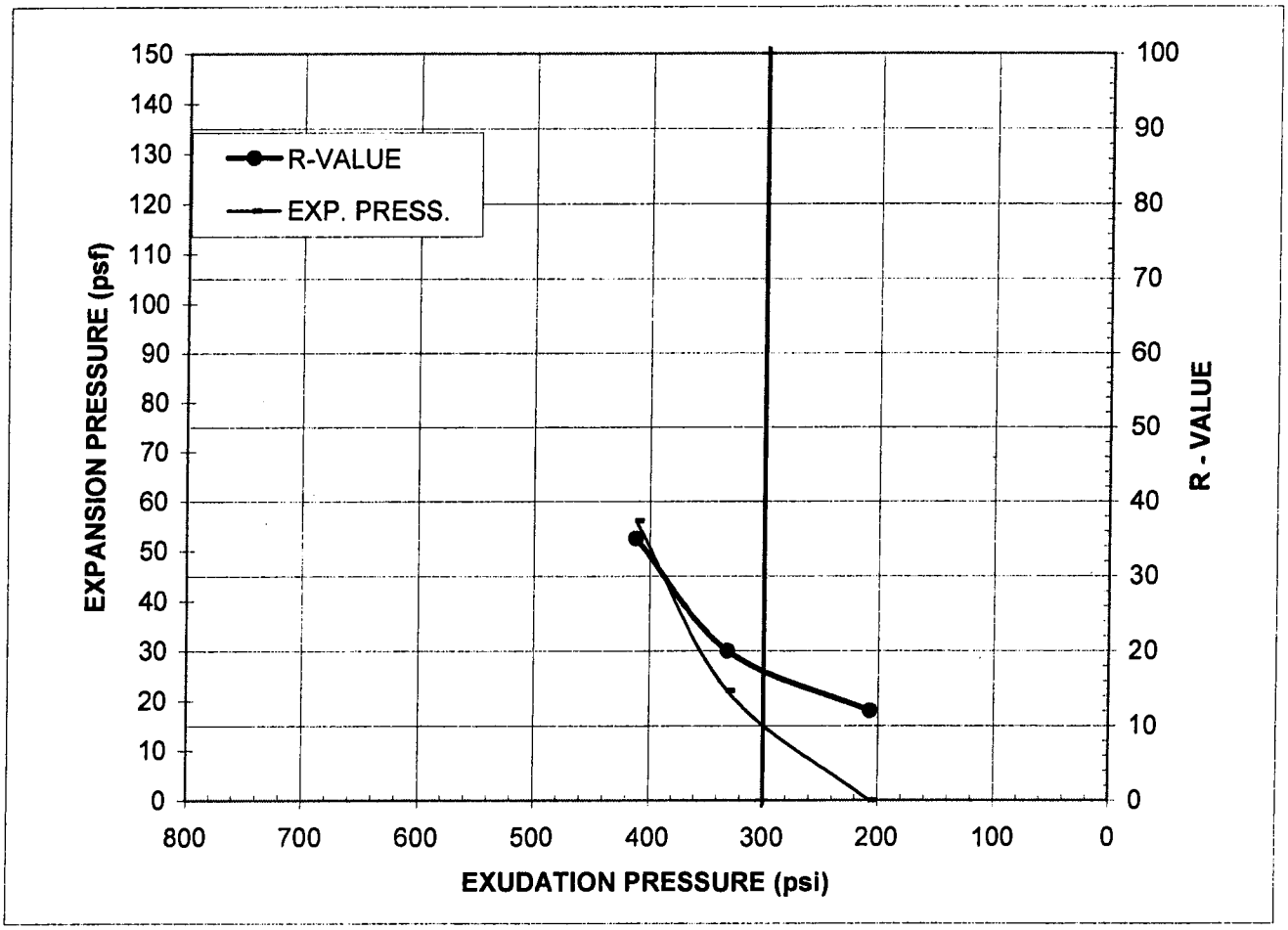
RVALUE with calcs pdp

PLATE NO: B-6E

R-VALUE REPORT

Parikh Consultants, Inc. | ASTM D2844 or CTM 301 | (408) 945-1011

Project Name:	I-880 SB - HOV Lane Ext. from Hegenberger to Marina Rd	Date:	7/28/08
Client:	Rajappan & Mayer	Project #:	206139.GDR
Sample #:	R-15 Depth: 0' - 5'	Lab #:	M722
Location / Source:	Onsite / Native	Sample Date:	
Material :	Sandy clay, dark brown	Sampled By:	



Specimen No.	A	B	C
Exudation Pressure, psi	207	331	412
Expansion Pressure, psf	0	22	56
R-Value	12	20	35
Moisture Content at Test, %	17.8	16.9	15.9
Dry Density at Test, pcf	107.3	109.9	111.9

R-Value @ 300 psi Exudation Pressure = 16

Expansion Pressure @300 psi Exudation, psf = **15**

Minimum R-Value Requirement:

Comments:

Report By: Prav Dayah

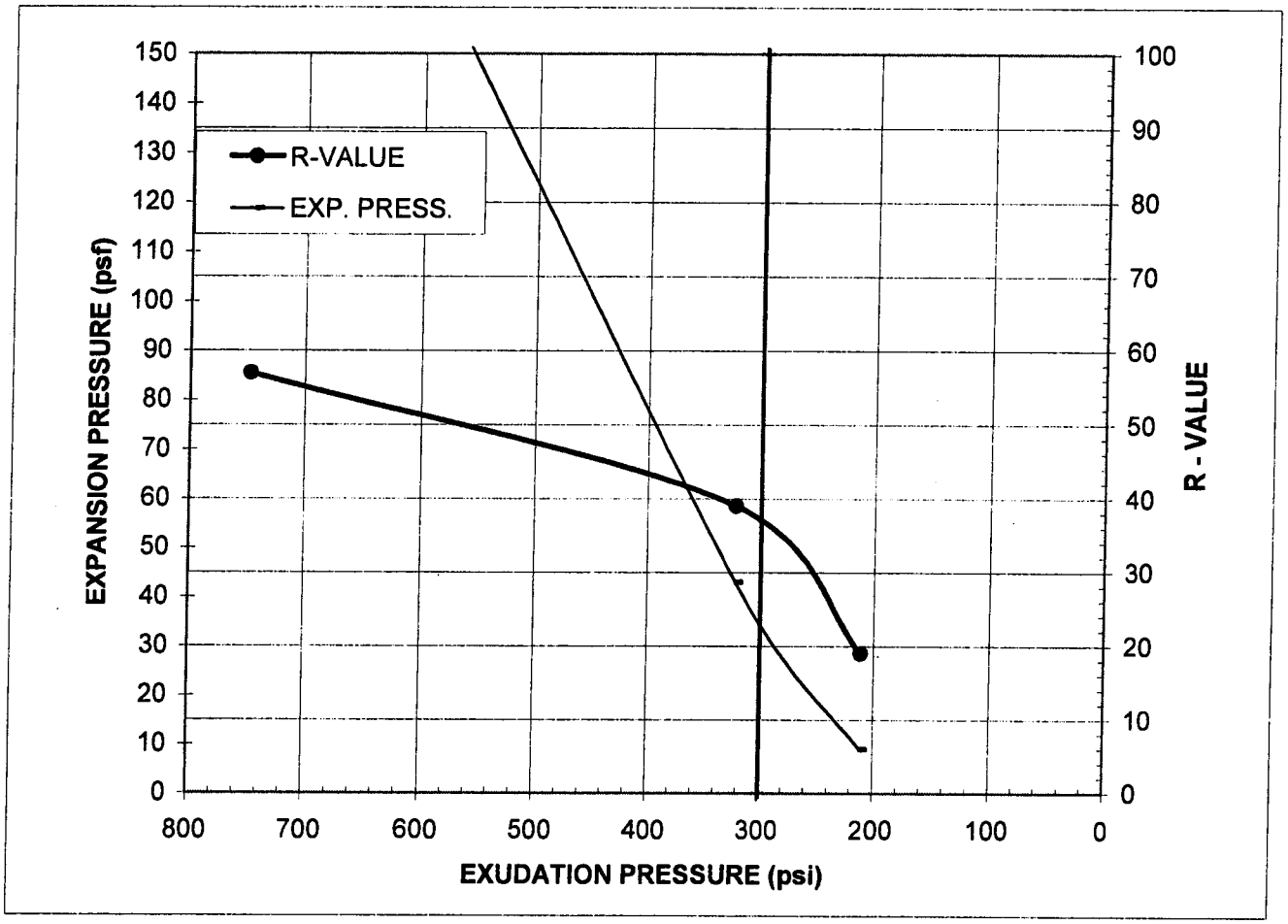
RVALUE with calcs pdp

PLATE NO: B-6F

R-VALUE REPORT

Parikh Consultants, Inc. ASTM D2844 or CTM 301 (408) 945-1011

Project Name:	I-880 SB - HOV Lane Ext. from Hegenberger to Marina Rd	Date:	7/28/08
Client:	Rajappan & Mayer	Project #:	206139.GDR
Sample #: R-18	Depth: 0' - 5'	Lab #:	M722
Location / Source:	Onsite / Native	Sample Date:	
Material :	Clayey sands, brown	Sampled By:	



Specimen No.	A	B	C
Exudation Pressure, psi	211	322	747
Expansion Pressure, psf	9	43	238
R-Value	19	39	57
Moisture Content at Test, %	15.3	14.0	13.0
Dry Density at Test, pcf	113.0	116.7	120.3

R-Value @ 300 psi Exudation Pressure = 37

Expansion Pressure @300 psi Exudation, psf = **34**

Minimum R-Value Requirement:

Comments:

Report By: Prav Dayah

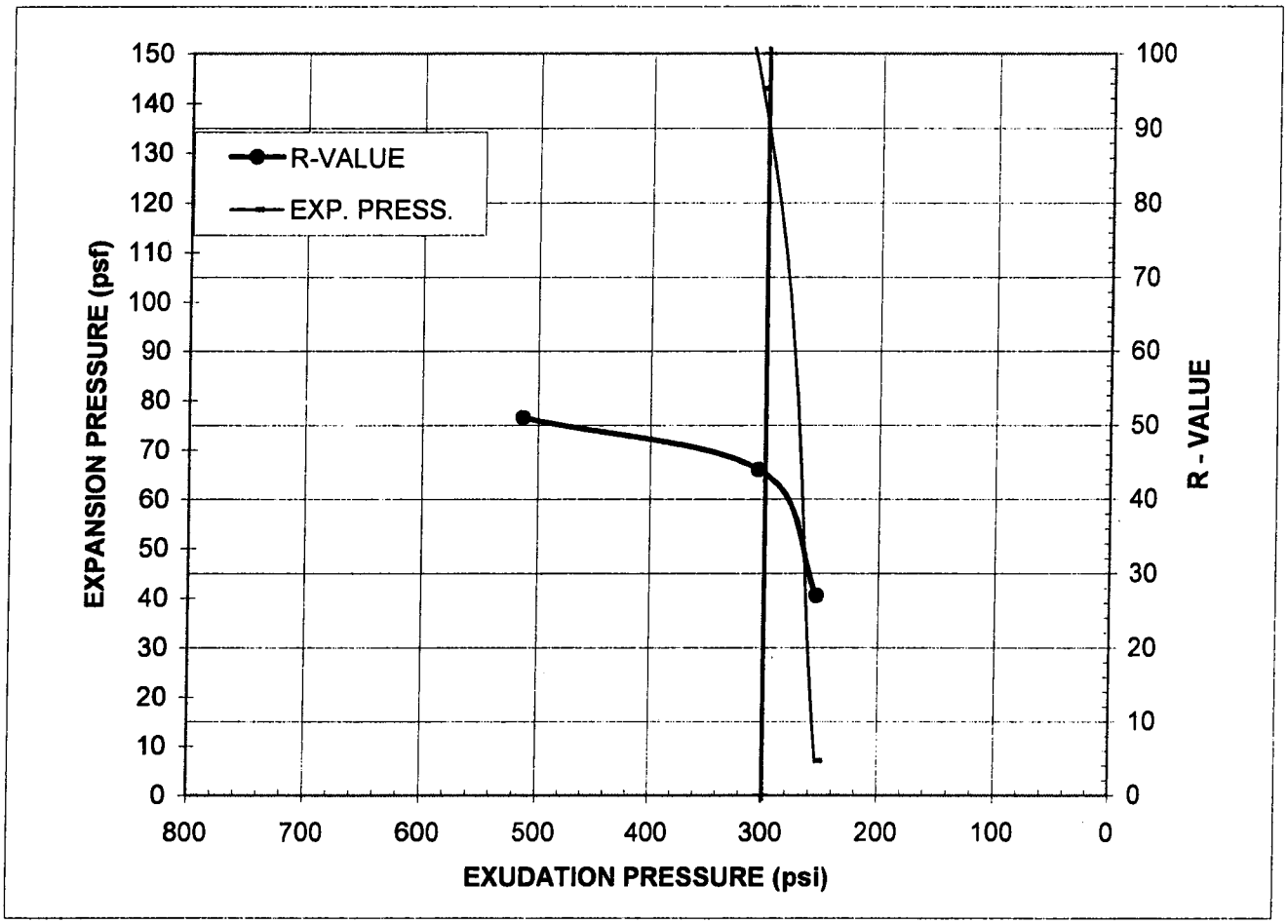
RVALUE with calcs pdp

PLATE NO: B-6G

R-VALUE REPORT

Parikh Consultants, Inc. ASTM D2844 or CTM 301 (408) 945-1011

Project Name:	I-880 SB - HOV Lane Ext. from Hegenberger to Marina Rd	Date:	7/28/08
Client:	Rajappan & Mayer	Project #:	206139.GDR
Sample #: R-20	Depth: 0' - 5'	Lab #:	M722
Location / Source:	Onsite / Native	Sample Date:	
Material :	Clayey sands, dark brown	Sampled By:	



Specimen No.	A	B	C
Exudation Pressure, psi	254	305	513
Expansion Pressure, psf	7	143	321
R-Value	27	44	51
Moisture Content at Test, %	18.7	17.7	16.6
Dry Density at Test, pcf	105.7	106.6	109.6

R-Value @ 300 psi Exudation Pressure = 44

Expansion Pressure @300 psi Exudation, psf = **135**

Minimum R-Value Requirement:

Comments:

Report By: Prav Dayah

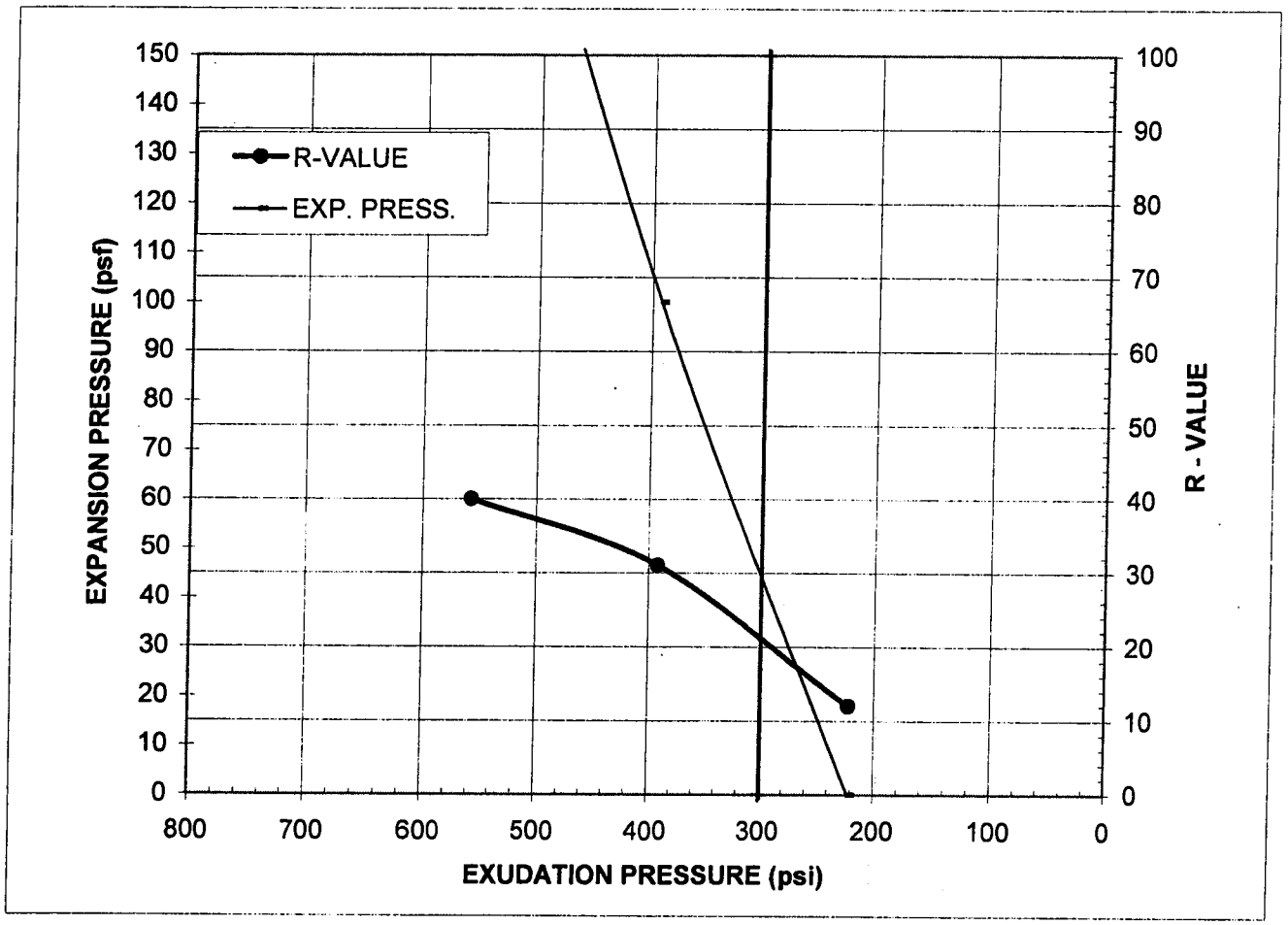
RVALUE with calcs pdp

PLATE NO: B-6H

R-VALUE REPORT

Parikh Consultants, Inc. ASTM D2844 or CTM 301 (408) 945-1011

Project Name:	I-880 SB - HOV Lane Ext. from Hegenberger to Marina Rd	Date:	7/28/08
Client:	Rajappan & Mayer	Project #:	206139.GDR
Sample #: R-26	Depth: 0' - 5'	Lab #:	M722
Location / Source:	Onsite / Native	Sample Date:	
Material :	Sandy clay, dark brown	Sampled By:	



Specimen No.	A	B	C
Exudation Pressure, psi	222	392	557
Expansion Pressure, psf	0	100	221
R-Value	12	31	40
Moisture Content at Test, %	17.5	15.6	15.0
Dry Density at Test, pcf	110.4	114.7	117.1

R-Value @ 300 psi Exudation Pressure = 21

Expansion Pressure @300 psi Exudation, psf = **45**

Minimum R-Value Requirement:

Comments:

Report By: Prav Dayah

RVALUE with calcs pdp

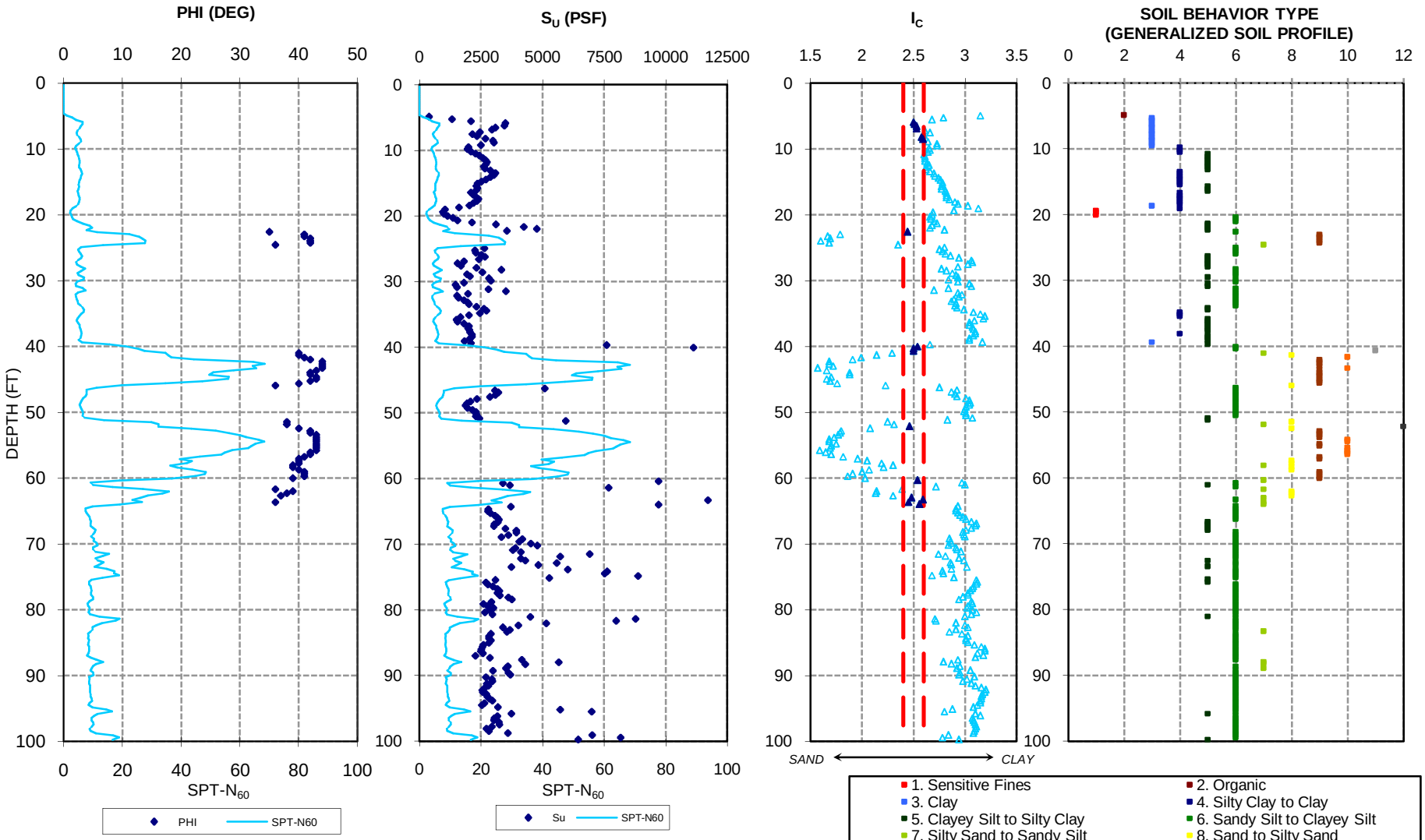
PLATE NO: B-6I

APPENDIX C

CPT CORRELATION & LIQUEFACTION ANALYSES

CPT DATA CORRELATION

CPT-MR1



Reference: CPT data and correlation provided by Gregg Drilling and Testing, Inc.

PARIKH

Practicing in the Geosciences

MARINA BLVD OC-RTE 880
ALAMEDA COUNTY, CALIFORNIA

JOB NO.: 206139.10

PLATE NO.:

LIQUEFACTION POTENTIAL ANALYSIS (per Youd & Idriss, 2001)

PROJECT NAME	***Marina Blvd /Rte 880***	*FAULT INFO*	
PROJECT NO.	***206139.MAR***	*COAST RANGE - SIERRAN BLOCK BOUNDARY ZONE (CSB)*	
CPT NO.	***CPT-MR1***	a_{max} *(g)=* 0.6	*FAULT* M_w *=* 7.5
			MSF = 1.00

Depth (ft)		Soil Behavior Type	*CPT RESULT INPUT* qc (tsf)	fs (tsf)	σ_v (tsf)	u (tsf)	σ_v' (tsf)	Ic*	C_N*	*CSR* γ_d	CSR	*$CRR_{7.5}$* Ic	C_Q	q_{c1N}	K_C	$(q_{c1N})_{cs}$	$CRR_{7.5}$	*F.S.=($CRR_{7.5}$/CSR)*MSF*Kσ*Kα* Kσ	Kα	F.S.
0.328									1.7	1.00									1	
0.656									1.7	1.00									1	
0.984									1.7	1.00									1	
1.312									1.7	1.00									1	
1.64									1.7	1.00									1	
1.969									1.7	1.00									1	
2.297									1.7	1.00									1	
2.625									1.7	1.00									1	
2.953									1.7	1.00									1	
3.281									1.7	0.99									1	
3.609									1.7	0.99									1	
3.937									1.7	0.99									1	
4.265									1.7	0.99									1	
4.593									1.7	0.99									1	
4.921	2	Organic	3.089	0.245	0.196		0.196	3.15	1.57593	0.99	0.386							1.00	1	
5.249	3	Clay	10.142	0.806	0.214		0.214	2.79	1.55587	0.99	0.386							1.00	1	
5.577	3	Clay	15.914	1.242	0.232		0.232	2.68	1.53631	0.99	0.386							1.00	1	
5.906	3	Clay	26.272	1.704	0.251		0.251	2.5	1.5162	0.99	0.385	2.500	1.52	39.83	2.768	110.277	0.20	1.00	1	
6.234	3	Clay	26.018	1.612	0.269		0.269	2.51	1.49762	0.99	0.385	2.510	1.50	38.97	2.820	109.862	0.20	1.00	1	
6.562	3	Clay	23.381	1.361	0.287		0.287	2.53	1.47949	0.99	0.385	2.530	1.48	34.59	2.925	101.173	0.18	1.00	1	
6.89	3	Clay	22.327	1.165	0.305		0.305	2.53	1.46179	0.99	0.385	2.530	1.46	32.64	2.925	95.457	0.16	1.00	1	
7.218	3	Clay	18.824	1.028	0.324		0.324	2.61	1.44357	0.99	0.384							1.00	1	
7.546	3	Clay	16.592	0.9	0.342		0.342	2.66	1.42672	0.98	0.384							1.00	1	
7.874	3	Clay	17.92	0.822	0.36		0.36	2.6	1.41026	0.98	0.384							1.00	1	
8.202	3	Clay	20.528	0.956	0.379		0.379	2.58	1.39329	0.98	0.383	2.580	1.39	28.60	3.206	91.709	0.15	1.00	1	
8.53	3	Clay	22.722	1.165	0.397		0.397	2.59	1.37758	0.98	0.383	2.590	1.38	31.30	3.266	102.232	0.18	1.00	1	
8.858	3	Clay	23.071	1.327	0.415		0.415	2.64	1.36223	0.98	0.383							1.00	1	
9.186	3	Clay	19.106	1.183	0.433		0.433	2.73	1.34721	0.98	0.383							1.00	1	
9.514	3	Clay	15.218	0.722	0.452		0.452	2.73	1.33172	0.98	0.382							1.00	1	
9.843	4	Silty Clay to Clay	15.02	0.514	0.47		0.47	2.65	1.31737	0.98	0.382							1.00	1	
10.171	4	Silty Clay to Clay	16.159	0.592	0.489	0.00534	0.489	2.66	1.30255	0.98	0.382							1.00	1	
10.499	4	Silty Clay to Clay	17.562	0.626	0.508	0.01557	0.508	2.64	1.28806	0.98	0.381							1.00	1	
10.827	5	Clayey Silt to Silty Clay	18.72	0.615	0.527	0.0258	0.527	2.6	1.27389	0.98	0.381							1.00	1	
11.155	5	Clayey Silt to Silty Clay	19.85	0.676	0.546	0.03604	0.546	2.61	1.26002	0.98	0.381							1.00	1	
11.483	5	Clayey Silt to Silty Clay	20.632	0.714	0.564	0.04627	0.564	2.61	1.24717	0.98	0.381							1.00	1	
11.811	5	Clayey Silt to Silty Clay	21.037	0.715	0.583	0.0565	0.583	2.61	1.23388	0.98	0.380							1.00	1	
12.139	5	Clayey Silt to Silty Clay	20.792	0.722	0.602	0.06674	0.602	2.63	1.22087	0.97	0.380							1.00	1	
12.467	5	Clayey Silt to Silty Clay	20.124	0.689	0.621	0.07697	0.621	2.65	1.20813	0.97	0.380							1.00	1	
12.795	5	Clayey Silt to Silty Clay	20.481	0.622	0.64	0.0872	0.64	2.62	1.19565	0.97	0.380							1.00	1	
13.123	5	Clayey Silt to Silty Clay	22.176	0.732	0.658	0.09744	0.658	2.62	1.18407	0.97	0.379							1.00	1	
13.451	4	Silty Clay to Clay	23.702	0.924	0.677	0.10767	0.677	2.66	1.17208	0.97	0.379							1.00	1	
13.78	4	Silty Clay to Clay	23.316	0.986	0.696	0.11794	0.696	2.7	1.16034	0.97	0.379							1.00	1	
14.108	4	Silty Clay to Clay	22.242	0.916	0.715	0.12817	0.715	2.71	1.14883	0.97	0.378							1.00	1	
14.436	4	Silty Clay to Clay	20.924	0.849	0.734	0.1384	0.734	2.74	1.13754	0.97	0.378							1.00	1	
14.764	4	Silty Clay to Clay	19.549	0.774	0.752	0.14864	0.752	2.76	1.12705	0.97	0.378							1.00	1	
15.092	4	Silty Clay to Clay	18.408	0.686	0.771	0.15887	0.771	2.78	1.11618	0.97	0.378							1.00	1	
15.42	4	Silty Clay to Clay	18.024	0.644	0.79	0.1691	0.79	2.78	1.10553	0.97	0.377							1.00	1	
15.748	5	Clayey Silt to Silty Clay	18.41	0.638	0.809	0.17934	0.809	2.77	1.09507	0.97	0.377							1.00	1	
16.076	5	Clayey Silt to Silty Clay	18.09	0.597	0.828	0.18957	0.828	2.77	1.08481	0.97	0.377							1.00	1	
16.404	5	Clayey Silt to Silty Clay	16.536	0.535	0.846	0.1998	0.846	2.81	1.07527	0.97	0.377							1.00	1	
16.732	4	Silty Clay to Clay	17.044	0.584	0.865	0.21004	0.865	2.82	1.06538	0.96	0.376							1.00	1	
17.06	4	Silty Clay to Clay	17.91	0.632	0.884	0.22027	0.884	2.82	1.05566	0.96	0.376							1.00	1	
17.388	4	Silty Clay to Clay	18.749	0.682	0.903	0.23051	0.903	2.82	1.04612	0.96	0.376							1.00	1	
17.717	4	Silty Clay to Clay	18.344	0.709	0.922	0.24077	0.922	2.85	1.03676	0.96	0.375							1.00	1	
18.045	4	Silty Clay to Clay	17.336	0.714	0.94	0.251	0.94	2.9	1.02804	0.96	0.375							1.00	1	
18.373	4	Silty Clay to Clay	16.131	0.667	0.959	0.26124	0.959	2.93	1.01899	0.96	0.375							1.00	1	
18.701	3	Clay	12.919	0.545	0.977	0.27147	0.977	3.03	1.01056	0.96	0.374							1.00	1	
19.029	4	Silty Clay to Clay	8.701	0.284	0.996	0.2817	0.996	3.13	1.00182	0.96	0.374							1.00	1	
19.357	1	Sensitive Fines	8.155	0.072	1.015	0.29194	1.015	2.89	0.99323	0.96	0.374							1.00	1	
19.685	1	Sensitive Fines	8.38	0.02	1.033	0.30217	1.033	2.69	0.98522	0.96	0.374							0.99	1	
20.013	1	Sensitive Fines	9.435	0.031	1.051	0.31241	1.051	2.68	0.97734	0.96	0.373							0.99	1	
20.341	6	Sandy Silt to Clayey Silt	11.187	0.052	1.07	0.32264	1.07	2.66	0.96916	0.96	0.373							0.99	1	
20.669	6	Sandy Silt to Clayey Silt	12.581	0.086	1.089	0.33287	1.089	2.67	0.96112	0.96	0.373							0.98	1	
20.997	6	Sandy Silt to Clayey Silt	17.054	0.247	1.107	0.34311	1.107	2.7	0.95362	0.95	0.372							0.98	1	
21.325	5	Clayey Silt to Silty Clay	24.22	0.667	1.126	0.35334	1.126	2.73	0.94583	0.95	0.372							0.98	1	
21.654	5	Clayey Silt to Silty Clay	32.864	1.097	1.145	0.3636	1.145	2.68	0.93817	0.95	0.371							0.97	1	
21.982	5	Clayey Silt to Silty Clay	36.716	1.29	1.164	0.37384	1.164	2.66	0.93063	0.95	0.371							0.97	1	
22.31	5	Clayey Silt to Silty Clay	27.638	1.077	1.183	0.38407	1.183	2.8	0.92321	0.95	0.371							0.97	1	
22.638	6	Sandy Silt to Clayey Silt	48.204	1.037	1.201	0.39431	1.201	2.44	0.91628	0.95	0.370	2.440	0.92	44.17	2.483	109.677	0.20	0.96	1	0.55
22.966	9	Sand	123.218	0.771	1.222	0.40454	1.222	1.79	0.90834	0.95	0.370	1.790	0.91	111.92	1.099	123.054	0.25	0.95	1	0.68
23.294	9	Sand	146.863	0.722	1.242	0.41477	1.242	1.67	0.9009	0.95	0.370	1.670	0.90	132.31	1.017	134.608	0.31	0.94	1	0.83
23.622	9	Sand	152.344	0.83	1.263	0.42501	1.263	1.69	0.89322	0.95	0.369	1.690	0.89	136.08	1.031	140.306	0.34	0.93	1	0.91
23.95	9	Sand	163.201	0.648	1.283	0.43524	1.283	1.6	0.88602	0.95	0.369	1.600	0.89	144.60	1.000	144.600	0.36	0.92	1	0.98
24.278	9	Sand	157.617	0.837	1.303	0.44547	1.303	1.68	0.87895	0.94	0.368	1.680	0.88	138.54	1.024	141.898	0.35	0.92	1	0.94
24.606	7	Silty Sand to Sandy Silt	59.061	1.024	1.323	0.45571	1.323	2.35	0.87198	0.94	0.368	2.350	0.87	51.50	2.120	109.162	0.20	0.95	1	0.55
24.934	6	Sandy Silt to Clayey Silt	21.159	0.48	1.341	0.46594	1.341	2.8	0.8658	0.94	0.367							0.94	1	
25.262	6	Sandy Silt to Clayey Silt	18.231	0.243	1.36	0.47617	1.36	2.75	0.85938	0.94	0.367							0.94	1	
25.591	6	Sandy Silt to Clayey Silt	18.589	0.291	1.379	0.48644	1.379	2.78	0.85304	0.94	0.366							0.94	1	
25.919	6	Sandy Silt to Clayey Silt	20.199	0.401	1.398	0.49667	1.398	2.81	0.84681	0.94	0.366							0.94	1	
26.247	5	Clayey Silt to Silty Clay	21.291	0.557	1.417	0.50691	1.417	2.86	0.84066	0.94	0.366							0.93	1	
26.575	5	Clayey Silt to Silty Clay	19.502	0.602	1.435	0.51714	1.435	2.94	0.83491	0.94	0.365							0.93	1	
26.903	5	Clayey Silt to Silty Clay	14.944	0.473	1.454	0.52737	1.454	3.06	0.82894	0.93	0.365							0.93	1	
27.231	5	Clayey Silt to Silty Clay	12.929	0.327	1.473	0.53761	1.466	3.07	0.82521	0.93	0.366							0.93	1	
27.559	5	Clayey Silt to Silty Clay	14.097	0.35	1.492	0.54784	1.475	3.03	0.82243	0.93	0.368							0.93	1	
27.887	5	Clayey Silt to Silty Clay	18.786	0.5	1.511	0.55807	1.483	2.93	0.81998	0.93	0.370							0.92	1	
28.215	6	Sandy Silt to Clayey Silt	26.339	0.613	1.529	0.56831	1.492	2.77	0.81724	0.93	0.371							0.92	1	
28.543	6	Sandy Silt to Clayey Silt	20.688	0.394	1.548	0.57854	1.5	2.82	0.81481	0.93	0.373							0.92	1	
28.871	6	Sandy Silt to Clayey Silt	15.867	0.241	1.567	0.58878	1.509	2.88	0.81211	0.93	0.375							0.92	1	
29.199	6	Sandy Silt to Clayey Silt	16.94	0.329	1.586	0.59901	1.517	2.91	0.80972	0.92	0.377							0.92	1	
29.528	5	Clayey Silt to Silty Clay	22.732	0.769	1.605	0.60927	1.526	2.93	0.80704	0.92	0.379							0.92	1	
29.856	6	Sandy Silt to Clayey Silt	23.25	0.569	1.623	0.61951	1.534	2.84	0.80468	0.92	0.380							0.92	1	
30.184	6	Sandy Silt to Clayey Silt	15.019	0.247	1.642	0.62974	1.543	2.93	0.80204	0.92	0.382							0.92	1	
30.512	5	Clayey Silt to Silty Clay	12.562	0.235	1.661	0.63997	1.552	3.04	0.79942	0.92	0.383							0.92	1	

LIQUEFACTION POTENTIAL ANALYSIS (per Youd & Idriss, 2001)

PROJECT NAME	***Marina Blvd /Rte 880***	*FAULT INFO*	
PROJECT NO.	***206139.MAR***	*COAST RANGE - SIERRAN BLOCK BOUNDARY ZONE (CSB)*	
CPT NO.	***CPT-MR1***	*a_{max} (g)=* 0.6	*FAULT M_w =* 7.5
			MSF = 1.00

		CPT RESULT INPUT							*CSR*		*$CRR_{7.5}$*						*F.S.=($CRR_{7.5}$/CSR)*MSF*K_σ*K_α*		
Depth (ft)		Soil Behavior Type	qc (tsf)	fs (tsf)	σ_v (tsf)	u (tsf)	σ_v' (tsf)	Ic*	C_N*	γ_d	CSR	Ic	C_Q	q_{c1N}	K_C	$(q_{c1N})_{cs}$	$CRR_{7.5}$	$K\sigma$	$K\alpha$	F.S.
30.84	5	Clayey Silt to Silty Clay	12.901	0.273	1.68	0.65021	1.56	3.06	0.7971	0.92	0.385							0.91	1	
31.168	6	Sandy Silt to Clayey Silt	22.516	0.503	1.699	0.66044	1.569	2.84	0.79451	0.91	0.386							0.91	1	
31.496	6	Sandy Silt to Clayey Silt	27.836	0.488	1.717	0.67068	1.577	2.7	0.79222	0.91	0.388							0.91	1	
31.824	6	Sandy Silt to Clayey Silt	16.253	0.298	1.736	0.68091	1.586	2.93	0.78966	0.91	0.389							0.91	1	
32.152	6	Sandy Silt to Clayey Silt	13.061	0.173	1.755	0.69114	1.594	2.97	0.7874	0.91	0.390							0.91	1	
32.48	6	Sandy Silt to Clayey Silt	13.532	0.166	1.774	0.70138	1.603	2.94	0.78487	0.91	0.391							0.91	1	
32.808	6	Sandy Silt to Clayey Silt	15.189	0.192	1.792	0.71161	1.611	2.89	0.78264	0.90	0.393							0.91	1	
33.136	6	Sandy Silt to Clayey Silt	16.206	0.213	1.811	0.72184	1.62	2.87	0.78014	0.90	0.394							0.91	1	
33.465	6	Sandy Silt to Clayey Silt	16.602	0.27	1.83	0.73211	1.629	2.91	0.77766	0.90	0.395							0.91	1	
33.793	6	Sandy Silt to Clayey Silt	19.069	0.376	1.849	0.74234	1.637	2.9	0.77547	0.90	0.396							0.91	1	
34.121	5	Clayey Silt to Silty Clay	21.301	0.559	1.868	0.75258	1.646	2.92	0.77301	0.90	0.397							0.91	1	
34.449	5	Clayey Silt to Silty Clay	22.054	0.805	1.886	0.76281	1.654	2.99	0.77085	0.89	0.398							0.90	1	
34.777	4	Silty Clay to Clay	20.142	0.888	1.905	0.77304	1.663	3.08	0.76842	0.89	0.399							0.90	1	
35.105	4	Silty Clay to Clay	16.677	0.696	1.924	0.78328	1.671	3.15	0.76628	0.89	0.400							0.90	1	
35.433	4	Silty Clay to Clay	14.266	0.541	1.943	0.79351	1.68	3.19	0.76389	0.89	0.400							0.90	1	
35.761	5	Clayey Silt to Silty Clay	13.089	0.4	1.962	0.80374	1.689	3.18	0.76151	0.89	0.401							0.90	1	
36.089	5	Clayey Silt to Silty Clay	13.324	0.277	1.98	0.81398	1.697	3.09	0.75941	0.88	0.402							0.90	1	
36.417	5	Clayey Silt to Silty Clay	15.246	0.329	1.999	0.82421	1.706	3.04	0.75705	0.88	0.402							0.90	1	
36.745	5	Clayey Silt to Silty Clay	16.771	0.428	2.018	0.83444	1.714	3.04	0.75498	0.88	0.403							0.90	1	
37.073	5	Clayey Silt to Silty Clay	16.573	0.476	2.037	0.84468	1.723	3.07	0.75265	0.88	0.404							0.90	1	
37.402	5	Clayey Silt to Silty Clay	17.119	0.542	2.056	0.85494	1.731	3.08	0.7506	0.87	0.404							0.90	1	
37.73	5	Clayey Silt to Silty Clay	17.355	0.596	2.074	0.86518	1.74	3.1	0.7483	0.87	0.405							0.90	1	
38.058	4	Silty Clay to Clay	17.939	0.635	2.093	0.87541	1.748	3.1	0.74627	0.87	0.405							0.89	1	
38.386	5	Clayey Silt to Silty Clay	17.92	0.591	2.112	0.88564	1.757	3.08	0.744	0.86	0.405							0.89	1	
38.714	5	Clayey Silt to Silty Clay	17.383	0.46	2.131	0.89588	1.766	3.04	0.74174	0.86	0.406							0.89	1	
39.042	5	Clayey Silt to Silty Clay	15.613	0.325	2.15	0.90611	1.774	3.04	0.73974	0.86	0.406							0.89	1	
39.37	3	Clay	17.751	0.781	2.168	0.91634	1.782	3.17	0.73776	0.86	0.406							0.89	1	
39.698	5	Clayey Silt to Silty Clay	59.071	2.135	2.187	0.92658	1.791	2.66	0.73554	0.85	0.407							0.89	1	
40.026	6	Sandy Silt to Clayey Silt	85.57	3.081	2.206	0.93681	1.799	2.54	0.73358	0.85	0.407	2.540	0.73	62.77	2.979	186.997		0.89	1	
40.354	6	Sandy Silt to Clayey Silt	104.318	4.009	2.224	0.94704	1.808	2.5	0.73138	0.85	0.407	2.500	0.73	76.30	2.768	211.222		0.89	1	
40.682	11	Stiff Fine-Grained	112.803	4.654	2.246	0.95728	1.819	2.5	0.72872	0.84	0.407	2.500	0.73	82.20	2.768	227.570		0.89	1	
41.011	7	Silty Sand to Sandy Silt	155.809	4.58	2.265	0.96754	1.828	2.29	0.72655	0.84	0.407	2.290	0.73	113.20	1.917	217.016		0.85	1	
41.339	8	Sand to Silty Sand	171.404	3.362	2.285	0.97778	1.838	2.14	0.72416	0.84	0.407	2.140	0.72	124.12	1.532	190.153		0.84	1	
41.667	10	Gravelly Sand to Sand	186.235	2.455	2.306	0.98801	1.848	1.99	0.72178	0.84	0.407	1.990	0.72	134.42	1.287	173.022		0.83	1	
41.995	9	Sand	232.932	2.95	2.326	0.99824	1.859	1.91	0.71919	0.83	0.406	1.910	0.72	167.52	1.198	200.760		0.81	1	
42.323	9	Sand	368.062	3.504	2.346	1.00848	1.869	1.68	0.71685	0.83	0.406	1.680	0.72	263.84	1.024	270.245		0.78	1	
42.651	9	Sand	390.936	3.859	2.367	1.01871	1.879	1.68	0.71452	0.83	0.406	1.680	0.71	279.33	1.024	286.108		0.78	1	
42.979	9	Sand	361.537	3.821	2.387	1.02894	1.889	1.72	0.7122	0.82	0.406	1.720	0.71	257.49	1.051	270.705		0.78	1	
43.307	10	Gravelly Sand to Sand	388.657	2.649	2.408	1.03918	1.9	1.57	0.70968	0.82	0.405	1.570	0.71	275.82	1.000	275.821		0.77	1	
43.635	9	Sand	332.684	2.594	2.428	1.04941	1.91	1.66	0.7074	0.82	0.405	1.660	0.71	235.34	1.010	237.788		0.77	1	
43.963	9	Sand	270.863	3.536	2.449	1.05965	1.92	1.88	0.70513	0.81	0.405	1.880	0.71	190.99	1.171	223.571		0.79	1	
44.291	9	Sand	264.13	3.249	2.469	1.06988	1.93	1.88	0.70288	0.81	0.404	1.880	0.70	185.65	1.171	217.317		0.79	1	
44.619	9	Sand	318.464	2.662	2.49	1.08011	1.94	1.7	0.70064	0.81	0.404	1.700	0.70	223.13	1.038	231.575		0.77	1	
44.948	9	Sand	321.883	2.341	2.51	1.09038	1.95	1.66	0.69841	0.80	0.404	1.660	0.70	224.81	1.010	227.146		0.77	1	
45.276	9	Sand	268.584	1.742	2.53	1.10061	1.96	1.69	0.6962	0.80	0.403	1.690	0.70	186.99	1.031	192.801		0.78	1	
45.604	9	Sand	191.772	1.008	2.551	1.11084	1.97	1.76	0.69401	0.80	0.403	1.760	0.69	133.09	1.078	143.530	0.35	0.82	1	0.88
45.932	8	Sand to Silty Sand	91.229	1.03	2.57	1.12108	1.98	2.23	0.69182	0.79	0.402	2.230	0.69	63.11	1.743	110.038	0.20	0.87	1	0.51
46.26	6	Sandy Silt to Clayey Silt	40.85	1.061	2.589	1.13131	1.989	2.75	0.68987	0.79	0.402							0.87	1	
46.588	6	Sandy Silt to Clayey Silt	25.82	0.614	2.608	1.14155	1.997	2.92	0.68815	0.79	0.401							0.87	1	
46.916	6	Sandy Silt to Clayey Silt	26.885	0.55	2.627	1.15178	2.006	2.87	0.68621	0.78	0.401							0.87	1	
47.244	6	Sandy Silt to Clayey Silt	25.915	0.575	2.646	1.16201	2.014	2.9	0.68451	0.78	0.400							0.87	1	
47.572	6	Sandy Silt to Clayey Silt	24.304	0.512	2.664	1.17225	2.023	2.92	0.68259	0.78	0.399							0.87	1	
47.9	6	Sandy Silt to Clayey Silt	20.509	0.441	2.683	1.18248	2.031	3.01	0.6809	0.77	0.399							0.87	1	
48.228	6	Sandy Silt to Clayey Silt	18.56	0.381	2.702	1.19271	2.04	3.04	0.67901	0.77	0.398							0.87	1	
48.556	6	Sandy Silt to Clayey Silt	17.412	0.313	2.721	1.20295	2.049	3.05	0.67713	0.77	0.397							0.87	1	
48.885	6	Sandy Silt to Clayey Silt	16.865	0.275	2.74	1.21321	2.057	3.04	0.67547	0.76	0.397							0.87	1	
49.213	6	Sandy Silt to Clayey Silt	17.59	0.269	2.758	1.22345	2.066	3.01	0.67361	0.76	0.396							0.86	1	
49.541	6	Sandy Silt to Clayey Silt	19.2	0.33	2.777	1.23368	2.074	3	0.67196	0.76	0.396							0.86	1	
49.869	6	Sandy Silt to Clayey Silt	20.264	0.384	2.796	1.24391	2.083	2.99	0.67012	0.75	0.395							0.86	1	
50.197	6	Sandy Silt to Clayey Silt	20.491	0.422	2.815	1.25415	2.091	3.01	0.66849	0.75	0.394							0.86	2	
50.525	6	Sandy Silt to Clayey Silt	20.283	0.406	2.834	1.26438	2.1	3.01	0.66667	0.75	0.393							0.86	3	
50.853	5	Clayey Silt to Silty Clay	21.404	0.597	2.852	1.27461	2.108	3.07	0.66505	0.74	0.393							0.86	4	
51.181	5	Clayey Silt to Silty Clay	47.592	1.84	2.871	1.28485	2.117	2.83	0.66325	0.74	0.392							0.86	5	
51.509	8	Sand to Silty Sand	137.465	2.592	2.891	1.29508	2.127	2.25	0.66126	0.74	0.391	2.250	0.66	90.90	1.798	163.461		0.84	6	
51.837	7	Silty Sand to Sandy Silt	144.716	3.488	2.91	1.30531	2.136	2.31	0.65947	0.73	0.390	2.310	0.66	95.44	1.981	189.082		0.83	7	
52.165	12	Sand to Clayey Sand	135.199	5.017	2.93	1.31555	2.145	2.46	0.6577	0.73	0.389	2.460	0.66	88.92	2.574	228.905		0.86	8	
52.493	8	Sand to Silty Sand	214.203	3.74	2.95	1.32578	2.155	2.08	0.65574	0.73	0.388	2.080	0.66	140.46	1.420	199.405		0.79	9	
52.822	9	Sand	283.321	2.583	2.97	1.33605	2.165	1.8	0.65379	0.72	0.388	1.800	0.65	185.23	1.107	204.989		0.76	10	
53.15	9	Sand	310.017	2.958	2.991	1.34628	2.175	1.79	0.65185	0.72	0.387	1.790	0.65	202.09	1.099	222.181		0.75	11	
53.478	9	Sand	332.364	3.187	3.011	1.35651	2.185	1.77	0.64993	0.72	0.386	1.770	0.65	216.01	1.085	234.448		0.74	12	
53.806	9	Sand	349.351	3.07	3.032	1.36675	2.195	1.73	0.64801	0.71	0.385	1.730	0.65	226.38	1.058	239.527		0.73	13	
54.134	10	Gravelly Sand to Sand	377.809	3.078	3.052	1.37698	2.206	1.68	0.64592	0.71	0.384	1.680	0.65	244.03	1.024	249.955		0.73	14	
54.462	10	Gravelly Sand to Sand	389.787	3.25	3.073	1.38721	2.217	1.68	0.64384	0.71	0.383	1.680	0.64	250.96	1.024	257.049		0.73	15	
54.79	9	Sand	363.853	3.547	3.094	1.39745	2.227	1.75	0.64196	0.71	0.382	1.750	0.64	233.58	1.072	250.303		0.73	16	
55.118	9	Sand	361.744	2.995	3.114	1.40768	2.237	1.7	0.64009	0.70	0.381	1.700	0.64	231.55	1.038	240.316		0.72	17	
55.446	10	Gravelly Sand to Sand	358.194	2.757	3.135	1.41792	2.248	1.69	0.63805	0.70	0.380	1.690	0.64	228.55	1.031	235.650		0.72	18	
55.774	10	Gravelly Sand to Sand	338.042	1.659	3.156	1.42815	2.258	1.59	0.63621	0.70	0.379	1.590	0.64	215.06	1.000	215.064		0.72	19	
56.102	10	Gravelly Sand to Sand	316.242	1.814	3.177	1.43838	2.269	1.65	0.63419	0.69	0.378	1.650	0.63	200.56	1.003	201.226		0.73	20	
56.43	10	Gravelly Sand to Sand	303.793	1.955	3.198	1.44862	2.28	1.7	0.63218	0.69	0.377	1.700	0.63	192.05	1.038	199.324		0.74	21	
56.759	9	Sand	251.248	1.984	3.218	1.45888	2.29	1.82	0.63037	0.69	0.377	1.820	0.63	158.38	1.122	177.625		0.76	22	
57.087	9	Sand	204.494	2.014	3.238	1.46911	2.3	1.96	0.62857	0.68	0.376	1.960	0.63	128.54	1.251	160.816		0.79	23	
57.415	8	Sand to Silty Sand	217.809	3.193	3.258	1.47935	2.309	2.05	0.62696	0.68	0.375	2.050	0.63	136.56	1.371	187.227		0.78	24	
57.743	8	Sand to Silty Sand	197.93	4.171	3.278	1.48958	2.319	2.19	0.62518	0.68	0.374	2.190	0.63	123.74	1.643	203.261		0.79	25	
58.071	7	Silty Sand to Sandy Silt	163.324	3.988	3.297	1.49982	2.328	2.3	0.62358	0.68	0.373	2.300	0.62	101.85	1.949	198.471		0.81	26	
58.399	8	Sand to Silty Sand	181.47	3.628	3.317	1.51005	2.338	2.21	0.62182	0.67	0.372	2.210	0.62	112.84	1.692	190.885		0.80	27	
58.727	8	Sand to Silty Sand	216.472	3.355	3.337	1.52028	2.347	2.07	0.62024	0.67	0.371	2.070	0.62	134.27	1.403	188.363		0.78	28	
59.055	9	Sand	246.182	3.407	3.357	1.53052	2.357	2	0.6185	0.67	0.371	2.000	0.62	152.26	1.300	197.942		0.76	29	
59.383	9	Sand	252.811	2.683	3.378	1.54075	2.368	1.91	0.61659	0.66	0.370	1.910	0.62	155.88	1.198	186.809		0.76	30	
59.711	9	Sand	241.144	1.939	3.398	1.55098	2.378	1.86	0.61487	0.66	0.369	1.860	0.61	148.27	1.153	171.008		0.76	31	
60.039	9	Sand	184.445	2.019	3.418	1.56122	2.388	2.03	0.61315	0.66	0.368	2.030	0.61	113.09	1.341	151.682	0.40	0.79	32	1.10
60.367	7	Silty Sand to Sandy Silt	76.351	1.688	3.438	1.57145	2.397	2.54	0.61162	0.66	0.367	2.540	0.61	46.70	2.979	139.112	0.33	0.84	33	0.90
60.696	6	Sandy Silt to Clayey Silt	29.051	0.748	3.457	1.58172	2.405	2.97	0.61026	0.65	0.366							0.84	34	
61.024	5	Clayey Silt to Silty Clay	31.339	1.02	3.475	1.59195	2.414	3	0.60874	0.65	0.366							0.84	35	
61.352	6	Sandy Silt to Clayey Silt	61.246	1.878	3.494	1.60218	2.423	2.72	0.60723	0.65	0.365							0.84	36	
61.68	7	Silty Sand to Sandy Silt	116.617	2.517	3.513	1.61242	2.432	2.39	0.60573	0.65	0.364	2.390	0.61	70.64	2.272	160.491		0.83	37	
62.008	8	Sand to Silty Sand	172.477	2.508	3.533	1.62265	2.441	2.14	0.60423	0.64	0.363	2.140	0.60	104.22	1.532	159.654	0.46	0.80	38	1.26

LIQUEFACTION POTENTIAL ANALYSIS (per Youd & Idriss, 2001)

PROJECT NAME ***Marina Blvd /Rte 880***
PROJECT NO. ***206139.MAR***
CPT NO. ***CPT-MR1***

FAULT INFO
COAST RANGE - SIERRAN BLOCK BOUNDARY ZONE (CSB)
a_{max} *(g)=* 0.6

FAULT M_w = 7.5
MSF = 1.00

			CPT RESULT INPUT							*CSR*		*$CRR_{7.5}$*						*F.S.=($CRR_{7.5}$/CSR)*MSF*K_σ*K_α*		
Depth (ft)		Soil Behavior Type	qc (tsf)	fs (tsf)	σ_v (tsf)	u (tsf)	σ_v' (tsf)	Ic*	C_N*	γ_d	CSR	Ic	C_Q	q_{c1N}	K_C	$(q_{c1N})_{cs}$	$CRR_{7.5}$	$K\sigma$	$K\alpha$	F.S.
62.336	8	Sand to Silty Sand	162.618	2.096	3.553	1.63288	2.451	2.13	0.60257	0.64	0.362	2.130	0.60	97.99	1.512	148.136	0.38	0.80	39	1.06
62.664	8	Sand to Silty Sand	129.414	2.245	3.573	1.64312	2.46	2.3	0.60109	0.64	0.362	2.300	0.60	77.79	1.949	151.592	0.40	0.82	40	1.12
62.992	7	Silty Sand to Sandy Silt	107.596	2.827	3.592	1.65335	2.47	2.48	0.59946	0.64	0.361	2.480	0.60	64.50	2.669	172.170		0.83	41	
63.32	6	Sandy Silt to Clayey Silt	91.7	2.914	3.611	1.66358	2.478	2.59	0.59815	0.63	0.360	2.590	0.60	54.85	3.266	179.144		0.83	42	
63.648	7	Silty Sand to Sandy Silt	112.492	2.777	3.63	1.67382	2.487	2.45	0.59669	0.63	0.359	2.450	0.60	67.12	2.528	169.701		0.83	43	
63.976	7	Silty Sand to Sandy Silt	76.662	1.712	3.65	1.68405	2.496	2.56	0.59524	0.63	0.359	2.560	0.60	45.63	3.091	141.029	0.34	0.83	44	0.95
64.304	6	Sandy Silt to Clayey Silt	31.828	0.764	3.669	1.69428	2.505	2.93	0.59379	0.63	0.358							0.83	45	
64.633	6	Sandy Silt to Clayey Silt	24.879	0.315	3.687	1.70455	2.513	2.91	0.59251	0.62	0.357							0.83	46	
64.961	6	Sandy Silt to Clayey Silt	24.841	0.313	3.706	1.71478	2.522	2.91	0.59108	0.62	0.357							0.83	47	
65.289	6	Sandy Silt to Clayey Silt	25.472	0.378	3.725	1.72502	2.531	2.93	0.58965	0.62	0.356							0.83	48	
65.617	6	Sandy Silt to Clayey Silt	26.847	0.488	3.744	1.73525	2.539	2.95	0.58839	0.62	0.355							0.83	49	
65.945	6	Sandy Silt to Clayey Silt	27.742	0.595	3.763	1.74548	2.548	2.98	0.58698	0.62	0.355							0.83	50	
66.273	6	Sandy Silt to Clayey Silt	28.156	0.698	3.781	1.75572	2.556	3.01	0.58573	0.61	0.354							0.83	51	
66.601	5	Clayey Silt to Silty Clay	27.826	0.834	3.8	1.76595	2.565	3.06	0.58433	0.61	0.353							0.83	52	
66.929	5	Clayey Silt to Silty Clay	26.838	0.899	3.819	1.77618	2.573	3.11	0.58309	0.61	0.353							0.83	53	
67.257	5	Clayey Silt to Silty Clay	26.753	0.858	3.838	1.78642	2.582	3.1	0.5817	0.61	0.352							0.83	54	
67.585	5	Clayey Silt to Silty Clay	30.124	1.007	3.857	1.79665	2.59	3.06	0.58047	0.61	0.352							0.83	55	
67.913	5	Clayey Silt to Silty Clay	33.57	1.113	3.875	1.80689	2.599	3.01	0.5791	0.60	0.351							0.83	56	
68.241	6	Sandy Silt to Clayey Silt	33.693	0.978	3.894	1.81712	2.608	2.98	0.57773	0.60	0.350							0.83	57	
68.57	6	Sandy Silt to Clayey Silt	31.282	0.843	3.913	1.82738	2.616	2.99	0.57652	0.60	0.350							0.83	58	
68.898	6	Sandy Silt to Clayey Silt	29.088	0.714	3.932	1.83762	2.625	3	0.57516	0.60	0.349							0.82	59	
69.226	6	Sandy Silt to Clayey Silt	35.52	0.661	3.95	1.84785	2.633	2.85	0.57396	0.60	0.349							0.82	60	
69.554	6	Sandy Silt to Clayey Silt	34.701	0.634	3.969	1.85808	2.642	2.86	0.57262	0.59	0.348							0.82	61	
69.882	6	Sandy Silt to Clayey Silt	38.043	0.852	3.988	1.86832	2.65	2.87	0.57143	0.59	0.348							0.82	62	
70.21	6	Sandy Silt to Clayey Silt	40.03	0.883	4.007	1.87855	2.659	2.84	0.5701	0.59	0.347							0.82	63	
70.538	6	Sandy Silt to Clayey Silt	33.476	0.706	4.026	1.88879	2.668	2.91	0.56877	0.59	0.347							0.82	64	
70.866	6	Sandy Silt to Clayey Silt	32.751	0.682	4.044	1.89902	2.676	2.92	0.5676	0.59	0.346							0.82	65	
71.194	6	Sandy Silt to Clayey Silt	35.152	0.963	4.063	1.90925	2.685	2.96	0.56628	0.59	0.346							0.82	66	
71.522	6	Sandy Silt to Clayey Silt	56.265	1.431	4.082	1.91949	2.693	2.74	0.56512	0.58	0.345							0.82	67	
71.85	6	Sandy Silt to Clayey Silt	47.149	1.19	4.101	1.92972	2.702	2.81	0.56381	0.58	0.345							0.82	68	
72.178	6	Sandy Silt to Clayey Silt	35.275	0.909	4.12	1.93995	2.71	2.94	0.56266	0.58	0.344							0.82	69	
72.507	5	Clayey Silt to Silty Clay	36.546	1.212	4.138	1.95022	2.719	2.99	0.56137	0.58	0.344							0.82	70	
72.835	6	Sandy Silt to Clayey Silt	46.17	1.338	4.157	1.96045	2.727	2.86	0.56022	0.58	0.343							0.82	71	
73.163	6	Sandy Silt to Clayey Silt	40.539	0.962	4.176	1.97069	2.736	2.87	0.55894	0.58	0.343							0.82	72	
73.491	5	Clayey Silt to Silty Clay	32.469	0.967	4.195	1.98092	2.745	3.02	0.55767	0.57	0.342							0.82	73	
73.819	6	Sandy Silt to Clayey Silt	49.598	1.612	4.214	1.99115	2.753	2.87	0.55654	0.57	0.342							0.82	74	
74.147	6	Sandy Silt to Clayey Silt	61.642	1.941	4.232	2.00139	2.762	2.78	0.55528	0.57	0.341							0.82	75	
74.475	6	Sandy Silt to Clayey Silt	60.926	1.977	4.251	2.01162	2.77	2.79	0.55416	0.57	0.341							0.82	76	
74.803	6	Sandy Silt to Clayey Silt	71.031	1.902	4.27	2.02185	2.779	2.68	0.5529	0.57	0.341							0.82	77	
75.131	6	Sandy Silt to Clayey Silt	44.051	1.284	4.289	2.03209	2.787	2.89	0.55179	0.57	0.340							0.81	78	
75.459	5	Clayey Silt to Silty Clay	27.6	0.821	4.308	2.04232	2.796	3.11	0.55055	0.57	0.340							0.81	79	
75.787	5	Clayey Silt to Silty Clay	24.85	0.636	4.326	2.05255	2.804	3.12	0.54945	0.56	0.340							0.81	80	
76.115	6	Sandy Silt to Clayey Silt	25.434	0.632	4.345	2.06279	2.813	3.11	0.54822	0.56	0.339							0.81	81	
76.444	6	Sandy Silt to Clayey Silt	26.904	0.681	4.364	2.07305	2.822	3.08	0.54699	0.56	0.339							0.81	82	
76.772	6	Sandy Silt to Clayey Silt	28.25	0.729	4.383	2.08329	2.83	3.07	0.54591	0.56	0.338							0.81	83	
77.1	6	Sandy Silt to Clayey Silt	28.862	0.716	4.402	2.09352	2.839	3.05	0.54469	0.56	0.338							0.81	84	
77.428	6	Sandy Silt to Clayey Silt	28.344	0.629	4.42	2.10375	2.847	3.03	0.54361	0.56	0.338							0.81	85	
77.756	6	Sandy Silt to Clayey Silt	29.069	0.652	4.439	2.11399	2.856	3.03	0.54241	0.56	0.337							0.81	86	
78.084	6	Sandy Silt to Clayey Silt	31.744	0.689	4.458	2.12422	2.864	2.98	0.54134	0.56	0.337							0.81	87	
78.412	6	Sandy Silt to Clayey Silt	32.883	0.645	4.477	2.13445	2.873	2.94	0.54014	0.55	0.337							0.81	88	
78.74	6	Sandy Silt to Clayey Silt	26.659	0.564	4.496	2.14469	2.882	3.06	0.53895	0.55	0.336							0.81	89	
79.068	6	Sandy Silt to Clayey Silt	24.182	0.432	4.514	2.15492	2.89	3.07	0.5379	0.55	0.336							0.81	90	
79.396	6	Sandy Silt to Clayey Silt	25.349	0.422	4.533	2.16516	2.899	3.03	0.53672	0.55	0.336							0.81	91	
79.724	6	Sandy Silt to Clayey Silt	27.214	0.492	4.552	2.17539	2.907	3.02	0.53567	0.55	0.335							0.81	92	
80.052	6	Sandy Silt to Clayey Silt	26.263	0.547	4.571	2.18562	2.916	3.07	0.5345	0.55	0.335							0.81	93	
80.381	6	Sandy Silt to Clayey Silt	24.71	0.543	4.59	2.19589	2.924	3.11	0.53346	0.55	0.335							0.81	94	
80.709	6	Sandy Silt to Clayey Silt	26.96	0.577	4.608	2.20612	2.933	3.06	0.5323	0.55	0.334							0.81	95	
81.037	5	Clayey Silt to Silty Clay	38.495	1.254	4.627	2.21635	2.941	3	0.53127	0.54	0.334							0.81	96	
81.365	6	Sandy Silt to Clayey Silt	70.653	1.929	4.646	2.22659	2.95	2.71	0.53012	0.54	0.334							0.81	97	
81.693	6	Sandy Silt to Clayey Silt	64.684	1.584	4.665	2.23682	2.959	2.72	0.52897	0.54	0.334							0.80	98	
82.021	6	Sandy Silt to Clayey Silt	43.373	1.167	4.684	2.24706	2.967	2.91	0.52796	0.54	0.333							0.80	99	
82.349	6	Sandy Silt to Clayey Silt	34.955	0.926	4.702	2.25729	2.976	3	0.52682	0.54	0.333							0.80	100	
82.677	6	Sandy Silt to Clayey Silt	30.228	0.678	4.721	2.26752	2.984	3.03	0.52581	0.54	0.333							0.80	101	
83.005	6	Sandy Silt to Clayey Silt	32.544	0.505	4.74	2.27776	2.993	2.91	0.52468	0.54	0.332							0.80	102	
83.333	7	Silty Sand to Sandy Silt	31.517	0.34	4.759	2.28799	3.002	2.85	0.52356	0.54	0.332							0.80	103	
83.661	6	Sandy Silt to Clayey Silt	26.64	0.342	4.778	2.29822	3.01	2.97	0.52257	0.54	0.332							0.80	104	
83.99	6	Sandy Silt to Clayey Silt	26.084	0.419	4.797	2.30849	3.019	3.03	0.52145	0.54	0.332							0.80	105	
84.318	6	Sandy Silt to Clayey Silt	26.188	0.388	4.816	2.31872	3.028	3.01	0.52034	0.53	0.331							0.80	106	
84.646	6	Sandy Silt to Clayey Silt	26.724	0.399	4.834	2.32896	3.036	3.01	0.51936	0.53	0.331							0.80	107	
84.974	6	Sandy Silt to Clayey Silt	26.122	0.412	4.853	2.33919	3.045	3.03	0.51826	0.53	0.331							0.80	108	
85.302	6	Sandy Silt to Clayey Silt	24.54	0.438	4.872	2.34942	3.053	3.09	0.51728	0.53	0.331							0.80	109	
85.63	6	Sandy Silt to Clayey Silt	24.267	0.562	4.891	2.35966	3.062	3.16	0.51619	0.53	0.331							0.80	110	
85.958	6	Sandy Silt to Clayey Silt	23.946	0.6	4.91	2.36989	3.07	3.19	0.51522	0.53	0.330							0.80	111	
86.286	6	Sandy Silt to Clayey Silt	23.862	0.598	4.928	2.38012	3.079	3.19	0.51414	0.53	0.330							0.80	112	
86.614	6	Sandy Silt to Clayey Silt	24.427	0.481	4.947	2.39036	3.088	3.12	0.51306	0.53	0.330							0.80	113	
86.942	6	Sandy Silt to Clayey Silt	22.233	0.452	4.966	2.40059	3.096	3.18	0.5121	0.53	0.330							0.80	114	
87.27	6	Sandy Silt to Clayey Silt	26.499	0.572	4.985	2.41082	3.105	3.1	0.51103	0.53	0.329							0.80	115	
87.598	6	Sandy Silt to Clayey Silt	36.358	0.707	5.004	2.42106	3.113	2.93	0.51009	0.53	0.329							0.80	116	
87.927	7	Silty Sand to Sandy Silt	47.667	0.873	5.023	2.43132	3.122	2.79	0.50902	0.52	0.329							0.80	117	
88.255	7	Silty Sand to Sandy Silt	37.478	0.591	5.042	2.44156	3.131	2.87	0.50797	0.52	0.329							0.80	118	
88.583	6	Sandy Silt to Clayey Silt	32.158	0.517	5.061	2.45179	3.14	2.95	0.50691	0.52	0.329							0.80	119	
88.911	7	Silty Sand to Sandy Silt	31.405	0.417	5.08	2.46202	3.149	2.92	0.50586	0.52	0.328							0.79	120	
89.239	6	Sandy Silt to Clayey Silt	27.61	0.496	5.099	2.47226	3.158	3.05	0.50482	0.52	0.328							0.79	121	
89.567	6	Sandy Silt to Clayey Silt	32.412	0.533	5.118	2.48249	3.166	2.95	0.50389	0.52	0.328							0.79	122	
89.895	6	Sandy Silt to Clayey Silt	33.081	0.536	5.137	2.49272	3.175	2.94	0.50286	0.52	0.328							0.79	123	
90.223	6	Sandy Silt to Clayey Silt	25.529	0.438	5.156	2.50296	3.183	3.09	0.50194	0.52	0.328							0.79	124	
90.551	6	Sandy Silt to Clayey Silt	27.337	0.401	5.174	2.51319	3.192	3.02	0.50091	0.52	0.327							0.79	125	
90.879	6	Sandy Silt to Clayey Silt	27.572	0.349	5.193	2.52342	3.2	2.98	0.5	0.52	0.327							0.79	126	
91.207	6	Sandy Silt to Clayey Silt	25.802	0.39	5.212	2.53366	3.209	3.06	0.49898	0.52	0.327							0.79	127	
91.535	6	Sandy Silt to Clayey Silt	26.319	0.504	5.231	2.54389	3.217	3.1	0.49808	0.52	0.327							0.79	128	
91.864	6	Sandy Silt to Clayey Silt	25.368	0.587	5.25	2.55416	3.226	3.16	0.49706	0.51	0.327							0.79	129	
92.192	6	Sandy Silt to Clayey Silt	24.549	0.612	5.268	2.56439	3.235	3.2	0.49605	0.51	0.327							0.79	130	
92.52	6	Sandy Silt to Clayey Silt	24.794	0.603	5.287	2.57462	3.243	3.19	0.49516	0.51	0.326							0.79	131	
92.848	6	Sandy Silt to Clayey Silt	25.783	0.609	5.306	2.58486	3.252	3.17	0.49416	0.51	0.326							0.79	132	
93.176	6	Sandy Silt to Clayey Silt	26.103	0.606	5.325	2.59509	3.26	3.16	0.49327	0.51	0.326							0.79	133	
93.504	6	Sandy Silt to Clayey Silt	26.772	0.663	5.344	2.60532	3.269	3.16	0.49228	0.51	0.326							0.79	134	

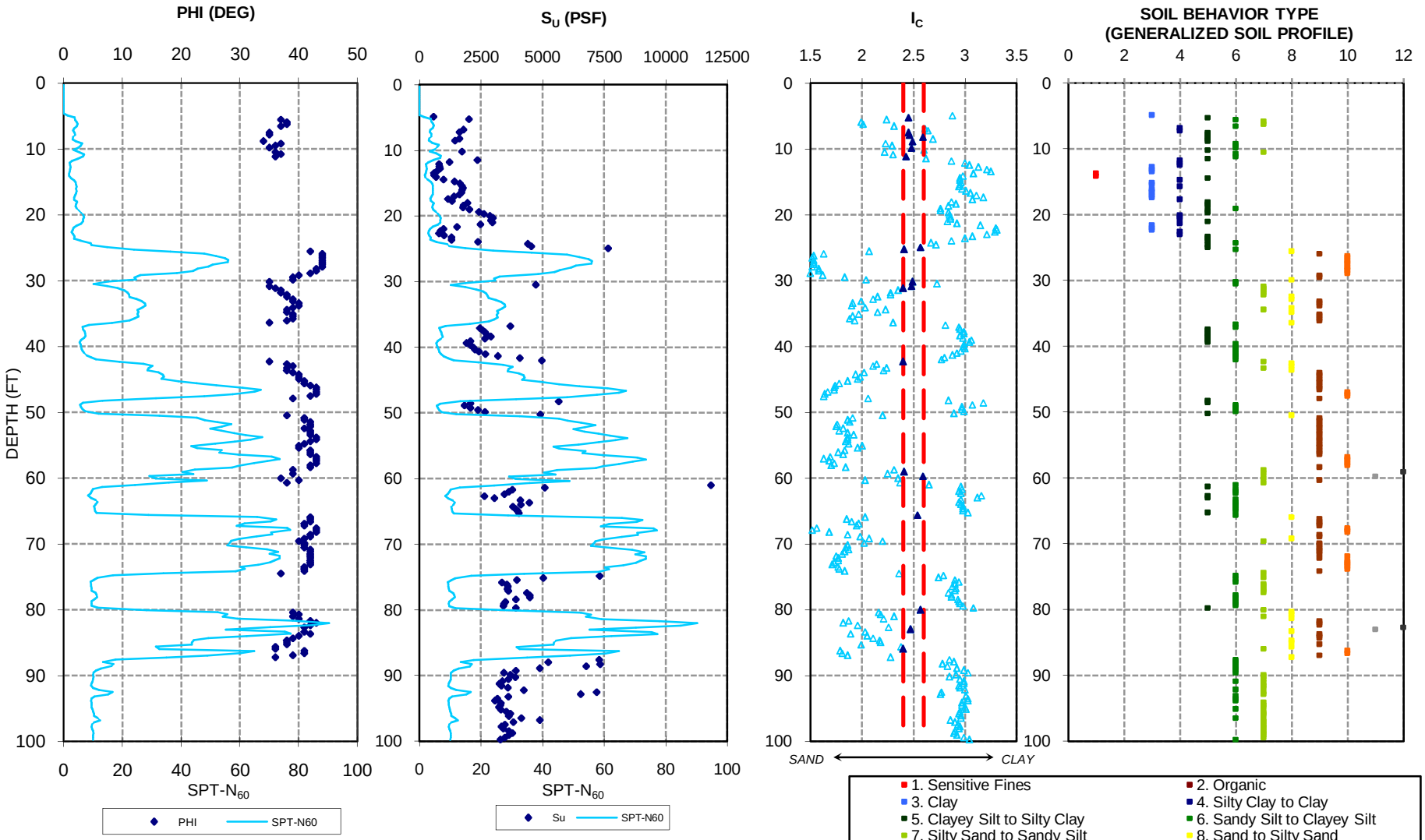
LIQUEFACTION POTENTIAL ANALYSIS (per Youd & Idriss, 2001)

PROJECT NAME	***Marina Blvd /Rte 880***	*FAULT INFO*	
PROJECT NO.	***206139.MAR***	*COAST RANGE - SIERRAN BLOCK BOUNDARY ZONE (CSB)*	
CPT NO.	***CPT-MR1***	a_{max} *(g)=* 0.6	*FAULT* M_w *=* 7.5
			MSF = 1.00

		CPT RESULT INPUT								*CSR*		*CRR 7.5*						*F.S.=(CRR 7.5/CSR)*MSF*Kσ*Kα*		
Depth (ft)		Soil Behavior Type	qc (tsf)	fs (tsf)	σ_v (tsf)	u (tsf)	σ_v' (tsf)	Ic*	C_N*	γ_d	CSR	Ic	C_Q	q_{c1N}	K_C	$(q_{c1N})_{cs}$	$CRR_{7.5}$	Kσ	Kα	F.S.
93.832	6	Sandy Silt to Clayey Silt	27.61	0.689	5.362	2.61556	3.277	3.15	0.4914	0.51	0.326							0.79	135	
94.16	6	Sandy Silt to Clayey Silt	25.265	0.517	5.381	2.62579	3.286	3.15	0.49041	0.51	0.326							0.79	136	
94.488	6	Sandy Silt to Clayey Silt	24.474	0.402	5.4	2.63603	3.295	3.12	0.48943	0.51	0.325							0.79	137	
94.816	6	Sandy Silt to Clayey Silt	29.399	0.633	5.419	2.64626	3.303	3.08	0.48856	0.51	0.325							0.79	138	
95.144	6	Sandy Silt to Clayey Silt	48.486	1.177	5.438	2.65649	3.312	2.88	0.48759	0.51	0.325							0.79	139	
95.472	6	Sandy Silt to Clayey Silt	58.016	1.376	5.456	2.66673	3.32	2.8	0.48673	0.51	0.325							0.79	140	
95.801	5	Clayey Silt to Silty Clay	33.664	1.009	5.475	2.67699	3.329	3.1	0.48576	0.51	0.325							0.79	141	
96.129	6	Sandy Silt to Clayey Silt	29.239	0.791	5.494	2.68722	3.337	3.15	0.4849	0.51	0.325							0.79	142	

CPT DATA CORRELATION

CPT-DV1



Reference: CPT data and correlation provided by Gregg Drilling and Testing, Inc.

PARIKH

Practicing in the Geosciences

DAVIS STREET OC (RTE 112-880 SEP)
ALAMEDA COUNTY, CALIFORNIA

JOB NO.: 206139.10

PLATE NO.:

LIQUEFACTION POTENTIAL ANALYSIS (per Youd & Idriss, 2001)

PROJECT NAME	***Davis Street/Rte 880***	*FAULT INFO*	
PROJECT NO.	***206139.DAV***	*COAST RANGE - SIERRAN BLOCK BOUNDARY ZONE (CSB)*	
CPT NO.	***CPT-DV1***	*a_{max} (g)=* 0.6	*FAULT M_w =* 7.5
			MSF = 1.00

		CPT RESULT INPUT							*CSR*		*$CRR_{7.5}$*						*F.S.=($CRR_{7.5}$/CSR)*MSF*K_σ*K_α*		
Depth (ft)		Soil Behavior Type	qc (tsf)	fs (tsf)	σ_v (tsf)	u (tsf)	σ_v' (tsf)	Ic*	C_N*	γ_d	CSR	Ic	C_Q	q_{c1N}	K_C	$(q_{c1N})_{cs}$	$CRR_{7.5}$	Kσ	Kα	F.S.
0.328									1.7	1.00									1	
0.656									1.7	1.00									1	
0.984									1.7	1.00									1	
1.312									1.7	1.00									1	
1.64									1.7	1.00									1	
1.969									1.7	1.00									1	
2.297									1.7	1.00									1	
2.625									1.7	1.00									1	
2.953									1.7	1.00									1	
3.281									1.7	0.99									1	
3.609									1.7	0.99									1	
3.937									1.7	0.99									1	
4.265									1.7	0.99									1	
4.593									1.7	0.99									1	
4.921	3	Clay	4.69	0.162	0.274		0.274	2.88	1.49254	0.99	0.386							1.00	1	
5.249	5	Clayey Silt to Silty Clay	15.368	0.465	0.293		0.293	2.45	1.47354	0.99	0.386	2.450	1.47	22.65	2.528	57.252	0.10	1.00	1	
5.577	6	Sandy Silt to Clayey Silt	18.09	0.292	0.312		0.312	2.24	1.45503	0.99	0.386	2.240	1.46	26.32	1.770	46.602	0.09	1.00	1	
5.906	7	Silty Sand to Sandy Silt	22.44	0.172	0.331		0.331	1.99	1.43697	0.99	0.385	1.990	1.44	32.25	1.287	41.505	0.08	1.00	1	
6.234	7	Silty Sand to Sandy Silt	23.956	0.202	0.35		0.35	2.01	1.41935	0.99	0.385	2.010	1.42	34.00	1.313	44.654	0.09	1.00	1	
6.562	6	Sandy Silt to Clayey Silt	19.512	0.369	0.369		0.369	2.31	1.40217	0.99	0.385	2.310	1.40	27.36	1.981	54.205	0.09	1.00	1	
6.89	4	Silty Clay to Clay	13.673	0.444	0.388		0.388	2.61	1.38539	0.99	0.385							1.00	1	
7.218	4	Silty Clay to Clay	12.496	0.389	0.407		0.407	2.64	1.36901	0.99	0.384							1.00	1	
7.546	5	Clayey Silt to Silty Clay	16.178	0.332	0.426		0.426	2.45	1.35301	0.98	0.384	2.450	1.35	21.89	2.528	55.340	0.10	1.00	1	
7.874	5	Clayey Silt to Silty Clay	16.14	0.321	0.444		0.444	2.46	1.3382	0.98	0.384	2.460	1.34	21.60	2.574	55.600	0.10	1.00	1	
8.202	5	Clayey Silt to Silty Clay	12.562	0.281	0.463		0.463	2.59	1.32291	0.98	0.383	2.590	1.32	16.62	3.266	54.276	0.09	1.00	1	
8.53	5	Clayey Silt to Silty Clay	11.244	0.293	0.482		0.482	2.69	1.30797	0.98	0.383							1.00	1	
8.858	5	Clayey Silt to Silty Clay	17.336	0.365	0.501		0.501	2.49	1.29336	0.98	0.383	2.490	1.29	22.42	2.718	60.951	0.10	1.00	1	
9.186	6	Sandy Silt to Clayey Silt	29.456	0.448	0.52		0.52	2.23	1.27907	0.98	0.383	2.230	1.28	37.68	1.743	65.687	0.11	1.00	1	
9.514	6	Sandy Silt to Clayey Silt	26.226	0.413	0.538		0.538	2.29	1.26582	0.98	0.382	2.290	1.27	33.20	1.917	63.641	0.10	1.00	1	
9.843	6	Sandy Silt to Clayey Silt	20.208	0.432	0.557		0.557	2.48	1.25213	0.98	0.382	2.480	1.25	25.30	2.669	67.543	0.11	1.00	1	
10.171	5	Clayey Silt to Silty Clay	13.4	0.244	0.576	0.00534	0.576	2.6	1.23874	0.98	0.382							1.00	1	
10.499	7	Silty Sand to Sandy Silt	25.717	0.264	0.595	0.01557	0.595	2.22	1.22563	0.98	0.381	2.220	1.23	31.52	1.717	54.125	0.09	1.00	1	0.25
10.827	6	Sandy Silt to Clayey Silt	31.264	0.534	0.614	0.0258	0.614	2.3	1.21279	0.98	0.381	2.300	1.21	37.92	1.949	73.889	0.12	1.00	1	0.31
11.155	6	Sandy Silt to Clayey Silt	28.439	0.674	0.633	0.03604	0.633	2.43	1.20022	0.98	0.381	2.430	1.20	34.13	2.439	83.251	0.13	1.00	1	0.35
11.483	5	Clayey Silt to Silty Clay	18.316	0.477	0.652	0.04627	0.652	2.62	1.1879	0.98	0.381							1.00	1	
11.811	4	Silty Clay to Clay	9.859	0.263	0.67	0.0565	0.67	2.87	1.17647	0.98	0.380							1.00	1	
12.139	4	Silty Clay to Clay	6.714	0.148	0.689	0.06674	0.689	3	1.16464	0.97	0.380							1.00	1	
12.467	4	Silty Clay to Clay	6.95	0.186	0.708	0.07697	0.708	3.04	1.15304	0.97	0.380							1.00	1	
12.795	3	Clay	6.968	0.26	0.726	0.0872	0.726	3.13	1.14226	0.97	0.380							1.00	1	
13.123	3	Clay	6.253	0.255	0.745	0.09744	0.745	3.21	1.13111	0.97	0.379							1.00	1	
13.451	3	Clay	5.206	0.173	0.763	0.10767	0.763	3.25	1.12073	0.97	0.379							1.00	1	
13.78	1	Sensitive Fines	5.291	0.081	0.781	0.11794	0.781	3.08	1.11055	0.97	0.379							1.00	1	
14.108	1	Sensitive Fines	5.942	0.067	0.799	0.12817	0.799	2.98	1.10055	0.97	0.378							1.00	1	
14.436	5	Clayey Silt to Silty Clay	8.155	0.156	0.818	0.1384	0.818	2.95	1.09019	0.97	0.378							1.00	1	
14.764	4	Silty Clay to Clay	11.517	0.369	0.837	0.14864	0.837	2.95	1.08002	0.97	0.378							1.00	1	
15.092	3	Clay	13.071	0.515	0.855	0.15887	0.855	2.96	1.07056	0.97	0.378							1.00	1	
15.42	3	Clay	13.777	0.559	0.874	0.1691	0.874	2.95	1.06075	0.97	0.377							1.00	1	
15.748	4	Silty Clay to Clay	14.107	0.549	0.892	0.17934	0.892	2.94	1.05163	0.97	0.377							1.00	1	
16.076	3	Clay	13.767	0.565	0.911	0.18957	0.911	2.97	1.04216	0.97	0.377							1.00	1	
16.404	3	Clay	13.579	0.601	0.929	0.1998	0.929	3.01	1.03335	0.97	0.377							1.00	1	
16.732	3	Clay	13.052	0.613	0.947	0.21004	0.947	3.05	1.02469	0.96	0.376							1.00	1	
17.06	3	Clay	11.47	0.553	0.965	0.22027	0.965	3.11	1.01617	0.96	0.376							1.00	1	
17.388	3	Clay	9.624	0.456	0.984	0.23051	0.984	3.18	1.00733	0.96	0.376							1.00	1	
17.717	4	Silty Clay to Clay	10.886	0.395	1.003	0.24077	1.003	3.07	0.99864	0.96	0.375							1.00	1	
18.045	5	Clayey Silt to Silty Clay	15.586	0.442	1.021	0.251	1.021	2.87	0.99054	0.96	0.375							1.00	1	
18.373	5	Clayey Silt to Silty Clay	14.268	0.405	1.04	0.26124	1.04	2.91	0.98214	0.96	0.375							0.99	1	
18.701	5	Clayey Silt to Silty Clay	14.267	0.286	1.059	0.27147	1.059	2.84	0.97388	0.96	0.374							0.99	1	
19.029	6	Sandy Silt to Clayey Silt	16.329	0.295	1.078	0.2817	1.078	2.76	0.96576	0.96	0.374							0.99	1	
19.357	5	Clayey Silt to Silty Clay	19.229	0.435	1.096	0.29194	1.096	2.76	0.95819	0.96	0.374							0.98	1	
19.685	5	Clayey Silt to Silty Clay	20.727	0.683	1.115	0.30217	1.115	2.84	0.95032	0.96	0.374							0.98	1	
20.013	4	Silty Clay to Clay	22.516	0.871	1.134	0.31241	1.134	2.85	0.94259	0.96	0.373							0.98	1	
20.341	4	Silty Clay to Clay	23.372	0.935	1.153	0.32264	1.153	2.86	0.93498	0.96	0.373							0.97	1	
20.669	4	Silty Clay to Clay	22.789	0.889	1.172	0.33287	1.172	2.86	0.92749	0.96	0.373							0.97	1	
20.997	5	Clayey Silt to Silty Clay	23.344	0.806	1.19	0.34311	1.19	2.83	0.9205	0.95	0.372							0.97	1	
21.325	4	Silty Clay to Clay	19.681	0.744	1.209	0.35334	1.209	2.92	0.91324	0.95	0.372							0.96	1	
21.654	3	Clay	12.543	0.557	1.228	0.3636	1.228	3.15	0.9061	0.95	0.371							0.96	1	
21.982	3	Clay	8.522	0.353	1.246	0.37384	1.246	3.3	0.89943	0.95	0.371							0.96	1	
22.31	3	Clay	7.722	0.268	1.264	0.38407	1.264	3.31	0.89286	0.95	0.371							0.95	1	
22.638	4	Silty Clay to Clay	7.242	0.194	1.283	0.39431	1.283	3.29	0.88602	0.95	0.370							0.95	1	
22.966	4	Silty Clay to Clay	8.758	0.233	1.302	0.40454	1.302	3.21	0.8793	0.95	0.370							0.95	1	
23.294	5	Clayey Silt to Silty Clay	11.008	0.245	1.32	0.41477	1.32	3.07	0.87302	0.95	0.370							0.95	1	
23.622	5	Clayey Silt to Silty Clay	10.989	0.179	1.339	0.42501	1.339	3	0.86648	0.95	0.369							0.94	1	
23.95	5	Clayey Silt to Silty Clay	19.201	0.485	1.358	0.43524	1.358	2.87	0.86005	0.95	0.369							0.94	1	
24.278	6	Sandy Silt to Clayey Silt	34.23	0.922	1.377	0.44547	1.377	2.67	0.85371	0.94	0.368							0.94	1	
24.606	5	Clayey Silt to Silty Clay	35.398	1.137	1.396	0.45571	1.396	2.72	0.84746	0.94	0.368							0.94	1	
24.934	5	Clayey Silt to Silty Clay	58.704	2.071	1.414	0.46594	1.414	2.57	0.84162	0.94	0.367	2.570	0.84	49.41	3.148	155.530	0.43	0.93	1	1.17
25.262	6	Sandy Silt to Clayey Silt	102.84	3.745	1.433	0.47617	1.433	2.41	0.83555	0.94	0.367	2.410	0.84	85.93	2.354	202.244		0.93	1	
25.591	8	Sand to Silty Sand	179.625	3.769	1.453	0.48644	1.453	2.07	0.82925	0.94	0.366	2.070	0.83	148.95	1.403	208.971		0.89	1	
25.919	9	Sand	277.399	2.157	1.473	0.49667	1.473	1.63	0.82305	0.94	0.366	1.630	0.82	228.31	1.000	228.312		0.86	1	
26.247	10	Gravelly Sand to Sand	312.278	1.908	1.494	0.50691	1.494	1.53	0.81663	0.94	0.366	1.530	0.82	255.02	1.000	255.015		0.85	1	
26.575	10	Gravelly Sand to Sand	330.066	2.068	1.515	0.51714	1.515	1.52	0.81031	0.94	0.365	1.520	0.81	267.46	1.000	267.457		0.85	1	
26.903	10	Gravelly Sand to Sand	336.837	2.177	1.536	0.52737	1.536	1.53	0.80409	0.93	0.365	1.530	0.80	270.85	1.000	270.848		0.84	1	
27.231	10	Gravelly Sand to Sand	335.076	2.132	1.557	0.53761	1.55	1.53	0.8	0.93	0.366	1.530	0.80	268.06	1.000	268.061		0.84	1	
27.559	10	Gravelly Sand to Sand	305.3	1.703	1.578	0.54784	1.561	1.53	0.79681	0.93	0.367	1.530	0.80	243.27	1.000	243.267		0.84	1	
27.887	10	Gravelly Sand to Sand	295.865	1.537	1.599	0.55807	1.571	1.52	0.79394	0.93	0.369	1.520	0.79	234.90	1.000	234.898		0.83	1	
28.215	10	Gravelly Sand to Sand	270.119	1.53	1.62	0.56831	1.582	1.58	0.7908	0.93	0.371	1.580	0.79	213.61	1.000	213.610		0.84	1	
28.543	10	Gravelly Sand to Sand	259.478	1.379	1.641	0.57854	1.593	1.58	0.78768	0.93	0.373	1.580	0.79	204.39	1.000	204.387		0.84	1	
28.871	10	Gravelly Sand to Sand	233.168	0.759	1.661	0.58878	1.603	1.5	0.78487	0.93	0.374	1.500	0.78	183.01	1.000	183.007		0.85	1	
29.199	9	Sand	151.967	0.372	1.682	0.59901	1.613	1.62	0.78208	0.92	0.376	1.620	0.78	118.85	1.000	118.851	0.24	0.87	1	0.63
29.528	9	Sand	131.09	0.691	1.702	0.60927	1.624	1.83	0.77904	0.92	0.377	1.830	0.78	102.12	1.129	115.316	0.22	0.88	1	0.59
29.856	8	Sand to Silty Sand	123.246	1.344	1.722	0.61951	1.633	2.04	0.77656	0.92	0.379	2.040	0.78	95.71	1.356	129.769	0.28	0.88	1	0.75
30.184	6	Sandy Silt to Clayey Silt	62.452	1.461	1.741	0.62974	1.642	2.49	0.7741	0.92	0.380	2.490	0.77	48.34	2.718	131.418	0.29	0.91	1	0.77
30.512	6	Sandy Silt to Clayey Silt	37.375	1.073	1.76	0.63997	1.65	2.73	0.77193	0.92	0.382							0.90	1	

LIQUEFACTION POTENTIAL ANALYSIS (per Youd & Idriss, 2001)

PROJECT NAME ***Davis Street/Rte 880***
PROJECT NO. ***206139.DAV***
CPT NO. ***CPT-DV1***

FAULT INFO
COAST RANGE - SIERRAN BLOCK BOUNDARY ZONE (CSB)
a_{max} (g)= 0.6

FAULT M_w = 7.5
MSF = 1.00

			CPT RESULT INPUT							*CSR*		*$CRR_{7.5}$*						*F.S.=($CRR_{7.5}$/CSR)*MSF*Kσ*Kα*		
Depth (ft)		Soil Behavior Type	qc (tsf)	fs (tsf)	σ_v (tsf)	u (tsf)	σ_v' (tsf)	Ic*	C_N*	γ_d	CSR	Ic	C_Q	q_{c1N}	K_C	$(q_{c1N})_{cs}$	$CRR_{7.5}$	Kσ	Kα	F.S.
30.84	7	Silty Sand to Sandy Silt	61.444	1.353	1.779	0.65021	1.659	2.48	0.7695	0.92	0.383	2.480	0.77	47.28	2.669	126.210	0.27	0.90	1	0.70
31.168	7	Silty Sand to Sandy Silt	78.893	1.795	1.798	0.66044	1.668	2.4	0.76709	0.91	0.384	2.400	0.77	60.52	2.312	139.939	0.33	0.90	1	0.87
31.496	7	Silty Sand to Sandy Silt	91.088	2.007	1.818	0.67068	1.677	2.35	0.76469	0.91	0.386	2.350	0.76	69.65	2.120	147.641	0.38	0.90	1	0.98
31.824	7	Silty Sand to Sandy Silt	98.207	1.872	1.837	0.68091	1.687	2.28	0.76204	0.91	0.387	2.280	0.76	74.84	1.886	141.156	0.34	0.89	1	0.88
32.152	7	Silty Sand to Sandy Silt	100.618	1.922	1.856	0.69114	1.696	2.28	0.75967	0.91	0.388	2.280	0.76	76.44	1.886	144.172	0.36	0.89	1	0.92
32.48	8	Sand to Silty Sand	107.135	1.414	1.876	0.70138	1.705	2.15	0.75731	0.91	0.389	2.150	0.76	81.13	1.553	125.986	0.27	0.88	1	0.68
32.808	8	Sand to Silty Sand	120.619	1.581	1.896	0.71161	1.715	2.11	0.75472	0.90	0.390	2.110	0.75	91.03	1.473	134.107	0.30	0.88	1	0.78
33.136	9	Sand	134.951	1.302	1.916	0.72184	1.725	1.99	0.75214	0.90	0.391	1.990	0.75	101.50	1.287	130.648	0.29	0.87	1	0.73
33.465	9	Sand	145.583	1.101	1.937	0.73211	1.735	1.91	0.74957	0.90	0.392	1.910	0.75	109.13	1.198	130.776	0.29	0.86	1	0.73
33.793	9	Sand	147.146	1.106	1.957	0.74234	1.745	1.9	0.74703	0.90	0.393	1.900	0.75	109.92	1.189	130.680	0.29	0.86	1	0.73
34.121	8	Sand to Silty Sand	135.065	1.46	1.977	0.75258	1.755	2.03	0.7445	0.90	0.394	2.030	0.74	100.56	1.341	134.867	0.31	0.87	1	0.78
34.449	7	Silty Sand to Sandy Silt	116.9	2.14	1.996	0.76281	1.764	2.23	0.74224	0.89	0.395	2.230	0.74	86.77	1.743	151.277	0.40	0.88	1	1.02
34.777	8	Sand to Silty Sand	122.267	1.794	2.016	0.77304	1.774	2.15	0.73974	0.89	0.395	2.150	0.74	90.45	1.553	140.444	0.34	0.87	1	0.85
35.105	9	Sand	129.019	1.03	2.036	0.78328	1.784	1.97	0.73727	0.89	0.396	1.970	0.74	95.12	1.263	120.112	0.24	0.87	1	0.61
35.433	9	Sand	133.831	0.846	2.057	0.79351	1.794	1.91	0.7348	0.89	0.397	1.910	0.73	98.34	1.198	117.851	0.23	0.86	1	0.59
35.761	9	Sand	128.934	0.677	2.077	0.80374	1.804	1.88	0.73236	0.89	0.397	1.880	0.73	94.43	1.171	110.532	0.21	0.86	1	0.52
36.089	9	Sand	117.258	0.647	2.097	0.81398	1.814	1.93	0.72993	0.88	0.398	1.930	0.73	85.59	1.218	104.288	0.19	0.87	1	0.47
36.417	8	Sand to Silty Sand	73.969	0.917	2.117	0.82421	1.824	2.3	0.72751	0.88	0.398	2.300	0.73	53.81	1.949	104.868	0.19	0.89	1	0.47
36.745	6	Sandy Silt to Clayey Silt	30.068	0.711	2.136	0.83444	1.832	2.81	0.72559	0.88	0.399							0.89	1	
37.073	6	Sandy Silt to Clayey Silt	20.811	0.443	2.155	0.84468	1.841	2.94	0.72345	0.88	0.400							0.89	1	
37.402	5	Clayey Silt to Silty Clay	21.612	0.511	2.174	0.85494	1.849	2.95	0.72155	0.87	0.400							0.88	1	
37.73	5	Clayey Silt to Silty Clay	22.393	0.651	2.192	0.86518	1.858	2.99	0.71942	0.87	0.400							0.88	1	
38.058	5	Clayey Silt to Silty Clay	22.874	0.679	2.211	0.87541	1.866	2.99	0.71755	0.87	0.401							0.88	1	
38.386	5	Clayey Silt to Silty Clay	24.211	0.683	2.23	0.88564	1.875	2.95	0.71545	0.86	0.401							0.88	1	
38.714	5	Clayey Silt to Silty Clay	22.328	0.602	2.249	0.89588	1.884	2.98	0.71336	0.86	0.401							0.88	1	
39.042	5	Clayey Silt to Silty Clay	18.033	0.449	2.268	0.90611	1.892	3.06	0.71151	0.86	0.402							0.88	1	
39.37	5	Clayey Silt to Silty Clay	16.668	0.329	2.286	0.91634	1.901	3.04	0.70945	0.86	0.402							0.88	1	
39.698	6	Sandy Silt to Clayey Silt	18.052	0.336	2.305	0.92658	1.909	2.99	0.70762	0.85	0.402							0.88	1	
40.026	6	Sandy Silt to Clayey Silt	18.918	0.379	2.324	0.93681	1.918	2.99	0.70558	0.85	0.402							0.88	1	
40.354	6	Sandy Silt to Clayey Silt	19.408	0.421	2.343	0.94704	1.926	3	0.70377	0.85	0.402							0.88	1	
40.682	6	Sandy Silt to Clayey Silt	20.604	0.43	2.362	0.95728	1.935	2.96	0.70175	0.84	0.402							0.88	1	
41.011	6	Sandy Silt to Clayey Silt	22.591	0.464	2.38	0.96754	1.944	2.92	0.69975	0.84	0.402							0.88	1	
41.339	6	Sandy Silt to Clayey Silt	26.433	0.598	2.399	0.97778	1.952	2.88	0.69797	0.84	0.402							0.87	1	
41.667	6	Sandy Silt to Clayey Silt	33.175	0.776	2.418	0.98801	1.961	2.8	0.69598	0.84	0.402							0.87	1	
41.995	6	Sandy Silt to Clayey Silt	39.711	1.101	2.437	0.99824	1.969	2.77	0.69423	0.83	0.402							0.87	1	
42.323	7	Silty Sand to Sandy Silt	81.907	1.549	2.456	1.00848	1.978	2.4	0.69226	0.83	0.402	2.400	0.69	56.70	2.312	131.113	0.29	0.87	1	0.72
42.651	8	Sand to Silty Sand	130.507	1.74	2.476	1.01871	1.988	2.14	0.69009	0.83	0.402	2.140	0.69	90.06	1.532	137.970	0.32	0.85	1	0.81
42.979	8	Sand to Silty Sand	147.165	1.994	2.496	1.02894	1.997	2.11	0.68815	0.82	0.401	2.110	0.69	101.27	1.473	149.189	0.39	0.84	1	0.97
43.307	7	Silty Sand to Sandy Silt	133.492	2.554	2.515	1.03918	2.007	2.24	0.686	0.82	0.401	2.240	0.69	91.58	1.770	162.133		0.85	1	
43.635	8	Sand to Silty Sand	133.68	2.272	2.535	1.04941	2.016	2.21	0.68408	0.82	0.401	2.210	0.68	91.45	1.692	154.695	0.42	0.85	1	1.06
43.963	9	Sand	162.721	1.781	2.555	1.05965	2.026	2.02	0.68196	0.81	0.400	2.020	0.68	110.97	1.327	147.257	0.38	0.83	1	0.94
44.291	9	Sand	175.764	1.571	2.576	1.06988	2.036	1.94	0.67985	0.81	0.400	1.940	0.68	119.49	1.229	146.856	0.37	0.82	1	0.94
44.619	9	Sand	174.794	1.765	2.596	1.08011	2.047	1.98	0.67755	0.81	0.399	1.980	0.68	118.43	1.275	150.969	0.40	0.82	1	1.00
44.948	9	Sand	172.195	1.587	2.616	1.09038	2.057	1.96	0.67547	0.80	0.399	1.960	0.68	116.31	1.251	145.519	0.37	0.82	1	0.92
45.276	9	Sand	209.381	1.72	2.637	1.10061	2.067	1.86	0.6734	0.80	0.398	1.860	0.67	141.00	1.153	162.618		0.80	1	
45.604	9	Sand	249.487	1.91	2.657	1.11084	2.077	1.78	0.67135	0.80	0.398	1.780	0.67	167.49	1.092	182.959		0.78	1	
45.932	9	Sand	290.506	2.253	2.678	1.12108	2.087	1.74	0.6693	0.79	0.397	1.740	0.67	194.44	1.065	207.038		0.76	1	
46.26	9	Sand	342.289	3.133	2.698	1.13131	2.097	1.73	0.66727	0.79	0.397	1.730	0.67	228.40	1.058	241.661		0.74	1	
46.588	9	Sand	377.376	3.74	2.718	1.14155	2.107	1.73	0.66526	0.79	0.396	1.730	0.67	251.05	1.058	265.627		0.74	1	
46.916	10	Gravelly Sand to Sand	370.624	3.015	2.739	1.15178	2.118	1.67	0.66305	0.78	0.396	1.670	0.66	245.74	1.017	250.012		0.74	1	
47.244	10	Gravelly Sand to Sand	333.654	2.089	2.76	1.16201	2.129	1.64	0.66086	0.78	0.395	1.640	0.66	220.50	1.000	220.498		0.74	1	
47.572	10	Gravelly Sand to Sand	278.792	1.292	2.781	1.17225	2.139	1.63	0.65888	0.78	0.394	1.630	0.66	183.69	1.000	183.690		0.76	1	
47.9	9	Sand	155.668	1.752	2.801	1.18248	2.149	2.06	0.65691	0.77	0.394	2.060	0.66	102.26	1.387	141.807	0.35	0.82	1	0.88
48.228	5	Clayey Silt to Silty Clay	45.464	1.734	2.82	1.19271	2.158	2.84	0.65515	0.77	0.393							0.86	1	
48.556	5	Clayey Silt to Silty Clay	18.636	0.621	2.839	1.20295	2.167	3.18	0.6534	0.77	0.392							0.86	1	
48.885	6	Sandy Silt to Clayey Silt	16.658	0.264	2.858	1.21321	2.175	3.07	0.65185	0.76	0.392							0.86	1	
49.213	6	Sandy Silt to Clayey Silt	18.645	0.244	2.876	1.22345	2.184	2.97	0.65012	0.76	0.391							0.86	1	
49.541	6	Sandy Silt to Clayey Silt	20.877	0.339	2.895	1.23368	2.192	2.97	0.64858	0.76	0.390							0.85	1	
49.869	6	Sandy Silt to Clayey Silt	23.071	0.506	2.914	1.24391	2.201	2.99	0.64687	0.75	0.389							0.85	1	
50.197	5	Clayey Silt to Silty Clay	39.824	1.468	2.933	1.25415	2.209	2.89	0.64535	0.75	0.389							0.85	2	
50.525	8	Sand to Silty Sand	153.098	2.648	2.953	1.26438	2.219	2.2	0.64346	0.75	0.388	2.200	0.64	98.51	1.667	164.198		0.82	3	
50.853	9	Sand	238.423	2.523	2.973	1.27461	2.229	1.91	0.64159	0.74	0.387	1.910	0.64	152.97	1.198	183.319		0.77	4	
51.181	9	Sand	257.266	2.491	2.993	1.28485	2.239	1.86	0.63972	0.74	0.386	1.860	0.64	164.58	1.153	189.816		0.76	5	
51.509	9	Sand	279.489	3.099	3.014	1.29508	2.249	1.88	0.63787	0.74	0.385	1.880	0.64	178.28	1.171	208.686		0.75	6	
51.837	9	Sand	317.043	2.686	3.034	1.30531	2.259	1.76	0.63602	0.73	0.385	1.760	0.64	201.65	1.078	217.463		0.74	7	
52.165	9	Sand	299.226	2.315	3.055	1.31555	2.27	1.75	0.63401	0.73	0.384	1.750	0.63	189.71	1.072	203.294		0.74	8	
52.493	9	Sand	271.588	2.385	3.075	1.32578	2.28	1.82	0.63218	0.73	0.383	1.820	0.63	171.69	1.122	192.556		0.75	9	
52.822	9	Sand	295.61	2.451	3.095	1.33605	2.29	1.78	0.63037	0.72	0.382	1.780	0.63	186.34	1.092	203.552		0.74	10	
53.15	9	Sand	311.412	3.589	3.116	1.34628	2.3	1.86	0.62857	0.72	0.381	1.860	0.63	195.74	1.153	225.761		0.74	11	
53.478	9	Sand	324.633	4.682	3.136	1.35651	2.31	1.92	0.62678	0.72	0.380	1.920	0.63	203.47	1.208	245.852		0.73	12	
53.806	9	Sand	362.225	4.848	3.156	1.36675	2.32	1.86	0.625	0.71	0.379	1.860	0.63	226.39	1.153	261.106		0.72	13	
54.134	9	Sand	341.545	4.222	3.177	1.37698	2.33	1.86	0.62323	0.71	0.378	1.860	0.62	212.86	1.153	245.502		0.73	14	
54.462	9	Sand	314.971	3.331	3.197	1.38721	2.34	1.84	0.62147	0.71	0.377	1.840	0.62	195.74	1.137	222.568		0.73	15	
54.79	9	Sand	275.025	2.804	3.217	1.39745	2.351	1.87	0.61954	0.71	0.376	1.870	0.62	170.39	1.162	197.965		0.75	16	
55.118	9	Sand	221.115	2.712	3.238	1.40768	2.361	2	0.6178	0.70	0.376	2.000	0.62	136.61	1.300	177.587		0.77	17	
55.446	9	Sand	234.524	2.715	3.258	1.41792	2.371	1.96	0.61607	0.70	0.375	1.960	0.62	144.48	1.251	180.764		0.77	18	
55.774	9	Sand	291.797	2.743	3.279	1.42815	2.381	1.83	0.61435	0.70	0.374	1.830	0.61	179.27	1.129	202.424		0.74	19	
56.102	9	Sand	293.124	2.209	3.299	1.43838	2.391	1.77	0.61264	0.69	0.373	1.770	0.61	179.58	1.085	194.907		0.73	20	
56.43	9	Sand	323.578	3.253	3.319	1.44862	2.401	1.82	0.61094	0.69	0.372	1.820	0.61	197.69	1.122	221.709		0.72	21	
56.759	10	Gravelly Sand to Sand	403.272	3.273	3.34	1.45888	2.412	1.69	0.60908	0.69	0.371	1.690	0.61	245.63	1.031	253.260		0.70	22	
57.087	10	Gravelly Sand to Sand	427.266	2.969	3.361	1.46911	2.423	1.63	0.60723	0.68	0.370	1.630	0.61	259.45	1.000	259.449		0.70	23	
57.415	10	Gravelly Sand to Sand	396.153	2.996	3.382	1.47935	2.433	1.68	0.60556	0.68	0.369	1.680	0.61	239.89	1.024	245.715		0.70	24	
57.743	10	Gravelly Sand to Sand	363.665	2.974	3.403	1.48958	2.444	1.73	0.60373	0.68	0.368	1.730	0.60	219.56	1.058	232.303		0.70	25	
58.071	10	Gravelly Sand to Sand	339.417	2.321	3.424	1.49982	2.454	1.7	0.60208	0.68	0.368	1.700	0.60	204.36	1.038	212.092		0.71	26	
58.399	9	Sand	310.536	3.038	3.444	1.51005	2.465	1.84	0.60027	0.67	0.367	1.840	0.60	186.41	1.137	211.950		0.72	27	
58.727	7	Silty Sand to Sandy Silt	199.692	5.911	3.463	1.52028	2.474	2.31	0.5988	0.67	0.366	2.310	0.60	119.58	1.981	236.909		0.78	28	
59.055	12	Sand to Clayey Sand	173.315	5.975	3.483	1.53052	2.483	2.41	0.59734	0.67	0.365	2.410	0.60	103.53	2.354	243.668		0.83	29	
59.383	7	Silty Sand to Sandy Silt	203.157	4.932	3.502	1.54075	2.492	2.25	0.59588	0.66	0.364	2.250	0.60	121.06	1.798	217.693		0.78	30	
59.711	11	Sitff Fine-Grained	114.988	4.574	3.524	1.55098	2.504	2.59	0.59395	0.66	0.363	2.590	0.59	68.30	3.266	223.062		0.83	31	
60.039	7	Silty Sand to Sandy Silt	138.021	3.051	3.543	1.56122	2.513	2.35	0.59251	0.66	0.362	2.350	0.59	81.78	2.120	173.343		0.82	32	
60.367	9	Sand	244.863	3.454	3.564	1.57145	2.523	2.03	0.59092	0.66	0.362	2.030	0.59	144.69	1.341	194.066		0.75	33	
60.696	7	Silty Sand to Sandy Silt	155.555	4.24	3.583	1.58172	2.532	2.37	0.5895	0.65	0.361	2.370	0.59	91.70	2.194	201.192		0.80	34	
61.024	6	Sandy Silt to Clayey Silt	92.623	3.528	3.602	1.59195	2.54	2.65	0.58824	0.65	0.360							0.83	35	
61.352	5	Clayey Silt to Silty Clay	41.923	1.722	3.621	1.60218	2.549	2.96	0.58682	0.65	0.359							0.83	36	
61.68	6	Sandy Silt to Clayey Silt	32.177	0.877	3.639	1.61242	2.558	2.97	0.58542	0.65	0.358							0.83	37	
62.008	6	Sandy Silt to Clayey Silt	31.113	0.721	3.658	1.62265	2.566	2.94	0.58417	0.64	0.358							0.83	38	

LIQUEFACTION POTENTIAL ANALYSIS (per Youd & Idriss, 2001)

PROJECT NAME	***Davis Street/Rte 880***	*FAULT INFO*	
PROJECT NO.	***206139.DAV***	*COAST RANGE - SIERRAN BLOCK BOUNDARY ZONE (CSB)*	
CPT NO.	***CPT-DV1***	*a_{max} (g)=* 0.6	*FAULT M_w =* 7.5
			MSF = 1.00

		CPT RESULT INPUT							*CSR*		*$CRR_{7.5}$*						*F.S.=($CRR_{7.5}$/CSR)*MSF*K_σ*K_α*		
Depth (ft)		Soil Behavior Type	qc (tsf)	fs (tsf)	σ_v (tsf)	u (tsf)	σ_v' (tsf)	Ic*	C_N*	γ_d	CSR	Ic	C_Q	q_{c1N}	K_C	$(q_{c1N})_{cs}$	$CRR_{7.5}$	$K\sigma$	$K\alpha$	F.S.
62.336	6	Sandy Silt to Clayey Silt	29.701	0.661	3.677	1.63288	2.575	2.96	0.58278	0.64	0.357							0.83	39	
62.664	5	Clayey Silt to Silty Clay	23.664	0.784	3.696	1.64312	2.583	3.16	0.58155	0.64	0.356							0.83	40	
62.992	5	Clayey Silt to Silty Clay	26.744	0.946	3.714	1.65335	2.592	3.12	0.58017	0.64	0.355							0.83	41	
63.32	6	Sandy Silt to Clayey Silt	34.644	1.014	3.733	1.66358	2.6	2.96	0.57895	0.63	0.355							0.83	42	
63.648	6	Sandy Silt to Clayey Silt	37.385	1.113	3.752	1.67382	2.609	2.94	0.57758	0.63	0.354							0.83	43	
63.976	6	Sandy Silt to Clayey Silt	34.889	1.014	3.771	1.68405	2.617	2.96	0.57637	0.63	0.354							0.82	44	
64.304	6	Sandy Silt to Clayey Silt	32.516	0.897	3.79	1.69428	2.626	2.98	0.57501	0.63	0.353							0.82	45	
64.633	6	Sandy Silt to Clayey Silt	33.401	0.963	3.808	1.70455	2.635	2.98	0.57366	0.62	0.352							0.82	46	
64.961	6	Sandy Silt to Clayey Silt	34.089	0.994	3.827	1.71478	2.643	2.98	0.57247	0.62	0.351							0.82	47	
65.289	5	Clayey Silt to Silty Clay	34.343	1.235	3.846	1.72502	2.652	3.03	0.57113	0.62	0.351							0.82	48	
65.617	6	Sandy Silt to Clayey Silt	116.052	3.741	3.865	1.73525	2.66	2.54	0.56995	0.62	0.350	2.540	0.57	66.14	2.979	197.040		0.82	49	
65.945	8	Sand to Silty Sand	330.33	6.056	3.885	1.74548	2.67	2.03	0.56848	0.62	0.349	2.030	0.57	187.78	1.341	251.858		0.71	50	
66.273	9	Sand	388.544	4.731	3.905	1.75572	2.68	1.85	0.56701	0.61	0.349	1.850	0.57	220.31	1.145	252.271		0.68	51	
66.601	9	Sand	371.199	5.016	3.925	1.76595	2.69	1.9	0.56555	0.61	0.348	1.900	0.57	209.93	1.189	249.577		0.69	52	
66.929	9	Sand	317.156	4.53	3.946	1.77618	2.7	1.97	0.5641	0.61	0.347	1.970	0.56	178.91	1.263	225.912		0.71	53	
67.257	9	Sand	305.837	3.912	3.966	1.78642	2.71	1.95	0.56266	0.61	0.347	1.950	0.56	172.08	1.240	213.358		0.71	54	
67.585	10	Gravelly Sand to Sand	451.9	2.285	3.987	1.79665	2.721	1.56	0.56108	0.61	0.346	1.560	0.56	253.55	1.000	253.553		0.67	55	
67.913	10	Gravelly Sand to Sand	463.369	2.104	4.008	1.80689	2.732	1.52	0.55951	0.60	0.345	1.520	0.56	259.26	1.000	259.260		0.67	56	
68.241	10	Gravelly Sand to Sand	403.818	2.718	4.029	1.81712	2.742	1.68	0.55809	0.60	0.345	1.680	0.56	225.37	1.024	230.836		0.67	57	
68.57	9	Sand	380.643	4.442	4.049	1.82738	2.752	1.86	0.55668	0.60	0.344	1.860	0.56	211.90	1.153	244.389		0.68	58	
68.898	9	Sand	336.677	5.157	4.07	1.83762	2.763	1.98	0.55513	0.60	0.344	1.980	0.56	186.90	1.275	238.249		0.70	59	
69.226	8	Sand to Silty Sand	294.838	5.312	4.089	1.84785	2.772	2.07	0.55388	0.60	0.343	2.070	0.55	163.30	1.403	229.103		0.72	60	
69.554	7	Silty Sand to Sandy Silt	267.85	6.607	4.109	1.85808	2.781	2.2	0.55262	0.59	0.342	2.200	0.55	148.02	1.667	246.716		0.73	61	
69.882	9	Sand	285.356	4.176	4.129	1.86832	2.791	2.02	0.55124	0.59	0.342	2.020	0.55	157.30	1.327	208.739		0.72	62	
70.21	9	Sand	298.652	2.581	4.149	1.87855	2.801	1.86	0.54986	0.59	0.341	1.860	0.55	164.22	1.153	189.399		0.70	63	
70.538	9	Sand	335.905	3.111	4.17	1.88879	2.812	1.84	0.54835	0.59	0.341	1.840	0.55	184.20	1.137	209.436		0.69	64	
70.866	9	Sand	368.92	4.267	4.19	1.89902	2.822	1.87	0.54699	0.59	0.340	1.870	0.55	201.80	1.162	234.454		0.68	65	
71.194	9	Sand	395.541	4.268	4.211	1.90925	2.832	1.83	0.54563	0.59	0.340	1.830	0.55	215.82	1.129	243.701		0.67	66	
71.522	9	Sand	382.809	3.671	4.231	1.91949	2.842	1.81	0.54429	0.58	0.339	1.810	0.54	208.36	1.114	232.112		0.67	67	
71.85	10	Gravelly Sand to Sand	409.628	3.495	4.252	1.92972	2.853	1.75	0.54281	0.58	0.338	1.750	0.54	222.35	1.072	238.269		0.66	68	
72.178	9	Sand	406.813	3.672	4.272	1.93995	2.863	1.77	0.54147	0.58	0.338	1.770	0.54	220.28	1.085	239.078		0.66	69	
72.507	10	Gravelly Sand to Sand	397.763	3.421	4.293	1.95022	2.873	1.77	0.54014	0.58	0.337	1.770	0.54	214.85	1.085	233.186		0.66	70	
72.835	10	Gravelly Sand to Sand	394.26	2.935	4.314	1.96045	2.884	1.73	0.53869	0.58	0.337	1.730	0.54	212.38	1.058	224.714		0.66	71	
73.163	10	Gravelly Sand to Sand	374.024	2.398	4.335	1.97069	2.895	1.71	0.53724	0.58	0.336	1.710	0.54	200.94	1.045	209.903		0.66	72	
73.491	10	Gravelly Sand to Sand	332.816	2.299	4.356	1.98092	2.905	1.77	0.53593	0.57	0.336	1.770	0.54	178.37	1.085	193.590		0.68	73	
73.819	10	Gravelly Sand to Sand	339.728	2.451	4.377	1.99115	2.916	1.78	0.5345	0.57	0.335	1.780	0.53	181.58	1.092	198.353		0.68	74	
74.147	9	Sand	317.212	2.493	4.397	2.00139	2.926	1.83	0.5332	0.57	0.335	1.830	0.53	169.14	1.129	190.988		0.69	75	
74.475	7	Silty Sand to Sandy Silt	148.577	3.12	4.416	2.01162	2.935	2.36	0.53204	0.57	0.334	2.360	0.53	79.05	2.156	170.463		0.79	76	
74.803	6	Sandy Silt to Clayey Silt	59.495	1.723	4.435	2.02185	2.944	2.79	0.53089	0.57	0.334							0.81	77	
75.131	7	Silty Sand to Sandy Silt	42.329	0.543	4.454	2.03209	2.953	2.74	0.52974	0.57	0.334							0.81	78	
75.459	6	Sandy Silt to Clayey Silt	34.419	0.585	4.473	2.04232	2.961	2.9	0.52872	0.57	0.333							0.80	79	
75.787	6	Sandy Silt to Clayey Silt	29.776	0.443	4.492	2.05255	2.97	2.94	0.52758	0.56	0.333							0.80	80	
76.115	7	Silty Sand to Sandy Silt	31.292	0.431	4.511	2.06279	2.979	2.9	0.52644	0.56	0.332							0.80	81	
76.444	7	Silty Sand to Sandy Silt	31.593	0.413	4.531	2.07305	2.988	2.88	0.52531	0.56	0.332							0.80	82	
76.772	7	Silty Sand to Sandy Silt	31.414	0.452	4.55	2.08329	2.997	2.91	0.52418	0.56	0.332							0.80	83	
77.1	7	Silty Sand to Sandy Silt	32.008	0.455	4.569	2.09352	3.006	2.9	0.52306	0.56	0.331							0.80	84	
77.428	7	Silty Sand to Sandy Silt	37.526	0.58	4.589	2.10375	3.015	2.84	0.52195	0.56	0.331							0.80	85	
77.756	6	Sandy Silt to Clayey Silt	38.467	0.686	4.607	2.11399	3.024	2.87	0.52083	0.56	0.331							0.80	86	
78.084	6	Sandy Silt to Clayey Silt	38.486	0.694	4.626	2.12422	3.033	2.87	0.51973	0.56	0.330							0.80	87	
78.412	6	Sandy Silt to Clayey Silt	34.324	0.63	4.645	2.13445	3.041	2.93	0.51875	0.55	0.330							0.80	88	
78.74	6	Sandy Silt to Clayey Silt	31.038	0.485	4.664	2.14469	3.05	2.94	0.51765	0.55	0.330							0.80	89	
79.068	6	Sandy Silt to Clayey Silt	30.595	0.471	4.683	2.15492	3.058	2.95	0.51667	0.55	0.329							0.80	90	
79.396	6	Sandy Silt to Clayey Silt	30.416	0.536	4.701	2.16516	3.067	2.98	0.51558	0.55	0.329							0.80	91	
79.724	5	Clayey Silt to Silty Clay	34.39	1.175	4.72	2.17539	3.075	3.08	0.51462	0.55	0.329							0.80	92	
80.052	7	Silty Sand to Sandy Silt	112.163	3.204	4.739	2.18562	3.084	2.57	0.51354	0.55	0.328	2.570	0.51	57.60	3.148	181.323		0.80	93	
80.381	8	Sand to Silty Sand	249.864	4.524	4.759	2.19589	3.094	2.16	0.51234	0.55	0.328	2.160	0.51	128.02	1.574	201.531		0.72	94	
80.709	8	Sand to Silty Sand	263.745	5.338	4.779	2.20612	3.104	2.18	0.51115	0.55	0.328	2.180	0.51	134.81	1.619	218.286		0.72	95	
81.037	7	Silty Sand to Sandy Silt	242.453	6.765	4.798	2.21635	3.113	2.31	0.51009	0.54	0.327	2.310	0.51	123.67	1.981	245.023		0.73	96	
81.365	8	Sand to Silty Sand	275.713	6.447	4.818	2.22659	3.122	2.21	0.50902	0.54	0.327	2.210	0.51	140.34	1.692	237.409		0.71	97	
81.693	9	Sand	415.966	4.835	4.839	2.23682	3.132	1.87	0.50785	0.54	0.327	1.870	0.51	211.25	1.162	245.435		0.64	98	
82.021	9	Sand	490.565	5.769	4.859	2.24706	3.143	1.82	0.50656	0.54	0.326	1.820	0.51	248.50	1.122	278.698		0.63	99	
82.349	9	Sand	437.53	7.16	4.879	2.25729	3.153	1.96	0.5054	0.54	0.326	1.960	0.51	221.13	1.251	276.653		0.64	100	
82.677	12	Sand to Clayey Sand	322.203	9.853	4.899	2.26752	3.162	2.26	0.50436	0.54	0.326	2.260	0.50	162.50	1.827	296.861		0.69	101	
83.005	11	Sitff Fine-Grained	229.42	10.018	4.921	2.27776	3.173	2.47	0.50309	0.54	0.326	2.470	0.50	115.42	2.621	302.547		0.79	102	
83.333	8	Sand to Silty Sand	378.139	6.617	4.94	2.28799	3.183	2.03	0.50194	0.54	0.325	2.030	0.50	189.80	1.341	254.565		0.66	103	
83.661	9	Sand	409.948	4.871	4.961	2.29822	3.193	1.89	0.5008	0.54	0.325	1.890	0.50	205.30	1.180	242.166		0.64	104	
83.99	9	Sand	310.404	4.72	4.981	2.30849	3.203	2.05	0.49966	0.54	0.325	2.050	0.50	155.10	1.371	212.645		0.69	105	
84.318	9	Sand	239.628	3.328	5.002	2.31872	3.213	2.11	0.49853	0.53	0.324	2.110	0.50	119.46	1.473	175.986		0.72	106	
84.646	8	Sand to Silty Sand	210.247	3.058	5.021	2.32896	3.223	2.17	0.4974	0.53	0.324	2.170	0.50	104.58	1.596	166.944		0.74	107	
84.974	8	Sand to Silty Sand	206.217	3.051	5.041	2.33919	3.233	2.18	0.49628	0.53	0.324	2.180	0.50	102.34	1.619	165.707		0.74	108	
85.302	9	Sand	222.866	1.711	5.062	2.34942	3.243	1.99	0.49516	0.53	0.324	1.990	0.50	110.35	1.287	142.044	0.35	0.72	109	1.07
85.63	8	Sand to Silty Sand	136.995	2.382	5.081	2.35966	3.252	2.38	0.49416	0.53	0.323	2.380	0.49	67.70	2.233	151.140	0.40	0.79	110	1.24
85.958	7	Silty Sand to Sandy Silt	140.423	2.71	5.101	2.36989	3.261	2.4	0.49316	0.53	0.323	2.400	0.49	69.25	2.312	160.135		0.79	111	
86.286	10	Gravelly Sand to Sand	355.717	2.447	5.122	2.38012	3.272	1.79	0.49195	0.53	0.323	1.790	0.49	174.99	1.099	192.397		0.65	112	
86.614	10	Gravelly Sand to Sand	330.066	2.167	5.143	2.39036	3.283	1.81	0.49074	0.53	0.323	1.810	0.49	161.98	1.114	180.445		0.66	113	
86.942	9	Sand	262.181	1.489	5.163	2.40059	3.293	1.86	0.48965	0.53	0.322	1.860	0.49	128.38	1.153	148.063	0.38	0.70	114	1.19
87.27	8	Sand to Silty Sand	158.785	2.288	5.183	2.41082	3.303	2.28	0.48856	0.53	0.322	2.280	0.49	77.58	1.886	146.322	0.37	0.77	115	1.15
87.598	6	Sandy Silt to Clayey Silt	60.163	1.867	5.202	2.42106	3.311	2.85	0.4877	0.53	0.322							0.79	116	
87.927	6	Sandy Silt to Clayey Silt	44.739	0.993	5.22	2.43132	3.32	2.89	0.48673	0.52	0.322							0.79	117	
88.255	6	Sandy Silt to Clayey Silt	60.522	1.416	5.239	2.44156	3.328	2.78	0.48587	0.52	0.321							0.79	118	
88.583	6	Sandy Silt to Clayey Silt	56.397	1.42	5.258	2.45179	3.337	2.83	0.4849	0.52	0.321							0.79	119	
88.911	6	Sandy Silt to Clayey Silt	42.149	0.901	5.277	2.46202	3.345	2.92	0.48405	0.52	0.321							0.79	120	
89.239	6	Sandy Silt to Clayey Silt	34.898	0.693	5.296	2.47226	3.354	2.99	0.48309	0.52	0.321							0.79	121	
89.567	6	Sandy Silt to Clayey Silt	31.151	0.583	5.314	2.48249	3.362	3.03	0.48224	0.52	0.321							0.78	122	
89.895	7	Silty Sand to Sandy Silt	33.269	0.413	5.334	2.49272	3.372	2.91	0.48119	0.52	0.321							0.78	123	
90.223	7	Silty Sand to Sandy Silt	34.795	0.363	5.353	2.50296	3.381	2.85	0.48024	0.52	0.320							0.78	124	
90.551	7	Silty Sand to Sandy Silt	32.742	0.46	5.372	2.51319	3.39	2.95	0.4793	0.52	0.320							0.78	125	
90.879	6	Sandy Silt to Clayey Silt	30.84	0.448	5.391	2.52342	3.398	2.99	0.47847	0.52	0.320							0.78	126	
91.207	7	Silty Sand to Sandy Silt	29.861	0.401	5.41	2.53366	3.407	2.99	0.47753	0.52	0.320							0.78	127	
91.535	7	Silty Sand to Sandy Silt	30.51	0.347	5.43	2.54389	3.416	2.94	0.4766	0.52	0.320							0.78	128	
91.864	7	Silty Sand to Sandy Silt	32.676	0.447	5.449	2.55416	3.426	2.95	0.47557	0.51	0.319							0.78	129	
92.192	6	Sandy Silt to Clayey Silt	37.469	0.868	5.468	2.56439	3.434	3	0.47475	0.51	0.319							0.78	130	
92.52	7	Silty Sand to Sandy Silt	59.721	1.248	5.487	2.57462	3.443	2.77	0.47383	0.51	0.319							0.78	131	
92.848	7	Silty Sand to Sandy Silt	54.721	0.937	5.506	2.58486	3.452	2.76	0.47291	0.51	0.319							0.78	132	
93.176	6	Sandy Silt to Clayey Silt	32.846	0.588	5.525	2.59509	3.461	3.01	0.472	0.51	0.319							0.78	133	
93.504	6	Sandy Silt to Clayey Silt	29.475	0.449	5.544	2.60532	3.469	3.03	0.47119	0.51	0.319							0.78	134	

LIQUEFACTION POTENTIAL ANALYSIS (per Youd & Idriss, 2001)

PROJECT NAME ***Davis Street/Rte 880***
PROJECT NO. ***206139.DAV***
CPT NO. ***CPT-DV1***

FAULT INFO
COAST RANGE - SIERRAN BLOCK BOUNDARY ZONE (CSB)
a_{max} *(g)=* 0.6

FAULT M_w = 7.5
MSF = 1.00

			CPT RESULT INPUT							*CSR*		*$CRR_{7.5}$*						*F.S.=($CRR_{7.5}$/CSR)*MSF*Kσ*Kα*		
Depth (ft)		Soil Behavior Type	qc (tsf)	fs (tsf)	σ_v (tsf)	u (tsf)	σ_v' (tsf)	Ic*	C_N*	γ_d	CSR	Ic	C_Q	q_{c1N}	K_C	$(q_{c1N})_{cs}$	$CRR_{7.5}$	Kσ	Kα	F.S.
93.832	6	Sandy Silt to Clayey Silt	28.683	0.405	5.563	2.61556	3.478	3.03	0.47029	0.51	0.319							0.78	135	
94.16	7	Silty Sand to Sandy Silt	30.435	0.371	5.582	2.62579	3.487	2.97	0.46938	0.51	0.318							0.78	136	
94.488	7	Silty Sand to Sandy Silt	30.313	0.361	5.601	2.63603	3.496	2.97	0.46848	0.51	0.318							0.78	137	
94.816	7	Silty Sand to Sandy Silt	29.908	0.398	5.621	2.64626	3.505	3	0.46759	0.51	0.318							0.78	138	
95.144	6	Sandy Silt to Clayey Silt	30.567	0.451	5.64	2.65649	3.514	3.01	0.46669	0.51	0.318							0.78	139	
95.472	7	Silty Sand to Sandy Silt	32.262	0.407	5.659	2.66673	3.523	2.95	0.46581	0.51	0.318							0.78	140	
95.801	7	Silty Sand to Sandy Silt	33.514	0.448	5.678	2.67699	3.532	2.94	0.46492	0.51	0.318							0.78	141	
96.129	7	Silty Sand to Sandy Silt	33.1	0.459	5.698	2.68722	3.541	2.96	0.46404	0.51	0.317							0.78	142	

ALTPIPE ANALYSIS RESULTS

AltPipe

Project EA: **3A9214**
Project Engineer: **Tim Lee**
Location: **04-ALA-880 / PM 22.5 - 24.0**
Description: **I-880 SB HOV (Marina to Davis)**

Steel Pipes

DSN/U		1b	1d	1v	1x	1z	1ab	1ad	2b	2e	2f	3b	4b	5b	6b	6d	7b	8b	8d	9b	11b	11d	11f	12b	13b	13d	15b	15d	15f	15h	15j	15n	15r	15t	15v	15ad	15ae	15ag	15al	15an
Pipe Diameter (in)		**18**	**18**	**18**	**18**	**18**	**12**	**12**	**18**	**21**	**24**	**21**	**12**	**18**	**18**	**18**	**18**	**18**	**18**	**24**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**24**	**24**	**24**	**24**	**18**	**24**	**18**	**18**	**18**	**24**
Pipe Type	**Coat**	**Minimum Thickness (in)**																																						
Corrugated Steel Pipe - Helical Corrugations - 2⅔" X ½" Corrugations	AL2	0.052	0.052			0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052		0.052	0.052		0.052	0.052	0.052	0.052	0.052	0.052											0.052	0.052		
	PA	0.052	0.052	0.064	0.064	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.079	0.052	0.052	0.052	0.052
	PS	0.052	0.052	0.064	0.064	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.079	0.052	0.052	0.052	0.052
Corrugated Steel Pipe - Annular Corrugations - 2⅔" X ½" Corrugations	AL2	0.064	0.064			0.064			0.064	0.064	0.064	0.064		0.064	0.064	0.064		0.064	0.064		0.064	0.064	0.064	0.064	0.064	0.064											0.064	0.064		
	PA	0.064	0.064	0.064	0.064	0.064			0.064	0.064	0.064	0.064		0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.079	0.064	0.064	0.064	0.064
	PS	0.064	0.064	0.064	0.064	0.064			0.064	0.064	0.064	0.064		0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.079	0.064	0.064	0.064	0.064
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch	AL2										0.064																													
	BC										0.109									0.109											0.109	0.109	0.109	0.109		0.109				0.109
	BCI										0.109									0.109											0.109	0.109	0.109	0.109		0.109				0.109
	PA										0.064									0.064											0.064	0.064	0.064	0.064		0.079				0.064
	PS										0.064									0.064											0.064	0.064	0.064	0.064		0.079				0.064
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 8½" Pitch	AL2										0.064																													
	BC										0.109									0.109											0.109	0.109	0.109	0.109		0.109				0.109
	BCI										0.109									0.109											0.109	0.109	0.109	0.109		0.109				0.109
	PA										0.064									0.064											0.064	0.064	0.064	0.064		0.079				0.064
	PS										0.064									0.064											0.064	0.064	0.064	0.064		0.079				0.064
Steel Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch	AL2										0.064																													
	BC										0.109									0.109											0.109	0.109	0.109	0.109		0.109				0.109
	BCI										0.109									0.109											0.109	0.109	0.109	0.109		0.109				0.109
	PA										0.064									0.064											0.064	0.064	0.064	0.064		0.079				0.064
	PS										0.064									0.064											0.064	0.064	0.064	0.064		0.079				0.064

Aluminum Pipes

DSN/U	1b	1d	1v	1x	1z	1ab	1ad	2b	2e	2f	3b	4b	5b	6b	6d	7b	8b	8d	9b	11b	11d	11f	12b	13b	13d	15b	15d	15f	15h	15j	15n	15r	15t	15v	15ad	15ae	15ag	15al	15an
Pipe Diameter (in)	**18**	**18**	**18**	**18**	**18**	**12**	**12**	**18**	**21**	**24**	**21**	**12**	**18**	**18**	**18**	**18**	**18**	**18**	**24**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**24**	**24**	**24**	**24**	**18**	**24**	**18**	**18**	**18**	**24**
Pipe Type	**Minimum Thickness (in)**																																						
Corrugated Aluminum Pipe - Annular Corrugations - 2⅔" X ½" Corrugations	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060		0.060	0.060		0.060	0.060	0.060	0.060	0.060	0.060											0.060	0.060		

DSN/U	1b	1d	1v	1x	1z	1ab	1ad	2b	2e	2f	3b	4b	5b	6b	6d	7b	8b	8d	9b	11b	11d	11f	12b	13b	13d	15b	15d	15f	15h	15j	15n	15r	15t	15v	15ad	15ae	15ag	15al	15an
Pipe Diameter (in)	18	18	18	18	18	12	12	18	21	24	21	12	18	18	18	18	18	18	24	18	18	18	18	18	18	18	18	18	18	24	24	24	24	18	24	18	18	18	24
Pipe Type	Minimum Thickness (in)																																						
Corrugated Aluminum Pipe - Helical Corrugations - 2⅔" X ½" Corrugations	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060		0.060	0.060		0.060	0.060	0.060	0.060	0.060	0.060										0.060	0.060		
Aluminum Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch										0.060																													
Aluminum Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch										0.060																													

Plastic Pipes

DSN/U	1b	1d	1v	1x	1z	1ab	1ad	2b	2e	2f	3b	4b	5b	6b	6d	7b	8b	8d	9b	11b	11d	11f	12b	13b	13d	15b
Pipe Diameter (in)	18	18	18	18	18	12	12	18	21	24	21	12	18	18	18	18	18	18	24	18	18	18	18	18	18	18
Pipe Type	Availability																									
PVC Corrugated	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowal
PVC Ribbed	Allowable	Allowable	Allowable	Allowable	Allowable			Allowable	Allowable	Allowable	Allowable		Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowal
HDPE Corrugated - Type S	Allowable	Allowable	Allowable	Allowable	Allowable			Allowable		Allowable			Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowal
HDPE Ribbed	Allowable	Allowable	Allowable	Allowable	Allowable			Allowable	Allowable	Allowable	Allowable		Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowal
HDPE Corrugated - Type C	Allowable	Allowable	Allowable	Allowable	Allowable			Allowable		Allowable			Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowal

Reinforced Concrete Pipes

DSN/U	1b	1d	1v	1x	1z	1ab	1ad	2b	2e	2f	3b	4b	5b	6b	6d	7b	8b	8d	9b	11b	11d	11f	12b	13b	13d	15b	15d	15f	15h	15j	15n	15r	15t	15v	15ad	15ae	15ag	15al	15an
Pipe Diameter (in)	18	18	18	18	18	12	12	18	21	24	21	12	18	18	18	18	18	18	24	18	18	18	18	18	18	18	18	18	18	24	24	24	24	18	24	18	18	18	24
Steel Cover (in)	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1	1	1	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1	1	1	1	0.75	1	0.75	0.75	0.75	1
Sacks of Cement	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Percentage Water	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0

Other Information

DSN/U	1b	1d	1v	1x	1z	1ab	1ad	2b	2e	2f	3b	4b	5b	6b	6d	7b	8b	8d	9b	11b	11d	11f	12b	13b	13d	15b	15d	15f	15h	15j	15n	15r	15t	15v	15ad	15ae	15ag	15al	15an
Soil pH	6.91	6.91	6.91	6.91	6.91	6.91	6.91	6.91	6.91	6.91	6.91	6.91	6.91	6.91	6.91	7.16	6.91	6.91	7.16	6.91	6.91	6.91	6.91	6.91	6.91	7.16	7.16	7.16	7.16	7.16	7.16	7.16	7.16	7.16	7.16	7.15	7.15	7.16	7.16

DSN/U	1b	1d	1v	1x	1z	1ab	1ad	2b	2e	2f	3b	4b	5b	6b	6d	7b	8b	8d	9b	11b	11d	11f	12b	13b	13d	15b	15d	15f	15h	15j	15n	15r	15t	15v	15ad	15ae	15ag	15al	15an
Minimum Soil Resistivity (ohm-cm)	1930	1930	1930	1930	1930	1930	1930	1930	1930	1930	1930	1930	1930	1930	1930	1180	1930	1930	1180	1930	1930	1930	1930	1930	1930	1180	1180	1180	1180	1180	1180	1180	1180	1180	1180	2170	2170	1180	1180
Sulfate Concentration (ppm)	133.4	133.4	133.4	133.4	133.4	133.4	133.4	133.4	133.4	133.4	133.4	133.4	133.4	133.4	133.4	23.6	133.4	133.4	23.6	133.4	133.4	133.4	133.4	133.4	133.4	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	20.3	20.3	23.6	23.6
Chloride Concentration (ppm)	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	13.8	38.1	38.1	13.8	38.1	38.1	38.1	38.1	38.1	38.1	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	15.6	15.6	13.8	13.8
Abrasion Level	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	2	1	1	1	1
2–5 Year Flow Velocity (ft/sec)	0.77	0.87	3.76	3.55	0.39	0.24	0.55	0.5	2.16	2.09	1.81	1.47	1.91	0.69	0.96	0.54	0.76	0.64	2.11	1.78	1.77	0.99	0.77	2.12	2.19	2.94	3.14	3.16	2.13	2.75	1.94	1.94	1.92	1.08	5	0.64	0.81	2.99	1.92
Design Service Life (years)	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Height of Cover (ft)	2	4.8	6	6	5	2	2	4.2	4.2	4.2	2.9	4.6	3.6	3.7	5.2	8	5.5	13	5.7	2	2.2	2	9.3	3.4	6	5.8	5.5	3.6	3.9	3.6	3.6	4	7	5	5	5	5	7	4

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AltPipe

Project EA: **3A9214**
Project Engineer: **Tim Lee**
Location: **04-ALA-880 / PM 22.5 - 24.0**
Description: **I-880 SB HOV (Marina to Davis)**

Steel Pipes

DSN/U		15aq	15as	16b	17d	17f	18b	18d	18f	18h	18q	18s	19d	19h	19j	19l	19p	19r	19t	19v	20b	20d	20f	20h	20j	20l	20n	20p	21b	21h	22b	22p	23b	23d	24b	24d	27b	27d
Pipe Diameter (in)		**18**	**18**	**18**	**18**	**18**	**24**	**24**	**24**	**24**	**18**	**24**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**24**	**24**	**24**	**24**	**24**	**30**	**30**	**18**	**24**	**18**	**18**	**18**	**18**	**18**	**18**
Pipe Type	**Coat**	**Minimum Thickness (in)**																																				
Corrugated Steel Pipe - Helical Corrugations - 2⅔" X ½" Corrugations	AL2				0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052					0.052	0.052	0.052	0.052			0.052	0.052	0.052	0.052			0.052	0.052
	BCI						0.079					0.079																										
	PA	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.064	0.064	0.064	0.064	0.052	0.052	0.052	0.052			0.052	0.052	0.052	0.052	0.064	0.064	0.052	0.052
	PS	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.064	0.064	0.064	0.064	0.052	0.052	0.052	0.052			0.052	0.052	0.052	0.052	0.064	0.064	0.052	0.052
Corrugated Steel Pipe - Annular Corrugations - 2⅔" X ½" Corrugations	AL2				0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064					0.064	0.064	0.064	0.064			0.064	0.064	0.064	0.064			0.064	0.064
	BCI						0.079					0.079																										
	PA	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064			0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
	PS	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064			0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch	GAL						0.109					0.109																										
	AL2						0.064	0.064	0.064	0.064		0.064													0.064	0.064	0.064	0.064				0.064						
	BC						0.109					0.109																										
	BCI						0.079	0.109	0.109	0.109		0.079																										
	PA						0.064	0.064	0.064	0.064		0.064												0.064	0.064	0.064	0.064	0.064				0.064						
	PS						0.064	0.064	0.064	0.064		0.064												0.064	0.064	0.064	0.064	0.064				0.064						
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 8½" Pitch	GAL						0.109					0.109																										
	AL2						0.064	0.064	0.064	0.064		0.064													0.064	0.064	0.064	0.064				0.064						
	BC						0.109					0.109																										
	BCI						0.079	0.109	0.109	0.109		0.079																										
	PA						0.064	0.064	0.064	0.064		0.064												0.064	0.064	0.064	0.064	0.064				0.064						
	PS						0.064	0.064	0.064	0.064		0.064												0.064	0.064	0.064	0.064	0.064				0.064						
Steel Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch	GAL						0.109					0.109																										
	AL2						0.064	0.064	0.064	0.064		0.064													0.064	0.064	0.064	0.064				0.064						
	BC						0.109					0.109																										
	BCI						0.079	0.109	0.109	0.109		0.079																										
	PA						0.064	0.064	0.064	0.064		0.064												0.064	0.064	0.064	0.064	0.064				0.064						
	PS						0.064	0.064	0.064	0.064		0.064												0.064	0.064	0.064	0.064	0.064				0.064						
	CSS																												0.064	0.064								

Aluminum Pipes

DSN/U	15aq	15as	16b	17d	17f	18b	18d	18f	18h	18q	18s	19d	19h	19j	19l	19p	19r	19t	19v	20b	20d	20f	20h	20j	20l	20n	20p	21b	21h	22b	22p	23b	23d	24b	24d	27b	27d
Pipe Diameter (in)	18	18	18	18	18	24	24	24	24	18	24	18	18	18	18	18	18	18	18	18	18	18	24	24	24	24	24	30	30	18	24	18	18	18	18	18	18
Pipe Type	Minimum Thickness (in)																																				
Corrugated Aluminum Pipe - Annular Corrugations - 2⅔" X ½" Corrugations				0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060					0.060	0.060	0.060	0.060			0.060	0.060	0.060	0.060			0.060	0.060
Corrugated Aluminum Pipe - Helical Corrugations - 2⅔" X ½" Corrugations				0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060					0.060	0.060	0.060	0.060			0.060	0.060	0.060	0.060			0.060	0.060
Aluminum Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch						0.060	0.060	0.060	0.060		0.060													0.060	0.060	0.060	0.060				0.060						
Aluminum Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch						0.060	0.060	0.060	0.060		0.060													0.060	0.060	0.060	0.060				0.060						

Plastic Pipes

DSN/U	15aq	15as	16b	17d	17f	18b	18d	18f	18h	18q	18s	19d	19h	19j	19l	19p	19r	19t	19v	20b	20d	20f	20h	20j	2(
Pipe Diameter (in)	18	18	18	18	18	24	24	24	24	18	24	18	18	18	18	18	18	18	18	18	18	18	24	24	2
Pipe Type	Availability																								
PVC Corrugated	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allow
PVC Ribbed	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allow
HDPE Corrugated - Type S	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allow
HDPE Ribbed	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allow
HDPE Corrugated - Type C	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allow

Reinforced Concrete Pipes

DSN/U	15aq	15as	16b	17d	17f	18b	18d	18f	18h	18q	18s	19d	19h	19j	19l	19p	19r	19t	19v	20b	20d	20f	20h	20j	20l	20n	20p	21b	21h	22b	22p	23b	23d	24b	24d	27b	27d
Pipe Diameter (in)	18	18	18	18	18	24	24	24	24	18	24	18	18	18	18	18	18	18	18	18	18	18	24	24	24	24	24	30	30	18	24	18	18	18	18	18	18
Steel Cover (in)	0.75	0.75	0.75	0.75	0.75	1	1	1	1	0.75	1	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1	1	1	1	1	1	1	0.75	1	0.75	0.75	0.75	0.75	0.75	0.75

DSN/U	15aq	15as	16b	17d	17f	18b	18d	18f	18h	18q	18s	19d	19h	19j	19l	19p	19r	19t	19v	20b	20d	20f	20h	20j	20l	20n	20p	21b	21h	22b	22p	23b	23d	24b	24d	27b	27d
Pipe Diameter (in)	**18**	**18**	**18**	**18**	**18**	**24**	**24**	**24**	**24**	**18**	**24**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**24**	**24**	**24**	**24**	**24**	**30**	**30**	**18**	**24**	**18**	**18**	**18**	**18**	**18**	**18**
Sacks of Cement	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Percentage Water	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0

Other Information

DSN/U	15aq	15as	16b	17d	17f	18b	18d	18f	18h	18q	18s	19d	19h	19j	19l	19p	19r	19t	19v	20b	20d	20f	20h	20j	20l	20n	20p	21b	21h	22b	22p	23b	23d	24b	24d	27b	27d
Soil pH	7.16	7.16	7.16	7.15	6.71	7.15	6.71	6.71	6.71	6.71	7.15	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.18	6.18	6.18	6.18	6.03	6.03	6.03	6.03	6.18	6.18	6.03	6.03	6.03	6.03	5.86	5.86	6.74	6.74
Minimum Soil Resistivity (ohm-cm)	1180	1180	1180	2170	2170	2170	2170	2170	2170	2170	2170	2170	2170	2170	2170	2170	2170	2170	2170	830	830	830	830	2220	2220	2220	2220	830	830	2220	2220	2220	2220	960	960	1960	1960
Sulfate Concentration (ppm)	23.6	23.6	23.6	20.3	24.8	20.3	24.8	24.8	24.8	24.8	20.3	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	214.9	214.9	214.9	214.9	61.1	61.1	61.1	61.1	214.9	214.9	61.1	61.1	61.1	61.1	12	12	1.4	1.4
Chloride Concentration (ppm)	13.8	13.8	13.8	15.6	10.3	15.6	10.3	10.3	10.3	10.3	15.6	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	19.6	19.6	19.6	19.6	15.6	15.6	15.6	15.6	19.6	19.6	15.6	15.6	15.6	15.6	8.6	8.6	6.1	6.1
Abrasion Level	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1
2–5 Year Flow Velocity (ft/sec)	2	2.08	1.49	0.25	0.15	1.82	1.7	1.47	1.52	1.2	1.72	0.15	0.11	1.31	1.93	1.7	1.41	1.06	1.81	2.37	2.47	1.74	1.05	1.07	1.2	1.26	1.37	4.61	3.6	1.24	0.28	1.9	1.95	3.3	3.47	0.62	0.69
Design Service Life (years)	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Height of Cover (ft)	6.1	5	2	2.3	2.3	5.6	5.6	5.6	5.6	6.1	6.6	2.2	2.2	2.3	2.2	2.3	2	2.8	2.3	5.5	6	6.4	6.1	8.6	9.4	6.3	9.8	4.9	6.5	9.5	7.3	8	3.7	3.4	3.7	3.6	4.5

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AltPipe

Project EA: **3A9214**
Project Engineer: **Tim Lee**
Location: **04-ALA-880 / PM 22.5 - 24.0**
Description: **I-880 SB HOV (Marina to Davis)**

Steel Pipes

DSN/U		27f	29b	29e	29g	30b	30d	31b	31d	31f	31h	31j	33b	33d	35b	38d	39b	40b	40d	40f	41b	42b	45b	46b	48b	51b	51d	51f	51h	53b	53d	55b	56b	57b	57d
Pipe Diameter (in)		**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**24**	**24**	**24**	**24**	**24**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**24**	**18**	**18**	**12**	**18**	**24**	**30**
Pipe Type	**Coat**	**Minimum Thickness (in)**																																	
Corrugated Steel Pipe - Helical Corrugations - 2⅔" X ½" Corrugations	AL2	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052			0.052	0.052	0.052	0.052	0.052		0.052	0.052		0.052	0.052	0.052	0.052	0.052	0.052			0.052	0.052		
	PA	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.064	0.064	0.052	0.052	0.052	0.052	0.052		0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.064	0.064
	PS	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.064	0.064	0.052	0.052	0.052	0.052	0.052		0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.064	0.064
Corrugated Steel Pipe - Annular Corrugations - 2⅔" X ½" Corrugations	AL2	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064			0.064	0.064	0.064	0.064	0.064		0.064	0.064		0.064	0.064	0.064	0.064	0.064	0.064				0.064		
	PA	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064		0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064		0.064	0.064	0.064
	PS	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064		0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064		0.064	0.064	0.064
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch	AL2															0.064	0.064	0.064	0.064										0.064						
	BC															0.109													0.109						
	BCI															0.109													0.109						
	PA															0.064	0.064	0.064	0.064	0.109									0.064					0.064	0.064
	PS															0.064	0.064	0.064	0.064	0.109									0.064					0.064	0.064
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 8½" Pitch	AL2															0.064	0.064	0.064	0.064										0.064						
	BC															0.109													0.109						
	BCI															0.109													0.109						
	PA															0.064	0.064	0.064	0.064	0.109									0.064					0.064	0.064
	PS															0.064	0.064	0.064	0.064	0.109									0.064					0.064	0.064
Steel Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch	AL2															0.064	0.064	0.064	0.064										0.064						
	BC															0.109													0.109						
	BCI															0.109													0.109						
	PA															0.064	0.064	0.064	0.064	0.109									0.064					0.064	0.064
	PS															0.064	0.064	0.064	0.064	0.109									0.064					0.064	0.064
	CSS																																		0.064

Aluminum Pipes

DSN/U	27f	29b	29e	29g	30b	30d	31b	31d	31f	31h	31j	33b	33d	35b	38d	39b	40b	40d	40f	41b	42b	45b	46b	48b	51b	51d	51f	51h	53b	53d	55b	56b	57b	57d
Pipe Diameter (in)	18	18	18	18	18	18	18	18	18	18	18	18	18	18	24	24	24	24	24	18	18	18	18	18	18	18	18	24	18	18	12	18	24	30
Pipe Type	Minimum Thickness (in)																																	
Corrugated Aluminum Pipe - Annular Corrugations - 2⅔" X ½" Corrugations	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060			0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060		0.060	0.060	0.060	0.060	0.060	0.060			0.060	0.060		
Corrugated Aluminum Pipe - Helical Corrugations - 2⅔" X ½" Corrugations	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060			0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060		0.060	0.060	0.060	0.060	0.060	0.060			0.060	0.060		
Aluminum Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch															0.060	0.060	0.060	0.060	0.060									0.060						
Aluminum Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch															0.060	0.060	0.060	0.060	0.060									0.060						

Plastic Pipes

DSN/U	27f	29b	29e	29g	30b	30d	31b	31d	31f	31h	31j	33b	33d	35b	38d	39b	40b	40d	40f	41b	42b	45b	4
Pipe Diameter (in)	18	18	18	18	18	18	18	18	18	18	18	18	18	18	24	24	24	24	24	18	18	18	1
Pipe Type	Availability																						
PVC Corrugated	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allov
PVC Ribbed	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allov
HDPE Corrugated - Type S	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allov
HDPE Ribbed	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allov
HDPE Corrugated - Type C	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allov

Reinforced Concrete Pipes

DSN/U	27f	29b	29e	29g	30b	30d	31b	31d	31f	31h	31j	33b	33d	35b	38d	39b	40b	40d	40f	41b	42b	45b	46b	48b	51b	51d	51f	51h	53b	53d	55b	56b	57b	57d
Pipe Diameter (in)	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**24**	**24**	**24**	**24**	**24**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**24**	**18**	**18**	**12**	**18**	**24**	**30**
Steel Cover (in)	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1	1	1	1	1	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1	0.75	0.75	0.75	0.75	1	1
Sacks of Cement	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Percentage Water	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0

Other Information

DSN/U	27f	29b	29e	29g	30b	30d	31b	31d	31f	31h	31j	33b	33d	35b	38d	39b	40b	40d	40f	41b	42b	45b	46b	48b	51b	51d	51f	51h	53b	53d	55b	56b	57b	57d
Soil pH	6.74	6.74	6.74	6.74	6.03	6.03	6.03	6.03	6.03	6.03	6.03	5.86	5.86	6.74	6.91	6.03	6.03	6.03	6.03	6.91	6.91	7.16	6.91	6.74	6.91	6.91	6.91	6.91	7.16	7.16	6.03	6.91	5.86	5.86
Minimum Soil Resistivity (ohm-cm)	1960	1960	1960	1960	2220	2220	2220	2220	2220	2220	2220	960	960	1960	1930	2220	2220	2220	2220	1930	1930	1180	1930	1960	1930	1930	1930	1930	1180	1180	2220	1930	960	960
Sulfate Concentration (ppm)	1.4	1.4	1.4	1.4	61.1	61.1	61.1	61.1	61.1	61.1	61.1	12	12	1.4	133.4	61.1	61.1	61.1	61.1	133.4	133.4	23.6	133.4	1.4	133.4	133.4	133.4	133.4	23.6	23.6	61.1	133.4	12	12
Chloride Concentration (ppm)	6.1	6.1	6.1	6.1	15.6	15.6	15.6	15.6	15.6	15.6	15.6	8.6	8.6	6.1	38.1	15.6	15.6	15.6	15.6	38.1	38.1	13.8	38.1	6.1	38.1	38.1	38.1	38.1	13.8	13.8	15.6	38.1	8.6	8.6
Abrasion Level	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2–5 Year Flow Velocity (ft/sec)	0.12	1.25	1.28	2.49	0.22	0.92	0.89	0.76	0.77	1.35	1.56	0.53	0.72	0.74	1.03	0.82	1.72	1.84	3.8	0.82	0.57	0.26	1.81	0.32	0.89	2.27	0.62	0.78	0.92	1.55	2.85	0.23	2.72	3.91
Design Service Life (years)	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Height of Cover (ft)	3.6	3.9	3.7	3.7	5.2	7.9	4.5	7.9	8.9	4.4	5.9	4.5	4.5	7.6	4.9	17	2.8	2.8	3.3	2.2	6.4	3.76	7	4.4	3.2	3.5	6.42	4.1	2.1	2.2	5.9	4.5	3	2

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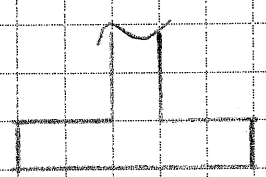
RETAINING WALL BEARING CAPACITY EVALUATION

RETAINING WALL NO. 1
(NORTH OF WILLIAMS ST OC TO NORTH OF MARINA BLVD - ALONG ROUTE 880 SB)

- APPROX. STA 339+50 TO 347+20

REFERENCE BORINGS: RW-7, RW-8 & RW-9
STANDARD TYPE 1 WALL, WALL HT: 6', 8', 10', 12'
WALL FOOTING ELEV. ≈ 20' ~ 21'±
PER BORINGS RW-7, RW-8 & RW-9, THE SUBSOILS ARE PRIMARILY FIRM TO STIFF CLAYS. EXISTING GRADE IS AT ELEV. 28' ~ 30'. GROUNDWATER WAS AT ELEV. 10' - 14'.
THE AVG. N (MOD. CAL) ≈ 17
ADOPT N SPT ≈ 11, SOIL STRENGTH, C ≈ 1350 psf.



CLAY
AVG. C = 1350 psf

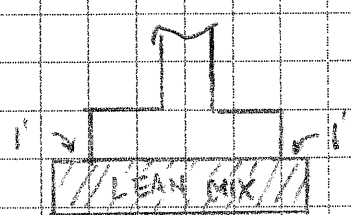
$q_{ult} = CN_c + \gamma D$
$= 5.53(1350) + (120)(3.5')$ (2' COVER, 1.5' ftg thick.)
$= 7885$ psf.

AVAILABLE $q_{allow} = q_{ult}/FS_{=3} \approx 2.6$ ksf.

ADOPT AVAILABLE $q_{allow} \approx 2.5$ ksf FOR DESIGN

∴ FOR WALL HT UP TO 10', FOOTING PRESSURE DEMAND ≈ 2.5 ksf
→ OKAY TO USE STANDARD TYPE 1 WALL

FOR WALL HT > 10', OVER-EX & REPLACE FOOTING SUBGRADE W/ LEAN CONCRETE TO REDUCE PRESSURE IN NATIVE SOIL TO ALLOWABLE BEARING



- H = 12', W = 7.25', q_{demand} = 2.9 ksf,
(USE 2' REPLACE BELOW FTG) → $q = 2.9 \times \frac{7.25'}{9.25'} = 2.3$ ksf OK

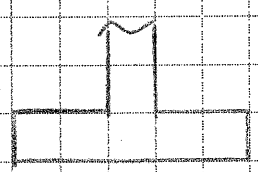
* THE 12' HIGH WALL IN STA. 347+20 TO 355+75 REQUIRES 3.5' OVER-EXCAVATION
∴ USE 3.5' REPLACEMENT FOR 12' HIGH WALL OVERALL.

RETAINING WALL NO. 1

- APPROX. STA. 347+20 TO 355+75

REFERENCE BORINGS: RW-10, OH-11, RW-12 & AS-BUILT B-1 (CALTRANS 1989) FOR WILLIAMS ST OC (33-169).

STANDARD TYPE 1 WALL, WALL HT = 8', 10', 12'
WALL FOOTING ELEV ≈ 22' ~ 23'
PER BORINGS RW-10, OH-11, RW-12 & AS-BUILT B-1, THE SUBSOILS ARE PRIMARILY FIRM CLAYS NEAR FOOTING LEVEL. GROUNDWATER WAS AT ELEV 19' ~ 20'.
THE AVG N (MOD. CAL) ≈ 13
ADOPT N-SPT ≈ 8 SOIL STRENGTH, C ≈ 1000 psf



CLAY
AVG. C ≈ 1000 psf

$q_{ult} = CN_c + \gamma D$
$= 5.53(1000) + (120)(3.5')$ ← 2' COVER, 1.5' ftg thick.
≈ 5950 psf.

AVAILABLE $q_{allow} = q_{ult}/FS_{=3} \approx 2$ ksf

NEED TO OVER-EX & REPLACE FOOTING SUBGRADE W/ LEAN CONCRETE TO REDUCE PRESSURE IN NATIVE SOIL TO ALLOWABLE BEARING.

- H = 8', W = 5.25', q demand = 2.2 ksf
  USE 2' REPLACE BELOW FTG → $q = 2.2 \times 5.25'/7.25' \approx 1.6$ ksf OK
- H = 10', W = 6.25', q demand = 2.5 ksf
  USE 2' REPLACE BELOW FTG → $q = 2.5 \times 6.25'/8.25' \approx 1.9$ ksf OK
- H = 12', W = 7.25', q demand = 2.9 ksf
  USE 3.5' REPLACE BELOW FTG → $q = 2.9 \times 7.25'/10.75' \approx 1.95$ ksf OK

RETAINING WALL NO. 2
(I-880 SB ON-RAMP FROM MARINA BLVD)

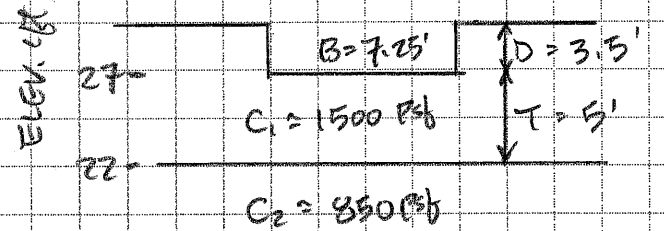
REFERENCE BORINGS: MR-2 & AS-BUILT B-2 (1962)

STANDARD TYPE I WALL (CALTRANS 2006 STD PLANS)
WALL HT = 4', 6', 8', 10' & 12'
FOOTING ELEV = 27' (TYPICAL)

PER THE BORING DATA, THE NEAR-SURFACE MATERIAL IS GENERALLY STIFF CLAY. AT ABOUT ELEV 20', THERE IS A LAYER OF FIRM CLAY (GW @ ELEV 16.5'). THIS FIRM LAYER GOVERNS FOOTING DESIGN OF WALL NO. 2.

PER NAVFAC DM 7.2, USE 2-LAYER SYSTEM TO VERIFY BEARING CAPACITY.

- WALL HT = 12'



ADOPT $C_1 = 1500$ psf (avg. of MR-2 & AS-BUILT)
$C_2 = 850$ psf (SPT-N = 7)

$C_2/C_1 = 850/1500 = 0.57$
$T/B = 5/7.25' = 0.69$ } $N_c = 4.2$
$D/B = 3.5/7.25' = 0.5 \rightarrow N_{CD}/N_c = 1.15$

$\therefore q_{net} = C_1 N_{CD} + \cancel{\gamma D}$
$= 1.5 \text{ ksf} \times 4.2 \times 1.15$
$= 7.2$ ksf

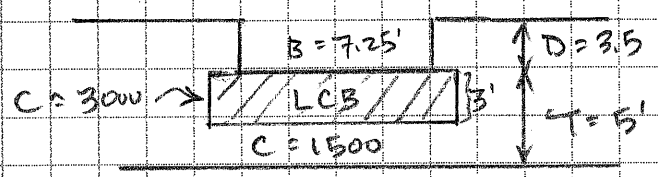
$\therefore q_{allow} = q_{net}/FS_{\sim 3} = 2.4$ ksf → THIS IS OK FOR H = 8'

* FOR STD TYPE I WALL UP TO 8' HIGH (TOE PRESSURE DEMAND = 2.2 ksf), NATIVE SOIL IS OK FOR SUPPORT

* FOR WALL HEIGHT OF 10' & 12', NEED TO IMPROVE FOOTING SUBGRADE BY OVER-EX & REPLACE W/ LCB

FOR WALL HEIGH = 10', THE TOE PRESSURE DEMAND IS 2.5 ksf ∴ MARGINAL CASE

CHECK WALL HEIGHT = 12'
IMPROVE FOOTING SUBGRADE BY OVER-EX & REPLACE WITH 3' LEAN CONCRETE BASE (LCB)



$C_2 = 850$ psf

ASSUME C = 3000 psf FOR LCB
AVG STRENGTH OF THE UPPER CRUST ≈ 3×.6 + 1.5×.4 = 2.4 ksf

∴ C_1 (AVG) ≈ 2400 psf
C_2 (WEAK LAYER) = 850 psf

$C_2/C_1 = 0.35$
$T/B = 0.69$ } $N_c = 3.7$
$D/B = 0.5 \rightarrow N_{cD}/N_c = 1.15$

∴ $q_{net} = C_1 N_{cD} + \gamma D$
$= 2.4 \times 3.7 \times 1.15 = 10$ ksf

$q_{allow} = q_{net}/FS = 3$ ksf. OK FOR H = 12' W/ TOE PRESSURE DEMAND ~ 2.8 ksf
(FS ≥ 3)

FOR WALL H = 12', SPECIFY OVER-EX & REPLACE W/ 3' LCB
TOE PRESSURE DEMAND ≈ 2.8 ksf < 3 ksf (IMPROVED CASE)

FOR WALL H = 10', USE MIN. 2' LCB TO REPLACE FOOTING SUBGRADE AS A MINIMUM.

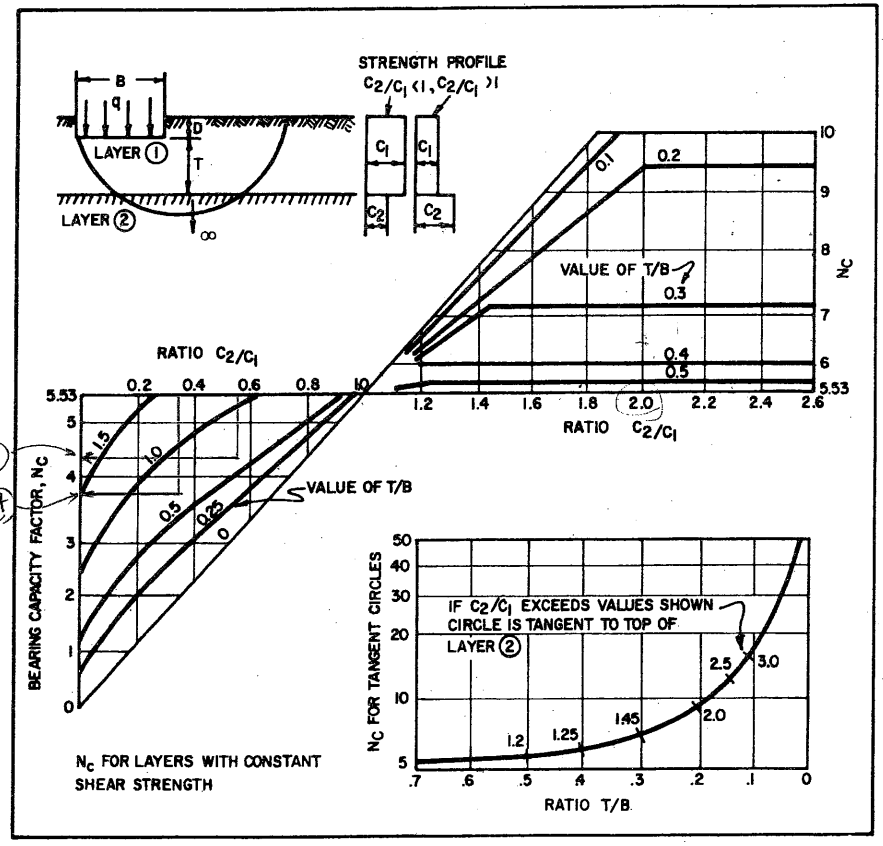
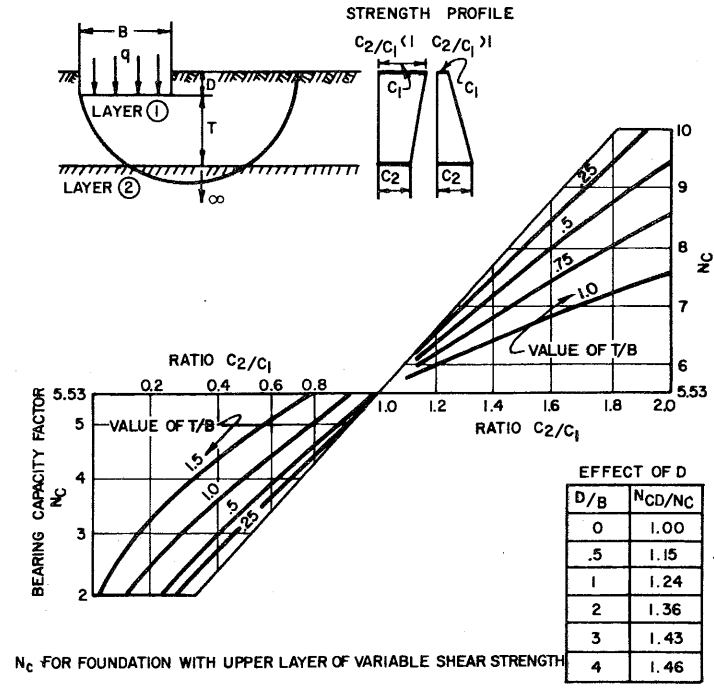


FIGURE 5
Ultimate Bearing Capacity of Two Layer Cohesive Soil (Ø=0)

C_2/C_1 > N_c > N_{CD} → $q_{ult} = C_1 N_{CD} + \gamma D$
T/B
D/B

REF: NAVFAC DM 7.2



EFFECT OF D

D/B	N_{CD}/N_C
0	1.00
.5	1.15
1	1.24
2	1.36
3	1.43
4	1.46

N_c FOR FOUNDATION WITH UPPER LAYER OF VARIABLE SHEAR STRENGTH

LEGEND

D = DEPTH OF EMBEDMENT OF FOOTING
N_C = BEARING CAPACITY FACTOR FOR CONTINUOUS FOOTING WITH D=0
N_{CD} = FACTOR FOR CONTINUOUS FOOTING WITH D>0
N_{CR} = FACTOR FOR RECTANGULAR FOOTING WITH D=0

CONTINUOUS FOOTING

$q_{ult} = c_1 N_{CD} + \gamma D$

RECTANGULAR FOOTING

$N_{CR} = N_{CD}\left[1+0.2\left(\frac{B}{L}\right)\right]$, $q_{ult} = c_1 N_{CR} + \gamma D$

N_{CD}/N_C FROM TABLE ABOVE

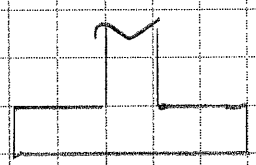
FIGURE 5 (continued)
Ultimate Bearing Capacity of Two Layer Cohesive Soil (Ø=0)

RETAINING WALL NO. 3
(DAVIS ST OC EAST APPROACH EMBANKMENT)

REFERENCE BORINGS: RW-17 & DV-1

STANDARD TYPE I WALL, WALL HT = 14', 16'
WALL FOOTING ELEV. = 31.5' ~ 36.5'

PER BORING RW-17 & CPT DV-1, THE SUBSOILS ARE GENERALLY STIFF CLAYS MIXED WITH SILTY SAND LAYER. EXISTING GRADE IS AT ELEV 30' to 36'. GROUNDWATER WAS AT ELEV. 22'. FOR PRACTICAL DESIGN, IT IS RECOMMEDED TO ASSUME FIRM TO STIFF CLAY AT FOOTING SUBGRADE FOR BEARING CAPACITY EVALUATION. PER CPT DV-1, ADOPT C = 1350 psf FOR DESIGN.



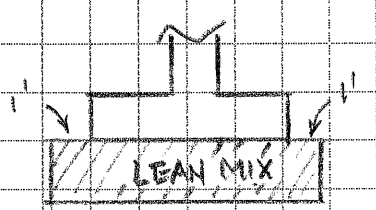
CLAY
AVG. C = 1350 psf

$q_{ult} = CN_c + \gamma D$ (2' cover + 1.5' ftg thick.)
$= 5.53(1350) + (120)(3.5)$
$= 7885$ psf

AVAILABLE $q_{allow} = q_{ult}/FS = 3 \sim 2.6$ ksf

ADOPT AVAILABLE $q_{allow} \simeq 2.5$ ksf FOR DESIGN

* FOR H = 14', MAX. FOOTING PRESSURE ≈ 3.3 ksf, FOOTING WIDTH = 8'
USE 3' OVER-EX & REPLACE W/ LEAN CONCRETE BELOW FOOTING SUBGRADE TO REDUCE THE PRESSURE IN NATIVE SOIL TO ALLOWABLE BEARING OF 2.5 ksf.



$3.3 \text{ ksf} \times 8'/(8+3) \simeq 2.4$ ksf OK.

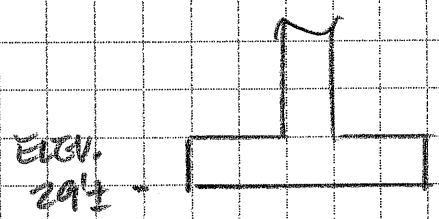
∴ USE 3' OVER-EX BELOW FTG, THE REPLACEMENT ALSO EXTENDS 1' BEYOND FTG WIDTH.

* FOR H = 16', FTG PRESSURE = 3.5 ksf (LOADING CASE 1), FTG W = 9'.
$3.5 \text{ ksf} \times 9'/(9+3.5') \simeq 2.5$ ksf, USE 3.5' REPLACE.

RETAINING WALL NO. 4
(ROUTE 880 NB OFF-RAMP TO MARINA BLVD).

REFERENCE BORING = BORINGS E-4 & E-5

STANDARD TYPE I WALL, MAX. WALL HT. ≈ 16'
FOOTING ELEV. ≈ 29' ~ 30'±
GROUNDWATER AT ELEV. 8.5'



STIFF CLAY
C = 2000 psf.
(SPT-N ≈ 16 avg.)

$q_{ult} = CN_c + \gamma D$

2' cover + 1.5' ftg thick

$= 5.53(2000) + (120)(3.5)$

$= 11480$ psf

$q_{allow} = q_{ult} / FS = 3$

$= 3826$ psf $= 3.8$ ksf.

WALL FOOTING PRESSURE DEMAND = 3.5 ksf (LOADING CASE I & H = 16' PER STANDARD PLAN)

∴ OKAY TO USE STANDARD TYPE I WALL.

RETAINING WALL SB-1
(ROUTE 880 SB OFF-RAMP TO DAVIS ST)

REFERENCE BORINGS: RW-22, RW-23
WALL TYPE: STANDARD SOUNDWALL ON RETAINING WALL (TYPE 5 SWB), WALL HT = 6', 8', 10' & 12'
WALL FOOTING ELEV. ≈ 24' ~ 25'

PER BORINGS RW-22 & RW-23, THE SUBSOILS AT THE PLANNED SUBGRADE LEVEL PRIMARILY CONSIST OF STIFF CLAY MIXED WITH GRAVEL. GROUNDWATER WAS AT ELEV 13' ~ 17'. ASSUME STIFF CLAY AT SUBGRADE TO EVALUATE BEARING CAPACITY.

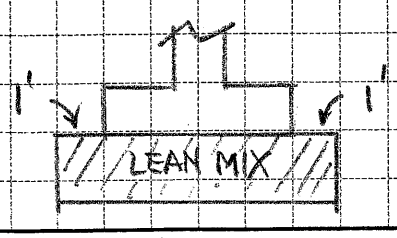
- CONSIDER THE MAX WALL HT AREA (BORING RW-22). THE AVG SOIL STRENGTH, C ≈ 1500 psf (Avg N-SPT ≈ 12.5) WITHIN 20' BELOW FTG. BORING RW-23 SHOWS WEAKER SOIL WITH AVG N-SPT ≈ 9-10, SAY C ≈ 1150 psf WITHIN 20' BELOW FTG.
- FOR PRACTICAL DESIGN, TAKE AVG SOIL STRENGTH, C = 1325 psf.

$q_{net} = 5.53\,C + \gamma D$
$= 5.53\,(1325) + (120)(3.5')$ — 2' cover, 1.5 ftg THICKNESS
$= 7.7$ ksf

FOR SOUNDWALL ON RETAINING TYPE 5SW, THE STANDARD PLANS SHOW ULTIMATE BEARING CAPACITY DEMAND

FOR H = 6', q_{net} = 6.3 ksf < 7.7 ksf ∴ OKAY TO USE STANDARD

FOR H = 8' & 10', q_{net} IS UP TO 8 & 9 ksf



NEED TO OVER-EX & REPLACE FOOTING SUBGRADE WITH LEAN CONCRETE TO REDUCE PRESSURE IN NATIVE SOIL TO BELOW AVAILABLE BEARING

- FOR H OF 8' & 10', W = 9.25', q_{net} = 9 ksf.

  USE 2' OVER-EX & REPLACE W/ LEAN CONCRETE BELOW FTG. THE REPLACEMENT ALSO EXTENDS 1' BEYOND FTG WIDTH.

  $$9^{ksf} \times \frac{9.25'}{11.25'} = 7.4^{ksf} < 7.7 \quad \underline{OK}$$

- FOR H = 12', W = 10', q_{net} = 10.3 ksf

  USE 3.5' OVER-EX & REPLACE W/ LEAN CONCRETE BELOW FTG. THE REPLACEMENT ALSO EXTENDS 1' BEYOND FTG WIDTH.

  $$10.3^{ksf} \times \frac{10'}{13.5'} = 7.6^{ksf} < 7.7 \quad \underline{OK}$$

- WALL SB-1 IS NEXT TO EXISTING SOUNDWALL (ON PILES). "SLOT" CONSTRUCTION IS RECOMMENDED FOR WALL FTG W/ OVER-EX & REPLACE OF LEAN CONCRETE.

STRUCTURAL PAVEMENT DESIGN

PARIKH
Practicing in the Geosciences

JOB ROUTE 880 SB - ALA 880 PM 22.5/25.5
SHEET NO OF
CALCULATED BY Y. DAVID WANG DATE 11/29/10
CHECKED BY DATE
SCALE 206139

ROUTE 880 SB HOV LANE EXTENSION

- PAVEMENT CALC - MAIN LINE WIDENING (MATCHING AS-BUILT AT P.B), TI=16.5
- PAVEMENT CALC - RAMP, TI=12

(COVER PAGE FOR HAND-CALC PAGES 1 THRU 11)

PARIKH

Practicing in the Geosciences

JOB ROUTE 880 - MARINA TO HEGENBERGER
SHEET NO OF
CALCULATED BY Y. DAVID WANG DATE 11/29/10
CHECKED BY DATE
SCALE 206139 pg 1/11

ROUTE 880 SB HOV LANE EXTENSION Ala 880-PM 22.5/25.5

- AS-BUILT SECTIONS CONSIST OF

(MARINA – DAVIS (1997)	(SAN LEANDRO CRK – HEGENBERGER (1998))
0.10' OGAC	0.10' OGAC
0.15' RAC-G	0.15' RAC-G
0.10 OGAC	0.10' OGAC
0.65' AC	0.65 AC
0.25' ATPB (W/ EDGE DRAIN)	0.25' ATPB (W/ EDGE DRAIN)
0.70' CTB	0.50' CTB
1.60' AS	1.55' AS

- THE AS-BUILT ATPB NEEDS TO BE PERPETUATED IN THE NEW SECTIONS.
- DESIGN TI = 16.5 (MAINLINE) > 20-YEAR DESIGN
  12 (RAMP)
- SUBGRADE R-VALUE DATA –

SUMMARY OF R-VALUE TEST RESULTS

ROUTE 880 SB HOV LANE EXTENSION Ala 880-PM 22.5/25.5

Boring No.	Station & Offset (ft.)	Date Drilled	Description	R-Value
R-1	"I-880" Line 314+49 82 Lt.	06/09/08	Clayey Sand	48
R-2	"I-880" Line 320+48 89 Lt.	06/09/08	Silty Gravel	82
R-3	"I-880" Line 324+34 70 Lt.	06/09/08	Lean Clay with Gravel	--
R-6	"I-880" Line 333+88 66' Lt.	06/09/08	Sandy Lean Clay	--
R-8	"I-880" Line 344+42 104' Lt	06/11/08	Clayey Sand	48
R-9	"I-880" Line 347+10 99' Lt.	06/11/08	Sandy Lean Clay with Gravel	--
R-10	"I-880" Line 349+97 87' Lt.	06/11/08	Lean Clay with Gravel	68
R-12	"I-880" Line 353+95 87' Lt.	06/10/08	Gravelly Lean Clay	--
R-13	"I-880" Line 365+43 81' Lt.	06/10/08	Sandy Lean Clay with Gravel	--
R-14	"I-880" Line 366+63 82' Lt.	06/09/08	Clayey Sand	58
R-15	"I-880" Line 369+06 182' Rt.	06/09/08	Sandy Lean Clay	16
R-16	"I-880" Line 370+05 417' Rt.	06/09/08	Sandy Lean Clay	--
R-18	"DA1" Line 21+92 112' Rt.	06/10/08	Clayey Sand	37
R-19	"DA1" Line 19+15 79' Rt.	06/10/08	Lean Clay with Gravel	--
R-20	"I-880" Line 375+43 749' Lt.	06/09/08	Clayey Sand	44
R-26	"I-880" Line 378+47 143' Lt.	06/09/08	Sandy Lean Clay	21
R-27	"I-880" Line 383+13 81' Lt.	06/09/08	Sandy Lean Clay with Gravel	--
R-29	"I-880" Line 393+28 83' Lt.	06/09/08	Sandy Lean Clay	26
R-33	"I-880" Line 419+13 83 Lt.	06/09/08	Silty Sand with Gravel	--
R-35	"I-880" Line 428+25 87' Lt.	06/16/08	Poorly-Graded Sand	--
R-36	"I-880" Line 428+31 84' Lt.	06/09/08	Clayey Sand	45
R-38	"I-880" Line 436+93 74' Lt.	06/16/08	Clayey Sand	47
R-40	"I-880" Line 446+85 87' Lt.	06/13/08	Clayey Gravel	73
R-41	"I-880" Line 456+02 100' Rt.	06/09/08	Sandy Clay	14

PM 22.5/24.0

PM 24.0/25.5

- PER CALTRANS COMMENT (7/28/09), IT IS REQUIRED TO SHOW PAVEMENT ALTERNATIVES, IDENTIFY THE PREFERRED ALTERNATIVES AND STATE REASONS FOR SELECTION.

- DESIGN R-VALUE
  THE PAVEMENT SUBGRADE IS EXISTING ROADWAY FILL/IMPORT THAT CONTAINS SUBSTANTIAL AMOUNT OF GRANULAR MATERIAL. THE LOWEST R-VALUE IS 14 ~ 16. MAJORITY ARE OVER 20. PER HDM 614.5 IT IS FEASIBLE TO USE A LAYER OF SUBGRADE ENHANCEMENT GEOTEXTILE (SEG) AND USE R-VALUE = 20 FOR DESIGN.

(I) MAINLINE WIDENING (TI = 16.5, R = 20)

CONSIDER THE FOLLOWING ALTERNATIVES:

(1) FLEXIBLE OPTION 1 - HMA, LCB & AS, NEED ATPB TO CONNECT TO EXIST. ATPB
(2) FLEXIBLE OPTION 2 - HMA, LCB & LIME TREATED SUBBASE (LTS), NEED ATPB
(3) FLEXIBLE OPTION 3 - FULL DEPTH HMA, NEED ATPB TO CONNECT TO EXIST. ATPB
(4) RIGID OPTION - JPCP, NEED ATPB

* FLEXIBLE OPTION 1 - HMA, LCB & AS (w/ ATPB)

$TI = 16.5$, $R_{base} = 20$ (w/ SEG), $R_{AS} = 50$ (CL.4 AS)

$$GE_{TOTAL} = 0.0032\, TI\,(100 - R_{base})$$
$$= 0.0032(16.5)(100-20)$$
$$= 4.22$$

$$GE_{HMA+ATPB+LCB} = 0.0032\, TI\,(100 - R_{AS})$$
$$= 0.0032(16.5)(100-50)$$
$$= 2.64$$

$$- GE_{HMA} = (GE_{HMA+ATPB+LCB})(0.4) + 0.2' = 1.26$$

$t > 0.5'$, $$G_f\,{}_{HMA} = (7.0)\frac{(t)^{1/3}}{(TI)^{1/2}} = (7.0)\frac{t^{1/3}}{16.5^{1/2}} = 1.72\,(t)^{1/3}$$

HMA THICKNESS $$t = GE_{HMA}/G_f = \frac{1.26}{1.72\,(t)^{1/3}}$$

$t \cdot t^{1/3} = \frac{1.26}{1.72}$, $t^{4/3} = 0.733$, $t = (0.733)^{3/4} = 0.79$

$G_{f\,HMA} = 1.72(t)^{1/3} = 1.59$, USE $G_f = 1.59$ FOR HMA

NEED TO USE $t = 0.90'$ OF HMA IN ORDER FOR ATPB TO MATCH AS-BUILT
$GE_{HMA} = 0.90 \times 1.59 = 1.43 > 1.26$ OK.

- ATPB LAYER ⟶ USE 0.25' ATPB TO MATCH AS-BUILT
  $G_{f\,ATPB} = 1.40$ ∴ $GE_{ATPB} = 0.25 \times 1.40 = 0.35$

- LCB LAYER
  $GE_{LCB} = GE_{HMA+ATPB+LCB} - GE_{HMA} - 0.35 + 0.2$
  $= 2.64 - 1.43 - 0.35 + 0.2 = 1.06$
  $G_{f\,LCB} = 1.9$ ∴ $t_{LCB} = 1.06/1.9 = 0.56'$

  USE $t_{LCB} = 0.60'$, $GE_{LCB} = 0.60 \times 1.9 = 1.14$

- AS LAYER
  $GE_{AS} = GE_{TOTAL} - GE_{HMA} - GE_{ATPB} - GE_{LCB}$
  $= 4.22 - 1.43 - 0.35 - 1.14 = 1.30$

CALCULATED SECTION: 0.90' HMA, 0.75' ATPB, 0.60' LCB & 1.30' AS

- THE AS-BUILT HAS 0.10' OGAC, 0.15' RAC-G, 0.10' OGAC ON TOP. ASLO THE EXISTING ATPB IS AT ~ 1.0' DEPTH. TRY TO MATCH THE AS-BUILT AS MUCH AS POSSIBLE. FOR SURFACE DRAINAGE, USE 0.10' OGFC & 0.15' RHMA-G TO REPLACE THE HMA (1:1 RATIO). OGFC HAS NO STRUCTURE VALUE

  ∴ PAVEMENT SECTION:
  0.10' OGFC
  0.15' RHMA-G
  0.75' HMA
  0.25' ATPB
  0.60' LCB
  1.30' AS OVER SEG

- IF THERE IS NO AS-BUILT ATPB TO MATCH, REPLACE THE 0.25' ATPB W/ 0.25' HMA.

* FLEXIBLE OPTION 2 - HMA, LCB & LTS (W ATPB)

- USE LIME TREATED SUBBASE (LTS), SPECIFY UNCONFINED COMP STRENGTH (UCS) = 300 PSI (HDM 614.4), AND $G_f = 1.2$ FOR LTS. USE 1.5' LTS, WHICH IS THE LIMIT CONTRACTOR CAN MIX & COMPACT IN ONE LIFT.

- USE 1.5' LTS, $GE_{LTS} = 1.5' \times 1.2 = 1.8$
- NATIVE R = 14, TI = 16.5

$$GE_{TOTAL} = 0.0032\, TI\,(100 - R_{native})$$
$$= 0.0032\,(16.5)(100-14)$$
$$= 4.54$$

$$GE_{HMA+ATPB+LCB} = GE_{TOTAL} - GE_{LTS}$$
$$= 4.54 - 1.8 = 2.74$$

$$GE_{HMA} = (GE_{HMA+ATPB+LCB})(0.4) + 0.2'$$
$$= (2.74)(0.4) + 0.2 = 1.30'$$

$t > 0.5'$, $G_{f\,HMA} = (7.0)\dfrac{t^{1/3}}{(TI)^{1/2}} = 1.72\,(t)^{1/3}$

HMA THICKNESS $t = GE_{HMA}/G_f = \dfrac{1.30}{1.72\,t^{1/3}}$

$t \cdot t^{1/3} = \dfrac{1.30}{1.72}$, $t^{4/3} = 0.756$, $t = (0.756)^{3/4} = 0.81'$ NEED TO USE 0.90'

NEED TO USE t = 0.90' TO LINE UP ATPB W/ THE AS-BUILT

$G_{f\,HMA} = 1.72\,(0.9)^{1/3} = 1.66$

$GE_{HMA} = 0.9' \times 1.66 = 1.49$

- ATPB LAYER → USE 0.25' ATPB TO MATCH AS-BUILT

$G_{f\,ATPB} = 1.40$, $GE_{ATPB} = 0.25 \times 1.4 = 0.35$

- LCB LAYER

$$GE_{LCB} = GE_{TOTAL} - GE_{HMA} - GE_{ATPB} - GE_{LTS}$$
$$= 4.54 - 1.49 - 0.35 - 1.8$$
$$= 0.90$$

$G_{f\,LCB} = 1.9$, ∴ $t_{LCB} = 0.9/1.9 = 0.47'$, USE LCB $t = 0.50'$

CALCULATED SECTION: 0.90' HMA, 0.25' ATPB, 0.50' LCB & 1.50' LTS
NEED TO USE 0.10' OGFC (WEARING SURFACE) & MATCH AS-BUILT ATPB (@ 1.0' DEPTH)

∴ PAVEMENT SECTIONS:

0.10' OGFC
0.90' HMA
0.25' ATPB
0.50' LCB
1.50' LTS

* FLEXIBLE OPTION 3 - FULL DEPTH HMA (W/ ATPB)

$GE_{TOTAL} = 0.0032\,TI\,(100 - R_{base})$
$= 0.0032\,(16.5)\,(100 - 20)$ w/ SEG
$= 4.22$

FULL DEPTH, $GE_{HMA} = 4.22 + 0.1\,(FS) - GE_{ATPB}$ ← 0.25'
$= 4.32 - 0.35 = 3.97$

$G_f = (7.0)\dfrac{t^{1/3}}{TI^{1/2}} = 7.0\dfrac{t^{1/3}}{16.5^{1/2}} = 1.72\,t^{1/3}$

FULL DEPTH THICKNESS $t = GE_{HMA}/G_f = \dfrac{3.97}{1.72\,t^{1/3}}$

$t \cdot t^{1/3} = \dfrac{3.97}{1.72}$, $t^{4/3} = 2.31$, $t = (2.31)^{3/4} = 1.87$, USE $t = 1.90'$ (FULL DEPTH)

- PER HDM 633.1(3), PLACE MIN. 0.5' AB (CL.2) UNDERNEATH.

CALCULATED SECTION: 1.90' HMA, 0.25' ATPB, 0.50' AB
NEED TO USE 0.10' OGFC (WEARING SURFACE) & MATCH AS-BUILT ATPB (@ 1.0' DEPTH). SANDWICH THE ATPB IN-BETWEEN HMA.

∴ PAVEMENT SECTIONS:

0.10' OGFC
0.90' HMA
0.25' ATPB
1.00' HMA
0.50' AB (CL.2) OVER SEG

FLEXIBLE OPTION 3A - FULL DEPTH HMA
(WITHOUT AS-BUILT ATPB)

$GE_{TOTAL} = 0.0032\,TI\,(100 - R_{base})$
$= 0.0032\,(16.5)\,(100 - 20)$
$= 4.22$

FULL DEPTH, $GE_{HMA} = 4.22 + 0.1\,(FS) = 4.32$

$$G_f = 7.0\frac{t^{1/3}}{TI^{1/2}} = 7.0\frac{t^{1/3}}{16.5^{1/2}} = 1.72\,t^{1/3}$$

$$t = GE/G_f = \frac{4.32}{1.72\,t^{1/3}}$$

$$t \cdot t^{1/3} = \frac{4.32}{1.72}, \quad t^{4/3} = 2.51, \quad t = (2.51)^{3/4} = 1.99,$$

$\therefore$ USE $t = 2.0$.

USE 0.10' OGFC (WEARING SURFACE) & EXTRA 0.50' AB TO IMPROVE PERFORMANCE

PAVEMENT SECTIONS : 0.10' OGFC
2.00' HMA
0.50' AB (CL 2)

* RIGID OPTION - JPCP

THE SUBGRADE R VALUE DATA FITS TYPE II SOIL OF HDM TABLE 623.1A. THE DESIG CAN DIRECTLY FOLLOW TABLE 623.1E. FOR TI = 16.5, HDM TABLE 623.1E (CENTRAL COAST, TYPE II SUBGRADE SOIL) INDICATE 1.10' JPCP, 0.50 LCB & 0.70' AS

THE FOOTNOTES OF TABLE 623.1E INDICATE THAT ATPB SHOULD BE PLACED BETWEEN THE SURFACE LAYER (JPCP) AND THE BASE LAYER. FOR SURFACE DRAINAGE PURPOSE, NEED 0.10' OGFC ON TOP OF THE JPCP (HDM 631.2, NEEDS MODIFIED BINDER) TO PROVIDE DRAINAGE OVER THE FULL CROSS SECTION WIDTH OF THE FREEWAY TO AVOID "BATHTUB".

PAVEMENT SECTIONS:

0.10' OGFC
1.10' JPCP
0.25' ATPB (TABLE 623.1E. FOOTNOTE)
0.50' LCB
0.70' AS

(* NOTE THE ATPB LAYER IS AT DIFFERENT ELEV. OF THE AS-BUILT ATPB. THE CONNECTION WOULD BE COMPLICATED AND MAY HAVE TO SACRIFICE THE JPCP THICKNESS.)

THIS OPTION IS NOT SUITABLE & NOT ADOPTED.

(II) RAMP (TI = 12, R = 20)

CONSIDER THE FOLLOWING ALTERNATIVES:

(1) FLEXIBLE OPTION 1 - HMA, LCB & AS
(2) FLEXIBLE OPTION 2 - HMA, LCB & LIME TREATED SUBBASE (LTS)
(3) FLEXIBLE OPTION 3 - FULL DEPTH HMA
(4) RIGID OPTION - JPCP

* FLEXIBLE OPTION 1 - HMA, LCB & AS

TI = 12, R_{base} = 20 (W/ SEG), R_{AS} = 50 (CL. 4 AS)

$GE_{TOTAL} = 0.0032\ TI(100 - R_{base})$
$= 0.0032(12)(100 - 20)$
$= 3.07$

- HMA, LCB & AS

$GE_{HMA+LCB} = 0.0032\ TI(100 - R_{AS})$
$= 0.0032(12)(100 - 50)$
$= 1.92$

- $GE_{HMA} = (GE_{HMA+LCB})(0.4) + 0.2' = 0.97$

$t > 0.5'$, $G_{f\,HMA} = (7.0)\dfrac{t^{1/3}}{TI^{1/2}} = 7.0\dfrac{t^{1/3}}{12^{1/2}} = 1.87\,t^{1/3}$

HMA THICKNESS $t = GE_{HMA}/G_f = \dfrac{0.97}{1.87\,t^{1/3}}$

$t \cdot t^{1/3} = \dfrac{0.97}{1.87}$, $t^{4/3} = 0.52$, $t = (0.52)^{3/4} = 0.61'$

USE HMA $t = 0.60'$ $G_f = 1.87\,t^{1/3} = 1.58$, $GE_{HMA} = 0.95$

- LCB LAYER

$GE_{LCB} = GE_{HMA+LCB} - GE_{HMA} + 0.2$
$= 1.92 - 0.95 + 0.2 = 1.17$, $G_{f\,LCB} = 1.9$

$t_{LCB} = 1.17/1.9 = 0.62'$, USE $t_{LCB} = 0.65'$, $GE_{LCB} = 1.24$

- AS LAYER

$GE_{AS} = GE_{TOTAL} - GE_{HMA} - GE_{LCB}$
$= 3.07 - 0.95 - 1.24 = 0.88$ USE $t_{AS} = 0.90'$

PAVEMENT SECTIONS: 0.60' HMA
0.65' LCB
0.90' AS OVER SEG

* FLEXIBLE OPTION 2 - HMA, LCB & LTS

- USE LIME TREATED SUBBASE (LTS). SPECIFY UNCONFINED COMP STRENGTH (UCS) = 300 PSI (HDM 614.4), AND $G_f = 1.2$ FOR LTS. USE 1.5' LTS, WHICH IS THE LIMIT CONTRACTOR CAN MIX & COMPACT IN ONE LIFT.

- USE 1.5' LTS, $GE_{LTS} = 1.5 \times 1.2 = 1.8$
- NATIVE R = 14, TI = 12

$$GE_{TOTAL} = 0.0032\,TI\,(100 - R_{native})$$
$$= 0.0032\,(12)\,(100-14)$$
$$= 3.30$$

$$GE_{HMA+LCB} = GE_{TOTAL} - GE_{LTS}$$
$$= 3.30 - 1.8 = 1.5$$

$$GE_{HMA} = (GE_{HMA+LCB})(0.4) + 0.2$$
$$= (1.5)(0.4) + 0.2 = 0.8$$

$$t > 0.5', \quad G_{f\,HMA} = (7.0)\frac{t^{1/3}}{(TI)^{1/2}} = 7.0\frac{t^{1/3}}{12^{1/2}} = 1.87\,t^{1/3}$$

HMA THICKNESS $t = GE_{HMA}/G_f = \dfrac{0.8}{1.87\,t^{1/3}}$

$$t \cdot t^{1/3} = \frac{0.8}{1.87}, \quad t^{4/3} = 0.428, \quad t = (0.428)^{3/4} = 0.53'$$

USE $t_{HMA} = 0.55'$, $G_{f\,HMA} = 1.87\,t^{1/3} = 1.53$

$$GE_{HMA} = 0.55' \times 1.53 = 0.84$$

- LCB LAYER

$$GE_{LCB} = GE_{TOTAL} - GE_{HMA} - GE_{LTS}$$
$$= 3.30 - 0.84 - 1.8$$
$$= 0.66$$

$G_{f\,LCB} = 1.9$ ∴ $t_{LCB} = 0.66/1.9 = 0.35$. USE $t_{LCB} = 0.35'$

PAVEMENT SECTIONS:

0.55' HMA
0.35' LCB
1.50' LTS

x FLEXIBLE OPTION 3 - FULL DEPTH HMA

$GE_{TOTAL} = 0.0032\ TI\,(100 - R_{base})$
$= 0.0032\,(12)(100 - 20)$ w/ SEG
$= 3.07$

FULL DEPTH, $GE_{HMA} = 3.07 + 0.1\ (CFS)$
$= 3.17$

$G_f = 7.0 \dfrac{t^{1/3}}{TI^{1/2}} = 7.0 \dfrac{t^{1/3}}{12^{1/2}} = 1.87\ t^{1/3}$

FULL DEPTH THICKNESS $t = GE_{HMA}/G_f = \dfrac{3.17}{1.87\,t^{1/3}}$

$t \cdot t^{1/3} = \dfrac{3.17}{1.87}$, $t^{4/3} = 1.70$, $t = (1.70)^{3/4} = 1.49$

USE $t = 1.50'$ (FULL DEPTH HMA)

- PER HDM 633.1(3), PLACE MIN. 0.5' AB (Cl. 2) UNDERNEATH.

∴ PAVEMENT SECTIONS:

1.50' HMA
0.50' AB (Cl. 2) OVER SEG

* RIGID OPTION - JPCP

THE SUBGRADE R-VALUE DATA FITS TYPE II SOIL OF HDM TABLE 623.1A. THE DESIGN CAN DIRECTLY FOLLOW TABLE 623.1E. FOR TI = 12 HDM TABLE 623.1E (CENTRAL COAST, TYPE II SUBGRADE SOIL) INDICATE 0.85' JPCP, 0.40' LCB & 0.60' AS

PAVEMENT SECTIONS: 0.85' JPCP
0.40' LCB
0.60' AS

PAVEMENT DESIGN

PER HIGHWAY DESIGN MANUAL, CHAP. 600

MARINA BLVD & DAVIS STREET

PROJECT NAME: *Route 880 - Marina Blvd to Davis St*
PROJECT NO.: *206139.WNH*

Design Case: AC over AB over AS

Design TI=	***12***	
R_{BS}=	***20***	
R_{AB}=	78	
R_{AS}=	50	(Class 4 AS)

$GE_{TOTAL} = 0..0032*TI*(100-R_{BS}) =$ 3.07

$GE_{AC} = 0.0032*TI*(100-R_{AB}) =$ 0.84

=> GE'_{AC} = 1.04 (add 0.2 ft safety factor)

AC thickness = 0.61 ft

=> AC Thickness= **0.65** ft (round up to the nearest 0.05 ft)

$G_{f,AC}$= 1.75

GE_{AC}= 1.14

$GE_{AB+AC} = 0.0032*TI*(100-R_{AS}) =$ 1.92

=> GE_{AC+AB}= 2.12 (add 0.2 ft safety factor)

$GE_{AB} = GE_{AC+AB} - GE_{AC} =$ 0.98

=> AB thickness= 0.89

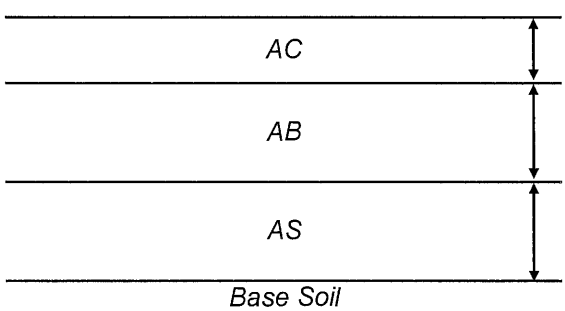
=> AB Thickness= **0.90** ft (round up to the nearest 0.05 ft)

GE_{AB}= 0.99 $G_{f,AB}$=1.1

$GE_{AS} = GE_{TOTAL} - GE_{AB} - GE_{AC} =$ 0.94

=> AS Thickness= **0.95** ft (round up to the nearest 0.05 ft)

Design Section:



0.65 ft

0.90 ft

0.95 ft

PAVEMENT DESIGN

PER HIGHWAY DESIGN MANUAL, CHAP. 600

MARINA BLVD & DAVIS STREET

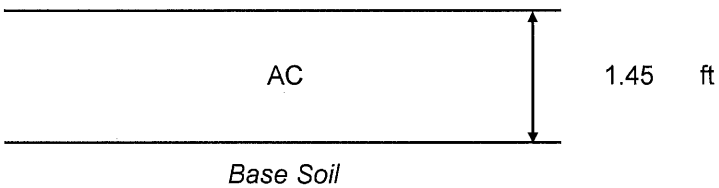
PROJECT NAME: *Route 880 - Marina Blvd to Davis St*
PROJECT NO.: *206139.WNH*

Design Case: Full depth AC

Design TI= ***12***
R_{BS}= ***20***

$GE_{AC} = 0.0032*TI*(100-R_{BS}) =$		3.07	
=>	GE'_{AC}=	3.17	(add 0.1 ft safety factor)
=>	AC Thickness=	1.40	
=>	AC Thickness=	**1.45**	ft (round up to the nearest 0.05 ft)

Design Section:



PAVEMENT DESIGN

PER HIGHWAY DESIGN MANUAL, CHAP. 600

TEMPORARY PAVEMENT

PROJECT NAME: *Route 880 - Marina Blvd to Davis St*
PROJECT NO.: *206139.WMH*

Design Case: AC over AB over AS

Design TI=	***9***	
R_{BS}=	***15***	
R_{AB}=	78	
R_{AS}=	50	(Class 4 AS)

$GE_{TOTAL} = 0..0032*TI*(100-R_{BS}) =$ 2.45

$GE_{AC} = 0.0032*TI*(100-R_{AB}) =$ 0.63

=> GE'_{AC} = 0.83 (add 0.2 ft safety factor)

AC thickness = 0.44 ft

=> AC Thickness= **0.45** ft (round up to the nearest 0.05 ft)

$G_{f,\,AC}$= 1.89

GE_{AC}= 0.85

$GE_{AB+AC} = 0.0032*TI*(100-R_{AS}) =$ 1.44

=> GE_{AC+AB}= 1.64 (add 0.2 ft safety factor)

$GE_{AB} = GE_{AC+AB} - GE_{AC} =$ 0.79

=> AB thickness= 0.72

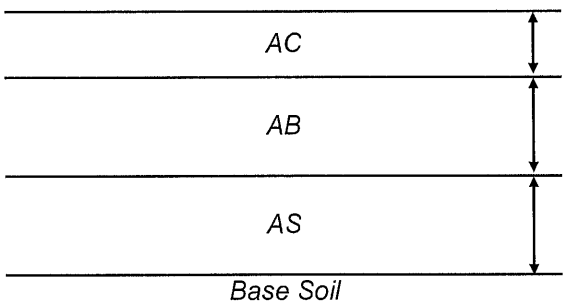
=> AB Thickness= **0.75** ft (round up to the nearest 0.05 ft)

GE_{AB}= 0.83 $G_{f,\,AB}$=1.1

$GE_{AS} = GE_{TOTAL} - GE_{AB} - GE_{AC} =$ 0.77

=> AS Thickness= **0.80** ft (round up to the nearest 0.05 ft)

Design Section:



0.45 ft

0.75 ft

0.80 ft

PAVEMENT DESIGN

PER HIGHWAY DESIGN MANUAL, CHAP. 600

TEMPORARY PAVEMENT

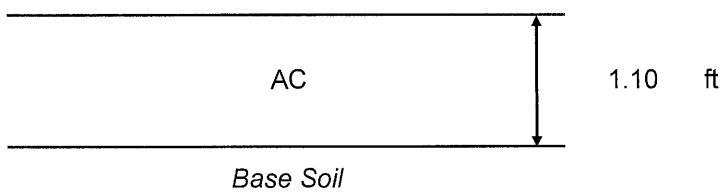
PROJECT NAME: *Route 880 - Marina Blvd to Davis St*
PROJECT NO.: *206139.WMH*

Design Case: Full depth AC

Design TI= ***9***
R_{BS}= ***15***

$GE_{AC} = 0.0032*TI*(100-R_{BS}) =$		2.45	
=>	GE'_{AC}=	2.55	(add 0.1 ft safety factor)
=>	AC Thickness=	1.07	
=>	AC Thickness=	**1.10**	ft (round up to the nearest 0.05 ft)

Design Section:



PAVEMENT DESIGN

PER HIGHWAY DESIGN MANUAL, CHAP. 600

PROJECT NAME: *Route 880 - Marina Blvd to Davis St*
PROJECT NO.: *206139.WMH*

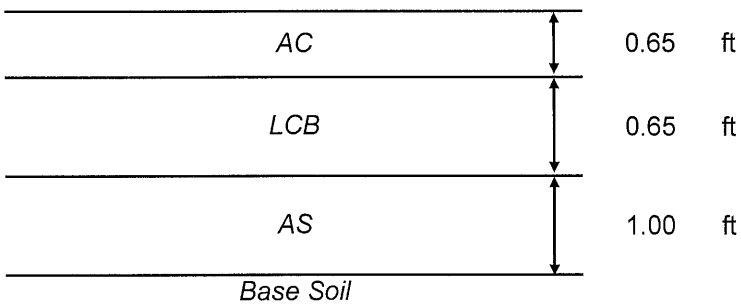
MEDIAN AT BRIDGE BENTS (MARINA BLVD & DAVIS STREET) DUE TO BRIDGE CONSTRUCTION

Design Case: AC over LCB over AS

Design TI=	***13***	
R_{BS}=	***20***	
R_{AB}=	***78***	
R_{AS}=	50	(Class 4 AS)

$GE_{TOTAL} = 0.0032*TI*(100-R_{BS}) =$		3.33	
$GE_{AC+LCB} = 0.0032*TI*(100-R_{AS}) =$		2.08	
$GE_{AC} = 0.4*GE_{AC+LCB} =$		0.83	
=>	GE'_{AC} =	1.03	(add 0.2 ft safety factor)
	AC thickness =	0.62	ft
=>	AC Thickness=	**0.65**	ft (round up to the nearest 0.05 ft)
	$G_{f,\,AC}$=	1.68	
	GE_{AC}=	1.09	
$GE_{LCB} = (GE_{AC+LCB})-GE_{AC} =$		0.99	
=>	GE_{AC+AB}=	1.19	(add 0.2 ft safety factor)
	$G_{f,\,LCB}$=	1.90	
	LCB thickness=	0.62	
=>	LCB Thickness=	**0.65**	ft (round up to the nearest 0.05 ft)
	GE_{LCB}=	1.24	
$GE_{AS} = GE_{TOTAL} - GE_{LCB} - GE_{AC} =$		1.00	
=>	AS Thickness=	**1.00**	ft (round up to the nearest 0.05 ft)

Design Section:



0.65 ft

0.65 ft

1.00 ft

PAVEMENT DESIGN

PER HIGHWAY DESIGN MANUAL, CHAP. 600

PROJECT NAME: *Route 880 - Marina Blvd to Davis St*
PROJECT NO.: *206139.WMH*

MEDIAN AT BRIDGE BENTS (MARINA BLVD & DAVIS STREET) DUE TO BRIDGE CONSTRUCTION

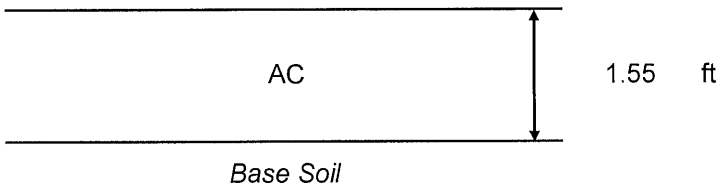
Design Case: Full depth AC

Design TI= ***13***
R_{BS}= ***20***

$GE_{AC} = 0.0032*TI*(100-R_{BS}) =$ 3.33
=> GE'_{AC}= 3.43 (add 0.1 ft safety factor)
=> AC Thickness= 1.53

=> AC Thickness= **1.55** ft (round up to the nearest 0.05 ft)

Design Section:



APPENDIX D

As-Built Structural Pavement Sections

Contract No.	Date
04-OC7024	11/2002
04-213404	12/1999
04-123174	12/1997 & 11/1995
04-292014	undated (Document No. 40000761)
04-174364	8/1970 (Document No. 40001996)
04-292024	3/1966 (Document No. 40000001)
56-14TC21-F	undated (Document No. 40000760)
51-4TC17	undated (Document No. 40000759)

2002

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	880	24.6/44.5	2	85

Vijith Thilakaratne 04-27-00
REGISTERED CIVIL ENGINEER

6-12-00
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER V. Thilakaratne No. 51278 Exp. 9-30-01 CIVIL STATE OF CALIFORNIA

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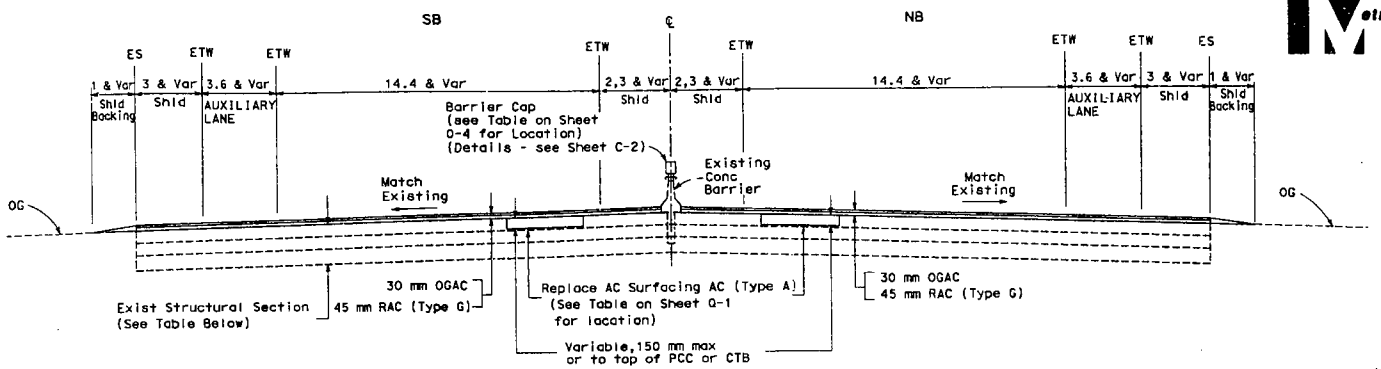
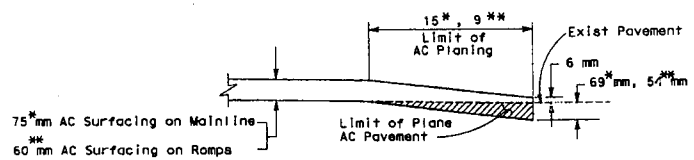
Caltrans now has a web site! To get to the web site, go to http://www.dot.ca.gov



TYPICAL CROSS SECTION

FROM KP 24.6 (PM 15.3) TO KP 44.5 (PM 27.6)



AC PLANING AT CONFORM

*For conform on the mainline at project limits, approach slabs of bridges, undercrossings and at ramps with no new AC surfacing. For conforming to pavement underneath overcrossings, use detail A on C-1

** For conform on ramps

DETAIL A

EXISTING MAINLINE STRUCTURAL SECTION

KILOMETER POST (POSTMILE)	DESCRIPTION: Inside Shoulder	#1,#2,#3 Lanes	#4 & Auxiliary Lane	Outside Shoulder
25.2(15.6) Tennyson Road to 29.5(18.4) "A" Street Northbound + Southbound	30 mm OGAC 200 mm AC 70 mm ATPB 210 mm CTB 375 mm AS	30 mm OGAC 110 mm AC 200 mm PCC 105 mm CTB 250 mm AS	30 mm OGAC 200 mm AC 75 mm ATPB 210 mm CTB 375 mm AS	30 mm OGAC 200 mm AC 75 mm ATPB 210 mm CTB 375 mm AS
29.5(18.4) "A" Street to 32.4(20.2) Hesperian Boulevard Northbound + Southbound	30 mm OGAC 200 mm AC 210 mm CTB 480 mm AS	30 mm OGAC 110 mm AC 200 mm PCC 105 mm CTB 250 mm AS	30 mm OGAC 200 mm AC 75 mm ATPB 210 mm CTB 375 mm AS	30 mm OGAC 200 mm AC 75 mm ATPB 210 mm CTB 375 mm AS
32.4(20.2) Hesperian Boulevard to 33.5(20.8) Washington Avenue Northbound + Southbound	30 mm OGAC 200 mm AC 210 mm CTB 480 mm AS	30 mm OGAC Var 60-150 mm AC 200 mm PCC 105 mm CTB 250 mm AS	30 mm OGAC 170 mm AC 300 mm CTB 300 mm AS	30 mm OGAC Var 105-170 mm AC 150 mm AB 450 mm AS
33.5(20.8) Washington Avenue to 38.1(23.6) Davis Street Northbound + Southbound	30 mm OGAC Var60-150 mm AC 20 mm PCC 100 mm CTB 400mm AB	30 mm OGAC Var 60-150 mm AC 200 mm PCC 400 mm AS	30 mm OGAC 170 mm AC 300 mm CTB 300 mm AS	30 mm OGAC Var 105-170 mm AC 150 mm AB 450 mm AS
38.1(23.6) Davis Street to 41.0(25.5) Hegenberger Road Northbound + Southbound	260 mm AC 150 mm CTB 375 mm AS	30 mm OGAC Var 100-150 mm AC 200 mm PCC 300 mm AS	200 mm AC 75 mm ATPB 300 mm CTB 465 mm AS	300 mm AC 75 mm ATPB 300 mm CTB 465 mm AS
41.0(25.5) Hegenberger Road to 44.5(27.6) High Street Overhead Northbound + Southbound	50 mm AC Var600 mm AS	30 mm CGAC 175 mm AC 200 mm PCC 100 mm CTB 400 mm AS	30 mm OGAC 200 mm AC 250 mm CTB 200 mm AS	50 mm AC 150 mm AB

200mm

NOTES:

1. Dimensions of the structural sections are subject to tolerances specified in the Standard Specifications.
2. Superelevation as shown or as directed by the Engineer.
3. No AC surfacing on structures, structure approach slabs and PCC Pavement.
4. Existing utility facilities have not been plotted on these plans.
5. See detail on C-2 for cross drainage correction between 98th Ave and Hegenberger Ave on southbound Route 880.

NO Construction Changes

CONTRACT No. 04-0C7024
DATE ACCEPTED 11/14/02
AS BUILT
RESIDENT ENGINEER S KANSIL

TYPICAL CROSS SECTIONS

NO SCALE

All Dimensions are in Meters unless otherwise shown

X-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans PROJECT DEVELOPMENT
PROJECT ENGINEER: VIJITH THILAKARATNE
CALCULATED/DESIGNED BY | CHECKED BY
DATE REVISED BY | DATE REVISED

LAST REVISION 04-22-00 | DATE PLOTTED => 25-MAR-2003 | TIME PLOTTED => 15:01

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => cburks
DGN FILE => 40c702b01.dgn

CU 04233 | EA 0C7021

04-OC7024
11/14/2002

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO	TOTAL SHEETS
04	Ala	880	38.0/50.0	1	47

STATE OF CALIFORNIA

DEPARTMENT OF TRANSPORTATION

ACIM-ACIMG-880-1(037)33E

PROJECT PLANS FOR CONSTRUCTION ON

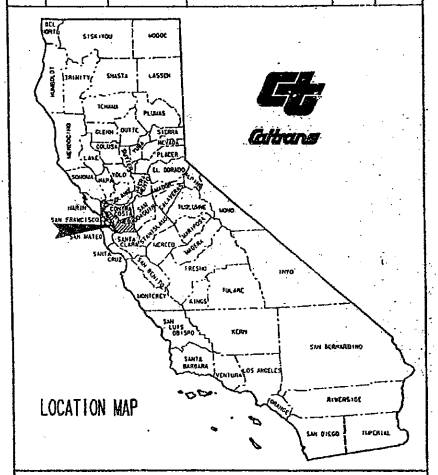
STATE HIGHWAY

IN ALAMEDA COUNTY
IN OAKLAND AND SAN LEANDRO
FROM ROUTE 112/880 SEPARATION
TO MADISON STREET UNDERCROSSING

To be supplemented by Standard Plans dated July, 1995

INDEX OF SHEETS

Sheet No.	
1	Title and Location Map
2-4	Typical Cross Sections
5-6	Standard Plans List
7-17	Layouts
18-21	Construction Details
22-26	Drainage Details and Quantities
27-28	Construction Area Signs
29-39	Pavement Delineation Plans, Details and quantities
40-41	Summary of Quantities
42	Sign Details
43	Electrical Plans
44-47	Revised Standard Plans



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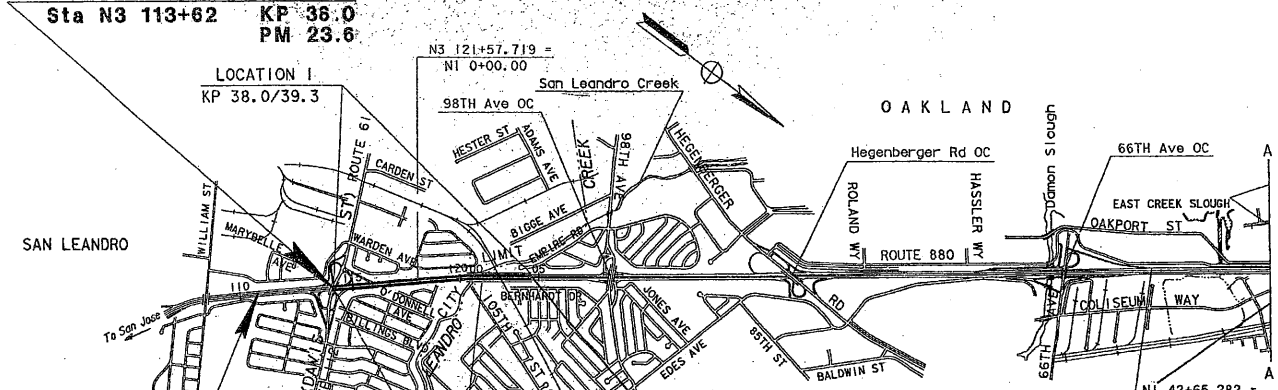
BEGIN CONSTRUCTION
Sta N3 113+62 KP 36.0
PM 23.6



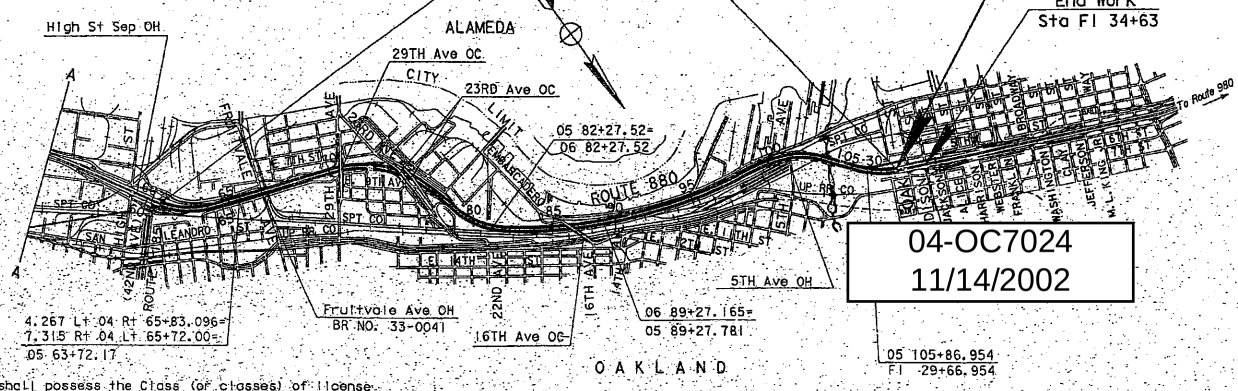
NO CONSTRUCTION THIS PORTION
Sta N1 4+76 to Sta 04 61+19
KP 39.3/KP43.5

END CONSTRUCTION
Sta F1 32+97 KP 50.0
PM 31.1

Begin Work
Sta N3 112+12

Route 112/880 Separation

San Leandro Creek Bridge OH
Br No 33-0100 OH



04-OC7024
11/14/2002

NO CONSTRUCTION CHANGES
CONTRACT No. 04-213404
DATE ACCEPTED 12-27-99
AS BUILT
RESIDENT ENGINEER

4-16-97
Project Engineer Date
Registered Civil Engineer

June 23, 1997
Plans Approval Date

REGISTERED PROFESSIONAL ENGINEER
D.N. Lee
No. 28032
Exp. 3-31-98
CIVIL
STATE OF CALIFORNIA

The Contractor shall possess the Class (or classes) of license as specified in the "Notice to Contractors".

Contract No. 04-2134U4

04-213404
12/27/1999

PROJECT ENGINEER: D.N. LEE | DATE | PROJECT ENGINEER: R.E. BAXTER | DATE

LAST REVISION 04-15-97 | DATE PLOTTED => 26-Jun-1997 | TIME PLOTTED => 15:04

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO	TOTAL SHEETS
04	Ala	880	38.0/50.0	2	47

REGISTERED CIVIL ENGINEER 4-16-97

6-23-97
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER D.N. Le No. 28032 Exp. 3-31-98 CIVIL STATE OF CALIFORNIA

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

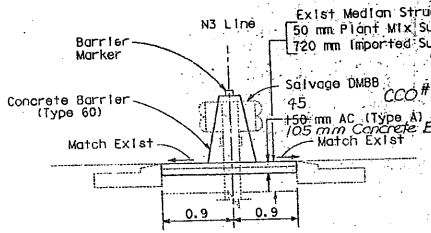
4 Caltrans Metric

NOTES:

1. Dimensions of the structural sections are subject to tolerances specified in the Standard Specifications.
2. All existing DMBB and SMBB are with wood post except noted.
3. Superelevation as shown, or as directed by the Engineer.
4. For work within median, see sheets X-1 and X-2.
5. For locations and limits of replace asphalt concrete surfacing and replace concrete pavement, see Layout sheets.
6. For Concrete Barrier Details not shown, see Sheets C-3 and C-4.
7. For offset roadway surface "H" see sheet C-3.

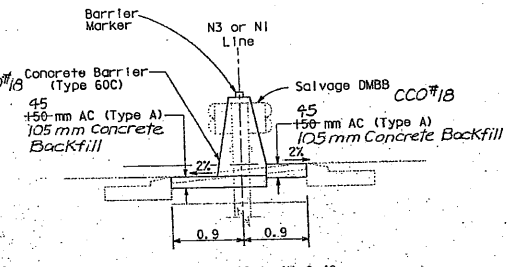
ABBREVIATION

SMBB - SINGLE METAL BEAM BARRIER



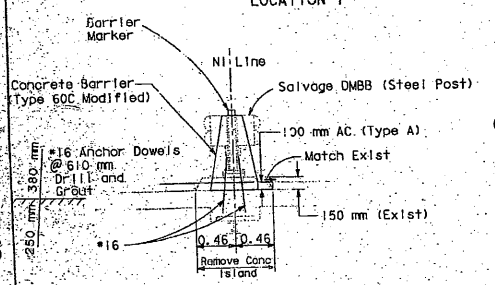
Sta N3 113+62.25 to N3 120+60

LOCATION 1



Sta N3 120+60 to N1 0+49

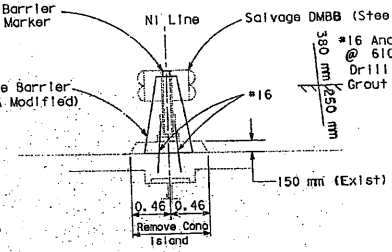
LOCATION 1



Sta N1 0+49 to N1 1+40

(SAN LEANDRO CREEK BRIDGE OH)
BR NO. 33-0100

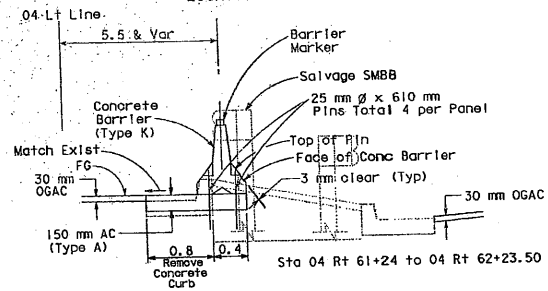
LOCATION 1



Sta N1 1+40 to N1 4+76.50

(SAN LEANDRO CREEK BRIDGE OH)
BR NO. 33-0100

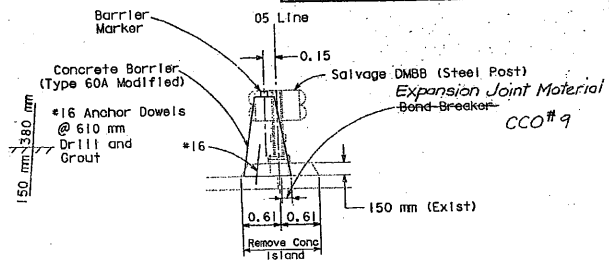
LOCATION 1



Sta 04 Rt 61+24 to 04 Rt 62+23.50

Sta 04 Lt 61+19 to 04 Lt 62+17

LOCATION 2

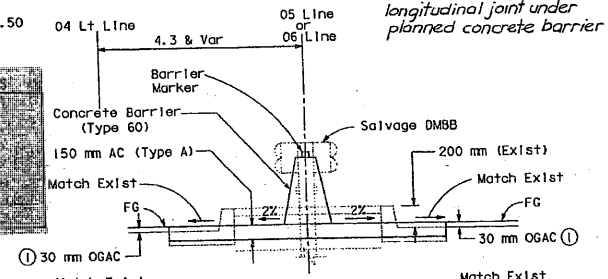


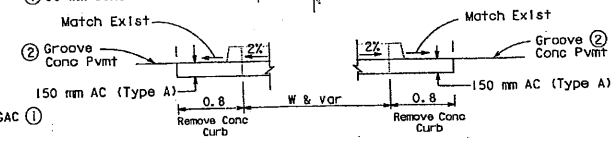
Sta 05 63+72.17 to 05 68+02

(FRUITVALE AVE OH)
BR NO. 33-0041

LOCATION 2

CCO #9
Substitute expansion joint material for bond breaker in longitudinal joint under planned concrete barrier

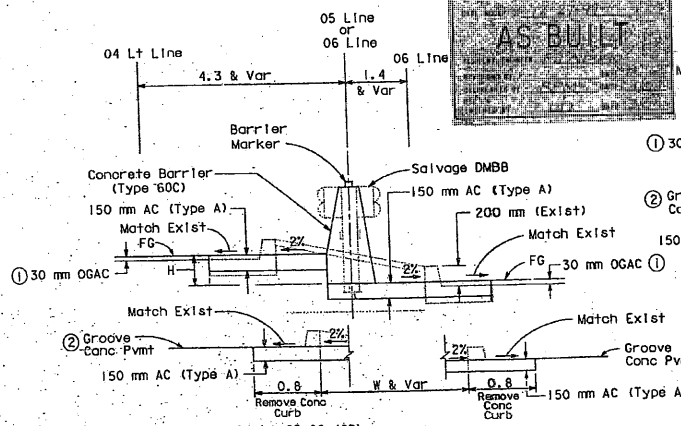




① Sta 04 Lt 65+00 to 04 Lt 65+72 (SB) W = 0.6
Sta 04 Rt 65+11 to 04 Rt 65+75 (NB) W = 1.1
Sta 05 89+38.00 to 05 89+83.00 (NB) W = 1.1

② Sta 05 68+02.00 to 05 68+80.00 W = 0.6
Sta 05 78+00.00 to 05 78+90.00 W = 1.9
Sta 06 85+00.00 to 06 86+42.00 W = 1.7
Sta 06 87+40.00 to 06 88+63.00 W = 1.9
Sta 05 89+38.00 to 05 89+83.00 (SB) W = 1.1
Sta 05 93+50 to 05 95+00 W = 0.7

LOCATION 2



① Sta 04 Lt 62+17 to 04 Lt 65+00 (SB) W = 0.7
Sta 04 Rt 62+23.50 to 04 Rt 65+11 (NB) W = 1.9

② Sta 05 78+90.00 to 05 79+94.00 W = 1.6
Sta 06 82+37.84 to 06 85+00.00 W = 1.5
Sta 06 88+63.00 to 05 89+38.00

LOCATION 2

CONSTRUCTION CHANGES
AS BUILT

4 REVISED PER ADDENDUM NO. 1 DATED SEPTEMBER 10, 1997

All Dimensions are in Meters unless otherwise shown

TYPICAL CROSS SECTIONS AND CONSTRUCTION DETAILS

NO SCALE

X-1

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => trlenard
DGN FILE => 42134ub0108134552

CU 04224

EA 2134U1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans SPECIAL PROJECTS

PROJECT ENGINEER DIEP N. LE

CALCULATED/DESIGNED BY SKC DATE 10/96 REVISED BY
CHECKED BY DATE REVISED

DATE PLOTTED => 8-Sep-1997
TIME PLOTTED => 13:47
04-15-97

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	880	38.0/50.0	3	7

REGISTERED CIVIL ENGINEER 4-16-97

6-23-97
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER D.N. Le No. 28032 EXP. 3-31-98 CIVIL STATE OF CALIFORNIA

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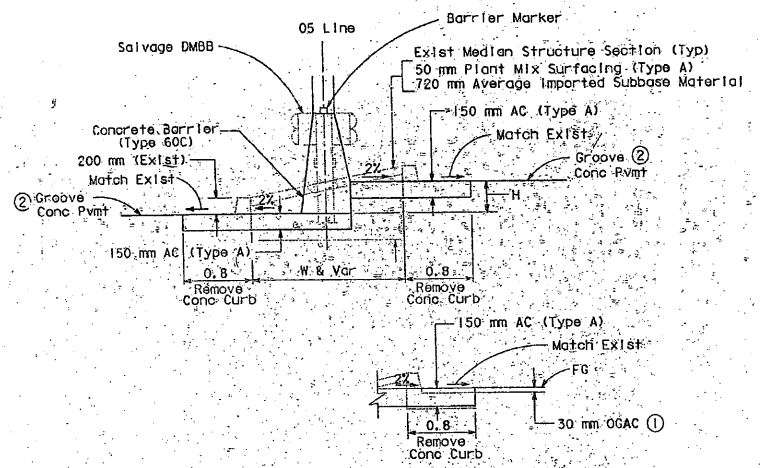
Caltrans Metric

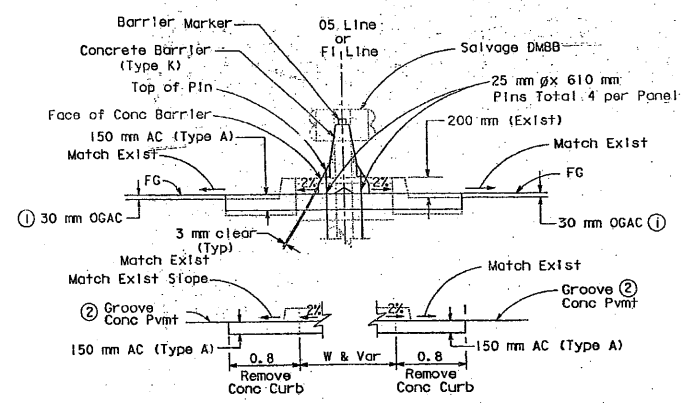


① Sta 05 89+83.00 to 05 91+40.00 (NB) ~~W = 0.1 H = 40 mm-110 mm~~

② Sta 05 68+80.00 to 05 70+84.00 ~~W = 1.5 H = 40 mm-680 mm~~
Sta 05 77+23.00 to 05 78+00.00 ~~W = 1.7 H = 40 mm-560 mm~~
Sta 05 89+83.00 to 05 93+50.00 (SB) ~~W = 0.1 H = 40 mm-110 mm~~
Sta 05 91+40.00 to 05 93+50.00 (NB) ~~W = 0.1 H = 40 mm-110 mm~~

4

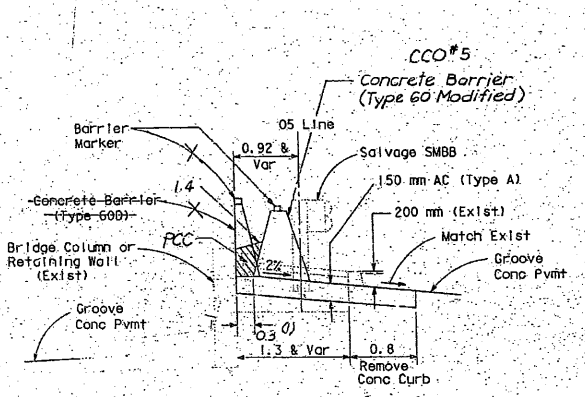
LOCATION 2



① Sta 05 105+82.50 to Fl 32+97.50 W = 1.7
② Sta 05 95+00.00 to 05 98+02.50 W = 0.8

LOCATION 2

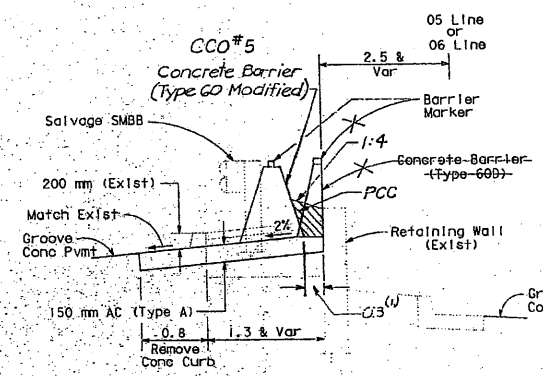
CONSTRUCTION CHANGES
AS BUILT



Sta 05 70+84.00 to 05 77+23.00

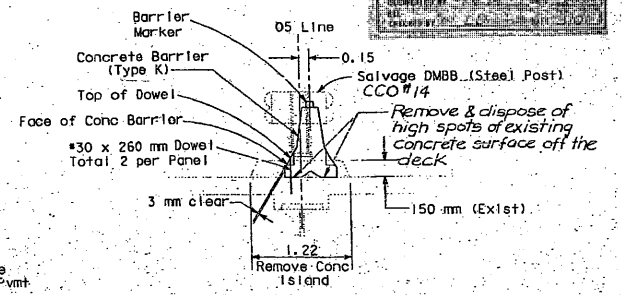
LOCATION 2

(1) Dimension can be reduced to be compatible with slip-form machine



Sta 05 79+94.00 to 06 82+37.84

LOCATION 2



Sta 05 98+02.50 to 05 105+82.50
(FIFTH AVE OH BR NO. 33-0027)

LOCATION 2

4 REVISED PER ADDENDUM NO. 1 DATED SEPTEMBER 10, 1997

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET X-1

All Dimensions are in Meters unless otherwise shown

TYPICAL CROSS SECTIONS AND CONSTRUCTION DETAILS

NO SCALE

X-2

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans SPECIAL PROJECTS

PROJECT ENGINEER: DIEP N. LE

CALCULATED/DESIGNED BY: SKC DATE 1/96 REVISED BY
CHECKED BY DATE REVISED

LAST REVISION 04-15-97 DATE PLOTTED => 8-Sep-1997 TIME PLOTTED => 13:44

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	880	38.0/50.0	4	47

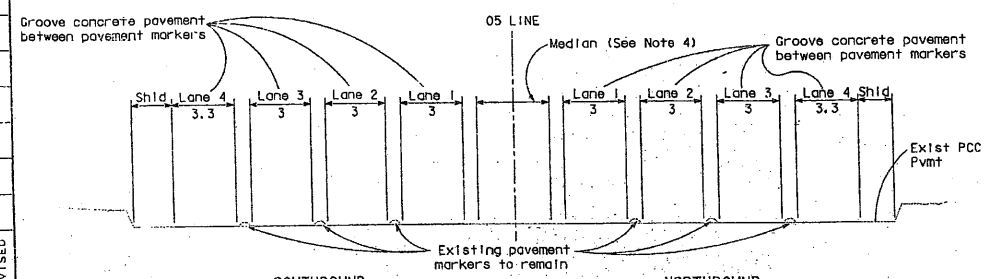
REGISTERED CIVIL ENGINEER 4-16-97

6-23-97
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER D. N. Le No. 28032 Exp. 3-31-98 CIVIL STATE OF CALIFORNIA

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

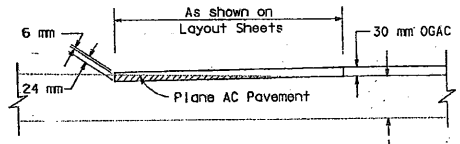
Caltrans Metric



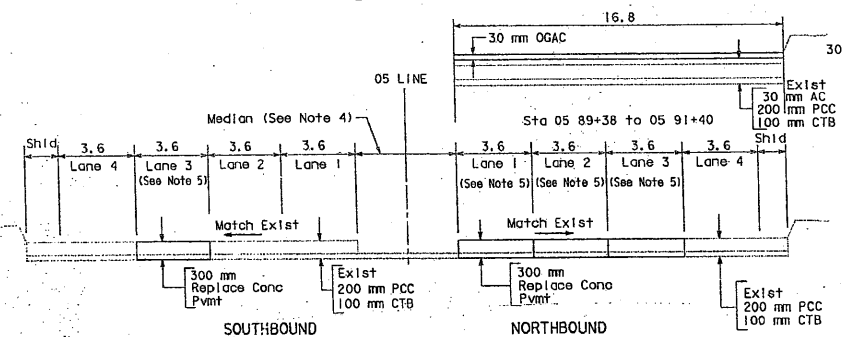
SOUTHBOUND
Sta 05 68+02 to 05 98+02.50

NORTHBOUND
Sta 05 68+02 to 05 89+38
Sta 05 91+40 to 05 98+02.50

LOCATION 2



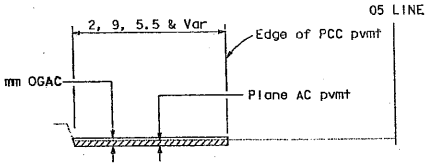
PAVEMENT CONFORM



SOUTHBOUND
Sta 05 91+25 to 97+39.2

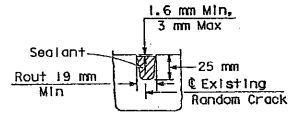
NORTHBOUND
Sta 05 91+45 to 05 95+45.6

LOCATION 2

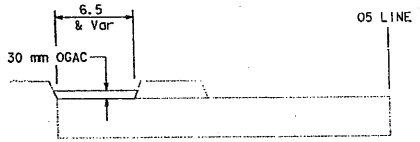


Sta 06 88+70.0 to 05 91+26.0
Sta 05 92+43.0 to 05 94+83.0

LOCATION 2



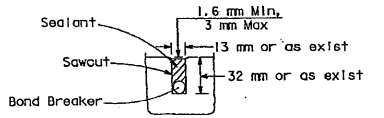
ROUT AND SEAL RANDOM CRACKS



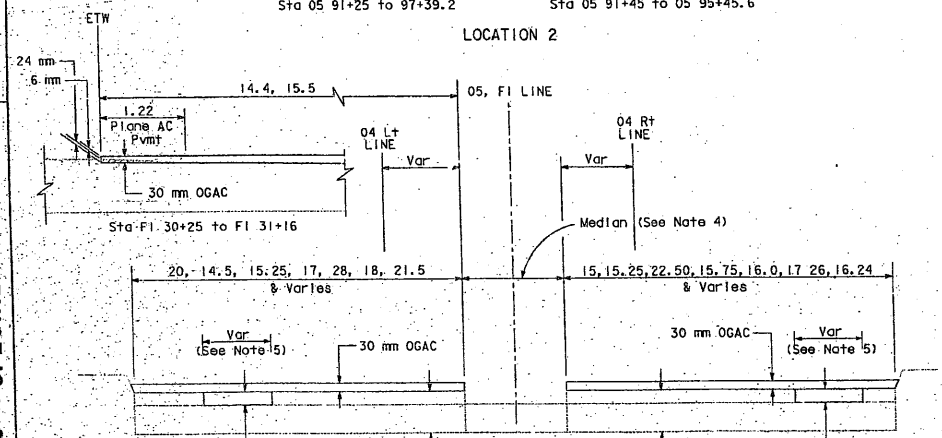
Sta 06 88+38.00 to 06 88+70.00

SOUTHBOUND ON RAMP FROM EMBARCADERO AND SOUTHBOUND OFF RAMP TO 16TH AVE / EMBARCADERO

LOCATION 2



SEAL LONGITUDINAL AND TRAVERSE JOINTS



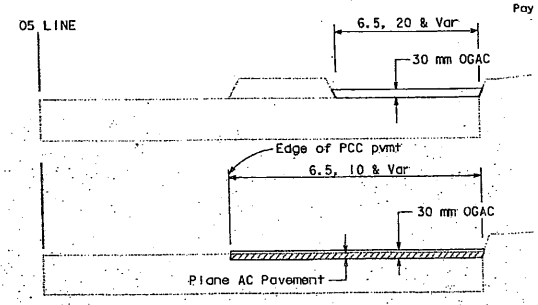
SOUTHBOUND
Sta 04 Lt 61+17 to 04 Lt 65+72
Sta FI 105+82.50 to FI 30+25
Sta FI 31+16 to FI 32+97.5

Exist 150 mm AC 114 mm CTB 348 mm AS

Exist 150 mm AC 114 mm CTB 348 mm AS

NORTHBOUND
Sta 04 Rt 61+24 to 04 Rt 65+75
Sta 05 105+82.50 to FI 32+97.50

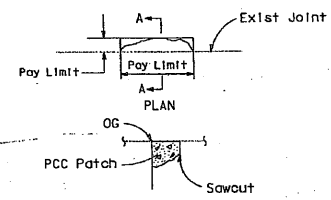
LOCATION 2



Sta 05 69+06 to 05 70+00

NORTHBOUND OFF RAMP TO 29TH AVE

LOCATION 2



SECTION A-A
REPAIR SPALLED JOINTS

NO CONSTRUCTION CHANGES
CONTRACT NO. 04-213404
DATE ACCEPTED 12-27-99
AS BUILT
RESIDENT ENGINEER F. J. Albano

TYPICAL CROSS SECTIONS AND CONSTRUCTION DETAILS

NO SCALE

All Dimensions are in Meters unless otherwise shown

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET X-1

X-3

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans SPECIAL PROJECTS

PROJECT ENGINEER DIEP N. LE
CALCULATED/DESIGNED BY SKC DATE 10/96
CHECKED BY
REVISED BY DATE REVISED

LAST REVISION 04-15-97
DATE PLOTTED => 26-Jun-1997
TIME PLOTTED => 15:15

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => trbing
DGN FILE => [ESC-OE]42134Ub03.psf

CU 04224 EA 21134U1

DIST	COUNTY	ROUTE	POST MILE TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	880	20.3/23.6	1	354

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

PROJECT PLANS FOR CONSTRUCTION ON STATE HIGHWAY IN ALAMEDA COUNTY IN SAN LEANDRO FROM 0.3 MILE SOUTH OF LEWELLING BOULEVARD UNDERCROSSING TO DAVIS STREET OVERCROSSING

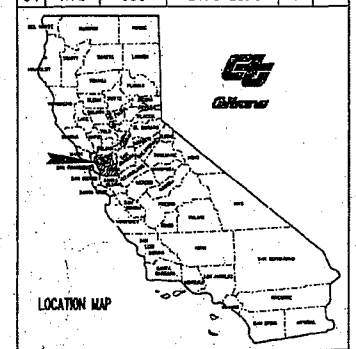
To be supplemented by Standard Plans dated January, 1989

INDEX OF SHEETS

Sheet No.	1	Title and Location Map
" "	2-4	Typical Cross Sections
" "	5	Standard Plans List
" "	6	Key Map and Line Index
" "	7-20	Layouts 9A,B,C & D
" "	21-44	Profiles 18A, 42A
" "	45-51	Construction Details
" "	52-56	Contour Grading
" "	57-121	Drainage Plans, Profiles; Details and Quantities 68A, 69A, 117A, 118A, 119A & B
" "	122-124	Utility Plans 122A & 124A,B,C,D,E,F & G
" "	125-165	Stage Construction Plans 170A, 171A & 172A
" "	166-179	Pavement Delineation Plans, Details and Quantities
" "	180-187	Summary of Quantities
" "	188-195	Sign Plans, Details and Quantities
" "	196-197	Retaining Wall
" "	198-209	Sound Wall
" "	210-211	Highway Planting
" "	212-235	Electrical 235A
" "	236-249	Revised and New Standard Plan

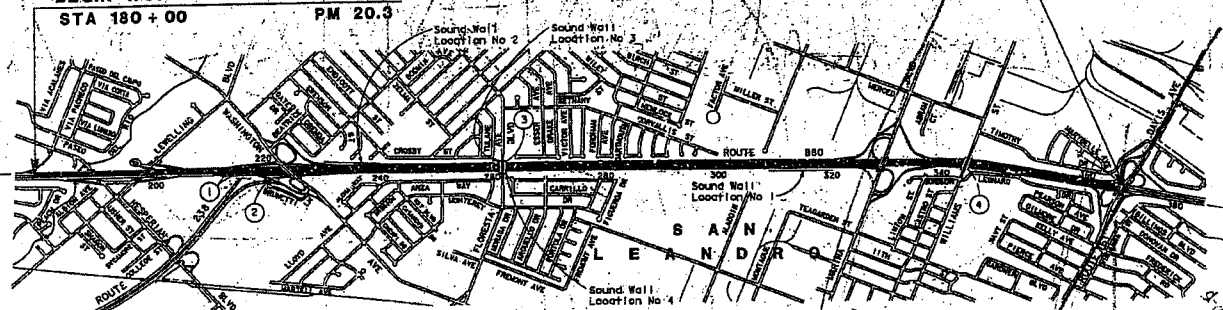
STRUCTURE PLANS

" "	250-265	Williams Street Overcrossing Br. No. 33-169
" "	266-280	Floresta Boulevard Overcrossing Br. No. 33-293
" "	281-297	880/238 Off-Ramp Br. No. 33-173S
" "	298-329	Rte. 880/238 Separation Br. No. 33-172
" "	330-354	Williams Street Overcrossing Pumping Plant Br. No. 33-169W



BEGIN WORK AND CONSTRUCTION
STA 180 + 00 PM 20.3

END WORK AND CONSTRUCTION
STA 372 + 00 PM 23.6



STRUCTURE LIST

	NAME	BRIDGE NO.
1	880/238 SEPARATION	33-172
2	880/238 OFF-RAMP	33-173
3	FLORESTA BLVD OC	33-293
4	WILLIAMS ST OC	33-169

NO Construction Changes
CONTRACT No. 04-123174
DATE ACCEPTED 1-29-98
AS BUILT
RESIDENT ENGINEER K Lonaharich

NO SCALE

AS-BUILT
DATE: 12-9-97
TYPE OF WORK: Widen freeway ramps and structures

Tony Wong
Project Engineer
Registered Civil Engineer
August 29, 1991
Plans Approved Date

T. Y. F. Rong
No. 40018
Exp. 12-31-93
CIVIL
STATE OF CALIFORNIA

The Contractor shall possess the Class (or Classes) of license as specified in the Notice to Contractors.

