

## 4.6 GEOLOGY, SOILS, AND MINERAL RESOURCES

This section describes the geology and soil conditions and mineral resources at the Project sites and the general vicinity. This section also analyzes issues that could occur with implementation of the Project (e.g., exposure of people and property to potential geologic, seismic, and other natural hazards such as earthquakes, liquefaction, soil expansion, landform alteration, and erosion).

### Scoping Issues Addressed

During the scoping period for the Projects, two public scoping meetings were conducted and written comments were received from agencies and the public. No comments related to geology, soils, and mineral resources were received.

### Applicant's Reports and Survey Results

Information used in preparing this section and in the evaluation of potential impacts to geology, soils, and mineral resources was derived from a number of sources, including a geotechnical report for the Hudson Ranch Power II Geothermal Flash Plant prepared on May 9, 2011 (Appendix G-1), a geotechnical report for equipment pad grading prepared by Landmark Consultants Inc. on January 31, 2011 (Appendix G-2), a percolation test report prepared by Landmark Consultants Inc. on January 28, 2011 (Appendix G-3), and These documents are contained in within Volume II (Technical Appendix) of this EIR.

### 4.6.1 EXISTING SETTING

#### REGIONAL SETTING

The Project sites are 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 on the southwest by the Peninsular Range and faults of the San Jacinto fault zone. Figure 4.6-1 depicts the sites location relative to regional faults and physiographic features (Landmark Consultants, Inc. 2011a).

The Salton Trough is a broad northwest-trending basin that represents the northward extension of the Gulf of California. The Imperial Valley is located in the southeastern half of the Salton Trough and is bounded by uplifted lacustrine sediments along the San Andreas Fault zone to the north, alluvial fans of the Chocolate Mountains to the east, dunes of the Sand Hills to the south, and the Salton Sea to the west. Tectonic activity that formed the trough continues at a high rate, as evidenced by deformed young sedimentary deposits and high levels of seismicity (Landmark Consultants, Inc. 2011a).

The Imperial Valley is directly underlain by lacustrine deposits derived from the periodic flooding of the Colorado River that formed Lake Cahuilla. These deposits are typically less than 100 feet thick, consisting of interbedded, lenticular, and tabular silt, sand, and clay layers. Although modern in age at the surface,

these lake/playa sediments increase in age with depth and may be late Pleistocene in age (40,000 years or less) (Maloney 1986). According to Van de Kamp (1973), the Lake Cahuilla sediments come from two sources. The first source was the Colorado River, which flowed intermittently into the southern portion of the Salton Trough and deposited sand and mud in deltaic, fluvial, and lacustrine environments. The second source was the sediments derived from the basin. A recent study by Li et al. (2007) dating various layers of calcareous tufa (a carbonate coral-like rock that encrusts boulders in freshwater lakes) at Travertine Rock, near Salton City, found evidence of at least 30 basin filling lakes in the Salton Trough in the last 20,000 years. Evidence of these inundations and subsequent desiccations are chronicled in the sediments of the Lake Cahuilla beds. Older deposits consist of Miocene to Pleistocene non-marine and marine sediments deposited during Gulf of California transgressions onto the continent. Basement rock consisting of Mesozoic granite and Paleozoic metamorphic rocks are estimated to exist at depths between 15,000 and 20,000 feet (Landmark Consultants, Inc. 2011a).

