San Luis West Solar Project

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GEOLOGY AND SOILS REPORT

Fresno County, California

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ACRONYMS AND ABBREVIATIONS

AC	alternating current
APN	Assessor's Parcel Number
BESS	Battery Energy Storage System
CEQA	California Environmental Quality Act
gen-tie	generation-tie
kV	Kilovolt
mg/kg	milligram per kilogram
MW	Megawatt
MWh	Megawatt hours
Ω-cm	Ohm-centimeter
POI	Point of Interconnect
PV	photovoltaic
SB	Senate Bill
SR	State Route
O&M	Operation & Maintenance
PG&E	Pacific Gas & Electric Company
Project	San Luis West Solar Project

1.0 BACKGROUND

San Luis West Solar, LLC proposes to construct and operate the proposed San Luis West Solar Project (Project), on an approximately 1,100-acre site in Fresno County, California (herein referred to as the Project site). The Project requires compliance with the California Environmental Quality Act (CEQA). This report provides an initial assessment of the geology and soils at the Project site to support CEQA analysis for the Project.

1.1 Report Objectives

This report is intended to provide a detailed desktop review of both the geologic setting of the Project site and the nature of the soils found on the Project site. The analysis included herein provides available information on bedrock geologic units, surficial (surface-level) geologic units, seismic setting and activity, and any potential risks at the Project site from landslides or liquefaction.

Soil descriptions and properties are provided from available Natural Resources Conservation Service (NRCS) data. Soil types, textures, and properties can help identify potentially unstable, or marginally stable, soil units on the Project site that might require specific engineered improvements during or prior to construction.

Geotechnical field investigations were performed for the Project by Westwood Professional Services [Westwood] in September 2018 and December 2023.

1.2 Project Description

The Project consists of a photovoltaic (PV) solar generating facility with a nameplate production capacity of 125 megawatts (MW) of alternating current (AC) renewable energy as well as a Battery Energy Storage System (BESS) capable of storing approximately 30 MW of energy with a 4-hour/120 MW-hour (MWh) storage duration. The Project is a utility-scale solar farm on seven parcels totaling approximately 1,400 acres, including solar panels, security fencing, and BESS storage modules. The Project site, which encompasses all areas of temporary and permanent impacts, is approximately 1,100 acres.

The Project site is located in an unincorporated area of southern Fresno County (County), approximately 10 miles northwest of Kettleman City and will connect to Pacific Gas and Electric Company's (PG&E's) 500-kV Gates substation (see Figure 1). The seven parcels associated with the project occupy parts of six different sections, spread among Townships 20 and 21 South, and Ranges 17 and 18 East, of the Mount Diablo Meridian (see Figure 2). The Project parcels are situated adjacent or proximal to West Jayne Avenue, from the Gates substation on the western extent to the California Aqueduct on the eastern extent. The Project site is primarily agricultural land, zoned AE-20 or AE-40 (Exclusive Agriculture with a minimum lot size) in the unincorporated areas of Fresno County. The parcels in the general vicinity of the Project site are similarly zoned.

Existing agricultural roads within the Project site will be used for access during construction. No road improvements have been proposed as a part of the Project at the time of this report. The Project site includes three subareas, shown on Figure 2 as Subareas A, B, and C. These Subareas are defined below:

Figure 1. Regional Setting

Figure 2. Project Layout

- **Subarea A** would include approximately 280 acres of solar arrays and associated infrastructure (i.e., internal roads, medium voltage collection lines, substation, BESS and project O&M building) located on four parcels totaling approximately 800 acres, of which approximately 650 acres are currently leased by the Project and approximately 150 acres are owned by the Project. Subarea A is located southeast of the existing PG&E Gates Substation, immediately south of West Jayne Avenue and approximately 0.5-mile due west of SR-269. The Substation will also be located within Subarea A and it is anticipated that the BESS will be co-located with the Substation in Subarea A. Two temporary laydown areas totaling approximately 10 acres would be located in Subarea A, along West Jayne Avenue.
- **Subarea B** would include approximately 250 acres of solar arrays and associated infrastructure (i.e., internal roads and medium voltage collection lines) on one parcel, consisting of approximately 300 acres of fully leased land. Subarea B is bordered by SR-269 to the west, West Jayne Avenue to the south, and active row crops to the east.
- **Subarea C** would include approximately 240 acres of solar arrays and associated infrastructure (i.e., internal roads and medium voltage collection lines) on approximately 325 acres of land leased by the Project. Subarea C consists of two parcels located just west of the California Aqueduct. West Jayne Avenue bisects the bottom half of Subarea C.

Energy from the various solar arrays transmitted to the Substation via a series of 34.5 kilovolt (kV) “collection lines”. As depicted in Figure 2, the collection line will begin in the middle section of Subarea B and run directly south along an existing agricultural road for approximately 0.75-mile before angling slightly west and undergrounding at West Jayne Avenue to connect with Subarea A. The collection line system will connect to the BESS and Substation in Subarea A, then a 230 kV gen-tie line will connect from Subarea A to the Point of Interconnection (POI) at the PG&E Gates substation.

1.3 Previous Investigations

Geotechnical field investigations were performed for the Project in September 2018 (Westwood 2018) and December 2023 (Westwood 2024). Data from a total of 18 boreholes were considered in preparing the current report; one was drilled to a depth of 51.5 feet, fourteen were drilled to a depth of 21.5 feet, and three were drilled to a depth of 17.5 feet. One or two samples were collected from the shallow boreholes (17.5 feet to 21.5 feet) and six were collected from the deep borehole (51.5 feet). A variable subset of these samples was evaluated for texture (grain-size distribution), chemistry, electrical resistivity, Atterberg limits, density (in-situ and maximum dry), and optimum moisture content. Six field electrical resistivity tests were also performed using north-south and east-west transects.

