

# Geology and Soils

This chapter identifies and evaluates the potential impacts of the proposed Project on geology, seismicity, and soil resources. The chapter includes a description of local topography, geology, seismicity, and soil resources; summarizes applicable state, local, and regional plans and programs, objectives, and policies; identifies potential impacts related to geology and soils; and details proposed mitigation measures to reduce potentially significant impacts, as applicable.

## 7.1 Existing Setting

The proposed Project would be constructed within the City of San Mateo; therefore, existing setting within the City is presented when localized information specific to the Project area is unavailable.

### 7.1.1 Geology and Topography

The City of San Mateo is located on the west side of San Francisco Bay, within the Coast Ranges geomorphic province of California. The Coast Ranges geomorphic province extends from near the Oregon border southward to the Santa Barbara area; the San Francisco Bay separates the northern and southern Coast Ranges (Schoenherr, 1995). The Coast Ranges consists of northwest-to-southeast-trending ridges and valleys associated with faulting and folding (Schoenherr, 1995). The City is situated on the northeasterly flank of the central Santa Cruz Mountains but is separated from the mountain range by the San Andreas Fault and associated rift valley, which run subparallel to the fault. Geologic formations within and near the City include the Santa Clara formation, which is typified by conglomerate sandstone and mudstone, and the Franciscan formation, which is also typified by sandstone and mudstone as well as metamorphic constituents (City of San Mateo, 2009 and 2010; USGS and CGS, 1987). Although the Franciscan formation may include units with serpentinite, there are no such units located within the Project area (see **Figure 7-1** and **Appendix C** [Brabb, et al., 1988]).

Near the shoreline are Bay muds and reclaimed lands, which extend to near US-101, where the historical shoreline existed prior to filling the Bay (City of San Mateo, 2009 and 2010). The Project site is located on a geologic unit comprised of artificial fill; nearby geologic units are shown on **Figure 7-1**, and descriptions of the geologic units are provided in **Appendix C** (Brabb, et al., 1988).

Landforms within the City are varied and include uplands, hillsides, valley, and alluvial fans (City of San Mateo, 2009 and 2010). Western areas contain broad uplands and hills that have been extensively uplifted and dissected by the drainage canyons of Laurel Creek and San Mateo Creek. Because the Project would be located on filled lands that have been previously developed and disturbed, the topography does not vary at the Project location; the grade at the site is less than 1 percent.

### 7.1.2 Geologic Hazards

The San Francisco Bay Area (Bay Area) is in a very seismically active region, with a high risk of geologic hazards that stem largely from movement of the earth's crust along well-defined active fault zones of the San Andreas Fault system (City of San Mateo, 2009). The San Andreas Fault is a northwest-southeast-trending fault zone located approximately 4 miles west of the Project site. The Hayward fault is located approximately 15 miles northeast of the site (USGS, 2017). The United States Geological Survey (USGS) and the California Geological Survey (CGS) have not identified active (with evidence of rupture within the last 11,000 years) or inactive (older features with no evidence of recent rupture) faults located in the City (USGS, 2006). The City is not within an Alquist-Priolo Earthquake Hazard Zone. Geologic hazards associated with seismic activity that could potentially affect the Project are described in the following sections.

### 7.1.2.1 Ground Shaking

Ground shaking from earthquakes can cause extensive damage to property and people. Factors that determine the amount of damage caused from ground shaking are interrelated and include the magnitude and depth of the earthquake, distance from the fault, duration of shaking, type of bedrock and soils, and topography, among others. The entire Bay Area, including the City of San Mateo and the Project site, is subject to strong ground shaking during earthquakes (City of San Mateo, 2009) (see **Figure 7-2**). Historically, there have been several strong earthquakes in the vicinity, including the magnitude 6.9 Loma Prieta earthquake in October 1989 and the magnitude 7.8 San Francisco earthquake in 1906, both of which occurred on the San Andreas Fault system. Ground shaking from these events was felt over large distances, and areas underlain by unconsolidated sediments experienced greater structural damage than areas underlain by bedrock. There are no mapped active or potentially active faults underlying the City; however, because of its proximity to the San Andreas Fault Zone, the Hayward Fault Zone, and other active faults, San Mateo could experience very intense ground shaking during a large earthquake. According to the 2008 Uniform California Earthquake Rupture Forecast (USGS, 2015) there is a 63 percent probability of a magnitude 6.7 or greater earthquake in the Bay Area within 30 years, with the greatest probabilities of earthquakes on the Hayward-Rogers Creek Fault and the San Andreas Fault. Therefore, San Mateo is very likely to experience very strong ground shaking from earthquakes in the future.

### 7.1.2.2 Landslides

Weak rocks and steep slopes are basic geologic characteristics that contribute to slope instability, including landslides. In susceptible areas, landslides can be triggered by earthquakes and high rainfall. In the City, the risk of landslides is greatest in the western hilly areas where landslides have occurred previously and in areas where slopes have been modified by grading (City of San Mateo, 2009 and 2010). Despite recorded historic landslides, slope instability is not widespread in the City (City of San Mateo, 2009 and 2010); however, during a major earthquake or heavy rainfall, landslides could occur where grading has steepened the natural slopes, contributing to slope instability (City of San Mateo, 2009 and 2010). As discussed in Section 1.1.1, the Project site is located on relatively flat terrain; the nearest topographically prominent feature is a golf course, located approximately 1.25 mile from the Project site.

