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4.4 GEOLOGICAL HAZARDS AND RESOURCES

This section describes geological hazards and resources at the Puente Power Project (P3 or project) site and vicinity, and evaluates potential impacts of the project on these resources. The project area discussed in this section refers to all areas of temporary and permanent disturbance associated with the construction and operation of the new plant and ancillary systems, and construction laydown areas. No new offsite linear facilities are required for P3. The study area for geological hazards and resources evaluated in this section is defined as the area within a 2-mile radius of the P3 site.

The sections below provide an overview of the affected environment; an evaluation of the environmental consequences of the proposed project relative to geological hazards and resources; a cumulative impact analysis; identification of mitigation measures that will avoid and reduce project impacts to less-than-significant levels; and applicable laws, ordinances, regulations, and standards (LORS).

Issues related to surface soils, such as erosion, are discussed in Section 4.11, Soils.

4.4.1 Affected Environment

P3 will be developed on approximately 3 acres of previously disturbed vacant brownfield land within the existing boundaries of the Mandalay Generating Station (MGS) in the City of Oxnard, Ventura County, California. The MGS is situated in the northwestern portion of the Transverse Ranges Geomorphic Province, on the western edge of the Oxnard Plain (Figure 4.4-1). This province extends to the San Bernardino Mountains to the east, and extends offshore to include the Channel Islands to the west. Mountain ranges and fault systems of the Transverse Ranges are east-west trending, which is oblique to the normal northwest trend of coastal California mountain ranges. This structure is due to intense north-south compression along the San Andreas Fault. Basins in the Transverse Ranges, which include the Oxnard Plain, are filled with substantial amounts of Tertiary and Quaternary sediments that were deposited in both marine and terrestrial settings (USGS, 2003a).

4.4.1.1 Regional Geology

The Oxnard Plain is a broad, low-lying coastal plain in the Ventura Basin. The Ventura Basin is a deep, structural trough filled with approximately 35,000 feet of Cretaceous through Cenozoic sedimentary and volcanic rocks. The Ventura Basin forms the Santa Clara River Valley, Oxnard Plain, and the offshore Santa Barbara Channel.

The Oxnard Plain ranges from sea level to about 100 feet in elevation, and is composed of unconsolidated alluvium consisting of stream deposits. The majority of these sediments were transported and deposited by the Santa Clara River to the north (Rincon Consultants, Inc., 2004).

4.4.1.2 Local Geology

The topography of the P3 site is virtually flat, sloping seaward and bounded by sand dunes along the coastline. The MGS is on relatively level ground at an elevation of approximately 14 feet mean lower low water (MLLW). The sand dunes and flood protection berm that border the facility range in elevation from 20 to 30 feet MLLW.

The site is predominately underlain by sand and silty sand sediments, with some interbedded sandy silt and clay. The alluvial plain in the vicinity of P3 is mapped as underlain by Holocene-age alluvial floodplain deposits composed predominately of clay, with interbedded sand and gravel layers (Figure 4.4-1). Young eolian (wind-blown) deposits overlie the alluvium within the borders of the project site.

Groundwater in the vicinity of P3 has been measured at depths of 5 to 9 feet below surface. Fluctuations in the depth to groundwater will occur due to seasonal precipitation, tidal variations, groundwater pumping, variations in ground elevations, projected sea-level rise, and other factors (Ninyo & Moore, 2013).

4.4.1.3 Stratigraphy

Upper Cretaceous and Tertiary consolidated rocks in the Ventura Basin include sedimentary, volcanic, igneous, and metamorphic rocks. The consolidated Tertiary sedimentary rocks comprise the mountains and hills surrounding the Oxnard Coastal Plain. The Quaternary unconsolidated deposits consist of the Santa Barbara Formation, San Pedro Formation, Las Posas Sand, Saugus Formation, Pico Formation, all of the Pleistocene epoch, and unnamed unconsolidated alluvial and fluvial deposits of the Pleistocene to Holocene epoch.

Santa Barbara Formation. This formation overlies consolidated Tertiary rocks and consists of marine sandstone, mudstone, siltstone, and shale. The thickness varies throughout the basin and is thickest—more than 5,000 feet—in the Ventura area.

San Pedro and Saugus Formations. The upper part of the San Pedro Formation consists of lenticular layers of sand, gravel, silt, and clay of marine and terrestrial origin. The continental fluvial silt, sand, and gravel deposits in the upper part of the San Pedro Formation are referred to as the Saugus Formation. The lower part of this formation consists of shallow marine sand and gravel beds. These deposits reach a maximum thickness of more than 2,000 feet in the Santa Clara River Valley, and consist of a series of relatively uniform, fine-grained sand layers (100 to 300 feet thick) separated by thin layers of silt and clay (10 to 20 feet thick) (USGS, 2003a).

Pico Formation. This formation consists of deep-marine sequence and can be extremely thick (approximately 18,000 feet) in areas throughout the basin. These strata consist of muddy siltstone, sandstone, and conglomerates. Shoreface sandstone in the Pico Formation interfingers with overlying braided-river deposits of the Saugus Formation (Squires et al., 2006).

Late Pleistocene and Holocene Deposits (including Las Posas Sand). These deposits consist of relatively flat-lying marine and continental unconsolidated deposits derived from the nearby Santa Clara River and Calleguas Creek. Alluvial and fluvial sand and gravel deposits with interbedded fine-grained deposits of the Holocene epoch overlie the Late Pleistocene deposits. Basal deposits of the Holocene epoch are relatively coarse-grained (e.g., gravels), and finer-grained deposits overlie these basal units (USGS, 2003a).

Surficial Holocene Deposits. Holocene alluvium covers the entire Oxnard Coastal Plain. In the project site, these surficial deposits consist of active coastal eolian (sand dune) deposits, composed of loose sand and silt (USGS, 2003b).

4.4.1.4 Structure

The main synclinal axis of the Ventura Basin coincides roughly with the course of the Santa Clara River. The younger (Quaternary) folds and faults trend east-west across the basin and are subparallel to the main synclinal axis. The flanks of the basin were uplifted along east-trending, left-lateral reverse-fault systems, exposing the older sedimentary and volcanic rocks that form the San Ynez Mountains along the north and the Santa Monica Mountains along the south (USGS, 2003a).

4.4.1.5 Seismicity

The project site is in a seismically active area, as is the majority of Southern California (Figure 4.4-2). The P3 site is not in a special study zone, as delineated by the Alquist-Priolo Special Studies Zone Act of 1972; and no known fault, active or inactive, reaches the surface in the Oxnard quadrangle (CGS, 2002a).

The most significant Quaternary faults within 50 miles of the P3 site, as well as estimates of the Maximum Moment Magnitude (M_{max}) for each fault, are listed in Table 4.4-1.

