APPENDIX D

PRELIMINARY GEOTECHNICAL AND GEOHARZARDS REPORT

Preliminary Geotechnical and GeoHazards Report

Wistaria Ranch Solar Energy Center
Rockwood Road – Schaniel Road to All American Canal (International Border)
Calexico, California

Prepared for:

Wistaria Ranch Solar, LLC
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Geo-Engineers and Geologists

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December 2013
(Revised February 2014)

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February 10, 2014

Mr. Kyle Gerking
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Omaha, NE 68154

Preliminary Geological and Geotechnical Hazard Evaluation
Wistaria Ranch Solar Energy Center
Rockwood Road – Schaniel Road to All American Canal (International Border)
Calexico, California
LCI Project No. LE12184

Dear Mr. Gerking:

This preliminary geotechnical report and geologic hazards study is provided for preliminary site evaluation and permitting of the photo-voltaic solar farm at the approximately 2,793-acre project area located between Schaniel Road (north) and the All American Canal (south) along Rockwood Road approximately 6 miles west of Calexico, California. The project site covers a distance of about 5 miles (north to south) and will be constructed in phases.

Scope of Work

The scope of work consisted of a geologic and geotechnical hazards evaluation of the project site which addresses the following items:

1. Site location in relation to mapped earthquake faults and seismic zones.
2. Review of published geologic literature and maps.
3. Intensity of ground shaking at the site determined by probabilistic methods (10% probability of occurrence in 50 years).
4. Potential for liquefaction, ground failure, and landslides at the site.
5. Potential for expansive soil hazards at the site including methods for mitigation.
6. Potential for flooding at the site from man-made facilities (dams, canals, etc.) and from natural storms.
7. Ability of site soils to support individual or community sewage disposal system leach fields.

Site Description

The project site is located along Rockwood Road between Schaniel Road to the north and the All American Canal (U.S./Mexico International Border) to the south and between Brockman Road (west) and Ferrell Road (east). The project site is comprised of thirty-four (34) separate parcels consisting of agricultural use lands currently in crop production. Several paved rural roads cross the project site. State Highway 98 crosses the project site in an east-west direction.

Agricultural fields are located around the perimeter of each of the project parcels. Dirt field roads are located along the margins and also cross the parcels. The adjacent properties are approximately the same elevation as the project sites, except along portions of the northeast area of the project, which abut the 35 foot deep incised flood channel of the New River. The International Border with the Republic of Mexico is located south of the project site.

Site Geological Conditions

Site Geology: The project site is located in the Imperial Valley portion of the Salton Trough physiographic province. The Salton Trough is a topographic and geologic structural depression resulting from large scale regional faulting. The trough is bounded on the northeast by the San Andreas Fault and Chocolate Mountains and the southwest by the Peninsular Range and faults of the San Jacinto Fault Zone. The Salton Trough represents the northward extension of the Gulf of California, containing both marine and non-marine sediments since the Miocene Epoch. Tectonic activity that formed the trough continues at a high rate as evidenced by deformed young sedimentary deposits and high levels of seismicity. Figure 1 shows the location of the site in relation to regional faults and physiographic features.

The Imperial Valley is directly underlain by lacustrine deposits, which consist of interbedded lenticular and tabular silt, sand, and clay. The Late Pleistocene to Holocene lake deposits are probably less than 100 feet thick and derived from periodic flooding of the Colorado River which intermittently formed a fresh water lake (Lake Cahuilla).

Older deposits consist of Miocene to Pleistocene non-marine and marine sediments deposited during intrusions of the Gulf of California. Basement rock consisting of Mesozoic granite and Paleozoic metamorphic rocks are estimated to exist at depths between 15,000 - 20,000 feet.

Based on Unified Soil Classification System, the permeability of these soils is expected to be low to very low.

Groundwater: The groundwater in the site area is brackish and typically encountered at a depth of 5 to 10 feet below ground surface in the vicinity of the project site. There is uncertainty in the accuracy of short-term water level measurements, particularly in fine-grained soil. Groundwater levels may fluctuate with precipitation, irrigation of adjacent properties, drainage, and site grading. The groundwater level noted should not be interpreted to represent an accurate or permanent condition.

The shallow groundwater levels will need to be considered when siting Onsite Wastewater Treatments Systems (septic tank and leach fields) for the O&M Building location(s). The shallow groundwater will also require that deep drilled pier foundations for the Gen-Tie line are cased to prevent excavation collapse during construction activities.

Onsite Wastewater Disposal: The near surface soils at the project site (all CUP areas) generally consist of silty clays and clays having a very low to low infiltration rate. The near surface soils are considered poor in supporting onsite septic systems and leach fields for wastewater disposal. Site specific studies will be required to determine that State health standards are met in regard to soil percolation rates and vertical separation of leach fields from shallow groundwater.

Geological Hazards

Landsliding: No ancient landslides are shown on geologic maps of the region and no indications of landslides were observed during our site investigation. The hazard of landsliding is unlikely due to the relatively planar topography of the project site; however, the northeastern margin of the project site (CUP's 13-0047, 13-0046, and 13-0045) is located adjacent to the incised New River channel. The bluffs range from 25 to 35 feet high and have a potential for small to moderate-scale landslides. Typical remedial action along the New River bluff consists of either re-grading the bluff slope to 2 horizontal to 1 vertical or to set back permanent structures beyond a 2:1 slope angle projected from the toe of the bluff slope. Typically, solar generation facility structures will require a setback from the top of the bluff equal to the height of the bluff above the New River flood plain.

Volcanic hazards: The site is not located proximal to any known volcanically active area and the risk of volcanic hazards is considered very low.

Tsunamis, seiches, and flooding: The site does not lie near any large bodies of water, so the threat of tsunami, seiches, or other seismically-induced flooding is considered unlikely. The All American Canal is located south of the project site (abuts the southern-most parcels). The water level in the All American Canal is at or slightly above the site elevation. There is a potential for sheet flooding of the southern portion of the site (CUPs 13-0050, 13-0051, and 13-0052) if the earthen embankments of the All American Canal are breached during a strong seismic event. Buildings and any substations should be elevated above any potential flood elevation should the embankments of the All American Canal breach.

Expansive and Corrosive soil: In general, much of the near surface soils within the project site (all CUP's) consist of silty clays and clays having a high to very high expansion potential and which are highly corrosive. The clay is expansive when wetted and can shrink with moisture loss (drying). Development of building foundations, concrete flatwork, and asphaltic concrete pavements should include provisions for mitigating potential swelling forces and reduction in soil strength, which can occur from saturation of the soil.

The expansive soils do not significantly affect driven steel posts (for supporting solar panel frames) or drilled pier foundations for the Gen-Tie transmission line.

All soils within the ancient lake bed in which the Imperial Valley is formed are moderately to highly corrosive to steel and concrete. Bare steel exposed to the native soils will require corrosion projection such as epoxy coatings, galvanizing, sacrificial (excess) metal thickness and/or cathodic protection. Reinforcing bars are protected from corrosion by utilizing a 3 to 5 inch concrete cover over all rebar exposed to the native soil. Additionally, concrete mixes are required to utilize increased quantities of Type II or Type V Portland cement to achieve a minimum strength of 4,500 psi compressive strength and be placed at low water-cement ratio (0.45 maximum by weight).

Liquefaction/Seismic Settlements: Liquefaction is a potential design consideration because of possible saturated sandy substrata underlying the site (all CUP's). Liquefaction occurs when granular soil below the water table is subjected to vibratory motions, such as produced by earthquakes. With strong ground shaking, an increase in pore water pressure develops as the soil tends to reduce in volume. If the increase in pore water pressure is sufficient to reduce the vertical effective stress (suspending the soil particles in water), the soil strength decreases and the soil behaves as a liquid (similar to quicksand). Liquefaction can produce excessive settlement, ground rupture, lateral spreading, or failure of shallow bearing foundations.

