## 3.6 GEOLOGY AND SOILS

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

### 3.6.1 Environmental Setting

The wharf is situated at approximately sea level (with water level about 32 feet above the soil/mudline), and the surrounding uplands rise abruptly from 3 to 5 feet at the shoreline to approximately 30 to 40 feet above sea level on the surrounding, mostly flat upland properties.

Based on the results of the subsurface exploration performed by Treadwell and Rollo (2014), the site is underlain by river deposits to the maximum depth explored (elevation -134 feet mean lower low water). The River deposits generally consist of stiff to hard clays with varying amounts of sand and medium dense to very dense sand with varying

amounts of silt and clay. At the face of the wharf, the top layer consists of stiff to very stiff clay and sandy clay. A bathymetric survey was not available at the time the geotechnical analysis was prepared; however, based on the available information the mudline is anticipated to have a fairly constant slope up to the existing shoreline, and it is unlikely that a landslide of significant soil erosion would occur at the Project site.

**Seismic Activity**

The major active faults in the Project area are the Hayward, San Andreas, Calaveras, Concord, and Green Valley. Since 1800, four major earthquakes have been recorded on the San Andreas Fault. In 1836, an earthquake with an estimated maximum intensity of VII on the Modified Mercalli scale (MMS) occurred east of Monterey Bay on the San Andreas Fault. The estimated Richter magnitude (Mw) for this earthquake is about 6.25. In 1838, an earthquake occurred with an estimated intensity of about VIII-IX MMS, corresponding to an Mw of about 7.5. The San Francisco Earthquake of 1906, which created a surface rupture along the San Andreas Fault from Shelter Cove to San Juan Bautista approximately 292 miles in length, had a maximum intensity of XI MMS, a Mw of about 7.9, and was felt 348 miles away in Oregon, Nevada, and Los Angeles. The most recent major earthquake to affect the Bay Area was the 1989 Loma Prieta Earthquake in the Santa Cruz Mountains with a Mw of 6.9, approximately 71 miles from the Project site.

In 1868, an earthquake with an estimated maximum intensity of X (MMS) occurred on the southern segment (between San Leandro and Fremont) of the Hayward Fault. The estimated Mw for the earthquake is 7.0. In 1861, an earthquake of unknown magnitude (probably a Mw of about 6.5) was reported on the Calaveras Fault. The most recent significant earthquake on this fault was the 1984 Morgan Hill earthquake (Mw = 6.2). The 2007 Working Group on California Earthquake Probabilities (WGCEP) at the U.S. Geologic Survey (USGS) predicted a 63 percent chance of a magnitude 6.7 or greater earthquake occurring in the San Francisco Bay Area in 30 years (WGCEP 2007).

The Project site would be subject to strong seismic shaking in the event of an earthquake. Using current analytical techniques, the geotechnical assessment concluded that the potential for liquefaction-induced ground surface movement or damage is low (Langan Treadwell Rollo 2014). Though the Project is in relative close proximity to active faults, a search of the Alquist-Priolo Earthquake Fault Zone Maps indicates that the Project does not lie within an Alquist-Priolo Earthquake zone. No known active faults cross the Project site; therefore, fault rupture is not considered a potential geologic hazard that could affect the Project.

### 3.6.2 Regulatory Setting

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

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

| | | |
|---|---|---|
| **CA** | Alquist-Priolo Earthquake Fault Zoning Act (Pub. Resources Code, §§ 2621-2630) | This Act requires that "sufficiently active" and "well-defined" earthquake fault zones be delineated by the State Geologist and prohibits locating structures for human occupancy across the trace of an active fault. |
| | California Seismic Hazards Mapping Act (Pub. Resources Code, § 2690 and following as Division 2, Chapter 7.8) | This Act and the Seismic Hazards Mapping Regulations (Cal. Code Regs., tit. 14, Div. 2, Ch. 8, Art. 10) are designed to protect the public from the effects of strong ground shaking, liquefaction, landslides, other ground failures, or other hazards caused by earthquakes. The Act requires that site-specific geotechnical investigations be conducted identifying the hazard and formulating mitigation measures prior to permitting most developments designed for human occupancy. Special Publication 117, *Guidelines for Evaluating and Mitigating Seismic Hazards in California* (California Geological Survey 2008), constitutes guidelines for evaluating seismic hazards other than surface fault rupture and for recommending mitigation measures as required by section 2695, subdivision (a). |

The Project site is within an area of Contra Costa County that was annexed by the city of Antioch in 2013; therefore, the pertinent local goals, policies, and/or regulations applicable to this issue area lie with the City.

