Appendix F

Structures Advance Planning Study

with Preliminary Design Geotechnical Report

PALOMAR GRADE SEPARATION PROJECT

ADVANCE PLANNING STUDY MEMO

- PALOMAR STREET UNDERPASS
- INDUSTRIAL BOULEVARD OVERCROSSING

Prepared by:

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HNTB

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PART A - DESIGN MEMO

Advanced Planning Study Memo – Palomar Grade Separation Project

1. Existing Conditions

The purpose of the proposed project is to remove the existing at-grade conflict between vehicular, pedestrian and bicycle traffic and rail traffic by constructing a grade separation on Palomar Street. The Project will reduce delay and provide a significant safety improvement. Industrial Boulevard intersects with Palomar street to the west of the MTS rail lines; and has a parallel alignment to the MTS rail lines in the Palomar Street area.

Along the rail corridor, MTS owns and operates daily trolley service. The corridor is used for freight rail traffic operations during off-peak transit times. Freight rail through the rail corridor is carried by the San Diego & Arizona Eastern (SD&AE) Railway, which is owned by MTS. The freight rail operator, under contract to SD&AE, is San Diego & Imperial Valley (SD&IV) Railroad.

2. Palomar Grade Separation – Palomar Street Underpass and Industrial Boulevard Overcrossing

2.1 Geometrics

The proposed bridges will carry the existing facilities along their current alignments. Both the MTS rail lines and Industrial Boulevard intersect Palomar Street at an approximately 25-deg skew.

The Palomar Street roadway typical section below both structures is 92-ft wide curb-to-curb. The median width under the bridge is proposed to be 10-ft in width to accommodate the rail bridge underpass columns and is offset to the south of the existing Palomar Street roadway centerline.

2.2 Clearances

The proposed railroad bridge, Palomar Street UC, will provide a minimum of 16'-6" vertical clearance over Palomar Street. The proposed roadway bridge, Industrial Boulevard OC, will provide a minimum of 16'-6" vertical clearance over Palomar Street.

2.3 Falsework Issues

Both structures are proposed to be constructed using a top-down excavation method, utilizing secant pile wall permanent shoring. The bridge superstructure types proposed are steel girders for the rail bridge, and prestressed-precast concrete girders for the roadway bridge; both of which do not require falsework.

2.4 Utilities

No utilities are currently proposed for the Palomar Street UC. Existing utilities in the area should be relocated prior to secant pile wall construction and roadway excavation. Relocated utilities will be placed in the Industrial Boulevard OC, including water, sewer (force main), communication, gas and electrical.

2.5 Aesthetics

Aesthetic treatment of the proposed bridge structures and retaining walls has not been determined at the time of this study; however nominal relief depth dimensions are provided for in the concrete fascia areas of the bridge barriers and retaining walls for the inclusion of architectural treatments.

2.6 Foundations

Preliminary foundation observations and recommendations in the Preliminary Design Geotechnical Report (PDGR), dated March 14, 2016 and included in Attachment 1, indicate that the bridge site is not located in a liquefaction zone. A deep foundation using cast-in-drilled-hole (CIDH) secant pile walls is proposed to allow top-down construction methods. These CIDH secant pile wall are proposed to support the new bridges at the abutments. In addition, the rail bridge is proposed to be supported on a center bent, utilizing Type 1 CIDH piles. The retaining walls adjacent to the structure are proposed to be CIDH secant pile walls as well, which serve as shoring for roadway excavation prior to construction of the final wall facing.

Excavation of the onsite soils is anticipated to be able to be performed using conventional heavy-duty earthwork equipment. The presence of gravel/cobble conglomerates may potentially impede excavation and drilling. Supplemental geotechnical field investigation to collect sufficient and appropriate information to characterize the subsurface soils and stratigraphy, as well as groundwater exploration will take place during the next phase of design.

2.7 Hazardous Materials

A limited Phase II site investigation was conducted and indicated the potential for hazardous materials along the rail corridor. Further investigations will be performed as part of PS&E phase of the project to better define the extent of hazardous materials.

2.8 Seismic Evaluation

A detailed seismic analysis will be performed during the final design phase in accordance with Caltrans Seismic Design Criteria (SDC) version 2.0.

2.9 Structure Staged Construction

Table 1 describes the sequential bridge construction stages. In all stages, 4 lanes of traffic will be maintained on Palomar Street, and 1 track will remain in operation throughout construction, aside for minor closures possible between stages of bridge construction.

Table 1 – Bridge Staged Construction

Project Stage	Track Phase	Bridge Construction Stage	Description	Activities
I	1		Install Shoring	•Shift roadway traffic to EB Palomar •Shift rail traffic to MT2 •Install shoring to retain MT2 •Install shoring to retain EB Palomar
		B1	Build NE quadrant of rail bridge	•Construct NE Abutment and Bent to support span 2 for MT1 •Install span 2 superstructure for MT1 and pedestrian walkway •Remove (portion of) shoring to top of bent cap on the south side of Bent 2 MT1 •Backfill up to south side of Bent 2
				•Install shoring for MT1, span 1 region •Shift rail traffic to MT1
	2			•Install shoring on the south side of Bent 2 MT2
		B2	Build NW quadrant of rail bridge	•Construct NW abutment and Bent to support span 2 for MT1 •Install span 2 superstructure for MT2
				•Build northerly abutment of road bridge •Construct walls along north side •Excavate & pave north side of Palomar.
III	3			•Shift roadway traffic to north side of Palomar on lowered side •Install Bent Cap closure pour and install remaining portion of span 2 superstructure
		B3	Build SW quadrant of rail bridge	•Construct SW abutment •Excavate between Bent 2 and south abutment •Remove shoring on the south side of Bent 2 MT2 •Install span 1 superstructure for MT2
				•Build southerly abutment of road bridge •Construct walls along south side •Shift rail traffic to MT2
	4	B4	Build SE quadrant of rail bridge	•Construct SE Abutment •Excavate between Bent 2 and south abutment •Remove shoring on the south side of Bent 2 MT1 •Install span 1 superstructure for MT1 and pedestrian walkway
				•Build southerly abutment of road bridge •Construct walls along south side •Excavate & pave south side of Palomar
III	5			•Open both tracks to operation •Build roadway superstructure

2.10 Cost

2.10.1 – Palomar Street UP

The total estimated cost of the railroad bridge is **$7,425,000** which does not include mobilization and contingency. The cost for the railroad bridge was estimated by assuming a baseline unit cost of approximately $15,000 per linear foot of track for a typical steel railroad bridge and adding an additional cost of $7,500 per linear foot of bridge length to capture the cost of the pedestrian walkway with substructure designed for a future third track.

Assumptions which modify the baseline unit-cost are:

- Palomar Street UP is 2-span, 132’ total length
- Palomar Street UP has complicated stage construction (4 stages and three track shifts) and is built with top down construction therefore, apply a multiplier of 1.5 to the cost for complexity

Given the above factors, a square-foot unit price was calculated to be $1025 per square foot, in present dollars.

2.10.2 – Industrial Boulevard OC

The total estimated cost of roadway bridge, Industrial Boulevard OC, is **$2,100,000** which does not include mobilization and contingency. The cost for the roadway bridge was estimated using Caltrans Comparative Bridge Cost Data, dated January 2017. Unit costs were adjusted for complexity, as well as escalated to present 2020 dollars.

Factors contributing to higher-end of unit-cost range are:

- Two construction stages
- Skewed Bridge

Factors contributing to lower-end of unit-cost range:

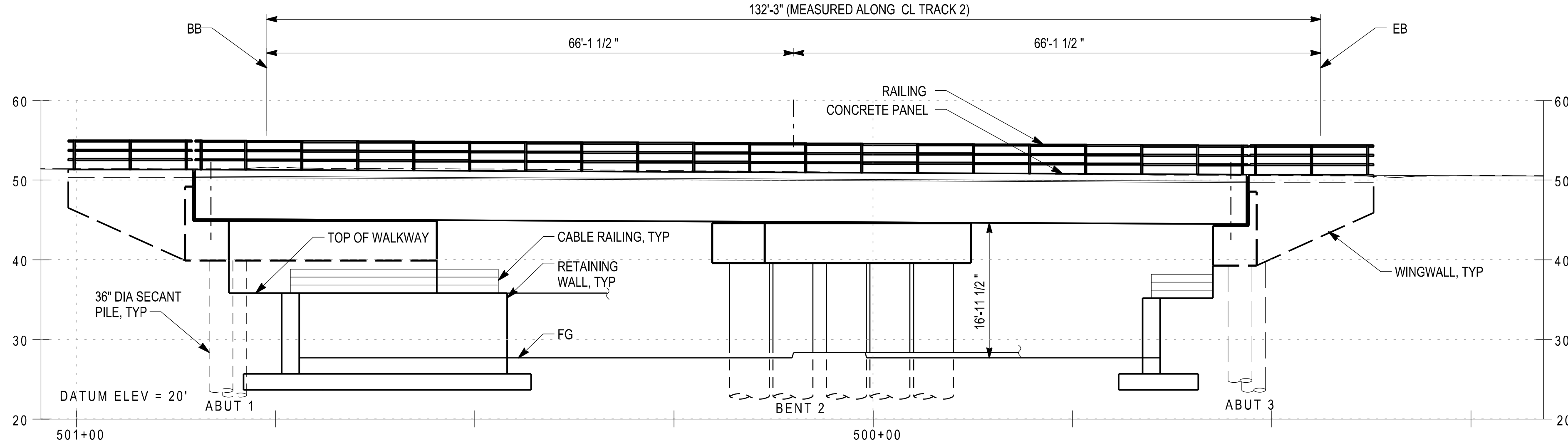
- Urban Location (Convenient freeway access to resources)
- Low Structure Height
- No Environmental Constraints

Given the above factors, a square-foot unit price was selected at the midpoint of the range, which equated to $280 per square foot, in present dollars.