In addition, two public documents for the proposed Orchard Substation Project (Orchard Substation), a proposed upgrade to the adjacent Gates Substation, were reviewed. Terracon (2019) performed a geotechnical investigation that relied on a field survey, two 51.5-foot-deep boreholes, sample collection, in-situ resistivity testing, and laboratory evaluation of samples for the proposed Orchard

Substation site. McComas and Deméré (2020) also prepared a technical report evaluating the potential for paleontological resources to be found on the Orchard Substation site. Relevant details from these documents were evaluated for applicability to the Project site and are summarized below (see Sections 2.3, Geotechnical Considerations and 2.4, Paleontological Concerns).

2.0 REGIONAL SETTING

The Project site is located in an unincorporated area of southern Fresno County, California, less than 2 miles northwest of the boundary with Kings County and about 1.5 miles east of Interstate 5 (I-5). It is situated between the towns of Huron (to the north), Kettleman City (to the southeast), and Coalinga (to the west) on the west side of the San Joaquin Valley (Figure 1). The Project site occupies parts of seven parcels that are divided among three contiguous groupings, or Subareas, with the westernmost Subarea (Subarea A) across Jayne Avenue from PG&E’s Gates Substation (Figure 2). This location is found on the Huron and Guijarral Hills U.S. Geological Survey (USGS) 7.5-minute topographic quadrangles with the center point of the Project site at approximately latitude 36° 8' 36.01" north and longitude 120° 5' 4.80" west (36.14334° N and -120.08466° W).

2.1 Geomorphology and Topography

The Project site is in the southern half of the Great Valley Geomorphic Province (Great Valley province), along its western edge where it adjoins the Coastal Ranges Geomorphic Province (Figure 1). The Great Valley province is a broad, flat, alluvial plain approximately 50 miles wide and 400 miles long in the central part of California. It is situated between the Sierra Nevada and Cascade mountains to the east and various mountains of the Coast Ranges to the west. The Great Valley province is composed of two parts: (1) the Sacramento Valley in the north, drained by the Sacramento River; and (2) the San Joaquin Valley in the south (CGS 2002). Drainage in the San Joaquin Valley predominantly flows to the north and the Sacramento-San Joaquin Delta. An exception to this is Tulare Lake, a low-lying, periodically flooded area to the east and south of the Project site. For the first time in over 40 years (during the wet season of 2022-23) it received enough runoff to temporarily recreate Tulare Lake (Bush 2023). Runoff from the Project site would ultimately lead to the Tulare Lake area.

The Project site is very flat, with a gentle (less than 0.5 percent) slope generally to the east, with elevations ranging from approximately 410 feet above sea level (asl) on the western portion to approximately 330 feet asl on the eastern portion. No natural drainage courses traverse the site and the nearest established channel, Los Gatos Creek, is approximately 1.1 miles northwest of the site. Los Gatos Creek drains to a small area of the Coast Ranges and flows east through Coalinga before turning northeast into the San Joaquin Valley.

Figure 3. Geology of Project Site

2.2 Faulting and Seismicity

The Central Valley has a relatively low seismic activity level, with the few active faults mapped within it generally occurring along the boundaries with adjoining geomorphic provinces. The Alquist-Priolo Earthquake Fault Zoning Act (1972) provides information on areas with active faults that could pose risks to new development or existing infrastructure. Areas along and adjacent to active faults require further evaluation to determine specific risks and development requirements to reduce or eliminate the risks. There are two such zones in the mountains of the Coast Ranges to the west of the site: the Nuñez Fault Zone, which extends approximately 3 miles in length, and the San Andreas Fault Zone, which extends the entire length of California. As shown in Figure 3, the Nuñez Fault Zone is located approximately 20 miles west-northwest of the site, while the closest point of the San Andreas Fault Zone is located approximately 26 miles to the southwest (CGS 2024). The areas immediately surrounding the Project site are classified as "unevaluated" and do not include any zones identified as requiring special studies (CGS 2024).

Scientists from the USGS, the California Geological Survey (CGS), and other organizations have developed a model to predict the likelihood of earthquakes on various faults and portions of fault zones throughout the state (Field et al 2015). The model, known as the Uniform California Earthquake Rupture Forecast (UCERF3) provides probabilities of an earthquake of various magnitudes for several faults that are not yet identified under the Alquist-Priolo program.

Table 1 presents the range of probabilities for an earthquake at or above a specific magnitude occurring on the various segments of these fault zones. Areas closest to the San Andreas Fault Zone have a relatively high likelihood (8 percent to 21 percent) of a significant earthquake occurring within the next 30 years. The rest of the faults have a very small likelihood (less than 1 percent) of a high magnitude earthquake occurring within the same time period.

Table 1. Earthquake Probabilities

Fault Zone	Distance (miles)	Probability of an Earthquake in the next 30 years		
Richter-Scale Magnitude:		**≥ 6.7**	**≥ 7.0**	**≥ 7.5**
Great Valley 12	19.0	0.52% - 0.63%	0.38% - 0.40%	0.14%
Great Valley 13 (Coalinga)	0.65	0.50% - 0.61%	0.41% - 0.47%	0.14%
Great Valley 14 (Kettleman Hills)	0.31	0.50%	0.37%	0.14%
Lost Hills	25.0	0.84% - 0.88%	--	--
San Andreas (Creeping section)	26.5	8.09% - 13.23%	7.92% - 13.05%	6.94% - 8.98%
San Andreas (Parkfield section)	24.2	13.44% - 16.88%	13.33% - 16.73%	10.19% - 12.41%
San Andreas (Cholame section)	27.8	18.92% - 21.52%	18.73% - 21.27%	13.63% - 15.70%
San Juan	27.0	0.41% - 0.50%	0.31% - 0.40%	0.03% - 0.05%

Source: Field et al (2015).

