4.7 GEOLOGY AND SOILS

This section describes existing geology and soils conditions, identifies associated regulatory requirements, evaluates potential project and cumulative impacts, and identifies mitigation measures for any significant or potentially significant impacts related to implementation of the Sustainability Policy and Regulatory Update of the County of Santa Cruz (County) General Plan and Local Coastal Program (LCP) and County Code (Sustainability Update or project). The analysis is based on a review of existing geological and geotechnical studies, reports, and analyses prepared by the state of California or prepared for local and regional projects and programs.

4.7.1 Environmental Setting

4.7.1.1 Regional Setting

Topography

Elevations in Santa Cruz County range from sea level to approximately 3,000 feet above mean sea level. Approximately 75% of the county lies within the Santa Cruz Mountains, which includes areas of very steep slopes exceeding 30% gradient (U.S. Department of Agriculture [USDA} Soil Conservation Service 1980 as cited in County of Santa Cruz 2017). The Santa Cruz Mountain Range is characterized by deep valleys, such as the San Lorenzo Valley, and intervening ridges. The north coast area of the county, including the unincorporated community of Davenport, is characterized by broad, gently sloping marine terraces that extend along the Pacific Ocean, as well as steep foothills that rise into the Santa Cruz Mountains via county roads, such as Bonny Doon Road and Empire Grade. The unincorporated urban area includes the communities of Live Oak, Soquel, and Aptos, and consists of developed marine terraces, hills, and valleys with open forested hillsides. The southern portion of the county consists of valley lowlands such as within Pajaro Valley, terraces, rolling hills, sloughs, and floodplains that are intensively used for irrigated and dry-farm crops, as well as the more arid, chaparral dominated mountain range above Watsonville (County of Santa Cruz 2017).

Regional Geology

Santa Cruz County is located along on the southwestern side of the Santa Cruz Mountains. These mountains are in the central portion of the Coast Ranges Physiographic Province of California, which is a series of coastal mountain chains paralleling the pronounced northwest-southeast structural grain of central California geology, between Point Arguello, in Santa Barbara County, and the California/Oregon border. The Santa Cruz Mountains are underlain by granitic and metamorphic rocks of the Salinian Block. This suite of basement rocks is separated from contrasting basement rock of the Franciscan Formation to the northeast by the San Andreas Fault System. While the core of the mountain range is dominated by gneiss, schist, limestone, quartzite, and granite, Cretaceous through Holocene sedimentary rocks and lesser amounts of Tertiary volcanic rocks overlie much of the region (United States Geological Survey [USGS} 1981a, 1981b; USGS 2020).

Along the coast, ongoing tectonic activity is most evident in the gradual uplift of the coastline, as indicated by the series of uplifted marine terraces that sculpt the coastline (Nolan Associates 2009). Coastal areas in the county are characterized by step-like marine terraces. The marine terraces were formed at or near current sea level; however, the terraces are now elevated well above sea level due to uplift of the coastal land mass (County of Santa Cruz 2006).

4.7.1.2 Seismic Conditions

An earthquake is a sudden release of energy in the earth's crust caused by movement along fault planes. A fault plane may be thought of as a large crack or fracture in the earth's crust. Earthquakes vary in size and severity depending on the size of the fault plane that moves. The focus of an earthquake is found at the first point of movement along the fault plane, usually deep underground. The epicenter is the corresponding point above the focus at the earth's surface. The size of an earthquake has been measured in various ways, the most familiar being the now obsolete Richter magnitude scale, which determines the amount of ground displacement or shaking that occurs near the epicenter. The Richter magnitude scale has now been replaced by the Moment Magnitude (Mw) scale for medium and large sized earthquakes. While this scale attempts to characterize the amount of energy released by an earthquake, another scale—the Modified Mercalli Intensity Scale—measures ground shaking intensity in terms of perception and damage and takes into account localized earthquake effects (County of Santa Cruz 2021a).

Regional Faulting

Santa Cruz County is in a portion of California that is crossed by several Holocene-active and Pre-Holocene faults. The California Geological Survey (CGS) classifies faults as:

- Holocene-active faults, which are faults that have moved during the past approximate 11,000 years. These faults are capable of surface rupture and are also known as active faults.
- Pre-Holocene faults, which are faults that show evidence of movement, but have not moved in the past 11,000 years. This class of fault may be capable of surface rupture but such faults are not regulated under the Alquist-Priolo Special Studies Zones Act of 1972. Pre-Holocene faults are also known as potentially active faults.
- Age-undetermined faults, which are faults where the recency of fault movement has not been determined (CGS 2018). Age-undetermined faults may be active or inactive faults.

This fault classification is consistent with criteria of the Alquist-Priolo Earthquake Fault Zoning Act of 1972 (see Section 4.7.2.2, State Regulations, for information about this act).

Regional Seismicity and Seismic Hazards

Santa Cruz County is located in a seismically active region of California, between two major Holocene-active faults, including the San Andreas Fault, located along the northeast county boundary, and the San Gregorio Fault, located along the northwest county coast. Historical earthquakes along the San

Andreas Fault and its branches have caused substantial seismic shaking in Santa Cruz County in historical time. The two largest historical earthquakes to affect the area were the Mw 7.9 San Francisco earthquake of April 18, 1906 and the Mw 6.9 Loma Prieta earthquake of October 17, 1989 (corresponding to Richter magnitudes of 8.3 and 7.1, respectively). The San Francisco earthquake caused severe seismic shaking and structural damage to many buildings in the Santa Cruz Mountains. The Loma Prieta earthquake may have caused more intense seismic shaking than the 1906 event in localized areas of the Santa Cruz Mountains, although its regional effects were not as extensive. There were also major earthquakes in northern California along or near the San Andreas Fault in 1838, 1865, and 1890 (Nolan Associates 2009).

Seismic Shaking

Seismically induced ground acceleration is the shaking motion that results from earthquakes. Earthquake-generated ground shaking is the greatest cause of widespread damage in an earthquake. The intensity of ground shaking resulting from an earthquake depends on the magnitude and failure mechanics of the earthquake; the distance from the focus; and the nature of the bedrock, alluvium, and soil through which the shock waves travel. Generally, seismic waves attenuate with distance from the focus of the earthquake.

Fault Rupture

Ground surface rupture due to faulting within the county is possible along the San Andreas, San Gregorio, Lomita, Butano, and Zayante-Vergeles faults. Fault zones within the county are depicted on Figure 4.7-1. Fault rupture occurs when movement on a fault within the earth breaks through to the surface. Rupture may occur suddenly during an earthquake or slowly in the form of fault creep, which is the slow rupture of the earth's crust.

State-designated Alquist-Priolo Earthquake Fault Zones are fault zones established by the State Geologist to regulate development (subdivisions of less than four units and dwellings up to two stories are exempted) in areas of potential surface fault rupture. State-designated fault zones include the San Andreas, San Gregorio, and portions of the Zayante and Butano faults (County of Santa Cruz 2021a). In addition to the Alquist-Priolo Fault zones, Santa Cruz County has designated fault zones for other portions of the Butano and Zayante faults, and for the Lomita fault and the Corralitos fault complex. In the both the state- and County-designated fault zones, the County requires a preliminary and/or full geologic report by a licensed professional to evaluate proposed development for the risk due to fault ground surface rupture. This requirement also serves to implement State seismic review requirements.

Liquefaction and Lateral Spreading

Soil liquefaction occurs when ground shaking from an earthquake causes a sediment layer saturated with groundwater to lose strength and take on the characteristics of a fluid, thus becoming like quicksand. Factors determining the liquefaction potential are soil type, the level and duration of seismic ground motions, the type and consistency of soils, and the depth to groundwater. Liquefaction generally occurs at depths of less than 40 feet in soils that are young (Holocene-age), saturated, and loose (CGS 2004). Soils that are most susceptible to liquefaction are clay-free deposits of sands and silts, and unconsolidated alluvium. Lateral spreading is the lateral movement of unsupported soils in association with liquefaction. Examples of areas/scenarios prone to lateral spreading include: 1) liquefaction-prone soils on slopes adjacent to rivers, canals, or lakes; and 2) liquefaction-prone soils during excavation and construction of subterranean parking garages.

As depicted on Figure 4.7-1, most of the valley bottoms in the southern regions of the county are underlain by alluvium and are considered at very high, high, or moderate risk for liquefaction potential. Coastal areas of the county also locally have a high to very high liquefaction potential (County of Santa Cruz 2021a). Liquefaction occurred in the county as a result of the 1906 San Francisco and the 1989 Loma Prieta earthquakes (Nolan Associates 2009).

