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5.15 GEOLOGICAL HAZARDS AND RESOURCES

Hydrogen Energy International LLC (HEI or Applicant) is jointly owned by BP Alternative Energy North America Inc. and Rio Tinto Hydrogen Energy LLC. HEI is proposing to build an Integrated Gasification Combined Cycle (IGCC) power generating facility called Hydrogen Energy California (HECA or Project) in Kern County, California. The Project will produce low-carbon baseload electricity by capturing carbon dioxide (CO_2) and transporting it for CO_2 enhanced oil recovery (EOR) and sequestration (storage)[1].

The Project will gasify petroleum coke (petcoke) (or blends of petcoke and coal, as needed) to produce hydrogen to fuel a combustion turbine operating in combined cycle mode. The Gasification Block feeds a 390-gross-megawatt (MW) combined cycle plant. The net electrical generation output from the Project will provide California with approximately 250 MW of low-carbon baseload power to the grid. The Gasification Block will also capture approximately 90 percent of the carbon from the raw syngas at steady-state operation, which will be transported to the Elk Hills Field for CO_2 EOR and Sequestration. In addition, approximately 100 MW of natural gas generated peaking power will be available from the Project.

The 473-acre Project Site is located approximately 7 miles west of the outermost edge of the city of Bakersfield and 1.5 miles northwest of the unincorporated community of Tupman in western Kern County, California, as shown in Figure 2-1, Project Vicinity. The Project Site is near a hydrocarbon-producing area known as the Elk Hills Field. The Project Site is currently used primarily for agricultural purposes. Existing surface elevations vary from about 282 feet to 291 feet above mean sea level.

The Project Site and linear facilities comprise the affected study area and are entirely located in Kern County, California. These Project components are described below.

Major on-site Project components will include, as shown on Figure 2-5, Preliminary Plot Plan:

- Solids Handling, Gasification, and Gas Treatment
  - Feedstock delivery, handling and storage
  - Gasification
  - Sour shift/gas cooling
  - Mercury removal
  - Acid gas removal

- Power Generation
  - Combined cycle power generation
  - Auxiliary combustion turbine generator
  - Electrical switching facilities

[1] This carbon dioxide will be compressed and transported via pipeline to the custody transfer point at the adjacent Elk Hills Field, where it will be injected. The CO_2 EOR process involves the injection and reinjection of carbon dioxide to reduce the viscosity and enhance other properties of the trapped oil, thus allowing it to flow through the reservoir and improve extraction. During the process, the injected carbon dioxide becomes sequestered in a secure geologic formation. This process is referred to herein as CO_2 EOR and Sequestration.

- Supporting Process Systems
  - Natural gas fuel systems
  - Air separation unit (ASU)
  - Sulfur recovery unit/Tail Gas Treating Unit
  - Zero liquid discharge (ZLD) units for process and plant waste water streams
  - Carbon dioxide compression
  - Raw water treatment plant
  - Other plant systems

The Project also includes the following off-site facilities, as shown on Figure 2-7, Project Location Map:

- **Electrical Transmission Line** – An electrical transmission line will interconnect the Project to Pacific Gas & Electric's (PG&E) Midway Substation. Two alternative transmission line routes are proposed; each alternative is approximately 8 miles in length.

- **Natural Gas Supply** – A natural gas interconnection will be made with PG&E or SoCalGas natural gas pipelines, each of which are located southeast of the Project Site. The natural gas pipeline will be approximately 8 miles in length.

- **Water Supply Pipelines** – The Project will utilize brackish groundwater supplied from the Buena Vista Water Storage District (BVWSD) located to the northwest. The raw water supply pipeline will be approximately 15 miles in length. Potable water for drinking and sanitary use will be supplied by West Kern Water District to the southeast. The potable water supply pipeline will be approximately 7 miles in length.

- **Carbon Dioxide Pipeline** – The carbon dioxide pipeline will transfer the carbon dioxide captured during gasification from the Project Site southwest to the custody transfer point. Two alternative carbon dioxide pipeline routes are proposed; each alternative will be approximately 4 miles in length.

The Project components described above are shown on Figure 2-8, Project Location Details, which depicts the region, the vicinity, the Project Site and its immediate surroundings.

All temporary construction equipment laydown and parking, including construction parking, offices, and construction laydown areas, will be located on the Project Site.

This section presents information on the general geology of the region, subsurface conditions at the Project Site, geologic hazards affecting the Project Site and linear facilities (transmission lines and pipelines), and potential impacts of the Project on the geologic resources in the area.

Identification of geologic hazards and mineral resources is based on published literature and a Project Site investigation. Regarding geologic resources, evaluations of impact significance are based on the type and the proximity of the resource to the Project. Recommendations are provided for mitigation of geologic hazards and geotechnical issues at the Project. Figures are located at the end of this section.

The information provided in this section is based on a review of published geologic and mineral resource references.

5.15.1 Affected Environment

5.15.1.1 Regional Stratigraphy

The Project is located within the Great Valley Geomorphic Province of California (CGS 2002). The Great Valley is an alluvial plain about 50 miles wide and 400 miles long in the central part of California. Its northern part is the Sacramento Valley, drained by the Sacramento River and its southern part is the San Joaquin Valley, drained by the San Joaquin River. The Great Valley is a trough in which sediments have been deposited almost continuously since the Jurassic period (about 160 million years ago).

