5.5 Geologic Hazards and Resources

This section discusses the potential effects of the Ridgecrest Solar Power Project (RSPP or Project) on geologic resources and the potential geologic hazards that the Project may encounter. It begins with identification of applicable laws, ordinances, regulations, and standards (LORS), describes existing environmental conditions, assesses Project impacts, and identifies mitigation measures needed to avoid or reduce adverse impacts.

The geological hazards and resources discussion presented in the following pages is intended to support compliance by the California Energy Commission (CEC) with the requirements of the California Environmental Quality Act (CEQA), and by the Bureau of Land Management (BLM) with the requirements of the National Environmental Policy Act (NEPA). The two agencies are conducting a joint review of the Project and a combined CEQA/NEPA document will be prepared.

Summary

The Project will not have significant adverse impacts due to geologic hazards nor will it have significant adverse impacts on geological resources. No major unique geologic or physical features have been identified in the Project area. No active fault zones are present within the Project boundaries or within a two-mile radius of the site; however, there is one inactive fault mapped through the center of the Project. This fault will be evaluated during the final geotechnical investigation. The Project site is located in Seismic Zone 4, the zone with the highest seismicity. All Project structures will be designed to meet the strict seismic design standards established for Seismic Zone 4.

Evidence of ground subsidence (e.g., fractures possibly caused by historic groundwater extraction) has not been documented at the Project site. The preliminary geotechnical investigations found that the potential for ground subsidence, expansive and collapsible soils, liquefaction, seismic settlement, and slope failures at the Project site are low. Given the high historic use of local groundwater resources for agricultural and residential development with no subsidence reported, it is not anticipated that the Project's limited pumping program from the Indian Wells Valley Water District's wells will induce subsidence.

5.5.1 LORS Compliance

This section addresses the LORS applicable to geologic hazards and resources that are relevant to the Project. The Project will comply with the applicable LORs during construction and operation. Table 5.5-1 summarizes these LORS.

Table 5.5-1 LORS Applicable to Geological Resources and Hazards

LORS	Applicability	Where Discussed in AFC
Federal:		
Uniform Building Code (UBC)	The UBC specifies acceptable design criteria for structures and excavations with respect to seismic design and load bearing capacity.	Section 5.5.2
State:		
California Building Code (CBC)	Specifies acceptable design criteria for structures and excavations with respect to seismic design and load bearing capacity.	Section 5.5.2
Alquist-Priolo (AP) Earthquake Fault Zoning Act	Identifies areas subject to surface rupture from active faults.	Sections 5.5.2 and 5.5.3
The Seismic Hazards Mapping Act: Title 14 California Code of Regulations Division 2, Chapter 8, Subchapter 1, Article 10	Identifies non-surface fault rupture earthquake hazards, including liquefaction and seismically induced landslides.	Sections 5.5.2 and 5.5.3
Local:		
Kern County Grading Ordinance	Kern County requires a grading permit for earth moving activities.	Section 5.5.1
Kern County Floodplain Management Ordinance (Ordinance G-7645.15): Kern County Code, Chapter 17.48.140	Kern County requires a development permit prior to any construction or other development within any area of special flood hazards, areas of flood-related erosion hazards, or areas of mudslide (i.e., mudflow).	Section 5.5.1

5.5.1.1 Federal LORS

The UBC specifies acceptable design criteria for structures with respect to seismic design and load bearing capacity. The State has adopted these provisions in the CBC, discussed below.

5.5.1.2 State LORS

The Project is subject to the applicable sections of the CBC. The Engineering & Survey Services Department, Building Inspection Division of Kern County is responsible for implementing the CBC for the Project.

Alquist-Priolo Earthquake Fault Zoning Act

The AP Earthquake Fault Zoning Act was enacted by the State of California in 1972 to mitigate the hazard of surface faulting to structures planned for human occupancy and other critical structures. This law was a direct result of the 1971 San Fernando Earthquake, which was associated with extensive surface fault ruptures that damaged numerous homes, commercial buildings, and other structures. The State has established regulatory zones (known as Earthquake Fault Zones and often referred to as “AP zones”) around the surface traces of active faults and has issued “Earthquake Fault Zone Maps” to be used by government agencies in planning and reviewing new construction. In addition to residential projects, structures planned for human occupancy that are associated with industrial and commercial projects are of concern. There are no designated AP zones on the Project site and thus the Act does not apply to the Project.

Seismic Hazards Mapping Act

The purpose of the Seismic Hazards Mapping Act is to protect public safety from the effects of strong ground shaking, liquefaction, landslides, or other ground failure, and other hazards caused by earthquakes. The program and actions mandated by the Seismic Hazards Mapping Act closely resemble those of the AP Earthquake Fault Zoning Act, which addresses only surface fault-rupture hazards.

5.5.1.3 Local LORS

The Project is subject to Kern County's Building Inspection Division's requirements for building, grading, and flood development permits. The development permit is for development in areas within special flood hazards.

The County Floodplain Management Ordinance, Kern County Code Section 17.48.200, requires that if a watercourse is to be altered or relocated, adjacent communities and the California Department of Water Resources must be notified prior to such alteration or relocation of a watercourse, and evidence of such notification must be submitted to the Federal Insurance Administration and Federal Emergency Management Agency. The ordinance also requires that the flood carrying capacity of the altered or relocated portion of said watercourse be maintained (Ordinance G-6914 Section 14, 2002).