PART B – BRIDGE APS GENERAL PLANS

XX% DESIGN — NOT FOR CONSTRUCTION

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3



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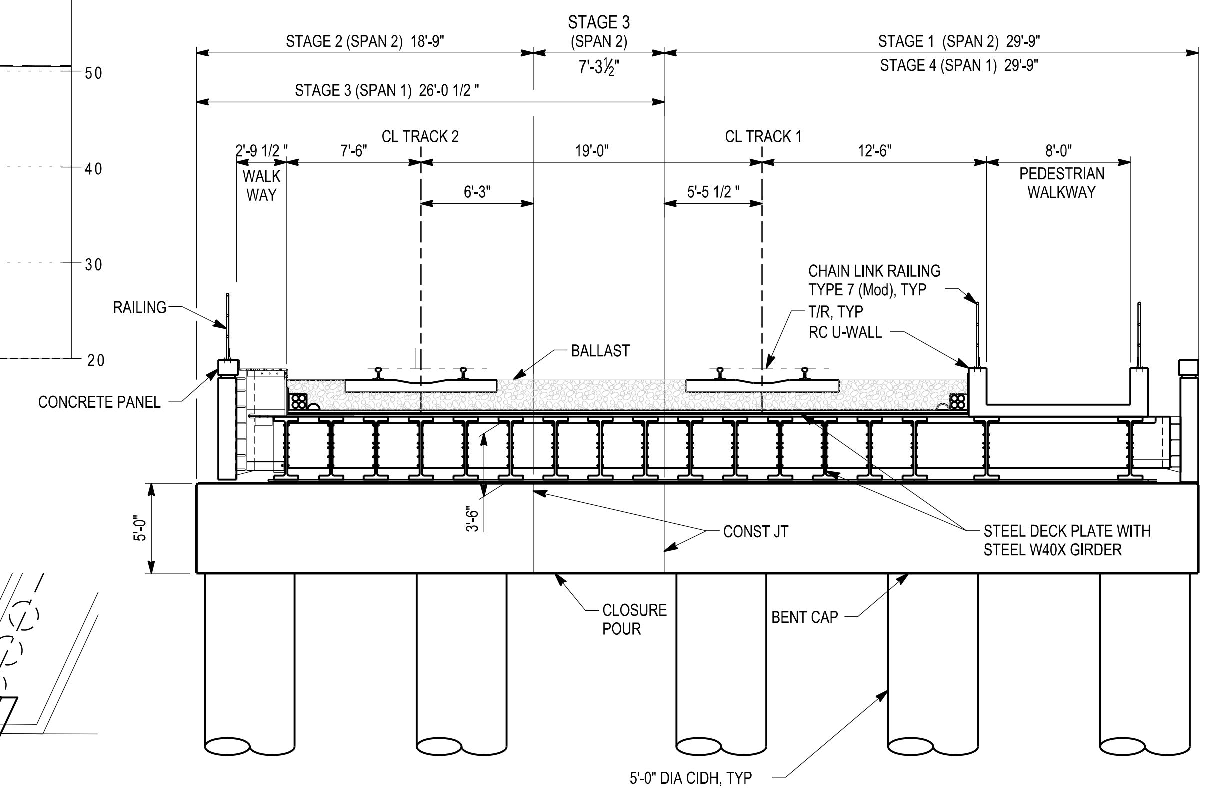

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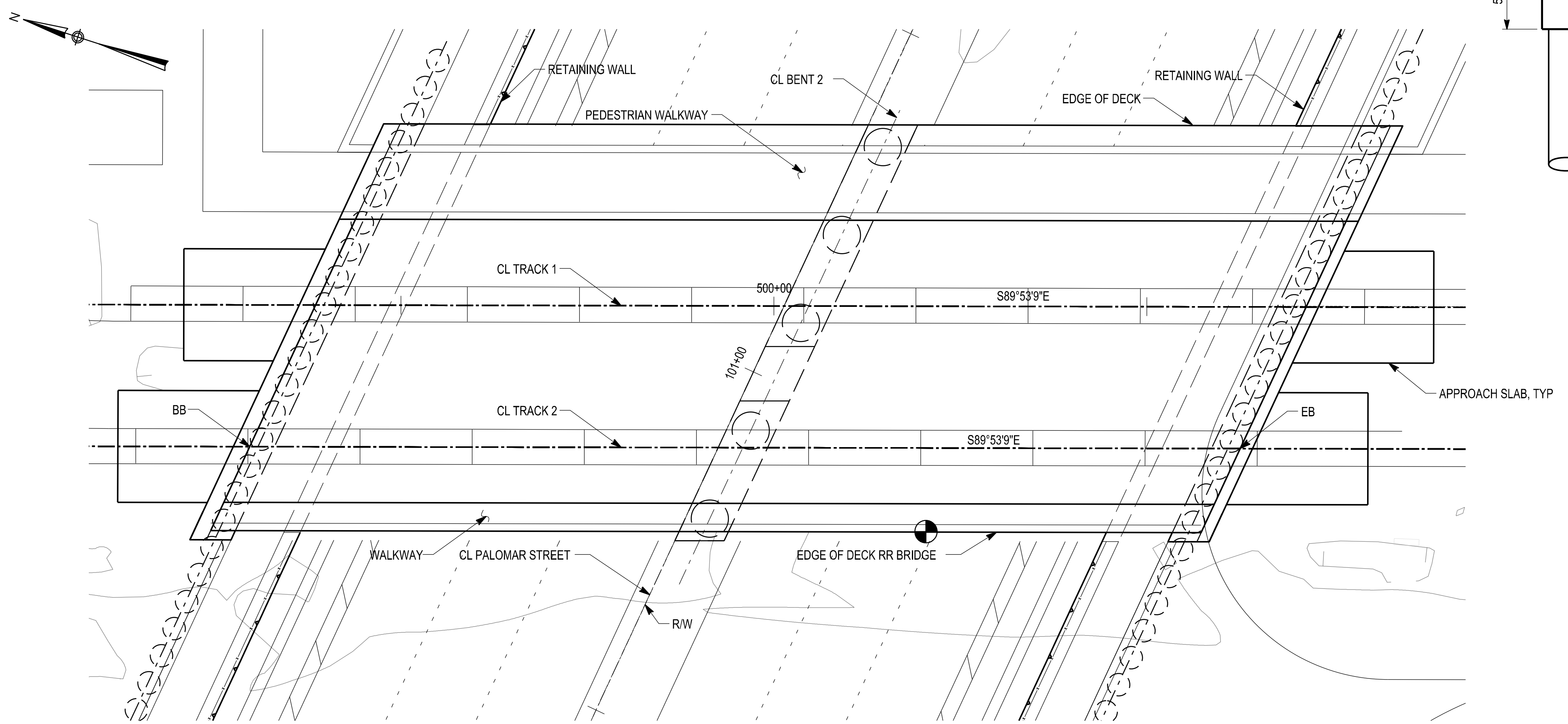


PLAN

1"=10'-0"

PLANNING STUDY

NO.	DATE	REVISIONS	BY	CHK	APRV

HNTB 401 B Street Suite 510 San Diego, CA 92101

DESIGNED BY P. PENCE | DATE
DRAWN BY L. KINGSBURY
CHECKED BY M. VAN DUYN
SANDAG T. DEWITT

SANDAG — MTS Metropolitan Transit System

CITY OF CHULA VISTA
PALOMAR STREET GRADE SEPARATION

PALOMAR STREET UNDERPASS
GENERAL PLAN

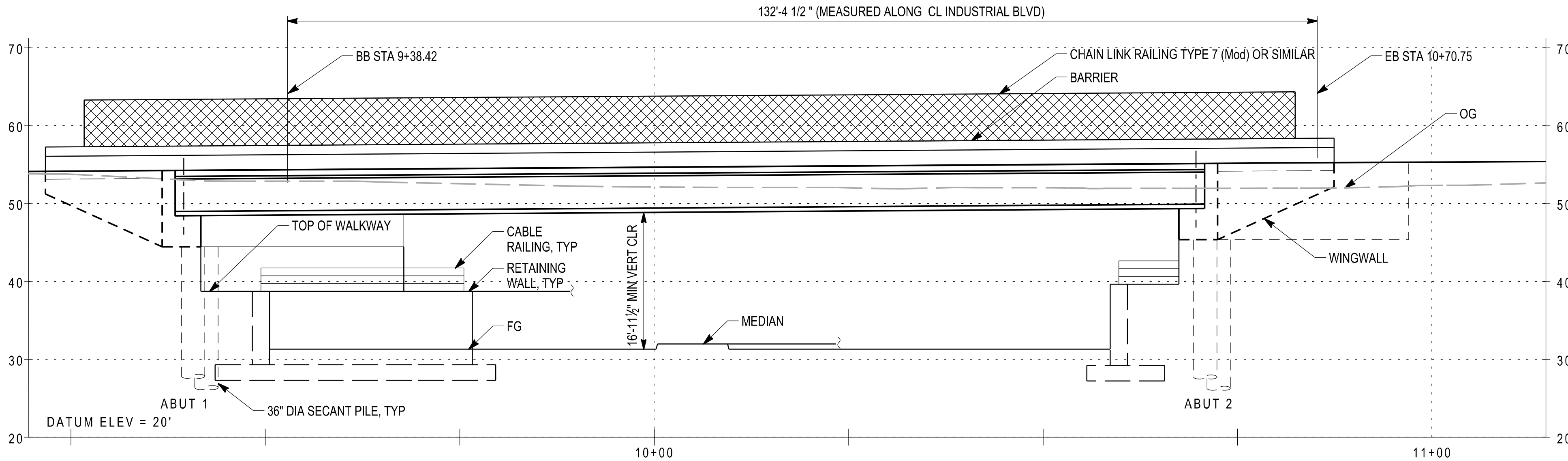
SCALE

SANDAG CONTRACT NO. XXXXXXX

DRAWING NO. | SHEET NO.

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES

XX% DESIGN — NOT FOR CONSTRUCTION



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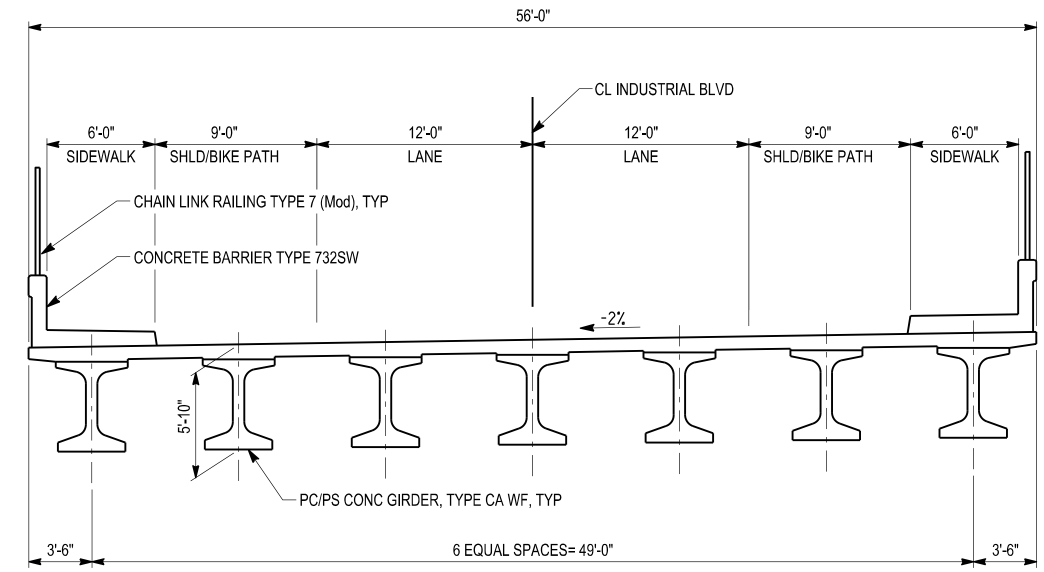
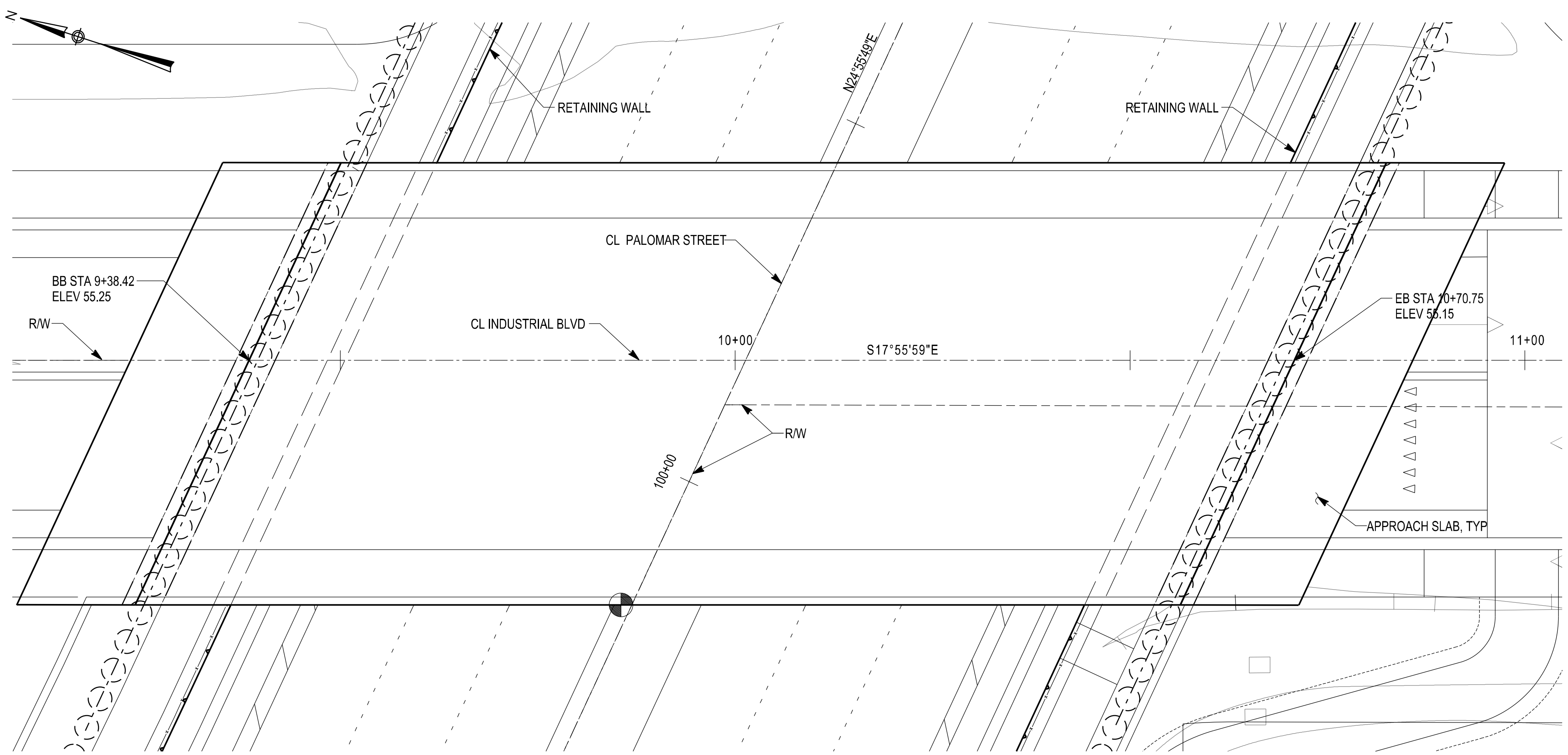