2.3 Geotechnical Considerations

The preliminary geotechnical investigation prepared for the Project used data from six boreholes placed in each of the three Project areas, and seven in-situ electric resistivity tests. All of the boreholes drilled in 2023 reached the target depth of 21.5 feet below the ground surface, except for one borehole in Area A intended to go deeper and reached its target depth of 51.5 feet. Three of the boreholes in Area C were drilled in 2018, and they all reached their target depth of 17.5 feet. Textural classifications were heavy on clay content, though clay soils were characterized as “lean” (less than 30% of grains in the clay size range) or as clay-silt mixtures (also suggesting lean clays). Soils in the sand and silt classifications also contained measurable amounts of clay. Moisture content ranged from under 3 percent to over 30 percent, but no groundwater was encountered at these depths. Based on the physical characteristics of these soils, Westwood (2023) assigned them a Seismic Site Class of “D” (Stiff Soil) under the American Society of Civil Engineers (ASCE) Standards. In this system, Site Class “A” (Hard Rock) is the most stable and Site Class “F” (Soil requires site response analysis) is the least stable.

Evaluation of samples in the lab provided soil properties such as pH (measured values ranged from 7.2 to 7.6), optimum moisture content (11.3 percent to 13.3 percent), soluble sulfates (46 mg/kg to 265 mg/kg), soluble chlorides (undetectable to 24 mg/kg), and electrical resistivity (700 Ω-cm [Ohm-centimeter] to 54,700 Ω-cm). These results suggest that subsurface conditions could be slightly to moderately corrosive to steel piles.

Additional field testing of electric resistivity showed a range of values from 1,300 Ω-cm to 72,500 Ω-cm, with average values relatively consistent for each area (Area A – 6,657 Ω-cm; Area B – 6,207 Ω-cm: and Area C – 2,302 Ω-cm). The highest resistivity value measured for Area A was 19,500 Ω-cm, Area B: 72,000 Ω-cm; and for Area C: 7,500 Ω-cm. Anything below 100,000 Ω-cm is considered a low resistivity value (IEEE 2012). This range of resistivity values offers favorable conditions for the design of an electrical grounding system.

As noted earlier, a geotechnical investigation and corresponding report were prepared for the adjacent Orchard Substation in 2019 (Terracon 2019). The investigation was performed just north of the westernmost extent of the Project site (see Figure 2). The investigation relied on soil samples collected from two boreholes drilled to a depth of 51.5 feet below ground and a surface grid of soil electrical resistivity testing. The borehole samples collected were used to characterize the soil’s physical and chemical properties, and the resistivity testing provided information on the corrosion potential and electrical grounding properties of the soils. The report identified four textural classifications of the soils that were found in multiple layers of varying thickness to the bottom of each borehole.

The textural units identified at the Orchard Substation are described in Table 2. Soil units 1 and 2 alternated in layers of 3 feet to 10 feet in thickness for much of the 51.5-foot depth of both boreholes. Each borehole had only one or two layers of unit 3 (3 feet to 5 feet thick) mixed in at varying depths, and a single layer of unit 4 at the bottom (the last 5 to 10 feet). The NRCS classification of this soil is Westhaven loam (0 to 2 percent slopes) which is the soil mapped on 66 percent of the Project site (see

Section 4, below, for more details). Based on the physical characteristics of their soils, Terracon (2019) also assigned a Seismic Site Class of "D."

Resistivity and chemical testing revealed that corrosivity to concrete from sulfate levels in soils is negligible. Resistivity in the soil sample collected from one of the boreholes was measured at 795 Ω-cm while the field testing of resistivity yielded values ranging from 2,112 Ω-cm to 2,959 Ω-cm. The resistivity values for the Orchard Substation site are considered "very low" and also would provide favorable conditions for electrical system grounding.

A final Geotechnical Investigation will be prepared for the Project to provide design-reliant, site-specific, required data on chemical characteristics, corrosivity potential, expansive soils, dry-sand settlement, and any other characteristics impacting Project safety considerations, in compliance with County building and permitting requirements.

Table 2. Soil Textures at the Adjacent Orchard Substation Site

Soil Unit	Soil Type	Description
1	Silt	Variable sand, fine to medium grained, brown to light brown, medium to very stiff
2	Silty sand	Fine to coarse grained, brown to light brown, loose to medium dense (contains some gravel)
3	Lean to silty clay	Fine grained, low plasticity, light brown and tan to dark brown, stiff to very stiff
4	Poorly graded to silty sand	Fine to coarse grained, subangular gravel, tan and brown to light brown, medium to very dense

Source: Terracon (2019)

2.4 Paleontological Concerns

A paleontological resources technical report was prepared in 2020 for Orchard Substation, located immediately north of the westernmost portion of the Project site (APN 085-050-01S). The report was prepared by the San Diego Natural History Museum (SDNHM) Department of PaleoServices (McComas and Deméré 2020). The report was based on a desktop evaluation of the local geology (at or near the surface) and previously identified paleontological resources in the vicinity. A list of previously identified paleontological resources was gathered from three main sources:

1) Records search of the paleontological collection of the SDNHM,
2) Records search of the paleontological collection of the University of California Museum of Paleontology (UCMP), and
3) A literature review of relevant published geologic maps and reports, peer-reviewed papers, field trip guidebooks, unpublished theses and dissertations, and archived paleontological reports.

The literature search assisted with matching the geologic history of the surrounding area with the types of fossils potentially found within specific geologic units. This aids in predicting the likelihood of finding paleontological resources based on the units found at the Orchard Substation site.

