Estrada, Andres

From: James Flournoy <fleurdnoix@hotmail.com>
Sent: Sunday, May 01, 2016 6:57 PM
To: Mesa CPUC
Subject: Fw: Mesa DEIR input
Attachments: Mesa overview.txt; Near Field Mesa.txt; Near Field Mesa.txt; ground motion Mesa.txt; Vertical Ground Motion Mesa.txt; seismology.txt

Please attach as comments to the DEIR
we do not see these in Scoping
WE will comment on the DEIR
We do not see a technical appendix on Geotechnical, is there one?

From: James Flournoy <fleurdnoix@hotmail.com>
Sent: Wednesday, August 5, 2015 10:07 PM
To: Mesa.CPUC@ene.com
Subject: Mesa DEIR input

Why wait till the public comment period
Why was this project not part of Tehachapi project, we'd be done by now

Comments onMesa project Planning EIR
Save Our Community
c/o 8655 Landis View
Rosemead CA 91770

Overview - references attached

Some Items that may have been overlooked but which MUST be addressed

Locations of all important, large structures and tanks must be identified, located, and their critical periods estimated

Whittier Fault system is usually underestimated

Draft SR 710 EIR shows that Whittier fault extends NNW with Geophysical contacts (Alhambra Wash branch) to the San Marino area instead of terminating in Whittier
Fault runs under 10/ Del Mar bridge and 60 Freeway near San Gabriel Blvd & Rio Hondo River, Fault crosses San Gabriel blvd South of Garvey which may be nearest point to the project.
(whittier-elsinore may interact with/ cut/ offset Puente Hills thrust)
Earth Shaking for Whittier has not been recalculated using new longer length.
Use the method on the CGS website
Beverly Blvd Bridge over Rio Hondo used 7.5 with consulting investigation by URS
more recent Montebello Hills EIR used 7.75 (before/ without considering longer length)

Project is Near fault
Possibly overlay Landers over Whittier fault for near fault effects

Directivity/ pulse, fling, heave must be considered is alluvium at site

Therefore calculate spectrum for each important structure, towers, heavy non structural objects like transformers
All data inputs into hazard analysis must be adjusted for location and severity
liquefaction and landslide studies must be run with revised data

Whittier-Elsinore is known for
Branching (Chino, Workman Hill, Whittier Heights, Montebello, Bullard and Lettis)
and
Reactivating old normal branches as strike-slip

Whittier Branches (here East Montebello fault) may branch near highway 19 (Rosemead Blvd)x San Gabriel blvd into the “Montebello fault” running E-W through the Merced Hills- which may impact project in Montebello Project Area- hopefully to the south
this branch does not appear to be reactivated See MA Thesis at Caltech Miller Quarles and others and SO CAL GAS decomissioning report at CPUC

The nexus of Whittier and the Later Puente Hills and Upper Elysian Park thrusts must be explored
The squeezing of Whittier by the shortening of the LA basin must be explored.

The squeezing may lengthen repeat times but increase severity.
Basin Depth amplification must be studied by modeling of the sycline.

Upper Elysian Park Fault
Evidently Terminates East against Whitter/ Alhambra Wash in the Project area
The SE corner of EPF must be identified and seismicity must be calculated given a NW to SE Break toward the Project. Directivity and Near-fault must be considered
Basin Depth amplification must be studied by modeling of the sycline.

Michelle Cooke of U Mass has co-authored at least Two papers showing a “Monterey Park Fault”
we have no Idea what this is- You must find out
Their crossection along the S side of the Repetto Hills would intersect Potrero Grande Sycline, may cross, may not
Our best guess is this might be a fault tip structure similar to that found W of Coalinga
Fault tips must be identified and any construction mitigated
We do not know how you would build a major structure of propagating fault tips

UEP - Montebello Fault intersection must be investigated as well as Potrero Grande Sycline, which is active and project over the deeper part. Basin Depth modeling is required through Potrero Grande Valley (old river channel)Long Period Long Duration San Andreas effects must be studied.

Puente Hills thrust must be considered as a multi segment break.
Data from SCEC simulation- Robert Graves (now Pasadena USGS) must be utilized and compared and contrasted with ARS and NGA, vertical must be recalculated
Site Specific Spectrums must be provided for and matched with each Bridge/ Structure/ Tank/ Station/ Aerial

Puente Hills/ Whittier system interaction must be investigated and discussed.

San Andreas
Long Period- Long duration data from San Andreas must be utilized from Cal State San Diego's Olsen and Day (Cybershake and subsequent), USGS Lucy Jones (Shakeout etc)
Large structures and tanks are especially vulnerable and must be identified.
This is the most probable hazard scenario
Energy is channeled down the Potrero Grande corridor.
Is the alluvium in the Potrero Grande “excitable” (is there a bowl of jelo effect?)
Ground Displacement must be determined as well as permanent ground displacement.

NGA only works well on rock site and rock path events which is not the case with San Andreas and especially path from source to site.
Community Velocity model data will show different results throughout the project area (Whittier Narrows and Potrero Grande).
Have CSUSD or SDSU provide data given your co-ordinates for each structure.
Compare and Contrast with NGA GMPE data

Liquefaction and landslide areas must be calculated using site specific long period- long duration SA fault data as well as the more common short period data.