### 7.1.2.3 Liquefaction

Liquefaction is the transformation of saturated, unconsolidated, granular material from a solid state to a semi-liquid state because of increased pore pressure that reduces the material's strength. During liquefaction, soil becomes fluid-like and mobile, and permanent displacement of the ground can occur, resulting in damage to utilities and structures (Association of Bay Area Governments [ABAG], 2001). Increased pore pressure in unconsolidated materials is caused by ground shaking during large earthquakes. Liquefaction can cause foundation failures in buildings and other facilities because of the reduction of foundation bearing strength. The potential for liquefaction depends on the duration and intensity of earthquake shaking, particle size distribution of the soil, density of the soil, and groundwater elevation. Areas at risk of liquefaction typically have a high groundwater table with underlying low- to medium-density, granular sediments, particularly younger alluvium and artificial fill. In San Mateo, the potential for liquefaction exists in areas with fill material and alluvium; **Figure 7-3** shows areas within the Project area that have potential for liquefaction (City of San Mateo, 2009).

### 7.1.2.4 Lateral Spreading

Lateral spreading is a ground failure that involves displacement of large blocks of ground down gentle slopes or toward stream channels. The potential for lateral spreading is highest in areas underlain by loose, saturated, liquefiable materials, especially where bordered by steep banks. In San Mateo, lateral spreading is possible along the banks of drainage courses that are not constrained in concrete channels and/or by other protective measures (City of San Mateo, 2009). Borel Creek, also known as the 19th

Avenue Channel, is located approximately 500 feet from the temporary holding structure and greater than 70 feet from the diversion pipelines along Saratoga Drive. The channel is not concrete-lined, but is an artificial stream channel unit (see **Figure 7-1**) which generally has minimal potential for geologic hazards to occur (see **Appendix C**). The soil materials above the bottom of the channel encountered in the borings along Borel Creek are non-liquefiable clay, and the risk of lateral spreading causing damage is low.

#### 7.1.2.5 Subsidence

Subsidence, or ground settlement caused by lowering of the groundwater level, may occur if dewatering of temporary excavations impact the groundwater level surrounding proposed excavations. The magnitude of subsidence is dependent upon the minimum historical groundwater elevation surrounding the Project, and the magnitude of groundwater drawdown below the minimum historical level. The type of dewatering system is a significant factor because it will determine the magnitude of groundwater drawdown and the zone of influence around the Project. The dewatering system would be coordinated with the shoring system to limit drawdown of groundwater beneath adjacent properties, and to prevent pumping of soil fines with the discharge water.

### 7.1.3 Soils

The general Project area contains soil types that vary with landscape position (see **Figure 7-4**). The proposed Project, including the temporary holding facility and all the diversion pipelines would be located on soils mapped as Urban Land-Orthents reclaimed complex (Kashiwagi and Hokholt, 1991; Map Unit 134). These lands were once part of San Francisco Bay and tidal flats and were filled as the area was developed. Soil composition is variable because the fill material used for reclamation varied in composition. Areas within Map Unit 134 may have a groundwater table that is tidally influenced and is estimated to fluctuate between 30 to 60 inches bgs. These soils are prone to settlement and liquefaction (see **Figure 7-3**).

Portions of the Project area comprise soils that have been cut and filled for development (Kashiwagi and Hokholt, 1991; Map Units 121 and 124) (see **Figure 7-4**), such as construction of roads and buildings. The City recently conducted a geotechnical analysis of the Project site (see **Appendix D**). The analysis consisted of exploratory borings within both the diversion pipeline alignment and holding structure location. The results of the analysis indicated that the soil conditions along the diversion pipelines include artificial fill, bay mud, coarse-grained alluvium, medium-grained alluvium, and fine-grained alluvium; and the location of the holding structure consisted of artificial fill (which included both sandy clay and clayey sand), bay mud, natural alluvial soil deposits (consisting of medium stiff-to-stiff lean clay and sandy clay), clayey sand, and very stiff to hard sandy to gravelly clay, followed by hard lean and sandy clay (ENGEO, 2018).

Urban lands are covered by asphalt, concrete, buildings and other structures, and urban soils contain fill material, similar to Orthents. These soils are largely placed and graded under engineering controls. Where slopes are relatively flat, the erosion hazard is slight because of the low velocity of runoff.

Some soil types in the Project area have physical properties that could limit construction. Such limitations include the erosion potential, shrink-swell behavior, and settlement. Settlement is the typically gradual drop in elevation of a ground surface caused by settling or compacting of soils under the weight of fill material or building loads. Settlement may continue over a long period. The degree of settlement is primarily influenced by the thickness of the compressible soils (e.g., Bay mud), site history, characteristics of fill material, and characteristics of building loads. Settlement is not always uniform; differential settlement is uneven, causing different parts of a structure to settle at different rates and magnitudes. Differential settlement could potentially occur in areas with non-uniform fill material, such as the filled Bay lands (City of San Mateo, 2009).

Erosion is the process whereby soil particles become detached and are transported by wind or water. Rates of erosion can vary, depending on several factors including soil texture, structure, amount of soil cover, and slope factors. The urbanized, relatively flat area surrounding the proposed Project site has a low erosion hazard.

