CHAPTER 3.4
GEOLOGY AND SOILS

This section presents an assessment of potential geologic and soil related impacts of the Proposed Project and alternatives. *Section 3.4.1* provides a discussion of the affected environment for hydrology of the project area. The impact assessment methodology is discussed, and potential impacts of the Proposed Project and alternatives are identified in *Section 3.4.3*. This section is based upon a Geotechnical Engineering Report, prepared by Earth Systems Southwest (ESSW), October 2006, and is included in *Appendix D*.

3.4.1 Affected Environment

Topography

The project site is located south of the I-10 Freeway, west of North Indian Canyon Drive in the northern portion of the City of Palm Springs. The proposed turbines will be located within the upper northwestern part of the Coachella Valley, east of the San Gorgonio Pass. The project area currently consists of active wind farms, with numerous operating turbines, vacant desert lands, and unpaved access roads. The project site is located on alluvial deposits that are derived from the erosion of the San Bernardino and San Jacinto Mountains to the north and west of the site. The alluvial sediments consist of fine to coarse grained sands with silt, gravel, cobbles and some boulders. The site slopes gently downward to the east-southeast ranging from approximately 810 ft. msl at the northwest corner to approximately 630 ft. msl at the southeast corner.

Soil Conditions

The soils onsite consist primarily of well graded to poorly graded sand with varying amounts of silt, gravel, and cobbles and some boulders. The upper soils are variably loose to medium dense near surface and become very dense with depth. Exploratory borings were performed by the geotechnical consultant as part of the geotechnical investigation. At several locations, the drilling operations using 8-inch diameter hollow-stem augers consistently encountered auger refusal at shallow depths on a cobbly or boulderly layer. Based on seismic refraction surveys, similar soils as encountered in the borings occur below the auger refusal layer. The soils have been visually classified to be in the very low expansion (EI < 20) category in accordance with Table 18A I B of the California Building Code (ESSW, 2006).

Geology

The site lies at the boundary of the San Gorgonio Pass to the west, and the Coachella Valley to the east. The San Gorgonio Pass forms the boundary between the Transverse Ranges geomorphic province to the north, and the Peninsular Ranges province to the south. The Transverse ranges are characterized by east-west trending mountain ranges which include the San Bernardino Mountains, located to the north of the site. The Peninsular ranges are characterized by northwest to southeast trending mountain ranges and valleys. The San Jacinto Mountains to the south of the site are part of the Peninsular Ranges province. The Coachella Valley is located immediately to the east of the site. The Coachella Valley is part of the tectonically active Salton Trough, which is an internally draining basin that extends from the San Gorgonio Pass southeast to the Colorado River delta near the Mexican border.

The San Bernardino Mountains north of the site are mostly underlain by the Precambrian-aged Chuckwalla Complex. This complex of igneous and metamorphic rocks consist of dark colored strongly foliated quartz-biotite gneiss and biotite schist that has been intruded by light colored slightly foliated granitic rocks (Rogers, 1965). The foothills of these mountains, including the vicinity of the site, are underlain by alluvial deposits of various ages, ranging from recent stream channel deposits, to Pleistocene older alluvium, to Tertiary sandstones and conglomerates (ESSW, 2006).

Faulting and Seismicity

Six historic seismic events (5.9 M or greater) have significantly affected the Coachella Valley in the past 100 years. These include:

- *Desert Hot Springs Earthquake* - On December 4, 1948, a magnitude 6.5 M_L (6.0M_W) earthquake occurred east of Desert Hot Springs. This event was strongly felt in the Palm Springs area.

- *Palm Springs Earthquake* - A magnitude 5.9 M_L (6.2M_W) earthquake occurred on July 8, 1986 in the Painted Hills causing minor surface creep of the Banning segment of the San Andreas Fault. This event was strongly felt in the Palm Springs area and caused structural damage as well as injuries.

- *Joshua Tree Earthquake* - On April 22, 1992, a magnitude 6.1 M_L (6.1M_W) earthquake occurred in the mountains 9 miles east of Desert Hot Springs. Structural damage and minor injuries occurred in the Palm Springs area as a result of this earthquake.