Four conditions are generally required for liquefaction to occur:

(1) the soil must be saturated (relatively shallow groundwater);
(2) the soil must be loosely packed (low to medium relative density);
(3) the soil must be relatively cohesionless (not clayey); and
(4) groundshaking of sufficient intensity must occur to function as a trigger mechanism.

All of these conditions may exist to some degree at this site (all CUP's). Liquefaction settlement and ground fissures are common occurrences in the bottom lands of the incised New River flood channel during strong seismic events. Solar facility improvements placed in the New River flood plain bottom lands will need site specific liquefaction studies. The independent nature of Gen-Tie foundations, electrical substation/switchgear equipment and steel posts to support solar panel frames do not generally require mitigation for small seismic settlements typical of the lake bed sediments within the proposed Wistaria Ranch Solar Energy Center.

Seismic Hazards

The project site is located in the seismically active Imperial Valley of southern California and is considered likely to be subjected to moderate to strong ground motion from earthquakes in the region.

Groundshaking. Imperial Valley has numerous mapped faults of the San Andreas Fault System traversing the region. The San Andreas Fault System is comprised of the San Andreas, San Jacinto, and Elsinore Fault Zones in southern California.

The Imperial fault represents a transition from the more continuous San Andreas fault to a more nearly echelon pattern characteristic of the faults under the Gulf of California (USGS 1990). We have performed a computer-aided search of known faults or seismic zones that lie within a 62 mile (100 kilometer) radius of the project site (Tables 1a-c).

A fault map illustrating known active faults relative to the site is presented on Figure 1, *Regional Fault Map*. Figure 2 shows the project site in relation to local faults. The criterion for fault classification adopted by the California Geological Survey defines Earthquake Fault Zones along active or potentially active faults. An active fault is one that has ruptured during Holocene time (roughly within the last 11,000 years).
A fault that has ruptured during the last 1.8 million years (Quaternary time), but has not been proven by direct evidence to have not moved within Holocene time is considered to be potentially active. A fault that has not moved during Quaternary time is considered to be inactive. Review of the current Alquist-Priolo Earthquake Fault Zone maps (CGS, 2000a) indicates that the nearest mapped Earthquake Fault Zone is an unnamed fault located approximately 3 to 5 miles west of the project site. The unnamed fault was recently identified and zoned after the April 4, 2010 magnitude $7.2M_w$ El Mayor-Cucapah earthquake.

CBC General Ground Motion Parameters: The 2013 CBC general ground motion parameters are based on the Risk-Targeted Maximum Considered Earthquake (MCE_R). The U.S. Geological Survey "U.S. Seismic Design Maps Web Application" (USGS, 2013) was used to obtain the site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters. The site soils have been classified as Site Class D (stiff soil profile).

Design spectral response acceleration parameters are defined as the earthquake ground motions that are two-thirds (2/3) of the corresponding MCE_R ground motions. Design earthquake ground motion parameters are provided in Table 2. A Risk Category I was determined using Table 1604.5 and the Seismic Design Category is D since S_1 is less than 0.75.

The Maximum Considered Earthquake Geometric Mean (MCE_G) peak ground acceleration (PGA_M) value was determined from the "U.S. Seismic Design Maps Web Application" (USGS, 2013) for liquefaction and seismic settlement analysis in accordance with 2013 CBC Section 1803.5.12 and CGS Note 48 ($PGA_M = F_{PGA}*PGA$). A PGA_M value of 0.50g is used for liquefaction settlement analysis.

Surface Rupture: The project site does not lie within a State of California, Alquist-Priolo Earthquake Fault Zone. Surface fault rupture at the project site is considered to be low. Ground failures (lateral spreading) were noted along the embankments of the All

American Canal after the April 4, 2010 magnitude 7.2M_w El Mayor-Cucapah earthquake. However, except for the river bottom areas, all recorded lateral spreading failures have been found to be within the right-of-ways for the Imperial Irrigation District canals and drains, which are not being proposed for Wistaria Solar Energy Center improvements.

Other Hazards

Hazardous Materials: The site is not located in proximity to any known hazardous materials (methane gas, tar seeps, hydrogen sulfide gas), and the risk of hazardous materials is considered very low.

Radon 222 Gas: Radon gas is not believed to be a potential hazard at the site. A report titled "California Statewide Radon Survey-Screening Results", dated November 1990 and published by the California State Department of Health Services, notes that Southern California showed a low risk of elevated radon levels, based on 2-day tests conducted from January through April 1990. Some of the reported testing was performed in Imperial County; however, no data was observed as being at or near the project site.

Naturally occurring asbestos: The site is not located in proximity to any known naturally occurring asbestos, and the risk of naturally occurring asbestos is considered very low.

Hydrocollapse: The site is dominantly underlain by clays that are not expected to collapse with the addition of water to the site. The risk of hydrocollapse is considered very low.

Regional Subsidence: Regional subsidence has not been documented in the area west of the New River; therefore, the risk of regional subsidence is considered low.

Conclusion

This preliminary report was prepared according to the generally accepted *geotechnical engineering standards of practice* that existed in Imperial County at the time the report was prepared. No express or implied warranties are made in connection with our services.

The project will be constructed in phases (Plate A-5). The geotechnical and geological hazards discussed in this report will apply to all phases of the project site, except as discussed in the Landslides and Flooding sections of this report.

Our research did not reveal conditions that would preclude implementation of the proposed project provided site specific geotechnical investigations are conducted prior to site development to provide recommendations for the design and construction of this project.

Sincerely Yours;
Landmark Consultants, Inc.