The nearest faults to the site are the McGrath and Oak Ridge fault zones, which are west-southwest–trending blind-thrust offshore faults approximately 2 miles to the northwest (USGS, 2003b; CGS, 2002a). These faults are subparallel to the axes of the anticlines and synclines of the Transverse Ranges Geomorphic Province (USGS, 2003a).

McGrath Fault. The McGrath thrust fault is a branch to the south of the Oak Ridge fault and extends approximately 2 miles offshore. This fault dips gently south off-shore, similar to the Oak Ridge fault, and cuts strata as young as late Pleistocene in age (USGS, 1985). There is no probable magnitude information available for this fault in U.S. Geological Survey or California Geological Survey databases (California Department of Conservation, 2015; CGS, 2002a; USGS, 2015).

Oak Ridge Fault. The Oak Ridge fault extends east–west for about 90 miles through the onshore Ventura and the offshore Santa Barbara sedimentary basins, where it forms a major basin-bounding fault (Fisher et al., 2005).

Oak Ridge fault is a steep south-dipping reverse fault with probable magnitudes of 6.5 to 7.5. The 1994 Northridge earthquake was probably part of the Oak Ridge fault system, because it shares many of the characteristics of this fault. This earthquake was a blind-thrust faulting with a 6.7 magnitude and originated 20 miles west-northwest of Los Angeles, 1 mile south-southwest of Northridge. This was the first earthquake to strike directly under an urban area of the United States since the 1933 Long Beach earthquake, which originated from the Newport-Inglewood fault zone (Rincon Consultants, 2004; SCEDC, 2012).

Other faults that have historically produced earthquakes of the greatest magnitude within 50 miles of the project site include the Ventura-Pitas Point, Mission Ridge-Arroyo Parida-Santa Ana, and Red Mountain fault zones to the north; the San Andreas Fault to the northeast; and the Simi-Santa Rosa fault zone to the east. These faults could affect the project site; their respective Mmax earthquakes are presented in Table 4.4-1.

Ventura-Pitas Point Fault. This fault zone is approximately 5.7 miles north of the P3 site. It is north-dipping, with left-reverse displacement, and has an M_{max} of 6.9.

Mission Ridge-Arroyo Parida-Santa Ana. The Mission Ridge, Arroyo Parida, and Santa Ana faults make up an essentially continuous fault system running west to east from Goleta to Ojai, on the southern flank of the Santa Ynez Mountain. This fault zone is left-lateral with varied vertical slip, and its most recent rupture was 30,000 years ago. As shown in Table 4.4-1, this fault zone has an M_{max} of 7.2.

Simi-Santa Rosa Fault. This fault zone has a reverse slip that dips to the north and is approximately 7.9 miles east of the P3 site. As shown in Table 4.4-1, this fault zone has an M_{max} of 7.0.

Red Mountain Fault. This fault is approximately 10.2 miles north of the P3 site, and has a generally east-west trend. As shown in Table 4.4-1, this fault also has an M_{max} of 7.0 (SCEDC, 2012).

San Andreas Fault. The San Andreas fault is the largest active fault in California, extending approximately 750 miles from the Gulf of Mexico on the south to Cape Mendocino on the north. This fault is approximately 44 miles northeast of the P3 site. There have been numerous historic earthquakes along this fault. This fault has right-lateral strike-slip displacement and an M_{max} of 8.5 (SCEDC, 2012).

4.4.1.6 Geologic Hazards

A preliminary geotechnical investigation was conducted for P3 by Ninyo & Moore in 2013. The scope of this investigation was to assess subsurface conditions, depth to groundwater, and preliminary engineering analysis for the proposed power plant. The following subsections discuss the potential geologic hazards that might occur in the project area. There are no linear facilities included in this assessment, because the P3 facility will use existing gas and water/wastewater lines in the MGS.

4.4.1.6.1 Ground Rupture

Ground rupture is caused when an earthquake event along a fault creates rupture at the surface. The nearest known active fault to the site is the McGrath fault, which is an east-west trending lateral fault approximately 2 miles north of the P3 site (USGS, 2003b). Therefore, the likelihood of ground rupture occurring at the project site is low. However, cracking of the ground surface as a result of nearby seismic events is possible.

4.4.1.6.2 Seismic Shaking

Strong ground shaking due to future seismic events is probably the most significant geologic hazard anticipated at the proposed P3 site. The Maximum Credible Earthquake (MCE) for a site is determined using a 1 percent probability of exceedance of the horizontal peak ground acceleration (PGA) in 50 years. The probabilistic PGA_{MCE} for the P3 site was calculated as 0.88g (Ninyo & Moore, 2013).

4.4.1.6.3 Liquefaction

Liquefaction is the phenomenon during which loose, saturated, cohesionless soils temporarily lose shear strength during strong ground shaking. Significant factors known to affect the liquefaction potential of soils are the characteristics of the materials such as grain-size distribution, relative density, degree of saturation, the initial stresses acting on the soils, and the characteristics of the earthquake, such as the intensity and duration of the ground shaking. Geologic units that are generally susceptible to liquefaction include late-Quaternary alluvial and fluvial sedimentary deposits, such as those underlying the project site (CGS, 2002b).

The project site is in a designated California Seismic Hazard Zone as an area considered susceptible to liquefaction (Figure 4.4-3). Potential hazards at the P3 site include compaction consolidation (settlement) and seismically induced settlement. Dissipation of excess pore pressure generated by ground shaking would produce volumetric change within the liquefied soil layers, which would manifest at the ground surface as settlement.

The geotechnical report indicates that scattered saturated sandy alluvial layers between depths of approximately 5 and 50 feet are potentially liquefiable during the design earthquake event. Liquefaction-induced dynamic settlement at the project site may range from approximately 0.5 inch to 2 inches, with an average dynamic settlement on the order of 1 inch. A majority of the dynamic settlement is expected to occur in the near-surface alluvial soils up to a depth of about 15 feet below the surface.

Lateral spread has generally been observed to take place in the direction of a free-face (i.e., slope-retaining wall, channel), but has also been observed to a lesser extent on ground surfaces with gentle slopes. For sites located in proximity to a free-face, the amount of lateral ground displacement is strongly correlated with the distance of the site from the free-face. Other factors such as earthquake magnitude, distance from the earthquake epicenter, thickness of the liquefiable layers, and the fines content and particle sizes of the liquefiable layers also affect the amount of lateral ground displacement.

The project site includes free-face slopes along the Edison Canal on the southern side of the existing MGS facility, and a gently sloping ground condition toward the ocean along the western side of the MGS facility. The canal is approximately 700 feet south of the P3 site. Based on the relative density of the potentially liquefiable soil layers and the distance from the canal, the P3 site is not considered susceptible to significant seismically induced lateral spread toward the canal or the ocean (Ninyo & Moore, 2013).

