5.5 GEOLOGIC RESOURCES AND HAZARDS

This section addresses the potential effects on geologic resources and the potential geologic hazards that may be encountered from development of the Palomar Energy Project.

5.5.1 Affected Environment

5.5.1.1 Regional Geology and Physiography

The Palomar project site and associated linear features are located in the foothills within the Peninsular Ranges Geomorphic province. The foothills consist of narrow winding valleys and rolling to hilly uplands.

Structurally, the area is composed of a complex series of granitic intrusions (Figure 5.5-1). The intrusions are Cretaceous in age and include granodiorites, tonalites, diorites, leucogranodiorites, and gabbros (Rogers, 1965, and Larsen Jr., 1948). The contacts between the intrusions are generally steeply dipping and can be sharp or gradational. Fracturing of the intrusive rocks is evident and weathering along fractures is common. To the south of the site are some Jurassic aged volcanic and metavolcanic rocks (Rogers, 1965). There is also a mineralized quartz vein to the south east that was successfully mined for gold and silver in the late 1800s to the early 1900s (Lorey, 1989). Additional information regarding the gold mining is included within this geological resources section.

Bedrock is exposed in portions of the site, and consists of Cretaceous aged, granitic, intrusive rock that has been named the Green Valley Tonalite (GEOCON, 1999). The bedrock surface exhibits a variable weathering pattern, ranging from deeply weathered along fractures to relatively fresh, hard rock.

Surface soils are discussed in Section 5.6, Agriculture and Soils, and consist primarily of colluvium composed of silty to clayey sand (GEOCON, 1999). Colluvium is soil that was formed in place by weathering of the underlying bedrock.

5.5.1.2 Seismicity

The Palomar site is located in a seismically active area. Characteristics of principal faults within 60 miles of the site are presented in Table 5.5-1. California law (the Alquist-Priolo Special Studies Zones Act) specifies that an area, termed an “Earthquake Fault Zone” is to be delineated surrounding faults that are deemed “sufficiently active” or “well defined” after a review of seismic records and geological studies. This legislation was passed to prohibit the location of most structures for human occupancy across the traces of active faults, and to mitigate thereby the hazard of earthquake-induced ground rupture. Cities and counties affected by zones must regulate certain existing and development projects within the zones by permitting and building code enforcement (CDMG, 1999).

Figure 5.5-1 Geologic Map

Table 5.5-1 Principal Faults Within 60 miles of the Palomar Site

Fault	Type	Activity	Maximum Earthquake Magnitude (M_w)	Distance From Site (miles)	Estimated[1] Peak Ground Acceleration (PGA g)
Rose Canyon	Strike Slip	Active	6.9	14.1	0.182
Elsinore –Julian	Strike Slip	Active	7.1	17.9	0.158
Newport-Englewood (offshore)	Strike Slip	Active	6.9	18.4	0.131
Elsinore –Temecula	Strike Slip	Active	6.8	18.9	0.118
Coronado Bank	Strike Slip	Active	7.4	28.8	0.108
Earthquake Valley	Strike Slip	Active	6.5	31.3	0.045
Elsinore -Glen Ivy	Strike Slip	Active	6.8	38.6	0.043
San Jacinto-Anza	Strike Slip	Active	7.2	40.5	0.057
San Jacinto-Coyote Creek	Strike Slip	Active	6.8	42.3	0.038
San Jacinto-San Jacinto Valley	Strike Slip	Active	6.9	44.4	0.039
Elsinore-Coyote Mountain	Strike Slip	Active	6.8	44.9	0.035
Palos Verdes	Strike Slip	Active	7.1	49.0	0.040
San Jacinto-Borrego	Strike Slip	Active	6.6	53.7	0.022
Chino Central Ave. (Elsinore)	Strike Slip	Active	6.7	55.4	0.023
Newport-Englewood (LA Basin)	Strike Slip	Active	6.9	57.7	0.026

1. Estimated peak acceleration is from Blake, 2000, EQFAULT using Campbell & Bozorgnia attenuation relation for soft rock.

Although located in an acknowledged seismically active area, the Palomar site is not located on a fault trace as designated by mapping and site investigations conducted as part of the Alquist-Priolo Act.

