4.5 Geology and Soils

This section describes the existing geology and soils conditions of the project site and vicinity, identifies associated regulatory requirements, evaluates potential project and cumulative impacts, and identifies mitigation measures for any significant or potentially significant impacts related to implementation of the of the Santa Cruz Water Rights Project (Proposed Project).

A summary of the comments received during the scoping period for this environmental impact report (EIR) is provided in Table 2-1 in Chapter 2, Introduction, and a complete list of comments is provided in Appendix A. One comment related to geology and soils was received from an individual. Issues identified in public comments related to potentially significant effects on the environment under the California Environmental Quality Act (CEQA), and issues raised by responsible and trustee agencies, are identified and addressed in this EIR.

4.5.1 Existing Conditions

4.5.1.1 Study Area

The Proposed Project involves the water system and the areas served of the City of Santa Cruz (City) and the water service areas of San Lorenzo Valley Water District (SLVWD), Scotts Valley Water District (SVWD), Soquel Creek Water District (SqCWD), and Central Water District (CWD). The Proposed Project is located within Santa Cruz County and is generally bounded by the unincorporated communities of Aptos and Le Selva Beach on the east, Bonny Doon Road on the west, Boulder Creek on the north, and the Pacific Ocean on the south (see Figure 3-1, in Chapter 3, Project Description). While the project area is much broader, the study area for geology and soils is focused on the proposed project and programmatic infrastructure component sites where construction and ground disturbance could occur and where new or upgraded facilities would be located (see Figure 3-4, in Chapter 3, Project Description). These sites include the following: aquifer storage and recovery (ASR) sites where known, intertie improvement sites, Felton Diversion fish passage improvement site, and the Tait Diversion and Coast Pump Station improvement site. ASR would include new ASR facilities at unidentified locations (referred to as “new ASR facilities” in this EIR) and Beltz ASR facilities at the existing Beltz well facilities (referred to as “Beltz ASR facilities” in this EIR). As there are no definitive sites identified to date for new ASR facilities, site-specific conditions are not available.

4.5.1.2 Regional Geologic Setting

Regional Geology

The study area is located along on the southwestern side of the Santa Cruz Mountains. The Santa Cruz Mountains are in the central portion of the Coast Ranges Physiographic Province of California, which is a series of coastal mountain chains paralleling the pronounced northwest-southeast structural grain of central California geology, between Point Arguello, in Santa Barbara County, and the California/Oregon border. The study area and surrounding region are underlain by granitic and metamorphic rocks of the Salinian Block. This suite of basement rocks is separated from contrasting basement rock of the Franciscan Formation to the northeast by the San Andreas Fault System. While the core of the mountain range is dominated by gneiss, schist, limestone, quartzite, and granite, Cretaceous through Holocene sedimentary rocks and lesser amounts of Tertiary volcanic rocks overlie much of the region (USGS 1981a, 1981b; AECOM 2018; USGS 2020a). The geologic conditions of each of the project and programmatic infrastructure components sites are provided in Section 4.5.1.5, Infrastructure Component Site Conditions.

Regional Seismicity and Seismic Hazards

The study area is located in a seismically active region of California, between two major Holocene-active faults, including the San Andreas Fault, located approximately 3 miles to the northeast, and the San Gregorio Fault, located approximately 3 miles to the southwest (see Figure 4.5-1). Historical earthquakes along the San Andreas Fault and its branches have caused substantial seismic shaking in Santa Cruz County in historical time. The two largest historical earthquakes to affect the area were the moment magnitude (Mw) 7.9 San Francisco earthquake of April 18, 1906, and the Mw 6.9 Loma Prieta earthquake of October 17, 1989 (corresponding to Richter magnitudes of 8.3 and 7.1, respectively). The San Francisco earthquake caused severe seismic shaking and structural damage to many buildings in the Santa Cruz Mountains. The Loma Prieta earthquake may have caused more intense seismic shaking than the 1906 event in localized areas of the Santa Cruz Mountains, although its regional effects were not as extensive. There were also major earthquakes in northern California along or near the San Andreas Fault in 1838, 1865, and possibly 1890 (City of Santa Cruz 2012a).

Regional Faulting

As previously discussed, Santa Cruz County is in a portion of California that is crossed by several faults. The California Geological Survey (CGS) classifies faults as:

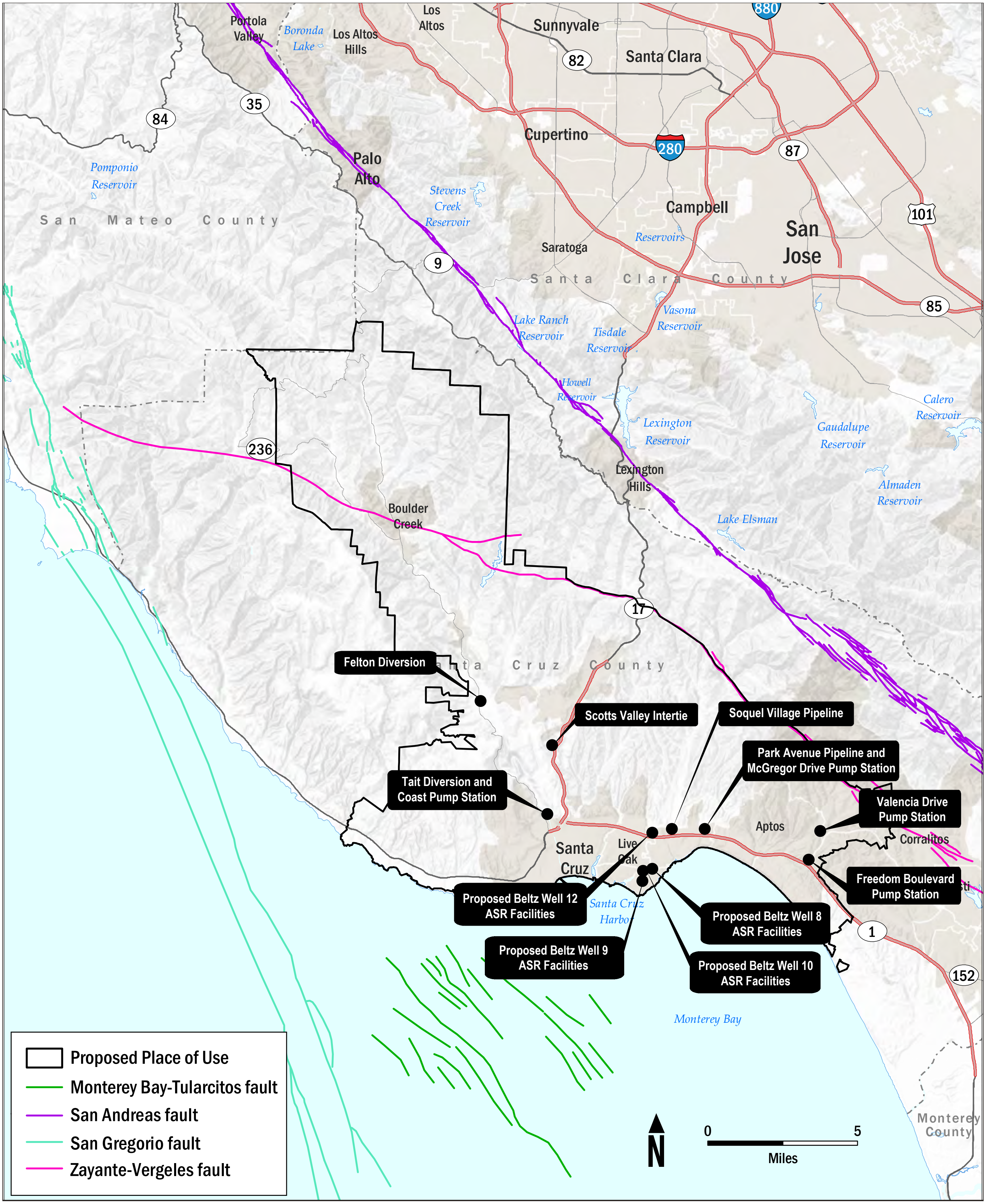
- Holocene-active faults, which are faults that have moved during the past approximate 11,700 years. These faults are capable of surface rupture and are also known as active faults.
- Pre-Holocene faults, which are faults that have not moved in the past 11,700 years. This class of fault may be capable of surface rupture but is not regulated under the Alquist-Priolo Special Studies Zones Act of 1972. Pre-Holocene faults are also known as potentially active faults.
- Age-undetermined faults, which are faults where the recency of fault movement has not been determined (California Geological Survey, 2018). Age-undetermined faults are also known as inactive faults.

This fault classification is consistent with criteria of the Alquist-Priolo Earthquake Fault Zoning Act of 1972 (see Section 4.5.2, Regulatory Framework, for information about this act). Distances to regional faults, maximum probable earthquake magnitudes, and recurrence intervals are shown in Table 4.5-1.

Table 4.5-1. Distances to Regional Faults

Fault	Distance from Study Area (miles)	Maximum Expected Earthquake Magnitude (Moment Magnitude)	Approximate Time Between Major Earthquakes (years)
San Gregorio	3	7.5	400
Zayante-Vergeles	0 (traverses study area)	7.5	8,821
Monterey Bay-Tularcitos	2	7.3	2,841
San Andreas	3	7.8	210

Sources: AECOM 2018; City of Santa Cruz 2012a; USGS 2017a, 2017b, 2017c, 2017d, 2020b.



Proposed Place of Use
Monterey Bay-Tularcitos fault
San Andreas fault
San Gregorio fault
Zayante-Vergeles fault
Felton Diversion
Scotts Valley Intertie
Soquel Village Pipeline
Park Avenue Pipeline and McGregor Drive Pump Station
Valencia Drive Pump Station
Tait Diversion and Coast Pump Station
Freedom Boulevard Pump Station
Proposed Beltz Well 12 ASR Facilities
Proposed Beltz Well 8 ASR Facilities
Proposed Beltz Well 9 ASR Facilities
Proposed Beltz Well 10 ASR Facilities
San Mateo County
Santa Clara County
Santa Cruz County
Monterey County
Portola Valley
Los Altos Hills
Los Altos
Sunnyvale
Santa Clara
Cupertino
Palo Alto
Campbell
San Jose
Saratoga
Lexington Hills
Boulder Creek
Santa Cruz
Live Oak
Aptos
Corralitos
Boronda Lake
Pomponio Reservoir
Stevens Creek Reservoir
Reservoirs
Lake Ranch Reservoir
Tisdale Reservoir
Vasona Reservoir
Howell Reservoir
Lexington Reservoir
Gaudalupe Reservoir
Calero Reservoir
Almaden Reservoir
Lake Elsman
Santa Cruz Harbor
Monterey Bay
880
82
280
87
101
85
84
35
9
236
17
1
152
N
0
5
Miles

The study area is traversed by the Zayante-Vergeles Fault (see Figure 4.5-1) (USGS 2020b), which is mapped by the U.S. Geological Survey (USGS) as a late Pleistocene to possibly Holocene fault, active within the past 15,000 years (i.e., Holocene-active to pre-Holocene fault). The Zayante-Vergeles Fault was considered Holocene-active in a review prepared as part of the City of Santa Cruz General Plan EIR (City of Santa Cruz 2012a, Appendix F-4), based on detailed geologic mapping by numerous geologists. Additionally, a magnitude 4.0 earthquake occurred in 1998 along this fault in the Santa Cruz Mountains (USGS 2000). The Zayante-Vergeles Fault is marked by a zone of relatively parallel fault traces that extend from the vicinity of West Waddell Creek, southeast through the Santa Cruz Mountains, beneath Quaternary alluvium of the Pajaro River, and across the northern Gabilan Range, where the fault has a complex junction with the San Andreas Fault, approximately 5 miles southeast of Hollister (USGS 2000). For planning purposes, the maximum probable earthquake associated with the Zayante-Vergeles Fault is Mw 7.5 (USGS 2017a).

The study area is located approximately 3 miles southwest of the San Andreas Fault (see Figure 4.5-1) (USGS 2020b), which is a 680-mile network of Holocene-active faults that collectively accommodate most of the north-south motion between the North American and Pacific tectonic plates. The San Andreas Fault Zone is considered to be a Holocene-active and historically active strike-slip fault that extends along most of coastal California, from its complex junction with the Mendocino Fault Zone on the north, southeast to the northern Transverse Range, and inland to the Salton Sea, where a well-defined zone of seismicity (i.e., the Brawley Seismic Zone) transfers slip to the Imperial Fault. Two major surface-rupturing earthquakes have occurred in historic time, including the 1857 Fort Tejon earthquake and the 1906 San Francisco earthquake (USGS 2002). For planning purposes, the maximum probable earthquake associated with the San Andreas Fault is Mw 7.8 (USGS 2017b).