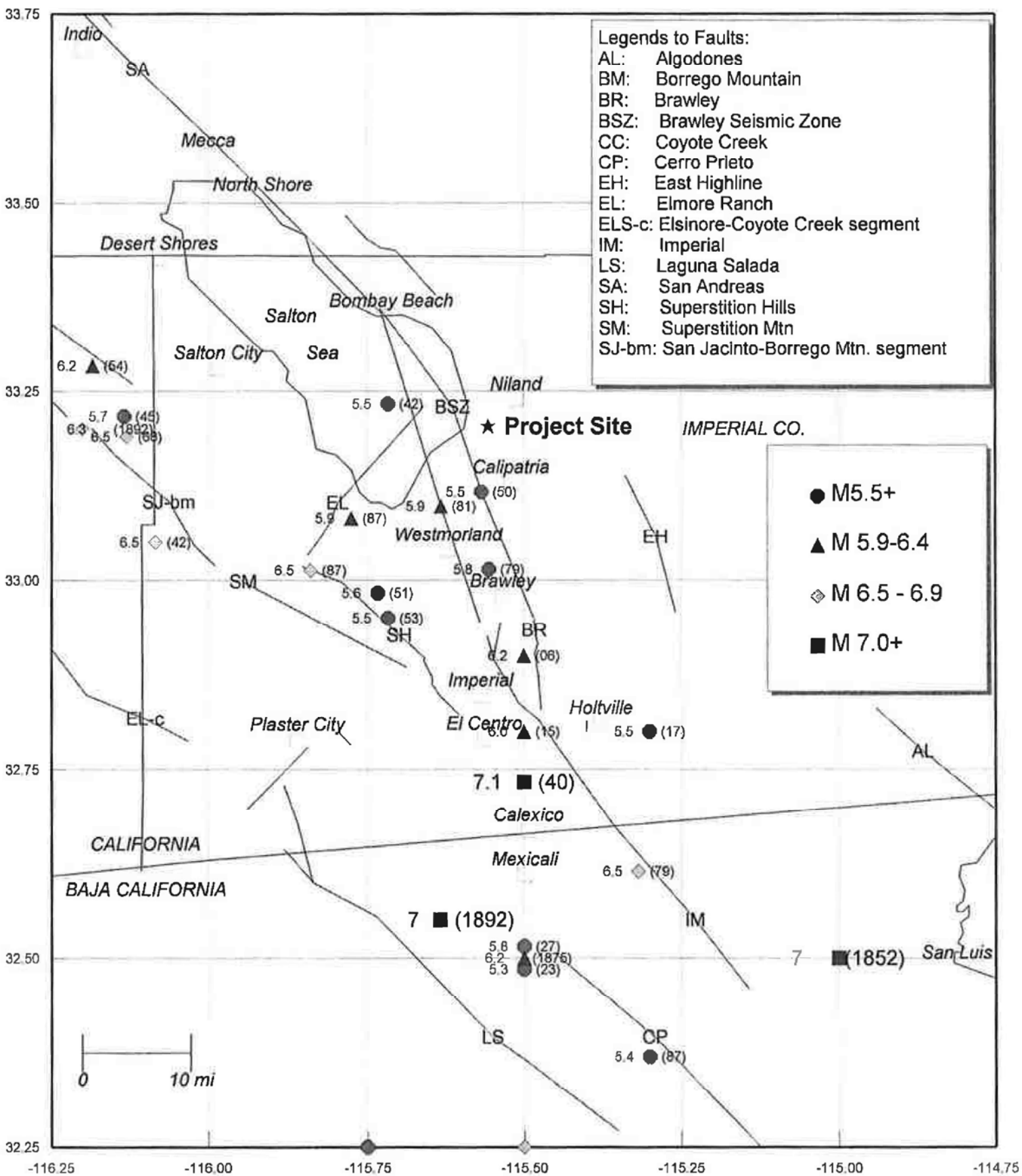
### **Project Sites**

The Project sites are located in an unincorporated area of County of Imperial, approximately 2.3 miles west-southwest of the Town of Niland, California. It is located within the Salton Sea Known Geothermal Resource Area (KGRA) of the County of Imperial. The Project sites lies at an elevation of approximately 210 feet below mean sea level (MSL) in the Imperial Valley region of the California low desert. The surrounding properties lie on terrain which is flat (planar), part of a large agricultural valley, which was previously an ancient lake bed covered with fresh water to an elevation of 43± feet above MSL.

### **Faults and Seismicity**

The proposed Project sites are located in the seismically active Salton Trough, near the southern terminus of the San Andreas Fault system and, therefore, have a high potential for strong earthquake shaking. Seismicity in the area of the Salton Trough (and Salton Sea) primarily results from movement along northwest-trending transform fault systems and oceanic-type spreading centers. Since 1987, 70 earthquakes with a magnitude greater than 5.0 have been reported within 100 miles of the Project sites. It is generally accepted that a maximum credible earthquake in this area would be in the range of magnitude 7.4 to 7.9 along the San Andreas Fault system, which is located approximately 14 miles northwest of the Project sites. Other significant seismicity includes a possible maximum credible earthquake of magnitude 6.4 on the Brawley seismic zone approximately 2.6 miles west-southwest of the Project sites (Landmark Consultants, Inc. 2011a, Table 1).

The Project sites do not lie within any of the state of California's Alquist-Priolo earthquake fault zones (Landmark Consultants, Inc. 2011a). No fault structures are mapped on or adjacent to the proposed geothermal power plant sites, and additional fault hazard mitigation or investigation is not considered necessary (see Figure 4.6-1).



**Hudson Ranch Power II CUP #G10-0002  
 & Simbol Calipatria II CUP #12-0005  
 Faults Map**

**Figure 4.6-1**

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### Liquefaction

Liquefaction occurs when granular soil below the water table is subjected to vibratory motions, such as those produced by earthquakes. With strong ground shaking, an increase in pore water pressure develops because 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) ground shaking of sufficient intensity must occur to function as a trigger mechanism. All of these conditions exist to some degree at the Project sites (Landmark Consultants, Inc. 2011a).

### Landslides

Landslides occur when slopes become unstable and collapse. Landslides are typically caused by natural factors such as fractured or weak bedrock, heavy rainfall, erosion, earthquake activity, and fire, but also by human alteration of topography and water content. A landslide at the proposed Project sites is unlikely because of the regional planar topography. No ancient landslides are shown on geologic maps of the region and no indications of landslides were observed by Landmark Consultants, Inc. during their sites investigation (Landmark Consultants, Inc. 2011a).

### Subsidence

Subsidence is a process characterized by the downward displacement or settling of the ground surface. Ground subsidence in the Imperial Valley may result for a number of causes, including groundwater withdrawal for irrigation, regional tectonic processes, withdrawal of geothermal fluids, and injection of fluids at a lower temperature than the field temperature. Subsidence of the ground surface due to natural causes occurs over a wide-spread area of the Imperial Valley. The Salton Sea Anomaly Master EIR (County of Imperial 1981) reports that because of the possibility of increased subsidence related to geothermal development, a monitoring program was developed to gather baseline data on natural subsidence. Data collected from 1972 to 1974 indicate that natural subsidence was greatest (up to -13 centimeters) in the area of the Salton Sea. As reported in Division 17 of the County of Imperial Land Use Ordinance, the County requires geothermal developers in the existing subsidence network to participate in identifying localized subsidence (County of Imperial 1999).

### Seiches

Seiches are defined as oscillations of enclosed and semi-enclosed bodies of water such as bays, lakes, or reservoirs, due to strong ground motion from seismic events, wind stress, volcanic eruptions, and local basin reflections of tsunamis. Seiches can result in the creation of long-period waves that can cause water to overtop containment features or cause seiche run-up on adjacent land masses, similar to tsunami run-up. The most likely location for a significant seiche to occur is the Salton Sea. While there have been a number

of seismic events since the formation of the Salton Sea, no significant seiches have occurred to date. However, a seiche could occur in the Salton Sea under the appropriate seismic conditions. The Salton Sea is proximal to the San Andreas and San Jacinto faults and would be subject to significant seismic ground shaking that could generate a seiche (County of Imperial 2003).

### Flooding

The proposed Projects would not expose people or structures to a significant risk of loss, injury, or death involving flooding as a result of the failure of a levee or dam. The Project sites are located on flat terrain that has little or no potential for inundation by seiche, tsunami, or mudflow.

### Volcanic Activity

The Imperial Valley portion of the Salton Trough physiographic province is a volcanically active area, containing four volcanic domes, several clusters of hot springs, mudpots (mud volcanoes), and small geysers. These features appear to be an on-land manifestation of the East Pacific Rise, a crustal spreading center that has been overridden by the North American continent. The four volcanic domes, from north to south, are Mullet Island, Red Island, Rock Hill, and Obsidian Butte. Although all are the result of late Pleistocene volcanism, they differ from one another in form and composition (Imperial County 1981). The Project sites are located in proximity to Obsidian Butte and Red Hill, but the risk of volcanic hazards is considered to be low (Landmark Consultants, Inc. 2011a).