TYPICAL SECTION
3/16"=1'-0"

NOTE: UTILITIES NOT SHOWN



PLAN
1"=10'-0"

PLANNING STUDY

NO.	DATE	REVISIONS	BY	CHK	APRV

HNTB 401 B Street
Suite 510
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DESIGNED BY P. PENCE	DATE
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SANDAG

MTS Metropolitan Transit System

CITY OF CHULA VISTA
PALOMAR STREET GRADE SEPARATION

INDUSTRIAL BRIDGE CROSSING
GENERAL PLAN

SCALE

SANDAG CONTRACT NO.
XXXXXXX

DRAWING NO. | SHEET NO.

Attachment 1 – PRELIMINARY DESIGN GEOTECHNICAL REPORT

PRELIMINARY DESIGN GEOTECHNICAL REPORT
PALOMAR STREET GRADE SEPARATION
CHULA VISTA, CALIFORNIA

Prepared For

HNTB CORPORATION
401 B Street, Suite 510
San Diego, California 92101

Project No. 10147.006

March 14, 2016

Leighton Consulting, Inc.
A LEIGHTON GROUP COMPANY

HNTB CORPORATION
QUALITY CONTROL ACTIVITY SHEET (Level I Review)

Project No: 56445 Project Name: TO14 - Palomar Grade Separation

Reviewed Document Title: Preliminary Design Geotechnical Report, Palomar Street Grade Separation, Chula Vista, California

Project Phase	**Document Type**
___ Conceptual Design (%)	___ Design Criteria
✓ Preliminary Design (10%)	___ Design Computations
___ Final Design (%)	___ Technical Specifications
___ Construction (%)	___ Cost Estimate
___ Other ________	___ Plans
	✓ Technical
	___ Other ________

QC Activity	**Completed by**	**Signature**	**Date**
Originator	Chris Livesey	[signature]	3-11-16
Checked	Sean Colorado	[signature]	3/14/16
Back-checked	Mike Jensen	MJ	3-14-16
Corrected	Janet Storey	Janet Storey	3-14-16
Verified	Sean Colorado	[signature]	3/14/16

Leighton Consulting, Inc.
A LEIGHTON GROUP COMPANY

March 14, 2016

Project No. 10147.006

HNTB Corporation
401 B Street, Suite 510
San Diego, California 92101

Attention: Mr. Rob Colosimo

Subject: Preliminary Design Geotechnical Report
Palomar Street Grade Separation
Chula Vista, California

In accordance with your request and authorization, we have conducted a preliminary geotechnical study for the proposed Palomar Street grade separation project in the city of Chula Vista, California. The project is located along Palomar Street between Walnut Avenue and Broadway in the county of San Diego, California. The accompanying report presents a summary of our study and provides preliminary geotechnical conclusions and recommendations relative to the proposed grade separation project.

If you have any questions regarding our report, please do not hesitate to contact this office. We appreciate this opportunity to be of service.

Respectfully submitted,

LEIGHTON CONSULTING, INC.

PROFESSIONAL GEOLOGIST MICHAEL D. JENSEN NO. 2457 CERTIFIED ENGINEERING GEOLOGIST Exp. 7/31/16 STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER SEAN A. COLORADO No. 2507 Exp: 12/31/17 GEOTECHNICAL STATE OF CALIFORNIA

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1.0 INTRODUCTION

Leighton Consulting, Inc. has performed a preliminary geotechnical study along the proposed Palomar Street grade separation project approximately between Walnut Avenue and Broadway in Chula Vista, California (Figure 1). This study was prepared to support the preliminary design phase. This report presents a summary of our assessment of the general geotechnical conditions and geologic hazards within the limits of the proposed grade separation project. The scope of our investigation included review of information from nearby sites (Appendix A), a site reconnaissance, a remote geologic review, and preparation of this preliminary report. The purpose of the study is meant to assist in preliminary decision making concerning geotechnical factors affecting feasibility for the proposed grade separation.

1.1 Project Location and Description

The Project is located east of Interstate Freeway I-5, along Palomar Street between Walnut Avenue and Broadway in Chula Vista, California (Figure 1). Based on our understanding, the project will consist of lowering the existing grades of Palomar Street to undercrosss Industrial Boulevard and the existing San Diego & Arizona Eastern Railway (SDAE) railroad right-of-way (Figure 1). The railroad accommodates rails for the Metropolitan Transit System (MTS) Trolley and BNSF freight. To accomplish the proposed railroad grade separation, retaining walls are anticipated to support adjacent grades and existing improvements adjacent to Palomar Street. In addition, Trenton Avenue may be connected with Industrial Avenue by crossing Palomar Street at-grade and extending though a vacant lot south of Palomar Street. The roadway grade separation at Industrial Boulevard will be accomplished by a bridge spanning over Palomar Street.

<u>Site Coordinates:</u>
Latitude: 32.6039° (N)
Longitude: 117.0853° (W)

1.2 Site Conditions

Currently, the project alignment along Palomar Street is developed as an oblique east-west trending six lane arterial throughway with vehicle turn pockets, associated traffic signals, and pedestrian sidewalks. Industrial Boulevard and the

San Diego MTS Trolley and BNSF freight railroad alignments transect the project site, at-grade, in a northwest-southeast trend. In the general vicinity, commercial developments to the northeast and southeast, single-family residential development to the northwest, and a vacant lot to the southwest. Overall topography of the existing street alignment grade gently descends from the east to the west; however, site specific topography is generally flat at approximately 40 feet above mean sea level.

2.0 METHODS OF EXPLORATION

2.1 Site Reconnaissance and Aerial Photo Review

A site reconnaissance was performed on March 20th of 2015. The site reconnaissance was limited to the project alignment and the areas immediately adjacent between Walnut Avenue and east of Oxford Street. It should be noted that the project limits are preliminary and future design may extend laterally outside the project limits discussed in this study. For that reason, future phases of study may need to revise the limits presented in the preliminary report. The site reconnaissance allowed a visual review of the site. To supplement our field reconnaissance, review of available geologic documents and aerial photographs was performed. Our review was performed to identify possible geologic constraints with respect to the proposed project.

2.2 Previous Studies

This study included a review of regional geologic, flood hazard, and tsunami maps (Appendix A). To supplement generalized mapping information, additional data was collected from nearby sites that were mapped within the same geologic unit. One source for subsurface information were the as-built plans for the Palomar Street Overcrossing over Interstate 5. Logs of test borings (LOTBs) from those plans are provided in Appendix B. Another source was the GeoTracker website that is maintained by the State Water Resource Board. From that website, data from monitoring performed at 800 Palomar Street was reviewed for subsurface soil profiles and groundwater elevation. The approximate locations of subsurface data are shown on Figure 2.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Regional Geologic Setting

The site is located in the coastal section of the Peninsular Range Province, a geomorphic province with a long and active geologic history throughout Southern California (Norris and Webb, 1990). Throughout the last 54 million years, the area known as the “San Diego Embayment” has undergone several episodes of marine inundation and subsequent marine regression, resulting in the deposition of a thick sequence of marine and nonmarine sedimentary rocks on the basement rock of the Southern California batholith.

Gradual emergence of the region from the sea occurred in Pleistocene time, and numerous wave-cut platforms, most of which were covered by relatively thin marine and nonmarine terrace deposits, formed as the sea receded from the land. Accelerated fluvial erosion during periods of heavy rainfall, coupled with the lowering of the base sea level during Quaternary time, resulted in the rolling hills, mesas, and deeply incised canyons which characterize the landforms we see in the general site area today.

3.2 Site Geology

Based on our review of published geologic maps, the project alignment is anticipated to be underlain by late Quaternary-aged Old Paralic Deposits and at greater depth Tertiary-aged San Diego Formation (Figure 3). Undocumented fills associated with historic site development is likely locally present where shallow grading was performed to construct existing improvements and as utility trench backfill.

3.2.1 Undocumented Fill (Afu)

Artificial fills are anticipated to be present where grading and earthwork was performed to construct existing road and rail improvements and as backfill for existing utilities. It is anticipated that fills were derived from local excavation and therefore would be comprised of materials found in the Old Paralic Deposits. Aggregate fills are also present within the existing railroad ballast section and anticipated to be present as base beneath existing asphalt concrete roadways.

3.2.2 Quaternary Old Paralic Deposits (Qop)

Based on our document review and our experience with similar sites within Old Paralic Deposits, the unit consists of orange to red brown, silt, silty sand and poorly graded cohesionless sand with local gravel and cobble beds. These materials and are generally considered to be medium dense to dense with favorable engineering characteristics. Near the surface, these materials may be more weathered and loose. Layers of firm to stiff clays are also found with Old Paralic Deposits.