As detailed in Section 3 (Geology), the geologic unit found at the surface of the Orchard Substation is characterized as Holocene-age surficial sediments. This is underlain by Pleistocene-age sediments that McComas and Deméré (2020) conservatively estimated at a depth of no less than 15 feet below the ground surface. Based on the likelihood of finding paleontological resources in each unit, the Holocene-age unit was judged to have “Low” paleontological potential while the Pleistocene-age unit was judged to have “Undetermined” paleontological potential. The report’s recommendation was to not implement a paleontological mitigation program due to the unlikely circumstance that grading or trenching activities would reach depths greater than 15 feet. They offered a contingent pair of mitigation measures should a paleontological resource be unearthed during construction activities.

The comparison between the Orchard Substation site and the Project site is strong. Both are located on the Holocene-age unit, and both are expected to have Pleistocene-age sediments underlying this unit at depths no less than 15 feet below ground surface.

3.0 GEOLOGY

The Project site is located in the Great Valley Geomorphic Province, in close proximity to the boundary with the Coast Ranges Geomorphic Province (see Figure 1). As described further below, the regional geology within the Coast Ranges province is complex, involving mountain building activity (orogeny), folding, and faulting. However, within the Central Valley province the geology is relatively simple with thick sequences of alluvial sediment extending to depths of 1,000 feet to 2,000 feet deep, and forming the broad flat surface of the central valley, and limited potential for hazards related to its physical setting (e.g. landslides, earthquakes, and significant surface erosion).

3.1 Regional Geology

The Great Valley is a broad alluvial plain spanning from Bakersfield to Sacramento. The valley is underlain by significant thicknesses of alluvial deposits that date from the Jurassic period to the Quaternary period. These deposits can be over 2,000 feet thick, with much of the older deposits transformed into sedimentary rock. The sediments were derived from erosion of the adjacent mountains and deposited primarily through alluvial transport (CGS 2002).

Due to its location near the western edge of the Great Valley, the sediments underlying the Project site have been derived primarily from eroded materials of the coast ranges that have been carried east by surface waters and deposited in the Great Valley. Alluvial deposition in the Great Valley has resulted in a very flat land surface or topography, with a gentle (less than 0.5 percent) slope to the northeast at the Project site. The low spot in this region, and ultimate flow destination of surface runoff is Tulare Lake, located east/southeast of the Project site.

The Coast Range mountains feature a much more complex geologic history and a greater variety of geologic units due to plate tectonic activity along the Pacific coast of California (see Figure 3 and Table 3). This includes predominantly thick layers of sedimentary rock with minor occurrences of igneous and metamorphic rocks, in addition to pockets of unconsolidated sediments (CGS 2002). The history of this province is characterized by episodic fault movement (reverse or thrust faulting as well as right lateral strike-slip), folding, and uplift, along with the long-term continuous erosion of the uplifted rocks.

One of the major features of geologic activity within the Coast Range province is the formation of, and movement along, the San Andreas Fault Zone. The nearest part of this fault zone is the Parkfield

Segment, located approximately 20 miles southwest of the Project site. The Parkfield Segment is bound by the Creeping Segment to the northwest and the Cholame Segment - adjacent to the San Juan Fault - to the southeast. As noted in Table 1, these segments of the San Andreas Fault Zone have a much greater likelihood of experiencing a significant earthquake within the next 30 years than any of the faults shown on Figure 3. Although they are much closer to the Project site, the segments of the Great Valley Fault Zone are far less likely to experience a significant earthquake over the same period.

Table 3. Regional Geologic Units

Symbol	Age	Rock type
Cenozoic		
Q	Quaternary	Alluvium, lake, playa, and terrace deposits; unconsolidated and semi-consolidated. Mostly non-marine, but includes marine deposits near the coast.
Qls	Quaternary	Landslide deposits.
QPc	Pliocene and/or Pleistocene	Loosely consolidated deposits. Includes sandstone, shale, and gravel deposits; in part Miocene.
P	Pliocene	Marine sedimentary rocks. Sandstone, siltstone, shale, and conglomerate; in part Pleistocene and Miocene.
M	Miocene	Marine sedimentary rocks. Sandstone, shale, siltstone, conglomerate and breccia; in part Pliocene and Oligocene.
Mc	Miocene	Non-marine sedimentary rocks. Sandstone, shale, conglomerate, and fanglomerate; in part Pliocene and Oligocene.
O	Oligocene	Marine sedimentary rocks.
E	Eocene	Marine sedimentary rocks. Shale, sandstone, conglomerate, and minor limestone; in part Oligocene and Paleocene.
Ep	Paleocene to middle Eocene	Marine sedimentary rocks. Sandstone, shale, and conglomerate; mostly well consolidated.
Mesozoic		
Ku	Upper Cretaceous	Marine sedimentary rocks; sandstone, shale, and conglomerate.
Kl	Lower Cretaceous	Marine sedimentary rocks; sandstone, shale, and conglomerate.
KJf	Cretaceous - Jurassic	Franciscan complex: Sandstone with smaller amounts of shale, chert, limestone, and conglomerate. Includes Franciscan melange, except where separated--see KJfm.
KJfm	Cretaceous - Jurassic	Melange of fragmented and sheared Franciscan complex rocks.
J	Jurassic	Marine sedimentary rocks. Shale, sandstone, minor conglomerate, chert, slate, limestone; minor pyroclastic rocks.
m	pre-Cenozoic	Metasedimentary and metavolcanic rocks undivided. Undivided pre-Cenozoic metasedimentary and metavolcanic rocks of great variety. Mostly slate, quartzite, hornfels, chert, phyllite, mylonite, schist, gneiss, and minor marble.
mv	pre-Cenozoic	Undivided metavolcanic rocks. Includes latite, dacite, tuff, and greenstone; commonly schistose.
gb	Mesozoic	Gabbro and dark dioritic rocks; chiefly Mesozoic.
grMz	Mesozoic	Granite, quartz monzonite, granodiorite, and quartz diorite.
Mzv	Mesozoic	Undivided Mesozoic volcanic and metavolcanic rocks. Andesite and rhyolite flow rocks, greenstone, volcanic breccia and other pyroclastic rocks; in part strongly metamorphosed. Includes volcanic rocks of Franciscan Complex: basaltic pillow lava, diabase, greenstone, and minor pyroclastic rocks.
um	chiefly Mesozoic	Ultramafic rocks, mostly serpentine. Minor peridotite, gabbro, and diabase.