The study area is located approximately 3 miles northeast of the San Gregorio Fault (see Figure 4.5-1) (USGS 2020b), which is a Holocene-active (past 11,700 years), structurally complex fault zone as much as 3 miles wide. The fault zone is primarily located offshore, west of San Francisco Bay and Monterey Bay, with onshore locations at promontories, such as Moss Beach, Pillar Point, Pescadero Point, and Point Año Nuevo. The San Gregorio Fault is a complex fault zone consisting of several named faults, including the Seal Cove, Frijoles, Coastways, Greyhound Rock, Carmel Canyon, Denniston Creek, and Año Nuevo Faults. This fault zone extends from Bolinas Lagoon south to the Point Sur region (USGS 1999). For planning purposes, the maximum probable earthquake associated with the San Gregorio Fault is Mw 7.5 (USGS 2017c).

The study area is located approximately 2 miles north of the Monterey Bay-Tularcitos Fault Zone (see Figure 4.5-1), which is generally considered late Quaternary (past 15,000 years) (USGS 2020b); however, portions of this fault are considered Holocene-active (past 11,700 years). This offshore fault zone is a complex, generally northwest-trending zone up to 9 miles wide, consisting primarily of right-lateral, reverse/thrust faults, extending across Monterey Bay southeast to the Monterey Peninsula, to near the crest of the Sierra de Salinas (USGS 2001). For planning purposes, the maximum probable earthquake associated with the Monterey Bay-Tularcitos Fault Zone is Mw 7.3 (USGS 2017d).

In addition, the study area is traversed by the Ben Lomond Fault, which has been mapped generally along the San Lorenzo River from Boulder Creek to Felton, as well as on the westside of the City of Santa Cruz, traversing the coastline just east of Mitchell's Cove. This late Quaternary fault (past 130,000 years) is not well-located throughout much of the study area and therefore is not included on Figure 4.5-1 (USGS 1981, 2020b).

Surface Rupture

Surface rupture involves the displacement and cracking of the ground surface along a fault trace. Surface ruptures are visible instances of horizontal or vertical displacement, or a combination of the two, typically confined to a narrow zone along the fault. Surface rupture is more likely to occur in conjunction with Holocene-active fault segments, where earthquakes are large, or where the location of the movement (earthquake hypocenter) is shallow.

As discussed in Section 4.5.2, Regulatory Framework, the Alquist-Priolo Earthquake Fault Zoning Act of 1972 regulates development near Holocene-active faults to mitigate the hazard of surface fault rupture. This Act requires the State Geologist to establish regulatory zones (known as Alquist-Priolo Special Study Fault Zones) around the surface traces of Holocene-active faults and to issue appropriate maps. Local agencies must regulate most development projects within the zones. The Alquist-Priolo Special Study Fault Zone located closest to the study area is associated with the San Andreas Fault, located approximately 3 miles to the northeast (USGS 2020b, CGS 2020). Therefore, the study area is not subject to fault rupture.

Liquefaction and Lateral Spreading

Soil liquefaction occurs when ground shaking from an earthquake causes a sediment layer saturated with groundwater to lose strength and take on the characteristics of a fluid, thus becoming like quicksand. Factors determining the liquefaction potential are soil type, the level and duration of seismic ground motions, the type and consistency of soils, and the depth to groundwater. Liquefaction generally occurs at depths of less than 40 feet in soils that are young (Holocene-age), saturated, and loose (CGS 2004). Soils that are most susceptible to liquefaction are clay-free deposits of sands and silts, and unconsolidated alluvium.

The California Geological Survey has completed regional liquefaction mapping for the San Francisco Bay Area and the greater Los Angeles area. No such maps are available for the study area (CGS 2020). Similarly, the County of Santa Cruz General Plan Safety Element (County of Santa Cruz 2020a) does not include liquefaction potential maps. However, the City of Santa Cruz 2030 General Plan– Hazards, Safety, and Noise Chapter (City of Santa Cruz 2012b); the City of Capitola General Plan Safety and Noise Element (City of Capitola 2019); and the County of Santa Cruz Geographic Information Services (County of Santa Cruz 2020b) provide liquefaction potential maps. Although the potential for liquefaction within Scotts Valley is described in the Scotts Valley General Plan Safety Element, the accompanying liquefaction figure (Figure S-3) is not available online (City of Scotts Valley 1999). As described in Section 4.5.1.5, Infrastructure Component Site Conditions, portions of the study area have been identified as zones of potential liquefaction.

Lateral spreading is the lateral movement of unsupported soils in association with liquefaction. Examples of areas/scenarios prone to lateral spreading include: 1) liquefaction-prone soils on slopes adjacent to rivers, canals, or lakes; and 2) liquefaction-prone soils during excavation and construction of subterranean parking garages.

Regional Subsidence

Land subsidence is a settling or sudden sinking of a geological surface due to subsurface movement of earth materials. The principal causes of subsidence in California are aquifer-system compaction, drainage and decomposition of organic soils, and oil and gas extraction. Effects of land subsidence include damage to buildings and infrastructure such as roads and canals, increased flood risk in low-lying areas, and lasting damage to groundwater aquifers and aquatic ecosystems. Based on a review of a USGS subsidence map, the study area is not in an area of regional ground subsidence (USGS 2020c).

4.5.1.3 Paleontological Resources

Paleontological resources are the fossilized remains, traces, and associated data of plants and animals, preserved in earth's crust, and are generally considered to be older than middle Holocene (approximately 5,000 years before present) by the Society of Vertebrate Paleontology (SVP 2010). Body fossils include bones, teeth, shells, leaves, and wood, while trace fossils include trails, trackways, footprints, and burrows. With the exception of fossils found in low-grade metasedimentary rocks, significant paleontological resources are found in sedimentary rock units that are old enough to preserve the remains or traces of plants and animals. The fossil potential of geological units is assessed based on the likelihood of encountering fossils within the unit. This study uses the SVP (2010) classification system, which ranks geological units as having high potential (proven track record of producing significant paleontological resources), undetermined potential (little information available on paleontological productivity of geological unit), low potential (rarely if ever produce fossils), and no potential (high-grade metamorphic and plutonic igneous rocks that do not preserve fossils).

To assist in determining the paleontological sensitivity of individual rock units present within the study area, a paleontological records search was requested from the Natural History Museum of Los Angeles County (LACM) on May 22, 2020 and a desktop geological and paleontological research were conducted. The results of this review are presented in Section 4.5.1.5, Infrastructure Component Site Conditions.

4.5.1.4 Unique Geological Features

According to the County of San Diego (2007), which provides guidelines for determining significance of unique geological features throughout California, unique geological features include one or more of the following criteria:

- Is the best example of its kind locally or regionally;
- Embodies the distinctive characteristics of a geologic principle that is exclusive locally or regionally;
- Provides a key piece of geologic information important in geology or geologic history;
- Is a "type locality" of a geologic feature;
- Is a geologic formation that is exclusive locally or regionally;
- Contains a mineral that is not known to occur elsewhere in the County; or
- Is used repeatedly as a teaching tool.

Unique geological features do not include surficial geological expressions that are visually appealing.

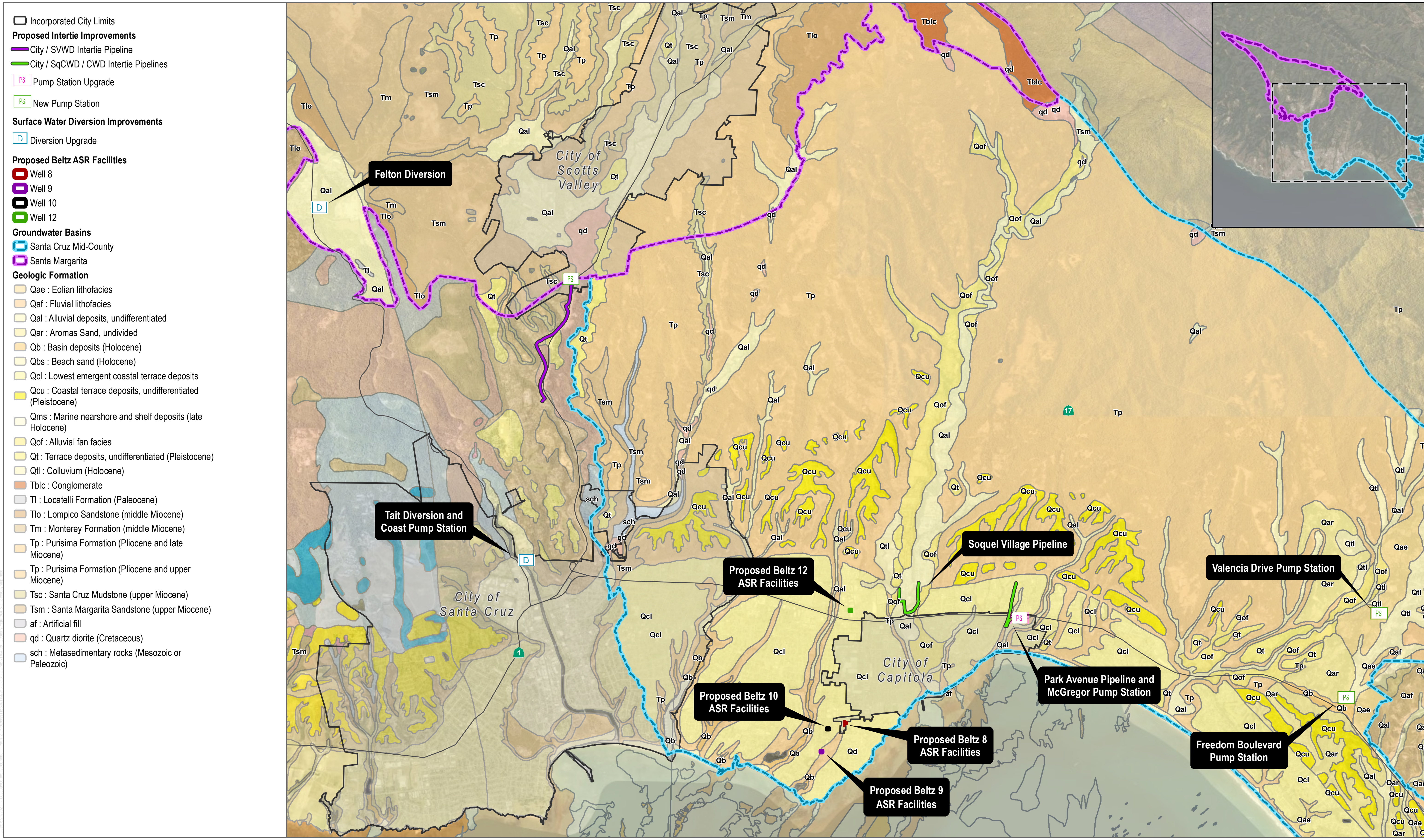
4.5.1.5 Infrastructure Component Site Conditions

This section provides the geology and soils conditions at each of the project and programmatic infrastructure component sites for which improvements and new facilities are proposed.

Aquifer Storage and Recovery Sites

As indicated previously, ASR would include new ASR facilities at unidentified locations (referred to as "new ASR facilities") and Beltz ASR facilities at the existing Beltz well facilities (referred to as "Beltz ASR facilities"). As no definitive sites have been identified to date new ASR facilities, the settings of such future facilities are unknown.

The Beltz 9 ASR site is mapped on the surface as Holocene (<11,700 years ago) basin deposits, which in turn is likely underlain by Pleistocene (approximately 11,700 years ago to 2.58 million years ago [mya]) lowest emergent marine terrace deposits (map unit Qmt2). The Beltz 8, Beltz 10, and Beltz 12 ASR sites are underlain by Pleistocene lowest emergent terrace deposits, which in turn are likely underlain by the Pliocene to late Miocene (approximately 2.58 mya to 11.63 mya) Purisima Formation (map unit Tp) (see Figure 4.5-2) (USGS 2016a, 2020a).



SOURCE: Bing Maps Accessed 2020, Kennedy/Jenks Consultants 2012 and 2014, URS 2013, County of Santa Cruz 2020, USGS 2020

DUDEK

0 2,500 5,000 Feet

FIGURE 4.5-2

Geology Map

Santa Cruz Water Rights Project

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Surface fault rupture is not anticipated in the vicinity of the Beltz ASR sites. The Alquist-Priolo Special Study Fault Zone located closest to the Beltz ASR sites is associated with the San Andreas Fault, located approximately 8 miles to the northeast (see Figure 4.5-1) (USGS 2020b, CGS 2020). Although not within an Alquist-Priolo Special Study Fault Zone, the Holocene-active Zayante-Vergeles, Monterey Bay-Tularcitos, and San Gregorio Faults are located approximately 5 miles, 4 miles, and 12 miles from the Beltz ASR sites, respectively (USGS 2020b).

