Section 3.6
Geology and Soils

This section addresses potential impacts related to geology, soils, and seismicity and impacts on paleontological resources that may result from implementation of the proposed San Rafael Transit Center Replacement Project (proposed project) and other build alternatives. The following discussion addresses existing geology, soils, seismicity, and paleontological conditions of the project area and surroundings, considers applicable goals and policies, identifies and analyzes environmental impacts, and recommends measures to reduce or avoid adverse impacts anticipated from project implementation, as applicable. Information in this section is based on the Preliminary Geotechnical Design Recommendations (Geotechnical Recommendation) (see Appendix J~~H~~) prepared for the proposed project, unless otherwise noted (Parikh 2020). Impacts related to the No-Project Alternative are discussed in Chapter 5, Alternatives to the Project.

3.6.1 Existing Conditions

3.6.1.1 Regulatory Setting

Federal

Earthquake Hazard Reduction Act of 1977

Federal laws codified in United States Code Title 42, Chapter 86, were enacted to reduce risks to life and property from earthquakes in the United States through the establishment and maintenance of an effective earthquake hazards reduction program. Implementation of these requirements is regulated, monitored, and enforced at the state and local levels.

State

The Alquist-Priolo Earthquake Fault Zoning Act of 1972 (Alquist-Priolo Act)

The Alquist-Priolo Act (Public Resources Code Section 2621 et seq.) is intended to reduce the risk to life and property from surface fault rupture during earthquakes. The Alquist-Priolo Act prohibits the location and construction of most types of structures intended for human occupancy[1] over active fault traces and strictly regulates construction in the corridors along active faults. The state geologist has established regulatory zones along active faults,[2] called "Earthquake Fault Zones," and published maps that identify areas where surface traces of active faults are present (California Geological Survey 2020a).

[1] According to the Alquist-Priolo Act, a structure for human occupancy is defined as one "used or intended for supporting or sheltering any use or occupancy that is expected to have human occupancy rate of more than 2,000 person-hours per year" (California Code of Regulations, title 14, division 2, section 3601(e)).

[2] An active fault, for the purposes of the Alquist-Priolo Act, is one that has ruptured in the past 11,000 years.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act of 1990 (California Public Resources Code Sections 2690–2699.6) directs the California Geological Survey to identify and map areas prone to the liquefaction and landslides resulting from seismic events. The act mandates that project sponsors have a site-specific geotechnical investigation performed to identify potential seismic hazards and formulate mitigation measures prior to the permitting of most developments within specific zoned areas.

California Building Standards Code

The California Building Standards Code, or state building code, is codified in Title 24 of the California Code of Regulations. The state building code provides standards that must be met to safeguard life or limb, health, property, and public welfare by regulating and controlling the design, construction, quality of materials, use and occupancy, location, and maintenance of all buildings and structures within the state. The state building code generally applies to all occupancies in California, with modifications adopted in some instances by state agencies or local governing bodies. The current state building code incorporates, by adoption, the 2018 edition of the International Building Code of the International Code Council, with the California amendments. These amendments include building design and construction criteria that have been tailored for California earthquake conditions.

Chapter 16 of the state building code deals with structural design requirements governing seismically resistant construction (Section 1604) including, but not limited to, factors and coefficients used to establish a seismic site class and seismic occupancy category appropriate for the soil/rock at the building location and the proposed building design (Sections 1613.5 through 1613.7). Chapter 18 includes, but is not limited to, the requirements for foundation and soil investigations (Section 1803); excavation, grading, and fill (Section 1804); allowable load-bearing values of soils (Section 1806); foundation and retaining walls (Section 1807); and foundation support systems (Sections 1808 through 1810). Chapter 33 includes, but is not limited to, requirements for safeguards at work sites to ensure stable excavations and cut-and-fill slopes (Section 3304) as well as the protection of adjacent properties, including requirements for noticing (Section 3307). Appendix J of the state building code includes, but is not limited to, grading requirements for the design of excavation and fill (Sections J106 and J107), specifying maximum limits on the slope of cut-and-fill surfaces and other criteria, required setbacks and slope protection for cut-and-fill slopes (Section J108), and erosion control through the provision of drainage facilities and terracing (Sections J109 and J110).

California Division of Occupational Safety and Health Regulations

Construction activities are subject to occupational safety standards for excavation, shoring, and trenching, as specified in California Division of Occupational Safety and Health regulations (Title 8).

State Historic Significance Criteria

Section 4.7.5.2, Significance Criteria, Appendix G of the California Environmental Quality Act (CEQA) Guidelines includes the following question: “Would the project directly or indirectly destroy a unique paleontological resource or site?” Although CEQA does not define what constitutes “a unique paleontological resource or site,” Section 21083.2 defines *unique archaeological resources* as

any archaeological artifact, object, or site about which it can be clearly demonstrated that, without merely adding to the current body of knowledge, there is a high probability that it meets any of the following criteria:

- Contains information needed to answer important scientific research questions and show that there is a demonstrable public interest in that information.
- Exhibits a special and particular quality, such as being the oldest of its type or the best available example of its type.
- Is directly associated with a scientifically recognized important prehistoric or historic event or person.

This definition is equally applicable to recognizing a unique paleontological resource or site. CEQA Section 15064.5(a)(3)(D) provides additional guidance, indicating that, generally, a resource is considered historically significant if it has yielded, or may be likely to yield, information important in history before or after European contact.

The CEQA lead agency having jurisdiction over a project is responsible for ensuring that paleontological resources are protected in compliance with CEQA and other applicable statutes. California Public Resources Code Section 21081.6 requires the CEQA lead agency to demonstrate project compliance with the mitigation measures developed during the environmental impact review process.

Local

San Rafael Municipal Code

Policies from the San Rafael Municipal Code that are relevant to geology and soils include the following:

~~Section 12.12.010 of the San Rafael Municipal Code adopts the 2016 California Building Code, consisting of Volume 1 and Volume 2, in its entirety, except that only the following appendices are adopted: Appendices C, H, and I.~~

12.100.010 - Adopted codes. The San Rafael Municipal Code adopts the following recognized codes together with the supplements, listed changes, additions and deletions as noted: 2019 Edition, California Building Code ("CBC"), chapters 2 through 28, 30, 31, 32, 33, 35 and Appendices C, H, I, and N.; 4. 2019 Edition, California Existing Building Code ("CEBC"), chapters 2 through 16 and Appendices.

14.16.170 - Geotechnical review. Development applications require geotechnical reports consistent with the geotechnical matrix in the general plan appendices to assess such hazards as potential seismic hazards, liquefaction, landsliding, mudsliding, erosion, sedimentation and settlement and hazardous soils conditions to determine the optimum location for structures, to advise of special structural requirements and to evaluate the feasibility and desirability of a proposed facility in a specific location.