- *Landers & Big Bear Earthquakes* - Early on June 28, 1992, a magnitude 7.5 M_S (7.3M_W) earthquake occurred near Landers, the largest seismic event in Southern California for 40 years. Surface rupture occurred just south of the town of Yucca Valley and extended some 43 miles toward Barstow. About three hours later, a magnitude 6.6 M_S (6.4M_W) earthquake occurred near Big Bear Lake. No significant structural damage from these earthquakes was reported in the Palm Springs area.

- *Hector Mine Earthquake* – Early on October 16, 1999 a magnitude 7.1M_W earthquake occurred on the Lavic Lake and Bullion Mountain faults north of 29 Palms. While this event was widely felt, no significant structural damage has been reported in the Coachella Valley.

The primary seismic risk at the site is a potential earthquake along the San Andreas Fault. Geologists believe that the San Andreas Fault has characteristic earthquakes that result from rupture of each fault segment. The estimated characteristic earthquake is magnitude 7.7 for the Southern Segment of the fault (USGS, 2002). This segment has the longest elapsed time since rupture of any part of the San Andreas Fault. The last rupture occurred about 1690 AD, based on dating by the USGS near Indio (WGCEP, 1995). This segment has also ruptured on about 1020, 1300, and 1450 AD, with an average recurrence interval of about 220 years. The San Andreas Fault may rupture in multiple segments, producing a higher magnitude earthquake. Recent paleoseismic studies suggest that the San Bernardino Mountain Segment to the north and the Coachella Segment may have ruptured together in 1450 and 1690 AD (WGCEP, 1995).

The nearest fault to the site is the Garnet Hill fault (GHF), a right-lateral, strike-slip fault that has been mapped along the southern margin of Alta Mesa, a prominent dissected mesa west of the Whitewater River and south of the Banning fault. This fault is believed to be related to the Coachella Valley segment of the Banning fault of late Quaternary age. The fault is fairly well-defined along its western margins in the Whitewater area, just northwest of the site, where several scarps are visible in aerial photographs. In addition, the abrupt scarp has subsequently been modified by erosion and landsliding.

On July 8, 1986, a moderate (ML5.9) earthquake near North Palm Springs produced a variety of ground fractures and, in particular, occurred along local portions of the GHF. Both extensional and compressional fractures occurred in alluvium and asphalt along the pre-July 8 scarp of the GHF at the mouth of Whitewater Canyon, just northwest of the site. Evidence of surface fault rupturing in the vicinity of the site was not reported (ESSW, 2006).

Groundwater

Free groundwater was not encountered in the borings during exploration. The depth to groundwater in the area is strongly influenced by periodic flooding and the influence of recharge of the Coachella Valley Water District detention basins to the west of the site. The depth to regional groundwater is mounded around the basins and reported to be as shallow as 58 feet (Well No. 3S/4E-20J1), but generally is excess of 100 feet based on water well data obtained from the USGS Water Resources Bulletin 91 4142 (ESSW, 2006).

3.4.2 Regulatory Setting

Federal

UBC—Uniform Building Code

The Uniform Building Code (UBC) was first enacted in 1927 and assists builders in the development of better building construction and provides greater safety to the public by establishing uniformity in building laws. The UBC covers fire, life and structural safety aspects of all buildings and related structures. Revised editions are published generally every three years (ICBO, 1985).

State

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act was passed in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. Its main purpose is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. This state law was a direct result of the 1971 San Fernando Earthquake, which was associated with extensive surface fault ruptures that damaged numerous homes, commercial buildings, and other structures.

3.4.3 Environmental Consequences

The following section describes the impacts to geologic and soil resources that are expected to occur as a result of project implementation.

Methodology and Significance Criteria

This section provides a discussion of the methodology and criteria used to assess impacts to geologic and soil resources that could occur as a result of construction and operation of the Proposed Project and alternatives.

CEQA Significance Criteria

Appendix G of the State CEQA Guidelines (Cal. Code Regs. Title 14 §15000 et seq., 1998) states that the project would have a significant effect on geology and soils if it would:

- Expose people or structures to potential substantial adverse effects including the risk of loss, injury, or death involving;
    - Rupture of a known earthquake fault,
    - Strong seismic ground shaking,

  - Seismic-related ground failure, including liquefaction,
  - Landslides;
- Result in substantial soil erosion or the loss of topsoil;
- 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 landslide, lateral spreading, subsidence, liquefaction or collapse;
- Be located on expansive soil, creating substantial risks to life or property;
- 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.

