State of California
DEPARTMENT OF TRANSPORTATION

State Transportation Agency

Memorandum

Serious drought
Help save water!

To: MR. TOM OSTROM
Supervising Bridge Engineer
Office of Earthquake Engineering

Date: June 17, 2014

Attention: Mark Yashinsky

File: 04-ALA-580 PM R38.92
59-93034-N
EFIS# 0000001016-N
Kuhnle Ave OC 33-0342

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Subject: EVALUATION OF FAULT RUPTURE POTENTIAL FOR KUHNLE AVENUE OVERCROSSING - BRIDGE 33-0342 ON STATE ROUTE 580, PM 38.92, ALAMEDA COUNTY

SUMMARY

Caltrans Bridge 33-0342, the Kuhnle Ave Overcrossing, lies in the city of Oakland, Alameda County (ALA-580-PM R38.92; Figure 1). The bridge is located within the boundaries of a State of California Earthquake Fault Zone and lies at least 104 meters (340 feet) from a trace of the active Hayward fault zone (northern Hayward section). The bridge is located far enough away from the fault that it is not at risk for significant offset during an earthquake.

INTRODUCTION

This evaluation was prepared as part of a statewide evaluation of fault rupture potential at Caltrans bridges. Caltrans policies regarding fault rupture at bridges are described in Memo to Designers 20-10 (2013). Caltrans requires a fault rupture evaluations for bridges located within an Alquist-Priolo Earthquake Fault Zone or within 305 meters (1,000 feet) of an un-zoned fault 15,000 years or younger in age. This fault displacement hazard evaluation consisted of reviewing selected literature and fault maps, performing offset calculations, and presenting the results of our evaluation in this memo.

BRIDGE DESCRPITION

The bridge was built in 1965. The bridge is a cast-in-place concrete box girder (24 cells) on reinforced concrete pier walls and diaphragm abutments. All bents are on reinforced concrete piles.

FAULT LOCATION EVALUATION

We reviewed the Alquist-Priolo Earthquake Fault Zone Map, East Oakland Quadrangle (CDMG, 1982) and the Digital Map of Recently Active Traces of the Hayward Fault, California (Lienkaemper 2008) to measure the shortest distance from the bridge to an active fault. The Alquist-Priolo Earthquake Fault Zone Map is intended to create zones that assist cities and counties in fulfilling their responsibilities for protecting the public from the effects of surface fault rupture as required by the AP Earthquake Fault Zoning Act (Public Resources Code Sections 2621-2630). The faults shown on this map are the basis for establishing the earthquake fault zones; however, all fault traces that have the potential for surface rupture may not be shown on this map.

The purpose of the Lienkaemper map is to show the location of and evidence for recent movement on active fault traces within the Hayward Fault Zone, California. The mapped traces represent the integration of three types of data: (1) geomorphic expression, (2) creep (aseismic fault slip), and (3) trench exposures. Since the focus of the Lienkaemper map is to map active fault traces as opposed to fault zones, in some areas, it may be more accurate than the Alquist-Priolo Earthquake Fault Zone Map, but it also does not include all potentially active fault traces.

Both the Alquist-Priolo Earthquake Fault Zone Map and the Lienkaemper map show two fault traces in the vicinity of the bridge (Figures 2 and 3). The Lienkaemper map indicates that the Hayward Fault traces are located at least 104 meters (340 feet) and 352 meters (1,152 feet) to the west of the bridge (measured on Google Earth).