### Soils

Figure 4.2-2 (Soils Map) identifies the soil types present at and in the vicinity of the Project sites. Landmark Consultant's geotechnical investigations indicated that the Project sites are underlain by clays of high expansion potential. Dust generation also is possible if grading occurs in dry weather. Characteristics of the soil types present at the Project sites are summarized in Table 4.6-1. As shown on Table 4.6-1, soils on the Project sites also have a high corrosive potential.

Subsurface soils encountered during the field exploration conducted for the geotechnical investigation consisted of approximately 17 feet of near-surface fat clays. Medium dense silty sands and silts were encountered from 17 to 20 feet below ground surface (bgs). Stiff clays were encountered at a depth of 24 to 98 feet bgs. A thin, medium-dense silty sand layer was encountered at 97 to 99 feet bgs. Stiff to very stiff clay was encountered from 99 to 100 feet bgs, the maximum depth of exploration.

### Groundwater

Groundwater was not noted during the subsurface investigations for the proposed Projects and equipment pad, but was encountered at approximately 10 feet bgs, which is typical for groundwater in the vicinity of the Project sites (Landmark Consultants, Inc. 2011a). A detailed discussion on water quality is presented in Section 4.8, Hydrology and Water Quality.

**TABLE 4.6-1 SOIL UNITS AND UNIT CHARACTERISTICS AT THE PROPOSED PROJECT SITES**

COMPLEX/ UNIT ID NUMBER	COMPLEX OR UNIT NAME/ASSOCIATION	PARENT MATERIAL/ COMPOSITION/SLOPE	SHRINK/ SWELL POTENTIAL	CORROSION POTENTIAL	
				CONCRETE	UNCOATED STEEL
114	Imperial Silty Clay, Wet/MCC and VIGG	Clayey alluvium and/or clayey lacustrine deposits from mixed sources:85% Imperial, wet; 4% Glenbar, wet; 4% Meloland, wet; 4% Holtville; 3% Niland/0-2%	High	Moderate	High
115	Imperial-Glenbar Silty Clay Loams, Wet/MCC and VIGG	Clayey alluvium and/or clayey lacustrine deposits from mixed sources:40% Glenbar, wet; 40% Imperial, wet; 10% Holtville; 10% Meloland/0-2%	Moderate - High	Moderate	High
116	Imperial - Glenbar Silty Clay Loams, Wet/MCC and VIGG	Clayey alluvium and/or clayey lacustrine deposits from mixed sources: 40% Glenbar, wet; 40% Imperial, wet; 10% Holtville; 10% Meloland/0-2%	Moderate - High	Moderate	High
122	Meloland Very Fine Sandy Loam, Wet/MCC and VIGG	Alluvium and/or eolian deposits from mixed sources:85% Meloland, wet; 3% Imperial; 3% Indio; 3% Holtville; 3% Glenbar; 3% Vint/0-2%	Low - High	Moderate	High
144	Vint and Indio Very Fine Sandy Loams, Wet/MCC and VIGG	Alluvium and/or eolian deposits from mixed sources:50% Vint, wet; 40% Indio, wet; 5% Rositas; 5% Meloland/0-2%	Low - High	Moderate	High

Source: NRCS 2008

Key:

MCC = Myoma-Carsitas-Carrizo

VIGG = Vint-Imperial-Glenbar-Gilman

### Mineral Resources

The Salton Sea Anomaly Master EIR reported that the only known commercially exploitable mineral resources within the Salton Sea KGRA are pumice in the Red Island dome area and sand and gravel deposits on the eastern and northern margins of the KGRA (County of Imperial 1981, p 3.1-12). Pumice was formerly extracted from Red Island, but mining operations were discontinued when the area was inundated by rising sea levels. Sand and gravel deposits in Salton Sea KGRA have not been commercially exploited (County of Imperial 1981, p 3.1-12). With respect to mineral and fossil collecting localities, the Master EIR reports pumice and obsidian localities in Obsidian Butte and Rock Hill, but no known fossil deposits. Because of its tectonic setting, the area is considered a unique geomorphic feature.

Within the Salton Sea KGRA, the geothermal brine has been found to be very high in minerals such as sodium, lithium, manganese, zinc and lead, among others. Imperial County's Geothermal/Alternative Energy and Transmission Element notes that it is feasible to extract minerals from the geothermal fluids

and because geothermal brines of the Salton Sea KGRA have a greater concentration of valuable minerals, this area's resource is being developed (Imperial County, 2006). Currently, the flashed-steam technical design has the greatest potential for mineral recovery in the Salton Sea area.

### **Adjacent Areas**

The Project sites are surrounded by flat-lying agricultural fields, a commercial algae farm and IID managed marshlands that have approximately the same elevation as the sites. Agricultural irrigation canals and drainage ditches are located along the northern and southern perimeters of the Project sites.

## **4.6.2 REGULATORY SETTING**

### **FEDERAL AND STATE**

#### **Alquist-Priolo Earthquake Fault Zoning Act**

The legislature of the State of California passed the Alquist-Priolo Geologic Hazards Zone Act in 1972, renamed the Alquist-Priolo Earthquake Fault Zoning Act in 1994. The intent of the legislation was to limit the hazards of fault surface rupture to occupied structures. Active faults are those with evidence of displacement within the past 11,000 years (Holocene period). Faults with evidence of displacement during the Pleistocene period (11,000 to 2,000,000 years before present [B.P]) are generally considered potentially active. In 1974, the California Division of Mines and Geology (currently known as the California Geological Survey) began establishing special study zones along known active faults, termed "earthquake fault zones." Starting in 1976, the California Division of Mines and Geology initiated the Fault Evaluation and Zoning Program to study faults identified in the Alquist-Priolo Earthquake Fault Zoning Act as "sufficiently active and well defined" to be considered for further evaluation. Fault Evaluation Reports were prepared for each earthquake fault zone summarizing data on fault location, age of activity, orientation, and probable magnitude of displacement. The Project sites are not within any Alquist-Priolo Earthquake Fault Zone.

#### **Seismic Hazards Mapping Act**

The Seismic Hazards Mapping Act addresses non-surface fault rupture earthquake hazards, including liquefaction and seismically induced landslides. Passed by the State Legislature in 1990, this law was codified in the California Public Resources Code (PRC) as Division 2, Chapter 7.8A, and became operative in April 1991. County of Imperial is not identified as having any seismic hazards zones according to the United States Geological Survey (USGS).

