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5.4 Geological Hazards and Resources

This section presents an evaluation of the Stanton Energy Reliability Center (SERC) in terms of potential exposure to geological hazards and potential to affect geologic resources of commercial, recreational, or scientific value. Section 5.4.1 describes the existing environment that could be affected, including regional and local geology and geological hazards. Section 5.4.2 identifies potential environmental effects from project development. Section 5.4.3 discusses potential cumulative effects. Section 5.4.4 discusses possible mitigation measures. Section 5.4.5 presents the laws, ordinances, regulations, and standards (LORS) applicable to geological hazards and resources. Section 5.4.6 identifies regulatory agencies and agency contacts. Section 5.4.7 describes the required permits. Section 5.4.8 provides the references used to develop this section.

5.4.1 Affected Environment

The SERC site is located in an industrial area within the City of Stanton, Orange County, California, at 10711 Dale Avenue. The SERC site and proposed gas and water supply pipelines will traverse flat terrain. The proposed generator tie-line will be along a 0.35-mile-long, 66-kilovolt underground generator tie-line to Southern California Edison Barre Substation adjacent to the site. The site is located on a gently sloping coastal plain that drains southwesterly toward the Pacific Ocean.

5.4.1.1 Regional Geology

The project site is in the Los Angeles Basin within the Peninsular Ranges geomorphic province of California (California Geological Survey [CGS], 2002). The Peninsular Ranges are a series of mountain ranges separated by northwest-trending valleys, which characterizes the southwestern portion of California. The project site is located on the Anaheim 7.5-minute Quadrangle. The main body of this quadrangle is underlain by the broad, northwest-plunging synclinal Los Angeles Basin. The Los Angeles Basin is underlain by over 4,000 feet of relatively unconsolidated Pleistocene marine and non-marine sediments (California Department of Conservation [CDOC], 1997).

5.4.1.1.1 Faulting and Seismicity

Numerous faults have been mapped in southern California, several of which are within approximately 62 miles (100 kilometers) of the project site. The CGS requires that faults within 100 kilometers that could affect the site be identified. The major active and potentially active fault systems that could produce significant ground shaking at the site include the Whittier and Newport-Inglewood, among other faults.

5.4.1.2 Local Geology and Stratigraphy

Underlying the site and project linears is a thick layer of Quaternary Age alluvium. During a recent preliminary geotechnical investigation conducted on the site (NV5 West, Inc. [NV5], 2016), alluvial soil was encountered to the maximum depth explored of 51.5 feet below the ground surface (bgs). The alluvium generally consists of light brown to dark gray medium dense silty to clayey sand and soft to firm sandy to clayey silts (NV5, 2016). Surficial geology in the vicinity of SERC is shown on Figure 5.4-1a and Figure 5-4-1b.

The preliminary site-specific preliminary geotechnical report for SERC is found in Appendix 5.4A.

5.4.1.3 Seismic Setting

The tectonic setting of Southern California is complex and is made up of numerous fault systems, including strike-slip, oblique, thrust, and blind thrust faults. Therefore, any specific area is subject to seismic hazards of varying degree, dependent on the proximity to and length of nearby active and potentially faults and the local geologic and topographic conditions. Seismic hazards include primary hazards: seismic shaking and ground rupture along the fault trace, and secondary hazards resulting from strong ground shaking such as liquefaction and lateral spreading. The SERC site area can be characterized as an active seismic area, with the potential for large-magnitude earthquakes to occur.

5.4.1.4 Potential Geological Hazards

The following subsections discuss the potential geological hazards that might occur in the project area.

5.4.1.4.1 Ground Rupture

Ground rupture is caused when an earthquake event along a fault results in rupture of the surface. As shown on Figure 5.4-2, the project site is not transected by known active or potentially active faults (CGS, 2010). The known active and potentially active faults in the vicinity of SERC are shown on Figure 5.4-2. The site is not located within an Alquist-Priolo Earthquake Fault Zone (AP EFZ) (CGS, 2007).

The nearest mapped EFZs are associated with the Whittier Fault located approximately 10 miles to the northeast of the site, the Newport-Inglewood Fault located approximately 7 miles to the southwest of the site, and a short unnamed fault located in the west Coyote Hills approximately 5 miles north of the site (CGS, 2007).

The likelihood of a ground rupture to occur due to movement along an active fault at the SERC site is considered low.