The southern portion of the Great Valley Province is characterized as being a nearly flat-surfaced, north-trending, asymmetric trough bounded by the Coast Ranges to the west and Sierra Nevada Mountains to the east. Tertiary rocks, which were deposited nearly continuously from Cretaceous to Pleistocene time, are largely of marine origin and underlie a relatively thin cover of Quaternary alluvium. The Tertiary rocks overlie Jurassic-Cretaceous marine sedimentary rocks along the west side of the valley. Northwest-trending anticlines in the Tertiary strata are reflected by the gas and oil fields and by low hills in the valleys.

5.15.1.2 Local Geology

The Project Site is located along the northeastern face of the Elk Hills, which are the surface manifestation of an anticlinal uplift along the western side of the San Joaquin Valley. The Elk Hills are composed of sands, conglomerates, mudstones, and shales derived from the Coast Ranges to the west. The Elk Hills are being dissected by numerous streams that redeposit the eroded materials on an apron of small coalescing fans along the northeast flank of the hills, which abut the much larger Kern River fan to the north.

As shown on Figure 5.15-3, Project Site Geologic Map, surficial deposits at the Project Site have been described as Quaternary age alluvial gravel and sand of valley areas (Q); and bedrock at the surface and underlying alluvium consisting of Pliocene- to Pleistocene-age Tulare Formation which consists of alternating beds of sandstone and mudstone (Dibblee 2005). According to Dibblee (2005) these deposits are stream-laid, weakly indurated pebble gravels, sands, and clays; light gray in color. The pebbles are composed chiefly of Monterey siliceous shale and debris from bedrock in the adjacent Temblor Range.

The Project is located in the Kern County sub-basin of the San Joaquin Valley Groundwater Basin. Groundwater was not encountered in any of the borings drilled at the Project Site during the subsurface investigation to the minimum elevation explored (approximately 185 feet above mean sea level [msl]) (URS 2009). A search of USGS National Water Information System groundwater well data identified a well (Well No. 030S24E14H001M) to the southeast of the site reported a historic high groundwater level at about Elevation +247 feet above mean sea level (MSL) (National Geodetic Vertical Datum [NGVD]), corresponding to approximately 35 feet below the ground surface at the lowest portion of the Project Site (elevation 282 feet above msl).

Therefore, groundwater is not expected to be within 35 feet of the ground surface based on Project Site geotechnical borings and historic data from Well No. 030S24E14H001M.

The linear facilities (electrical transmission line, natural gas supply, water supply pipelines and carbon dioxide pipeline) will be underlain by earth materials that are similar to those as the Project Site.

5.15.1.3 Tectonic Framework

The Project, like most of California, is within a seismically active region. A review of geologic literature did not identify the presence of any known active or potentially active faults at the Project Site or crossing the Project linears. Figure 5.15-1, Regional Geologic Map of Project, does not show any faults mapped within the Project.

The closest known faults classified as active by the State of California Geologic Survey (CGS) are the San Andreas Fault located, using Blake (2000), approximately 21 miles to the west, the White Wolf fault which is located approximately 23 miles to the southeast, and the Pleito Thrust, which is located approximately 27 miles south of the Project Site. These faults are shown on Figure 5.15-2, Regional Fault Map – Major Faults of Southern California.

5.15.1.4 Historic Seismic Events – Southern California

The most significant recorded seismic events of Southern California in terms of their location and magnitude are summarized in Table 5.15-1.

Table 5.15-1
Significant Recorded Seismic Events in Southern California

Date	Location / Event	Approximate Distance to Project Site[1] (miles [km])	Earthquake Moment Magnitude[2] (M_w)	Approximate Site Acceleration at Project Site[3] (g)
09 Jan 1857	Fort Tejon	23.5 [37.8]	7.9	0.242
21 Jul 1952	Kern County	30.9 [49.8]	7.3	0.169
28 Jun 1992	Landers	184.6 [297.0]	7.3	0.015
16 Oct 1999	Hector Mine	183.4 [295.1]	7.1	0.010
19 May 1940	Imperial County	285.7 [459.7]	7.0	0.003
17 Jan 1994	Northridge	91.0 [146.5]	6.7	0.020
09 Feb 1971	San Fernando	84.6 [136.1]	6.6	0.017

Sources: Blake (2000) and California Geological Survey (2007)

Note:
1 Site Coordinates for Blake analysis: Latitude 35.3327, Longitude 119.3845
2 CGS, Appendix A, 2002 Fault Parameters
3 Attenuation Relation for Blake analysis: Sadigh et al. (1997) Horiz. – soil

The largest magnitude earthquake recorded was a magnitude 7.9 along the San Andreas Fault at Fort Tejon on January 9, 1857. Figure 5.15-4, Epicentral Location of Major Earthquakes in Southern California, presents the location of the epicenters of recorded seismic events greater than magnitude 3.0 since 1735.

Naturally occurring seismic events on the order of magnitude 6 and smaller, even if located in the immediate area of the field, should not cause significant damage to the Project or wells within Elk Hills Field.

There is no history of induced seismicity at Elk Hills Field, and the chance of project-induced seismicity is viewed as remote. In the unlikely event of project-induced seismicity, the magnitude of the seismic event would be less than a magnitude 4, considering the geologic setting, areal extent and depth of proposed operations, and anticipated pressure and stress changes (Terralog Technologies 2008). Seismic events of magnitude 4 may be felt in the immediate area but would not cause structural damage to buildings or facilities.

Any potential induced seismicity is at least an order of magnitude smaller than natural seismicity hazards for the area. For a detailed review of seismicity and potential seismic impacts related to carbon sequestration, see Appendix F.