9.30.150 - Erosion and sediment control plan requirements. When required by the Phase II Stormwater Permit or by the agency, a project shall have an Erosion and Sediment Control Plan (ESCP) which addresses erosion and sediment control and pollution prevention during the construction phase as well as final stabilization control measures. The ESCP shall be submitted for review and approval by the City.

The San Rafael Municipal Code does not reference paleontological resources.

City of San Rafael General Plan 2020

The City of San Rafael General Plan 2020 (City of San Rafael 2016) contains goals, policies, and programs describing the community's vision for economic viability, livable neighborhoods, and environmental protection. *The City of San Rafael General Plan 2020* includes the following policies associated with geology and soils. No policies associated with paleontological resources are presented in this document.

S-4. Geotechnical Review. Continue to require geotechnical investigations for development proposals as set forth in the City's Geotechnical Review Matrix (Appendix F). Such studies should determine the actual extent of geotechnical hazards, optimum design for structures, the advisability of special structural requirements, and the feasibility and desirability of a proposed facility in a specified location.

S-4a: Geotechnical Review of Proposed Development. Require soils and geologic peer review of development proposals in accordance with the Geotechnical Review Matrix to assess such hazards as potential seismic hazards, liquefaction, landsliding, mudsliding, erosion, sedimentation and settlement in order to determine if these hazards can be adequately mitigated. Levels of exposure to seismic risk for land uses and structures are also outlined in the Geotechnical Review Matrix, which shall be considered in conjunction with development review.

S-4b. Geotechnical Review Matrix. Periodically review and update the Geotechnical Review Matrix, which describes procedures for site-specific investigations for projects being reviewed according to proposed occupancy, type and hazard zone(s) within which the site is located.

S-5. Minimize Potential Effects of Geological Hazards. Development proposed within areas of potential geological hazards shall not be endangered by, nor contribute to, the hazardous conditions on the site or on adjoining properties. Development in areas subject to soils and geologic hazards shall incorporate adequate mitigation measures. The City will only approve new development in areas of identified hazard if such hazard can be appropriately mitigated.

S-6. Seismic Safety of New Buildings. Design and construct all new buildings to resist stresses produced by earthquakes. The minimum level of seismic design shall be in accordance with the most recently adopted building code as required by State law.

S-6a: Seismic Design. The minimum seismic design of structures should be in accordance with the building code, as adopted in accordance with State law

S-7. Minimize Potential Effects of Landslides. Development proposed in areas with existing landslides or with the potential for landslides (as identified by a registered engineering geologist or geotechnical engineer) shall not be endangered by, nor contribute to, the hazardous conditions on the site or on adjoining properties. Development in areas subject to landslide hazards shall incorporate adequate mitigation measures that have a design factor of safety of at least 1.5 for static conditions and 1.0 for pseudo-static (earthquake) conditions. The landslide mitigation should consider multiple options in order to reduce the secondary impacts (loss of vegetation, site grading, traffic, visual) associated with landslide mitigation. The City will only approve new development in areas of identified landslide hazard if such hazard can be appropriately mitigated.

S-8. Seismic Safety of Existing Buildings. Encourage the rehabilitation or elimination of structures susceptible to collapse or failure in an earthquake. Historic buildings shall be treated in accordance with the Historic Preservation Ordinance.

S-8a: Seismic Safety Building Reinforcement. Enforce State and local requirements for reinforcement of existing buildings.

~~**S-9. Post Earthquake Inspections.** Require post-earthquake building inspections of critical facilities, and restrict entry into compromised structures. Inspections shall be conducted when the earthquake intensity is VII or higher per the Modified Mercalli Intensity Scale. Require inspections as necessary in conjunction with other non-city public agencies and private parties for structural integrity of water storage facilities, storm drainage structures, electrical transmission lines, major roadways, bridges, elevated freeways, levees, canal banks, and other important utilities and essential facilities.~~

~~**S-9a: Inspection List.** Identify a list of facilities that would be inspected after a major earthquake. The list shall identify City-owned essential or hazardous facilities as defined by Category 1 and 2 of Table 16-K of the Uniform Building Code, and shall prioritize the list for inspection scheduling purposes in case of an earthquake.~~

~~**S-22. Erosion**. Require appropriate control measures in areas susceptible to erosion, in conjunction with proposed development. Erosion control measures and management practices should conform to the most recent editions of the Regional Water Quality Control Board's Erosion and Sediment Control Field Manual and the Association of Bay Area Governments' Manual of Standards for Erosion and Sediment Control or equivalent.~~

~~**S-22a: Erosion Control Programs.** Review and approve erosion control programs for projects involving grading one acre or more or 5,000 square feet of built surface as required by Standard Urban Stormwater Management Plans (SUSUMP). Evaluate smaller projects on a case-by-case basis.~~

~~**Draft City of**~~ San Rafael General Plan 2040

The City ~~is currently working on the Draft~~adopted *San Rafael General Plan 2040* (City of San Rafael ~~2020a~~2021) on August 2, 2021. ~~which~~ *San Rafael General Plan 2040* contains goals, policies, and programs describing the community's vision for economic viability, livable neighborhoods, and environmental protection. ~~The Draft~~ *San Rafael General Plan 2040* includes the following policies associated with geology and soils. No policies associated with paleontological resources are presented in this document.

Goal S-2: Resilience to Geologic Hazards. Minimize potential risks associated with geologic hazards, including earthquake-induced ground shaking and liquefaction, landslides, mudslides, erosion, sedimentation, and settlement.

- **Policy S-2.1: Seismic Safety of New Buildings.** Design and construct all new buildings to resist stresses produced by earthquakes. The minimum level of seismic design shall be in accordance with the most recently adopted building code as required by State law.
    - **Program S-2.1A: Seismic Design**. Adopt and enforce State building codes which ensure that new or altered structures meet the minimum seismic standards set by State law. State codes may be amended as needed to reflect local conditions.
    - **Program S-2.1B: Geotechnical Review**. Continue to require soil and ~~geotechnical~~ geologic hazard studies and peer review for proposed development as set forth in the City's Geotechnical Review Matrix (See Appendix F and text box at right). ~~Such~~ These studies should determine the extent of geotechnical hazards, optimum design for structures and the suitability and feasibility of proposed development for its location, the need for special structural requirements, and measures to mitigate any identified hazards. Periodically ~~Review~~ review and update the Geotechnical Review Matrix to ensure that it supports and implements the Local Hazard Mitigation Plan by identifying potentially hazardous areas~~, reflects current practices and is internally consistent, and potentially~~. Consider ~~remove~~ removing the procedures from the General Plan and instead adopting them as part of the Zoning Ordinance or through a separate resolution.

- **Program S-2.1C: Earthquake Hazard Study**. As recommended by the Local Hazard Mitigation Plan, complete an Earthquake Hazard Study that examines geologic hazards in the city.