4.4.1.6.4 Slope Stability

Landslides, slope failures, and mudflows of earth materials generally occur where slopes are steep and/or the earth materials too weak to support themselves. Earthquake-induced landslides may also occur due to seismic ground shaking. The project site is located on a flat coastal plain. The lack of significant slopes on or near the site indicates that the hazard from slope instability, both landslides and debris flows, is negligible (Ninyo & Moore, 2013).

4.4.1.6.5 Subsidence

Subsidence of the land surface can be attributed to natural phenomena, such as tectonic deformation, consolidation, hydrocompaction, collapse of underground cavities, oxidation of organic-rich soils, or rapid sedimentation; and also by manmade activities, such as the withdrawal of groundwater or hydrocarbons.

Historical groundwater withdrawal on the Oxnard Plain since the late 1800s has resulted in approximately 3 feet of land subsidence in the site region. The land subsidence occurred primarily during the drought of the late 1920s, and during the agricultural expansion of the 1950s and 1960s. Artificial recharge of groundwater in the Oxnard Plain, which had begun in the 1930s, had abated the ground subsidence by the early 1990s (Ninyo & Moore, 2013). Therefore, the potential for subsidence to affect the project site is relatively low.

4.4.1.6.6 Expansive Soils

Expansive soils shrink and swell with wetting and drying. Changes in soil moisture content can result from rainfall, irrigation, surface drainage, pipeline leakage, perched groundwater, drought, or other factors. Aggregate change of expansive soil may cause excessive cracking and heaving of structures with shallow foundations, concrete slabs-on-grade, or pavements supported on these materials. New development or project improvements on soils known to be potentially expansive could have a significant impact to the project.

Subsurface exploration at the P3 site indicates that the near-surface soils are predominantly composed of sandy soils, which typically have a low potential for expansion (Ninyo & Moore, 2013). Therefore, the potential for expansive soils to affect the project site is relatively low.

4.4.1.6.7 Tsunami Run-Up and Seiche

Tsunamis are large ocean surges generated by submarine fault movements or landslides that can impact low-lying coastal areas. Water surge caused by tsunamis is measured by distance of run-up on the shore. The project site is adjacent to a State of California Tsunami Inundation Area mapped for susceptibility to tsunami run-up hazard (California Emergency Management Agency, 2009). The tsunami threat in Ventura County is mainly confined to immediate beach areas and river mouths. In some areas, the tsunami hazard zone extends 1 to 2 miles inland from the Pacific Ocean (County of Ventura, 2011).

In the vicinity of P3, the potential tsunami inundation area is along Mandalay Beach on the western side of the dunes that border the western side of the MGS property (Figure 4.4-4). The dunes are elevated up to approximately 20 to 30 feet MLLW and offer adequate protection to the site from tsunami run-up.

Tsunami Inundation Maps for Emergency Planning developed by the California Emergency Management Agency (2009) were reviewed to determine whether a tsunami could inundate the P3 project site. A copy of the Tsunami Inundation Map for the Oxnard area is included in Appendix N-2, Technical Memorandum, Sea-Level Rise Analysis. The map (and Figure 4.4-4) shows that the project site is not in the tsunami inundation zone. The inundation area on the map represents a combination of inundation results for an ensemble of source events affecting the Ventura County coastline. Therefore, all of the inundation region in a particular area will not likely be inundated during a single tsunami event (California Emergency Management Agency, 2009). The contours on the map indicate that the tsunami is at an elevation of between 10 and 15 feet. To confirm the elevation, the tsunami inundation boundary was compared to the National Oceanic and Atmospheric Administration Light Detection and Ranging data used for the analysis in the Technical Memorandum. Based on this comparison, the tsunami water elevation at the project site was estimated to be about 14 to 15 feet.

It was assumed that the elevation of tsunami would increase by the predicted amount of sea-level rise (see Section 4.15, Water Resources); which for the P3 site would be between about 7 inches by 2030, and 2 feet by 2050. With 2 feet of sea-level rise, the estimated elevation of the tsunami in 2050 would be 16 to 17 feet. This elevation is still less than the elevation of the ocean front dunes and berm to the north of the facility.

Loss of life due to tsunami hazards is mitigated through the Emergency Alert System, which includes every radio and TV station, as well as all cable companies throughout the county. In the event of an emergency, the Alaska Tsunami Warning Center will issue a statement to inform the public if an earthquake or landslide has occurred and there is potential for tsunami (City of Oxnard, 2011a).

Evacuation routes and potential reunification areas are identified in the Ventura County Operational Area Tsunami Evacuation Plan (County of Ventura, 2011). Evacuation instructions from the project area are:

- Proceed north (left) on Harbor Boulevard, east (right) on Gonzales Road, south (right) on Victoria Avenue, and east (left) on 5th Street to Southwest Community Park; or

- Proceed south (right) on Harbor Boulevard, and east (left) on 5th Street to Southwest Community Park (County of Ventura, 2011).

Due to the site location near an area mapped as susceptible to tsunami run-up hazards, the potential for tsunami run-up hazard at the project site, along with possible mitigation techniques, will be further evaluated during the detailed design phase of the project (Ninyo & Moore, 2013).

Seiches result from the "sloshing" action of confined bodies of water during seismic events. Although there could be some sloshing of water in McGrath Lake or the Edison Canal during an earthquake, due to the configuration of these features, adjacent landform, and shallow nature of the water within these features, the potential for seiche hazard at the P3 site is extremely low (Rincon Consultants, 2004).

4.4.1.7 Geologic Resources

Geologic resources in the project vicinity that could be affected include aggregate resources, oil and gas fields, and scenic natural resources. Geologic resources of commercial value were identified from the City of Oxnard General Plan Draft Background Report (Matrix Design Group, Inc., 2006), and the Ventura County General Plan (County of Ventura, 2008). These resources are shown on Figure 4.4-5.

There are no known geologic resources that provide a significant scientific value in the vicinity of the P3 site.

4.4.1.7.1 Sand and Gravel Aggregate Resources

Aggregates are a significant type of mineral resource extracted in Ventura County. Aggregates include sand, gravel, and rock, which are used for fill, construction-grade concrete, and in the production of other materials. Areas categorized as Mineral Resource Zone-3a are located within 0.5 mile of the P3 site (Figure 4.4-5). These are areas known to contain mineral deposits; however, the significance of this cannot be evaluated from available data (Matrix Design Group, Inc., 2006). Although many sand and gravel sites exist throughout the County, most of the extraction sites are located in and along the Santa Clara River bed, north of the P3 site (County of Ventura, 2008).

4.4.1.7.2 Oil and Gas Resources

Petroleum and natural gas are principal resources in Ventura County. The P3 site is situated above the West Montalvo Oil Field, which extends along the coastline and upstream from the mouth of the Santa Clara River. The West Montalvo Field contains 29 active wells and 24 inactive or shut-in wells, and is the only local field to increase the number of active wells in recent years (California Department of Conservation, 2001; Matrix Design Group, Inc., 2006). There are 21 oil wells within 0.5 mile of the project site, reportedly owned by Chevron U.S.A. Inc. and Venoco Inc. (EDR, 2015). Figure 4.4-5 depicts oil fields and oil and gas wells in the project area. No wells are present on the P3 site or MGS property.

