5.3 Geological Resources

This section describes the geologic setting, faults, seismicity, and other geologic considerations pertaining to the proposed project. Ground disturbances would be associated with the modifications at Valve Site #2, installation of power poles and the substation, and pipeline repair and maintenance activities. Discussions of the physiography, stratigraphy, and related geotechnical properties (e.g., erosion, slope stability, expansive/ collapsible soils) are included for the offshore bottomhole locations and existing pipeline route. A probabilistic seismic hazard analysis is provided for the entire project area. This section also describes general geohazards associated with the seismic setting (e.g., ground accelerations, liquefaction). Specific probabilities of pipeline and associated facility failure are discussed in Section 5.1, Risk of Upset/Hazardous Materials.

5.3.1 Environmental Setting

5.3.1.1 Physiography

The project site is located in the Santa Maria Basin region. Within the basin, the project pipeline traverses the offshore Mainland Shelf, Lompoc Valley, Burton Mesa, Purisima Hills, Solomon Hills, Casmalia Hills, and the Santa Maria Valley. The Mainland Shelf area is a relatively flat area with slopes less than one degree from the shoreline to approximately 330 to 360 feet (100 to 110 meters) of water depth. Water depths along the offshore pipeline route vary from sea level to 243 feet at Platform Irene (Arthur D. Little, 1985).

The pipeline landfall is located approximately 1.4 miles (4.3 kilometers) north of Surf on a 400-foot (124-meter) wide, gently sloping, sandy beach. The onshore pipeline from landfall to the Lompoc Oil and Gas Plant (LOGP) traverses easterly, roughly paralleling the north margin of the Lompoc Valley. The pipeline then traverses northeastward and eastward through a portion of Burton Mesa, a mildly dissected planar surface that is tilted slightly to the south and stretches from the Purisima Hills on the north and east to the Lompoc Valley on the south. From the LOGP northward, the pipeline traverses approximately one mile of highlands and bedrock ridges before descending into the San Antonio Valley and Harris Canyon (Arthur D. Little, 1985). From Orcutt northward, the pipeline traverses the relatively flat Santa Maria River Valley.

5.3.1.2 Stratigraphy

The bedrock stratigraphy of the onshore and offshore portions of the Santa Maria Basin is relatively similar. The bulk of the offshore sequence comprises Pliocene and Miocene age strata that correlate with the onshore Careaga sand, Foxen claystone, Sisquoc Formation laminated diatomite and diatomaceous shale, and Monterey shale (Dibblee, 1988). The offshore Pleistocene and Holocene section is composed of marine unconsolidated muds, silts, and sands, which mantle underlying Tertiary bedrock (Payne, et al., 1979). The offshore unconsolidated sediments are generally less than 100 feet thick in the vicinity of Platform Irene. The thickness of these sediments generally decreases, and the grain size increases toward shore. The sediments range from sandy and clayey silts to silty fine sand and then fine sand as one progresses from the top of the continental shelf toward shore (Arthur D. Little 1985).

Only three main stratigraphic units are crossed along the pipeline corridor from landfall to the LOGP. Between landfall and the location where the alignment climbs out of the Lompoc Valley, the alignment weaves in and out of poorly defined contacts between recent stream alluvium, stream terrace and alluvial fan deposits, and Orcutt Sands. The alignment across the Burton Mesa is underlain by the Orcutt Sand composed of friable to locally indurated aeolian sand, except in channel crossings where thin alluvium deposits are present. From LOGP to Orcutt, the pipeline crosses Orcutt Sand, Paso Robles Formation, the Careaga Sand, the Sisquoc Formation, and Foxen Claystone of the Burton Mesa and Purisima Hills. The pipeline then crosses unconsolidated alluvium of the San Antonio Valley and Harris Canyon (Arthur D. Little, 1985). From Orcutt northward, the pipeline primarily traverses the alluvial-filled Santa Maria Valley.

5.3.1.3 Erosion

The onshore surficial soil deposits are generally erodible; however, vegetative cover generally arrests erosion. Wind erosion (aeolian) is prevalent at the pipeline landfall location, where extensive dunes are present. In addition, potential erosion may occur along slopes located approximately one-half mile south of Orcutt (Arthur D. Little, 1985). Generally, the unconsolidated, uncemented and granular nature of all the formations renders them susceptible to erosion, particularly on slopes.

5.3.1.4 Scour

Scour as discussed in this section is defined as removal of soil particles along stream channels caused by concentrated flow. In addition, scour is caused in the littoral zone by wave action along the oceanfront. The former type of scour is prevalent throughout the Santa Ynez River floodplain and seems to be the primary cause of the destruction of the former 35th Street Bridge across the river, movements in the railroad trestle at the mouth of the Santa Ynez River, and maintenance problems with the 13th Street Bridge. Alluvial/stream channel deposits are subject to scour and redeposition during periods of high surface runoff. The depth of scour and erosion is variable. Limited information suggests that the depth of scour in a stream channel can be as much as three to four times the height of rise in river stage. The pipeline crosses the Santa Ynez and Santa Maria floodplains in areas susceptible to scour during flood conditions. In addition, scour is expected at areas of concentrated flow where stream channels enter the floodplains (Arthur D. Little, 1985; Staal, Gardner & Dunne, 1991) or along smaller drainage channels such as San Antonio Creek.

5.3.1.5 Slope Stability

The onshore and offshore sediments are locally prone to landslides. Onshore, the occurrence of landslides is related to a variety of factors, including excess precipitation, changes in drainage characteristics, excess load, removal of lateral or underlying support at the toe of a slope, oversteepening of a slope, exposure of bedding planes that dip out of slope, removal of vegetation, seismic activity, or a combination of these factors.

Landslides can be classified into four general types: falls, rotational slides, translational slides, and flows. Rotational slides predominate in the shale and claystone formations and associated soils where weathered material exhibits large dessication cracks during dry periods. Such cracks facilitate infiltration of precipitation following dry periods, which in turn can lead to temporary saturated conditions along the contact between weathered and unweathered material, increased hydraulic head, decreased shear strength of the weathered material, and increased likelihood of failure. Translational landslides typically occur along bedding planes in the Sisquoc and

Monterey Formations. These rock units contain abundant interbeds of diatomite and bentonite, which when saturated with water, expand and form lubricated surfaces which act as sliding planes for landslides.

A review of aerial photographs indicate that a number of small to large landslides exist along the pipeline route in the southern project area. The slides are located in three general areas, including: (1) the north-facing slopes of the Lompoc Terrace; (2) near major drainage channels; and (3) in the Purisima Hills (Arthur D. Little, 1985).

Offshore, thick deposits of unconsolidated sediments are prone to failure. This primarily occurs in steeply sloping areas but can also occur on slopes of only a few degrees. Areas with evidence of previous instability have a high potential for future instability and thus such areas are potential geologic hazards to the project pipeline. However, no areas of mass movement have been mapped in the vicinity of the pipeline. Most mass transport areas in the vicinity of the proposed project are located further seaward along the shelf-slope break and associated submarine canyons (Arthur D. Little, 1985).

5.3.1.6 Seafloor Channels and Buried Channels

Offshore, steep slopes and steep-walled submarine canyons are potential geologic hazards to the existing pipeline due to potential turbidity currents and debris flows. Buried channels are features that were cut during periods of lower sea level and subsequently infilled with sediments by transgressing seas or by shifting submarine canyon/fan systems. Shallow buried channels are potential geologic hazards because of potential contrasts in geotechnical properties between the infilling sediments and the surrounding sediments. However, the offshore pipeline route is not located in the immediate vicinity of either buried or seafloor channels (Arthur D. Little, 1985). Also, as per the 1985 Point Pedernales EIR/EIS geology technical appendix, there are no rocky outcroppings which could present a geological constraint along the offshore pipeline route.