3.2 Local Geology

Within a five-mile perimeter of the Project site, the geology is much less complicated. The Project site sits on Quaternary alluvium (Q), which is likely to extend to a depth of at least 15 feet below the ground surface (Terracon 2019). To the west and southwest of the site are sedimentary rocks (QPc) of Pleistocene to Pliocene age, while to the south and southeast are marine sedimentary rocks (P) of Pleistocene to Pliocene age. Much of these older sedimentary rocks are covered by Quaternary alluvium that thins towards the west. The area immediately surrounding the Project site is very flat and gently sloping to the east. The Kettleman Hills are located to the southwest, past which elevations increase significantly in the Diablo Range, in some areas exceeding 4,000 feet. The simplicity of the local geology (unconsolidated alluvial deposits under the surface to a depth of at least 100 feet to 200 feet) and topography (very flat with a very shallow slope) influence the hazards associated with the physical setting, as described in further detail below.

3.3 Landslides

Landslides occur when rock, soil, and other materials are displaced due to the effects of gravity. The potential for material to detach and move down slope depends on multiple factors, including soil type, moisture content, and steepness of terrain. However, as noted above, the Project site has very low topographic relief with no adjacent hills. As a result, there are no mapped areas of landslide hazard on or near the site (DOC 2024). The geotechnical report for the proposed Orchard Substation assessed the relative risk of landslides at the site to be low (Terracon 2019). Since the geologic and topographic conditions at the Project site and the Orchard Substation site are essentially the same, the potential for landslide hazards at the Project site is considered to be low.

3.4 Surface Rupture

The Project site does not intersect with an established Alquist-Priolo Earthquake Fault Zone. The nearest such zones are the Nuñez Fault Zone (approximately 20 miles west-northwest) and the San Andreas Fault Zone (approximately 26 miles to the southwest). Since neither of these fault zones overlap with the Project site, an earthquake evaluation and report is not considered necessary. However, since two segments of the Great Valley Fault Zone are adjacent to the Project site, a final geotechnical investigation is recommended to establish design requirements for planned facility structures.

The UCERF3 model, which provides probabilities for surface rupture caused by an earthquake along the fault zones in the region (see Table 1), gives probabilities of less than 1 percent of a significant earthquake occurring within the next 30 years. In contrast, the probability of a significant earthquake on the nearest San Andreas Fault Zone segments ranged from just under 7 percent to more than 20 percent.

3.5 Liquefaction

Liquefaction can occur when unconsolidated and water-saturated sediments become unstable due to the effects of strong seismic shaking. During an earthquake, sediments under such conditions can behave like a liquid, potentially causing severe damage to overlying structures. A related condition known as “lateral spreading” can also occur. Lateral spreading is a type of landslide that can occur when unconsolidated liquefiable materials break and spread due to the effects of gravity, usually down gentle slopes. Liquefaction-induced lateral spreading is defined as the finite, lateral displacement of gently sloping ground as a result of pore-pressure buildup or liquefaction in a shallow underlying deposit during an earthquake. The occurrence of this phenomenon is dependent on many complex factors, including the intensity and duration of ground shaking, the particle-size distribution of the soil, the density of the soil, and shallow groundwater.

The State of California does not identify any areas of concern for liquefaction in this part of the Great Valley (DOC 2024). The site conditions also do not suggest the likelihood of liquefaction or lateral spreading; no shallow groundwater conditions are found in the general vicinity and underlying sediments are quite cohesive. Therefore, the potential for liquefaction at the Project site is expected to be low.

3.6 Subsidence

Land subsidence is the gradual settling or sudden sinking of the earth's surface due to subsurface movement of earth materials, or extraction of liquids. The primary cause of land subsidence is the compaction of subsurface geologic layers due to a reduction in pore space. Local, and even regional ground subsidence typically is caused by compaction of sub-surface geology as a result of petroleum or groundwater withdrawal (anthropogenic) or natural lowering of the water table due to drought (evaporation) or springs. Subsidence has been well-documented throughout the San Joaquin Valley, initially in the twentieth century (Ireland, et al, 1984) followed by a more or less continuous monitoring since. Subsidence near the Project site from 1926 to 1970 was on the order of 7 to 8 meters (Figure 4). More recent measurements reveal subsidence of under 50 millimeters between 2008 and 2010 (Figure 5).

However, the amount and persistence of subsidence in the immediate vicinity of the Project site should be a design consideration for the Project.