Other oil and gas fields in the Oxnard area include Santa Clara Avenue, Oxnard, El Rio, and Saticoy Oil Fields. The Santa Clara Avenue Oil Field contains approximately 18 active oil and gas wells and 12 inactive wells. The Oxnard Oil Field contains 38 active oil and gas wells and 59 inactive wells. The El Rio Oil Field is located at the crossing of Ventura Freeway and the Santa Clara River. The Saticoy Oil Field is on the south side of the Santa Clara Valley. No recent production data are available for El Rio and Saticoy oil fields. Major petroleum companies in the area include Chevron, Shell, Texaco, Mobil, and Western LNG (Matrix Design Group, Inc., 2006).

4.4.1.7.3 Recreational Geologic Resources

The P3 site is immediately inland from Mandalay State Beach, where tall sand dunes and sandy ocean beach provide a natural scenic resource. Coastal dune formations are dynamic in nature, migrating and reforming, depending on wind and wave patterns and coastal topography. Coastal sand dunes are extremely fragile, yet highly protective. They inhibit beach erosion and form a protective buffer from both wind and wave action for areas and resources, both natural and manmade, immediately inland. They also protect coastal salt marshes and wetlands. Beaches and coastal dunes are significant contributions to the Ventura County tourist industry (County of Ventura, 2008).

4.4.2 Environmental Consequences

4.4.2.1 Significance Criteria

The following sections evaluate the potential impacts to geological hazards and resources associated with construction and operation of P3. Appendix G of the California Environmental Quality Act describes project-related effects that would normally be considered to have a significant effect on the environment. Based on this guidance, project-related geologic impacts are considered significant if the proposed project would do any of the following:

- Expose people or structures to potential, substantial adverse effects, including the risk of loss, injury, or death involving:
  - 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;
  - Strong seismic ground shaking;
  - Seismic-related ground failure, including liquefaction; or
  - Landslides.

- 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 onsite or offsite landslide, lateral spreading, subsidence, liquefaction, or collapse.

- 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.

- Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state.

- Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan.

- 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 wastewater.

4.4.2.2 Geological Hazards

Seismically induced ground shaking and the potential for liquefaction during future seismic events present a significant hazard to the P3 site. Granular soil layers to a depth of approximately 50 feet below the existing grade could liquefy during the design seismic event. With incorporation of the project design features discussed in Section 4.4.4, the hazards will be less than significant. As discussed in Section 4.4.1.6, no other geological hazards with the potential to significantly affect the proposed power plant or other project elements were identified; therefore, impacts related to landslide, lateral spreading, subsidence, collapse, and expansive soil would be less than significant.

4.4.2.3 Geologic Conditions and Topography

Construction will require grading and excavation, thereby altering the terrain of the P3 site. Impacts on the geologic conditions involve changes in drainage, cuts, and fills. Because the site is generally level, site grading is expected to have less-than-significant impacts on the geologic environment.

4.4.2.4 Geological Resources

Natural resources occurring in the vicinity of the P3 site include sand, gravel, and oil and natural gas. All of these resources have been exploited to some extent in the site vicinity, but with the exception of oil and gas, no active development operations are occurring at this time. P3 will not require development of geological resources on or off site. P3 will not impact the adjacent coastal sand dunes. Impacts on geological resources as a result of project implementation would be less than significant.

4.4.2.5 Septic Systems

The project site is not served by the City of Oxnard's sanitary sewer system. Sanitary wastewater will be discharged to the existing MGS septic system. This system is operated in accordance with Waste Discharge Requirements Order No. R4-2008-0087 (LARWQCB, 2008). Wastewaters from the advance treatment system are discharged to the groundwater through a drip disposal system, which has been installed to maintain a groundwater separation of at least 5 feet below the drip system. Because the minimum standard for the vertical separation between the bottom of a subsurface drip system and the high groundwater table should be at least 10 feet, the treatment includes disinfection to protect groundwater quality. The septic system will continue to be operated and monitored in accordance with the provisions of the waste discharge requirements; therefore, impacts to the geologic environment due to the project's use of the septic system will be less than significant.

4.4.3 Cumulative Impacts Analyses

Of the cumulative projects identified in Section 4.0, four projects are within the 2-mile study area for geologic resources; these include three residential developments and a shopping center. Seismically induced ground shaking and the potential for liquefaction during future seismic events present a hazard risk to P3. With incorporation of the project design features discussed in Section 4.4.4, the hazards will be less than significant. Geologic and seismic conditions in the region would not be impacted by the proposed project. Because any impacts resulting from geologic hazards would be site-specific, and because other projects would be subject to similar design features and building standards, cumulative impacts on geologic hazards and resources are not expected.

4.4.4 Mitigation Measures

This section presents design features that will be implemented as part of project. With implementation of these measures, impacts to geological resources would be less than significant, and no mitigation measures would be required.

GEO-1 Seismic Design Requirements

The power plant may be subjected to strong ground shaking from earthquake events in the future. Therefore, plant components will be designed and constructed to the seismic design requirements for ground shaking specified in the International Building Code (2015) for Seismic Design Category D.

GEO-2 Geotechnical Investigation

The hazard from seismically induced liquefaction at the P3 site is considered to be locally high. The nature of the alluvial and fluvial deposits on which P3 will be sited and the presence of potentially liquefiable materials indicate that liquefaction and lateral spreading could occur. Because of the location of new structures with respect to the existing geotechnical database, a site-specific program of exploratory borings and accompanying laboratory testing will be required to delineate potentially liquefiable materials beneath the construction area. These geotechnical investigations will also be required for consideration prior to foundation design, and development of site-specific design criteria. These are normal design and construction techniques.

GEO-3 Engineering Geologist

Prior to the start of construction, the project owner shall assign to the project an engineering geologist(s), certified by the State of California, to carry out the duties required by the 1998 edition of the California Building Code Appendix, Chapter 33, Section 3309.4, Engineered Grading Requirement, and Section 3318.1 – Final Reports. Those duties are:

1. Preparing the Engineering Geology Report, which shall accompany the Plans and Specifications when applying to the Chief Building Officer for the grading permit;
2. Monitoring geologic conditions during construction; and
3. Preparing the Final Engineering Geology Report.

The certified engineering geologist(s) assigned must be approved by the Compliance Project Manager. The functions of the engineering geologist can be performed by the responsible geotechnical engineer, if that person has an appropriate California license.

4.4.5 Laws, Ordinances, Regulations, and Standards

P3 will be constructed and operated in accordance with all LORS applicable to geological hazards and resources. Federal, state, and local LORS applicable to geological hazards and resources are discussed below and summarized in Table 4.4-2.

