SECTION 4.6

GEOLOGY AND SOILS

This section describes federal, state and local regulations applicable to geology and soils. It also describes the environmental setting of the project site with regard to the soils, seismicity and geologic conditions on and in the vicinity of the project site. A discussion of geology and soil impacts is also provided and mitigation measures are identified to address impacts. The analysis in this section is based on the *Soil Survey of Imperial County, California, Imperial Valley Area* (USDA, 1981) and the *Preliminary Geotechnical Investigation: Proposed Mount Signal Solar Farm and Associated Structures West of Drew Road and South of Interstate 8 Imperial County, California* prepared by EGA Consultants (EGA, 2011). This document is **Appendix D** of the Technical Appendices of this EIR on the attached CD.

4.6.1 REGULATORY FRAMEWORK

A. STATE

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Zoning Act (Chapter 7.5, Division 2, Public Resources Code, State of California, effective May 4, 1975) provides a statewide mechanism for reducing losses from surface fault rupture. The Act promotes public safety by prohibiting siting of most structures for human occupancy across traces of active faults that constitute a hazard to structures from surface faulting or fault creep. In accordance with the Act, the Office of State Geologist delineated Special Study Zones that encompass potentially and recently active traces of four major faults: San Andreas, Calaveras, Hayward and San Jacinto. The County of Imperial is responsible for enforcing the Act by ensuring that homes, offices, hospitals, public buildings, and other structures for human occupancy that are built on or near active faults or within a special study zone, are designed and constructed in compliance with the County of Imperial Codified Ordinance (Imperial County, Seismic and Public Safety Element).

While the project site is approximately 15 kilometers (or approximately 9 miles) southwest of the San Jacinto Fault, it is not located in an Alquist-Priolo Earthquake fault zone (EGA, 2011, p. 6).

California Building Code

The California Building Code (CBC) was approved and incorporated into the Uniform Building Code in 1998. In 2007, California adopted statewide, mandatory codes based on the International Code Council's (ICC) Uniform codes. Among other elements, Chapter 16 of this code dictates the design and construction standards applicable to resist seismic shaking on structures. The CBC (2007) includes standards used in project investigation, design, and construction (including grading and erosion control). The project would be subject to the CBC.

Surface Mining and Reclamation Act

The Surface Mining and Reclamation Act of 1975 acknowledges that mineral extraction is essential to California's economy and that the reclamation of mined lands after extraction is necessary to prevent or minimize adverse effects on the environment and to protect the public health and safety. The Act also classifies mineral resources in the State and provides information to local governments. Local governments are responsible for designating lands that contain regionally significant mineral resources in their local General Plans for preserving such areas from encroachment or conversion to other uses. The law has resulted in the preparation of Mineral Land Classification Maps delineating Mineral Resource Zones (MRZ) for aggregate resources (sand, gravel, and stone). Mining does occur throughout the County of Imperial as shown on the Active Surface Mining Operations Map (County of Imperial, 2003). However, the project site is not located in an area with any MRZ zones.

B. LOCAL

County Land Use Ordinance

Title 9 Division 15 (Geological Hazards) of the County Land Use Ordinance has established procedures and standards for development within earthquake fault zones. Per County regulations, construction of buildings intended for human occupancy which are located across the trace of an active fault are prohibited. An exception exists when such buildings located near the fault or within a designated Special Studies Zone are demonstrated through a geotechnical analysis and report not to expose a person to undue hazard created by the construction. The proposed project does not include any residential structures nor are any active faults located across the site.

Imperial County General Plan

The Seismic and Public Safety Element of the Imperial County General Plan contains goals and policies to minimize the risks associated with natural and human-made hazards including seismic/geological hazards, flood hazards, and Imperial Irrigation District Lifelines.

Table 4.6-1 analyzes the consistency of the project with the applicable policies relating to seismic hazards and soil conditions in the Imperial County General Plan. While this EIR analyzes the project's consistency with the General Plan pursuant to CEQA Guidelines Section 151250, the Imperial County Board of Supervisors ultimately determines consistency with the General Plan.

TABLE 4.6-1
IMPERIAL COUNTY GENERAL PLAN CONSISTENCY ANALYSIS

General Plan Policies	Consistent with General Plan?	Analysis
Seismic and Public Safety Element		
Land Use Planning and Public Safety		
Goal 1: Include public health and safety considerations in land use planning.	Yes	The proposed project is located in a rural portion of Imperial County. Public health and safety would not be affected in association with development of a solar generation facility in this area based on its remote location away from population centers. Therefore, the proposed project is consistent with this goal.
Objective 1.4 Require, where possessing the authority, that avoidable seismic risks be avoided; and that measures, commensurate with risks, be taken to reduce injury, loss of life, destruction of property, and disruption of service.	Yes	The proposed project is sited in an area subject to seismic shaking. However, no evidence of active faulting was found during a site investigation (EGA, 2011). Several faults are located within 10 miles of the project site. The proposed project could experience strong ground shaking during an earthquake. However, the project would be designed in accordance with

TABLE 4.6-1
IMPERIAL COUNTY GENERAL PLAN CONSISTENCY ANALYSIS

General Plan Policies	Consistent with General Plan?	Analysis
		all applicable federal, State and local building codes. No habitable structures are proposed. Damage to proposed structures can be mitigated through engineering and compliance with building standards (refer to mitigation measure 4.6.1). Therefore, the proposed project is consistent with this objective.
Objective 1.7 Require developers to provide information related to geologic and seismic hazards when siting a proposed project.	Yes	A Preliminary Geotechnical Investigation has been prepared by EGA Consultants for the proposed project. The Investigation was used in the analysis of geology and soils. The Investigation included recommendations to address potential geologic or seismic hazards that may be associated with the project site. These recommendations have been included in this EIR as mitigation measure 4.6.1. Therefore, the proposed project is consistent with this objective.
Emergency Preparedness		
Objective 2.8 Prevent and reduce death, injuries, property damage, and economic and social dislocation resulting from natural hazards including flooding, land subsidence, earthquakes, other geologic phenomena, levee or dam failure, urban and wildland fires and building collapse by appropriate planning and emergency measures.	Yes	The project site is located in a seismically active area. The Preliminary Geotechnical Investigation prepared for the project includes recommendations that all structures be designed in accordance with the California Building Code (CBC). Recommendations of the Investigation have been included as mitigation measure MM 4.6.1 to reduce risks associated with seismic hazards. Therefore, the proposed project is consistent with this objective.
Seismic/Geologic Hazards		
Policy 4 Ensure that no structure for human occupancy, other than one-story wood frame structures, shall be	Yes	The proposed project does not include any habitable structures and is not located within fifty feet of an active

TABLE 4.6-1
IMPERIAL COUNTY GENERAL PLAN CONSISTENCY ANALYSIS

General Plan Policies	Consistent with General Plan?	Analysis
permitted within fifty feet of an active fault trace as designated under the Alquist-Priolo Geologic Hazards Zone Act.		fault. Therefore, the proposed project is consistent with this policy.