T. Y. F. RONG

Contract No. 04-123174

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3

CU 04173 EA 123171

FORM OC-OC-93-PP (REV. 3/93)

04-123174
11/29/1995 & 12/19/1997

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
D4	Ala	680	20.3/23.6	2	354

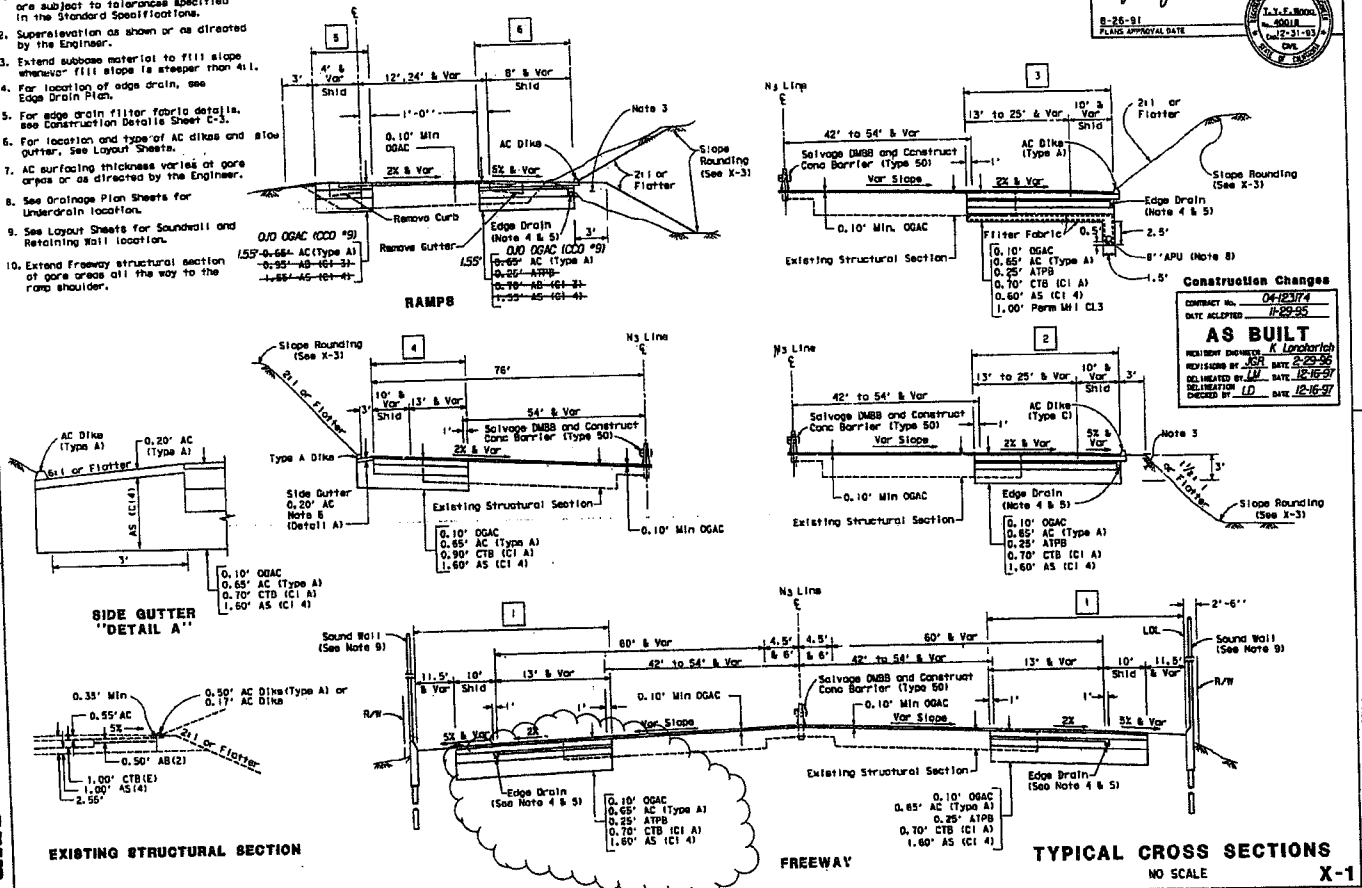
REGISTERED CIVIL ENGINEER

8-26-91
PLANS APPROVAL DATE

T.Y.F. Bong
No. 40018
Exp. 12-31-93
CIVIL
STATE OF CALIFORNIA

NOTES:

1. Dimensions of the structural sections are subject to tolerances specified in the Standard Specifications.
2. Superelevation as shown or as directed by the Engineer.
3. Extend subbase material to fill slope whenever fill slope is steeper than 4:1.
4. For location of edge drain, see Edge Drain Plan.
5. For edge drain filter fabric details, see Construction Details Sheet C-3.
6. For location and type of AC dikes and slow gutter, See Layout Sheets.
7. AC surfacing thickness varies at gore areas or as directed by the Engineer.
8. See Drainage Plan Sheets for Underdrain location.
9. See Layout Sheets for Soundwall and Retaining Wall location.
10. Extend freeway structural section of gore areas all the way to the ramp shoulder.



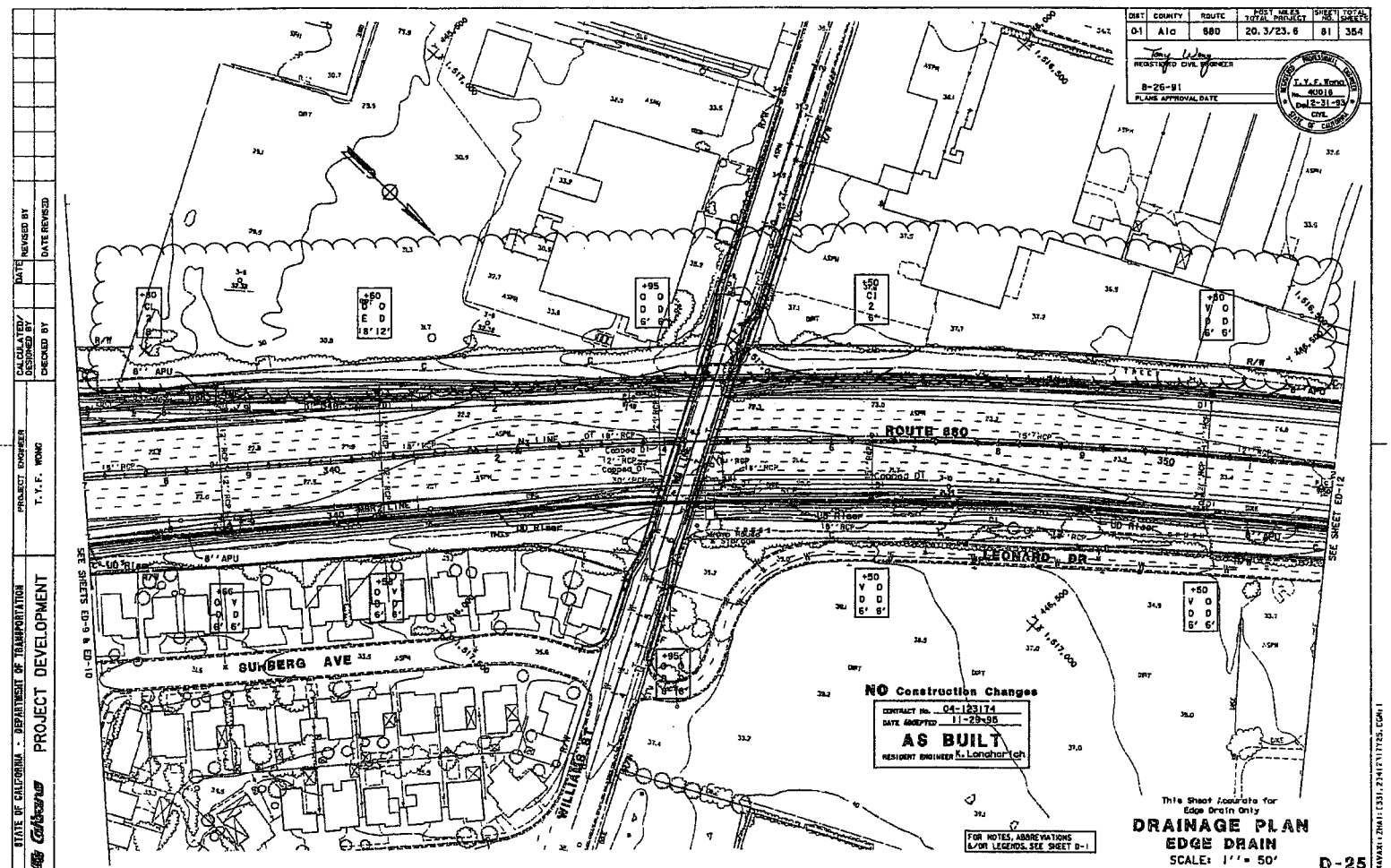
TYPICAL CROSS SECTIONS
NO SCALE
X-1

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES

DU 04173 | EA 123171

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
PROJECT DEVELOPMENT
PROJECT ENGINEER T.Y.F. BONG
CALCULATED/DESIGNED BY | CHECKED BY | DATE REVISED BY | DATE REVISED

t4hkhall 412317y25 25-Nov-1997 07:52 /home/t4ldelac/123171/412317y25.osb



t4hkhall 412317y25 25-Nov-1997 07:52 /home/t4ldelac/123171/412317y25.osb

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	880	20.3/23.6	180	354

REGISTERED CIVIL ENGINEER
8-28-91
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER T.Y.F. Wong No. 40018 Exp. 12-31-93 CIVIL STATE OF CALIFORNIA

ROADWAY QUANTITIES

STATION LIMITS	ASPHALT CONCRETE (TYPE A)	ASPHALT CONCRETE (OPEN GRADED)	ATPM	CTB (PLANT-MIXED CLASS A)	CLASS 3 AGGREGATE BASE	CLASS 4 AGGREGATE SUBBASE	CLASS 3 PERM NTL (BLANKET)	ASPHALTIC EMULSION (PAINT BINDER)	LIQUID ASPHALT (CURING SEAL)
	TON			CUBIC YARD				TON	
N3 180+00.00 to 372+00.00	32360	18740	5835	17975		40600	3560	120.00	63.00
L2N ~~199+88.58 to 202+17.2~~	~~[illegible]~~	~~[illegible]~~	~~16~~		105	200		0.30	0.30
W9N 214+15± to 219+67±	760	18	130		450	950		0.11	1.50
W7N 210+00.00 to 237+30±	1960	146	240		1200	2350		0.88	3.50
W3N 215-95± to 229+41±	320		66		183	405			0.61
W6 217+25± to 220+25±	720	50						0.30	
W8N 224+54± to 228+25±	550		113		315	700			1.05
W6N 224+90± to 228+25±		73						0.45	
W2N 223+50± to 229+41±	445	50	80		270	578		0.30	0.87
MBR1 323+72± to 328+00±	226	95	38		145	298		0.60	0.50
MBR2 330+15± to 335+28±	250	90	46		157	167	240	0.55	0.50
MBR3 329+84± to 339+90±	737	55	132		445	573	470	0.34	1.48
MBR4 319+74± to 323+58±		36						0.22	
MBL4 326-51± to 328+85±	95	21	18		50	110		0.12	0.17
DSR1 370+95± to 374+45±	147	117	7		100	173		0.26	0.70
DSR4 363+53± to 370+68±	316	135	62		198	425		0.85	0.65
FB 16+00± to 24+50.40±	798				662	980		0.30	2.50
WM 23+85± to 32+00±	695				415	615		0.40	1.50
Maintance Vehicle Pullout	108				75				0.35
TOTAL	40655	19674	6785	17975	4770	49124	4270	125.98	79.18

EARTHWORK SUMMARY

STATION LIMITS	ROADWAY EXC	EMBANKMENT (N)
	CY	
N3 195+00 to 370+00 Lt	36000	10000
N3 210+00 to 370+00 Rt	39100	6400
W9N 214+15 to 217+62	1390	4090
W7N 210+25 to 237+33	1700	1670
W3N 215+95 to 223+90	1700	7650
W2N 222+00 to 226+84	900	
MBR1 323+71 to 328+00	970	20
MBR2 330+15 to 335+28	2000	
MBR3 329+85 to 339+90	5900	
DSR1 370+95 to 374+44	780	
DSR4 363+53 to 370+68	1350	
L2N 200+00 to 202+14	680	700
FB 16+00 to 24+50.40		2900
WM 23+85 to 32+00.00		760
LOOP Lt of DSR4 370+00	8334	
W8N 224+40 to 230+95	1150	245
MBR4 321+00 to 323+50	130	75
W7N 214+14 to 217+46	400	
W6 217+25 to 220+25	360	
TOTAL	102844	34510

(N) Not a separate pay item, for information only.

NO Construction Changes

CONTRACT No. 04-123174
DATE ACCEPTED 11-29-95
AS BUILT
RESIDENT ENGINEER K. Lonchar 1/3

SOUNDWALL QUANTITIES

SOUND WALL NO	STATION LIMITS	SOUND WALL (MASONRY BLOCK)	CONCRETE BARRIER TYPE 275V HE=1	HE=2	HE=3	(N) 18" CIDH CONCRETE PILING	(N) ACCESS GATE (SOUND-WALL)
		SQFT	LF			LF	EA
1	N3 307+94 to 320+30	11730	480	792		3280	1
2	N3 231+90 to 241+47	12700	260	623	80	2624	
3	N3 261+24.50 to 262+48.50	1654	124			288	
4	N3 261+24.50 to 262+48.22	1654	124			288	
SUBTOTAL			988	1415	80		
TOTAL		27738	2483			6480	1

SALVAGE CHAIN LINK FENCE

STATION LIMITS	LOCATION	LF
N3 231+05 to 241+47	LT	1042
N3 307+95 to 320+30	RT	1235
TOTAL		2277

RECONSTRUCT METAL BEAM GUARD RAILING (WOOD POST)

STATION LIMITS	LOCATION	LF	CABLE ANCHOR ASSEMBLY BREAKAWAY (EA) TYPE A	TYPE B	TERMINAL SECTION (EA) TYPE B	TYPE C	RETURN
N3 195+10 to 197+15	Lt	205	1		1	1	
N3 198+90 to 202+55	Lt	365	1		1	1	
L2N 201+42 to W9N 215+50	Lt	1408	1		1		
N3 209+75 to W3N 213+90	Rt	415		1	1		
W3N 217+40 to 218+15	Lt	75	1		1	1	
FB 17+89 to 18+84	Lt	75	1		1	1	
FB 21+36 to 22+11	Lt	75	1		1	1	
WM 25+09 to 25+84	Rt	75	1		1	1	
WM 28+55 to 29+20	Lt	75	1		1	1	
DSR4 368+06 to 370+70	Rt	264	1		1	1	
TOTAL		3032	9	1	10	9	

RECONSTRUCT CHAIN LINK FENCE

STATION LIMITS	LOCATION	LF
N3 231+00 to 231+80	LT	80
TOTAL		80

CONCRETE BARRIER

STATION LIMITS	LOC	TYPE 25B	50	500	50E	50E MODIFIED	275V
		LF					
N3 214+76 to 216+24	Lt			146			
N3 219+10 to 227+10	Lt			800			
N3 218+30 to 226+00	Rt			770			
N3 209+85 to 371+45	Med		15702				
N3 222+18 to 223+68	Med				150		
N3 261+32 to 262+40	Med				108		
N3 329+95 to 331+05	Med				110		
N3 343+93 to 344+83	Med				90		
W7N 213+95 to 218+00	Rt					408	
W7N 213+66 to 217+20	Lt					354	
W3N 215+62.50 to 217+76.50	Rt	214					
W3N 221+92 to 222+70	Rt	72					
DSR4 361+50 to 368+06	Rt						640
TOTAL		286	15702	1716	458	760	640

SUMMARY OF QUANTITIES
Q-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans PROJECT DEVELOPMENT

PROJECT ENGINEER T.Y.F. WONG
CALCULATED/DESIGNED BY
CHECKED BY
DATE REVISED BY
DATE REVISED

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3

CU 04173 EA 123171

FORM DC-OE-02-07 REV. 3/90

1966

STATE OF CALIFORNIA
HIGHWAY TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

PLANS FOR CONSTRUCTION ON

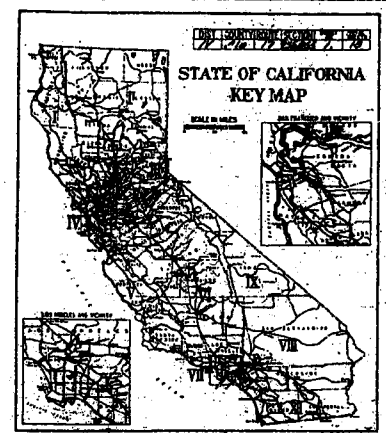
STATE HIGHWAY

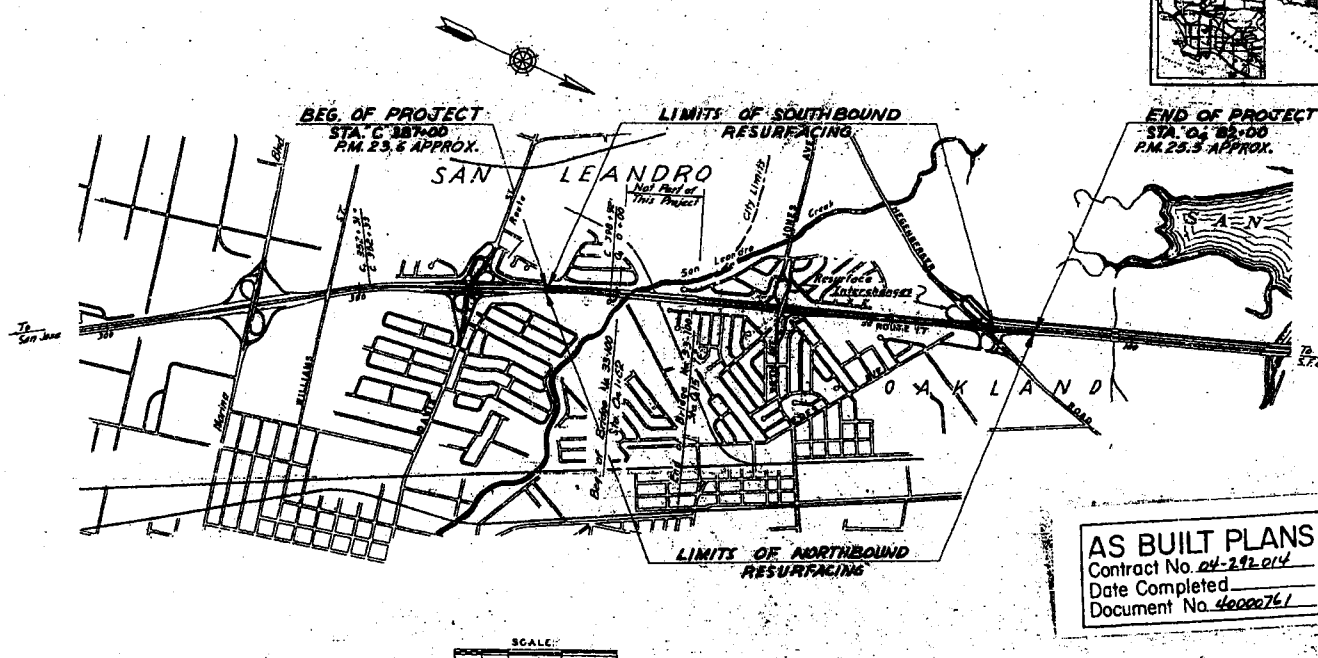
IN ALAMEDA COUNTY
BETWEEN DAVIS STREET IN SAN LEANDRO
AND HEGENBERGER ROAD IN OAKLAND

INDEX OF SHEETS

Sheet No.	1	Title Sheet
" "	2	Typical Cross-Sections
" "	3-4	Construction Details
" "	5-6	Drainage Details
" "	7	Structure List
" "	8-18	Standard Construction Details

STATE OF CALIFORNIA
KEY MAP





SCALE:
0 500 1000 2000 3000 FEET

LENGTH OF PROJECT: 9,392 FEET 1.78 MILES

AS BUILT PLANS
Contract No. 04-292014
Date Completed
Document No. 40000761

04-292014

292011
04602

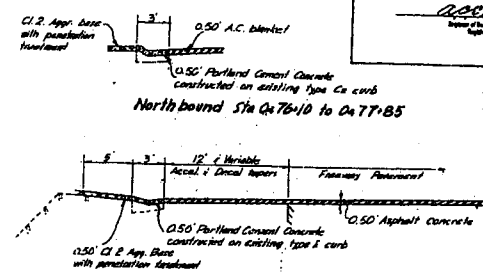
64-04T10H2920.1

04-292014
Undated
(Document No. 40000761)

DIST.	STATE	FEDERAL PROJECT NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
7	CALIF.				

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
IV	Ala	17	23.6/25.5	2	18

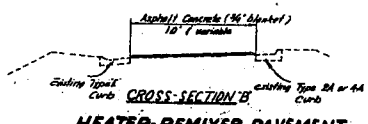
July 1, 1964



Northbound Sta Oa 76+10 to Oa 77+85

CROSS-SECTION "D"

ACCELERATION, DECELERATION AND AUXILIARY LANES

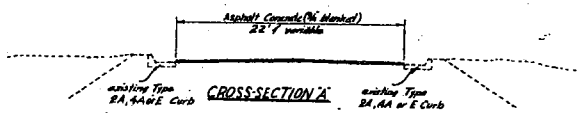


CROSS-SECTION "B"

HEATER-REMIXER PAVEMENT ONE-WAY RAMPS

No Scale

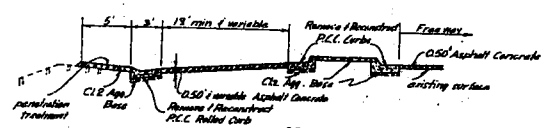
AS BUILT PLANS
Contract No. 04-292.014
Date Completed
Document No. 40000761



CROSS-SECTION "A"

HEATER-REMIXER PAVEMENT 2 LANE-2 WAY STREETS & RAMPS

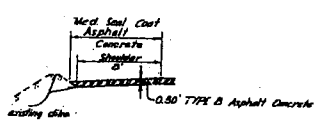
No Scale



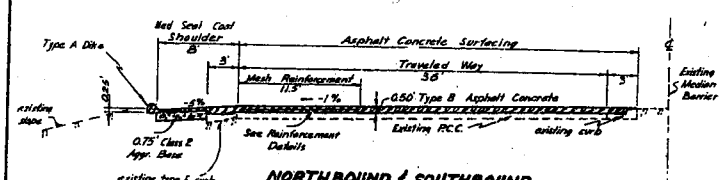
CROSS-SECTION "C"

CONFORM SECTION AT RAMP CONNECTIONS

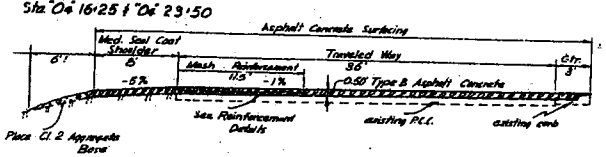
No Scale



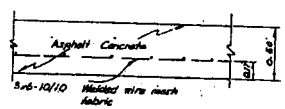
Shoulder Between
Sta "Oa" 16+25 & "Oa" 23+50



NORTHBOUND & SOUTHBOUND LANES BETWEEN
Sta Oa 28+00 & Sta Oa 1+62
(Southbound shown)



NORTHBOUND & SOUTHBOUND LANES BETWEEN
Sta Oa 18+72 & Sta Oa 21+00
(Southbound shown)



DETAILS FOR MESH REINFORCEMENT

No Scale

IV-Ala-17-23.6/25.5

TYPICAL CROSS SECTIONS

Scale: 1"=5'

Note: Dimensions are subject to tolerances specified in the Standard Specifications

04-292014

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
DISTRICT IV

TYPICAL CROSS SECTIONS

DRAWN BY: N.T.T. DATE: 1-23-64 SCALE: As Shown

04-04T10H2920.1

(29.5)

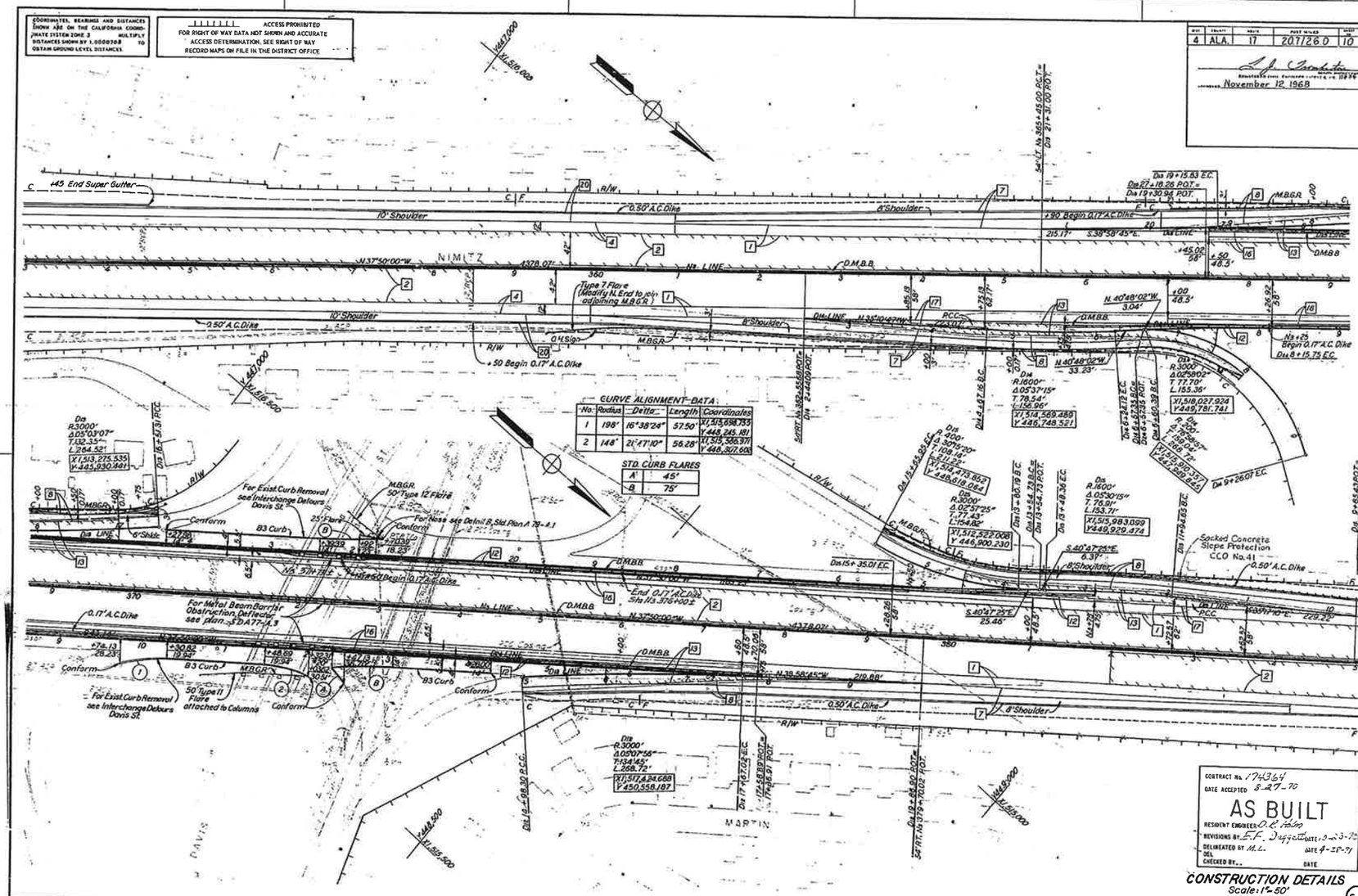
2

COORDINATES, BEARINGS AND DISTANCES SHOWN ARE ON THE CALIFORNIA COORDINATE SYSTEM ZONE 3 MULTIPLY DISTANCES SHOWN BY 1.0000708 TO OBTAIN GROUND LEVEL DISTANCES.

ACCESS PROHIBITED
FOR RIGHT OF WAY DATA NOT SHOWN AND ACCURATE ACCESS DETERMINATION, SEE RIGHT OF WAY RECORD MAPS ON FILE IN THE DISTRICT OFFICE

DIST.	COUNTY	ROUTE	POST MILEAGE	SHEET NO.	TOTAL SHEETS
4	ALA.	17	207/260	10	146

November 12 1968



AS BUILT PLANS
Contract No. 04-174364
Date Completed
Document No. 40001996

10

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE July 4, 1971 SIGNATURE [illegible] TITLE Assistant Supervisor

04-174364
8/1970
(Document No. 40001996)

1970

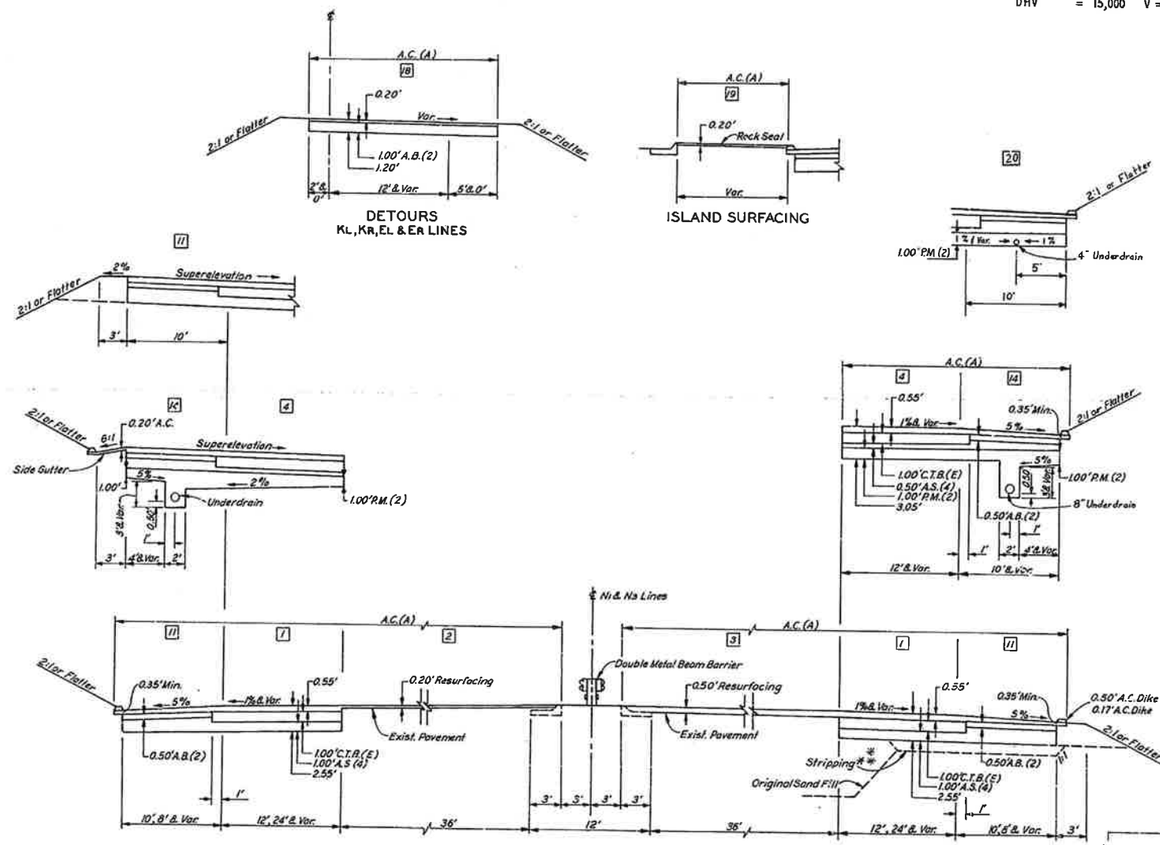
U-033-1(14)

DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL
4	ALA.	17	20.7/26.0	2	146

DESIGN CLASSIFICATION

ADT '67 = 110,000 D = 60 %
ADT (90) = 160,000 T = 4 %
DHV = 15,000 V = 60 MPH

REGISTERED CIVIL ENGINEER
REGISTRATION NO. 11336
November 12, 1968
APPROVED



*Stripping Limits:
Strip to 3.5' below finished grade
from Sta. Ni 63+00 to 71+50 on Rt.
and Sta. Ni 74+75 to 79+25 on Rt.
& Sta. Ni 77+00 to 80+00 on Rt.

CCO #16

CCO # 17
Stripping between
Stations Ni 37+00 ± & Ni 63+00 ±

Notes:

1. Dimensions shown are subject to tolerances specified in the Standard Specifications.
2. Superelevations as directed by the Engineer or as shown on the Plans.
3. Permeable material blanket and standard underdrain trenches are to be placed as shown on the Plans or as directed by the Engineer.
4. Wherever fill slope is steeper than 4:1 base materials are to be extended to the fill slope.
5. For location of median barrier and guard railing see Construction Details.
6. For size and location of A.C. dike see Construction Details.
7. For additional details and location limits see Construction Details.
8. Existing structural section need be removed only where required by the Engineer.

ABBREVIATIONS

A.S. (4) ..... Aggregate Subbase (Class 4)
A.B. (2) ..... Aggregate Base (Class 2)
C.T.B. (A) ..... Cement Treated Base (Class A)
C.T.B. (E) ..... Cement Treated Base (Class E)
A.C. (A) ..... Asphalt Concrete (Type A)
A.C. (B) ..... Asphalt Concrete (Type B)
P.M. (2) ..... Permeable Material (Class 2)
Var. ..... Variable
Ma ..... Indicates type of surface and structural section.
PCC (B) ..... Portland Cement Concrete (Class B)

CONTRACT 04-174364
DATE ACCEPTED 8-27-70
AS BUILT
RESIDENT ENGINEER O.R. Hoke DATE 10-23-70
REVISIONS BY E.F. Dorsett DATE 4/29/71
DELINEATED BY N.L.
DES. CHECKED BY J. TIGAR DATE 5-3-71

AS BUILT PLANS
Contract No. 04-174364
Date Completed
Document No. 4000 1996

04-Ala-17-20.7/26.0

TYPICAL CROSS SECTIONS ①

Scale: 1" = 5'

PROJECT ENGINEER	DATE	DESIGN ENGINEER	DATE	APPROVAL RECOMMENDED BY	DATE
E.A. HANSEN	6-68	K.C. SCENDERMAN	6-68	J.F. O'SHEA	6-68

04219 - 174361

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE July 14, 1971 SIGNATURE Jotten R. Eng TITLE Assistant Sec'y of Supply

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

1970

MICROFILMED.

DIST.	COUNTY	ROUTE	POSTMILE	SHEET NO.	TOTAL SHEETS
04	Ala	17	22.2-23.9	2	23

APPROVED June 28, 1965

J. C. Womack
STATE HIGHWAY ENGINEER
REGISTERED CIVIL ENGINEER NO. 5646

BY: STATE HIGHWAY ENGINEER
REGISTERED CIVIL ENGINEER NO. 5646

for: ASSISTANT STATE HIGHWAY ENGINEER
REGISTERED CIVIL ENGINEER NO. 9937

REGISTERED CIVIL ENGINEER NO. 9937

AS BUILT PLANS
Contract No. 04-292024
Date Completed 3-30-66
Document No. 40000001

MICROFILMED.

12'
Lateral limits of Pvmt. Grinding

Typical Cross Section in Deceleration Lane Areas not shown

TRANSVERSE SECTION

No Scale

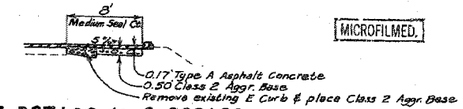
GRIND PAVEMENT
C, 320+00 to C, 342+66
OUTSIDE SOUTHBOUND LANE

SHOULDER
C, 363+30 to 387+00 SHT.# 4

SHOULDER
C, 316+93 to C, 319+00 SHT# 5

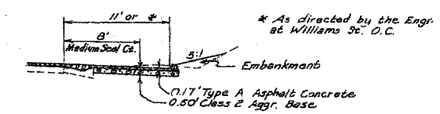
PAVEMENT AND SHOULDER TRANSITIONS BETWEEN STATIONS

C, 301+00 to C, 302+00	Sht. # 6	
C, 319+00 to C, 320+00	"	
C, 342+66 to C, 343+66	"	
C, 387+00 to C, 388+00	"	
C, 315+93 to C, 316+93	"	



C, 387+00 to C, 388+00

SHOULDER
C, 360+25 to C, 381+88 SHT# 4 & 6

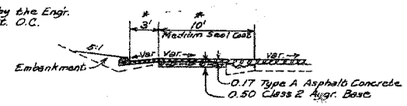


* As directed by the Engr. at Williams St. O.C.

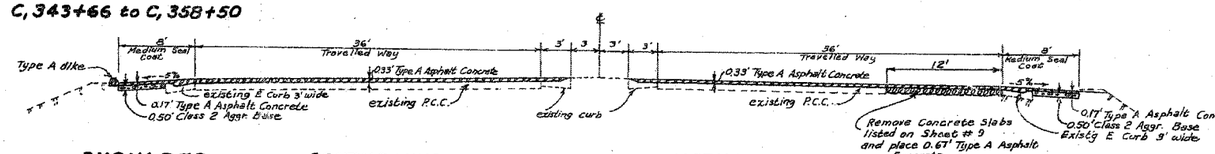
C, 342+97 to C, 360+25

SHOULDER
C, 316+35 to C, 342+97 SHT# 5 & 6

* As directed by the Engr. at Williams St. O.C.



C, 343+66 to C, 358+50



SHOULDER
C, 302+00 to C, 315+93
C, 358+50 to C, 363+30

SOUTHBOUND LANES
C, 343+66 to C, 387+00
C, 302+00 to C, 319+00

NORTHBOUND LANES
C, 302+00 to C, 387+00

SHOULDER
C, 302+00 to C, 316+35
C, 381+88 to C, 387+00

MICROFILMED.

NO CONSTRUCTION CHANGES

CONTRACT No. 04-292024
DATE ACCEPTED 3-30-66
AS BUILT
RESIDENT ENGINEER R. Tom
REVISIONS BY... DATE
DELINEATED BY DATE
REV.
CHECKED BY... DATE

Note: Dimensions are subject to tolerances specified in the Standard Specifications

No Scale

TYPICAL CROSS SECTIONS
C, 301+00 to C, 388+00

04-Ala-17 P.M. 22.2/23.9

Ⓐ

Project Engineer	Date	Design Engineer	Date	Approval Recommended by	Date
[illegible]	3/66	Tom [illegible]	3/66	R.D. Kenney [illegible]	3/66

04-602-292021

2

292024

04-292024
3/1966
(Document No. 40000001)

1966

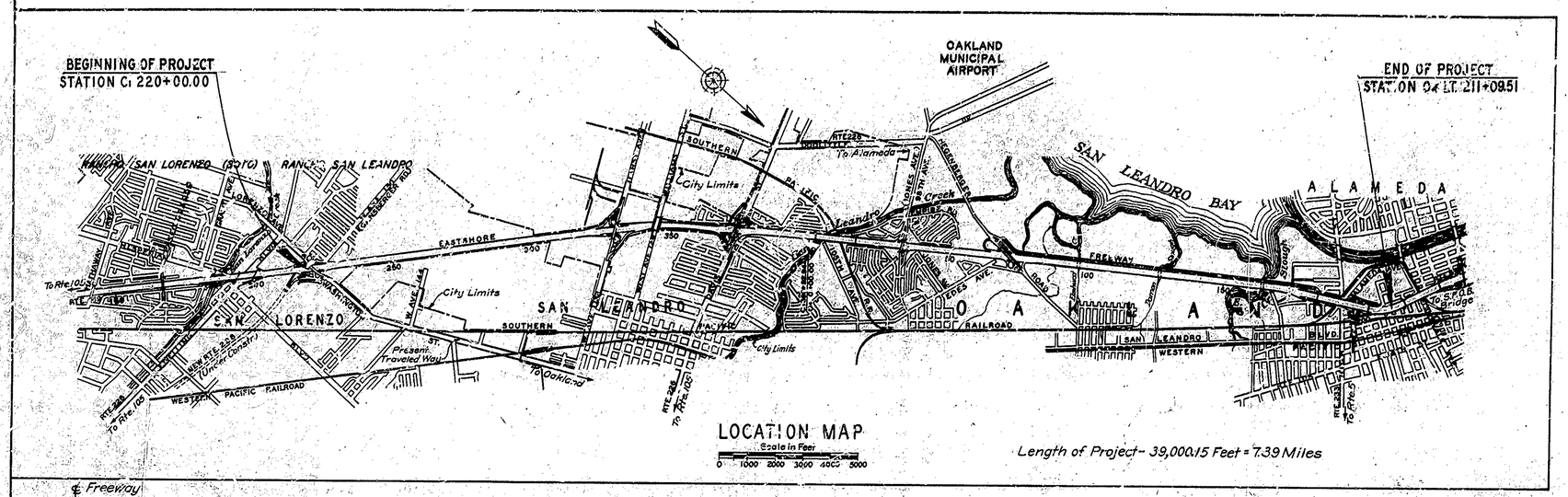
DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
IV	ALA.	69	C.S.L.N. Oak.	2	14

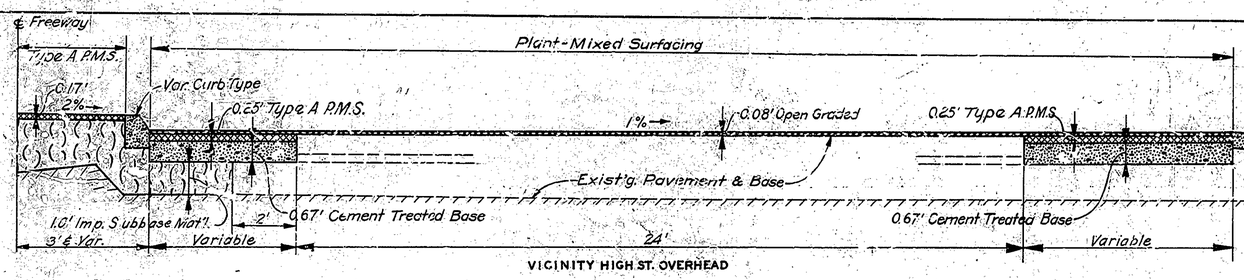
APPROVED October 24, 1955

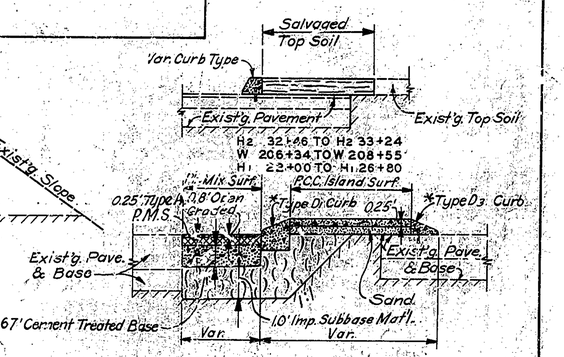
State Highway Engineer
Civil Engineer License No. 7884

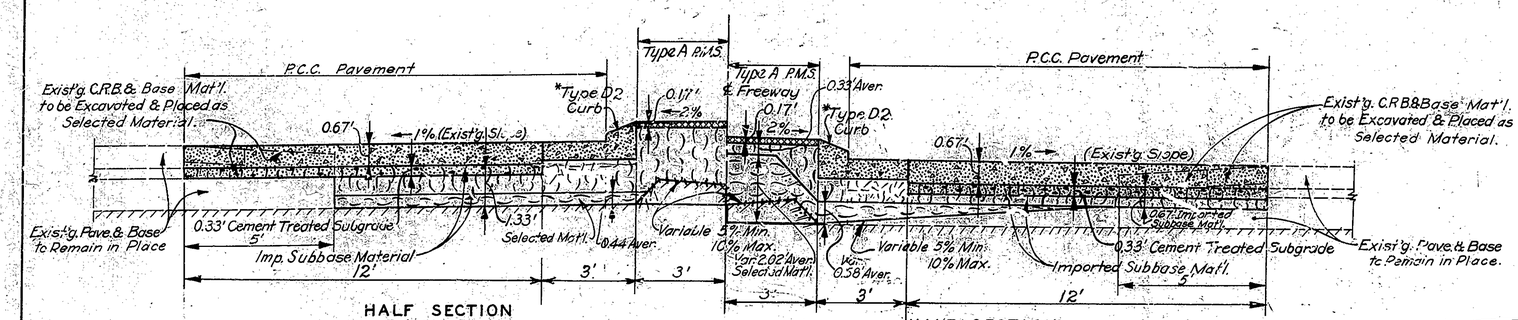
Asst. Engineer of Design
Civil Engineer License No. 5474 6565

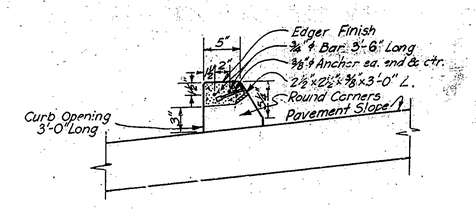
Assistant State Highway Engineer











CURB OPENING LT. OF STA. H1 23+03
SCALE: 1 1/2" = 1'

*Note:
See Miscellaneous Detail Sheet for Scored Surface of Type D1, D2 & D3

TYPICAL CROSS-SECTIONS
Scale:- 1" = 2'

AS BUILT PLANS
Contract No. 56-14TC21-F
Date Completed
Document No. 40000 760

LOCATION MAP & TYPICAL CROSS-SECTIONS
BETWEEN
JCT. RTE. 228 (NEW) & 0.2 MI. NO. OF HIGH ST.

56-14TC21-F

Scales:- As Shown

Nov. 1954

IV-1047

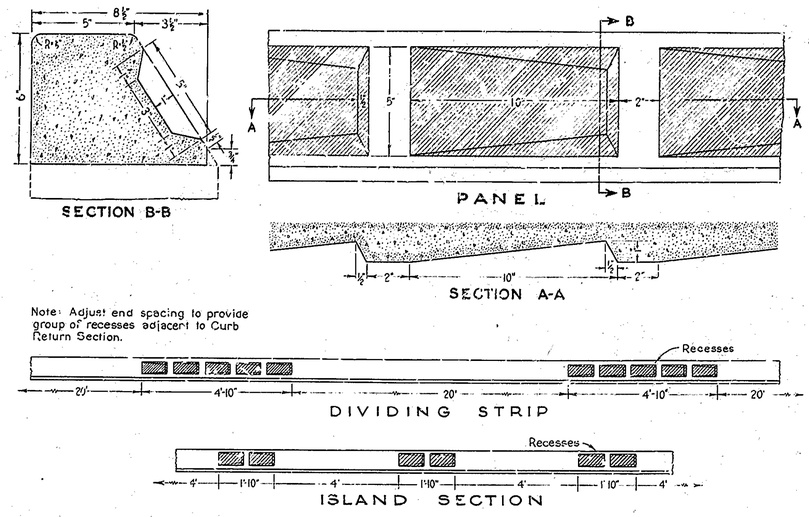
56-14TC21-F
undated
(Document No. 40000760)

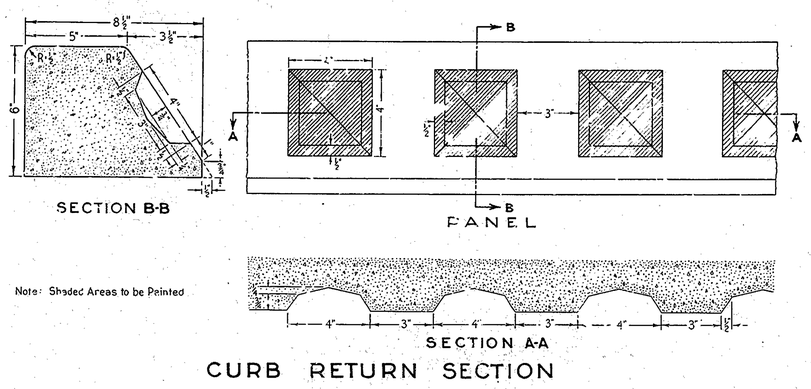
1955

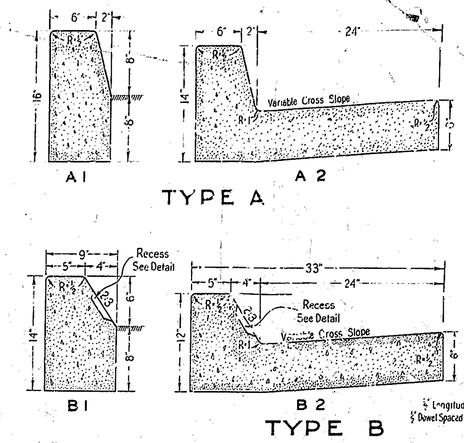
FED. REG. DIV. NO.	STATE	FEDERAL PROJECT NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
	CALIF.	U-341(12)		14	62

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
11	Ala	69	Chula Vista	14	14

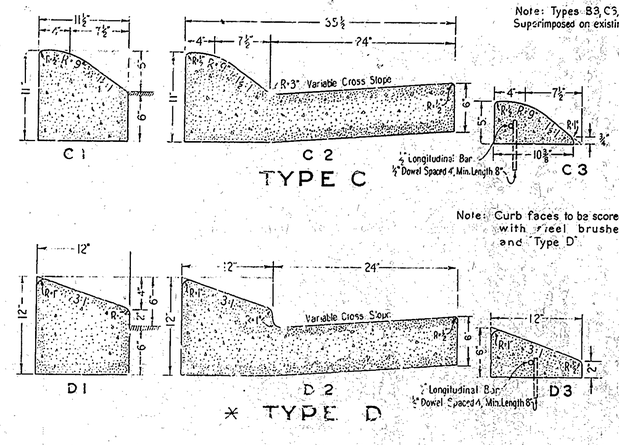
Approval Recommended
Assistant State Highway Engineer
October 27, 1950
State Highway Engineer
Civil Engineer License No. 2084
To Accompany Plans Dated October 24, 1955.



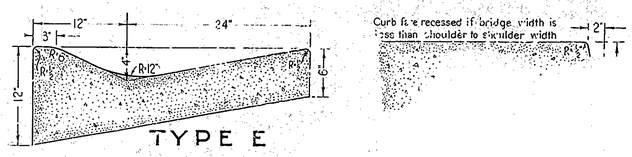




Note: Types B3, C3, D3 Superimposed on existing pavement



Note: Curb faces to be scored transversely with steel brushes on Type C and Type D.



AS BUILT PLANS
Contract No. 56-14TC21-F
Date Completed
Document No. 40000760

* See Miscellaneous Detail Sheet for scored surface of Type D curbs.

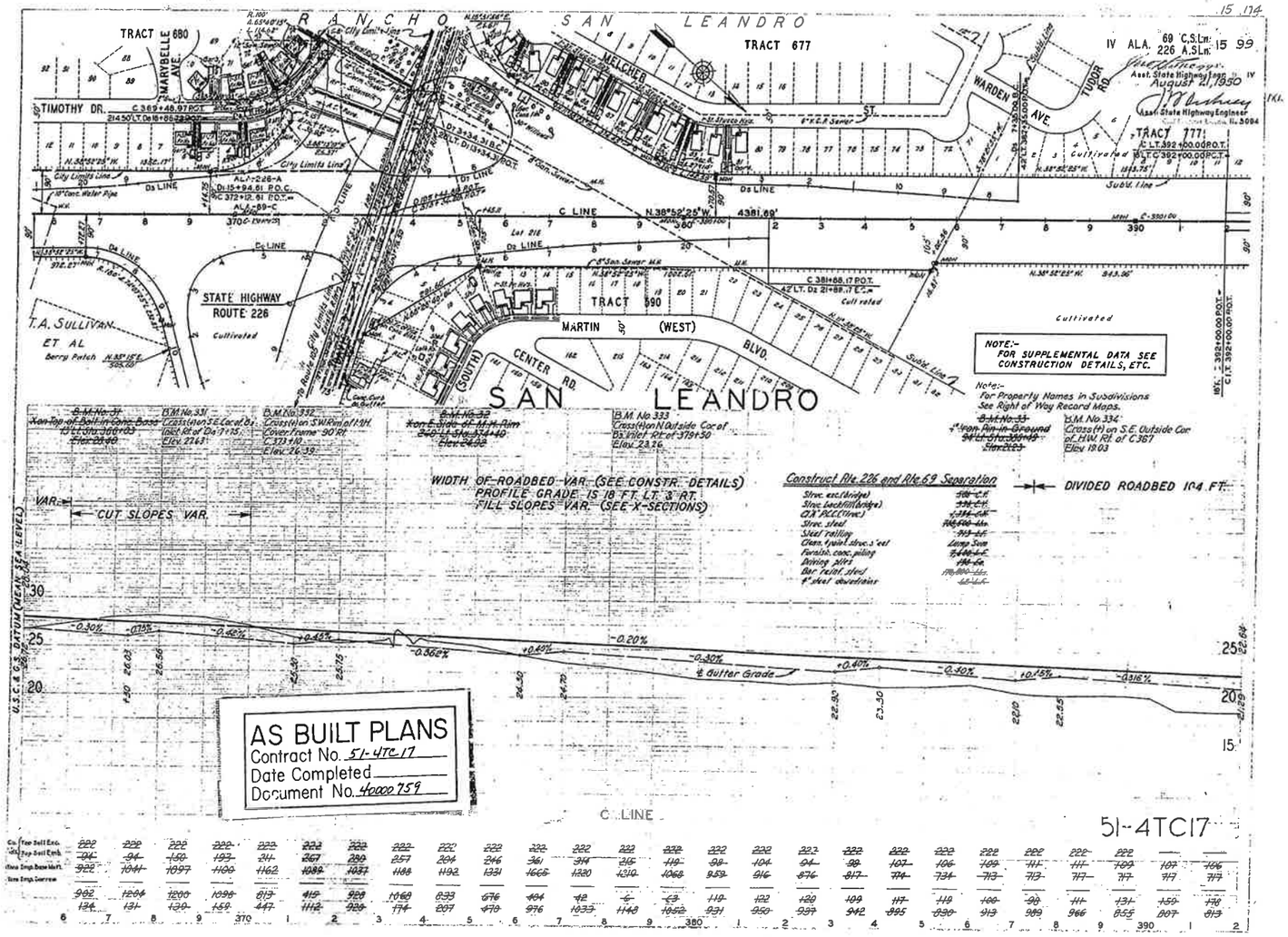
CURB QUANTITIES

Type	C.Y. Per Lin. Ft.	Type	C.Y. Per Lin. Ft.
A1	0.03084	C2	0.06457
A2	0.06379	C3	0.00965
B1	0.02930	D1	0.03073
B2	0.06171	D2	0.06782
B3	0.01074	D3	0.01223
C1	0.02752	E	0.06661

S7

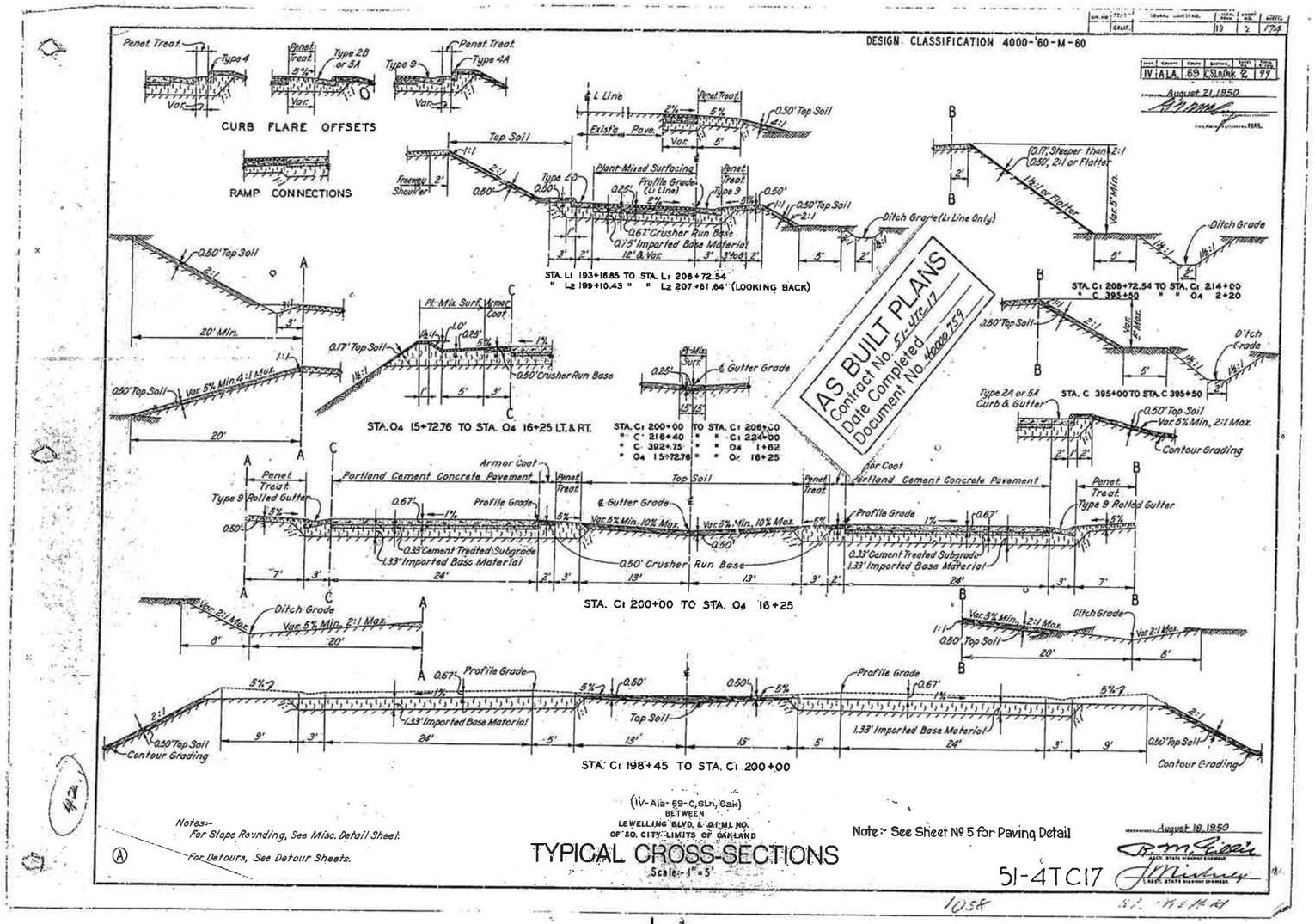
Revised

1955



51-4TC17
undated
(Document No. 40000759)

1950


DESIGN CLASSIFICATION 4000-'60-M-60
IV-ALA. 69 CSLnOak 2 97
August 21, 1950
CURB FLARE OFFSETS
RAMP CONNECTIONS
STA. L1 193+16.85 TO STA. L1 206+72.54
" L2 199+10.43 " " L2 207+81.64' (LOOKING BACK)
STA. C1 208+72.54 TO STA. C1 214+00
" C 395+50 " " O4 2+20
STA. C 395+00 TO STA. C 395+50
STA. O4 15+72.76 TO STA. O4 16+25 LT. & RT.
STA. C1 200+00 TO STA. C1 206+00
" C 316+40 " " C1 224+00
" C 392+75 " " O4 1+62
" O4 15+72.76 " " O4 16+25
STA. C1 200+00 TO STA. O4 16+25
STA. C1 198+45 TO STA. C1 200+00
AS BUILT PLANS
Contract No. 51-4TC17
Date Completed
Document No. 46000759
(IV-Ala-69-C, 6Ln, Oak)
BETWEEN
LEWELLING BLVD. & 0.1 MI. NO.
OF SO. CITY LIMITS OF OAKLAND
Notes:-
For Slope Rounding, See Misc. Detail Sheet.
For Detours, See Detour Sheets.
Note:- See Sheet № 5 for Paving Detail
TYPICAL CROSS-SECTIONS
Scale:- 1" = 5'
August 18, 1950
51-4TC17

1950

Memorandum of
September 23, 2010

MEMORANDUM

To: Tony Wong, Caltrans District 4

From: Tim Lee, WMH

Date: September 23, 2010

Subject: **04-Ala-880 PM 22.5/24.0, EA 3A9211**
I-880 Southbound HOV Lane Project (Marina to Davis)
Deflection Testing and Analysis Report

Dear Tony:

This memorandum addresses comments from Luis Tacuri, Materials Branch dated July 19, 2010 and August 3, 2010 regarding the Deflection Testing and Analysis Report (CHEC Report) prepared by CHEC Consultants dated March 29, 2010 ï as it pertains to the south segment project (Project).

Existing Median Structural Section
Based upon a review of available as-built information, the existing I-880 median structural section and adjacent mainline structural section within the limits of the Project is shown in Figure A. The chronology of pavement structural section improvements for the freeway including the median shoulder, and that have evolved over time, is summarized in the table below. A copy of relevant sheets from the as-builts is included in Attachment A.

Year	EA	Median	Notes
1950	51-4TC17	36ôwide median with 26ôunpaved width	4-lane freeway constructed (lane #ôs 2 and 3) with 5ôwide median shoulders
1955	56-14TC21-F	Median fully paved. 12ôwide lane added with 3ôwide PCC curbs and paved median. 12ômedian width including PCC curbs	Inside freeway widening to 6-lanes (lane #ôs 1, 2 and 3). Median shoulder constructed with 3ôwide PCC curbs overlain on 1.33ôAS. Remainder of median was 2.16ôAS overlain with 0.17ô PCC.
1966	292024	No change.	0.33ôAC overlay added to mainline (lane #ôs 1,2 and 3)
1970	174364	No change. MBGR installed in median	Outside freeway widening to 8-lanes. 0.2ô AC overlay added to mainline (lane #ôs 1,2 and 3)
1997	123174	Median concrete barrier added. No median structural section detail provided.	Add auxiliary lane between Marina and Davis with ramp modifications. 0.1; OGAC added to mainline (lane #ôs 1, 2, 3 and 4).
1999	2134U4	Median Concrete barrier added (north of Davis) with 0.15ôAC overlay on 0.3ôPCC.	As-built not found for south of Davis. Assume similar median work covered under EA 123174.
2002	0C7024	Overlay extended to median barrier	0.1ôOGAC over 0.15ôRAC-G Overlay

Figure A shows that the structural section for the mainline and the portion of the median shoulder with the buried 3-feet wide PCC curb are the same depth and make up - except that the mainline has a CTB/AS subbase whereas the median shoulder has an AS subbase. Both have the same overall depth of AC.

The pavement width , 5 feet from the face of the median barrier, is considered the median shoulder and denoted as Zone A on Figure A.

Southbound I-880 Existing Median Shoulder Width
Existing and proposed median widths on southbound I-880 within the project limits are shown in the table below.

Station Limits	Length	Existing Median Shoulder Width (SB I-880)	Proposed Median Shoulder Width (SB I-880)	Encroachment Into Existing Median Shoulder	Existing Shoulder in Zone A
ñAò Sta. 313+00 To "A" Sta. 317+40	440	5.2	5		
ñAò Sta. 317+40 To "A" Sta. 319+00	160	5.2	5 to 3	**0 to 2.2**	
"A" Sta. 319+00 To "A" Sta. 322+40	340	5.2	3	**2.2**	
"A" Sta. 322+40 To "A" Sta. 324+03	163	5.2 to 5.1	3 to 5.1	**2.2 to 0**	
"A" Sta. 324+03 To "A" Sta. 328+00	397	5.1	5.1 to 10		
"A" Sta. 328+00 To "A" Sta. 329+02	102	5.1 to 5.3	10		
"A" Sta. 329+02 To "A" Sta. 331+44	MARINA OC BARRIER TRANSITION				
"A" Sta. 331+44 To "A" Sta. 331+50	6	5.1 to 5.0	10		
"A" Sta. 331+50 To "A" Sta. 341+94	1044	5.0 to 4.6	10		Yes
"A" Sta. 341+94 To "A" Sta. 352+57	1063	4.6 to 5.0	10		Yes
"A" Sta. 352+57 To "A" Sta. 357+22	465	5.0 to 5.3	10 to 5.3		
"A" Sta. 357+22 To "A" Sta. 359+82	260	5.3 to 5.2	5.3 to 2	**0 to 3.2**	
"A" Sta. 359+82 To "A" Sta. 366+30	648	5.2 to 5.0	2	**3.2 to 3**	
"A" Sta. 366+30 To "A" Sta. 370+50	420	5.0 to 4.0	2	3 to 2	Yes
"A" Sta. 370+50 To "A" Sta. 371+87	137	4.0 to 3.7	2 to 3.7	2 to 0	Yes
"A" Sta. 371+87 To "A" Sta. 374+56	DAVIS OC BARRIER TRANSITION				
"A" Sta. 374+56 To "A" Sta. 385+00	1044	3.4 to 3	3.4 to 2	0 to 1	Yes

The existing median shoulder width on southbound I-880, within the limits of the Project, varies from 3 to 5 feet. As shown in the rightmost column of the table, approximately 3,700 feet of existing Lane #1 north of Marina Overcrossing encroach into the median shoulder (Zone A) with traffic running on the 3 feet wide PCC curb section.

A visual assessment of the pavement for Lane #1 shows no signs of significant pavement distress. A video driving along Lane #1 is available on the Project ftp site.

The proposed median shoulder varies from 2 to 10 feet and Lane #1 would encroach into the median shoulder at additional locations as shown in bold text on the fifth column of the table.

Deflection Testing Analysis - Existing Median Shoulder
Deflection testing/coring for the Project was done approximately 3 feet from the face of the median barrier. Evidence of the buried 3-feet wide PCC curb was found in some of the core samples.

Based on comments received from Luis Tacuri, CHEC reanalyzed the deflection test data for a 20-year design life and TI of 13.0 for Lane #1 (Note: The TI calculation was reviewed and accepted by Thong Nguyen, Traffic Forecasting Branch on 9/16/10).

CHECôs revised pavement rehabilitation recommendations are shown on Table 1 and call for a mill and overlay depth varying from 3-inches to 5.5-inches with pavement fabric. The rehabilitation strategy is shown as Alternative A on Figure B.

The construction cost for Alternative A rehabilitation work would be **$184,000** for the entire length of the Project, and **$118,000** for portions of the median shoulder where the new HOV lane encroaches into it. The total cost of Alternative A for both the north and south contracts is **$383,000**.

Conclusions
The structural sections for Lane #1 and the median shoulder (overlying the buried PCC curb) are essentially the same. Within the Project limits, existing Lane #1 encroaches into the median shoulder over a distance of 3,700 feet (approx. 50 percent of the overall Project length). Widening to accommodate the new HOV lane would add an additional1,570 feet of encroachment into the median shoulder.

Based on as-built information, the existing encroachment into the median shoulder has been ongoing since approximately 1997 and based on a visual assessment of Lane #1 there is no sign of significant pavement distress.

Since shifting traffic into the median shoulder is the focus of this study, Alternative B on Figure B is considered a more effective rehabilitation strategy for a 20-year design life ï compared to piecemeal improvements as new projects come along or when significant pavement distress shows up. Pavement rehabilitation is outside the scope of the Project, and should be done under a separate contract. An assessment of the mainline structural section should also be conducted at that time to assess rehabilitation requirements for the mainline structural section.

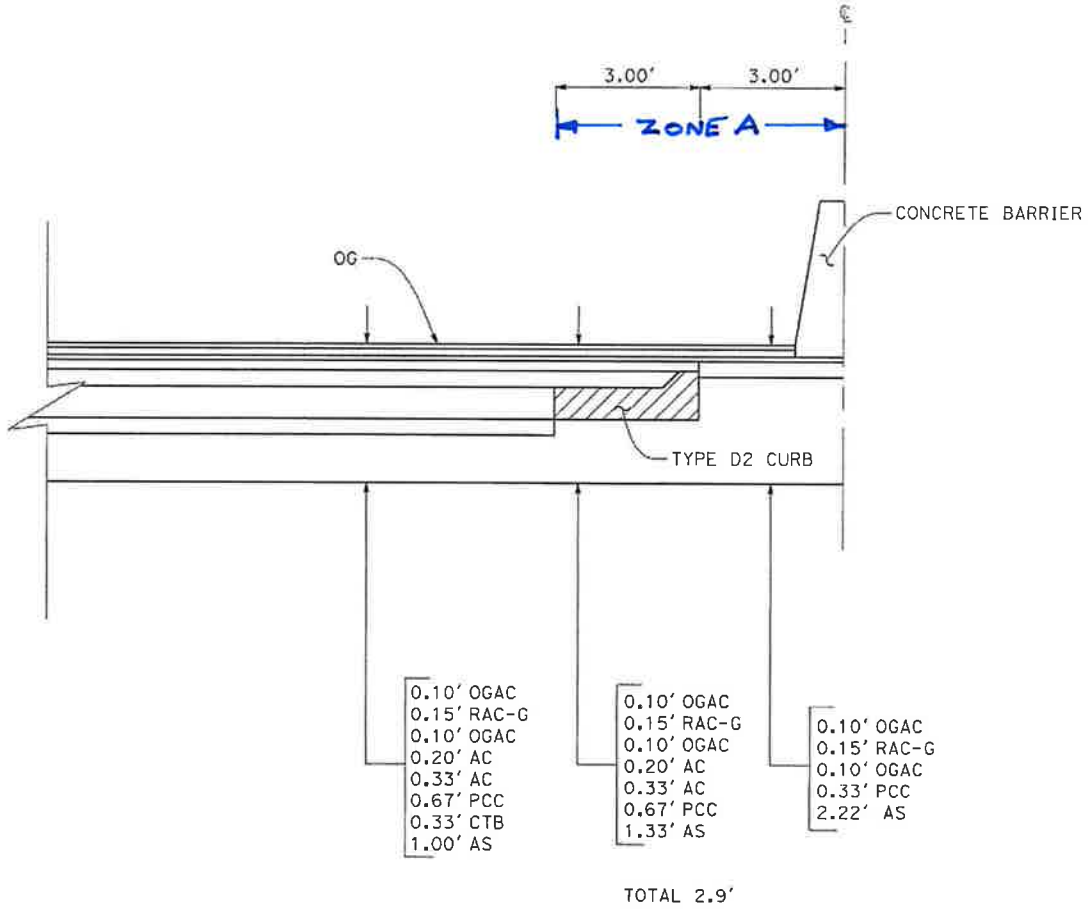
No action on pavement rehabilitation is proposed by the Project but instead deferred to a future project. Caltrans concurrence on this strategy is requested at this time.

If you have any questions or need additional information on this matter please contact me at timlee@wmhcorporation.com or at (415) 806-7500.

Regards,

Tim Lee, P.E.
WMH Corporation

cc. Stanley Gee, Caltrans Project Management
Luis Tacuri, Caltrans Materials
Matt Todd (ACCMA)
Arul Edwin (ACCMA)
Gary Parikh/David Wang (Parikh)
File 441.01



USERNAME: BRUHLE

FILENAME: 880-HOV Mod2Fwd.dgn

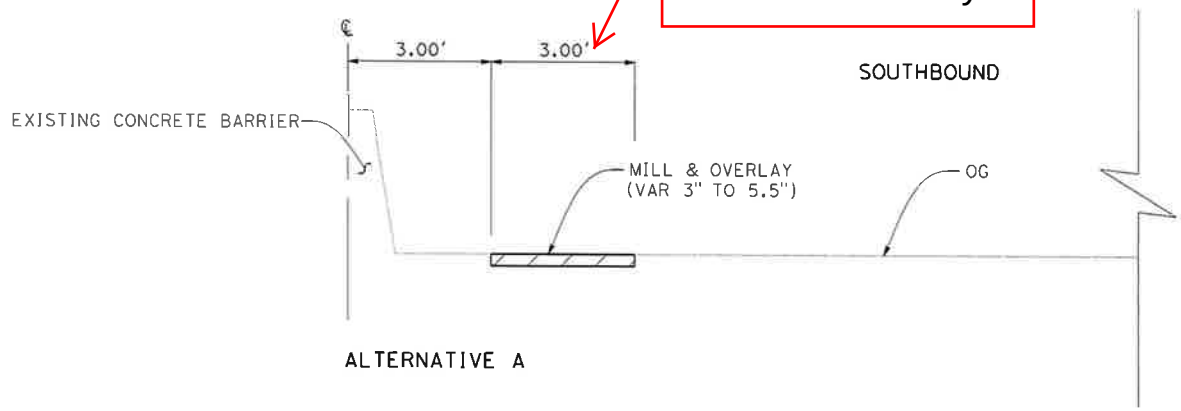
WMH

I-880 MEDIAN STRUCTURAL SECTION (MARINA TO DAVIS)

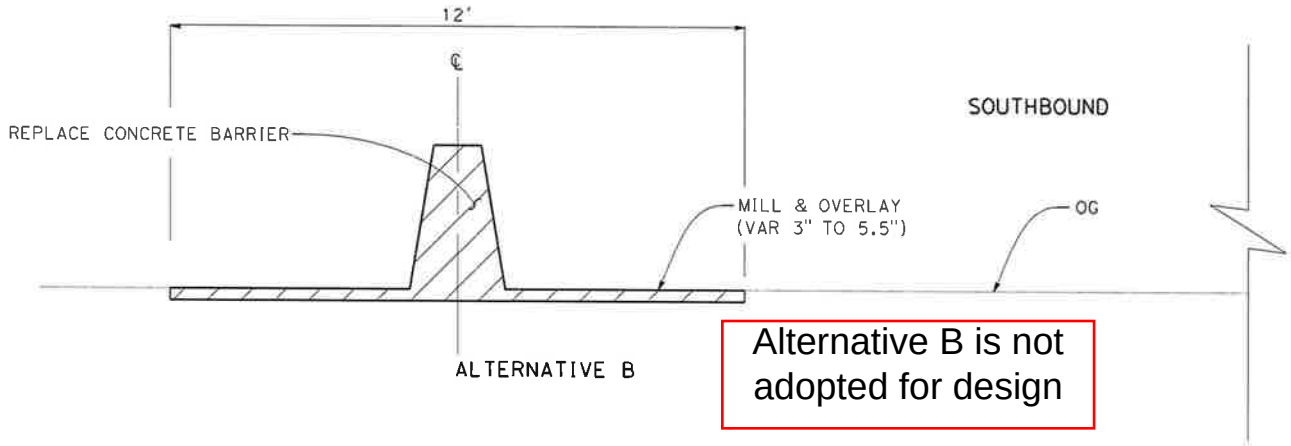
DATE: 8/10/10 NO SCALE

FIGURE A

The final design calls for 5' mill & overlay



ALTERNATIVE A



ALTERNATIVE B

Alternative B is not adopted for design

WMH

I-880 SB HOV LANE PROJECT (MARINA TO HEGENBERGER) - MEDIAN SHOULDER REHAB ALTERNATIVES

DATE: 9/22/2010 NO SCALE

FIGURE B

Table 1

Summary of Findings

20 Year Designs

Road Name	**From**	**To**	**CTM Structural Requirement (20 Year Design)**	**CHEC's Design Recommendations**
Hwy 880 (SB) Median	MP 25.5 Hegenburger Way	MP 23.75	**T.I. 13.0** **MP 25.5 – MP 25.25** 0.10 ft. HMAC Overlay **MP 25.0 – MP 24.75** 0.00 ft. HMAC Overlay **MP 24.5 – MP 24.25** 0.00 ft. HMAC Overlay **MP 24.0 – MP 23.75** 0.15 ft. HMAC Overlay	**SB Median Shoulder MP 25.5 to MP 23.75** 1. Mill 3.0" / 3.0" HMAC Overlay with Paving Fabric
Hwy 880 (SB) Median	MP 23.5	MP 23.25	**T.I. 13.0** **MP 23.5 – 23.25** 0.25 ft. HMAC Overlay	**SB Median Shoulder MP 23.5 to MP 23.25** 1. Mill 5 ½ " / 5 ½ " HMAC Overlay with Paving Fabric
Hwy 880 (SB) Median	MP 23.0	MP 22.75	**T.I. 13.0** **MP 23.0 – MP 22.75** 0.15 ft. HMAC Overlay	**SB Median Shoulder MP 23.0 to MP 22.75** 1. Mill 4.0" / 4.0" HMAC Overlay with Paving Fabric

ATTACHMENT A

RELEVANT AS-BUILT MAPS

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	880	24.6/44.5	40	85

Vijith Thilakaratne 04-27-00
REGISTERED CIVIL ENGINEER

6-12-00
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER V. Thilakaratne No. 51278 Exp. 9-30-01 CIVIL STATE OF CALIFORNIA

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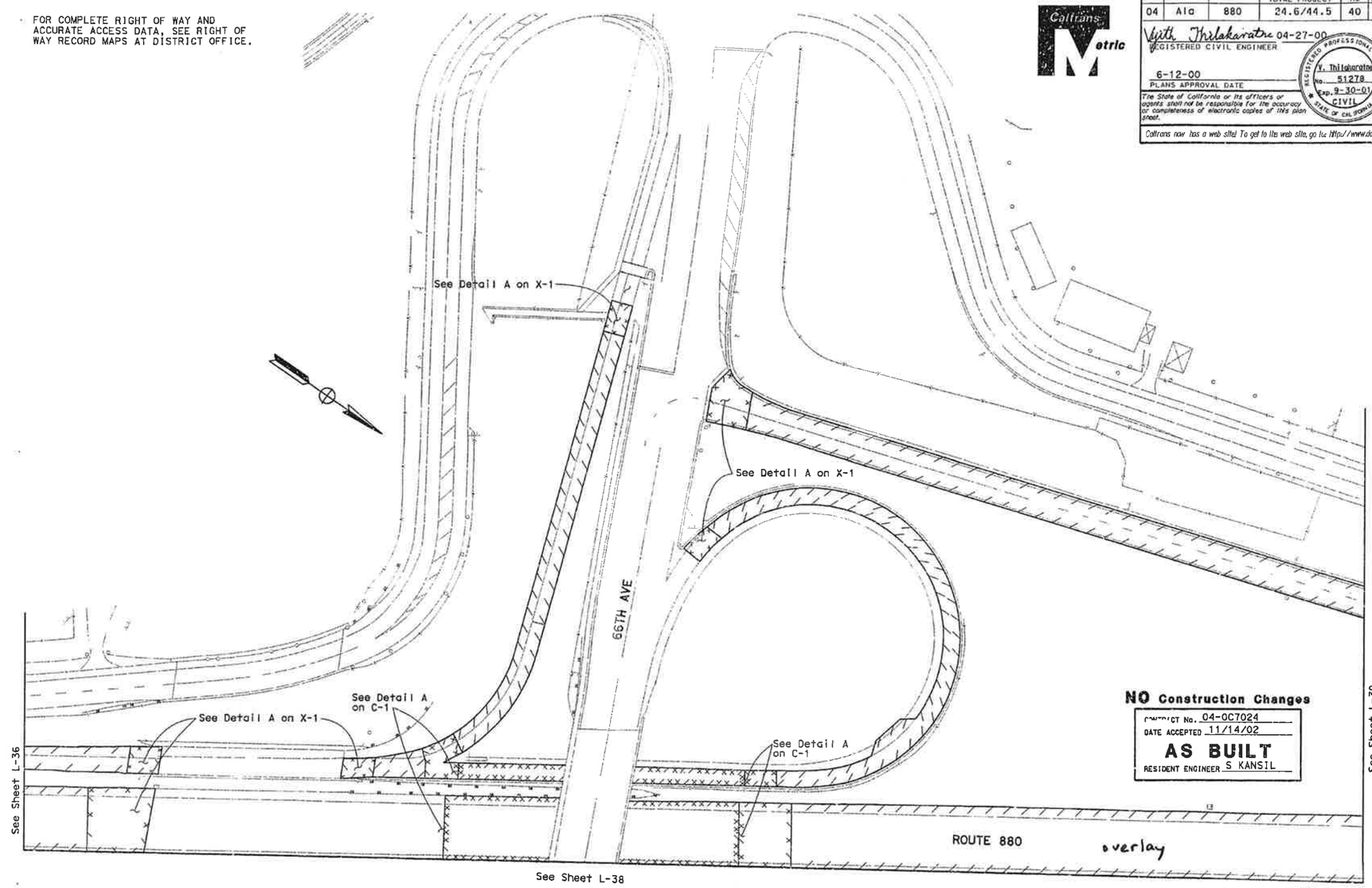
Caltrans now has a web site! To get to the web site, go to: http://www.dot.ca.gov

Caltrans Metric

FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.



NO Construction Changes
CONTRACT No. 04-0C7024
DATE ACCEPTED 11/14/02
AS BUILT
RESIDENT ENGINEER S KANSIL

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET L-1

All Dimensions are in Meters unless otherwise shown

LAYOUT

SCALE: 1:500

L-37

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans PROJECT DEVELOPMENT

PROJECT ENGINEER
VIJITH THILAKARATNE

CALCULATED/DESIGNED BY
CHECKED BY

DATE REVISED BY
DATE REVISED

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

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DGN FILE => 40c702e37.dsb

CU 04233

EA 0C7021

LAST REVISION 04-27-00
DATE PLOTTED => 26-MAR-2003
TIME PLOTTED => 13:20

2002

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	880	24.6/44.5	2	85

Vijith Thilakaratne 04-27-00
REGISTERED CIVIL ENGINEER

6-12-00
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER V. Thilakaratne No. 51278 Exp. 9-30-01 CIVIL STATE OF CALIFORNIA

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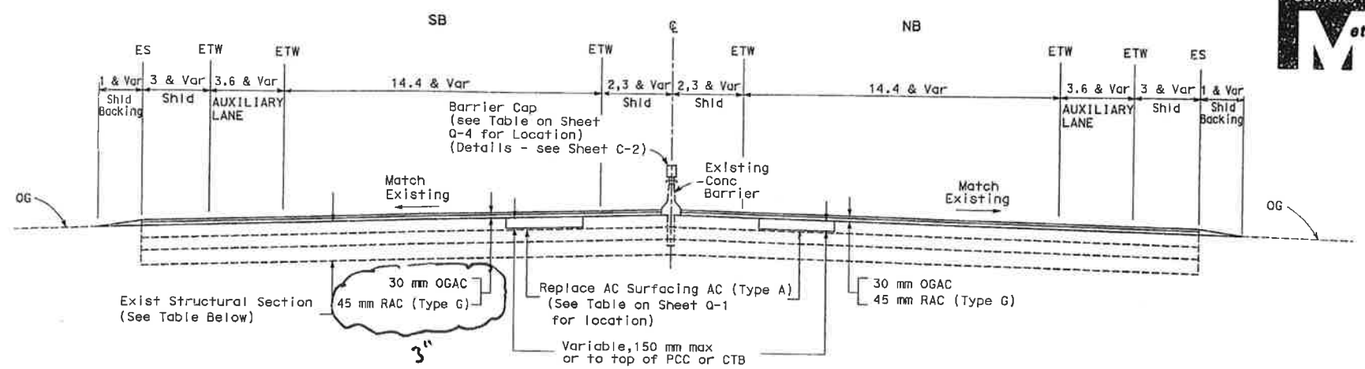
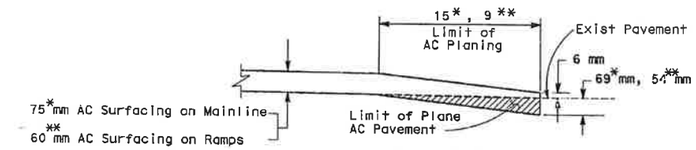


TYPICAL CROSS SECTION
FROM KP 24.6 (PM 15.3) TO KP 44.5 (PM 27.6)



AC PLANING AT CONFORM

*For conform on the mainline at project limits, approach slabs of bridges, undercrossings and at ramps with no new AC surfacing. For conforming to pavement underneath overcrossings, use detail A on C-1

** For conform on ramps

DETAIL A

EXISTING MAINLINE STRUCTURAL SECTION

KILOMETER POST (POSTMILE)	DESCRIPTION			
	Inside Shoulder	#1,#2,#3 Lanes	#4 & Auxiliary Lane	Outside Shoulder
25.2(15.6) Tennyson Road to 29.5(18.4) "A" Street Northbound + Southbound	30 mm OGAC 200 mm AC 70 mm ATPB 210 mm CTB 375 mm AS	30 mm OGAC 110 mm AC 200 mm PCC 105 mm CTB 250 mm AS	30 mm OGAC 200 mm AC 75 mm ATPB 210 mm CTB 375 mm AS	30 mm OGAC 200 mm AC 75 mm ATPB 210 mm CTB 375 mm AS
29.5(18.4) "A" Street to 32.4(20.2) Hesperian Boulevard Northbound + Southbound	30 mm OGAC 200 mm AC 210 mm CTB 480 mm AS	30 mm OGAC 110 mm AC 200 mm PCC 105 mm CTB 250 mm AS	30 mm OGAC 200 mm AC 75 mm ATPB 210 mm CTB 375 mm AS	30 mm OGAC 200 mm AC 75 mm ATPB 210 mm CTB 375 mm AS
32.4(20.2) Hesperian Boulevard to 33.5(20.8) Washington Avenue Northbound + Southbound	30 mm OGAC 200 mm AC 210 mm CTB 480 mm AS	30 mm OGAC Var 60-150 mm AC 200 mm PCC 105 mm CTB 250 mm AS	30 mm OGAC 170 mm AC 300 mm CTB 300 mm AS	30 mm OGAC Var 105-170 mm AC 150 mm AB 450 mm AS
33.5(20.8) Washington Avenue to 38.1(23.6) Davis Street Northbound + Southbound	30 mm OGAC Var60-150 mm AC 20 mm PCC 100 mm CTB 400mm AB	30 mm OGAC Var 60-150 mm AC 200 mm PCC 400 mm AS	30 mm OGAC 170 mm AC 300 mm CTB 300 mm AS	30 mm OGAC Var 105-170 mm AC 150 mm AB 450 mm AS
38.1(23.6) Davis Street to 41.0(25.5) Hegenberger Road Northbound + Southbound	260 mm AC 150 mm CTB 375 mm AS	30 mm OGAC Var 100-150 mm AC 200 mm PCC 300 mm AS	200 mm AC 75 mm ATPB 300 mm CTB 465 mm AS	300 mm AC 75 mm ATPB 300 mm CTB 465 mm AS
41.0(25.5) Hegenberger Road to 44.5(27.6) High Street Overhead Northbound + Southbound	50 mm AC Var600 mm AS	30 mm OGAC 175 mm AC 200 mm PCC 100 mm CTB 400 mm AS	30 mm OGAC 200 mm AC 250 mm CTB 200 mm AS	50 mm AC 150 mm AB

NOTES:

1. Dimensions of the structural sections are subject to tolerances specified in the Standard Specifications.
2. Superelevation as shown or as directed by the Engineer.
3. No AC surfacing on structures, structure approach slabs and PCC Pavement.
4. Existing utility facilities have not been plotted on these plans.
5. See detail on C-2 for cross drainage correction between 98th Ave and Hegenberger Ave on southbound Route 880.

NO Construction Changes

CONTRACT No. 04-0C7024
DATE ACCEPTED 11/14/02
AS BUILT
RESIDENT ENGINEER S KANSIL

TYPICAL CROSS SECTIONS
NO SCALE

All Dimensions are in Meters unless otherwise shown

X-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans PROJECT DEVELOPMENT
PROJECT ENGINEER VIJITH THILAKARATNE
CALCULATED/DESIGNED BY
CHECKED BY
DATE REVISED BY
DATE REVISED

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

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DGN FILE => 40c702b01.asb

CU 04233

EA 0C7021

LAST REVISION 04-22-00
DATE PLOTTED => 25-MAR-2003
TIME PLOTTED => 15:01

2002

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO	TOTAL SHEETS
04	Ala	880	38.0/50.0	7	47

4-16-97
REGISTERED CIVIL ENGINEER

6-23-97
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER D.N. Le No. 28032 Exp. 3-31-98 CIVIL STATE OF CALIFORNIA

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FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

NOTES:

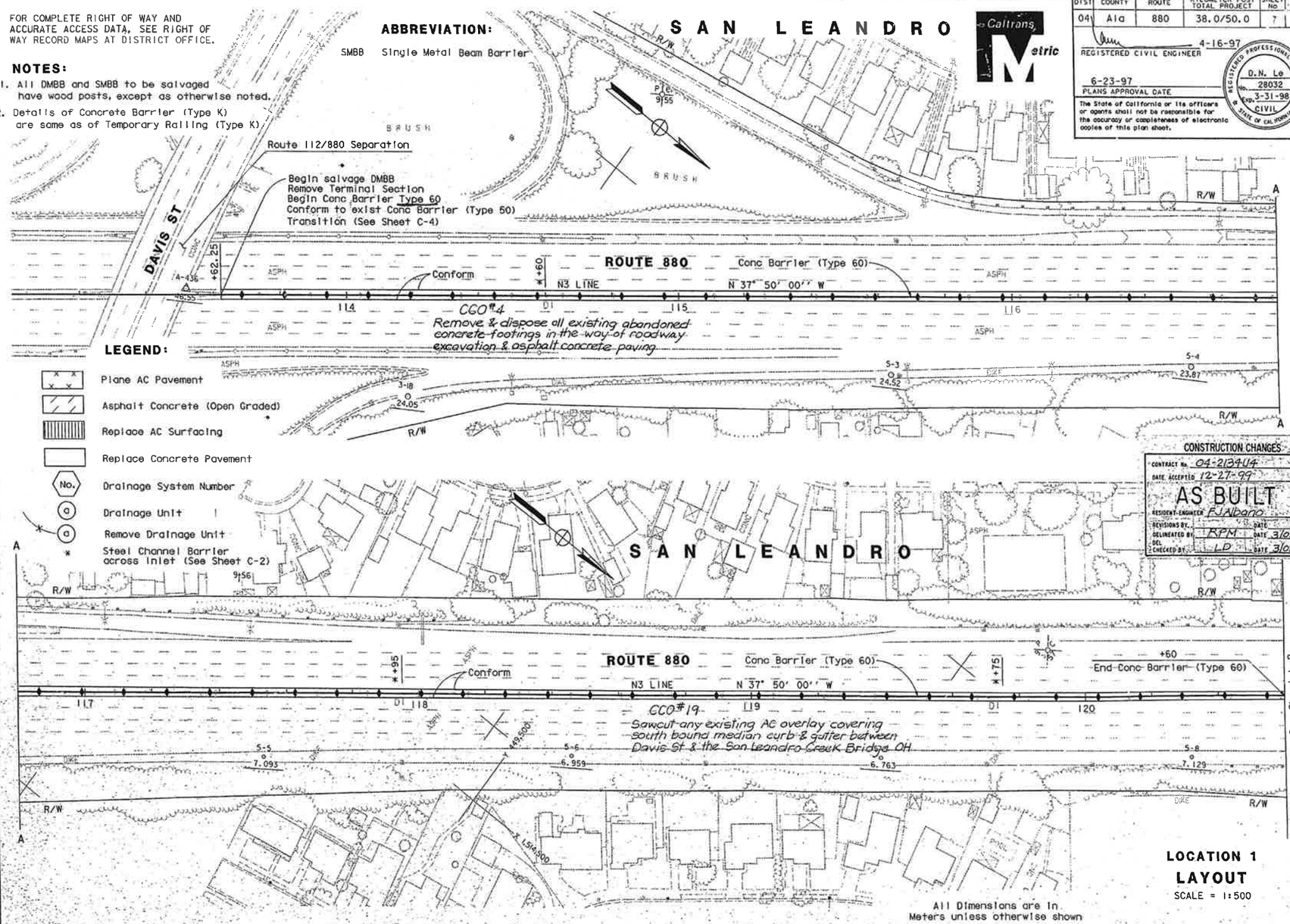
1. All DMBB and SMBB to be salvaged have wood posts, except as otherwise noted.
2. Details of Concrete Barrier (Type K) are same as of Temporary Railing (Type K).

ABBREVIATION:

SMBB Single Metal Beam Barrier

LEGEND:

- Plane AC Pavement
- Asphalt Concrete (Open Graded)
- Replace AC Surfacing
- Replace Concrete Pavement
- No. Drainage System Number
- Drainage Unit
- Remove Drainage Unit
- Steel Channel Barrier across Inlet (See Sheet C-2)



CONSTRUCTION CHANGES
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DATE ACCEPTED 12-27-99
AS BUILT
RESIDENT ENGINEER F.J. Albario
REVISIONS BY DATE
DELINEATED BY RPM DATE 3/01
DCL
CHECKED BY LD DATE 3/01

All Dimensions are in Meters unless otherwise shown

LOCATION 1
LAYOUT
SCALE = 1:500

L-1

DATE	REVISED BY	DATE REVISED

CALCULATED/DESIGNED BY
CHECKED BY

PROJECT ENGINEER D.N. LE

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans SPECIAL PROJECTS

LAST REVISION 04-15-97
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CU 04224 EA 2134U1

1999

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO	TOTAL SHEETS
04	Ala	880	38.0/50.0	2	47

4-16-97
REGISTERED CIVIL ENGINEER

6-23-97
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER D.N. Le No. 28032 Exp. 3-31-98 CIVIL STATE OF CALIFORNIA

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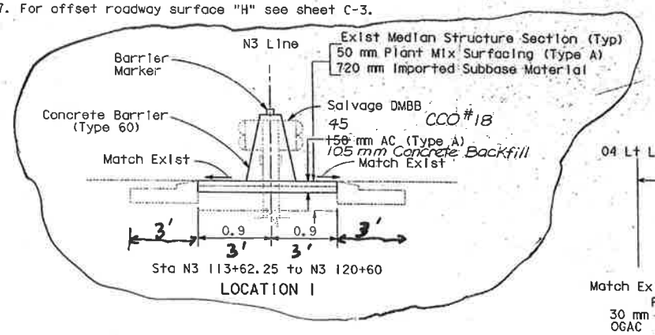
4 Caltrans Metric

NOTES:

1. Dimensions of the structural sections are subject to tolerances specified in the Standard Specifications.
2. All existing DMBB and SMBB are with wood post except noted.
3. Superelevation as shown, or as directed by the Engineer.
4. For work within median, see sheets X-1 and X-2.
5. For locations and limits of replace asphalt concrete surfacing and replace concrete pavement, see Layout sheets.
6. For Concrete Barrier Details not shown, see Sheets C-3 and C-4.
7. For offset roadway surface "H" see sheet C-3.

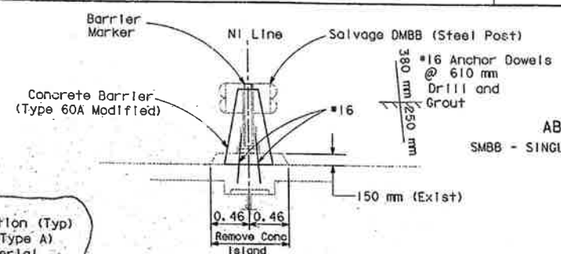
ABBREVIATION

SMBB - SINGLE METAL BEAM BARRIER



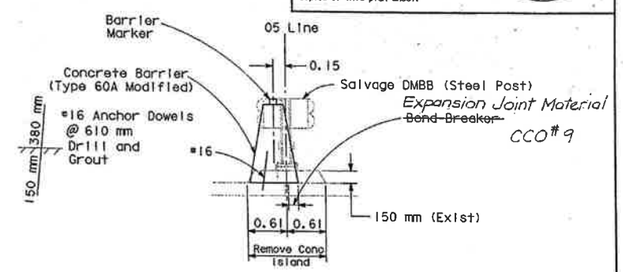
Sta N3 113+62.25 to N3 120+60

LOCATION 1



Sta N1 1+40 to N1 4+76.50
(SAN LEANDRO CREEK BRIDGE OH)
BR NO. 33-0100

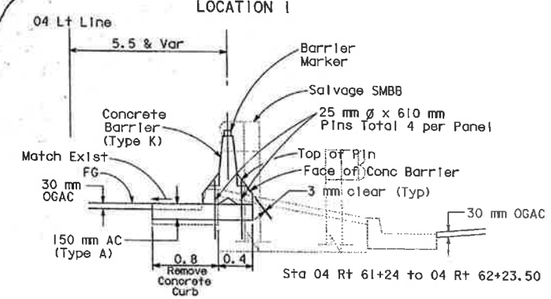
LOCATION 1



Sta 05 63+72.17 to 05 68+02
(FRUITVALE AVE OH)
BR NO. 33-0041

LOCATION 2

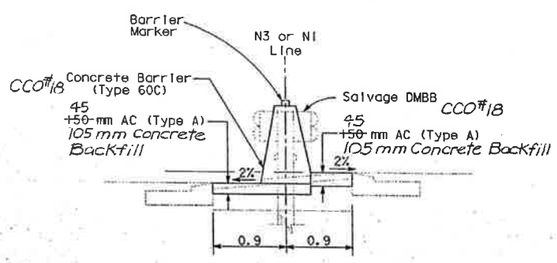
CCO #9
Substitute expansion joint material for bond breaker in longitudinal joint under planned concrete barrier



Sta 04 Rt 61+24 to 04 Rt 62+23.50

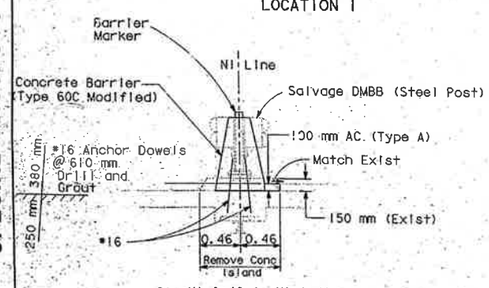
Sta 04 Lt 61+19 to 04 Lt 62+17

LOCATION 2



Sta N3 120+60 to N1 0+49

LOCATION 1



Sta N1 0+49 to N1 1+40
(SAN LEANDRO CREEK BRIDGE OH)
BR NO. 33-0100

LOCATION 1

CONSTRUCTION CHANGES
CONTRACT No. 04-213404
DATE ACCEPTED 12-27-99
AS BUILT
RESIDENT ENGINEER F. J. Albano
REVISIONS BY
DELINEATED BY RPM DATE 3/01
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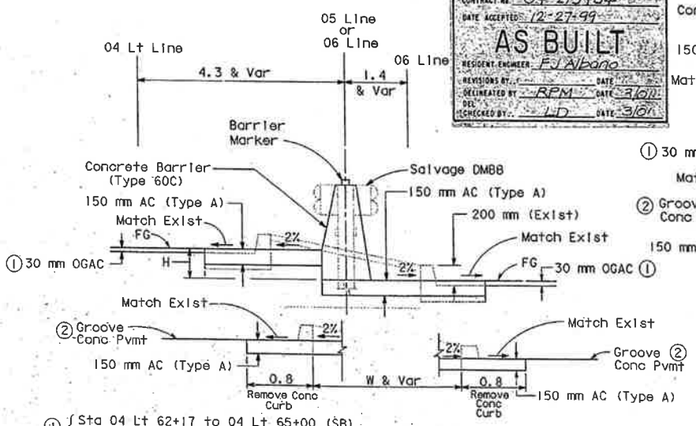
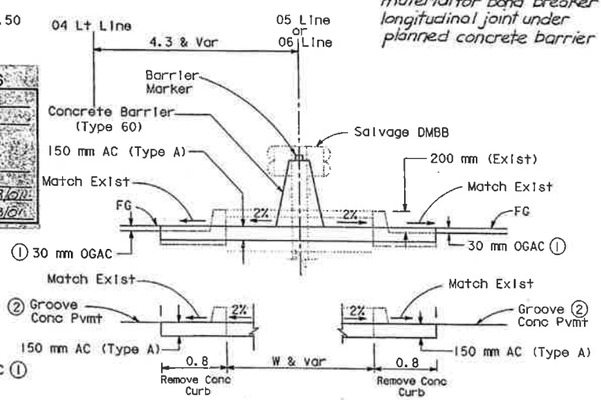
CHECKED BY LD DATE 3/01



① Sta 04 Lt 62+17 to 04 Lt 65+00 (SB)
Sta 04 Rt 62+23.50 to 04 Rt 65+11 (NB) W = 0.7

② Sta 05 78+90.00 to 05 79+94.00 W = 1.9
Sta 06 82+37.84 to 06 85+00.00 W = 1.6
Sta 06 88+63.00 to 05 89+38.00 W = 1.5

LOCATION 2



① Sta 04 Lt 65+00 to 04 Lt 65+72 (SB) W = 0.6
Sta 04 Rt 65+11 to 04 Rt 65+75 (NB) W = 1.1
Sta 05 89+38.00 to 05 89+83.00 (NB) W = 1.1

② Sta 05 68+02.00 to 05 68+80.00 W = 0.6
Sta 05 78+00.00 to 05 78+90.00 W = 1.9
Sta 06 85+00.00 to 06 86+42.00 W = 1.7
Sta 06 87+40.00 to 06 88+63.00 W = 1.9
Sta 05 89+38.00 to 05 89+83.00 (SB) W = 1.1
Sta 05 93+50 to 05 95+00 W = 0.7

LOCATION 2

4 REVISED PER ADDENDUM NO. 1 DATED SEPTEMBER 10, 1997

All Dimensions are in Meters unless otherwise shown

TYPICAL CROSS SECTIONS AND CONSTRUCTION DETAILS

NO SCALE

X-1

REVISED BY	DATE REVISED

CALCULATED/DESIGNED BY	SKC	DATE 10/96
CHECKED BY		

PROJECT ENGINEER DIEP N. LE

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans SPECIAL PROJECTS

DATE PLOTTED => 8-SEP-1997
TIME PLOTTED => 13:47

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

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CU 04224

EA 2134U1

1999

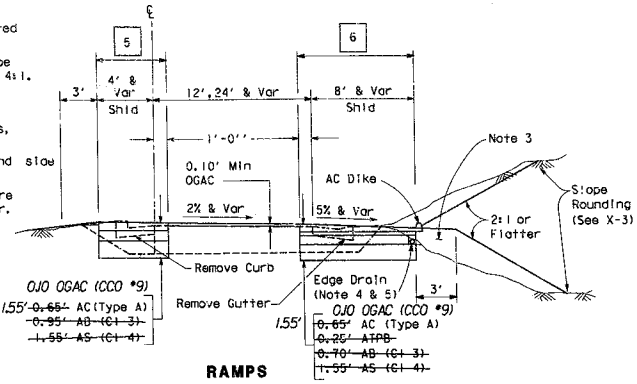
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	880	20.3/23.6	2	354

Tony Wong
REGISTERED CIVIL ENGINEER
8-26-91
PLANS APPROVAL DATE

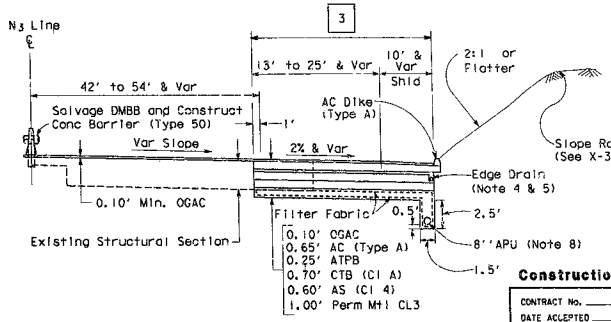
REGISTERED PROFESSIONAL ENGINEER T.Y.F. WONG No. 40018 Exp. 12-31-93 CIVIL STATE OF CALIFORNIA

NOTES:

1. Dimensions of the structural sections are subject to tolerances specified in the Standard Specifications.
2. Superelevation as shown or as directed by the Engineer.
3. Extend subbase material to fill slope whenever fill slope is steeper than 4:1.
4. For location of edge drain, see Edge Drain Plan.
5. For edge drain filter fabric details, see Construction Details Sheet C-3.
6. For location and type of AC dikes and gutter, See Layout Sheets.
7. AC surfacing thickness varies at gore areas or as directed by the Engineer.
8. See Drainage Plan Sheets for Underdrain location.
9. See Layout Sheets for Soundwall and Retaining Wall location.
10. Extend Freeway structural section at gore areas all the way to the ramp shoulder.



RAMPS

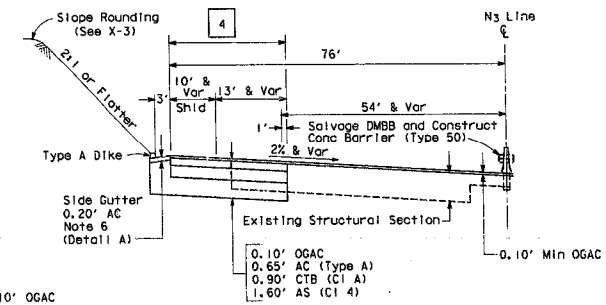


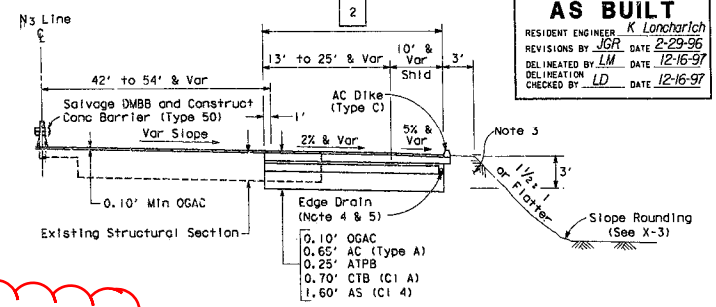
Construction Changes

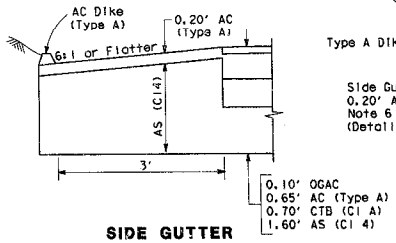
CONTRACT No. 04-123174
DATE ACCEPTED 11-29-95

AS BUILT

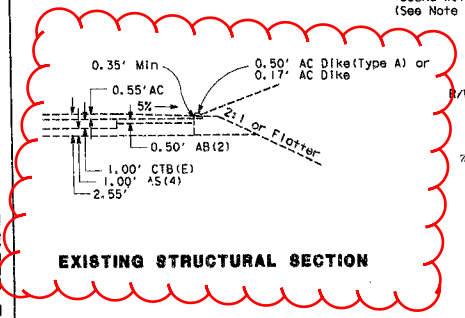
RESIDENT ENGINEER K Lonchariich
REVISIONS BY JGR DATE 2-29-96
DELINEATED BY LM DATE 12-16-97
DELINEATION CHECKED BY LD DATE 12-16-97



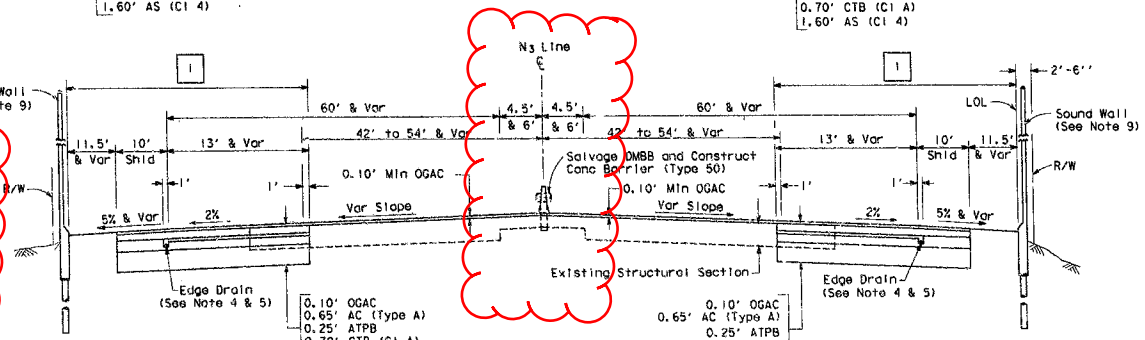




SIDE GUTTER "DETAIL A"



EXISTING STRUCTURAL SECTION



FREEWAY

TYPICAL CROSS SECTIONS

NO SCALE

X-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
PROJECT DEVELOPMENT

DATE	REVISED BY	DATE REVISED	CALCULATED/DESIGNED BY	CHECKED BY	PROJECT ENGINEER T.Y.F. WONG

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3

CU 04173	EA	123171

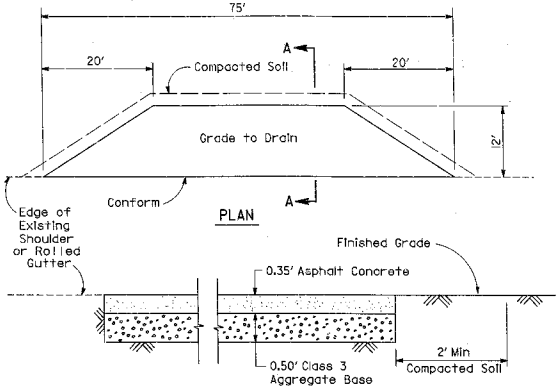
FORM DC-DE-92-PF (REV. 3/98)

T:\AVAX:;ZHAI:(331.2341231)X01.DGN:1

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	880	20.3/23.6	47	354

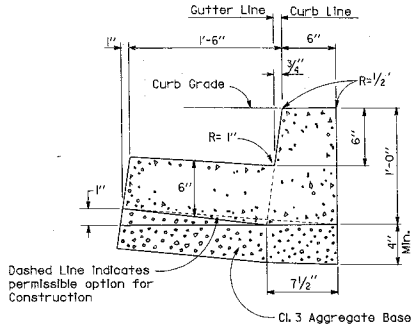
Tony Wong
REGISTERED CIVIL ENGINEER
8-26-91
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER T. Y. F. Wong No. 40018 Exp. 12-31-93 CIVIL STATE OF CALIFORNIA

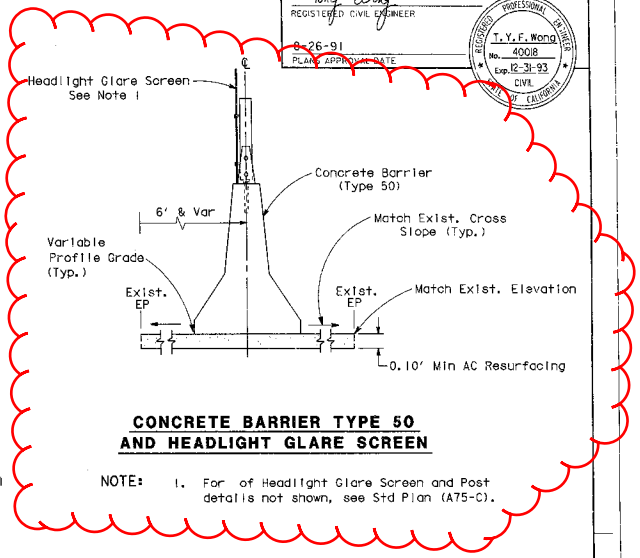


SECTION A - A

MAINTENANCE VEHICLE PULLOUT

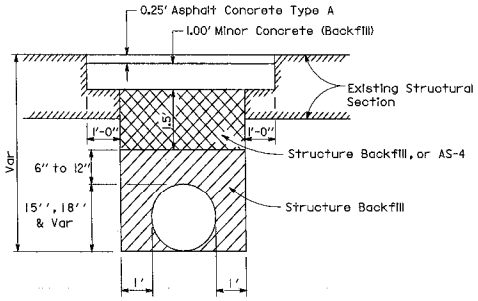


TYPE G
COUNTY OF ALAMEDA STANDARD
PCC CURB AND GUTTER

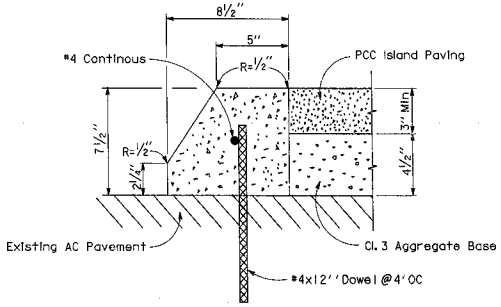


CONCRETE BARRIER TYPE 50
AND HEADLIGHT GLARE SCREEN

NOTE: 1. For of Headlight Glare Screen and Post details not shown, see Std Plan (A75-C).

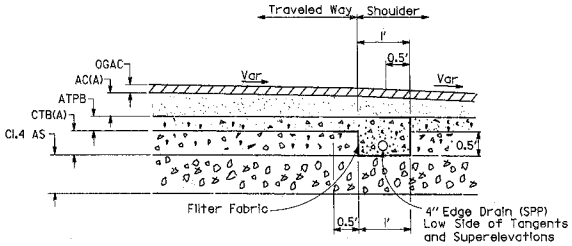


STREET TRENCH PAVING TYPIACL



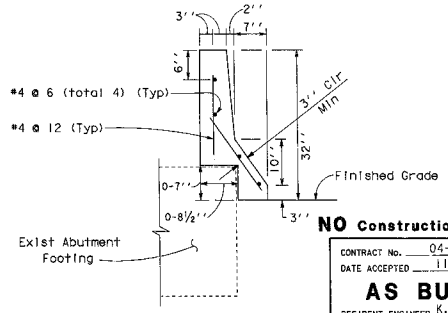
NOTE : Batter Backface 1/2" if Extruded Curb is used.

TYPE 1
COUNTY OF ALAMEDA STANDARD
PCC MEDIAN CURB WITH ISLAND PAVING



TYPICAL AC SECTION WITH ATPB
DRAINAGE LAYER

(For details not shown, see D 9P D-1 Type 5)



NO Construction Changes

CONTRACT No. 04-123174
DATE ACCEPTED 11-29-95
AS BUILT
RESIDENT ENGINEER K. Loncharich

MODIFIED CONCRETE BARRIER TYPE 50E

CONSTRUCTION DETAILS
NO SCALE
C-3

CU	04173	EA	123171

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3

FORM DC-OE-92-PF (REV. 3/88)

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
PROJECT ENGINEER T. Y. F. WONG
CALCULATED/DESIGNED BY
CHECKED BY
DATE REVISED BY
DATE REVISED

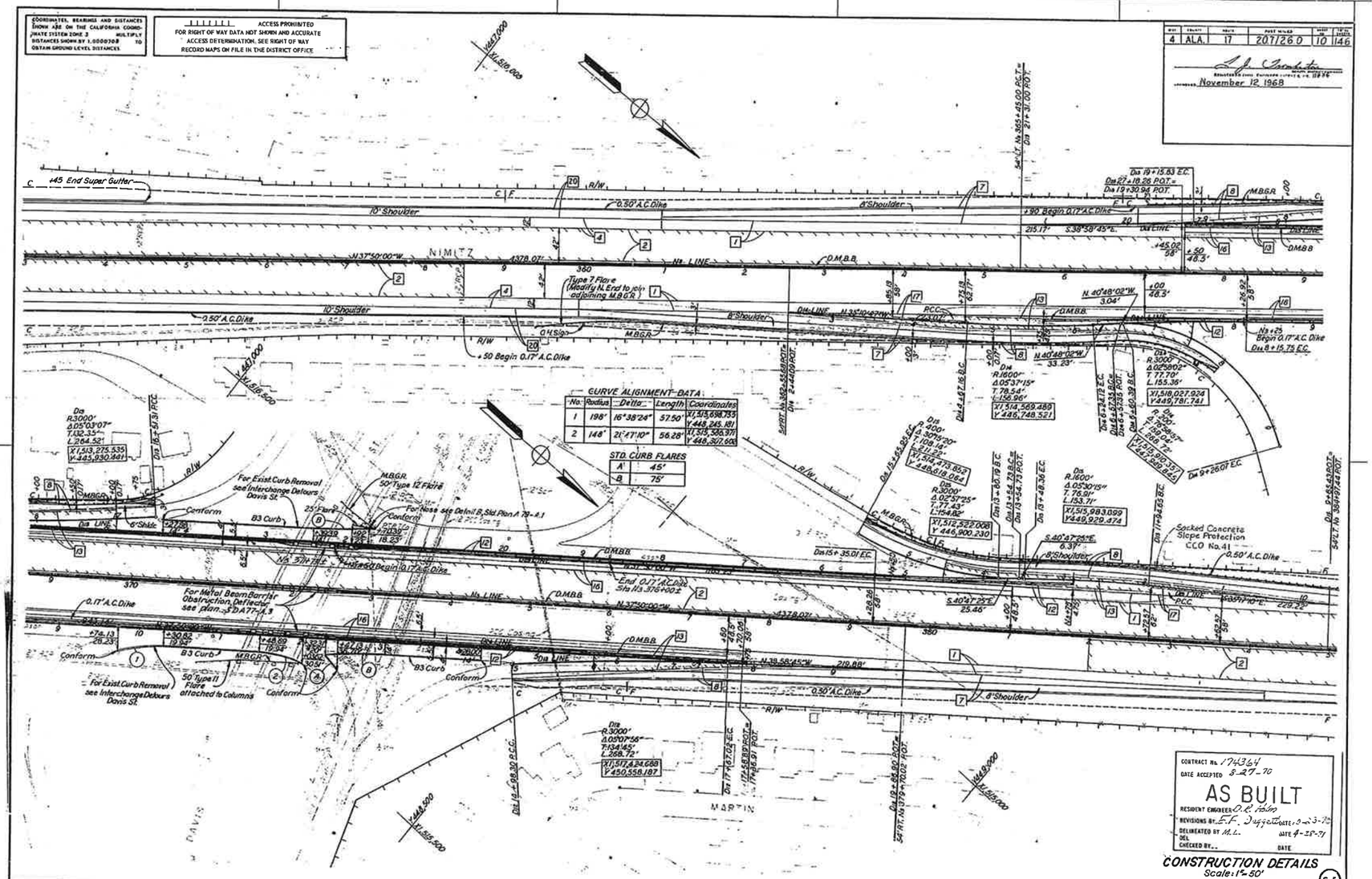
H:\DGN\C3\C3\HAYWARD\123174\C3\123174\HDDD\C3\C3.DGN

COORDINATES, BEARINGS AND DISTANCES SHOWN ARE ON THE CALIFORNIA COORDINATE SYSTEM ZONE 3 MULTIPLY DISTANCES SHOWN BY 1.0000708 TO OBTAIN GROUND LEVEL DISTANCES.

ACCESS PROHIBITED
FOR RIGHT OF WAY DATA NOT SHOWN AND ACCURATE ACCESS DETERMINATION, SEE RIGHT OF WAY RECORD MAPS ON FILE IN THE DISTRICT OFFICE

DIST.	COUNTY	ROUTE	POST MILEAGE	SHEET NO.	TOTAL SHEETS
4	ALA.	17	207/260	10	146

November 12 1968



CURVE ALIGNMENT DATA

No.	Radius	Delta	Length	Coordinates
1	198'	16°38'24"	57.50'	X1,515,698.733 Y448,245.181
2	148'	21°47'10"	56.28'	X1,515,588.976 Y448,307.065

STD. CURB FLARES

A	45'
B	75'

CONTRACT No. 174364
DATE ACCEPTED 8-27-70
AS BUILT
RESIDENT ENGINEER O.R. Hahn
REVISIONS BY E.F. Duggan DATE 8-23-70
DELINEATED BY M.L. DATE 4-28-71
CHECKED BY... DATE

PROJECT ENGINEER | DATE | DESIGN ENGINEER | DATE | APPROVAL RECOMMENDED BY | DATE

AS BUILT PLANS
Contract No. 04-17-1364
Date Completed
Document No. 4000 1976

10

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE July 4, 1971 SIGNATURE [illegible] TITLE Assistant Section Supervisor

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

1970

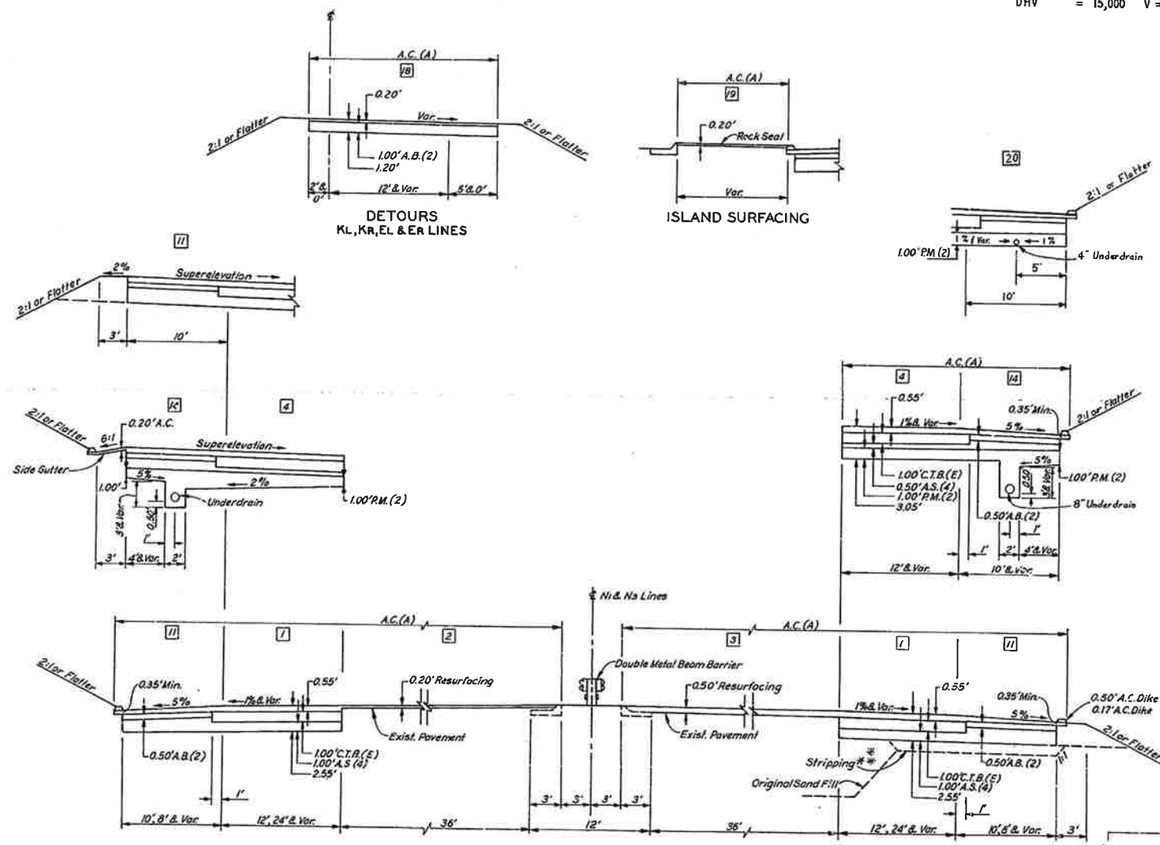
U-033-1(14)

DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL
4	ALA.	17	20.7/26.0	2	146

DESIGN CLASSIFICATION

ADT '67 = 110,000 D = 60 %
ADT (90) = 160,000 T = 4 %
DHV = 15,000 V = 60 MPH

REGISTERED CIVIL ENGINEER
REGISTRATION NO. 11336
November 12, 1968
APPROVED



*Stripping Limits:
Strip to 3.5' below finished grade
from Sta. Ni 63+00 to 71+50 on Rt.
and Sta. Ni 74+75 to 79+25 on Rt.
& Sta. Ni 77+00 to 80+00 on Rt.

CCO #16

CCO # 17
Stripping between
Stations Ni 37+00 ± & Ni 63+00 ±

Notes:

1. Dimensions shown are subject to tolerances specified in the Standard Specifications.
2. Superelevations as directed by the Engineer or as shown on the Plans.
3. Permeable material blanket and standard underdrain trenches are to be placed as shown on the Plans or as directed by the Engineer.
4. Wherever fill slope is steeper than 4:1 base materials are to be extended to the fill slope.
5. For location of median barrier and guard railing see Construction Details.
6. For size and location of A.C. dike see Construction Details.
7. For additional details and location limits see Construction Details.
8. Existing structural section need be removed only where required by the Engineer.

ABBREVIATIONS

A.S. (4) ..... Aggregate Subbase (Class 4)
A.B. (2) ..... Aggregate Base (Class 2)
C.T.B. (A) ..... Cement Treated Base (Class A)
C.T.B. (E) ..... Cement Treated Base (Class E)
A.C. (A) ..... Asphalt Concrete (Type A)
A.C. (B) ..... Asphalt Concrete (Type B)
P.M. (2) ..... Permeable Material (Class 2)
Var. ..... Variable
Ma ..... Indicates type of surface and structural section.
PCC (B) ..... Portland Cement Concrete (Class B)

CONTRACT 04-174364
DATE ACCEPTED 8-27-70
AS BUILT
RESIDENT ENGINEER O.R. Hoke DATE 10-23-70
REVISIONS BY E.F. Dorsett DATE 4/29/71
DELINEATED BY N.L.
DES. CHECKED BY J. TIGAR DATE 5-3-71

AS BUILT PLANS
Contract No. 04-174364
Date Completed
Document No. 4000 1996

04-Ala-17-20.7/26.0

TYPICAL CROSS SECTIONS ①

Scale: 1" = 5'

PROJECT ENGINEER	DATE	DESIGN ENGINEER	DATE	APPROVAL RECOMMENDED BY	DATE
E.A. HANSEN	6-68	K.C. SCENDERMAN	6-68	J.F. O'SHEA	6-68

04219 - 174361

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE July 14, 1971 SIGNATURE Jotten R. Eng TITLE Assistant Sec'y of Supply

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

1970

MICROFILMED.

DIST.	COUNTY	ROUTE	POSTMILE	SHEET No.	TOTAL SHEETS
04	Ala	17	22.2-23.9	2	23

APPROVED June 28, 1965

J. C. Womack
STATE HIGHWAY ENGINEER
REGISTERED CIVIL ENGINEER NO. 5646

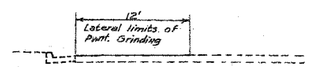
BY: STATE HIGHWAY ENGINEER
REGISTERED CIVIL ENGINEER NO. 5646

for: ASSISTANT STATE HIGHWAY ENGINEER
REGISTERED CIVIL ENGINEER NO. 9937

REGISTERED CIVIL ENGINEER NO. 9937

AS BUILT PLANS
Contract No. 04-292024
Date Completed 3-30-66
Document No. 4000001

MICROFILMED.



Typical Cross Section in Deceleration Lane Areas not shown

TRANSVERSE SECTION

No Scale

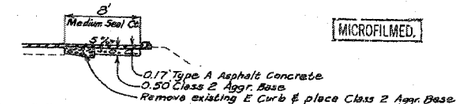
GRIND PAVEMENT
C, 320+00 to C, 342+66
OUTSIDE SOUTHBOUND LANE

SHOULDER
C, 363+30 to 387+00 SHT.# 4

SHOULDER
C, 316+93 to C, 319+00 SHT# 5

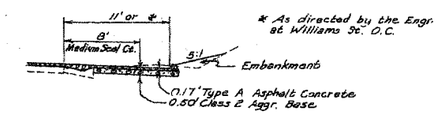
PAVEMENT AND SHOULDER
TRANSITIONS BETWEEN STATIONS

C, 301+00 to C, 302+00	Sht. # 6	
C, 319+00 to C, 320+00	"	
C, 342+66 to C, 343+66	"	
C, 387+00 to C, 388+00	"	
C, 315+93 to C, 316+93	"	



C, 387+00 to C, 388+00

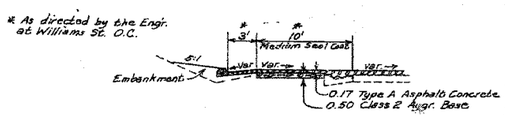
SHOULDER
C, 360+25 to C, 381+88 SHT# 4 & 6



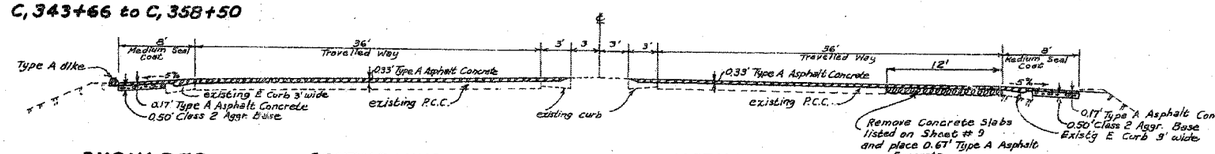
* As directed by the Engr. at Williams St. O.C.

C, 342+97 to C, 360+25

SHOULDER
C, 316+35 to C, 342+97 SHT# 5 & 6



C, 343+66 to C, 358+50



SHOULDER
C, 302+00 to C, 315+93
C, 358+50 to C, 363+30

SOUTHBOUND LANES
C, 343+66 to C, 387+00
C, 302+00 to C, 319+00

NORTHBOUND LANES
C, 302+00 to C, 387+00

SHOULDER
C, 302+00 to C, 316+35
C, 381+88 to C, 387+00

MICROFILMED.

NO CONSTRUCTION CHANGES

CONTRACT No. 04-292024
DATE ACCEPTED 3-30-66
AS BUILT
RESIDENT ENGINEER R. Tom
REVISIONS BY... DATE
DELINEATED BY DATE
CHECKED BY... DATE

No Scale

Note: Dimensions are subject to tolerances specified in the Standard Specifications

TYPICAL CROSS SECTIONS
C, 301+00 to C, 388+00

04-Ala-17 PM 22.2/23.9

Ⓐ

Project Engineer	Date	Design Engineer	Date	Approval Recommended by	Date
[illegible]	5/6/65	Tom [illegible]	5/6/65	R D Kenney [illegible]	6/1/65

04-602-292021

2

292021

1966

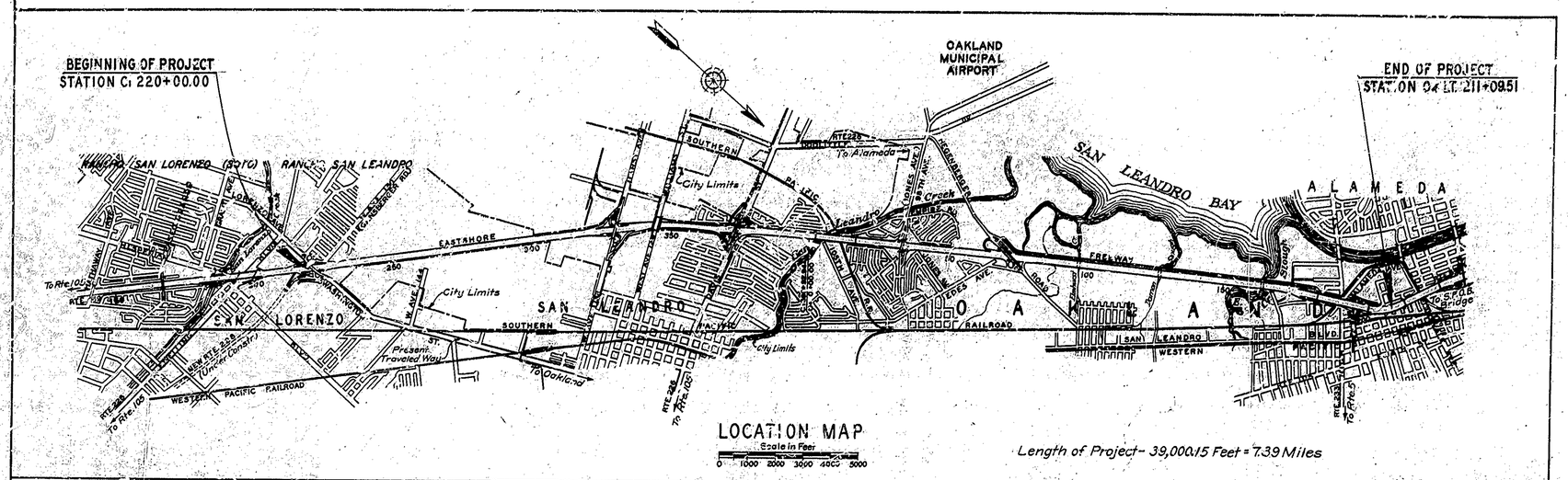
DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
IV	ALA.	69	C.S.L.N. Oak.	2	14

APPROVED October 24, 1955

State Highway Engineer
Civil Engineer's License No. 7884

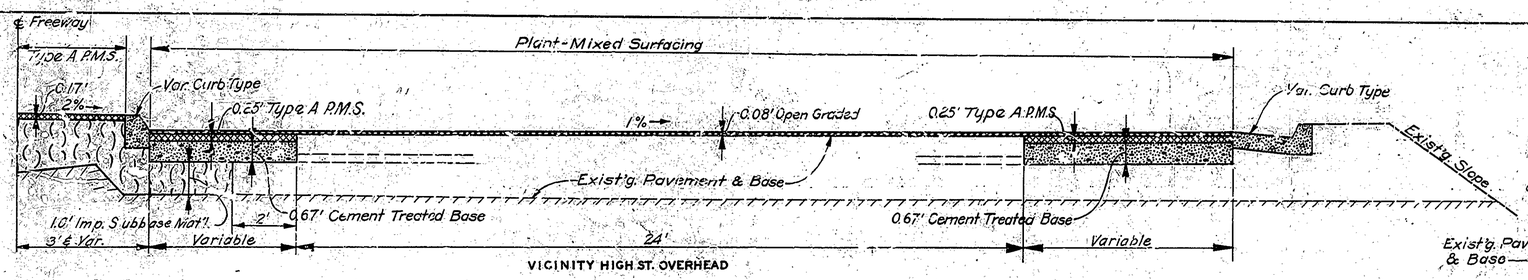
Asst. Engineer of Design
Civil Engineer's License No. 5474 6565

Assistant State Highway Engineer

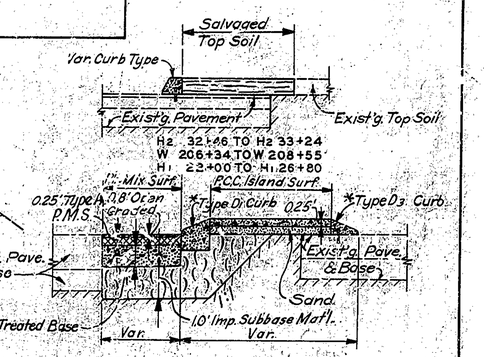


LOCATION MAP
Scale in Feet
0 1000 2000 3000 4000 5000

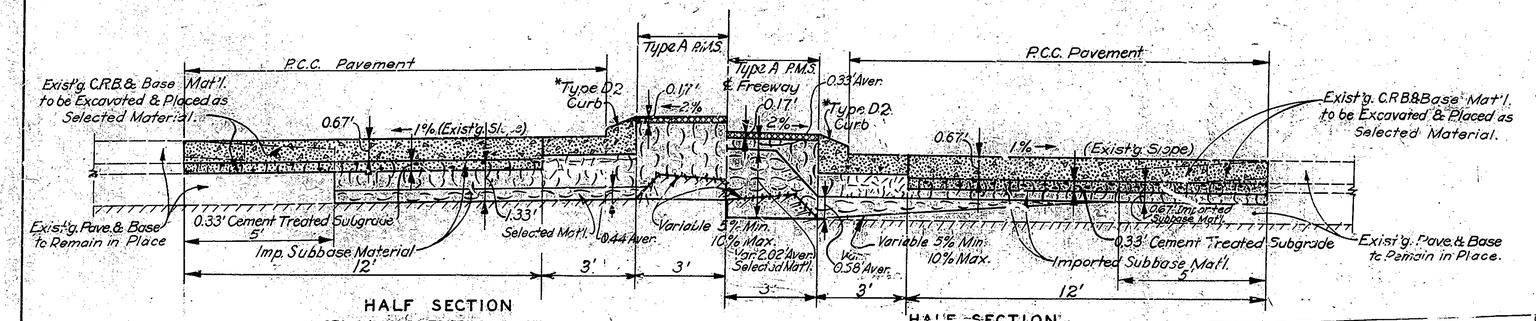
Length of Project - 39,000.15 Feet = 7.39 Miles



VICINITY HIGH ST. OVERHEAD

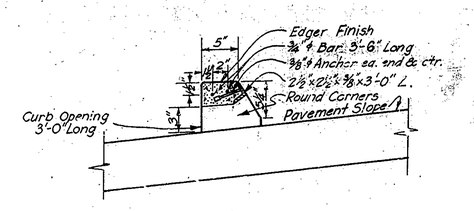


STA. H1 26+85 TO STA. H1 27+46
STA. W 202+00 TO STA. W 203+68
(VICINITY HIGH ST. OVERHEAD)
SCALE: 1" = 2'



HALF SECTION
STA. C1 220+00 TO STA. 04 1+62.17

HALF SECTION
STA. 04 15+72.76 TO { STA. 04 LT. 175+25.13 / STA. 04 RT. 177+25.64 }



CURB OPENING LT. OF STA. H1 23+03
SCALE: 1 1/2" = 1'

*Note:
See Miscellaneous Detail Sheet for Scored Surface of Type D1, D2 & D3

TYPICAL CROSS-SECTIONS
Scale:- 1" = 2'

AS BUILT PLANS
Contract No. 56-14TC21-F
Date Completed
Document No. 40000 760

LOCATION MAP & TYPICAL CROSS-SECTIONS
BETWEEN
JCT. RTE. 228 (NEW) & 0.2 MI. NO. OF HIGH ST.

56-14TC21-F

Scales:- As Shown

Nov. 1954

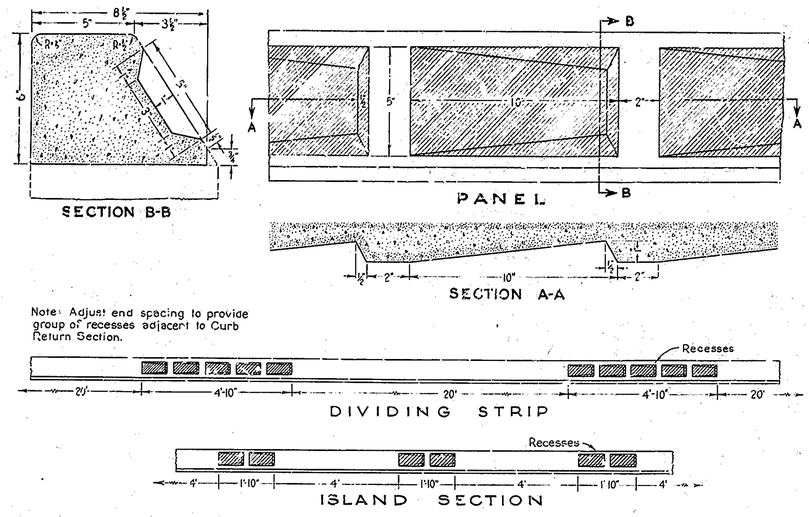
IV-1047

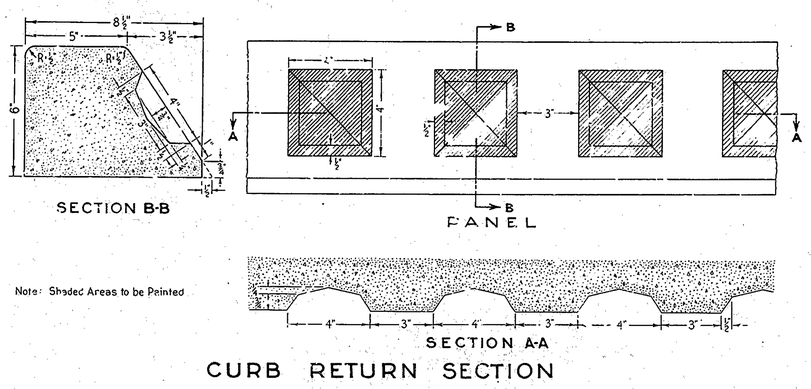
1955

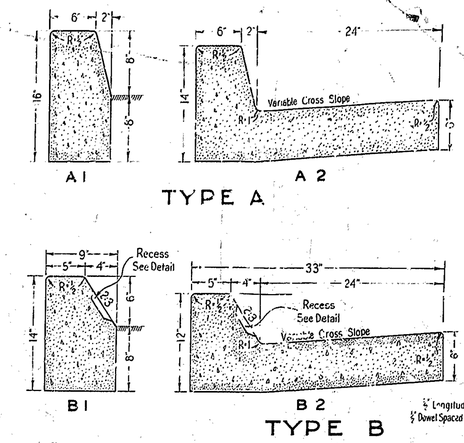
FED. REG. DIV. NO.	STATE	FEDERAL PROJECT NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
	CALIF.	U-341(12)		14	62

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
11	Ala	69	Chula Vista	14	14

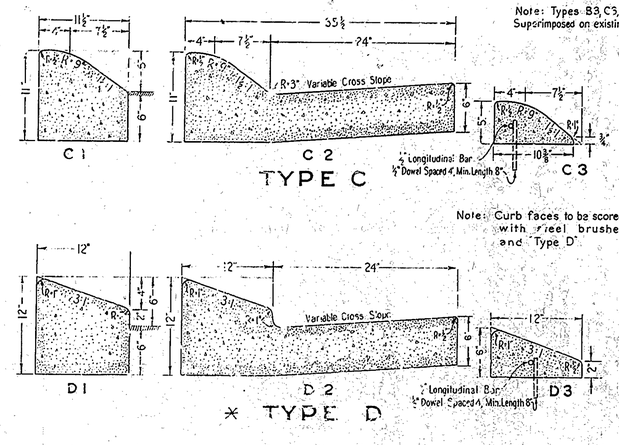
Approval Recommended
Assistant State Highway Engineer
October 27, 1950
State Highway Engineer
Civil Engineer License No. 2084
To Accompany Plans Dated October 24, 1955.



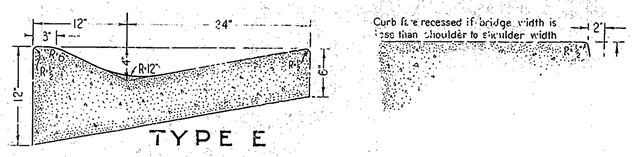




Note: Types B3, C3, D3 Superimposed on existing pavement



Note: Curb faces to be scored transversely with steel brushes on Type C and Type D.



AS BUILT PLANS
Contract No. 56-14TC21-F
Date Completed
Document No. 40000760

* See Miscellaneous Detail Sheet for scored surface of Type D curbs.

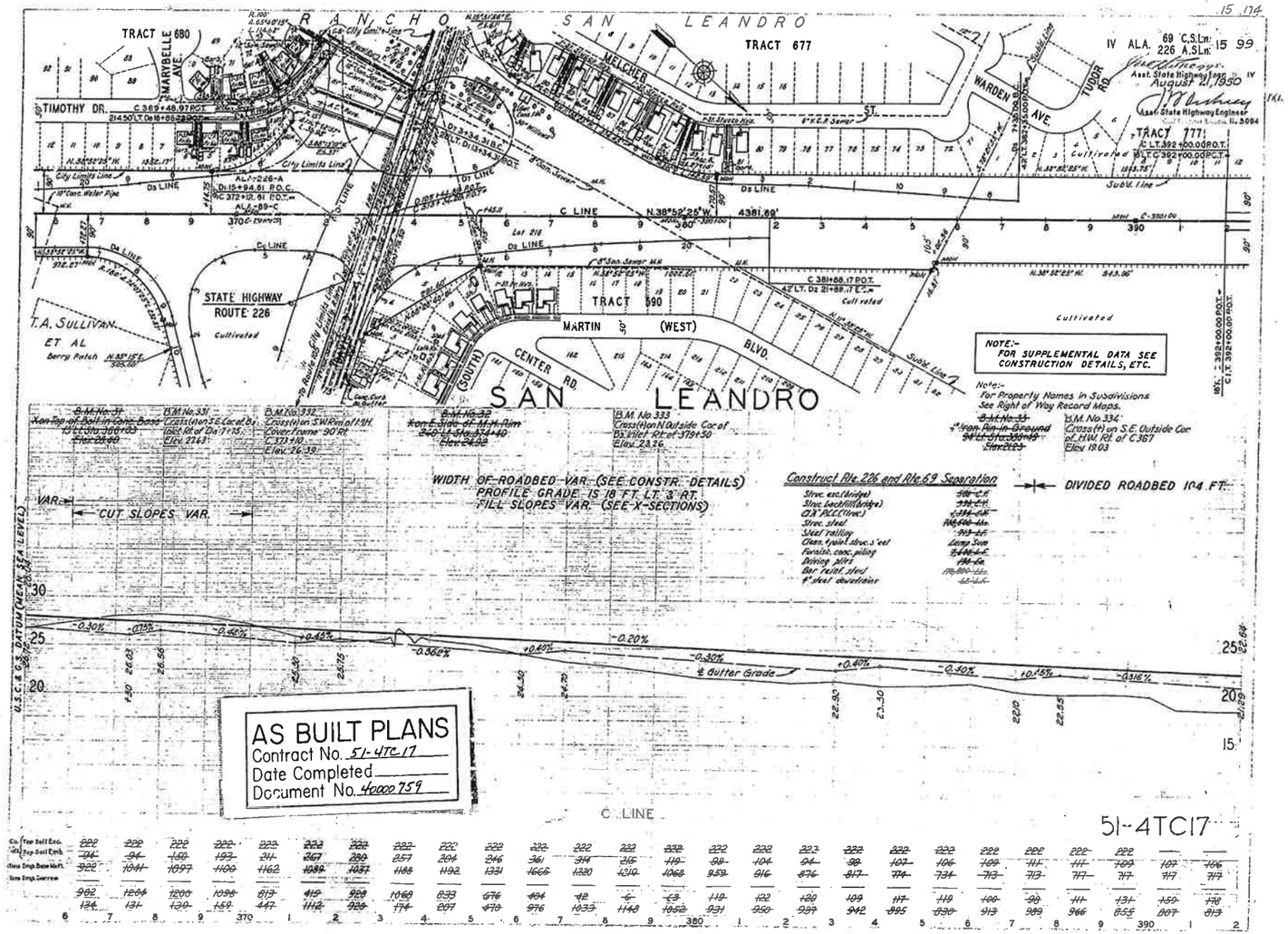
CURB QUANTITIES

Type	C.Y. Per Lin. Ft.	Type	C.Y. Per Lin. Ft.
A1	0.03084	C2	0.06457
A2	0.06379	C3	0.00965
B1	0.02930	D1	0.03073
B2	0.06171	D2	0.06782
B3	0.01074	D3	0.01223
C1	0.02752	E	0.06661

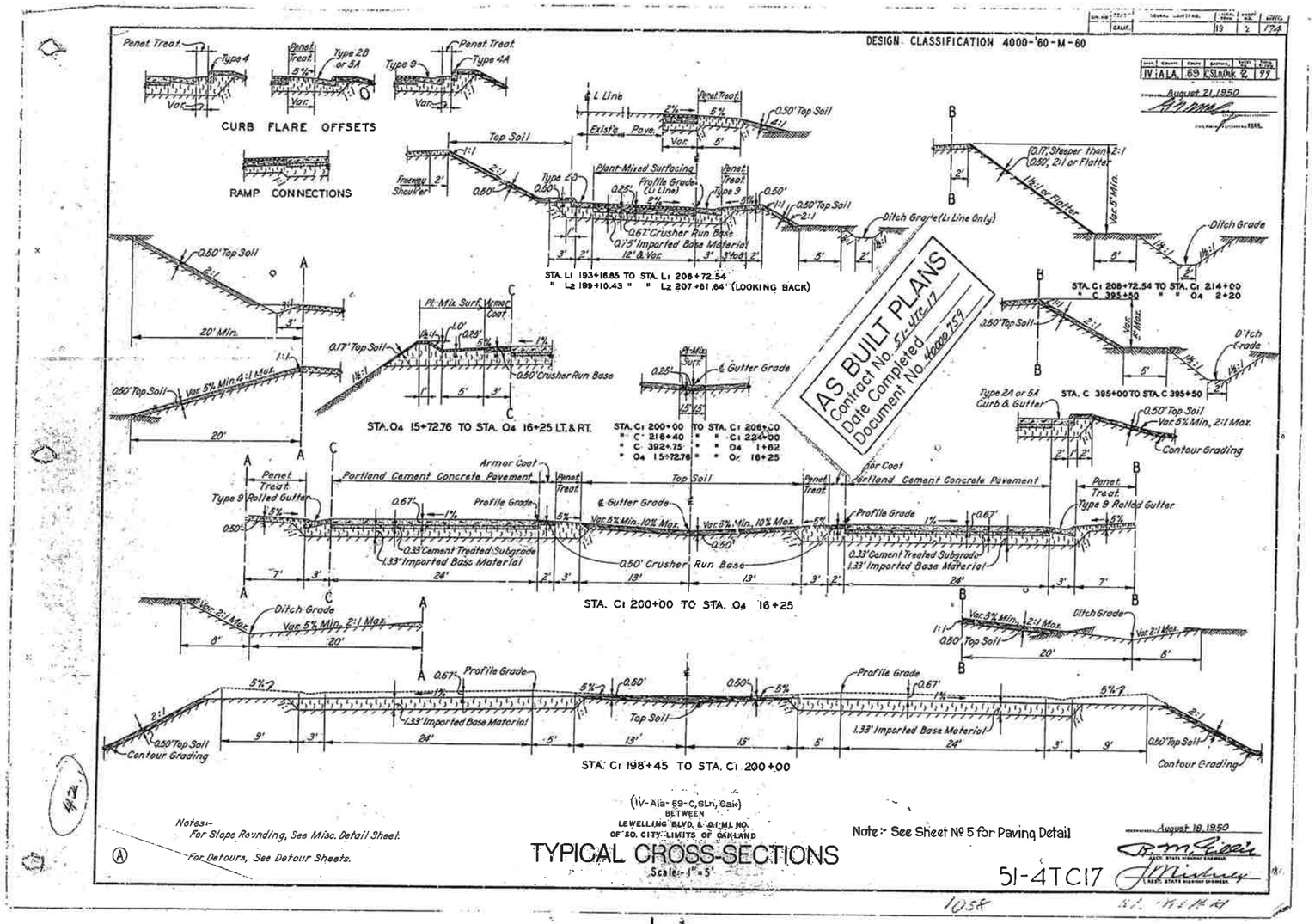
S7

Revised

1955


RANCHO SAN LEANDRO
TRACT 680
TRACT 677
TRACT 777
TRACT 590
MARYBELLE AVE.
TIMOTHY DR.
MELCHER ST.
WARDEN AVE.
TUDOR RD.
STATE HIGHWAY ROUTE 226
T.A. SULLIVAN ET AL
MARTIN (WEST) BLVD.
CENTER RD. (SOUTH)
SAN LEANDRO
C LINE
N.38°59'25"W. 4381.69'
IV ALA. 69 C.S.Lm. 226 A.S.Lm. 15 99
Asst. State Highway Engineer
August 21, 1950
NOTE:- FOR SUPPLEMENTAL DATA SEE CONSTRUCTION DETAILS, ETC.
Note:- For Property Names in Subdivisions See Right of Way Record Maps.
B.M. No. 334 Cross (+) on S.E. Outside Cor. of H.W. Rt. of C 367 Elev. 19.03
B.M. No. 333 Cross (+) on N. Outside Cor. of Ds. Inlet Rt. of 379+50 Elev. 23.26
B.M. No. 332 Cross (+) on S.W. Rim of H.H. Cover Frame 90 Rt. C 373+10 Elev. 26.39
B.M. No. 331 Cross (+) on S.E. Corr. Ds. Inlet Rt. of Ds 371+35 Elev. 22.43
WIDTH OF ROADBED VAR. (SEE CONSTR. DETAILS)
PROFILE GRADE IS 18 FT. LT. & RT.
FILL SLOPES VAR. (SEE X-SECTIONS)
CUT SLOPES VAR.
Construct Rte. 226 and Rte. 69 Separation
DIVIDED ROADBED 104 FT.
U.S.C.&G.S. DATUM (MEAN SEA LEVEL)
℄ Gutter Grade
AS BUILT PLANS
Contract No. 51-4TC17
Date Completed
Document No. 40000759
C LINE
51-4TC17

1950


DESIGN CLASSIFICATION 4000-'60-M-60
IV-ALA. 69 CSLnOak 2 97
August 21, 1950
CURB FLARE OFFSETS
RAMP CONNECTIONS
STA. L1 193+16.85 TO STA. L1 206+72.54
" L2 199+10.43 " " L2 207+81.64' (LOOKING BACK)
STA. C1 208+72.54 TO STA. C1 214+00
" C 395+50 " " O4 2+20
STA. C 395+00 TO STA. C 395+50
STA. O4 15+72.76 TO STA. O4 16+25 LT. & RT.
STA. C1 200+00 TO STA. C1 206+00
" C 316+40 " " C1 224+00
" C 392+75 " " O4 1+62
" O4 15+72.76 " " O4 16+25
STA. C1 200+00 TO STA. O4 16+25
STA. C1 198+45 TO STA. C1 200+00
AS BUILT PLANS
Contract No. 51-4TC17
Date Completed
Document No. 46000759
(IV-Ala-69-C, 6Ln, Oak)
BETWEEN
LEWELLING BLVD. & 0.1 MI. NO.
OF SO. CITY LIMITS OF OAKLAND
Notes:-
For Slope Rounding, See Misc. Detail Sheet.
For Detours, See Detour Sheets.
Note:- See Sheet № 5 for Paving Detail
TYPICAL CROSS-SECTIONS
Scale:- 1" = 5'
August 18, 1950
51-4TC17

1950

Typical Cross Sections
(X-sheets)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	880	22.6/24.0		

REGISTERED CIVIL ENGINEER — DATE 11-16-11

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — B. RAZEGHI — No. C52725 — Exp. 12-31-12 — CIVIL — STATE OF CALIFORNIA

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ACTC
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Suites 220 & 300
Oakland, CA 94612

NOTES:

1. DIMENSIONS OF THE PAVEMENT STRUCTURES (STRUCTURAL SECTIONS) ARE SUBJECT TO TOLERANCES SPECIFIED IN THE STANDARD SPECIFICATIONS.
2. SUPERELEVATIONS AS SHOWN ON THE SUPERELEVATION DIAGRAMS.
3. FOR LOCATION OF SAWCUT/CONFORM LINES, SEE CONSTRUCTION DETAIL PLANS.
4. FOR LOCATION AND TYPE OF RETAINING WALL, SEE RETAINING WALL AND STRUCTURE PLANS.
5. FOR SOUNDWALL LOCATION, SEE SOUND WALL PLANS.
6. FOR LOCATION OF GUTTERS AND DITCHES, SEE DRAINAGE PLANS.
7. FOR LIMITS AND TYPES OF CONCRETE BARRIER, DIKE, FENCE, AND MBGR, SEE LAYOUT AND QUANTITY SHEETS.
8. FOR LOCATIONS OF EDGE DRAINS, SEE EDGE DRAIN PLANS.
9. FOR LOCATIONS OF UNDERDRAINS, SEE SHEET D-4.
10. PLACE 0.25' (Min) HMA (TYPE A) UNDER DIKES AND CONCRETE BARRIER (TYPE 60, 60C AND 60E). DO NOT EXTEND HMA (OG) AND RHMA-G LAYERS UNDER DIKES AND BARRIERS.
11. SEE CONSTRUCTION DETAIL PLANS, SHEET C-21, FOR LIMITS OF PAVEMENT COLD PLANE AND OVERLAY.

LEGEND AND ABBREVIATIONS:

GPI	GEOSYNTHETIC PAVEMENT INTERLAYER
HMA (OG)	HOT MIX ASPHALT (OPEN GRADED)
RAC-G	RUBBERIZED ASPHALT CONCRETE (GAP GRADED)
RHMA-G	RUBBERIZED HOT MIX ASPHALT (GAP GRADED)
RSCB	RAPID STRENGTH CONCRETE BASE
SEG	SUBGRADE ENHANCEMENT GEOTEXTILE
[No.]	NEW STRUCTURAL SECTIONS
◇No.◇	EXISTING STRUCTURAL SECTIONS

DESIGN DESIGNATION (ROUTE 880):

ADT (2012)	237,600	D	52%
ADT (2035)	263,700	T	8.7%
DHV	8,500	V	80 mph
ESAL	128,000,000	TI_{20}	15.0

EXISTING STRUCTURAL SECTION

◇1
- 0.10' OGAC
- 0.15' RAC-G
- 0.10' OGAC
- Var 0.20' TO 0.85' AC
- 1.00' PCC
- Var 1.33' TO 1.50' AS

◇2
- 0.10' OGAC
- 0.15' RAC-G
- 0.10' OGAC
- 0.65' AC (TYPE A)
- 0.25' ATPB
- Var 0.70' TO 1.00' CTB (Cl A)
- Var 1.00' TO 1.60' Cl 4 AS

◇3
- 0.10' OGAC
- 0.15' RAC-G
- 0.10' OGAC
- 0.65' AC (TYPE A)
- 0.90' CTB (Cl A)
- 1.60' Cl 4 AS

◇4
- 0.32' AC (TYPE A)

◇5
- 0.10' OGAC
- 0.15' RAC-G
- 0.30' TO 0.5' AC (TYPE A)
- 0.70' PCC
- 1.00' Cl 4 AS

◇6
- 0.33' AC
- 0.67' CTB (Cl B)
- 1.00' Cl 1 AS

◇7
- 0.10' OGAC
- 0.15' RAC-G
- 0.10' OGAC
- 1.55' AC (TYPE A)

◇8
- 0.10' OGAC
- 0.15' RAC-G
- 0.65' AC (TYPE A)
- 0.95' Cl 3 AB
- 1.50' Cl 4 AS

◇9
- 0.10' OGAC
- 0.15' RAC-G
- 0.25' AC (TYPE A)
- 0.67' Cl 3 AB
- 0.75' Cl 4 AS

◇10
- 0.65' AC (TYPE A)
- 0.95' Cl 3 AB
- 1.50' Cl 4 AS

◇11
- 0.10' OGAC
- 0.15' RAC-G
- 0.10' OGAC
- 0.17' AC (TYPE A)
- 1.00' PCC
- 1.33' AS

◇12
- 0.10' OGAC
- 0.15' RAC-G
- 0.10' OGAC
- Var 0.35' TO 0.85' AC (TYPE A)
- 1.00 PCC
- 1.33' AS

◇13
- 0.10' OGAC
- 0.15' RAC-G
- 0.10' OGAC
- 0.70' Cl A CTB
- 0.60' Cl 4 AS
- 1.00' Cl 3 Perm Mtl

◇14
- Var 0.25' TO 1.00' AC
- Var 0.67' TO 0.875' AB
- Var 0.75' TO 1.25' AS

NEW STRUCTURAL SECTION

[1]
- 0.10' HMA (OG)
- 0.15' RHMA-G
- 0.75' HMA (TYPE A)
- 0.25' ATPB
- 0.60' LCB
- 1.30' Cl 4 AS

[2]
- 0.10' HMA (OG)
- 0.15' RHMA-G
- 0.75' HMA (TYPE A)
- 0.25' ATPB
- 0.60' LCB
- 1.30' Cl 4 AS OVER SEG

[3]
- Var 0.10' TO 0.45' COLD PLANE AC Pvmt
- 0.10' HMA (OG)
- Var 0.00' TO 0.35' HMA (TYPE A)
- (SEE NOTE 11)

[4]
- 0.65' HMA (TYPE A)
- 0.90' Cl 3 AB
- 0.95' Cl 4 AS

[5]
- 0.10' HMA (OG)
- 0.15' RHMA-G
- 1.00' HMA (TYPE A)
- 0.60' LCB
- 1.30' Cl 4 AS

[6]
- 0.60' HMA (TYPE A)
- 0.65' LCB
- 0.90' Cl 4 AS

[7]
- 0.60' HMA (TYPE A)
- 0.65' LCB
- 0.90' Cl 4 AS
- 1.00' Cl 3 Perm Mtl (BLANKET)

[8]
- 0.33' MINOR Conc (Misc Const)
- 0.50' Cl 3 AB

[9]
- 0.10' COLD PLANE AC Pvmt
- 0.10' HMA (OG)
- 0.1' TO 0.30' HMA (LEVELING)
- GPI

[10]
- 0.10' HMA (OG)
- 0.65' HMA (TYPE A)
- 0.65' LCB
- 1.00' Cl 4 AS

[11]
- 0.10' HMA (OG)
- 0.65' HMA (TYPE A)
- 0.65' LCB
- 1.00' Cl 4 AS OVER SEG

[12]
- 0.60' HMA (TYPE A)
- 0.65' RSCB
- 0.90' Cl 4 AS

[13]
- 0.10' COLD PLANE AC Pvmt
- Var 0.10' TO 0.30' HMA (TYPE A)

[14]
- 0.60' HMA (TYPE A)
- 0.65' RSCB
- 0.90' Cl 4 AS
- 1.00' Cl 3 Perm Mtl (BLANKET)

TYPICAL CROSS SECTIONS

NO SCALE

X-1

	REVISED BY	GS	BG	LMH
	DATE REVISED	5/26/2011	05/31/11	9/13/11

CALCULATED-DESIGNED BY: GRACE SIMARD/BEN GRIMM
CHECKED BY: KEVIN AZARMI
SUPERVISOR: TIMOTHY J. LEE
CONSULTANT FUNCTIONAL SUPERVISOR

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	880	22.6/24.0		

REGISTERED CIVIL ENGINEER — DATE 11-16-11

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — B. RAZEGHI — No. C52725 — Exp. 12-31-12 — CIVIL — STATE OF CALIFORNIA

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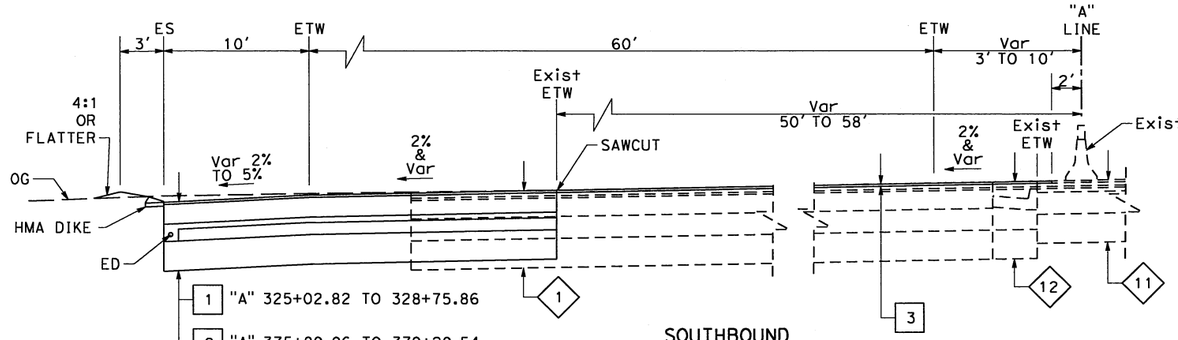
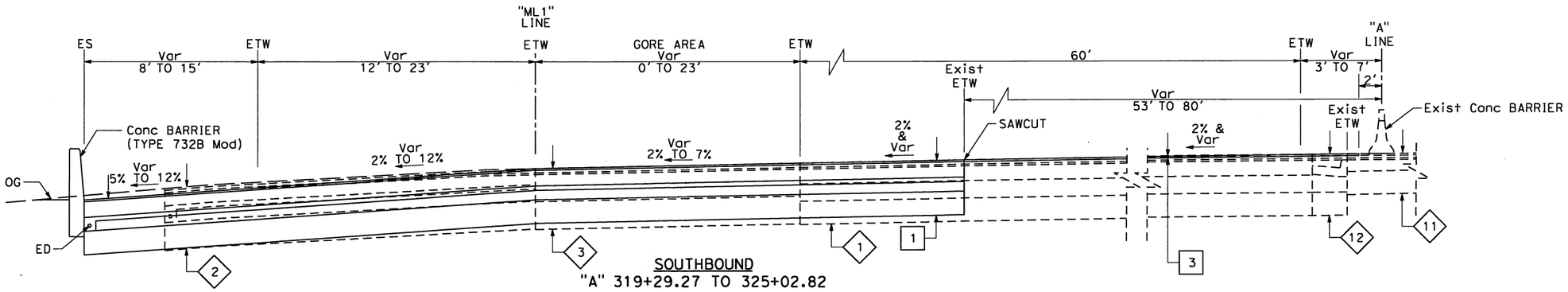
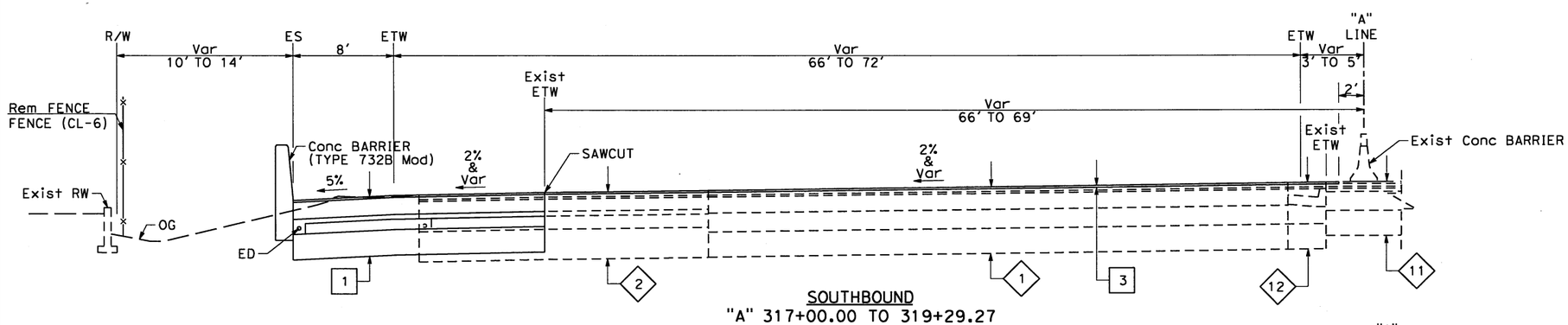


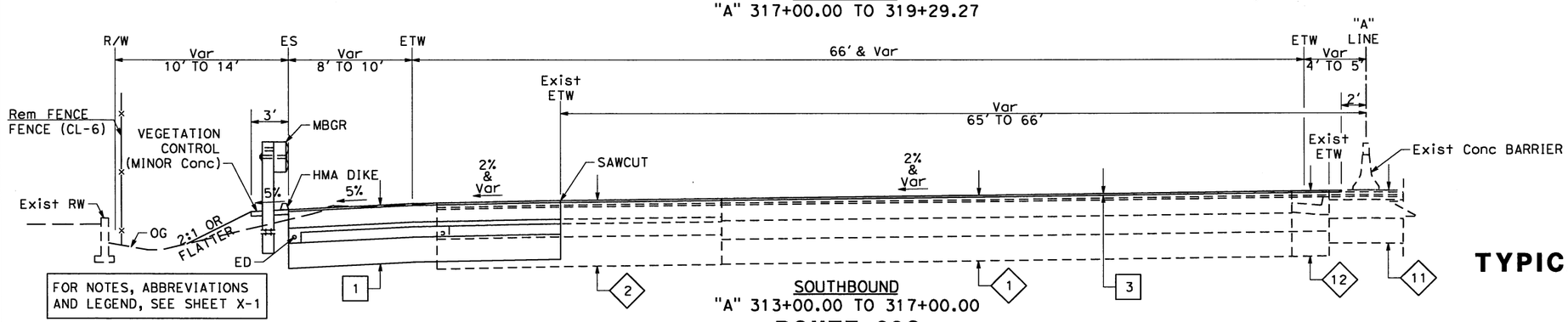
SOUTHBOUND
"A" 375+44.37 TO 379+20.54
"A" 325+02.82 TO 328+75.86



SOUTHBOUND
"A" 319+29.27 TO 325+02.82



SOUTHBOUND
"A" 317+00.00 TO 319+29.27



FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

SOUTHBOUND
"A" 313+00.00 TO 317+00.00

ROUTE 880

TYPICAL CROSS SECTIONS

NO SCALE

X-2

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LMH	9/13/11	
BG	05/31/11	
GS	5/26/2011	
REVISED BY	DATE REVISED	

GRACE SIMARD/BEN GRIMM — KEVIN AZARMI

CALCULATED-DESIGNED BY — CHECKED BY

TIMOTHY J. LEE — CONSULTANT FUNCTIONAL SUPERVISOR

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BORDER LAST REVISED 7/2/2010 | USERNAME => svogtman | DGN FILE => 43a921ca002.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0725 | PROJECT NUMBER & PHASE 00000000004

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	880	22.6/24.0		

B. Razeghi 11-16-11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER B. RAZEGHI No. C52725 Exp. 12-31-12 CIVIL STATE OF CALIFORNIA

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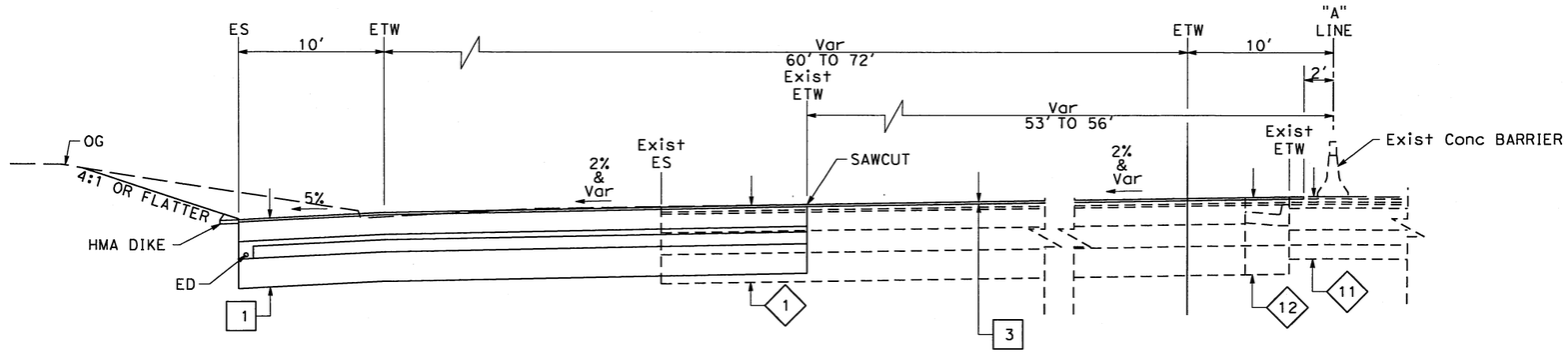
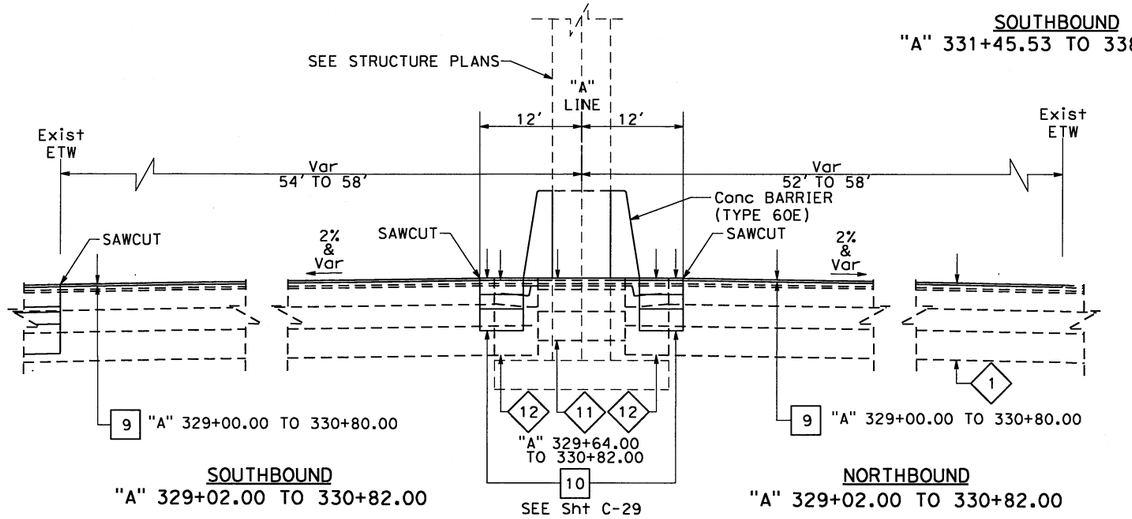
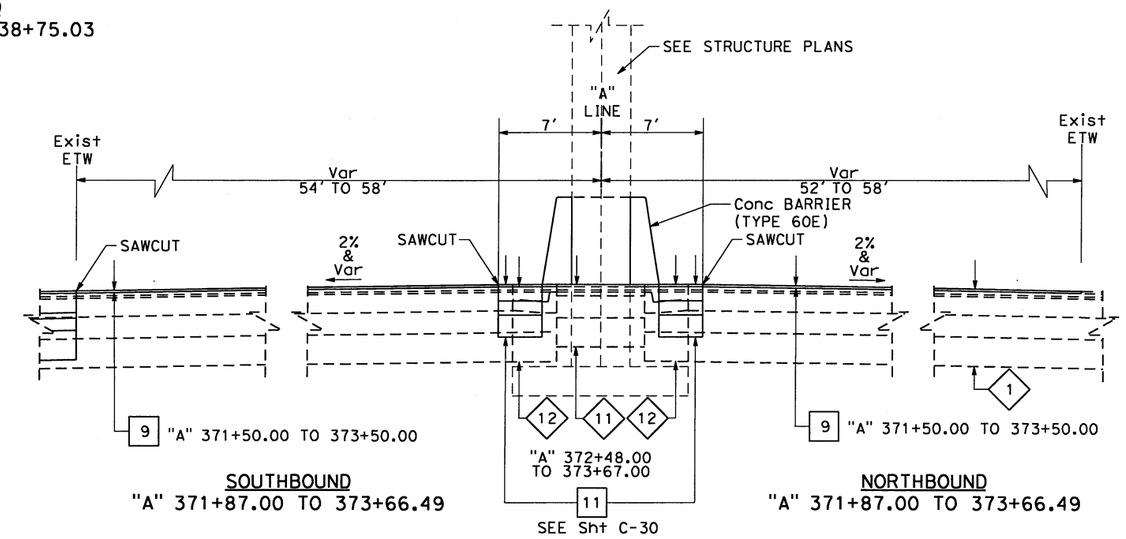


SOUTHBOUND
"A" 331+45.53 TO 338+75.03



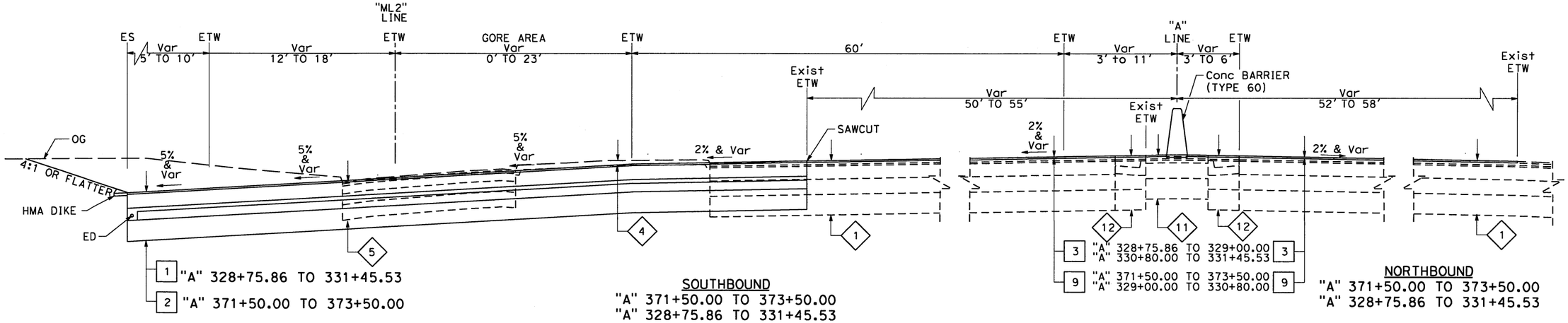
SOUTHBOUND
"A" 329+02.00 TO 330+82.00

NORTHBOUND
"A" 329+02.00 TO 330+82.00



SOUTHBOUND
"A" 371+87.00 TO 373+66.49

NORTHBOUND
"A" 371+87.00 TO 373+66.49



1 "A" 328+75.86 TO 331+45.53
2 "A" 371+50.00 TO 373+50.00

SOUTHBOUND
"A" 371+50.00 TO 373+50.00
"A" 328+75.86 TO 331+45.53

"A" 328+75.86 TO 329+00.00
"A" 330+80.00 TO 331+45.53

"A" 371+50.00 TO 373+50.00
"A" 329+00.00 TO 330+80.00

NORTHBOUND
"A" 371+50.00 TO 373+50.00
"A" 328+75.86 TO 331+45.53

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

ROUTE 880

TYPICAL CROSS SECTIONS

NO SCALE

X-3

	DATE	REVISED BY	CALCULATED-DESIGNED BY	CHECKED BY
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GS	5/26/2011			

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CONSULTANT FUNCTIONAL SUPERVISOR — TIMOTHY J. LEE

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	880	22.6/24.0		

REGISTERED CIVIL ENGINEER 11-16-11 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER B. RAZEGHI No. C52725 Exp. 12-31-12 CIVIL STATE OF CALIFORNIA

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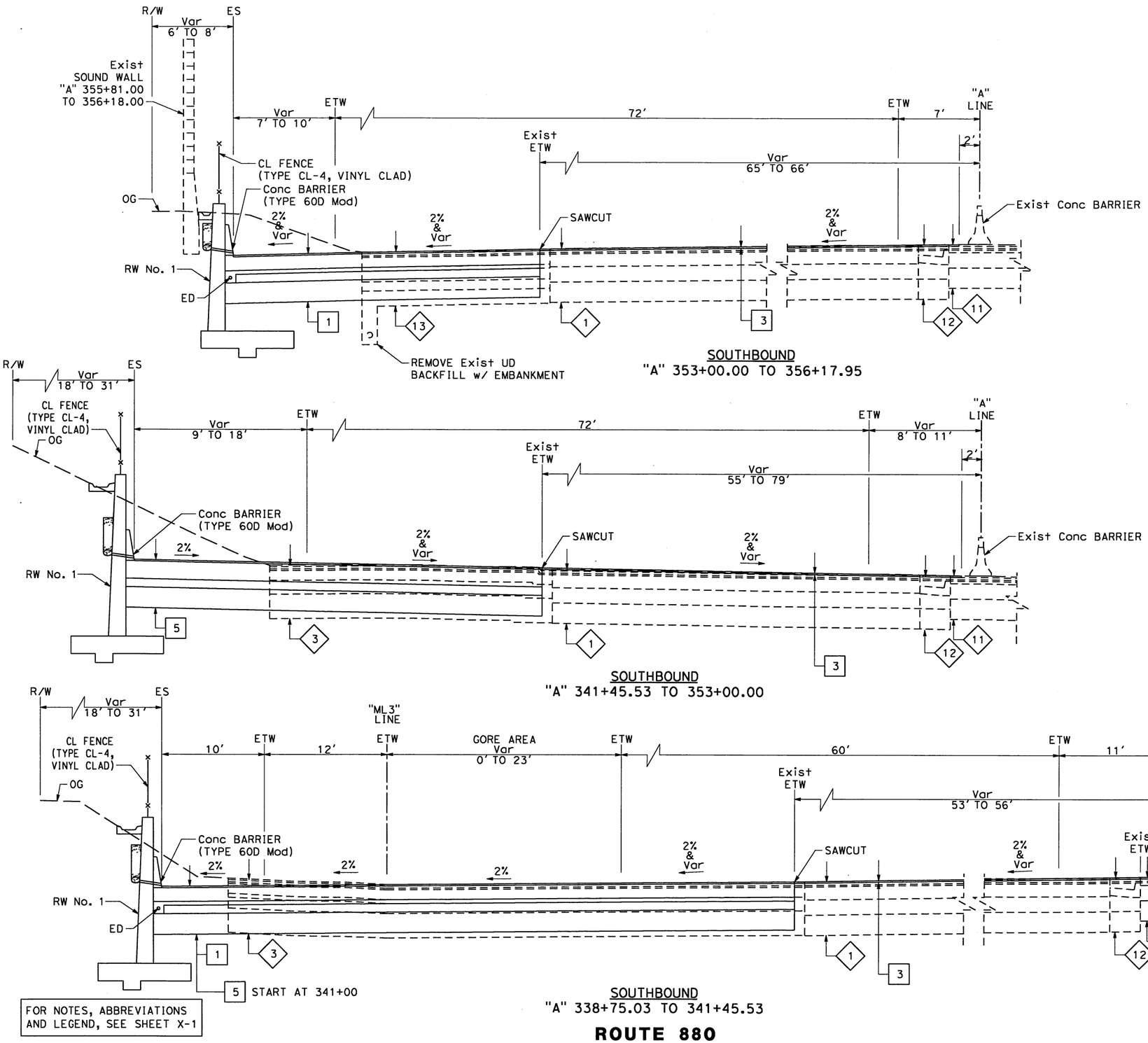

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

TYPICAL CROSS SECTIONS

NO SCALE

ROUTE 880

X-4

LAST REVISION	11-16-11
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BG	05/31/11	CHECKED BY	KEVIN AZARMI
GS	5/26/2011	CONSULTANT FUNCTIONAL SUPERVISOR	TIMOTHY J. LEE
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DATE REVISED			

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BORDER LAST REVISED 7/2/2010

USERNAME => svogtman
DGN FILE => 43a921ca004.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0725

PROJECT NUMBER & PHASE 00000000004

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	880	22.6/24.0		

B. Razeghi 11-16-11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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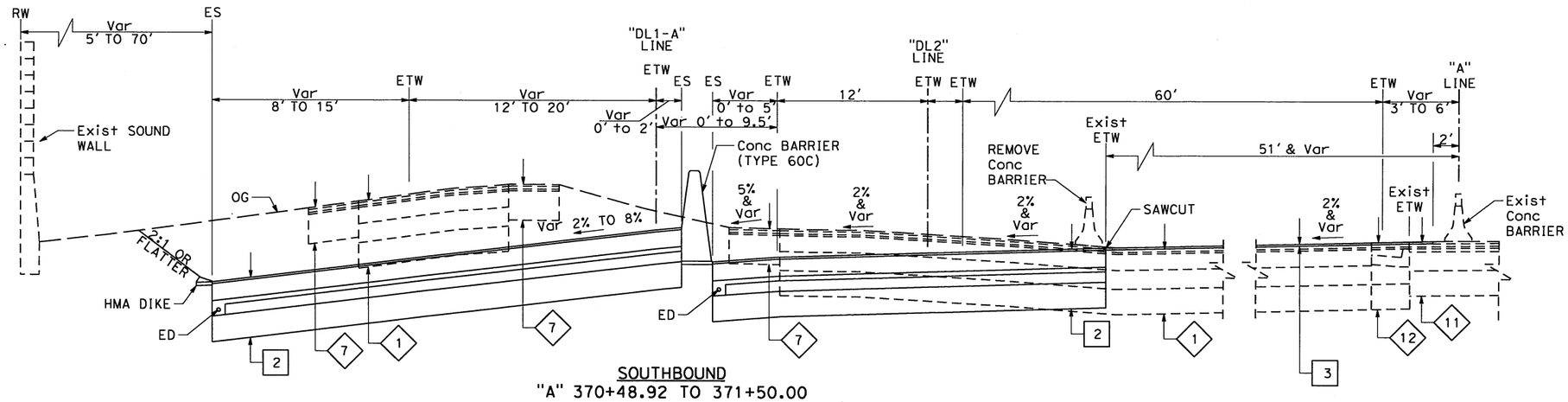
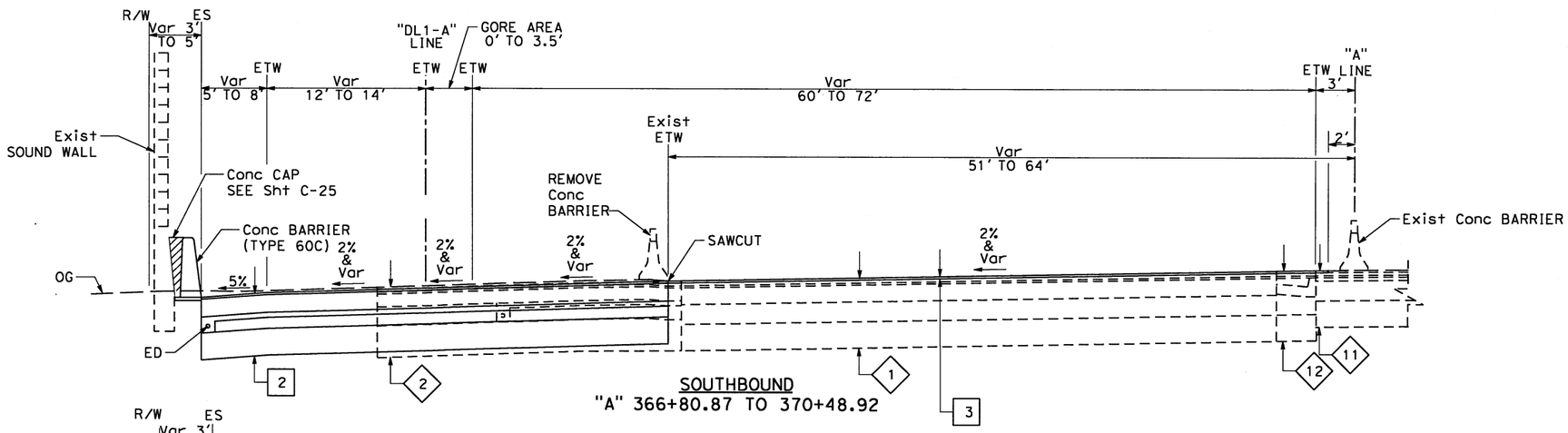
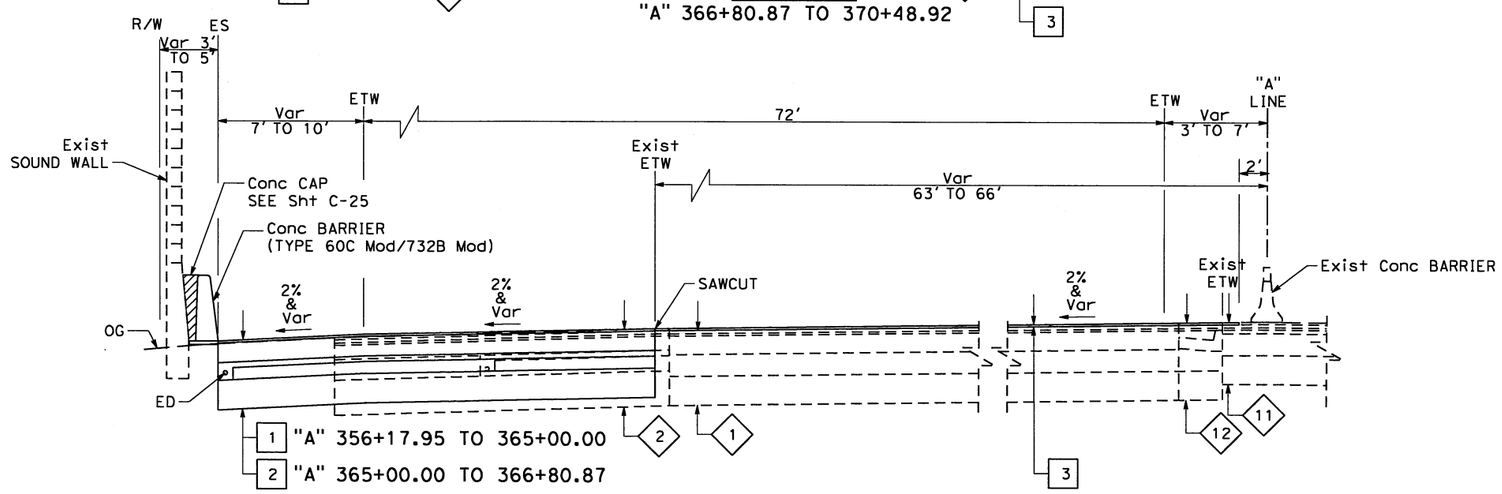


SOUTHBOUND
"A" 370+48.92 TO 371+50.00



SOUTHBOUND
"A" 366+80.87 TO 370+48.92



1 "A" 356+17.95 TO 365+00.00
2 "A" 365+00.00 TO 366+80.87

SOUTHBOUND
"A" 356+17.95 TO 366+80.87

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

ROUTE 880

TYPICAL CROSS SECTIONS

NO SCALE

X-5

LMH	9/13/11			
BG	05/31/11			
GS	5/26/2011			
REVISED BY	DATE REVISED			
GRACE SIMARD/BEN GRIMM	KEVIN AZARMI			
CALCULATED-DESIGNED BY	CHECKED BY			
CONSULTANT FUNCTIONAL SUPERVISOR	TIMOTHY J. LEE			

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LAST REVISION 11-16-11
DATE PLOTTED => 12/29/2011
TIME PLOTTED => 2:51:33 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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B. Razeghi 11-16-11
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PLANS APPROVAL DATE

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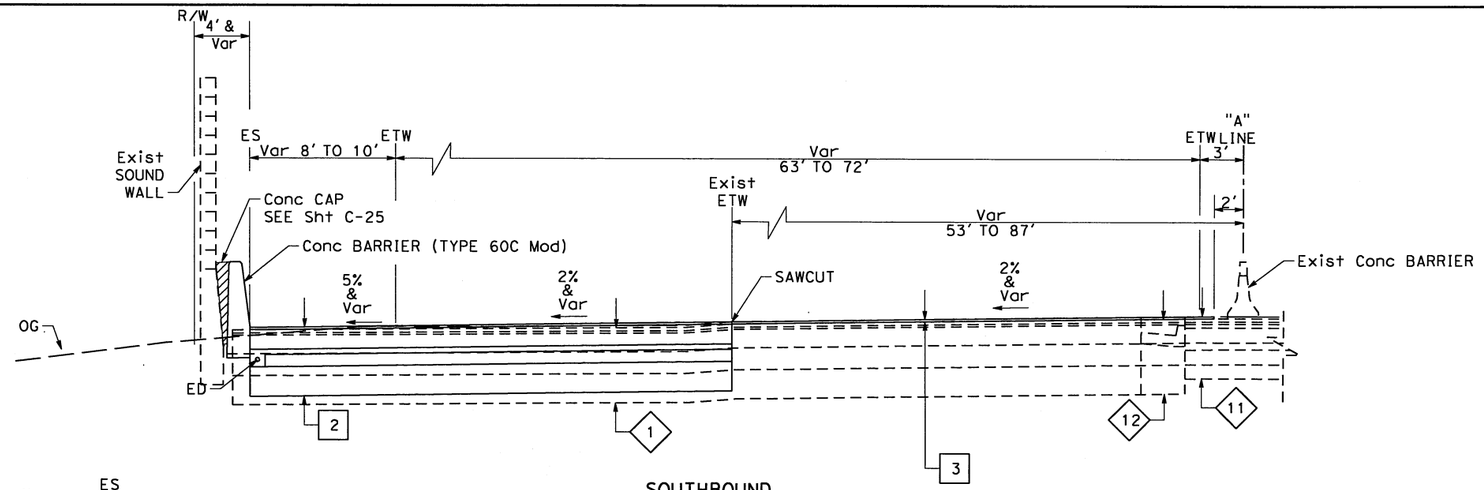
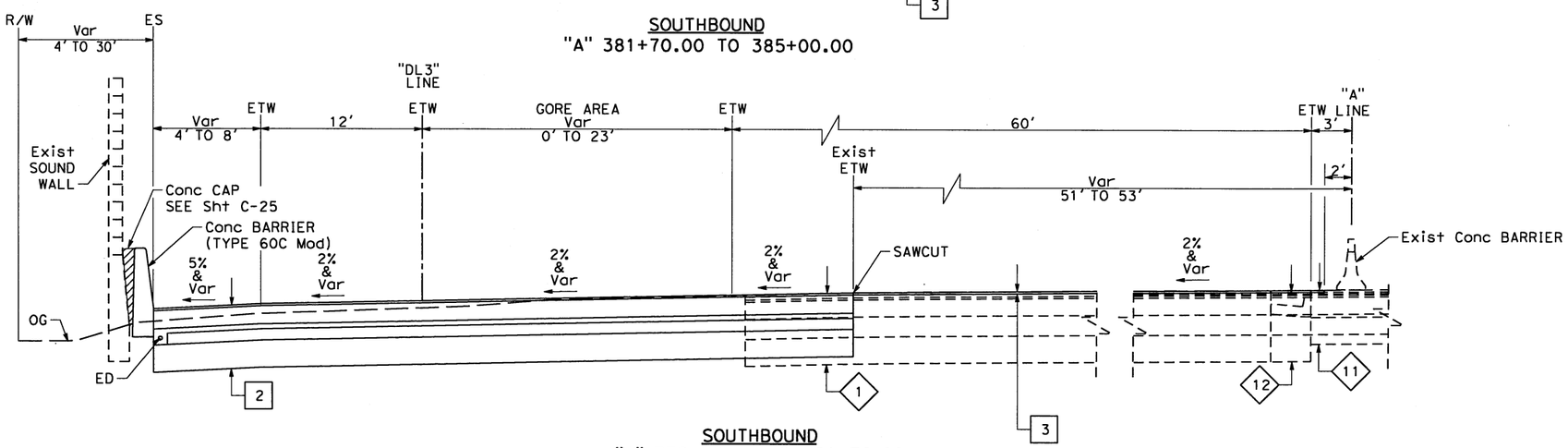
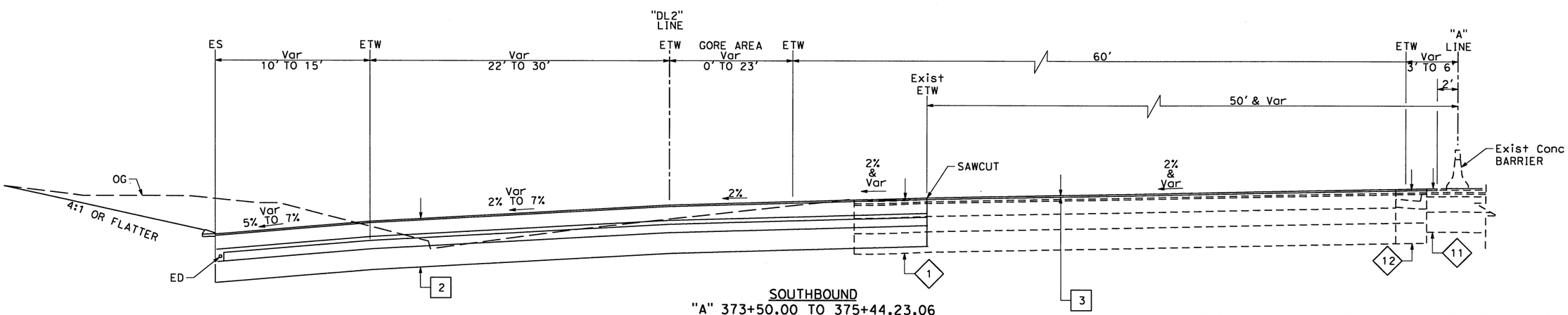


SOUTHBOUND
"A" 381+70.00 TO 385+00.00



SOUTHBOUND
"A" 379+20.54 TO 381+70.00



SOUTHBOUND
"A" 373+50.00 TO 375+44.23.06

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

ROUTE 880

TYPICAL CROSS SECTIONS

NO SCALE

X-6

LMH	9/13/11	GRACE SIMARD/BEN GRIMM	KEVIN AZARMI	TIMOTHY J. LEE	
BG	05/31/11	CALCULATED-DESIGNED BY	CHECKED BY	CONSULTANT FUNCTIONAL SUPERVISOR	
GS	5/26/2011	REVISED BY	DATE REVISED	STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	Caltrans

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	880	22.6/24.0		

B. Razeghi 11-16-11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER B. RAZEGHI No. C52725 Exp. 12-31-12 CIVIL STATE OF CALIFORNIA

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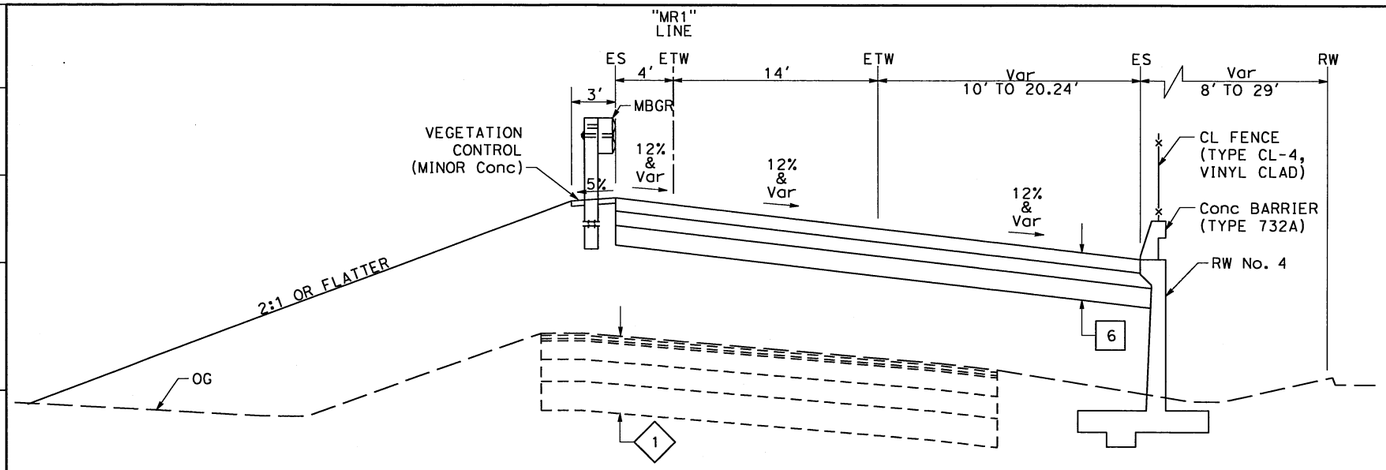
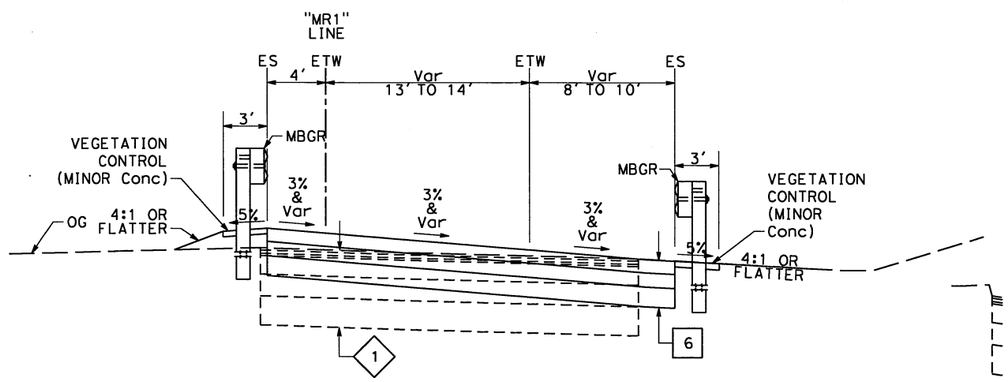
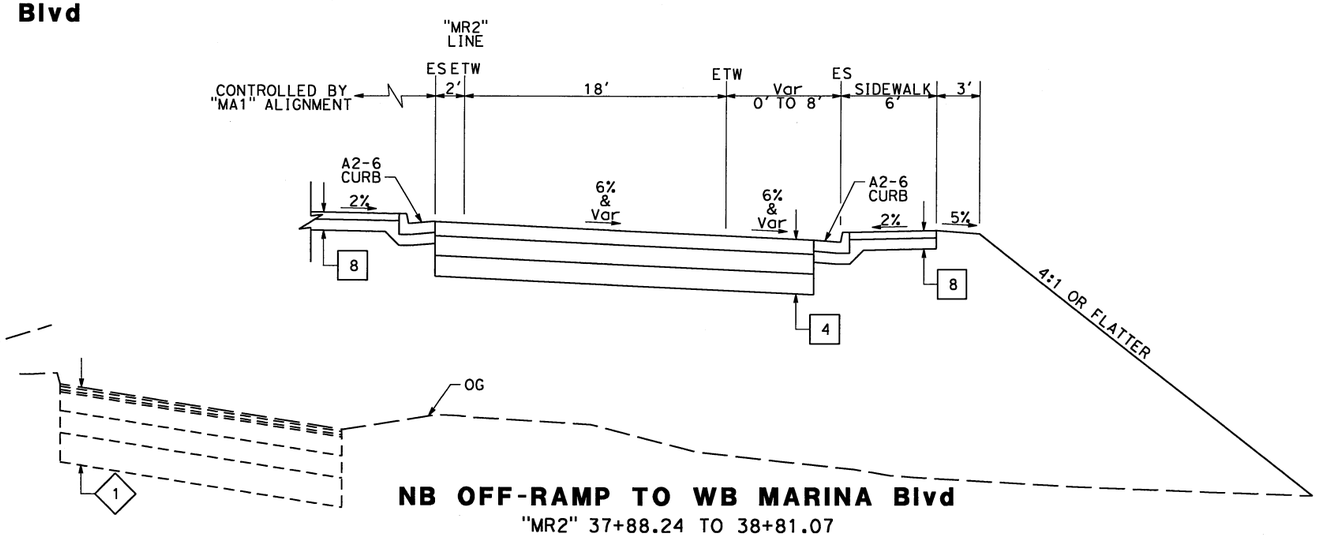


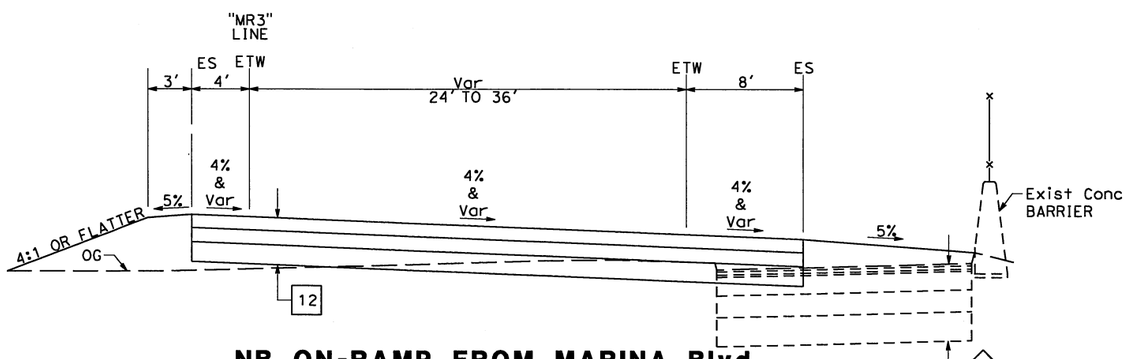
NB OFF-RAMP TO EB MARINA Blvd
"MR1" 26+53.41 TO 28+94.85



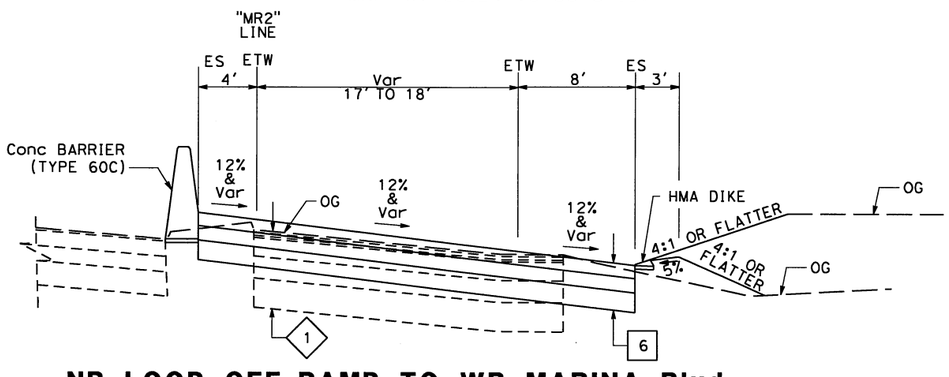
NB OFF-RAMP TO EB MARINA Blvd
"MR1" 23+61.05 TO 26+53.41



NB OFF-RAMP TO WB MARINA Blvd
"MR2" 37+88.24 TO 38+81.07



NB ON-RAMP FROM MARINA Blvd
"MR3" 26+89.38 TO 29+78.20



NB LOOP OFF-RAMP TO WB MARINA Blvd
"MR2" 33+22.07 TO 37+88.24

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

TYPICAL CROSS SECTIONS
NO SCALE

X-7

LMH	9/13/11		
BG	05/31/11		
GS	5/26/2011		
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GRACE SIMARD/BEN GRIMM			
KEVIN AZARMI			
CALCULATED-DESIGNED BY			
CHECKED BY			
TIMOTHY J. LEE			
CONSULTANT FUNCTIONAL SUPERVISOR			

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04	Ala	880	22.6/24.0		

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PLANS APPROVAL DATE

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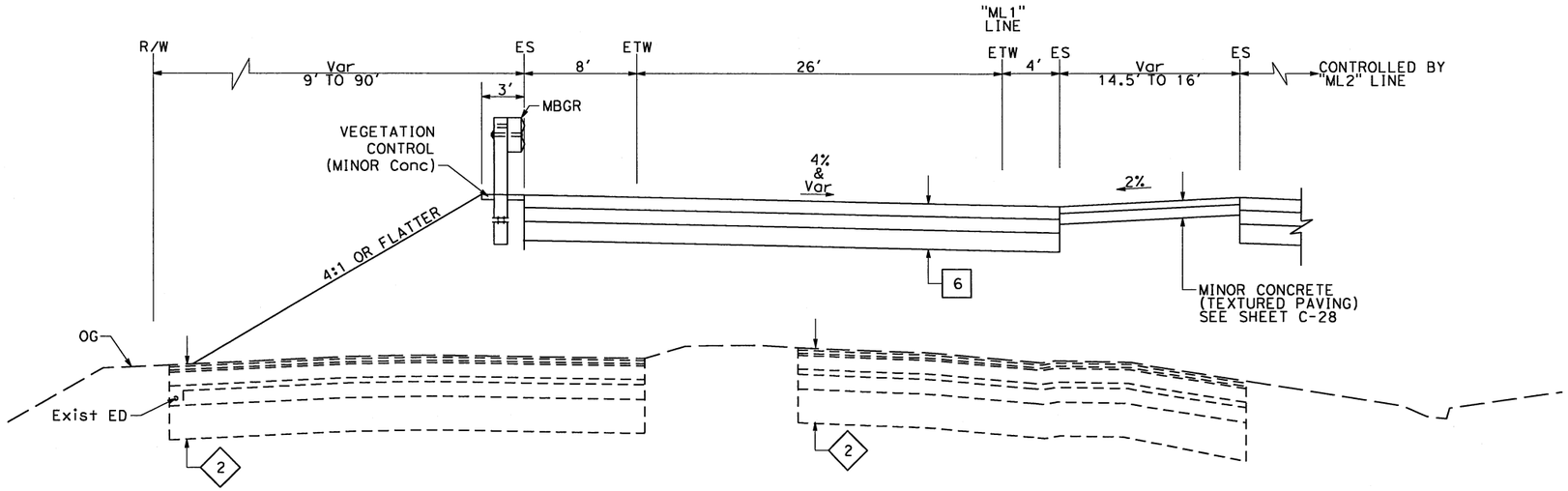
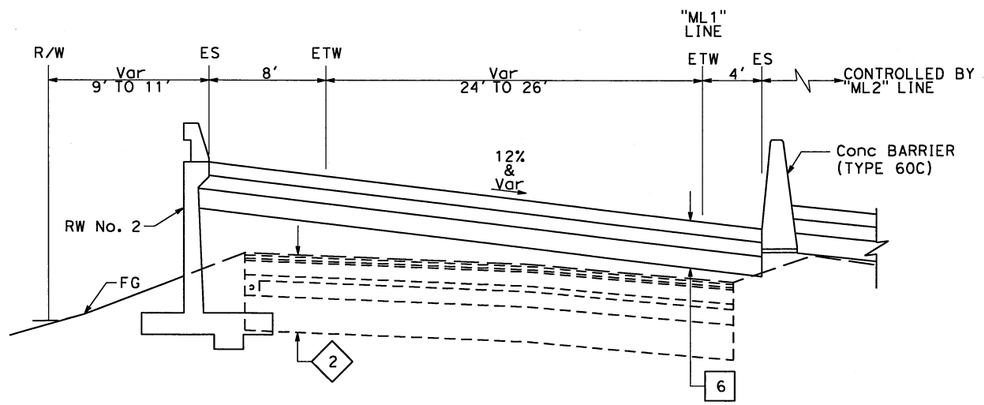
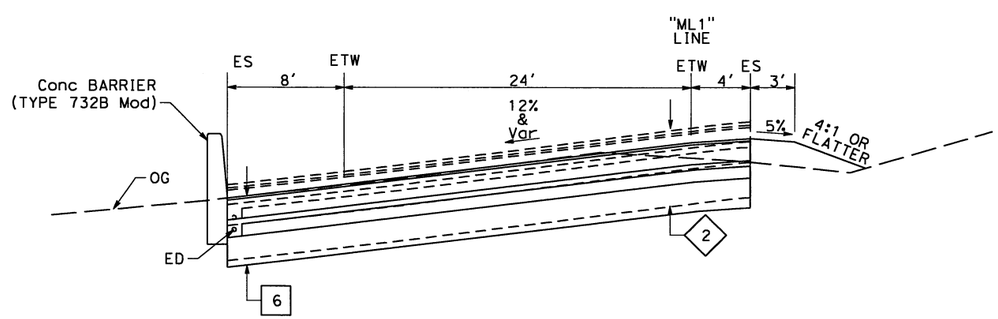


"ML1" 31+44.71 TO 32+78.00



"ML1" 27+50.00 TO 31+44.71



"ML1" 25+02.96 TO 27+50.00

SB ON-RAMP FROM MARINA Blvd

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

TYPICAL CROSS SECTIONS

NO SCALE

X-8

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CONSULTANT FUNCTIONAL SUPERVISOR: TIMOTHY J. LEE

CALCULATED-DESIGNED BY: GRACE SIMARD/BEN GRIMM

CHECKED BY: KEVIN AZARMI

REVISED BY	DATE REVISED
GS	5/26/2011
BG	05/31/11
LMH	9/13/11

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04	Ala	880	22.6/24.0		

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PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER B. RAZEGHI No. C52725 Exp. 12-31-12 CIVIL STATE OF CALIFORNIA

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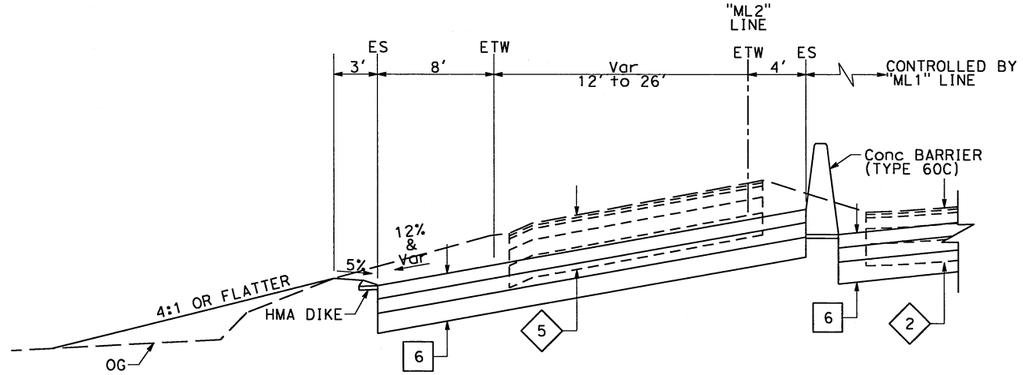
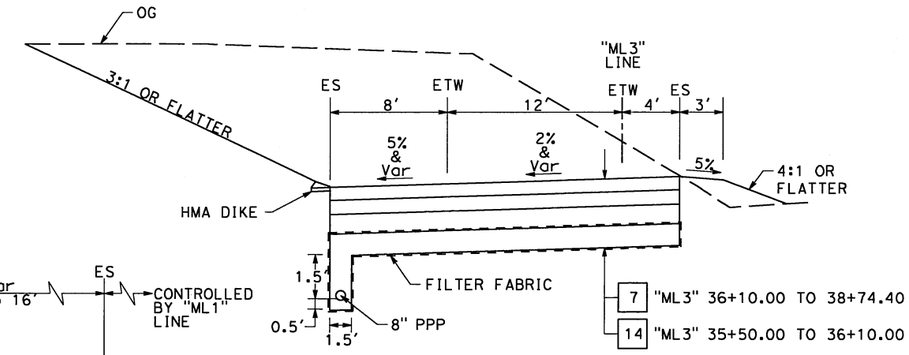


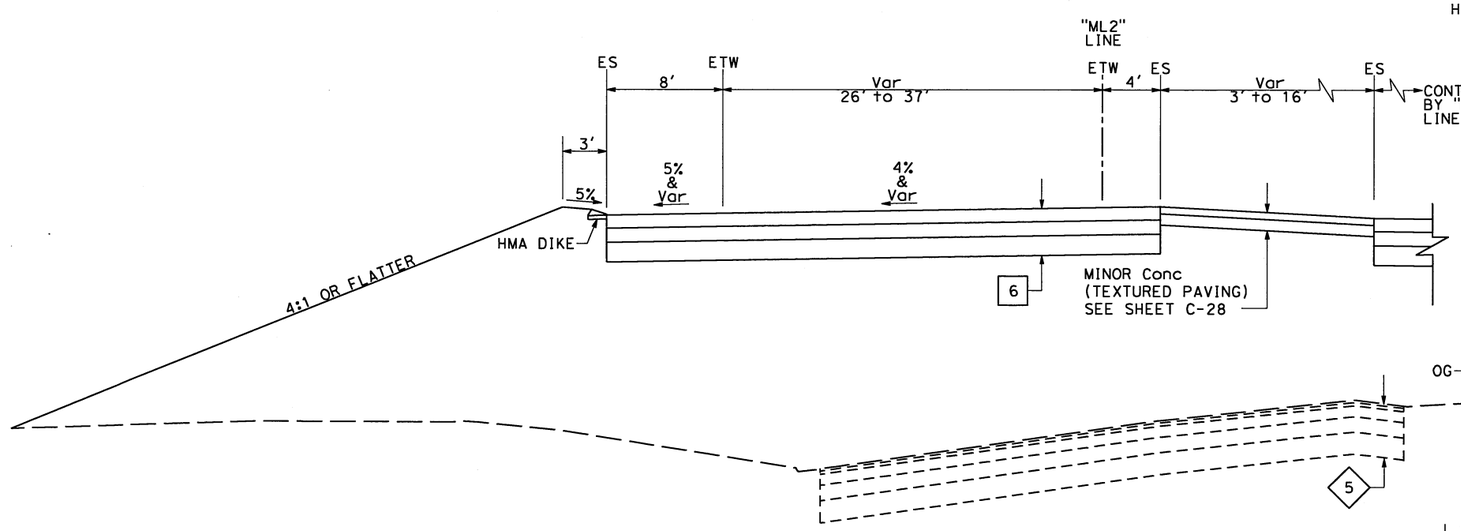
SB OFF-RAMP TO EB MARINA Blvd

"ML2" 22+35.00 TO 28+75.22



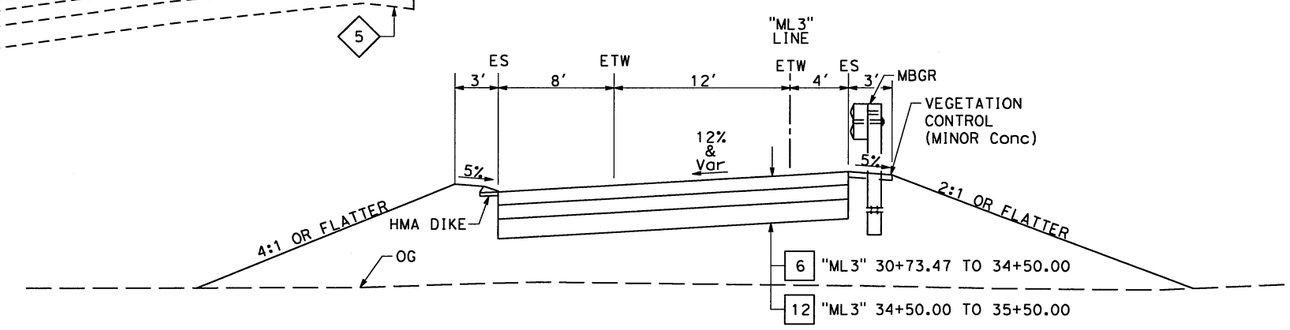
SB OFF-RAMP TO WB MARINA Blvd

"ML3" 35+50.00 TO 38+74.40



SB OFF-RAMP TO EB MARINA Blvd

"ML2" 21+61.00 TO 22+35.00



SB OFF-RAMP TO WB MARINA Blvd

"ML3" 30+73.47 TO 35+50.00

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

TYPICAL CROSS SECTIONS

NO SCALE

X-9

REVISED BY	DATE REVISED
LMH	9/13/11
BG	05/31/11
GS	5/26/2011

CALCULATED-DESIGNED BY: GRACE SIMARD/BEN GRIMM
CHECKED BY: KEVIN AZARMI
SUPERVISOR: TIMOTHY J. LEE
CONSULTANT FUNCTIONAL SUPERVISOR

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	880	22.6/24.0		

REGISTERED CIVIL ENGINEER — DATE 11-16-11

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — B. RAZEGHI — No. C52725 — Exp. 12-31-12 — CIVIL — STATE OF CALIFORNIA

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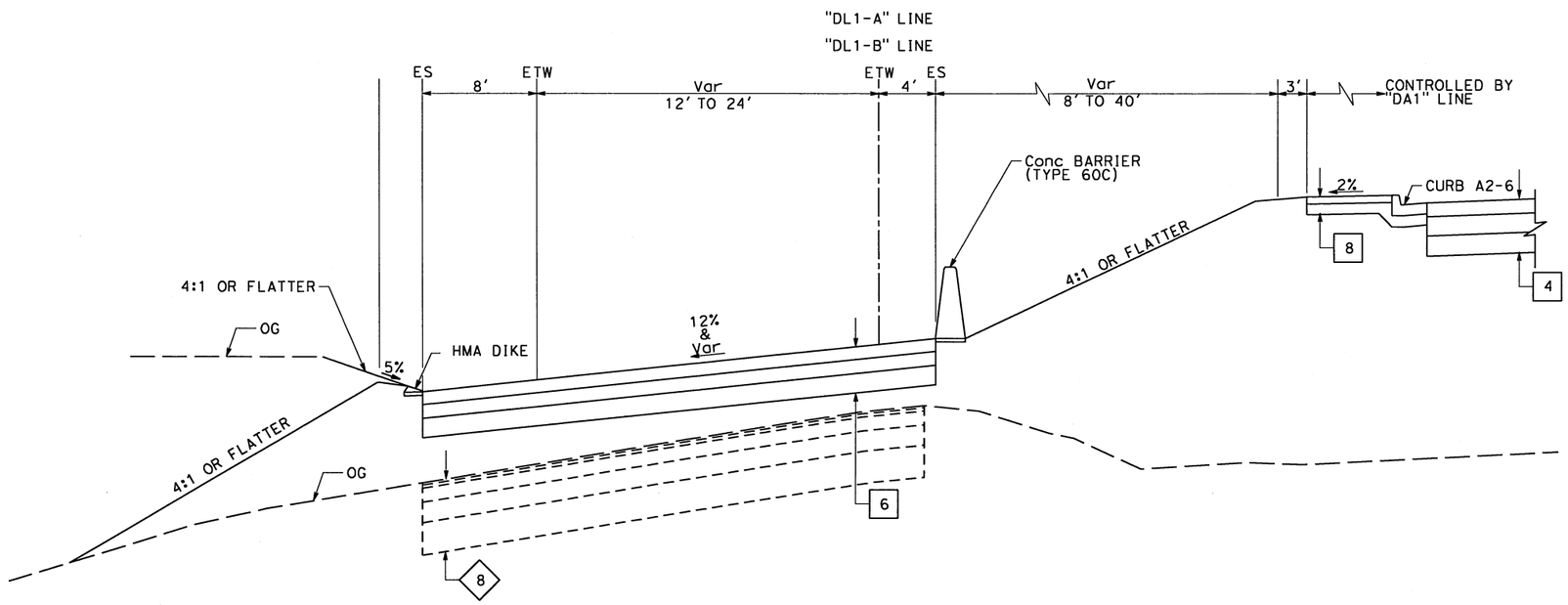
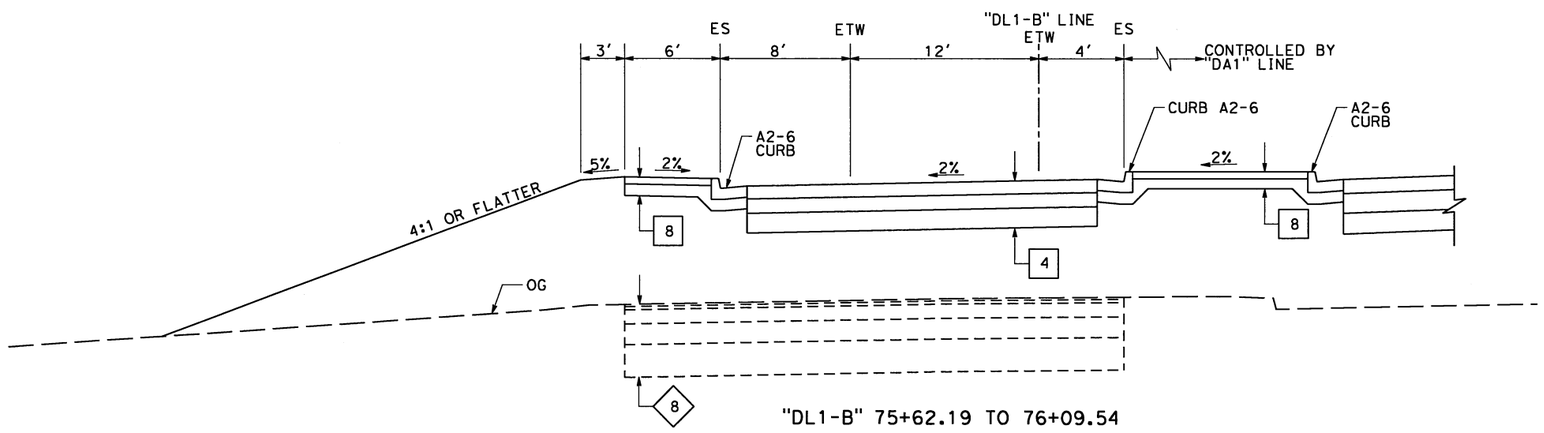


"DL1-A" 71+47.98 TO 75+02.65
"DL1-B" 75+02.65 TO 75+62.19



"DL1-B" 75+62.19 TO 76+09.54

SB ON-RAMP FROM DAVIS St

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

TYPICAL CROSS SECTIONS

NO SCALE

X-10

LMH	9/13/11		
BG	05/31/11		
GS	5/26/2011	REVISED BY	DATE REVISED
GRACE SIMARD/BEN GRIMM		CALCULATED-DESIGNED BY	
KEVIN AZARMI		CHECKED BY	
TIMOTHY J. LEE		CONSULTANT FUNCTIONAL SUPERVISOR	

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	880	22.6/24.0		

B. Razeghi 11-16-11
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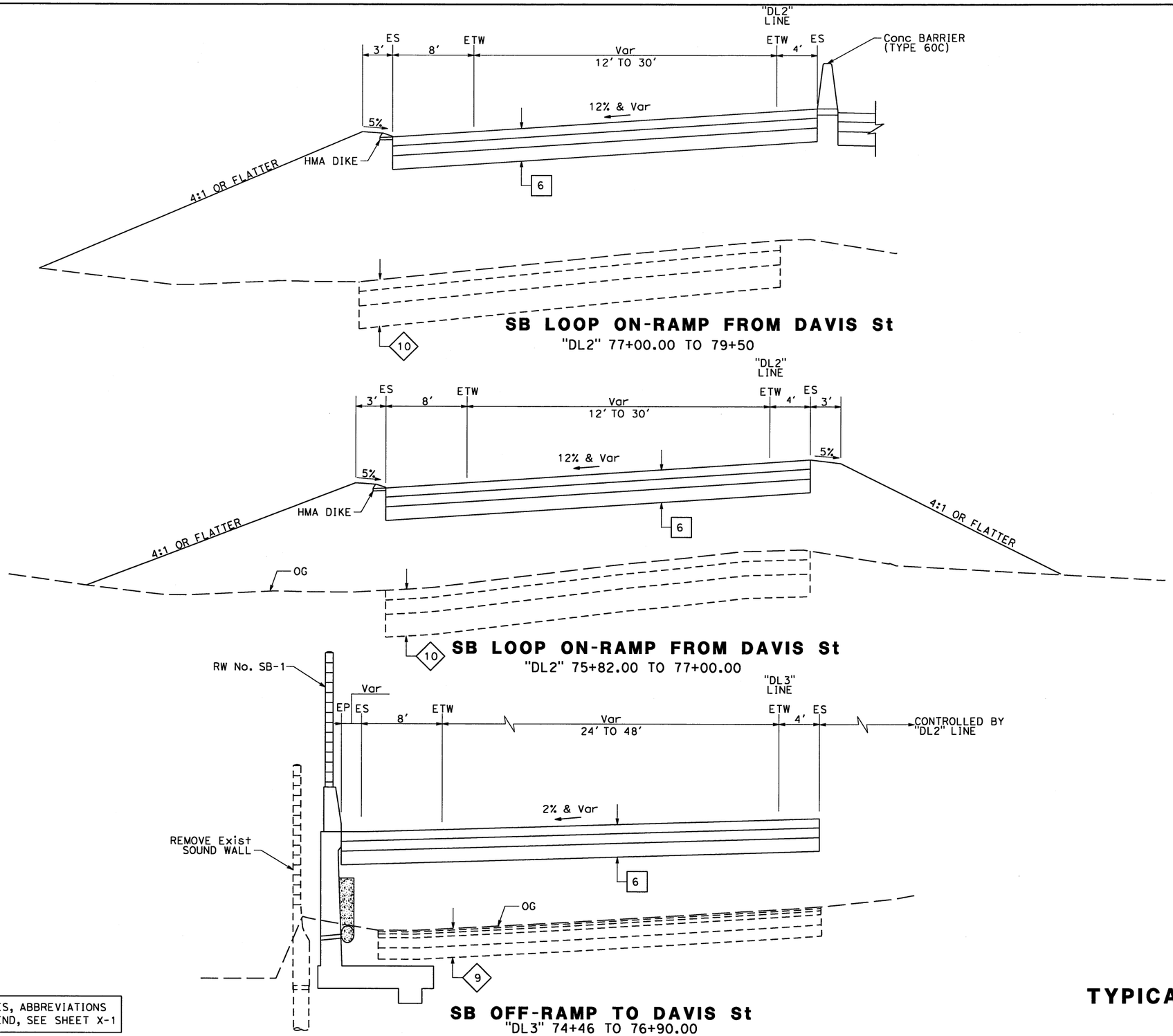

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

TYPICAL CROSS SECTIONS

NO SCALE

X-11

LMH	9/13/11		
BG	05/31/11		
GS	5/26/2011	REVISED BY	DATE REVISED
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KEVIN AZARMI		CHECKED BY	
TIMOTHY J. LEE		CONSULTANT FUNCTIONAL SUPERVISOR	

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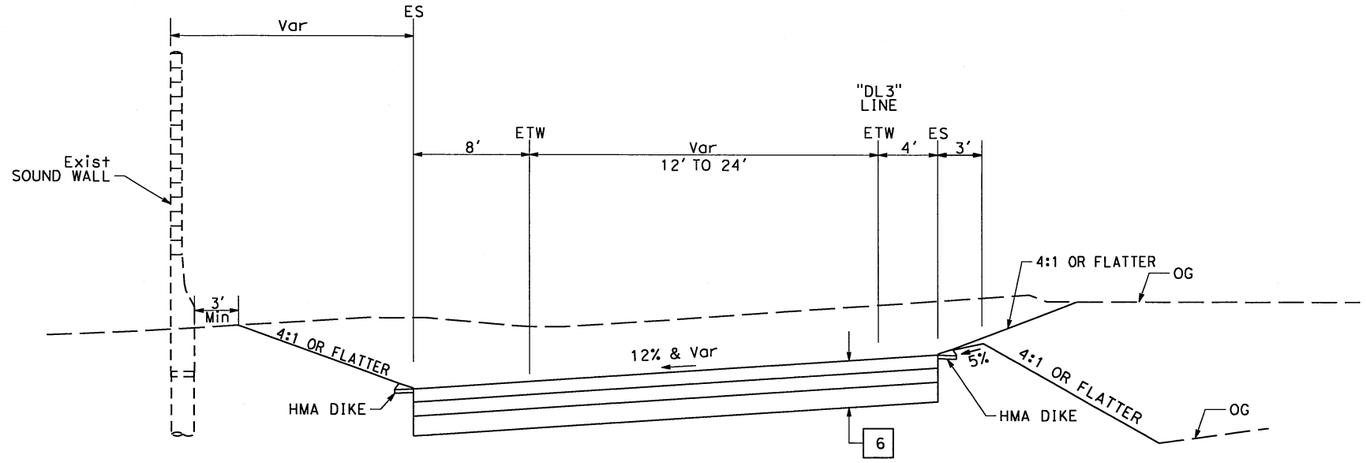
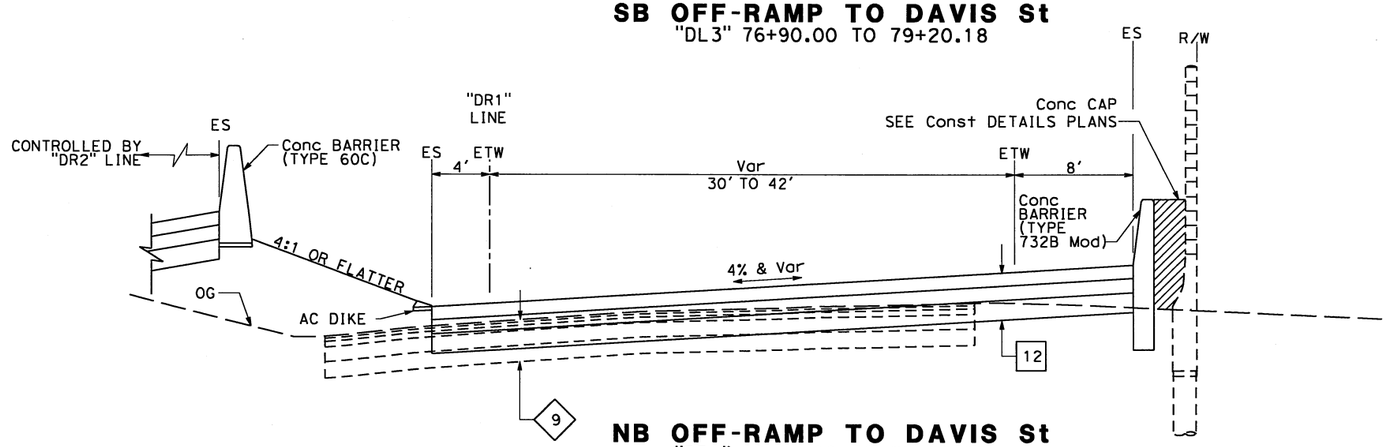
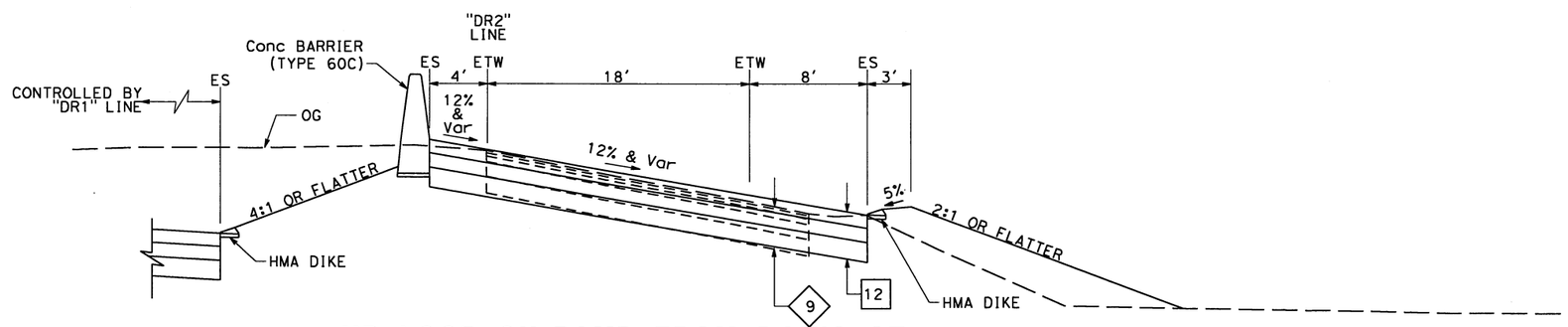


SB OFF-RAMP TO DAVIS St
"DL3" 76+90.00 TO 79+20.18



NB OFF-RAMP TO DAVIS St
"DR1" 69+00.00 TO 72+69.95



NB LOOP ON-RAMP FROM DAVIS ST
"DR2" 65+38.08 TO "DR2" 69+00.00

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

TYPICAL CROSS SECTIONS
NO SCALE

X-12

LMH	9/13/11			
BG	05/31/11			
GS	5/26/2011			
REVISED BY	DATE REVISED			
GRACE SIMARD/BEN GRIMM				
KEVIN AZARMI				
CALCULATED-DESIGNED BY				
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CONSULTANT FUNCTIONAL SUPERVISOR				
TIMOTHY J. LEE				

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B. Razeghi 11-16-11
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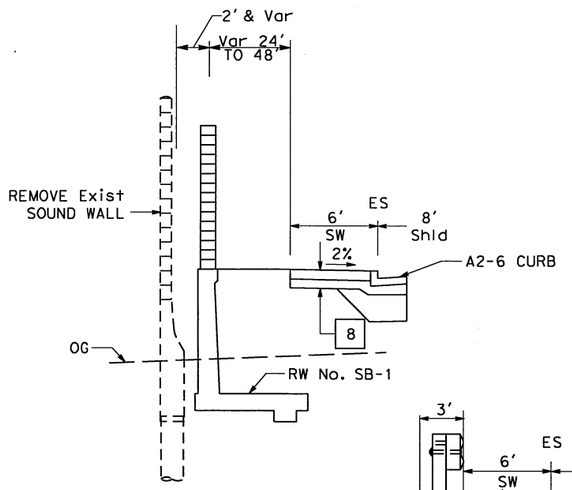
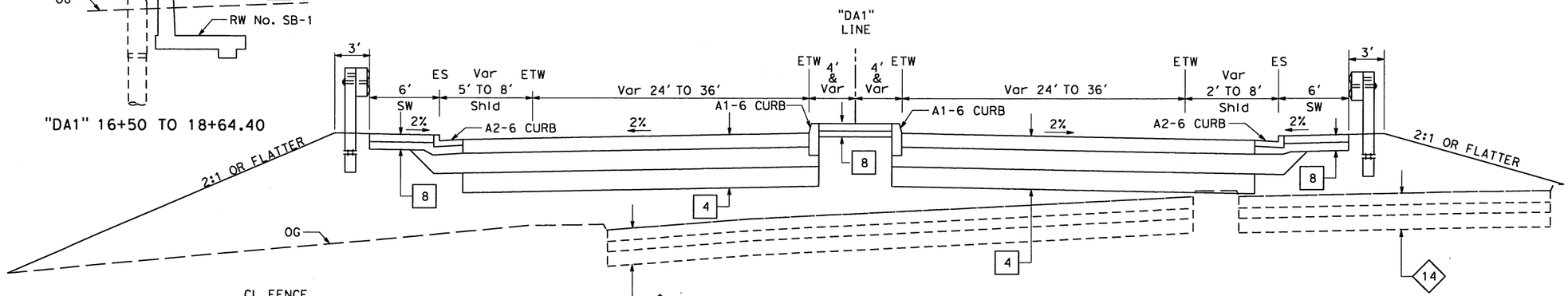
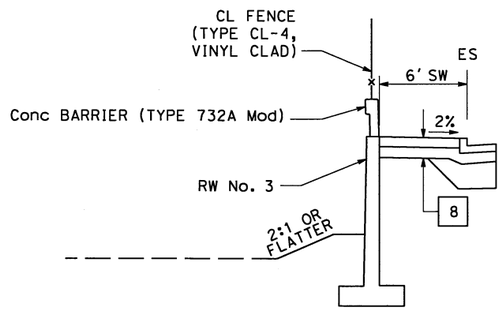


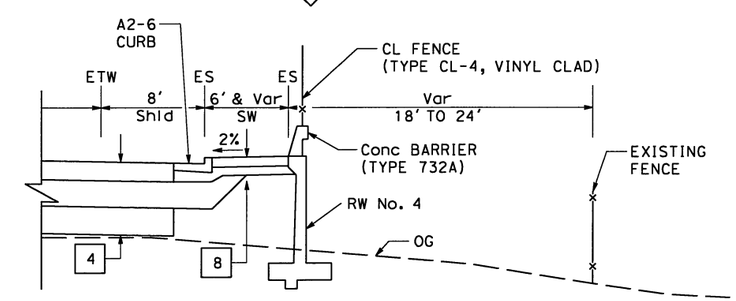
"DA1" 16+50 TO 18+64.40



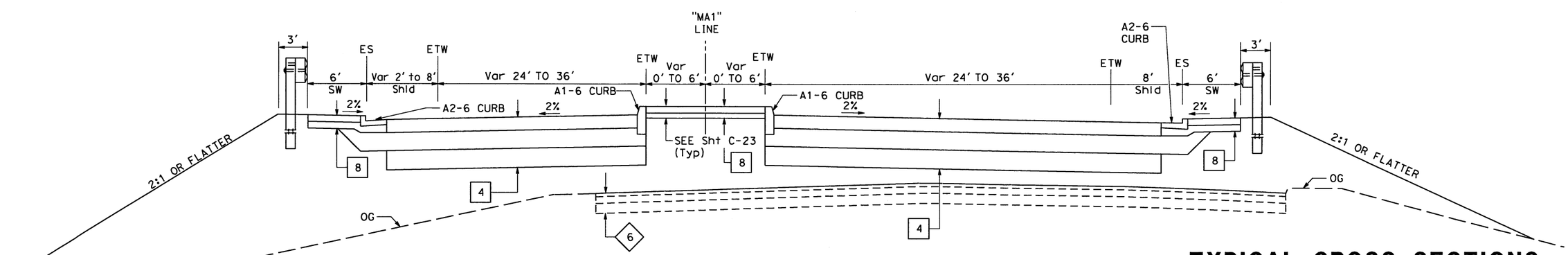
DAVIS St
"DA1" 15+34.47 TO 21+89.91
"DA1" 25+14.41 TO 31+00.00



"DA1" 24+94.03 TO 27+24.12



"MA1" 23+34.77 TO 25+03.13



MARINA Blvd
"MA1" 8+81.05 TO 16+83.69
"MA1" 20+29.14 TO 26+00.00

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

TYPICAL CROSS SECTIONS
NO SCALE

X-13

LMH	9/13/11
BG	05/31/11
GS	5/26/2011
REVISED BY	DATE REVISED
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CALCULATED-DESIGNED BY	CHECKED BY
TIMOTHY J. LEE	
CONSULTANT FUNCTIONAL SUPERVISOR	

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PLANS APPROVAL DATE

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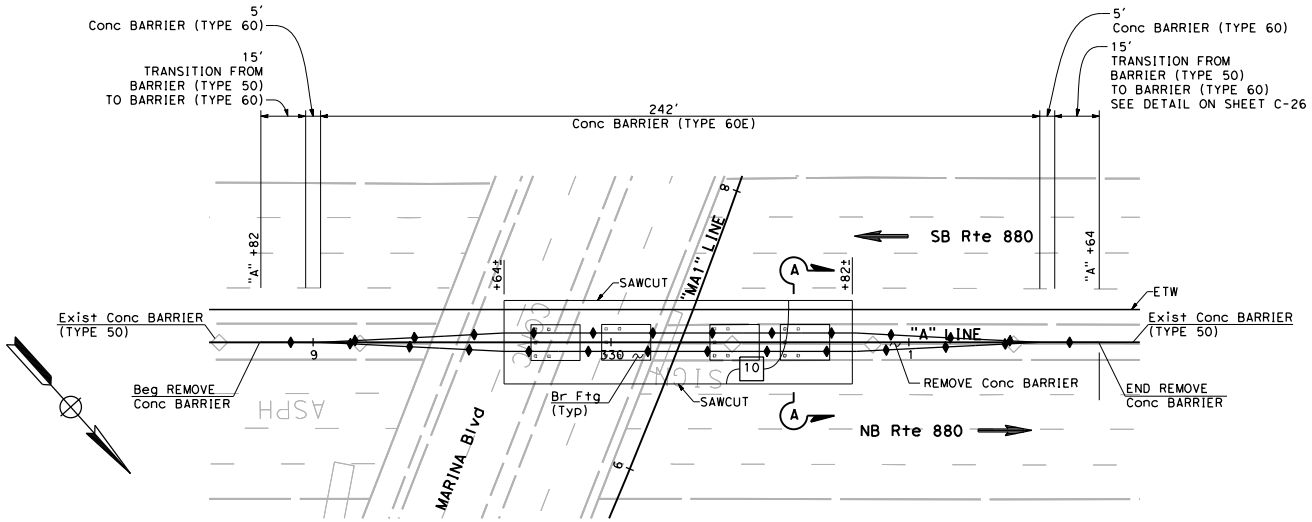
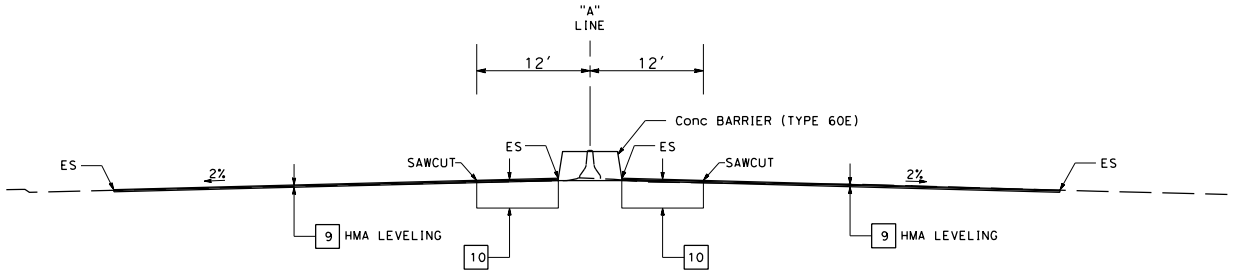


MEDIAN BARRIER TRANSITION DETAIL
MARINA Blvd



SECTION A-A

CONSTRUCTION DETAILS

SCALE: 1"=20'

C-29

LMH	9/15/11	E. ANJORIN/G. SIMARD	BEN RAZEGHI
GS	5/31/11	REVISED BY	DATE REVISED
CALCULATED-DESIGNED BY	CHECKED BY		
CONSULTANT FUNCTIONAL SUPERVISOR	TIMOTHY J. LEE		

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

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LAST REVISION 00-00-00 | DATE PLOTTED => 10/17/2011 | TIME PLOTTED => 12:55:01 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	880	22.6/24.0		

REGISTERED CIVIL ENGINEER DATE

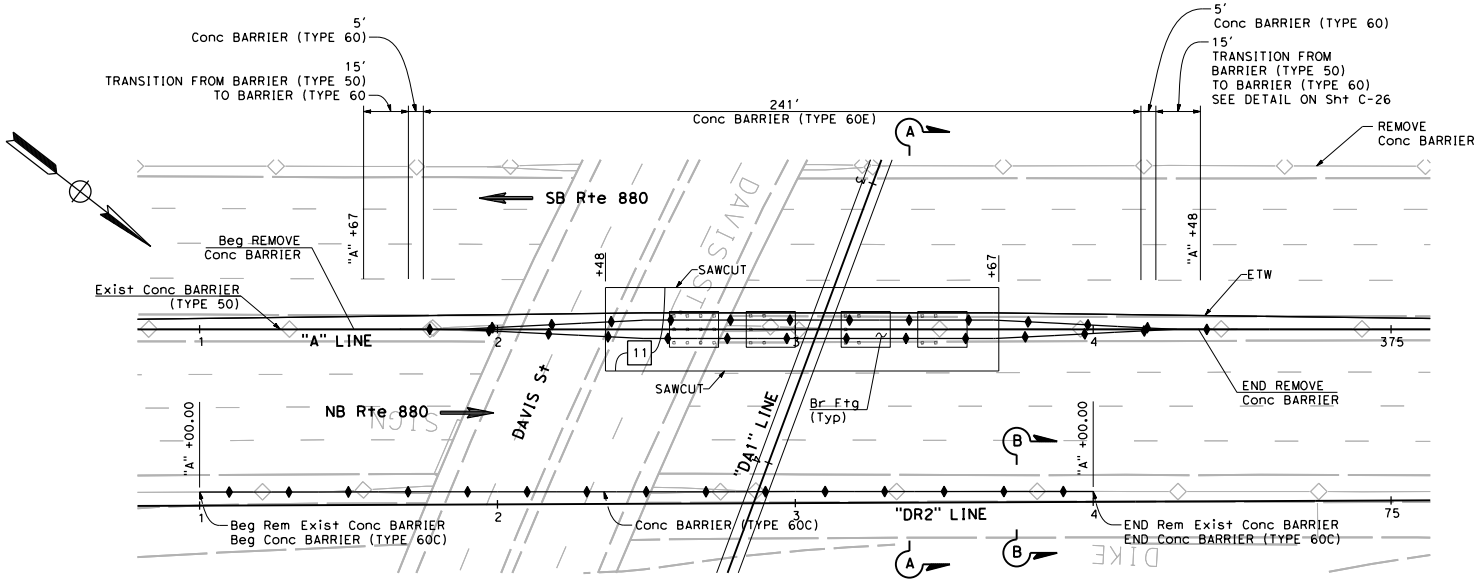
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER B. RAZEGHI No. C52725 Exp. 12-31-12 CIVIL STATE OF CALIFORNIA

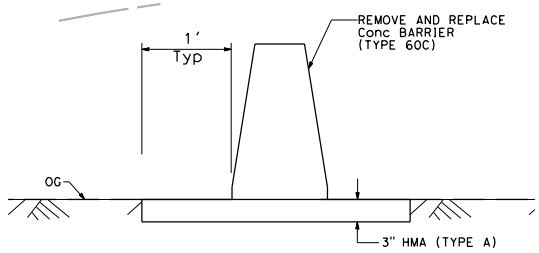
THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

WMH CORPORATION
555 12th St
Suite 1900
Oakland, CA 94607

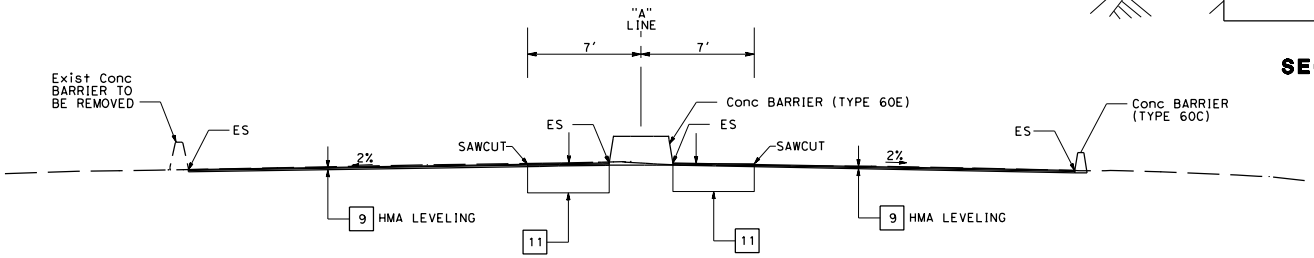
ALAMEDA COUNTY CONGESTION MANAGEMENT AGENCY
1333 Broadway, Suite 220
Oakland, CA 94612



MEDIAN BARRIER TRANSITION DETAIL
DAVIS St



SECTION B-B



SECTION A-A

CONSTRUCTION DETAILS

SCALE: 1"=20'

C-30

LMH	9/15/11		
GS	5/31/11		
REVISED BY	DATE REVISED		
E. ANJORIN/G. SIMARD	BEN RAZEGHI		
CALCULATED-DESIGNED BY	CHECKED BY		
CONSULTANT FUNCTIONAL SUPERVISOR	TIMOTHY J. LEE		

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

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LAST REVISION 00-00-00 | DATE PLOTTED => 10/17/2011 | TIME PLOTTED => 12:55:07 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => lhatch | DGN FILE => 43a921ga030.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0725 | PROJECT NUMBER & PHASE 00000000004

Median Deflection Testing & Analysis (CHEC, October 24, 2011)

CHEC
MANAGEMENT SYSTEMS INC.

Pavement Engineering
Pavement Management
Asset Management
GIS Linkage & Mapping
Visual Condition Rating
Deflection Testing

October 24, 2011

Job No. 09088
REVISED

Parikh Consultants, Inc.
2360 Qume Drive
Suite A
San Jose, CA 95131

Attn: Mr. Y. David Wang, Ph.D., P.E.
Principal

Subject: Hwy 880 Median Deflection Testing and Analysis
MP 25.5 to MP 22.5 southbound direction.

Gentlemen:

We have completed our analysis for the subject project and revised it allowing for a Traffic Index of 13. In this report, CHEC has included the structural overlay requirements based on California Test Method 356, our recommendations, and graphs for this project.

The Appendix of this report contains all data to support our findings. If you have any questions regarding this information, please contact CHEC at 800-523-2124.

Very truly yours,
MANAGEMENT SYSTEMS, INC.

James B. Curtis
President

Reviewed by:

REGISTERED PROFESSIONAL ENGINEER
Charles Alan Curtis
No. 23,326
CIVIL
STATE OF CALIFORNIA

Alan Curtis, P. E.
Vice President
CA C. E. #23326

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BACKGROUND

CHEC Management Systems, Inc. was hired by Parikh Consultants, Inc. to provide a structural adequacy determination for the median shoulder of Highway 880 starting at PM 25.5 in the north and continuing south to PM 22.5. In this revised final report, we have provided our analysis using a traffic index value of 13. Within this final design report recommendations are given to minimize the vertical elevation change while satisfying the structural and reflective cracking needs of the existing pavement.

Parikh Consultants, Inc. provided the limits of deflection testing and the Traffic Index for this project. We have prepared this report, which provides a measure of the structural adequacy of each pavement section and our recommendation of current repair techniques.

On the evening of March 23, 2010, Mr. Bob Freeman performed deflection testing, and Mr. Ian Anderson collected 6 core samples, one for each test section. In all 6 different pavement test sections were established, with testing and coring being completed on each test section. Highway Technologies, Inc. provided traffic control on March 23 where full lane closures were required. Figure 1 of this report provides a pictorial representation of each test section location, the existing AC thickness, and the corresponding CTM 356 overlay recommendation.

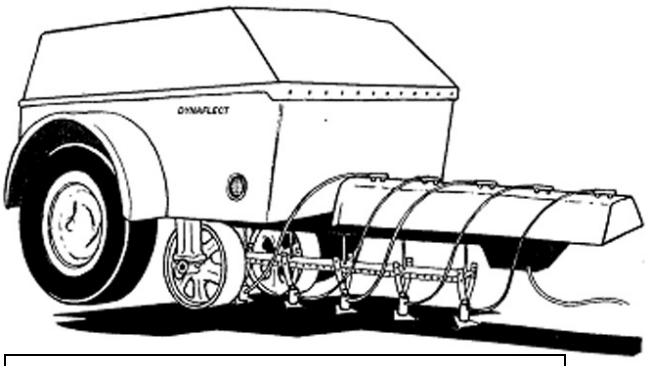
After field testing was completed, all field notes and data sheets were provided to the engineer for review and analysis. The engineer has provided his analysis within this bound report.

This report provides overlay requirements required to protect the existing shoulder median investment for a 20-year service life at a traffic index of 13.0. Alternative design methods were utilized, as appropriate, to evaluate the most cost effective or feasible approach, while still providing a 20-year design life.

DEFLECTION TESTING AND ANALYSIS

TESTING AND ANALYSIS PROCEDURE

California Test Method 356



The image above provides a schematic of a dvnaflect.

Testing was performed using a DYNAFLECT nondestructive pavement testing device. The device places a 1000-lb. oscillatory load on the pavement surface. Motion sensing geophones (sensors) placed on the pavement surface "read" the pavement deflection resulting from the load. A strong pavement will deflect less than a weak pavement under the same loading. A single sensor was used for this analysis. The testing equipment and analysis procedure is based on California Test Method (CTM) 356 (using a DYNAFLECT and the Caltrans Rehabilitation Design Manual dated 2001).

Design Analysis

1. The procedure is basically a fatigue analysis. The measured maximum deflection is the amplitude of pavement bending for each repetition of a load. (The design number of load repetitions is indicated by the Traffic Index - T.I.) If the existing pavement is fairly thick, the tolerable deflection to prevent fatigue failure is lower than for a comparable thinner pavement. Thus, a thicker pavement requires a thicker overlay to reduce the deflection.

2. The second half of the analysis is based on the need to retard reflective cracking, or the propagation of old cracks in the underlying pavement through the new overlay. The overlay should be at least half the thickness of the existing pavement to retard reflective cracking. A fabric interlayer may be substituted for 0.10 ft. of HMAC for crack control purposes only. The structural needs of the pavement must first be satisfied before reflective crack retardation is considered.

DESIGNER'S GENERAL NOTES

The following notes are provided to assist the design engineer in developing the plans and specifications for this project. Some of these guidelines are reflected in the recommendations found within this report.

1. All specified thicknesses in this report are design minimums and do not include construction tolerances.

2. With asphalt overlays, wedge cutting is recommended at all conforms to provide a smooth taper and transition.

3. Prior to an overlay, an adequate application of a tack coat is required for a proper bond. The type and application rates are to be determined by the design engineer.

4. When placing paving fabric over a milled surface, the tack oil coverage rate must be increased to cover the additional surface area and promote a good bond. This is typically a minor increase depending on the type of fabric being utilized.

5. All areas of moderate to severe alligator cracking and/or bleeding should be removed and replaced with full-depth AC repairs. The thickness of the repairs may vary, but should never be less than the thickness of the existing AC section, and preferably one to two inches below the existing AC surface layer.