5.15.1.5 Geologic Hazards

Geologic hazards that are known to be present in portions of California and that could potentially affect the Project Site or the linear facilities are described in the following paragraphs. The primary geologic hazards at the Project (Project Site and linear facilities) include ground motion from a seismic event and the potential for expansive soils due to high clay content in surface soils. The identified geologic hazards are considered less than significant with the proposed mitigation. A complete listing of potential geologic hazards, likelihood of occurrence, and potential impacts at the Project are discussed in further detail below.

Surface Rupture

Primary ground rupture is defined as the surface displacement that occurs along the surface trace of the causative fault during an earthquake. Ground rupture can occur along known pre-existing faults, unknown pre-existing faults, or new faults that develop as a result of a seismic event.

According to the California Geological Survey (1997), the Project is not located within an Alquist-Priolo Earthquake Fault Zone. Based on a review of available geologic data, no surface traces of active or inactive faults pass through the Project. Therefore, the potential for primary ground rupture at the Project is considered to be low. Consequently, potential impacts from a primary ground rupture will be less than significant.

Seismic Ground Shaking

The Project is susceptible to ground shaking generated during earthquakes on nearby faults. The intensity of ground shaking, or strong ground motion, is dependent upon the distance of the fault to the Project, the magnitude of the earthquake, and the underlying soil conditions. This hazard

can be mitigated by designing and constructing improvements and buildings in conformance with current building codes and engineering practices. With the implementation of Geo-1, discussed in Section 5.15.4, Mitigation Measures, potential impacts from seismic shaking will be less than significant.

Liquefaction

Liquefaction is a process in which soil grains in a saturated sandy deposit lose contact because of earthquakes or other sources of ground shaking. The soil deposit temporarily behaves as a viscous fluid; pore pressures rise, and the strength of the deposit is greatly diminished. Liquefaction is often accompanied by sand boils, lateral spreading, and post-liquefaction settlement as the pore pressures dissipate. Liquefiable soils typically consist of cohesionless sands and silts that are loose to medium dense and saturated.

Based upon findings of the URS (2009) geotechnical report, the potential for liquefaction to occur and impact the Project Site is low to nil. As a result, impacts will be less than significant. The Project linears may require additional evaluation during detailed design.

Seismic-Induced Dry Sand Settlement

The presence of loose, unsaturated granular soil layers could result in some seismic-induced settlement that will need to be taken into account during foundation design. The potential for seismic-induced settlement for the Project Site was evaluated by URS (2009). In general, seismic-induced settlement could occur within the susceptible native, loose to medium dense sandy soils in the upper 50 feet. However, remedial grading and design can reduce the impact of seismically-induced dry sand settlement to less than significant. The Project linears may require additional evaluation during detailed design. With the implementation of Geo-2, discussed in Section 5.15.4, impacts will be less than significant.

Subsidence

Subsidence ground failure can be aggravated by several causes, including ground shaking and withdrawal of large volumes of fluids from underground reservoirs, and also by the addition of surface water to certain types of soils (hydro-compaction). According to the Kern County General Plan Safety Element (1997), the Project Site is not located within an area mapped as having measured land subsidence between 1926 and 1965 or hydro-compaction; therefore, it is unlikely that subsidence will occur at the site. As a result, potential impacts will be less than significant.

Flooding

According to Figure 14 of the Kern County General Plan Safety Element, the Project Site is not located within an area identified as having flood hazards or shallow groundwater. The Project linears extending to the west and south of the Project Site will cross a flood hazard zone located on the northeast side of the California State Water Project.

Provided with proper drainage design, the Project Site is not likely to experience flooding. As a result, impacts will be less than significant.

Tsunamis

A tsunami is a great sea wave, commonly called a tidal wave, produced by a significant undersea disturbance such as tectonic displacement of the sea floor associated with large, shallow earthquakes. The Project is situated greater than 200 feet above sea level. As such, the potential for tsunamis at the Project is nil. As a result, impacts will be less than significant.

Seiches

A wave created by an earthquake shaking in an enclosed body of water is called a seiche. The potential for a seiche to occur is related to the natural frequency of vibration of the body of water as well as to the predominate frequencies of vibration in the seismic event. The potential for seiches at the Project is nil to low due to the absence of lakes or large bodies of water in the immediate area. As a result, impacts will be less than significant.

Volcanic Hazards

No centers of potential volcanic activity occur within hundreds of miles of the Project. Volcanic hazards, such as lava flows and ash falls, are therefore not anticipated to present a hazard. As a result, impacts will be less than significant.

Landslides and Lateral Spreading

Landsliding and lateral spreading are often triggered by earthquakes and usually occur in areas of moderate to high relief, weak soil or rock strength, and high groundwater. The Project Site is in an area of low relief. Therefore, the potential for localized landslides or lateral spreading to, or occurring within the Project Site is generally low. However, man-made excavations and fills to construct the site existing drainage system consist of un-engineered soils with weak soil strength. These un-engineered fill slopes have a medium potential for landsliding lateral spreading. The carbon dioxide pipelines that will extend south of the Project Site will traverse areas of moderate relief. The Project slopes and carbon dioxide pipeline will require slope stability evaluation, which will be provided by a design level geotechnical investigation. With the implementation of Geo-3, discussed in Section 5.15.4, impacts will be less than significant.

Expansive Soils

Expansive soils are fine-grained soils (generally high-plasticity clays) that can undergo a significant increase in volume with an increase in water content and a significant decrease in volume with a decrease in water content. Changes in the water content of a highly expansive soil can result in severe distress to structures constructed upon the soil.