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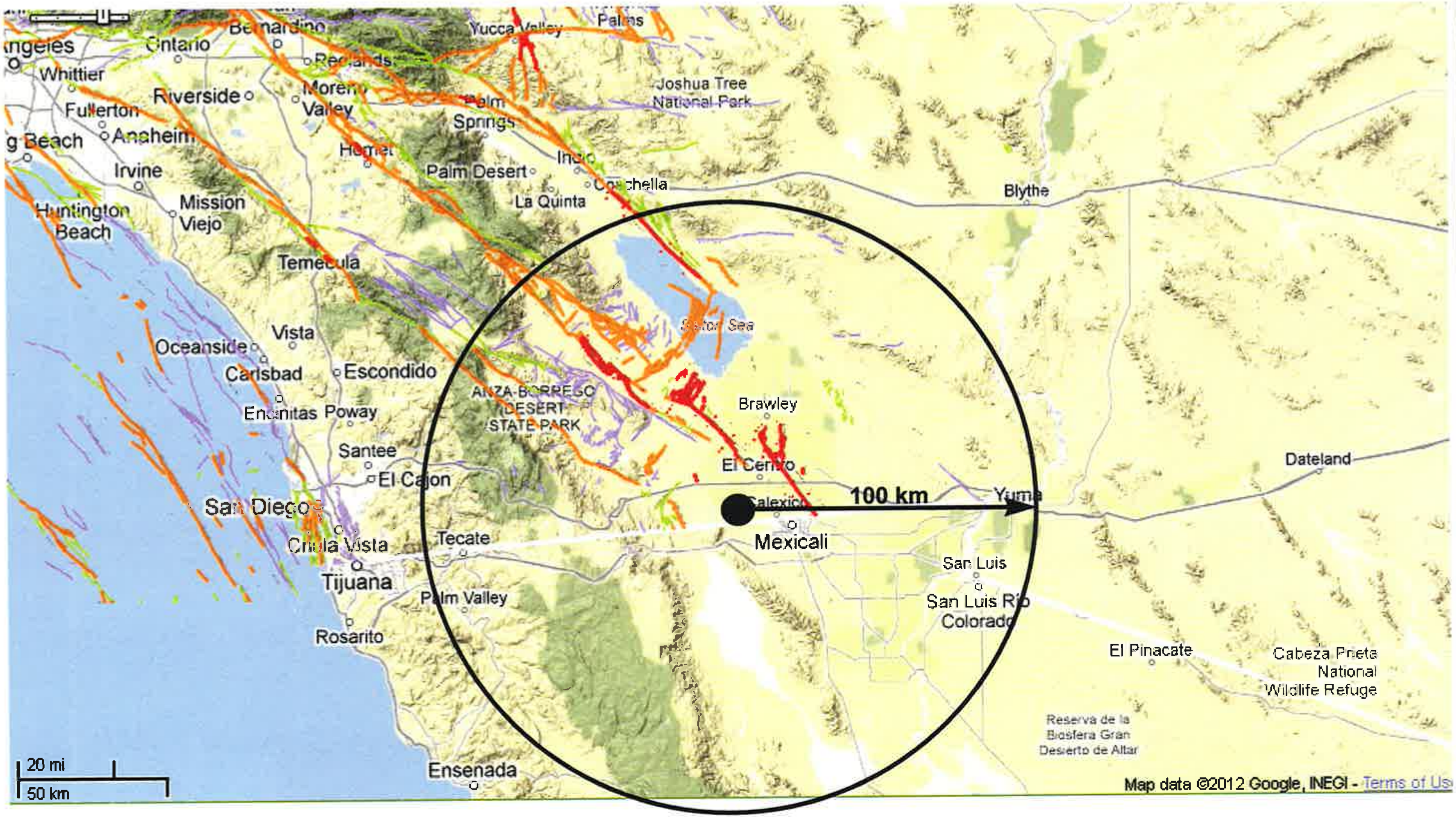
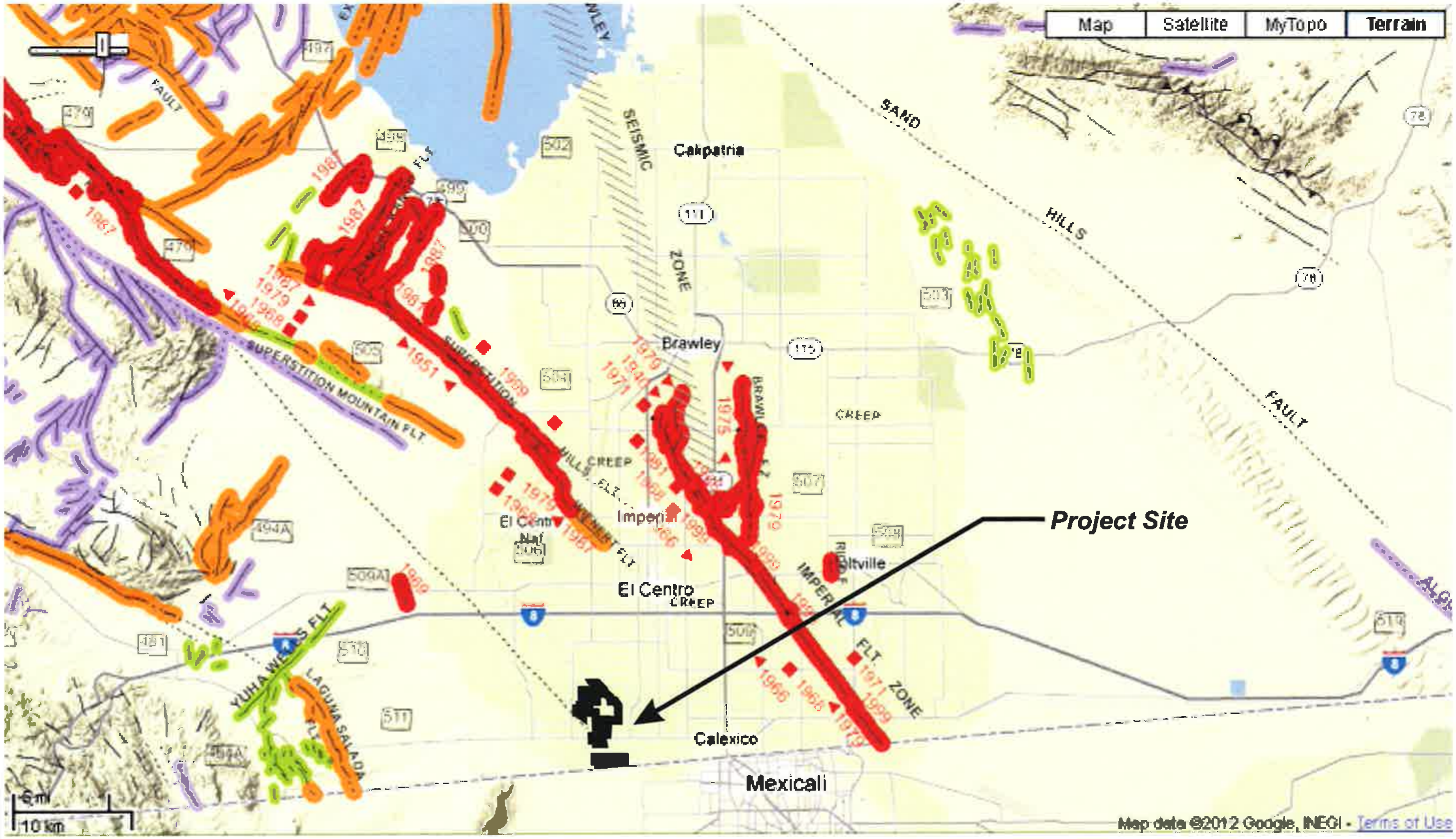


Source: California Geological Survey 2010 Fault Activity Map of California
http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html#

LANDMARK Geo-Engineers and Geologists Project No.: LE12184	Regional Fault Map	Figure 1



Source: California Geological Survey 2010 Fault Activity Map of California
http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html#

LANDMARK Geo-Engineers and Geologists Project No.: LE12184	Map of Local Faults	Figure 2

EXPLANATION

Fault traces on land are indicated by solid lines where well located, by dashed lines where approximately located or inferred, and by dotted lines where concealed by younger rocks or by lakes or bays. Fault traces are queried where continuation or existence is uncertain. Concealed faults in the Great Valley are based on maps of selected subsurface horizons, so locations shown are approximate and may indicate structural trend only. All offshore faults based on seismic reflection profile records are shown as solid lines where well defined, dashed where inferred, queried where uncertain.

FAULT CLASSIFICATION COLOR CODE
(Indicating Recency of Movement)

Fault along which historic (last 200 years) displacement has occurred and is associated with one or more of the following:

(a) a recorded earthquake with surface rupture. (Also included are some well-defined surface breaks caused by ground shaking during earthquakes, e.g. extensive ground breakage, not on the White Wolf fault, caused by the Arvin-Tehachapi earthquake of 1952). The date of the associated earthquake is indicated. Where repeated surface ruptures on the same fault have occurred, only the date of the latest movement may be indicated, especially if earlier reports are not well documented as to location of ground breaks.

(b) fault creep slippage - slow ground displacement usually without accompanying earthquakes.

(c) displaced survey lines.

A triangle to the right or left of the date indicates termination point of observed surface displacement. Solid red triangle indicates known location of rupture termination point. Open black triangle indicates uncertain or estimated location of rupture termination point.