Off-Fault Ground Cracking

The 1989 Loma Prieta earthquake produced dramatic ground ruptures in the Summit Road-Skyland Ridge area of the southern Santa Cruz Mountains. Extensive linear fissures up to 600 meters long and several meters deep were the subject of intensive scientific and media scrutiny immediately following the earthquake. While no through-going surface faulting was produced along the trace of the San Andreas Fault, northwest-trending extensional ground fissures formed mostly along ridge tops southwest of the fault. Many of these fissures are parallel or sub-parallel to the San Andreas Fault and follow pre-existing linear troughs, swales, and scarps. Similar fissures occurred in the same area following the 1906 San Francisco earthquake, suggesting the Loma Prieta ground ruptures may be independent of fault rupture (Ponti and Wells 1991). Where the ground cracks crossed under buildings, the buildings were often severely damaged. The co-seismic ground cracks are generally associated with steep topography, particularly ridge crests (Nolan Associates 2009). Ground cracking can also occur due to liquefaction, but such cracks are generally grouped with lurch cracking and are not included in this category.

Many of these ground cracks can be attributed to movement or consolidation of large and moderate sized landslides while other ground cracks were most likely related to ridge spreading. Although much of the ground cracking was found near the fault zones and in the Summit area of the county, other ground cracking has been found on ridge tops in other portions of Santa Cruz County. During the past five years Santa Cruz County has not experienced similar ground cracking as a result of an earthquake (County of Santa Cruz 2021a).

Differential Settlement

Differential settlement is the term used in structural engineering for a condition in which a building's support foundation settles in an uneven fashion, often leading to structural damage. All buildings settle somewhat in the years following construction, and this natural phenomenon generally causes no problems if the settling is uniform across the building's foundation. But when one section of the foundation settles at a faster rate than the other sections, it can lead to major structural damage to the building itself. Differential settlement can result in damage to foundations, utilities, and other infrastructure, as well as uneven settling of doors and windows. Differential settlement can result from construction on weak and highly compressible soils; poorly compacted soil; changes in soil moisture; trees and vegetation; soil consolidation; seismic shaking; and vibrations. Differential settlement could potentially occur throughout the unincorporated county area.

Seismically-Induced Landslides

Seismically induced landsliding results when earthquake shaking adds extra stress to an already marginally stable slope. Landsliding that occurred in the county as a result of the 1989 Loma Prieta earthquake included: 1) reactivation of existing landslides, including several very large landslide complexes that had previously been thought to be stable; 2) shallow slumps, calving, and toppling of natural cliffs and stream banks; and 3) slumping of steep cut slopes and embankments associated with grading for roads and development (Nolan Associates 2009).

Renewed movement of the large, existing landslides that occurred during the 1989 earthquake involved incremental movements, on the order of a few inches to a several feet. These landslides tended to move while the strong shaking was occurring, and then came to rest as soon as the shaking diminished. Because of the size and limited displacement of these landslides, damage to homes sited on the landslides was often remarkably light, except where the homes spanned the cracks around the landslide margins. The other types of landsliding that occurred during the Loma Prieta earthquake were generally localized, affecting single homes or blocking roadways with loose soil and rock debris. Extensive, but very shallow failures of sea cliffs occurred around Monterey Bay and on very steep to vertical banks along creeks and rivers. In addition, a number of moderate-sized landslides occurred, mostly from cut slopes, that closed roads in the Santa Cruz Mountains, including State Highway 17. In most cases, the landslides were cleared within a few days, although permanent repair of the roadways took longer. In terms of hazards posed to public safety, landslide hazards associated with the seismic shaking are similar to those occurring under static (non-seismic) conditions (Nolan Associates 2009).

The CGS has created maps delineating areas of seismically induced landslide hazards for portions of the state, but to date, the CGS has not created seismically induced landslide hazard maps for Santa Cruz County (CGS 2021). The Santa Cruz County landslide map (Figure 4.7-1) delineates areas of known or suspected landsliding that broadly define areas of potential landslide hazards (seismic and non-seismic) throughout the County.

4.7.1.3 Non-Seismic Geologic Hazards

Landslides and Slope Stability

Landsliding is a general term that describes a wide variety of mass movements of soil and rock in response to gravity. Landsliding occurs as falls, topples, slides, spreads, flows, and a combination of these categories, and may change from one form of failure to another during their movement. Factors causing landsliding include the rock strength and rock structure, erosion, weathering, high rainfall, steepness of slopes, recent fire activity, and human activities such as the removal of vegetation and inappropriate grading (County of Santa Cruz 2021a).

Slope stability is a function of the height and steepness of slopes, the inherent strength of underlying soil and rock, moisture levels, and the presence and orientation of geologic planes of weakness such as bedding, joints, and faults. Mountainous areas of the county with characteristically steep slopes are generally classified as having moderate to high potential for slope stability problems (Figure 4.7-1). Based on 1975 USGS mapping, potential landslide areas within the county encompass approximately 36,680 acres. The north coast and mountain areas of the county have the greatest distribution of potential landslide areas; however, there are also more limited landslide hazard areas within the southern and urban areas of the county. Hazards due to landslides and slope instability include both naturally occurring features and slope failures that could result from site development (County of Santa Cruz Planning Department 2017).

Landsliding occurs throughout Santa Cruz County but is centered primarily along the steeper slopes in the hills and mountains, along stream corridors, and along coastal bluffs and inlets. Large areas of the county are subject to several forms of landsliding as shown in Figure 4.7-1, but isolated slides occur throughout the county (County of Santa Cruz 2021a). The types of landsliding that occur in Santa Cruz County include:

- Coastal bluffs: Shallow landslides, debris flows and topples
- Rivers and streams: Shallow landslides, rotational landslides, and lateral spreading
- Hillslopes: Large deep composite landslides, and debris flows (County of Santa Cruz 2021a).

Landslides are a common occurrence in the Santa Cruz Mountains. Intense winter storms, high rainfall amounts, especially during El Nino weather patterns, and steep terrain are conducive to landsliding. Severe storms in January 1982 caused multiple landslides throughout the Bay Area and especially in the Santa Cruz Mountains. One very large composite landslide along Love Creek, west of Loch Lomond Reservoir, killed ten people. This landslide was and continues to be an indicator of the potential severity of landslide activity and the need for observation and/or mitigation. In addition, El Nino Winter Storms of 1986, 1998, and 2005 caused multiple landslides, particularly debris flows, throughout the Santa Cruz Mountains. During the 1998 winter, many homes were affected by landsliding and several roadways were damaged including Highway 9, Branciforte Road, and Amesti Road. Winter rains also induced landsliding within the quarries throughout the county (County of Santa Cruz 2021a).

Subsidence

Land subsidence is a settling or sinking of land due to compaction of earth materials. The principal causes of subsidence in California are aquifer-system compaction due to groundwater withdrawal, drainage and decomposition of organic soils, and oil and gas extraction. Effects of land subsidence include damage to buildings and infrastructure such as roads and canals, increased flood risk in lowlying areas, and lasting damage to groundwater aquifers and aquatic ecosystems. Based on a review of a USGS subsidence map, the county is not in an area of regional ground subsidence (USGS 2021a).

However, subsidence caused by groundwater withdrawal is identified as a potential effect in Pajaro Valley. The USGS in cooperation with the Pajaro Valley Water Management Agency performed an analysis of land-surface deformation (subsidence and uplift) for 2015–2018 in Pajaro Valley using remote sensing techniques. The study indicated that the land surface was generally stable with only small magnitudes (less than one inch) of seasonal land-surface deformation during this period. During this time, the largest magnitude of land-surface deformation was less than two inches of subsidence and was localized in one area just north of the city limits of Watsonville. Groundwater levels during 2015–2018 demonstrated seasonal variability and annual to multi-annual increases after reaching historical lows by the mid-1990s. The study indicated that groundwater levels throughout the Pajaro Valley have increased above historical lows, and observed increases in groundwater levels coincided with changes in groundwater management activities. The study indicates that management of groundwater supplies could minimize the potential for permanent land-surface deformation in Pajaro Valley, although subsidence could occur should future groundwater levels decline below historical lows (Brandt et al. 2021).

