3.6 GEOLOGY AND SOILS

GEOLOGY AND SOILS – Would the Project:	**Potentially Significant Impact**	**Less Than Significant with Mitigation**	**Less Than Significant Impact**	**No Impact**
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.	☐	☐	☐	☒
ii) Strong seismic ground shaking?	☐	☐	☐	☒
iii) Seismic-related ground failure, including liquefaction?	☐	☐	☐	☒
iv) Landslides?	☐	☐	☐	☒
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☒	☐
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the Project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?	☐	☐	☐	☒
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?	☐	☐	☐	☒
e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?	☐	☐	☐	☒

3.6.1 Environmental Setting

3.6.1.1 Regional Setting

Geology

The Project area is within the Peninsular Ranges geomorphic province, which is characterized by major northwest-striking, right-lateral strike-slip faults (CEC 2009). The Rose Canyon Fault (part of the Newport-Inglewood-Rose Canyon Fault Zone mapped approximately 2 miles southwest of the EPS) and Elsinore Fault are the closest major offshore and onshore faults, respectively. Since the Project area is in an active geologic area, it could be subject to intense levels of earthquake-related ground shaking.

The geology of the Peninsular Ranges is similar to the Sierra Nevada Range. Mesozoic granitic and lesser gabbroic and metamorphic rocks form the core of the geomorphic province (CEC 2009). The nearest mapped Mesozoic rocks are approximately 2.5 miles east of the EPS site. Relatively thin Tertiary and Quaternary sediments deposited in marine and transitional environments overlie the crystalline basement rocks. Continental sediments are locally common as well, particularly in modern drainages. Post-Mesozoic rocks are prevalent along the coast and extend 5 to 8 miles inland in the vicinity of Carlsbad. The inland sediments reflect periods of higher sea levels in the past, as well as uplift due to tectonic activity.

According to CEC (2009), fill from grading of the EPS site covers Quaternary and Tertiary sediments that were deposited in marine and transitional environments. Quaternary age paralic sediments immediately underlie the artificial fill. These deposits represent transitional facies associated with a series of wave-cut terraces. The oldest paralic deposits are present to the east and uphill from the coastline. As sea level fell in response to decreases in ocean water volume and/or temperature and uplift associated with regional and local tectonics, paralic sediments were deposited on progressively lower wave-cut terraces. The most recent terrace deposits associated with a stranded bench are represented by the materials present at the EPS. Terraces were cut into middle Eocene deposits of the Santiago Formation in the Carlsbad area, so Quaternary sediments are in unconformable contact with Tertiary sediments. The marine arkosic sandstones were derived from granitic sources to the east.

Soils

The current Natural Resources Conservation Service (2013) mapping for San Diego County, as accessed via the Web Soil Survey on January 21, 2013, identifies soils in the Project area as Cr – Coastal beaches (nearshore and shoreline), TeF – Terrace escarpments (part of the shoreline), and MIC – Marina loamy coarse sand (immediately inland from the shore). Subsurface exploration conducted by Geo-Logic Associates for the Poseidon Desalination Plant site, which is located adjacent to the EPS, is underlain by artificial fill and very light brown to green-brown silty sandstone interbedded with siltstone and mapped as mid-Eocene Santiago Formation. It is not known if the portion of the EPS where the beach valve pit is located received fill prior to construction.

Groundwater

Groundwater beneath the EPS is generally brackish and is designated as having no beneficial uses (CEC 2009). Due to seasonal and tidal influences, groundwater levels fluctuate between 14 feet and 10 feet above mean sea level. As reported in the EIR for the Poseidon Desalination Plant (City of Carlsbad 2005), the groundwater table at the site was encountered during drilling at a depth of 20.8 to 28.9 feet below the existing ground surface (an approximate elevation of 1.1 to 14.2 feet above mean sea level).

Topography

The topography of the EPS site is moderate to flat and generally slopes west toward Carlsbad Boulevard and the Pacific Ocean.

3.6.1.2 Offshore Conditions

Regional Sediment Movement

Offshore sediment transport via movement of sand suspended in the water column generally moves parallel to the San Diego coastline (CSLC 2005). Longshore transport in the Project vicinity is 80 percent to the south and 20 percent to the north when averaged for the year; in winter, longshore transport from north to south is more dominant. Net annual movement of sand is approximately 310,000 cubic yards of sand per year toward the south. Jetties constructed along the coast can interrupt both the northward and southward movement of sand; because southward longshore transport dominates, sand tends to accumulate on beaches on the north side of the jetties and tends to be eroded from beaches on the south side of the jetties (CSLC 2005). Artificial replenishment of beaches in the Project area has focused on three beaches—the beach located north of Agua Hedionda Lagoon (referred to as the North Beach), the beach between the inlet and outlet of the lagoon (Middle Beach), and the beach south of the discharge channel (South Beach)—to partially offset the erosion caused by the existing jetties at the inlet and discharge channels of the Agua Hedionda Lagoon.