Date bracketed by triangles indicates local fault break.

No triangle by date indicates an intermediate point along fault break.

Fault that exhibits fault creep slippage. Hachures indicate linear extent of fault creep. Annotation (creep with leader) indicates representative locations where fault creep has been observed and recorded.

Square on fault indicates where fault creep slippage has occured that has been triggered by an earthquake on some other fault. Date of causative earthquake indicated. Squares to right and left of date indicate terminal points between which triggered creep slippage has occurred (creep either continuous or intermittent between these end points).

Holocene fault displacement (during past 11,700 years) without historic record. Geomorphic evidence for Holocene faulting includes sag ponds, scarps showing little erosion, or the following features in Holocene age deposits: offset stream courses, linear scarps, shutter ridges, and triangular faceted spurs. Recency of faulting offshore is based on the interpreted age of the youngest strata displaced by faulting.

Late Quaternary fault displacement (during past 700,000 years). Geomorphic evidence similar to that described for Holocene faults except features are less distinct. Faulting may be younger, but lack of younger overlying deposits precludes more accurate age classification.

Quaternary fault (age undifferentiated). Most faults of this category show evidence of displacement sometime during the past 1.6 million years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age. Unnumbered Quaternary faults were based on Fault Map of California, 1975. See Bulletin 201, Appendix D for source data.

Pre-Quaternary fault (older that 1.6 million years) or fault without recognized Quaternary displacement. Some faults are shown in this category because the source of mapping used was of reconnaissnce nature, or was not done with the object of dating fault displacements. Faults in this category are not necessarily inactive.

ADDITIONAL FAULT SYMBOLS

Bar and ball on downthrown side (relative or apparent).

Arrows along fault indicate relative or apparent direction of lateral movement.

Arrow on fault indicates direction of dip.

Low angle fault (barbs on upper plate). Fault surface generally dips less than 45° but locally may have been subsequently steepened. On offshore faults, barbs simply indicate a reverse fault regardless of steepness of dip.

OTHER SYMBOLS

Numbers refer to annotations listed in the appendices of the accompanying report. Annotations include fault name, age of fault displacement, and pertinent references including Earthquake Fault Zone maps where a fault has been zoned by the Alquist-Priolo Earthquake Fault Zoning Act. This Act requires the State Geologist to delineate zones to encompass faults with Holocene displacement.

Structural discontinuity (offshore) separating differing Neogene structural domains. May indicate discontinuities between basement rocks.

Brawley Seismic Zone, a linear zone of seismicity locally up to 10 km wide associated with the releasing step between the Imperial and San Andreas faults.

Geologic Time Scale			Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION: ON LAND	DESCRIPTION: OFFSHORE
Quaternary	Late Quaternary	Historic				Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
			200				
		Holocene				Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
			11,700				
		Pleistocene				Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of Late Pleistocene age.
			700,000				
	Early Quaternary					Undivided Quaternary faults - most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	Fault cuts strata of Quaternary age.
			1,600,000*				
Pre-Quaternary						Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.
			4.5 billion (Age of Earth)				

* Quaternary now recognized as extending to 2.6 Ma (Walker and Geissman, 2009). Quaternary faults in this map were established using the previous 1.6 Ma criterion.

Table 1a
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Unnamed 2*	4.4	7.1			
Superstition Hills	6.6	10.6	6.6	23 ± 2	4 ± 2
Unnamed 1*	6.8	10.8			
Yuha*	8.2	13.1			
Imperial	10.2	16.4	7	62 ± 6	20 ± 5
Brawley *	11.3	18.1			
Superstition Mountain	11.3	18.1	6.6	24 ± 2	5 ± 3
Shell Beds	12.0	19.2			
Borrego (Mexico)*	12.1	19.3			
Laguna Salada	12.3	19.6	7	67 ± 7	3.5 ± 1.5
Yuha Well *	12.5	20.0			
Rico *	14.0	22.4			
Vista de Anza*	15.3	24.5			
Cerro Prieto *	18.5	29.6			
Pescadores (Mexico)*	18.5	29.7			
Painted Gorge Wash*	18.8	30.1			
Ocotillo*	20.1	32.2			
Cucapah (Mexico)*	20.4	32.7			
Elsinore - Coyote Mountain	23.8	38.1	6.8	39 ± 4	4 ± 2
Elmore Ranch	24.5	39.2	6.6	29 ± 3	1 ± 0.5
San Jacinto - Borrego	29.0	46.4	6.6	29 ± 3	4 ± 2
Algodones *	40.5	64.8			

* Note: Faults not included in CGS database.

Table 2a
2013 California Building Code (CBC) and ASCE 7-10 Seismic Parameters

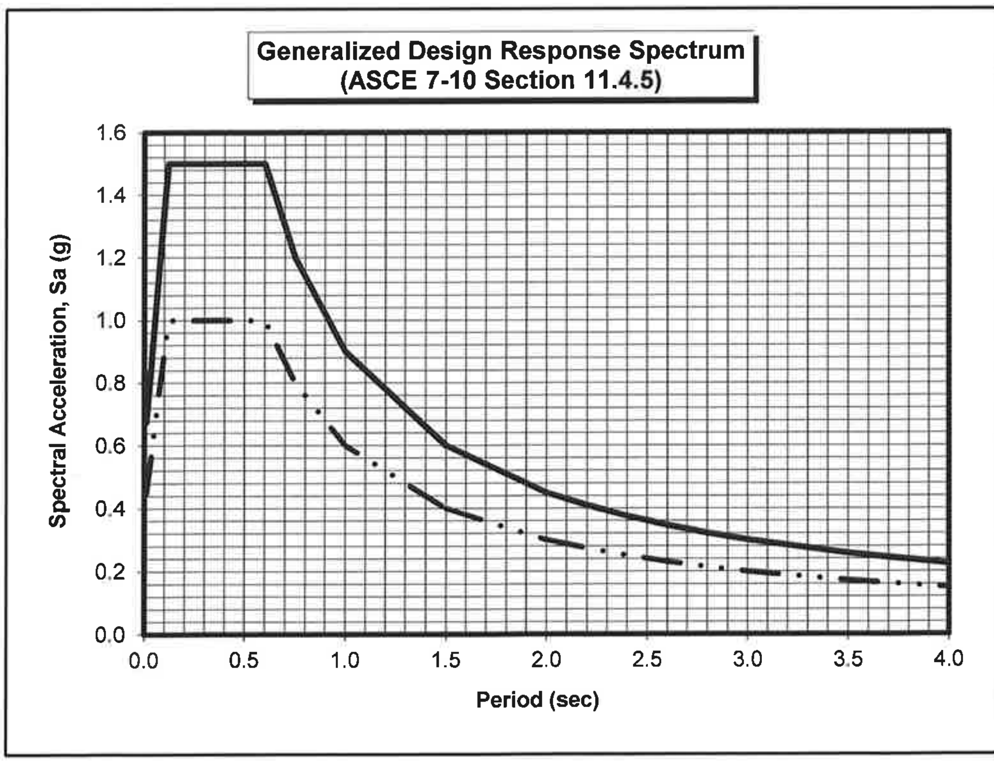
		CBC Reference
Site Class:	D	Table 20.3-1
Latitude:	32.7289 N	
Longitude:	-115.6267 W	
Risk Category:	I	
Seismic Design Category:	D	