5.3.1.7 Shallow Gas, Gasified Sediments, and Seeps

Gas within shallow sediments can occur in three forms: 1) as pockets or zones within unconsolidated sediments (gasified sediments); 2) as zones within the upper portions of consolidated formations (shallow formational gas); and 3) as gas seeps either in the form of gas bubbles (water column anomalies) or tar mounds on the sea floor. All three types of gas occurrences are found throughout the offshore site vicinity. Shallow formational gas is widespread throughout the eastern portion of the Central Santa Maria Basin. Gasified sediment zones are considered potential geologic hazards because: 1) large contrasts in load-bearing capacity may exist within these zones or between these zones and the surrounding sediments; 2) dissolved gas in interstitial spaces can contribute to spontaneous liquefaction of sediments when subjected to cyclic loading under abnormal conditions; and 3) interstitial gas could contribute to spontaneous slope failure by effectively lowering the shear strength of the sediments. Short zones of gasified sediments are present along the offshore pipeline route. These zones occur in areas of very gentle (less than one percent) seafloor slopes. On sloping ground, liquefaction induced by gasified sediments could result in slope failure. Shallow formational gas is present beneath the pipeline route at depths of 300 feet (90 meters) or more (Arthur D. Little, 1985).

5.3.1.8 Expansive/Collapsible Soils

Certain soils, when exposed to wetting as a result of natural conditions or construction activities, undergo volume change. This volume change is generally limited to the uppermost few feet (less than 10 feet or 3 meters) and is critical in the engineering design of structures. In general, clays are expansive and loose deposits of sand or silt are collapsible. The pipeline traverses cohesionless deposits formed of sands, silty sands, and sandy silts over most of its onshore alignment. Silts and clays are also locally present. In general, the bearing capacity and settlement characteristics of soils along the alignment are good. However, the Orcutt Sand, intermittently present from landfall at Surf, eastward and northward to the San Antonio Valley, is subject to collapse. Only in limited zones of clay are expansive clays present, such as in the Purisima Hills between Lompoc and Orcutt (Arthur D. Little, 1985).

The oil plant portion of the LOGP facility has experienced subsidence (settlement) since installation. Subsidence has occurred near the crude tank and the processing equipment as well as the control building. Ground elevation monitoring since 1992 has measured settlement ranging from 0.3 to 1.3 feet (0.09 to 0.4 meters). These areas have required remedial action to prevent damage to the facility, which has ranged from additional bracing to subsurface grouting to form columns down to stable soils (about 50 feet or 15.2 meters). Settlement began to decrease in 1998 and the rate of settlement in late 2005 is generally very low. The gas plant (installed after the oil plant) was completely excavated before installation and therefore has not exhibited any subsidence issues. Orcutt Sand and alluvial fan and valley fill areas are present at and to the south of the LOGP facility.

5.3.1.9 Liquefaction

Liquefaction is the almost complete loss of strength of saturated sandy or silty soil accompanying ground shaking during an earthquake. On sloping ground, liquefaction usually results in slope failure called lateral spreading. The unconsolidated offshore sediments are generally not dense and, therefore, are susceptible to liquefaction. Although there is no historic evidence of liquefaction along the onshore project route, most of the low coastal plains and valley bottoms underlain by alluvium, such as the Santa Ynez River, San Antonio Creek, Santa Maria River, and Sisquoc River flood plains have a moderate potential for liquefaction. The remainder of the onshore sediments is generally not susceptible to liquefaction, as groundwater is generally deeper than 50 feet (15.2 meters) along the pipeline route. However, local high groundwater conditions may create conditions susceptible to liquefaction (Arthur D. Little, 1985; Staal, Gardner & Dunne, 1991).

5.3.1.10 Faulting and Seismicity

This section describes faults and associated seismicity that may have an impact on the proposed projects. The determination of which faults are relevant is based on the recency of activity, the potential for causing surface faulting, and the potential for generating earthquakes that could cause damaging ground motion. Specifically, faults are either active, potentially active, or inactive. These faults can be classified as historically active, active, potentially active, or inactive, based on the following criteria (CGS, 1999):

- Faults that have generated earthquakes accompanied by surface rupture during historic time (approximately the last 200 years) and faults that exhibit aseismic fault creep, but in which no earthquakes have been observed, are defined as **Historically Active**.

- Faults that show geologic evidence of movement within Holocene time (approximately the last 11,000 years) are defined as **Active**.
- Faults that show geologic evidence of movement during the Quaternary (approximately the last 1.6 million years) are defined as **Potentially Active**.
- Faults that show direct geologic evidence of inactivity during all of Quaternary time or longer are classified as **Inactive**.

Although it is difficult to quantify the probability that an earthquake will occur on a specific fault, this classification is based on the assumption that if a fault has moved during the Holocene epoch, it is likely to produce earthquakes in the future. Table 5.3.1 is a summary of active and potentially active faults that may have an impact on the project. Many of these faults are located within Santa Barbara and San Luis Obispo Counties.

Table 5.3.1 Summary of Significant Faults and Associated Maximum Earthquakes for the Project Area and Study Region

Fault or Fault Systems	Activity [1]	Fault Length, miles/km	Maximum Estimated Magnitude [2]
Hosgri Fault	PA-A	108/172	7.3
Santa Lucia Bank Fault	PA-A	68/114	7.5
Unnamed Faults on Santa Lucia Bank	PA-A	48/80	7.5
Offshore Lompoc Fault	A	12/20	6.5
Offshore Purisima Fault	PA	16/26	6.5
Point Conception (F-1) Fault Zone	A	12/20	6.5
Molino Fault	A	5/9	6.0
Santa Ynez Fault (with South Branch)	PA-A	83/133	6.9
Lompoc-Solvang (Santa Ynez R.) Fault	I	-	-
Pacifico Fault	I	-	-
Honda Fault	I	-	-
Lions Head	I	26/41	-
Pezzoni-Casmalia Fault	I-PA (?)	18/29	6.5
Los Alamos-Baseline Fault System	A-PA	36/55	7.0
Santa Maria River-Foxen Canyon - Little Pine Fault System	PA	62/100	7.4
Santa Maria/Bradley Canyon Faults	I	-	-
Orcutt Oil Field Faults (except north trace)	I	-	-
Arroyo Parida-Santa Ana Fault	PA	43/69	6.7
Big Pine Fault	PA-A	26/41	6.7
Rinconada Fault (northern segment)	PA	119/190	7.5
South Cuyama, Ozena, Panza Faults, etc.	PA (?)	21/35	6.75
San Andreas Fault Zone (Carrizo-Cholame segments)	A	678/1130	7.3-7.4
White Wolf-Pleito Fault	A	57/95	7.2
Garlock Fault	PA-A	158/252	7.3

Source: USGS Hazard Maps (1996), Arthur D. Little (1995).

1. *A-Fault shows evidence of displacement or seismicity within the last 11,000 years (Holocene Epoch); active. PA-Fault shows evidence of displacement older than 11,000 years, but younger than approximately 500,000 years; potentially active. I-Fault shows no evidence of displacement within the last 500 years; inactive.*
2. *Magnitude estimate from CGS (2003), Petersen, et. al (1996) for onshore faults; and Slemmons (1977) length-magnitude relationships for offshore faults. Magnitudes are surface wave magnitudes, (Mw).*

No active faults traverse the project pipeline route; however, several potentially active faults do traverse the route, including the Lion's Head, Casmalia, Santa Maria, Bradley Canyon, and Santa Maria River faults (California Department of Mines and Geology (CDMG), 1994).

Table 5.3-1 also lists the maximum estimated earthquake considered capable of occurring on faults in the Central Santa Maria Basin region. These magnitudes are based on seismological data such as maximum historical earthquakes and on geologic data such as fault length and fault displacement parameters (Petersen et al, 1996; CGS, 2003). The maximum estimated magnitudes for offshore faults were calculated using empirical data of Slemmons (1977) of fault length and surface wave magnitude relationships (Arthur D. Little, 1985).

Offshore faults potentially capable of generating strong ground motion at project facilities include the Hosgri, Offshore Lompoc, Offshore Purisima, and Santa Lucia Bank faults. Several major unnamed faults are also present offshore west of the Santa Lucia Bank fault. Onshore faults potentially capable of generating strong ground motion at project facilities include the Santa Ynez, Pezzoni-Casmalia, Santa Maria River-Foxen Canyon-Little Pine, Rinconada, Bradley Canyon, and San Andreas faults. The Santa Maria River, Pezzoni-Casmalia, and Bradley Canyon faults, which traverse the project pipeline, are potentially capable of surface rupture (Arthur D. Little, 1985; Staal, Gardner & Dunne, 1991; County of Santa Barbara, 1979).