Coastal Erosion

The county is bounded to the west and south by the Pacific Ocean. Coastal erosion is the wearing away of coastal land. It is commonly used to describe the landward retreat of the shoreline along the ocean. Erosion can be measured as a rate, with respect to either a linear retreat (feet of shoreline recession per year) or volumetric loss (cubic yards of eroded sediment per linear foot of shoreline frontage per year). Erosion rates are not uniform and vary over time at any single location. Annual variations are the result of seasonal changes in wave action and water levels. Erosion is caused by coastal storms and flood events, changes in the geometry of tidal inlets and bays and human-made structures and human activities such as shore protection structures and dredging (County of Santa Cruz 2021a).

With the exception of areas in the southern portion of the county, which consist of continuous beach backed by coastal sand dunes, landward erosion by wind and wave action over time has created coastal bluffs along most of the county coastline. Coastal erosion includes both cliff or bluff erosion and beach erosion and is a result of both winter wave attack as well as constant wave action. The term bluff retreat is commonly used to describe the horizontal (landward) erosion of the shoreline along the coastline. Wind, waves, and long-shore currents are the driving forces behind coastal erosion (County of Santa Cruz 2021a). Winter storm waves are larger, steeper, and contain more energy, and typically move significant amounts of sand from the beaches to offshore bars, creating steep, narrow beaches. In the summer, lower, less energetic waves allow return of the sand, making for wider beaches. During the winter months when beaches are narrow, or absent altogether, the storm waves attack the cliffs and bluffs more frequently (Nolan Associates 2009).

The entire coastal edge of the county is affected by coastal erosion. The north coast area of the county (from the City of Santa Cruz to the Santa Cruz County/San Mateo County line) is underlain by bedrock of the geologically older Santa Cruz Mudstone formation, which is less susceptible to coastal erosion than bedrock and coastal dunes in the county to the south. On the north coast, where there are few structures near the coastline, the risk to structures and infrastructure is less than along the coastline in the middle and southern portions of the county, where homes and some businesses, as well as roads and related infrastructure are located very close to the shoreline. Most of the significant cliff, bluff and dune erosion occurs in the area of the county from the urban Live Oak area to the southern county line during major winter storms at times of very high tides. The bluffs in the Live Oak area and eastward to Rio Del Mar are underlain by the younger Purisima formation capped by terrace deposits, which have been estimated to be retreating at a rate of six inches to one to two feet per year. Eolian deposits that are also sensitive to coastal erosion underlie the areas south of Rio Del Mar (County of Santa Cruz 2021a).

Bluff retreat is usually expressed in terms of a uniform rate, such as feet per year or cubic yards of eroded sediment per linear foot of shoreline per year. However, bluff retreat is mostly the result of specific events associated with major coastal storms, earthquakes, or landslides. Many years' worth of retreat at a particular point may occur during the course of one particularly intense winter storm or may be due to a single landslide event. Therefore, while average retreat rates calculated over many decades may be accurate, actual retreat events may be much larger than average retreat rates would predict. Bluff retreat rates are calculated by comparing older survey information along the coast that shows where the bluff was in the past with modern survey data, as well as review of aerial photos. Human activities, such as construction of shore protection structures and dredging may also impact retreat rates (Nolan Associates 2009).

Another factor that affects the rate of bluff retreat is gradual sea level rise due to global warming. The precise impact of observed sea level rise on bluff retreat rates is not known, and uncertainty in the rate of future sea level rise compounds the difficulty in predicting the impacts of sea level rise.

Wildfire-Induced Debris Flows

Post-wildfire landslide hazards include fast-moving, highly destructive debris flows that can occur in the years immediately after wildfires in response to high intensity rainfall events. Post-fire debris flows are particularly hazardous because such flows can occur with little warning, can exert great impulsive loads on objects in their paths, and can strip vegetation, block drainages, damage structures, and endanger human life. Wildfires could also potentially result in the destabilization of pre-existing deep-seated landslides over long time periods (USGS 2021b).

The 2020 C.Z.U. Lightning Complex Fire burned 86,000 acres, including large areas of Santa Cruz County. The burn areas are susceptible to debris flows in the event of an intense precipitation event. The County of Santa Cruz has prepared a debris flow risk area map, delineating areas of potential debris flows in the burn areas (County of Santa Cruz 2021b, Atkins 2021).

4.7.1.5 Soils and Erosion

Soils within the county include a mixture of loams, sands, silts, and/or clay soils that vary from area to area, depending on local geology. There are 33 types of soil series that occur within the county (USDA Soil Conservation Service 1980). Soil stability and related hazards depend on soil characteristics and slope (see Table 4.7-1).

Table 4.7-1. Soil Characteristics in Santa Cruz County

Soil Types	Slope Range	Representative Characteristics and Known Hazards	General Areas in County
Sandy loam, loam, clay loam, and clay Example: Watsonville series	Level to moderately steep	These soils are characteristic of lowlands, valleys, and floodplain areas within the county. Mainly used for crops and sometimes housing developments. Clay minerals that are subject to water seepage may be expansive. These soils are susceptible to liquefaction and generally lack strength for the support of structures.	Urban and South County
Coarse sand, loamy sand, or gravelly sandy loam Example: Zayante series	Gently sloping to moderately steep	These soils are characteristic of sand dunes, hills, and mountains within the county. On slopes these soils are susceptible to erosion and landslides.	North Coast, Mountain, Urban, and South County
Loam, sandy loam, or stony sandy loam Example: Ben Lomond series	Moderately sloping to very steep	These soils are characteristic of mountains and hills dominantly under forest vegetation within the county. A few areas where these soils occur are used for housing developments; however, on slopes these soils are susceptible to erosion and landslides.	North Coast, Mountain, Urban, and South County
Loam, stony loam, gravelly sandy loam, or shaly clay loam Example: Bonny Doon series	Moderately sloping to extremely steep	These soils are characteristic of mountains and hills dominantly underbrush vegetation within the county. A few areas where these soils occur are used for rangeland, timber production, and for housing developments. These soils are susceptible to erosion and landslides.	North Coast, Mountain, and Urban

Source: USDA Soil Conservation Service 1980; County of Santa Cruz Planning Department 2017

Expansive Soils and Soil Hazards

Expansive soils are generally clay-rich soils, which experience volume changes as a result of moisture variation. The hazard that expansive soils create can be significant. Many of the expansive soils do not create large areas of destruction; however, they can disrupt supply lines (i.e. roads, power lines, railways, and bridges) and damage structures. Other adverse soil conditions can include but are not limited to areas of loose fill due to improper grading, slopes, roads or structures undermined by erosion, and areas of low soil strength (County of Santa Cruz 2018).

Expansive soils shrink and swell depending on moisture level, as the clay minerals in these soils expand and contract. Clay-rich soils with moderate or high shrink-swell potential are a common cause of foundation deterioration, pavement damage, cracking of concrete slabs, and shifting of underground utilities as they expand and contract with seasonal variations in soil moisture. These soils are undesirable for use as engineered fill or subgrade directly underneath foundations or pavement and must be replaced with non-expansive engineered fill or require treatment to mitigate their expansion potential. Although shrink-swell tendency presents a potentially serious hazard to development, it can be mitigated by a variety of standard engineering measures (Nolan Associates 2009). As indicated in Table 4.7-1, clays in the lowlands, valleys, and floodplain areas within the urban and southern portions of the county consist of sandy loam, loam, clay loam, and clay. The general areas of expansive soils within Santa Cruz County also include portions of the north coast area as shown on Figure 4.7-2. The Natural Resources Conservation Service's (NRCS) Soil Survey of Santa Cruz County mapped various soils types throughout the county. In addition, soils reports performed over the years throughout the county for building permits have corroborated the locations of expansive soils. The primary soil types mapped by NRCS as expansive are Watsonville Loam, Clear Lake Clay, Diablo Clay, Fagan Loam, Los Osos Loam, Mocho Silt Loam, Pinto Loam, Felton Sandy Loam, Cropley Silty Clay, Danville Loam and Lompico Varient Loam. The general locations of expansive soils are in the coastal terraces in Live Oak and Seacliff and in south county near Watsonville. However, smaller pockets of expansive soils may exist throughout the county (County of Santa Cruz 2021a).

Soil Erosion

Soil erosion potential is the susceptibility of the soil to erosion by water or wind. 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 by mechanical grading or cattle grazing can accelerate the erosion process. 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, but it is also affected by soil texture. Finer grained soils with strong cohesion tend to resist erosion better than loose, sandy soils. The principal risk associated with erosion in an urban or semi-urban setting is due to accelerated erosion, caused directly or indirectly by human activities or land management. Accelerated erosion is caused principally by grading for roads and other development and by land clearing. Both these processes remove vegetative cover that protects soils from erosion, and they change natural drainage patterns in a way that can concentrate runoff, increasing its erosive potential. Consequently, erosion hazards can be best mitigated by proper planning and implementation of erosion control measures on a site-specific basis during construction, and by implementation of permanent, fail-safe drainage systems post-construction (Nolan Associates 2009).