For all faults (and structures): IN ADDITION TO SAN ANDREAS
Community Velocity Model (Soils- Basin Depth amplification) MUST be studied.
Easiest would be to use the SCEC Cybershake Platform -Rob Graves at USGS Pasadena and SCEC
Identify critical points as mentioned above but I would expand to include all transmission lines across the San Gabriel river basin (Whittier Narrows) and along the river (605 freeway) all the way to rock in the San Gabriel Mountains
Data from Whittier Fault extension must be included before simulation is run
Probability may be modified from Building Code return period (and personal risk criteria) to critical structure and post event operational criteria.
Compare and Contrast with NGA GMPE results
WE CONSIDER GMPE -NGA- Magnitude- Distance results to be totally inadequate. The do not consider basin depth or basin reflections or channeling. Community Velocity Model must be utilized for each path from each seismic source to the project.
Potrero Grande may act as a wave guide

Near Field

McGill, S.F. 1993. Near-field investigations of the Landers earthquake sequence.
April to July 1992, Science: 171-176.
Near-Field Investigations of the Landers Earthquake Sequence, April to July 1992
Sieh, Kerry and Jones, Lucile and Hauksson, Egill and Hudnut, Kenneth and Eberhard-Phillips, Donna and Heaton, Thomas and Hough, Susan and Hutton, Kate and Kanamori, Hiroo and Lilje, Anne and Lindvall, Scott and McGill, Sally F. and Mori, James and Rubin, Charles and Spotila, James A. and Stock, Joann and Thio, Hong Kie and Treiman, Jerome and Wernicke, Brian and Zachariasen, Judith (1993)
Near-Field Investigations of the Landers Earthquake Sequence, April to July 1992.
Science, 260 (5105). pp. 171-176. ISSN 0036-8075.

Campbell, K. W., Near-source attenuation of peak horizontal acceleration, Bull. Seismol. Soc. Am., 71, 2039-2070, 1981

Characterization of forward-directivity ground motions in the near-fault region
JD Bray, A Rodriguez-Marek - Soil Dynamics and Earthquake Engineering, 2004

Ground motions close to a ruptured fault resulting from forward-directivity are significantly different than other ground motions. These pulse-type motions can place severe demands on structures in the near-fault region. To aid in the characterization of these special type of ground motions, a simplified parameterization is proposed based on a representative amplitude, pulse period, and number of significant pulses in the velocity–time history.
Empirical relationships were developed for estimating the peak ground velocity (PGV) and ...

Magnitude scaling of the near fault rupture directivity pulse
PG Somerville - Physics of the earth and planetary interiors, 2003 - Elsevier
Current ground motion models all assume monotonically increasing spectral amplitude at all periods with increasing magnitude. However, near fault recordings from recent earthquakes confirm that the near fault fault-normal forward rupture directivity velocity pulse is a narrow ...
http://manishathesis.googlecode.com/svn-history/r90/trunk/Papers/somerville.pdf
Proceedings of the International Workshop on the Quantitative Prediction of Strong-Motion and the Physics of Earthquake Sources, 23–25 October 2000, Tsukuba, Japan.Tel.: +1-626-449-7650; fax: +1-626-449-3536. E-mail address: paul somerville@urscorp.com (P.G. Somerville

The conditions required for forward directivity are also met in dip slip faulting.
The alignment of both the rupture direction and the slip direction updip on the fault plane produces rupture directivity effects at sites located

around the surface exposure of the fault(or its updip projection if it does not break the surface).
Dip slip faulting produces directivity effects on the ground surface that are most concentrated in a limited region
updip from the hypocenter.

Norm Abrahamson, Ralph Archuleta

Characterization of forward-directivity ground motions in the near-fault region
http://manishathesis.googlecode.com/svn-history/r111/trunk/Papers/MarekBray.pdf
Quantitative classification of near-fault ground motions using wavelet analysis
http://www.stanford.edu/~bakerjw/Publications/Baker%20(2007)%20Pulse%20ID,%20BSSA.pd

Progress and trend on near-field problems in civil engineering
http://link.springer.com/article/10.1007/s11589-007-0105-0

Design spectra including effect of rupture directivity in near-fault region
A Rodriguez-Marek - Earthquake Engineering and Engineering …, 2006 - Springer

http://link.springer.com/article/10.1007/s11803-006-0636-8

Selection of near-fault pulse motions for use in design
Connor P. Hayden, Jonathan D. Bray, Norman A. Abrahamson, Selection of Near-Fault Pulse Motions,
Journal of Geotechnical and Geoenvironmental Engineering, 2014, 140, 7, 04014030
http://www.iitk.ac.in/nicee/wcee/article/WCEE2012_3752.pdf
connor.hayden@berkeley.edu, jonbray@berkeley.edu, abrahamson@berkeley.edu
http://ascelibrary.org/doi/abs/10.1061/%28ASCE%29GT.1943-5606.0001129

Earthquake ground motions in the near-fault region frequently have intense, double-sided pulses in the velocity-time series that can be very damaging to structures.
Many of these velocity pulses are attributed to the effects of forward directivity, which occurs when a fault ruptures toward a site.
However, pulses are not always observed in the forward directivity region, and some pulses cannot be explained by forward directivity.
The relative contribution of pulse-type motions to the overall seismic hazard should be considered when selecting records in a suite of design ground motions for a site in the near-fault region.

Read More: http://ascelibrary.org/doi/abs/10.1061/%28ASCE%29GT.1943-5606.0001129
Design ground motions near active faults Jonathan D Bray, Adrian Rodriguez-Marek, Joanne L Gillie
http://www.nzsee.org.nz/db/Bulletin/Archive/42%281%290001.pdf
Forward-Directivity (FD) in the near-fault regioncan produce intense, pulse-type motions that differ significantly from ordinaryground motions that occur further from the ruptured fault

PGVvaries significantly with magnitude, distance, and site effects.
Tv is a function of magnitude and site conditions with most of the energy being concentrated within a narrow-period band centred on the pulse period

As the number of near-fault recordings is still limited, fully nonlinear bi-directional shaking simulations are employed to gain additional insight
. It is shown that site effects generally cause Tv to increase. Although the amplification of
PGV at soil sites depends on site properties, amplification is generally observed even for very intense rock motions
. At soft soil sites, seismic site response can be limited by the yield strength of the soil, but then seismic instability may be a concern

FORWARD-DIRECTIVITY
Near-fault ground motions are significantly influenced by the rupture mechanism and slip direction relative to the site and by the permanent ground displacement at the site resulting from tectonic movement. When the rupture and slip direction relative to a site coincide, and a significant portion of the fault ruptures towards the site, the ground motion can exhibit the effects of forward-directivity (FD) [1].