The subsurface investigation (URS 2009) indicates that the surficial soils at the Project Site are fine-grained soils comprised predominantly of clays and silty clays. The Project Site clays have high plasticity and highly organic soils with remnants of vegetations from past and current

agricultural use. In general, these upper soils possess relatively high moisture contents and are unsuitable for direct support of shallow foundations or new engineered fills. With the implementation of Geo-4 discussed in Section 5.15.4, impacts will be less than significant.

5.15.1.6 Geologic Resources

Geologic resources of recreational, commercial, or scientific value in the Project vicinity that could be affected include oil and gas reserves. The Project is not located over mines, aggregate deposits, or mineral deposits; no known scientific or recreational geologic resources were identified in the vicinity of the Project, based on published information (CDMG 1962, Mines and Mineral Resources of Kern County California, Plate 1). Department of Conservation, Division of Oil, Gas, and Geothermal Resources (DOGGR) Map 421 identifies a plugged and abandoned –dry hole (Quintana Production Co. "Union-Gamay" 56X-10) drilled at the Project Site. The well drilled on the Project Site did not encounter petroleum. Therefore, the likelihood of petroleum reserves being located below the Project Site is unlikely.

The Project linears pass through the Elk Hills, North Coles Levee and South Coles Levee petroleum fields. Construction of the Project linears through these petroleum fields is not likely to prevent recovery of the resources, and injection of carbon dioxide into the Elk Hills Field, discussed in Section 8 and Appendix F. They will be designed to enhance recovery of those deposits while sequestering the carbon dioxide.

As a result, the negative impacts to geologic resources will be less than significant.

5.15.2 Environmental Consequences

Potential impacts of the Project on the geologic or mineral resources and potential impacts of geologic hazards can be divided into those related to construction activities and those related to power plant operation.

5.15.2.1 Construction-Related Impacts

Construction-related impacts to the geologic or mineral resources primarily involve grading operations and operations for foundation support. The Project Site slopes and temporary construction slopes and excavations should be properly designed to be stable. Project development is not anticipated to result in significant adverse impacts to geologic or mineral resources. Potentially, significant impacts by geologic conditions on construction are not anticipated. With implementation of the mitigation measures outlined in Section 5.15.4, Mitigation Measures, impacts to power plant construction by the geologic environment will be reduced to less than significant levels.

5.15.2.2 Power Plant Operation-Related Impacts

No significant adverse impacts to geologic resources have been identified as a result of operation. Potential impacts of geologic hazards on the Project and ancillary facility operations include seismic shaking. With implementation of the measures outlined in Section 5.15.4,

Mitigation Measures, impacts to power plant operations from geologic hazards will be reduced to a less than a significant level.

There will be no significant impacts to the geologic environment resulting from construction or operation of the Project linears.

5.15.3 Cumulative Impacts Analyses

Cumulative impacts to the geologic resources at the Project are considered to be negligible.

5.15.4 Mitigation Measures

5.15.4.1 Seismic Shaking

The potential exists for ground shaking from a variety of nearby sources, including the San Andreas Fault.

- **Geo-1:** Project facilities will be designed in accordance with applicable building codes' seismic design criteria. Seismic design criteria will be provided either by codes or a design level geotechnical investigation.

5.15.4.2 Liquefaction

No liquefaction hazard exists at the Project Site and no mitigations are suggested. In general, mitigation of liquefaction on Project linears will be accomplished in the design of the specific structures.

5.15.4.3 Seismic-Induced Dry Sand Settlement

- **Geo-2:** To reduce the potential for adverse differential settlement beneath heavily loaded, settlement-sensitive structures, removal of the susceptible soils and replacement with engineered fill have been recommended for structures that will be founded on shallow foundations. Alternatively, deep foundations (driven piles) have been recommended. Settlement design criteria can be provided by a design-level geotechnical investigation.

5.15.4.4 Subsidence

Subsidence at the Project Site is not considered to be a significant hazard and no mitigations are needed.

5.15.4.5 Flooding

Flooding at the Project Site is not considered to be a significant hazard and no mitigations are needed.

5.15.4.6 Tsunamis, Seiches, and Volcanic Hazards

Tsunami, seiches, and volcanic hazards are not present in the Project area and no mitigations are needed.

5.15.4.7 Landslides and Lateral-Spreading Hazards

Geo-3: To reduce the potential for landsliding and lateral spreading, Project Site slopes that may be susceptible will be designed to mitigate these potential hazards. Mitigation will include removal of the susceptible soils and replacement with engineered fill or reducing the hazard by elimination of Project Site slopes. Slope stability design criteria will be provided by a design level geotechnical investigation.

5.15.4.8 Expansive Soils

Geo-4: To reduce the potential for adverse expansion potential beneath Project Site improvements, removal of the susceptible soils and replacement with engineered fill have been recommended, as appropriate. Expansive soil design criteria can be provided by a design level geotechnical investigation.

5.15.4.9 Geologic Resources

There are no significant adverse impacts to geologic resources; therefore, no mitigation is needed.

5.15.5 Laws, Ordinances, Regulations, and Standards

The Project will be constructed and operated in accordance with all laws, ordinances, regulations, and standards (LORS) applicable to geologic hazards and resources discussed below and summarized in Table 5.15-2, Summary of LORS – Geological Hazards.

5.15.5.1 Federal

There are no federal LORS for geological hazards and resources, or for grading and erosion control.