4.7.1.5 Unique Geological Features and Paleontological Resources

Unique Geological Features

The existing General Plan/LCP identifies significant geological features as caves, large rock outcrops, inland cliffs and special formations of scenic or scientific value, hydrological features such as major waterfalls or springs, and paleontological features. The General Plan/LCP identifies four areas within the Bonny Doon planning area as being "Significant Hydrological, Geological and Paleontological Features." (It is noted that the proposed Sustainability Update amendments also retain the policy that identifies these four areas.) These areas consist of the following locations:

- Majors Creek Canyon: The cliffs and exposed rocks of this canyon to the east of Highway 1 are outstanding scenic features.
- Martin Road: Unusual sandhill outcroppings in botanical sites east and west of Martin Road.
- Table Rock: Highly scenic coastal rock formations (sedimentary) are found in the vicinity of Table Rock and Yellow Bank Creek.
- Wilder Creek: This area contains a concentration of limestone caves.

Paleontological Resources

Paleontological resources are contained within the geologic deposits or bedrock that underlie the soil layer. Paleontological resources are the fossilized remains, traces, and associated data of plants and animals, preserved in earth's crust, that are generally considered to be older than middle Holocene (approximately 5,000 radiocarbon years before present) (Society of Vertebrate Paleontology 2010). Body fossils include bones, teeth, shells, leaves, and wood, while trace fossils include trails, trackways, footprints, and burrows. With the exception of fossils found in low-grade metasedimentary rocks, significant paleontological resources are found in sedimentary rock units that are old enough to preserve the remains or traces of plants and animals.

Seven areas within the county are likely to have rare or unique geological and paleontological resources related to their scarcity, scientific or educational value, aesthetic quality or cultural significance. The largest of these areas is located between the Lompico and Glenwood areas in the Santa Cruz Mountains and Scotts Valley. Another area is located within the north coast and urban areas on the northwestern edge of the City of Santa Cruz. The remaining five areas are all located within the north coast area, with two occurring close together north of Bonny Doon, and three located on marine terraces along the coast between Davenport and the City of Santa Cruz (County of Santa Cruz 2017).

The total area of mapped geologic paleontological resource areas in the county is approximately 6,161 acres, or approximately 1.6 percent of the entire county. Additionally, the University of California Museum of Paleontology contains records for 679 paleontological localities in the county (County of Santa Cruz 2017).

4.7.2 Regulatory Framework

4.7.2.1 Federal Regulations

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

4.7.2.2 State Regulations

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Act (Public Resources Code [PRC] sections 2621 through 2630) was passed in 1972 to mitigate the hazard of surface faulting to structures designed for human occupancy. The main purpose of the law is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. A structure for human occupancy is defined as any structure used or intended for supporting or sheltering any use or occupancy, which is expected to have a human occupancy rate of more than 2,000 person-hours per year. The law addresses only the hazard of surface fault rupture and is not directed toward other earthquake hazards. An active fault, for the purposes of the Alquist-Priolo Act, is one that has ruptured in the last 11,000 years.

The Alquist-Priolo Act requires the State Geologist to establish regulatory zones known as Earthquake Fault Zones around the surface traces of active faults and to issue appropriate maps. The maps are distributed to all affected cities, counties, and state agencies for their use in planning efforts. Before a structure for human occupancy can be permitted in a designated Alquist-Priolo Earthquake Fault Zone, the local agency must require a geologic investigation to demonstrate that proposed buildings would not be constructed across active faults. As previously indicated, Alquist-Priolo designated areas occur along the San Andreas, San Gregorio, and portions of the Zayante and Butano faults in Santa Cruz County.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act (PRC sections 2690 through 2699.6 et seq.), passed by the California legislature in 1990, addresses earthquake hazards other than surface fault rupture, including liquefaction and seismically induced landslides. The act established a mapping program for areas that have the potential for liquefaction, strong ground shaking, or other earthquake and geologic hazards. To date, the CGS has not created liquefaction and seismically induced landslide hazard maps for Santa Cruz County (CGS 2021).

California Building Code

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

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

State Earthquake Protection Law

The State Earthquake Protection Law (Health and Safety Code section 19100 et seq.) requires that structures be designed and constructed to resist stresses produced by lateral forces caused by wind and earthquakes, as provided in the California Building Code. Chapter 16 of the California Building Code sets forth specific minimum seismic safety and structural design requirements, requires a site-specific geotechnical study to address seismic issues, and identifies seismic factors that must be considered in structural design.

Caltrans Seismic Safety Retrofit Program

The California Department of Transportation (Caltrans) Seismic Safety Retrofit Program was established by emergency legislation (SB 36X) after the October 17, 1989, Loma Prieta earthquake. The purpose of this program is to evaluate all publicly owned bridges in California and to take actions necessary to prevent their collapse due to earthquakes. The local component of the Seismic Safety

Retrofit Program provides funding and other assistance to cities and counties for evaluating bridges and improving their resistance to seismic shaking.

4.7.2.3 Local Regulations

County of Santa Cruz General Plan/Local Coastal Program

The existing County General Plan/LCP includes policies that address geological hazards, unique geologic features, and paleontological resources. Unique geologic and paleontological resources are included in the existing General Plan/LCP and some of these policies (unique geologic and paleontological resources) have been revised as part of the proposed project and are summarized in the impact analyses in Section 4.7.3. The Public Safety Element, Chapter 6 of the General Plan/LCP guides land use planning by providing goals, objectives and policies related to geologic, soil, seismic, fire, and flood hazards and is not part of the proposed project. The County adopted a series of amendments to the Public Safety Element and related General Plan/LCP chapters and Santa Cruz County Code (SCCC) Title 16 in 2020. The revisions (all except sections related to coastal bluffs and beaches) were approved by the California Coastal Commission in February 2022 subject to County acceptance of modifications… The existing Public Safety Element includes policies that set forth requirements for protection against seismic, geological, and soils hazards. All relevant policies are summarized in the impact analyses in Section 4.7.3.

Local Hazard Mitigation Plan 2021-2026

Pursuant to requirements of the Federal Emergency Management Agency (FEMA), the County recently updated its Local Hazard Mitigation Plan (LHMP) for the years 2021-2026. The LHMP provides risk assessments for specific hazards, including earthquakes and liquefaction, coastal erosion, landslides, and expansive soils. Goals, objectives, and action items are identified as part of the mitigation strategy formulated for each hazard.

Santa Cruz County Code

Chapter 12, Building Code

The County Building Code, adopted as Chapter 12.10 of the SCCC, implements the 2019 California Building Code, subject to amendments, changes, and exceptions where it finds that there are certain conditions and situations in the county that require modification of California codes for buildings and related construction. The County Building Code contains standards and regulations relating to soil stability, design standards for seismic safety, and construction standards for building foundations. The County Building Code addresses grading, excavations, cuts, fills, setbacks, drainages, terracing, erosion control, seismic shaking, and the minimum standards to safeguard and protect life, buildings, and structures within the county.

Chapter 16.10, Geologic Hazards and 16.11, Floodplain Management Regulations

The County Geologic Hazards Ordinance, adopted as Chapter 16.10 of the SCCC, provides policy implementation, public health and safety, development standards, and notice of geologic hazards. This chapter sets forth regulations and review procedures for development and construction activities, including grading, septic systems installation, development permits, building permits, minor land divisions, and subdivisions throughout the county and particularly within mapped geologic hazards areas. Chapter 16.11 regulates special flood hazard areas. These regulations and procedures are administered through a system of geologic hazard assessment, geologic reports, technical review, and development and building permits.

Chapter 16.20, Grading and 16.22, Erosion Control

The County Grading Ordinance, adopted as Chapter 16.20 of the SCCC, sets forth rules and regulations to control all grading, including excavations, earthwork, road construction, dredging, diking, fills, and embankments. It also establishes administrative procedures for issuance of permits and provides for approval of grading plans and inspections. Grading permits require Planning Commission approval for grading in excess of 8,000 cubic yards, or for which an environmental impact report (EIR) was prepared, or for grading in excess of 1,000 cubic yards which is visible from a scenic corridor roadway. All other grading permits, including those for agricultural grading, must be approved by the Planning Director, pursuant to section 16.20.040 and section 16.20.195 of the SCCC, through a staff-level administrative process. Agricultural grading is defined as any grading which takes place on land designated for commercial agricultural use, as specified in section 16.50.040; provided, however, that agricultural grading does not include any grading on such lands connected with the construction of access roads or building sites, except greenhouse sites. Specialized agricultural activities also require a regular grading permit rather than a less-specific agricultural grading permit. A proposed grading plan must be accompanied by an erosion control plan and erosion preventative measures, in accordance with the requirements of the County Erosion Control Ordinance of SCCC Chapter 16.22.