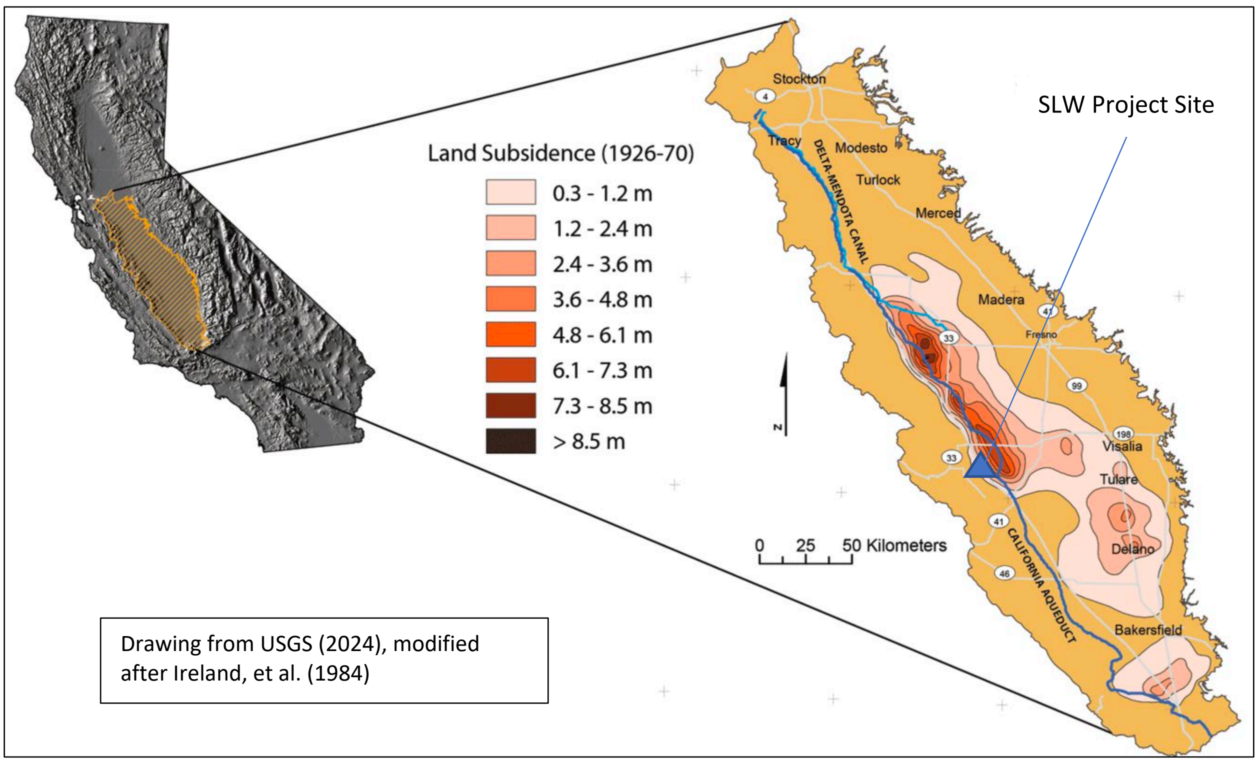

Figure 4. San Joaquin Valley Subsidence 1926 to 1970

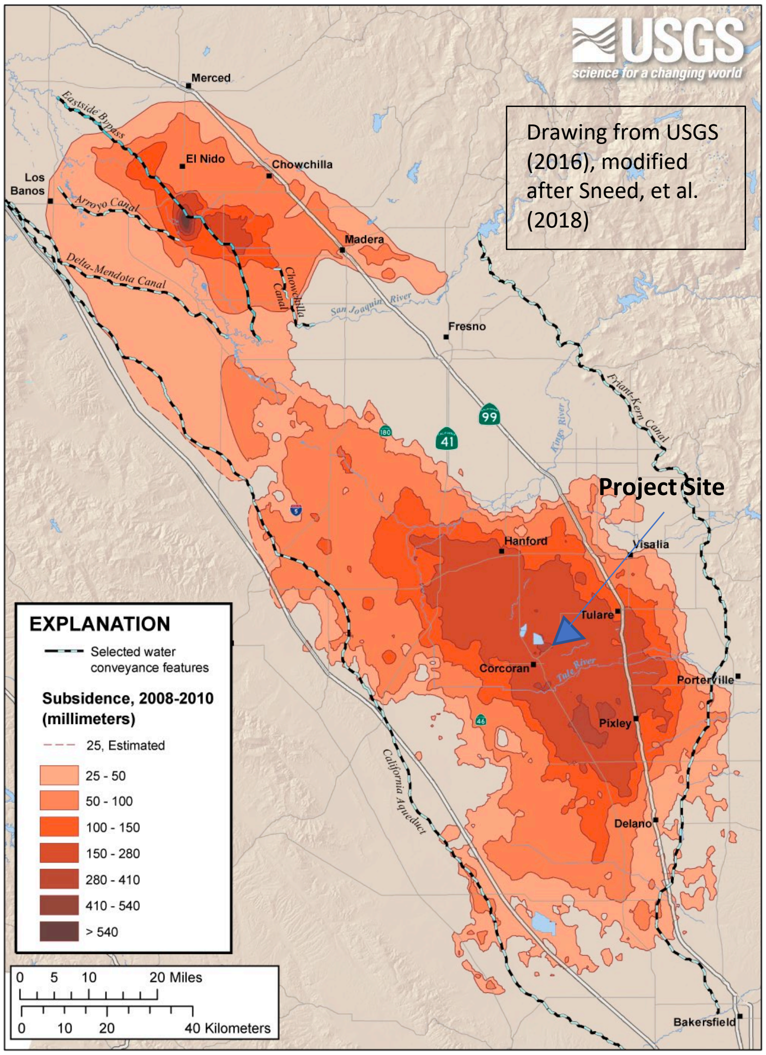

Figure 5. San Joaquin Valley Subsidence 2008 to 2010

4.0 AREA SOILS

The Project site is located on the western edge of the Great Valley province, in close proximity to the adjoining Coastal Ranges province. The ground surface is a flat, gently sloping topographic surface overlaying thick sequences of alluvial sediments that provide the parent material for soil development. Two sources of information were used to characterize the local soils at the site: the NRCS Web Soil Survey (NRCS 2024), and a geotechnical investigation report for the adjacent proposed Orchard Substation project (Terracon 2019).