3.2.3 Tertiary San Diego Formation (Tsd)

The Tertiary-aged San Diego Formation, as described in geologic literature consists of shallow marine deposits. Stratigraphically down section, the unit is capped with light reddish brown to yellow-brown, fine to coarse grained sandstone and interbedded conglomerate with sandstone matrix that interfinger with shallow marine deposits consisting of yellow brown fine grained sandstone. The San Diego Formation is estimated to be as thick as 280 feet. (Brown, 2001).

3.3 Geologic Structure

Based on our review of published geologic literature (Appendix A), the Tertiary-age San Diego Formation is anticipated to underlay the site at depth. Available geologic maps pertaining to the site vicinity indicates that the San Diego Formation generally has bedding that dips approximately 3 to 5 degrees toward the southwest. Old Paralic Deposits develop as on terraces and are characterized by beds, lenses, and cross bedded sediments that are generally near horizontal in structure.

3.4 Groundwater

Within the site vicinity, the Old Paralic Deposits are generally present to the west and east of the site. Toward the north and south, alluvial materials are mapped (Figure 3). To provide information on historic groundwater, information was obtained from the LOTBs taken from Palomar Street Overcrossing as-built plans and from monitoring data at 800 Palomar Street. Both of these sites are within 1500 feet of the intersection of Palomar Street and Industrial Boulevard and within the mapped limits of the Old Paralic Deposits. As part of our review of geologic literature, groundwater data was compiled to better understand anticipated groundwater conditions. The compiled groundwater data has been summarized in Table 1.

Table 1 Nearby Historical Groundwater Data						
Boring ID	Site Name	GW Elev (ft)	Date	Datum	GW Elev NAVD 88 (ft)	Distance From Site (ft)
MW-4	Arco - 800 Palomar St	11.0	6/9/05	NAVD 88	11.0	900 West
B-4	Palomar O.C. (I-5)	16.3	3/12/67	NGVD 29	18.4	1450 West

Regional and local groundwater elevations and gradients can vary over time. In addition, based on our experience, perched groundwater conditions can develop within channelized cemented conglomerate beds and on clay beds within the Old Paralic Deposits. Over a 10 year period of monitoring of groundwater levels at 800 Palomar Street, groundwater levels were measured to vary by approximately 3-½ feet (Orion, 2014). On the LOTBs for the Palomar Street Overcrossing, a change in groundwater elevation of approximately 7-½ feet is recorded between measurements made in 1956 and those made in 1967.

We anticipate groundwater gradients generally flow toward the west below the site. As a result, we anticipate that historic groundwater elevations were generally be higher at the project location than at the locations of historical data summarized in Table 1.

3.5 Engineering Characteristics of On-site Soils

Based on our professional experience on adjacent sites with similar soils, and our review of adjacent existing subsurface data, the generalized engineering characteristics of the on-site soils are discussed below.

3.5.1 Expansion Potential

Based on our experience on similar projects with similar soil types, the anticipated expansion potential of the Old Paralic Deposits are anticipated to exhibit a generally low to medium expansion potential (ASTM D4829);

where clay beds are encountered, those materials may be highly expansive. As artificial fill is anticipated to be derived from grading of near surface soils, it is our professional opinion the artificial fill exhibits similar physical qualities of Old Paralic Deposits to consist of a low to medium expansion potential.

3.5.2 Excavation Characteristics

Based on our experience on similar projects with similar soil types, it is anticipated these on-site materials can be excavated with conventional heavy-duty construction equipment. Cohesionless deposits (clean sands and gravel supported conglomerates) may tend to cave where steep or near vertical excavations are made, particularly near or below the water table. The presence of dense to very dense gravel/cobble conglomerates within the Old Paralic Deposits may potentially impede excavation, drilling and pile driving.

4.0 SEISMICITY AND GEOLOGIC HAZARDS

4.1 Faulting

Our discussion of faults on the site is prefaced with a discussion of California legislation and policies concerning the classification and land-use criteria associated with faults. By definition of the California Geological Survey, an active fault is a fault which has had surface displacement within Holocene time (about the last 11,000 years). The state geologist has defined a potentially active fault as any fault considered to have been active during Quaternary time (last 1,600,000 years). This definition is used in delineating Earthquake Fault Zones as mandated by the Alquist-Priolo Geologic Hazards Zones Act of 1972 and most recently revised in 2007 (Bryant and Hart, 2007). The intent of this act is to assure that unwise urban development and certain habitable structures do not occur across the traces of active faults. The subject site is not located within any State mapped Earthquake Fault Zones. The principal source of seismic activity is movement along the northwest-trending regional fault zones such as the San Andreas, San Jacinto and Elsinore Faults Zones, as well as along less active faults such as the Rose Canyon/Newport-Inglewood Fault Zone (Figure 4).

Our review of geologic literature pertaining to the site and general vicinity indicates that there are no known major or active faults on or in the immediate vicinity of the site (Appendix A). Based on the current Caltrans Fault model, the nearest known active fault is the Rose Canyon Fault Zone located approximately 4 miles west of the project alignment.

4.2 Caltrans Preliminary Spectral Accelerations

Based on the Caltrans ARS Online (2.3.07), a PGA at the site of approximately 0.4g is calculated for rock site conditions (760 m/sec). Actual site class at the site is likely near the boundary between Site Classes C and D. Additionally, the Silver Strand section of the Rose Canyon Fault is modeled to have a maximum magnitude of M6.8 at a distance of 4.6 km (2.9 mi) from the site. Based on this data, we recommend preliminary seismic analysis consider Caltrans preliminary spectra for M7.0, PGA of 0.4g, and Site Class D (Appendix C).

To account for near fault effects, spectral accelerations should be increased by 20 percent at periods of 1.0 second and greater. Spectral acceleration between

0.5 seconds on 1.0 second should be determined by linear interpolation of the 20 percent increase.

4.3 Building Code Mapped Spectral Acceleration Parameters

The effect of seismic shaking may be mitigated by adhering to the California Building Code and state-of-the-art seismic design practices of the Structural Engineers Association of California. Provided below in Table 2 are the risk-targeted spectral acceleration parameters for the project determined in accordance with the 2013 California Building Code (CBSC, 2013) and the USGS U.S. Seismic Design Map tool.

Table 2
CBC Mapped Spectral Acceleration Parameters

Site Class	D		
Site Coefficients	F_a	=	1.095
	F_v	=	1.634
Mapped MCE_R Spectral Accelerations	S_S	=	1.011g
	S_1	=	0.383g
Site Modified MCE_R Spectral Accelerations	S_{MS}	=	1.108g
	S_{M1}	=	0.626g
Design Spectral Accelerations	S_{DS}	=	0.739g
	S_{D1}	=	0.417g

Utilizing ASCE Standard 7-10, in accordance with Section 11.8.3, the following additional parameters for the peak horizontal ground acceleration are associated with the Geometric Mean Maximum Considered Earthquake (MCE_G). The mapped MCE_G peak ground acceleration (PGA) is 0.428g for the site. For a Site Class D, the F_{PGA} is 1.072 and the mapped peak ground acceleration adjusted for Site Class effects (PGA_M) is 0.459g for the site.

4.4 Secondary Seismic Hazards

In general, secondary seismic hazards for sites in the region could include soil liquefaction, earthquake-induced settlement, lateral displacement, surface manifestations of liquefaction, landsliding, and seiches and tsunamis. These potential secondary seismic hazards are discussed below.

4.4.1 Shallow Ground Rupture

No active or potentially active faults are mapped crossing the site or projecting toward the site as known by the state of California, and the site is not located within a mapped Alquist-Priolo Earthquake Fault Zone. The nearest modeled segment of the Newport-Inglewood Offshore Fault Zone known as the Rose Canyon Fault Zone is located approximately 4 miles (6.4 kilometers) west of the approximate central vicinity of the site. Because of the lack of known active faults at the site, the potential for fault surface rupture at the site is considered low.

4.4.2 Liquefaction

Liquefaction of soils can be caused by strong vibratory motion due to earthquakes. Both research and historical data indicate that loose, saturated, granular soils are susceptible to liquefaction and dynamic settlement. Liquefaction is typified by a reduction in or loss of shear strength in the affected soil layer. Liquefaction may be manifested by excessive settlement, sand boils, and bearing failure.

Previously completed subsurface data along the alignment (Appendix B) and our experience at similar sites indicate that the Old Paralic Deposits are not susceptible to liquefaction due to their dense character. In addition, underlying materials of the San Diego Formation are also generally dense to very dense, well-indurated, sandstones and hard silty sandstones and are not subject to liquefaction. The site is not with a liquefaction hazard zone (San Diego County, 2010).

4.4.3 Earthquake-Induced Settlement

Granular soils tend to densify when subjected to shear strains induced by ground shaking during earthquakes. Based on the underlying onsite soils are not susceptible to a liquefaction event, earthquake induced settlement, during a seismic event, is considered negligible.

4.4.4 Seismic Slope Instability

Slope instability, in the form of landslides and mudslides, is a potential adverse impact associated with seismic shaking. Due to the relatively low lying topography of the site and surrounding vicinity, the potential of seismic slope instability is considered negligible.

4.4.5 Lateral Spread

Empirical relationships have been derived by Youd and others (Youd et. al., 2002) to estimate the magnitude of lateral spread due to liquefaction. These relationships include parameters such as earthquake magnitude, distance of the earthquake from the site, slope height and angle, the thickness of liquefiable soil, and gradation characteristics of the soil.

The susceptibility to earthquake-induced lateral spreading is not considered to be a possibility based on the dense character and shallow contact with the Old Paralic Deposits.

4.4.6 Tsunamis and Seiches

Tsunamis are long wavelength seismic sea waves (long compared to the ocean depth) generated by sudden movements of the ocean bottom during submarine earthquakes, landslides, or volcanic activity. A seiche is an oscillation (wave) of a body of water in an enclosed or semi-enclosed basin that varies in period, depending on the physical dimensions of the basin, from a few minutes to several hours, and in height from several inches to several feet. A seiche is caused chiefly by local changes in atmospheric pressure, aided by winds, tidal currents, and occasionally earthquakes.

Specifically, southern California is oriented obliquely (i.e., not directly in line) with the major originating tsunami zones, and it has a relatively wide (about 220 kilometers) and rugged continental shelf (or borderland) that acts as a diffuser and reflector of remotely generated tsunami wave energy (Joy, 1968). These conditions, in addition to the geologic and seismic conditions (such as the strike-slip fault regime and the infrequent large submarine earthquakes) along the coastline, also tend to minimize the likelihood of a large tsunami at the site. For example, tsunami wave heights and run-up elevations experienced along the Southern California coastline during the last 170 years have fallen within the normal range of tidal fluctuations.

Based on our review of the Tsunami Inundation Map for Emergency Planning, State of California, County of San Diego, Imperial Beach Quadrangle, published June 1, 2009 (Figure 5) the project is not located within a tsunami inundation zone, and therefore, adverse effects from a tsunami event is considered low.

4.5 Landslides

Landslides occur in hillside and mountainous topographic regions as natural or anthropogenic influence due to geologic and in-situ instability. No landslides have been mapped within the project site nor within the proximate vicinity; therefore adverse effects derived from a landslide event is considered low.

4.6 Flood Hazard

According to a Federal Emergency Management Agency (FEMA) flood insurance rate map (FEMA, 1997); the site is not located within a 100-year floodplain (Figure 6).

Furthermore, based on review of our available topographic maps, the site is not located downstream of a lake or engineered dam and according to County of San Diego Hazard Mapping (San Diego County, 2010); the site is not within a dam inundation area.

5.0 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

5.1 Earthwork

We anticipate that earthwork at the site will consist of site preparation, installation of shoring, excavation, and placement of backfill.