CALCULATIONS OF POTENTIAL OFFSET

To quantify potential fault offset, we used the Strike-Slip Fault Rupture Hazard Version 9.0 spreadsheet developed by the Division of Research and Innovation in collaboration with Geotechnical Services, based upon methods presented in Petersen, et al. (2011), and Abrahamson (2008). The Alquist-Priolo Earthquake Fault Zone map (Figure 2) and Lienkaemper map (Figure 3) show two traces of the active Hayward Fault in the vicinity of the bridge. The fault trace to the west (350 meters from bridge) is accurately located with trenches. The fault trace to the east (104 meters from bridge) is a concealed and queried trace. We weighted the accurately located trace 95% and the concealed and queried trace closer to the bridge 5%. The following input parameters were used:

Input	Value	Source
Distance – Hayward fault, northern section	104 m (5%)	Lienkaemper (2008), measured with Google Earth
Map Rating	inferred, simple	Lienkaemper (2008), measured with Google Earth
Distance – Hayward fault, northern section	352 m (95%)	Lienkaemper (2008), measured with Google Earth
Map Rating	accurate, simple	Lienkaemper (2008)
Mmax	7.3	CT fault database[1]; USGS (2008)
Slip Rate	9 mm/year	Dawson and Weldon (2012)
Creep Rate	3.4 mm/yr	H73A 73rd (McFarland and others 2014)
Empirical Slip Measurements	None	n/a
Type of Slip	Right-lateral strike-slip	CT fault database; USGS (2008)

Based on our calculations, no potential offset is calculated at the bridge site (Figure 4).

RECOMMENDATIONS

No further geologic work is recommended at this time. If you have any questions, please contact Anna Sojourner at (510) 622-8839.

c: TPokrywka, CRisden, Daily File
Karpowicz/mm

List of Attachments:
Figure 1, Location Map
Figure 2, Special Studies Zones Map
Figure 3, Lienkaemper 2008 Fault Location Map
Figure 4, Probabilistic Offset

[1] CT fault database: http://dap3.dot.ca.gov/shake_stable/v2/technical.php

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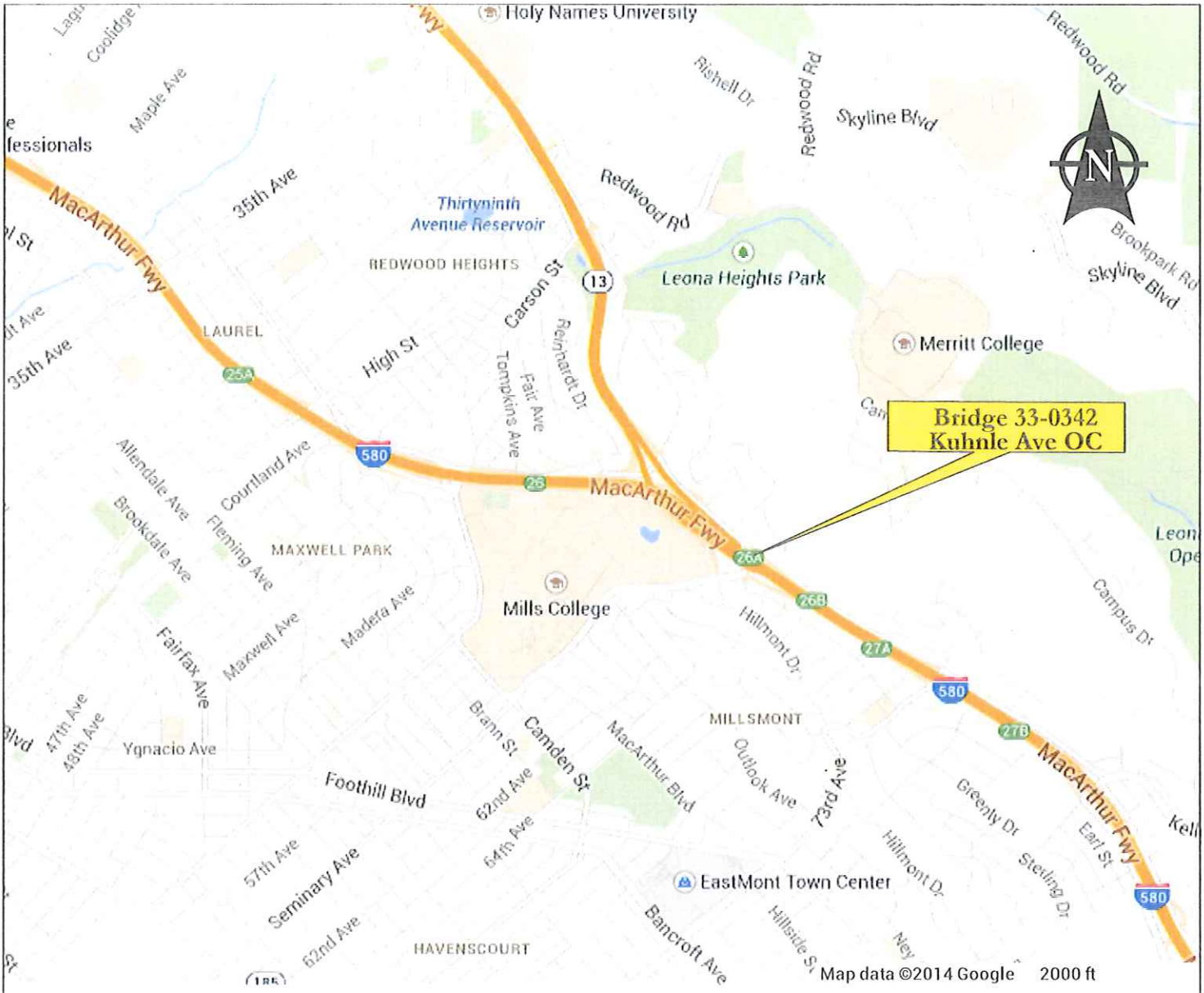
Petersen, M.D., Dawson, T.E., Chen, R., Cao, T., Wills, C.J., Schwartz, D.P, and Frankel, A.D., 2011, Fault Displacement Hazard for Strike-slip Faults, Bulletin of the Seismological Society of America, vol. 101, no. 2, p 805-825.