Most of the energy in FD motions is concentrated in a narrow frequency band and is expressed as one or more high intensity velocity pulses oriented in the fault-normal direction.
These intense velocity pulses can lead to severe structural damage

Ground motions close to the surface rupture may also contain a significant permanent displacement, which is called fling-step, and this may lead to a high intensity velocity pulse in the direction of the fault displacement.
Pulses from fling-step have different characteristics than FD pulses

s. Whereas FD is a dynamic phenomenon that produces no permanent ground displacement and hence two-sidd velocity pulses, fling-step is a result of a permanent ground displacement that generates one sided velocity pulses.
The development of design ground motions for a project site close to an active fault should account for these special aspects of near-fault ground motion

Somerville, P. G. (1998). Development of an improved representation of near fault ground motions. In Seminar on Utilization of Strong-Motion Data, Oakland, CA, 1–20.

Somerville, P. G. (2003). Magnitude scaling of the near fault rupture directivity pulse.Physics of the Earth and Planetary Interiors 137 , no. 1, 1–12.

Kempton, J. J. and J. P. Stewart (2006). Prediction equations for significant duration of earthquake ground motions considering site and near-source effects.Earthquake Spectra 22, no. 4, 985–1013

Bray, J. D. and A. Rodriguez-Marek (2004). Characterization of forward-directivity ground mo-
tions in the near-fault region. Soil Dynamics and Earthquake Engineering 24, no. 11, 815–828
Directivity pulses are a double-sided velocity pulse caused by constructive interference of seismic waves as a rupture propagates along a fault.
They tend to occur at sites that are far from the epicenter, but close to the fault, and are strongest in the fault normal direction.
These pulsesamplify structural response at long periods and are thus a serious design concern for structures located close to a fault (Somerville et al., 1997; Somerville, 2003)

DESIGN GROUND MOTIONS NEAR ACTIVE FAULTS
Jonathan D. Bray, Adrian Rodriguez-Marek and Joanne L. Gillie
BULLETIN OF THE NEW ZEALAND SOCIETY FOR EARTHQUAKE ENGINEERING,
 Vol. 42, No. 1, March 2009
http://www.nzsee.org.nz/db/Bulletin/Archive/42%281%290001.pdf see pg 8 for References

Forward-Directivity (FD) in the near-fault region can produce intense, pulse
-type motions that differ significantly from ordinary ground motions that occur further from the ruptured fault. Near-fault FD motions typically govern the design of structures built close to active faults so the selection of design ground motions is critical for achieving effective performance without costly over-desig

Near-fault ground motions are significantly influenced by the rupture mechanism and slip direction relative to the site and by the permanent ground displacement at the site resulting from tectonic movement. When the rupture and slip direction relative to a site coincide, and a significant portion of the fault ruptures towards the site, the ground motion can exhibit the effects of forward-directivity

There are not a sufficient number of rock and soil recordings in close proximity to each other that contain near-fault FD characteristics to allow a detailed empirical study of site effects. Instead, numerical simulations are utiliz

Near-fault forward-directivity motions typically govern the design of structures built close to active faults. Hence, ground motions for use in evaluating designs in the near-fault region should be selected carefully to represent satisfactorily the unique nature of FD motions. Forward-directivity motions are often intense, pulse-type motions, which are significantly different from ordinary ground motions. These motions are best described by their velocity-time history, which requires estimation of its peak ground velocity (
PGV), predominant pulse period (Tv), and number of significant velocity pulses (Nc)

In this paper, near-fault forward-directivity effects are addressed
Somerville, P.G., Smith, N.F., Graves, R.W., and Abrahamson, N.A. (1997) “Modification of empirical strong ground motion attenuation relations to include the amplitude and duration effects of rupture directivity”. Seismological Research Letters , 68 (1), 199-222. .

Fling-step considerations are disc used in
Stewart, J.P., Chiou, S-J, Bray, J.D., Graves, R.W., Somerville, P.G., Abrahamson, N.A. (2001)
“Ground Motion Evaluation Procedures For Performance-Based Design, PEER-2001/09”.
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Baker, J. W. (2007). Quantitative classification of near-fault ground motions using wavelet analysis
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Soil Dynam.Earthq. Eng.24,no. 11, 815–828.

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Earthq. Spectra 21,no. 4, 1063–1092

Iervolino, I., and C. A. Cornell (2008). Probability of occurrence of velocity pulses in near-source ground motions, Bull.Seismol. Soc. Am.98,no. 5, 2262–2277

Mavroeidis, G. P., and A. S. Papageorgiou (2002). Near-source strong ground motion: Characterizations and design issues,
U.S. National Conference on Earthquake Engineering, Boston, Massachusetts,21–25 July 2002, 12 pp.

Somerville, P. G. (2003). Magnitude scaling of the near fault rupture directivity pulse,
Phys. Earth Planet. In.137,nos. 1/4, 201–212.

Baker J.W. (2008). Identification of near-fault velocity pulses and prediction of resulting response spectra, in Geotechnical Earthquake Engineering and Soil Dynamics IV, Sacramento, California, 10 pp.