It is noted that agricultural grading on less than 20% slopes, as well as vineyards and associated terracing (regardless of slope), does not require a regular grading permit and is instead subject to agricultural grading regulations. However, defined "specialized agricultural activities" such as greenhouses, indoor growing, aquaculture and any cannabis cultivation activities involving more than 100 cubic yards is not considered agricultural grading and requires a regular grading permit, and grading on 20% slopes or more also requires a regular grading permit (August 2018).

Chapter 16.44, Paleontological Resource Protection

This chapter of the SCCC is intended to protect paleontological resources and provides methods and regulations for the identification and treatment of paleontological resources within the county. Section 16.44.040 requires preparation of a paleontological survey for specified developments in areas of known paleontological resources,, and measures must be included to protect resources during ground-disturbing development activities. Specifically, this chapter requires that a paleontological report shall be required if the County Environmental Coordinator determines on the basis of the paleontological survey that further information is required to ensure protection of paleontological resources. Pursuant to section 16.44.060, in granting the required permit(s) for a project on the site of a significant paleontological resource, the Planning Director shall attach reasonable conditions to ensure compliance with the purposes of this chapter. Such conditions could include but are not limited to, having a qualified paleontologist approved by the County present to observe, to examine and to evaluate the site during ground disturbing development activities; and to convey fossil finds to an appropriate museum or research institute.

4.7.3 Impacts and Mitigation Measures

4.7.3.1 Thresholds of Significance

The thresholds of significance used to evaluate the impacts of the proposed project related to geology and soils are based on Appendix G of the CEQA Guidelines and, if applicable, other agency standards, as listed below. A significant impact would occur 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 or based on other substantial evidence of a known fault.
ii. Strong seismic ground shaking.
iii. Seismic-related ground failure, including liquefaction.
iv. Landslides.

GEO-2 Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse.

GEO-3 Result in substantial soil erosion or the loss of topsoil.

GEO-4 Be located on expansive soil, as defined in the 2019 California Building Code, creating substantial direct or indirect risks to life or property.

GEO-5 Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.

Analytical Methods

The following analysis considers whether the proposed project would cause geologic and soils impacts, taking into account state-mandated construction methods, as specified in the California Safety and Health Administration regulations (Title 8 of the California Code of Regulations), the County Building Code (Chapter 12.10 of the SCCC), and in Chapter 33 of the California Building Code, as described in Section 4.7.2.3, Local Regulations. Moreover, the analysis considers whether a unique paleontological resource, site, or unique geologic feature would be directly or indirectly destroyed as a result of the proposed project. If impacts are determined to be potentially significant, mitigation measures would be provided to reduce impacts to less-than-significant levels, if feasible.

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

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

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

Potential Growth Assumptions

Adoption and implementation of the proposed Sustainability Update would not directly result in impacts related to geology and soils. However, the proposed General Plan/LCP amendments could indirectly lead to future development, potentially resulting in impacts related to geology and soils. The Countywide Design Guidelines component of the proposed project does not include guidelines related to geology and soils. The proposed SCCC amendments do not include amendments to existing regulations pertaining to geological and soils reviews or paleontological resources. The other components of the proposed project include:

- Amendments to the General Plan/LCP include policies that support new development, redevelopment, and potential intensified development, primarily within the Urban Services Line (USL), as well as amendments to policies pertaining to unique geologic features and paleontological resources contained in the Agriculture, Natural Resources + Conservation (ARC) Element.

- Amendments to General Plan and/or zone districts for 23 specified parcels.

As described in Section 4.0, Introduction to Analyses, and shown in Table 4.0-2, this EIR estimates of the potential to accommodate approximately 4,500 housing units over existing conditions in the year 2040, with approximately 75% projected to occur within urban areas. This EIR also estimates in the potential to accommodate approximately 6,210,000 square feet of non-residential uses, as shown on Table 4.0-3, with approximately 60% expected to occur within urban areas. These forecasts provide an estimate of potential growth that could occur as a result of adoption and implementation of the proposed Sustainability Update for the purpose of evaluation in this EIR. This estimate of growth may or may not occur, and this estimate does not establish a limit to development, Annual limits for residential units are set annually by the County pursuant to Measure J and SCCC provisions, as explained in Section 4.13 of this EIR, Population and Housing. Additionally, some of this projected development and growth would occur under the existing General Plan/LCP without the proposed project.

EIR Notice of Preparation Comments

Public and agency comments were received during the public scoping period in response to the Notice of Preparation (NOP), which is included in Appendix A. A summary of the comments received during the scoping period for this EIR, as well as written comments received, are included in Appendix B. There were no comments related to geology and soils.

4.7.3.2 Project Impact Analysis

Impact GEO-1: Seismic Hazards (Significance Threshold GEO-1). Adoption and implementation of the proposed Sustainability Update would not 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, or landslides. **(*Less than Significant*)**

Future development and associated population growth could occur on lands subject to seismic hazards, including active faulting, off-fault ground cracking, liquefaction, lateral spreading, seismically induced landslides, differential settlement, and collapsible soils. Several active faults, including the San Andreas, Sargent, Butano, and Zayante-Vergeles faults, traverse the county and many of the alluvial-filled canyons and valleys in the county, including areas along watercourses, are subject to liquefaction. However, anticipated future development would not cause or exacerbate the potential for such seismic hazards to occur. Adherence to existing regulations and standards, including the California Building Code, County Building Code, and various policies and actions established in the proposed Sustainability Update, would minimize seismic related impacts. None of the 23 parcels proposed for General Plan/LCP and/or zoning map amendments are mapped as being within a designated fault zone (County of Santa Cruz 2021c).

Buildings would be required to be designed in accordance with the latest edition of the California Building Code, which sets forth structural design parameters for buildings to withstand seismic shaking without substantial structural damage. The County Building Code, adopted as Chapter 12.10 of the SCCC, implements the 2019 California Building Code and contains standards and regulations relating to seismic safety and construction standards for building foundations. Conformance with the California Building Code, as required by state law, and the County, would ensure the maximum practicable protection available for structures and their foundations. The continuation of development plan review to meet current seismic standards is the primary mitigation strategy to avoid or reduce damage from an earthquake.

Since the 1989 Loma Prieta Earthquake, most commercial and public buildings have been seismically retrofitted, and as infrastructure is repaired or replaced, updated seismic safety standards would be incorporated. Typically, standard geotechnical engineering procedures, soil testing, and proper design can identify and mitigate liquefiable soils. By using the most up-to-date standards, potential damage related to liquefaction and lateral spreading, including differential settlement, would be reduced to levels that are generally considered acceptable. Section 1803 of the California Building Code requires preparation of a site-specific geotechnical investigation to assess the degree of potential seismic hazards and recommend appropriate design/mitigation measures.

The existing General Plan/LCP objectives and policies, noted Section 4.7.2,3, Local Regulations, and summarized in Table 4.7-2, would also serve to reduce exposure to seismic hazards. Public Safety Element policies 6.1.1, 6.1.2, 6.1.3, and 6.1.6 require completion of geotechnical reports prior to construction of discretionary projects, projects within fault zones, and reservoirs. Fault zones designated for review include the Butano, Sargent, Zayante, and Corralitos fault zones, as well as the state designated Alquist Priolo Earthquake Fault Zones. Required geologic reviews shall examine all potential seismic hazards and may consist of a Geologic Hazards Assessment and a more complete investigation where required. Policies 6.1.8 and 6.1.11 require that projects be set back from active faults and be designed to withstand an earthquake on the San Andreas Fault. In addition, Policy 6.1.12 provides minimum lot sizes for new parcels located in State-designated active fault zones or County-designated seismic review zones.

Each of these policies seek to reduce the potential for loss of life, injury, and property damage due to faulting, seismically induced ground shaking, and seismically induced ground failure. Under existing county regulations, all related development, grading, and building permits would be reviewed by the County to ensure compliance with the County's Building Regulations, Geologic Hazards Ordinance, and Grading Ordinance (Chapters 12.10, 16.10, and 16.20 of the SCCC, respectively), and would be required to provide adequate engineering design to address or avoid unstable earth conditions. As a result of implementation of requirements of the SCCC and existing and proposed General Plan/LCP policies outlined in Table 4.7-2, the proposed Sustainability Update would not 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, or landslides. Therefore, the project would result in a *less-than-significant impact*.