6. All transverse and longitudinal cracks wider than 1/4 of an inch should be sealed with an emulsified crack seal.

7. Paving Fabric - We highly recommend a paving fabric, such as TruPave, to be utilized to help retard reflective cracking. The TruPave fabric is recommended because of the recycling capabilities, the extremely high operating temperature range, and the fact that disposal of the asphalt with TruPave fabric does not have an

increase in cost over asphalt alone. For example; the operating range of a standard paving fabric is 325 degrees F and then the material crystallizes, melt or begins to breakdown. TruPave paving fabric has an operation range that is over 400 degrees F which is well above the placement temperatures of HMAC or RAC therefore being able to be used in either environment without concerns.

8. Defects After Milling – When performing a partial depth milling as part of the rehabilitation design the possibility always exists that the underlying material is not as good of quality as the surface material that is visually present. If during or after the milling process has been completed the remaining asphalt concrete is in considerably worse case than the surface layer some structural repairs may be required. These repairs will typically be in the form of a full-depth AC repair of a localized area.

SUMMARY OF FINDINGS

From the testing completed, CHEC Management Systems, Inc. was able to identify different pavement design sections. When performing the engineering analysis, CHEC Management Systems, Inc. tried to provide a design that would meet both the structural and reflective crack control needs; as well as, minimize the vertical elevation change if possible. From our analysis the project can be broken into three (3) different pavement design areas. Each design recommendation is discussed in detail within the section "CHEC'S FINDINGS AND RECOMMENDATIONS".

In general, the engineering analysis shows the existing pavement need between zero (0) inches and 3 ¾ inches of new HMAC per CTM 256 and the CALTRANS Flexible Pavement Rehabilitation Design Manual – June 2001. Alternate designs were produced to try and minimized the vertical elevation change, while still meeting the structural and reflective crack control needs. The alternate designs range from milling 3.0 inches of existing AC and placing 3.0 inches of new HMAC, to milling only 5.5 inches of the existing AC and placing 5.5 inches of new HMAC. By utilizing a mill and

overlay technique, the maximum vertical elevation change is 0 inches. This is one of the design constraints of the project, zero vertical elevation change if possible.

None of the overlay thicknesses recommended are thicker than one-half of the existing AC that will be left after milling. So CHEC Management Systems, Inc. recommends the use of a paving fabric to help retard reflective cracking. The recommended designs take into account the different existing asphalt layer thicknesses with respect to the recommended milling depths.

The summary table, Table 1, provides a quick look at the limits and design recommendation of each pavement section. Figures 1, found in the Appendix, provide a pictorial view of the location of each test section and its limits. A detailed look at each test section can be found in the section titled “CHEC’S FINDINGS AND RECOMMENDATIONS”.

Table 1

Summary of Findings

20 Year Designs

Road Name	**From**	**To**	**CTM Structural Requirement (20 Year Design)**	**CHEC's Design Recommendations**
Hwy 880 (SB) Median	MP 25.5 Hegenburger Way	MP 23.75	**T.I. 13.0** **MP 25.5 – MP 25.25** 0.10 ft. HMAC Overlay **MP 25.0 – MP 24.75** 0.00 ft. HMAC Overlay **MP 24.5 – MP 24.25** 0.00 ft. HMAC Overlay **MP 24.0 – MP 23.75** 0.15 ft. HMAC Overlay	**SB Median Shoulder MP 25.5 to MP 23.75** 1. Mill 3.0" / 3.0" HMAC Overlay with Paving Fabric
Hwy 880 (SB) Median	MP 23.5	MP 23.25	**T.I. 13.0** **MP 23.5 – 23.25** 0.25 ft. HMAC Overlay	**SB Median Shoulder MP 23.5 to MP 23.25** 1. Mill 5 ½ " / 5 ½ " HMAC Overlay with Paving Fabric
Hwy 880 (SB) Median	MP 23.0	MP 22.75	**T.I. 13.0** **MP 23.0 – MP 22.75** 0.15 ft. HMAC Overlay	**SB Median Shoulder MP 23.0 to MP 22.75** 1. Mill 4.0" / 4.0" HMAC Overlay with Paving Fabric

Note: Figures 1 of this report show the project sections as described in the table above.

PROCEDURE

The structural overlay requirement was determined using California Test Method 356 and the Caltrans Rehabilitation Manual (2001), which is based on a 20-year design. CHEC's design recommendations are for a 20-year service life. CHEC Management Systems, Inc. evaluated the different sections of Hwy 880 SB Median from MP 25.5 to MP 22.5 utilizing a Traffic Index factor of 13.0. Parikh Consultants, Inc. provided the Traffic Index factor to CHEC Management Systems, Inc. for this project. In all, three different pavement design sections were established, and six test sections were evaluated.

Deflection testing was performed within the median lane two and one-half to three feet from the median barrier. Segments were selected based on pavement type and visual defects present in the road; as well as the avoidance of physical structures, such as bridge decks. The testing occurred in the southbound median lane, and tests were taken at an interval that provided at least 20 points per segment. The actual interval used is stated on the deflection graphs located in the Appendix.

The next step in our field work was to note the existing visible defects. Photographs were not taken due to the nighttime conditions during testing. Coring data was taken and recorded during the testing process to determine the existing thickness of asphalt concrete (AC), which aided in segmentation of the roadway. In all, six different test sections were created over the project area.

The following section describes the test sections CHEC analyzed in detail, providing our primary design recommendations.

CHEC'S FINDINGS AND RECOMMENDATIONS

Hwy 880 SB Median
MP 25.5 to MP 23.75
(SB: 0 to 9,240 ft.)

Section Limits: (Approx.)	MP 25.5 to MP 23.75	**Current Structural Section**	SB Median MP 25.5 to MP 24.25 14.0 inches AC MP 24.0 to MP 23.75 5" AC / 9" PCC
Direction Tested	SB Median Shoulder	**CTM 356 – T.I. 13.0**	**MP 25.5 – MP 25.25** 0.10 ft. HMAC Overlay **MP 25.0 – MP 24.75** 0.00 ft. HMAC Overlay **MP 24.5 – MP 24.25** 0.00 ft. HMAC Overlay **MP 24.0 – MP 23.75** 0.15 ft. HMAC Overlay
CHEC Primary Recommendation	**SB Median Shoulder** Mill 3.0" / 3.0" HMAC Overlay with Paving Fabric	**CHEC Alternate Recommendations**	Mill 3.0" / .15' RAC Over .15'HMAC with TruPave Paving Fabric

This section of highway median starts at MP 25.5 (Hegenburger Road) and continues southbound for 1 ¾ miles to approximately Davis Street. The median shoulder was found to be between 13 ½ inches and 14 inches thick. The first three test sections were comprised of only asphalt concrete (AC). In general, there were four to five different lifts of asphalt concrete to make up the 13 ½ inch thick structural section.

The fourth test section was comprised of AC and Portland Cement Concrete (PCC), with an overall thickness of 14 plus inches. This location has three distinct layers of AC totaling 5 inches, and 9 plus inches of PCC.

Because testing was completed at night, photographs were not taken that represent the physical condition of the median shoulder. From the field notes taken, the shoulder has

a minimal amount of transverse cracking present. CHEC Management Systems, Inc. did not see any alligator cracking or other structural defects present at the time the testing was completed.

CHEC's Design Recommendation

When developing this final rehabilitation design two major factors played a role. First we needed to satisfy the structural needs of the existing pavement section. Secondly, if possible, we needed to determine if there is a mill and overlay design that does not raise the vertical elevation higher than the current pavement section.

Based on CTM 356 analysis, the current structural requirement for these median sections are as follows:

- Test Section #1 MP 25.5 to 25.25 – 0.10 ft. HMAC Overlay
- Test Section #2 MP 25.0 to 24.75 – 0.00 ft. HMAC Overlay
- Test Section #3 MP 24.5 to 24.25 – 0.00 ft HMAC Overlay
- Test Section #4 MP 24.0 to 23.75 – 0.15 ft HMAC Overlay

For this project area, the fourth test section was determined to be the control for the overall design. This test section has a structural requirement of 0.15 ft. HMAC Overlay based on the CTM 356 and CALTRANS Flexible Pavement Rehabilitation Design Manual – June 2001. To control reflective cracking, the overlay thickness required would be much greater than the 0.15 structural requirement currently measured. With little to no defects present at the surface, CHEC Management Systems, Inc. feels that reflective crack control is not a controlling factor for this design. A Traffic Index factor (TI) of 13.0 was utilized for all analysis completed.

For this section of road, to satisfy both the structural and reflective cracking requirements of the design procedure, we recommend:

Mill the existing pavement surface 3.0 inches and overlay the remaining pavement with a 3.0 inch HMAC overlay utilizing a paving fabric to aid in the retardation of reflective cracks after milling. This design will be sufficient where there is both AC and PCC underlying the milled surface. The pavement thickness after milling will be between 10 and 11 inches of AC where there was only an AC structural section found. The composite pavement sections will still have 2 inches of AC over 9 inches of PCC after milling. With the recommended overlay thickness being less than one-half the remaining pavement thickness after milling, a paving fabric is recommended to help prevent reflective cracking. The overall elevation change for these pavement sections will be zero (0) inches higher than the existing surface elevation.

Figure 1 of this report shows the existing pavement thickness with existing layers for each test section, the CTM 356 overlay requirement, and the approximate location of each test section.

CHEC's Alternate Design

To help prevent reflective cracking better than the primary design, the use of RAC can be substituted for the standards HMAC overlay. If rubberized AC is utilized, then a standard paving fabric is not recommended because of the higher associated temperatures of rubberized AC. A better alternative is to utilize TruPave paving fabric instead. This material is a fiberglass material that has a very high temperature threshold of 400+ degrees F, which is well above the RAC temperatures. So the alternate design is as follows:

Mill the existing pavement surface 3.0 inches and overlay the remaining pavement with a 1.5 inch RAC overlay over 1.5 inch HMAC utilizing TruPave paving fabric by Owens Corning to aid in the retardation of reflective cracks after milling.

Both designs provide for the structural needs of the pavement sections. The Alternate design will provide better reflective crack control if deemed a major issue or concern.

Hwy 880 SB Median
MP 23.5 to MP 23.25
(SB: 10,560 to 11,880 ft.)

Section Limits: (Approx.)	MP 23.5 to MP 23.25	**Current Structural Section (both directions)**	MP 23.5 to MP 23.25 6 1/2" AC / 7 ½+" of PCC
Direction Tested	SB Median	**CTM 356 – T.I. 13.0**	0.25 ft. HMAC Overlay
CHEC Primary Recommendation	Mill 5.5" / 5.5" HMAC Overlay with Paving Fabric	**CHEC Alternate Recommendations**	NONE

This section of highway median starts at MP 23.5 which is about ¼ mile south of Davis Street overpass and continues southbound for ¼ mile. The median shoulder was found to be 14.0 plus inches thick and a composite section of pavement. This location has two distinct layers of AC totaling 6 ½ inches, and 7 ½ plus inches of PCC. During the coring process, the lowest section of PCC could not be extracted, the core broke at 7 ½ inches with more left in the hole.

CHEC Management Systems, Inc. did not see any alligator cracking or other structural defects present at the time the testing was completed. From the field notes taken by our technician, the shoulder has a minimal amount transverse cracking present.

CHEC's Design Recommendation

When developing this final rehabilitation design, two major factors played a role. First, we needed to satisfy the structural needs of the existing pavement section. Secondly, if possible, we needed to determine if there is a mill and overlay design that does not raise the vertical elevation higher than the current pavement section.

Based on CTM 356 analysis, the current structural requirement for these median sections are as follows:

- Test Section #5 MP 23.5 to 23.25 – 0.25 ft. HMAC Overlay

This test section has a structural requirement of 0.25 ft. HMAC overlay based on the CTM 356 and CALTRANS Flexible Pavement Rehabilitation Design Manual – June 2001. To control reflective cracking the overlay thickness required would be much greater than the 0.25 structural requirement currently measured. With little to no defects present at the surface, CHEC Management Systems, Inc. feels that reflective crack control is not a controlling factor for this design. A Traffic Index Factor (TI) of 13.0 was utilized for all analysis completed.

For this section of road, to satisfy both the structural and reflective cracking requirements of the design procedure, we recommend:

Mill the existing pavement surface 5.5 inches and overlay the remaining pavement with 5.5 inches of new HMAC overlay utilizing a paving fabric to aid in the retardation of reflective cracks after milling. The composite pavement sections will still have 1 ½ inches of AC over 7 ½+ inches of PCC after milling. With the recommended overlay thickness being less than one-half the remaining pavement thickness after milling, a paving fabric is recommended to help prevent reflective cracking of the composite section.

The overall elevation change for these pavement sections will be 0 inches higher than the existing surface elevation. Because of the extremely high deflections present for the existing structural section, a mill and overlay design that does not raise the vertical elevation is possible.

Figure 1 of this report shows the existing pavement thickness with existing layers for each test section, the CTM 356 overlay requirement, and the approximate location of each test section.

CHEC‘s Alternate Design

For this section of highway median there isn't an alternate design recommendation that will not raise the vertical elevation higher than the existing pavement section. The design recommendation mentioned earlier is the most cost effective approach available utilizing the stated design constraints.

Hwy 880 SB Median
MP 23.0 to MP 22.75
(SB: 13,200 to 14,520 ft.)

Section Limits: (Approx.)	MP 23.0 to MP 22.75	**Current Structural Section**	MP 23.0 to MP 22.75 7 ½ ” AC / 7 ½” PCC
Direction Tested	SB Median Shoulder	**CTM 356 – T.I. 13.0**	0.15 ft. HMAC Overlay
CHEC Primary Recommendation	Mill 4.0” / 4.0” HMAC Overlay with Paving Fabric	**CHEC Alternate Recommendations**	Mill 4.0” / 2.0” RAC Overlay over 2.0” HMAC Overlay with Paving Fabric

This section of highway median starts at MP 23.0 and continues southbound for ¼ mile. The median shoulder was found to be 14.0 plus inches thick, and a composite section of pavement. This location has two distinct layers of AC totaling 7 ½ inches on average, and 7½ inches of PCC on average. Under the PCC layer a CTB type material was found.

CHEC Management Systems, Inc. did not see any alligator cracking or other structural defects present at the time the testing was completed. From the field notes taken by our technician, the shoulder has a minimal amount transverse cracking present.

CHEC’s Design Recommendation

When developing this final rehabilitation design, two major factors played a role. First, we needed to satisfy the structural needs of the existing pavement section. Secondly, if possible, we needed to determine if there is a mill and overlay design that does not raise the vertical elevation higher than the current pavement section.

Based on CTM 356 analysis, the current structural requirement for these median sections are as follows:

- Test Section #6 MP 23.0 to 22.75 – 0.15 ft. HMAC Overlay

This test section has a structural requirement of 0.15 ft. HMAC overlay based on the CTM 356 and CALTRANS Flexible Pavement Rehabilitation Design Manual – June 2001. To control reflective cracking the overlay thickness required would be much greater than the 0.15 structural requirement currently measured. With little to no defects present at the surface CHEC Management Systems, Inc. feels that reflective crack control is not a controlling factor for this design. A Traffic Index Factor (TI) of 13.0 was utilized for all analysis completed.

For this section of road, to satisfy both the structural and reflective cracking requirements of the design procedure, we recommend:

Mill the existing pavement surface 4.0 inches and overlay the remaining pavement with 4.0 inches of new HMAC overlay utilizing a paving fabric to aid in the retardation of reflective cracks after milling. The composite pavement sections will still have 4 inches of AC over 7 inches of PCC after milling. With the recommended overlay thickness being less than one-half the remaining pavement thickness after milling, a paving fabric is recommended to help retard reflective cracking of the composite section.

The overall elevation change for these pavement sections will be one-half inch higher than the existing surface elevation. Because of the high deflections present for the existing structural section a mill and overlay design that does not raise the vertical elevation is not possible. The structural need is too great and is the overall controlling factor for this rehabilitation design.

Figure 1 of this report shows the existing pavement thickness with existing layers for each test section, the CTM 356 overlay requirement, and the approximate location of each test section.

CHEC's Alternate Design

For this section of highway median there isn't an alternative design that will not raise the vertical elevation higher than the existing pavement section. The design recommendation above is the most cost effective approach available utilizing the stated design constraints.

An alternate design that may provide better reflective crack control would be to mill the existing surface 4.0 inches and place a 2.0 inch RAC Overlay over a 2.0 inch HMAC overlay with the use of a paving fabric between the HMAC and the milled asphalt concrete surface.

The total elevation change is still one-half of an inch higher than the original surface elevations due to the structural needs, but the RAC provides better reflective crack control than the HMAC material alone.

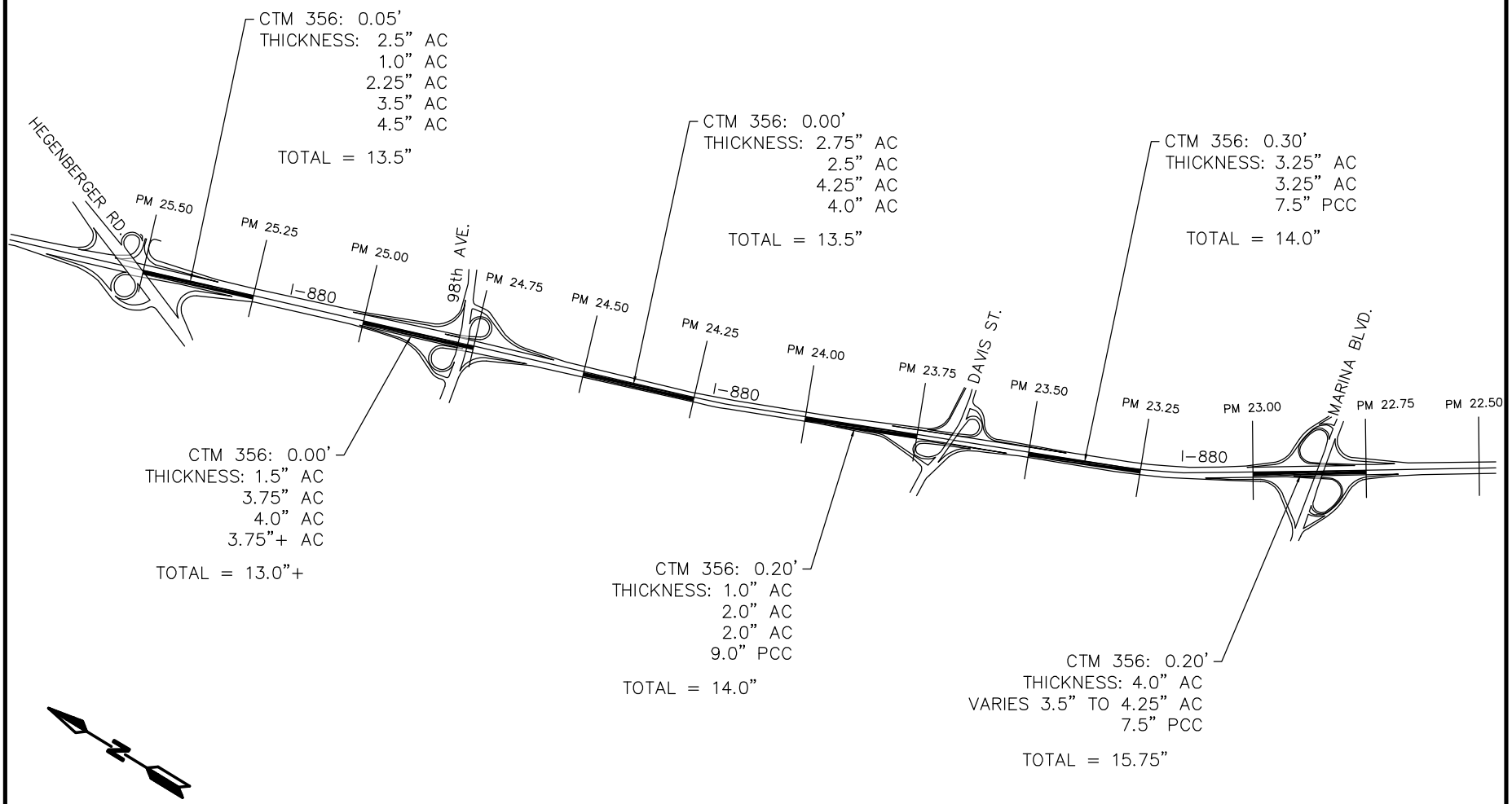
APPENDIX

Figures 1
Deflection Plots & Graph

HIGHWAY 880

S.B. MEDIAN TESTING

EXISTING THICKNESS



CHEC Management Systems, Inc.
20202 Charlanne Drive
Redding, CA 96002
(530) 222-3116

FIGURE 1

ENGINEER: JC
DWG2009\09088

Dynaflect Analysis

Parikh Eng. Services Dept.

Hwy 880

ROAD: Hwy 880 HW
MP 25.5 - MP 25.25
SB: 0 - 1320

STATISTICAL ANALYSIS	80th %	90th %	Mean	Min	Max
	9	9	7	4	10

STRUCTURAL DATA **CTB:** N **Thickness:** 13.50 **TI:** 13.0

STRUCTURAL DESIGN	Deflec	Toler	% Reduction	Overlay
	9	8	8	0.05

ROAD: Hwy 880 HW
MP 25.0 - MP 24.75
SB: 2690 - 3960

STATISTICAL ANALYSIS	80th %	90th %	Mean	Min	Max
	6	7	6	4	7

STRUCTURAL DATA **CTB:** N **Thickness:** 13.50 **TI:** 13.0

STRUCTURAL DESIGN	Deflec	Toler	% Reduction	Overlay
	6	8	0	0.00

ROAD: Hwy 880 HW
MP 24.5 - MP 24.25
SB: 5280 - 6600

STATISTICAL ANALYSIS	80th %	90th %	Mean	Min	Max
	7	7	6	3	7

STRUCTURAL DATA **CTB:** N **Thickness:** 13.50 **TI:** 13.0

STRUCTURAL DESIGN	Deflec	Toler	% Reduction	Overlay
	7	8	0	0.00

ROAD: Hwy 880 HW
MP 24.0 - MP 23.75
SB: 7985 - 9240

STATISTICAL ANALYSIS	80th %	90th %	Mean	Min	Max
	9	9	8	6	10

STRUCTURAL DATA **CTB:** Y **Thickness:** 14.00 **TI:** 13.0

STRUCTURAL DESIGN	Deflec	Toler	% Reduction	Overlay
	9	7	22	0.10

ROAD: Hwy 880 HW
MP 23.5 - MP 23.25
SB: 10560 - 11880

STATISTICAL ANALYSIS	80th %	90th %	Mean	Min	Max
	11	12	10	8	13

STRUCTURAL DATA **CTB:** Y **Thickness:** 14.00 **TI:** 13.0

STRUCTURAL DESIGN	Deflec	Toler	% Reduction	Overlay
	11	7	37	0.20

Dynaflect Analysis

Parikh Eng. Services Dept.

Hwy 880

ROAD: Hwy 880 HW

MP 23.0 - MP 22.75

SB: 13200 - 14520

STATISTICAL ANALYSIS

80th %	90th %	Mean	Min	Max
9	10	8	4	10

STRUCTURAL DATA **CTB:** Y **Thickness:** 14.50 **TI:** 13.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
9	7	25	0.10

Dynaflect Analysis

Parikh Eng. Services Dept.

Hwy 880

ROAD: Hwy 880 HW

MP 25.5 - MP 25.25 ...x|....

SB: 0 - 1320	Reading	Plot	Comment
Interval 0	33.00	7	
Interval 50	44.00	10	
Interval 100	42.00	9	
Interval 150	40.00	9	
Interval 200	42.00	9	
Interval 250	43.00	9	
Interval 300	42.00	9	
Interval 350	37.00	8	
Interval 400	42.00	9	
Interval 450	39.00	8	
Interval 500	38.00	8	
Interval 550	34.00	7	
Interval 600	32.00	7	
Interval 650	36.00	8	
Interval 700	30.00	6	
Interval 750	33.00	7	
Interval 800	43.00	9	
Interval 850	29.00	6	
Interval 900	34.00	7	
Interval 950	31.00	7	
Interval 1000	20.00	4	
Interval 1050	19.00	4	
Interval 1100	32.00	7	
Interval 1150	26.00	6	
Interval 1200	29.00	6	
Interval 1250	30.00	6	
Interval 1300	27.00	6	

STATISTICAL ANALYSIS

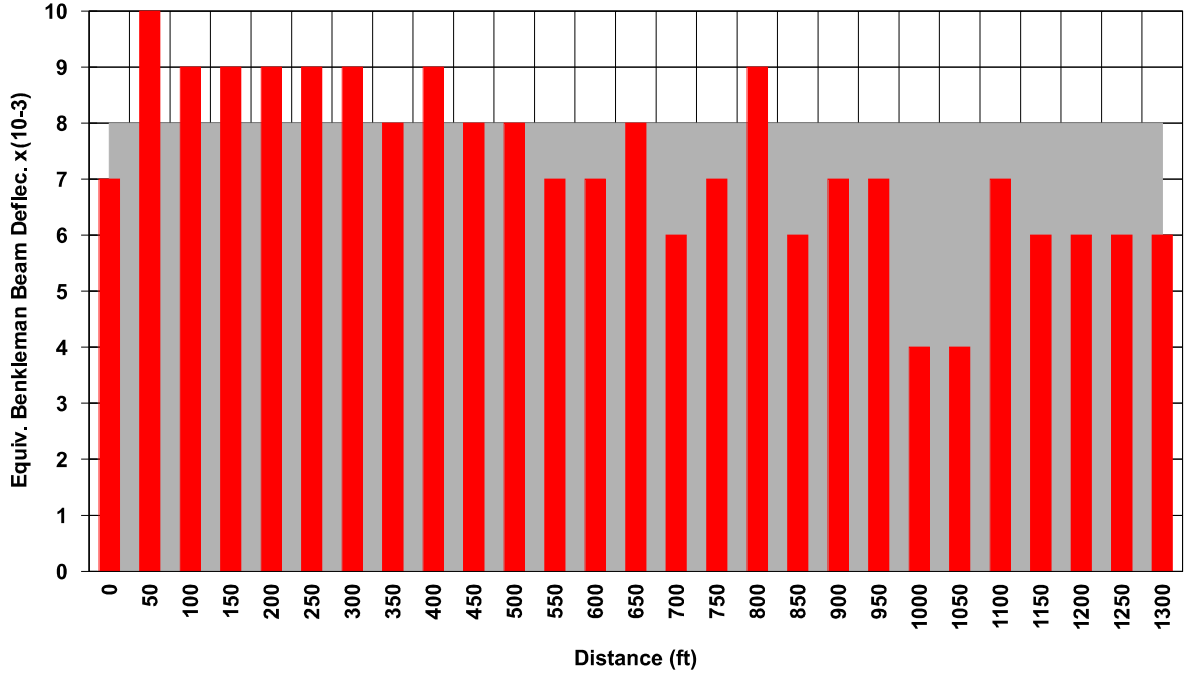
80th %	90th %	Mean	Min	Max
9	9	7	4	10

STRUCTURAL DATA **CTB:** N **Thickness:** 13.50 **TI:** 13.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
9	8	8	0.05

Dynaflect Analysis
Hwy 880
Parikh Eng. Services Dept.



Deflection Data Tolerable Limit

Road Name: Hwy 880 HW Direction: S(...x|....) Start: 0 Interval: 0 ft
Road Number: SB: 0 - 1320 From: MP 25.5 To: MP 22.5

STATISTICAL ANALYSIS AS TESTED 80th %: 9 90th %: 9 Mean: 7 Min: 4 Max: 10

STRUCTURAL DATA CTB: N Thickness: 13.50 TI: 13.0

STRUCTURAL DESIGN AS TESTED Deflection: 9 Tolerable: 8 % Reduction: 8 Overlay: 0.05 ft

Dynaflect Analysis

Parikh Eng. Services Dept.

Hwy 880

ROAD: Hwy 880 HW

MP 25.0 - MP 24.75 ...x|....

SB: 2690 - 3960	Reading	Plot	Comment
Interval 2690	24.00	5	
Interval 2740	21.00	5	
Interval 2790	23.00	5	
Interval 2840	23.00	5	
Interval 2890	23.00	5	
Interval 2940	24.00	5	
Interval 2990	21.00	5	
Interval 3040	26.00	6	
Interval 3090	23.00	5	
Interval 3140	26.00	6	
Interval 3190	25.00	5	
Interval 3240	29.00	6	
Interval 3290	26.00	6	
Interval 3340	24.00	5	
Interval 3390	25.00	5	
Interval 3440	20.00	4	
Interval 3490	22.00	5	
Interval 3540	25.00	5	
Interval 3590	32.00	7	
Interval 3640	32.00	7	
Interval 3690	25.00	5	
Interval 3740	28.00	6	
Interval 3790	32.00	7	
Interval 3840	33.00	7	
Interval 3890	33.00	7	
Interval 3940	33.00	7	

STATISTICAL ANALYSIS

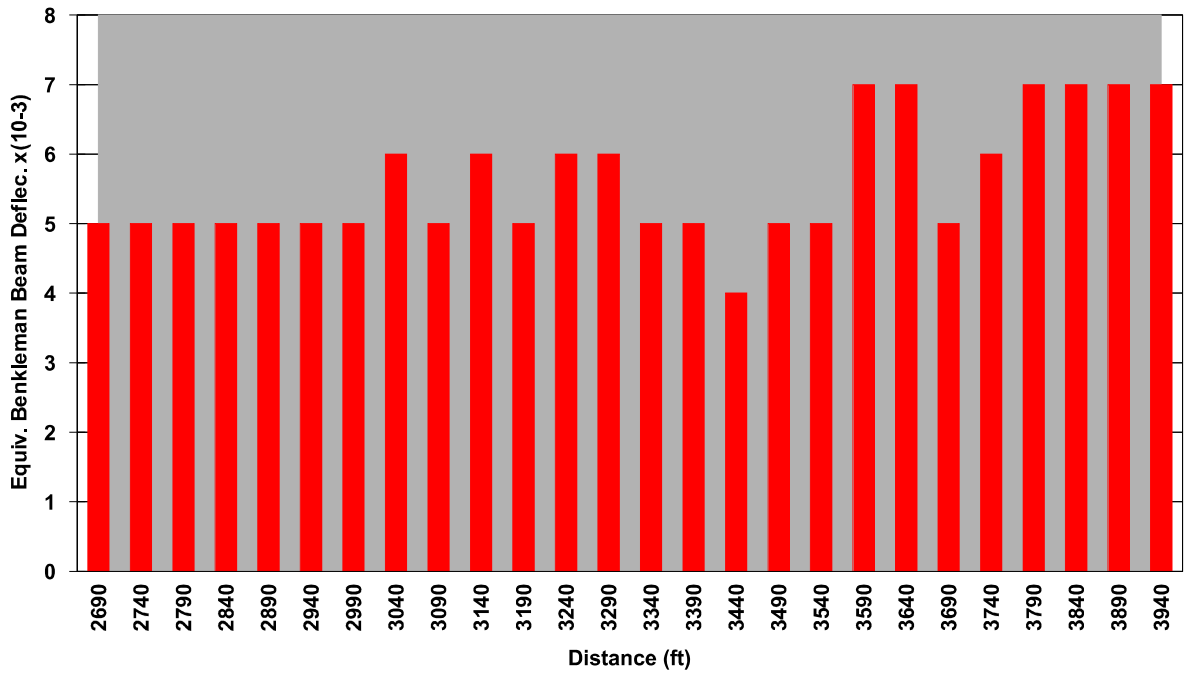
80th %	90th %	Mean	Min	Max
6	7	6	4	7

STRUCTURAL DATA **CTB:** N **Thickness:** 13.50 **TI:** 13.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
6	8	0	0.00

Dynaflect Analysis
Hwy 880
Parikh Eng. Services Dept.



Deflection Data Tolerable Limit

Road Name: Hwy 880 HW Direction: S(...x|....) Start: 0 Interval: 0 ft
Road Number: SB: 0 - 1320 From: MP 25.5 To: MP 22.5

STATISTICAL ANALYSIS AS TESTED 80th %: 9 90th %: 9 Mean: 7 Min: 4 Max: 10

STRUCTURAL DATA CTB: N Thickness: 13.50 TI: 13.0

STRUCTURAL DESIGN AS TESTED Deflection: 9 Tolerable: 8 % Reduction: 8 Overlay: 0.05 ft

Dynaflect Analysis

Parikh Eng. Services Dept.

Hwy 880

ROAD: Hwy 880 HW

MP 24.5 - MP 24.25 ...x|....

SB: 5280 - 6600	Reading	Plot	Comment
Interval 5280	33.00	7	
Interval 5330	30.00	6	
Interval 5380	29.00	6	
Interval 5430	31.00	7	
Interval 5480	33.00	7	
Interval 5530	34.00	7	
Interval 5580	29.00	6	
Interval 5630	28.00	6	
Interval 5680	28.00	6	
Interval 5730	27.00	6	
Interval 5780	28.00	6	
Interval 5830	28.00	6	
Interval 5880	28.00	6	
Interval 5930	26.00	6	
Interval 5980	27.00	6	
Interval 6030	26.00	6	
Interval 6080	25.00	5	
Interval 6130	25.00	5	
Interval 6180	24.00	5	
Interval 6230	21.00	5	
Interval 6280	23.00	5	
Interval 6330	22.00	5	
Interval 6380	16.00	3	
Interval 6430	24.00	5	
Interval 6480	26.00	6	
Interval 6530	28.00	6	
Interval 6550	26.00	6	

STATISTICAL ANALYSIS

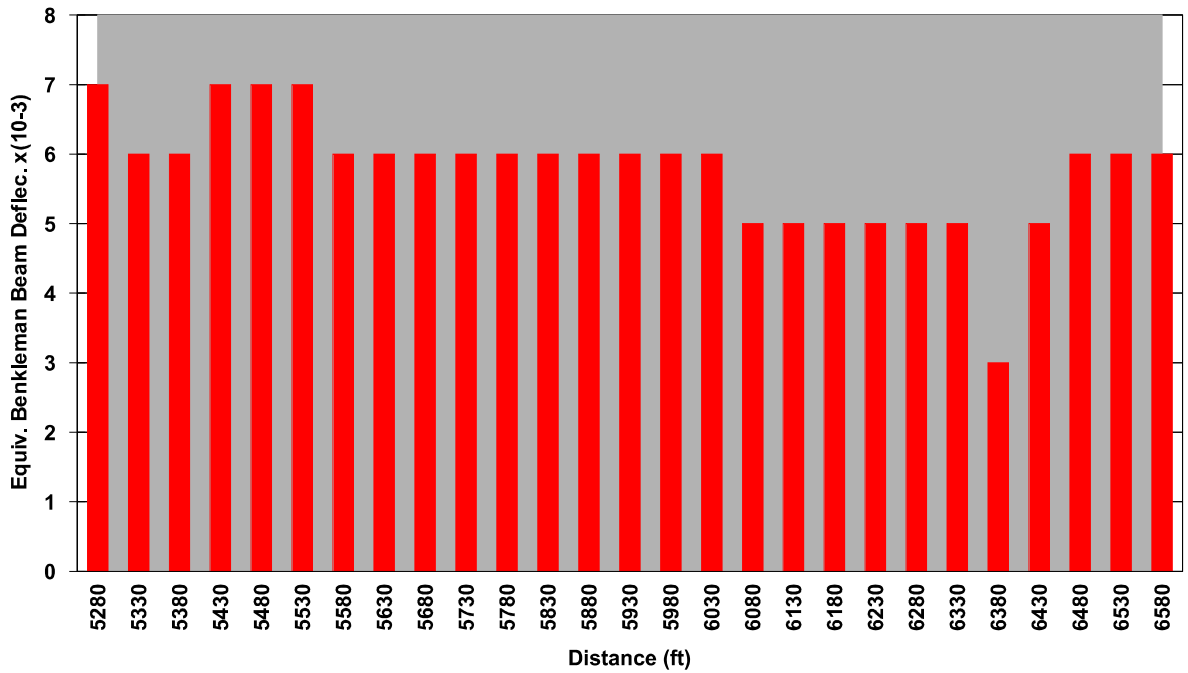
80th %	90th %	Mean	Min	Max
7	7	6	3	7

STRUCTURAL DATA **CTB:** N **Thickness:** 13.50 **TI:** 13.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
7	8	0	0.00

Dynaflect Analysis
Hwy 880
Parikh Eng. Services Dept.



Deflection Data Tolerable Limit

Road Name: Hwy 880 HW Direction: S(...x|....) Start: 0 Interval: 0 ft
Road Number: SB: 0 - 1320 From: MP 25.5 To: MP 22.5

STATISTICAL ANALYSIS AS TESTED 80th %: 9 90th %: 9 Mean: 7 Min: 4 Max: 10

STRUCTURAL DATA CTB: N Thickness: 13.50 TI: 13.0

STRUCTURAL DESIGN AS TESTED Deflection: 9 Tolerable: 8 % Reduction: 8 Overlay: 0.05 ft

Dynaflect Analysis

Parikh Eng. Services Dept.

Hwy 880

ROAD: Hwy 880 HW

MP 24.0 - MP 23.75 ...x|....

SB: 7985 - 9240	Reading	Plot	Comment
Interval 7985	45.00	10	
Interval 8035	45.00	10	
Interval 8085	38.00	8	
Interval 8135	35.00	8	
Interval 8185	36.00	8	
Interval 8235	36.00	8	
Interval 8285	38.00	8	
Interval 8335	41.00	9	
Interval 8385	30.00	6	
Interval 8435	39.00	8	
Interval 8485	39.00	8	
Interval 8535	39.00	8	
Interval 8585	44.00	10	
Interval 8635	40.00	9	
Interval 8685	40.00	9	
Interval 8735	34.00	7	
Interval 8785	41.00	9	
Interval 8835	37.00	8	
Interval 8885	40.00	9	
Interval 8935	38.00	8	
Interval 8985	38.00	8	
Interval 9035	41.00	9	
Interval 9085	39.00	8	
Interval 9135	42.00	9	
Interval 9185	39.00	8	
Interval 9235	39.00	8	

STATISTICAL ANALYSIS

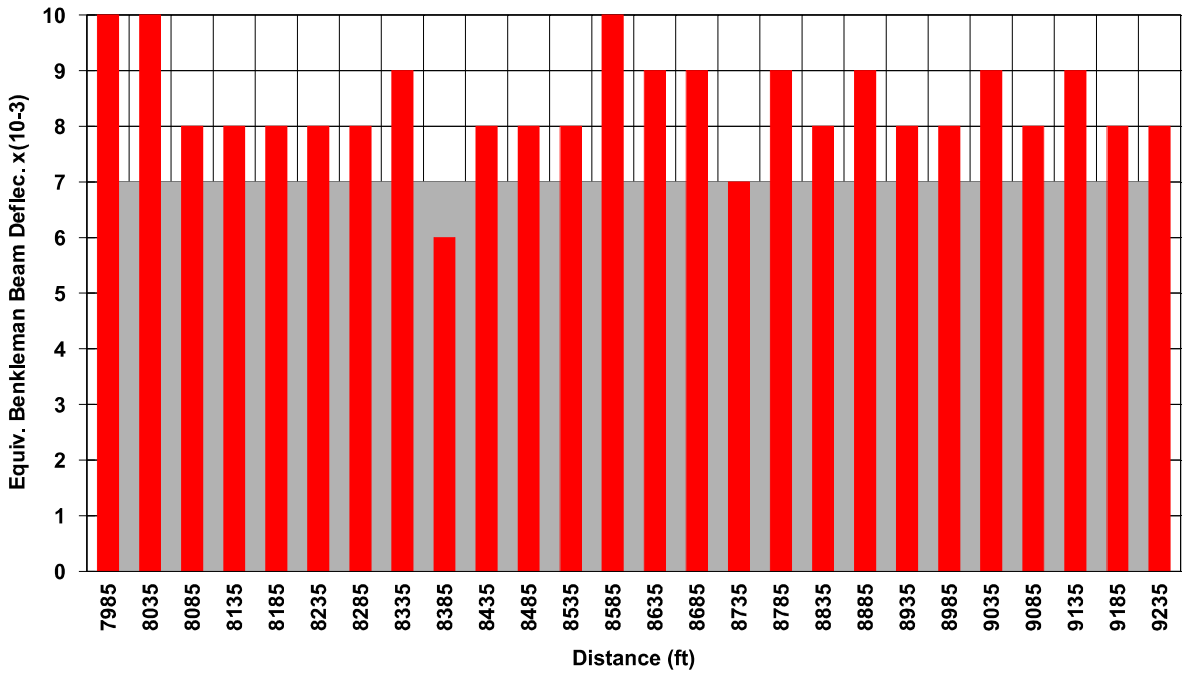
80th %	90th %	Mean	Min	Max
9	9	8	6	10

STRUCTURAL DATA **CTB:** Y **Thickness:** 14.00 **TI:** 13.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
9	7	22	0.10

Dynaflect Analysis
Hwy 880
Parikh Eng. Services Dept.



Deflection Data Tolerable Limit

Road Name: Hwy 880 HW Direction: S(...x|....) Start: 0 Interval: 0 ft
Road Number: SB: 0 - 1320 From: MP 25.5 To: MP 22.5

STATISTICAL ANALYSIS AS TESTED 80th %: 9 90th %: 9 Mean: 7 Min: 4 Max: 10

STRUCTURAL DATA CTB: N Thickness: 13.50 TI: 13.0

STRUCTURAL DESIGN AS TESTED Deflection: 9 Tolerable: 8 % Reduction: 8 Overlay: 0.05 ft

Dynaflect Analysis

Parikh Eng. Services Dept.

Hwy 880

ROAD: Hwy 880 HW

MP 23.5 - MP 23.25 ...x|....

SB: 10560 - 11880	Reading	Plot	Comment
Interval 10560	47.00	10	
Interval 10610	46.00	10	
Interval 10660	48.00	10	
Interval 10710	49.00	11	
Interval 10760	50.00	11	
Interval 10810	39.00	8	
Interval 10860	43.00	9	
Interval 10910	46.00	10	
Interval 10960	61.00	13	
Interval 11010	54.00	12	
Interval 11060	41.00	9	
Interval 11110	38.00	8	
Interval 11160	42.00	9	
Interval 11210	38.00	8	
Interval 11260	47.00	10	
Interval 11310	54.00	12	
Interval 11360	46.00	10	
Interval 11410	57.00	12	
Interval 11460	45.00	10	
Interval 11510	48.00	10	
Interval 11560	51.00	11	
Interval 11610	50.00	11	
Interval 11660	48.00	10	
Interval 11710	47.00	10	
Interval 11760	41.00	9	
Interval 11810	40.00	9	
Interval 11860	41.00	9	

STATISTICAL ANALYSIS

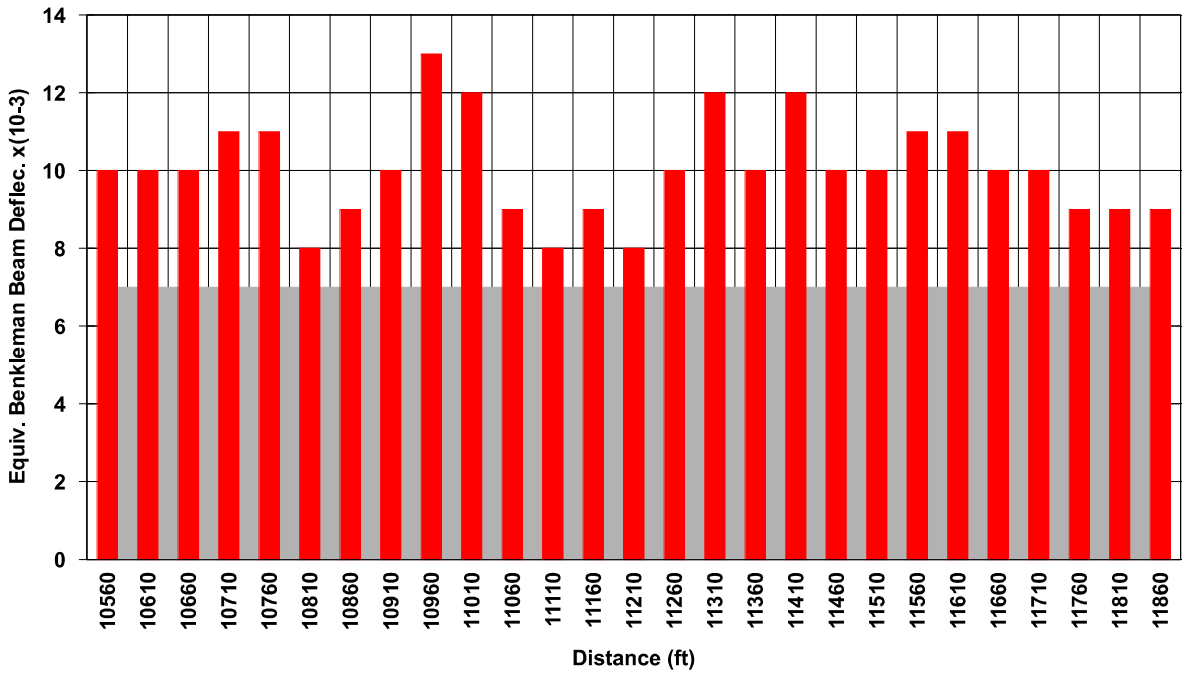
80th %	90th %	Mean	Min	Max
11	12	10	8	13

STRUCTURAL DATA **CTB:** Y **Thickness:** 14.00 **TI:** 13.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
11	7	37	0.20

Dynaflect Analysis
Hwy 880
Parikh Eng. Services Dept.



Deflection Data Tolerable Limit

Road Name: Hwy 880 HW Direction: S(...x|....) Start: 0 Interval: 0 ft
Road Number: SB: 0 - 1320 From: MP 25.5 To: MP 22.5

STATISTICAL ANALYSIS AS TESTED 80th %: 9 90th %: 9 Mean: 7 Min: 4 Max: 10

STRUCTURAL DATA CTB: N Thickness: 13.50 TI: 13.0

STRUCTURAL DESIGN AS TESTED Deflection: 9 Tolerable: 8 % Reduction: 8 Overlay: 0.05 ft

Dynaflect Analysis

Parikh Eng. Services Dept.

Hwy 880

ROAD: Hwy 880 HW

MP 23.0 - MP 22.75 ...x|....

SB: 13200 - 14520	Reading	Plot	Comment
Interval 13200	35.00	8	
Interval 13250	32.00	7	
Interval 13300	34.00	7	
Interval 13350	39.00	8	
Interval 13400	35.00	8	
Interval 13450	41.00	9	
Interval 13500	18.00	4	
Interval 13550	36.00	8	
Interval 13600	34.00	7	
Interval 13650	36.00	8	
Interval 13700	38.00	8	
Interval 13750	47.00	10	
Interval 13800	46.00	10	
Interval 13850	42.00	9	
Interval 13900	39.00	8	
Interval 13950	39.00	8	
Interval 14000	42.00	9	
Interval 14050	42.00	9	
Interval 14100	43.00	9	
Interval 14150	39.00	8	
Interval 14200	42.00	9	
Interval 14250	42.00	9	
Interval 14300	41.00	9	
Interval 14350	42.00	9	
Interval 14400	41.00	9	
Interval 14450	41.00	9	
Interval 14500	40.00	9	

STATISTICAL ANALYSIS

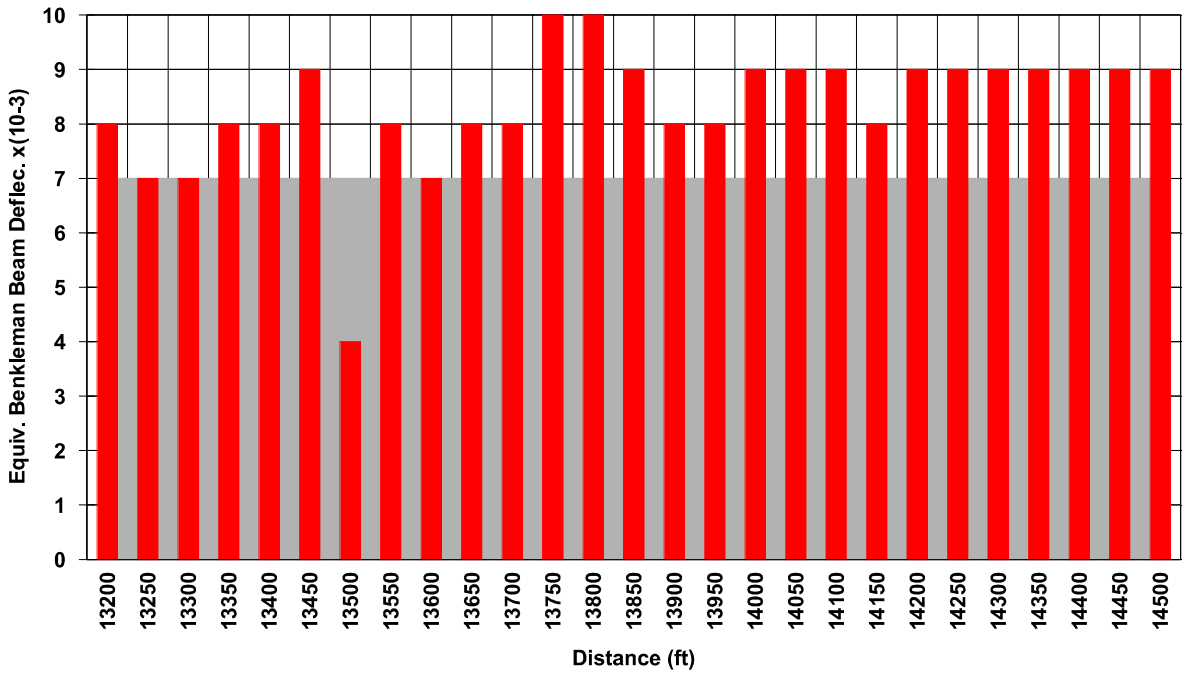
80th %	90th %	Mean	Min	Max
9	10	8	4	10

STRUCTURAL DATA **CTB:** Y **Thickness:** 14.50 **TI:** 13.0

STRUCTURAL DESIGN

Deflec	Toler	% Reduction	Overlay
9	7	25	0.10

Dynaflect Analysis
Hwy 880
Parikh Eng. Services Dept.



Deflection Data Tolerable Limit

Road Name: Hwy 880 HW Direction: S(...x|....) Start: 0 Interval: 0 ft
Road Number: SB: 0 - 1320 From: MP 25.5 To: MP 22.5

STATISTICAL ANALYSIS AS TESTED 80th %: 9 90th %: 9 Mean: 7 Min: 4 Max: 10

STRUCTURAL DATA CTB: N Thickness: 13.50 TI: 13.0

STRUCTURAL DESIGN AS TESTED Deflection: 9 Tolerable: 8 % Reduction: 8 Overlay: 0.05 ft

APPENDIX E

<u>RESPONSE TO COMMENTS OF February 15, 2012 by L. Tachri on GDMR</u>

(Comments of 2/15/2012 Attached for Reference)

I. Geotechnical Design and Materials Report

Comment: Item No. 74. Could the two adjacent projects (04-3A9221 and 04-3A9211) be coordinated for excavation, surplus material, pay item, etc. ?

Response: The designer has indicated that the South and North segments are being advertised separately with different start and finish dates. Each project has a CMIA funding deadlines, which preclude the designer from further delay of advertising the contracts. However, when the projects are in construction, the RE can make the necessary coordination to allow for use of surplus material from the North segment in the South contract.

Comment: …no response to GDMR-related items 8, 9, 10 & 11 of email dated 1/4/12..

Response: Comment Items 8, 9, 10 & 11 have been addressed and incorporated in the GDMR.

Comment: Page 6, Table. Show proposed (approx.) finished grade of the widening in a separate column…

Response: Concur. A separate column has been inserted to show the approx. FG at the planned widening.

Comment: …Perform a "thorough" As-Built plans research so that all pavement structural sections being shown as existing on the plans reflect all original construction work and any subsequent rehabilitation, maintenance or widening…

Response: Concur. A thorough research of the as-built plans has been performed. The as-built plans have been listed and attached in Appendix D.

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. TONY WONG
District Branch Chief
Design, Alameda I

Attention: N. Gohil

Date: February 15, 2012

File: 04-ALA-880 PM 22.6/24.0
EA 04-3A9211
SB HOV Lane Extension from
Marina Blvd. to Davis St.

From: LUIS TACURI, P.E.
Materials Design Engineer
Eng. Services I - Materials A

Subject: Review of Consultant's Reponses to GD&MR and 95% PS&E Submittal (e-mailed to us on February 7, 2012) and Additional Comments and Recommendations

Having reviewed the above-referenced document for the southbound HOV lane extension on I-880 between Marina Blvd. and Davis St. below are our comments. Also, "Additional Comments" or "Additional Recommendations" are included. Further review of the updated GD&MR and PS&E documents will be necessary once they become available and had been submitted for our consideration.

I. GEOTECHNICAL DESIGN AND MATERIALS REPORT (dated October 26, 2011)

Comments to Consultant's Reponses (received via e-mail on February 7, 2012)

- **Item No. 74:** You acknowledge that the surplus material from the adjacent project 04-3A9221 can be used in the embankment construction of this project (04-3A9211). Could not these two adjacent projects be coordinated so that the State does not have to pay first for the excavation of what will become surplus material under 04-3A9221, and second for its reuse as imported borrow under 04-3A9211?
- There are no responses to GD&MR-related items 8, 9, 10, and 11 of our e-mail dated January 4, 2012.

Additional Comments

- **Page 6, Table 1:** Insert a column to show the proposed (approximate) widening finished grade so that we can ascertain the depth of the groundwater in relation to the finished pavement grade and whether permeable material (blanket) and "pavement" underdrains are required at some locations.

- As-built data is missing, especially for existing structural sections adjacent to the new widenings. Perform a "thorough" As-Built plans research so that all pavement structural sections being shown as existing on the project plans reflect all original construction work and any subsequent pavement rehabilitation, maintenance, or widenings that had been carried out over the years.

II. PLANS (dated November 28, 2011)

TYPICAL CROSS SECTIONS SHEETS

Additional Recommendations

To ensure continuity of the new 0.10' HMA (O) surface layer across the mainline traffic lanes, median and outside shoulders:

We recommend extending the lateral limit of new structural section No. 3 (shown on sheets X-1 thru X-6), new structural section No. 9 (shown on sheets X-1 and X-3), and new median pavement work (shown on sheet C-21) to the bottom face of the existing median concrete barrier to remain in place. It was brought out to our attention that cold planing of an existing AC to the bottom face of an existing median concrete barrier was recently carried out along westbound Ala I-80 PM 2.5/8.0 (see attached Title Sheet and Typical Cross Sections sheet X-4 for EA 04-1G3104).

Sheet X-1, All New Structural Sections with SEG: Since there is a Bid Item for "Subgrade Enhancement Geotextile Class B2" (Item 198209), edit all occurrences of "SEG" to red "SEG Class B2".

Sheet X-1, All New Structural Sections with GPI: We recommend using "Geosynthetic Pavement Interlayer (Paving Mat)" instead of just GPI. Update GPI description accordingly.

CONSTRUCTION DETAILS SHEETS

Comments to Consultant's Reponses (received via e-mail on February 7, 2012)

Item No. 30: Disagree. Moving the typical cross section shown on sheet C-21 to sheet X-1 or any other X- sheet is a matter of a simple "cut and paste" operation. Besides, it is preferable to have all typical cross sections incorporated on the X- sheets rather than scattered on the project plans --you could easily miss quantifying the proposed work.

SUMMARY OF QUANTITIES SHEETS

Additional Comments

Sheet Q-1, "Roadway Summary" Table:

- Edit the "Subgrade Enhancement Geotextile" column heading to read "Subgrade Enhancement Geotextile Class B2". Refer to preceding comments.
- Edit the "Geosynthetic Pavement Interlayer" column heading to read "Geosynthetic Pavement Interlayer (Paving Mat)". Refer to preceding comments.
- There is a row labeled as "L-2 & L-7" with 174 CY of Class 3 AB and 246 TON of HMA (Type A) but without any information regarding "Station Limits" or "Location." Where are these materials going to be used/placed?

Refer to all of our comments/recommendations above and update respective quantities sheets accordingly.

III. SPECIAL PROVISIONS (dated November 28, 2011)

Comments to Consultant's Reponses (received via e-mail on February 7, 2012)

Items No. 17 and No. 68 (SSP 26-080 vs. SSP 26-030): You are right; Class 2 AB is required per SSP 73-100, "Miscellaneous Clauses for Textured Paving" but Para 6 takes you back to the Class 2 AB provisions already spelled out in the Standard Specifications. However, the Class 3 aggregate base grading and quality requirements shown on SSP 26-080 (that you want to use) are inconsistent with D4 practice and GD&MR recommendations. Therefore, you have two choices: 1) you either keep SSP 26-080 and edit the "Grading" and "Quality" tables under Para 6 to show the D4 requirements spelled out below (in which case this SSP will become a NSSP); or 2) you replace SSP 26-080 with SSP 26-030 and just fill out the empty "Grading" and "Quality" tables under Para 5 with data reflecting the D4 practice. For your information, in D4 the Class 3 AB shall conform to all of the provisions for Class 2 AB of the Standard Specifications except for the following grading change to the Percentage Passing the No. 200 sieve:

	1-1/2" Maximum		¾" Maximum	
Sieve Size	Operating Range	Contract Compliance	Operating Range	Contract Compliance
No. 200	2-11	0-14	2-11	0-14

Class 3 AB shall also conform to the following "Quality Requirements": Sand Equivalent Operating Range = 25 Min, Sand Equivalent Contract Compliance = 22 Min, R-value Contract Compliance = 78 Min (consistent with assumptions made by the pavement designer, refer to the GD&MR) and a Durability Index Contract Compliance = 35 Min.

Item No. 22, SSP 68-010, "Underdrains": Once again, incorporate version e-mailed to you on December 20, 2011 –in D4, for underdrains we prefer perforated plastic pipe of the corrugated polyvinyl chloride type with a smooth interior surface.

Additional Comments

- SSP S8-M81, Para 2: Reinstate it and specify that filter fabric for edge drains and underdrains shall be Class B --since according to the GD&MR (Page 26), the majority of the plasticity indexes are in the range of 15 to 20 and per Para's 2 leading instructions.
- SSP 26-080, "Aggregate Base": Either edit it to include D4 Class 3 AB requirements (in which case this SSP will become a NSSP) or replace it with SSP 26-030 including the aforementioned D4 requirements for Class 3 AB. Refer to comments above.
- SSP 39-050, "Hot Mix Asphalt": Para 16 - edit it to specify that the aggregate for HMA Type A must comply with the ½-inch grading for layer thickness less than 0.20 foot and with the ¾-inch grading for layer thickness 0.20 foot and above.
- SSP 39-400, "Hot Mix Asphalt Aggregate Lime Treatment – Slurry Method": Delete "OGFC" from Para 2 and delete Para 24 as our district does not treat aggregates for OGFC with lime.
- SSP 39-450, "Hot Mix Asphalt Aggregate Lime Treatment – Dry Lime Method": Delete "OGFC" from Para 2 and delete Para 20 as our district does not treat aggregates for OGFC with lime.

IV. ENGINEER'S ESTIMATE (dated November 28, 2011)

Additional Comments

- Replace Bid Item No. 198205 with Bid Item No. 198209, "Subgrade Enhancement Geotextile Class B2". Refer to our comment above to Sheet X-1.
- Replace Bid Item No. 393003 with Bid Item No. 393005, "Geosynthetic Pavement Interlayer (Paving Mat)". Refer to our comment above to Sheet X-1.
- **Refer to all of our comments/recommendations above and update Bid Items and quantities accordingly.**

If you have questions, please contact me at 622-1755 or Tinu Mishra at 286-4841.

C: Daily File, Project File

Attachment:
Contract 04-1G3104 -- Title Sheet and Typical Cross Sections sheet X-4.

ACIM-080-1(112)E

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	80	2.5/8.0	1	63

STATE OF CALIFORNIA

DEPARTMENT OF TRANSPORTATION

PROJECT PLANS FOR CONSTRUCTION ON

STATE HIGHWAY

IN ALAMEDA COUNTY

IN OAKLAND, EMERYVILLE, BERKELEY AND ALBANY

FROM PORT OF OAKLAND OVERCROSSING

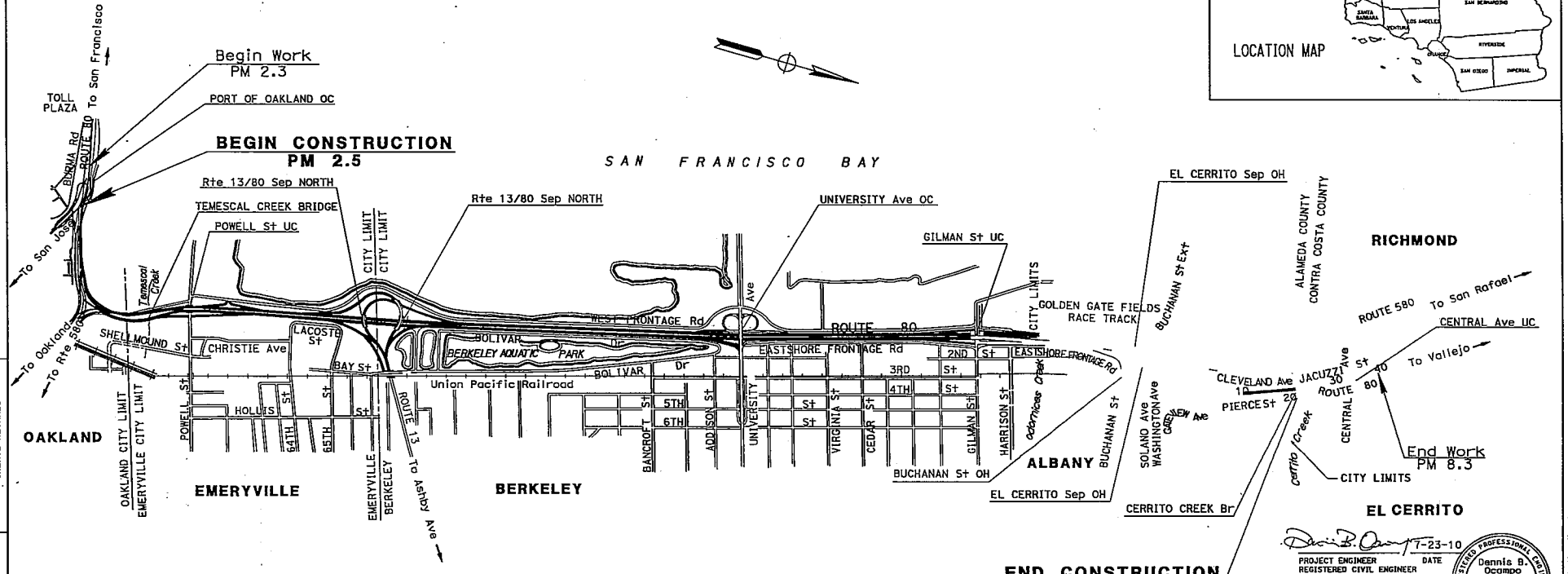
TO THE ALAMEDA/CONTRA COSTA COUNTY LINE

TO BE SUPPLEMENTED BY STANDARD PLANS DATED MAY 2006

INDEX OF PLANS

SHEET No.	DESCRIPTION
1	TITLE SHEET AND LOCATION MAP
2 - 7	TYPICAL CROSS SECTIONS
8 - 17	CONSTRUCTION DETAILS
18 - 32	CONSTRUCTION AREA SIGNS
33 - 44	PAVEMENT DELINEATION PLAN, DETAILS AND QUANTITIES
45 & 46	SUMMARY OF QUANTITIES
47 - 52	ELECTRICAL PLANS
53 - 63	REVISED AND NEW STANDARD PLANS

THE STANDARD PLANS LIST APPLICABLE TO THIS CONTRACT IS INCLUDED IN THE NOTICE TO BIDDERS AND SPECIAL PROVISIONS BOOK.



THE CONTRACTOR SHALL POSSESS THE CLASS (OR CLASSES) OF LICENSE AS SPECIFIED IN THE "NOTICE TO BIDDERS."

PROJECT MANAGER: CHERYL NEVARES

DESIGN ENGINEER: VINCE BONNER

7-23-10

PROJECT ENGINEER REGISTERED CIVIL ENGINEER — DATE

Dennis B. Ocampo, No. 53523, Exp. 6-30-11, CIVIL, REGISTERED PROFESSIONAL ENGINEER, STATE OF CALIFORNIA

July 27, 2010

PLANS APPROVAL DATE

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

CONTRACT No.	04-1G3104
PROJECT ID	0400020028

LAST REVISION 07-26-10 — DATE PLOTTED => 17-NOV-2010 — TIME PLOTTED => 08:16

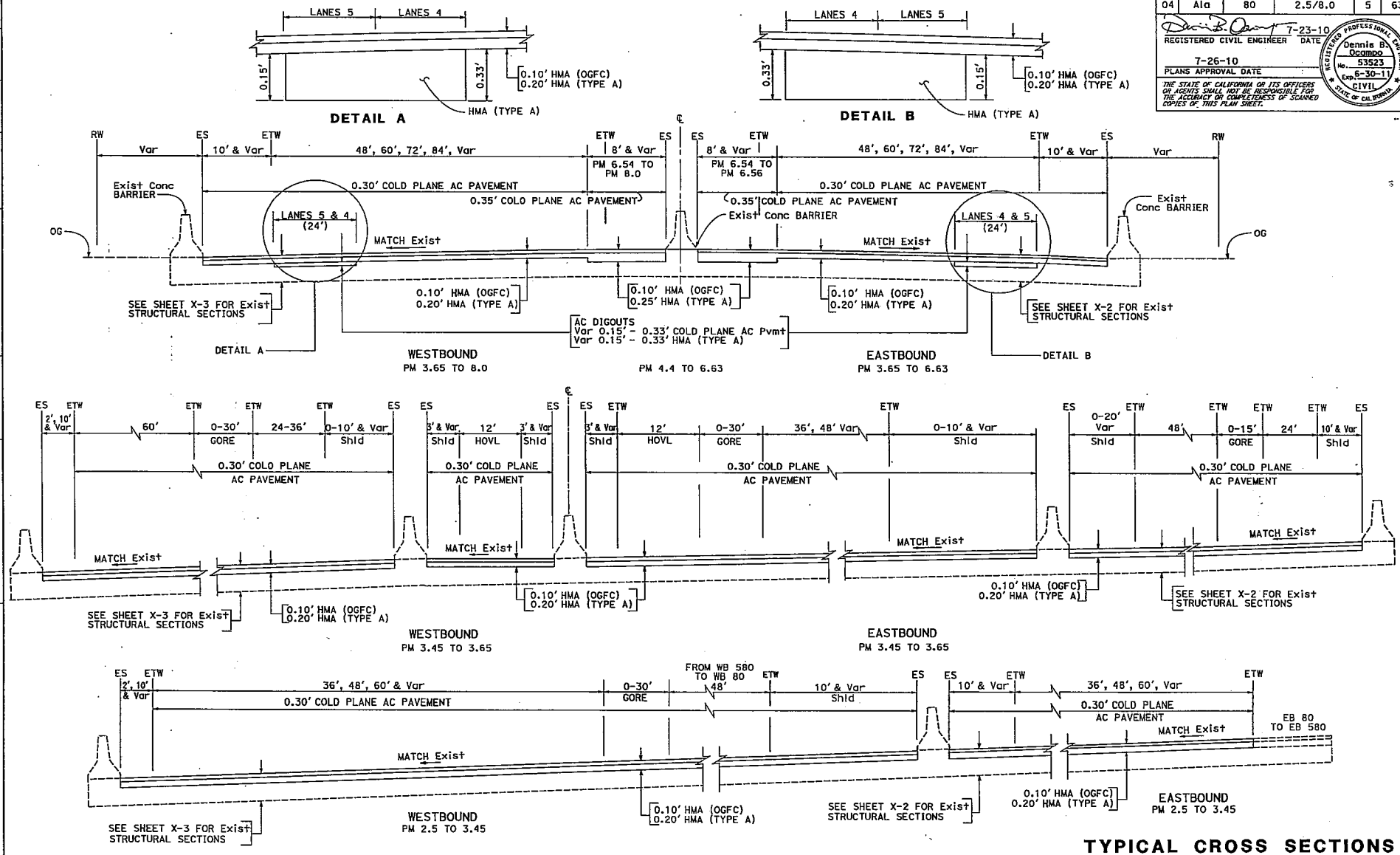
Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	80	2.5/8.0	5	63

REGISTERED CIVIL ENGINEER 7-23-10 DATE

7-26-10
PLANS APPROVAL DATE

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

REGISTERED PROFESSIONAL ENGINEER Dennis B. Ocampo No. 53523 Exp. 6-30-11 CIVIL STATE OF CALIFORNIA



TYPICAL CROSS SECTIONS

NO SCALE

FOR NOTES AND ABBREVIATIONS, SEE SHEET X-1

X-4

DO	7/12/10	DENNIS OCAMPO	JAY FONG
REVISED BY	DATE REVISED	CALCULATED-DESIGNED BY	CHECKED BY

FUNCTIONAL SUPERVISOR: VINCE BONNER

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans DESIGN

LAST REVISION 07-26-10 DATE PLOTTED => 17-NOV-2010 TIME PLOTTED => 08:17

BORDER LAST REVISED 4/11/2008 | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | USERNAME => s133721 DGN FILE => 41g310co004.dgn | CU 04271 | EA 1G3101

PROJECT COMMENT REVIEW AND RESPONSE MATRIX								
I-880 Southbound HOV Lane Extension from Marina				Final PS&E Submittal	!	Proposed Action	Incorporated	Agency Concurs
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12/5/2011	Luis Tacuri	1	**X-1**	Unless there have been changes I am not aware of, this project is supposed to maintain the existing mainline profile (at least that can be inferred from new structural No. 3 described on updated sheet X-1). If you are going to maintain the existing mainline profile, then: What is the reason for the "Typical Transverse Conform Detail (Route 880)" included in sheet C-22 where apparently the new section No. 3 is depicted as an overlay --which means raising the mainline profile? Implementing a mainline overlay would imply reconstructing the existing median concrete barrier to remain in place (since at some locations said barrier seem to have already a substandard height).	Agreed, The referenced detail has already been deleted in the final Plans, dated 11/28/11	A		
12/6/2011	Luis Tacuri	2	\	New pavement structural sections adjacent to existing mainline RAC-G: To avoid a "bath tub section" that traps water beneath the surface of the existing traveled way, extend the existing RAC-G (now known as RHMA-G) under the new widenings. The new RHMA-G thickness and depth measured from the ultimate FG must match those of the existing. Adjust thicknesses of HMA-A to incorporate the RHMA-G layer.	Agreed, the new pavement section for mainline widening includes RHMA-G. This revisions has already been addressed in the final plans submitted to CT HQ.	A		
12/6/2011	Luis Tacuri	3	X-1	New pavement structural sections adjacent to existing mainline ATPB: The new ATPB thickness and depth measured from the ultimate FG must match those of the existing.	Agreed, confirmed the new ATPB thickness and depth measured from the ultimate FG must matches those of the existing.	A		
12/6/2011	Luis Tacuri	4	X-1	New pavement structural sections with OGFC as a top layer: To be consistent with the standard BEES item triggered by SSP 39-100, "Hot Mix asphalt Open Graded Friction Course," rename all occurrences of the proposed OGFC" to read "HMA (OG)."	Complied, This revisions has already been addressed in the final plans submitted to CT HQ.	A		
12/6/2011	Luis Tacuri	5	X-1	"Legend and Abbreviations" block: Delete abbreviation OGFC and its description. Include the abbreviation HMA (OG) and its description. Include the abbreviation RHMA-G and its description.	Complied, This revisions has already been addressed in the final plans submitted to CT HQ.	A		
12/6/2011	Luis Tacuri	6	X-1	"Notes" block: Edit Note No. 9 so the instructions given here clearly identify which layer(s) of the revised mainline structural sections [HMA (OG) / RHMA-G / HMA-A ...] need to be extended under the new dikes and barriers (on which layer they are supposed to seat).	Complied, This revisions has already been addressed in the final plans submitted to CT HQ.	A		
12/6/2011	Luis Tacuri	7	X-1	"Notes" block: Consider adding a note to direct the contractor/reviewer where to look for locations of proposed underdrains. A Note similar to Note No. 8.	Will do, will add the suggested note after CT HQ submittal	A		

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12/30/2011	Luis Tacuri	8	X-1	New structural section No. 4 (shown to be used in some of the ramps): It is not consistent with any of the Flexible Options shown on Table 9 of the GD&MR dated October 26, 2011. Explain.	The new pavement section No. 4 is mainly used on local street. Where the new Section No. 4 is shown for the ramp pavement section, the area of the ramp is near the intersection with the local street, where the local street pavement section (pavement section No. 4) extended along the ramp and ends at the end of curb return. Therefore, the pavement section as shown is correct and no changes will be made.	C		
				New structural section No. 6 and No. 12 (shown to be used in some of the ramps): The recommended SEG is missing (refer to Flexible Option 1 shown on Table 9 of the GD&MR dated October 26, 2011). Explain.	The SEG is recommended for use only on the mainline and the ramp gore area, it is not intended to extend the SEG beyond the ramp gore area. The Table 9 on GD&MR will be updated to reflect that.	A		
				New structural section No. 7 and No. 14 (shown to be used in some of the ramps): The additional Class 3 Permeable Material (Blanket) is missing as a component of Flexible Option 1 --and where it will be applicable-- included in Table 9 of the GD&MR dated October 26,	Agreed, the GD&MR will be updated to include use of Class 3 Permeable Material (Blanket), where underdarin system is placed.			
	Luis Tacuri	9	X-1	New structural section No. 9: Per subsection 39-1.09D, "GPI," of the latest Amendments to the 2006 Std. Specs, the minimum HMA thickness over the interlayer (GPI) must be 0.12'. Adjust the Min. thickness of the proposed HMA (Leveling) for compliance.	The section of 39-1.09D, "GPI," of the latest Amendment requires a minimum thickness of 0.12' HMA over the interlayer (GPI), without differentiating between HMA (Type A) versus HMA (OG). We believe the specified minimum HMA requirements is to have a minimum cover of 0.12' over GPI and since the combination of 0.1' HMA and 0.1' HMA (OG) exceeds the 0.12'. therefore, the current design meet the minimum requirements.	A		
				Also, per this structural section description, whereas you are cold planning 0.10' only, you are placing back 0.10' to 0.30' of HMA (Leveling) followed by 0.10' of OGFC; this means that you are raising the mainline profile at the locations where section No. 9 will be placed. Is this correct? If it is, you will need a paving conform detail (no such a detail is included in any of the C- sheets). If am not wrong, in one of your replies to my e-mails you said that the mainline profile would not be raised.	The new section 9 is intended for use in the mainline area to fill the existing pavement depression under the existing freeway bridge, which will not raise the mainline profile.	C		
	Luis Tacuri	10	X-1	New structural section No. 10 and No. 11 (shown to be used on mainline median under new structures): It is not consistent with any of the Flexible Options shown in Table 8 of the GD&MR dated October 26, 2011. Explain.	GD&MR will be updated to cover the new sections 10 and 11	A		
				New structural section No. 13: Per its structural section description, whereas you are cold planning 0.10' only, you are placing back 0.10' to 0.30' of HMA-A; this means that you are raising the profile at the locations where section No. 13 will be placed. Is this correct? If it is, you will need a paving conform detail (no such a detail is included in any of the C- sheets).	The new section 13 is used on approaches to new overcrossing, where the new overcrossing profile is higher than the existing. the proposed section is used near the conform limit, where the elevation difference between the existing pavement and new pavement is within 0' to 0.30'. In order to avoid replacing the existing pavement, which would require lane/road closure for an extended period of time, the existing pavement will be overlaid to match the new grade.	C		

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	Luis Tacuri	11	X-1	New structural section No. 10 and No. 11 (shown to be used on mainline median under new structures): It is not consistent with any of the Flexible Options shown in Table 8 of the GD&MR dated October 26, 2011. Explain.	GD&MR will be updated to cover the new sections 10 and 11	A		
				New structural section No. 13: Per its structural section description, whereas you are cold planning 0.10' only, you are placing back 0.10' to 0.30' of HMA-A; this means that you are raising the profile at the locations where section No. 13 will be placed. Is this correct? If it is, you will need a paving conform detail (no such a detail is included in any of the C- sheets).	The new section 13 is used on approaches to new overcrossing, where the new overcrossing profile is higher than the existing. the proposed section is used near the conform limit, where the elevation difference between the existing pavement and new pavement is within 0' to 0.30'. In order to avoid replacing the existing pavement, which would require lane/road closure for an extended period of time, the existing pavement will be overlaid to match the new grade.	A		
12/31/2011	Luis Tacuri	12	X-1	New structural section No. 9: Per HDM Index 631.5, a GPI (also called SAMI-F) cannot be placed directly on a cold planed surface and a layer of HMA shall be used prior to the placement of the fabric; therefore, revise this structural section for compliance. Also, refer to comments e-mailed earlier today regarding the minimum HMA thickness over the GPI.	Will place GPI between layers of HMA (leveling)	A		
12/6/2011	Luis Tacuri	13	Other Project Plans	Update all applicable typical cross sections, construction details, drainage details, quantity sheets, etc. to reflect implementation of above changes.	Will comply	A		
12/6/2011	Luis Tacuri	14	Special Provisions	SSP 39-100, "Hot Mix Asphalt Open Graded Friction Course": Edit Para 9 to specify that the grade of the asphalt binder to be mixed with aggregate for HMA (OG) must be "PG 58-34 PM" instead of the proposed "PG 64-10." Strikethrough Para 11. Incorporate SSP for RHMA-G and all other specs triggered by it.	Complied	A		
12/7/2011	Luis Tacuri	15	Typical Sections (with Gutter Pans)	Per HDM Index 404.4 and Index 613.5(2)(c), when the tracking width lines encroach onto any portion of a gutter pan, the gutter pan must be engineered to match the adjacent shoulder pavement structure. Are the proposed structural sections under the gutter pans structurally adequate for said encroachment? Update typicals and quantities accordingly.	Based on the geometric layout of the project (i.e., at the curb returns), tire tracking is not expected to encroach into the gutter pan. However as a precautionary measure, the entire thickness of the AB layer proposed under the TW/shoulder will be extended beneath the gutter pan.	A		
12/7/2011	Luis Tacuri	16	Side Gutters	It seems that you might need a side gutter along the right ES (toe of proposed cut slope) of the SB Off-ramp to Davis St ("DL3" 76+90 to 79+20.18) shown on top portion of sheet X-12. Likewise, even though on the D- and DQ- sheets you do propose side gutters at 3 locations at least, they are not shown on any of the typicals (X-sheets). Verify that, within the limits of this project, ALL side gutters you might need at cut slopes are shown on the plans and accounted for. Update typicals and quantities accordingly.	As noted under general notes on sheet X-1, for the gutters and ditches, the Contractor should refer to the drainage plans. I prefer to see the roadway typical cross section use mainly for the purpose of showing structural elements of the roadway and not cover every items of work.	A		
12/20/2011	Luis Tacuri	17	SSP 26-080	**"Aggregate Base": According to the project plans only Class 3 AB will be used; therefore, replace this spec with SSP 26-030, "Aggregate Base."**	According to the Standard SSP 73-100, the class of aggregate base under minor concrete textured paving should be class 2. Therefore, the use of SSP 26-080 in the current special provisions is appropriate since both class 2 and 3 used in this project.	C		
12/20/2011	Luis Tacuri	18	SSP 39-100	HMA (OGFC): See comments e-mailed to you on 12/06/2011.	Noted	A		

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12/20/2011	Luis Tacuri	19	SSP 39-150	RHMA-G: Since RHMA-G is also going to be used in this project, incorporate this spec and any others triggered by it.	Complied	A		
12/20/2011	Luis Tacuri	20	SSP39-400	HMA Aggregate Lime Treatment - Slurry Method: Since RHMA-G is also going to be used in this project and if its estimated quantity is at least 10,000 tons, include RHMA-G in the list in Para 2.	Since the estimated quantity of RHMA is less than 10,000 tons, RHMA-G will not be listed under Para 2 of SSP 39-400	C		
12/20/2011	Luis Tacuri	21	SSP 39-450	HMA Aggregate Lime Treatment - Dry Lime Method: Since RHMA-G is also going to be used in this project and if its estimated quantity is at least 10,000 tons, include RHMA-G in the list in Para 2.	Since the estimated quantity of RHMA is less than 10,000 tons, RHMA-G will not be listed under Para 2 of SSP 39-400	C		
12/20/2011	Luis Tacuri	22	SSP 68-010	"Underdrains": Missing. Incorporate attached version.	The requirements for "Underdrain" is covered by the Standard Specifications.	C		
12/20/2011	Luis Tacuri	23	SSP 68-230	"Permeable Material": Restore it. This spec is supposed to be used to specify the gradation requirements of the required Class 3 Permeable Material. Keep in mind that when used to backfill underdrain trenches, compensation for the PM is already included in the contract price paid per linear foot for pipe underdrains --per Section 68-1.05 of the Standard Specifications. On the other hand, per SSP 68-250, the permeable material (blanket) is a separate contract item. Edit the "Grading Requirements" table under Para 2 of SSP 68-230 as shown below. Sieve Size Percentage Passing 1-1 1/2" 100 1' 90-100 3/4' 40-100 3/8" 0- 50 No. 4 0-15 No. 8 0- 5 Update typical cross section with underdrains (sheet X-9, etc.) to show the limits of the Class 3 PM and the Class 3 PM (Blanket)	Will comply	A		
12/20/2011	Luis Tacuri	24	SSP 83-025	"Vegetation Control (Minor Concrete)": Delete Para 23 –it does not apply to our District. Per Standard Plans, the thickness of the Minor Concrete and Grout to be placed underneath the MBGRs is supposed to be 3 inches.	Will comply	A		
12/20/2011	Luis Tacuri	25	General	In general, incorporate all other SSPs triggered by a specific SSP or NSSP.	Noted	A		
12/28/2011	Luis Tacuri	26	X-1	"Notes" block: Add a note to direct the contractor to look at sheets G-10 thru G-12 for typical cross sections depicting the proposed fill areas available to deposit the existing ADL Type Y-1 material being excavated.	Will do	A		
12/28/2011	Luis Tacuri	27	X-1	"Notes" block: Add a note to direct the contractor to look at sheet DE-1 for "Temporary Pavement Structure Section" and sheets DE-18 thru DE-26 for "Temporary Typical Cross Sections." Consider renaming Sheets DE-18 thru DE-26 to identify them as "Temporary Typical Cross Sections" instead of just "Typical Cross Sections."	Disagree, it is not a common practice to reference the temporary construction work on 'X" sheet	C		
12/28/2011	Luis Tacuri	28	X-1	All existing PCC layers: Be more specific (are they already cracked and seated? OR uncracked and unseated?) --refer to as-built plans.	Will do, if is specified on the as-built plans	A		

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12/28/2011	Luis Tacuri	29	X-4, X-5	Extend the lateral limits of the NEW mainline structural sections No. 1, 5, and 2 to the lateral limits of the EXISTING pavement structural section No. 1 --so that no slivers of existing sections No. 3, 13, or 2 are to remain in place (that is, adjust the proposed lateral position of the sawcut line to the right of what is shown).	Moving the sawcut line laterally to close the gap in existing pavement section will not be feasible due to stage construction and traffic handling issues. As the current design stands, some of the lanes will have to be narrowed under 11' to avoid closing the freeway traffic lanes for extended period of time. moving the sawcut line as suggested by the comment will require closing one or two lanes of the mainline during construction	C		
12/28/2011	Luis Tacuri	30	C-21	"SB I-880 Pavement Overlay" typical cross section: Consider renaming it to read "SB I-880 Cold Plane and Pavement Overlay" --to be consistent with Note No. 10 on sheet X-1. Replace all occurrences of OGFC with HMA (OG). In my opinion, this typical cross section is misplaced; consider moving it to the middle portion of the X-1 sheet	Complied, change in the detail name description included in the Final plans submitted to CT HQ. Prefer to keep the plans as shown, Note 11on sheet X-1 refers to sheet C-21	A C		
12/30/2011	Luis Tacuri	31	C-25	Be specific regarding the proposed "Granular Mtl" to be placed under the Minor Conc Caps. Is AS or AB and what class? If any of these, where are their quantities? They are not shown on any of the Q- sheets.	the requirements for Granular Mtl behind the Concrete barrier is covered in the section 83 of the Standard Specifications. as specified in the SSPs 83-450, full compensation for furnishing and placing granular material is included in the contract price paid per linear foot for the concrete barrier	C		
12/28/2011	Luis Tacuri	32	C-27	"Typical Maintenance Vehicle Pullout (MVP)" plan and section C-C: As a minimum, extend the proposed Class 3 AB at least 2 feet behind the back of the MVP --refer to CT Std Plan H9.	Will do	A		
12/28/2011	Luis Tacuri	33	C-28	Section A-A of "Extended Gore Paving": Change proposed Class 2 AB to Class 3 AB --since you don't have a Class 2 AB in the Q-sheets.	See previous response to the similar comment on the specs , per standard SSP 73-100, the price paid per square foot for minor concrete (textured paving) include full compensation for aggregate base class 2)	C		
12/28/2011	Luis Tacuri	34	G-10 thru G-12	Add a note to direct the contractor to look at the X-sheets for the "Pvmt Structural Section." Is the proposed "2' Min Clean Soil Cover (Typ)" being placed on the fill side slopes the same material as Imported Borrow? If so, rename it accordingly --"2' Min Imported Borrow Cover (Typ)"? If not, include a separate item in the Q- sheets.	Do not see any benefit of adding the suggested loop reference note. The Contractor is expected to look at the entire plans the 2' clean soil (non ADL soil) could comes from native excavation or imported borrow. This is not a separate pay item	C C		
12/31/2011	Luis Tacuri	35	G-10 thru G-12	It seems there is an inconsistency between what is shown on the typicals on these sheets and what is stated in SSP 19-900, "Materials Containing Hazardous Waste Concentrations of ADL." Whereas on said sheets a "2' Min Clean Soil Cover (Typ)" is shown, in the edits to Para 2 of the spec a "minimum 1-foot layer" cover is specified. See also comments e-mailed to you on December 28, 2011.	Agreed, will edit the SSP 19-900, Para 2, to require a minimum of 2' clean soil	A		
11/21/2011	Luis Tacuri	36	DD-2	Sheet DD-2, "Minor Concrete Backfill" detail: Extend out the proposed 6-inch thick slab and its reinforcement --shown on top of the APC-- at least 12 inches on each side of the trench (one-foot-wide reinforced concrete wings similar to what is shown for the "Roadway Trench Backfill" detail on sheet DD-5).	Complied, change in the detail included in the Final plans submitted to CT HQ.	A		
11/21/2011	Luis Tacuri	37	DD-5	Specify that the minimum thickness of the proposed Class 3 AB layer must be 12 inches. Specify the drainage systems and units where this detail must be implemented.	Complied, change in the detail included in the Final plans submitted to CT HQ.	A		

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12/28/2011	Luis Tacuri	38	DD-5	"Double 18" & 24" Pipes Trench Backfill" detail: Extend out the proposed 6-inch thick slab and its reinforcement --shown on top of the pipes-- at least 12 inches on each side of the trench (one-foot-wide reinforced concrete wings similar to what is shown for the "Roadway Trench Backfill" detail on the same sheet).	Will do	A		
12/28/2011	Luis Tacuri	39	TDD-2	"Roadway Trench Backfill" detail: Be consistent. Instead of "Varies", the minimum thickness of Class 3 AB should be 12" (as shown on sheet DD-5).	Complied, change in the detail included in the Final plans submitted to CT HQ.	A		
12/28/2011	Luis Tacuri	40	SSD-2	"Trench Detail on City Street": Extend out the proposed 6-inch thick slab --shown on top of the Class 3 AB-- at least 12 inches on each side of the trench (one-foot-wide concrete wings similar to what is shown for the "Roadway Trench Backfill" detail on sheet DD-5). Specify the Sanitary Sewer System(s) and Unit(s) where this detail would apply.	Will do	A		
12/30/2011	Luis Tacuri	41	DE-1	Temporary pavement structure of 1.30' HMA-A is not consistent with any of the recommendations in the GD&MR dated October 26, 2011 --refer to bottom of Page 28 of the report. Explain.	Revised thickness of temporary pavement (HMA-A) to 1.10' to match with GD&MR. this change included in the Final plans submitted to CT HQ.	A		
12/30/2011	Luis Tacuri	42	DEQ-1	"Temporary Pavement" table: Are the quantities of the proposed Temp 0.33' HMA sidewalks included in the quantities shown for HMA-A? If yes, disclose them. If not, you need to include them. In the table, consider categorizing the Temp HMA-A (e.g. one column for Detour Pvmt Structure and another one for Sidewalk`	The temporary HMA sidewalk is quantified as "Place HMA Miscellaneous Area" as shown on sheet DEQ-2,	C		
12/28/2011	Luis Tacuri	43	DE-18 thru DE-26	Consider renaming them to identify them as "Temporary Typical Cross Sections" instead of just "Typical Cross Sections." Temp HMA sidewalks and Temp pavement structure No. 1 constructed in CUT sections: There is no mention about the permanent backfill material to be placed and its finished grade after these Temp facilities are removed. Temp HMA sidewalks and Temp pavement structure No. 1 constructed in FILL sections: There is no mention about what is going to happen with the Temp embankments after these Temp facilities are removed. Will the Temp embankments be removed to place permanent embankments? Will the Temp embankments became permanent? Likewise, there is no mention about the permanent backfill material to be placed and its finished grade after these Temp facilities are removed. All typical cross sections: Consider showing the ultimate/permanent side slope lines (especially at those locations where the proposed Temp side slopes will overlap with the ultimate side slopes). Clearly identify the Temp and the ultimate/ permanent embankments.	The current plans shows clearly that these typical cross sections are related to the detour plan. First of all there is no distinguish between the permanent backfill and temporary backfill as the comment implied. Placement of embankment whether is for temporary use or permanent shall be in accordance with the Standard Specifications. Secondly, it is obvious that the final grading of the project shall follow the contract grading plans. Furthermore, your suggested idea of temporary embankment as the comment implied will require a NSSP, which is much preferable to avoid.	C		

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				Missing: Trench Backfill detail on city street --for those portions of the proposed 10" PVC overflow to be installed under Davis St --refer to sheet SS-3. See also comments sent in a previous e-mail to provide the additional 1-foot extensions in all of the proposed trench backfill details. See also comment below regarding staging.	The detail for Trench Backfill detail on the city street applies only to a single 10" PVC overflow sewer pipe location.			
12/28/2011	Luis Tacuri	45	DEQ-1	Based on the information provided on sheet DE-1, the only Temp pavement structure is No. 1 and its only component is 1.30' of HMA-A, that is, the proposed Temp section is a full-depth HMA-A section without a "BASE"; shouldn't then the "Remove Base and Surfacing (Detour)" table be renamed to be consistent with the material to be removed (1.30' HMA-A)? You also need to check with the DOE regarding compensation for removal of this Temp pavement structure. Is this going to be a separate pay item or its compensation is assumed to be included in the unit price of the Temp HMA?	Since the district OE has already reviewed and concurred with the current plans and all the NSSPs for the project have already been approved, we prefer to keep the removal of temporary detour surface as a remove base and surfacing as shown. Quantifying the temporary pavement as something other than remove base and surfacing, requires a NSSP approval, which may not be appropriate at this late stage of PS&E process. This contract is expected to be in RTL by 3/1/12.			
12/30/2011	Luis Tacuri	46	UD_2, 3	Missing: Cover backfill details for all locations where trenching is proposed in PAVED areas (refer to U- sheets for locations). The details shown on these UD- sheets could be applicable for trench backfilling within UNPAVED areas only. Special details might be needed for all of those locations where two parallel trenches are required (6-foot apart) within PAVED areas. Revise trench details accordingly. Submit them for our review.	all the utility trench work falls within the area of new pavement construction. The trench will be placed prior to placing pavement surface.	C		
12/30/2011	Luis Tacuri	47	SC and TH	Unless I overlooked at the plans or their notes, I couldn't find how you are planning to stage the installation -- especially across the freeway-- of the new storm drainage pipes, sanitary sewer pipes, and other new underground utilities which will require trench excavation and backfilling. Incorporate details or notes to clarify how these work activities will be carried out/staged.	The sequence of installation of the major storm drain pipes and joint trench for utilities installation are shown on stage construction plans (SC sheets). The only facility that will cross under the freeway is a 48" storm drain pipe, which will be installed by a jack and bore operation. The other utilities that cross the freeway will be installed through the bridge structure.	C		
12/28/2011	Luis Tacuri	48	Q-1	"Roadway Summary" table, Temp pavement quantity: Lumping the Temp HMA-A quantity of 24,254 tons with the rest of permanent HMA-A (37,128 tons) implies that the Temp HMA-A will be subjected to comply with the same specifications for permanent HMA-A. Is this correct? If not, it seems that you will need a separate pay item (probably one including all related activities such as excavation, materials, removal, backfill, etc.) and maybe a specific SSP . Contact the DOE and follow its instructions.	Temp HMA-A will be subjected to comply with the same specifications as for permanent HMA-A. therefore, there is no need for a separate pay item for temporary pavement.	C		
				"Roadway Summary" table: Don't you need "Prime Coat" the Temp grading plane prior to start placing the Temp 1.30' full-depth HMA-A? If so, include a column for the "Prime Coat" pay item.	Our understanding is that a 'Tack Coat" will be more appropriate for this application	C		

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I-880 Southbound HOV Lane Extension from Marina				Final PS&E Submittal	!			
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04-3A9211					C – No Action Required			
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12/30/2011	Luis Tacuri	49	Q-1	"Roadway Summary" table, "Tack Coat" column: Explain how come no tack coat is required for the temporary pavement (that is, to place 24,254 tons of Temp HMA-A).	Will adjust the quantity of tack coat for use with temporary pavement	A		
				"Roadway Summary" table: Aren't you missing quantities for "Prime Coat"-related pay items? See also comments submitted to you via e-mail on December 28, 2011. "Roadway Summary" table: Aren't you missing quantities for RHMA-G pay item? See also comments submitted to you via e-mails in previous weeks	See above response	C		
12/31/2011	Luis Tacuri	50	Q-1	"Roadway Summary" table: Tack coat quantity for "HMA (Miscellaneous Areas)" is missing --refer to comment below to SSP 39-250. Aren't you also missing tack coat quantities for placement of HMA dikes, and vertical surfaces of curbs, gutters, construction joints, etc.? --refer to Amendments to the 2006 Standard Specifications.	Will adjust the quantity of tack coat	A		
12/28/2011	Luis Tacuri	51	Q-2	"Earthwork Summary" table, Detour quantity of Remove Base and Surfacing: Lumping the detours' Temp quantity of 11,977 CY with the rest of Remove Base and Surfacing (3,532 CY) implies that it will be subjected to comply with the same specifications for permanent Remove Base and Surfacing. Is this correct? If not, it seems that you will need a separate pay item (probably one including all related activities such as removal, backfill, etc.) and maybe a specific SSP. See also comment above to Sheet DEQ-1. Contact the DOE and follow its instructions.	Remove base and surfacing of the temporary pavement will be subject to the same specifications for permanent remove base and surfacing.	C		
				"Earthwork Summary" table, Imported Borrow quantity You have arrived to the calculated quantity of 49,740 CY assuming that all of the estimated 15,509 CY of "Remove Base and Surfacing" will be reused in the embankments. Is this correct? Keep in mind that 11,977 CY of what has been categorized as "Remove Base and Surfacing" come from the detour pavement structures which are made up of full-depth of HMA-A only (1.30'). So, are you proposing to place said Temp HMA-A as permanent embankment material and to be compliant with the permanent embankment specifications? If not, the estimated quantity of Imported Borrow is short by the equivalent to the 1.30' FDHMA-A. See also other detour-related comments above.	It is intended to use the base and surfacing material that generate rom removal of the temporary pavement in the roadway embankment as shown on the plans.	C		
12/30/2011	Luis Tacuri	52	Q-2	"Earthwork Summary" table: Since the GD&MR dated October 26, 2011, does not address if the existing AC or new Temp HMA (Temp detours) are "acceptable" materials from excavations to construct the required embankments (as it has apparently been assumed to come up with the required quantity of Imported Borrow shown on this table), contact the Geotechnical Consultant, adjust quantities accordingly and incorporate any additional language in the specs (if any is required). By "acceptable" materials we mean if they will comply with all specs (special and standard) required to be placed in the proposed permanent embankments. See also comments submitted to you via e-mail on December 28, 2011	Will coordinate with the geotech engineer to address the reuse of excavated AC in the new embankment	A		
12/31/2011	Luis Tacuri	53	Q-2	Earthwork Summary" table: Is any existing AC or PCC material included in the "Roadway Excavation" quantities? If so, are they "acceptable" materials to be reused in the embankments as it is proposed? See also other embankment-related comments e-mailed to you previously.	Removal of PCC is not part of the roadway excavation. Use of any other excavated material as long as it satisfy the requirements of the standard specifications is considered as acceptable for use in embankment	C		

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12/31/2011	Luis Tacuri	54		Please make sure that the project plans for both projects are compliant with the above-referenced document (Division of Construction CPD 11-1, memo dated April 5, 2011). For EA 3A9211, it seems that these requirements are applicable at the following temporary pedestrian facilities - HMA sidewalks shown on sheets DE-18 thru DE-26 - HMA curb ramps shown on sheets DE-27 thru D-29	Noted, the project is in compliance with the referenced document	A		
12/31/2011	Luis Tacuri	55	SSPs	Is there no need for any SSP or NSSP for the Temporary Hot Mix Asphalt (Type A) proposed to construct the temporary detours and temporary sidewalks? Contact the DOE and follow its instructions. SSP 12-150: Explain why you have deleted it. Based on the Detour plans, pedestrian traffic will be allowed through construction areas (if not, what is the reason for all of the proposed temp sidewalks and curb ramps shown on some of the DE- sheets.	The construction of the temporary roadway will conform to the standard specifications and standard special provisions. The DOE has reviewed and concurred with the current plans and specifications. The temporary pedestrian facilities are shown on the plans and being paid for by the quantity of HMA involved. It seems that the SSP 12-150 is for the situation where the temporary pedestrian facilities will not be paid for separately. The DOE agreed with deleting the SSP 12-150	C		
12/31/2011	Luis Tacuri	56	SSPs	SSP 15-640, "Remove Base and Surfacing": Per its lead instructions, this SSP is applicable when removed "base and surfacing" are not to be replaced with structural section material. Based on the quantity in the "Preliminary Schedule of Prices and Quantities," --which reflects the quantity shown on sheet Q-2--, first, the proposed Temp Pavement Structure which consists of 1.30' HMA-A does not have any "base" layer; and second, this is just a Temp Surfacing, and its compensation for removal could already be included in the unit price of the Temp HMA. Contact the DOE and follow its instructions. Reedit the spec accordingly. Avoid duplicate payments. See also comments e-mailed to you previously.	As responded to the similar comments above, the construction and removal of the temporary pavement will follow the same standards as for the construction of the permanent pavement and removal of the existing pavement. Furthermore, there is no provisions in the Specs that indicates that the cost of removal of the temporary pavement is included in the price paid for construction of temporary pavement. Therefore, there is no duplicate payment. The DOE has reviewed and concurred with the current PS&E	C		
12/31/2011	Luis Tacuri	57	SSPs	SSP 19-090, Item D: Explain how did you arrive to the quantity of 3,000 CY (anticipated effect of subsidence) to be added to the imported borrow for payment.	Assumed area under bridge approach embankment (300' long and 200' wide) sink maximum of 4": 300' x 200' x 4/12= 20000 cubic feet = 740 CY for 4 approaches: 740 CY x 4= 2962 CY, say 3000 CY	A		
12/31/2011	Luis Tacuri	58	SSPs	SSP 19-900, "Materials Containing Hazardous Waste Concentrations of ADL": Whereas on typicals on sheets G-10 thru G-12 is shown a "2' Min Clean Soil Cover (Typ)", in the edits to Para 2 of this spec a "minimum 1-foot layer" cover is specified. Explain.	Revised SSP 19-900 to match with the plans	A		
12/31/2011	Luis Tacuri	59	SSPs	SSP 25-020, "Aggregate Subbase", Para 5 tables: "Grading" and "Quality" requirements are different from those in the GD&MR dated October 26, 2011. I will get back to you next week on this to determine which ones are correct.	Will revise aggregate subbase grading requirements to match with GD&MR	A		
12/31/2011	Luis Tacuri	60	SSPs	SSP 39-250, "HMA (Miscellaneous Areas)": Since you have deleted Para 6, you need to add the tack coat quantity for this work to the tack coat quantities shown on sheet Q-1.	Will do	A		
12/31/2011	Luis Tacuri	61	SSPs	SSP 39-550, "Prime Coat": Restore it. This spec is needed when placing the first lift of HMA on aggregate base or subbase --which is the case of the proposed flexible section for the city streets, Temporary HMA detours, temporary HMA sidewalks, etc.	Will do	A		

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12/31/2011	Luis Tacuri	62	SSPs	SSP 83-025, "Vegetation Control (Minor Concrete)": According to the quantities shown on sheet Q-2, there is no surplus material in this project, therefore, what is the reason to keep Para 19 of this spec? Likewise, you are not using SSP 07-330 on this project (you are using SSP S5-740 and SSP 19-900 instead), therefore, what is the reason to keep Para 20 of this spec? See also comments e-mailed to you on December 20, 2011.	Deleted paras 19. and 20	A		
1/4/2012	Luis Tacuri	63	SSPs	All specs in pages 319 thru 396 of the Special Provisions document submitted for our review are not included in the SSP's table of contents (that is, under Section 10-1___).	Those sections on page 319 thru 396 are considered as subsections under Existing Highway Facilities, which they have left out intentionally from table of contents .	C		
1/4/2012	Luis Tacuri	64	SSPs	Section 10-4.02, Page 879, Paras 7 thru 12, "Abandon Sanitary Sewer Pipe": Is the language in these Paras supplemental to what is already stated in NSSP 15-080, "Abandon Culvert and Sewer Pipe" (page 331)? If they are, why not including them and their respective Ce NSSP? Contact Hydraulics Office regarding this and proceed accordingly.	Yes, the language on page 879 is supplemental to what is already stated in NSSP 15-080. SSP 15-080 applies to both drainage and sanitary sewer.	C		
1/4/2012	Luis Tacuri	65	SSPs	Section 10-4.02, Page 879, Paras 13 thru 15, "Abandon Sanitary Sewer Manhole": Is the language in these Paras supplemental to what is already stated in SSP 15-060, "Abandon Manhole" (page 330)? If they are, why not including them and their respective measurement and payment clauses in the SSP? Contact Hydraulics Office regarding this and proceed accordingly..	Yes, the language on page 879 is supplemental to what is already stated in NSSP 15-060.	A		
1/4/2012	Luis Tacuri	66	SSPs	Section 10-4.02, Page 880, Paras 16 thru 21, "Adjust Manhole": Is the language in these Paras supplemental to what is already stated in NSSP 15-540, "Adjust Manhole" (page 374)? If they are, why not including them and their respective measurement and payment clauses in the NSSP? Contact Hydraulics Office regarding this and proceed accordingly.	Deleted the modified SSP 15-540 (on page 374), since provisions for sewer manhole adjustment is covered under section 10-4, "Sanitary Sewer Facilities".	A		
1/4/2012	Luis Tacuri	67		SSP 25-020, "Aggregate Subbase": Revise the "Gradation Requirements" for Class 4. See the GD&MR (dated October 26, 2011 (Rev)) for correct "gradation". Your "quality" requirements are OK. Also, restore Paras 10 and 11. Fill in the blanks in Para 10 to specify that Class 1 AS can be placed instead of Class 4 AS.	Will change the AS gradation to match with information in the latest GD&MR and reinstate para 10 and 11	A		
1/4/2012	Luis Tacuri	68	SSPs	SSP 26-080, "Aggregate Base": Incorporate it (refer to our e-mail dated December 20, 2011). See the GD&MR (dated October 26, 2011 (Rev)) for correct gradation and quality requirements. Again, delete SSP 26-080 since you are only going to use Class 3 AB in this project.	Both Class 2 and 3 needed for this project. Per standard SSP 73-100, aggregate base class 2 will be used with minor concrete textured paving	C		

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1/4/2012	Luis Tacuri	69	GD&MR	Table 7, "Station & Offset" column: Are the referenced station lines ("I-880" and "DA1") the same as those shown in the project plans? If so, be consistent: Use as reference/station lines those shown on the project plans and in other sections of the report (e.g. "A" Line, etc.). Also, to avoid misleading, consider excluding from the table all data that does not belong or that is not relevant to this segment of I-880 (per title sheet of project plans, the construction limits for this segment are between Sta "A" 313+00 and Sta "A" 385+00). Should you exclude any data, update also top Para of Page 26. If the referenced station lines are not coincident, provide station equation(s) to establish a correlation between them.	Concur. The control lines and stations are consistent with the plans. Will update the GDMR to use the same line names ("A" and "DA1") and reference stations as the design plans. Will update the table to show data relevant to this segment of I-880 (approx. Sta. 313+00 to 385+00).	A		
1/4/2012	Luis Tacuri	70	GD&MR	Table 7, "R-value" column: Explain why no R-values are shown for some stretches?	The pavement subgrade consists of imported roadbed material that contains substantial amount of sand and gravel. A screening process was performed first. Some of the bulk samples did not have R-value tests done because they are similar or contain more sand and gravel that will yield higher R-values. We still listed these sample locations in the table to show that we have verified the material along the alignment.	A		
1/4/2012	Luis Tacuri	71	GD&MR	Page 26: Statement regarding SEG for ramps is not consistent with Ramp's Flexible Option 1 shown on Table 9, Page 27-1. Reconcile them. Use of OGFC Para (Page 27): This paragraph should be revised. A separate paragraph for RHMA-G should be added. RHMA-G can be placed in this project since paving can be done during daytime as the work is done behind the k-rail (see also comments e-mailed previously to Ben). Besides, the existing mainline RAC-G needs to be extended to avoid creating bath tub sections.	Concur. Will revise Table 9 to be consistent with Page 26. Will update Page 27 for the use of RHMA-G. RHMA-G will be used to match existing RAC-G to avoid "bath tub" condition.	A		
1/4/2012	Luis Tacuri	72	GD&MR	Page 27 & 32, "Aggregate Base" Paras. There are inconsistencies on the Class of Aggregate Base (AB). Are you recommending Class 2 or Class 3? Whereas Class 3 is shown on Page 27, Class 2 and Class 3 are shown on page 32. Class 3 is also shown on the plans (X-1 sheet) and in the cost estimate. Make sure to verify that the proposed gradation and quality requirements in the report are consistent with the respective Class and special provision being used for this project.	Both Class 2 and 3 AB are needed in this project. Will update Page 32 to reflect Class 3 AB.	A		
1/4/2012	Luis Tacuri	73	GD&MR	Incorporate a new Para to address permanent and temporary fill or embankment material only. Clearly state if the materials from temporary embankments can or cannot be reused in the permanent embankments. Likewise, besides what is already stated on middle of page 27, include what kind of materials from the excavated areas are considered "acceptable" to be used in the required embankments. Clearly state the minimum requirements (specs) that the materials coming from "Roadway Excavation," "Roadway Excavation (Type Y-1, ADL)," "Remove Base and Surfacing," Temporary HMA (from Temp full-depth HMA detours, Temp HMA sidewalks, and Temp HMA curb ramps), etc. must comply with to be considered "acceptable" materials to be placed in the embankments -- keep in mind that some of these materials have AC and PCC.	Concur. A paragraph will be added as commented. These materials are acceptable to be used as embankment material provided that they meet the requirements of standard specifications and have a minimum R-value of 20 if they are to be placed within 4 ft of the finish pavement subgrade. Excavated AC and PCC, if broken down to 3" minus particles, are acceptable to be used in embankments. Chunks and large size cracked PCC (> 3") should not be used in embankments.	A		

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1/4/2012	Luis Tacuri	74	GD&MR	Include recommendations for placement of ADL in the embankments (where and minimum covers). For your information, according to the project plans, 100% of all of these materials are shown as components of the new permanent embankments (refer to "Earthwork Summary" table, sheet Q-2). Also, state reasons why the surplus material from adjacent project 04-3A9221 cannot be used in the construction of the embankments for this project (04-3A9211). Whereas in 04-3A9221 the estimated combined surplus material to be disposed is approximately 30,000 CY, in 04-3A9211 the estimated required imported borrow material to construct the permanent embankments and to be paid for is approximately 50,000 CY.	ADL may be used in permanent embankment provided that they are covered with min. 2' of clean soil cover. I do not see any reason why the surplus material from project 04-3A9221 cannot be used in the embankment construction of this project (04-3A9211).	A		
1/4/2012	Luis Tacuri	75	GD&MR	Tables 8 and 9: Not all of the proposed new pavement structural sections shown on sheet X-1 of the project plans are included in these tables. Also, include recommendations for minimum HMA thickness over a cold planed surface prior to the placement of a GPI and also minimum HMA thickness over the GPI.	Will update GD&MR to include all the new sections shown on sheet X-1	A		

I-880 SB HOV LANE PROJECT (Marina Blvd to Davis St)
PROJECT COMMENT REVIEW AND RESPONSE (95% Design SUBMITTAL)

PROJECT COMMENT REVIEW AND RESPONSE MATRIX

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8/3/2010	Luis Tacuri Materials Design	1	GD&MR	**Adequacy of using RHMA at this Location:** Will the required temperatures (atmospheric, surface, compaction, etc.) exist during the season(s) and times (traffic lane closures) the Contractor will be placing the RHMA? Have you checked the temperature historical data for this location? Should the use of RHMA be inappropriate due to temperature requirements, what are the options to be considered? This critical issue needs to be addressed in the GD&MR.	Based on historical climate information from the Western Regional Climate Center website, the San Leandro area may have average min. temperature between 40 and 53 deg F. However, based on work staging and traffic handling, all the RHMA work can be done behind k-rail during day light hours and that would help to control the temperature for RHMA paving. RHMA-G is proposed to match the as-built RAC-G section.	A	A	

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8/3/2010	Luis Tacuri Materials Design	2	GD&MR	**Structural Adequacy of Existing Shoulders:** Based on the proposed Stage Construction (SC-sheets), Traffic Handling (TH- sheets), and Pavement Delineation (PD- sheets), the existing median and outside shoulders will be subjected to traffic either temporarily (during stage construction) or permanently (a portion of the existing median shoulder will be converted to a portion ofthe new HOV lane): Within the limits of this project, has the structural adequacy of the existing shoulder pavement been analyzed to determine that its structural section is adequate to withstand the projected traffic? The existing shoulder structural sections might not be structurally adequate to support the projected traffic. Attach to the GD&MR the following calculations: •Specific/interim Traffic Index (TI), that is, based on the anticipated duration of the traffic shifting (1-, 2-, 3-year, etc), Our Traffic Forecasting Office will have to validate them. •Structural adequacy analysis of existing flexible shoulders to be converted either temporarily or permanently to a traffic lane. •Pavement design using the specific/interim TI.	It is planned to remove and reconstruct the outside shoulder. The structural adequacy of the existing median shoulder is discussed in a memo, prepared by WMH, dated September 23, 2010 and submitted to Caltrans. Following the coordination meeting with Materials Design Branch on 11/30/11, a rehabilitation strategy for the median shoulder was discussed and agreed upon. The revised GD&MR discusses the outcome of the studies and the plans have been updated to include the agreed upon rehab work.	A	A	

PROJECT COMMENT REVIEW AND RESPONSE MATRIX

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				Also, refer to our comments to the "Hwy 880 Median Deflection Testing and Analysis Report" --prepared by CHEC-- and submitted to you via e-mail on July 19, 2010, for additional considerations and comments directly related to the median pavement outstanding issue.	Please see response above			

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8/3/2010	Luis Tacuri Materials Design	3	GD&MR	**Structural Pavement Sections of Temporary Facilities:** Submit pavement design backup calculations for all the proposed temporary facilities such as temporary ramps, detours, etc. Specific/interim Traffic Indexes (TIs) based on the anticipated duration of their use (1, 2, 3 years, etc.) need to be validated by CT D4 Traffic Forecasting Office. Incorporate said calculations in the corresponding Appendix.	The temporary pavement (temp ramps and local street widenings) will be designed for TI of 9 and using full depth HMA section. TI calculations have been accepted by the Office of Traffic.			
8/3/2010	Luis Tacuri Materials Design	4	GD&MR	**Subsections 8.5 and 8.6, Corrosion Investigation and Culverts:** Update corrosion analysis and culvert recommendations based on the AltPipe computer program (refer to HDM, 6th edition, last updated on November 2, 2009). Update Appendix C accordingly.	Will update the corrosion analysis and pipe design using AltPipe program.			
8/3/2010	Luis Tacuri Materials Design	5	GD&MR	**Section 9: Structural Pavement Sections** **As-Built Pavement Section** (last paragraph) Per your acknowledgment, the new HOV lane will encroach into the existing median shoulder; therefore, provide specific recommendations to make the median shoulder structurally adequate to withstand the permanent HOV traffic. Any uncertainties about the "existing median shoulder" and its capability to support traffic must be resolved.	We have reviewed the as-built data and compiled the information of the existing median shoulder sections in a memo (WMH, 9/23/10). The memo also discusses deflection test data and CHEC's reanalysis of the pavement recommendations. The findings will be included in the updated GDMR.	A	A	

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8/3/2010	Luis Tacuri Materials Design	6	GD&MR	**Section 9: Structural Pavement Sections** **Findings and Recommendations** ATPB, Edge Drains & Underdrains (last sentence): Any uncertainties about any "existing underdrains" must be resolved and their recommendations must also be reflected in the project plans.	Will do. Please note that underdrains in the vicinity of Retaining Wall No. 1 are replaced by a back of wall drainage system as shown on the 95% PS&E plans.	A	A	
8/3/2010	Luis Tacuri Materials Design	7	GD&MR	**Section 9: Structural Section** **Findings and Recommendations** **Design R-value & Subgrade Enhancement** **Geotextile** (last sentence): Justify the use of SEG for the ramps.	The ramp area using SEG is only the ramp merging or diverging away from the mainline. The finish grades are similar and we like to improve the design R-value to 20.	A	A	
8/3/2010	Luis Tacuri Materials Design	8	GD&MR	**Section 9: Structural Sections** **Findings and Recommendations** **Atterberg Limits** (last sentence): Justify the use of SEG for the ramps.	This is for ramps between mainline ("A" Line) Sta.365+00 and 383+00, near Davis Street/Rte 880 I.C. Similar to the previous comment, we like to improve the design R-value to 20.	A	A	
8/3/2010	Luis Tacuri Materials Design	9	GD&MR	**Section 9: Structural Sections** **Findings and Recommendations** **Existing median shoulder:** See comments above.	Similar responses to Items 2 and 5.	A	A	

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I-880 Southbound HOV Lane Extension from Marina 04-Ala-880-PM 22.5/24.0 04-3A9211				95% Submittal Jun-10	Code: A – Will Comply B – Agency/Consultant to Evaluate C – No Action Required D – Response by Others (If no code is listed, only answer to question is provided.)			
Date	**Reviewer**	**Item No.**	**Drawing or Page No.**	**Review Comments**	**Design Responses**	**Proposed Action**	**Incorporated**	**Agency Concurs**
8/3/2010	Luis Tacuri Materials Design	10	GD&MR	**Section 9: Structural Sections** **Findings and Recommendations** **40-year Flexible Pavement Design and Design Alternatives:** Back on March 10,2010, in our meeting with CT Design and upper management representatives, it was agreed that the proposed designs would be considered 20-year designs instead of 40-year designs and that all reports would reflect this change. Also, replace any proposed RHMA-O with Hot Mix Asphalt (Open Graded) PG 58-34 PM. See also comments below under "Appendices" and update structural sections shown in Tables 8 and 9 accordingly.	Will comply	A	A	
8/3/2010	Luis Tacuri Materials Design	11	GD&MR	**Section 9: Structural Sections** **Findings and Recommendations** **Missing:** Reasons for proposed 0.10' Cold Plane AC Pavement / 0.10' RHMA-O (section No. 3 in the project plans). Also, see previous comment regarding replacing RHMA-O with HMA (OG).	The 0.10' RHMA-O is intended to match the as-built 0.10' OGAC (wearing surface) for surface drainage. Will use HMA (OG) instead per comment. The reason for the overlay is to clean up the roadway surface after all stage construction is complete.	A	A	
8/3/2010	Luis Tacuri Materials Design	12	GD&MR	**Section 9: Structural Sections** **Findings and Recommendations** **Crossing City Streets Pavement Sections:** Submit backup calculations.Incorporate them in the corresponding Appendix.	Back-Up Calculations will be provided	A	A	

PROJECT COMMENT REVIEW AND RESPONSE MATRIX

I-880 Southbound HOV Lane Extension from Marina 04-Ala-880-PM 22.5/24.0 04-3A9211				95% Submittal Jun-10	Code: A – Will Comply B – Agency/Consultant to Evaluate C – No Action Required D – Response by Others (If no code is listed, only answer to question is provided.)			
Date	**Reviewer**	**Item No.**	**Drawing or Page No.**	**Review Comments**	**Design Responses**	**Proposed Action**	**Incorporated**	**Agency Concurs**
8/3/2010	Luis Tacuri Materials Design	13	GD&MR	**Section 9: Structural Sections** **Findings and Recommendations** **Table 8** **Missing:** "Joint Trench" backfill/paving recommendations.	The open trench crossing of I-880 is no longer proposed. Instead utilities will be installed by jack and bore or similar construction method.	C	C	
8/3/2010	Luis Tacuri Materials Design	14	GD&MR	**Section 9: Structural Sections** **Findings and Recommendations** **Table 9** **Missing:** "Ramp Termini" recommendations. Even though ramp recommendations are included in the GD&MR, no rigid pavement is recommended for the exit ramp termini of the new/realigned flexible pavement ramps. A flexible section is proposed for the entire length of the new ramps. Per CT HDM Index 636.1(3): "At a minimum, rigid pavement termini should be used for exit ramp termini of flexible pavement ramps where a significant volume of trucks is anticipated (TI > 12.0)."	Not required since TI is not greater than 12. Ramp TI is 12 per HDM Table 613.5A for heavy ramp traffic and 20-year design life. Rigid pavement not practical due to complex stage construction	C	C	
8/3/2010	Luis Tacuri Materials Design	15	GD&MR	**Appendix C: Structural Pavement Design** **Mainline ATPB layer misalignment:** Based on the existing structural section information shown under "As-Built Pavement Sections" of the GD&MR, the new ATPB layer does not match with the existing ATPB layer to allow its continuity (i.e. whereas in the existing structural section the ATPB layer is at a depth of 1.00' below the FG, in the proposed structural sections its depth is assumed to be only at 0.90' below the FG). Verify this information and make corresponding corrections.	Design section has been revised to match up ATPB layers	A	A	

PROJECT COMMENT REVIEW AND RESPONSE MATRIX

I-880 Southbound HOV Lane Extension from Marina 04-Ala-880-PM 22.5/24.0 04-3A9211				95% Submittal Jun-10	Code: A – Will Comply B – Agency/Consultant to Evaluate C – No Action Required D – Response by Others (If no code is listed, only answer to question is provided.)			
Date	**Reviewer**	**Item No.**	**Drawing or Page No.**	**Review Comments**	**Design Responses**	**Proposed Action**	**Incorporated**	**Agency Concurs**
8/3/2010	Luis Tacuri Materials Design	16	GD&MR	**Appendix C: Structural Pavement Design** Include pavement design calculations supporting the proposed structural sections No. 1 and No. 5 (see project plans sheet X-1). Since you have removed the ATPB layer from the proposed mainline structural section No. 5, it seems that it is underdesigned (don't you need an equivalent HMA thickness in order to provide the required GE_{total}?). Consider replacing the 0.25' ATPB --you have removed-- with 0.25' HMA-A.	Will include Section No. 5 in revised GDMR. Concur with the comment of replacing with 0.25' HMA-A.	A	A	
8/3/2010	Luis Tacuri Materials Design	17	GD&MR	**Appendix C: Structural Pavement Design** Usually we don't recommend any open graded wearing surface course for the ramps. Remove the proposed OGFC from the ramps' backup calculations.	Will comply	A	A	
8/3/2010	Luis Tacuri Materials Design	18	GD&MR	**Appendix C: Structural Pavement Design** Missing: Pavement design backup calculations for the proposed structural sections for Marina Blvd. and Davis St.	Back-Up Calculations will be provided	A	A	
8/3/2010	Luis Tacuri Materials Design	19	GD&MR	**Appendix C: Structural Pavement Design** Replace the "Culvert4 Analysis and Report" with the corresponding AltPipe.	ALTPIPE calculations will be provided	A	A	
8/3/2010	Luis Tacuri Materials Design	20	GD&MR	**Appendix C: Structural Pavement Design** Incorporate a copy ofthe updated/revised "Hwy 880 Median Deflection Testing and Analysis Report" -- prepared by CHEC.	Will comply. WMH memo dated 9/23/10 will also be included	A	A	
8/3/2010	Luis Tacuri Materials Design	21	95% Plans	Update project plans based on recommendations to convert the existing median shoulders into portions of the new HOV lane. Refer to comments above.	Will comply	A	A	

DESIGN COMMENT REVIEW AND RESPONSE

Project Title: I-880 Southbound HOV Lane Extension	Submittal: Geotechnical Design & Materials Report	Location: San Leandro/ Oakland		
By: Rajappan & Meyer Consulting Engineers, Inc. / Parikh Consultants Inc.	Date of Response: December 11, 2008	CODE:	A-Will Comply C-Will Not Incorporate	B-Consultant to Evaluate D-CITY to Evaluate

Comment By	Item No.	Drawing/ Page No.	Review Comment	Design Response
Luis Tacuri	1	Section 9 & Appendix C	• Since no median pavement work is shown in the Typical Cross Sections, it can be inferred that it has been assumed – probably without any supporting study, documentation, deflection study, or pavement coring – that the existing median pavement structural section is structurally adequate to withstand the projected traffic loading and be converted to portions of the new HOV lane. Only mainline restriping to accommodate the new HOV lane is shown. **Deflection studies must be performed to determine the structural adequacy of an in-place shoulder to be converted to portions of a traffic lane. Should the existing median shoulder structural section be inadequate, it would have to be replaced.** • For your information and consideration, the as-built plans corresponding to contract EA 04-0C7024 – accepted in November 14, 2002 – show that the existing mainline inside shoulder, traffic lanes No. 1,2,3 and 4, auxiliary lanes, and outside shoulder have different pavement structural sections. Verify that said data is correct. Do a thorough as-built-plan research for mainline, ramps, and streets. Field verification can be performed by coring.	The prime designer (R&M) will have to discuss with ACCMA. The mainline pavement design and deflection testing are not included in current scope. Will double-check the as-built plans for as-built pavement sections. We already notice different sections on the "inside" and "outside" lanes, most likely due to widenings & overlays through the years.
	2	Section 9 & Appendix C	Revise mainline and ramps' typical Crosss Section to depict accurately the existing pavement structural sections – **before and after the** aforementioned contract was completed. The existing 0.10' OGAC/0.15' RAC-G mainline overlay placed under said contract is not shown in the corresponding typicals.	The prime designer (R&M) will revise the typical cross sections.

DESIGN COMMENT REVIEW AND RESPONSE

Project Title: I-880 Southbound HOV Lane Extension	Submittal: Geotechnical Design & Materials Report	Location: San Leandro/ Oakland
By: Rajappan & Meyer Consulting Engineers, Inc. / Parikh Consultants Inc.	Date of Response: December 11, 2008	CODE: A-Will Comply; B-Consultant to Evaluate; C-Will Not Incorporate; D-CITY to Evaluate

Comment By	Item No.	Drawing/ Page No.	Review Comment	Design Response
	3	Section 9 & Appendix C	• No supporting documentation, studies, calculations, etc. are included or provided to support the **TI** = 16 used for the mainline, and the **TI** = 12 used for the Interchange/ramps. **Provide traffic data and the TI calculations for each type of facility, that is, for the HOV lane, regular traffic lanes, auxiliary lane (if any is proposed), outside shoulder, ramps, and streets.** Also provide current, 20-year, and 40-year AADTs. • Request that the District office of Traffic Forecasting reviews and validates the traffic data and TI calculations. • Consider designing the ramps for heavy traffic (using a minimum 40-year TI = 14, per HDM Table 613.5A). • Also, keep in mind that per HDM Index 636.1(3) rigid pavement should be used for exit ramp termini of flexible pavement ramps when the TI is greater than 12.0. Minimum length guidelines for the rigid pavement ramp termini are spelled out in Index 626.1(3).	The TI values were provided by the designer. The prime designer (R&M) will address the comment and provide supporting documents. The prime designer (R&M) will make decision if the ramp should be designed for TI = 14 and consider rigid pavement section for exit ramp termini if TI>12.
	4	Section 9 & Appendix C	• Design factors such as Traffic Index and R–value need to be determined for each type of facility: mainline regular lanes, HOV lane, truck lane, auxiliary lane, shoulder, street, ramp, etc. • Per HDM Index 633.0(1)(c). **for TIs greater than 15, a rigid or composite pavement should be used. Use the catalog in HDM Index 623.1 to engineer rigid pavement alternatives for each type of facility.** Take into account all the requirements and the considerations spelled out in HDM Chapter 620, "Rigid Pavement."	We understand that the general guideline is to use rigid pavement when TI is over 15 (HDM 633.1). For the project, the as-built section contain ATPB layer, and the design has to continue the ATPB layer and connect to new edge drain on the outside. We cannot "dam/block" the ATPB layer in the travel lane. We cannot "sandwich" the ATPB in-between to layers of JPCP, but it is allowed to "sandwich" the ATPB in HMA layers. To use rigid pavement, there could be some connection details of the as-built ATPB and new ATPB. The JPCP thickness may have to be sacrificed/reduced at the edge within the travel lane, which is not desirable.

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Comment By	Item No.	Drawing/ Page No.	Review Comment	Design Response
	5	Section 9 & Appendix C	**Make sure that any proposed 40-year flexible structural section is designed according to HDM Index 633.1(3), "Modifications for Pavement Design Life greater than 20 years." Implement all the "enhancements" spelled out in said Index.**	Will looked at HDM 633.1 (3) for the enhancements. The section is using RHMA-O, RHMA-G, and LCB.
	6	Section 9 & Appendix C	**Perform and document Life Cycle Cost Analysis (LCAA)– for the mainline, ramps and streets – to compare life – cycle cost for different pavement types (rigid, flexible, and composite viable/buildable alternatives), different viable/buildable widening/rehabilitation strategies, and different pavement design lives (20 vs. 40 years). The designs with the lowest life–cycle cost have to be implemented. Submit the LCCAs, along with all pertinent supporting documentation, for our review.**	The prime designer (R&M) will have to perform a Life Cycle Cost analysis (LCCA) and determine TI for 20 and 40 years. It is our understanding that the design life was fixed to 40 years by Caltrans for the project. If required, we will provide different pavement types for cost analysis.
	7	Section 9 & Appendix C	• Should it be proven by the LCCA that a flexible structural section has the lowest-life cycle cost, you will need to extend the existing mainline 0.10'OAGC/0.15' RAC-G layers over the new widenings. Interrupting the RAC-G layer could cause that a "bathtub" section forms under the mainline surface – water can trap beneath the existing surface if it is not allowed to drain across the new widenings and can cause detrimental effect to the structural integrity of the pavement. To prevent this effect, RHMA-G (formerly known as RAC-G) should be placed over the whole cross section of the road (traveled way and shoulders). • **The proposed 40-year flexible design will be submitted to Caltrans HQ for their review and approval.** Provide all supporting documentation to submit a request for HQ approval.	We are using 0.10' RHMA-O and 0.20' RHMA-G as allowed by HDM (Table 633.1) for replacing HMA-A. The pavement design calculation is attached.

DESIGN COMMENT REVIEW AND RESPONSE

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Comment By	Item No.	Drawing/ Page No.	Review Comment	Design Response
	8	Section 9 & Appendix C	Per HDM Index 612.3, when widening a roadway, the existing pavement should be rehabilitated and brought up to the same life expectancy as the new widening portion. **Provide backup calculations supporting that the proposed 0.10' Cold Plane/0.10' OGFC over the existing mainline will meet the new widenings life expectancy.**	Per the comment, we have reviewed the as-built typical cross sections (Contract 04-0C7024) to evaluate the adequacy of the existing median/inside shoulder pavement sections for the project design life with TI = 14. For Davis St to Hegenberger Rd, the as-built sections consist of 30 mm OGAC & 45 mm RAC-G (2002 construction) over 260 mm AC, 150 mm CTB & 375 mm AS (Pre-2002). For Washington Ave – Marina Blvd- Davis St segment, the as-built sections consist of 30 mm OGAC & 45 mm RAC-G (2002 construction) over 30 mm OGAC, Var. 60-150 mm AC, 200 mm PCC, 100 mm CTB & 400 mm AB. We neglected the OGAC layer (wearing surface and no structural value) and evaluated the gravel equivalent for the anticipated design life of TI = 14. We concluded that the existing median/inside shoulder pavement sections are adequate for the projected design life. The calculation is attached.
	9	Section 9 & Appendix C	Missing: • Minimum and maximum width dimensions of proposed outside widenings in all typical cross sections. • Existing median ETW in some sections. • Lateral clearance dimension from the existing median ETWs to the face of the existing median barrier. • Typical Cross Sections for approach/departure pavement to any existing or new structures (Marina Blvd, Davis St, etc.). • Typical Cross Sections for ramp termini.	The prime designer (R&M) will have to revise the typical sections.

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Comment By	Item No.	Drawing/ Page No.	Review Comment	Design Response
	10	Section 9 & Appendix C	Any new pavement construction, reconstruction, widening, lane replacement or rehabilitation has to be engineered using the standards and the guidance spelled out in Chapters 600 thru 670 of the most current Caltrans Highway Design Manual (HDM), that is, the 6th edition last revised on July 1, 2008. According to said manual, following are some of the principal factors to be considered in designing pavement structures: • The need for temporary pavement and detours should also be considered. Should they be warranted, they should be engineered – using the standards and procedures for new construction – for the anticipated traffic loading during the construction period. Provide structural sections for temporary pavement and detours – if any is anticipated. • Shoulder structural section should be designed as the adjacent traveled way – especially when the tracking width lines encroach onto paved shoulder. • The median pavement structure should be equivalent to the adjacent lanes when the median width is 14 feet or less. • Rigid or composite pavements should not be specified in areas with expansive soils (PI > 12) unless the pavement has been adequately treated to address soil expansion. Submit PI data. • Subgrade Enhancement Geotextile (SEG) is required for poor or weak soils (R-value < 20). • Rubberized hot Mix Asphalt (RHMA) must be considered as an alternative when flexible pavement is considered and there is no justified reason that RHMA is not viable for the location. If RHMA is found to be inappropriate it shall be documented in the report. • Deviations from **pavement-related Mandatory Standards** need to be documented and approved by the Chief, Office of pavement Design.	We have reviewed the latest Caltrans Highway Design Manual (Ch. 600-670), last revised on July 1, 2008 and modified the design. Based on the latest HDM, a Subgrade Enhancement Geotextile (SEG) fabric is recommended at pavement subgrade. According to HDM 614.5, the use of SEG on weak subgrade can raise the effective R-value to 20. In reality, majority of lab data (12 out of 14) show R-value greater than 20; the only two tests show R-value of 14 & 16. With the use of SEG, we recommend that the design R-value be raised to 20. The current calculation and pavement sections are based on R-value of 20. According to Caltrans Subgrade Enhancement Geotextiles Guide (December 10, 2008), it is recommended that the requirements for SEG conform to Stabilization Application (STAB), Class B2 of the guide. Plasticity Index (PI) data are presented in Appendix B (Plates B-2A through B-2D – Plasticity Chart) of the report. Majority of the borings were done for the proposed retaining walls along Rte 880. Glancing through the charts and noticing the data points at shallow depth (2 to 5 feet depth, relevant to pavement design), we found that majority of PI are in the range of 15 to 20. The PI data per se, however, should not be construed to imply that we have significant expansive clay issue for pavement design. The Atterberg Limits test is performed in accordance with ASTM D4318, and the specimen is processed to remove any material retained on No. 40 sieve. Therefore, the effects of gravel and sand (coarser than No. 40 sieve) only manifest in the R-value tests. For pure "clays" with such PIs and no presence of sand/gravel, the R-values

DESIGN COMMENT REVIEW AND RESPONSE

Project Title: I-880 Southbound HOV Lane Extension	Submittal: Geotechnical Design & Materials Report	Location: San Leandro/ Oakland
By: Rajappan & Meyer Consulting Engineers, Inc. / Parikh Consultants Inc.	Date of Response: December 11, 2008	CODE: A-Will Comply; B-Consultant to Evaluate; C-Will Not Incorporate; D-CITY to Evaluate

Comment By	Item No.	Drawing/ Page No.	Review Comment	Design Response
			• When feasible, consider engineering new widenings with structural sections similar to the adjacent ones in order to provide continuity of existing pavement and ensure consistency in maintenance operations.	would have been much lower, probably similar to that shown in HDM 623 Table 623.1A, 7/1/08). The Rte 880 widening subgrade soils contain certain amount of sand and gravel, and therefore the R-values are in the range of 20 and higher. Many samples may be classified as sandy lean clay with gravel. Some of the subgrade soil could be imported material for roadway prism construction through the years. Per current HDM guideline, the material is still considered relatively poor and weak. Therefore, a layer of SEG fabric for separation and stabilization should suffice.
	11	Section 9 & Appendix C	Unless I overlooked it, the potential for differential settlements (between existing pavement and new widenings or new pavements) has not been addressed in the report.	Majority of the widening is in cut and near OG. The only fill area is near the San Leandro Creek where retaining walls are planned and wedge fill on existing sloping embankment (roadway prism). Based on the boring data, we do not expect significant different settlements between existing pavement and new widening.
	12	Section 9 & Appendix C	**Revise the report substantiating any proposed pavement structural section or rehabilitation strategies. Include deflection studies, rigid pavement alternatives, and LCCAs.**	Will revise as appropriate.
	13	Section 13.2	**Standard Specifications:** Language shall be consistent with the most – current specifications, that is, those included in the "Amendments to the Standard Specifications dated May 2006" (last revised/issued on December 5, 2008). Entire Section 90, "Portland Cement Concrete" was replaced on this date.	Will revise the language to indicate the there are most current specifications amendments (December 5, 2008) available in addition to May 2006 standard specifications.
	14	Section 13.2	**[Standard] Special Provisions (SSPs):** Language shall be consistent with the most -current provisions, unless deviations from the SSPs are proposed, in which case HQ-approved NSSPs shall be submitted. The last update to some of the SSPs was issued on December 5, 2008. Include up-to-date SSPs for all pavement - related items to be used.	Will revise the language to indicate that there are most current standard special provisions (December 5, 2008) available.

Memorandum

Flex your power!
Be energy efficient!

To: **ERAJ KAZEMINEJAD, P. E.**
D4 - Design Ala I

Date: August 11, 2009

File: 04-3A9200
Ala 880 – PM 22.5/25.5
SB HOV Lane Extension

REGISTERED PROFESSIONAL ENGINEER
LUIS P. TACURI
No. C 56176
Exp. 12/31/10
CIVIL
STATE OF CALIFORNIA

From: **LUIS P. TACURI, P. E.**
D4 Materials Design Engineer
Engineering Services I - Materials "A"

Subject: **ADDITIONAL COMMENTS TO CONSULTANT'S REQUEST FROM CONDUCTING DEFLECTION STUDY**

The comments below supplement those submitted to you via memorandum dated July 28, 2009.

Unless I had overlooked the as-built plans available, I found that:

1. Contract No. 04-233284 (dated September 2, 1998) and Contract No. 04-233194 (dated January 30, 1998) show that between PM 24.4 to PM 26.1 the existing median DMBB was replaced with either a concrete barrier constructed over a new median structural section consisting of 0.85' AC (A) / 0.50' CTB (A) / 1.25' AS (4).
2. Contract No. 04-2134U4 (dated December 1999) shows that between PM 23.6 to PM 24.4 the existing median DMBB was replaced with a concrete barrier constructed over a 3-foot-wide, 0.15' AC (A) / 0.35' concrete backfill structural section. It is also shown that an existing median concrete curb –adjacent to said structural section and that has been previously overlaid-- remains in place. Per as-built plans corresponding to contract No. 56-14TC21-F, Document No. 40000760 (1955), the original SB median is 6-foot-wide and: 1) a 3-foot-wide concrete curb Type D2 was constructed adjacent to the inner 12-foot-wide PCC lane; and 2) the remaining 3-foot-wide median was paved with 0.17' PMS Type A. Over the course of the years the median concrete curb has been overlaid with asphalt concrete –there are several as-built plans showing the overlays placed on it-- and apparently, the overlaid median concrete curb remains in place.
3. Contract No. 04-123174 (accepted on November, 1995) shows that between PM 20.3 to PM 23.6 the existing median DMBB was replaced with a concrete barrier over a variable or 6-foot-wide, 0.10' Min AC resurfacing (refer to as-built sheet No. 47, "Construction Details" C-3).

Consequently, for the stretch of I-880 between PM 22.5 to PM 24.4, the as-built information from contracts No. 04-2134U4 and No. 04-123174 do not substantiate any of those "pre-2002" median structural sections used for the "Shoulder Pavement Adequacy Calculations"

prepared by the consultant (refer to Attachment C of the original request submitted for our review). The existing median structural section might not be structurally adequate to be converted to a portion of the new HOV lane.

Please verify the aforementioned information and update the median shoulder pavement adequacy postmile limits and calculations accordingly.

Should you have any questions, please call me at (510) 622-1755.

c: TMishra / LTacuri / Daily File / Materials File

LIMITED SITE INVESTIGATION REPORT

ROUTE 880 SOUTHBOUND IMPROVEMENTS PROJECT OAKLAND/SAN LEANDRO, CALIFORNIA

PREPARED FOR:
RAJAPPAN & MEYER CONSULTING ENGINEERS, INC.
1038 LEIGH AVENUE, SUITE 100
SAN JOSE, CALIFORNIA

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

GEOCON

GEOCON PROJECT NO. E8449-06-01

DATE 15th DECEMBER 2008
LOG # 13 MAIN FILE # 421.04
FROM R&M TO ACCMA
DESCRIPTION
SITE INVESTIGATION REPORT

Project No. E8449-06-01
December 15, 2008

Bala Rajappan
Rajappan & Meyer Consulting Engineers, Inc.
1038 Leigh Avenue, Suite 100
San Jose, California 95126

Subject: LIMITED SITE INVESTIGATION REPORT
ROUTE I-880 SOUTHBOUND IMPROVEMENTS
HEGENBERGER ROAD TO SOUTH OF MARINA BOULEVARD
ALAMEDA COUNTY, CALIFORNIA

Dear Mr. Rajappan:

Geocon has performed environmental engineering services at the subject site in general accordance with the scope of work outlined in our Revised Final workplan dated October 23, 2008. The subject site includes the southbound shoulder, and three overcorssings within the project limits of the Route I-880 Southbound Improvements Project in Oakland and San Leandro, Alameda County, California.

The accompanying report summarizes the services performed including limited soil sample collection from soil borings advanced using hand-auger and direct-push drilling equipment, and laboratory testing.

The contents of this report reflect the views of Geocon Consultants, Inc., who is 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.

If there are any questions concerning the contents of this report, or if Geocon may be of further service, please contact the undersigned at your convenience.

Sincerely,

GEOCON CONSULTANTS, INC.

Lauren Vigliotti
Senior Staff Geologist

Richard Day, CEG, CHG
Regional Manager

LV:RWD:ls

(3) Addressee

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LIMITED SITE INVESTIGATION REPORT

1.0 INTRODUCTION

This *Limited Site Investigation Report* was prepared for the Route I-880 Southbound Improvements Project in Oakland and San Leandro, Alameda County, California. The Route I-880 Southbound Improvements Project limits extend from the Hegenberger Road interchange to south of the Marina Boulevard interchange and consists of an approximately three mile roadway segment.

This report documents the limited site investigation for metals, petroleum hydrocarbons, and volatile organic compounds (VOCs) in shallow soil and groundwater within the limits of the Route I-880 Southbound Improvements Project, as depicted on the Vicinity Map, Figure 1. Soil samples were collected along the southbound shoulders and at three interchanges within the project boundaries. The soil boring locations advanced during the site investigation within the project area are depicted on the Site Plans, Figures 2a through 2f.

1.1 Purpose

The purpose of the proposed scope of services was to evaluate whether impacts due to metals, including aerially deposited lead (ADL), petroleum hydrocarbon compounds, including benzene, toluene, ethylbenzene, and xylenes (BTEX), and methyl-tert-butyl ether (MTBE), exist in the surface and near surface soil at the Site, associated with historical automobile emissions from the use of leaded gasoline or historical agricultural activities. Grab-groundwater samples were also collected at locations where groundwater may be encountered during proposed project construction activities. Grab-groundwater samples were analyzed for metals, total petroleum hydrocarbons (TPH), and VOCs, including BTEX and MTBE.

The information obtained from this investigation will be used by the Client to coordinate interchange project activities, evaluate soil reuse and soil/groundwater disposal options, and for health, safety, and waste management purposes.

In addition, we conducted an asbestos containing materials/lead containing paint (ACM/LCP) survey of the three bridge structures located within the project boundaries, which is presented under separate cover.

1.2 Proposed Improvements

The I-880 Southbound Improvement Project is proposed to include the following:

- Construction of a new HOV lane between Hegenberger Road and south of Marina Boulevard;

- Widening of SB I-880 bridge over UPRR right-of-way (ROW) crossing;
- Construction of retaining walls north and south of UPRR bridge;
- Construction of soundwalls between Davis Street and 98th Avenue interchanges;
- Replacement of Davis Street bridge O/C
- Replacement of Marina Boulevard bridge O/C; and
- Construction of a retaining wall beneath Williams Street O/C;

The site investigation was performed on the southbound shoulders and three overcrossings (O/Cs) within the project limits, which extend from the I-880/Hegenberger Road interchange south to the I-880/Marina Boulevard interchange, consisting of approximately three miles. The site location is depicted on the Vicinity Map, Figure 1. A Site Plan, presented as Figures 2a through 2f, depicts proposed project improvement areas and the boring locations.

Soil borings were located along the southbound shoulder and at the interchanges of I-880 with 98th Avenue, Davis Street, and Marina Boulevard. ADL soil samples were collected from three depths at each boring for the purpose of evaluating potential vertical impacts of lead in soil and 20% of the soil samples were analyzed for CAM17 Metals. We advanced soil borings in the vicinity of proposed retaining walls to a depth of five feet using direct-push drilling methods. One soil boring at each of the retaining walls was further advanced to attempt to collect a grab-groundwater and/or saturated soil sample. Additionally, deeper soil borings were advanced in the vicinity of three overcrossing structures to attempt to collect grab-groundwater and/or saturated soil samples.

2.0 BACKGROUND

2.1 Previous Initial Site Assessment

Parikh Consultants, Inc. (Parikh) performed a Phase I Initial Site Assessment (ISA), dated November 30, 2006, which presented the following conclusions and recommendations:

- It is highly likely that the surface soils along I-880 are affected by deposition of aerial lead. Therefore it is recommended that surface samples of soil be collected and analyzed for total lead.
- There are existing structures (including bridges) within the proposed roadway improvements that will be either replaced or widened. Due to the age of these structures there is a potential for presence of ACM and lead based paint. Surveys for ACM and lead based paint should be conducted by a certified inspector.
- Soils below the railroad tracks may be impacted from historical operations with heavy metals due to possible presence of slag ballast, total petroleum hydrocarbons (TPH) as diesel and motor oil (TPHd/mo), polynuclear aromatic hydrocarbons (PAHs). It is

therefore recommended that the soils in the vicinity of the tracks be tested for these constituents. Prior to testing a workplan should be prepared detailing testing locations and analytical methods; testing locations should be similar to any proposed track realignment or soil excavation locations, so potentially excavated soils could be characterized.

The site investigation presented in this report was conducted to evaluate the items described above.

2.2 Aerially Deposited Lead

Ongoing testing by Caltrans throughout the State has indicated that ADL exists along major freeway routes due to emissions from vehicles powered by leaded gasoline. The ADL is generally limited to the upper two feet of soil material within the unpaved shoulder and median areas.

2.3 Hazardous Waste Determination Criteria

Regulatory criteria to classify a waste as California hazardous for handling and disposal purposes are contained in the CCR, Title 22, Division 4.5, Chapter 11, Article 3, §66261.24. Criteria to classify a waste as Resource, Conservation, and Recovery Act (RCRA) hazardous are contained in Chapter 40 of the Code of Federal Regulations (40 CFR), Section 261.

For waste containing metals, the waste is classified as California hazardous when: 1) the total metal content exceeds the respective Total Threshold Limit Concentration (TTLC); or 2) the soluble metal content exceeds the respective Soluble Threshold Limit Concentration (STLC) based on the standard Waste Extraction Test (WET). A waste has the potential of exceeding the STLC when the waste's total metal content is greater than or equal to ten times the respective STLC value since the WET uses a 1:10 dilution ratio. Hence, when a total metal is detected at a concentration greater than or equal to ten times the respective STLC, and assuming that 100 percent of the total metals are soluble, soluble metal analysis is required. A material is classified as RCRA hazardous, or Federal hazardous, when the soluble metal content exceeds the Federal regulatory level 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 and corrosivity; 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.

The Department of Toxic Substances Control (DTSC) regulates and interprets hazardous waste laws in California. The DTSC generally considers excavated or transported materials that exhibit "hazardous waste" characteristics to be a "waste" requiring proper management, treatment and

disposal. Soil that contains lead above hazardous waste thresholds and is left in-place would not be necessarily classified by DTSC as a "waste." The DTSC has provided site-specific determinations that "movement of wastes within an area of contamination does not constitute "land disposal" and, thus, does not trigger hazardous waste disposal requirements. Therefore, lead-impacted soil that is scarified in-place, moisture-conditioned, and re-compacted during landscaping improvement activities might not be considered a "waste;" DTSC should be consulted to confirm waste classification. It is noted that in addition to DTSC regulations, health and safety requirements and other local agency requirements may also apply to the handling and disposal of lead-impacted soil. Waste that is classified as either "California hazardous" or "RCRA hazardous," requires management as a hazardous waste and disposal at an appropriately permitted disposal facility.

2.4 DTSC Variance

The DTSC issued a variance on September 22, 2000 for Caltrans District 4 regarding the disposition of ADL-impacted soils within Caltrans projects. Review of the District 4 Variance, as modified by DTSC on September 12, 2003, and June 17, 2008, indicates the following conditions regarding reuse and management of ADL-impacted soil as fill material for construction and maintenance operations in Caltrans right-of-way.

Category 1 (Caltrans Type Y-1):

Soil exhibiting soluble lead concentrations less than or equal to 0.5 milligrams per liter (mg/l) [based on a modified waste extraction test using deionized water as the extractant (WET-DI)] and total lead concentrations of 1,411 mg/kg or less may be used as fill provided that the lead-impacted soil is placed a minimum of 5 feet above the maximum water table elevation and covered with at least 1 foot of clean soil.

Category 2 (Caltrans Type Y-2):

Soil exhibiting soluble lead concentrations greater than 0.5 mg/l and less than 50 mg/l (based on the WET-DI) and total lead concentrations greater than 1,411 mg/kg and less than 3,397 mg/kg may be used as fill provided that the lead-impacted soil is placed a minimum of 5 feet above the maximum water table elevation and protected from infiltration by a pavement structure maintained by Caltrans.

Category 3 (Caltrans Type Y-2):

Lead-impacted soil with a pH less than 5.0 shall only be used as fill material under the paved portion of the roadway.

2.5 Environmental Screening Levels

The San Francisco Bay Regional Water Quality Control Board (SFRWQCB) has prepared a technical report entitled *Screening For Environmental Concerns At Sites With Contaminated Soil and Groundwater, Interim Final* (November 2007), which presents Environmental Screening Levels (ESLs) for soil, groundwater, soil gas, and surface water, to assist in evaluating sites impacted by releases of hazardous chemicals. The ESLs are conservative values for more than 100 commonly detected contaminants, which may be used to compare with environmental data collected at a site. ESLs are strictly risk assessment tools and "not regulatory clean up standards." The presence of a chemical at concentrations in excess of an ESL does not necessarily indicate that adverse impacts to human health or the environment are occurring; this simply indicates that a potential for adverse risk may exist and that additional evaluation is or may be warranted (SFRWQCB, 2007). The most restrictive ESL table was used for this characterization: Table A – Shallow Soil (≤3 meters below ground surface; bgs) – Groundwater is a Current or Potential Source of Drinking Water.

The most restrictive ESL table was used for this characterization: Table A – Shallow Soil (≤3 meters below ground surface; bgs) – Groundwater is a Current or Potential Source of Drinking Water. The respective ESLs are listed at the end of Tables 3 through 6 for comparative purposes.

3.0 SCOPE OF SERVICES

The following scope of services was performed by Geocon:

3.1 Pre-Field Activities

- Prepared the *Revised Final Site Investigation Workplan, Route I-880 Southbound Improvements Project, Alameda County, California,* dated October 23, 2008. The Workplan was electronically transmitted to the client and Caltrans, and was formally approved by Caltrans in a memo dated November 4, 2008. The Revised Final Workplan was prepared in response to Caltrans comments provided via email dated September 4, 2008, on the Final Site Investigation Workplan (Final Workplan). The Final Workplan was submitted on September 2, 2008 to address Caltrans comments (dated July 23, 2008) on the Revised Site Investigation Workplan (Revised Workplan). The Revised Workplan was submitted on July 16, 2008, to address previous Caltrans comments (dated June 30, 2008) on the Site Investigation Workplan (dated June 16, 2008).
- Prepared a Health and Safety Plan (HSP) for the project that provided guidelines on the use of personal protective equipment and the health and safety procedures to be implemented during the investigation activities.
- Retained the services of a Gregg Drilling & Testing direct push drill rig to advance soil borings at the Site.

- Retained the services of Advanced Technology Laboratories (ATL) to perform the analyses of the soil samples.
- Notified Underground Service Alert (USA) at least 48 hours prior to fieldwork involving drilling or direct push sampling activities.

3.2 Field Activities

The field activities consisted of advancing soil borings along the southbound shoulder, and at the interchanges with 98th Avenue, Davis Street, and Marina Boulevard using hand-auger and direct-push methods. Soil samples were collected from the borings as follows:

- On November 4 and 5, 2008, we collected 177 soil samples from 59 soil borings (SB-1 through SB-18, and SB-28 through SB-68) at the following depth intervals: 0 foot to 0.5 foot, 1.0 foot to 1.5 feet (ft) and 2.0 ft to 2.5 ft. Note that boring ID's SB-19 through SB-27 were not utilized.
- On November 19 and 20, 2008, we collected 86 soil samples from 18 borings (RW1-1 through RW1-5, RW2-1 through RW2-2, RW3-2, RW3-3, RW4-1, RW4-2, RW5-1, RW8-1, and RW8-2. Soil samples from the nine of the retaining wall borings were collected at depth intervals of 1.0 ft to 1.5 ft and 5.0 ft to 5.5 ft. The remaining nine soil borings were further advanced to depths between 16 ft and 24 ft to attempt to collect grab-groundwater and/or saturated soil samples. Grab-groundwater samples were obtained from the following five borings: DSGW1, MBGW2, RW2-1, RW3-2, RW8-1, and UPRR1.

Soil boring coordinates were obtained using global positioning system (GPS) equipment. The GPS coordinates are presented in Table 1. The boring locations are depicted on the Site Plans, Figures 2a through 2f.

4.0 INVESTIGATIVE METHODS

4.1 Sampling Procedures

The soil samples collected for metals, TPH and VOCs analysis were retrieved using direct-push and hand-auger methods. Soil samples obtained from the direct-push borings were collected using 1.5-inch diameter acetate liners, which were secured with Teflon tape and plastic end caps. Soil samples collected using the hand auger were transferred from the auger bucket into individual polyethylene sample bags, with the exception of samples collected for CAM17 metals analysis, which were collected in stainless steel tubes secured with Teflon tape and plastic end caps. Grab-groundwater samples were collected using a clean stainless steel bailer into appropriate, pre-preserved, laboratory-supplied containers. Soil and grab-groundwater samples were labeled and placed in a chilled cooler for transport to the analytical laboratory. Completed shallow soil borings were backfilled to surface grade with soil cuttings, and soil borings advanced to groundwater were backfilled with neat cement grout.

Sampling equipment was cleansed by washing the equipment with a Liquinox solution followed by two successive rinses with distilled water. The decontamination water was returned to the site surface away from storm drains and inlets in a manner not to create runoff.

The soil samples were transported to ATL for analysis, under standard chain-of-custody documentation.

4.2 Laboratory Analyses

Laboratory analyses were performed under a 48-hour turn-around-time (TAT) for lead analyses, and standard TATs for the other analyses. Reproductions of the laboratory reports and chain-of-custody documentation are presented as Appendix A. The laboratory analyses performed are summarized below:

Soil

- A total of 138 soil samples were analyzed for total lead following Environmental Protection Agency (EPA) Test Method 6010
- A total of 86 soil samples were analyzed for CAM17 metals using EPA Test Methods 6010B/7471A
- A total of 81 soil samples with total lead concentrations greater than 50 mg/kg (i.e. ten times the STLC of 5 mg/l) were further analyzed for soluble WET lead
- A total of 38 soil samples with soluble WET lead concentrations greater than the STLC of 5 mg/l were further analyzed for soluble WET-DI lead
- A total of 31 soil samples with total and soluble WET lead concentrations greater than 100 mg/kg and 5 mg/l, respectively, were further analyzed for soluble TCLP lead
- A total of 20 soil samples were analyzed for total petroleum hydrocarbons (TPH) as diesel and as motor oil (TPHd/mo) using EPA Test Method 8015M
- A total of 29 soil samples were analyzed for TPH as gasoline (TPHg), BTEX, and MTBE using EPA Test Method 8021B
- Three soil samples were analyzed for VOCs using EPA Method 8260B
- Four soil samples (those collected from boring UPRR1) were analyzed for semi volatile organic compounds (SVOCs) using EPA Method 8270
- A total of 19 soil samples were analyzed for soil pH following EPA Test Method 9045

Grab-Groundwater

- Six grab-groundwater samples were analyzed for CAM17 metals using EPA Test Methods 6010B/7471A
- Six grab-groundwater samples were analyzed for TPHd/mo using EPA Test Method 8015M
- Six grab-groundwater samples were analyzed for TPHg, BTEX, and MTBE using EPA Test Method 8021B
- Six grab-groundwater samples were analyzed for VOCs using EPA Method 8260B
- One grab-groundwater sample (UPRR1) was analyzed for SVOCs using EPA Method 8270

4.3 QA/QC Procedures

Quality assurance/quality control (QA/QC) procedures were performed for each method of analysis with specificity for each analyte listed in the test method's QA/QC. The laboratory QA/QC procedures included the following:

- One method blank for every ten samples, batch of samples or type of matrix, whichever was more frequent.
- One sample analyzed in duplicate for every ten samples, batch of samples or type of matrix, whichever was more frequent.
- One spiked sample for every ten samples, batch of samples or type of matrix, whichever was more frequent, with spike made at ten times the detection limit or at the analyte level.

Prior to submitting the soil samples to the laboratory, the chain-of-custody documentation was reviewed for accuracy and completeness.

5.0 INVESTIGATIVE RESULTS

5.1 Shoulder Borings

Analytical results of the soil samples are summarized in Tables 2 through 4.

- Total lead concentrations ranged from less than (<) the laboratory reporting limit of 5 mg/kg to 2,000 mg/kg, with 74 samples having reported concentrations equal to or exceeding 50 mg/kg (i.e. ten times the STLC of 5 mg/l).
- Soluble WET lead was reported in the soil samples at concentrations ranging from <0.25 mg/l to 76 mg/l.
- Soluble WET-DI lead was reported in the soil samples at concentrations ranging from <0.25 mg/l to 1.8 mg/l.
- Soluble TLCP lead was reported in the soil samples at concentrations ranging from <0.25 mg/l to 3.3 mg/l.
- Chromium was reported in the soil samples at concentrations ranging from 9.3 mg/kg to 75 mg/kg, with two samples exceeding ten times the STLC of 5.0 mg/kg. Soluble WET chromium was not detected above the laboratory reporting limit of 1.0 mg/l in the two samples.
- Mercury was reported in the soil samples at concentrations ranging from <0.10 mg/kg to 20 mg/kg, with one sample (SB-10-0) exceeding ten time the STLC of 2.0 mg/kg. Soluble WET mercury was not detected above the laboratory reporting limit of 1.0 mg/l in the sample.
- Antimony, arsenic, barium, cadmium, cobalt, copper, nickel, selenium, vanadium, and zinc were reported in the soil samples at concentrations below ten times their respective STLC values. Beryllium, silver, and thallium were not detected above their respective laboratory reporting limits in the soil samples.
- Reported soil pH values in the soil samples ranged from 6.4 to 8.4.

5.2 Retaining Wall and Structure Borings

Analytical results for soil and grab-groundwater samples collected at locations adjacent to proposed retaining walls and bent/structures are presented below.

5.2.1 Soil Samples

Analytical results for soil samples are presented in Tables 2 through 4.

- Total lead concentrations ranged from <5 mg/kg to 150 mg/kg, with four samples exceeding 50 mg/kg.
- Soluble WET lead was reported in the soil samples at concentrations ranging from 0.90 mg/l to 4.1 mg/l.
- Antimony, arsenic, barium, cadmium, chromium, cobalt, copper, mercury, nickel, selenium, vanadium, and zinc were reported in the soil samples at concentrations below ten times their

respective STLC values. Beryllium, silver, and thallium were not detected above their respective laboratory reporting limits in the soil samples.

- TPHd was reported in the soil samples at concentrations between 1.1 mg/kg and 1,100 mg/kg; TPHmo was reported in the soil samples at concentrations between 1.5 mg/kg and 1,600 mg/kg.
- TPHg, BTEX, MTBE, VOCs or SVOCs were not detected above their respective laboratory reporting limits in the soil samples analyzed for these constituents.

5.2.2 Grab-Groundwater Samples

Results for the grab-groundwater samples are presented in Tables 5 and 6.

- CAM17 metals were reported in the grab-groundwater samples as follows:
  - Arsenic was detected in two samples at concentrations of 0.011 mg/l and 0.021 mg/l
  - Barium was detected in the six samples at concentrations between 0.48 mg/l and 2.0 mg/l
  - Beryllium was detected in three samples at concentrations between 0.0038 mg/l and 0.0062 mg/l
  - Cadmium was detected in three samples at concentrations between 0.0061 mg/l and 0.0069 mg/l
  - Chromium was detected in five samples at concentrations between 0.0042 mg/l and 0.055 mg/l
  - Cobalt was detected in the six samples at concentrations between 0.023 mg/l and 0.11 mg/l
  - Copper was detected in the six samples at concentrations between 0.0072 mg/l and 0.089 mg/l
  - Lead was detected in sample DSGW1 at a concentration of 0.013 mg/l
  - Molybdenum was detected in sample MBGW2 at a concentration of 0.0077 mg/l
  - Nickel was detected in the six samples at concentrations between 0.025 mg/l and 0.39 mg/l
  - Selenium was detected in two samples at concentrations of 0.011 mg/l and 0.013 mg/l
  - Vanadium was detected in the six samples at concentrations between 0.038 mg/l and 0.082 mg/l
  - Zinc was detected in the six samples at concentrations between 0.049 mg/l and 0.38 mg/l
  - Antimony, mercury, silver, and thallium were not detected above their respective laboratory reporting limits in the grab-groundwater samples.
- TPHd was reported at concentrations between 0.060 mg/l and 0.25 mg/l
- TPHmo was reported at concentrations between 0.070 mg/l and 0.24 mg/l
- TPHg, BTEX, or MTBE were not detected above their respective laboratory reporting limits in the grab-groundwater samples
- VOCs were reported in three of the grab-groundwater samples as follows:

- 1,1-Dichloroethene (1,1-DCE) was detected in sample MBGW2 at a concentration of 0.53 micrograms per liter (µg/l)
- Dichlorodifluoromethane was detected in sample RW3-2 at a concentration of 1.8 µg/l
- Tetrachloroethene (PCE) was reported at concentrations between 3.8 µg/l and 32 µg/l
- Trichloroethene (TCE) was reported at concentrations between 0.57 µg/l and 5.5 µg/l

- SVOCs were not detected above their respective laboratory reporting limits the in grab-groundwater sample analyzed for these constituents

5.3 Laboratory Quality Assurance/Quality Control

We reviewed the laboratory QA/QC provided with the laboratory report. The data show acceptable surrogate recoveries and non-detect results for the method blanks.

The relative percent differences (RPDs) of the duplicate samples for three metals and one of the TPH analyses were outside criteria. Matrix Spike (MS) and/or Matrix Spike Duplicate (MSD) were outside recovery criteria for several analyses. The Case Narratives in the laboratory reports state that each analytical batch was validated by the Laboratory Control Sample (LCS). The data showed acceptable recoveries and RPDs for the remainder of the duplicates and matrix spikes.

Several samples required dilution due to sample matrix. The surrogate recovery for one of the laboratory duplicate sample was biased high, which was also likely due to matrix interferences. However, acceptable reporting limits were achieved and other laboratory QA/QC samples were within criteria.

Based on this limited data review, no additional qualifications of the soil data are necessary and the data are of sufficient quality for the purposes of this report.

5.4 Statistical Evaluation for Lead Detected in Soil Samples

Statistical methods were applied to the total lead data to evaluate: 1) the upper confidence limits (UCLs) of the arithmetic means of the total lead concentrations for each sampling depth; and 2) if an acceptable correlation between total and soluble lead concentrations exists that would allow the prediction of soluble lead concentrations based on calculated UCLs. The statistical methods used are discussed in a book entitled *Statistical Methods for Environmental Pollution Monitoring,* by Richard Gilbert; in an EPA *Technology Support Center Issue* document entitled, *The Lognormal Distribution in Environmental Applications,* by Ashok Singh et. al., dated December 1997; and in a book entitled *An Introduction to the Bootstrap,* by Bradley Efron and Robert J. Tibshirani.

The lead data for the Site were treated as five sample populations for statistical evaluation, which consisted of the following:

A) Soil samples collected from shoulder borings SB-1 through SB-7
B) Soil samples collected from shoulder borings SB-8 through SB-18 and retaining wall borings RW8-1 and RW8-2
C) Soil samples collected from shoulder borings SB-28 through SB-34 and retaining wall boring RW5-1
D) Soil samples collected from shoulder borings SB-35 through SB-50 and retaining wall/structure borings DSGW1, RW1-1 through RW1-5, RW2-1 RW2-2, RW3-2, RW3-3, RW4-1, and RW4-2
E) Soil samples collected from shoulder borings SB-51 through SB-68, and Marina Boulevard structure borings MBGW1 and MBGW2.

5.4.1 Calculating the UCLs for the Arithmetic Mean

The upper one-sided 90% and 95% UCLs of the arithmetic mean are defined as the values that, when calculated repeatedly for randomly drawn subsets of site data, equal or exceed the true mean 90% and 95% of the time, respectively. Statistical confidence limits are the classical tool for addressing uncertainties of a distribution mean. The UCLs of the arithmetic mean concentration are used as the mean concentrations because it is not possible to know the true mean due to the essentially infinite number of soil samples that could be collected from a site. The UCLs therefore account for uncertainties due to limited sampling data. As data become less limited at a site, uncertainties decrease, and the UCLs move closer to the true mean.

Non-parametric bootstrap techniques used to calculate the UCLs are discussed in the previously referenced EPA document and in *An Introduction to the Bootstrap.* For those samples in which total lead was not detected at concentrations exceeding the laboratory MRL, a value equal to one-half of the detection limit was used in the UCL calculation. In addition to the computation of 90% and 95% UCLs, outlier tests were performed on the total lead results for the samples collected at the Site. The statistical tests indicated that the total lead analytical result of 2,000 mg/kg reported for sample SB35-2 was determined to be an outlier; therefore, this sample was reanalyzed for total and soluble WET lead, with a reported result of 2,000 mg/kg. Therefore, the analytical results for this sample were not included in the calculation of lead UCLs. The bootstrap test results are included in Appendix B, and the following tables present the calculated UCLs and statistics for the data set.

Borings SB-1 through SB-7

SAMPLE INTERVAL (feet)	90% TOTAL LEAD UCL (mg/kg)	95% TOTAL LEAD UCL (mg/kg)	TOTAL LEAD MEAN (mg/kg)	MINIMUM VALUE (mg/kg)	MAXIMUM VALUE (mg/kg)
0 to 0.5	126.9	132.7	106.4	43	170
1.0 to 1.5	95.4	101.1	75.7	20	130
2.0 to 2.5	51.9	54.7	43.1	17	66

Borings SB-8 through SB-18, RW8-1, and RW8-2

SAMPLE INTERVAL (feet)	90% TOTAL LEAD UCL (mg/kg)	95% TOTAL LEAD UCL (mg/kg)	TOTAL LEAD MEAN (mg/kg)	MINIMUM VALUE (mg/kg)	MAXIMUM VALUE (mg/kg)
0 to 0.5	43.8	45.4	38.4	22	71
1.0 to 1.5	64.1	68.0	52.0	0.5	120
2.0 to 2.5	39.7	41.2	34.2	7.4	55

Borings SB-28 through SB-34 and RW5-1

SAMPLE INTERVAL (feet)	90% TOTAL LEAD UCL (mg/kg)	95% TOTAL LEAD UCL (mg/kg)	TOTAL LEAD MEAN (mg/kg)	MINIMUM VALUE (mg/kg)	MAXIMUM VALUE (mg/kg)
0 to 0.5	46.6	49.6	37.1	17	65
1.0 to 1.5	142.4	152.3	105.4	20	240
2.0 to 2.5	105.6	119.1	64.0	6.2	270

Borings SB-35 through SB-50, DSGW1, RW1-1 through RW1-5, RW2-1 RW2-2, RW3-2, RW3, RW4-1, and RW4-2 (excluding outlier sample SB35-2)

SAMPLE INTERVAL (feet)	90% TOTAL LEAD UCL (mg/kg)	95% TOTAL LEAD UCL (mg/kg)	TOTAL LEAD MEAN (mg/kg)	MINIMUM VALUE (mg/kg)	MAXIMUM VALUE (mg/kg)
0 to 0.5	62.6	65.3	51.9	2.5	160
1.0 to 1.5	48.1	50.7	38.4	0.5	150
2.0 to 2.5	45.8	49.4	32.8	2.5	150

Borings SB-51 through SB-68, MBGW1 and MBGW2

SAMPLE INTERVAL (feet)	90% TOTAL LEAD UCL (mg/kg)	95% TOTAL LEAD UCL (mg/kg)	TOTAL LEAD MEAN (mg/kg)	MINIMUM VALUE (mg/kg)	MAXIMUM VALUE (mg/kg)
0 to 0.5	221.2	238.2	165.2	6.4	670
1.0 to 1.5	64.1	68.5	50.1	6.1	180
2.0 to 2.5	172.0	191.6	107.8	5.3	970

5.4.2 Correlation of Total and Soluble Lead

Total and corresponding soluble WET lead concentrations are bivariate data with a linear structure. This linear structure should allow for the prediction of soluble WET lead concentrations based on the UCLs calculated above in Section 5.4.1.

To estimate the degree of interrelation between total and corresponding soluble WET lead values (x and y, respectively), the *correlation coefficient [r]* is used. The correlation coefficient is a ratio that ranges from +1 to –1. A *correlation coefficient* of +1 indicates a perfect direct relationship between two variables; a *correlation coefficient* of –1 indicates that one variable changes inversely with relation to the other. Between the two extremes is a spectrum of less-than-perfect relationships, including zero, which indicates the lack of any sort of linear relationship at all. The *correlation coefficient* was calculated for the 81 (x, y) data points (i.e., soil samples analyzed for both total lead [x] and soluble WET lead [y]). The resulting *coefficient of determination* (r^2) equaled 0.883, which yields a corresponding *correlation coefficient* (r) of 0.940. To achieve an acceptable correlation, data for the outlier sample SB35-2 was excluded from the regression.

For the *correlation coefficient* that indicates a linear relationship between total and soluble WET lead concentrations, it is possible to compute the line of dependence or a best-fit line between the two variables. A least squares method was used to find the equation of a best-fit line (regression line) by forcing the y-intercept equal to zero since that is a known point. The equation of the regression line was determined to be $y = 0.0678(x)$, where x represents total lead concentrations and y represents predicted soluble lead WET concentrations.

This equation was used to estimate the expected WET soluble lead concentrations for the UCLs calculated in for samples collected from the Site (see Section 5.4.1). Regression analysis results and a scatter plot depicting the (x, y) data points along with the regression line are included in Appendix C. The predicted soluble WET lead concentrations for the soil samples collected at the Site are summarized in Tables 7a through 7e.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Waste classifications are evaluated based on the 90% UCL of the lead content for the relevant excavation depths; this has historically been considered sufficient to satisfy a good faith effort by the EPA as discussed in SW-846. Risk assessment characterization is based on the 95% UCL of the lead content in the waste for the relevant depths; this is in accordance with the Risk Assessment Guidance for Superfund (RAGS) Volume 1 Documentation for Exposure Assessment. Per Caltrans, the 90% UCLs are to be used to evaluate onsite reuse and the 95% UCLs are to be used to evaluate offsite disposal.

6.1 Predicted Soluble Lead

6.1.1 Borings SB-1 through SB-7 (Station 468 to 443)

The following table summarizes the predicted soluble WET lead concentrations and the waste classification for excavated soil based on the calculated total lead UCLs and the relationship between total and soluble WET lead for data collected at the Site. The total and soluble WET lead calculations are summarized in Table 7a.

Excavation Depth	90% UCL Total Lead (mg/kg)	90% UCL Predicted WET Lead (mg/l)	95% UCL Total Lead (mg/kg)	95% UCL Predicted WET Lead (mg/l)	Waste Classification
0 to 1.0 ft	127	**8.6**	133	**9.0**	**Hazardous**
Underlying soil (1.0 to 2.5 ft)	*81*	*5.5*	*86*	*5.8*	***Hazardous***
0 to 2.0 ft	111	**7.6**	117	**7.9**	**Hazardous**
Underlying Soil (2.0 to 2.5 ft)	*52*	*3.5*	*55*	*3.7*	*Non-Hazardous*
0 to 2.5 ft	99	**6.8**	104	**7.1**	**Hazardous**

90% UCL applicable for waste classification and onsite reuse; 95% UCL applicable for risk assessment.

Based on the data presented in the above table, soil excavated from the surface to a depth of 2.0 feet would be classified as a California hazardous waste since the 90% UCL-predicted soluble WET lead concentration is greater than the lead STLC of 5.0 mg/l. Underlying soil (i.e. deeper than 2.0 ft) may be reused as non-hazardous.

Based on the reported WET-DI results, soil excavated from the surface to a depth of 2.0 feet may be reused onsite in accordance with the DTSC Variance by placing the excavated soil under clean fill or pavement.

Based on the soluble TCLP lead concentrations, soil will not be classified as a RCRA hazardous waste.

6.1.2 Borings SB-8 through SB-18, and RW8 (Station 443 to 425)

The following table summarizes the predicted soluble WET lead concentrations and the waste classification for excavated soil based on the calculated total lead UCLs and the relationship between total and soluble WET lead for data collected at the Site. The total and soluble WET lead calculations are summarized in Table 7b.

Excavation Depth	90% UCL Total Lead (mg/kg)	90% UCL Predicted WET Lead (mg/l)	95% UCL Total Lead (mg/kg)	95% UCL Predicted WET Lead (mg/l)	Waste Classification
0 to 1.0 ft	44	3.0	45	3.1	Non-Hazardous
Underlying soil (1.0 to 2.5 ft)	*56*	*3.8*	*59*	*4.0*	*Non-Hazardous*
0 to 2.0 ft	54	3.7	57	3.9	Non-Hazardous
Underlying Soil (2.0 to 2.5 ft)	*40*	*2.7*	*41*	*2.8*	*Non-Hazardous*
0 to 2.5 ft	51	3.5	54	3.6	Non-Hazardous

90% UCL applicable for waste classification and onsite reuse; 95% UCL applicable for risk assessment.

Based on the data presented in the above table, soil excavated from this portion of the Site would not be classified as a California hazardous waste since the 90% UCL-predicted soluble WET lead concentrations are less than the lead STLC of 5.0 mg/l. Consequently, excavated soil may be reused onsite as non-hazardous with respect to lead content.

6.1.3 Borings SB-28 through SB-34, and RW5-1 (Station 398 to 377)

The following table summarizes the predicted soluble WET lead concentrations and the waste classification for excavated soil based on the calculated total lead UCLs and the relationship between total and soluble WET lead for data collected at the Site. The total and soluble WET lead calculations are summarized in Table 7c.

Excavation Depth	90% UCL Total Lead (mg/kg)	90% UCL Predicted WET Lead (mg/l)	95% UCL Total Lead (mg/kg)	95% UCL Predicted WET Lead (mg/l)	Waste Classification
0 to 1.0 ft	47	3.2	50	3.4	Non-Hazardous
Underlying soil (1.0 to 2.5 ft)	*130*	***8.8***	*141*	***9.6***	***Hazardous***
0 to 2.0 ft	94	**6.4**	101	**6.9**	**Hazardous**
Underlying Soil (2.0 to 2.5 ft)	*106*	***7.2***	*119*	***8.1***	***Hazardous***
0 to 2.5 ft	97	**6.6**	105	**7.1**	**Hazardous**

90% UCL applicable for waste classification and onsite reuse; 95% UCL applicable for risk assessment.

Based on the data presented in the above table, if excavated as whole, soil from the surface to a depth of 2.5 feet would be classified as a California hazardous waste since the 90% UCL-predicted soluble WET lead concentration is greater than the lead STLC of 5.0 mg/l.

Based on the reported WET-DI lead results, soil excavated from the surface to a depth of 2.5 feet may be reused onsite in accordance with the DTSC Variance by placing the excavated soil under clean fill or pavement.

If excavated separately, soil between the surface and a depth of 1.0 foot would not be classified as a California hazardous waste since the 90% UCL-predicted soluble WET lead concentration is less than the lead STLC of 5.0 mg/l, and may be disposed as non-hazardous. Underlying soil excavated to a depth of 2.5 feet would be classified as a California hazardous waste.

Based on the soluble TCLP lead concentrations, soil will not be classified as a RCRA hazardous waste.

6.1.4 Borings SB-35 through SB-50, DSGW1, RW1, RW2, RW3, and RW4 (Station 377 to 340)

The following table summarizes the predicted soluble WET lead concentrations and the waste classification for excavated soil based on the calculated total lead UCLs and the relationship between total and soluble WET lead for data collected at the Site. The total and soluble WET lead calculations are summarized in Table 7d.

Excavation Depth	90% UCL Total Lead (mg/kg)	90% UCL Predicted WET Lead (mg/l)	95% UCL Total Lead (mg/kg)	95% UCL Predicted WET Lead (mg/l)	Waste Classification
0 to 1.0 ft	63	4.3	65	4.4	Non-Hazardous
Underlying soil (1.0 to 2.5 ft)	*47*	*3.2*	*50*	*3.4*	*Non-Hazardous*
0 to 2.0 ft	55	3.8	58	3.9	Non-Hazardous
Underlying Soil (2.0 to 2.5 ft)	*46*	*3.1*	*49*	*3.4*	*Non-Hazardous*
0 to 2.5 ft	53	3.6	56	3.8	Non-Hazardous

90% UCL applicable for waste classification and onsite reuse; 95% UCL applicable for risk assessment.

Based on the data presented in the above table, soil excavated from the surface to a depth of at least 2.5 ft would not be classified as a California hazardous waste since the 90% UCL-predicted soluble WET lead concentrations are less than the lead STLC of 5.0 mg/l.

The total lead result for soil sample SB-35-2 was determined to be a statistical outlier and was removed from the above data set (see Section 5.4.1 and Appendix B). Soil in the vicinity of outlier sample SB-35-2 should be either 1) managed and disposed of as a California hazardous waste or 2) resampled to confirm waste classification in accordance with specific disposal facility acceptance criteria.

6.1.5 Borings SB-51 through SB-68, MBGW1 and MBGW2 (Station 340 to 314)

The following table summarizes the predicted soluble WET lead concentrations and the waste classification for excavated soil based on the calculated total lead UCLs and the relationship between total and soluble WET lead for data collected at the Site. The total and soluble WET lead calculations are summarized in Table 7e.

Excavation Depth	90% UCL Total Lead (mg/kg)	90% UCL Predicted WET Lead (mg/l)	95% UCL Total Lead (mg/kg)	95% UCL Predicted WET Lead (mg/l)	Waste Classification
0 to 1.0 ft	221	**15**	238	**16**	**Hazardous**
Underlying soil (1.0 to 2.5 ft)	*100*	***6.8***	*110*	***7.4***	***Hazardous***
0 to 2.0 ft	143	**9.7**	153	**10**	**Hazardous**
Underlying Soil (2.0 to 2.5 ft)	*172*	*12*	*192*	*13*	***Hazardous***
0 to 2.5 ft	149	**10**	161	**11**	**Hazardous**

90% UCL applicable for waste classification and onsite reuse; 95% UCL applicable for risk assessment.

Based on the data presented in the above table, soil excavated from the surface to a depth of 2.5 feet would be classified as a California hazardous waste since the 90% UCL-predicted soluble WET lead concentration is greater than the lead STLC of 5.0 mg/l.

Based on the reported WET-DI results, soil excavated from the surface to a depth of 2.5 feet may be reused onsite in accordance with the DTSC Variance by placing the excavated soil under clean fill or pavement.

Based on the soluble TCLP lead concentrations, soil will not be classified as a RCRA hazardous waste.

6.2 Soil

6.2.1 CAM17 Metals

The total CAM17 metal results for soil samples are summarized in Table 3. Based on the total CAM17 metals concentrations (with the exception of lead) and the reported levels of soluble WET chromium and mercury, soil excavated from the Site should not be considered a hazardous waste.

The CAM17 metals concentrations in soil were compared to ESLs (SFRWQCB, November 2007, Table A). Reported arsenic concentrations were between <1.0 mg/kg and 11 mg/kg in the soil samples, which exceed the residential and commercial/industrial land use ESLs of 0.38 mg/kg and 1.5 mg/kg, respectively. Reported vanadium concentrations were between 18 mg/kg and 93 mg/kg in the soil samples, exceeding the residential land use ESL of 15 mg/kg. Reported mercury concentrations were between <0.10 mg/kg and 20 mg/kg, with two samples exceeding the residential ESL of 1.0 mg/kg.

Upper one-sided 90% and 95% UCLs were calculated for the reported arsenic, mercury, and vanadium concentrations for the soil samples collected at the Site. The UCLs were compared with the residential and commercial/industrial land use ESLs and with published background levels typically present in California soils as presented in *Background Concentrations of Trace and Major Elements in California Soils* (Kearney Foundation of Soil Science, Division of Agriculture and Natural Resources, University of California, March 1996). The bootstrap results are included in Appendix B. The calculated standard bootstrap UCLs, ESLs and published background concentrations are summarized in the table below:

Metal	90% UCL	95% UCL	Residential ESL	Commercial/ Industrial ESL	PUBLISHED BACKGROUND MEAN[1]	PUBLISHED BACKGROUND RANGE [1]
Arsenic	4.7	4.8	0.38	1.5	3.5	0.6 to 11.0
Mercury	0.67	0.76	1.0	10	0.26	0.05 to 0.9
Vanadium	35.5	35.9	15	190	112	39 to 288

Concentrations reported in milligrams per kilogram (mg/kg); [1] Kearney Foundation of Soil Science, March 1996

The 90% and 95% UCL values for arsenic in the soil samples collected at the Site are greater than the ESLs; however are within the published background concentration range. The SFRWQCB *November 2007 Update to Environmental Screening Levels (ESLs) Technical Document* states that ambient background concentrations of arsenic typically exceed risk-based screening levels. In such instances, it may be more appropriate to compare site data to regionally-specific established background levels (Kearney Foundation of Soil Science, 1996).

The 90% and 95% UCL values for mercury in the soil samples collected at the Site are less than the residential ESL and are within the published background concentration range.

The 90% and 95% UCL values for vanadium in the soil samples collected at the Site are greater than the residential land use ESL, and are less than both the commercial/industrial land use ESL and published background concentrations.

Based on the calculated UCLs for arsenic, mercury, and vanadium, and comparisons to ESLs and the published background concentrations, offsite disposal of soil may be restricted based on metals content, depending on proposed use.

6.2.2 Petroleum Hydrocarbon Compounds

TPHg, BTEX, MTBE, VOCs or SVOCs were not detected above the laboratory reporting limit in the soil samples.

TPHd was detected above the laboratory reporting limit in the soil samples at concentrations between 1.1 mg/kg and 1,100 mg/kg, with four samples exceeding the residential and commercial/industrial land use ESL of 83 mg/kg for middle distillates in shallow soil (SFRWQCB, Table A). TPHmo was reported in the soil samples at concentrations between 1.4 mg/kg and 6,700 mg/kg, with exceeding the residential and commercial/industrial land use ESLs of 410 mg/kg and 2,500 mg/kg, respectively, for residual fuels in shallow soil (SFRWQCB, Table A).

Upper one-sided 90% and 95% upper confidence limits (UCLs) were calculated for the full set of TPHd/mo results for soil samples collected at the Site. For those samples in which TPHd/mo was not detected at concentrations exceeding the laboratory MRL, a value equal to one-half of the detection limit was used in the UCL calculation. The bootstrap results are included in Appendix B. The calculated standard bootstrap UCLs and ESLs for TPHd/mo are summarized in the following table:

Compound	90% UCL	95% UCL	Mean	Minimum	Maximum	Residential ESL	Commercial/ Industrial ESL
TPHd	266.5	293.7	167.5	1.1	1,100	83	83
TPHmo	1,360	1,511	833.7	1.4	6,700	410	2,500

Concentrations reported in milligrams per kilogram (mg/kg)

The calculated 90% and 95% UCLs for TPHd are greater than the residential and commercial/industrial land use ESL value of 83 mg/kg. The calculated UCLs for TPHmo exceed the residential land use ESL and are less than the commercial/industrial land use ESL. Therefore, offsite disposal of soil may be restricted based on petroleum hydrocarbon content, depending on proposed use.

6.3 Groundwater

6.3.1 CAM17 Metals

CAM17 metals were reported in the grab-groundwater samples collected at the Site at concentrations exceeding applicable standards. Specifically, barium, beryllium, cadmium,

chromium, nickel, and vanadium were reported above their respective ESLs for Groundwater that IS a Potential Drinking Water Source and Freshwater (SFRWQCB, Tables A and F, November 2007), Department of Health Services Maximum Contaminant Levels (DHS MCLs, Title 22, CCR, Division 4, Chapter 15, Article 4, September 12, 2003), and Water Quality Objectives (WQOs) for Municipal and Agricultural Supply (SFRWQCB Basin Plan, January 2007). The following CAM17 metals were reported in the grab-groundwater samples at concentrations below their respective ESLs, MCLs, and WQOs: antimony, arsenic, cobalt, copper, lead, mercury, molybdenum, selenium, silver, thallium, and zinc. Therefore, there may be restrictions for handling groundwater generated during the proposed project.

6.3.2 Organics

TPHg, BTEX, MTBE, and SVOCs were not detected above laboratory reporting limits in the samples. Reported concentrations of TPHd/mo in the grab-groundwater samples are below their respective ESLs, MCLs, and WQOs.

VOCs were and reported in the grab-groundwater samples at concentrations exceeding their respective ESLs, MCLs, and WQOs. Specifically, PCE and TCE were reported in grab-groundwater sample MBGW2 at concentrations of 32 µg/l and 5.5 µg/l, respectively. These reported values are greater than the ESLs for Groundwater That is a Current/Potential Source of Drinking Water (SFRWQCB, Tables A and F, November 2007), MCLs (Title 22, CCR, Division 4, Chapter 15, Article 4, September 12, 2003), and WQOs for Municipal Supply of 5.0 µg/l for each compound (SFRWQCB Basin Plan, January 2007). The detection of these compounds in the grab-groundwater samples is likely attributable to a well-documented regional plume of VOC-impacted groundwater. Therefore, there may be restrictions for handling groundwater generated during the proposed project.

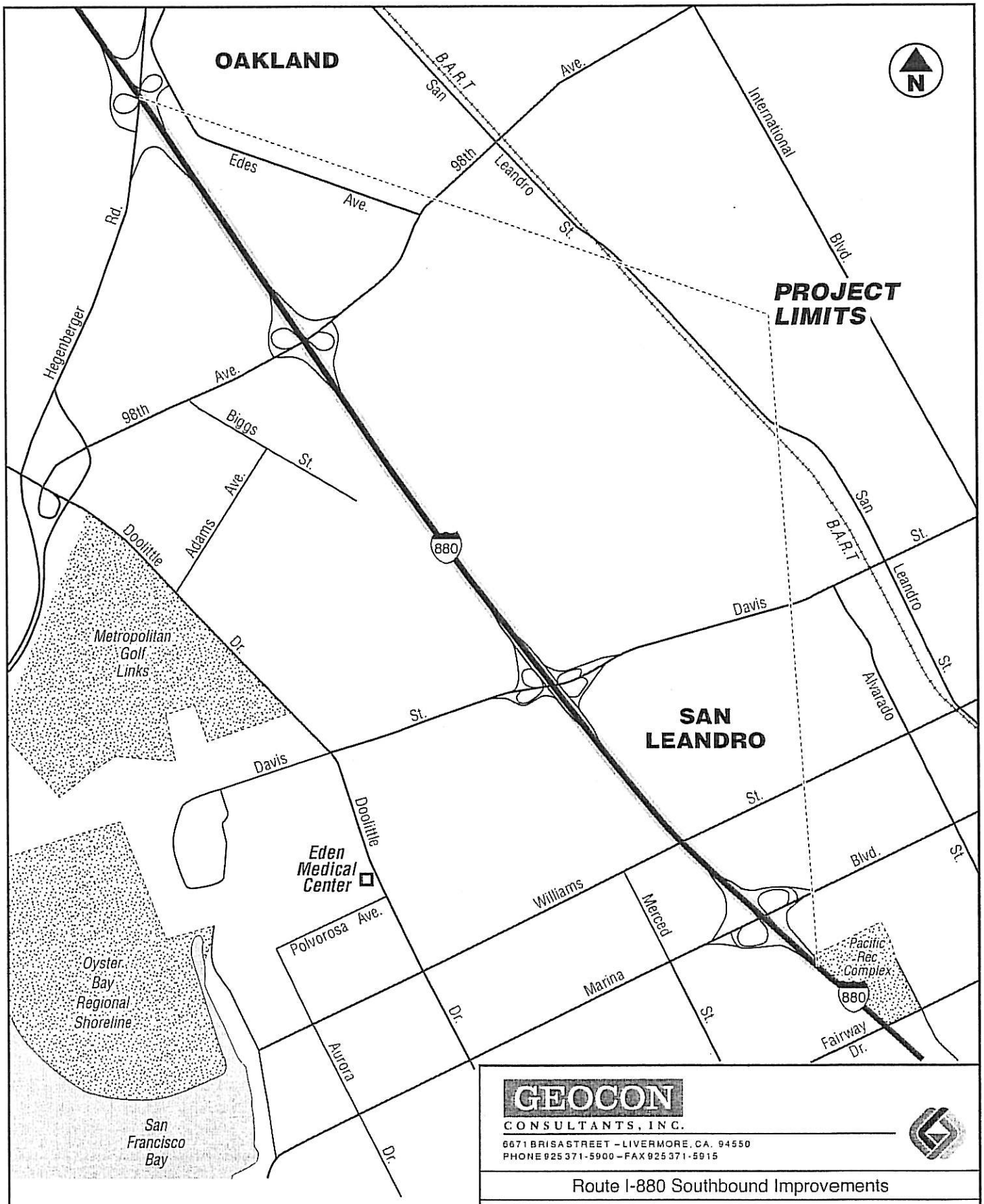
6.4 Worker Protection

Per Caltrans requirements, the contractor(s) should prepare a project-specific lead compliance plan (CCR Title 8, Section 1532.1, the "Lead in Construction" standard) to minimize worker exposure to lead-impacted soil. The plan should include protocols for environmental and personnel monitoring, requirements for personal protective equipment, and other health and safety protocols and procedures for the handling of lead-impacted soil.

7.0 REPORT LIMITATIONS

This report has been prepared exclusively for Rajappan & Meyer Consulting Engineers, Inc. The information contained herein is only valid as of the date of the field sampling, 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.



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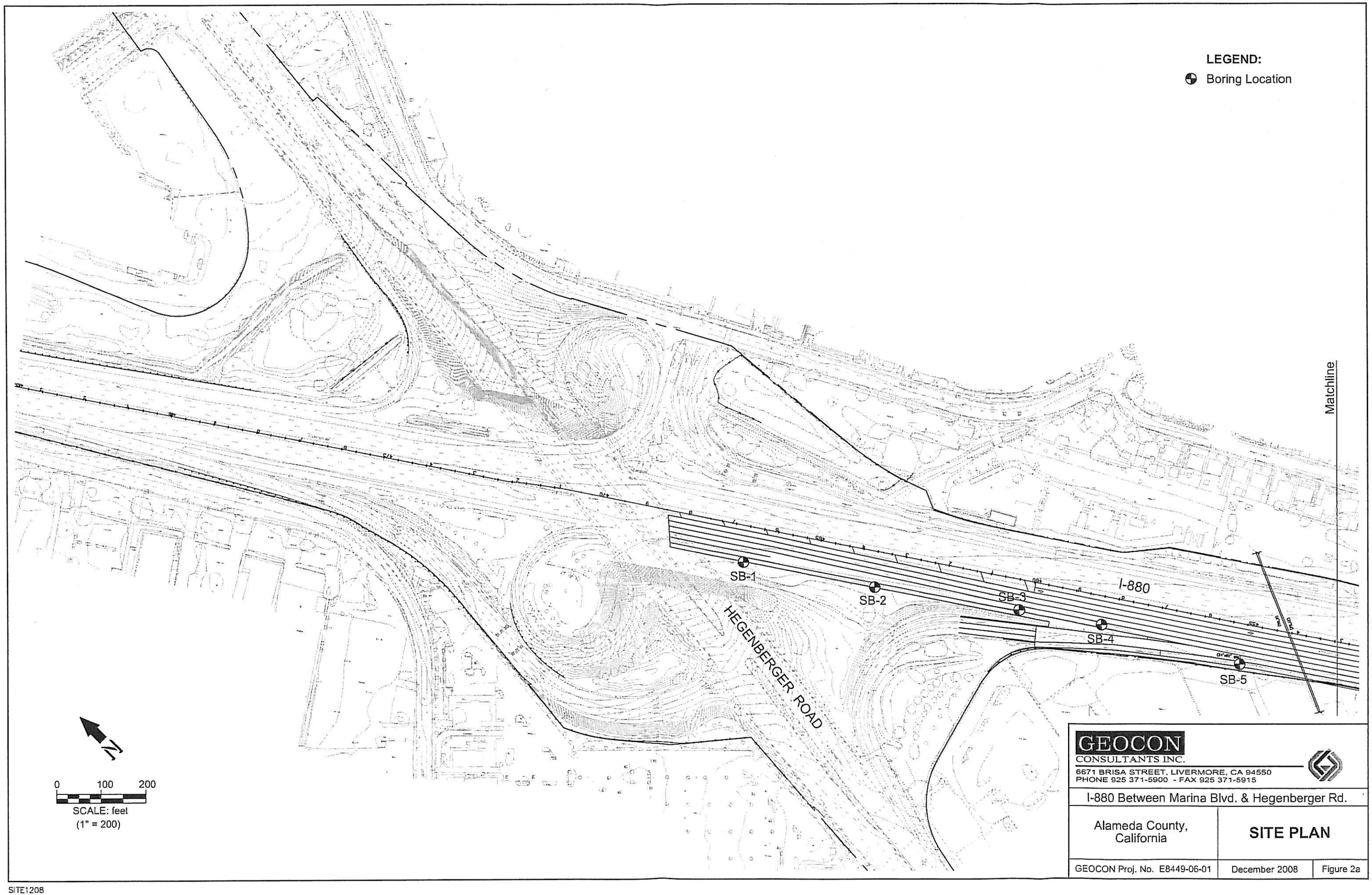
Route I-880 Southbound Improvements

Oakland & San Leandro,
California

VICINITY MAP

E8449-06-01	December 2008	Figure 1



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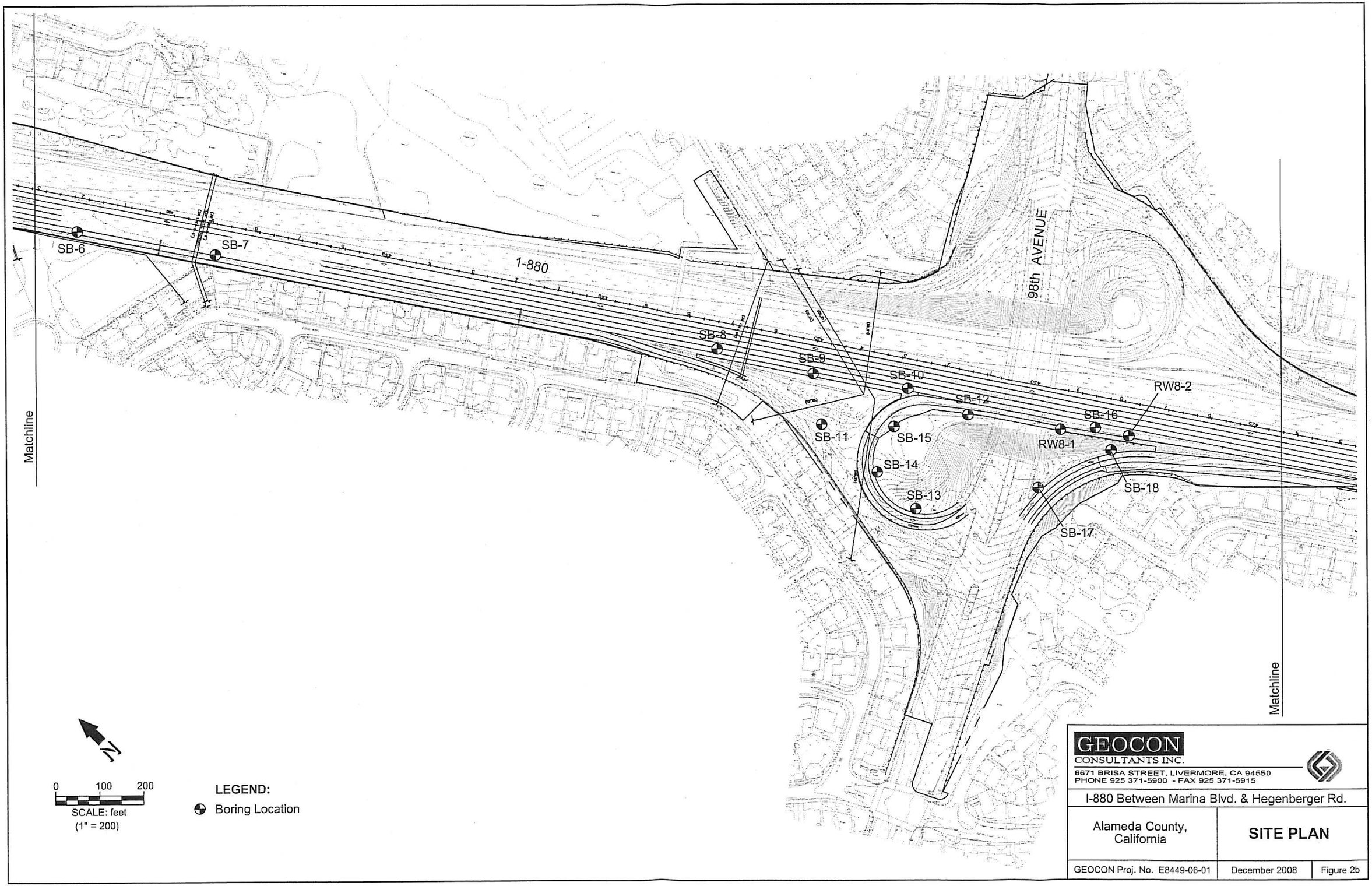
Alameda County, California	SITE PLAN	
GEOCON Proj. No. E8449-06-01	December 2008	Figure 2a

SITE1208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SB-7
I-880
SB-8
SB-9
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SB-14
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SB-17
SB-18
RW8-1
RW8-2
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(1" = 200)
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Boring Location
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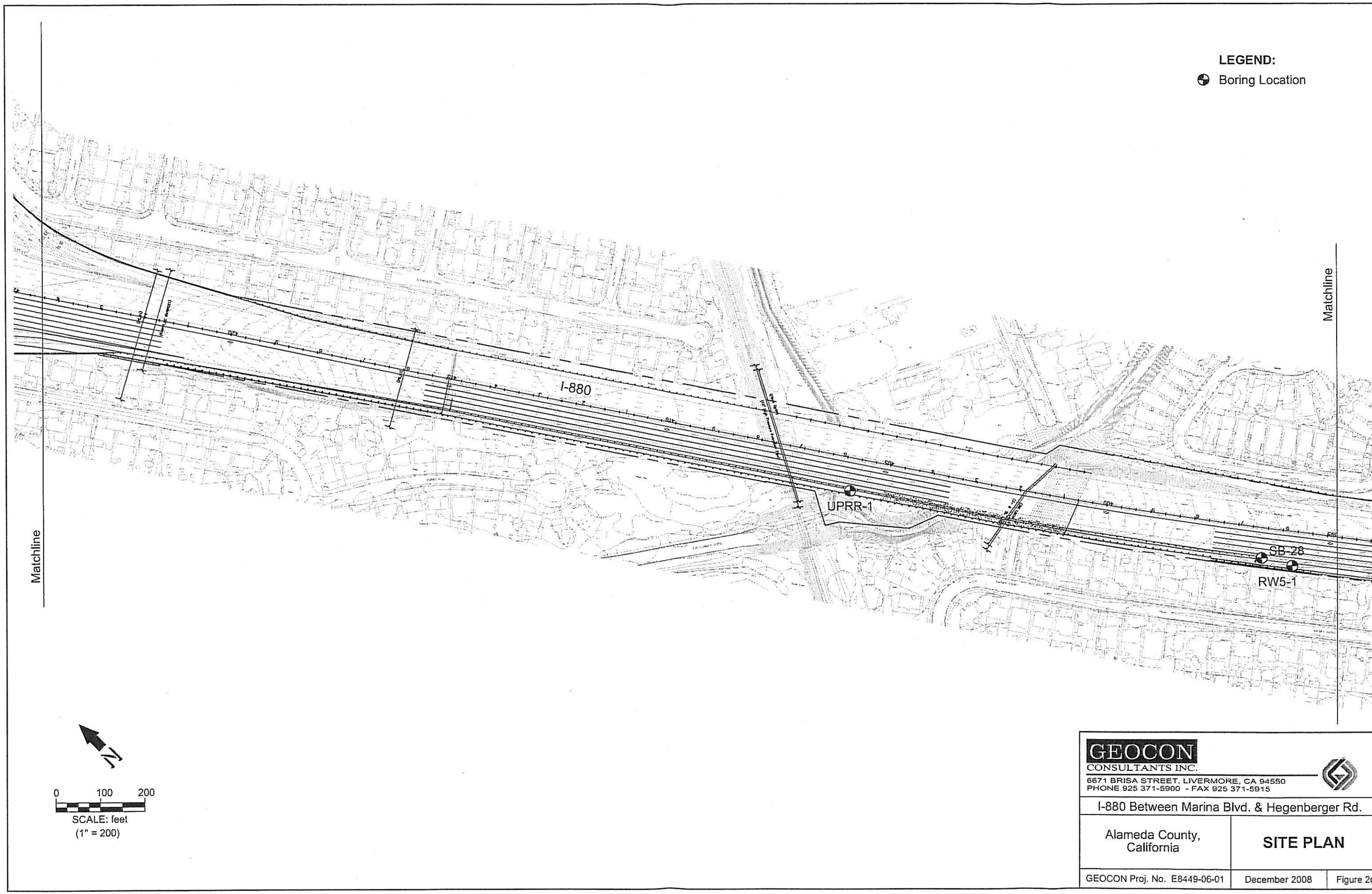
Alameda County, California
SITE PLAN
GEOCON Proj. No. E8449-06-01
December 2008
Figure 2b

SITE1208



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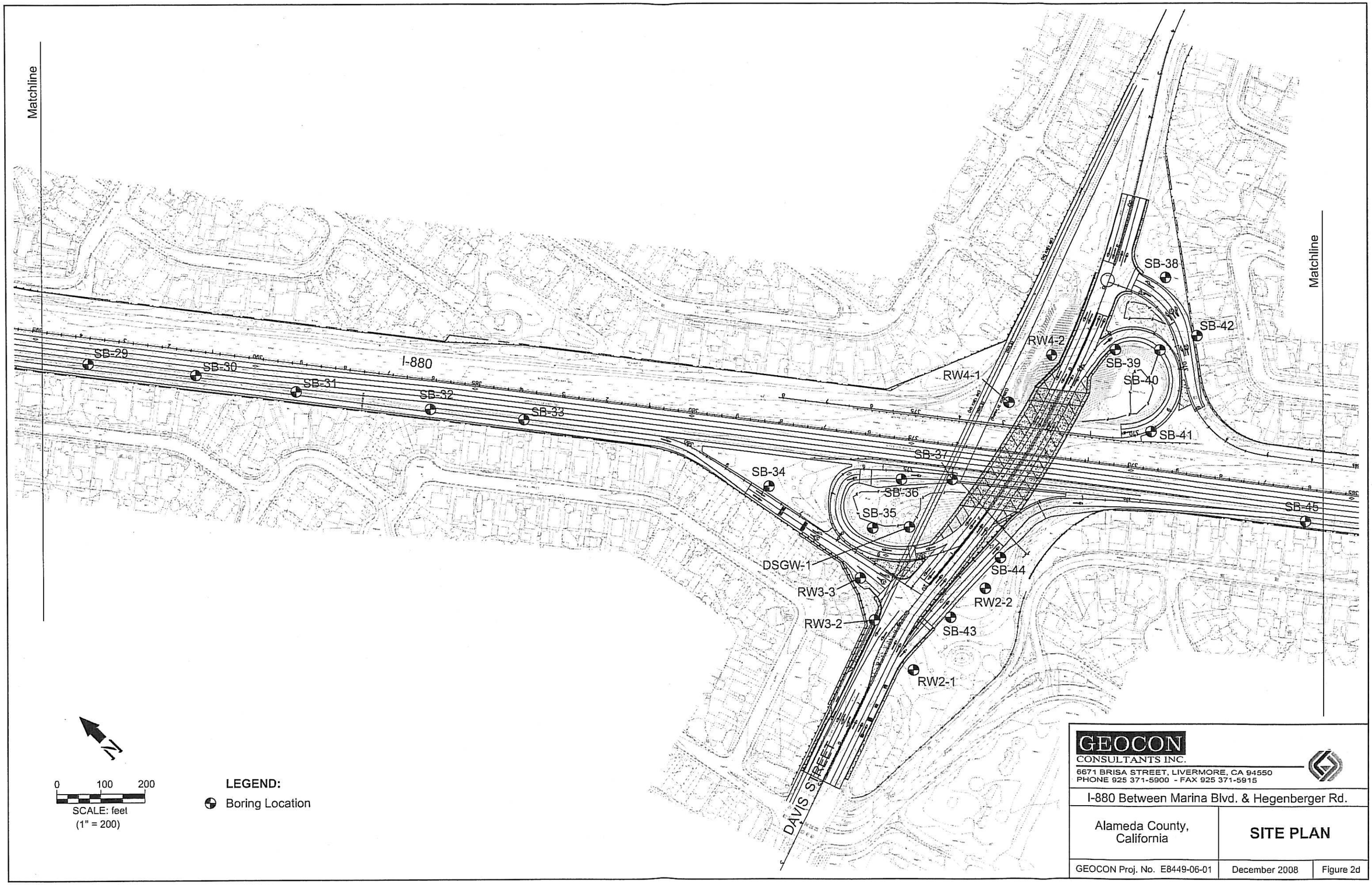
Alameda County, California

SITE PLAN

GEOCON Proj. No. E8449-06-01 | December 2008 | Figure 2c

SITE1208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SB-41
SB-42
SB-43
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SB-45
RW4-1
RW4-2
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RW3-3
RW3-2
RW2-2
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DAVIS STREET
N
0 100 200
SCALE: feet
(1" = 200)
LEGEND:
Boring Location
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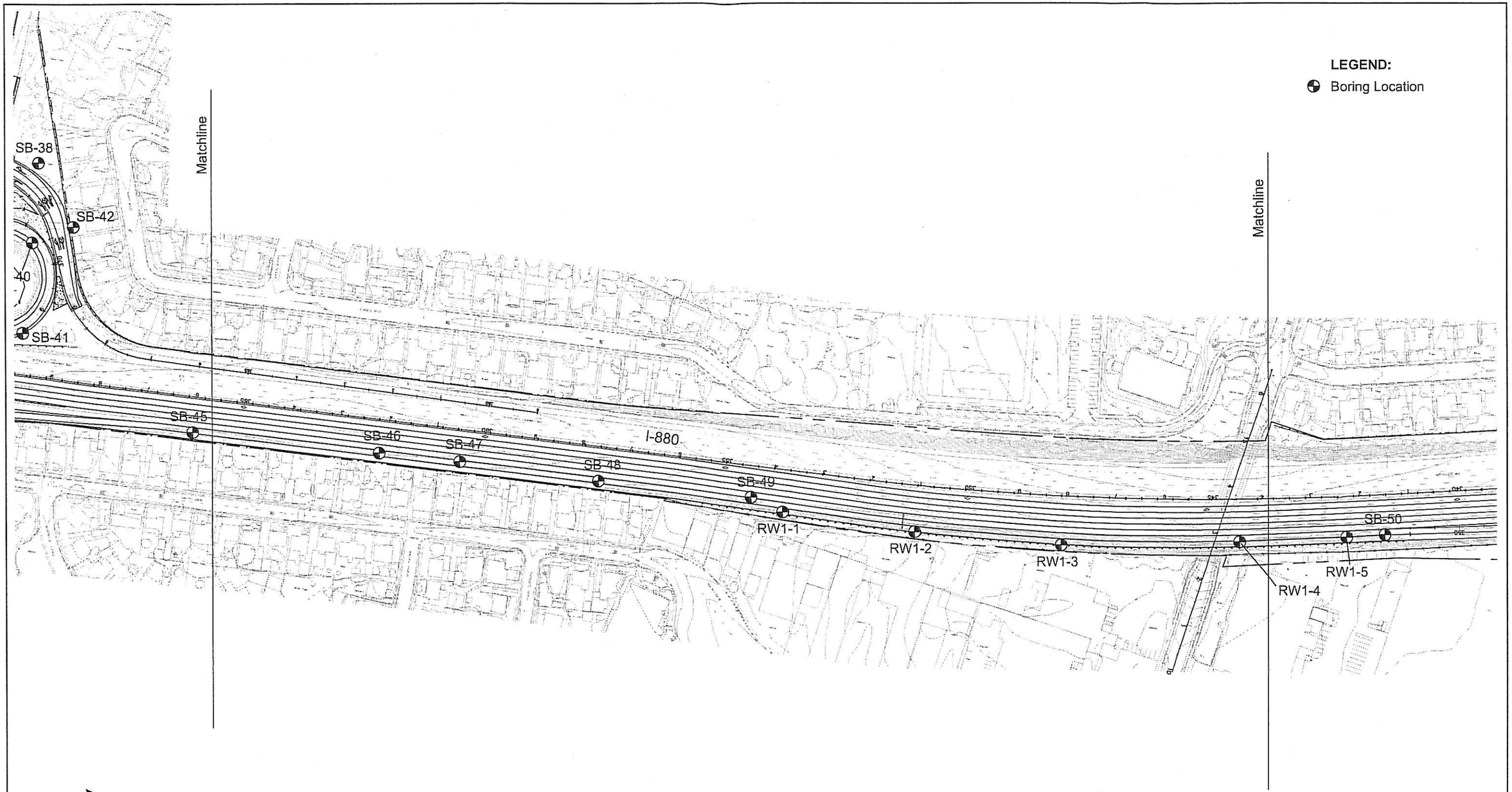
December 2008
Figure 2d

SITE1208



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0 100 200

SCALE: feet
(1" = 200)

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SITE PLAN

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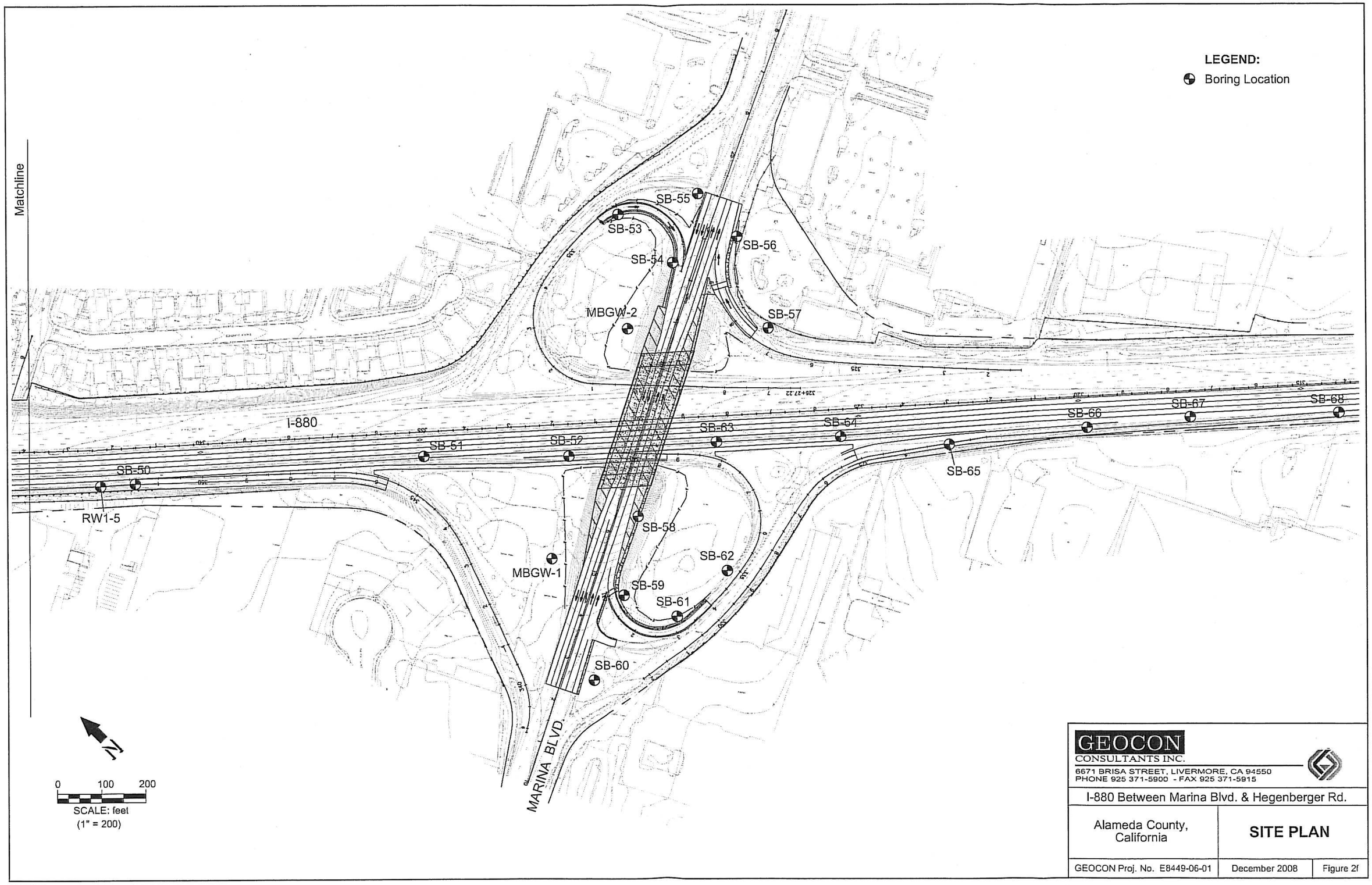
SITE1208



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SITE PLAN

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SITE120B

TABLE 1
Boring Coordinates
Route I-880 Southbound Improvements Project
Alameda County, California

Boring	Northing	Easting
DSGW1	2,088,686.121	6,076,438.409
MBGW1	2,085,393.074	6,079,206.597
MBGW2	2,085,638.471	6,079,698.861
RW1-1	2,087,089.124	6,077,819.306
RW1-2	2,086,869.290	6,077,981.690
RW1-3	2,086,637.952	6,078,174.760
RW1-4	2,086,382.330	6,078,439.432
RW1-5	2,086,235.348	6,078,600.536
RW2-1	2,088,452.227	6,076,215.931
RW2-2	2,088,467.564	6,076,461.424
RW3-2	2,088,594.097	6,076,233.831
RW3-3	2,088,683.565	6,076,278.583
RW4-1	2,088,727.021	6,076,797.698
RW4-2	2,088,734.689	6,076,942.181
RW5-1	2,090,416.041	6,075,249.303
RW8-1	2,093,176.819	6,073,354.405
RW8-2	2,093,056.677	6,073,452.858
SB-01	2,096,285.597	6,071,278.507
SB-02	2,096,034.699	6,071,449.494
SB-03	2,095,766.096	6,071,644.067
SB-04	2,095,610.261	6,071,753.266
SB-05	2,095,327.419	6,071,910.469
SB-06	2,095,072.543	6,072,097.946
SB-07	2,094,813.354	6,072,281.484
SB-08	2,093,857.561	6,072,932.392
SB-09	2,093,662.998	6,073,047.477
SB-10	2,093,486.771	6,073,175.020
SB-11	2,093,568.587	6,072,979.260
SB-12	2,093,347.954	6,073,229.832
SB-13	2,093,282.113	6,072,993.874
SB-14	2,093,402.333	6,072,991.609
SB-15	2,093,447.692	6,073,091.750
SB-16	2,093,122.954	6,073,413.202
SB-17	2,093,120.100	6,073,223.842
SB-18	2,093,062.203	6,073,402.168
SB-28	2,090,476.200	6,075,214.284
SB-29	2,090,266.778	6,075,387.519
SB-30	2,090,076.334	6,075,540.425
SB-31	2,089,889.540	6,075,673.425
SB-32	2,089,646.202	6,075,859.434
SB-33	2,089,479.526	6,075,992.031
SB-34	2,088,975.800	6,076,280.066
SB-35	2,088,743.370	6,076,378.476
SB-36	2,088,774.803	6,076,502.430
SB-37	2,088,694.308	6,076,582.689
SB-38	2,088,675.928	6,077,247.949
SB-39	2,088,640.652	6,077,053.379
SB-40	2,088,570.009	6,077,122.719

TABLE 1
Boring Coordinates
Route I-880 Southbound Improvements Project
Alameda County, California

Boring	Northing	Easting
SB-41	2,088,453.656	6,076,977.522
SB-42	2,088,533.024	6,077,205.342
SB-43	2,088,477.359	6,076,359.265
SB-44	2,088,492.150	6,076,534.438
SB-45	2,088,064.339	6,077,079.030
SB-46	2,087,763.252	6,077,318.960
SB-47	2,087,632.904	6,077,423.531
SB-48	2,087,402.953	6,077,596.395
SB-49	2,087,156.310	6,077,795.725
SB-50	2,086,183.419	6,078,659.908
SB-51	2,085,762.565	6,079,166.617
SB-52	2,085,529.013	6,079,399.740
SB-53	2,085,835.451	6,079,867.259
SB-54	2,085,669.709	6,079,879.662
SB-55	2,085,738.768	6,080,030.446
SB-56	2,085,608.047	6,080,023.819
SB-57	2,085,412.004	6,079,926.358
SB-58	2,085,321.420	6,079,413.450
SB-59	2,085,218.338	6,079,263.922
SB-60	2,085,130.370	6,079,080.226
SB-61	2,085,097.944	6,079,316.274
SB-62	2,085,090.592	6,079,469.614
SB-63	2,085,313.809	6,079,660.335
SB-64	2,085,122.330	6,079,867.960
SB-65	2,084,935.475	6,080,028.752
SB-66	2,084,740.945	6,080,277.329
SB-67	2,084,593.835	6,080,457.905
SB-68	2,084,364.094	6,080,701.166
UPRR1	2,091,230.835	6,074,671.372

Boring Coordinates are in coordinate Zone 3, Datum NAD 83 (feet).

TABLE 2
Summary of Lead and pH Results
Route I-880 Southbound Improvements Project
Alameda County, California

Sample ID	Sample Depth (ft)	Total Lead (mg/kg)	WET Lead (mg/l)	WET-DI Lead (mg/l)	TCLP Lead (mg/l)	pH
DSGW1-1	1	150	4.1	---	---	---
DSGW1-5	5	55	0.90	---	---	---
DSGW1-15.5	15.5	4.0	---	---	---	---
MBGW1-1	1	9.7	---	---	---	---
MBGW1-5	5	5.0	---	---	---	---
MBGW1-15.5	15.5	6.2	---	---	---	---
MBGW1-19.5	19.5	5.0	---	---	---	---
MBGW2-1	1	6.8	---	---	---	---
MBGW2-5	5	5.6	---	---	---	---
MBGW2-23.5	23.5	1.8	---	---	---	---
RW1-1-1	1	<1.0	---	---	---	---
RW1-1-5	5	4.9	---	---	---	---
RW1-2-1	1	22	---	---	---	---
RW1-2-5	5	29	---	---	---	---
RW1-3-1	1	28	---	---	---	---
RW1-3-5	5	37	---	---	---	---
RW1-4-1	1	7.0	---	---	---	---
RW1-4-5	5	15	---	---	---	---
RW1-4-19.5	19.5	5.6	---	---	---	---
RW1-5-1	1	4.8	---	---	---	---
RW1-5-5	5	12	---	---	---	---
RW2-1-1	1	33	---	---	---	---
RW2-1-5	5	4.6	---	---	---	---
RW2-1-14	14	3.2	---	---	---	---
RW2-2-1	1	71	2.7	---	---	---
RW2-2-5	5	9.3	---	---	---	---
RW3-2-1	1	50	---	---	---	---
RW3-2-5	5	5.9	---	---	---	---
RW3-3-1	1	27	---	---	---	---
RW3-3-5	5	6.7	---	---	---	---
RW4-1-1	1	3.0	---	---	---	---
RW4-1-5	5	5.1	---	---	---	---
RW4-2-1	1	89	2.6	---	---	---
RW4-2-5	5	4.4	---	---	---	---
RW4-2-19.5	19.5	6.3	---	---	---	---

TABLE 2
Summary of Lead and pH Results
Route I-880 Southbound Improvements Project
Alameda County, California

Sample ID	Sample Depth (ft)	Total Lead (mg/kg)	WET Lead (mg/l)	WET-DI Lead (mg/l)	TCLP Lead (mg/l)	pH
RW5-1-1	1	120	2.4	---	---	---
RW5-1-5	5	6.5	---	---	---	---
RW5-1-19.5	19.5	2.1	---	---	---	---
RW8-1-1	1	60	3.4	---	---	---
RW8-1-5	5	6.1	---	---	---	---
RW8-1-16	15.5	11	---	---	---	---
RW8-2-1	1	<1.0	---	---	---	---
RW8-2-5	5	5.1	---	---	---	---
SB-1-0	0	92	2.5	---	---	---
SB-1-1	1	110	7.4	<0.25	<0.25	---
SB-1-2	2	66	11	<0.25	---	---
SB-2-0	0	43	---	---	---	7.5
SB-2-1	1	20	---	---	---	---
SB-2-2	2	17	---	---	---	---
SB-3-0	0	120	5.4	<0.25	<0.25	---
SB-3-1	1	120	8.0	<0.25	0.29	---
SB-3-2	2	49	---	---	---	---
SB-4-0	0	66	3.9	---	---	8.0
SB-4-1	1	43	---	---	---	---
SB-4-2	2	52	2.5	---	---	---
SB-5-0	0	170	7.8	<0.25	<0.25	---
SB-5-1	1	42	---	---	---	---
SB-5-2	2	35	---	---	---	---
SB-6-0	0	160	6.5	<0.25	<0.25	---
SB-6-1	1	130	9.3	<0.25	<0.25	---
SB-6-2	2	20	---	---	---	---
SB-7-0	0	94	6.9	<0.25	---	---
SB-7-1	1	65	2.4	---	---	7.6
SB-7-2	2	63	1.1	---	---	---
SB-8-0	0	51	3.3	---	---	---
SB-8-1	1	12	---	---	---	---
SB-8-2	2	7.4	---	---	---	---

TABLE 2
Summary of Lead and pH Results
Route I-880 Southbound Improvements Project
Alameda County, California

Sample ID	Sample Depth (ft)	Total Lead (mg/kg)	WET Lead (mg/l)	WET-DI Lead (mg/l)	TCLP Lead (mg/l)	pH
SB-9-0	0	39	---	---	---	---
SB-9-1	1	35	---	---	---	---
SB-9-2	2	49	---	---	---	---
SB-10-0	0	71	1.6	---	---	---
SB-10-1	1	120	8.2	<0.25	<0.25	---
SB-10-2	2	45	---	---	---	---
SB-11-0	0	27	---	---	---	7.6
SB-11-1	1	56	3.2	---	---	---
SB-11-2	2	43	---	---	---	---
SB-12-0	0	36	---	---	---	---
SB-12-1	1	94	3.5	---	---	---
SB-12-2	2	55	3.6	---	---	---
SB-13-0	0	37	---	---	---	---
SB-13-1	1	36	---	---	---	---
SB-13-2	2	40	---	---	---	---
SB-14-0	0	22	---	---	---	7.2
SB-14-1	1	110	2.3	---	---	---
SB-14-2	2	44	---	---	---	---
SB-15-0	0	51	1.5	---	---	---
SB-15-1	1	42	---	---	---	---
SB-15-2	2	27	---	---	---	---
SB-16-0	0	37	---	---	---	---
SB-16-1	1	25	---	---	---	---
SB-16-2	2	18	---	---	---	---
SB-17-0	0	24	---	---	---	---
SB-17-1	1	52	0.36	---	---	8.4
SB-17-2	2	23	---	---	---	---
SB-18-0	0	27	---	---	---	---
SB-18-1	1	33	---	---	---	---
SB-18-2	2	25	---	---	---	---
SB-28-0	0	19	---	---	---	7.3
SB-28-1	1	20	---	---	---	---
SB-28-2	2	37	---	---	---	---
SB-29-0	0	65	2.8		---	---
SB-29-1	1	240	18	<0.25	2.4	---
SB-29-2	2	14	---	---	---	---

TABLE 2
Summary of Lead and pH Results
Route I-880 Southbound Improvements Project
Alameda County, California

Sample ID	Sample Depth (ft)	Total Lead (mg/kg)	WET Lead (mg/l)	WET-DI Lead (mg/l)	TCLP Lead (mg/l)	pH
SB-30-0	0	17	---	---	---	---
SB-30-1	1	210	12	<0.25	1.4	---
SB-30-2	2	29	---	---	---	---
SB-31-0	0	60	6.4	<0.25	---	---
SB-31-1	1	30	---	---	---	7.6
SB-31-2	2	270	25	<0.25	3.3	---
SB-32-0	0	19	---	---	---	---
SB-32-1	1	140	11	<0.25	<0.25	---
SB-32-2	2	64	5.1	<0.25	---	---
SB-33-0	0	52	6.2	<0.25	---	---
SB-33-1	1	57	4.4	---	---	---
SB-33-2	2	6.2	---	---	---	---
SB-34-0	0	28	---	---	---	---
SB-34-1	1	26	---	---	---	---
SB-34-2	2	28	---	---	---	6.4
SB-35-0	0	36	---	---	---	---
SB-35-1	1	44	---	---	---	---
SB-35-2	2	2,000	45	0.76	1.3	---
SB-35-2	*2*	*2,000*	*38*	---	---	---
SB-36-0	0	33	---	---	---	---
SB-36-1	1	<5.0	---	---	---	---
SB-36-2	2	<5.0	---	---	---	7.1
SB-37-0	0	35	---	---	---	---
SB-37-1	1	8.0	---	---	---	---
SB-37-2	2	5.5	---	---	---	---
SB-38-0	0	31	---	---	---	---
SB-38-1	1	69	4.2	---	---	---
SB-38-2	2	42	---	---	---	---
SB-39-0	0	47	---	---	---	---
SB-39-1	1	44	---	---	---	---
SB-39-2	2	40	---	---	---	7.5
SB-40-0	0	83	2.8	---	---	---
SB-40-1	1	150	6.9	<0.25	<0.25	---
SB-40-2	2	150	7.5	<0.25	<0.25	---
SB-41-0	0	160	6.9	<0.25	<0.25	---
SB-41-1	1	61	4.3	---	---	---
SB-41-2	2	<5.0	---	---	---	---

TABLE 2
Summary of Lead and pH Results
Route I-880 Southbound Improvements Project
Alameda County, California

Sample ID	Sample Depth (ft)	Total Lead (mg/kg)	WET Lead (mg/l)	WET-DI Lead (mg/l)	TCLP Lead (mg/l)	pH
SB-42-0	0	54	4.3	---	---	---
SB-42-1	1	17	---	---	---	---
SB-42-2	2	9.3	---	---	---	---
SB-43-0	0	39	---	---	---	---
SB-43-1	1	79	3.1	---	---	7.0
SB-43-2	2	87	3.8	---	---	---
SB-44-0	0	57	3.3	---	---	---
SB-44-1	1	23	---	---	---	---
SB-44-2	2	36	---	---	---	---
SB-45-0	0	37	---	---	---	---
SB-45-1	1	42	---	---	---	---
SB-45-2	2	59	<1.0	---	---	---
SB-46-0	0	59	5.1	<0.25	---	---
SB-46-1	1	14	---	---	---	---
SB-46-2	2	30	---	---	---	7.8
SB-47-0	0	<5.0	---	---	---	---
SB-47-1	1	13	---	---	---	---
SB-47-2	2	6.7	---	---	---	---
SB-48-0	0	35	---	---	---	---
SB-48-1	1	6.8	---	---	---	---
SB-48-2	2	14	---	---	---	---
SB-49-0	0	66	2.8	---	---	---
SB-49-1	1	12	---	---	---	---
SB-49-2	2	<5.0	---	---	---	7.4
SB-50-0	0	56	<1.0	---	---	---
SB-50-1	1	5.8	---	---	---	---
SB-50-2	2	5.4	---	---	---	---
SB-51-0	0	120	9.3	<0.25	<0.25	---
SB-51-1	1	36	---	---	---	---
SB-51-2	2	6.0	---	---	---	---
SB-52-0	0	380	34	<0.25	0.28	---
SB-52-1	1	15	---	---	---	---
SB-52-2	2	9.6	---	---	---	---
SB-53-0	0	130	5.7	<0.25	<0.25	7.4
SB-53-1	1	94	3.0	---	---	---
SB-53-2	2	14	---	---	---	---

TABLE 2
Summary of Lead and pH Results
Route I-880 Southbound Improvements Project
Alameda County, California

Sample ID	Sample Depth (ft)	Total Lead (mg/kg)	WET Lead (mg/l)	WET-DI Lead (mg/l)	TCLP Lead (mg/l)	pH
SB-54-0	0	180	8.3	<0.25	<0.25	---
SB-54-1	1	40	---	---	---	---
SB-54-2	2	99	2.3	---	---	---
SB-55-0	0	79	3.6	---	---	---
SB-55-1	1	86	4.3	---	---	---
SB-55-2	2	92	4.1	---	---	---
SB-56-0	0	26	---	---	---	---
SB-56-1	1	13	---	---	---	7.3
SB-56-2	2	55	1.6	---	---	---
SB-57-0	0	35	---	---	---	---
SB-57-1	1	12	---	---	---	---
SB-57-2	2	11	---	---	---	---
SB-58-0	0	670	58	<0.25	0.65	---
SB-58-1	1	33	---	---	---	---
SB-58-2	2	150	8.8	<0.25	<0.25	---
SB-59-0	0	270	13	<0.25	0.29	---
SB-59-1	1	140	5.7	<0.25	<0.25	---
SB-59-2	2	130	8.0	1.8	<0.25	6.8
SB-60-0	0	570	25	<0.25	0.40	---
SB-60-1	1	40	---	---	---	---
SB-60-2	2	150	6.7	<0.25	<0.25	---
SB-61-0	0	190	9.2	<0.25	<0.25	---
SB-61-1	1	37	---	---	---	---
SB-61-2	2	5.9	---	---	---	---
SB-62-0	0	140	3.2	---	---	---
SB-62-1	1	11	---	---	---	---
SB-62-2	2	22	---	---	---	---
SB-63-0	0	120	5.4	<0.25	<0.25	7.2
SB-63-1	1	27	---	---	---	---
SB-63-2	2	12	---	---	---	---
SB-64-0	0	9.8	---	---	---	---
SB-64-1	1	56	2.9	---	---	---
SB-64-2	2	5.3	---	---	---	---
SB-65-0	0	52	1.7	---	---	---
SB-65-1	1	20	---	---	---	---
SB-65-2	2	42	---	---	---	---

TABLE 2
Summary of Lead and pH Results
Route I-880 Southbound Improvements Project
Alameda County, California

Sample ID	Sample Depth (ft)	Total Lead (mg/kg)	WET Lead (mg/l)	WET-DI Lead (mg/l)	TCLP Lead (mg/l)	pH
SB-66-0	0	6.4	---	---	---	---
SB-66-1	1	6.1	---	---	---	---
SB-66-2	2	85	2.3	---	---	7.9
SB-67-0	0	67	4.7	---	---	---
SB-67-1	1	180	13	<0.25	<0.25	---
SB-67-2	2	970	76	0.44	1.4	---
SB-68-0	0	81	5.0	<0.25	---	---
SB-68-1	1	140	7.5	<0.25	<0.25	---
SB-68-2	2	81	4.9	---	---	---
UPRR1-1	1	93	3.6	---	---	---
UPRR1-5	5	6.7	---	---	---	---
UPRR1-12	12	32	---	---	---	---
UPRR1-23.5	23.5	5.1	---	---	---	---

Notes:

Result for sample SB35-2, shown in italics, is for replicate analysis.

WET = Waste Extraction Test
WET DI = Waste Extraction Test using de-ionized water
TCLP = Toxicity Characteristic Leaching Procedure
mg/kg = milligrams per kilogram
mg/l = milligrams per liter
< = Not detected above the laboratory reporting limit
--- = Not analyzed

TABLE 3
Summary of CAM17 Metals Results
Route I-880 Southbound Improvements Project
Alameda County, California

Sample ID	Sample Depth (ft)	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc	Mercury
DSGW1-1	1	<2.0	4.9	210	<1.0	<1.0	22	7.9	31	150	<1.0	35	2.2	<1.0	<1.0	28	120	0.23
DSGW1-5	5	<2.0	4.1	110	<1.0	<1.0	26	6.7	21	55	<1.0	33	1.6	<1.0	<1.0	26	82	<0.10
DSGW1-15.5	15.5	<2.0	4.5	110	<1.0	<1.0	22	7.0	13	4.0	<1.0	40	1.4	<1.0	<1.0	26	33	<0.10
MBGW1-1	1	<2.0	4.9	160	<1.0	<1.0	29	7.4	18	9.7	<1.0	35	1.2	<1.0	<1.0	28	44	0.68
MBGW1-5	5	<2.0	4.2	130	<1.0	<1.0	29	7.8	14	5.0	<1.0	40	1.1	<1.0	<1.0	29	37	0.11
MBGW1-15.5	15.5	<2.0	5.1	150	<1.0	<1.0	33	9.2	21	6.2	<1.0	51	1.4	<1.0	<1.0	30	52	<0.10
MBGW1-19.5	19.5	<2.0	2.9	140	<1.0	<1.0	38	5.9	19	5.0	<1.0	43	1.3	<1.0	<1.0	29	47	<0.10
MBGW2-1	1	<2.0	5.1	140	<1.0	<1.0	35	9.6	18	6.8	<1.0	47	1.7	<1.0	<1.0	32	41	<0.10
MBGW2-5	5	<2.0	3.8	93	<1.0	<1.0	24	5.2	13	5.6	<1.0	32	1.1	<1.0	<1.0	24	33	<0.10
MBGW2-23.5	23.5	<2.0	2.5	58	<1.0	<1.0	17	4.3	9.9	1.8	<1.0	24	<1.0	<1.0	<1.0	18	26	<0.10
RW1-1-1	1	<2.0	<1.0	33	<1.0	<1.0	28	14	41	<1.0	<1.0	31	2.2	<1.0	<1.0	58	51	<0.10
RW1-1-5	5	<2.0	2.8	150	<1.0	<1.0	34	7.2	17	4.9	<1.0	43	1.5	<1.0	<1.0	26	43	<0.10
RW1-2-1	1	<2.0	1.7	71	<1.0	<1.0	17	5.3	17	22	<1.0	25	1.1	<1.0	<1.0	25	41	<0.10
RW1-2-5	5	<2.0	2.7	95	<1.0	<1.0	26	8.4	26	29	<1.0	36	1.3	<1.0	<1.0	32	65	0.23
RW1-3-1	1	<2.0	2.0	76	<1.0	<1.0	26	7.9	29	28	<1.0	35	1.3	<1.0	<1.0	37	52	<0.10
RW1-3-5	5	<2.0	2.5	99	<1.0	<1.0	25	7.4	63	37	<1.0	32	1.7	<1.0	<1.0	41	94	0.19
RW1-4-1	1	<2.0	4.6	110	<1.0	<1.0	29	8.9	18	7.0	<1.0	41	2.2	<1.0	<1.0	28	50	<0.10
RW1-4-5	5	<2.0	3.2	98	<1.0	<1.0	27	8.4	21	15	<1.0	35	1.3	<1.0	<1.0	24	64	<0.10
RW1-4-19.5	19.5	<2.0	3.7	140	<1.0	<1.0	26	7.9	16	5.6	<1.0	31	1.5	<1.0	<1.0	26	39	<0.10
RW1-5-1	1	<2.0	3.4	180	<1.0	<1.0	32	9.8	29	4.8	<1.0	41	2.3	<1.0	<1.0	34	44	<0.10
RW1-5-5	5	<2.0	3.4	92	<1.0	<1.0	26	8.8	21	12	<1.0	32	1.4	<1.0	<1.0	36	42	0.15
RW2-1-1	1	<2.0	5.0	110	<1.0	<1.0	25	8.3	24	33	<1.0	32	2.0	<1.0	<1.0	32	62	0.14
RW2-1-5	5	17	11	58	<1.0	<1.0	14	8.6	43	4.6	<1.0	24	1.7	<1.0	<1.0	30	36	<0.10
RW2-1-14	14	<2.0	3.3	65	<1.0	<1.0	18	4.5	9.5	3.2	<1.0	21	1.0	<1.0	<1.0	21	28	<0.10

TABLE 3
Summary of CAM17 Metals Results
Route I-880 Southbound Improvements Project
Alameda County, California

Sample ID	Sample Depth (ft)	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc	Mercury
RW2-2-1	1	<2.0	5.1	130	<1.0	<1.0	28	8.5	32	71	<1.0	37	1.9	<1.0	<1.0	34	76	0.11
RW2-2-5	5	7.1	8.6	90	<1.0	<1.0	26	11	57	9.3	<1.0	34	2.1	<1.0	<1.0	44	60	0.10
RW3-2-1	1	4.5	8.5	120	<1.0	<1.0	31	12	46	50	<1.0	39	2.3	<1.0	<1.0	46	78	<0.10
RW3-2-5	5	<2.0	3.4	120	<1.0	<1.0	23	6.4	14	5.9	<1.0	32	1.5	<1.0	<1.0	21	33	<0.10
RW3-3-1	1	<2.0	2.9	75	<1.0	<1.0	33	12	41	27	<1.0	31	1.8	<1.0	<1.0	48	51	<0.10
RW3-3-5	5	<4.0	3.5	130	<2.0	<2.0	27	8.0	17	6.7	<2.0	37	<2.0	<2.0	<2.0	26	39	<0.10
RW4-1-1	1	<2.0	2.7	88	<1.0	<1.0	20	5.3	11	3.0	<1.0	28	<1.0	<1.0	<1.0	20	28	<0.10
RW4-1-5	5	<2.0	3.1	87	<1.0	<1.0	19	6.1	12	5.1	<1.0	29	1.2	<1.0	<1.0	22	35	<0.10
RW4-2-1	1	<2.0	4.1	130	<1.0	<1.0	20	7.6	27	89	<1.0	30	1.5	<1.0	<1.0	27	100	0.10
RW4-2-5	5	<2.0	3.6	130	<1.0	<1.0	30	8.2	19	4.4	<1.0	44	1.5	<1.0	<1.0	26	53	<0.10
RW4-2-19.5	19.5	<2.0	5.7	150	<1.0	<1.0	33	8.8	19	6.3	<1.0	45	1.5	<1.0	<1.0	33	50	<0.10
RW5-1-1	1	<2.0	5.4	140	<1.0	<1.0	37	9.4	39	120	<1.0	43	1.4	<1.0	<1.0	33	110	0.16
RW5-1-5	5	<2.0	5.0	180	<1.0	<1.0	34	11	20	6.5	<1.0	58	1.8	<1.0	<1.0	33	42	<0.10
RW5-1-19.5	19.5	<2.0	3.3	110	<1.0	<1.0	30	6.4	13	2.1	<1.0	37	1.0	<1.0	<1.0	22	27	<0.10
RW8-1-1	1	<2.0	3.3	76	<1.0	<1.0	24	7.5	24	60	<1.0	28	1.6	<1.0	<1.0	28	45	<0.10
RW8-1-5	5	<2.0	3.1	160	<1.0	<1.0	43	8.0	27	6.1	<1.0	55	2.3	<1.0	<1.0	38	52	<0.10
RW8-1-16	15.5	<2.0	3.9	120	<1.0	<1.0	23	6.7	17	11	<1.0	33	1.6	<1.0	<1.0	26	34	<0.10
RW8-2-1	1	<2.0	2.6	24	<1.0	<1.0	23	13	55	<1.0	<1.0	21	2.1	<1.0	<1.0	56	42	1.5
RW8-2-5	5	<2.0	3.7	120	<1.0	<1.0	26	9.1	17	5.1	<1.0	38	1.4	<1.0	<1.0	30	36	<0.10
SB-1-0	0	<2.0	7.1	170	<1.0	<1.0	35	11	48	92	<1.0	37	<1.0	<1.0	<1.0	46	160	0.15
SB-1-1	1	<2.0	5.7	160	<1.0	<1.0	36	9.1	29	110	<1.0	42	<1.0	<1.0	<1.0	34	65	0.20
SB-1-2	2	<2.0	4.0	130	<1.0	<1.0	33	8.5	31	66	<1.0	36	<1.0	<1.0	<1.0	51	53	0.21
SB-5-0	0	<2.0	7.8	170	<1.0	1.2	36	12	45	170	<1.0	42	<1.0	<1.0	<1.0	39	190	0.91
SB-5-1	1	<2.0	5.5	160	<1.0	<1.0	46	9.6	27	42	<1.0	57	<1.0	<1.0	<1.0	40	67	<0.10
SB-5-2	2	<2.0	3.8	160	<1.0	<1.0	28	6.7	23	35	<1.0	32	<1.0	<1.0	<1.0	36	67	0.15

TABLE 3
Summary of CAM17 Metals Results
Route I-880 Southbound Improvements Project
Alameda County, California

Sample ID	Sample Depth (ft)	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc	Mercury
SB-10-0	0	<2.0	2.8	160	<1.0	<1.0	35	7.4	210	71	<1.0	36	<1.0	<1.0	<1.0	36	220	20
																		<1.0
SB-10-1	1	<2.0	4.0	130	<1.0	1.1	35	7.6	35	120	<1.0	37	<1.0	<1.0	<1.0	36	190	0.24
SB-10-2	2	<2.0	3.6	100	<1.0	<1.0	35	10	40	45	<1.0	37	<1.0	<1.0	<1.0	44	58	0.11
SB-15-0	0	<2.0	3.9	160	<1.0	<1.0	38	8.4	40	51	<1.0	45	<1.0	<1.0	<1.0	38	250	0.18
SB-15-1	1	<2.0	2.6	89	<1.0	<1.0	23	6.0	32	42	<1.0	27	<1.0	<1.0	<1.0	35	50	<0.10
SB-15-2	2	<2.0	2.8	140	<1.0	<1.0	43	7.5	23	27	<1.0	46	<1.0	<1.0	<1.0	35	53	<0.10
SB-30-0	0	<2.0	3.2	49	<1.0	<1.0	9.3	6.2	53	17	<1.0	10	2.3	<1.0	<1.0	26	120	0.20
SB-30-1	1	<2.0	5.3	91	<1.0	<1.0	32	9.6	46	210	<1.0	34	2.1	<1.0	<1.0	39	130	0.11
SB-30-2	2	<2.0	4.5	33	<1.0	<1.0	75	19	150	29	<1.0	44	2.4	<1.0	<1.0	43	36	0.10
							<1.0											
SB-35-0	0	<2.0	3.6	95	<1.0	<1.0	22	5.8	20	36	<1.0	28	<1.0	<1.0	<1.0	23	82	0.11
SB-35-1	1	<2.0	4.6	140	<1.0	<1.0	32	8.9	24	44	<1.0	42	<1.0	<1.0	<1.0	33	57	0.13
SB-35-2	2	<2.0	5.5	490	<1.0	1.5	30	7.6	42	2,000	<1.0	39	<1.0	<1.0	<1.0	28	510	0.14
SB-40-0	0	<2.0	4.2	120	<1.0	<1.0	34	8.6	32	83	<1.0	39	<1.0	<1.0	<1.0	33	97	0.15
SB-40-1	1	<2.0	5.1	120	<1.0	<1.0	35	9.8	46	150	<1.0	39	<1.0	<1.0	<1.0	37	100	0.21
SB-40-2	2	<2.0	5.0	97	<1.0	<1.0	30	8.5	47	150	<1.0	32	<1.0	<1.0	<1.0	35	110	0.21
SB-45-0	0	<2.0	2.7	100	<1.0	<1.0	29	5.4	42	37	1.2	36	<1.0	<1.0	<1.0	23	230	0.33
SB-45-1	1	<2.0	5.6	160	<1.0	<1.0	41	9.0	34	42	<1.0	46	<1.0	<1.0	<1.0	37	89	0.14
SB-45-2	2	<2.0	6.5	170	<1.0	<1.0	39	9.3	27	59	<1.0	44	<1.0	<1.0	<1.0	37	80	<0.10
SB-50-0	0	<2.0	4.0	150	<1.0	1.1	44	12	58	56	1.7	44	<1.0	<1.0	<1.0	29	250	0.14
SB-50-1	1	<2.0	4.9	160	<1.0	<1.0	40	11	22	5.8	<1.0	54	<1.0	<1.0	<1.0	35	50	<0.10
SB-50-2	2	<2.0	4.2	130	<1.0	<1.0	38	6.6	19	5.4	<1.0	42	<1.0	<1.0	<1.0	32	43	<0.10
SB-55-0	0	6.0	11	180	<1.0	<1.0	23	11	48	79	<1.0	35	1.1	<1.0	<1.0	36	200	0.29
SB-55-1	1	8.5	11	280	<1.0	<1.0	18	13	50	86	<1.0	27	1.7	<1.0	<1.0	38	110	0.17
SB-55-2	2	7.5	9.7	180	<1.0	<1.0	27	12	50	92	<1.0	36	1.2	<1.0	<1.0	41	100	0.14

TABLE 3
Summary of CAM17 Metals Results
Route I-880 Southbound Improvements Project
Alameda County, California

Sample ID	Sample Depth (ft)	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc	Mercury
SB-60-0	0	<2.0	3.9	190	<1.0	1.3	35	7.0	63	570	2.9	36	1.1	<1.0	<1.0	29	430	0.20
SB-60-1	1	<2.0	4.2	120	<1.0	<1.0	45	10	24	40	<1.0	78	<1.0	<1.0	<1.0	30	56	0.11
SB-60-2	2	<2.0	4.2	120	<1.0	<1.0	26	12	27	150	<1.0	36	<1.0	<1.0	<1.0	30	89	0.17
SB-65-0	0	<2.0	5.2	150	<1.0	<1.0	34	9.5	30	52	<1.0	42	1.1	<1.0	<1.0	38	100	0.11
SB-65-1	1	<2.0	4.7	140	<1.0	<1.0	39	10	43	20	<1.0	53	1.4	<1.0	<1.0	42	78	0.12
SB-65-2	2	3.2	7.0	140	<1.0	<1.0	30	9.1	31	42	<1.0	38	1.0	<1.0	<1.0	35	60	<0.10
SB-68-0	0	<2.0	4.1	170	<1.0	1.2	58	7.7	81	81	4.3	36	<1.0	<1.0	<1.0	37	290	0.20
							<1.0											
SB-68-1	1	<2.0	4.0	79	<1.0	<1.0	28	14	53	140	<1.0	26	1.3	<1.0	<1.0	93	62	0.28
SB-68-2	2	<2.0	2.9	78	<1.0	<1.0	15	9.5	35	81	<1.0	22	1.1	<1.0	<1.0	65	73	0.52
UPRR1-1	1	<2.0	4.0	110	<1.0	<1.0	35	8.2	31	93	<1.0	41	1.4	<1.0	<1.0	34	59	0.34
UPRR1-5	5	<2.0	4.6	170	<1.0	<1.0	37	9.7	22	6.7	<1.0	51	1.8	<1.0	<1.0	33	45	<0.10
UPRR1-12	12	<2.0	3.0	130	<1.0	<1.0	25	6.8	20	32	<1.0	31	1.3	<1.0	<1.0	30	52	<0.10
UPRR1-23.5	23.5	<2.0	2.9	150	<1.0	<1.0	30	13	15	5.1	<1.0	48	1.3	<1.0	<1.0	25	32	<0.10
ESLs																		
Shallow Soils (≤3 m bgs)																		
Residential Land Use		6.1	0.38	750	4.0	1.7	750*	40	230	200	40	150	10	20	1.2	15	600	1.0
Comm/Ind Land Use		40	1.5	1,500	8.0	7.4	750*	80	230	750	40	150	10	40	15	190	600	100

Notes:

Results are shown in milligrams per kilogram (mg/kg)

Results in italics are soluble metal concentrations analyzed using the Waste Extraction Test (WET), shown in units of milligrams per liter (mg/l), with the exception of mercury results, which are presented in micrograms per liter (ug/l).

<= Analyte was not detected above the laboratory reporting limit

ESLs = Environmental Screening Levels, SFRWQCB, November 2007, Tables A and C.

* = Value is for Chromium III, no standard for total chromium

TABLE 4
Summary of Organics Results
Route I-880 Southbound Improvements Project
Alameda County, California

Sample ID	Sample Depth (ft)	TPHd (mg/kg)	TPHg (mg/kg)	TPHmo (mg/kg)	BTEX (ug/kg)	MTBE (ug/kg)	VOCs (ug/kg)	SVOCs (mg/kg)
DSGW1-1	1	14	---	40	---	---	---	---
DSGW1-5	5	---	<1.0	---	ND	<5.0	---	---
DSGW1-15.5	15.5	---	<1.0	---	ND	<5.0	---	---
MBGW1-1	1	16	---	54	---	---	---	---
MBGW1-5	5	---	<1.0	---	ND	<5.0	---	---
MBGW1-15.5	15.5	---	<1.0	---	ND	<5.0	---	---
MBGW1-19.5	19.5	---	<1.0	---	ND	<5.0	---	---
MBGW2-1	1	1.6	---	3.0	---	---	---	---
MBGW2-5	5		<1.0	---	ND	<5.0	---	---
MBGW2-23.5	23.5	1.1	<1.0	1.5	ND	<5.0	---	---
RW1-1-1	1	1,100	---	6,700	---	---	---	---
RW1-1-5	5	---	<1.0	---	ND	<5.0	---	---
RW1-2-1	1	760	---	3,400	---	---	---	---
RW1-2-5	5	---	<1.0	---	ND	<5.0	---	---
RW1-3-1	1	910	---	4,100	---	---	---	---
RW1-3-5	5	---	<1.0	---	ND	<5.0	---	---
RW1-4-1	1	11	---	32	---	---	---	---
RW1-4-5	5	---	<1.0	---	ND	<5.0	---	---
RW1-4-19.5	19.5	1.1	<1.0	1.4	ND	<5.0	ND	---
RW1-5-1	1	21	---	81	---	---	---	---
RW1-5-5	5	---	<1.0	---	ND	<5.0	---	---
RW2-1-1	1	24	---	120	---	---	---	---
RW2-1-5	5	---	<1.0	---	ND	<5.0	---	---
RW2-1-14	14	---	<1.0	---	ND	<5.0	---	---
RW2-2-1	1	33	---	130	---	---	---	---
RW2-2-5	5	---	<1.0	---	ND	<5.0	---	---
RW3-2-1	1	68	---	280	---	---	---	---
RW3-2-5	5	---	<1.0	---	ND	<5.0	---	---
RW3-3-1	1	43	---	140	---	---	---	---
RW3-3-5	5	---	<1.0	---	ND	<5.0	---	---
RW4-1-1	1	8.9	---	25	---	---	---	---
RW4-1-5	5	---	<1.0	---	ND	<5.0	---	---

TABLE 4
Summary of Organics Results
Route I-880 Southbound Improvements Project
Alameda County, California

Sample ID	Sample Depth (ft)	TPHd (mg/kg)	TPHg (mg/kg)	TPHmo (mg/kg)	BTEX (ug/kg)	MTBE (ug/kg)	VOCs (ug/kg)	SVOCs (mg/kg)
RW4-2-1	1	88	---	390	---	---	---	---
RW4-2-5	5	---	<1.0	---	ND	<5.0	---	---
RW4-2-19.5	19.5	---	<1.0	---	ND	<5.0	ND	---
RW5-1-1	1	27	---	140	---	---	---	---
RW5-1-5	5	---	<1.0	---	ND	<5.0	---	---
RW5-1-19.5	19.5	---	<1.0	---	ND	---	ND	---
RW8-1-1	1	46	---	180	---	---	---	---
RW8-1-5	5	---	<1.0	---	ND	<5.0	---	---
RW8-1-16	15.5	---	<1.0	---	ND	<5.0	---	---
RW8-2-1	1	8.8	---	22	---	---	---	---
RW8-2-5	5	---	<1.0	---	ND	<5.0	---	---
UPRR1-1	1	10	---	21	---	---	---	ND
UPRR1-5	5	---	<1.0	---	ND	<5.0	---	ND
UPRR1-12	12	---	<1.0	---	ND	<5.0	---	ND
UPRR1-23.5	23.5	---	<1.0	---	ND	<5.0	---	ND
ESLs								
Shallow Soils (≤3 m bgs)								
Residential Land Use		83	83	410	---	23	---	---
Commercial/Industrial Land Use		83	83	2,500	---	23	---	---

Notes:
TPHmo = Total Petroleum Hydrocarbons as motor oil
TPHd = Total Petroleum Hydrocarbons as diesel
TPHg = Total Petroleum Hydrocarbons as gasoline
VOCs = Volatile Organic Compounds
mg/kg = milligrams per kilogram
ND = Not Detected above laboratory reporting limit
--- = Not Analyzed or Not Applicable
< = Not detected above the stated laboratory reporting limit
ESLs = Environmental Screening Levels, SFRWQCB, November 2007, Table A.
BTEX = Benzene, toluene, ethylbenzene, and xylenes
MTBE = Methyl-tert-butyl ether
SVOCs = Semi-volatile organic compounds
ug/kg = micrograms per kilogram

TABLE 5
Summary of CAM 17 Metals Results - Groundwater
Route I-880 Southbound Improvements Project
Alameda County, California

Sample I.D.	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc	Mercury (ug/l)
DSGW1	<0.0050	<0.010	1.0	0.0038	0.0069	0.055	0.091	0.044	0.013	<0.0050	0.39	0.011	<0.0030	<0.015	0.057	0.38	<0.20
MBGW2	<0.0050	<0.010	1.9	<0.0030	<0.0030	0.022	0.027	0.043	<0.0050	0.0077	0.068	<0.010	<0.0030	<0.015	0.082	0.11	<0.20
RW2-1	<0.0050	<0.010	1.5	0.0062	0.0061	0.033	0.11	0.089	<0.0050	<0.0050	0.34	<0.010	<0.0030	<0.015	0.061	0.23	<0.20
RW3-2	<0.0050	0.021	1.5	0.0058	0.0062	0.0065	0.084	0.036	<0.0050	<0.0050	0.17	<0.010	<0.0030	<0.015	0.053	0.091	<0.20
RW8-1	<0.0050	0.011	0.48	<0.0030	<0.0030	<0.0030	0.029	0.019	<0.0050	<0.0050	0.058	<0.010	<0.0030	<0.015	0.038	0.049	<0.20
UPRR1	<0.0050	<0.010	2.0	<0.0030	<0.0030	0.0042	0.023	0.0072	<0.0050	<0.0050	0.025	0.013	<0.0030	<0.015	0.040	0.074	<0.20
WQOs																	
Municipal Supply	0.006	0.05	1.0	0.004	0.005	0.05	---	1.0	0.05	---	0.1	0.05	0.1	0.002	---	5.0	0.002
Agricultural Supply	---	2.0	---	0.5	0.5	1.0	5.0	5.0	10.0	0.05	2.0	0.02	---	---	1.0	10.0	---
California MCLs																	
Primary	0.006	0.05	1.0	0.004	0.005	0.05	---	---	---	---	0.1	0.05	---	0.002	---	---	2.0
Secondary	---	---	---	---	---	---	---	1.0	---	---	---	---	0.1	---	---	5.0	---
ESLs																	
GW IS Current/Potential Source of Drinking Water	0.006	0.050	1.0	0.004	0.005	0.05	0.14	1.0	0.015	0.035	0.1	0.050	0.035	0.002	0.015	5.0	2.0
GW IS NOT Current/Potential Source of Drinking Water	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Surface Water Bodies																	
Freshwater	6	0.14	1.0	0.004	0.005	0.05	0.14	1.0	0.015	0.035	0.1	0.05	0.035	0.002	0.015	5.0	5.1E-05
Marine	4,300	0.14	50	50	50	50	50	50	50	50	4.6	50	50	0.0063	50	50	5.1E-05
Estuarine	4,300	0.14	50	50	50	50	50	50	50	50	4.6	50	50	0.0063	50	50	5.1E-05

Notes:

Data are shown in units of milligrams per liter (mg/l), with the exception of mercury, which is presented in micrograms per liter (ug/l).