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.500 g	Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.600 g	Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.50	Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.500 g	$= F_a * S_s$	Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	0.900 g	$= F_v * S_1$	Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.000 g	$= 2/3*S_{MS}$	Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.600 g	$= 2/3*S_{M1}$	Equation 16-40
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.12 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.60 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.50 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.01	0.45	0.68
0.03	0.55	0.83
0.10	0.90	1.35
0.12	1.00	1.50
0.15	1.00	1.50
0.20	1.00	1.50
0.30	1.00	1.50
0.40	1.00	1.50
0.50	1.00	1.50
0.60	1.00	1.50
0.75	0.80	1.20
1.00	0.60	0.90
1.50	0.40	0.60
2.00	0.30	0.45
2.20	0.27	0.41
2.40	0.25	0.38
2.60	0.23	0.35
2.80	0.21	0.32
3.00	0.20	0.30
3.50	0.17	0.26
4.00	0.15	0.23

Design Response Spectra
MCE_R Response Spectra

Table 1b
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Unnamed 2*	3.8	6.0			
Unnamed 1*	7.7	12.3			
Yuha*	8.7	14.0			
Superstition Hills	8.8	14.1	6.6	23 ± 2	4 ± 2
Borrego (Mexico)*	9.9	15.9			
Laguna Salada	10.8	17.3	7	67 ± 7	3.5 ± 1.5
Imperial	11.4	18.3	7	62 ± 6	20 ± 5
Brawley *	12.4	19.9			
Shell Beds	13.0	20.9			
Superstition Mountain	13.7	21.9	6.6	24 ± 2	5 ± 3
Yuha Well *	13.7	21.9			
Rico *	14.4	23.1			
Vista de Anza*	15.9	25.4			
Pescadores (Mexico)*	16.2	25.9			
Cerro Prieto *	16.3	26.0			
Cucapah (Mexico)*	18.1	28.9			
Painted Gorge Wash*	20.3	32.5			
Ocotillo*	21.1	33.8			
Elsinore - Coyote Mountain	24.9	39.8	6.8	39 ± 4	4 ± 2
Elmore Ranch	26.8	42.8	6.6	29 ± 3	1 ± 0.5
San Jacinto - Borrego	31.1	49.7	6.6	29 ± 3	4 ± 2
Algodones *	40.4	64.6			

* Note: Faults not included in CGS database.

Table 2b
2013 California Building Code (CBC) and ASCE 7-10 Seismic Parameters

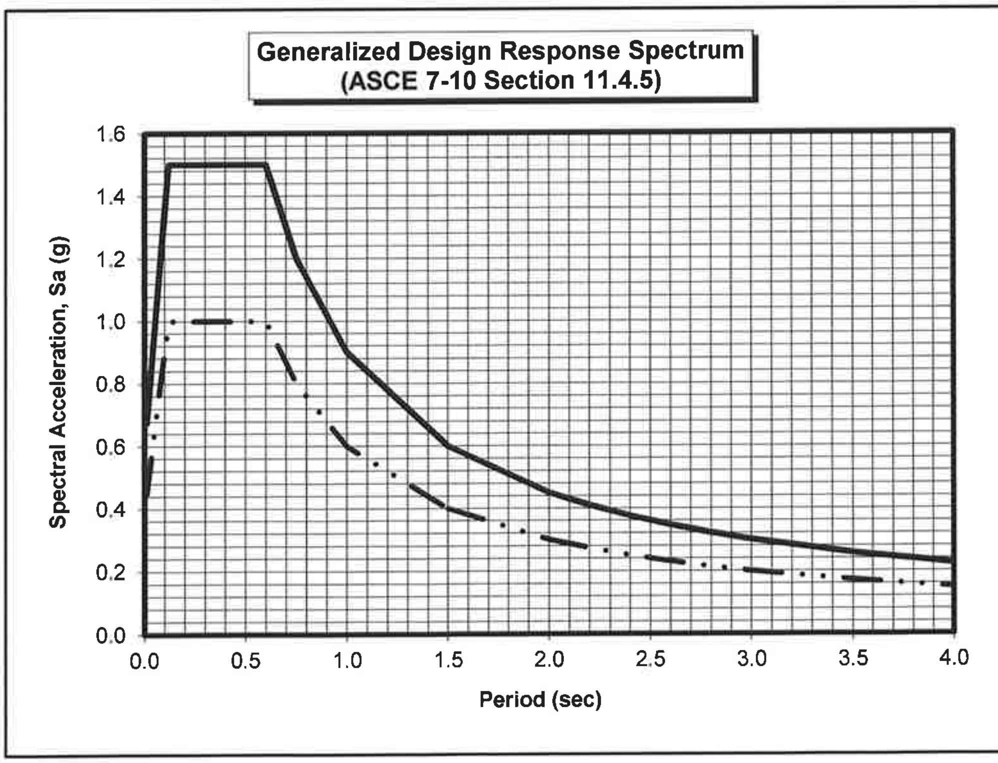
			CBC Reference
Site Class:	D		Table 20.3-1
Latitude:	32.6959	N	
Longitude:	-115.6166	W	
Risk Category:	I		
Seismic Design Category:	D		

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.500 g	Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.600 g	Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.50	Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.500 g	$= F_a * S_s$	Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	0.900 g	$= F_v * S_1$	Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.000 g	$= 2/3*S_{MS}$	Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.600 g	$= 2/3*S_{M1}$	Equation 16-40
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.12 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.60 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.50 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.01	0.45	0.68
0.03	0.55	0.83
0.10	0.90	1.35
0.12	1.00	1.50
0.15	1.00	1.50
0.20	1.00	1.50
0.30	1.00	1.50
0.40	1.00	1.50
0.50	1.00	1.50
0.60	1.00	1.50
0.75	0.80	1.20
1.00	0.60	0.90
1.50	0.40	0.60
2.00	0.30	0.45
2.20	0.27	0.41
2.40	0.25	0.38
2.60	0.23	0.35
2.80	0.21	0.32
3.00	0.20	0.30
3.50	0.17	0.26
4.00	0.15	0.23

— · · — · · — Design Response Spectra
——— MCE_R Response Spectra

Table 1c
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Unnamed 2*	4.6	7.3			
Borrego (Mexico)*	7.9	12.7			
Unnamed 1*	8.9	14.3			
Laguna Salada	9.4	15.1	7	67 ± 7	3.5 ± 1.5
Yuha*	10.0	16.0			
Superstition Hills	11.2	17.9	6.6	23 ± 2	4 ± 2
Imperial	12.3	19.7	7	62 ± 6	20 ± 5
Pescadores (Mexico)*	13.7	21.9			
Brawley *	13.8	22.2			
Cerro Prieto *	13.9	22.3			
Shell Beds	14.5	23.2			
Rico *	15.2	24.3			
Yuha Well *	15.3	24.5			
Cucapah (Mexico)*	15.6	24.9			
Superstition Mountain	16.2	25.9	6.6	24 ± 2	5 ± 3
Vista de Anza*	16.8	26.8			
Painted Gorge Wash*	22.1	35.4			
Ocotillo*	22.4	35.8			
Elsinore - Coyote Mountain	26.3	42.1	6.8	39 ± 4	4 ± 2
Elmore Ranch	29.2	46.7	6.6	29 ± 3	1 ± 0.5
San Jacinto - Borrego	33.3	53.3	6.6	29 ± 3	4 ± 2
Algodones *	40.3	64.5			

* Note: Faults not included in CGS database.