#### **California Building Code**

The State of California provides minimum standards for building design through the California Building Code. The County has adopted the 2010 California Building Code (CBC). The CBC is based on the Uniform Building, which is used widely throughout the United States (generally adopted on a state-by-state or district-by-district basis) and has been modified for conditions in California.



## Regional Water Quality Control Board

The Regional Water Quality Control Board (RWQCB) issues permits for activities that could cause impacts to surface waters and groundwater in the vicinity of any Project sites, including construction activities. The National Pollutant Discharge Elimination System (NPDES) storm water permitting program, under Section 402(p) of the federal Clean Water Act (CWA), is administered by the RWQCB on behalf of the U.S. Environmental Protection Agency (EPA). The proposed Project sites fall under the jurisdiction of the California Colorado River Basin (CRB) RWQCB. Permits issued to control pollution (i.e., waste discharge requirements and NPDES permits) must implement California CRB RWQCB requirements (i.e., water quality standards), taking into consideration beneficial uses to be protected.

## LOCAL

### County of Imperial General Plan

The County of Imperial General Plan Conservation and Open Space Element provides goals, objectives, and policies related to geology, soils, and seismicity. Table 4.6-2 identifies applicable General Plan policies related to geology, soils, and seismicity, and addresses the Projects' consistency with General Plan policies.

**TABLE 4.6-2 HR-2 AND SMCP-2 PROJECTS' CONSISTENCY WITH GEOLOGY, SOILS, AND SEISMICITY POLICIES OF THE GENERAL PLAN**

GENERAL PLAN POLICIES	CONSISTENCY	ANALYSIS
<b>SEISMIC AND PUBLIC SAFETY ELEMENT (SPSE)</b>		
SPSE Policy 2: Monitor, evaluate, and analyze existing seismic and geological data as it pertains to County of Imperial to determine future regulations and programs.	Yes	Geotechnical reports have been prepared by Landmark Consultants, Inc. for the proposed HR-2 Project (see Appendix G). The report's recommended measures address potential geologic or seismic hazards have been incorporated into this Draft EIR. A geotechnical report will also be prepared for the SmCP-2 Project, which will identify recommended measures for the proposed mineral extraction plant facilities.
SPSE Policy 4: Ensure that no structure for human occupancy, other than one-story wood frame structures, shall be permitted within 50 feet of an active fault trace as designated on maps compiled by the State Geologist under the Alquist-Priolo Geologist Hazards Zone Act.	Yes	The Project sites are not located within 50 feet of an active fault trace.  Development facilities will be built in accordance with the applicable 2010 California Building Code requirements. Building permits will be obtained for the Projects from the County prior to commencement of construction. No human-occupied structures will be placed across the trace of an active fault, and no human-occupied structure will be placed within 50 feet of the trace of an active fault or within a seismic special studies zone without a geologic report, satisfactory to the State Geologist,

**TABLE 4.6-2 HR-2 AND SMCP-2 PROJECTS' CONSISTENCY WITH GEOLOGY, SOILS, AND SEISMICITY POLICIES OF THE GENERAL PLAN**

GENERAL PLAN POLICIES	CONSISTENCY	ANALYSIS
		demonstrating that no undue hazard will be created by the construction or placement of the structure.
SPSE Objective 4.2: Control and prevent soil erosion when possible.	Yes	The proposed Projects will adopt relevant California CRB RWQCB best management practices (BMPs), as necessary, to prevent soil erosion.

While this Draft EIR analyzes the Projects' consistency with the County of Imperial General Plan pursuant to California Environmental Quality Act (CEQA) Guidelines, Section 15125(d), the County of Imperial Planning Commission will make a determination as to the Projects' consistency with the General Plan.

### **4.6.3 IMPACTS AND MITIGATION MEASURES**

#### **STANDARDS OF SIGNIFICANCE**

Based on the criteria derived from Appendix G of the CEQA Guidelines, impacts related to geology, soils, and mineral resources are considered to be significant if implementation of the proposed Projects would result in any of the following:

1. Exposure of people or structures to potential substantial adverse impacts, including the risk of loss, injury, or death involving the following:
  - a) rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault;
  - b) strong seismic ground shaking;
  - c) seismically related ground failure, including liquefaction; and/or
  - d) landslides.
2. Substantial soil erosion or the loss of topsoil.
3. The project being situated on a geologic unit or unstable soil, or a location that would become unstable as a result of the project, with the potential for an on- or off-site landslide, lateral spreading, liquefaction, or collapse.
4. The project being situated on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), thereby creating substantial risks to life or property.

5. The project being situated on soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water.
6. The loss of availability of a known mineral resource that would be of value to the region and the residents of the state.
7. The loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan.

## **ENVIRONMENTAL PROTECTION MEASURES**

Chapter 3 provides a complete list and descriptions of environmental protection measures (EPMs) that Hudson Ranch Power II, LLC and Simbol, Inc. have incorporated into the Projects to avoid or minimize impacts to minimize or avoid impacts to geology, soils and minerals.

The following EPMs are included as part of the proposed HR-2 Project to minimize or avoid impacts on geology, soils, and mineral resources:

- HR-2 EPM GEO-1: Seismic Impacts. Development facilities will be built in accordance with the applicable 2010 California Building Code requirements. Building permits will be obtained for the Project from the County before beginning power plant construction. No human-occupied structure will be placed across the trace of an active fault, and no human-occupied structure will be placed within 50 feet of the trace of an active fault or within a seismic special studies zone without a geologic report, satisfactory to the State Geologist, demonstrating that no undue hazard will be created by the construction or placement of the structure.
- HR-2 EPM GEO-2: Soil Erosion. Where fill is needed in the construction of well pads, construction sites, or access roads, it will be provided from off-site sources. Runoff will be channeled to energy dissipaters, as necessary, to minimize erosion. In addition, the Project will adopt relevant California CRB RWQCB best management practices (BMPs), if necessary, to further prevent soil erosion.
- HR-2 EPM AQ-1: Fugitive Dust Suppression Plan. This plan will provide a detailed list of control measures to reduce fugitive emissions from construction and operational activities, including, but not limited to, watering of unpaved roads, vehicle speed limits, windbreaks, transport container covers, and cleaning and sweeping procedures.