< = Not detected above the stated laboratory reporting limit
WQOs = Water Quality Objectives, SFRWQCB Basin Plan, Table 3-5 - WQO for Municipal Supply, January 2007.
MCLs = Maximum Contaminant Levels, Title 22, CCR, Division 4, Chapter 15, Article 4, September 12, 2003.
ESLs = Environmental Screening Levels, San Francisco Regional Water Quality Control Board (SFRWQCB), November 2007, Tables A, C and F.
GW = Groundwater
--- = Not Analyzed or No Standard

TABLE 6
Summary of Organics Results - Groundwater
Route I-880 Southbound Improvements Project
Alameda County, California

Sample I.D.	TPHd (mg/l)	TPHg (mg/l)	TPHmo (mg/l)	BTEX (ug/l)	MTBE (ug/l)	VOCs (ug/l)	SVOCs (ug/l)
DSGW1	0.10	<0.050	0.12	ND	<0.50	Tetrachloroethene=3.8 Trichloroethene=0.57	---
MBGW2	0.060	<0.050	0.070	ND	<0.50	1,1-Dichloroethene=0.53 Tetrachloroethene=32 Trichloroethene=5.5	---
RW2-1	0.079	<0.050	0.099	ND	<0.50	ND	---
RW3-2	0.078	<0.050	0.089	ND	<0.50	Dichlorodifluoromethane=1.8 Tetrachloroethene=13 Trichloroethene=2.5	---
RW8-1	0.25	<0.050	0.24	ND	<0.50	ND	---
UPRR1	0.078	<0.050	0.090	ND	<0.50	ND	ND
WQOs Municipal Supply	---	---	---	---	---	1,1-Dichloroethene=6.0 Tetrachloroethene=5.0 Trichloroethene=5.0	---
California MCLs Primary Standards	---	---	---	---	---	1,1-Dichloroethene=6.0 Tetrachloroethene=5.0 Trichloroethene=5.0	---
ESLs GW IS Current/Potential Source of Drinking Water	1.0	1.0	1.0	---	---	1,1-Dichloroethene=6.0 Tetrachloroethene=5.0 Trichloroethene=5.0	---
Surface Water Bodies Freshwater	1.0	1.0	1.0	---	---	1,1-Dichloroethene=3.2 Tetrachloroethene=5.0 Trichloroethene=5.0	--- ---
Marine/Estuarine	2.5	5.0	2.5	---	---	1,1-Dichloroethene=3.2 Tetrachloroethene=8.9 Trichloroethene=81	---

Notes:

mg/l = milligrams per liter
TPHd = Total Petroleum Hydrocarbons as diesel
TPHg = Total Petroleum Hydrocarbons as gasoline
TPHmo = Total Petroleum Hydrocarbons as motor oil
ND = No analytes detected above the method detection limit
< = Analyte was not detected above the laboratory reporting limit
WQOs = Water Quality Objective, SFRWQCB Basin Plan, Table 3-5 - WQO for Municipal Supply, January 2007
MCLs = Maximum Contaminant Levels, Title 22, CCR, Division 4, Chapter 15, Article 4, September 12, 2003
ESLs = Environmental Screening Levels, SFRWQCB, November 2007, Tables A, C and F.

ug/l = micrograms per liter
VOCs = Volatile organic compounds
SVOCs = Semi-volatile organic compounds
--- = No Standard

TABLE 7a
Summary of Statistical Analysis
Route I-880 Southbound Improvements Project
Alameda County, California

Shoulder Borings SB1 through SB7

TOTAL LEAD UCLs

	Total Lead (mg/kg)	
	90% UCL	95% UCL
0 to 0.5 ft	126.9	132.7
1 to 1.5 ft	95.4	101.1
2 to 2.5 ft	51.9	54.7

EXCAVATION SCENARIOS

	90% UCL		95% UCL	
Excavation Depth	Total Lead (mg/kg)	Soluble (WET) Lead* (mg/l)	Total Lead (mg/kg)	Soluble (WET) Lead* (mg/l)
0 to 1 ft	127	8.6	133	9.0
Underlying Soil (1 to 2.5 ft)	*81*	*5.5*	*86*	*5.8*
0 to 2 ft	111	7.5	117	7.9
Underlying Soil (2 to 2.5 ft)	*52*	*3.5*	*55*	*3.7*
0 to 2.5 ft	99	6.7	104	7.1

Notes:

UCL = Upper Confidence Level (90% UCL is applicable for onsite reuse; 95% UCL is applicable for offsite reuse/disposal)
mg/kg = milligrams per kilogram
mg/l = milligrams per liter
* = Soluble (WET) lead concentrations are predicted using slope of regression line, where y = predicted soluble (WET) lead and x= total lead.

Regression Line Slope: $y = 0.0678\ x$

TABLE 7b
Summary of Statistical Analysis
Route I-880 Southbound Improvements Project
Alameda County, California

Shoulder Borings SB8 through SB18 and Retaining Wall Borings RW8-1 and RW8-2

TOTAL LEAD UCLs

	Total Lead (mg/kg)	
	90% UCL	95% UCL
0 to 0.5 ft	43.8	45.4
1 to 1.5 ft	64.1	68.0
2 to 2.5 ft	39.7	41.2

EXCAVATION SCENARIOS

	90% UCL		95% UCL	
Excavation Depth	Total Lead (mg/kg)	Soluble (WET) Lead* (mg/l)	Total Lead (mg/kg)	Soluble (WET) Lead* (mg/l)
0 to 1 ft	44	3.0	45	3.1
Underlying Soil (1 to 2.5 ft)	*56*	*3.8*	*59*	*4.0*
0 to 2 ft	54	3.7	57	3.8
Underlying Soil (2 to 2.5 ft)	*40*	*2.7*	*41*	*2.8*
0 to 2.5 ft	51	3.5	54	3.6

Notes:

UCL = Upper Confidence Level (90% UCL is applicable for onsite reuse; 95% UCL is applicable for offsite reuse/disposal)
mg/kg = milligrams per kilogram
mg/l = milligrams per liter
* = Soluble (WET) lead concentrations are predicted using slope of regression line.
where y = predicted soluble (WET) lead and x= total lead.

Regression Line Slope: $y = 0.0678\ x$

TABLE 7c
Summary of Statistical Analysis
Route I-880 Southbound Improvements Project
Alameda County, California

Shoulder Borings SB28 through SB34 and Retaining Wall Boring RW5-1

TOTAL LEAD UCLs

	Total Lead (mg/kg)	
	90% UCL	95% UCL
0 to 0.5 ft	46.6	49.6
1 to 1.5 ft	142.4	152.3
2 to 2.5 ft	105.6	119.1

EXCAVATION SCENARIOS

	90% UCL		95% UCL	
Excavation Depth	Total Lead (mg/kg)	Soluble (WET) Lead* (mg/l)	Total Lead (mg/kg)	Soluble (WET) Lead* (mg/l)
0 to 1 ft	47	3.2	50	3.4
Underlying Soil (1 to 2.5 ft)	*130*	*8.8*	*141*	*9.6*
0 to 2 ft	94	6.4	101	6.8
Underlying Soil (2 to 2.5 ft)	*106*	*7.2*	*119*	*8.1*
0 to 2.5 ft	97	6.6	105	7.1

Notes:

UCL = Upper Confidence Level (90% UCL is applicable for onsite reuse; 95% UCL is applicable for offsite reuse/disposal)
mg/kg = milligrams per kilogram
mg/l = milligrams per liter
* = Soluble (WET) lead concentrations are predicted using slope of regression line,
where y = predicted soluble (WET) lead and x= total lead.

Regression Line Slope: $y = 0.0678\ x$

TABLE 7d
Summary of Statistical Analysis
Route I-880 Southbound Improvements Project
Alameda County, California

Shoulder Borings SB35 through SB50, and Retaining Wall/Structure Borings DSGW1, RW1-1 through RW1-5, RW2-1, RW2-2, RW3-2, RW3-3, RW4-1, and RW4-2 (excluding outlier sample SB35-2)

TOTAL LEAD UCLs

	Total Lead (mg/kg)	
	90% UCL	95% UCL
0 to 0.5 ft	62.6	65.3
1 to 1.5 ft	48.1	50.7
2 to 2.5 ft	45.8	49.4

EXCAVATION SCENARIOS

	90% UCL		95% UCL	
Excavation Depth	Total Lead (mg/kg)	Soluble (WET) Lead* (mg/l)	Total Lead (mg/kg)	Soluble (WET) Lead* (mg/l)
0 to 1 ft	63	4.2	65	4.4
Underlying Soil (1 to 2.5 ft)	*47*	*3.2*	*50*	*3.4*
0 to 2 ft	55	3.8	58	3.9
Underlying Soil (2 to 2.5 ft)	*46*	*3.1*	*49*	*3.3*
0 to 2.5 ft	53	3.6	56	3.8

Notes:

UCL = Upper Confidence Level (90% UCL is applicable for onsite reuse; 95% UCL is applicable for offsite reuse/disposal)
mg/kg = milligrams per kilogram
mg/l = milligrams per liter
* = Soluble (WET) lead concentrations are predicted using slope of regression line, where y = predicted soluble (WET) lead and x = total lead.

Regression Line Slope: $y = 0.0678\ x$

TABLE 7e
Summary of Statistical Analysis
Route I-880 Southbound Improvements Project
Alameda County, California

Shoulder Borings SB51 through SB68 and Marina Boulevard Structure Borings MBGW1 and MBGW2

TOTAL LEAD UCLs

	Total Lead (mg/kg)	
	90% UCL	95% UCL
0 to 0.5 ft	221.2	238.2
1 to 1.5 ft	64.1	68.5
2 to 2.5 ft	172.0	191.6

EXCAVATION SCENARIOS

	90% UCL		95% UCL	
Excavation Depth	Total Lead (mg/kg)	Soluble (WET) Lead* (mg/l)	Total Lead (mg/kg)	Soluble (WET) Lead* (mg/l)
0 to 1 ft	221	15	238	16
Underlying Soil (1 to 2.5 ft)	*100*	*6.8*	*110*	*7.4*
0 to 2 ft	143	9.7	153	10
Underlying Soil (2 to 2.5 ft)	*172*	*12*	*192*	*13*
0 to 2.5 ft	149	10	161	11

Notes:

UCL = Upper Confidence Level (90% UCL is applicable for onsite reuse; 95% UCL is applicable for offsite reuse/disposal)
mg/kg = milligrams per kilogram
mg/l = milligrams per liter
* = Soluble (WET) lead concentrations are predicted using slope of regression line,
where y = predicted soluble (WET) lead and x= total lead.

Regression Line Slope: $y = 0.0678\ x$

FOUNDATION REPORT
MARINA BLVD OVERCROSSING (REPLACE)
(BRIDGE NO. 33-0735)
ALAMEDA COUNTY, CALIFORNIA
04-ALA-880 EA 3A9211

For

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October 17, 2011 Job No. 206139.WMH

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Log of Test Borings (Br. No. 33-0735)

As-Built Boring Data (Br. No. 37-0167, Caltrans 1950 & 1962)

CPT Site Investigation Report by Gregg In Situ, Inc. (June 6, 2008)

Appendix B

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C-2: Liquefaction Potential per CPT Procedures
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Comment & Response Form (July 26, 2011)

Comment & Response Form (February 2, 2010)

FOUNDATION REPORT
MARINA BLVD OVERCROSSING (REPLACE)
(BRIDGE NO. 33-0735)
ALAMEDA COUNTY, CALIFORNIA
04-ALA-880 EA 3A9211

INTRODUCTION

This report presents the results of our geotechnical engineering investigation for the proposed Marina Boulevard Overcrossing (Replace) at Interstate 880 (I-880), hereinafter referred to as "PROJECT", in Alameda County, California. The work was performed in general accordance with the scope of work outlined in our proposal to WMH Corporation. The general location of the project site and its vicinity are shown on the Project Location Map, Plate 1.

The geotechnical recommendations presented in this report are intended for design input and are not intended to be used as specifications. These recommendations should not be used for direct bidding purposes and cost estimate.

PROPOSED CONSTRUCTION

A new High Occupancy Vehicle (HOV) lane is proposed from Hegenberger Road overcrossing to the existing HOV lane south of Marina Boulevard. The new HOV lane will increase capacity in the I-880 corridor to reduce delay for HOV lane and mixed flow vehicles, reduce the accident rate and improve safety along I-880.

The existing Marina Blvd OC is a two-span structure, approximately 255 feet long. The structure was originally built in 1952 and was widened in 1963. The Marina Boulevard OC will need to be reconstructed to accommodate the new HOV lane. The structure will also be widened to conform to interchange improvement works.

The profile of the bridge will be raised to provide standard vertical clearance over I-880. The proposed Marina Blvd OC (Replace) will be a 2-span, cast-in-place/ prestressed concrete box girder structure with approximate length of 286 feet measured along "MA1" line and approximate width of 114 feet. The foundations will consist of 16-inch diameter open end steel pipes (Alt."W") at Abutments and Bent 2 Left, and 18-inch diameter open end pipe piles at Bent 2 Right where existing utilities are present.

PURPOSE AND SCOPE

The purpose of this investigation was to evaluate the general subsurface conditions at the project site, to evaluate their engineering properties, and to provide geotechnical recommendations for foundation design of the proposed project.

The scope of work performed for this investigation included a review of the readily available soils and geologic literature pertaining to the site including available as-built Log of Test Borings (LOTB) for the existing structure (Br. No. 37-0167); site reconnaissance; obtaining representative soil samples and logging materials encountered in the boring and cone penetration test (CPT); laboratory testing of the collected soil samples, performing engineering analyses based on the field and laboratory data, and preparation of this foundation report for the overcrossing structure.

Due to limitations inherent in geotechnical investigations, it is neither uncommon to encounter unforeseen variations in the subsurface soil conditions during construction nor is it practical to determine all such variations during an acceptable program of drilling and sampling for a project of this scope. Such variations, when encountered, generally require additional engineering services to attain properly constructed project. We, therefore, recommend that a contingency fund be provided to accommodate any additional charges resulting from technical services that may be required during construction. Our recommendations in this report are based on the above information. Any major deviation should be reported to this office for consideration.

SITE CONDITIONS

The existing Marina Blvd/I-880 interchange was originally built in 1952 and was widened in 1963. The existing interchange is a partial cloverleaf interchange with Marina Blvd OC carrying three lanes of traffic each way. The area within the project is generally level. The slopes in the vicinity of the abutments have gradient of 2H: 1V or flatter and are covered with vegetations. Based on the topographic information provided, the existing grade along I-880 is at approx. Elev. 28 to 30 feet, and the existing approach embankment is at approx. Elev. 45 feet.

FIELD EXPLORATION AND LABORATORY TESTING

Based on the preliminary plans, discussions with the designers, and readily available geotechnical data in the area, one exploratory boring and one cone penetration test (CPT) were performed for the Marina Blvd OC near the abutment areas to maximum depth of 100 feet below the existing ground surface. The locations and description of the materials are shown on the Log of Test Borings in the Appendix A of the report.

The borings were advanced using a truck-mounted hollow stem auger drilling method. Selected samples were obtained from 2.0-inch O.D. & 1.4-inch I.D. (Standard Penetration) and 3.0-inch O.D. & 2.5-inch I.D. (Modified California) samplers at various depths. The samplers were driven into subsurface soils under the impact of a 140-pound hammer having a free fall of 30 inches. When correlating standard penetration data, the blow counts for the Modified California sampler may be converted to equivalent SPT blow counts by multiplying a factor of 0.65. The samples were sealed and transported to our laboratory for further evaluation and testing. The field investigation was conducted under the supervision of our field engineer who logged the test borings and prepared the samples for subsequent laboratory testing and evaluation. The descriptions of the materials encountered in the field exploration are also shown on the Log of Test Boring (LOTB) sheet.

Gregg Drilling & In Situ, Inc. performed the CPT on June 6, 2008. The CPT was conducted using a 20-Ton capacity cone with a tip area of 15 cm^2 and a friction sleeve area of 225 cm^2. The soil resistance exerted to the tip and side of the cone were recorded and correlated to "Soil Behavior Type", classification and strength characteristics. Gregg's CPT report is attached in Appendix A.

Laboratory tests were performed on selected soil samples collected during field exploration to evaluate the physical and index properties of the subsurface soils. The laboratory test methods and test results are presented on plates included in Appendix B. Laboratory test results for moisture content, Plasticity Indexes, and grain size distribution of the soil samples are presented on the LOTB in Appendix A. Detail results of laboratory tests are presented in Appendix B.

It should be noted that the descriptions of the soils encountered and relevant boring information presented on the LOTB depict subsurface conditions only at the locations indicated on the plan and

on the particular date noted on the LOTB. Because of the variability from place to place within soil/rock in general, subsurface conditions at other locations may differ from conditions occurring at the boring locations explored. The abrupt stratum changes shown on the logs may be gradational and relatively minor changes in soil types within a stratum may not be noted on the logs due to field limitations. Also, the passage of time may result in a change in the soil conditions at these locations due to environmental changes.

SUBSURFACE CONDITIONS

The subsurface conditions are based on the as-built LOTB sheet (Caltrans 1950 & 1962) and exploratory boring and CPT data performed in May and June 2008 (Parikh 2008). The approximate boring locations are shown on the attached LOTB sheet and Plate 2 (Site Plan). The CPT was performed within the existing clove leaves of the interchange at about the same level of Interstate 880. The CPT interpretation was provided by Gregg In Situ, Inc. A complete report (6/6/08) prepared by Gregg is attached in Appendix A of the foundation report. Per Gregg's report, the interpretation follows the comprehensive review by Lunne, Robertson and Powell (1997). Note that the Gregg's CPT interpretation starts at 5 ft depth because the upper 5 ft was hand-augered as a safety practice. Parikh provided spread sheets for data correlation (attached in Appendix C) only to read Gregg's data and present/plot certain selected parameters along depth for convenience of reading the file.

The CPT data and the drilled boring performed in 2008 are relatively consistent. The as-built soil data (Caltrans 1950 & 1962) also appears to be in general agreement with the current investigation. The subsoils primarily consist of firm to stiff clay soils with sand layers. A 4-foot gravel layer is encountered between Elev. 6 and 2 ft. The sand layers vary from 5 to 10 feet thick and are interbedded between Elev. 2 and -34 ft, with apparent densities ranging from loose (N_{MC}=12 or equivalent N_{SPT}=7~8 at Elev. 10 ft) to very dense (N_{SPT}=51 at Elev. -15 ft). There appear to be some sporadic, relatively thin sand/gravel lenses mixed in the clay strata above Elev. 0. In Boring MR-2, a thin sand lens of medium consistency with N_{MC} of 32 blows/ft (or equivalent N_{SPT} of 21 blow/ft) was encountered at approx. Elev. 7 ft, which appears to be comparable to the CPT data. The drilled boring (MR-2) shows that the N_{SPT} values may be on the order of 7 to 50 blows/ft in these layers.

The clay soils are generally firm to stiff with natural moisture content in the range of 20 to 30%. Based on the investigation and CPT correlation, the undrained shear strength of the clay appears to be typically in the range of 1000 to 2000 psf above Elev. -30 ft. Below that, the clay becomes very stiff to hard. A generalized soil profile with strength parameter is attached in Appendix C of the report.

Groundwater Data. Groundwater was encountered at about Elev. 16.5 ft in current investigation, which appears to be comparable to the as-built LOTB. We have considered groundwater level at Elev. 20 ft (approx. 10-ft depth below existing I-880 level) for project design. The groundwater level is anticipated to vary with the passage of time due to seasonal groundwater fluctuation, surface and subsurface flows, ground surface run-off, and other factors that may not be present at the time of investigation.

GEOLOGY

General geologic features pertaining to the site were evaluated by reference to the "Geologic Map and Map Database of the Oakland Metropolitan Area, Alameda, Contra Costa, and San Francisco Counties, California" by R.W. Graymer, 2000 (USGS Map, MF-2342). Based on the geologic map, the site subsoil's consist of Basin Deposits (Holocene, Qhb). A geologic map of the project vicinity is shown on Plate 3.

Qhb (Basin Deposits, Holocene) – Very fine silty clay to clay deposits occupying flat-floored basins at the distal edge of alluvial fans adjacent to the bay mud (Qhbm).

EARTHQUAKE CONSIDERATIONS

Seismic Sources

The project is located in a seismically active part of northern California. Many faults in the San Francisco Bay Area are capable of producing earthquakes that may cause strong ground shaking at the site. The attached Fault Map (Plate 4) presents the locations of the fault systems relative to the project site.

Caltrans has recently updated the Seismic Hazard Map (2007 Deterministic PGA Map) and released 2009 Seismic Design Criteria that incorporate both deterministic approach using Next Generation Attenuation (NGA) model and USGS probabilistic model. Caltrans indicated that for projects type-selected after September 30, 2009 the new Seismic Design Criteria should apply. The Marina Blvd OC (Replace) project was type-selected in June 2009. Therefore, the seismic design of the project follows the Caltrans 1996 Seismic Hazard Map and standard ARS curves contained in the Seismic Design Criteria v.1.4. This was discussed and agreed upon during type selection meeting in June 2009.

Maximum Credible Earthquake (MCE) magnitudes for some of the major faults in the area determined by Mualchin (California Seismic Hazard Map 1996) are summarized below. These maximum credible earthquake magnitudes represent the largest earthquakes that could occur on the given fault based on the current understanding of the regional tectonic structure.

EARTHQUAKE DATA

Fault	Estimated Closest Distance to the Project Area (mi)	Maximum Credible Earthquake	Peak Bedrock Acceleration (g)
Hayward Fault (strike - slip)	2.5	7.5	0.6
Calaveras-Pacines-San Benito (strike – slip)	11.2	7.5	0.3
San Andreas Fault (strike – slip)	16.3	8.0	0.3

Based on the seismic hazard map prepared by Mualchin (1996) and the attenuation relationship by Sadigh et Al. (1997), the anticipated Peak Bedrock Acceleration (PBA) at the project site is 0.6 g.

Seismic Hazards/Liquefaction Impact

Potential seismic hazards may arise from three sources: surface fault rupture; ground shaking; and liquefaction. Since no active fault pass through the project site, the potential for fault rupture is relatively low. Based on available geological and seismic data, the possibility of the site to experience strong ground shaking may be considered moderate to high.

Liquefaction Potential

Liquefaction is a phenomenon in which saturated cohesionless soils are subject to a temporary but

essentially total loss of shear strength under the reversing, cyclic shear stresses associated with earthquake shaking. Submerged cohesionless sands and silts of low relative density are the type of soils, which usually are susceptible to liquefaction. Clays are generally not susceptible to liquefaction.

Liquefaction analysis was performed in accordance with Youd, et al (2001) using both CPT and SPT procedures. Based on the CPT liquefaction analysis performed for CPT-MR1, it appears that a very thin sand layer at 22.5-ft to 24.5-ft depth (Elev. 7.5 to 5.5 ft) may be subject to triggering of liquefaction. Liquefaction potential of the medium dense sand/gravel layers was also analyzed based on the drilled Boring MR-2. Based on the SPT procedures, the medium sense sand/gravel between Elev. 7 and 3 ft in MR-2 could be subject to triggering of liquefaction. Based on the CPT and boring data, we have conservatively assumed that the material between Elev. 7 and 3 ft could be subject to triggering of liquefaction and neglected capacity contribution from the layer for project design. Since the layer is relatively thin, probably 2 to 4 ft thick, the impact of liquefaction is considered relatively insignificant.

FINDINGS AND RECOMMENDATIONS

General

This report was prepared specifically for the proposed project according to the plans provided to us. Normal construction procedures were assumed throughout our analysis and represent one of the bases of recommendations presented herein. Our design criteria have been based upon the materials encountered at the site. Therefore, we should be notified in the event that these conditions are changed, so as to modify or amend our recommendations.

Foundations

Based on the boring/CPT data and discussion with the designer, the recommended foundation type consists of 16-inch diameter open end steel pipe piles and 18-inch diameter open end pipe piles (at Bent 2 Right due to high load demand). The planned pile caps may overlap with existing footings that are supported on step tapered piles. It is recommended that the existing piles be abandoned and neglected for current design. Although the as-built plans are available, the actual locations of

the existing piles may not be revealed until the caps are demolished during construction. Therefore, the design may require certain flexibility and contingency if the field condition is different from that shown on the as-built drawings.

Predrill Near Existing Utilities. There are two existing sewer lines (18-inch and 21-inch diameter) at the site. The two lines are in the longitudinal direction of the structure. In order to reduce impact on existing sewer lines from pile driving, it is recommended that the new piles stay minimum 3.5 ft clear from the existing lines based on interaction with the designer. The proposed pile locations within 8 ft from the existing lines should be predrilled to minimum 4 ft below the invert prior to pile driving. Based on the information provided, the anticipated sewer line inverts are at approx. Elev. 15.6 ft (Abut 1), Elev. 16.0 ft (Bent 2), and Elev. 16.3 ft (Abut 3). The predrill should follow Caltrans standard specifications (Section 49-1.06). Pea gravel is recommended for backfill. For piles in the vicinity of the existing sewer lines, we have assumed that the pile capacity starts from approx. Elev. 12 ft due to the predrill.

Pertinent foundation design information provided by the structural designer, including Foundation Design Data and Foundation Design Loads, are presented in the following tables.

FOUNDATION DESIGN DATA (per Structural Designer)

Support No.	Design Method	Pile Type	Finish Grade Elev. (ft)	Pile Cut-off Elev. (ft)	Pile Cap Size (ft)		Permissible Settlement (in.)	No. of Piles per Support per Bridge
					B	L		
Abut 1	WSD	Class 200 Alt. "W"	42.90	36.42	11	126.5	1	Stage-I= 18 piles Stage-II= 19 piles
Bent 2 Left	LRFD	Class 200 Alt. "W"	28.70	20.67	12	19	1	15 piles per column footing
Bent 2 Right	LRFD	PP 18x0.5	28.70	18.92	12	50.5	1	23 piles per column footing
Abut 3	WSD	Class 200 Alt. "W"	42.40	34.42	11	128.8	1	Stage-I= 21 piles Stage-II= 21 piles

FOUNDATION DESIGN LOADS (per Structural Designer)

Support No.	Service-I Limit State (kips)			Strength Limit State (Controlling Group, kips)				Extreme Event Limit State (Controlling Group, kips)			
	Total Load		Perma-nent Loads	Compression		Tension		Compression		Tension	
	Per Support	Max. Per Pile	Per Support Column	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile
Abut 1	4300	178	4200	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bent 2 Left	3100	207	2350	4440	296	N/A	N/A	3550	435	N/A	75
Bent 2 Right	5650	332	5100	7350	460	N/A	N/A	5075	460	N/A	12
Abut 3	4850	196	4750	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Consistent with the current Caltrans requirements, Working Stress Design (WSD) is used for the abutment foundations and Load and Resistant Factor Design (LRFD) is used for the foundations for Bent 2 for the bridge. The abutment foundations are evaluated for the foundation design data and loading conditions using Caltrans November 2003 Bridge Design Specifications for foundations, using Working Stress Design (WSD) methods. The Bent 2 foundations are evaluated for the foundation design data and loading conditions using AASHTO LRFD Bridge Design Specifications–3rd Edition, with Interims through 2006 and current Caltrans Memo To Designer (July 2008), Section 3-1 (Attachment 1).

The recommended minimum pile spacing is three times the pile diameter (3D). The pile capacity is primarily form shaft friction. The thin sand layer between Elev. 7 and 3 ft is neglect for capacity contribution due to liquefaction potential. The impact on design pile capacity is considered relatively low due to the thin thickness. Based on the load demand and subsoil information, the recommended specified pile tip elevations are shown in the Pile Data Table below.

FOUNDATION RECOMMENDAIONS FOR ABUTMENTS

Support	Pile Type	Cut-off Elev. (ft)	LRFD Service-I Limit State Load (kips) per Support		LRFD Service-I Limit State Total Load (kips) per Pile (Compression)	Nominal Resistance (kips)	Design Tip Elev. (ft)	Specified Tip Elev. (ft)	Nominal Driving Resistance Required (kips)
			Total	Perma-nent					
Abut 1 (adjacent to utilities)	Class 200 Alt. "W"	36.42	4300	4200	178	400	-50.0 (a) -10.0 (b)	-50.0	424
Abut 1	Class 200 Alt. "W"	36.42	4300	4200	178	400	-40.0 (a) -10.0 (b)	-40.0	424
Abut 3 (adjacent to utilities)	Class 200 Alt. "W"	34.42	4850	4750	196	400	-50.0 (a) -10.0 (b)	-50.0	424
Abut 3	Class 200 Alt. "W"	34.42	4850	4750	196	400	-40.0 (a) -10.0 (b)	-40.0	424

Notes: 1. Design tip elevations are controlled by (a) compression, (b) lateral load.
2. The Nominal Driving Resistance Required is equal to the Nominal Resistance needed to support the factored load plus driving resistance from the unsuitable penetrated soil layer (liquefiable) which does not contribute to the design resistance. Unsuitable soil layer is present between Elev. 7 and 3 ft. The estimated driving resistance from the unsuitable penetrated soil layer is 24 kips.

FOUNDATION RECOMMENDAIONS FOR BENT

Support Loca-tion	Pile Type	Cut-Off Elev. (ft)	Service-I Limit State Load (kips) per Support	Total Permissible Support Settlement (in.)	Required Factored Nominal Resistance (kips)				Design Tip Elev. (ft)	Speci-fied Tip Elev. (ft)	Nominal Driving Resistance Required (kips)
					Strength Limit		Extreme Event				
					Comp. (ϕ=0.7)	Tension (ϕ=0.7)	Comp. (ϕ=1)	Tension (ϕ=1)			
Bent 2 Left	Class 200 Alt. "W" (MOD)	20.7	3100	1	296	0	435	75	-48.0 (a-I) -50.0 (a-II) -3.0 (b-II) -20.0(c)	-50.0	464
Bent 2 Right	PP 18x0.5	18.9	5650	1	460	0	460	12	-62.0 (a-I) -45.0 (a-II) 12.0 (b-II) -20.0(c)	-62.0	687
Bent 2 Right (adjacent to utilities)	PP 18x0.5	18.9	5650	1	460	0	460	12	-70.0 (a-I) -50.0 (a-II) 7.0 (b-II) -20.0(c)	-70.0	687

Notes: 1. Design tip elevations are controlled by: (a-I) Compression (Strength Limit), (b-I) Tension (Strength Limit), (a-II) Compression (Extreme Event), (b-II) Tension (Extreme Event), (c) Lateral Load.
2. The Nominal Driving Resistance Required is equal to the Nominal Resistance needed to support the factored load plus driving resistance from the unsuitable penetrated soil layer (liquefiable) which does not contribute to the design resistance. Unsuitable soil layer is present between Elev. 7 and 3 ft. The estimated driving resistance from the unsuitable penetrated soil layer is 24 kips for 16-inch pipe piles and 27 kips for 18-inch pipe piles, respectively.

PILE DATA TABLE

Location	Pile Type	Nominal Resistance (kips)		Design Tip Elev. (ft)	Specified Tip Elev. (ft)	Nominal Driving Resistance Required (kips)
		Compression	Tension			
Abut 1 (adjacent to utilities)	Class 200 Alt. "W"	400	0	-50.0 (a); -10.0 (c)	-50.0	424
Abut 1				-40.0 (a); -10.0 (c)	-40.0	424
Bent 2 Left	Class 200 Alt."W" (MOD)	440	75	-50.0 (a); -3.0 (b); -20.0 (c)	-50.0	464
Bent 2 Right (adjacent to utilities)	PP 18 x 0.5	660	12	-70.0 (a); 7.0 (b); -20.0 (c)	-70.0	687
Bent 2 Right				-62.0 (a); 12.0 (b); -20.0 (c)	-62.0	687
Abut 3 (adjacent to utilities)	Class 200 Alt. "W"	400	0	-50.0 (a); -10.0 (c)	-50.0	424
Abut 3				-40.0 (a); -10.0 (c)	-40.0	424

Notes:
(1) Design tip elevations for Abutments are controlled by (a) Compression, (b) Tension, (c) Lateral Load.
(2) Piles locations within 8 ft of the existing sewer lines should be predrilled to 4 ft below inverts prior to pile driving. The lowest inverts are anticipated at Elev. 15.6 ft (Abut 1), 16.0 ft (Bent 2) and 16.3 ft (Abut 3).
(3) Unsuitable soil layer (liquefiable) that does not contribute to the design nominal resistance exists between Elev. 7 and 3 ft. The estimated driving resistance from the unsuitable penetrated soil layer is 24 kips for 16-inch pipe piles and 27 kips for 18-inch pipe piles, respectively.

Due to the stiff to hard clay and dense sand layers present at the site, moderate to hard driving conditions should be anticipated. We recommend that the piles be driven to the specified tip elevations. The estimation of the driven pile capacity in clay is based on the adhesion factor per FHWA manual (Tomlinson, 1980). The pile capacity derives primarily from frictional resistance along the pile shaft. It is anticipated the pile capacity will develop after driving as a result of soil "freeze" and dissipation of excess pore water pressures. The gain of pile capacity after initial driving may be evaluated based on "redriving" after 24-hour (minimum) set-up. The Gates formula per Caltrans standard specifications (Section 49-1.08) may be used in the field for driving and capacity verification.

Per Caltrans Standard Specifications (Section 49-1.06), oversize predrill through the approach embankment is anticipated for abutment piles. The predrill is also applicable for pile locations in the vicinity of existing sewer lines. Pea gravel should be used to backfill the annular space.

In the event that unanticipated pile driving conditions are encountered, it is recommended that a Pile Driving Analyzer (PDA) be used to evaluate the pile capacity. Typical application includes capacity evaluation (for both during driving and re-striking) for piles that have experienced hard driving. The geotechnical engineer should be consulted for any unanticipated pile driving conditions.

Lateral Pile Capacity

The recommended geotechnical parameters for LPILE analysis are provided below. To account for group effect, p-multipliers of 0.6 and 0.8 are recommended for pile spacing of 3D & 4D, respectively. The existing Rte 880 is at approx. Elev. 30 ft.

Approx. Elevation (ft.)	Generalized Soil Profile	LPILE Soil Type	Soil Strength	K (pci)	E_{50} (in/in)	Effect Unit Wt. (pci)
Above 30	Embankment	3, CLAY	C = 1500 psf	--	0.007	0.072
30 to 22	Lean Clay, stiff	3, CLAY	C = 2000 psf	--	0.007	0.072
22 to 18	Lean Clay, firm to stiff	3, CLAY	C = 1000 psf	--	0.007	0.036
18 to 7	Lean Clay, stiff	3, CLAY	C = 2000 psf	--	0.007	0.036
7 to 3	Poorly-Graded Gravel/ Sand, medium dense	4, SAND (without liquefaction)	ϕ = 34 deg	60	--	0.036
		10, Liquefiable Sand (Rollins, 2003 as adopted in LPILE V. 5)				
3 to -3	Poorly-Graded Sand, medium dense to dense	4, SAND	ϕ = 34 deg	60	--	0.036
-3 to -8	Lean Clay	3, CLAY	C = 1000 psf	--	0.007	0.036
-8 to -18	Poorly-Graded Sand, very dense	4, SAND	ϕ = 36 deg	125	--	0.036
-18 to -26	Lean Clay	3, CLAY	C = 2000 psf	--	0.007	0.036
-26 to -33	Well-Graded Sand w/ Silt, dense	4, SAND	ϕ = 36 deg	125	--	0.036
Below -33	Lean Clay, very stiff	3, CLAY	C = 2500 psf	--	0.005	0.036

Based on discussion with the designer, preliminary LPILE analyses were performed with the results attached in Appendix C showing deflection, moment, shear and soil reaction along the pile length. The abutment piles were modeled as "pinned-connection" (free head), and the bent piles were modeled as "fixed head" condition per discussion with the designer. Generally, abutment piles are designed for service loads only, and batter piles are used for resisting static lateral earth pressures. The bent piles are governed by seismic loading conditions. At service condition, there

is minimal shear demand on the bent piles. In common engineering practice, a maximum pile head deflection of 1/4 inch is recommended for service condition for vertical piles. Under seismic loading condition, pending the overall structural design and considerations, a maximum pile head deflection up to about one to two inches is generally tolerable and accepted for design of bent piles.

In addition to lateral capacity of the piles, passive resistance against the vertical sides of the pile caps/footings may also contribute to the lateral design. It is assumed that the pile caps/footings are poured neat against undisturbed native soil. For Marina Blvd OC (Replace), the recommended passive resistance against the vertical sides of the pile caps is 4.5 ksf. The value is a uniformly distributed resistance for seismic & ultimate condition. The mobilization of the passive resistance, as shown in Appendix C, follows the guidelines of FEMA 356 (November 2000).

Lateral Earth Pressures

Abutment retaining walls and wing walls should be designed to resist the following Applied Lateral Earth Pressures and live load. These values assume no hydrostatic pore pressure buildup behind the wall and are based on well-drained backfill behind the walls supported in native soil.

	Applied Lateral Earth Pressure
Active Condition	36 pcf Equivalent Fluid Pressure (EFP) for engineered fill
At-Rest Condition	55 pcf Equivalent Fluid Pressure (EFP) for engineered fill
Passive Resistance	5 ksf (ultimate) for seismic design of the abutment backwall (5.5 feet high or greater); for activated height less than 5.5 feet modify proportionally, i.e. 5 x (H/5.5) ksf per SDC v. 1.4. A minimum lateral wall movement of 2% of wall height to mobilize the full ultimate passive pressure is required.

Cantilever walls which are free to rotate at least 0.004 radians may be assumed flexible for the active condition. Walls that are not capable of this movement should be assumed rigid and designed for the at-rest condition. The effect of any surcharge (dead, live, or traffic load) should be added to the preceding lateral earth pressures. Coefficients of 0.3 and 0.5 may be used to determine the additional earth pressure resulting from the surcharge for cantilever walls and rigid walls, respectively.

Seismic Design Criteria

Caltrans has recently released the 2009 Seismic Design Criteria. Seismic design of bridge structures type-selected after September 30, 2009 will follow the 2009 criteria. Bridge structures type-selected prior to September 30, 2009 may follow Seismic Design Criteria v. 1.4 (June 2006). The project went through the type selection process in June 2009, and this structure has been designed in accordance with Seismic Design Criteria v. 1.4 (June 2006). Based on the available boring information in the vicinity of the project site, the subsurface soil conditions at the project site generally matches the criteria for Soil Type D, as per Caltrans Seismic Design Criteria (Version 1.4, June 2006). Based on Caltrans Seismic Design Criteria and the above information, the seismic design criteria are as follows:

1. Governing Fault = Hayward Fault (strike-slip; Mw=7.5)
2. Closest Distance to Fault = 2.5 miles
3. PBA = 0.6 g
4. Design ARS Curve = Caltrans Seismic Design Criteria June 2006 Version 1.4 Figure B.8 for Soil Type D with (1) 20% increase of spectral accelerations (S_a) for structural periods ≥ 1 sec. (2) No change in S_a for structural periods ≤ 0.5 sec. and (3) Linear interpolation of S_a for structural periods between 0.5 sec. and 1 sec.

A copy of the ARS Design Curve is included on Plate No. 5 of this report.

Embankment Settlement & Waiting Period

Embankments are required at the abutments for the proposed modification of Marina Blvd Interchange. Based on discussion with the design team, a maximum embankment height of up to 25 feet may be expected. The embankments will have side slopes (2H:1V or flatter) similar to existing condition. The new approach embankments will abut existing embankments.

The boring data indicates that the subsurface soil conditions generally consist of firm to stiff clay in the upper 30 feet overlying sand layer and more stiff clays at depth. The clay layers were considered in the settlement analysis. The evaluation of the consolidation settlements under the new fill was based on the consolidation test results, understanding of the consolidation behavior of the clay and empirical correlations in the literatures. The evaluation of the consolidation settlements and data were presented in the Geotechnical Design & Materials Report of the roadway

design submittal. Based on the results of the settlement analyses, the consolidation settlements are estimated to be on the order of 4 to 5 inches at Marina Blvd. Majority of settlements are in the overconsolidated/elastic range. A 30-day settlement period is recommended for ground adjustment under the anticipated 25-foot embankment.

It is recommended that settlement platforms be installed and settlement be monitored per California Test 112. As a common practice, this is typically handled by the project Resident Engineer. It is recommended that a minimum of 3 to 4 settlement platforms be installed per abutment since earthwork and construction equipment tend to destroy some platforms during fill placement.

Embankment Stability

Stability analyses were performed for the proposed embankment slope (with maximum height of about 25 ft) at the Marina Blvd Interchange. Based on the results of the stability analyses, the stability of the proposed fill slopes appears acceptable with minimum factor of safety >2 under liquefaction condition. The results of the stability analyses and the strength parameters adopted in the stability are included in Appendix C.

Corrosion

Corrosion tests were performed on a sample retrieved at the existing interchange. A summary of the corrosion test results is presented below. For structural elements, Caltrans Corrosion Guidelines (September 2003) consider a site to be corrosive if one or more of the following conditions exist for the representative soil/water samples at the site:

> *Chloride concentration is 500 ppm or greater, sulfate concentration is 2000 ppm or greater, or the pH is 5.5 or less.*

SUMMARY OF CORROSION TEST RESULTS

Boring No.	Station & Offset	Depth (ft)	Min. Resistivity (ohm-cm)	pH	Sulfate (ppm)	Chloride (ppm)
E-4	"MA1" Sta. 22+47, 111 Rt.	4.5	1930	6.91	133.4	38.1

Based on the data, the site subsoil is considered non-corrosive per Caltrans corrosion design guidelines, and standard Type II modified or Type I-P (MS) modified cement may be used for the

concrete substructures. The minimum cement factor and cover thickness should be per Caltrans Bridge Design Specifications (Section 8.22).

Plan Review

We recommend that final plans for foundations be reviewed by this office prior to construction so that the intent of our recommendations is included in the project plans and specifications and to further see that no misunderstandings or misinterpretations have occurred.

Construction Observation

To a degree, the performance of any structure is dependent upon construction procedures and quality. Hence, observation of foundation excavations, and pile installations should be carried out by this office. If the subsurface conditions different from those forming the basis of our recommendations is encountered this office should be informed in order to assess the need for design changes. Therefore, the recommendations presented in this report are contingent upon good quality control and these geotechnical observations during construction.

INVESTIGATION LIMITATIONS

Our services consist of professional opinions and recommendations made in accordance with generally accepted geotechnical engineering principles and practices and are based on our site reconnaissance and the assumption that the subsurface conditions do not deviate from observed conditions. All work done is in accordance with generally accepted geotechnical engineering principles and practices. No warranty, expressed or implied, of merchantability or fitness, is made or intended in connection with our work or by the furnishing of oral or written reports or findings. The scope of our services did not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in structures, soil, surface water, groundwater or air, below or around this site. Unanticipated soil conditions are commonly encountered and cannot be fully determined by taking soil samples and excavating test borings; different soil conditions may require that additional expenditures be made during construction to attain a properly constructed project. Some contingency fund is thus recommended to accommodate these possible extra costs.

This report has been prepared for the proposed project as described earlier, to assist the engineer in the design of this project. In the event any changes in the design or location of the facilities are planned, or if any variations or undesirable conditions are encountered during construction, our conclusions and recommendations shall not be considered valid unless the changes or variations are reviewed and our recommendations modified or approved by us in writing.

This report is issued with the understanding that it is the designer's responsibility to ensure that the information and recommendations contained herein are incorporated into the project and that necessary steps are also taken to see that the recommendations are carried out in the field.

The findings in this report are valid as of the present date. However, changes in the subsurface conditions can occur with the passage of time, whether they are due to natural processes or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur, whether they result from legislation or from the broadening of knowledge. Accordingly, the findings in this report might be invalidated, wholly or partially, by changes outside of our control.

Respectfully submitted,
PARIKH CONSULTANTS, INC.

Y. David Wang, Ph.D., P.E. C52911
Senior Engineer

REGISTERED PROFESSIONAL ENGINEER
GAURANG R. PARIKH
No. 666
EXP. 12-31-11
GEOTECHNICAL
STATE OF CALIFORNIA

Gary Parikh, G.E. 666
Project Manager

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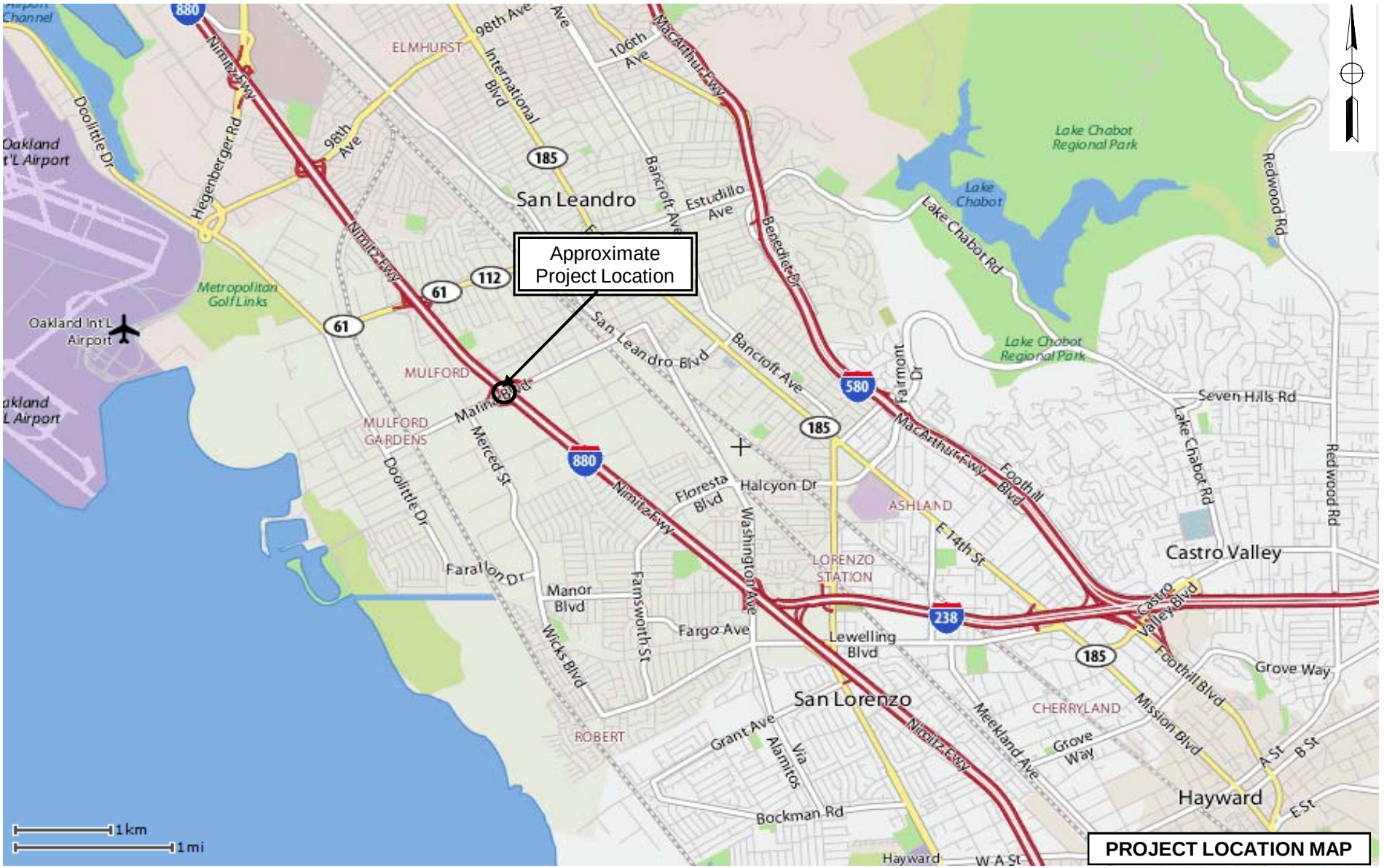


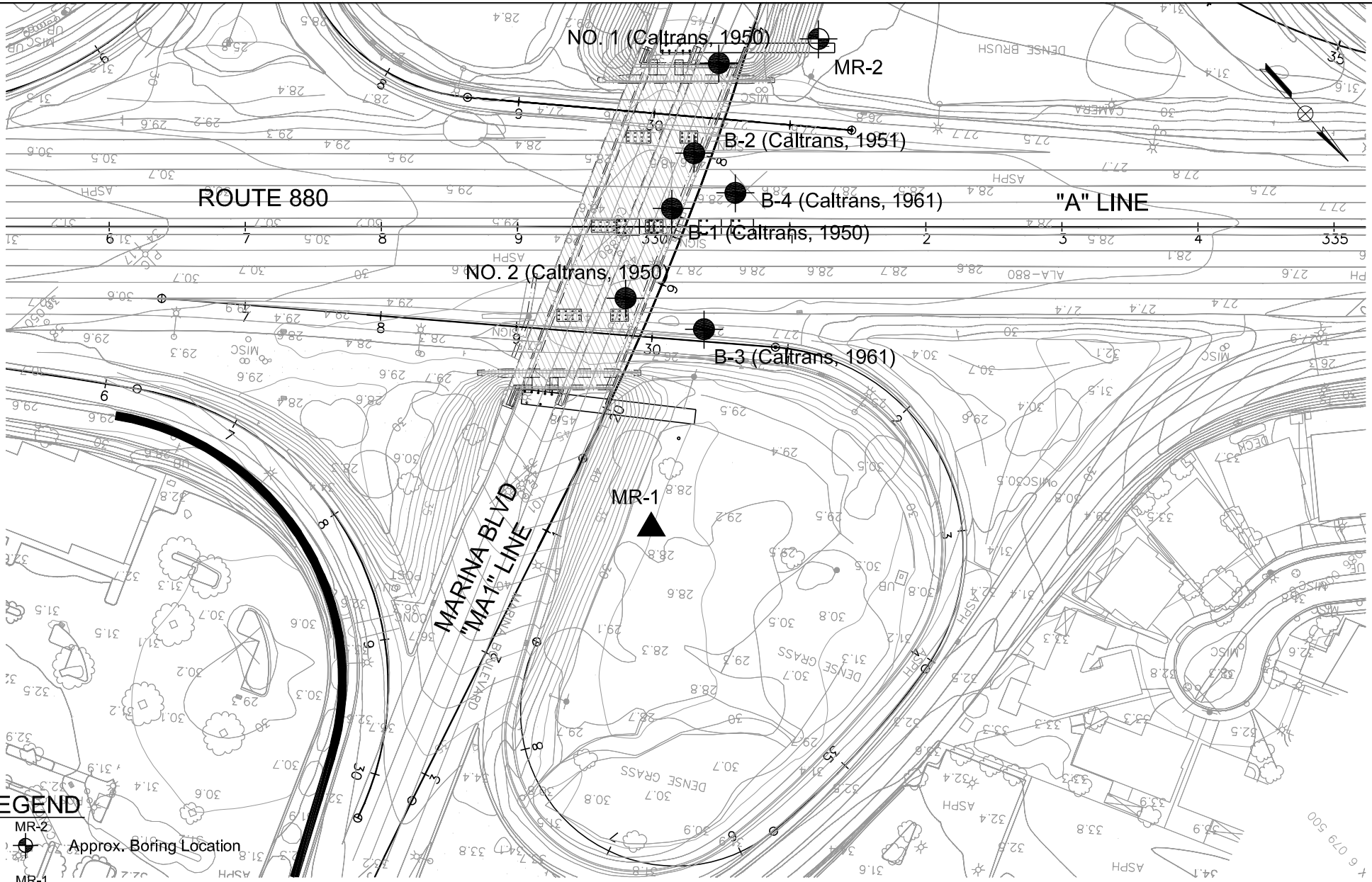
PROJECT LOCATION MAP

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS TESTING

MARINA BLVD. OC (REPLACE)
ALAMEDA COUNTY, CALIFORNIA

JOB NO.: 206139.10

PLATE NO.: 1



LEGEND

MR-2 — Approx. Boring Location

MR-1 — Approx. Cone Penetration Test Location

No. 1 — Approx. Caltrans As-Built Boring Location

SCALE 1 inch = 100 feet

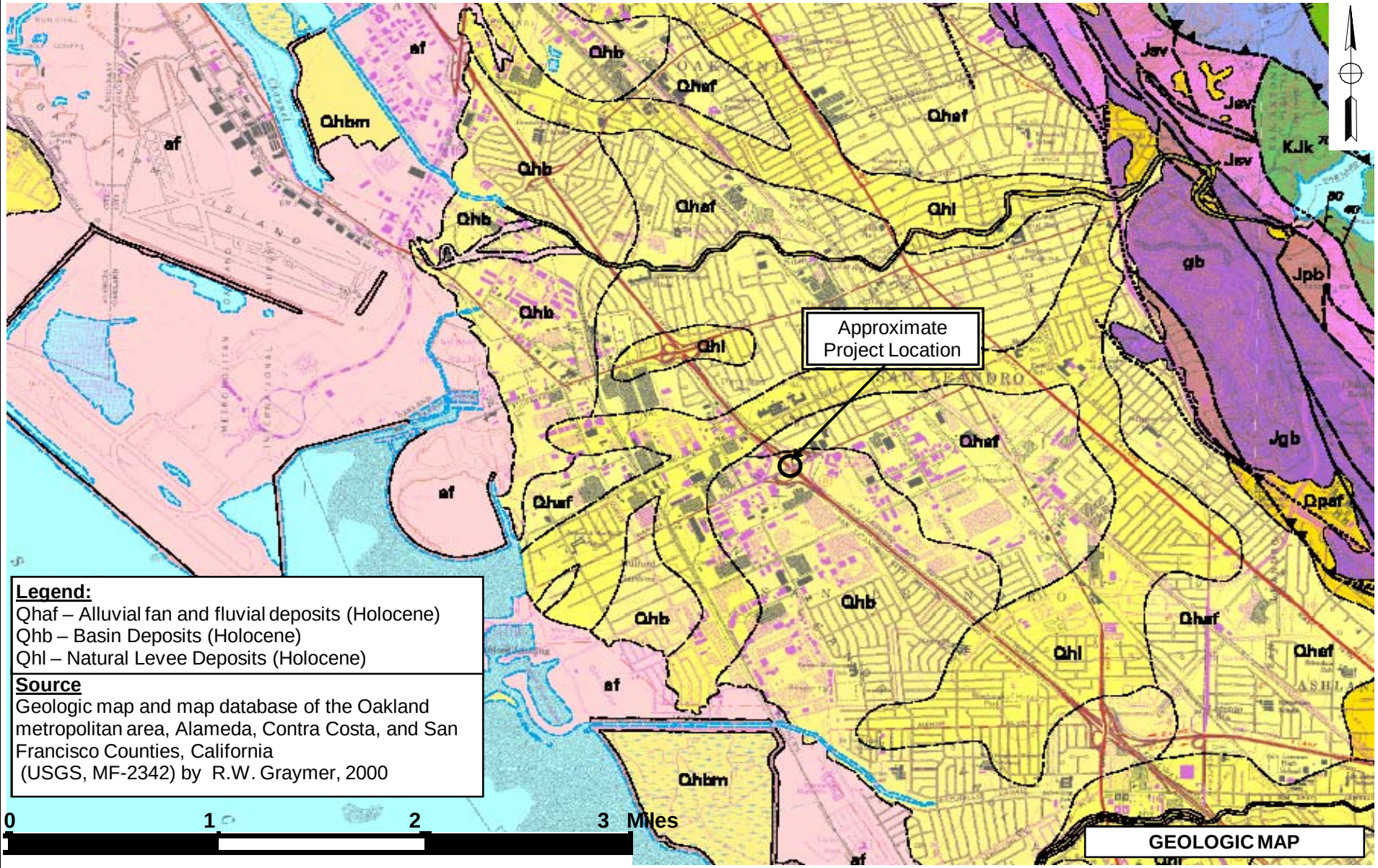
Note: All units are in feet unless otherwise specified
Reference Map was provided by WMH Corporation

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

MARINA BLVD. OC (REPLACE)
ALAMEDA COUNTY, CALIFORNIA

JOB NO.:206139.10

PLATE NO. 2



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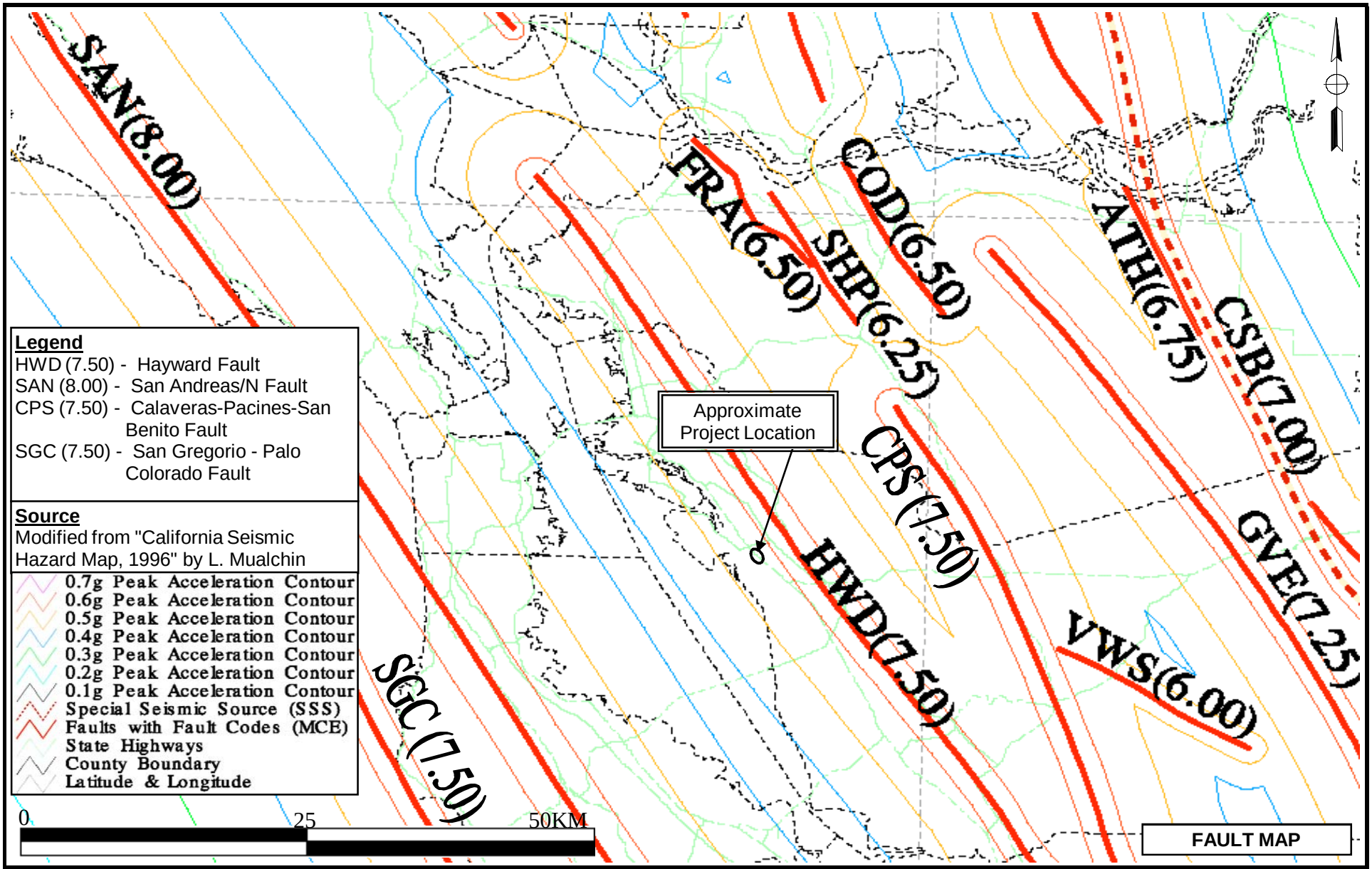
MATERIALS TESTING

MARINA BLVD. OC (REPLACE)
ALAMEDA COUNTY, CALIFORNIA

JOB NO.: 206139.10

PLATE NO.: 3



FAULT MAP

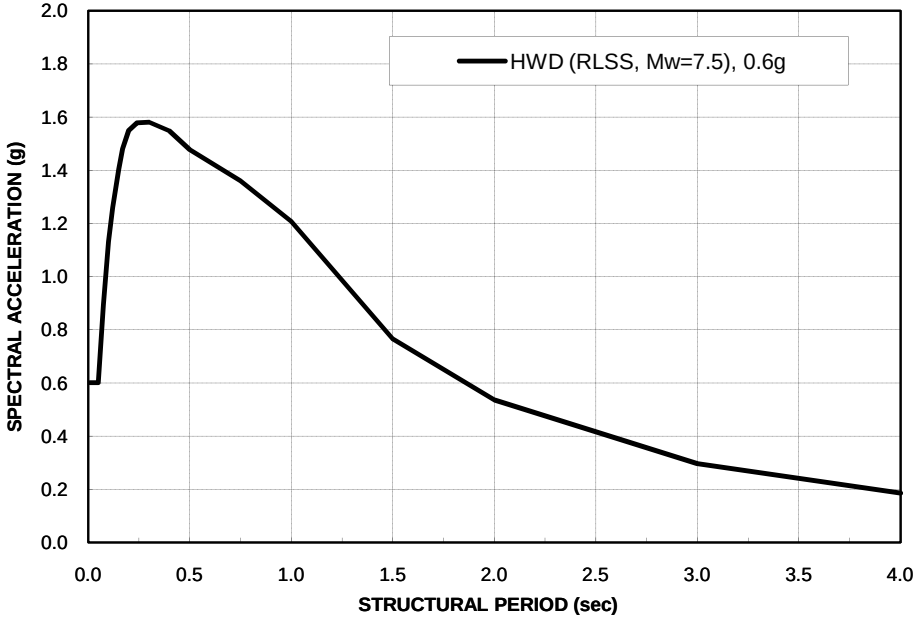
PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS TESTING

MARINA BLVD. OC (REPLACE)
ALAMEDA COUNTY, CALIFORNIA

JOB NO.: 206139.10

PLATE NO.: 4

ARS DESIGN CURVE
MARINA BLVD. OC (REPLACE)
ALAMEDA COUNTY, CALIFORNIA



Spectral Data

Period (sec)	Spectral Accel. (g)
0.010	0.600
0.020	0.600
0.030	0.600
0.050	0.600
0.075	0.893
0.100	1.132
0.120	1.259
0.150	1.403
0.170	1.480
0.200	1.550
0.240	1.578
0.300	1.581
0.400	1.548
0.500	1.477
0.750	1.360
1.000	1.207
1.500	0.765
2.000	0.536
3.000	0.296
4.000	0.186

Caltrans SDC (v 1.4, June 2006), Figure B.8,
Governing Fault: Hayward Fault
Fault Distance = 2.5 miles
(Mw = 7.5, Soil Profile Type D, PBA = 0.6g)

Notes:
(A) PBA was obtained by using Sadigh Attenuation Relationship
(B) The following modifications were then applied for near-fault effects:
(1) No change of Sa for structural periods $\leq$ 0.5 sec
(2) 20% increase of Sa for structural periods > 1 sec
(3) Linear interpolation for structural periods between 0.5 and 1 sec

APPENDIX A

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	880			

GEOTECHNICAL PROFESSIONAL — DATE 12/1/11

PLANS APPROVAL DATE

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

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/11 — GEOTECHNICAL — STATE OF CALIFORNIA

PARIKH CONSULTANTS, INC.
2360 QUME DRIVE, SUITE A
SAN JOSE, CA 95131

ACTC
1333 BROADWAY, SUITES 220 & 300
OAKLAND, CA 94612

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (2010)

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

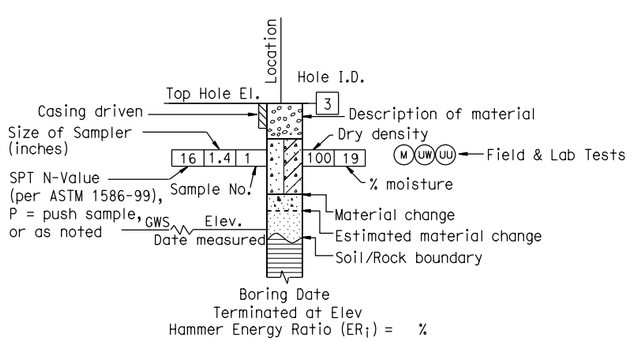
BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring (hollow or solid stem bucket)
Size	R RW RC P	Rotary drilled boring (conventional) Rotary drilled with self-casing wire-line Rotary core with continuously-sampled, self-casing wire-line Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778)
⬚	O	Other (note on LOTB)

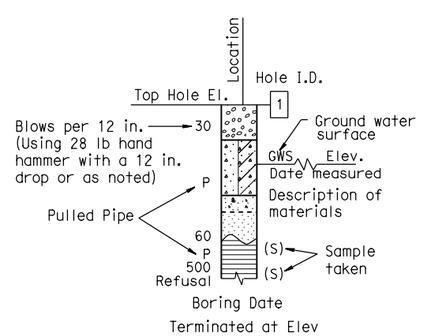
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

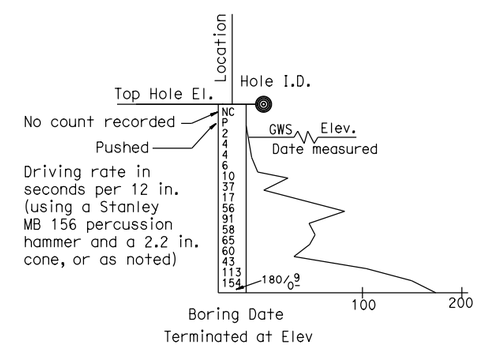
Description	Shear Strength (tsf)	Pocket Penetrometer Measurement, PP, (tsf)	Torvane Measurement, TV, (tsf)	Vane Shear Measurement, VS, (tsf)
Very Soft	Less than 0.12	Less than 0.25	Less than 0.12	Less than 0.12
Soft	0.12 - 0.25	0.25 - 0.5	0.12 - 0.25	0.12 - 0.25
Medium Stiff	0.25 - 0.5	0.5 - 1	0.25 - 0.5	0.25 - 0.5
Stiff	0.5 - 1	1 - 2	0.5 - 1	0.5 - 1
Very Stiff	1 - 2	2 - 4	1 - 2	1 - 2
Hard	Greater than 2	Greater than 4	Greater than 2	Greater than 2



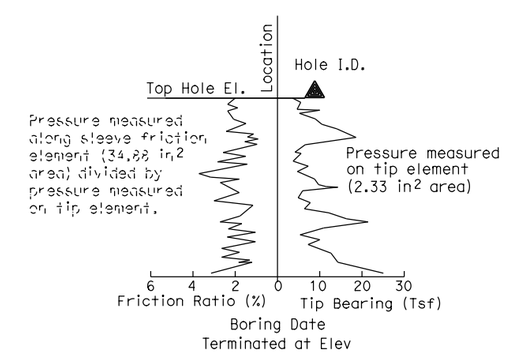
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) BORING

DESIGN OVERSIGHT	DRAWN BY	L. TRAN	L. BHANGOO / G. TRIPATHI	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	D. WANG	BRIDGE NO. 33-0735	MARINA BLVD OC (REPLACE)
SIGN OFF DATE	CHECKED BY	D. WANG	FIELD INVESTIGATION BY: DATE: MAY & JUNE 2008		PROJECT ENGINEER	POST MILES 22.84	LOG OF TEST BORINGS 1 OF 5

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: PROJECT NUMBER & PHASE: CONTRACT NO.:

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES 11/16/09 5/31/11 10/17/11 — SHEET 26 OF 30

FILE => 33-0735-z-ltb01.dgn

USERNAME => eanjorin DATE PLOTTED => 02-DEC-2011 TIME PLOTTED => 16:52

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (2010)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly-graded GRAVEL Poorly-graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly-graded GRAVEL with SILT Poorly-graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly-graded GRAVEL with CLAY (or SILTY CLAY) Poorly-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly-graded SAND Poorly-graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly-graded SAND with SILT Poorly-graded SAND with SILT and GRAVEL		
SP-SC	Poorly-graded SAND with CLAY (or SILTY CLAY) Poorly-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	880			

GEOTECHNICAL PROFESSIONAL — DATE 12/1/11

PLANS APPROVAL DATE

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

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/11 — GEOTECHNICAL — STATE OF CALIFORNIA

PARIKH CONSULTANTS, INC.
2360 QUME DRIVE, SUITE A
SAN JOSE, CA 95131

ACTC
1333 BROADWAY, SUITES 220 & 300
OAKLAND, CA 94612

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 in.)
Very Loose	0 - 5
Loose	5 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Greater than 50

MOISTURE

Description	Criteria
Dry	No discernable moisture
Moist	Moisture present, but no free water
Wet	Visible free water

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5% - 10%
Little	15% - 25%
Some	30% - 45%
Mostly	50% - 100%

PARTICLE SIZE

Description		Size (in.)
Boulder		Greater than 12
Cobble		3 - 12
Gravel	Coarse	3/4 - 3
	Fine	1/5 - 3/4
Sand	Coarse	1/16 - 1/5
	Medium	1/64 - 1/16
	Fine	1/300 - 1/64
Silt and Clay		Less than 1/300

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY L. TRAN

CHECKED BY D. WANG

L. BHANGOO / G. TRIPATHI
FIELD INVESTIGATION BY:
DATE: MAY & JUNE 2008

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

D. WANG
PROJECT ENGINEER

BRIDGE NO. 33-0735
POST MILES 22.84

MARINA BLVD OC (REPLACE)
LOG OF TEST BORINGS 2 OF 5

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE:
CONTRACT NO.:

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES 11/16/09 5/31/11 10/17/11

SHEET 27 OF 30

FILE => 33-0735-z-1tb02.dgn

USERNAME => eanjorin DATE PLOTTED => 02-DEC-2011 TIME PLOTTED => 16:52

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	880			

GEOTECHNICAL PROFESSIONAL — DATE 12/1/11

PLANS APPROVAL DATE

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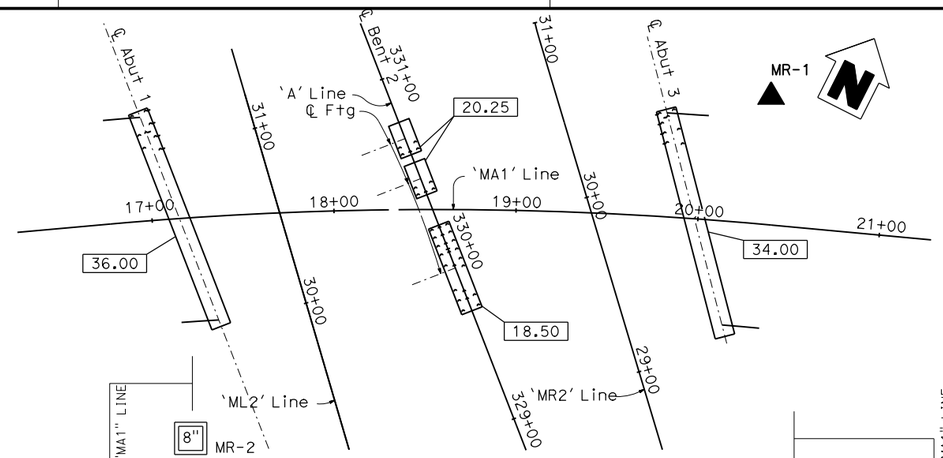
REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/11 — GEOTECHNICAL — STATE OF CALIFORNIA

PARIKH CONSULTANTS, INC.
2360 QUME DRIVE, SUITE A
SAN JOSE, CA 95131

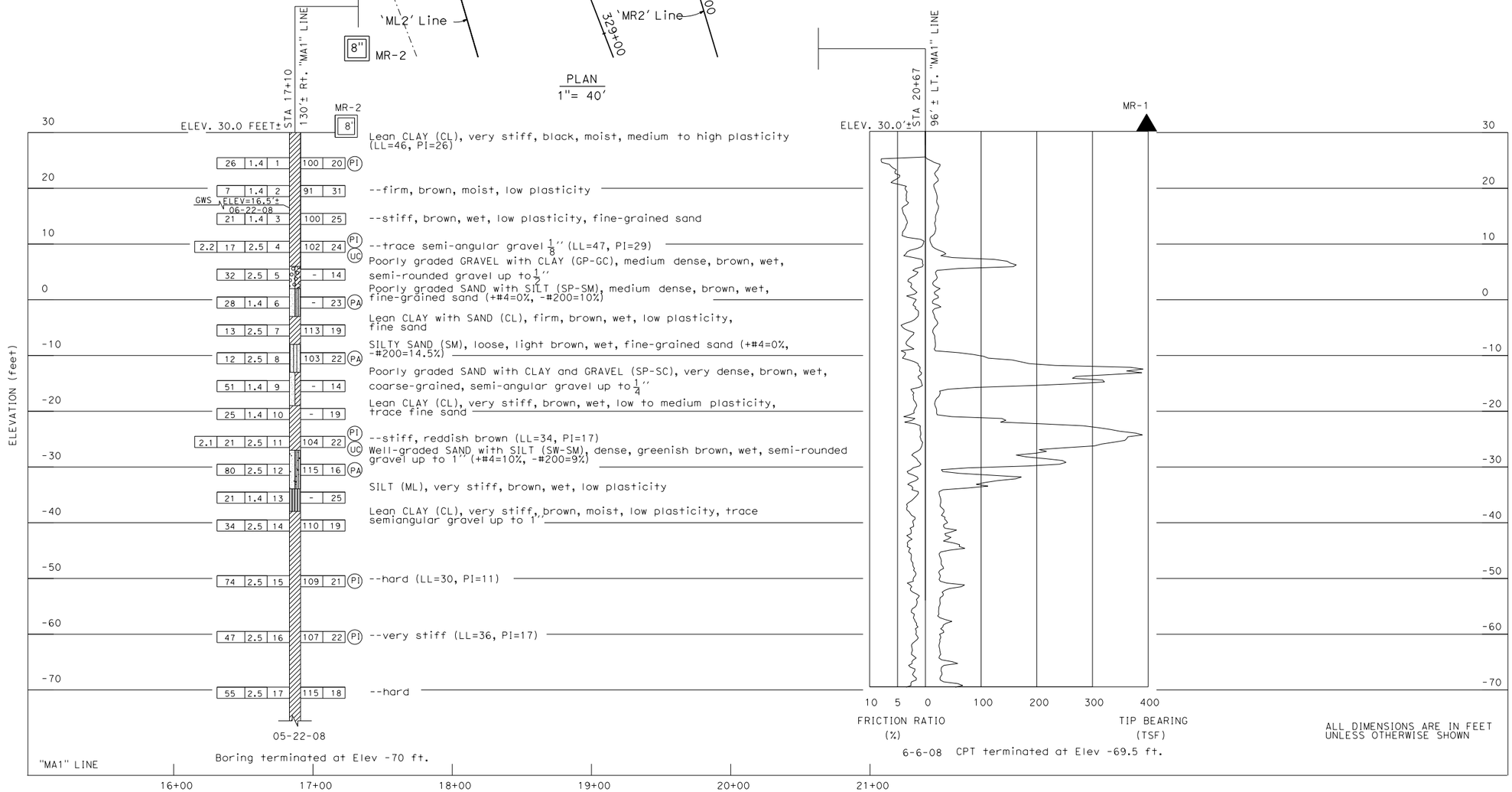
ACTC
1333 BROADWAY, SUITES 220 & 300
OAKLAND, CA 94612



PLAN
1"= 40'

BENCHMARK:
3/4" IRON PIPE WITH PLUG ON NORTHBOUND ROUTE 880 ON-RAMP FROM WESTBOUND MARINA BLVD., ±17.4' SOUTH OF EDGE OF PAVEMENT.
NORTHING: 2,085,802.77; EASTING: 6,079,495.08;
ELEV. 30.97.

Note:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)



ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

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

X DESIGN OVERSIGHT	DRAWN BY	L. TRAN	L. BHANGOO / G. TRIPATHI FIELD INVESTIGATION BY:
X SIGN OFF DATE	CHECKED BY	D. WANG	DATE: MAY & JUNE 2008

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

D. WANG — PROJECT ENGINEER

BRIDGE NO. 33-0735 — POST MILES 22.84

MARINA BLVD OC (REPLACE)
LOG OF TEST BORINGS 3 OF 5

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE:
CONTRACT NO.:

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES 11/16/09 5/31/11 10/17/11

SHEET 28 OF 30

FILE => 33-0735-z-1tb03.dgn

USERNAME => eanjorin DATE PLOTTED => 02-DEC-2011 TIME PLOTTED => 16:52

DIST. NO	STATE	PROJ. NO	YEAR	NO	SHEETS
2	CAL.			143	174

DIST	COUNTY	ROUTE	BRIDGE NO	SHEET NO	TOTAL SHEETS
IV	Ala	880	0	2	8

Stuart M. Stoll
August 21, 1950

DIVISION OF ENGINEERING SERVICES – GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES–TOTAL PROJECT	Sheet No.	Total Sheets
04	ALA	880			

GEOTECHNICAL PROFESSIONAL — DATE 12/1/11

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/11 — GEOTECHNICAL — STATE OF CALIFORNIA

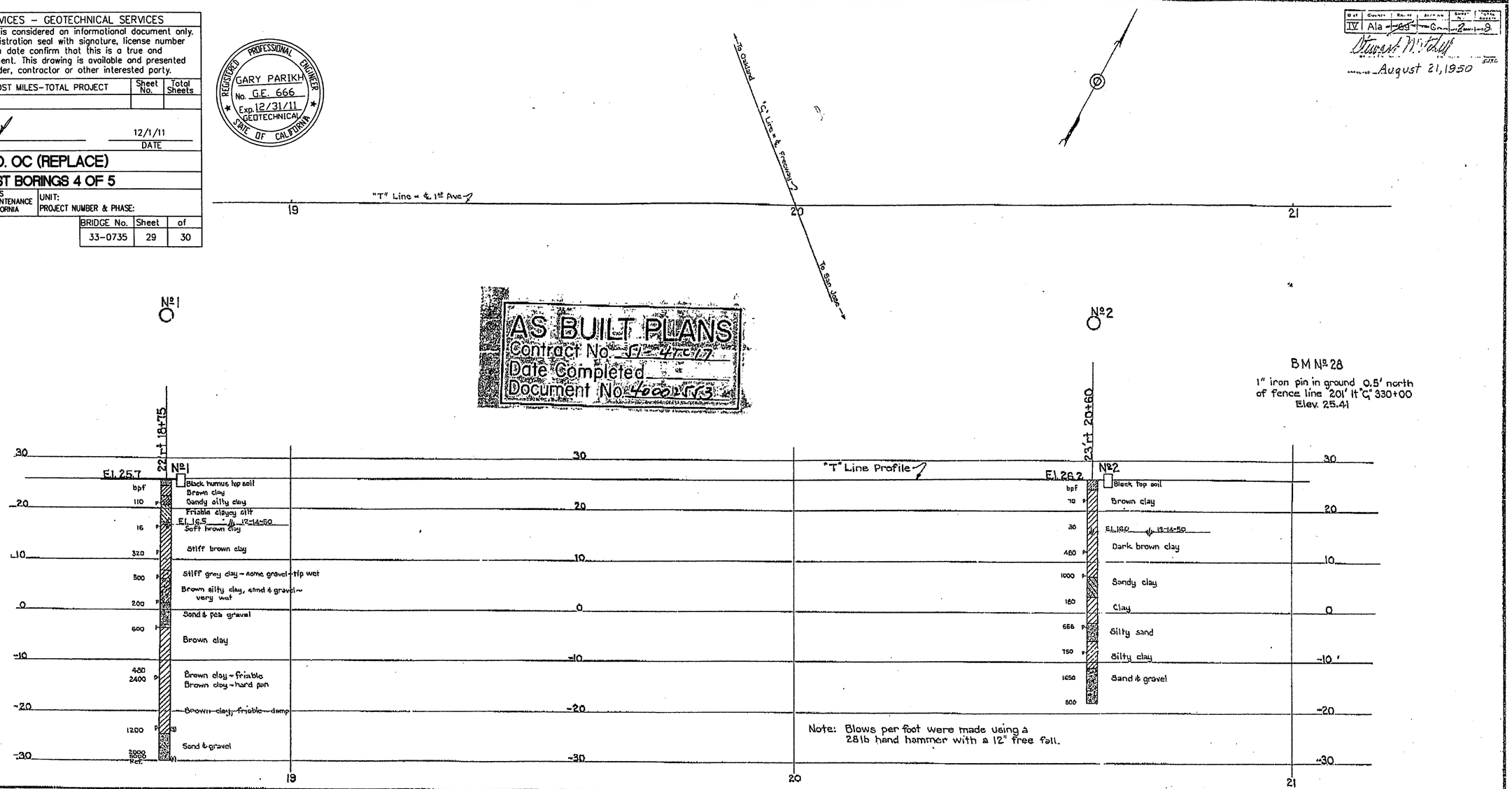
MARINA BLVD. OC (REPLACE)

LOG OF TEST BORINGS 4 OF 5

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

UNIT:
PROJECT NUMBER & PHASE:

BRIDGE No.	Sheet	of
33-0735	29	30



AS BUILT PLANS
Contract No. 59-4C17
Date Completed
Document No. 4000553

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

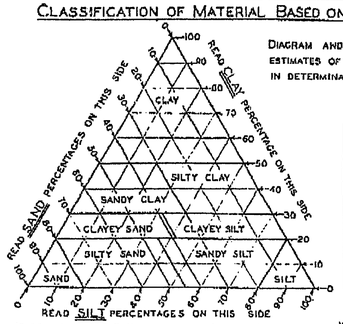


DIAGRAM AND TABLE SHOWING THE BASIS FOR ESTIMATES OF GRADE SIZE DISTRIBUTION USED IN DETERMINATION OF CLASS NAMES.

GROUPING USED IN TRIANGULAR CLASSIFICATION			
CLASS NAME	PERCENTAGE OF SIZES PRESENT		
	SAND	SILT	CLAY
SAND	80–100	0–20	0–20
SILTY SAND	45–80	0–55	0–20
SANDY SILT	0–45	35–80	0–20
SILT	0–20	80–100	0–20
CLAYEY SAND	35–80	0–42	20–30
CLAYEY SILT	0–35	35–80	20–30
SANDY CLAY	30–70	0–40	30–50
SILTY CLAY	0–30	20–70	30–50
CLAY	0–50	0–50	50–100

IF GRAVEL IS PRESENT IN APPRECIABLE AMOUNTS THE TERM "GRAVELLY" MAY BE ADDED TO THE CLASS NAME, VIS. "GRAVELLY SAND." THE TERMS "COARSE," "MEDIUM" AND "FINE" WHEN USED TO DESCRIBE GRAVEL, SAND AND SILT REFER TO STANDARD GRADE SIZE LIMITS.

LEGEND OF BORING OPERATIONS

- PLAN OF ANY BORING
- 1" SAMPLER BORING
- ROTARY WASH BORING
- 1" CLOSED SAMPLER DRIVEN
- CORE BORING
- 2½" PENETROMETER DRIVEN
- 2" SAMPLER BORING
- 2"to5" AUGER BORING
- 6"to20" AUGER BORING
- CASING DRIVEN
- JET BORING
- (S) SAMPLE TAKEN

THE APPROPRIATE BORING SYMBOLS DESIGNATING THE METHOD OF OPERATION ARE SHOWN AT THE UPPER RIGHT-HAND CORNER OF THE RESPECTIVE BORING. WHERE TOOL CHANGES WERE MADE DURING THE BORING OPERATION SYMBOLS ARE SHOWN AT THE POINT OF CHANGE.

LEGEND OF EARTH MATERIALS

- GRAVEL – G
- SAND – S
- SILT – SI
- CLAY – C
- SILTY SAND – SI S
- CLAYEY SAND – C S
- SANDY SILT – S SI
- CLAYEY SILT – C SI
- SANDY CLAY – SC
- SILTY CLAY – SI C
- PEAT and/or ORGANIC CLAY – O
- SANDSTONE – SS
- SHALE – SH
- BROKEN ROCK (FRAGMENTS) – BR
- ROCK – R

ABBREVIATIONS

EL. 89.4	ELEVATION OF GROUND AT TEST HOLE
bpf	BLOWS PER FOOT – (SEE NOTE ABOVE)
P	PULLED PIPE
M	MOISTURE AS % DRY WEIGHT
EL. 64.3 8-12-49	ELEVATION OF GROUND WATER AND DATE

NOTES

THE CONTRACTOR'S ATTENTION IS DIRECTED TO SECTION 2, ARTICLE (c) OF THE STANDARD SPECIFICATIONS AND TO THE SPECIAL PROVISIONS ACCOMPANYING THIS SET OF PLANS.

CLASSIFICATION OF EARTH MATERIAL AS SHOWN ON THIS SHEET IS BASED UPON FIELD INSPECTION AND IS NOT TO BE CONSTRUED TO IMPLY MECHANICAL ANALYSIS.

See Pile Driving Log

MICROFILMED

FIRST AVE. OVERCROSSING
LOG OF TEST BORINGS

SCALE 1" = 10' | FILE NO
BRIDGE NO. 33-187 | DRAWING NO. C-2325-2

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
BRIDGE DEPARTMENT

10.0 5-50

Details Correct
Bridge Engineer

Bridge Engineering Engineer

202

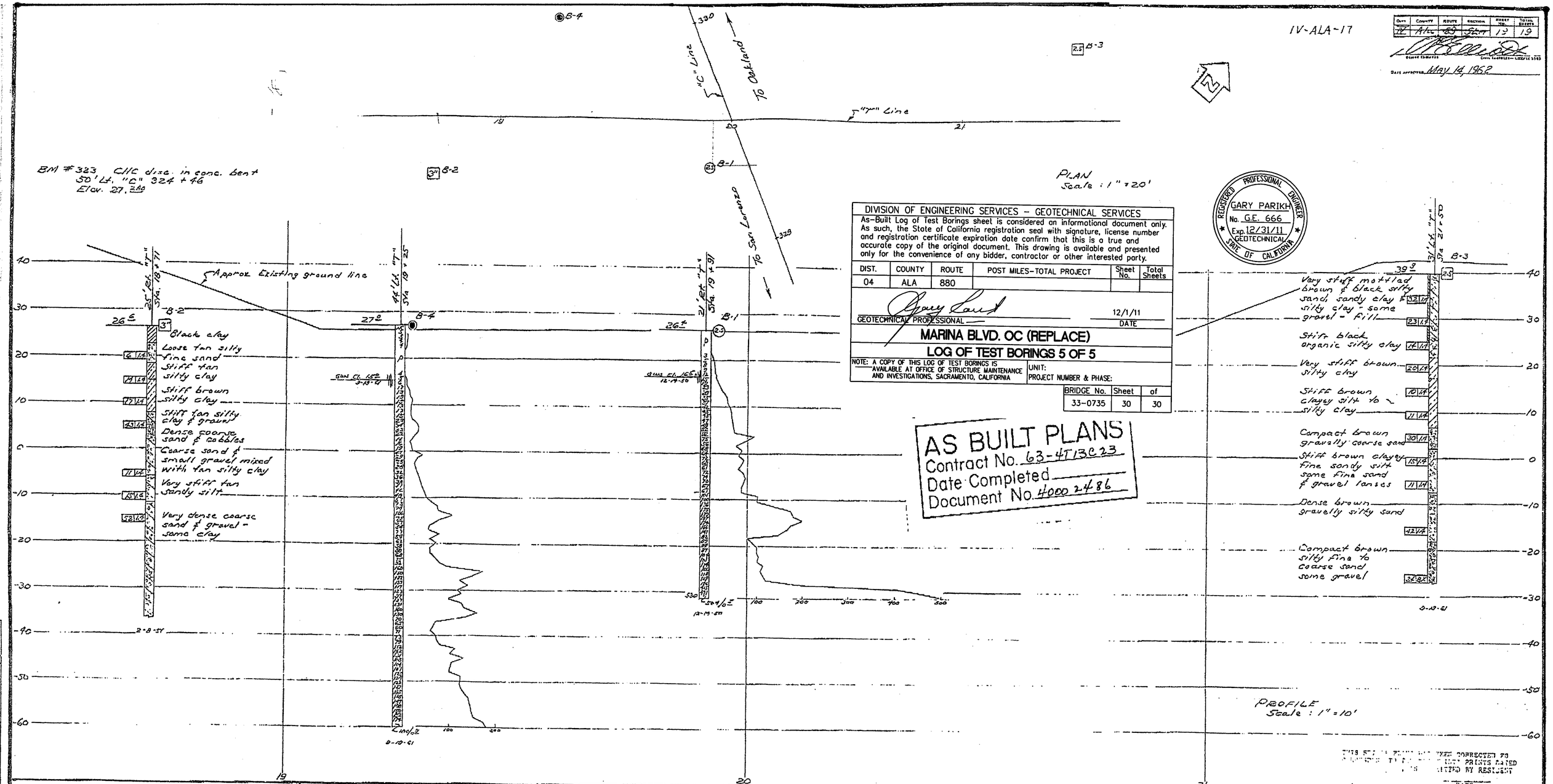
IV-ALA-17

DIST.	COUNTY	ROUTE	SECTION	SHEET No.	TOTAL SHEETS
04	ALA	880	Start	13	19

Signature Omitted — Civil Engineer — License 5785

DATE APPROVED May 14, 1962

BRIDGE DEPARTMENT



REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/11 — GEOTECHNICAL — STATE OF CALIFORNIA

DIVISION OF ENGINEERING SERVICES – GEOTECHNICAL SERVICES

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DIST.	COUNTY	ROUTE	POST MILES–TOTAL PROJECT	Sheet No.	Total Sheets
04	ALA	880			

GEOTECHNICAL PROFESSIONAL — DATE 12/1/11

MARINA BLVD. OC (REPLACE)

LOG OF TEST BORINGS 5 OF 5

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

UNIT:
PROJECT NUMBER & PHASE:

BRIDGE No.	Sheet	of
33-0735	30	30

AS BUILT PLANS
Contract No. 63-4T13C23
Date Completed
Document No. 4000 24 86

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

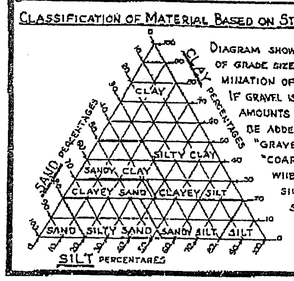


DIAGRAM SHOWING THE BASIS FOR ESTIMATES OF GRADE SIZE DISTRIBUTION USED IN DETERMINATION OF CLASS NAMES.

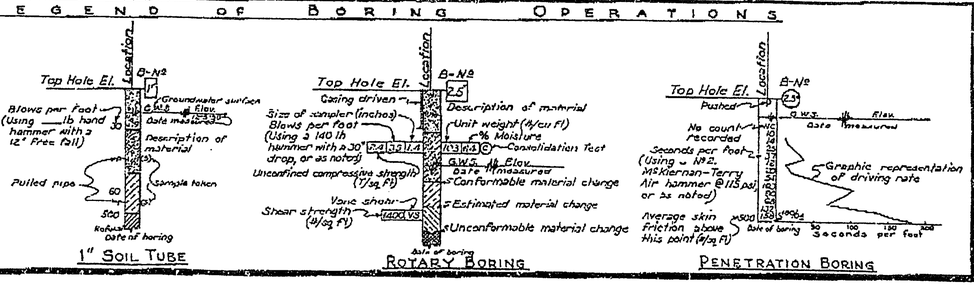
IF GRAVEL IS PRESENT IN APPRECIABLE AMOUNTS THE TERM "GRAVELLY" MAY BE ADDED TO THE CLASS NAME, VIZ. "GRAVELLY SAND." THE TERMS "COARSE", "MEDIUM" AND "FINE" WHEN USED TO DESCRIBE SAND, SILT AND GRAVEL REFER TO STANDARD GRADE SIZE LIMITS.

LEGEND OF EARTH MATERIALS

- GRAVEL
- SAND
- SILT
- CLAY
- SANDY CLAY OR CLAYEY SAND
- SANDY SILT OR SILTY SAND
- SILTY CLAY OR CLAYEY SILT
- PEAT AND/OR ORGANIC MATTER
- FILL MATERIAL
- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

LEGEND OF BORING OPERATIONS

- PENETROMETER
- 2¼" CONE PENETROMETER
- SAMPLER BORING (DRY)
- ROTARY BORING (WET)
- AUGER BORING (DRY)
- JET BORING
- CORE BORING
- TEST PIT



NOTE

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

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

Marina Blvd. OC.
~~FIRST AVENUE OC~~

LOG OF TEST BORINGS

SCALE	BRIDGE	FILE	DRAWING
As Noted	33-167		C-33167-19

GREGG DRILLING & TESTING, INC.
GEOTECHNICAL AND ENVIRONMENTAL INVESTIGATION SERVICES

June 9, 2008

Parikh Consultants
Attn: Gary Parikh
356 S. Milpitas Blvd.
Milpitas, California 95035

Subject: CPT Site Investigation
I-880 Widening
San Leandro, California
GREGG Project Number: 08-156MA

Dear Mr. Parikh:

The following report presents the results of GREGG Drilling & Testing's Cone Penetration Test investigation for the above referenced site. The following testing services were performed:

1	Cone Penetration Tests	(CPTU)	☒
2	Pore Pressure Dissipation Tests	(PPD)	☒
3	Seismic Cone Penetration Tests	(SCPTU)	☐
4	Resistivity Cone Penetration Tests	(RCPTU)	☐
5	UVOST Laser Induced Fluorescence	(UVOST)	☐
6	Groundwater Sampling	(GWS)	☐
7	Soil Sampling	(SS)	☐
8	Vapor Sampling	(VS)	☐
9	Vane Shear Testing	(VST)	☐
10	SPT Energy Calibration	(SPTE)	☐

A list of reference papers providing additional background on the specific tests conducted is provided in the bibliography following the text of the report. If you would like a copy of any of these publications or should you have any questions or comments regarding the contents of this report, please do not hesitate to contact our office at (925) 313-5800.

Sincerely,
GREGG Drilling & Testing, Inc.

Mary Walden
Operations Manager

950 Howe Rd • Martinez, California 94553 • (925) 313-5800 • FAX (925) 313-0302
OTHER OFFICES: LOS ANGELES • HOUSTON • SOUTH CAROLINA
www.greggdrilling.com

Cone Penetration Testing Procedure (CPT)

Gregg Drilling carries out all Cone Penetration Tests (CPT) using an integrated electronic cone system, *Figure CPT*. The soundings were conducted using a 20 ton capacity cone with a tip area of 15 cm^2 and a friction sleeve area of 225 cm^2. The cone is designed with an equal end area friction sleeve and a tip end area ratio of 0.80.

The cone takes measurements of cone bearing (q_c), sleeve friction (f_s) and penetration pore water pressure (u_2) at 5-cm intervals during penetration to provide a nearly continuous hydrogeologic log. CPT data reduction and interpretation is performed in real time facilitating on-site decision making. The above mentioned parameters are stored on disk for further analysis and reference. All CPT soundings are performed in accordance with revised (2002) ASTM standards (D 5778-95).

The cone also contains a porous filter element located directly behind the cone tip (u_2), *Figure CPT.* It consists of porous plastic and is 5.0mm thick. The filter element is used to obtain penetration pore pressure as the cone is advanced as well as Pore Pressure Dissipation Tests (PPDT's) during appropriate pauses in penetration. It should be noted that prior to penetration, the element is fully saturated with silicon oil under vacuum pressure to ensure accurate and fast dissipation.

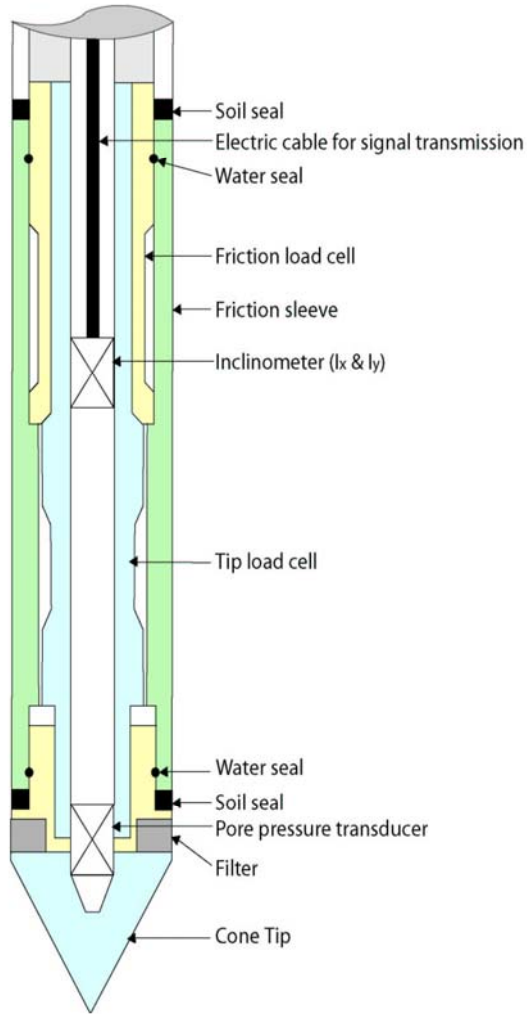


Figure CPT

When the soundings are complete, the test holes are grouted using a Gregg In Situ support rig. The grouting procedures generally consist of pushing a hollow CPT rod with a "knock out" plug to the termination depth of the test hole. Grout is then pumped under pressure as the tremie pipe is pulled from the hole. Disruption or further contamination to the site is therefore minimized.

Cone Penetration Test Sounding Summary

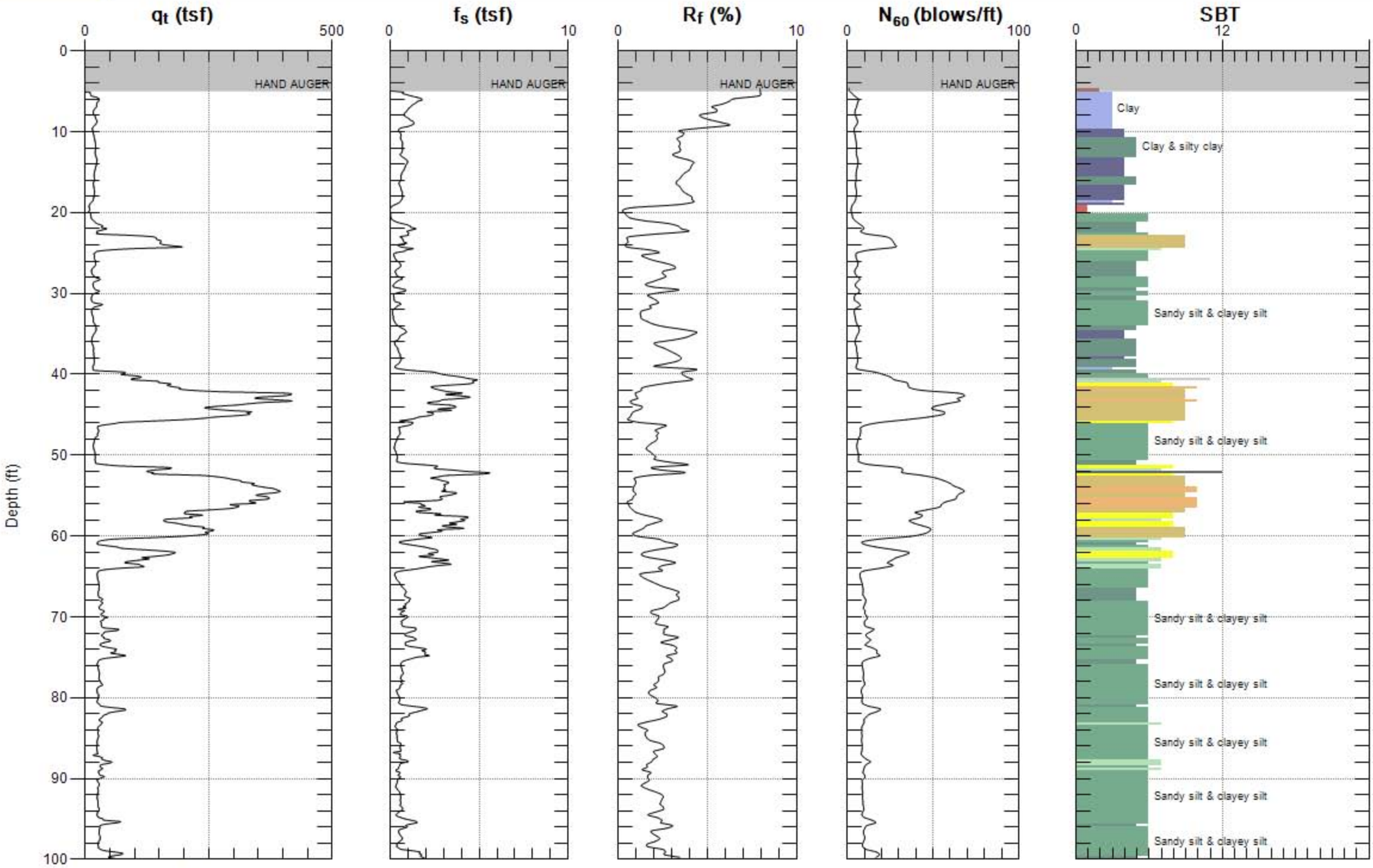
-Table 1-

CPT Sounding Identification	Date	Termination Depth (Feet)	Depth of Groundwater Samples (Feet)	Depth of Soil Samples (Feet)	Depth of Pore Pressure Dissipation Tests (Feet)
CPT-MR1	6/06/08	100	-	-	24.1, 43.8
CPT-DV1	6/06/08	100	-	-	44.9, 66.3, 68.3

PARIKH CONSULTANTS

Site: I-880 WIDENING
Sounding: CPT-MR1

Engineer: G.PARIKH
Date: 6/6/2008 09:34



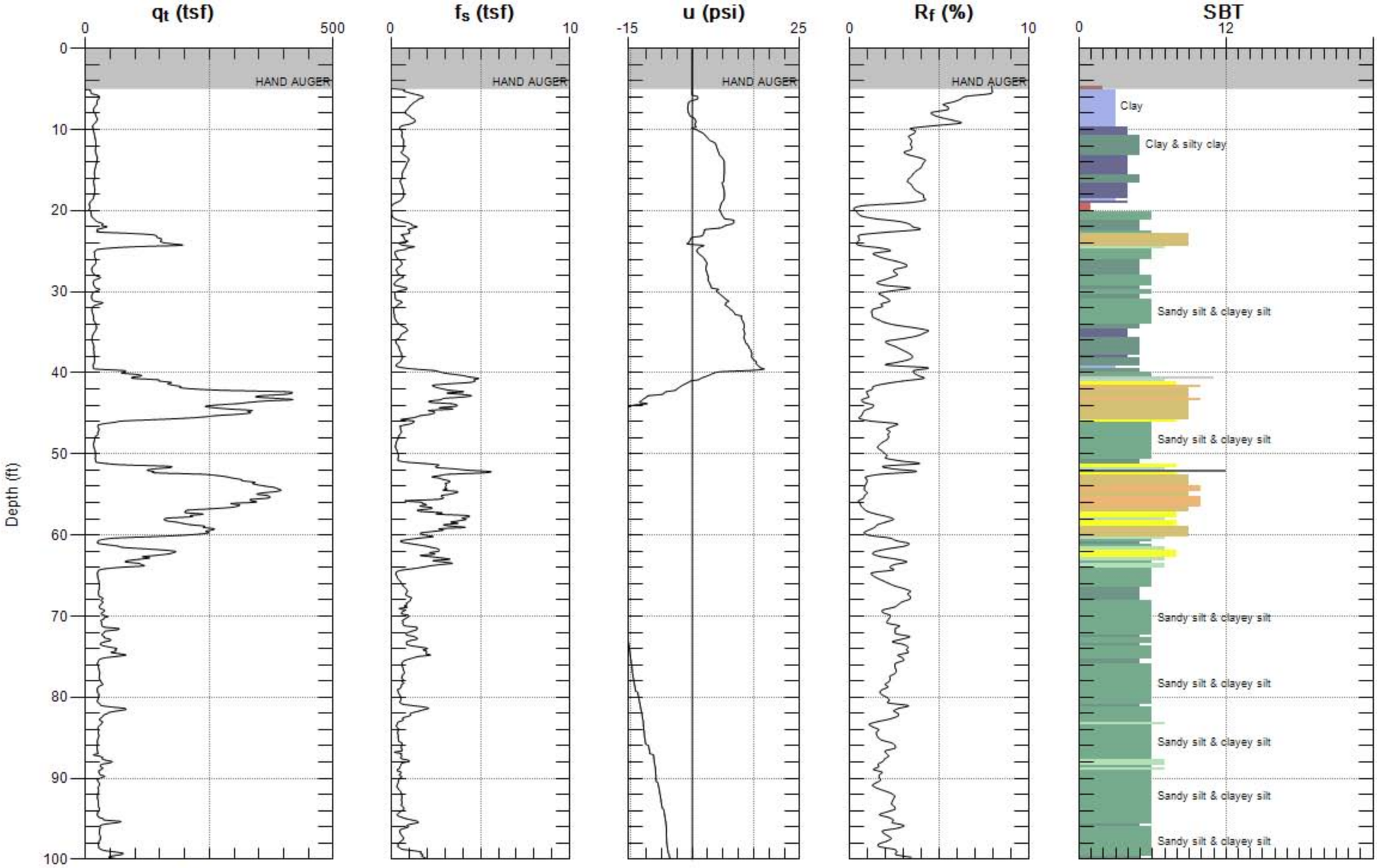
Max. Depth: 99.902 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

PARIKH CONSULTANTS

Site: I-880 WIDENING
Sounding: CPT-MR1

Engineer: G.PARIKH
Date: 6/6/2008 09:34



Max. Depth: 99.902 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

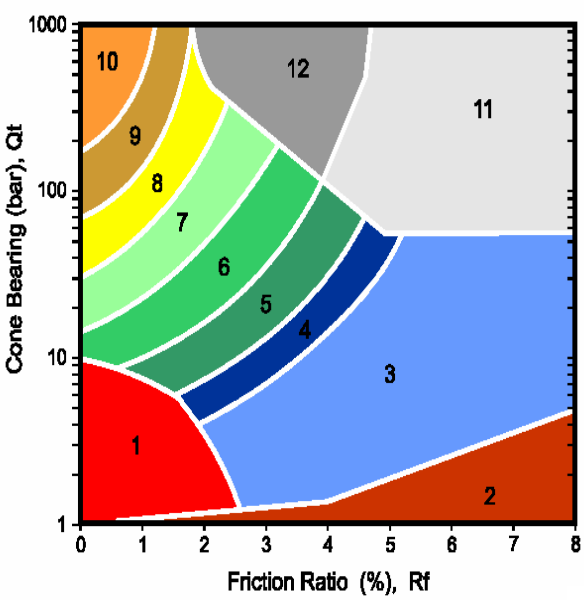
Cone Penetration Test Data & Interpretation

The Cone Penetration Test (CPT) data collected from your site are presented in graphical form in the attached report. The plots include interpreted Soil Behavior Type (SBT) based on the charts described by Robertson (1990). Typical plots display SBT based on the non-normalized charts of Robertson et al (1986). For CPT soundings extending greater than 50 feet, we recommend the use of the normalized charts of Robertson (1990) which can be displayed as SBTn, upon request. The report also includes spreadsheet output of computer calculations of basic interpretation in terms of SBT and SBTn and various geotechnical parameters using current published correlations based on the comprehensive review by Lunne, Robertson and Powell (1997), as well as recent updates by Professor Robertson. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg InSitu and Gregg Drilling & Testing Inc. do not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and do not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software.

Some interpretation methods require input of the groundwater level to calculate vertical effective stress. An estimate of the in-situ groundwater level has been made based on field observations and/or CPT results, but should be verified by the user.

A summary of locations and depths is available in Table 1. Note that all penetration depths referenced in the data are with respect to the existing ground surface.

Note that it is not always possible to clearly identify a soil type based solely on q_t, f_s, and u_2. In these situations, experience, judgment, and an assessment of the pore pressure dissipation data should be used to infer the correct soil behavior type.



(After Robertson, et al., 1986)

ZONE		SBT
1		Sensitive, fine grained
2		Organic materials
3		Clay
4		Silty clay to clay
5		Clayey silt to silty clay
6		Sandy silt to clayey silt
7		Silty sand to sandy silt
8		Sand to silty sand
9		Sand
10		Gravely sand to sand
11		Very stiff fine grained*
12		Sand to clayey sand*

*over consolidated or cemented

Figure SBT

Cone Penetration Test (CPT) Interpretation

Gregg have recently updated their CPT interpretation and plotting software (2007). The software takes the CPT data and performs basic interpretation in terms of soil behavior type (SBT) and various geotechnical parameters using current published empirical correlations based on the comprehensive review by Lunne, Robertson and Powell (1997). The interpretation is presented in tabular format using MS Excel. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software.

The following provides a summary of the methods used for the interpretation. Many of the empirical correlations to estimate geotechnical parameters have constants that have a range of values depending on soil type, geologic origin and other factors. The software uses 'default' values that have been selected to provide, in general, conservatively low estimates of the various geotechnical parameters.

Input:

1. Units for display (Imperial or metric) (atm. pressure, pa = 0.96 tsf or 0.1 MPa)
2. Depth interval to average results,(ft or m). Data are collected at either 0.02 or 0.05m and can be averaged every 1, 3 or 5 intervals.
3. Elevation of ground surface (ft or m)
4. Depth to water table, z_w (ft or m) – input required
5. Net area ratio for cone, a (default to 0.80)
6. Relative Density constant, C_{Dr} (default to 350)
7. Young's modulus number for sands, α (default to 5)
8. Small strain shear modulus number
   a. for sands, S_G (default to 180 for SBT_n 5, 6, 7)
   b. for clays, C_G (default to 50 for SBT_n 1, 2, 3 & 4)
9. Undrained shear strength cone factor for clays, N_{kt} (default to 15)
10. Over Consolidation ratio number, k_{ocr} (default to 0.3)
11. Unit weight of water, (default to γ_w = 62.4 lb/ft^3 or 9.81 kN/m^3)

Column

1. Depth, z, (m) – CPT data is collected in meters
2. Depth (ft)
3. Cone resistance, q_c (tsf or MPa)
4. Sleeve friction, f_s (tsf or MPa)
5. Penetration pore pressure, u (psi or MPa), measured behind the cone (i.e. u_2)
6. Other – any additional data, if collected, e.g. electrical resistivity or UVIF
7. Total cone resistance, q_t (tsf or MPa) $q_t = q_c + u\,(1-a)$

8	Friction Ratio, R_f (%)	$R_f = (f_s/q_t) \times 100\%$
9	Soil Behavior Type (non-normalized), SBT	see note
10	Unit weight, γ (pcf or kN/m^3)	based on SBT, see note
11	Total overburden stress, σ_v (tsf)	$\sigma_{vo} = \gamma z$
12	Insitu pore pressure, u_o (tsf)	$u_o = \gamma_w (z - z_w)$
13	Effective overburden stress, σ'_{vo} (tsf)	$\sigma'_{vo} = \sigma_{vo} - u_o$
14	Normalized cone resistance, Q_{t1}	$Q_{t1} = (q_t - \sigma_{vo}) / \sigma'_{vo}$
15	Normalized friction ratio, F_r (%)	$F_r = f_s / (q_t - \sigma_{vo}) \times 100\%$
16	Normalized Pore Pressure ratio, B_q	$B_q = u - u_o / (q_t - \sigma_{vo})$
17	Soil Behavior Type (normalized), SBT_n	see note
18	SBT_n Index, I_c	see note
19	Normalized Cone resistance, Q_{tn} (n varies with Ic)	see note
20	Estimated permeability, k_{SBT} (cm/sec or ft/sec)	see note
21	Equivalent SPT N_{60}, blows/ft	see note
22	Equivalent SPT $(N_1)_{60}$ blows/ft	see note
23	Estimated Relative Density, D_r, (%)	see note
24	Estimated Friction Angle, ϕ', (degrees)	see note
25	Estimated Young's modulus, E_s (tsf)	see note
26	Estimated small strain Shear modulus, Go (tsf)	see note
27	Estimated Undrained shear strength, s_u (tsf)	see note
28	Estimated Undrained strength ratio	s_u/σ_v'
29	Estimated Over Consolidation ratio, OCR	see note

Notes:

1 Soil Behavior Type (non-normalized), SBT — Lunne et al. (1997)
listed below

2 Unit weight, γ either constant at 119 pcf or based on Non-normalized SBT
(Lunne et al., 1997 and table below)

3 Soil Behavior Type (Normalized), SBT_n — Lunne et al. (1997)

4 SBT_n Index, I_c — $I_c = ((3.47 - \log Q_{t1})^2 + (\log F_r + 1.22)^2)^{0.5}$

5 Normalized Cone resistance, Q_{tn} (n varies with Ic)

$Q_{tn} = ((q_t - \sigma_{vo})/pa)\ (pa/(\sigma'_{vo})^n$ and recalculate I_c, then iterate:

When $I_c < 1.64$, $n = 0.5$ (clean sand)
When $I_c > 3.30$, $n = 1.0$ (clays)
When $1.64 < I_c < 3.30$, $n = (I_c - 1.64)0.3 + 0.5$
Iterate until the change in n, $\Delta n < 0.01$

6 Estimated permeability, k_{SBT} (based on Normalized SBT_n)
(Lunne et al., 1997 and table below)

7 Equivalent SPT N_{60}, blows/ft Lunne et al. (1997)

$$\frac{(q_t/p_a)}{N_{60}} = 8.5\left(1 - \frac{I_c}{4.6}\right)$$

8 Equivalent SPT $(N_1)_{60}$ blows/ft $(N_1)_{60} = N_{60}\, C_N$,
where $C_N = (pa/\sigma'_{vo})^{0.5}$

9 Relative Density, D_r, (%) $D_r^2 = Q_{tn} / C_{Dr}$
Only SBT_n 5, 6, 7 & 8 *Show 'N/A' in zones 1, 2, 3, 4 & 9*

10 Friction Angle, ϕ', (degrees) $\tan\phi' = \frac{1}{2.68}\left[\log\left(\frac{q_c}{\sigma'_{vo}}\right) + 0.29\right]$
Only SBT_n 5, 6, 7 & 8 *Show'N/A' in zones 1, 2, 3, 4 & 9*

11 Young's modulus, E_s $E_s = \alpha\, q_t$
Only SBT_n 5, 6, 7 & 8 *Show 'N/A' in zones 1, 2, 3, 4 & 9*

12 Small strain shear modulus, Go
a. $G_o = S_G\,(q_t\ \sigma'_{vo}\ pa)^{1/3}$ *For SBT_n 5, 6, 7*
b. $G_o = C_G\, q_t$ *For SBT_n 1, 2, 3& 4*
Show 'N/A' in zones 8 & 9

13 Undrained shear strength, s_u $s_u = (q_t - \sigma_{vo}) / N_{kt}$
Only SBT_n 1, 2, 3, 4 & 9 *Show 'N/A' in zones 5, 6, 7 & 8*

14 Over Consolidation ratio, OCR $OCR = k_{ocr}\, Q_{t1}$
Only SBT_n 1, 2, 3, 4 & 9 *Show 'N/A' in zones 5, 6, 7 & 8*

SBT Zones **SBT_n Zones**

The following updated and simplified SBT descriptions have been used in the software:

1	sensitive fine grained	1	sensitive fine grained
2	organic soil	2	organic soil
3	clay	3	clay
4	clay & silty clay	4	clay & silty clay
5	clay & silty clay		
6	sandy silt & clayey silt		
7	silty sand & sandy silt	5	silty sand & sandy silt
8	sand & silty sand	6	sand & silty sand
9	sand		
10	sand	7	sand
11	very dense/stiff soil*	8	very dense/stiff soil*
12	very dense/stiff soil*	9	very dense/stiff soil*

* heavily overconsolidated and/or cemented

Track when soils fall with zones of same description and print that description (i.e. if soils fall only within SBT zones 4 & 5, print 'clays & silty clays')

Estimated Permeability (see Lunne et al., 1997)

SBT_n	Permeability (ft/sec)	(m/sec)
1	$3x\ 10^{-8}$	$1x\ 10^{-8}$
2	$3x\ 10^{-7}$	$1x\ 10^{-7}$
3	$1x\ 10^{-9}$	$3x\ 10^{-10}$
4	$3x\ 10^{-8}$	$1x\ 10^{-8}$
5	$3x\ 10^{-6}$	$1x\ 10^{-6}$
6	$3x\ 10^{-4}$	$1x\ 10^{-4}$
7	$3x\ 10^{-2}$	$1x\ 10^{-2}$
8	$3x\ 10^{-6}$	$1x\ 10^{-6}$
9	$1x\ 10^{-8}$	$3x\ 10^{-9}$

Estimated Unit Weight (see Lunne et al., 1997)

SBT	Approximate Unit Weight (lb/ft^3)	(kN/m^3)
1	111.4	17.5
2	79.6	12.5
3	111.4	17.5
4	114.6	18.0
5	114.6	18.0
6	114.6	18.0
7	117.8	18.5
8	120.9	19.0
9	124.1	19.5
10	127.3	20.0
11	130.5	20.5
12	120.9	19.0

GREGG & TESTING, INC.

CONE PENETRATION TEST DATA

Client:	PARIKH CONSULTANTS	Units:	Imperial
Site:	I-880 WIDENING	Data averaging interval:	0.100 meters
Engineer:	G.PARIKH	Assumed depth of water:	27.007 feet — Assumed 10 ft for analysis
Sounding:	CPT-MR1	Net area ratio of cone:	0.80
Date:	6/6/2008	Unit weight of water:	62.4 lb/ft3
Time:	9:34 AM	Relative density constant, CDR:	350
		Young's modulus for sands, a:	4
		Small strain shear modulus number, SG (sands):	180
		Small strain shear modulus number, CG (clays):	50
		Nkt for clays:	15
		OCR number, kocr:	0.3

Interpretation based on Lunne, Robertson and Powell, 1997

Col 1i	Col 2i	Col 3i	Col 4i	Col 5i	Col 6i	Col 7i	Col 8i	Col 9i	Col 10i	Col 11i	Col 12i	Col 13i	Col 14i	Col 15i	Col 16i	Col 17i	Col 18i	Col 19i	Col 20i	Col 21i	Col 22i	Col 23i	Col 24i	Col 25i	Col 26i	Col 27i	Col 28i	Col 29i
Depth	Depth	qc	fs	u	Other	qt	Rf	SBT	Unit Weight, γ	Total Overburden Stress, σv	Insitu pore pressure, uo	Effective overburden stress, σ'v	Normalized cone resistance, Qtl	Normalized Friction raio, Fr	Normalized pore pressure ratio, Bq	Soil Behavior Type (normalized) SBTn	SBTn Index, Ic	Normalized Cone resistance, Qtn	Estimated permeability, kSBT	SPT N60	SPT (N1)60	Relative Density, Dr	Friction Angle, φ'	Young's modulus, Es	Small strain shear modulus, Go	Undrained shear strength, su	Undrained strength ratio, su/σ'v	Over consolidation ratio, OCR
(m)	(ft)	(tsf)	(tsf)	(psi)		(tsf)	(%)		(pcf)	(tsf)	(tsf)	(tsf)							(ft/sec)	(blows/ft)	(blows/ft)	(%)	(degrees)	(tsf)	(tsf)	(tsf)		
0.100	0.328	0.000	0.000	0.000							0.000																	
0.200	0.656	0.000	0.000	0.000							0.000																	
0.300	0.984	0.000	0.000	0.000							0.000																	
0.400	1.312	0.000	0.000	0.000							0.000																	
0.500	1.640	0.000	0.000	0.000							0.000																	
0.600	1.969	0.000	0.000	0.000							0.000																	
0.700	2.297	0.000	0.000	0.000							0.000																	
0.800	2.625	0.000	0.000	0.000							0.000																	
0.900	2.953	0.000	0.000	0.000							0.000																	
1.000	3.281	0.000	0.000	0.000							0.000																	
1.100	3.609	0.000	0.000	0.000							0.000																	
1.200	3.937	0.000	0.000	0.000							0.000																	
1.300	4.265	0.000	0.000	0.000							0.000																	
1.400	4.593	0.000	0.000	0.000							0.000																	
1.500	4.921	3.089	0.245	-0.013		3.09	7.92	2	80	0.196	0.000	0.196	14.77	8.46	0.00	3	3.15	13.63	1.00E-9	1.1	2.5				154	0.19	0.98	4.4
1.600	5.249	10.142	0.806	-0.039		10.14	7.94	3	111	0.214	0.000	0.214	46.37	8.12	0.00	3	2.79	36.21	1.00E-9	2.9	6.4				507	0.66	3.09	13.9
1.700	5.577	15.914	1.242	-0.013		15.91	7.80	3	111	0.232	0.000	0.232	67.49	7.92	0.00	9	2.68	50.75	1.00E-8	4.2	9.0					1.05	4.50	20.2
1.800	5.906	26.272	1.704	0.832		26.28	6.48	3	111	0.251	0.000	0.251	103.87	6.55	0.00	9	2.50	73.36	1.00E-8	6.4	13.2					1.74	6.92	31.2
1.900	6.234	26.018	1.612	0.885		26.03	6.19	3	111	0.269	0.000	0.269	95.80	6.26	0.00	9	2.51	68.95	1.00E-8	6.4	12.6					1.72	6.39	28.7
2.000	6.562	23.381	1.361	-0.462		23.37	5.82	3	111	0.287	0.000	0.287	80.40	5.90	0.00	9	2.53	59.37	1.00E-8	5.8	11.1					1.54	5.36	24.1
2.100	6.890	22.327	1.165	-0.937		22.31	5.22	3	111	0.305	0.000	0.305	72.05	5.29	0.00	9	2.53	53.85	1.00E-8	5.5	10.2					1.47	4.80	21.6
2.200	7.218	18.824	1.028	-1.016		18.81	5.47	3	111	0.324	0.000	0.324	57.10	5.56	0.00	4	2.61	44.54	3.00E-8	4.8	8.7				940	1.23	3.81	17.1
2.300	7.546	16.592	0.900	-1.016		16.58	5.43	3	111	0.342	0.000	0.342	47.47	5.55	0.00	4	2.66	38.13	3.00E-8	4.4	7.7				829	1.08	3.16	14.2
2.400	7.874	17.920	0.822	-0.884		17.91	4.59	3	111	0.360	0.000	0.360	48.70	4.68	0.00	4	2.60	38.74	3.00E-8	4.6	7.8				895	1.17	3.25	14.6
2.500	8.202	20.528	0.956	-0.607		20.52	4.66	3	111	0.379	0.000	0.379	53.21	4.74	0.00	4	2.58	42.48	3.00E-8	5.2	8.7				1026	1.34	3.55	16.0
2.600	8.530	22.722	1.165	0.132		22.72	5.13	3	111	0.397	0.000	0.397	56.27	5.22	0.00	4	2.59	45.58	3.00E-8	5.8	9.4				1136	1.49	3.75	16.9
2.700	8.858	23.071	1.327	0.726		23.08	5.75	3	111	0.415	0.000	0.415	54.60	5.85	0.00	4	2.64	45.24	3.00E-8	6.0	9.6				1154	1.51	3.64	16.4
2.800	9.186	19.106	1.183	0.753		19.12	6.19	3	111	0.433	0.000	0.433	43.11	6.33	0.00	3	2.73	36.95	1.00E-9	5.2	8.2				956	1.25	2.87	12.9
2.900	9.514	15.218	0.722	0.739		15.23	4.74	3	111	0.452	0.000	0.452	32.72	4.88	0.00	4	2.73	28.25	3.00E-8	4.2	6.4				761	0.99	2.18	9.8
3.000	9.843	15.020	0.514	0.594		15.03	3.42	4	115	0.470	0.000	0.470	30.94	3.53	0.00	4	2.65	26.40	3.00E-8	3.9	5.9				751	0.97	2.06	9.3
3.100	10.171	16.159	0.592	1.518		16.18	3.66	4	115	0.489	0.005	0.489	32.07	3.77	0.01	4	2.66	27.63	3.00E-8	4.3	6.3				809	1.05	2.14	9.6
3.200	10.499	17.562	0.626	2.574		17.60	3.56	4	115	0.508	0.016	0.508	33.64	3.66	0.01	4	2.64	29.04	3.00E-8	4.6	6.6				880	1.14	2.24	10.1
3.300	10.827	18.720	0.615	3.234		18.77	3.28	5	115	0.527	0.026	0.527	34.62	3.37	0.01	4	2.60	29.89	3.00E-8	4.8	6.8				938	1.22	2.31	10.4
3.400	11.155	19.850	0.676	3.775		19.90	3.39	5	115	0.546	0.036	0.546	35.48	3.49	0.01	4	2.61	30.87	3.00E-8	5.1	7.1				995	1.29	2.37	10.6
3.500	11.483	20.632	0.714	4.672		20.70	3.45	5	115	0.564	0.046	0.564	35.67	3.54	0.02	4	2.61	31.28	3.00E-8	5.3	7.3				1035	1.34	2.38	10.7
3.600	11.811	21.037	0.715	5.438		21.12	3.38	5	115	0.583	0.057	0.583	35.20	3.48	0.02	4	2.61	31.07	3.00E-8	5.4	7.3				1056	1.37	2.35	10.6
3.700	12.139	20.792	0.722	5.689		20.87	3.46	5	115	0.602	0.067	0.602	33.67	3.56	0.02	4	2.63	30.03	3.00E-8	5.4	7.2				1044	1.35	2.24	10.1
3.800	12.467	20.124	0.689	5.887		20.21	3.41	5	115	0.621	0.077	0.621	31.55	3.52	0.02	4	2.65	28.39	3.00E-8	5.3	6.9				1010	1.31	2.10	9.5
3.900	12.795	20.481	0.622	6.125		20.57	3.03	5	115	0.640	0.087	0.640	31.16	3.12	0.02	4	2.62	28.07	3.00E-8	5.3	6.8				1028	1.33	2.08	9.3
4.000	13.123	22.176	0.732	6.402		22.27	3.29	5	115	0.658	0.097	0.658	32.82	3.39	0.02	4	2.62	29.78	3.00E-8	5.7	7.3				1113	1.44	2.19	9.8
4.100	13.451	23.702	0.924	6.917		23.80	3.88	4	115	0.677	0.108	0.677	34.15	3.99	0.02	4	2.66	31.31	3.00E-8	6.2	7.8				1190	1.54	2.28	10.2
4.200	13.780	23.316	0.986	7.299		23.42	4.21	4	115	0.696	0.118	0.696	32.65	4.34	0.02	4	2.70	30.24	3.00E-8	6.3	7.7				1171	1.51	2.18	9.8
4.300	14.108	22.242	0.916	7.444		22.35	4.10	4	115	0.715	0.128	0.715	30.27	4.23	0.02	4	2.71	28.23	3.00E-8	6.0	7.3				1117	1.44	2.02	9.1
4.400	14.436	20.924	0.849	7.471		21.03	4.04	4	115	0.734	0.138	0.734	27.67	4.18	0.03	4	2.74	26.00	3.00E-8	5.8	6.9				1052	1.35	1.84	8.3
4.500	14.764	19.549	0.774	7.471		19.66	3.94	4	115	0.752	0.149	0.752	25.13	4.10	0.03	4	2.76	23.77	3.00E-8	5.4	6.5				983	1.26	1.68	7.5
4.600	15.092	18.408	0.686	7.471		18.52	3.70	4	115	0.771	0.159	0.771	23.01	3.86	0.03	4	2.78	21.88	3.00E-8	5.2	6.0				926	1.18	1.53	6.9
4.700	15.420	18.024	0.644	7.444		18.13	3.55	4	115	0.790	0.169	0.790	21.95	3.71	0.03	4	2.78	20.96	3.00E-8	5.1	5.9				907	1.16	1.46	6.6
4.800	15.748	18.410	0.638	7.405		18.52	3.45	5	115	0.809	0.179	0.809	21.89	3.60	0.03	4	2.77	20.97	3.00E-8	5.2	5.9				926	1.18	1.46	6.6
4.900	16.076	18.090	0.597	7.378		18.20	3.28	5	115	0.828	0.190	0.828	20.99	3.44	0.03	4	2.77	20.18	3.00E-8	5.1	5.7				910	1.16	1.40	6.3
5.000	16.404	16.536	0.535	7.207		16.64	3.22	5	115	0.846	0.200	0.846	18.66	3.39	0.03	4	2.81	18.05	3.00E-8	4.7	5.3				832	1.05	1.24	5.6
5.100	16.732	17.044	0.584	7.049		17.15	3.41	4	115	0.865	0.210	0.865	18.82	3.59	0.03	4	2.82	18.28	3.00E-8	4.9	5.4				857	1.09	1.25	5.6
5.200	17.060	17.910	0.632	7.220		18.01	3.51	4	115	0.884	0.220	0.884	19.38	3.69	0.03	3	2.82	18.88	1.00E-9	5.1	5.6				901	1.14	1.29	5.8
5.300	17.388	18.749	0.682	7.352		18.85	3.62	4	115	0.903	0.231	0.903	19.89	3.80	0.03	3	2.82	19.43	1.00E-9	5.4	5.8				943	1.20	1.33	6.0
5.400	17.717	18.344	0.709	7.444		18.45	3.84	4	115	0.922	0.241	0.922	19.02	4.04	0.03	3	2.85	18.67	1.00E-9	5.4	5.8				923	1.17	1.27	5.7
5.500	18.045	17.336	0.714	7.484		17.44	4.10	4	115	0.940	0.251	0.940	17.55	4.33	0.03	3	2.90	17.30	1.00E-9	5.2	5.5				872	1.10	1.17	5.3
5.600	18.373	16.131	0.667	7.444		16.24	4.11	4	115	0.959	0.261	0.959	15.93	4.37	0.04	3	2.93	15.75	1.00E-9	4.9	5.2				812	1.02	1.06	4.8
5.700	18.701	12.919	0.545	7.247		13.02	4.18	3	111	0.977	0.271	0.977	12.32	4.52	0.04	3	3.03	12.24	1.00E-9	4.2	4.4				651	0.80	0.82	3.7
5.800	19.029	8.701	0.284	6.851		8.80	3.22	4	115	0.996	0.282	0.996	7.83	3.64	0.06	3	3.13	7.81	1.00E-9	3.0	3.1				440	0.52	0.52	2.3
5.900	19.357	8.155	0.072	6.613		8.25	0.88	1	111	1.015	0.292	1.015	7.13	1.00	0.07	4	2.89	7.09	3.00E-8	2.4	2.5				412	0.48	0.48	2.1
6.000	19.685	8.380	0.020	6.441		8.47	0.24	1	111	1.033	0.302	1.033	7.20	0.27	0.06	1	2.69	7.17	3.00E-8	2.2	2.3				424	0.50	0.48	2.2
6.100	20.013	9.435	0.031	6.454		9.53	0.33	1	111	1.051	0.312	1.051	8.07	0.37	0.05	4	2.68	8.05	3.00E-8	2.5	2.5				476	0.57	0.54	2.4
6.200	20.341	11.187	0.052	6.745		11.28	0.46	6	115	1.070	0.323	1.070	9.55	0.51	0.05	4	2.66	9.57	3.00E-8	2.9	2.9				564	0.68	0.64	2.9
6.300	20.669	12.581	0.086	7.101		12.68	0.68	6	115	1.089	0.333	1.089	10.65	0.74	0.04	4	2.67	10.71	3.00E-8	3.3	3.3				634	0.77	0.71	3.2
6.400	20.997	17.054	0.247	8.170		17.17	1.44	6	115	1.107	0.343	1.107	14.51	1.54	0.04	4	2.70	14.63	3.00E-8	4.6	4.5				859	1.07	0.97	4.4
6.500	21.325	24.220	0.667	9.635		24.36	2.74	5	115	1.126	0.353	1.126	20.63	2.87	0.03	4	2.73	20.85	3.00E-8	6.6	6.4				1218	1.55	1.38	6.2
6.600	21.654	32.864	1.097	8.870		32.99	3.33	5	115	1.145	0.364	1.145	27.81	3.45	0.02	4	2.68	28.23	3.00E-8	8.8	8.4				1650	2.12	1.85	8.3
6.700	21.982	36.716	1.290	7.101		36.82	3.50	5	115	1.164	0.374	1.164	30.63	3.62	0.01	4	2.66	31.20	3.00E-8	9.7	9.2				1841	2.38	2.04	9.2
6.800	22.310	27.638	1.077	4.065		27.70	3.89	5	115	1.183	0.384	1.183	22.42	4.06	0.01	3	2.80	22.80	1.00E-9	7.8	7.4				1385	1.77	1.49	6.7
6.900	22.638	48.204	1.037	2.772		48.24	2.15	6	115	1.201	0.394	1.201	39.16	2.21	0.00	5	2.44	40.47	3.00E-6	11.4	10.7	34	35	193	710			
7.000	22.966	123.218	0.771	2.442		123.25	0.63	9	124	1.222	0.405	1.222	99.88	0.63	0.00	6	1.79	106.63	3.00E-4	22.4	20.9	55	41	493	976			
7.100	23.294	146.863	0.722	0.581		146.87	0.49	9	124	1.242	0.415	1.242	117.24	0.50	0.00	6	1.67	126.82	3.00E-4	25.7	23.7	60	41	587	1040			
7.200	23.622	152.344	0.830	-0.502		152.34	0.54	9	124	1.263	0.425	1.263	119.66	0.55	0.00	6	1.69	130.36	3.00E-4	26.8	24.5	61	42	609	1059			
7.300	23.950	163.201	0.648	-0.884		163.19	0.40	9	124	1.283	0.435	1.283	126.20	0.40	0.00	6	1.60	138.96	3.00E-4	27.8	25.2	63	42	653	1089			
7.400	24.278	157.617	0.837	1.188		157.63	0.53	9	124	1.303	0.445	1.303	119.95	0.54	0.00	6	1.68	132.76	3.00E-4	27.6	24.9	62	42	631	1082			
7.500	24.606	59.061	1.024	1.584		59.08	1.73	7	118	1.323	0.456	1.323	43.67	1.77	0.00	5	2.35	46.57	3.00E-6	13.4	12.0	36	36	236	784			
7.600	24.934	21.159	0.480	1.148		21.18	2.27	6	115	1.341	0.466	1.341	14.79	2.42	0.00	4	2.80	15.32	3.00E-8	6.0	5.4				1059	1.32	0.99	4.4
7.700	25.262	18.231	0.243	1.465		18.25	1.33	6	115	1.360	0.476	1.360	12.42	1.44	0.01	4	2.75	12.95	3.00E-8	5.0	4.4				913	1.13	0.83	3.7
7.800	25.591	18.589	0.291	2.178		18.62	1.56	6	115	1.379	0.486	1.379	12.50	1.69	0.01	4	2.78	13.04	3.00E-8	5.2	4.6				931	1.15	0.83	3.8
7.900	25.919	20.199	0.401	2.785		20.24	1.98	6	115	1.398	0.497	1.398	13.48	2.13	0.01	4	2.81	14.06	3.00E-8	5.8	5.0				1012	1.26	0.90	4.0
8.000	26.247	21.291	0.557	3.181		21.34	2.61	5	115	1.417	0.507	1.417	14.06	2.79	0.01	4	2.86	14.63	3.00E-8	6.3	5.4				1067	1.33	0.94	4.2
8.100	26.575	19.502	0.602	3.366		19.55	3.08	5	115	1.435	0.517	1.435	12.62	3.32	0.01	3	2.94	13.05	1.00E-9	6.0	5.2				978	1.21	0.84	3.8
8.200	26.903	14.944	0.473	3.234		14.99	3.15	5	115	1.454	0.527	1.454	9.31	3.49	0.02	3	3.06	9.53	1.00E-9	5.0	4.2				750	0.90	0.62	2.8
8.300	27.231	12.929	0.327	3.207		12.98	2.52	5	115	1.473	0.538	1.466	7.85	2.84	0.02	3	3.07	8.03	1.00E-9	4.3	3.7				649	0.77	0.52	2.4
8.400	27.559	14.097	0.350	3.366		14.15	2.48	5	115	1.492	0.548	1.475	8.58	2.77	0.02	3	3.03	8.82	1.00E-9	4.6	3.9				707	0.84	0.57	2.6
8.500	27.887	18.786	0.500	3.564		18.84	2.66	5	115	1.511	0.558	1.483	11.68	2.89	0.01	3	2.93	12.14	1.00E-9	5.8	4.9				942	1.16	0.78	3.5
8.600	28.215	26.339	0.613	3.696		26.39	2.32	6	115	1.529	0.568	1.492	16.67	2.46	0.01	4	2.77	17.62	3.00E-8	7.3	6.2				1320	1.66	1.11	5.0
8.700	28.543	20.688	0.394	3.709		20.74	1.90	6	115	1.548	0.579	1.500	12.79	2.05	0.01	4	2.82	13.47	3.00E-8	5.9	5.0				1037	1.28	0.85	3.8
8.800	28.871	15.867	0.241	3.960		15.92	1.51	6	115	1.567	0.589	1.509	9.52	1.68	0.02	4	2.88	9.96	3.00E-8	4.7	4.0				796	0.96	0.63	2.9
8.900	29.199	16.940	0.329	4.250		17.00	1.93	6	115	1.586	0.599	1.517	10.16	2.13	0.02	4	2.91	10.61	3.00E-8	5.1	4.3				850	1.03	0.68	3.0
9.000	29.528	22.732	0.769	5.002		22.80	3.37	5	115	1.605	0.609	1.526	13.89	3.63	0.01	3	2.93	14.48	1.00E-9	7.0	5.8				1140	1.41	0.93	4.2
9.100	29.856	23.250	0.569	5.821		23.33	2.44	6	115	1.623	0.620	1.534	14.15	2.62	0.02	4	2.84	14.91	3.00E-8	6.8	5.6				1167	1.45	0.94	4.2
9.200	30.184	15.019	0.247	6.164		15.11	1.64	6	115	1.642	0.630	1.543	8.73	1.84	0.03	4	2.93	9.10	3.00E-8	4.6	3.8				755	0.90	0.58	2.6
9.300	30.512	12.562	0.235	6.930		12.66	1.85	5	115	1.661	0.640	1.552	7.09	2.13	0.04	3	3.04	7.31	1.00E-9	4.1	3.4				633	0.73	0.47	2.1
9.400	30.840	12.901	0.273	7.655		13.01	2.10	5	115	1.680	0.650	1.560	7.26	2.41	0.04	3	3.06	7.47	1.00E-9	4.3	3.5				651	0.76	0.48	2.2

Col 1i	Col 2i	Col 3i	Col 4i	Col 5i	Col 6i	Col 7i	Col 8i	Col 9i	Col 10i	Col 11i	Col 12i	Col 13i	Col 14i	Col 15i	Col 16i	Col 17i	Col 18i	Col 19i	Col 20i	Col 21i	Col 22i	Col 23i	Col 24i	Col 25i	Col 26i	Col 27i	Col 28i	Col 29i
Depth	Depth	qc	fs	u	Other	qt	Rf	SBT	Unit Weight, γ	Total Overburden Stress, σv	Insitu pore pressure, uo	Effective overburden stress, σ'v	Normalized cone resistance, Qtl	Normalized Friction raio, Fr	Normalized pore pressure ratio, Bq	Soil Behavior Type (normalized) SBTn	SBTn Index, Ic	Normalized Cone resistance, Qtn	Estimated permeability, kSBT	SPT N60	SPT (N1)60	Relative Density, Dr	Friction Angle, φ'	Young's modulus, Es	Small strain shear modulus, Go	Undrained shear strength, su	Undrained strength ratio, su/σ'v	Over consolidation ratio, OCR
(m)	(ft)	(tsf)	(tsf)	(psi)		(tsf)	(%)		(pcf)	(tsf)	(tsf)	(tsf)							(ft/sec)	(blows/ft)	(blows/ft)	(%)	(degrees)	(tsf)	(tsf)	(tsf)		
9.500	31.168	22.516	0.503	8.144		22.63	2.22	6	115	1.699	0.660	1.569	13.35	2.40	0.02	4	2.84	14.10	3.00E-8	6.5	5.4				1132	1.40	0.89	4.0
9.600	31.496	27.836	0.488	7.801		27.95	1.75	6	115	1.717	0.671	1.577	16.63	1.86	0.02	4	2.70	17.89	3.00E-8	7.5	6.1				1397	1.75	1.11	5.0
9.700	31.824	16.253	0.298	8.170		16.37	1.82	6	115	1.736	0.681	1.586	9.23	2.04	0.03	3	2.93	9.66	1.00E-9	5.0	4.1				819	0.98	0.62	2.8
9.800	32.152	13.061	0.173	8.923		13.19	1.31	6	115	1.755	0.691	1.594	7.17	1.52	0.04	3	2.97	7.48	1.00E-9	4.1	3.3				659	0.76	0.48	2.2
9.900	32.480	13.532	0.166	9.582		13.67	1.22	6	115	1.774	0.701	1.603	7.42	1.40	0.04	4	2.94	7.77	3.00E-8	4.2	3.4				683	0.79	0.49	2.2
10.000	32.808	15.189	0.192	10.453		15.34	1.25	6	115	1.792	0.712	1.611	8.41	1.41	0.04	4	2.89	8.86	3.00E-8	4.5	3.7				767	0.90	0.56	2.5
10.100	33.136	16.206	0.213	11.443		16.37	1.30	6	115	1.811	0.722	1.620	8.99	1.46	0.04	4	2.87	9.50	3.00E-8	4.8	3.9				819	0.97	0.60	2.7
10.200	33.465	16.602	0.270	11.602		16.77	1.61	6	115	1.830	0.732	1.629	9.17	1.81	0.04	4	2.91	9.66	3.00E-8	5.0	4.1				838	1.00	0.61	2.8
10.300	33.793	19.069	0.376	11.906		19.24	1.96	6	115	1.849	0.742	1.637	10.62	2.16	0.04	4	2.90	11.21	3.00E-8	5.7	4.6				962	1.16	0.71	3.2
10.400	34.121	21.301	0.559	12.064		21.47	2.60	5	115	1.868	0.753	1.646	11.91	2.85	0.03	3	2.92	12.54	1.00E-9	6.5	5.2				1074	1.31	0.79	3.6
10.500	34.449	22.054	0.805	12.024		22.23	3.62	5	115	1.886	0.763	1.654	12.30	3.96	0.03	3	2.99	12.82	1.00E-9	7.0	5.6				1111	1.36	0.82	3.7
10.600	34.777	20.142	0.888	11.998		20.32	4.37	4	115	1.905	0.773	1.663	11.07	4.82	0.03	3	3.08	11.41	1.00E-9	6.8	5.4				1016	1.23	0.74	3.3
10.700	35.105	16.677	0.696	12.169		16.85	4.13	4	115	1.924	0.783	1.671	8.93	4.66	0.04	3	3.15	9.13	1.00E-9	5.9	4.7				843	1.00	0.60	2.7
10.800	35.433	14.266	0.541	12.103		14.44	3.75	4	115	1.943	0.794	1.680	7.44	4.33	0.05	3	3.19	7.56	1.00E-9	5.2	4.1				722	0.83	0.50	2.2
10.900	35.761	13.089	0.400	12.077		13.26	3.02	5	115	1.962	0.804	1.689	6.69	3.54	0.05	3	3.18	6.81	1.00E-9	4.7	3.7				663	0.75	0.45	2.0
11.000	36.089	13.324	0.277	12.302		13.50	2.05	5	115	1.980	0.814	1.697	6.79	2.40	0.05	3	3.09	7.00	1.00E-9	4.5	3.6				675	0.77	0.45	2.0
11.100	36.417	15.246	0.329	12.645		15.43	2.13	5	115	1.999	0.824	1.706	7.87	2.45	0.05	3	3.04	8.19	1.00E-9	5.0	3.9				771	0.90	0.52	2.4
11.200	36.745	16.771	0.428	13.080		16.96	2.53	5	115	2.018	0.834	1.714	8.72	2.87	0.04	3	3.04	9.07	1.00E-9	5.5	4.3				848	1.00	0.58	2.6
11.300	37.073	16.573	0.476	13.463		16.77	2.84	5	115	2.037	0.845	1.723	8.55	3.23	0.04	3	3.07	8.85	1.00E-9	5.5	4.3				838	0.98	0.57	2.6
11.400	37.402	17.119	0.542	13.753		17.32	3.13	5	115	2.056	0.855	1.731	8.81	3.55	0.04	3	3.08	9.11	1.00E-9	5.8	4.5				866	1.02	0.59	2.6
11.500	37.730	17.355	0.596	13.872		17.55	3.40	5	115	2.074	0.865	1.740	8.90	3.85	0.04	3	3.10	9.17	1.00E-9	5.9	4.6				878	1.03	0.59	2.7
11.600	38.058	17.939	0.635	13.938		18.14	3.50	4	115	2.093	0.875	1.748	9.18	3.96	0.04	3	3.10	9.47	1.00E-9	6.1	4.7				907	1.07	0.61	2.8
11.700	38.386	17.920	0.591	14.387		18.13	3.26	5	115	2.112	0.886	1.757	9.12	3.69	0.04	3	3.08	9.43	1.00E-9	6.0	4.7				906	1.07	0.61	2.7
11.800	38.714	17.383	0.460	14.875		17.60	2.61	5	115	2.131	0.896	1.766	8.76	2.97	0.05	3	3.04	9.12	1.00E-9	5.7	4.4				880	1.03	0.58	2.6
11.900	39.042	15.613	0.325	15.205		15.83	2.05	5	115	2.150	0.906	1.774	7.71	2.38	0.05	3	3.04	8.04	1.00E-9	5.1	3.9				792	0.91	0.51	2.3
12.000	39.370	17.751	0.781	16.023		17.98	4.34	3	111	2.168	0.916	1.782	8.87	4.94	0.05	3	3.17	9.07	1.00E-9	6.3	4.9				899	1.05	0.59	2.7
12.100	39.698	59.071	2.135	12.301		59.25	3.60	5	115	2.187	0.927	1.791	31.86	3.74	0.01	4	2.66	35.28	3.00E-8	15.6	12.0				2962	3.80	2.12	9.6
12.200	40.026	85.570	3.081	5.346		85.65	3.60	6	115	2.206	0.937	1.799	46.37	3.69	0.00	4	2.54	52.40	3.00E-8	21.2	16.3				4282	5.56	3.09	13.9
12.300	40.354	104.318	4.009	3.564		104.37	3.84	6	115	2.224	0.947	1.808	56.50	3.92	0.00	4	2.50	64.34	3.00E-8	25.4	19.4				5218	6.81	3.77	17.0
12.400	40.682	112.803	4.654	2.072		112.83	4.12	11	131	2.246	0.957	1.819	60.79	4.21	0.00	4	2.50	69.33	3.00E-8	27.5	20.9				5642	7.37	4.05	18.2
12.500	41.011	155.809	4.580	0.026		155.81	2.94	7	118	2.265	0.968	1.828	83.99	2.98	0.00	5	2.29	99.17	3.00E-6	34.6	26.3	53	40	623	1207			
12.600	41.339	171.404	3.362	-1.558		171.38	1.96	8	121	2.285	0.978	1.838	92.01	1.99	0.00	5	2.14	111.65	3.00E-6	35.6	27.0	56	40	686	1248			
12.700	41.667	186.235	2.455	-2.653		186.20	1.32	10	127	2.306	0.988	1.848	99.49	1.33	0.00	6	1.99	123.92	3.00E-4	36.6	27.7	60	41	745	1285			
12.800	41.995	232.932	2.950	-3.577		232.88	1.27	9	124	2.326	0.998	1.859	124.05	1.28	0.00	6	1.91	157.03	3.00E-4	44.3	33.4	67	42	932	1387			
12.900	42.323	368.062	3.504	-5.543		367.98	0.95	9	124	2.346	1.008	1.869	195.67	0.96	0.00	6	1.68	258.13	3.00E-4	64.5	48.6	86	44	1472	1619			
13.000	42.651	390.936	3.859	-7.919		390.82	0.99	9	124	2.367	1.019	1.879	206.76	0.99	0.00	6	1.68	273.73	3.00E-4	68.4	51.3	88	44	1563	1655			
13.100	42.979	361.537	3.821	-10.625		361.38	1.06	9	124	2.387	1.029	1.889	190.06	1.06	0.00	6	1.72	250.23	3.00E-4	64.3	48.1	85	44	1446	1615			
13.200	43.307	388.657	2.649	-11.536		388.49	0.68	10	127	2.408	1.039	1.900	203.25	0.69	0.00	6	1.57	272.33	3.00E-4	65.6	49.0	88	44	1554	1658			
13.300	43.635	332.684	2.594	-11.549		332.52	0.78	9	124	2.428	1.049	1.910	172.85	0.79	0.00	6	1.66	231.31	3.00E-4	57.9	43.1	81	43	1330	1577			
13.400	43.963	270.863	3.536	-12.750		270.68	1.31	9	124	2.449	1.060	1.920	139.72	1.32	-0.01	6	1.88	180.16	3.00E-4	51.0	37.9	72	42	1083	1475			
13.500	44.291	264.130	3.249	-14.804		263.92	1.23	9	124	2.469	1.070	1.930	135.47	1.24	-0.01	6	1.88	175.35	3.00E-4	49.6	36.7	71	42	1056	1465			
13.600	44.619	318.464	2.662	-15.000		318.25	0.84	9	124	2.490	1.080	1.940	162.76	0.84	-0.01	6	1.70	217.92	3.00E-4	56.2	41.5	79	43	1273	1562			
13.700	44.948	321.883	2.341	-15.000		321.67	0.73	9	124	2.510	1.090	1.950	163.66	0.73	-0.01	6	1.66	221.36	3.00E-4	56.0	41.2	80	43	1287	1570			
13.800	45.276	268.584	1.742	-15.000		268.37	0.65	9	124	2.530	1.101	1.960	135.61	0.66	-0.01	6	1.69	182.81	3.00E-4	47.2	34.7	72	42	1073	1481			
13.900	45.604	191.772	1.008	-15.000		191.56	0.53	9	124	2.551	1.111	1.970	95.92	0.53	-0.01	6	1.76	127.91	3.00E-4	34.6	25.3	60	40	766	1326			
14.000	45.932	91.229	1.030	-15.000		91.01	1.13	8	121	2.570	1.121	1.980	44.67	1.16	-0.02	5	2.23	54.70	3.00E-6	19.7	14.4	40	36	364	1036			
14.100	46.260	40.850	1.061	-15.000		40.63	2.61	6	115	2.589	1.131	1.989	19.13	2.79	-0.04	4	2.75	21.26	3.00E-8	11.3	8.2				2032	2.54	1.28	5.7
14.200	46.588	25.820	0.614	-15.000		25.60	2.40	6	115	2.608	1.142	1.997	11.51	2.67	-0.07	3	2.92	12.40	1.00E-9	7.9	5.7				1280	1.53	0.77	3.5
14.300	46.916	26.885	0.550	-15.000		26.67	2.06	6	115	2.627	1.152	2.006	11.99	2.29	-0.07	4	2.87	13.04	3.00E-8	7.9	5.8				1333	1.60	0.80	3.6
14.400	47.244	25.915	0.575	-15.000		25.70	2.24	6	115	2.646	1.162	2.014	11.44	2.50	-0.07	3	2.90	12.37	1.00E-9	7.8	5.7				1285	1.54	0.76	3.4
14.500	47.572	24.304	0.512	-15.000		24.09	2.13	6	115	2.664	1.172	2.023	10.59	2.39	-0.08	3	2.92	11.41	1.00E-9	7.4	5.4				1204	1.43	0.71	3.2
14.600	47.900	20.509	0.441	-15.000		20.29	2.17	6	115	2.683	1.182	2.031	8.67	2.51	-0.10	3	3.01	9.20	1.00E-9	6.6	4.7				1015	1.17	0.58	2.6
14.700	48.228	18.560	0.381	-15.000		18.34	2.08	6	115	2.702	1.193	2.040	7.67	2.44	-0.11	3	3.04	8.08	1.00E-9	6.1	4.4				917	1.04	0.51	2.3
14.800	48.556	17.412	0.313	-15.000		17.20	1.82	6	115	2.721	1.203	2.049	7.07	2.16	-0.12	3	3.05	7.44	1.00E-9	5.7	4.1				860	0.96	0.47	2.1
14.900	48.885	16.865	0.275	-15.000		16.65	1.65	6	115	2.740	1.213	2.057	6.76	1.97	-0.13	3	3.04	7.13	1.00E-9	5.5	4.0				832	0.93	0.45	2.0
15.000	49.213	17.590	0.269	-15.000		17.37	1.55	6	115	2.758	1.223	2.066	7.08	1.84	-0.12	3	3.01	7.51	1.00E-9	5.7	4.1				869	0.97	0.47	2.1
15.100	49.541	19.200	0.330	-15.000		18.98	1.74	6	115	2.777	1.234	2.074	7.81	2.03	-0.11	3	3.00	8.32	1.00E-9	6.1	4.4				949	1.08	0.52	2.3
15.200	49.869	20.264	0.384	-15.000		20.05	1.92	6	115	2.796	1.244	2.083	8.28	2.23	-0.10	3	2.99	8.83	1.00E-9	6.5	4.6				1002	1.15	0.55	2.5
15.300	50.197	20.491	0.422	-15.000		20.27	2.08	6	115	2.815	1.254	2.091	8.35	2.42	-0.10	3	3.01	8.87	1.00E-9	6.6	4.7				1014	1.16	0.56	2.5
15.400	50.525	20.283	0.406	-15.000		20.07	2.02	6	115	2.834	1.264	2.100	8.21	2.36	-0.11	3	3.01	8.72	1.00E-9	6.5	4.6				1003	1.15	0.55	2.5
15.500	50.853	21.404	0.597	-15.000		21.19	2.82	5	115	2.852	1.275	2.108	8.70	3.26	-0.10	3	3.07	9.14	1.00E-9	7.1	5.1				1059	1.22	0.58	2.6
15.600	51.181	47.592	1.840	-15.000		47.38	3.88	5	115	2.871	1.285	2.117	21.02	4.13	-0.04	3	2.83	23.24	1.00E-9	13.7	9.7				2369	2.97	1.40	6.3
15.700	51.509	137.465	2.592	-15.000		137.25	1.89	8	121	2.891	1.295	2.127	63.18	1.93	-0.01	5	2.25	78.86	3.00E-6	29.9	21.1	47	38	549	1217			
15.800	51.837	144.716	3.488	-15.000		144.50	2.41	7	118	2.910	1.305	2.136	66.30	2.46	-0.01	5	2.31	81.87	3.00E-6	32.3	22.7	48	38	578	1240			
15.900	52.165	135.199	5.017	-15.000		134.98	3.72	12	121	2.930	1.316	2.145	61.55	3.80	-0.01	4	2.46	73.62	3.00E-8	32.3	22.7				6749	8.80	4.10	18.5
16.000	52.493	214.203	3.740	-15.000		213.99	1.75	8	121	2.950	1.326	2.155	97.93	1.77	-0.01	5	2.08	127.12	3.00E-6	43.5	30.5	60	40	856	1417			
16.100	52.822	283.321	2.583	-15.000		283.11	0.91	9	124	2.970	1.336	2.165	129.39	0.92	-0.01	6	1.80	178.75	3.00E-4	51.8	36.2	71	42	1132	1558			
16.200	53.150	310.017	2.958	-15.000		309.80	0.95	9	124	2.991	1.346	2.175	141.05	0.96	-0.01	6	1.79	195.90	3.00E-4	56.4	39.3	75	42	1239	1608			
16.300	53.478	332.364	3.187	-15.000		332.15	0.96	9	124	3.011	1.357	2.185	150.62	0.97	-0.01	6	1.77	210.53	3.00E-4	60.0	41.8	78	43	1329	1648			
16.400	53.806	349.351	3.070	-15.000		349.14	0.88	9	124	3.032	1.367	2.195	157.65	0.89	-0.01	6	1.73	222.79	3.00E-4	62.2	43.2	80	43	1397	1679			
16.500	54.134	377.809	3.078	-15.000		377.59	0.82	10	127	3.052	1.377	2.206	169.78	0.82	-0.01	6	1.68	242.94	3.00E-4	66.2	45.8	83	43	1510	1726			
16.600	54.462	389.787	3.250	-15.000		389.57	0.83	10	127	3.073	1.387	2.217	174.36	0.84	-0.01	6	1.68	250.18	3.00E-4	68.3	47.2	85	43	1558	1747			
16.700	54.790	363.853	3.547	-15.000		363.64	0.98	9	124	3.094	1.397	2.227	161.91	0.98	-0.01	6	1.75	229.21	3.00E-4	65.3	45.0	81	43	1455	1710			
16.800	55.118	361.744	2.995	-15.000		361.53	0.83	9	124	3.114	1.408	2.237	160.22	0.84	-0.01	6	1.70	229.62	3.00E-4	63.9	43.9	81	43	1446	1709			
16.900	55.446	358.194	2.757	-15.000		357.98	0.77	10	127	3.135	1.418	2.248	157.88	0.78	-0.01	6	1.69	227.60	3.00E-4	62.9	43.2	81	43	1432	1706			
17.000	55.774	338.042	1.659	-15.000		337.83	0.49	10	127	3.156	1.428	2.258	148.20	0.50	-0.01	6	1.59	216.50	3.00E-4	57.4	39.3	79	43	1351	1676			
17.100	56.102	316.242	1.814	-15.000		316.03	0.57	10	127	3.177	1.438	2.269	137.89	0.58	-0.01	6	1.65	201.25	3.00E-4	54.9	37.5	76	42	1264	1642			
17.200	56.430	303.793	1.955	-15.000		303.58	0.64	10	127	3.198	1.449	2.280	131.77	0.65	-0.01	6	1.70	190.74	3.00E-4	53.6	36.5	74	42	1214	1622			
17.300	56.759	251.248	1.984	-15.000		251.03	0.79	9	124	3.218	1.459	2.290	108.23	0.80	-0.01	6	1.82	152.61	3.00E-4	46.3	31.5	66	41	1004	1525			
17.400	57.087	204.494	2.014	-15.000		204.28	0.99	9	124	3.238	1.469	2.300	87.42	1.00	-0.01	6	1.96	119.73	3.00E-4	39.6	26.8	58	40	817	1426			
17.500	57.415	217.809	3.193	-15.000		217.59	1.47	8	121	3.258	1.479	2.309	92.81	1.49	-0.01	6	2.05	124.59	3.00E-4	43.7	29.6	60	40	870	1458			
17.600	57.743	197.930	4.171	-15.000		197.71	2.11	8	121	3.278	1.490	2.319	83.84	2.15	-0.01	5	2.19	109.04	3.00E-6	42.0	28.4	56	40	791	1414			
17.700	58.071	163.324	3.988	-15.000		163.11	2.44	7	118	3.297	1.500	2.328	68.64	2.50	-0.01	5	2.30	87.13	3.00E-6	36.3	24.5	50	39	652	1328			
17.800	58.399	181.470	3.628	-15.000		181.25	2.00	8	121	3.317	1.510	2.338	76.12	2.04	-0.01	5	2.21	98.91	3.00E-6	38.8	26.1	53	39	725	1378			
17.900	58.727	216.472	3.355	-15.000		216.26	1.55	8	121	3.337	1.520	2.347	90.71	1.58	-0.01	5	2.07	121.82	3.00E-6	43.8	29.4	59	40	865	1463			
18.000	59.055	246.182	3.407	-15.000		245.97	1.39	9	124	3.357	1.531	2.357	102.91	1.40	-0.01	6	2.00	140.93	3.00E-4	48.4	32.4	63	41	984	1530			
18.100	59.383	252.811	2.683	-15.000		252.60	1.06	9	124	3.378	1.541	2.368	105.26	1.08	-0.01	6	1.91	147.37	3.00E-4	48.1	32.2	65	41	1010	1545			
18.200	59.711	241.144	1.939	-15.000		240.93	0.80	9	124	3.398	1.551	2.378	99.90	0.82	-0.01	6	1.86	142.11	3.00E-4	44.9	30.0	64	41	964	1523			
18.300	60.039	184.445	2.019	-15.000		184.23	1.10	9	124	3.418	1.561	2.388	75.72	1.12	-0.01	6	2.03	103.31	3.00E-4	36.8	24.5	54	39	737	1395			
18.400	60.367	76.351	1.688	-15.000		76.13	2.22	7	118	3.438	1.571	2.397	30.33	2.32	-0.03	4	2.54	36.58	3.00E-8	19.0	12.6				3807	4.85	2.02	9.1
18.500	60.696	29.051	0.748	-15.000		28.83	2.59	6	115	3.457	1.582	2.405	10.55	2.95	-0.08	3	2.97	11.45	1.00E-9	9.1	6.1				1442	1.69	0.70	3.2
18.600	61.024	31.339	1.020	-15.000		31.12	3.28	5	115	3.475	1.592	2.414	11.45	3.69	-0.08	3	3.00	12.35	1.00E-9	10.0	6.6				1556	1.84	0.76	3.4
18.700	61.352	61.246	1.878	-15.000		61.03	3.08	6	115	3.494	1.602	2.423	23.75	3.26	-0.04	4	2.72	27.49	3.00E-8	16.7	11.0				3052	3.84	1.58	7.1
18.800	61.680	116.617	2.517	-15.000		116.40	2.16	7	118	3.513	1.612	2.432	46.42	2.23	-0.02	5	2.39	58.36	3.00E-6	27.0	17.8	41	36	466	1204			
18.900	62.008	172.477	2.508	-15.000		172.26	1.46	8	121	3.533	1.623	2.441	69.11	1.49	-0.01	5	2.14	92.52	3.00E-6	35.9	23.6	51	39	689	1374			
19.000	62.336	162.618	2.096	-15.000		162.40	1.29	8	121	3.553	1.633	2.451	64.81	1.32	-0.01	5	2.13	87.13	3.00E-6	33.7	22.1	50	38	650	1349			
19.100	62.664	129.414	2.245	-15.000		129.20	1.74	8	121	3.573	1.643	2.460	51.06	1.79	-0.02	5	2.30	65.94	3.00E-6	28.7	18.8	43	37	517	1252			
19.200	62.992	107.596	2.827	-15.000		107.38	2.63	7	118	3.592	1.653	2.470	42.03	2.72	-0.02	4	2.48	51.86	3.00E-8	26.0	17.0				5369	6.92	2.80	12.6
19.300	63.320	91.700	2.914	-15.000		91.48	3.18	6	115	3.611	1.664	2.478	35.46	3.32	-0.03	4	2.59	42.56	3.00E-8	23.4	15.3				4574	5.86	2.36	10.6
19.400	63.648	112.492	2.777	-15.000		112.28	2.47	7	118	3.630	1.674	2.487	43.68	2.56	-0.02	5	2.45	54.43	3.00E-6	26.7	17.4	39	36	449	1199			
19.500	63.976	76.662	1.712	-15.000		76.45	2.24	7	118	3.650	1.684	2.496	29.16	2.35	-0.03	4	2.56	35.34	3.00E-8	19.2	12.5				3822	4.85	1.94	8.7
19.600	64.304	31.828	0.764	-15.000		31.61	2.42	6	115	3.669	1.694	2.505	11.16	2.73	-0.08	3	2.93	12.28	1.00E-9	9.8	6.4				1581	1.86	0.74	3.3
19.700	64.633	24.879	0.315	-15.000		24.66	1.28	6	115	3.687	1.705	2.513	8.35	1.50	-0.11	4	2.91	9.26	3.00E-8	7.5	4.9				1233	1.40	0.56	2.5
19.800	64.961	24.841	0.313	-15.000		24.63	1.27	6	115	3.706	1.715	2.522	8.29	1.49	-0.11	4	2.91	9.20	3.00E-8	7.5	4.9				1231	1.39	0.55	2.5
19.900	65.289	25.472	0.378	-15.000		25.26	1.50	6	115	3.725	1.725	2.531	8.51	1.76	-0.11	4	2.93	9.38	3.00E-8	7.8	5.1				1263	1.44	0.57	2.6
20.000	65.617	26.847	0.488	-15.000		26.63	1.83	6	115	3.744	1.735	2.539	9.01	2.13	-0.10	3	2.95	9.89	1.00E-9	8.3	5.4				1332	1.53	0.60	2.7
20.100	65.945	27.742	0.595	-15.000		27.53	2.16	6	115	3.763	1.745	2.548	9.33	2.51	-0.10	3	2.98	10.17	1.00E-9	8.8	5.6				1376	1.58	0.62	2.8
20.200	66.273	28.156	0.698	-15.000		27.94	2.50	6	115	3.781	1.756	2.556	9.45	2.89	-0.10	3	3.01	10.23	1.00E-9	9.0	5.8				1397	1.61	0.63	2.8
20.300	66.601	27.826	0.834	-15.000		27.61	3.02	5	115	3.800	1.766	2.565	9.28	3.50	-0.10	3	3.06	9.91	1.00E-9	9.3	5.9				1381	1.59	0.62	2.8
20.400	66.929	26.838	0.899	-15.000		26.62	3.38	5	115	3.819	1.776	2.573	8.86	3.94	-0.10	3	3.11	9.34	1.00E-9	9.2	5.9				1331	1.52	0.59	2.7
20.500	67.257	26.753	0.858	-15.000		26.54	3.23	5	115	3.838	1.786	2.582	8.79	3.78	-0.10	3	3.10	9.29	1.00E-9	9.1	5.8				1327	1.51	0.59	2.6
20.600	67.585	30.124	1.007	-15.000		29.91	3.37	5	115	3.857	1.797	2.590	10.06	3.86	-0.09	3	3.06	10.75	1.00E-9	10.0	6.4				1495	1.74	0.67	3.0
20.700	67.913	33.570	1.113	-15.000		33.35	3.34	5	115	3.875	1.807	2.599	11.34	3.77	-0.08	3	3.01	12.29	1.00E-9	10.8	6.9				1668	1.97	0.76	3.4
20.800	68.241	33.693	0.978	-15.000		33.48	2.92	6	115	3.894	1.817	2.608	11.34	3.30	-0.08	3	2.98	12.41	1.00E-9	10.6	6.8				1674	1.97	0.76	3.4
20.900	68.570	31.282	0.843	-15.000		31.07	2.71	6	115	3.913	1.827	2.616	10.38	3.10	-0.09	3	2.99	11.30	1.00E-9	10.0	6.3				1553	1.81	0.69	3.1

Col 1i	Col 2i	Col 3i	Col 4i	Col 5i	Col 6i	Col 7i	Col 8i	Col 9i	Col 10i	Col 11i	Col 12i	Col 13i	Col 14i	Col 15i	Col 16i	Col 17i	Col 18i	Col 19i	Col 20i	Col 21i	Col 22i	Col 23i	Col 24i	Col 25i	Col 26i	Col 27i	Col 28i	Col 29i
Depth	Depth	qc	fs	u	Other	qt	Rf	SBT	Unit Weight, γ	Total Overburden Stress, σv	Insitu pore pressure, uo	Effective overburden stress, σ'v	Normalized cone resistance, Qtl	Normalized Friction raio, Fr	Normalized pore pressure ratio, Bq	Soil Behavior Type (normalized) SBTn	SBTn Index, Ic	Normalized Cone resistance, Qtn	Estimated permeability, kSBT	SPT N60	SPT (N1)60	Relative Density, Dr	Friction Angle, φ'	Young's modulus, Es	Small strain shear modulus, Go	Undrained shear strength, su	Undrained strength ratio, su/σ'v	Over consolidation ratio, OCR
(m)	(ft)	(tsf)	(tsf)	(psi)		(tsf)	(%)		(pcf)	(tsf)	(tsf)	(tsf)							(ft/sec)	(blows/ft)	(blows/ft)	(%)	(degrees)	(tsf)	(tsf)	(tsf)		
21.000	68.898	29.088	0.714	-15.000		28.87	2.47	6	115	3.932	1.838	2.625	9.50	2.86	-0.10	3	3.00	10.32	1.00E-9	9.3	5.9				1444	1.66	0.63	2.9
21.100	69.226	35.520	0.661	-15.000		35.30	1.87	6	115	3.950	1.848	2.633	11.91	2.11	-0.08	4	2.85	13.49	3.00E-8	10.4	6.6				1765	2.09	0.79	3.6
21.200	69.554	34.701	0.634	-15.000		34.48	1.84	6	115	3.969	1.858	2.642	11.55	2.08	-0.08	4	2.86	13.07	3.00E-8	10.2	6.4				1724	2.03	0.77	3.5
21.300	69.882	38.043	0.852	-15.000		37.83	2.25	6	115	3.988	1.868	2.650	12.77	2.52	-0.07	4	2.87	14.41	3.00E-8	11.2	7.1				1891	2.26	0.85	3.8
21.400	70.210	40.030	0.883	-15.000		39.81	2.22	6	115	4.007	1.879	2.659	13.47	2.47	-0.07	4	2.84	15.31	3.00E-8	11.6	7.3				1991	2.39	0.90	4.0
21.500	70.538	33.476	0.706	-15.000		33.26	2.12	6	115	4.026	1.889	2.668	10.96	2.41	-0.08	3	2.91	12.23	1.00E-9	10.1	6.4				1663	1.95	0.73	3.3
21.600	70.866	32.751	0.682	-15.000		32.54	2.10	6	115	4.044	1.899	2.676	10.65	2.39	-0.09	3	2.92	11.86	1.00E-9	10.0	6.3				1627	1.90	0.71	3.2
21.700	71.194	35.152	0.963	-15.000		34.94	2.76	6	115	4.063	1.909	2.685	11.50	3.12	-0.08	3	2.96	12.68	1.00E-9	10.9	6.9				1747	2.06	0.77	3.4
21.800	71.522	56.265	1.431	-15.000		56.05	2.55	6	115	4.082	1.919	2.693	19.30	2.75	-0.05	4	2.74	22.59	3.00E-8	15.5	9.7				2802	3.46	1.29	5.8
21.900	71.850	47.149	1.190	-15.000		46.93	2.54	6	115	4.101	1.930	2.702	15.85	2.78	-0.06	4	2.81	18.21	3.00E-8	13.5	8.5				2347	2.86	1.06	4.8
22.000	72.178	35.275	0.909	-15.000		35.06	2.59	6	115	4.120	1.940	2.710	11.42	2.94	-0.08	3	2.94	12.64	1.00E-9	10.9	6.8				1753	2.06	0.76	3.4
22.100	72.507	36.546	1.212	-15.000		36.33	3.34	5	115	4.138	1.950	2.719	11.84	3.77	-0.08	3	2.99	12.93	1.00E-9	11.6	7.3				1817	2.15	0.79	3.6
22.200	72.835	46.170	1.338	-14.965		45.95	2.91	6	115	4.157	1.960	2.727	15.32	3.20	-0.06	3	2.86	17.38	1.00E-9	13.6	8.5				2298	2.79	1.02	4.6
22.300	73.163	40.539	0.962	-14.875		40.32	2.38	6	115	4.176	1.971	2.736	13.21	2.66	-0.07	4	2.87	14.97	3.00E-8	12.0	7.4				2016	2.41	0.88	4.0
22.400	73.491	32.469	0.967	-14.769		32.26	3.00	5	115	4.195	1.981	2.745	10.22	3.45	-0.09	3	3.02	11.09	1.00E-9	10.5	6.5				1613	1.87	0.68	3.1
22.500	73.819	49.598	1.612	-14.664		49.39	3.26	6	115	4.214	1.991	2.753	16.41	3.57	-0.06	3	2.87	18.61	1.00E-9	14.6	9.1				2469	3.01	1.09	4.9
22.600	74.147	61.642	1.941	-14.584		61.43	3.16	6	115	4.232	2.001	2.762	20.71	3.39	-0.04	4	2.78	24.13	3.00E-8	17.3	10.7				3072	3.81	1.38	6.2
22.700	74.475	60.926	1.977	-14.505		60.72	3.26	6	115	4.251	2.012	2.770	20.38	3.50	-0.04	4	2.79	23.67	3.00E-8	17.2	10.6				3036	3.76	1.36	6.1
22.800	74.803	71.031	1.902	-14.440		70.82	2.69	6	115	4.270	2.022	2.779	23.95	2.86	-0.04	4	2.68	28.72	3.00E-8	18.9	11.7				3541	4.44	1.60	7.2
22.900	75.131	44.051	1.284	-14.360		43.84	2.93	6	115	4.289	2.032	2.787	14.19	3.25	-0.06	3	2.89	16.00	1.00E-9	13.2	8.1				2192	2.64	0.95	4.3
23.000	75.459	27.600	0.821	-14.255		27.39	3.00	5	115	4.308	2.042	2.796	8.26	3.56	-0.11	3	3.11	8.75	1.00E-9	9.5	5.8				1370	1.54	0.55	2.5
23.100	75.787	24.850	0.636	-14.188		24.65	2.58	5	115	4.326	2.053	2.804	7.25	3.13	-0.13	3	3.12	7.64	1.00E-9	8.6	5.3				1232	1.35	0.48	2.2
23.200	76.115	25.434	0.632	-14.070		25.23	2.51	6	115	4.345	2.063	2.813	7.42	3.03	-0.12	3	3.11	7.87	1.00E-9	8.7	5.3				1262	1.39	0.49	2.2
23.300	76.444	26.904	0.681	-14.004		26.70	2.55	6	115	4.364	2.073	2.822	7.92	3.05	-0.11	3	3.08	8.45	1.00E-9	9.1	5.6				1335	1.49	0.53	2.4
23.400	76.772	28.250	0.729	-13.951		28.05	2.60	6	115	4.383	2.083	2.830	8.36	3.08	-0.11	3	3.07	8.97	1.00E-9	9.4	5.8				1402	1.58	0.56	2.5
23.500	77.100	28.862	0.716	-13.872		28.66	2.50	6	115	4.402	2.094	2.839	8.55	2.95	-0.11	3	3.05	9.22	1.00E-9	9.5	5.8				1433	1.62	0.57	2.6
23.600	77.428	28.344	0.629	-13.779		28.15	2.23	6	115	4.420	2.104	2.847	8.33	2.65	-0.11	3	3.03	9.04	1.00E-9	9.3	5.6				1407	1.58	0.56	2.5
23.700	77.756	29.069	0.652	-13.674		28.87	2.26	6	115	4.439	2.114	2.856	8.56	2.67	-0.11	3	3.03	9.30	1.00E-9	9.4	5.7				1444	1.63	0.57	2.6
23.800	78.084	31.744	0.689	-13.568		31.55	2.18	6	115	4.458	2.124	2.864	9.46	2.54	-0.09	3	2.98	10.44	1.00E-9	10.0	6.1				1577	1.81	0.63	2.8
23.900	78.412	32.883	0.645	-13.449		32.69	1.97	6	115	4.477	2.134	2.873	9.82	2.29	-0.09	3	2.94	10.97	1.00E-9	10.1	6.1				1634	1.88	0.65	2.9
24.000	78.740	26.659	0.564	-13.344		26.47	2.13	6	115	4.496	2.145	2.882	7.62	2.57	-0.12	3	3.06	8.22	1.00E-9	8.8	5.4				1323	1.46	0.51	2.3
24.100	79.068	24.182	0.432	-13.239		23.99	1.80	6	115	4.514	2.155	2.890	6.74	2.22	-0.13	3	3.07	7.24	1.00E-9	8.1	4.9				1200	1.30	0.45	2.0
24.200	79.396	25.349	0.422	-12.829		25.16	1.68	6	115	4.533	2.165	2.899	7.12	2.05	-0.12	3	3.03	7.73	1.00E-9	8.3	5.0				1258	1.38	0.47	2.1
24.300	79.724	27.214	0.492	-12.578		27.03	1.82	6	115	4.552	2.175	2.907	7.73	2.19	-0.11	3	3.02	8.44	1.00E-9	8.8	5.3				1352	1.50	0.52	2.3
24.400	80.052	26.263	0.547	-12.460		26.08	2.10	6	115	4.571	2.186	2.916	7.38	2.54	-0.12	3	3.07	7.93	1.00E-9	8.8	5.3				1304	1.43	0.49	2.2
24.500	80.381	24.710	0.543	-12.341		24.53	2.21	6	115	4.590	2.196	2.924	6.82	2.72	-0.13	3	3.11	7.23	1.00E-9	8.5	5.1				1227	1.33	0.45	2.0
24.600	80.709	26.960	0.577	-12.222		26.78	2.16	6	115	4.608	2.206	2.933	7.56	2.60	-0.12	3	3.06	8.14	1.00E-9	9.0	5.4				1339	1.48	0.50	2.3
24.700	81.037	38.495	1.254	-12.103		38.32	3.27	5	115	4.627	2.216	2.941	11.45	3.72	-0.08	3	3.00	12.57	1.00E-9	12.3	7.4				1916	2.25	0.76	3.4
24.800	81.365	70.653	1.929	-11.998		70.48	2.74	6	115	4.646	2.227	2.950	22.32	2.93	-0.04	4	2.71	26.81	3.00E-8	19.1	11.5				3524	4.39	1.49	6.7
24.900	81.693	64.684	1.584	-11.879		64.51	2.45	6	115	4.665	2.237	2.959	20.23	2.65	-0.04	4	2.72	24.27	3.00E-8	17.6	10.5				3226	3.99	1.35	6.1
25.000	82.021	43.373	1.167	-11.734		43.20	2.70	6	115	4.684	2.247	2.967	12.98	3.03	-0.07	3	2.91	14.69	1.00E-9	13.1	7.8				2160	2.57	0.87	3.9
25.100	82.349	34.955	0.926	-11.628		34.79	2.66	6	115	4.702	2.257	2.976	10.11	3.08	-0.09	3	3.00	11.12	1.00E-9	11.2	6.7				1739	2.01	0.67	3.0
25.200	82.677	30.228	0.678	-11.522		30.06	2.25	6	115	4.721	2.268	2.984	8.49	2.67	-0.10	3	3.03	9.26	1.00E-9	9.8	5.9				1503	1.69	0.57	2.5
25.300	83.005	32.544	0.505	-11.416		32.38	1.56	6	115	4.740	2.278	2.993	9.24	1.83	-0.09	4	2.91	10.45	3.00E-8	9.9	5.9				1619	1.84	0.62	2.8
25.400	83.333	31.517	0.340	-11.377		31.35	1.09	7	118	4.759	2.288	3.002	8.86	1.28	-0.10	4	2.85	10.22	3.00E-8	9.2	5.5				1568	1.77	0.59	2.7
25.500	83.661	26.640	0.342	-11.325		26.48	1.29	6	115	4.778	2.298	3.010	7.21	1.58	-0.12	3	2.97	8.00	1.00E-9	8.4	5.0				1324	1.45	0.48	2.2
25.600	83.990	26.084	0.419	-11.259		25.92	1.62	6	115	4.797	2.308	3.019	7.00	1.98	-0.12	3	3.03	7.63	1.00E-9	8.5	5.0				1296	1.41	0.47	2.1
25.700	84.318	26.188	0.388	-11.179		26.03	1.49	6	115	4.816	2.319	3.028	7.01	1.83	-0.12	3	3.01	7.68	1.00E-9	8.4	5.0				1301	1.41	0.47	2.1
25.800	84.646	26.724	0.399	-11.139		26.56	1.50	6	115	4.834	2.329	3.036	7.16	1.84	-0.12	3	3.01	7.87	1.00E-9	8.6	5.1				1328	1.45	0.48	2.1
25.900	84.974	26.122	0.412	-11.060		25.96	1.59	6	115	4.853	2.339	3.045	6.93	1.95	-0.12	3	3.03	7.56	1.00E-9	8.5	5.0				1298	1.41	0.46	2.1
26.000	85.302	24.540	0.438	-10.955		24.38	1.80	6	115	4.872	2.349	3.053	6.39	2.24	-0.13	3	3.09	6.84	1.00E-9	8.3	4.9				1219	1.30	0.43	1.9
26.100	85.630	24.267	0.562	-10.876		24.11	2.33	6	115	4.891	2.360	3.062	6.28	2.93	-0.14	3	3.16	6.58	1.00E-9	8.6	5.1				1206	1.28	0.42	1.9
26.200	85.958	23.946	0.600	-10.374		23.80	2.52	6	115	4.910	2.370	3.070	6.15	3.18	-0.14	3	3.19	6.39	1.00E-9	8.7	5.1				1190	1.26	0.41	1.8
26.300	86.286	23.862	0.598	-10.071		23.72	2.52	6	115	4.928	2.380	3.079	6.10	3.18	-0.14	3	3.19	6.34	1.00E-9	8.7	5.1				1186	1.25	0.41	1.8
26.400	86.614	24.427	0.481	-9.939		24.28	1.98	6	115	4.947	2.390	3.088	6.26	2.49	-0.13	3	3.12	6.64	1.00E-9	8.5	5.0				1214	1.29	0.42	1.9
26.500	86.942	22.233	0.452	-9.582		22.10	2.05	6	115	4.966	2.401	3.096	5.53	2.64	-0.15	3	3.18	5.76	1.00E-9	8.0	4.7				1105	1.14	0.37	1.7
26.600	87.270	26.499	0.572	-8.989		26.37	2.17	6	115	4.985	2.411	3.105	6.89	2.67	-0.12	3	3.10	7.35	1.00E-9	9.1	5.3				1318	1.43	0.46	2.1
26.700	87.598	36.358	0.707	-8.909		36.23	1.95	6	115	5.004	2.421	3.113	10.03	2.26	-0.08	3	2.93	11.34	1.00E-9	11.1	6.5				1811	2.08	0.67	3.0
26.800	87.927	47.667	0.873	-8.857		47.54	1.84	7	118	5.023	2.431	3.122	13.62	2.05	-0.06	4	2.79	16.08	3.00E-8	13.5	7.9				2377	2.83	0.91	4.1
26.900	88.255	37.478	0.591	-8.764		37.35	1.58	7	118	5.042	2.442	3.131	10.32	1.83	-0.08	4	2.87	11.90	3.00E-8	11.1	6.4				1868	2.15	0.69	3.1
27.000	88.583	32.158	0.517	-8.632		32.03	1.61	6	115	5.061	2.452	3.140	8.59	1.92	-0.09	3	2.95	9.66	1.00E-9	10.0	5.8				1602	1.80	0.57	2.6
27.100	88.911	31.405	0.417	-8.566		31.28	1.33	7	118	5.080	2.462	3.149	8.32	1.59	-0.10	4	2.92	9.44	3.00E-8	9.6	5.5				1564	1.75	0.55	2.5
27.200	89.239	27.610	0.496	-8.526		27.49	1.80	6	115	5.099	2.472	3.158	7.09	2.22	-0.11	3	3.05	7.71	1.00E-9	9.1	5.3				1374	1.49	0.47	2.1
27.300	89.567	32.412	0.533	-8.474		32.29	1.65	6	115	5.118	2.482	3.166	8.58	1.96	-0.09	3	2.95	9.64	1.00E-9	10.1	5.8				1615	1.81	0.57	2.6
27.400	89.895	33.081	0.536	-8.447		32.96	1.63	6	115	5.137	2.493	3.175	8.76	1.93	-0.09	3	2.94	9.89	1.00E-9	10.2	5.9				1648	1.85	0.58	2.6
27.500	90.223	25.529	0.438	-8.407		25.41	1.72	6	115	5.156	2.503	3.183	6.36	2.16	-0.13	3	3.09	6.84	1.00E-9	8.6	5.0				1270	1.35	0.42	1.9
27.600	90.551	27.337	0.401	-8.117		27.22	1.47	6	115	5.174	2.513	3.192	6.91	1.82	-0.12	3	3.02	7.60	1.00E-9	8.8	5.1				1361	1.47	0.46	2.1
27.700	90.879	27.572	0.349	-7.893		27.46	1.27	6	115	5.193	2.523	3.200	6.96	1.57	-0.12	3	2.98	7.74	1.00E-9	8.7	5.0				1373	1.48	0.46	2.1
27.800	91.207	25.802	0.390	-7.761		25.69	1.52	6	115	5.212	2.534	3.209	6.38	1.90	-0.13	3	3.06	6.93	1.00E-9	8.6	4.9				1285	1.37	0.43	1.9
27.900	91.535	26.319	0.504	-7.629		26.21	1.92	6	115	5.231	2.544	3.217	6.52	2.40	-0.12	3	3.10	6.98	1.00E-9	9.0	5.1				1310	1.40	0.43	2.0
28.000	91.864	25.368	0.587	-7.536		25.26	2.32	6	115	5.250	2.554	3.226	6.20	2.93	-0.13	3	3.16	6.50	1.00E-9	9.0	5.2				1263	1.33	0.41	1.9
28.100	92.192	24.549	0.612	-7.444		24.44	2.51	6	115	5.268	2.564	3.235	5.93	3.19	-0.13	3	3.20	6.14	1.00E-9	9.0	5.1				1222	1.28	0.40	1.8
28.200	92.520	24.794	0.603	-7.325		24.69	2.44	6	115	5.287	2.575	3.243	5.98	3.11	-0.13	3	3.19	6.22	1.00E-9	9.0	5.1				1234	1.29	0.40	1.8
28.300	92.848	25.783	0.609	-7.233		25.68	2.37	6	115	5.306	2.585	3.252	6.27	2.99	-0.13	3	3.17	6.57	1.00E-9	9.2	5.2				1284	1.36	0.42	1.9
28.400	93.176	26.103	0.606	-7.140		26.00	2.33	6	115	5.325	2.595	3.260	6.34	2.93	-0.12	3	3.16	6.67	1.00E-9	9.2	5.3				1300	1.38	0.42	1.9
28.500	93.504	26.772	0.663	-7.035		26.67	2.49	6	115	5.344	2.605	3.269	6.52	3.11	-0.12	3	3.16	6.86	1.00E-9	9.5	5.4				1334	1.42	0.43	2.0
28.600	93.832	27.610	0.689	-6.745		27.51	2.50	6	115	5.362	2.616	3.277	6.76	3.11	-0.12	3	3.15	7.13	1.00E-9	9.7	5.5				1376	1.48	0.45	2.0
28.700	94.160	25.265	0.517	-6.547		25.17	2.05	6	115	5.381	2.626	3.286	6.02	2.61	-0.13	3	3.15	6.35	1.00E-9	8.9	5.1				1259	1.32	0.40	1.8
28.800	94.488	24.474	0.402	-6.454		24.38	1.65	6	115	5.400	2.636	3.295	5.76	2.12	-0.14	3	3.12	6.14	1.00E-9	8.5	4.8				1219	1.27	0.38	1.7
28.900	94.816	29.399	0.633	-6.348		29.31	2.16	6	115	5.419	2.646	3.303	7.23	2.65	-0.11	3	3.08	7.80	1.00E-9	9.9	5.6				1465	1.59	0.48	2.2
29.000	95.144	48.486	1.177	-6.230		48.40	2.43	6	115	5.438	2.656	3.312	12.97	2.74	-0.06	4	2.88	15.00	3.00E-8	14.4	8.2				2420	2.86	0.86	3.9
29.100	95.472	58.016	1.376	-6.137		57.93	2.38	6	115	5.456	2.667	3.320	15.80	2.62	-0.05	4	2.80	18.80	3.00E-8	16.5	9.3				2896	3.50	1.05	4.7
29.200	95.801	33.664	1.009	-6.084		33.58	3.01	5	115	5.475	2.677	3.329	8.44	3.59	-0.09	3	3.10	9.06	1.00E-9	11.5	6.5				1679	1.87	0.56	2.5
29.300	96.129	29.239	0.791	-6.018		29.15	2.71	6	115	5.494	2.687	3.337	7.09	3.34	-0.11	3	3.15	7.49	1.00E-9	10.3	5.8				1458	1.58	0.47	2.1
29.400	96.457	28.430	0.526	-6.018		28.34	1.86	6	115	5.513	2.697	3.346	6.82	2.30	-0.11	3	3.07	7.39	1.00E-9	9.5	5.4				1417	1.52	0.45	2.0
29.500	96.785	28.241	0.535	-6.018		28.15	1.90	6	115	5.532	2.708	3.354	6.74	2.37	-0.12	3	3.08	7.28	1.00E-9	9.5	5.4				1408	1.51	0.45	2.0
29.600	97.113	29.757	0.636	-6.018		29.67	2.14	6	115	5.550	2.718	3.363	7.17	2.64	-0.11	3	3.09	7.74	1.00E-9	10.1	5.6				1484	1.61	0.48	2.2
29.700	97.441	29.988	0.692	-5.979		29.90	2.31	6	115	5.569	2.728	3.372	7.22	2.84	-0.11	3	3.10	7.75	1.00E-9	10.2	5.7				1495	1.62	0.48	2.2
29.800	97.769	27.699	0.562	-5.939		27.61	2.04	6	115	5.588	2.738	3.380	6.52	2.55	-0.12	3	3.11	6.97	1.00E-9	9.5	5.3				1381	1.47	0.43	2.0
29.900	98.097	26.150	0.423	-5.887		26.07	1.62	6	115	5.607	2.749	3.389	6.04	2.07	-0.13	3	3.10	6.50	1.00E-9	8.9	5.0				1303	1.36	0.40	1.8
30.000	98.425	26.800	0.441	-5.808		26.72	1.65	6	115	5.626	2.759	3.397	6.21	2.09	-0.13	3	3.09	6.70	1.00E-9	9.1	5.1				1336	1.41	0.41	1.9
30.100	98.753	32.714	0.809	-5.728		32.63	2.48	6	115	5.644	2.769	3.406	7.92	3.00	-0.10	3	3.08	8.58	1.00E-9	11.0	6.1				1632	1.80	0.53	2.4
30.200	99.081	58.327	1.526	-5.623		58.25	2.62	6	115	5.663	2.779	3.414	15.40	2.90	-0.05	4	2.84	18.17	3.00E-8	16.9	9.4				2912	3.51	1.03	4.6
30.300	99.409	66.924	1.721	-5.425		66.85	2.58	6	115	5.682	2.790	3.423	17.87	2.81	-0.04	4	2.78	21.54	3.00E-8	18.8	10.4				3342	4.08	1.19	5.4
30.400	99.738	54.033	1.853	-5.253		53.96	3.43	5	115	5.701	2.800	3.432	14.06	3.84	-0.05	3	2.94	16.00	1.00E-9	16.7	9.2				2698	3.22	0.94	4.2

Pore Pressure Dissipation Tests (PPDT)

Pore Pressure Dissipation Tests (PPDT's) conducted at various intervals measured hydrostatic water pressures and determined the approximate depth of the ground water table. A PPDT is conducted when the cone is halted at specific intervals determined by the field representative. The variation of the penetration pore pressure (u) with time is measured behind the tip of the cone and recorded by a computer system.

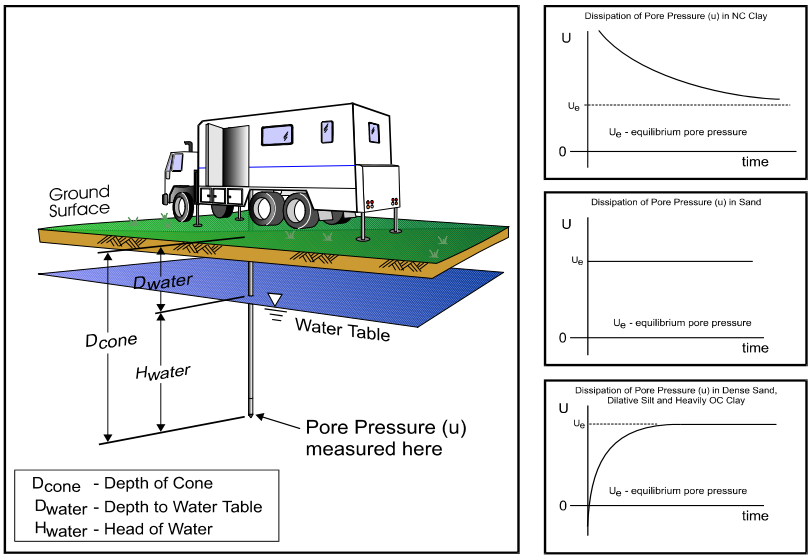
Pore pressure dissipation data can be interpreted to provide estimates of:

- Equilibrium piezometric pressure
- Phreatic Surface
- In situ horizontal coefficient of consolidation (c_h)
- In situ horizontal coefficient of permeability (k_h)

In order to correctly interpret the equilibrium piezometric pressure and/or the phreatic surface, the pore pressure must be monitored until such time as there is no variation in pore pressure with time, *Figure PPDT*. This time is commonly referred to as t_{100}, the point at which 100% of the excess pore pressure has dissipated.

A complete reference on pore pressure dissipation tests is presented by Robertson et al. 1992.

A summary of the pore pressure dissipation tests is summarized in Table 1.



Water Table Calculation

$$D_{water} = D_{cone} - H_{water}$$

where $H_{water} = U_e$ (depth units)

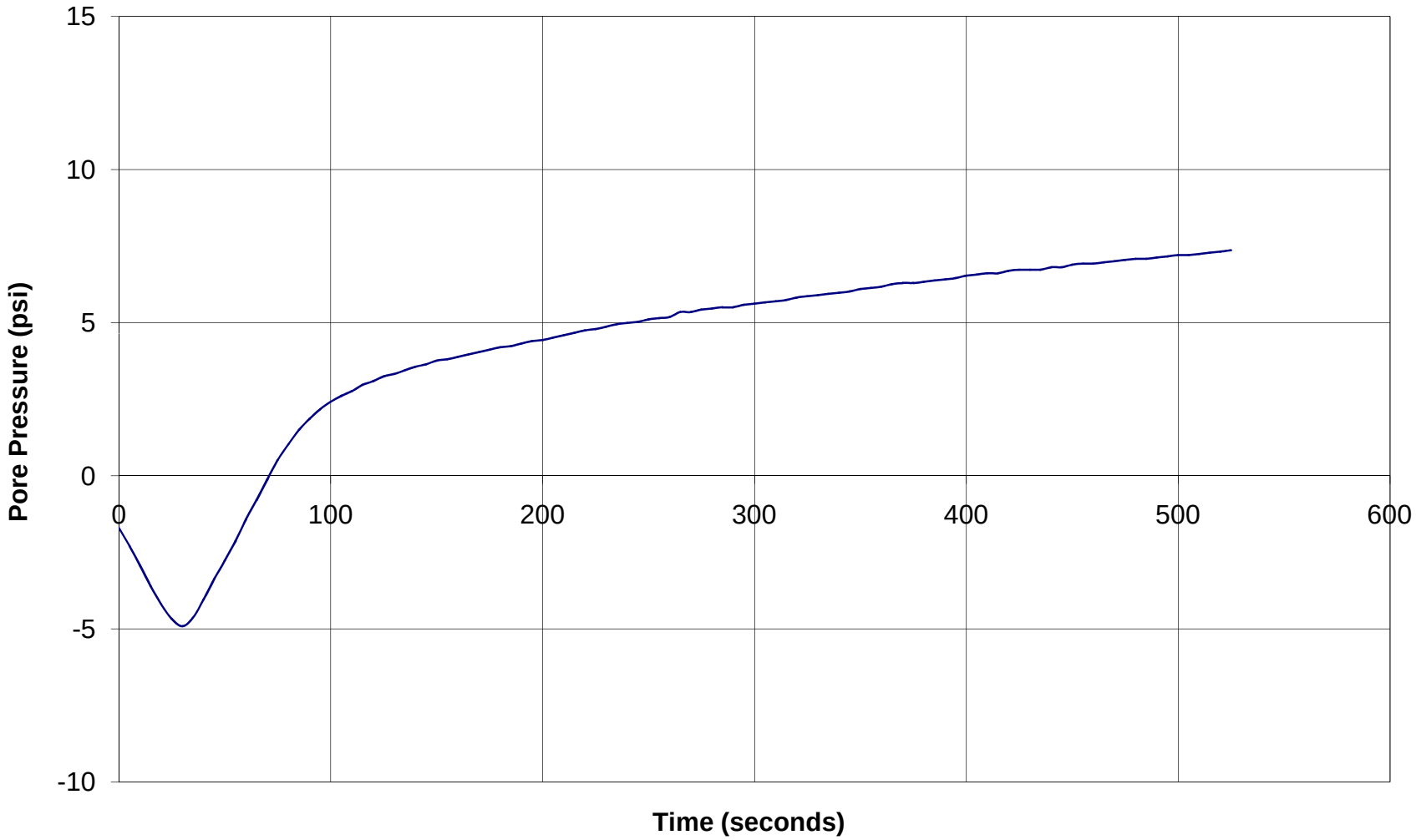
Useful Conversion Factors:
1psi = 0.704m = 2.31 feet (water)
1tsf = 0.958 bar = 13.9 psi
1m = 3.28 feet

Figure PPDT

GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

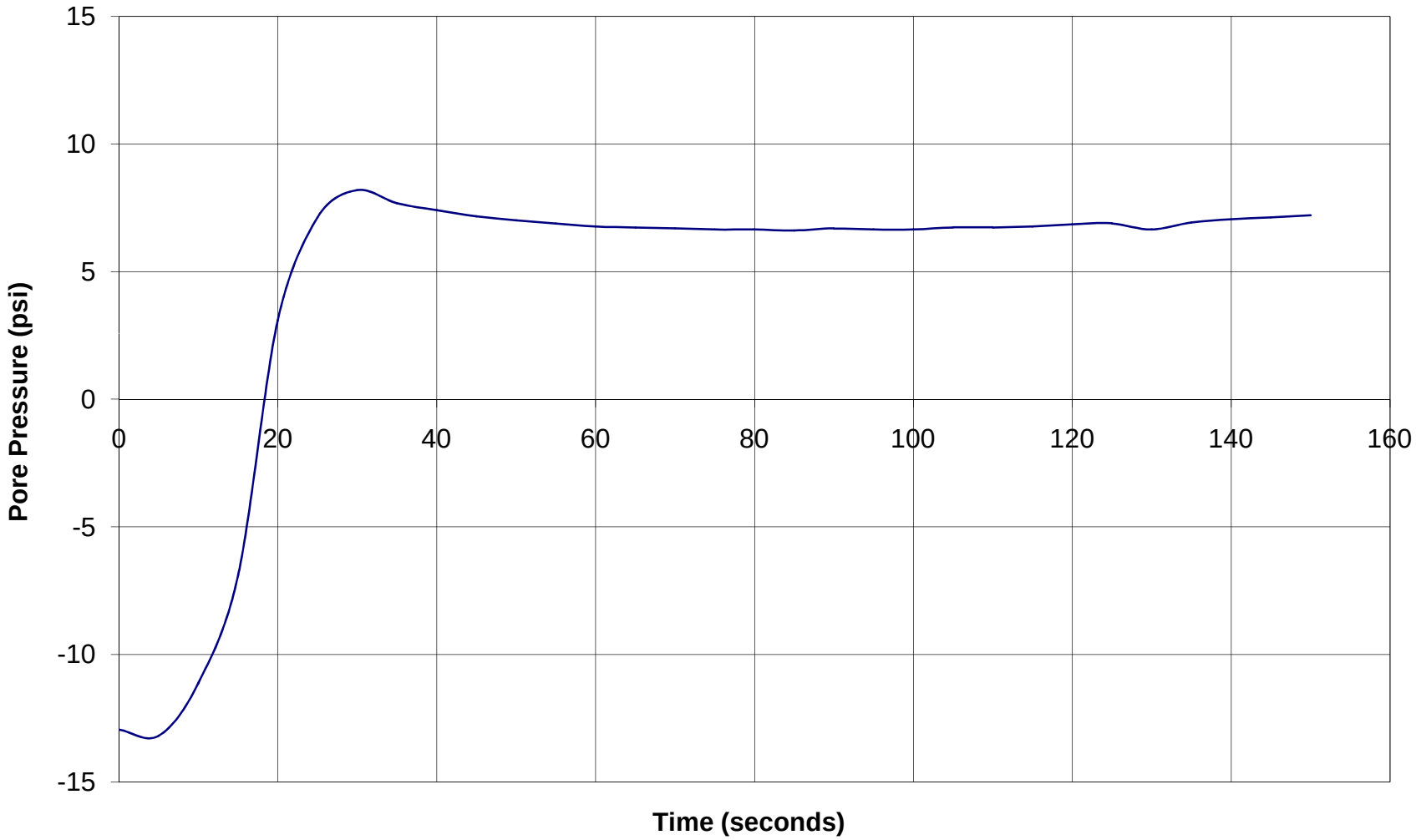
Sounding: CPT-MR1
Depth: 24.114
Site: I-880 WIDENING
Engineer: G.PARIKH



GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

Sounding: CPT-MR1
Depth: 43.799
Site: I-880 WIDENING
Engineer: G.PARIKH



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Copies of ASTM Standards are available through www.astm.org

APPENDIX B

APPENDIX B

LABORATORY TESTS

Classification Tests
The field classification of the samples was visually verified in the laboratory according to the Unified Soil Classification System. The results are presented in “Log of Test Borings”, Appendix A.

Moisture-Density
The natural moisture contents and dry unit weights were determined for selected undisturbed samples of the soils in general accordance with ASTM Test Method D 2216-92. This information was used to classify and correlate the soils. The results are presented at the appropriate depths on the "Log of Test Borings", Appendix A.

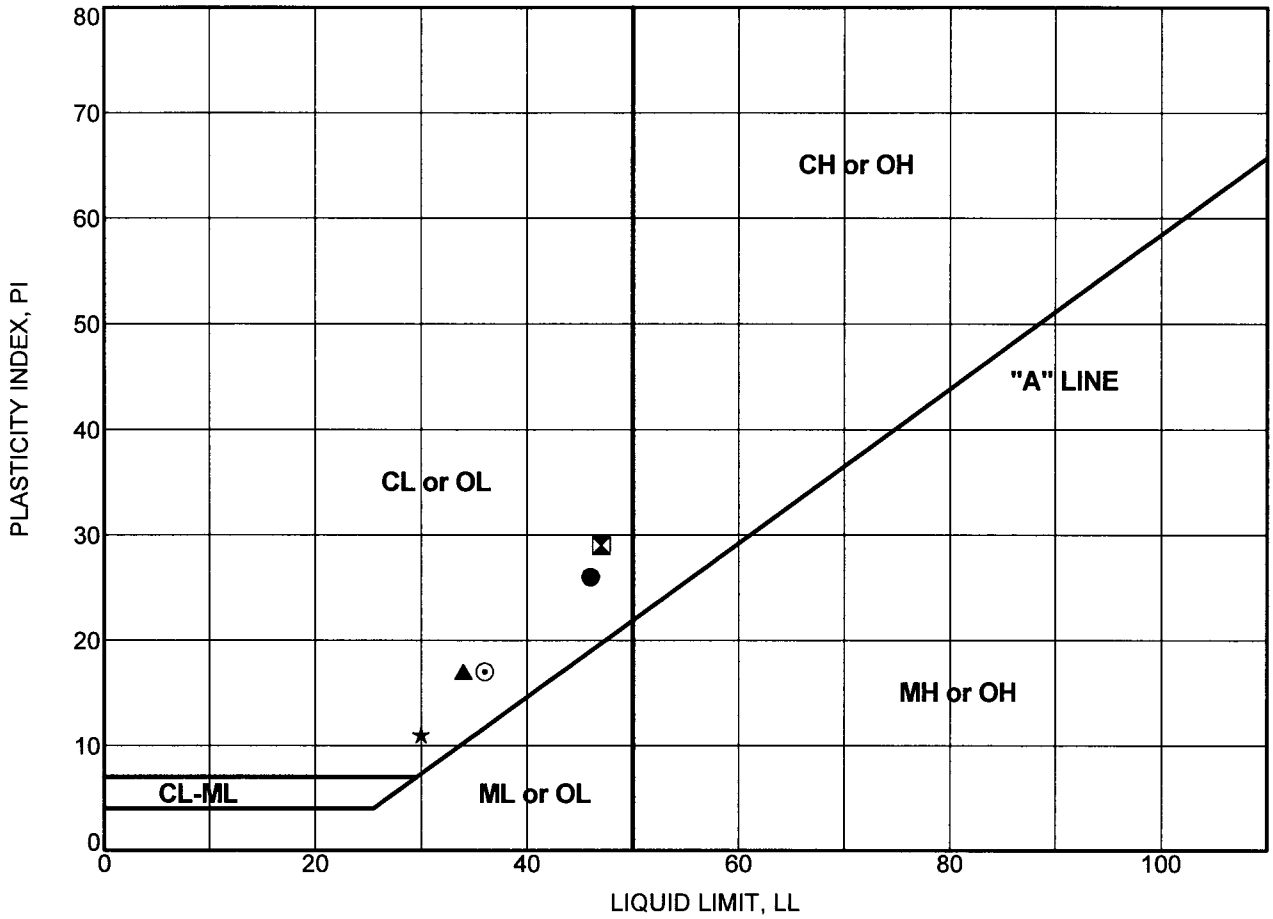
Atterberg Limits
The Atterberg Limits were determined for selected samples of the fine-grained materials. These results were used to classify the soils, as well as to obtain an indication of the effective strength characteristics and expansion potential with variations in moisture content. The Atterberg Limits were determined in general accordance with ASTM Test Method D 4318-93. The results of these tests are presented on Plat B-2, “Plasticity Chart”.

Grain Size Classification
Grain size classification tests (ASTM Test Method D422-63) were performed on selected samples of granular soil to aid in the classification. The results are presented on Plate B-3, “Grain Size Distribution Curves”.

Unconfined Compression Tests
Strength tests were performed on selected undisturbed samples using unconfined compression machine. Unconfined compression tests were performed in general accordance with ASTM Test Method D 2166-91. The results are presented on “Log of Test Borings”, Appendix A.

Corrosion Tests
Corrosion tests were performed on selected samples to determine the corrosion potential of the soils. The pH and minimum resistively tests were performed according to California Test Method 643. The tests were performed by Sunland Analytical. The test results are presented on Plate B-4A.

Consolidation Tests
Consolidation tests (California Test Method T219) were performed on two selected undisturbed samples. The test results are presented on Plates B-5A thru B-5F.



PLASTICITY CHART

Boring Number	Sample Number	Depth (feet)	Test Symbol	Moisture Content (%)	LL	PL	PI	Description
MR-2	MC-1	4.5	●	20	46	20	26	LEAN CLAY (CL)
MR-2	MC-4	19.5	⊠	24	47	18	29	LEAN CLAY (CL)
MR-2	MC-11	54.5	▲	22	34	17	17	LEAN CLAY (CL)
MR-2	MC-15	79.5	★	21	30	19	11	LEAN CLAY (CL)
MR-2	MC-16	89.5	⊙	22	36	19	17	LEAN CLAY (CL)

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

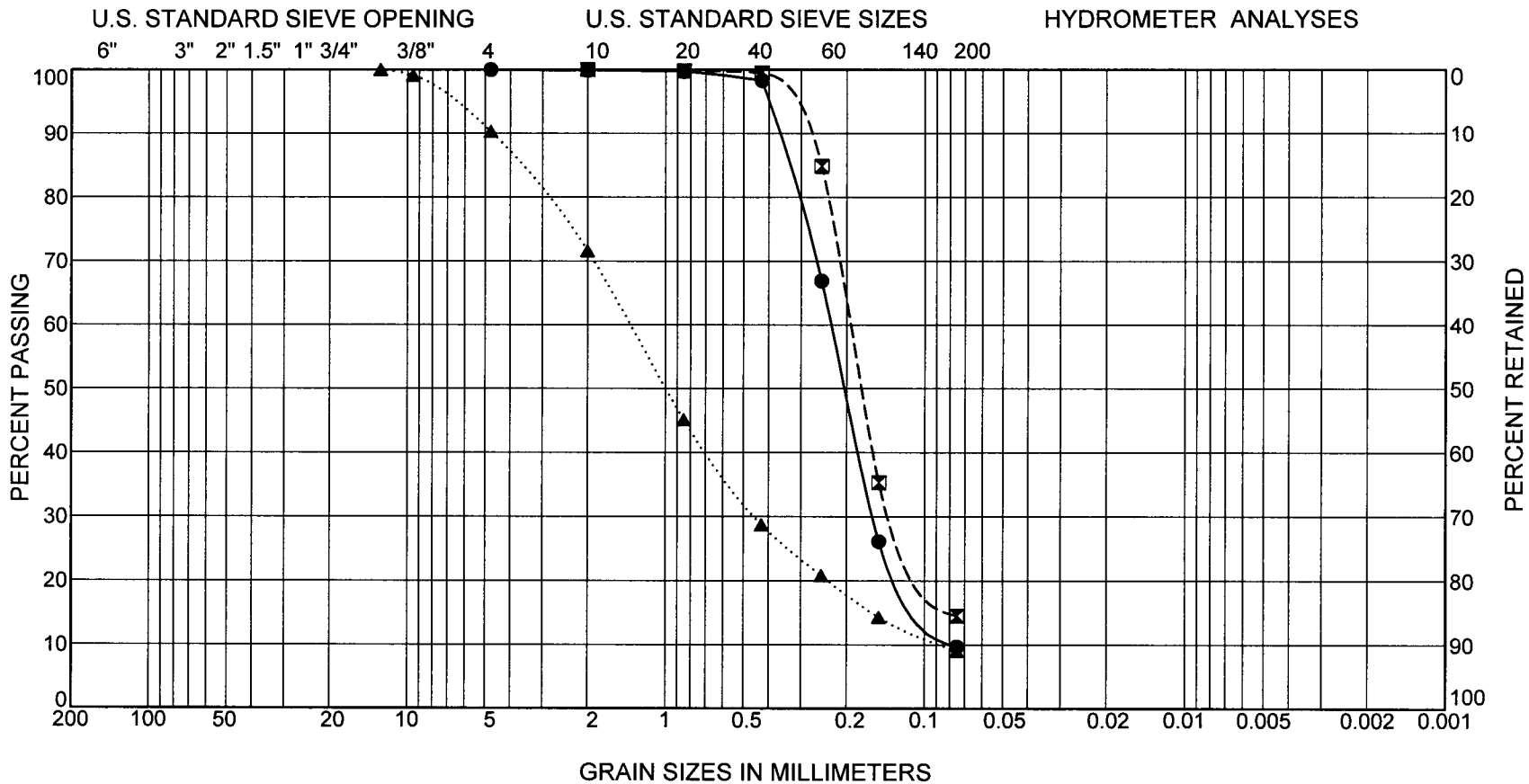
MARINA BLVD. OC (REPLACE)
ALAMEDA COUNTY, CALIFORNIA

JOB NO: 206139.10

PLATE NO: B-2

GRAIN SIZE DISTRIBUTION CURVES

COBBLES	GRAVEL		SAND			SILT AND CLAY
	coarse	fine	coarse	medium	fine	



Boring Number	Sample Number	Depth (feet)	Symbol	LL	PI	Description
MR-2	SPT-6	29.5	●			POORLY-GRADED SAND WITH SILT (SP-SM)
MR-2	MC-8	39.5	⊠			SILTY SAND (SM)
MR-2	MC-12	59.5	▲			WELL-GRADED SAND WITH SILT (SW-SM)

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GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

JOB NO: 206139.10

MARINA BLVD. OC (REPLACE)
ALAMEDA COUNTY, CALIFORNIA

PLATE NO: B-3

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 08/27/2008
Date Submitted 08/20/2008

To: Prav Dayah
Parikh Consultants, Inc.
356 S. Milpitas Blvd.
Milpitas, CA 95035

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager RH

The reported analysis was requested for the following location:
Location : 206139.GDR I-880 Site ID : E4#2@4.5'.
Thank you for your business.

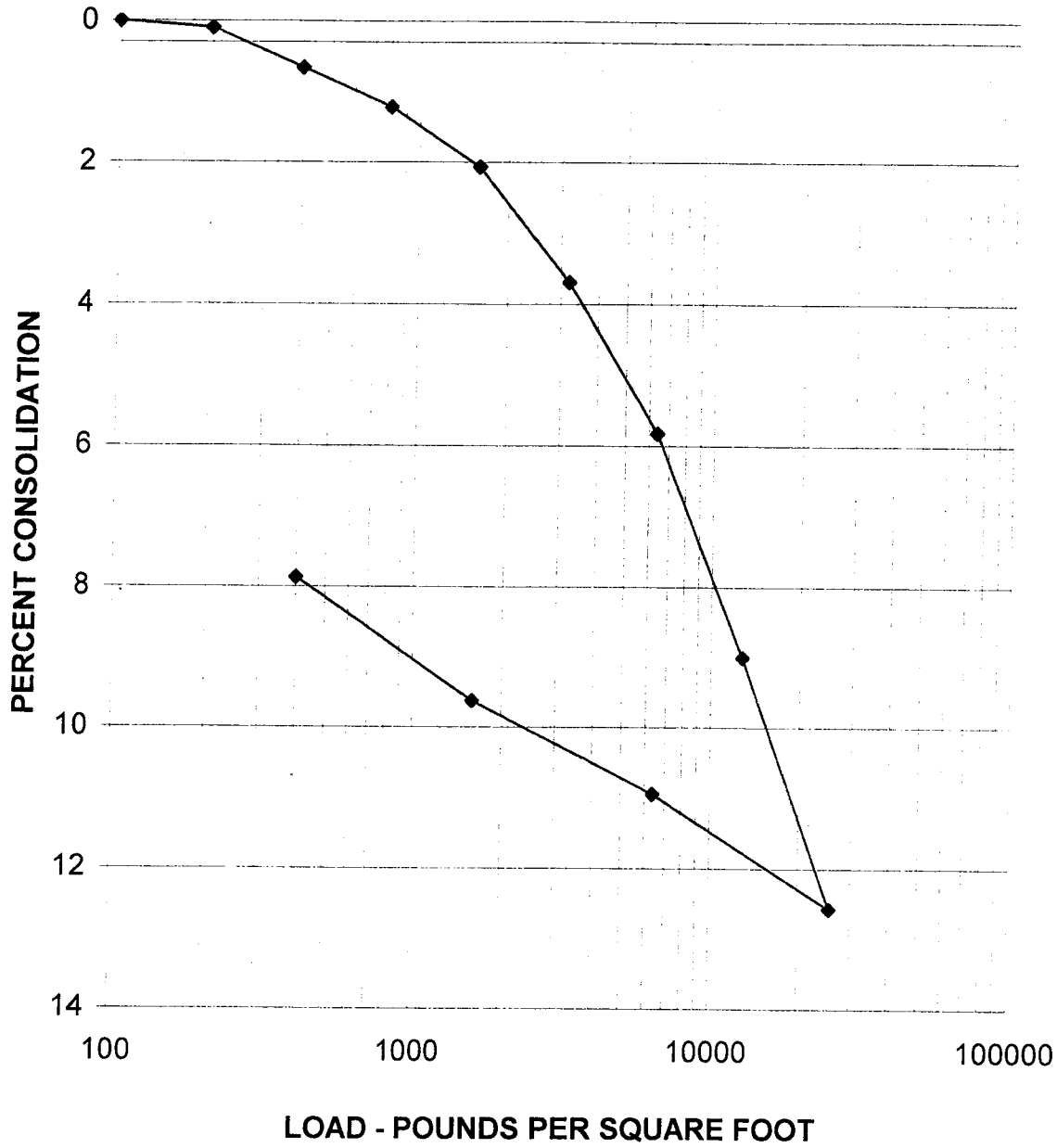
* For future reference to this analysis please use SUN # 54220-108793.

EVALUATION FOR SOIL CORROSION

Soil pH	6.91	
Minimum Resistivity	1.93 ohm-cm (x1000)	
Chloride	38.1 ppm	00.00381 %
Sulfate	133.4 ppm	00.01334 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

CONSOLIDATION TEST RESULTS



	MOISTURE CONTENT %	DRY DENSITY PCF	HEIGHT (INCHES)	DIAMETER (INCHES)
INITIAL	37.2	90.4	1.0000	2.416
FINAL	28.4	98.1	0.9213	2.416

BORING NO.	E-4	SAMPLE NO.	3	ELEV. OR DEPTH	9.5'
DESCRIPTION	Lean clay, brown				

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MATERIALS ENGINEERING

I-880 SB HOV Lane Extension
R & M

DATE	JOB NO:
9/12/08	206139.GDR

Reported by: Prav Dayah

PLATE NO: B-5A

CONSOLIDATION TEST - TIME CURVE

JOB #: 206139.GDR

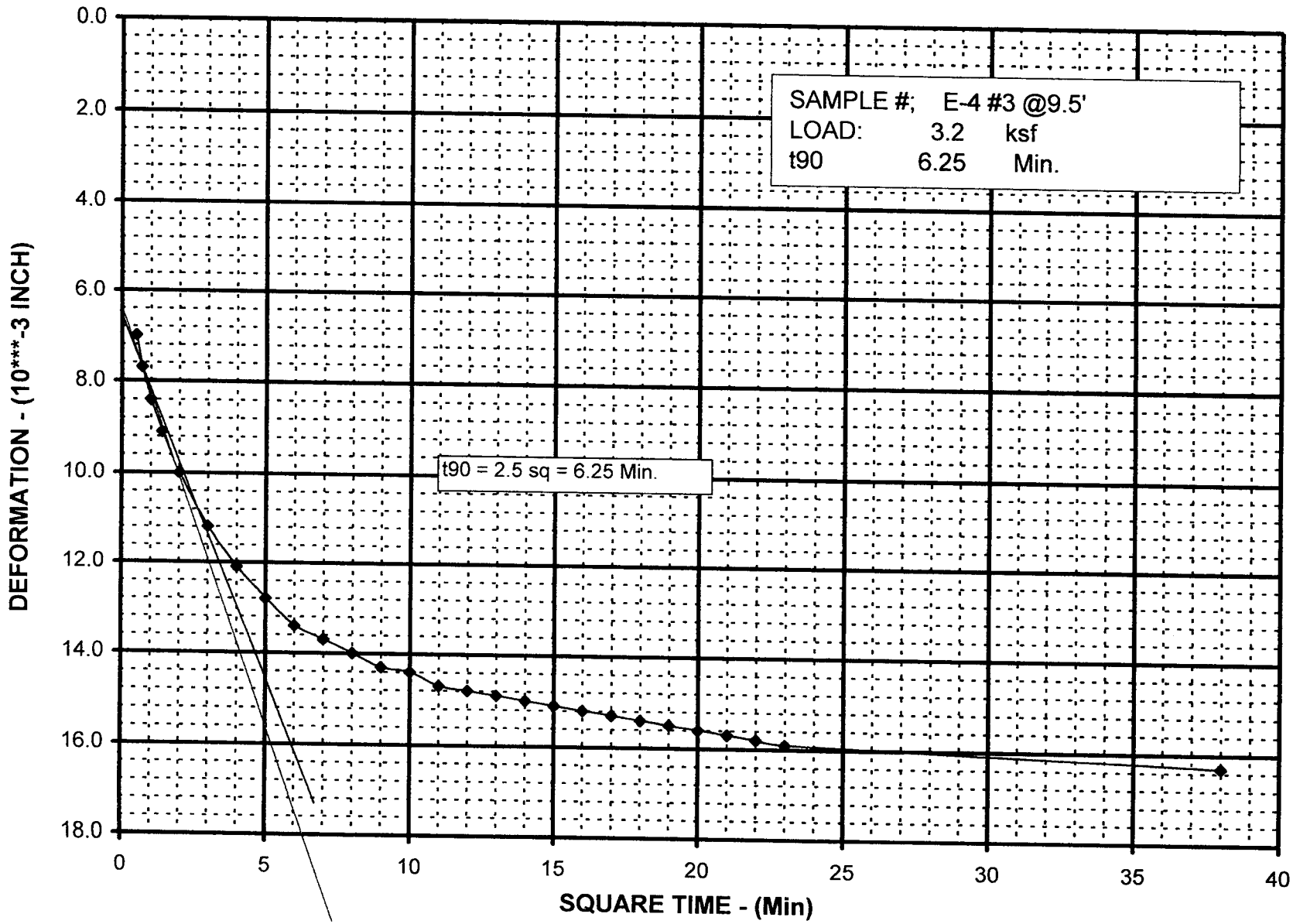


PLATE NO: B-5B

CONSOLIDATION TEST - TIME CURVE

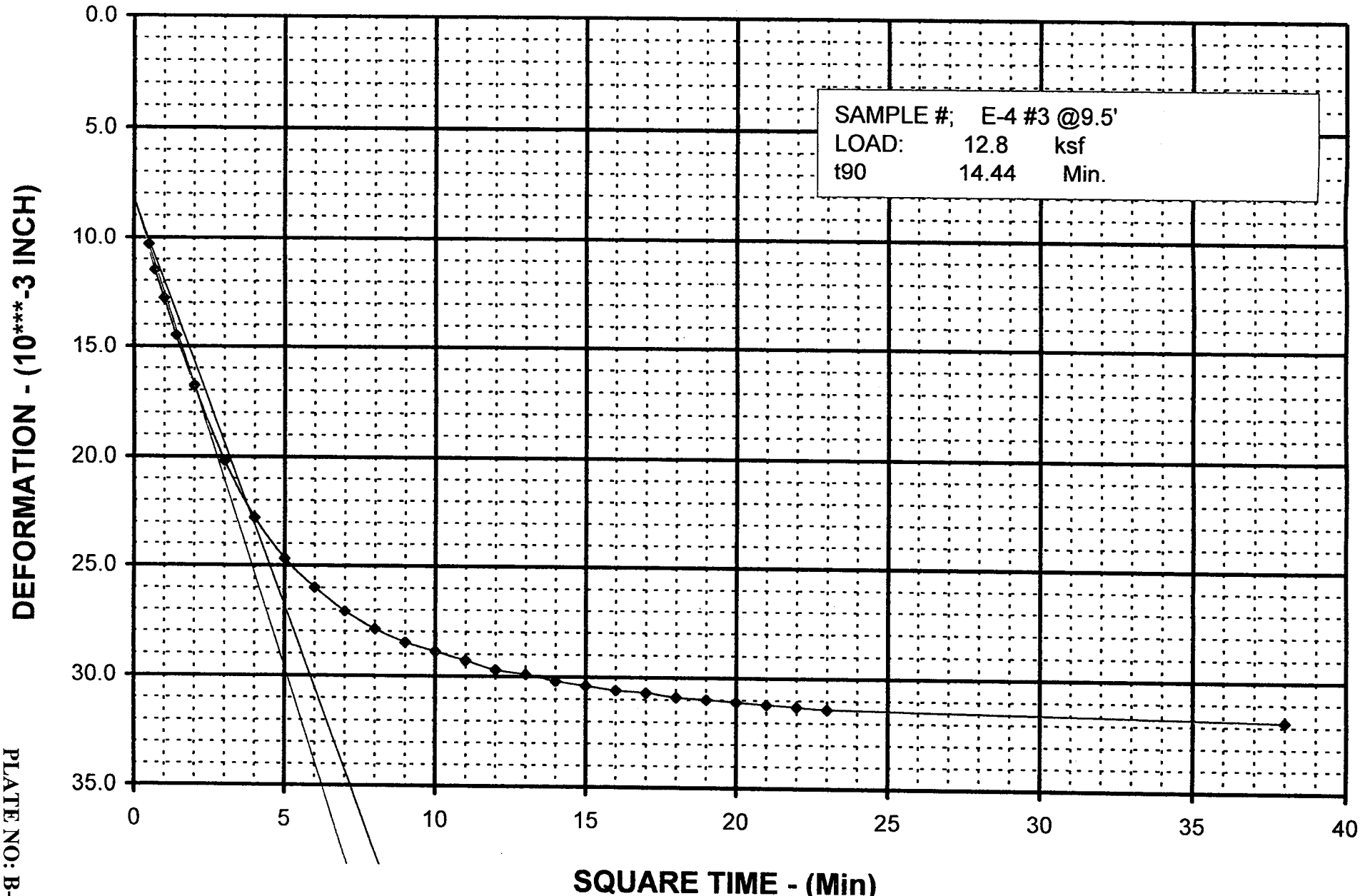
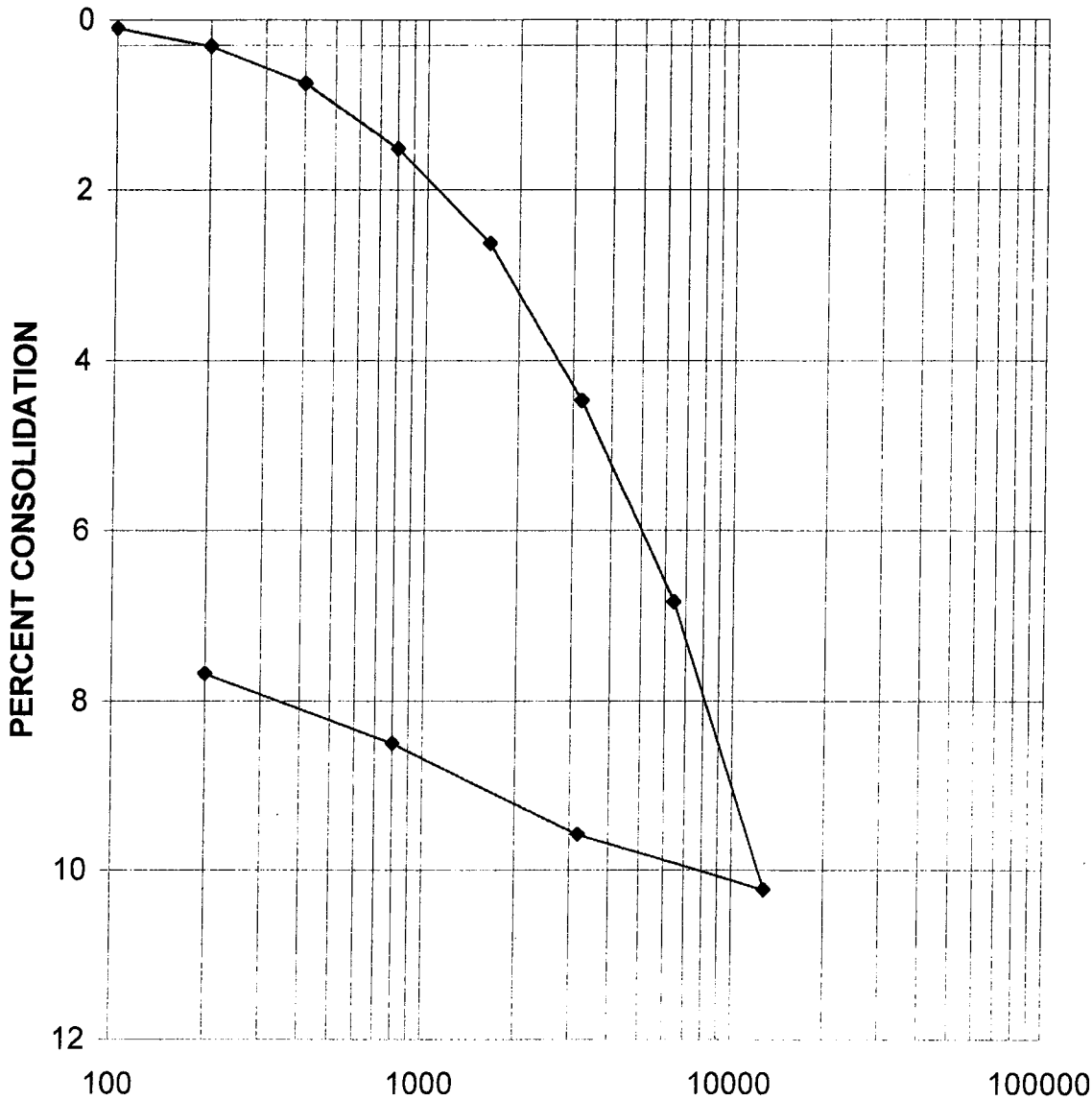


PLATE NO: B-5C

CONSOLIDATION TEST RESULTS



	MOISTURE CONTENT %	DRY DENSITY PCF	HEIGHT (INCHES)	DIAMETER (INCHES)
INITIAL	9.7	98.2	1.0000	2.416
FINAL	22.8	106.3	0.9232	2.416

BORING NO.	E-5	SAMPLE NO.	4	ELEV. OR DEPTH	14.5'
DESCRIPTION	Lean clay, yellowish brown				

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GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

I-880 SB HOV Lane Extension
R & M

DATE	JOB NO:
8/5/08	206139.GDR

Reported by: Prav Dayah

PLATE NO: B-5D

CONSOLIDATION TEST - TIME CURVE

JOB #: 206139.GDR

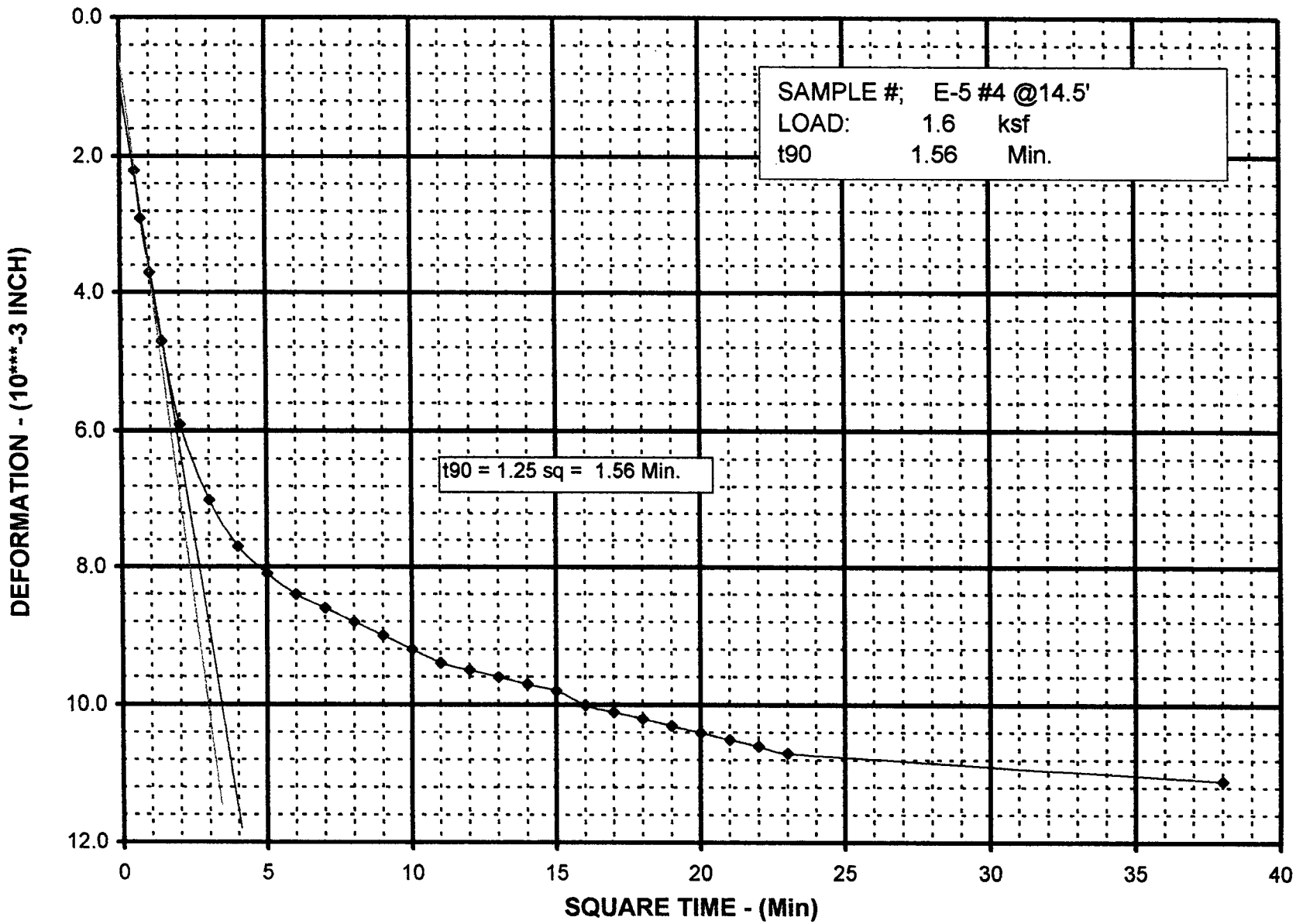


PLATE NO: B-5E

CONSOLIDATION TEST - TIME CURVE

JOB #: 206139.GDR

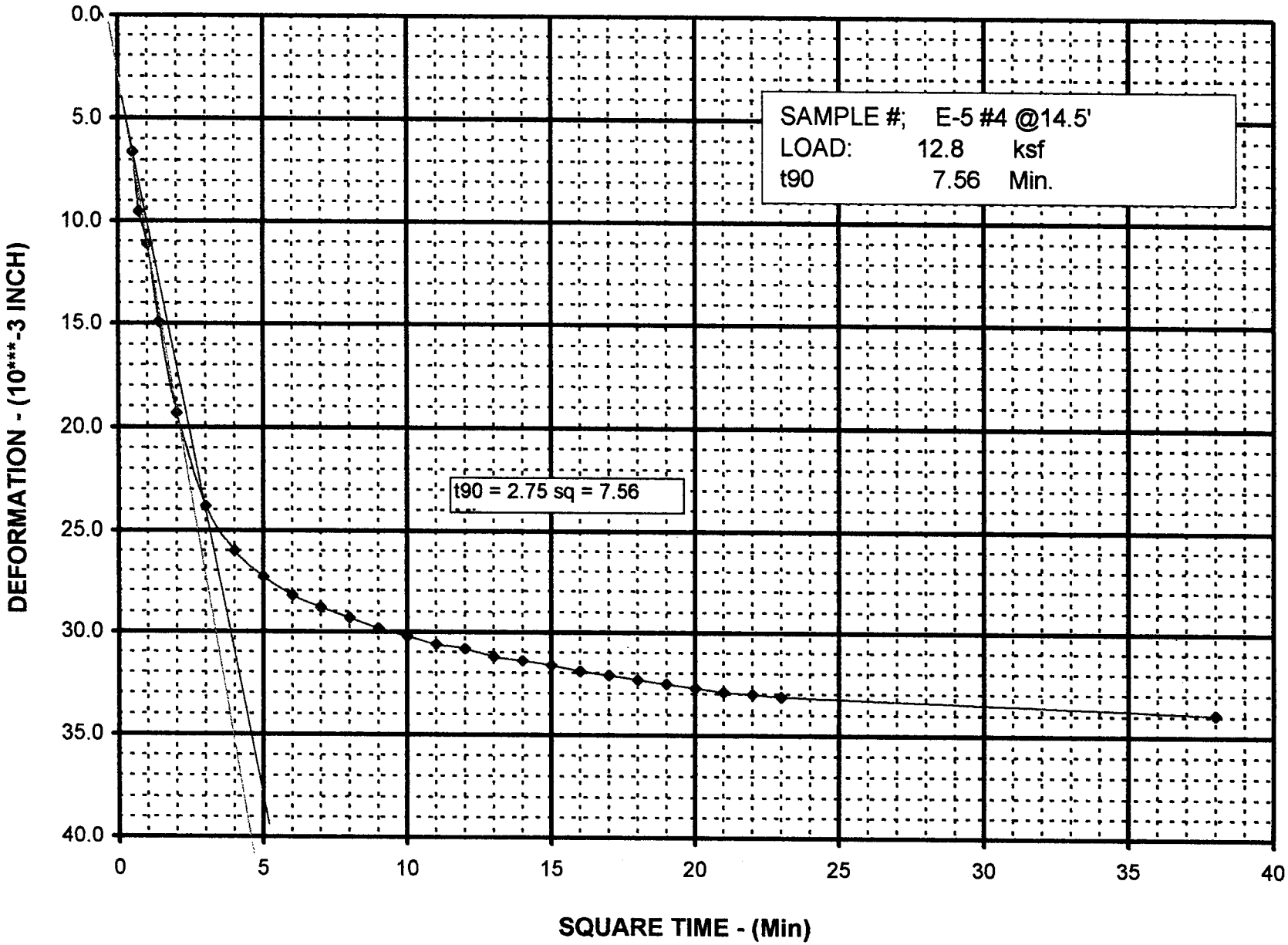


PLATE NO: B-5F

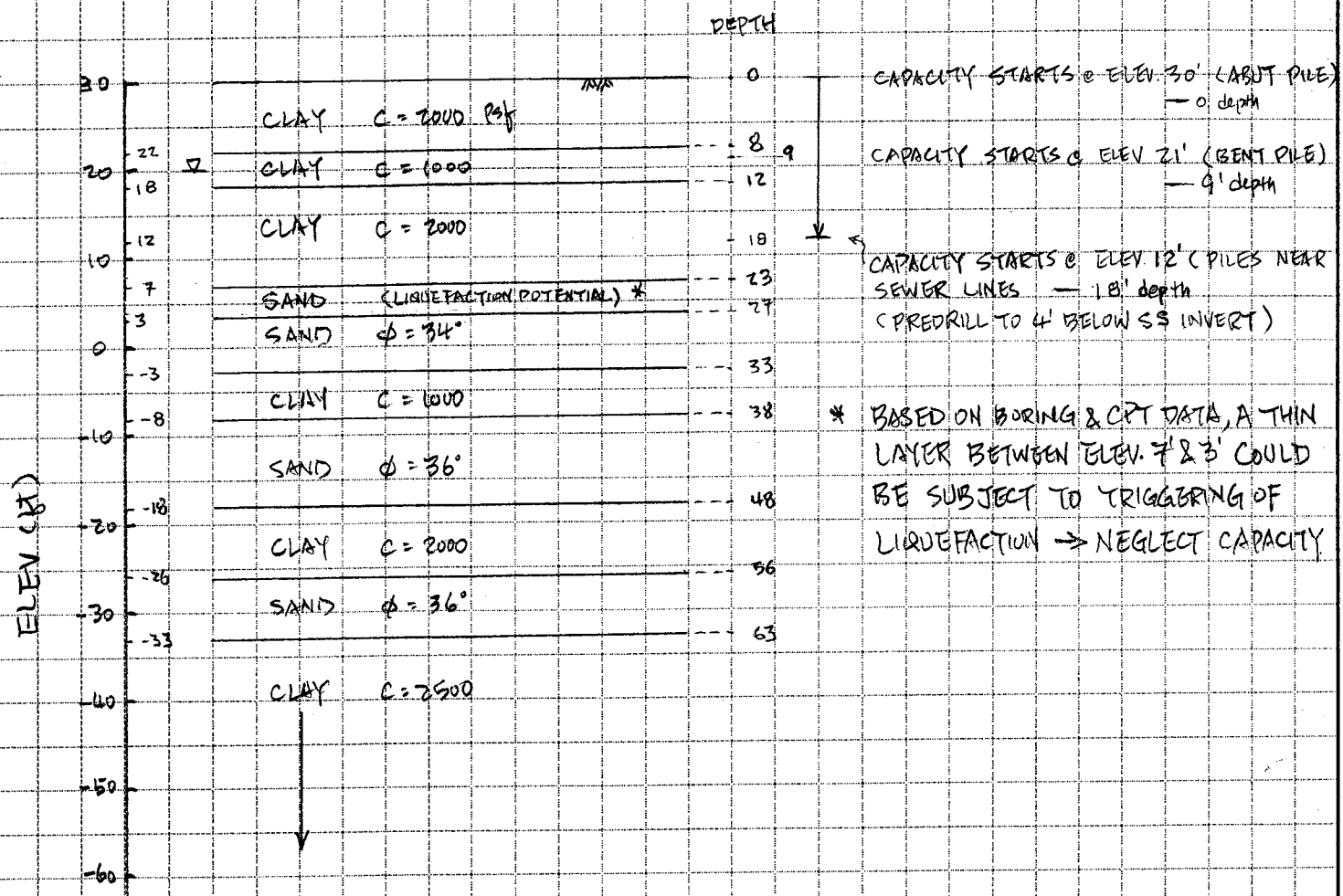
APPENDIX C

APPENDIX C-1

GENERALIZED SOIL PROFILE, STRENGTH PARAMETERS & PILE CAPACITY EVALUATION

MARINA BLVD OC / RTE 880

GENERALIZED SOIL PROFILE & STRENGTH PARAMETERS PER PARIKH (2008) EXPLORATION & CALTRANS AS-BUILT LOTS



DRIVEN PILE CAPACITY -
Design per FHWA Manual

Marina Blvd OC/Route 880 (Abut Piles w/out Predrill)
206139.WMH

ALLOWABLE FRICTIONAL PILE CAPACTY

PILE DIA, B (ft) = 1.33
PILE LENGTH, L (ft) = 70

PILE SHAPE = 1
(1=CIRCLE, 2=SQ., 3=OCT.)
PILE MATERIAL = 2
(1=CONCRETE, 2=STEEL, 3=H PILE)

GROUPS
1. GRAVELS, SANDS AND NONPLASTIC SILTS
2. CLAYS AND PLASTIC SILTS

SOIL TYPES
GRAVEL, SAND, NSILT, CLAY, PSILT

INCREAMENTS (ft)=

F.S. FOR COMPRESSION = 2

F.S. FOR UPLIFT = 1

PERIMETER OF THE PILE (ft) = 4.19
AREA OF THE PILE TIP (ft^2)= 1.40

DEPTH FROM	DEPTH TO	SOIL GROUP	γ' (pcf)	$\Delta\sigma'$ (psf)	σ' (psf)	SOIL TYPE	CONSISTENCY	ϕ (°)	SHEAR STRENGTH PARAMETERS c(psf)	FHWA Manual (Tomlinson, 1980) α	PER SECTION COMP. (Ton)	ALLOWABLE COMPRESSION CAPACITY (Ton)	PER SECTION UPLIFT (Ton)	ULTIMATE UPLIFT CAPACITY (Ton)
OG														
0	8	2	120	960	480	CLAY	STIFF		2000	0.60	10.05	10.05	20.10	20.10
8	9	2	62	62	991	CLAY	MEDIUM		1000	0.90	0.94	10.99	1.88	21.99
9	12	2	62	186	1115	CLAY	MEDIUM		1000	0.90	2.83	13.82	5.65	27.64
12	18	2	62	372	1394	CLAY	STIFF		2000	0.60	7.54	21.36	15.08	42.71
18	20	2	62	124	1642	CLAY	STIFF		2000	0.60	2.51	23.87	5.03	47.74
20	23	2	62	186	1797	CLAY	STIFF		2000	0.60	3.77	27.64	7.54	55.28
23	27	1	62	248	2014	SAND	MED DENSE	34			(Neglect capacity contribution; Driving resistance = 24 kips)			
27	33	1	62	372	2324	SAND	MED DENSE	34			8.99	36.63	8.03	63.31
33	38	2	62	310	2665	CLAY	MEDIUM		1000	1.00	5.23	41.87	10.47	73.78
38	43	1	62	310	2975	SAND	DENSE	36			8.03	49.90	7.18	80.96
43	48	1	62	310	3285	SAND	DENSE	36			7.98	57.88	7.13	88.09
48	56	2	62	496	3688	CLAY	STIFF		2000	1.00	16.75	74.64	33.50	121.59
56	63	1	62	434	4153	SAND	DENSE	36			11.31	85.95	10.11	131.70
63	70	2	62	434	4587	CLAY	V.STIFF		2500	0.80	14.66	100.61	29.31	161.01
70	75	2	62	310	4959	CLAY	V.STIFF		2500	0.80	10.47	111.07	20.94	181.95
75	80	2	62	310	5269	CLAY	V.STIFF		2500	0.80	10.47	121.54	20.94	202.89
80	85	2	62	310	5579	CLAY	V.STIFF		2500	0.80	10.47	132.01	20.94	223.83
85	90	2	62	310	5889	CLAY	V.STIFF		2500	0.60	7.85	139.87	15.70	239.53
90	95	2	62	310	6199	CLAY	V.STIFF		2500	0.60	7.85	147.72	15.70	255.24
95	100	2	62	310	6509	CLAY	V.STIFF		2500	0.60	7.85	155.57	15.70	270.94

For abutment piles not in the vicinity of existing sewer lines, no predrill is required and capacity starts from OG (Elev. 30')
Use 70' pile length below Elev. 30' for 100-Ton Pile. Use Class 200 Alt "W", PP 16 x 0.5.
OG Elev. = 30', Pile Tip Elev. = 30 - 70 = Elev. -40' for service load of 100 Tons per pile at Abuts 1 & 3.

DRIVEN PILE CAPACITY -
Design per FHWA Manual

Marina Blvd OC/Route 880 (Abut Pile with Predrill)
206139.WMH

ALLOWABLE FRICTIONAL PILE CAPACTY

PILE DIA, B (ft) = 1.33
PILE LENGTH, L (ft) = 70

PILE SHAPE = 1
(1=CIRCLE, 2=SQ., 3=OCT.)
PILE MATERIAL = 2
(1=CONCRETE, 2=STEEL, 3=H PILE)

GROUPS
1. GRAVELS, SANDS AND NONPLASTIC SILTS
2. CLAYS AND PLASTIC SILTS

SOIL TYPES
GRAVEL, SAND, NSILT, CLAY, PSILT

INCREAMENTS (ft)=

F.S. FOR COMPRESSION = 2

F.S. FOR UPLIFT = 1

PERIMETER OF THE PILE (ft) = 4.19
AREA OF THE PILE TIP (ft^2)= 1.40

DEPTH FROM	DEPTH TO	SOIL GROUP	γ' (pcf)	$\Delta\sigma'$ (psf)	σ' (psf)	SOIL TYPE	CONSISTENCY	ϕ (°)	SHEAR STRENGTH PARAMETERS c(psf)	FHWA Manual (Tomlinson, 1980) α	PER SECTION COMP. (Ton)	ALLOWABLE COMPRESSION CAPACITY (Ton)	PER SECTION UPLIFT (Ton)	ULTIMATE UPLIFT CAPACITY (Ton)
OG														
0	8	2	120	960	480	CLAY	STIFF		2000	0.60		0.00		0.00
8	9	2	62	62	991	CLAY	MEDIUM		1000	0.90	Predrill to	0.00	Predrill to	0.00
9	12	2	62	186	1115	CLAY	MEDIUM		1000	0.90	Elev. 12' for SS	0.00	Elev. 12' for SS	0.00
12	18	2	62	372	1394	CLAY	STIFF		2000	0.60		0.00		0.00
18	20	2	62	124	1642	CLAY	STIFF		2000	0.60	2.51	2.51	5.03	5.03
20	23	2	62	186	1797	CLAY	STIFF		2000	0.60	3.77	6.28	7.54	12.56
23	27	1	62	248	2014	SAND	MED DENSE	34			(Neglect capacity contribution; Driving resistance =24 kips)			
27	33	1	62	372	2324	SAND	MED DENSE	34			8.99	15.28	8.03	20.60
33	38	2	62	310	2665	CLAY	MEDIUM		1000	1.00	5.23	20.51	10.47	31.07
38	43	1	62	310	2975	SAND	DENSE	36			8.03	28.55	7.18	38.25
43	48	1	62	310	3285	SAND	DENSE	36			7.98	36.53	7.13	45.38
48	56	2	62	496	3688	CLAY	STIFF		2000	1.00	16.75	53.28	33.50	78.88
56	63	1	62	434	4153	SAND	DENSE	36			11.31	64.59	10.11	88.98
63	70	2	62	434	4587	CLAY	V.STIFF		2500	0.80	14.66	79.25	29.31	118.30
70	75	2	62	310	4959	CLAY	V.STIFF		2500	0.80	10.47	89.72	20.94	139.24
75	80	2	62	310	5269	CLAY	V.STIFF		2500	0.80	10.47	100.19	20.94	160.18
80	85	2	62	310	5579	CLAY	V.STIFF		2500	0.80	10.47	110.66	20.94	181.11
85	90	2	62	310	5889	CLAY	V.STIFF		2500	0.60	7.85	118.51	15.70	196.82
90	95	2	62	310	6199	CLAY	V.STIFF		2500	0.60	7.85	126.36	15.70	212.52
95	100	2	62	310	6509	CLAY	V.STIFF		2500	0.60	7.85	134.21	15.70	228.23

There are two existing sewer lines (18" & 21") at the site. The inverts are at Elev. 15.6' (Abut 1), 16' (Bent 2) & 16.3' (Abut 3).
Recommend that piles within 8' of the sewer lines be predrilled to 4 ' below invert prior to pile driving.
Therefore, pile capacity starts from approx. Elev. 12', which is about 18' below OG (Elev. 30').
Use 80' pile length below Elev. 30' for 100-Ton Pile. Use Class 200 Alt "W", PP 16 x 0.5.
OG Elev. = 30', Pile Tip Elev. = 30 - 80 = Elev. -50' for service load of 100 Tons per pile at Abuts 1 & 3.