Expansive soils exhibit a cycle of shrinking and swelling (contraction and expansion) with drying and wetting. This occurs in fine-textured soils containing expansive clay minerals. Structures built on expansive soils can be damaged over time, and foundations can crack or shift. Proper engineering during Project construction can mitigate this potential problem. Some of the fill material used to fill the Bay in the Project area consists of expansive clay, generally associated with Bay mud, and is likely to be encountered around the Project site during construction.

## 7.2 Regulatory Framework

This section describes the federal and state laws and regulations, and local policies and ordinances that are applicable to implementation of the UFES Project with respect to geology and soil resources.

### 7.2.1 Federal Regulations

#### 7.2.1.1 Clean Water Act

The federal CWA, as amended, is the fundamental federal law for regulating discharges of waste into waters of the United States. This regulation is described in detail in Section 10, *Hydrology and Water Quality*.

### 7.2.2 State Regulations

#### 7.2.2.1 Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act provides for protection of the quality of all waters of the State of California. This regulation is described in detail in Section 10, *Hydrology and Water Quality*.

#### 7.2.2.2 Seismic Hazards Mapping Act of 1990

The Seismic Hazards Mapping Act of 1990 (PRC, Chapter 7.8, Sections 2690–2699.6) directs the Department of Conservation, CGS to identify and map areas prone to earthquake hazards, including liquefaction, earthquake-induced landslides, and amplified ground shaking. In addition, the act requires local permitting agencies to regulate certain development projects within these hazard zones. Before a local development permit is issued for a site within a seismic hazard zone, a geotechnical investigation of the site must be conducted, and appropriate mitigation measures incorporated into the Project design.

#### 7.2.2.3 Alquist-Priolo Earthquake Fault Zoning Act of 1972

The Alquist-Priolo Earthquake Fault Zoning Act (Alquist-Priolo) prohibits the siting of structures for human occupancy across traces of active faults that represent a potential hazard to structures because of surface faulting or fault creep. Alquist-Priolo only addresses the hazard of surface fault rupture and is not directed toward other earthquake hazards. Alquist-Priolo requires the State Geologist to establish regulatory zones (known as Earthquake Fault Zones) around the surface traces of active faults and to issue appropriate maps. The maps are distributed to all affected cities, counties, and state agencies for use in planning and controlling new or renewed construction. All land division and most structures for human occupancy are regulated by local agencies within the Earthquake Fault Zones; however, local agencies can be more restrictive than state laws.

Before a project can be permitted within an Earthquake Fault Zone, cities and counties must require a geologic investigation to demonstrate that proposed buildings would not be constructed across active

faults. An evaluation and written report for the specific site must be prepared by a licensed geologist. If an active fault is found, structures for human occupancy must be set back from the fault (generally 50 feet) (CGS, 2015).

#### 7.2.2.4 California Building Code

The California Building Code (CBC) is codified in 24 CCR Part 2. The California Building Standards Commission administers Title 24. The CBC establishes minimum standards to safeguard public health, safety, and general welfare through structural strength, means of egress facilities, and general stability. The CBC regulates and controls the design, construction, quality of materials, use and occupancy, location, and maintenance of all building and structures within its jurisdiction. In addition, the CBC contains requirements that are based on the American Society of Civil Engineers Minimum Design Standards 7-05, including requirements for general structural design and a means for determining earthquake loads and other loads (e.g., flood and wind) for inclusion in structural design. CBC provisions apply to the construction, alteration, movement, replacement, and demolition of every building, structure, and appurtenance connected or attached to such buildings or structures throughout California. The earthquake design requirements take into account the occupancy category of the structure, site class, soil classifications, and various seismic coefficients used to determine a Seismic Design Category (SDC) for projects. The SDC is a classification system that combines the occupancy categories with the level of expected ground motions at the site; classifications range from SDC A (very small seismic vulnerability) to SDC E/F (very high seismic vulnerability and near a major fault). Design specifications are determined in accordance with the SDC.

### 7.2.3 Local Regulations

#### 7.2.3.1 Association of Bay Area Governments Manual of Standards for Erosion and Sediment Control

The *Manual of Standards for Erosion and Sediment Control* (ABAG, 1995) provides policy guidance, legal guidelines, and technical standards to control erosion and sediment control impacts for urban and developing areas, with an emphasis on construction erosion management.

#### 7.2.3.2 City of San Mateo Site Development Code

The City of San Mateo Site Development Code (Chapter 23.40 of the Municipal Code [City of San Mateo, 2015]) establishes administrative procedures, regulations, required approvals, and performance standards for site grading, construction on slopes, and removal of major vegetation. Its intent is to minimize adverse impacts on people and property as the result of development. The code provides an exemption from applying for and obtaining a site development permit for various types of projects, including excavation below finished grade for installation of sewer facilities and excavations by public companies or the City within public utility easements, streets, ROWs, or property owned in fee title by the utility company for the purpose of maintaining or installing new facilities, either above ground or below ground [Section 23.40.030(d) of the Municipal Code]. Therefore, construction of the proposed Project may be exempt from requirements of the Site Development Code.

#### 7.2.3.3 General Plan – Safety and Hazardous Waste Management

The following applicable safety and hazardous waste policies are listed as they appear in the General Plan (City of San Mateo, 2010):

**Policy S 1.1: Geologic Hazards.** Require site-specific geotechnical and engineering studies, subject to the review and approval of the City Engineer and Building Official, for development proposed on sites identified in Figure S-2 [of the City's General Plan] as having moderate or high potential for ground failure. Permit development in areas of potential geologic hazards only where it can be demonstrated that the project will not

be endangered by, nor contribute to, the hazardous condition on the site or on adjacent properties.