The following EPMs are included as part of the proposed SmCP-2 Project to minimize or avoid impacts on geology, soils, and mineral resources:

- SmCP-2 EPM GEO-1: Seismic Impacts. Facilities will be built in accordance with the applicable 2010 California Building Code requirements. Building permits would be obtained for the Project from the County prior to commencement of plant construction. No human-occupied structures

would be placed across the trace of an active fault, and no human-occupied structure would be placed within fifty feet of the trace of an active fault or within a seismic special studies zone without a geologic report, satisfactory to the State Geologist, demonstrating that no undue hazard would be created by the construction or placement of the structure.

- SmCP-2 EPM GEO-2: Prevention of Soil Erosion. Where fill is needed in the construction of the SmCP-2 plant site or access road it will be provided. Runoff will be channeled to the storm water retention basin to minimize erosion. In addition, the Project will adopt relevant CRB RWQCB best management practices (BMP), if necessary, to further prevent soil erosion. A Drainage and Grading Plan will be prepared identifying the BMP that will be implemented. The Drainage and Grading Plan will be submitted to the Imperial County Department of Public Works (ICDPW) for review and approval prior to site construction.
- SmCP-2 EPM AQ-9: Fugitive Dust Suppression Plan. Fugitive dust generated during construction and use of the plant access road will be minimized by watering as necessary. To further reduce fugitive dust emissions, vehicle traffic on plant roads will be kept below 15 miles per hour. The Project will comply with any requirements concerning emissions of air pollutants from plant facilities and internal combustion emission sources.

## **METHODOLOGY**

Evaluation of potential geologic and soil impacts of the proposed Projects was based on the Geotechnical Investigations prepared by Landmark Consultants, Inc. (Appendices G-1, G-2 and G-3) and the County of Imperial General Plan Seismic and Public Safety Element. The Project sites will not be impacted by geologic hazards involving landslides and volcanic activity. The Project sites are relatively flat and not located immediately adjacent to steep areas susceptible to landslide.

## **HR-2 IMPACTS AND MITIGATION MEASURES**

Impact GEO-1a: The HR-2 Project would not expose people or structures to substantial adverse impacts, including the risk of loss, injury, or death involving rupture of a known earthquake fault.

Ground rupture is generally considered most likely to occur along pre-existing faults. The existence of active fault-related features and historic ground rupture has been documented in the County. The Project site does not lie within a State of California Alquist-Priolo Earthquake Fault Zone (Land Mark Consultants, 2011a). Surface fault rupture at the Project site is considered to be unlikely.

The proposed HR-2 Project would be required to comply with the 2010 California Building Code standards as adopted by the County. Adherence to these standards would reduce the potential for structural damage to facilities and corollary indirect impacts associated with seismic-related ground rupture, to the extent feasible.

Because the proposed Project site does not contain any known earthquake fault lines, impacts associated with fault rupture on the proposed Project site are considered less than significant.

Mitigation Measures: None required.

Impact GEO-1b: The HR-2 Project would not expose people or structures to substantial adverse impacts, including the risk of loss, injury, or death involving strong seismic groundshaking.

The HR-2 Project site has the potential to experience ground shaking during earthquakes along the Brawley and Imperial faults. The Brawley seismic zone is approximately 2.6 miles west-southwest of the Project site. The nearest Alquist-Priolo-defined Type A fault is the Coachella Valley fault (San Andreas Fault System), located approximately 18 miles northwest of the Project site (Landmark Consultants Inc. 2011a). Based on the proximity of mapped strands of these known faults, the potential for moderate to strong ground shaking at the site resulting from seismic activity in the region is likely.

The geotechnical study calculated the site coefficients and adjusted the maximum considered earthquake spectral response acceleration parameters for the proposed Project (Landmark Consultants, Inc. 2011a, Table 2). The site soils are classified as Site Class D (stiff soil profile). Because of the potential for structural damage to facilities, site structures will be designed in accordance with the latest edition of the California Building Code for Seismic Zone 4 for a "Maximum Considered Earthquake," as adopted by the County and with the appropriate site coefficients (HR-2 EPM GEO-1). Adherence to these standards would ensure that the potential for structural damage to facilities and corollary indirect impacts associated with seismic-related ground shaking would be less than significant.

Mitigation Measures: None required.

Impact GEO-1c: The HR-2 Project site could experience seismic-related ground failure, including liquefaction.

Evaluation of liquefaction potential at the site indicates that the 2.5-foot-thick, isolated, interbedded layer of silt at a depth between 17 to 19.5 feet bgs may liquefy under seismically induced ground shaking, potentially resulting in an estimated 0.5 inch of deep-seated settlement (Landmark Consultants, Inc. 2011a). The risk of seismically induced liquefaction impacts are considered potentially significant because of underlying saturated sandy substrata at the site and mitigation is required.

**MM GEO-1.1: Liquefaction Mitigation**

Liquefaction settlements shall be mitigated by one of the following methods:

- (1) Structural flat-plate mats, either conventionally reinforced or tied with post-tensioned tendons;
- (2) Deep foundations (drilled piers or auger cast piles) founded at a minimum depth of 25 feet; or
- (3) Soil improvement by soil-cement mixing or soil replacement to create non-liquefying soils (20-foot minimum depth).

Timing/Implementation: Prior to approval of initial grading or building permits (whichever comes first) permits.

Enforcement/Monitoring: Imperial County Department of Public Works.

**Significance after Mitigation:**

Implementation of MM GEO-1.1 would reduce the potential for structural damage to facilities and corollary indirect impacts associated with seismically induced liquefaction. Upon implementation of MM GEO-1.1, Project impacts related to seismically induced liquefaction would be less than significant.

**Impact GEO-1d:**

The HR-2 Project would not expose people or structures to substantial adverse impacts, including the risk of loss, injury, or death involving landslides.

The HR-2 Project site and the surrounding terrain are flat. Furthermore, no ancient landslides are shown on geologic maps of the region, and no indications of landslides were observed during the May 2011 site investigation by Landmark Consultants, Inc. (Landmark Consultants, Inc. 2011a), therefore, impacts related to landslides would be less than significant.

**Mitigation Measures:**

None required.

**Impact GEO-2:**

HR-2 Project construction would require excavation and grading that may result in soil erosion and loss of topsoil.

