4.3 GEOLOGY AND SOILS

This section analyzes geologic and soils conditions and impacts of the proposed Riverfront Project (Project) based on a review of technical studies prepared for the Project and existing City plans and studies. This EIR tiers from the City of Santa Cruz Downtown Plan Amendments EIR (SCH#2017022050), which was certified on November 14, 2017. This section also draws from the City of Santa Cruz General Plan 2030 EIR (SCH#2009032007), which was certified on June 26, 2012, regarding background. Relevant sections of both EIRs are incorporated by reference in accordance with section 15150 of the State CEQA Guidelines. Relevant discussions from these prior EIRs are summarized in subsection 4.3.1. Both EIRs are available for review at the City of Santa Cruz Planning and Community Development Department (809 Center Street, Room 101, Santa Cruz, California) by appointment[1]. Both EIRs are also available online on the City's website at:

- Downtown Plan Amendments EIR http://www.cityofsantacruz.com/Home/Components/BusinessDirectory/BusinessDirectory/101/2849
- General Plan 2030 EIR http://www.cityofsantacruz.com/government/city-departments/planning-and-community-development/long-range-policy-planning/general-plan

Public and agency comments related to geology and soils were received during the public scoping period in response to the Notice of Preparation (NOP). Issues raised in these comments include:

- ❒ Concerns were expressed regarding the appropriate foundation type and ground improvement methods proposed for the Project, especially concerns that the pressurized sand-cement mixture could be dispersed into the San Lorenzo River, causing seepage or contamination.
- ❒ Concern was expressed that the depth required for the foundation would affect the water table and water quality.

To the extent that issues identified in public comments involve potentially significant effects on the environment according to the California Environmental Quality Act (CEQA) and/or are raised by responsible agencies, they are identified and addressed within this EIR. Public comments received during the public scoping period are included in Appendix A.

[1] Contact Samantha Haschert at SHaschert@cityofsantacruz.com or by phone at (831)-420-5196 to make an appointment to review the EIR. See section 1.4.2 of this EIR for further information.

4.3.1 Environmental Setting

Regulatory Setting

A brief summary of relevant laws is provided below, and a full description is provided on pages 4.10-1 to 4.10-3 of the General Plan 2030 EIR (Draft EIR volume), which is incorporated by reference.

Federal and State

The Uniform Building Code (UBC) is published by the International Conference of Building Officials. It forms the basis of about half of the state building codes in the United States, including California's, and has been adopted by the California Legislature together with Additions, Amendments, and the Repeals to address the specific building conditions and structural requirements in California. The UBC defines different regions of the United States and ranks them according to their seismic hazard potential. There are four types of these regions, which include Seismic Zones 1 through 4, with Zone 1 having the least seismic potential, and Zone 4 having the highest seismic potential. Further, the UBC provides guidance on foundation design and structural engineering for a variety of soils.

The Federal Disaster Mitigation Act (DMA) of 2000 (Public Law 106-390), adopted by Congress in October 2000, requires state and local governments to develop hazard mitigation plans as a condition for federal grant assistance. The City of Santa Cruz adopted its "Local Hazard Mitigation Plan" in September 2007, which was updated in 2017. The detailed five-year plan identifies potential natural and man-made hazards, assesses their likely risk, and includes mitigation methods to reduce risks. The potential hazards identified in the plan include earthquakes and liquefaction, wildfires, floods and associated coastal storms, coastal erosion, drought, tsunami, dam failure, and landslides. Mitigation measures proposed to address these risks include prioritized actions that include hazard event planning, emergency preparedness coordination and education, facility upgrades, monitoring actions and other actions in response to specific hazards.

State

Alquist-Priolo Earthquake Fault Zoning Act. The Alquist-Priolo Earthquake Fault Zoning Act was passed by the state of California in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. The purpose of the act is to prevent the construction of buildings used for human occupancy over the surface trace of active faults. The 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. Local agencies must regulate most development projects within the zones. Before a project can be permitted, cities and counties must require a geologic investigation to demonstrate that proposed buildings will not be constructed across active faults. If an active fault is found, a structure for human occupancy cannot be placed over the trace of the fault and must be set back from the fault (generally 50 feet), although local agencies can be more restrictive than state law requires. There are no state-delineated Alquist-Priolo fault zones in the City of Santa Cruz.