Earthquake epicenters in the regional vicinity of the site are scattered throughout Santa Barbara and San Luis Obispo Counties, with a cluster of epicenters located offshore of southeastern Santa Barbara County. Notable features of the seismicity in this region include: 1) the relatively low level of activity (both frequency and magnitude) compared to the eastern Santa Barbara Basin; 2) the general random distribution of epicenters; and 3) the occurrence of a swarm of earthquakes in the vicinity of the Santa Lucia Bank in October and November of 1969. Except for perhaps the Santa Lucia Bank swarm, none of the earthquake trends are readily correlated to known faults (Schell, 1979). This may be due to long recurrence intervals for major faults, or to the poor location accuracy of seismographic networks in the area (Arthur D. Little, 1985).

The largest earthquakes in the region were the 1812, 1857, and 1927 earthquakes. The 1812 earthquake probably occurred within the Western Transverse Ranges geomorphic province (USGS, 1976). The magnitude and epicenter of this event are poorly understood, but based on reports of damage and the occurrence of tsunamis, it appears to have been a shallow-focus, large-magnitude earthquake (magnitude greater than 7.0), which occurred offshore in the Santa Barbara Basin. Several major faults in the vicinity of the presumed epicenter location are sizeable enough to have generated such a large earthquake, and thus no correlation can be made with confidence (Arthur D. Little, 1985).

The 1857 earthquake of magnitude approximately 7.9 occurred on the San Andreas fault. The 1927 event of magnitude 7.3 (Gutenberg and Richter, 1954) was probably associated with one of the northwesterly-trending faults of the California Continental Borderland (Gawthrop, 1978; Hanks, 1979; Schell, 1979; Yerkes, 1980) and caused damage in the town of Surf. Although the source of the earthquake is controversial, the presence of long active and potentially active faults, such as the Santa Lucia Bank faults, the Hosgri fault, and the Offshore Lompoc fault, indicates that earthquakes in the 7.5 magnitude range can be generated by more than one source in this region (Arthur D. Little, 1985).

Other notable earthquake events in the project region were the 1902 and 1915 Los Alamos earthquakes of approximate magnitude of 5.5. These events were probably associated with onshore faults in the Los Alamos area, which show evidence of very young, probably Holocene, near-surface displacements (Guptil, et al., 1980).

An example of the effects of a small to moderate magnitude earthquake on nearby oil platforms and related facilities is provided by the August 13, 1978 earthquake that occurred in the Santa Barbara Basin. The magnitude of the event was approximately 5.4 (Lee et al., 1979; Miller and Felszeghy, 1978). Strong-motion instruments recorded peak ground accelerations of approximately 0.44 g (acceleration of gravity) at the University of California and approximately 0.21 g in downtown Santa Barbara. The earthquake caused almost no damage to the 14 offshore oil platforms in the Santa Barbara Channel. At the ARCO and Aminoil onshore oil production and storage facilities, minor damage was reported, consisting of minor cracks in concrete, broken water lines, downed power lines, and minor landslides along the bluffs. The large oil storage tanks sustained no damage (Arthur D. Little, 1985).

As an example of the anticipated degree of ground motion in the project vicinity, a probabilistic seismic hazard analysis was performed by The Earth Technology Corporation (1984), for the existing Platform Irene location. Results indicate that 0.15 g, 0.20 g, and 0.25 g ground motions were possible with return periods of 200, 400, and 600 years, respectively. The study indicated that future seismic activity may be greater than that recorded in the last 50 years. For example, a maximum or rare event of magnitude 7.5 on the Hosgri fault could substantially affect Platform Irene to higher degrees than the probabilistic analysis suggests. Using a deterministic analysis, the study indicated that medium level ground motion for a magnitude 7.5 event would increase the expected acceleration to 0.30 g for the 200, 400, and 600 year ground motions (Arthur D. Little, 1985).

Similarly, Staal, Gardner & Dunne, Inc. (1991) performed a probabilistic seismic hazard analysis for the Sisquoc Pipeline, which extends from the Santa Maria Pump Station to Sisquoc Pump Station. This study indicated that significant ground shaking could be expected during the life of that pipeline in response to nearby or distant earthquakes. Based on this analysis, estimated peak horizontal bedrock accelerations with a 10 percent probability of exceedance in 50 years are estimated to range from approximately 0.3 g to approximately 0.6 g. Peak horizontal accelerations in alluvial materials are typically about one-third lower than those estimated for bedrock sites. This range is consistent with those typically estimated for other areas of southern California near major active and potentially active faults. In addition, this range in peak ground accelerations is less than those used to develop Uniform Building Code seismic zone IV design criteria (in which the project is located). Therefore, it was concluded that the potential hazard due to ground shaking is low.

5.3.2 Regulatory Setting

The criteria used to estimate fault activity in California are described in the Alquist-Priolo Special Studies Zones Act of 1972, which addresses only surface fault-rupture hazards. The legislative guidelines to determine fault activity status are based on the age of the youngest geologic unit offset by the fault. An active fault is described by the CDMG as a fault that has “had surface displacement within Holocene time (about the last 11,000 years)”. A potentially active fault is defined as “any fault that showed evidence of surface displacement during

Quaternary time (last 1.6 million years)." As indicated above in the *Faulting and Seismicity* section, this report identifies potentially active faults in the southern project area as those with evidence of displacement or associated seismicity within the last 500,000 years.

The Seismic Hazards Mapping Act of 1990 (Public Resources Code Sections 2690 and following as Division 2, Chapter 7.8), as supported by the Seismic Hazards Mapping Regulations (California Code of Regulations, Title 14, Division 2, Chapter 8, Article 10), were promulgated for the purpose of protecting public safety from the effects of strong ground shaking, liquefaction, landslides, or other ground failures, or other hazards caused by earthquakes. Special Publication 117, Guidelines for Evaluating and Mitigating Seismic Hazards in California (CDMG, 1997), constitutes the guidelines for evaluating seismic hazards other than surface fault-rupture, and for recommending mitigation measures as required by Public Resources Code Section 2695(a).

The California Coastal Act of 1976 created the California Coastal Commission, which is charged with the responsibility of overseeing development permits for coastal projects and for determining consistency between Federal and State coastal management programs. Also in 1976, the state legislature created the California State Coastal Conservancy to take steps to preserve, enhance, and restore coastal resources and to address issues that regulation alone cannot resolve. The Coastal Act created a unique partnership between the State (acting through the California Coastal Commission) and local government to manage the conservation and development of coastal resources through a comprehensive planning and regulatory program. The California Coastal Commission uses the Coastal Act policies as standards in its coastal development permit decisions and for the review of local coastal programs (LCPs), which are prepared by local governments. Among many issues, the LCPs require protection against loss of life and property from coastal hazards, including geologic hazards. This requirement is implemented locally through the Santa Barbara County (SBC) Comprehensive Plan, Seismic Safety and Safety Element.

5.3.3 Significance Criteria

As specified in the SBC Environmental Thresholds and Guidelines Manual (as updated through October 2006), geologic impacts would be considered significant if a proposed project:

- Is located on land having substantial geologic constraints, such as active or potentially active faults, compressible/collapsible soils, landslides, or severe erosion.
- Would result in potentially hazardous geologic conditions, such as the construction of cut slopes exceeding a grade of 1.5:1 (horizontal:vertical).
- Proposes construction of a cut slope over 15 feet in height, as measured from the lowest finished grade.
- Is located on slopes exceeding 20 percent grade.

5.3.4 Impact Analysis for the Proposed Project

Geologic impacts of the proposed project are primarily associated with pipeline replacement activities due to maintaining the pipeline over a longer lifetime and remediation activities associated with pipeline rupture and resultant oil spills. In addition, continued use and the extended lifetime of the LOGP may result in additional or prolonged ground settlement at the facility. The following describes these potential geologic impacts.