5.4.1.4.2 Seismic Shaking

The SERC site area has experienced strong ground motion during past earthquakes, and it is likely that strong ground motions will occur at the site in the future. The primary geological hazard at the SERC site is strong ground-shaking during an earthquake. A Design Spectral Acceleration (parameter S_{D1}) of 0.54g is considered for the design of the project (NV5, 2016). An updated seismic evaluation will be conducted during the project's future design-level geotechnical investigation, in accordance with current California Building Code (CBC) standards, and will be conducted post-certification pursuant to standard California Energy Commission (CEC) Conditions of Certification.

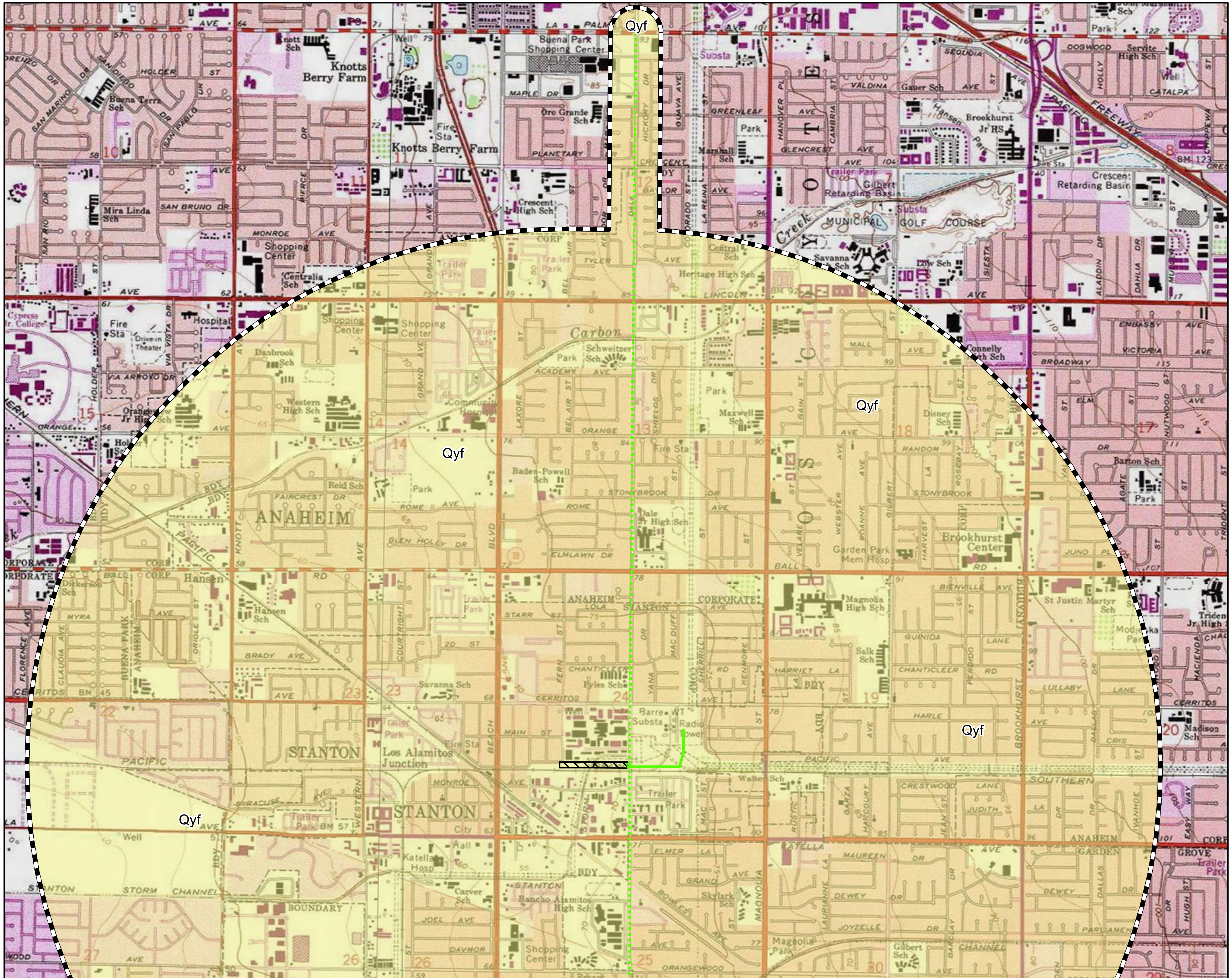
5.4.1.4.3 Liquefaction

During strong ground shaking, loose, saturated, cohesionless soils can experience a temporary loss of shear strength and can act as a fluid. This phenomenon is known as liquefaction. Liquefaction typically occurs within the upper 50 to 75 feet bgs, and is dependent on the depth to water table, grain size distribution, relative soil density, degree of saturation, and intensity and duration of the earthquake. The potential hazards associated with liquefaction are ground deformation (soil densification) and lateral spreading.