**Policy S 1.3: Erosion Control.** Require erosion control measures for all development sites where grading activities are occurring, including those having landslide deposits, past erosion problems, the potential for storm water quality impacts, or slopes of 15% or greater which are to be altered. Control measures shall retain natural topographic and physical features of the site if feasible.

## 7.3 Assessment Methods and Thresholds of Significance

Potential impacts on geology and soil resources were evaluated by using existing information regarding the geologic, soil, and seismic characteristics of the Project area and overlaying Project features on maps of geological and soil constraints.

Impacts related to geology and soil resources may occur if the Project would result in the following:

- Directly or indirectly cause 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. Refer to Division of Mines and Geology Special Publication 42.
  - Strong seismic ground shaking
  - Seismic-related ground failure, including liquefaction
  - Landslides
- Substantial soil erosion or the loss of topsoil
- A project being 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
- A project being 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

## 7.4 Environmental Impacts

***Impact 7-1. Would implementation of the proposed Project directly or indirectly cause potential substantial adverse effects involving rupture of a known earthquake fault, strong seismic shaking, and/or seismic-related ground failure, including liquefaction and landslides?***

There are no active faults or potentially active faults within the Project area, according to published geologic maps, and the Project area is not within an Alquist-Priolo Earthquake Fault Study Area. The San Andreas Fault is approximately 4 miles west of the Project site, and the Hayward Fault is approximately 15 miles northeast of the site (City of San Mateo, 2009). There is no evidence of surface rupturing at the Project site during the last 1 million years, and inactive faults show no evidence of recent motion. Therefore, impacts related to rupture of a known earthquake fault resulting from implementation of the proposed Project are considered to be less than significant.

The entire Bay Area is susceptible to strong ground shaking during major earthquakes because of the proximity to active earthquake faults. Ground shaking is amplified and lasts longer where soils are unconsolidated or saturated with water, such as the eastern portion of the City near San Francisco Bay where soils are comprised of Bay muds (City of San Mateo, 2009 and 2010). Ground shaking impacts

would be less severe in upland areas underlain by hard bedrock (City of San Mateo, 2009). In the Project area, ground shaking intensity is potentially very strong or violent (see **Figure 7-2**). Damage to buildings and utilities would likely be greatest in areas underlain by alluvial deposits, Bay mud, and artificial fill, such as those in the vicinity of the proposed Project site (ABAG, 2015).

Ground shaking associated with earthquakes could affect the Project by causing breakage to diversion pipelines, the holding structure, or the pump station. The Project structures, including the holding structure, pump station, odor control equipment room, and diversion pipelines, would be unoccupied, with only occasional occupancy by operations staff for maintenance and related activities.

The Project site is located in an area identified as having moderate to high liquefaction potential (see **Figure 7-3**). Consistent with **Final PEIR Mitigation Measure 7-1**, the City conducted a site-specific evaluation of the Project site to identify potential seismic hazards that could occur due to a nearby moderate to major earthquake. The local soil conditions beneath the proposed Project that are presented in the geotechnical report consist mainly of fine-grained soil that has low susceptibility to liquefaction (**Appendix D**). Some thin layers of liquefiable sand were encountered around the Diversion Sewer Branch 1 but are above the level of the pipeline. Proposed Project facilities are unlikely to be damaged by earthquake-induced liquefaction. Pipeline breaks resulting from ground displacement in liquefiable areas during earthquakes are common; however, the estimated seismic-induced settlement in the Project area was 0.25 inch (ENGEO, 2018), which is unlikely to cause significant damage to the Project facilities. The diversion pipelines associated with the Project would be installed at a depth that is less prone to displacement. The risk of damage to the Project from seismic-related ground failure would be less than significant as it would be prevented through implementation of the recommendations identified in the geotechnical report (ENGEO, 2018) that was prepared for the Project.

***Impact 7-2. Would implementation of the proposed Project result in substantial soil erosion or loss of topsoil?***

The proposed Project would include a new underground temporary holding structure, pump station, odor control equipment room, and associated diversion pipelines. Construction activities in an urbanized area and within City ROWs, including roadways, would limit disturbance acreage to the excavation footprint and thereby limit the risk of erosion. Soils within the relatively flat areas in the Project area have low erosion hazard, further reducing erosion risk (see **Figures 7-1 and 7-4**). See **Appendix C** for erosion hazards associated with geologic units and soils in the Project area.

Construction of new pipeline sections and storage facilities would require soil trenching and excavation. If not properly managed, substantial erosion of stockpiled soils could occur, and sediment could be transported into storm drains or sensitive receiving waters. During implementation of the Project, and other projects within the CWP, to the extent feasible, soil materials may be stored in a central location where they could be effectively managed. This would aid stockpile management and reduce the risk of erosion and sediment transport outside of Project work areas.

Coverage under the State's Construction General Permit (CGP) is required for projects that disturb 1 acre or more of land. Although the proposed Project is within a paved, urbanized area, land disturbance would likely be greater than 1 acre, and CGP coverage would, thus, be required. General Plan Policy 1.3 also requires erosion control measures for all development sites where grading activities occur, including those having the potential for stormwater quality impacts. Therefore, even projects with land disturbance acreage less than 1 acre would be required to implement appropriate erosion and sediment control measures where there is risk of erosion and/or impacts on water quality. The *Manual of Standards for Erosion and Sediment Control* (ABAG, 1995) provides guidance and technical standards for erosion and sediment control measures during construction; conformance to the standards would provide further control of erosion and topsoil loss.