4.6.2 ENVIRONMENTAL SETTING

A. SOLAR GENERATION FACILITY

Geology

According to a United States Geological Survey (USGS) Map of the Mt. Signal Quadrangle, the site is approximately 35 feet below mean sea level (-35 ft. msl) (EGA, 2011, p. 5). The site is located within the Salton Trough, a topographic and structural depression bound to the north by the Coachella Valley and to the south by the Gulf of California. The Salton Trough is a region of transition from the East Pacific Rise to the San Andreas system. The Salton Trough is an actively growing rift valley. As rifting continued, the Colorado River delta filled the trough and conditions gradually changed from marine, to deltaic to subaerial river and lake deposits.

The site is located in an area that was covered by lakes during the Quaternary time (i.e. a measure of geologic time). The Imperial Valley is directly underlain by lacustrine (lake) deposits, which consist of silt, sand, and clay. The Late Pleistocene to Holocene lake deposits are generally between 15 to 50 feet thick and were created by periodic flooding of the Colorado River which formed an ancient freshwater lake (Lake Cahuilla). Records indicated approximately 300 years ago the shorelines of Lake Cahuilla raised as high as 40 feet above msl. Older deposits in the region consist of non-marine and marine sediments deposited during intrusions of the Gulf of California and are located to the west of the site. Basement rock consisting of Mesozoic granite and Paleozoic metamorphic rocks are estimated to exist at depths between 15,000-20,000 feet near the center of the basin (EGA, 2011, p. 5).

Deposits to the west of the project site consist of the Pliocene Palm Spring and Imperial Formations. The Palm Spring Formation consists of non-marine sandstones and claystones. The Imperial Formation consists of fossil containing marine sediments.

Seismicity

Based on a review by EGA Consultants of the "Seismic Zone Map" published by the California Department of Mines and Geology in conjunction with Special Publication 117, there are no earthquake landslide zones on or adjacent to the site (EGA, 2011, p. 6). **Figure 4.6-1** shows the location of the site in relation to regional faults and seismicity. The Imperial Fault is located approximately 20 kilometers (km) (approximately 12 miles) east of the project site and has a maximum magnitude of 7.0 (EGA, 2011).

Groundwater

The project site is located in an area that contains groundwater. Perched groundwater was encountered between 10 and 15 feet below grade during the drilling of 25 borings in April, 2011.

Perched levels are expected to fluctuate with changes in seasons (rainfall), canal flow, and irrigation. Therefore, perched groundwater levels encountered during drillings do not represent a permanent condition (EGA, 2011, p. 8).

Landslides

According to the Preliminary Geotechnical Investigation, hazards such as landslides do not appear to be evident on the project site (EGA, 2011, p. 7). A landslide occurs when slopes become unstable and collapse. Natural factors such as fractured or weak bedrock, heavy rainfall, erosion, earthquake activity, and fire, as well as by human alteration of topography and water content, cause landslides or slope instability. The project site is generally flat and is not prone to landslides. In addition, the project site does not adjoin any elevated areas that would make it susceptible to landslide effects.

Soil Map Units

Figure 4.6-2 depicts the ten soil map units within the boundaries of the project site. Various characteristics of the soils are summarized in **Table 4.6-2**, and briefly described below.

TABLE 4.6-2
SUMMARY OF PROJECT SITE SOIL MAP UNITS

Soil	Texture[1]	Depth of Surface Layer[1]	Wind Erodability Group[2]	Erosion (K) Factor[3]	Erosion Hazard Paths and Trails[4]	Permeability Inches Per Hour[3]
Badland	Gravely Sand	10	N/A	N/A	N/A	N/A
Holtville	Silty Clay	17	5	.32	Moderate: Too clayey	.06 - .20
Imperial	Silty Clay Loam	10	5	.43	Moderate: Too clayey	.06 - .20
Imperial-Glenbar silty clay loams, wet, 0 to 2% slopes	Silty Clay Loam	12	5	.43	Moderate: Too clayey	.06 - .20
Indio-Vint Complex	Loam	12	5	.55	Slight	0.6-2.0
Meloland very fine sandy loam, wet	Very Fine Sandy Loam	12	5	.43	Moderate: Wetness	0.6-2.0
Meloland and Holtville loam, wet	Sand	27	1	.20	Severe: Soil blowing	6.0-20.0
Rositas sand, (0 to 2% slopes)	Fine Sand	9	1	.2	Severe: Too sandy	6.0-20.0
Vint loamy very fine sand, wet	Loamy Very Fine Sand	10	3	.32	Moderate: Too sandy	2.0 – 6.0
Vint-Indio very sandy loams, wet	Loamy Very Fine Sand	10	3	.32	Slight	2.0 – 6.0

Source: U.S. Department of Agricultural Soil Conservation Service, 1981, Ericsson-Grant, Inc. 2011.
Notes:
N/A = not applicable or not available.
[1] Taken from Table 11, Engineering Index Properties.
[2] Wind erodibility groups range from 1 to 8, with 1 being highly erodible and 8 having low erodibility. Taken from Table 12, Physical and Chemical Properties of Soils.
[3] This is an index of erodibility for standard condition and includes susceptibility of soil to erosion and rate of runoff. Low K values (below 0.15) indicate low erosion potential. High K values (above 0.4) are highly erodible. Taken from Table 12, Physical and Chemical Properties of Soils
[4] Qualitative descriptors of erosion hazard: Slight = little or no erosion is anticipated, Moderate = some erosion anticipated, Severe = significant erosion potential exists. Taken from Table 9, Recreational Development (Paths and Trails).