Based on County of Santa Cruz geographic information system (GIS) data (County of Santa Cruz 2020) and the City of Capitola General Plan Safety and Noise Element (City of Capitola 2019) liquefaction potential maps, the Beltz ASR sites are in an area of low liquefaction potential (see Figure 4.5-3). Although the Pleistocene marine terrace deposits generally consist of sand and gravel, these older sediments have been compacted over time and are not loose and unconsolidated, thus minimizing the potential for liquefaction. Similarly, the underlying Purisima Formation consists of consolidated materials, which would not be prone to liquefaction. Incised (i.e., down-cut) drainages/creeks, including an unnamed creek to the west and Soquel Creek/Capitola Beach to the east, are zones of medium to high liquefaction potential, but the intervening terraced areas, including the Beltz ASR sites, are not prone to liquefaction. The liquefaction potential in the creek areas is a result of shallow perched groundwater and loose, Holocene-age sandy soils in the vicinity of the creeks.

The Beltz ASR sites are located on relatively flat to gently sloping topography. Beltz 8, 9, and 12 ASR sites are located on Watsonville loam soils, which occur on terraces and alluvial fans, on 0% to 15% slopes. Beltz 10 is located on Elkhorn sandy loam, which occurs on terraces and alluvial fans, on 2% to 9% slopes (USDA NRCS 2020). No hillsides are in proximity to these sites. Therefore, there is no potential for landslides or slope instability at the Beltz ASR sites.

Watsonville loam soils, which include loam, clay loam, and sandy clay loam, are somewhat poorly drained and have a very low to moderately low capacity to transmit water. Elkhorn sandy loam and clay loam are well drained and have a moderately high capacity to transmit water (USDA NRCS 2020). The well-drained soils reduce erosion rates by enhancing stormwater infiltration into on-site soils.

The LACM reported no paleontological records from the Beltz 8, Beltz 9, Beltz 10, and Beltz 12 ASR sites (McLeod 2020). However, Pleistocene marine terrace deposits have produced significant invertebrate and vertebrate fossils throughout California. Addicot (1966) reported over 100 marine mollusk, chiton, echinoid, coral, and barnacle species from Santa Cruz Pleistocene marine terraces. In his compilation of Quaternary vertebrate fossil localities in California, Jefferson (1991) listed two Pleistocene fossil localities from Santa Cruz County that included specimens of Columbian mammoth (*Mammuthus columbi*). Jefferson et al (1992) described a variety of fossil terrestrial vertebrate fossils collected from the lowest emergent Pleistocene marine terrace, including horse (*Equus* sp. cf. *E. occidentalis*), camel (*Camelops* sp. cf. *C. hesternus*), bison (*Bison latifrons*), and ground sloth (*Glossotherium harlani*).

No unique geological features were identified from the Beltz 8, Beltz 9, Beltz 10, and Beltz 12 ASR sites.

Intertie Improvement Sites

City/SVWD Intertie Site

The City/SVWD intertie site is underlain by undifferentiated Pleistocene terrace deposits (map unit Qt), the late Miocene (approximately 5.33 mya to 11.63 mya) Santa Margarita Sandstone (Santa Margarita Formation) (map unit Tsm), and Cretaceous/Mesozoic (approximately 66 mya to 145) quartz diorite (map unit qd), which is a plutonic (intrusive) igneous rock unit (see Figure 4.5-2) (USGS 1997, 2020a).

Surface fault rupture is not anticipated in the vicinity of the City/SVWD intertie site. The Alquist-Priolo Special Study Fault Zone located closest to the site is associated with the San Andreas Fault, located approximately 8 miles to the northeast (see Figure 4.5-1) (USGS 2020b, CGS 2020). Although not within an Alquist-Priolo Special Study Fault Zone, the Holocene-active Zayante-Vergeles, Monterey Bay-Tularcitos, and San Gregorio Faults are located approximately 5 miles, 7 miles, and 11 miles from the City/SVWD intertie site, respectively (USGS 2020b).

Based on County of Santa Cruz GIS data (County of Santa Cruz 2020) liquefaction potential maps, the central portion of the City/SVWD intertie site is in an area of low liquefaction potential. The remainder of the site has not been mapped with respect to liquefaction (see Figure 4.5-3); however, only younger alluvial materials along creeks and other water courses have a moderate potential for liquefaction (City of Scotts Valley 1999). As indicated above, the City/SVWD intertie site is not underlain by alluvium.

The topography along the City/SVWD intertie site is gently to moderately sloping, but locally trends immediately downslope of moderately steep hillsides within the Santa Cruz Mountains. The intertie also traverses the banks of a creek subsidiary to Carbonera Creek. Steeper sections of the site are underlain by Ben Lomond-Felton complex soils, which are located on 50% to 75% mountain slopes. Locally steep slopes may be susceptible to failure. Other sections of the intertie site are underlain by Pfeiffer gravelly sandy loam, on 15% to 30% slopes; Zayante coarse sand, on 5% to 30% slopes; and Watsonville loam, on 2% to 15% slopes (USDA NRCS 2020).

Ben Lomond-Felton complex soils are located on mountain slopes and consist of sandy loam, clay loam, and weathered bedrock. These soils are well drained and have a moderately low to high capacity to transmit water. Pfeiffer gravelly sandy loams are located on hills and terraces, are well drained, and have a high capacity to transmit water. Zayante coarse sands are located on hills and mountains, are somewhat excessively well drained, and have a high to very high capacity to transmit water. Watsonville loam soils, which include loam, clay loam, and sandy clay loam, are somewhat poorly drained and have a very low to moderately low capacity to transmit water. The Watsonville soils are in the relatively flat-lying portions of the site (USDA NRCS 2020). Project areas on moderate to steep slopes have a relatively higher erosion potential; however, well-drained soils reduce the potential for erosion by reducing stormwater runoff through rainwater infiltration.

The LACM reported no paleontological records from within the City/SVWD intertie site (McLeod 2020). However, there are known Pleistocene and Santa Margarita Formation fossil localities from Santa Cruz County and the vicinity. The quartz diorite does not have the potential to produce fossils. Pleistocene deposits have produced vertebrate fossils throughout California. Jefferson (1991) reported two Pleistocene fossil localities in Santa Cruz County that produced Columbian Mammoth (*Mammuthus columbi*) specimens.

The closest LACM vertebrate fossil localities from the Santa Margarita Formation were found east of Highway 17 on the western side of DeLaveaga Park, north along Glen Canyon Road. These localities include LACM 1779 [= LACM 3255], 3332, 3334, 3544, and 4939-4941, yielded an assemblage of fossil marine vertebrates including bonito shark (*Isurus hastalis*), dogfish (*Squalus serriculus*), sturgeon (*Acipenser*), jack (Carangidae) sea bass (*Stereolepis*), salmon (*Smilodonichthys*), sea turtle (Cheloniidae), sea bird (Aves), sea lions (*Imagotaria downsi* and *Pithanotaria starri*), dolphin (*Liolithax*), 'river' dolphin (*Zarhachis*), four-legged marine mammals (*Desmostylus* and *Paleoparadoxia tabatai*), and sea cow (*Dusisiren jordani)* (McLeod 2020). *Dusisiren jordani* specimens from LACM 1179 (= LACM 3255) and 3544 were figured or published in the scientific literature (Domning 1978).

No unique geological features were identified from the eastern City/SVWD intertie site.

SOURCE: Bing Maps Accessed 2020, Kennedy/Jenks Consultants 2012 and 2014, County of Santa Cruz 2020

DUDEK

0 5,000 10,000 Feet

FIGURE 4.5-3

Liquefaction Map

Santa Cruz Water Rights Project

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City/SqCWD/CWD Intertie

Soquel Village Pipeline Site

The Soquel Village pipeline site is underlain by late Holocene (approximately 4,200 years ago – Present) alluvial deposits (map unit Qal) and undivided Holocene (<11,700 years ago) alluvial deposits (map unit Qya). A portion of the eastern and western segments of the pipeline site is underlain by Pleistocene alluvial fan deposits (map unit Qof) and these deposits likely underly the Holocene deposits (see Figure 4.5-2) (USGS 2016a, 2020a).

Surface fault rupture is not anticipated in the vicinity of the Soquel Village pipeline site. The Alquist-Priolo Special Study Fault Zone located closest to the intertie site is associated with the San Andreas Fault, located approximately 8 miles to the northeast (see Figure 4.5-1) (USGS 2020b, CGS 2020). Although not within an Alquist-Priolo Special Study Fault Zone, the Holocene-active Zayante-Vergeles, Monterey Bay-Tularcitos, and San Gregorio Faults are located approximately 5 miles, 7 miles, and 12 miles from this portion of the City/SqCWD/CWD intertie site, respectively (USGS 2020b).

Based on County of Santa Cruz GIS data (County of Santa Cruz 2020) and City of Capitola General Plan Safety and Noise Element (City of Capitola 2019) liquefaction potential maps, most of the Soquel Village pipeline site is in an area of high to very high liquefaction potential, associated with shallow groundwater beneath Soquel Creek (see Figure 4.5-3).

The Soquel Village pipeline site is located on variable topography, including relatively flat to gently sloping areas, with localized steep slopes adjacent to and in the vicinity of Soquel Creek. These slopes could potentially be prone to slope instability.

The flat-lying portions of the Soquel Village pipeline site are underlain by Elder sandy loam, Soquel loam, and Elkhorn sandy loam, which occur on alluvial fans, terraces, and flood plains, on 0% to 9% slopes. These soils are well drained and have a high capacity to transmit water. The steeper hillside areas are underlain by Elkhorn-Pfeiffer Complex soils, which consist of sandy loam, gravelly sandy loam, and weathered bedrock. These well-drained soils occur on hills and terraces, on 30% to 50% slopes (USDA NRCS 2020).

The LACM reported no paleontological records from within the Soquel Village pipeline site; however, there are known Pleistocene fossil localities from Santa Cruz County and the vicinity. Pleistocene alluvial fan deposits have produced vertebrate fossils throughout California. Jefferson (1991) reported two Pleistocene fossil localities in Santa Cruz County that produced Columbian Mammoth (*Mammuthus columbi*) specimens.

No unique geological features were identified from the Soquel Village pipeline site.

Park Avenue Pipeline and McGregor Drive Pump Station Sites

The southern portion of the Park Avenue pipeline site is underlain by artificial fill (map unit Af) in the vicinity of the Highway 1 overpass, Pleistocene lowest emergent marine terrace deposits, and the Pliocene to late Miocene Purisima Formation (map unit Tp). The northern portion of the Park Avenue pipeline and McGregor Drive pump station sites are underlain by Pleistocene lowest emergent marine terrace deposits (see Figure 4.5-2) (USGS 2016a, 2020a).

Surface fault rupture is not anticipated in the vicinity of this intertie site. The Alquist-Priolo Special Study Fault Zone located closest to the site is associated with the San Andreas Fault, located approximately 8 miles to the northeast (see Figure 4.5-1) (USGS 2020b, CGS 2020). Although not within an Alquist-Priolo Special Study Fault Zone, the

Holocene-active Zayante-Vergeles, Monterey Bay-Tularcitos, and San Gregorio Faults are located approximately 5 miles, 7 miles, and 12 miles from this portion of the City/SqCWD/CWD intertie site, respectively (USGS 2020b).

Based on County of Santa Cruz GIS data (County of Santa Cruz 2020) and the City of Capitola General Plan Safety and Noise Element (City of Capitola 2019) liquefaction potential maps, portions of the Park Avenue pipeline and McGregor Drive pump station sites are in an area of very high liquefaction potential, associated with shallow groundwater beneath a tributary drainage to Tannery Gulch (see Figure 4.5-3).

The northern part of the Park Avenue pipeline site is located on relatively flat to gently sloping topography. The southern portion traverses slopes associated with Tannery Gulch. The northern portion of the pipeline site overlies Watsonville loam soils, which occur on terraces and alluvial fans, on 0% to 15% slopes (USDA NRCS 2020). This area would not be prone to slope instability. The southern portion of the Park Avenue pipeline site and the McGregor Drive pump station site are located on Tierra-Watsonville complex soils, on 15% to 30% slopes. Based on these slope gradients, localized areas may be susceptible to slope instability.

Watsonville loam soils, which include loam, clay loam, and sandy clay loam, are somewhat poorly drained and have a very low to moderately low capacity to transmit water. Tierra-Watsonville complex soils consist of clay, clay loam, sandy loam, and gravelly sandy loam. These soils are somewhat poorly drained and have very low ability to transmit water (USDA NRCS 2020). Poorly drained soils are not prone to absorbing precipitation, resulting in higher runoff rates and increased erosion potential.