Implementation of the Final PEIR **Mitigation Measure 7-2, Comply with regulations and policies for erosion control**, would reduce impacts of the Project to a less-than-significant level. Compliance with the CGP and local policies for implementing appropriate erosion control measures, including appropriate management of soil stockpiles, would minimize erosion and topsoil loss.

***Impact 7-3. Would the proposed Project be located on a geologic unit or soil that is unstable or that would become unstable as a result of the Project, potentially resulting in onsite or offsite landslides, lateral spreading, subsidence, liquefaction, or collapse?***

The Project area contains mapped geologic units or soils that are unstable and have a moderate to high potential for liquefaction, as shown in **Figure 7-3**. These areas are also prone to settlement, both seismic-induced (i.e., areas with a high water table, non-uniform fill material, and liquefiable soils) and from subsidence during construction dewatering if dewatering is not controlled adequately to limit excessive lowering of groundwater beyond the excavation. Lateral spreading may also occur in areas underlain by loose, saturated, liquefiable materials, especially where bordered by unsupported sloping ground. In the vicinity of the Project area, the area along Borel Creek has a low potential for lateral spreading. Landslides would not be anticipated to occur in the Project area due to lack of slopes.

The proposed Project could have geological, seismic, and soil impacts given the potential for liquefaction and settlement. As per Final PEIR **Mitigation Measure 7-1**, a geotechnical investigation was conducted to identify site-specific geotechnical and engineering methods (**Appendix D**), which are subject to the review and approval of the city engineer and building official, for development projects planned in areas with moderate or high potential for ground failure. The investigation identified general construction recommendations, including following the latest CBC and State of California Department of Transportation earthquake design requirements, such that implementation of the Project would not cause or contribute to increased instability of the soils or geologic unit and impacts would be less than significant.

The Project includes the use of dewatering wells within the vicinity of the temporary holding structure to reduce groundwater levels in areas that require excavation. Lowering groundwater levels around the exterior of the excavation can result in settlement of surrounding infrastructure such as utilities, manholes, pavement, sidewalks, and nearby buildings and non-building structures. For the proposed Project, additional considerations include potential groundwater drawdown impacts to surface water features such as nearby ponds and wetlands within the adjacent Bay Meadows Park, as well as the less visible hydrostatic groundwater levels in the surrounding area.

Dewatering has the potential to induce settlement of the ground surface because of an increase in the effective stress in the subsurface soil due to removal of buoyancy of the soil particles. The increased stress causes the soil grains to rearrange and become denser, resulting in subsidence or ground settlement. Areas close to the groundwater drawdown zone are most susceptible to these risks; however, dewatering activities necessary for construction within the excavation limits could affect groundwater levels beyond the excavation. If static groundwater levels around the exterior of the shoring system drop excessively, settlement is more likely to occur.

The bay mud and alluvial deposits within the upper 15 feet bgs have the greatest potential for consolidation from a drop in groundwater levels. A dewatering monitoring program will be implemented to prevent excessive groundwater drawdown. For this Project, a drawdown more than of 5 feet below the historical low groundwater table measured from monitoring wells located 50 feet from the edge of the excavation is considered excessive. Dewatering pump rates will be reduced to allow recharge of groundwater if excessive groundwater drawdown is measured in the observation wells during construction.

**Mitigation Measure 7-3a, Measures to reduce dewatering-related settlements**, would be implemented to reduce impacts from dewatering-related settlement to a less-than-significant level.



Excavation of the temporary holding structure would also require the installation of a shoring system to prevent the exterior walls of the excavated area from collapsing. Depending on the method of installation of the shoring system and the type of shoring, localized settlement can occur due to response to lateral deformations of the shoring system. This type of settlement is limited to areas within a distance equal to the depth of the excavation.

**Mitigation Measure 7-3b, Measures to reduce shoring-related settlements,** would be implemented to reduce impacts from shoring-related settlement to a less-than-significant level.

Project-specific geotechnical and engineering methods to minimize risks from ground shaking, landslides, or liquefaction to a level meeting City requirements, CBC earthquake design requirements, and other building safety codes, combined with implementation of **Mitigation Measures 7-1a and 7-1b** would reduce exposure of people or structures to potential adverse effects from liquefaction and settlement as a result of the Project to a less-than-significant impact.

***Impact 7-4. Would the proposed Project be located on expansive soils, creating substantial direct or indirect risks to property?***

The Project area is urbanized and is predominantly comprised of land that has previously been cut and filled for development, including areas within City streets where the diversion pipelines would be located. Engineered fill is well graded and would not shrink or swell. However, expansive clay soil, generally associated with Bay mud used for fill material, is likely to be encountered around the Project site during construction.

As required by Final PEIR **Mitigation Measure 7-1**, a geotechnical investigation was conducted (ENGEO, 2018) to identify site-specific geotechnical and engineering methods, which are subject to the review and approval by the City Engineer and Building Official, for development projects planned in areas with moderate or high potential for ground failure. By implementing geotechnical and engineering recommendations identified in the geotechnical report, and by following CBC earthquake design requirements, implementation of the Project would not cause or contribute to increased risk to property and impacts would be less than significant.