Furthermore, the County continues to implement its LHMP strategies that include high priority measures to address seismic design in new development and retrofitting/replacement of utilities.

Mitigation Measures

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

Table 4.7-2. Existing General Plan/LCP Policies that Avoid/Minimize Impacts Related to Seismic Hazards

Potential Impact	Policies
Exposure to seismic hazards	• Geologic review required for all discretionary development projects in designated fault zones. (Public Safety Policy 6.1.1) • Preliminary or full engineering geology report required for development on parcels within an Alquist-Priolo state-designated seismic review zones. (Public Safety Policy 6.1.2) • Geology report required for all new public facilities and critical structures within designated fault zones. (Public Safety Policy 6.1.3) • Site-specific investigation required for all development proposals of more than four residential units in areas designated as having a high or very high liquefaction potential. (Public Safety Policy 6.1.4.) • Require new public facilities and critical structures to be designed to withstand expected ground shaking along the San Andreas Fault. (Public Safety Policy 6.1.8) • All new habitable structures on existing lots of record shall be set back a minimum of 50 feet from the edge of an area of fault-induced offset (may be reduced to 25 feet based upon paleoseismic studies). (Public Safety Policy 6.1.11) • Outside the USL and Rural Services Line, require minimum parcel of 20 gross acres for the creation of new parcels within state and County-designated seismic review zones if proposed building sites lie within a fault zone. Require a minimum parcel of 10 gross acres for the creation of new parcels within the portions of the County-designated seismic review zones that are not part of a State Alquist-Priolo Earthquake Fault Zone, and which lie outside the Urban and Rural Services Lines and the coastal zone, if 25% or more of the parcel perimeter is bounded by parcels 1-acre or less in size. (Public Safety Policy 6.1.12)

NOTE: In September 2020, the County Board of Supervisors adopted revisions to the General Plan Public Safety Element. The revisions (all except sections related to coastal bluffs and beaches) were approved by the California Coastal Commission in February 2022 subject to County acceptance of modifications.

Impact GEO-2: Other Geologic Hazards (Significance Threshold GEO-2). Adoption and implementation of the proposed Sustainability Update would not directly or indirectly result in structures being located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse. (*Less than Significant*)

Future development and associated population growth could occur on lands subject to non-seismic geologic hazards, including landslides, subsidence, soil collapse, and coastal erosion. (See Impact GEO-1 pertaining to seismic related impacts, including liquefaction, lateral spreading, and soil collapse.) As indicated in Section 4.7.1, the county is not in an area of regional ground subsidence; therefore, no impacts would occur with respect to subsidence. Grading and construction on moderately steep to steep slopes could exacerbate the potential for landslides if not properly completed. Mountainous areas of the county with characteristically steep slopes are generally classified as having moderate to high potential for slope stability problems (Figure 4.7-1). As previously indicated, potential landslide areas within the county encompass approximately 36,680 acres, approximately 13% of the total county area. The north coast and mountain areas of the county have the largest distribution of potential landslide areas; however, there are also more limited landslide hazard areas within the southern and urban areas of the county. None of the 23 parcels proposed for General Plan/LCP and/or zoning map amendments are mapped as being within a geologic hazard area (County of Santa Cruz 2021c).

Future development and associated population growth could occur on lands subject to coastal erosion, which in turn can result in bluff retreat, landslides, and unstable soils. With the exception of portions of the southern area of the county, which consists of coastal sand dunes, landward erosion by wind and wave action over time has created coastal bluffs along most of the county coastline. These bluffs are susceptible to continued erosion, ground cracking, retreat, and slope failures as a result of major coastal storms and sea level rise, which could potentially undermine coastal structures. Improper drainage over the bluff face could exacerbate potential slope instability.

Future development in association with the proposed project could potentially require cut-and-fill grading in hillside areas. Such grading could be required for building pads, road construction, driveway construction, and utility extensions. Improper oversteepening of cut slopes could increase the potential for landslides. In addition, future development would include construction along coastal bluffs. In the absence of site-specific geologic studies, including sea cliff retreat, slope stability, and drainage analyses, bluff-top construction could create or exacerbate the potential for coastal landsliding.

However, grading and construction would adhere to SCCC and County General Plan/LCP requirements. Pursuant to the County's Building Code (SCCC Chapter 12.10), along with the County's Geologic Hazard Code (SCCC Chapter 16.10), Grading Ordinance (SCCC Chapter 16.20), and Erosion Control Ordinance (SCCC Chapter 16.22), development completed in association with the proposed project would be required to avoid exposure to unstable earth and unsuitable soil conditions. The County Planning Department and Building & Safety Division would enforce County development standards that require a geological study and/or soils engineering report, in addition to erosion control measures, which would substantially reduce landslide impacts.

The existing and proposed General Plan/LCP policies outlined in Table 4.7-3 would also serve to reduce impacts associated with other geologic hazards, including landslides. Public Safety policies 6.2.1 and 6.2.2 would require completion of geologic hazards assessments for projects that may be affected by slope instability or other geologic hazards. Policies 6.2.5, 6.2.6, 6.2.10, and 6.3.1 would place restrictions on properties with steep slopes, potentially unstable slopes, or other geologic hazards. Policy 6.1.9 would require owners to record a Notice of Hazards disclosing geologic hazards on the property, and Policy 6.2.4 would allow the County to deny grading permits if it is found that geologic hazards cannot be satisfactorily mitigated.

With respect to coastal erosion and slope instability, Policy 6.2.11 would require a geologic hazards assessment for development within coastal hazard areas, including all development within 100 feet of a coastal bluff. Policies 6.2.11 and 6.2.20 would allow reconstruction of structures damaged as a result of coastal hazards, including slope instability.

As a result of implementation of requirements of the SCCC and existing and proposed General Plan/LCP policies outlined in Table 4.7-3, the proposed Sustainability Update would not result in new development on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse, resulting in a *less-than-significant impact*.

Furthermore, the County continues to implement its LHMP strategies that include very high priority measures to address landslides and geologic review for new development in areas potentially subject to landslides.

Mitigation Measures

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

Table 4.7-3. Proposed and Retained General Plan/LCP Policies that Avoid/Minimize Impacts Related to Geologic Hazards

Potential Impact	Policies
Landslides	• Require geologic hazards assessment required for all development, including grading permits, that may be affected by slope instability. (Public Safety Policy 6.2.1/6.3.1*) • Exclude land with slopes greater than 30% in urban areas and 50% in rural areas and land with recent or active landslides from density calculations for land divisions. (Public Safety Policy 6.2.5/6.3.5*) • Require location of structures away from potentially unstable slopes when a feasible building site exists away from unstable areas. (Public Safety Policy 6.2.6/6.3.6*) • Prohibit septic leachfields in areas subject to landsliding. (Public Safety Policy 6.2.7/6.3.7*) • Prohibit structures in discretionary projects on slopes greater 30%. (Public Safety Policy 6.3.1/6.5.1*)
Location in geologically unstable area	• Require owners of parcels in area of potential geologic hazards to record a Notice of Hazards and the level of geologic and/or Geotech investigation conducted. (Public Safety Policy 6.1.9) • Require geology report and/or soils engineering report when the hazards assessment identifies unsafe geologic conditions. (Public Safety Policy 6.2.2/6.3.2*) • Deny proposed development or grading permits if geologic hazards cannot be mitigated to within acceptable risk. (Public Safety Policy 6.2.4/6.3.2*) • Require all developments to be sited and designed to avoid or minimize geologic hazards. (Public Safety Policy 6.2.10/6.4.2*) • Require geologic hazards assessment for all development activities within coastal hazard areas, including within 100 feet of a coastal bluff. (Public Safety Policy 6.2.11/6.4.3*) • Require coastal bluff setbacks. (Public Safety Policy 6.4.11*, 6.4.12*) • Require intake and outfall lines to be underground unless it would result in geologic instability. (ARC-2.2.8) • Site sewage or stormwater dispersal systems 100 feet from sinkholes and karst features. (ARC-4.5.4)

Note: * In September 2020, the County Board of Supervisors adopted revisions to the General Plan Public Safety Element. The revisions (all except sections related to coastal bluffs and beaches) were approved by the California Coastal Commission in February 2022 subject to County acceptance of modifications.