5.15.5.2 State

California Public Resources Code 25523(a): 20 CCR § 1252 (b) and (c)

None of the Project components are located within or cross an Alquist–Priolo earthquake zone, therefore, the Project will not be subject to requirements for construction within an earthquake fault zone.

Table 5.15-2
Summary of LORS – Geological Hazards

LORS	Requirements	Conformance Section	Administering Agency
Federal Jurisdiction			
No federal LORS are applicable			
State Jurisdiction			
Cal PRC 25523(a), Alquist-Priolo Earthquake Fault Zone	Not Applicable	Section 5.15.5.2, State	California Energy Commission Facilities Siting Division Siting Office, California Energy Commission Facilities Siting Division Engineering Office, and Kern County Building Inspection Division
Local Jurisdiction			
Kern County General Plan/Safety Element	Minimize injuries and loss of life and reduce property damage. Reduce economic and social disruption resulting from earthquakes, fire, flooding, and other geologic hazards by assuring the continuity of vital emergency public services and functions.	Section 5.15.5.3, Local	Kern County Planning Department
California Building Code, Chapters 16, 18, and 33	Codes address excavation, grading and earthwork construction, including construction applicable to earthquake safety and seismic activity.	Section 5.15.5.3, Local	Kern County Planning Department

California Building Code

The 2007 edition of the California Building Code (CBC) is based on the International Building Code (IBC) 2006 edition with revisions specifically tailored to geologic hazards in California.

Chapter 16: Structural Design Requirements, Division IV Earthquake Design. This section requires that structural designs be based on geologic information for seismic parameters, soil characteristics, and site geology.

Chapter 18: Foundations and Retaining Walls, Division I. This section sets requirements for excavations and fills, foundations, and retaining structures with regard to expansive soils, subgrade bearing capacity, and seismic parameters. It also addresses waterproofing and damp-proofing foundations. In Seismic Zones 3 and 4, as defined by the Uniform Building Code (UBC), liquefaction potential at the site should be evaluated.

Division III contains requirements for mitigating effects of expansive soils for slab-on-grade foundations.

Chapter 33: Site Work, Demolition and Construction, and Appendix Chapter 33. These sections establish rules and regulations for construction of cut-and-fill slopes, to fill placement for structural support, and for slope setbacks for foundations.

California Environmental Quality Act of 1970

The California Energy Commission will be the lead agency for rules and regulations to implement the California Environmental Quality Act (CEQA). Appendix G, Section VI of the CEQA guidelines contains the geologic hazards and resources related to the Project.

5.15.5.3 Local

Kern County General Plan, Chapter 4, Safety Element

The Safety Element of the Kern County General Plan provides an implementation program to reduce the threat of seismic and public safety hazards within unincorporated areas of Kern County.

The Project will comply with all of the Seismic/Geologic Hazard Elements of the Kern County General Plan. No active faults will be crossed by the Project linears.

The county will review the geologic information and geotechnical recommendations presented in design level geotechnical reports.

5.15.6 Involved Agencies and Agency Contacts

Agencies with jurisdiction to enforce LORS related to geologic hazards and resources, and the appropriate contact person are summarized in Table 15.5-3, Involved Agencies and Agency Contacts.

Table 15.5-3
Involved Agencies and Agency Contacts

Number	Agency	Contact/Title	Telephone
1	California Energy Commission Facilities Siting Division Siting Office	Eileen Allen/ Facilities Siting Program Manager	(916) 654-4082
2	California Energy Commission Facilities Siting Division Engineering Office	Rick Tyler/ Senior Mechanical Engineer	(916) 653-1646
3	Kern County Planning Department 2700 “M” Street, Suite 100 Bakersfield, CA 93301	Cheryl Casdorph/ Supervising Planner	(661) 862-8600
4	Kern County Building Inspection Division 2700 “M” Street, Suite 100 Bakersfield, CA 93301	Charles Lackey/ Director	(661) 862-8650

5.15.7 Permits Required and Permit Schedule

There are no applicable permits required for geologic hazards.