Soil conditions at the SERC site predominantly consist of quaternary alluvial deposits that could include liquefiable materials. According to the State of California seismic hazards zones map, the SERC site is located in a *Zone of Required Investigation* for liquefaction (CDOC, 1998).

Depth to water during the geotechnical investigation conducted at this property (NV5, 2016) was reported at 20 feet bgs. Borings advanced to 51.5 feet bgs identified subsurface material consisting of poorly to moderately consolidated alluvial silt and with varying contents of clay. The findings of the 2016 study concluded that some of the soil layers underlying the site are susceptible to liquefaction.

In addition, a previous geotechnical investigation conducted at the site in 2011 also determined that the site is susceptible to liquefaction based on the assumed groundwater surface. The potential for liquefaction to occur at the site is moderate based on the depth and thickness of the liquefiable soil. Factors of safety against liquefaction within the liquefiable zones ranged up to 1.0. Given the depth below the ground surface and the thickness of liquefiable soil, the potential for surface expression of liquefaction (i.e., sand boils and so on) is considered low (Kling, 2011).



LEGEND

- Project Site
- Generator Tie-Line
- Proposed Natural Gas Pipeline Route Alternatives
- 2-Mile Project Site Buffer
- Qyf Quaternary young alluvial fan

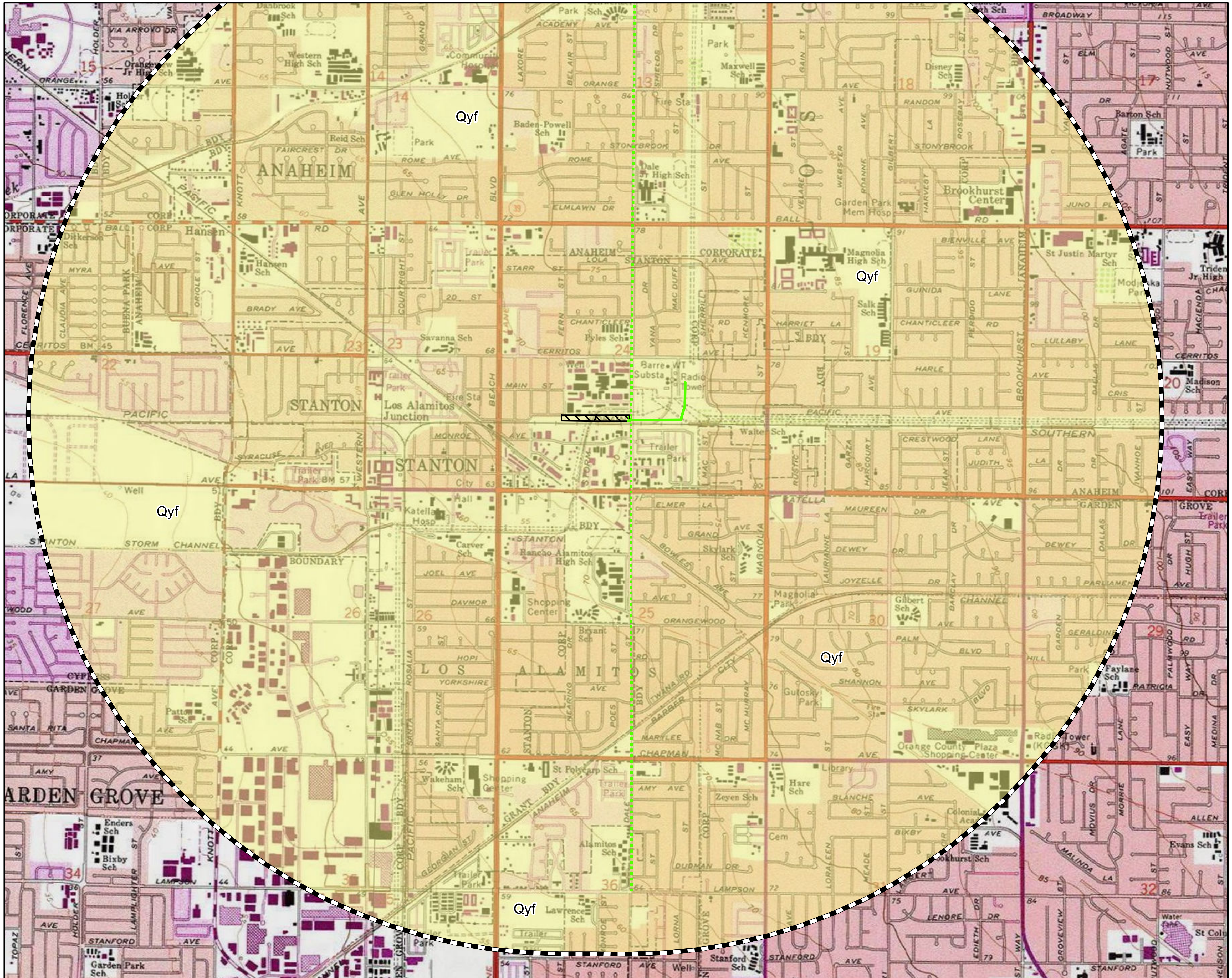
Source:
USGS Geologic Map of the Los Alamitos, Anaheim 7.5' Quadrangles, Orange County, California (1977).