The following subsections provide a discussion of the major active and potentially active faults in the region. Information on the faults is from Blake, 2000; Rogers, 1965; Jennings, 1994; and URS Greiner Woodward Clyde, 1999. Figure 5.5-2 shows fault locations in a radius of 62 miles (100 kilometers) from the site.

Rose Canyon Fault Zone

The Rose Canyon Fault Zone is located offshore approximately 14 miles west-southwest the Palomar site. It is an active strike slip fault that consists of a series of sub parallel fault traces that trend generally toward the north-northwest. The fault is seismically active and produced a moderate sized earthquake (Magnitude 5.4) in 1964. It is considered as the southern extension of the Newport-Englewood fault zone. The maximum earthquake expected from the Rose Canyon Fault is Magnitude 6.9 (Blake, 2000).

Elsinore Fault

The Elsinore fault is located approximately 18 miles to the east-northeast of the Palomar site. It is a strike slip fault that exhibits a narrow linear trend throughout much of its length. Near its closest approach to the site, it splits into two parallel linear strands. The western strand retains the Elsinore fault name. For the peak ground acceleration calculations the fault is subdivided into segments including the Elsinore-Julian, Elsinore-Temecula, Elsinore-Glen-Ivy, Elsinore-Coyote Mountain and Chino Central Avenue (Elsinore). The maximum earthquake expected on the Elsinore-Julian fault is Magnitude 7.1 (Blake, 2000).

Newport Englewood (offshore)

The closest strand of the Newport-Englewood fault is offshore, and is approximately 18.4 miles from the Palomar site. This fault is active and has numerous sub-parallel strands where it has been mapped on shore. The maximum earthquake on the offshore strand is Magnitude 6.9 (Blake, 2000).

San Jacinto Fault

The San Jacinto fault is located approximately 42 miles east-northeast of the Palomar site, and is a significant tectonic feature in the region. It is a right lateral strike slip fault over 200 miles in length. It has produced earthquakes of magnitude 6.2 and 6.5 in November 1987, and is reported to have a recurrence interval of 10 years for moderate to large earthquakes. For peak ground acceleration calculations, the fault is subdivided into segments, including the San Jacinto-Anza, San Jacinto-Coyote Creek, San Jacinto-San Jacinto Valley, and San Jacinto-Borrego. The maximum earthquake expected from the San Jacinto-Anza segment of the fault is Magnitude 7.2 (Blake, 2000).

Coronado Bank Fault

The Coronado Bank fault is approximately 28 miles from the project site. This fault is part of a group of faults located offshore. The Coronado Bank fault is estimated to be capable of generating a maximum earthquake of Magnitude 7.4 (Blake, 2000).

Figure 5.5-2 Regional Fault Map

5.5.1.3 Geologic Resources

A gravel pit is located approximately 0.5 mile northwest of the Palomar site. Weathered granitic rock is mined and crushed at this quarry for road base, granular fill and other uses. There also are several quarries 1.0 to 1.5 miles southwest of the Palomar site. The quarries mine black rock of the San Marcos gabbro. Stone from these deposits is used as building stone, monuments, and surface plates. No other mineral resources were identified within two miles of the site.

In the past, gold was mined about 3.5 miles southeast of the Palomar site. Gold was taken out of a single quartz vein that ranged in width between two inches and six feet. The vein was located in the hills just west of the intersection of State Highway 78 and Bear Valley Parkway. The area was mined from before 1860 to the mid-1920s (Lorey, 1989).

Based on review of published literature, City of Escondido planning documents, and a site visit, there are no known recreational geologic resources associated with the proposed site or pipeline routes. Recreational geologic resources typically include rock or mineral collecting, surface hydrothermal features, or surface expression of geologic features unique enough to generate recreational interests of the general public (e.g., natural bridges, caves, waterfalls).

5.5.1.4 Geologic Hazards

This section analyzes the existing geologic hazards within and surrounding the site. The five types of hazards that were reviewed for potential significance are:

- Seismic ground shaking,
- Seismic ground failure and fault rupture,
- Subsidence,
- Landslides or mudflows, and
- Erosion.