Hudson Ranch Power II, LLC would obtain fill from off-site sources if needed for construction of well pads, construction sites, or access roads. Runoff will be channeled to energy dissipaters, as necessary, to minimize erosion and relevant California CRB RWQCB best management practices (BMPs), would be adopted as necessary to further prevent soil erosion (HR-2 EPM GEO-2). In addition, a

fugitive dust plan would be implemented to reduce dust and fugitive emissions from construction and other operational activities (HR-2 EPM AQ-1).

Dust potential at the HR-2 site would be moderate to high during dry periods. Temporary (during construction) and permanent (after construction) erosion control will be required for all disturbed areas. The construction phase of the HR-2 Project would involve grading the site, excavation to prepare the site for building foundations, and trenching to install necessary infrastructure. Soil disturbance and stockpiling could be subject to erosion from both wind and water.

Therefore, impacts related to soil erosion and loss of topsoil would be potentially significant and mitigation is required.

MM GEO-2.1:

**Reduce Soil Erosion**

Erosion potential shall be managed by implementing standard industry methods such as BMPs for dust suppression and for preventing surface water runoff and erosion impacts that are in place at the time of grading plan approval. Because the site is more than 5-acres, compliance with storm water NPDES criteria is required, including preparation of a Storm Water Pollution Prevention Plan (SWPPP) and the inclusion of BMPs to control erosion and the off-site transport of soils. The recently adopted State General Permit for construction imposes more minimum BMPs and requirements than were previously required only as elements of the SWPPP or were suggested by guidance. Additionally, erosion control shall be accomplished, in part, through compliance with Imperial County Air Pollution Control District (ICAPCD) Regulation VIII requirements (see Section 4.3, Air Quality). Compliance with these procedures shall ensure that potential erosion is controlled during the construction process. Additional information on the Project's storm water NPDES permitting requirements, as well as SWPPP requirements, is available in Section 4.8, Hydrology and Water Quality.

Timing/Implementation: Prior to issuance of grading permits.

Enforcement/Monitoring: Imperial County Public Works Department or local engineers.

Significance after

Mitigation:

Implementation of mitigation measures MM GEO-1.2 and HR- 2 EPM AQ-1 and HR- 2 EPM GEO-2 would reduce impacts to less than significant.

Impact GEO-3:

The HR-2 Project site could be subject to instability from geothermal related subsidence.

The withdraw of geothermal fluids at the Project site and the reinjection of spent brine at a lower temperature than the ground field could cause localized subsidence. Since the HR-2 Project would reinject spent geothermal fluids into geothermal resource via injection wells, at a rate to be approved by the CDOGGR, subsidence due to geothermal fluid withdrawal is expected to reduce the potential for localized differential settlement. This impact is considered to be potentially significant.

The conditional use permit for the HR-2 Project would require annual monitoring of subsidence to determine the baseline and subsidence elevations at the project site in the context of the Imperial Valley monitoring data that is coordinated by the Imperial County Public Works Department. Should the natural subsidence and any project-induced subsidence be identified as severe enough to result in off-site impacts, the County would then require that further actions be considered to mitigate subsidence impacts to an appropriate level such that impacts are avoided. Such measures include, but are not limited to, increasing the injection volume into the geothermal resource, deeper injection wells, and grading of areas affected by the subsidence, reduction or total cessation of geothermal activities.

MM GEO-1.1:

**Subsidence Monitoring**

Hudson Ranch Power II, LLC shall participate in the County's subsidence detection program, consistent with the California Division of Oil, Gas, and Geothermal Resources (CDOGGR) found in Section 1971 of Title 14 of the California Code of Regulations (CCR), and in connection therewith, submit a plan for Public Works Department approval, showing proposed locations of benchmark monuments. Monuments shall connect with the County's geothermal subsidence detection network. Benchmarks installed shall conform to County standards. Surveying shall be performed to National Geodetic Survey standards and all field surveying procedures shall conform with such standards.

Hudson Ranch Power II, LLC shall perform surveying on an annual basis as required by the Director of Public Works, except the Director may require such surveying at shorter intervals if he deems it necessary. All work shall be performed under the supervision of a person licensed to practice surveying in California. All field surveying data (such as forms and instrument checks), along with an adjustment of said data and analysis, all in conformity with the National Geodetic Survey standards, shall be submitted for review and approval to the Department of Public Works within two months of completion of field work.

If the Department of Public Works determines good cause exists to require additional surveying and analysis or additional subsurface data, the County



reserves the right to require such work to be accomplished at the expense of the Permittee. The County further reserves the right, with Hudson Ranch Power II, LLC's input, to designate the consultant or firm to accomplish the work. Proprietary information shall not be released to the public.

Should subsidence be identified as severe enough to result in off-site impacts, the County shall require that further actions be considered to mitigate subsidence impacts to an appropriate level such that impacts are avoided. Such measures include, but are not limited to, increasing the injection volume into the geothermal resource and grading of irrigated areas affected by the subsidence by Hudson Ranch Power II, LLC.

Timing/Implementation: Hudson Ranch Power II, LLC shall submit a seismic and subsidence monitoring plan to the Imperial County Public Works Department for review and approval prior to commencement of grading. After start of commercial operation the Hudson Ranch Power II, LLC shall submit to the County an annual report outlining the seismic and subsidence monitoring performed during the previous year as required by the above referenced requirements.

Enforcement/Monitoring: CDOGGR, Imperial County Public Works Department or local engineers.

Significance after

Mitigation:

Implementation of MM GEO-3.1 would reduce impacts from localized subsidence to below a level of significance through annual monitoring efforts and implementation of corrective actions if detected.

Impact GEO-4:

The HR-2 Project site contains expansive clay soils (as defined in Table 18-1-B of the Uniform Building Code [1994]<sup>1</sup>), thereby creating substantial risks to life or property.

Newly constructed facilities could be damaged by differential settlement due to soil expansion and contraction because foundations have the tendency to rise during the wet season and shrink during the dry season. Movements can vary under the structures which, in turn, create new stresses on various sections of the foundation. These variations in ground settlement can lead to structural failure and damage to infrastructure. Impacts associated with expansive soils are considered potentially significant and mitigation is required.

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<sup>1</sup> California Building Code.