5.1.1 Site Preparation

Prior to grading, all areas to receive structural fill or engineered structures should be cleared of surface and subsurface obstructions, including any existing debris and undocumented or loose fill or weathered soils, and stripped of vegetation. Removed vegetation and debris should be properly disposed off-site. All areas to receive fill and/or other surface improvements should be scarified to a minimum depth of 6 inches, brought to above-optimum moisture conditions, and recompacted to at least 90 percent relative compaction (based on ASTM Test Method D1557).

5.1.2 Excavations and Oversize Material

Excavations of the onsite materials may generally be accomplished with conventional heavy-duty earthwork equipment. Surficial soils along with friable underlying sands present on site may cave during trenching and excavation operations. In accordance with OSHA requirements, excavations deeper than 5 feet should be shored or be laid back. Based on knowledge of Old Paralic Deposits and nearby sites, there is a potential to generate oversized material (larger than 6 inches in any dimension).

Where existing overhead high voltage lines are present, excavations should avoid impacting the lateral capacity of foundations.

5.1.3 Removal and Recompaction

In areas that are to receive fill or other surface improvements, these soils should be removed down to competent paralic deposits and recompacted to proposed grades. The thickness of these soils may vary across the site and may be locally deeper in certain areas. Also, as typical in areas of redevelopment, buried active and abandoned utilities both public and private, may be encountered which may need to be mitigated with respect to the design and construction of the project.

5.1.4 Expansive Soils and Selective Grading

Earthwork for the project is expected to be predominantly excavation and export. We anticipate that the cuts for the grade separation will be excavated into material that has a low to moderate potential for expansion. Expansion testing should be performed on during design level exploration to verify the expansion potential of materials at planned grades and behind retaining walls. If soils having an expansion index of 50 or more are present near finish grade, special foundation and slab considerations may be required. Similarly, clayey expansive materials should not be utilized as retaining wall backfill.

5.2 Excavations and Embankments

For the planned shallow permanent slopes, a slope ratio of 2 to 1 (horizontal to vertical), or flatter, is recommended. Excavations that affect the track bed support should be made in accordance with Metropolitan Transit System (MTS) and American Railway Engineering and Maintenance-of-way Association (AREMA) requirements.

5.3 Bridge Foundations

Spread footings or deep foundations may be considered for bridge foundations. We anticipate that site constraints may make deep foundations a preferred system. Due the consolidated nature and conglomerate layers of the underlying deposits, drilled piles are considered more practical than driven piles.

5.4 Earth Retaining Systems

Where cuts are planned in adjacent embankments conventional retaining walls may be considered along with slopes or shoring. Shoring or permanent top down retaining systems, such as cantilevered pile walls or anchored pile walls should be considered where temporary sloping is not practical. Soil nail walls may also be considered where cuts in Old Paralic Deposits are planned, but may be difficult to construct where cuts are made in gravel/cobble support conglomerate channels or interbeds, as well as poorly indurated (grain supported) clean sand and sandstones. Where anchors or soil nails are utilized, right-of-way constraints should be considered.

5.5 Corrosive Soils

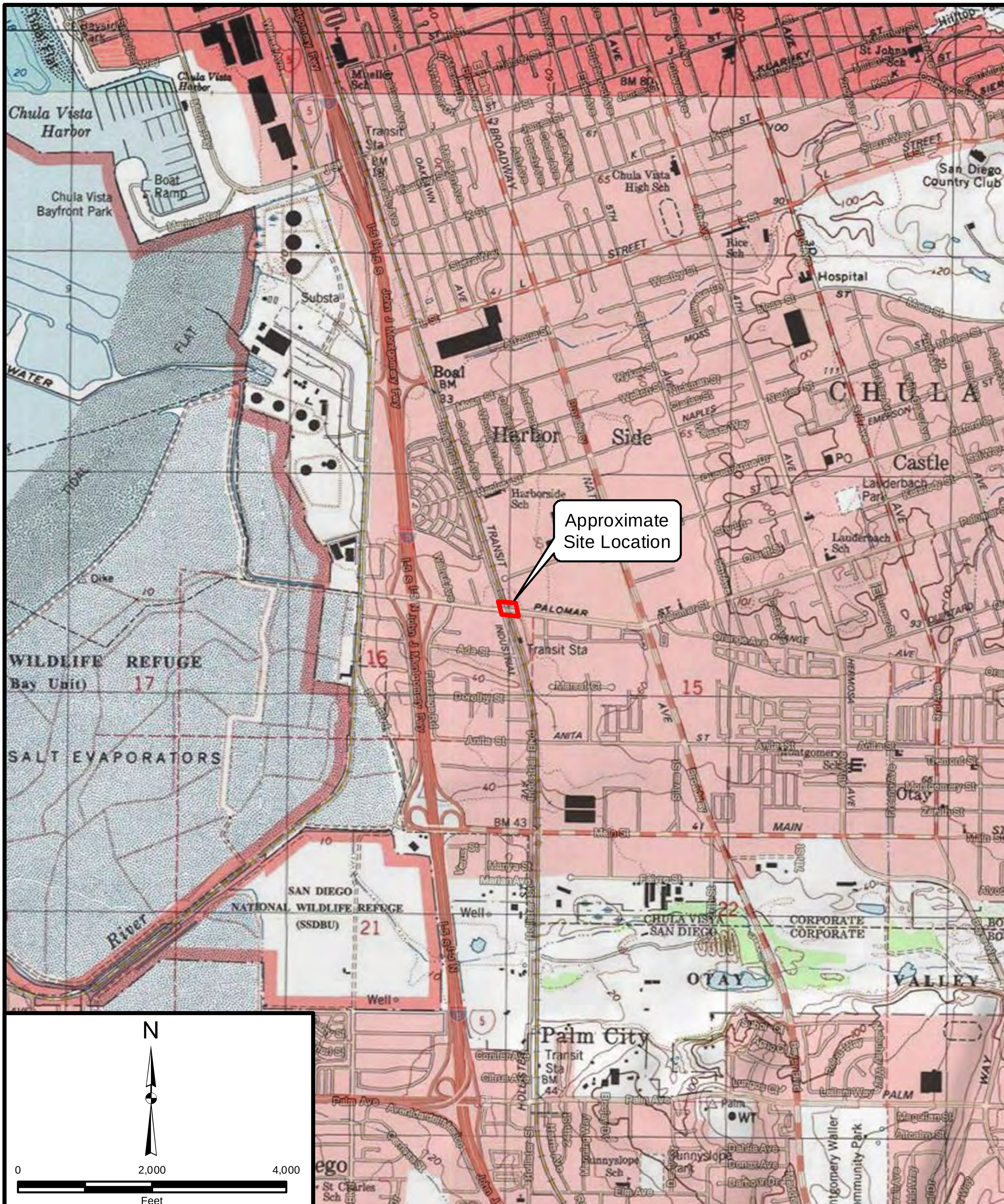
Currently, there is no geochemical data available. Based on the proximity of the site to the coast, provisions to mitigate coastal atmosphere conditions are considered appropriate.

6.0 LIMITATIONS

The recommendations contained in this report are based on preliminary project information. Conceptual changes made during design development should be reviewed by Leighton Consulting, Inc. to determine if preliminary recommendations are still applicable. Any questions regarding the contents of this report should be directed to the attention of Sean Colorado, GE, (858) 300-8490 of Leighton Consulting, Inc.

Please also note that our evaluation was limited to assessment of the preliminary geotechnical aspects of the project, and did not include evaluation of structural issues, environmental concerns, or the presence of hazardous materials.

Figures



Project: 10147.006	Eng/Geol: SAC/MDJ
Scale: 1 " = 2,000 '	Date: March 2016

Base Map: ESRI ArcGIS Online 2016
Thematic Information: Leighton
Author: Leighton Geomatics (mmurphy)

SITE LOCATION MAP

Palomar Grade Separation
Chula Vista, California

Figure 1

Leighton

Map Saved as P:\Drafting\10147\006\Maps\Preliminary Geotechnical Report\10147-006_F01_SLM_2016-03-11.mxd on 3/14/2016 11:00:05 AM

Project: 10147.006	Eng/Geol: SAC/MDJ
Scale: 1 " = 1,000 '	Date: March 2016

Base Map: ESRI ArcGIS Online 2016
Thematic Information: Leighton
Author: Leighton Geomatics (mmurphy)

HISTORIC GROUNDWATER MEASUREMENT LOCATIONS

Palomar Grade Separation
Chula Vista, California

Figure 2

Leighton

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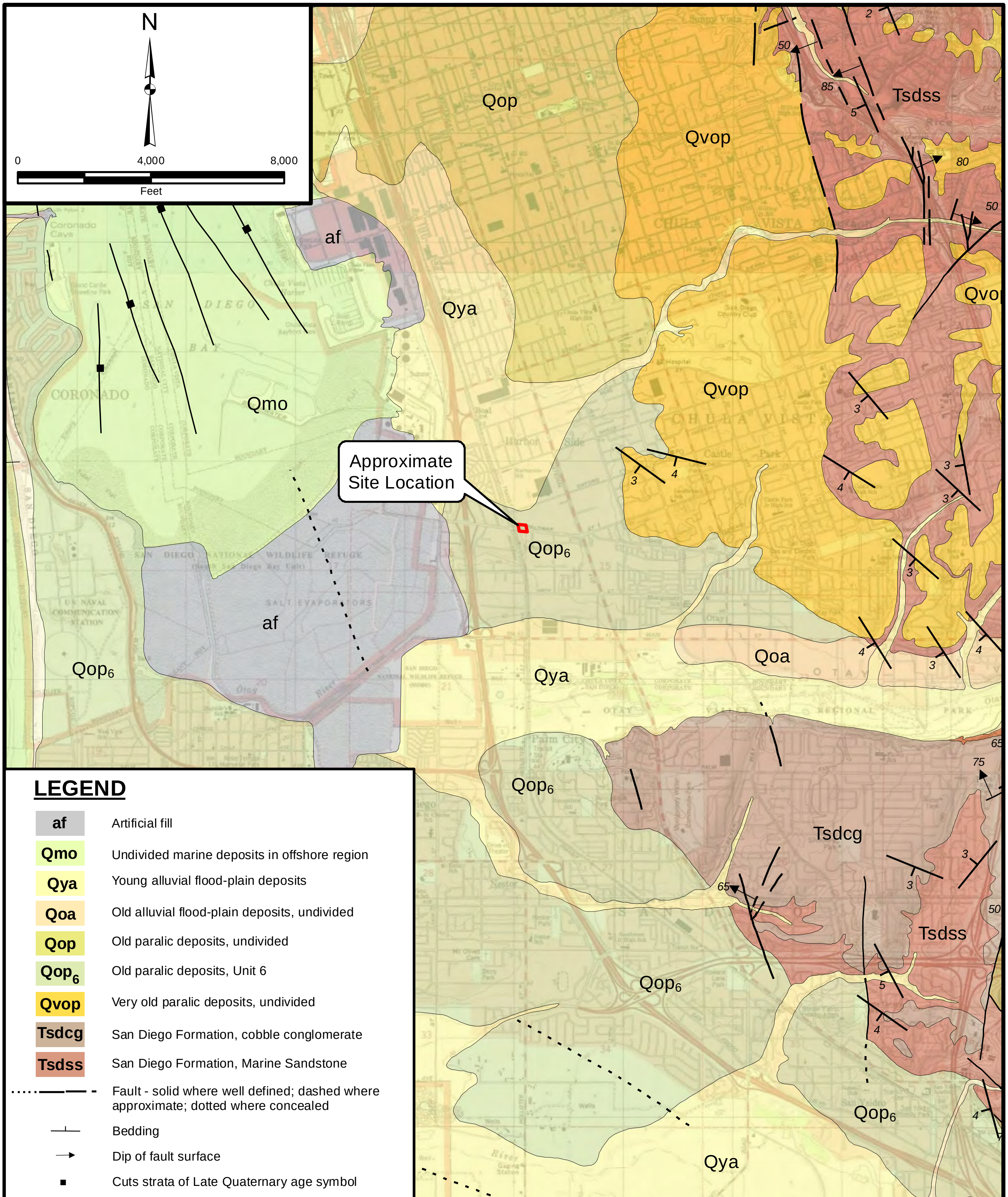