- **Policy S-2.2: Minimize the Potential Effects of Landslides.** Development proposed in areas with existing or potential landslides (as identified by a Certified Engineering Geologist, ~~registered~~ Registered ~~geologist or geotechnical~~ Geotechnical ~~engineer~~Engineer, or the [Local Hazard Mitigation Plan]) shall not be endangered by, or contribute to, hazardous conditions on ~~a~~ the site or adjoining properties. The City will only approve new development in areas of identified landslide hazard if the hazard can be appropriately mitigated, including erosion control and replacement of vegetation
  - **Program S-2.2A: Landslide Mitigation and Repair Projects**. Undertake landslide hazard mitigation and repair projects, as outlined in the [Local Hazard Mitigation Plan]. These projects include a landslide identification and management program, repair of the Fairhills Drive landslide, and repair of the Bret Harte sewer easement.
- **Policy S-2.3: Seismic Safety of Existing Buildings.** Encourage the rehabilitation or elimination of structures susceptible to collapse or failure in an earthquake. Historic buildings shall be treated in accordance with the Historic Preservation Ordinance and Historic Building Code (see also Program CDP-5.5A).
  - **Program S-2.3A: Seismic Safety Building Reinforcement.** Enforce State and local requirements for reinforcement of existing buildings, including the ~~City's~~ city's remaining unreinforced masonry (URM) buildings.
  - **Program S-2.3B: Soft-Story Building Mitigation Plan**. Complete a citywide assessment of soft-story buildings and develop a mitigation strategy and cost-benefit analysis to modify these structures to reduce their potential to collapse during an earthquake.
- **Policy S-2.4: Post-Earthquake Inspections.** Require post-earthquake inspections of critical facilities and other impacted buildings and restrict entry into compromised structures as appropriate. Following a major earthquake, inspections shall be conducted as necessary in conjunction with other non-~~city~~ City public agencies and private parties to ensure the structural integrity of water storage facilities, storm drainage structures, sewer lines and treatment facilities, transmission and telecommunication facilities, major roadways, bridges, elevated freeways, levees, canal banks, and other important utilities and essential facilities.
  - **Program S-2.4A: Inspection List**. Develop and maintain a list of facilities that would be inspected after a major earthquake, including City-owned essential or hazardous facilities. Facilities on the list should be prioritized for inspection-scheduling purposes.
- **Policy S-2.5: Erosion Control.** Require appropriate control measures in areas susceptible to erosion, in conjunction with proposed development. Erosion control measures should incorporate best management practices (BMPs) and should be coordinated with requirements for on-site water retention, water quality improvements, and runoff control.
  - **Program S-2.5A: Erosion and Sediment Control Plans**. Require Erosion and Sediment Control Plans (ESCPs) for projects meeting the criteria defined by the Marin County Stormwater Pollution Prevention Program, including those requiring grading permits and those with the potential for significant erosion and sediment discharges. Projects that disturb more than one acre of soil must prepare a Stormwater Pollution Prevention Plan, pursuant to State law.
  - **Program S-2.5B: Grading During the Wet Season**. Avoid grading during the wet season due to soil instability and sedimentation risks, unless the City Engineer

determines such risks will not be present. Require that development projects implement erosion and/or sediment control measures and runoff discharge measures based on their potential to impact storm drains, drainageways, and creeks.

- **Program S-2.5C: Sediment Use**. Explore the use of sediment from human activities such as dredging and natural processes such as erosion for wetlands restoration and shoreline resiliency projects.

~~Draft City of San Rafael Downtown Precise Plan~~

~~The Draft *Downtown San Rafael Precise Plan* (City of San Rafael 2020b) contains goals, policies, and programs describing the community's vision for economic viability, livable neighborhoods, and environmental protection. The *Downtown San Rafael Precise Plan* includes no policies associated with geology and soils or paleontological resources.~~

3.6.1.2 Environmental Setting

Physiography

The project area is in a depression within the Coast Ranges geomorphic province. The Coast Ranges are northwest-trending mountain ranges (2,000 to 4,000 and occasionally up to 6,000 feet elevation above sea level) and valleys, composed of thick Mesozoic and Cenozoic sedimentary strata. The northern and southern ranges are separated by a depression containing the San Francisco Bay. The northern Coast Ranges are dominated by irregular, knobby, landslide-topography of the Franciscan Complex. The eastern border is characterized by strike-ridges and valleys in Upper Mesozoic strata. In several areas, Franciscan rocks are overlain by volcanic cones and flows of the Quien Sabe, Sonoma, and Clear Lake volcanic fields. The Coast Ranges are subparallel to the active San Andreas fault. The San Andreas fault is more than 600 miles long, extending from Point Arena to the Gulf of California. West of the San Andreas fault is the Salinian Block, a granitic core extending from the southern extremity of the Coast Ranges to the north of the Farallon Islands (California Geological Survey n.d.).

Subsurface Conditions

The bedrock unit in the vicinity of the project area consists of Franciscan Complex mélange. The mélange is composed of a tectonic mixture of variably sheared shale and sandstone, high-grade metamorphic rocks, serpentinite, and variably resistant blocks of Greywacke sandstone, greenstone, and serpentinite. Geologic mapping shows alluvial stream deposits consisting of unconsolidated clay, silt, sand, and gravel in the project area.

Seismicity and Seismic Hazards

Primary Seismic Hazards

Surface Fault Rupture

The project area is not within an Alquist-Priolo earthquake fault zone, and no known fault or potentially active fault exists on the project area (California Geological Survey 2020b). The Geotechnical Recommendation found no active faults passing through the project area. Therefore, likelihood of surface fault rupture within the project area is considered to be low. However, the

project area is between two active fault zones: the Hayward Fault Zone, approximately 10 miles east of the project area, and the San Andreas Fault Zone, approximately 10 miles west of the project area (United States Geological Survey 2020). In a seismically active area such as the San Francisco Bay Area, the possibility of future surface fault rupture occurring in areas where faults have not been mapped is small, but the possibility exists.

Seismic Ground Shaking

Ground shaking is the most widespread hazardous phenomenon associated with seismic activity. The project area is between two active faults. There is a 52 percent combined chance of a major (6.7 or greater magnitude) earthquake occurring on one of these faults between now and 2036 (ABAG 2020a). The project area could experience "Very Strong"[3] ground shaking (Modified Mercalli Intensity Shaking Severity Level 8) during a seismic event (ABAG 2020b).

Secondary Seismic Hazards

Liquefaction

Liquefaction occurs when saturated soils lose cohesion, strength, and stiffness with applied shaking, such as that from an earthquake. The lack of cohesion causes solid soil to behave like a liquid, resulting in ground failure. When a load such as a structure is placed on ground that is subject to liquefaction, ground failure can result in the structure sinking and soil being displaced. Ground failure can take on many forms, including flow failures, lateral spreading, lowering of the ground surface, ground settlement, loss of bearing strength, ground fissures, and sand boils. Liquefaction within subsurface layers, which can occur during ground shaking associated with an earthquake, can also result in ground settlement.