## 7.5 Mitigation Measures

### 7.5.1 Final PEIR Mitigation Measures

Implementation of the following mitigation measures from the Final PEIR, would ensure that potential impacts on geology and soil resources would remain at a less-than-significant level.

**Mitigation Measure 7-2. Comply with regulations and policies for erosion control.**

The City of San Mateo and its construction contractors shall develop prior to start of construction and implement a project-specific SWPPP for construction projects with a land disturbance area equal to or greater than 1 acre. For projects with disturbance area less than 1 acre in size, a site-specific Erosion and Sediment Control Plan shall be prepared. For projects with any land disturbance, construction shall comply with the San Mateo Site Development Code and shall incorporate an effective combination of erosion and sediment control measures that are identified in ABAG and/or California Stormwater Quality Association guidance manuals. Construction erosion and sediment control BMPs typically include, but are not limited to, the following measures:

- Scheduling site grading during the non-rainy season (April 15 to October 15), where possible
- Segregation of topsoil during rough grading
- Temporary soil stabilization during site grading and active construction

- Permanent post-construction site soil stabilization
- Erosion and sediment controls during construction dewatering activities
- Control of site run-on and runoff to isolate the work area and prevent onsite or offsite erosion and sediment transport during construction
- Dust suppression
- Stockpile management; in accordance with City standard construction practices, materials shall be stockpiled at central location(s) instead of within work areas, where feasible

## 7.5.2 Project-Specific Mitigation Measures

Implementation of the following Project-specific mitigation measures would ensure that potential impacts on geology and soil resources would remain at a less-than-significant level.

### **Mitigation Measure 7-3a, Measures to reduce dewatering-related settlements.**

Measures to reduce impacts from dewatering-related settlements could include, but are not limited to, the following:

- Prior to construction, install piezometers outside the limits of excavation; take continuous readings to create a historical baseline of the hydrostatic groundwater level and to measure the seasonal fluctuations.
- Specify groundwater drawdown thresholds within observation wells (piezometers) installed around the excavation and enforceable actions in the contract documents. Specify early-alert values that trigger corrective action requirements, as well as dewatering shut-down values. From preliminary review of the geotechnical data, these early alert values are anticipated to be on the order of 5 feet of drawdown below historical low groundwater level in observation wells located 50 feet from the edge of the excavation. In the event that groundwater drawdown reaches the threshold, the dewatering rate will be reduced or potentially discontinued until additional mitigation measures are implemented, or further analyses of the measured settlement data for the threshold drawdown show no detrimental effects are likely.
- Require installation of a watertight temporary shoring system.
- Require a groundwater cutoff extending a minimum of 15 feet below the base of the excavation, or as required to penetrate low-permeability soil layers that limit drawdown outside of the Project area.
- Prohibit dewatering wells outside of the excavation limits.
- Limit the dewatering inside the excavation so it draws the groundwater table down to allow for construction, but will be limited to minimize drawdown outside the excavation shoring.
- Perform construction period monitoring (weekly, daily, or continuously) to measure movement – settlement and tilt in the vicinity of the construction site. Movement in permanent and critical structures, such as pipelines and buildings, located within an approximate 100-foot radius of the construction zone should be monitored.
- Perform construction period monitoring (weekly, daily, or continuously) to measure existing building movement – settlement and tilt.
- Perform post-construction monitoring. Groundwater levels should be monitored approximately quarterly for 1 to 2 years following construction to document post-construction groundwater levels

**Mitigation Measure 7-3b, Measures to reduce shoring-related settlements.**

Measures to reduce impacts from shoring-related settlements could include, but are not limited to, the following:

- Implement pre- and post-construction surveys to document the condition of specific buildings and structures located within a potential zone of influence or a specific distance from the edge of the excavation. Critical or major utilities, sensitive or historic buildings, and nearby homes may also be included in the surveys. A pre-construction survey provides a record of the existing conditions of the structures prior to construction. A post-construction survey and report documents the post-construction conditions and any changes in condition that occurred during the construction period. These surveys help to differentiate between construction related impacts and pre-existing conditions. (Building owners and tenants may be unaware of the condition of their buildings prior to construction. Construction activity can alert an owner or tenant to a previously unrecognized crack or tilt in the foundation even though it may have been pre-existing.) The surveys may be used to establish agreements with neighbors prior to construction. They also may form the basis for repairs if movement occurs beyond an agreed upon threshold.
- Require the shoring system to be designed to be rigid. Include a maximum calculated deflection limit as part of the contract document requirements.
- Require the shoring system to be designed using at-rest soil pressures instead of active pressures. Consider requiring the shoring system to be designed to resist additional pressures that could result from earthquake loading.
- Specify maximum vibration limits and enforceable actions in the contract documents. Specify monitoring requirements along with early-alert and shutdown values that trigger corrective action requirements.
- Perform continuous vibration monitoring during periods of shoring installation. Provide monitors within the construction site and at pre-determined locations in-between the construction site and the nearest permanent structures to measure vibration magnitudes.
- Specify maximum lateral deflection limits for the shoring elements and enforceable actions in the contract documents. Specify monitoring requirements along with early-alert and values that trigger corrective action requirements.
- Perform construction period monitoring (weekly, daily, or continuously) to measure shoring displacements and the potential effects to the nearby area. Require monitors for shoring deformation such as inclinometers and survey prisms.
- Perform construction period monitoring (weekly, daily, or continuously) to measure existing building movement – settlement, tilt, and vibration.
- Perform post-construction monitoring. Neighboring structures should be monitored approximately quarterly for 1 to 2 years following construction to ensure post-construction movement is minimal.