Impact #	Impact Description	Phase	Residual Impact
GR.1	Remediation activities associated with a pipeline spill could increase slope failures, erosion, sedimentation, and gullying.	*Increased throughput Extension of Life*	*Class II*

Landfall to LOGP Pipelines

Oil and/or produced water spills from the pipelines could result from third-party activities, corrosion, or seismic-induced failures (see Section 5.1). Cleanup activities related to pipeline spills could potentially induce or accelerate gullying, soil erosion, increased sedimentation in streams, and slope failures in or near the areas impacted by a spill or by cleanup activities (such as equipment staging, transportation or affected materials storage, etc.). Such impacts are evident along the pipeline corridor related to construction activities conducted on the Vandenberg Air Force Base (VAFB) (near Valve Site #3 between catchment basins 5 and 6).

Drainage crossings along the existing pipeline corridor, such as those at Valve Site #3 or before Valve Site #6 along the Platform Irene to LOGP pipelines, also would be susceptible to increased gullying, soil erosion, sedimentation, and slope failure in the event of spill response activities and associated pipeline repair. The 1985 Point Pedernales EIR/EIS (Arthur D. Little) classified stream crossing impacts to be significant but mitigable.

Although the potential for these impacts exists with the current Point Pedernales operations, a greater amount of oil transmitted through the pipeline, as indicated in Section 5.1, Risk of Upset/Hazardous Materials, would result in an increase in potential spill volumes, thereby exacerbating an existing significant impact.

LOGP to Summit Pipeline

Impacts would be similar to those described for the pipelines from landfall to LOGP. Potential stream crossing impacts and slope impacts would exist in the Purisima Hills and in the Casmalia Solomon Hills for the LOGP-Orcutt pipeline segments and at the Santa Maria River and along the Nipomo Creek for the Orcutt to Summit pipeline sections. The 1985 Point Pedernales EIR/EIS classified stream crossing impacts as significant but mitigable.

Mitigation Measures

GR-1 Best Management Practices (BMPs), such as temporary berms and sedimentation traps, such as silt fencing, straw bales, and sand bags, shall be installed to minimize erosion of soils and sedimentation in nearby drainages. The BMPs shall be included in the Oil Spill Response Plan (OSRP). The BMPs shall include maintenance and inspection of the berms and sedimentation traps during rainy and non-rainy periods, as well as revegetation of impacted areas. Revegetation shall address plant type as well as monitoring to ensure appropriate coverage of exposed areas and shall be consistent with existing project revegetation plans.

Residual Impacts

By implementing erosion control measures and revegetating disturbed areas, geologic impact GR.1 would be *significant but mitigable (Class II)*.

Impact #	Impact Description	Phase	Residual Impact
GR.2	Ground-disturbing construction activities could result in geologic disturbances such as slope failure, gullying, erosion, and sedimentation.	*Construction*	*Class II*

Ground-disturbing construction activities at Valve Site #2 could cause gullying, erosion, and sedimentation, which could adversely affect the nearby Santa Ynez River. These construction activities would include areas adjacent to the construction or from the installation of power poles along 13th Street, north of Renwick Avenue or along Terra Road. A gully currently exists north of Terra Road due to construction related-activities at VAFB. Similar impacts could occur as a result of the proposed project construction activities and would be considered significant.

Grading associated with new substation construction would result in a temporary, minor increase in exposure of soils to wind and water erosion. This would result in a minor increase in potential siltation of nearby drainages. In addition, substation construction would result in an incremental increase in structures subject to seismically induced ground failure. The proposed structure would be constructed in accordance with SBC building requirements and Uniform Building Code seismic requirements.

All LOGP and pump station upgrades and modifications would occur within the existing boundaries of the facilities and would therefore have minimal, if any, impact on the geologic environment. Equipment would either be placed on existing pads or previously graded or disturbed areas.

Mitigation Measures

See Mitigation Measure GR-1 above.

Residual Impacts

The proposed mitigation measure, consisting of erosion control measures and revegetation, would render the onshore portion of this geologic impact *significant but mitigable (Class II)*.

Impact #	Impact Description	Phase	Residual Impact
GR.3	Upgrades and modifications of facilities at LOGP could result in new, continued or accelerated ground settlement.	*Construction*	*Class II*

Minor modifications and upgrades of existing equipment is planned at LOGP. The actual installation of the equipment, particularly the associated heavy equipment traffic, could potentially trigger or renew ground settlement at the facility.

Mitigation Measures

GR-2 The 2007 grouting program shall be completed prior to any equipment additions/modifications at the LOGP. If deemed necessary by the County System Safety and Reliability Review Committee (SSRRC), based on equipment weights and foundation requirements, an elevation survey shall be conducted before and during the equipment ~~recommissioning~~additions/modification period followed by routine post-construction monitoring as deemed appropriate by the SSRRC. The elevation survey should use existing benchmarks to continue the subsidence monitoring currently being conducted at LOGP. ~~and a pre- and post-recommissioning monitoring plan shall be developed. The plan shall require a baseline survey 30 days prior to construction and once per month during LOGP equipment recommissioning/modifications. Post-commissioning survey frequency shall be based on the settlement results measured during recommissioning. The plan shall include contingencies for soil grouting or other ground stabilization measures to prevent damage to the facility.~~

Residual Impact

With the incorporation of Mitigation Measure GR-2, this impact is considered *significant but mitigable (Class II).*

Impact #	Impact Description	Phase	Residual Impact
GR.4	Ground-disturbing maintenance activities could result in geologic disturbances such as slope failure, gullying, erosion, and sedimentation.	*Extension of Life*	*Class II*

Extending the life of the facilities would extend the risk of geologic disturbance. Pipeline maintenance and repair activities, such as excavation and replacement of pipeline segments, could result in gullying, erosion, sedimentation, and/or slope failure. While these activities pose the same risk under current operations, the extension of life of the facilities due to the Tranquillon Ridge Project would extend the potential for these types of disturbances. Onshore pipeline replacement would most likely occur in the following areas of potential pipeline damage.

- Topographic lows or troughs where external corrosion is more pronounced;
- Areas of collapsible soils, such as the Orcutt Sands, located intermittently from the landfall at Surf eastward and northward to the San Antonio Valley;
- Unstable slopes, such as along north-facing slopes of the Lompoc Terrace, near major drainage channels, and in the Purisima Hills;
- Stream channel crossings, where the pipeline is susceptible to scour; and
- Floodplains of San Antonio Creek, Santa Ynez River, and Santa Maria River, where the pipeline is susceptible to scour and liquefaction.

Removal of vegetation and repair work in these excavation areas could increase the potential for short-term erosion and result in siltation of nearby rivers, creeks, and drainages. Grading that would occur as part of these activities could occur on slopes of over 20 percent, thus contributing to the potential for erosion. Therefore, geologic impacts would be potentially significant.

Offshore pipeline replacement would most likely occur in the following areas.

- The littoral zone, where the pipeline is susceptible to scour;
- Unstable slopes, such as in steeply sloping areas and areas of previous instability;
- Areas of gasified sediments, which can contribute to differential settlement, liquefaction, and slope failure;
- Areas of liquefiable soils; and
- Potentially active fault crossings, such as possible offshore extensions of the onshore Santa Ynez River/Lompoc-Solvang or Honda faults and possible southerly extensions of the offshore Hosgri, Purisima, or Offshore Lompoc faults.

Substantial alteration of the existing bottom topography is not anticipated during pipeline repair operations. Underwater depositional processes would be temporarily disrupted by repair operations, but would be reestablished within a short period of time. No regional, long-term depositional disruptions would occur. Therefore, geologic impacts would be adverse but not significant.

Mitigation Measures

See Mitigation Measure GR-1 above.