**MM GEO-4.1: Remove/Replace Expansive Soil**

The upper 3 feet of clays within the building foundation areas, extending five (5) feet beyond all exterior wall/column lines, shall be replaced with imported non-expansive granular fill to mitigate the expansion forces and eliminate the need for special foundation designs. Design and construction of site improvements (concrete flatwork, curbs, housekeeping slabs, etc.) shall include provisions to mitigate clay soil movement. Additionally, the weak clay subgrade soil requires thickened structural sections for pavements.

Imported fill soil shall be non-expansive, granular soil meeting the Unified Soil Classification System classifications of SM, SP-SM or SW-SM, with a maximum rock size of 3 inches and 5% to 35% passing the No. 200 sieve. A geotechnical engineer shall approve imported fill soil sources before hauling material to the site. To reduce settlement in the power plant structures, compressible clays shall be strengthened by soil improvement (soil mixing or replacement with sand/cement) or by using deep foundation system-like auger casts or driven piles.

Timing/Implementation: Prior to issuance of initial grading or building permits (whichever comes first).

Enforcement/Monitoring: Imperial County Department of Public Works and Department of Planning and Development Services.

**Significance after****Mitigation:**

Implementation of MM GEO-4.1 will reduce expansive soil impacts to less than significant because the expansive soils would be removed and replaced with non-expansive soils or a licensed geotechnical engineer would design the facilities to withstand expansive soils.

**Impact GEO-5:**

The HR-2 Project would be situated on soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water.

Portable chemical toilets would be provided on-site during construction and waste pumped and transported by licensed contractors to a sanitary water treatment plant. Sanitary waste generated during operations would be discharged to a sanitary water treatment plant that would be constructed on the HR-2 Project site. Liquids generated by the waste water treatment plant would be injected into the geothermal reservoir. Sludge generated by the waste water treatment plant would be pumped by licensed contractors as needed and transported to a sanitary water treatment plant. All sanitary waste would be addressed per requirements of the

Imperial County Public Health Department, Section of Environmental Health & Consumer Protection Services. The proposed wastewater treatment system would not require an on-site leach field or percolation that would release effluent into the soil or surface water. Therefore, this impact is considered less than significant impact.

Mitigation Measures: None required.

Impact GEO-6: The HR-2 Project would not result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state.

Other than the geothermal resources being developed in the Project vicinity, there are no known mineral resources within the immediate vicinity of the Project site. The only known commercially exploitable mineral resources in the Salton Sea KGRA are pumice in the Red Island dome area. However, within the Salton Sea KGRA, geothermal brine has been found to be very high in minerals such as sodium, lithium, manganese, zinc and lead, among others. Minerals can be extracted from the geothermal fluids. Geothermal flashed-steam technology has the greatest potential for mineral recovery within the Salton Sea KGRA.

The proposed HR-2 Project would not result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state. In fact, the proposed HR-2 Project would facilitate the utilization of a previously untapped source of minerals. This would be a beneficial impact.

Mitigation Measures: None required.

Impact GEO-7: The HR-2 Project would not result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan.

There are no known mineral recovery sites in the vicinity of the HR-2 Project. As such, the proposed HR-2 Project would not result in the loss of availability of a locally important resource recovery site. No impacts would occur.

Mitigation Measures: None required.

## **SMCP-2 IMPACTS AND MITIGATION MEASURES**

Impact GEO-1a: The SmCP-2 Project would not expose people or structures to substantial adverse impacts, including the risk of loss, injury, or death involving rupture of a known earthquake fault.

Ground rupture is generally considered most likely to occur along pre-existing faults. The existence of active fault-related features and historic ground rupture has been documented in the County. According to the geotechnical investigation prepared by Landmark Consultants, Inc. (2011), the SmCP-2 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 unlikely.

The proposed SmCP-2 Project would be required to comply with the California Building Code standards as adopted by the County. Adherence to these standards would reduce the potential for structural damage to facilities and corollary indirect impacts associated with seismic-related ground rupture, to the extent feasible. Because the proposed Project site does not contain any known earthquake fault lines, impacts associated with fault rupture on the Project site are considered less than significant.

Mitigation Measures: None required.

Impact GEO-1b: The SmCP-2 Project would not expose people or structures to substantial adverse impacts, including the risk of loss, injury, or death involving strong seismic groundshaking.

The SmCP-2 Project site has the potential to experience ground shaking during earthquakes along the Brawley and Imperial faults. The Brawley seismic zone is approximately 2.6 miles west-southwest of the Project site (Land Mark Consultants, Inc., 2011a). The nearest Alquist-Priolo-defined Type A fault is the Coachella Valley fault (San Andreas Fault System), located approximately 18 miles northwest of the Project site (Landmark Consultants Inc. 2011a). Based on the proximity of mapped strands of these known faults, the potential for moderate to strong ground shaking at the site resulting from seismic activity in the region is likely.

The geotechnical study calculated the site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters for the Project (Landmark Consultants, Inc. 2011a, Table 2). The site soils are classified as Site Class D (stiff soil profile). Because of the potential for structural damage to facilities, site structures shall be designed in accordance with the latest edition of the California Building Code for Seismic Zone 4 for a "Maximum Considered Earthquake," as adopted by the County and with the appropriate site coefficients (SMCP-2 EPM GEO-4). Adherence to these standards would ensure that the potential for structural damage to facilities and corollary indirect impacts associated with seismic-related ground shaking would be less than significant.

Mitigation Measures: None required.

Impact GEO-1c: The SmCP-2 Project site could experience seismically related ground failure, including liquefaction.

Evaluation of liquefaction potential at the SmCP-2 Project site indicates that 2.5-foot-thick, isolated, interbedded layer of silt at a depth between 17 to 19.5 feet bgs may liquefy under seismically induced ground shaking, potentially resulting in an estimated 0.5 inch of deep seated settlement (Landmark Consultants, Inc. May 2011a). The risk of seismically induced liquefaction impacts are considered potentially significant because of underlying saturated sandy substrata at the site and mitigation is required.

MM GEO-3.1: **Prepare Geotechnical Investigation and Incorporate Results into Project Design**

A registered professional civil/geotechnical engineer shall prepare a geotechnical investigation for the SmCP-2 Project that includes comprehensive subsurface exploration, appropriate laboratory testing, and detailed evaluation of potential constraints to critical Project structures, including liquefaction, subsidence and expansive soils. The geotechnical investigation shall also include specific recommendations to address issues identified in the geotechnical investigation of the Project site to meet State and County seismic building code requirements. The recommendations shall be incorporated into the design of the structures.