## 7.6 References

Association of Bay Area Governments (ABAG). 1995. *Manual of Standards for Erosion and Sediment Control*. 422 pp.

\_\_\_\_\_. 2001. *The Real Dirt on Liquefaction: A Guide to the Liquefaction Hazard in Future Earthquakes Affecting the San Francisco Bay Area*. 29 pp.

\_\_\_\_\_. 2015. *Resilience Program, San Mateo Earthquake Hazard*.

<http://resilience.abag.ca.gov/earthquakes/sanmateo/>. Accessed May 21, 2015.

Brabb, E.E., R.W. Graymer, and D.L. Jones. 1998. *Geology of Onshore Part of San Mateo County*. U.S. Geological Survey Open-File Report 98-137.

California Geological Survey (CGS). 2015. "Alquist-Priolo Earthquake Fault Zoning Act." <http://www.consrv.ca.gov/cgs/rghm/ap/Pages/main.aspx>. Accessed May 21, 2015.

City of San Mateo. 2009. *Draft Environmental Impact Report for the City of San Mateo General Plan Update*. July 27.

\_\_\_\_\_. 2010. *City of San Mateo General Plan – Vision 2030*. Resolution No. 134-2010. Adopted by the City Council on October 18.

\_\_\_\_\_. 2015. San Mateo City Charter and Municipal Code. <http://qcode.us/codes/sanmateo/>. May 20, 2015.

ENGEO. 2018. Basin 2 and 3 Collection System Improvements Underground Flow Equalization System and Diversion Sewers Geotechnical Interpretive Report. San Mateo, CA. May 21.

Kashiwagi, J.H. and L.A. Hokholt. 1991. *Soil Survey of San Mateo County, Eastern Part, and San Francisco County, California*. U.S. Department of Agriculture Soil Conservation Service. 120 pp.

Schoenherr, A.A. 1995. *A Natural History of California*. Chapter 1: California's Natural Regions. University of California Press. 772 pp.

U.S. Geological Survey and California Geological Survey (CGS). 1987. Franciscan Complex, unit 1 (Coast Ranges). <https://mrdata.usgs.gov/geology/state/sgmc-unit.php?unit=CAKJf1%3B0>. Accessed September 18, 2018.

\_\_\_\_\_. 2006. *Quaternary Fault and Fold Database for the United States*. <https://earthquake.usgs.gov/hazards/qfaults/>. Accessed September 11, 2018.

\_\_\_\_\_. 2015. *2008 Bay Area Earthquake Probabilities*. <http://earthquake.usgs.gov/regional/nca/ucerf/>. Accessed May 21, 2015.

\_\_\_\_\_. 2017. Bay Area Faults layer. <https://earthquake.usgs.gov/earthquakes/events/1906calif/virtualtour/kml/SanAndreasBayAreaFaults.kmz>. Accessed December 20, 2017.





**Legend**

- Diversion Structure
- Road
- Watercourse
- Diversion Pipeline
- 10' Construction Buffer

Underground Temporary Holding Structure

**Geologic Units**

- Qhaf - Alluvial Fan Deposits (Holocene)
- Qhasc - Artificial Stream Channel
- Qhb - Flood Basin Deposits (Holocene)
- Qpaf - Alluvial Fan Deposits (Pleistocene)
- af - Artificial Fill (Historic)

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Source: Geologic Units, U.S. Geological Survey, California Geological Survey, 2000

**FIGURE 7-1**

**Project Area Geology**

Underground Flow Equalization System,  
Environmental Impact Report  
City of San Mateo Clean Water Program