The City of Antioch General Plan, Environmental Hazards Element, Section 11.3.1 includes the geologic and seismic objective to “Minimize the potential for loss of life, physical injury, property damage, and social disruption resulting from seismic groundshaking and other geologic events.” Section 11.3.2 of the Environmental Hazards Element requires detailed geologic and soils reports for proposed development sites, and incorporation of appropriate design considerations in geologically hazardous areas.

### 3.6.3 Impact Analysis

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

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

***(ii) Strong seismic ground shaking?***

***(iii) Seismic-related ground failure, including liquefaction?***

***(iv) Landslides?***

**Less than Significant Impact.** The wharf would be subject to strong seismic shaking in a major earthquake on any of the regional faults. The geotechnical evaluation for the Project used the available subsurface data to perform engineering analyses and to develop geotechnical recommendations to guide the Project design. The design recommendations address the primary geotechnical issues which are:

- potential strong ground shaking due to an earthquake on a nearby fault;
- the presence of potentially liquefiable River deposit;
- additional lateral loads due to lateral displacement of the River deposits during a strong earthquake; and
- the ability to adequately embed piles into the River deposits to resist these potential lateral loads.

For seismic design criteria, site-specific response spectra were developed for the Project in accordance with Chapter 16 of the 2013 California Building Code (CBC), as well as Chapter 31F of the 2013 CBC for marine oil terminals (MOTEMS). Since the spectral acceleration of the spectra developed in accordance with Chapter 16 was larger, it was used in the Project design basis to be conservative. As the Project has been designed in accordance with current construction codes and guidelines, the upgraded wharf facility would not be expected to experience major damage or failure in the event of a major earthquake. The Project is not located within an Alquist-Priolo Special Study zone, and is not expected to be subject to fault rupture (City of Antioch 2003 [p. 11-1]). The site is on gently sloping subsurface lands and therefore is not subject to landsliding hazards. Therefore the Project would not expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death from geologic hazards.

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

**Less than Significant Impact.** The Project would be located in the active channel of the San Joaquin River, where large-scale erosion and deposition are a constant and natural feature of the hydrologic system. Removal of the old pilings and installation of new ones would add slightly to the generation of sediment for short periods (hours) during those activities, which would occur intermittently over the 8-week construction period. Due to the small construction footprint and brief time window, these activities and the associated erosion would have a minimal contribution to overall erosion and deposition occurring in the River during those periods. Following construction, the upgraded wharf facility would have no increased potential for erosion than under current

conditions. Therefore the Project would not result in substantial soil erosion or loss of topsoil.

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

**Less than Significant Impact.** See discussion under item a), above. The Project is not located within an Alquist-Priolo Special Study zone, and is not expected to be subject to fault rupture (City of Antioch 2003 [p. 11-1]). The site is on gently sloping subsurface lands and therefore is not subject to landsliding hazards. The River deposits in the Project area generally consist of stiff to hard clays with varying amounts of sand and medium dense to very dense sand with varying amounts of silt and clay. At the face of the wharf, the top layer consists of stiff to very stiff clay and sandy clay. Therefore, the Project is not located on an unstable geologic unit and the potential for the Project to be subject to resulting hazards is less than significant.

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

**No Impact.** Soils underlying the wharf are completely saturated and under water at all times; therefore, the wetting/drying that causes shrinking and swelling of expansive soils could not occur on the Project site and no impacts due to expansive soils would occur.

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

**No Impact.** The Project is a wharf renovation that does not include any septic systems; therefore, no waste water disposal impacts would occur.

### 3.6.4 Mitigation Summary

The Project would not result in significant impacts to Geology and Soils; therefore, no mitigation is required.