Table 2c
2013 California Building Code (CBC) and ASCE 7-10 Seismic Parameters

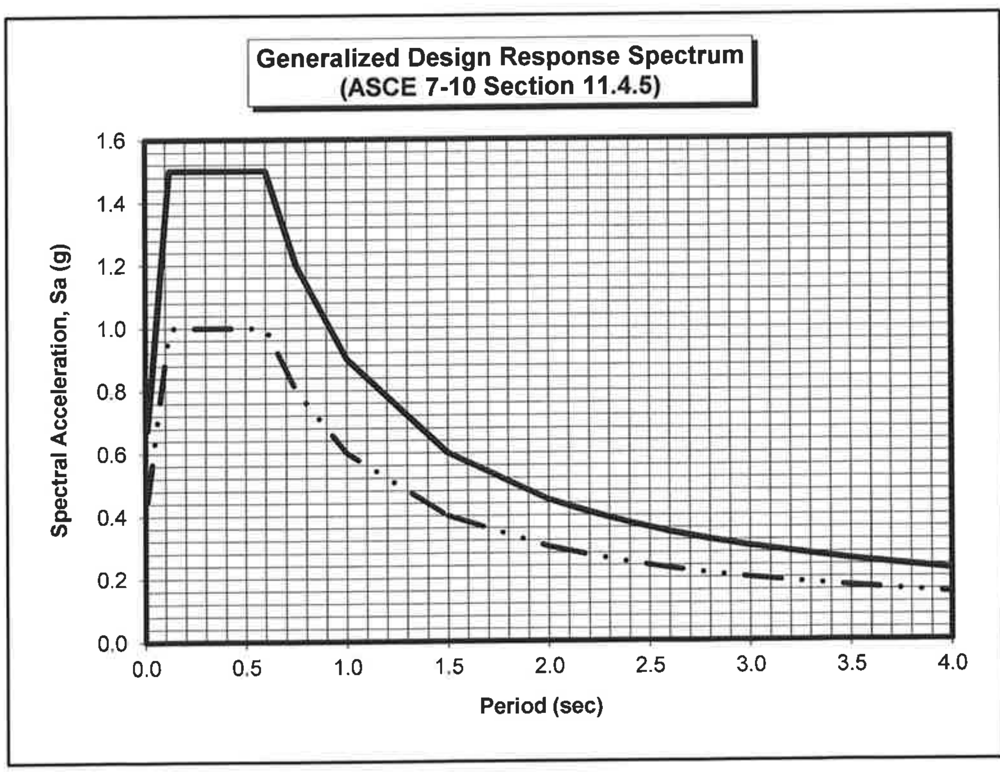
		CBC Reference
Site Class:	**D**	Table 20.3-1
Latitude:	32.6613 N	
Longitude:	-115.6038 W	
Risk Category:	I	
Seismic Design Category:	D	

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.500 g	Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.600 g	Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.50	Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.500 g	$= F_a * S_s$	Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	0.900 g	$= F_v * S_1$	Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.000 g	$= 2/3*S_{MS}$	Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.600 g	$= 2/3*S_{M1}$	Equation 16-40
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.12 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.60 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.50 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.01	0.45	0.68
0.03	0.55	0.83
0.10	0.90	1.35
0.12	1.00	1.50
0.15	1.00	1.50
0.20	1.00	1.50
0.30	1.00	1.50
0.40	1.00	1.50
0.50	1.00	1.50
0.60	1.00	1.50
0.75	0.80	1.20
1.00	0.60	0.90
1.50	0.40	0.60
2.00	0.30	0.45
2.20	0.27	0.41
2.40	0.25	0.38
2.60	0.23	0.35
2.80	0.21	0.32
3.00	0.20	0.30
3.50	0.17	0.26
4.00	0.15	0.23

—··—··—··— Design Response Spectra
——————— MCE_R Response Spectra

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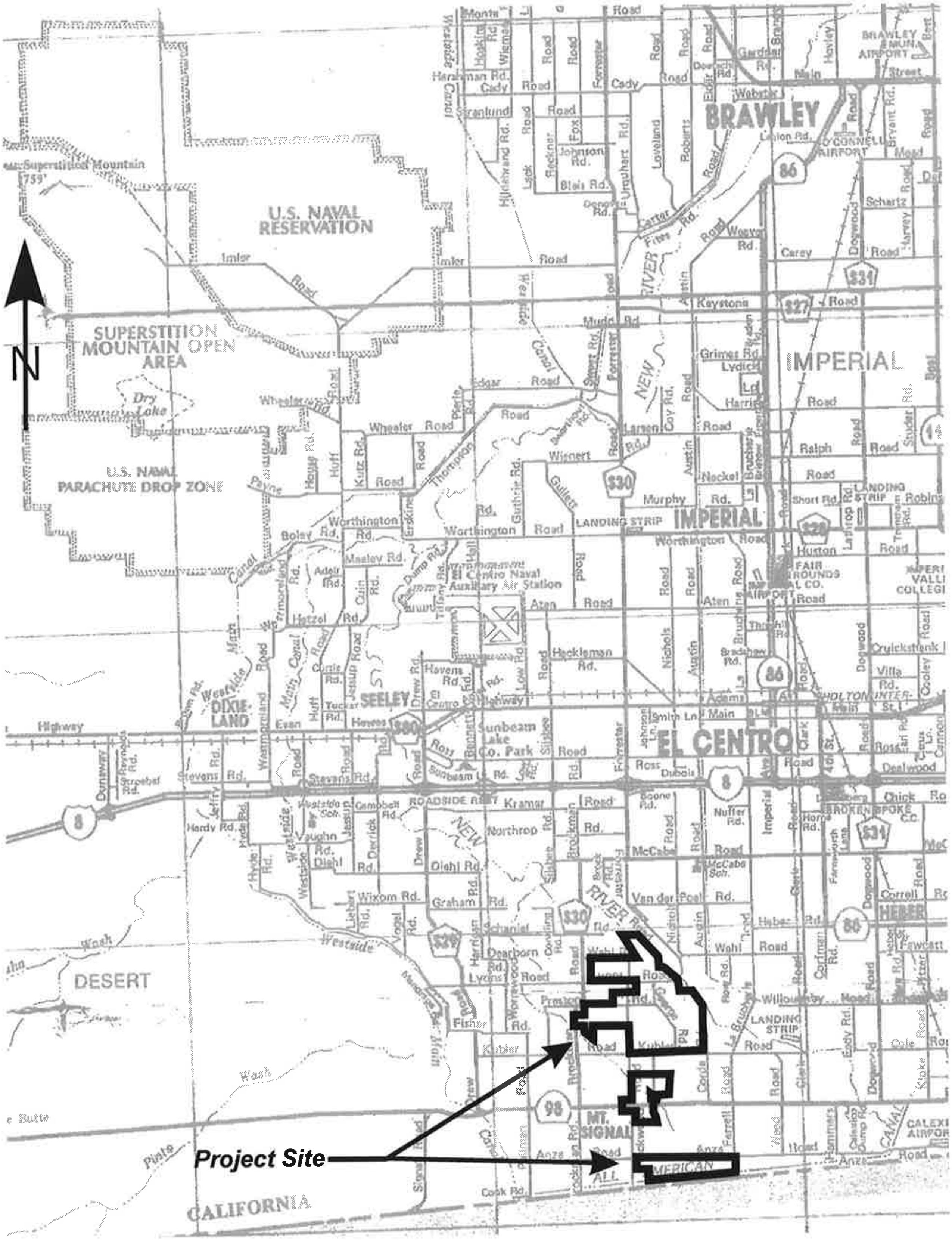
APPENDIX A