Project: 10147.006	Eng/Geol: SAC/MDJ
Scale: 1 " = 4,000 '	Date: March 2016

Base Map: ESRI ArcGIS Online 2016
Geoogy map: Map of the San Diego 30'x60' quadrangle, California, compiled by Michael P. Kennedy and Siang S. Tan, 2008
Author: (mmurphy)

REGIONAL GEOLOGY MAP

Palomar Grade Separation
Chula Vista, California

Figure 3

Leighton

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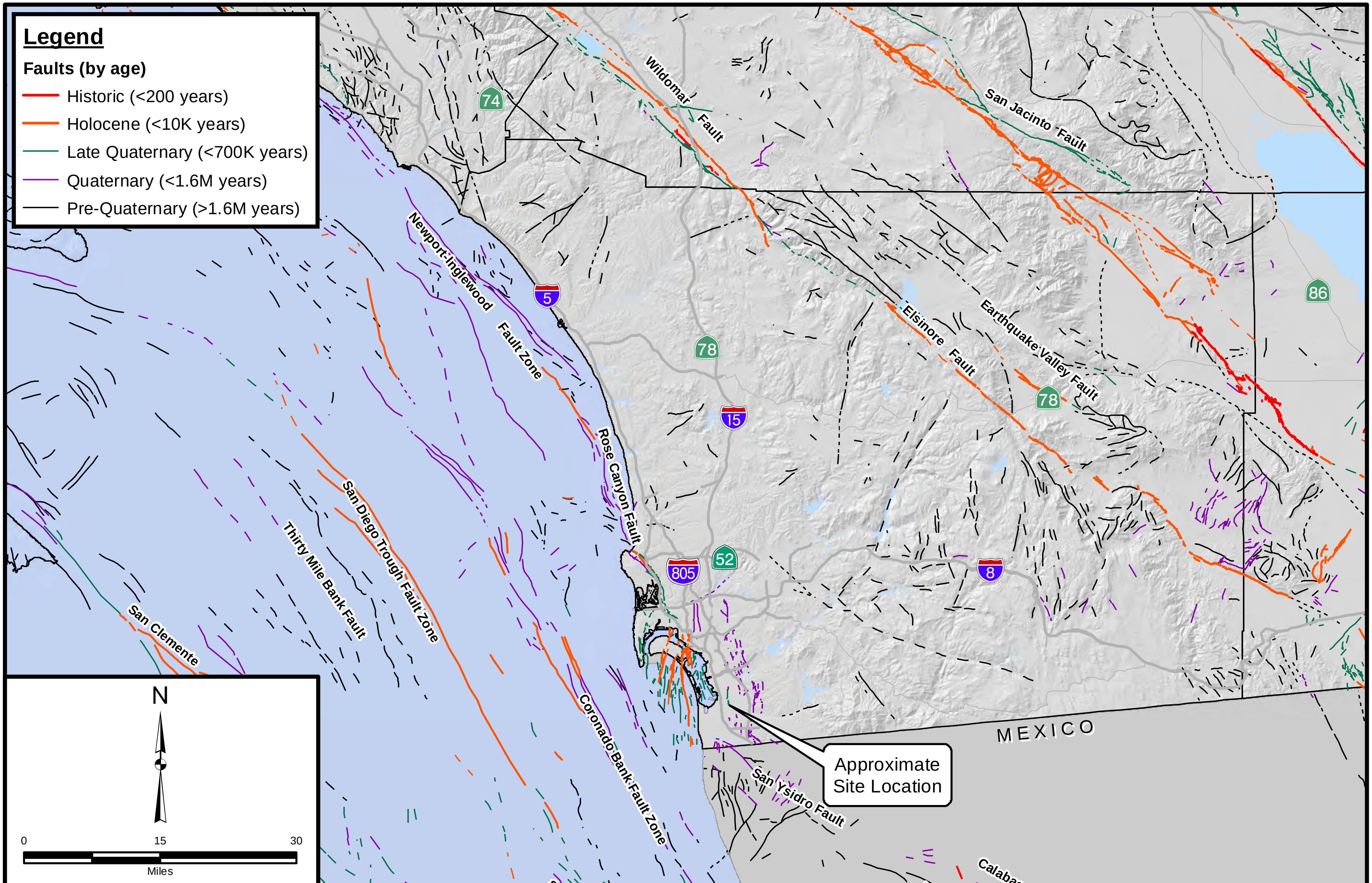

Project: 10147.006	Eng/Geol: SAC/MDJ
Scale: 1 " = 15 miles	Date: March 2016

Faults: Bryant, Bryant CGS 2010
Thematic Information: Leighton
Author: Leighton Geomatics (mmurphy)

REGIONAL FAULT MAP

Palomar Grade Separation
Chula Vista, California

Figure 4

Leighton

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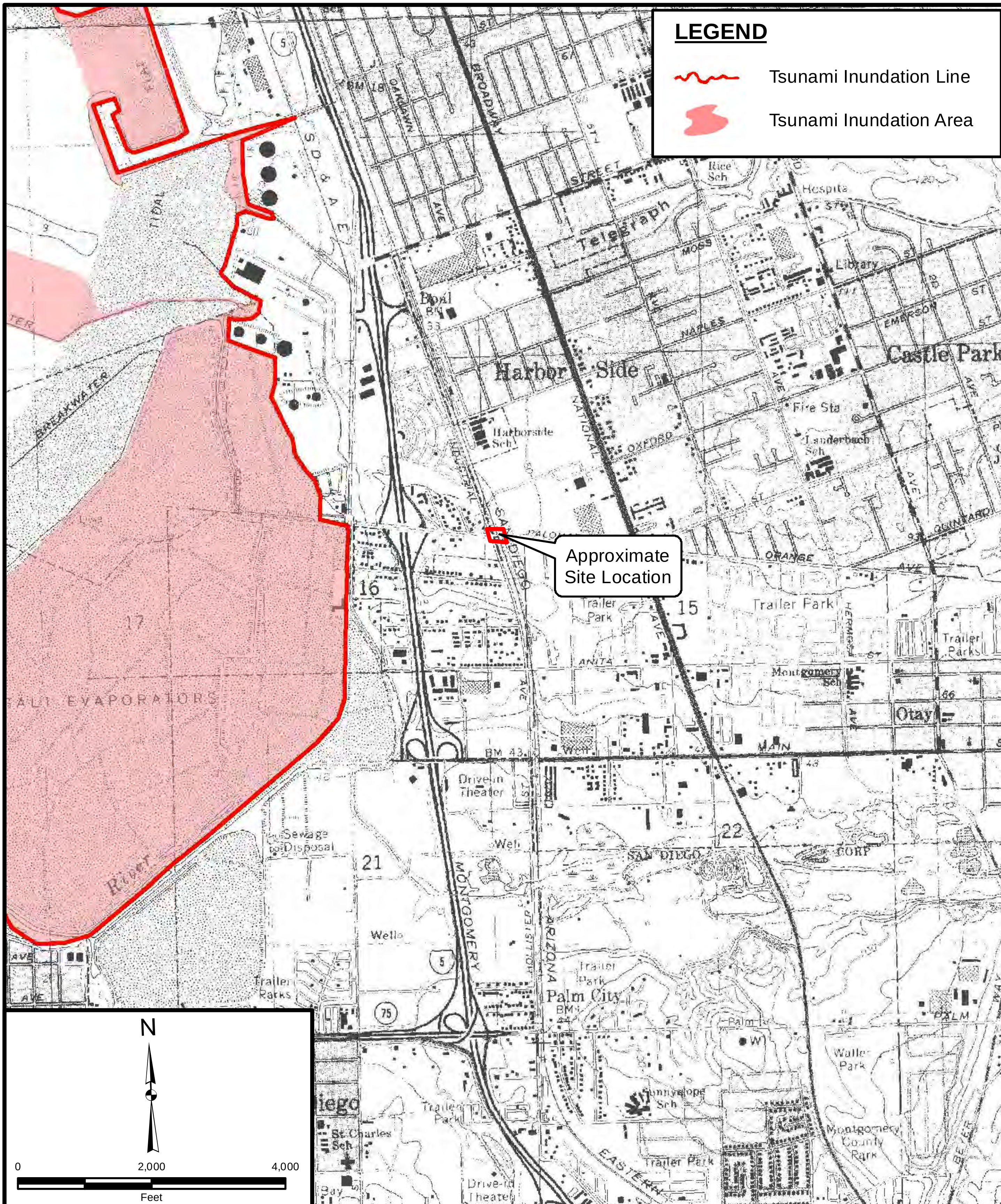

Project: 10147.006	Eng/Geol: SAC/MDJ
Scale: 1 " = 2,000 '	Date: March 2016

Reference: Tsunami Inundatin Map for Emergency Planning, State of California County of San Diego Imperial Beach Quadrangle, June 1, 2009.

Author: Leighton Geomatics (mmurphy)