Residual Impact

Implementation of the proposed mitigation measure, consisting of erosion control measures and revegetation, would render the impact *significant but mitigable (Class II).*

Impact #	Impact Description	Phase	Residual Impact
GR.5	Scouring along drainage areas could cause impacts to the pipeline and increase pipeline failure probabilities.	*Extension of Life*	*Class II*

Platform Irene to LOGP

Scouring along drainage areas in the vicinity of the pipeline could weaken the integrity of the pipeline and increase the likelihood of failure. Gullying, or scouring, is evident along several areas of the pipeline right-of-way, particularly between catchment basins 5 and 6, due to activities at VAFB. The pipeline also crosses numerous creeks and drainage areas that could be affected in the event of a large rain event. Extension of the pipeline operating life due to the Tranquillon Ridge Project would increase the possibility of scour-related pipeline failures. This would be considered a significant impact.

LOGP to Summit Pipeline

Impacts are similar to the discussion regarding the Platform Irene to LOGP pipelines. Numerous creek and drainage crossings exist along the pipeline route that could present a significant impact to the pipeline integrity.

Mitigation Measures

GR-3 The applicant shall implement a creek and drainage maintenance program to monitor and repair potential scour areas that could affect the pipeline integrity. The plan shall include annual surveys of the pipeline route and any adjacent drainages within 500 feet that are up slope of the pipeline right-of-way. Any areas that exhibit scouring or erosion shall be documented. Areas that exhibit increased scour should be addressed through stabilization or other appropriate permanent erosion control measures.

Residual Impact

The proposed mitigation measure, consisting of establishment of pipeline right-of-way surveys and permanent erosion control measures, would reduce the potential for scour-related pipeline failures and render the impact *significant but mitigable (Class II)*.

Impact #	Impact Description	Phase	Residual Impact
GR.6	Earthquake-induced tsunami could cause scour and endanger worker safety.	*Operation*	*Class III*

An offshore earthquake with sufficient magnitude could trigger a tsunami resulting in surge waves and flooding along low-lying areas of the coast from Point Pedernales to the existing PXP Pipeline landfall. Areas likely to be affected by a tsunami include the Santa Ynez River Valley and the beach. The coast of central and southern California is characterized by a broad off-shore shelf which would reflect most of the energy of distantly generated tsunamis back out to sea. Due to this minimizing effect of the broad continental borderland on distantly generated tsunami waves, local offshore fault zones represent the most likely sources of significant tsunami waves impacting the VAFB coastline. Near shore underwater landslides in the Channel Islands could also be a source of tsunami waves impacting the VAFB coastline due to underwater unstable cliffs (www.dailynexus.com/news/20058651/html). There has only been one recorded tsunami in the lower 48 states that has resulted in human casualties. The tsunami occurred in 1964 in Crescent City, California, and was caused by the Good Friday Earthquake in Alaska. There were 12 fatalities and approximately $15 million in damages (http://en.wikipedia.org). The tsunami's largest wave was approximately 21 feet tall (http://tvhs.tvusd.k12.ca.us/…). In 1927, the Lompoc Earthquake caused a small tsunami along the California coastline. The coast at the western end of Santa Barbara County and southern part of San Luis Obispo County was sparsely inhabited at this time, but it was reported by railroad workers that a small tsunami, approximately six feet high, occurred near Pismo shortly after the earthquake (http://projects.crustal.ucsb.edu/sb_eqs/1927/small_tsunami.html).

Tsunami inundation maps are being created for the California coastline based on the latest research from National Oceanic & Atmospheric Administration (NOAA) and U.S. Geologic Service (USGS). According to The Tsunami Threat to California: Findings and Recommendations on Tsunami Hazards and Risks dated December 2005 by the State of California Seismic Safety Commission, "Present building codes and guidelines do not adequately address the impacts of tsunamis on structures. Currently available tsunami inundation maps are not appropriate for code or guideline applications." In the unlikely event of a tsunami occurring along the California coastline, the Pacific Tsunami Warning Center (operated by NOAA) would likely be able to provide advance notice; thereby, providing time for project-related construction, drilling, or operation activities to prepare.

In the event of an earthquake-induced tsunami, seawater run-up/surge could reach and flood Valve #1 and maybe Valve #2. Scour from the surge could undermine and expose the pipeline and possibly cause rupture. In addition, workers in low-lying areas could be injured or killed by the surge. However, the probability of a tsunami occurring during the life of the proposed project (30 years) is considered to be very low.

Mitigation Measures

GR-4 The applicant shall conduct a study to determine the probable maximum tsunami and evaluate potential flooding and scour in the Santa Ynez River valley and at project facilities, as appropriate. The scour analysis shall determine a minimum burial depth to protect the pipe. In addition, the Applicant shall include in the Project Safety Plan a discussion of tsunami hazards, training and ensure that work crews receive tsunami-warning notifications from the Pacific Tsunami Warning Center (operated by NOAA) in accordance with the safety plan. If no such Project Safety Plan is prepared, a tsunami safety plan is herein required and shall include a protocol for workers to follow in the event of a tsunami. The tsunami plan shall be submitted to SBC P&D for review and approval prior to land use clearance.

Residual Impact

Although the probability of a tsunami occurring of the life of the proposed project is considered to be very low, Mitigation Measure GR-4 is required to mitigate the potential impact to the maximum extent feasible. This impact is considered *adverse but not significant (Class III)*.

5.3.5 Impact Analysis for the Alternatives

Detailed descriptions of the various alternatives are provided in Chapter 3.0, Alternatives. This section provides a discussion of the geological impacts of the various alternatives.

5.3.5.1 No Project Alternative

Scenarios 2 and 3. As discussed in Section 3.2, under the No Project Alternative Scenarios 2 and 3, production of the federal portion of the Tranquillon Ridge field would and would not occur, respectively. However, no extension of life of Point Pedernales facilities (Platform Irene, pipelines, and LOGP) is assumed under either scenario. Impacts GR.1 through GR.5 for the proposed Tranquillon Ridge Project would not occur under the No Project Alternative Scenarios 2 and 3 since there would be no new construction, and the oil production rates would be the same as the current operations (i.e., baseline). However, as identified under Impact GR.6, the existing pipeline facilities would still be a risk for tsunami scour and potential pipeline and valve damage.

Options for Meeting California Fuel Demand. The relative geologic and soil impacts associated with the various options for meeting California fuel demand are summarized in Table 5.3.2.

Table 5.3.2 No Project Alternative Comparison to Options for Meeting California Fuel Demand, Geologic Resources

Source of Energy		Impacts
Other Conventional Oil & Gas		
	Domestic onshore crude oil and gas	Likely to displace, rather than eliminate, geologic and soil related impacts.
	Increased marine tanker imports of crude oil	Eliminate or displace geologic and soil related impacts.
	Increased gasoline imports[1]	Eliminate or displace geologic and soil related impacts.
	Increased natural gas imports (LNG)	Eliminate or displace geologic and soil related impacts.
Alternatives to Oil and Gas		
	Fuel Demand Reduction: increased fuel efficiencies, conservation, electrification[2]	
	Alternative transportation modes	Proposed project impacts would be eliminated.
	Implementation of regulatory measures	Proposed project impacts would be eliminated.
	Coal, Nuclear, Hydroelectric	Proposed project impacts would be eliminated; however, could introduce power facility construction and operation impacts which could likely be greater than the proposed project.
	Alternative Transportation Fuels	
	Ethanol/Biodiesel[3]	Proposed project impacts would be reduced. Potential soil disturbance impacts because of new plant construction.
	Hydrogen[2]	Proposed project impacts would be reduced. Potential soil disturbance impacts because of hydrogen delivery infrastructure development.
	Other Energy Resources[2]	
	Solar[2,4]	Increased construction impacts because of solar facility infrastructure construction.
	Wind[2,4]	Increased construction impacts because of wind facility infrastructure construction.
	Wave[2,4]	Increased construction impacts because of wave facility infrastructure construction, including potential offshore geologic impacts.

Footnotes:
1. Pipeline and tanker truck import from out-of-State assumed.
2. Assumes that Tranquillon Ridge production would not be replaced with other petroleum-based energy supply.
3. Assumes ethanol and biodiesel used as blends only and therefore would reduce, but not eliminate Tranquillon Ridge or equivalent production.
4. Assumes, large centralized facilities.