5.5.1.4 Involved Agencies

The agency and person(s) to contact for grading, building, National Pollutant Discharge Elimination System (NPDES), and floodplain development permits are identified in Table 5.5-2.

Table 5.5-2 Agencies and Agency Contacts

Agency Contact	Phone/E-mail	Permit/Issue
Kim Baldwin Kern County Engineering and Survey Services Department – Building Inspections Division 2700 M Street Bakersfield, CA 93301	(661) 862-8650 baldwink@co.kern.ca.us	Building permits, grading permit for earthmoving activities exceeding 50 cubic yards, and floodplain development permit for construction in a special flood hazard area
Richard Booth Senior Engineering Geologist Lahontan Regional Water Quality Control Board South Lake Tahoe Office 2501 Lake Tahoe Boulevard South Lake Tahoe, CA 96150	(530) 542-5574 Rbooth@waterboards.ca.gov	Waste Discharge Requirements, NPDES and Storm Water Permits, Clean Water Act 401

5.5.1.5 Required Permits and Permit Schedule

Building and grading permits are required by the Kern County Engineering and Survey Services Department, Building Inspections Division. According to department staff, applications are required at least six weeks prior to construction.

Table 5.5-3 Permits Required and Permit Schedule

Permit/Approval	Schedule
Building permit	Application must be submitted six weeks prior to the start of construction.
Grading permit	Application must be submitted six weeks prior to the start of construction.
Floodplain development permit	Application must be submitted six weeks prior to the start of construction.

5.5.2 Affected Environment

This section discusses the existing geologic environment of the Project site. Underlying geologic structures, seismicity, and geologic hazards are discussed.

5.5.2.1 Geological Setting

The Project site is located within Indian Wells Valley, which is in the southern end of the Basin and Range Province east of the Sierra Nevada, south of the Caso range, north of the El Paso Mountains, and west of the Argus Range. Indian Wells Valley is also situated between the Sierra Nevada Fault Zone to the west and the El Paso and Garlock faults to the south. The Valley is characterized by a broad alluvial basin of Cenozoic-age sedimentary and volcanic material overlying older plutonic and metamorphic rocks (Figure 5.5-1a and Figure 5.5-1b). Quaternary lacustrine deposits are also found in the region as a result of playas in the northeastern portion of the valley. Indian Wells Valley is underlain with alluvial deposits up to 2,000 feet thick.

The Project site is underlain by three stratigraphic units: Jurassic age basement complex, Quaternary and Tertiary age Black Mountain Basalt and Quaternary alluvium of Holocene age. A basement complex of Jurassic, undifferentiated plutonic, hypabyssal, and metamorphic rocks outcrop in the eastern portion of the site. The basement complex forms a basin in which the Tertiary and Quaternary age deposits are found. The Black Mountain Basalt is thought to be of late Pliocene and Pleistocene age and consists of olivine basalt flows that are more than 100 feet thick in some places. An unconformity is formed at the boundary of the Black Mountain Basalt and the overhead Tertiary age continental deposits that comprise the Goler and Ricardo Formations. Surficial Quaternary alluvium sits atop the Tertiary continental deposits.

The Project site is located in the southeast portion of Indian Wells Valley. Topography at the site is relatively flat and slopes gently downward in a northwest direction at a gradient of approximately 0.2 percent. Ground surface elevations range from approximately 2,890 feet above mean sea level (msl) in the southeast to 2,580 feet above msl in the northwest. The Project site is bisected by a concealed, inactive fault. The fault shows evidence of displacement during the late Quaternary time, most likely during the Pleistocene. The inactive fault trends northwest and is located in the southern half of the site.

The majority of the Project site is underlain by Quaternary alluvium and alluvial fan deposits of Holocene age. These deposits consist of unconsolidated moderately to well-sorted gravel, sand silt, and clay. These deposits are derived as alluvial fans from the surrounding mountainous regions and may include fluvial deposits.

There are no perennial surface water bodies in Indian Wells Valley. During wet years, some surface flow enters the Valley through the Little Lake Gap. The water budget inflows for the Valley consist of mountain front recharge, subflow from the Rose Valley Basin and Coso Valley Basin, and infiltration of surface flows through Little Lake Gap. The only outflows are through groundwater pumping and evapotranspiration from the playa areas. Generally, groundwater flow directions throughout Indian Wells Valley are directed towards the playa just north of Ridgecrest. Groundwater flow direction on the Project site trends northeast towards the playa. In the region, groundwater elevations range from approximately 2,150 feet above msl to 2,350 feet above msl. Beneath the Project plant site groundwater flows to the northeast towards Ridgecrest and ranges from approximately 2,250 feet above msl and 2,350 feet above msl.

5.5.2.2 Seismicity

The Project site is located in seismically active Southern California, a region that has experienced numerous earthquakes in the past. A review of the AP Earthquake Fault Zone maps and the Kern County Online Mapping System Faults and Fault Zones layer indicate that there are no AP fault zones present within the Project boundaries; however there are three AP fault zones within a 10-mile radius of the center of the Project site. The closest of these AP fault zones is the Little Lake Fault Zone which is located approximately 6.6 miles northeast of the site. Two segments of the Airport and Little Lake Fault Zone are located to the north and northwest of the Project site, approximately 10 miles from the center of the site.

An unnamed buried fault trace has been mapped as trending northwest-southeast across the center of the site. Based on personal communication with Glen Harris (BLM Ridgecrest office), site features, and observations made during a July 2009 field reconnaissance, the more probable location of the unnamed fault is just north of, and parallel to Brown Road, and trends roughly east-west (Figure 5.17-2). This fault has not been mapped by the United States Geological Survey (USGS) as a Quaternary (sufficiently active) fault, and is not listed by the EQFAULT program as a fault potentially affecting the site.