TSUNAMI INUNDATION MAP

Palomar Grade Separation
Chula Vista, California

Figure 5

Leighton

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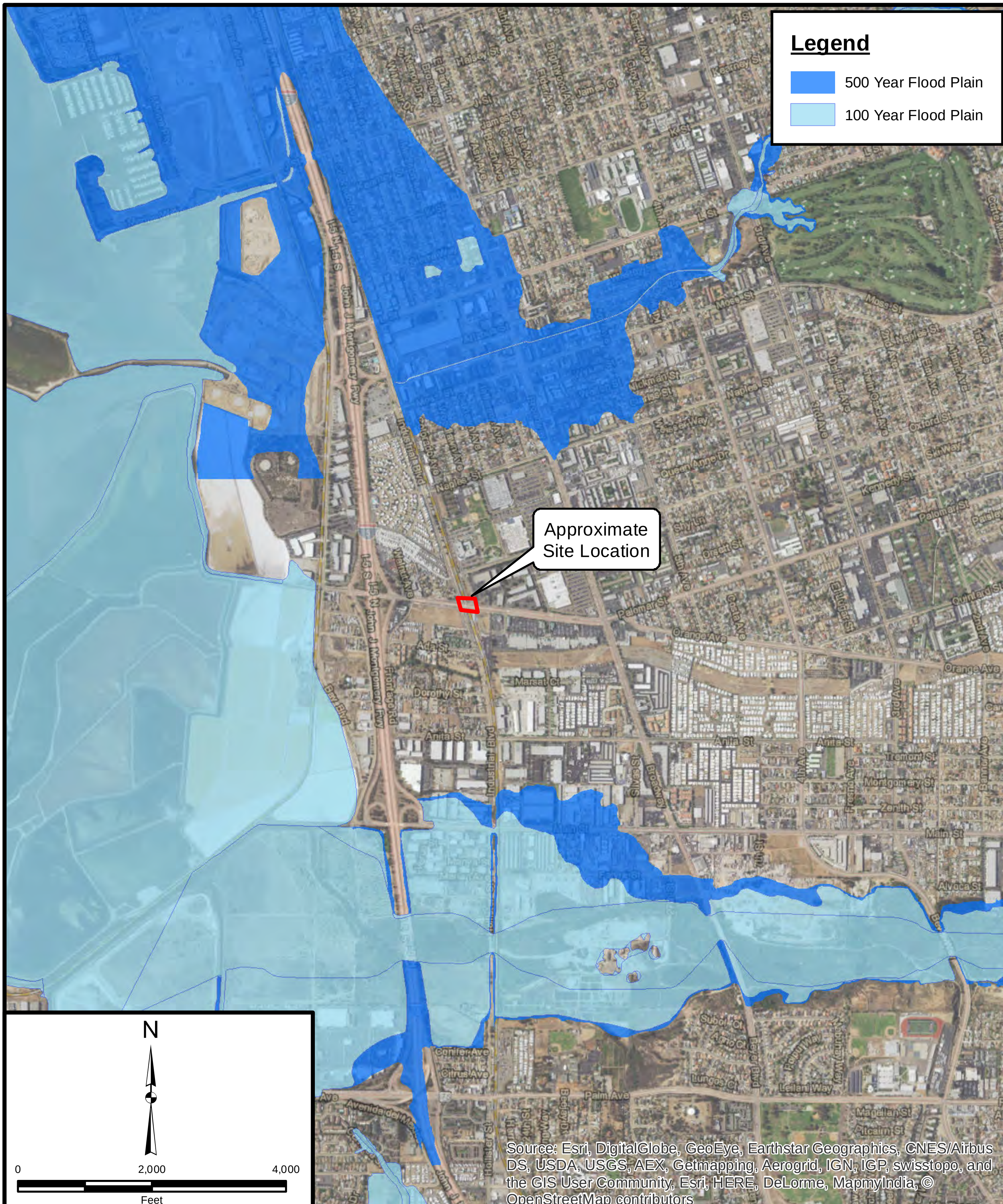

Project: 10147.006	Eng/Geol: SAC/MDJ
Scale: 1 " = 2,000 '	Date: March 2016

Flood Q3 data, San Diego County, CA

Author: Leighton Geomatics (mmurphy)

FLOOD HAZARD MAP

Palomar Grade Separation
Chula Vista, California

Figure 6

Leighton

Map Saved as P:\Drafting\10147\006\Maps\Preliminary Geotechnical Report\10147-006_F06_FHM_2016-03-14.mxd on 3/14/2016 10:01:10 AM

Appendix A

References

APPENDIX A

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APPENDIX A (Continued)

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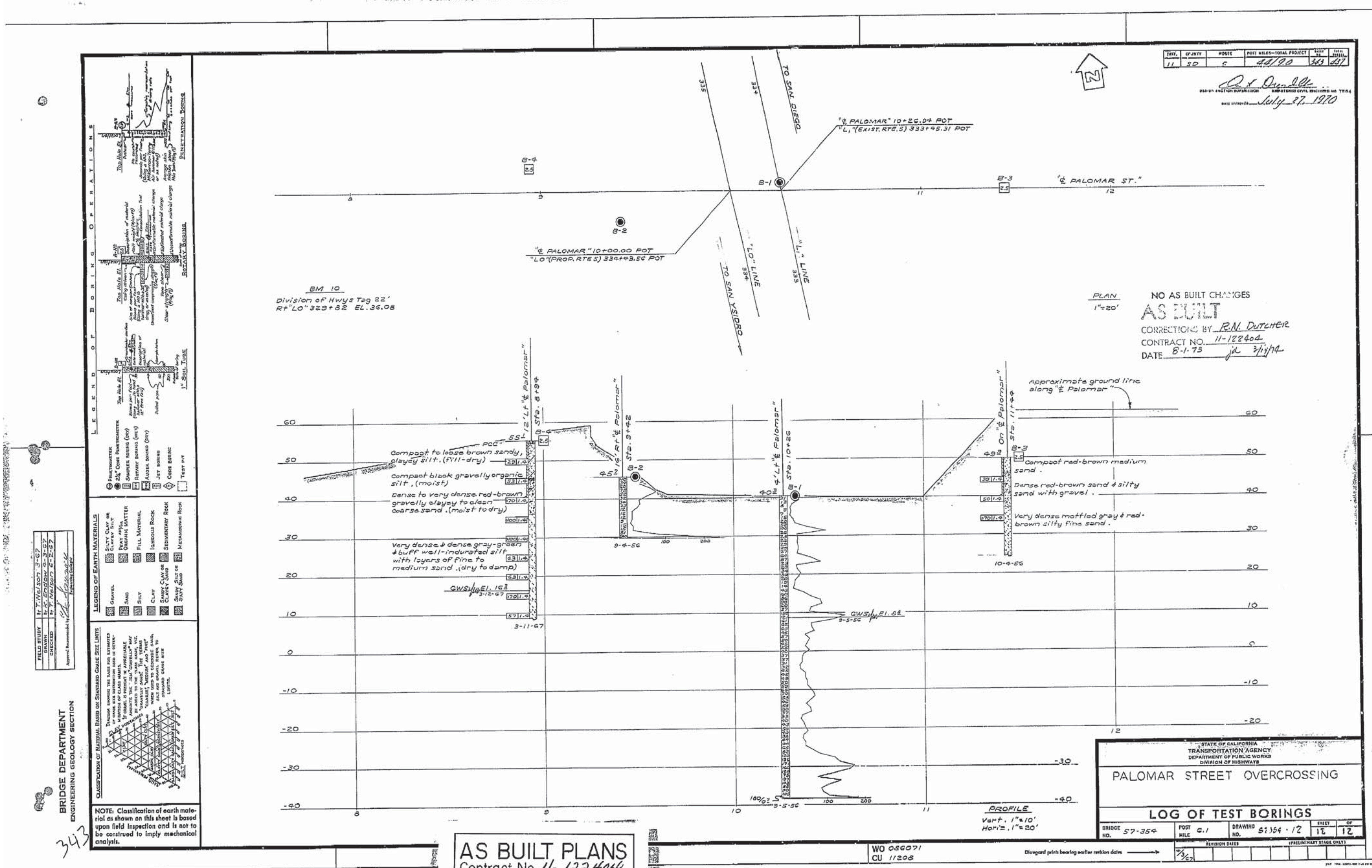
Appendix B

Logs from Previous Studies



AS BUILT PLANS
Contract No. 11-122404
Date Completed 7-27-70
Document No. 11 000 2600

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 TRANSPORTATION.
DATE 5-9-74 TITLE Microfilm Supervisor

SECOR

BOREHOLE / WELL LOG

Number: MW-4	Client: ATLANTIC RICHFIELD	Job No: 08BP.U6133.05	Sheet: 1 of 2
SECOR Rep: Brain Demme	Approved by:	Location: ARCO Facility #6133 800 Palomar Street Chula Vista, California 91911	Drilling Company/Driller: West Hazmat Drilling Rick Hastings

Date Started:	Date Finished:	Drill Rig/Sampling Method:	Borehole Dia.:	Casing Dia:.	Surface Elevation:
12/2/04	12/2/04	CME-75 with Hollow Stem Augers/ CA Split Spoon Sampler	10"	4"	52.61

SAMPLE LOG				BOREHOLE LOG			WELL LOG
Sample No./ Time	OVA/PID (ppm)	Lab Results TPH(ppm)	Density Blows/ft	Depth in Feet	USCS Symbol	Geologic Description (Soil Type, Color, grain, minor soil component, moisture, density, odor, etc.)	Well Design
				0		4" Concrete	
				1	SW	Fill: Well graded GRAVEL and sand	
				3	ML	Clayey SILT, brown (7.5YR 5/4), some fine sand, moist, hard, no hydrocarbon (HC) odor	
MW-4/5' 925	0.2	NA	26/50	5			
				9	SM	Fine silty SAND, brown (10YR 5/3), dry, medium dense, no HC odor	
MW-4/10' 935	0.1	NA	8/8/11	10			
				14	ML	Sandy SILT, brown (7.5YR 5/3), moist, very hard, no HC odor	
MW-4/15' 945	0.1	NA	26/50	15			
				19	SM	Fine silty SAND, brown (10YR 5/3), trace clay, moist, dense, no HC odor	
MW-4/20' 952	0.1	<10	22/50	20			
MW-4/25' 1000	0.1	NA	10/15/23	25			
				28	SM	Silty SAND, dark gray (5Y 4/1), moist, dense, slight HC odor	
				30			