102-Badland soils - steep to very steep barren land soils dissected by drainageways in local steep topography. Texture is clay to gravelly sand. Surface runoff is rapid or very rapid, and the hazard of erosion is high.

110-Holtville Silt Clays, wet - very deep, stratified soils on flood plains, and alluvial basin floors. Permeability is slow in the clayey layer and moderately rapid in the underlying material. Available water capacity is high to very high. The soil is non-saline or slightly saline. Surface runoff is slow and the hazard of erosion is slight.

114-Imperial Silty Clay, wet – very deep soil on flood plains and in basins and lakebeds. Permeability is slow and available water is very high. Soil is slightly saline and surface runoff is slow. Hazard of erosion is slight.

115-Imperial Glenbar Silty Clay Loams, wet, 0 to 2 percent slopes – nearly level soils located on flood plains and in basins and lakebeds within the irrigated area of Imperial Valley. It is formed in clayey sediment from mixed sources. Permeability is slow, and available water capacity is high to very high. The soil is non-saline to slightly saline. Surface runoff is slow, and the hazard of erosion is slight.

118-Indio Loam, wet – very deep, nearly level soil on flood plains and basin floors. Permeability is moderate and available water capacity is high to very high. Surface runoff is slow and the hazard of erosion is slight.

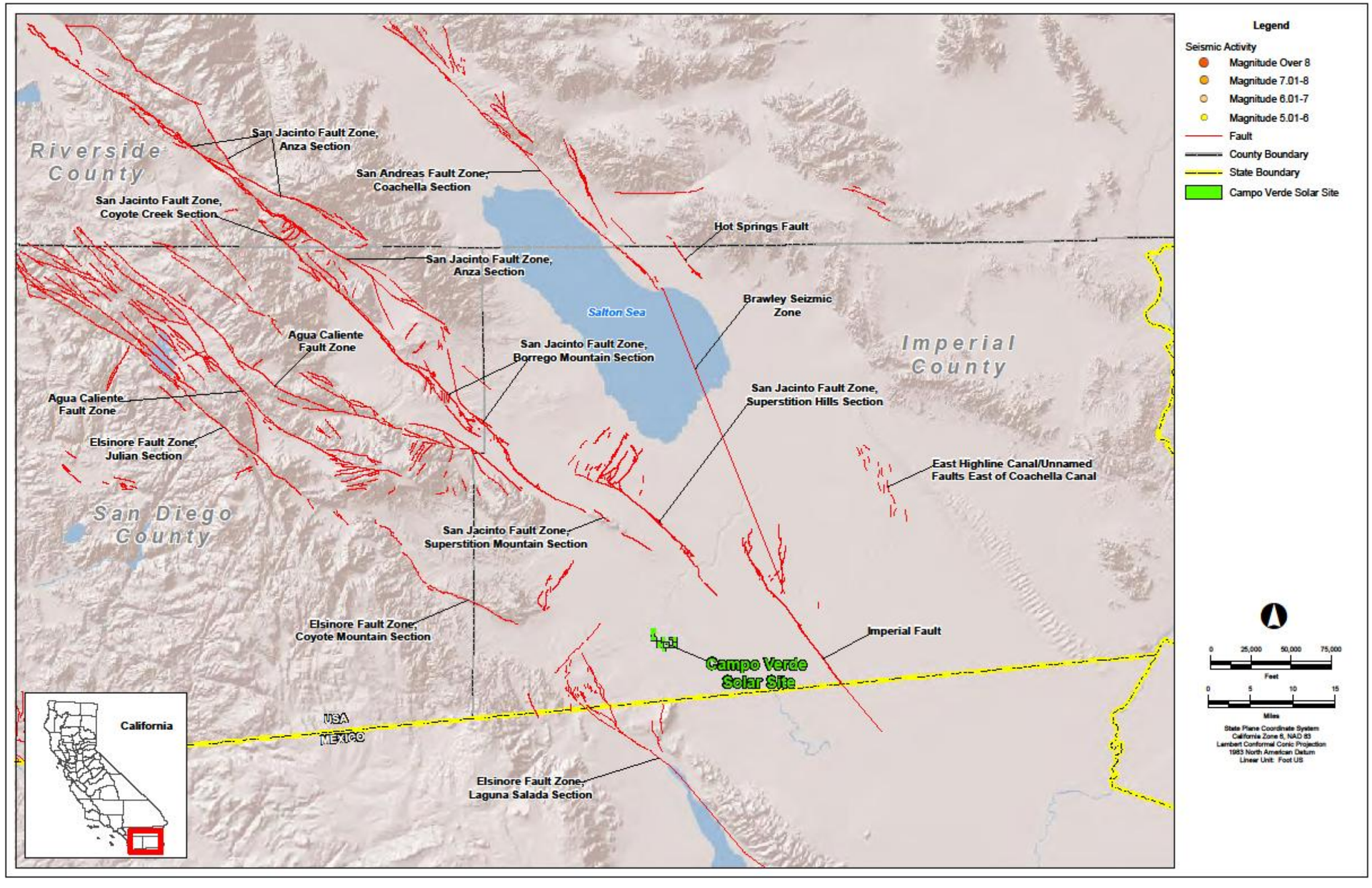
122-Meloland very fine sandy loam, wet - very deep, nearly level and found on flood plains and alluvial basin floors. Permeability is slow, and available water capacity is high to very high. Surface runoff is low, and the hazard of erosion is slight.

123-Meloland and Holtville Loams, wet - nearly level soils formed on floodplains and alluvial basin floors. Permeability of the Meloland series is slow and available water capacity is high to very high. Surface runoff is slow. The hazard of erosion is slight, and the hazard of soil blowing is moderate. Holtville loam is very deep and stratified. Permeability of the Holtville soil is slow, and available water capacity is high to very high. Surface runoff is slow, and the hazard of erosion is slight. The hazard of soil blowing is moderate.