Regardless of whether there are faults across the site, because the Project is located in a seismically-active area, all Project structures must be designed to comply with the CBC and UBC Zone 4 requirements. The CBC and UBC are considered to be standard safeguards against major structural failures and loss of life. The goals of the Codes are to provide structures that will: 1) resist minor earthquakes without damage; 2) resist moderate earthquakes without structural damage but with some non-structural damage; and 3) resist major earthquakes without collapse but with some structural and non-structural damage. The CBC and UBC base seismic design on minimum lateral seismic forces ("ground shaking"). The CBC and UBC requirements operate on the principle that providing appropriate foundations, among other aspects, helps to protect buildings from failure during earthquakes.

Although the Project is in an area that does not include mapped AP zones, a geotechnical/geologic constraints evaluation will be conducted to identify and evaluate geologic and geotechnical constraints that could affect the Project, including an evaluation of whether fault rupture; moderate to severe seismic shaking; subsidence and ground failure related to groundwater withdrawal; and/or expansive or collapsible alluvial soils exist within the Project plant site. The results of this evaluation are included in the Preliminary Geotechnical Investigation Report provided in Appendix B.

Site geotechnical work undertaken for this Project included soil borings and test pits in the solar array fields, and borings in the area of the power block and other Project structures. Soil borings were drilled to obtain samples of the site soils for laboratory testing and soil classification. The purpose of the test pits was to gain a better spatial assessment of the near-surface soil materials and to provide a better understanding of the general grading recommendation, such as stripping depths and effects of the existing moisture conditions on the general grading operations. The investigation included excavation and logging of test pits of approximately five feet in length, and five and a half to nine feet in depth.

5.5.2.3 Geologic Hazards

Seismic hazards related to ground shaking include ground rupture, slope stability, liquefaction, subsidence, tsunamis, and seiches. Due to the inland location of the Project site and the absence of nearby large bodies of water, hazards from tsunamis and seiches are not present.

Seismic Ground Shaking

Because the Project site is located in a seismically active area, it likely will be subjected to ground shaking from movement along one or more of the sufficiently active or well-defined faults in the region. A “sufficiently active fault” (previously referred to as an “active fault”) is defined as a fault that has broken the surface in the past 11,000 years. A “well-defined fault” (previously referred to as a “potentially active fault”) is defined as a fault whose trace is clearly detectable by a trained geologist as a physical feature at or just below the ground surface.

A search identified a total of 47 sufficiently active faults and well-defined faults within a 100-mile radius of the Project site. It is important to note that of the 47 faults identified, only seven have the potential to generate ground accelerations of 0.1 gravity (g) or greater. Table 5.5-4 highlights the seven most proximal faults that have the potential to generate ground acceleration greater than 0.1g. The 0.1g value is an industry standard for significance in terms of foundational design, and this potential acceleration can be managed with proper foundational design and site geotechnical investigation. The highest potential ground acceleration (0.391g) is for the Southern Sierra Nevada Fault Zone, located approximately 8.6 miles to the northwest of the site. The Sierra Nevada Fault Zone may be capable of generating a moment magnitude 7.1 earthquake, which would be considered the maximum credible event that could impact the Project. Studies suggest that the Sierra Nevada Fault Zone has an estimated slip rate of less than one millimeter per year with an unknown recurrence interval for large earthquakes. The most recent earthquake on the Sierra Nevada Fault Zone was during the Holocene.

The closest seismically active area to the site is the Little Lake Fault Zone. This fault zone is located approximately 6.6 miles to the northwest and has the potential to generate a moment magnitude of 6.7. The possible maximum ground acceleration for this fault zone is 0.333g. The Little Lake Fault Zone is near China Lake and is part of the Eastern California Shear Zone.

Based on available online Seismic Hazard Zone Maps by the California Geological Survey, the Project site is located in an area that has not been mapped for seismic hazards. Based on the California Geological Survey's, Probabilistic Seismic Hazards Mapping Ground Motion Page, there is a 10 percent probability of earthquake ground motion exceeding 0.361g at the Project plant site over a 50-year period.

Table 5.5-4 Active and Potentially Active Faults with Peak Site greater than 0.1 g

Fault Name	Approximate Distance from Site		Peak Site Acceleration (g)
	Miles	Kilometers	
Little Lake	6.6	10.6	0.333
Garlock (East)	8.6	13.8	0.368
Southern Sierra Nevada	8.6	13.9	0.391
Blackwater	20	32.2	0.137
Lenwood-Lockhart-Old Woman Springs	23.2	37.3	0.159
Garlock (West)	24.9	40	0.125
Gravel Hills – Harper Lake	26.3	42.3	0.100

Ground Rupture

Although located in an acknowledged seismically active area, the Project site is not located on a sufficiently active or well-defined fault trace as designated by mapping as part of the AP Earthquake Fault Zoning Act. Therefore, the Project is not subject to AP zone requirements and the risk of earthquake-induced ground rupture is considered to be low. However, an unnamed northwest-southeast trending fault trace is mapped across the center of the site (Figure 5.5-1a). This fault has not been classified as an earthquake fault zone by the California Geological Survey and is not listed by the EQFAULT program as a fault potentially affecting the site; however, additional studies should be conducted to investigate if the potential for this fault to affect the site exists. The mapped fault trace in relation to the Project layout is shown on Figure 5.5-2. Fissures caused by the lowering of groundwater tables and by hydrocollapse when groundwater tables have risen have not been reported in the Indian Wells Valley. Based on the preliminary geotechnical investigation data and observations of the soil profile exposed in the test pits, the potential for ground rupture due to collapsible soil conditions on site is considered to be low.