Seismic Ground Shaking

According to the California Uniform Building Code (UBC, Section 2312), the Palomar site is located within Seismic Zone 4. Seismic Zone 4 is the highest potential for seismic ground shaking, based on a scale from 0 to 4. This category requires structural design considerations to protect buildings and other structures from earthquake effects. Based on an earthquake engineering study of the area, the peak ground acceleration calculated for the site is 0.18 g (GEOCON, 1999). The earthquake that would cause this acceleration would be from movement on the nearby Rose Canyon Fault. As shown on Table 5.5-1, earthquakes occurring on the other faults in the area would cause lower ground accelerations at the Palomar site

Ground Failure and Fault Rupture

No historically active faults have been identified on the site.

Subsidence

Potential subsidence as a result of seismic settlement on the Palomar site is considered unlikely. This is because the near surface bedrock and the coarse grained soils generally are not prone to subsidence or collapse (U.S. Soil Conservation Service and Forest Service, 1973).

Landslides and Mudflows

Landslides and mudflows will not occur on the portion of the site that is composed of bedrock. The potential for landslides in soil-covered areas depends on a variety of factors, including soil properties and slopes. The soil survey conducted at the site did not identify a high risk of landslides, but it did identify the potential for erosion and gully formation in the areas where soil cover remains, following grading (GEOCON, 1999). The geologic conditions conducive to the formation of a mudflow are not present at the site.

Erosion

The potential for erosion in most bedrock areas of the Palomar site is low. Where colluvium is present on steep slopes, the potential for soil erosion is high (U.S. Soil Conservation Service and Forest Service, 1973). The erosion potential is not the only variable that affects the actual volumes of eroded material. Other important variables include precipitation (which is relatively low in the project area), the area of disturbance, and the duration of construction (i.e., the time during which soil is disturbed).

5.5.1.5 Power Plant Site

Geology and Physiography

Bedrock is exposed in portions of the project site, and consists of Cretaceous aged, granitic, intrusive rock that has been named the Green Valley Tonalite (GEOCON, 1999). Tonalite is also referred to as quartz diorite, and is mineralogically very similar to quartz monzonite (American Geological Institute, 1962). The bedrock is light brown to gray brown, and is composed primarily of plagioclase, quartz, hornblende and biotite. The bedrock surface exhibits a variable weathering pattern, ranging from deeply weathered along fractures to relatively fresh, hard rock. A preliminary geotechnical investigation conducted in the area revealed that the bedrock is very competent, and becomes particularly hard at depths exceeding 15 feet below ground surface (GEOCON, 1999). This geotechnical investigation is provided as Appendix C.

Surface soils are discussed in the Section 5.6, Agriculture and Soils, and consist primarily of silty to clayey sand (GEOCON, 1999). The soil has been formed from the decomposition of the bedrock and it is soft and easily eroded. It contains angular to subangular sand fragments that act as an abrasive when carried by runoff. The soils in the area are divided into groups, associations and types. The Palomar site is within the Fallbrook-Vista, Rocky soil association that consists of well-drained sandy loams and coarse sandy loams that have a subsoil of sandy clay loam and sandy loam, over decomposed granitic bedrock. The soil present beneath most of the Palomar site has a low shrink swell potential. As shown on Figure 5.6-1 (Section 5.6, Agricultural and Soils), the soil along the southwest edge of the site that is underlain by Fallbrook eroded sandy loam has a moderate shrink swell potential (U. S. Soil Conservation Service and Forest Service, 1973).

Seismicity

As discussed above, the power plant site is subject to ground shaking from nearby and distant earthquakes. The peak ground acceleration calculated for this site is 0.18 g (GEOCON, 1999). Seismic design consistent with stringent UBC Seismic Zone 4 requirements is required to protect project buildings and other structures from earthquake effects.

Liquefaction

Potential for liquefaction of soils beneath the plant site appears to be very low because the site is underlain by bedrock.

Geological Resources

No mineral resources have been commercially developed in the immediate vicinity other than the granite aggregate quarry 1.5 miles south of the Palomar site. There are no known recreational geologic resources associated with the site.