Baker J.W. (2007). Quantitative classification of near-fault ground motions using wavelet analysis,
Bulletin of the Seismological Society of America, 97 (5), 1486-1501

Tothong P., Cornell C.A., and Baker J.W. (2007). Explicit directivity-pulse inclusion in probabilistic seismic hazard analysis, Earthquake Spectra, 23 (4), 867-891.
Forward directivity–induced velocity pulses, which may occur in near-fault (or near-source) motions, are known to cause relatively severe elastic and inelastic response in structures of certain periods

Green R.A., Lee J., White T.M., and Baker J.W., (2008) The significance of near-fault effects on liquefaction,
14th World Conference on Earthquake Engineering. Beijing, China. 8p.

Somerville, P. G., Smith, N. F., Graves, R. W., and Abrahamson, N. A. (1997).
"Modification of Empirical Strong Ground Motion Attenuation Relations to Include the Amplitude and Duration Effects of Rupture Directivity." Seismological Research Letters, 68(1), 199-222.

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http://www.ce.berkeley.edu/~mahin/CE227web/Bozorgni-CampbellCh BerteroBozorgnia.pdf 5.4.5 Effects of Near-Fault Directivity
Under certain conditions, ground motions recorded at stations located near faults can exhibit two special characteristics:
(a) fault rupture directivity or directivity pulse; and
(b) a fling step (see Chapter 2).

5.4.5.4 Engineering Implications of Near-Fault Ground Motion
These near-fault pulses can cause very large inelastic deformation demands on a structure

. The near-source elastic design spectra in the 1997 UBC are generally compatible with the average of the two horizontal components; however, this code does not specifically address the larger ground motion expected for the strike-normal component (Somerville, 1998, the International Building Code (IBC, 2000), does not explicitly have near-source factor

1996 USGS hazard maps, which are the basis for the seismic provisions in the 2000 IBC, as well as the 2002 USGS hazard maps do not specifically include directivity effects (Frankel et al. 2002

s. If one wanted to take these effects into account, the only alternative was to develop a site-specific design spectru

5.6.2 Better Understanding and Modeling of Fault Rupture Directivity and Fling Currently used wide-band modifications of ground motion relation s to develop elastic response spectra need to be enhanced to include the observed narrow-band characteristics of near-fault pulses. The observed period of such pulses increases with magnitude. Such a characteristic needs to be reliably modeled and included in the engineering prediction of ground motion. Also, there is a need to reliably quantify and simplify the effects of fault rupture directivity and fling for the design of civil engineering faciliti

5.6.3 Inclusion of the Directivity Effects in Probabilistic Hazard Analysis In the United States, the 1996 and 2002 national seismic hazard maps that provide the fundamental data for seismic design, do not include fault rupture directivity effects. The hazard analysis for sites located near active faults should incorporate such effects, once the wide-band versus narrow-band issues regarding near-fault pulses are resolved. Inclusion of such effects can have important consequences on the seismic design of civil engineering systems

BSSA Special issue Loma Prieta
http://www.bssaonline.org/content/81/5/1415.full.pdf+html with bibliography
Directional site resonances observed from aftershocks of the 18 October 1989 Loma Prieta earthquake
Ornella Bonamassa and John E. Vidale UCSC
Bulletin of the Seismological Society of America October 1991 vol. 81 no. 5 1945-1957
http://earthweb.ess.washington.edu/vidale/John_Vidale/Pubs_83-99_files/1991_Bonamassa_Vidale.pdf

The anomalous seismic response of the ground at the Tarzana hill site during the Northridge 1994 southern California earthquake: A resonant, sliding block?
1. J. A. Rial U No Carolina Chapel Hill Bulletin of the Seismological Society of America December 1996 vol. 86 no. 6 1714-1723
massa@mi.ingv.it
http://www.bssaonline.org/content/86/6/1714.short
An Experimental Approach for Estimating Seismic Amplification Effects at the Top of a Ridge, and the Implication for Ground-Motion Predictions: The Case of Narni, Central Italy
1. M. Massa,
2. S. Lovati and
3. E. D’Alema
1. Istituto Nazionale di Geofisica e Vulcanologia (INGV), Sezione di Milano-Pavia, via Bassini 15, 20133 Milano, Italy massa@mi.ingv.it
1. G. Ferretti
1. Dipartimento per lo Studio del Territorio e delle sue Risorse, Università di Genova, Viale Benedetto XV, 5, 16132 Genova, Italy

1. M. Bakavoli
Bulletin of the Seismological Society of America December 2010 vol. 100 no. 6 3020-3034
http://www.bssaonline.org/content/100/6/3020.short

From March to September 2009, a velocimetric network was installed in Narni, central Italy, a village on the top of a limestone ridge. The aim was to investigate local site effects due to the 220-m-high ridge, which is characterized by slopes ranging from 22° to 35°. To investigate amplification without and with a reference site, three stations were installed at the base of the hill and seven at the crest. The network recorded 702 earthquakes, many of them from the 2009 L'Aquila sequence. To determine the dependence of amplification on the morphological features, the spectra were computed for horizontal components rotated into a range of azimuths. Both the ratio of the horizontal-to-vertical-component spectra and the ratio of the spectra at the ridge crest with respect to a reference station at the base of the ridge showed amplification by a factor of circa 4.5 for frequencies between 4 Hz and 5 Hz. The highest amplifications were seen for the directions of the ground motion perpendicular to the main elongation of the ridge.

Interpretation of significant ground-response and structure strong motions recorded during the 1994 Northridge earthquake
1. A. F. Shakal, M. J. Huang and R. B. Darragh DMG Bulletin of the Seismological Society of America February 1996 vol. 86 no. 1B S231-S246
Some of the largest accelerations and velocities ever recorded at ground-response and structural sites occurred during the Northridge earthquake. These motions are greater than most existing attenuation models would have predicted.