5.3.5.2 VAFB Onshore Alternative

The VAFB Onshore Alternative consists of the following major components: the drilling and production facilities, 20-inch oil emulsion and 8-inch gas pipelines, and an overhead 69kV power line and associated substation. In addition, a pipeline tie-in station and associated power line and substation would be required. The near-coast project components just north of La Honda Canyon and along Surf and Coast Roads would be constructed on Holocene and Pleistocene dune sand; the pipelines traverse about 200 feet of alluvium at Bear Creek. The new pipelines from the northern end of Coast Road to the connection at the existing PXP pipeline traverse Monterey Shale for about 0.5-mile along Highway 246 and then pass through Holocene alluvium in the Santa Ynez River valley. The drilling and production area would disturb and grade about 25-acres of unconsolidated dune sand that overlies Monterey Shale. No steep slopes or landslide-prone areas are crossed by the VAFB Onshore Alternative.

Geologic impacts of the VAFB Onshore Alternative are primarily associated with construction and operation of the drilling and production facilities, pipeline construction and maintenance, and construction of the overhead 69kV power line. In addition, remediation activities associated with pipeline rupture and resultant oil spills could result in geologic impacts. The following describes these geologic impacts associated with the VAFB Onshore Alternative. Impact GR.1, oil spill clean-up impacts, and Impact GR.3, LOGP settlement, would be the same as the proposed project. Impact GR-8, offshore pipeline installation impacts, would not apply to the VAFB Onshore Alternative.

Impact GR.2 – Ground Disturbance during Construction: Grading and construction of the drilling and production facilities could cause gullying, erosion, and sedimentation, which could adversely affect the nearby drainages. Trenching for the pipelines, power pole installation, and temporary stockpiles could also cause erosion and sedimentation along these linear project components, potentially impacting other drainages including Bear Creek and Santa Ynez River. Finally, grading of the electrical substations and pipeline tie-in station could cause further erosion and sedimentation. Gully erosion is likely in the poorly consolidated sediments throughout the alternative and wherever the protective vegetative cover is removed. These impacts could occur as a result of the alternative construction activities and would be considered significant, but mitigable (*Class II*). However, given that the VAFB Onshore Alternative would require extensive ground disturbance in comparison to the proposed project, Impact GR.2 is considered more severe for the alternative. Operational maintenance and repair activities that disturb the soil or remove vegetation would have the same impacts. With the implementation of Mitigation Measure GR-1, consisting of erosion control measures and revegetation, this geologic impact is considered *significant but mitigable (Class II).*

Impact GR.4 – Ground Disturbance during Maintenance Activities: Drainage crossings along the proposed pipeline corridor, including Bear Creek and Santa Ynez River, would be susceptible to increased gullying, soil erosion, sedimentation, and slope failure in the event of spill response activities and associated pipeline repair. Given the crossing of the Santa Ynez River, this impact is considered more severe for the VAFB Onshore Alternative than the proposed project. With the implementation of Mitigation Measure GR-1, consisting of erosion control measures and revegetation, this geologic impact is considered *significant but mitigable (Class II).*

Impact GR.5 – Scour: Scouring along drainage areas in the vicinity of the pipelines could weaken the integrity of the pipeline and increase the likelihood of failure. Gullying, or scouring, is evident along several areas of existing pipeline rights-of-way within VAFB, due to activities at the VAFB. The pipelines would cross the Santa Ynez River, Bear Creek, and several drainage areas that could be affected in the event of a large rain event. Similar to the proposed project, this would be considered a *significant but mitigable* impact (*Class II*). However, given the crossing of the Santa Ynez River, this impact is considered more severe for the VAFB Onshore

Alternative than the proposed project. With the implementation of Mitigation Measure GR-3, consisting of establishment of pipeline right-of-way surveys and permanent erosion control measures, this geologic impact is considered *significant but mitigable (Class II).*

Impact GR.6 – Tsunami: An offshore earthquake or landslide with sufficient magnitude could trigger a tsunami resulting in surge waves and flooding along low-lying areas of the coast from Point Pedernales to the existing PXP Pipeline landfall. Areas likely to be affected by a tsunami include the Santa Ynez River Valley and the beach.

In the event of an earthquake or landslide induced tsunami, seawater run-up/surge could reach and flood the Santa Ynez River valley. Scour from the surge could undermine and expose the pipeline and possibly cause rupture. In addition, workers in low-lying areas, such as the drilling and production site, could be injured or killed if the run-up washes into the drilling/production facility. The surge could also possibly undermine the integrity of the drilling and production facilities, causing a possible oil spill. However, the probability of a tsunami occurring during the life of the alternative (30 years) is considered to be very low.

Although the probability of a tsunami occurring of the life of the alternative is considered to be very low, Mitigation Measure GR-4 (including study of the drilling and production site) would be required to mitigate potential impacts to the maximum extent feasible. This impact is considered *adverse but not significant (Class III).*

Impact #		Phase	Residual Impact
GR.7	Liquefaction could jeopardize the integrity of the VAFB Onshore Alternative pipelines at the Santa Ynez River valley and Bear Creek crossings.	*Operation*	*Class II*

Liquefaction often results in loss of ground bearing capacity and/or lateral spreading, both of which could result in damage to the pipelines crossing the Santa Ynez River valley. During loss of ground bearing capacity, large deformations can occur within the soil mass, allowing the pipeline to settle or become buoyant and float upward. The most serious liquefaction hazard results from burial of the pipeline in a competent soil that overlies deeper liquefiable soil layers. Liquefaction of the deeper layers may result in substantial lateral spreading of the upper competent soil. Lateral spreading can extend several hundred feet back from a slope and displacements of tens of feet may occur if soil conditions are especially favorable for liquefaction and if earthquake shaking is of sufficient duration. Lateral spreading along the alternative pipelines is particularly likely at the north and south margins of Santa Ynez Valley and perhaps at Bear Creek.

Mitigation Measures

GR-5 Reduce Liquefaction Hazard. Final geotechnical investigations shall be conducted in the areas underlain by alluvium and dune sand at the Santa Ynez River and Bear Creek crossings. The results and recommendations of the geotechnical investigations shall be incorporated into the final pipeline design. If moderate to high liquefaction potential is confirmed by the geotechnical analyses, then design measures shall be implemented at the corresponding locations. Appropriate design is dependent on site-specific conditions and could include deep burial of the pipeline below liquefiable layers, densification of the ground above the pipeline to mitigate uplift, and selection of thick-walled, ductile steel pipe. The applicant shall submit the final geotechnical studies and design recommendations to SBC for review and approval prior to land use clearance.

Residual Impact

With the implementation of Mitigation Measure GR-5, the potential for liquefaction and lateral spreading damage to the pipelines is considered *significant but mitigable* (*Class II*).

5.3.5.3 Casmalia East Oil Field Processing Location

For this alternative, Impacts GR.1, oil spill, GR.3, LOGP settlement, and GR.6, tsunami impacts, would be the same as for the proposed project. Impact GR.7, liquefaction at Santa Ynez River, would not apply to the Casmalia Alternative since it does not cross the river.

Impact GR.2 – Ground-disturbing Construction Activities: Excavations and grading associated with the new pipeline and Casmalia processing facility construction would result in an increase in removal of vegetation and temporary exposure of soils to wind and water erosion. This would result in an increase in potential siltation of nearby drainages. In addition, grading would potentially result in additional permanent changes in topography and an incremental increase in persons and structures subject to seismically induced ground failure.

The location of the new pipeline would partly follow the current pipeline ROW. The pipeline would also traverse a new area west of Orcutt in order to connect the existing pipelines to the new Casmalia facility. No additional faults would need to be traversed in order to install these new pipelines. The closest fault is the Los Alamos fault at approximately six miles away (USGS web site information, http://www.data.scec.org/faults/nwfault.html).

The areas traversed by the existing LOGP to Orcutt pipeline and new pipeline to connect Orcutt to Casmalia could traverse areas that have landslide potential, particularly in the Purisima Hills areas. Several slide areas have been identified in the Purisima Hills area near to the pipeline ROW (Arthur D. Little, 1985). Expansive and collapsible soils could be present for the new pipeline. Orcutt Sand is present in areas north of Lompoc and in the San Antonio Valley which is susceptible to sliding. Expansive clays are also present in the Purisima Hills.