The LACM reported no paleontological records from within the Park Avenue pipeline and McGregor Drive pump station sites; however, there are known Pleistocene and Purisima Formation fossil localities from Santa Cruz County and the vicinity. Pleistocene marine terrace deposits have produced significant invertebrate and vertebrate fossils throughout California. Addicot (1966) reported over 100 marine mollusk, chiton, echinoid, coral, and barnacle species from Santa Cruz Pleistocene marine terraces. In his compilation of Quaternary vertebrate fossil localities in California, Jefferson (1991) listed two Pleistocene fossil localities from Santa Cruz County that included specimens of Columbian mammoth (*Mammuthus columbi*). Jefferson et al (1992) described a variety of fossil terrestrial vertebrate fossils collected from the lowest emergent Pleistocene marine terrace, including horse (*Equus* sp. cf. *E. occidentalis*), camel (*Camelops* sp. cf. *C. hesternus*), bison (*Bison latifrons*), and ground sloth (*Glossotherium harlani*). The LACM did report several fossil localities from the Purisima Formation nearby including LACM 4291-4293 at Seacliff State Beach, LACM 4278 and 7846 at Capitola Beach, and LACM 4339, 4957, 5141, 5986, 6120-6121, 7969 and 7991 along Opal Cliffs (McLeod 2020). These localities yielded a complex fauna of marine vertebrates including dogfish (*Squalus*), hake (*Merluccius*), surfperch (*Cymatogaster* and *Hyperprosopon*), croaker (Sciaenidae), halibut, (*Paralichthys californicus*), sanddabs (*Citharichthys sordidus* and *Citharichthys stigmaeus*), smelt (*Hypomesus* and *Spirinchus*), rockfish (*Sebastes*), walrus (Dusignathinae), right whale (Balaenidae), river dolphin (*Parapontoporia*), common dolphin (*Delphinus*), beluga whale (Delphinapterinae), porpoise (*Phocoena sinus* and *Semirostrum*).

No unique geological features were identified from the Park Avenue pipeline and McGregor Drive pump station sites.

<u>Freedom Boulevard Pump Station Site</u>

The Freedom Boulevard pump station site is underlain by Holocene basin deposits (map unit Qb) and colluvium and Pleistocene undivided Aromas Sand (map unit Qar), and these deposits likely underly the Holocene deposits (see Figure 4.5-2) (USGS 2016a, 2020a). The Aromas Sand is composed of eolian and fluvial (river-deposited) gravels, sands, silts, and clays.

Surface fault rupture is not anticipated in the vicinity of the Freedom Boulevard pump station site. The Alquist-Priolo Special Study Fault Zone located closest to the site is associated with the San Andreas Fault, located approximately 6 miles to the northeast (see Figure 4.5-1) (USGS 2020b, CGS 2020). Although not within an Alquist-Priolo Special Study Fault Zone, the Holocene-active Zayante-Vergeles, Monterey Bay-Tularcitos, and San Gregorio Faults are located approximately 3 miles, 8 miles, and 18 miles from the Freedom Boulevard Pump Station, respectively (USGS 2020b).

Based on County of Santa Cruz GIS data (County of Santa Cruz 2020) liquefaction potential maps, the Freedom Boulevard pump station site is in an area of low liquefaction potential (see Figure 4.5-3). This pump station site is gently sloping and underlain by Baywood loamy sand, which is somewhat excessively drained, on 15% to 30% slopes. The somewhat excessively drained soils would enhance stormwater infiltration and reduce runoff rates.

The LACM reported no paleontological records from the Freedom Boulevard pump station site (McLeod 2020). However, Pleistocene eolian and fluvial deposits have produced significant vertebrate fossils throughout California. In his compilation of Quaternary vertebrate fossil localities in California, Jefferson (1991) listed two Pleistocene fossil localities from Santa Cruz County that included specimens of Columbian mammoth (*Mammuthus columbi*).

No unique geological features were identified from the Freedom Boulevard pump station site.

<u>Valencia Drive Pump Station Site</u>

The Valencia Drive pump station site is underlain by Holocene (approximately 11,700 years ago – Present) colluvial deposits (map unit Qtl) and Pleistocene eolian (wind-blown sands) lithofacies (map unit Qae). The Pleistocene eolian deposits likely underly the Holocene deposits where present (see Figure 4.5-2) (USGS 2016a, 2020a).

Surface fault rupture is not anticipated in the vicinity of the Valencia Drive pump station site. The Alquist-Priolo Special Study Fault Zone located closest to the site is associated with the San Andreas Fault, located approximately 5 miles to the northeast (see Figure 4.5-1) (USGS 2020b, CGS 2020). Although not within an Alquist-Priolo Special Study Fault Zone, the Holocene-active Zayante-Vergeles, Monterey Bay-Tularcitos, and San Gregorio Faults are located approximately 1.5 miles, 10 miles, and 19 miles from the Valencia Drive pump station site, respectively (USGS 2020b).

Based on County of Santa Cruz GIS data (County of Santa Cruz 2020) liquefaction potential maps, the Valencia Drive pump station site is in an area of low liquefaction potential (see Figure 4.5-3).

The Valencia Drive pump station site is gently sloping and underlain by Baywood loamy sand, which is somewhat excessively drained, on 15% to 30% slopes. The somewhat excessively drained soils would enhance stormwater infiltration and reduce runoff rates.

The LACM reported no paleontological records from the Valencia Drive pump station site (McLeod 2020). However, Pleistocene eolian deposits have produced significant vertebrate fossils throughout California. In his compilation of Quaternary vertebrate fossil localities in California, Jefferson (1991) listed two Pleistocene fossil localities from Santa Cruz County that included specimens of Columbian mammoth (*Mammuthus columbi*).

No unique geological features were identified from the Valencia Drive pump station site.

Felton Diversion Site

The Felton Diversion site is underlain by undifferentiated, Holocene alluvial deposits (map unit Qal), which are likely underlain by Pleistocene alluvium and the Miocene Lompico Sandstone at depth (see Figure 4.5-2) (USGS 1997, 2020a).

Surface fault rupture is not anticipated in the vicinity of the Felton Diversion site. The Alquist-Priolo Special Study Fault Zone located closest to the site is associated with the San Andreas Fault, located approximately 9 miles to the northeast (see Figure 4.5-1) (USGS 2020b, CGS 2020). Although not within an Alquist-Priolo Special Study Fault Zone, the Holocene-active Zayante-Vergeles, Monterey Bay-Tularcitos, and San Gregorio Faults are located approximately 4 miles, 8 miles, and 9 miles from Felton Diversion site, respectively (USGS 2020b).

Based on County of Santa Cruz GIS data (County of Santa Cruz 2020) liquefaction potential maps, the Felton Diversion is in an area of moderate liquefaction potential (see Figure 4.5-3).

The topography at the Felton Diversion site is relatively flat to gently sloping. Except for the San Lorenzo River bank, most of which has been modified for the existing intake structure and fish ladder, no slopes that could be susceptible to failure are present on site.

The Felton Diversion site is underlain by Soquel loam, on 2% to 9% slopes (USDA NRCS 2020). These soils, which include silt loam, silty clay loam, and clay loam, are located on alluvial plains, are moderately well drained, and have moderately high capacity to transmit water. The well-drained soils reduce erosion rates by enhancing stormwater infiltration into on-site soils.

The LACM reported no fossil localities from the Felton Diversion site, as the Holocene alluvium present is generally too young to produce significant paleontological resources. However, Holocene alluvium is oftentimes underlain by Pleistocene alluvium or sedimentary geological formations/units that have the potential to produce fossils.

No unique geological features were identified from the Felton Diversion site.

Tait Diversion and Coast Pump Station Site

The Tait Diversion and Coast Pump Station site is underlain by late Holocene alluvial deposits (map unit Qal) , which in turn are likely underlain by Pleistocene alluvium or the Miocene Lompico Sandstone at depth (see Figure 4.5-2) (USGS 2016b, 2020a).

Surface fault rupture is not anticipated in the vicinity of the Coast Pump Station site. The Alquist-Priolo Special Study Fault Zone located closest to the site is associated with the San Andreas Fault, located approximately 10 miles to the northeast (see Figure 4.5-1) (USGS 2020b, CGS 2020). Although not within an Alquist-Priolo Special Study Fault Zone, the Holocene-active Zayante-Vergeles, Monterey Bay-Tularcitos, and San Gregorio Faults are located approximately 8 miles, 5 miles, and 10 miles from pump station site, respectively (USGS 2020b).

Based on the County of Santa Cruz GIS data (County of Santa Cruz 2020b) and the City of Santa Cruz 2030 General Plan (City of Santa Cruz 2012b) liquefaction potential maps, the Tait Diversion and Coast Pump Station site is in an area of high liquefaction potential, associated with shallow groundwater beneath the San Lorenzo River (see Figure 4.5-3).

The topography at the Coast Pump Station site is relatively flat to gently sloping. The site is underlain by Baywood loamy sand, on 0% to 2% slopes, and Soquel loam, on 2% to 9 % slopes (USDA NRCS 2020). Except for the San Lorenzo River bank, some of which has been modified for the existing intake structure/diversion weir, no slopes that could be susceptible to failure are present on site.

The Baywood loamy sand is found on valley floors, is somewhat excessively drained, and has high to very high capacity to transmit water. The Soquel loam is found on alluvial plains, is moderately well drained, and has a moderately high capacity to transmit water (USDA NRCS 2020). Well-drained soils reduce erosion rates by enhancing stormwater infiltration into on-site soils.

The LACM reported no fossil localities from the Tait Diversion and Coast Pump Station site, as the Holocene alluvium present is generally too young to produce significant paleontological resources. However, Holocene alluvium is oftentimes underlain by Pleistocene alluvium or sedimentary geological formations/units that have the potential to produce fossils.

No unique geological features were identified from the Tait Diversion and Coast Pump Station site.

4.5.2 Regulatory Framework

4.5.2.1 Federal

Federal regulations do not directly apply to geology and soils with respect to the Proposed Project. Nonetheless, installation of underground infrastructure/utility lines must comply with national industry standards specific to the type of utility (e.g., National Clay Pipe Institute for sewers, American Water Works Association for water lines), and the discharge of contaminants must be controlled through the National Pollutant Discharge Elimination System (NPDES) permitting program for management of construction and municipal stormwater runoff. These standards contain specifications for installation, design, and maintenance to reflect site-specific geologic and soils conditions.

4.5.2.2 State

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Act (Public Resources Code [PRC] Sections 2621 through 2630) was passed in 1972 to mitigate the hazard of surface faulting to structures designed for human occupancy. The main purpose of the law is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. A structure for human occupancy is defined as any structure used or intended for supporting or sheltering any use or occupancy, which is expected to have a human occupancy rate of more than 2,000 person-hours per year. The law addresses only the hazard of surface fault rupture and is not directed toward other earthquake hazards. The Alquist-Priolo Act 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 their use in planning efforts. Before a structure for human occupancy can be permitted in a designated Alquist-Priolo Earthquake Fault Zone, the local agency must require a geologic investigation to demonstrate that proposed buildings would not be constructed across active faults.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act (PRC Sections 2690 through 2699.6 et seq.), passed by the California legislature in 1990, addresses earthquake hazards from non-surface fault rupture, including liquefaction and seismically induced landslides. The act established a mapping program for areas that have the potential for liquefaction, strong ground shaking, or other earthquake and geologic hazards. To date, the CGS has only created liquefaction hazard maps for USGS quadrangle maps in the greater Los Angeles and San Francisco Bay areas (CGS 2007).

California Building Code

The state regulations protecting structures from geo-seismic hazards are contained in the California Code of Regulations, Title 24, Part 2 (the California Building Code), which is updated every three years. These regulations apply to public and private buildings in the state. Until January 1, 2008, the California Building Code was based on the then-current Uniform Building Code and contained additions, amendments, and repeals specific to building conditions and structural requirements of the State of California. The 2019 California Building Code, effective January 1, 2020, is based on the current (2018) International Building Code and enhances the sections dealing with existing structures. Seismic-resistant construction design is required to meet more stringent technical standards than those set by previous versions of the California Building Code.

Construction activities are subject to occupational safety standards for excavation and trenching, as specified in the California Safety and Health Administration regulations (Title 8 of the California Code of Regulations) and in Chapter 33 of the California Building Code. These regulations specify the measures to be used for excavation and trench work where workers could be exposed to unstable soil conditions. The Project would be required to employ these safety measures during excavation and trenching.

State Earthquake Protection Law

The State Earthquake Protection Law (Health and Safety Code Section 19100 et seq.) requires that structures be designed and constructed to resist stresses produced by lateral forces caused by wind and earthquakes, as provided in the California Building Code. Chapter 16 of the California Building Code sets forth specific minimum seismic safety and structural design requirements, requires a site-specific geotechnical study to address seismic issues, and identifies seismic factors that must be considered in structural design. Because the program and programmatic infrastructure component sites are not located within an Alquist-Priolo Earthquake Fault Zone, as noted above, no special provisions would be required for development of the Proposed Project related to fault rupture.

California Environmental Quality Act

The California Environmental Quality Act (CEQA) Guidelines require that all private and public activities not specifically exempted be evaluated against the potential for environmental damage, including effects to paleontological resources. Paleontological resources, which are limited, nonrenewable resources of scientific, cultural, and educational value, are recognized as part of the environment under these state guidelines. This analysis satisfies project requirements in accordance with CEQA (13 PRC Section 21000 et seq.) and PRC Section 5097.5 (Stats 1965, c. 1136, p. 2792). This analysis also complies with guidelines and significance criteria specified by the SVP (2010).