135-Rositas series (sand) - very deep, nearly level soil on flood plains, and basin floors. Permeability is rapid and available water capacity is low. Surface runoff is slow, and the hazard of erosion is slight. There is high hazard of soil blowing.

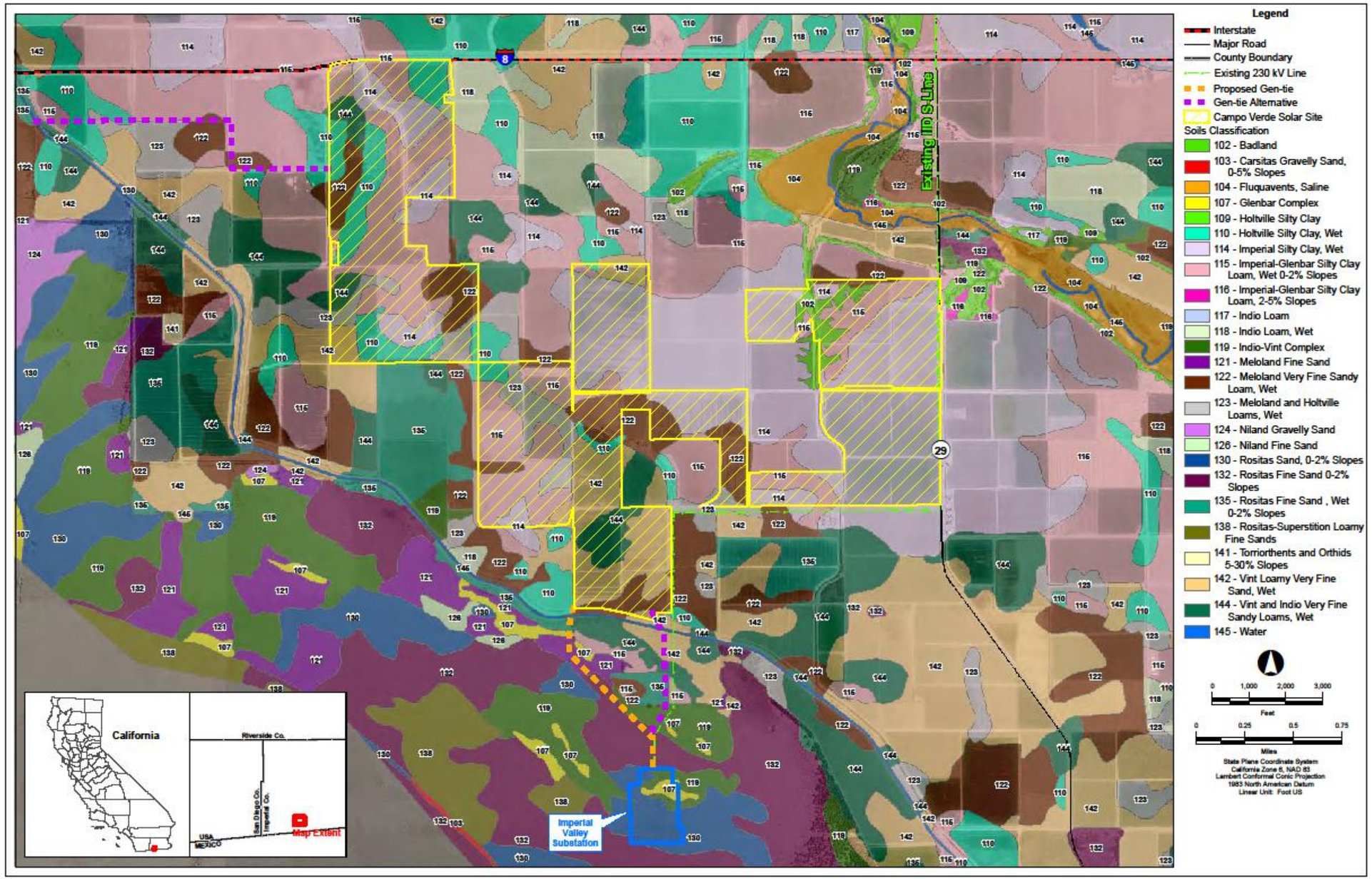
142-Vint loamy very fine sandy loam - very deep, nearly level soils is on basin floors and flood plains. Permeability of Vint soil is moderately rapid permeability and available water capacity is moderate. Surface runoff is slow, and the hazard of erosion is slight. The hazard of soil blowing is moderate.

144-Vint and Indio very fine sandy loams, wet – undifferentiated unit consists of deep, nearly level soils on the bed of old Lake Cahuilla. Permeability of the Vint series is moderately rapid, and available water capacity is moderate. Surface runoff is slow, and the hazard of erosion is slight. There is moderate hazard of soil blowing. Indio very fine sand loam, wet is deep. Available water capacity is high to very high. Surface runoff is slow, and the hazard of erosion is slight. The hazard of soil blowing is moderate.



Source: kp environmental, 2012.

FIGURE 4.6-1
REGIONAL FAULTS AND SEISMICITY



Source: kp environmental, 2012.

FIGURE 4.6-2
SOILS MAP

Subsurface Soils

Test borings revealed that the site is underlain by fill/crop, lacustrine clays, and alluvial soils. Fill and/or crop soils were encountered in the upper 1 to 2 feet in each of the 25 test borings. The fill soils consist generally of gray and olive brown, moist to very moist, soft to firm, sandy silty clay and clayey silts with mica grains and rootlets . The fill/crop soils are similar in consistency to the surficial lake deposits from which they were derived.

The fill/crop soils are underlain by lacustrine deposits associated with the ancient lakes in the area. The lacustrine deposits generally consisted of lean clay with a few thin beds of sandy silt (Ml). The lacustrine deposits were generally moist to saturated, and firm to very stiff in consistency. The lacustrine deposits are underlain by medium dense to dense, saturated, fine-grained silty sands and sands.

Liquefaction

Liquefaction of soils can be caused by strong vibratory motion in response to earthquakes. Both research and historical data indicate that loose, granular soils are susceptible to liquefaction, while cohesive clays are not adversely affected by vibratory motion. Liquefaction is generally known to occur only in saturated or near saturated granular soils at depths shallower than approximately 50 feet. The soils which predominantly underlie the site are lean, stiff, clays. Liquefaction is not considered to be a hazard in clays (EGA, 2011, p. 7).