Slope Stability

The Project is not considered to be in an area with the potential for permanent ground displacement due to earthquake-induced landslides (mass wasting) because surface topography at and near the site is relatively flat. A review of aerial photographs did not identify any active or inactive landslides at the site or in the adjacent areas. The El Paso Mountains are directly adjacent to the western portion of the site. These mountains have slopes with angles of 30 percent or greater and have a high potential for seismically induced rockfalls and landslides to occur. The steepest slopes (30 and 34 percent grade) to the Project are located adjacent to and along the western site boundary in Sections 27 and 34 of T27S R39E. Given that these slopes are located directly adjacent to and on the site, it is possible that falling rock would reach the edge of the Project site. Observations of these slopes were made during the geotechnical field reconnaissance for boulders along the current limits of the Project site. Based on topography and initial review of available data, the potential for seismically induced rockfalls and landslides to affect the site is low. Local areas adjacent to drainages with higher banks might be subject to localized slope instability.

Erosion

Erosion is the displacement of solids (soil, mud, rock, and other particles) by wind, water, or ice and by downward or down-slope movement in response to gravity. Due to generally flat terrain, the Project site is not prone to significant mass wasting. The Kern County Fire Department Office of Emergency Services (KERN OES) Multi-Hazard Mitigation Plan states that erosion problems in Kern County are prevalent on steep slopes and alluvial fans, both of which are found at the site. However, based on wind erosion maps, the site is not located in an area prone to wind erosion.

Soil characteristics at the Project site have not been mapped by the U.S. Department of Agriculture, Natural Resource Conservation Service; however, a field reconnaissance soil survey and water and wind erosion modeling was commissioned by the Applicant. Under current conditions (undisturbed), the soil loss due to water erosion is estimated to be about 0.48 ton per acre per year and erosion in disturbed areas during construction activities is estimated to be about 0.8 ton per acre per year. Soil loss due to wind erosion for undisturbed conditions is estimated to be about 135 tons per acre per year, and for disturbed conditions is estimated at 141 tons per acre per year. Construction activities would increase the potential for soil loss from wind erosion without implementation of Best Management Practices (BMPs). The implementation of BMPs is expected to reduce water and wind erosion of soils to less than significant levels. Soil erosion from wind and water during construction activities is further evaluated in Section 5.12, Soils.

Liquefaction

Liquefaction is a soil condition in which seismically induced ground motion causes an increase in soil water pressure in saturated, loose, sandy soils, resulting in loss of soil shear strength. Liquefaction can lead to near-surface ground failure, which may result in loss of foundation support and/or differential ground settlement. Sandy deposits deeper than 50 feet below ground surface usually are not prone to causing surface damage. In addition, soils above the groundwater table (soils that are not saturated) will not liquefy. The Kern OES Multi-Hazard Mitigation Plan has identified areas with shallow groundwater that would be susceptible to liquefaction; however, the Project site has not been identified as being susceptible to liquefaction. Depth to water at Ridgecrest is estimated to be 240 feet below ground surface (bgs) on the southwest and 450 ft bgs on the northeast. Based on the estimated depth of the groundwater at the site and the geologic age of the soils, liquefaction is considered unlikely (see Section 5.17, Water Resources).

Subsidence

Subsidence due to groundwater withdrawal is occurring in Kern County over a large area south of Bakersfield and in the Antelope Valley near Edwards Air Force Base. As much as four feet of subsidence

has been reported. These areas are located approximately 70 miles west and 45 miles south, respectively, of the Project site. No subsidence has been documented at or near the Project site.

The Project is located within the Indian Wells Valley Groundwater Basin. Groundwater development within the Basin is sparse, with the exception of the Ridgecrest area, Inyokern area, and the China Lake Naval Weapons Station (NAWS). Historically, groundwater pumping in the Basin was minor prior to the beginning of China Lake NAWS operation in the late 1940s. By 1950, annual groundwater pumping rates were estimated to be approximately 6,000 acre-feet per year, and some time in the late 1950s to early 1960s, groundwater pumping equaled or exceeded the sum of natural recharge. Groundwater pumping within the Basin is currently (2006 through 2007) estimated to total approximately 30,000 acre-feet per year with the principle entities pumping groundwater being Indian Wells Valley Water District, China Lake NAWS, Searles Valley Minerals, and commercial agricultural operations. Groundwater level data for the City of Ridgecrest show an overall decline (approximately 100 feet) in the water table between the 1920s and 2006. The increased groundwater pumping in the area is causing a cone of depression beneath the City of Ridgecrest. However, because subsidence associated with the lowering of the groundwater table has not been reported at the Project area potential subsidence from groundwater withdrawal associated with the Project is considered to be less than significant.

Seismically-induced settlement can occur in areas where earthquake shaking causes densification of relatively loose sediments. Settlement can cause damage to surface and near-surface structures. However, with implementation of planned mitigation measures, the potential for damage due to seismically induced settlement is considered to be low at the Project site. Based on the preliminary geotechnical investigation conducted the Project site, seismically induced settlement is considered to be low. Although the potential for damage due to seismically induced settlement is considered to be low, the results of the preliminary investigation will be verified during the design geotechnical investigation for the Project design and construction.