Paleontological resources are explicitly afforded protection by CEQA, specifically in Section VII(f) of CEQA Guidelines Appendix G, the “Environmental Checklist Form,” which addresses the potential for adverse impacts to “unique paleontological resource[s] or site[s] or … unique geological feature[s].” This provision covers fossils of significant importance – remains of species or genera new to science, for example, or fossils exhibiting features not previously recognized for a given animal group – as well as localities that yield fossils significant in their abundance, diversity, preservation, and so forth. Chapter 1.7, Sections 5097.5 and 30244 of the PRC defines unauthorized removal of fossil resources as a misdemeanor and requires mitigation of disturbed sites.

4.5.2.3 Local

The study area for the Proposed Project includes the jurisdictions of the City of Santa Cruz, City of Capitola, City of Scotts Valley, and County of Santa Cruz. The general plans and, where relevant, the local coastal programs of these jurisdictions include policies and programs related to geology and soils. Section 4.9, Land Use, Agriculture and Forestry, and Mineral Resources, discusses applicable general plan and local coastal program policies related to geology and soils, as relevant to the Proposed Project.

4.5.3 Impacts and Mitigation Measures

This section contains the evaluation of potential environmental impacts associated with the Proposed Project related to geology and soils. The section identifies the standards of significance used in evaluating the impacts, describes the methods used in conducting the analysis, and evaluates the Proposed Project's impacts and contribution to significant cumulative impacts, if any are identified.

4.5.3.1 Standards of Significance

The standards of significance used to evaluate the impacts of the Proposed Project related to geology and soils are based on Appendix G of the CEQA Guidelines and the City of Santa Cruz CEQA Guidelines, as listed below. A significant impact would occur if the Proposed Project would:

A. 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.
B. Result in substantial soil erosion or the loss of topsoil. (See Section 4.8, Hydrology and Water Quality, for an analysis of this standard.)
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 direct or indirect risks to life or property.
E. Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater.
F. Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.

4.5.3.2 Analytical Methods

This section evaluates the potential geology and soils impacts associated with construction and operation of the Proposed Project. The analysis of potential impacts addresses the various project and programmatic components listed in Table 4.5-2, which are described in detail in Chapter 3, Project Description.

Table 4.5-2. Project and Programmatic Components

Proposed Project Components	Project Components	Programmatic Components
WATER RIGHTS MODIFICATIONS		
Place of Use	✓	
Points of Diversion	✓	
Underground Storage and Purpose of Use	✓	
Method of Diversion	✓	
Extension of Time	✓	
Bypass Requirement (Agreed Flows)	✓	
INFRASTRUCTURE COMPONENTS		
Water Supply Augmentation		
Aquifer Storage and Recovery (ASR)		✓
New ASR Facilities at Unidentified Locations		✓
Beltz ASR Facilities at Existing Beltz Well Facilities	✓	
Water Transfers and Exchanges and Intertie Improvements		✓
Surface Water Diversion Improvements		
Felton Diversion Fish Passage Improvements		✓
Tait Diversion and Coast Pump Station Improvements		✓

Construction-related impacts are considered for each component of the Proposed Project that would require construction. Specifically, the components of the Proposed Project that require construction include the proposed project and programmatic infrastructure components listed in Table 4.5-2. Operational-related impacts of the proposed infrastructure components are considered in the context of long-term geologic hazards. The following analysis considers whether the Proposed Project would directly or indirectly cause geologic and soils impacts, taking into account state-mandated construction methods, as specified in the California Safety and Health Administration regulations (Title 8 of the California Code of Regulations) and in Chapter 33 of the California Building Code, as described in Section 4.5.2, Regulatory Framework, and Proposed Project standard construction practices described in detail in Chapter 3, Project Description and evaluated below. Moreover, the analysis considers whether a unique paleontological resource, site, or unique geologic feature would be directly or indirectly destroyed as a result of the Proposed Project. If impacts are determined to be potentially significant, mitigation measures would be provided to reduce impacts to less-than-significant levels, if feasible.

Additionally, the analysis below has been written against the backdrop of CEQA case law addressing the scope of analysis required in EIRs for potential impacts resulting from existing environmental hazards such as geological hazards in the vicinity of a site for a proposed project. In *California Building Industry Association v. Bay Area Air Quality Management District* (2015) 62 Cal.4th 369, 377 (“CBIA”), the California Supreme Court held that "agencies subject to CEQA generally are *not* required to analyze the impact of existing environmental conditions on a project's future users or residents." (Italics added.) For this reason, the court found the following former language from CEQA Guidelines Section 15126.2, subdivision (a), to be invalid: "[A]n EIR on a subdivision astride an active fault line should identify as a significant effect the seismic hazard to future occupants of the subdivision. The subdivision would have the effect of attracting people to the location and exposing them to the hazards found there." (*Id*. at p. 390.)

The court did not hold, however, that CEQA never requires consideration of the effects of existing environmental conditions on the future occupants or users of a proposed project. But the circumstances in which such conditions may be considered are narrow: "when a proposed project risks exacerbating those environmental hazards or conditions that already exist, an agency must analyze the potential impact of such hazards on future residents or users. In those specific instances, it is the project's impact on the environment—and not the environment's impact on the project—that compels an evaluation of how future residents or users could be affected by exacerbated conditions." (*Id*. at pp. 377-378, italics added.) Because this exception to the general rule would presumably never apply to existing seismic hazards, the court concluded that this particular topic was outside the ambit of CEQA. (*Id*. at p. 390.)

These considerations are reflected in the significance thresholds set forth above, which consider the extent to which the Proposed Project would "[d]irectly or indirectly *cause* potential substantial adverse effects[.]"

Application of Relevant Standard Practices

The Proposed Project includes a standard operational practice (see Section 3.4.5.1, Standard Operational Practices), that the City or its contractors would implement to avoid or minimize effects to groundwater and specifically subsidence due to groundwater withdrawals. This practice and its effectiveness in avoiding and minimizing effects is described below.

Standard Operational Practice #2 requires compliance with both the Santa Cruz Mid-County Groundwater Basin Sustainability Plan (GSP) and the pending Santa Margarita Groundwater Basin GSP, as well as any future revisions to these GSPs. It further requires that new ASR facilities in the Santa Margarita Groundwater Basin be installed and operated after the Santa Margarita Groundwater Basin GSP is submitted to the Department of Water Resources in January 2022. This measure documents the City's commitment to installing and operating ASR facilities in compliance with these GSPs and any further revisions and indicates that the City would not pursue new ASR facilities in the Santa Margarita Groundwater Basin until after that GSP is submitted. This practice would be effective in providing for ASR operations in conformance with the applicable GSP and any future revisions.

If the Proposed Project would have potentially significant impacts even with the implementation of the above standard operational practice, the impact analysis identifies mitigation measures.

4.5.3.3 Project Impact Analysis

Areas of No Impact

The Proposed Project would not have impacts with respect to the following standards of significance for the following reasons:

- **Earthquake Fault Rupture (Significance Standard A-i).** As indicated in Section 4.5.1, Existing Conditions, the project and programmatic infrastructure components would not be located on 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. Therefore, the Proposed Project would have no impacts related to fault rupture.
- **Septic Tanks/Alternative Wastewater Disposal (Significance Standard E).** The project and programmatic infrastructure components would not involve the installation of septic tanks or alternative wastewater disposal systems. Therefore, the Proposed Project would have no impacts related to soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems.

Impacts

This section provides a detailed evaluation of geology and soils impacts associated with the Proposed Project. Construction-related impacts associated with soil erosion/loss of topsoil (Significance Standard B) is addressed in Section 4.8, Hydrology and Water Quality.

Impact GEO-1:	**Seismic Hazards (Significance Standards A-ii and A-iii).** Construction and operation of the Proposed Project could directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death resulting from seismic ground shaking, landslides, or seismic related ground failure, including liquefaction and associated lateral spreading. ***(Less than Significant with Mitigation)***

This evaluation addresses impacts related to induced liquefaction/lateral spreading, induced seismicity, and collapse (due to seismically induced ground failure). Impact GEO-2 addresses other types of unstable soil conditions that can result from landslide, slope failure/instability, and subsidence.

Water Rights Modifications

The water rights modifications of the Proposed Project would not directly result in construction or operation of new infrastructure facilities and would not directly cause potential substantial adverse effects, including the risk of loss, injury, or death resulting from seismic ground shaking, landslides, or seismic related ground failure, including liquefaction and lateral spreading. Therefore, this project component would have no direct impacts.

The following analysis evaluates the potential indirect impacts related to seismic hazards as a result of the proposed water rights modifications, that once approved could result in the implementation of the project and programmatic infrastructure components of the Proposed Project.

Infrastructure Components

<u>Aquifer Storage and Recovery Facilities</u>

New ASR Facilities

New Facility Impacts. The Proposed Project could result in installation of new ASR facilities in the Santa Cruz Mid-County Groundwater Basin, inside or outside the City's service area, and in the Santa Margarita Groundwater Basin, outside the City's service area, to allow for injection of treated water from the City's Graham Hill Water Treatment Plant and possible subsequent extraction. This programmatic component includes ASR of sufficient capacity to address the City's agreed-upon worst-year water supply gap of 1.2 billion gallons per year, during modeled worst-year conditions. Other than the Beltz ASR facilities (see evaluation below), the locations of new ASR facilities have not been determined to date. New ASR facilities would likely consist of the following components: (1) a pump control and chemical storage building; (2) a treatment system; (3) backwash tank(s) used in the treatment system; (4) a water well and monitoring wells, submersible pump and concrete pedestal, station piping including treated water pipelines, sewer connections, and stormwater drainage facilities that would connect to nearby facilities in adjacent roadways. A typical facility would require a site approximately 0.25 acres in size.

These facilities would potentially be subject to damage as a result of strong seismically induced ground shaking and ground failure associated with an earthquake on regional faults. However, the design and construction of the facility infrastructure would be completed in accordance with CBC regulations, thus minimizing the potential for damage. In addition, installation of new ASR facilities would not exacerbate the potential for seismically induced ground shaking and ground failure to occur. As such, construction and operation of the proposed infrastructure facilities would not directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death resulting from seismic ground shaking or seismic related ground failure. As a result, this programmatic component would have a less-than-significant impact.

Induced Seismicity Impacts. A public comment received during the Scoping period (see Chapter 2, Introduction, and Appendix A) expressed concern that the injection of water into ASR wells associated with the Proposed Project could cause earthquakes. New ASR facility injections would not cause earthquakes, such as have occurred in oil field related wastewater injections in the central United States, including Oklahoma, Kansas, Colorado, and Arkansas, which have locally resulted in earthquakes with magnitudes up to 5.8. Most of the earthquakes are in the magnitude 3 to 4 range. This induced seismicity is due to long-duration, high-volume injection of wastewater in disposal wells in deep geologic formations, far below water extracted for drinking water. Wastewater injection typically occurs at depths of 3,000 to 7,000 feet below ground surface, in cratonic basement rocks. Earthquakes occur when the injection pressure of the wastewater is greater than the fracture pressure of faults in the vicinity of the injection well. Few of the surge in oil field related earthquakes in Oklahoma, where most of the earthquakes have occurred since 2009, have occurred due to fracking (USGS 2021; Castro et al. 2019; CalGEM 2021). While very strong statistical evidence exists of induced seismicity in Oklahoma, only moderate evidence exists of induced seismicity in California associated with wastewater injection (McClure et al. 2017).

The Proposed Project could result in installation of new ASR facilities in the Santa Cruz Mid-County Groundwater Basin and in the Santa Margarita Groundwater Basin. Currently, the deepest aquifers used for groundwater production are the Purisima-AA and Tu aquifers, which are underlain by impervious granitic basement rocks. Based on water well data, the base of the Purisima-AA aquifer is as deep as 1,000 feet, and based on oil well data, the base of the Tu aquifer is as deep as 3,000 feet. However, groundwater wells extending to the base of the Purisima-AA and Tu aquifers are less than 1,000 feet deep (SCMGA 2019). Based on these well depths, ASR injection in new facilities would not be completed in deep basement rocks, as occurs in wastewater injection wells in the central United States where induced seismicity has occurred. Injection would generally occur into relatively shallow (i.e., less than 1,000 feet), semi-consolidated, permeable deposits, which would not be prone to fracturing and induced seismicity and therefore would not directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death resulting from seismic ground shaking or seismic related ground failure. As a result, this programmatic component would have a less-than-significant impact.

Induced Liquefaction Impacts. As discussed in Section 4.5.1, Existing Conditions, factors determining liquefaction potential are soil type, the level and duration of seismic ground motions, the type and consistency of soils, and the depth to groundwater. Liquefaction generally occurs at depths of less than 40 feet in soils that are young (Holocene-age), saturated, and loose. If ASR operations were to raise water elevations to within 40 feet of the ground surface and the soils are prone to liquefaction (as illustrated in Figure 4.5-3), liquefaction would potentially occur due to the operation of new ASR facilities. ASR-induced liquefaction could result in damage to existing overlying structures and infrastructure, including utilities. As a result, this programmatic component would potentially cause substantial adverse effects, including the risk of loss, injury, or death resulting from liquefaction and associated lateral spreading and impacts would be potentially significant.