Mitigation Measures

In addition to mitigation measure GR-1 mentioned above, the Casmalia alternative would also require the following mitigation measure:

GR-6 Ensure that all pipeline and facility construction areas have adequate review by geotechnical engineers and geologists for expansive/collapsible soils and for potential areas of slope instability prior to construction. The geotechnical report shall be submitted to SBC for review and approval prior to land use clearance.

Residual Impact

The ground-disturbing construction would be similar in nature to the proposed project but with more construction and a greater amount of earth disturbance. The impact would remain *significant but mitigable (Class II).* If this alternative is selected, a more detailed geologic impacts evaluation would be necessary as part of a separate CEQA review.

Impact GR.4 – Ground Disturbance During Maintenance Activities: Pipeline maintenance activities would be similar in nature to the proposed project, but potentially more frequent due to the greater length of the pipeline connecting the LOGP to the Casmalia site. The impact would remain *significant but mitigable (Class II).*

Impact GR.5 – Scour: Scour along drainages would be more severe for the Casmalia alternative because of the additional length of pipeline associated with this alternative. This impact is considered to be *significant but mitigable (Class II).*

5.3.5.4 Alternative Power Line Routes to Valve Site #2

Impacts GR.1, oil spill remediation, GR.3, LOGP settlement, GR.4, ground disturbance during maintenance activities, GR.5, scour, and GR.6, tsunami impacts, would be the same as for the proposed project regardless of power line route alternative. Impact GR.2, ground disturbance during construction, is discussed below for each of the power line alternatives.

Alternative Power Line Route – Option 2a

The impacts associated with this alternative are similar to the proposed project (installation of poles and substation). Geologic impacts resulting from installation of new pole lines across an agricultural field or crossing of the river on pole lines would be the same as those described in Impact GR.2. As more poles would be installed with this alternative versus the proposed project (the power line length would be increased, see Figure 5.3.3), there would be a slight increase of severity versus severity of the proposed project. Mitigation Measure GR-1 would also be applicable to this alternative.

Alternative Power Line Route – Option 2b

Geologic impacts as a result of installing new pole lines across an agricultural field would be the same as those described in Impact GR.2. Directional boring under the river would result in temporarily stockpiled soil associated with boring operations. Exposure of these soils would result in an increase in potential erosion and associated siltation of nearby drainages. Impacts would be *significant but mitigable (Class II).* Mitigation measure GR-1 would also be applicable to this alternative.

Underground Power Line along Terra Road

This alternative involves burying the portion of the power line that runs along Terra Road to Valve Site #2. This alternative would require the construction of a trench from the intersection of Terra Road and 13th Street to Valve Site #2. The trench would follow the existing roadway. It is estimated that approximately two months would be needed to install this underground cable using a backhoe and other small construction equipment.

Construction associated with the installation of the power line could generate erosion, gullying, and sedimentation of nearby drainages. These effects could be caused by the removal of vegetation, the stockpiling of excavated materials, the storage of materials and construction equipment, and grading of areas and the movement of vehicles on unpaved and graded areas. These activities would increase the potential for short-term erosion and siltation of the nearby

Santa Ynez River and adjoining creeks and drainages. Such erosion impacts would be considered significant over the short term. No long-term impacts associated with the power line presence are expected.

Mitigation Measure GR-1, mentioned above would be required. The proposed mitigation measure, consisting of establishment of erosion control measures and revegetation, would render Impact GR.2 *significant but mitigable (Class II);* however, this impact would be more severe for the underground alternative than the overhead power line alternatives, including the proposed project.

5.3.5.5 Replacement of Oil Emulsion Pipeline from Platform Irene to LOGP

Impacts GR.3, LOGP settlement, and GR.6, tsunami, would be the same as the proposed project. Impact GR.7, liquefaction at Santa Ynez River, would not apply to the Emulsion Pipeline Replacement Alternative since it does not cross the river.

Impact GR.1 – Remediation Activities: Impacts due to remediation activities would be less than the proposed project because there is a reduction in the probability of a spill. However, the impact would still be *significant but mitigable (Class II).* Mitigation Measure GR-1 would be applicable.

Impact GR.2 – Ground-disturbing Construction Activities: Although Valve Site #2 construction would not occur under this alternative and would therefore not result in ground disturbances, this alternative would result in greater ground disturbances than the proposed project due to new trenching and grading to install the pipeline. Pipeline replacement between landfall at Wall/Surf Beach and the LOGP would occur within the existing right-of-way.

Construction associated with installing and replacing the pipeline could generate erosion, gullying, and sedimentation of nearby drainages. These effects could be caused by the removal of vegetation, the stockpiling of excavated materials, the storage of materials and construction equipment, grading, and the movement of vehicles on unpaved and graded areas. These activities would increase the potential for short-term erosion and siltation of the nearby Santa Ynez River and adjoining creeks and drainages. Many stream crossings have steep slopes; areas at Valve Site #3, have slopes ranging up to 15 percent, Valve Site #6 slopes up to 10 percent, Santa Lucia Canyon, slopes upwards of 15 percent, and before Valve Site #9 just north of Highway 1 slopes of close to 15 percent. Any of these areas could contribute to the potential for erosion as well as landslides due to construction-related activities. Such erosion impacts would be considered significant over the short term.

Mitigation Measures

Mitigation Measure GR-1, mentioned above, and the following mitigation measure would be required:

GR-7 Geotechnical analyses shall be completed in existing erosion-prone areas (as described by Coastal Geoscience, Inc., 2001) to determine proper pipeline burial depth.

Residual Impact

The proposed mitigation measures, consisting of geotechnical analyses in erosion prone areas, establishment of erosion control measures, and revegetation, would render the potential onshore construction impacts *significant but mitigable (Class II)*. However, given that construction associated with the Emulsion Pipeline Replacement Alternative would be much more extensive than for the proposed project, this impact is considered to be more severe for the alternative.

Impact GR.4 – Ground Disturbance During Maintenance Activities: Impacts related to the extension of life issues and pipeline maintenance would be less than the proposed project due to the less frequent maintenance requirements associated with a new pipeline. However, any maintenance activities would still be subject to Mitigation Measure GR-1. Annual geologic monitoring indicates that the onshore portion of the pipeline has performed in a fundamentally sound manner from a geotechnical standpoint (Russell Consulting, 2006). Therefore, no long-term geological impacts associated with the pipeline presence are expected for a new pipeline.

Impact GR.5 – Scour: Scour along drainages would be more severe for the Emulsion Pipeline Replacement Alternative than the proposed project because of the additional construction associated with this alternative. This impact is considered to be *significant but mitigable (Class II)*.

Impact #	Impact Description	Phase	Residual Impact
GR.8	Pipeline installation offshore could result in increased resuspension of bottom sediment material, increased bottom sediment drift, and decreased stability of sediments within the offshore pipeline ROW.	*Construction*	*Class II*

Replacement of the existing pipeline from Platform Irene to the landing at Wall/Surf Beach would occur within the existing ROW. Installation of the pipeline would involve jetting, which could affect bottom sediment stability. The bathemetry could also be altered by the construction and pipeline laying activities. Pipelines lying on the sea floor also could entrap migrating bottom sediments and cause mounding above the pipeline. Also, minor erosion could occur due to deflection and concentration effects. Bottom substrate could be disturbed and resuspended during pipeline laying activities. From a geotechnical standpoint, the existing pipeline appears to have performed satisfactorily since initial construction except for the issue of unsupported spans, which may have contributed to the 1997 release from the emulsion pipeline. An unsupported span could have occurred as a result of shifting bottom sediment due to the presence of the pipeline. As a result of this issue, replacement of the pipeline within the existing corridor would result in significant geohazard impacts.

Mitigation Measures

GR-8 Pipeline surveys shall be conducted to confirm the absence of unsupported spans after installation of the offshore pipeline and at periodic intervals during the life of the facility. Initial surveys shall be conducted annually, but may be reduced in frequency at the discretion of the Minerals Management Service, California State Lands Commission, and Santa Barbara County.