Seismic Hazards Mapping Act. The Seismic Hazards Mapping Act (SHMA) addresses non-surface fault rupture earthquake hazards, including strong ground shaking, liquefaction, and seismically induced landslides. The goal is to mitigate seismic hazards to protect public health and safety. Pursuant to the SHMA, the state Department of Conservation is directed to provide local governments with seismic hazard zone maps that identify areas susceptible to amplified shaking, liquefaction, and earthquake-induced landslides or other ground failures. Site-specific geotechnical hazard investigations are required by SHMA when construction projects fall within these areas. The City of Santa Cruz is not located within a currently designated state-Seismic Hazard Mapping Program zone.

California Building Code. Title 24 of the California Code of Regulations, formerly known as the California Building Code (CBC), sets forth minimum requirements for building design and construction in public buildings and a large percentage of private buildings. In the context of earthquake hazards, the CBC design standards have a primary objective of ensuring public safety and a secondary goal of minimizing property damage and maintaining function during and following a seismic event. The CBC prescribes seismic design criteria for different types of structures and provides methods to obtain ground motion inputs. The CBC also requires analysis of liquefaction potential, slope instability, differential settlement, and surface displacement due to faulting or lateral spreading for various categories of construction. Recognizing that the risk of severe seismic ground motion varies from place to place, the California Building Standards Code seismic code provisions vary depending on location (Seismic Zones 0, 1, 2, 3, and 4—with 0 being the least stringent and 4 being the most stringent). The City of Santa Cruz is located in Seismic Zone 4.

Paleontological Resources. California Public Resources Code Section 5097.5 prohibits excavation or removal of any "vertebrate paleontological site…or any other archaeological, paleontological or historical feature, situated on public lands, except with express permission of the public agency having jurisdiction over such lands." Unauthorized disturbance or removal is a misdemeanor.

Local

The City's Municipal Code Chapter 24.14 (Environmental Resource Management) includes "Conservation Regulations." Section 24.14.070 requires a site-specific geotechnical investigation for all development, except projects with less than four units, in areas identified in the General Plan as having a high liquefaction potential. Section 24.16.060 requires an erosion control plan for projects located within high erosion hazard areas as designated in the General Plan or for development on slopes greater than ten percent.

The Grading Ordinance is a subset of Title 18, Buildings and Construction, of the City's Municipal Code and is included in Chapter 18.45 – Excavation and Grading Regulations." It provides technical regulations of grading and excavation, in conjunction with the Environmental Resource Management provisions in Chapter 24.14, in order to safeguard life, health, safety and the public welfare; protect fish and wildlife, riparian corridors and habitats, water supplies, and private and public property, and to protect the environment from the effects of flooding, accelerated erosion and/or deposition of silt. The ordinance accomplishes this by providing guidelines, regulations, and minimum standards

for clearing, excavation, cuts, fills, earth moving, grading operations (including cumulative grading), water runoff and sediment control. In addition, the ordinance includes provisions regarding administrative procedures for issuance of permits and approval of plans and inspections during construction and subsequent maintenance.

Geologic Setting

The following overview is summarized from the General Plan 2030 Draft EIR (pages 4.10-4 to 4.10-18), which is incorporated by reference.

Regional Geologic Setting

The City of Santa Cruz is situated on the southwestern slope of the central Santa Cruz Mountains, part of the Coast Ranges physiographic province of California. The northwest-southeast structural grain of the Coast Ranges is controlled by a complex of active faults within the San Andreas fault system. Southwest of the San Andreas fault, the Coast Ranges, including the Santa Cruz Mountains, are underlain by a large, northwest-trending, fault-bounded, elongated prism of granitic and metamorphic basement rocks. The granitic and metamorphic basement is Cretaceous in age, or older, and is overlain by a sequence of dominantly marine sedimentary rocks of Paleocene to Pliocene age and non-marine sediments of Pleistocene and Holocene age. The older sedimentary rocks are moderately to strongly deformed, with steep-limbed folds and several generations of faults associated with uplift of the Santa Cruz Mountains (City of Santa Cruz, April 2012-DEIR volume).