Implementation of MM GEO-1 would avoid substantial adverse effects, including the risk of loss, injury, or death resulting from liquefaction and associated lateral spreading by maintaining and operating ASR injections in new wells located in potential liquefaction zones, as depicted on Figure 4.5-3, such that existing shallow groundwater (i.e., depth generally less than 100 feet) does not rise to within 40 feet of the ground surface, which would limit liquefaction potential. Similarly, ASR injections in potential liquefaction zones shall be maintained and operated such that existing groundwater within a depth of 40 feet or less does not rise closer to the ground surface. Therefore, with the implementation of this mitigation measure, the impact of this programmatic component would be reduced to a less-than-significant level.

Beltz ASR Facilities

Facility Upgrade Impacts. This project component would involve injecting treated surface water into the Santa Cruz Mid-County Groundwater Basin, which would act as an underground storage reservoir, consistent with the Groundwater Sustainability Plan (GSP) for this basin (Santa Cruz Mid-County Groundwater Agency 2019). Specifically, treated surface water would be injected at the existing Beltz 8, 9, 10, and 12 facilities, which would be modified as part of the Proposed Project, to allow for injection of treated water and subsequent extraction. The Beltz system would be modified to accommodate proposed ASR injection capacity of 2.10 million gallons per day (mgd), and proposed ASR extraction capacity of 2.17 mgd. In addition, the proposed Beltz ASR system would retain its existing groundwater extraction capacity of 1.1 mgd, subject to seasonal and hydrological constraints. Proposed upgrades to the Beltz system to allow for ASR would include new connection pipelines within each well infrastructure; wellhead modifications; new submersible pump and motor assembly; and new valves, electrical conduit, and backwash tanks. Up to three monitoring wells, approximately 400 feet deep, would be installed at Beltz 9.

These facilities would potentially be subject to damage as a result of strong seismically induced ground shaking and ground failure associated with an earthquake on regional faults. However, the design and construction of the facility upgrades would be completed in accordance with CBC regulations, thus minimizing the potential for damage. In addition, installation of new facilities would not exacerbate the potential for seismically induced ground shaking and ground failure to occur. As such, construction and operation of the proposed upgrades would not directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death resulting from seismic ground shaking or seismic related ground failure. As a result, this programmatic component would have a less-than-significant impact.

Induced Seismicity Impacts. As indicated for new ASR facilities, Beltz ASR facility injections would not cause earthquakes, such as have occurred in oil field related wastewater injection in the central United States. Oil field related wastewater disposal in the central United States has locally resulted in earthquakes due to long-duration, high-volume injection of wastewater in injection wells in deep geologic formations, far below water extracted for drinking water. Wastewater injection typically occurs at depths of 3,000 to 7,000 feet below ground surface, in cratonic basement rocks. The Proposed Project would include injecting surface water at the Beltz 8, 9, 10, and 12 ASR facilities, which would be upgraded for ASR operations. These wells are in the western portion of the Santa Cruz Mid-County Groundwater Basin and extend to the base of the AA-Purisima aquifer, at depths less than 700 feet below ground surface (SCMGA 2019). Based on these well depths, ASR injection in the Beltz wells would not be completed in deep basement rocks, as occurs in wastewater injection wells in the central United States where induced seismicity has occurred. Injection would generally occur into relatively shallow (i.e., less than 1,000 feet), semi-consolidated, permeable deposits, which would not be prone to fracturing and induced seismicity and would not directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death resulting from seismic ground shaking or seismic related ground failure. As a result, this programmatic component would have a less-than-significant impact.

Induced Liquefaction Impacts. As indicated for new ASR facilities, liquefaction generally occurs at depths of less than 40 feet in soils that are young (Holocene-age), saturated, and loose. Based on the City of Capitola General Plan Safety and Noise Element liquefaction potential maps and County of Santa Cruz GIS data, the Beltz sites are in an area of low liquefaction potential, as described in Section 4.5.1.5, Infrastructure Component Site Conditions. Incised (i.e., down-cut) drainages/creeks, including an unnamed creek to the west and Soquel Creek/Capitola Beach to the east, are zones of medium to high liquefaction potential, but the intervening terraced areas, including the Beltz sites, are not prone to liquefaction. Given that, the potential for lateral spreading on the Beltz sites is also low.

If Beltz ASR operations were to raise water elevations to within 40 feet of the ground surface and the soils are prone to liquefaction, the potential for increased liquefaction would occur. Treated surface water injection from Beltz ASR into the Santa Cruz Mid-County Groundwater Basin, could result in groundwater levels within 40 feet of the ground surface. Groundwater modeling was completed as part of the Mid-County GSP to determine the adequacy of well injection in raising groundwater levels over time to prevent undesirable results related to seawater intrusion. Groundwater modeling simulated Pure Water Soquel Groundwater Replenishment and Seawater Intrusion Project (Pure Water Soquel) and Beltz ASR, in combination, because the expected benefits of ASR injection are to raise groundwater levels above minimum thresholds (as determined in the GSP) at the City wells to prevent seawater intrusion and maintain sustainability of the Santa Cruz Mid-County Groundwater Basin (see Section 4.8, Hydrology and Water Quality, for additional information regarding minimum thresholds of groundwater levels). Although Beltz 8, 9, 10, and 12 are deep, ranging from 210 to 640 feet, groundwater levels in nested wells (i.e., screened within shallow, medium, and deep aquifer intervals) in the Santa Cruz Mid-County Groundwater Basin are similar for each screened interval within individual wells, indicating that there is hydraulic connectivity between aquifers. There is a demonstrable indirect influence on shallow groundwater from deeper aquifers pumped by municipal and private wells. As these observations are made from only a few wells on Soquel Creek, further study as part of GSP implementation would revise the current understanding of the relationship between streamflow and groundwater (Santa Cruz Mid-County Groundwater Agency 2019). However, based on the currently known effects of municipal pumping on shallow groundwater levels in the vicinity of Soquel Creek, Beltz ASR injection into the deeper screened intervals of the Beltz wells could result in shallow groundwater conditions in the vicinity of the Beltz wells.

As previously discussed, the Beltz wells are located in areas of low liquefaction potential. Although the liquefaction potential could increase in the adjacent liquefaction-prone drainages as a result of a rise in groundwater levels from the operation of Pure Water Soquel and Beltz ASR, these areas are not overlain by residences, businesses, schools, or infrastructure that would be susceptible to damage from liquefaction. As such, this project component would not directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death resulting from liquefaction and would have a less-than-significant impact.

<u>Water Transfers and Exchanges and Intertie Improvements</u>

New or improved intertie facilities between the water systems of the City and of neighboring water agencies are proposed to facilitate future water transfers and exchanges once City water rights are modified. The facilities include the City/SVWD intertie, which includes a new pipeline and pump station; and the City/SqCWD/CWD intertie, which includes the Soquel Village and Park Avenue pipeline replacements, the McGregor Drive pump station upgrade, and the new Freedom Boulevard and Valencia Road pump stations.

Based on County of Santa Cruz GIS data and the City of Capitola General Plan Safety and Noise Element liquefaction potential map, most of the Soquel Village pipeline site is in an area of high to very high liquefaction potential, associated with shallow groundwater beneath Soquel Creek. In addition, portions of the Park Avenue pipeline site are in an area of very high liquefaction potential, associated with shallow groundwater beneath a tributary drainage to Tannery Gulch. The McGregor Drive, Freedom Boulevard, and Valencia Drive pump station sites are in areas of low liquefaction potential. The liquefaction potential for the City/SVWD intertie has not been fully determined as a portion of the site has not been mapped with respect to liquefaction. Although the intertie facilities would be susceptible to damage as a result of ground shaking, seismic related ground failure, and liquefaction and associated lateral spreading, design and construction of the interties would be completed in accordance with standard, site-specific geotechnical investigations, in accordance with CBC and Cal/OSHA regulations, thus minimizing the potential for damage and safety impacts. In addition, construction and operation of new intertie facilities would not exacerbate the potential for seismically induced ground shaking and ground failure to occur. As such, construction and operation of the interties would not directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death resulting from seismic ground shaking or seismic related ground failure, including liquefaction and lateral spreading. As a result, this programmatic component would have a less-than-significant impact.

<u>Felton Diversion Improvements</u>

Felton Diversion improvements would include fish screen replacement, installation of a traveling brush system to keep the fish screens operating at optimum efficiency, and construction of a continuous downstream outmigration bypass route within the existing bypass channel with downstream opening slide gate. These improvements would be constructed on the west side of the Felton Diversion on the existing diversion facility structure. Based on County of Santa Cruz GIS data, the Felton Diversion is in an area of moderate liquefaction potential. Design and construction of the diversion improvements would be completed in accordance with CBC and Cal/OSHA regulations, thus minimizing the potential for damage and safety impacts. In addition, construction and operation of Felton Diversion improvements would not exacerbate the potential for seismically induced ground shaking and ground failure to occur. As such, construction and operation of the diversion improvements would not directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death resulting from seismic ground shaking or seismic related ground failure, including liquefaction and associated lateral spreading. As a result, this programmatic component would have a less-than-significant impact.

<u>Tait Diversion and Coast Pump Station Improvements</u>

Improvements at the Tait Diversion could include, but would not be limited to, (1) a new or modified intake design, (2) upstream and/or downstream hydraulic modifications, (3) improvements to the check dam, and (4) any required fish passage upgrades. Upgrades would be implemented to meet current state and federal fisheries protection criteria. The River Pumps at the Coast Pump Station facility would also require improvements, which could include, but would not be limited to (1) new pumps and motors; (2) primary and backup power upgrades, which could include upgrades to the Pacific Gas & Electric substation; (3) a new or modified concrete wet well; and (4) a solids handling system.

Based on County of Santa Cruz GIS data and the City of Santa Cruz 2030 General Plan liquefaction potential maps, the Tait Diversion and Coast Pump Station are in an area of high liquefaction potential, associated with shallow groundwater beneath the San Lorenzo River. Creation of over-steepened excavations along the riverbank would be prone to lateral spreading, but would temporary pending completion of construction, thus minimizing the potential for lateral spreading. However, design and construction of the diversion and pump station improvements would be completed in accordance with CBC and Cal/OSHA regulations, thus minimizing the potential for damage and safety impacts. In addition, construction and operation of the diversion and pump station improvements would not exacerbate the potential for seismically induced ground shaking and ground failure to occur. As such, construction and operation of the diversion and pump station improvements would not directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death resulting from seismic ground shaking or seismic related ground failure, including liquefaction and associated lateral spreading. As a result, this programmatic component would have a less-than-significant impact.

Mitigation Measures

Implementation of the following mitigation measure would reduce potentially significant geology and soils impacts of the Proposed Project related to liquefaction to a less-than-significant level, as described above.

MM GEO-1: **Operation of New Aquifer Storage and Recovery (ASR) Facilities in Liquefaction-Prone Areas (Applies to New ASR Facilities).** To avoid increasing the potential for liquefaction, ASR injections in new wells located in potential liquefaction zones, as depicted on Figure 4.5-3, shall be maintained and operated such that existing shallow groundwater (i.e., depth generally less than 100 feet) does not rise to within 40 feet of the ground surface. Similarly, ASR injections in potential liquefaction zones shall be maintained and operated such that existing groundwater within a depth of 40 feet or less does not rise closer to the ground surface.

Impact GEO-2: **Unstable Geologic Unit or Soils (Significance Standards A-iv and C).** Construction and operation of the Proposed Project would not cause adverse effects involving landslides or be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the Proposed Project, and potentially result in on- or off-site landslide, slope failure/instability, subsidence, or collapse. ***(Less than Significant)***

Impact GEO-1 addresses impacts related to liquefaction, lateral spreading and collapse (due to seismically induced ground failure). This impact discussion addresses other types of unstable soil conditions that can result from landslide, slope failure/instability, and subsidence. As indicated in Section 4.5.1.2, Regional Geologic Setting, the study area is not in an area of regional ground subsidence. Therefore, subsidence is discussed below only where the project and programmatic infrastructure components have the potential to cause subsidence.

Water Rights Modifications

The water rights modifications of the Proposed Project would not directly result in construction or operation of new infrastructure facilities and would not directly cause potential substantial adverse effects, including being located on a geologic unit or soil that is unstable, or that would become unstable as a result of the Proposed Project. Therefore, this project component would have no direct impacts.

The following analysis evaluates the potential indirect impacts related to unstable geologic units or soils as a result of the proposed water rights modifications, that once approved could result in the implementation of the project and programmatic infrastructure components of the Proposed Project.