Collapsible Soil Conditions

Alluvial soils in arid and semi-arid environments have the tendency to possess characteristics that make them prone to collapse with an increase in moisture content and without increase in external loads. The Project is located in a geologic environment where the potential exists for collapsible soils. Site-specific soil properties that may contribute to collapsible soil conditions were investigated during the preliminary geotechnical investigation. Based on the geotechnical data and observation of the soil profile exposed in the test pits, the potential for collapsible soil on site is considered to be low. In addition, the potential for damage due to collapsible soils is considered to be very low provided that the mitigation measures for sub-grade improvements are implemented. Active mitigation measures will be implemented to minimize soil erosion and collapse, including:

- Engineering berms and drainage to minimize wetting of these soils; and directing runoff away from the power block;
- Pre-watering the plant site to induce hydro-consolidation in advance of the grading program that will be part of Project construction; and
- Removing collapsible soils as part of the grading program.

Expansive Soil

Expansive soil consists of fine-grained clay that occurs naturally. It is generally found in areas that were historically a flood plain or lake area, but can occur in hillside areas also. Expansive soil is subject to swelling and shrinkage, varying in proportion to the amount of moisture present in the soil. As water is initially introduced into the soil (by rainfall or watering), expansion takes place. If dried out, the soil will contract, often leaving small fissures or cracks. Excessive drying and wetting of the soil can progressively deteriorate structures over the years by leading to differential settlement within buildings and other improvements.

The USGS has mapped swelling soil potential based on geologic formations that have abundant sources of clay. Based on this map, the Project site is located in an area where data is insufficient and where the unit contains little or no swelling clay. Surface soils observed in the borings and test pits during the preliminary geotechnical exploration consist primarily of granular soil; therefore, the potential for soil swelling is generally low to none.

5.5.2.4 Geologic Resources

Recreational and unique geologic resources and features typically include rock or mineral collecting, surface hydrothermal features, or surface expression of geologic features unique enough to generate recreational interests of the general public (natural bridges, caves, waterfalls, etc.). There has been mining prospecting on the site in the past, and mining claims exist near the project site. Also, the BLM has stated that rock/mineral collecting does occur on the site (see Section 5.7, Land Use, for further discussion). Based on a search of State recreation-related websites, and the Kern Regional Atlas, there are no known recreational or unique geologic resources associated with the Project site.

California Division of Oil, Gas, and Geothermal Resources oil and gas maps were reviewed to check for oil or gas resources beneath the Project site or in the adjacent areas; however, there is no map coverage for the Project area. The Project is located in the east-central portion of District 4. The Kern OES Multi-Hazard Mitigation Plan was reviewed for the presence of geologic resources; however, no mineral or energy resources are located at the Project site.

A review of the USGS Mineral Resources database shows that there is an occurrence of lead on the southern portion of the site. The database refers to the location as “The Lead Mine” (MRSDS ID# M020914) and the ground surface appears undisturbed. Construction of the Project would limit access to this occurrence of lead for the proposed life of the Project.

5.5.3 Environmental Impacts

Environmental impacts associated with the construction and operation of the Project are discussed in the following sections.

5.5.3.1 Construction

Construction-related impacts to the geologic environment primarily are related to terrain modification (cuts, fills, and drainage diversion measures) and dust generation (excavation and grading). Dust generation and the potential for erosion-related impacts associated with construction are discussed further in Section 5.12, Soils. No major unique geologic or physical features have been identified at the Project site. Based on the conceptual grading plan (see Appendix L) for the Project site, construction will require cut and fill activities on the site, but import/export of earthen materials to and from the site will not be required. Therefore, potential construction-related impacts to the geologic environment would be confined to the Project site.

Evidence of ground subsidence as a result of past groundwater withdrawal has not been documented in the Project area. The Project water supply will come from existing water supply wells in the Indian Wells Valley Water District, located northeast of the site, in the City of Ridgecrest. Therefore, subsidence as a result of groundwater withdrawal is not anticipated at the Project site. Groundwater modeling for the Indian Wells Valley Water District wells that will be pumped indicated that for the 30-year period of Project operations when water use would be about 129,600 gallons per day, about 51 feet of drawdown can be anticipated. By comparison, groundwater modeling indicates that under current water pumping rates (without the Project or related construction), the maximum drawdown in these wells for the same period of time would be about 51 feet. Therefore the amount of drawdown as a result of pumping is relatively insignificant. For the period of significant water usage (i.e., during the 28-month construction period) when about 561,600 gallons per day of water would be used, about 21 feet of drawdown would occur at

these well sites. This is only a two-foot increase in drawdown during this period of time as the drawdown from current water usage would still be about 19 feet. It is anticipated that the moderate level of drawdown during this short period of pumping will not induce subsidence.

The preliminary geotechnical investigation, consisting of soil borings and test pits, indicates that soil properties that may contribute to fractures and collapsible soil conditions (when wetted), as well as expansive soil conditions, are generally not present at the site. To ensure that collapse potential is minimized, all foundations for Project facilities will be designed in accordance with the recommendations of the preliminary and future geotechnical investigations. Recommendations may include overexcavation and recompaction where necessary.

Because the Project site is in the seismically active Southern California region, it is subject to ground shaking and potentially subject to fault movement from earthquakes along faults in the region. The potential for earthquake-related impacts would begin during Project construction. However, seismic impacts would be of greater concern during long-term Project operation than during the limited duration of the Project construction phase. These impacts are discussed immediately below.