Seismic Hazards

The City is located in a seismically active region of California, and the region is considered to be subject to very intense shaking during a seismic event. The City of Santa Cruz is situated between two major active faults: the San Andreas, approximately 11.5 miles to the northeast and the San Gregorio, approximately nine miles to the southwest. There are no active fault zones or risk of fault rupture within the City (City of Santa Cruz, April 2012-DEIR volume).

According to maps developed as part of the City's adopted *General Plan 2030* and included in the General Plan and General Plan EIR, areas of the City that are identified as being subject to liquefaction hazards are mostly found along rivers and creeks and in the downtown area (City of Santa Cruz, April 2012-DEIR volume - Figure 4.10-4). Liquefaction occurs in loose, cohesionless, granular materials that are saturated with ground water. The effects of seismic shaking can cause this type of sediment to lose strength and flow like a liquid. Liquefaction related ground deformation includes lurch cracking, fissuring, and lateral spreading. Lateral spreading occurs most often on level terraces or flood plains bounded on one side by a steep stream or river bank. When the sediments adjacent to the river liquefy, they flow into the stream or river channel. Lurch cracking and lateral spreading are potential hazards in areas susceptible to liquefaction (Ibid.).

Soils

Soils throughout the City vary. Soil erosion potential is the susceptibility of the soil to erosion by water or wind. The many soil types within the City are broadly separable into three principal units: 1) soils developed on marine terraces and alluvial flats along streams, 2) soils on hills and mountains developed under forest canopy, and 3) soils on hills and mountains developed under brush vegetation. The soils developed on marine terraces and stream-side alluvial flats that underlie much of the City include the Watsonville, Watsonville-Tierra, Elkhorn, Pinto, Baywood, Cropley, Danville, and Soquel soil series (City of Santa Cruz, April 2012-DEIR volume).

The City's General Plan defines erosion as "the loosening and transportation of rock and soil debris by wind, rain, or running water, and/or the gradual wearing away of the upper layers of earth. Erosion of soils is influenced by bedrock and soil types, steep slopes, and construction methods. The risk of erosion depends upon the type of soil, slope of the land, slope length, rainfall amount and intensity, and vegetation cover. Removal of vegetation and the disturbance of the ground can lead to erosion. Impervious surfaces from urban development can also concentrate runoff, causing gullying and other problems. The result may include not only the loss of valuable soils but also sedimentation of stream beds, habitat degradation, landslides and increased downstream flooding potential. In general, erosion potential increases with the steepness of slope (City of Santa Cruz, April 2012-DEIR volume).

Erosion potential is rated high to very-high on the Aptos, Ben Lomond, Bonny Doon, Elkhorn, Lompico-Felton, Nisene-Aptos, Pfeiffer, Sur-Catelli, Tierra-Watsonville, Watsonville, and Zayante soil types. These soils are found within Pogonip, DeLaveaga Park, and portions of Moore Creek Preserve and Arroyo Seco (City of Santa Cruz, April 2012, DEIR volume).

Paleontological Resources

According to maps developed for the City's *General Plan 2030* and included in the General Plan EIR, parts of the City and some parks are located within areas of mapped geologic formations with potential paleontological resources (City of Santa Cruz, April 2012, DEIR volume-Figure 4.9-5). The Project area is not within a mapped sensitive paleontological resource area as shown in the City's Local Coastal Plan (City of Santa Cruz 1994-Map CR-2).