Project Impacts

Soil Conditions

The soils onsite have been visually classified to be in the very low expansion (EI < 20) category, therefore, the project would result in a less than significant impact with regard to expansive soils and would not create substantial risks to life or property.

The project site is subject to periodic flooding and significant scour erosion has and should be expected to occur. Appropriate project design, construction, and maintenance can reduce the impact of scour erosion.

Seismic Hazards

Surface Fault Rupture - The turbine sites do not lie within a currently delineated State of California, Alquist-Priolo (A-P) Earthquake Fault Zone (Hart, 1997). Well-delineated fault lines cross through this region as shown on California Geological Survey (CGS) maps (Jennings, 1994). A 1,000 foot wide "County Fault Zone" traverses to the north of the site, south of Interstate 10. The County Fault Zone is intended to identify the Garnet Hill fault, a potentially active fault, as discussed further below. Active fault rupture is unlikely to occur at the project site. While fault rupture would most likely occur along previously established fault traces, future fault rupture could occur at other locations.

Groundshaking - The primary geologic hazard is severe ground shaking from earthquakes originating on nearby faults. A major earthquake above magnitude 7 originating on the local segment of the San Andreas Fault zone would be the critical seismic event that may affect the site within the design life of the proposed development. Engineered design and earthquake-resistant construction increase safety and allow development of seismic areas. Because the project does not propose any habitable structures, the most serious potential result of earthquake activity would be structural damage. Compliance with the most recent version of the UBC for Seismic Zone 4 and implementation of safety setbacks for wind turbines required by the City of Palm Springs (which have been incorporated into the project design) will mitigate the effects of groundshaking to a level less than significant.

Liquefaction - Liquefaction is the loss of soil strength from sudden shock (usually earthquake shaking), causing the soil to become a fluid mass. In general, for the effects of liquefaction to be manifested at the surface, groundwater levels must be within 50 feet of the ground surface and the soils within the saturated zone must also be susceptible to liquefaction. The potential for liquefaction to occur at this site is considered negligible because the depth of groundwater beneath the site exceeds 100 feet. No free groundwater was encountered during exploratory borings. In addition, the project does not lie within the Riverside County designated liquefaction hazard zone. For these reasons, potential impacts due to liquefaction are considered less than significant.

Ground Subsidence: - The potential for seismically induced ground subsidence is considered to be low to moderate at the site. Dry sands tend to settle and densify when subjected to strong earthquake shaking. The amount of subsidence is dependent on relative density of the soil, ground motion, and earthquake duration. Potential impacts due to seismically induced ground subsidence are considered less than significant.

Slope Instability - Potential hazards from slope instability, landslides and debris flows are considered low at the subject property, as the site contains gentle sloping topography (less than 10% slope) and is not located adjacent to any hillsides or elevated slopes. The project proposes no major manufactured slopes. Therefore, slope instability issues are considered less than significant.

3.4.4 Mitigation Measures

3.4-1. The geotechnical engineering recommendations of the report entitled "Geotechnical Engineering Report for Mountain View IV Wind Project", and attached as *Appendix D* of this EIR shall be consulted and implemented during project design and construction.

3.4-2. Permanent structures shall be designed by a professional engineer using, at a minimum, the latest seismic safety design standards outlined in the 2001 edition of the California Building Code for Seismic Zone 4.

3.4.5 Reduced Development Alternative

The reduced development alternative would introduce fewer turbines to the project site, to be developed in Section 28 only. Since this alternative would still develop structures on the site, there would still be a need to mitigate potential geotechnical effects on the project. The reduced development alternative is therefore not regarded as environmentally superior to the proposed project (preferred alternative).

3.4.6 No Action Alternative

The geotechnical report indicates the site could experience strong ground motion during project life. Additionally, erosion may occur during the construction period which could pose a potential impact. Mitigation for the project or any proposed development at the site would consist of compliance with the 2001 edition of the California Building Code for seismic safety as well as recommendations of the site specific geotechnical report. The No Action alternative would not result in any impacts requiring mitigation with regard to geologic conditions due to lack of potential buildings or structures. Therefore, for geologic issues, the no action alternative is considered to be environmentally superior.