5.5.3.2 Operation

Regional and local geologic conditions will not be altered significantly by the long-term operation of the Project. No major unique geologic or physical features have been identified at the Project site. The Project area may be underlain by deposits of sand, gravel, and lead and these resources could not be recovered and used during the active life of the Project. No other impacts to the geologic environment have been identified.

The Project area is subject to ground shaking from nearby and distant earthquakes. Ground acceleration greater than 0.1g may be experienced at the Project site, which represents the potential for moderate to severe shaking. The Project site is located in Seismic Zone 4, the zone with highest potential for seismic ground shaking. The Southern Sierra Nevada Fault has been identified as having the greatest potential to affect the Project site and thus, impacts resulting from severe shaking at the Project site may be anticipated. Project structures will be designed to meet the seismic design standards appropriate for Seismic Zone 4. The Project preliminary geotechnical investigation program will address site-specific soil conditions and the potential for significant seismicity. Due to the depth to groundwater (240 to 450 feet bgs or more), liquefaction is not expected to occur.

Evidence of ground subsidence, such as fractures possibly caused by groundwater extraction, has not been noted at the Project site. The potential for local settlement due to groundwater withdrawal could be present at the Project site if the regional groundwater table were to be lowered significantly. As discussed in Section 5.17, Water Resources, the source of water for the Project will not be groundwater beneath the Project site. Given that groundwater use continues in the Basin and that no subsidence has been reported, it is not anticipated that the Project will experience subsidence below the site.

As discussed above, the Project water supply will come from existing water supply wells in the Indian Wells Valley Water District. Water use of about 129,600 gallons per day for 30 years of site operations would cause less than one foot of additional drawdown at these well sites beyond the amount of drawdown that would occur under current or existing water use rates. During the 28-month period of Project construction, it is anticipated that the moderate level of drawdown (approximately two feet beyond what would normally occur) during this period of pumping will not induce subsidence. Additional geotechnical investigations will be conducted to support the Project detailed design process.

In summary, the only identified potential geologic hazard for the Project is ground shaking. Construction of facilities in accordance with the mitigation measures identified below will ensure that earthquake-related impacts are minimized such that Project impacts are considered less than significant.

5.5.3.3 Cumulative Impacts

The Project will be designed and constructed to meet UBC/CBC requirements for industrial facilities located in Seismic Zone 4 and will adhere to sound professional practices and appropriate regulatory requirements related to geologic hazards (e.g., grading, slope stability). For these reasons, the Project is expected to have no significant impacts on geologic hazards or resources. Other projects in the same vicinity would also be expected to adhere to the appropriate professional standards and regulatory requirements. For these reasons, the Project would not be expected to contribute considerably to significant cumulative effects on geologic resources and hazards during construction or operation.

5.5.4 Mitigation Measures

5.5.4.1 Construction

Geologic impacts associated with the construction of the Project are expected to be less than significant. Site-specific geotechnical, seismic, and collapsible soil conditions will be appropriately addressed during Project-detailed design and during construction. The following mitigation measures are proposed to ensure that impacts are less than significant.

GEOL–1 Power plant structures and equipment as well as offsite linear facilities (natural gas, pipeline and transmission line) will be designed in accordance with Seismic Zone 4 requirements.

GEOL–2 Project foundations will be designed in accordance with recommendations (e.g., overexcavation and recompaction beneath project structures and paved areas) provided in the Preliminary Geotechnical Investigation Report and as amended by future geotechnical investigations.

5.5.4.2 Operations

Geologic impacts associated with the Project operations are expected to be less than significant. Thus, no geology-related mitigation measures are proposed.