Topography effect at the critical SV-wave incidence: possible explanation of damage pattern by the Whittier Narrows, California, earthquake of 1 October 1987 Bulletin of the Seismological Society of America February 1990 vol. 80 no. 1 1-22 Keiiti Aki USC
http://www.bssaonline.org/content/80/1/1.short
The results show that the amplification due to the hill relative to the flat surface is more than 1.5 for all the source models. Since this amplification is nearly independent of the source type and spectrum, we conclude that the combined effect of the topographic irregularity and critically incident SV waves might be responsible for the concentration of damage observed during the Whittier Narrows earthquake.

Mathematical Representation of Near-Fault Ground Motions Bulletin of the Seismological Society of America June 1, 2003 93:1099-1131 George P. Mavroeidis and Apostolos S. Papageorgiou
Bulletin of the Seismological Society of America June 2003 vol. 93 no. 3 1099-1131

Parameterization of fling
-
step from ground motion recordings and
simulations
,
Jack W. Baker and Lynne S. Burks Stanford

(
Poster
046
)
We identify potential data sources for fling step and discuss their value, compile a dataset of simulated and recorded ground motions containing fling, extract fling pulses from these ground motions, and derive a predictive model for fling amplitude and period that is compared to existing empirical models. Fling is the result of permanent static offset of the ground during an earthquake, but is usually ignored because ground motion records from accelerometers contain errors that make it difficult to measure static offsets. But some data sources include fling, such as specially processed recordings, ground motion simulations, and high rate global positioning systems (GPS). From this data, we extract fling pulses using the pattern search global optimization algorithm. The resulting displacement amplitudes and periods are used to create a new predictive equation for fling parameters, and are compared to existing empirical models for pulse period, fling amplitude, and surface displacement along the fault, and match reasonably well

Ground motion selection for simulation-based seismic hazard analysis,Lynne S. Burks, Brendon A. Bradley, and Jack W. Baker(Poster047)

Somerville, P. G. (2003), Magnitude scaling of the near fault rupture directivity pulse, Phys. Earth Planet. Inter., 137, 201–212.

B.T. Aagaard and T.H. Heaton, “Near-Source Ground Motions from Simulations of Sustained Intersonic and Supersonic Fault Ruptures,” Bull. Seis. Soc. Am vol. 94,no.6, 2004, pp. 2064- 2078

Spudich, P., and Chiou, B., (2008). “Directivity in NGA earthquake ground motions: Analysis using isochrone theory,” Earthquake Spectra 24. 279–298.

Potrero Grande Sycline

Include but I think not controlling
Lower Elysian Park thrust
Carson Fault
Compton Fault

Controlling
San Andreas Fault- distence is irrelevant.
What is relevant is how much shaking can it generate.
Especially at long periods and for long durations
Puente Hills Thrust (also vertical)
Whittier-Elsinore
Upper Elysian Park

Liquefaction
"The primary factors affecting the possibility of liquefaction in a soil deposit are: (1) intensity and
duration of earthquake shaking"
Study must be rerun with latest data. It must also be run with long period/ long duration seismology from the San Andreas. There is a simulation in Shakeout.
The USGS has not studied long period- long duration events

Sloughing of the sides of the chanalized rivers must be studied and reported, using also the long period- long duration San Andreas data

SCEC Tom Jordan writes in US DOE Office of Science "big iron"
The geological record suggests that huge earthquakes shook the southern part of the San Andreas Fault in 1713, 1614, 1565, 1462 and 1417. Because the intervals are between 50 and 100 years, seismologists calculate that southern California is overdue for an enormous shock. -

California, like many earthquake-prone areas of the world, has sedimentary basins filled with soft material that has eroded from mountains. Early settlers tended to establish their largest cities and towns in those flat basins – cities like Los Angeles and San Bernardino.
The soft basins "act like big bowls of jelly" during large earthquakes, Jordan says. Seismic energy in the form of large-amplitude waves is injected into them, rattling around and causing enormous motion in the very areas where people and buildings are most concentrated.

Disastrous path
"Based on our calculations, we are finding that the basin regions, including Los Angeles,
are getting larger shaking than is predicted by the standard methods," Jordan says. "By improving the predictions, making them more realistic, we can help engineers make new buildings safer."
The chance of a magnitude-8-or-greater earthquake on the southern San Andreas Fault in the next 30 years is just 2 percent, but the impact would be dramatic, especially if ground motion followed the basins toward high-population areas.

“You certainly wouldn’t want to be in that earthquake,” Jordan says. Especially in sedimentary basins, it would cause huge ground motions and last a long time.

The earthquake center has been generating large suites of earthquake simulations to estimate ground-shaking, taking into account three-dimensional effects, the directivity effect and the sedimentary basin effect.
“We model an ensemble of such earthquakes and attach probabilities to each. We start with an earthquake rupture forecast to select a large number of events that represent the possibilities for future earthquakes. We don’t know which will happen next.”
- See more at: http://ascr-discovery.science.doe.gov/bigiron/quake3.shtml#sthash.MPFjI0bv.dpuf

http://scec.usc.edu/research/cme/
http://scec.usc.edu/scecpedia/Community_Velocity_Model
SCEC's community velocity models (CVM's) provide detailed 3D properties for southern California.

CVM-H for use in fault systems analysis, strong ground motion prediction, and earthquake hazards assessment. The model describes seismic P- and S-wave velocities and densities, and is comprised of basin structures embedded in tomographic and teleseismic crust and upper mantle models.