4.4.5.1 Federal

4.4.5.1.1 International Building Code (2015)

Acceptable design criteria for excavations and structures for static and dynamic loading conditions are specified by the International Building Code (ICC, 2014).

4.4.5.2 State

4.4.5.2.1 Alquist-Priolo Earthquake Fault Zoning Act (1972)

The Alquist-Priolo Earthquake Fault Zoning Act (AP Act) provides a mechanism for reducing losses from surface fault rupture on a statewide basis. The intent of the AP Act is to ensure public safety by prohibiting the siting of most structures for human occupancy across traces of active faults that constitute a potential hazard to structures from surface faulting or fault creep. The project is not intended for human occupancy; therefore, the AP Act does not apply.

4.4.5.2.2 California Building Code (2013)

Given the nature of the project, the California Building Code (CBC, 2013) would be superseded by the International Building Code, as discussed above.

4.4.5.2.3 California Coastal Act, Section 30253

Coastal Act Section 30253 requires that new development minimize risks to life and property in areas of high geologic, flood, and fire hazard. New development must also be designed and sited in such a way that it will not cause or add 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.” Structures must also be designed to eliminate or mitigate adverse impacts on local shoreline sand supply. In addition, although shoreline devices may extend onto the beach, any impacts that may have on public access or other coastal resources must be avoided or mitigated. P3 will be designed and constructed to the seismic design requirements for ground shaking specified in the International Building Code (2015) for Seismic Design Category D.

4.4.5.2.4 Seismic Hazards Mapping Act (1990)

The purpose of the Seismic Hazards Mapping Act (SHMA) is to minimize loss of life and property through the identification, evaluation, and mitigation of seismic hazards. The SHMA requires that site-specific geotechnical investigations be conducted within the Zones of Required Investigation to identify and evaluate seismic hazards and formulate mitigation measures prior to permitting most developments designed for human occupancy. The project is not intended for human occupancy; therefore, the SHMA does not apply.

4.4.5.3 Local

4.4.5.3.1 Ventura County General Plan (2010)

The Hazards Chapter of the Ventura County General Plan identifies goals, policies, and programs relating to known existing and potential geologic hazards, and other significant physical constraints to development/land use.

4.4.5.3.2 City of Oxnard General Plan (2011)

The City of Oxnard General Plan Safety and Hazards Element requires that all new buildings and alterations to existing buildings be built according to the seismic requirements adopted in the most current City of Oxnard Building Code (City of Oxnard, 2011b). It also requires the submission of a geotechnical report for proposed development located in a potential liquefaction area.

The City will review the geologic information and geotechnical recommendations presented in design-level geotechnical reports.

4.4.6 Involved Agencies and Agency Contacts

Involved agencies and agency contacts are listed in Table 4.4-3.

4.4.7 Permits Required and Permit Schedule

Required permits related to geologic resources are listed in Table 4.4-4.

4.4.8 References

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Table 4.4-1
Principal Active Faults

Fault	Approximate Fault-to-Site Distance (miles)	Maximum Moment Magnitude (M_{max})
McGrath	2.0	—
Oak Ridge	2.4	7.1
Montalvo-Oak Ridge Trend	3.2	6.6
Ventura-Pitas Point	5.7	6.9
Simi-Santa Rosa	7.9	7.0
Red Mountain	10.2	7.0
Mission Ridge-Arroyo Parida-Santa Ana	15.4	7.2
Anacapa-Dume	15.6	7.5
Channel Island Thrust (Eastern)	16.0	7.5
San Cayetano	17.8	7.0
Malibu Coast	21.2	6.7
Santa Cruz Island	21.3	7.0
Santa Ynez (East)	21.5	7.1
North Channel Slope	26.9	7.4
Santa Ynez (West)	29.2	7.1
Santa Susana	29.5	6.7
Big Pine	32.4	6.9
Holser	32.5	6.5
Northridge (Pico Thrust)	34.1	7.0
Santa Rosa Island	39.6	7.1
San Andreas	44	8.5
Newport-Inglewood	50	6.9

Sources: Ninyo & Moore (2013), Rincon Consultants, Inc. (2004), SCEDC (2012), California Department of Conservation (2015)
Note: Maximum moment magnitude information for the McGrath Fault is not available.

Table 4.4-2
Summary of LORS – Geological Hazards and Resources

LORS	Administering Agency	Applicability	AFC Section
Federal			
International Building Code (IBC), 2015	City of Oxnard	Design criteria for excavations and structures under static and dynamic loading conditions	4.4.5.1
State			
Alquist-Priolo Earthquake Fault Zoning Act, PRC Sections 2621 through 2630	CEC City of Oxnard, Building and Engineering Services	Not applicable	4.4.5.2
CBC (latest edition available)	Superseded by IBC	Not applicable	4.4.5.2
California Coastal Act, Section 30253	CEC City of Oxnard, Building and Engineering Services	Design criteria for new development in coastal regions	4.4.5.2
Seismic Hazards Mapping Act, PRC Section 2690 through 2699.6	CEC City of Oxnard, Building and Engineering Services	Not applicable	4.4.5.2
Local			
Ventura County General Plan, Hazards Chapter (2010)	Ventura County	Outlines objectives and policies related to geologic hazards	4.4.5.3
City of Oxnard General Plan Safety Element (2011)	City of Oxnard	Outlines City objectives and policies related to geology and seismicity	4.4.5.3