5.5.5 References

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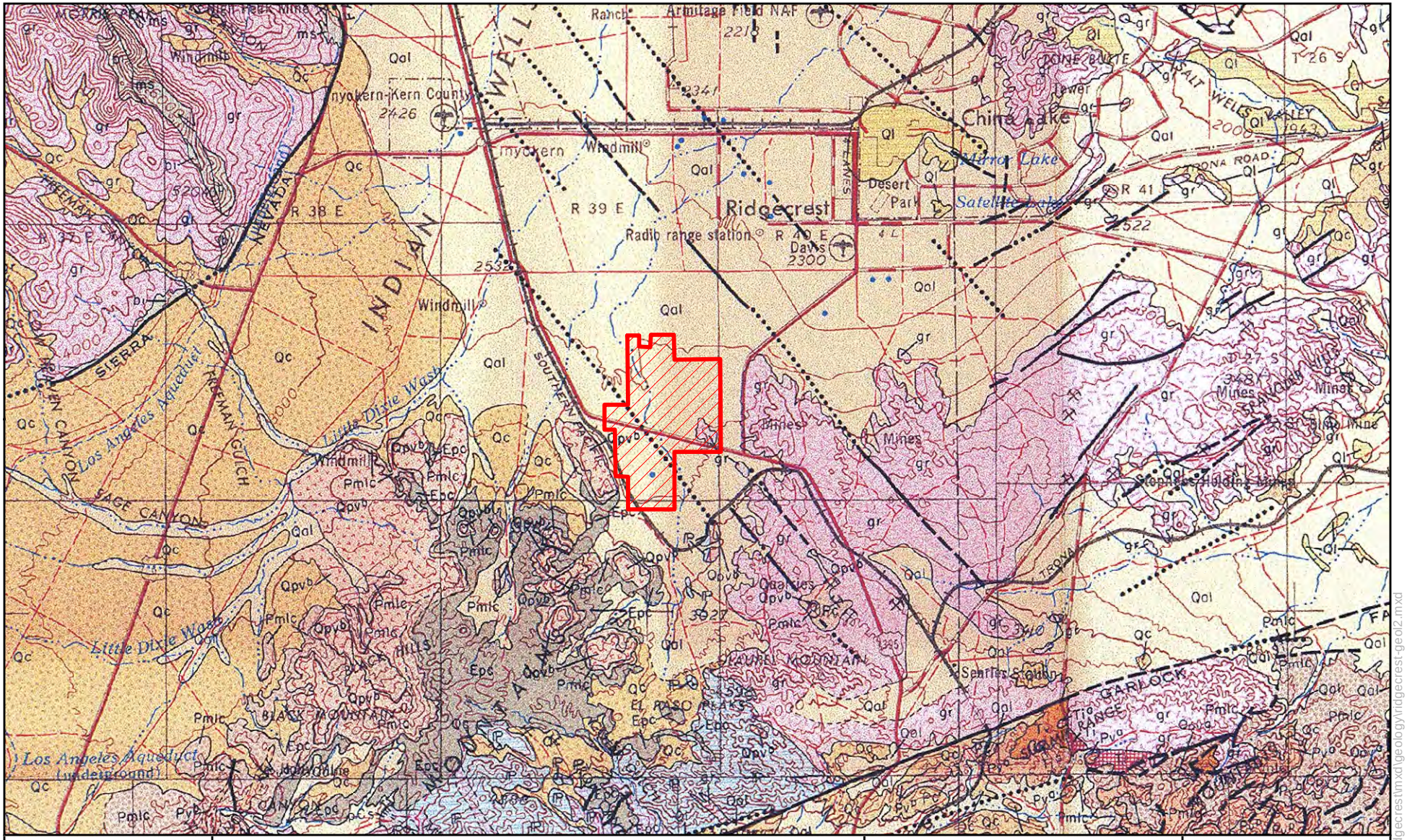

Map Location

Legend

Project Right-of-Way

See Figure 5.5-1b for Geologic Legend

Sources:
Division of Mines and Geology, Geologic Map of California, Trona Sheet, Scale 1:250,000, 1963

1 in = 3 miles

0 3 6 Miles

N W E S

Ridgecrest Solar Power Plant

Figure 5.5-1a
Regional Geologic Map

Solar Millennium

AECOM

Project: 12944-003
Date: September 2009

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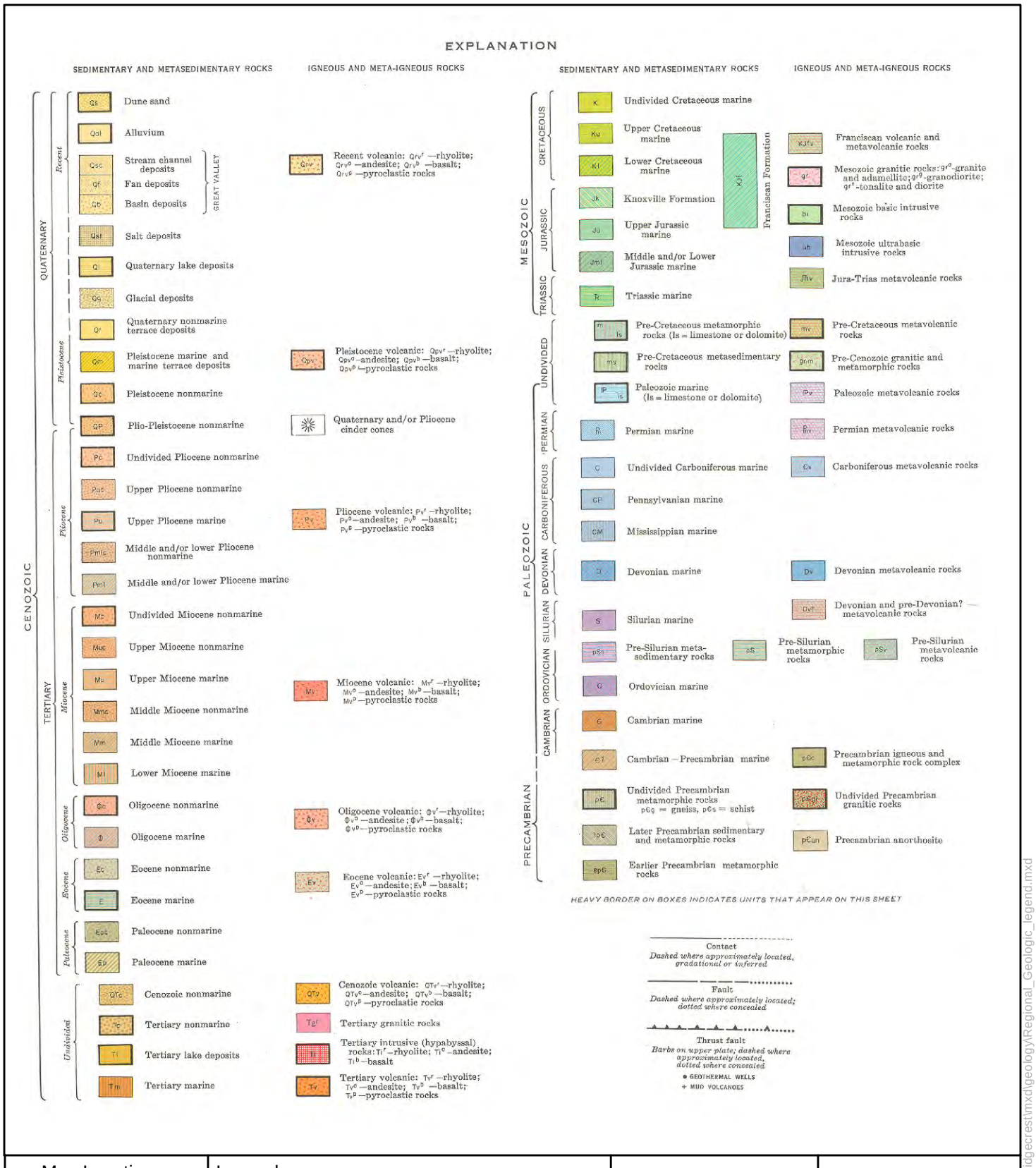