Links broken Contact Harvard Andreas Plesch, John Shaw, Peter Suess
http://isites.harvard.edu/icb/icb.do?keyword=k93600&pageid=icb.page577442&pageContentId=icb.pagecontent1243182&state=maximize&view=view.do&viewParam_name=SCEC%20CVM%20Community%20Velocity%20Model/SCEC%20Community%20Velocity%20Modeul%20CVM-H

The CVM-H consists of basin structures defined using high-quality industry seismic reflection profiles and tens of thousands of direct velocity measurements from boreholes (Plesch et al., 2009; Süss and Shaw, 2003). The basin structures are also compatible with the locations and displacements of major faults represented in the SCEC Community Fault Model (CFM) (Plesch et al., 2007). These basin structures were used to develop travel time tomographic models of the crust (after Hauksson, 2000) extending to a depth of 35 km, and upper mantle teleseismic and surface wave models extending to a depth of 300 km (Prindle and Tanimoto, 2006). These various model components were integrated and used to perform a series of 3D adjoint tomographic inversions that highlight areas of the model that were responsible for mismatches between observed and synthetic waveforms (Tape et al, 2009). Sixteen tomographic iterations, requiring 6800 wavefield simulations, yielded perturbations to the starting model that have been incorporated in the latest model release.

CVM-S

http://www.data.scec.org/research-tools/3d-velocity.html

The purpose of the Three-Dimensional Community Velocity Model for Southern California is to provide a unified reference model for the several areas of research that depend of the subsurface velocity structure in their analysis. These include strong motion modeling, seismicity location, and tomographic velocity modeling. It is also hoped that the geologic community will find the basin models useful because they are based on structures and interfaces that are largely derived from geologic structure models. The deeper sediment velocities themselves are obtained from empirical relationships that take into account age of the formation and depth of burial. The coefficients of these relationships are calibrated to sonic logs taken from boreholes in the region. Shallow sediment velocities are taken from geotechnical borehole measurements. Hardrock velocities are based on tomographic studies.
Vp-density: The new Vp-density relation is based on density measurements from oil well samples in the Los Angeles basin and the San Gabriel Valley, geotechnical boreholes throughout southern California, and 12 oil wells along the LARSE lines. (LARSE1 ran up the San Gabriel River)
The newly determined Vp-density ratio is constant, in contrast to the old relation. This is true even for low Vp, as defined by the geotechnical data. The new densities are higher, for a given Vp, than the old. This will tend to lower the Poisson ratio, which will lower Vp/Vs; that is, changing the Vp-density relation produces a new Vs model.

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Reference V2: Magistrale, H., S. Day, R. Clayton, and R. Graves, 2000, The SCEC southern California reference three-dimensional seismic velocity model version 2, Bulletin Seismological Society of America, 90 (6B), S65-S76.*
Magistrale is at FM Global (Factory Mutual); Day at SDSU; Graves at USGS Pasadena

Reference V1: Magistrale, H., K. McLaughlin, and S. Day, 1996, A geology based 3-D velocity model of the Los Angeles basin sediments, Bulletin Seismological Society of America 86, 1161-1166

http://scec.usc.edu/research/cme/groups/broadband
The SCEC Broadband Platform is a software system which generates 0-10 Hz seismograms for historical and scenario earthquakes in California.

The goal of the SCEC Broadband Simulation Platform is to generate ground motions for a particular earthquake scenario using deterministic low-frequency and stochastic high-frequency simulations. It provides multiple approaches for generating the rupture description, modeling high- and low-frequency wave propagation, and incorporating site amplification effects. These codes have been validated against recorded ground motions from real events, to increase confidence in their results. With the Broadband Platform, a user can select which combination of approaches to use and simulate an earthquake, producing seismograms which include high and low frequency data. Ultimately these seismograms can be used to improve ground motion attenuation models, resulting in more accurate predictions of future ground motions for building engineers.

- Ralph Archuleta UC Santa Barbara Earth Science

- Scott Callaghan
- Nancy Collins
- Rob Graves USGS Pasadena
- Walter Imperatori
- Thomas Jordan SCEC
- Philip Maechling SCEC
- Kim Olsen San Diego State University
- Jan Schmedes
- Paul Somerville URS Corp Pasadena

http://scec.usc.edu/research/cme/groups/cybershake
http://scec.usc.edu/scecpedia/CyberShake_Project
SCEC's CyberShake project utilizes 3D simulations and finite-fault rupture descriptions to compute deterministic (scenario-based) and probabilistic seismic hazard in Southern California.
CyberShake is a computationally intensive way to improve standard probabilistic seismic hazard analysis
The CyberShake computational approach improves on standard PSHA calculations in a number of ways including:

1. Wave propagation simulations more accurately describe the distribution of ground motions than the currently used ground motion prediction equations [GMPE].
2. Wave propagation simulations provide good estimates of both ground motion amplitude as well as ground motion duration. Ground motion duration is not available from empirical peak ground motion methods.

http://scec.usc.edu/scecpedia/CyberShake_Data_Request

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- Graves, R., S. Callaghan, E. Deelman, E. Field, N. Gupta, T. H. Jordan, G. Juve, C. Kesselman, P. Maechling, G. Mehta, D. Meyers, D. Okaya and K. Vahi (2008) Physics Based Probabilistic Seismic Hazard Calculations for Southern California,14th World Conference on Earthquake Engineering, October, 2008, Beijing China
- The SCEC CyberShake Project: A Computational Platform for Full Waveform Seismic Hazard Analysis Robert Graves (USGS), Scott Callaghan (USC), Patrick Small (USC), Gaurang Mehta (USC), Kevin Milner (USC), Gideon Juve (USC), Karan Vahi (USC), Edward Field (USGS), Ewa Deelman (USC/ISI), David Okaya (USC), Philip Maechling (USC), Thomas H. Jordan (USC) - SSA April 2011

For Scoping the above can give you the information you need on ground Motion, XYZ seismogrms etc for PHT
You also need the Shakeout, Terrashake, "Wall to Wall" and M8 simulation data from the San Andreas

You can Calculate the Seismic Source effects, Path effects using the velocity model (CVM) and site effects (bowl of jello in this case) but good news the work has already been done.