About 400 to 500 feet south of the Agua Hedionda Lagoon discharge jetty is the riprap covering the fuel oil submarine pipeline, also known as the South Beach Groin. In order to excavate and remove the pipeline, this riprap groin would need to be temporarily removed. To determine potential near-field effects of removing the South Beach Groin, Jenkins (2013) conducted a shoreline evolution analysis (see Appendix L) using computer simulations from a peer-reviewed Coastal Evolution Model and reached the following conclusions from simulations using the model to predict shoreline evolution over 20-year long historic periods of waves, tides, currents, and dredge disposal.

- Removal of the South Beach Groin would have no apparent effect on shoreline change over the short-term. Only after 5 years was there a discernible difference in shoreline change in the absence of the South Beach Groin, which was localized to South Beach where removal of the groin caused a small amount of shoreline retreat on the order of 6 feet.
- Removal of the South Beach Groin would have a cumulative impact, generally erosional in nature, on the shoreline over the long-term (10 to 20 years). The largest erosional impacts would occur at South Beach, where beach widths would be locally reduced by as much as 17 feet, 20 years after the groin is removed. Removal of the South Beach Groin would also reduce the median

retention time of dredged sands placed on South Beach by 1 month; longer retention times (18 to 20 months) are possible, but dependent on the South Beach Groin remaining in its present condition and location. Since dredging and beach disposal of the dredged sands typically occurs every 2 years, an average loss of 1 month of retention time adds up to a significant loss of beach sand volume over many years for the North Beach/Middle Beach/South Beach back-passing, sand re-cycling system.

Although the long-term effects of removing the groin on the beach bluff or public infrastructure, such as the sea wall in the Project area, was not modeled, it is possible that under storm conditions bluff erosion and erosion in the vicinity of the sea wall may occur based upon the conclusion that the beach's width would be reduced by as much as 17 feet, 20 years after the removal of the groin.

Project Area Seafloor Conditions

In 2005, Divecon recorded underwater video during an overhaul of the MOT, which was later reviewed by Padre Associates, Inc. staff to evaluate the seafloor conditions in the Project area. Based on the video footage, the fuel oil submarine pipeline appears to be on soft bottom substrate closer to shore and buried about halfway in the ocean sediment. In Merkel & Associates, Inc.'s February 2013 marine biological survey (see Appendix I), portions of the pipeline and some of the anchors and chains were on the surface of the seafloor; however, the condition of the MOT fuel oil submarine pipeline and mooring anchors with respect to their location on or beneath sediments or rock varies depending upon the time of year and other factors affecting the longshore transport of marine sand. Based on the Merkel & Associates, Inc. (2013b) study and Fugro's bathymetric and geophysical survey conducted in the spring of 2013, low relief rocky substrate is present in the nearshore/shallow subtidal area immediately south of the pipeline corridor. The seafloor topography between the shore and the tanker moorings slopes moderately westward to an ocean depth of -100 feet, as shown on the EPS MOT drawing (Cabrillo Power I LLC 2008). Beyond the -100 water depth there is a steep drop in the offshore topography.

3.6.2 Regulatory Setting

3.6.2.1 Federal and State

Federal and State laws and regulations pertaining to this issue area and relevant to the Project are identified in Table 3.6-1.

Table 3.6-1. Laws, Regulations, and Policies (Geology and Soils)

CA	Alquist-Priolo Earthquake Fault Zoning Act (Pub. Resources Code, §§ 2621-2630)	This Act requires that "sufficiently active" and "well-defined" earthquake fault zones be delineated by the State Geologist and prohibits locating structures for human occupancy across the trace of an active fault.
	California Building Code (CBC) (Cal. Code Regs., tit. 23)	The CBC contains requirements related to excavation, grading, and construction of pipelines alongside existing structures. A grading permit is required if more than 50 cubic yards of soil are moved. Sections 3301.2 and 3301.3 contain provisions requiring protection of adjacent properties during excavations and require a 10-day written notice and access agreements with adjacent property owners.
	California Seismic Hazards Mapping Act (Pub. Resources Code, § 2690 and following as Division 2, Chapter 7.8)	This Act and the Seismic Hazards Mapping Regulations (Cal. Code Regs., tit. 14, Div. 2, Ch. 8, Art. 10) are designed to protect the public from the effects of strong ground shaking, liquefaction, landslides, other ground failures, or other hazards caused by earthquakes. The Act requires that site-specific geotechnical investigations be conducted identifying the hazard and formulating mitigation measures prior to permitting most developments designed for human occupancy. Special Publication 117, *Guidelines for Evaluating and Mitigating Seismic Hazards in California* (California Geological Survey 2008), constitutes guidelines for evaluating seismic hazards other than surface fault rupture and for recommending mitigation measures as required by section 2695, subdivision (a).
CA	Coastal Act Chapter 3 policies (see also Table 1-2)	Coastal Act policies applicable to this issue area are: • Section 30253 requires, in part, that: New development shall: (a) Minimize risks to life and property in areas of high geologic, flood, and fire hazard; and (b) Assure stability and structural integrity, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs. • Section 30243 states in part: The long-term productivity of soils and timberlands shall be protected….