5.15.8 References

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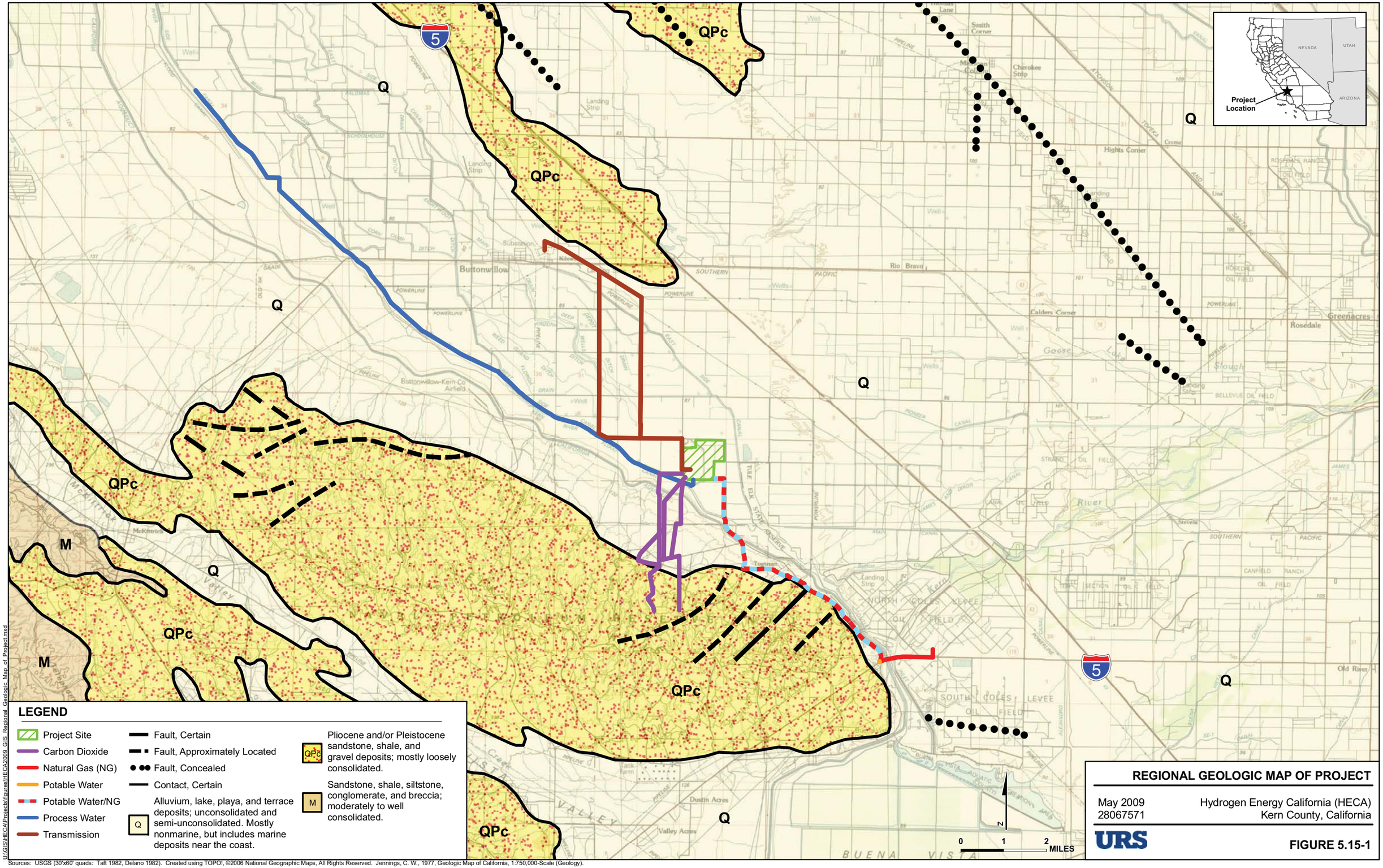
QPc
Q
M
5
Buttonwillow
Rio Bravo
Smith Corner
Hights Corner
Calders Corner
Greenacres
Rosedale
Bellevue Oil Field
Rosedale Oil Field
Buttonwillow-Kern Co Airfield
Dustin Acres
Valley Acres
Project Location
NEVADA
UTAH
ARIZONA
LEGEND
Project Site
Carbon Dioxide
Natural Gas (NG)
Potable Water
Potable Water/NG
Process Water
Transmission
Fault, Certain
Fault, Approximately Located
Fault, Concealed
Contact, Certain
Q Alluvium, lake, playa, and terrace deposits; unconsolidated and semi-unconsolidated. Mostly nonmarine, but includes marine deposits near the coast.
QPc Pliocene and/or Pleistocene sandstone, shale, and gravel deposits; mostly loosely consolidated.
M Sandstone, shale, siltstone, conglomerate, and breccia; moderately to well consolidated.
0 1 2 MILES
N
REGIONAL GEOLOGIC MAP OF PROJECT
May 2009
28067571
Hydrogen Energy California (HECA)
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FIGURE 5.15-1
U:\GIS\HECA\Projects\figures\HECA2009_GIS_Regional_Geologic_Map_of_Project.mxd
Sources: USGS (30'x60' quads: Taft 1982, Delano 1982). Created using TOPO!, ©2006 National Geographic Maps, All Rights Reserved. Jennings, C. W., 1977, Geologic Map of California, 1:750,000-Scale (Geology).