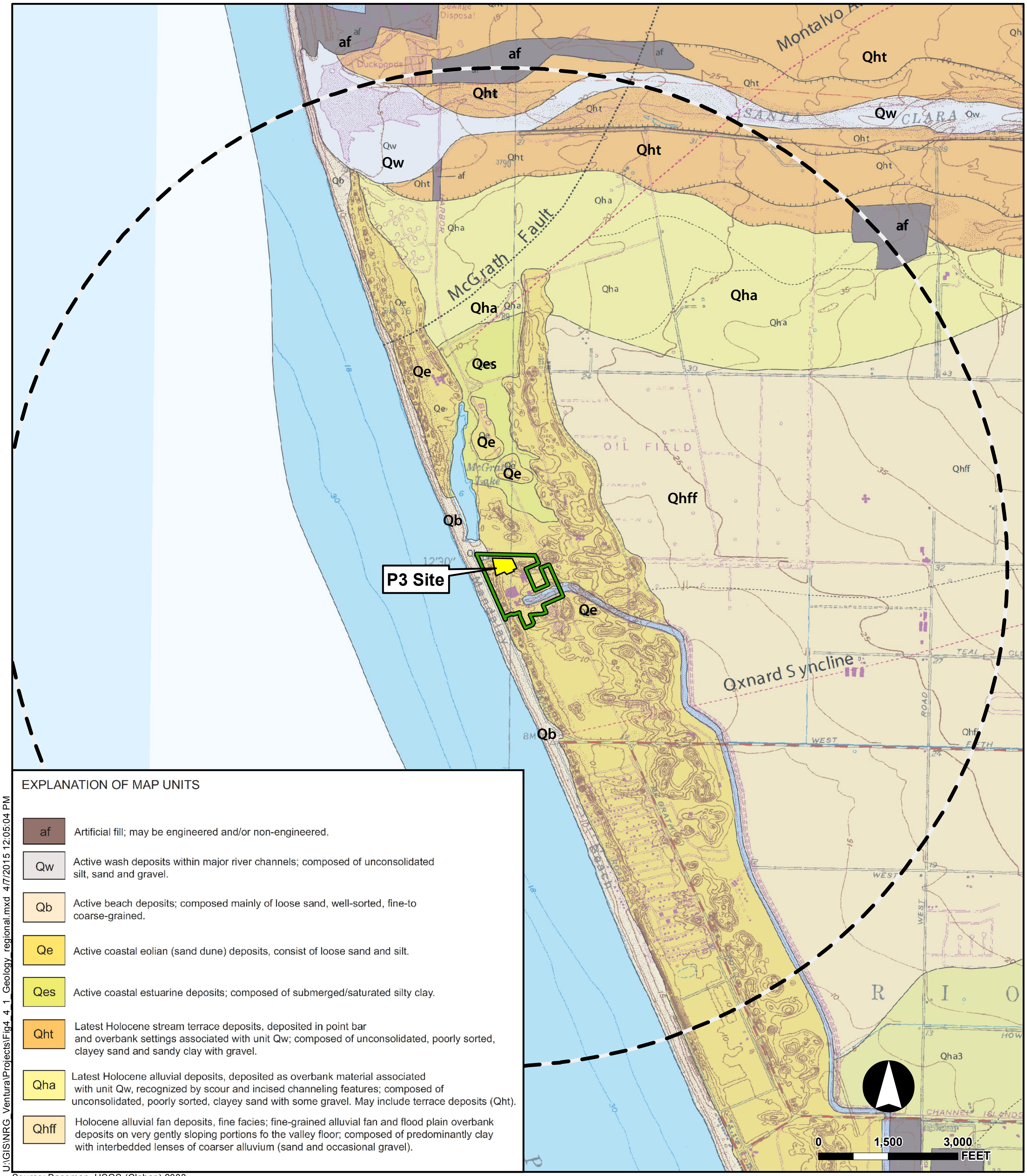
Notes:
AFC = Application for Certification
CEC = California Energy Commission
PRC = Public Resources Code

Table 4.4-3
Involved Agencies and Agency Contacts

Issue	Agency/Address	Telephone
Geologic Resources	California Geological Survey Headquarters/Office of the State Geologist 801 K Street, MS 24-01 Sacramento, CA 95814 cgshq@consrv.ca.gov	(916) 322-1080 (916) 445-0732 fax
Geologic Hazards	City of Oxnard, Building and Engineering Services City of Oxnard Service Center 214 South C Street Oxnard, CA 93030	(805) 385-7925 (805) 385-7854 fax

Table 4.4-4
Geological Hazards and Resources Permits Required and Permit Schedule

Responsible Agency	Permit/Approval	Schedule
City of Oxnard, Building and Engineering Services	Construction (and Grading) Permit	To be obtained before construction begins.



Source: Basemap, USGS (Clahan) 2003

Puente Power Project (P3) Site

Mandalay Generating Station Property

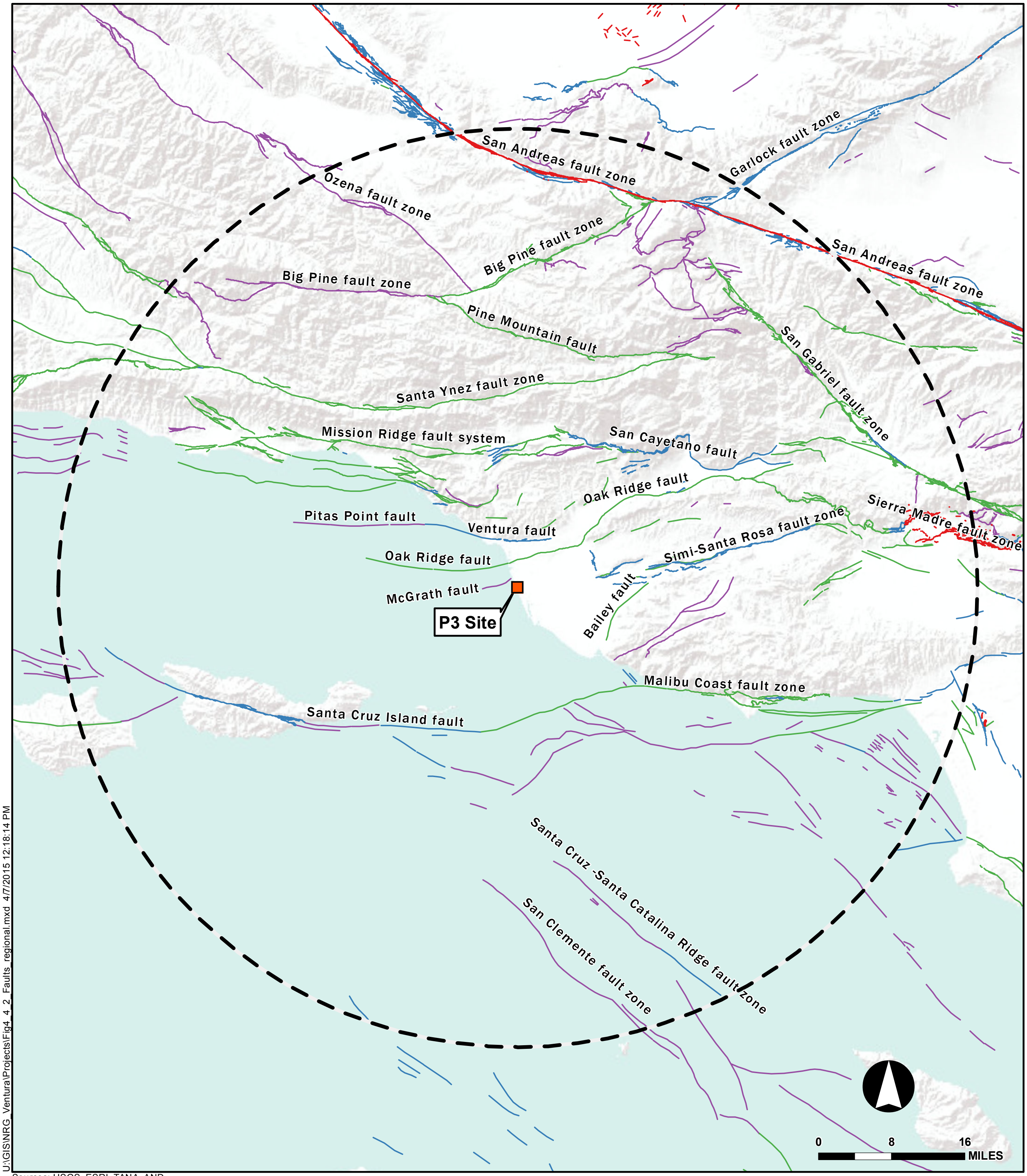
2-mile Buffer of Property

REGIONAL GEOLOGY

NRG
Puente Power Project
Oxnard, California

April 2015

FIGURE 4.4-1



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Sources: USGS, ESRI, TANA, AND