4.1 NRCS Soil Series

Figure 6 displays soils mapped throughout the Project site (NRCS 2024). Table 4 includes a description of each soil series on the Project site, as well as its water and wind erodibilities (NRCS 2000).

Figure 6. Soils on Project Site

Table 4. NRCS Soil Series on Project Site

ID	Soil Series	Description	Water Erodibility[1]		Wind Erodibility[2]	
					Group	Index
425	Kimberlina sandy loam 0 to 2 percent slopes Percent of Project site: 10.6	The Kimberlina series consists of very deep, well drained soils on alluvial fans. These soils formed in alluvium derived from calcareous sedimentary rock. These soils are more than 60 inches deep. The content of organic matter is less than 1 percent and decreases regularly with depth. The content of gravel ranges from 0 to 10 percent.	0.32	0.32	3	86
445	Excelsior sandy loam 0 to 2 percent slopes Percent of Project site: 2.1	The Excelsior series consists of very deep, well drained soils on alluvial fans. These soils formed in alluvium derived from calcareous sedimentary rock. These soils are more than 60 inches deep. The content of organic matter is less than 1 percent at the surface and decreases irregularly with increasing depth. Texture is loamy sand or sandy loam. The content of clay ranges from 3 to 18 percent. The loamy sand phase is eroded.	0.28	0.28	3	86
447	Excelsior sandy loam, sandy substratum 0 to 2 percent slopes Percent of Project site: 18.5		0.28	0.28	3	86
474	Westhaven loam 0 to 2 percent slopes Percent of Project site: 66.0	The Westhaven series consists of very deep, well drained soils on alluvial fans. These soils formed in alluvium derived dominantly from calcareous sedimentary rock. These soils are more than 60 inches deep. The content of organic matter is less than 1 percent below the Ap horizon and decreases irregularly with depth. The particle-size control section averages 18 to 35 percent clay. By weighted average, less than 15 percent of the particles are fine sand or coarser between depths of 10 to 40 inches.	0.37	0.37	6	48
477	Westhaven clay loam 0 to 2 percent slopes Percent of Project site: 2.7		0.37	0.37	6	48

Source: NRCS (2000)

1 Erosion factors include the K factor (Kw and Kf); these indicate the susceptibility of a soil to sheet and rill erosion by water. Erosion factor Kw indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments. Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and permeability. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

2 Wind erodibility groups are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. Group 1 soils are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. Wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Five soil series are identified within the three Subareas of the Project site, and all are considered to have a loam texture (well-represented mixtures of sand, silt, and clay particle sizes). Three of the soil series are classified as sandy loam, clay loam, and loam. Only the Excelsior Sandy Loam (445) has been given a hydric rating but without any specific hydric criteria. This classification could prove inconsequential since this series represents a very small part of the total project area and is restricted to one parcel (APN 078-080-55) in Subarea C.

All of these soils are considered moderately susceptible to water erosion, while the Kimberlina and Excelsior series are considered slightly more susceptible to wind erosion than the Westhaven series.

4.2 Subsurface Observations

Results of the site-specific field geotechnical investigation for the Project provide local, subsurface details of the soil materials for the three Project site Subareas. Westwood (2024) drilled 18 boreholes at the Project, six in each of the three Subareas. These boreholes were placed predominantly in areas of Westhaven loam, 0 to 2 percent slopes soil and extended to depths between 17.5 feet and 21.5 feet, except one which was extended to a depth of 51.5 feet below the ground surface. At these depths, the subsurface investigation extended well below the zone of agrarian soil development (about 60 inches) and into the underlying geologic stratigraphy (parent material). Three textural units were identified in these boreholes, the latter two were found at multiple levels within the boreholes. Table 5 provides details of the occurrence of these soil units in the boreholes.

- Unit 1 **Topsoil or Tilled Zone**: Loose, surficial topsoil and tilled soil measured between 6 and 12 inches. Was generally dark yellowish brown to gray, moist, sandy and clayey, and contained trace roots.
- Unit 2 **CLAYS: Lean Clay (CL), Sandy Lean Clay (CL), Sandy Silty Clay (CL-ML)**. Primary texture on site; lean clay with varying amounts of sand and silt. Typically exhibited various shades of brown, was dry to moist, and varied in density from soft to very stiff. This unit was found in layers at depths up to 45 ft.
- Unit 3 **SANDS: Poorly Graded Sand with Clay (SP), Clayey Sand (SC), Silty Sand (SM), Silty Clayey Sand (SM-SC)**. Interbedded within Unit 2 and contained variable amounts of clay and silt. Typically exhibited various shades of light brown to gray, was dry to moist, and had a very loose to medium density. It was found in layers at depths up to 51.5 feet. This unit also showed weak calcareous cementation interspersed throughout.

No groundwater was encountered in any borehole to its maximum depth, and the depth to groundwater for this general area was noted as greater than 500 feet below the ground surface (Westwood 2024).

Based on the field sampling and testing, and the laboratory testing results, Terracon provided design recommendations for site preparation, excavation, subgrade preparation, placement of engineered fill, mat foundations, drilled shaft foundations, and floor slabs. They also provided results for soil resistivity and corrosivity testing that could be applicable to the Project site. However, these results can only provide guidelines for Project design, which should only rely on a site-specific and targeted geotechnical investigation performed intentionally for this project.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The following sections highlight the hazards identified by CEQA for consideration relative to geologic and soil resources (italicized text) and provides interpretations for their significance relative to the Project site.