Subsidence

Subsidence is the gradual, local settling or sinking of the earth's surface with little or no horizontal motion. Subsidence is usually the result of gas, oil, or water extraction, hydro-compaction, or peat oxidation, and not the result of a landslide or slope failure. Ground surface effects related to subsidence are generally restricted to long surface structures such as canals, drains, and sewers, which are sensitive to slight changes in elevation. According to the Imperial County Seismic and Public Safety Element, subsidence from earthquakes and other activities, including geothermal resources development, can disrupt drainage systems and cause localized flooding. Subsidence was not identified as an issue on the project site by the Preliminary Geotechnical Investigation (EGA, 2011, p. 7).

Expansive Soils

Expansive soils are primarily comprised of clay particles. Clay increases in volume when water is absorbed and shrinks when dry. Expansive soils can damage building foundations, concrete flatwork, and asphaltic concrete pavements as a result of swelling forces that reduce soil strength. In general, much of the near surface soils in the agricultural area of the Imperial Valley consist of silty clays and clays which are moderately to highly expansive. Laboratory results indicate that the subgrade earth materials possess an Expansion Index ranging from very low to medium (EGA, 2011). Thus, expansive soils are present on the project site.

Differential Settlement

Differential settlement refers to uneven settlement of a slab-on-ground foundation. When differential settlement occurs, some portions of the foundation settle more than other portions. Soil and groundwater conditions on the project site are favorable to post-liquefaction differential settlement (EGA, 2011, p. 7).

Soil Corrosivity

Soils on the project site have characteristics which make them corrosive to metals. A major factor in determining soil corrosivity is electrical resistivity. The electrical resistivity of a soil is a measure of its resistance to the flow of electrical current. Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of electrical current (direct current [DC]) from the metal into the soil. Lower electrical resistivities result from higher moisture and soluble salt contents and indicate corrosive soil.

Other soil characteristics that may influence corrosivity towards metals are pH, soluble salt content, soil types, aeration, anaerobic conditions, and site drainage. Soil pH values ranged from 7.6 to 8 which are considered mildly to moderately alkaline. The soluble salt content of the samples ranges from low to very high. Chloride and sulfate salts are the predominant constituents.

Mineral Resources

Imperial County contains diverse mineral resources. Those with the highest economic value include gold, gypsum, sand, gravel, lime, clay, and stone. Geologic factors restrict mining operations to the relatively few locations where mineral deposits are feasible for extraction. The majority of the mining areas are in the eastern portion of Imperial County as depicted on Figure 5, Mining Resources, of the Imperial County General Plan Conservation and Open Space Element (Imperial County, 1993). The solar generation facility site currently consists of agricultural land. A portion of the gen-tie extends through desert lands with native vegetation cover. The project site appears to contain no mineral resources, and no mining activities occur in the vicinity of, or on, the project site.

B. GEN-TIE

The Preliminary Geotechnical Investigation did not include the portion of the gen-tie to be located on lands under the jurisdiction of the BLM. This portion of the project is undergoing separate environmental analysis under NEPA. However, the regional settings such as seismicity described for the solar generation facility would also apply to the gen-tie.

4.6.3 IMPACTS AND MITIGATION MEASURES

A. STANDARDS OF SIGNIFICANCE

The impact analysis provided below is based on the following State CEQA Guidelines, as listed in Appendix G. The project would result in a significant impact to geology and soils if it would result in any of the following:

a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

   i) 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? Refer to Division of Mines and Geology Special Publication 42?

   ii) Strong Seismic ground shaking?

   iii) Seismic-related ground failure, including liquefaction and seiche/tsunami?

   iv) Landslides?

b) Result in substantial soil erosion or the loss of topsoil?

c) Be located on a geologic unit or soil that is unstable or that would become unstable as a result of the project, and potentially result in on- or off-site landslides, lateral spreading, subsidence, liquefaction or collapse?

d) Be located on expansive soil, as defined in the latest Uniform Building Code, creating substantial risk to life or property?

e) Have 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?

B. ISSUES SCOPED OUT AS PART OF THE INITIAL STUDY

Several checklist criteria were eliminated from further evaluation as part of the Initial Study and review of the Preliminary Geotechnical Investigation. Surface rupture is the opening of the earth when a deep fault moves. Rupture typically is associated with pre-existing fault strands but may occur suddenly during an earthquake or over time in the form of fault creep. The project site is not located within a State of California, Alquist-Priolo Earthquake Fault Zone and no active faults are known to cross the site (EGA, 2011, p. 6). Thus, no impact is identified relative to fault rupture and this issue will not be discussed further.

The project site is not near a large body of water and is not along the coast. The project site is approximately 100 miles inland from the Gulf of California most likely precluding damage due to seismically induced waves. Therefore, no impact would occur with respect to a tsunami. However, it is possible that a seiche could occur within one of the shallow reservoirs adjacent to the proposed PV arrays. This could result in limited earthquake induced flooding at the site (EGA, 2011, p. 7). No impact is anticipated based on the amount of water involved.

Subsidence or collapse was not identified as a potential geologic issue in the Preliminary Geotechnical Investigation prepared for the project site (EGA, 2011). As such, it is not discussed further with regard to the proposed project. Other geologic hazards such as landsliding do not appear to be evident at the project site or adjacent site. Topography for soil landslides, soil creep, or lateral spreading is insufficient. In addition, as identified in the Seismic and Public Safety Element of the County of Imperial General Plan, the hazard of landsliding is unlikely due to the regional planar topography. Thus, no impact is identified for these issue areas.

One additional issue, corrosive soils, was identified in the Preliminary Geotechnical Investigation and is discussed below.

C. METHODOLOGY

Existing conditions were evaluated based on potential to be affected by construction activities, operation and maintenance activities, and decommissioning of the project. Construction, operation, and maintenance activities were identified based on analysis provided in the Applicant's Plan of Development (Campo Verde Solar, 2011). Impacts to geology and soil resources were formulated based on the findings of the *Preliminary Geotechnical Investigation: Proposed Mount Signal Solar Farm and Associated Structures West of Drew Road and South of Interstate 8 Imperial County, California* prepared by EGA Consultants (EGA, 2011) included in **Appendix D** of the Technical Appendices of this EIR on the attached CD.