0 100

Scale in Miles

Source:
United Stated Geological Survey: http://earthquake.usgs.gov

REGIONAL FAULT MAP:
MAJOR FAULTS OF SOUTHERN CALIFORNIA

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Kern County, California

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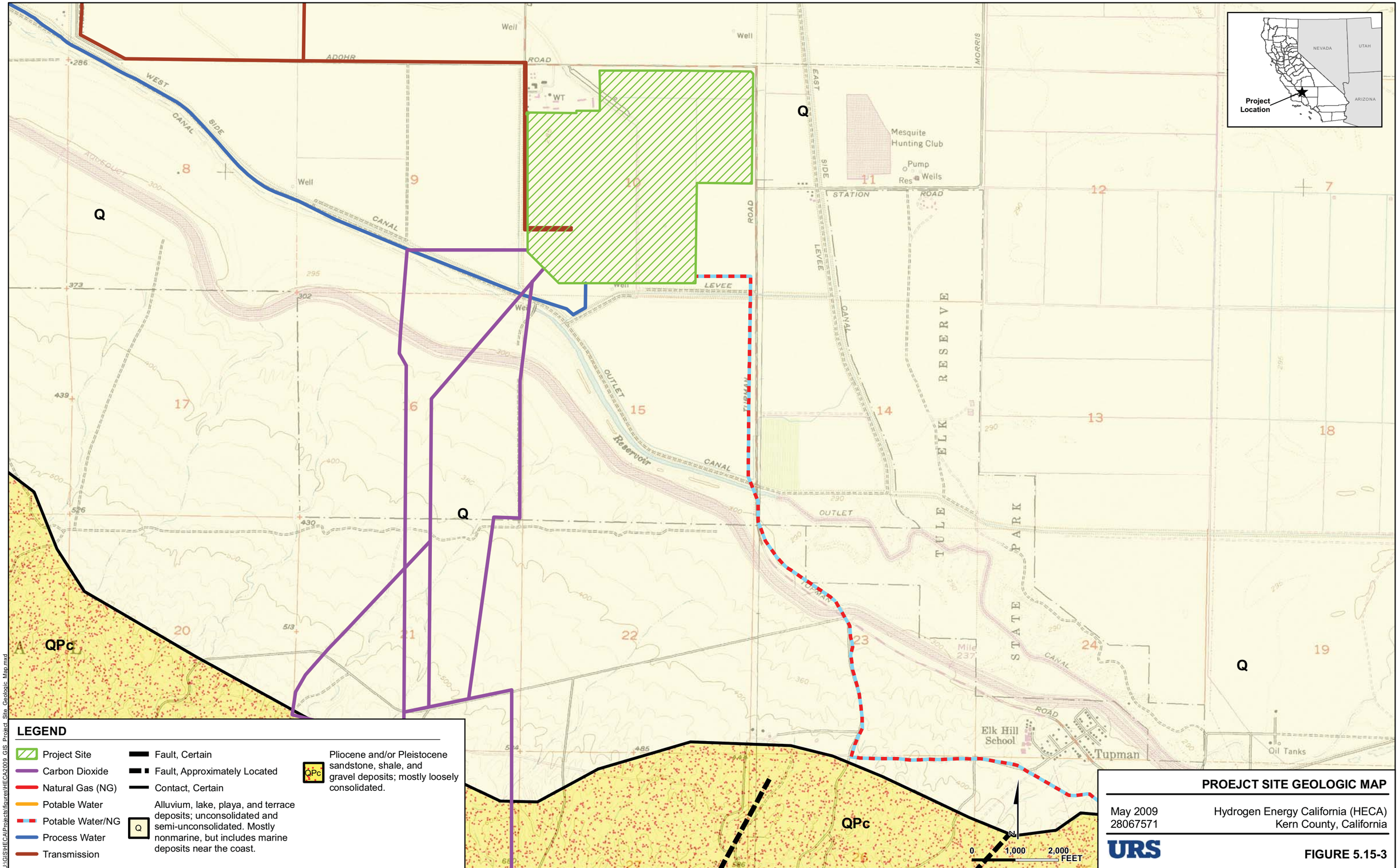
FIGURE 5.15-2

3/24/09 vsa..T:\HECA\GRAPHICS\5.15 Geo\5.15-2_regional fault.ai



U:\GIS\HECA\Projects\figures\HECA2009 GIS Project Site Geologic Map.mxd

Sources: USGS (7.5' quads: East Elk Hills 1977, Tupman 1977). Created using TOPO!, ©2006 National Geographic Maps, All Rights Reserved. Jennings, C. W., 1977, Geologic Map of California, 1:750,000-Scale (Geology).

PROEJCT SITE GEOLOGIC MAP

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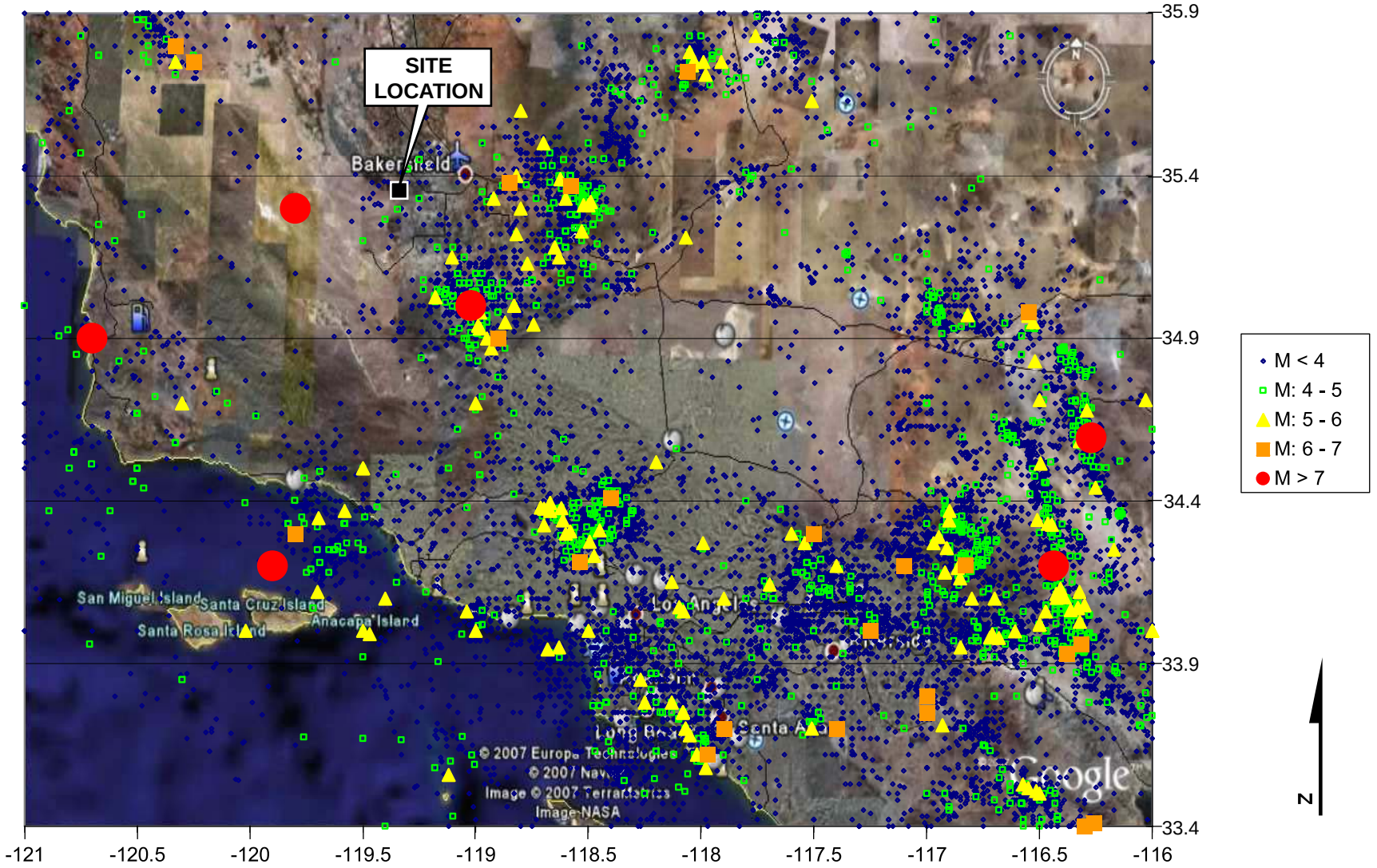
FIGURE 5.15-3