The project area has not been evaluated for liquefaction by the California Geological Survey (California Geological Survey 2020b). However, portions of Marin County are underlain with Bay mud and Marshland, which is susceptible to liquefaction (ABAG 2020b). The *Marin Countywide Plan* identifies the project area as an area susceptible to high to very light levels of liquefaction (Marin County Community Development Agency 2007).

The Geotechnical Recommendation prepared for the proposed project reviewed relevant as-built geotechnical data including soil samples and identified underlying soils consisting predominantly of stiff to very stiff, clayey soils with low liquefaction potential. The risk of liquefaction in the project area west of U.S. Highway 101 (US-101) is considered low. However, soil samples closer to Irwin Creek/US-101, outside of but near the project area, revealed loose granular material that could potentially liquefy during a seismic event. Therefore, the potential for liquefaction could exist at the southern portion of the project area.

Lateral Spreading

Lateral spreading is a phenomenon in which a surficial soil displaces along a shear zone that formed within an underlying liquefied layer. The surficial blocks are transported downslope or in the direction of a free face, such as a bay or creek, by earthquake and gravitational forces. Lateral

[3] A "very strong" earthquake is defined on the Modified Mercalli Intensity Scale as an VIII, which could result in extensive damage to unreinforced masonry buildings (e.g., masonry walls falling, wood-frame houses moving off their foundations, loose partition walls being thrown out of alignment) (ABAG 2020c).

spreading is generally the most pervasive and damaging type of liquefaction-induced ground failure generated by earthquakes. The *Marin Countywide Plan* identifies the project area as susceptible to high to very high levels of liquefaction (Marin County Community Development Agency 2007). The southern portion of the project area is close to Irwin Creek and San Rafael Creek, which could provide a free face toward which liquefiable soils could displace. The Geotechnical Recommendation noted that the risk of liquefaction is low in soils underlying much of the project area, with groundwater in the project area varying between 22 to 32 feet below the current ground surface. However, borings outside of but near the southern portion of the project area have recorded groundwater levels of 6 to 8 feet below the ground surface. In addition, borings made by the California Department of Transportation (Caltrans) in the 1960s along the San Rafael Viaduct encountered groundwater between 4 and 6 feet below ground surface. Groundwater levels in combination with the loose, granular nature of soils in the area along Irwin Creek, south of the project area, indicate that risk of liquefaction could exist in this area, and therefore the potential risk of lateral spreading exists in the southern part of the project area. The water table measurements near the southern portion of the project area and the water table measurements along the viaduct do not affect the conclusion that the risk of liquefaction in the majority of the project area is low.

Expansive Soils and Weak Soils

Expansive soils are characterized by their ability to undergo substantial volume changes (i.e., shrink and swell) due to variation in moisture content. Expansive soils are typically very fine grained and have a high to very high percentage of clay. They can damage structures and buried utilities and increase maintenance requirements. The presence of expansive soils is typically associated with high clay content. Generally, projects in areas with expansive soils may require special building foundations or grade preparation, such as the removal of problematic soils and replacement with engineered soils. However, the relative strength or weakness of alluvial soils also depends on the combination of clay and sand.

The Geotechnical Recommendation reviewed existing as-built borehole data and identified subsurface conditions in the project area.[4] The project area is underlain with 1.5 to 5 feet of fill, generally consisting of clayey sand with gravel and stiff, sandy clay of low to medium plasticity. Fill consisting of medium-stiff silt at depths of 1 to 3 feet was encountered near the southernmost portion of the project area, near San Rafael Creek. Below the fill, the borings show predominantly native alluvial soil consisting of very stiff, sandy clay of low plasticity extending to depths of 32 feet or more. Bedrock is on the order of 50 to 60 feet below the area between 3rd Street and 5th Avenue. Therefore, as the underlying fill has been noted as demonstrating low plasticity, the risk of expansion is considered low to moderate.

Weak soils can compress or collapse under the weight of buildings and fill, causing settlement relative to the thickness of the weak soil. Usually the thickness of weak soil varies, and differential settlement will occur. Some weak soils, specifically unconsolidated settlements, can amplify shaking during an earthquake, and when saturated can be susceptible to liquefaction. ~~According to *The City of San Rafael General Plan 2020*, the~~ The San Francisco Bay mud that underlies the eastern portion of San Rafael can be weak, result<u>ing</u> in substantial settlement of the ground surface (City of San Rafael 2017). The Geotechnical Recommendation reviewed as-built borehole data and identified

[4] No site-specific borings were for performed for the Geotechnical Recommendation. The Geotechnical Recommendation reviewed data from borings completed for previous projects by Miller Pacific Engineering Group, Parikh Consultants Inc., and the California Department of Transportation.

subsurface conditions in the project area. As-built data west of US-101 revealed underlying soils consisting of stiff to very stiff, clayey soils. However, as-built borehole data along Irwin Creek/US-101 (but outside the project area) revealed loose fills over layers of soft Bay mud. Therefore, while soils underlying the project area are generally stiff and pose a low risk for compression or collapse, there exists the possibility of loose fill in the southern portion of the project area.

Landslides

Landslides occur when the stability of a slope changes from a stable to an unstable condition. The stability of a slope is affected by the following primary factors: inclination, material type, moisture content, orientation of layering, and vegetative cover. In general, steeper slopes are less stable than more gently inclined ones. The California Geological Survey Landslide Inventory shows no reported landslides in the immediate vicinity (California Geological Survey 2020c) and the project area is described as flat land posing little landslide risk on the Metropolitan Transportation Commission/Association of Bay Area Governments Hazard View Map (MTC/ABAG 2020). ~~*The City of San Rafael General Plan 2020* shows the~~ The project area is not in an area of landslide deposits (City of San Rafael 2017). Therefore, the likelihood of a landslide in the project area is low.

Paleontological Resources

Fossils preserve information about ancient animals and plants (University of California Museum of Paleontology n.d.). There are two types of fossils: body fossils (remains of an organism) and trace fossils (e.g., footprints, burrows, trails). Fossils can add to the scientific record by providing information about the anatomy of an organism and clues to its life processes, successive evolutional development of organisms, and successive colonization of habitats. Fossils are a nonrenewable resource; that is, once destroyed, a fossil cannot be replaced. Fossils represent irreplaceable evidence of past life on the planet (National Park Service n.d.).

Fossils occur within geologic units. A geologic unit is a volume of rock or sediments of identifiable origin with an age range defined by distinctive and dominant features. The geologic units exposed at and near ground surface in the project area are Holocene alluvium (Q), Holocene intertidal deposits (i.e., peaty mud), and Jurassic and Cretaceous Franciscan Formation (KJf) (Wagner et al. 1991). Geologic units from the Holocene are considered too young to contain fossils (Society of Vertebrate Paleontology 2010). While the Franciscan Formation has yielded vertebrate fossils (University of California Museum of Paleontology 2020), such fossils are rare. Vertebrate fossils recorded from the Franciscan Formation include *Ichthyosaurus franciscanus* and *Plesiosaurus hesternus*, both species of reptile.