D. PROJECT IMPACTS AND MITIGATION MEASURES

Strong Seismic Ground Shaking

Impact 4.6.1 The project site is located in a seismically active region and would be subject to strong seismic ground shaking in the event of an earthquake. This is considered a **potentially significant impact**.

One of the seismic hazards most likely to impact the project site is strong ground shaking during an earthquake. The project site is located in the seismically active Imperial Valley in Southern California and could experience moderate to strong ground motion from earthquakes in the region. Multiple faults are located in the vicinity of the project. The faults closest to the project site include the San Jacinto Fault (Superstition Hills Section approximately 7 miles to the northeast; Superstition Mountain Section approximately 10 miles to the north), the Imperial Fault (approximately 15 miles east of the project site); and the Elsinore Fault (Laguna Salada Section, approximately 10 miles to the southwest of the project site) as shown in **Figure 4.6-2**. The Superstition Hills Section and Superstition Mountain Section both have a Maximum Magnitude (Mmax) of 6.6; the Imperial Fault has an Mmax of 7.0; and the Laguna Salada Section has a 7.0 Mmax (BRG, 2008).

The amount of ground shaking in an area during an earthquake depends on several factors: 1) proximity of the area to the fault; 2) the depth of focus; 3) the location of the epicenter; and 4) the size (magnitude) of the earthquake. Soil type also plays a role in the intensity of shaking. Bedrock or other dense or consolidated materials are less prone to intense ground shaking than alluvial soils. The site is underlain by fill/crop, lacustrine clays, and alluvial soils. Thus, the site includes soils that are susceptible to ground shaking.

Imperial County is classified as Seismic Zone 4 by the Uniform Building Code (Sections 1626 through 1635). Developments within in Seismic Zone 4 (highest risk on a scale of 0 to 4) are required to incorporate the most stringent earthquake resistant measures. While the project would not include habitable structures, the solar facilities proposed on the site could be damaged by strong seismic shaking. Thus, impacts associated with strong seismic shaking are considered **potentially significant**.

Mitigation Measures

MM 4.6.1 The proposed development shall be designed in accordance with seismic considerations contained in the 2010 California Building Code, 2010 Uniform Building Code or the standards of care established by the Structural Engineers Association of California and the County of Imperial building requirements.

Timing/Implementation: *Prior to approval of final building plans/As part of project design.*

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

Significance After Mitigation

Implementation of mitigation measure MM 4.6.1 would reduce potential structural damage caused by strong seismic ground shaking by adhering to the appropriate codes and standards of care. Thus, this impact is can be mitigated to a **less than significant** level through adherence to applicable codes and standards.

Liquefaction/Unstable Soils

Impact 4.6.2 Soils on the project site could be subject to liquefaction. However, if liquefaction were to occur, it will only be in small areas of the site and result in ¼-inch differential settlement of the arrays. This is considered a **less than significant impact**.

According to the Soil Survey of Imperial County, the proposed project site is covered with ten soil types (refer to **Table 4.6-2**) (USDA, 1981) and (**Figure 4.6-2**). Some of these soils are prone to liquefaction under certain conditions. The soils which predominantly underlie the site are lean, stiff, clays. Liquefaction is not considered to be a hazard in clays. However, liquefaction is known to occur in saturated or near saturated granular soils at depths shallower than 50 feet.

Sandy zones underlying the lacustrine clays down to 50 feet in depth may liquefy given the Design Basis Earthquake (i.e. the earthquake which the structure is required to safely withstand with repairable damage). Assuming a groundwater level of 5 feet, the total post-liquefaction settlement is estimated to vary from roughly 0 to 1/2-inch at the site. According to State guidelines, a differential settlement equal to approximately one-half of the anticipated total liquefaction settlement may be conservatively assumed for structural design. Consequently, a 1/4-inch post-liquefaction differential settlement is estimated to occur across the length of the proposed arrays (EGA, 2011, p. 7). A total dynamic settlement of up to 1/2-inch may occur at the site. Piles may experience increased internal stress and undergo a small fraction of the total dynamic settlement. This level of settlement is considered a **less than significant impact** on the project site.

The soils that predominantly underlie the proposed gen-tie route within the solar generation facility site are stiff clays from ancient lake deposits. As a result, liquefaction is not likely along the gen-tie route within the solar energy site. The portion of the gen-tie on BLM land is being analyzed under separate analysis.

The proposed solar generation facility and gen-tie will be designed in accordance with a Final Geotechnical Evaluation report(s) that will be prepared by a licensed professional engineer during the final design phase. This Final Geotechnical Evaluation report will be submitted to Imperial County Planning and Development Services Department for review and approval prior to obtaining building permits as required by the Imperial County requirements.

Mitigation Measures

None Required.

Significance After Mitigation

Not Applicable.

Erosion

Impact 4.6.3 Construction activities would result in earth disturbance and potential for erosion and loss of top soil. Multiple requirements have been established to address erosion which the Applicant must comply with. Therefore, this impact is considered **less than significant**.

Soil erosion could result during construction of the proposed project in association with grading and earthmoving activities. Minor grading would be done over the project site because the current topography is suitable for the placement of PV panels with minimal site preparation or improvements.

Existing vegetation will be grubbed and the soil surface will be smoothed and compacted to prepare the site for installation of the PV solar panels. Excavation would be required for activities such as trenching for underground wiring and cables, for placing electric poles, preparing equipment pads and for the O&M building. All excavations are anticipated to be relatively shallow.

During construction, erosion would be controlled in accordance with County standards including preparation, review and approval of a grading plan by the County Engineer; implementation of a dust control plan (Rule 801) (discussed further in Section 4.3, Air Quality); and compliance with the National Pollutant Discharge Elimination System (NPDES) Construction General Permit (discussed further in Section 4.11, Hydrology and Water Quality). These actions would mitigate the potential soil erosion impacts to less than significant.