DRIVEN PILE CAPACITY -
Design per FHWA Manual

PILE DIA, B (ft) = 1.33
PILE LENGTH, L (ft) = 70

PILE SHAPE = 1
(1=CIRCLE, 2=SQ., 3=OCT.)
PILE MATERIAL = 2
(1=CONCRETE, 2=STEEL, 3=H PILE)

Marina Blvd OC/Route 880 (Bent 2 Left - Piles w/out Predrill)
206139.WMH
Reference Borings: MR-1 & MR-2 (Parikh 2008)

GROUPS
1. GRAVELS, SANDS AND NONPLASTIC SILTS
2. CLAYS AND PLASTIC SILTS

SOIL TYPES
GRAVEL, SAND, NSILT, CLAY, PSILT

INCREAMENTS (ft)=

FRICTIONAL PILE CAPACTY

F.S. FOR COMPRESSION = 1

F.S. FOR UPLIFT = 1

PERIMETER OF THE PILE (ft) = 4.19
AREA OF THE PILE TIP (ft^2)= 1.40

DEPTH FROM	DEPTH TO	SOIL GROUP	γ' (pcf)	Δσ' (psf)	σ' (psf)	SOIL TYPE	CONSISTENCY	φ (°)	SHEAR STRENGTH PARAMETERS c(psf)	FHWA Manual (Tomlinson, 1980) α	PER SECTION COMP. (Ton)	ULTIMATE COMPRESSION CAPACITY (Ton)	PER SECTION UPLIFT (Ton)	ULTIMATE UPLIFT CAPACITY (Ton)
OG														
0	8	2	120	960	480	CLAY	STIFF		2000	0.60	Bent ftg	0.00		0.00
8	9	2	62	62	991	CLAY	MEDIUM		1000	0.90	at Elev. 21'	0.00		0.00
9	12	2	62	186	1115	CLAY	MEDIUM		1000	0.90	5.65	5.65	5.65	5.65
12	18	2	62	372	1394	CLAY	STIFF		2000	0.60	15.08	20.73	15.08	20.73
18	20	2	62	124	1642	CLAY	STIFF		2000	0.60	5.03	25.75	5.03	25.75
20	23	2	62	186	1797	CLAY	STIFF		2000	0.60	7.54	33.29	7.54	33.29
23	27	1	62	248	2014	SAND	MED DENSE	34			(Neglect capacity contribution; Driving resistance = 24 kips)			
27	33	1	62	372	2324	SAND	MED DENSE	34			17.99	51.28	8.03	41.33
33	38	2	62	310	2665	CLAY	MEDIUM		1000	1.00	10.47	61.75	10.47	51.80
38	43	1	62	310	2975	SAND	DENSE	36			16.07	77.82	7.18	58.97
43	48	1	62	310	3285	SAND	DENSE	36			15.96	93.78	7.13	66.11
48	56	2	62	496	3688	CLAY	STIFF		2000	1.00	33.50	127.29	33.50	99.61
56	63	1	62	434	4153	SAND	DENSE	36			22.63	149.91	10.11	109.71
63	70	2	62	434	4587	CLAY	V.STIFF		2500	0.80	29.31	179.23	29.31	139.03
70	75	2	62	310	4959	CLAY	V.STIFF		2500	0.80	20.94	200.16	20.94	159.97
75	80	2	62	310	5269	CLAY	V.STIFF		2500	0.80	20.94	221.10	20.94	180.90
80	85	2	62	310	5579	CLAY	V.STIFF		2500	0.80	20.94	242.04	20.94	201.84
85	90	2	62	310	5889	CLAY	V.STIFF		2500	0.60	15.70	257.75	15.70	217.55
90	95	2	62	310	6199	CLAY	V.STIFF		2500	0.60	15.70	273.45	15.70	233.25
95	100	2	62	310	6509	CLAY	V.STIFF		2500	0.60	15.70	289.15	15.70	248.96

For bent piles not in the vicinity of existing sewer lines, no predrill is required and capacity starts from ftg bottom (at Elev. 21')
Use 80' pile length below OG (Elev. 30') for nominal load of 440 kips (220 Tons). Use Class 200 Alt "W", PP 16 x 0.5.
OG Elev. = 30', Pile Tip Elev. = 30 - 80 = Elev. -50' for nominal load of 440 kips per pile at Bent 2 Left.

DRIVEN PILE CAPACITY -
Design per FHWA Manual

Marina Blvd OC/Route 880 (Bent 2 Right - Piles w/out Predrill)
206139.WMH
Reference Borings: MR-1 & MR-2 (Parikh 2008)

FRICTIONAL PILE CAPACTY

PILE DIA, B (ft) = 1.50
PILE LENGTH, L (ft) = 70

PILE SHAPE = 1
(1=CIRCLE, 2=SQ., 3=OCT.)
PILE MATERIAL = 2
(1=CONCRETE, 2=STEEL, 3=H PILE)

GROUPS
1. GRAVELS, SANDS AND NONPLASTIC SILTS
2. CLAYS AND PLASTIC SILTS

SOIL TYPES
GRAVEL, SAND, NSILT, CLAY, PSILT

INCREAMENTS (ft)=

F.S. FOR COMPRESSION = 1

F.S. FOR UPLIFT = 1

PERIMETER OF THE PILE (ft) = 4.71
AREA OF THE PILE TIP (ft^2)= 1.77

DEPTH FROM	DEPTH TO	SOIL GROUP	γ' (pcf)	Δσ' (psf)	σ' (psf)	SOIL TYPE	CONSISTENCY	φ (°)	SHEAR STRENGTH PARAMETERS c(psf)	FHWA Manual (Tomlinson, 1980) α	PER SECTION COMP. (Ton)	ULTIMATE COMPRESSION CAPACITY (Ton)	PER SECTION UPLIFT (Ton)	ULTIMATE UPLIFT CAPACITY (Ton)
	OG													
0	8	2	120	960	480	CLAY	STIFF		2000	0.60	Bent ftg	0.00		0.00
8	9	2	62	62	991	CLAY	MEDIUM		1000	0.90	at Elev. 21'	0.00		0.00
9	12	2	62	186	1115	CLAY	MEDIUM		1000	0.90	6.36	6.36	6.36	6.36
12	18	2	62	372	1394	CLAY	STIFF		2000	0.60	16.96	23.33	16.96	23.33
18	20	2	62	124	1642	CLAY	STIFF		2000	0.60	5.65	28.98	5.65	28.98
20	23	2	62	186	1797	CLAY	STIFF		2000	0.60	8.48	37.46	8.48	37.46
23	27	1	62	248	2014	SAND	MED DENSE	34			(Neglect capacity contribution; Driving resistance = 27 kips)			
27	33	1	62	372	2324	SAND	MED DENSE	34			23.36	60.82	10.43	47.90
33	38	2	62	310	2665	CLAY	MEDIUM		1000	1.00	11.78	72.60	11.78	59.68
38	43	1	62	310	2975	SAND	DENSE	36			20.87	93.47	9.32	69.00
43	48	1	62	310	3285	SAND	DENSE	36			20.73	114.20	9.26	78.26
48	56	2	62	496	3688	CLAY	STIFF		2000	1.00	37.70	151.90	37.70	115.96
56	63	1	62	434	4153	SAND	DENSE	36			29.38	181.28	13.12	129.08
63	70	2	62	434	4587	CLAY	V.STIFF		2500	0.80	32.99	214.26	32.99	162.07
70	75	2	62	310	4959	CLAY	V.STIFF		2500	0.80	23.56	237.82	23.56	185.63
75	80	2	62	310	5269	CLAY	V.STIFF		2500	0.80	23.56	261.39	23.56	209.19
80	85	2	62	310	5579	CLAY	V.STIFF		2500	0.80	23.56	284.95	23.56	232.75
85	90	2	62	310	5889	CLAY	V.STIFF		2500	0.60	17.67	302.62	17.67	250.42
90	92	2	62	124	6106	CLAY	V.STIFF		2500	0.60	7.07	309.69	7.07	257.49
92	100	2	62	496	6416	CLAY	V.STIFF		2500	0.60	28.27	337.96	28.27	285.77

For bent piles not in the vicinity of existing sewer lines, no predrill is required and capacity starts from ftg bottom (at Elev. 21')
Be conservative, assume end bearing in clay to check end bearing. Adopt total capacity from friction capacity plus tipping in clay.
End bearing = 9C Atip = 9*2.5 ksf*1.77 sq. ft = 40 kips = 20 Tons (Ult).
Use 92' pile length below OG (Elev. 30') for nominal load of 657 kips (=460/0.7=329 Tons). Use PP 18 x 0.5.
OG Elev. = 30', Pile Tip Elev. = 30 - 92 = Elev. -62' for nominal load of 657 kips per pile at Bent 2 Right.

DRIVEN PILE CAPACITY -
Design per FHWA Manual

Marina Blvd OC/Route 880 (Bent 2 Right - Pile with Predrill)
206139.WMH

FRICTIONAL PILE CAPACTY

PILE DIA, B (ft) = 1.50
PILE LENGTH, L (ft) = 70

PILE SHAPE = 1
(1=CIRCLE, 2=SQ., 3=OCT.)
PILE MATERIAL = 2
(1=CONCRETE, 2=STEEL, 3=H PILE)

GROUPS
1. GRAVELS, SANDS AND NONPLASTIC SILTS
2. CLAYS AND PLASTIC SILTS

SOIL TYPES
GRAVEL, SAND, NSILT, CLAY, PSILT

INCREAMENTS (ft)=

F.S. FOR COMPRESSION = 1

F.S. FOR UPLIFT = 1

PERIMETER OF THE PILE (ft) = 4.71
AREA OF THE PILE TIP (ft^2)= 1.77

DEPTH FROM	DEPTH TO	SOIL GROUP	γ' (pcf)	$\Delta\sigma'$ (psf)	σ' (psf)	SOIL TYPE	CONSISTENCY	ϕ (°)	SHEAR STRENGTH PARAMETERS c(psf)	FHWA Manual (Tomlinson, 1980) α	PER SECTION COMP. (Ton)	ULTIMATE COMPRESSION CAPACITY (Ton)	PER SECTION UPLIFT (Ton)	ULTIMATE UPLIFT CAPACITY (Ton)
	OG													
0	8	2	120	960	480	CLAY	STIFF		2000	0.60		0.00		0.00
8	9	2	62	62	991	CLAY	MEDIUM		1000	0.90	Predrill to	0.00	Predrill to	0.00
9	12	2	62	186	1115	CLAY	MEDIUM		1000	0.90	Elev. 12' for SS	0.00	Elev. 12' for SS	0.00
12	18	2	62	372	1394	CLAY	STIFF		2000	0.60		0.00		0.00
18	20	2	62	124	1642	CLAY	STIFF		2000	0.60	5.65	5.65	5.65	5.65
20	23	2	62	186	1797	CLAY	STIFF		2000	0.60	8.48	14.14	8.48	14.14
23	27	1	62	248	2014	SAND	MED DENSE	34			(Neglect capacity contribution; Driving resistance =27 kips)			
27	33	1	62	372	2324	SAND	MED DENSE	34			23.36	37.49	10.43	24.57
33	38	2	62	310	2665	CLAY	MEDIUM		1000	1.00	11.78	49.28	11.78	36.35
38	43	1	62	310	2975	SAND	DENSE	36			20.87	70.14	9.32	45.67
43	48	1	62	310	3285	SAND	DENSE	36			20.73	90.87	9.26	54.93
48	56	2	62	496	3688	CLAY	STIFF		2000	1.00	37.70	128.57	37.70	92.63
56	63	1	62	434	4153	SAND	DENSE	36			29.38	157.95	13.12	105.75
63	70	2	62	434	4587	CLAY	V.STIFF		2500	0.80	32.99	190.94	32.99	138.74
70	75	2	62	310	4959	CLAY	V.STIFF		2500	0.80	23.56	214.50	23.56	162.30
75	80	2	62	310	5269	CLAY	V.STIFF		2500	0.80	23.56	238.06	23.56	185.86
80	85	2	62	310	5579	CLAY	V.STIFF		2500	0.80	23.56	261.62	23.56	209.42
85	90	2	62	310	5889	CLAY	V.STIFF		2500	0.60	17.67	279.29	17.67	227.10
90	95	2	62	310	6199	CLAY	V.STIFF		2500	0.60	17.67	296.96	17.67	244.77
95	100	2	62	310	6509	CLAY	V.STIFF		2500	0.60	17.67	314.64	17.67	262.44

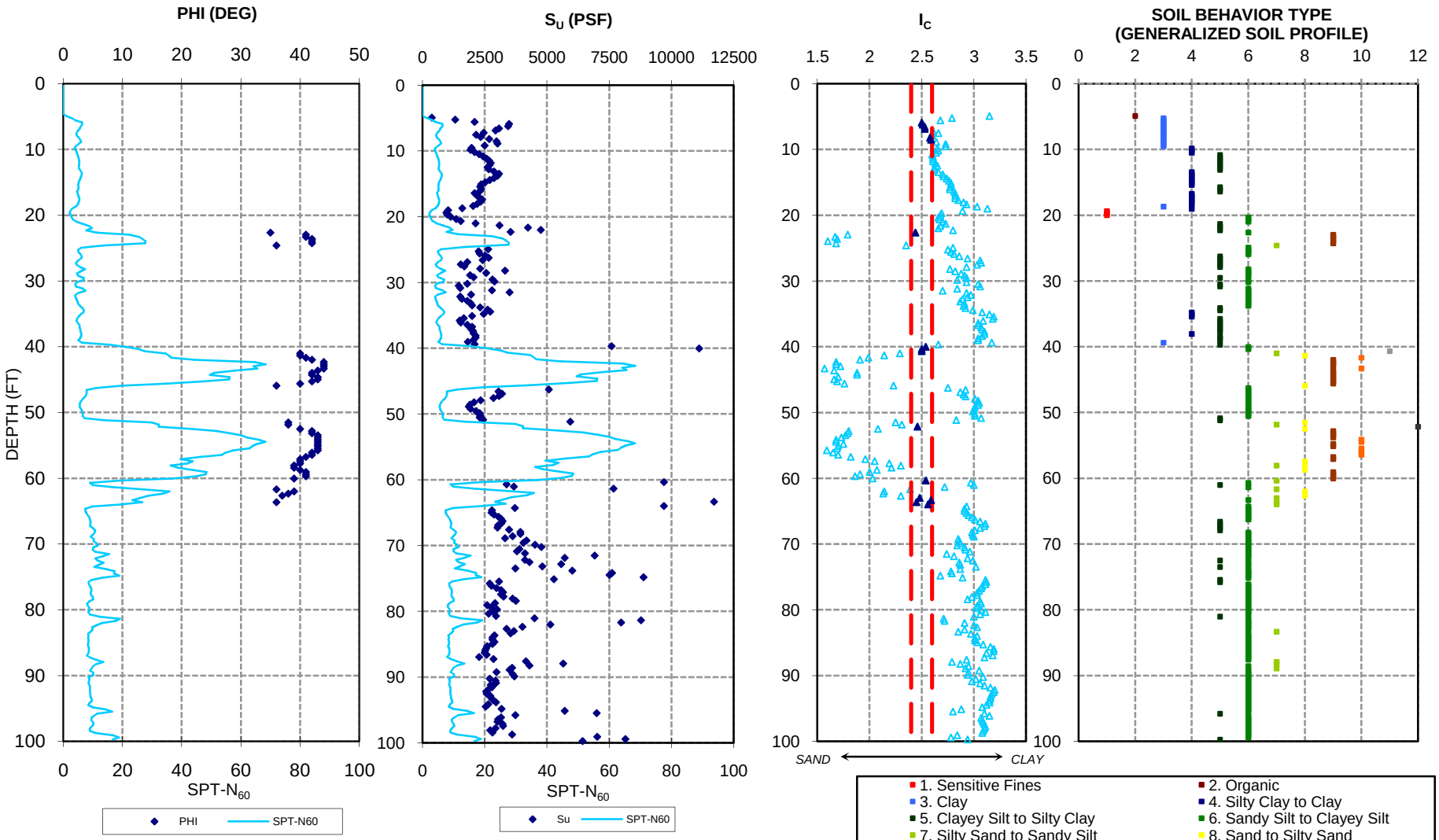
There are two existing sewer lines (18" & 21") at the site. The inverts are at Elev. 15.6' (Abut 1), 16' (Bent 2) & 16.3' (Abut 3).
Recommend that piles within 8' of the sewer lines be predrilled to 4 ' below invert prior to pile driving.
Therefore, pile capacity starts from approx. Elev. 12', which is about 18' below OG (Elev. 30').
Be conservative, assume end bearing in clay to check end bearing. Adopt total capacity from friction capacity plus tipping in clay.
End bearing = 9C Atip = 9*2.5 ksf*1.77 sq. ft = 40 kips = 20 Tons (Ult).
Use 100' pile length below OG (Elev. 30') for nominal load of 657 kips (=460/0.7=329 Tons). Use PP 18 x 0.5.
OG Elev. = 30', Pile Tip Elev. = 30 - 100 = Elev. -70' for nominal load of 657 kips per pile at Bent 2 Right piles with predrill.

APPENDIX C-2

LIQUEFACTION POTENTIAL PER CPT PROCEDURES

CPT DATA CORRELATION

CPT-MR1



Reference: CPT data and correlation provided by Gregg Drilling and Testing, Inc.

PARIKH

Practicing in the Geosciences

MARINA BLVD OC (REPLACE)
ALAMEDA COUNTY, CALIFORNIA

JOB NO.: 206139.MRN

PLATE NO.:

LIQUEFACTION POTENTIAL ANALYSIS (per Youd & Idriss, 2001)

PROJECT NAME	***Marina Blvd OC (Replace)***	*FAULT INFO*	
PROJECT NO.	***206139.MRN***	*COAST RANGE - SIERRAN BLOCK BOUNDARY ZONE (CSB)*	
CPT NO.	***CPT-MR1***	a_{max} *(g)=* 0.6	*FAULT* M_w *=* 7.5
			MSF = 1.00

Depth (ft)		Soil Behavior Type	*CPT RESULT INPUT* qc (tsf)	fs (tsf)	σ_v (tsf)	u (tsf)	σ_v' (tsf)	Ic*	C_N*	*CSR* γ_d	CSR	*$CRR_{7.5}$* Ic	C_Q	q_{c1N}	K_C	$(q_{c1N})_{cs}$	$CRR_{7.5}$	*F.S.=($CRR_{7.5}$/CSR)*MSF*Kσ*Kα* Kσ	Kα	F.S.
0.328									1.7	1.00									1	
0.656									1.7	1.00									1	
0.984									1.7	1.00									1	
1.312									1.7	1.00									1	
1.64									1.7	1.00									1	
1.969									1.7	1.00									1	
2.297									1.7	1.00									1	
2.625									1.7	1.00									1	
2.953									1.7	1.00									1	
3.281									1.7	0.99									1	
3.609									1.7	0.99									1	
3.937									1.7	0.99									1	
4.265									1.7	0.99									1	
4.593									1.7	0.99									1	
4.921	2	Organic	3.089	0.245	0.196		0.196	3.15	1.57593	0.99	0.386							1.00	1	
5.249	3	Clay	10.142	0.806	0.214		0.214	2.79	1.55587	0.99	0.386							1.00	1	
5.577	3	Clay	15.914	1.242	0.232		0.232	2.68	1.53631	0.99	0.386							1.00	1	
5.906	3	Clay	26.272	1.704	0.251		0.251	2.5	1.5162	0.99	0.385	2.500	1.52	39.83	2.768	110.277	0.20	1.00	1	
6.234	3	Clay	26.018	1.612	0.269		0.269	2.51	1.49762	0.99	0.385	2.510	1.50	38.97	2.820	109.862	0.20	1.00	1	
6.562	3	Clay	23.381	1.361	0.287		0.287	2.53	1.47949	0.99	0.385	2.530	1.48	34.59	2.925	101.173	0.18	1.00	1	
6.89	3	Clay	22.327	1.165	0.305		0.305	2.53	1.46179	0.99	0.385	2.530	1.46	32.64	2.925	95.457	0.16	1.00	1	
7.218	3	Clay	18.824	1.028	0.324		0.324	2.61	1.44357	0.99	0.384							1.00	1	
7.546	3	Clay	16.592	0.9	0.342		0.342	2.66	1.42672	0.98	0.384							1.00	1	
7.874	3	Clay	17.92	0.822	0.36		0.36	2.6	1.41026	0.98	0.384							1.00	1	
8.202	3	Clay	20.528	0.956	0.379		0.379	2.58	1.39329	0.98	0.383	2.580	1.39	28.60	3.206	91.709	0.15	1.00	1	
8.53	3	Clay	22.722	1.165	0.397		0.397	2.59	1.37758	0.98	0.383	2.590	1.38	31.30	3.266	102.232	0.18	1.00	1	
8.858	3	Clay	23.071	1.327	0.415		0.415	2.64	1.36223	0.98	0.383							1.00	1	
9.186	3	Clay	19.106	1.183	0.433		0.433	2.73	1.34721	0.98	0.383							1.00	1	
9.514	3	Clay	15.218	0.722	0.452		0.452	2.73	1.33172	0.98	0.382							1.00	1	
9.843	4	Silty Clay to Clay	15.02	0.514	0.47		0.47	2.65	1.31737	0.98	0.382							1.00	1	
10.171	4	Silty Clay to Clay	16.159	0.592	0.489	0.00534	0.489	2.66	1.30255	0.98	0.382							1.00	1	
10.499	4	Silty Clay to Clay	17.562	0.626	0.508	0.01557	0.508	2.64	1.28806	0.98	0.381							1.00	1	
10.827	5	Clayey Silt to Silty Clay	18.72	0.615	0.527	0.0258	0.527	2.6	1.27389	0.98	0.381							1.00	1	
11.155	5	Clayey Silt to Silty Clay	19.85	0.676	0.546	0.03604	0.546	2.61	1.26002	0.98	0.381							1.00	1	
11.483	5	Clayey Silt to Silty Clay	20.632	0.714	0.564	0.04627	0.564	2.61	1.24717	0.98	0.381							1.00	1	
11.811	5	Clayey Silt to Silty Clay	21.037	0.715	0.583	0.0565	0.583	2.61	1.23388	0.98	0.380							1.00	1	
12.139	5	Clayey Silt to Silty Clay	20.792	0.722	0.602	0.06674	0.602	2.63	1.22087	0.97	0.380							1.00	1	
12.467	5	Clayey Silt to Silty Clay	20.124	0.689	0.621	0.07697	0.621	2.65	1.20813	0.97	0.380							1.00	1	
12.795	5	Clayey Silt to Silty Clay	20.481	0.622	0.64	0.0872	0.64	2.62	1.19565	0.97	0.380							1.00	1	
13.123	5	Clayey Silt to Silty Clay	22.176	0.732	0.658	0.09744	0.658	2.62	1.18407	0.97	0.379							1.00	1	
13.451	4	Silty Clay to Clay	23.702	0.924	0.677	0.10767	0.677	2.66	1.17208	0.97	0.379							1.00	1	
13.78	4	Silty Clay to Clay	23.316	0.986	0.696	0.11794	0.696	2.7	1.16034	0.97	0.379							1.00	1	
14.108	4	Silty Clay to Clay	22.242	0.916	0.715	0.12817	0.715	2.71	1.14883	0.97	0.378							1.00	1	
14.436	4	Silty Clay to Clay	20.924	0.849	0.734	0.1384	0.734	2.74	1.13754	0.97	0.378							1.00	1	
14.764	4	Silty Clay to Clay	19.549	0.774	0.752	0.14864	0.752	2.76	1.12705	0.97	0.378							1.00	1	
15.092	4	Silty Clay to Clay	18.408	0.686	0.771	0.15887	0.771	2.78	1.11618	0.97	0.378							1.00	1	
15.42	4	Silty Clay to Clay	18.024	0.644	0.79	0.1691	0.79	2.78	1.10553	0.97	0.377							1.00	1	
15.748	5	Clayey Silt to Silty Clay	18.41	0.638	0.809	0.17934	0.809	2.77	1.09507	0.97	0.377							1.00	1	
16.076	5	Clayey Silt to Silty Clay	18.09	0.597	0.828	0.18957	0.828	2.77	1.08481	0.97	0.377							1.00	1	
16.404	5	Clayey Silt to Silty Clay	16.536	0.535	0.846	0.1998	0.846	2.81	1.07527	0.97	0.377							1.00	1	
16.732	4	Silty Clay to Clay	17.044	0.584	0.865	0.21004	0.865	2.82	1.06538	0.96	0.376							1.00	1	
17.06	4	Silty Clay to Clay	17.91	0.632	0.884	0.22027	0.884	2.82	1.05566	0.96	0.376							1.00	1	
17.388	4	Silty Clay to Clay	18.749	0.682	0.903	0.23051	0.903	2.82	1.04612	0.96	0.376							1.00	1	
17.717	4	Silty Clay to Clay	18.344	0.709	0.922	0.24077	0.922	2.85	1.03676	0.96	0.375							1.00	1	
18.045	4	Silty Clay to Clay	17.336	0.714	0.94	0.251	0.94	2.9	1.02804	0.96	0.375							1.00	1	
18.373	4	Silty Clay to Clay	16.131	0.667	0.959	0.26124	0.959	2.93	1.01899	0.96	0.375							1.00	1	
18.701	3	Clay	12.919	0.545	0.977	0.27147	0.977	3.03	1.01056	0.96	0.374							1.00	1	
19.029	4	Silty Clay to Clay	8.701	0.284	0.996	0.2817	0.996	3.13	1.00182	0.96	0.374							1.00	1	
19.357	1	Sensitive Fines	8.155	0.072	1.015	0.29194	1.015	2.89	0.99323	0.96	0.374							1.00	1	
19.685	1	Sensitive Fines	8.38	0.02	1.033	0.30217	1.033	2.69	0.98522	0.96	0.374							0.99	1	
20.013	1	Sensitive Fines	9.435	0.031	1.051	0.31241	1.051	2.68	0.97734	0.96	0.373							0.99	1	
20.341	6	Sandy Silt to Clayey Silt	11.187	0.052	1.07	0.32264	1.07	2.66	0.96916	0.96	0.373							0.99	1	
20.669	6	Sandy Silt to Clayey Silt	12.581	0.086	1.089	0.33287	1.089	2.67	0.96112	0.96	0.373							0.98	1	
20.997	6	Sandy Silt to Clayey Silt	17.054	0.247	1.107	0.34311	1.107	2.7	0.95362	0.95	0.372							0.98	1	
21.325	5	Clayey Silt to Silty Clay	24.22	0.667	1.126	0.35334	1.126	2.73	0.94583	0.95	0.372							0.98	1	
21.654	5	Clayey Silt to Silty Clay	32.864	1.097	1.145	0.3636	1.145	2.68	0.93817	0.95	0.371							0.97	1	
21.982	5	Clayey Silt to Silty Clay	36.716	1.29	1.164	0.37384	1.164	2.66	0.93063	0.95	0.371							0.97	1	
22.31	5	Clayey Silt to Silty Clay	27.638	1.077	1.183	0.38407	1.183	2.8	0.92321	0.95	0.371							0.97	1	
22.638	6	Sandy Silt to Clayey Silt	48.204	1.037	1.201	0.39431	1.201	2.44	0.91628	0.95	0.370	2.440	0.92	44.17	2.483	109.677	0.20	0.96	1	0.55
22.966	9	Sand	123.218	0.771	1.222	0.40454	1.222	1.79	0.90834	0.95	0.370	1.790	0.91	111.92	1.099	123.054	0.25	0.95	1	0.68
23.294	9	Sand	146.863	0.722	1.242	0.41477	1.242	1.67	0.9009	0.95	0.370	1.670	0.90	132.31	1.017	134.608	0.31	0.94	1	0.83
23.622	9	Sand	152.344	0.83	1.263	0.42501	1.263	1.69	0.89322	0.95	0.369	1.690	0.89	136.08	1.031	140.306	0.34	0.93	1	0.91
23.95	9	Sand	163.201	0.648	1.283	0.43524	1.283	1.6	0.88602	0.95	0.369	1.600	0.89	144.60	1.000	144.600	0.36	0.92	1	0.98
24.278	9	Sand	157.617	0.837	1.303	0.44547	1.303	1.68	0.87895	0.94	0.368	1.680	0.88	138.54	1.024	141.898	0.35	0.92	1	0.94
24.606	7	Silty Sand to Sandy Silt	59.061	1.024	1.323	0.45571	1.323	2.35	0.87198	0.94	0.368	2.350	0.87	51.50	2.120	109.162	0.20	0.95	1	0.55
24.934	6	Sandy Silt to Clayey Silt	21.159	0.48	1.341	0.46594	1.341	2.8	0.8658	0.94	0.367							0.94	1	
25.262	6	Sandy Silt to Clayey Silt	18.231	0.243	1.36	0.47617	1.36	2.75	0.85938	0.94	0.367							0.94	1	
25.591	6	Sandy Silt to Clayey Silt	18.589	0.291	1.379	0.48644	1.379	2.78	0.85304	0.94	0.366							0.94	1	
25.919	6	Sandy Silt to Clayey Silt	20.199	0.401	1.398	0.49667	1.398	2.81	0.84681	0.94	0.366							0.94	1	
26.247	5	Clayey Silt to Silty Clay	21.291	0.557	1.417	0.50691	1.417	2.86	0.84066	0.94	0.366							0.93	1	
26.575	5	Clayey Silt to Silty Clay	19.502	0.602	1.435	0.51714	1.435	2.94	0.83491	0.94	0.365							0.93	1	
26.903	5	Clayey Silt to Silty Clay	14.944	0.473	1.454	0.52737	1.454	3.06	0.82894	0.93	0.365							0.93	1	
27.231	5	Clayey Silt to Silty Clay	12.929	0.327	1.473	0.53761	1.466	3.07	0.82521	0.93	0.366							0.93	1	
27.559	5	Clayey Silt to Silty Clay	14.097	0.35	1.492	0.54784	1.475	3.03	0.82243	0.93	0.368							0.93	1	
27.887	5	Clayey Silt to Silty Clay	18.786	0.5	1.511	0.55807	1.483	2.93	0.81998	0.93	0.370							0.92	1	
28.215	6	Sandy Silt to Clayey Silt	26.339	0.613	1.529	0.56831	1.492	2.77	0.81724	0.93	0.371							0.92	1	
28.543	6	Sandy Silt to Clayey Silt	20.688	0.394	1.548	0.57854	1.5	2.82	0.81481	0.93	0.373							0.92	1	
28.871	6	Sandy Silt to Clayey Silt	15.867	0.241	1.567	0.58878	1.509	2.88	0.81211	0.93	0.375							0.92	1	
29.199	6	Sandy Silt to Clayey Silt	16.94	0.329	1.586	0.59901	1.517	2.91	0.80972	0.92	0.377							0.92	1	
29.528	5	Clayey Silt to Silty Clay	22.732	0.769	1.605	0.60927	1.526	2.93	0.80704	0.92	0.379							0.92	1	
29.856	6	Sandy Silt to Clayey Silt	23.25	0.569	1.623	0.61951	1.534	2.84	0.80468	0.92	0.380							0.92	1	
30.184	6	Sandy Silt to Clayey Silt	15.019	0.247	1.642	0.62974	1.543	2.93	0.80204	0.92	0.382							0.92	1	
30.512	5	Clayey Silt to Silty Clay	12.562	0.235	1.661	0.63997	1.552	3.04	0.79942	0.92	0.383							0.92	1	

LIQUEFACTION POTENTIAL ANALYSIS (per Youd & Idriss, 2001)

PROJECT NAME	***Marina Blvd OC (Replace)***	*FAULT INFO*	
PROJECT NO.	***206139.MRN***	*COAST RANGE - SIERRAN BLOCK BOUNDARY ZONE (CSB)*	
CPT NO.	***CPT-MR1***	*a_{max} (g)=* 0.6	*FAULT M_w =* 7.5
			MSF = 1.00

		CPT RESULT INPUT							*CSR*		*$CRR_{7.5}$*						*F.S.=($CRR_{7.5}$/CSR)*MSF*K_σ*K_α*		
Depth (ft)		Soil Behavior Type	qc (tsf)	fs (tsf)	σ_v (tsf)	u (tsf)	σ_v' (tsf)	Ic*	C_N*	γ_d	CSR	Ic	C_Q	q_{c1N}	K_C	$(q_{c1N})_{cs}$	$CRR_{7.5}$	$K\sigma$	$K\alpha$	F.S.
30.84	5	Clayey Silt to Silty Clay	12.901	0.273	1.68	0.65021	1.56	3.06	0.7971	0.92	0.385							0.91	1	
31.168	6	Sandy Silt to Clayey Silt	22.516	0.503	1.699	0.66044	1.569	2.84	0.79451	0.91	0.386							0.91	1	
31.496	6	Sandy Silt to Clayey Silt	27.836	0.488	1.717	0.67068	1.577	2.7	0.79222	0.91	0.388							0.91	1	
31.824	6	Sandy Silt to Clayey Silt	16.253	0.298	1.736	0.68091	1.586	2.93	0.78966	0.91	0.389							0.91	1	
32.152	6	Sandy Silt to Clayey Silt	13.061	0.173	1.755	0.69114	1.594	2.97	0.7874	0.91	0.390							0.91	1	
32.48	6	Sandy Silt to Clayey Silt	13.532	0.166	1.774	0.70138	1.603	2.94	0.78487	0.91	0.391							0.91	1	
32.808	6	Sandy Silt to Clayey Silt	15.189	0.192	1.792	0.71161	1.611	2.89	0.78264	0.90	0.393							0.91	1	
33.136	6	Sandy Silt to Clayey Silt	16.206	0.213	1.811	0.72184	1.62	2.87	0.78014	0.90	0.394							0.91	1	
33.465	6	Sandy Silt to Clayey Silt	16.602	0.27	1.83	0.73211	1.629	2.91	0.77766	0.90	0.395							0.91	1	
33.793	6	Sandy Silt to Clayey Silt	19.069	0.376	1.849	0.74234	1.637	2.9	0.77547	0.90	0.396							0.91	1	
34.121	5	Clayey Silt to Silty Clay	21.301	0.559	1.868	0.75258	1.646	2.92	0.77301	0.90	0.397							0.91	1	
34.449	5	Clayey Silt to Silty Clay	22.054	0.805	1.886	0.76281	1.654	2.99	0.77085	0.89	0.398							0.90	1	
34.777	4	Silty Clay to Clay	20.142	0.888	1.905	0.77304	1.663	3.08	0.76842	0.89	0.399							0.90	1	
35.105	4	Silty Clay to Clay	16.677	0.696	1.924	0.78328	1.671	3.15	0.76628	0.89	0.400							0.90	1	
35.433	4	Silty Clay to Clay	14.266	0.541	1.943	0.79351	1.68	3.19	0.76389	0.89	0.400							0.90	1	
35.761	5	Clayey Silt to Silty Clay	13.089	0.4	1.962	0.80374	1.689	3.18	0.76151	0.89	0.401							0.90	1	
36.089	5	Clayey Silt to Silty Clay	13.324	0.277	1.98	0.81398	1.697	3.09	0.75941	0.88	0.402							0.90	1	
36.417	5	Clayey Silt to Silty Clay	15.246	0.329	1.999	0.82421	1.706	3.04	0.75705	0.88	0.402							0.90	1	
36.745	5	Clayey Silt to Silty Clay	16.771	0.428	2.018	0.83444	1.714	3.04	0.75498	0.88	0.403							0.90	1	
37.073	5	Clayey Silt to Silty Clay	16.573	0.476	2.037	0.84468	1.723	3.07	0.75265	0.88	0.404							0.90	1	
37.402	5	Clayey Silt to Silty Clay	17.119	0.542	2.056	0.85494	1.731	3.08	0.7506	0.87	0.404							0.90	1	
37.73	5	Clayey Silt to Silty Clay	17.355	0.596	2.074	0.86518	1.74	3.1	0.7483	0.87	0.405							0.90	1	
38.058	4	Silty Clay to Clay	17.939	0.635	2.093	0.87541	1.748	3.1	0.74627	0.87	0.405							0.89	1	
38.386	5	Clayey Silt to Silty Clay	17.92	0.591	2.112	0.88564	1.757	3.08	0.744	0.86	0.405							0.89	1	
38.714	5	Clayey Silt to Silty Clay	17.383	0.46	2.131	0.89588	1.766	3.04	0.74174	0.86	0.406							0.89	1	
39.042	5	Clayey Silt to Silty Clay	15.613	0.325	2.15	0.90611	1.774	3.04	0.73974	0.86	0.406							0.89	1	
39.37	3	Clay	17.751	0.781	2.168	0.91634	1.782	3.17	0.73776	0.86	0.406							0.89	1	
39.698	5	Clayey Silt to Silty Clay	59.071	2.135	2.187	0.92658	1.791	2.66	0.73554	0.85	0.407							0.89	1	
40.026	6	Sandy Silt to Clayey Silt	85.57	3.081	2.206	0.93681	1.799	2.54	0.73358	0.85	0.407	2.540	0.73	62.77	2.979	186.997		0.89	1	
40.354	6	Sandy Silt to Clayey Silt	104.318	4.009	2.224	0.94704	1.808	2.5	0.73138	0.85	0.407	2.500	0.73	76.30	2.768	211.222		0.89	1	
40.682	11	Stiff Fine-Grained	112.803	4.654	2.246	0.95728	1.819	2.5	0.72872	0.84	0.407	2.500	0.73	82.20	2.768	227.570		0.89	1	
41.011	7	Silty Sand to Sandy Silt	155.809	4.58	2.265	0.96754	1.828	2.29	0.72655	0.84	0.407	2.290	0.73	113.20	1.917	217.016		0.85	1	
41.339	8	Sand to Silty Sand	171.404	3.362	2.285	0.97778	1.838	2.14	0.72416	0.84	0.407	2.140	0.72	124.12	1.532	190.153		0.84	1	
41.667	10	Gravelly Sand to Sand	186.235	2.455	2.306	0.98801	1.848	1.99	0.72178	0.84	0.407	1.990	0.72	134.42	1.287	173.022		0.83	1	
41.995	9	Sand	232.932	2.95	2.326	0.99824	1.859	1.91	0.71919	0.83	0.406	1.910	0.72	167.52	1.198	200.760		0.81	1	
42.323	9	Sand	368.062	3.504	2.346	1.00848	1.869	1.68	0.71685	0.83	0.406	1.680	0.72	263.84	1.024	270.245		0.78	1	
42.651	9	Sand	390.936	3.859	2.367	1.01871	1.879	1.68	0.71452	0.83	0.406	1.680	0.71	279.33	1.024	286.108		0.78	1	
42.979	9	Sand	361.537	3.821	2.387	1.02894	1.889	1.72	0.7122	0.82	0.406	1.720	0.71	257.49	1.051	270.705		0.78	1	
43.307	10	Gravelly Sand to Sand	388.657	2.649	2.408	1.03918	1.9	1.57	0.70968	0.82	0.405	1.570	0.71	275.82	1.000	275.821		0.77	1	
43.635	9	Sand	332.684	2.594	2.428	1.04941	1.91	1.66	0.7074	0.82	0.405	1.660	0.71	235.34	1.010	237.788		0.77	1	
43.963	9	Sand	270.863	3.536	2.449	1.05965	1.92	1.88	0.70513	0.81	0.405	1.880	0.71	190.99	1.171	223.571		0.79	1	
44.291	9	Sand	264.13	3.249	2.469	1.06988	1.93	1.88	0.70288	0.81	0.404	1.880	0.70	185.65	1.171	217.317		0.79	1	
44.619	9	Sand	318.464	2.662	2.49	1.08011	1.94	1.7	0.70064	0.81	0.404	1.700	0.70	223.13	1.038	231.575		0.77	1	
44.948	9	Sand	321.883	2.341	2.51	1.09038	1.95	1.66	0.69841	0.80	0.404	1.660	0.70	224.81	1.010	227.146		0.77	1	
45.276	9	Sand	268.584	1.742	2.53	1.10061	1.96	1.69	0.6962	0.80	0.403	1.690	0.70	186.99	1.031	192.801		0.78	1	
45.604	9	Sand	191.772	1.008	2.551	1.11084	1.97	1.76	0.69401	0.80	0.403	1.760	0.69	133.09	1.078	143.530	0.35	0.82	1	0.88
45.932	8	Sand to Silty Sand	91.229	1.03	2.57	1.12108	1.98	2.23	0.69182	0.79	0.402	2.230	0.69	63.11	1.743	110.038	0.20	0.87	1	0.51
46.26	6	Sandy Silt to Clayey Silt	40.85	1.061	2.589	1.13131	1.989	2.75	0.68987	0.79	0.402							0.87	1	
46.588	6	Sandy Silt to Clayey Silt	25.82	0.614	2.608	1.14155	1.997	2.92	0.68815	0.79	0.401							0.87	1	
46.916	6	Sandy Silt to Clayey Silt	26.885	0.55	2.627	1.15178	2.006	2.87	0.68621	0.78	0.401							0.87	1	
47.244	6	Sandy Silt to Clayey Silt	25.915	0.575	2.646	1.16201	2.014	2.9	0.68451	0.78	0.400							0.87	1	
47.572	6	Sandy Silt to Clayey Silt	24.304	0.512	2.664	1.17225	2.023	2.92	0.68259	0.78	0.399							0.87	1	
47.9	6	Sandy Silt to Clayey Silt	20.509	0.441	2.683	1.18248	2.031	3.01	0.6809	0.77	0.399							0.87	1	
48.228	6	Sandy Silt to Clayey Silt	18.56	0.381	2.702	1.19271	2.04	3.04	0.67901	0.77	0.398							0.87	1	
48.556	6	Sandy Silt to Clayey Silt	17.412	0.313	2.721	1.20295	2.049	3.05	0.67713	0.77	0.397							0.87	1	
48.885	6	Sandy Silt to Clayey Silt	16.865	0.275	2.74	1.21321	2.057	3.04	0.67547	0.76	0.397							0.87	1	
49.213	6	Sandy Silt to Clayey Silt	17.59	0.269	2.758	1.22345	2.066	3.01	0.67361	0.76	0.396							0.86	1	
49.541	6	Sandy Silt to Clayey Silt	19.2	0.33	2.777	1.23368	2.074	3	0.67196	0.76	0.396							0.86	1	
49.869	6	Sandy Silt to Clayey Silt	20.264	0.384	2.796	1.24391	2.083	2.99	0.67012	0.75	0.395							0.86	1	
50.197	6	Sandy Silt to Clayey Silt	20.491	0.422	2.815	1.25415	2.091	3.01	0.66849	0.75	0.394							0.86	2	
50.525	6	Sandy Silt to Clayey Silt	20.283	0.406	2.834	1.26438	2.1	3.01	0.66667	0.75	0.393							0.86	3	
50.853	5	Clayey Silt to Silty Clay	21.404	0.597	2.852	1.27461	2.108	3.07	0.66505	0.74	0.393							0.86	4	
51.181	5	Clayey Silt to Silty Clay	47.592	1.84	2.871	1.28485	2.117	2.83	0.66325	0.74	0.392							0.86	5	
51.509	8	Sand to Silty Sand	137.465	2.592	2.891	1.29508	2.127	2.25	0.66126	0.74	0.391	2.250	0.66	90.90	1.798	163.461		0.84	6	
51.837	7	Silty Sand to Sandy Silt	144.716	3.488	2.91	1.30531	2.136	2.31	0.65947	0.73	0.390	2.310	0.66	95.44	1.981	189.082		0.83	7	
52.165	12	Sand to Clayey Sand	135.199	5.017	2.93	1.31555	2.145	2.46	0.6577	0.73	0.389	2.460	0.66	88.92	2.574	228.905		0.86	8	
52.493	8	Sand to Silty Sand	214.203	3.74	2.95	1.32578	2.155	2.08	0.65574	0.73	0.388	2.080	0.66	140.46	1.420	199.405		0.79	9	
52.822	9	Sand	283.321	2.583	2.97	1.33605	2.165	1.8	0.65379	0.72	0.388	1.800	0.65	185.23	1.107	204.989		0.76	10	
53.15	9	Sand	310.017	2.958	2.991	1.34628	2.175	1.79	0.65185	0.72	0.387	1.790	0.65	202.09	1.099	222.181		0.75	11	
53.478	9	Sand	332.364	3.187	3.011	1.35651	2.185	1.77	0.64993	0.72	0.386	1.770	0.65	216.01	1.085	234.448		0.74	12	
53.806	9	Sand	349.351	3.07	3.032	1.36675	2.195	1.73	0.64801	0.71	0.385	1.730	0.65	226.38	1.058	239.527		0.73	13	
54.134	10	Gravelly Sand to Sand	377.809	3.078	3.052	1.37698	2.206	1.68	0.64592	0.71	0.384	1.680	0.65	244.03	1.024	249.955		0.73	14	
54.462	10	Gravelly Sand to Sand	389.787	3.25	3.073	1.38721	2.217	1.68	0.64384	0.71	0.383	1.680	0.64	250.96	1.024	257.049		0.73	15	
54.79	9	Sand	363.853	3.547	3.094	1.39745	2.227	1.75	0.64196	0.71	0.382	1.750	0.64	233.58	1.072	250.303		0.73	16	
55.118	9	Sand	361.744	2.995	3.114	1.40768	2.237	1.7	0.64009	0.70	0.381	1.700	0.64	231.55	1.038	240.316		0.72	17	
55.446	10	Gravelly Sand to Sand	358.194	2.757	3.135	1.41792	2.248	1.69	0.63805	0.70	0.380	1.690	0.64	228.55	1.031	235.650		0.72	18	
55.774	10	Gravelly Sand to Sand	338.042	1.659	3.156	1.42815	2.258	1.59	0.63621	0.70	0.379	1.590	0.64	215.06	1.000	215.064		0.72	19	
56.102	10	Gravelly Sand to Sand	316.242	1.814	3.177	1.43838	2.269	1.65	0.63419	0.69	0.378	1.650	0.63	200.56	1.003	201.226		0.73	20	
56.43	10	Gravelly Sand to Sand	303.793	1.955	3.198	1.44862	2.28	1.7	0.63218	0.69	0.377	1.700	0.63	192.05	1.038	199.324		0.74	21	
56.759	9	Sand	251.248	1.984	3.218	1.45888	2.29	1.82	0.63037	0.69	0.377	1.820	0.63	158.38	1.122	177.625		0.76	22	
57.087	9	Sand	204.494	2.014	3.238	1.46911	2.3	1.96	0.62857	0.68	0.376	1.960	0.63	128.54	1.251	160.816		0.79	23	
57.415	8	Sand to Silty Sand	217.809	3.193	3.258	1.47935	2.309	2.05	0.62696	0.68	0.375	2.050	0.63	136.56	1.371	187.227		0.78	24	
57.743	8	Sand to Silty Sand	197.93	4.171	3.278	1.48958	2.319	2.19	0.62518	0.68	0.374	2.190	0.63	123.74	1.643	203.261		0.79	25	
58.071	7	Silty Sand to Sandy Silt	163.324	3.988	3.297	1.49982	2.328	2.3	0.62358	0.68	0.373	2.300	0.62	101.85	1.949	198.471		0.81	26	
58.399	8	Sand to Silty Sand	181.47	3.628	3.317	1.51005	2.338	2.21	0.62182	0.67	0.372	2.210	0.62	112.84	1.692	190.885		0.80	27	
58.727	8	Sand to Silty Sand	216.472	3.355	3.337	1.52028	2.347	2.07	0.62024	0.67	0.371	2.070	0.62	134.27	1.403	188.363		0.78	28	
59.055	9	Sand	246.182	3.407	3.357	1.53052	2.357	2	0.6185	0.67	0.371	2.000	0.62	152.26	1.300	197.942		0.76	29	
59.383	9	Sand	252.811	2.683	3.378	1.54075	2.368	1.91	0.61659	0.66	0.370	1.910	0.62	155.88	1.198	186.809		0.76	30	
59.711	9	Sand	241.144	1.939	3.398	1.55098	2.378	1.86	0.61487	0.66	0.369	1.860	0.61	148.27	1.153	171.008		0.76	31	
60.039	9	Sand	184.445	2.019	3.418	1.56122	2.388	2.03	0.61315	0.66	0.368	2.030	0.61	113.09	1.341	151.682	0.40	0.79	32	1.10
60.367	7	Silty Sand to Sandy Silt	76.351	1.688	3.438	1.57145	2.397	2.54	0.61162	0.66	0.367	2.540	0.61	46.70	2.979	139.112	0.33	0.84	33	0.90
60.696	6	Sandy Silt to Clayey Silt	29.051	0.748	3.457	1.58172	2.405	2.97	0.61026	0.65	0.366							0.84	34	
61.024	5	Clayey Silt to Silty Clay	31.339	1.02	3.475	1.59195	2.414	3	0.60874	0.65	0.366							0.84	35	
61.352	6	Sandy Silt to Clayey Silt	61.246	1.878	3.494	1.60218	2.423	2.72	0.60723	0.65	0.365							0.84	36	
61.68	7	Silty Sand to Sandy Silt	116.617	2.517	3.513	1.61242	2.432	2.39	0.60573	0.65	0.364	2.390	0.61	70.64	2.272	160.491		0.83	37	
62.008	8	Sand to Silty Sand	172.477	2.508	3.533	1.62265	2.441	2.14	0.60423	0.64	0.363	2.140	0.60	104.22	1.532	159.654	0.46	0.80	38	1.26

LIQUEFACTION POTENTIAL ANALYSIS (per Youd & Idriss, 2001)

PROJECT NAME ***Marina Blvd OC (Replace)***
PROJECT NO. ***206139.MRN***
CPT NO. ***CPT-MR1***

FAULT INFO
COAST RANGE - SIERRAN BLOCK BOUNDARY ZONE (CSB)
a_{max} *(g)=* 0.6

FAULT M_w = 7.5
MSF = 1.00

		CPT RESULT INPUT							*CSR*		*CRR 7.5*						*F.S.=(CRR 7.5/(CSR)*MSF*Kσ*Kα*		
Depth (ft)		Soil Behavior Type	qc (tsf)	fs (tsf)	σ_v (tsf)	u (tsf)	σ_v' (tsf)	Ic*	C_N*	γ_d	CSR	Ic	C_Q	q_{c1N}	K_C	$(q_{c1N})_{cs}$	$CRR_{7.5}$	Kσ	Kα	F.S.
62.336	8	Sand to Silty Sand	162.618	2.096	3.553	1.63288	2.451	2.13	0.60257	0.64	0.362	2.130	0.60	97.99	1.512	148.136	0.38	0.80	39	1.06
62.664	8	Sand to Silty Sand	129.414	2.245	3.573	1.64312	2.46	2.3	0.60109	0.64	0.362	2.300	0.60	77.79	1.949	151.592	0.40	0.82	40	1.12
62.992	7	Silty Sand to Sandy Silt	107.596	2.827	3.592	1.65335	2.47	2.48	0.59946	0.64	0.361	2.480	0.60	64.50	2.669	172.170		0.83	41	
63.32	6	Sandy Silt to Clayey Silt	91.7	2.914	3.611	1.66358	2.478	2.59	0.59815	0.63	0.360	2.590	0.60	54.85	3.266	179.144		0.83	42	
63.648	7	Silty Sand to Sandy Silt	112.492	2.777	3.63	1.67382	2.487	2.45	0.59669	0.63	0.359	2.450	0.60	67.12	2.528	169.701		0.83	43	
63.976	7	Silty Sand to Sandy Silt	76.662	1.712	3.65	1.68405	2.496	2.56	0.59524	0.63	0.359	2.560	0.60	45.63	3.091	141.029	0.34	0.83	44	0.95
64.304	6	Sandy Silt to Clayey Silt	31.828	0.764	3.669	1.69428	2.505	2.93	0.59379	0.63	0.358							0.83	45	
64.633	6	Sandy Silt to Clayey Silt	24.879	0.315	3.687	1.70455	2.513	2.91	0.59251	0.62	0.357							0.83	46	
64.961	6	Sandy Silt to Clayey Silt	24.841	0.313	3.706	1.71478	2.522	2.91	0.59108	0.62	0.357							0.83	47	
65.289	6	Sandy Silt to Clayey Silt	25.472	0.378	3.725	1.72502	2.531	2.93	0.58965	0.62	0.356							0.83	48	
65.617	6	Sandy Silt to Clayey Silt	26.847	0.488	3.744	1.73525	2.539	2.95	0.58839	0.62	0.355							0.83	49	
65.945	6	Sandy Silt to Clayey Silt	27.742	0.595	3.763	1.74548	2.548	2.98	0.58698	0.62	0.355							0.83	50	
66.273	6	Sandy Silt to Clayey Silt	28.156	0.698	3.781	1.75572	2.556	3.01	0.58573	0.61	0.354							0.83	51	
66.601	5	Clayey Silt to Silty Clay	27.826	0.834	3.8	1.76595	2.565	3.06	0.58433	0.61	0.353							0.83	52	
66.929	5	Clayey Silt to Silty Clay	26.838	0.899	3.819	1.77618	2.573	3.11	0.58309	0.61	0.353							0.83	53	
67.257	5	Clayey Silt to Silty Clay	26.753	0.858	3.838	1.78642	2.582	3.1	0.5817	0.61	0.352							0.83	54	
67.585	5	Clayey Silt to Silty Clay	30.124	1.007	3.857	1.79665	2.59	3.06	0.58047	0.61	0.352							0.83	55	
67.913	5	Clayey Silt to Silty Clay	33.57	1.113	3.875	1.80689	2.599	3.01	0.5791	0.60	0.351							0.83	56	
68.241	6	Sandy Silt to Clayey Silt	33.693	0.978	3.894	1.81712	2.608	2.98	0.57773	0.60	0.350							0.83	57	
68.57	6	Sandy Silt to Clayey Silt	31.282	0.843	3.913	1.82738	2.616	2.99	0.57652	0.60	0.350							0.83	58	
68.898	6	Sandy Silt to Clayey Silt	29.088	0.714	3.932	1.83762	2.625	3	0.57516	0.60	0.349							0.82	59	
69.226	6	Sandy Silt to Clayey Silt	35.52	0.661	3.95	1.84785	2.633	2.85	0.57396	0.60	0.349							0.82	60	
69.554	6	Sandy Silt to Clayey Silt	34.701	0.634	3.969	1.85808	2.642	2.86	0.57262	0.59	0.348							0.82	61	
69.882	6	Sandy Silt to Clayey Silt	38.043	0.852	3.988	1.86832	2.65	2.87	0.57143	0.59	0.348							0.82	62	
70.21	6	Sandy Silt to Clayey Silt	40.03	0.883	4.007	1.87855	2.659	2.84	0.5701	0.59	0.347							0.82	63	
70.538	6	Sandy Silt to Clayey Silt	33.476	0.706	4.026	1.88879	2.668	2.91	0.56877	0.59	0.347							0.82	64	
70.866	6	Sandy Silt to Clayey Silt	32.751	0.682	4.044	1.89902	2.676	2.92	0.5676	0.59	0.346							0.82	65	
71.194	6	Sandy Silt to Clayey Silt	35.152	0.963	4.063	1.90925	2.685	2.96	0.56628	0.59	0.346							0.82	66	
71.522	6	Sandy Silt to Clayey Silt	56.265	1.431	4.082	1.91949	2.693	2.74	0.56512	0.58	0.345							0.82	67	
71.85	6	Sandy Silt to Clayey Silt	47.149	1.19	4.101	1.92972	2.702	2.81	0.56381	0.58	0.345							0.82	68	
72.178	6	Sandy Silt to Clayey Silt	35.275	0.909	4.12	1.93995	2.71	2.94	0.56266	0.58	0.344							0.82	69	
72.507	5	Clayey Silt to Silty Clay	36.546	1.212	4.138	1.95022	2.719	2.99	0.56137	0.58	0.344							0.82	70	
72.835	6	Sandy Silt to Clayey Silt	46.17	1.338	4.157	1.96045	2.727	2.86	0.56022	0.58	0.343							0.82	71	
73.163	6	Sandy Silt to Clayey Silt	40.539	0.962	4.176	1.97069	2.736	2.87	0.55894	0.58	0.343							0.82	72	
73.491	5	Clayey Silt to Silty Clay	32.469	0.967	4.195	1.98092	2.745	3.02	0.55767	0.57	0.342							0.82	73	
73.819	6	Sandy Silt to Clayey Silt	49.598	1.612	4.214	1.99115	2.753	2.87	0.55654	0.57	0.342							0.82	74	
74.147	6	Sandy Silt to Clayey Silt	61.642	1.941	4.232	2.00139	2.762	2.78	0.55528	0.57	0.341							0.82	75	
74.475	6	Sandy Silt to Clayey Silt	60.926	1.977	4.251	2.01162	2.77	2.79	0.55416	0.57	0.341							0.82	76	
74.803	6	Sandy Silt to Clayey Silt	71.031	1.902	4.27	2.02185	2.779	2.68	0.5529	0.57	0.341							0.82	77	
75.131	6	Sandy Silt to Clayey Silt	44.051	1.284	4.289	2.03209	2.787	2.89	0.55179	0.57	0.340							0.81	78	
75.459	5	Clayey Silt to Silty Clay	27.6	0.821	4.308	2.04232	2.796	3.11	0.55055	0.57	0.340							0.81	79	
75.787	5	Clayey Silt to Silty Clay	24.85	0.636	4.326	2.05255	2.804	3.12	0.54945	0.56	0.340							0.81	80	
76.115	6	Sandy Silt to Clayey Silt	25.434	0.632	4.345	2.06279	2.813	3.11	0.54822	0.56	0.339							0.81	81	
76.444	6	Sandy Silt to Clayey Silt	26.904	0.681	4.364	2.07305	2.822	3.08	0.54699	0.56	0.339							0.81	82	
76.772	6	Sandy Silt to Clayey Silt	28.25	0.729	4.383	2.08329	2.83	3.07	0.54591	0.56	0.338							0.81	83	
77.1	6	Sandy Silt to Clayey Silt	28.862	0.716	4.402	2.09352	2.839	3.05	0.54469	0.56	0.338							0.81	84	
77.428	6	Sandy Silt to Clayey Silt	28.344	0.629	4.42	2.10375	2.847	3.03	0.54361	0.56	0.338							0.81	85	
77.756	6	Sandy Silt to Clayey Silt	29.069	0.652	4.439	2.11399	2.856	3.03	0.54241	0.56	0.337							0.81	86	
78.084	6	Sandy Silt to Clayey Silt	31.744	0.689	4.458	2.12422	2.864	2.98	0.54134	0.56	0.337							0.81	87	
78.412	6	Sandy Silt to Clayey Silt	32.883	0.645	4.477	2.13445	2.873	2.94	0.54014	0.55	0.337							0.81	88	
78.74	6	Sandy Silt to Clayey Silt	26.659	0.564	4.496	2.14469	2.882	3.06	0.53895	0.55	0.336							0.81	89	
79.068	6	Sandy Silt to Clayey Silt	24.182	0.432	4.514	2.15492	2.89	3.07	0.5379	0.55	0.336							0.81	90	
79.396	6	Sandy Silt to Clayey Silt	25.349	0.422	4.533	2.16516	2.899	3.03	0.53672	0.55	0.336							0.81	91	
79.724	6	Sandy Silt to Clayey Silt	27.214	0.492	4.552	2.17539	2.907	3.02	0.53567	0.55	0.335							0.81	92	
80.052	6	Sandy Silt to Clayey Silt	26.263	0.547	4.571	2.18562	2.916	3.07	0.5345	0.55	0.335							0.81	93	
80.381	6	Sandy Silt to Clayey Silt	24.71	0.543	4.59	2.19589	2.924	3.11	0.53346	0.55	0.335							0.81	94	
80.709	6	Sandy Silt to Clayey Silt	26.96	0.577	4.608	2.20612	2.933	3.06	0.5323	0.55	0.334							0.81	95	
81.037	5	Clayey Silt to Silty Clay	38.495	1.254	4.627	2.21635	2.941	3	0.53127	0.54	0.334							0.81	96	
81.365	6	Sandy Silt to Clayey Silt	70.653	1.929	4.646	2.22659	2.95	2.71	0.53012	0.54	0.334							0.81	97	
81.693	6	Sandy Silt to Clayey Silt	64.684	1.584	4.665	2.23682	2.959	2.72	0.52897	0.54	0.334							0.80	98	
82.021	6	Sandy Silt to Clayey Silt	43.373	1.167	4.684	2.24706	2.967	2.91	0.52796	0.54	0.333							0.80	99	
82.349	6	Sandy Silt to Clayey Silt	34.955	0.926	4.702	2.25729	2.976	3	0.52682	0.54	0.333							0.80	100	
82.677	6	Sandy Silt to Clayey Silt	30.228	0.678	4.721	2.26752	2.984	3.03	0.52581	0.54	0.333							0.80	101	
83.005	6	Sandy Silt to Clayey Silt	32.544	0.505	4.74	2.27776	2.993	2.91	0.52468	0.54	0.332							0.80	102	
83.333	7	Silty Sand to Sandy Silt	31.517	0.34	4.759	2.28799	3.002	2.85	0.52356	0.54	0.332							0.80	103	
83.661	6	Sandy Silt to Clayey Silt	26.64	0.342	4.778	2.29822	3.01	2.97	0.52257	0.54	0.332							0.80	104	
83.99	6	Sandy Silt to Clayey Silt	26.084	0.419	4.797	2.30849	3.019	3.03	0.52145	0.54	0.332							0.80	105	
84.318	6	Sandy Silt to Clayey Silt	26.188	0.388	4.816	2.31872	3.028	3.01	0.52034	0.53	0.331							0.80	106	
84.646	6	Sandy Silt to Clayey Silt	26.724	0.399	4.834	2.32896	3.036	3.01	0.51936	0.53	0.331							0.80	107	
84.974	6	Sandy Silt to Clayey Silt	26.122	0.412	4.853	2.33919	3.045	3.03	0.51826	0.53	0.331							0.80	108	
85.302	6	Sandy Silt to Clayey Silt	24.54	0.438	4.872	2.34942	3.053	3.09	0.51728	0.53	0.331							0.80	109	
85.63	6	Sandy Silt to Clayey Silt	24.267	0.562	4.891	2.35966	3.062	3.16	0.51619	0.53	0.331							0.80	110	
85.958	6	Sandy Silt to Clayey Silt	23.946	0.6	4.91	2.36989	3.07	3.19	0.51522	0.53	0.330							0.80	111	
86.286	6	Sandy Silt to Clayey Silt	23.862	0.598	4.928	2.38012	3.079	3.19	0.51414	0.53	0.330							0.80	112	
86.614	6	Sandy Silt to Clayey Silt	24.427	0.481	4.947	2.39036	3.088	3.12	0.51306	0.53	0.330							0.80	113	
86.942	6	Sandy Silt to Clayey Silt	22.233	0.452	4.966	2.40059	3.096	3.18	0.5121	0.53	0.330							0.80	114	
87.27	6	Sandy Silt to Clayey Silt	26.499	0.572	4.985	2.41082	3.105	3.1	0.51103	0.53	0.329							0.80	115	
87.598	6	Sandy Silt to Clayey Silt	36.358	0.707	5.004	2.42106	3.113	2.93	0.51009	0.53	0.329							0.80	116	
87.927	7	Silty Sand to Sandy Silt	47.667	0.873	5.023	2.43132	3.122	2.79	0.50902	0.52	0.329							0.80	117	
88.255	7	Silty Sand to Sandy Silt	37.478	0.591	5.042	2.44156	3.131	2.87	0.50797	0.52	0.329							0.80	118	
88.583	6	Sandy Silt to Clayey Silt	32.158	0.517	5.061	2.45179	3.14	2.95	0.50691	0.52	0.329							0.80	119	
88.911	7	Silty Sand to Sandy Silt	31.405	0.417	5.08	2.46202	3.149	2.92	0.50586	0.52	0.328							0.79	120	
89.239	6	Sandy Silt to Clayey Silt	27.61	0.496	5.099	2.47226	3.158	3.05	0.50482	0.52	0.328							0.79	121	
89.567	6	Sandy Silt to Clayey Silt	32.412	0.533	5.118	2.48249	3.166	2.95	0.50389	0.52	0.328							0.79	122	
89.895	6	Sandy Silt to Clayey Silt	33.081	0.536	5.137	2.49272	3.175	2.94	0.50286	0.52	0.328							0.79	123	
90.223	6	Sandy Silt to Clayey Silt	25.529	0.438	5.156	2.50296	3.183	3.09	0.50194	0.52	0.328							0.79	124	
90.551	6	Sandy Silt to Clayey Silt	27.337	0.401	5.174	2.51319	3.192	3.02	0.50091	0.52	0.327							0.79	125	
90.879	6	Sandy Silt to Clayey Silt	27.572	0.349	5.193	2.52342	3.2	2.98	0.5	0.52	0.327							0.79	126	
91.207	6	Sandy Silt to Clayey Silt	25.802	0.39	5.212	2.53366	3.209	3.06	0.49898	0.52	0.327							0.79	127	
91.535	6	Sandy Silt to Clayey Silt	26.319	0.504	5.231	2.54389	3.217	3.1	0.49808	0.52	0.327							0.79	128	
91.864	6	Sandy Silt to Clayey Silt	25.368	0.587	5.25	2.55416	3.226	3.16	0.49706	0.51	0.327							0.79	129	
92.192	6	Sandy Silt to Clayey Silt	24.549	0.612	5.268	2.56439	3.235	3.2	0.49605	0.51	0.327							0.79	130	
92.52	6	Sandy Silt to Clayey Silt	24.794	0.603	5.287	2.57462	3.243	3.19	0.49516	0.51	0.326							0.79	131	
92.848	6	Sandy Silt to Clayey Silt	25.783	0.609	5.306	2.58486	3.252	3.17	0.49416	0.51	0.326							0.79	132	
93.176	6	Sandy Silt to Clayey Silt	26.103	0.606	5.325	2.59509	3.26	3.16	0.49327	0.51	0.326							0.79	133	

LIQUEFACTION POTENTIAL ANALYSIS (per Youd & Idriss, 2001)

PROJECT NAME	***Marina Blvd OC (Replace)***	*FAULT INFO*	
PROJECT NO.	***206139.MRN***	*COAST RANGE - SIERRAN BLOCK BOUNDARY ZONE (CSB)*	
CPT NO.	***CPT-MR1***	a_{max} *(g)=* 0.6	*FAULT* M_w *=* 7.5
			MSF = 1.00

		CPT RESULT INPUT								*CSR*		*CRR 7.5*						*F.S.=(CRR 7.5/CSR)*MSF*K σ*K α*		
Depth (ft)		Soil Behavior Type	qc (tsf)	fs (tsf)	σ_v (tsf)	u (tsf)	σ_v' (tsf)	Ic*	C_N*	γ_d	CSR	Ic	C_Q	q_{c1N}	K_C	$(q_{c1N})_{cs}$	$CRR_{7.5}$	Kσ	Kα	F.S.
93.504	6	Sandy Silt to Clayey Silt	26.772	0.663	5.344	2.60532	3.269	3.16	0.49228	0.51	0.326							0.79	134	
93.832	6	Sandy Silt to Clayey Silt	27.61	0.689	5.362	2.61556	3.277	3.15	0.4914	0.51	0.326							0.79	135	
94.16	6	Sandy Silt to Clayey Silt	25.265	0.517	5.381	2.62579	3.286	3.15	0.49041	0.51	0.326							0.79	136	
94.488	6	Sandy Silt to Clayey Silt	24.474	0.402	5.4	2.63603	3.295	3.12	0.48943	0.51	0.325							0.79	137	
94.816	6	Sandy Silt to Clayey Silt	29.399	0.633	5.419	2.64626	3.303	3.08	0.48856	0.51	0.325							0.79	138	
95.144	6	Sandy Silt to Clayey Silt	48.486	1.177	5.438	2.65649	3.312	2.88	0.48759	0.51	0.325							0.79	139	
95.472	6	Sandy Silt to Clayey Silt	58.016	1.376	5.456	2.66673	3.32	2.8	0.48673	0.51	0.325							0.79	140	
95.801	5	Clayey Silt to Silty Clay	33.664	1.009	5.475	2.67699	3.329	3.1	0.48576	0.51	0.325							0.79	141	
96.129	6	Sandy Silt to Clayey Silt	29.239	0.791	5.494	2.68722	3.337	3.15	0.4849	0.51	0.325							0.79	142	

APPENDIX C-3

EMBANKMENT SETTLEMENT & STABILITY EVALUATION

SETTLEMENT ANALYSIS *** MARINA BLVD OC -ROUTE 880, SANTA CLARA COUNTY *** **APPROACH EMBANKMENTS (TYPICAL)** 11/08/09

LOCATION: APPROACH EMBANKMENTS FOR THE BRIDGE

Height of fill = 25 ft — Based on reference Borings MR-1 (CPT), MR-2 & E-4

Width of fill = 60 ft — The new embankment is about 60 ft wide abutting existing fill.

Fill Density = 130 pcf

- The undrained shear strength (Su) is correlated with SPT-N values based on Terzaghi and Peck (1967), and NAVFAC DM-7.1 (1982).
- Approximate estimation of preconsolidation pressure is based on Su/P ratio per Skempton (1957) and NAVFAC DM-7.1 (1982).
- The modified compression index (Cc/1+e0) is correlated with natural moisture content based on Lambe and Whitman (1969).
- The recompression index is adopted as 20% of the virgin compression index per lab data & literature.
- The applied pressure is estimated from 2V:1H distribution of the embankment load.

DEPTH FROM	TO	EFFECTIVE UNIT WEIGHT(pcf) (psf)	WEIGHT OF LAYER (psf)	MIDLAYER EFFECTIVE OVERBURDEN PRESSURE (psf)	APPLIED PRESSURE (psf)	UNDRAINED SHEAR STRENGTH (psf)	PRECONSO-LIDATION PRESSURE (psf)	NATURAL WATER CONTENT (%)	MODIFIED VIRGIN COM-PRESSION INDEX	MODIFIED RECOM-PRESSION INDEX	CONSOLIDATION SETTLEMENTS (in.) OC	NC	SUM
			0										
0	8	120	960	480	3047	2000	8000	20	0.0847	0.0169	1.41	0.00	1.41
8	12	58	232	1076	2786	1000	4000	31	0.1578	0.0316	0.84	0.00	0.84
12	17	58	290	1337	2617	2000	8000	25	0.1174	0.0235	0.66	0.00	0.66
17	23	58	348	1656	2438	2000	8000	24	0.1107	0.0221	0.63	0.00	0.63
20	25	58	290	1975	2364				(SAND LAYER)				
25	30	58	290	2265	2229								
30	35	58	290	2555	2108	1000	4000	19	0.0785	0.0157	0.18	0.31	0.50
35	40	58	290	2845	2000				(SAND LAYER)				
40	45	58	290	3135	1902								
45	50	58	290	3425	1814	2000	8000	19	0.0785	0.0157	0.17	0.00	0.17
50	55	58	290	3715	1733	2000	8000	22	0.0975	0.0195	0.19	0.00	0.19
55	60	58	290	4005	1660				(SAND LAYER)				
60	65	58	290	4295	1592								
65	70	58	290	4585	1529	2500	10000	20	0.0847	0.0169	0.13	0.00	0.13

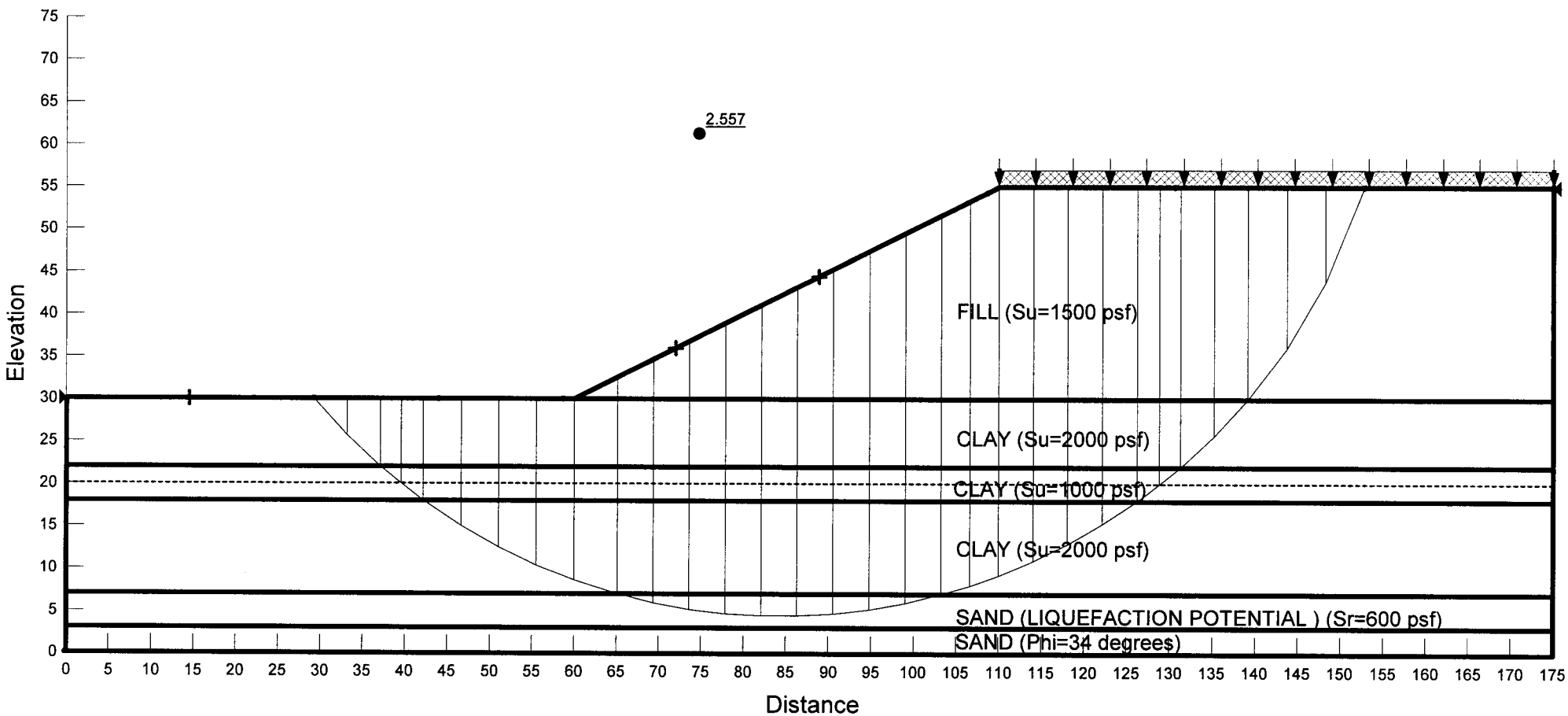
TOTAL SETTLEMENT (IN.) = 4.22 0.31 4.53

O.C. RANGE SETTLEMENT = 4.22 INCHES

N.C. RANGE SETTLEMENT = 0.31 INCHES

Majority of the settlement is in the overconsolidated/elastic range.

MARINA BLVD. OC / I-880 - EMBANKMENT STABILITY



APPENDIX C-4

LPILE ANALYSES

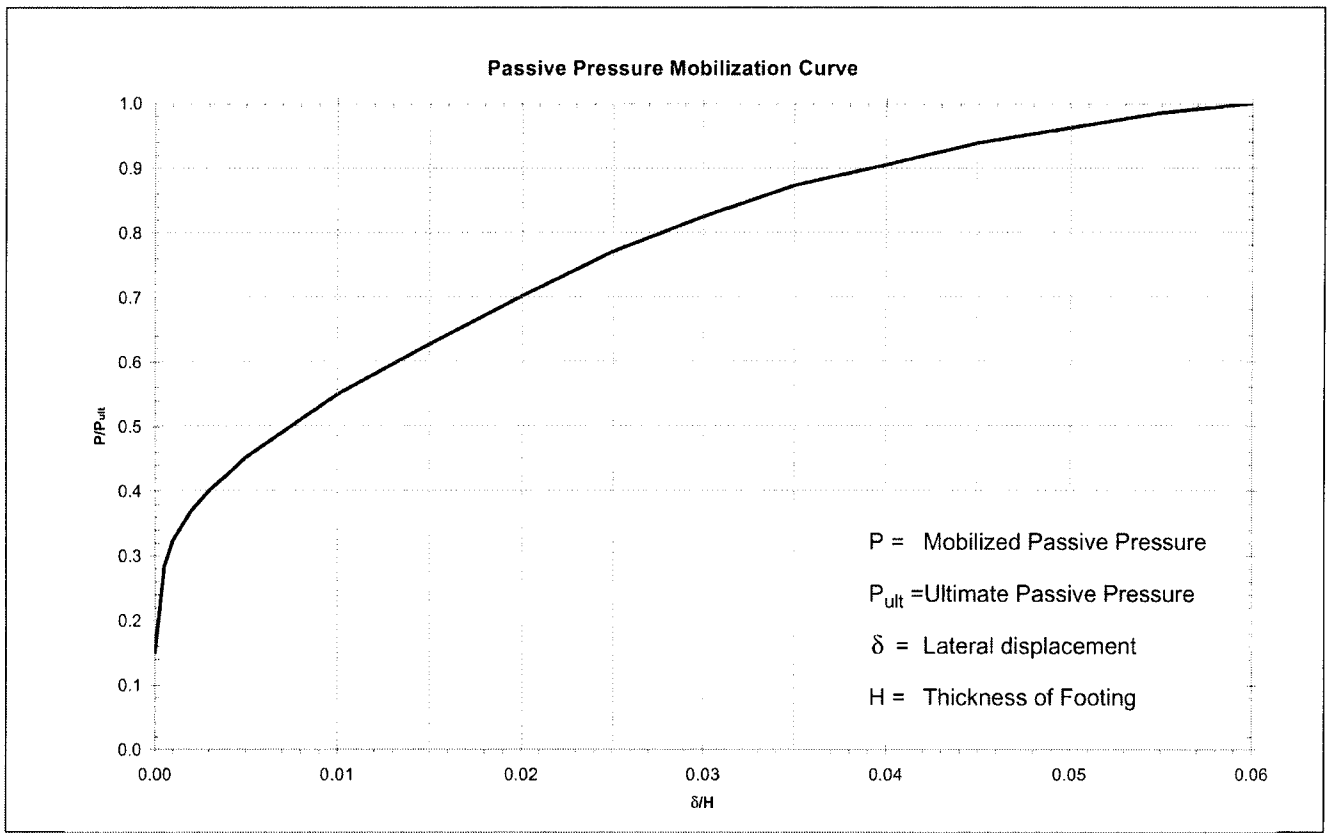
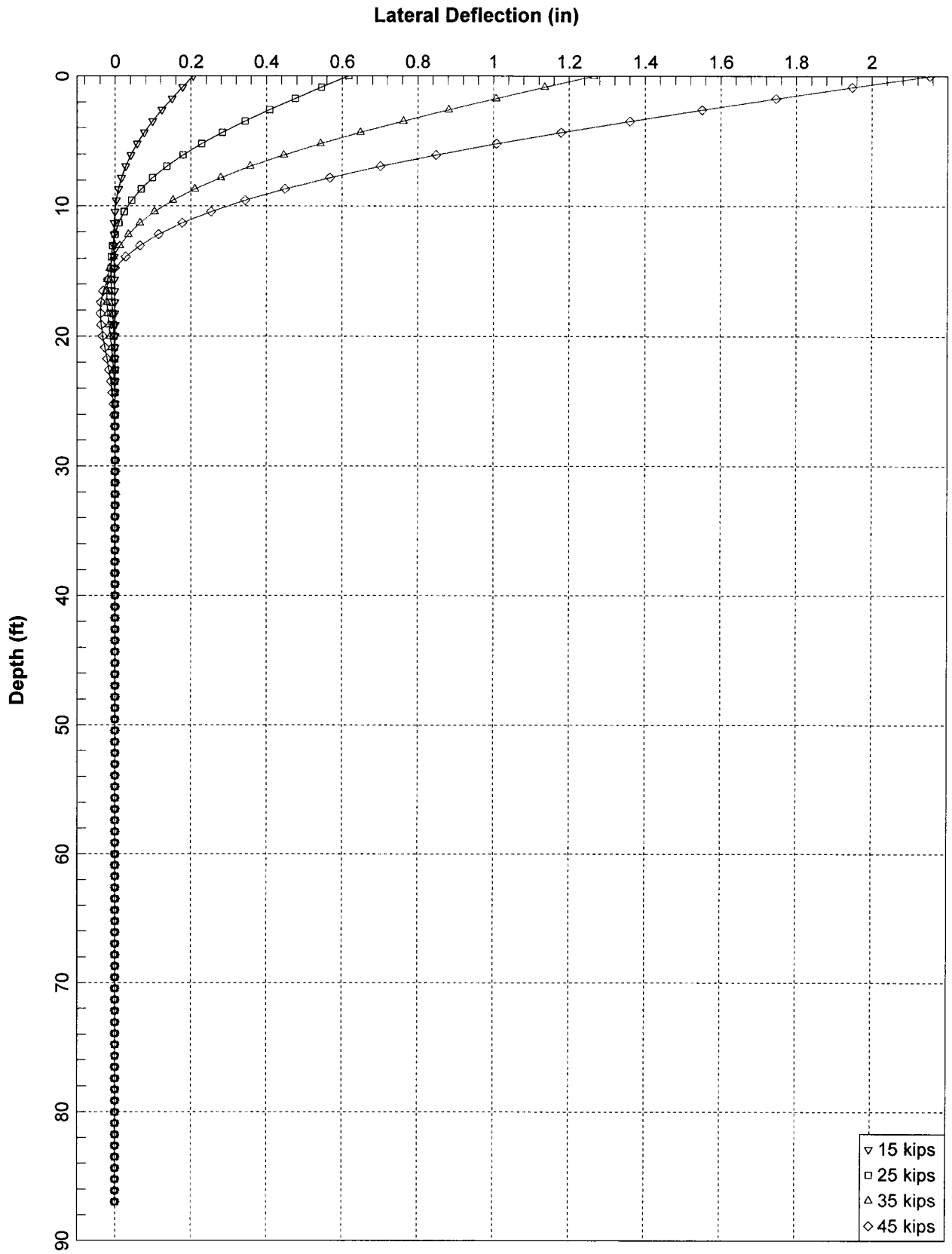


Figure 4-6 ***Passive Pressure Mobilization Curve***

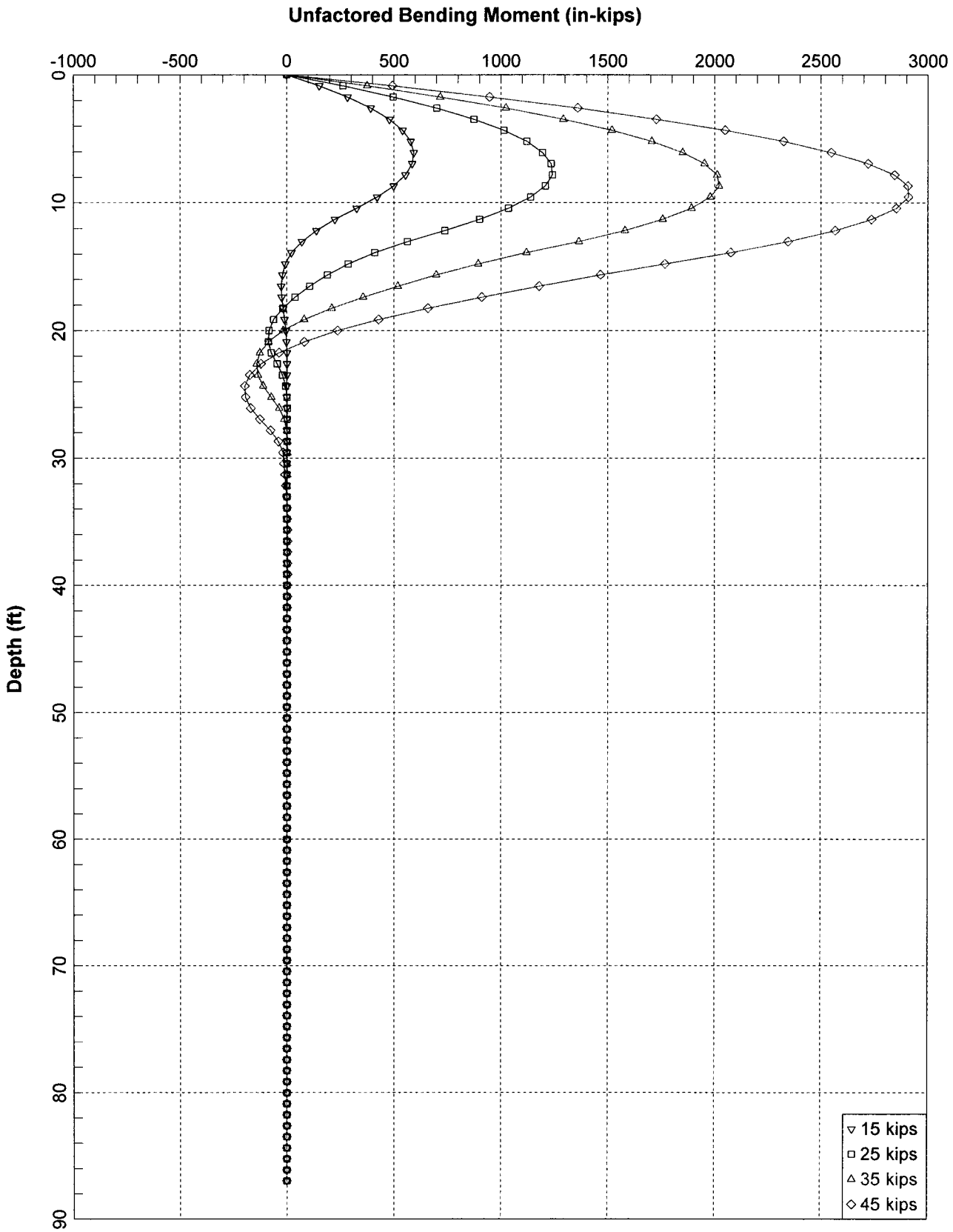
Reference: Chapter 4, Foundation and Geologic Site Hazards, FEMA 356, November 2000

For Marina Blvd OC (Replace)/I-880, the recommened passive resistance against the vertical side of the pile caps is 4.5 ksf. This is a uniformly distributed resistance for seismic & ultimate condition.

PASSIVE PRESSURE MOBILIZATION AGAINST PILE CAPS

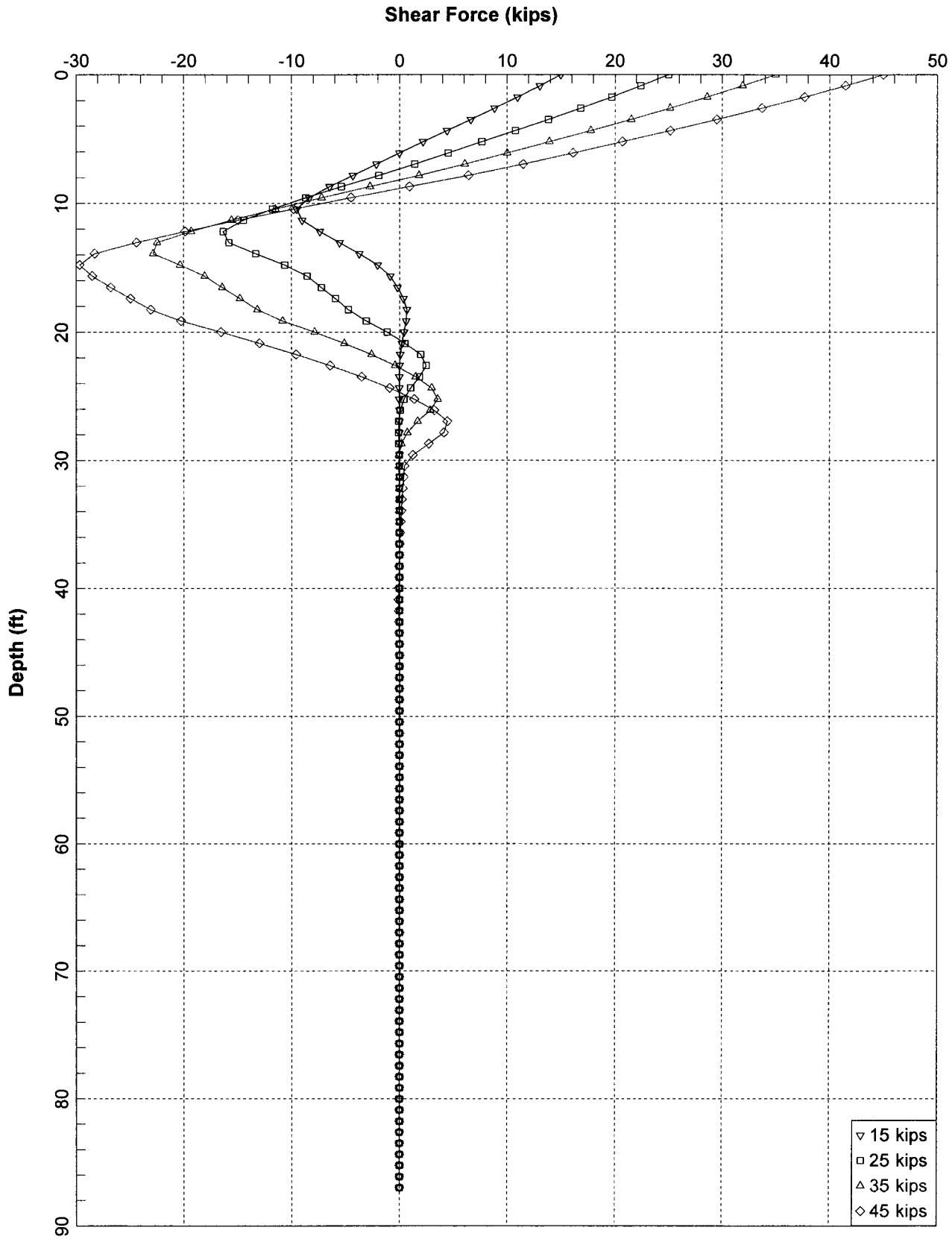


MARINA BLVD. OC (REPLACE) (ABUTMENTS)

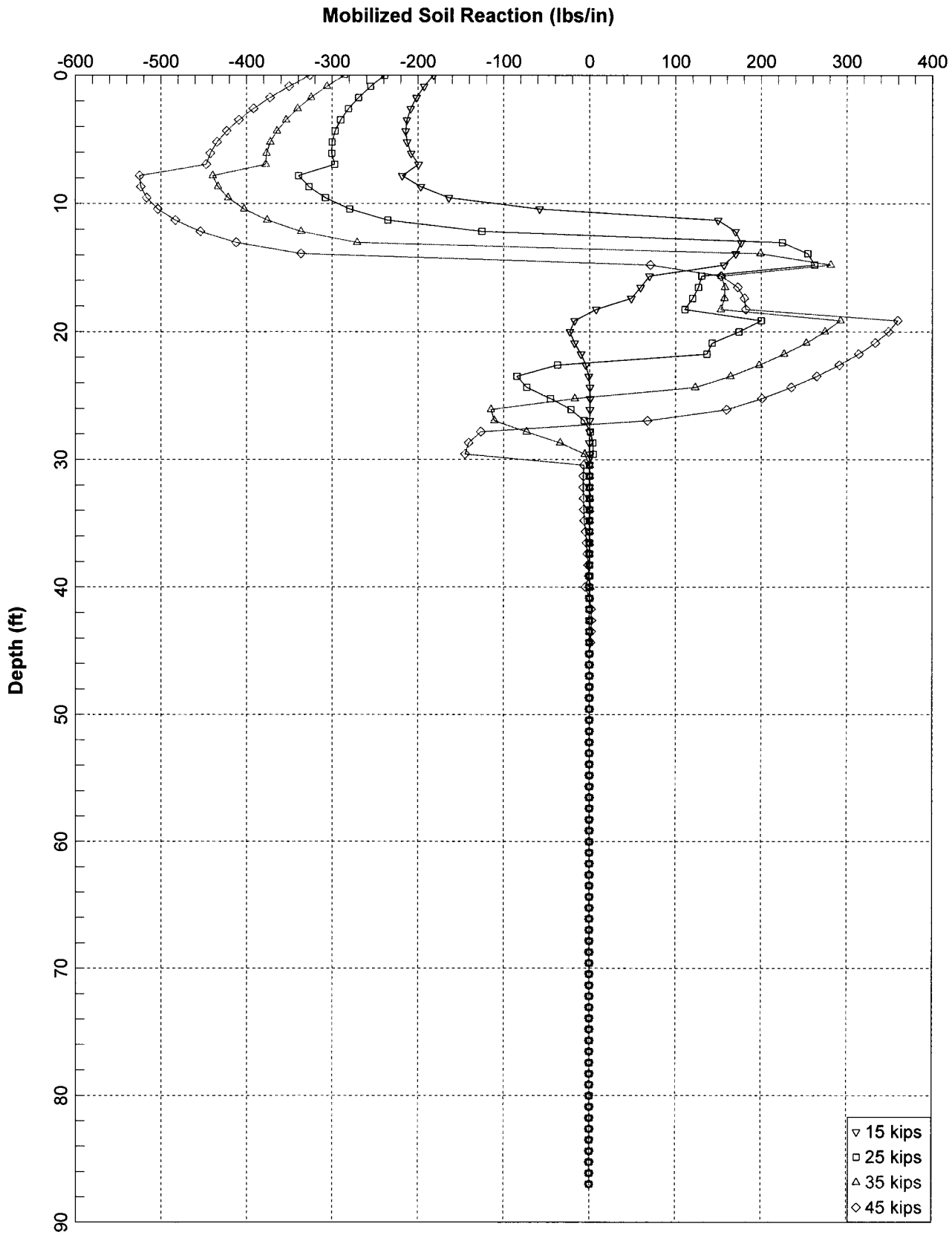


MARINA BLVD. OC (REPLACE) (ABUTMENTS)

2/6



MARINA BLVD. OC (REPLACE) (ABUTMENTS)



MARINA BLVD. OC (REPLACE) (ABUTMENTS)

```
LPILEP5
Marina Blvd. OC (Abutments)
1       1       0       0       0       0
100     2       -24     1044    0
0       16      731     24.35   30000000
1044    16      731     24.35   30000000
12      24      24      0       2
3       -24     84      0       0
3       84      180     0       0
3       180     204     0       0
3       204     228     0       0
3       228     360     0       0
10      360     408     0       0
4       408     480     60      60
3       480     540     0       0
4       540     660     125     125
3       660     756     0       0
4       756     840     125     125
3       840     1044    0       0
-24     0.072
84      0.072
84      0.072
180     0.072
180     0.072
204     0.072
204     0.036
228     0.036
228     0.036
360     0.036
360     0.036
408     0.036
408     0.036
480     0.036
480     0.036
540     0.036
540     0.036
660     0.036
660     0.036
756     0.036
756     0.036
840     0.036
840     0.036
1044    0.036
-24     10.416667       0       0.007   0
84      10.416667       0       0.007   0
84      13.888889       0       0.007   0
180     13.888889       0       0.007   0
180     6.9444444       0       0.007   0
204     6.9444444       0       0.007   0
204     6.9444444       0       0.007   0
228     6.9444444       0       0.007   0
228     13.888889       0       0.007   0
360     13.888889       0       0.007   0
360     0       0       0       0
408     0       0       0       0
408     0       34      0       0
480     0       34      0       0
480     6.9444444       0       0.007   0
540     6.9444444       0       0.007   0
540     0       36      0       0
660     0       36      0       0
660     13.888889       0       0.007   0
756     13.888889       0       0.007   0
```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```
756     0       36      0       0
840     0       36      0       0
840     17.361111       0       0.005   0
1044    17.361111       0       0.005   0
0       0.6     1
1044    0.6     1
0       1       1
4
1       15000   0       200000
1       25000   0       200000
1       35000   0       200000
1       45000   0       200000
0
1       1       0
100     1E-5    100
```


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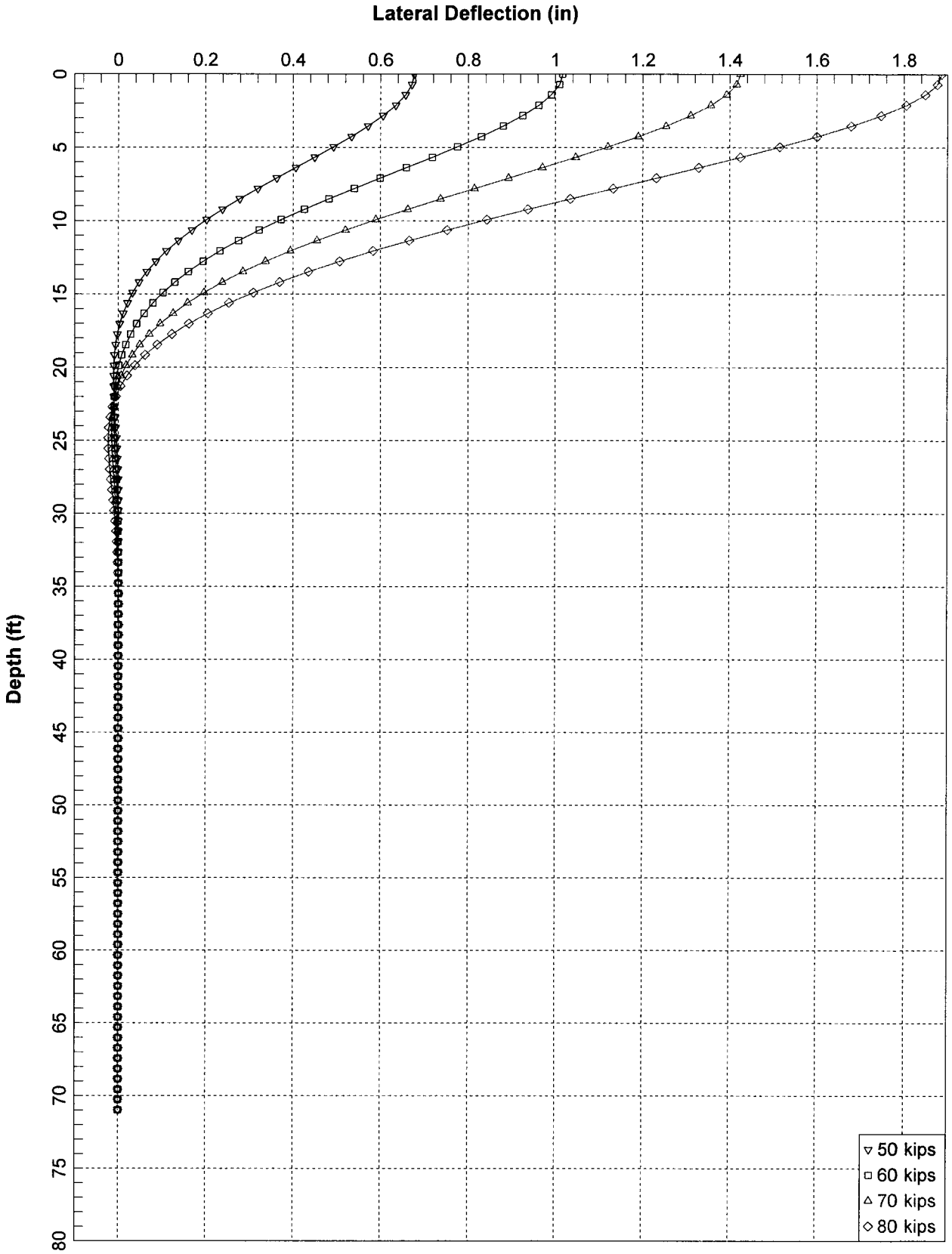
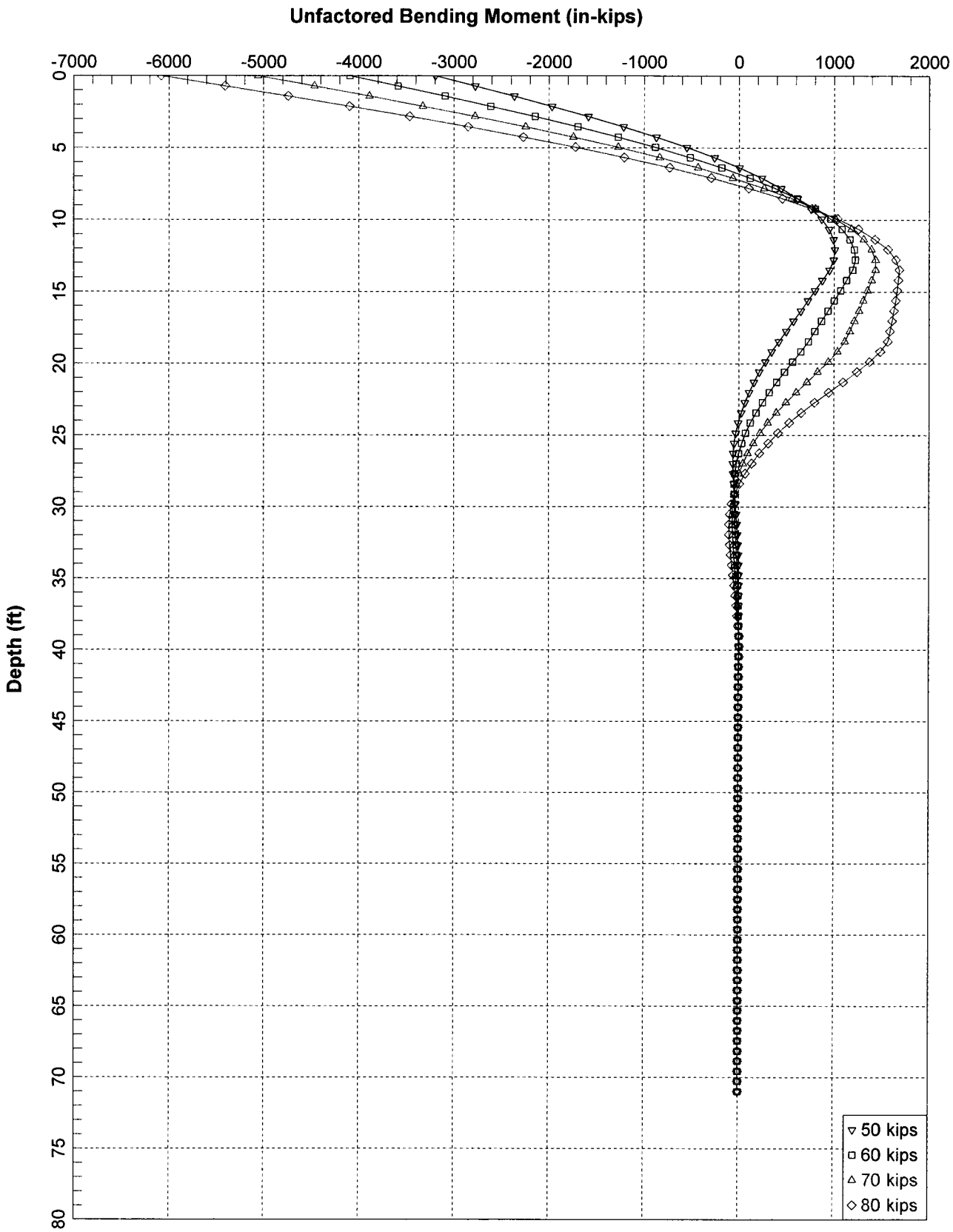
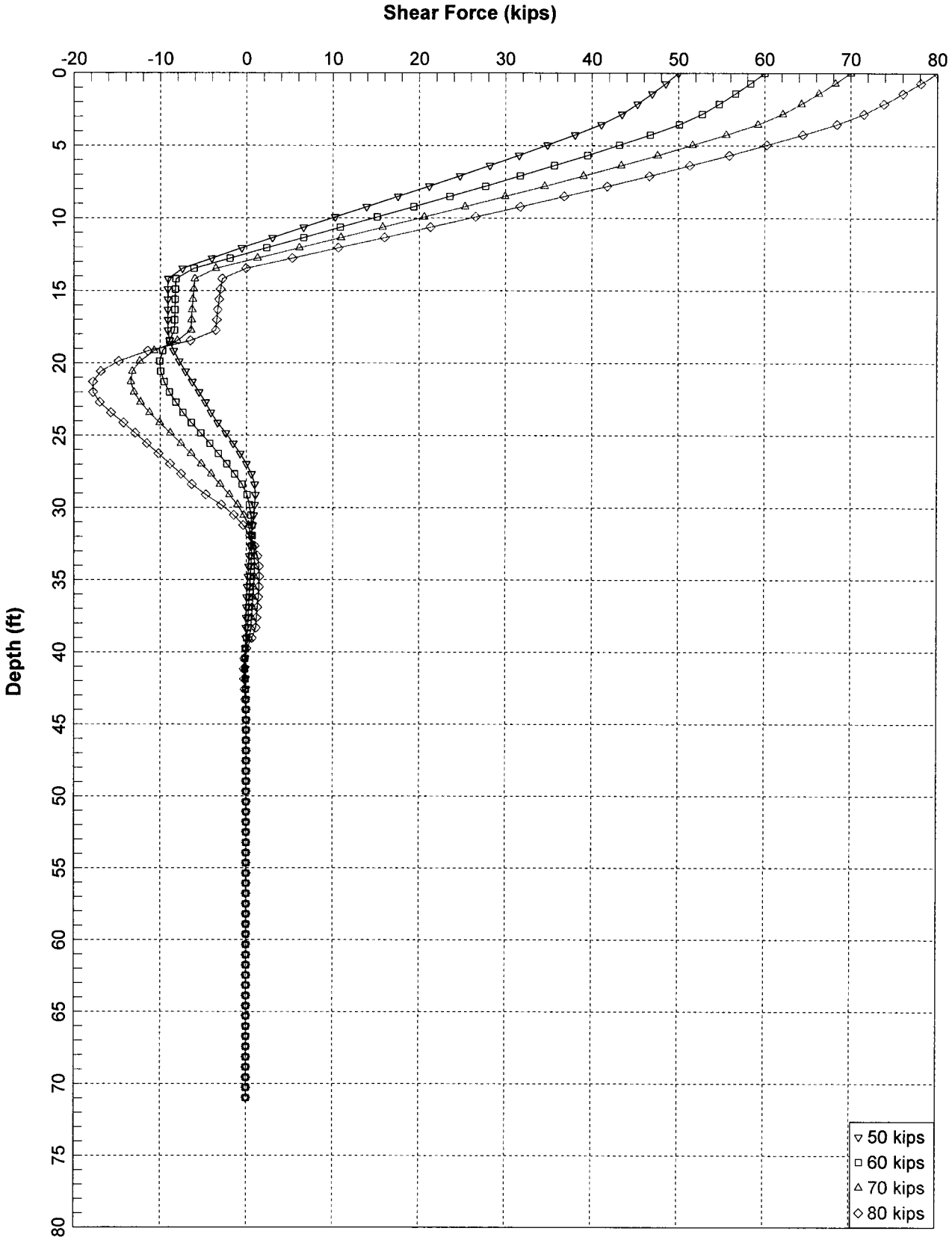


MARINA BLVD. OC (REPLACE) (BENT) (16" pipe pile)

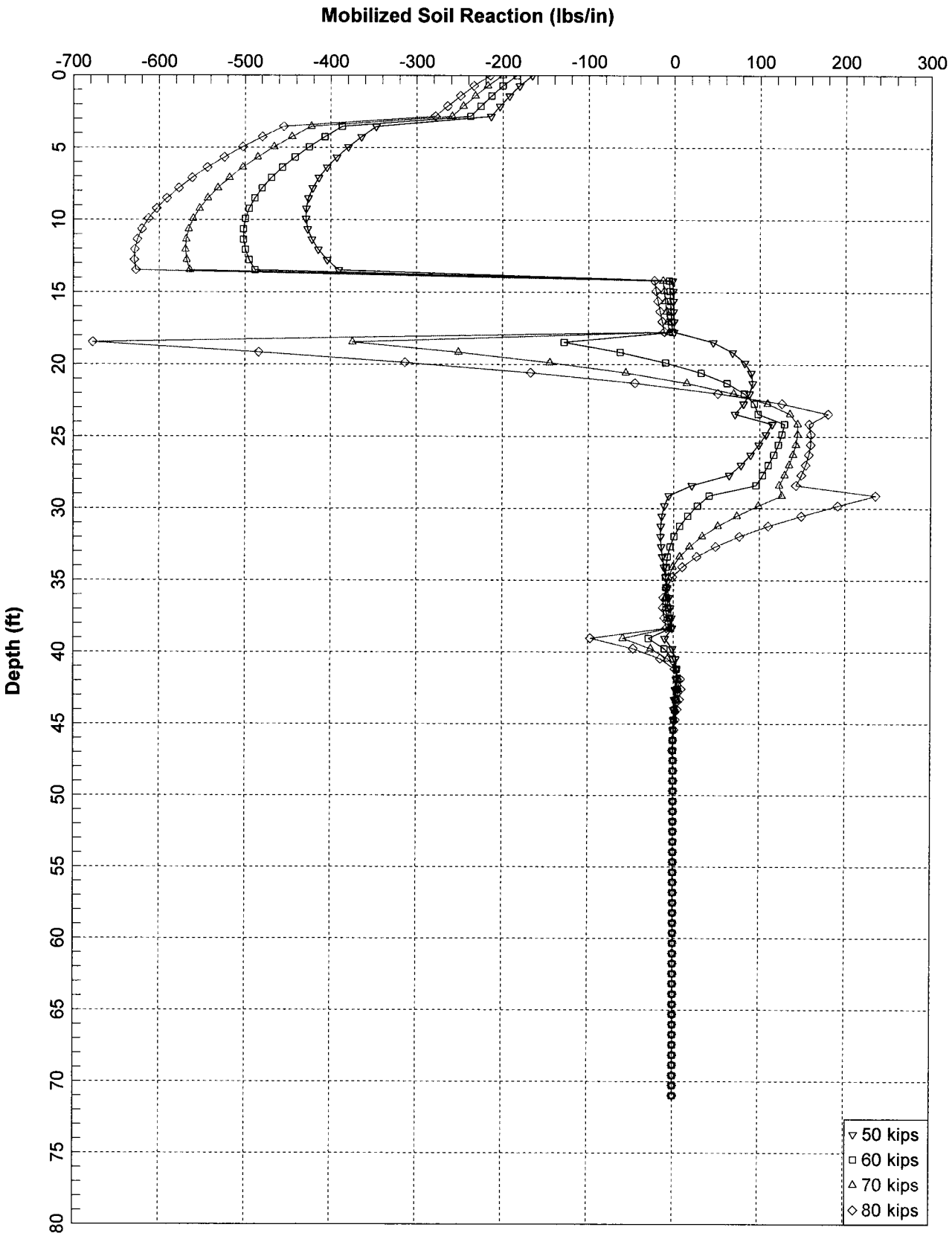


MARINA BLVD. OC (REPLACE) (BENT) (16" Pipe Pile)

2/6



MARINA BLVD. OC (REPLACE) (BENT) (16" pipe pile)



MARINA BLVD. OC (REPLACE) (BENT) (16" pipe pile)

```
LPILEP5
Marina Blvd. OC (Bent)
1       1       0       0       0       0
100     2       -24     852     0
0       16      731     24.35   30000000
852     16      731     24.35   30000000
10      20      20      0       2
3       -24     12      0       0
3       12      36      0       0
3       36      168     0       0
10      168     216     0       0
4       216     288     60      60
3       288     348     0       0
4       348     468     125     125
3       468     564     0       0
4       564     648     125     125
3       648     852     0       0
-24     0.072
12      0.072
12      0.036
36      0.036
36      0.036
168     0.036
168     0.036
216     0.036
216     0.036
288     0.036
288     0.036
348     0.036
348     0.036
468     0.036
468     0.036
564     0.036
564     0.036
648     0.036
648     0.036
852     0.036
-24     6.9444444       0       0.007   0
12      6.9444444       0       0.007   0
12      6.9444444       0       0.007   0
36      6.9444444       0       0.007   0
36      13.888889       0       0.007   0
168     13.888889       0       0.007   0
168     0       0       0       0
216     0       0       0       0
216     0       34      0       0
288     0       34      0       0
288     6.9444444       0       0.007   0
348     6.9444444       0       0.007   0
348     0       36      0       0
468     0       36      0       0
468     13.888889       0       0.007   0
564     13.888889       0       0.007   0
564     0       36      0       0
648     0       36      0       0
648     17.361111       0       0.005   0
852     17.361111       0       0.005   0
0       0.6     1
1044    0.6     1
0       1       1
4
2       50000   0       200000
2       60000   0       200000
```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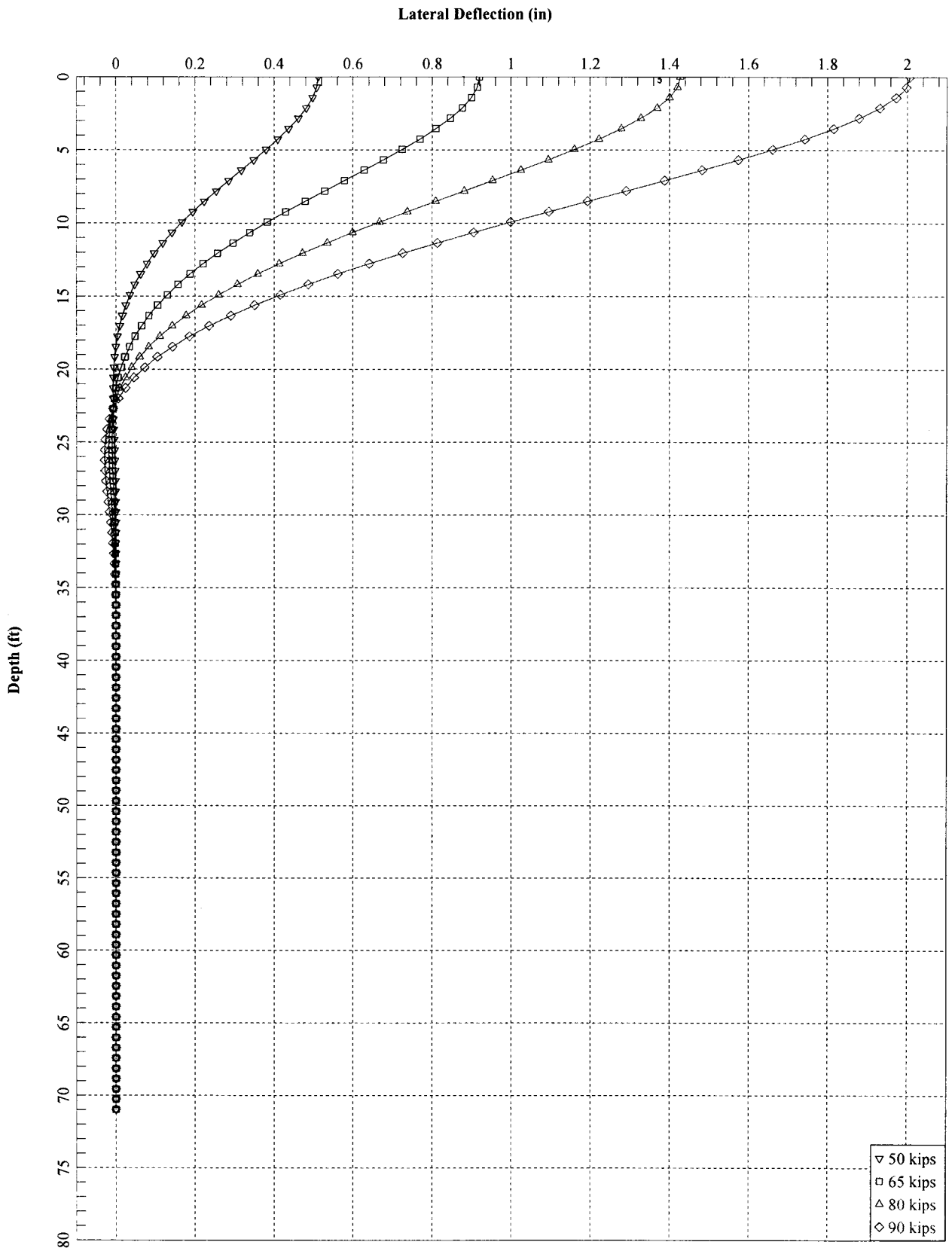
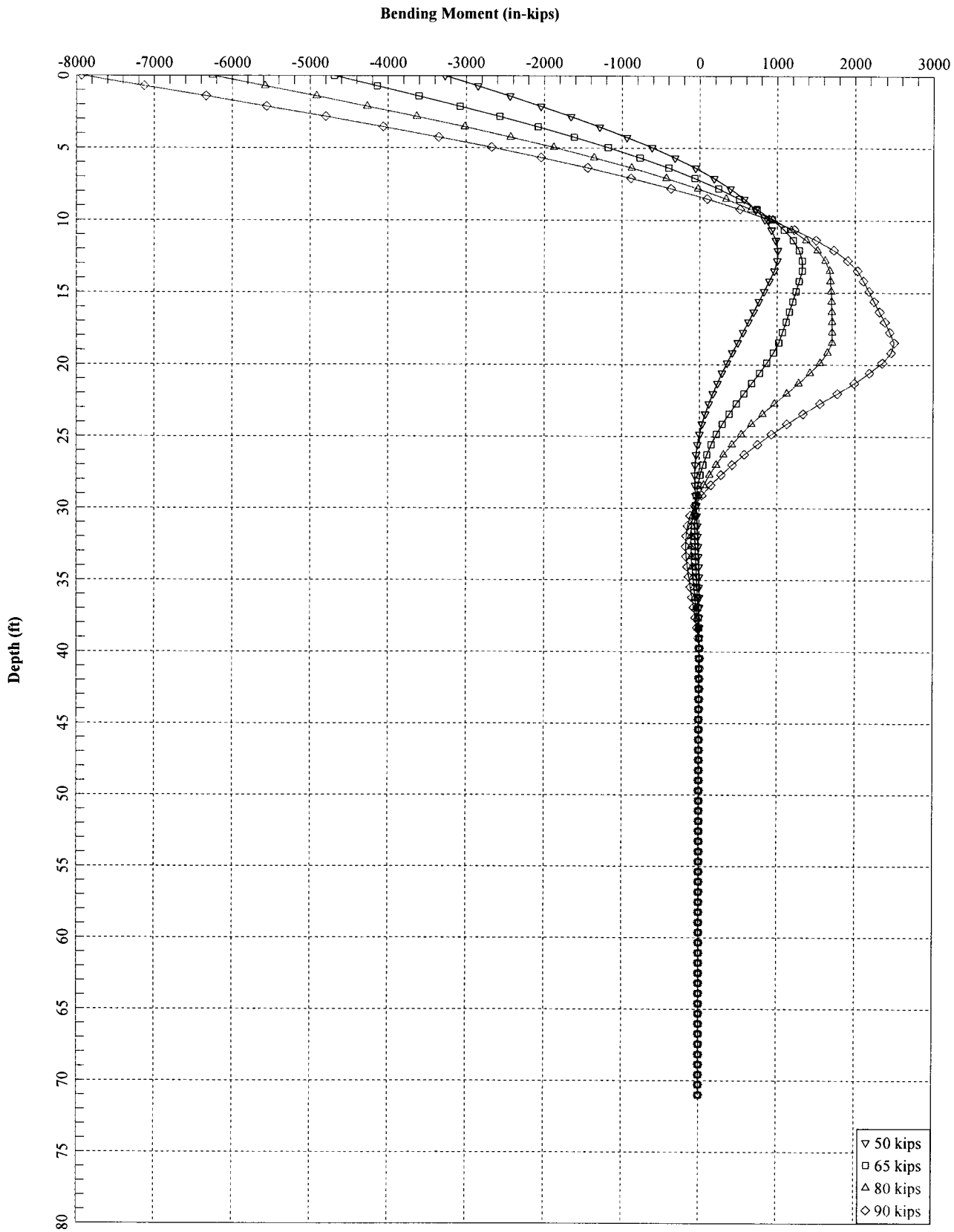
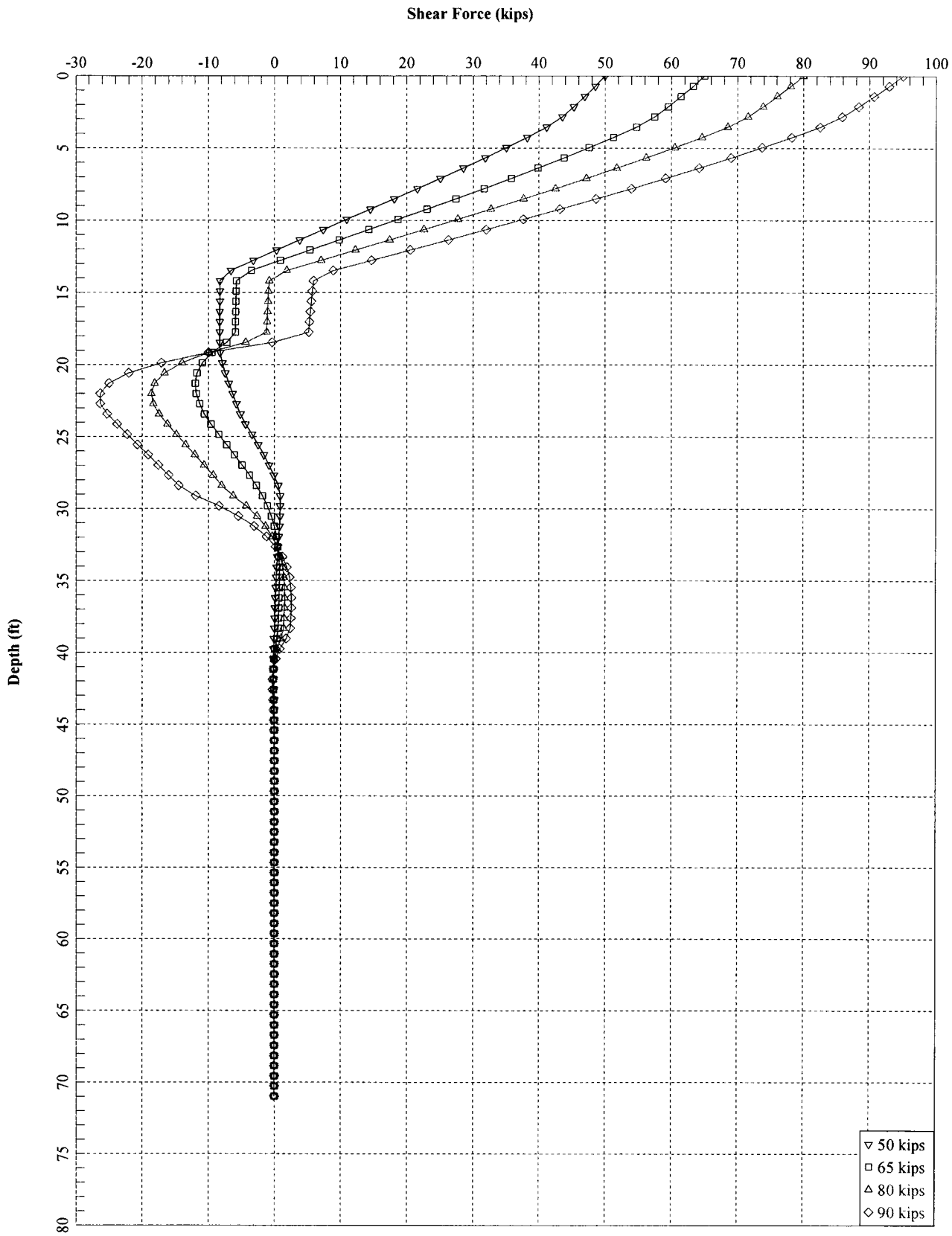
```
2       70000   0       200000
2       80000   0       200000
0
1       1       0
100     1E-5    100
```



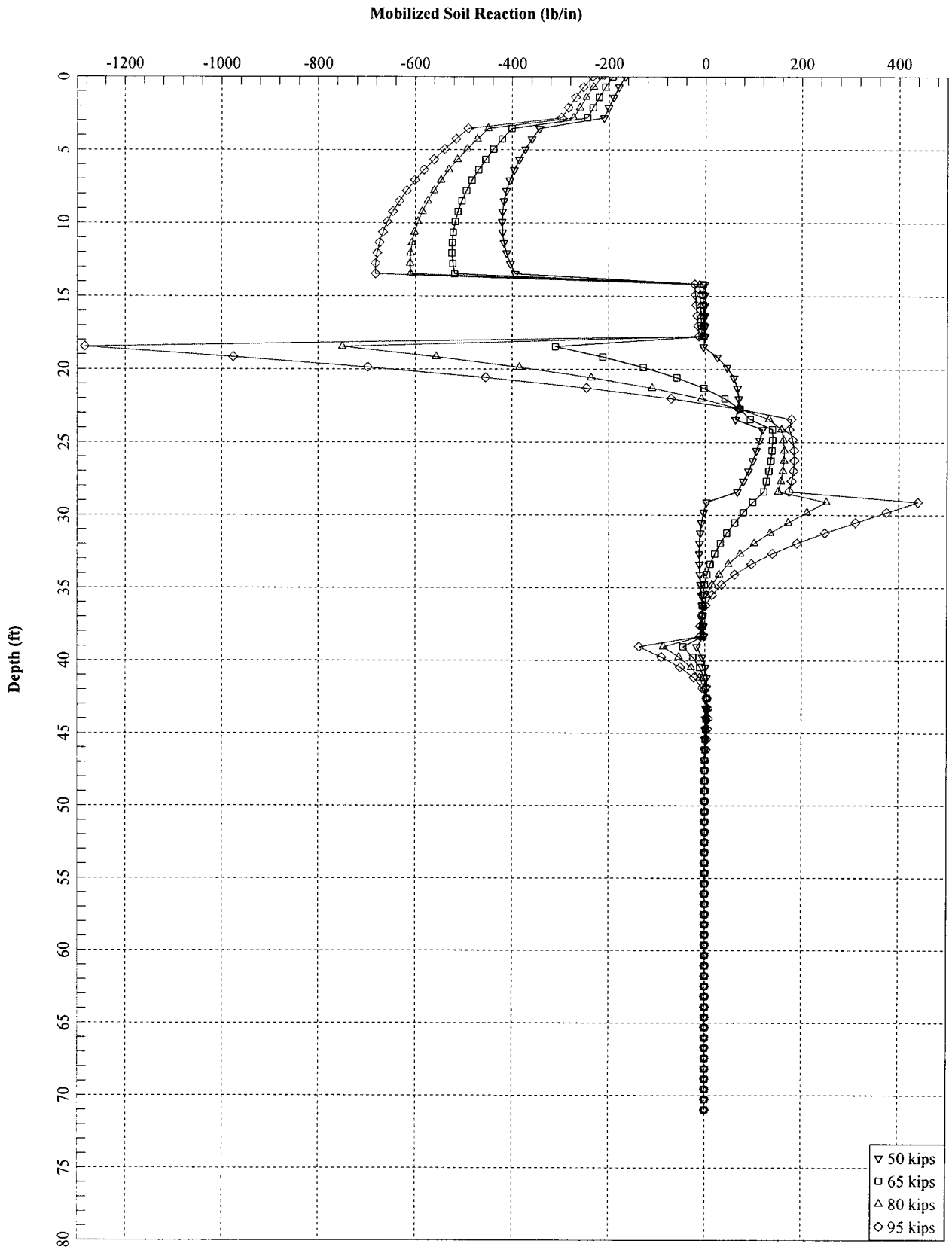
Marina Blvd. OC (Bent) - 18" Diameter Steel Pipe Pile



Marina Blvd. OC (Bent) - 18" Diameter Steel Pipe Pile



Marina Blvd. OC (Bent) - 18" Diameter Steel Pipe Pile



Marina Blvd. OC (Bent) - 18" Diameter Steel Pipe Pile

```
LPILEP5
Marina Blvd. OC (Bent) - 18" Diameter
1       1       0       0       0       0
100     2       -24     852     0
0       18      1053.2  27.5    30000000
852     18      1053.2  27.5    30000000
10      20      20      0       2
3       -24     12      0       0
3       12      36      0       0
3       36      168     0       0
10      168     216     0       0
4       216     288     60      60
3       288     348     0       0
4       348     468     125     125
3       468     564     0       0
4       564     648     125     125
3       648     852     0       0
-24     0.072
12      0.072
12      0.036
36      0.036
36      0.036
168     0.036
168     0.036
216     0.036
216     0.036
288     0.036
288     0.036
348     0.036
348     0.036
468     0.036
468     0.036
564     0.036
564     0.036
648     0.036
648     0.036
852     0.036
-24     6.9444444       0       0.007   0
12      6.9444444       0       0.007   0
12      6.9444444       0       0.007   0
36      6.9444444       0       0.007   0
36      13.888889       0       0.007   0
168     13.888889       0       0.007   0
168     0       0       0       0
216     0       0       0       0
216     0       34      0       0
288     0       34      0       0
288     6.9444444       0       0.007   0
348     6.9444444       0       0.007   0
348     0       36      0       0
468     0       36      0       0
468     13.888889       0       0.007   0
564     13.888889       0       0.007   0
564     0       36      0       0
648     0       36      0       0
648     17.361111       0       0.005   0
852     17.361111       0       0.005   0
0       0.6     1
1044    0.6     1
0       1       1
4
2       50000   0       320000
2       65000   0       320000
```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```
2       80000   0       320000
2       95000   0       320000
0
1       1       0
100     1E-5    100
```

APPENDIX D

OSFP Review Comment & Response Form

General Project Information	Review Phase		Reviewer Information
Dist: 04 EA: 3A9201 **Project Name: Marina Blvd O.C (Replace)** **OSFP Liaison: Yiwei Hu** **Phone: 916-227-8917** **e-mail: Yiwei hu@dot.ca.gov**	☐ PSR/PDS (Review No. _) ☐ APS/PSR (Review No. _) ☐ APS/PR (Review No. _) ☐ Type Selection	☐ 65% PS&E Unchecked Details ☐ PS&E (Review No. _) ☐ Construction Support ☒ Other: FR	**Reviewer Name: R. Nashed** **Functional Unit: GS-GDW** **Phone Number: (510)266-1773** **e-mail: rifaat.nashed@dot.ca.gov** **Date of Review: 7/26/2011**
	Structure Information (Use when necessary to document comments by individual structure) **Structure Name: Marina Blvd. OC (Replace)** **Br No: 33-0735**		

Consultant Information (to be filled in by Consultant)

Consultant Structure Lead (First and Last Name)	Structure Consultant Firm	Phone Number	e-mail	Response Date

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	
1	Foundation Report (FR)	FR	Geotechnical Foundation Report for WMH Corporation, Oakland, by Parikh Consultant, Inc., dated May 20,2010.		
2	FR	**SUBSURFACE CONDITIONS** Page 4	Plate 2 (Site Plan) shows the location of borings that are not included in the report such as borings No. E-4, E-5 and R-6, whereas As-built borings No. B1, B2, B3, B4, No.1 and No.2 are not shown.	These borings were included in the GDMR; we have removed Borings E-4, E-5, and R-6 from the site plan to avoid any confusion. As-built borings have been included on the Site Plan (Plate 2).	
3	FR	**SUBSURFACE CONDITIONS** Page 4	The Statement " *The data indicate two dense layers,……..on the order of 50 blows/ ft in these layers"* should be revised due to the presence of a loose layer of silty sand with blow counts 12.	We have revised that statement and discussed the varying apparent density in the sand layers.	
4	FR	**APPENDIX A**	For Log Of Test borings, Sheet 1 of 3, the bench mark is missing as required by Soil/Rock classification manual.	The bench mark has been included in the Log of Test Boring.	

Note 1: Abbreviations for Typical Documents (if Abbr. is not below, type in the document type)					
P=Structure Plans	SP=Special Provisions	FR=Foundation Rpt	DC=Design Calcs	TS=Type Sel. Report	QCC=Quant. Check Calcs
RP=Road Plans	E=Estimate	H=Hydraulics Rpt	CC=Check Calcs	QC=Quant. Calcs	

✓= Comment Resolved (for Reviewer's use)

Office of Special Funded Projects
Comment & Response Form

(Revised 10/21/09)

General Project Information (OSFP Liaison to complete)	Review Phase (OSFP Liaison to complete)	Reviewer Information (Reviewer Liaison to complete)
Dist: 04 **EA:** 3A9211 **Project Name:** Marina Blvd O.C (Replace) **OSFP Liaison:** Yiwei Hu **Phone:** 916-227-8917 **e-mail:** Yiwei_hu@dot.ca.gov	__ PSR/PDS (Review No.___ __ APS/PSR (Review No.) X APS/PR (Review No. 1) _ Type Selection __ 65% PS&E Unchecked Details __ PS&E (Review No.__ __ Construction __ Other:_____	**Reviewer Name:** John Moore **Functional Unit:** GS **Phone Number:** (510) 622-8742 **e-mail:** j_moore@dot.ca.gov **Date of Review:** 2/2/10 **Structure Name*:** Marina Blvd. OC (Replace) **Br No*:** 33-0735 (*Use if necessary to when comment sheets are by individual structure)

Consultant Information (to be filled in by Consultant)

Consultant Structure Lead (First and Last Name)	Structure Consultant Firm	Phone Number	e-mail	Response Date
	Biggs Cardosa Associates	408-296-5515		

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
1	Foundation Report (FR)	FR	Geotechnical Foundation Report prepared for WMH Corporation, Oakland, CA, by Parikh Consultants, Inc., San Jose, CA; dated November 16, 2009		
2	FR	Page 3	In the second paragraph of "Field Exploration and Laboratory Testing," it is stated that, "When correlating standard penetration data, the blow counts for the Modified California sampler may be converted to equivalent SPT blow counts by multiplying a factor of 0.65." Please explain and provide the basis for this statement.	A paper titled "A method for correlating large penetration test (LPT) to standard penetration test (SPT) blow counts" by Chris R. Daniel, John A. Howie and Alex Sy (Canadian Geotechnical Journal 40:66-77, 2003) is referenced for the correlation between Mod. California (MC) and SPT blow counts. Based on the correlation suggested in the paper, it is reasonable to use a conversion factor of 0.65. The derivation and the reference paper are attached. Additional comparison of blow counts of different samplers in	

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✓= Comment Resolved (for Reviewer's use)

				different soil type and consistency are discussed in Fig 1.24 of the Foundation Engineering Handbook, 2nd ed., edited by Hsai-Yang Fang, 1991, Van Nostrand Reinhold.	
3	FR	Page 3	In the fourth paragraph of "Field Exploration and Laboratory Testing," it is stated that, "The soil resistance exerted to the tip and side of the cone were recorded and correlated to soil type, classification and strength characteristics." When CPT data is used, soils are classified by "soil behavior type", not "soil type", correct? Which classification chart was used?	Concur. We have revised the wording to "soil behavior type" in the report. Based on Gregg's submittal (attached in Appendix A), the CPT graphic presentation is based on the 12-zone Soil Behavior Type (Robertson et al 1986).	
4	FR	Page 8	Regarding the paragraph ***Predrill Near Existing Utility***, the word "exiting" should be changed to "existing." Please proofread report before submitting it.	Correction made as noted.	
5	FR	Page 10	In the table "Foundation Recommendations for Abutments," LRFD is referred to in two columns. LRFD is not used for abutments	We understand that foundation design at abutment is based on WSD. The format of the Table follows that shown in Memo To Designers 3-1, Attachment1 (Example 1), July 2008.	
6	FR	Page 15	In the "Corrosion" section, the word "exiting" should be changed to "existing." Please proofread report before submitting it.	Correction made as noted.	
7	FR	Page 15	In the "Corrosion" section, Caltrans Corrosion design guidelines are referred to. Please state what those design guidelines are. Please include Caltrans criteria defining corrosive soils.	Concur. The criteria per Caltrans Corrosion Guidelines (September 2003) – chloride concentration is 500 ppm or greater, sulfate concentration is 2000 ppm or greater, or the pH is 5.5 or less, are stated in the report.	
8	FR	FR	This office has not yet received the structural plans for review but suggests that both the geotechnical designer and the structural designer insure that there is consistency between the Pile Data Table listed in the foundation report and Pile Data Table shown on the plans. Pile Data Table inconsistencies are a common occurrence with Parikh Consultants, Inc. reports.	Coordinated with the structural designer to verify the consistency of the Pile Data Table shown on the plans and in the report.	

CORRELATION BETWEEN MOD. CALIFORNIA SAMPLER & SPT SAMPLER BLOW COUNTS PER DANIEL, HOWIE & SY (2003)

REF: A METHOD FOR CORRELATING LARGE PENETRATION TEST (LPT) TO STANDARD PENETRATION TEST (SPT) BLOW COUNTS
- CHRIS DANIEL, JOHN HOWIE & ALEX SY
- CANADIAN GEOTECH JOURNAL 40: 66-77 (2003)

MODIFIED CALIFORNIA SAMPLER (MC) : OD = 3", ID = 2.416" (W/ RINGS)
STANDARD PENETRATION TEST SAMPLER (SPT) : OD = 2", ID = 1.375"
USE THE SAME HAMMER ASSEMBLAGE : 140 lb & 30" DROP

PER THE PUBLICATION, $\frac{(N_{60})_{SPT}}{(N_{60})_{MC}} = \frac{(A_{TE})_{SPT}}{(A_{TE})_{MC}}$

$A_{TE} = C_1 A_T + C_2 (ID+OD)\pi \cdot L \cdot R_f$

PER THE PUBLICATION, ASSUME $C_1 = C_2 = 1.0$,

$A_T = \pi/4 (OD^2 - ID^2)$ - SAMPLER TIP BEARING AREA

L = EMBEDMENT DEPTH OF THE SAMPLER, USE 12"

$R_f = f_s/q_c$ (CPT FRICTION SLEEVE STRESS / CPT TIP STRESS)

R_f = 0.35% TYPICAL FOR GRANULAR SOIL AS STATED IN THE PAPER

= 3% TYPICAL FOR CLAY SOIL PER OUR OBSERVATION OF CPT DATA.

	SPT	MC
$A_T = \pi/4 (OD^2 - ID^2)$	$\pi/4 (2^2 - 1.375^2) = 1.66$	$\pi/4 (3^2 - 2.416^2) = 2.484$
$(ID+OD)\pi \cdot L$	$(1.375+2)\cdot\pi\cdot 12 = 127.23$	$(2.416+3)\cdot\pi\cdot 12 = 204.2$
$A_{TE} = C_1 A_T + C_2 (ID+OD)\pi L \cdot R_f$	$1.66 + 127.23 R_f$	$2.484 + 204.2 R_f$
GRANULAR SOIL, R_f = 0.35%	$(A_{TE})_{SPT} = 2.10$	$(A_{TE})_{MC} = 3.20$
CLAY SOIL, R_f = 3%	$(A_{TE})_{SPT} = 5.48$	$(A_{TE})_{MC} = 8.61$

$\therefore$ SAND — $\frac{(N_{60})_{SPT}}{(N_{60})_{MC}} = \frac{2.10}{3.20} = 0.66$

CLAY — $\frac{(N_{60})_{SPT}}{(N_{60})_{MC}} = \frac{5.48}{8.61} = 0.64$

FOR PRACTICAL DESIGN, IT IS REASONABLE TO USE A CONVERSION FACTOR OF 0.65 FOR $(N_{60})_{SPT}/(N_{60})_{MC}$

A method for correlating large penetration test (LPT) to standard penetration test (SPT) blow counts

Chris R. Daniel, John A. Howie, and Alex Sy

Abstract: The standard penetration test (SPT) split-spoon sampler is too small for investigations in gravelly soils. For this reason, several researchers have developed scaled-up versions of the SPT, commonly referred to as "large penetration tests" (LPT), and attempted to correlate the measured blow counts to SPT blow counts. Several LPTs have been in use worldwide; each with different drill rods, sampler dimensions, and hammer energies; hence existing published LPT–SPT correlations differ for each system. This paper summarizes the LPT data in the literature and presents a fundamental method for predicting LPT–SPT correlations. The proposed method is based on wave equation analyses of SPT and LPT and considers variations in test equipment, penetration resistance, and energy. It is shown that the method provides a unified approach for assimilating the various published LPT–SPT correlations. Additional SPT and LPT data were collected at a sand research site to check the proposed method and to expand the LPT database. The observed and predicted correlation factors are shown to be in good agreement. The proposed correlation method will be useful as a logical framework for the comparison of LPT data collected throughout the world. Additional research will be required to extend this procedure to gravel sites.

Key words: large penetration test, LPT, fundamental correlation method, wave equation analysis, grain size effects.

Résumé : L'essai de pénétration standard (SPT) avec l'échantillonneur à cuillère fendue est à une échelle trop petite pour les études dans les sols graveleux. En conséquence, plusieurs chercheurs ont développé des versions de SPT à plus grande échelle, auxquelles on réfère communément sous le vocable de « grands essais de pénétration » (LPT), et ils ont tenté de mettre en corrélation les nombres de coups mesurés avec les nombres de coups du SPT. Plusieurs LPT ont été utilisés à travers le monde; chacun avec des tiges de forage, des dimensions d'échantillonneur et des énergies de marteau différentes; ainsi, les corrélations LPT–SPT existantes publiées diffèrent pour chaque système. Cet article résume les données des LPT disponibles dans la littérature et présente une méthode fondamentale pour prédire les corrélations LPT–SPT. La méthode proposée est basée sur les analyses des équations de transmission d'ondes du SPT et des LPT et prend en considération les variations de l'équipement de l'essai, de la résistance à la pénétration et de l'énergie. On montre que la méthode fournit une approche unifiée pour comparer les diverses corrélations LPT–SPT publiées. Des données SPT et LPT additionnelles ont été recueillies sur un site de recherche constitué de sable pour vérifier la méthode proposée et élargir la base de données de LPT. On montre que les coefficients de corrélation observés et prédits sont en bonne concordance. La méthode de corrélation proposée sera utile comme cadre logique de comparaison des données de LPT recueillies à travers le monde. Des recherches additionnelles vont être requises pour étendre cette procédure aux sites de gravier.

Mots clés : grand essai de pénétration, LPT, méthode fondamentale de corrélation, analyse d'équation de transmission d'ondes, effets de granulométrie.

[Traduit par la Rédaction]

Introduction

Complex geotechnical engineering problems involving gravel deposits are appearing with increasing regularity in the literature. In some cases, engineers are attempting to utilize the known higher strength and stiffness of gravels for design, while in others engineers have found it necessary to re-assess the stability of existing gravel foundations in light of new evidence of gravel liquefaction during cyclic earthquake loading. In a sand deposit, the engineer would typically initiate a field investigation of these issues using the standard penetration test (SPT, see American Society for

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Table 1. Details of the SPT and four types of LPT.

Parameter	SPT[a]	JLPT[b]	Burmister LPT[c]	ILPT[d]	NALPT[e]
Sampler outer diameter, cm (in.)	5.08 (2)	7.3 (2.9)	9.21 (3.625)	14.0 (5.5)	7.62 (3)
Sampler inner diameter, cm (in.)					
Open shoe	3.49 (1.375)	5.0 (2)	7.44 (2.93)	10.0 (3.9)	6.1 (2.4)
Barrel (no liner)	3.81 (1.5)	5.4 (2.13)	na	11.0 (4.3)	6.4 (2.52)
Hammer weight, N (lb)	623 (140)	981 (220)	1112 (250)	5592 (1256)	1335 (300)
Hammer drop height, cm (in.)	76.2 (30)	150.0 (59.1)	50.8 (20)	50.0 (19.7)	76.2 (30)
Hammer potential energy, kJ (ft-kip)	0.473 (0.350)	1.472 (1.084)	0.565 (0.417)	2.796 (2.062)	1.020 (0.750)
% SPT	100	311	119	591	214
N_{SPT}/N_{LPT}					
Observed in sand	—	1.5	0.42	1.14[f]	—
Observed in gravel	—	2.0[g]	—	0.89–1.02[f]	—

Note: — indicates data not available; na indicates not applicable.
[a]ASTM D 1586–84.
[b]Kaito et al. (1971); Yoshida et al. (1988).
[c]Winterkorn and Fang (1975).
[d]Crova et al. (1993).
[e]Koester et al. (2000); Daniel (2000).
[f]SPT and ILPT blow counts used to develop this correlation were corrected to 60% ER_r and an effective overburden pressure of 100 kPa.
[g]Soil used to develop the correlation is classified as medium to coarse sand using the Unified Soil Classification (USC) system.

Testing and Materials (ASTM) D1586–84 for test details), the most widely used geotechnical characterization tool in the world, upon which numerous empirical design methods are based. The sampler dimensions and hammer potential energy of the SPT were originally selected for use in sands, however, and the SPT is generally considered either unreliable for use in gravel because of grain size effects or impractical because of insufficient input energy. Some researchers have attempted to overcome these problems by deriving equivalent SPT blow counts (N) from blow counts recorded using oversized split-spoon samplers and hammers, commonly referred to as "large penetration tests" (LPT). Others have begun developing new soil performance databases indexed directly to LPT blow counts. Several versions of the LPT have been developed independently worldwide. This paper summarizes LPT details from the literature, including published empirical LPT–SPT correlations, and presents a theoretical method of estimating equivalent SPT blow counts from those recorded using any combination of split-spoon sampler and hammer (i.e., any LPT). The method is based on wave equation analyses of SPT and LPT and considers variations in test equipment, penetration resistance, and energy. Carefully collected SPT and "North American LPT" (NALPT) data from a sand research site are compared to expand the LPT database and to check the proposed theoretical correlation procedure.

LPT in the literature

Though split-spoon samplers of varying dimensions are widely available, very few accounts of their use for geotechnical applications are given in the literature. The few descriptions that have been published are summarized below (names have been assigned by region of origin when necessary).

(1) Japanese LPT (JLPT)
First proposed by Kaito et al. (1971), JLPT–SPT correlation factors were developed for sands and gravels by Yoshida et al. (1988) using the results of saturated sand and gravel calibration chamber tests. The mean grain sizes (D_{50}) of the two "gravels" tested were 1.13 and 2.28 mm. A "Tonbi" type hammer was used for the tests, but penetration energy (ENTHRU) was not monitored. The sampler design is unique in that the outer diameter of the shoe is 73 mm while that of the barrel is only 70 mm.

(2) Burmister LPT
Winterkorn and Fang (1975) provided a Burmister LPT–SPT correlation factor based on field data gathered in sands. The ENTHRU was not monitored during the testing.

(3) Italian LPT (ILPT)
Crova et al. (1993) provided ILPT–SPT correlation factors based on field data from sands and sandy gravels at the Messina bridge site in Italy. The mean grain size of the sandy gravels ranged from roughly 0.5 to 44 mm. The ENTHRU was measured using the force-squared (F^2) method. The SPT and ILPT blow counts were corrected to 60% of the theoretical hammer energies.

(4) North American LPT (NALPT)
Koester et al. (2000) and Daniel (2000) describe an investigation of sandy gravels and gravelly sands near Seward, Alaska that are believed to have liquefied during the 1964 Good Friday earthquake. The testing program included SPT, NALPT, and dynamic cone penetration tests (DCPT). The ENTHRU was measured using both the F^2 and force-velocity (FV) methods. The SPT and NALPT blow counts were corrected to 60% of the theoretical hammer energies.

Test details and observed LPT–SPT correlation factors are summarized in Table 1. The inner and outer sampler diame-

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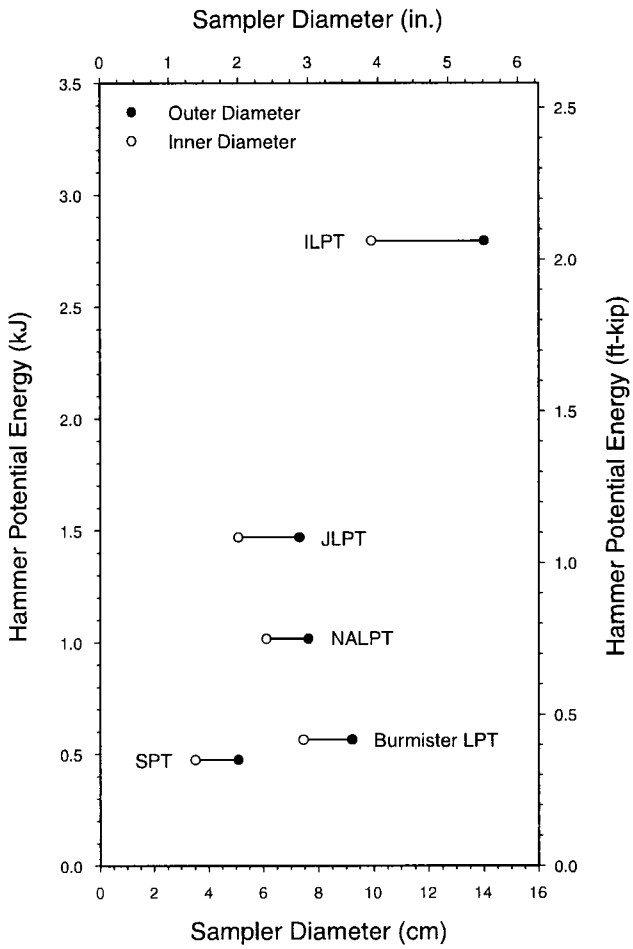
Fig. 1. Comparison of SPT and LPT equipment details.



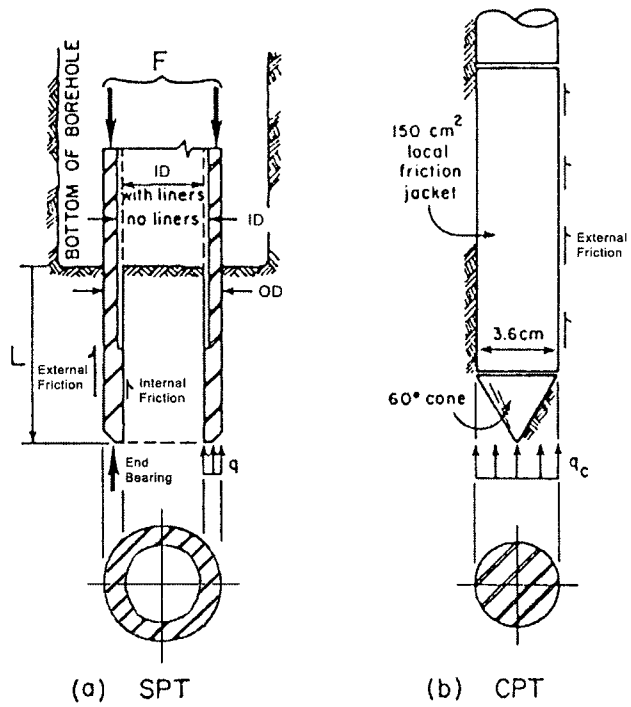
ters and the hammer energies are compared graphically in Fig. 1.

The correlation factors listed in Table 1 differ mainly because of differences in the LPT test equipment, though some variations of the SPT equipment actually used are to be expected. Comparison of the correlation factors is further complicated by the fact that only half are derived from energy corrected blow counts. A method of correlation that specifically addresses variations of hammer potential energy, efficiency of energy transfer, and relative magnitudes of sampler penetration resistance is developed herein.

Framework for comparison of LPT and SPT

The blow count measured during an LPT or SPT is mainly a function of the resistance acting on the sampler during penetration and the input energy of the test. These are comparable to the factors affecting the penetration of a pile. Thus, it is possible to gain insight into the relationship between different sampler, rod, and hammer systems used during SPT and LPT using wave equation modelling techniques developed for pile driving. Wave equation modelling software that considers damping forces may be used to predict blow counts based on the details of the hammer, rods and

Fig. 2. Forces acting on (*a*) an SPT split-spoon sampler and (*b*) a standard 10 cm^2 CPT during quasistatic penetration (modified after Schmertmann 1979).



sampler, and estimated soil parameters. Background information relevant to such a study is presented below.

Penetration resistance considerations

Schmertmann (1979) compared the resistance acting on an SPT sampler penetrating soil at a slow, steady rate to that acting on a standard 10.0 cm^2 cone during a cone penetration test (CPT, Fig. 2). He hypothesized that the force (F) required for "quasistatic" penetration of an SPT sampler at the standard CPT penetration rate of 2 cm/s could be estimated from CPT measurements at the same depth using the formula

$$[1] \qquad F = [C_1 A_T + C_2(\mathrm{ID} + \mathrm{OD})\pi L R_f] q_c - W'$$

where

C_1 is the SPT-CPT end bearing correlation factor;
$A_T = \pi/4(\mathrm{OD}^2 - \mathrm{ID}^2)$ is the sampler tip bearing area;
C_2 is the SPT-CPT friction correlation factor;
ID is the sampler inner diameter (cm);
OD is the sampler outer diameter (cm);
L is the embedment depth of the split-spoon (cm);
$R_f = f_s/q_c$;
f_s is the measured CPT friction sleeve stress (N/cm^2)
q_c is the measured CPT tip stress (N/cm^2); and
W' is the buoyant weight of the drill rods (N).

Schmertmann compared CPT data obtained with a Begemann mechanical cone to F measurements obtained at the same depths and proposed C_1 and C_2 values of 1.0 and 0.7, respectively. He suggested that the measured f_s was too high because of the design of the mechanical cone and predicted that both C_1 and C_2 would be roughly equal to 1.0 for electric cone data. Sy and Campanella (1991*a*) used this ap-

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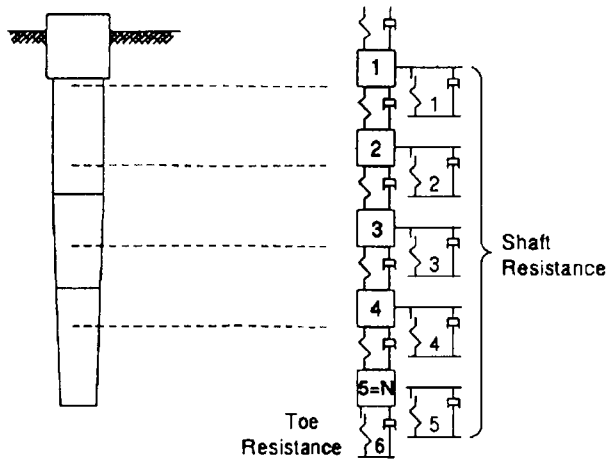
Fig. 3. Typical pile or drill rod model for a wave equation analysis (modified after GRLWEAP 1997).



proach to estimate static penetration resistance values for wave equation analyses of SPT data. The widely used Laboratoire Central des Ponts et Chaussées (LCPC) pile design method described by Bustamante and Gianeselli (1982) uses a similar approach to estimate the axial capacity of driven piles from CPT data.

Energy input

The efficiency of energy transfer from the hammer to the drill rods is quantified by the rod energy ratio (ER_r)

$$[2] \qquad ER_r = \frac{ENTHRU}{WH} 100\%$$

where ENTHRU is the stress wave energy passing a measurement point on the drill rods, W is the hammer weight, and H is the hammer drop height. One can measure ENTHRU using the F^2 method described in ASTM D4633–86 or the FV method that was first recommended for SPT applications by Sy and Campanella (1991*b*).

Schmertmann and Palacios (1979) showed that measured SPT blow counts are inversely proportional to the energy ratio for blow counts less than 50. Seed et al. (1985) and Skempton (1986) subsequently proposed that measured blow counts should be corrected to the value that would have been recorded if a standard amount of energy had been transmitted through the rods. A standard value of 60% of the hammer potential energy has been adopted because it is the historical average measured for most drill rigs and operators. The energy corrected SPT blow count $(N_{60})_{SPT}$ is calculated using inverse proportionality as follows:

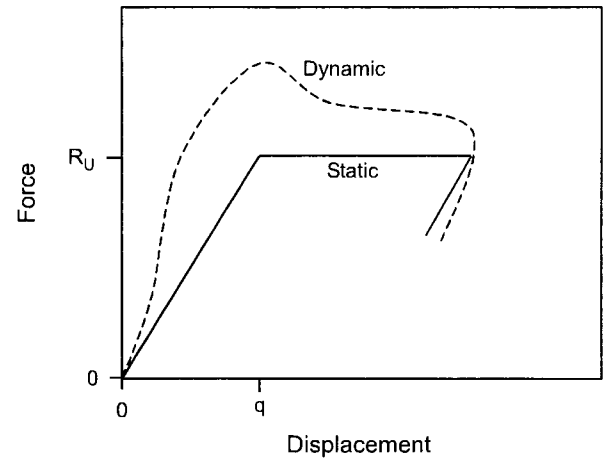
$$[3] \qquad (N_{60})_{SPT} = (N)_{SPT} \frac{ER_r}{60\%}$$

Similarly, energy corrected LPT blow counts are calculated using the formula

$$[4] \qquad (N_{ER_s})_{LPT} = (N)_{LPT} \frac{ER_r}{ER_s}$$

where ER_S is the selected standard energy ratio for the particular hammer and rods. Note that ENTHRU should be measured during each test because the energy ratio can vary with depth.

Fig. 4. Idealized soil response to static and dynamic loading.



Wave equation modeling

As described above, the measured blow count is primarily a function of the penetration resistance and the input energy. It would be simple to relate the work done by the sampler to the hammer input energy if the soil behaved as a plastic or elastic-plastic material. It is well known, however, that damping forces contribute significantly to the total resistance force acting on the sampler. The damping force is a function of the sampler penetration rate that is, in turn, a function of the characteristics of the stress wave that transfers energy from the plane of impact to the sampler-soil interface.

A widely used commercial wave equation program, GRLWEAP (GRLWEAP 1997), models drill rods subjected to dynamic loading as a series of discrete elements connected by spring and dashpot pairs, as shown in Fig. 3. The mass of each element and the stiffness of each spring are determined from the density, elastic modulus, and cross-sectional area of the drill rods they represent. Damping forces in the steel rods are low and empirical dashpot parameters are typically used. The same approach is used to model the hammer.

The total resistance to sampler penetration includes both static (S) and dynamic (D) components. It is assumed that the static component is elastic-plastic in nature and is present during driving and subsequent static loading. Input soil parameters for the static component are the ultimate static resistance (R_u) and the quake (q), as shown in Fig. 4. It is assumed that the dynamic component is directly proportional to the product of the velocity and the ultimate static resistance (Smith Damping)

$$[5] \qquad D = J V R_u$$

where J is the Smith damping factor, and V is the velocity.

Conceptually, all rod elements are at rest and all hammer elements are moving with an assigned velocity at the beginning of a hammer blow (or program execution). The program calculates the dashpot resistance and spring displacement over a very short time step at existing element velocities. The resulting net forces that act on each element are used to

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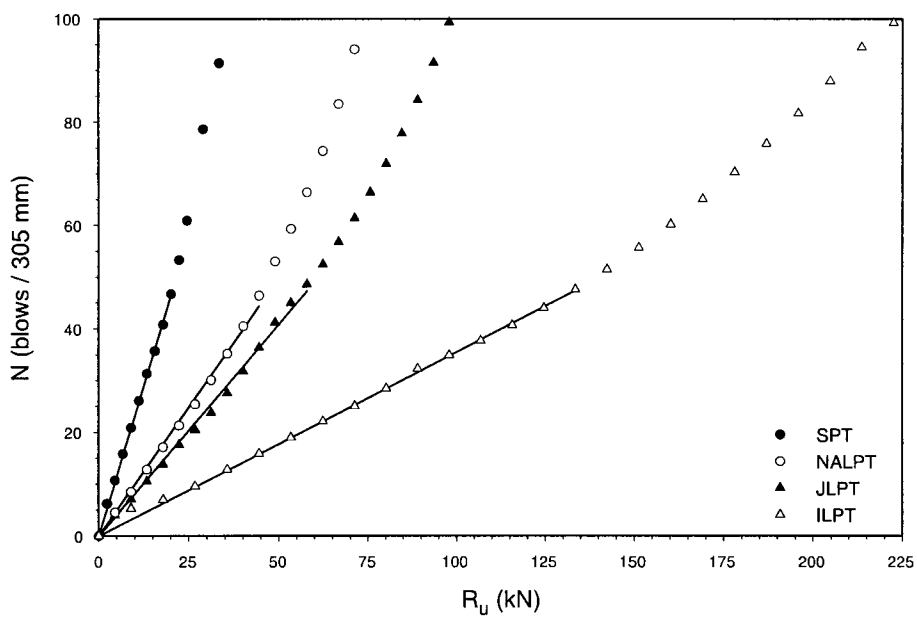
Table 2. Input for wave equation analyses of the SPT, NALPT, JLPT, and ILPT.

Detail	Units	SPT	NALPT	JLPT	ILPT
Hammer weight	N	623	1335	981	5592
	(lb)	(140)	(300)	(220)	(1256)
Hammer length	cm	53.3	69.9	36.8	59.9
	(in.)	(21)	(27.5)	(14.5)	(23.6)
Hammer diameter	cm	14.0	17.8	21.1	39.1
	(in.)	(5.5)	(7)	(8.3)	(15.4)
Drop height	cm	76.2	76.2	150	50
	(in.)	(30)	(30)	(59)	(19.7)
ER_r	(%)	60	60	60	60
ENTHRU	kJ	0.285	0.610	0.883	1.678
	(ft-kip)	(0.210)	(0.450)	(0.649)	(1.237)
Rod length	m	17.83	17.83	17.83	17.83
	(ft)	(58.5)	(58.5)	(58.5)	(58.5)
Rod area	cm^2	8.0	9.3	10.1	60.6
	($in.^2$)	(1.24)	(1.44)	(1.57)	(9.4)
Sampler area[a]	cm^2	8.8	13.9	18.8	59.4
	($in.^2$)	(1.37)	(2.16)	(2.93)	(9.2)
Sampler length	cm	45.7	45.7	45.7	45.7
	(in.)	(18)	(18)	(18)	(18)

[a]Calculated using the inner diameter of the sampler barrel (this is the applicable steel cross-sectional area for the majority of the sampler).

Fig. 5. Wave equation analysis results for SPT, NALPT, JLPT, and ILPT (ER_r = 60%).



calculate element-specific accelerations using Newton's second law. New velocities and displacements are then calculated for the next time-step using the revised accelerations. This process is repeated until all spring forces and element velocities are zero. The final displacement of the sampler is then used to calculate the blow count (number of blows for 305 mm displacement).

Proposed LPT–SPT correlation method

Wave equation analyses of the SPT, NALPT, JLPT, and ILPT were performed using GRLWEAP. Table 2 summarizes the input parameters used for each analysis (the Burmister LPT was not analysed because relevant test details were not available). The soil parameters used were those recommended in the GRLWEAP manual for granular soils. Soil resistance was applied over the bottom 305 mm (12 in.) of the sampler to simulate the average sampler embedment depth during an SPT or LPT. The inner diameter of the sampler barrel (no liner) was used to calculate the sampler area because the majority of the sampler has this cross-sectional area of steel. All SPT and LPT blow counts were referenced to an energy ratio of 60% for convenience. The predicted blow counts (N) are plotted in Fig. 5 as a

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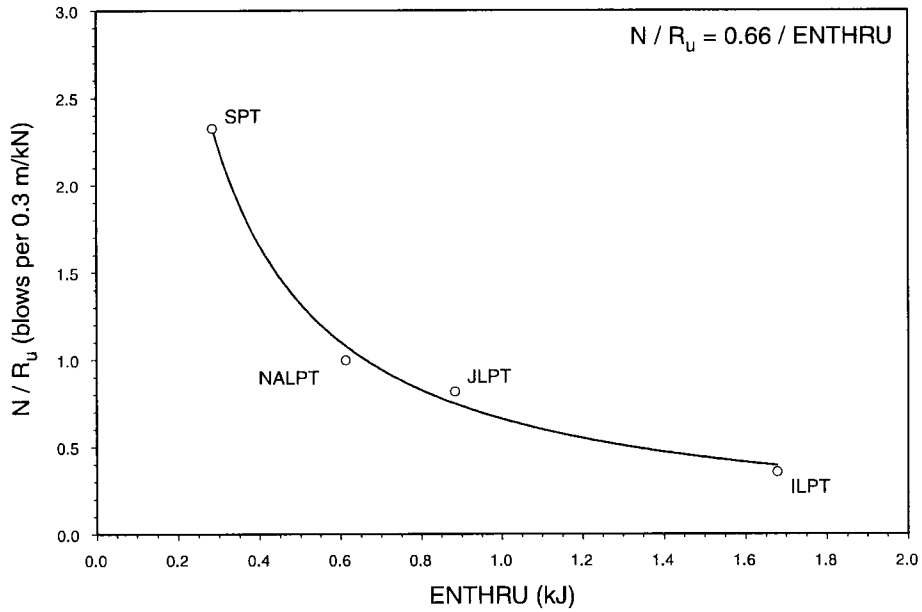
Fig. 6. Wave equation analysis results showing inversely proportional relationship between the blow count to soil resistance ratio (N/R_u) and ENTHRU.



function of the ultimate static resistance R_u for each of the penetration tests.

Figure 5 illustrates that, for a given test system and ENTHRU, N increases with R_u. This trend is similar to the bearing graphs used to relate pile capacity to pile penetration resistance (e.g., Authier and Fellenius 1983). Note that the relationships between N and R_u are essentially linear for blow counts less than about 50. This is convenient because each test type can be uniquely defined by the slope of its best-fit line, i.e., the blow count to soil resistance ratio (N/R_u). Figure 6 compares the ratios determined for each of the tests shown in Fig. 5 to the corresponding ENTHRU values. The data are well represented by a single best-fit curve, wherein the N/R_u ratios are inversely proportional to ENTHRU. This is equivalent to the inversely proportional blow count to input energy relationship observed by Schmertmann and Palacios (1979). Sensitivity analyses performed by the authors indicate that, although the vertical position and, to a lesser extent, the shape of the best-fit curve in Fig. 6 are functions of the input soil parameters (quake and damping) and the geometry of the hammer and drill rods, ENTHRU is the dominant factor controlling the magnitude of the N/R_u ratio for a given test. Using an energy ratio other than 60% for any of the SPT or LPT wave equation analyses causes the corresponding data point in Fig. 6 to move parallel to the best-fit curve. This indicates that equations similar to eqs. [3] and [4] may be useful for correlating LPT to SPT blow counts.

Figure 6 shows that, for a given site condition, all of the dynamic penetration tests can theoretically be correlated to each other. More specifically, any LPT blow count (N_{LPT}) can be correlated to an SPT blow count (N_{SPT}) provided the ENTHRU and relative sampler penetration resistances are known. The relative penetration resistances may be quantified by the appropriate values of R_u, which are very similar to the quasistatic penetration resistance value F described by Schmertmann (1979). As a first approximation, the blow count for any of the SPT or LPT systems may be estimated using the equation

$$[6] \qquad N_{ER_S} = (N/R_u)F$$

as long as (ER_S) is the energy ratio used to determine the N/R_u ratio. Similarly, the correlation factor between the SPT and any of the LPTs may be estimated by taking the ratio of the two

$$[7] \qquad \frac{(N_{60})_{SPT}}{(N_{ER_S})_{LPT}} = \frac{(N/R_u)_{SPT}F_{SPT}}{(N/R_u)_{LPT}F_{LPT}}$$

Alternatively, since the N/R_u ratios of the SPT and LPTs are well approximated by an inversely proportional relationship (Fig. 6), the various ratios are related as follows:

$$[8] \qquad \frac{(N/R_u)_{SPT}}{(N/R_u)_{LPT}} = \frac{0.66(\text{ENTHRU})_{LPT}}{0.66(\text{ENTHRU})_{SPT}}$$

and so eq. [7] can be written as

$$[9] \qquad \frac{(N_{60})_{SPT}}{(N_{ER_S})_{LPT}} = \frac{(\text{ENTHRU})_{LPT}F_{SPT}}{(\text{ENTHRU})_{SPT}F_{LPT}}$$

Referring to eq. [1], the ratio of the quasistatic penetration resistances F may be determined entirely from the geometry of the split-spoon samplers if it is assumed that the buoyant unit weight of the rods is negligible; and the same values of CPT q_c and R_f may be used for the SPT and LPT (i.e., no scale effects).

Equation [9] then reduces to

$$[10] \qquad \frac{(N_{60})_{SPT}}{(N_{ER_S})_{LPT}} = \frac{(\text{ENTHRU})_{LPT}(A_{TE})_{SPT}}{(\text{ENTHRU})_{SPT}(A_{TE})_{LPT}}$$

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Table 3. Application of proposed correlation method to four types of LPT.

Test	A_T, cm^2 (in.^{2})	A_F, cm^2 (in.^{2})	A_{TE},[a] cm^2 (in.^{2})	ER_r (%)	ENTHRU, kJ (ft·kip)	$\frac{(N_{60})_{SPT}}{(N_{60})_{LPT}}$
SPT	10.71	820.6	13.58	60	0.285	na
	(1.66)	(127.2)	(2.10)		(0.210)	
NALPT	16.39	1313.5	20.99	60	0.610	1.38
	(2.54)	(203.6)	(3.26)		(0.450)	
JLPT	22.32	1191.6	26.49	60	0.883	1.58
	(3.46)	(184.7)	(4.11)		(0.649)	
Burmister LPT	23.15	1595.4	28.73	60	0.339	0.56
	(3.59)	(247.3)	(4.45)		(0.250)	
ILPT	76.19	2286.4	84.19	60	1.678	0.95
	(11.81)	(354.4)	(13.05)		(1.237)	

Note: na indicates data not applicable.
[a]Assumes $C_1 = C_2 = 1.0$, $R_f = 0.35\%$.

where the effective sampler bearing area (A_{TE}) is defined by

$$[11] \quad A_{TE} = C_1 A_T + C_2(\mathrm{ID} + \mathrm{OD})\pi L R_f = C_1 A_T + C_2 A_F R_f$$

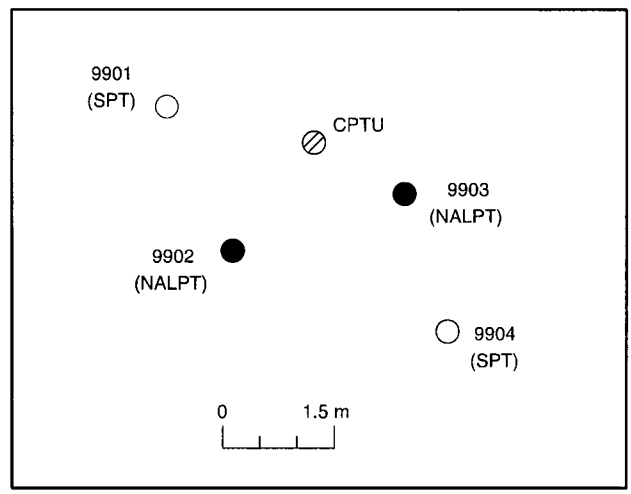
Equation [10] shows that the LPT–SPT correlation factor (N_{SPT}/N_{LPT}) is a function only of the transferred energy in the drill rods, ENTHRU, and the sampler bearing area, A_{TE}. Thus, given the ENTHRU and A_{TE} of any LPT system, the N_{LPT} can theoretically be correlated to N_{SPT} by this simple relationship. As for the wave equation analyses, a sampler embedment depth L of 305 mm (12″) should be used to calculate A_{TE}. Unlike the wave equation analysis, the inner diameter of the open shoe should be used to calculate A_{TE}, as the majority of the internal frictional forces will be generated in the shoe. Table 3 summarizes calculated values of A_T, sampler frictional area (A_F), and A_{TE}, assuming $C_1 = C_2 = 1.0$, and predicted correlation factors from eq. [10] for the NALPT, JLPT, and ILPT. An R_f of 0.35% has been assumed as a typical value for granular deposits. Because the available database is so limited, the correlation factor for the Burmister LPT has also been calculated, assuming a rod energy ratio of 60%.

The predicted ILPT–SPT correlation factor of 0.95 is in excellent agreement with the observed average field values of 1.14 and 0.96 for sand and gravel sites, respectively. The predicted JLPT–SPT correlation factor of 1.58 is also in good agreement with the observed calibration chamber values of 1.5 and 2.0 for sands and "gravels", respectively. The predicted Burmister LPT–SPT correlation factor of 0.56 is in good agreement with the observed value of 0.42. A field research program was carried out by the authors to further investigate the suitability of the correlation method described above.

Field verification

Drilling and in situ testing were conducted at a sand site called "Kidd2" on the Fraser River Delta near Vancouver, BC, Canada (Daniel 2000). This site was well characterized during the Canadian Liquefaction Experiment (CANLEX) and during subsequent UBC research efforts (e.g., Howie et al. 1999; Daniel et al. 1999). For the current study, four mud-rotary test holes and one piezocone penetration test (CPTU) were completed to roughly 20 m depth in a diamond pattern (Fig. 7). The SPTs were carried out in two of the test holes (9901 and 9904) and NALPTs in the other two (9902 and 9903). The site stratigraphy consisted of roughly 4 m of clayey silt, underlain by sand and silty sand to greater than 20 m depth, as shown by the CPTU data in Fig. 8. Also shown in Fig. 8 are four CPTU corrected tip stress (q_t) profiles recorded at Kidd2 during the CANLEX study to illustrate the relatively low degree of lateral variability at the site. The mean grain size of the sand samples recovered during the current investigation ranged from 0.19 to 0.56 mm (Fig. 9). Quasistatic penetration tests of SPT and LPT samplers, similar to those performed by Schmertmann (1979), were conducted in addition to the dynamic penetration tests in the four mud-rotary test holes.

Fig. 7. Plan view of test hole layout, Kidd2 site.



Quasistatic testing

Quasistatic penetration tests of SPT and NALPT samplers were conducted at selected test depths using a constant flow-rate hydraulic ram calibrated to a penetration rate of 2 cm/s. The axial force in the drill rods was monitored using piezoresistive strain gauges attached to one of the rods. The strain gauge voltage output was recorded as a function of time using a strip chart and transformed to force using linear calibration factors determined under controlled laboratory

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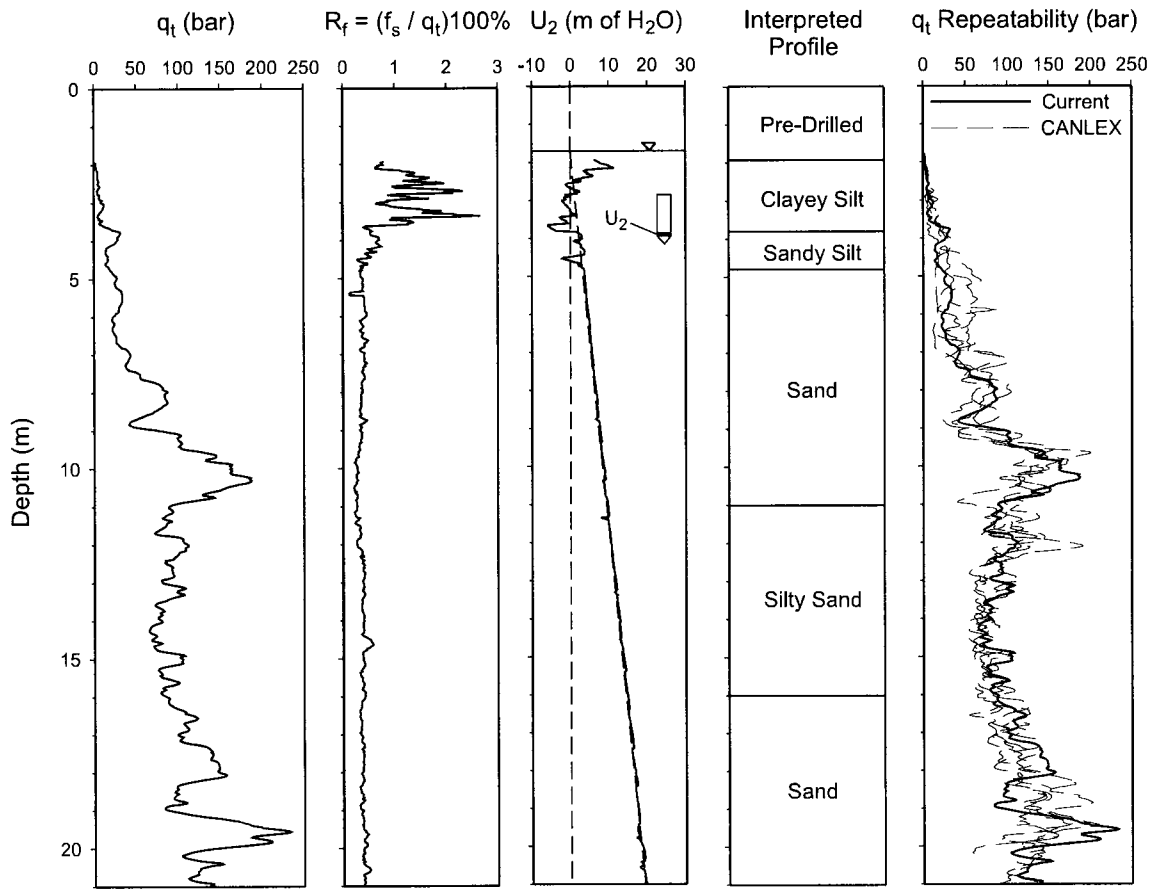
Fig. 8. Cone penetration test data, Kidd2 site.



conditions. Figure 10 shows a typical voltage versus time plot recorded during quasistatic penetration of the SPT sampler in sand. Figure 11 compares the total applied force (i.e., the measured axial force plus the rod weight) recorded at 305 mm (12 in.) sampler penetration to the forces predicted using the measured CPTU data as input for eq. [1]. Assuming that the values of C_1 and C_2 are both equal to a single value C, the best-fit relationship shown in Fig. 11 indicates that the actual value of C is about 1.4 for the SPT and NALPT samplers. The proposed correlation method is unchanged, however, because C appears in both the numerator and denominator of eq. [10].

Dynamic testing

The SPTs and NALPTs were performed at 1.5 m depth intervals. The NALPT sampler used had the dimensions listed in Table 1. A 1460 N (328 lb) safety hammer with a drop height of 762 mm (30 in.) was used, yielding a hammer potential energy of 1115 J (820 ft·lb). Hammer kinetic energy was measured using a commercial radar system that records velocity as a function of time, as shown in Fig. 12. Average hammer impact velocities were 3.14 and 3.42 m/s (10.3 and 11.24 ft/s) for the SPT and NALPT, respectively. The corresponding hammer kinetic energies were 65 and 78.5% of the hammer potential energies for the SPT and NALPT, respectively. The ENTHRU was measured for each hammer blow using a proprietary dynamic energy monitoring (DEM) sys-

Fig. 9. Envelope of grain size distribution curves for sand samples collected at the Kidd2 site.

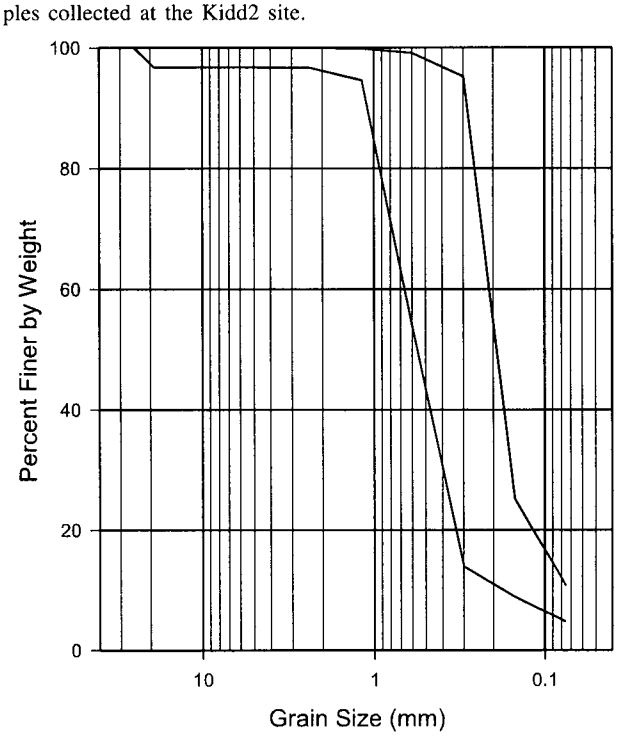


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Fig. 10. Typical strip chart record of axial force in rods during the quasistatic penetration of an SPT sampler in sand, Kidd2 site.

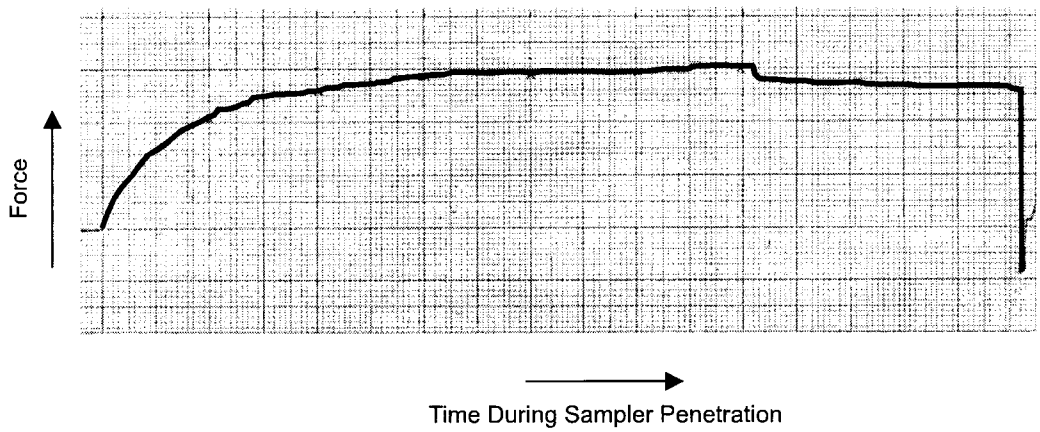


Fig. 11. Comparison of measured and predicted forces required for quasistatic penetration of SPT and NALPT samplers embedded 0.3 m (12 in.) in sand.

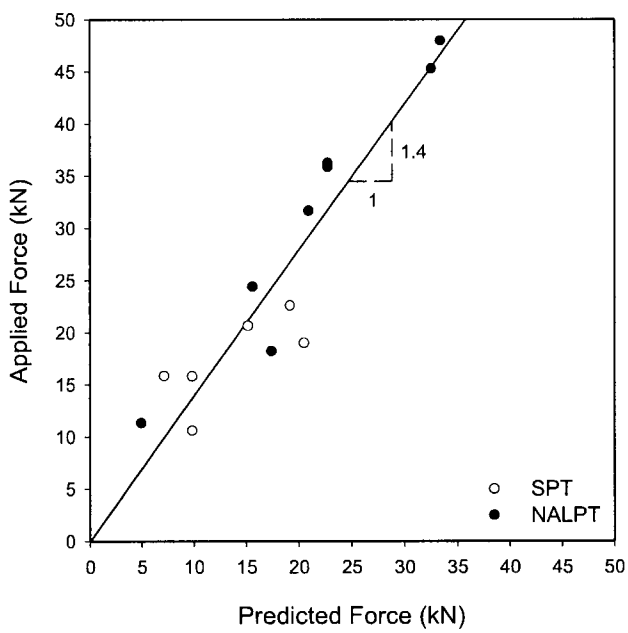
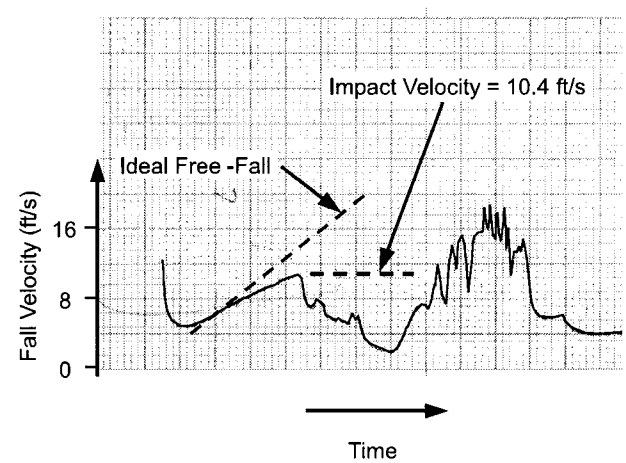


Fig. 12. Typical strip chart record of SPT hammer fall velocity measured with radar system, Kidd2 site.



tem. The DEM consisted of a personal computer, signal-processing equipment, and a drill rod instrumented with four strain gauges and a high-capacity accelerometer. The data recorded with the DEM were used to calculate ENTHRU using the F^2 and FV methods. The SPT and NALPT blow counts were corrected to 60% of the hammer potential energies listed in Table 1 using eqs. [3] and [4]. In this manner, a data set consisting of two SPT and two NALPT energy corrected blow counts at each test depth was developed. Overburden corrections were not applied because the blow counts to be compared were obtained at the same depths.

The CPTU corrected tip resistance (q_t) and energy corrected SPT and NALPT blow counts are plotted as a function of depth in Fig. 13, and the energy corrected SPT and NALPT blow counts are directly compared in Fig. 14. The observed correlation factor $[(N_{60})_{SPT}/(N_{60})_{NALPT}]$ is 1.29, which is in good agreement with the predicted correlation factor of 1.38.

Discussion

Table 4 summarizes the observed and predicted correlation factors. Note that Crova et al. (1993) applied overburden correction factors to the recorded SPT and ILPT blow counts. Since the correlation factors were determined by comparing blow counts that were recorded at the same depth, they are independent of the overburden corrections.

Conceptually, the predicted correlation factors should be compared to those observed for sands, which should be free of grain size effects. The observed sand correlations and the predicted correlations are both plotted versus the ratio of ENTHRU to A_{TE} in Fig. 15 (note that eq. [10] is represented by a single line on this plot). The observed Burmister LPT, ILPT, NALPT, and JLPT correlation factors are 75, 120, 93, and 95% of the predicted values, respectively. This agreement is likely near the level of accuracy of the observed correlations because factors such as natural site variability (Fig. 8) and, in the cases of the JLPT and Burmister LPT

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Fig. 13. CPTU tip resistance and energy-corrected SPT and NALPT blow counts, Kidd2 site.

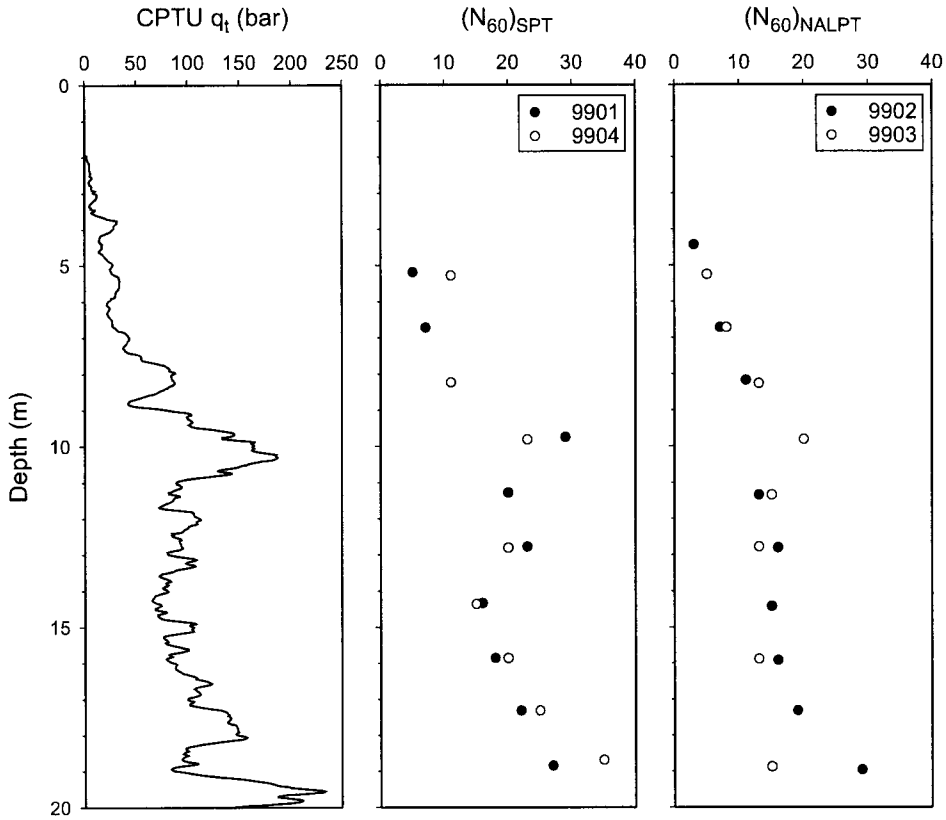
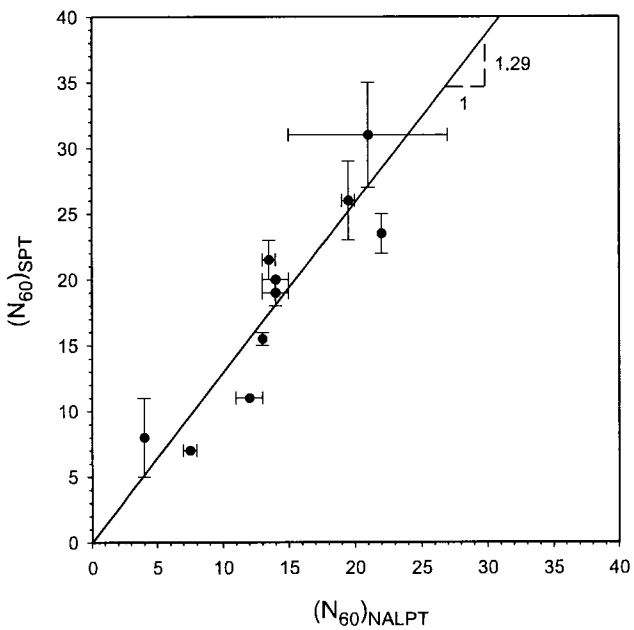


Fig. 14. Comparison of SPT and NALPT energy-corrected blow counts recorded in sand, Kidd2 site.



studies, lack of energy correction increase the overall level of uncertainty.

Table 4 also presents the correlation factors that were observed in gravels. It is generally believed that blow counts for a given test system and soil density will increase with increasing grain size and that, for a given gravel, SPT blow counts will be subject to more severe grain size effects than LPT blow counts. Thus, it would be anticipated that the ratio of SPT to LPT blow counts should tend to increase with increasing grain size, as shown by the JLPT correlations. However, the observed JLPT correlation factor increase (from 1.5 to 2.0) is large compared to the range of soil types tested (fine to coarse sand), and the observed increase may be partly due to uncertainties associated with the lack of energy correction or the use of un-aged calibration chamber samples. In contrast, the results of the well-controlled ILPT study show the opposite, counter-intuitive response. This apparent contradiction has not been explained in the literature to date and is one component of an ongoing UBC investigation.

Conclusions

LPT data from the literature have been summarized, and a fundamental method of predicting LPT–SPT correlation factors for any type of LPT has been presented. It is shown in this paper that the proposed method is easy to apply and that it uniquely relates the LPT–SPT correlation factor to the transferred energy and sampler bearing area of the LPT under consideration. A carefully controlled NALPT field investigation was conducted to check the assumptions of the proposed method and to enlarge the existing LPT database. Comparisons of the correlation factors from the literature and from the NALPT field investigation to those predicted

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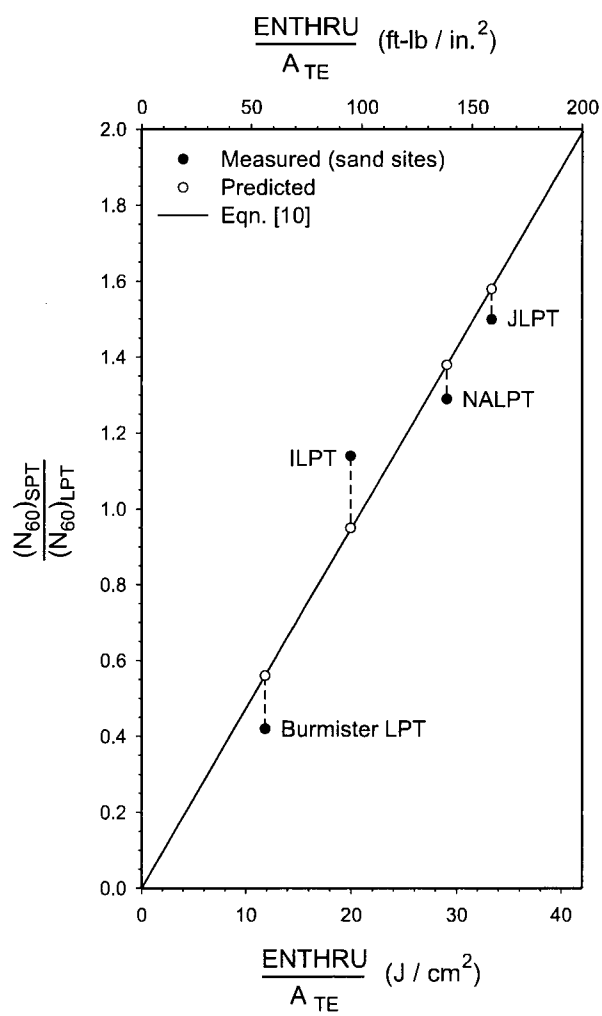
Table 4. Summary of observed and predicted correlation factors.

Test	Observed: Location	Observed: Soil type	D_{50} (mm)	$\frac{N_{SPT}}{N_{LPT}}$	Predicted[a] $\frac{(N_{60})_{SPT}}{(N_{60})_{LPT}}$
NALPT[b]	Kidd2	Sand	0.19–0.56	1.29	1.38
JLPT[c]	Calibration chamber	Fine sand	0.34	1.5	1.58
		Medium to coarse sand	1.13–2.28	2.0	
Burmister LPT[c]	NA	Sand and silt	—	0.42	0.56
ILPT[b]	Messina, Italy	Sand	0.2–0.6	1.14	0.95
		Sand and gravel	1–5	1.02	
		Sand and gravel	1–15	0.89	

Note: — indicates data not available.
[a]Equation [10] of this paper.
[b]N_{SPT}/N_{LPT} corrected to ER_r = 60%.
[c]No energy correction explicitly indicated by researcher.

Fig. 15. Comparison of predicted correlation factors to those observed at sand sites.



using the proposed correlation method yielded encouraging results. Additional data are required to further verify the proposed methodology. These data should be collected at both sand and gravel sites using a range of split-spoon samplers and hammers (i.e., as many types of LPT as possible). It is of critical importance that the penetration energy is monitored, and that all blow counts are corrected to a standard energy appropriate to the LPT with which they were recorded. It is suggested that all SPT and LPT blow counts be normalized to 60% of the potential energy of the hammer used for the test. The authors feel that the proposed correlation method will be useful as a logical framework for comparison of LPT data collected throughout the world.

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List of symbols

A_F split-spoon sampler frictional area
A_T split-spoon sampler tip bearing area
A_{TE} effective sampler bearing area
C generalized SPT-CPT correlation factor
C_1 SPT-CPT end bearing correlation factor
C_2 SPT-CPT friction correlation factor
CPT cone penetration test
CPTU piezocone penetration test
D_{50} mean grain size
D dynamic component of soil resistance
DCPT dynamic cone penetration test
DEM dynamic energy monitoring system
ENTHRU stress wave energy
ER_r rod energy ratio
ER_S selected standard energy ratio
f_s CPT or CPTU friction sleeve stress
F force required for quasi-static penetration of a split-spoon sampler
F^2 force-squared energy measurement method
FV force-velocity energy measurement method
H hammer drop height
ID split-spoon sampler inner diameter
ILPT Italian large penetration test
J Smith damping factor
JLPT Japanese large penetration test
L embedment depth of split-spoon sampler
N blow count
N_{60} blow count normalized to 60% energy ratio
$(N_1)_{60}$ blow count normalized to 60% energy ratio and effective overburden pressure of 100 kPa
N_{ER_s} blow count normalized to selected standard energy ratio (ER_S)
NALPT North American large penetration test
OD split-spoon sampler outer diameter
q soil quake
q_c CPT or CPTU tip resistance
q_t CPTU corrected tip resistance
R_f CPT friction ratio
R_u ultimate static resistance of soil
S static component of soil resistance
SPT standard penetration test
U_2 pore-water pressure measured behind the cone tip during CPTU
V velocity
W' buoyant weight of drill rods
W hammer weight

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GEOLOGIC MAP ..... Plate 3

FAULT MAP ..... Plate 4

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Appendix A

Log of Test Borings (Br. No. 33-0736)

As-Built Boring Data (Br. No. 37-0168, Caltrans 1968)

CPT Site Investigation Report by Gregg In-Situ, Inc. (June 6, 2008)

Appendix B

Laboratory Test Data

Appendix C

C-1: Generalized Soil Profile, Strength Parameters & Pile Capacity Evaluation
C-2: Liquefaction Potential per CPT Procedures
C-3: Embankment Settlement & Stability Evaluation
C-4: LPILE Analyses

Appendix D

Comment & Response Form (July 26, 2011)
Comment & Response Form (February 2, 2010)

FOUNDATION REPORT
ROUTE 112/880 SEPARATION (REPLACE)
(BRIDGE NO. 33-0736)
ALAMEDA COUNTY, CALIFORNIA
04-ALA-880 EA 3A9211

INTRODUCTION

This report presents the results of our geotechnical engineering investigation for the proposed Route 112/880 Separation (Replace), hereinafter referred to as "PROJECT", in Alameda County, California. The work was performed in general accordance with the scope of work outlined in our proposal to WMH Corporation. The general location of the project site and its vicinity are shown on the Project Location Map, Plate 1.

The geotechnical recommendations presented in this report are intended for design input and are not intended to be used as specifications. These recommendations should not be used for direct bidding purposes and cost estimate.

PROPOSED CONSTRUCTION

A new High Occupancy Vehicle (HOV) lane is proposed from Hegenberger Road overcrossing to the existing HOV lane south of Marina Boulevard. The new HOV lane will increase capacity in the Interstate-880 (I-880) corridor to reduce delay for HOV lane and mixed flow vehicles, reduce the accident rate and improve safety along I-880. The existing Route 112/880 Separation is a seven-span structure, approximately 341 feet long. The structure was originally built in 1952 and was widened in 1971.

The Route 112/880 Separation will need to be reconstructed to accommodate the new HOV lane. The structure will be widened to conform to interchange improvement works. The profile of the bridge will be raised to provide standard vertical clearance over I-880. The proposed Route 112/880 Separation (Replace) will be a 2-span, cast-in-place/prestressed concrete box girder structure with approximate length of 265 feet measured along "DA1" line and approximate width of 110 feet. The bent and abutments will be supported on pile caps with Caltrans standard Class 200 Alt. "W" pipe piles (16-inch diameter open end pipe). The wingwalls will be supported on Class 90 Alt. "W" pipe piles (14-inch diameter open end pipe).

PURPOSE AND SCOPE

The purpose of this investigation was to evaluate the general subsurface conditions at the project site, to evaluate their engineering properties, and to provide geotechnical recommendations for foundation design of the proposed project.

The scope of work performed for this investigation included a review of the readily available soils and geologic literature pertaining to the site including available as-built Log of Test Borings (LOTB) for the existing structure (Br. No. 33-0168); site reconnaissance; obtaining representative soil samples and logging materials encountered in a drilled boring and a cone penetration test (CPT); laboratory testing of the collected soil samples, performing engineering analyses based on the field and laboratory data, and preparation of this foundation report.

Due to limitations inherent in geotechnical investigations, it is neither uncommon to encounter unforeseen variations in the subsurface soil conditions during construction nor is it practical to determine all such variations during an acceptable program of drilling and sampling for a project of this scope. Such variations, when encountered, generally require additional engineering services to attain properly constructed project. We, therefore, recommend that a contingency fund be provided to accommodate any additional charges resulting from technical services that may be required during construction. Our recommendations in this report are based on the above information. Any major deviation should be reported to this office for consideration.

SITE CONDITIONS

The existing Route 112/880 Separation structure was originally built in 1952 and was widened in 1971. The existing interchange is a partial cloverleaf interchange with Davis Street (Route 112) carrying two lanes of traffic each way. The area within the project is generally level. The slopes in the vicinity of the abutments have gradient of 2H: 1V or flatter and are covered with vegetations. Based on the topographic information provided, the existing grade along I-880 is at approx. Elev. 28 feet, and the existing approach embankment is at approx. Elev. 46 feet.

FIELD EXPLORATION AND LABORATORY TESTING

Based on the preliminary plans, discussions with the designers, and readily available geotechnical data in the area, one exploratory boring and one cone penetration test (CPT) were performed for the Route 112/880 Separation near the abutment areas to maximum depth of 100 feet below the existing ground surface. The locations and description of the materials are shown on the Log of Test Borings in the Appendix A of the report.

The borings were advanced using a truck-mounted hollow stem auger drilling method. Selected samples were obtained from 2.0-inch O.D. & 1.4-inch I.D. (Standard Penetration) and 3.0-inch O.D. & 2.5-inch I.D. (Modified California) samplers at various depths. The samplers were driven into subsurface soils under the impact of a 140-pound hammer having a free fall of 30 inches. When correlating standard penetration data, the blow counts for the Modified California sampler may be converted to equivalent SPT blow counts by multiplying a factor of 0.65. The samples were sealed and transported to our laboratory for further evaluation and testing. The field investigation was conducted under the supervision of our field engineer who logged the test borings and prepared the samples for subsequent laboratory testing and evaluation. The descriptions of the materials encountered in the field exploration are also shown on the Log of Test Boring (LOTB) sheet.

Gregg Drilling & In Situ, Inc. performed the CPT on June 6, 2008. The CPT was conducted using a 20-Ton capacity cone with a tip area of 15 cm^2 and a friction sleeve area of 225 cm^2. The soil resistance exerted to the tip and side of the cone were recorded and correlated to "Soil Behavior Type", classification and strength characteristics. Gregg's CPT report is attached in Appendix A.

Laboratory tests were performed on selected soil samples collected during field exploration to evaluate the physical and index properties of the subsurface soils. The laboratory test methods and test results are presented on plates included in Appendix B. Laboratory test results for moisture content, Plasticity Indexes, and grain size distribution of the soil samples are presented on the LOTB in Appendix A. Detail results of laboratory tests are presented in Appendix B.

It should be noted that the descriptions of the soils encountered and relevant boring information presented on the LOTB depict subsurface conditions only at the locations indicated on the plan and

on the particular date noted on the LOTB. Because of the variability from place to place within soil/rock in general, subsurface conditions at other locations may differ from conditions occurring at the boring locations explored. The abrupt stratum changes shown on the logs may be gradational and relatively minor changes in soil types within a stratum may not be noted on the logs due to field limitations. Also, the passage of time may result in a change in the soil conditions at these locations due to environmental changes.

SUBSURFACE CONDITIONS

The subsurface conditions are based on the as-built LOTB sheet (Caltrans 1968) and exploratory boring and CPT data performed in May and June 2008 (Parikh 2008). The approximate boring locations are shown on the attached LOTB sheet and Plate 2 (Site Plan). The CPT was performed within the existing clove leaves of the interchange at about the same level of Interstate 880. The CPT interpretation was provided by Gregg In Situ, Inc. A complete report (6/6/08) prepared by Gregg is attached in Appendix A of the foundation report. Per Gregg's report, the interpretation follows the comprehensive review by Lunne, Robertson and Powell (1997). Note that the Gregg's CPT interpretation starts at 5 ft depth because the upper 5 ft was hand-augered as a safety practice. Parikh provided spread sheets for data correlation (attached in Appendix C) only to read Gregg's data and present/plot certain selected parameters along depth for convenience of reading the file.

The CPT data and the drilled boring performed in 2008 are relatively consistent. The as-built soil information (Caltrans LOTB sheet of November 1968) compiled boring data performed in 1949, 1951 and 1967. The subsoils primarily consist of stiff clay soil mixed with sand layers at varying depths. The CPT data indicate relatively dense sand layers with clay below Elev. -20 ft (approx.). A layer of loose to medium dense sand/silty sand was encountered at approx. Elev. -1 to -8 feet (depth of 29 feet to 36 feet below existing grade of I-880) in the exploration data of 2008. To further evaluate the liquefaction potential, we have also referenced the as-built boring data. Based on as-built Borings B-3 (1967) and B-7 (1951), the materials within the zone also include stiff clays and compact to dense sand. It appears that some of the relatively loose to medium dense sand layers/lenses could be isolated, but still subject to triggering of liquefaction and lose strength. We have considered cyclic softening/triggering of liquefaction potential as a result of pore pressure build-up of the zone in foundation design of the structure.

The clay soils are generally stiff to very stiff with natural moisture content in the range of 20 to 30%. Based on the investigation and CPT correlation, the undrained shear strength of the clay appears to be typically in the range of 1000 to 2000 psf above Elev. -20 ft. Below that, the clay becomes very stiff to hard. A generalized soil profile with strength parameters is attached in Appendix C of the report.

Groundwater Data. Groundwater was encountered at about Elev. 18.5 ft in current investigation, which appears to be higher than that shown on the as-built LOTB. We have considered groundwater level at Elev. 20 ft (approx. 10-ft depth below existing I-880 level) for project design. The groundwater level is anticipated to vary with the passage of time due to seasonal groundwater fluctuation, surface and subsurface flows, ground surface run-off, and other factors that may not be present at the time of investigation.

GEOLOGY

General geologic features pertaining to the site were evaluated by reference to the "Geologic Map and Map Database of the Oakland Metropolitan Area, Alameda, Contra Costa, and San Francisco Counties, California" by R.W. Graymer, 2000 (USGS Map, MF-2342). Based on the geologic map, the site subsoil's consist of Natural levee deposits (Holocene, Qhl). A geologic map of the project vicinity is shown on Plate 3.

Qhl (Natural levee deposits, Holocene) – Loose, moderately-sorted to well-sorted sandy or clayey silt grading to sandy or silty clay.

EARTHQUAKE CONSIDERATIONS

Seismic Sources

The project is located in a seismically active part of northern California. Many faults in the San Francisco Bay Area are capable of producing earthquakes that may cause strong ground shaking at the site. The attached Fault Map (Plate 3) presents the locations of the fault systems relative to the project site.

Caltrans has recently updated the Seismic Hazard Map (2007 Deterministic PGA Map) and released 2009 Seismic Design Criteria that incorporate both deterministic approach using Next

Generation Attenuation (NGA) model and USGS probabilistic model. Caltrans indicated that for projects type-selected after September 30, 2009 the new Seismic Design Criteria should apply. The project was type-selected in June 2009. Therefore, the seismic design of the project follows the Caltrans 1996 Seismic Hazard Map and standard ARS curves contained in the Seismic Design Criteria v.1.4. This was discussed and agreed upon during type selection meeting in June 2009.

Maximum Credible Earthquake (MCE) magnitudes for some of the major faults in the area determined by Mualchin (California Seismic Hazard Map 1996) are summarized below. These maximum credible earthquake magnitudes represent the largest earthquakes that could occur on the given fault based on the current understanding of the regional tectonic structure.

EARTHQUAKE DATA

Fault	Estimated Closest Distance to the Project Area (mi)	Maximum Credible Earthquake	Peak Bedrock Acceleration (g)
Hayward Fault (strike - slip)	2.5	7.5	0.6
Calaveras-Pacines-San Benito (strike – slip)	11.2	7.5	0.3
San Andreas Fault (strike – slip)	16.1	8.0	0.3

Based on the seismic hazard map prepared by Mualchin (1996) and the attenuation relationship by Sadigh et Al. (1997), the anticipated Peak Bedrock Acceleration (PBA) at the project site is 0.6 g.

Seismic Hazards/Liquefaction Impact

Potential seismic hazards may arise from three sources: surface fault rupture; ground shaking; and liquefaction. Since no active fault pass through the project site, the potential for fault rupture is relatively low. Based on available geological and seismic data, the possibility of the site to experience strong ground shaking may be considered moderate to high.

Liquefaction Potential

Liquefaction is a phenomenon in which saturated cohesionless soils are subject to a temporary but essentially total loss of shear strength under the reversing, cyclic shear stresses associated with earthquake shaking. Submerged cohesionless sands and silts of low relative density are the type of soils, which usually are susceptible to liquefaction. Clays are generally not susceptible to liquefaction.

Liquefaction analysis was performed in accordance with Youd, et al (2001). Based on the CPT liquefaction analysis performed, it appears that the material between Elev. -1 and -8 ft (depth of 29 feet to 36 feet below existing grade of I-880) in the exploration data of 2008 could be subject to triggering of liquefaction. To further evaluate the liquefaction potential, we have also referenced the as-built boring data (Caltrans Borings B-3, 1967 and B-7, 1951), and the materials within the zone also include stiff clays and compact to dense sand. It appears that some of the relatively loose to medium dense sand layers/lenses could be isolated, but still subject to triggering of liquefaction and lose strength. Therefore, we have considered liquefaction potential (cyclic softening) of the zone and neglect capacity contribution in foundation design of the structure.

FINDINGS AND RECOMMENDATIONS

General

This report was prepared specifically for the proposed project according to the plans provided to us. Normal construction procedures were assumed throughout our analysis and represent one of the bases of recommendations presented herein. Our design criteria have been based upon the materials encountered at the site. Therefore, we should be notified in the event that these conditions are changed, so as to modify or amend our recommendations.

Foundations

Based on the boring/CPT data and discussion with the designer, the recommended foundation type is Caltrans standard Class 200 Alt."W" piles (16-inch diameter open end steel pipe). The wingwalls will be supported on Class 90 Alt. "W" piles (14-inch diameter open end steel pipe). The planned pile caps may overlap with existing footings that are supported on step tapered piles (1951 construction) and pipe piles (Alt. "V", 1996 retrofit). It is recommended that the existing piles be abandoned and neglected for current design. Although the as-built plans are available, the actual locations of the existing piles may not be revealed until the caps are demolished during construction. Therefore, the design may require certain flexibility and contingency if the field condition is different from that shown on the as-built drawings.

Predrill Near Abandoned Utilities. Based on information provided, there are multiple existing abandoned utilities at the site. In order to reduce impact on pile driving, the piles near the abandoned utilities should be predrilled. Based on available data, the anticipated inverts are mainly at approx. Elev. 22 to 23 ft (some lines are too old and there is no information about the invert). The predrill should follow Caltrans standard specifications (Section 49-1.06). Pea gravel is recommended for backfill. For piles in the vicinity of the abandoned existing utilities, we have assumed that the pile capacity starts from approx. Elev. 20 ft.

Pertinent foundation design information provided by the structural designer, including Foundation Design Data and Foundation Design Loads, are presented in the following tables.

FOUNDATION DESIGN DATA (per Structural Designer)

Support No.	Design Method	Pile Type	Finish Grade Elev. (ft)	Pile Cut-off Elev. (ft)	Pile Cap Size (ft)		Permissible Settlement (in.)	No. of Piles per Support per Bridge
					B	L		
Abut 1	WSD	Class 200 Alt. "W"	36.75	29.92	11	123.3	1	Stage-I= 20 piles Stage-II= 21 piles
Bent 2	LRFD	Class 200 Alt. "W"	29.50	22.42	12	Typ: 19 Rt: 24	1	Typ=15 piles/ftg Rt=16 piles
Abut 3	WSD	Class 200 Alt. "W"	38.50	31.92	11	123.3	1	Stage-I= 20 piles Stage-II= 20 piles

FOUNDATION DESIGN LOADS (per Structural Designer)

Support No.	Service-I Limit State (kips)			Strength Limit State (Controlling Group, kips)				Extreme Event Limit State (Controlling Group, kips)			
	Total Load		Perma-nent Loads	Compression		Tension		Compression		Tension	
	Per Support	Max. Per Pile	Per Support Column	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile
Abut 1	4700	195	4650	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bent 2 Typ	2500	167	1950	3760	248	N/A	N/A	3140	400	N/A	75
Bent 2 Right	2640	165	2025	3840	240	N/A	N/A	3200	400	N/A	75
Abut 3	4700	194	4560	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Consistent with the current Caltrans requirements, Working Stress Design (WSD) is used for the abutment foundations and Load and Resistant Factor Design (LRFD) is used for the foundations for Bent 2 for the bridge. The abutment foundations are evaluated for the foundation design data

and loading conditions using Caltrans November 2003 Bridge Design Specifications for foundations, using Working Stress Design (WSD) methods. The Bent 2 foundations are evaluated for the foundation design data and loading conditions using AASHTO LRFD Bridge Design Specifications–3rd Edition, with Interims through 2006 and current Caltrans Memo To Designer (July 2008), Section 3-1 (Attachment 1).

The recommended minimum pile spacing is three times the pile diameter (3D). The pile capacity is primarily form shaft friction. The sand layer (which also contains stiff clays) between Elev. -1 and -8 ft is neglect for capacity contribution due to liquefaction/cyclic softening potential as a result of pore-pressure buildup. The impact on design pile capacity is considered relatively low. Based on the load demand and subsoil information, the recommended specified pile tip elevations are shown in the Pile Data Table below.

FOUNDATION RECOMMENDAIONS FOR ABUTMENTS

Support	Pile Type	Cut-off Elev. (ft)	LRFD Service-I Limit State Load (kips) per Support		LRFD Service-I Limit State Total Load (kips) per Pile (Compression)	Nominal Resistance (kips)	Design Tip Elev. (ft)	Specified Tip Elev. (ft)	Nominal Driving Resistance Required (kips)
			Total	Perma-nent					
Abut 1 (near obstructions)	Class 200 Alt. "W"	29.92	4700	4650	200	400	-52.0 (a) -10.0 (b)	-52.0	444
Abut 1	Class 200 Alt. "W"	29.92	4700	4650	200	400	-47.0 (a) -10.0 (b)	-47.0	444
Abut 3 (near obstructions)	Class 200 Alt. "W"	31.92	4700	4650	200	400	-52.0 (a) -10.0 (b)	-52.0	444
Abut 3	Class 200 Alt. "W"	31.92	4700	4650	200	400	-47.0 (a) -10.0 (b)	-47.0	444

Notes:

1. Design tip elevations are controlled by (a) compression, (b) lateral load.
2. The Nominal Driving Resistance Required is equal to the Nominal Resistance needed to support the factored load plus driving resistance from the unsuitable penetrated soil layer (liquefiable) which does not contribute to the design resistance. Unsuitable soil layer is present between Elev. -1 and -8 ft. The estimated driving resistance from the unsuitable penetrated soil layer is 44 kips.

FOUNDATION RECOMMENDAIONS FOR BENT

Support Loca-tion	Pile Type	Cut-Off Elev. (ft)	Service-I Limit State Load (kips) per Support	Total Permissible Support Settlement (in.)	Required Factored Nominal Resistance (kips)				Design Tip Elev. (ft)	Speci-fied Tip Elev. (ft)	Nominal Driving Resistance Required (kips)
					Strength Limit		Extreme Event				
					Comp. (ϕ=0.7)	Tension (ϕ=0.7)	Comp. (ϕ=1)	Tension (ϕ=1)			
Bent 2 (near obstruction)	Class 200 Alt. "W"	22	-	1	250	0	400	75	-47.0 (a-I) -52.0 (a-II) -12.0 (b-II) -20.0(c)	-52.0	444
Bent 2	Class 200 Alt. "W"	22	-	1	250	0	400	75	-42.0 (a-I) -47.0 (a-II) -1.0 (b-II) -20.0(c)	-47.0	444

Notes:

1. Design tip elevations are controlled by: (a-I) Compression (Strength Limit), (b-I) Tension (Strength Limit), (a-II) Compression (Extreme Event), (b-II) Tension (Extreme Event), (c) Lateral Load.
2. The Nominal Driving Resistance Required is equal to the Nominal Resistance needed to support the factored load plus driving resistance from the unsuitable penetrated soil layer (liquefiable) which does not contribute to the design resistance. Unsuitable soil layer is present between Elev. -1 and -8 ft. The estimated driving resistance from the unsuitable penetrated soil layer is 44 kips.

PILE DATA TABLE

Location	Pile Type	Nominal Resistance (kips)		Design Tip Elev. (ft)	Specified Tip Elev. (ft)	Nominal Driving Resistance Required (kips)
		Compression	Tension			
Abut 1 (near obstructions)	Class 200 Alt. "W"	400	0	-52.0 (a); -10.0 (c)	-52.0	444
Abut 1				-47.0 (a); -10.0 (c)	-47.0	444
Bent 2 (near obstructions)	Class 200 Alt. "W" (MOD)	400	75	-52.0 (a); -12.0 (b); -20.0 (c)	-52.0	444
Bent 2				-47.0 (a); -1.0 (b); -20.0 (c)	-47.0	444
Abut 3 (near obstructions)	Class 200 Alt. "W"	400	0	-52.0 (a); -10.0 (c)	-52.0	444
Abut 3				-47.0 (a); -10.0 (c)	-47.0	444
Wingwalls	Class 90 Alt "W"	180	0	-27.0 (a)	-27.0	212

Notes:

(1) Design tip elevations for Abutments are controlled by (a) Compression, (b) Tension , (c) Lateral Load.
(2) Unsuitable soil layer (liquefiable) that does not contribute to the design nominal resistance exists between Elev. -1 and -8 ft. The estimated driving resistance from the unsuitable penetrated soil layer is 44 kips for 16-inch pipe piles and 32 kips for 14-inch pipe piles (at wingwalls), respectively.

Due to the stiff to hard clay and dense sand layers present at the site, moderate to hard driving conditions should be anticipated. We recommend that the piles be driven to the specified tip elevations. The estimation of the driven pile capacity in clay is based on the adhesion factor per

FHWA manual (Tomlinson, 1980). The pile capacity derives primarily from frictional resistance along the pile shaft. It is anticipated the pile capacity will develop after driving as a result of soil "freeze" and dissipation of excess pore water pressures. The gain of pile capacity after initial driving may be evaluated based on "redriving" after 24-hour (minimum) set-up. The Gates formula per Caltrans standard specifications (Section 49-1.08) may be used in the field for driving and capacity verification.

Per Caltrans Standard Specifications (Section 49-1.06), oversize predrill through the approach embankment is anticipated for abutment piles. The predrill is also applicable for pile locations in the vicinity of existing sewer lines. Pea gravel should be used to backfill the annular space after driving.

In the event that unanticipated pile driving conditions are encountered, it is recommended that a Pile Driving Analyzer (PDA) be used to evaluate the pile capacity. Typical application includes capacity evaluation (for both during driving and re-striking) for piles that have experienced hard driving. The geotechnical engineer should be consulted for any unanticipated pile driving conditions.

Lateral Pile Capacity

The recommended geotechnical parameters for LPILE analysis are provided below. To account for group effect, p-multipliers of 0.6 and 0.8 are recommended for pile spacing of 3D & 4D, respectively. The existing Rte 880 is at approx. Elev. 28 ft.

Approx. Elevation (ft.)	Generalized Soil Profile	LPILE Soil Type	Soil Strength	K (pci)	E_{50} (in/in)	Effect Unit Wt. (pci)
Above 28	Embankment	3, CLAY	C = 1500 psf	--	0.007	0.072
28 to 22	Lean Clay, stiff	3, CLAY	C = 2000 psf	--	0.007	0.072
22 to 16	Lean Clay, firm to stiff	3, CLAY	C = 1000 psf	--	0.007	0.036
16 to 3	Lean Clay, stiff	3, CLAY	C = 2000 psf	--	0.007	0.036
3 to -1	Sand, dense	4, SAND	ϕ = 36 deg	125	-	0.036
-1 to -8	Poorly-Graded Gravel/ Sand, medium dense	4, SAND (without liquefaction)	ϕ = 34 deg	60	--	0.036
		10, Liquefiable Sand (Rollins, 2003 as adopted in LPILE V. 5)				
-8 to -14	Lean Clay, stiff	3, CLAY	C = 2000 psf	--	0.007	0.036

Approx. Elevation (ft.)	Generalized Soil Profile	LPILE Soil Type	Soil Strength	K (pci)	E_{50} (in/in)	Effect Unit Wt. (pci)
-14 to -32	Sand, dense	4, SAND	ϕ = 36 deg	125	--	0.036
-32 to -37	Lean Clay, very stiff	3, CLAY	C = 3000 psf	--	0.005	0.036
-37 to -47	Sand, dense	4, SAND	ϕ = 36 deg	125	--	0.036
-47 to -52	Lean Clay, very stiff	3, CLAY	C = 3000 psf	--	0.005	0.036
-52 to -60	Sand, dense	4, SAND	ϕ = 36 deg	125	--	0.036
Below -60	Lean Clay, very stiff	3, CLAY	C = 3000 psf	--	0.005	0.036

Based on discussion with the designer, preliminary LPILE analyses were performed with the results attached in Appendix C showing deflection, moment, shear and soil reaction along the pile length. The abutment piles were modeled as "pinned-connection" (free head), and the bent piles were modeled as "fixed head" condition per discussion with the designer. Generally, abutment piles are designed for service loads only, and batter piles are used for resisting static lateral earth pressures. The bent piles are governed by seismic loading conditions. At service condition, there is minimal shear demand on the bent piles. In common engineering practice, a maximum pile head deflection of 1/4 inch is recommended for service condition for vertical piles. Under seismic loading condition, pending the overall structural design and considerations, a maximum pile head deflection up to about one to two inches is generally tolerable and accepted for design of bent piles.

In addition to lateral capacity of the piles, passive resistance against the vertical sides of the pile caps/footings may also contribute to the lateral design. It is assumed that the pile caps/footings are poured neat against undisturbed native soil. For Route 112/880 Separation (Replace), the recommended passive resistance against the vertical sides of the pile caps is 3 ksf. The value is a uniformly distributed resistance for seismic & ultimate condition. The mobilization of the passive resistance, as shown in Appendix C, follows the guidelines of FEMA 356 (November 2000).

Lateral Earth Pressures

Abutment retaining walls and wing walls should be designed to resist the following Applied Lateral Earth Pressures and live load. These values assume no hydrostatic pore pressure buildup behind the wall and are based on well-drained backfill behind the walls supported in native soil.

Applied Lateral Earth Pressure

Active Condition	36 pcf Equivalent Fluid Pressure (EFP) for engineered fill
At-Rest Condition	55 pcf Equivalent Fluid Pressure (EFP) for engineered fill
Passive Resistance	5 ksf (ultimate) for seismic design of the abutment backwall (5.5 feet high or greater); for activated height less than 5.5 feet modify proportionally, i.e. 5 x (H/5.5) ksf per SDC v. 1.4. A minimum lateral wall movement of 2% of wall height to mobilize the full ultimate passive pressure is required.

Cantilever walls which are free to rotate at least 0.004 radians may be assumed flexible for the active condition. Walls that are not capable of this movement should be assumed rigid and designed for the at-rest condition. The effect of any surcharge (dead, live, or traffic load) should be added to the preceding lateral earth pressures. Coefficients of 0.3 and 0.5 may be used to determine the additional earth pressure resulting from the surcharge for cantilever walls and rigid walls, respectively.

Seismic Design Criteria

Caltrans has recently released the 2009 Seismic Design Criteria. Seismic design of bridge structures type-selected after September 30, 2009 will follow the 2009 criteria. Bridge structures type-selected prior to September 30, 2009 may follow Seismic Design Criteria v. 1.4 (June 2006). The Route 112/880 Separation project went through the type selection process in June 2009, and this structure has been designed in accordance with Seismic Design Criteria v. 1.4 (June 2006).
Based on the available boring information in the vicinity of the project site, the subsurface soil conditions at the project site generally matches the criteria for Soil Type D, as per Caltrans Seismic Design Criteria (Version 1.4, June 2006). Based on Caltrans Seismic Design Criteria and the above information, the seismic design criteria are as follows:

1. Governing Fault	=	Hayward Fault (strike-slip; Mw=7.5)
2. Closest Distance to Fault	=	2.5 miles
3. PBA	=	0.6 g
4. Design ARS Curve	=	Caltrans Seismic Design Criteria June 2006 Version 1.4 Figure B.8 for Soil Type D with (1) 20% increase of spectral accelerations (S_a) for structural periods ≥ 1 sec. (2) No change in S_a for structural periods ≤ 0.5 sec. and (3) Linear interpolation of S_a for structural periods between 0.5 sec. and 1 sec.

A copy of the ARS Design Curve is included on Plate No. 5 of this report.

Embankment Settlement & Waiting Period

Embankments are required at the abutments for the proposed modification of Route 112/880 Separation Interchange. Based on information provided, a maximum embankment height of up to 23 feet may be expected. The embankments will have side slopes (2H:1V or flatter) at NW and SE quadrant. Retaining walls are planned at NE and SW quadrant. The new approach embankments will abut existing embankments.

The boring data indicates that the subsurface soil conditions generally consist of firm to stiff clay mixed with sand layers in the upper 40 feet overlying dense sand layers and stiff to very stiff clays at depth. The clay layers were considered in the settlement analysis. The evaluation of the consolidation settlements under the new fill was based on the consolidation test results, understanding of the consolidation behavior of the clay and empirical correlations in the literatures. The evaluation of the consolidation settlements and data were presented in the Geotechnical Design & Materials Report of the roadway design submittal. Based on the results of the settlement analyses, the consolidation settlements are estimated to be on the order of 3 to 4 inches at Route 112/880 Separation Interchange. Majority of settlements are in the overconsolidated/elastic range. A 30-day settlement period is recommended for ground adjustment under the anticipated 23-foot embankment.

It is recommended that settlement platforms be installed and settlement be monitored per California Test 112. As a common practice, this is typically handled by the project Resident Engineer. It is recommended that a minimum of 3 to 4 settlement platforms be installed per abutment since earthwork and construction equipment tend to destroy some platforms during fill placement.

Embankment Stability

Stability analyses were performed for the proposed embankment with side slopes of 2H:1V and with a retaining wall up to 20 ft high in the NE quadrant at the interchange. Based on the results of the stability analyses, the global stability of the proposed fill slopes and retaining wall (NE quadrant), for “undrained/end-of-construction” case, appears acceptable with minimum factors of safety of 2.0 and 1.9, respectively. The analysis results and the strength parameters adopted are

included in Appendix C.

Corrosion

Corrosion tests were performed on a sample retrieved at the existing interchange. A summary of the corrosion test results is presented below. For structural elements, Caltrans Corrosion Guidelines (September 2003) consider a site to be corrosive if one or more of the following conditions exist for the representative soil/water samples at the site:

> *Chloride concentration is 500 ppm or greater, sulfate concentration is 2000 ppm or greater, or the pH is 5.5 or less.*

SUMMARY OF CORROSION TEST RESULTS

Boring No.	Station & Offset	Depth (ft)	Min. Resistivity (ohm-cm)	pH	Sulfate (ppm)	Chloride (ppm)
RW-17	"DA1" Sta. 27+40, 15 Rt.	4.5	1960	6.74	1.4	6.1

Based on the data, the site subsoil is considered non-corrosive per Caltrans corrosion design guidelines, and standard Type II modified or Type I-P (MS) modified cement may be used for the concrete substructures. The minimum cement factor and cover thickness should be per Caltrans Bridge Design Specifications (Section 8.22).

Plan Review

We recommend that final plans for foundations be reviewed by this office prior to construction so that the intent of our recommendations is included in the project plans and specifications and to further see that no misunderstandings or misinterpretations have occurred.

Construction Observation

To a degree, the performance of any structure is dependent upon construction procedures and quality. Hence, observation of foundation excavations, and pile installations should be carried out by this office. If the subsurface conditions different from those forming the basis of our recommendations is encountered this office should be informed in order to assess the need for design changes. Therefore, the recommendations presented in this report are contingent upon good quality control and these geotechnical observations during construction.

INVESTIGATION LIMITATIONS

Our services consist of professional opinions and recommendations made in accordance with generally accepted geotechnical engineering principles and practices and are based on our site reconnaissance and the assumption that the subsurface conditions do not deviate from observed conditions. All work done is in accordance with generally accepted geotechnical engineering principles and practices. No warranty, expressed or implied, of merchantability or fitness, is made or intended in connection with our work or by the furnishing of oral or written reports or findings. The scope of our services did not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in structures, soil, surface water, groundwater or air, below or around this site. Unanticipated soil conditions are commonly encountered and cannot be fully determined by taking soil samples and excavating test borings; different soil conditions may require that additional expenditures be made during construction to attain a properly constructed project. Some contingency fund is thus recommended to accommodate these possible extra costs.

This report has been prepared for the proposed project as described earlier, to assist the engineer in the design of this project. In the event any changes in the design or location of the facilities are planned, or if any variations or undesirable conditions are encountered during construction, our conclusions and recommendations shall not be considered valid unless the changes or variations are reviewed and our recommendations modified or approved by us in writing.

This report is issued with the understanding that it is the designer's responsibility to ensure that the information and recommendations contained herein are incorporated into the project and that necessary steps are also taken to see that the recommendations are carried out in the field. The findings in this report are valid as of the present date. However, changes in the subsurface conditions can occur with the passage of time, whether they are due to natural processes or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur, whether they result from legislation or from the broadening of knowledge.

Accordingly, the findings in this report might be invalidated, wholly or partially, by changes outside of our control.

Respectfully submitted,
PARIKH CONSULTANTS, INC.

Y. David Wang, Ph.D., P.E. C52911
Senior Engineer

Gary Parikh, G.E. 666
Project Manager

REGISTERED PROFESSIONAL ENGINEER
GAURANG R. PARIKH
No. 666
EXP. 12-31-11
GEOTECHNICAL
STATE OF CALIFORNIA

S:\ONGOING PROJECTS\206139 WMH|\RTE 112/880 SEPARATION

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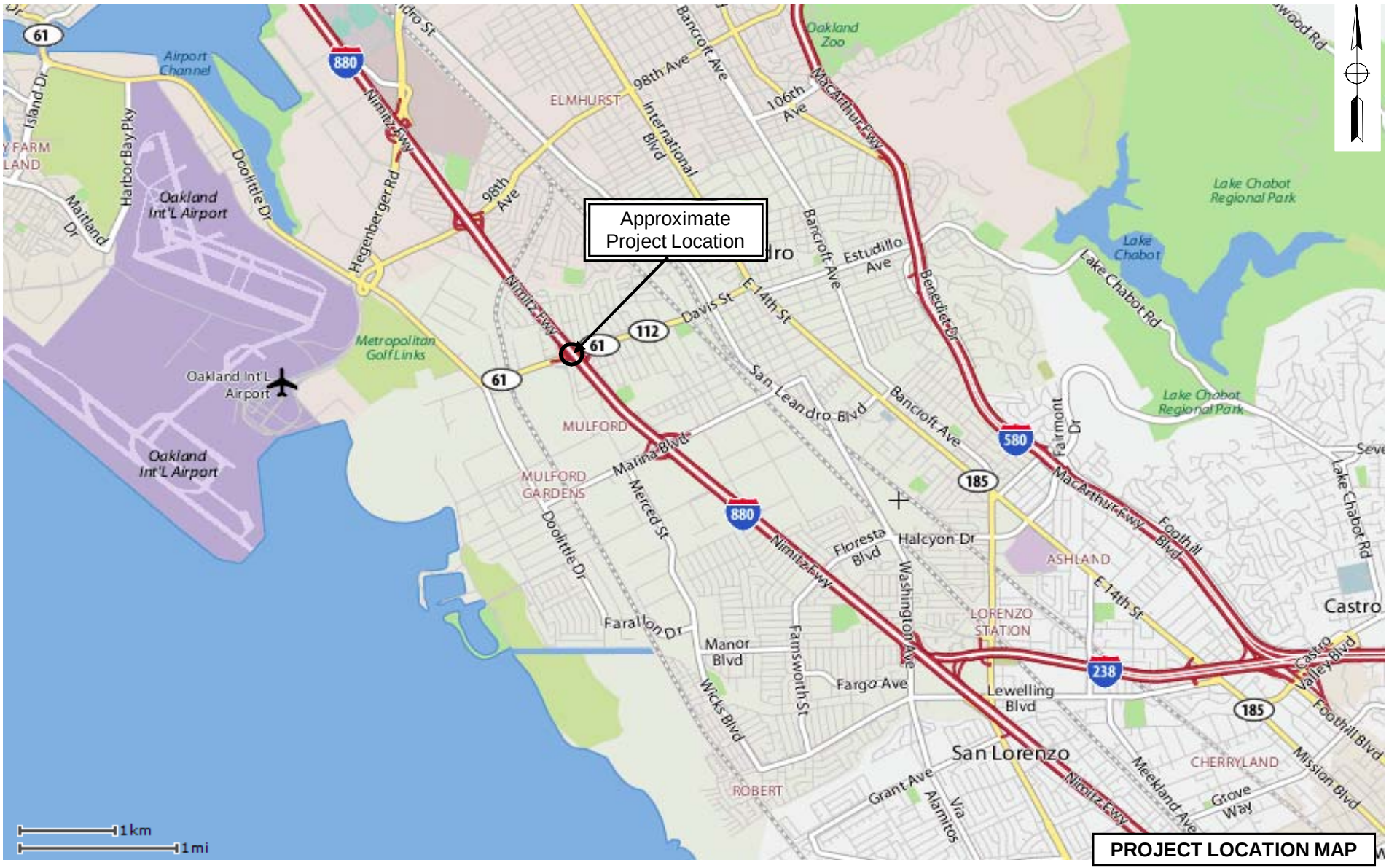


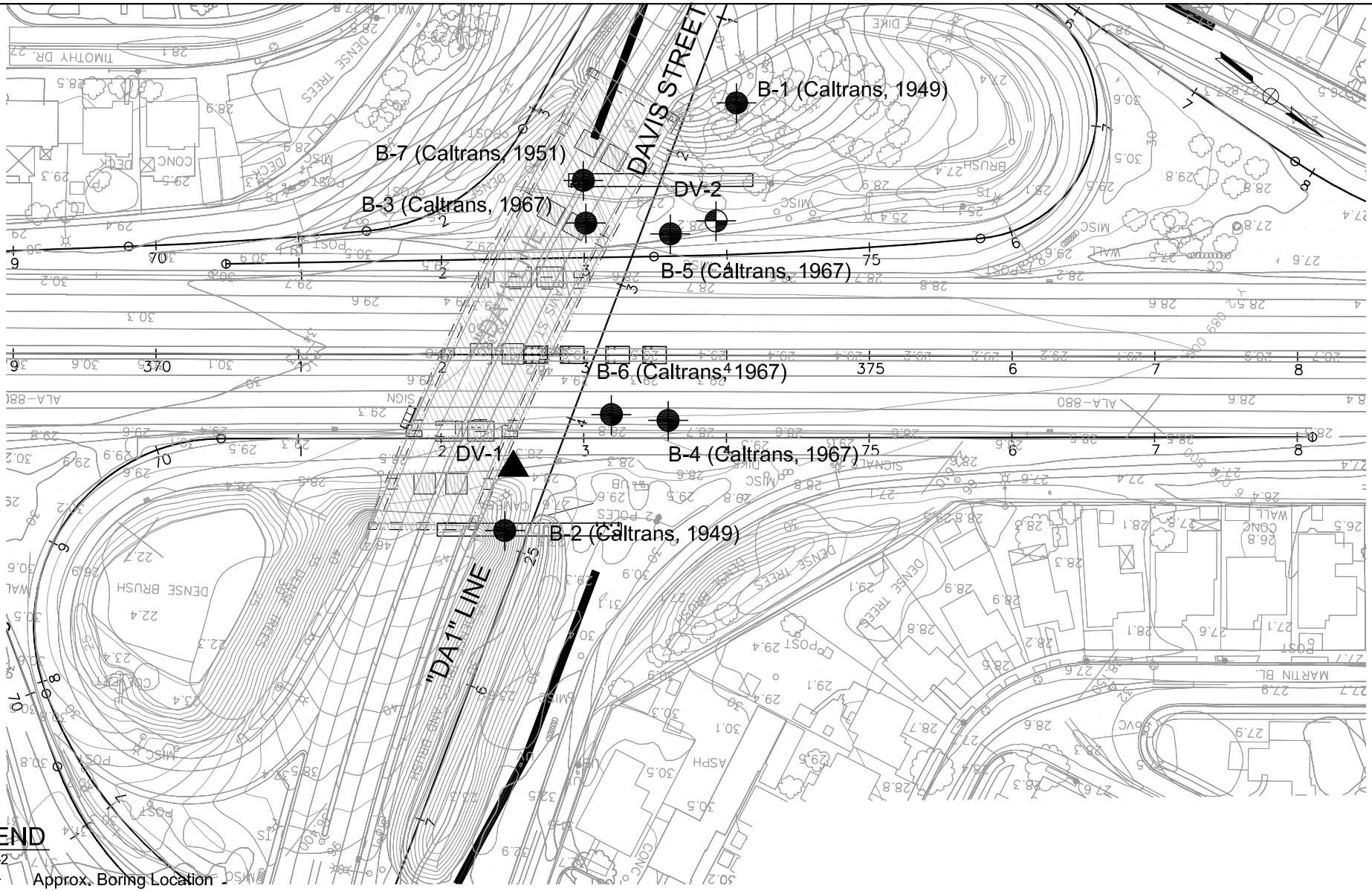
PROJECT LOCATION MAP

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS TESTING

ROUTE 112/880 SEPARATION (REPLACE)
ALAMEDA COUNTY, CALIFORNIA

JOB NO.: 206139.10

PLATE NO.: 1



LEGEND

DV-2 — Approx. Boring Location

DV-1 — Approx. Cone Penetration Test Location

B-1 — Approx. Caltrans As-Built Boring Location

SITE PLAN

SCALE 1 inch = 100 feet

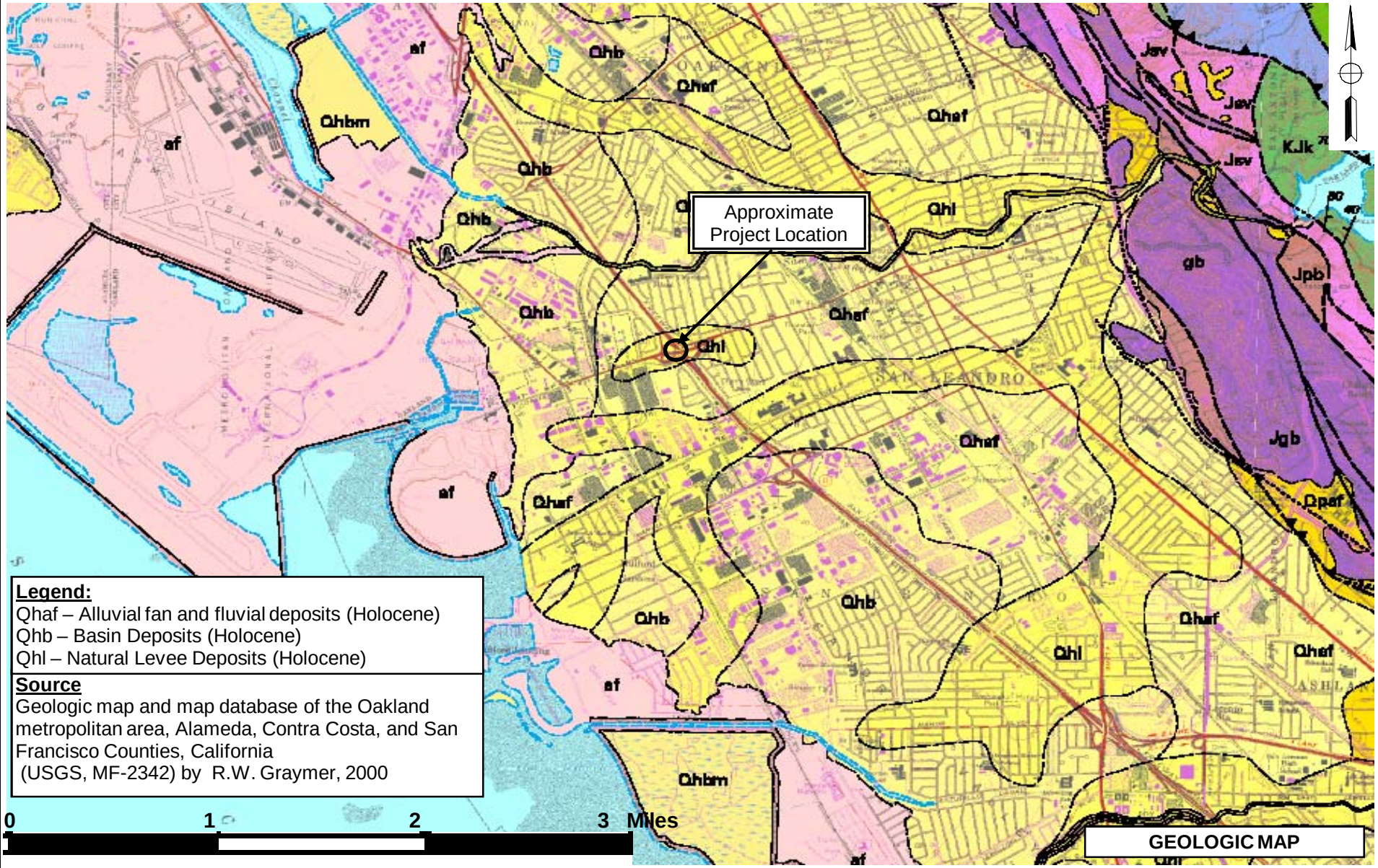
Note: All units are in feet unless otherwise specified
Reference Map was provided by WMH Corporation

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

ROUTE 112/880 SEPARATION (REPLACE)
ALAMEDA COUNTY, CALIFORNIA

JOB NO.:206139.10

PLATE NO. 2



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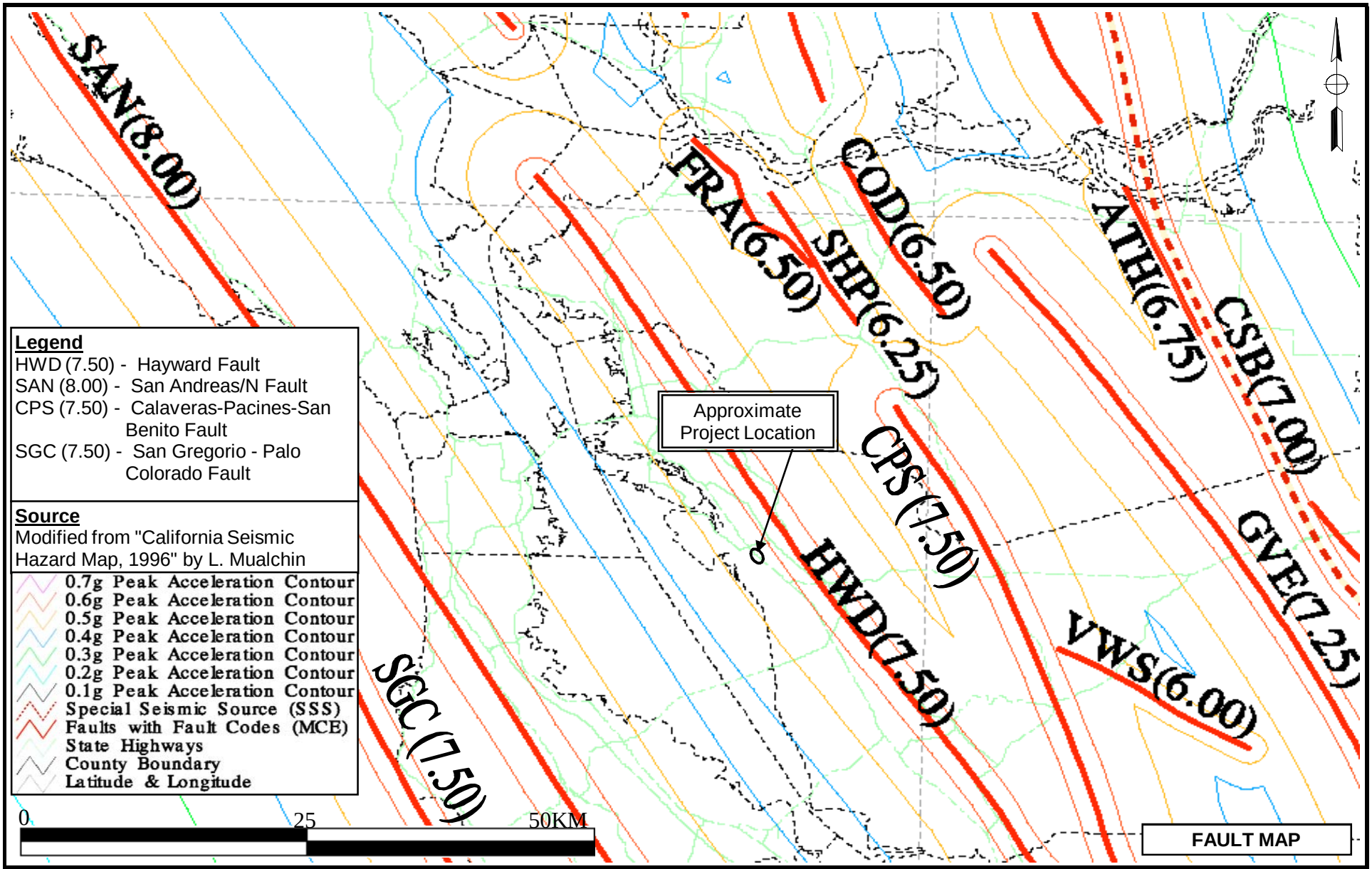
GEOTECHNICAL CONSULTANTS
MATERIALS TESTING

ROUTE 112/880 SEPARATION (REPLACE)
ALAMEDA COUNTY, CALIFORNIA

JOB NO.: 206139.10

PLATE NO.: 3



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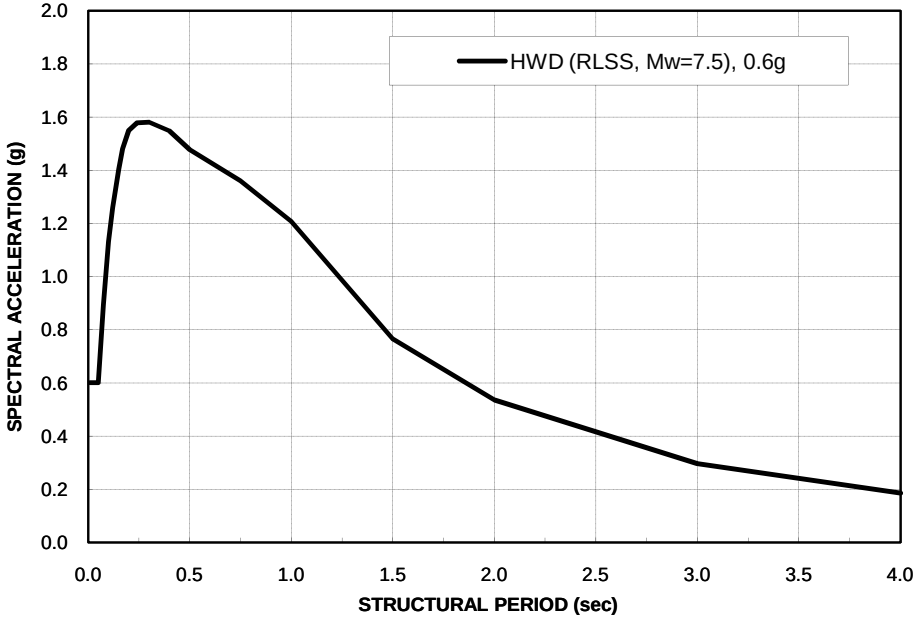
MATERIALS TESTING

ROUTE 112/880 SEPARATION (REPLACE)
ALAMEDA COUNTY, CALIFORNIA

JOB NO.: 206139.10

PLATE NO.: 4

ARS DESIGN CURVE
ROUTE 112/880 SEPARATION (REPLACE)
ALAMEDA COUNTY, CALIFORNIA



Spectral Data

Period (sec)	Spectral Accel. (g)
0.010	0.600
0.020	0.600
0.030	0.600
0.050	0.600
0.075	0.893
0.100	1.132
0.120	1.259
0.150	1.403
0.170	1.480
0.200	1.550
0.240	1.578
0.300	1.581
0.400	1.548
0.500	1.477
0.750	1.360
1.000	1.207
1.500	0.765
2.000	0.536
3.000	0.296
4.000	0.186

Caltrans SDC (v 1.4, June 2006), Figure B.8,
Governing Fault: Hayward Fault
Fault Distance = 2.5 miles
(Mw = 7.5, Soil Profile Type D, PBA = 0.6g)

Notes:
(A) PBA was obtained by using Sadigh Attenuation Relationship
(B) The following modifications were then applied for near-fault effects:
(1) No change of Sa for structural periods $\leq$ 0.5 sec
(2) 20% increase of Sa for structural periods > 1 sec
(3) Linear interpolation for structural periods between 0.5 and 1 sec

APPENDIX A

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	880			

GEOTECHNICAL PROFESSIONAL — DATE 12/1/11

PLANS APPROVAL DATE

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PARIKH CONSULTANTS, INC.
2360 QUME DRIVE, SUITE A
SAN JOSE, CA 95131

ACTC
1333 BROADWAY, SUITES 220 & 300
OAKLAND, CA 94612

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (2010)

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

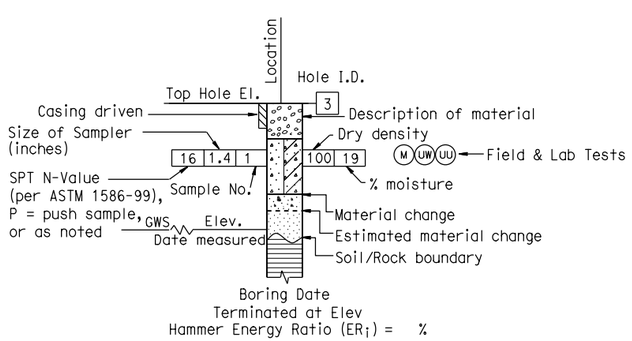
BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring (hollow or solid stem bucket)
Size	R RW RC P	Rotary drilled boring (conventional) Rotary drilled with self-casing wire-line Rotary core with continuously-sampled, self-casing wire-line Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778)
⬚	O	Other (note on LOTB)

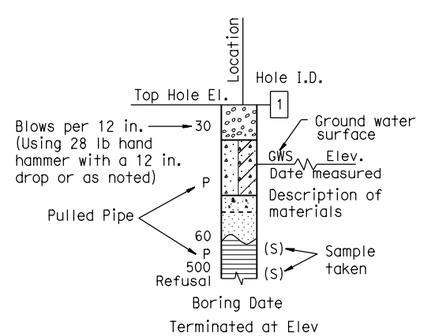
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

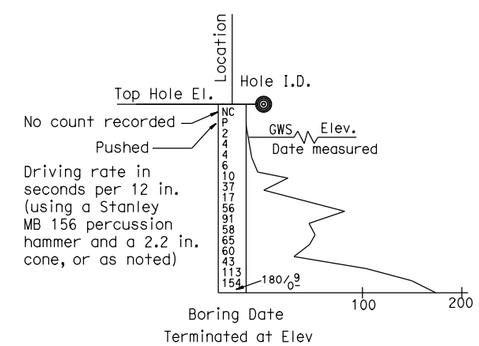
Description	Shear Strength (tsf)	Pocket Penetrometer Measurement, PP, (tsf)	Torvane Measurement, TV, (tsf)	Vane Shear Measurement, VS, (tsf)
Very Soft	Less than 0.12	Less than 0.25	Less than 0.12	Less than 0.12
Soft	0.12 - 0.25	0.25 - 0.5	0.12 - 0.25	0.12 - 0.25
Medium Stiff	0.25 - 0.5	0.5 - 1	0.25 - 0.5	0.25 - 0.5
Stiff	0.5 - 1	1 - 2	0.5 - 1	0.5 - 1
Very Stiff	1 - 2	2 - 4	1 - 2	1 - 2
Hard	Greater than 2	Greater than 4	Greater than 2	Greater than 2



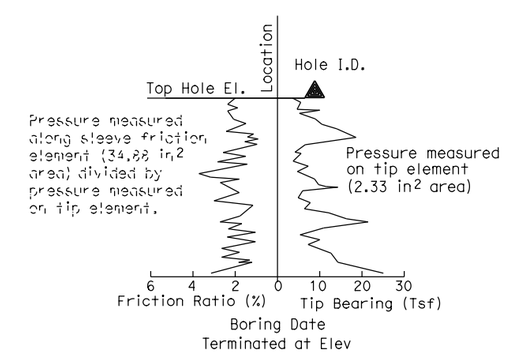
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) BORING

DESIGN OVERSIGHT	DRAWN BY	L. TRAN	L. BHANGOO / G. TRIPATHI	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	D. WANG	BRIDGE NO. 33-0736	ROUTE 112/880 SEPARATION (REPLACE)
SIGN OFF DATE	CHECKED BY	D. WANG	FIELD INVESTIGATION BY: DATE: MAY & JUNE 2008		PROJECT ENGINEER	POST MILES 23.64	LOG OF TEST BORINGS 1 OF 4

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE:
CONTRACT NO.:

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES 11/16/09 5/31/11 10/17/11 — SHEET 28 OF 31

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REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (2010)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly-graded GRAVEL Poorly-graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly-graded GRAVEL with SILT Poorly-graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly-graded GRAVEL with CLAY (or SILTY CLAY) Poorly-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly-graded SAND Poorly-graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly-graded SAND with SILT Poorly-graded SAND with SILT and GRAVEL		
SP-SC	Poorly-graded SAND with CLAY (or SILTY CLAY) Poorly-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	880			

GEOTECHNICAL PROFESSIONAL — DATE 12/1/11

PLANS APPROVAL DATE

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REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/11 — GEOTECHNICAL — STATE OF CALIFORNIA

PARIKH CONSULTANTS, INC.
2360 QUME DRIVE, SUITE A
SAN JOSE, CA 95131

ACTC
1333 BROADWAY, SUITES 220 & 300
OAKLAND, CA 94612

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 in.)
Very Loose	0 - 5
Loose	5 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Greater than 50

MOISTURE

Description	Criteria
Dry	No discernable moisture
Moist	Moisture present, but no free water
Wet	Visible free water

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5% - 10%
Little	15% - 25%
Some	30% - 45%
Mostly	50% - 100%

PARTICLE SIZE

Description		Size (in.)
Boulder		Greater than 12
Cobble		3 - 12
Gravel	Coarse	3/4 - 3
	Fine	1/5 - 3/4
Sand	Coarse	1/16 - 1/5
	Medium	1/64 - 1/16
	Fine	1/300 - 1/64
Silt and Clay		Less than 1/300

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY L. TRAN

CHECKED BY D. WANG

L. BHANGOO / G. TRIPATHI
FIELD INVESTIGATION BY:
DATE: MAY & JUNE 2008

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

D. WANG
PROJECT ENGINEER

BRIDGE NO. 33-0736
POST MILES 23.64

ROUTE 112/880 SEPARATION (REPLACE)
LOG OF TEST BORINGS 2 OF 4

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE:
CONTRACT NO.:

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES 11/16/09 5/31/11 10/17/11

SHEET 29 OF 31

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DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	880			

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PARIKH CONSULTANTS, INC.
2360 QUME DRIVE, SUITE A
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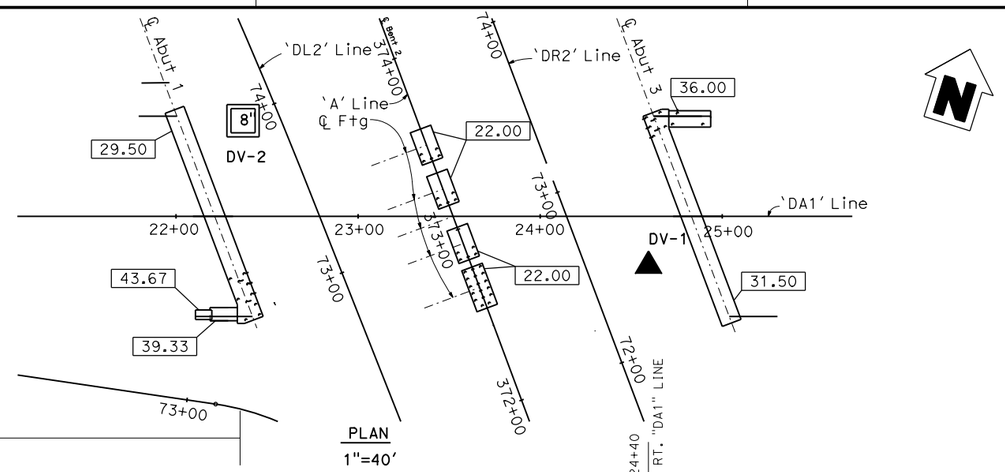
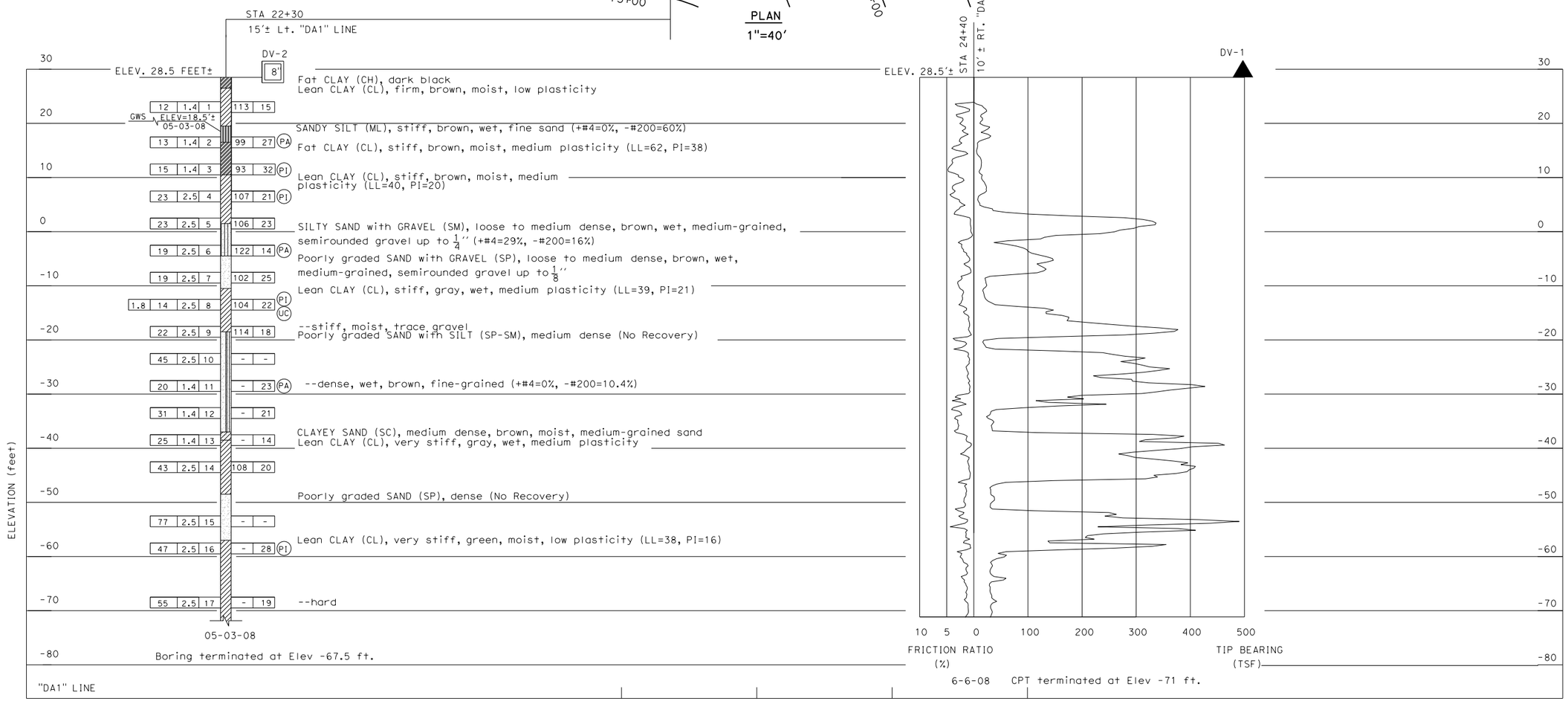
ACTC
1333 BROADWAY, SUITES 220 & 300
OAKLAND, CA 94612

BENCHMARK:
3/4" IRON PIPE WITH PLUG ON NORTHBOUND ROUTE 880 ON-RAMP FROM EASTBOUND DAVIS STREET, ±5' EAST OF EDGE OF PAVEMENT AND ±63' SOUTH OF METERING LIGHT (STA 374+10.5)
NORTHING: 2,088,799.01; EASTING: 6,076,699.29;
ELEV. 28.72.