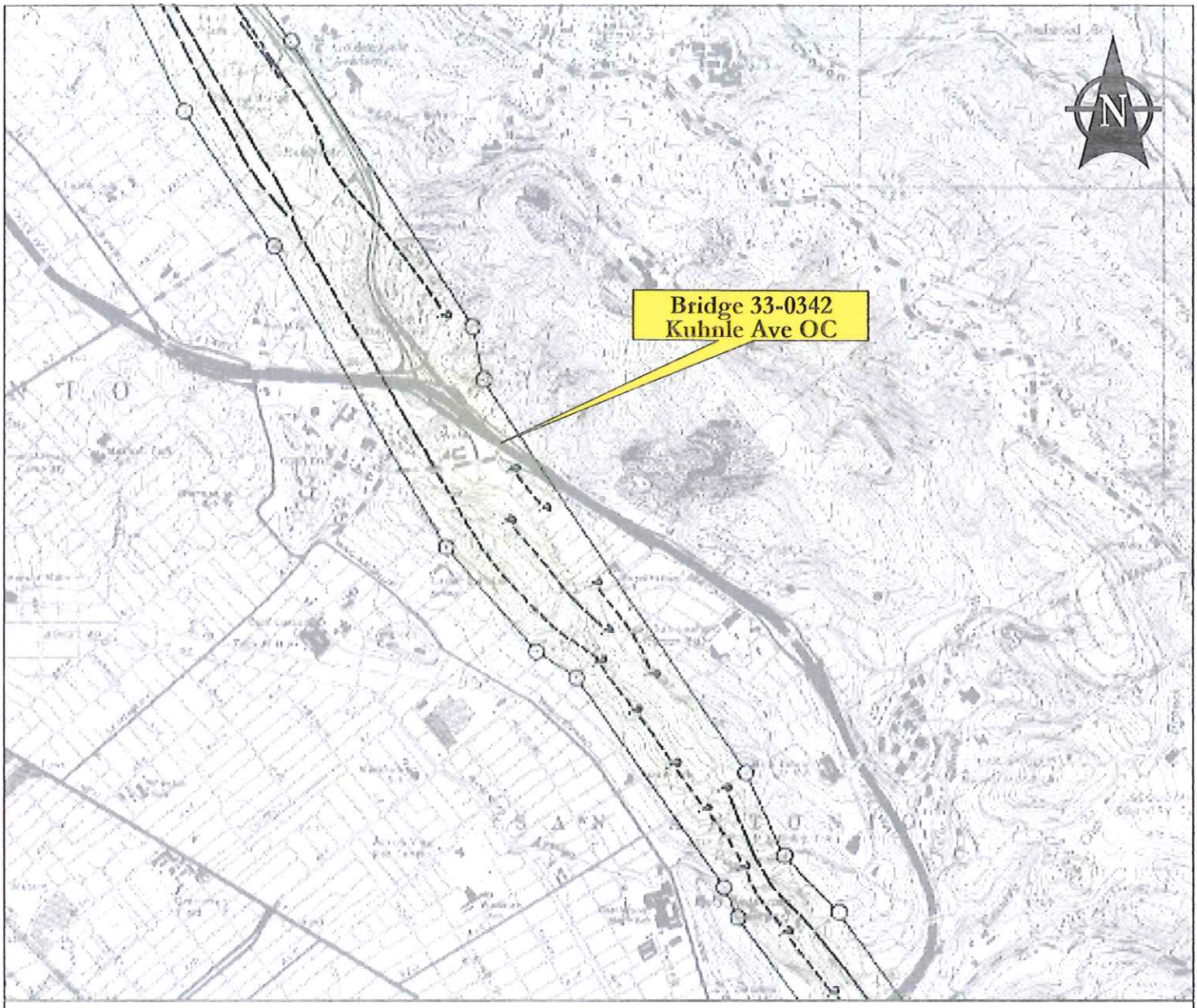
US Geological Survey, 2008, National Seismic Hazard Maps – Fault Parameters, http://geohazards.usgs.gov/cfusion/hazfaults_search/hf_search_main.cfm