5.5.1.6 Pipeline Routes

Geology and Physiography

The pipeline routes are underlain by weathered bedrock of the Green Valley Tonalite and the following soils: the Fallbrook Sandy Loam, Cieneba Rocky Sandy Loam, Vista Coarse Sandy Loam, and Placentia Sandy Loam (see Figure 5.6-1 in Section 5.6, Agricultural and Soils).

Seismicity

As discussed above for the plant site, the pipeline routes are subject to ground shaking from nearby and distant earthquakes. The peak ground acceleration calculated for this area is 0.18 g (GEOCON, 1999). Project pipelines will be designed to the applicable criteria for UBC Seismic Zone 4.

Liquefaction

Potential for liquefaction of soils beneath the pipeline routes appears to be very low in places where the soil cover is shallow and bedrock is present at depths of less than 10 feet. The potential for liquefaction is larger where bedrock is deeper than 20 feet and sandy soil is present.

Geological Resources

No mineral resources have been commercially developed along the proposed water supply/wastewater return pipeline or gas pipeline routes. There are no known recreational geologic resources associated with the proposed pipeline routes.

5.5.2 Environmental Impacts

The potential environmental impacts from construction and operation of the power plant on geologic resources and risks to life and property from geologic hazards are presented in the following subsections.

Impacts would be considered significant if the project:

- would expose individuals or structures to geologic hazards or
- would affect significant mineral resources

The Palomar project will have no effect on geological resources. The Palomar site is within Planning Area 1 of the ERTC industrial park, and grading of the Palomar site will occur as part of the industrial park project prior to the beginning of power plant construction. This prior grading will excavate into a granite formation that has no unique geologic values. Section 5.5.5 assesses the cumulative effects of the Palomar project together with the industrial park project.

5.5.2.1 Construction

Power Plant Site

Construction-related impacts to the geologic environment primarily involve terrain modification (cuts, fills, and drainage diversion measures) and dust generation. The power plant pad will be rough graded as part of the development of the planned ERTC industrial park within which the Palomar site is located. Final grading is part of Palomar project construction, and will be performed in accordance with sound professional practice and City of Escondido grading requirements to ensure the stability of slopes and soil structures. Areas adjacent to power plant structures will be surfaced with asphalt or crushed rock. The final site grading is not expected to result in significant adverse impacts.

The plant site is not located near known faults, rupture zones, landslide areas, subsidence areas, or other hazardous geomorphic features.

Construction of the proposed facility is not expected to negatively impact natural resources because none are present.

Pipelines Routes

Neither the proposed water supply/wastewater pipeline route, nor the gas pipeline upgrade route cross known faults, rupture zones, landslide areas, subsidence or settlement areas, or other hazardous geomorphic features. Seismic hazards and potential adverse foundation conditions will be minimized by conformance with the recommended seismic and foundation design criteria of the UBC for Seismic Zone 4.

Temporary soil disturbances will occur during construction along portions of the water supply/wastewater return pipeline route that runs south through the industrial park site. The remainder of the proposed pipeline route runs along the unvegetated right-of-way on Harmony Grove Road. The gas pipeline route runs entirely within existing paved streets. Disturbed surface soils will be graded and compacted and, where appropriate repaved to minimize erosion and deposition.

5.5.2.2 Operation

Plant Site

The power plant structures and equipment will be designed in accordance with UBC Seismic Zone 4 requirements. In addition, the major structures and equipment will be designed to withstand the strong ground motion of the Functional Basis Earthquake. No major structures or equipment are within the projected trace of any active or potentially active faults. The plant site is not prone to landslides, subsidence, settlement, or other geologic hazards; project operations also will not result in a significant loss of geologic resources.

Pipelines

Few, if any, geologic hazards are anticipated during operation of the gas, water supply and wastewater pipelines. The pipelines will be designed in accordance with the Seismic Zone 4 provisions of the UBC. Neither the proposed nor the alternative pipeline routes cross active faults or surface rupture zones, nor are they prone to landslides, subsidence, settlement, or other geologic hazards.

5.5.3 Mitigation Measures

This section describes the Applicant-proposed mitigation measures that will be implemented to reduce potential impacts to geologic resources and geologic hazards.