Impact GEO-3: Erosion Hazards (Significance Threshold GEO-3). Adoption and implementation of the proposed Sustainability Update would not directly or indirectly result in substantial soil erosion or the loss of topsoil. (***Less than Significant***)

Future development and associated population growth would result in ground disturbance during clearing and grading, which in turn could result in soil erosion and loss of topsoil. Vegetation clearing and grading on steep slopes with erodible soils would exacerbate the potential for erosion. As indicated in Table 4.7-3, with the exception of the clay-rich soils, such as the Watsonville soil series, most of the soils in the county consist of loamy sands and sandy loams, which are susceptible to erosion. Grading and construction that occurs as part of the proposed project would be required to adhere to SCCC and County General Plan/LCP requirements, including best practices to manage grading, erosion, and stormwater runoff. Under existing regulation, all related development, grading and building permits would be reviewed by the County to ensure compliance with the County's Building Regulations, Geologic Hazards Ordinance, Grading Ordinance, and Erosion Control Ordinance (Chapters 12.10, 16.10, 16.20, and 16.22 of the SCCC, respectively) and would be required to provide adequate engineering design to address or avoid unstable earth conditions.

The existing and proposed General Plan/LCP policies outlined in Table 4.7-4 would also serve to reduce soil erosion and loss of topsoil. Public Safety Element policies 6.3.2 and 6.3.3 require mitigation measures to reduce and prevent soil impacts. Policies 6.3.7, 6.3.8, and 6.3.12 require minimization of grading and vegetation removal, as well as reuse of topsoil to promote native vegetation growth. Policy 6.3.10 requires permits for land clearing and Policy 6.3-13 requires restoration to pre-graded conditions when cannabis activities are relocated or ceased.

In addition, for development including ground disturbance in excess of 1 acre, grading and construction would be completed in compliance with the State Water Resources Control Board Construction General Permit, which would minimize soil erosion through implementation of a Stormwater Pollution Prevention Plan (SWPPP) and associated Best Management Practices (BMPs). Typical BMPs would include silt fences, straw wattles, and temporary desilting basins, which would prevent off-site transport of soils. See Section 4.10, Hydrology and Water Quality, for additional information pertaining to the Construction General Permit.

As a result of implementation of requirements of the SCCC, Construction General Permit, and existing and proposed General Plan/LCP policies outlined in Table 4.7-4, the proposed Sustainability Update would not result in substantial soil erosion or the loss of topsoil, resulting in a *less-than-significant impact*.

Mitigation Measures

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

Table 4.7-4. Existing General Plan/LCP Policies that Avoid/Minimize Impacts Related to Soil Erosion

Potential Impact	Policies
Soils and Erosion	• Deny grading projects if adequate mitigation measures cannot be undertaken. (Public Safety Policy 6.3.2/6.5.2*) • Require abatement of any grading or drainage condition which may increase existing or potential erosion problems as a condition of approval. (Public Safety Policy 6.3.3/6.5.3*) • Erosion control plan required for all development, as specified in the Erosion Control Ordinance. (Public Safety Policy 6.3.4/6.5.4*) • Prohibit earthmoving operations in areas of very high or high erosion hazard potential between October 15 and April 15, unless preauthorized by the Planning Director. (Public Safety Policy 6.3.6/6.5.6*) • Require topsoil to be reused (stockpiled and reapplied upon completion of grading) to promote regrowth of native vegetation. (Public Safety Policy 6.3.7/6.5.7*) • Require site design in all areas to minimize grading activities and reduce vegetation removal. (Public Safety Policy 6.3.8/6.5.8*) • Land clearing permit and erosion control plan required for clearing one or more acres, except for agricultural uses. (Public Safety Policy 6.3.10/6.5.10*) • Avoid excessive grading and disturbance associated with cannabis cultivation. (Public Safety Policy 6.3.12/6.5.12*) • Ensure sites used for cannabis activities are restored to pre-graded condition when cannabis activities are relocated or ceased. (Public Safety Policy 6.3.13/6.5.13*)

Note: In September 2020, the County Board of Supervisors adopted revisions to the General Plan Public Safety Element. The revisions (all except sections related to coastal bluffs and beaches) were approved by the California Coastal Commission in February 2022 subject to County acceptance of modifications.

Impact GEO-4: Soils Constraints (Significance Threshold GEO-4). Adoption and implementation of the proposed Sustainability Update could indirectly lead to development on expansive soil, as defined in the 2019 California Building Code, but would not create substantial risks to life or property with implementation of required policies and regulations. (***Less than Significant***)

Future development and associated population growth resulting from the proposed project could occur on soil types that pose constraints to structural development. Expansive soils is one example in which soils with high clay content are prone to expansion and contraction, known as “shrink-swell,” which can result in damage to building foundations, pavement, and underground utilities. These soils are undesirable for use as engineered fill or subgrade directly underneath foundations or pavement, and must be replaced with non-expansive engineered fill or require treatment to mitigate their expansion potential.

Many of the expansive soils do not create large areas of destruction; however, these soils can disrupt infrastructure (i.e., roads, power lines, railways, and bridges) and damage structures. Patios, driveways and walkways may also crack and heave as the underlying expansive soils become wet and swell. Other adverse soil conditions can include but are not limited to areas of unconsolidated fill due to historic or improper grading, undermined slopes, roads or structures, and areas of low soil strength (County of Santa Cruz 2021a). Many of the 23 parcels proposed for General Plan/LCP and/or zoning map amendments are identified as having expansive soils (County of Santa Cruz 2021c).

Structural designs and construction implementation in accordance with standard geotechnical/soils investigations can mitigate impacts posed by expansive soils. The County Building Code and California Building Code (Chapter 18) requires preparation of a geotechnical report for most new structures, with the exception of one-story, wood-frame and light steel-frame buildings of Type II or Type V construction and 4,000 square feet or less in floor area, and not located within Alquist Priolo Earthquake Fault Zones or Seismic Hazard Zones, as designated by the CGS.

Although the proposed Sustainability Update would potentially result in new development on properties with soil constraints, such as expansive soils, with incorporation of standard geotechnical engineering, in compliance with the County Building Code and the California Building Code, the proposed Sustainability Update would not create substantial direct or indirect risks to life or property. Therefore, the project would result in a *less-than-significant impact* regarding expansive soils.

Furthermore, the County continues to implement its LHMP strategies that measures to address new development in areas with expansive soils.

Mitigation Measures

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

Impact GEO-5: Unique Geologic Features and Paleontological Resources (Significance Threshold GEO-5). Adoption and implementation of the proposed Sustainability Update would not directly or indirectly destroy a unique paleontological resource or site or unique geologic feature. (***Less than Significant***)

Potential development that could occur under the proposed project could result in excavation activities that could potentially damage or destroy unique paleontological or geologic features, if present. None of the 23 parcels proposed for General Plan/LCP and/or zoning map amendments are mapped as being within an area of paleontological resources (County of Santa Cruz 2021c).

However, and proposed General Plan/LCP policies outlined in Table 4.7-5 would also serve to avoid or reduce impacts to these features. Specifically, Policy ARC-6.1.1 seeks to protect the specific identified significant unique features. Additionally, SCCC Chapter 16.44 seeks to protect paleontological resources and provides methods and regulations for the identification and treatment of paleontological resources within the county, including preparation of a paleontological survey for specified developments in areas of known paleontological resources, and implementation of measures to protect resources during ground disturbing development activities. With implementation of proposed policies and existing regulations to evaluate and protect unique paleontological and geologic features, the proposed Sustainability Update would not result in destruction of these features, resulting in a *less-than-significant impact*

Table 4.7-5. Proposed and Retained Policies that Avoid/Minimize Impacts Related to Unique Geological Features and Paleontological Resources

Potential Impact	Policies
Unique paleontological or geologic resources	• Protect significant geological features (caves, large rock outcrops, cliffs, special formations) (specific locations identified)). (ARC-6.1.1) • Encourage/obtain easements were possible to conserve as open space, areas with hydrological, geological, or paleontological features of significance. (ARC-6.1.2)

Mitigation Measures

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

4.7.4 Cumulative Impact Analysis

Potential cumulative impacts on geology and soils would result from projects that combine to create geologic hazards, including unstable geologic conditions. The majority of impacts from geologic hazards, such as liquefaction, landslides, and unstable soils, are site-specific and are therefore generally mitigated on a project-by-project basis. Each cumulative project, as identified within Table 4.0-1 of this EIR, would be required to adhere to required building/engineering design standards, per the most recent version of the California Building Code, to ensure the safety of building occupants and avoid a cumulative geologic hazard. Additionally, as needed, projects would incorporate individual mitigation or geotechnical requirements for site-specific geologic hazards present on each individual cumulative project site. Therefore, a potential cumulative impact related to site-specific geologic hazards would not occur, and the proposed project, in combination with other cumulative projects, would not contribute to a significant cumulative impact associated with geology and soils.