3.6.1.2 Local

The City of Carlsbad (2006) General Plan OSCE contains the following geology and soils-related objective and policies relevant to onshore Project activities.

- Objective B.2: To protect public health and safety by preserving natural and man-made hazard areas as open space and taking special precautionary measures to protect the public safety where development is possible and permitted.
- Policy C.8: Require a city permit for any grading, grubbing, or clearing of vegetation in undeveloped areas, with appropriate penalties for violations.
- Policy C.12: Require that grading be accomplished in a manner that will maintain the appearance of natural hillsides and other landforms wherever possible.
- Policy C.13: Require that soil reports, plans for erosion and sediment control measures and provisions of maintenance responsibilities.

3.6.3 Impact Analysis

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

i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.

No Impact. As reported in the City of Carlsbad (undated[a]) General Plan Public Safety Element, there are no known active or potentially active faults within city limits, and the closest known active fault is the Rose Canyon Fault Zone, several miles offshore. Additionally, no risk of loss of life or property in a seismic event would result from the Project, which involves decommissioning of infrastructure and does not include the construction of any buildings or structures that would potentially be damaged or cause injury or death. Therefore, this Project is not likely to expose people or structures to potential substantial adverse effects due to the rupture of a known earthquake fault.

ii) Strong seismic ground shaking?

No Impact. There is the potential for Project infrastructure and workers to be subjected to seismic ground shaking if a significant earthquake occurred in the area during Project implementation. However, decommissioning activities would not create adverse effects to people or structures related to ground shaking; therefore, no impact would occur.

iii) Seismic-related ground failure, including liquefaction?

No Impact. As stated in the City of Carlsbad (undated[a]) General Plan Public Safety Element, portions of the City underlain by deep, soft, saturated soils may be susceptible to liquefaction, lurch cracking, lateral spreading, and local subsidence. However, the Project is limited to the removal and in-place abandonment of existing onshore and offshore infrastructure. Infrastructure abandoned in place would be filled with earth or cement for stabilization (e.g., the Project includes filling the underpass conduit and rectangular horizontal shafts with cement slurry and abandoning the structures in place; see Figure A1-4 in Appendix A). These structures are buried under existing sidewalks and Carlsbad Boulevard, and filling these voids would ensure continued stability of the road and sidewalks over the long-term. The vertical vault of the underpass end structure is completely buried underneath the sand beach and would be removed and backfilled with sand to restore the disturbed area to pre-Project conditions. Removal of the vertical vault may require demolition and replacement in-kind of the western sidewalk along Carlsbad Boulevard where it crosses the underpass; however, no new construction is proposed that would be subject to seismic-related ground failure such as liquefaction.

Therefore, this Project is not likely to expose people or structures to potential substantial adverse effects due to seismic-related ground failure, including liquefaction.

iv) Landslides?

No Impact. The Project site is located both onshore and offshore. The topography of the Project area does not include slopes or other features that would have the potential to become unstable and result in a landslide. Therefore, this Project is not likely to expose people or structures to potential substantial adverse effects due to landslides.

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

Less than Significant Impact. Excavation would be required to remove the underpass end structure vertical vault, the fuel oil submarine pipeline, and any contaminated soils that are identified. Excavated areas would be backfilled to re-establish pre-Project conditions. Because of the nature of the activity and location, the Project would not result in substantial soil erosion or loss of topsoil. The Project would also require the temporary removal and subsequent replacement of the South Beach Groin. Since the riprap groin would be restored to pre-Project conditions, the temporary removal of the groin would have a less than significant impact on beach erosion or loss of beach sand.

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

No Impact. See discussion for ***a)*** above.

d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?

No Impact. See discussion for ***a)*** above.

e) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of waste water?

No Impact. The Project does not require a wastewater disposal system; therefore, no impacts will occur.

3.6.4 Mitigation Summary

The Project would not result in significant impacts relating to geology and soils; no mitigation is required.