The generally flat topography of the site and the low average annual precipitation for the area would reduce the likelihood of substantial erosion and loss of topsoil. Daily operations and routine maintenance (such as occasional PV panel washing) are not anticipated to increase erosion. Further, to control erosion during operation of the project, the solar field would be coated with a permeable dust suppressant and the roadways within and around the solar field would be covered with gravel. Likewise, during operation soil erosion and sedimentation would be controlled in accordance with the Best Management Practices (BMPs) included as part of the project's Storm Water Pollution Prevention Plan (SWPPP) (discussed further in Section 4.11, Hydrology and Water Quality). Thus, erosion impacts would be reduced to less than significant levels during operations.

During decommissioning, soil erosion and sedimentation is anticipated to be controlled in accordance with implementation of a Dust Control Plan (Rule 801) and compliance with the National Pollutant Discharge Elimination System (NPDES) Construction General Permit. These actions would mitigate the potential soil erosion impacts to a **less than significant level**.

Mitigation Measures

None required.

Significance After Mitigation

Not applicable.

Expansive Soils

Impact 4.6.4 Some of the soils identified on the project site have expansive characteristics. This is considered a **potentially significant impact**.

Soils on the project site predominately consist of clays with imbedded silts and sandy silts. The native clays within the agricultural lands exhibit very low to medium swell potential when tested according to the Uniform Building Code Standard 18-2 methods. The project site structures (building/inverter foundations, concrete flatwork, etc.) could be subject to some potential swelling forces and reduction in soil strength resulting from saturation of the soil. Exposure of proposed structures to expansive soils on the project site is not anticipated to cause damage to the majority of the proposed structures. However, inverter pads located on areas of expansive soils (EGA, 2011) could be subject to damage due to their weight. This is considered a **potentially significant impact**.

Soils on the gen-tie route with the solar generation facility predominately consist of sands and sandy loams. Therefore, the Gen-tie is not expected to be subject to direct impacts resulting from potential swelling forces and reduction in soil strength resulting from saturation.

Decommissioning would result in the dismantling and removal of all infrastructure constructed as part of the project. The solar field would be removed and no longer be subject to potential swelling forces and reduction in soil strength resulting from saturation of the soil. Thus, following decommissioning, no impacts resulting from exposure to expansive soils would occur.

Mitigation Measure

MM 4.6.4 The proposed solar generation facility and gen-tie shall be designed in accordance with a Final Geotechnical Evaluation report that will be prepared by a licensed professional engineer during the final design phase. The Final Geotechnical Evaluation report will be submitted to Imperial County Department of Planning and Development Services for review and approval prior to issuance of building permits as required by the Imperial County. The Final Geotechnical Evaluation report will include an analysis and recommendations regarding design for expansive soil conditions.

Timing/Implementation: *Prior to issuance of building permits.*

Enforcement/Monitoring: *Imperial County Department of Planning and Development Service*s.

Significance After Mitigation

Implementation of mitigation measure MM 4.6.4 would reduce exposure of Power Conversion Station (PCS) vaults or pad structures to damage caused by expansive soils. Thus, impacts associated with expansive soils on the project site would be reduced to **less than significant**.

Soil Capability to Support Septic Systems

Impact 4.6.5 The project proposes to construct a septic system to accommodate wastewater flows generated on the project site. The project will be engineered in compliance with County Environmental Health Department standards. Therefore, soil capability to support septic systems is considered a **less than significant impact**.

The project site and surrounding areas are rural and not served by municipal wastewater. Rural residences in this portion of the County use septic systems for sanitary waste. Temporary septic systems or holding tanks and portable toilets will be used during the construction phase of the project to provide needed sanitary facilities for workers on site. However, during operations, the project proposes to collect wastewater from sinks and toilets located in the O&M building and convey the waste stream to an onsite sanitary waste septic system. Alternatively, the project may be designed to direct sanitary waste streams to an underground tank for storage.

The proposed project is underlain by 10 soil types (refer to **Table 4.6-2**). These soils have moderate absorptive capabilities and provide moderate infiltration and drainage but can be used effectively for septic leach systems with the proper design. The septic system would be engineered based on on-site soil characteristics, and designed and installed in compliance with County Environmental Health Department standards. If a leach field is proposed, it would be engineered based on on-site soil characteristics and designed and installed in compliance with County Environmental Health Department standards. If the County prefers that a leach field not be used, an underground tank would be installed according to County specifications. Therefore, impacts to soil ability to support the use of septic tanks or alternative wastewater disposal systems are considered **less than significant**.

Mitigation Measures

None required.

Significance After Mitigation

Not applicable.

Soil Corrosivity

Impact 4.6.6 Soils within the project site are severely corrosive. Portions of metal structures coming in contact with these soils could be damaged. This is considered a **potentially significant impact**.

Resistivity determinations on the soil indicate very severe potential for metal loss because of electro-chemical corrosion processes. Additionally, negligible to severely high levels of sulfate ions in the native soils could weaken concrete structures they come in contact with. Chloride and sulfate salts are also present in onsite soils. Chloride is particularly corrosive to ferrous metals, and in the higher concentrations measured in the soil samples, chloride can overcome the corrosion inhibiting effect of concrete on reinforcing steel. High concentrations of sulfate, as was measured in the soil samples, can react with components in concrete to cause degradation and reduced strength in a mechanism known as sulfate attack (EGA, 2011).

Likewise, the ammonium and nitrate concentration was high enough to be aggressive to copper. Tests were not made for sulfide and negative oxidation-reduction (redox) potential because these samples did not exhibit characteristics typically associated with anaerobic conditions. This soil is classified as severely corrosive to ferrous metals, aggressive to copper, severe for sulfate attack on concrete, and aggressive with respect to exposure of reinforcing steel to the migration of chloride. Laboratory testing indicates that the soluble sulfate content of on-site soils likely to come in contact with concrete is negligible to severe. Soils were also considered to be severely corrosive towards ferrous metals (EGA, 2011, p. 13). Potential damage to foundations as a result of soil chemistry is considered a **potentially significant impact**.

As part of decommissioning, all concrete foundations (if used for poles and towers) will be removed to a depth of at least 4-feet below ground level and demolished. Likewise, other concrete foundations, such as those for buildings and inverter pads, would be demolished and removed or used onsite for fill as needed as part of decommissioning. The site would be reclaimed for agricultural uses cleared of structures with concrete foundations. Therefore, no impacts associated with corrosive soils are anticipated to occur under decommissioning of the project.