Four geologic units within the City are known to contain fossils: Late Pleistocene alluvium, the Purisima Formation, the Santa Cruz Mudstone, and the Santa Margarita Sandstone (City of Santa Cruz, April 2012-DEIR volume). Although Holocene alluvium is generally considered too young to contain paleontological resources, this geologic unit is moderately sensitive for paleontological resources because it is underlain by sedimentary geologic units that have a high paleontological sensitivity (Ibid.). General Plan Action HA1.2.3 requires the City to notify applicants within paleontologically sensitive areas of the potential for encountering such resources during construction and condition approvals that work would be halted, and resources examined in the event of encountering paleontological resources during construction. If the find is significant, the City would require treatment of the find in accordance with the recommendations of the evaluating

paleontologist. Treatment may include, but is not limited to, specimen recovery and curation or thorough documentation.

Project Site Conditions

Project Site Geotechnical Conditions

According to maps developed as part of the City's *General Plan 2030* and included in the General Plan EIR (City of Santa Cruz, April 2012, DEIR volume), the Project site is located in an area identified as being subject to liquefaction hazards (Figure 4.10-4), but not landslides (Figure 4.10-3). The Project site is developed and located on a level site with the exception of the San Lorenzo river levee that consists of a created slope. Section 24.14.070 of the City's Municipal Code requires preparation of a site-specific geotechnical investigation for all development, except less than four units, in areas identified in the General Plan as having a high liquefaction potential to assess the degree of potential liquefaction and recommend appropriate design/mitigation measures. General Plan Action HZ6.3.6 also requires site-specific geologic investigations by qualified professionals for proposed development in potential liquefaction areas shown on the Liquefaction Hazard Map to assess potential liquefaction hazards and require developments to incorporate the design and other mitigation measures recommended by the investigations.

Geotechnical investigations were conducted for the Project site in 2016 by TRC and in October 2018 by AECOM. AECOM's geotechnical investigation focused on potential seepage and slope stability of the levee as a result of the proposed placement of fill on landward side of the levee, which is further discussed below. Rockridge Geotechnical provided recommendations regarding foundation design in October 2019 and January 2020.

The Project geotechnical investigation prepared by TRC included two soils borings and testing. Subsurface materials on the Project site encountered during geotechnical borings consisted of interbedded layers of loose to medium dense silty sand, and loose to very dense poorly graded sand to a depth of approximately 25 to 26 feet. Below 25 to 26 feet, the borings encountered hard sandy silt bedrock of the Purisima Formation. Free ground water was encountered during subsurface exploration at depths of approximately 8½ to 9½ feet (TRC 2016).

The Project geotechnical investigation found that the primary geotechnical and geologic concerns at the site are:

- Strong seismic shaking
- Liquefaction, ground rupture, and lateral spreading
- Shallow ground water
- Differential settlement between below-grade and at-grade portions of the structure
- Differential settlement at utilities tie-ins (TRC 2016).

According to maps developed as part of the City's *General Plan 2030* and included in the General Plan EIR, soils at the Project site consist primarily of Baywood loamy sand, 0 to 2 percent slopes (City of Santa Cruz, April 2012-DEIR volume-Figure 4.10.6). As described in the General Plan EIR, Baywood soils are not rated as having a high to very high erosion potential.

San Lorenzo River Levee Geotechnical Conditions

Based on the existing geotechnical data along the centerline of the levee (USACE 1957 and 1994 as cited in AECOM 2018), the composition of the levee is variable and consists of a mixture of dense well-graded sand with gravel, poorly graded sand, sandy silt/silty sand and clayey sand from its current crest elevation of +24.6 feet (NAVD88) down to the underlying foundation, which blends into the native fine-grained layers between elevations +14.6 and +6.6 feet (NAVD88). Beneath the levee, the exploration data indicates an upper surface layer of mixed and interbedded sand, silt and clay from approximate elevation of +14.6 feet (NAVD88) to +6.6 feet NAVD88. The same material can be identified in the landside explorations in the same approximate elevation range (AECOM 2018).

Seismic Hazards and Liquefaction

Earthquake Fault Zones. The site is not located within a currently designated Alquist-Priolo Earthquake Fault Zone (known formerly as a Special Studies Zone). The geotechnical investigation identifies maximum estimated ground shaking and earthquake probabilities for design parameters for the proposed buildings.