What you can't do is just use magnitued distence relationships (which might work if there was rock all the way from seismic sources to a rock site) even with a basin depth factor. Just not adequate in Project area

VERTICAL GROUND MOTION

New Chapter 23, Vertical Ground Motions for Seismic Design
Add the following new Chapter 23 and renumber the existing ASCE/SEI 7-05 Chapter 23 as Chapter 24: site-specific procedures MUST be used, and included "a site-specific study may be performed to obtain Sav at vertical periods less than or equal to 2.0 seconds, but the value so determined shall not be less than 80 percent of the
Sav value determined from Equations 23.1-1 through 23.1-4. and
23.2 MCER VERTICAL RESPONSE SPECTRUM.
The MCER vertical response spectral acceleration shall be 150 percent of the Sav determined in Section 23.1. read at least 150% when site specific study is utilized

VERTICAL GROUND MOTIONS FOR SEISMIC DESIGN
Chapter C23.1 DESIGN VERTICAL RESPONSE SPECTRUM
General.
ASCE/SEI 7-05 and the earlier editions of the Provisions use the term 0.2 SDSD to reflect the effects of vertical ground motion.
Where a more explicit consideration of vertical ground motion effects is advised—as for certain tanks, materials storage facilities, and electric power generation facilities—BACKUP GENERATORS the requirements of this chapter may be applied. Professional practices interpret may as must

Historically, the amplitude of vertical ground motion has been inferred to be two-thirds (2/3) the amplitude of the horizontal ground motion.

However, studies of horizontal and vertical ground motions over the past 25 years have shown that such a simple approach is not valid in many situations (e.g., Bozorgnia and Campbell, 2004, and references therein) for the following main reasons:
(a) vertical ground motion has a larger proportion of short-period (high-frequency) spectral content than horizontal ground motion and this difference increases with decreasing soil stiffness and

(b) vertical ground motion attenuates at a higher rate than horizontal ground motion and this difference increases with decreasing distance from the earthquake lead to the following observations regarding the vertical/horizontal (V/H) spectral ratio (Bozorgnia and Campbell, 2004):

1. The V/H spectral ratio is relatively sensitive to: spectral period, distance from the earthquake, local site conditions, and earthquake magnitude (but only for relatively soft sites) and relatively insensitive to earthquake mechanism and sediment depth;

2. The V/H spectral ratio has a distinct peak at short periods that generally exceeds 2/3 in the near-source region of an earthquake; and

3. The V/H spectral ratio is generally less than 2/3 at mid-to-long periods. Therefore, depending on the period, the distance to the fault, and the local site conditions of interest, use of the traditional

2/3V/H spectral ratio can result in either an underestimation or an overestimation of the expected vertical ground motions.

The procedure for defining the design vertical response spectrum in the Provisions is based on the studies of horizontal and vertical ground motions conducted by Campbell and Bozorgnia (2003) and Bozorgnia and Campbell (2004).
These procedures are also generally compatible with the general observations of Abrahamson and Silva (1997) and Silva (1997) and the proposed design procedures of Elnashai (1997).

HOWEVER FOR THE SPECIAL CASE Potrero Grande Sycline AREA SIMULATION MUST BE UTILIZED
Maps are inadequate site-specific procedures MUST be used, and included "a site-specific study may be performed to obtain Sav at vertical periods less than or equal to 2.0 seconds, but the value so determined shall not be less than 80 percent of the Sav value determined from Equations 23.1-1 through 23.1-4.

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Vertical Ground Motions Cal Trans after Northridge

High levels of vertical acceleration were recorded during the Northridge earthquake.
This was in a frequency range that could excite structures to ductilities of 2 or higher.

The high vertical acceleration usually was accompanied with very large horizontal shaking.

This high vertical acceleration appears to be related to the near field behavior of thrust faults.

Since blind thrust faults may be a problem for California, it may be prudent to develop some criteria to deal with them.

A vertical response spectra was used for the replacement of the 5/14 Connector overcrossing Bridge #53-27950 (Figure 2).

It is an envelope of five vertical acceleration records obtained during the Northridge earthquake. No decision has been made so far on including this type of response spectra in a future bridge code.

Caltrans recommended that engineers working on the 5/14 Interchange Replacement Project also design the super-structure for a vertical force of 1.5 g in an upward direction and 0.5 g in a downward direction.

Moments and shears for this loading were combined with moments and shears for an unfactored dead load and compared to all other loading cases.

The superstructure was designed for the critical loads.
End conditions were carefully considered so that if a bridge had a seat type abutment, the end condition would be a cantilever for the upward direction.

However, tiedowns should probably be provided where uplift is a problem. The moment capacity of columns would also be much lower as the axial load becomes smaller.

Areas that are especially vulnerable for vertical loads would be Outriggers, C-Bents and very long spans.

The end result of all of this was the addition of a nominal amount of mild steel being placed in the soffit near the supports and the top deck at midspan for superstructure moments caused by upward vertical loads.

Other areas that should be examined are the bent cap to superstructure connection, girder stirrups, and bearing devices.