USGS, 2004. Preliminary Digital Geologic Map of the Santa Ana 30' X 60' Quadrangle, Southern California. Open File Report 99-172, Version 2.0 – 2004.

0 1,500 3,000
Feet

Figure 5.4-1a
Surface Geology
Within Two Miles of Project Site
Stanton Energy Reliability Center AFC
Stanton, California

ch2m



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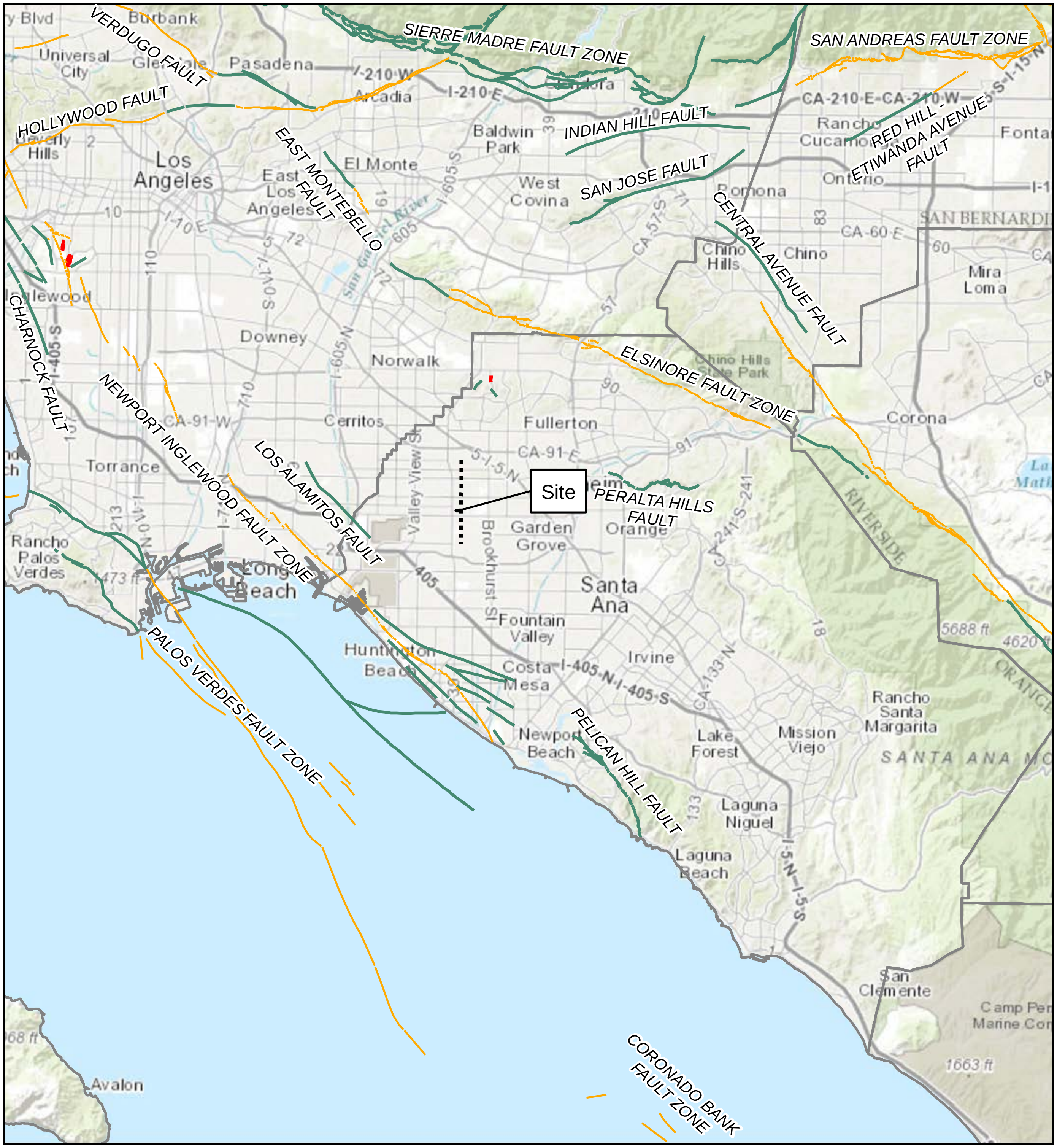
0 1,500 3,000
Feet