3.6.2 Environmental Impacts

Four different build alternatives, which are all in Downtown San Rafael within 500 feet of the existing transit center, are being evaluated. Geology, soils, seismicity, and paleontological impacts were analyzed for the project area rather than specific build alternatives because the location of each build alternative would experience a nearly equivalent impact for each resource considered here. Impacts for the build alternatives are presented together unless they differ substantially among alternatives. Information in this section is based on the Geotechnical Recommendation prepared for the proposed project, unless otherwise noted (Parikh 2020).

3.6.2.1 Methodology

The study area for geology and soils consists of the area that comprises all four build alternatives, extending from Lincoln Avenue on the west to Irwin Street on the east, and from 5th Avenue in the north to 2nd Street in the south. For paleontology, the study area consists of the area of disturbance to the maximum depth of excavation.

Geology, Soils, and Seismicity

Evaluation of the proposed project is based on the Geotechnical Recommendation prepared for the proposed project, unless otherwise noted. The Geotechnical Recommendation reviewed data from borings completed for previous projects by Miller Pacific Engineering Group, Parikh Consultants Inc., and Caltrans. The Geotechnical Recommendation was prepared to assist the design team in the alternative selection process and concluded that the proposed project is feasible from a geotechnical standpoint; however, the Geotechnical Recommendation noted that a site-specific geotechnical investigation will need to be performed when an alternative is chosen.

In the *California Building Industry Association v. Bay Area Air Quality Management District* case, decided in 2015,[5] the California Supreme Court held that CEQA does not generally require lead agencies to consider how existing environmental conditions might affect a project, except where the project would significantly exacerbate an existing environmental condition. Accordingly, placing new development in an existing or future seismic hazard area or an area with unstable soils is not considered an impact under CEQA unless the project would significantly exacerbate a seismic hazard or unstable soil conditions. Therefore, the analysis below evaluates whether the proposed project would exacerbate existing or future seismic hazards or unstable soils in the project area and result in potentially significant environmental impacts or a substantial risk of loss, injury, or death.

Paleontological Resources

The *Standard Procedures for the Assessment and Mitigation of Adverse Impacts to Paleontological Resources* (Procedures) of the Impact Mitigation Guidelines Revision Committee of the Society of Vertebrate Paleontology include procedures for the investigation, collection, preservation, and cataloging of fossil-bearing sites. This includes the designation of paleontological sensitivity. The Procedures are widely accepted among paleontologists and followed by most investigators. The Procedures identify two key phases of paleontological resource protection: (1) assessment and (2) implementation. Assessment involves identifying the potential for a project site or area to contain significant, nonrenewable paleontological resources that could be damaged or destroyed by project excavation or construction. Implementation involves formulating and applying measures to reduce such adverse effects. *Paleontological potential* refers to the potential for yielding abundant fossils, a few significant fossils, or recovered evidence for new and significant taxonomic, phylogenetic, paleoecologic, taphonomic, biochronologic, or stratigraphic data.

For the assessment phase, the Society of Vertebrate Paleontology uses one of four sensitivity categories for sedimentary rocks (i.e., high, undetermined, low, no potential) to define the level of potential.

[5] *California Building Industry Association v. Bay Area Air Quality Management District*, 62 Cal.4th 369. Opinion filed December 17, 2015. Available: https://caselaw.findlaw.com/ca-supreme-court/1721100.html. Accessed: March 13, 2020.

- **High Potential.** Assigned to geologic units from which vertebrate or significant invertebrate, plant, or trace fossils have been recovered as well as sedimentary rock units suitable for the preservation of fossils (e.g., middle Holocene and older fine-grained fluvial sandstones, fine-grained marine sandstones).
- **Undetermined Potential.** Assigned to geologic units for which little information is available concerning their paleontological content, geologic age, and depositional environment. In cases where no subsurface data already exist, paleontological potential can sometimes be assessed by subsurface site investigations.
- **Low Potential.** Field surveys or paleontological research may determine that a geologic unit has low potential for yielding significant fossils (e.g., basalt flows). Mitigation is generally not required to protect fossils.
- **No Potential.** Some geologic units have no potential to contain significant paleontological resources (e.g., high-grade metamorphic rocks [gneisses and schists] and plutonic igneous rocks [granites and diorites]). Mitigation is not required.

3.6.2.2 Thresholds of Significance

The following State CEQA Guidelines Appendix G thresholds identify significance criteria to be considered for determining whether a project could have significant impacts related to geology and soils.

Would the proposed project:

- Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:
    - Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? (Refer to Division of Mines and Geology Special Publication 42.)
    - Strong seismic ground shaking?
    - Seismic-related ground failure, including liquefaction?
    - Landslides?
- Result in substantial soil erosion or the loss of topsoil?
- 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 onsite or offsite landslide, lateral spreading, subsidence, liquefaction, or collapse?
- 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?
- Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of wastewater?
- Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?

3.6.2.3 Impacts

Impact GEO-1: Directly or Indirectly Cause Potential Substantial Adverse Effects, Including the Risk of Loss, Injury, or Death Involving Rupture of a Known Earthquake Fault, Strong Seismic Ground Shaking, Seismic-Related Ground Failure (Including Liquefaction), or Landslides

Fault Rupture

All Build Alternatives

Construction and operation of the proposed project would not exacerbate the risk of fault rupture. As discussed above under Seismicity and Seismic Hazards, the project area is not within an Alquist-Priolo earthquake fault zone, and no known potentially active fault exists in the vicinity of the project area. The Geotechnical Recommendation found no active faults passing through the project area and concluded that the risk of surface fault rupture from previously unknown faults is very low. Therefore, construction and operation of the proposed project would not exacerbate the risk of surface fault rupture and this impact would be ***less than significant***. No mitigation is required.

Ground Shaking

All Build Alternatives

Construction and operation of the proposed project would not exacerbate the risk of ground shaking. As discussed above under Seismicity and Seismic Hazards, the project area is in a seismically active area between two active faults. Consequently, the project area could experience ground shaking (Modified Mercalli Intensity Shaking Severity Level 8) during a seismic event. However, the proposed project would comply with the California Buildings Standard Code, Marin County policies, and San Rafael Municipal Code seismic requirements, which would ensure the design of the proposed project would reduce risks to life from damage to the newly constructed project due to seismic hazards. Therefore, the proposed project would not exacerbate the risk of ground shaking resulting from a seismic event and this impact would be ***less than significant***. No mitigation is required.

Soil Liquefaction

Move Whistlestop Alternative

Construction and operation of the Move Whistlestop Alternative could potentially result in impacts related to soil liquefaction. As discussed above under Seismicity and Seismic Hazards, portions of Marin County are underlain with liquefiable Bay mud and the project area is in an area identified by the Marin Countywide Plan as being susceptible to liquefaction. The Geotechnical Recommendation found a low risk of liquefaction in soils west of US-101, because as-built borehole data found very stiff, sandy clay to a depth of 32 feet or more. Therefore, the potential for liquefaction in the majority of the project area is low. Additionally, as noted in Section 3.6.1.2, Environmental Setting, the Geotechnical Recommendation reviewed data from borings completed for previous projects by Miller Pacific Engineering Group, Parikh Consultants Inc., and Caltrans. The preliminary analysis in the Geotechnical Recommendation provides substantial evidence that it is highly unlikely for liquefaction to occur at the majority of the project site.