Residual Impact

The residual impact would be considered *significant but mitigable (Class II)*.

5.3.5.6 Alternative Drill Muds and Cuttings Disposal

Inject Drill Muds and Cuttings into Reservoir

No additional geologic impacts would occur as a result of injecting muds and cuttings into the subsurface. Impacts GR.1, GR.2, GR.3, GR.4, GR.5, and GR.6 would be the same as the proposed project.

Transport Drill Muds and Cuttings to Shore for Disposal

No additional geologic impacts would occur as a result of transportation of muds and cuttings to shore for disposal. Impacts GR.1, GR.2, GR.3, GR.4, GR.5 and GR.6 would be the same as the proposed project.

5.3.6 Cumulative Impacts and Mitigation Measures

Cumulative projects that could impact the current analysis include both offshore oil and gas projects, and onshore development projects, as discussed in Sections 4.2 through 4.4. Potential cumulative impacts associated with these off- and onshore projects are discussed separately below.

5.3.6.1 Offshore Oil and Gas Projects

The proposed project would involve minimal new disturbances, primarily related to construction activities at Valve Site #2. Due to the limited scope of these activities, regional geologic impacts resulting from the proposed project would not be expected. Although some of the potential federal outer continental Shelf (OCS) could involve new land disturbances (development of the Santa Maria, Lion Rock, Point Sal, and Purisima Point Units and Lease OCS-P 0409), none of their onshore components would be located in close proximity to the proposed project, and with implementation of appropriate BMPs and project-specific mitigation measures during construction, their cumulative geologic impacts would not be expected to be significant. Potential offshore oil and gas development projects located in State waters would be located a substantial distance away from the proposed project, and would involve minimal to no new land disturbances. Therefore, their cumulative geologic impacts would not be expected to be significant.

The proposed project and each of the cumulative offshore oil and gas projects outlined in Sections 4.2 and 4.3 would involve repair and maintenance activities, which could require ground disturbing activities, and could result in erosion and possible sedimentation. In general, however, such repairs and maintenance would be expected to be highly localized in nature, and with the implementation of appropriate erosion control measures, BMPs, and other required mitigation measures, cumulative geologic impacts, and the proposed project’s incremental contribution to them, would not be considered significant.

5.3.6.2 Onshore Projects

Ground disturbance and potential erosion associated with the proposed project would likely be limited in scope and localized. Potential erosional impacts due to sedimentation in nearby drainages can be reduced to a level of less than significant through implementation of standard erosion control measures. Therefore, although ground disturbance associated with pipeline repair or soil remediation may occur simultaneously with construction of some of the other potential onshore development projects outlined in Section 4.4, potential cumulative erosion and sedimentation impacts, and the proposed project's incremental contribution to them, would not be expected to be cumulatively significant.

5.3.7 Mitigation Monitoring Plan

Mitigation Measure	Mitigation Requirements and Timing	Method of Verification	Timing of Verification	Party Responsible For Verification
GR-1	Best Management Practices (BMPs), such as temporary berms and sedimentation traps, such as silt fencing, straw bales, and sand bags, shall be installed to minimize erosion of soils and sedimentation in nearby drainages. The BMPs shall be included in the Oil Spill Response Plan (OSRP). The BMPs shall include maintenance and inspection of the berms and sedimentation traps during rainy and non-rainy periods, as well as revegetation of impacted areas. Revegetation shall address plant type as well as monitoring to ensure appropriate coverage of exposed areas and shall be consistent with existing project revegetation plans.	Review of OSRP. Site inspections during remediation activities	Prior to issuance of coastal development permit or land use clearance for grading.	SBC P&D CCC
GR-2	The 2007 grouting program shall be completed prior to any equipment additions/modifications at the LOGP. If deemed necessary by the County System Safety and Reliability Review Committee (SSRRC), based on equipment weights and foundation requirements, an elevation survey shall be conducted before and during the equipment ~~recommissioning~~additions/modification period followed by routine post-construction monitoring as deemed appropriate by the SSRRC. The elevation survey should use existing benchmarks to continue the subsidence monitoring currently being conducted at LOGP~~and a pre- and post-recommissioning monitoring plan shall be developed. The plan shall require a baseline survey 30-days prior to construction and once per month during LOGP equipment recommissioning/modifications. Post-commissioning survey frequency shall be based on the settlement results measured during recommissioning. The plan shall include contingencies for soil grouting or other ground stabilization measures to prevent damage to the facility.~~	Annual erosion control survey reports	Annually	SBC P&D

Mitigation Measure	Mitigation Requirements and Timing	Method of Verification	Timing of Verification	Party Responsible For Verification
GR-3	The applicant shall implement a creek and drainage maintenance program to monitor and repair potential scour areas that could affect the pipeline integrity. The plan shall include annual surveys of the pipeline route and any adjacent drainages within 500 feet that are up slope of the pipeline right-of-way. Any areas that exhibit scouring or erosion shall be documented. Areas that exhibit increased scour should be addressed through stabilization or other appropriate permanent erosion control measures.	Review of creek and drainage maintenance program Annual surveys following construction	Annually	SBC P&D <u>CCC</u>
GR-4	The applicant shall conduct a study to determine the probable maximum tsunami and evaluate potential flooding and scour in the Santa Ynez River valley and at project facilities, as appropriate. The scour analysis shall determine a minimum burial depth to protect the pipe. In addition, the Applicant shall include in the Project Safety Plan a discussion of tsunami hazards, training and ensure that work crews receive tsunami-warning notifications from the Pacific Tsunami Warning Center (operated by NOAA) in accordance with the safety plan. If no such Project Safety Plan is prepared, a tsunami safety plan is herein required and shall include a protocol for workers to follow in the event of a tsunami. The tsunami plan shall be submitted to SBC P&D for review and approval prior to land use clearance.	Review of tsunami probability and scour analysis	Prior to land use clearance	SBC P&D <u>CCC</u>
GR-5 (VAFB Onshore Alternative only)	Reduce Liquefaction Hazard. Final geotechnical investigations shall be conducted in the areas underlain by alluvium and dune sand at the Santa Ynez River and Bear Creek crossings. The results and recommendations of the geotechnical investigations shall be incorporated into the final pipeline design. If moderate to high liquefaction potential is confirmed by the geotechnical analyses, then design measures shall be implemented at the corresponding locations. Appropriate design is dependent on site-specific conditions and could include deep burial of the pipeline below liquefiable layers, densification of the ground above the pipeline to mitigate uplift, and selection of thick-walled, ductile steel pipe. The applicant shall submit the final geotechnical studies and design recommendations to SBC for review and approval prior to land use clearance.	Review of geotechnical investigations	Prior to land use clearance	SBC P&D <u>CCC</u>

Mitigation Measure	Mitigation Requirements and Timing	Method of Verification	Timing of Verification	Party Responsible For Verification
GR-6 (Casmalia Alternative only)	Ensure that all pipeline and facility construction areas have adequate review by geotechnical engineers and geologists for expansive/collapsible soils and for potential areas of slope instability prior to construction. The geotechnical report shall be submitted to SBC for review and approval prior to land use clearance.	Plan check review. Site inspection during construction	Before permit issuance. Site inspection during construction.	SBC P&D
GR-7 (Emulsion Pipeline Replacement Alternative only)	Geotechnical analyses shall be completed in existing erosion-prone areas (as described by Coastal Geoscience, Inc., 2001) to determine proper pipeline burial depth.	Plan check review. Site inspection during construction	Before permit issuance. Site inspection during construction.	SBC P&D CCC
GR-8 (Emulsion Pipeline Replacement Alternative only)	Pipeline surveys shall be conducted to confirm the absence of unsupported spans after installation of the offshore pipeline and at periodic intervals during the life of the facility. Initial surveys shall be conducted annually, but may be reduced in frequency at the discretion of the Minerals Management Service, California State Lands Commission and Santa Barbara County.	Annual survey	During operation	MMS CSLC SBC P&D CCC

5.3.8 References

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