Note:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop
(Automatic Hammer)





ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

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

X DESIGN OVERSIGHT	DRAWN BY	L. TRAN	L. BHANGOO / G. TRIPATHI FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	D. WANG PROJECT ENGINEER	BRIDGE NO. 33-0736	ROUTE 112/880 SEPARATION (REPLACE)
X SIGN OFF DATE	CHECKED BY	D. WANG	DATE: MAY & JUNE 2008			POST MILES 23.64	LOG OF TEST BORINGS 3 OF 4

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE:
CONTRACT NO.:

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES 11/16/09 5/31/11 10/17/11 — SHEET 30 OF 31

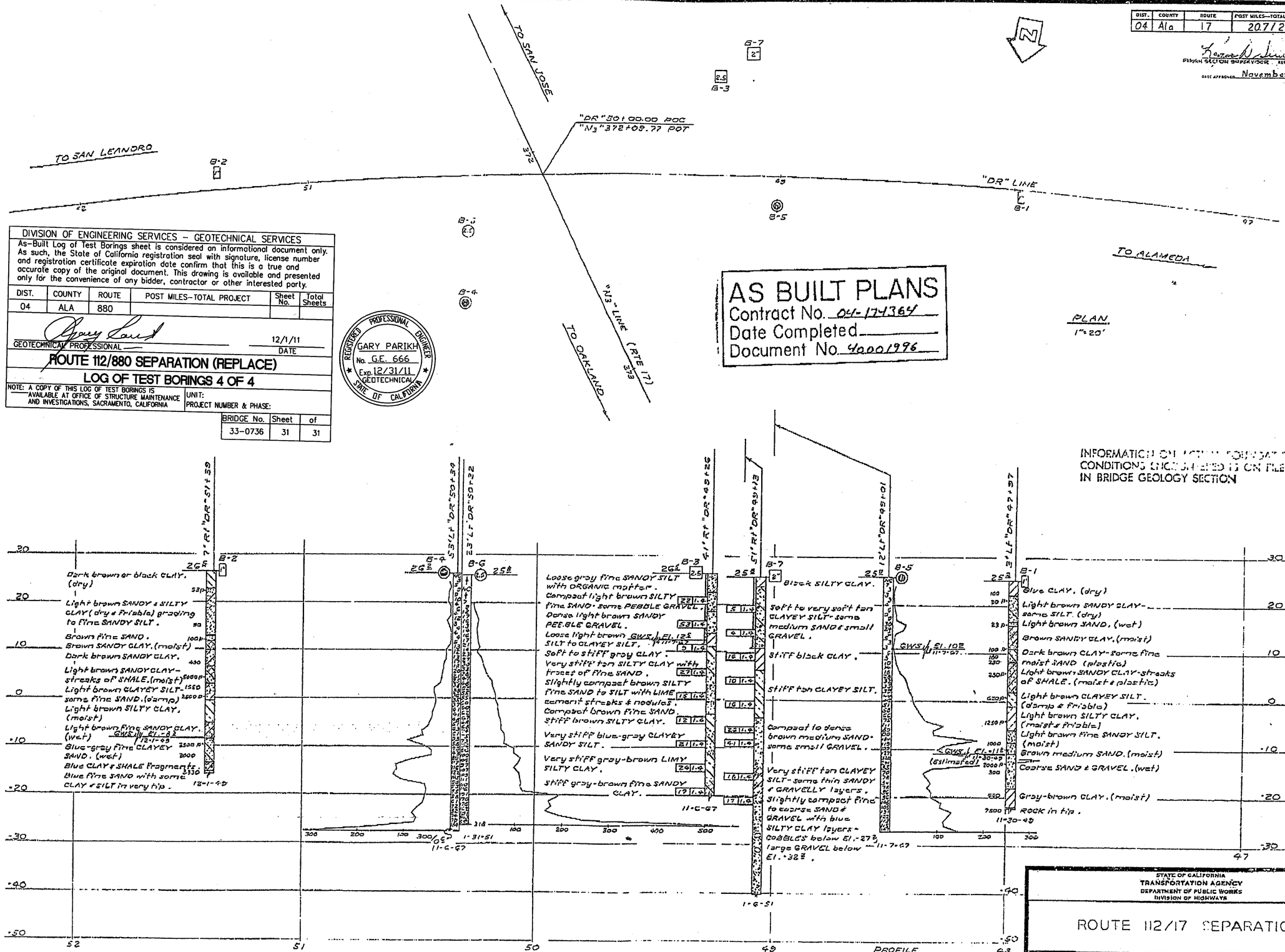
FILE => 33-0736-z-1tb03.dgn

USERNAME => eanjorin DATE PLOTTED => 02-DEC-2011 TIME PLOTTED => 16:52

DIST.	COUNTY	ROUTE	POST MILES—TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	17	20.7/26.0	117	146

DESIGN SECTION SUPERVISOR REGISTERED CIVIL ENGINEER NO. 27190

DATE APPROVED November 12, 1968



DIVISION OF ENGINEERING SERVICES – GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES–TOTAL PROJECT	Sheet No.	Total Sheets
04	ALA	880			

GEOTECHNICAL PROFESSIONAL — DATE 12/1/11

ROUTE 112/880 SEPARATION (REPLACE)

LOG OF TEST BORINGS 4 OF 4

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

UNIT:
PROJECT NUMBER & PHASE:

BRIDGE No.	Sheet	of
33-0736	31	31

REGISTERED PROFESSIONAL ENGINEER
GARY PARIKH
No. G.E. 666
Exp. 12/31/11
GEOTECHNICAL
STATE OF CALIFORNIA

AS BUILT PLANS
Contract No. 04-174364
Date Completed
Document No. 4000 1996

INFORMATION ON ACTUAL FOUNDATION CONDITIONS ENCOUNTERED IS ON FILE IN BRIDGE GEOLOGY SECTION

LEGEND OF BORING OPERATIONS

PENETROMETER — 2½" CONE PENETROMETER — SAMPLER BORING (DRY) — ROTARY BORING (WET) — AUGER BORING (DRY) — JET BORING — CORE BORING — TEST PIT

PENETRATION BORING — ROTARY BORING — 1" SOIL TUBE

LEGEND OF EARTH MATERIALS

GRAVEL — SAND — SILT — CLAY — SANDY CLAY OR SILTY CLAY — SANDY SILT OR SILTY SAND — SILTY CLAY OR CLAYEY SILT — PEAT AND ORGANIC MATTER — FILL MATERIAL — IGNEOUS ROCK — SEDIMENTARY ROCK — METAMORPHIC ROCK

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

DIAGRAM SHOWS THE BASIS FOR ESTIMATES OF MINOR GRADE SIZE PROPORTIONS IN DETERMINING THE CLASS OF MATERIAL. IF GRAVEL IS PRESENT IN APPRECIABLE AMOUNTS THE TERMS "GRAVELLY" MAY BE ADDED TO THE CLASS NAME, VIZ. "GRAVELLY SILTY CLAY". THE TERMS "COARSE", "MEDIUM" AND "FINE" WHICH MAY BE ADDED TO DESCRIBE SAND, SHOULD BE USED TO REFER TO SIZES WITHIN THE GRAVEL RANGE.

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

STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

ROUTE 112/17 SEPARATION

LOG OF TEST BORINGS

BRIDGE NO.	POST MILE	DRAWING NO.	SHEET	OF
33-168	23.64		7	7

REVISION DATES (PRELIMINARY STAGE ONLY)

WO 174361

GREGG DRILLING & TESTING, INC.
GEOTECHNICAL AND ENVIRONMENTAL INVESTIGATION SERVICES

June 9, 2008

Parikh Consultants
Attn: Gary Parikh
356 S. Milpitas Blvd.
Milpitas, California 95035

Subject: CPT Site Investigation
I-880 Widening
San Leandro, California
GREGG Project Number: 08-156MA

Dear Mr. Parikh:

The following report presents the results of GREGG Drilling & Testing's Cone Penetration Test investigation for the above referenced site. The following testing services were performed:

1	Cone Penetration Tests	(CPTU)	☒
2	Pore Pressure Dissipation Tests	(PPD)	☒
3	Seismic Cone Penetration Tests	(SCPTU)	☐
4	Resistivity Cone Penetration Tests	(RCPTU)	☐
5	UVOST Laser Induced Fluorescence	(UVOST)	☐
6	Groundwater Sampling	(GWS)	☐
7	Soil Sampling	(SS)	☐
8	Vapor Sampling	(VS)	☐
9	Vane Shear Testing	(VST)	☐
10	SPT Energy Calibration	(SPTE)	☐

A list of reference papers providing additional background on the specific tests conducted is provided in the bibliography following the text of the report. If you would like a copy of any of these publications or should you have any questions or comments regarding the contents of this report, please do not hesitate to contact our office at (925) 313-5800.

Sincerely,
GREGG Drilling & Testing, Inc.

Mary Walden
Operations Manager

950 Howe Rd • Martinez, California 94553 • (925) 313-5800 • FAX (925) 313-0302
OTHER OFFICES: LOS ANGELES • HOUSTON • SOUTH CAROLINA
www.greggdrilling.com

Cone Penetration Testing Procedure (CPT)

Gregg Drilling carries out all Cone Penetration Tests (CPT) using an integrated electronic cone system, *Figure CPT*. The soundings were conducted using a 20 ton capacity cone with a tip area of 15 cm^2 and a friction sleeve area of 225 cm^2. The cone is designed with an equal end area friction sleeve and a tip end area ratio of 0.80.

The cone takes measurements of cone bearing (q_c), sleeve friction (f_s) and penetration pore water pressure (u_2) at 5-cm intervals during penetration to provide a nearly continuous hydrogeologic log. CPT data reduction and interpretation is performed in real time facilitating on-site decision making. The above mentioned parameters are stored on disk for further analysis and reference. All CPT soundings are performed in accordance with revised (2002) ASTM standards (D 5778-95).

The cone also contains a porous filter element located directly behind the cone tip (u_2), *Figure CPT.* It consists of porous plastic and is 5.0mm thick. The filter element is used to obtain penetration pore pressure as the cone is advanced as well as Pore Pressure Dissipation Tests (PPDT's) during appropriate pauses in penetration. It should be noted that prior to penetration, the element is fully saturated with silicon oil under vacuum pressure to ensure accurate and fast dissipation.

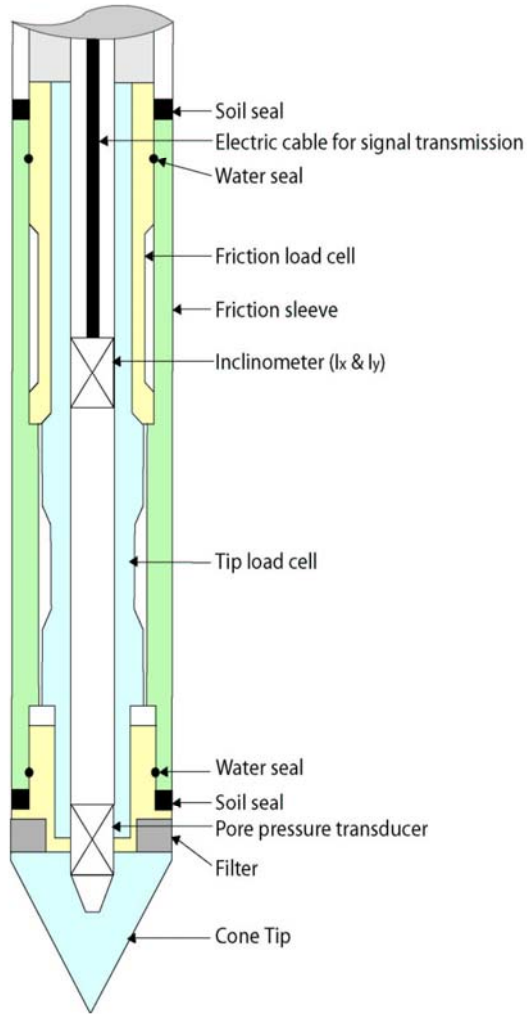


Figure CPT

When the soundings are complete, the test holes are grouted using a Gregg In Situ support rig. The grouting procedures generally consist of pushing a hollow CPT rod with a "knock out" plug to the termination depth of the test hole. Grout is then pumped under pressure as the tremie pipe is pulled from the hole. Disruption or further contamination to the site is therefore minimized.

Cone Penetration Test Sounding Summary

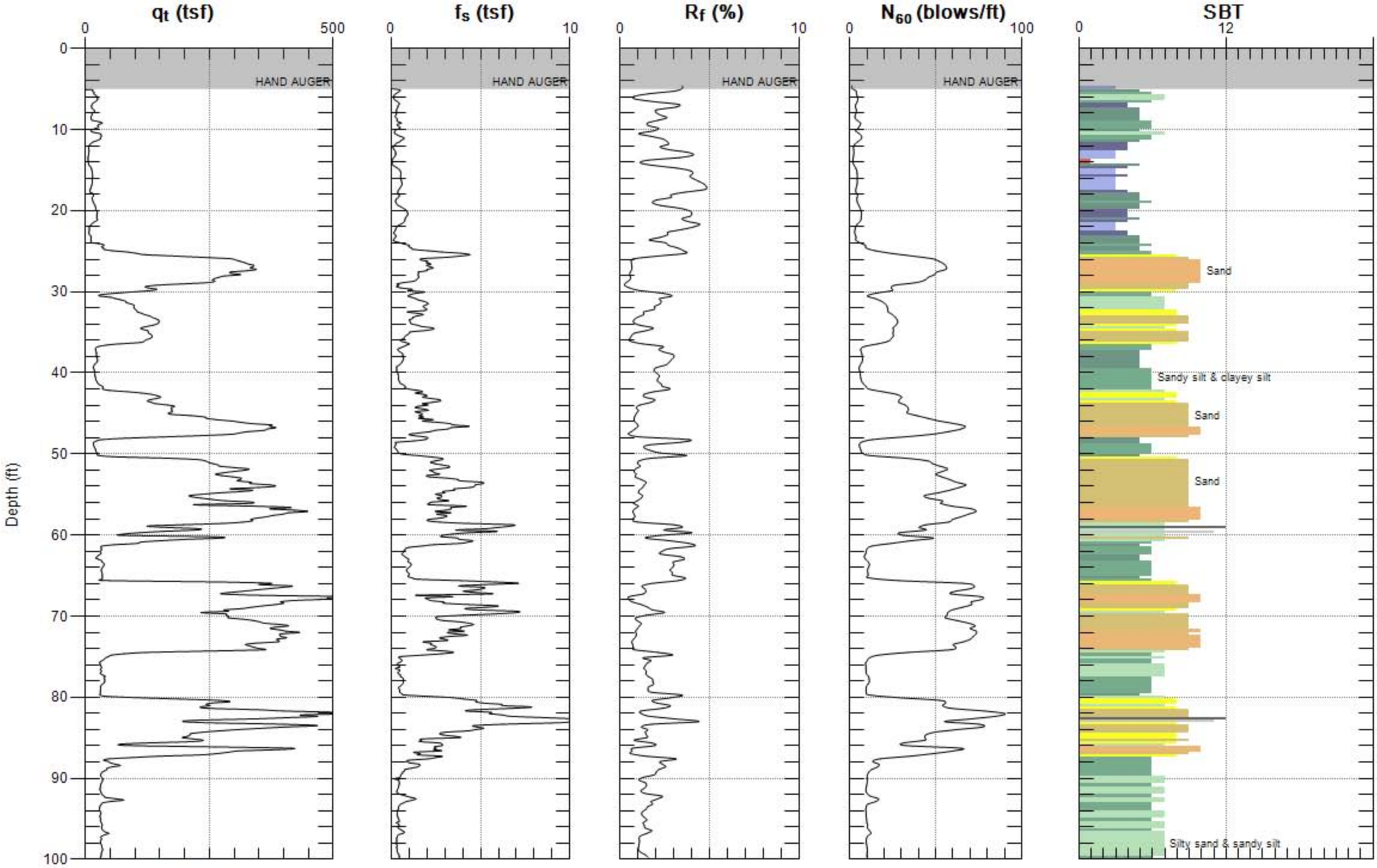
-Table 1-

CPT Sounding Identification	Date	Termination Depth (Feet)	Depth of Groundwater Samples (Feet)	Depth of Soil Samples (Feet)	Depth of Pore Pressure Dissipation Tests (Feet)
CPT-MR1	6/06/08	100	-	-	24.1, 43.8
CPT-DV1	6/06/08	100	-	-	44.9, 66.3, 68.3

PARIKH CONSULTANTS

Site: I-880 WIDENING
Sounding: CPT-DV1

Engineer: G.PARIKH
Date: 6/6/2008 12:11



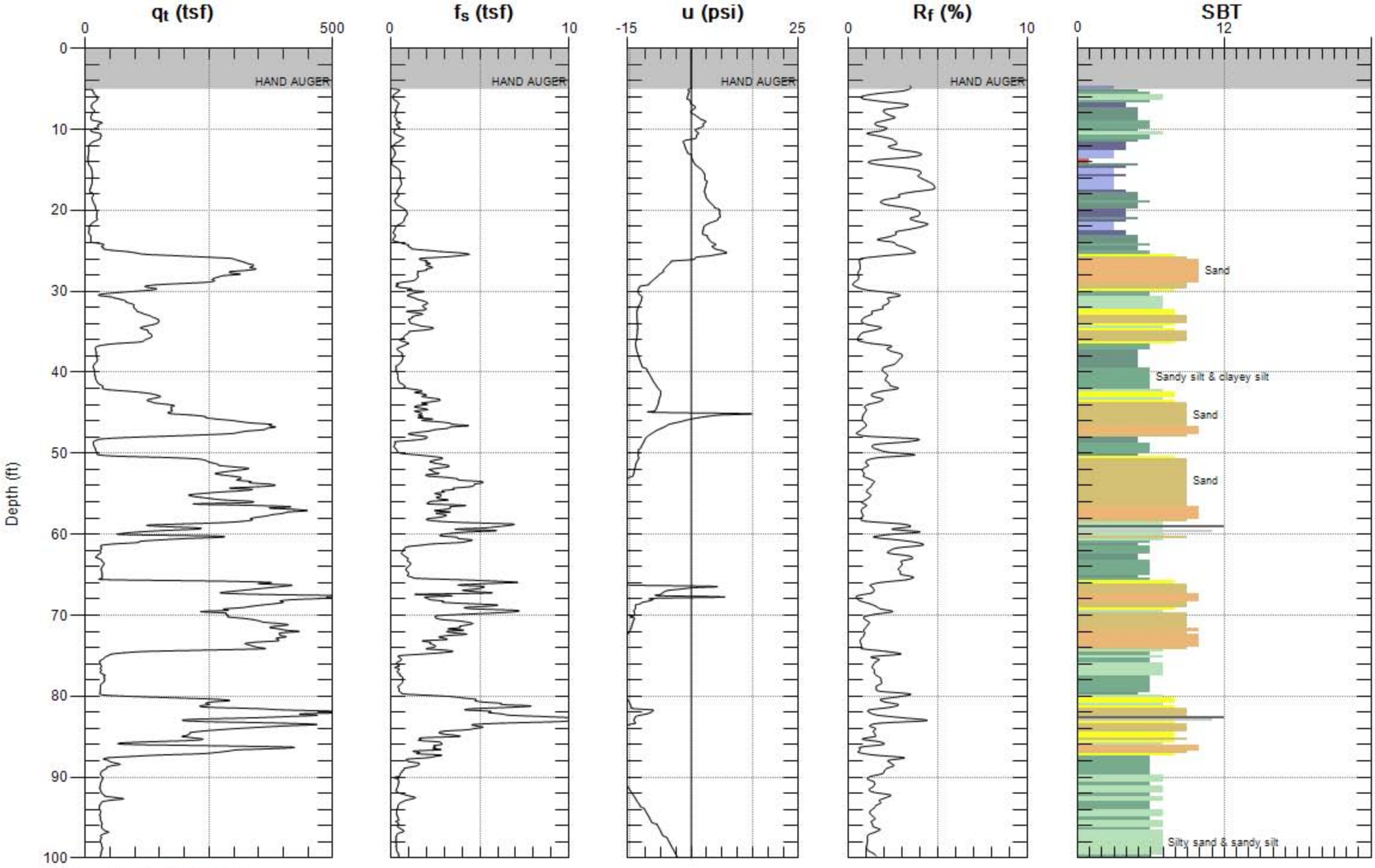
Max. Depth: 100.066 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

PARIKH CONSULTANTS

Site: I-880 WIDENING
Sounding: CPT-DV1

Engineer: G.PARIKH
Date: 6/6/2008 12:11



Max. Depth: 100.066 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

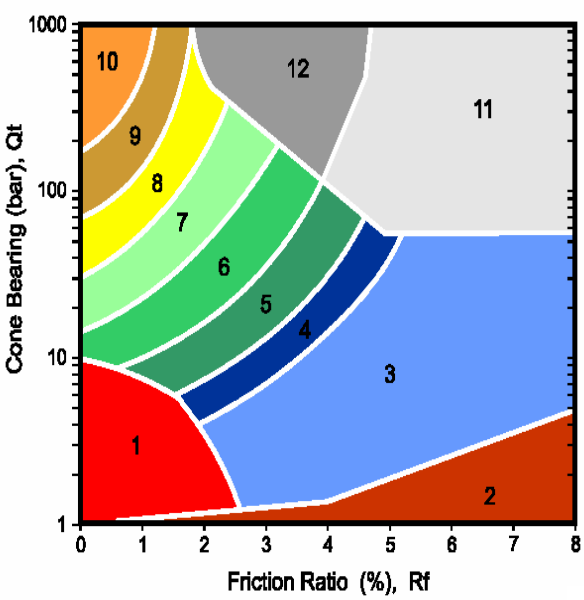
Cone Penetration Test Data & Interpretation

The Cone Penetration Test (CPT) data collected from your site are presented in graphical form in the attached report. The plots include interpreted Soil Behavior Type (SBT) based on the charts described by Robertson (1990). Typical plots display SBT based on the non-normalized charts of Robertson et al (1986). For CPT soundings extending greater than 50 feet, we recommend the use of the normalized charts of Robertson (1990) which can be displayed as SBTn, upon request. The report also includes spreadsheet output of computer calculations of basic interpretation in terms of SBT and SBTn and various geotechnical parameters using current published correlations based on the comprehensive review by Lunne, Robertson and Powell (1997), as well as recent updates by Professor Robertson. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg InSitu and Gregg Drilling & Testing Inc. do not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and do not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software.

Some interpretation methods require input of the groundwater level to calculate vertical effective stress. An estimate of the in-situ groundwater level has been made based on field observations and/or CPT results, but should be verified by the user.

A summary of locations and depths is available in Table 1. Note that all penetration depths referenced in the data are with respect to the existing ground surface.

Note that it is not always possible to clearly identify a soil type based solely on q_t, f_s, and u_2. In these situations, experience, judgment, and an assessment of the pore pressure dissipation data should be used to infer the correct soil behavior type.



(After Robertson, et al., 1986)

ZONE		SBT
1		Sensitive, fine grained
2		Organic materials
3		Clay
4		Silty clay to clay
5		Clayey silt to silty clay
6		Sandy silt to clayey silt
7		Silty sand to sandy silt
8		Sand to silty sand
9		Sand
10		Gravely sand to sand
11		Very stiff fine grained*
12		Sand to clayey sand*

*over consolidated or cemented

Figure SBT

Cone Penetration Test (CPT) Interpretation

Gregg have recently updated their CPT interpretation and plotting software (2007). The software takes the CPT data and performs basic interpretation in terms of soil behavior type (SBT) and various geotechnical parameters using current published empirical correlations based on the comprehensive review by Lunne, Robertson and Powell (1997). The interpretation is presented in tabular format using MS Excel. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software.

The following provides a summary of the methods used for the interpretation. Many of the empirical correlations to estimate geotechnical parameters have constants that have a range of values depending on soil type, geologic origin and other factors. The software uses 'default' values that have been selected to provide, in general, conservatively low estimates of the various geotechnical parameters.

Input:

1. Units for display (Imperial or metric) (atm. pressure, pa = 0.96 tsf or 0.1 MPa)
2. Depth interval to average results,(ft or m). Data are collected at either 0.02 or 0.05m and can be averaged every 1, 3 or 5 intervals.
3. Elevation of ground surface (ft or m)
4. Depth to water table, z_w (ft or m) – input required
5. Net area ratio for cone, a (default to 0.80)
6. Relative Density constant, C_{Dr} (default to 350)
7. Young's modulus number for sands, α (default to 5)
8. Small strain shear modulus number
   a. for sands, S_G (default to 180 for SBT_n 5, 6, 7)
   b. for clays, C_G (default to 50 for SBT_n 1, 2, 3 & 4)
9. Undrained shear strength cone factor for clays, N_{kt} (default to 15)
10. Over Consolidation ratio number, k_{ocr} (default to 0.3)
11. Unit weight of water, (default to γ_w = 62.4 lb/ft^3 or 9.81 kN/m^3)

Column

1. Depth, z, (m) – CPT data is collected in meters
2. Depth (ft)
3. Cone resistance, q_c (tsf or MPa)
4. Sleeve friction, f_s (tsf or MPa)
5. Penetration pore pressure, u (psi or MPa), measured behind the cone (i.e. u_2)
6. Other – any additional data, if collected, e.g. electrical resistivity or UVIF
7. Total cone resistance, q_t (tsf or MPa) $q_t = q_c + u\,(1-a)$

8	Friction Ratio, R_f (%)	$R_f = (f_s/q_t) \times 100\%$
9	Soil Behavior Type (non-normalized), SBT	see note
10	Unit weight, γ (pcf or kN/m^3)	based on SBT, see note
11	Total overburden stress, σ_v (tsf)	$\sigma_{vo} = \gamma z$
12	Insitu pore pressure, u_o (tsf)	$u_o = \gamma_w (z - z_w)$
13	Effective overburden stress, σ'_{vo} (tsf)	$\sigma'_{vo} = \sigma_{vo} - u_o$
14	Normalized cone resistance, Q_{t1}	$Q_{t1} = (q_t - \sigma_{vo}) / \sigma'_{vo}$
15	Normalized friction ratio, F_r (%)	$F_r = f_s / (q_t - \sigma_{vo}) \times 100\%$
16	Normalized Pore Pressure ratio, B_q	$B_q = u - u_o / (q_t - \sigma_{vo})$
17	Soil Behavior Type (normalized), SBT_n	see note
18	SBT_n Index, I_c	see note
19	Normalized Cone resistance, Q_{tn} (n varies with Ic)	see note
20	Estimated permeability, k_{SBT} (cm/sec or ft/sec)	see note
21	Equivalent SPT N_{60}, blows/ft	see note
22	Equivalent SPT $(N_1)_{60}$ blows/ft	see note
23	Estimated Relative Density, D_r, (%)	see note
24	Estimated Friction Angle, ϕ', (degrees)	see note
25	Estimated Young's modulus, E_s (tsf)	see note
26	Estimated small strain Shear modulus, Go (tsf)	see note
27	Estimated Undrained shear strength, s_u (tsf)	see note
28	Estimated Undrained strength ratio	s_u/σ_v'
29	Estimated Over Consolidation ratio, OCR	see note

Notes:

1 Soil Behavior Type (non-normalized), SBT — Lunne et al. (1997)
listed below

2 Unit weight, γ either constant at 119 pcf or based on Non-normalized SBT
(Lunne et al., 1997 and table below)

3 Soil Behavior Type (Normalized), SBT_n — Lunne et al. (1997)

4 SBT_n Index, I_c — $I_c = ((3.47 - \log Q_{t1})^2 + (\log F_r + 1.22)^2)^{0.5}$

5 Normalized Cone resistance, Q_{tn} (n varies with Ic)

$Q_{tn} = ((q_t - \sigma_{vo})/pa)\ (pa/(\sigma'_{vo})^n$ and recalculate I_c, then iterate:

When $I_c < 1.64$, $n = 0.5$ (clean sand)
When $I_c > 3.30$, $n = 1.0$ (clays)
When $1.64 < I_c < 3.30$, $n = (I_c - 1.64)0.3 + 0.5$
Iterate until the change in n, $\Delta n < 0.01$

6 Estimated permeability, k_{SBT} (based on Normalized SBT_n)
(Lunne et al., 1997 and table below)

7 Equivalent SPT N_{60}, blows/ft Lunne et al. (1997)

$$\frac{(q_t/p_a)}{N_{60}} = 8.5\left(1 - \frac{I_c}{4.6}\right)$$

8 Equivalent SPT $(N_1)_{60}$ blows/ft $(N_1)_{60} = N_{60}\, C_N$,
where $C_N = (pa/\sigma'_{vo})^{0.5}$

9 Relative Density, D_r, (%) $D_r^2 = Q_{tn} / C_{Dr}$
Only SBT_n 5, 6, 7 & 8 *Show 'N/A' in zones 1, 2, 3, 4 & 9*

10 Friction Angle, ϕ', (degrees) $\tan\phi' = \frac{1}{2.68}\left[\log\left(\frac{q_c}{\sigma'_{vo}}\right) + 0.29\right]$
Only SBT_n 5, 6, 7 & 8 *Show'N/A' in zones 1, 2, 3, 4 & 9*

11 Young's modulus, E_s $E_s = \alpha\, q_t$
Only SBT_n 5, 6, 7 & 8 *Show 'N/A' in zones 1, 2, 3, 4 & 9*

12 Small strain shear modulus, Go
a. $G_o = S_G\,(q_t\ \sigma'_{vo}\ pa)^{1/3}$ *For SBT_n 5, 6, 7*
b. $G_o = C_G\, q_t$ *For SBT_n 1, 2, 3& 4*
Show 'N/A' in zones 8 & 9

13 Undrained shear strength, s_u $s_u = (q_t - \sigma_{vo}) / N_{kt}$
Only SBT_n 1, 2, 3, 4 & 9 *Show 'N/A' in zones 5, 6, 7 & 8*

14 Over Consolidation ratio, OCR $OCR = k_{ocr}\, Q_{t1}$
Only SBT_n 1, 2, 3, 4 & 9 *Show 'N/A' in zones 5, 6, 7 & 8*

SBT Zones **SBT_n Zones**

The following updated and simplified SBT descriptions have been used in the software:

1	sensitive fine grained	1	sensitive fine grained
2	organic soil	2	organic soil
3	clay	3	clay
4	clay & silty clay	4	clay & silty clay
5	clay & silty clay		
6	sandy silt & clayey silt		
7	silty sand & sandy silt	5	silty sand & sandy silt
8	sand & silty sand	6	sand & silty sand
9	sand		
10	sand	7	sand
11	very dense/stiff soil*	8	very dense/stiff soil*
12	very dense/stiff soil*	9	very dense/stiff soil*

* heavily overconsolidated and/or cemented

Track when soils fall with zones of same description and print that description (i.e. if soils fall only within SBT zones 4 & 5, print 'clays & silty clays')

Estimated Permeability (see Lunne et al., 1997)

SBT_n	Permeability (ft/sec)	(m/sec)
1	$3x\ 10^{-8}$	$1x\ 10^{-8}$
2	$3x\ 10^{-7}$	$1x\ 10^{-7}$
3	$1x\ 10^{-9}$	$3x\ 10^{-10}$
4	$3x\ 10^{-8}$	$1x\ 10^{-8}$
5	$3x\ 10^{-6}$	$1x\ 10^{-6}$
6	$3x\ 10^{-4}$	$1x\ 10^{-4}$
7	$3x\ 10^{-2}$	$1x\ 10^{-2}$
8	$3x\ 10^{-6}$	$1x\ 10^{-6}$
9	$1x\ 10^{-8}$	$3x\ 10^{-9}$

Estimated Unit Weight (see Lunne et al., 1997)

SBT	Approximate Unit Weight (lb/ft^3)	(kN/m^3)
1	111.4	17.5
2	79.6	12.5
3	111.4	17.5
4	114.6	18.0
5	114.6	18.0
6	114.6	18.0
7	117.8	18.5
8	120.9	19.0
9	124.1	19.5
10	127.3	20.0
11	130.5	20.5
12	120.9	19.0

GREGG & TESTING, INC.

CONE PENETRATION TEST DATA

									Units:			Imperial																	
									Data averaging interval:			0.100	meters																	
		Client:	PARIKH CONSULTANTS						Assumed depth of water:			27.007	feet	Boring DV-2 encountered GW @ 10 ft																
		Site:	I-880 WIDENING						Net area ratio of cone:			0.80																		
		Engineer:	G.PARIKH						Unit weight of water:			62.4	lb/ft3																	
									Relative density constant, CDR:			350																			
		Sounding:	CPT-DV1 (Davis Street/Rte 880)						Young's modulus for sands, a:			4																		
		Date:	6/6/2008						Small strain shear modulus number, SG (sands):			180																		
		Time:	12:11 PM						Small strain shear modulus number, CG (clays):			50																		
									Nkt for clays:			15																		
									OCR number, kocr:			0.3																		
		Interpretation based on Lunne, Robertson and Powell, 1997																												

Col 1i	Col 2i	Col 3i	Col 4i	Col 5i	Col 6i	Col 7i	Col 8i	Col 9i	Col 10i	Col 11i	Col 12i	Col 13i	Col 14i	Col 15i	Col 16i	Col 17i	Col 18i	Col 19i	Col 20i	Col 21i	Col 22i	Col 23i	Col 24i	Col 25i	Col 26i	Col 27i	Col 28i	Col 29i
Depth (m)	Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf (%)	SBT	Unit Weight, γ (pcf)	Total Overburden Stress, σv (tsf)	Insitu pore pressure, uo (tsf)	Effective overburden stress, σ'v (tsf)	Normalized cone resistance, Qtl	Normalized Friction raio, Fr	Normalized pore pressure ratio, Bq	Soil Behavior Type (normalized) SBTn	SBTn Index, Ic	Normalized Cone resistance, Qtn	Estimated permeability, kSBT (ft/sec)	SPT N60 (blows/ft)	SPT (N1)60 (blows/ft)	Relative Density, Dr (%)	Friction Angle, φ' (degrees)	Young's modulus, Es (tsf)	Small strain shear modulus, Go (tsf)	Undrained shear strength, su (tsf)	Undrained strength ratio, su/σ'v	Over consolidation ratio, OCR
0.100	0.328	0.000	0.000	0.000							0.000																	
0.200	0.656	0.000	0.000	0.000							0.000																	
0.300	0.984	0.000	0.000	0.000							0.000																	
0.400	1.312	0.000	0.000	0.000							0.000																	
0.500	1.640	0.000	0.000	0.000							0.000																	
0.600	1.969	0.000	0.000	0.000							0.000																	
0.700	2.297	0.000	0.000	0.000							0.000																	
0.800	2.625	0.000	0.000	0.000							0.000																	
0.900	2.953	0.000	0.000	0.000							0.000																	
1.000	3.281	0.000	0.000	0.000							0.000																	
1.100	3.609	0.000	0.000	0.000							0.000																	
1.200	3.937	0.000	0.000	0.000							0.000																	
1.300	4.265	0.000	0.000	0.000							0.000																	
1.400	4.593	0.000	0.000	0.000							0.000																	
1.500	4.921	4.690	0.162	-0.238		4.69	3.46	3	111	0.274	0.000	0.274	16.10	3.68	0.00	3	2.88	13.56	1.00E-9	1.4	2.7				234	0.29	1.07	4.8
1.600	5.249	15.368	0.465	-0.594		15.36	3.03	5	115	0.293	0.000	0.293	51.44	3.09	0.00	4	2.45	37.01	3.00E-8	3.7	7.0				768	1.00	3.43	15.4
1.700	5.577	18.090	0.292	-0.634		18.08	1.61	6	115	0.312	0.000	0.312	57.00	1.64	0.00	5	2.24	38.50	3.00E-6	3.9	7.2	33	37	72	326			
1.800	5.906	22.440	0.172	-0.832		22.43	0.77	7	118	0.331	0.000	0.331	66.75	0.78	0.00	6	1.99	42.12	3.00E-4	4.4	7.8	35	38	90	358			
1.900	6.234	23.956	0.202	-0.726		23.95	0.84	7	118	0.350	0.000	0.350	67.35	0.86	0.00	6	2.01	43.75	3.00E-4	4.7	8.2	35	38	96	373			
2.000	6.562	19.512	0.369	-0.225		19.51	1.89	6	115	0.369	0.000	0.369	51.85	1.93	0.00	5	2.31	37.87	3.00E-6	4.4	7.4	33	37	78	354			
2.100	6.890	13.673	0.444	0.145		13.68	3.25	4	115	0.388	0.000	0.388	34.25	3.34	0.00	4	2.61	27.73	3.00E-8	3.5	5.8				684	0.89	2.28	10.3
2.200	7.218	12.496	0.389	0.778		12.51	3.11	4	115	0.407	0.000	0.407	29.75	3.21	0.00	4	2.64	24.57	3.00E-8	3.3	5.3				625	0.81	1.98	8.9
2.300	7.546	16.178	0.332	0.422		16.18	2.05	5	115	0.426	0.000	0.426	37.03	2.10	0.00	5	2.45	29.29	3.00E-6	3.8	6.1	29	35	65	349			
2.400	7.874	16.140	0.321	0.053		16.14	1.99	5	115	0.444	0.000	0.444	35.33	2.04	0.00	5	2.46	28.31	3.00E-6	3.9	5.9	28	35	65	354			
2.500	8.202	12.562	0.281	0.752		12.57	2.23	5	115	0.463	0.000	0.463	26.15	2.32	0.00	4	2.59	21.91	3.00E-8	3.2	4.8				629	0.81	1.74	7.8
2.600	8.530	11.244	0.293	1.663		11.27	2.60	5	115	0.482	0.000	0.482	22.38	2.72	0.01	4	2.69	19.35	3.00E-8	3.0	4.5				563	0.72	1.49	6.7
2.700	8.858	17.336	0.365	2.745		17.38	2.10	5	115	0.501	0.000	0.501	33.70	2.16	0.01	5	2.49	28.05	3.00E-6	4.2	6.1	28	34	70	377			
2.800	9.186	29.456	0.448	3.062		29.50	1.52	6	115	0.520	0.000	0.520	55.78	1.54	0.01	5	2.23	44.29	3.00E-6	6.3	9.1	36	37	118	456			
2.900	9.514	26.226	0.413	2.745		26.27	1.57	6	115	0.538	0.000	0.538	47.79	1.61	0.01	5	2.29	38.88	3.00E-6	5.8	8.1	33	36	105	444			
3.000	9.843	20.208	0.432	1.808		20.23	2.14	6	115	0.557	0.000	0.557	35.32	2.20	0.01	5	2.48	30.11	3.00E-6	4.9	6.7	29	35	81	411			
3.100	10.171	13.400	0.244	1.161		13.42	1.82	5	115	0.576	0.005	0.576	22.30	1.90	0.01	4	2.60	19.59	3.00E-8	3.4	4.6				671	0.86	1.49	6.7
3.200	10.499	25.717	0.264	1.465		25.74	1.03	7	118	0.595	0.016	0.595	42.24	1.05	0.00	5	2.22	35.04	3.00E-6	5.5	7.4	32	36	103	456			
3.300	10.827	31.264	0.534	1.240		31.28	1.71	6	115	0.614	0.026	0.614	49.94	1.74	0.00	5	2.30	42.35	3.00E-6	6.9	9.1	35	37	125	491			
3.400	11.155	28.439	0.674	0.264		28.44	2.37	6	115	0.633	0.036	0.633	43.94	2.42	0.00	5	2.43	38.40	3.00E-6	6.7	8.7	33	36	114	481			
3.500	11.483	18.316	0.477	-1.611		18.29	2.61	5	115	0.652	0.046	0.652	27.07	2.71	-0.01	4	2.62	24.51	3.00E-8	4.7	6.0				915	1.18	1.80	8.1
3.600	11.811	9.859	0.263	-1.663		9.84	2.68	4	115	0.670	0.057	0.670	13.67	2.87	-0.01	3	2.87	12.89	1.00E-9	2.9	3.7				492	0.61	0.91	4.1
3.700	12.139	6.714	0.148	-1.452		6.69	2.22	4	115	0.689	0.067	0.689	8.71	2.47	-0.02	3	3.00	8.37	1.00E-9	2.1	2.7				335	0.40	0.58	2.6
3.800	12.467	6.950	0.186	-1.201		6.93	2.69	4	115	0.708	0.077	0.708	8.79	2.99	-0.01	3	3.04	8.52	1.00E-9	2.3	2.8				347	0.41	0.59	2.6
3.900	12.795	6.968	0.260	-0.911		6.96	3.74	3	111	0.726	0.087	0.726	8.58	4.17	-0.01	3	3.13	8.41	1.00E-9	2.4	2.9				348	0.42	0.57	2.6
4.000	13.123	6.253	0.255	-0.238		6.25	4.07	3	111	0.745	0.097	0.745	7.39	4.63	0.00	3	3.21	7.32	1.00E-9	2.3	2.7				312	0.37	0.49	2.2
4.100	13.451	5.206	0.173	0.132		5.21	3.32	3	111	0.763	0.108	0.763	5.83	3.88	0.00	3	3.25	5.80	1.00E-9	2.0	2.3				260	0.30	0.39	1.7
4.200	13.780	5.291	0.081	0.343		5.30	1.53	1	111	0.781	0.118	0.781	5.78	1.79	0.01	3	3.08	5.66	1.00E-9	1.8	2.1				265	0.30	0.39	1.7
4.300	14.108	5.942	0.067	0.646		5.95	1.12	1	111	0.799	0.128	0.799	6.45	1.29	0.01	3	2.98	6.27	1.00E-9	1.9	2.2				298	0.34	0.43	1.9
4.400	14.436	8.155	0.156	1.135		8.17	1.91	5	115	0.818	0.138	0.818	8.99	2.13	0.01	3	2.95	8.75	1.00E-9	2.5	2.9				409	0.49	0.60	2.7
4.500	14.764	11.517	0.369	1.914		11.54	3.20	4	115	0.837	0.149	0.837	12.79	3.45	0.01	3	2.95	12.47	1.00E-9	3.6	4.0				577	0.71	0.85	3.8
4.600	15.092	13.071	0.515	2.561		13.11	3.93	3	111	0.855	0.159	0.855	14.33	4.20	0.02	3	2.96	14.01	1.00E-9	4.1	4.5				655	0.82	0.96	4.3
4.700	15.420	13.777	0.559	2.983		13.82	4.04	3	111	0.874	0.169	0.874	14.82	4.32	0.02	3	2.95	14.52	1.00E-9	4.3	4.7				691	0.86	0.99	4.4
4.800	15.748	14.107	0.549	3.154		14.15	3.88	4	115	0.892	0.179	0.892	14.86	4.14	0.02	3	2.94	14.59	1.00E-9	4.4	4.7				708	0.88	0.99	4.5
4.900	16.076	13.767	0.565	3.194		13.81	4.09	3	111	0.911	0.190	0.911	14.17	4.38	0.02	3	2.97	13.96	1.00E-9	4.3	4.7				691	0.86	0.94	4.3
5.000	16.404	13.579	0.601	3.524		13.63	4.41	3	111	0.929	0.200	0.929	13.67	4.73	0.02	3	3.01	13.51	1.00E-9	4.4	4.7				681	0.85	0.91	4.1
5.100	16.732	13.052	0.613	3.504		13.10	4.68	3	111	0.947	0.210	0.947	12.83	5.04	0.02	3	3.05	12.72	1.00E-9	4.3	4.5				655	0.81	0.86	3.9
5.200	17.060	11.470	0.553	3.353		11.52	4.80	3	111	0.965	0.220	0.965	10.93	5.24	0.02	3	3.11	10.87	1.00E-9	3.9	4.1				576	0.70	0.73	3.3
5.300	17.388	9.624	0.456	3.181		9.67	4.71	3	111	0.984	0.231	0.984	8.83	5.25	0.03	3	3.18	8.81	1.00E-9	3.5	3.6				484	0.58	0.59	2.6
5.400	17.717	10.886	0.395	3.128		10.93	3.62	4	115	1.003	0.241	1.003	9.90	3.98	0.02	3	3.07	9.87	1.00E-9	3.6	3.7				547	0.66	0.66	3.0
5.500	18.045	15.586	0.442	3.300		15.63	2.83	5	115	1.021	0.251	1.021	14.31	3.02	0.02	3	2.87	14.24	1.00E-9	4.6	4.7				782	0.97	0.95	4.3
5.600	18.373	14.268	0.405	3.485		14.32	2.83	5	115	1.040	0.261	1.040	12.77	3.05	0.02	3	2.91	12.74	1.00E-9	4.3	4.4				716	0.89	0.85	3.8
5.700	18.701	14.267	0.286	3.854		14.32	2.00	5	115	1.059	0.271	1.059	12.53	2.16	0.02	4	2.84	12.53	3.00E-8	4.1	4.1				716	0.88	0.84	3.8
5.800	19.029	16.329	0.295	4.395		16.39	1.80	6	115	1.078	0.282	1.078	14.21	1.93	0.02	4	2.76	14.25	3.00E-8	4.5	4.5				820	1.02	0.95	4.3
5.900	19.357	19.229	0.435	5.029		19.30	2.25	5	115	1.096	0.292	1.096	16.60	2.39	0.02	4	2.76	16.70	3.00E-8	5.3	5.2				965	1.21	1.11	5.0
6.000	19.685	20.727	0.683	5.781		20.81	3.28	5	115	1.115	0.302	1.115	17.66	3.47	0.02	3	2.84	17.79	1.00E-9	6.0	5.9				1040	1.31	1.18	5.3
6.100	20.013	22.516	0.871	6.586		22.61	3.85	4	115	1.134	0.312	1.134	18.94	4.05	0.02	3	2.85	19.12	1.00E-9	6.6	6.4				1131	1.43	1.26	5.7
6.200	20.341	23.372	0.935	6.639		23.47	3.99	4	115	1.153	0.323	1.153	19.36	4.19	0.02	3	2.86	19.58	1.00E-9	6.9	6.6				1173	1.49	1.29	5.8
6.300	20.669	22.789	0.889	6.705		22.89	3.89	4	115	1.172	0.333	1.172	18.53	4.10	0.02	3	2.86	18.78	1.00E-9	6.7	6.4				1144	1.45	1.24	5.6
6.400	20.997	23.344	0.806	6.375		23.44	3.44	5	115	1.190	0.343	1.190	18.69	3.62	0.02	4	2.83	19.01	3.00E-8	6.7	6.4				1172	1.48	1.25	5.6
6.500	21.325	19.681	0.744	5.451		19.76	3.76	4	115	1.209	0.353	1.209	15.34	4.01	0.02	3	2.92	15.58	1.00E-9	6.0	5.6				988	1.24	1.02	4.6
6.600	21.654	12.543	0.557	3.973		12.60	4.42	3	111	1.228	0.364	1.228	9.26	4.90	0.03	3	3.15	9.33	1.00E-9	4.4	4.1				630	0.76	0.62	2.8
6.700	21.982	8.522	0.353	3.088		8.57	4.12	3	111	1.246	0.374	1.246	5.88	4.83	0.03	3	3.30	5.88	1.00E-9	3.4	3.1				428	0.49	0.39	1.8
6.800	22.310	7.722	0.268	2.811		7.76	3.46	3	111	1.264	0.384	1.264	5.14	4.13	0.03	3	3.31	5.14	1.00E-9	3.1	2.8				388	0.43	0.34	1.5
6.900	22.638	7.242	0.194	2.693		7.28	2.67	4	115	1.283	0.394	1.283	4.68	3.24	0.03	3	3.29	4.68	1.00E-9	2.8	2.6				364	0.40	0.31	1.4
7.000	22.966	8.758	0.233	3.036		8.80	2.65	4	115	1.302	0.405	1.302	5.76	3.11	0.03	3	3.21	5.80	1.00E-9	3.2	2.9				440	0.50	0.38	1.7
7.100	23.294	11.008	0.245	3.801		11.06	2.21	5	115	1.320	0.415	1.320	7.38	2.51	0.03	3	3.07	7.50	1.00E-9	3.7	3.3				553	0.65	0.49	2.2
7.200	23.622	10.989	0.179	4.171		11.05	1.62	5	115	1.339	0.425	1.339	7.25	1.85	0.03	3	3.00	7.41	1.00E-9	3.5	3.1				552	0.65	0.48	2.2
7.300	23.950	19.201	0.485	4.910		19.27	2.51	5	115	1.358	0.435	1.358	13.19	2.71	0.02	4	2.87	13.63	3.00E-8	5.7	5.0				964	1.19	0.88	4.0
7.400	24.278	34.230	0.922	5.359		34.31	2.69	6	115	1.377	0.445	1.377	23.92	2.80	0.01	4	2.67	25.14	3.00E-8	9.1	8.0				1715	2.20	1.59	7.2
7.500	24.606	35.398	1.137	5.240		35.47	3.21	5	115	1.396	0.456	1.396	24.42	3.34	0.01	4	2.72	25.64	3.00E-8	9.6	8.4				1774	2.27	1.63	7.3
7.600	24.934	58.704	2.071	6.797		58.80	3.52	5	115	1.414	0.466	1.414	40.57	3.61	0.01	4	2.57	43.24	3.00E-8	14.8	12.8				2940	3.83	2.70	12.2
7.700	25.262	102.840	3.745	7.378		102.95	3.64	6	115	1.433	0.476	1.433	70.83	3.69	0.01	4	2.41	76.84	3.00E-8	24.0	20.7				5147	6.77	4.72	21.2
7.800	25.591	179.625	3.769	4.052		179.68	2.10	8	121	1.453	0.486	1.453	122.65	2.11	0.00	5	2.07	137.94	3.00E-6	36.4	31.0	63	42	719	1172			
7.900	25.919	277.399	2.157	0.858		277.41	0.78	9	124	1.473	0.497	1.473	187.27	0.78	0.00	6	1.63	220.99	3.00E-4	47.9	40.5	79	44	1110	1361			
8.000	26.247	312.278	1.908	-2.944		312.24	0.61	10	127	1.494	0.507	1.494	207.94	0.61	0.00	6	1.53	247.12	3.00E-4	52.0	43.8	84	44	1249	1423			
8.100	26.575	330.066	2.068	-5.069		329.99	0.63	10	127	1.515	0.517	1.515	216.78	0.63	0.00	6	1.52	259.42	3.00E-4	54.9	45.9	86	44	1320	1456			
8.200	26.903	336.837	2.177	-5.689		336.76	0.65	10	127	1.536	0.527	1.536	218.22	0.65	0.00	6	1.53	262.94	3.00E-4	56.1	46.6	87	44	1347	1472			
8.300	27.231	335.076	2.132	-6.257		334.99	0.64	10	127	1.557	0.538	1.550	215.11	0.64	0.00	6	1.53	260.36	3.00E-4	55.9	46.1	86	44	1340	1474			
8.400	27.559	305.300	1.703	-6.613		305.21	0.56	10	127	1.578	0.548	1.561	194.55	0.56	0.00	6	1.53	236.28	3.00E-4	50.8	41.8	82	44	1221	1432			
8.500	27.887	295.865	1.537	-7.312		295.76	0.52	10	127	1.599	0.558	1.571	187.21	0.52	0.00	6	1.52	228.13	3.00E-4	49.2	40.3	81	44	1183	1421			
8.600	28.215	270.119	1.530	-8.038		270.00	0.57	10	127	1.620	0.568	1.582	169.65	0.57	0.00	6	1.58	207.44	3.00E-4	45.7	37.4	77	43	1080	1381			
8.700	28.543	259.478	1.379	-8.751		259.35	0.53	10	127	1.641	0.579	1.593	161.82	0.54	0.00	6	1.58	198.52	3.00E-4	43.9	35.8	75	43	1037	1366			
8.800	28.871	233.168	0.759	-9.437		233.03	0.33	10	127	1.661	0.589	1.603	144.31	0.33	0.00	6	1.50	177.64	3.00E-4	38.5	31.3	71	42	932	1321			
8.900	29.199	151.967	0.372	-10.559		151.82	0.24	9	124	1.682	0.599	1.613	93.05	0.25	-0.01	6	1.62	114.91	3.00E-4	26.1	21.1	57	40	607	1148			
9.000	29.528	131.090	0.691	-12.104		130.92	0.53	9	124	1.702	0.609	1.624	79.59	0.54	-0.01	6	1.83	96.17	3.00E-4	24.2	19.6	52	39	524	1095			
9.100	29.856	123.246	1.344	-12.368		123.07	1.09	8	121	1.722	0.620	1.633	74.30	1.11	-0.01	6	2.04	87.64	3.00E-4	24.6	19.8	50	39	492	1074			
9.200	30.184	62.452	1.461	-12.302		62.27	2.35	6	115	1.741	0.630	1.642	36.87	2.41	-0.02	5	2.49	41.07	3.00E-6	15.1	12.1	34	35	249	858			
9.300	30.512	37.375	1.073	-11.813		37.21	2.88	6	115	1.760	0.640	1.650	21.48	3.03	-0.03	4	2.73	23.19	3.00E-8	10.2	8.2				1860	2.36	1.43	6.4
9.400	30.840	61.444	1.353	-11.509		61.28	2.21	7	118	1.779	0.650	1.659	35.86	2.27	-0.02	5	2.48	40.08	3.00E-6	14.8	11.8	34	35	245	856			

Col 1i	Col 2i	Col 3i	Col 4i	Col 5i	Col 6i	Col 7i	Col 8i	Col 9i	Col 10i	Col 11i	Col 12i	Col 13i	Col 14i	Col 15i	Col 16i	Col 17i	Col 18i	Col 19i	Col 20i	Col 21i	Col 22i	Col 23i	Col 24i	Col 25i	Col 26i	Col 27i	Col 28i	Col 29i
Depth	Depth	qc	fs	u	Other	qt	Rf	SBT	Unit Weight, γ	Total Overburden Stress, σv	Insitu pore pressure, uo	Effective overburden stress, σ'v	Normalized cone resistance, Qtl	Normalized Friction raio, Fr	Normalized pore pressure ratio, Bq	Soil Behavior Type (normalized) SBTn	SBTn Index, Ic	Normalized Cone resistance, Qtn	Estimated permeability, kSBT	SPT N60	SPT (N1)60	Relative Density, Dr	Friction Angle, φ'	Young's modulus, Es	Small strain shear modulus, Go	Undrained shear strength, su	Undrained strength ratio, su/σ'v	Over consolidation ratio, OCR
(m)	(ft)	(tsf)	(tsf)	(psi)		(tsf)	(%)		(pcf)	(tsf)	(tsf)	(tsf)							(ft/sec)	(blows/ft)	(blows/ft)	(%)	(degrees)	(tsf)	(tsf)	(tsf)		
9.500	31.168	78.893	1.795	-11.681		78.73	2.28	7	118	1.798	0.660	1.668	46.11	2.33	-0.01	5	2.40	52.15	3.00E-6	18.4	14.6	39	36	315	932			
9.600	31.496	91.088	2.007	-11.932		90.92	2.21	7	118	1.818	0.671	1.677	53.11	2.25	-0.01	5	2.35	60.63	3.00E-6	20.7	16.4	42	37	364	980			
9.700	31.824	98.207	1.872	-12.249		98.03	1.91	7	118	1.837	0.681	1.687	57.03	1.95	-0.01	5	2.28	65.81	3.00E-6	21.7	17.2	43	37	392	1007			
9.800	32.152	100.618	1.922	-12.500		100.44	1.91	7	118	1.856	0.691	1.696	58.14	1.95	-0.01	5	2.28	67.25	3.00E-6	22.2	17.5	44	38	402	1017			
9.900	32.480	107.135	1.414	-12.645		106.95	1.32	8	121	1.876	0.701	1.705	61.62	1.35	-0.01	5	2.15	72.67	3.00E-6	22.4	17.7	46	38	428	1040			
10.000	32.808	120.619	1.581	-12.658		120.44	1.31	8	121	1.896	0.712	1.715	69.13	1.33	-0.01	5	2.11	82.17	3.00E-6	24.8	19.5	48	39	482	1084			
10.100	33.136	134.951	1.302	-12.631		134.77	0.97	9	124	1.916	0.722	1.725	77.02	0.98	-0.01	6	1.99	93.37	3.00E-4	26.5	20.7	52	39	539	1128			
10.200	33.465	145.583	1.101	-12.605		145.40	0.76	9	124	1.937	0.732	1.735	82.68	0.77	-0.01	6	1.91	101.79	3.00E-4	27.6	21.6	54	40	582	1159			
10.300	33.793	147.146	1.106	-12.553		146.97	0.75	9	124	1.957	0.742	1.745	83.09	0.76	-0.01	6	1.90	102.59	3.00E-4	27.9	21.7	54	40	588	1165			
10.400	34.121	135.065	1.460	-12.513		134.88	1.08	8	121	1.977	0.753	1.755	75.74	1.10	-0.01	6	2.03	91.93	3.00E-4	26.9	20.9	51	39	540	1135			
10.500	34.449	116.900	2.140	-12.500		116.72	1.83	7	118	1.996	0.763	1.764	65.04	1.87	-0.01	5	2.23	76.73	3.00E-6	25.2	19.5	47	38	467	1083			
10.600	34.777	122.267	1.794	-12.526		122.09	1.47	8	121	2.016	0.773	1.774	67.70	1.49	-0.01	5	2.15	80.96	3.00E-6	25.5	19.7	48	38	488	1101			
10.700	35.105	129.019	1.030	-12.566		128.84	0.80	9	124	2.036	0.783	1.784	71.09	0.81	-0.01	6	1.97	87.60	3.00E-4	25.1	19.4	50	39	515	1123			
10.800	35.433	133.831	0.846	-12.631		133.65	0.63	9	124	2.057	0.794	1.794	73.36	0.64	-0.01	6	1.91	91.58	3.00E-4	25.4	19.5	51	39	535	1139			
10.900	35.761	128.934	0.677	-12.684		128.75	0.53	9	124	2.077	0.804	1.804	70.22	0.53	-0.01	6	1.88	88.23	3.00E-4	24.2	18.6	50	39	515	1127			
11.000	36.089	117.258	0.647	-12.816		117.07	0.55	9	124	2.097	0.814	1.814	63.38	0.56	-0.01	6	1.93	79.19	3.00E-4	22.5	17.2	48	38	468	1094			
11.100	36.417	73.969	0.917	-12.948		73.78	1.24	8	121	2.117	0.824	1.824	39.30	1.28	-0.02	5	2.30	46.34	3.00E-6	16.4	12.5	36	35	295	940			
11.200	36.745	30.068	0.711	-12.909		29.88	2.38	6	115	2.136	0.834	1.832	15.14	2.56	-0.04	4	2.81	16.43	3.00E-8	8.6	6.5				1494	1.85	1.01	4.5
11.300	37.073	20.811	0.443	-12.816		20.63	2.15	6	115	2.155	0.845	1.841	10.03	2.40	-0.07	3	2.94	10.66	1.00E-9	6.4	4.9				1031	1.23	0.67	3.0
11.400	37.402	21.612	0.511	-12.658		21.43	2.38	5	115	2.174	0.855	1.849	10.41	2.65	-0.06	3	2.95	11.05	1.00E-9	6.7	5.1				1071	1.28	0.69	3.1
11.500	37.730	22.393	0.651	-12.447		22.21	2.93	5	115	2.192	0.865	1.858	10.78	3.25	-0.06	3	2.99	11.37	1.00E-9	7.1	5.4				1111	1.33	0.72	3.2
11.600	38.058	22.874	0.679	-12.275		22.70	2.99	5	115	2.211	0.875	1.866	10.98	3.31	-0.06	3	2.99	11.59	1.00E-9	7.3	5.5				1135	1.37	0.73	3.3
11.700	38.386	24.211	0.683	-12.064		24.04	2.84	5	115	2.230	0.886	1.875	11.63	3.13	-0.06	3	2.95	12.36	1.00E-9	7.5	5.7				1202	1.45	0.78	3.5
11.800	38.714	22.328	0.602	-11.839		22.16	2.72	5	115	2.249	0.896	1.884	10.57	3.03	-0.06	3	2.98	11.19	1.00E-9	7.0	5.3				1108	1.33	0.70	3.2
11.900	39.042	18.033	0.449	-11.615		17.87	2.52	5	115	2.268	0.906	1.892	8.24	2.88	-0.08	3	3.06	8.61	1.00E-9	6.0	4.5				893	1.04	0.55	2.5
12.000	39.370	16.668	0.329	-11.127		16.51	1.99	5	115	2.286	0.916	1.901	7.48	2.31	-0.08	3	3.04	7.84	1.00E-9	5.5	4.1				825	0.95	0.50	2.2
12.100	39.698	18.052	0.336	-10.335		17.90	1.88	6	115	2.305	0.927	1.909	8.17	2.15	-0.07	3	2.99	8.64	1.00E-9	5.7	4.3				895	1.04	0.54	2.5
12.200	40.026	18.918	0.379	-10.005		18.77	2.02	6	115	2.324	0.937	1.918	8.58	2.31	-0.07	3	2.99	9.08	1.00E-9	6.0	4.5				939	1.10	0.57	2.6
12.300	40.354	19.408	0.421	-9.649		19.27	2.18	6	115	2.343	0.947	1.926	8.79	2.49	-0.07	3	3.00	9.29	1.00E-9	6.2	4.6				963	1.13	0.59	2.6
12.400	40.682	20.604	0.430	-9.279		20.47	2.10	6	115	2.362	0.957	1.935	9.36	2.37	-0.06	3	2.96	9.96	1.00E-9	6.4	4.8				1024	1.21	0.62	2.8
12.500	41.011	22.591	0.464	-8.936		22.46	2.07	6	115	2.380	0.968	1.944	10.33	2.31	-0.05	3	2.92	11.08	1.00E-9	6.9	5.1				1123	1.34	0.69	3.1
12.600	41.339	26.433	0.598	-8.540		26.31	2.27	6	115	2.399	0.978	1.952	12.25	2.50	-0.04	4	2.88	13.25	3.00E-8	7.9	5.8				1316	1.59	0.82	3.7
12.700	41.667	33.175	0.776	-8.117		33.06	2.35	6	115	2.418	0.988	1.961	15.63	2.53	-0.03	4	2.80	17.18	3.00E-8	9.4	6.9				1653	2.04	1.04	4.7
12.800	41.995	39.711	1.101	-7.695		39.60	2.78	6	115	2.437	0.998	1.969	18.87	2.96	-0.03	4	2.77	20.86	3.00E-8	11.1	8.1				1980	2.48	1.26	5.7
12.900	42.323	81.907	1.549	-7.220		81.80	1.89	7	118	2.456	1.008	1.978	40.11	1.95	-0.01	5	2.40	47.54	3.00E-6	19.1	13.9	37	35	327	1000			
13.000	42.651	130.507	1.740	-7.127		130.40	1.33	8	121	2.476	1.019	1.988	64.35	1.36	-0.01	5	2.14	80.20	3.00E-6	27.2	19.8	48	38	522	1170			
13.100	42.979	147.165	1.994	-7.259		147.06	1.36	8	121	2.496	1.029	1.997	72.37	1.38	-0.01	5	2.11	90.96	3.00E-6	30.2	22.0	51	39	588	1219			
13.200	43.307	133.492	2.554	-7.458		133.38	1.92	7	118	2.515	1.039	2.007	65.22	1.95	-0.01	5	2.24	80.03	3.00E-6	28.9	21.0	48	38	534	1182			
13.300	43.635	133.680	2.272	-7.589		133.57	1.70	8	121	2.535	1.049	2.016	64.99	1.73	-0.01	5	2.21	80.38	3.00E-6	28.6	20.7	48	38	534	1184			
13.400	43.963	162.721	1.781	-7.748		162.61	1.10	9	124	2.555	1.060	2.026	78.99	1.11	-0.01	6	2.02	101.52	3.00E-4	32.2	23.3	54	39	650	1267			
13.500	44.291	175.764	1.571	-8.012		175.65	0.89	9	124	2.576	1.070	2.036	84.99	0.91	-0.01	6	1.94	111.17	3.00E-4	33.8	24.4	56	40	703	1302			
13.600	44.619	174.794	1.765	-8.302		174.67	1.01	9	124	2.596	1.080	2.047	84.08	1.03	-0.01	6	1.98	109.42	3.00E-4	34.1	24.5	56	40	699	1302			
13.700	44.948	172.195	1.587	-1.122		172.18	0.92	9	124	2.616	1.090	2.057	82.44	0.94	0.00	6	1.96	107.88	3.00E-4	33.3	23.9	56	40	689	1298			
13.800	45.276	209.381	1.720	8.025		209.50	0.82	9	124	2.637	1.101	2.067	100.09	0.83	0.00	6	1.86	133.84	3.00E-4	39.1	28.0	62	41	838	1388			
13.900	45.604	249.487	1.910	1.834		249.51	0.77	9	124	2.657	1.111	2.077	118.86	0.77	0.00	6	1.78	161.81	3.00E-4	45.3	32.3	68	41	998	1473			
14.000	45.932	290.506	2.253	-1.267		290.49	0.78	9	124	2.678	1.121	2.087	137.90	0.78	0.00	6	1.74	189.96	3.00E-4	51.9	36.9	74	42	1162	1552			
14.100	46.260	342.288	3.133	-3.854		342.23	0.92	9	124	2.698	1.131	2.097	161.90	0.92	0.00	6	1.73	223.75	3.00E-4	61.0	43.3	80	43	1369	1642			
14.200	46.588	377.376	3.740	-5.715		377.29	0.99	9	124	2.718	1.142	2.107	177.75	1.00	0.00	6	1.73	246.48	3.00E-4	67.1	47.6	84	43	1509	1699			
14.300	46.916	370.624	3.015	-6.983		370.52	0.81	10	127	2.739	1.152	2.118	173.65	0.82	0.00	6	1.67	244.00	3.00E-4	64.8	45.8	83	43	1482	1692			
14.400	47.244	333.654	2.089	-8.249		333.54	0.63	10	127	2.760	1.162	2.129	155.39	0.63	0.00	6	1.64	220.40	3.00E-4	57.6	40.6	79	43	1334	1636			
14.500	47.572	278.792	1.292	-9.253		278.66	0.46	10	127	2.781	1.172	2.139	128.96	0.47	0.00	6	1.63	183.37	3.00E-4	47.9	33.7	72	42	1115	1544			
14.600	47.900	155.668	1.752	-10.137		155.52	1.13	9	124	2.801	1.182	2.149	71.05	1.15	-0.01	6	2.06	92.56	3.00E-4	31.4	22.0	51	39	622	1273			
14.700	48.228	45.464	1.734	-10.704		45.31	3.83	5	115	2.820	1.193	2.158	19.69	4.08	-0.03	3	2.84	21.74	1.00E-9	13.2	9.3				2265	2.83	1.31	5.9
14.800	48.556	18.636	0.621	-11.034		18.48	3.36	5	115	2.839	1.203	2.167	7.22	3.97	-0.09	3	3.18	7.41	1.00E-9	6.7	4.7				924	1.04	0.48	2.2
14.900	48.885	16.658	0.264	-11.351		16.49	1.60	6	115	2.858	1.213	2.175	6.27	1.94	-0.11	3	3.07	6.60	1.00E-9	5.6	3.9				825	0.91	0.42	1.9
15.000	49.213	18.645	0.244	-11.668		18.48	1.32	6	115	2.876	1.223	2.184	7.14	1.56	-0.10	3	2.97	7.68	1.00E-9	5.9	4.1				924	1.04	0.48	2.1
15.100	49.541	20.877	0.339	-12.130		20.78	1.64	6	115	2.895	1.234	2.192	8.12	1.91	-0.09	3	2.97	8.75	1.00E-9	6.5	4.5				1035	1.19	0.54	2.4
15.200	49.869	23.071	0.506	-12.315		22.89	2.21	6	115	2.914	1.244	2.201	9.08	2.53	-0.08	3	2.99	9.73	1.00E-9	7.3	5.1				1145	1.33	0.61	2.7
15.300	50.197	39.824	1.468	-12.341		39.65	3.70	5	115	2.933	1.254	2.209	16.62	4.00	-0.04	3	2.89	18.20	1.00E-9	11.9	8.3				1982	2.45	1.11	5.0
15.400	50.525	153.098	2.648	-12.275		152.92	1.73	8	121	2.953	1.264	2.219	67.59	1.77	-0.01	5	2.20	86.42	3.00E-6	32.6	22.5	50	38	612	1279			
15.500	50.853	238.423	2.523	-12.446		238.24	1.06	9	124	2.973	1.275	2.229	105.55	1.07	-0.01	6	1.91	144.16	3.00E-4	45.4	31.3	64	41	953	1485			
15.600	51.181	257.266	2.491	-12.790		257.08	0.97	9	124	2.993	1.285	2.239	113.47	0.98	-0.01	6	1.86	157.00	3.00E-4	48.1	33.0	67	41	1028	1526			
15.700	51.509	279.489	3.099	-12.975		279.30	1.11	9	124	3.014	1.295	2.249	122.83	1.12	-0.01	6	1.88	169.79	3.00E-4	52.5	36.0	70	42	1117	1571			
15.800	51.837	317.043	2.686	-13.133		316.85	0.85	9	124	3.034	1.305	2.259	138.89	0.86	-0.01	6	1.76	197.59	3.00E-4	57.1	39.0	75	42	1267	1641			
15.900	52.165	299.226	2.315	-13.265		299.04	0.77	9	124	3.055	1.316	2.270	130.41	0.78	-0.01	6	1.75	186.10	3.00E-4	53.8	36.7	73	42	1196	1612			
16.000	52.493	271.588	2.385	-13.410		271.40	0.88	9	124	3.075	1.326	2.280	117.70	0.89	-0.01	6	1.82	165.63	3.00E-4	50.0	34.1	69	41	1086	1563			
16.100	52.822	295.610	2.451	-13.872		295.41	0.83	9	124	3.095	1.336	2.290	127.66	0.84	-0.01	6	1.78	181.81	3.00E-4	53.6	36.4	72	42	1182	1610			
16.200	53.150	311.412	3.589	-14.781		311.20	1.15	9	124	3.116	1.346	2.300	133.95	1.16	-0.01	6	1.86	187.64	3.00E-4	58.1	39.4	73	42	1245	1641			
16.300	53.478	324.633	4.682	-15.000		324.42	1.44	9	124	3.136	1.357	2.310	139.08	1.46	-0.01	6	1.92	192.59	3.00E-4	61.9	41.9	74	42	1298	1666			
16.400	53.806	362.225	4.848	-15.000		362.01	1.34	9	124	3.156	1.367	2.320	154.66	1.35	-0.01	6	1.86	217.40	3.00E-4	67.6	45.7	79	43	1448	1731			
16.500	54.134	341.545	4.222	-15.000		341.33	1.24	9	124	3.177	1.377	2.330	145.11	1.25	-0.01	6	1.86	204.61	3.00E-4	63.7	42.9	76	43	1365	1699			
16.600	54.462	314.971	3.331	-15.000		314.76	1.06	9	124	3.197	1.387	2.340	133.12	1.07	-0.01	6	1.84	188.95	3.00E-4	58.3	39.2	73	42	1259	1657			
16.700	54.790	275.025	2.804	-15.000		274.81	1.02	9	124	3.217	1.397	2.351	115.54	1.03	-0.01	6	1.87	162.92	3.00E-4	51.6	34.6	68	41	1099	1586			
16.800	55.118	221.115	2.712	-15.000		220.90	1.23	9	124	3.238	1.408	2.361	92.20	1.25	-0.01	6	2.00	126.31	3.00E-4	43.5	29.1	60	40	884	1476			
16.900	55.446	234.524	2.715	-15.000		234.31	1.16	9	124	3.258	1.418	2.371	97.46	1.18	-0.01	6	1.96	134.87	3.00E-4	45.5	30.4	62	40	937	1508			
17.000	55.774	291.797	2.743	-15.000		291.58	0.94	9	124	3.279	1.428	2.381	121.09	0.95	-0.01	6	1.83	173.31	3.00E-4	53.9	36.0	70	42	1166	1624			
17.100	56.102	293.124	2.209	-15.000		292.91	0.75	9	124	3.299	1.438	2.391	121.12	0.76	-0.01	6	1.77	176.31	3.00E-4	53.0	35.3	71	42	1172	1629			
17.200	56.430	323.578	3.253	-15.000		323.36	1.01	9	124	3.319	1.449	2.401	133.28	1.02	-0.01	6	1.82	192.05	3.00E-4	59.5	39.5	74	42	1293	1686			
17.300	56.759	403.272	3.273	-15.000		403.06	0.81	10	127	3.340	1.459	2.412	165.73	0.82	-0.01	6	1.69	247.28	3.00E-4	70.8	46.9	84	43	1612	1817			
17.400	57.087	427.266	2.969	-15.000		427.05	0.70	10	127	3.361	1.469	2.423	174.90	0.70	0.00	6	1.63	264.64	3.00E-4	73.5	48.6	87	43	1708	1855			
17.500	57.415	396.153	2.996	-15.000		395.94	0.76	10	127	3.382	1.479	2.433	161.34	0.76	-0.01	6	1.68	242.46	3.00E-4	69.3	45.7	83	43	1584	1812			
17.600	57.743	363.665	2.974	-15.000		363.45	0.82	10	127	3.403	1.490	2.444	147.33	0.83	-0.01	6	1.73	218.99	3.00E-4	64.8	42.6	79	43	1454	1763			
17.700	58.071	339.417	2.321	-15.000		339.20	0.68	10	127	3.424	1.500	2.454	136.80	0.69	-0.01	6	1.70	205.04	3.00E-4	59.9	39.4	77	42	1357	1726			
17.800	58.399	310.536	3.038	-15.000		310.32	0.98	9	124	3.444	1.510	2.465	124.51	0.99	-0.01	6	1.84	180.85	3.00E-4	57.4	37.6	72	42	1241	1677			
17.900	58.727	199.692	5.911	-15.000		199.48	2.96	7	118	3.463	1.520	2.474	79.24	3.02	-0.01	5	2.31	102.03	3.00E-6	44.7	29.2	54	39	798	1449			
18.000	59.055	173.315	5.975	-15.000		173.10	3.45	12	121	3.483	1.531	2.483	68.30	3.52	-0.01	4	2.41	85.97	3.00E-8	40.4	26.4				8655	11.31	4.55	20.5
18.100	59.383	209.157	4.932	-15.000		202.94	2.43	7	118	3.502	1.541	2.492	80.02	2.47	-0.01	5	2.25	105.02	3.00E-6	44.2	28.8	55	39	812	1461			
18.200	59.711	114.988	4.574	-15.000		114.77	3.99	11	131	3.524	1.551	2.504	44.44	4.11	-0.02	4	2.59	53.54	3.00E-8	29.2	19.0				5739	7.42	2.96	13.3
18.300	60.039	138.021	3.051	-15.000		137.81	2.21	7	118	3.543	1.561	2.513	53.44	2.27	-0.02	5	2.35	68.50	3.00E-6	31.4	20.4	44	37	551	1288			
18.400	60.367	244.863	3.454	-15.000		244.65	1.41	9	124	3.564	1.571	2.523	95.56	1.43	-0.01	6	2.03	133.36	3.00E-4	48.7	31.5	62	40	979	1562			
18.500	60.696	155.555	4.240	-15.000		155.34	2.73	7	118	3.583	1.582	2.532	59.94	2.79	-0.01	5	2.37	76.49	3.00E-6	35.8	23.1	47	38	621	1344			
18.600	61.024	92.623	3.528	-15.000		92.41	3.82	6	115	3.602	1.592	2.540	34.96	3.97	-0.02	4	2.65	41.55	3.00E-8	24.3	15.7				4620	5.92	2.33	10.5
18.700	61.352	41.923	1.722	-15.000		41.71	4.13	5	115	3.621	1.602	2.549	14.94	4.52	-0.06	3	2.96	16.36	1.00E-9	13.1	8.4				2085	2.54	1.00	4.5
18.800	61.680	32.177	0.877	-15.000		31.96	2.74	6	115	3.639	1.612	2.558	11.07	3.10	-0.08	3	2.97	12.11	1.00E-9	10.1	6.5				1598	1.89	0.74	3.3
18.900	62.008	31.113	0.721	-15.000		30.90	2.33	6	115	3.658	1.623	2.566	10.62	2.65	-0.08	3	2.94	11.69	1.00E-9	9.6	6.2				1545	1.82	0.71	3.2
19.000	62.336	29.701	0.661	-15.000		29.48	2.24	6	115	3.677	1.633	2.575	10.02	2.56	-0.08	3	2.96	11.00	1.00E-9	9.2	5.9				1474	1.72	0.67	3.0
19.100	62.664	23.664	0.784	-15.000		23.45	3.34	5	115	3.696	1.643	2.583	7.65	3.97	-0.11	3	3.16	7.95	1.00E-9	8.4	5.4				1172	1.32	0.51	2.3
19.200	62.992	26.744	0.946	-15.000		26.53	3.56	5	115	3.714	1.653	2.592	8.80	4.15	-0.10	3	3.12	9.25	1.00E-9	9.3	5.9				1326	1.52	0.59	2.6
19.300	63.320	34.644	1.014	-15.000		34.43	2.95	6	115	3.733	1.664	2.600	11.80	3.30	-0.07	3	2.96	12.95	1.00E-9	10.8	6.9				1721	2.05	0.79	3.5
19.400	63.648	37.385	1.113	-15.000		37.17	3.00	6	115	3.752	1.674	2.609	12.81	3.33	-0.07	3	2.94	14.16	1.00E-9	11.5	7.3				1858	2.23	0.85	3.8
19.500	63.976	34.889	1.014	-15.000		34.67	2.92	6	115	3.771	1.684	2.617	11.81	3.28	-0.07	3	2.96	12.97	1.00E-9	10.9	6.9				1734	2.06	0.79	3.5
19.600	64.304	32.516	0.897	-15.000		32.30	2.78	6	115	3.790	1.694	2.626	10.86	3.15	-0.08	3	2.98	11.87	1.00E-9	10.3	6.5				1615	1.90	0.72	3.3
19.700	64.633	33.401	0.963	-15.000		33.19	2.90	6	115	3.808	1.705	2.635	11.15	3.28	-0.08	3	2.98	12.19	1.00E-9	10.5	6.7				1659	1.96	0.74	3.3
19.800	64.961	34.089	0.994	-15.000		33.87	2.93	6	115	3.827

Col 1i	Col 2i	Col 3i	Col 4i	Col 5i	Col 6i	Col 7i	Col 8i	Col 9i	Col 10i	Col 11i	Col 12i	Col 13i	Col 14i	Col 15i	Col 16i	Col 17i	Col 18i	Col 19i	Col 20i	Col 21i	Col 22i	Col 23i	Col 24i	Col 25i	Col 26i	Col 27i	Col 28i	Col 29i
Depth	Depth	qc	fs	u	Other	qt	Rf	SBT	Unit Weight, γ	Total Overburden Stress, σv	Insitu pore pressure, uo	Effective overburden stress, σ'v	Normalized cone resistance, Qtl	Normalized Friction raio, Fr	Normalized pore pressure ratio, Bq	Soil Behavior Type (normalized) SBTn	SBTn Index, Ic	Normalized Cone resistance, Qtn	Estimated permeability, kSBT	SPT N60	SPT (N1)60	Relative Density, Dr	Friction Angle, φ'	Young's modulus, Es	Small strain shear modulus, Go	Undrained shear strength, su	Undrained strength ratio, su/σ'v	Over consolidation ratio, OCR
(m)	(ft)	(tsf)	(tsf)	(psi)		(tsf)	(%)		(pcf)	(tsf)	(tsf)	(tsf)							(ft/sec)	(blows/ft)	(blows/ft)	(%)	(degrees)	(tsf)	(tsf)	(tsf)		
21.400	70.210	298.652	2.581	-13.595		298.46	0.86	9	124	4.149	1.879	2.801	105.05	0.88	-0.01	6	1.86	160.41	3.00E-4	55.7	34.2	68	41	1194	1728			
21.500	70.538	335.905	3.111	-13.368		335.71	0.93	9	124	4.170	1.889	2.812	117.92	0.94	-0.01	6	1.84	181.39	3.00E-4	62.2	38.2	72	41	1343	1799			
21.600	70.866	368.920	4.267	-13.595		368.72	1.16	9	124	4.190	1.899	2.822	129.19	1.17	-0.01	6	1.87	197.02	3.00E-4	69.2	42.4	75	42	1475	1859			
21.700	71.194	395.541	4.268	-13.793		395.34	1.08	9	124	4.211	1.909	2.832	138.12	1.09	-0.01	6	1.83	213.60	3.00E-4	73.0	44.6	78	42	1581	1905			
21.800	71.522	382.809	3.671	-13.978		382.61	0.96	9	124	4.231	1.919	2.842	133.14	0.97	-0.01	6	1.81	207.62	3.00E-4	70.1	42.8	77	42	1530	1886			
21.900	71.850	409.628	3.495	-14.268		409.42	0.85	10	127	4.252	1.930	2.853	142.03	0.86	-0.01	6	1.75	225.52	3.00E-4	73.6	44.8	80	42	1638	1932			
22.000	72.178	406.813	3.672	-14.638		406.60	0.90	9	124	4.272	1.940	2.863	140.54	0.91	-0.01	6	1.77	222.21	3.00E-4	73.6	44.7	80	42	1626	1929			
22.100	72.507	397.763	3.421	-14.936		397.55	0.86	10	127	4.293	1.950	2.873	136.86	0.87	-0.01	6	1.77	217.09	3.00E-4	71.8	43.6	79	42	1590	1917			
22.200	72.835	394.260	2.935	-15.000		394.04	0.74	10	127	4.314	1.960	2.884	135.13	0.75	-0.01	6	1.73	217.07	3.00E-4	70.3	42.6	79	42	1576	1914			
22.300	73.163	374.024	2.398	-15.000		373.81	0.64	10	127	4.335	1.971	2.895	127.64	0.65	-0.01	6	1.71	206.66	3.00E-4	66.2	40.0	77	42	1495	1883			
22.400	73.491	332.816	2.299	-15.000		332.60	0.69	10	127	4.356	1.981	2.905	112.98	0.70	-0.01	6	1.77	179.82	3.00E-4	60.2	36.3	72	41	1330	1813			
22.500	73.819	339.728	2.451	-15.000		339.51	0.72	10	127	4.377	1.991	2.916	114.93	0.73	-0.01	6	1.78	182.94	3.00E-4	61.6	37.1	72	41	1358	1828			
22.600	74.147	317.212	2.493	-15.000		317.00	0.79	9	124	4.397	2.001	2.926	106.83	0.80	-0.01	6	1.83	167.83	3.00E-4	58.5	35.2	69	41	1268	1789			
22.700	74.475	148.577	3.120	-15.000		148.36	2.10	7	118	4.416	2.012	2.935	49.04	2.17	-0.02	5	2.36	65.45	3.00E-6	34.0	20.4	43	37	593	1390			
22.800	74.803	59.495	1.723	-15.000		59.28	2.91	6	115	4.435	2.022	2.944	18.63	3.14	-0.05	4	2.79	21.83	3.00E-8	16.8	10.1				2964	3.66	1.24	5.6
22.900	75.131	42.329	0.543	-15.000		42.11	1.29	7	118	4.454	2.032	2.953	12.75	1.44	-0.07	4	2.74	15.20	3.00E-8	11.6	7.0				2106	2.51	0.85	3.8
23.000	75.459	34.419	0.585	-15.000		34.20	1.71	6	115	4.473	2.042	2.961	10.04	1.97	-0.09	4	2.90	11.40	3.00E-8	10.3	6.2				1710	1.98	0.67	3.0
23.100	75.787	29.776	0.443	-15.000		29.56	1.50	6	115	4.492	2.053	2.970	8.44	1.77	-0.10	3	2.94	9.47	1.00E-9	9.2	5.5				1478	1.67	0.56	2.5
23.200	76.115	31.292	0.431	-15.000		31.08	1.39	7	118	4.511	2.063	2.979	8.92	1.62	-0.10	4	2.90	10.13	3.00E-8	9.4	5.6				1554	1.77	0.59	2.7
23.300	76.444	31.593	0.413	-15.000		31.38	1.32	7	118	4.531	2.073	2.988	8.98	1.54	-0.10	4	2.88	10.25	3.00E-8	9.4	5.6				1569	1.79	0.60	2.7
23.400	76.772	31.414	0.452	-15.000		31.20	1.45	7	118	4.550	2.083	2.997	8.89	1.70	-0.10	4	2.91	10.07	3.00E-8	9.5	5.6				1560	1.78	0.59	2.7
23.500	77.100	32.008	0.455	-15.000		31.79	1.43	7	118	4.569	2.094	3.006	9.06	1.67	-0.10	4	2.90	10.29	3.00E-8	9.6	5.7				1590	1.81	0.60	2.7
23.600	77.428	37.526	0.580	-15.000		37.31	1.55	7	118	4.589	2.104	3.015	10.85	1.77	-0.08	4	2.84	12.55	3.00E-8	10.9	6.5				1866	2.18	0.72	3.3
23.700	77.756	38.467	0.686	-15.000		38.25	1.79	6	115	4.607	2.114	3.024	11.13	2.04	-0.08	4	2.87	12.78	3.00E-8	11.3	6.7				1913	2.24	0.74	3.3
23.800	78.084	38.486	0.694	-15.000		38.27	1.81	6	115	4.626	2.124	3.033	11.09	2.06	-0.08	4	2.87	12.74	3.00E-8	11.4	6.7				1914	2.24	0.74	3.3
23.900	78.412	34.324	0.630	-15.000		34.11	1.85	6	115	4.645	2.134	3.041	9.69	2.14	-0.09	3	2.93	10.92	1.00E-9	10.5	6.2				1705	1.96	0.65	2.9
24.000	78.740	31.038	0.485	-15.000		30.82	1.57	6	115	4.664	2.145	3.050	8.58	1.85	-0.10	3	2.94	9.63	1.00E-9	9.6	5.6				1541	1.74	0.57	2.6
24.100	79.068	30.595	0.471	-15.000		30.38	1.55	6	115	4.683	2.155	3.058	8.40	1.83	-0.11	3	2.95	9.42	1.00E-9	9.5	5.6				1519	1.71	0.56	2.5
24.200	79.396	30.416	0.536	-15.000		30.20	1.77	6	115	4.701	2.165	3.067	8.31	2.10	-0.11	3	2.98	9.23	1.00E-9	9.6	5.6				1510	1.70	0.55	2.5
24.300	79.724	34.390	1.175	-15.000		34.17	3.44	5	115	4.720	2.175	3.075	9.58	3.99	-0.09	3	3.08	10.29	1.00E-9	11.6	6.8				1709	1.96	0.64	2.9
24.400	80.052	112.163	3.204	-15.000		111.95	2.86	7	118	4.739	2.186	3.084	34.76	2.99	-0.03	4	2.57	44.05	3.00E-8	28.2	16.5				5597	7.15	2.32	10.4
24.500	80.381	249.864	4.524	-14.833		249.65	1.81	8	121	4.759	2.196	3.094	79.15	1.85	-0.01	5	2.16	114.37	3.00E-6	52.4	30.7	57	39	999	1683			
24.600	80.709	263.745	5.338	-14.492		263.54	2.03	8	121	4.779	2.206	3.104	83.37	2.06	-0.01	5	2.18	119.93	3.00E-6	55.7	32.6	59	40	1054	1715			
24.700	81.037	242.453	6.765	-14.215		242.25	2.79	7	118	4.798	2.216	3.113	76.28	2.85	-0.01	5	2.31	105.41	3.00E-6	54.1	31.5	55	39	969	1669			
24.800	81.365	275.713	6.447	-13.885		275.51	2.34	8	121	4.818	2.227	3.122	86.70	2.38	-0.01	5	2.21	123.65	3.00E-6	59.1	34.4	59	40	1102	1744			
24.900	81.693	415.966	4.835	-10.612		415.81	1.16	9	124	4.839	2.237	3.132	131.20	1.18	-0.01	6	1.87	209.51	3.00E-4	77.9	45.3	77	42	1663	2003			
25.000	82.021	490.565	5.769	-9.648		490.43	1.18	9	124	4.859	2.247	3.143	154.51	1.19	0.00	6	1.82	250.96	3.00E-4	90.3	52.4	85	43	1962	2119			
25.100	82.349	437.530	7.160	-11.773		437.36	1.64	9	124	4.879	2.257	3.153	137.18	1.66	-0.01	6	1.96	213.14	3.00E-4	84.8	49.1	78	42	1749	2042			
25.200	82.677	322.203	9.853	-13.146		322.01	3.06	12	121	4.899	2.268	3.162	100.28	3.11	-0.01	5	2.26	141.61	3.00E-6	70.3	40.7	64	41	1288	1845			
25.300	83.005	229.420	10.018	-13.305		229.23	4.37	11	131	4.921	2.278	3.173	70.68	4.47	-0.01	4	2.47	92.98	3.00E-8	55.2	31.9				11461	14.95	4.71	21.2
25.400	83.333	378.139	6.617	-13.556		377.94	1.75	8	121	4.940	2.288	3.183	117.18	1.77	-0.01	5	2.03	178.67	3.00E-6	75.3	43.4	71	41	1512	1951			
25.500	83.661	409.948	4.871	-14.818		409.73	1.19	9	124	4.961	2.298	3.193	126.76	1.20	-0.01	6	1.89	202.92	3.00E-4	77.3	44.5	76	42	1639	2006			
25.600	83.990	310.404	4.720	-15.000		310.19	1.52	9	124	4.981	2.308	3.203	95.28	1.55	-0.01	5	2.05	144.58	3.00E-6	62.3	35.8	64	40	1241	1830			
25.700	84.318	239.628	3.328	-15.000		239.41	1.39	9	124	5.002	2.319	3.213	72.95	1.42	-0.01	5	2.11	108.58	3.00E-6	49.3	28.3	56	39	958	1681			
25.800	84.646	210.247	3.058	-15.000		210.03	1.46	8	121	5.021	2.329	3.223	63.61	1.49	-0.01	5	2.17	92.92	3.00E-6	44.3	25.4	52	38	840	1611			
25.900	84.974	206.217	3.051	-15.000		206.00	1.48	8	121	5.041	2.339	3.233	62.17	1.52	-0.01	5	2.18	90.52	3.00E-6	43.7	25.0	51	38	824	1602			
26.000	85.302	222.866	1.711	-15.000		222.65	0.77	9	124	5.062	2.349	3.243	67.10	0.79	-0.01	6	1.99	104.57	3.00E-4	43.6	24.9	55	38	891	1645			
26.100	85.630	136.995	2.382	-15.000		136.78	1.74	8	121	5.081	2.360	3.252	40.49	1.81	-0.02	5	2.38	55.38	3.00E-6	31.5	18.0	40	36	547	1400			
26.200	85.958	140.423	2.710	-15.000		140.21	1.93	7	118	5.101	2.370	3.261	41.42	2.01	-0.02	5	2.40	56.30	3.00E-6	32.6	18.6	40	36	561	1413			
26.300	86.286	355.717	2.447	-15.000		355.50	0.69	10	127	5.122	2.380	3.272	107.08	0.70	-0.01	6	1.79	178.93	3.00E-4	64.8	36.8	72	41	1422	1929			
26.400	86.614	330.066	2.167	-15.000		329.85	0.66	10	127	5.143	2.390	3.283	98.91	0.67	-0.01	6	1.81	164.61	3.00E-4	60.4	34.3	69	41	1319	1884			
26.500	86.942	262.181	1.489	-15.000		261.97	0.57	9	124	5.163	2.401	3.293	77.99	0.58	-0.01	6	1.86	127.68	3.00E-4	48.9	27.7	60	39	1048	1746			
26.600	87.270	158.785	2.288	-15.000		158.57	1.44	8	121	5.183	2.411	3.303	46.45	1.49	-0.02	5	2.28	65.97	3.00E-6	35.0	19.8	43	36	634	1478			
26.700	87.598	60.163	1.867	-15.000		59.95	3.11	6	115	5.202	2.421	3.311	16.53	3.41	-0.05	3	2.85	19.31	1.00E-9	17.6	10.0				2997	3.65	1.10	5.0
26.800	87.927	44.739	0.993	-15.000		44.52	2.23	6	115	5.220	2.431	3.320	11.84	2.53	-0.08	3	2.89	13.64	1.00E-9	13.4	7.6				2226	2.62	0.79	3.6
26.900	88.255	60.522	1.416	-15.000		60.31	2.35	6	115	5.239	2.442	3.328	16.55	2.57	-0.05	4	2.78	19.83	3.00E-8	17.0	9.6				3015	3.67	1.10	5.0
27.000	88.583	56.397	1.420	-15.000		56.18	2.53	6	115	5.258	2.452	3.337	15.26	2.79	-0.06	4	2.83	17.99	3.00E-8	16.3	9.2				2809	3.39	1.02	4.6
27.100	88.911	42.149	0.901	-15.000		41.93	2.15	6	115	5.277	2.462	3.345	10.96	2.46	-0.08	3	2.92	12.54	1.00E-9	12.8	7.2				2097	2.44	0.73	3.3
27.200	89.239	34.898	0.693	-15.000		34.68	2.00	6	115	5.296	2.472	3.354	8.76	2.36	-0.10	3	2.99	9.79	1.00E-9	11.1	6.2				1734	1.96	0.58	2.6
27.300	89.567	31.151	0.583	-15.000		30.93	1.89	6	115	5.314	2.482	3.362	7.62	2.28	-0.12	3	3.03	8.38	1.00E-9	10.2	5.7				1547	1.71	0.51	2.3
27.400	89.895	33.269	0.413	-15.000		33.05	1.25	7	118	5.334	2.493	3.372	8.22	1.49	-0.11	4	2.91	9.44	3.00E-8	10.1	5.6				1653	1.85	0.55	2.5
27.500	90.223	34.795	0.363	-15.000		34.58	1.05	7	118	5.353	2.503	3.381	8.65	1.24	-0.10	4	2.85	10.12	3.00E-8	10.2	5.7				1729	1.95	0.58	2.6
27.600	90.551	32.742	0.460	-15.000		32.53	1.41	7	118	5.372	2.513	3.390	8.01	1.69	-0.11	3	2.95	9.08	1.00E-9	10.1	5.7				1626	1.81	0.53	2.4
27.700	90.879	30.840	0.448	-14.989		30.62	1.46	6	115	5.391	2.523	3.398	7.43	1.78	-0.12	3	2.99	8.31	1.00E-9	9.8	5.5				1531	1.68	0.50	2.2
27.800	91.207	29.861	0.401	-14.743		29.65	1.35	7	118	5.410	2.534	3.407	7.11	1.66	-0.13	3	2.99	7.96	1.00E-9	9.5	5.3				1482	1.62	0.47	2.1
27.900	91.535	30.510	0.347	-14.361		30.30	1.15	7	118	5.430	2.544	3.416	7.28	1.40	-0.12	4	2.94	8.27	3.00E-8	9.4	5.2				1515	1.66	0.49	2.2
28.000	91.864	32.676	0.447	-13.965		32.48	1.38	7	118	5.449	2.554	3.426	7.89	1.65	-0.11	3	2.95	8.95	1.00E-9	10.1	5.6				1624	1.80	0.53	2.4
28.100	92.192	37.469	0.868	-13.555		37.27	2.33	6	115	5.468	2.564	3.434	9.26	2.73	-0.09	3	3.00	10.32	1.00E-9	12.0	6.7				1864	2.12	0.62	2.8
28.200	92.520	59.721	1.248	-13.120		59.53	2.10	7	118	5.487	2.575	3.443	15.70	2.31	-0.06	4	2.77	18.97	3.00E-8	16.7	9.3				2977	3.60	1.05	4.7
28.300	92.848	54.721	0.937	-12.764		54.54	1.72	7	118	5.506	2.585	3.452	14.20	1.91	-0.06	4	2.76	17.23	3.00E-8	15.2	8.4				2727	3.27	0.95	4.3
28.400	93.176	32.846	0.588	-12.368		32.67	1.80	6	115	5.525	2.595	3.461	7.84	2.17	-0.11	3	3.01	8.72	1.00E-9	10.6	5.8				1633	1.81	0.52	2.4
28.500	93.504	29.475	0.449	-11.969		29.30	1.53	6	115	5.544	2.605	3.469	6.85	1.89	-0.12	3	3.03	7.56	1.00E-9	9.6	5.3				1465	1.58	0.46	2.1
28.600	93.832	28.683	0.405	-11.219		28.52	1.42	6	115	5.563	2.616	3.478	6.60	1.77	-0.13	3	3.03	7.29	1.00E-9	9.3	5.2				1426	1.53	0.44	2.0
28.700	94.160	30.435	0.371	-10.678		30.28	1.22	7	118	5.582	2.626	3.487	7.08	1.50	-0.12	3	2.97	7.99	1.00E-9	9.5	5.3				1514	1.65	0.47	2.1
28.800	94.488	30.313	0.361	-10.322		30.16	1.20	7	118	5.601	2.636	3.496	7.03	1.47	-0.12	3	2.97	7.93	1.00E-9	9.5	5.2				1508	1.64	0.47	2.1
28.900	94.816	29.908	0.398	-9.965		29.76	1.34	7	118	5.621	2.646	3.505	6.89	1.65	-0.12	3	3.00	7.69	1.00E-9	9.6	5.2				1488	1.61	0.46	2.1
29.000	95.144	30.567	0.451	-9.636		30.43	1.48	6	115	5.640	2.656	3.514	7.05	1.82	-0.11	3	3.01	7.85	1.00E-9	9.8	5.4				1521	1.65	0.47	2.1
29.100	95.472	32.262	0.407	-9.279		32.13	1.27	7	118	5.659	2.667	3.523	7.51	1.54	-0.11	3	2.95	8.54	1.00E-9	10.0	5.5				1606	1.76	0.50	2.3
29.200	95.801	33.514	0.448	-8.342		33.39	1.34	7	118	5.678	2.677	3.532	7.85	1.62	-0.10	3	2.94	8.94	1.00E-9	10.4	5.7				1670	1.85	0.52	2.4
29.300	96.129	33.100	0.459	-7.695		32.99	1.39	7	118	5.698	2.687	3.541	7.71	1.68	-0.10	3	2.96	8.74	1.00E-9	10.3	5.6				1649	1.82	0.51	2.3
29.400	96.457	36.801	0.645	-7.339		36.69	1.76	6	115	5.716	2.697	3.550	8.73	2.08	-0.09	3	2.96	9.90	1.00E-9	11.5	6.3				1835	2.07	0.58	2.6
29.500	96.785	42.394	0.624	-7.022		42.29	1.48	7	118	5.736	2.708	3.559	10.27	1.71	-0.07	4	2.86	12.11	3.00E-8	12.4	6.8				2115	2.44	0.68	3.1
29.600	97.113	34.475	0.382	-6.705		34.38	1.11	7	118	5.755	2.718	3.568	8.02	1.33	-0.09	4	2.90	9.32	3.00E-8	10.4	5.6				1719	1.91	0.53	2.4
29.700	97.441	31.763	0.332	-5.913		31.68	1.05	7	118	5.774	2.728	3.577	7.24	1.28	-0.10	4	2.93	8.32	3.00E-8	9.7	5.3				1584	1.73	0.48	2.2
29.800	97.769	30.737	0.328	-5.372		30.66	1.07	7	118	5.794	2.738	3.586	6.93	1.32	-0.10	4	2.95	7.90	3.00E-8	9.5	5.2				1533	1.66	0.46	2.1
29.900	98.097	31.443	0.328	-5.029		31.37	1.05	7	118	5.813	2.749	3.595	7.11	1.28	-0.10	4	2.94	8.14	3.00E-8	9.7	5.2				1569	1.70	0.47	2.1
30.000	98.425	33.223	0.337	-4.712		33.15	1.02	7	118	5.832	2.759	3.604	7.58	1.23	-0.09	4	2.90	8.79	3.00E-8	10.0	5.4				1658	1.82	0.51	2.3
30.100	98.753	34.230	0.343	-4.382		34.17	1.00	7	118	5.852	2.769	3.613	7.84	1.21	-0.09	4	2.89	9.15	3.00E-8	10.2	5.5				1708	1.89	0.52	2.4
30.200	99.081	33.204	0.367	-4.053		33.15	1.11	7	118	5.871	2.779	3.622	7.53	1.35	-0.09	4	2.92	8.68	3.00E-8	10.1	5.5				1657	1.82	0.50	2.3
30.300	99.409	31.876	0.439	-3.709		31.82	1.38	7	118	5.890	2.790	3.631	7.14	1.69	-0.10	3	2.99	8.03	1.00E-9	10.1	5.5				1591	1.73	0.48	2.1
30.400	99.738	30.501	0.475	-3.379		30.45	1.56	6	115	5.909	2.800	3.640	6.74	1.94	-0.10	3	3.04	7.44	1.00E-9	10.0	5.4				1523	1.64	0.45	2.0

Pore Pressure Dissipation Tests (PPDT)

Pore Pressure Dissipation Tests (PPDT's) conducted at various intervals measured hydrostatic water pressures and determined the approximate depth of the ground water table. A PPDT is conducted when the cone is halted at specific intervals determined by the field representative. The variation of the penetration pore pressure (u) with time is measured behind the tip of the cone and recorded by a computer system.

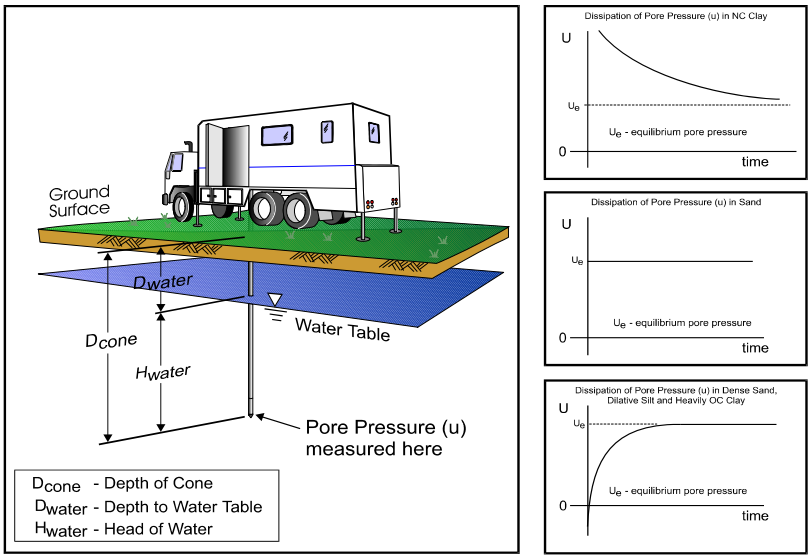
Pore pressure dissipation data can be interpreted to provide estimates of:

- Equilibrium piezometric pressure
- Phreatic Surface
- In situ horizontal coefficient of consolidation (c_h)
- In situ horizontal coefficient of permeability (k_h)

In order to correctly interpret the equilibrium piezometric pressure and/or the phreatic surface, the pore pressure must be monitored until such time as there is no variation in pore pressure with time, *Figure PPDT*. This time is commonly referred to as t_{100}, the point at which 100% of the excess pore pressure has dissipated.

A complete reference on pore pressure dissipation tests is presented by Robertson et al. 1992.

A summary of the pore pressure dissipation tests is summarized in Table 1.



Water Table Calculation

$$D_{water} = D_{cone} - H_{water}$$

where $H_{water} = U_e$ (depth units)

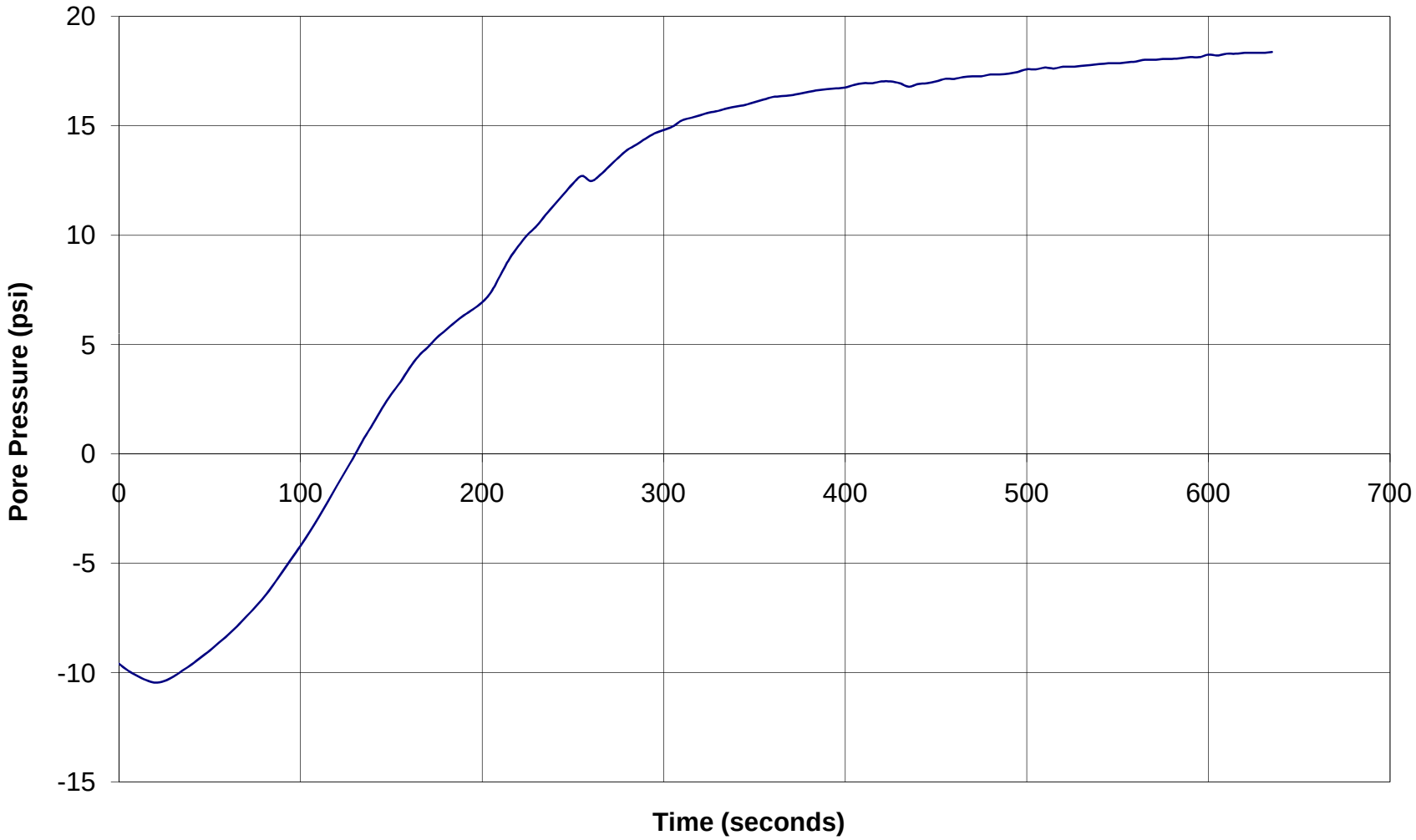
Useful Conversion Factors:
1psi = 0.704m = 2.31 feet (water)
1tsf = 0.958 bar = 13.9 psi
1m = 3.28 feet

Figure PPDT

GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

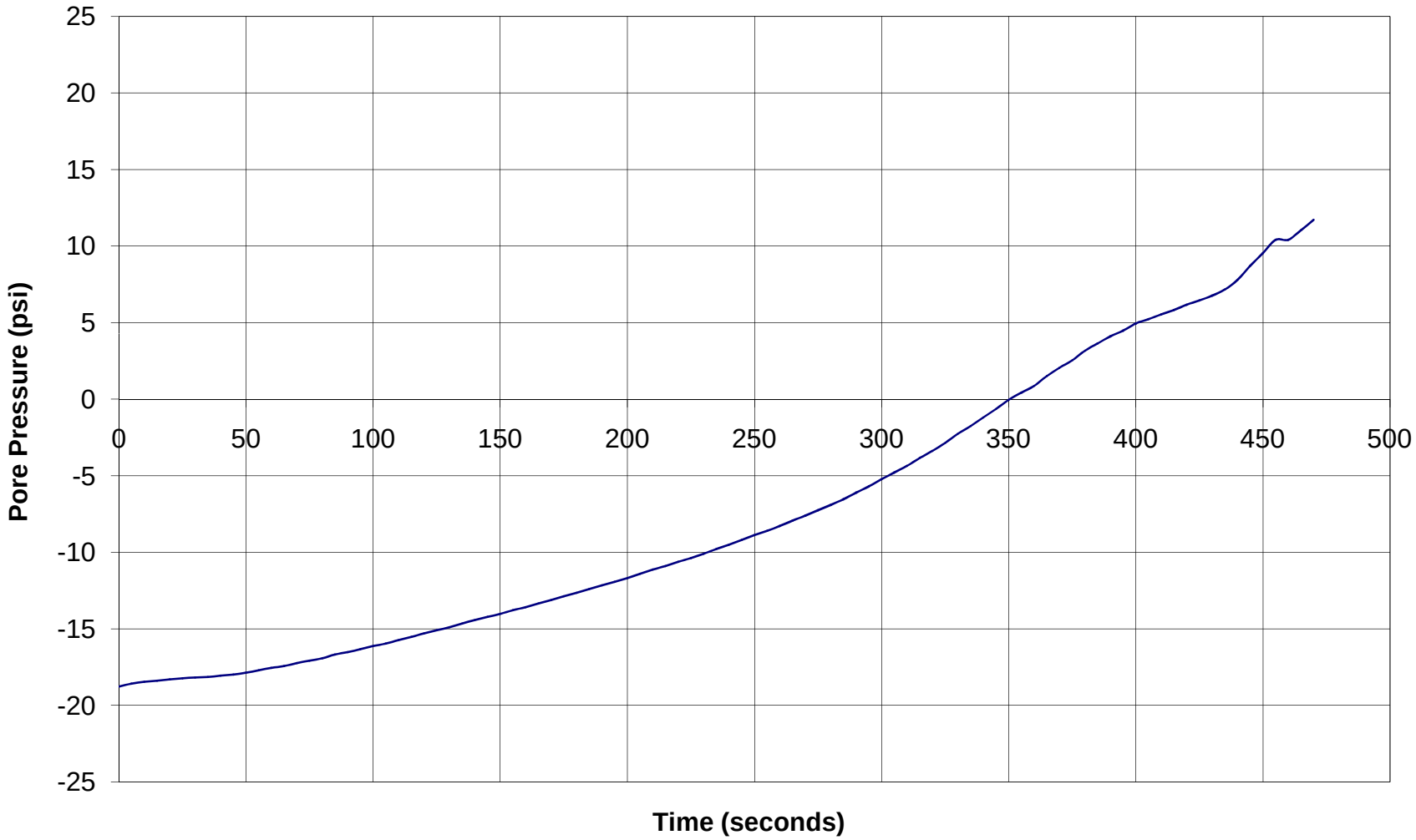
Sounding: CPT-DV1
Depth: 44.947
Site: I-880 WIDENING
Engineer: G.PARIKH



GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

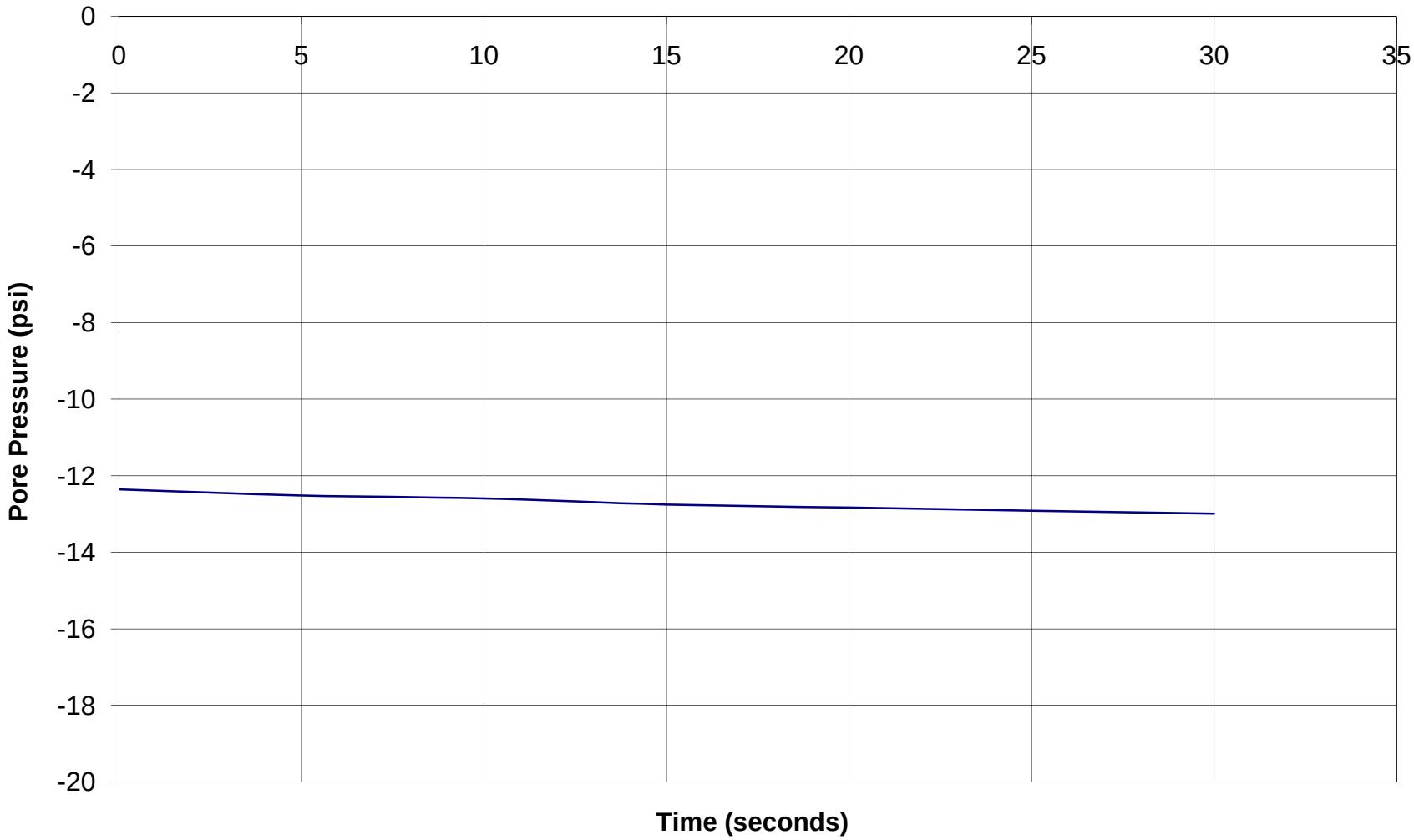
Sounding: CPT-DV1
Depth: 66.273
Site: I-880 WIDENING
Engineer: G.PARIKH



GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

Sounding: CPT-DV1
Depth: 68.569
Site: I-880 WIDENING
Engineer: G.PARIKH



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Copies of ASTM Standards are available through www.astm.org

APPENDIX B

APPENDIX B

LABORATORY TESTS

Classification Tests
The field classification of the samples was visually verified in the laboratory according to the Unified Soil Classification System. The results are presented in “Log of Test Borings”, Appendix A.

Moisture-Density
The natural moisture contents and dry unit weights were determined for selected undisturbed samples of the soils in general accordance with ASTM Test Method D 2216-92. This information was used to classify and correlate the soils. The results are presented at the appropriate depths on the "Log of Test Borings", Appendix A.

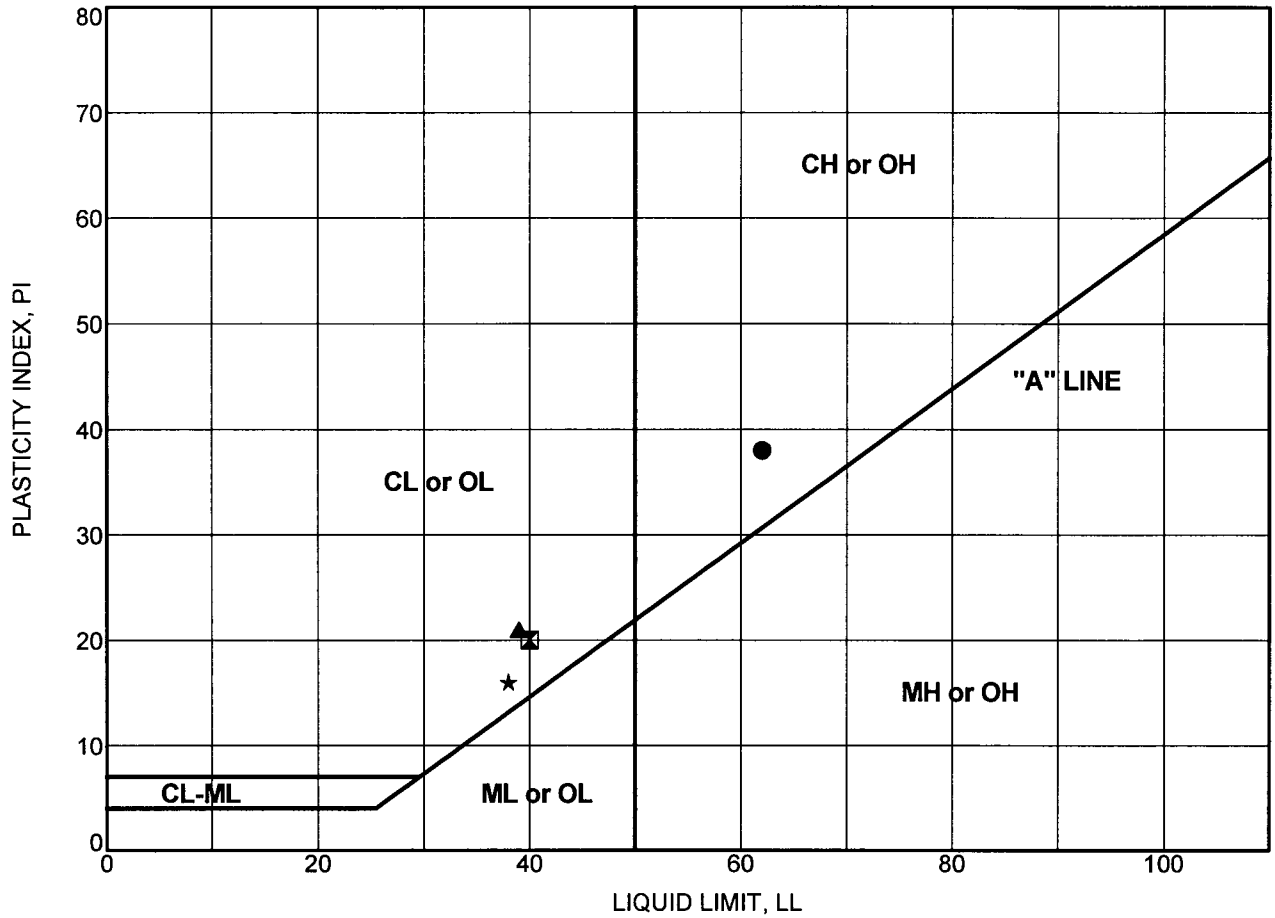
Atterberg Limits
The Atterberg Limits were determined for selected samples of the fine-grained materials. These results were used to classify the soils, as well as to obtain an indication of the effective strength characteristics and expansion potential with variations in moisture content. The Atterberg Limits were determined in general accordance with ASTM Test Method D 4318-93. The results of these tests are presented on Plat B-2, “Plasticity Chart”.

Grain Size Classification
Grain size classification tests (ASTM Test Method D422-63) were performed on selected samples of granular soil to aid in the classification. The results are presented on Plate B-3, “Grain Size Distribution Curves”.

Unconfined Compression Tests
Strength tests were performed on selected undisturbed samples using unconfined compression machine. Unconfined compression tests were performed in general accordance with ASTM Test Method D 2166-91. The results are presented on “Log of Test Borings”, Appendix A.

Corrosion Tests
Corrosion tests were performed on selected samples to determine the corrosion potential of the soils. The pH and minimum resistively tests were performed according to California Test Method 643. The tests were performed by Sunland Analytical. The test results are presented on Plates B-4A and 4B, Appendix B.

Consolidation Tests
Consolidation tests (California Test Method T219) were performed on two selected undisturbed samples. The test results are presented on Plates B-5A thru B-5C.



PLASTICITY CHART

Boring Number	Sample Number	Depth (feet)	Test Symbol	Moisture Content (%)	LL	PL	PI	Description
DV-2	MC-3	16.0	●	32	62	24	38	FAT CLAY (CH)
DV-2	MC-4	21.0	⊠	21	40	20	20	LEAN CLAY (CL)
DV-2	MC-8	41.0	▲	22	39	18	21	LEAN CLAY (CL)
DV-2	SPT-16	86.0	★	28	38	22	16	LEAN CLAY (CL)

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

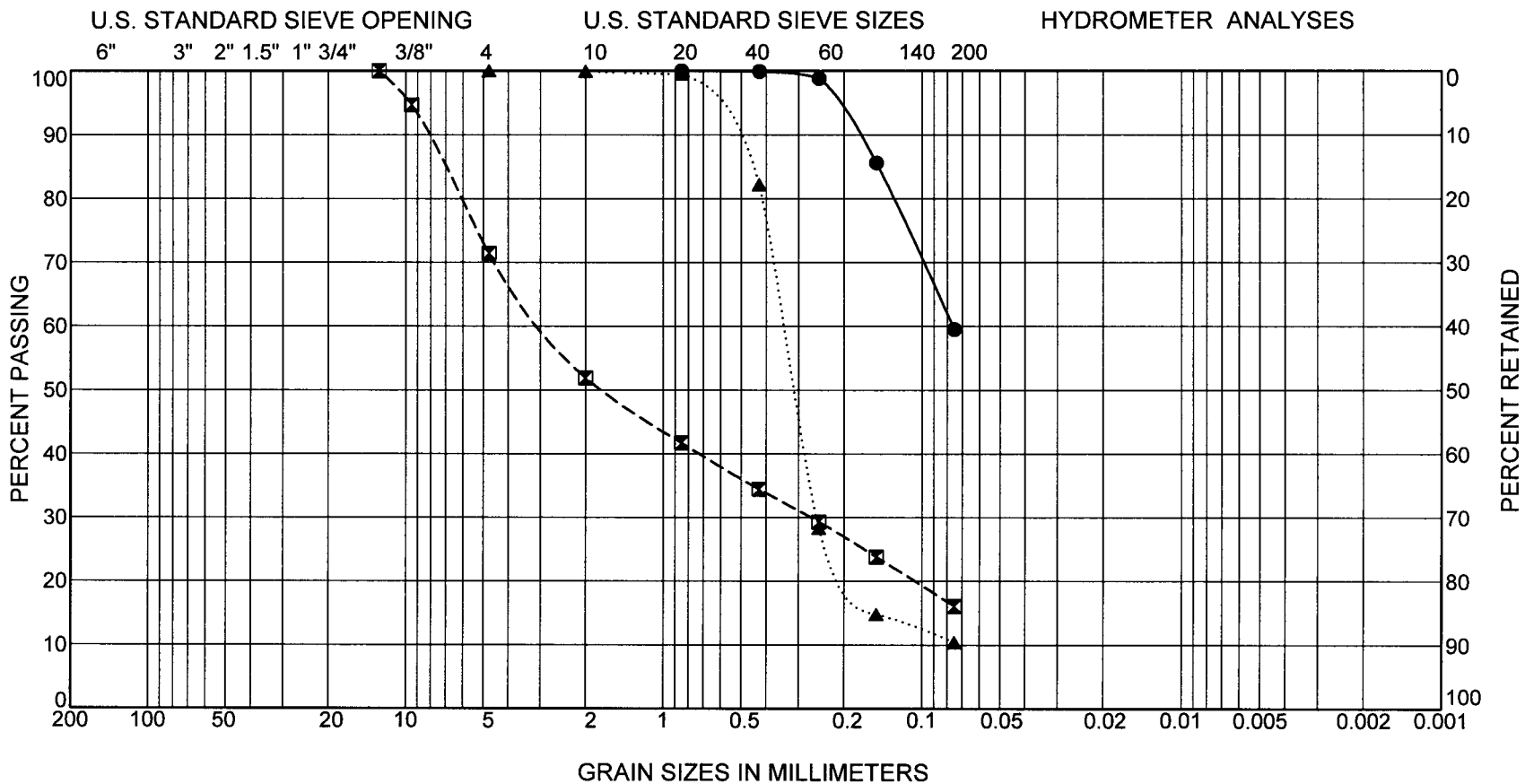
ROUTE 112/880 SEPARATION (REPLACE)
ALAMEDA COUNTY, CALIFORNIA

JOB NO: 206139.10

PLATE NO: B-2

GRAIN SIZE DISTRIBUTION CURVES

COBBLES	GRAVEL		SAND			SILT AND CLAY
	coarse	fine	coarse	medium	fine	



Boring Number	Sample Number	Depth (feet)	Symbol	LL	PI	Description
DV-2	MC-2	11.0	●			SANDY SILT (ML)
DV-2	MC-6	31.0	⊠			SILTY SAND WITH GRAVEL (SM)
DV-2	SPT-11	56.0	▲			POORLY-GRADED SAND WITH SILT (SP-SM)

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

JOB NO: 206139.10

ROUTE 112/880 SEPARATION (REPLACE)
ALAMEDA COUNTY, CALIFORNIA

PLATE NO: B-3

Sunland Analytical
11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 08/27/2008
Date Submitted 08/20/2008

To: Prav Dayah
Parikh Consultants, Inc.
356 S. Milpitas Blvd.
Milpitas, CA 95035

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 206139.GDR I-880 Site ID : E24#2@4.5'.
Thank you for your business.

* For future reference to this analysis please use SUN # 54220-108792.

EVALUATION FOR SOIL CORROSION

Soil pH	6.03		
Minimum Resistivity	2.22 ohm-cm (x1000)		
Chloride	15.6 ppm	00.00156	%
Sulfate	61.1 ppm	00.00611	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical
11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 08/06/2008
Date Submitted 08/01/2008

To: Prav Dayah
Parikh Consultants, Inc.
356 S. Milpitas Blvd.
Milpitas, CA 95035

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 206139.GDR/ I-880 Site ID : RW-17 #2 @ 4.5'.
Thank you for your business.

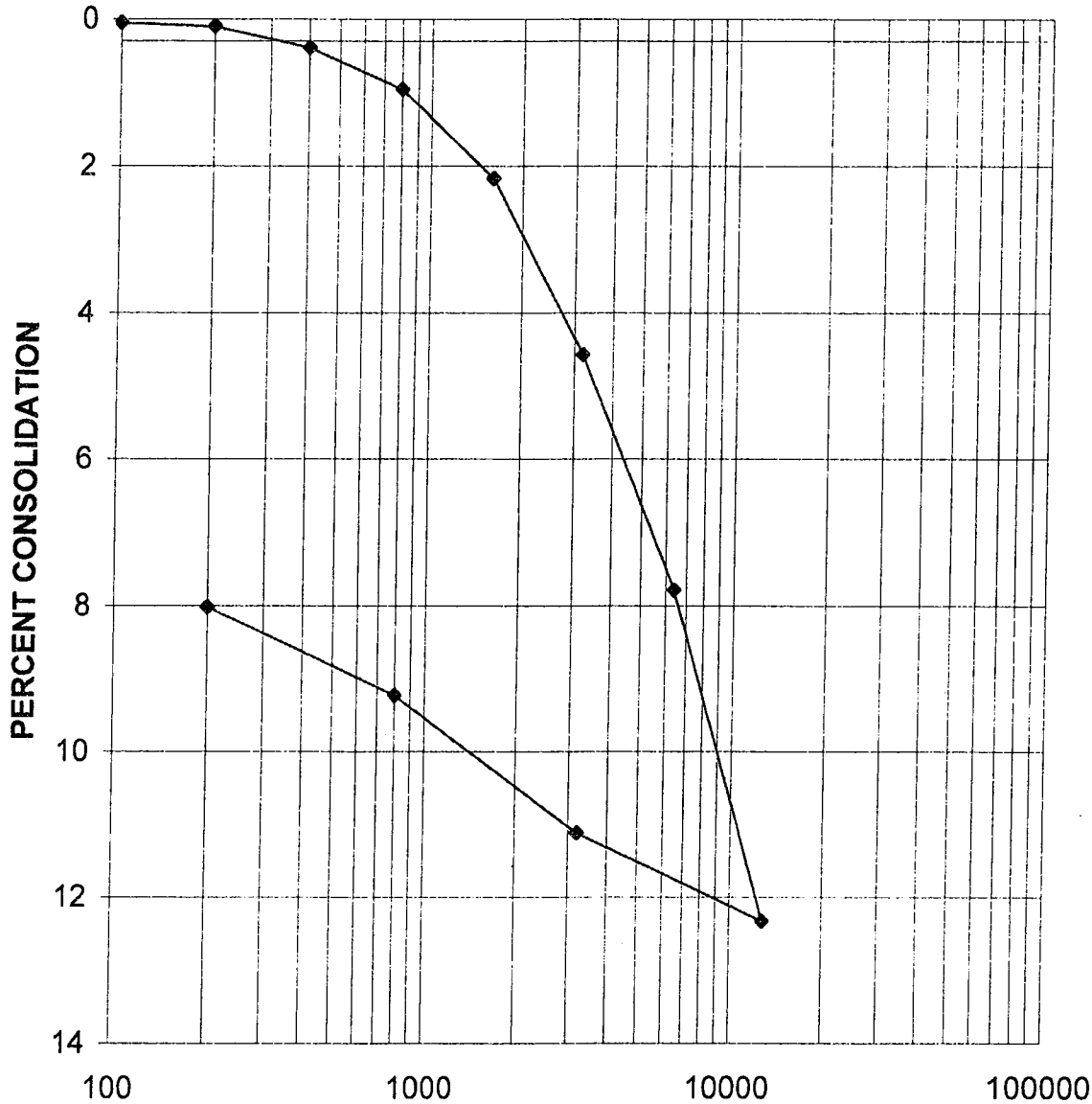
* For future reference to this analysis please use SUN # 54032-108392.

EVALUATION FOR SOIL CORROSION

Soil pH	6.74	
Minimum Resistivity	1.96 ohm-cm (x1000)	
Chloride	6.1 ppm	00.00061 %
Sulfate	1.4 ppm	00.00014 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

CONSOLIDATION TEST RESULTS



	MOISTURE CONTENT %	DRY DENSITY PCF	HEIGHT (INCHES)	DIAMETER (INCHES)
INITIAL	32.6	90.4	1.0000	2.416
FINAL	28.4	98.3	0.9198	2.416

BORING NO.	E-24	SAMPLE NO.	4	ELEV. OR DEPTH	14.5'
DESCRIPTION	Lean clay, yellowish brown				

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GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

I-880 SB HOV Lane Extension
R & M

DATE	JOB NO:
8/5/08	206139.GDR

Reported by: Prav Dayah

CONSOLIDATION TEST - TIME CURVE

JOB #: 206139.GDR

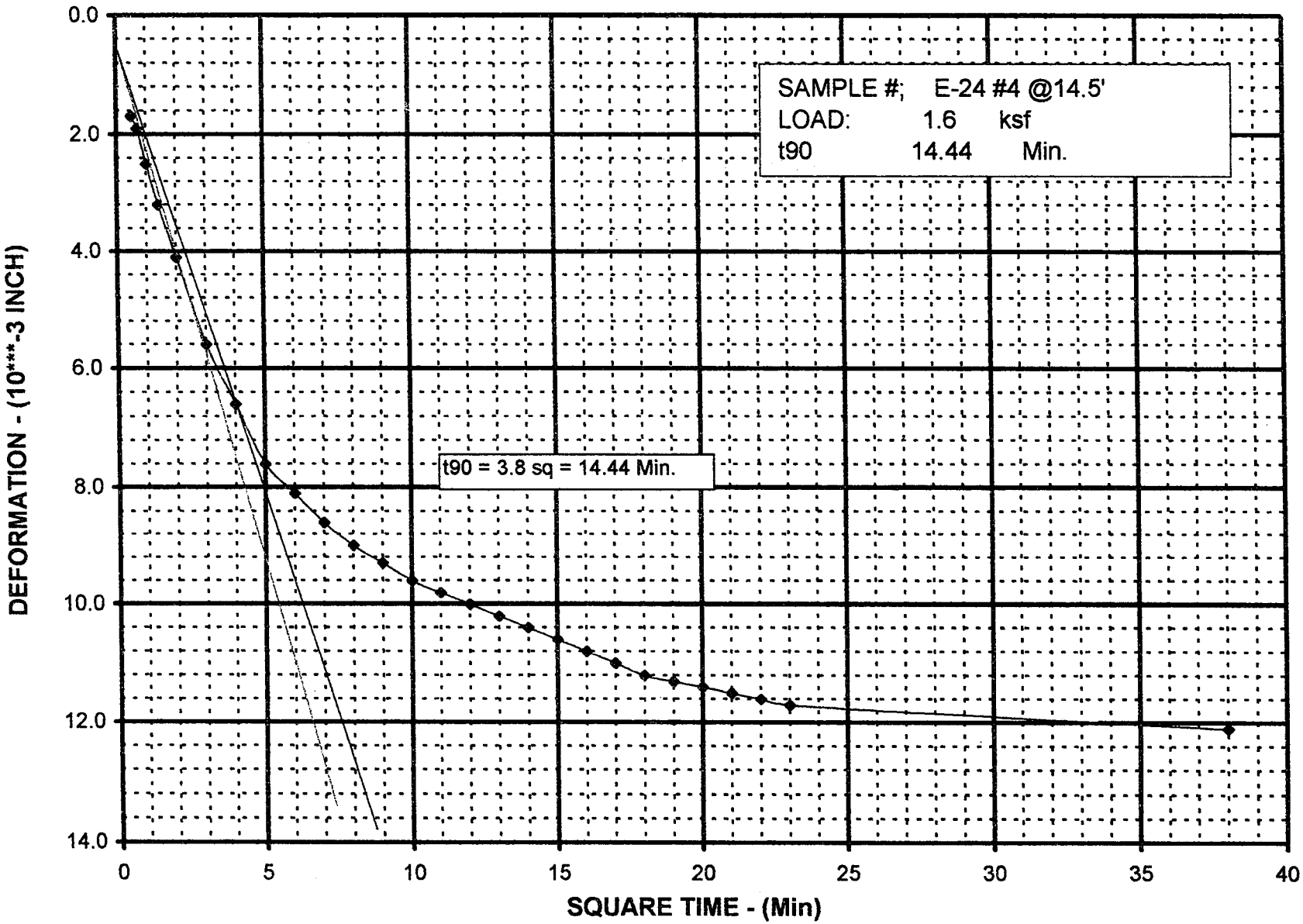


PLATE NO.: B-5B

CONSOLIDATION TEST - TIME CURVE

JOB #: 206139.GDR

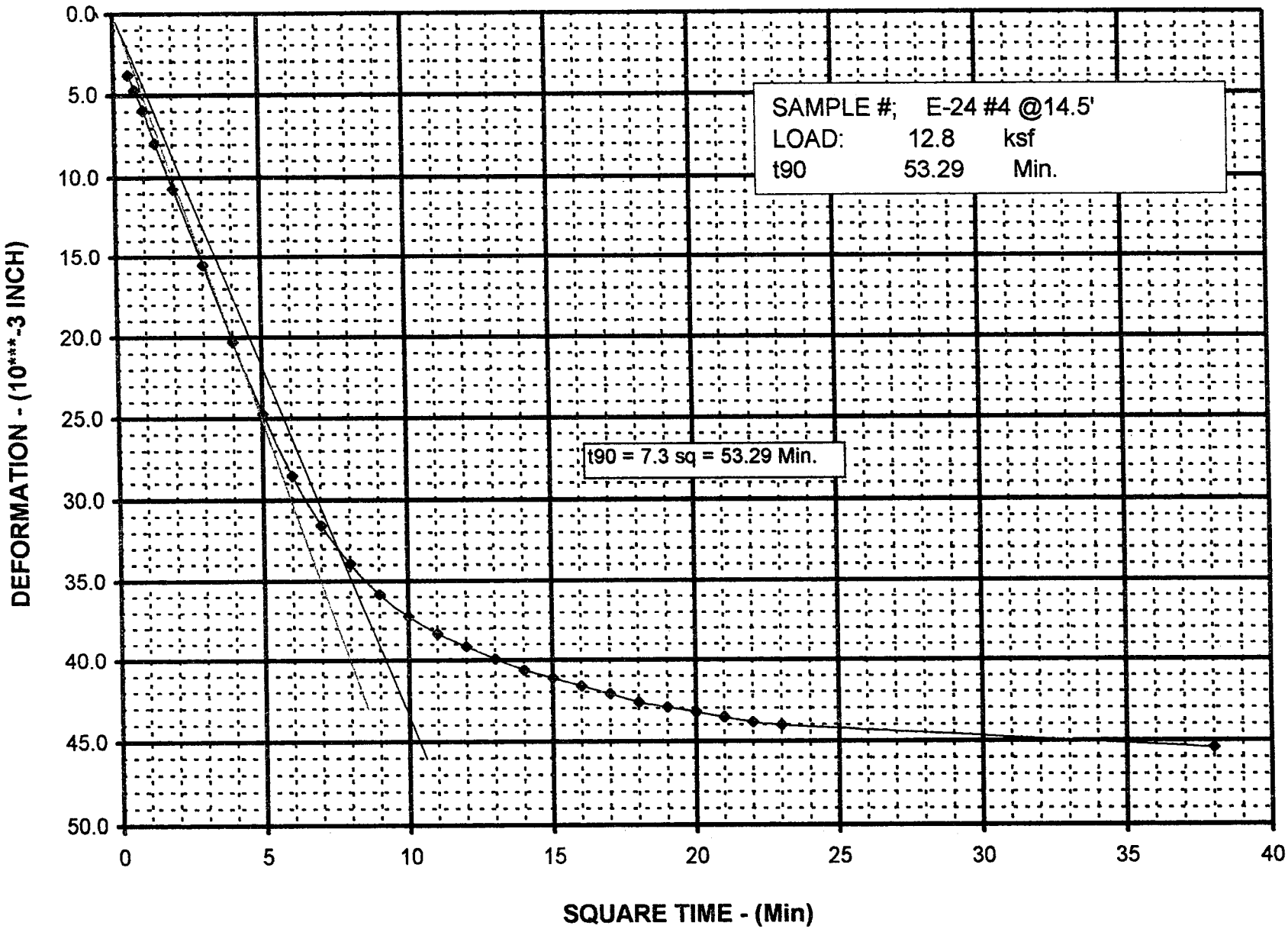


PLATE NO.: B-5C

APPENDIX C

APPENDIX C-1

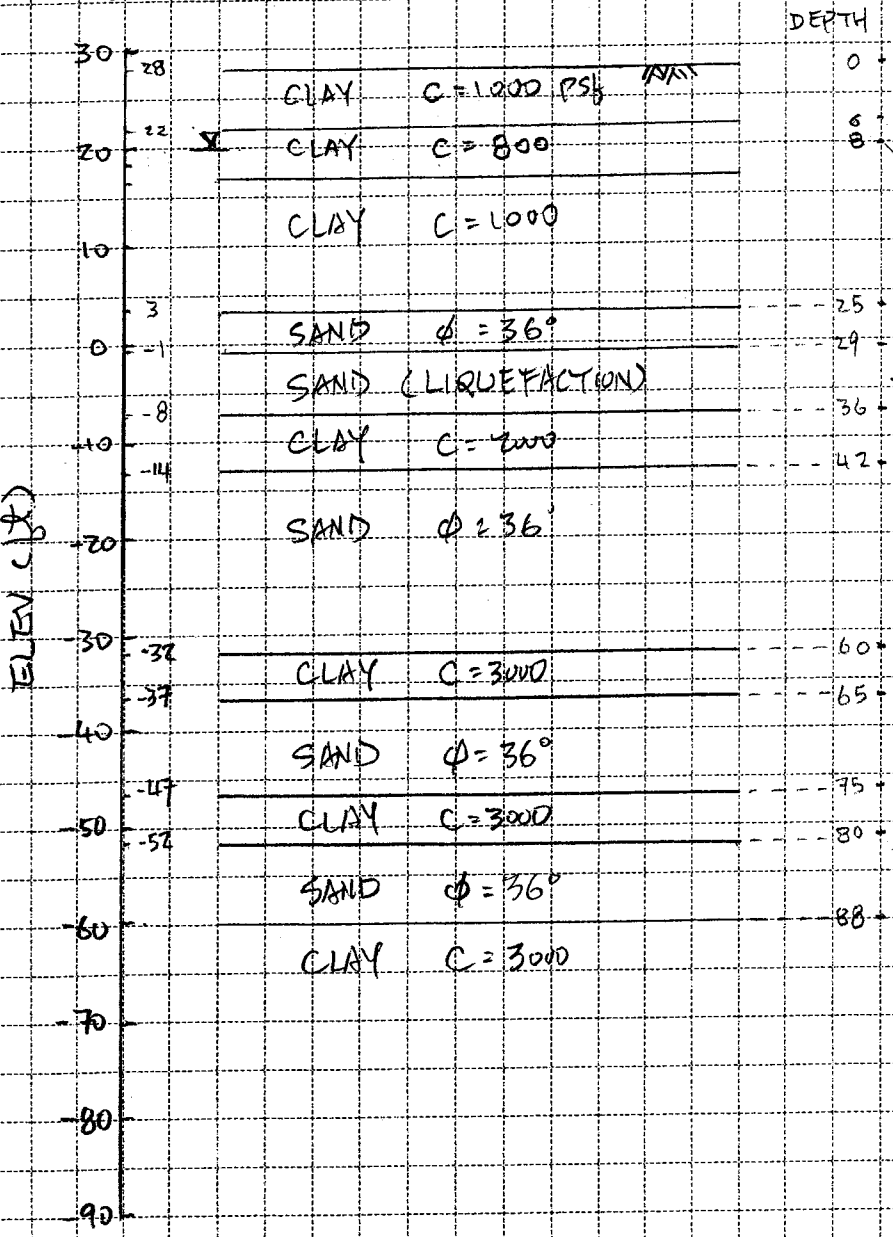
GENERALIZED SOIL PROFILE, STRENGTH PARAMETERS & PILE CAPACITY EVALUATION

PARIKH
Practicing in the Geosciences

JOB: DAVIS ST / ROUTE 880
SHEET NO: ____ OF ____
CALCULATED BY: Y. DAVID WANG — DATE: 9/3/09
CHECKED BY: ____ DATE: 5/15/10
SCALE: ____

DAVIS STREET OC / RTE 880

GENERALIZE SOIL PROFILE & STRENGTH PARAMETERS PER CPT (2008) & CALTRANS AS-BUILT LOTB (1951 & 1967)



* WHERE NOT AFFECTED BY SEWER, PILE CAPACITY STARTS @ ELEV. 28' (OG) (ABUT PILES) & ELEV. 22' (BENT PILES)

* WHERE AFFECTED BY SS PREDRILL IS REQ'D, AND PILE CAPACITY STARTS @ ELEV. 20' AT ABUTS & BENT.

* BASED ON 2008 EXPLORATION AND CALTRANS AS-BUILT B-3 (1967) & B-7 (1951), THE MATERIAL BETWEEN ELEV -1 & -8 ft MAY INCLUDE LOOSE SAND, DENSE SAND & STIFF CLAYS. THE LAYER IS CONSIDERED LIQUEFIABLE OR CYCLIC SOFTENING → NEGLECT CAPACITY CONTRIBUTION

DRIVEN PILE CAPACITY -
Design per FHWA Manual

Davis St OC/Route 880 (Abuts 1 & 3 Piles w/out Predrill)
206139.WMH

ALLOWABLE FRICTIONAL PILE CAPACTY

PILE DIA, B (ft) = 1.33
PILE LENGTH, L (ft) = 70

PILE SHAPE = 1
(1=CIRCLE, 2=SQ., 3=OCT.)
PILE MATERIAL = 2
(1=CONCRETE, 2=STEEL, 3=H PILE)

GROUPS
1. GRAVELS, SANDS AND NONPLASTIC SILTS
2. CLAYS AND PLASTIC SILTS

SOIL TYPES
GRAVEL, SAND, NSILT, CLAY, PSILT

INCREAMENTS (ft)=

F.S. FOR COMPRESSION = 2

F.S. FOR UPLIFT = 1

PERIMETER OF THE PILE (ft) = 4.19
AREA OF THE PILE TIP (ft^2)= 1.40

DEPTH FROM	DEPTH TO	SOIL GROUP	γ' (pcf)	$\Delta\sigma'$ (psf)	σ' (psf)	SOIL TYPE	CONSISTENCY	ϕ (°)	SHEAR STRENGTH PARAMETERS c(psf)	FHWA Manual (Tomlinson, 1980) α	PER SECTION COMP. (Ton)	ALLOWABLE COMPRESSION CAPACITY (Ton)	PER SECTION UPLIFT (Ton)	ULTIMATE UPLIFT CAPACITY (Ton)
OG														
0	6	2	120	720	360	CLAY	MEDIUM		1000	0.90	5.65	5.65	11.31	11.31
6	8	2	120	240	840	CLAY	MEDIUM		800	0.95	1.59	7.24	3.18	14.49
8	10	2	62	124	1022	CLAY	MEDIUM		800	0.95	1.59	8.84	3.18	17.67
10	12	2	62	124	1146	CLAY	MEDIUM		800	0.95	1.59	10.43	3.18	20.85
12	13	2	62	62	1239	CLAY	MEDIUM		1000	0.90	0.94	11.37	1.88	22.74
13	18	2	62	310	1425	CLAY	MEDIUM		1000	0.90	4.71	16.08	9.42	32.16
18	25	2	62	434	1797	CLAY	MEDIUM		1000	0.90	6.60	22.68	13.19	45.35
25	29	1	62	248	2138	SAND	DENSE	36			6.76	29.44	6.04	51.39
29	36	1	62	434	2479	SAND	MED DENSE	33			(Neglect capacity contribution; Driving resistance = 44 kips)			
36	42	2	62	372	2882	CLAY	STIFF		2000	0.90	11.31	40.74	22.61	74.01
42	45	1	62	186	3161	SAND	DENSE	36			5.10	45.84	4.55	78.56
45	50	1	62	310	3409	SAND	DENSE	36			8.45	54.29	7.55	86.11
50	55	1	62	310	3719	SAND	DENSE	36			8.60	62.90	7.69	93.80
55	60	1	62	310	4029	SAND	DENSE	36			8.55	71.45	7.64	101.44
60	65	2	62	310	4339	CLAY	V.STIFF		3000	0.75	11.78	83.23	23.56	124.99
65	70	1	62	310	4649	SAND	DENSE	36			8.46	91.68	7.56	132.55
70	75	1	62	310	4959	SAND	DENSE	36			8.50	100.19	7.60	140.14
75	80	2	62	310	5269	CLAY	V.STIFF		3000	0.75	11.78	111.96	23.56	163.70
80	85	1	62	310	5579	SAND	DENSE	36			8.58	120.54	7.66	171.36
85	88	1	62	186	5827	SAND	DENSE	36			5.13	125.67	4.58	175.94

For abutment piles not in the vicinity of abandoned sewer lines, no predrill is required and capacity starts from OG (Elev. 28')
Use 75' pile length below Elev. 28' for 100-Ton Pile. Use Class 200 Alt "W", PP 16 x 0.5.
OG Elev. = 28', Pile Tip Elev. = 28 - 75 = Elev. -47' for service load of 100 Tons per pile at Abuts 1 & 3 .

DRIVEN PILE CAPACITY -
Design per FHWA Manual

Davis St OC/Route 880 (Abuts 1 & 3 Piles with Predrill)
206139.WMH

ALLOWABLE FRICTIONAL PILE CAPACTY

PILE DIA, B (ft) = 1.33
PILE LENGTH, L (ft) = 70

PILE SHAPE = 1
(1=CIRCLE, 2=SQ., 3=OCT.)
PILE MATERIAL = 2
(1=CONCRETE, 2=STEEL, 3=H PILE)

GROUPS
1. GRAVELS, SANDS AND NONPLASTIC SILTS
2. CLAYS AND PLASTIC SILTS

SOIL TYPES
GRAVEL, SAND, NSILT, CLAY, PSILT

INCREAMENTS (ft)=

F.S. FOR COMPRESSION = 2

F.S. FOR UPLIFT = 1

PERIMETER OF THE PILE (ft) = 4.19
AREA OF THE PILE TIP (ft^2)= 1.40

DEPTH FROM	DEPTH TO	SOIL GROUP	γ' (pcf)	$\Delta\sigma'$ (psf)	σ' (psf)	SOIL TYPE	CONSISTENCY	ϕ (°)	SHEAR STRENGTH PARAMETERS c(psf)	FHWA Manual (Tomlinson, 1980) α	PER SECTION COMP. (Ton)	ALLOWABLE COMPRESSION CAPACITY (Ton)	PER SECTION UPLIFT (Ton)	ULTIMATE UPLIFT CAPACITY (Ton)
OG														
0	6	2	120	720	360	CLAY	MEDIUM		1000	0.90	Predrill to	0.00	Predrill to	0.00
6	8	2	120	240	840	CLAY	MEDIUM		800	0.95	Elev. 20'	0.00	Elev. 20'	0.00
8	10	2	62	124	1022	CLAY	MEDIUM		800	0.95	1.59	1.59	3.18	3.18
10	12	2	62	124	1146	CLAY	MEDIUM		800	0.95	1.59	3.18	3.18	6.37
12	13	2	62	62	1239	CLAY	MEDIUM		1000	0.90	0.94	4.12	1.88	8.25
13	18	2	62	310	1425	CLAY	MEDIUM		1000	0.90	4.71	8.84	9.42	17.67
18	25	2	62	434	1797	CLAY	MEDIUM		1000	0.90	6.60	15.43	13.19	30.86
25	29	1	62	248	2138	SAND	DENSE	36			6.76	22.19	6.04	36.90
29	36	1	62	434	2479	SAND	MED DENSE	34			(Neglect capacity contribution; Driving resistance = 44 kips)			
36	42	2	62	372	2882	CLAY	STIFF		2000	0.90	11.31	33.50	22.61	59.52
42	45	1	62	186	3161	SAND	DENSE	36			5.10	38.60	4.55	64.07
45	50	1	62	310	3409	SAND	DENSE	36			8.45	47.05	7.55	71.62
50	55	1	62	310	3719	SAND	DENSE	36			8.60	55.65	7.69	79.31
55	60	1	62	310	4029	SAND	DENSE	36			8.55	64.20	7.64	86.95
60	65	2	62	310	4339	CLAY	V.STIFF		3000	0.75	11.78	75.98	23.56	110.50
65	70	1	62	310	4649	SAND	DENSE	36			8.46	84.44	7.56	118.06
70	75	1	62	310	4959	SAND	DENSE	36			8.50	92.94	7.60	125.65
75	80	2	62	310	5269	CLAY	V.STIFF		3000	0.75	11.78	104.72	23.56	149.21
80	85	1	62	310	5579	SAND	DENSE	36			8.58	113.30	7.66	156.87
85	88	1	62	186	5827	SAND	DENSE	36			5.13	118.43	4.58	161.45

There are abandoned utilities (12" & 18" sewerlines) at site. Available data provided by designer indiate the ivert at Elev. 20' plus.
Recommend that the piles near obstructions be predrilled to about invert prior to pile driving.
Pile capacity starts from approx. Elev. 20' or 8' depth below OG.
Use 80' pile length below Elev. 28' for 100-Ton Pile. Use Class 200 Alt "W", PP 16 x 0.5.
OG Elev. = 28', Pile Tip Elev. = 28 - 80 = Elev. -52' for service load of 100 Tons per pile at Abuts 1 & 3 .

DRIVEN PILE CAPACITY -
Design per FHWA Manual

Davis St OC/Route 880 (Abut Wingwall Piles)
206139.WMH

ALLOWABLE FRICTIONAL PILE CAPACTY

PILE DIA, B (ft) = 1.17
PILE LENGTH, L (ft) = 70

PILE SHAPE = 1
(1=CIRCLE, 2=SQ., 3=OCT.)
PILE MATERIAL = 2
(1=CONCRETE, 2=STEEL, 3=H PILE)

GROUPS
1. GRAVELS, SANDS AND NONPLASTIC SILTS
2. CLAYS AND PLASTIC SILTS

SOIL TYPES
GRAVEL, SAND, NSILT, CLAY, PSILT

INCREAMENTS (ft)=

F.S. FOR COMPRESSION = 2

F.S. FOR UPLIFT = 1

PERIMETER OF THE PILE (ft) = 3.66
AREA OF THE PILE TIP (ft^2)= 1.07

DEPTH FROM	DEPTH TO	SOIL GROUP	γ' (pcf)	$\Delta\sigma'$ (psf)	σ' (psf)	SOIL TYPE	CONSISTENCY	ϕ (°)	SHEAR STRENGTH PARAMETERS c(psf)	FHWA Manual (Tomlinson, 1980) α	PER SECTION COMP. (Ton)	ALLOWABLE COMPRESSION CAPACITY (Ton)	PER SECTION UPLIFT (Ton)	ULTIMATE UPLIFT CAPACITY (Ton)
	OG													
0	6	2	120	720	360	CLAY	MEDIUM		1000	0.90	4.95	4.95	9.89	9.89
6	8	2	120	240	840	CLAY	MEDIUM		800	0.95	1.39	6.34	2.78	12.67
8	10	2	62	124	1022	CLAY	MEDIUM		800	0.95	1.39	7.73	2.78	15.46
10	12	2	62	124	1146	CLAY	MEDIUM		800	0.95	1.39	9.12	2.78	18.24
12	13	2	62	62	1239	CLAY	MEDIUM		1000	0.90	0.82	9.95	1.65	19.89
13	18	2	62	310	1425	CLAY	MEDIUM		1000	0.90	4.12	14.07	8.24	28.13
18	25	2	62	434	1797	CLAY	MEDIUM		1000	0.90	5.77	19.84	11.54	39.67
25	29	1	62	248	2138	SAND	DENSE	36			4.97	24.81	4.44	44.11
29	36	1	62	434	2479	SAND	MED DENSE	33			(Neglect capacity contribution; Driving resistance =32 kips)			
36	42	2	62	372	2882	CLAY	STIFF		2000	0.90	9.89	34.70	19.78	63.89
42	45	1	62	186	3161	SAND	DENSE	36			3.75	38.44	3.35	67.24
45	50	1	62	310	3409	SAND	DENSE	36			6.21	44.66	5.55	72.79
50	55	1	62	310	3719	SAND	DENSE	36			6.32	50.98	5.65	78.44
55	60	1	62	310	4029	SAND	DENSE	36			6.29	57.27	5.62	84.06
60	65	2	62	310	4339	CLAY	V.STIFF		3000	0.75	10.30	67.57	20.60	104.66
65	70	1	62	310	4649	SAND	DENSE	36			6.22	73.79	5.56	110.22
70	75	1	62	310	4959	SAND	DENSE	36			6.25	80.04	5.58	115.80
75	80	2	62	310	5269	CLAY	V.STIFF		3000	0.75	10.30	90.34	20.60	136.41
80	85	1	62	310	5579	SAND	DENSE	36			6.31	96.65	5.63	142.04
85	88	1	62	186	5827	SAND	DENSE	36			3.77	100.42	3.37	145.41

For abutment wingwalls, use Caltrans Class 90 Alt. "W" pipe piles.
The capacity starts from OG (Elev. 28') due to Caltrans embankment predrill requirements.
Use 55' pile length below Elev. 28' for 45-Ton design. Use Class 90 Alt "W", PP 14 x 0.375.
OG Elev. = 28', Pile Tip Elev. = 28 - 55 = Elev. -27' for service load of 45 Tons per pile.

DRIVEN PILE CAPACITY -
Design per FHWA Manual

Davis St OC/Route 880 (Bent 2 Piles w/out Predrill)
206139.WMH

FRICTIONAL PILE CAPACTY

PILE DIA, B (ft) = 1.33
PILE LENGTH, L (ft) = 70

PILE SHAPE = 1
(1=CIRCLE, 2=SQ., 3=OCT.)
PILE MATERIAL = 2
(1=CONCRETE, 2=STEEL, 3=H PILE)

GROUPS
1. GRAVELS, SANDS AND NONPLASTIC SILTS
2. CLAYS AND PLASTIC SILTS

SOIL TYPES
GRAVEL, SAND, NSILT, CLAY, PSILT

INCREAMENTS (ft)=

F.S. FOR COMPRESSION = 1

F.S. FOR UPLIFT = 1

PERIMETER OF THE PILE (ft) = 4.19
AREA OF THE PILE TIP (ft^2)= 1.40

DEPTH FROM	DEPTH TO		SOIL GROUP	γ' (pcf)	$\Delta\sigma'$ (psf)	σ' (psf)	SOIL TYPE	CONSISTENCY	ϕ (°)	SHEAR STRENGTH PARAMETERS c(psf)	FHWA Manual (Tomlinson, 1980) α	PER SECTION COMP. (Ton)	ULTIMATE COMPRESSION CAPACITY (Ton)	PER SECTION UPLIFT (Ton)	ULTIMATE UPLIFT CAPACITY (Ton)
0	6	OG Ftg	2	120	720	360	CLAY	MEDIUM		1000	0.90	0.00	0.00	0.00	0.00
6	8		2	120	240	840	CLAY	MEDIUM		800	0.95	3.18	3.18	3.18	3.18
8	10		2	62	124	1022	CLAY	MEDIUM		800	0.95	3.18	6.37	3.18	6.37
10	12		2	62	124	1146	CLAY	MEDIUM		800	0.95	3.18	9.55	3.18	9.55
12	13		2	62	62	1239	CLAY	MEDIUM		1000	0.90	1.88	11.43	1.88	11.43
13	18		2	62	310	1425	CLAY	MEDIUM		1000	0.90	9.42	20.85	9.42	20.85
18	25		2	62	434	1797	CLAY	MEDIUM		1000	0.90	13.19	34.05	13.19	34.05
25	29		1	62	248	2138	SAND	DENSE	36			13.52	47.57	6.04	40.09
29	36		1	62	434	2479	SAND	MED DENSE	33			(Neglect capacity contribution; Driving resistance = 44 kips)			
36	42		2	62	372	2882	CLAY	STIFF		2000	0.90	22.61	70.18	22.61	62.70
42	45		1	62	186	3161	SAND	DENSE	36			10.19	80.37	4.55	67.25
45	50		1	62	310	3409	SAND	DENSE	36			16.90	97.28	7.55	74.80
50	55		1	62	310	3719	SAND	DENSE	36			17.21	114.49	7.69	82.49
55	60		1	62	310	4029	SAND	DENSE	36			17.10	131.59	7.64	90.13
60	65		2	62	310	4339	CLAY	V.STIFF		3000	0.75	23.56	155.14	23.56	113.68
65	70		1	62	310	4649	SAND	DENSE	36			16.92	172.06	7.56	121.24
70	75		1	62	310	4959	SAND	DENSE	36			17.00	189.07	7.60	128.84
75	80		2	62	310	5269	CLAY	V.STIFF		3000	0.75	23.56	212.62	23.56	152.39
80	85		1	62	310	5579	SAND	DENSE	36			17.16	229.78	7.66	160.06
85	88		1	62	186	5827	SAND	DENSE	36			10.26	240.03	4.58	164.64

For piles not in the vicinity of abandoned sewer lines, no predrill is required and capacity starts from Ftg bottom (Elev. 22')
Use 75' pile length below Elev. 28' for Class 200 Pile. Use Class 200 Alt "W", PP 16 x 0.5.
Be conservative, assume end bearing in clay to check end bearing. Adopt total capacity from friction capacity plus tipping in clay.
End bearing = 9C Atip = 9*3 ksf*1.40 sq. ft = 38 kips = 19 Tons (Ult).
OG Elev. = 28', Pile Tip Elev. = 28 - 75 = Elev. -47' for nominal load of 200 Tons per pile at Bent 2.

DRIVEN PILE CAPACITY -
Design per FHWA Manual

Davis St OC/Route 880 (Bent 2 Piles with Predrill)
206139.WMH

FRICTIONAL PILE CAPACTY

PILE DIA, B (ft) = 1.33
PILE LENGTH, L (ft) = 70

PILE SHAPE = 1
(1=CIRCLE, 2=SQ., 3=OCT.)
PILE MATERIAL = 2
(1=CONCRETE, 2=STEEL, 3=H PILE)

GROUPS
1. GRAVELS, SANDS AND NONPLASTIC SILTS
2. CLAYS AND PLASTIC SILTS

SOIL TYPES
GRAVEL, SAND, NSILT, CLAY, PSILT

INCREAMENTS (ft)=

F.S. FOR COMPRESSION = 1

F.S. FOR UPLIFT = 1

PERIMETER OF THE PILE (ft) = 4.19
AREA OF THE PILE TIP (ft^2)= 1.40

DEPTH FROM	DEPTH TO	SOIL GROUP	γ' (pcf)	$\Delta\sigma'$ (psf)	σ' (psf)	SOIL TYPE	CONSISTENCY	ϕ (°)	SHEAR STRENGTH PARAMETERS c(psf)	FHWA Manual (Tomlinson, 1980) α	PER SECTION COMP. (Ton)	ULTIMATE COMPRESSION CAPACITY (Ton)	PER SECTION UPLIFT (Ton)	ULTIMATE UPLIFT CAPACITY (Ton)
	OG													
0	6	2	120	720	360	CLAY	MEDIUM		1000	0.90	Predrill to	0.00	Predrill to	0.00
6	8	2	120	240	840	CLAY	MEDIUM		800	0.95	Elev. 20'	0.00	Elev. 20'	0.00
8	10	2	62	124	1022	CLAY	MEDIUM		800	0.95	3.18	3.18	3.18	3.18
10	12	2	62	124	1146	CLAY	MEDIUM		800	0.95	3.18	6.37	3.18	6.37
12	13	2	62	62	1239	CLAY	MEDIUM		1000	0.90	1.88	8.25	1.88	8.25
13	18	2	62	310	1425	CLAY	MEDIUM		1000	0.90	9.42	17.67	9.42	17.67
18	25	2	62	434	1797	CLAY	MEDIUM		1000	0.90	13.19	30.86	13.19	30.86
25	29	1	62	248	2138	SAND	DENSE	36			13.52	44.38	6.04	36.90
29	36	1	62	434	2479	SAND	MED DENSE	34			(Neglect capacity contribution; Driving resistance = 44 kips)			
36	42	2	62	372	2882	CLAY	STIFF		2000	0.90	22.61	67.00	22.61	59.52
42	45	1	62	186	3161	SAND	DENSE	36			10.19	77.19	4.55	64.07
45	50	1	62	310	3409	SAND	DENSE	36			16.90	94.10	7.55	71.62
50	55	1	62	310	3719	SAND	DENSE	36			17.21	111.30	7.69	79.31
55	60	1	62	310	4029	SAND	DENSE	36			17.10	128.41	7.64	86.95
60	65	2	62	310	4339	CLAY	V.STIFF		3000	0.75	23.56	151.96	23.56	110.50
65	70	1	62	310	4649	SAND	DENSE	36			16.92	168.88	7.56	118.06
70	75	1	62	310	4959	SAND	DENSE	36			17.00	185.88	7.60	125.65
75	80	2	62	310	5269	CLAY	V.STIFF		3000	0.75	23.56	209.44	23.56	149.21
80	85	1	62	310	5579	SAND	DENSE	36			17.16	226.60	7.66	156.87
85	88	1	62	186	5827	SAND	DENSE	36			10.26	236.85	4.58	161.45

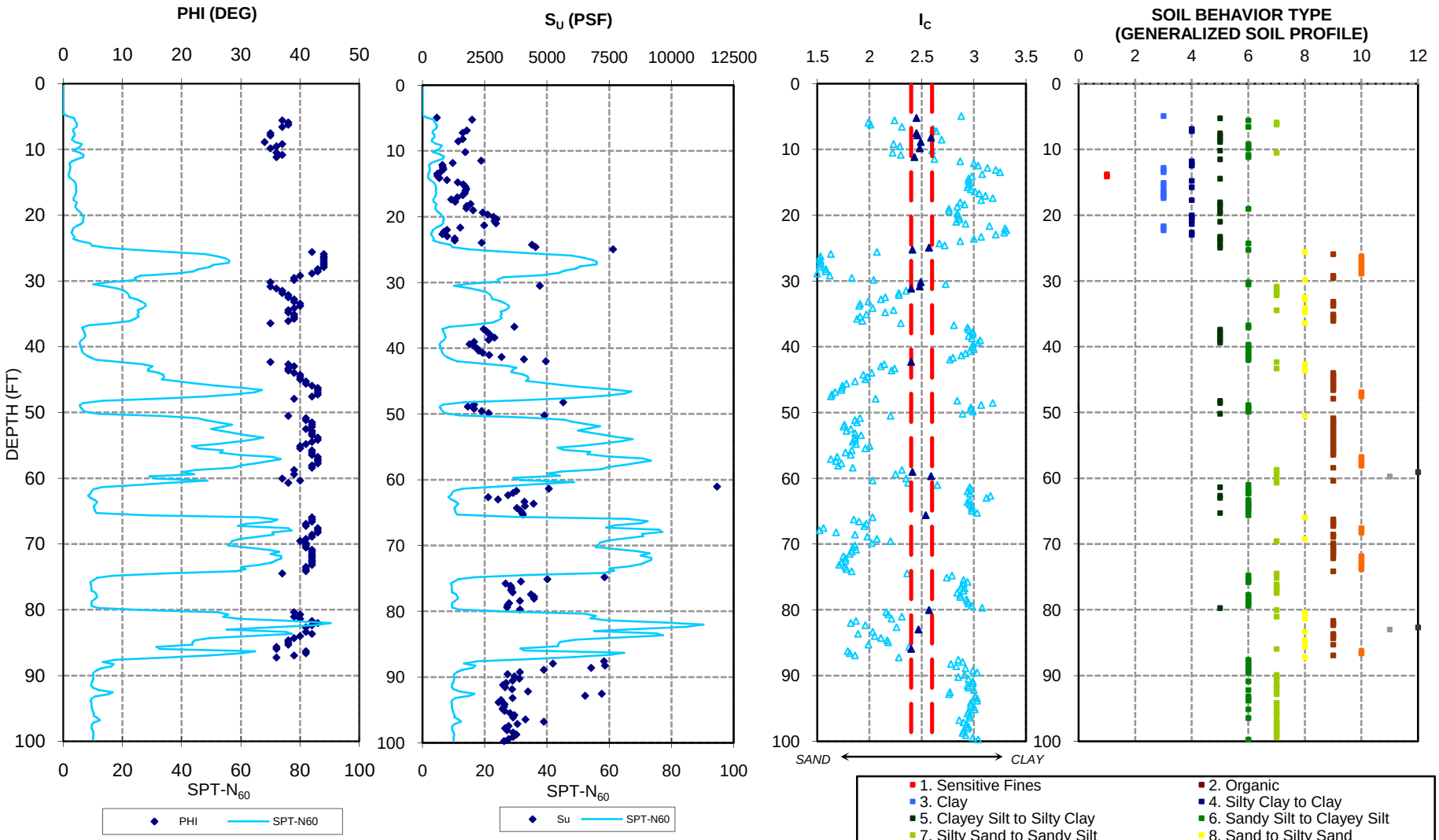
There are abandoned utilities (12" & 18" sewerlines) at site. Available data provided by designer indiate the ivert at Elev. 20' plus.
Recommend that the piles near obstructions be predrilled to about invert prior to pile driving.
Pile capacity starts from approx. Elev. 20' or 8' depth below OG.
Use 80' pile length below Elev. 28' for Cla 200 Pile. Use Class 200 Alt "W", PP 16 x 0.5.
OG Elev. = 28', Pile Tip Elev. = 28 - 80 = Elev. -52' for nominal load of 200 Tons per pile at Bent 2.

APPENDIX C-2

LIQUEFACTION POTENTIAL PER CPT PROCEDURES

CPT DATA CORRELATION

CPT-DV1



Reference: CPT data and correlation provided by Gregg Drilling and Testing, Inc.

PARIKH

Practicing in the Geosciences

ROUTE 112/880 SEPARATION (REPLACE)
ALAMEDA COUNTY, CALIFORNIA

JOB NO.: 206139.DAV

PLATE NO.:

LIQUEFACTION POTENTIAL ANALYSIS (per Youd & Idriss, 2001)

PROJECT NAME	***Route 112/880 Separation (Replace)***	*FAULT INFO*	
PROJECT NO.	***206139.DAV***	*COAST RANGE - SIERRAN BLOCK BOUNDARY ZONE (CSB)*	
CPT NO.	***CPT-DV1***	*a_{max} (g)=* 0.6	*FAULT M_w =* 7.5
			MSF = 1.00

		CPT RESULT INPUT							*CSR*		*$CRR_{7.5}$*						*F.S.=($CRR_{7.5}$/CSR)*MSF*K_σ*K_α*		
Depth (ft)		Soil Behavior Type	qc (tsf)	fs (tsf)	σ_v (tsf)	u (tsf)	σ_v' (tsf)	Ic*	C_N*	γ_d	CSR	Ic	C_Q	q_{c1N}	K_C	$(q_{c1N})_{cs}$	$CRR_{7.5}$	Kσ	Kα	F.S.
0.328									1.7	1.00									1	
0.656									1.7	1.00									1	
0.984									1.7	1.00									1	
1.312									1.7	1.00									1	
1.64									1.7	1.00									1	
1.969									1.7	1.00									1	
2.297									1.7	1.00									1	
2.625									1.7	1.00									1	
2.953									1.7	1.00									1	
3.281									1.7	0.99									1	
3.609									1.7	0.99									1	
3.937									1.7	0.99									1	
4.265									1.7	0.99									1	
4.593									1.7	0.99									1	
4.921	3	Clay	4.69	0.162	0.274		0.274	2.88	1.49254	0.99	0.386							1.00	1	
5.249	5	Clayey Silt to Silty Clay	15.368	0.465	0.293		0.293	2.45	1.47354	0.99	0.386	2.450	1.47	22.65	2.528	57.252	0.10	1.00	1	
5.577	6	Sandy Silt to Clayey Silt	18.09	0.292	0.312		0.312	2.24	1.45503	0.99	0.386	2.240	1.46	26.32	1.770	46.602	0.09	1.00	1	
5.906	7	Silty Sand to Sandy Silt	22.44	0.172	0.331		0.331	1.99	1.43697	0.99	0.385	1.990	1.44	32.25	1.287	41.505	0.08	1.00	1	
6.234	7	Silty Sand to Sandy Silt	23.956	0.202	0.35		0.35	2.01	1.41935	0.99	0.385	2.010	1.42	34.00	1.313	44.654	0.09	1.00	1	
6.562	6	Sandy Silt to Clayey Silt	19.512	0.369	0.369		0.369	2.31	1.40217	0.99	0.385	2.310	1.40	27.36	1.981	54.205	0.09	1.00	1	
6.89	4	Silty Clay to Clay	13.673	0.444	0.388		0.388	2.61	1.38539	0.99	0.385							1.00	1	
7.218	4	Silty Clay to Clay	12.496	0.389	0.407		0.407	2.64	1.36901	0.99	0.384							1.00	1	
7.546	5	Clayey Silt to Silty Clay	16.178	0.332	0.426		0.426	2.45	1.35301	0.98	0.384	2.450	1.35	21.89	2.528	55.340	0.10	1.00	1	
7.874	5	Clayey Silt to Silty Clay	16.14	0.321	0.444		0.444	2.46	1.3382	0.98	0.384	2.460	1.34	21.60	2.574	55.600	0.10	1.00	1	
8.202	5	Clayey Silt to Silty Clay	12.562	0.281	0.463		0.463	2.59	1.32291	0.98	0.383	2.590	1.32	16.62	3.266	54.276	0.09	1.00	1	
8.53	5	Clayey Silt to Silty Clay	11.244	0.293	0.482		0.482	2.69	1.30797	0.98	0.383							1.00	1	
8.858	5	Clayey Silt to Silty Clay	17.336	0.365	0.501		0.501	2.49	1.29336	0.98	0.383	2.490	1.29	22.42	2.718	60.951	0.10	1.00	1	
9.186	6	Sandy Silt to Clayey Silt	29.456	0.448	0.52		0.52	2.23	1.27907	0.98	0.383	2.230	1.28	37.68	1.743	65.687	0.11	1.00	1	
9.514	6	Sandy Silt to Clayey Silt	26.226	0.413	0.538		0.538	2.29	1.26582	0.98	0.382	2.290	1.27	33.20	1.917	63.641	0.10	1.00	1	
9.843	6	Sandy Silt to Clayey Silt	20.208	0.432	0.557		0.557	2.48	1.25213	0.98	0.382	2.480	1.25	25.30	2.669	67.543	0.11	1.00	1	
10.171	5	Clayey Silt to Silty Clay	13.4	0.244	0.576	0.00534	0.576	2.6	1.23874	0.98	0.382							1.00	1	
10.499	7	Silty Sand to Sandy Silt	25.717	0.264	0.595	0.01557	0.595	2.22	1.22563	0.98	0.381	2.220	1.23	31.52	1.717	54.125	0.09	1.00	1	0.25
10.827	6	Sandy Silt to Clayey Silt	31.264	0.534	0.614	0.0258	0.614	2.3	1.21279	0.98	0.381	2.300	1.21	37.92	1.949	73.889	0.12	1.00	1	0.31
11.155	6	Sandy Silt to Clayey Silt	28.439	0.674	0.633	0.03604	0.633	2.43	1.20022	0.98	0.381	2.430	1.20	34.13	2.439	83.251	0.13	1.00	1	0.35
11.483	5	Clayey Silt to Silty Clay	18.316	0.477	0.652	0.04627	0.652	2.62	1.1879	0.98	0.381							1.00	1	
11.811	4	Silty Clay to Clay	9.859	0.263	0.67	0.0565	0.67	2.87	1.17647	0.98	0.380							1.00	1	
12.139	4	Silty Clay to Clay	6.714	0.148	0.689	0.06674	0.689	3	1.16464	0.97	0.380							1.00	1	
12.467	4	Silty Clay to Clay	6.95	0.186	0.708	0.07697	0.708	3.04	1.15304	0.97	0.380							1.00	1	
12.795	3	Clay	6.968	0.26	0.726	0.0872	0.726	3.13	1.14226	0.97	0.380							1.00	1	
13.123	3	Clay	6.253	0.255	0.745	0.09744	0.745	3.21	1.13111	0.97	0.379							1.00	1	
13.451	3	Clay	5.206	0.173	0.763	0.10767	0.763	3.25	1.12073	0.97	0.379							1.00	1	
13.78	1	Sensitive Fines	5.291	0.081	0.781	0.11794	0.781	3.08	1.11055	0.97	0.379							1.00	1	
14.108	1	Sensitive Fines	5.942	0.067	0.799	0.12817	0.799	2.98	1.10055	0.97	0.378							1.00	1	
14.436	5	Clayey Silt to Silty Clay	8.155	0.156	0.818	0.1384	0.818	2.95	1.09019	0.97	0.378							1.00	1	
14.764	4	Silty Clay to Clay	11.517	0.369	0.837	0.14864	0.837	2.95	1.08002	0.97	0.378							1.00	1	
15.092	3	Clay	13.071	0.515	0.855	0.15887	0.855	2.96	1.07056	0.97	0.378							1.00	1	
15.42	3	Clay	13.777	0.559	0.874	0.1691	0.874	2.95	1.06075	0.97	0.377							1.00	1	
15.748	4	Silty Clay to Clay	14.107	0.549	0.892	0.17934	0.892	2.94	1.05163	0.97	0.377							1.00	1	
16.076	3	Clay	13.767	0.565	0.911	0.18957	0.911	2.97	1.04216	0.97	0.377							1.00	1	
16.404	3	Clay	13.579	0.601	0.929	0.1998	0.929	3.01	1.03335	0.97	0.377							1.00	1	
16.732	3	Clay	13.052	0.613	0.947	0.21004	0.947	3.05	1.02469	0.96	0.376							1.00	1	
17.06	3	Clay	11.47	0.553	0.965	0.22027	0.965	3.11	1.01617	0.96	0.376							1.00	1	
17.388	3	Clay	9.624	0.456	0.984	0.23051	0.984	3.18	1.00733	0.96	0.376							1.00	1	
17.717	4	Silty Clay to Clay	10.886	0.395	1.003	0.24077	1.003	3.07	0.99864	0.96	0.375							1.00	1	
18.045	5	Clayey Silt to Silty Clay	15.586	0.442	1.021	0.251	1.021	2.87	0.99054	0.96	0.375							1.00	1	
18.373	5	Clayey Silt to Silty Clay	14.268	0.405	1.04	0.26124	1.04	2.91	0.98214	0.96	0.375							0.99	1	
18.701	5	Clayey Silt to Silty Clay	14.267	0.286	1.059	0.27147	1.059	2.84	0.97388	0.96	0.374							0.99	1	
19.029	6	Sandy Silt to Clayey Silt	16.329	0.295	1.078	0.2817	1.078	2.76	0.96576	0.96	0.374							0.99	1	
19.357	5	Clayey Silt to Silty Clay	19.229	0.435	1.096	0.29194	1.096	2.76	0.95819	0.96	0.374							0.98	1	
19.685	5	Clayey Silt to Silty Clay	20.727	0.683	1.115	0.30217	1.115	2.84	0.95032	0.96	0.374							0.98	1	
20.013	4	Silty Clay to Clay	22.516	0.871	1.134	0.31241	1.134	2.85	0.94259	0.96	0.373							0.98	1	
20.341	4	Silty Clay to Clay	23.372	0.935	1.153	0.32264	1.153	2.86	0.93498	0.96	0.373							0.97	1	
20.669	4	Silty Clay to Clay	22.789	0.889	1.172	0.33287	1.172	2.86	0.92749	0.96	0.373							0.97	1	
20.997	5	Clayey Silt to Silty Clay	23.344	0.806	1.19	0.34311	1.19	2.83	0.9205	0.95	0.372							0.97	1	
21.325	4	Silty Clay to Clay	19.681	0.744	1.209	0.35334	1.209	2.92	0.91324	0.95	0.372							0.96	1	
21.654	3	Clay	12.543	0.557	1.228	0.3636	1.228	3.15	0.9061	0.95	0.371							0.96	1	
21.982	3	Clay	8.522	0.353	1.246	0.37384	1.246	3.3	0.89943	0.95	0.371							0.96	1	
22.31	3	Clay	7.722	0.268	1.264	0.38407	1.264	3.31	0.89286	0.95	0.371							0.95	1	
22.638	4	Silty Clay to Clay	7.242	0.194	1.283	0.39431	1.283	3.29	0.88602	0.95	0.370							0.95	1	
22.966	4	Silty Clay to Clay	8.758	0.233	1.302	0.40454	1.302	3.21	0.8793	0.95	0.370							0.95	1	
23.294	5	Clayey Silt to Silty Clay	11.008	0.245	1.32	0.41477	1.32	3.07	0.87302	0.95	0.370							0.95	1	
23.622	5	Clayey Silt to Silty Clay	10.989	0.179	1.339	0.42501	1.339	3	0.86648	0.95	0.369							0.94	1	
23.95	5	Clayey Silt to Silty Clay	19.201	0.485	1.358	0.43524	1.358	2.87	0.86005	0.95	0.369							0.94	1	
24.278	6	Sandy Silt to Clayey Silt	34.23	0.922	1.377	0.44547	1.377	2.67	0.85371	0.94	0.368							0.94	1	
24.606	5	Clayey Silt to Silty Clay	35.398	1.137	1.396	0.45571	1.396	2.72	0.84746	0.94	0.368							0.94	1	
24.934	5	Clayey Silt to Silty Clay	58.704	2.071	1.414	0.46594	1.414	2.57	0.84162	0.94	0.367	2.570	0.84	49.41	3.148	155.530	0.43	0.93	1	1.17
25.262	6	Sandy Silt to Clayey Silt	102.84	3.745	1.433	0.47617	1.433	2.41	0.83555	0.94	0.367	2.410	0.84	85.93	2.354	202.244		0.93	1	
25.591	8	Sand to Silty Sand	179.625	3.769	1.453	0.48644	1.453	2.07	0.82925	0.94	0.366	2.070	0.83	148.95	1.403	208.971		0.89	1	
25.919	9	Sand	277.399	2.157	1.473	0.49667	1.473	1.63	0.82305	0.94	0.366	1.630	0.82	228.31	1.000	228.312		0.86	1	
26.247	10	Gravelly Sand to Sand	312.278	1.908	1.494	0.50691	1.494	1.53	0.81663	0.94	0.366	1.530	0.82	255.02	1.000	255.015		0.85	1	
26.575	10	Gravelly Sand to Sand	330.066	2.068	1.515	0.51714	1.515	1.52	0.81031	0.94	0.365	1.520	0.81	267.46	1.000	267.457		0.85	1	
26.903	10	Gravelly Sand to Sand	336.837	2.177	1.536	0.52737	1.536	1.53	0.80409	0.93	0.365	1.530	0.80	270.85	1.000	270.848		0.84	1	
27.231	10	Gravelly Sand to Sand	335.076	2.132	1.557	0.53761	1.55	1.53	0.8	0.93	0.366	1.530	0.80	268.06	1.000	268.061		0.84	1	
27.559	10	Gravelly Sand to Sand	305.3	1.703	1.578	0.54784	1.561	1.53	0.79681	0.93	0.367	1.530	0.80	243.27	1.000	243.267		0.84	1	
27.887	10	Gravelly Sand to Sand	295.865	1.537	1.599	0.55807	1.571	1.52	0.79394	0.93	0.369	1.520	0.79	234.90	1.000	234.898		0.83	1	
28.215	10	Gravelly Sand to Sand	270.119	1.53	1.62	0.56831	1.582	1.58	0.7908	0.93	0.371	1.580	0.79	213.61	1.000	213.610		0.84	1	
28.543	10	Gravelly Sand to Sand	259.478	1.379	1.641	0.57854	1.593	1.58	0.78768	0.93	0.373	1.580	0.79	204.39	1.000	204.387		0.84	1	
28.871	10	Gravelly Sand to Sand	233.168	0.759	1.661	0.58878	1.603	1.5	0.78487	0.93	0.374	1.500	0.78	183.01	1.000	183.007		0.85	1	
29.199	9	Sand	151.967	0.372	1.682	0.59901	1.613	1.62	0.78208	0.92	0.376	1.620	0.78	118.85	1.000	118.851	0.24	0.87	1	0.63
29.528	9	Sand	131.09	0.691	1.702	0.60927	1.624	1.83	0.77904	0.92	0.377	1.830	0.78	102.12	1.129	115.316	0.22	0.88	1	0.59
29.856	8	Sand to Silty Sand	123.246	1.344	1.722	0.61951	1.633	2.04	0.77656	0.92	0.379	2.040	0.78	95.71	1.356	129.769	0.28	0.88	1	0.75
30.184	6	Sandy Silt to Clayey Silt	62.452	1.461	1.741	0.62974	1.642	2.49	0.7741	0.92	0.380	2.490	0.77	48.34	2.718	131.418	0.29	0.91	1	0.77
30.512	6	Sandy Silt to Clayey Silt	37.375	1.073	1.76	0.63997	1.65	2.73	0.77193	0.92	0.382							0.90	1	

LIQUEFACTION POTENTIAL ANALYSIS (per Youd & Idriss, 2001)

PROJECT NAME	***Route 112/880 Separation (Replace)***	*FAULT INFO*	
PROJECT NO.	***206139.DAV***	*COAST RANGE - SIERRAN BLOCK BOUNDARY ZONE (CSB)*	
CPT NO.	***CPT-DV1***	*a_{max} (g)=* 0.6	*FAULT M_w =* 7.5
			MSF = 1.00

		CPT RESULT INPUT							*CSR*		*$CRR_{7.5}$*						*F.S.=($CRR_{7.5}$/CSR)*MSF*K$_\sigma$*K$_\alpha$*		
Depth (ft)		Soil Behavior Type	qc (tsf)	fs (tsf)	σ_v (tsf)	u (tsf)	σ_v' (tsf)	Ic*	C_N*	γ_d	CSR	Ic	C_Q	q_{c1N}	K_C	$(q_{c1N})_{cs}$	$CRR_{7.5}$	Kσ	Kα	F.S.
30.84	7	Silty Sand to Sandy Silt	61.444	1.353	1.779	0.65021	1.659	2.48	0.7695	0.92	0.383	2.480	0.77	47.28	2.669	126.210	0.27	0.90	1	0.70
31.168	7	Silty Sand to Sandy Silt	78.893	1.795	1.798	0.66044	1.668	2.4	0.76709	0.91	0.384	2.400	0.77	60.52	2.312	139.939	0.33	0.90	1	0.87
31.496	7	Silty Sand to Sandy Silt	91.088	2.007	1.818	0.67068	1.677	2.35	0.76469	0.91	0.386	2.350	0.76	69.65	2.120	147.641	0.38	0.90	1	0.98
31.824	7	Silty Sand to Sandy Silt	98.207	1.872	1.837	0.68091	1.687	2.28	0.76204	0.91	0.387	2.280	0.76	74.84	1.886	141.156	0.34	0.89	1	0.88
32.152	7	Silty Sand to Sandy Silt	100.618	1.922	1.856	0.69114	1.696	2.28	0.75967	0.91	0.388	2.280	0.76	76.44	1.886	144.172	0.36	0.89	1	0.92
32.48	8	Sand to Silty Sand	107.135	1.414	1.876	0.70138	1.705	2.15	0.75731	0.91	0.389	2.150	0.76	81.13	1.553	125.986	0.27	0.88	1	0.68
32.808	8	Sand to Silty Sand	120.619	1.581	1.896	0.71161	1.715	2.11	0.75472	0.90	0.390	2.110	0.75	91.03	1.473	134.107	0.30	0.88	1	0.78
33.136	9	Sand	134.951	1.302	1.916	0.72184	1.725	1.99	0.75214	0.90	0.391	1.990	0.75	101.50	1.287	130.648	0.29	0.87	1	0.73
33.465	9	Sand	145.583	1.101	1.937	0.73211	1.735	1.91	0.74957	0.90	0.392	1.910	0.75	109.13	1.198	130.776	0.29	0.86	1	0.73
33.793	9	Sand	147.146	1.106	1.957	0.74234	1.745	1.9	0.74703	0.90	0.393	1.900	0.75	109.92	1.189	130.680	0.29	0.86	1	0.73
34.121	8	Sand to Silty Sand	135.065	1.46	1.977	0.75258	1.755	2.03	0.7445	0.90	0.394	2.030	0.74	100.56	1.341	134.867	0.31	0.87	1	0.78
34.449	7	Silty Sand to Sandy Silt	116.9	2.14	1.996	0.76281	1.764	2.23	0.74224	0.89	0.395	2.230	0.74	86.77	1.743	151.277	0.40	0.88	1	1.02
34.777	8	Sand to Silty Sand	122.267	1.794	2.016	0.77304	1.774	2.15	0.73974	0.89	0.395	2.150	0.74	90.45	1.553	140.444	0.34	0.87	1	0.85
35.105	9	Sand	129.019	1.03	2.036	0.78328	1.784	1.97	0.73727	0.89	0.396	1.970	0.74	95.12	1.263	120.112	0.24	0.87	1	0.61
35.433	9	Sand	133.831	0.846	2.057	0.79351	1.794	1.91	0.7348	0.89	0.397	1.910	0.73	98.34	1.198	117.851	0.23	0.86	1	0.59
35.761	9	Sand	128.934	0.677	2.077	0.80374	1.804	1.88	0.73236	0.89	0.397	1.880	0.73	94.43	1.171	110.532	0.21	0.86	1	0.52
36.089	9	Sand	117.258	0.647	2.097	0.81398	1.814	1.93	0.72993	0.88	0.398	1.930	0.73	85.59	1.218	104.288	0.19	0.87	1	0.47
36.417	8	Sand to Silty Sand	73.969	0.917	2.117	0.82421	1.824	2.3	0.72751	0.88	0.398	2.300	0.73	53.81	1.949	104.868	0.19	0.89	1	0.47
36.745	6	Sandy Silt to Clayey Silt	30.068	0.711	2.136	0.83444	1.832	2.81	0.72559	0.88	0.399							0.89	1	
37.073	6	Sandy Silt to Clayey Silt	20.811	0.443	2.155	0.84468	1.841	2.94	0.72345	0.88	0.400							0.89	1	
37.402	5	Clayey Silt to Silty Clay	21.612	0.511	2.174	0.85494	1.849	2.95	0.72155	0.87	0.400							0.88	1	
37.73	5	Clayey Silt to Silty Clay	22.393	0.651	2.192	0.86518	1.858	2.99	0.71942	0.87	0.400							0.88	1	
38.058	5	Clayey Silt to Silty Clay	22.874	0.679	2.211	0.87541	1.866	2.99	0.71755	0.87	0.401							0.88	1	
38.386	5	Clayey Silt to Silty Clay	24.211	0.683	2.23	0.88564	1.875	2.95	0.71545	0.86	0.401							0.88	1	
38.714	5	Clayey Silt to Silty Clay	22.328	0.602	2.249	0.89588	1.884	2.98	0.71336	0.86	0.401							0.88	1	
39.042	5	Clayey Silt to Silty Clay	18.033	0.449	2.268	0.90611	1.892	3.06	0.71151	0.86	0.402							0.88	1	
39.37	5	Clayey Silt to Silty Clay	16.668	0.329	2.286	0.91634	1.901	3.04	0.70945	0.86	0.402							0.88	1	
39.698	6	Sandy Silt to Clayey Silt	18.052	0.336	2.305	0.92658	1.909	2.99	0.70762	0.85	0.402							0.88	1	
40.026	6	Sandy Silt to Clayey Silt	18.918	0.379	2.324	0.93681	1.918	2.99	0.70558	0.85	0.402							0.88	1	
40.354	6	Sandy Silt to Clayey Silt	19.408	0.421	2.343	0.94704	1.926	3	0.70377	0.85	0.402							0.88	1	
40.682	6	Sandy Silt to Clayey Silt	20.604	0.43	2.362	0.95728	1.935	2.96	0.70175	0.84	0.402							0.88	1	
41.011	6	Sandy Silt to Clayey Silt	22.591	0.464	2.38	0.96754	1.944	2.92	0.69975	0.84	0.402							0.88	1	
41.339	6	Sandy Silt to Clayey Silt	26.433	0.598	2.399	0.97778	1.952	2.88	0.69797	0.84	0.402							0.87	1	
41.667	6	Sandy Silt to Clayey Silt	33.175	0.776	2.418	0.98801	1.961	2.8	0.69598	0.84	0.402							0.87	1	
41.995	6	Sandy Silt to Clayey Silt	39.711	1.101	2.437	0.99824	1.969	2.77	0.69423	0.83	0.402							0.87	1	
42.323	7	Silty Sand to Sandy Silt	81.907	1.549	2.456	1.00848	1.978	2.4	0.69226	0.83	0.402	2.400	0.69	56.70	2.312	131.113	0.29	0.87	1	0.72
42.651	8	Sand to Silty Sand	130.507	1.74	2.476	1.01871	1.988	2.14	0.69009	0.83	0.402	2.140	0.69	90.06	1.532	137.970	0.32	0.85	1	0.81
42.979	8	Sand to Silty Sand	147.165	1.994	2.496	1.02894	1.997	2.11	0.68815	0.82	0.401	2.110	0.69	101.27	1.473	149.189	0.39	0.84	1	0.97
43.307	7	Silty Sand to Sandy Silt	133.492	2.554	2.515	1.03918	2.007	2.24	0.686	0.82	0.401	2.240	0.69	91.58	1.770	162.133		0.85	1	
43.635	8	Sand to Silty Sand	133.68	2.272	2.535	1.04941	2.016	2.21	0.68408	0.82	0.401	2.210	0.68	91.45	1.692	154.695	0.42	0.85	1	1.06
43.963	9	Sand	162.721	1.781	2.555	1.05965	2.026	2.02	0.68196	0.81	0.400	2.020	0.68	110.97	1.327	147.257	0.38	0.83	1	0.94
44.291	9	Sand	175.764	1.571	2.576	1.06988	2.036	1.94	0.67985	0.81	0.400	1.940	0.68	119.49	1.229	146.856	0.37	0.82	1	0.94
44.619	9	Sand	174.794	1.765	2.596	1.08011	2.047	1.98	0.67755	0.81	0.399	1.980	0.68	118.43	1.275	150.969	0.40	0.82	1	1.00
44.948	9	Sand	172.195	1.587	2.616	1.09038	2.057	1.96	0.67547	0.80	0.399	1.960	0.68	116.31	1.251	145.519	0.37	0.82	1	0.92
45.276	9	Sand	209.381	1.72	2.637	1.10061	2.067	1.86	0.6734	0.80	0.398	1.860	0.67	141.00	1.153	162.618		0.80	1	
45.604	9	Sand	249.487	1.91	2.657	1.11084	2.077	1.78	0.67135	0.80	0.398	1.780	0.67	167.49	1.092	182.959		0.78	1	
45.932	9	Sand	290.506	2.253	2.678	1.12108	2.087	1.74	0.6693	0.79	0.397	1.740	0.67	194.44	1.065	207.038		0.76	1	
46.26	9	Sand	342.289	3.133	2.698	1.13131	2.097	1.73	0.66727	0.79	0.397	1.730	0.67	228.40	1.058	241.661		0.74	1	
46.588	9	Sand	377.376	3.74	2.718	1.14155	2.107	1.73	0.66526	0.79	0.396	1.730	0.67	251.05	1.058	265.627		0.74	1	
46.916	10	Gravelly Sand to Sand	370.624	3.015	2.739	1.15178	2.118	1.67	0.66305	0.78	0.396	1.670	0.66	245.74	1.017	250.012		0.74	1	
47.244	10	Gravelly Sand to Sand	333.654	2.089	2.76	1.16201	2.129	1.64	0.66086	0.78	0.395	1.640	0.66	220.50	1.000	220.498		0.74	1	
47.572	10	Gravelly Sand to Sand	278.792	1.292	2.781	1.17225	2.139	1.63	0.65888	0.78	0.394	1.630	0.66	183.69	1.000	183.690		0.76	1	
47.9	9	Sand	155.668	1.752	2.801	1.18248	2.149	2.06	0.65691	0.77	0.394	2.060	0.66	102.26	1.387	141.807	0.35	0.82	1	0.88
48.228	5	Clayey Silt to Silty Clay	45.464	1.734	2.82	1.19271	2.158	2.84	0.65515	0.77	0.393							0.86	1	
48.556	5	Clayey Silt to Silty Clay	18.636	0.621	2.839	1.20295	2.167	3.18	0.6534	0.77	0.392							0.86	1	
48.885	6	Sandy Silt to Clayey Silt	16.658	0.264	2.858	1.21321	2.175	3.07	0.65185	0.76	0.392							0.86	1	
49.213	6	Sandy Silt to Clayey Silt	18.645	0.244	2.876	1.22345	2.184	2.97	0.65012	0.76	0.391							0.86	1	
49.541	6	Sandy Silt to Clayey Silt	20.877	0.339	2.895	1.23368	2.192	2.97	0.64858	0.76	0.390							0.85	1	
49.869	6	Sandy Silt to Clayey Silt	23.071	0.506	2.914	1.24391	2.201	2.99	0.64687	0.75	0.389							0.85	1	
50.197	5	Clayey Silt to Silty Clay	39.824	1.468	2.933	1.25415	2.209	2.89	0.64535	0.75	0.389							0.85	2	
50.525	8	Sand to Silty Sand	153.098	2.648	2.953	1.26438	2.219	2.2	0.64346	0.75	0.388	2.200	0.64	98.51	1.667	164.198		0.82	3	
50.853	9	Sand	238.423	2.523	2.973	1.27461	2.229	1.91	0.64159	0.74	0.387	1.910	0.64	152.97	1.198	183.319		0.77	4	
51.181	9	Sand	257.266	2.491	2.993	1.28485	2.239	1.86	0.63972	0.74	0.386	1.860	0.64	164.58	1.153	189.816		0.76	5	
51.509	9	Sand	279.489	3.099	3.014	1.29508	2.249	1.88	0.63787	0.74	0.385	1.880	0.64	178.28	1.171	208.686		0.75	6	
51.837	9	Sand	317.043	2.686	3.034	1.30531	2.259	1.76	0.63602	0.73	0.385	1.760	0.64	201.65	1.078	217.463		0.74	7	
52.165	9	Sand	299.226	2.315	3.055	1.31555	2.27	1.75	0.63401	0.73	0.384	1.750	0.63	189.71	1.072	203.294		0.74	8	
52.493	9	Sand	271.588	2.385	3.075	1.32578	2.28	1.82	0.63218	0.73	0.383	1.820	0.63	171.69	1.122	192.556		0.75	9	
52.822	9	Sand	295.61	2.451	3.095	1.33605	2.29	1.78	0.63037	0.72	0.382	1.780	0.63	186.34	1.092	203.552		0.74	10	
53.15	9	Sand	311.412	3.589	3.116	1.34628	2.3	1.86	0.62857	0.72	0.381	1.860	0.63	195.74	1.153	225.761		0.74	11	
53.478	9	Sand	324.633	4.682	3.136	1.35651	2.31	1.92	0.62678	0.72	0.380	1.920	0.63	203.47	1.208	245.852		0.73	12	
53.806	9	Sand	362.225	4.848	3.156	1.36675	2.32	1.86	0.625	0.71	0.379	1.860	0.63	226.39	1.153	261.106		0.72	13	
54.134	9	Sand	341.545	4.222	3.177	1.37698	2.33	1.86	0.62323	0.71	0.378	1.860	0.62	212.86	1.153	245.502		0.73	14	
54.462	9	Sand	314.971	3.331	3.197	1.38721	2.34	1.84	0.62147	0.71	0.377	1.840	0.62	195.74	1.137	222.568		0.73	15	
54.79	9	Sand	275.025	2.804	3.217	1.39745	2.351	1.87	0.61954	0.71	0.376	1.870	0.62	170.39	1.162	197.965		0.75	16	
55.118	9	Sand	221.115	2.712	3.238	1.40768	2.361	2	0.6178	0.70	0.376	2.000	0.62	136.61	1.300	177.587		0.77	17	
55.446	9	Sand	234.524	2.715	3.258	1.41792	2.371	1.96	0.61607	0.70	0.375	1.960	0.62	144.48	1.251	180.764		0.77	18	
55.774	9	Sand	291.797	2.743	3.279	1.42815	2.381	1.83	0.61435	0.70	0.374	1.830	0.61	179.27	1.129	202.424		0.74	19	
56.102	9	Sand	293.124	2.209	3.299	1.43838	2.391	1.77	0.61264	0.69	0.373	1.770	0.61	179.58	1.085	194.907		0.73	20	
56.43	9	Sand	323.578	3.253	3.319	1.44862	2.401	1.82	0.61094	0.69	0.372	1.820	0.61	197.69	1.122	221.709		0.72	21	
56.759	10	Gravelly Sand to Sand	403.272	3.273	3.34	1.45888	2.412	1.69	0.60908	0.69	0.371	1.690	0.61	245.63	1.031	253.260		0.70	22	
57.087	10	Gravelly Sand to Sand	427.266	2.969	3.361	1.46911	2.423	1.63	0.60723	0.68	0.370	1.630	0.61	259.45	1.000	259.449		0.70	23	
57.415	10	Gravelly Sand to Sand	396.153	2.996	3.382	1.47935	2.433	1.68	0.60556	0.68	0.369	1.680	0.61	239.89	1.024	245.715		0.70	24	
57.743	10	Gravelly Sand to Sand	363.665	2.974	3.403	1.48958	2.444	1.73	0.60373	0.68	0.368	1.730	0.60	219.56	1.058	232.303		0.70	25	
58.071	10	Gravelly Sand to Sand	339.417	2.321	3.424	1.49982	2.454	1.7	0.60208	0.68	0.368	1.700	0.60	204.36	1.038	212.092		0.71	26	
58.399	9	Sand	310.536	3.038	3.444	1.51005	2.465	1.84	0.60027	0.67	0.367	1.840	0.60	186.41	1.137	211.950		0.72	27	
58.727	7	Silty Sand to Sandy Silt	199.692	5.911	3.463	1.52028	2.474	2.31	0.5988	0.67	0.366	2.310	0.60	119.58	1.981	236.909		0.78	28	
59.055	12	Sand to Clayey Sand	173.315	5.975	3.483	1.53052	2.483	2.41	0.59734	0.67	0.365	2.410	0.60	103.53	2.354	243.668		0.83	29	
59.383	7	Silty Sand to Sandy Silt	203.157	4.932	3.502	1.54075	2.492	2.25	0.59588	0.66	0.364	2.250	0.60	121.06	1.798	217.693		0.78	30	
59.711	11	Sitff Fine-Grained	114.988	4.574	3.524	1.55098	2.504	2.59	0.59395	0.66	0.363	2.590	0.59	68.30	3.266	223.062		0.83	31	
60.039	7	Silty Sand to Sandy Silt	138.021	3.051	3.543	1.56122	2.513	2.35	0.59251	0.66	0.362	2.350	0.59	81.78	2.120	173.343		0.82	32	
60.367	9	Sand	244.863	3.454	3.564	1.57145	2.523	2.03	0.59092	0.66	0.362	2.030	0.59	144.69	1.341	194.066		0.75	33	
60.696	7	Silty Sand to Sandy Silt	155.555	4.24	3.583	1.58172	2.532	2.37	0.5895	0.65	0.361	2.370	0.59	91.70	2.194	201.192		0.80	34	
61.024	6	Sandy Silt to Clayey Silt	92.623	3.528	3.602	1.59195	2.54	2.65	0.58824	0.65	0.360							0.83	35	
61.352	5	Clayey Silt to Silty Clay	41.923	1.722	3.621	1.60218	2.549	2.96	0.58682	0.65	0.359							0.83	36	
61.68	6	Sandy Silt to Clayey Silt	32.177	0.877	3.639	1.61242	2.558	2.97	0.58542	0.65	0.358							0.83	37	
62.008	6	Sandy Silt to Clayey Silt	31.113	0.721	3.658	1.62265	2.566	2.94	0.58417	0.64	0.358							0.83	38	

LIQUEFACTION POTENTIAL ANALYSIS (per Youd & Idriss, 2001)

PROJECT NAME ***Route 112/880 Separation (Replace)***
PROJECT NO. ***206139.DAV***
CPT NO. ***CPT-DV1***

FAULT INFO
COAST RANGE - SIERRAN BLOCK BOUNDARY ZONE (CSB)
a_{max} *(g)=* 0.6

FAULT M_w *=* 7.5
MSF = 1.00

		CPT RESULT INPUT							*CSR*		*$CRR_{7.5}$*						*F.S.=($CRR_{7.5}$/CSR)*MSF*K_σ*K_α*		
Depth (ft)		Soil Behavior Type	qc (tsf)	fs (tsf)	σ_v (tsf)	u (tsf)	σ_v' (tsf)	Ic*	C_N*	γ_d	CSR	Ic	C_Q	q_{c1N}	K_C	$(q_{c1N})_{cs}$	$CRR_{7.5}$	$K\sigma$	$K\alpha$	F.S.
62.336	6	Sandy Silt to Clayey Silt	29.701	0.661	3.677	1.63288	2.575	2.96	0.58278	0.64	0.357							0.83	39	
62.664	5	Clayey Silt to Silty Clay	23.664	0.784	3.696	1.64312	2.583	3.16	0.58155	0.64	0.356							0.83	40	
62.992	5	Clayey Silt to Silty Clay	26.744	0.946	3.714	1.65335	2.592	3.12	0.58017	0.64	0.355							0.83	41	
63.32	6	Sandy Silt to Clayey Silt	34.644	1.014	3.733	1.66358	2.6	2.96	0.57895	0.63	0.355							0.83	42	
63.648	6	Sandy Silt to Clayey Silt	37.385	1.113	3.752	1.67382	2.609	2.94	0.57758	0.63	0.354							0.83	43	
63.976	6	Sandy Silt to Clayey Silt	34.889	1.014	3.771	1.68405	2.617	2.96	0.57637	0.63	0.354							0.82	44	
64.304	6	Sandy Silt to Clayey Silt	32.516	0.897	3.79	1.69428	2.626	2.98	0.57501	0.63	0.353							0.82	45	
64.633	6	Sandy Silt to Clayey Silt	33.401	0.963	3.808	1.70455	2.635	2.98	0.57366	0.62	0.352							0.82	46	
64.961	6	Sandy Silt to Clayey Silt	34.089	0.994	3.827	1.71478	2.643	2.98	0.57247	0.62	0.351							0.82	47	
65.289	5	Clayey Silt to Silty Clay	34.343	1.235	3.846	1.72502	2.652	3.03	0.57113	0.62	0.351							0.82	48	
65.617	6	Sandy Silt to Clayey Silt	116.052	3.741	3.865	1.73525	2.66	2.54	0.56995	0.62	0.350	2.540	0.57	66.14	2.979	197.040		0.82	49	
65.945	8	Sand to Silty Sand	330.33	6.056	3.885	1.74548	2.67	2.03	0.56848	0.62	0.349	2.030	0.57	187.78	1.341	251.858		0.71	50	
66.273	9	Sand	388.544	4.731	3.905	1.75572	2.68	1.85	0.56701	0.61	0.349	1.850	0.57	220.31	1.145	252.271		0.68	51	
66.601	9	Sand	371.199	5.016	3.925	1.76595	2.69	1.9	0.56555	0.61	0.348	1.900	0.57	209.93	1.189	249.577		0.69	52	
66.929	9	Sand	317.156	4.53	3.946	1.77618	2.7	1.97	0.5641	0.61	0.347	1.970	0.56	178.91	1.263	225.912		0.71	53	
67.257	9	Sand	305.837	3.912	3.966	1.78642	2.71	1.95	0.56266	0.61	0.347	1.950	0.56	172.08	1.240	213.358		0.71	54	
67.585	10	Gravelly Sand to Sand	451.9	2.285	3.987	1.79665	2.721	1.56	0.56108	0.61	0.346	1.560	0.56	253.55	1.000	253.553		0.67	55	
67.913	10	Gravelly Sand to Sand	463.369	2.104	4.008	1.80689	2.732	1.52	0.55951	0.60	0.345	1.520	0.56	259.26	1.000	259.260		0.67	56	
68.241	10	Gravelly Sand to Sand	403.818	2.718	4.029	1.81712	2.742	1.68	0.55809	0.60	0.345	1.680	0.56	225.37	1.024	230.836		0.67	57	
68.57	9	Sand	380.643	4.442	4.049	1.82738	2.752	1.86	0.55668	0.60	0.344	1.860	0.56	211.90	1.153	244.389		0.68	58	
68.898	9	Sand	336.677	5.157	4.07	1.83762	2.763	1.98	0.55513	0.60	0.344	1.980	0.56	186.90	1.275	238.249		0.70	59	
69.226	8	Sand to Silty Sand	294.838	5.312	4.089	1.84785	2.772	2.07	0.55388	0.60	0.343	2.070	0.55	163.30	1.403	229.103		0.72	60	
69.554	7	Silty Sand to Sandy Silt	267.85	6.607	4.109	1.85808	2.781	2.2	0.55262	0.59	0.342	2.200	0.55	148.02	1.667	246.716		0.73	61	
69.882	9	Sand	285.356	4.176	4.129	1.86832	2.791	2.02	0.55124	0.59	0.342	2.020	0.55	157.30	1.327	208.739		0.72	62	
70.21	9	Sand	298.652	2.581	4.149	1.87855	2.801	1.86	0.54986	0.59	0.341	1.860	0.55	164.22	1.153	189.399		0.70	63	
70.538	9	Sand	335.905	3.111	4.17	1.88879	2.812	1.84	0.54835	0.59	0.341	1.840	0.55	184.20	1.137	209.436		0.69	64	
70.866	9	Sand	368.92	4.267	4.19	1.89902	2.822	1.87	0.54699	0.59	0.340	1.870	0.55	201.80	1.162	234.454		0.68	65	
71.194	9	Sand	395.541	4.268	4.211	1.90925	2.832	1.83	0.54563	0.59	0.340	1.830	0.55	215.82	1.129	243.701		0.67	66	
71.522	9	Sand	382.809	3.671	4.231	1.91949	2.842	1.81	0.54429	0.58	0.339	1.810	0.54	208.36	1.114	232.112		0.67	67	
71.85	10	Gravelly Sand to Sand	409.628	3.495	4.252	1.92972	2.853	1.75	0.54281	0.58	0.338	1.750	0.54	222.35	1.072	238.269		0.66	68	
72.178	9	Sand	406.813	3.672	4.272	1.93995	2.863	1.77	0.54147	0.58	0.338	1.770	0.54	220.28	1.085	239.078		0.66	69	
72.507	10	Gravelly Sand to Sand	397.763	3.421	4.293	1.95022	2.873	1.77	0.54014	0.58	0.337	1.770	0.54	214.85	1.085	233.186		0.66	70	
72.835	10	Gravelly Sand to Sand	394.26	2.935	4.314	1.96045	2.884	1.73	0.53869	0.58	0.337	1.730	0.54	212.38	1.058	224.714		0.66	71	
73.163	10	Gravelly Sand to Sand	374.024	2.398	4.335	1.97069	2.895	1.71	0.53724	0.58	0.336	1.710	0.54	200.94	1.045	209.903		0.66	72	
73.491	10	Gravelly Sand to Sand	332.816	2.299	4.356	1.98092	2.905	1.77	0.53593	0.57	0.336	1.770	0.54	178.37	1.085	193.590		0.68	73	
73.819	10	Gravelly Sand to Sand	339.728	2.451	4.377	1.99115	2.916	1.78	0.5345	0.57	0.335	1.780	0.53	181.58	1.092	198.353		0.68	74	
74.147	9	Sand	317.212	2.493	4.397	2.00139	2.926	1.83	0.5332	0.57	0.335	1.830	0.53	169.14	1.129	190.988		0.69	75	
74.475	7	Silty Sand to Sandy Silt	148.577	3.12	4.416	2.01162	2.935	2.36	0.53204	0.57	0.334	2.360	0.53	79.05	2.156	170.463		0.79	76	
74.803	6	Sandy Silt to Clayey Silt	59.495	1.723	4.435	2.02185	2.944	2.79	0.53089	0.57	0.334							0.81	77	
75.131	7	Silty Sand to Sandy Silt	42.329	0.543	4.454	2.03209	2.953	2.74	0.52974	0.57	0.334							0.81	78	
75.459	6	Sandy Silt to Clayey Silt	34.419	0.585	4.473	2.04232	2.961	2.9	0.52872	0.57	0.333							0.80	79	
75.787	6	Sandy Silt to Clayey Silt	29.776	0.443	4.492	2.05255	2.97	2.94	0.52758	0.56	0.333							0.80	80	
76.115	7	Silty Sand to Sandy Silt	31.292	0.431	4.511	2.06279	2.979	2.9	0.52644	0.56	0.332							0.80	81	
76.444	7	Silty Sand to Sandy Silt	31.593	0.413	4.531	2.07305	2.988	2.88	0.52531	0.56	0.332							0.80	82	
76.772	7	Silty Sand to Sandy Silt	31.414	0.452	4.55	2.08329	2.997	2.91	0.52418	0.56	0.332							0.80	83	
77.1	7	Silty Sand to Sandy Silt	32.008	0.455	4.569	2.09352	3.006	2.9	0.52306	0.56	0.331							0.80	84	
77.428	7	Silty Sand to Sandy Silt	37.526	0.58	4.589	2.10375	3.015	2.84	0.52195	0.56	0.331							0.80	85	
77.756	6	Sandy Silt to Clayey Silt	38.467	0.686	4.607	2.11399	3.024	2.87	0.52083	0.56	0.331							0.80	86	
78.084	6	Sandy Silt to Clayey Silt	38.486	0.694	4.626	2.12422	3.033	2.87	0.51973	0.56	0.330							0.80	87	
78.412	6	Sandy Silt to Clayey Silt	34.324	0.63	4.645	2.13445	3.041	2.93	0.51875	0.55	0.330							0.80	88	
78.74	6	Sandy Silt to Clayey Silt	31.038	0.485	4.664	2.14469	3.05	2.94	0.51765	0.55	0.330							0.80	89	
79.068	6	Sandy Silt to Clayey Silt	30.595	0.471	4.683	2.15492	3.058	2.95	0.51667	0.55	0.329							0.80	90	
79.396	6	Sandy Silt to Clayey Silt	30.416	0.536	4.701	2.16516	3.067	2.98	0.51558	0.55	0.329							0.80	91	
79.724	5	Clayey Silt to Silty Clay	34.39	1.175	4.72	2.17539	3.075	3.08	0.51462	0.55	0.329							0.80	92	
80.052	7	Silty Sand to Sandy Silt	112.163	3.204	4.739	2.18562	3.084	2.57	0.51354	0.55	0.328	2.570	0.51	57.60	3.148	181.323		0.80	93	
80.381	8	Sand to Silty Sand	249.864	4.524	4.759	2.19589	3.094	2.16	0.51234	0.55	0.328	2.160	0.51	128.02	1.574	201.531		0.72	94	
80.709	8	Sand to Silty Sand	263.745	5.338	4.779	2.20612	3.104	2.18	0.51115	0.55	0.328	2.180	0.51	134.81	1.619	218.286		0.72	95	
81.037	7	Silty Sand to Sandy Silt	242.453	6.765	4.798	2.21635	3.113	2.31	0.51009	0.54	0.327	2.310	0.51	123.67	1.981	245.023		0.73	96	
81.365	8	Sand to Silty Sand	275.713	6.447	4.818	2.22659	3.122	2.21	0.50902	0.54	0.327	2.210	0.51	140.34	1.692	237.409		0.71	97	
81.693	9	Sand	415.966	4.835	4.839	2.23682	3.132	1.87	0.50785	0.54	0.327	1.870	0.51	211.25	1.162	245.435		0.64	98	
82.021	9	Sand	490.565	5.769	4.859	2.24706	3.143	1.82	0.50656	0.54	0.326	1.820	0.51	248.50	1.122	278.698		0.63	99	
82.349	9	Sand	437.53	7.16	4.879	2.25729	3.153	1.96	0.5054	0.54	0.326	1.960	0.51	221.13	1.251	276.653		0.64	100	
82.677	12	Sand to Clayey Sand	322.203	9.853	4.899	2.26752	3.162	2.26	0.50436	0.54	0.326	2.260	0.50	162.50	1.827	296.861		0.69	101	
83.005	11	Sitff Fine-Grained	229.42	10.018	4.921	2.27776	3.173	2.47	0.50309	0.54	0.326	2.470	0.50	115.42	2.621	302.547		0.79	102	
83.333	8	Sand to Silty Sand	378.139	6.617	4.94	2.28799	3.183	2.03	0.50194	0.54	0.325	2.030	0.50	189.80	1.341	254.565		0.66	103	
83.661	9	Sand	409.948	4.871	4.961	2.29822	3.193	1.89	0.5008	0.54	0.325	1.890	0.50	205.30	1.180	242.166		0.64	104	
83.99	9	Sand	310.404	4.72	4.981	2.30849	3.203	2.05	0.49966	0.54	0.325	2.050	0.50	155.10	1.371	212.645		0.69	105	
84.318	9	Sand	239.628	3.328	5.002	2.31872	3.213	2.11	0.49853	0.53	0.324	2.110	0.50	119.46	1.473	175.986		0.72	106	
84.646	8	Sand to Silty Sand	210.247	3.058	5.021	2.32896	3.223	2.17	0.4974	0.53	0.324	2.170	0.50	104.58	1.596	166.944		0.74	107	
84.974	8	Sand to Silty Sand	206.217	3.051	5.041	2.33919	3.233	2.18	0.49628	0.53	0.324	2.180	0.50	102.34	1.619	165.707		0.74	108	
85.302	9	Sand	222.866	1.711	5.062	2.34942	3.243	1.99	0.49516	0.53	0.324	1.990	0.50	110.35	1.287	142.044	0.35	0.72	109	1.07
85.63	8	Sand to Silty Sand	136.995	2.382	5.081	2.35966	3.252	2.38	0.49416	0.53	0.323	2.380	0.49	67.70	2.233	151.140	0.40	0.79	110	1.24
85.958	7	Silty Sand to Sandy Silt	140.423	2.71	5.101	2.36989	3.261	2.4	0.49316	0.53	0.323	2.400	0.49	69.25	2.312	160.135		0.79	111	
86.286	10	Gravelly Sand to Sand	355.717	2.447	5.122	2.38012	3.272	1.79	0.49195	0.53	0.323	1.790	0.49	174.99	1.099	192.397		0.65	112	
86.614	10	Gravelly Sand to Sand	330.066	2.167	5.143	2.39036	3.283	1.81	0.49074	0.53	0.323	1.810	0.49	161.98	1.114	180.445		0.66	113	
86.942	9	Sand	262.181	1.489	5.163	2.40059	3.293	1.86	0.48965	0.53	0.322	1.860	0.49	128.38	1.153	148.063	0.38	0.70	114	1.19
87.27	8	Sand to Silty Sand	158.785	2.288	5.183	2.41082	3.303	2.28	0.48856	0.53	0.322	2.280	0.49	77.58	1.886	146.322	0.37	0.77	115	1.15
87.598	6	Sandy Silt to Clayey Silt	60.163	1.867	5.202	2.42106	3.311	2.85	0.4877	0.53	0.322							0.79	116	
87.927	6	Sandy Silt to Clayey Silt	44.739	0.993	5.22	2.43132	3.32	2.89	0.48673	0.52	0.322							0.79	117	
88.255	6	Sandy Silt to Clayey Silt	60.522	1.416	5.239	2.44156	3.328	2.78	0.48587	0.52	0.321							0.79	118	
88.583	6	Sandy Silt to Clayey Silt	56.397	1.42	5.258	2.45179	3.337	2.83	0.4849	0.52	0.321							0.79	119	
88.911	6	Sandy Silt to Clayey Silt	42.149	0.901	5.277	2.46202	3.345	2.92	0.48405	0.52	0.321							0.79	120	
89.239	6	Sandy Silt to Clayey Silt	34.898	0.693	5.296	2.47226	3.354	2.99	0.48309	0.52	0.321							0.79	121	
89.567	6	Sandy Silt to Clayey Silt	31.151	0.583	5.314	2.48249	3.362	3.03	0.48224	0.52	0.321							0.78	122	
89.895	7	Silty Sand to Sandy Silt	33.269	0.413	5.334	2.49272	3.372	2.91	0.48119	0.52	0.321							0.78	123	
90.223	7	Silty Sand to Sandy Silt	34.795	0.363	5.353	2.50296	3.381	2.85	0.48024	0.52	0.320							0.78	124	
90.551	7	Silty Sand to Sandy Silt	32.742	0.46	5.372	2.51319	3.39	2.95	0.4793	0.52	0.320							0.78	125	
90.879	6	Sandy Silt to Clayey Silt	30.84	0.448	5.391	2.52342	3.398	2.99	0.47847	0.52	0.320							0.78	126	
91.207	7	Silty Sand to Sandy Silt	29.861	0.401	5.41	2.53366	3.407	2.99	0.47753	0.52	0.320							0.78	127	
91.535	7	Silty Sand to Sandy Silt	30.51	0.347	5.43	2.54389	3.416	2.94	0.4766	0.52	0.320							0.78	128	
91.864	7	Silty Sand to Sandy Silt	32.676	0.447	5.449	2.55416	3.426	2.95	0.47557	0.51	0.319							0.78	129	
92.192	6	Sandy Silt to Clayey Silt	37.469	0.868	5.468	2.56439	3.434	3	0.47475	0.51	0.319							0.78	130	
92.52	7	Silty Sand to Sandy Silt	59.721	1.248	5.487	2.57462	3.443	2.77	0.47383	0.51	0.319							0.78	131	
92.848	7	Silty Sand to Sandy Silt	54.721	0.937	5.506	2.58486	3.452	2.76	0.47291	0.51	0.319							0.78	132	
93.176	6	Sandy Silt to Clayey Silt	32.846	0.588	5.525	2.59509	3.461	3.01	0.472	0.51	0.319							0.78	133	
93.504	6	Sandy Silt to Clayey Silt	29.475	0.449	5.544	2.60532	3.469	3.03	0.47119	0.51	0.319							0.78	134	

LIQUEFACTION POTENTIAL ANALYSIS (per Youd & Idriss, 2001)

PROJECT NAME	***Route 112/880 Separation (Replace)***	*FAULT INFO*	
PROJECT NO.	***206139.DAV***	*COAST RANGE - SIERRAN BLOCK BOUNDARY ZONE (CSB)*	
CPT NO.	***CPT-DV1***	a_{max} *(g)=* 0.6	*FAULT* M_w *=* 7.5
			MSF = 1.00

		CPT RESULT INPUT								*CSR*		*CRR 7.5*						*F.S.=(CRR 7.5/CSR)*MSF*K σ*K α*		
Depth (ft)		Soil Behavior Type	qc (tsf)	fs (tsf)	σ_v (tsf)	u (tsf)	σ_v' (tsf)	Ic*	C_N*	γ_d	CSR	Ic	C_Q	q_{c1N}	K_C	$(q_{c1N})_{cs}$	$CRR_{7.5}$	Kσ	Kα	F.S.
93.832	6	Sandy Silt to Clayey Silt	28.683	0.405	5.563	2.61556	3.478	3.03	0.47029	0.51	0.319							0.78	135	
94.16	7	Silty Sand to Sandy Silt	30.435	0.371	5.582	2.62579	3.487	2.97	0.46938	0.51	0.318							0.78	136	
94.488	7	Silty Sand to Sandy Silt	30.313	0.361	5.601	2.63603	3.496	2.97	0.46848	0.51	0.318							0.78	137	
94.816	7	Silty Sand to Sandy Silt	29.908	0.398	5.621	2.64626	3.505	3	0.46759	0.51	0.318							0.78	138	
95.144	6	Sandy Silt to Clayey Silt	30.567	0.451	5.64	2.65649	3.514	3.01	0.46669	0.51	0.318							0.78	139	
95.472	7	Silty Sand to Sandy Silt	32.262	0.407	5.659	2.66673	3.523	2.95	0.46581	0.51	0.318							0.78	140	
95.801	7	Silty Sand to Sandy Silt	33.514	0.448	5.678	2.67699	3.532	2.94	0.46492	0.51	0.318							0.78	141	
96.129	7	Silty Sand to Sandy Silt	33.1	0.459	5.698	2.68722	3.541	2.96	0.46404	0.51	0.317							0.78	142	

APPENDIX C-3

EMBANKMENT SETTLEMENT & STABILITY EVALUATION

SETTLEMENT ANALYSIS *** DAVIS STREET OC -ROUTE 880, SANTA CLARA COUNTY ** **APPROACH EMBANKMENTS (TYPICAL)** 09/27/09

LOCATION: APPROACH EMBANKMENTS FOR THE BRIDGE

Height of fill = 23 ft
Width of fill = 60 ft
Fill Density = 130 pcf

Based on reference Borings DV-2, CPT DV-1 & E-24
The new embankment is about 60 ft wide abutting existing fill.

- The undrained shear strength (Su) is correlated with SPT-N values based on Terzaghi and Peck (1967), and NAVFAC DM-7.1 (1982).
- Approximate estimation of preconsolidation pressure is based on Su/P ratio per Skempton (1957 and NAVFAC DM-7.1 (1982).
- The modified compression index (Cc/1+e0) is correlated with natural moisture content based on Lambe and Whitman (1969).
- The recompression index is adopted as 20% of the virgin compression index per lab data & literature.
- The applied pressure is estimated from 2V:1H distribution of the embankment load.

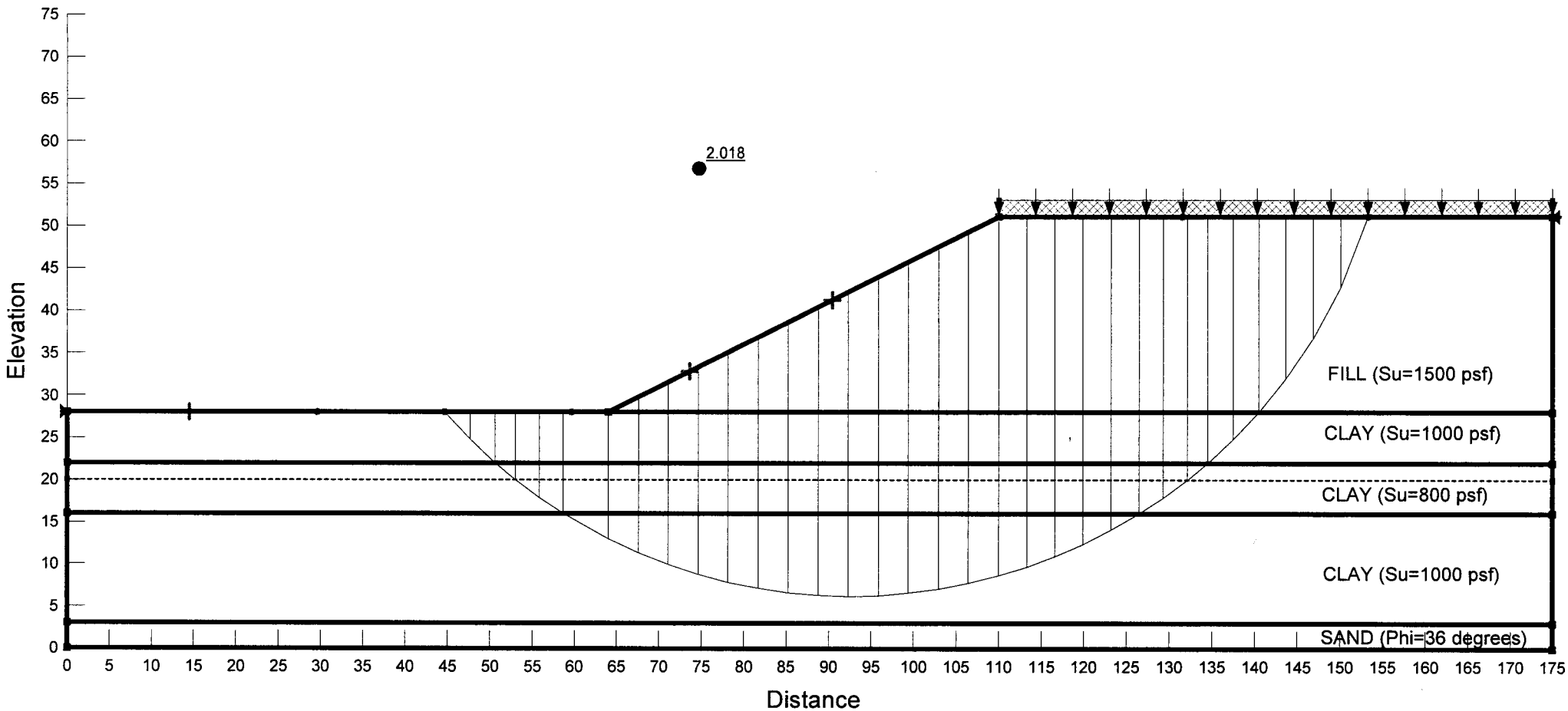
DEPTH FROM	TO	EFFECTIVE UNIT WEIGHT(pcf) (psf)	WEIGHT OF LAYER (psf)	MIDLAYER EFFECTIVE OVERBURDEN PRESSURE (psf)	APPLIED PRESSURE (psf)	UNDRAINED SHEAR STRENGTH (psf)	PRECONSO-LIDATION PRESSURE (psf)	NATURAL WATER CONTENT (%)	MODIFIED VIRGIN COM-PRESSION INDEX	MODIFIED RECOM-PRESSION INDEX	CONSOLIDATION SETTLEMENTS (in.) OC	NC	SUM
			0										
0	3	120	360	180	2917	1000	4000	15	0.0563	0.0113	0.50	0.00	0.50
3	6	120	360	540	2781	1000	4000	15	0.0563	0.0113	0.32	0.00	0.32
6	12	58	348	894	2600	800	3200	27	0.1309	0.0262	1.04	0.36	1.40
12	17	58	290	1213	2408	1000	4000	32	0.1645	0.0329	0.94	0.00	0.94
17	22	58	290	1503	2257	1000	4000	21	0.0910	0.0182	0.43	0.00	0.43
22	25	58	174	1735	2149	1000	4000	23	0.1041	0.0208	0.26	0.00	0.26
25	30	58	290	1967	2050	1875			(sand layer)				
30	36	58	348	2286	1929	1875							
36	39	58	174	2547	1840	2000	8000	22	0.0975	0.0195	0.17	0.00	0.17
39	42	58	174	2721	1785	2000	8000	18	0.0725	0.0145	0.11	0.00	0.11
42	45	58	174	2895	1733	3750							
45	50	58	290	3127	1669	3750			(sand layer)				
50	55	58	290	3417	1595	3750							
55	60	58	290	3707	1527	3750							

	OC	NC	SUM
TOTAL SETTLEMENT (IN.) =	3.78	0.36	4.14

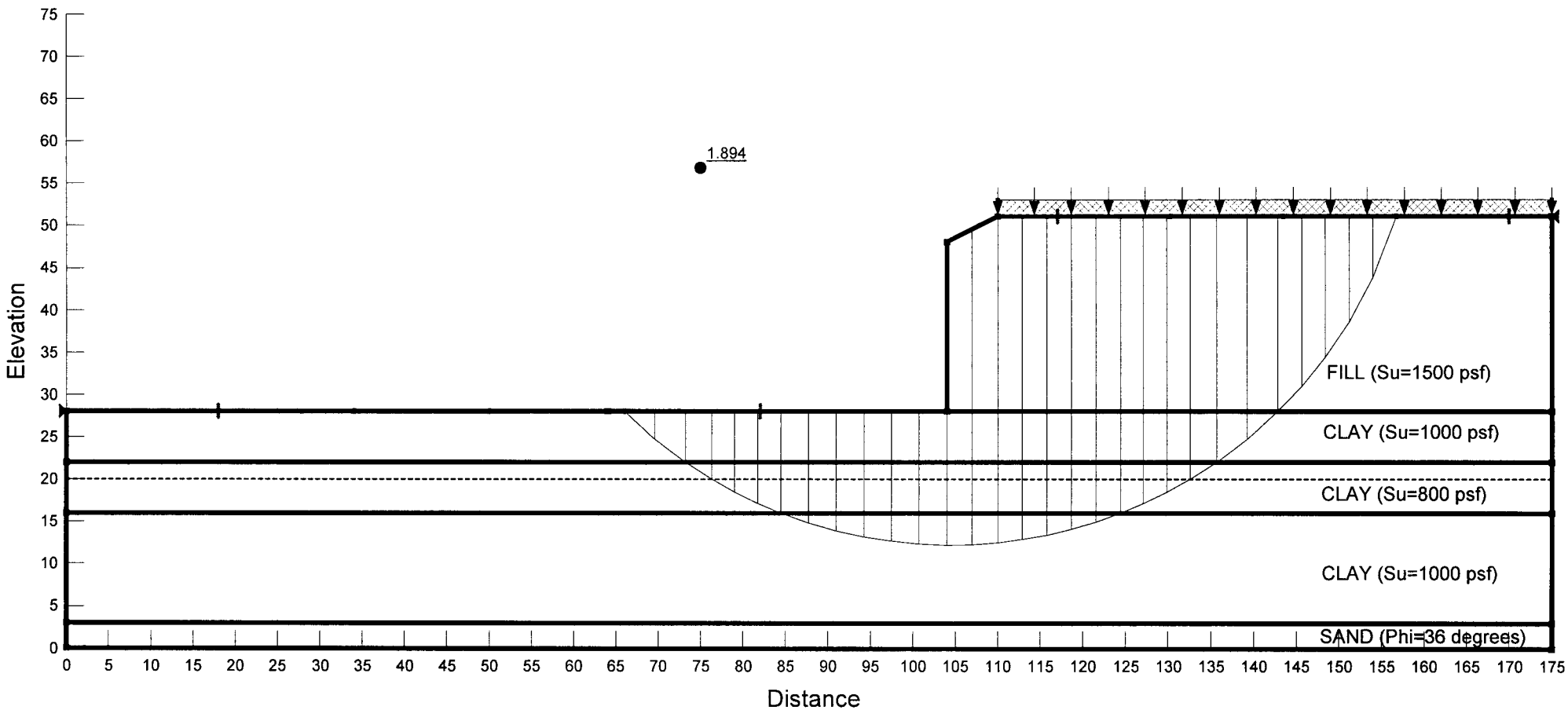
O.C. RANGE SETTLEMENT = 3.78 INCHES
N.C. RANGE SETTLEMENT = 0.36 INCHES

Majority of the settlement is in the overconsolidated/elastic range.

ROUTE 112/880 SEPARATION (REPLACE) - EMBANKMENT STABILITY



ROUTE 112/880 SEPARATION (REPLACE) - GLOBAL STABILITY (NORTHEAST QUADRANT)



APPENDIX C-4

LPILE ANALYSES

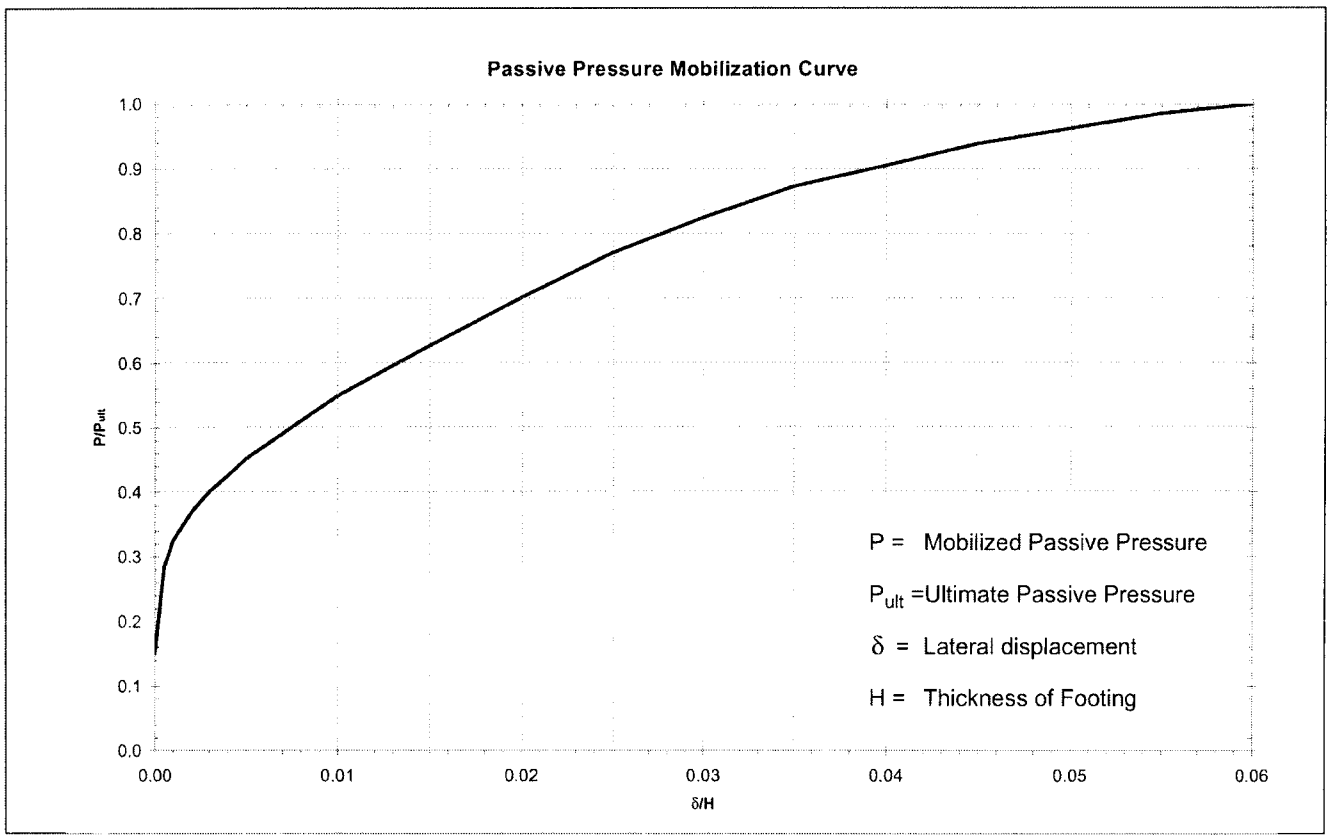


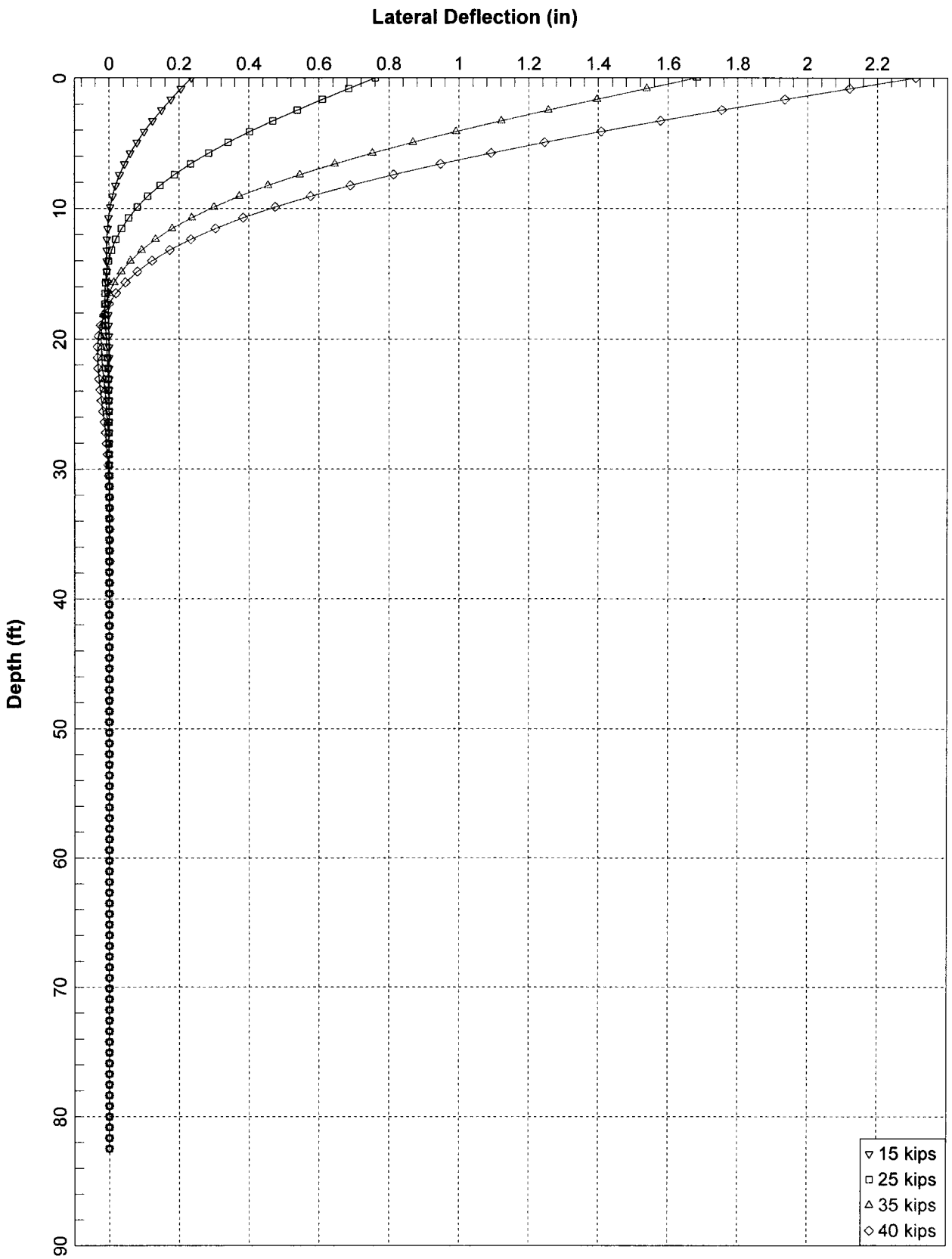
Figure 4-6 ***Passive Pressure Mobilization Curve***

Reference: Chapter 4, Foundation and Geologic Site Hazards, FEMA 356, November 2000

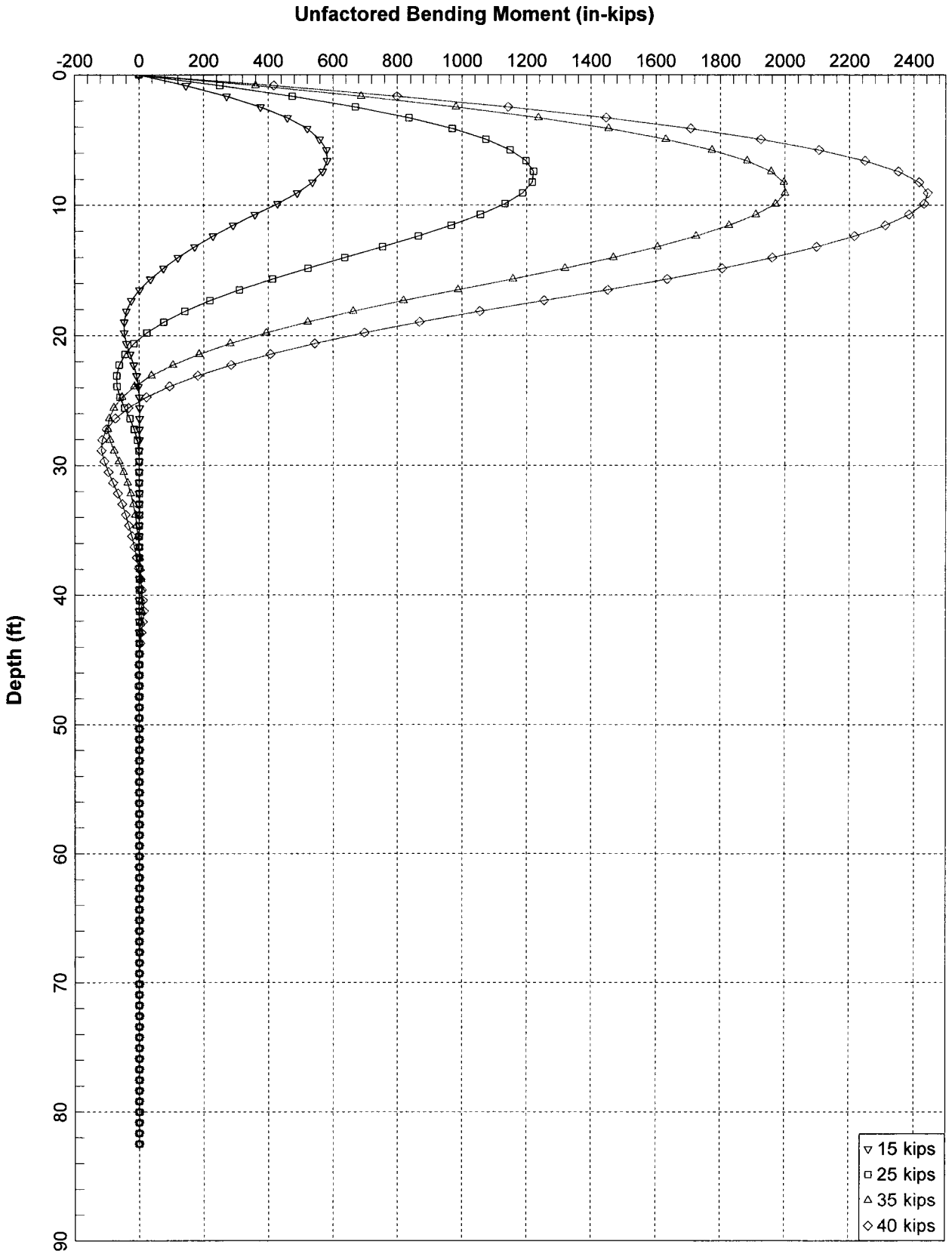
For Route 112/880 Separation (Replace), the recommened passive resistance against the vertical side of the pile caps is 3 ksf. This is a uniformly distributed resistance for seismic & ultimate condition.