However, a portion of the Move Whistlestop Alternative site extends south toward 2nd Street, where the presence of Bay mud beneath fill was confirmed in boring data, resulting in a higher risk of liquefaction in this portion of the alternative. The Geotechnical Recommendation recommends excavation to approximately 2 feet and reworking of the subgrade (either proof-rolled, ripped, or moisture-conditioned). It is anticipated that most of the onsite soil would meet the requirements for engineered fill, but if the subgrade is soft or wet, the Geotechnical Recommendation suggests it be excavated and replaced with engineered fill. Although the Geotechnical Recommendation provided preliminary recommendations to aid in the selection of an alternative, the Move Whistlestop Alternative would still need to complete a site-specific detailed geotechnical investigation as required by the California Building Code, the *Marin Countywide Plan*, the San Rafael Municipal Code, and ~~*The City of* ~~*San Rafael General Plan* ~~*2020*~~*2040*. This site-specific geotechnical investigation would provide specific recommendations which would reduce impacts related to liquefiable soils, including any potentially liquefiable soil present in the southern portion extending toward 2nd Street where Bay mud was identified. Therefore, as the risk of liquefaction in the majority of the project area is low, and with adherence to the Geotechnical Recommendation's suggestions, as well as any recommendations resulting from the site-specific geotechnical investigation, the Move Whistlestop Alternative would result in a ***less-than-significant*** impact related to ground failure resulting from liquefaction. No mitigation is required.

Adapt Whistlestop Alternative

The construction and operation impacts related to liquefaction of the Adapt Whistlestop Alternative would be the similar to those of the Move Whistlestop Alternative outlined above; therefore, the Adapt Whistlestop Alternative would pose a similar liquefaction risk as the Move Whistlestop Alternative. As outlined above, the Adapt Whistlestop Alternative would adhere to the Geotechnical Recommendation's suggestions as well as any recommendations resulting from the site-specific geotechnical investigation and would therefore result in a ***less-than-significant*** impact related to ground failure from liquefaction. No mitigation is required.

4th Street Gateway Alternative

The construction and operation impacts related to liquefaction of the 4th Street Gateway Alternative would be the same as those of the Move Whistlestop Alternative outlined above. Therefore, the impact would be ***less than significant***.

Under the Freeway Alternative

The construction and operation impacts related to liquefaction of the Under the Freeway Alternative would be the same as those of the Move Whistlestop Alternative outlined above. Therefore, the impact would be ***less than significant***.

Seismic Densification

All Build Alternatives

Construction and operation of the proposed project would not result in impacts related to seismic densification. As discussed above under Secondary Seismic Hazards, the Geotechnical Recommendation identified very stiff, clayey soils underlying the project area in the area west of US-101 and relatively weak, loose, granular materials underlying an area outside of but near the eastern portion of the project area, and soft Bay mud near the southern portion of the project area.

Therefore, there is a risk of seismically induced settlement at the southern portion of the project area. While the Geotechnical Recommendation provided preliminary suggestions to aid in the selection of an alternative, the proposed project would still need to complete a site-specific detailed geotechnical investigation as required by the California Building Code, the *Marin Countywide Plan*, the San Rafael Municipal Code, and *San Rafael General Plan 2040*~~*The City of San Rafael General Plan 2020*~~. This site-specific geotechnical investigation would include boring samples, which would determine the weakness and compressibility of soils in the project area. The site-specific geotechnical investigation would provide specific recommendations if weak, compressible soils are found (such a replacement with stable, engineered fill), which would reduce impacts related to these soils to a less-than-significant level. Therefore, with adherence to any specific recommendations in the geotechnical investigation, the proposed project would result in a ***less-than-significant*** impact related to seismic densification. No mitigation is required.

Lateral Spreading

Move Whistlestop Alternative

Construction and operation of the Move Whistlestop Alternative could potentially result in impacts related to lateral spreading. As discussed above under Secondary Seismic Hazards, the Geotechnical Recommendation noted that the risk of liquefaction is low in soils underlying much of the project area; therefore, the potential for soils to liquify and spread toward an open face are low. The Geotechnical Recommendation reviewed data from borings completed for previous projects by Miller Pacific Engineering Group, Parikh Consultants Inc., and Caltrans and found a low risk of liquefaction in soils west of US-101, because as-built borehole data found very stiff, sandy clay to a depth of 32 feet or more. Therefore, the potential for liquefaction in the majority of the project area is low. However, a portion of the Move Whistlestop Alternative project site extends south toward 2nd Street, where the risk of lateral spreading is greater due to the proximity of San Rafael Creek. In addition, the depth of groundwater near the southern part of the project area has been recorded as being high (6 feet) (outside the project footprint) and the presence of Bay mud was detected in borings. Therefore, risk of lateral spreading exists in the southern portion of the project area. The preliminary analysis in the Geotechnical Recommendation provides substantial evidence that it is highly unlikely for liquefaction to occur at the majority of the project site. However, the proposed project would be required to complete a site-specific detailed geotechnical investigation per the California Building Code, the *Marin Countywide Plan*, the San Rafael Municipal Code, and *San Rafael General Plan 2040*~~*The City of San Rafael General Plan 2020*~~. The site-specific geotechnical investigation would provide specific design and geotechnical recommendations, which would address the risk of lateral spreading in this southern portion of the project area and reduce impacts related to lateral spreading to a less-than-significant level. Therefore, the Move Whistlestop Alternative would result in a ***less-than-significant*** impact related to lateral spreading. No mitigation is required.

Adapt Whistlestop Alternative

The construction and operation impacts related to lateral spreading for the Adapt Whistlestop Alternative would be the same as those of the Move Whistlestop Alternative outlined above. As outlined above, the Adapt Whistlestop Alternative would adhere to the Geotechnical Recommendation's suggestions as well as any recommendations resulting from the site-specific geotechnical investigation and would therefore result in a ***less-than-significant*** impact related to lateral spreading. No mitigation is required.

4th Street Gateway Alternative

The construction and operation impacts related to lateral spreading for the 4th Street Gateway Alternative would be the same as those of the Move Whistlestop Alternative outlined above. Therefore, the impact would be ***less than significant***.

Under the Freeway Alternative

The construction and operation impacts related to lateral spreading for the Under the Freeway Alternative would be the same as those of the Move Whistlestop Alternative outlined above. Therefore, the impact would be ***less than significant***.