Soils on the gen-tie route portion of the solar generation facility site predominately consist of sands and sandy loams. The soil resistivity and corrosivity conditions at the proposed gen-tie are not expected to cause damage to structure foundations. As part of decommissioning, all concrete foundations would be removed to a depth of at least 4-feet below ground level and demolished. The gen-tie structure locations would be reclaimed. Thus, no impacts associated with corrosive soils would occur in association with decommissioning the gen-tie.

Mitigation Measures

MM 4.6.6 A Field Resistivity and Ground Potential Rise Evaluation shall be prepared by a qualified engineer, which shall include specific measures to address corrosion impacts. Potential

measures may include, but are not limited to, galvanization, epoxy coatings, thicker steel, and cathodic protection.

Timing/Implementation: *Prior to issuance of the structural post building permit.*

Enforcement/Monitoring: *Imperial County Department of Planning and Development Service*s.

Significance After Mitigation

Implementation of mitigation measure MM 4.6.6 would ensure that the project is designed and constructed to protect against corrosion. With implementation of this measure impacts resulting from soil corrosivity would be reduced to **less than significant**.

4.6.4 CUMULATIVE SETTING, IMPACTS AND MITIGATION MEASURES

A. CUMULATIVE SETTING

The geographic scope for the cumulative geology and soils setting is the Imperial Valley portion of the Salton Trough physiographic province of Southern California. In general, geology and soils impacts are site-specific and limited to the boundaries of a proposed project rather than cumulative in nature. Project-specific impacts within the geographic scope are based on the soil characteristics and topography of each site. A list of approved, proposed, and reasonably foreseeable projects is identified in Table 3.0-1 in Chapter 3.0, Introduction to the Environmental Analysis and Assumptions Used.

B. CUMULATIVE IMPACTS AND MITIGATION MEASURES

Cumulative Exposure to Geologic and Seismic Impacts

Impact 4.6.7 Implementation of the proposed project, in combination with existing, approved, proposed, and reasonably foreseeable development, may result in cumulative exposure to geologic and seismic hazards. This is considered a **less than cumulatively considerable impact**.

Ground Shaking

As discussed above, the project site is located in a seismically active area which would make it susceptible to seismic ground shaking in the event of an earthquake. Exposure of the site to strong seismic ground shaking is a potentially significant site-specific impact. Mitigation measure MM 4.6.1 requires structures to be in conformance with the 2010 California Building Code, 2010 Uniform Building Code or the standards of care established by the Structural Engineers Association of California and the County of Imperial building requirements. Implementation of MM 4.6.1 would reduce the project's exposure to damage from seismic ground shaking to less than significant. Furthermore, ground shaking impacts to the proposed project are not expected to combine with approved, proposed, and reasonably foreseeable projects identified in Table 3.0-1 in Chapter 3.0, Introduction to the Analysis and Assumptions Used. The proposed project would have a less than cumulatively considerable contribution to ground shaking impacts and result in a **less than cumulatively considerable impact**.

Expansive Soils

Development of the proposed project would be subject to expansive soils. Inverter pads located on areas of expansive soils (EGA, 2011) could be subject to damage due to their weight. Mitigation measure MM 4.6.4 requires that the proposed solar generation facility and gen-tie be designed in

accordance with a Final Geotechnical Evaluation and associated recommendations regarding design for expansive soil conditions. Implementation of MM 4.6.4 would reduce the project's potential exposure to damage from expansive soils to less than significant. Furthermore, expansive soil impacts to the proposed project are not expected to combine with similar impacts of approved, proposed, and reasonably foreseeable projects identified in Table 3.0-1 in Chapter 3.0, Introduction to the Analysis and Assumptions Used. Therefore, the proposed project would have a less than cumulatively considerable contribution to exposure to expansive soils and result in a **less than cumulatively considerable impact**.

Soil Erosion

Construction soil erosion impacts are considered potentially significant short-term, site-specific impacts under CEQA. Erosion would be controlled on-site with site-specific measures, a grading plan approved by the County Engineer, implementation of a dust control plan (Rule 801), and compliance with the National Pollutant Discharge Elimination System (NPDES) Construction General Permit. Therefore, soil erosion impacts are not expected to combine with similar impacts of past, present, or reasonably foreseeable projects. The proposed project would have a less than cumulatively considerable contribution to soil erosion impacts. Therefore, cumulative impacts associated with soil erosion would be **less than cumulatively considerable.**

Corrosive Soils

Chloride and sulfate salts are present in soils on the solar generation facility site representing a potential threat to concrete foundations. Ammonium and nitrate content in onsite soils would be aggressive to copper and some soils were also considered to be severely corrosive towards ferrous metals (EGA, 2011, p. 13). Mitigation measure MM 4.6.6 would require preparation of a Field Resistivity and Ground Potential Rise evaluation which would identify specific measures to address corrosion impacts. These measures could include galvanization, epoxy coatings, thicker steel, and cathodic protection thereby mitigating damage due to corrosive soils. Corrosive soils impacts are would not combine with approved, proposed, and reasonably foreseeable projects identified in Table 3.0-1 in Chapter 3.0, Introduction to the Analysis and Assumptions Used. The proposed project would have a less than cumulatively considerable contribution to corrosive soils impacts. Thus, cumulative impacts associated with corrosive soils would be **less than cumulatively considerable**.

Mitigation Measures

As discussed throughout this analysis, the proposed project would be subject to all applicable building codes and standards (MM 4.6.1) as well as any further engineering requirements set forth in the Final Geotechnical Evaluation (MM 4.6.4). Likewise, the project would be responsible for incorporating measures from Field Resistivity and Ground Potential Rise evaluation (MM 4.6.6). Therefore, following mitigation, cumulative geological and seismic impacts would be reduced to **less than cumulatively considerable**.

Significance After Mitigation

Project-specific impacts are mitigated on a project-by-project basis. Following implementation of the mitigation measures MM 4.6.2, MM 4.6.4 and MM 4.6.6, geology and soils impacts would be reduced to less than cumulatively considerable levels.