N

Figure 5.4-1b
Surface Geology
Within Two Miles of Project Site
Stanton Energy Reliability Center AFC
Stanton, California

\\BROOKSIDE\GIS_SHARE\ENBG\00_PROJ\S\SERC\MAPFILES\REPORT\2016\FIG_5 4-1B_GEOLOGICAL_2MI.MXD SSTEWAR8 10/18/2016 7:41:32 PM

ch2m.



Source: Esri World Terrain Imagery, Califorina Geological Survey (GGS)
Reference: 2010 CGS Fault Activity Map

LEGEND
- Historically Active
- Holocene Active
- Late Quaternary (Potentially Active)
- Quaternary (Potentially Active)
- County Boundaries
- Proposed Natural Gas Pipeline Route Alternatives
- Project Site

N

0 22,000 44,000 Feet

FIGURE 5.4-2
Regional Fault Map
Stanton ERC
Stanton, California

ch2m

Seismically induced settlement could occur up to 6 inches within the footprint of proposed structures from a design-level earthquake (NV5, 2016).

5.4.1.4.4 Mass Wasting

The potential for mass wasting (landsliding) to occur depends on steepness of the slope, underlying geology, surface soil strength, and moisture in the soil. Significant excavating, grading, or fill work during construction might introduce mass wasting hazards at the project site. Because the SERC site is relatively flat and no significant excavation is planned, the potential for direct impact from mass wasting at the site is considered low to negligible.

5.4.1.4.5 Subsidence

Subsidence is any settling or sinking of the ground surface over a regional area typically as a result of groundwater and/or oil extraction. The SERC area is not noted to be within an area of known subsidence hazards.

The 2016 geotechnical investigation conducted at the site concluded that the potential for subsidence to occur at the site attributable to withdrawal of oil, gas, or water is considered low (NV5, 2016).

5.4.1.4.6 Expansive Soils

Expansive soils shrink and swell with wetting and drying. The shrink-swell capacity of expansive soils can result in differential movement beneath foundations. Expansive soils, if present, can be readily mitigated by either soil amendments or by removal and replacement with nonexpansive soils, among other methods.

The SERC area is not noted to be in an area of expansive soil. The materials encountered during the 2016 geotechnical investigation borings did not note the presence of clay rich soils (NV5, 2016). The expansion potential of the onsite soils is low (NV5, 2016).

5.4.1.4.7 Tsunamis and Seiches

Tsunamis are seismically induced ocean waves with very long periods. Tsunamis may be manifested in the form of wave bores or a gradual upwelling of sea level and can be caused by offshore landslides or earthquakes. Because the SERC is located roughly 70 feet above mean sea level (United States Geological Survey, 2012), the potential for a significant tsunami event that would affect the site is negligible. In addition, the SERC site does not lie within a mapped inundation area, according to the CGS (CGS, 2009).