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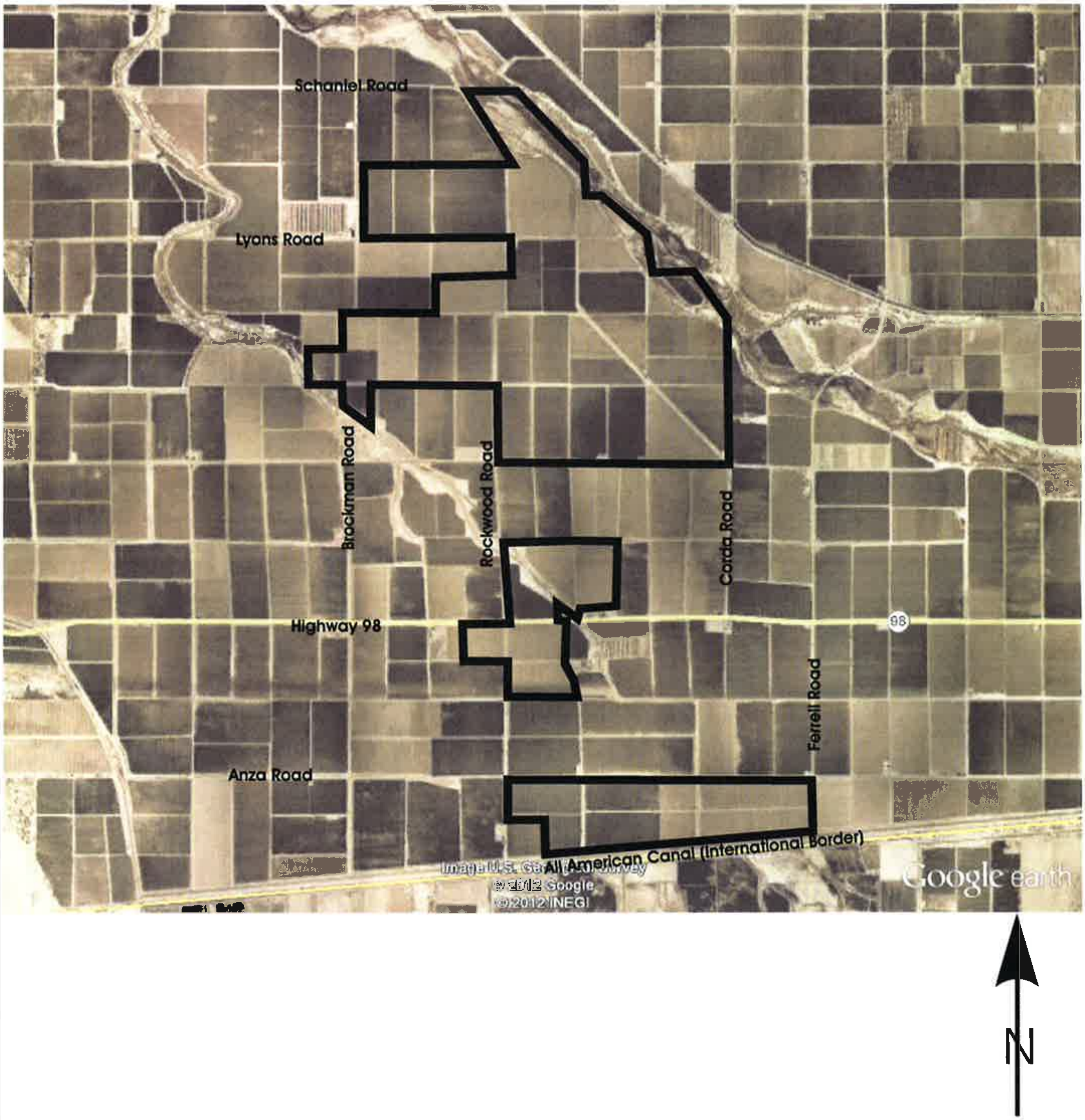
Vicinity Map

Plate A-1



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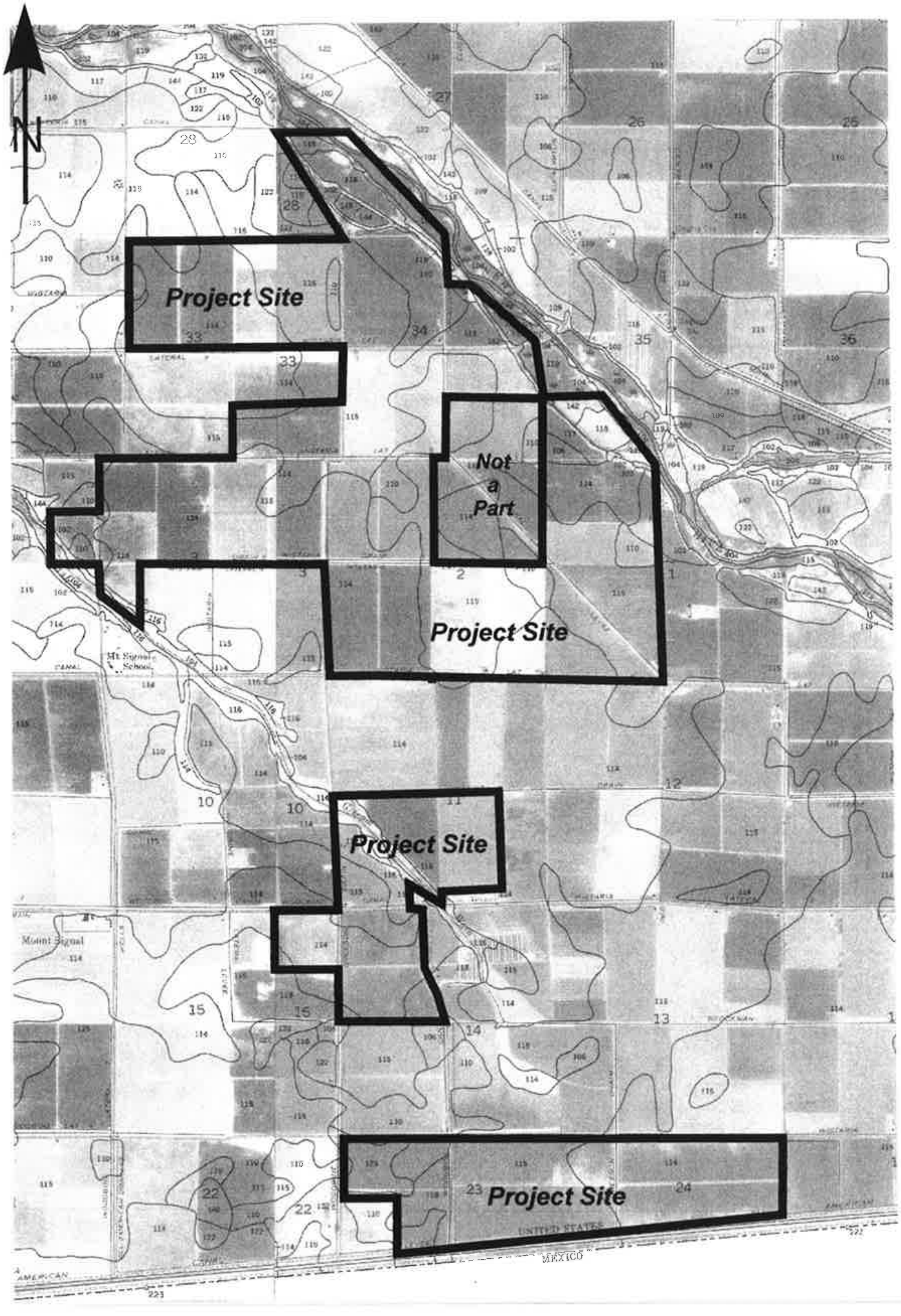
Project Area Map