Fault Activity

- Historically Active
- Holocene Active
- Late Quaternary (Potentially Active)
- Quaternary (Potentially Active)

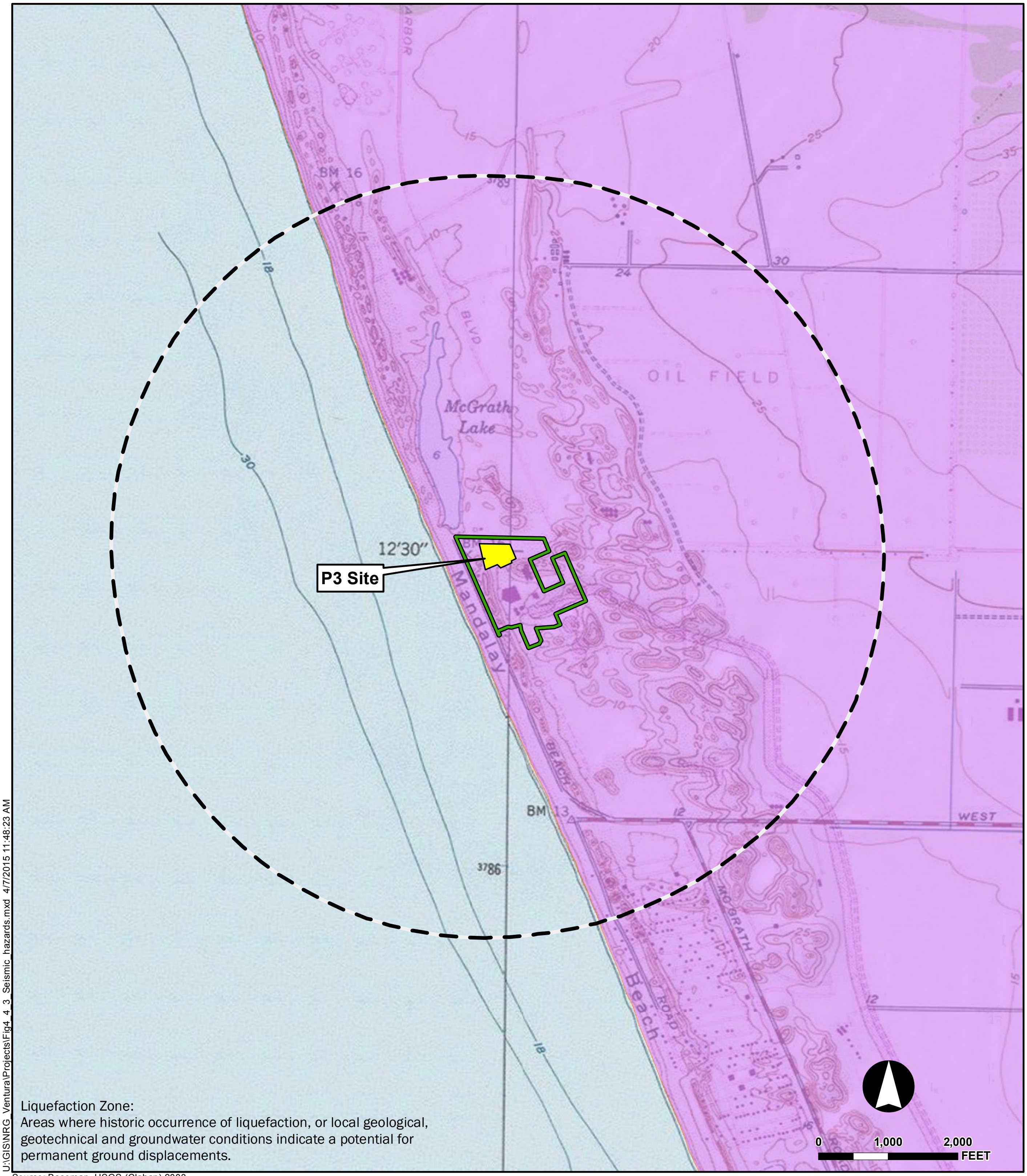
50-mile Buffer of Property

REGIONAL FAULTS

NRG
Puente Power Project
Oxnard, California

April 2015

FIGURE 4.4-2



Source: Basemap, USGS (Clahan) 2003

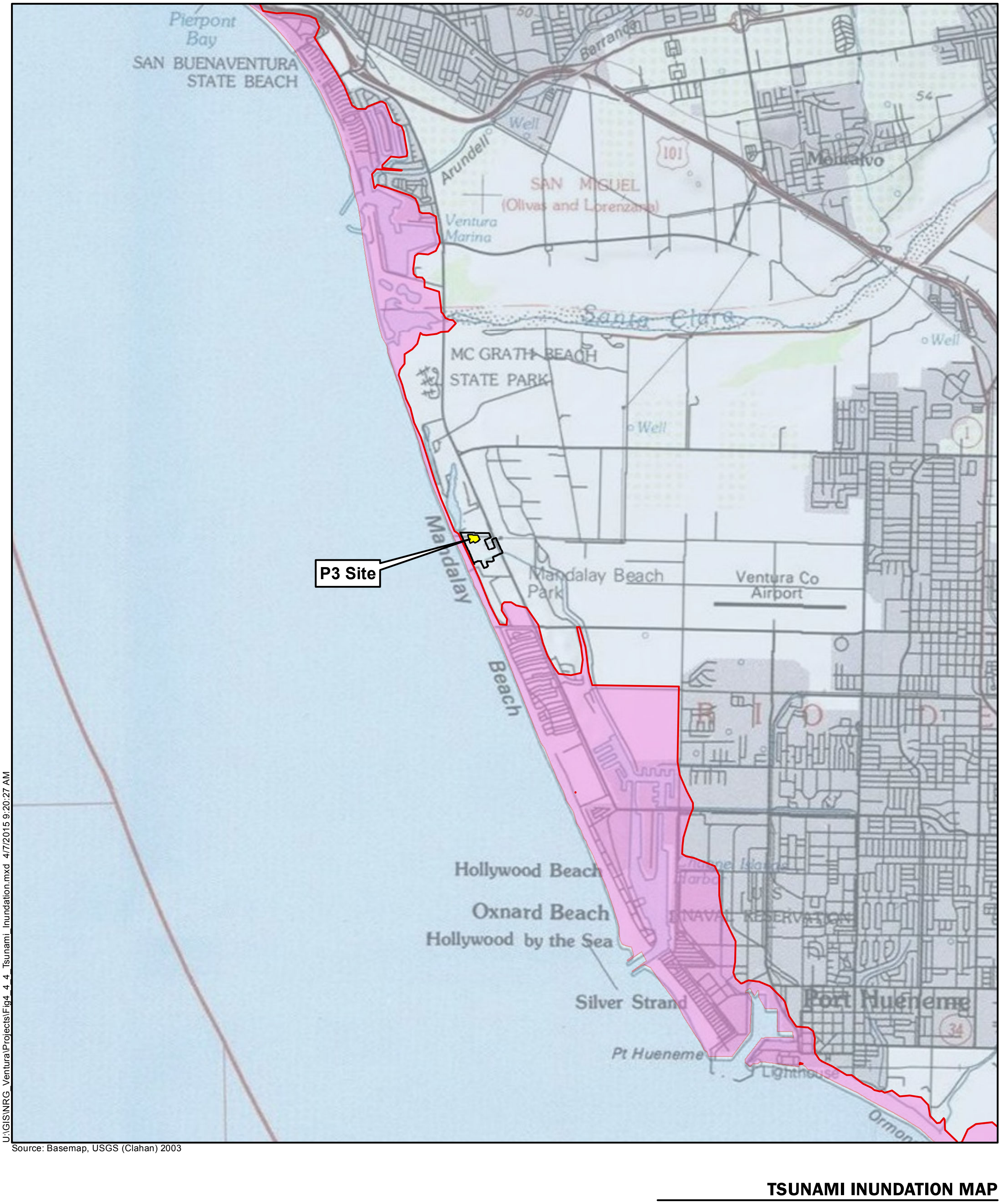
- Liquefaction Zone
- Puente Power Project (P3) Site
- Mandalay Generating Station Property
- 1-mile Buffer of Property

CALIFORNIA SEISMIC HAZARD ZONE

NRG
Puente Power Project
Oxnard, California

April 2015

FIGURE 4.4-3



Source: Basemap, USGS (Clahan) 2003

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Tsunami Inundation Area