Landslides

All Build Alternatives

Construction and operation of the proposed project would have no impact regarding landslides. As discussed above under Landslides, the project area is flat and there have been no reported landslides or recorded landslide deposits in the immediate vicinity. It is not in a landslide risk area; therefore, there is no potential for a landslide occurring in or near the project area. Therefore, the proposed project would result in ***no impact*** related to landslides. No mitigation is required.

Mitigation Measures

No mitigation is required.

Impact GEO-2: Result in Substantial Soil Erosion or the Loss of Topsoil

All Build Alternatives

Neither construction nor operation of the proposed project would lead to erosion or the loss of topsoil. The proposed project is in an urbanized area and would not disturb any established vegetation. The project area would require excavation and grading to provide a secure foundation, allow for positive drainage, and, depending on the alternative selected, for the installation of piles. Due to the composition of fill in the project area, it is likely that onsite soils could be moisture conditioned and reused on site, minimizing the amount of soil that would be off-hauled. The proposed project would disturb more than 1 acre of land and would therefore be required to the comply with the National Pollutant Discharge Elimination System Construction General Permit, ~~the~~ *San Rafael General Plan 2040*~~*The City of San Rafael General Plan 2020*~~, and the San Rafael Municipal Code and, as discussed in Section 3.9, Hydrology and Water Quality, would be required to implement best management practices (BMPs) to control sediment and minimize erosion. BMPs could include the installation of erosion control measures (e.g., silt fences, staked straw bales/wattles, silt/sediment basins or traps), geofabric, sandbag dikes, covers for stockpiles, or storage precautions for outdoor material storage areas. Therefore, with adherence to the BMPs included in the erosion control plan, impacts related to soil erosion or loss of topsoil would be ***less than significant***. No mitigation is required.

Mitigation Measures

No mitigation is required.

Impact GEO-3: 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 Onsite or Offsite Landslide, Lateral Spreading, Subsidence, Liquefaction, or Collapse

Move Whistlestop Alternative

A portion of the Move Whistlestop Alternative could potentially be located on a geologic unit or on soil that is unstable or would become unstable as a result of the proposed project. As discussed above under Expansive Soils and Weak Soils, boring samples indicate the majority of the project area is underlain with soils consisting of stiff to very stiff, clayey soils. Sand boils and liquefaction-related ground fissures can occur when surface layers above the liquefiable soils are thin. The majority of the project area does not appear to pose a risk of liquefaction; however, a portion of the Move Whistlestop Alternative extends south toward 2nd Street, where the presence of Bay mud beneath fill was confirmed in boring data outside of but near the project footprint. Therefore, there may be a higher risk of liquefaction in this portion of the alternative. Although the Geotechnical Recommendation provided preliminary recommendations to aid in the selection of an alternative, the Move Whistlestop Alternative would still need to complete a site-specific detailed geotechnical investigation as required by the California Building Code, the *Marin Countywide Plan*, the San Rafael Municipal Code, and *San Rafael General Plan 2040*~~*The City of San Rafael General Plan 2020*~~. Any liquefiable soils that might be present in this area would be identified in the site-specific geotechnical report and design requirements and recommendations regarding these soils would be followed. Therefore, the project area poses a low risk of liquefaction, and the risk of sand boils or fissure during a seismic event is low.

Lateral spreading is a phenomenon in which a surficial soil displaces along a shear zone that formed within an underlying liquefied layer. As discussed above under Lateral Spreading, while the risk of lateral spreading is considered low in the majority of the project area, a portion of the Move Whistlestop Alternative project site extends south toward 2nd Street, where the risk of lateral spreading is greater due to the proximity of San Rafael Creek, the depth of groundwater, and the presence of Bay mud. Although the Geotechnical Recommendation provided preliminary recommendations to aid in the selection of an alternative, the Move Whistlestop Alternative would still need to complete a site-specific detailed geotechnical investigation as required by the California Building Code, the *Marin Countywide Plan*, the San Rafael Municipal Code, and *San Rafael General Plan 2040*~~*The City of San Rafael General Plan 2020*~~. The site-specific geotechnical investigation would provide specific design and geotechnical recommendations, which would address the risk of lateral spreading in this southern portion of the project area and reduce impacts related to lateral spreading to a less-than-significant level. Therefore, instability as a result of lateral spreading is unlikely to occur as a result of the proposed project.

Weak soils can compress or subside under the weight of buildings and fill, causing settlement relative to the thickness of the weak soil. Usually the thickness and composition of weak soil will vary throughout an area, and differential settlement can occur under a load. The Geotechnical Recommendation determined that the project site, north of 3rd Street on the west side of Tamalpais Avenue, was underlain with stiff to very stiff, clayey soils, which had strength and low compressibility. However, as-built borehole data taken from near but outside of the footprint of the southern portion of the Move Whistlestop Alternative revealed loose fills over layers of soft Bay mud, which poses a risk of compression. Although the Geotechnical Recommendation provided

preliminary recommendations to aid in the selection of an alternative, the Move Whistlestop Alternative would still need to complete a site-specific detailed geotechnical investigation as required by the California Building Code, the *Marin Countywide Plan*, the San Rafael Municipal Code, and *San Rafael General Plan 2040~~The City of San Rafael General Plan 2020~~*. This site-specific geotechnical investigation required for the proposed project would identify the presence of weak soils and would provide site-specific recommendations.

The Geotechnical Recommendation identified groundwater near the project site as varying between 22 and 32 feet below the current ground surface, well below the anticipated excavation necessary for the build alternatives. However, borings taken outside of but close to the southern portion of the alternative have identified groundwater at 6 to 8 feet below the ground surface. A portion of the footprint of the Move Whistlestop Alternative stretches toward this southern area near 2nd Street and San Rafael Creek. The Geotechnical Recommendation anticipates the project site would need to be excavated to 2 feet below ground surface, and as deep as 9 feet below ground surface for storm drain trenching, above groundwater levels for most of the project site but possibly below groundwater levels in the southern portion near 2nd Street. As groundwater levels fluctuate seasonally, particularly near creeks, excavations for utility trenches may encounter groundwater in this area and may require dewatering, shoring, and other ground-stabilizing measures. Although the Geotechnical Recommendation provided preliminary recommendations to aid in the selection of an alternative, the Move Whistlestop Alternative would still need to complete a site-specific detailed geotechnical investigation as required by the California Building Code, the *Marin Countywide Plan*, the San Rafael Municipal Code, and *San Rafael General Plan 2040~~The City of San Rafael General Plan 2020~~*. This site-specific geotechnical investigation required for the proposed project would provide site-specific analysis for depth to groundwater and recommendations on how to address groundwater-related concerns.

Dewatering, if it is extensive, can result in subsidence. Subsidence occurs when the compaction of underlying soils results in a lowering of land surface. However, the amount of dewatering necessary for the Move Whistlestop Alternative would not be great enough to result in subsidence.