Plate
A-2



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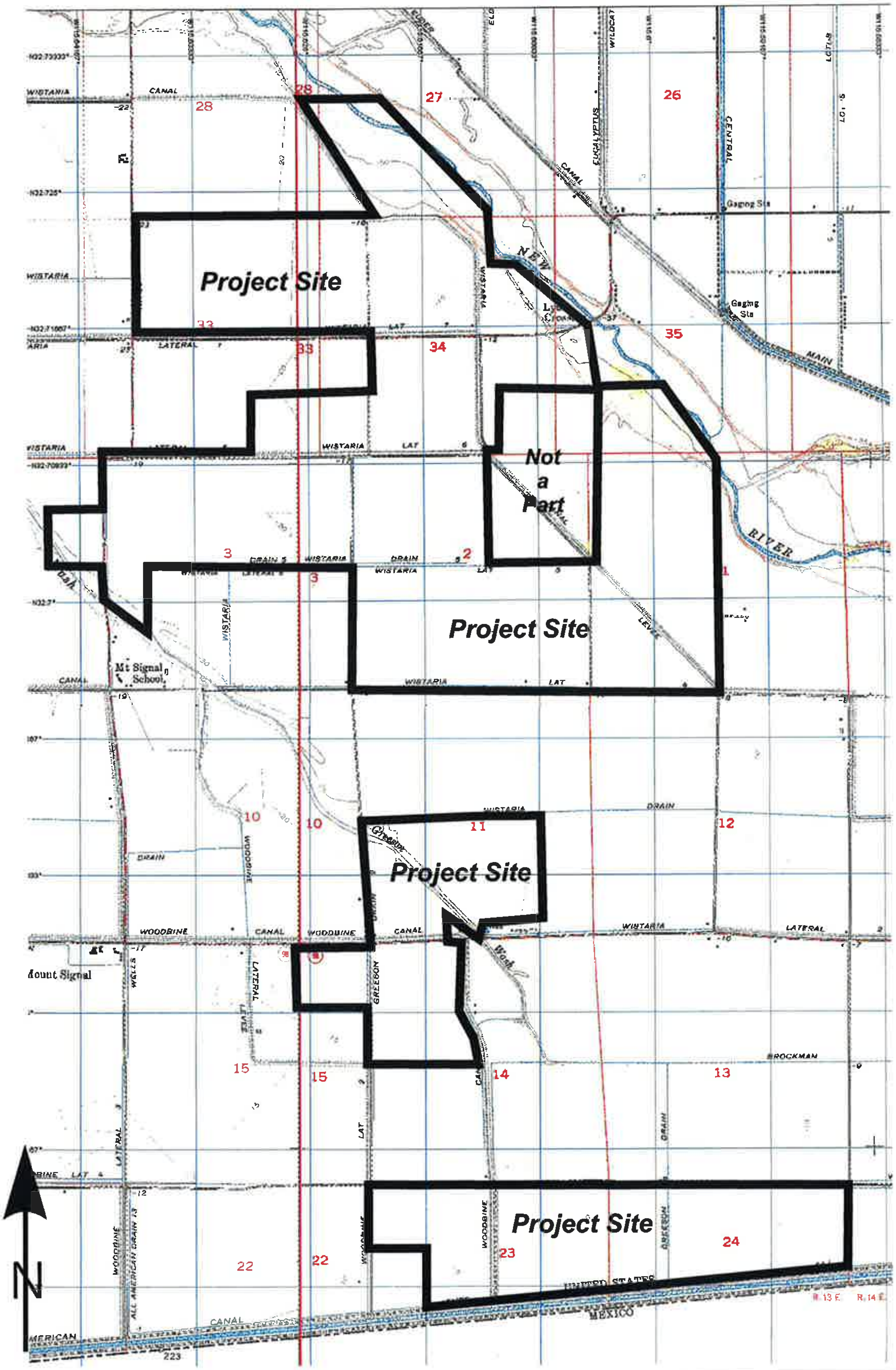
Soil Survey Map

Plate A-3



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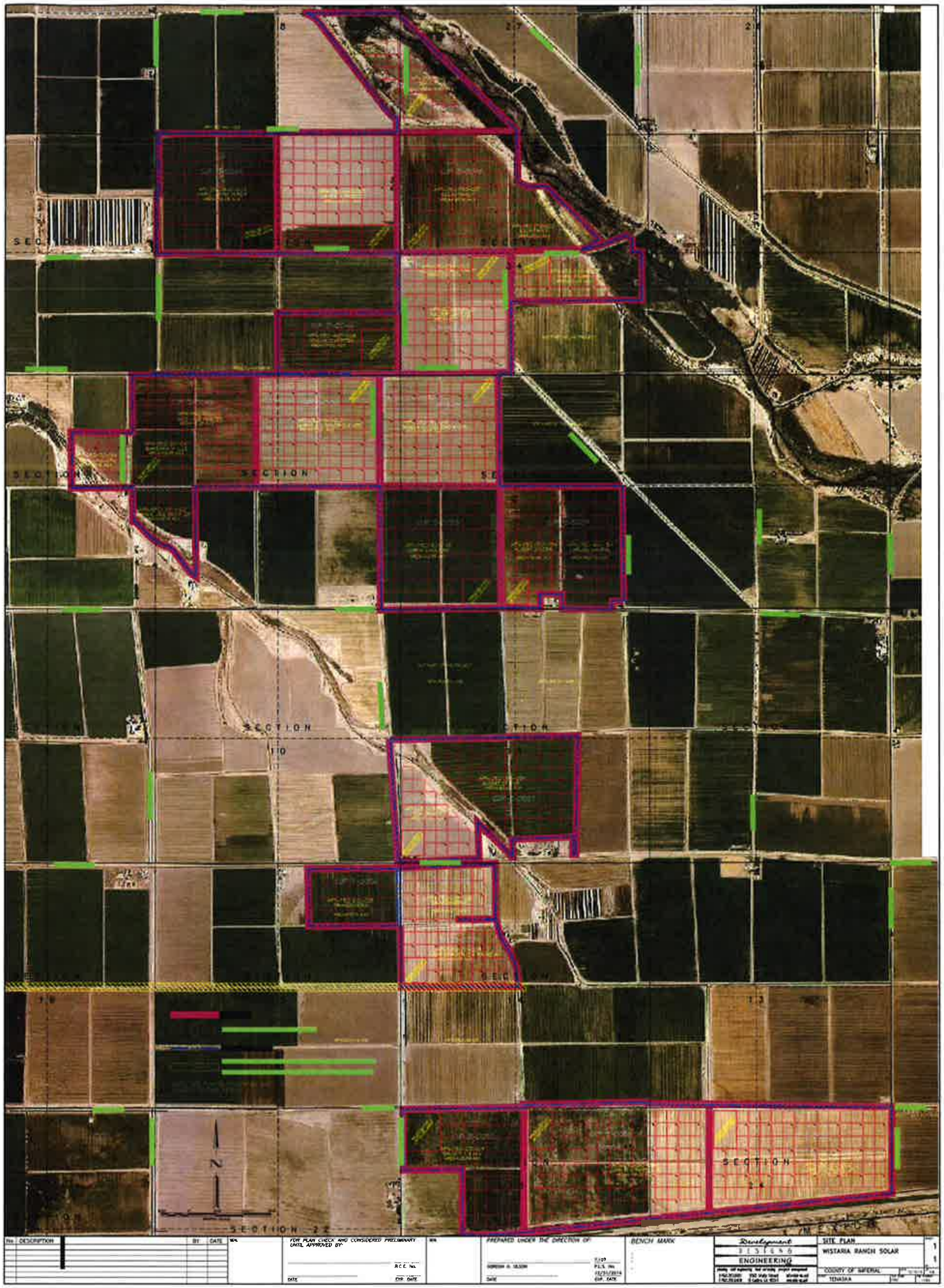
Topographic Map

Plate
A-4



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CUP Map

Plate A-5