Liquefaction Hazard. As indicated above, the Project site is located within an area subject to liquefaction as identified in the City's General Plan 2030 EIR. The site is not located within an area that has been mapped by for seismically induced liquefaction hazards. The site is located within an area zoned in the Santa Cruz County Geologic Hazard Maps as having very high susceptibility to soil liquefaction. Soils most susceptible to liquefaction are loose to moderately dense, saturated, non-cohesive soils with poor drainage, such as sands and silts with interbedded or capping layers of relatively low permeability soil (TRC 2016).

A liquefaction analysis was conducted for the Project site by TRC. Several sand and silt layers were encountered below the design ground water depth, which was five feet below the existing grade. These layers were evaluated to assess liquefaction potential and the effects liquefaction may have on the proposed Project structures. No liquefaction analyses were performed on layers above the design ground water depth. The current methods for estimating liquefaction settlement are generally applicable for the upper 50 feet. The effects of liquefaction settlement below 50 feet on the proposed structures should be minimal, and the settlement below a depth of 50 feet was not addressed in the liquefaction analysis. The analysis indicates that several sand and silt layers below the design ground water depth may theoretically liquefy, resulting in approximately 5 to 9¾ inches of total settlement for the top 50 feet. The analysis estimated that differential settlements from liquefaction would be on the order of ¾-inch in 50 horizontal feet (TRC 2016).

Lateral Spreading. Lateral spreading typically occurs as a form of horizontal displacement of relatively flat-lying alluvial material toward an open or "free" face such as an open body of water, channel, or excavation. In soils this movement is generally due to failure along a weak plane and may often be associated with liquefaction. As cracks develop within the weakened material, blocks of soil displace laterally towards the open face. Cracking and lateral movement may gradually propagate away from the face as blocks continue to break free (TRC 2016). The San Lorenzo River is located approximately 100 feet east of the Project site. Loose to medium dense silty sand and poorly graded sand layers were encountered at depths ranging approximately from 5 to 73.5 feet below the ground surface. These soil layers have a high potential for liquefaction. If liquefaction were to occur, the potential for lateral spreading would be moderate to high in localized areas (Ibid.).

4.3.2 Impacts and Mitigation Measures

Thresholds of Significance

In accordance with the California Environmental Quality Act (CEQA), State CEQA Guidelines (including Appendix G), City of Santa Cruz plans, policies, and/or guidelines, and agency and professional standards, a project impact would be considered significant if the project would:

GEO-1 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 of based on other substantial evidence of a known fault;
- (ii) strong seismic ground shaking;
- (iii) seismic-related ground failure, including liquefaction; or
- (iv) landslides;

GEO-2 Result in substantial erosion or the loss of topsoil;

GEO-3 Be located on a geologic unit or soil that is unstable, or would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse;

GEO-4 Be located on an 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;

GEO-5 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; or

GEO-6 Directly or indirectly destroy a unique paleontological resource or site or unique geological feature.

Impacts and Mitigation Measures

Areas of No Project Impact

GEO-1(i) *Fault Rupture.* The City of Santa Cruz is situated between two major active faults: the San Andreas, approximately 11.5 miles to the northeast, and the San Gregorio, approximately 10 miles to the southwest. There are no active fault zones or risk of fault rupture within the City (City of Satna Cruz, April 2012-DEIR volume). The Project geotechnical investigation concluded that fault rupture through the site, therefore, is not anticipated (TRC 2016).

GEO-5 *Use of Septic Systems*. The Project would be connected to City sanitary sewers and would not use septic systems. Therefore, there would be *no impact*.

Project Impacts

Impact GEO-1: **Exposure to Seismic Hazards.** The Project would not 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 with implementation of recommendations in the Project geotechnical investigation. This is considered a *less-than-significant* impact.