SECOR

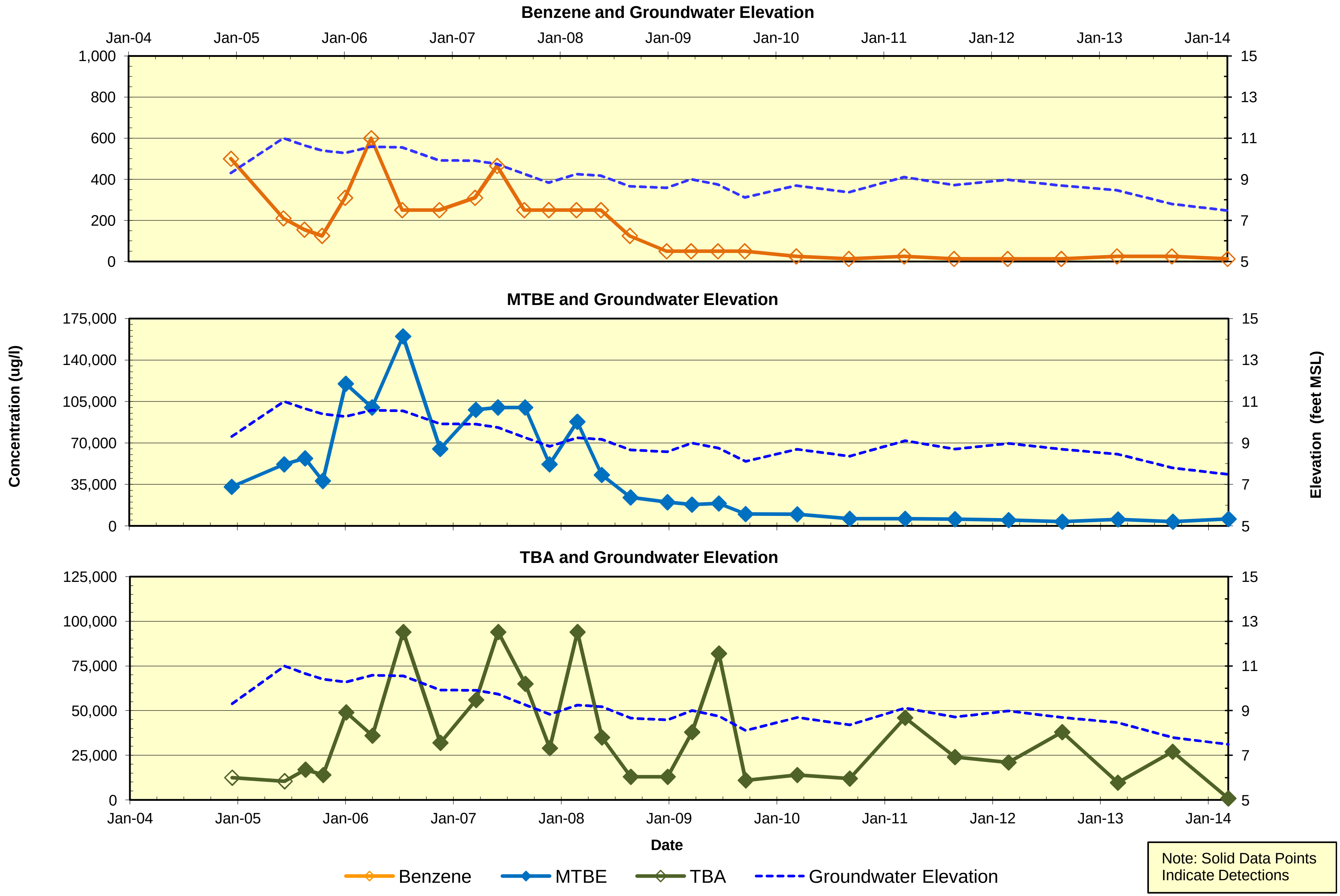
BOREHOLE / WELL LOG

Number:	MW-4
Client:	ATLANTIC RICHFIELD
Job No:	08BP.U6133.05
Sheet:	2 of 2
SECOR Rep:	Brain Demme
Approved by:	
Location:	ARCO Facility #6133 800 Palomar Street Chula Vista, California 91911
Drilling Company/Driller:	West Hazmat Drilling Rick Hastings
Date Started:	12/2/04
Date Finished:	12/2/04
Drill Rig/Sampling Method:	CME-75 with Hollow Stem Augers/ CA Split Spoon Sampler
Borehole Dia.:	10"
Casing Dia:.	4"
Surface Elevation:	52.61

SAMPLE LOG				BOREHOLE LOG			
Sample No./ Time	OVA/PID (ppm)	Lab Results TPH(ppm)	Density Blows/ft	Depth in Feet	USCS Symbol	Geologic Description (Soil Type, Color, grain, minor soil component, moisture, density, odor, etc.)	Well Design
MW-4/30' 1020	15	<10	50/5	30	SP	Gravely SAND, dark gray (5Y 4/1), trace clay, moist, wet, dense, slight HC odor	
MW-4/35' 1030	0.5	NA	13/15/17	35			
MW-4/40' 1045	30.0	<10	15/21/25	39–40	ML	Clayey SILT, brown (7.5YR 5/3), trace sand, wet, slight HC odor	
MW-4/45' 1055	5.0	<10	50/6	44–45	SM	Silty fine SAND, light gray (5Y 7/1), wet, very dense, very slight HC odor	
				49	ML	Clayey SILT, brown (7.5YR 5/3), trace fine sand, wet, very slight HC odor	
MW-4/50' 1102	2.0	<10	8/12/17	50		TOTAL DEPTH DRILLED = 50' BGS	

TOTAL DEPTH DRILLED = 50' BGS

Installed 4-inch diameter schedule 40 PVC monitoring well with 0.020-inch screen placed from 30 to 50 feet bgs, blank casing from ground surface to 30 feet bgs, #3 Monterey sand filter pack (8-50 lb bags) placed from 28 to 50 feet bgs, bentonite chips placed from 25 to 28 feet bgs and bentonite grout placed from 3 to 25 feet bgs. Completed well with a traffic rated well box set in concrete from the ground surface to 3 feet bgs.



Orion Environmental Inc.	Tesoro - Chula Vista Palomar 800 Palomar Street, Chula Vista, California	HYDROCARBON CONCENTRATIONS WITH GROUNDWATER ELEVATIONS FOR WELL MW-4	Figure 6C
TBL001.xlsx / 5/15/2014			

Appendix C

Caltrans Preliminary Spectral Accelerations

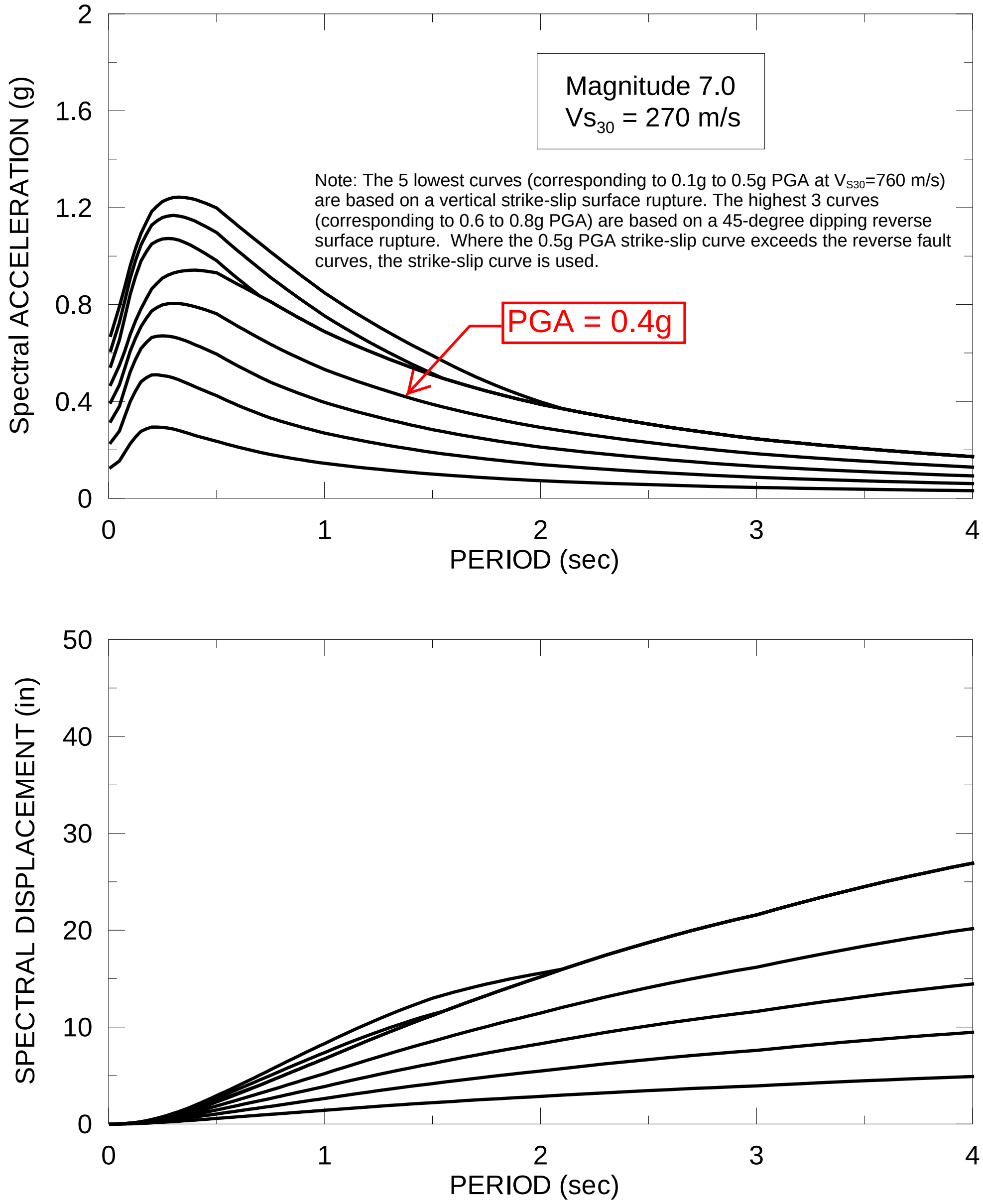


Figure B.18 Spectral Acceleration and Displacement for V_{s30} = 270 m/s (M = 7.0)

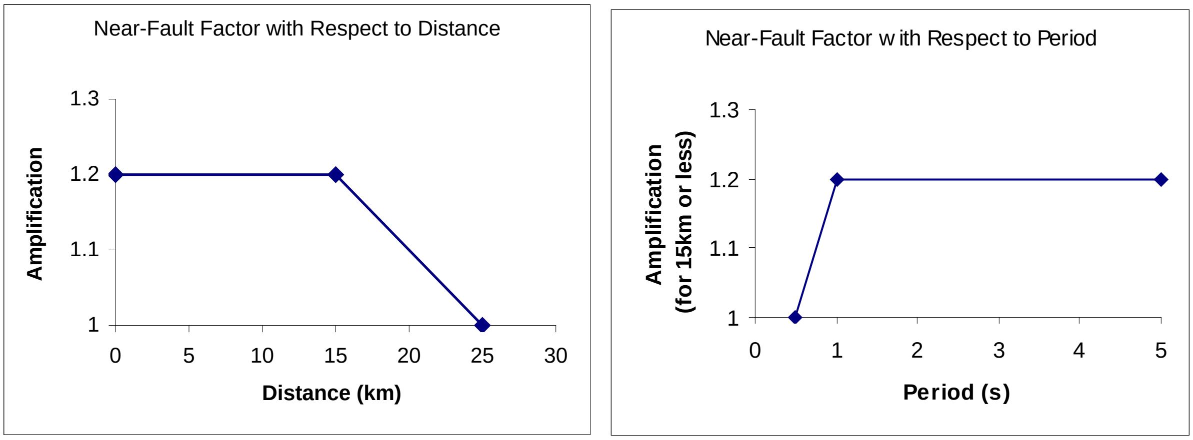


Figure B.3 Near-Fault adjustment factor as a function of distance and spectral period. The distance measure is based on the closest distance to any point on the fault plane.

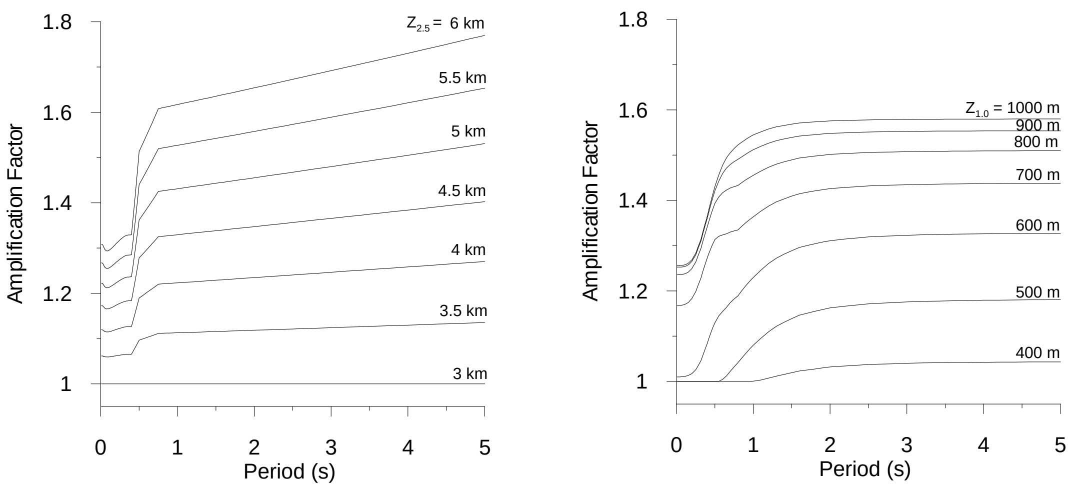


Figure B.4 Basin amplification factors for the Campbell-Bozorgnia (2008) and Chiou-Youngs (2008) ground motion prediction equations. Curves may be slightly conservative at periods less than 0.5 seconds.