5.6 Geology and Soils

Based on Appendix G of the *State CEQA Guidelines*, the focus of the following analysis addresses the Project's potential impacts with regard to geology and soils. Specifically, this DEIR section will evaluate the potential impacts related to exposing people or structures to the risk of loss, injury or death due to the rupture of an earthquake fault, seismic ground shaking, seismic ground failure, and/or landslides; resulting in soil erosion or the loss of topsoil; being located on an unstable geologic unit or expansive soil; and having soils that are incapable of supporting the use of septic tanks or alternative waste water disposal systems. Copies of all comment letters received during the NOP public review comment period are located in Appendix A of this EIR and summarized in the Introduction Section.

The analysis in this section is based, in part, on the *Report of Geophysical Investigation, Proposed 950,000 Square Foot Distribution Center, Sycamore V Project, Riverside, California* (CHJ(a)), prepared by CHJ Consultants on May 14, 2014; *Phase I Environmental Site Assessment Update, 17 Vacant Parcels, ±75 Acres, Northwest of Sierra Ridge Drive and Lance Drive, Riverside, California* (CHJ(b)), prepared by CHJ Consultants on September 16, 2014; and *Geotechnical Investigation, Proposed Industrial Development, Lance and Sierra Ridge Drives, Riverside, California* (CHJ(c)), prepared by CHJ Consultants on July 20, 2007. These reports are included in their entirety in Appendices E, F, and G of this DEIR.

5.6.1 Setting

The Project site is bounded by existing industrial warehouse development adjacent to the east and south, residential development to the north and northwest, and the Sycamore Canyon Wilderness Park to the west (see **Figure 3-2 – Location Map**). The southern portion of the Project site is graded and relatively level. This portion of the site is several feet lower in elevation than the rest of the site. The northern portion of the Project site is separated from the southern portion via a soil berm approximately four to five feet in height. This area of the Project site, to the north of this soil berm, is undeveloped and the topography consists of rolling hills and valleys. A south-draining stream traverses the central portion of the Project site. (CHJ(a), p. 2) The (approximate) southeast quarter of the Project has been previously utilized for rock crushing and sand stockpiling (CHJ(b), p. 13). Throughout the 1980's a surface mining operation (granite quarry) occurred on portions of the subject site and surrounding area to the south (Ralph's Distribution Center) and west (now Sycamore Canyon Wilderness Park) for the export of decomposed granite with the original overburden soil to be used as on site fill. Overall, the area used for surface mining was to be leveled to a uniform slope of 1.7% downward to the south. The surface mining began in 1982 and was permitted under a conditional use permit (CU-013-812), approved and revised throughout the 1980's, with the last approval taking place on June 9, 1987. It is unknown when the surface mining was completed. Areas of dense vegetation are present within the areas of low elevation, and numerous bedrock outcrops are located on the hilltops (CHJ(a), p. 2). Moreover, the Project site is at an elevation ranging from approximately 1,600 feet above mean sea level in the northern portion to approximately 1,540 feet above mean sea level in the southern portion of the site (CHJ(b), p. 13).

Site Geology

The Project site is located on the Perris Block, which is a portion of the Peninsular Ranges Geomorphic Province. The Perris Block is a fault-bounded region of relative tectonic stability, a mass of relatively high land composed of crystalline bedrock of the Southern California batholith that is thinly and discontinuously mantled by sedimentary material. Several geomorphic surfaces that represent former, local, erosional/depositional base levels are well developed on the Perris Block. The Project site is located on the youngest of the Perris Block surfaces, known as the Paloma surface. The Paloma surface is characterized by crystalline bedrock overlain by fine-grained alluvial deposits. (CHJ(a), p. 4)

Regional geologic mapping shows the site as underlain by Val Verde tonalite (granitic bedrock). The Val Verde tonalite is characterized as medium crystalline gray bedrock with black accessory minerals. In some areas, including the Project site, it includes dark, elliptical, fine-grained inclusions of more mafic-appearing rock, known as schlieren. Tonalite exhibiting various degrees of weathering, including some hard, rounded boulder outcrops (corestones), was exposed in scattered areas throughout the Project site. In general, the corestones at the surface are “rooted” at depth with hard bedrock. Hard bedrock corestones can be anticipated to be encountered within the rock during grading, even where no surface manifestation of corestones exists. (CHJ(a), p. 4)

Based on CHJ Consultant’s exploratory borings at the Project site, bedrock was encountered in all of the borings and it appears that the bedrock is at or near the surface over a large portion of the site. In only 4 of the 16 borings was bedrock material encountered at a depth of 4 feet or greater; the greatest depth of bedrock encountered by a boring was 17 feet. (CHJ(c), p. 5)

Site Soils

Data from CHJ Consultant’s exploratory borings at the Project site indicate the site is generally blanketed by a layer of silty sand, which is underlain by the aforementioned Val Verde tonalite (granitic bedrock). In the areas explored, the silty sand is medium dense to dense and on about 0 to 17 feet in thickness. The upper soils are generally granular and not anticipated to have significant expansion potential. Localized areas of clay bearing silty sand were encountered, and the results of expansion index testing performed on a selected sample of this clay bearing soil indicate a “very low” expansion potential. (CHJ(c), p. 5)