Ground Shaking. The Project could be subject to strong seismic shaking during an earthquake on regional faults. Project construction and associated population could expose structures and people to seismic hazards, particularly seismic shaking and liquefaction. The Downtown Plan Amendments EIR (DEIR volume, pages 32 to33 of Appendix A) and General Plan EIR (DEIR volume, pages 4.10-21 to 4.10-23) concluded that adherence to existing regulations and standards, including the California Building Code (CBC) and policies and actions established in the *General Plan 2030*, would minimize harm to people and structures from adverse geologic events and conditions. Buildings would be required to be designed in accordance with the latest edition of the CBC, which sets forth structural design parameters for buildings to withstand seismic shaking without substantial structural damage. Conformance to the CBC as required by state law and the City would ensure the maximum practicable protection available for structures and their associated trenches, excavations and foundations. The proposed structures would be designed in accordance with the seismic design criteria presented in the Project geotechnical investigation.

Liquefaction. The Project would require excavation to a depth of approximately 11 feet below ground surface (existing grade) to accommodate the partially below-grade parking garage. The geotechnical investigation prepared for the Project site encountered groundwater at depths ranging from 7.75 to 12.25 feet below grade. Because the groundwater depth measured at the time of geotechnical drilling may not reflect a stabilized level, a design groundwater depth of 5 feet was deemed appropriate for purposes of liquefaction potential (TRC 2016). The liquefaction analysis indicated that several sand

and silt layers below the design groundwater depth may theoretically liquefy, resulting in approximately 5 to 9.75 inches of total settlement for the top 50 feet. Differential settlements were estimated to be on the order of 0.75 inches in 50 horizontal feet. The investigation also concluded that the proximity to the San Lorenzo River and potential for liquefaction could result in up to moderate to high lateral spreading on localized areas of the site on the order of several feet (Ibid.).

A subsequent geotechnical review was conducted by Rockridge Geotechnical regarding the most appropriate foundation type and ground improvement methods for the proposed Project due to potential liquefaction and lateral spreading. The Project would result in construction of a seven-story residential building over one level of below-grade parking with a finished floor about 13 feet below sidewalk grade on Front Street. Because the site slopes gently down to the east, the first level above the garage will be at grade along Front Street and about 10 feet below grade at the rear of the building (Rockridge Geotechnical 2019).

The TRC geotechnical report indicates the loose to medium dense sand and silty sand below the groundwater table is susceptible to liquefaction during a large earthquake. Estimated free-field settlements resulting from post-liquefaction reconsolidation presented in the TRC report range from 4.9 to 15.2 inches. The report also states there is a moderate to high potential for lateral spreading to occur towards the nearby San Lorenzo River during a large earthquake, but that no significant evidence of lateral spreading towards the river was reported as a result of the October 17, 1989 Loma Prieta Earthquake (U.S. Geological Survey Professional Paper 1551-B, 1998 as cited in Rockridge Geotechnical 2019). The Rockridge Geotechnical review concurred with the findings of the TRC report that the loose to medium dense sand and silty sand below the groundwater table is susceptible to liquefaction during a large earthquake. Soil susceptible to lateral spreading is generally limited to the top 10 to 18 feet of soil at the boring locations. Although the soil below these depths may liquefy, it is sufficiently dense to resist lateral spreading (Ibid).

Several foundation types were identified in response to liquefaction and lateral spreading potential at the Project site. These included: deep soil cement treatment of the upper 30 feet of the on-site soils below the proposed partially one-level below grade excavation depth; ground improvement consisting of rammed aggregate piers (RAPs) or stone columns to a depth of 30 feet; and a structural foundation supported by piles. A mat foundation on soil strengthened with ground improvement has been recommended for the Project (Rockridge Geotechnical, October 2019) to address effects of liquefaction within the building footprint and potential for building damage from lateral spreading that occurs outside the building footprint. The ground improvement method recommended for the Project would consist of drilled displacement columns (DDCs) by pumping a sand-cement mixture into drilled holes. The required size, spacing, length, and strength of columns would be determined at the building permit stage, but it estimated that these columns would be spaced at six feet on center and would extend at least five feet into the Purisma formation which is approximately 24 to 68 feet below existing grade or approximately 10 to 60 feet below the foundation subgrade. With this foundation type, it is estimated that total static settlement of a building supported on DDCs will be less than one inch and differential settlement would be less than 3/4 inch over a horizontal distance of 30 feet (Rockridge Geotechnical 2019).