Seiches are defined as oscillations in confined or semiconfined bodies of water due to earthquake shaking. Because there are no large bodies of water near the project site, there is no potential for a seiche to impact the SERC.

5.4.1.5 Geologic Resources of Recreational, Commercial, or Scientific Value

At the SERC site, the geologic units at the surface and in the subsurface are widespread alluvial deposits that occur throughout the greater Orange County/Los Angeles County areas; these units are not unique in terms of commercial value. The potential for recreational or scientific (e.g., rare mineral or fossil) deposits is very low, given the geologic environment in the area.

Known commercial petroleum deposits are in the vicinity of the SERC area. There are a small number of older petroleum wells, but they are no longer active and have been plugged. According to online maps of the California Division of Oil, Gas, and Geothermal Resources (2016), there are no active wells within 2 miles of the SERC site.

In 1994, the California Division of Mines and Geology published a comprehensive mineral land classification for aggregate materials in the Orange County area. Based on this study, the SERC area is mapped as Mineral Resource Zone 4 (CDOC, 1994). Mineral Resource Zone 4 is defined by the Surface Mining and Reclamation Act of 1975 as an area where inadequate information is available to determine the appropriate Mineral Resource Zone categorization (CDOC, 2000).

5.4.2 Environmental Analysis

The potential effects from construction and operation of SERC on geologic resources and risks to life and property from geological hazards are presented in the following subsections.

5.4.2.1 Significance Criteria

According to Appendix G of the California Environmental Quality Act statutes, a project would have a significant environmental impact in terms of geological hazards and resources if it would do the following:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving the following:
  - Rupture of a known earthquake fault (AP EFZ)
  - Strong seismic ground shaking
  - Seismic-related ground failure, including liquefaction
- 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 offsite landslide, subsidence, or liquefaction
- 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 plan, specific plan, or other land use plan

5.4.2.2 Geological Hazards

Similar to most sites within southern California, there is significant potential for seismic ground shaking to affect the SERC site and linears in the event of a large-magnitude earthquake occurring on fault segments near the site. The SERC, however, is not located within a mapped AP EFZ area. The project will, therefore, not be likely to cause direct human exposure due to ground rupture during an earthquake. Seismic hazards will be minimized by conformance with the recommended seismic design criteria of the 2013 or more recent and applicable CBCs (California Building Standards Commission, 2013). Liquefaction and subsidence potential present at the site will need to be considered during SERC design.

The probability of mass wasting or flooding at the SERC site is low to negligible.

In summary, compliance with the applicable CBC requirements will reduce the exposure of people to the risks associated with large seismic events and associated liquefaction to less-than-significant levels. Additionally, major structures will be designed to withstand the strong ground motion of a Design Basis Earthquake, as defined by the applicable CBC. Through compliance with CBC standards, impacts associated with geological hazards will be less than significant.

5.4.2.3 Geological Resources

The SERC will not result in a loss of availability of a known mineral resource that would be of value to the region and the residents of the state. Additionally, SERC will not result in the loss of availability of a locally important mineral resource recovery site delineated on a local plan, specific plan, or other land use plan.

5.4.3 Cumulative Effects

A cumulative impact refers to a proposed project's incremental effect together with other closely related past, present, and reasonably foreseeable future projects whose impacts may compound or increase the incremental effect of the SERC (Public Resources Code Section 21083; CCR, Title 14, Sections 15064[h], 15065[c], 15130, and 15355).

The SERC will not cause adverse impacts on geological resources and will not cause an exposure of people or property to geological hazards. Additionally, there are no minor impacts that could combine cumulatively with those of other projects. Thus, the SERC will not result in a cumulatively considerable impact.

5.4.4 Mitigation Measures

To address potential impacts related to geological hazards, the following mitigation measures are proposed for the SERC:

- Structures will be designed to meet seismic requirements of the applicable CBC. Moreover, the design of plant structures and equipment will be in accordance with applicable CBC seismic design requirements to withstand the ground motion of the Design Basis Earthquake.
- A geotechnical engineer and/or engineering geologist will be assigned to the project to carry out the duties required by the CBC to assess geologic conditions during construction and to approve actual mitigation measures used to protect the facility from geological hazards.
- Potential liquefaction-derived settlement will be reduced to acceptable levels by the use of either ground improvement techniques (such as compaction grouting, vibro replacement, or dry soil mixing, among others) or deep foundations (such as drilled piers, rock columns, or drilled piles, among others) that account for the estimated liquefaction-derived settlement. The final foundation type selected will be based on the recommendations presented in the final geotechnical engineering report prepared in accordance with the CEC standard Conditions of Certification.