Wells, D., and Coppersmith, K., 1994, New Empirical Relationships Among Magnitude, Rupture Length, Rupture Width, Rupture Area, and Surface Displacement, Bulletin of the Seismological Society of America, vol. 84, No. 4, p. 974-1002.



Base: Google Maps, no scale

Caltrans	FAULT RUPTURE POTENTIAL EVALUATION HIGHWAY 580 PM 38.92 BRIDGE 33-0342 ALAMEDA COUNTY, CALIFORNIA	LOCATION MAP
	EFIS#: 0000001016-N | JUNE 2014	FIGURE 1



Legend

1906 C

Faults considered to have been active during Holocene time and to have a relatively high potential for surface rupture; solid line where accurately located, long dash where approximately located, short dash where inferred, dotted where concealed; query (?) indicates additional uncertainty. Evidence of historic offset indicated by year of earthquake-associated event or C for displacement caused by creep or possible creep.

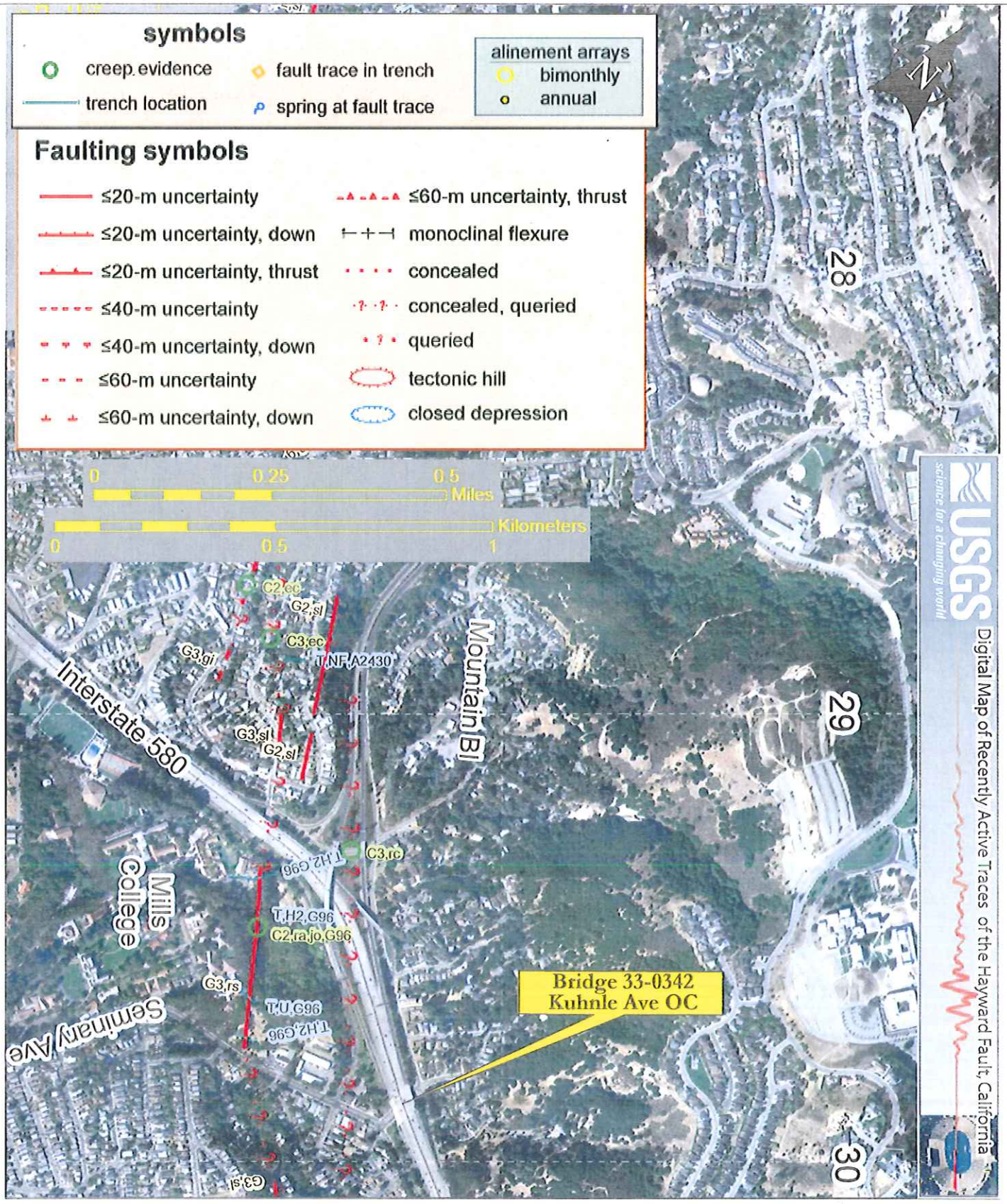
Special Studies Zone Boundaries

These are delineated as straight-line segments that connect encircled turning points so as to define special studies zone segments.

Seaward projection of zone boundary.