A subsequent review in response to comments raised during the EIR scoping period found that although the sand-cement mixture placed in DDCs has a relatively high slump when it is pumped into the continuous augers, it gains strength within hours as the water in the mixture is absorbed during hydration of the cement and fly ash. Therefore, there is no free water available in the sand-cement mixture that would migrate laterally into the groundwater around the columns or into the adjacent San Lorenzo River. It was also noted that many thousands of DDCs and auger-cast piles are installed annually in the Bay Area, including areas that are adjacent to various bodies of water (e.g., rivers, sloughs, marshlands), and there have been no reported adverse impacts to the quality of the water in the various bodies of water or the groundwater at these sites (Rockridge Geotechnical 2020).

With implementation of the recommendations in the geotechnical investigations prepared for the project and as required by City and state building regulations, impacts related to seismic and geologic hazards would be less than significant.

Mitigation Measures

No mitigation measures are required as a significant impact has not been identified.

Impact GEO-2: **Soils and Erosion.** The proposed Project would not result in substantial erosion or loss of topsoil. Therefore, this is a *less-than-significant* impact.

According to maps developed as part of the City's *General Plan 2030* and included in the General Plan EIR, soils at the Project site consist primarily of Baywood loamy sand, 0 to 2 percent slopes (City of Santa Cruz, April 2012, DEIR volume-Figure 4.10.6). As described in the General Plan EIR, Baywood soils are not rated as having a high to very high erosion potential. The Project proposes a below-grade parking garage that will require an 11-foot-deep excavation, which would result in approximately 16,500 cubic yards of excavated material. The Project plans include an erosion control plan that includes measures to manage excavated soils, prevent sediments from entering storm drains, and completing revegetation of disturbed areas.

The Downtown Plan Amendments EIR noted that the Project area is not located in an area subject to high erosion and the amendments to the Downtown Plan would not change the development footprint, and thus no impacts would occur related to erosion with implementation of the Downtown Plan amendments. The General Plan EIR concluded that future development accommodated by the Plan could result in erosion during construction, but could be mitigated with adherence to local regulations that require implementation of erosion control plans, and thus, potential erosion during construction would be minimized, resulting in a less-than-significant impact. With implementation of the Project erosion control plan and compliance with requirements set forth in the City's Municipal Code Chapter 18.45 and section 24.14.060, the Project would not result in a significant erosion impact.

Mitigation Measures

No mitigation measures are required as a significant impact has not been identified.

Impact GEO-3: **Unstable Geologic Units or Soils.** The proposed Project would not be located on a geologic unit or soil that is unstable or would become unstable as a result of the Project. Therefore, this is a *less-than-significant* impact.

From a geotechnical engineering viewpoint, the proposed structure may be constructed as planned, provided the design and construction are performed in accordance with the recommendations presented in the geotechnical investigation (TRC 2016).

The Project would involve placement of approximately 3,500 cubic yards (cy) of engineered earthen fill on the land side of the west levee slope along San Lorenzo River. The fill would result in creation of a uniform elevation between the existing Riverwalk and the adjacent future private mixed-use development for the purpose connecting residents and visitors to the Riverwalk. The back wall of the proposed Project and two wing walls on each end of the development and perpendicular to the levee along the landside slope would be constructed to retain the engineered fill within the Project limits. A vertical wall is proposed to be constructed along the Project's eastern boundary, extending approximately 20 feet below existing grade to accommodate a proposed parking structure underneath a proposed mixed-use building. This retaining wall will serve a dual purpose as a bearing wall for the proposed Project structures and a retaining wall for the earthen fill. Earthen fill would be placed between the vertical wall and the landside levee crest hinge, approximately at the elevation of the levee crest (+24.6 feet NAVD88) (AECOM 2018). The foundation for the back wall will be integrated with the mat foundation for the development structure.