With the implementation of these mitigation measures, SERC will not result in significant direct, indirect, or cumulative geology-related impacts.

5.4.5 Laws, Ordinances, Regulations, and Standards

The LORS that may apply to geologic resources and hazards are summarized in Table 5.4-1. The local LORS discussed in this section are certain ordinances, plans, or policies of the City of Stanton. There are no federal LORS that apply to geological hazards and resources.

Table 5.4-1. LORS for Geological Hazards and Resources

LORS	Requirements/ Applicability	Administering Agency	Application for Certification Section Explaining Conformance
State			
CBC, 2013 as amended by City of Stanton	Acceptable design criteria for structures with respect to seismic design and load-bearing capacity	California Building Standards Commission, State of California, and City of Stanton	Section 5.4.2.2
AP EFZ Act (Title 14, Division 2, Chapter 8, Subchapter 1, Article 3, CCR)	Identifies areas subject to surface rupture from active faults	California Building Standards Commission, State of California, and City of Stanton	Section 5.4.2.2
The Seismic Hazards Mapping Act (Title 14, Division 2, Chapter 8, Subchapter 1, Article 10, CCR)	Identifies secondary seismic hazards: liquefaction and seismically induced landslides	California Building Standards Commission, State of California, and City of Stanton	Section 5.4.2.2
Local			
City of Stanton General Plan, 2013	City of Stanton	City of Stanton	Section 5.4.2.2

5.4.6 Agencies and Agency Contacts

Compliance of building construction with CBC standards is covered under engineering and construction permits for the SERC. There are no other permit requirements that specifically address geologic resources and hazards. However, excavation/grading and inspection permits may be required prior to construction, and they will be included in the overall project construction permit (see Section 5.6, Land Use).

5.4.7 Permits and Permit Schedule

No permits are required for compliance with geological LORS. However, the City of Stanton Building Department is responsible for inspections and for ensuring compliance with building standards.

5.4.8 References

California Building Standards Commission. 2013. *2013 California Building Code*, California Code of Regulations.

California Department of Conservation (CDOC). 1994. *Generalized Mineral Land Classification Map of Orange County, Aggregate Resources Only. Open File Report 94-15, Plate 1.*

California Division of Oil, Gas, and Geothermal Resources (CDOGGR). 2016. Oil and Gas Field Maps. http://www.consrv.ca.gov/dog. Accessed August 15, 2016.

California Geological Survey (CGS). 2010. *Fault Activity Map. Geologic Data Map No. 6.* California Department of Conservation. Available online: http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html. Accessed August 16, 2016.

California Geological Survey (CGS). 2009. *Tsunami Inundation Map for Emergency Planning.* Available online: http://www.conservation.ca.gov/cgs/geologic_hazards/Tsunami/Inundation_Maps/Orange/Documents/. Accessed August 16, 2016.

California Geological Survey (CGS). 2007. *Special Publication 42 (Interim Revision 2007). Fault-Rupture Hazard Zones in California. Alquist-Priolo Earthquake Fault Zoning Act*. California Department of Conservation.

California Geological Survey (CGS). 2002. *California Geomorphic Provinces, Note 36.* California Department of Conservation. December.

California State Mining and Geology Board, Department of Conservation (CDOC). 2000. *Surface Mining and reclamation Act (SMARA) Regulations. Third Revision.* January.

Division of Mines and Geology, Department of Conservation (CDOC). 1998. *Seismic Hazards Map. Anaheim Quadrangle.* April.

Division of Mines and Geology, Department of Conservation (CDOC). 1997. *Seismic Hazard Zone Report foe the Anaheim and Newport Beach 7.5-Minute Quadrangles, Orange County, California.*

Kling Consulting Group (Kling) 2011. *Geotechnical Investigation and Percolation Testing, Proposed David's Tree Service Center, 10711 Dale Street, Stanton CA*. August.

NV5 West, Inc. (NV5). 2016. Draft Stanton Energy Reliability Center Preliminary Geotechnical Investigation Report. September.

United States Geological Survey. 2012. Topographic Map of the Anaheim 7.5 Minute Quadrangle.