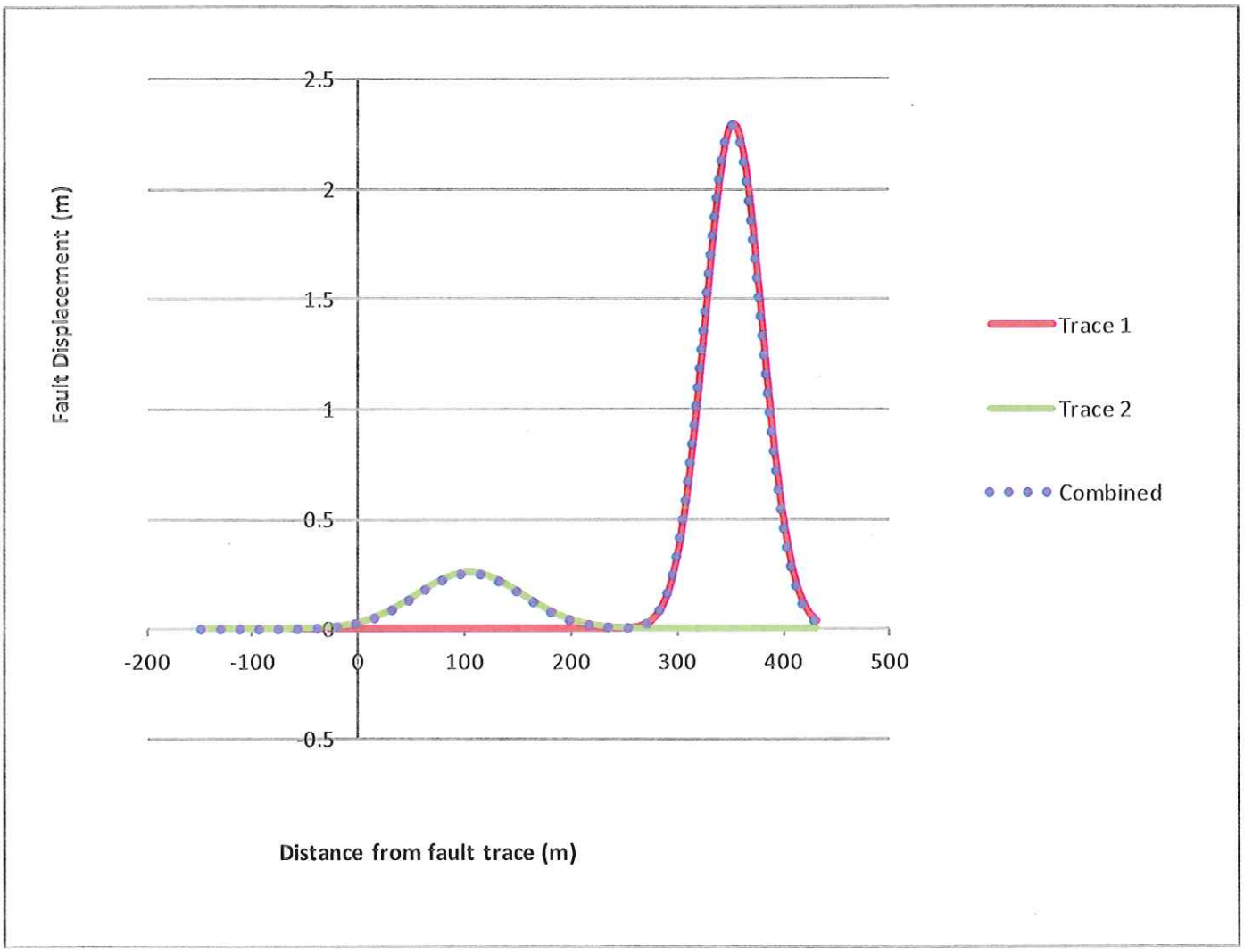
Base is State of California Special Studies Zones, Oakland East Quadrangle, 1982.
Scale: 1 inch = 2,000 feet

Caltrans	FAULT RUPTURE POTENTIAL EVALUATION HIGHWAY 580 PM 38.92 BRIDGE 33-0342 ALAMEDA COUNTY, CALIFORNIA	SPECIAL STUDIES ZONES MAP
EFIS#: 0000001016-N	JUNE 2014	FIGURE 2



Base: Map of recently active traces of the Hayward Fault, California (Lienkaemper 2008)

Caltrans	FAULT RUPTURE POTENTIAL EVALUATION HIGHWAY 580 PM 38.92 BRIDGE 33-0342 ALAMEDA COUNTY, CALIFORNIA	LIENKAEMPER 2008 FAULT LOCATION MAP
	EFIS#: 0000001016-N / JUNE 2014	FIGURE 3



Graph showing probabilistic offset on the southern Hayward fault within the bridge footprint. Offset at the bridge (distance=0) would be negligible. The smaller deterministic offset is not shown.

Caltrans	FAULT RUPTURE POTENTIAL EVALUATION HIGHWAY 580 PM 38.92 BRIDGE 33-0342 ALAMEDA COUNTY, CALIFORNIA	PROBABILISTIC OFFSET
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