It is proposed to have an additional Group VII load case as shown below:

Proposed EQ Load Case 3 = l.O(DL) + l.O C Vert. ARS) -I- 0.3(Long. ARS) + 0.3(Trans. ARS)

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5.4.6 Vertical Ground Motion
Characteristics of the vertical component of ground motion are significantly different than those of the horizontal component. This is clearly evident in the recorded ground acceleration time histories. Compare, for example, the vertical ground acceleration recorded at Rinaldi Receiving Station during the Northridge earthquake (Figure 5.33) with that of the horizontal component recorded at this same station (Figure 5.29). It is evident from this comparison that the vertical component is richer in high frequency content than the horizontal component. This results in high vertical response spectral ordinates at short periods (Figure 5.5)

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Interseismic Strain Accumulation Across Metropolitan Los Angeles: Puente Hills Thrust
,
Donald F. Argus, NASA/JPL Zhen Liu,
Michael B. Heflin, Angelyn W. Moore,
Susan Owen, Paul Lundgren, Vicki G. Drake, and Ivan I. Rodriquez-Pinto

The Puente Hills Thrust and nearby thrust faults (such as the upper Elysian Park Thrust) are slipping at 9 ±2 mm/yr beneath a locking depth of 12 ±5 km (95% confidence limits).
Incorporating sedimentary basin rock either reduces the slip rate by 10 per cent or increases the locking rate by 20 per cent.
The 9 mm/yr rate for the Puente Hills Thrust and nearby faults exceeds the cumulative 3–5 mm/yr rate estimated using paleoseismology along the Puente Hills Thrust (1.2–1.6 mm/yr, Dolan et al. 2003), upper ElysianPark Thrust (0.6–2.2 mm/yr, Oskin et al. 2000), and western Compton Thrust (1.2 mm/yr, Leon et al. 2009], though all the paleoseismic estimates are minimums.
We infer that M 7 earthquakes in northern metropolitan Los Angeles may occur more frequently that previously thought

Luminescence dating inter-comparison for sediments associated with the Puente Hills Blind-Thrust System recovered from cores, Wendy A. Barrera, UCLA Edward J. Rhodes, Madhav K. Murari, Lewis A. Owen, Michael J. Lawson, Kristian J. Bergen, James F. Dolan, and John H. Shaw
(Poster 138)
Using Risk Targeted Ground Motions to Evaluate Seismic Hazard Models, Peter M. Powers USGS (Poster 050

The ambient seismic noise approach is promising because it can be used to estimate expected long -period ground motions even though strong ground motion from earthquakes that would excite that shaking have not yet been recorded instrumentally Denolle et al. (2014a&b)

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The Los Angeles basin region shows very strong amplification for CVM-S4 with PGV exceeding 50 cm/s throughout most of the basin, and reaching nearly 200 cm/s in the Whitter-Narrows region connecting the San Gabriel and LA basins. Robert Graves 2014

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Compares different velocity models, emperical relationships

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The backbone of UCERF3 is the long-term, time-independent model (UCERF3-TI), which was published as a USGS Open-File Report on Nov. 5, 2013, and includes a main report, 20 appendices, and various supplements (http://pubs.usgs.gov/of/2013/1165/).

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Reducing Epistemic Uncertainty in Seismic Risk Estimation,
Norm Abrahamson(PG&E) Sunday, September
http://www.scec.org/meetings/2014am/SCEC2014Proceedings.pdf 7, 2014 (18:00)
For most critical infrastructure, seismic safety is evaluated using standards based seismic design criteria, but there is a move to also consider risk-informed regulation and risk-informed decision making as part of seismic safety. The residual risk of critical infrastructure that meet the standards-based criteria should be considered with a long-term goal of risk reduction over decades.
P111

047Ground motion selection for simulation-based seismic hazard analysis, Lynne S. Burks, Brendon A. Bradley, and Jack W. Bake

Reducing Epistemic Uncertainty in Seismic Risk Estimation, Norman A. Abrahamson

For most critical infrastructure, seismic safety is evaluated using standards-based seismic design criteria, but there is a move to also consider risk-informed regulation and risk-informed decision making as part of seismic safety. The residual risk of critical infrastructure that meet the standards-based criteria should be considered with a long term goal of risk reduction over decades.
A key impediment to risk-informed regulation is that the epistemic uncertainty in the current estimates of seismic risk is huge, making it difficult to determine if the risk is small enough or to distinguish between the risks for different facilities for prioritization of mitigation efforts.
Of the three main parts of seismic risk(seismic hazard, structure capacity, and consequences of a failure), the largest source of epistemic uncertainty in the seismic risk is due to the uncertainty in the seismic hazard, and in particular, in the ground motion model for a given site and seismic source.
The greatly expanded ground motion data sets available in the last decade have shown that the systematic site and path effects account for about 50% of the aleatory variance in typical global ground motion models that use the ergodic assumption and the region-specific source effects account for an additional 15-20%.
While we know the aleatory variability in ergodic ground motion models is too large, using the reduced aleatory variability requires estimation of the site/source-specific effects on the median ground motions.
Properly capturing these site/source-specific effects can drastically change the estimates of seismic risk for a particular structure.

To be able to have useful seismic risk estimates, regulators and owners of critical infrastructure need improved site-specific seismic hazard models that capture the systematic source and path effects. Path effects can be estimated using analytical modeling of wave propagation in a 3-D crustal model, such as cybershake, but before s such models are used in engineering applications, they require adequate validation against recorded data.

The current seismic instrumentation in California does not provide the density of stations required to adequately validate the analytical 3 - D models for engineering applications.

Greatly expanded seismic instrumentation in the regions around critical infrastructure will be needed in the next decade to support the move to risk-informed decision making and optimizing seismic risk reduction

Adjoint analysis of the source and path sensitivities of basin-guided Waves Steven M. Day,Daniel Rotenand Kim B. Olsen 1Geophys. J. Int.(2012)189,1103–11
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