Infrastructure Components

Aquifer Storage and Recovery Facilities

New ASR Facilities. As indicated in Impact GEO-1, the locations of new ASR facilities have not been determined to date. However, City wells are typically located on flat-lying topography that is not susceptible to landslides or other forms of slope failure and given that it is expected that new ASR facilities would be located in similar conditions. Therefore, new ASR construction and operation would not occur on geologic units or soils that are unstable, or that would become unstable as a result of construction and operation, and therefore would not result in on- or off-site landslide or slope failure/instability.

As indicated in Section 4.5.1.2, Regional Geologic Setting, the principal causes of subsidence in California are aquifer-system compaction due to lowered groundwater levels, drainage and decomposition of organic soils, and oil and gas extraction. Based on regional mapping by the USGS, the study area is not an area of regional ground subsidence. As discussed in more detail in Section 4.8, Hydrology and Water Quality, new ASR facilities would be operated in accordance with the Santa Cruz Mid-County Groundwater Basin GSP or the Santa Margarita Groundwater Basin GSP, depending on the location of the facilities. This is confirmed by the inclusion of Standard Operational Practice #2, which requires compliance with both of these GSPs as well as any future revisions to these GSPs and further requires that new ASR facilities be installed and operated after the Santa Margarita Groundwater Basin GSP is submitted to the Department of Water Resources in January 2022 (see Section 4.5.3.2, Analytical Methods, for additional information about the effectiveness of this practice). The Santa Cruz Mid-County Groundwater Basin GSP has included, and the Santa Margarita Groundwater Basin GSP would include quantifiable minimum thresholds related to groundwater levels and associated subsidence, such that undesirable effects would not occur, and groundwater basin sustainability would be maintained. Based on compliance with the Santa Cruz Mid-County Groundwater Basin GSP and Santa Margarita Groundwater Basin GSP, including the associated groundwater monitoring programs, new ASR facilities would not decrease groundwater levels such that subsidence would occur. As a result, this programmatic component would have a less-than-significant impact.

Beltz ASR Facilities. The Beltz ASR sites are located on relatively flat to gently sloping topography. Beltz 8, 9, and 12 ASR sites are located on Watsonville loam soils, which occur on terraces and alluvial fans, on 0% to 15% slopes. Beltz 10 is located on Elkhorn sandy loam, which occurs on terraces and alluvial fans, on 2% to 9%. No hillsides are in proximity to the Beltz ASR sites. Design and construction of the Beltz ASR improvements would be completed in accordance with CBC regulations, thus minimizing the potential for slope instability. Water injection into the Beltz ASR facilities and construction and operation of the ASR upgrades would not occur on a geologic unit or soil that is unstable, or that would become unstable as a result of the Project, and would not potentially result in on- or off-site landslide or slope failure/instability.

Similar to that discussed for new ASR facilities, Beltz ASR facilities would be completed and operated in accordance with the Santa Cruz Mid-County Groundwater Basin GSP, as documented in Standard Operational Practice #2 (see Section 4.5.3.2, Analytical Methods, for additional information about the effectiveness of this practice), which includes quantifiable minimum thresholds related to groundwater levels and associated subsidence, such that undesirable effects would not occur, and groundwater basin sustainability would be maintained. Based on compliance with the Santa Cruz Mid-County Groundwater Basin GSP, including the associated groundwater monitoring programs, Beltz ASR facilities would not decrease groundwater levels such that subsidence would occur. As a result, this project component would not be located on a geologic unit or soil that is unstable, or that would become unstable as a result of this Project component, and would not result in on- or off-site landslide, subsidence, or collapse. Therefore, this project component would have a less-than-significant impact.

Water Transfers and Exchanges and Intertie Improvements

The topography along the City/SVWD intertie pipeline site is gently to moderately sloping, but locally trends immediately downslope of moderately steep hillsides within the Santa Cruz Mountains. This intertie also traverses the banks of a creek subsidiary to Carbonera Creek. Steeper sections of the site are underlain by Ben Lomond-Felton complex soils, which are located on 50% to 75% mountain slopes. Locally steep slopes may be susceptible to failure. Other sections of the intertie alignment are underlain by Pfeiffer gravelly sandy loam, on 15% to 30% slopes; Zayante coarse sand, on 5% to 30% slopes; and Watsonville loam, on 2% to 15% slopes. Steeper slopes within these areas of Pfeiffer gravelly sandy loam may similarly be susceptible to failure.

Related to the City/SqCWD/CWD intertie, the Soquel Village pipeline site is located on variable topography, including relatively flat to gently sloping areas, with localized steep slopes adjacent to and in the vicinity of Soquel Creek. These slopes could potentially be prone to slope instability. The northern part of the Park Avenue pipeline site is located on relatively flat to gently sloping topography; however, the southern portion of this site is located on Tierra-Watsonville complex soils, which occur on slopes up to 30%. Based on these slope gradients, localized areas may be susceptible to slope instability. The McGregor Drive, Freedom Boulevard, and Valencia Drive pump station sites are located on relatively flat to gently sloping topography. Slope instability or other geologic hazards are not anticipated in association with construction and operation of these pump stations.

It is anticipated that all intertie pipeline construction would take place in existing public roadways, which would minimize the potential for slope instability or failure. Additionally, design and construction of these interties and pump stations would be completed in accordance with site-specific geotechnical investigations and applicable CBC regulations pertaining to slope stability, further minimizing the potential for slope instability during construction and operation. Construction and operation of the interties and pump stations would not occur on a geologic unit or soil that is unstable, or that would become unstable as a result this programmatic component, and would not result in on- or off-site landslide, or slope failure/instability. Therefore, this programmatic component would have a less-than-significant impact.

Felton Diversion Improvements

The topography at the Felton Diversion site is relatively flat to gently sloping. Except for the San Lorenzo River bank, most of which has been modified for the existing intake structure and fish ladder, no slopes that could be susceptible to failure are present on-site. Design and construction of proposed diversion improvements would be completed in accordance with applicable CBC regulations related to slope stability, thus minimizing the potential for slope instability along the San Lorenzo River bank during construction and operation. Construction and operation of the diversion improvements would not occur on a geologic unit or soil that is unstable, or that would become unstable as a result of this programmatic component, and would not result in on- or off-site landslide or slope failure/instability. Therefore, this programmatic component would have a less-than-significant impact.

Tait Diversion and Coast Pump Station Improvements

The topography at the Tait Diversion and Coast Pump Station site is also relatively flat to gently sloping. Except for the San Lorenzo River bank, some of which has been modified for the existing intake structure/diversion weir, no slopes that could be susceptible to failure are present on-site. Design and construction of proposed diversion and pump station improvements would be completed in accordance with applicable CBC regulations related to slope stability, thus minimizing the potential for slope instability along the San Lorenzo River bank during construction and operation. Construction and operation of the diversion and pump station improvements would not occur on a geologic unit or soil that is unstable, or that would become unstable as a result of this programmatic component, and would not result in on- or off-site landslide or slope failure/instability. Therefore, this programmatic component would have a less-than-significant impact.

Mitigation Measures

As described above, the Proposed Project would not result in significant impacts related to unstable geologic units or soils, and therefore, no mitigation measures are required.

Impact GEO-3:	**Expansive Soil (Standard of Significance D).** Construction of Proposed Project infrastructure components may be located on expansive soil, as defined by the 2019 California Building Code, but would not create substantial direct or indirect risks to life or property caused in whole or in part by the Proposed Project's exacerbation of the existing environmental conditions. ***(Less than Significant)***

Water Rights Modifications

The water rights modifications of the Proposed Project would not directly result in construction or operation of new infrastructure facilities and would not create substantial direct risks to life or property related to expansive soil. Therefore, this project component would have no direct impacts.

The following analysis evaluates the potential indirect impacts related to expansive soil as a result of the proposed water rights modifications, that once approved could result in the implementation of the project and programmatic infrastructure components of the Proposed Project.

Infrastructure Components

Some of the project and programmatic infrastructure components are located in areas with expansive soils. Expansive soils are clay-rich deposits that expand when wet and contract when dry. Alternating soil expansion and contraction can result in distress and damage to overlying structure foundations and/or infrastructure, such as pipelines. The Beltz ASR sites, northern portion of the City/SqCWD/CWD intertie Park Avenue pipeline site, and limited portions of the City/SVWD pipeline site are located on Watsonville loam soils, which may be susceptible to soil expansion, resulting in possible damage to proposed improvements at these sites. The Felton Diversion site is underlain by Soquel loam, which may also be susceptible to soil expansion. The McGregor Drive pump station site is located on Tierra-Watsonville complex soils, which consist of clay, clay loam, sandy loam, and gravelly sandy loam. The Valencia Drive and Freedom Boulevard pump station sites are located on Baywood loamy sand. Depending on the ultimate sites selected for new ASR facilities expansive soils may be present at these sites, as well. None of the other programmatic component sites are located in areas with expansive soils.

Site-specific geotechnical investigations, which typically include an analysis of the soil expansion potential, have not been completed for the project and programmatic infrastructure components of the Proposed Project. However, construction would be completed in accordance with CBC regulations, which include provisions for construction on expansive soils. These construction techniques include over-excavation of soils beneath structures and pipelines, followed by construction on a layer of sandy, nonexpansive soils. Alternatively, post-tensioned slabs can be constructed to prevent cracking associated with expansive soils. In addition, construction and operation of the infrastructure components would not exacerbate the potential for soil expansion to occur. As a result, the project and programmatic infrastructure components would have less-than-significant impacts.

Mitigation Measures

As described above, the Proposed Project would not result in significant impacts related to expansive soil, and therefore, no mitigation measures are required.

Impact GEO-4:	**Paleontological Resources (Standard of Significance F).** Construction of the Proposed Project could potentially directly or indirectly destroy a unique paleontological resource or site during construction. However, the Proposed Project would not directly or indirectly destroy a unique geological feature. ***(Less than Significant with Mitigation)***

As indicated in Section 4.5.1.4, Unique Geological Features, the study area does not contain unique geological features. Therefore, this impact evaluation addresses the potential that the Proposed Project could directly or indirectly destroy a unique paleontological resource during construction.

Water Rights Modifications

The water rights modifications of the Proposed Project would not directly result in construction or operation of new infrastructure facilities and would not directly destroy a unique paleontological resource during construction. Therefore, this project component would have no direct impacts.

The following analysis evaluates the potential indirect impacts to paleontological resources as a result of the proposed water rights modifications, that once approved could result in the implementation of the project and programmatic infrastructure components of the Proposed Project.

Infrastructure Components

Aquifer Storage and Recovery Facilities

New ASR Facilities. Given that there are not identified locations for these facilities at this time, site-specific information about potential paleontological resources is not available. If the selected sites are determined to be situated on igneous bedrock or high-grade metamorphic bedrock with low paleontological sensitivity, it is unlikely that a unique paleontological resource would be destroyed with construction of this programmatic component. If the selected sites are underlain by sedimentary geological units with moderate or high paleontological sensitivity, construction of these programmatic components could directly or indirectly destroy a unique paleontological resource during construction and the impact would be potentially significant.

Implementation of MM GEO-2 would avoid directly or indirectly destroying a unique paleontological resource by requiring: a paleontological records search and desktop geological and paleontological research be conducted by a qualified paleontologist when a new ASR facility site is being pursued; preparation and implementation of a Paleontological Resources Impact Mitigation Program (PRIMP) if known or identified resources are present on the site, or if the site is determined to have moderate or high paleontological sensitivity; implementation of standard paleontological clauses in construction contracts at sites with known resources or with high sensitivity for such resources, which require paleontological resource sensitivity training for workers prior to conducting earth disturbance activities and procedures to follow in the event that paleontological resources are unearthed during grading. Specifically, the PRIMP and the paleontological clauses in construction contracts shall require that collection and documentation of identified fossils occurs before construction is initiated for a known find or resumed for a find discovered during construction, thereby avoiding complete destruction of the find. Therefore, with the implementation of this mitigation measure, the impact of this programmatic component would be reduced to a less-than-significant level.

Beltz ASR Facilities. The Beltz ASR sites are underlain by Pleistocene marine terrace deposits that have high paleontological sensitivity owing to their record of producing significant paleontological resources throughout California. Excavations and construction associated with the Beltz ASR upgrades could directly or indirectly destroy a unique paleontological resource during construction and the impact would be potentially significant.

Implementation of MM GEO-2 would avoid directly or indirectly destroying a unique paleontological resource by requiring: preparation and implementation of a PRIMP; and implementation of standard paleontological clauses in construction contracts, which require paleontological resource sensitivity training for workers prior to conducting earth disturbance activities and procedures to follow in the event that paleontological resources are unearthed during grading. Specifically, the PRIMP and the paleontological clauses in construction contracts shall require that collection and documentation of identified fossils occurs before construction is initiated for a known find or resumed for a find discovered during construction, thereby avoiding complete destruction of the find. Therefore, with the implementation of this mitigation measure, the impact of this project component would be reduced to a less-than-significant level.