5.1 Known Faults and Seismic Ground Shaking Potential

a) *Will the project directly or indirectly cause 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?*

Given that the Project site nearly intersects with two segments of the Great Valley Fault Zone and is located approximately 26 miles from the San Andreas Fault Zone, the likelihood for seismic activity and significant ground shaking should be considered high. A preliminary, site-specific geotechnical engineering investigation was performed to provide design recommendations for earthquake resistance and compliance with state and local building code requirements. Westwood (2024) assessed the Project location to be a Seismic Site Class "D." Although the potential for significant ground shaking is considered high, the potential for surface rupture or dry sand settlement is undetermined, and the potential for liquefaction or landslide is considered low.

A final geotechnical investigation report with design-specific recommendations will be provided during the design phase of the Project. By incorporating recommended and required safety standards into the Project design, the final facility would pose a less than significant risk for impact.

Table 5. Project Geotechnical Boreholes

Borehole	Area	NRCS Soil Type	Unit 1 Depth	Unit 2		Unit 3	
				Number of Layers	Thickness	Number of Layers	Thickness
PV-01	A	474	1 inch	2	2.5 - 3.0 feet	2	4.0 – 11.5 feet
PV-02	A	474	3 inches	1	8.0 feet	2	4.0 – 7.0 feet
PV-03	A	425	1 inch	2	4.5 – 13.0 feet	1	2.5 feet
PV-04	A	474	3 inches	1	4.5 feet	2	5.0 – 11.5 feet
PV-05	A	474	6 inches	1	1.5 feet	2	4.5 – 15.0 feet
PV-06	B	474	8 inches	4	2.5 – 5.0 feet	2	2.5 – 5.0 feet
PV-07	B	447	6 inches	1	2.5 feet	4	2.5 – 9.0 feet
PV-08	B	474	8 inches	3	2.0 – 10.0 feet	2	1.5 – 5.0 feet
PV-09	B	474	9 inches	2	4.5 – 9.0 feet	1	7.5 feet
PV-10	B	474	10 inches	2	2.0 – 11.5 feet	1	7.5 feet
PV-11	B	447	1 inch	3	2.0 – 9.0 feet	2	2.5 – 5.0 feet
PV-12	C	474	8 inches	2	5.0 – 6.2 feet	1	9.5 feet
PV-13	C	474	9 inches	2	7.0 – 14.0 feet	0	--
PV-14	C	445	8 inches	2	1.5 - 7.5 feet	2	5.0 – 5.5 feet
SUB-01	A	474	1 inch	2	5.0 – 7.0 feet	4	2.5 – 17.5 feet
B-01	C	474	12 inches	3	1.5 – 6.5 feet	0	--
B-02	C	474	12 inches	2	2.5 – 5.5 feet	0	--
B-08	C	474	12 inches	2	1.5 – 4.0 feet	3	2.5 – 3.0 feet

5.2 Soil Erosion

b) Will the project result in substantial soil erosion or the loss of topsoil?

The soils found at the Project site, and concurred by the adjacent geotechnical investigation, are moderately susceptible to erosion from surface water sheet flow and rill runoff. They are also moderately susceptible to the effects of wind erosion. However, the Project site is generally flat, which will help limit the erosive tendencies of the soils. A limited amount of earthwork will be necessary for site preparation and this will limit the potential for water erosion of disturbed surfaces.

Standard construction Best Management Practices (BMPs) should be developed and implemented to moderate both water and wind erosion. A stormwater pollution prevention plan (SWPPP), a water quality control plan, and a Dust Control Plan are recommended for preparation. With the development and implementation of the above plans, erosion and loss of topsoil would be controlled throughout construction and no additional mitigation measures are recommended.

5.3 Unstable Geologic Unit or Soil

c) Will the project 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 unstable soil or geologic unit has been identified on or near the Project site. Therefore, the activities planned for this project are not at all likely to make conditions worse, and lead to landslides, lateral spreading, subsidence, liquefaction, or soil collapse. No additional measures are recommended.

5.4 Expansive Soil

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

None of the NRCS soil series identified at the site have been flagged as having a high capacity for swelling and shrinking. The geotechnical investigation report prepared for the proposed Orchard Substation did not include an expansive characteristics analysis (Terracon 2019). No additional measures are recommended. The final geotechnical investigation report will provide definitive, site-specific information and data on expansive soils, and will provide recommendations (if necessary) to limit structural risks.

5.5 Soil Use for Septic systems

e) Will the Project 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?

There is no plan or expectation to use a permanent, on-site septic system for the Project. Therefore, no evaluation is required for the capacity of on-site soils to support a leach field for a septic system.

5.6 Paleontological Resources

f) *Will the project directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?*

It is possible, though unlikely, that paleontological resources might be encountered if excavations exceed a depth of 15 feet below the ground surface at the Project site. No site-specific resource surveys were performed at the site as part of this report in order to confirm or refute this potential. However, a desktop assessment was prepared for the adjacent Orchard Substation, and it concluded that the surface sediments found at their site, Quaternary alluvium (Q), have a low probability of containing paleontological resources. It was concluded the older geologic unit underlying the Quaternary alluvium, the loosely consolidated Pliocene and/or Pleistocene sedimentary rocks (QPc), could potentially contain paleontological resources. However, it was anticipated that the older unit would underlie the Quaternary alluvium by a minimum of 15 feet. Since the Project site and the Orchard Substation are located in close proximity and therefore are essentially the same geologically, similar conclusions would apply to both sites. Therefore, the Project site is assumed to have a low potential for paleontological resources and no additional measures are recommended.

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