N  
0 150 300  
Feet

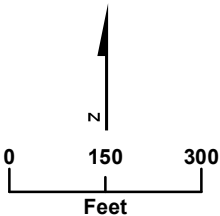
CLEAN WATER PROGRAM  
PROTECTING THE BAY FOR A SUSTAINABLE FUTURE





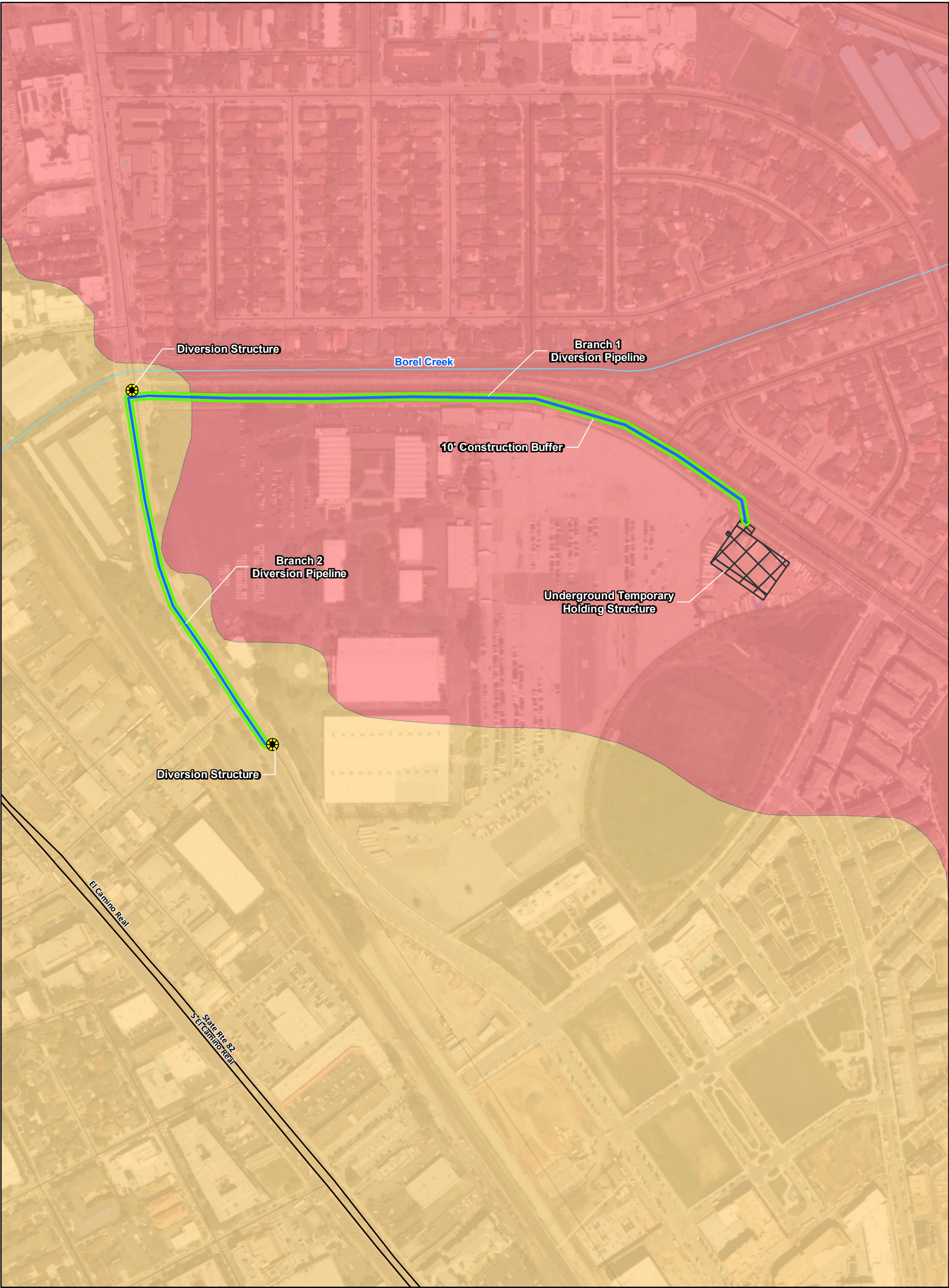
- Legend**
- Diversion Structure
  - Diversion Pipeline
  - Watercourse
  - Road
  - 10' Construction Buffer
  - Underground Temporary Holding Structure







Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community





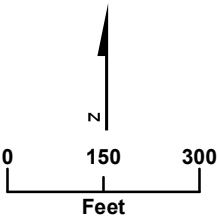
**FIGURE 7-2**  
**Project Area Shaking Intensity**  
Underground Flow Equalization System,  
Environmental Impact Report  
City of San Mateo Clean Water Program





- Legend**
-  Diversion Structure
  -  Diversion Pipeline
  -  Watercourse
  -  Road
  -  10' Construction Buffer
  -  Underground Temporary Holding Structure

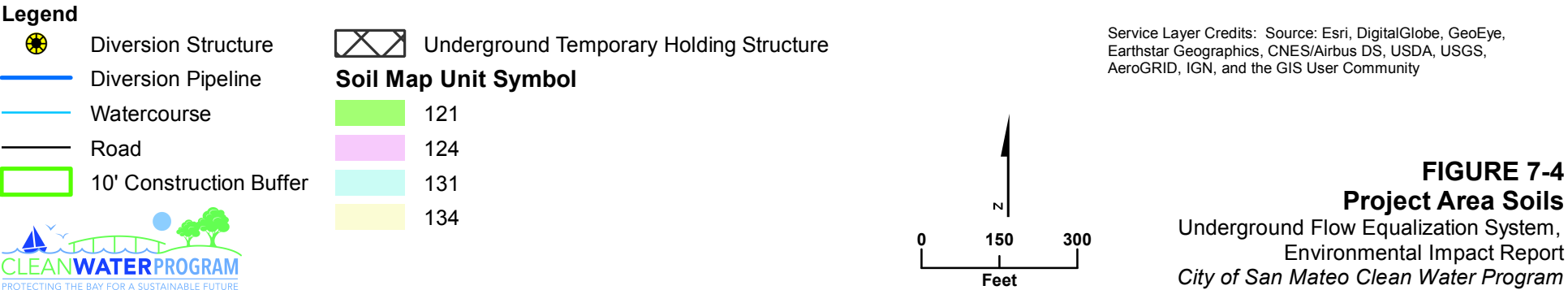
- Liquefaction Potential**
-  High
  -  Moderate



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**FIGURE 7-3**  
**Project Area Liquefaction Potential**  
Underground Flow Equalization System,  
Environmental Impact Report  
City of San Mateo Clean Water Program





Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

0

150

300

Feet

FIGURE 7-4

Project Area Soils

Underground Flow Equalization System,

Environmental Impact Report

City of San Mateo Clean Water Program