A geotechnical evaluation (AECOM 2018) was performed include seepage and slope stability analysis results for current site conditions (pre-construction) and after completion of the preferred alternative (post-construction). The evaluation consisted of review of existing geotechnical data with completion of two transversal cross sections that were developed to represent the changing aquifer conditions between the northern and southern portions of the area of fill. Based on these two profiles, numerical models were setup in GeoStudio 2018 software to study the seepage and slope stability for the current and post-construction site conditions (AECOM 2018).

Through- and under-seepage has the potential to weaken levee foundations. However, the geotechnical evaluation concluded that the proposed fill would not have an adverse effect on the integrity and performance of the San Lorenzo River West Project Levee with regard to under-seepage and slope stability problems (AECOM 2018). A stormwater bioretention feature is proposed at the southern end of the levee, consisting of small vegetated areas and pervious pavers. This feature would have a liner, and stormwater that infiltrates through the vegetation would be captured by a storm drain. Stormwater would not infiltrate though the proposed fill. Therefore, this Project element would not result in unstable conditions along the river level.

Mitigation Measures

No mitigation measures are required as a significant impact has not been identified.

Impact GEO-4: **Expansive Soils.** The Project would be located on areas of expansive soils, but would not result in hazards to the Project building or people with implementation of recommendations of the Project geotechnical report. Therefore, this is a *less-than-significant* impact.

Expansive soils contain large amounts of clays that expand when wetted and contract when dried. As described above, soils at the Project site consist of Baywood loamy sand. According to the U.S. Department of Agriculture, Soil Conservation Service's Soil Survey of Santa Cruz County, this soil type has a low expansion potential.

The Project geotechnical report indicated that some moderately expansive clay is present on site (TRC 2016). Implementation of recommendations set forth in the Project geotechnical report is required by the California Building Code and City regulations and policies, which would ensure that potential exposure to hazards associated with expansive soils would be avoided.

The General Plan EIR concluded that future development accommodated by the Plan could be exposed to expansive soils, which would be addressed through compliance with state and local regulations, including the California Building Code requirements and Section 24.14.070 of the City's Municipal Code (requirement for geotechnical investigations), which would ensure that buildings are designed and to prevent structural damages based on Project-specific geotechnical investigations. As indicated above, with implementation of the recommendations set forth in the Project geotechnical report that is required by state and local regulations, potential exposure to hazards related to expansive soils would be avoided. Thus, this is a *less-than-significant impact*.

Mitigation Measures

No mitigation measures are required as a significant impact has not been identified.

Impact GEO-6: **Paleontological Resources.** The proposed Project would not directly or indirectly destroy a unique paleontological resource or site or unique geological feature. Therefore, this is a *less-than-significant* impact.

According to maps developed for the City's *General Plan 2030* and included in the General Plan EIR, the Project site is within an area mapped as Holocene alluvium formations (City of Santa Cruz, April 2012-DEIR volume-Figure 4.9-5). Although the Holocene alluvium formation is generally considered too young to contain paleontological resources, it is considered moderately sensitive for paleontological resources because it is underlain by sedimentary geologic units that have a high paleontological sensitivity (Ibid.).

The Downtown Plan Amendments EIR found that, with adherence to City procedures described in the General Plan, impacts to paleontological resources would be less than significant (DEIR volume, pages 30 to 31 of Appendix A). The General Plan EIR proposed Mitigation 4.9-2, which was added to the General Plan as Action HA1.2.3. It requires the City to notify applicants within paleontologically sensitive areas of the potential for encountering such resources during construction and condition approvals that work will be halted, and resources examined in the event of encountering paleontological resources during construction. If the find is significant, the City would require treatment in accordance with the recommendations of the evaluating paleontologist. Treatment may include, but is not limited to, specimen recovery and curation or thorough documentation. This provision was added to the City's Municipal Code (section 24.12.431), and all projects are subject to this requirement. Therefore, with implementation of the General Plan EIR mitigation measure and corresponding City regulations, the proposed Project would not result in a significant paleontological resource impact.

Mitigation Measures

No mitigation measures are required as a significant impact has not been identified.