Timing/Implementation: Prior to approval of grading plans.

Enforcement/Monitoring: Imperial County Department of Public Works and Department of Planning and Development Services.

Significance after

Mitigation:

Implementation of MM GEO-1.1 would reduce the potential for structural damage to facilities and corollary indirect impacts associated with seismically induced liquefaction. Upon implementation of MM GEO-1.1, Project impacts related to seismically induced liquefaction would be less than significant.

Impact GEO-1d:

The SmCP-2 Project would not expose people or structures to substantial adverse impacts, including the risk of loss, injury, or death involving landslides.

The SmCP-2 Project site and the surrounding terrain are flat. Furthermore, no ancient landslides are shown on geologic maps of the region, and no indications of landslides were observed during the May 2011 site investigation by Landmark

Consultants, Inc. therefore, impacts related to landslides would be less than significant.

Mitigation Measures: None required.

Impact GEO-2: SmCP-2 Project construction would require excavation and grading that may result in soil erosion and loss of topsoil.

Dust potential at the SmCP-2 site would be moderate to high during dry periods. Temporary (during construction) and permanent (after construction) erosion control will be required for all disturbed areas. The construction phase of the SmCP-2 Project would involve grading the site, excavation to prepare the site for building foundations, and trenching to install necessary infrastructure. Soil disturbance and stockpiling could be subject to erosion from both wind and water.

Therefore, impacts related to soil erosion and loss of topsoil would be potentially significant and mitigation is required.

MM GEO-2.1: **Reduce Soil Erosion**

Erosion potential shall be managed by implementing standard industry methods such as BMPs for dust suppression and for preventing surface water runoff and erosion impacts during grading. Because the site is more than 5-acres, compliance with storm water NPDES criteria is required, including preparation of a Storm Water Pollution Prevention Plan (SWPPP) and the inclusion of BMPs to control erosion and the off-site transport of soils. The recently adopted State General Permit for construction imposes more minimum BMPs and requirements than were previously required only as elements of the SWPPP or were suggested by guidance. Additionally, erosion control shall be accomplished, in part, through compliance with Imperial County Air Pollution Control District (ICAPCD) Regulation VIII requirements (see Section 4.3, Air Quality). Compliance with these procedures shall ensure that potential erosion is controlled during the construction process. Additional information on the Project's storm water NPDES permitting requirements, as well as SWPPP requirements, is available in Section 4.8, Hydrology and Water Quality.

Timing/Implementation: Prior to issuance of grading permits.

Enforcement/Monitoring: Imperial County Public Works Department or local engineers.

Significance after

Mitigation:

Implementation of mitigation measures MM GEO-1.2 and SmCP-2 EPM AQ-9 and SmCP-2 EPM GEO-2 would reduce impacts to less than significant.

Impact GEO-3:

The SmCP-2 Project could be situated on a geologic unit or unstable soil, or a location that would become unstable as a result of the Project.

Appropriate engineering and/or construction specifications would be based on the findings of a geotechnical investigation conducted at the proposed site and these measures would be incorporated into the SmCP-2 Project design. Potential impacts of geologic hazards (lateral spreading, subsidence, or a collapse associated with unstable geologic units or soils) would be potentially significant.

MM GEO-1.1:

Prepare Geotechnical Investigation and Incorporate Results into Project Design (see full text under Impact GEO-1).

Significance after

Mitigation:

Implementation of MM GEO-1.1 would ensure that impacts from off-site landslide, lateral spreading, subsidence, or collapse on an on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse, and expansive soils would remain less than significant.

Impact GEO-4:

The SmCP-2 Project site contains expansive clay soils as defined in Table 18-1-B of the Uniform Building Code (1994), thereby creating substantial risks to life or property.

Newly constructed facilities could be damaged by differential settlement due to soil expansion and contraction as foundations have the tendency to rise during the wet season and shrink during the dry season. Movements can vary under the structures which, in turn, create new stresses on various sections of the foundation. These variations in ground settlement can lead to structural failure and damage to infrastructure. Impacts associated with expansive soils are considered potentially significant and mitigation is required.

MM GEO-1.1:

Prepare Geotechnical Investigation and Incorporate Results into Project Design (see full text under Impact GEO-1)

Significance after

Mitigation:

Implementation of MM GEO-3.1 would reduce expansive soil impacts to less than significant.

Impact GEO-5: The SmCP-2 Project would be situated on soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water.

Portable chemical toilets would be provided on-site during construction and waste pumped and transported by licensed contractors to a sanitary water treatment plant. Sanitary waste generated during operations would be discharged to a sanitary water treatment plant that would be constructed on the SmCP-2 Project site. Liquids generated by the waste water treatment plant would be sent to the HR-2 facility to be injected into the geothermal reservoir. Sludge generated by the waste water treatment plant would be pumped by licensed contractors as needed and transported to a sanitary water treatment plant. All sanitary waste would be addressed per requirements of the Imperial County Public Health Department, Section of Environmental Health & Consumer Protection Services. The proposed wastewater treatment system would not require an on-site leach field or percolation that would release effluent into the soil or surface water. Therefore, this impact is considered less than significant impact.

Mitigation Measures: None required.

Impact GEO-6: The SmCP-2 Project would not result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state.

Other than the geothermal resources being developed in the Project vicinity, there are no known mineral resources within the immediate vicinity of the Project site. The only known commercially exploitable mineral resources in the Salton Sea KGRA are pumice in the Red Island dome area. However, within the Salton Sea KGRA, geothermal brine has been found to be very high in minerals such as sodium, lithium, manganese, zinc and lead, among others. Minerals can be extracted from the geothermal fluids. Geothermal flashed-steam technology has the greatest potential for mineral recovery within the Salton Sea KGRA.

The proposed SmCP-2 Project would not result in the loss of availability of a known mineral resource. In fact, the proposed SmCP-2 Project would enable the utilization of a previously untapped source of minerals. Therefore, the proposed SmCP-2 Project would have a beneficial impact on mineral resources.

Mitigation Measures: None required.

Impact GEO-7: The SmCP-2 Project would not result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan.



There are no known mineral recovery sites in the SmCP-2 Project vicinity. Therefore no impact would occur.

Mitigation Measures: None required.

#### 4.6.4 REFERENCES

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