The Geotechnical Recommendation provided preliminary suggestions to aid in the selection of an alternative. If selected, the Move Whistlestop Alternative would still need to complete a site-specific detailed geotechnical investigation as required by the California Building Code, the *Marin Countywide Plan*, the San Rafael Municipal Code, and *San Rafael General Plan 2040~~The City of San Rafael General Plan 2020~~*. The Move Whistlestop Alternative would comply with the recommendations in the site-specific detailed geotechnical investigation regarding the design of foundations, floor slabs, and other geotechnical aspects of the proposed project. In addition, the Move Whistlestop Alternative would comply with regulations required by the California Building Code, which are adopted by reference in the San Rafael Municipal Code. Therefore, impacts related to potential liquefaction, lateral spreading, soil compression, and settlement and subsidence due to dewatering in soil that is unstable, or could become unstable as a result of such construction, would be ***less than significant***. No mitigation is required.

Adapt Whistlestop Alternative

The construction and operation impacts of the Adapt Whistlestop Alternative would be similar to those of the Move Whistlestop Alternative outlined above, but without the portion of the Move Whistlestop Alternative site that extends south toward 2nd Street and San Rafael Creek. The Adapt Whistlestop Alternative would adhere to the Geotechnical Recommendation's suggestions as well as

any recommendations resulting from the site-specific geotechnical investigation. Therefore, impacts related to potential liquefaction, lateral spreading, soil compression, and settlement and subsidence due to dewatering in soil that is unstable, or could become unstable as a result of such construction, would be ***less than significant***. No mitigation is required.

4th Street Gateway Alternative

The construction and operation impacts of the 4th Street Gateway Alternative would be the same as those of the Move Whistlestop Alternative outlined above. Therefore, the impact would be ***less than significant***.

Under the Freeway Alternative

The construction and operation impacts of the Under the Freeway Alternative would be similar to those of the Move Whistlestop Alternative outlined above; however, a portion of the Under the Freeway Alternative site extends east toward Irwin Street/US-101, where Caltrans borings taken in the 1960s identified groundwater at between 4 and 6 feet below ground surface. Utility trenching for the Under the Freeway Alternative could reach 6 feet below ground surface, potentially encountering groundwater. As groundwater levels fluctuate seasonally, particularly near creeks, excavations for utility trenches may require dewatering, shoring, and other ground-stabilizing measures. However, any dewatering required would not be great enough to result in subsidence. Although the Geotechnical Recommendation provided preliminary recommendations to aid in the selection of an alternative, the Under the Freeway Alternative would still need to complete a site-specific detailed geotechnical investigation as required by the California Building Code, *the Marin Countywide Plan*, the San Rafael Municipal Code, and *San Rafael General Plan 2040*~~*The City of San Rafael General Plan 2020*~~. The Under the Freeway Alternative would adhere to any recommendations resulting from the site-specific geotechnical investigation. Therefore, impacts related to potential liquefaction, lateral spreading, soil compression, and settlement and subsidence due to dewatering in soil that is unstable or could become unstable as a result of such construction would be ***less than significant***. No mitigation is required.

Mitigation Measures

No mitigation is required.

Impact GEO-4: 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

All Build Alternatives

The construction and operation of the proposed project would not create a direct or indirect risk to life or property by being located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994). As discussed above under Expansive Soils and Weak Soils, the Geotechnical Recommendation determined that the project area is underlain with 1.5 to 5 feet of fill, generally consisting of clayey sand with gravel and stiff, sandy clay of low to medium plasticity, posing a low to moderate risk of expansion. However, the Geotechnical Recommendation analysis was based on old as-built borings, and the proposed project would still need to complete a site-specific detailed geotechnical investigation as required by the California Building Code, the *Marin Countywide Plan*,

the San Rafael Municipal Code, and *San Rafael General Plan 2040*~~*The City of San Rafael General Plan 2020*~~. The site-specific geotechnical investigation would provide an updated analysis of the plasticity of the underlying soils and, depending on the result, offer specific recommendations regarding how to reduce any risk associated with expansive soils. As the Geotechnical Recommendation determined the risk of expansive soils was low, and as a site-specific geotechnical report would be required, which would provide specific design recommendations, adherence to these recommendations would reduce any related impacts to a ***less-than-significant*** level. No mitigation is required.

Mitigation Measures

No mitigation is required.

Impact GEO-5: Have Soils Incapable of Adequately Supporting the Use of Septic Tanks or Alternative Waste Water Disposal Systems Where Sewers Are not Available for the Disposal of Wastewater

All Build Alternatives

The construction and operation of the proposed project would have no impact regarding the support of septic tanks. The proposed project would connect to San Rafael's existing sewer, water, and power infrastructure to operate the planned restrooms, kitchenette, and building spaces. Therefore, the proposed project would not use a septic tank or alternative water disposal system and would have ***no impact***. No mitigation is required.

Mitigation Measures

No mitigation is required.

Impact GEO-6: Directly or Indirectly Destroy a Unique Paleontological Resource or Site or Unique Geologic Feature

One geologic unit underlying the project area is known to have yielded significant fossils: the Franciscan Formation. However, significant fossils from this geologic unit are rare, so generally the Franciscan Formation is considered to have low potential for paleontological resources (see Section 3.6.2.1, Methodology). Furthermore, the Franciscan Complex is known for its chaotic and disjointed structure, and the typical assemblage of diverse rock types present at most locations sometimes is referred to as a "mélange." The chaotic assemblage mainly is the result of the deformation, folding, breaking, and mixing associated with movement along the nearby San Andreas fault. Because of this, rocks within the mélange zones contain only a sparse assemblage of fossils, and those that are rarely present usually are microfossils. Vertebrate fossils are extremely rare. Based on this information, the likelihood of paleontological resources being present is low and paleontological sensitivity is also considered low.

In addition, the Holocene geologic units at the project area, because they are too young to contain fossils, have low paleontological sensitivity.

Construction

Move Whistlestop Alternative

Maximum depth of excavation is anticipated to be up to 6 feet below ground surface to accommodate storm drain utility trenching. Because all geologic units in the project area have low paleontological sensitivity, this alternative is unlikely to disturb or destroy any significant fossils. The impact would be ***less than significant***.

Adapt Whistlestop Alternative

The Adapt Whistlestop Alternative construction impacts would be the same as those of the Move Whistlestop Alternative outlined above. Therefore, the impact would be ***less than significant***.

4th Street Gateway Alternative

Maximum depth of excavation is anticipated to be up to 9 feet below ground surface to accommodate storm drain utility trenching. Otherwise, the 4th Street Gateway Alternative construction impacts would be the same as those of the Move Whistlestop Alternative outlined above. Therefore, the impact would be ***less than significant***.

Under the Freeway Alternative

The Under the Freeway Alternative construction impacts would be the same as those of the Move Whistlestop Alternative outlined above. Therefore, the impact would be ***less than significant***.

Operations

All Build Alternatives

The operations period of the proposed project would not include ground-disturbing activities. There would be ***no impact***.

Mitigation Measures

No mitigation is required.