Mitigation Measures

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

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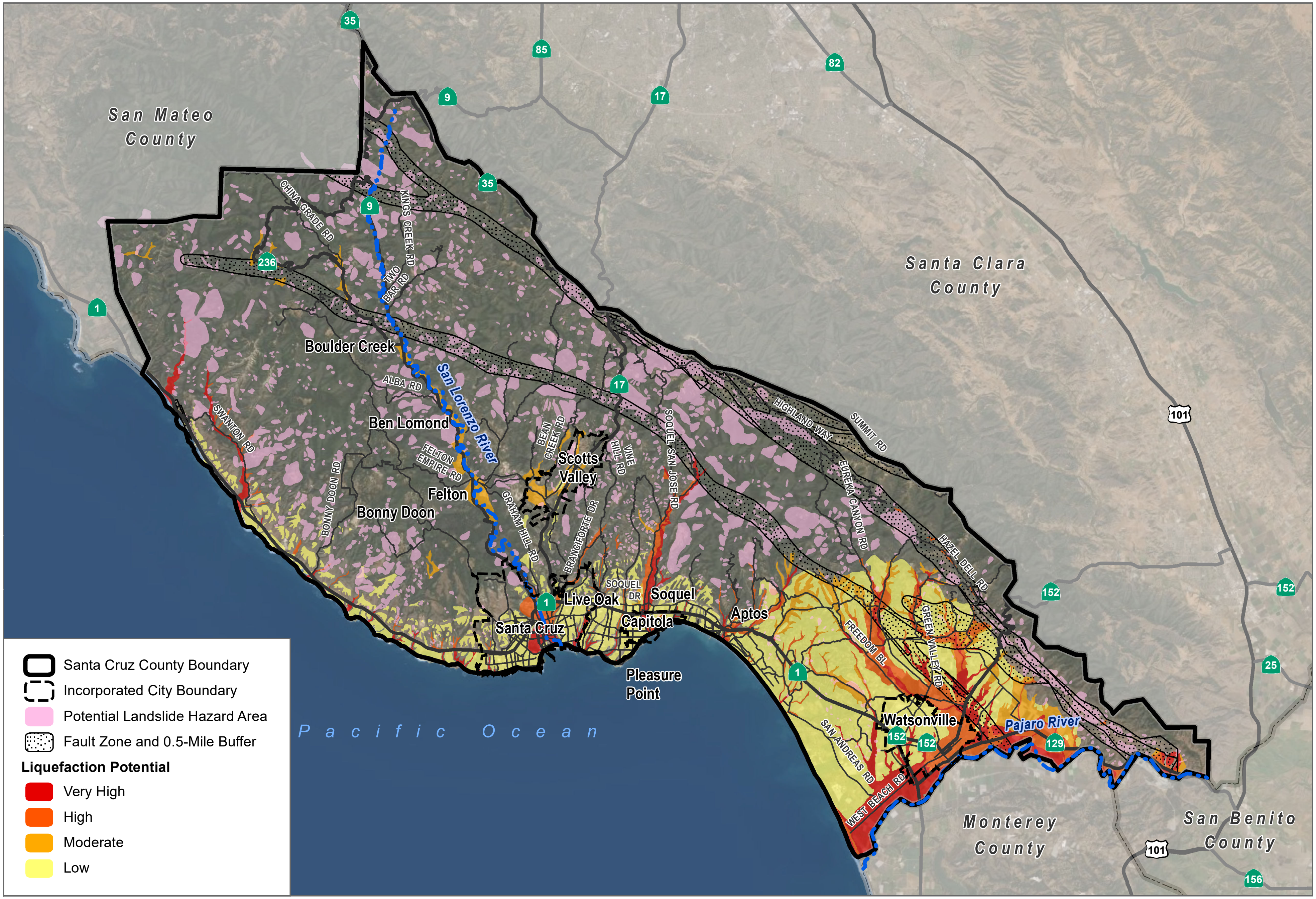
4.7.5 Figures

Figure 4.7-1. Geologic Hazard Areas in Santa Cruz County

Figure 4.7-2. Areas of Expansive Soils in Santa Cruz County



SOURCE: ESRI 2021, County of Santa Cruz 2010

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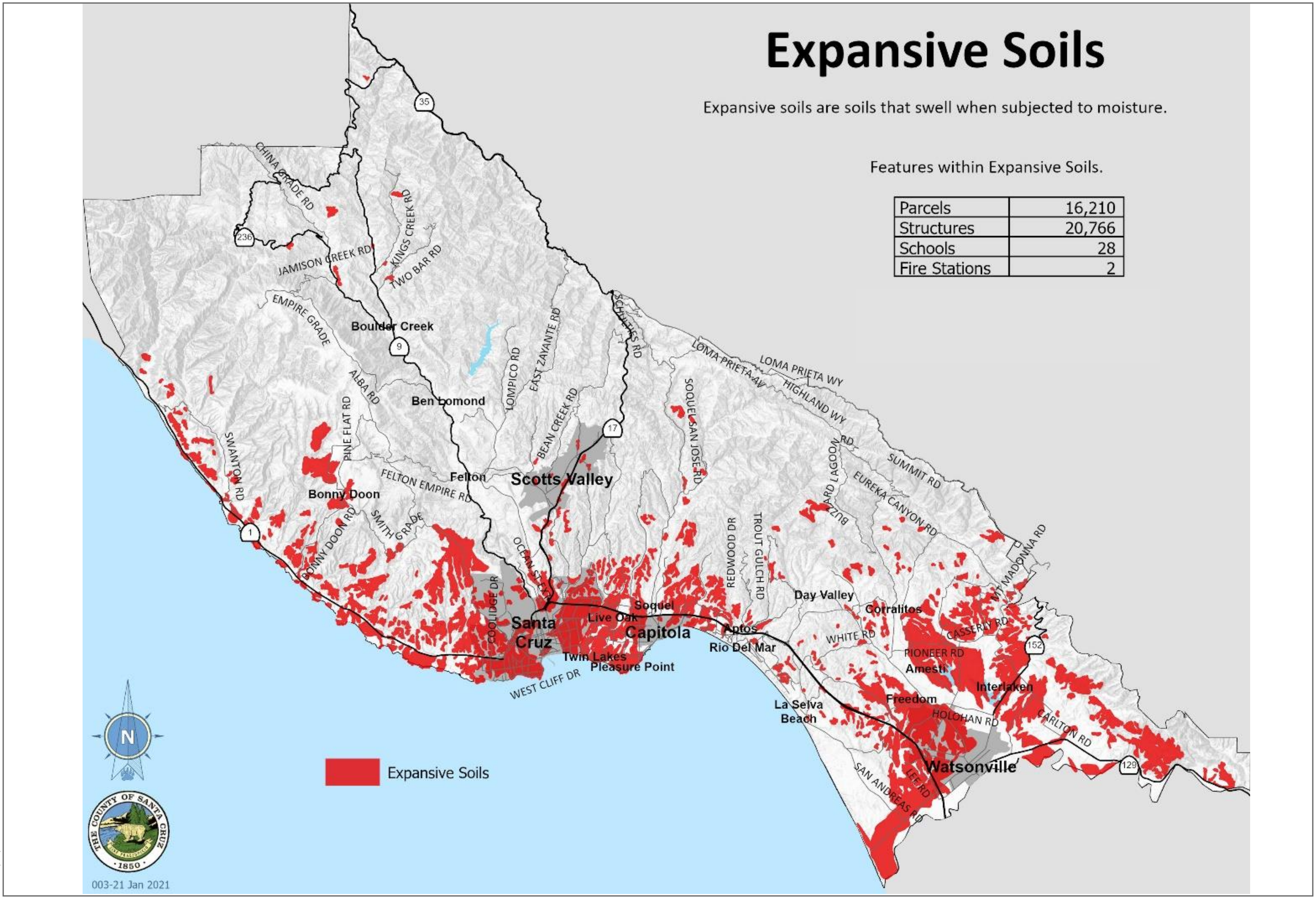
FIGURE 4.7-1

Geologic Hazard Areas in Santa Cruz County

County of Santa Cruz Sustainability Policy and Regulatory Update



SOURCE: County of Santa Cruz 2021

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FIGURE 4.7-2

Areas of Expansive Soils in Santa Cruz County

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