GEO–1 Power plant structures and equipment as well as project pipelines will be designed in accordance with UBC, Seismic Zone 4 requirements. In addition,

the major structures and equipment will be designed to withstand the strong ground motion of the Functional Basis Earthquake.

5.5.4 Significant Unavoidable Adverse Impacts

All impacts associated with geologic hazards and geologic resources are temporary and/or insignificant in nature. Therefore, no significant unavoidable adverse impacts are expected as a result of Palomar Energy Project construction and operation.

5.5.5 Cumulative Impacts

The projects included in the assessment are the two small power plants under development near the Palomar site and the planned ERTC industrial park within which the power plant site is located. The two small power plant sites are adjacent to the northern boundary (CalPeak) and 0.5 mile northwest of the Palomar site (RAMCO), respectively. The industrial park consists of Planning Areas 1-8, and the Palomar facility is proposed for Planning Area 1.

As discussed in Section 5.5.2, the Palomar Energy Project will be designed and constructed to the requirements of UBC Seismic Zone 4, and will adhere to sound professional practice and appropriate regulatory requirements related to geologic hazards (grading, slope stability, etc.). It is assumed that the two small power plants also are being constructed to UBC Seismic Zone 4 requirements, and that they also will adhere to the appropriate professional standards and regulatory requirements that relate to geologic hazards. No significant geologic resources are expected to be affected by the power plant projects.

Overall ERTC Industrial Park Construction

Rough grading for the entire industrial park site, including Planning Area 1, will be performed in an integrated fashion. Earth materials removed from Planning Area 1 will be used as fill material elsewhere on the industrial park site. The entire earthmoving operation, including the creation of the pads in Planning Area 1 and the other planning areas, the slopes that will be created surrounding the building pads themselves in Planning Area 1 and the other planning areas, etc., will be conducted in accordance with sound professional practice, and in accordance with the applicable regulatory requirements, such as the City of Escondido grading ordinance. This will ensure that geologic hazards are properly addressed and minimized. Likewise, it is assumed that the facilities in the remainder of the industrial park will be designed and constructed to the requirements of UBC Seismic Zone 4, as will the Palomar facility. No geologic resources will be lost in the various industrial park planning areas, including Planning Area 1.

ERTC Industrial Park Operation

Because the overall industrial park site is not prone to geologic hazards (subsidence, settlement, landslides, etc.), because the site is not on a known active or potentially active earthquake fault, because the facilities will be designed to appropriate earthquake standards, and because there are no geologic resources present on the industrial park site, no cumulative geologic hazard or geologic resources impacts are expected during operations in the remainder of the industrial park site outside Planning Area 1.

In summary, the Palomar facility, singly or in combination with the other projects, will not cause or contribute to the loss of significant geologic resources or to geologic hazards.

5.5.6 LORS Compliance

Design, construction and operation of the Palomar project including linear features (pipelines) will be conducted in accordance with all LORS pertinent to geologic resources or hazards. The applicable LORS are discussed in Section 6.4.5.

5.5.7 Involved Agencies and Agency Contacts

There are a number of agencies that are involved with permitting and approvals related to geologic resources and hazards. Grading plans are approved by the City of Escondido's Engineering Section and the permits are issued by the City's Permits and Inspection section. Building permits are issued by the Escondido Public Works Department. The agency contacts are shown in Table 5.5-2.

5.5.8 Permits Required and Permit Schedule

Permits required and permit schedule for matters dealing with geologic resources and hazards for the Palomar project are provided in Table 5.5-3.

Table 5.5-2 Involved Agencies and Agency Contacts

Agency/Address	Contact/Telephone	Permits/Reason for Involvement
City of Escondido Permits and Inspection 201 N. Broadway Escondido, CA 92025	Field Engineers Office (760) 839-4664	Grading Permit
City of Escondido Public Works Department 201 N. Broadway Escondido, CA 92025	Ronald Anderson (760) 839-4657	Building Permit

Table 5.5-3 Permits Required and Permit Schedule

Permit	Schedule
Building Permit including Seismic Design Criteria	Submit application 30 days prior to start of construction.
Grading/Erosion Control Permit	30 days prior to start of construction activities.

5.5.9 References

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