Puente Power Project (P3) Site

Mandalay Generating Station Property

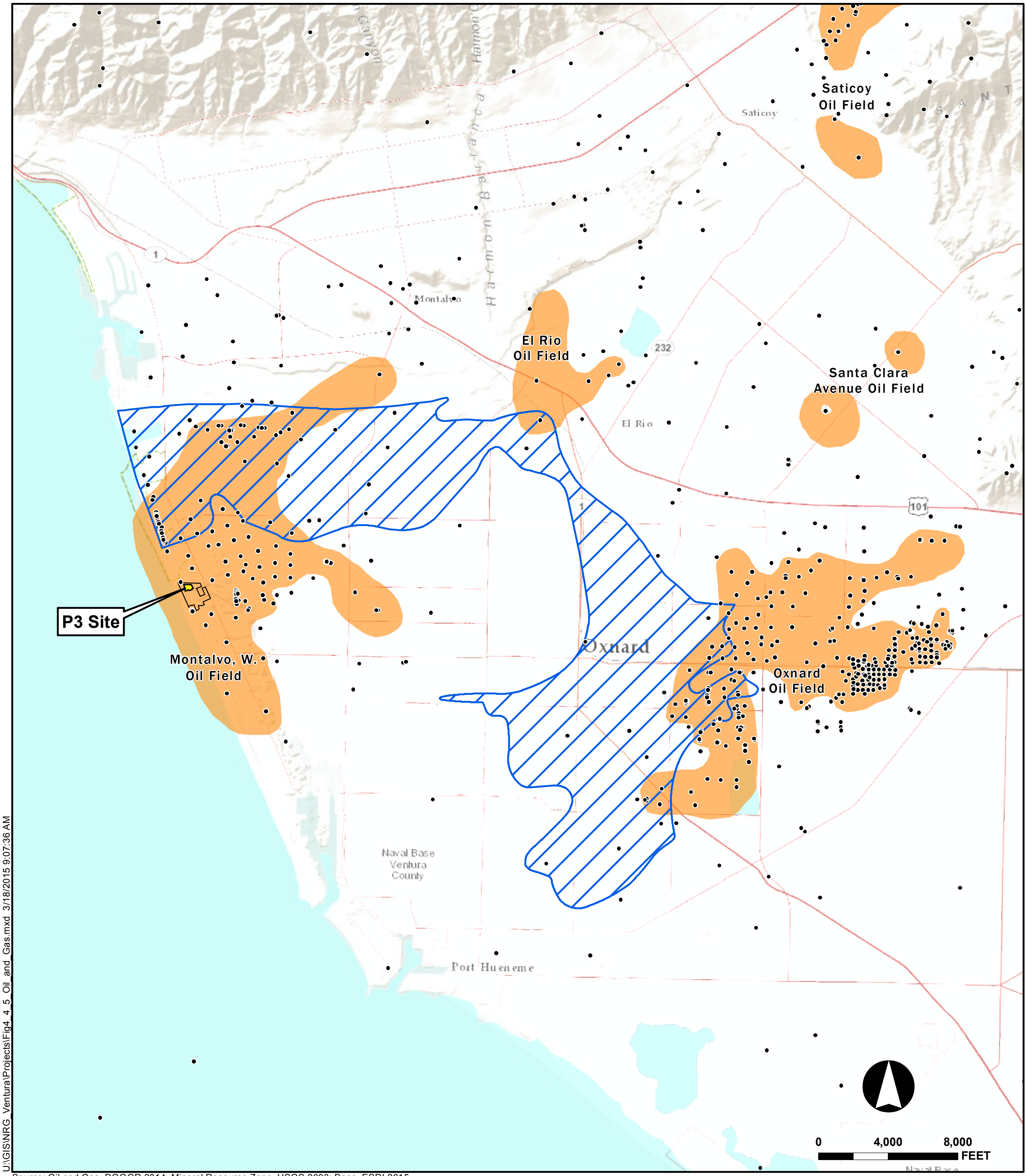
0 3,000 6,000 FEET

TSUNAMI INUNDATION MAP

April 2015

NRG
Puente Power Project
Oxnard, California

FIGURE 4.4-4



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Source: Oil and Gas, DOGGR 2014; Mineral Resource Zone, USGS 2003; Base, ESRI 2015.

- Oil/Gas Well
- Oil and Gas Field
- Mineral Resource Zone 3a[1]

[1] MRZ-3a:
Areas containing known mineral deposits, however the significance of which cannot be evaluated from available data.

MINERAL, OIL AND GAS RESOURCES

NRG
Puente Power Project
Oxnard, California

April 2015

FIGURE 4.4-5