PASSIVE PRESSURE MOBILIZATION AGAINST PILE CAPS

PARIKH *Practicing in the Geosciences*	**ROUTE 112/880 SEPARATION (REPLACE) ALAMEDA COUNTY, CALIFORNIA**	
	JOB NO.: 206139.10	**Plate No.**



ROUTE 112/880 SEPARATION (REPLACE) (ABUTMENTS)



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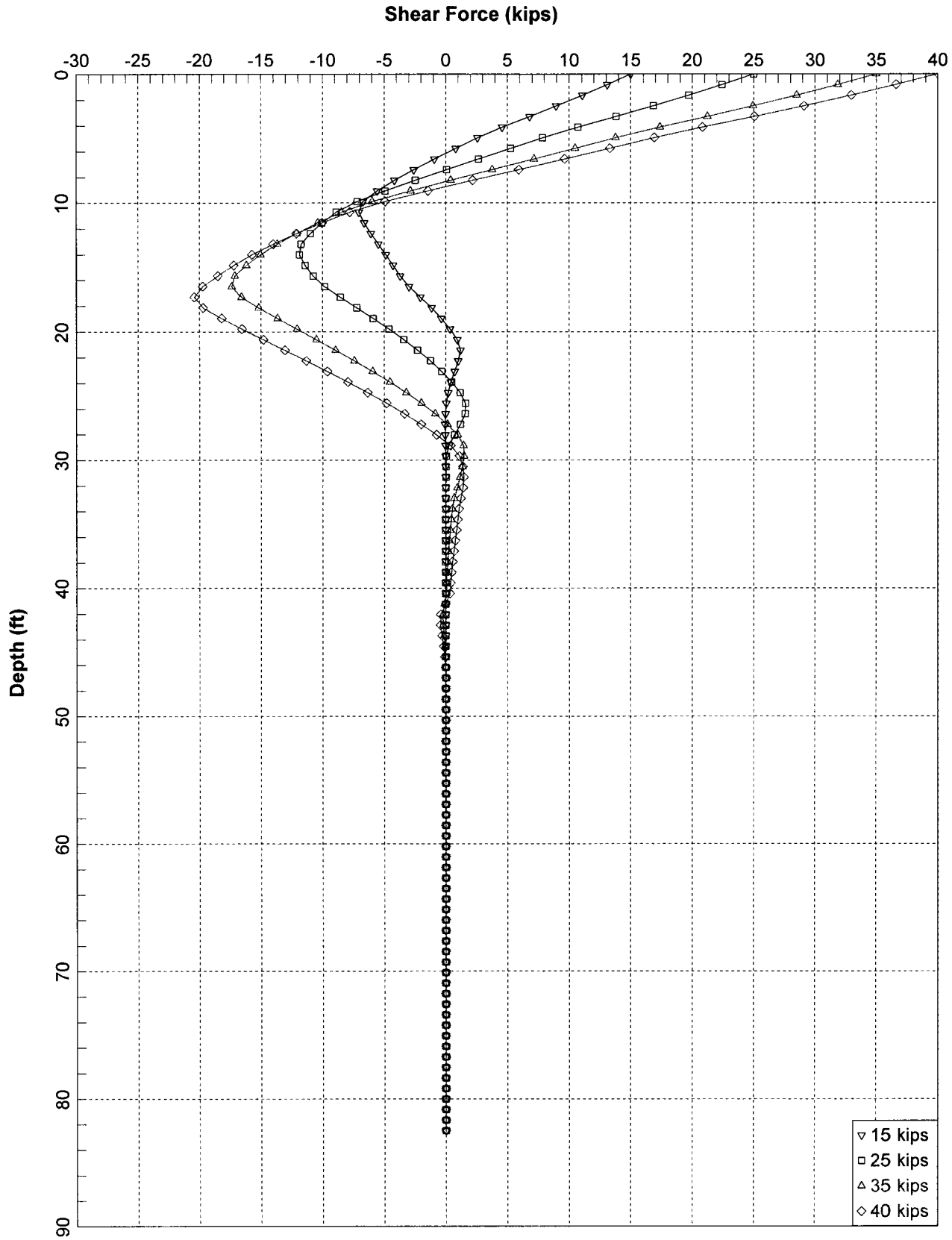

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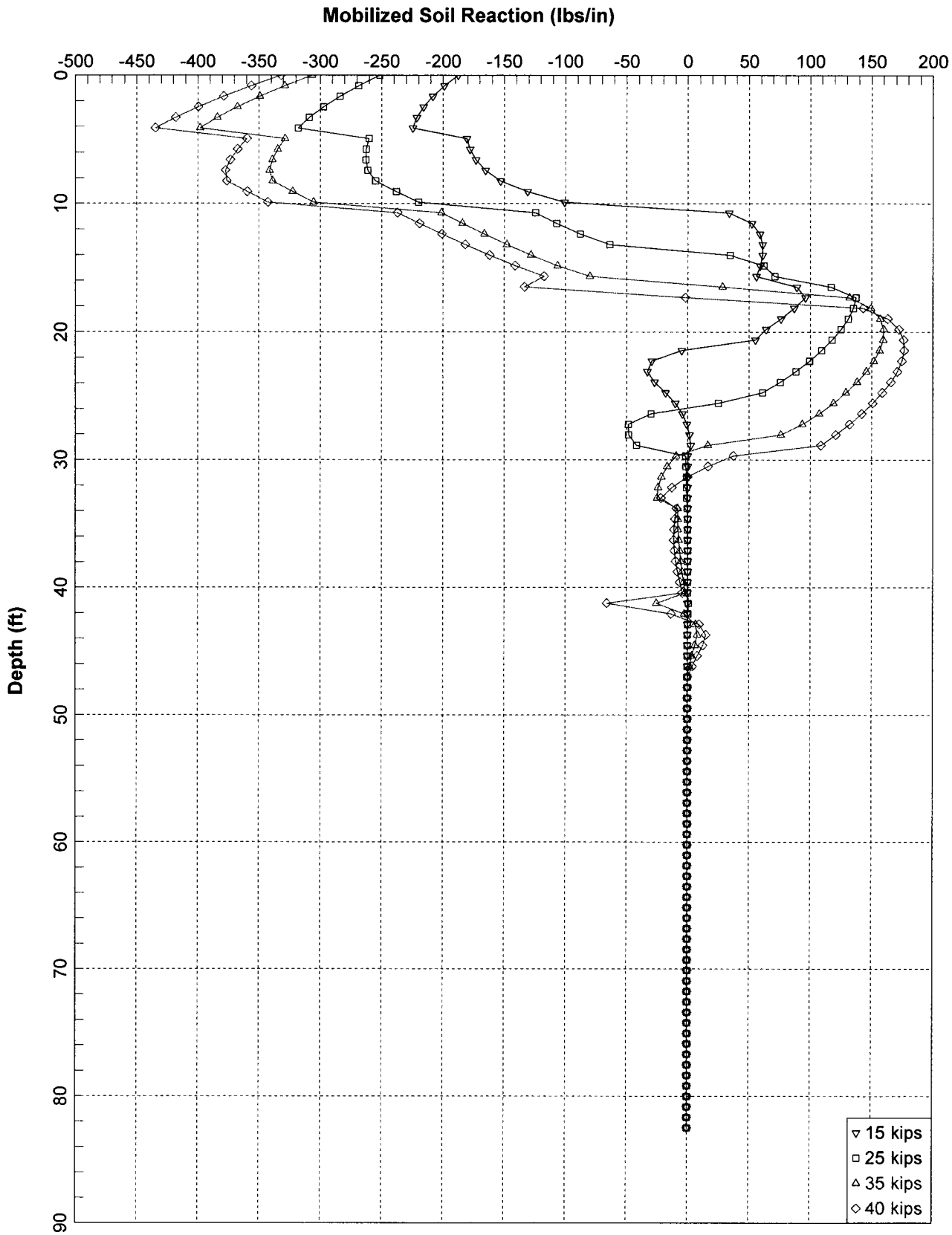

ROUTE 112/880 SEPARATION (REPLACE) (ABUTMENTS)

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LPILEP5
Route 112/880 Separation (Replace) (Abutments)
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100     2       -24     990     0
0       16      731     24.35   30000000
990     16      731     24.35   30000000
12      24      24      0       2
3       -24     54      0       0
3       54      126     0       0
1       126     150     0       0
1       150     198     0       0
3       198     354     0       0
4       354     402     125     125
10      402     486     0       0
3       486     558     0       0
4       558     774     125     125
3       774     834     0       0
4       834     954     125     125
3       954     990     0       0
-24     0.072
54      0.072
54      0.072
126     0.072
126     0.072
150     0.072
150     0.036
198     0.036
198     0.036
354     0.036
354     0.036
402     0.036
402     0.036
486     0.036
486     0.036
558     0.036
558     0.036
774     0.036
774     0.036
834     0.036
834     0.036
954     0.036
954     0.036
990     0.036
-24     10.416667       0       0.007   0
54      10.416667       0       0.007   0
54      6.9444444       0       0.007   0
126     6.9444444       0       0.007   0
126     5.5555556       0       0.01    0
150     5.5555556       0       0.01    0
150     5.5555556       0       0.01    0
198     5.5555556       0       0.01    0
198     6.9444444       0       0.007   0
354     6.9444444       0       0.007   0
354     0       36      0       0
402     0       36      0       0
402     0       0       0       0
486     0       0       0       0
486     13.888889       0       0.007   0
558     13.888889       0       0.007   0
558     0       36      0       0
774     0       36      0       0
774     20.833333       0       0.005   0
834     20.833333       0       0.005   0
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834     0       36      0       0
954     0       36      0       0
954     20.833333       0       0.005   0
990     20.833333       0       0.005   0
0       0.6     1
990     0.6     1
0       1       1
4
1       15000   0       200000
1       25000   0       200000
1       35000   0       200000
1       40000   0       200000
0
1       1       0
100     1E-5    100
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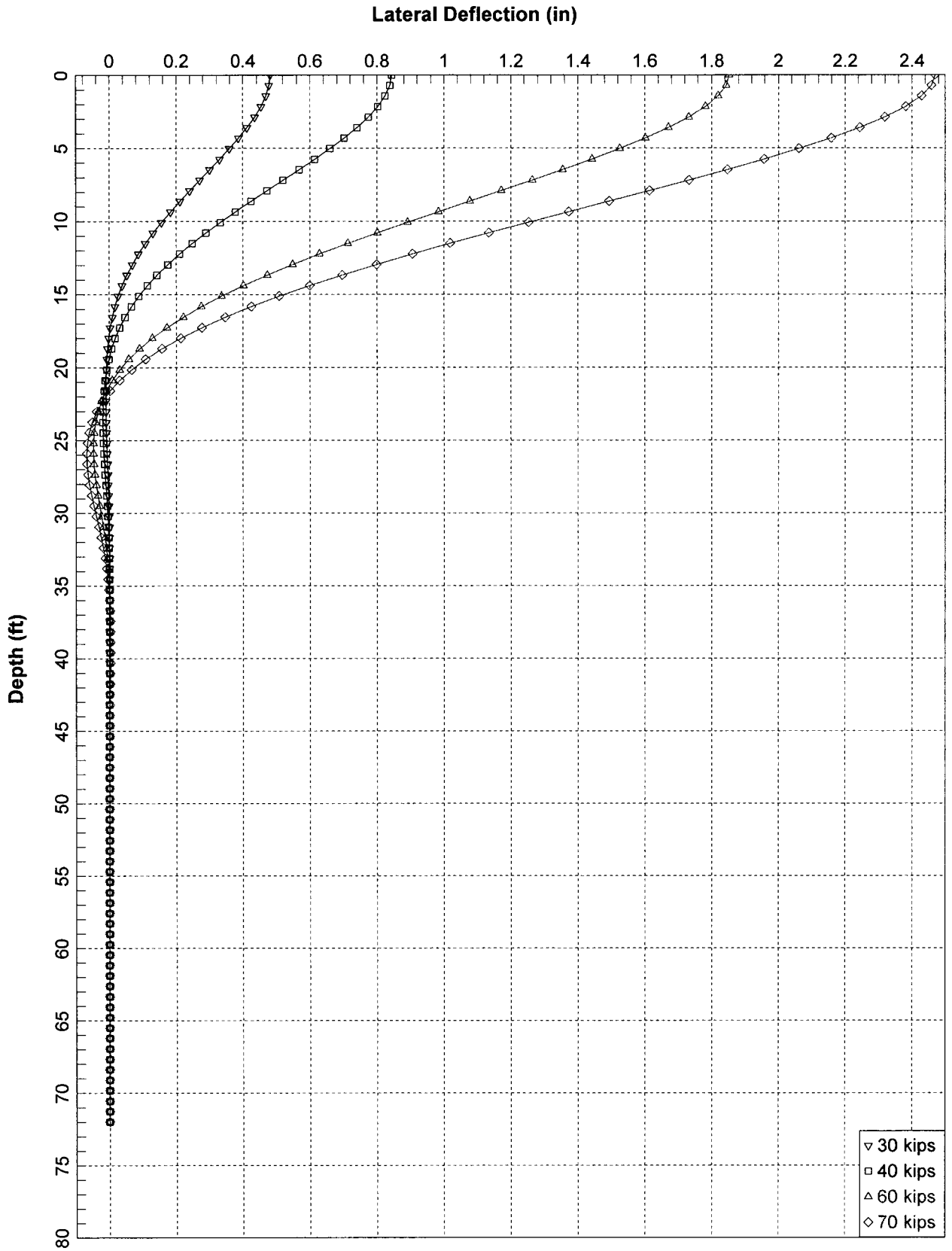
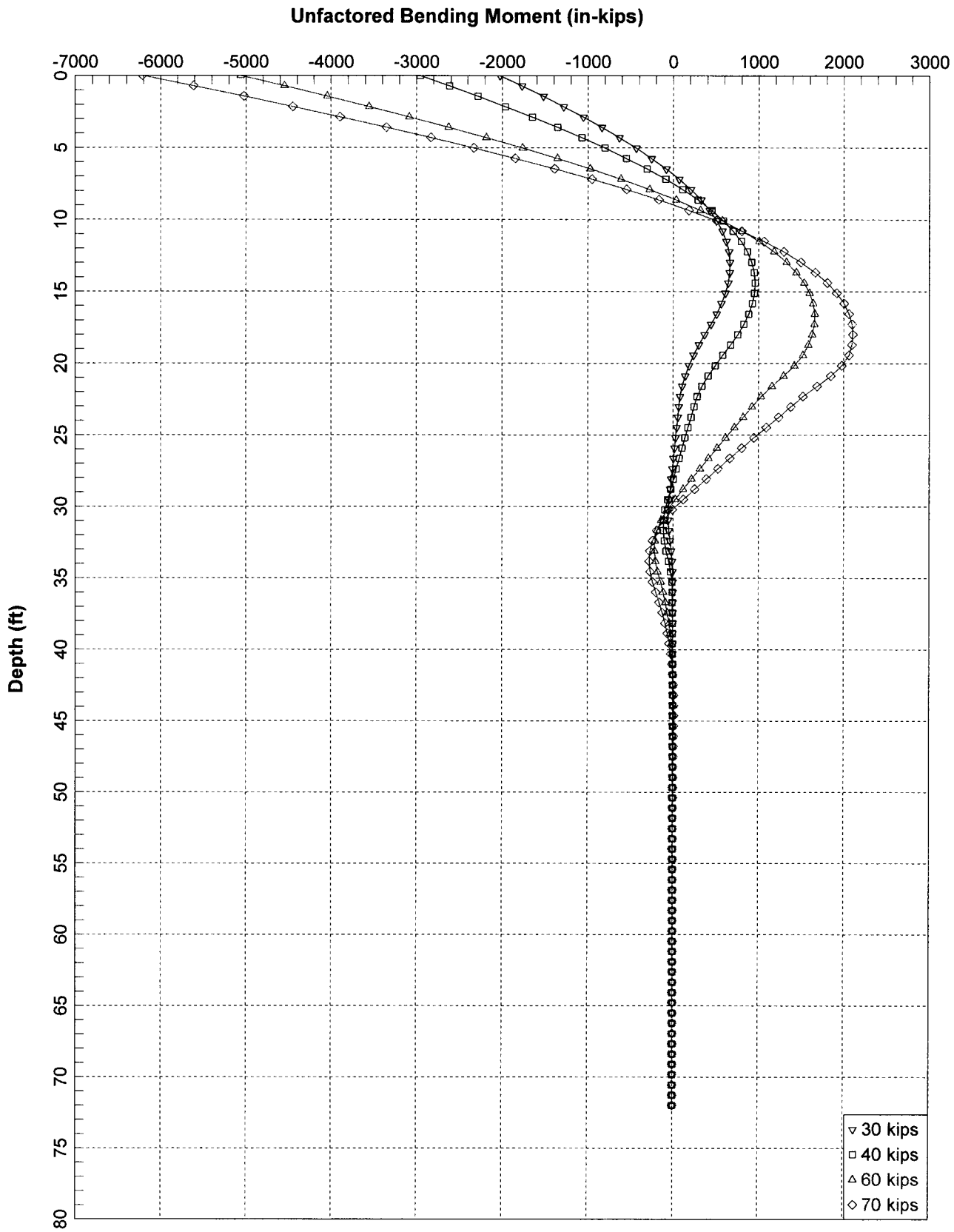


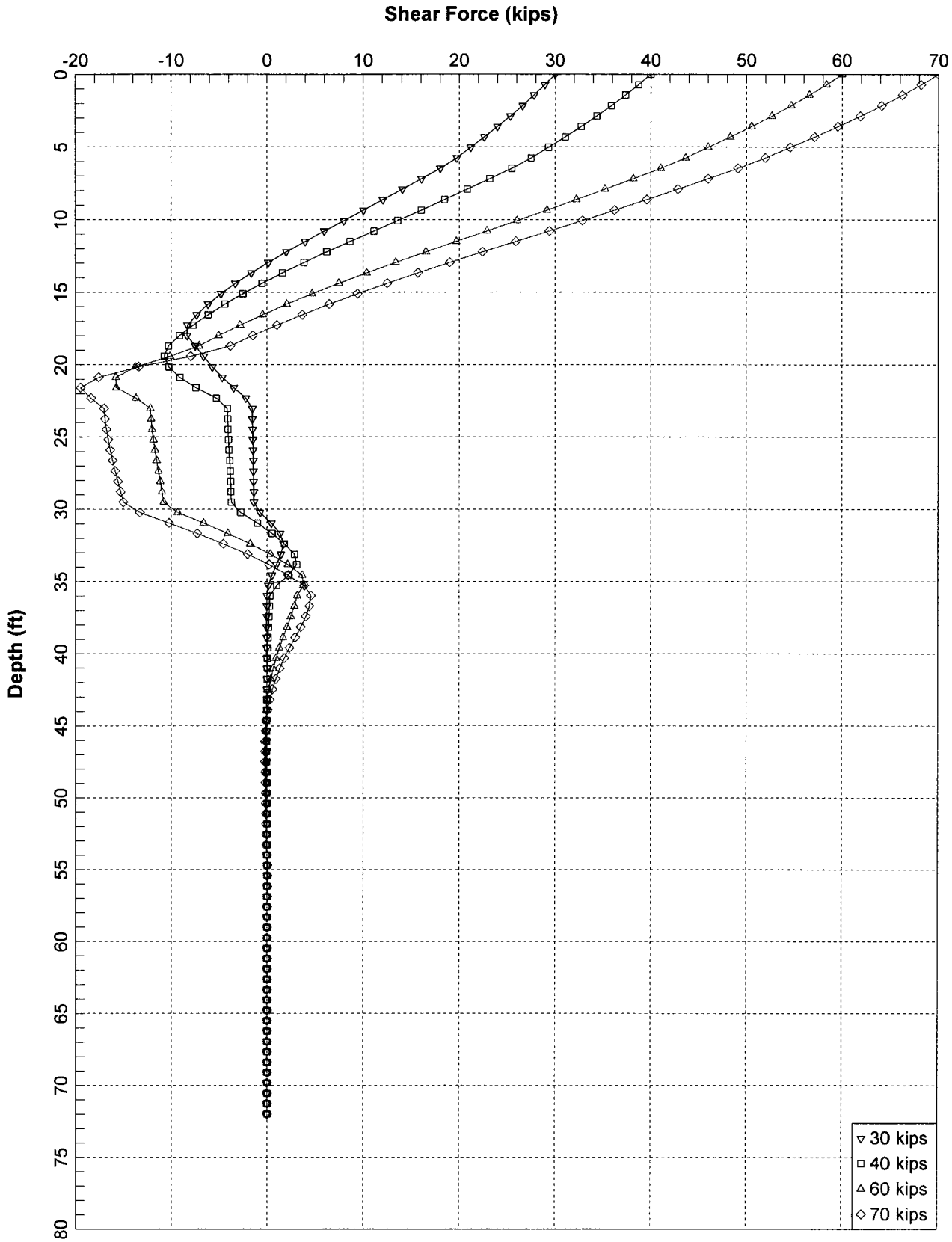
ROUTE 112/880 SEPARATION (REPLACE) (BENT)

1/6



ROUTE 112/880 SEPARATION (REPLACE) (BENT)

2/6



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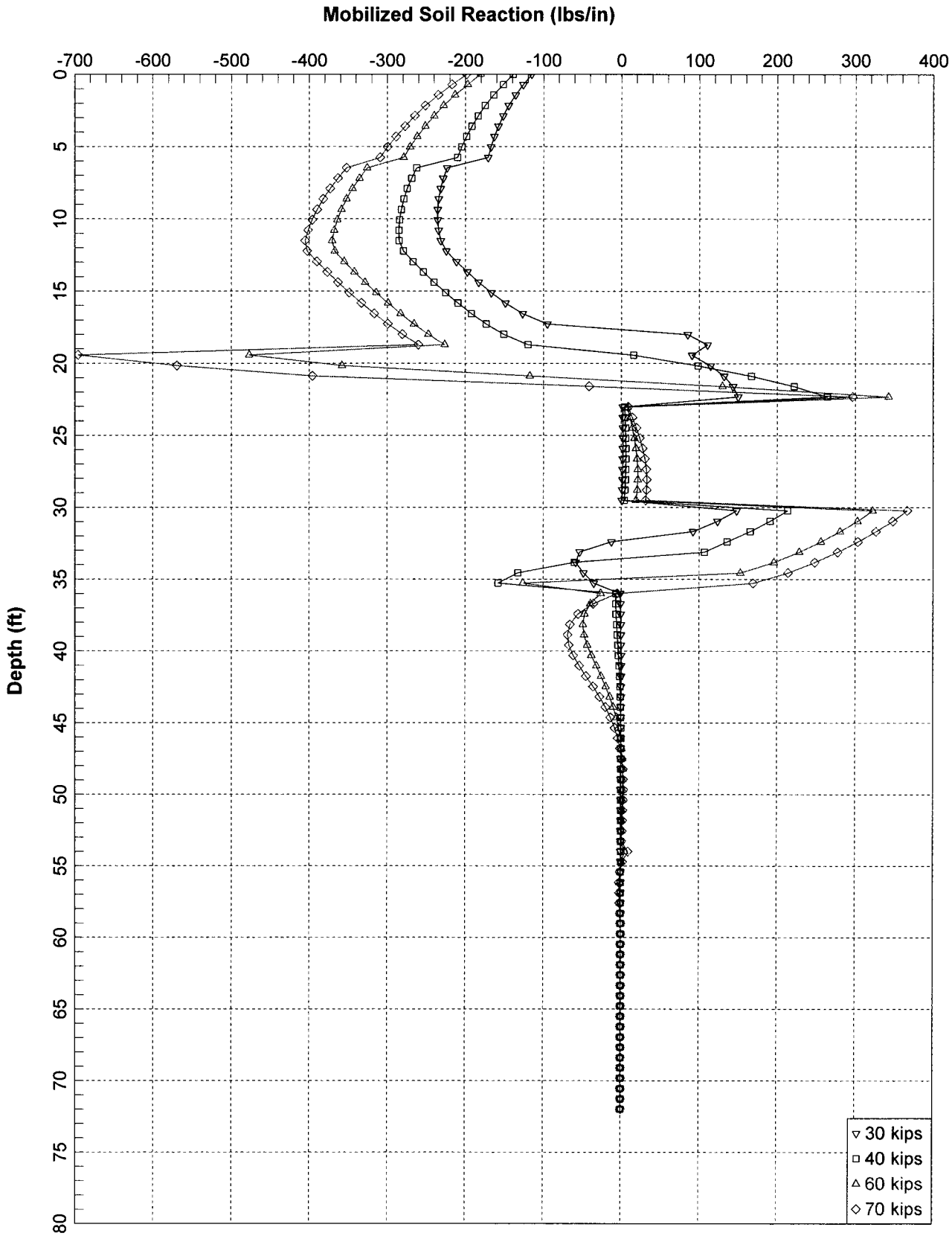

ROUTE 112/880 SEPARATION (REPLACE) (BENT)

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Route 112/880 Separation (Replace) (Bent)
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0       16      731     24.35   30000000
864     16      731     24.35   30000000
10      20      20      0       2
1       -24     24      0       0
1       24      72      0       0
3       72      228     0       0
4       228     276     125     125
10      276     360     0       0
3       360     432     0       0
4       432     648     125     125
3       648     708     0       0
4       708     828     125     125
3       828     864     0       0
-24     0.072
24      0.072
24      0.036
72      0.036
72      0.036
228     0.036
228     0.036
276     0.036
276     0.036
360     0.036
360     0.036
432     0.036
432     0.036
648     0.036
648     0.036
708     0.036
708     0.036
828     0.036
828     0.036
864     0.036
-24     5.5555556       0       0.01    0
24      5.5555556       0       0.01    0
24      5.5555556       0       0.01    0
72      5.5555556       0       0.01    0
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228     6.9444444       0       0.007   0
228     0       36      0       0
276     0       36      0       0
276     0       0       0       0
360     0       0       0       0
360     13.888889       0       0.007   0
432     13.888889       0       0.007   0
432     0       36      0       0
648     0       36      0       0
648     20.833333       0       0.005   0
708     20.833333       0       0.005   0
708     0       36      0       0
828     0       36      0       0
828     20.833333       0       0.005   0
864     20.833333       0       0.005   0
0       0.6     1
864     0.6     1
0       1       1
4
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2       40000   0       200000
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5/6

```
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2       70000   0       200000
0
1       1       0
100     1E-5    100
```

APPENDIX D

OSFP Review Comment & Response Form

General Project Information	Review Phase		Reviewer Information
Dist: 04 EA: 3A9201 **Project Name: Route 112/880 Separation (Replace)** **OSFP Liaison: Yiwei Hu** **Phone: 916-227-8917** **e-mail: Yiwei hu@dot.ca.gov**	☐ PSR/PDS (Review No. _) ☐ APS/PSR (Review No. _) ☐ APS/PR (Review No. _) ☐ Type Selection	☐ 65% PS&E Unchecked Details ☐ PS&E (Review No. _) ☐ Construction Support ☒ Other: FR	**Reviewer Name: R. Nashed** **Functional Unit: GS-GDW** **Phone Number: (510)266-1773** **e-mail: rifaat.nashed@dot.ca.gov** **Date of Review: 7/26/2011**
	Structure Information (Use when necessary to document comments by individual structure) **Structure Name: Route 112/880 Separation (Replace)** **Br No: 33-0736**		

Consultant Information (to be filled in by Consultant)

Consultant Structure Lead (First and Last Name)	Structure Consultant Firm	Phone Number	e-mail	Response Date

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	
1	Foundation Report (FR)	FR	Geotechnical Foundation Report for WMH Corporation, Oakland, by Parikh Consultant, Inc., dated May 20,2010.		
2	FR	**SUBSURFACE CONDITIONS** Page 4	Plate 2 (Site Plan) shows the location of borings are not included in the report such as borings No. E-24 and R-17, whereas As-built borings are not shown.	These borings were included in the GDMR; we have removed Borings E-24 and RW-17 from the site plan to avoid any confusion. As-built borings have been included on the Site Plan (Plate 2).	
3	FR	**APPENDIX A**	For Log Of Test borings, Sheet 1 of 3: 1- The bench mark is missing as required by Soil/Rock classification manual. 2- There is a contradict between the loose sand layers at elevation -1 to -8 and the blow counts are 19. Please explain.	1- The bench mark has been included in the Log of Test Boring. 2 –The SPT blow count is border line and the apparent density may be considered loose to medium dense due to some minor difference in different references of conversion factors adopted. Therefore, we have changed the apparent density to "loose to medium dense".	

Note 1: Abbreviations for Typical Documents (if Abbr. is not below, type in the document type)					
P=Structure Plans	SP=Special Provisions	FR=Foundation Rpt	DC=Design Calcs	TS=Type Sel. Report	QCC=Quant. Check Calcs
RP=Road Plans	E=Estimate	H=Hydraulics Rpt	CC=Check Calcs	QC=Quant. Calcs	

✓= Comment Resolved (for Reviewer's use)

Office of Special Funded Projects
Comment & Response Form

(Revised 10/21/09)

General Project Information (OSFP Liaison to complete)	Review Phase (OSFP Liaison to complete)	Reviewer Information (Reviewer Liaison to complete)
Dist: 04 **EA:** 3A9211 **Project Name: *:** Route 112/880 Separation (Replace) **OSFP Liaison:** Yiwei Hu **Phone:** 916-227-8917 **e-mail:** Yiwei_hu@dot.ca.gov	__ PSR/PDS (Review No.___ __ APS/PSR (Review No.) __X APS/PR (Review No.__1__) _ Type Selection __ 65% PS&E Unchecked Details __ PS&E (Review No.__ __ Construction __ Other:_____	**Reviewer Name:** John Moore **Functional Unit:** GS **Phone Number:** (510) 622-8742 **e-mail:** j_moore@dot.ca.gov **Date of Review:** 2/2/10 **Structure Name*:** Route 112/880 Separation (Replace) **Br No*:** 33-0736 (*Use if necessary to when comment sheets are by individual structure)

Consultant Information (to be filled in by Consultant)

Consultant Structure Lead (First and Last Name)	Structure Consultant Firm	Phone Number	e-mail	Response Date
	Biggs Cardosa Associates	408-296-5515		

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
1	Foundation Report (FR)	FR	Geotechnical Foundation Report prepared for WMH Corporation, Oakland, CA, by Parikh Consultants, Inc., San Jose, CA; dated November 16, 2009		
2	FR	Page 3	In the second paragraph of "Field Exploration and Laboratory Testing," it is stated that, "When correlating standard penetration data, the blow counts for the Modified California sampler may be converted to equivalent SPT blow counts by multiplying a factor of 0.65." Please explain and provide the basis for this statement.	A paper titled "A method for correlating large penetration test (LPT) to standard penetration test (SPT) blow counts" by Chris R. Daniel, John A. Howie and Alex Sy (Canadian Geotechnical Journal 40:66-77, 2003) is referenced for the correlation between Mod. California (MC) and SPT blow counts. Based on the correlation suggested in the paper, it is reasonable to use a conversion factor of 0.65. The derivation and the reference paper are attached. Additional	

Note 1: Abbreviations for Typical Documents (if Abbr. is not below, type in the document type)					
P=Structure Plans	SP=Special Provisions	FR=Foundation Rpt	DC=Design Calcs	TS=Type Sel. Report	QCC=Quant. Check Calcs
RP=Road Plans	E=Estimate	H=Hydraulics Rpt	CC=Check Calcs	QC=Quant. Calcs	

✓= Comment Resolved (for Reviewer's use)

				comparison of blow counts of different samplers in different soil type and consistency are discussed in Fig 1.24 of the Foundation Engineering Handbook, 2nd ed., edited by Hsai-Yang Fang, 1991, Van Nostrand Reinhold.	
3	FR	Page 3	In the fourth paragraph of "Field Exploration and Laboratory Testing," it is stated that, "The soil resistance exerted to the tip and side of the cone were recorded and correlated to soil type, classification and strength characteristics." When CPT data is used, soils are classified by "soil behavior type", not "soil type", correct? Which classification chart was used?	Concur. We have revised the wording to "soil behavior type" in the report. Based on Gregg's submittal (attached in Appendix A), the CPT graphic presentation is based on the 12-zone Soil Behavior Type (Robertson et al 1986).	
4	FR	Page 8	Regarding the paragraph ***Predrill Near Existing Utility***, the word "exiting" should be changed to "existing." Please proofread report before submitting it.	Correction made as noted.	
5	FR	Page 10	In the table "Foundation Recommendations for Abutments," LRFD is referred to in two columns. LRFD is not used for abutments	We understand that foundation design at abutment is based on WSD. The format of the Table follows that shown in Memo To Designers 3-1, Attachment1 (Example 1), July 2008.	
6	FR	Page 15	In the "Corrosion" section, the word "exiting" should be changed to "existing." Please proofread report before submitting it.	Correction made as noted.	
7	FR	Page 15	In the "Corrosion" section, Caltrans Corrosion design guidelines are referred to. Please state what those design guidelines are. Please include Caltrans criteria defining corrosive soils.	Concur. The criteria per Caltrans Corrosion Guidelines (September 2003) – chloride concentration is 500 ppm or greater, sulfate concentration is 2000 ppm or greater, or the pH is 5.5 or less, are stated in the report.	
8	FR	FR	This office has not yet received the structural plans for review but suggests that both the geotechnical designer and the structural designer insure that there is consistency between the Pile Data Table listed in the foundation report and Pile Data Table shown on the plans. Pile Data Table inconsistencies are a common occurrence with Parikh Consultants, Inc. reports.	Coordinated with the structural designer to verify the consistency of the Pile Data Table shown on the plans and in the report.	

CORRELATION BETWEEN MOD. CALIFORNIA SAMPLER & SPT SAMPLER BLOW COUNTS PER DANIEL, HOWIE & SY (2003)

REF: A METHOD FOR CORRELATING LARGE PENETRATION TEST (LPT) TO STANDARD PENETRATION TEST (SPT) BLOW COUNTS
- CHRIS DANIEL, JOHN HOWIE & ALEX SY
- CANADIAN GEOTECH JOURNAL 40: 66-77 (2003)

MODIFIED CALIFORNIA SAMPLER (MC) : OD = 3", ID = 2.416" (W/ RINGS)
STANDARD PENETRATION TEST SAMPLER (SPT) : OD = 2", ID = 1.375"
USE THE SAME HAMMER ASSEMBLAGE : 140 lb & 30" DROP

PER THE PUBLICATION, $\frac{(N_{60})_{SPT}}{(N_{60})_{MC}} = \frac{(A_{TE})_{SPT}}{(A_{TE})_{MC}}$

$A_{TE} = C_1 A_T + C_2 (ID+OD)\pi \cdot L \cdot R_f$

PER THE PUBLICATION, ASSUME $C_1 = C_2 = 1.0$,

$A_T = \pi/4 (OD^2 - ID^2)$ - SAMPLER TIP BEARING AREA

L = EMBEDMENT DEPTH OF THE SAMPLER, USE 12"

$R_f = f_s/q_c$ (CPT FRICTION SLEEVE STRESS / CPT TIP STRESS)

R_f = 0.35% TYPICAL FOR GRANULAR SOIL AS STATED IN THE PAPER

= 3% TYPICAL FOR CLAY SOIL PER OUR OBSERVATION OF CPT DATA.

	SPT	MC
$A_T = \pi/4 (OD^2 - ID^2)$	$\pi/4 (2^2 - 1.375^2) = 1.66$	$\pi/4 (3^2 - 2.416^2) = 2.484$
$(ID+OD)\pi \cdot L$	$(1.375+2)\cdot\pi\cdot 12 = 127.23$	$(2.416+3)\cdot\pi\cdot 12 = 204.2$
$A_{TE} = C_1 A_T + C_2 (ID+OD)\pi L \cdot R_f$	$1.66 + 127.23 R_f$	$2.484 + 204.2 R_f$
GRANULAR SOIL, R_f = 0.35%	$(A_{TE})_{SPT} = 2.10$	$(A_{TE})_{MC} = 3.20$
CLAY SOIL, R_f = 3%	$(A_{TE})_{SPT} = 5.48$	$(A_{TE})_{MC} = 8.61$

$\therefore$ SAND — $\frac{(N_{60})_{SPT}}{(N_{60})_{MC}} = \frac{2.10}{3.20} = 0.66$

CLAY — $\frac{(N_{60})_{SPT}}{(N_{60})_{MC}} = \frac{5.48}{8.61} = 0.64$

FOR PRACTICAL DESIGN, IT IS REASONABLE TO USE A CONVERSION FACTOR OF 0.65 FOR $(N_{60})_{SPT}/(N_{60})_{MC}$

A method for correlating large penetration test (LPT) to standard penetration test (SPT) blow counts

Chris R. Daniel, John A. Howie, and Alex Sy

Abstract: The standard penetration test (SPT) split-spoon sampler is too small for investigations in gravelly soils. For this reason, several researchers have developed scaled-up versions of the SPT, commonly referred to as "large penetration tests" (LPT), and attempted to correlate the measured blow counts to SPT blow counts. Several LPTs have been in use worldwide; each with different drill rods, sampler dimensions, and hammer energies; hence existing published LPT–SPT correlations differ for each system. This paper summarizes the LPT data in the literature and presents a fundamental method for predicting LPT–SPT correlations. The proposed method is based on wave equation analyses of SPT and LPT and considers variations in test equipment, penetration resistance, and energy. It is shown that the method provides a unified approach for assimilating the various published LPT–SPT correlations. Additional SPT and LPT data were collected at a sand research site to check the proposed method and to expand the LPT database. The observed and predicted correlation factors are shown to be in good agreement. The proposed correlation method will be useful as a logical framework for the comparison of LPT data collected throughout the world. Additional research will be required to extend this procedure to gravel sites.

Key words: large penetration test, LPT, fundamental correlation method, wave equation analysis, grain size effects.

Résumé : L'essai de pénétration standard (SPT) avec l'échantillonneur à cuillère fendue est à une échelle trop petite pour les études dans les sols graveleux. En conséquence, plusieurs chercheurs ont développé des versions de SPT à plus grande échelle, auxquelles on réfère communément sous le vocable de « grands essais de pénétration » (LPT), et ils ont tenté de mettre en corrélation les nombres de coups mesurés avec les nombres de coups du SPT. Plusieurs LPT ont été utilisés à travers le monde; chacun avec des tiges de forage, des dimensions d'échantillonneur et des énergies de marteau différentes; ainsi, les corrélations LPT–SPT existantes publiées diffèrent pour chaque système. Cet article résume les données des LPT disponibles dans la littérature et présente une méthode fondamentale pour prédire les corrélations LPT–SPT. La méthode proposée est basée sur les analyses des équations de transmission d'ondes du SPT et des LPT et prend en considération les variations de l'équipement de l'essai, de la résistance à la pénétration et de l'énergie. On montre que la méthode fournit une approche unifiée pour comparer les diverses corrélations LPT–SPT publiées. Des données SPT et LPT additionnelles ont été recueillies sur un site de recherche constitué de sable pour vérifier la méthode proposée et élargir la base de données de LPT. On montre que les coefficients de corrélation observés et prédits sont en bonne concordance. La méthode de corrélation proposée sera utile comme cadre logique de comparaison des données de LPT recueillies à travers le monde. Des recherches additionnelles vont être requises pour étendre cette procédure aux sites de gravier.

Mots clés : grand essai de pénétration, LPT, méthode fondamentale de corrélation, analyse d'équation de transmission d'ondes, effets de granulométrie.

[Traduit par la Rédaction]

Introduction

Complex geotechnical engineering problems involving gravel deposits are appearing with increasing regularity in the literature. In some cases, engineers are attempting to utilize the known higher strength and stiffness of gravels for design, while in others engineers have found it necessary to re-assess the stability of existing gravel foundations in light of new evidence of gravel liquefaction during cyclic earthquake loading. In a sand deposit, the engineer would typically initiate a field investigation of these issues using the standard penetration test (SPT, see American Society for

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Table 1. Details of the SPT and four types of LPT.

Parameter	SPT[a]	JLPT[b]	Burmister LPT[c]	ILPT[d]	NALPT[e]
Sampler outer diameter, cm (in.)	5.08 (2)	7.3 (2.9)	9.21 (3.625)	14.0 (5.5)	7.62 (3)
Sampler inner diameter, cm (in.)					
Open shoe	3.49 (1.375)	5.0 (2)	7.44 (2.93)	10.0 (3.9)	6.1 (2.4)
Barrel (no liner)	3.81 (1.5)	5.4 (2.13)	na	11.0 (4.3)	6.4 (2.52)
Hammer weight, N (lb)	623 (140)	981 (220)	1112 (250)	5592 (1256)	1335 (300)
Hammer drop height, cm (in.)	76.2 (30)	150.0 (59.1)	50.8 (20)	50.0 (19.7)	76.2 (30)
Hammer potential energy, kJ (ft-kip)	0.473 (0.350)	1.472 (1.084)	0.565 (0.417)	2.796 (2.062)	1.020 (0.750)
% SPT	100	311	119	591	214
N_{SPT}/N_{LPT}					
Observed in sand	—	1.5	0.42	1.14[f]	—
Observed in gravel	—	2.0[g]	—	0.89–1.02[f]	—

Note: — indicates data not available; na indicates not applicable.
[a]ASTM D 1586–84.
[b]Kaito et al. (1971); Yoshida et al. (1988).
[c]Winterkorn and Fang (1975).
[d]Crova et al. (1993).
[e]Koester et al. (2000); Daniel (2000).
[f]SPT and ILPT blow counts used to develop this correlation were corrected to 60% ER_r and an effective overburden pressure of 100 kPa.
[g]Soil used to develop the correlation is classified as medium to coarse sand using the Unified Soil Classification (USC) system.

Testing and Materials (ASTM) D1586–84 for test details), the most widely used geotechnical characterization tool in the world, upon which numerous empirical design methods are based. The sampler dimensions and hammer potential energy of the SPT were originally selected for use in sands, however, and the SPT is generally considered either unreliable for use in gravel because of grain size effects or impractical because of insufficient input energy. Some researchers have attempted to overcome these problems by deriving equivalent SPT blow counts (N) from blow counts recorded using oversized split-spoon samplers and hammers, commonly referred to as "large penetration tests" (LPT). Others have begun developing new soil performance databases indexed directly to LPT blow counts. Several versions of the LPT have been developed independently worldwide. This paper summarizes LPT details from the literature, including published empirical LPT–SPT correlations, and presents a theoretical method of estimating equivalent SPT blow counts from those recorded using any combination of split-spoon sampler and hammer (i.e., any LPT). The method is based on wave equation analyses of SPT and LPT and considers variations in test equipment, penetration resistance, and energy. Carefully collected SPT and "North American LPT" (NALPT) data from a sand research site are compared to expand the LPT database and to check the proposed theoretical correlation procedure.

LPT in the literature

Though split-spoon samplers of varying dimensions are widely available, very few accounts of their use for geotechnical applications are given in the literature. The few descriptions that have been published are summarized below (names have been assigned by region of origin when necessary).

(1) Japanese LPT (JLPT)
First proposed by Kaito et al. (1971), JLPT–SPT correlation factors were developed for sands and gravels by Yoshida et al. (1988) using the results of saturated sand and gravel calibration chamber tests. The mean grain sizes (D_{50}) of the two "gravels" tested were 1.13 and 2.28 mm. A "Tonbi" type hammer was used for the tests, but penetration energy (ENTHRU) was not monitored. The sampler design is unique in that the outer diameter of the shoe is 73 mm while that of the barrel is only 70 mm.

(2) Burmister LPT
Winterkorn and Fang (1975) provided a Burmister LPT–SPT correlation factor based on field data gathered in sands. The ENTHRU was not monitored during the testing.

(3) Italian LPT (ILPT)
Crova et al. (1993) provided ILPT–SPT correlation factors based on field data from sands and sandy gravels at the Messina bridge site in Italy. The mean grain size of the sandy gravels ranged from roughly 0.5 to 44 mm. The ENTHRU was measured using the force-squared (F^2) method. The SPT and ILPT blow counts were corrected to 60% of the theoretical hammer energies.

(4) North American LPT (NALPT)
Koester et al. (2000) and Daniel (2000) describe an investigation of sandy gravels and gravelly sands near Seward, Alaska that are believed to have liquefied during the 1964 Good Friday earthquake. The testing program included SPT, NALPT, and dynamic cone penetration tests (DCPT). The ENTHRU was measured using both the F^2 and force-velocity (FV) methods. The SPT and NALPT blow counts were corrected to 60% of the theoretical hammer energies.

Test details and observed LPT–SPT correlation factors are summarized in Table 1. The inner and outer sampler diame-

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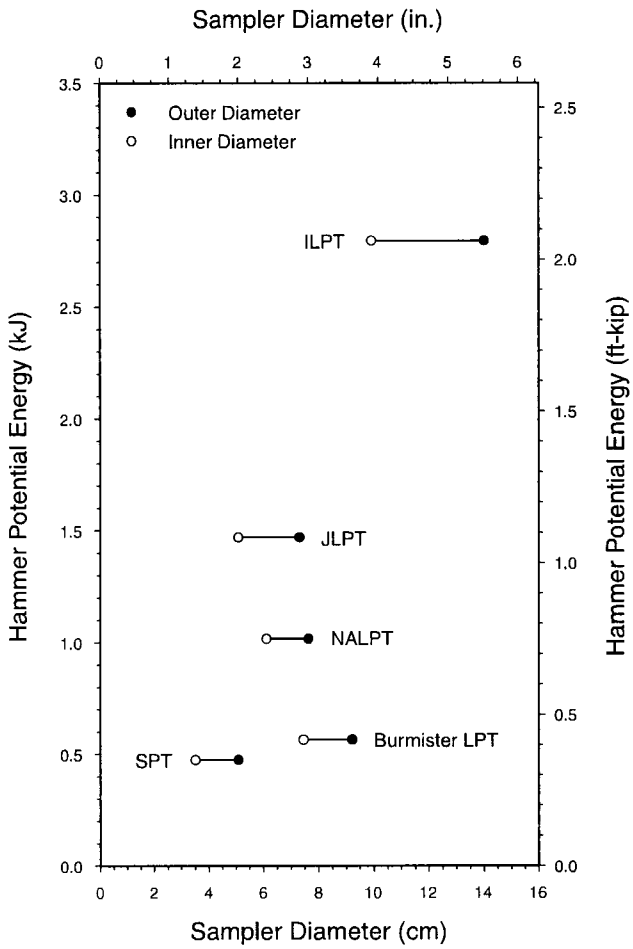
Fig. 1. Comparison of SPT and LPT equipment details.



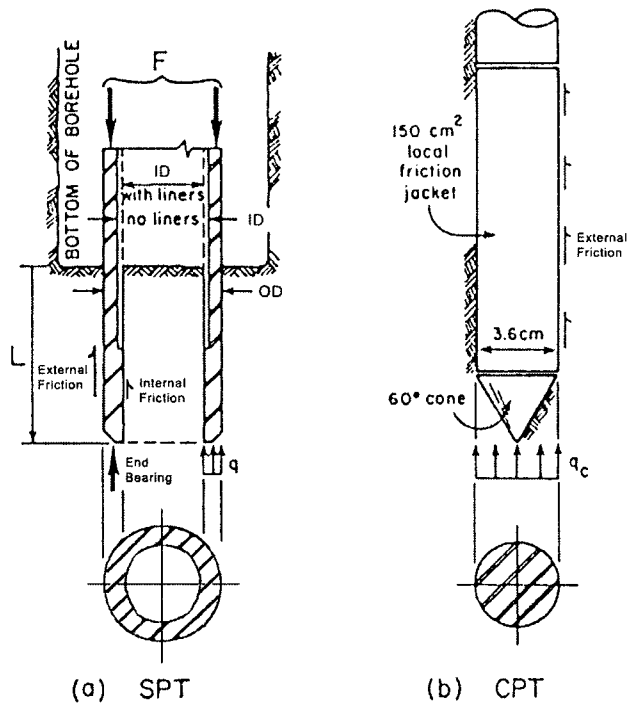
ters and the hammer energies are compared graphically in Fig. 1.

The correlation factors listed in Table 1 differ mainly because of differences in the LPT test equipment, though some variations of the SPT equipment actually used are to be expected. Comparison of the correlation factors is further complicated by the fact that only half are derived from energy corrected blow counts. A method of correlation that specifically addresses variations of hammer potential energy, efficiency of energy transfer, and relative magnitudes of sampler penetration resistance is developed herein.

Framework for comparison of LPT and SPT

The blow count measured during an LPT or SPT is mainly a function of the resistance acting on the sampler during penetration and the input energy of the test. These are comparable to the factors affecting the penetration of a pile. Thus, it is possible to gain insight into the relationship between different sampler, rod, and hammer systems used during SPT and LPT using wave equation modelling techniques developed for pile driving. Wave equation modelling software that considers damping forces may be used to predict blow counts based on the details of the hammer, rods and

Fig. 2. Forces acting on (*a*) an SPT split-spoon sampler and (*b*) a standard 10 cm^2 CPT during quasistatic penetration (modified after Schmertmann 1979).



sampler, and estimated soil parameters. Background information relevant to such a study is presented below.

Penetration resistance considerations

Schmertmann (1979) compared the resistance acting on an SPT sampler penetrating soil at a slow, steady rate to that acting on a standard 10.0 cm^2 cone during a cone penetration test (CPT, Fig. 2). He hypothesized that the force (F) required for "quasistatic" penetration of an SPT sampler at the standard CPT penetration rate of 2 cm/s could be estimated from CPT measurements at the same depth using the formula

$$[1] \qquad F = [C_1 A_T + C_2(\mathrm{ID} + \mathrm{OD})\pi L R_f] q_c - W'$$

where

C_1 is the SPT-CPT end bearing correlation factor;
$A_T = \pi/4(\mathrm{OD}^2 - \mathrm{ID}^2)$ is the sampler tip bearing area;
C_2 is the SPT-CPT friction correlation factor;
ID is the sampler inner diameter (cm);
OD is the sampler outer diameter (cm);
L is the embedment depth of the split-spoon (cm);
$R_f = f_s/q_c$;
f_s is the measured CPT friction sleeve stress (N/cm^2)
q_c is the measured CPT tip stress (N/cm^2); and
W' is the buoyant weight of the drill rods (N).

Schmertmann compared CPT data obtained with a Begemann mechanical cone to F measurements obtained at the same depths and proposed C_1 and C_2 values of 1.0 and 0.7, respectively. He suggested that the measured f_s was too high because of the design of the mechanical cone and predicted that both C_1 and C_2 would be roughly equal to 1.0 for electric cone data. Sy and Campanella (1991*a*) used this ap-

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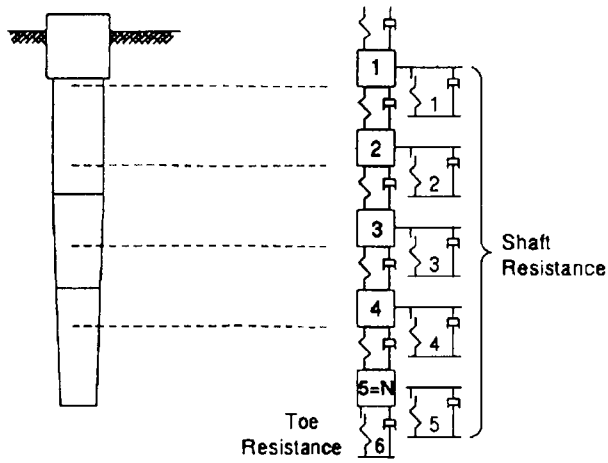
Fig. 3. Typical pile or drill rod model for a wave equation analysis (modified after GRLWEAP 1997).



proach to estimate static penetration resistance values for wave equation analyses of SPT data. The widely used Laboratoire Central des Ponts et Chaussées (LCPC) pile design method described by Bustamante and Gianeselli (1982) uses a similar approach to estimate the axial capacity of driven piles from CPT data.

Energy input

The efficiency of energy transfer from the hammer to the drill rods is quantified by the rod energy ratio (ER_r)

$$[2] \qquad ER_r = \frac{ENTHRU}{WH} 100\%$$

where ENTHRU is the stress wave energy passing a measurement point on the drill rods, W is the hammer weight, and H is the hammer drop height. One can measure ENTHRU using the F^2 method described in ASTM D4633–86 or the FV method that was first recommended for SPT applications by Sy and Campanella (1991*b*).

Schmertmann and Palacios (1979) showed that measured SPT blow counts are inversely proportional to the energy ratio for blow counts less than 50. Seed et al. (1985) and Skempton (1986) subsequently proposed that measured blow counts should be corrected to the value that would have been recorded if a standard amount of energy had been transmitted through the rods. A standard value of 60% of the hammer potential energy has been adopted because it is the historical average measured for most drill rigs and operators. The energy corrected SPT blow count $(N_{60})_{SPT}$ is calculated using inverse proportionality as follows:

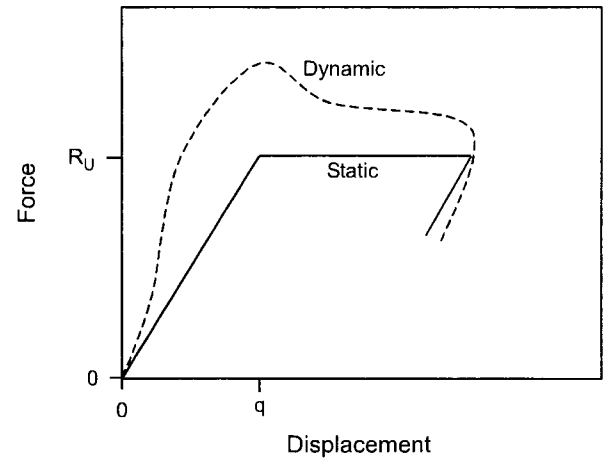
$$[3] \qquad (N_{60})_{SPT} = (N)_{SPT} \frac{ER_r}{60\%}$$

Similarly, energy corrected LPT blow counts are calculated using the formula

$$[4] \qquad (N_{ER_s})_{LPT} = (N)_{LPT} \frac{ER_r}{ER_s}$$

where ER_S is the selected standard energy ratio for the particular hammer and rods. Note that ENTHRU should be measured during each test because the energy ratio can vary with depth.

Fig. 4. Idealized soil response to static and dynamic loading.



Wave equation modeling

As described above, the measured blow count is primarily a function of the penetration resistance and the input energy. It would be simple to relate the work done by the sampler to the hammer input energy if the soil behaved as a plastic or elastic-plastic material. It is well known, however, that damping forces contribute significantly to the total resistance force acting on the sampler. The damping force is a function of the sampler penetration rate that is, in turn, a function of the characteristics of the stress wave that transfers energy from the plane of impact to the sampler-soil interface.

A widely used commercial wave equation program, GRLWEAP (GRLWEAP 1997), models drill rods subjected to dynamic loading as a series of discrete elements connected by spring and dashpot pairs, as shown in Fig. 3. The mass of each element and the stiffness of each spring are determined from the density, elastic modulus, and cross-sectional area of the drill rods they represent. Damping forces in the steel rods are low and empirical dashpot parameters are typically used. The same approach is used to model the hammer.

The total resistance to sampler penetration includes both static (S) and dynamic (D) components. It is assumed that the static component is elastic-plastic in nature and is present during driving and subsequent static loading. Input soil parameters for the static component are the ultimate static resistance (R_u) and the quake (q), as shown in Fig. 4. It is assumed that the dynamic component is directly proportional to the product of the velocity and the ultimate static resistance (Smith Damping)

$$[5] \qquad D = J V R_u$$

where J is the Smith damping factor, and V is the velocity.

Conceptually, all rod elements are at rest and all hammer elements are moving with an assigned velocity at the beginning of a hammer blow (or program execution). The program calculates the dashpot resistance and spring displacement over a very short time step at existing element velocities. The resulting net forces that act on each element are used to

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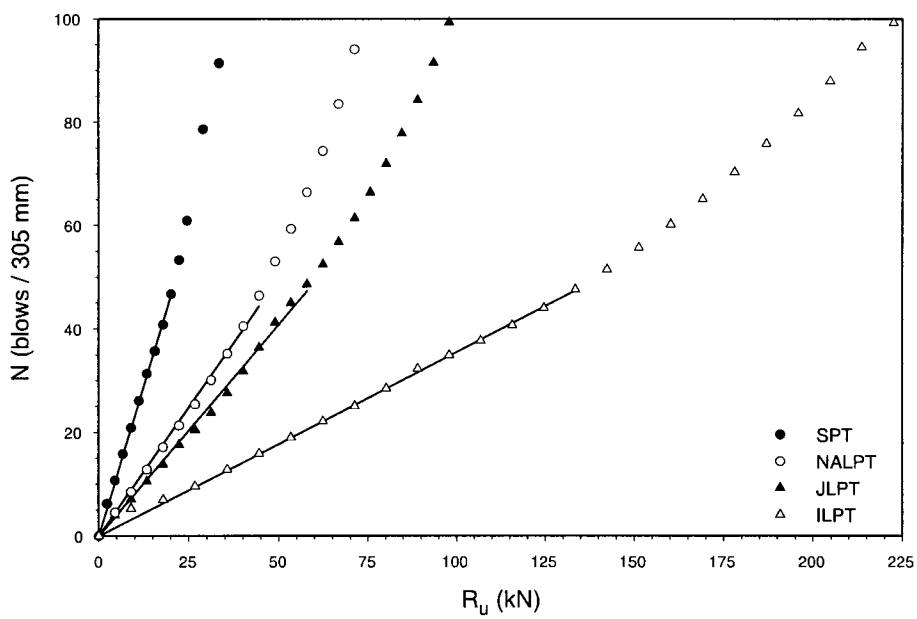
Table 2. Input for wave equation analyses of the SPT, NALPT, JLPT, and ILPT.

Detail	Units	SPT	NALPT	JLPT	ILPT
Hammer weight	N	623	1335	981	5592
	(lb)	(140)	(300)	(220)	(1256)
Hammer length	cm	53.3	69.9	36.8	59.9
	(in.)	(21)	(27.5)	(14.5)	(23.6)
Hammer diameter	cm	14.0	17.8	21.1	39.1
	(in.)	(5.5)	(7)	(8.3)	(15.4)
Drop height	cm	76.2	76.2	150	50
	(in.)	(30)	(30)	(59)	(19.7)
ER_r	(%)	60	60	60	60
ENTHRU	kJ	0.285	0.610	0.883	1.678
	(ft-kip)	(0.210)	(0.450)	(0.649)	(1.237)
Rod length	m	17.83	17.83	17.83	17.83
	(ft)	(58.5)	(58.5)	(58.5)	(58.5)
Rod area	cm^2	8.0	9.3	10.1	60.6
	($in.^2$)	(1.24)	(1.44)	(1.57)	(9.4)
Sampler area[a]	cm^2	8.8	13.9	18.8	59.4
	($in.^2$)	(1.37)	(2.16)	(2.93)	(9.2)
Sampler length	cm	45.7	45.7	45.7	45.7
	(in.)	(18)	(18)	(18)	(18)

[a]Calculated using the inner diameter of the sampler barrel (this is the applicable steel cross-sectional area for the majority of the sampler).

Fig. 5. Wave equation analysis results for SPT, NALPT, JLPT, and ILPT (ER_r = 60%).



calculate element-specific accelerations using Newton's second law. New velocities and displacements are then calculated for the next time-step using the revised accelerations. This process is repeated until all spring forces and element velocities are zero. The final displacement of the sampler is then used to calculate the blow count (number of blows for 305 mm displacement).

Proposed LPT–SPT correlation method

Wave equation analyses of the SPT, NALPT, JLPT, and ILPT were performed using GRLWEAP. Table 2 summarizes the input parameters used for each analysis (the Burmister LPT was not analysed because relevant test details were not available). The soil parameters used were those recommended in the GRLWEAP manual for granular soils. Soil resistance was applied over the bottom 305 mm (12 in.) of the sampler to simulate the average sampler embedment depth during an SPT or LPT. The inner diameter of the sampler barrel (no liner) was used to calculate the sampler area because the majority of the sampler has this cross-sectional area of steel. All SPT and LPT blow counts were referenced to an energy ratio of 60% for convenience. The predicted blow counts (N) are plotted in Fig. 5 as a

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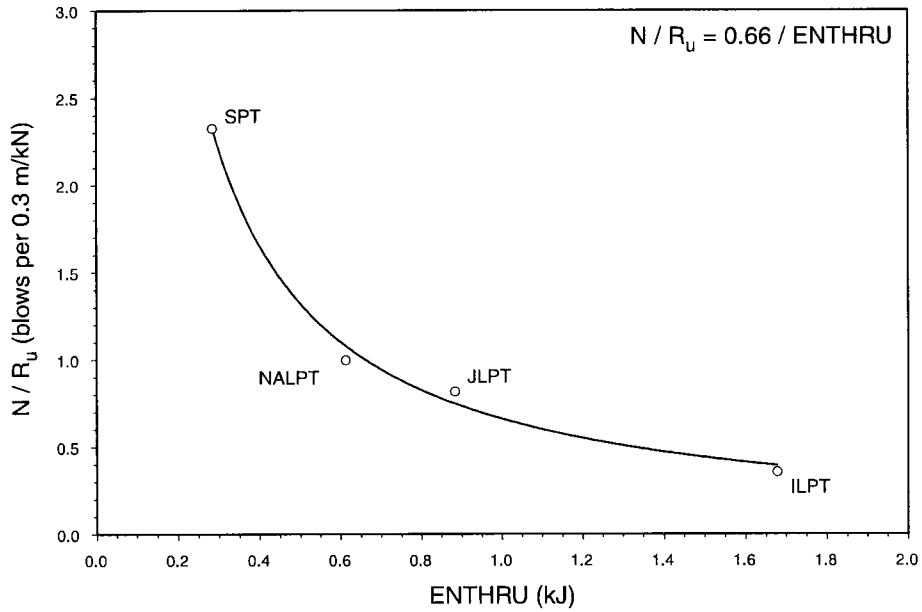
Fig. 6. Wave equation analysis results showing inversely proportional relationship between the blow count to soil resistance ratio (N/R_u) and ENTHRU.



function of the ultimate static resistance R_u for each of the penetration tests.

Figure 5 illustrates that, for a given test system and ENTHRU, N increases with R_u. This trend is similar to the bearing graphs used to relate pile capacity to pile penetration resistance (e.g., Authier and Fellenius 1983). Note that the relationships between N and R_u are essentially linear for blow counts less than about 50. This is convenient because each test type can be uniquely defined by the slope of its best-fit line, i.e., the blow count to soil resistance ratio (N/R_u). Figure 6 compares the ratios determined for each of the tests shown in Fig. 5 to the corresponding ENTHRU values. The data are well represented by a single best-fit curve, wherein the N/R_u ratios are inversely proportional to ENTHRU. This is equivalent to the inversely proportional blow count to input energy relationship observed by Schmertmann and Palacios (1979). Sensitivity analyses performed by the authors indicate that, although the vertical position and, to a lesser extent, the shape of the best-fit curve in Fig. 6 are functions of the input soil parameters (quake and damping) and the geometry of the hammer and drill rods, ENTHRU is the dominant factor controlling the magnitude of the N/R_u ratio for a given test. Using an energy ratio other than 60% for any of the SPT or LPT wave equation analyses causes the corresponding data point in Fig. 6 to move parallel to the best-fit curve. This indicates that equations similar to eqs. [3] and [4] may be useful for correlating LPT to SPT blow counts.

Figure 6 shows that, for a given site condition, all of the dynamic penetration tests can theoretically be correlated to each other. More specifically, any LPT blow count (N_{LPT}) can be correlated to an SPT blow count (N_{SPT}) provided the ENTHRU and relative sampler penetration resistances are known. The relative penetration resistances may be quantified by the appropriate values of R_u, which are very similar to the quasistatic penetration resistance value F described by Schmertmann (1979). As a first approximation, the blow count for any of the SPT or LPT systems may be estimated using the equation

$$[6] \qquad N_{ER_S} = (N/R_u)F$$

as long as (ER_S) is the energy ratio used to determine the N/R_u ratio. Similarly, the correlation factor between the SPT and any of the LPTs may be estimated by taking the ratio of the two

$$[7] \qquad \frac{(N_{60})_{SPT}}{(N_{ER_S})_{LPT}} = \frac{(N/R_u)_{SPT}F_{SPT}}{(N/R_u)_{LPT}F_{LPT}}$$

Alternatively, since the N/R_u ratios of the SPT and LPTs are well approximated by an inversely proportional relationship (Fig. 6), the various ratios are related as follows:

$$[8] \qquad \frac{(N/R_u)_{SPT}}{(N/R_u)_{LPT}} = \frac{0.66(\text{ENTHRU})_{LPT}}{0.66(\text{ENTHRU})_{SPT}}$$

and so eq. [7] can be written as

$$[9] \qquad \frac{(N_{60})_{SPT}}{(N_{ER_S})_{LPT}} = \frac{(\text{ENTHRU})_{LPT}F_{SPT}}{(\text{ENTHRU})_{SPT}F_{LPT}}$$

Referring to eq. [1], the ratio of the quasistatic penetration resistances F may be determined entirely from the geometry of the split-spoon samplers if it is assumed that the buoyant unit weight of the rods is negligible; and the same values of CPT q_c and R_f may be used for the SPT and LPT (i.e., no scale effects).

Equation [9] then reduces to

$$[10] \qquad \frac{(N_{60})_{SPT}}{(N_{ER_S})_{LPT}} = \frac{(\text{ENTHRU})_{LPT}(A_{TE})_{SPT}}{(\text{ENTHRU})_{SPT}(A_{TE})_{LPT}}$$

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Table 3. Application of proposed correlation method to four types of LPT.

Test	A_T, cm^2 (in.^{2})	A_F, cm^2 (in.^{2})	A_{TE},[a] cm^2 (in.^{2})	ER_r (%)	ENTHRU, kJ (ft·kip)	$\frac{(N_{60})_{SPT}}{(N_{60})_{LPT}}$
SPT	10.71	820.6	13.58	60	0.285	na
	(1.66)	(127.2)	(2.10)		(0.210)	
NALPT	16.39	1313.5	20.99	60	0.610	1.38
	(2.54)	(203.6)	(3.26)		(0.450)	
JLPT	22.32	1191.6	26.49	60	0.883	1.58
	(3.46)	(184.7)	(4.11)		(0.649)	
Burmister LPT	23.15	1595.4	28.73	60	0.339	0.56
	(3.59)	(247.3)	(4.45)		(0.250)	
ILPT	76.19	2286.4	84.19	60	1.678	0.95
	(11.81)	(354.4)	(13.05)		(1.237)	

Note: na indicates data not applicable.
[a]Assumes $C_1 = C_2 = 1.0$, $R_f = 0.35\%$.

where the effective sampler bearing area (A_{TE}) is defined by

$$[11] \quad A_{TE} = C_1 A_T + C_2(\mathrm{ID} + \mathrm{OD})\pi L R_f = C_1 A_T + C_2 A_F R_f$$

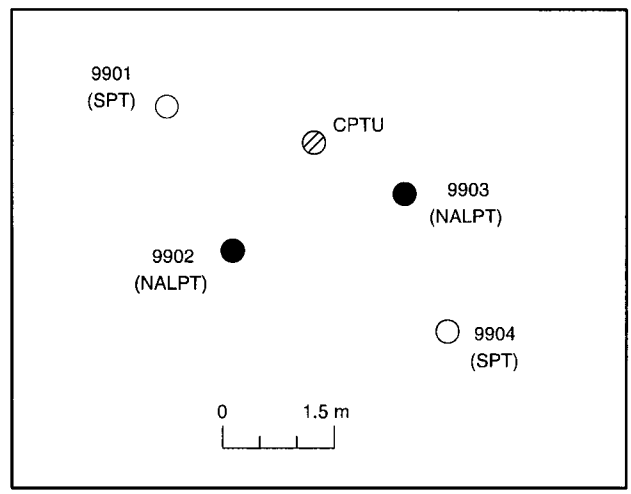
Equation [10] shows that the LPT–SPT correlation factor (N_{SPT}/N_{LPT}) is a function only of the transferred energy in the drill rods, ENTHRU, and the sampler bearing area, A_{TE}. Thus, given the ENTHRU and A_{TE} of any LPT system, the N_{LPT} can theoretically be correlated to N_{SPT} by this simple relationship. As for the wave equation analyses, a sampler embedment depth L of 305 mm (12″) should be used to calculate A_{TE}. Unlike the wave equation analysis, the inner diameter of the open shoe should be used to calculate A_{TE}, as the majority of the internal frictional forces will be generated in the shoe. Table 3 summarizes calculated values of A_T, sampler frictional area (A_F), and A_{TE}, assuming $C_1 = C_2 = 1.0$, and predicted correlation factors from eq. [10] for the NALPT, JLPT, and ILPT. An R_f of 0.35% has been assumed as a typical value for granular deposits. Because the available database is so limited, the correlation factor for the Burmister LPT has also been calculated, assuming a rod energy ratio of 60%.

The predicted ILPT–SPT correlation factor of 0.95 is in excellent agreement with the observed average field values of 1.14 and 0.96 for sand and gravel sites, respectively. The predicted JLPT–SPT correlation factor of 1.58 is also in good agreement with the observed calibration chamber values of 1.5 and 2.0 for sands and "gravels", respectively. The predicted Burmister LPT–SPT correlation factor of 0.56 is in good agreement with the observed value of 0.42. A field research program was carried out by the authors to further investigate the suitability of the correlation method described above.

Field verification

Drilling and in situ testing were conducted at a sand site called "Kidd2" on the Fraser River Delta near Vancouver, BC, Canada (Daniel 2000). This site was well characterized during the Canadian Liquefaction Experiment (CANLEX) and during subsequent UBC research efforts (e.g., Howie et al. 1999; Daniel et al. 1999). For the current study, four mud-rotary test holes and one piezocone penetration test (CPTU) were completed to roughly 20 m depth in a diamond pattern (Fig. 7). The SPTs were carried out in two of the test holes (9901 and 9904) and NALPTs in the other two (9902 and 9903). The site stratigraphy consisted of roughly 4 m of clayey silt, underlain by sand and silty sand to greater than 20 m depth, as shown by the CPTU data in Fig. 8. Also shown in Fig. 8 are four CPTU corrected tip stress (q_t) profiles recorded at Kidd2 during the CANLEX study to illustrate the relatively low degree of lateral variability at the site. The mean grain size of the sand samples recovered during the current investigation ranged from 0.19 to 0.56 mm (Fig. 9). Quasistatic penetration tests of SPT and LPT samplers, similar to those performed by Schmertmann (1979), were conducted in addition to the dynamic penetration tests in the four mud-rotary test holes.

Fig. 7. Plan view of test hole layout, Kidd2 site.



Quasistatic testing

Quasistatic penetration tests of SPT and NALPT samplers were conducted at selected test depths using a constant flow-rate hydraulic ram calibrated to a penetration rate of 2 cm/s. The axial force in the drill rods was monitored using piezoresistive strain gauges attached to one of the rods. The strain gauge voltage output was recorded as a function of time using a strip chart and transformed to force using linear calibration factors determined under controlled laboratory

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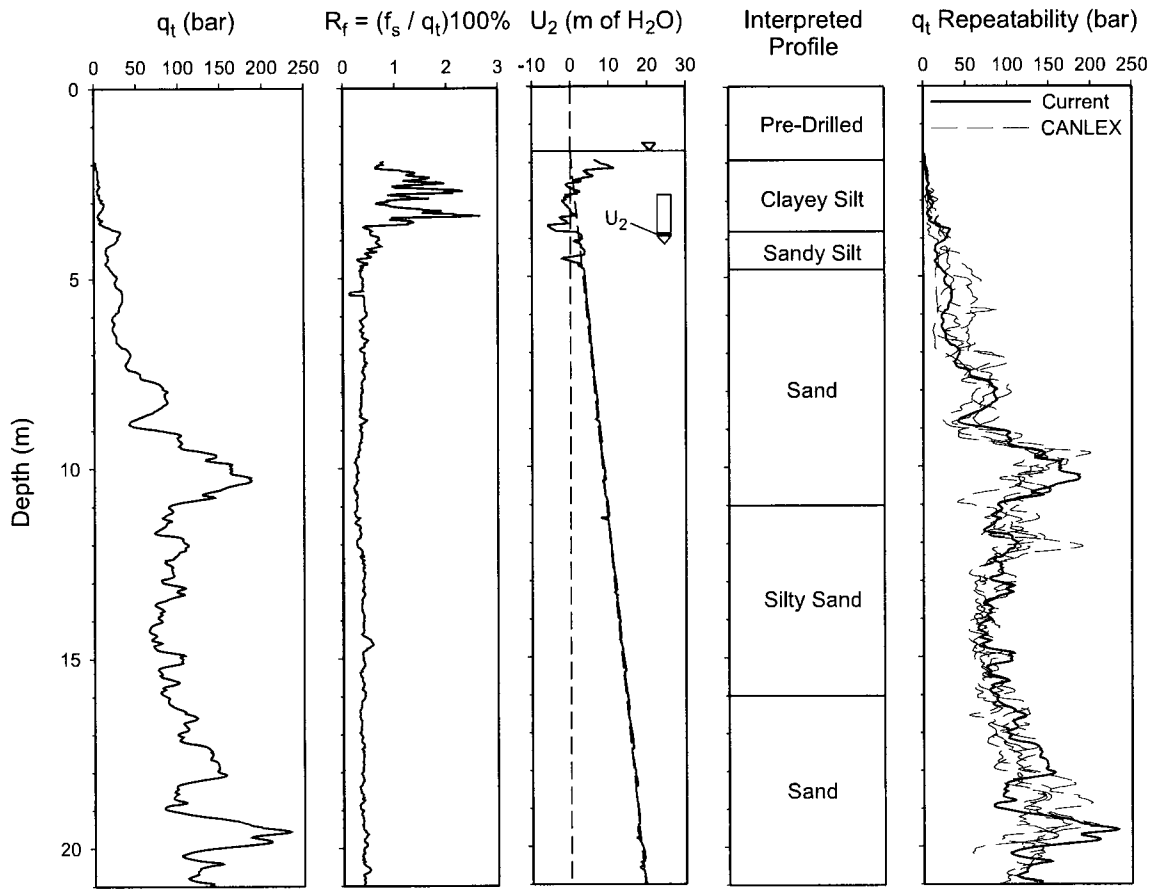
Fig. 8. Cone penetration test data, Kidd2 site.



conditions. Figure 10 shows a typical voltage versus time plot recorded during quasistatic penetration of the SPT sampler in sand. Figure 11 compares the total applied force (i.e., the measured axial force plus the rod weight) recorded at 305 mm (12 in.) sampler penetration to the forces predicted using the measured CPTU data as input for eq. [1]. Assuming that the values of C_1 and C_2 are both equal to a single value C, the best-fit relationship shown in Fig. 11 indicates that the actual value of C is about 1.4 for the SPT and NALPT samplers. The proposed correlation method is unchanged, however, because C appears in both the numerator and denominator of eq. [10].

Dynamic testing

The SPTs and NALPTs were performed at 1.5 m depth intervals. The NALPT sampler used had the dimensions listed in Table 1. A 1460 N (328 lb) safety hammer with a drop height of 762 mm (30 in.) was used, yielding a hammer potential energy of 1115 J (820 ft·lb). Hammer kinetic energy was measured using a commercial radar system that records velocity as a function of time, as shown in Fig. 12. Average hammer impact velocities were 3.14 and 3.42 m/s (10.3 and 11.24 ft/s) for the SPT and NALPT, respectively. The corresponding hammer kinetic energies were 65 and 78.5% of the hammer potential energies for the SPT and NALPT, respectively. The ENTHRU was measured for each hammer blow using a proprietary dynamic energy monitoring (DEM) sys-

Fig. 9. Envelope of grain size distribution curves for sand samples collected at the Kidd2 site.

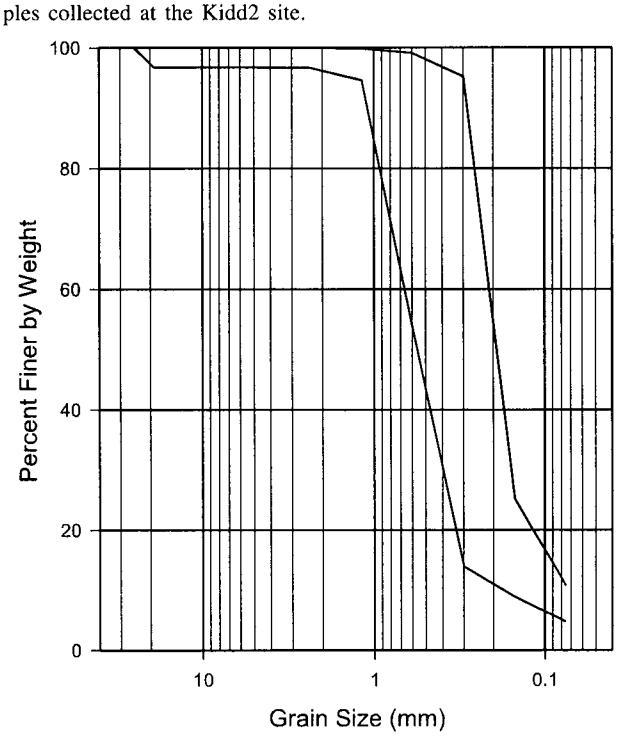


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Fig. 10. Typical strip chart record of axial force in rods during the quasistatic penetration of an SPT sampler in sand, Kidd2 site.

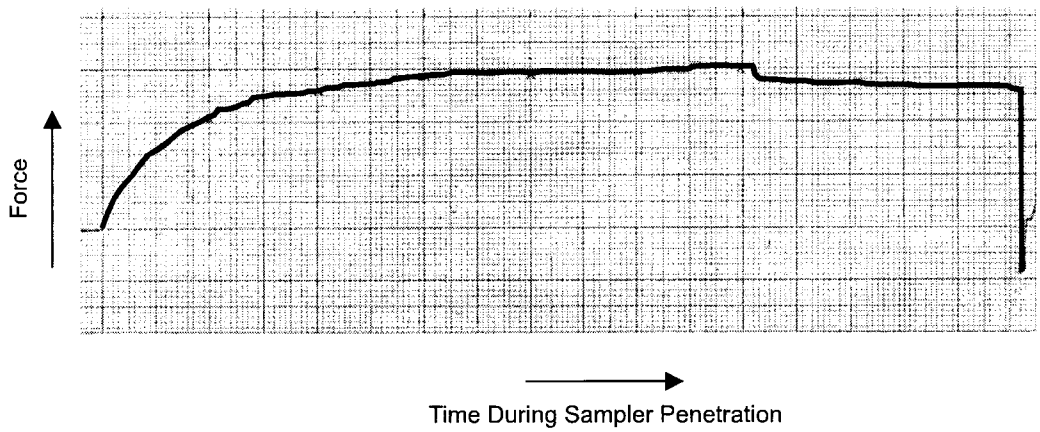


Fig. 11. Comparison of measured and predicted forces required for quasistatic penetration of SPT and NALPT samplers embedded 0.3 m (12 in.) in sand.

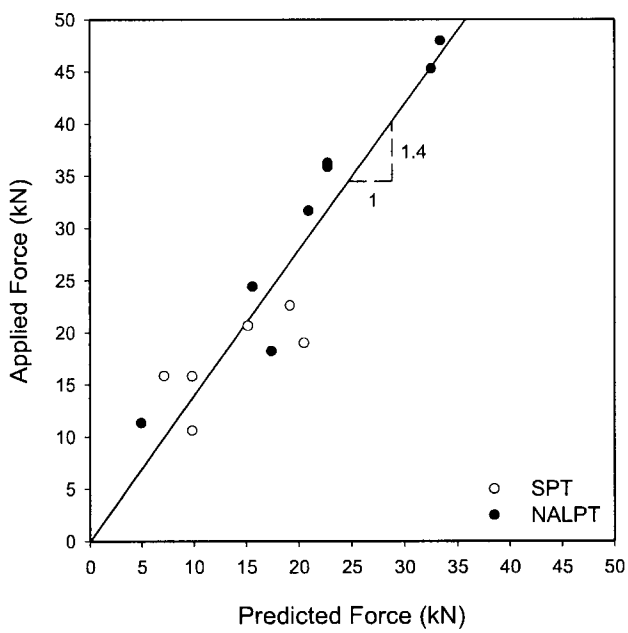
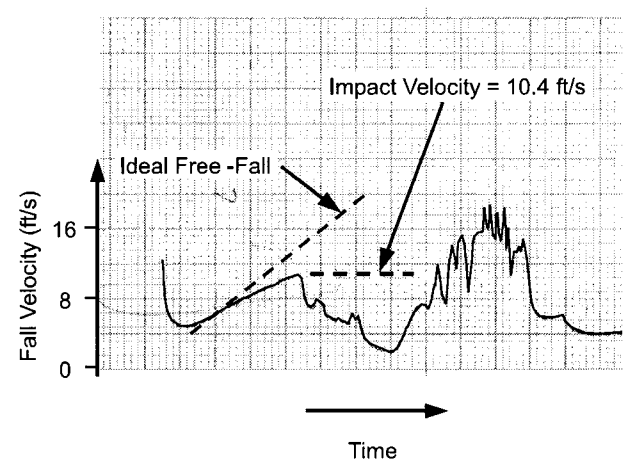


Fig. 12. Typical strip chart record of SPT hammer fall velocity measured with radar system, Kidd2 site.



tem. The DEM consisted of a personal computer, signal-processing equipment, and a drill rod instrumented with four strain gauges and a high-capacity accelerometer. The data recorded with the DEM were used to calculate ENTHRU using the F^2 and FV methods. The SPT and NALPT blow counts were corrected to 60% of the hammer potential energies listed in Table 1 using eqs. [3] and [4]. In this manner, a data set consisting of two SPT and two NALPT energy corrected blow counts at each test depth was developed. Overburden corrections were not applied because the blow counts to be compared were obtained at the same depths.

The CPTU corrected tip resistance (q_t) and energy corrected SPT and NALPT blow counts are plotted as a function of depth in Fig. 13, and the energy corrected SPT and NALPT blow counts are directly compared in Fig. 14. The observed correlation factor $[(N_{60})_{SPT}/(N_{60})_{NALPT}]$ is 1.29, which is in good agreement with the predicted correlation factor of 1.38.

Discussion

Table 4 summarizes the observed and predicted correlation factors. Note that Crova et al. (1993) applied overburden correction factors to the recorded SPT and ILPT blow counts. Since the correlation factors were determined by comparing blow counts that were recorded at the same depth, they are independent of the overburden corrections.

Conceptually, the predicted correlation factors should be compared to those observed for sands, which should be free of grain size effects. The observed sand correlations and the predicted correlations are both plotted versus the ratio of ENTHRU to A_{TE} in Fig. 15 (note that eq. [10] is represented by a single line on this plot). The observed Burmister LPT, ILPT, NALPT, and JLPT correlation factors are 75, 120, 93, and 95% of the predicted values, respectively. This agreement is likely near the level of accuracy of the observed correlations because factors such as natural site variability (Fig. 8) and, in the cases of the JLPT and Burmister LPT

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Fig. 13. CPTU tip resistance and energy-corrected SPT and NALPT blow counts, Kidd2 site.

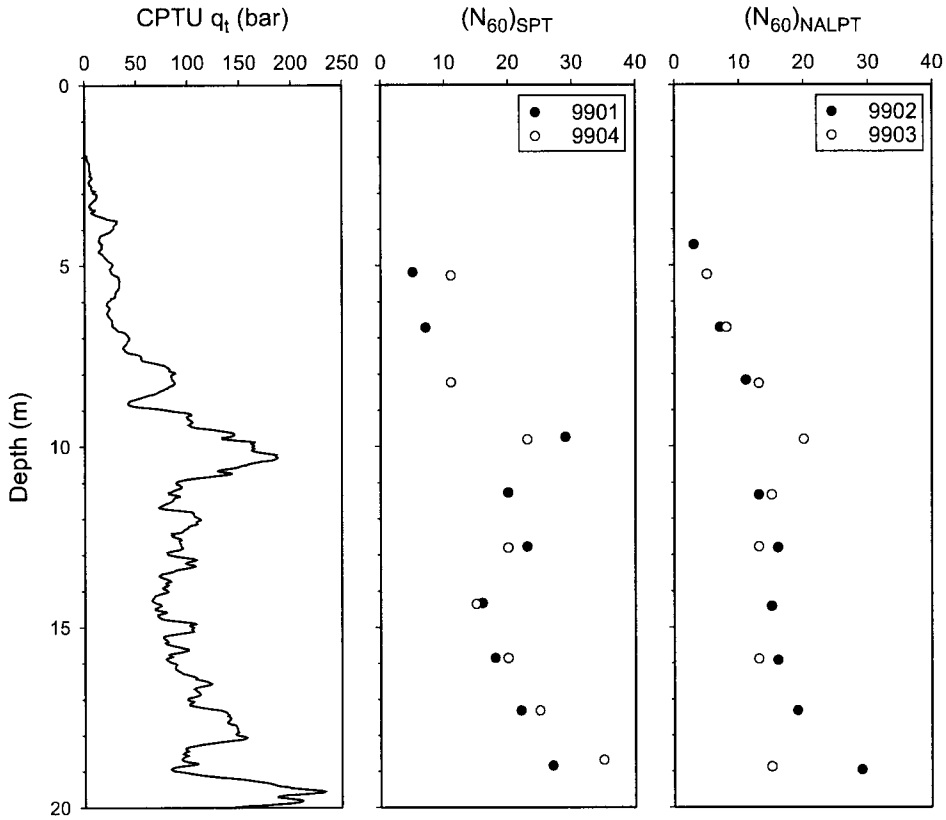
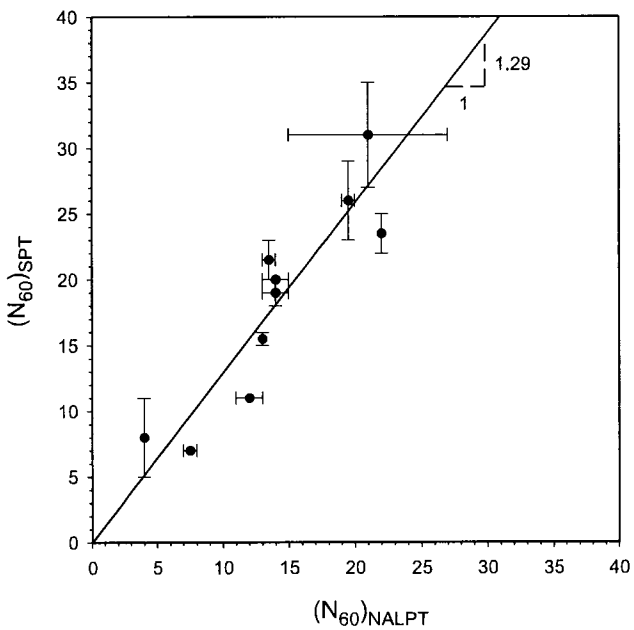


Fig. 14. Comparison of SPT and NALPT energy-corrected blow counts recorded in sand, Kidd2 site.



studies, lack of energy correction increase the overall level of uncertainty.

Table 4 also presents the correlation factors that were observed in gravels. It is generally believed that blow counts for a given test system and soil density will increase with increasing grain size and that, for a given gravel, SPT blow counts will be subject to more severe grain size effects than LPT blow counts. Thus, it would be anticipated that the ratio of SPT to LPT blow counts should tend to increase with increasing grain size, as shown by the JLPT correlations. However, the observed JLPT correlation factor increase (from 1.5 to 2.0) is large compared to the range of soil types tested (fine to coarse sand), and the observed increase may be partly due to uncertainties associated with the lack of energy correction or the use of un-aged calibration chamber samples. In contrast, the results of the well-controlled ILPT study show the opposite, counter-intuitive response. This apparent contradiction has not been explained in the literature to date and is one component of an ongoing UBC investigation.

Conclusions

LPT data from the literature have been summarized, and a fundamental method of predicting LPT–SPT correlation factors for any type of LPT has been presented. It is shown in this paper that the proposed method is easy to apply and that it uniquely relates the LPT–SPT correlation factor to the transferred energy and sampler bearing area of the LPT under consideration. A carefully controlled NALPT field investigation was conducted to check the assumptions of the proposed method and to enlarge the existing LPT database. Comparisons of the correlation factors from the literature and from the NALPT field investigation to those predicted

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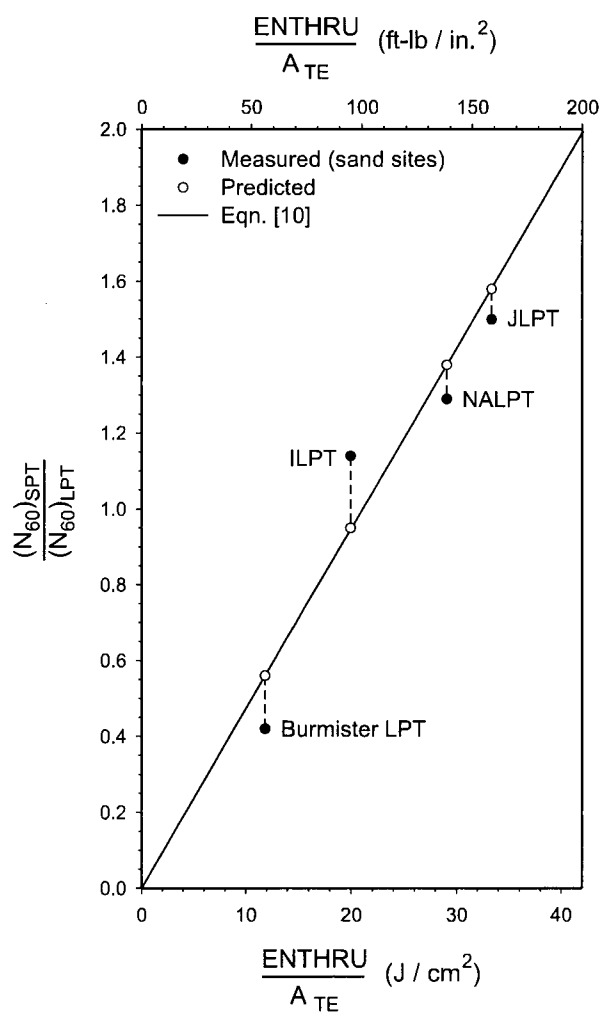
Table 4. Summary of observed and predicted correlation factors.

Test	Observed: Location	Observed: Soil type	D_{50} (mm)	$\frac{N_{SPT}}{N_{LPT}}$	Predicted[a] $\frac{(N_{60})_{SPT}}{(N_{60})_{LPT}}$
NALPT[b]	Kidd2	Sand	0.19–0.56	1.29	1.38
JLPT[c]	Calibration chamber	Fine sand	0.34	1.5	1.58
		Medium to coarse sand	1.13–2.28	2.0	
Burmister LPT[c]	NA	Sand and silt	—	0.42	0.56
ILPT[b]	Messina, Italy	Sand	0.2–0.6	1.14	0.95
		Sand and gravel	1–5	1.02	
		Sand and gravel	1–15	0.89	

Note: — indicates data not available.
[a]Equation [10] of this paper.
[b]N_{SPT}/N_{LPT} corrected to ER_r = 60%.
[c]No energy correction explicitly indicated by researcher.

Fig. 15. Comparison of predicted correlation factors to those observed at sand sites.



using the proposed correlation method yielded encouraging results. Additional data are required to further verify the proposed methodology. These data should be collected at both sand and gravel sites using a range of split-spoon samplers and hammers (i.e., as many types of LPT as possible). It is of critical importance that the penetration energy is monitored, and that all blow counts are corrected to a standard energy appropriate to the LPT with which they were recorded. It is suggested that all SPT and LPT blow counts be normalized to 60% of the potential energy of the hammer used for the test. The authors feel that the proposed correlation method will be useful as a logical framework for comparison of LPT data collected throughout the world.

Acknowledgments

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List of symbols

A_F split-spoon sampler frictional area
A_T split-spoon sampler tip bearing area
A_{TE} effective sampler bearing area
C generalized SPT-CPT correlation factor
C_1 SPT-CPT end bearing correlation factor
C_2 SPT-CPT friction correlation factor
CPT cone penetration test
CPTU piezocone penetration test
D_{50} mean grain size
D dynamic component of soil resistance
DCPT dynamic cone penetration test
DEM dynamic energy monitoring system
ENTHRU stress wave energy
ER_r rod energy ratio
ER_S selected standard energy ratio
f_s CPT or CPTU friction sleeve stress
F force required for quasi-static penetration of a split-spoon sampler
F^2 force-squared energy measurement method
FV force-velocity energy measurement method
H hammer drop height
ID split-spoon sampler inner diameter
ILPT Italian large penetration test
J Smith damping factor
JLPT Japanese large penetration test
L embedment depth of split-spoon sampler
N blow count
N_{60} blow count normalized to 60% energy ratio
$(N_1)_{60}$ blow count normalized to 60% energy ratio and effective overburden pressure of 100 kPa
N_{ER_s} blow count normalized to selected standard energy ratio (ER_S)
NALPT North American large penetration test
OD split-spoon sampler outer diameter
q soil quake
q_c CPT or CPTU tip resistance
q_t CPTU corrected tip resistance
R_f CPT friction ratio
R_u ultimate static resistance of soil
S static component of soil resistance
SPT standard penetration test
U_2 pore-water pressure measured behind the cone tip during CPTU
V velocity
W' buoyant weight of drill rods
W hammer weight

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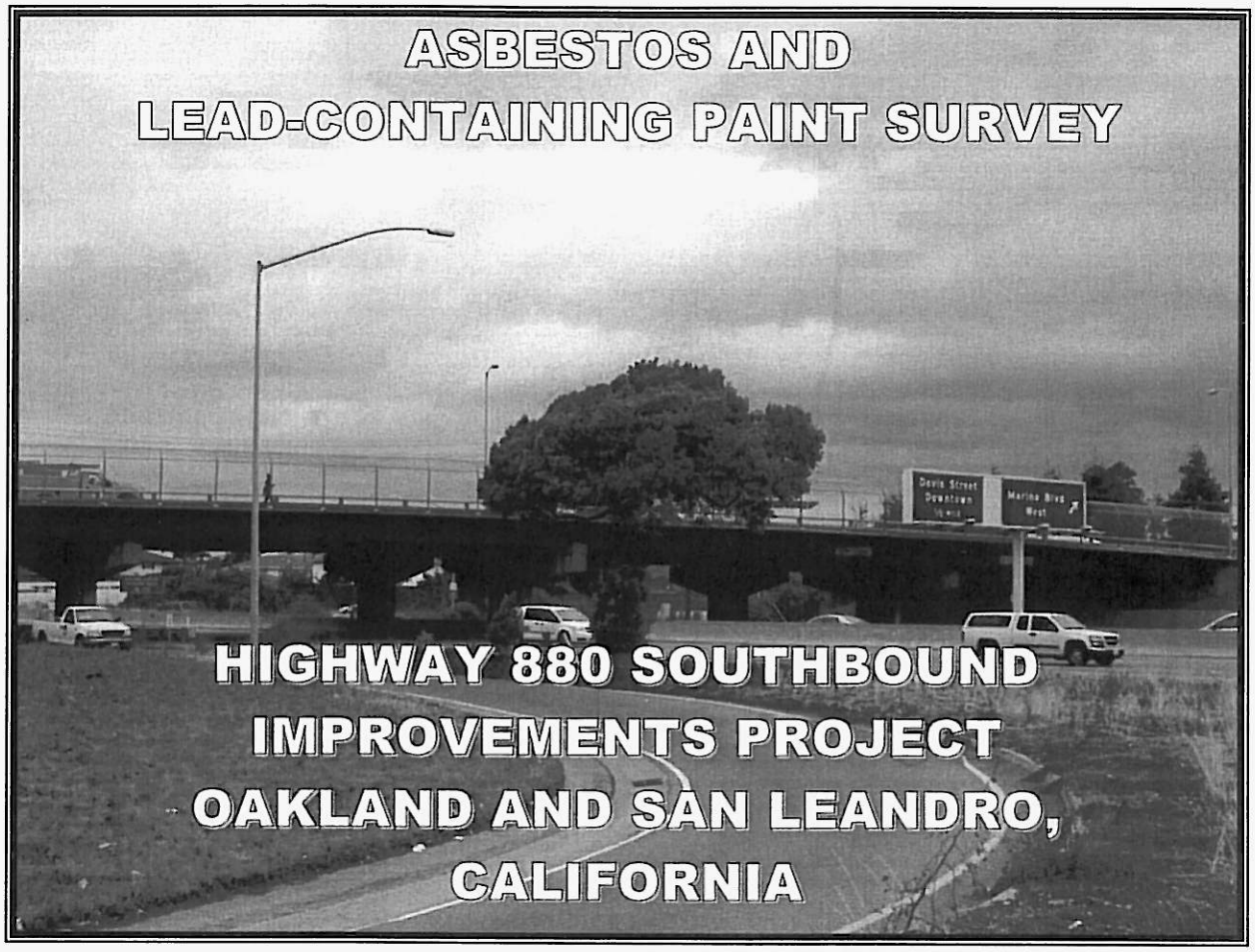

ASBESTOS AND LEAD-CONTAINING PAINT SURVEY

HIGHWAY 880 SOUTHBOUND IMPROVEMENTS PROJECT OAKLAND AND SAN LEANDRO, CALIFORNIA

PREPARED FOR:
RAJAPPAN & MEYER CONSULTING ENGINEERS, INC.
1038 LEIGH AVENUE, SUITE 100
SAN JOSE, CALIFORNIA

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

GEOCON

GEOCON PROJECT NO. E8449-06-01

DECEMBER 2008

DATE 12/16/08
LOG # 7 MAIN FILE # 421.04
FROM R&M TO ACCMA
DESCRIPTION
ASBESTOS – LEAD PAINT
SURVEY

DRAFT

Project No. E8449-06-01
December 16, 2008

Bala Rajappan
Rajappan & Meyer Consulting Engineers, Inc.
1038 Leigh Avenue, Suite 100
San Jose, California 95126

Subject: ASBESTOS AND LEAD-CONTAINING PAINT SURVEY
HIGHWAY 880 SOUTHBOUND IMPROVEMENTS PROJECT
HEGENBERGER ROAD TO SOUTH OF MARINA BOULEVARD
ALAMEDA COUNTY, CALIFORNIA

Dear Mr. Rajappan:

We have performed an asbestos and lead-containing paint (LCP) survey of the subject location in Alameda County, California. The scope of services provided by Geocon included surveying three bridge structures and associated soundwalls indicated for renovation or demolition at the subject location for suspect asbestos-containing materials and LCP, collecting bulk samples, and submitting the samples to laboratories for analyses.

The accompanying report summarizes the services performed and the results of laboratory testing.

The contents of this report reflect the views of Geocon, who are responsible for the facts and accuracy of the data presented herein. This report does not constitute a standard, specification, or regulation.

If there are any questions concerning the contents of this report, or if Geocon may be of further service, please contact me at your convenience.

Sincerely,

GEOCON CONSULTANTS, INC.

Chris Giuntoli, CAC
Senior Project Scientist

David Watts, CAC
Senior Project Scientist

CGG:DAW:ls

(1) Addressee

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ASBESTOS AND LEAD PAINT SURVEY REPORT

1.0 INTRODUCTION

1.1 Site Description

The project consists of the Marina Boulevard Overcrossing (OC) [Bridge No. 33-0167], the Davis Street OC (Bridge No. 33-0168), the San Leandro Creek Bridge (Bridge No. 33-0100), and soundwalls designated for renovation or demolition within the project area associated with the Highway 880 Southbound Improvements project located in Alameda County, California (the project location). The approximate project location is depicted on the Vicinity Map, Figure 1, and Site Plans, Figures 2A through 2C.

1.2 Objectives

Our objectives were to assess the potential presence and quantity of asbestos and lead-containing paint (LCP) at the project location prior to planned demolition activities. The information obtained from this investigation will be used by Rajappan & Meyer Consulting Engineers, Inc. for waste profiling, determining California Occupational Safety and Health Administration (Cal/OSHA) applicability, and coordinating asbestos and LCP disturbance activities.

> *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 (e.g., wall, ceiling, window sill, window frame, door frame, molding, etc.) in each room.*

2.0 BACKGROUND

2.1 Asbestos

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 *more 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 non-friable 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 non-friable 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, California Code of Regulations (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 or renovation operations) must be removed from buildings prior to demolition or renovation. Certain nonfriable ACM and materials containing 1% or less asbestos may remain in buildings 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. Intact LCP on a component is currently accepted by most landfill facilities; 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 exceeds the respective Total Threshold Limit Concentration (TTLC) of 1,000 milligrams per kilogram (mg/kg); or 2) the soluble lead content 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 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 lead-containing paint. 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.

3.0 HISTORY

3.1 Previous Survey Activities

Previous asbestos or LCP survey reports of the project location were not available for our review.

3.2 Architectural Plans

Architectural plans of the project location were not available for our review.

4.0 SCOPE OF SERVICES

Mr. Chris Giuntoli, a California-Certified Asbestos Consultant (CAC), certification No. 02-3163 (expiration June 19, 2009), and Certified Lead Paint Inspector/Assessor with the California Department of Public Health (DPH), certification number I-5502 (expiration June 14, 2009) completed an asbestos and LCP survey of the project location on November 3, 2008.

4.1 Asbestos

Suspect ACM were grouped into homogeneous areas with representative samples randomly collected from each. In addition, each potential ACM was evaluated for quantity and friability. A total of 19 bulk asbestos samples were collected from the project location.

Our procedures for inspection and sampling are discussed below:

- Collected bulk asbestos samples after first wetting friable material with a light mist of water. The samples were then cut from the substrate and transferred to a labeled container. Note that when multiple samples were collected, the sampling locations were distributed throughout the homogeneous area (spaces where the material was observed).
- Relinquished bulk asbestos samples to EMSL Analytical, Inc., a California-licensed laboratory, for asbestos analysis in accordance with EPA Test Method 600/R-93/116 using polarized light microscopy (PLM) under standard chain-of-custody procedures. EMSL Analytical, Inc. is a laboratory accredited by the National Institute of Standards and Technology National Voluntary Laboratory Accreditation Program (NIST-NVLAP) for bulk asbestos fiber analysis. The laboratory analyses were requested on a 24-hour turn-around-time.

Sample locations are presented on the Site Plans, Figures 2A through 2C. Geocon sample group identification numbers, material descriptions, approximate quantities, friability assessments, and photo references are summarized in Table 1. Photos of suspect asbestos-containing materials are presented with the Site Photographs.

4.2 LCP

A total of seven bulk paint samples were collected from the project location. Our sampling procedures are discussed below:

- Collected representative bulk samples of suspect LCP using techniques presented in HUD guidelines. In addition, each painted area was evaluated for evidence of deterioration such as flaking or cracking.
- Relinquished LCP samples to Advanced Technology Laboratories, a California-licensed laboratory, for lead analyses in accordance with EPA Test Method 6010 under standard chain-of-custody procedures. Advanced Technology Laboratories is accredited by the DPH for lead analysis. The laboratory analyses were requested on a 24-hour turn-around-time.

Sample locations are presented on the Site Plans, Figures 2A through 2C. Geocon paint sample identification numbers, paint descriptions, approximate peeling/flaking quantities, and photo references are summarized on Table 2. Photos of paints sampled by Geocon are presented with the Site Photographs.

5.0 INVESTIGATIVE RESULTS

5.1 Asbestos Analytical Results

Chrysotile asbestos at concentrations of 5% and 6% was detected in samples representing an undetermined quantity of nonfriable bolt thread compound used on the guard rail system of the Marina Boulevard OC (Bridge No. 33-0167).

Chrysotile asbestos at a concentration of 40% was detected in samples representing approximately 15 square feet of rail shims used on the guard rail system of the Marina Boulevard OC (Bridge No. 33-0167).

No asbestos fibers were observed in samples of the remaining suspect materials at the project location. Summaries of the analytical laboratory test results for asbestos are presented on Table 1.

5.2 Paint Analytical Results

Samples of intact green paint used on the bridge girder system at the Marina Boulevard OC (Bridge No. 33-0167) exhibited total lead concentrations of 32 mg/kg and 290,000 mg/kg and a soluble (TCLP) lead concentration of 110 mg/l.

Samples of intact green paint used on the bridge girder system at the Davis Street OC (Bridge No. 33-0168) exhibited total lead concentrations of 180,000 mg/kg and 300,000 mg/kg and soluble (TCLP) lead concentrations of 830 mg/l and 150 mg/l.

A sample of intact white paint used on the bridge bents of the Davis Street OC (Bridge No. 33-0168) exhibited a total lead concentration of 89 mg/kg and a soluble (WET) lead concentration of less than 0.25 mg/l.

Samples of intact green paint used on the bridge girder system at the San Leandro Creek Bridge (Bridge No. 33-0100) exhibited total lead concentrations of 24,000 mg/kg and 50,000 mg/kg and soluble (TCLP) lead concentrations of 3.1 mg/l and 16 mg/l.

Summaries of the analytical laboratory test results for paint are presented on Table 2.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Asbestos

NESHAP regulations do not require that asbestos-containing bolt thread compound or rail shims (Category I nonfriable/nonhazardous materials) identified during our survey be removed prior to renovation or demolition, or treated as hazardous waste. However, the disturbance of these materials is still covered by the Cal/OSHA asbestos standard. We recommend that a licensed contractor registered with Cal/OSHA for asbestos-related work perform any activities that will disturb the barrier rail shims or thread compound. Contractors are responsible for segregating and characterizing waste streams prior to disposal. Contractors are responsible for informing the landfill of the contractor's intent to dispose of asbestos-containing waste.

We also recommend the notification of contractors (that will be conducting demolition, or related activities) of the presence of asbestos in their areas (i.e., provide the contractor[s] with a copy of this report and a list of asbestos removed during subsequent activities). Contractors who are not trained for asbestos-related work should be instructed not to disturb asbestos.

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

Intact LCP identified during our survey would be considered a California and Federal hazardous waste based on lead content if it were stripped, blasted, or otherwise separated from the substrate. We recommend that all paints at the project location be treated as lead-containing for purposes of determining the applicability of the Cal/OSHA lead standard during any future maintenance, renovation, and demolition activities. This recommendation is based on LCP sample results 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.

7.0 REPORT LIMITATIONS

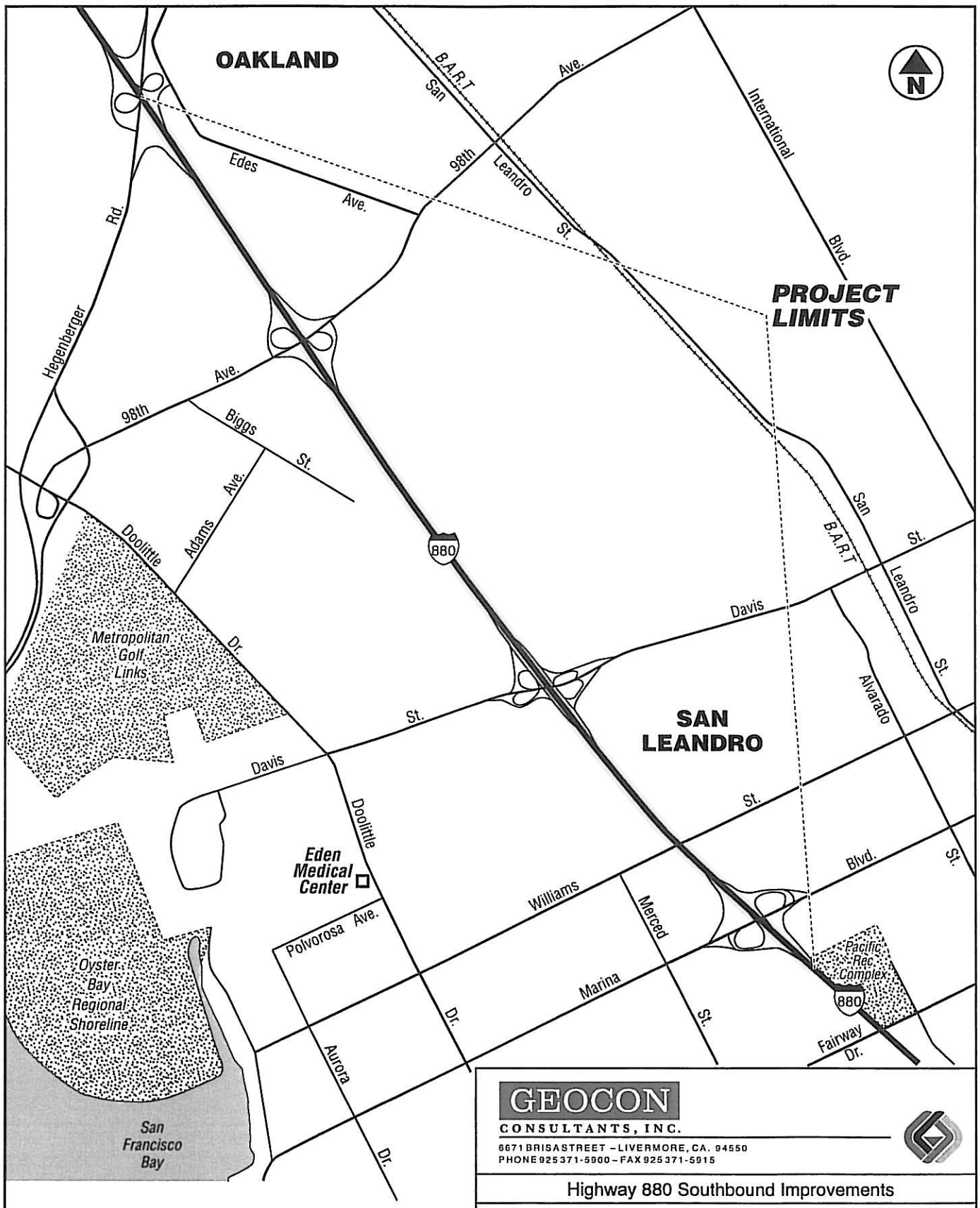
This report has been prepared exclusively for Rajappan & Meyer Consulting Engineers, Inc. The information contained herein is only valid as of the date of the report, and will require an update to reflect additional information obtained.

The asbestos and deteriorated LCP survey was conducted in conformance with generally accepted standards of practice for identifying and evaluating asbestos and LCP in structures. The survey addressed only the structures identified in Section 1.1. Due to the nature of building surveys, asbestos and LCP use, and laboratory analytical limitations, some asbestos or deteriorated LCP in the structures may not have been identified. Building spaces, such as wall cavities, crawlspaces, voids, and pipe chases, may have been concealed to Geocon's investigator. Previous 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. Asbestos and/or LCP may exist in areas not accessible or sampled in conjunction with our scope of services.

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 additional suspect materials are found, they should be treated as ACM until/unless sampling and analysis indicate otherwise.

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 author who is responsible for the facts and accuracy of the data presented herein. This report does not constitute a standard, specification, or regulation.



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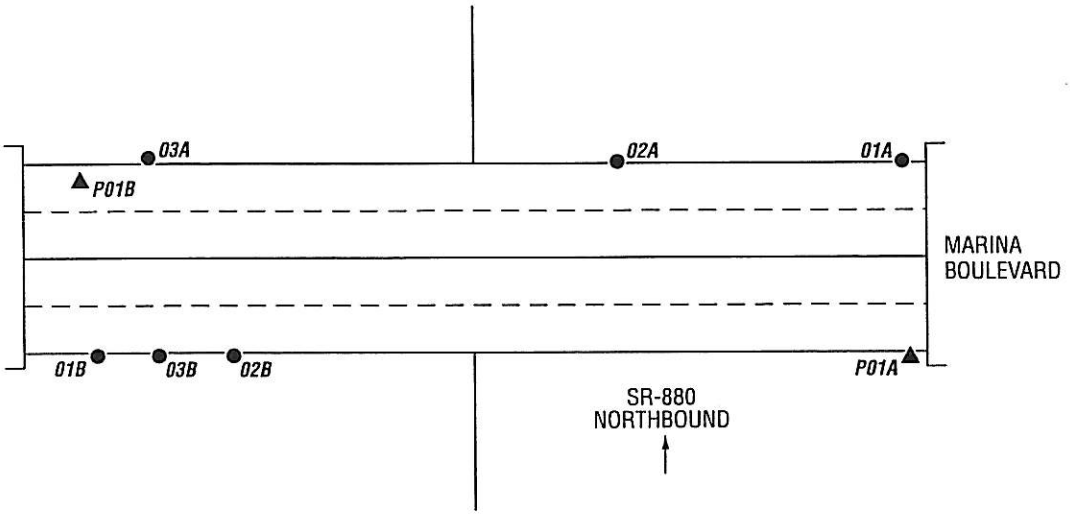
Highway 880 Southbound Improvements

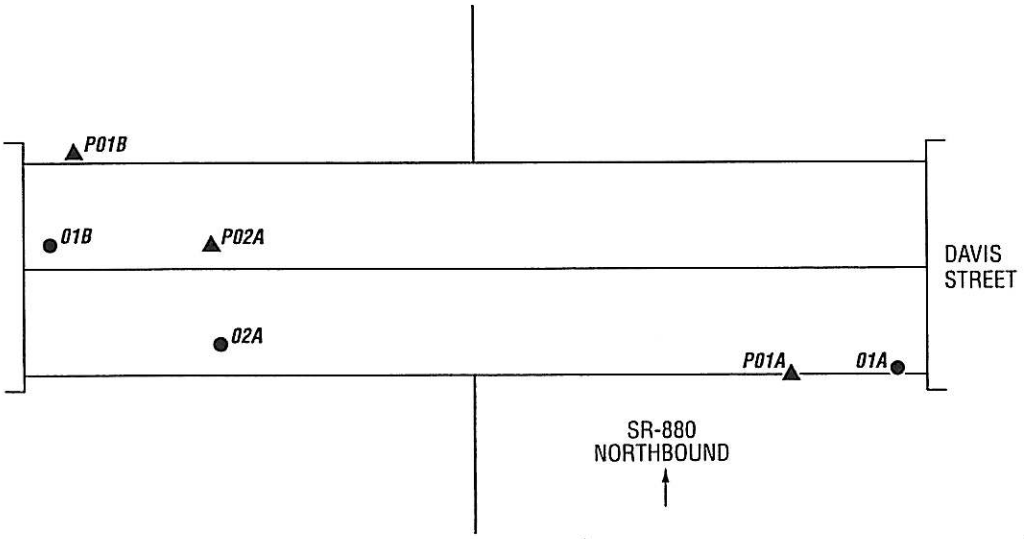
Oakland & San Leandro,
California

VICINITY MAP

E8449-06-01	December 2008	Figure 1



BRIDGE NO. 33-0167



BRIDGE NO. 33-0168

NOT TO SCALE

LEGEND:

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

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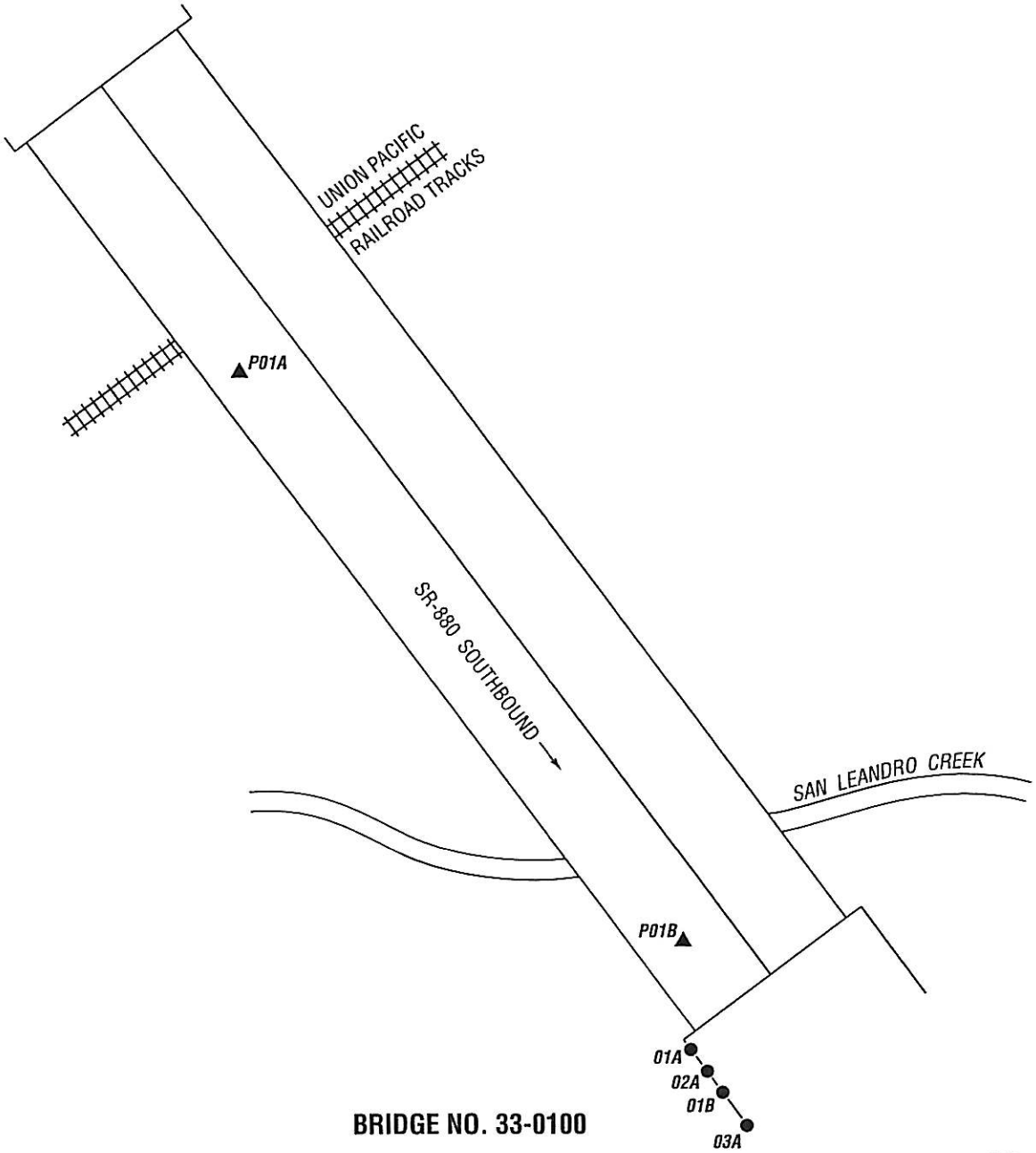
California

SITE PLAN

E8449-06-01	December 2008	Figure 2A



NOT TO SCALE

LEGEND:

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

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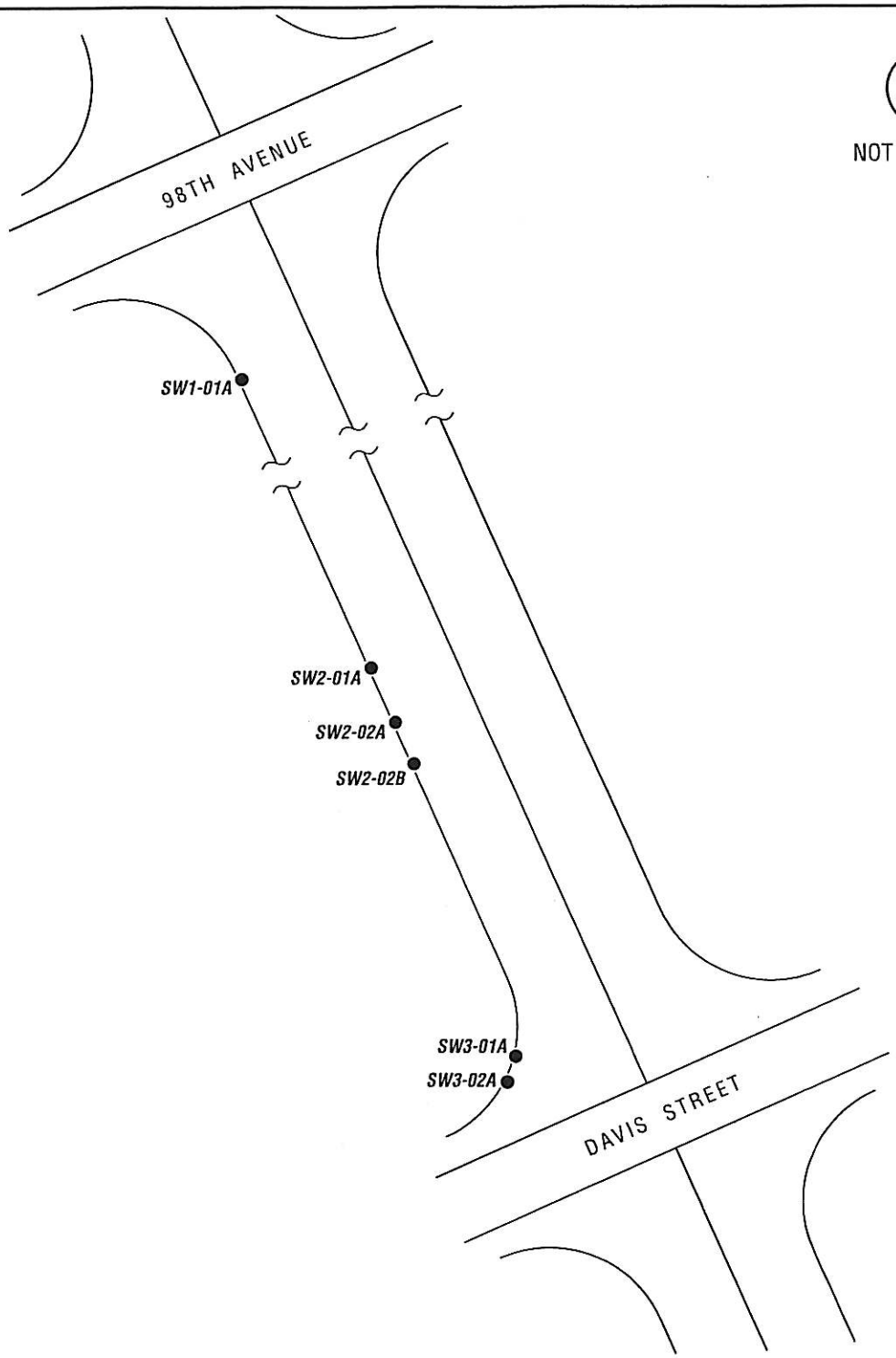
Highway 880 Southbound Improvements Project

Oakland/San Leandro, California

SITE PLAN

E8449-06-01	December 2008	Figure 2B



NOT TO SCALE

LEGEND:

- Approximate Asbestos Sample Location

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Highway 880 Southbound Improvements Project

Oakland/San Leandro,
California

SITE PLAN

E8449-06-01	December 2008	Figure 2C

Photo 1 – Marina Boulevard OC (Bridge No. 33-0167) span

Photo 2 – Asbestos-containing bolt thread compound use on guard rails system at Marina Boulevard OC

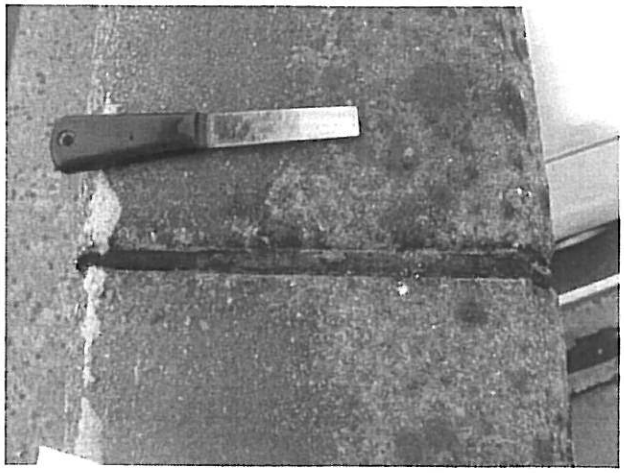

Photo 3 – Brown fiberboard (not asbestos containing material) on the Marina Boulevard OC

Photo 4 – Asbestos-containing rail shim use on guard rails system at the Marina Boulevard OC

Photo 5 – Typical bridge deck joint material (non-suspect) at the Marina Boulevard OC

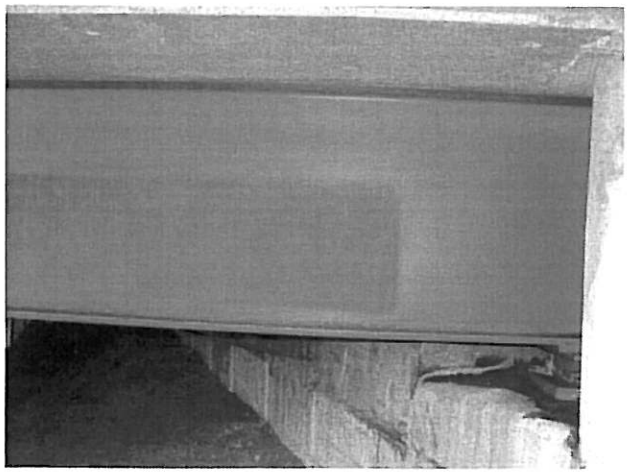

Photo 6 – Typical intact paint used on girder system at the Marina Boulevard OC

Photo 7 – Davis Street OC (Bridge No. 33-0168) span

Photo 8 – Brown fiberboard (not asbestos containing material) on the Davis Street OC

Photo 9 – Brown fiberboard (not asbestos containing material) on the Davis Street OC

Photo 10 – Typical bridge deck joint material (non-suspect) at the Davis Street OC

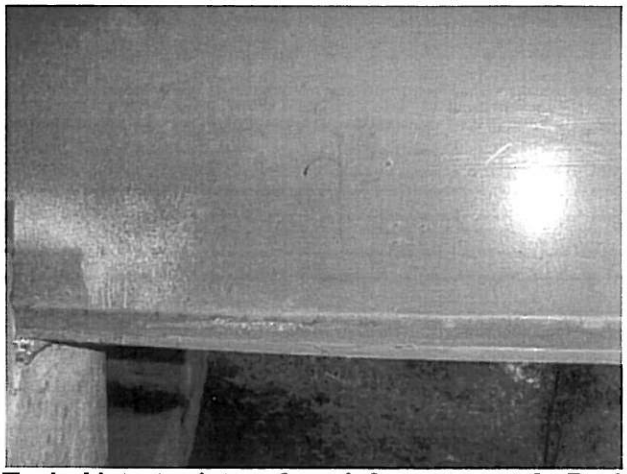

Photo 11 – Typical intact paint used on girder system at the Davis Street OC

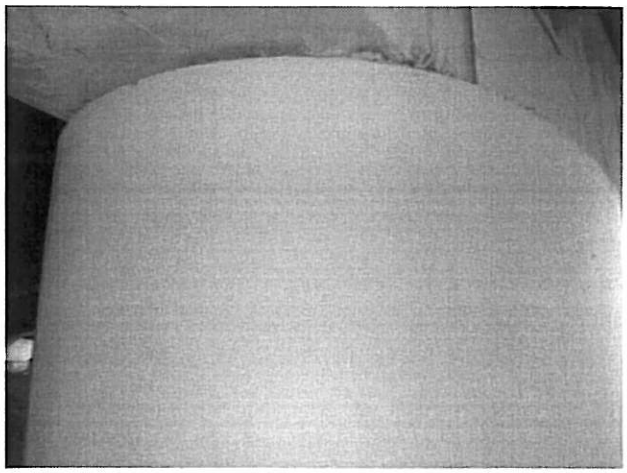

Photo 12 – Typical intact paint used on bridge bents at the Davis Street OC

Photo 13 – San Leandro Creek Bridge (Bridge No. 33-0100) span

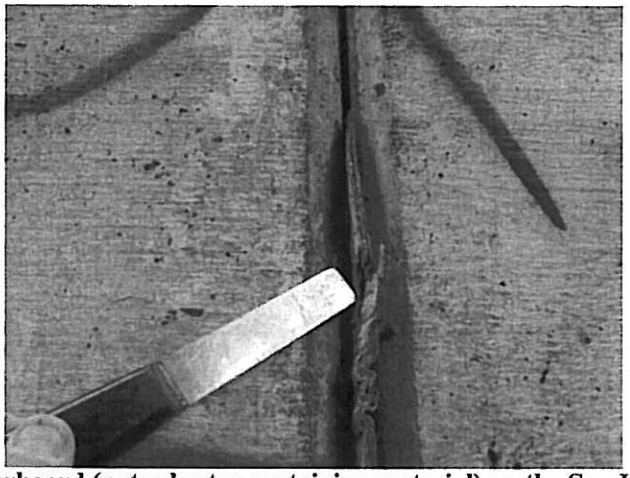

Photo 14 – Brown fiberboard (not asbestos containing material) on the San Leandro Creek Bridge

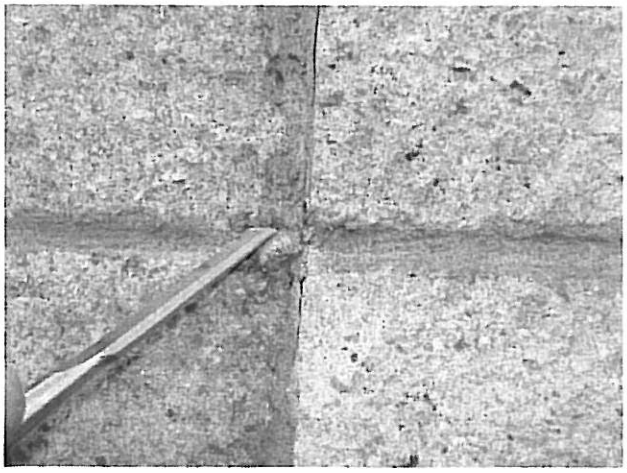

Photo 15 – Mortar (not asbestos containing material) on the San Leandro Creek Bridge

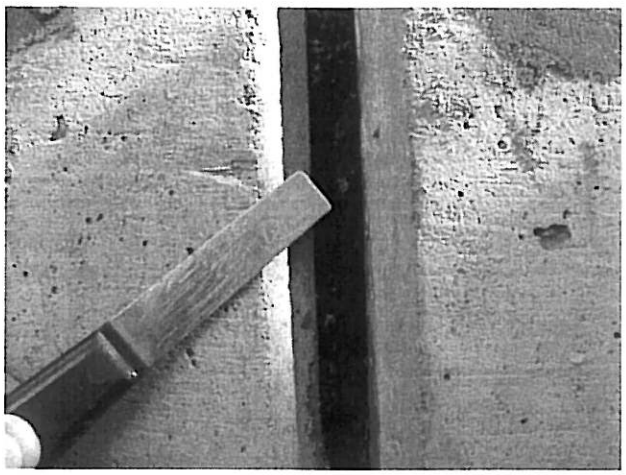

Photo 16 – Brown fiberboard (not asbestos containing material) on the San Leandro Creek Bridge

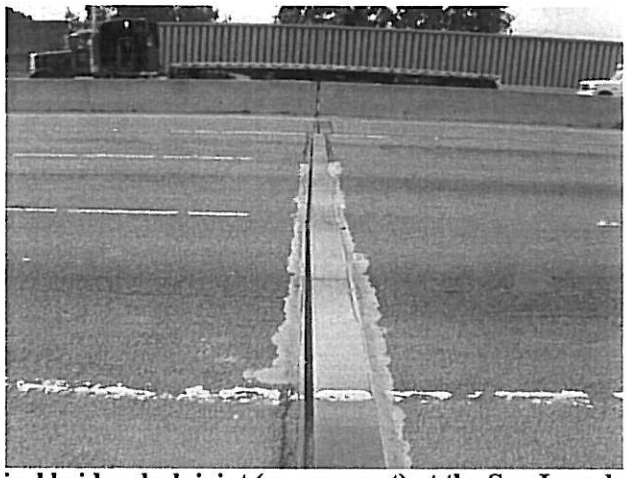

Photo 17 – Typical bridge deck joint (non-suspect) at the San Leandro Creek Bridge

Photo 18 – Typical intact paint used on girder system at the San Leandro Creek Bridge

Photo 19 – Soundwall at 98th Avenue entrance ramp to southbound Highway 880

Photo 20– Southbound Highway 880 soundwall south of San Leandro Bridge

Photo 21 – Soundwall at Davis Street exit ramp from southbound Highway 880

Photo 22– Typical mortar (not asbestos containing material) used at soundwalls within the project area

Photo 23 – Typical brown fiberboard (not asbestos containing material) at soundwalls within the project area

TABLE 1
SUMMARY OF ANALYTICAL TEST RESULTS - ASBESTOS
HIGHWAY 880 SOUTHBOUND IMPROVEMENTS PROJECT
OAKLAND AND SAN LEANDRO, CALIFORNIA

Polarized Light Microscopy (PLM) - EPA Test Method 600/R-93/116						
Bridge No.	Sample Group No.	Description of Material	Approximate Quantity	Friable	Site Photo	Asbestos Content
33-0167	167-01	Thread sealant	unable to quantify	No	2	5-6% chrysotile
	167-02	Brown fiberboard	NA	NA	3	ND
	167-03	Shims (barrier rail)	15 square feet (multi-layered)	No	4	40% chrysotile
33-0168	168-01	Brown fiberboard	NA	NA	8	ND
	168-02	Brown fiberboard	NA	NA	9	ND
33-0100	100-01	Brown fiberboard	NA	NA	14	ND
	100-02	Mortar	NA	NA	15	ND
	100-03	Brown fiberboard	NA	NA	16	ND

Notes:

NA = Not applicable (no asbestos detected)

ND = Not detected

TABLE 2
SUMMARY OF ANALYTICAL TEST RESULTS - PAINT
HIGHWAY 880 SOUTHBOUND IMPROVEMENTS PROJECT
OAKLAND AND SAN LEANDRO, CALIFORNIA

Bridge No.	Sample No.	Paint Description	Approximate Quantity Peeling/Flaking	Site Photo	Total Lead (mg/kg)	WET Lead (mg/l)	TCLP Lead (mg/l)
33-0167	167-P01A	Green Paint (girder system)	Intact	6	32	NA	NA
	167-P01B				290,000	NA	110
33-0168	168-P01A	Green Paint (girder system)	Intact	11	180,000	NA	830
	168-P01B				300,000	NA	150
	168-P02A	White Paint (bridge bents)	Intact	12	87	<0.25	NA
33-0100	100-P01A	Green Paint (girder system)	Intact	18	24,000	NA	3.1
	100-P01A				50,000	NA	16

Notes:
mg/kg = milligrams per kilogram (EPA 6010)
mg/l = milligrams per liter
WET = Waste Extraction Test
TCLP = Toxicity Characteristic Leaching Procedure
<= Less than the indicated laboratory method detection limits
NA = Not analyzed

04-Ala-880
PM 22056/24.0
EA 04-3A9211

I-880 Southbound HOV Lane Project
Alameda County, California

Non-Storm Water Information Handout

Prepared by
WMH Corporation

March 21, 2012

Purpose and Objective

The purpose of this Informational Handout is to highlight and summarize key elements of the Contract Plans and Special Provisions related to non- storm water discharge management within the project site for Contract No. 04-03A9211. This Handout also provides additional guidance and information to assist the Contractor in complying with non- storm water discharge requirements. Non-storm water includes groundwater or storm water combined with groundwater.

The objective of providing this information is to assist the Contractor in developing an approach to non-storm water management at the site that will ensure that all necessary elements are taken into account so that chances of discharges of contaminated storm water and non-storm water discharge offsite during construction activities and non-compliance with the California Department of Transportation (Department) storm water permit are minimized. Proper storm water and non-storm water discharge management will be essential during the construction activities covered by this contract.

The site conditions and construction activities contain a number of elements that make storm water and non-storm water discharge management a significant challenge at this site. This Handout also provides guidance to assist the Contractor in eventual preparation of the Contractor storm water Pollution Prevention Plan (SWPPP) and the Dewatering and Discharge Plan (DDP).

It is critical that the Contractor makes every effort to ensure proper storm water and non storm water discharge management at this complex and challenging site. The Contractor is responsible for penalties assessed or levied on the Contractor or the Department as a result of the Contractor's failure to comply with the provisions in the Water Pollution Control and Non storm water Discharge Special provisions, including, but not limited to, compliance with the applicable provisions of the Permits, the Manuals, and Federal, State and local regulations and requirements as set forth therein,

This Handout docs not relieve the Contractor from having to account for all storm water and non storm water related discharges according to the special provisions for the full duration of the contract.

This Handout is designed to provide information to be used as guidance for the Contractor in preparing: required contract documents related to stormwater and non-stormwater discharge requirements. This Handout is not a substitute for all other specific requirements in the contract Plans and Special Provisions.

DEWATERING AND NON·STORM WATER DISCHARGECONTROL

Non-storm water includes groundwater or storm water combined with groundwater. This special provision covers work related to groundwater and non-storm water dewatering from, but not limited to construction work areas, sediment trap s and basin s, streams and creek s and excavations. This work involves collection, conveyance, treatment and disposal of dewatering discharges. Collection and conveyance may require temporary holding tanks, and will require pump s and piping to convey water from the holding tanks to the treatment system for turbidity removal and to the disposal location.

As part of the non-storm water discharge control work, the Contractor is to prepare a Dewatering and Discharge Plan (DDP) In general, the DDP should cover: construction areas and activities related to excavation and embankment areas that would result in a non-storm water discharges;

collection and conveyance systems for conveying the discharges to the treatment system for turbidity removal; staging areas for treatment systems; disposal of solids removed from the treatment systems; and the reuse of treated water for dust control and construction water for fill compaction.

The DDP will be reviewed by the Regional Water Quality Control Board and the Engineer. Until the DDP is approved, no discharges will be allowed from any dewatering operations.

The treatment system for turbidity will need to include, but not be limited to the following components: temporary holding tanks, sediment traps and/or basins, weir tanks, settling tanks, gravity bag filters, sand media filters, pressurized bag filters, cartridge filters, in-line flocculants, or a combination of these.

Reuse of treated water for dust control or fill compaction is required prior to considering discharges to the storm drain system or surface water body. Discharges for dust will need to be accomplished in a manner promote infiltration and not cause runoff to be generated.

If treatment does not result in compliance with Water Quality Requirements listed in this special provision, the water will need to be disposed off-site outside the right -o f-way at a Publicly Owned Treatment Work s (POTW). Information on the POTWs within Alameda County, and the contact information/location for obtaining a permit for discharge to the POTW as provided in this document.

Inspection, monitoring and reporting requirements include visual inspections, flow rate monitoring and water quality monitoring. Water quality measurements arc required for effluent turbidity and pH. In the event of an exceedance of the WQRs, all discharges will need to be terminated, and the Engineer will need to be notified. Discharges from dewatering operations shall commence after corrective actions are taken and verification sampling is done to ensure compliance with WQRs.

Based on the results of the soil investigation for the project, it appears that the foundation for the bridge and retaining wall footings elevations are above groundwater level and dewatering of groundwater operations is not expected to be significant.

04-Ala-880
PM 22.6/24.0
(04-3A9211)

I-880 Southbound HOV Lane Project
Alameda County, California
(04-3A9211)
June 2011

Storm Water Information Handout

Prepared for:

Prepared by:

June 2011

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Appendix A Notice of Intent (NOI)
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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 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 OVERVIEW

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 Construction General Permit (CGP), which became effective as of July 1, 2010; 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 (NOI) 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 Section 3.1 of this document for details.

A risk assessment was done for the **I-880 Southbound HOV Lane Project**, and the Project was determined to be **RL 2.**

RL2 projects are subject to best management practice (BMP) implementation and visual monitoring requirements, in addition to monitoring and sampling requirements and Numeric Action Levels (NALs) for pH and turbidity.

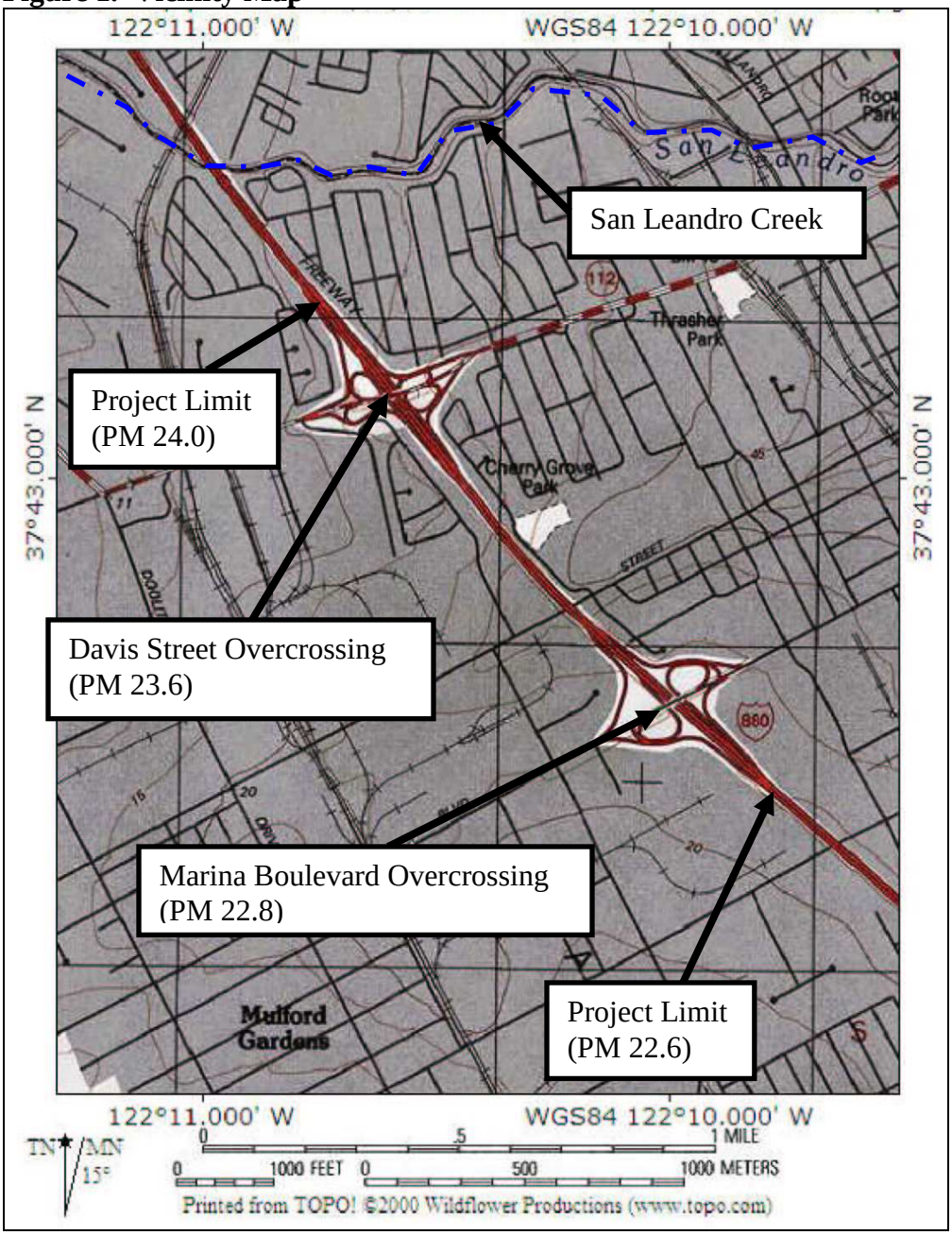
All projects will have to upload storm water data into SMARTS, such as Notices of Intent (NOIs), SWPPPs, annual reports, and monitoring data, as applicable.

2 GENERAL PROJECT INFORMATION

2.1 Location

The Project is located in Alameda County along Interstate 880 (I-880) approximately 1,700 feet south of the Marina Boulevard Overcrossing (PM 22.6) to just north of the Davis Street Interchange (PM 24.0), see Figure 1.

Figure 1. Vicinity Map



Source: USGS

2.2 Major Engineering Features

The Project involves extending the existing southbound high-occupancy vehicle (HOV) lane along I-880 from PM 22.6 to just PM 24.0. The proposed improvements will widen the southbound mainline to the outside to provide the additional width for a standard HOV lane; replace the Davis Street and Marina Boulevard overcrossings to increase lateral clearance and provide standard vertical clearance over the freeway; reconstruct interchange ramps at the Davis Street and Marina Boulevard interchanges to conform to new elevations; construct retaining walls, relocate underground drainage and utilities, reconstruct electrical facilities, and construct other associated highway improvements.

2.3 Receiving Water Bodies

The Project is within the jurisdiction of the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB).

The Project location is within hydrologic sub-area 204.20, which is described as being within the South Bay hydrologic unit and East Bay Cities hydrologic area.

The only receiving water body for the Project is San Francisco Bay, Lower, located approximately 1.2 miles west of the Project area.

The San Francisco Bay, Lower is on the 2006 Clean Water Act Section 303(d) List (see Table 1)

Table 1. San Francisco Bay, Lower 303(d) List Summary

Pollutant	Source	Proposed or US EPA Approved TDML Completion Date
Chlordane	Nonpoint Source	2008
DDT	Nonpoint Source	2008
Dieldrin	Nonpoint Source	2008
Dioxin Compounds	Atmospheric Deposition	2019
Exotic Species	Ballast Water	2019
Furan Compounds	Atmospheric Deposition	2019
Mercury	Atmospheric Deposition Industrial Point Sources Municipal Point Sources Natural Sources Nonpoint Sources Resource Extraction	2006
PCBs (Polychlorinated Biphenyls)	Unknown Nonpoint Source	2006
PCBs (Polychlorinated Biphenyls) (Dioxin-like)	Unknown Nonpoint Source	2019

Beneficial uses for San Francisco Bay, Lower include:

- Potential Beneficial Uses:
  - Fish Spawning (SPWN)

- Existing Beneficial Uses
  - Industrial Service Supply (IND)
  - Ocean, Commercial and Sport Fishing (COMM)
  - Shellfish Harvesting (SHELL)
  - Estuarine Habitat (EST)
  - Fish Migration (MIGR)
  - Preservation of Rare and Endangered Species (RARE)
  - Wildlife Habitat (WILD)
  - Water Contact Recreation (REC-1)
  - Non Contact Recreation (REC-2)
  - Navigation (NAV)

2.4 Climate and Rainfall

The National Oceanic and Atmospheric Administration (NOAA) Atlas 2, Volume XI was used to determine the compliance storm event depth (see Figure 2). A NOAA weather station located at the Oakland Museum, approximately 8 miles northwest of the Project site was used to obtain precipitation data (see Figure 3)

Compliance Storm Event (rainfall total for the 5 year, 24 hour storm)	3.3 inches
Rainy days per year (assumed equal to precipitation 0.10 inches or greater):	41.7 days
Qualifying rain events per year (precipitation 0.5 inches or greater):	15.6 days

Figure 2. From NOAA Atlas 2, Volume XI (5-year, 24 hour, in tenths of inches)

Source: NOAA

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data,
and Information Service

Climatography of the United States No. 20 1971-2000

National Climatic Data Center
Federal Building
151 Patton Avenue
Asheville, North Carolina 28801
www.ncdc.noaa.gov

Station: OAKLAND MUSEUM, CA

COOP ID: 046336

Climate Division: CA 4 **NWS Call Sign:** **Elevation: 30 Feet** **Lat: 37°48N** **Lon: 122°16W**

Precipitation (inches)

	Precipitation Totals									Mean Number of Days (3)				Precipitation Probabilities (1) Probability that the monthly/annual precipitation will be equal to or less than the indicated amount										
	Means/ Medians(1)		Extremes							Daily Precipitation				Monthly/Annual Precipitation vs Probability Levels These values were determined from the incomplete gamma distribution										
Month	Mean	Med-ian	Highest Daily(2)	Year	Day	Highest Monthly(1)	Year	Lowest Monthly(1)	Year	>= 0.01	>= 0.10	>= 0.50	>= 1.00	.05	.10	.20	.30	.40	.50	.60	.70	.80	.90	.95
Jan	4.85	4.23	4.74	1982	4	12.45	1998	.31	1976	10.5	7.9	3.2	1.4	.45	.79	1.44	2.12	2.85	3.69	4.68	5.92	7.62	10.46	13.24
Feb	4.27	3.84	3.05	2000	13	15.14	1998	.21	1995	10.1	7.2	3.1	1.2	.31	.58	1.13	1.71	2.37	3.12	4.03	5.18	6.78	9.48	12.15
Mar	3.56	2.81	2.87	1982	31	9.83	1983	.03	1988	10.5	6.8	2.8	.6	.27	.50	.96	1.45	1.99	2.62	3.37	4.33	5.65	7.87	10.07
Apr	1.38	1.00	2.07	1974	1	4.13	1982	.00	1977	5.9	3.1	.8	.2	.04	.13	.31	.51	.73	.98	1.29	1.68	2.22	3.14	4.04
May	.57	.12	1.73	1996	15	2.98	1998	.00+	1992	3.0	1.3	.3	.1	.00	.00	.00	.03	.10	.21	.36	.59	.95	1.62	2.35
Jun	.11	.02	.44	1988	6	.92	1995	.00+	1996	1.0	.4	.0	.0	.00	.00	.00	.00	.00	.02	.05	.11	.19	.34	.50
Jul	.07	.00	.95	1974	8	1.19	1974	.00+	2000	.3	.2	@	.0	.00	.00	.00	.00	.00	.00	.00	.00	.01	.16	.37
Aug	.10	.00	1.00	1997	19	1.25	1997	.00+	2000	.7	.2	.1	@	.00	.00	.00	.00	.00	.00	.00	.00	.06	.29	.53
Sep	.33	.07	.78	1989	16	1.54	1986	.00+	1995	1.8	.9	.2	.0	.00	.00	.00	.00	.04	.11	.21	.36	.58	.98	1.41
Oct	1.33	1.14	2.06	1992	29	4.25	1972	.00	1978	3.8	2.2	.9	.4	.02	.09	.24	.42	.63	.88	1.19	1.59	2.17	3.15	4.14
Nov	3.14	2.42	4.15	1994	5	9.67	1973	.07	1995	8.5	5.5	2.2	.7	.13	.29	.64	1.05	1.53	2.11	2.82	3.75	5.07	7.35	9.63
Dec	3.23	3.06	3.43	1979	24	8.90	1996	.00	1989	8.7	6.0	2.0	.8	.32	.70	1.23	1.70	2.18	2.70	3.28	3.99	4.93	6.45	7.90
Ann	22.94	21.02	4.74	Jan 1982	4	15.14	Feb 1998	.00+	Aug 2000	64.8	41.7	15.6	5.4	10.37	12.40	15.21	17.49	19.62	21.76	24.05	26.67	29.96	34.96	39.47

+ Also occurred on an earlier date(s)
# Denotes amounts of a trace
@ Denotes mean number of days greater than 0 but less than .05
** Statistics not computed because less than six years out of thirty had measurable precipitation

(1) From the 1971-2000 Monthly Normals
(2) Derived from station's available digital record: 1970-2001
(3) Derived from 1971-2000 serially complete daily data
Complete documentation available from:
www.ncdc.noaa.gov/oa/climate/normals/usnormals.html

152-B

Figure 3. Rainfall Data

Source: NOAA

2.5 Soils and Geology

A soil map for the Project is obtained from the United States Department of Agriculture Natural Resources Conservation Service (NRCS) "Web Soil Survey" is shown in Figure 4. Table 2 lists the soil types and the soil erodibility factor (K) by soil type.

2.6 Hazardous Waste

Site investigations revealed that the top 2.0 to 2.5 feet of exposed soil at selected locations is likely to be classified as hazardous because it contains Aerially Deposited Lead (ADL). The Project does not involve reuse of soil containing ADL. All soil containing ADL within the Project area will be hauled off-site.

2.7 Existing (Pre-Construction) Control Practices

There are no existing treatments BMPs within the Project limits.

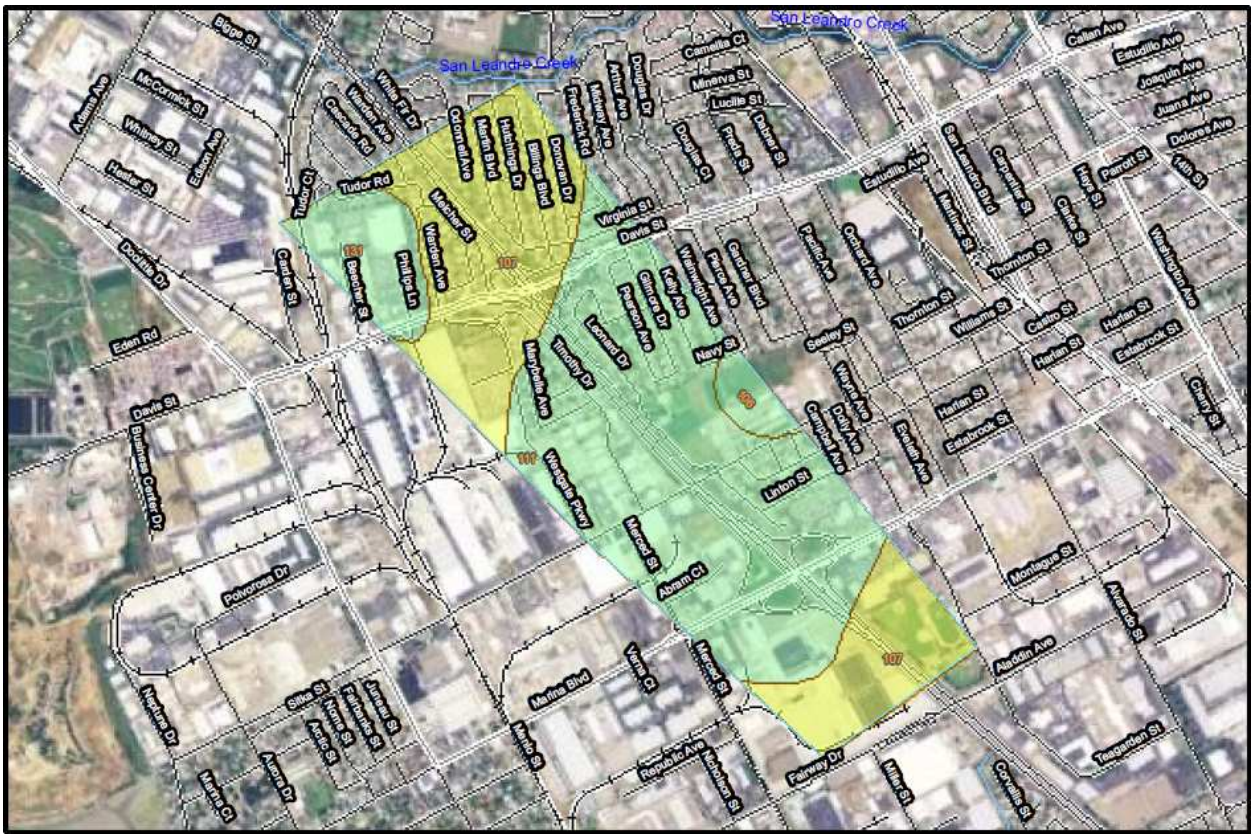


Figure 4. Soil Map

Source: NRCS

Table 2. K Rock Free Rating by soil type

K Factor, Rock Free— Summary by Map Unit — Alameda County, California, Western Part				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
106	Botella loam, 0 to 2 percent slopes	.28	11.8	2.5%
107	Clear Lake clay, 0 to 2 percent slopes, drained	.20	170.6	35.8%
111	Danville silty clay loam, 0 to 2 percent slopes	.28	256.9	53.9%
131	Omni silty clay loam, drained	.28	37.1	7.8%
Totals for Area of Interest			**476.4**	**100.0%**

Note: 1. Rating - Soil erodibility factor (K)
2. AOI – Area of Interest

Source: NRCS

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 **Medium Site Sediment Risk Factor** and a **Low Receiving Water Risk Factor**; the combined risk is **Level 2**. The risk factors are detailed in the following sections.

3.1.1 Sediment Risk

The sediment risk is based on the following equation from the CGP "Fact Sheet" (Section J.1.a pg. 28):

Equation 1. Sediment Risk Equation
A = (R)(K)(LS)(C)(P)

Where:

R = Runoff erosivity factor
K = Soil erodibility factor
LS = Length-slope
C = Cover
P = Management operations and support practices
A = Rate of sheet and rill erosion (tons per acre)

The rainfall runoff erosivity factor (R) of **123.29** was determined from the United States Environmental Protection Agency (EPA) "Rainfall Erosivity Factor Calculator for Small Construction Sites," see Figure 5

The weighted average K of **0.25** was calculated based on the values shown in Table 2.

The length-slope factor (LS) of **0.86** was determined by examining the original grade delineated electronic cross sections, see Table 3.

The cover factor (C) and management operations and support practices (P) are given values of 1.0 by the CGP to simulate bare ground conditions.

Based on these factors, the rate of sheet and rill erosion (A) is **27** tons per acre. Because this value is between 15 and 75, the Project is classified as having a medium sediment risk.

Rainfall Erosivity Factor Calculator for Small Construction Sites

Facility Information

Facility Name: 04-3A9211 I-880 Southbound HOV Lane Project
Start Date: 09/01/2012
End Date: 09/30/2015
Latitude: 37.7149
Longitutde: -122.1725

Erosivity Index Calculator Results

AN EROSIVITY INDEX VALUE OF **123.29** HAS BEEN DETERMINED FOR THE CONSTRUCTION PERIOD OF **09/01/2012 - 09/30/2015**.

A rainfall erosivity factor of 5.0 or greater has been calculated for your site and period of construction.
You do not qualify for a waiver from NPDES permitting requirements.

Figure 5. R Factor

Source: U.S. EPA

Table 3. LS Factor

Sheet Flow Length (ft)	Average Watershed Slope (%) 0.2	0.5	1.0	2.0	3.0	4.0	5.0
<3	0.05	0.07	0.09	0.13	0.17	0.20	0.23
6	0.05	0.07	0.09	0.13	0.17	0.20	0.23
9	0.05	0.07	0.09	0.13	0.17	0.20	0.23
12	0.05	0.07	0.09	0.13	0.17	0.20	0.23
15	0.05	0.07	0.09	0.13	0.17	0.20	0.23
25	0.05	0.07	0.10	0.16	0.21	0.26	0.31
50	0.05	0.08	0.13	0.21	0.30	0.38	0.46
75	0.05	0.08	0.14	0.25	0.36	0.47	0.58
100	0.05	0.09	0.15	0.28	0.41	0.55	0.68
150	0.05	0.09	0.17	0.33	0.50	0.68	0.86
200	0.06	0.10	0.18	0.37	0.57	0.79	1.02

Source: CGP

	A	B	C
1	**Sediment Risk Factor Worksheet**		**Entry**
2	**A) R Factor**		
3	Analyses of data indicated that when factors other than rainfall are held constant, soil loss is directly proportional to a rainfall factor composed of total storm kinetic energy (E) times the maximum 30-min intensity (I30) (Wischmeier and Smith, 1958). The numerical value of R is the average annual sum of EI30 for storm events during a rainfall record of at least 22 years. "Isoerodent" maps were developed based on R values calculated for more than 1000 locations in the Western U.S. Refer to the link below to determine the R factor for the project site.		
4	http://cfpub.epa.gov/npdes/stormwater/LEW/lewCalculator.cfm		
5	**R Factor Value**		123.29
6	**B) K Factor (weighted average, by area, for all site soils)**		
7	The soil-erodibility factor K represents: (1) susceptibility of soil or surface material to erosion, (2) transportability of the sediment, and (3) the amount and rate of runoff given a particular rainfall input, as measured under a standard condition. Fine-textured soils that are high in clay have low K values (about 0.05 to 0.15) because the particles are resistant to detachment. Coarse-textured soils, such as sandy soils, also have low K values (about 0.05 to 0.2) because of high infiltration resulting in low runoff even though these particles are easily detached. Medium-textured soils, such as a silt loam, have moderate K values (about 0.25 to 0.45) because they are moderately susceptible to particle detachment and they produce runoff at moderate rates. Soils having a high silt content are especially susceptible to erosion and have high K values, which can exceed 0.45 and can be as large as 0.65. Silt-size particles are easily detached and tend to crust, producing high rates and large volumes of runoff. Use Site-specific data must be submitted.		
8	Site-specific K factor guidance		
9	**K Factor Value**		0.25
10	**C) LS Factor (weighted average, by area, for all slopes)**		
11	The effect of topography on erosion is accounted for by the LS factor, which combines the effects of a hillslope-length factor, L, and a hillslope-gradient factor, S. Generally speaking, as hillslope length and/or hillslope gradient increase, soil loss increases. As hillslope length increases, total soil loss and soil loss per unit area increase due to the progressive accumulation of runoff in the downslope direction. As the hillslope gradient increases, the velocity and erosivity of runoff increases. Use the LS table located in separate tab of this spreadsheet to determine LS factors. Estimate the weighted LS for the site prior to construction.		
12	LS Table		
13	**LS Factor Value**		0.86
14			
15	**Watershed Erosion Estimate (=RxKxLS) in tons/acre**	27	
16	**Site Sediment Risk Factor**	**Medium**	
17	Low Sediment Risk: < 15 tons/acre		
18	Medium Sediment Risk: >=15 and <75 tons/acre		
19	High Sediment Risk: >= 75 tons/acre		
20			

Figure 6. Sediment Risk Assessment

3.1.2 Receiving Water Body Risk

Because the San Francisco Bay, Lower, is not on the 303(d) listed as impaired for sediment and does not have the combined beneficial uses of SPWN, COLD, and MIGR, the receiving water body risk for this Project is low (Figure 7).

Receiving Water (RW) Risk Factor Worksheet	**Entry**	**Score**
A. Watershed Characteristics	**yes/no**	
A.1. Does the disturbed area discharge (either directly or indirectly) to a **303(d)-listed waterbody impaired by sediment**? For help with impaired waterbodies please check the attached worksheet or visit the link below: 2006 Approved Sediment-impared WBs Worksheet http://www.waterboards.ca.gov/water_issues/programs/tmdl/303d_lists2006_epa.shtml **OR** A.2. Does the disturbed area discharge to a waterbody with designated beneficial uses of SPAWN & COLD & MIGRATORY? http://www.ice.ucdavis.edu/geowbs/asp/wbguse.asp	**NO**	**Low**

Figure 7. Receiving Water Body Risk Assessment

Figure 8 shows the combined RL matrix for the sediment and receiving water risks.

Combined Risk Level Matrix

Receiving Water Risk	Sediment Risk: Low	Sediment Risk: Medium	Sediment Risk: High
Low	Level 1	Level 2	
High	Level 2		Level 3

Project Sediment Risk: Medium
Project RW Risk: Low
Project Combined Risk: Level 2

Figure 8. Combined RL Matrix

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 CGP "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

Below is a list forms that have been developed by the Caltrans Division of Construction, as of 06/2011, to comply with the CGP. For a full list of Division of Construction Forms go to: http://www.dot.ca.gov/hq/construc/forms.htm.

- CEM-2030 "Stormwater Site Inspection Report"
- CEM-2034 "Stormwater Best Management Status Report"
- CEM-2035 "Stormwater Site Inspection Report Corrective Actions Summary"
- CEM-2045 "Rain Event Action Plan-Highway Construction Phase"
- CEM-2090 "Notice of Completion of Construction"

4 RUN-ON DISCHARGES

There are minimal anticipated run-on discharges within the Project limits. Based on the contour grading, the Project primarily consists of placing fill or has existing or proposed retaining walls that should prevent any run-on. While run-on is anticipated to be minimal, the Contractor is responsible for determining any actual run-on discharges based on anticipated in-field work and document measures to address run-on discharges in the SWPPP.

Generally, the Rational Method is used to calculate the run-on discharges.

Equation 1. Rational Method for run-on discharge

$$Q = CiA$$

Where:

Q = Run-on discharge (cubic feet per second)
C = Runoff coefficient = **0.8**
i = 2-year, 24-hour rainfall intensity (inches/hour) = **0.102**
A = Drainage area (acre)

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 the 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 CGP. 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. Locations of sensitive habitats, watercourses, or other features which are not to be disturbed
    m. Locations of all post-construction BMPs
    n. 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 documentation
    ii. Sediment sensitive water bodies list
    iii. EPA Rainfall Erosivity Factor Calculator Website
    iv. Sediment risk documentation

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

The SWPPP should be submitted with the PRDs and will be forthcoming from the Contractor.

5.3 Notice of Intent (NOI)

Caltrans will be responsible for submitting the NOI to SMARTS. The contractor should provide Caltrans with the information necessary to complete the NOI. The NOI must be submitted once the contractor submits the SWPPP. A draft of the NOI is included in Appendix A.

5.4 Site Maps

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

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

Appendix A Notice of Intent (NOI)

Attachment 2

State Water Resources Control Board

NOTICE OF INTENT

TO COMPLY WITH THE TERMS OF THE
GENERAL PERMIT TO DISCHARGE STORM WATER
ASSOCIATED WITH CONSTRUCTION ACTIVITY (WQ ORDER No. 99-08-DWQ)

I. NOI STATUS (SEE INSTRUCTIONS)

MARK ONLY ONE ITEM 1. [ ] New Construction 2. [ ] Change of Information for WDID#

II. PROPERTY OWNER

Name: California Department of Transportation	Contact Person: Bijan Sartipi		
Mailing Address: 111 Grand Ave.	Title: District Director		
City: Oakland	State: CA	Zip: 94623	Phone: (510) 286-5900

Owner Type (*check one*) 1.[ ] Private Individual 2.[ ] Business 3.[ ] Municipal 4.[X] State 5.[ ] Federal 6.[ ] Other

III. DEVELOPER/CONTRACTOR INFORMATION

Developer/Contractor	Contact Person		
Mailing Address	Title		
City	State	Zip	Phone

IV. CONSTRUCTION PROJECT INFORMATION

Site/Project Name: I-880 Southbound HOV Lane Project	Site Contact Person		
Physical Address/Location: I-880 from Marina Blvd to Davis Street	Latitude: 37.714°	Longitude: 122.17°	County: Alameda
City (or nearest City): San Leandro	Zip: 94577	Site Phone Number	Emergency Phone Number

A. Total size of construction site area: _____ Acres

B. Total area to be disturbed: 24.46 Acres (% of total _____)

C. Percent of site imperviousness (including rooftops):

Before Construction: _____%

After Construction: _____%

D. Tract Number(s): _____, _____

E. Mile Post Marker: 22.6/24.0

F. Is the construction site part of a larger common plan of development or sale?

[ ] YES [X] NO

G. Name of plan or development:

H. Construction commencement date: 09 / ____ / 12

I. % of site to be mass graded: _____

J. Projected construction dates:

Complete grading: ____/____/____ Complete project: 09 / ____ / 15

K. Type of Construction (Check all that apply):

1. [ ] Residential 2. [ ] Commercial 3. [ ] Industrial 4. [ ] Reconstruction 5. [X] Transportation

6. [ ] Utility Description: _____ 7. [ ] Other (Please List): _____

V. BILLING INFORMATION

SEND BILL TO: [X] OWNER (as in II. above)	Name	Contact Person	
[ ] DEVELOPER (as in III. above)	Mailing Address	Phone/Fax	
[ ] OTHER (enter information at right)	City	State	Zip

VI. REGULATORY STATUS

A. Has a local agency approved a required erosion/sediment control plan?..... ☒ YES ☐ NO

Does the erosion/sediment control plan address construction activities such as infrastructure and structures?..... ☒ YES ☐ NO

Name of local agency: California Department of Transportation Phone: _____

B. Is this project or any part thereof, subject to conditions imposed under a CWA Section 404 permit of 401 Water Quality Certification?..... ☐ YES ☒ No

If yes, provide details: _____

VII. RECEIVING WATER INFORMATION

A. Does the storm water runoff from the construction site discharge to (Check all that apply):

1. ☒ **Indirectly to waters of the U.S.**
2. ☒ **Storm drain system - Enter owner's name:** California Department of Transportation and Alameda County
3. ☐ **Directly to waters of U.S. (e.g. , river, lake, creek, stream, bay, ocean, etc.)**

B. Name of receiving water: (river, lake, creek, stream, bay, ocean): San Francisco Bay, Lower

VIII. IMPLEMENTATION OF NPDES PERMIT REQUIREMENTS

A. STORM WATER POLLUTION PREVENTION PLAN (SWPPP) (check one)

☐ A SWPPP has been prepared for this facility and is available for review: Date Prepared: ____/____/____ Date Amended: ____/____/____

☐ A SWPPP will be prepared and ready for review by (enter date): ____/____/____

☐ A tentative schedule has been included in the SWPPP for activities such as grading, street construction, home construction, etc.

B. MONITORING PROGRAM

☐ A monitoring and maintenance schedule has been developed that includes inspection of the construction BMPs before anticipated storm events and after actual storm events and is available for review.

If checked above: A qualified person has been assigned responsibility for pre-storm and post-storm BMP inspections to identify effectiveness and necessary repairs or design changes..... ☐ YES ☐ NO

Name: _____ Phone: _____

C. PERMIT COMPLIANCE RESPONSIBILITY

A qualified person has been assigned responsibility to ensure full compliance with the Permit, and to implement all elements of the Storm Water Pollution Prevention Plan including:

1. Preparing an annual compliance evaluation..... ☐ YES ☐ NO

Name: _____ Phone: _____

2. Eliminating all unauthorized discharges..... ☐ YES ☐ NO

IX. VICINITY MAP AND FEE (must show site location in relation to nearest named streets, intersections, etc.)

Have you included a vicinity map with this submittal? ..... ☒ YES ☐ NO

Have you included payment of the annual fee with this submittal?..... ☐ YES ☐ NO

X. CERTIFICATIONS

"I certify under penalty of law that this document and all attachments were prepared under my direction and supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment. In addition, I certify that I have read the entire General Permit, including all attachments, and agree to comply with and be bound by all of the provisions, requirements, and prohibitions of the permit, including the development and implementation of a Storm Water Pollution Prevention Plan and a Monitoring Program Plan will be complied with."

Printed Name: _____

Signature: _____ **Date:** _____

Title: _____

Appendix B Conceptual Sampling Plan

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	880	22.6/24.0		

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PLANS APPROVAL DATE

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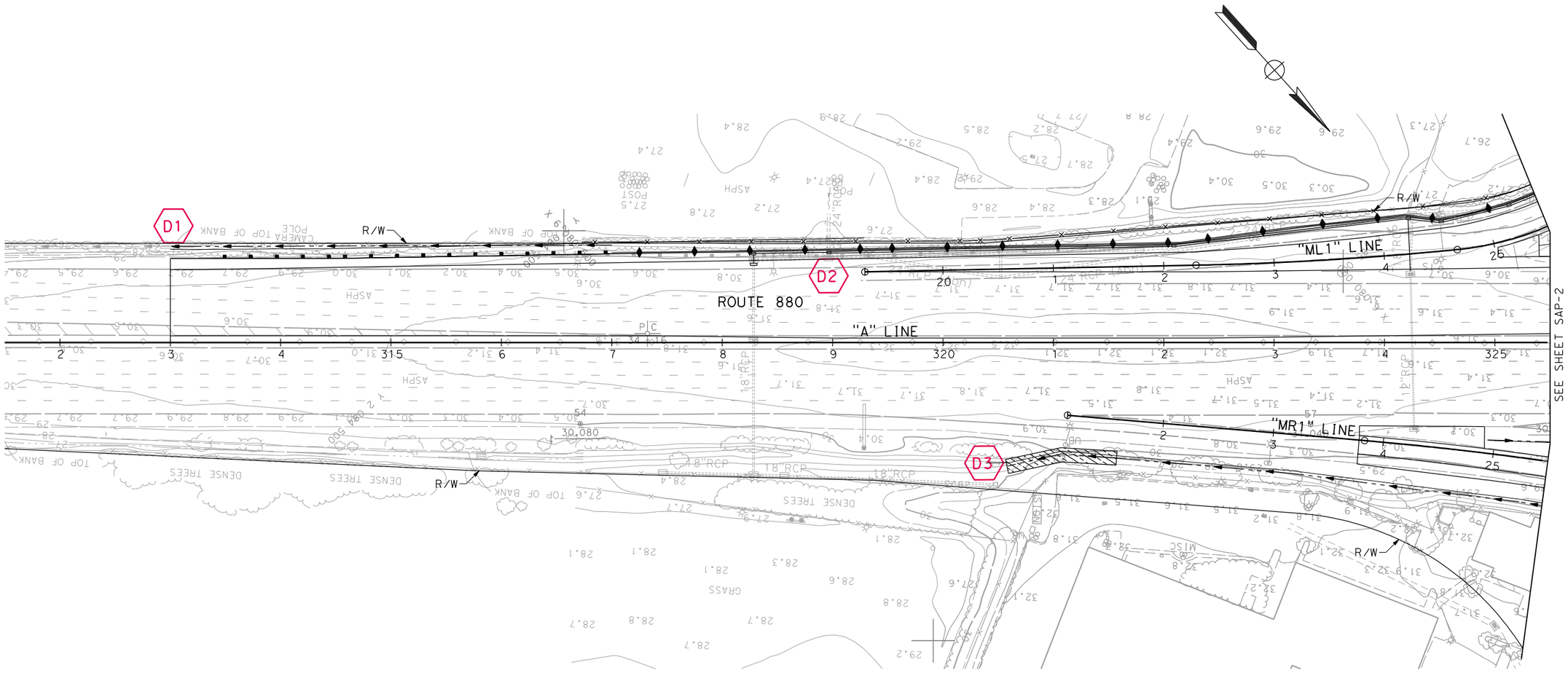
LEGEND:

D# DISCHARGE POINT AND SAMPLING LOCATION

S# ADDITIONAL SAMPLING LOCATION



CONCEPTUAL SAMPLING PLAN

SCALE: 1" = 50'

SAP-1

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Caltrans

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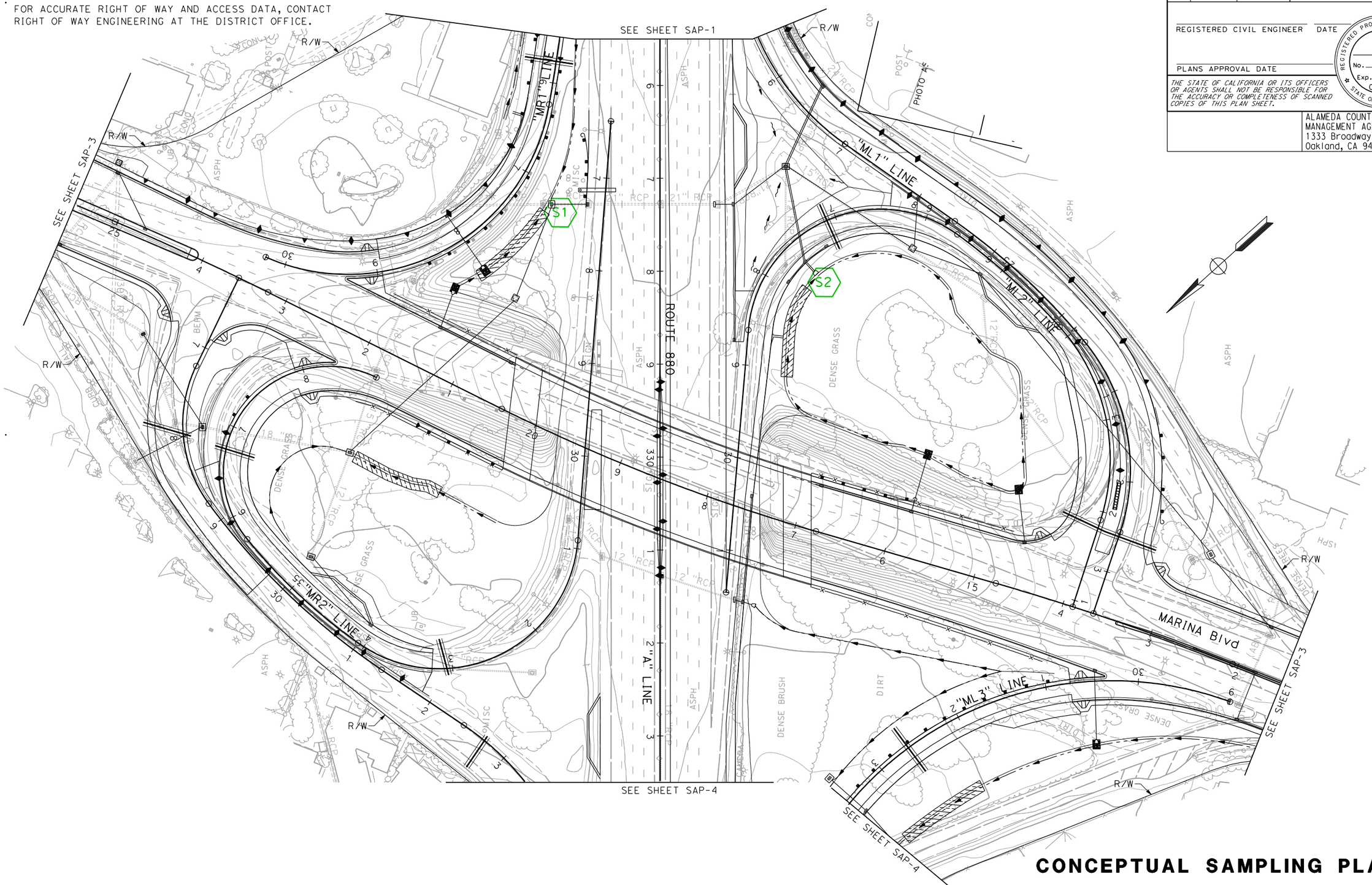

CONCEPTUAL SAMPLING PLAN

SCALE: 1" = 50'

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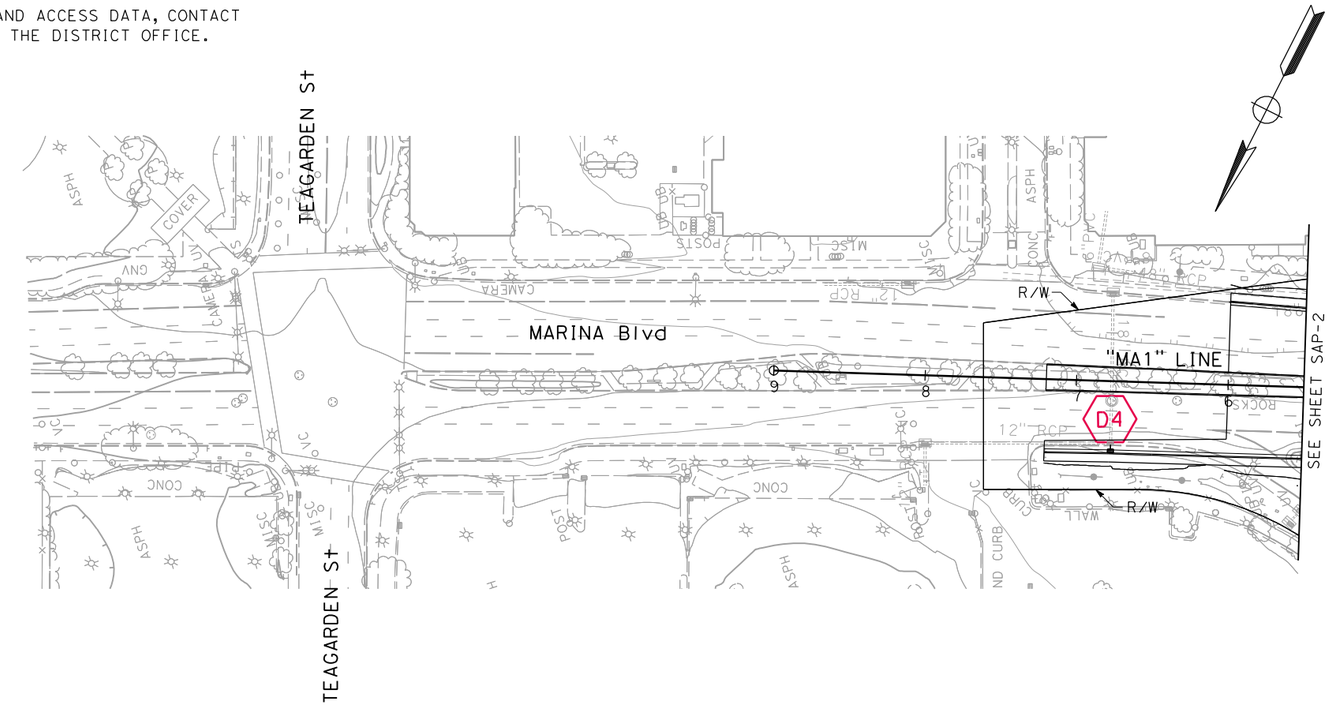

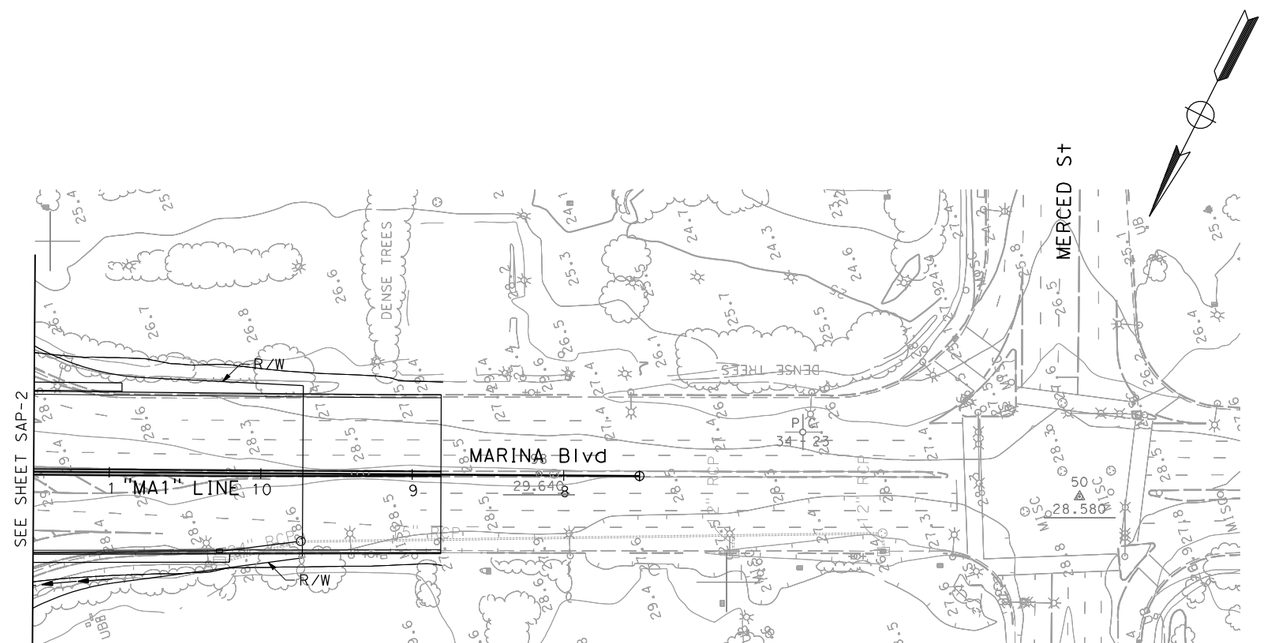

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SCALE: 1" = 50'

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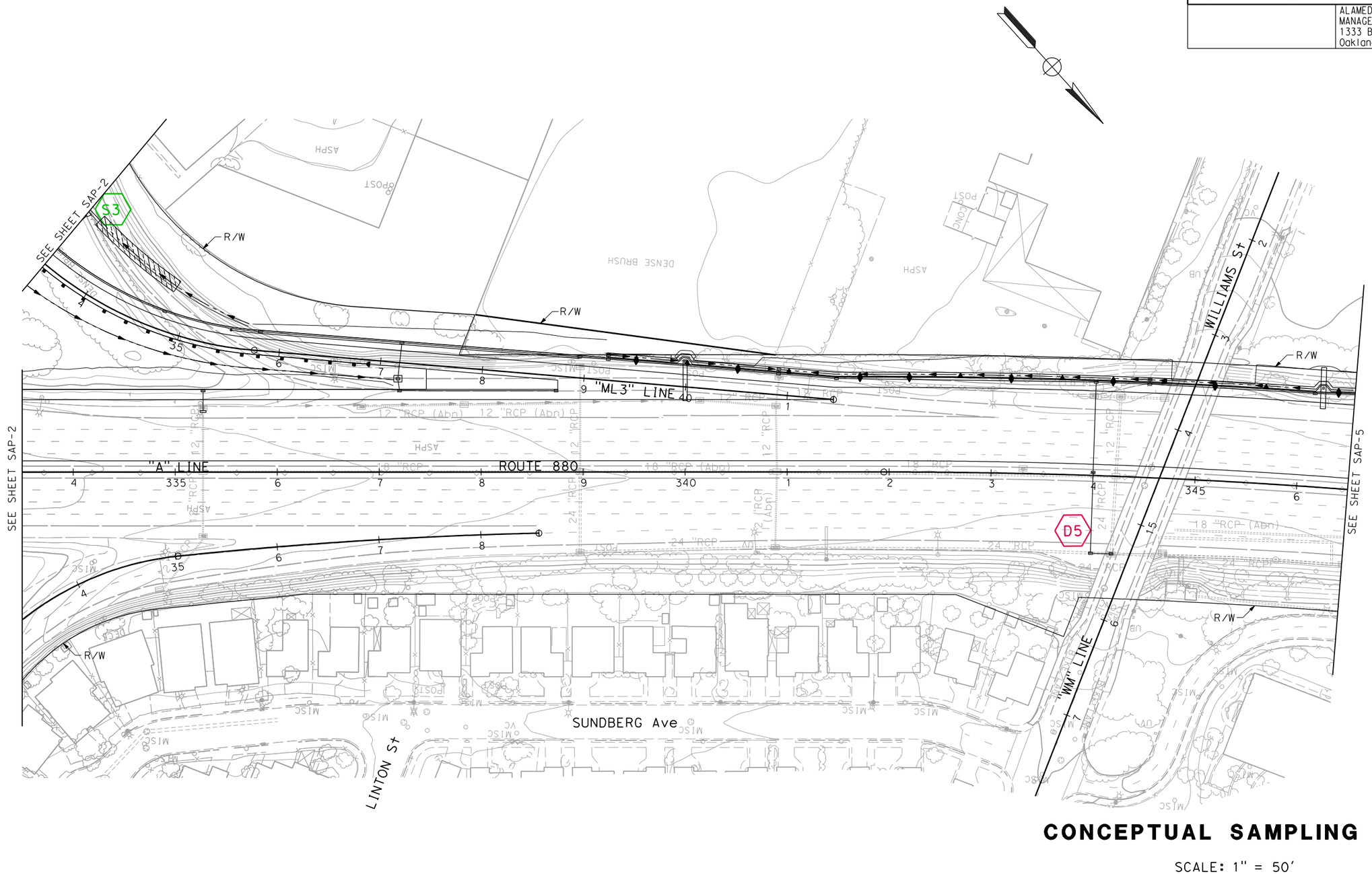

CONCEPTUAL SAMPLING PLAN

SCALE: 1" = 50'

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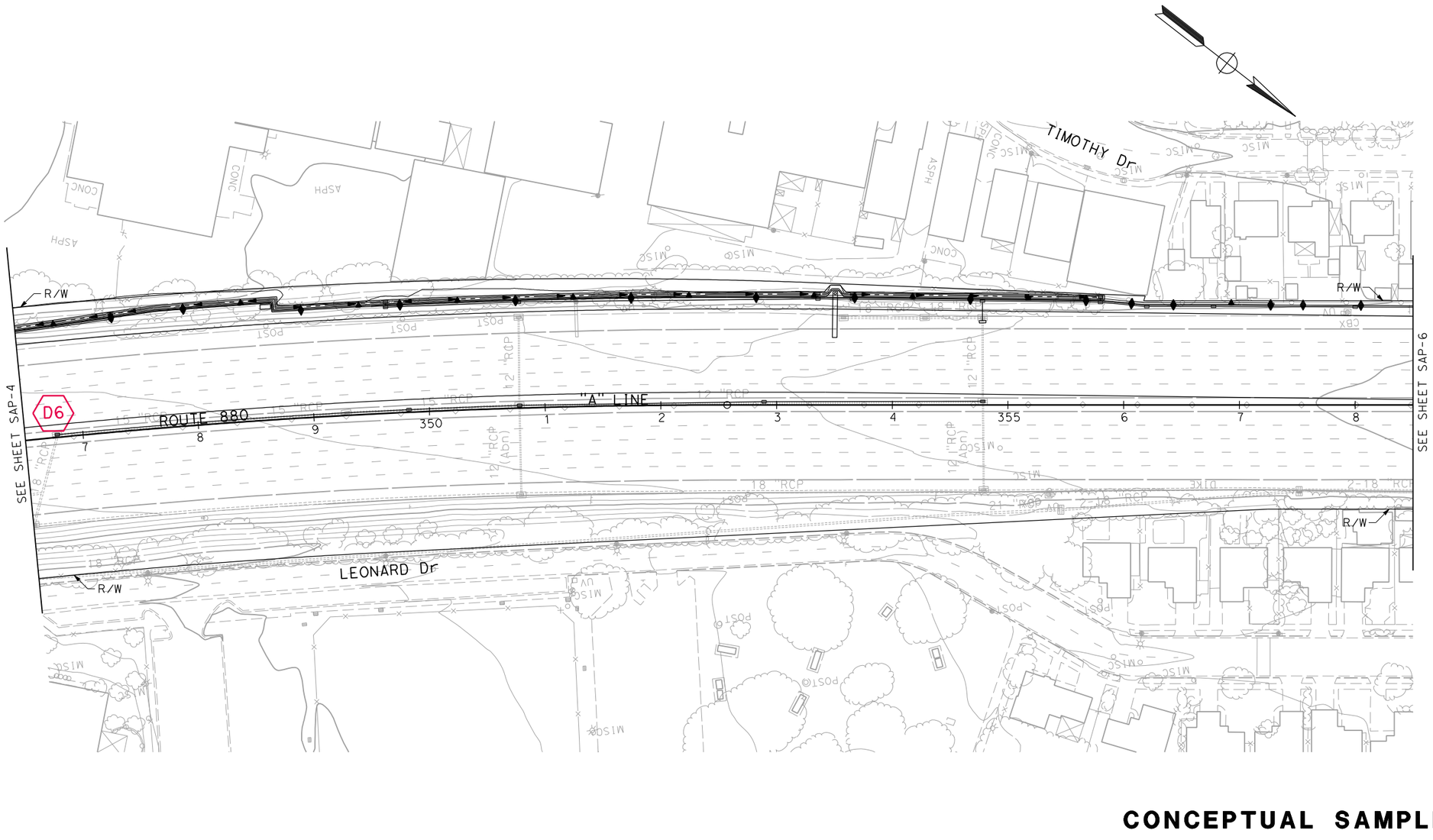

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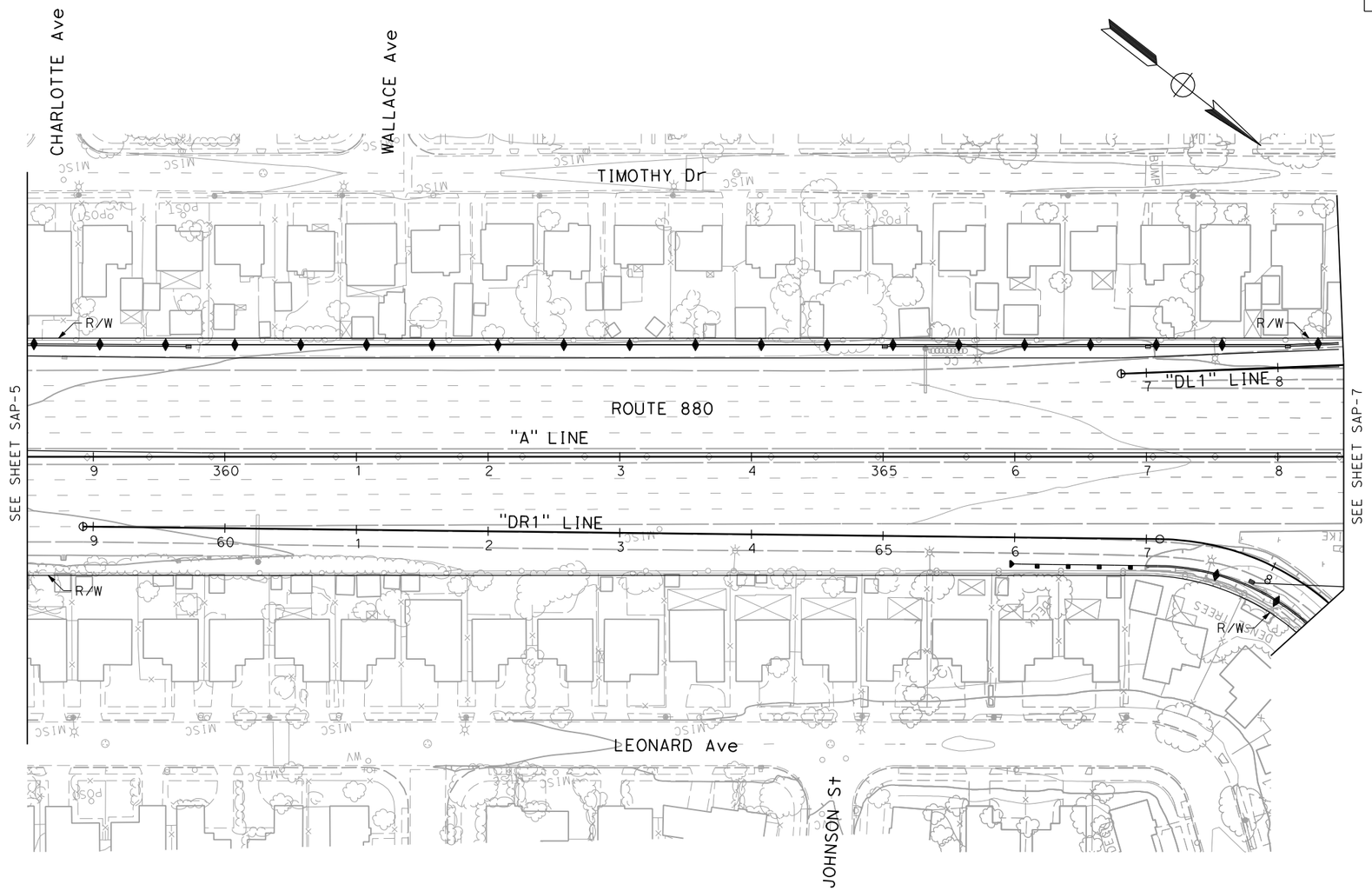

CONCEPTUAL SAMPLING PLAN

SCALE: 1" = 50'

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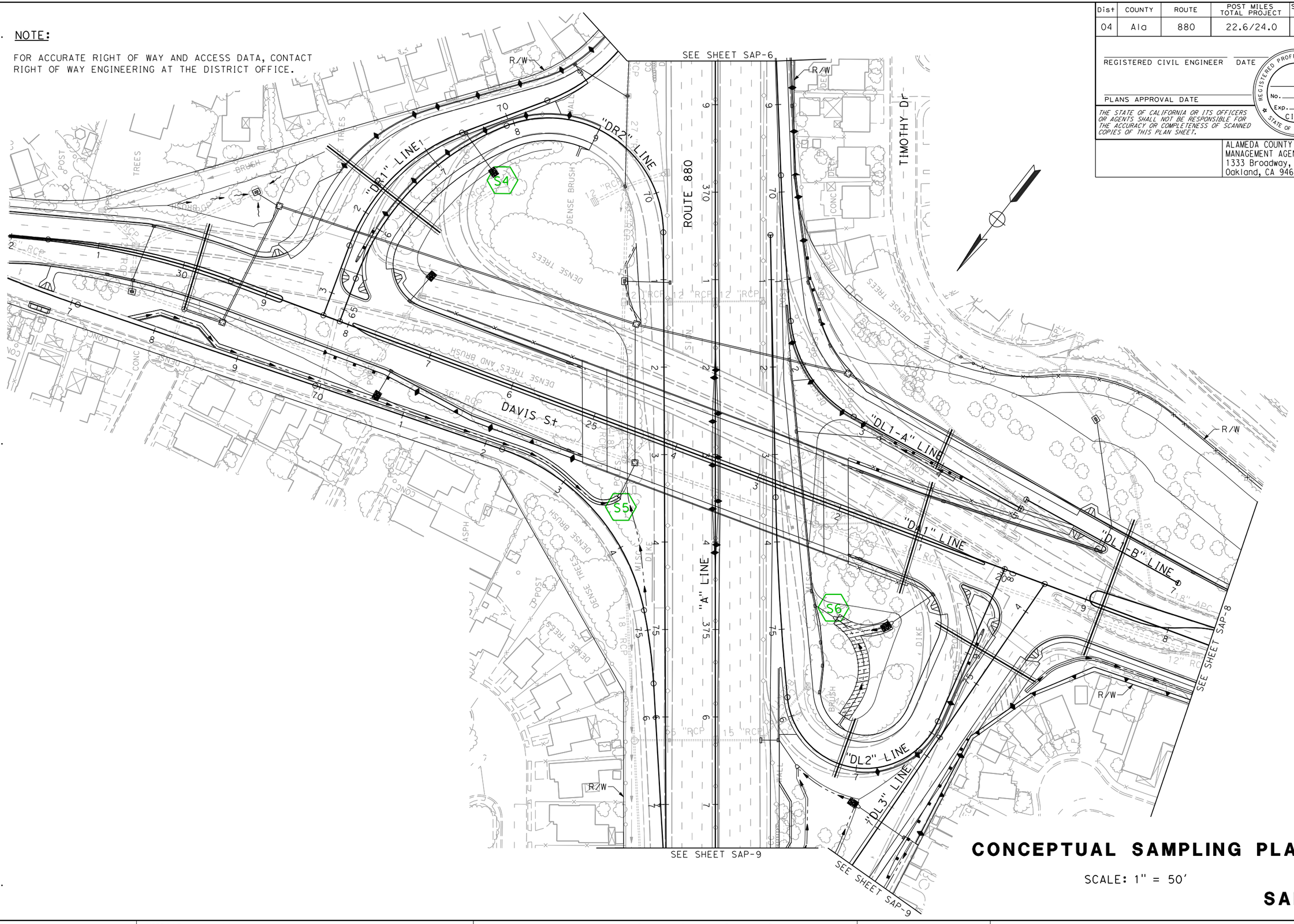

CONCEPTUAL SAMPLING PLAN

SCALE: 1" = 50'

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04	Ala	880	22.6/24.0		

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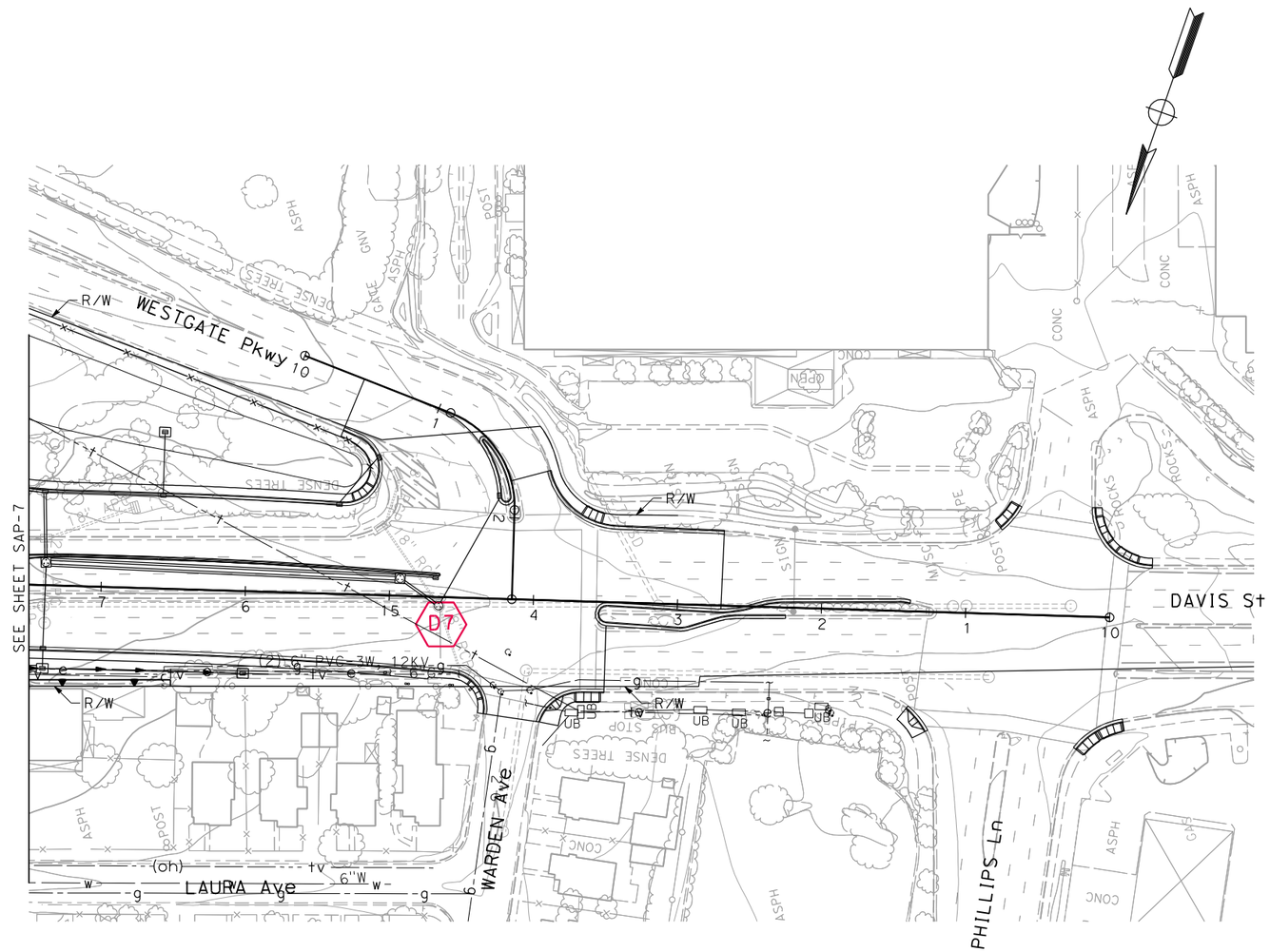

CONCEPTUAL SAMPLING PLAN

SCALE: 1" = 50'

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PROJECT NUMBER & PHASE 00000000001

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	880	22.6/24.0		

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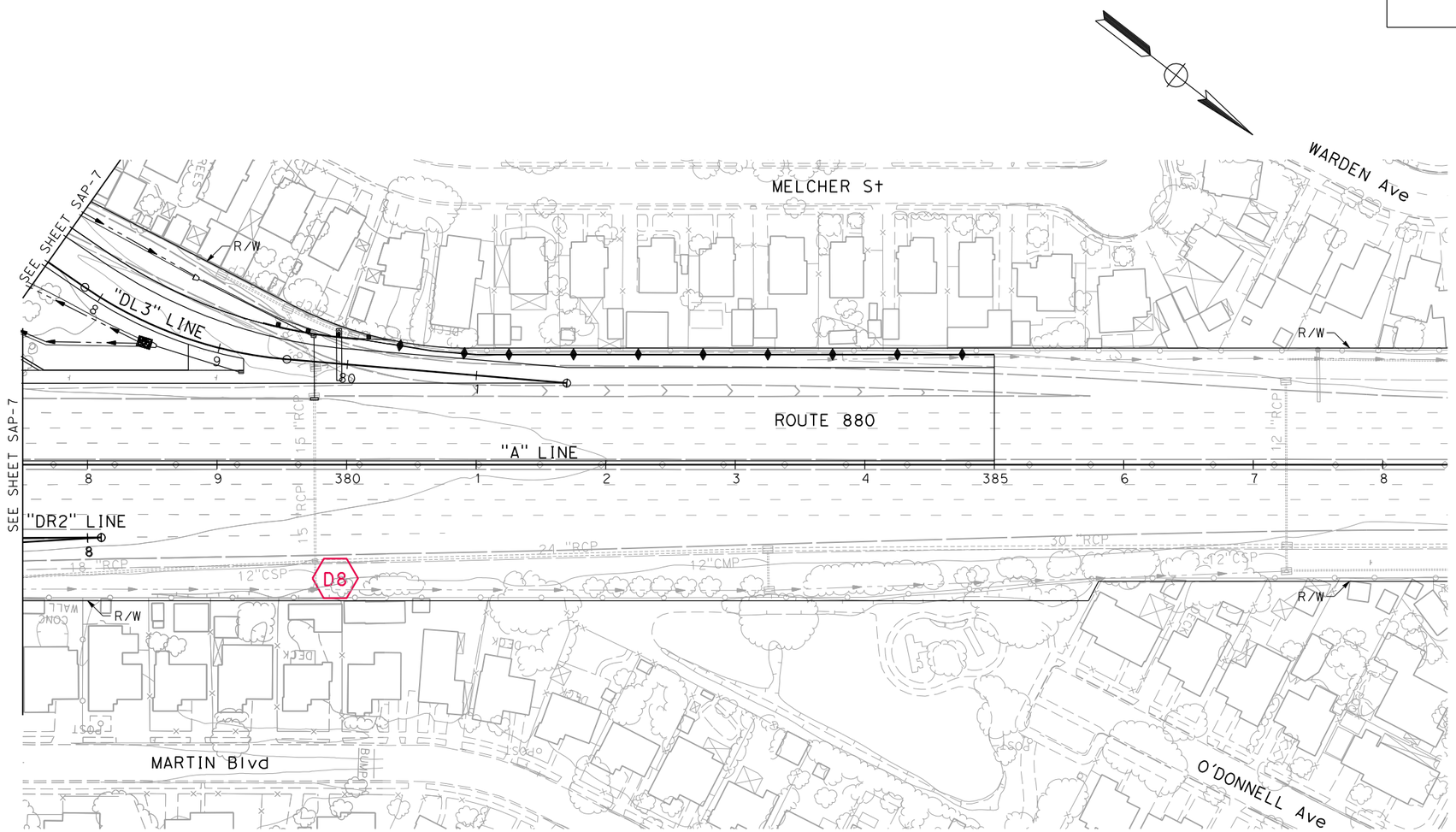

CONCEPTUAL SAMPLING PLAN

SCALE: 1" = 50'

SAP-9

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

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

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PART 2 - CONSTRUCTION MATERIALS

Materials for all work performed on public property in the City of San Leandro shall conform with the Standard Specifications for Public Works Construction, the "GREENBOOK", the 2006 edition and 2008 supplements thereto, adopted by the Southern California Chapter of the American Public Works Association; and Sections 82, 84, 85, and 86 of the May 2006 edition of California Department of Transportation (Caltrans) Standard Specifications; and the Special Provisions (Technical Specifications) thereto adopted by the Engineer as follows:

All work within the public Right-of-Way or on public property of the City of San Leandro shall be performed under auspices of either improvement drawings signed and approved by the Engineer or a valid encroachment permit.

SECTION 200 – ROCK MATERIALS

200-1 ROCK PRODUCTS. Rock products shall conform to the provisions of Section 200-1 "Rock Products," of the Standard Specifications, these Special Provisions, and the Standard Plans.

200-1.1 GENERAL. The following is added to Section 200-1.1 "General" of the Standard Specifications: A Certificate of Compliance shall be furnished by the Contractor for all aggregate used under these specifications.

The contractor shall furnish all labor, materials, equipment, and incidentals required to perform all operations in connection with the Street Rehabilitation Project, in accordance with the lines, grades, design and dimensions shown on the plans, the Standard Specifications and these Special Provisions.

200-1.2 CRUSHED ROCK AND ROCK DUST. The following is added to Section 200-1.2 "Crushed Rock and Rock Dust" of the Standard Specifications: percentage of material with fractured faces shall be determined by California Test 205.

Table 200-1.2A is revised as follows for 19 mm (3/4 in) Crushed Drain Rock:

TABLE 200-1.2 (A)

Percentage Passing Sieves	
Sieve Size	19.0 mm (3/4 in)
37.5 mm (1-1/2 in)	-
25.0 mm (1 in)	100
19.0 mm (3/4 in)	90 – 100
12.5 mm (1/2 in)	10 – 60
9.5 mm (3/8 in)	0 – 20
4.75 mm (No. 4)	0 – 5
2.36 mm (No. 8)	-
ASTM C 131 Test Grading	B

200-1.2.1 Screenings The following is added to Section 200-1.2.2 of the Standard Specifications: Screenings shall be medium fine size 8.0 x 2.36 mm (5/16" x No. 8) as shown in Table 200-1.2.1 (A) of the Standard Specifications.

200-1.4 COURSE AGGREGATE FOR CEMENT CONCRETE. Concrete aggregate shall be No. 3 of Table200-1.4 (B)

Sieve Sizes	Percent Passing Sieve
6"	100%
4"	25 – 100%
1"	5 – 25%
¾"	0 – 5%

200-2 UNTREATED BASE MATERIALS Untreated base materials shall conform to the provisions of Section 200-2 "Untreated Base Materials," of the Standard Specifications and these Special Provisions.

200-2.2 Crushed Aggregate Base Crushed aggregate base (CAB) shall conform to the provisions of Section 200-2.2 of the Standard Specifications and these Special Provisions.

200-2.2.1 General The following is added to section 200-2.2 of the Standard Specifications:

Material shall conform with this section or with Section 26-1.02A, Class 2 Aggregate Base, of the Caltrans Standard Specifications.

200-2.2.3 Quality Requirements The following modifications are made to Section 200-2.2.3 of the Standard Specifications:

The percentage wear test shall be waived. R-value shall be 78 minimum. Sand Equivalent shall be 30 minimum.

200-2.4 Crushed Miscellaneous Base Crushed miscellaneous base (CMB) shall conform to the provisions of Section 200-2.4 of the Standard Specifications and these Special Provisions.

200-2.4.1 General The following is added to Section 200-2.4.1 of the Standard Specifications:

Material shall conform with this section or with Section 25-1.02A, of the Caltrans Standard Specifications; material defined as coarse shall conform with class 1, material defined as fine shall conform with class 2.

200-2.4.3 Quality Requirements The following modifications are made to Section 200-2.4.3 of the Standard Specifications:

The percentage wear test shall be waived. R-value shall be 60 minimum. Sand Equivalent shall be 25 minimum.

200-2.5 Processed Miscellaneous Base Processed miscellaneous base shall conform to the provisions of Section 200-2.5, "Processed Miscellaneous Base," of the Standard Specifications and these Special Provisions.

200-2.5.3 Quality Requirements The following modifications are made to Section 200-2.5.3 of the Standard Specifications:

The percentage wear test and R-value shall be waived. Sand equivalent shall be 25 minimum.

200-2.6 Select Subbase Work shall be done per the Standard Specifications.

SECTION 201 – CONCRETE, MORTAR AND RELATED MATERIALS

201-1 PORTLAND CEMENT CONCRETE. Portland cement concrete shall conform to the provisions of Section 201-1, "Portland Cement Concrete," of the Standard Specifications, these Special Provisions and the Standard Plans.

201-1.1.2 CONCRETE SPECIFIED BY CLASS AND ALTERNATE CLASS The second sentence of the second paragraph has been replaced with the following:

The first number is the weight of cementitious material in kg per m^3 (lb. per yd^3), which consists of 100% portland cement conforming to 201-1.2.1.

201-2 REINFORCEMENT FOR CONCRETE. Work shall be done per the Standard Specifications.

201-2.3 FIBER REINFORCEMENT. The following is added to City Standard Plan 222, Section 201-2.3 of the Standard Specifications. Concrete for utility frame and cover adjustments shall contain 0.68 Kg (1 ½ lbs) of concrete engineered reinforcing fibers per cubic yard. Fibers shall be Type III, consisting of 100% virgin homopolymer polypropylene, multifilament fibers. Fibermesh 150 from Propex Concrete Systems Corp, Chattanooga, TN, 1-8000621-1273, www.fibermesh.com, or approved equal.

201-3 EXPANSION JOINT FILLER AND JOINT SEALANTS Expansion Joint Filler and Joint Sealants shall conform to the provisions of Section 201-3, "Expansion Joint Filler and Joint Sealants," of the Standard Specifications and these Special Provisions.

201-3.2 PREMOLDED JOINT FILLER The following is added to Section 210-3 of the Standard Specifications:

EXPANSION JOINT FILLER for Portland cement concrete "Concrete Curbs , Walks, Gutters, and Driveways," shall be 6mm (1/4") Nonextruding and Resilient Filler (Bituminous) ASTM 1751.

EXPANSION JOINTS shall be installed in accordance with Section 303-5.4.2 of the Standard Specifications and these Special Provisions.

201-4 CONCRETE CURING COMPOUND. Work shall be done per the Standard Specifications.

201-5 CEMENT MORTAR Cement Mortar shall conform to the provisions of Section 201-5, "Cement Mortar," of the Standard Specifications and these Special Provisions.

The following is added to Section 201-5 of the Standard Specifications:

MANHOLE MORTAR AND PLASTER Mortar and plaster for manhole frame and cover adjustment shown on City Standard Plan for "Utility Frame and Cover Adjustment," (Dwg. 222, Case 3101) shall be Class D conforming to the provisions of Section 201-5, "Cement Mortar," of the Standard Specifications to which ¼ to ½ part hydrated lime or lime putty has been added as specified in Section 202-1.5.1 "Mortar," of the Standard Specifications.

201-6 CONTROLLED LOW STRENGTH MATERIAL (CLSM). Controlled low strength material shall conform with Section 201-6 "Controlled Low Strength Material" of the Standard Specifications and these Special Provisions. The following is added to Section 201-6.1 of the Standard Specifications: Controlled Density Fill (CDF) shall conform with the requirements for CLSM.

201-6.2 MATERIALS The following is added to Section 201-6.2 of the Special Provisions:

CONTROLLED DENSITY FILL (CDF) for excavation backfill shall be a mixture of cement, fly ash, sand, air entraining agent and water batched by a ready mixed concrete plant and delivered to the jobsite by means of transit mixing trucks. Each cubic yard of CDF shall conform to the following requirements in the subsections below:

201-6.2.1 PORTLAND CEMENT

PORTLAND CEMENT Portland Cement for CDF shall be Type II Cement (ASTM C-150) - 14kg – 18 kg (30-40 lbs) **maximum** per cubic yard.

201-6.2.2 AGGREGATES

SAND Sand for CDF shall conform to the gradation for asphalt concrete sand shown in Table 200 – 1.5.5 (A) of the Standard Specifications.

COARSE AGGREGATES – Coarse aggregates for CDF shall conform to gradation for No. 4 aggregates shown in Table 200-1.4(B)

201-6.2.4 ADMIXTURES

AIR ENTRAINING AGENT Air entraining agent for CDF shall conform to ASTM C-260 and shall result in 7% minimum entrained air.

201-6.2.5 FLY ASH

FLY ASH Fly ash for CDF shall be Type F, ASTM C-618, 136kg (300lbs) minimum per cubic yard

201-6.3 PROPORTIONING. CDF for excavation backfill shall be a mixture of cement, fly ash, sand, air entraining agent and water batched by a ready mixed concrete plant and delivered to the jobsite by means of transit mixing trucks. Each cubic yard of CDF shall contain the following:

Type II Cement (ASTM C-150) - 14kg – 18 kg (30-40 lbs) per cubic yard.

Type F Fly Ash (ASTM C-618) - 136 kg. (300 lbs) per cubic yard.

Sand – Conforming to the gradation for asphalt concrete shown in Table 200 – 1.5.5 (A) of the Standard Specifications.

Air Entraining Agent (ASTM C-260) – Entrained air shall be 7% minimum.

Slump – 150 – 200 mm (6” – 8”)

Compressive Strength – Unconfined, 28 day compressive strength shall be 345 – 1035 kPa (50 – 150 psi).

The actual mix proportions shall be determined by the producer.

201-7 NON-MASONRY GROUT. Work shall be done per the Standard Specifications.

SECTION 203 BITUMINOUS MATERIALS

203-1 PAVING ASPHALT. Paving asphalt shall conform to the provisions of Section 203-1, "Paving Asphalt," of the Standard Specifications and these Special Provisions.

203-2 LIQUID ASPHALT. Liquid asphalt shall conform to the provisions of Section 203-2 "Liquid Asphalt" of the Standard Specifications and these Special Provisions.

203-2.1 GENERAL. The following is added to Section 203-2.1 of the Standard Specifications:

PRIME COAT Prime coat shall be SC-70.

TACK COAT used as asphalt binder for pavement reinforcing fabric shall be PG 64-10.

203-3 EMULSIFIED ASPHALT. Emulsified asphalt shall conform to the provisions of Section 203-3 "Emulsified Asphalt" of the Standard Specifications and these Special Provisions.

203.3.1 GENERAL. The following is added to Section 203-3.1 of the Standard Specifications:

FOG SEAL Fog seal shall be SS1h with one part water added to one part emulsified asphalt.

TACK COAT Excepting asphalt binder for pavement reinforcing fabric or mesh, tack coat shall be SS1h with no water added.

203-6 ASPHALT CONCRETE. Asphalt Concrete shall conform to the provisions of Section 203-6, "Asphalt Concrete," of the Standard Specifications and these Special Provisions.

203-6.1 GENERAL. The following is added to Section 203-6.1 of the Standard Specifications:

Asphalt Concrete for base courses shall be PG 64-10 or PG 64-10 RAP (15% maximum reclaimed asphalt pavement), 3/4-inch maximum Caltrans Type A aggregate.

Asphalt Concrete for surface courses shall **ONLY** be PG 64-10, 3/4-inch maximum Caltrans Type A aggregate.

The Engineer may specify PG-70-10 Paving Grade Asphalt to bridge poor subgrade conditions or if air temperatures become hot enough to warrant its use at no additional cost to the City.

CRACK FILLER Asphalt concrete for filling cracks larger than one (1") inch and other uses as directed by the Engineer shall be F-PG-64-10 (channel liner/sheet fines) conforming to Table 203-6.4.3 (A).

PAVEMENT TRANSITION Asphalt concrete for pavement transitions shall be class D2-SC-800 ("cut back").

TEMPORARY RESURFACING Asphalt concrete for temporary trench resurfacing shall be class D2-SC-800 ("cut back").

203-6.3.2 AGGREGATE Coarse aggregate shall conform to the provision of Section 203-6.3.2 "Aggregate," and these Special Provisions. Coarse and fine aggregate fractured faces shall meet the requirements of 200-1.2 as tested by California Test 205. (Caltrans Type 'A', Coarse, equivalent).

The required grading of the combined aggregates and the percentage of asphalt binder, represented by "B" above, shall conform to the requirements indicated in Section 203-6.4.2, "Composition and Grading," of the Standard Specifications (Type 'A' coarse, Caltrans equivalent).

SECTION 203-7 RECYCLED ASPHALT CONCRETE-HOT MIXED

203-7.1 GENERAL Recycled asphalt concrete (RAC) shall conform to the provisions of Section 203-7, "RECYCLED ASPHALT CONCRETE-HOT MIXED," of the Standard Specifications and these Special Provisions.

The Contractor shall use recycled asphalt concrete (RAC) conforming to Section 203-7 for base courses (lower lifts) and pavement repairs ONLY. All surface or riding courses (final lifts) shall be Asphalt Concrete conforming to Section 203-6.

The amount of recycled asphalt concrete shall be fifteen (15) percent or less of the total mix. The product shall meet both the asphalt grade and gradation specified in these Special Provisions.

The supplier of recycled asphalt concrete shall maintain a job mix formula at the plant. The formula shall be based on current test data and shall conform to Section 203-7.2.2 of the Standard Specifications. RAC mix designs and all test data shall be submitted to the Engineer for his review and approval before the use of any RAC material on the project.

Recycled asphalt concrete shall be PG 64-10 RAC, unless otherwise specified (Caltrans Type A, 3/4" max, course equivalent). The Engineer may specify PG 70-10 Paving Grade Asphalt to bridge poor subgrade conditions or provide resistance to retting or, if air temperatures become hot enough to warrant its use, at no additional cost to the City.

203-8 ASPHALT PAINT. Work shall be done per the Standard Specifications.

SECTION 206 MISCELLANEOUS METAL ITEMS

206-3.3 MANHOLE FRAME AND COVER SETS. The following is added to Section 203-3.3 of the Standard Specifications: Manhole Frame and Covers shall be as shown on Standard Plan 220. The following suppliers stock frames and covers that meet these specifications:

D&L Supply	Phoenix Iron Works
250 5th Street	888 Cedar Street
Oakland, CA 94606	Oakland, CA 94607
(510) 832-2171	(510) 465-9900

EBMUD VALVE POTS:
If the bid alternate is incorporated into the contract, then EBMUD shall furnish the contractor with EBMUD standard water valve pot grade rings and G-5 valve boxes and covers at no cost to the contractor. The Contractor shall be responsible for the transportation of these water valve pot grade rings, boxes, and covers from EBMUD, Oakport Storage, 5601 Oakport Street, Oakland, CA 94621-4001.

If the bid alternate is not incorporated into the contract, then EBMUD shall adjust their own water valve pots and manholes.

SURVEY MONUMENT Survey Monument Frame and Covers shall be adjusted as shown on Standard Plan 134.

SECTION 209 – ELECTRICAL COMPONENTS

209-1 GENERAL

209-2 REFERENCE SPECIFICATIONS
The following is added to Section 209-2 "Reference Specifications" of the Standard Specifications and these Special Provisions:

All work performed on Traffic Signal systems shall be performed by electricians certified pursuant to Labor Code 3099 et. seq. and California Code of Regulations (CCR) Title 8, Section 230 et. seq. Copies of said certificates shall be provided in accordance with Section 2-5.3.4, Section 6-1, and Section 7-5 of these Special Provisions.

209-2.6 EQUIPMENT LIST Unless otherwise permitted in writing by the Engineer, the Contractor shall, within 15 days following approval of the contract, submit to the Engineer for review, a list of equipment and materials, which he proposes to install. The List shall provide the Engineer a means by which to approve partial payments.

209-3 COMPONENTS FOR STREET LIGHTING AND TRAFFIC SIGNAL SYSTEMS. The following is added to Section 209-3 "Components for Street Lighting and Traffic Signal Systems" of the Standard Specifications and these Special Provisions:

TRAFFIC SIGNAL SYSTEMS The material furnished for Traffic Signal Systems shall conform to the provisions of Section 86, "Signal and Lighting", of the May 2006 edition of the California Department of Transportation (Caltrans) Standard Specifications. Standard Plans referenced in this Section 209, "Electrical Components", for Traffic Signal Systems shall mean the most current edition of the California Department of Transportation (Caltrans) Standard Plans.

209-5 MATERIALS FOR TRAFFIC SIGNAL SYSTEMS

209-5.3 CONDUCTORS AND CABLES

209-5.3.1 GENERAL
Conductors, cables and wiring shall conform to the provisions in Section 86-2.08, "Conductors" of the Caltrans Standard Specifications and these Special Provisions.

Except as provided for elsewhere in these Special Provisions, all conductors No. 12 and smaller, shall be solid copper with Type THHN insulation.

209-5.3.2 MATERIALS. The following is added to Section 86-2.05 of the Caltrans Standard Specifications:

Traffic signal systems conduit shall be 50 mm (2") minimum rigid non-metallic conforming to the provisions of Section 86-2.05A(3).

Rigid non-metallic conduit shall be furnished with a ground wire conforming to the specifications in Section 209-4.2 of these Special Provisions.

209-5.8 DETECTORS. The following modifications are made to Section 209-5.8 "Detectors":

209-5.8.1 GENERAL. Detector handholes shall be installed at all inductive loop locations conforming to the details on Standard Plan ES-5D.

209-5.8.2 INDUCTIVE LOOP DETECTORS. The following is added to Section 209-5.8.2 "Inductive Loop Detectors".

209-5.8.2.3 CONDUCTORS.

INDUCTIVE LOOP DETECTOR Inductive loop detectors shall be Type 2 conforming to the provisions of Section 86-5.01A(4), "Construction Material" of the Caltrans Standard Specifications.

DETECTOR LEAD-IN CABLE. Detector lead-in cable (DLC) shall be Type B conforming to the provisions of Section 86-5.01A(4), "Construction Material" of the Caltrans Standard Specifications.

209-5.8.2.4 INDUCTIVE LOOP SLOT SEALANT. Sealant for inductive loop detectors shall conform to the provisions of Section 86-5.01A(5), "Installation Details," for Asphalt Emulsion sealant of the Caltrans Standard Specifications and these Special Provisions.

SECTION 210 - PAINT AND PROTECTIVE COATINGS

210-1 PAINT. Paint shall conform with Section 210-1 "Paint" of the Standard Specifications and these special provisions.

210-1.6.1 GENERAL. The following is added to Section 210-1.6.1 "General" of the Standard Specifications: Unless otherwise specified or shown on the plans, traffic striping and pavement markings shall be thermoplastic conforming to the provisions of Section 84-2, "Thermoplastic Traffic Stripes and Pavement Markings" of May 2006 edition of the California Department of Transportation (Caltrans) Standard Specifications, these Special Provisions and City Standard Plans.

All pavement marker, markings, and striping shall be done in accordance with Standard Plan 616.

SKID RESISTANT THERMOPLASTIC

Composition	
Binder	20% (18% min)
Glass Beads	20% (15% min)
TiO2 Pigment	10% (7% min)
Filler	35% (37% min)
Cullet	15% (10% min)

The crushed glass cullet in such a mixture shall be produced from cullet of clear glass, with a maximum size of 850 micrometers (100% passing by weight) and minimum size of 425 micrometers (0-5% passing by weight). The skid resistance shall be a minimum of 55 BPN. The maximum thickness shall be 3 mm (1/8").

Skid resistant Thermoplastic can be substituted with Flint Trading, Inc. "Pre-Mark" preformed thermoplastic with VIZIGRIP products, 336-475-6600, www.flinttrading.com. Paint for red curbs shall be Pervo 7000 series red paint or approved equal.

SECTION 211 - SOILS AND AGGREGATE TESTS

211-1 SIEVE ANALYSES. Work shall be done per the Standard Specifications.

211-2 COMPACTION TESTS. Compaction tests shall conform with Section 211-2 "Compaction Tests" of the Standard Specifications and these special provisions.

211-2.1 LABORATORY MAXIMUM DENSITY. The following is added to Section 211-2.1 "Laboratory Maximum Density" of the Standard Specifications: Relative compaction tests will be performed in accordance with California Test Methods 216 and 231 for soils and aggregates, and California Test Methods 308, 309 and 375 for asphalt concrete.

211-3 SAND PERMEABILITY TEST. Work shall be done per the Standard Specifications.

211-4 PERMEABILITY TEST. Work shall be done per the Standard Specifications.

SECTION 214 PAVEMENT MARKERS

214-1 GENERAL. Pavement Markers shall conform to Section 82 and 85 of the Caltrans Standard Specifications and applicable Caltrans Standard Plans, and City Standard Plans.

Rubber speed cushion pavement markings shall conform to City Standard detail Dwg. No. 131A & 131B, Case 3101.

214-2 TYPE OF MARKERS. The following is added to Section 85-1.02 "Type of Markers" of the Caltrans Standard Specifications:

Type I – Two-Way Blue Reflective Markers

214-7 BITUMINOUS ADHESIVE. The following modification is made to Section 85-1.055 "Adhesives" of the Caltrans Standard Specifications: Epoxy adhesives shall not be used. All markers shall be secured with hot melt bituminous adhesives.

SECTION 215 ROADSIDE SIGNS, CONSTRUCTION AREA SIGNS AND TRAFFIC CONTROL SIGNS

Section 215 "Roadside Signs, Construction Area Signs and Traffic Control Signs" is added to the Standard Specifications and these Special Provisions.

215-2 CONSTRUCTION AREA SIGNS

215-2.1 GENERAL.
All construction area signs shall be install and maintained throughout the duration of the projects at the locations shown on the plans and as directed by the Engineer in accordance with the 2006 CA MUTCD and these Special Provisions. This requirement will apply continuously and will not be limited to normal working hours. All construction area signs shall conform to the nominal dimensions, color and legend requirements of the plans, the 2006 CA MUTCD. All sign panels shall be the product of a commercial sign manufacturer.

Construction Area Signs shall meet the requirements of Section 7-10, "Public Convenience and Safety" of the Standard Specifications and these Special Provisions.

Sign panels for all Construction Area Signs shall be visible at 152 m (500') and legible at 91 m (300'), at noon on a cloudless day and at night under illumination of legal low beam headlights, by persons with vision of or corrected to 20/20. Sign panels for construction area signs shall consist of 3M Scotchlite Diamond Grade VIP Reflective Sheeting, Series 3990 applied to an aluminum or plywood sign substrate.

Signs shall be the size indicated in the following table:

Description	Size
W20-1 "Road Work Ahead"	1.22 m (48") x 1.22 m (48") minimum
G20-2 "End Road Work"	1.5m (60") x 0.6m (24") minimum
W8-8 "Rough Road"	0.75 m (30") x 0.75 m (30") minimum
W8-7 "Loose Gravel"	0.75 m (30") x 0.75 m (30") minimum
W21-2 "Fresh Oil"	0.6 m (24") x 0.6 m (24") minimum
Type P "Steel Plates Ahead"	0.9 m (36") x 0.9 m (36") minimum

Used signs with the specified sheeting material will be considered satisfactory if they conform to the requirements for visibility and legibility and the colors conform to the requirements above. A significant difference between day and night-time reflective color will be grounds for rejecting signs.

All construction area signs shall have the Contractor's name and telephone number labeled on the back of the sign panel.

ACTIA funding signs shall be provided by the City. Contractor shall pick up the ACTIA signs at the City of San Leandro Public Works corporation yard located at 14200 Chapman Road in San Leandro. These signs shall be returned to the San Leandro Public Works corporation yard after construction is completed.

215-3 TRAFFIC CONTROL SIGNS

215-3.1 GENERAL. Traffic control shall meet the requirement of Section 7-10, "Public Convenience and Safety" of the Standard Specifications and these Special Provisions.

All traffic control signs shall conform to the nominal dimensions, color and legend requirements of the plans, the 2006 CA MUTCD. All sign panels shall be the product of a commercial sign manufacturer.

Sign panels for all traffic control signs shall be visible at 152 m (500') and legible at 91 M (300'), at noon on a cloudless day and at night under illumination of legal low beam headlights, by persons with vision of or corrected to 20/20. Sign panels for traffic control shall consist of 3M Scotchlite Diamond Grade VIP Reflective Sheeting applied to an aluminum or plywood substrate.

Used signs with the specified sheeting material will be considered satisfactory if they conform to the requirements for visibility and legibility and the colors conform to the requirements above. A significant difference between day and night-time reflective color will be grounds for rejecting signs.

All traffic control signs shall have the Contractor's name and telephone number labeled on the back of the sign panel.

If any component in the traffic control systems is displaced, or ceases to operate or function specified, from any cause, during the progress of the work, the Contractor shall immediately repair said component to its original condition or replace said component and shall restore the component to its original location.

When lane closures are made for work periods only, at the end of each work period, all components of the traffic control system, except portable delineators placed along open trenches or excavation adjacent to the traveled way shall be removed for the traveled way. If the Contractor so elects, said components may be stored at selected central locations, approved by the Engineer, within the limits of the street right-of-way.

Contractor is hereby directed to the presence of high volume of pedestrians in the vicinity of the project site. The city will require that the Contractor provide clear pedestrian access within the construction limit. The Contractor shall at all times be responsible for the safety of all pedestrians within construction limit through the duration of this project. Contractor equipment shall not obstruct automobile line of sight to pedestrians. The Contractor's attention is directed to Section 7-10.1.1 "Pedestrian Access".

SECTION 216 – RUBBER SPEED CUSHIONS

216-1 GENERAL. Rubber speed cushions shall conform to the following:

Rubber speed cushions shall be manufactured by an ISO 9002 approved company in the USA. Products by other manufacturers are not acceptable unless approved by the Engineer.

The speed cushions shall be modular in design with a standard width of 6'-6" and standard length of 6'-8", but both the width and length shall be adjustable by adding or changing modules. The rubber speed cushions shall have a flat top with a height of 3", and the entrance and exit ramp gradient shall be 1: 10 (max), and the side ramp gradient shall be 1 : 4 (max). The entrance, exit and side ramps shall provide a smooth transition to the pavement with a maximum step of 1/2".

The speed cushion modules shall be made from 100% recycled rubber and a two-part polyurethane binder. The rubber shall contain no rubber dust, granules or fly that will weaken the product. The rubber speed cushion modules shall be compress molded and have the following properties:

a) Shore A Hardness - 65 minimum
b) Specific Gravity - 1.13
c) Skid Resistance - 89 (dry)
d) Tensile Strength - 500 p.s.i. minimum
e) Deform Rate - None (100% recovery after compression)
f) Color - black
g) Markings – two white reflective arrows (16" wide by 27" high) made of marking tape molded into the rubber

PART 3 - CONSTRUCTION METHODS

Methods of construction for all work performed on public property in the City of San Leandro shall conform with the Standard Specifications for Public Works Construction, the "GREENBOOK", the 2006 edition and 2008 supplements thereto, adopted by the Southern California Chapter of the American Public Works Association; and Sections 82, 84, 85, and 86 of the May 2006 edition of California Department of Transportation (Caltrans) Standard Specifications; and the Special Provisions (Technical Specifications) thereto adopted by the Engineer as follows:

All work within the public Right-of-Way or on public property of the City of San Leandro shall be performed under auspices of either improvement drawings signed and approved by the Engineer or a valid encroachment permit.

SECTION 300 - EARTHWORK

300-1 CLEARING AND GRUBBING Clearing and Grubbing shall conform to the provisions of Section 300-1, "Clearing and Grubbing" of the Standard Specifications and these Special Provisions.

300-1.1 GENERAL. The following is added to Section 300-1.1 "General" of the Standard Specifications: Roots and stumps shall be removed to a minimum depth of 600 mm (24") below finish grade. Unless otherwise shown on the plans or directed by the Engineer, existing trees shall be protected and remain in place.

300-1.3.1 GENERAL. The following is added to Section 300-1.3.1 "General" of the Standard Specifications: Burning of material is not permitted. All sawcut residues shall be collected concurrent with the sawcutting operation by vacuum or other method approved by the Engineer and disposed of by the Contractor.

All overlapping asphalt, concrete, slurry seal, etc. shall be removed from gutters and driveways that are adjacent to cold mill, keycut, or pavement removal work and shall be considered included work required by Section 300-1 and/or 302-1.

Removal of asphalt or concrete from gutter pans in excess of 75mm (3") shall be considered as "Remove AC or Concrete from Gutter Pan".

Any damaged curb or gutter shall be replaced at Contractor's sole expense.

REMOVE WEEDS The Contractor shall remove all weeds between the gutter lip and the existing street pavement after grinding operation is complete.

REMOVE PAINT AND THERMOPLASTIC PAVEMENT MARKING Existing paint and thermoplastic traffic stripes and pavement legends within the limit of work not shown as existing to remain shall be removed by grinding. Pavement markings in areas which are not to be subsequently resurfaced shall be ground in a rectangular pattern to completely obliterate the original message. The Contractor shall remove and dispose of the grinding material. All areas not subsequently resurfaced shall be fog sealed and sanded in accordance with Section 302-12 of these Special Provisions.

REMOVE PAVEMENT MARKERS AND TRAFFIC BARS Existing pavement markers and traffic bars within the limits of work not shown as existing to remain shall be removed and disposed of.

300-1.3.2 REQUIREMENTS. The following modifications are made to Section 300-1.3.2 "Requirements" of the Standard Specifications:

a) Existing AC improvements shall be sawcut to a minimum depth of 150 mm (6").
b) Existing PCC improvements shall be sawcut to a minimum depth of 150 mm (6"). PCC improvements to be removed shall be sawcut along existing scorelines.

MEASUREMENT AND PAYMENT –BID ITEM NO. (14)

The Contract lump sum price paid for Remove and Replace Thermoplastic Stripes, Pavement Markings, and Markers, Bid Item (14) shall be considered as full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all work involved in removing pavement markings; removing and disposing of pavement markers and traffic bars as shown on the plans, as specified in the Standard Specification and these Special Provisions, and as directed by the Engineer.

MEASUREMENT AND PAYMENT –BID ITEM NO. (4)

The Contract unit price paid for Roadway Excavation & Offhaul (AC w/Petromat), Bid Item (4) shall be considered as full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all work involved in excavating/milling of the existing asphalt concrete with Petromat and disposing of said material as shown on the plans and specified in the Standard Specification and these Special Provisions, and as directed by the Engineer.

MEASUREMENT AND PAYMENT –BID ITEM NO. (20 & 21)
The Contract unit price paid for Remove AC or Concrete in Gutter Pan, Bid Item (20), and Remove AC in Gutter Pan on Begier Ave from Bancroft Ave to Chetland Rd, Bid Item (21) shall be considered as full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all work involved in removing and disposing of AC/Concrete in the existing gutter pan as shown on the plans, as specified in the Standard Specification and these Special Provisions, and as directed by the Engineer.

300-2 UNCLASSIFIED EXCAVATION. Unclassified excavation including roadway excavation, shall conform to the provisions of Section 300-2, "Unclassified Excavation" of the Standard Specifications and these Special Provisions.

300-2.1 GENERAL The following is added to Section 300-2.1 "General" of the Standard Specifications :

300-2.1 UNCLASSIFIED EXCAVATION Unclassified excavation shall conform to the provisions of Section 300-2,10 "Unclassified Excavation" of the Standard Specifications and these Special Provisions.

The Contractor's attention is directed to Section 7-8, "Project Site Maintenance" of the Standard Specifications and these Special Provisions.

Excavation shall be done to the lines and grades shown on the plans or marked in the field and shall include excavation under PCC improvements for placement of base materials.

Excavation equipment shall be approved by the engineer prior to its use. Preferred method of roadway excavation for street rehabilitation shall conform to Sections 302-1 "Cold Milling Existing Pavement" of the Standard Specifications and these Special Provisions.

All streets shall be cleaned of all excavated material grinding residue immediately following the grinding machine and before opening the street to traffic.

The Contractor shall remove all weeds between the gutter lip and the existing street pavement after grinding operation is complete. All AC, concrete, slurry seal, etc. shall be removed from the gutters and driveways in accordance with Section 300-1.3.1 of these Special Provisions.

300-2.2 UNSUITABLE MATERIAL. The following is added to Section 300-2.2 "Unsuitable Material" of the Standard Specifications:

After scarification and cultivation is completed in accordance with Section 301-1 and when the subgrade material cannot be compacted to a firm, hard, unyielding condition under heavy construction equipment by the methods specified in Section 301-1, "Subgrade Preparation" through no fault of the Contractor, the material shall be considered as Unsuitable Subgrade Material. Scarification and cultivation of the top six (6) inches of subgrade shall be required prior to determination of Unsuitable Subgrade Material.

Unsuitable Subgrade Material shall be removed and disposed of, and suitable material shall be placed and compacted to the planned subgrade as directed by the Engineer and shall be paid for in accordance with Section 3-2.4 "Agreed Prices" of the Standard Specifications.

300-2.6 SURPLUS MATERIALS. The following is added to Section 300-2.6, "Surplus Materials", of the Standard Specifications.

Excess material shall become the property of the contractor and shall be removed and legally disposed of by the Contractor. This material may be a mixture of AC and/or AB materials mixed with routine soil materials. There is no guarantee implied as to the recyclability and/or resale value of grading residue/excavated materials. Adequate tests shall be performed at the Contractor's expense to determine the profile of waste materials to determine appropriate disposal locations. Class 3 disposal sites shall be considered in the bid item price. Class 1 or 2 materials shall be paid for in accordance with Section 3-2.4 "Agreed Prices" of the Standard Specifications. The Contractor shall be responsible for any storage or stockpiling of materials as necessary for the profile testing.

SECTION 301 – TREATED SOIL, SUBGRADE PREPARATION, AND PLACEMENT OF BASE MATERIALS

301-1 SUBGRADE PREPARATION. Subgrade preparation shall conform to the provisions of Section 301-1, "Subgrade Preparation" of the Standard Specifications and these Special Provisions.

301-1.2 Preparation Of Subgrade. The following is added to Section 301-1.2 "Preparation of Subgrade" of the Standard Specifications:

301-1.3 Relative Compaction. The following is added to Section 301-1. "Relative Compaction" of the Standard Specifications: After compaction and trimming, the subgrade shall be firm, hard and unyielding under the load of heavy construction equipment.

The subgrade relative compaction shall not be less than 95 percent in all areas **EXCEPT** where curb, gutter, driveway, curb ramp or sidewalk is to be placed.

The subgrade relative compaction shall not be less than 90 percent in all areas where curb, gutter, driveway, curb ramp or sidewalk is to be placed.

Relative compaction tests of the subgrade may be made by the City. Contractor shall make the work available for such testing. Relative compaction tests will be performed in accordance with California Test Method No.'s 216 and 231.

301-1.6 ADJUSTMENT OF MANHOLE FRAME AND COVER SETS TO GRADE. Adjustment of Manhole Frame and Cover Sets shall conform to the provisions of Section 301-1.6, "Adjustment of Manhole Frame and Cover Sets to Grade" of the Standard Specifications and these Special Provisions.

All utility frames and covers shall be adjusted to grade in conformance with the details shown on City Standard Plan "Utility Frame and Cover Adjustment" (Dwg. 222, Case 3101).

Contractor is responsible for referencing out all manholes, valves, monuments, etc. and for locating them after the paving work. The locations of manholes, valves, monuments, etc., shown on the plans are general locations intended to assist contractor with the bid. The City does not expressly or by implication agree that the actual locations shall be as shown on the plans, or that all manholes, valve or monuments that are on the streets are shown on the plans. Contractor is responsible for locating and adjusting all manholes, valves, monuments, etc., and notifies the City of any discrepancies found in the field. If existing manholes, etc. are not properly referenced, the City will deduct the cost of researching and locating manholes, etc. from monies due the Contractor.

The Contractor shall lower all frames and covers for manholes, monuments, clean-outs, splice boxes, etc and Utility Company manholes and valves below the lowest grading plane (375mm (15 inches) max) in all streets prior to beginning of any grinding/excavation operations. This work is not limited to removal of riser rings and shall include cutting, chipping, or sawing of collars, cones, barrels, bricks, metallic valve pot/riser sections, etc. to provide on unobstructed grading plane. Facilities below shall be protected from damage and debris from entering. False bottoms shall be installed in all manholes and storm water inlets to prevent debris from entering. Such false bottoms shall be immediately removed upon completion of adjustment to grade operations. The Contractor may arrange with the appropriate Utility Company to perform this work on their facilities or use his own forces. The Contractor shall keep affected utilities notified daily of the progress of work.

Unless shown otherwise on the plans, Utility Company manholes, valve covers and risers etc., shall be adjusted by the utility company after the paving work is completed unless the utility company provides the necessary labor, materials, tools, equipment, and incidentals to make the adjustments during the

paving operation. Utility Company manholes, valve covers, etc., that are not adjusted during the paving operation shall have a rake hole left over the casting exposing the entire cover to provide emergency access.

Utility Company valve covers shall be masked or otherwise protected from tack coat. All covers shall be cleaned and restored to their original condition, including repainting if necessary, regardless of the condition of the manhole covers prior to construction.

Two inch (2") rake hole shall be provided on all other manholes, monuments, cleanouts, etc., to be adjusted after paving.

Manhole frames and covers etc. shall be adjusted to grade to conform within 1/8 inch of the adjusted pavement elevation within three (3) days after paving operation is completed on each street. All City owned manhole frames and covers that do not match Standard Plan 220, Case 1301shall be replaced with new fames and covers. Where existing manhole castings are to be raised to new street elevation, the Contractor shall remove all new and old asphalt concrete from the cover and rim. The Contractor shall also mark or index each cover to its respective frame ("matched pairs") prior to beginning work. Any frames and covers found to rock or otherwise noisy shall be replaced at the contractor sole expense. Notify City if noisy prior to lowering otherwise Contractor is responsible. Any valve boxes, splice boxes, etc. that are damaged shall be replaced at the Contractor's expense.

The Contractor shall complete the adjustment to final grade of all manholes, etc., in accordance with the following requirements:

1. Coordinate work among subcontractors to avoid cutting through new traffic stripes and vehicle detector loops. Contractor shall be responsible for the reinstallation of all damaged detector loops and traffic stripes caused by poor coordination work.
2. All traffic lanes to be opened by 4:30 p.m. or as otherwise noted on Lane Closure Charts.
3. No depressions after traffic lanes are open. Protect newly poured collars subject to vehicular traffic with trench plates until concrete has sufficiently set to withstand damage.
4. No more than five (5) manholes may be opened at any one time on any one street.
5. All work must be confined to one traffic lane at a time in each direction. Traffic is not to weave to avoid adjustments.

301-1.6.1 ADJUST SURVEY MONUMENT FRAME AND COVER TO GRADE. The following section is added to the Standard Specifications.

Survey Monument frames and covers shall be adjusted to final grade after paving work is completed, to conform within 1/8 inch of the adjusted pavement elevation in accordance with Section 301-1.6 .

Existing survey monument frames and covers which do not comply with Standard Plan 134 shall be replaced with new frames and covers.

301-1.6.2 ADJUST SANITARY SEWER CLEANOUT FRAME AND COVER TO GRADE. The following section is added to the Standard Specifications.

Sanitary Sewer Riser and Cleanout Frames and Covers shall adjusted to final grade, after paving work is completed, to conform within 1/8 inch of the adjusted pavement elevation in accordance with Section 301-1.6.

Existing Sanitary Sewer and Cleanout Frames and Covers which do not comply with Standard Plan 302, shall be replaced with new frames and covers.

301-1.6.3 ADJUST EBMUD WATER VALVE POT TO GRADE. If the bid alternate is not made part of this contract and EBMUD is to adjust their water pots to grade, then the Contractor shall notify EBMUD fifteen (15) working days prior to start of construction to allow EBMUD to lower their water valve pots prior to road grinding or excavation. Contractor shall keep EBMUD updated on the construction schedule and give EBMUD two weeks notice prior to completion of final paving such that EBMUD can schedule crews to raise the water valves to finish grade. If the schedule should change after the two weeks notice, then the Contractor shall allow EBMUD four weeks to schedule crews for water valve adjustment to finish grade.

EBMUD shall be contacted immediately if any EBMUD facilities are damaged or disturbed during construction.

301-1.7 PAYMENT. The following is added to Section 301-1.7 "PAYMENT" of the Standard Specifications:

The contract unit price paid per each for Adjust Sanitary Sewer Frame & Cover to Grade" Bid Item No. (5) shall include all work required by Section 301-1.6.2.

The contract unit price paid per each for "Adjust Storm Water Manhole Frame & Cover to Grade" Bid Item No. (6) shall include all work required by Section 301-1.6.

The contract unit price paid per each for Bid Item No. (8) shall include all work required by Section 301-1.6.1., Adjust Survey Monument Frame & Cover to Grade.

Payment for all other work in Section 301 shall be included in the bid price paid for the item for which the subgrade was prepared.

301-3 CEMENT TREATED SOIL

301-3.1.1 GENERAL The following is added to section 301-3.1.1 of the Standard Specifications and these Special Provisions:

This specification shall govern the process known as Full-Depth Rehabilitation (FDR). FDR consist of reconstructing an existing distressed pavement section by in-place recycling of the pavement materials and chemical treatment to enhance the structural properties of the recycled materials. This work shall consist of pulverizing existing roadway materials and uniformly mixing with Portland cement and water. Mixture shall then be compacted, finished, and cured in such a manner that the in-place cement treated mixture forms a dense, uniform mass conforming to the lines, grades, and cross sections shown on the plans.

This work shall proceed once the top layer of existing asphalt concrete has been removed. The cement-treatment phase of this work consists of mixing the existing in-place soil-aggregate with a stabilizing reagent and water, and compact the mixture to the lines, grades and dimensions shown on the plans and as specified in these special provisions. Once the proper grade is established, a new asphalt concrete section will be installed.

301-3.1.2 MATERIALS The following is added to section 301-3.1.2 of the Standard Specifications and these Special Provisions:

In-place material – Material to be treated with Portland cement shall consist of pulverized asphaltic concrete, existing aggregate base, and underlying native subgrade soils.

Existing materials shall be pulverized so that 100 percent will pass a 2-inch (50-mm) sieve and a minimum of 85 percent will pass a 1-inch (25-mm) sieve.

If underlying soil conditions are unstable due to high moisture content, Contractor shall notify engineer for additional direction.

Stabilizing Reagent – Portland cement is proposed for use as a composite stabilizing reagent. All cement to be used or furnished shall conform to ASTM C150. The cement shall be protected from moisture until used and be sufficiently dry to flow freely when handled. Cement shall be furnished in bulk and not exposed until applied to prepared grade.

Prior to spreading, a Certificate of Compliance and a certified copy of the shipping weight shall be submitted to the Engineer for each delivery.

Water – Water shall be clean and potable and shall be added as needed during mixing and re-mixing operations, during compacting, during the curing period, and to keep the cured material moist until covered.

301-3.1.3 EQUIPMENT The following is added to section 301-3.1.3 of the Standard Specifications and these Special Provisions:

FDR section shall be constructed utilizing a combination of equipment that will produce results that meet all the requirements herein. The Engineer prior to use shall approve such machines.

Cement Spreader: The cement spreader shall be equipped with such instrumentation and control equipment to control spread rates over variable travel speeds. The operator shall demonstrate that the instrumentation and control equipment is calibrated and capable of controlling the spread rates within specifications.

Mixer: The mixing equipment shall be capable of mixing the full-specified depth of cement treatment, leaving a relatively smooth plane at the bottom of the FDR section. Mixing equipment shall be equipped with a visible depth indicator showing the mixing depth, and odometer or footmeter to indicate travel speed, and a controllable water additive system for regulating water added to the mixture.

Compactors: When compacting cement treated sections greater than eight (8) inches, a sheepsfoot type compactor capable of compacting the entire section to the project specification shall be used.

301-3.1.4 PREPARATION The following is added to section 301-3.1.4 of the Standard Specifications and these Special Provisions:

The existing asphalt concrete (AC) surfacing and the underlying base material shall be pulverized to a depth twice the thickness of the existing AC section or the thickness of the cement-treated section designated on the plans, whichever is greater. When the thickness of the existing base section is less then the thickness of the existing AC section, the pulverized depth may be reduced per Engineers approval.

The pulverized materials shall be graded to conform to the lines and grade shown on the Plans prior to application of the cement. Grading operations will require some movement of material along the grade and/or off-hauled to conform to the lines and elevations shown on the Plans and to allow for the new asphalt concrete section to be installed.

At the contractor's option, the existing AC section may be removed by other means, if contractor can demonstrate to the Engineer that pre-removal of AC will still allow for new grade requirements to be met with remaining materials. This paragraph shall not relieve the Contractor of conforming to requirements

contained elsewhere in these special provisions, or in the Standard Specifications Section 300-2.6 "Surplus Materials".

No more of the existing roadway sections shall be pulverized or removed in any working day than can be relayed as specified above in that working day. Pulverized material shall be temporarily compacted at the end of each day with a smooth drum roller, to allow for traffic.

301-3.1.5 Cement Application, Mixing, and Spreading The following is added to section 301-3.1.5 of the Standard Specifications and these Special Provisions:

The depth of treatment shall be the depth designated on the Plans or as determined by the Engineer. In areas where mixer can not access, such as around manholes or curbs, Contractor shall process the same day by pulling the material away from obstacles immediately after cement application. Material and cement shall be relayed to an area accessible to mixing equipment.

The Portland cement shall be applied in one operation to the required width, grade and cross section. Cement shall be evenly spread at the designated rate and shall not vary more than 10 percent on any area. Only a calibrated spreader able to provide a uniform distribution of the cement throughout the treatment area shall spread cement. The cement shall be added in a dry state and every precaution shall be taken to prevent dusting.

The spreader truck shall demonstrate the ability to maintain a consistent spread rate over variable travel speeds. The contractor will demonstrate the consistency of the spread rate by conducting multiple pan tests.

Cement treatment can be conducted in one lift provided the contractor can demonstrate that the spread rate, particle size, and compaction can be achieved. The mixer shall be capable of automatically adjusting itself to maintain a constant depth. On the initial mix, the water truck must have a solid connection to the mixer. The water shall be injected directly into the mixing chamber and shall produce a homogenous blend free from streaks or pockets of dry cement. Leakage of water from equipment will not be permitted. Care shall be exercised to avoid the addition of any excessive water.

The pan test consists of placing a 3 square foot pan on the grade in front of the spreader truck. After cement has been spread, the cement is weighed to determine the rate of spread in pounds per square foot. Truck tags will be used to verify amount of cement delivered to project.

When mixed material, exclusive of one inch or larger clods, is sprayed with phenolphthalein alcohol indicator solution, areas showing no color reaction will be considered evidence of inadequate mixing.

No traffic other than the mixing equipment or other related construction equipment will be allowed to pass over the exposed cement until after completion of mixing.

Cement shall not be spread or mixed/hydrated while the atmospheric temperature is below 35° F or below 1.67° C. At the Engineers discretion, processing will be allowed if temperature is rising.

Contractor is required to complete mixing and initial compaction of the FDR-cement section within 2 hours of initial hydration of cement.

301-3.1.8 PLACING, COMPACTING, AND FINISHING The third paragraph in this section regarding cement-treated sections greater than 8 inches has been removed. The following is added to section 301-3.1.8 of the Standard Specifications and these Special Provisions:

Proportioning / Spreading

The stabilizing reagent shall be spread in one operation to the required width, grade and cross section. Reagent shall be evenly spread at the designated rate and shall not vary more than 10 percent on any area. Only a calibrated spreader able to provide a uniform distribution of the reagent throughout the treatment area shall spread the reagent. The reagent shall be added in a dry state and every precaution shall be taken to prevent dusting.

Tailgate spreading of the stabilizing reagent will not be permitted. Tailgating is defined as having manual control of the spread rate, instead of automatic. The spreader truck shall demonstrate the ability to maintain a consistent spread rate over variable travel speeds. The contractor will demonstrate the consistency of the spread rate by conducting multiple pan tests.