Map Location

Legend

Sources:
Division of Mines and Geology, Geologic Map of California, Trona, Scale 1:250,000, 1963

Ridgecrest Solar Power Project

Figure 5.5-1b Regional Geologic Map Legend

Solar Millennium

AECOM

Project: 12944-003
Date: September 2009

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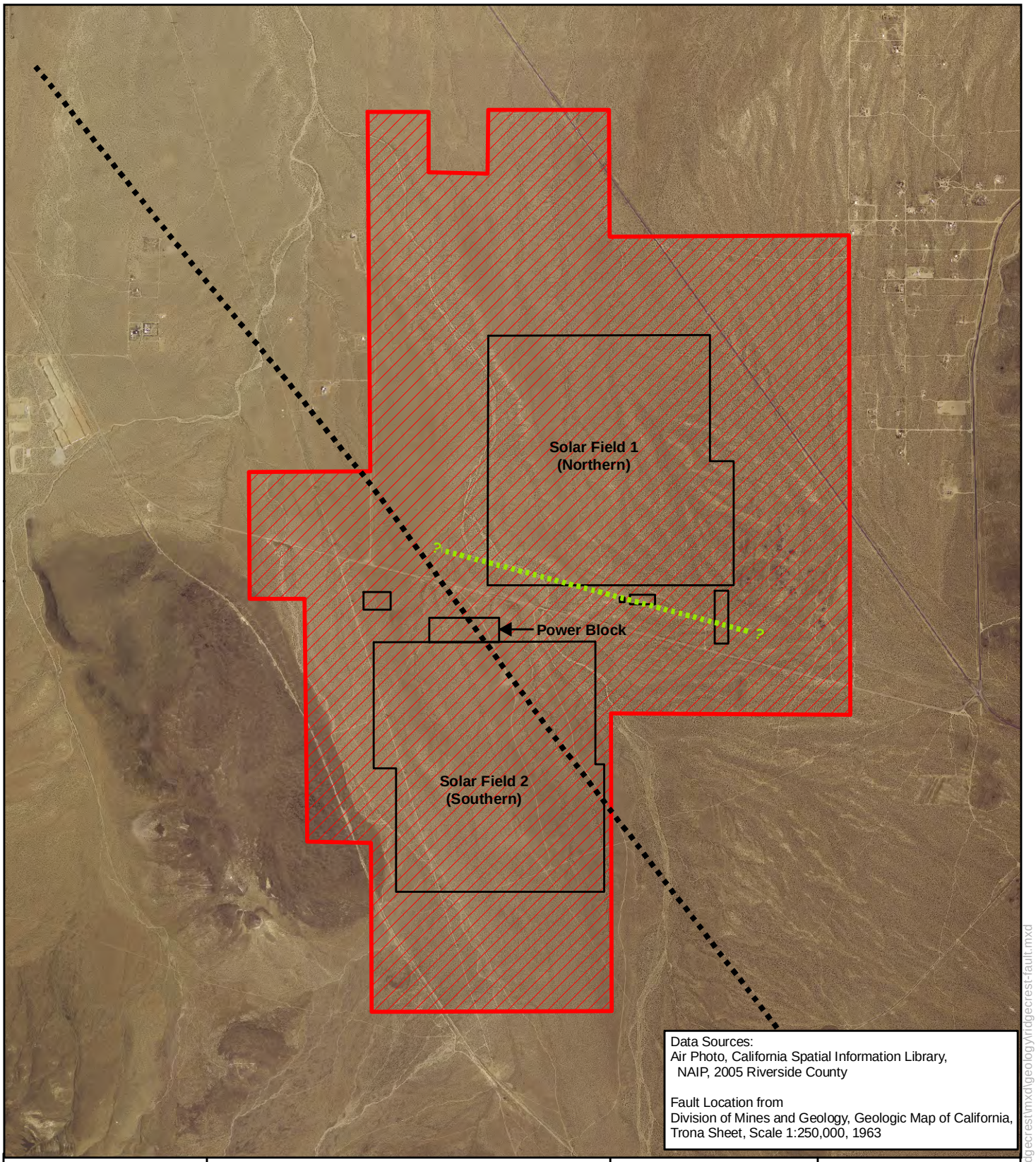

Map Location

Legend

- Project Right-of-Way
- Unnamed Fault (DMG, 1963)
- Approximate Location Fault Trace Based on Field Reconnaissance in July 2009

0 3,000 6,000 Feet

N W E S

Ridgecrest Solar Power Plant

Figure 5.5-2
Site Layout vs. Inactive Fault Mapped Onsite

Solar Millennium

AECOM

Project: 12944-003
Date: September 2009

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