EPICENTRAL LOCATION OF MAJOR EARTHQUAKES IN SOUTHERN CALIFORNIA

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FIGURE 5.15-4

5/08/09 vsa..T:\HECA\GRAPHICS\5.15 Geo\5.15-4_Epicentral Locs.ai

Adequacy Issue: Adequate ____ Inadequate ____ DATA ADEQUACY WORKSHEET Revision No. 0 Date ____

Technical Area: **Geological Hazards** Project: ____ Technical Staff: ____

Project Manager: ____ Docket: ____ Technical Senior: ____

SITING REGULATIONS	INFORMATION	AFC PAGE NUMBER AND SECTION NUMBER	ADEQUATE YES OR NO	INFORMATION REQUIRED TO MAKE AFC CONFORM WITH REGULATIONS
Appendix B (g) (1)	...provide a discussion of the existing site conditions, the expected direct, indirect and cumulative impacts due to the construction, operation and maintenance of the project, the measures proposed to mitigate adverse environmental impacts of the project, the effectiveness of the proposed measures, and any monitoring plans proposed to verify the effectiveness of the mitigation.	Section 5.15.1, p. 5.15-3 Section 5.15.2, p. 5.15-8 Section 5.15.3, p. 5.15-9 Section 5.15.4, p. 5.15-9		
Appendix B (g) (17) (A)	A summary of the geology, seismicity, and geologic resources of the project site and related facilities, including linear facilities.	Section 5.15.1, p. 5.15-3		
Appendix B (g) (17) (B)	A map at a scale of 1:24,000 and description of all recognized stratigraphic units, geologic structures, and geomorphic features within two (2) miles of the project site and along proposed facilities. Include an analysis of the likelihood of ground rupture, seismic shaking, mass wasting and slope stability, liquefaction, subsidence, tsunami runup, and expansion or collapse of soil structures at the plant site. Describe known geologic hazards along or crossing linear facilities.	Section 5.15.1, p. 5.15-3 Figures 5.15-1 and 5.15-3		
Appendix B (g) (17) (C)	A map and description of geologic resources of recreational, commercial, or scientific value which may be affected by the project. Include a discussion of the techniques used to identify and evaluate these resources.	Section 5.15.1.6, p. 5.15-8 Figure 5.15-3		

Adequacy Issue: Adequate ____ Inadequate ____ DATA ADEQUACY WORKSHEET Revision No. 0 Date ____

Technical Area: **Geological Hazards** Project: ____ Technical Staff: ____

Project Manager: ____ Docket: ____ Technical Senior: ____

SITING REGULATIONS	INFORMATION	AFC PAGE NUMBER AND SECTION NUMBER	ADEQUATE YES OR NO	INFORMATION REQUIRED TO MAKE AFC CONFORM WITH REGULATIONS
Appendix B (i) (1) (A)	Tables which identify laws, regulations, ordinances, standards, adopted local, regional, state, and federal land use plans, leases, and permits applicable to the proposed project, and a discussion of the applicability of, and conformance with each. The table or matrix shall explicitly reference pages in the application wherein conformance, with each law or standard during both construction and operation of the facility is discussed; and	Section 5.15.5, p. 5.15-10 Table 5.15-2, p. 5.15-10		
Appendix B (i) (1) (B)	Tables which identify each agency with jurisdiction to issue applicable permits, leases, and approvals or to enforce identified laws, regulations, standards, and adopted local, regional, state and federal land use plans, and agencies which would have permit approval or enforcement authority, but for the exclusive authority of the commission to certify sites and related facilities.	Section 5.15.5, p. 5.15-10 Table 5.15-2, p. 5.15-10		
Appendix B (i) (2)	The name, title, phone number, address (required), and email address (if known), of an official who was contacted within each agency, and also provide the name of the official who will serve as a contact person for Commission staff.	Section 5.15.6, p. 5.15-12 Table 15.5-3, p. 5.15-12		
Appendix B (i) (3)	A schedule indicating when permits outside the authority of the commission will be obtained and the steps the applicant has taken or plans to take to obtain such permits.	Section 5.15.7, p. 5.15-13		