The spreading operations shall be conducted in such a manner that a hazard is not present to construction personnel or the public. All reagent spread shall be thoroughly mixed into the soil the same day that reagent-spreading operations are performed.

No traffic other than the mixing equipment or other related construction equipment will be allowed to pass over the spread reagent until after completion of mixing.

Initial Hydration Mixing

Mixing equipment shall be equipped with a visible depth indicator showing mixing depth, a speedometer to indicate travel speed and a controllable water additive system for regulating water added to the mixture. The initial mix shall be done while introducing water through a controllable pump on the mixing machine. Mixing and re-mixing, regardless of equipment used, will continue until the material is uniformly mixed, free of streaks or pockets of un-hydrated reagent.

Reagent material shall not be mixed or spread while the atmospheric temperature is below 35 F or below 1.67 C. At the Engineers discretion, treatment will be allowed if temperature is rising.

Mellowing and Re-Mixing

Quicklime Stabilization - After initial mixing and hydration, the treated material shall mellow for a minimum of 16 hours prior to re-mixing. Once the mellowing period has been completed, the treated soil shall be re-mix to the full depth of treatment. Water truck is not required to hook-up to mixer during re-mixing.

Portland Cement – After initial mixing and hydration, the treated material shall mellow for a minimum of 1-hour and a maximum of 2-hours, prior to re-mixing and compacting.

Adequate mixing will be determined by testing with standard phenolphthalein alcohol indicator. Non-uniformity of color reaction of the treated material, exclusive of one inch or larger clods, will be considered evidence of inadequate mixing.

Compacting - Maintain moisture above the optimum moisture content, but within allowable range as determined by the moisture/density relationship of the compaction curve. The FDR-cement section shall be compacted to 95 percent of the maximum density as determined by ASTM 1557.

The maximum compacted thickness of a single layer may be any thickness the contractor can demonstrate to the engineer that his equipment and method of operation will provide the required compacted density throughout the treated layer.

Initial compaction – Contractor shall achieve the projects minimum compaction requirement during initial compaction operation. Lift thickness of 4 to 8 inches shall be by means of a steel-tired or pneumatic-tired roller. Lift thickness of 8 to 12 inches shall be compacted by means of a sheepsfoot compactor. Lift thickness greater than 12 inches shall be compacted by a sheepsfoot compactor with an open ring design to prevent bridging of the lower half of the FDR section. Areas inaccessible to rollers shall be compacted to the required compaction by other means satisfactory to the Engineer.

Surface compaction. Surface compaction is defined as the upper 3 inches of the FDR section. Surface compaction shall be by means of steel-tired or pneumatic-tired roller. Areas inaccessible to rollers shall be compacted to the required compaction requirement by other means satisfactory to the Engineer.

Final Grading. Surface compaction and finish grading shall proceed in such a manner as to produce, in not more than 2 hours from initial compaction, a smooth, closely knit surface conforming to the crown, grade and line indicated and will be free of cracks, ridges or loose material.

Maintain moisture content on surface within allowable range during all grading procedures.

All excess material above the grade tolerance specified by the plans should be removed from the grade prior to final surface compaction of the FDR section. This excess material can be used in areas inaccessible to treatment equipment, provided the cement base material is used within the allotted time constraints.

The trimmed and completed surface shall be rolled with steel or pneumatic tired rollers. Minor indentations may remain in the surface of the finished material as long as no loose material remains in the indentations.

Curing - After placement and compaction of the FDR-cement section is completed, it shall be protected against drying and traffic for 3-days. The Engineer, based on factors such as degree of traffic, temperature, and stability may reduce the 3-day cure period.

Curing shall be moist (water fogging), bituminous seal, or other method approved by the Engineer. If moist curing is used, exposed surfaces of the FDR section shall be kept continuously moist with a fog spray for 3 days. If a bituminous curing is used, it shall consist of liquid asphalt or emulsified asphalt meeting the requirements of Section 203.

The bituminous curing seal shall be applied in sufficient quantity to provide a continuous membrane over the soil at a rate of between 0.45 L/m2 and 0.90 L/m2 (0.10 and 0.20 gallon per square yard) of surface with the exact rate determined by the Engineer. It shall be applied as soon as possible after the completion of final rolling. The surface shall be kept moist while the seal is applied. At the time the bituminous material is applied, the soil surface shall be dense, shall be free of all loose and extraneous material, and shall contain sufficient moisture to prevent excessive penetration of the bituminous material.

Traffic Loading – Once hydration and compaction requirements have been met, contractor may be allowed to place subsequent structural sections over the stabilized base section provided that the following criteria's are met:

A. The FDR section is stable and non-yielding under a minimum 15 ton proof-roll.

B. The FDR section has no evidence of shrinkage cracking

C. The FDR section criteria's have been met, including the FDR section thickness, percentage of cement placed, and quantity or volume of FDR treatment confirmed.

Repair – If the FDR-cement section is damaged, it shall be repaired by removing and replacing the entire depth of affected layers in the damaged area. Feathering will not be permitted for repair of low areas.

301-3.4.1 PERFORMANCE REQUIREMENT (Stabilized Base)

Material to be tested shall include soil/aggregate within the proposed stabilized base section. Stabilized base section shall consist of the upper **11 inches** of existing materials below the new asphalt concrete section on **Andover St**, **12" inches** on **Begier Ave**, **15"** on **Blossom Way**, **XX"** on **Astor Dr**, and **XX"** on **Sybil Ave**. Stabilized base section shall have a minimum unconfined compressive strength of 500 psi and a Plasticity Index (ASTM D4318-05) of less than 12.

Unconfined Compressive Strength shall be determined as followed:

- Portland cement shall be tested using ASTM D1633 (Method A)
  *Curing of UCS samples shall incorporate the accelerated cure method as described by CT373.

General

The above testing shall determine the proper percentage of stabilizing reagent necessary to meet the project performance requirement. However, for bidding purposes, Portland Cement shall be proposed at the rate of **5-percent (5%)** of an estimated soil weight of 140 pcf on all streets.

If it is determined during construction that additional Portland Cement is required to achieve the minimum unconfined compressive strength listed above for each street, then the cost for materials shall be per the contract unit price for item 10, "Cement needed for full-depth rehab".

301-3.4.2 PROTECTION OF EXISTING UTILITIES

Where existing underground utilities or utility services lie within the proposed stabilized section, the contractor shall verify, by potholing or other means acceptable to and approved by the Engineer, that there is sufficient cover over the utilities to provide clearance for the soil mixing process without damage to the existing utility facilities. This verification shall be done where each utility crosses the boundary of a stabilized area, and at a minimum of one location in between. This paragraph shall not relieve the Contractor of conforming with all utility protection requirements contained elsewhere in these Special Provisions, or in the Standard Specifications.

The Contractor shall be responsible for the protection of existing pipelines, manholes, catch basins, valve boxes and other utility structures that are to remain within the excavation work area. Any such utility facilities that are damaged from roadway excavation work performed by the Contractor shall be either repaired or replaced to the satisfaction of the Engineer at no cost to the City, in accordance with Greenbook Specifications

Utility Clearance Specification for Stabilized Base Section

This specification covers work necessary to prepare, avoid, and repair existing utilities during installation of the stabilized base section. Specifications address minimum clearance requirements for existing utilities below the treated section and installation methods for utilities located within the treated section.

At all phases of the project, the Contractor shall be responsible for the protection of existing pipelines, manholes, catch basins, valve boxes and other utility structures that are to remain within the stabilized base work area. Any such utility or utility facility that is damaged during

the installation of the stabilized base section by the Contractor shall be either repaired or replaced to the satisfaction of the Engineer at no cost, in accordance with Greenbook Specifications

General

Where mixing or excavation equipment is used, a qualified person shall be on-site at all times to direct and respond to utility interference and safety issues. The Contractor shall provide adequate proof that qualified person is trained. Where such work is sub-contracted, the same requirements will follow.

Contractor shall provide all labor, equipment, and materials necessary to complete work in areas where stabilized base section is utilized. The contractor shall verify soil type by any means up to and including digging test holes and provide such information to the owner, upon request, prior to installation of stabilized base section.

Location of Existing Utility Pipeline, Conduits and Service Laterals

The contractor shall obtain, in advance of stabilization processing, the layout for all buried utilities through a utility locator service. In areas where stabilized section crosses over buried utilities, contractor shall verify, by opening utility covers, excavating or other means acceptable to the Engineer, the location and depth of the utility. This verification shall be required where each utility crosses the boundary of a stabilized base area, and at a minimum of one location in between. For stabilized sections not within a 3.5 feet radius of any utilities, exposure holes are deemed as optional.

This paragraph shall not relieve the Contractor of conforming with all utility protection requirements contained elsewhere in these special provisions, or in the Standard Specifications.

Clearance Requirement of Existing Utilities below Stabilized Base

Clearance shall be measured from the bottom of the proposed stabilized base section to the top of the existing utility.

Stable Conditions – When conditions between the stabilized base section and the utility or below the utility are stable (unyielding), a minimum clearance of six (6) inches is required between the bottom of the stabilized base section and the top of the utility.
Unstable Conditions – When conditions between the stabilized base section and the utility or directly below the utility are unstable (movement under load), a minimum clearance of twelve (12) inches will be required between the bottom of stabilized base section and top of utility.

Utilities within the Stabilized Base Section

When the existing utility is located within the stabilized base section, the Contractor shall utilize other methods to install the stabilized base section. Stabilized base section installation options that the contractor may consider include, but not limited to:

Stabilizing reagent may be spread over the utility, but not mixed in-place. After the reagent has been applied to the exposed grade contractor may excavate the material around the utility, including the reagent, and relayed to an area where mixing can occur away from the exposed utility. Once the excavated materials have been properly hydrated and mixed, the treated material can be used to backfill around the utility. The mixing machine should have a minimum horizontal clearance of twelve (12) inches from the edge of any utility.

The contractor shall provide special care to ensure that no damage occurs to the exposed utility. Where applicable and soil conditions could warrant, sand bags, pipe rollers or other approved supports shall be used and spaced at sufficient distance to prevent pipe from coming in contact with the ground.

Contractor may elect to use a controlled Low Strength Material (CLSM/CDF) as specified in these Special Provisions material to backfill below or around the utility. Flowable fill material must meet a minimum unconfined compressive strength of 500 psi to be used as backfill.

301-3.4.3 CONTRACTOR'S QUALIFICATIONS

The contractor performing FDR cement stabilization shall document a minimum of five years' experience performing similar cement stabilization work. The contractor shall submit a list of equipment to be utilized in performance of the cement stabilization work. The contractor shall submit a detailed description of work procedures for approval by the Engineer prior to beginning FDR cement stabilization work.

The contractor performing FDR cement stabilization shall have a representative on site with a minimum of 5 years' experience in cement stabilization. Their function should include coordinating with other contractors and site representatives. All personnel should be properly trained in the FDR treatment process, including quality control and safety procedures.

301-5.10 MEASUREMENT AND PAYMENT. The contract price paid per square foot for the Stabilized Base Section shall include full compensation for furnishing all labor, tools, equipment, and incidentals and for doing all the work involved in treating the base, complete in place, including City Tests, furnishing and placing stabilizing reagent, mixing, compacting and curing, potholing and protection of utilities, repair or replacement of utilities, as shown on the plans, as specified in the Standard Specifications and these Special Provisions, and as directed by the Engineer.

Payment for cement used to stabilize the base section shall be under contract bid item (10), "Cement Needed for Full-Depth Rehab". Contractor shall be reimbursed for the actual amount of cement used for soil stabilization. Contractor shall supply the City with material tags to quantify the amount of cement.

Removal of surplus pulverized material shall be included in the contract price paid per cubic yard for removing existing AC surfacing and any existing base, and no additional compensation will be allowed therefore in accordance with Section 300-2 "Unclassified Excavation".

SECTION 302 ROADWAY SURFACING

302-1 COLD MILLING OF EXISTING PAVEMENT. Pavement grinding shall conform to the provisions of Section 302-1, "Cold Milling Asphalt Concrete Pavement" of the Standard Specifications and these Special Provisions and City Standard Plans 126 and 128.

Existing asphalt concrete pavement shall be removed by milling or grinding to the lines and grades shown on the plans and as directed by the Engineer. The contractor shall immediately notify the Engineer if the existing subgrade grading planes and/or the pavement surface plane (existing or cold milled) will affect the Contractor from meeting the specified tolerance. Failure to notify prior to completion of grinding operations and/or commencement for paving operation shall be considered as Contractor's concurrence that existing surface is suitable for compliance to tolerances stated.

All asphalt concrete, concrete, slurry seal emulsion, etc., up to 75 mm (3") wide shall be removed from the concrete gutter after grinding operation is complete and shall be considered included work required by Section 300-1 and/or Section 302-1. Asphalt concrete, slurry seal emulsion and other residue on concrete gutters to be removed, may be intermittent throughout the project: Some concrete gutters when exposed after such milling work may require the use of new asphalt concrete to provide smooth flow line to adjacent concrete gutter surfaces.

302-1.2 MILLING MACHINE. Pavement grinding equipment shall conform to the provisions of Section 302-1.2 "Milling Machine" of the Standard Specifications and these Special Provisions shall be approved by the Engineer prior to use.

A diamond blade pavement grinder (Caltrans designation PGD1A shall be used to grind to specified tolerance any high areas of pavement. Contractors attention is directed to Section 302-5.6.2 "Density and Smoothness" of these Special Provisions.

302-1.7 WORK SITE MAINTENANCE. The Contractor shall clean the street of all grinding residue as provided for in Section 302-1.7 "Work Site Maintenance", of the Standard Specification immediately following the grinding machine and prior to opening the street to traffic. Grinding residue shall be disposed of as provided for in Section 300-2.6 "Surplus Materials" of these Special Provisions.

302-1.10 PAVEMENT TRANSITIONS. The following is added to Section 302-1.10 "Pavement Transitions" of the Standard Specifications.

The Contractor shall immediately construct Pavement Transition in accordance with Section 203-6.1 "Pavement Transition" of these Special Provisions conforms at private property to provide continual access.

Areas which have been cold milled or excavated that are subject to pedestrian traffic, including but not limited to marked and un-marked crosswalks, and at all driveways, where the offset equals or exceeds 3/8 inch shall be immediately overlaid with Pavement Transition two (2) feet in width and the length of crosswalk or driveway prior to opening the area to pedestrian or vehicle traffic.

At pavement conforms or excavations where the offset equals or exceeds 3/8 inch shall be immediately overlaid with Pavement Transition six (6') feet minimum in width or a slope of 1:8 maximum prior to opening the street to traffic.

Longitudinal cold mill or excavated joints where the offset equals or exceeds 3/8 inch shall be overlaid with Pavement Transition two (2) feet in width prior to opening the street to traffic.

302-1.11 MEASUREMENT The following is added to Section 302-1.11:

The estimated quantity for Roadway Excavation and Offhaul, Bid Item No. (3) and Roadway Excavation and Offhaul (AC w/Petromat), Bid Item No. (4) shall be the FINAL QUANTITY for which payment for excavation will be made unless the dimensions, scope, limits or grades of excavation shown on the plans are revised by the Engineer. If such dimensions are revised and such revisions result in any increase or decrease in the quantities of such work, the final quantities for payment will be revised in the amount represented by the changes in the dimensions based on the unit price in the bid. The estimated quantities for excavation shall be considered as approximate only and no guarantee is made that theses quantities which are determine by computations, based on the details and dimensions shown on the plans, will equal the actual quantities excavated. No allowance will be made in the event that the quantities based on computations do not equal the actual quantities excavated.

302-1.12 PAYMENT. Section 302-1.12 "Payment" is amended as follows:

The contract unit price paid per cubic yard – for Roadway Excavation and Offhaul, Bid Item No. (3) and Roadway Excavation and Offhaul (AC w/Petromat), Bid Item No. (4), shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all work required by Section 300-2 including excavating, sloping, rounding, tops and ends of excavations; installing, removal, and disposal of pavement transitions; waste profile testing; loading hauling, and disposing of surplus material; stockpiling, and hauling to its final location as shown on the plans, as specified in the Standard Specifications and these Special Provisions, and as directed by the Engineer.

302-5 ASPHALT CONCRETE PAVEMENT. Asphalt concrete pavement shall conform to the provisions of Section 302-5, "Asphalt Concrete Pavement", of the Standard Specifications and these Special Provisions.

302-5.1 GENERAL. The following is added to Section 302-5.1, "General", of the Standard Specifications:

The Contractor shall use Reclaimed Asphalt pavement (RAP) conforming to Section 203-6 of these Special Provisions for base courses (lower lifts).

The final lift, surface or riding course, shall be Asphalt Concrete conforming to Section 203-6 of these Special Provisions.

All streets shall be paved with five (5) calendar days from the date of completion of the keycut or excavation work.

302-5.3 PRIME COAT. The following is added to Section 302-5.3, "Prime Coat", of the Standard Specifications: Unless otherwise noted on the plans, prime coat shall not be required.

302-5.4 TACK COAT. The following is added to Section 302-5.4, "Tack Coat", of the Standard Specifications :

Prior to the application or tack coat on existing pavement, the pavement shall be power broomed to remove all dirt, rocks, leaves water or other foreign material and shall be done to the satisfaction of the Engineer.

Tack coat shall be applied where AC is to be installed directly on any existing hard surfaced pavement or improvement or to the surface of any course over 12 hours old or when the Engineer determines that the surface condition of the course will prevent a satisfactory bond between it and the succeeding course.

302-5.5 DISTRIBUTION AND SPREADING. The following is added to Section 302-5.5, "Distribution and Spreading", of the Standard Specifications:

Asphalt concrete shall be placed only upon the specific approval of the Engineer. The Engineer's decision regarding satisfactory paving conditions shall be final. Open graded asphalt concrete shall not be placed when atmospheric temperature is less than 70 degrees Fahrenheit.

Asphalt concrete shall be spread and compacted in the number of layers of the thicknesses indicated in the following table:

Total Thickness Shown on Plans	No. of Layers	Top Layer Thickness (ft)		Next Lower Layer Thickness (ft)		All Other Lower Layer Thickness (ft)	
		Min.	Max.	Min.	Max.	Min.	Max.
0.20' or less	1	-	-	-	-	-	-
0.25'	2*	0.12	0.13	0.12	0.13	-	-
0.30' – 0.40'	2	0.15	0.20	0.15	0.25	-	-
0.45' or more	**	0.15	0.20	0.15	0.25	0.15	0.40

*At the option of the Contractor, one layer 0.25-foot thick may be placed.
**At least 2 layers shall be placed if total thickness is 0.45-foot. At least 3 layers shall be placed if total thickness is more than 0.45-foot and less than 0.90-foot. At least 4 layers shall be placed if total thickness is 0.90-foot or more

Asphalt concrete shall only be placed by the methods described in this section. Blade lay by a motor grader is not permitted.

Asphalt concrete may be deposited by transfer trucks in a windrow on the roadway in advance of the paving operation for pick-up and depositing into the self-propelled paving machine subject to the following conditions:

1. Transfer trucks must be capable of backing up.
2. Double bottom dump trucks are prohibited.
3. The pick-up machine shall not transmit loads to the paving machine that adversely affect the finished surface.
4. The windrow shall not be placed at intersections or block side streets
5. The maximum windrow length in front of the paving machine shall be 200 feet.
6. The Contractor shall furnish a "Dump Man" whose sole responsibility shall be for the control of windrow distribution.

Asphalt concrete distribution shall commence at the roadway gutter lip or the low edge of the roadway. Unless operations have been suspended for the day, subsequent asphalt concrete distribution passes shall be placed adjacent to the previous pass while the previous asphalt concrete distribution pass is still hot. The maximum distribution pass shall be 1,000 feet.

The tracks or wheels of spreading equipment shall not be operated on the new asphalt concrete pavement until final compaction has been completed. Trucks, loaded or empty, shall not be allowed on the new roadway surface until the asphalt concrete reaches ambient temperature.

The Contractor shall have the option of providing the extra manpower and equipment necessary to work under low over hanging branches or to hire a licensed arborist to trim trees for adequate clearance. A list of proposed trees to be trimmed shall be submitted for Engineer approval prior to proceeding. Written permission shall be obtained from the property owner for any trees on private property prior to proceeding.

In areas inaccessible to the paving equipment spreading and compacting of asphalt shall be performed by any method which will produce an asphalt concrete pavement of uniform smoothness, texture and density. Said area shall not exceed 20 square feet each without approval of the Engineer.

302-5.6 ROLLING. Rolling shall conform to the provisions of Section 302-5.6, "Rolling", of the Standard Specifications and these Special Provisions.

302-5.6.1 GENERAL. The following is modifications are made to Section 302-5.6.1, "General" of the Standard Specifications:

Base courses at all conforms, and any areas deemed inaccessible to rollers by the Engineer such as around manholes, water valves, etc. shall be mechanically compacted with a rammer or tamper with particular attention to the edges and corners of the excavations.

The first coverage of initial or breakdown compaction shall be performed when the temperature is not less than 250 degrees Fahrenheit and all breakdown compaction shall be completed before the temperature of the machine drops below 200 degrees Fahrenheit.

Open graded asphalt concrete shall be placed at temperatures between 200 degrees and 250 degrees Fahrenheit and shall be compacted as soon as possible after placement.

Use of a pneumatic-tired roller shall not be required.

302-5.6.2 DENSITY AND SMOOTHNESS. The following is added to Section 302-5.6.2, "Density and Smoothness" of the Standard Specifications:

The Contractor shall immediately notify the Engineer in writing if the existing subgrade grading plane and/or the pavement surface plane (existing or cold milled) will affect the contractor from meeting the specified grade tolerance. Failure to notify prior to completion of grinding operations and/or commencement for paving operation shall be considered as Contractor's concurrence that existing surface is suitable for compliance to tolerance stated.

Low areas for pavement not meeting smoothness tolerances shall be ground to 37.5 mm (1 1/2") or 2 times the maximum size of the aggregate minimum depth and repaved. High areas shall be ground to tolerance with diamond blade pavement grinder. (Caltrans designations PGD1A) and fog sealed in accordance with Section 302-12 of these Special Provisions. All corrective work shall be at Contractor's sole expense.

All new asphalt concrete pavement to be subsequently resurfaced and/or Chip or Slurry Sealed and parking lots shall be fog sealed in accordance with Section 302-12 of these Special Provisions.

302-5.7 Joints. Work shall be done per the Standard Specifications.

302-5.8 Manholes (and other structures). The following is added to Section 302-5.8 "Manholes (and other structures)" of the Standard Specifications:

All City owned manhole frames and covers within limit of work that do not match Drawing 220, Case 3101 shall be replaced with new frames and covers; All other frames and covers shall be either punched or marked "Matched Pairs" prior to removal, cleaning and reuse. Contractor shall install false bottom on all manholes prior to roadway excavation to prevent debris from entering.

Structures shall be reset in accordance with section 301-1.6.

The Contractor's attention is directed to Section 301-1.6 "Adjustment of Manhole Frame and Cover Sets to Grade and Section 302-5.8 "Manholes (and Other structures)" of these Special Provisions.

Manholes, monuments, water valves, clean-outs, etc. within keycut and repair/rehab areas shall be lowered below the grinding plane prior to grinding. Grinding shall be done to the grinding plane required, chipping and/or jack hammering is strictly prohibited. All utility frame and covers shall be adjusted to grade in conformance with the details shown of City Standard Plan 222 "Utility Frame and Cover Adjustment".

302-5.9 Measurement and Payment. The following is added to Section 302-5, "Measurement and Payment", of the Standard Specifications:
Bid Item (11) Asphalt Concrete Paving shall include payment for all work required by section 302-5 "Asphalt Concrete Pavement" except work specified under Section 302-5.8.
Bid item (5, 6 & 8) shall include payment for all work required by Section 302-5.8 "Manholes (and other structures)".

The Contractor shall furnish to the Engineer a legible copy of a licensed weighmaster's certificate showing gross, tare and net weight of each truck load of asphalt concrete mixture. When an automatic batching system is used, the licensed weighmaster's certificate may show only the net weight of material in the truckload. These certificates may be signed by a representative of the Engineer at the plant as well as at the project site. These certificates will be used as the basis of payment.

302-5.10 COMPENSATION ADJUSTMENT FOR ASPHALT CONCRETE. Section 302-5.10 "Compensation Adjustment for Asphalt Concrete" is added to these Special Provisions:
The provisions of this Section shall apply only to all bid Asphalt Concrete:

The compensation payable for asphalt concrete bid items will be increased or decreased in conformance with the provisions of this Section for paving asphalt price fluctuations exceeding 10 percent (Iu/Ib is greater than 1.10 or less than 0.90) which occur during performance of the work.

The adjustment in compensation will be determined in conformance with the following formula when the item of asphalt concrete bid items is included in a monthly estimate:

A. Total monthly adjustment – AQ
B. For an increase in paving asphalt price index exceeding 10 percent:

$$A = 0.90\ (Iu/Ib - 1.10)\ Ib.$$

C. For a decrease in paving asphalt price index exceeding 10 percent:

$$A = 0.90\ (Iu/Ib - 0.90)\ Ib.$$

D. Where:

A = Adjustment in dollars per ton of paving asphalt used to produce asphalt concrete and/or asphalt concrete base rounded to the nearest $0.01.

Iu = The California Statewide Paving Asphalt Price Index which is in effect on the first business day of the month within the pay period in which the quantity subject to adjustment was included in the estimate.

Ib = The California Statewide Paving Asphalt Price Index for the month in which the bid opening for opening for the project occurred.

Q = Quantity in ton of paving asphalt that was used in producing the quantity of asphalt concrete bid items included on the monthly estimate using the submitted weighmaster's certificate

The adjustment in compensation will also be subject to the following:

A. The compensation adjustments provided herein will be shown separately on payment estimates.

B. Compensation adjustments made under this Section will be taken into account in making adjustments in conformance with the provisions in the contract for increased or decreased quantities.

C. In the event of an overrun of contract time, adjustment in compensation for paving asphalt included in estimates during the overrun period will be determined using the California Statewide Paving Asphalt Price Index in effect on the first business day of the month within the pay period in which the overrun began.

The California Statewide Paving Asphalt Price Index is determined each month on the first business day of the month by the California Department of Transportation (Caltrans) using the median of posted prices in effect as posted by Chevron Mobil, and Unocal for the Buena Vista, Huntington Beach, Kern River, Long Beach, Midway Sunset, and Wilmington Fields. In the event that the companies discontinue posting their prices for a field, Caltrans will determine an index from the remaining posted prices, and Caltrans reserves the right to include in the index determination the posted prices of additional fields

302-12 FOG SEAL The following Section is added to the Standard Specifications.

302-12.1 APPLICATION Prior to the applications of fog seal on existing pavement, the pavement shall be power broomed to remove all dirt, rocks, leaves, water, or other foreign material.

Fog seal shall be applied at a rate of 0.05 to 0.10 gallon per square yard. Application shall commence after 7:00 a.m. and shall be completed prior to 1:00 p.m. Fog seal shall not be applied when the air temperature is less than 40 degrees Fahrenheit. Adjacent improvements shall be protected from overspray. The area shall not be opened to traffic until the fog seal has penetrated or dried to the extent that no free liquid remains on the surface.

Fog seal shall be applied to the surface of any area where pavement stripes and markings have been removed and are not to be subsequently resurfaced and shall be immediately covered by broadcasting sufficient common sand to prevent the emulsion from being tracked by vehicles.

All asphalt concrete to be subsequently resurfaced and/or chip or slurry sealed shall be fog sealed. All parking lots shall be fog sealed.

302-12.2 MEASUREMENT AND PAYMENT Full compensation for Section 302-12 shall be considered included in the various contract items for Asphalt Concrete and not additional compensation will be paid therefore.

302-13.1 RUBBER SPEED CUSHIONS Section 302-13 "Rubber Speed Cushions" is added to the Standard Specification and these Special Provisions as follows:

Speed Bumps in the form of rubber speed cushions shall be installed at the approximate locations shown on the Plans, in accordance with the "Rubber Speed Cushion Installation Detail" shown on sheet 23 and

also in accordance with the manufacturer's specifications. Exact locations of the speed cushions and speed bump signs shall be determined by the Traffic Division of the San Leandro Engineering and Transportation Department and will be marked in the field by the City prior to construction.

SECTION 303 CONCRETE AND MASONARY CONSTRUCTION

303-1 CONCRETE STRUCTURES Concrete structures shall conform to the provisions of Section 303-1 "Concrete Structures" of the Standard Specifications and these Special Provisions.

303-1.7 Placing Reinforcement The following is added to section 303-1.7 of the Standard Specifications:

Reinforcing steel shall be placed center to center as shown on the Plans. Placement tolerances shall comply with ACI 301 Chapter 5, ACI 318 Chapter 7 and CRSI Manual of Standard Practice Chapter 8.

Reinforcing steel shall be installed in place, spaced, and rigidly and securely tied with wire at all splices, at crossing points, and intersections in the position indicated. Rebending of reinforcing steel on the job site to fit site conditions will not be allowed without approval from the Engineer. Point end of wire ties away from forms.

303-1.7.2 SPLICING The following is added to Section 303-1.7.2 of the Standard Specifications.

Splice length not shown on the Plans shall be 1.2 times longer than standard splice length.

303-4 MASONRY CONSTRUCTION Work shall be done per the Standard Specifications.

303-5 CONCRETE CURBS, WALKS, GUTTERS, CROSS GUTTERS, ALLEY INTERSECTIONS, ACCESS RAMPS, AND DRIVEWAYS Concrete curbs, walks, gutters, cross gutters, alley intersections, access ramps, and driveways shall conform to the provisions of Section 303-1 "Concrete curbs, walks, gutters, cross gutters, alley intersections, access ramps, and driveways" of the Standard Specifications and these Special Provisions.

303-5.1.1 General The following is added to section 303-5.1.1 of the Standard Specifications:

All PCC improvements shall be doweled to adjacent PCC improvements using 12" long #3 or #4 reinforcing steel dowels at 3' spacing. Drill for drive tight fit or epoxy in place.

303-5.1.3 Concrete Driveway The following is added to section 303-5.1.3 of the Standard Specifications:

Concrete driveway shall be constructed according to the details shown on the City of San Leandro Standard Plan for "Concrete Driveway", (Dwg. 102, Case 3101) or Rolled Curb Modified Driveway, (Dwg. 110 Case 3101) if rolled curb exists, and the specifications shown on the City of San Leandro Standard Plan for "General Concrete Notes", (Dwg. 104, Case 3101).

Commercial and/or Industrial Driveways shall be eight (8) inches thick.

303-5.4.2 Expansion Joints The following is added to Section 303-5.4.2 of the Standard Specifications:

Expansion joints in longitudinal sections of curb, gutter and sidewalk shall be at intervals of 16 to 20 feet, where directed by the Engineer, or where designated on the plans.

303-5.4.3 WEAKENED PLANE JOINTS The following is added to Section 303-5.4.3 of the Standard Specifications:

Weakened plane joints shall be constructed according to the details shown on the City of San Leandro Standard Plan for "General Concrete Notes," (Dwg. 104, Case 3101).

303-5.5.2 Concrete Curb and Gutter The following is added to Section 303-5.5.2 of the Standard Specifications:

Concrete curb and gutter shall be constructed according to the details shown on the City of San Leandro Standard Plans "Concrete Curb, Gutter and Sidewalk", (Dwg. 100, Case 3101) and "General Concrete Notes" (Dwg. 104, Case 3101).

Mortar shall not be applied to any part of the curb.

303-5.5.3 Sidewalk The following is added to Section 303-5.5.3 of the Standard Specifications:

Concrete sidewalk shall be constructed according to the details shown on the City of San Leandro Standard Plans "Concrete, Curb, Gutter, Sidewalk", (Dwg. 100, Case 3101) and "General Concrete Notes", (Dwg. 104, Case 3101).

303-5.5.4 Concrete Valley Gutter The following is added to Section 303-5.5.4 of the Standard Specifications:

Concrete Valley Gutter shall be constructed according to the details shown on the City of San Leandro Standard Plans "Valley Gutter", (Dwg. 114, Case 3101) and "General Concrete Notes", (Dwg. 104, Case 3101).

303-5.5.5 Concrete Curb Ramps The following is added to Section 303-5.5.5 of the Standard Specifications:

Concrete Curb Ramps of the type shown on the plans shall be constructed according to the details shown on the City of San Leandro Plans "Standard Curb Ramps", (Dwg. 106, Case 3101) and "General Concrete Notes" (Dwg. 104, Case 3101).

Concrete curb ramps shall be of the types shown on the plans.

MEASUREMENT AND PAYMENT The following is added to section 303-5.9, "Measurement and Payment", of the Standard Specifications:

Curbs shall be measured linearly along the top at the face. Curb and gutter shall be measured linearly at the flow line. Walks shall be measured linearly along the centerline and multiplied by the width, unpaved areas for boxes, planting, vaults, etcetera shall be deducted. Valley gutters shall be measured linearly along the flow line. Access ramps and driveways shall be paid on a unit basis unless otherwise shown on the bid form.

All work listed in section 303-5.9 shall be installed as shown on the Plan or as advised by Engineer.

SECTION 307 - STREET LIGHTING AND TRAFFIC SIGNALS

307-1 GENERAL General comments about street lighting and traffic signals shall conform to the provisions of Section 307-1, "General", of the Standard Specifications and these Special Provisions.

TRAFFIC SIGNAL Traffic Signal modifications shall conform to the provisions of Section 86, "Signals, Lighting, and Electrical Systems", of the May 2006 California Department of Transportation (Caltrans) Standard Specifications, and these Special Provisions. **All such work shall be accomplished by Certified Electricians in accordance with Labor Code Section 3099 from the Division of Industrial Safety and CCR Title 8 Section 290 et. seq.**

Standard Plans referenced in this Section 307, "Street Lighting and Traffic Signals", for Traffic Control System shall mean the California Department of Transportation (Caltrans) Standard Plans most current edition, and the City of San Leandro Standard Plans (Dwg. 500A, 500B, 500C, 500D).

307-1.1 DESCRIPTION. The following is added to Section 307-1.1, "Description", of the Standard Specifications: The Work shall include furnishing and installing the in-road lighted crosswalk warning system, replacing inductive loops, and adjusting signal heads as shown on the plans and in the Standard Specifications .

TRAFFIC SIGNAL SYSTEMS Work shall consist of replacement of traffic detection loops as shown on the Plans.

307-1.5 MAINTENANCE OF EXISTING SYSTEMS. The following is added to Section 307-1.5, "Maintenance of Existing Systems", of the Standard Specifications: Existing electrical systems (traffic signal and street lighting and other facilities), or approved temporary replacements thereof, shall be kept in effective operation for the benefit of the traveling public during the progress of the work, except when shutdown is permitted, to allow for alterations or final removal of the systems. The traffic signal shutdowns shall be limited to periods allowed for lane closures listed, or shall be as specified in the Special Provisions. Lighting system shutdowns shall not interfere with the regular lighting schedule, unless otherwise permitted by the Engineer. The Contractor shall notify the Engineer prior to performing any work on existing systems.

The Contractors attention is directed to Section 7-10.1 "Traffic and Access" of the Standard Specifications and these Special Provisions.

At least two (2) working days prior to performing any work on existing City systems, the Contractor shall notify the City Public Works Service Center Traffic Supervisor at (510) 577-3451.

307-1.5.2 SCHEDULING OF WORK.

TRAFFIC SIGNAL SYSTEMS, STREET LIGHTING SYSTEMS, PARK LIGHTING SYSTEMS AND COMMUNICATION SYSTEMS. Scheduling of work shall conform to the provisions in Section 86-1.07 "Scheduling of Work", of the Caltrans Standard Specification, the Standard Specifications, and these Special Provisions.

307-2 CONSTRUCTION GENERAL. General construction shall conform to the provisions of Section 307-2, "Construction General", of the Standard Specifications and these Special Provisions.

A ground wire and tracing conductor conforming to the provisions of Section 209-2.4, "Wire", of these Special Provisions shall be installed in all non-metallic conduit.

307-2.6 WIRING.

TRAFFIC SIGNAL SYSTEMS. The following is added to Section 86-2.4A, "Conductor Identification" of the Caltrans Standard Specifications: All single conductors and cables, except detector lead-in cables, shall have clear, distinctive and permanent markings on the outer surface throughout the entire length showing the manufacturer's name of trademark, insulation type letter designation, conductor size, voltage rating and the number of conductors if a cable.

SPLICES FOR TRAFFIC SIGNAL SYSTEMS The following is added to Section 86-2.09D, "Splicing and Terminations" of the Caltrans Standard Specifications: Splices shall be "Method B".

307-4.9 VEHICLE DETECTORS INDUCTIVE LOOPS. The installation and testing of inductive loop vehicle detectors shall conform to the provisions in Section 86-5, "Detectors", of the Caltrans Standard Specifications, details shown on applicable Caltrans Standard Plans and these Special Provisions.

Per Caltrans Standard Plan ES-5A and ES-5B, vehicle detectors shall be Type E except the front detectors which shall be circular Type D loop detectors.

Vehicle detector loops shall be installed within three (3) working days from the date of approval of the striping layout by the Engineer. Manholes, monuments, cleanouts, etc. within the vicinity of vehicle detectors shall be raised prior to loop installation. Vehicle detector looks shall be installed prior to the application of final traffic striping and pavement marking. **Failure to install vehicle detector loops within the specified time shall subject the Contractor to liquidated damages specified in Section 6-9 of these Special Provisions.**

The sides of the slot for Type E vehicle detector loops shall be vertical and the minimum radius of the slot entering and leaving the circular loop shall be 1-1/2 inches. The slot width shall be ¾ inch minimum.

All sawcut residue from detector loop slot shall be collected concurrent with the sawcutting operation by vacuum or other method approved by the Engineer and disposed of off City property.

Detector loop conductors shall be Type 2 and lead-in cables shall be Type B conforming to the provisions of Section 209-4.2, "Wire", of these Special Provisions.

Vehicle detector loop slots shall be sealed with Asphalt Emulsion Sealant conforming to the provisions of Section 209-5.8.2.4 of these Special Provisions and shall be filled in conformance with Section 86-501A (5) "Installation Details" of the Caltrans Standard Specifications.

Type A detector handholes shall be installed at all loop installations to the details on Caltrans Standard Plan ES-5E.

307-8 MEASUREMENT AND PAYMENT BID ITEMS (12 & 13) The Contract Lump Sum price paid for "Install Traffic Loops" Bid Item 12; and "Install Traffic Detector Wells" Bid Item 13 shall include full compensation for furnishing all labor, materials, tools, loops, equipment, and incidentals, and for doing all work involved in Section 307.

Full compensation for all additional materials and labor, not shown on the plans or specified, which are necessary to complete the Street Light System, Traffic Signal Installation & Traffic Signal Modification shall be considered as included in the contract lump sum price paid and as additional compensation will be allowed thereafter.

SECTION 309 MONUMENTS

309 REPLACE SURVEY MONUMENTS Section 309, "Monuments" of the Standard Specifications is revised as follows:

Contractor shall notify the Engineer 2 weeks in advance prior to the disturbance or removal of any existing monuments.

Contractor shall not disturb existing found monuments outside of proposed project limits as shown on the plans. When Contractor's work displaces existing found monuments, the existing monument shall be completely removed and disposed of and reset with a new survey monument at the Contractor's expense.

Replaced survey monuments shall be installed in accordance with Section 2-9.1, "Permanent Survey Markers' of the Standard Specifications and these Special Provisions, and the details shown on the City Standard Plan "Survey Monument" (Dwg. 134, Case 3101).

Survey Monument frames and covers shall be adjusted to final grade after paving work is completed, to confirm within 1/8 inch of the adjusted pavement elevation in accordance with Section 301-1.6.

SECTION 310 PAINTING

310-1 GENERAL. Work shall be done per the Standard Specifications.

310-5 PAINTING VARIOUS SURFACES. Painting various surfaces shall conform with section 310-5, "Painting Various Surfaces", of the Standard Specifications and these special provisions.

310-5.6.1 GENERAL. The following is added to section 310-5.6.1, "General", of the Standard Specifications:

Traffic striping shall conform to the provisions of Section 82, "Markers and Delineators", Section 84, "Traffic Stripes and Pavement Markings" and Section 85, "Pavement Markers" of the May 2006 California Department of Transportation (CALTRANS) Specifications and Standard Plans; these Special Provisions, and City Standard Plans.

Unless new striping plans are included, Contractor shall, prior to the actual work, inventory and reference all existing striping, pavement markings, delineator, etc. and provide a copy to the Engineer. If existing striping is not recorded prior to the work, t he City will deduct the cost of researching and redesigning striping plans from the money due or become due from the Contractor.

Existing stripes and markings with 15m (50 feet) of the Limit of Work shall be re-striped or touched up. Damaged or marred markers within 15 m (50 feet) of Limit of Work shall be replaced.

Pavement marking, including all arrows, symbols, words, speed bumps, crosswalks, and stripes shall be thermoplastic or skid resistant thermoplastic in accordance with City Standard Plan Dwg. Nos. 131 and 616. Skid Resistant Thermoplastic may be substituted with flint Trading, Inc. "PreMark" Preformed Thermoplastic with ViziGRIP products as applicable, (336) 475-6600, www.flintrading.com.

Temporary traffic markings, centerlines, lane lines, and temporary 300 mm (8 inches) white tape stop bar at each stop sign shall be installed immediately after their removal and at completion of surface sealant application is open to traffic.

Striping layout lines shall be installed within twenty-four (24) hours after the street is opened to traffic. Layout lines shall be "Cat Track" type markings. Paint drip lines are not acceptable as layout lines.

Before permanent markings are installed, the layout "Cat Track" marking lines shall be inspected and approved by the Engineer. A smooth transition shall be made on streets where widths of the street changes. The contractor shall allow 3 days for review. No compensation will be made for this delay.

Permanent pavement markers and thermoplastic striping and pavement markings not in conflict with vehicle detectors, manholes, monuments, cleanouts, etc. that require additional work shall be applied within three working days after the layout markings have been approved.

Pavement markers and thermoplastic striping and pavement markings in conflict with vehicle detectors, manholes, monuments, cleanouts, etc. that require additional work shall be painted with one coat of paint within three (3) working days after layout lines are approved by the Engineer. Permanent pavement markers and thermoplastic pavement markings shall be applied immediately after the additional work is complete.

Contractor's attention is directed to Section 6-9 regarding liquidated damages for failure to install within specified time temporary stripes and markings, layout lines and permanent traffic stripes, markings, etc.

310-5.6.1.1 MEASUREMENT AND PAYMENT. The following Section is added to the Standard Specifications:

Bid item (14), "Remove and Replace Thermoplastic Stripes, Pavement Markings, and Markers" shall constitute full compensation for all work listed in section 310-5.6

SECTION 312 PAVEMENT MARKER PLACEMENT AND REMOVAL

312-1 PLACEMENT. The following is added to Section 312-1 "Placement" of the Standard Specifications:

Pavement markers shall be removed and installed in accordance with the provisions of: Section 82, "Markers and Delineators", Section 84, "Traffic Stripes and Pavement Markings", and Section 85, "Pavement Markers" of the May 2006 edition of the California Department of Transportation (Caltrans) Specifications, and Standard Plans; and these Special Provisions, and City Standard Plans.

All markers shall be secured with bituminous adhesives. Epoxy adhesives shall not be used.

MEASUREMENT AND PAYMENT The following is added to section 312-4 Measurement and Payment of the Standard Specifications:

Bid item (14), "Remove and Replace Thermoplastic Stripes, Pavement Markings, and Markers" shall constitute full compensation for all work listed in Section 312.

SECTION 315 ROADSIDE SIGNS, CONSTRUCTION AREA SIGNS AND TRAFFIC CONTROL

The following Sections are added to the Standard Specifications:

315-2 CONSTRUCTION AREA SIGNS.

Except as shown on the plans, locations where construction activities lasting less than five (5) working days, Temporary Mounted Construction Area Signs may be mounted on portable supports or barricades in conformance to the provisions in Section 315-2.1.1.

For locations where construction activities last five (5) or more working days, Stationary Mounted Construction Area Signs in conformance to the provisions in Section 315-2.1.2 shall be used.

ACTIA funding signs shall be provided by the City. Contractor shall pick up ACTIA signs at the City of San Leandro Public Works corporation yard located at 14200 Chapman Road in San Leandro. Contractor shall provide posts and installation for ACTIA signage. ACTIA funding signs are to be returned to the City of San Leandro Public Works corporation yard upon project completion.

315-2.1 GENERAL.

Contractor shall maintain signs so that they are legible and accurately reflect the limits of work. This requirement will apply continuously and will not be limited to the normal days and/or working hours (24 hour/day; 7 days/week).

Type W20-1 and G20-2 construction area signs shall be installed at the locations shown on the plans. Contractor shall coordinate exact sign locations with the Engineer.

Construction Area Signs W8-7 “Loose Gravel”, W21-2 “Fresh Oil”, W8-8 “Rough Road” or “Uneven Pavement” signs shall be installed and maintained at all conforms, intersections and approaches to streets to be sealed, overlaid or reconstructed. Additional signs shall be installed along both sides of streets every 91 m (300 feet) O.C. W8-8 “Rough Road” or “Uneven Pavement” signs shall be installed at all streets to be overlaid or reconstructed. W21-2 “Fresh Oil” shall be required for streets to be slurry sealed. W8-7 “Loose Gravel” signs shall be required for streets to be ship sealed. The requirement will apply continuously and will not be limited to normal working days and/or working hours (24 hours/day; 7 days/week).

Construction Area Sign Type P “Steel Plates Ahead” signs shall be installed and maintained at all steel plated excavations. This requirement will apply continuously and will not be limited to normal working days and/or working hours (24 hours/day; 7 day/week).

Signs shall be covered whenever there is cessation of work for three (3) consecutive working days. Covers for construction area signs shall be of sufficient size and density to completely block out the message so that it is not visible either during the day or at night. Covers shall be fastened securely to prevent movement caused by wind action.

The Contractor shall clean all construction area signs panels at the time of installation and as often thereafter as the Engineer determines to be necessary, but at least once every four (4) months.

To properly provide for changing traffic conditions and damage caused by public traffic or otherwise, the Contractor shall be prepared to furnish on short notice additional construction area sign panels, posts and mounting hardware. The Contractor shall maintain an inventory of commonly required items at the

jobsite or shall make arrangements with a supplier who is able, on a daily basis, to furnish such items on short notice.

315-2.1.1 TEMPORARY MOUNTED CONSTRUCTION AREA SIGNS.

Each Temporary Mounted Construction Area Sign shall consist of a base, framework and a sign panel and shall be mounted on a portable support or appropriately sized barricade. The support or barricade shall be in good condition, capable of staying in position under anticipated traffic or weather conditions. The unit shall be capable of being delivered to the site o fuse and placed in immediate operation and removed after construction.

Sign panels shall conform to the provisions in Section 215-2, "Construction Area Signs". Size, color, and legend shall be the same as stationary construction area signs.

The height to the bottom of the sign panel above the edge of traveled way shall be at least one foot and be visible to traffic. Signs may be placed on both sides of the roadway and within the roadway. Sign supports shall be placed in such a way as not to interfere with pedestrians or bicyclists. A minimum 4-foot of lateral width shall be maintained for pedestrian pathways.

If temporary mounted signs are displaced or overturned, from any cause, during the progress of the work, the contractor shall immediately replace the signs in their original locations.

W21-2, W8-7 and W8-8 or "Uneven Pavement" or Type P signs shall be placed on Type I barricades with operating flashers immediately prior to the work and along streets per above.

315-2.1.2 STATIONARY MOUNTED CONSTRUCTION AREA SIGNS.

Stationary Mounted Construction Area Signs may be installed on above ground temporary platform sign supports as approved by the Engineer, or signs may be installed on existing lighting standards or other supports as approved by the owner of the support. When stationary Mounted Construction Area Signs are installed on existing lighting standards, holes shall not be made in the standards to support the sign. Contractor shall be liable for any damage caused by the attachment to existing facilities. Contractor shall supply and install temporary posts as necessary.

The height to the bottom of the sign panel above the edge of traveled way shall be at least 1.5 m (5 feet), except when the sign is located in the path of pedestrians or bicycles the height to the bottom of the sign panel shall be at least 2.1 m (7 feet). Temporary sign supports or posts shall provide a minimum of 4-foot lateral width for pedestrian access.

Contractor shall install all funding signs, including the 'Measure B' sign to be provided by the City and as shown on the plans.

All Stationary Mounted Construction Area Signs and supplemental signs shall be removed immediately upon substantial completion of the work. If the Contractor fails to remove said signs in a timely manner, the City shall proceed with removal and deduct the cost thereof from money due or to become due from the Contractor.

315-2.2 MEASUREMENT AND PAYMENT.
Bid item (2) shall constitute full compensation for all work required by section 315-2.

315-3 TRAFFIC CONTROL SYSTEM, LANE CLOSURES AND DETOURS

315-3.1 GENERAL.

The Contractor shall submit a Traffic Control Plan(s) for acceptance by the City's Traffic Engineer prior to performing any work affecting public traffic. Flashing arrow boards shall be use at all intersections of the streets listed in City Standard Plan 608A and 608B and 608C.

Traffic shall be directed through the construction zone by certified flagpersons as required by 2006 CA MUTCD or as directed by the Engineer. Flagpersons shall perform their duties and shall be provided with the necessary equipment in accordance with said manual and shall be certified in accordance with California Code of Regulations (CCR) Title 8, Section 1599 et seq.

When lane closures are made for work periods only, at the end of each work period all components of the traffic control system, except portable delineators used to direct traffic away from the work area, shall be removed from the traveled way. If the contractor so elects, said components may be stored at selected central locations approved by the Engineer within the right-of-way.

If any component in the traffic control system is displaced or ceases to operate or function as specified, said component shall be immediately replaced or repaired to its original condition and restored to its original location by the Contractor.

During traffic stripe operations, traffic shall be controlled with lane closures, as provided for under "Traffic Control system" of these Special Provisions, or by use of an alternative traffic control plan proposed by the Contractor. The Contractor shall not start traffic stripe operations using an alternative plan until he has submitted his plan to the Engineer and has received written approval of said plan.

Alternative traffic control plans for striping operations shall conform to the provisions in section 7-10 "Public Convenience and Safety" of the Standard Specifications and these Special Provisions. Attention is directed to Section 214, "Pavement Markers" of these Special Provisions in regard to placing pavement markers with bitumen adhesive.

Traffic Signal System shutdown shall be limited to periods between the hours of 8:00 a.m. and 2:30 p.m. no shut down shall occur on Friday. The Contractor shall notify the City's Public Works Service Center, Electrical Section, (510) 577-3445, forty-eight (48) hours in advance of any traffic signal system shutdowns.

The Contractor shall place W3-4 "Be Prepared to Stop" and R1-1 "Stop" signs to direct vehicles and pedestrian traffic through the intersection during traffic signal shutdown. Temporary "Stop Ahead" and "Stop" signs shall be either covered or removed when the system is turned on.

"Be Prepared to Stop" and "Stop" signs shall be furnished by the Contractor. The minimum size of "Be Prepared to Stop" and "Stop" signs shall be 900 mm (36 feet).

For single lane approaches, one "Be Prepared to Stop" and one "Stop" sign shall be placed for each single lane approach. For multiple lane approaches, two "Be Prepared to Stop" and two "Stop" signs shall be placed for each multiple lane approach.

315-3.2 MEASUREMENT AND PAYMENT.

Bid item (2) shall constitute full compensation for all work required by section 315-3.

ATTACHMENT A

PG&E ELECTRIC SPECIFICATIONS

Prepared by: EOB1

PRIMARY ELECTRIC UNDERGROUND EQUIPMENT ENCLOSURES 062000

Department: Electric T&D **Section:** T&D Engineering and Technical Support

Approved by: R. D. Kauzer (RDK6) Rich Kauzer **Date:** 11-21-03

Rev. #10: This document replaces PG&E Document 062000, Rev. #09. For a description of the changes, see Page 14.

Purpose and Scope

This document provides dimensions, illustrations, and ordering information for surface-operable, primary, electric underground equipment and splice enclosures. The primary enclosures shown in this document are the preferred enclosures. Precast and poured-in-place manholes should be used only when space for surface-operable enclosures cannot be obtained.

General Information

1. Monolithically poured concrete enclosures may be provided by the supplier, for any depth combination of body and extension, if the enclosure is delivered "in-hole" by the supplier.
2. Size all enclosures to accommodate the largest size cable or piece of equipment that may ultimately be installed.
3. The greatest cost savings is achieved by taking delivery of the enclosure at the jobsite and using supplier's equipment to install the enclosure into the prepared excavation.
4. It is the responsibility of the installing party to check and prepare the jobsite as follows:
   A. Make space available for the supplier's equipment and/or a crane.
   B. Arrange for the removal of any overhead facilities that might prohibit the use of the supplier's equipment and/or crane (if necessary).
   C. Provide the excavation in the proper location and of the correct size, depth, and alignment.
   D. Prepare the excavation with 6 inches of compacted, 3/4-inch minus rock base. Provide for backfilling, compaction, and resurfacing.
   E. Provide the necessary manpower to assist in the installation of the enclosure.
5. Mastic sealant is to be provided by the supplier for all concrete-to-concrete joints.
6. When grade-adjustment bolts are used, the frame shall be grouted to the enclosure. When grade-adjustment bolts are not used (frame is sitting directly on concrete extension), grouting is required in full-traffic applications. In incidental applications, grouting is recommended as a seal against backfill material and other debris. After grouting, the adjustment bolts are to be completely removed from the frame. Install enclosures as level as practicable, but do not exceed 1/8" per foot slope.
7. **Do not** break out the bottom of the sump hole. The compacted rock base is for leveling the enclosure, not for drainage.
8. The enclosures in this document are equipped with conduit terminators. When entering these enclosures with conduit of a different diameter than the terminator, use a swedge reducer (Document 062288). When entering a knockout, use an end bell and grout.
9. Design Loads

   Concrete enclosures are to be designed per the latest edition of ASTM C-857 "Minimum Structural Design Loading for Underground Precast Concrete Utility Structures" and ACI-318 "Building Code Requirements for Reinforced Concrete."

   A. Vertical Loads
      (1) Incidental-traffic enclosures shall be designed for 8,000 pounds (H-10).
      (2) Heavy full-vehicular-traffic (HFVT) enclosures shall be designed for 20,000 pounds (H-20).

B. Lateral Backfill Load
Enclosures are to be designed per the latest edition ASTM C-857 for full-traffic application.

C. Weight Lightening Panels
Optional weight lightening panels must meet the requirement of ACI-318 (latest edition).

10. Pulling Irons
Pulling irons shall be designed for 10,000 pounds ultimate, with a safety factor of two (20,000 pounds).

11. Lifting
A. All extensions shall be provided with four 7/8-inch diameter, 2-1/4-inch minimum deep inserts with unified coarse thread, Class 2A threads.
B. Boxes shall be lifted using pulling irons in the floor.

12. Marking
A. All covers shall be marked with one "High Voltage" and three blank number ID plates in accordance with Document 051768.
B. All concrete parts shall be permanently identified as to manufacturer on the inside and outside surface.
C. All concrete parts shall have the weight stenciled on the outside surface.

13. All bodies and extensions shall conform to the dimensional specifications so as to be fully interchangeable with the bodies and extensions of all other manufacturers.

14. All covers shall have a PG&E-approved, high coefficient of friction (0.65 or better), slip-resistant surface.

Application

15. General: Selection of the correct type of enclosure involves judgment, taking into account the present and future intended traffic for the area where the enclosure will be located, and future cable or equipment changes.

16. Incidental-vehicular-traffic (ASTM C-857, Rating H-10, medium duty): For use in sidewalks, paved and unpaved pedestrian areas, parkway strips adjacent to curbs, and any other area subject to occasional vehicular traffic up to 10 tons gross vehicle weight (GVW) and/or 10 MPH speed limits.

17. Heavy full-vehicular-traffic (ASTM C-857, Rating H-20, heavy traffic): For use in streets, driveways, parking lots, and all other areas subject to vehicular traffic in excess of 10 tons GVW, but not to exceed 20 tons GVW.

18. Heavy full-vehicular-traffic enclosures are not to be used for sectionalizing equipment or transformers, except on reconstruction projects where a location for an incidental-vehicular-traffic box is unavoidable.

References **Document**

Identification Plates for Subsurface Equipment 051768

Table 1 Size of Enclosure and Excavation for Subsurface Equipment for New Installations

Application	Location		Enclosure Size	Excavation Size [1]	
	Incidental	Heavy Full-Traffic		Incidental	Heavy Full-Traffic
200-Amp Cable and Non-Lead Splices	Yes	Yes	3'x5'x3'6"	5'x7'x5'	5'x7'x6'
200-Amp Junctions Through 3–4 Way		No	3'x5'x3'6"	5'x7'x5'	–
200-Amp Sectionalizing Switches		Yes	3'x5'x3'6"	5'x7'x5'	5'x7'x6'
200-Amp Fused Sectionalizing Switches		No	3'x5'x3'6"	5'x7'x5'	–
1Ø Horizontal Transformers		Yes [2]	3'x5'x4'6"	5'x7'x6'	5'x7'x7'
600-Amp Cable, Non-Lead Splices		Yes	4'6"x8'6"x6'	6'6"x10'6"x7'6"	6'6"x10'6"x8'6"
600-Amp Separable Connectors		No	4'6"x8'6"x6'	6'6"x10'6"x7'6"	–
3Ø Duplex Transformer [3]		Yes [2]	4'6"x8'6"x6'	6'6"x10'6"x7'6"	6'6"x10'6"x8'6"
600-Amp Sectionalizing Switch		Yes	4'6"x8'6"x6'	6'6"x10'6"x7'6"	6'6"x10'6"x8'6"
3Ø UCD (112.5 through 1,000 kVA) [4]		Yes [2]	4'6"x8'6"x7'6"	6'6"x10'6"x9'0"	6'6"x10'6"x10'0"

1 Depth allows for 6" of a compacted, 3/4" minus rock base.
2 When installing this equipment in heavy full-traffic enclosures give special consideration to the placement of the equipment to ensure the proper operation of all switches and fuses. Refer to Item 18 in the General Application section of this document.
3 See Document 051776.
4 112.5 through 500 kVA UCD transformers with 4-hole secondary spades will fit into existing 4' 6" x 8' 6" x 6' 6" enclosures.

Primary Electric Underground Equipment Enclosures

3' 0" x 5' 0" Complete Enclosure Assemblies (incidental transformer shown)

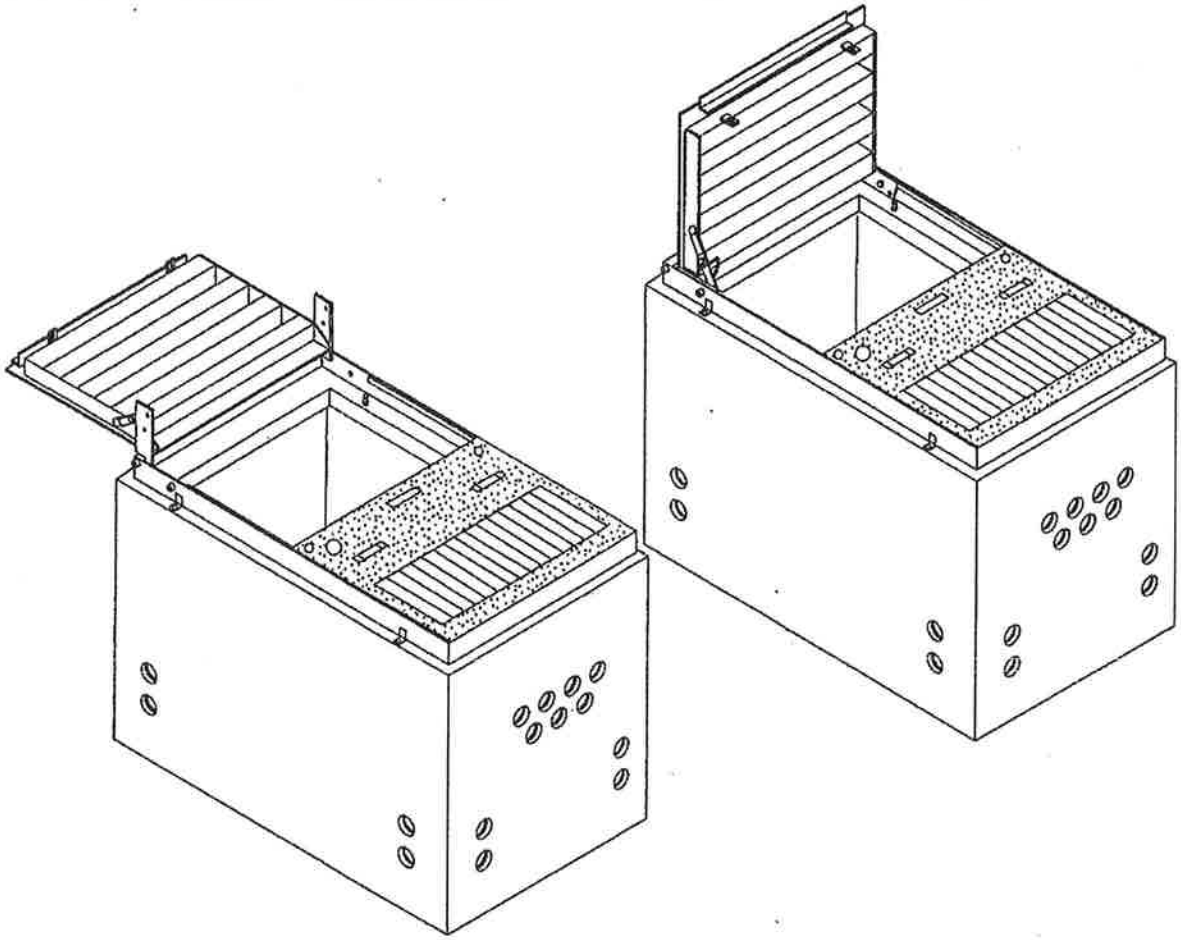


Table 2 Complete Enclosure Assembly (for 200-amp distribution)

Type of Enclosure	Type of Traffic Loading	Type of Cover	Code [1]
Transformer 3' x 5' x 4'6"	Incidental	Aluminum	025597
	Heavy Full-Traffic	Concrete	041611 [2]
Equipment or Splice Box 3' x 5' x 3'6"	Incidental	Aluminum	025601
	Heavy Full-Traffic	Concrete	041612 [2]
Equipment or Splice Box 3' x 5' x 4'6"	Incidental	Aluminum	040334
	Heavy Full-Traffic	Concrete	040327 [2]

1 Code includes body, extensions (as appropriate), frame, and cover assembly. When extra depth is required, order additional extension from Table 4 on Page 4.

2 Includes a 12" extension to accommodate the cover.

Table 3 Complete Frame Assembly

Type of Enclosure	Type of Traffic Loading	Type of Cover	Code
Transformer	Incidental	Aluminum	025603
	Heavy Full-Traffic	Concrete	041614
Equipment or Splice Box	Incidental	Aluminum	025604
	Heavy Full-Traffic	Concrete	041616

3' 0" x 5' 0" Enclosure and Extensions

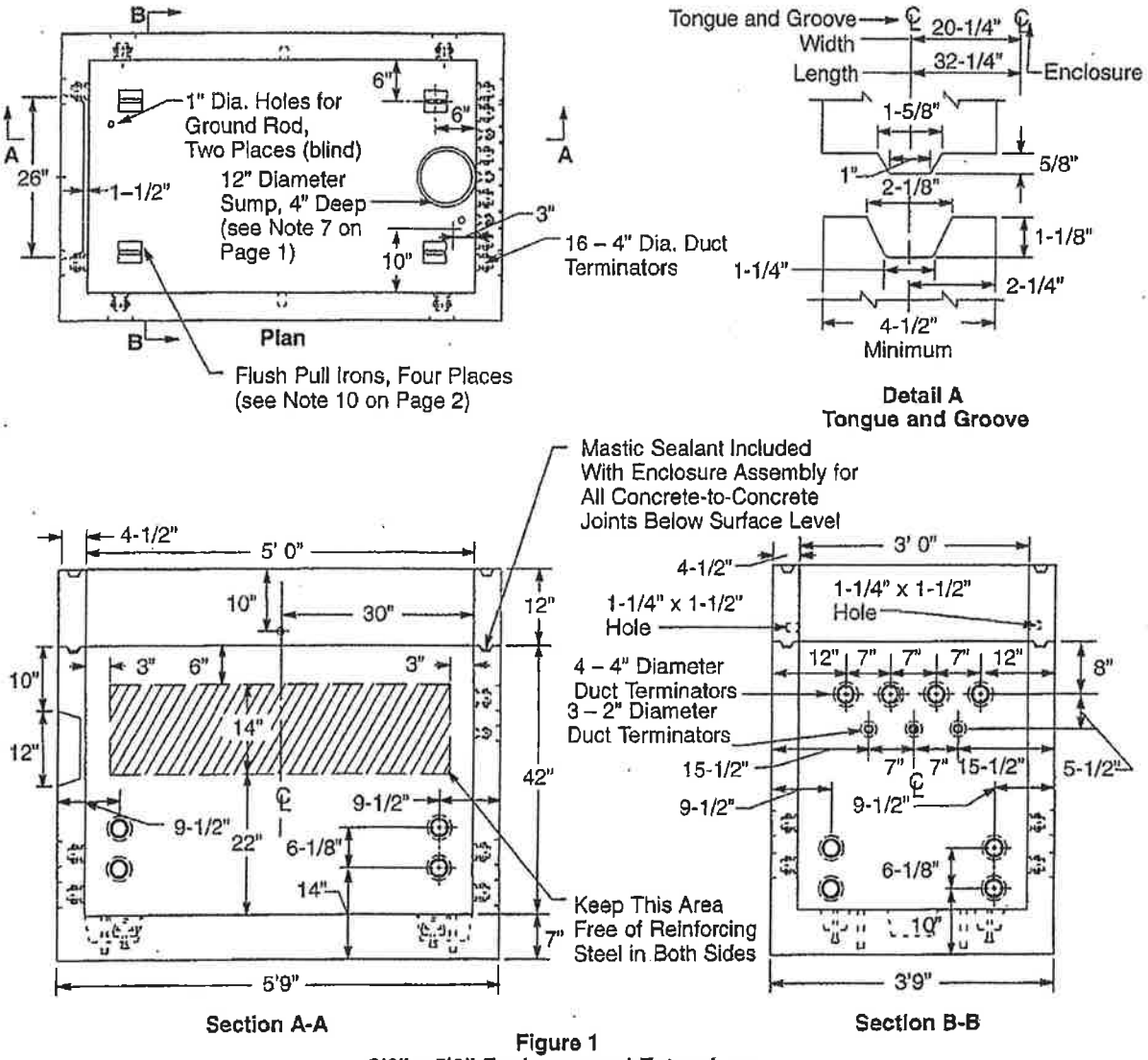


Figure 1
3'0" x 5'0" Enclosure and Extensions

Table 4 Codes for Enclosure (Figure 1)

Description	Code	Weight - Approximate (lbs.)
Body, 42" Depth	043361	5,070
Body, 54" Depth	043588	6,000
Extension,12" Depth	043362	970
Extension, 24" Depth	043531	1,940

Joints must be interchangeable with those shown in Detail A and approved by the PG&E Electric Distribution department.

3' 0" x 5' 0" Aluminum Quick-Release Cover Assembly - Incidental Traffic

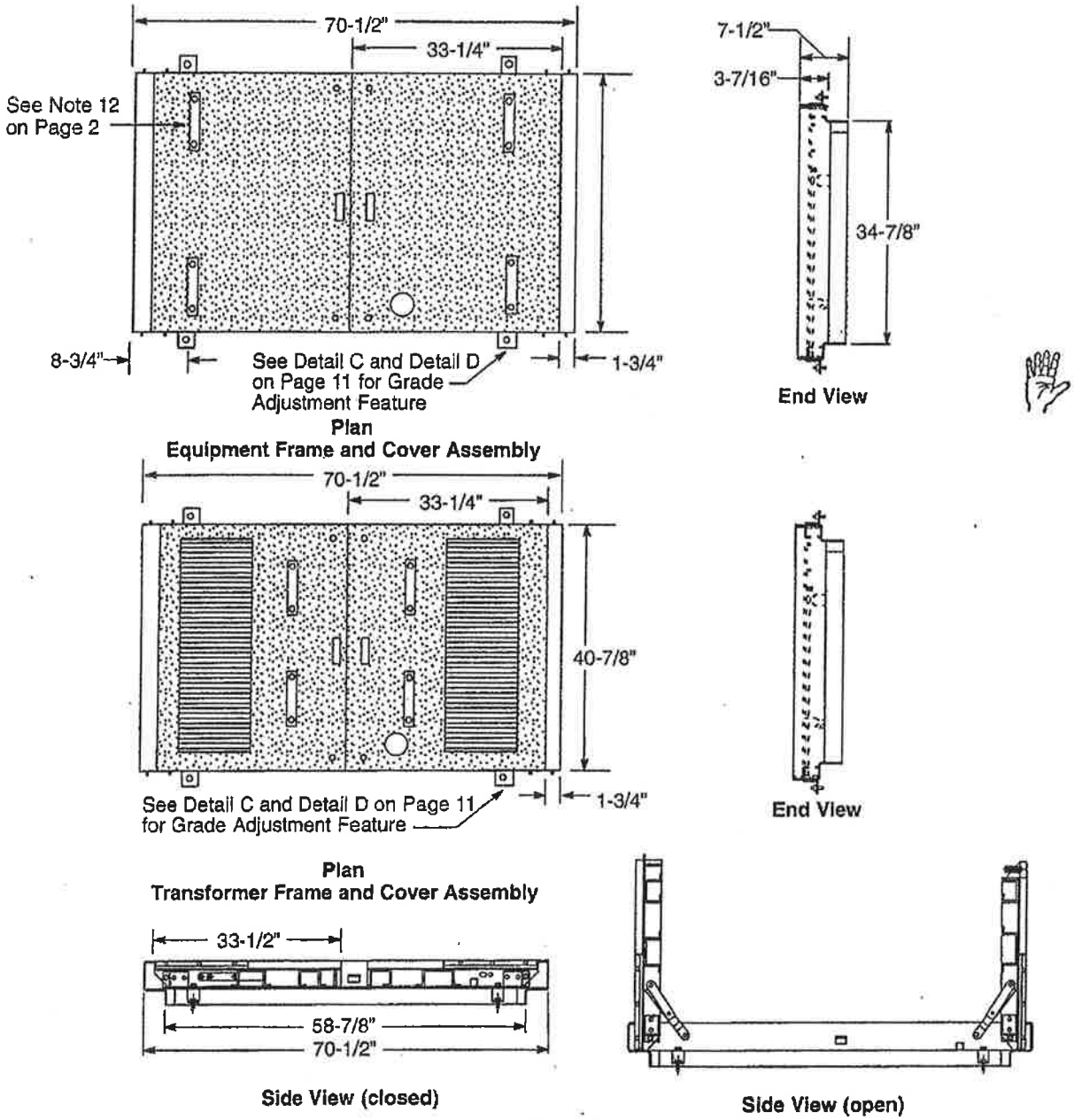


Figure 2
3' 0" x 5' 0" Quick-Release Cover Assembly - Incidental Traffic

3' 0" x 5' 0" Heavy Full-Traffic Cover Assemblies

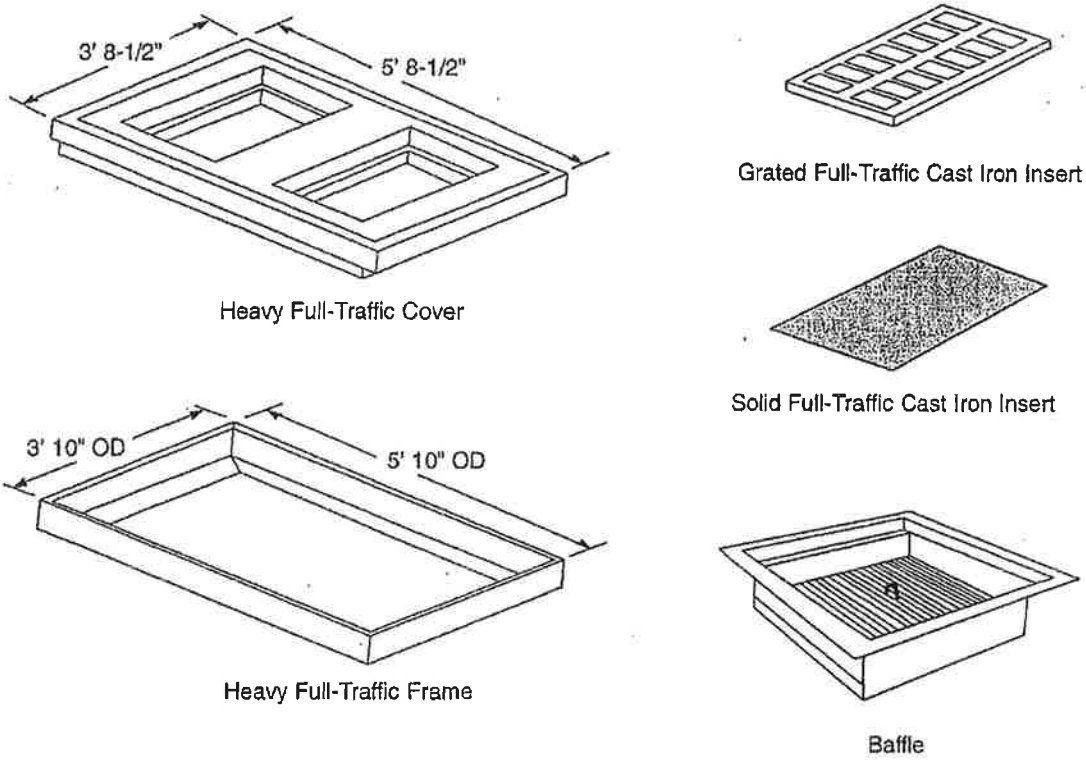


Figure 3
3' 0" x 5' 0" Heavy Full-Traffic Cover Assemblies

Table 5 Component Parts

Description	Weight	Code
3' x 5' HFVT, Concrete Cover Without Inserts	1,160 lbs.	040338
3' x 5' HFVT, 5' x 5' x 1/2" Steel Frame With Adjustment Feature	290 lbs.	040339
Cast Iron Grate Inserts for Transformer Enclosures	120 lbs.	040346
Cast Iron Solid Inserts for Splice/Equipment Enclosures	180 lbs.	040343
Baffle	25 lbs.	360036

4' 6" x 8' 6" Complete Enclosure Assemblies

Notes

1. Does not include frame.
2. Swedge reducers are necessary with conduit smaller than 6 inches (see Document 062288).

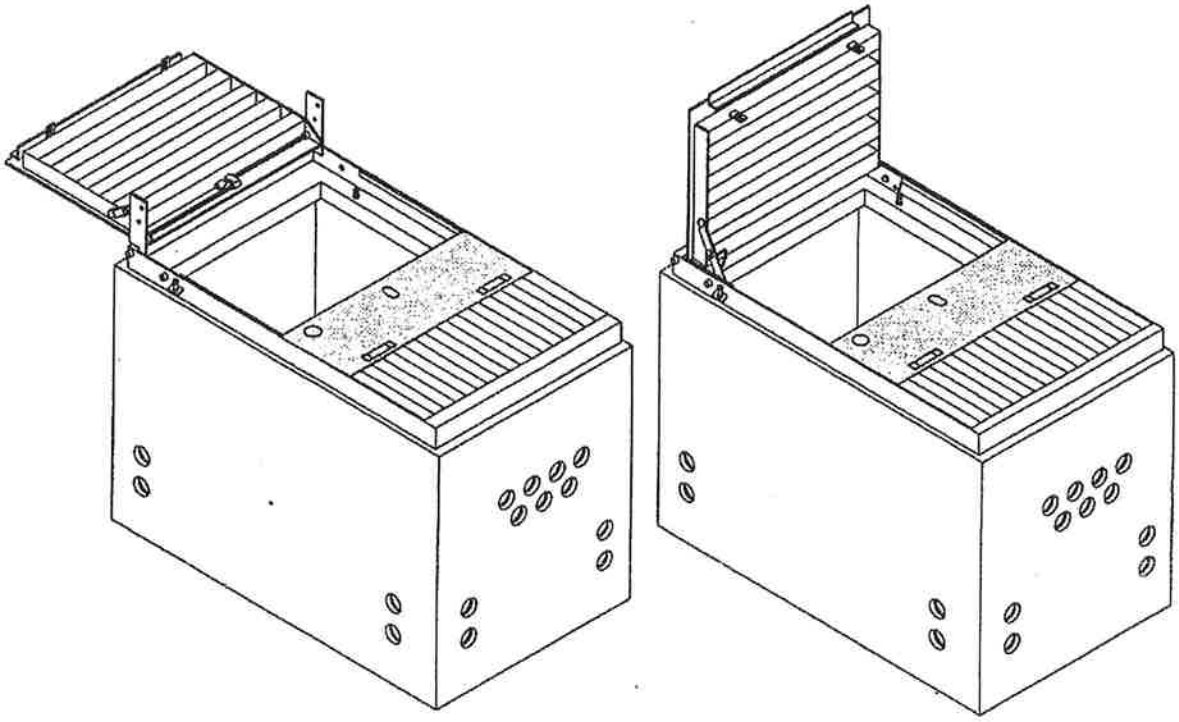


Table 6 Complete Enclosure Assembly (for 600-amp distribution)

Type of Enclosure	Type of Traffic	Type of Cover	Code [1]
3∅ Duplex Transformer [2] 4' 6" x 8' 6" x 6' 0"	Incidental	Quick-Release	043371
	Heavy Full-Traffic	Concrete	041439 [5]
Equipment [3] 4' 6" x 8' 6" x 6'	Incidental	Quick-Release	043411
	Heavy Full-Traffic	Concrete	041441 [5]
UCD Transformer [4] 4' 6" x 8' 6" x 7' 6"	Incidental	Quick-Release	040325
	Heavy Full-Traffic	Concrete	040324 [5]

1 Code includes body, extension (as appropriate), frame, and cover assembly. When extra depth is required, order additional extension from Table 8 on Page 8.
2 See Document 051776.
3 600-amp splices, 600-amp switches, 600-amp non-lead splices, 600-amp separable connectors.
4 112.5 through 500 kVA UCD transformers with 4-hole secondary spades will fit into existing 4' 6" x 8' 6" x 6' 6" exclosures.
5 Includes a 12" extension to accommodate the heavy full-traffic cover.

Table 7 Complete Frame Assembly

Type of Enclosure	Type of Traffic	Type of cover	Code
Transformer	Incidental	Quick-Release	031830
	Heavy Full-Traffic	Concrete	041442
Equipment	Incidental	Quick-Release	040642
	Heavy Full-Traffic	Concrete	041443

4' 6" x 8' 6" Enclosure and Extensions

Notes

1. Do not break out sump.
2. Joints must be interchangeable with those shown in Detail B and approved by the PG&E Electric Distribution department.

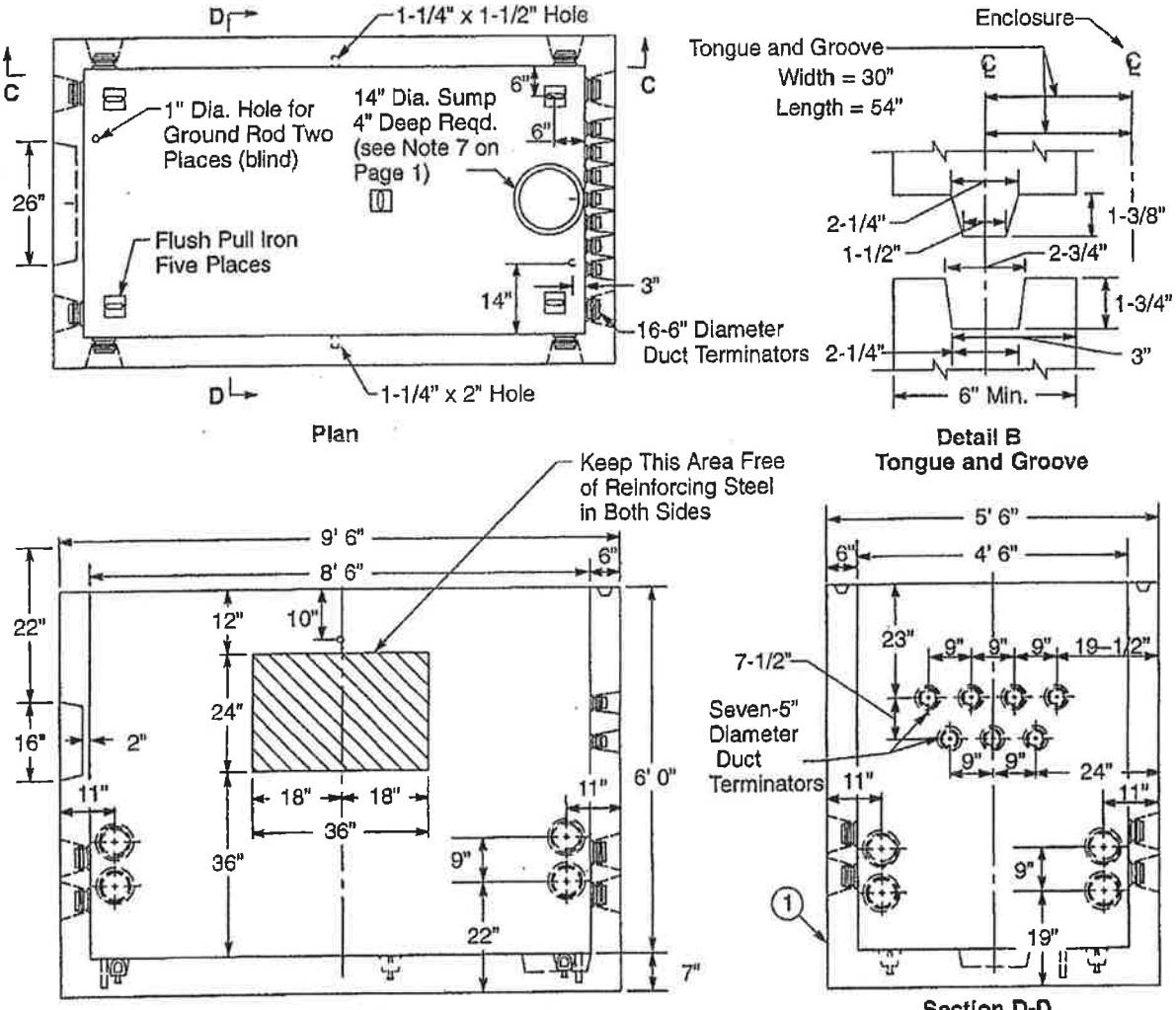


Figure 4
4' 6" x 8' 6" Enclosure and Extensions

Table 8 Parts for Enclosure Replacement (Figure 4)

Item	Description	Code	Weight - Approximate (lbs.)
1	Body, 72" Depth	043376	16,850
2	Extension,12" Depth	043415	2,200
3	Extension,18" Depth	043377	3,300

4' 6" x 8' 6" Aluminum Quick-Release Cover Assembly - Incidental Traffic

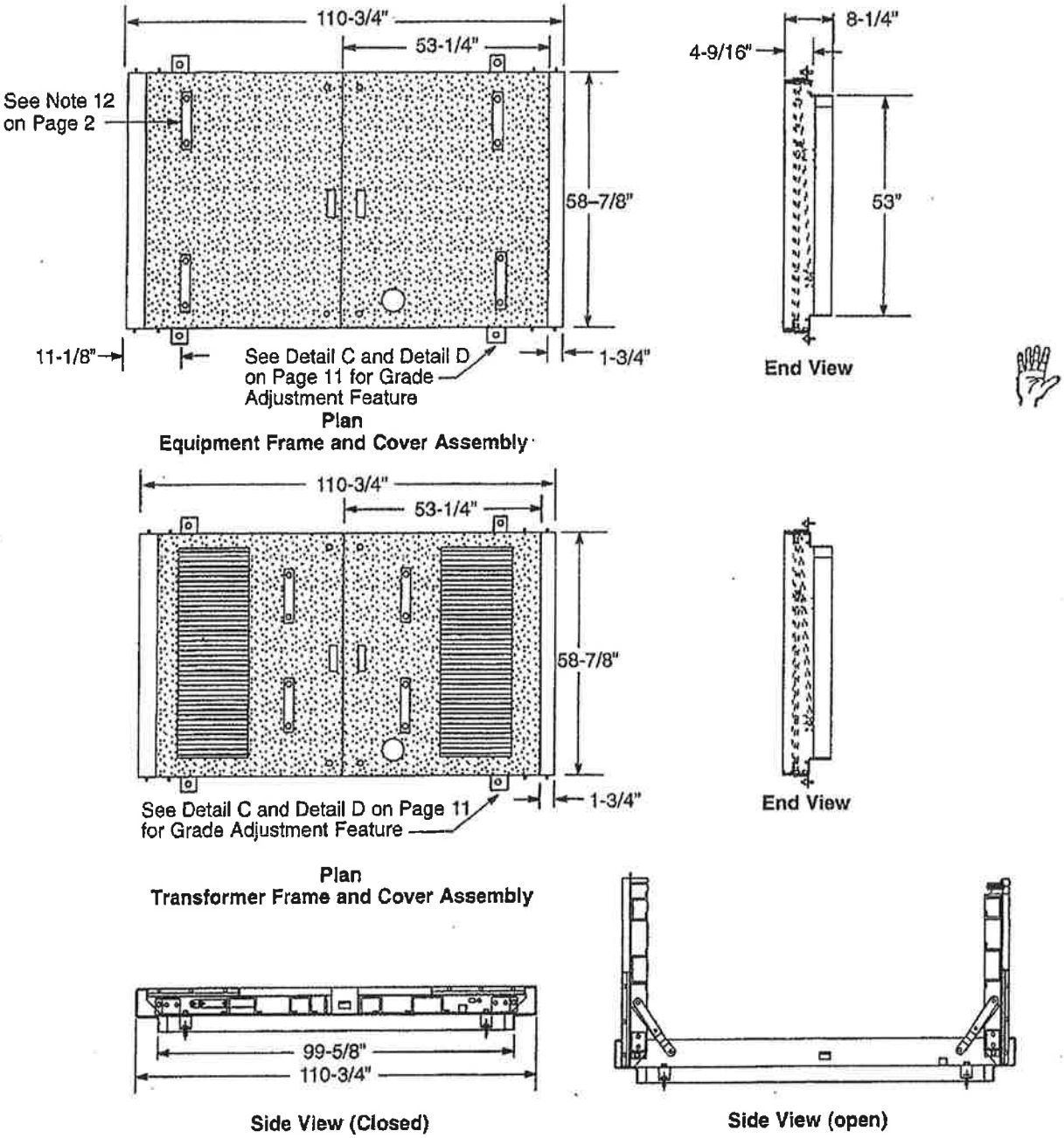


Figure 5
4' 6" x 8' 6" Quick-Release Cover Assembly - Incidental Traffic

4' 6" x 8' 6" Heavy Full-Traffic Cover Assemblies

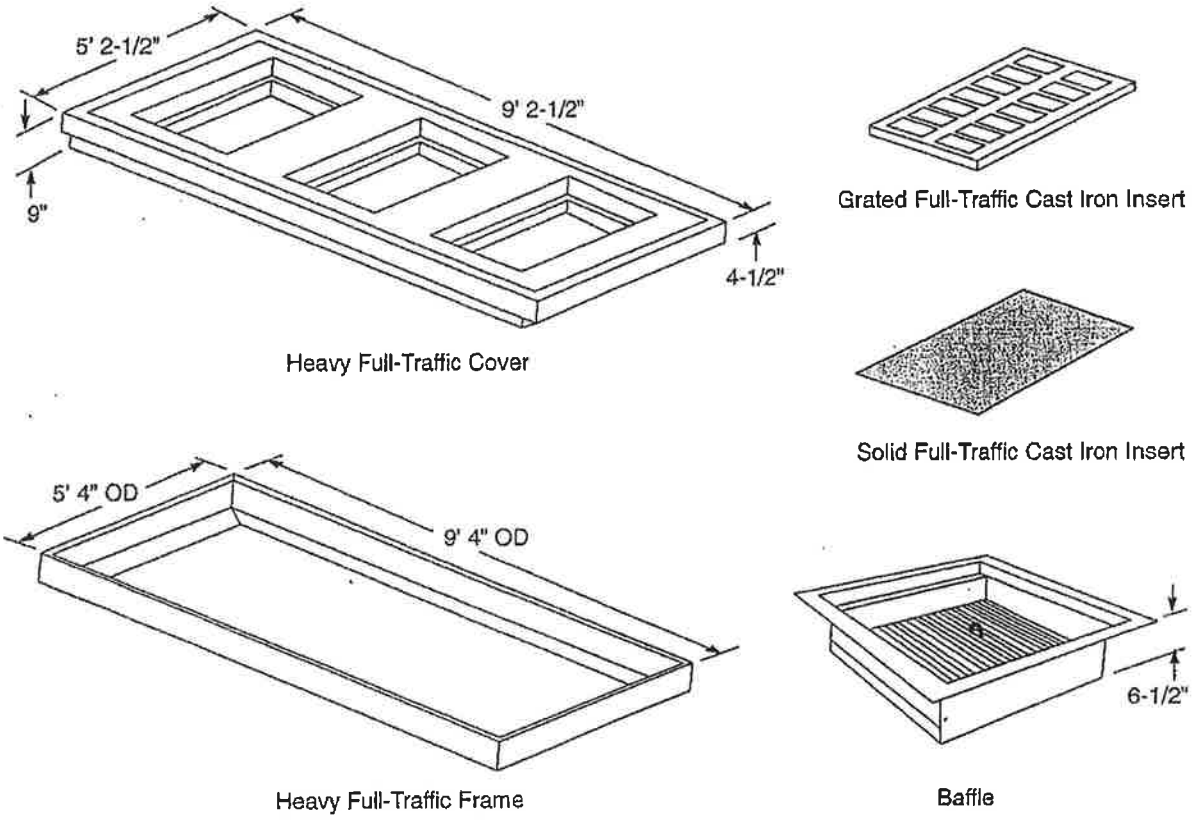


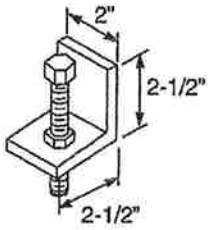
Figure 6
4' 6" x 8' 6" Heavy Full-Traffic Cover Assembly

Table 9 Component Parts

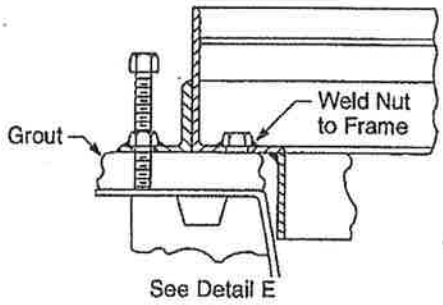
Description	Weight	Code
4' 6" x 8' 6", HFVT Concrete Cover Without Inserts	3,840 lbs.	040340
4' 6" x 8' 6", HFVT 5' x 5' x 1/2" Steel Frame With Adjustment Feature	450 lbs.	040341
Cast Iron Grate Inserts for Transformer Enclosures	120 lbs.	040346
Cast Iron Solid Inserts for Splice Equipment Enclosures	180 lbs.	040343
Baffle	25 lbs.	360036

Primary Electric Underground Equipment Enclosures

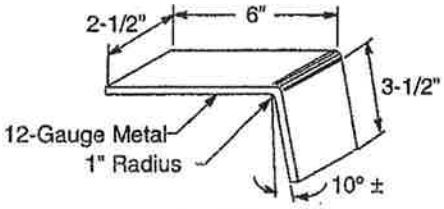
Details for Frame Assemblies



Detail C
Grade Adjusting Bolt



Detail D
Grade Adjusting Feature



Detail E
Adjustment Bolt Support
Bracket

Cement Grouting Instructions for Incidental Enclosure Frame

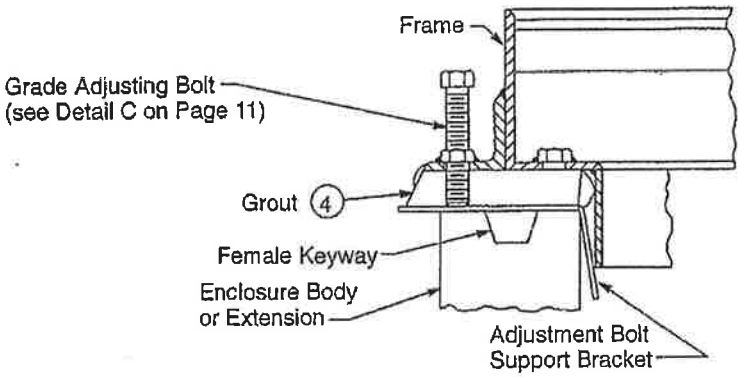


Figure 7
Grouting Incidental Enclosure Frame

Table 10 Grouting Material (structural - Figure 7)

Item	Quantity	Description	Code
4 [1]	Sack - 55 lbs.	Grout, Zero Shrink, High-Early Strength	121016

[1] One sack of grout is required for approximately each 1/2" of space between the enclosure and the frame on a 4' 6" x 8' 6" enclosure.

Instructions

Step 1. Thoroughly clean all surfaces of the enclosure that the grout will contact. Use clean water to remove dust from surfaces.

Step 2. Remove sufficient soil from around the enclosure to preclude accidentally mixing dirt with the grout. Install the enclosure frame and adjust it to grade.

Step 3. Saturate all grout-contact surfaces of the enclosure with water for as long as possible before grouting using wet rags laid in and around the keyway. The recommended minimum saturation time is **24 hours.** Re-saturate the keyways with water before leaving the job. Remove excess water from the female keyway just prior to grouting.

Step 4. Mix grout in a wheelbarrow with **clean** water. Do not mix more grout than can be easily used within 15 minutes. The consistency of the grout should allow it to flow under pressure.

Step 5. Install the grout directly from a shovel onto the enclosure using hands with gloves. After an adequate amount of grout has been applied, use a trowel to apply additional pressure to the grout so that all voids are filled and the grout is completely consolidated. This is necessary to ensure a full bearing surface for the frame.

Step 6. After wiping off any excess grout and making sure that all voids are filled with grout, cover the grout surface with water-saturated rags. While on the job, moisten the rags often. Re-saturate the rags with water before leaving the job. The water-saturated rags are required to cure the grout properly.

Step 7. Keep wet rags on and traffic off the enclosure for **24 hours** to allow the grout to set up properly.

Step 8. Do not backfill and tamp around the enclosure until the set-up period has concluded.

Step 9. Remove the rags before backfilling around the enclosure.

Step 10. Repair any damaged grout by repeating the above procedure.

Step 11. Ready-mix concrete (5-sack mix) is an acceptable alternate.

Step 12. Can be used with full-traffic frames in parking lots, sidewalks, etc.

Foam Grouting Instructions for Full- and Heavy Full-Traffic Enclosure Frames

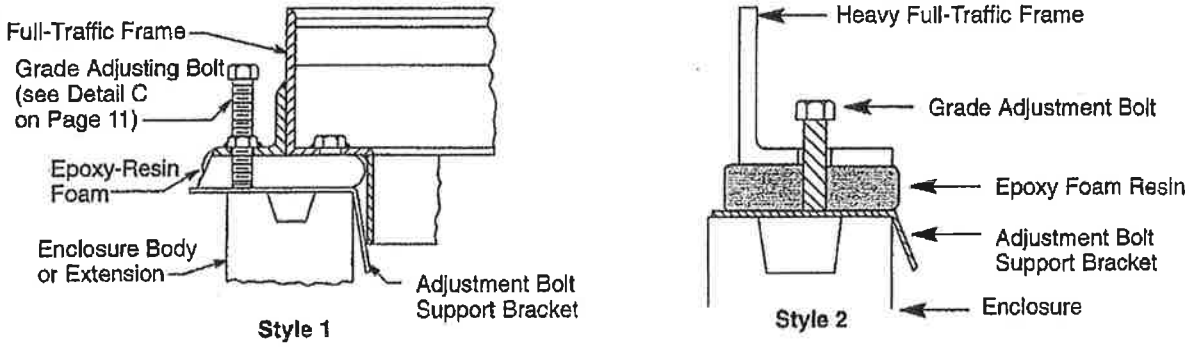


Figure 8
Grouting Enclosure Frame

Table 11 Grouting Material Structural (Figure 8)

Item	Quantity	Description	Code
5	1	3' x 5' Grout Kit	120042
6	1	4' 6" x 8' 6" Grout Kit	120041
7	1	Reusable Mixing Head	120043

Table 12 Epoxy Foam Mixing Table (Figure 8)

Temperature (°F)	Mixing Time
70°– 90°	1 Minute
50°– 70°	2 Minutes
30°– 50°	5 Minutes
30° and Below	8 Minutes

Instructions

Step 1. Remove loose dirt and debris from the enclosure surface.

Step 2. Install the enclosure frame and adjust it to grade.

Step 3. Read the mixing instructions provided with the grouting kit.

Step 4. Combine the catalyst (603 bottle) with the epoxy material in the large container.

Step 5. Mix the two components thoroughly, using the large container for mixing (see Table 12 for mixing times).

Step 6. Using a cable tie, seal one end of the provided canvas bag.

Step 7. Squeeze all of the epoxy material into the canvas bag. Seal the open end with another cable tie.

Step 8. Place the filled bag on a flat surface, preferably on a board. Do not use hot asphalt or concrete pavement that has been exposed to direct sunlight. Distribute the epoxy foam evenly inside the canvas bag.

Step 9. Place the bag between the enclosure and the frame, with the seam on the top facing the frame. Within 5 minutes the epoxy foam will expand to fill the bag, filling the area between the top of the enclosure and the frame.

Step 10. Repeat the installation until the area under the frame has been filled. Overlap the bags 3 to 4 inches to provide a water-tight barrier.

Step 11. Epoxy foam reaches sufficient strength in 1 hour to withstand applied loads.

Step 12. For full-traffic concrete covers, remove the grade adjustment bolts and install the cover. For drag-off lids, the bolts may be left in place.

Step 13. Consult the instructions during the grouting procedure to ensure that all proper steps are being taken.

Step 14. Use with full- and heavy full-traffic frames.

Revision Notes

Revision 10 has the following changes:

1. Added new Item 18 on Page 2 under the Application section.
2. Revised Footnote 2 on Page 2.
3. Revised the location of the adjusting bolts in the End Views in Figure 2 on Page 5.
4. Revised the location of the adjusting bolts in the End Views in Figure 5 on Page 9.

Prepared by: NIB1

REPAIRING PLASTIC CONDUIT AND FITTINGS

058548

Department: Electric T&D **Section:** T&D Engineering and Technical Support

Approved by: J. D. Sprecher (JDS8) J. D. Sprecher **Date:** 02-02-02

Rev. #01: This document replaces PG&E Document 058548, Rev. #00. For a description of the changes, see Page 6.

Purpose and Scope

This document provides ordering information, installation instructions, and illustrations for the repair of PVC conduit and polyethylene conduit.

General Information

1. Repair materials are available in 2-inch through 6-inch sizes.
2. For cement ordering information, see Document 062288.

References **Document**

Underground Conduits 062288

Split Plastic Conduit and Fittings

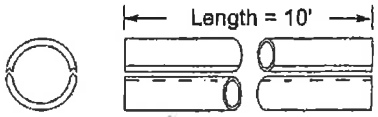


Figure 1
Split Plastic Conduit

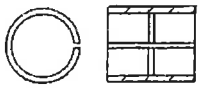


Figure 2
Split Coupling

Table 1 Split Plastic Conduit

Conduit Size (inches)	Code	Carlon Cat. No.
2	360722	49011SD
3	360723	49013SD
4	360724	49015SD
5	360725	49016SD
6	360726	49017SD

Table 2 Split Coupling

Conduit Size (inches)	Code	Carlon Cat. No.
2	360740	E200JS6
3	360741	E200LS7
4	360742	E200NS8
5	360743	E200PS9
6	360744	E200RS1

Table 3 Repair Assemblies [1]

Conduit Size (inches)	Code	Carlon Cat. No.
2	360746	48811A
3	360747	48813A
4	360748	48815A
5	360749	48816A
6	360750	48817A

[1] Assembly includes:
1-10' split plastic conduit (2 pieces-Table 1)
2-Split couplings (Table 2)

Split Plastic Conduit and Fittings (continued)

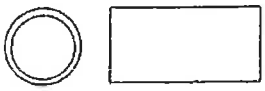


Figure 3
Repair Coupling

Table 4 Repair Coupling

Conduit Size (inches)	Code	Carlon Cat. No.
2	360734	E200J
3	360735	E200L
4	360736	E200N
5	360737	E200P
6	360738	E200R

Repairing Vacant Conduits

Step 1 Remove a sufficient amount of the concrete and/or backfill material to completely expose all of the damaged ducts and to also provide adequate working space in the trench. The damaged duct(s) should be exposed back to a point at least 1 foot on both sides of the damaged area.

Step 2 If more than one duct line is damaged at the same location, repair them one at a time starting at the bottom of the duct structure and working to the top.

Step 3 Cut out the damaged portions of the duct(s). The cut should be made as square as possible. Deburr and chamfer the edges.

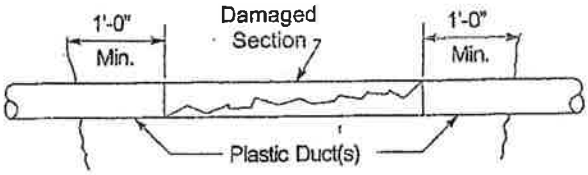


Figure 4

Step 4 Cut the replacement section from a piece of duct with the same outside diameter and wall thickness. The replacement section should be the same length (-1/8") as the removed section. Deburr and chamfer the edges.

Step 5 Thoroughly clean the exposed ends of the fixed duct and both ends of the replacement section.

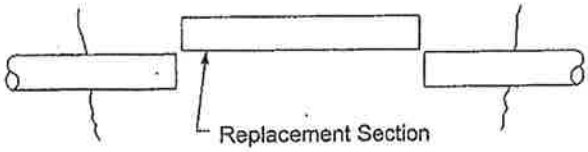


Figure 5

Repairing Vacant Conduits (continued)

Step 6 Slide the repair couplings over the ends of the exposed duct. Mark lines around the ends of the replacement section, one half the length of the repair coupling away from the ends in order to center the repair coupling.

Step 7 Apply cement to outside surface of both ends of the replacement section and on both ends of the fixed duct.

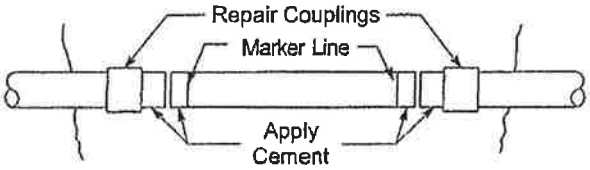


Figure 6

Step 8 Place the repair section into the duct line and slide the repair coupling over the joints until the coupling is flush with the marker line on the replacement section.

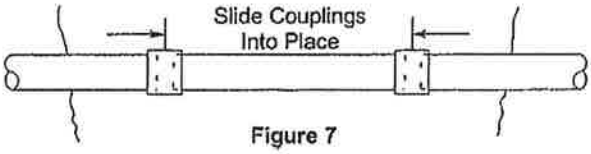


Figure 7

Step 9 After completion of the duct repair, replace any duct spacers that were removed, and replace the concrete and/or backfill material.

Repairing Conduit(s) Filled With Cables

Step 1 Remove a sufficient amount of the concrete and/or backfill material to completely expose all of the damaged duct(s) and also provide adequate working space in the trench. The damaged duct(s) should be exposed back to a point at least 1 foot on both sides of the damaged area.

Step 2 If more than one duct line is damaged at the same location, repair them one at a time starting at the bottom of the duct structure and working to the top.

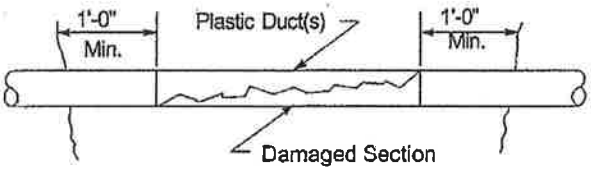


Figure 8

Step 3 Cut out the damaged portion of the duct(s). Use extreme care to avoid damaging cables. The cut should be made as square as possible. Deburr and chamfer the edges.

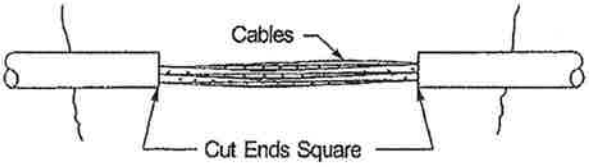


Figure 9

Repairing Conduit(s) Filled With Cables (continued)

Step 4 Check cables for possible damage.

Step 5 Thoroughly clean the exposed ends of the fixed duct and the inside of the split couplings.

Step 6 Slilghtly open the split coupling and slip it over the exposed cable, taking care not to damage the cable. Slide the split couplings over the ends of the exsposed conduit.

Step 7 Measure length of conduit section to be replaced and cut a piece of split conduit 1/8 inch shorter than the measurement. Provide marks around each end of the split conduit at one half the measured length of the split coupling from each end. This will aid in centering the coupling.

Step 8 Thoroughly clean the edges of the split conduit with a moistened rag. Allow to dry thoroughly before applying cement.

Step 9 Apply cement to both sides of both halves of the split conduit. Position the split conduit over the cables and join together. Attach nylon lashing tires, Code 399107, to each end of split conduit, and every two feet to hold assembly together while cement sets.

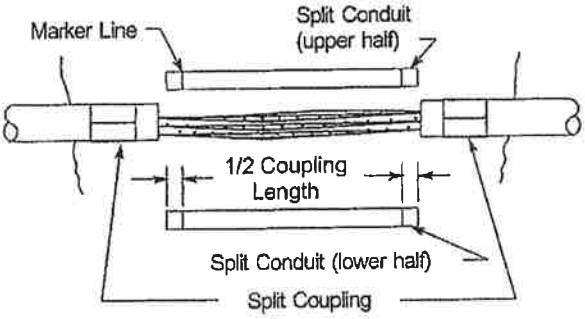


Figure 10

Step 10 Thoroughly clean the exposed ends of the fixed conduit and both ends of the split conduit with a moistened rag. Allow to dry thoroughly before applying cement.

Step 11 Apply cement to both ends of the fixed conduit and both ends of the split conduit.

Step 12 Slide the split couplings over the joints until the couplings are flush with the marker lines on the replacement section.

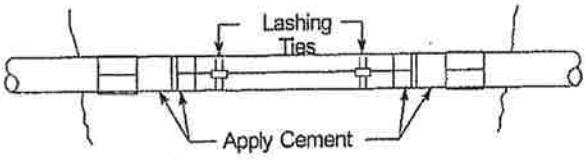


Figure 11

Step 13 For added strength, attach a nylon lashing tie, PG&E Code 569204, around the middle of the split couplings. Use two lashing ties connected together for 5-inch and 6-inch conduits.

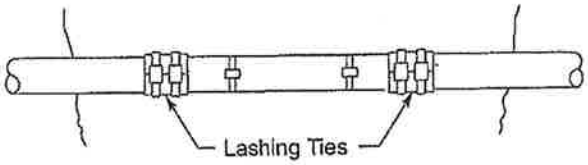


Figure 12

Step 14 After completion of the duct repair, replace any duct spacers that were removed, and replace the concrete and/or backfill material.

Repairing CIC Conduit Systems

Notes

1. It may occasionally be necessary to replace (or repair) a section of polyethylene conduit. The conduit may be joined as shown in Figure 14 and Figure 15 on Page 6.
2. Standard conduit length shall be 200 feet, packaged in coils. Longer continuous lengths may be ordered in reels.
3. Material - All polyethylene conduit furnished under this specification shall comply with NEMA Standard TC-7 and PG&E Engineering Material Specification #105. The conduit shall be black, high density polyethylene meeting the requirements given in ASTM D1248 for Type III,Class C polyethylene, except for dimensions which are shown in Table 5. The conduit shall be virgin material. Marking on the conduit shall consist of the manufacturer's name, conduit size, and the designation Type III PE at not more than 5 foot intervals, the sequential footage shall be marked at least every 2 feet along the conduit length.
   A. Ordering Information - The purchase order should show the following:
   B. Code number (Table 5)
      1. Number of 200-foot coils and total conduit length. (Example: Three 200-foot coils, 600-foot total conduit length).
      2. State on order: "Conduit shall be furnished in accordance with PG&E Document 058548"
4. Approved suppliers
   A. Conduit
      1. Kerona Plastic Extrusions Company
      2. Philips Products Company
   B. ABS Sleeve
      Kerona Plastic Extrusions Company

Figure 13
Polyethylene Conduit (CIC)

Table 5 Data and Code for Continuous Flexible Polyethylene Conduit [1]

Cond. Size Nominal (inches)	Dimensions (inches)				Approx. Weight (lbs./100 ft.)	Code
	OD	ID	T			
			Min.	Max.		
2	2.48	2.065 ± .015	.155	.175	480	360457

[1] For the repair of CIC only. See Document 062288 for high density flexible conduit information.

Continuous Flexible Polyethylene Conduit (CIC) (continued)

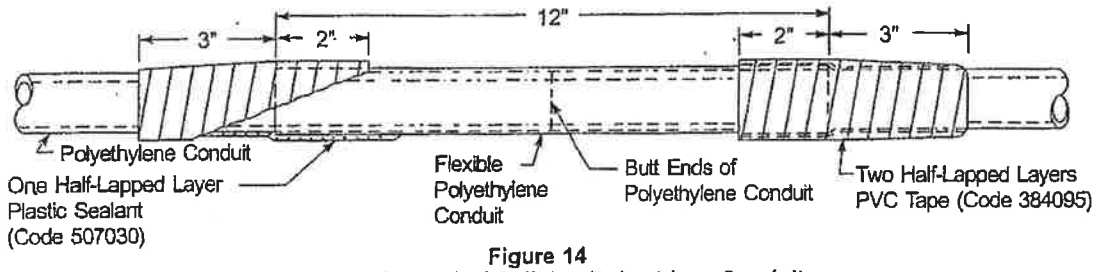


Figure 14
Preferred Method of Splicing Polyethlene Conduit

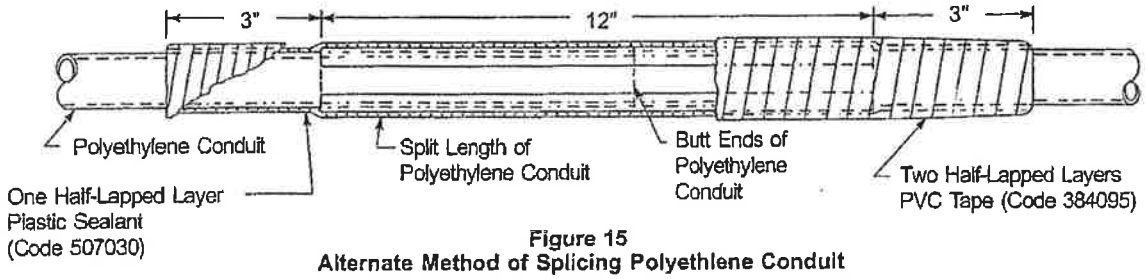


Figure 15
Alternate Method of Splicing Polyethlene Conduit

Revision Notes

Revision 01 has the following changes:

1. Revised length dimension in Figure 1 on Page 1, corrected catalog number in Table 2 on Page 1 and added Table 3 on Page 1 to show repair assemblies.
2. General revisions to "Repairing Conduit(s) Filled with Cables" (Page 3 and Page 4) instructions to clarify procedures.

Prepared by: EOB1

SECONDARY ENCLOSURES FOR ELECTRIC UNDERGROUND 028028

Department: Electric T&D **Section:** T&D Engineering and Technical Support

Approved by: R. D. Kauzer (RDK6) Rich Kauzer **Date:** 05-28-04

Rev. #11: This document replaces PG&E Document 028028, Rev. #10. For a description of the changes, see Page 14.

This document is also included in the following manual:

- *Electric and Gas Service Requirements* (Greenbook)

Purpose and Scope

This document provides fabrication details and specifications for secondary enclosures through 36" x 60". Also included are ordering information, illustrations, and application instructions. Location of enclosures, obstructions, depth of duct lines, or other field conditions may make it necessary to deviate from this guide.

General Information

1. This document also illustrates the various sizes of non-concrete and precast concrete enclosures used in secondary electric underground distribution.
2. Design loads and subsurface enclosures:
   A. Vertical loading
      (1) Incidental-traffic boxes and covers shall be designed for 8,000 pounds minimum, single-wheel load over any 10" x 10" area.
      (2) Full-vehicular-traffic boxes shall be based on ASTM C-857 "Minimum Structural Design Loading for Underground Precast Concrete Utility Structures."
   B. Horizontal loading
      (1) Incidental-traffic boxes shall meet Western Underground Committee (WUC) Guide 3.6 (latest published edition) sidewall deflection criteria.
3. Requirements for non-concrete boxes:
   A. Non-concrete boxes for incidental loading must meet the requirements of WUC Guide 3.6 for non-concrete hand holes.
   B. The cover and exposed portions of a box shall be a concrete color.
   C. Boxes shall also comply with this document's requirements, such as marking, security devices, and dimensions.
   D. Box covers must have PG&E identification. The box body, cover, and extension must be labeled with the manufacturer's name and PG&E code number on inside surfaces.
   E. The cover shall be made of polymer concrete and shall have a PG&E-approved high coefficient of friction (0.65 or better), slip-resistant surface.
4. Requirements for concrete boxes:
   A. Concrete boxes for full-traffic must meet the requirements of the latest ASTM C-857.
   B. Boxes shall also comply with this document's requirements, such as marking, security devices, and dimensions.
   C. Concrete parts shall be interchangeable. Concrete joints shall be interchangeable with those shown on Pages 7 through 10.
   D. Covers shall have a PG&E-approved high coefficient of friction (0.65 or better), slip-resistant surface.
   E. Box covers must have PG&E identification. The box body, cover, and extension must be labeled with the manufacturer's name and PG&E code number on inside surfaces.

5. Requirements for pedestals:
   A. Pedestals must meet the WUC Guide 3.6 sidewall deflection criteria with 600 pounds per square foot (psf) applied to the base per the WUC Guide 3.6 test protocol.
   B. Pedestal covers must withstand, without damage, 60 foot-pound impact test with a 2-1/2 inch diameter test tup dropped directly on top of the cover.
   C. Pedestals shall comply with this document's requirements, such as marking, security devices, and dimensions.
   D. The pedestal covers must have PG&E identification. The pedestal body and covers must be labeled with the manufacturer's name and shall be Muncell green in color.

Application

6. Consider the following when selecting box/pedestal sizes:
   A. Secondary pedestals are the preferred method of terminating 600 V conductors in residential, small commercial applications, and in flood plain areas. Do not use secondary pedestals where wild grassland fires are prevalent.
   B. Ultimate predictable conductor size and number.
   C. Location of duct entrances, cable layout, and minimum bending radius of cables.
7. Box body extensions are required for installations of conductors larger than 350 kcmil.
8. When setting concrete boxes in place, use spacers to adjust the box to grade. Install boxes as level as practicable, but do not exceed 1/8" per foot slope in any direction. Place grout in between the body and the top section, and around duct entrances. Do not pave over the box cover.
9. These boxes shall not be used for primary cable. The minimum box size for primary cable is 3' x 5' x 42".
10. Swedge reducers are necessary with conduit smaller than the terminators supplied (see Document 062288).
11. All conduits are to be stubbed a minimum of 2 feet from the pedestal or subsurface enclosure.
12. Conduit entry shall be as shown in Figure 4 on Page 4 for pedestals and Figure 9 on Page 7 for splice boxes. When extensions are used, conduits may enter through terminals or knockouts.
13. Conduits that do not terminate in a duct terminator must be fitted with an end bell.
14. See Document 066205 for replacement parts for older style installations.

References

	Document
Connectors for Insulated Cables Underground Distribution Systems	015251
Enclosure Repair/Replacement Criteria and Replacement Materials	066205
Identification Plates for Subsurface Enclosures	051768
Multi-Tap Splice for 600 Volt Insulated Cables	036640
PG&E Approved Manufacturers	066211
Primary Electric Underground Equipment Enclosures	062000
Straight and Tap Splice for 600 Volt Insulated Cable	051034
Underground Conduits	062288

Table 1 Guide for Application of Splice Boxes and Pedestals in New Construction for Underground Secondary Using Multi-Tap Splices (see Document 036640) [1]

Bus Bar Information		Enclosure Size					Pedestal Size [2]	
Description	–	11-1/2"	13" x 24"	17" x 30"	24" x 36"	36" x 60"	10" x 14"	14" x 22"
4 Terminal	#6 Str - 350 kcmil	For Streetlight Applications Only (see Note 2 on Page 5)	For Service Runs and Non-Bus Bar Splices (4/0 max)	x	–	–	x	–
6 Terminal	#6 Str - 350 kcmil			x	–	–	x	–
8 Terminal	#6 Str - 350 kcmil			–	x	–	–	x
4 Terminal	4/0 - 1,000 kcmil			–	x [4]	x [3]	–	x
6 Terminal	4/0 - 1,000 kcmil			–	x [4]	x [3]	–	x
6 Terminal	(4) #6 – 350, (2) 4/0 - 1,000			–	x [4]	x [3]	–	x
8 Terminal	(4) #6 – 350, (4) 4/0 - 1,000			–	x [4]	x [3]	–	x

1 For approved suppliers, see Document 066211.
2 For single-phase applications only.
3 The 36" x 60" enclosure is required when the number of 1,000 kcmil conductors exceeds the capacity of a 6-terminal secondary bus and requires the use of splices.
4 700 kcmil and 1,000 kcmil installations require a 16-inch extension with non-concrete enclosures and a 12-inch extension with concrete enclosures.

Installation of Boxes in Special-Finish Sidewalks

Notes

1. Frequently the customer or city (or other public body) installs special-surface sidewalks (brick, tile, terrazzo, etc.). When required with boxes through 3 feet x 5 feet, the box and standard cover shall be installed 2 inches below the final grade, and the customer or city shall furnish and install the special-finish cover as illustrated in Figure 1.
2. The requirements for this cover shall be as follows:
   A. No single section of cover shall exceed 125 pounds.
   B. Provisions for removal shall be provided.
   C. The special-finish cover shall be identified by the letter "E" to indicate the location of the PG&E splice box.
   D. This type of installation shall not be installed in traffic locations.
   E. **Caution:** PG&E cover design allows for a maximum of 1/2-inch deflection under an 8,000-pound wheel load.

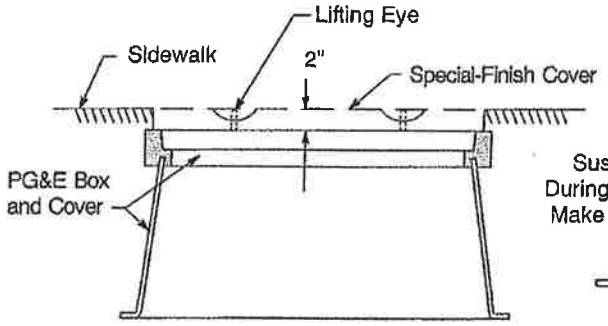


Figure 1
Installation of Boxes in Special-Finish Sidewalks

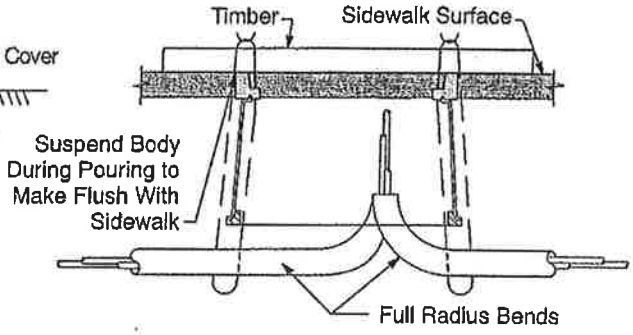


Figure 2
Installation of Non-Concrete Boxes in Sidewalks

Secondary Pedestals

Notes

1. See Document 036640 for appropriate sized connector.
2. The 10 x 14 pedestal can be used for conductor combinations through 6-way, 350 kcmil.
3. The 14 x 22 pedestal can be used for conductor combinations through 8-way, 4-1,000 kcmil; 4-350 kcmil.

Table 2 Dimensions and Codes for Secondary Pedestals

Type	A	B	C	D	E	F	G	Weight	Code
10 x 14	14-1/2"	10-1/4"	24"	22"	18-5/8"	14-5/8"	2"	20 lbs.	360007
14 x 22	22-1/2"	14-1/2"	24-1/2"	22"	25"	17-1/2"	2"	30 lbs.	360006

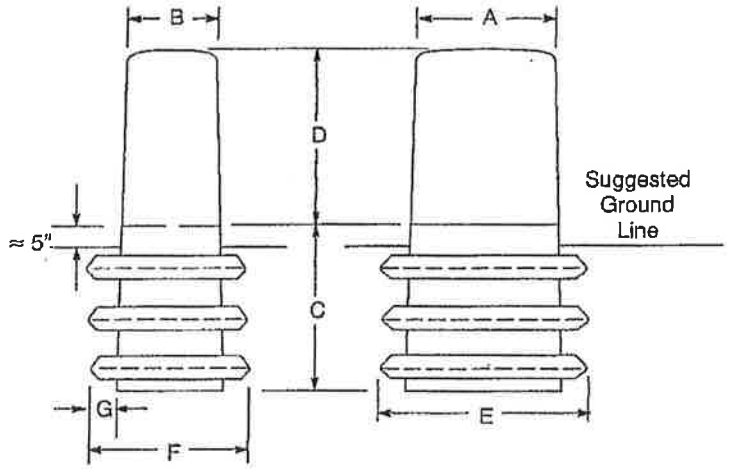


Figure 3
Dimensions of Secondary Pedestal Enclosure

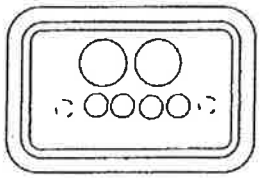


Figure 4
Preferred Location of
Conduits Entering Pedestal

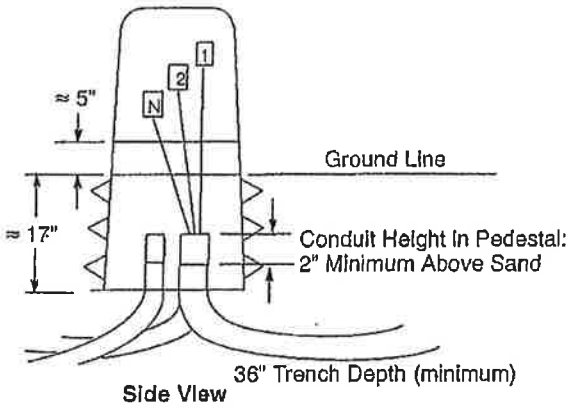


Figure 5
Secondary Pedestal Enclosure Installation

Streetlight Box Assembly

Notes

1. In conduit systems, enter the bottom of the box with 90° sweeps.
2. Do not connect more than two streetlights per box.
3. For streetlight applications only (see Table 1 on Page 3).

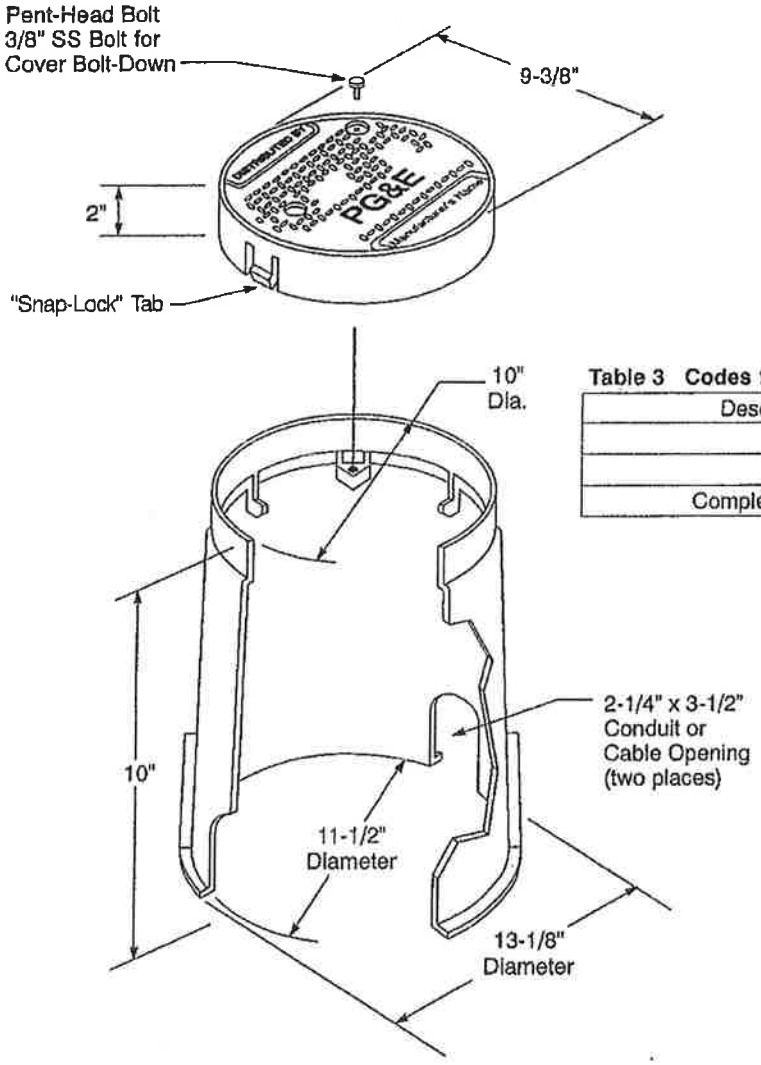


Table 3 Codes for Streetlight Box Components

Description	Code
Cover	032509
Body	032510
Complete Assembly	032511

Figure 6
Streetlight Box

Non-Concrete Boxes for Incidental Traffic

Note

1. See Table 4 on Page 7 for box dimensions.

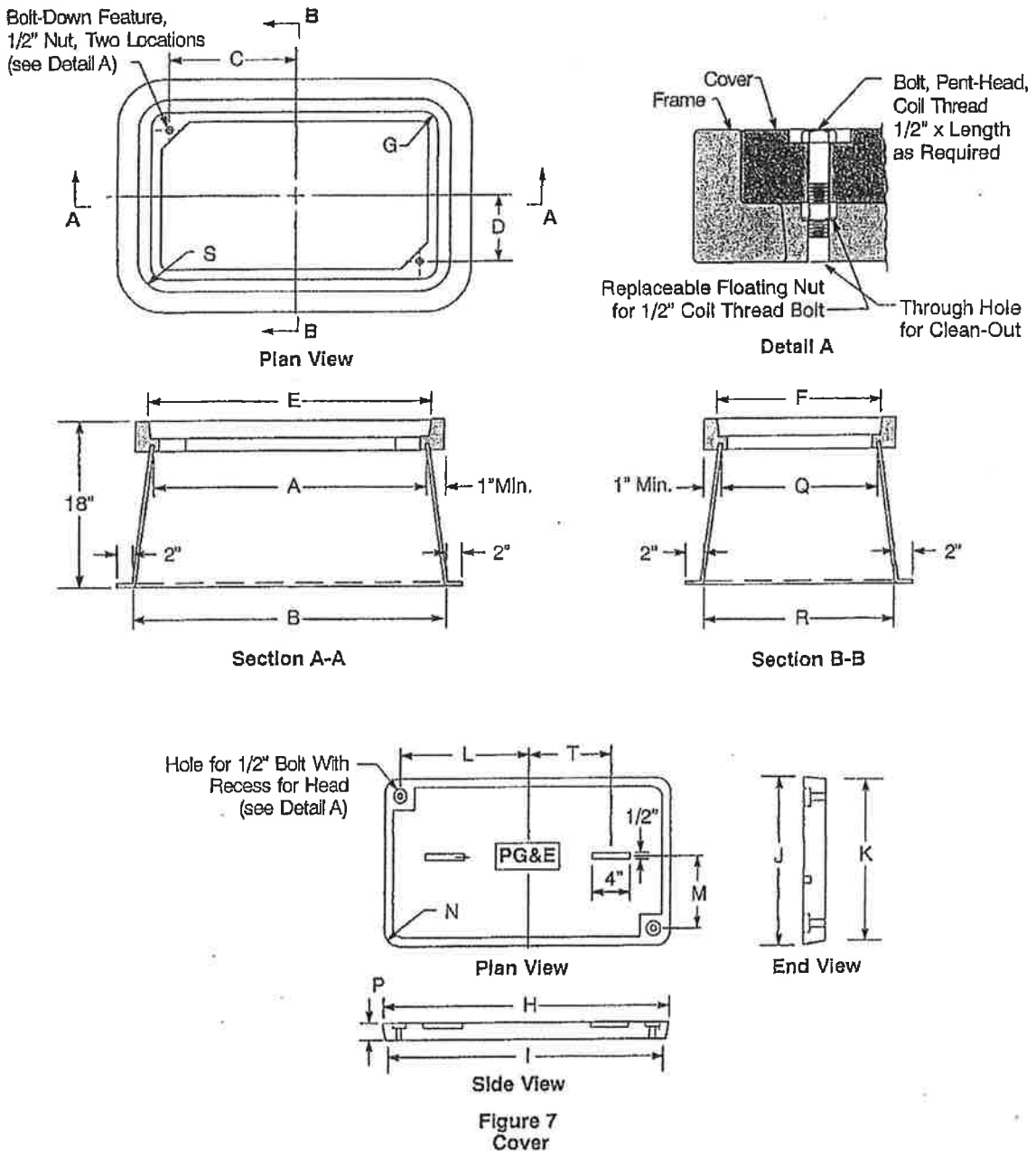
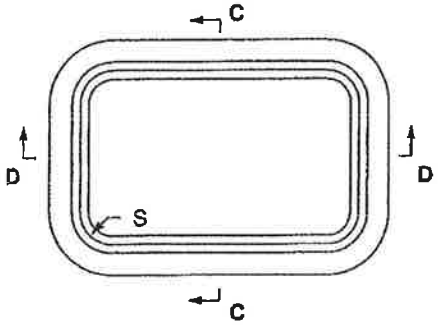
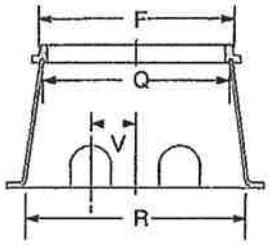


Figure 7
Cover

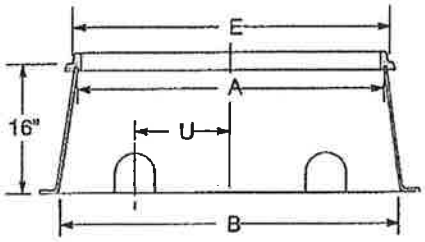
Non-Concrete Boxes for Incidental Traffic (continued)



Plan View

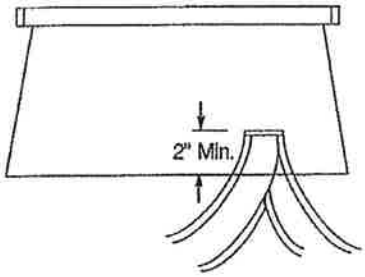


Section C-C



Section D-D

Figure 8
Non-Concrete Extension
(16" extension shown)



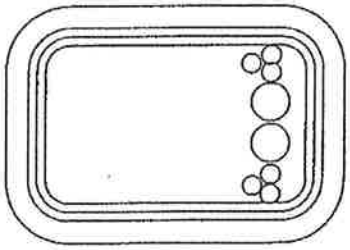


Figure 9
Preferred Location of Conduits
Entering Splice Box

Table 4 Codes for Box Components and Assemblies

Box		Description	Code
Size (inches)	Depth (inches)		
13 x 24	18	Body	043713
	8	Extension	043714
	16	Extension	043715
	–	Cover	043716
	Assembly Without Extension		043460
	Assembly With 8" Extension		043459
17 x 30	18	Body	043717
	8	Extension	043718
	16		043719
	–	Cover	043720
	Assembly Without Extension		043465
	Assembly With 8" Extension		043464
24 x 36	18	Body	043721
	8	Extension	043722
	16		043723
	–	Cover	043724
	Assembly Without Extension		043470
	Assembly With 8" Extension		043469
All	Pent-Head Bolt Coil Thread 1/2" x	2-1/2"	192853
		3-1/2"	017488
		4-1/2"	017489

Non-Concrete Boxes for Incidental Traffic (continued)

Table 5 Dimensions of Non-Concrete Boxes

Box Size (inches)	Dimensions (inches)									
	A	B	C	D	E	F	G	H	I	J
13 x 24 x 18 [1]	26	29-1/2	9-7/8	5-1/8	23-1/2	14	1-1/2	–	–	–
13 x 24 x 8 [2]	28-1/2	30	–	–	29-1/4	19-3/4	–	–	–	–
13 x 24 x 16 [2]	28-1/2	31-3/4	–	–	29-1/4	19-3/4	–	–	–	–
13 x 24 Cover	–	–	–	–	–	–	–	23-1/4	23	13-3/4
17 x 30 x 18 [1]	33-1/4	36-3/4	13-1/4	6-3/4	30-3/4	17-3/4	1-1/2	–	–	–
17 x 30 x 8 [2]	35-3/4	37-1/4	–	–	36-1/2	23-1/2	–	–	–	–
17 x 30 x 16 [2]	35-3/4	39	–	–	36-1/2	23-1/2	–	–	–	–
17 x 30 Cover	–	–	–	–	–	–	–	30-1/2	30-1/4	17-1/2
24 x 36 x 18 [1]	39-1/8	42-1/8	15-9/16	9-3/4	35-7/8	24-1/4	5-1/8	–	–	–
24 x 36 x 8 [2]	41-1/8	42-5/8	–	–	41-7/8	30-1/4	–	–	–	–
24 x 36 x 16 [2]	41-1/8	44-3/8	–	–	41-7/8	30-1/4	–	–	–	–
24 x 36 Cover	–	–	–	–	–	–	–	35-5/8	35-1/8	24

Box Size (inches)	Dimensions (inches)								
	K	L	M	N	P	Q	R	S	T
13 x 24 x 18 [1]	–	–	–	–	–	16-1/2	20	4-5/8	–
13 x 24 x 8 [2]	–	–	–	–	–	19	20-1/2	4-1/2	–
13 x 24 x 16 [2]	–	–	–	–	–	19	22-1/4	4-1/2	–
13 x 24 Cover	13-1/2	9-7/8	5-1/8	1-3/8	2	–	–	–	6
17 x 30 x 18 [1]	–	–	–	–	–	20-1/4	23-3/4	4-5/8	–
17 x 30 x 8 [2]	–	–	–	–	–	22-3/4	24-1/4	4-1/2	–
17 x 30 x 16 [2]	–	–	–	–	–	22-3/4	26	4-1/2	–
17 x 30 Cover	17-1/4	13-1/4	6-3/4	1-3/8	2	–	–	–	9
24 x 36 x 18 [1]	–	–	–	–	–	27-1/2	30-1/2	8-3/4	–
24 x 36 x 8 [2]	–	–	–	–	–	29-1/2	31	8-5/8	–
24 x 36 x 16 [2]	–	–	–	–	–	29-1/2	32-3/4	8-5/8	–
24 x 36 Cover	23-1/2	15-9/16	9-3/4	5	3	–	–	–	11

[1] Body
[2] Extension

Table 6 Knockout Dimensions of Non-Concrete Extensions [1]

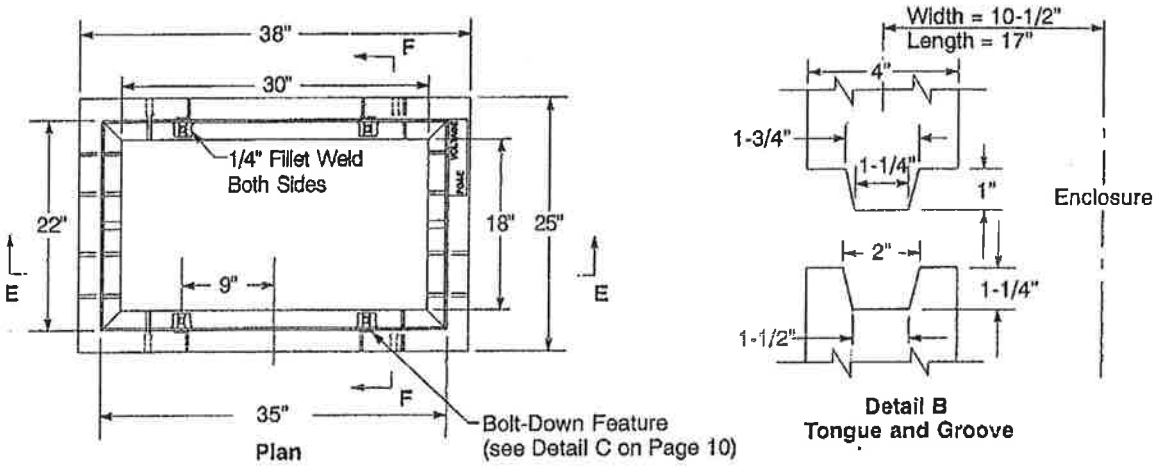
Extension	Dimensions (inches)		Number of Knockouts
	U	V	
13" x 24"	7-1/2	0	6
17" x 30"	10-1/2	5	8
24" x 36"	11	5-1/2	8

[1] 5" duct terminators or 4-3/4" knockouts or mouse holes in all positions.

17" x 30" Concrete Boxes for Full Traffic

Notes

1. Grade adjustment, when required, shall be made between the box and the extension or top section.
2. A base is not required.
3. All concrete parts shall be permanently identified as to the manufacturer on the inside surface. The weight shall be stenciled on the outside of all concrete parts.
4. All concrete parts shall be provided with four 7/8-inch diameter, 1-3/4-inch minimum deep inserts with UNC Class 2A threads.
5. Joints must be interchangeable with those shown in Detail B and approved by the Electric Distribution department.



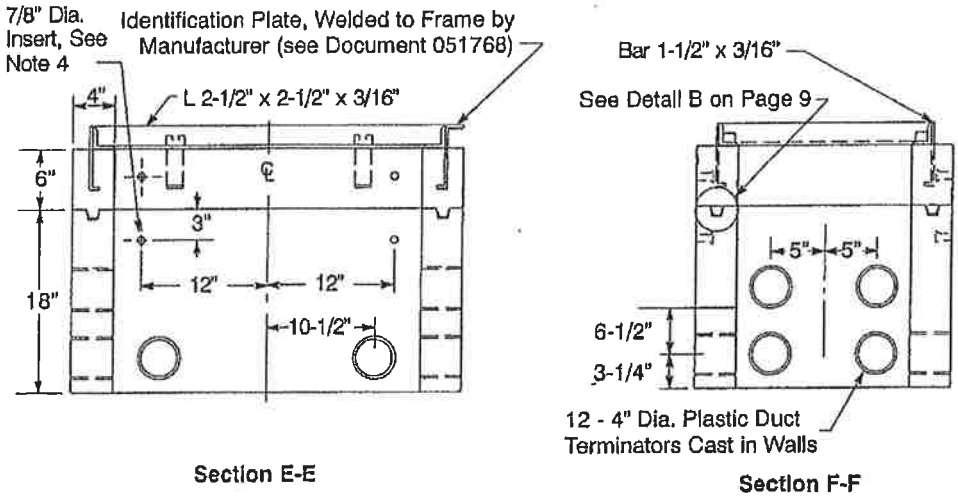
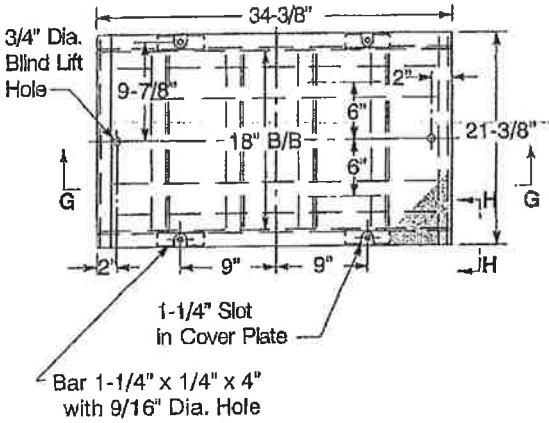
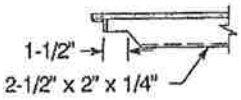


Figure 10
Concrete Enclosure

17" x 30" Concrete Boxes for Full Traffic (continued)



Cover

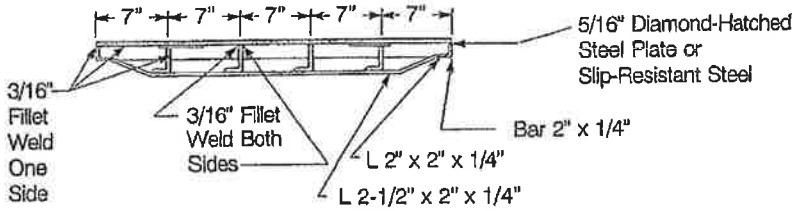


Section H-H

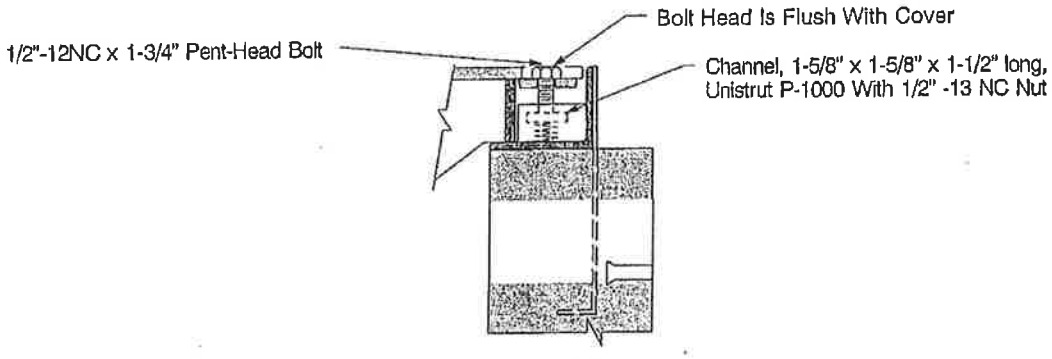
Table 7 Codes for Complete 17" x 30" Concrete Box Assemblies

Box		Code [1]
Type	Depth	
Full-Vehicular-Traffic With Slip-Resistant Cover	24"	019588
	30"	019597
Extension	6"	043517

1 PG&E assembly code includes body with a 6" or 12" top section with cast-in frame and a cover. If more depth is required, order the 6" extension.



Section G-G



Detail C
Bolt-Down Feature

Figure 11
17" x 30" Cover

24" x 36" Concrete Boxes for Full Traffic

Notes

1. Grade adjustment, when required, shall be made between the box and the extension or top section.
2. A base is not required.
3. All concrete parts shall be permanently identified as to the manufacturer on the inside surface. The weight shall be stenciled on the outside of all concrete parts.
4. All concrete parts shall be provided with four 7/8-inch diameter, 1-3/4-inch minimum deep inserts with UNC Class 2A threads.
5. The identification plate is to be welded to the frame by the manufacturer (see Document 051768 and Figure 12).

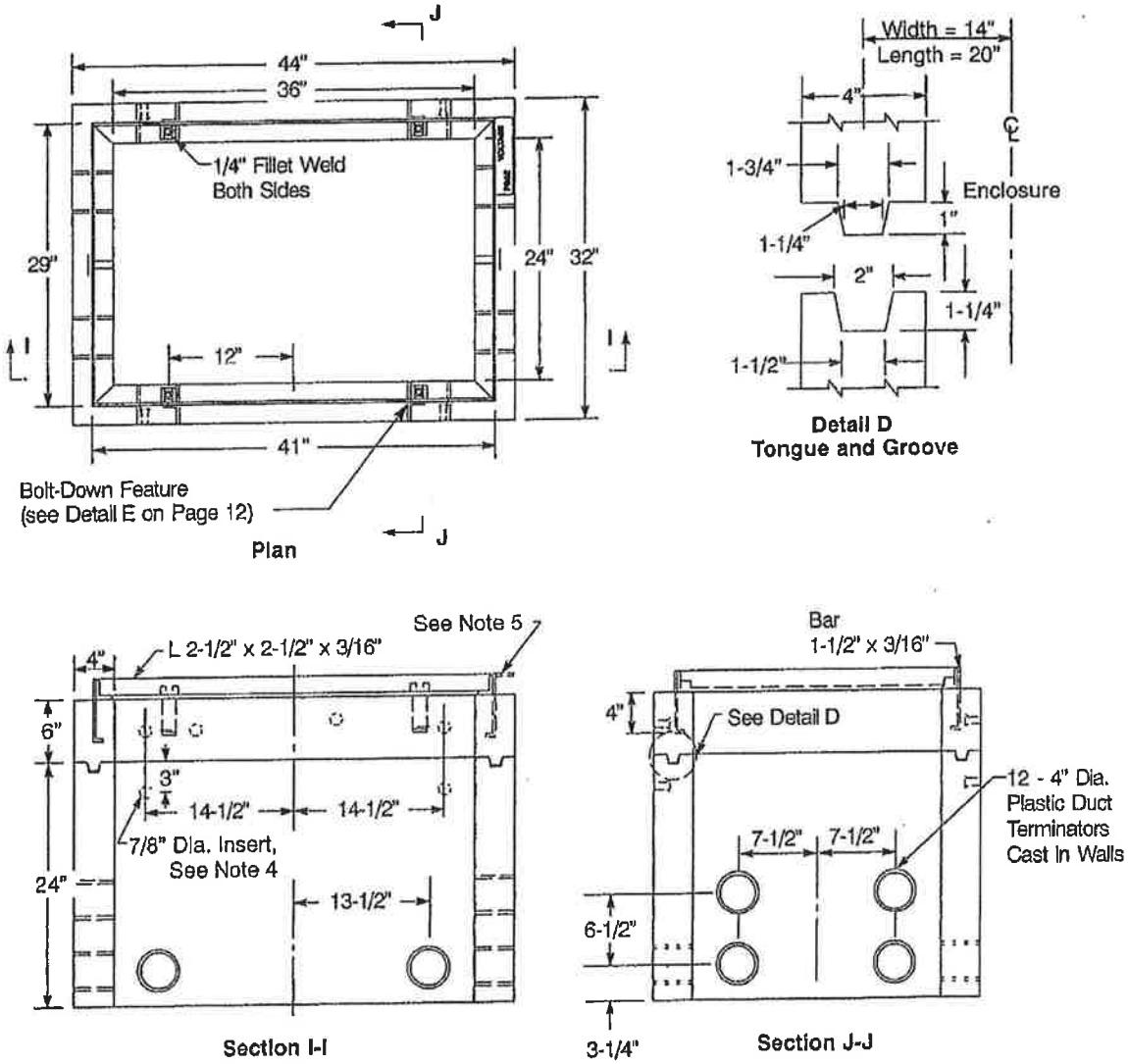
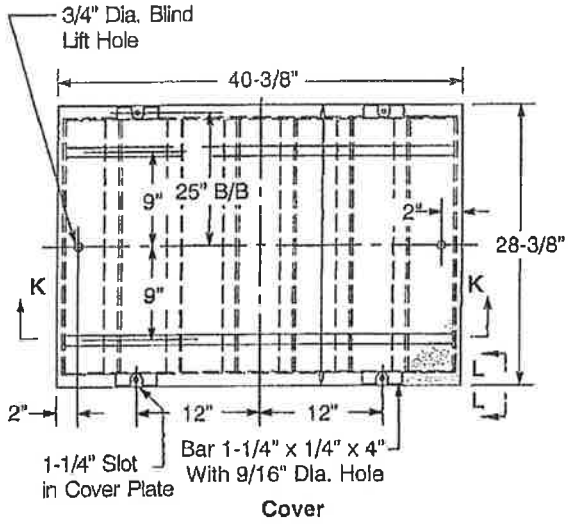
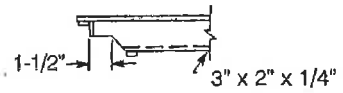


Figure 12
24" x 36" Concrete Box

24" x 36" Concrete Boxes for Full Traffic (continued)



Cover

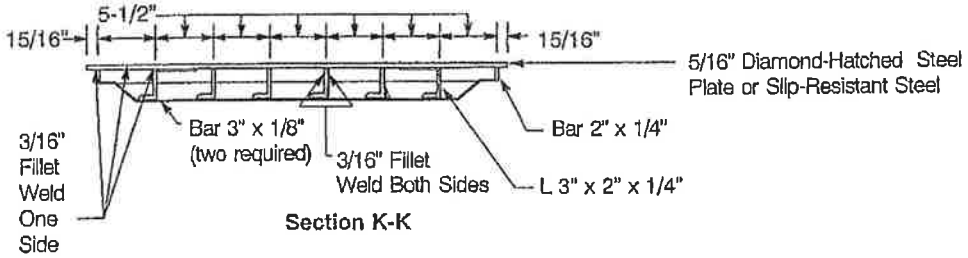


Section L-L

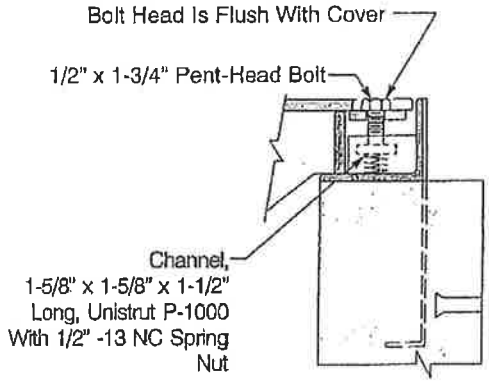
Table 8 Codes for Complete 24" x 36" Concrete Box Assemblies

Box		Code [1]
Type	Depth	
Full-Vehicular-Traffic With Slip-Resistant Cover	30"	019598
	36"	019599
Extension	6"	043521

[1] PG&E assembly code includes body, 6" or 12" top section with cast-in frame and cover. If more depth is required, order a 6" extension.



Section K-K



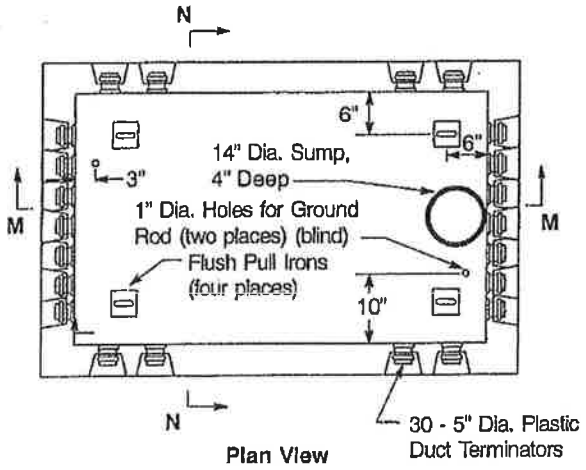
Detail E
Bolt-Down Feature

Figure 13
24" x 36" Steel Cover

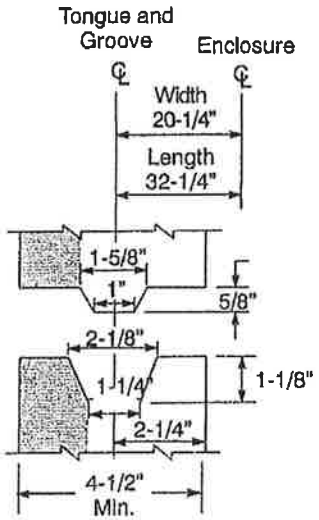
36" x 60" Incidental- and Full-Traffic Concrete Boxes

Notes

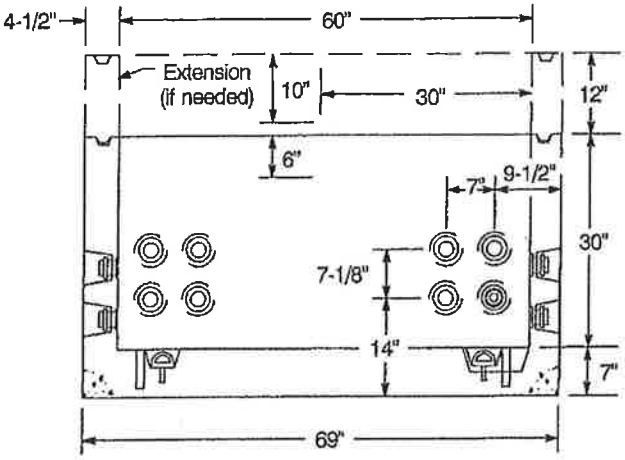
1. Joints must be interchangeable with those shown in Detail F.
2. Mastic sealant is to be included with the enclosure assembly for all concrete-to-concrete joints below surface level.
3. Pulling irons shall be designed for 20,000 pounds ultimate, with a safety factor of 2 (40,000 pounds).
4. Boxes shall be lifted using pulling irons in the floor.



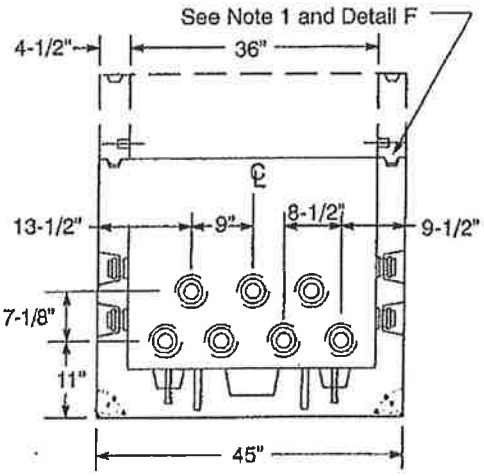
Plan View



Detail F
Tongue and Groove



Section M-M



Section N-N

Figure 14
36" x 60" Concrete Box

36" x 60" Incidental- and Full-Traffic Concrete Boxes (continued)

Table 9 Codes for 36" x 60" Concrete Box

Box		Code
Type	Depth [1]	
Incidental-Traffic Assembly	30"	032506
Full-Traffic Assembly		032507 [2]
Body		032508

1 When extra depth is required, order additional 12" extensions (see Document 062000).
2 This code includes a 12" extension to accommodate the heavy full-traffic cover.

Revision Notes

Revision 11 has the following changes:

1. Revised Section N-N of Figure 14 on Page 13 to correct the end wall cable entrance dimension.

Prepared by: EOB1

PG&E	**UNDERGROUND CONDUITS**	**062288**
Department: Electric T&D		**Section:** T&D Engineering and Technical Support
Approved by: R. D. Kauzer (RDK6) Rich Kauzer		**Date:** 10-29-04
Rev. #07: This document replaces PG&E Document 062288, Rev. #06. For a description of the changes, see Page 14.		

Purpose and Scope

This document covers steel and plastic conduit for underground installations, with or without concrete encasement.

General Information

1. Applications for underground conduit are as follows:
   A. Residential: All residential installations requiring conduit should be made without concrete encasement.
   B. Light Commercial, Industrial, and Underground Residential Distribution (URD) Feeder: Installation of circuits of this type, which are three-way or less, should normally be made without concrete encasement. Conduit banks involving more than three conduits will normally require concrete encasement.
   C. Severe exposure to "dig-ins" and other hazards may require concrete encasement of conduit lines.
2. When conduit, including service conduit, is to be installed for PG&E by others, the following are acceptable alternatives to the American Society of Testing and Materials (ASTM) F512 conduits listed in this document:
   A. PVC Schedule 40 or 80 UL approved 90°C conduit that is so marked.
   B. Hot-dip galvanized rigid steel conduit conforming to American National Standards Institute (ANSI) Specification C80.1.

   It is the installer's responsibility to use the proper fitting to join conduits. This transition may involve changes in both conduit type and size. If equal diameter conduits of different wall thicknesses are joined, the inside edge of the spigot end must be chamfered.
3. The current carrying capacity of an insulated cable is reduced if it is surrounded by other loaded cables. For this reason, conduit banks should be arranged so that each conduit is in an outside position.
4. Every effort should be made to obtain a straight, watertight conduit line.
5. In commercial distribution systems, consideration should be given to providing one or more spare conduits in the original construction for future load growth requirements. The addition of such conduits at a later time is much more costly.
6. A mandrel shall be used to prove that all conduits are free and clear of dirt, rocks, and other debris.
7. A pulling tape with sequential footage markings (Code 560154) shall be installed in all conduits and attached to an end cap. The tape shall be proven free and not glued or caught on joints.
8. All conduits shall be capped. All conduits not terminating in a subsurface enclosure, pedestal, or vault are to be capped with unglued rigid caps (see Table 12 on Page 6). Conduits terminating in a subsurface enclosure, pedestal, or vault shall be capped with temporary plugs (see Table 12 on Page 6).
9. When the intrusion of water into buildings can be reasonably expected through lateral service ducts, PG&E is responsible for sealing both ends of the conduit (refer to Document 063927 and Document 063928).

Material Specifications

10. Plastic conduits and fittings shall comply with the latest revision of ASTM Standard F512 for PVC. In addition, the conduit shall also meet the following specific requirements:
    A. Conduit cell classification of 12164-B or 12264-B, tensile modulus of 500,000 psi.

Underground Conduits

B. Fittings cell classification of 12234-B, tensile modulus of 500,000 psi.

C. Marking shall conform to ASTM Standard F512 requirements.

D. The inside edge of conduit ends (spigot-end only in the case of belled-end conduit) shall be beveled to eliminate sharp edges and minimize the possibility of cable damage.

E. PVC conduit and fittings will be gray in color.

Application

11. Plastic conduit may be cut with a hacksaw or a fine-toothed wood saw. Clean off burrs. Bevel the inside to eliminate sharp edges.

12. Apply a thin, uniform coat of cement to both surfaces to be glued. Avoid excessive use of cement to prevent the formation of a bead of cement on the interior shoulder of the joint since, when hardened, the bead can cause cable damage during installation. Immediately after applying the coat of cement to the conduit, insert the conduit into the fitting socket until it bottoms at the fitting shoulder. Turn the conduit 1/4 turn during insertion to distribute the cement evenly. Hold the conduit in place for about 1 minute to prevent backing out in case of tight interference fit joints. Wipe any excess cement away from the outside of the joint. Weather conditions may vary the curing time. When using cement in confined areas, adequate ventilation must be provided.

Table 1 Cement for Use With Plastic Conduits

Application	Quantity	Code
PVC to PVC	1 Quart	490157
	1 Pint	490151

13. Backfill containing large rock, paving material, cinders, large amounts of sharply angular substance, or corrosive material shall not be placed in excavations where such material may damage conduits, prevent adequate compaction of the fill, or contribute to corrosion of the conduits.

14. End bells are to be used to terminate all conduits, unless the conduit has been terminated in an enclosure equipped with duct terminators. Cable protectors are to be used on reconstruction projects only, when end bells cannot be installed.

15. Conduits shown in Table 10 and Table 11 on Page 5 are for directional boring applications only.

16. **Caution:** When pulling conduits in boring applications, be certain to cut the conduits allowing sufficient extra length for the conduit to relax. It may take as long as 72 hours for an excessively stretched conduit to fully relax.

References

	Document
Engineering Material Specification 99, "Underground Electric Duct System (Installed by applicant)"	EMS99
Methods and Requirements for Installing Commercial Underground Electric Services 0-600 Volts to Customer-Owned Facilities	063928
Methods and Requirements for Installing Residential Underground Electric Services 0-600 Volts to Customer-Owned Facilities	063927
Underground Conduit Without Concrete Encasement (For Reference Only)	031793
Underground Duct Lines Concrete Encased (For Reference Only)	031792
UO Guideline EG 4123, "Backfill Sand Specification"	EG 4123

Underground Conduits

Rigid Steel Conduit and Fittings

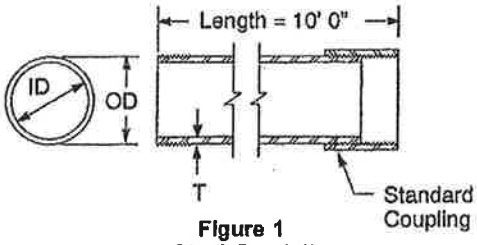


Figure 1
Steel Conduit

Table 2 Codes for Rigid Steel Conduit

Conduit Size (Inches)	Dimensions (Inches)			Weight (lbs.)[1]	Code
	OD	ID	T		
2	2.4	2.06	0.154	33	362103
3	3.5	3.06	0.216	69	362092
4	4.5	4.02	0.237	98	362093
5	5.6	5.04	0.258	134	362104
6	6.6	6.06	0.280	177	362141

[1] Weight for one 10-foot length, including one standard coupling furnished with each length.

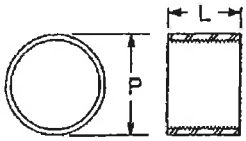


Figure 2
Steel Coupling

Table 3 Codes for Standard Steel Coupling

Conduit Size (Inches)	Dimensions (Inches)		Code
	P	L	
2	2.73	2.18	362105
3	4.00	3.25	362094
4	5.00	3.50	362095
5	6.29	3.75	362106
6	7.39	4.00	362142

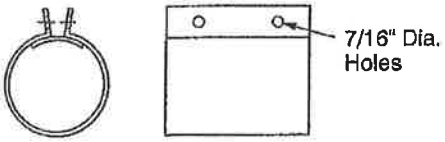


Figure 3
Split Coupling

Table 4 Codes for Galvanized Steel Split Coupling

Conduit Size (Inches)	Code
2	362019
3	362021
4	362023
5	362107
6	362143

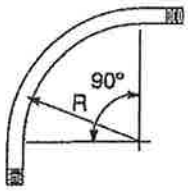


Figure 4
Conduit Sweep
Threaded Both Ends

Table 5 Codes for 90° Steel Conduit Sweeps, TBE

Conduit Size (Inches)	Radius (Inches)	Code
2	24	360393
3	36	362091
4	36	362090
	60	360812
5	36	362109
6	36	362144
	48	362145
	60	360813

Plastic Conduit and Fittings

Notes

1. The depth of all couplings, adapters, swedge reducers, and bell ends shall conform to the requirements listed in Table 2 of ASTM Standard F-512.

Table 6 Data and Codes for Rigid Plastic Conduit DB120 [1]

Conduit Size (inches)	Dimensions (inches)				Code
	Outside Diameter	Minimum ID	Wall Thickness		
			Minimum	Maximum	
2	2.375	2.161	0.077	0.107	016468
3	3.500	3.204	0.118	0.148	016471
4	4.500	4.132	0.154	0.184	016472
5	5.563	5.121	0.191	0.221	016473
6	6.625	6.111	0.227	0.257	016474

[1] See Note 10 on Page 1 for material specifications.

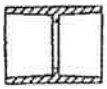


Figure 5
Standard Coupling

Table 7 Codes for Standard Couplings [1]

Standard Coupling	
Conduit Size (inches)	Code
2	360321
3	360322
4	360323
5	360401
6	360482

[1] Standard couplings made from DB-60 conduit are acceptable.

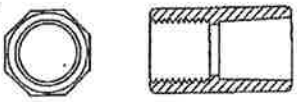


Figure 6
Plastic-to-Steel Adapter

Table 8 Codes for Plastic-to-Steel Adapters

Conduit Size (inches)	Code
2	360324
3	360325
4	360326
5	360402
6	360489

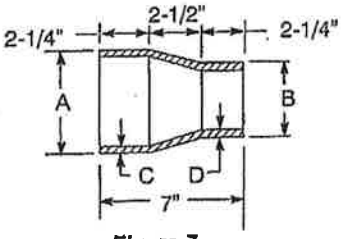


Figure 7
Swedge Reducer

Table 9 Data and Codes for Swedge Reducers

Reducer Size (inches)	Dimensions (inches)				Code
	OD		Min. Wall Thickness		
	A	B [1]	C	D	
3 x 2	3.500	2.375	0.60	0.60	018585
4 x 3	4.500	3.500	0.60	0.60	018584
4 x 2	4.500	2.375	0.60	0.60	018586
5 x 4	5.563	4.742	0.60	0.60	360777
6 x 5	6.625	5.563	0.60	0.60	360778
6 x 4	6.625	4.812	0.60	0.60	016476

[1] Dimensions shown are for a swedge reducer with a spigot end. A belled end may be substituted.

Underground Conduits

Plastic Conduit and Fittings (continued)

Table 10 High Density Polyethlene (HDPE) Conduit [1]

Conduit				Mechanical Couplings [2, 3]	
Size	Length (feet)	Description	Code	Size (Inches)	Code
2" Sch 80	500	Coil [4]	360511	2	360690
2" Sch 80	40	Stick	360017		
3" Sch 80	500	Coil [4]	360644	3	360691
3" Sch 80	40	Stick	360018		
4" Sch 80	625	Coil [4]	360687	4	360692
4" Sch 80	625	Coil [5]	360014		
4" Sch 80	40	Stick	360015		
5" SDR 13.5	450	Coil [4]	360688	5	360694
5" SDR 13.5	450	Coil [5]	360012		
5" SDR 13.5	40	Stick	360013		
6" SDR 13.5	450	Coil [4]	360689	6	360695
6" SDR 13.5	450	Coil [5]	360010		
6" SDR 13.5	40	Stick	360011		

1 Color shall be black with at least 3 red longitudinal strips.
2 May be used to connect PE conduit to PVC conduit.
3 Mechanical couplings are not designed for directional drilling. Fusion joints are required.
4 No reel.
5 With reel.

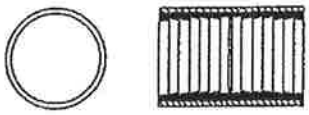


Figure 8
HDPE Coupling

Table 11 PVC Directional Boring Conduit

Size (Inches)	Description	Code
3	Conduit 10', Schedule 40	360055
3	Conduit 20', Schedule 40	360056
3	Replacement Locking Straps [1]	360058
3	Replacement Seal Gaskets [1]	360057
4	Conduit 10', Schedule 40	360026
4	Conduit 20', Schedule 40	360025
4	Replacement Locking Straps [1]	360031
4	Replacement Seal Gaskets [1]	360029
6	Conduit 10', Schedule 40	360027
6	Conduit 20', Schedule 40	360028
6	Replacement Locking Straps [1]	360032
6	Replacement Seal Gaskets [1]	360030

1 Package of 10.

Plastic Conduit and Fittings (continued)

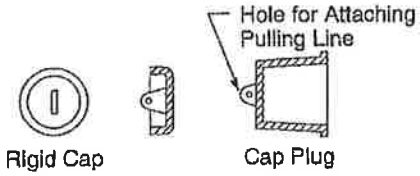


Figure 9
Plastic Conduit Caps

Table 12 Codes for Rigid Conduit Caps and Cap Plugs

Conduit Size (inches)	Codes	
	Rigid Cap	Cap Plug
2	360425	360440
3	360426	360441
4	360428	360443
5	360429	360444
6	360488	360494

Figure 10
End Bell

Table 13 Codes for End Bells

Conduit Size (inches)	Code
2	360420
3	360421
4	360423
5	360424
6	360487

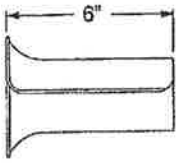


Figure 11
Cable Protector

Table 14 Codes for Cable Protectors [1]

Conduit Size (inches)	Code
2	382034
3	382032
4	
5	
6	

[1] Not for new installations; for replacement only.

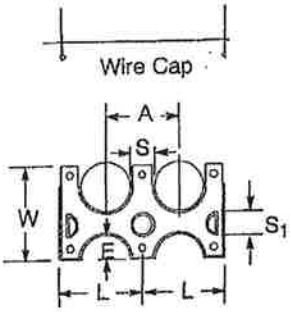


Figure 12
Formex Spacer and Wire Cap

Table 15 Codes for Formex Spacers and Wire Caps

Conduit Size (Inches)	Dimensions (inches)						Codes	
	A	W	L	E	S	S_1	Spacer	Cap
3	5-1/8	6-1/8	5-7/8	1-13/16	1-1/2	1	360459	360466
4	6-3/16	7-1/8	7-7/16	2-5/16	1-1/2	1	360460	360467
5	7-1/4	8-3/16	8-17/32	2-7/8	1-1/2	1	360461	360468
6	8-3/16	9-3/16	8-15/16	3-11/16	1-1/2	1	360491	360492

Underground Conduits

Plastic Conduit and Fittings (continued)

Figure 13
5° Coupling

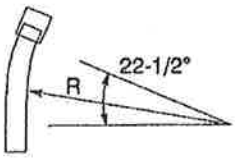


Figure 14
22-1/2° PVC Conduit Bend

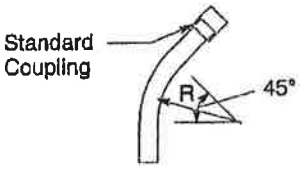


Figure 15
45° PVC Conduit Bend

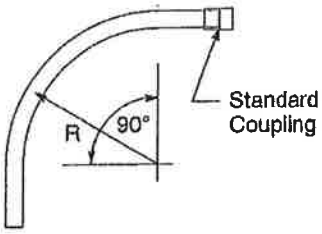


Figure 16
90° PVC Conduit Bend

Table 16 Codes for DB120 PVC Conduit Bends (sweeps)

Conduit Size (inches)	Sweep		Code
	Degree	Radius (inches)	
2	5	30	360458
	11-1/4	24	360797
		36	360798
	22-1/2	24	360795
		36	360796
	45	24	360391
		36	360794
	90	24	360393
		36	026491
3	5	36	360399
	11-1/4	36	360801
	22-1/2	36	360800
	45	36	360403
	90	24	360405
		36	360328
4	5	36	360400
	11-1/4	36	360804
		60	360805
	22-1/2	36	360760
		60	360761
	45	36	360412
		60	360413
	90	36	360414
		60	360415
5	5	48	360407
	11-1/4	36	360808
		60	360809
	22-1/2	36	360806
		60	360763
	45	36	360416
		60	360417
	90	36	360418
		60	360419
6	5	60	360495
	11-1/4	60	360811
	22-1/2	60	360765
	45	60	360486
	90	60	360484

Large Radius Sweeps

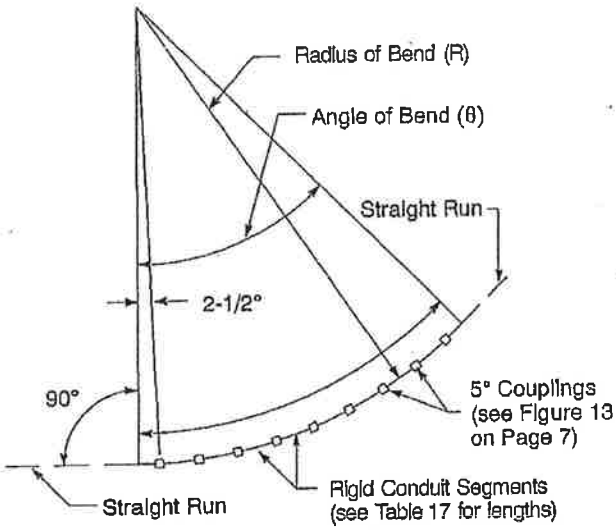


Figure 17
Typical Application of 5° Couplings

Example

Radius Bend (R) = 60 Feet
Angle of Bend (θ) = 45°

From Table 17 The nearest value to 60-foot radius is 57' 6".
The length of conduit segments = 5 feet.

From Table 18 For a 45° angle bend:
The number of 5° couplings required = 9.
The number of conduit segments required = 8.

Table 17 Length of Rigid PVC Conduit Segments

Approximate Radius of Bend (R)	Length of Rigid Conduit Segments (feet)
11' 6"	1
17' 3"	1.5
23' 0"	2
28' 9"	2.5
34' 6"	3
40' 3"	3.5
46' 0"	4
51' 9"	4.5
57' 6"	5
69' 0"	6
80' 6"	7
92' 0"	8

Table 18 Number of Couplings and Conduit Segments Required

Angle of Bend (θ)	Number of Couplings and Conduit Segments Required	
	Coupling	Conduit
15°	3	2
30°	6	5
45°	9	8
60°	12	11
75°	15	14
90°	18	17

Table 19 PE Conduit and Fittings for Large Radius Sweeps (20' length)

Size	4"	6"
Minimum Bending Radius	8'	12'
–	Code	Code
Conduit	360335	360369
Coupling	360339	360375
Gasket	360343	360376
Bell Adapter	360358	360390
Spigot Adapter	360367	360435

Underground Conduits

Trench Requirements

Notes

1. Field conditions may require a minimum depth greater than shown.
2. Maintain 3-inch separation between ducts for substation outlet and main feeder circuits. When necessary, this separation may be reduced for less critical circuits.
3. Sharp turns, bends, or other irregularities in the conduit must be avoided.
4. If the bottom of a trench which will contain plastic conduit is rocky, use backfill material conforming to the requirements of UO Guideline EG 4123. Before tamping in the area of plastic conduit, apply at least 6 inches of backfill over the top of the conduit to avoid breakage. Final backfill may then be placed in the trench and tamping employed to finish grade. In order to reduce costs, the soil originally removed from the trench should be used as backfill wherever possible (see Note 13 on Page 2).
5. Do not use salt-water sand backfill with steel conduit.
6. Other utility practices may require a greater minimum conduit separation.
7. Refer to state of California, Department of Industrial Relations: *Trench Construction Safety Orders* for trench construction requirements. These orders are issued by the Department of Occupational Safety and Health.
8. When crossing obstructions, such as shown in Figure 21 and Figure 22 on Page 10, maintain 6-inch minimum separation.

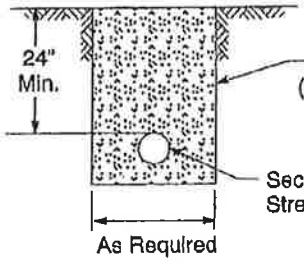


Figure 18
Secondary or Streetlight Trench

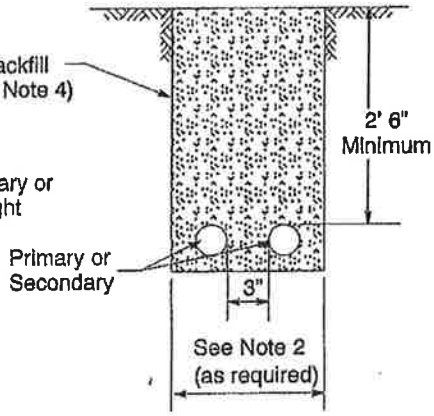
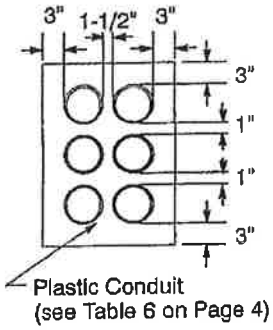


Figure 19
Primary or Secondary Trench

Conduit Construction, Built-up Method



Section A-A

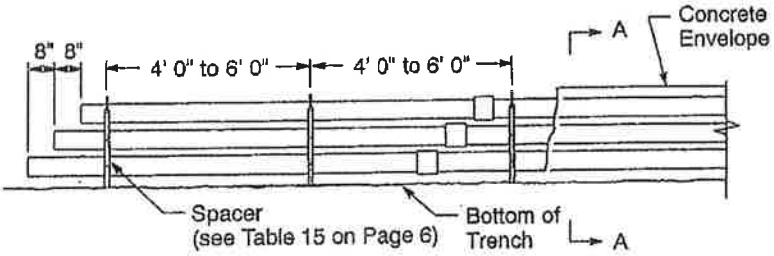


Figure 20
Typical Straight Run Installation
(5" conduit, 6-way shown)

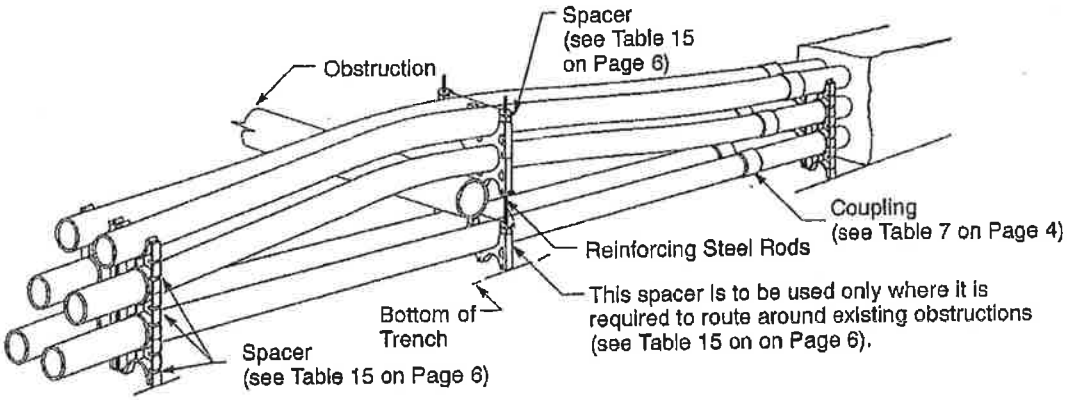


Figure 21
Typical Perspective View of
Installation Around Obstruction

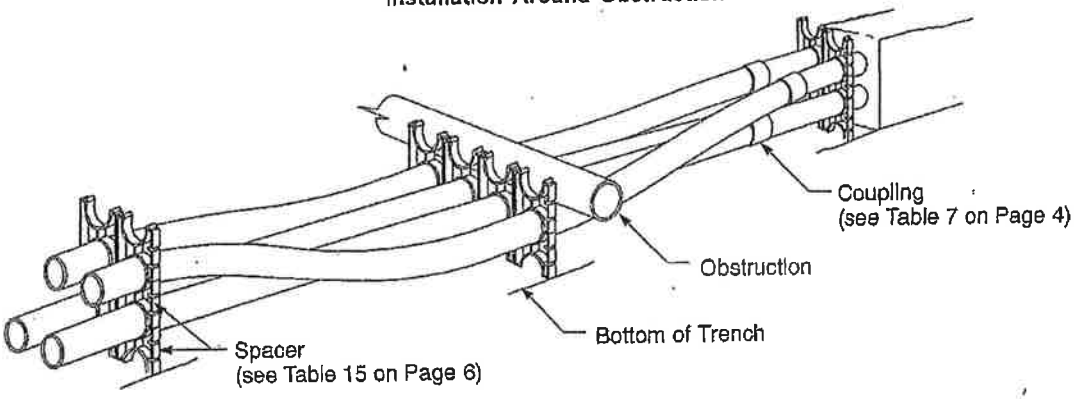


Figure 22
Typical Perspective View of
Installation Under Obstruction

Underground Conduits

Construction and Termination of Conduit Line

Notes

1. Slope the conduit sufficiently to provide adequate drainage. On level ground, slope the duct line from the center to each manhole.
2. Local ordinances may require a minimum depth greater than 2' 6". Depth may be reduced to 1' 6" in sidewalk area if local ordinances permit.
3. Where required, the depth of the conduit window may be increased. Where this is necessary, tie the conduit envelope concrete into the manhole reinforcing steel.
4. Vertical staggering of conduits at entrance shown in Detail A will assist in arranging for cable crossover if required.

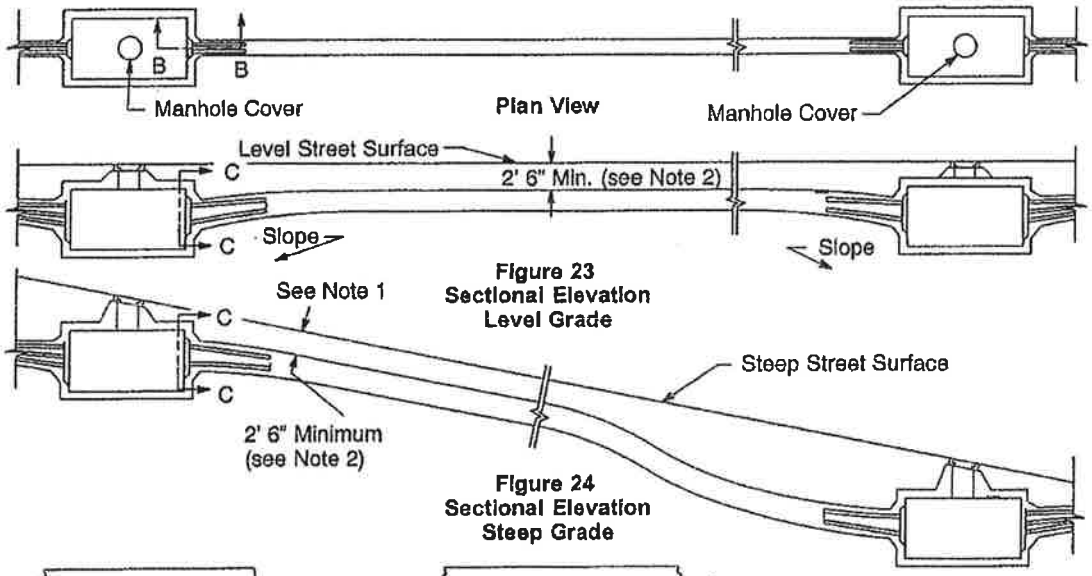
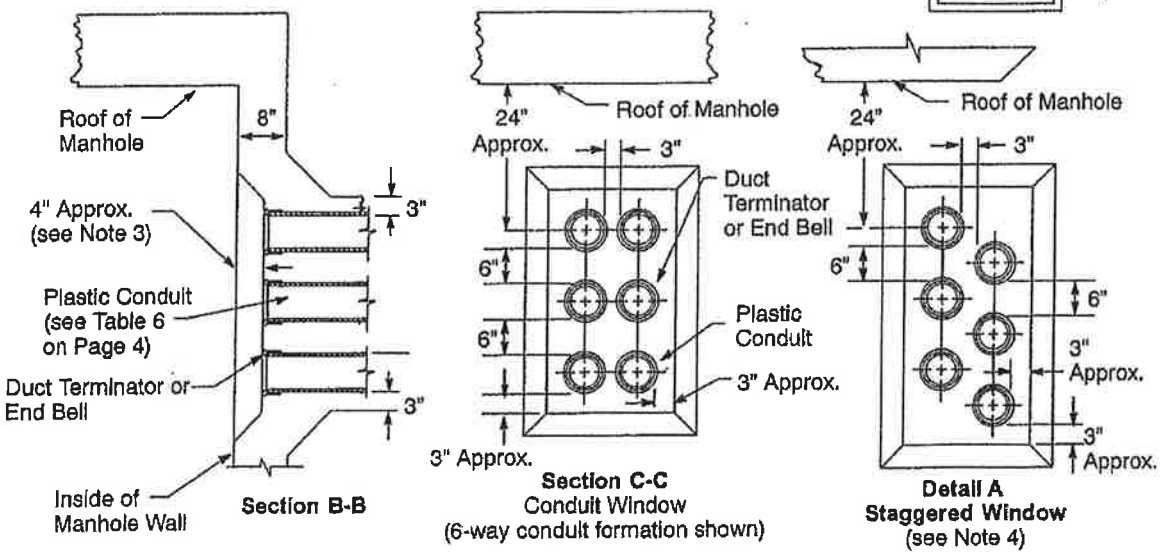


Figure 23
Sectional Elevation
Level Grade

Figure 24
Sectional Elevation
Steep Grade



Underground Conduits

Conduit Configuration Tables

Notes

1. For conduit lines four-way and larger in fill areas or areas of known differential ground settlement, install #4 reinforcing bars in all four corners of the conduit envelope. Overlap bars 15 inches and install a minimum of 3 inches from the top or bottom and 1 inch from the side of the envelope.
2. Where the width of the trench is greater than the required width of the envelope, the horizontal spacing between conduits may be increased as long as 3-inch spacing between the conduit and the outside edge of the envelope is maintained.

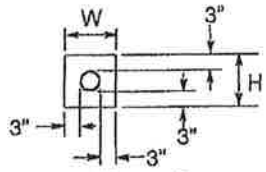


Figure 25
Single Conduit Configuration

Table 20 Dimensions for Single Conduit Configurations

Conduit		Envelope Dim.		Concrete Reqd. Cubic Yards per 100 ft. [1]
Description	Size	W	H	
Single	2"	8-1/2"	8-1/2"	1.9
	3"	9-1/2"	9-1/2"	2.3
	4"	10-1/2"	10-1/2"	2.8
	5"	11-1/2"	11-1/2"	3.1
	6"	12-1/2"	12-1/2"	3.4

[1] Quantities are approximate and include 10% added for variations encountered in construction.

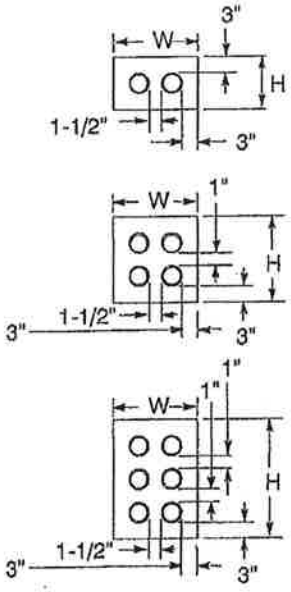


Figure 26
Two, Four, and Six-Way Conduit Configuration

Table 21 Dimensions for Multiple Conduit Configurations

Conduit		Envelope Dim.		Concrete Reqd. Cubic Yards per 100 ft. [1]
Description	Size	W	H	
2-way	3"	14-1/2"	9-1/2"	3.4
	4"	16-1/2"	10-1/2"	4.0
	5"	19"	11-1/2"	5.2
	6"	23-1/2"	12-1/2"	6.4
4-way	4"	16-1/2"	16-1/2"	6.2
	5"	19"	19"	8.2
	6"	23-1/2"	23-1/2"	11.7
6-way	4"	16-1/2"	22-1/2"	7.8
	5"	19"	26"	11.0
	6"	23-1/2"	28"	12.7
8-way	4"	16-1/2"	28-1/2"	9.7
	5"	19"	33"	13.8
	6"	23-1/2"	34-1/2"	15.1

[1] Quantities are approximate and include 10% added for variations encountered in construction.

Instructions for Sealing Conduit

Notes

1. Within minutes, polyurethane foam expands to form a water and gas barrier that can be easily removed in the future.
2. Consult the manufacturer's instructions included in each kit.

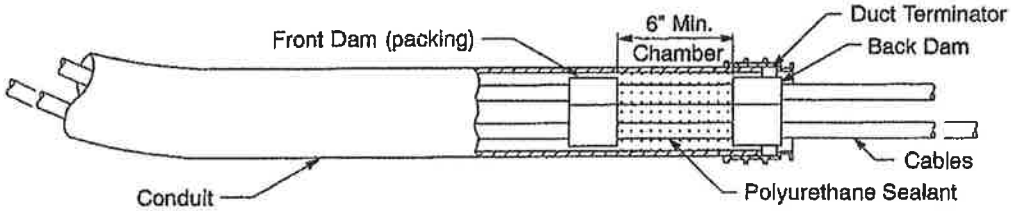


Figure 27
Details of a Polyurethane Seal

Step 1 Wipe off loose dirt and grime from cables.

Step 2 Install front dam (packing). Wind a strip of packing around each cable. Push the dam approximately 6 inches to 8 inches into the conduit. Install the back dam in the same manner as the front dam, and push it into the conduit until the dam is flush with the duct terminator.

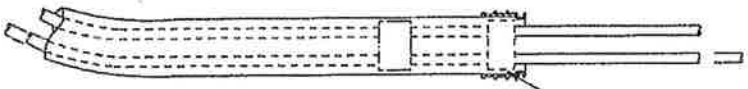


Figure 28

Step 3 Insert the nozzle into the chamber between the dams and inject polyurethane.

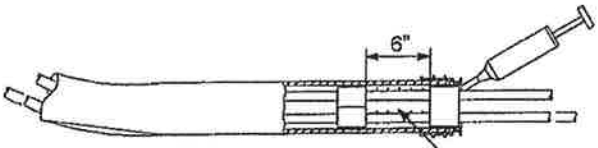


Figure 29

Table 22 Codes for Polyurethane Conduit Seal Kits

Conduit Size	Code	Manfacturer and Catalog Number	
		Polywater [1]	Arnco Hydro Seal
2" Through 6"	019178	FST-180PGE	S-60-C6P

[1] Order application gun, Code 204870.

Instructions for Sealing Conduit (continued)

Termination Enclosure Riser Seal Method

Step 1 Place the residential riser seal on the cable and slowly push it into the mouth of the riser conduit. Turn the allen screw until the neoprene gasket expands to form a tight seal.

Step 2 This riser seal is to be used to seal the riser conduit at the customer's service termination enclosure only. The top of the service riser is the preferred location. Belowground use is approved if an alternative to foam is needed.

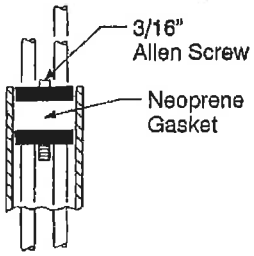


Figure 30
Termination Enclosure Riser Seal

Table 23 Codes for Termination Enclosure Riser Seals

Conduit Size	Cable Size	Code	Manufacturer and Catalog No. Environmental Solutions Cat.
2"	1/0 Triplex	019179	ESC - 103
	4/0 Triplex	019180	ESC - 403

Revision Notes

Revision 07 has the following changes:

1. Revised Note 10B and added new Note 10E on Page 2 in the "Material Specifications" section.
2. Added UO Guideline EG 4123 in the "References" section on Page 2.
3. Added new Footnote 1 to Table 10 on Page 5.
4. Deleted old Figure 12, "Wye Coupling", and old Table 15, "Codes for Wye Couplings", on Page 6.
5. Added Footnote 1 to Table 14 on Page 6.
6. Revised Note 4 on Page 9 to update the reference document, UO Guideline EG 4123 (was Engineering Material Specification #90).
7. Revised Table 22 on Page 13 to correct the catalog number of the conduit.

ATTACHMENT C

PG&E GAS SPECIFICATIONS

AT&T SPECIFICATIONS

at&t

AT&T Specifications

Trenching

Conduit

Boxes and Manholes

Service Cabinets

Bonding and Grounding

Pre-wire

A Guide for California Developers of Residential Subdivisions

This guide consists of AT&T California specifications and diagrams for trenching, underground support structure, pre-wiring, and other make ready work performed by developers and their agents as required by AT&T for installation of its communication facilities. Any deviation from the information provided in this document must be approved by the local AT&T Engineer.

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General Requirements 3
Trenching 4
Conduit 5
  Material Requirements 5
  Installation Requirements 6
Boxes and Manholes 7
  Material Specifications 7
  Installation Specifications for Boxes 8
  Installation Specifications for Manholes 8
Service Cabinets, Bonding and Grounding 9
Pre-wire 11

General Requirements

1. Contact the AT&T company trench coordinator 15 days prior to construction to establish a pre-construction meeting date.

2. Notify AT&T Inspector at least 48 hours prior to trenching to ensure inspector will be on site.

3. Verify the location of AT&T and all utility substructures and buried facilities two (2) days prior to excavation.
   Call Underground Service Alert:

   North 1-800-227-2600
   South 1-800-422-4133

4. Provide supervision and coordination between the various contractors working within the project in order to prevent damage to AT&T facilities. The developer is responsible for the cost of repairs, replacement or relocation made necessary by damage to the AT&T facilities by other work operations.

5. Construct trench and place substructures according to AT&T plans and specifications.

6. Request and get authorization for any design change from the AT&T company trench inspector or engineer prior to implementing the change.

7. Provide "As Built" drawings with the footages to the AT&T Inspector or Engineer upon completion of the conduit system.

Trenching

1. Area of proposed trench route must be graded to within 6" of final grade prior to trenching.

2. Minimum clearance is 12" from all trench occupants except CATV (C.P.U.C. Order 128), unless there is a prior signed agreement with AT&T.

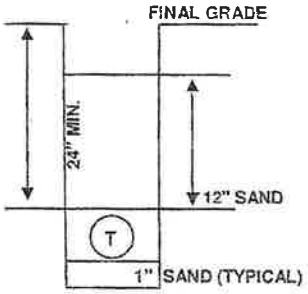
3. Bends, sweeps or grade changes that have a radius of 80' or less or a grade change of 20% or more must be encased in 2500 psi concrete.

4. Minimum trench cover must meet the governing agency requirement.

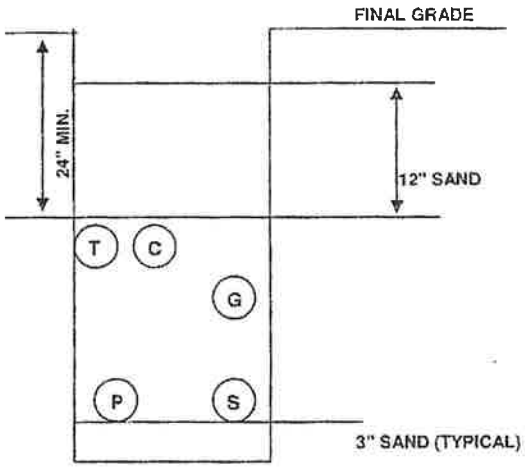
5. Property corners of each residential or business lot must be staked prior to cable placement to determine the exact location for AT&T fixtures.

6. All trench backfill material must be minimum Class B and compacted in accordance with governing agency specifications.

TELCO (AT&T) ONLY TRENCH



JOINT TRENCH



Conduit

Conduit placed for AT&T must be for its exclusive use. AT&T will not occupy the same conduit with other utilities or foreign cable/communication systems. AT&T may refuse to occupy conduit that deviates from our plans and specifications. Electrical four inch (4") conduit is never acceptable for AT&T use.

The developer is responsible for repairing or resolving any problems with the conduit they have installed that prevents AT&T from pulling its cable through the conduit using normal installation methods. All conduit sections must be rodded, cleared, and roped prior to AT&T pulling in cable.

If the job calls for AT&T to provide the conduit material to the job site, the developer or his/her agent must be on site to sign for the delivery.

Material Requirements

1. Four inch (4") conduit must be type C plastic.
    - Minimum sweep for 4" conduit is three (3) ft 90 degree radius.
    - Maximum number of 90 degree bends not to exceed 2 (two), unless otherwise specified by AT&T Engineer.
    - Three-eighth inch (3/8") minimum polypropylene pull line or equivalent strength Polyester Woven Mule Tape must be installed in 4" terminated conduit end to end.
    - All terminated conduit must be measured, end to end, and the lengths included in the "As-Builts".

2. Two inch (2") conduit must be type PTS 66/DB 120 rigid plastic.
    - Minimum sweep for 2" conduit is two (2) ft 90 degree radius.
    - Maximum of four (4) 90 degree bends for service connections that exceed 200'.
    - Three-sixteenth inch (3/16") or larger, polypropylene pull line or equivalent strength Polyester Woven Mule Tape must be installed in 2" terminated conduit end to end.
    - All terminated conduit must be measured, end to end, and the lengths included in the "As-Builts".

3. One inch (1") conduit must be ABS-DB, Schedule 40 or equivalent.
    - Three-sixteenth inch (3/16") polypropylene rope or equivalent strength Polyester Woven Mule Tape must be installed in 1" terminated conduit end to end.

4. Conduit exposed to sunlight MUST be Schedule 40 or equivalent.

5. Only standard factory bends may be used, no field bending of conduit if radius is less than 80'.

6. Conduit placed on private property for service to the individual residence may <u>not</u> exceed two inch (2") diameter. NOTE: 1" conduit is only acceptable for service wire installations to single family units.

7. Two inch (2") conduit must be placed for service connections (from property line to residence) that exceed 200' in length. Plastic or polymer boxes ("water boxes") may be used with one inch (1") conduit for longer distances as long as the maximum pull between terminating points does not exceed 200' or have more than four (4) 90 degree bends.

8. All stubbed conduit must be capped.

9. If plastic or polymer boxes are used for service connection pulls on private property they must be 9" diameter x 10" for round boxes, or 10" wide x 15" long x 12' deep for square boxes.

Installation Requirements

1. Minimum trench coverage is detailed on page 4.

2. Boxes are to be ordered with the appropriate number of knockouts or terminators to accommodate the conduits (excluding 9" round or 11" "water boxes"). Service conduit (1"or 2") is to be terminated above distribution conduits (4") in the box to prevent water flowing from the box and down service conduit toward the building.

Boxes and Manholes

Material Specifications

All boxes and manholes placed by the developer that will be owned and maintained by AT&T must be NewBasis or Utility Vault. All approved boxes have an AT&T PID number.

1. The approved manufacturer for plastic or polymer boxes is NewBasis. Boxes installed for AT&T use that are 30" x 60" or smaller must be plastic or polymer. The main number for New Basis is 951-787-0600. They can also be contacted through their website at www.newbasis.com .

   9"Diameter x 10"D with gravel base
   10"x15"x12" with gravel base
   14"x20"x15" with gravel base
   17"x30"x24" with gravel base and side wall racking
   24"x36"x42" with comes with cable racking, need to pour concrete base.

   The following box comes with pulling eye kit and cable racking. A concrete base needs to be poured.
   30"x48"x32"

   The following box has racking, a pulling eye as well as integrated concrete base.
   30"x60"x36"

2. The approved manufacturer for concrete boxes and manholes is Utility Vault (Oldcastle). Contact information for Utility Vault's distribution centers is posted on their website at www.oldcastleprecast.com
   All Utility Vault boxes have racking and pulling eyes, as well as integrated concrete base.

   36"x60"x48"
   48"x78"x48"
   4.5'x8.5'x6.5'
   6'x12'x7'

Installation Specifications for Boxes

1. All boxes must be placed in areas outside of vehicular traffic. Manholes will be specified by AT&T if protected areas are not available.

2. Placement of boxes and manholes must allow for the final grade of new sidewalk and parkways.

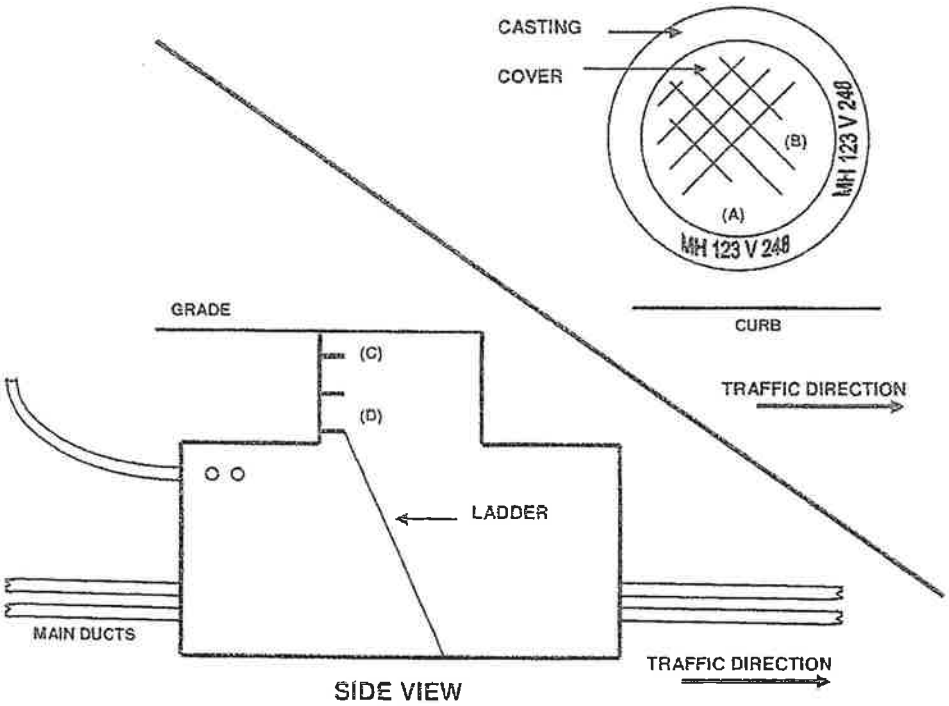
3. A minimum of six inches (6") of compacted sand, graded level is required under all hand holes and splice boxes. Six inches (6") of gravel, drain rock or base rock is required for manholes.

4. Conduit must terminate at the end wall or side wall in a terminator or knockout as specified by the AT&T Engineer. Entry through the bottom is never acceptable.

5. All conduits entering knockouts in a plastic or polymer box must be cut within one inch (1") flush with the inside of the wall and sealed. All joints must be mortared and all unused ports and openings sealed. Use cement mortar, water plug cement or other approved prepared mortars.

Installation Specifications for Manholes

1. Conduits must be terminated in the manufactured terminators only. Main conduits must be placed in lower terminators first. From each terminator, a minimum of 5' of straight conduit is required (no bends). Manholes are not to be cored without prior AT&T approval.
2. Manhole number (MH #123) and volume (v 248) must be stenciled with a ½" die stamp on the frame casting (not cover). If the stenciling can be read from the curb then stamp at position (A) as shown on the diagram below. If not, then stamp at position (B) when facing the oncoming traffic.
3. Steps and ladder must face oncoming traffic. Steps: First step 6"- 17" from grade to step (C). All other steps 12" separation from each other (D). All steps must be concreted in place and extended 6" from MH wall.
4. Cover from grade to MH roof must be a minimum of 24" and a maximum of 60", unless otherwise indicated by the AT&T engineer.
5. Neck of MH (extension) must be painted with white latex paint after joints are mortared.
6. Floor of MH must be level.



Service Cabinets, Bonding and Grounding

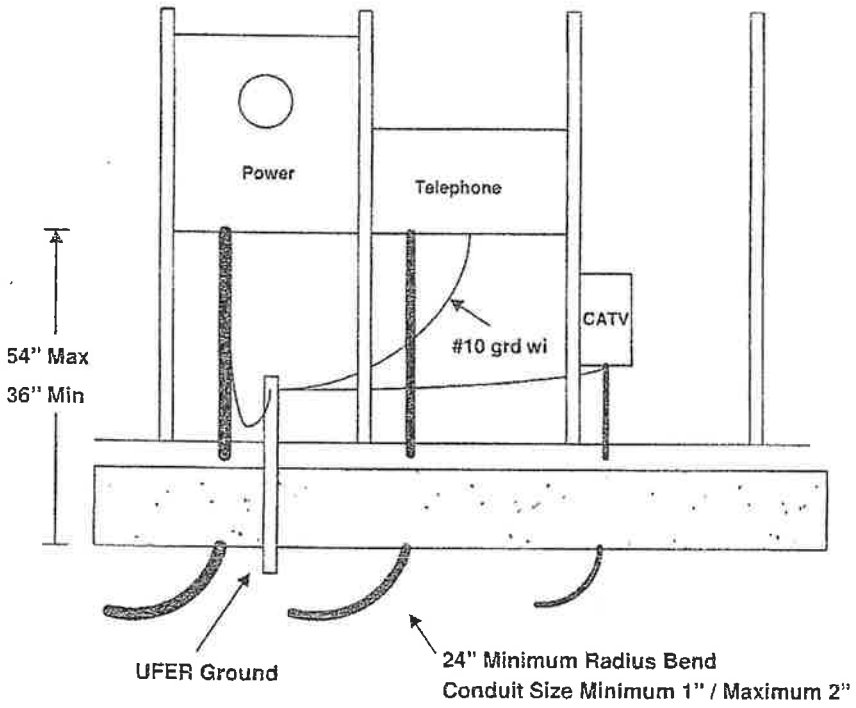
All service cabinets, bonding and grounding requirements must meet the National Electrical Code. The list of requirements and diagram below provide the minimum specifications accepted by AT&T for residential use.

- 20 Gauge Steel Weatherproof UL Listed Cabinet
  Must meet the following UL 50 Standard for Safety Criteria:
  Edge Requirements, Number 1 or 2 for Interior Use, Number 3 R for Exterior Use, Protection Against Corrosion, Overlap Requirements
- Minimum 11 ¼ " H X 14" W X 4" D (Less Mounting Flange)
- Equipped With ½" Plywood Backboard
- Allow 3' Minimum Clearance In Front Of Cabinet

Grounding Options Are Listed In Order of AT&T Preference:

1. UFER Bar Extended Maximum 1" Into Telco Cabinet
2. #10 Ground Wire From UFER To Telco Cabinet

3. Conduit From UFER To Telco Cabinet For Ground Wire Placement
4. Without electrical service, bond to a driven ground rod that is a minimum of 12.7 mm (0.50 in) in diameter and 1.5m (5 ft) long.



SAFETY PLEDGE

I ALWAYS PUT SAFETY FIRST.
I LOOK FOR AND ACT TO RESOLVE UNSAFE SITUATIONS.
I HELP AND ENCOURAGE OTHERS TO ACT SAFELY.

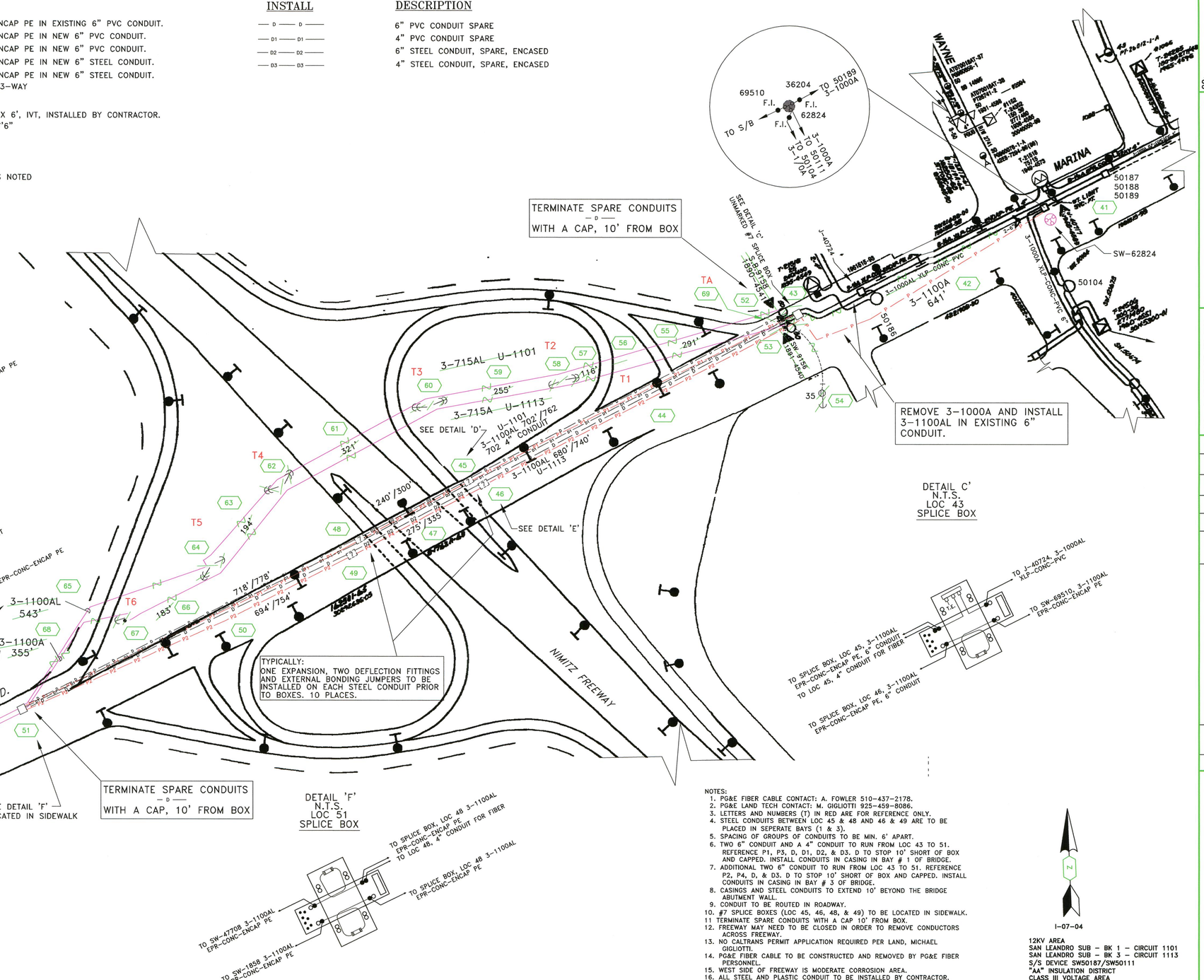
LEGEND

INSTALL	DESCRIPTION
P — P	3-1100AL 25kV EPR-CONC-ENCAP PE IN EXISTING 6" PVC CONDUIT.
P1 — P1	3-1100AL 25kV EPR-CONC-ENCAP PE IN NEW 6" PVC CONDUIT.
P2 — P2	3-1100AL 25kV EPR-CONC-ENCAP PE IN NEW 6" PVC CONDUIT.
P3 — P3	3-1100AL 25kV EPR-CONC-ENCAP PE IN NEW 6" STEEL CONDUIT.
P4 — P4	3-1100AL 25kV EPR-CONC-ENCAP PE IN NEW 6" STEEL CONDUIT.
	SW, 600A, SS, 23kV, 3-WAY 3-WAY
[?]	FAULT INDICATOR
	#7 SPLICE BOX, 4'6" X 8'6" X 6', IVT, INSTALLED BY CONTRACTOR. EXCAVATE 6'6" X 10'6" X 7'6"

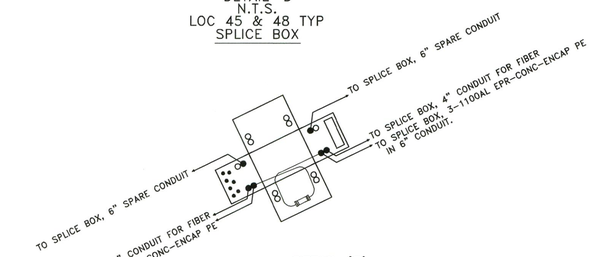
INSTALL	DESCRIPTION
D — D	6" PVC CONDUIT SPARE
D1 — D1	4" PVC CONDUIT SPARE
D2 — D2	6" STEEL CONDUIT, SPARE, ENCASED
D3 — D3	4" STEEL CONDUIT, SPARE, ENCASED

REMOVE	DESCRIPTION
	3-715AL 12kV UG CABLE
	POLE, WOOD, 55 FT, CLASS AS NOTED
	RISER 5"
	DISCONNECT 600A PT-57H
	ANCHOR, HELIX
	POLE, WOOD
	SPAN GUY

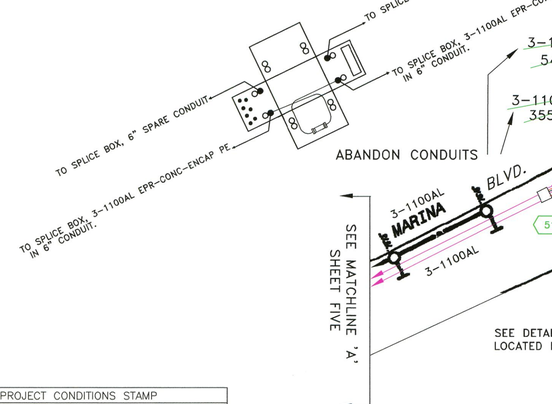
EXISTING	
	SPLICE BOX



DETAIL 'D'
N.T.S.
LOC 45 & 48 TYP
SPLICE BOX



DETAIL 'E'
N.T.S.
LOC 46 & 49 TYP
SPLICE BOX



DETAIL 'F'
N.T.S.
LOC 51
SPLICE BOX

DETAIL C'
N.T.S.
LOC 43
SPLICE BOX

NOTES:
1. PG&E FIBER CABLE CONTACT: A. FOWLER 510-437-2178.
2. PG&E LAND TECH CONTACT: M. GIGLIOTTI 925-459-8086.
3. LETTERS AND NUMBERS (?) IN RED ARE FOR REFERENCE ONLY.
4. STEEL CONDUITS BETWEEN LOC 45 & 48 AND 46 & 49 ARE TO BE PLACED IN SEPERATE BAYS (1 & 3).
5. SPACING OF GROUPS OF CONDUITS TO BE MIN. 6' APART.
6. TWO 6" CONDUIT AND A 4" CONDUIT TO RUN FROM LOC 43 TO 51. REFERENCE P1, P3, D, D1, D2, & D3. D TO STOP 10' SHORT OF BOX AND CAPPED. INSTALL CONDUITS IN CASING IN BAY # 1 OF BRIDGE.
7. ADDITIONAL TWO 6" CONDUIT TO RUN FROM LOC 43 TO 51. REFERENCE P2, P4, D, & D3. D TO STOP 10' SHORT OF BOX AND CAPPED. INSTALL CONDUITS IN CASING IN BAY # 3 OF BRIDGE.
8. CASINGS AND STEEL CONDUITS TO EXTEND 10' BEYOND THE BRIDGE ABUTMENT WALL.
9. CONDUIT TO BE ROUTED IN ROADWAY.
10. #7 SPLICE BOXES (LOC 45, 46, 48, & 49) TO BE LOCATED IN SIDEWALK.
11 TERMINATE SPARE CONDUITS WITH A CAP 10' FROM BOX.
12. FREEWAY MAY NEED TO BE CLOSED IN ORDER TO REMOVE CONDUCTORS ACROSS FREEWAY.
13. NO CALTRANS PERMIT APPLICATION REQUIRED PER LAND, MICHAEL GIGLIOTTI.
14. PG&E FIBER CABLE TO BE CONSTRUCTED AND REMOVED BY PG&E FIBER PERSONNEL.
15. WEST SIDE OF FREEWAY IS MODERATE CORROSION AREA.
16. ALL STEEL AND PLASTIC CONDUIT TO BE INSTALLED BY CONTRACTOR.

I-07-04

12KV AREA
SAN LEANDRO SUB – BK 1 – CIRCUIT 1101
SAN LEANDRO SUB – BK 3 – CIRCUIT 1113
S/S DEVICE SW50187/SW50111
"AA" INSULATION DISTRICT
CLASS III VOLTAGE AREA
THOMAS BROS. 690-J3 (2006)

PROJECT CONDITIONS STAMP
Type(s) of Work:
☐ New Business
☒ PG&E Maintenance & Construction
Project Conditions:
☒ NONE APPARENT (if project design changes, contact ADE)
or
☐ CONDITIONS APPLY:
☐ PERMITS ☐ TAILBOARD ☐ OTHER
(Provide additional information on line below)
BY: MJG6 12-01-2010
SIGNATURE, NAME, [CORPORATE ID], DATE

NOTIFIED U.S.A.
DATE:
TICKET #
BY:

UG CONSTRUCTION DWG.
HWY 880 & MARINA BLVD.
SAN LEANDRO

NO.	DATE	DESCRIPTION	ORDER #	DWN	CHKD	SUPV	APVD	BY
		REVISIONS						

EST: G. LE COZE 925-270-2218
ADE: M. STRAHM 925-270-2297
SUPV: E. GILLEN 925-270-2254
REP: R. KENNEDY 925-674-6330
PLNR: L. BAEZ 408-725-2005
SCALE: N/A DATE: 01-04-2011

ENGINEERING AND PLANNING DEPT.
1850 GATEWAY BLVD. 6070D
CONCORD, CA 94520
PHONE #:925-270-2218 FAX #:925-459-7323
PG&E PACIFIC GAS AND ELECTRIC COMPANY

CO:
SD:
NOTIF.: 104614513
Other: 100
SHT: 7 OF 7 SHEETS
PM: 30769867 REV. –

SERVICE OF SAFETY

SAFETY PLEDGE

I ALWAYS PUT SAFETY FIRST.
I LOOK FOR AND ACT TO RESOLVE UNSAFE SITUATIONS.
I HELP AND ENCOURAGE OTHERS TO ACT SAFELY.

PG&E

LEGEND

EXISTING

DESCRIPTION
6" CONDUIT
3-4/0CU
1/0A TPX XLP 600V
2-4/0CU
JOINT POLE
TX, SIZE AS INDICATED, 120/240V 1ø

INSTALL

DESCRIPTION
13" X 24" X 18", # 1 BOX
3' X 5' X3'6", # 5 BOX
4'6" X 8'6" X 6'0" # 7 INCIDENTAL BOX, EXCAVATE 6'6" X 10'6" X 7'6"
6" SPARE CONDUIT
6" SPARE CONDUIT
3-1100AL EPR-CONC-ENCAP-PE
3-397AL
2-1/0AL EPR-CONC-ENCAP-PE IN 4" CONDUIT
3-1/0AL EPR-CONC-ENCAP-PE
1/0AL XLP 600V TRIPLEX IN 2" CONDUIT
25kVA TX 12kV 240/480V 1ø PM
TX, AS INDICATED, 12kV 120/240V 1ø OH
SWITCH 3/3 WAY, SS
METER PEDESTAL
POLE, AS INDICATED
RISER
ANCHOR, SOLE
COMBO FUSE/DISC AS INDICATED
CUTOUT, FUSE SIZE AS INDICATED
SOLID BLADE DISCONNECT
FAULT INDICATOR
SUBSURFACE SWITCH-INTERRUPTER-SWITCH
SUBSURFACE FUSED SWITCH

REMOVE

DESCRIPTION
3-4/0CU
3-397AL
3-700AL XLP-CONC-PVC
POLE, AS INDICATED
AS INDICATED TX 12kV 120/240V 1ø, OH
10kVA TX 12kV 240/480V 1ø OH

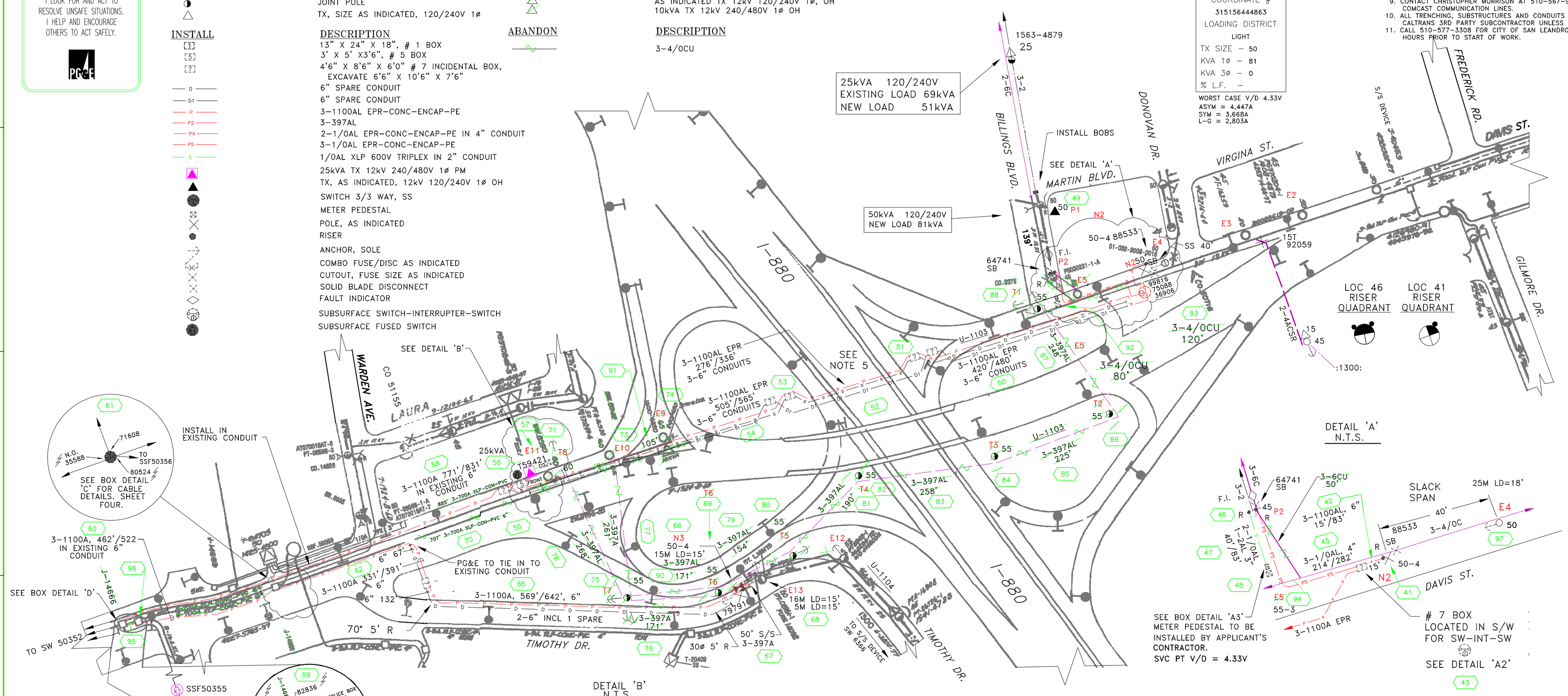
ABANDON

DESCRIPTION
3-4/0CU

14. REMOVE FOLLOWINGS SERVICES FROM TX AT CGC 315156344879 AND RE-ASSIGN TO NEW TX AT CGC 315156444863:
    1150 BILLINGS BLVD SAN LEANDRO
    1176 BILLINGS BLVD SAN LEANDRO
    1192 BILLINGS BLVD SAN LEANDRO
    1193 BILLINGS BLVD SAN LEANDRO
    1175 BILLINGS BLVD SAN LEANDRO
    NEW PEDESTAL METER DAVIS ST SAN LEANDRO
15. PG&E TO REROUTE EXISTING CONDUIT TO NEW #7 BOX AT LOC 55.

12. CALL 510-784-3317 FOR THE PG&E INSPECTION DESK TO ARRANGE FOR PG&E INSPECTIONS.
13. REFER TO PG&E GREEN BOOK, S5453, EXHIBIT B, FOR JOINT TRENCH CONFIGURATION & OCCUPANCY GUIDE.

NOTES:
1. WEST SIDE OF FREEWAY IS MODERATE CORROSION AREA.
2. E #'s DESIGNATED EXISTING POLE LOCATIONS.
3. T #'S DESIGNATED TEMPORARY POLE LOCATIONS.
4. N #'S DESIGNATED NEW POLE LOCATIONS.
5. NEW 1103 CIRCUIT TO GO THRU NEW OVERPASS AND BE IN STEEL CONDUIT (200') IN OVERPASS WITH EXPANSION JOINTS.
6. INSTALL DEFLECTORS AND EXPANSION FITTINGS ON ALL CONDUITS ON EITHER SIDE OF OVERPASS.
7. LINE P AND D ARE IN SAME TRENCH.
8. LINE D1 LOCATED IN TRENCH 6' FROM LINE P AND D TRENCH.
9. CONTACT CHRISTOPHER MORRISON AT 510-567-9211 FOR REMOVAL OF COMCAST COMMUNICATION LINES.
10. ALL TRENCHING, SUBSTRUCTURES AND CONDUITS TO BE INSTALLED BY CALTRANS 3RD PARTY SUBCONTRACTOR UNLESS NOTED DIFFERENTLY.
11. CALL 510-577-3308 FOR CITY OF SAN LEANDRO INSPECTION 24 HOURS PRIOR TO START OF WORK.



NOTIFIED U.S.A.
DATE:
TICKET #
BY:

PROJECT CONDITIONS STAMP
Type(s) of Work:
☐ New Business
☒ PG&E Maintenance & Construction
Project Conditions:
☒ NONE APPARENT (if project design changes, contact ADE) or
☐ CONDITIONS APPLY:
☐ PERMITS ☐ TAILBOARD ☐ OTHER (Provide additional information on line below)
BY: MJG6 12/1/2010
SIGNATURE, NAME, [CORPORATE ID], DATE

COORDINATE # 315146244792
LOADING DISTRICT
LIGHT
TX SIZE – 25
KVA 1ø – 3
KVA 3ø – 0
% L.F. –
240/480V

95 = REMOVE 15' 3-700 XLP-CONC-PVC 6"
INSTALL 75' 3-1100AL EPR-CONC-ENCAP-PE

CABLE/CONDUIT PULL DATA

LOC FROM	LOC TO	TENSION	GRIP/COND
43	51	1370	GRIP
46	43	139	GRIP
51	53	922	GRIP
53	55	1583	GRIP
55	59	2305	COND
96	61	1412	GRIP
61	62	931	GRIP
64	62	411	GRIP
66	62	431	GRIP

LOC'S #'S NOT USED

39, 40, 44, 63, 64, 72, 89

MINIMUM BEND RADIUS

CONDUIT DIA	VERT RADIUS	HORZ
2"	24"	36"
4"	36"	36"
6"	36	60"

DISTRIBUTION POLE #'S

#	POLE #
E3	110143924
E4	110143923
E5	110143922
E6	110143921
E7	110128751
E8	110114020
E9	110114021
E10	110114022
E11	110114023
E12	110114136
E13	110114135
T1	NEW TEMP POLE
T2	TEMP POLE
T3	TEMP POLE
T4	TEMP POLE
T5	TEMP POLE
T6	TEMP POLE
T7	TEMP POLE
T8	TEMP POLE
N2	NEW POLE
N3	NEW POLE
P1	110143904
P2	110143903

H-07-22/23

12KV AREA
SAN LEANDRO SUB – BK 1 – CIRCUIT 1103
SAN LEANDRO SUB – BK 1 – CIRCUIT 1104
S/S DEVICE SW40653 ON 1103
S/S DEVICE SW6366 ON 1104
"A" INSULATION DISTRICT
CLASS III VOLTAGE AREA
THOMAS BROS. 690-H2 (2006)

SEE SHEET FOUR FOR BOX DETAILS

CONSTRUCTION DWG.
HWY 880 & DAVIS ST.
SAN LEANDRO

NO.	DATE	DESCRIPTION	ORDER #	DWN	CHKD	SUPV	APVD	BY

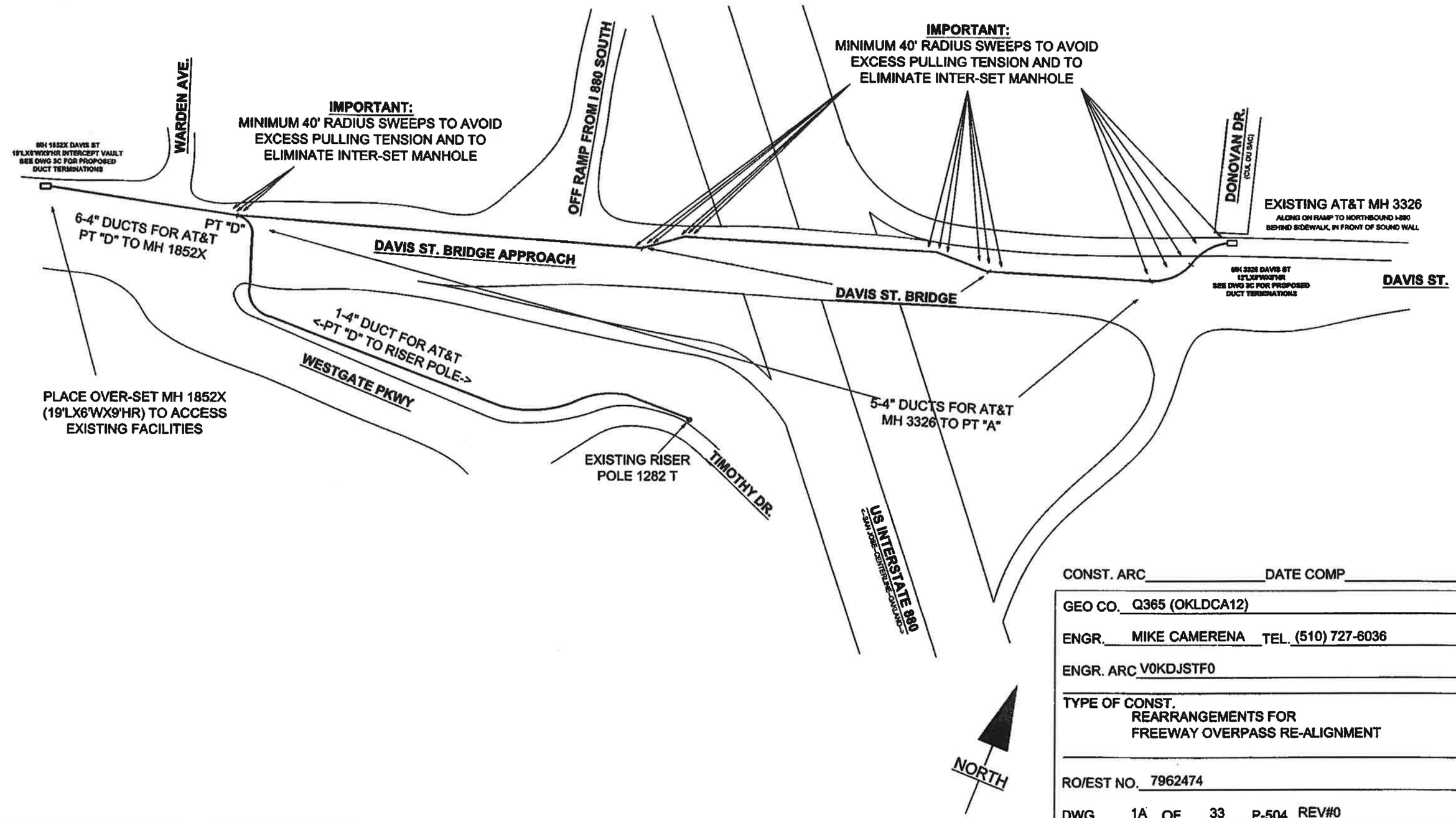
REVISIONS

EST: G. LE COZE 925-270-2218
ADE: W. STRAHM 925-270-2297
SUPV: E. GILLEN 925-270-2254
REP: W. KENNEDY 925-674-6350
PLNR: I. BAEZ 408-725-2005
SCALE: N/A DATE: 08-11-2011

CO:
SD:
NOTIF.: 104593905
Other: 10Q
SHT: 2 OF 4 SHEETS
PM: 30769865 REV. -

ENGINEERING AND PLANNING DEPT.
1850 GATEWAY BLVD. 6070D
CONCORD, CA 94520
PHONE #:925-270-2218 FAX #:925-459-7323
PG&E PACIFIC GAS AND ELECTRIC COMPANY

ISSUE	DATE
REL#0	9/11



CONST. ARC_____ DATE COMP_____

GEO CO. Q365 (OKLDCA12)

ENGR. MIKE CAMERENA TEL. (510) 727-6036

ENGR. ARC V0KDJSTF0

TYPE OF CONST.
REARRANGEMENTS FOR
FREEWAY OVERPASS RE-ALIGNMENT

RO/EST NO. 7962474

DWG 1A OF 33 P-504 REV#0

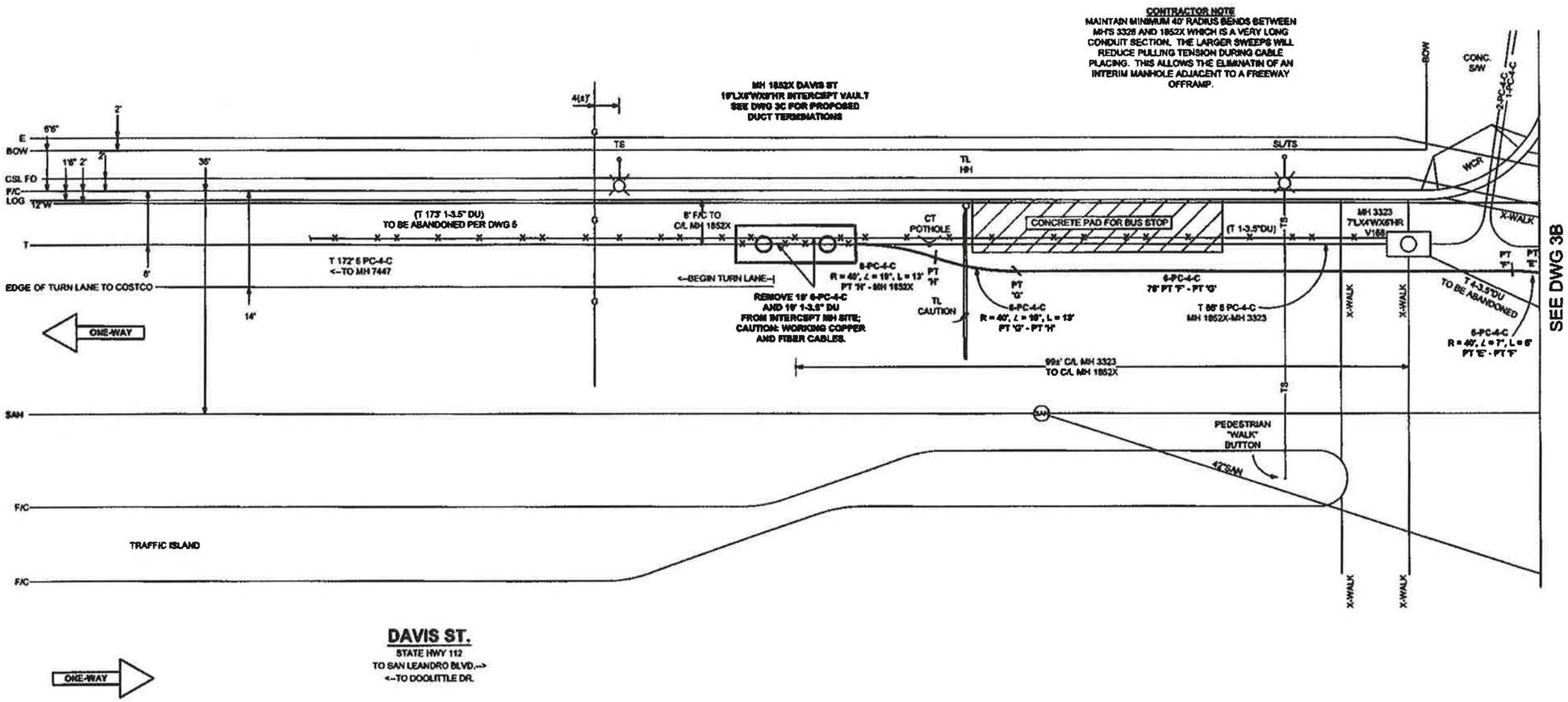
CALTRANS DISTRICT 4
ALAMEDA COUNTY
ROUTE 112 POST MILE 0.4

-->CALL USA<--
TWO WORKING DAYS
BEFORE YOU DIG:
811 OR 800 227 2600

at&t

ISSUE	DATE
REL#0	9/11

CALTRANS PERMITS REQUIRED



ABBREVIATIONS & DESCRIPTIONS:

ABBREVIATION	DESCRIPTION
BOW	BACK OF SIDEWALK
CB	CATCH BASIN
COMM	COMMUNICATIONS
CT	CALTRANS
DU	DUCT(S)
DWY	DRIVEWAY
E	ELECTRIC
EOP	EDGE OF PAVEMENT
FC	FACE OF CURB
FOW	FRONT OF WALK
G	GAS
HH	HH
JT	JOINT TRENCH
LOG	LIP OF GUTTER
JB	JUNCTION BOX
MH	MH
OS	OFFSET
P	POLE
PED	PEDESTAL
PL	PROPERTY LINE
ROW	RIGHT OF WAY
SAN	SANITARY SEWER
SB	SERVICE BOX
SD	STORM DRAIN
SIG	SIGNAL
SL	STREET LIGHT
STS	STREET SIGN
T	TELEPHONE--AT&T
TL	TRAFFIC LOOP
TS	TRAFFIC SIGNAL
TS SL	TRAFFIC SIGNAL & STREET LIGHT
UNK	UNKNOWN
W	WATER
WM	WATER METER HH
WCR	WHEEL CHAIR RAMP
XW	CROSS-WALK

NORTH

0' 10' 20'
SCALE: 1" = 20'

CONST. ARC_____ DATE COMP_____

GEO CO. Q365 (OKLDCA12)

ENGR. MIKE CAMERENA TEL. (510) 727-6036

ENGR. ARC V0KDJSTF0

TYPE OF CONST.
REARRANGEMENTS FOR
FREEWAY OVERPASS RE-ALIGNMENT

RO/EST NO. 7962474

DWG 3A OF 33 P-504 REV#0

CALTRANS DISTRICT 4
ALAMEDA COUNTY
ROUTE 112 POST MILE 0.4

–>CALL USA<–
TWO WORKING DAYS
BEFORE YOU DIG:
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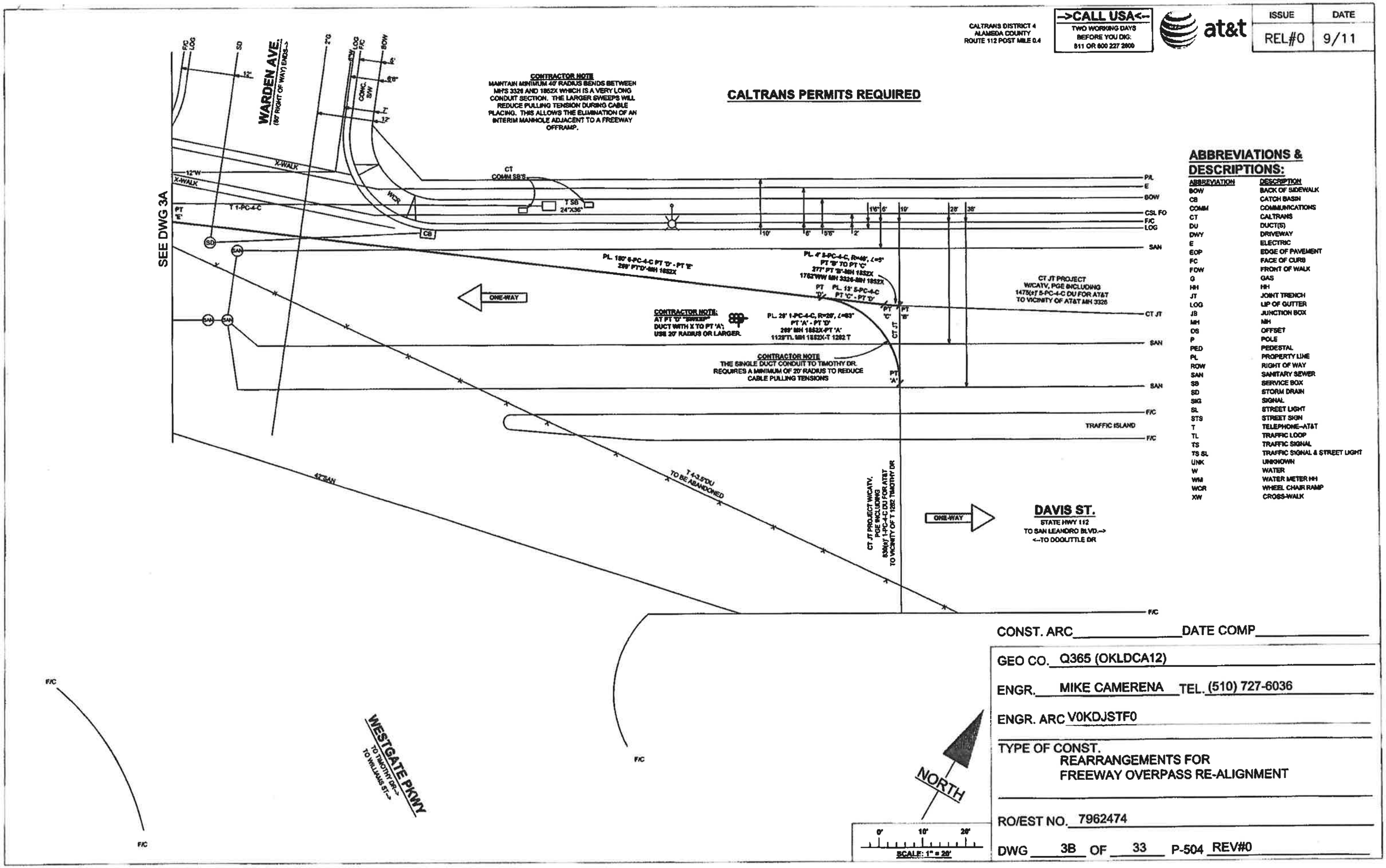

ABBREVIATIONS & DESCRIPTIONS:

ABBREVIATION	DESCRIPTION
BOW	BACK OF SIDEWALK
CB	CATCH BASIN
COMM	COMMUNICATIONS
CT	CALTRANS
DU	DUCT(S)
DWY	DRIVEWAY
E	ELECTRIC
EOP	EDGE OF PAVEMENT
FC	FACE OF CURB
FOW	FRONT OF WALK
G	GAS
HH	HH
JT	JOINT TRENCH
LOG	LIP OF GUTTER
JB	JUNCTION BOX
MH	MH
OS	OFFSET
P	POLE
PED	PEDESTAL
PL	PROPERTY LINE
ROW	RIGHT OF WAY
SAN	SANITARY SEWER
SB	SERVICE BOX
SD	STORM DRAIN
SIG	SIGNAL
SL	STREET LIGHT
STS	STREET SIGN
T	TELEPHONE–AT&T
TL	TRAFFIC LOOP
TS	TRAFFIC SIGNAL
TS SL	TRAFFIC SIGNAL & STREET LIGHT
UNK	UNKNOWN
W	WATER
WM	WATER METER HH
WCR	WHEEL CHAIR RAMP
XW	CROSS-WALK

CONST. ARC_____ DATE COMP_____

GEO CO. Q365 (OKLDCA12)

ENGR. MIKE CAMERENA TEL. (510) 727-6036

ENGR. ARC V0KDJSTF0

TYPE OF CONST.
REARRANGEMENTS FOR
FREEWAY OVERPASS RE-ALIGNMENT

RO/EST NO. 7962474

DWG 3B OF 33 P-504 REV#0

CALTRANS DISTRICT 4
ALAMEDA COUNTY
ROUTE 112 POST MILE 0.4

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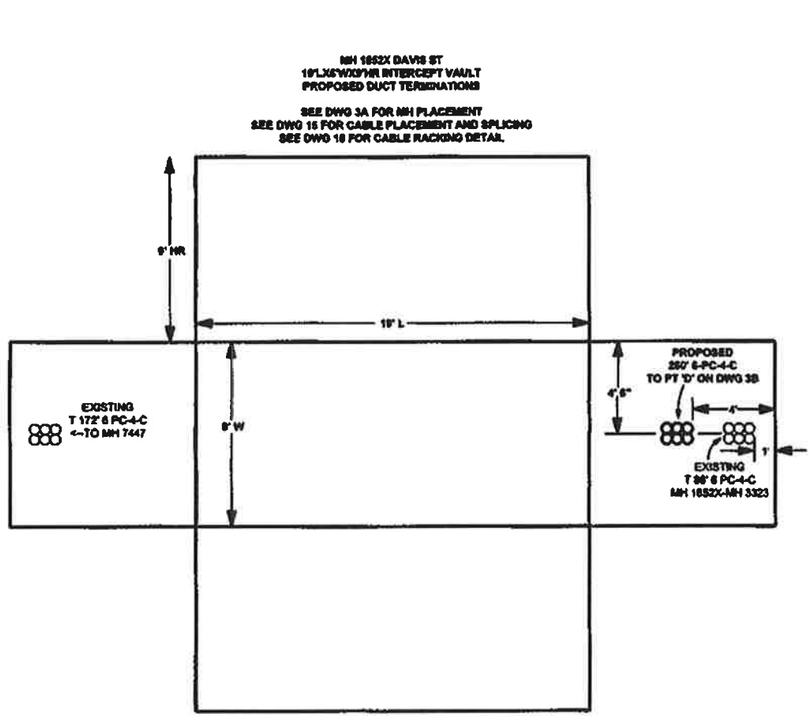

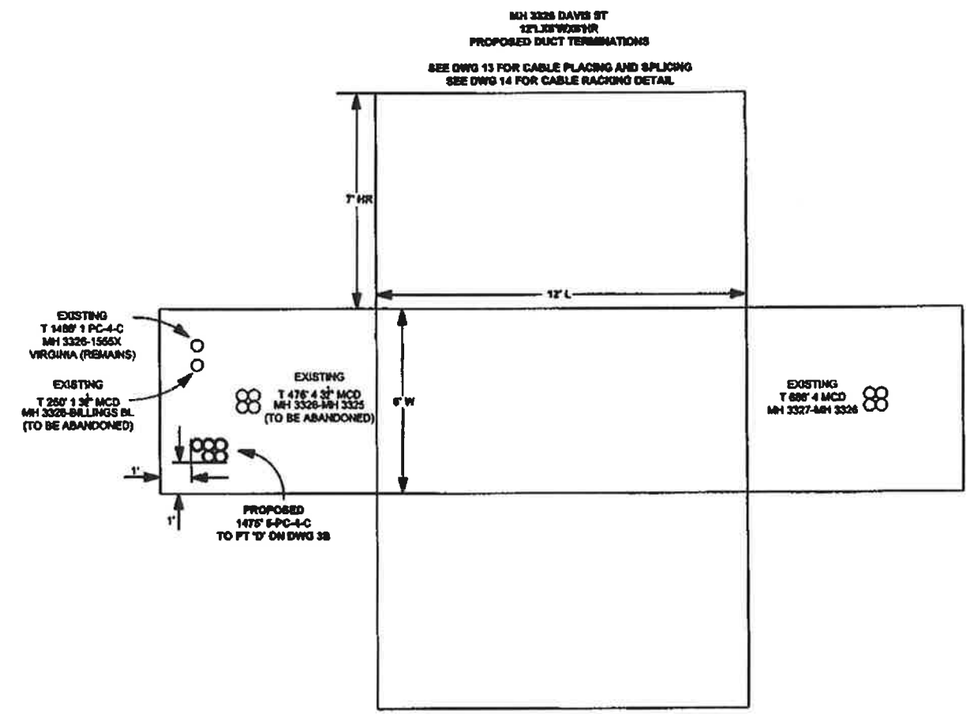

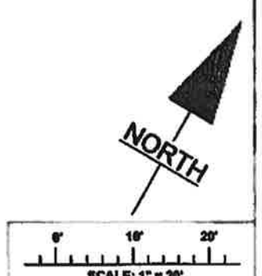

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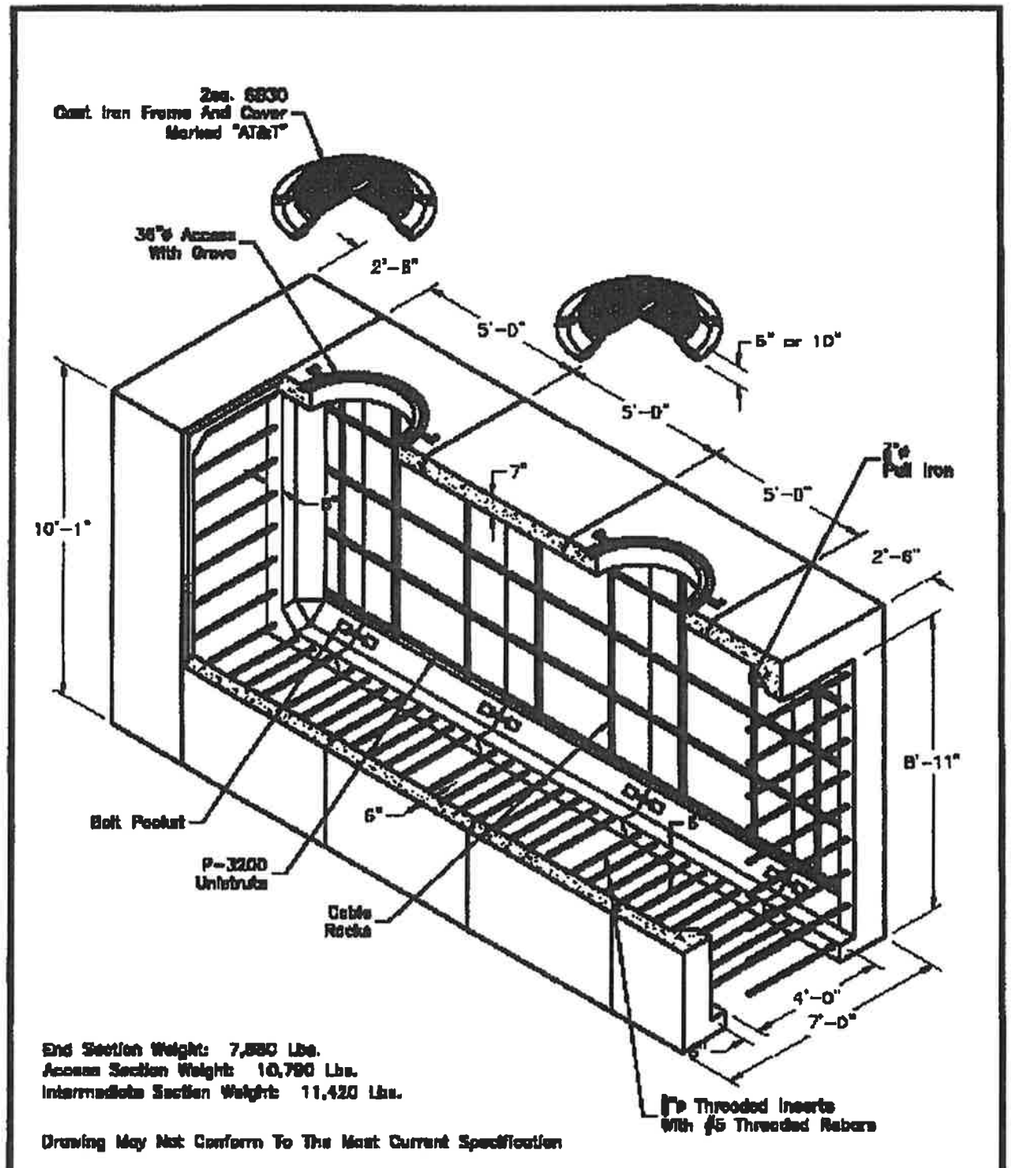

Oldcastle Precast
Utility Vault Division
3700 Valley Ave. Pleasanton California 94566
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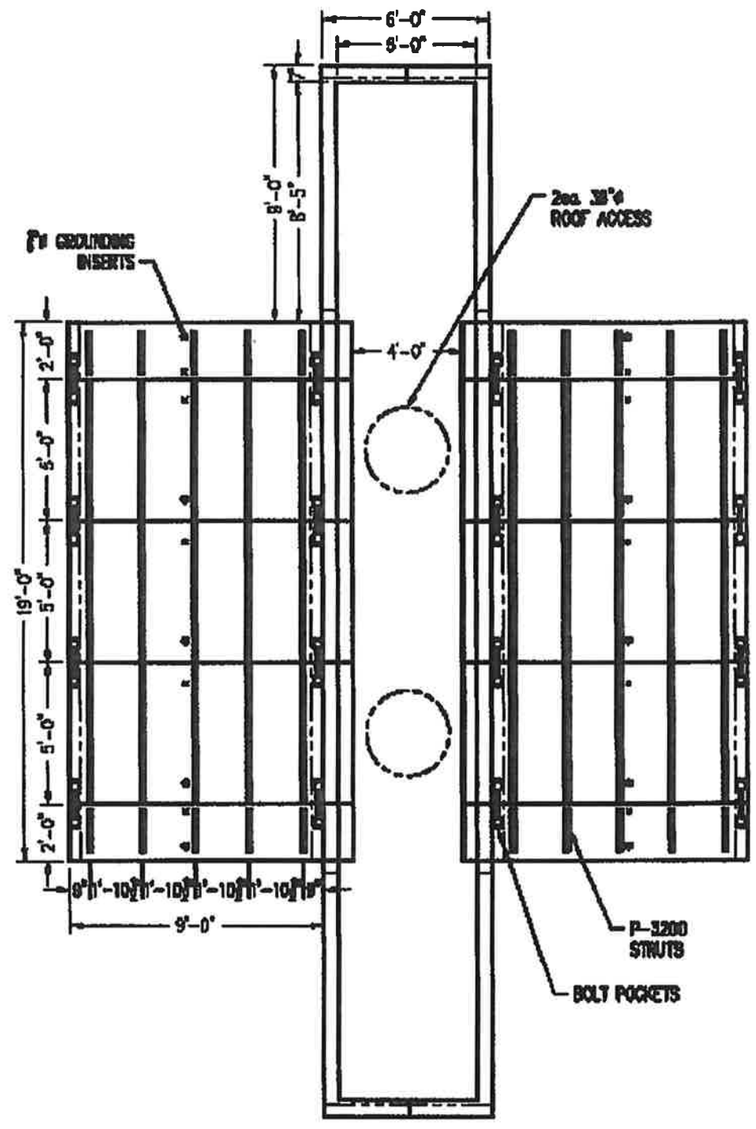

SCALE: Not To Scale

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MH CONFIGURATION FOR PROPOSED MH 1852X

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DWG 30 OF 33 P-504 REV#0