<u>Water Transfers and Exchanges and Intertie Improvements</u>

The various intertie improvements are underlain by artificial fill, Holocene and Pleistocene alluvial deposits, Pleistocene marine terrace deposits, Pliocene to late Miocene Purisima Formation, late Miocene Santa Margarita Formation, and Cretaceous/Mesozoic quartz diorite. Artificial fill and diorite have no paleontological sensitivity, Holocene alluvial deposits have low paleontological sensitivity that increases to high with depth; and Pleistocene alluvial and marine terrace deposits have high paleontological sensitivity, as do the Purisima and Santa Margarita Formations. The City/SVWD intertie site is in an area of high paleontological sensitivity as it is underlain by Pleistocene terrace deposits and Santa Margarita Formation. Related to the City/SqCWD/CWD intertie, the Park Avenue pipeline site and McGregor pump station site are also in an area of high paleontological sensitivity as they are underlain by Pleistocene marine terrace deposits and Purisima Formation. The Soquel Village pipeline site, and the Freedom Boulevard and Valencia Drive pump station sites are in areas of low paleontological sensitivity that increases to high with depth as they are underlain by Holocene deposits, which in turn are underlain by Pleistocene or older sedimentary deposits. Any excavations in undisturbed Pleistocene deposits and excavations into Holocene deposits or colluvium that are deeper than five feet below the ground surface could directly or indirectly destroy a unique paleontological resource during construction, and the impact would be potentially significant.

Implementation of MM GEO-2 would avoid directly or indirectly destroying a unique paleontological resource, as described above for Beltz ASR facilities. Therefore, with the implementation of this mitigation measure, the impact of this programmatic component would be reduced to a less-than-significant level.

<u>Felton Diversion Improvements</u>

The Felton Diversion site is underlain by Holocene alluvium with low paleontological sensitivity on the surface that increases with depth if the Holocene alluvium is underlain by Pleistocene alluvium or sedimentary geological formations/units that have the potential to produce fossils. If excavations at this site are deeper than five feet below the ground surface such activities could directly or indirectly destroy a unique paleontological resource during construction and the impact would be potentially significant.

Implementation of MM GEO-2 would avoid directly or indirectly destroying a unique paleontological resource, as described above for Beltz ASR facilities. Therefore, with the implementation of this mitigation measure, the impact of this programmatic component would be reduced to a less-than-significant level.

Tait Diversion and Coast Pump Station Improvements

Like the Felton Diversion site, the Tait Diversion and Coast Pump Station site is also underlain by Holocene alluvium with low paleontological sensitivity on the surface that increases with depth if the Holocene alluvium is underlain by Pleistocene alluvium or sedimentary geological formations/units that have the potential to produce fossils. If excavations at this site are deeper than five feet below the ground surface such activities could directly or indirectly destroy a unique paleontological resource during construction and the impact would be potentially significant.

Implementation of MM GEO-2 would avoid directly or indirectly destroying a unique paleontological resource, as described above for Beltz ASR facilities. Therefore, with the implementation of this mitigation measure, the impact of this programmatic component would be reduced to a less-than-significant level.

Mitigation Measures

Implementation of the following mitigation measure would reduce potentially significant paleontological resource impacts of the Proposed Project related to paleontological resources to a less-than-significant level, as described above.

MM GEO-2: **Paleontological Resources Impact Mitigation Program and Paleontological Monitoring.** Potentially significant impacts to paleontological resources on the project and programmatic infrastructure component sites shall be addressed through the following measures:

a. **Identify Potential Paleontological Resources (Applies to New Aquifer Storage and Recovery [ASR] Facilities).** When new ASR facilities sites are identified and those components are being pursued by the City or other lead agency, a qualified a qualified paleontologist pursuant to the Society of Vertebrate Paleontology (SVP) 2010 guidelines, shall conduct a paleontological records search from the Natural History Museum of Los Angeles County (LACM) and conduct a desktop geological and paleontological research. Based on the above, all paleontological sites within or near the programmatic component site shall be identified. The sensitivity of the site for discovering unknown paleontological resources, shall also be identified. The qualified paleontologist will prepare a brief technical report with the results of the above. If known or identified resources are present on the site, or if the site has moderate to high sensitivity for paleontological resources, measures b and c shall be implemented.

b. **Develop Paleontological Resources Impact Mitigation Program (Applies to all Known Infrastructure Components and May Apply to New ASR Facilities).** Prior to commencement of any grading activity on infrastructure component sites with moderate to high paleontological sensitivity or that may have such sensitivity at depth, the City or other lead agency shall retain a qualified paleontologist pursuant to the SVP (2010) guidelines. The paleontologist shall prepare a Paleontological Resources Impact Mitigation Program (PRIMP) for the Proposed Project. The PRIMP can be written to include all infrastructure components located in sites with moderate to high paleontological sensitivity. The PRIMP shall be consistent with the SVP (2010) guidelines and shall, at a minimum, contain the following elements:

- Introduction to the project, including project location, description of grading activities with the potential to impact paleontological resources, and underlying geologic units.
- Description of the relevant laws, ordinances, regulations, and standards pertinent to the project and potential paleontological resources.
- Requirements for preconstruction meeting attendance by the qualified paleontologist and/or their designee and worker environmental awareness training for grading contractors that outlines laws protecting paleontological resources and the types of resources that may be encountered on site.
- Identification of locations where full-time paleontological monitoring within geological units with high paleontological sensitivity is required within the project or programmatic sites based on construction plans and/or geotechnical reports.
- Requirements and frequency of paleontological monitoring spot-checks below a depth of five feet below the ground surface in areas underlain by Holocene sedimentary deposits.
- The types of paleontological field equipment the paleontological monitor shall have on-hand during monitoring.
- Discoveries treatment protocols and paleontological methods (including sediment sampling for microinvertebrate and microvertebrate fossils).
- Requirements for adequate reporting and collections management, including daily logs, monthly reports, and a final paleontological monitoring report that details the monitoring program and includes analyses of recovered fossils and their significance and the stratigraphy exposed during construction.
- Requirements for collection and complete documentation of fossils identified within the project site prior to construction and during construction, including procedures for temporarily halting construction within a 50-foot radius of the find while documentation and salvage occurs and allowing construction to resume once collection and documentation of the find is completed. Prepared fossils along with copies of all pertinent field notes, photos, maps, and the final paleontological monitoring report shall be deposited in a scientific institution with paleontological collections. Any curation costs shall be paid for by the City.

c. **Standard Paleontological Clauses in Construction Contracts (Applies to all Infrastructure Components).** The City or other lead agency shall include standard clauses in construction contracts for infrastructure components located in areas with moderate to high paleontological sensitivity. A standard clause shall be included that requires paleontological resource sensitivity training for workers prior to conducting earth disturbance activities. A standard inadvertent discovery clause shall also be included that indicates that in the event that paleontological resources (e.g., fossils) are unearthed during grading, the paleontological monitor will temporarily halt and/or divert grading activity to allow recovery of paleontological resources. The area of discovery will be roped off with a 50-foot-radius buffer. Once documentation and collection of the find is completed, the monitor will allow grading to recommence in the area of the find.

4.5.3.4 Cumulative Impact Analysis

This section provides an evaluation of cumulative geology and soils impacts associated with the Proposed Project and past, present, and reasonably foreseeable future projects, as identified in Table 4.0-2 in Section 4.0, Introduction to Analyses, and as relevant to this topic. The geographic area considered in the cumulative analysis for geology and soils is generally the immediate vicinity of the project and programmatic infrastructure component sites, with the exception that the ASR-induced liquefaction analysis considers other active recharge projects located in the Santa Cruz Mid-County Groundwater Basin and the Santa Margarita Groundwater Basin.

The Proposed Project would not contribute to cumulative impacts related to earthquake fault rupture (Significance Standard A-i) or septic tanks/alternative wastewater disposal (Significance Standard E) because it would have no impacts related to these standards as described above. Therefore, these significance standards are not further evaluated. Erosion-related cumulative impacts (Significance Standard B) are addressed in Section 4.8, Hydrology and Water Quality. Additionally, the proposed water rights modifications are not further evaluated given no geology and soils impacts were identified for this project component (see Impact GEO-1 through Impact GEO-4) and therefore this component would not contribute to cumulative impacts.

Impact GEO-5:	**Cumulative Geologic Hazards (Significance Standards A-ii, A-iii, A-iv, C, and D).** Construction and operation of the Proposed Project, in combination with past, present, and reasonably foreseeable future development, could result in a significant cumulative impact related to geology and soils, but the Proposed Project's contribution to this impact would not be cumulatively considerable. ***(Less than Significant)***

With the exception of potential ASR injection-induced liquefaction, the Proposed Project would not have the potential to result in cumulative impacts related to geologic hazards, including faulting, seismically induced ground shaking/failure, landslides, subsidence, and expansive soils, because potential cumulative impacts related to geologic hazards would be reduced on a site-by-site basis by modern construction methods and compliance with CBC and Cal/OSHA regulatory requirements that minimize the potential for damage and safety impacts. Therefore, these geologic hazards are not further evaluated.

The geographic area considered in the cumulative analysis related to liquefaction is the Santa Cruz Mid-County Groundwater Basin and the Santa Margarita Groundwater Basin. As indicated in Table 4.0-2, groundwater recharge would occur in the Santa Cruz Mid-County Groundwater Basin in association with the Pure Water Soquel Groundwater Replenishment and Seawater Intrusion project. This project is a water supply project that would supplement natural recharge of the Santa Cruz Mid-County Groundwater Basin with purified water, at three injection sites in unincorporated Santa Cruz County. As described for Beltz ASR facilities in Impact GEO-1, if ASR injection was to raise water elevations to within 40 feet of the ground surface and the soils are prone to liquefaction (as illustrated in Figure 4.5-3), liquefaction would potentially occur. However, Beltz ASR facility sites are not located on soils prone to liquefaction. Similar to the Beltz ASR sites, the Pure Water Soquel groundwater replenishment wells would be located in areas of low liquefaction potential (SqCWD 2020). These wells would be located on Pleistocene marine terrace deposits and Pliocene marine bedrock, which do not consist of Holocene loose sandy soils and therefore are not prone to liquefaction. Although the liquefaction potential could increase in the adjacent liquefaction-prone drainages as a result of a rise in groundwater levels from the operation of Pure Water Soquel and Beltz ASR, these adjacent areas are not overlain by residences, businesses, schools, or infrastructure that would be susceptible to damage from liquefaction.

The only other known cumulative project that could result in active groundwater recharge is the Conjunctive Use Plan for the San Lorenzo River Watershed (Conjunctive Use Plan), which is considering injection of excess surface water during wet periods and extraction of groundwater during dry periods in the Olympia area of the Santa Margarita Groundwater Basin. Such injections would be completed in accordance with the Santa Margarita Groundwater Basin GSP, once it is completed, thus minimizing the potential for liquefaction to occur. However, while there are many unknowns, there is some possibility that the implementation of the Conjunctive Use Plan in conjunction with the new ASR facilities of the Proposed Project in the Santa Margarita Groundwater Basin could result in substantial adverse effects, including the risk of loss, injury, or death resulting from seismic ground shaking or seismic related ground failure, including liquefaction and associated lateral spreading. As a result, the cumulative impact would be potentially significant. However, as described in Impact GEO-1, implementation of MM GEO-1 would avoid substantial adverse effects, including the risk of loss, injury, or death resulting from liquefaction and associated lateral spreading by maintaining and operating ASR injections in new wells located in potential liquefaction zones, such that existing shallow groundwater does not rise to levels that would cause liquefaction. Therefore, with the implementation of this mitigation measure, the Proposed Project would not have a considerable contribution to the cumulative impact. As such, the Proposed Project would result in a less-than-significant cumulative impact related to liquefaction.

Impact GEO-6: **Cumulative Paleontological Resources Impacts (Significance Standard F).** Construction of the Proposed Project, in combination with past, present, and reasonably foreseeable future development, could result in a significant cumulative impact related to paleontological resources, but the Proposed Project's contribution to this impact would not be cumulatively considerable. ***(Less than Significant)***

Potential cumulative impacts on paleontological resources would result from projects that combine to create an environment where fossils, exposed on the surface, are vulnerable to destruction by earthmoving equipment, looting by the public, and natural causes such as weathering and erosion. Most impacts to paleontological resources are site-specific and are therefore generally mitigated on a project-by-project basis. Cumulative projects should be required to assess impacts to paleontological resources as part of the discretionary approval process and should incorporate individual mitigation for site-specific geological units present on each individual project site. However, it is possible that these cumulative projects could have a significant cumulative impact if individual projects are not properly mitigated. However, as indicated in Impact GEO-4, the Proposed Project does not propose construction (including grading/excavation) or design features which could directly or indirectly contribute to an increase in a cumulative impact to paleontological resources, as MM GEO-2 ensures that any significant paleontological resources uncovered during excavations for project and programmatic infrastructure components would be properly analyzed and salvaged by the on-site paleontological monitor thereby avoiding complete destruction of the find. Therefore, with the implementation of this mitigation measure, the Proposed Project would not have a considerable contribution to the cumulative impact. As such, the Proposed Project would result in a less-than-significant cumulative impact related paleontological resources.

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