Fill soil, an earthy material used to fill in a depression or hole in the ground to artificially change the grade or elevation, was encountered in one of the borings to a depth of 11 feet. The area of this boring is associated with road construction across a stream channel (near the former rock crushing area in the southeast quadrant of the site). Fill soil was not encountered in the remaining borings for the investigation; however, it is anticipated that undocumented fill soil may exist in certain areas of the site associated with previous usage. (CHJ(c), p. 5)

Groundwater

The site is located in the Riverside Hydrologic Subarea of the Santa Ana Drainage Province. Groundwater was not encountered within 16 exploratory borings drilled to a maximum depth of 37 feet below ground surface in 2007 (CHJ(b), p. 12; CHJ(c), p. 5). No groundwater was encountered within any of the exploratory trenches in 2014 (CHJ(a), p. 5). There is a potential for perched, seasonal groundwater along the bedrock/alluvium interface due to the presence of relatively impermeable shallow bedrock overlain by more permeable alluvium). The most recent available regional groundwater data (May 15, 2014) indicates that the depth to groundwater in State Well Number 03S/04W-10B, located approximately one mile southeast of the Project site, was 29 feet below ground surface. The groundwater gradient in the regional aquifer east of the subject site is toward the south. (CHJ(b), pp. 12-13)

Seismicity and Faulting

The Project site is not within or adjacent to an Alquist-Priolo Earthquake Fault Zone.[1] No evidence of active faulting was observed on the Project site during the geologic field reconnaissance or the review of aerial photographs. (CHJ(c), p. 6)

While no known active or potentially active faults traverse the City and its Sphere of Influence, several faults in the region have the potential to produce seismic impacts within the City. Three significant faults pass within 20 miles of the City (GP 2025, Figure PS-1).

- The San Andreas Fault runs along the southwest margin of the San Bernardino Mountains and is approximately 16 miles northeast of the Project site (CHJ(c), p. 7). The San Andreas Fault extends 600 miles from Eureka in Northern California's Humboldt County south to the Mexican border. The San Andreas Fault is estimated to have the capability of producing up to an 8.3 magnitude earthquake. One of the more direct impacts that an earthquake of this magnitude could have on the City is the disruption of potable water supplies to the City. The City's primary water supplies come from a series of wells located north of the City, with the water lines from these sources running directly across segments of the San Andreas Fault. (GP 2025, p. PS-3)
- The San Jacinto Fault is approximately six miles northeast from the Project site at its nearest point (CHJ(c), p. 6). This fault runs more than 125 miles, from northwest of El Centro in Imperial County to northwest of San Bernardino, passing through the intersection of Interstates 10 and 215, the city of Loma Linda and the Box Springs Mountains. This fault has the capability of producing up to a 7.0 magnitude earthquake. (GP 2025, p. PS-3)

[1] The Alquist-Priolo Earthquake Fault Zoning Act is discussed in Section 5.6.2.

- The Elsinore Fault is approximately 17 miles southwest of the Project site (CHJ(c), p. 7). The fault extends approximately 4 miles west of Lake Mathews and Corona and south into the city of Lake Elsinore. This northwest-southwest trending fault has the capability of producing up to a 6.0 magnitude earthquake. Northwest of Corona, the Elsinore Fault splits into two segments and forms the two upper strands of the Elsinore Fault. The southwestern strand becomes the 40 kilometer (25 mile)-long Whittier Fault, with the capacity of producing up to a 7.2 magnitude earthquake, and the northeastern strand becomes the 21 kilometer (13 mile)-long Chino Fault, with the capacity of producing up to a 7.0 magnitude earthquake. (GP 2025, p. PS-3)

Although no Alquist-Priolo fault zone or active or potentially active fault has been mapped at the surface within the City, one northwest-southeast trending unnamed fault (identified as County Fault on GP 2025 Figure PS-1) is projected toward the southwest corner of the City's Sphere of Influence boundary south of Lake Mathews (GP 2025, p. PS-4).

Thus, as is the case for most areas of Southern California, the Project site is situated in a seismically active region and ground-shaking resulting from earthquakes associated with nearby and more distant faults may occur at the Project site. Seismic activity associated with active faults can be expected to generate moderate to strong ground shaking at the Project site as with the City in general.

Earthquake Intensity

It is important to note that magnitude and intensity measure different characteristics of earthquakes. Magnitude measures the energy released at the source or epicenter of the earthquake with the use of a seismograph. Intensity measures the strength of shaking produced by the earthquake at a certain location and is determined from effects on people, human structures and the natural environment. The estimated maximum earthquake event would generate site intensities in the range of moderate to strong in the City with a magnitude of 5.0 to 6.9. (GP 2025, pp. PS-4, PS-6)Factors of primary importance in groundshaking severity include the size of the earthquake, its distance, the paths the seismic waves take as they travel through the earth, the type of rock or soils underlying the site and topography. The amount of resulting damage also depends on the size, shape, age and engineering characteristics of affected structures. Interactions between ground motion and man-made structures are complex. Governing factors include a structure's height, construction and stiffness, a soil's strength and resonant period, and the period of high-amplitude seismic waves. Waves come in different lengths and thus repeat their motions with varying frequency. Short waves are short-period or high-frequency. In general, long-period seismic waves, which are characteristic of large earthquakes, are most likely to damage long-period structures such as high-rise buildings and bridges. Shorter period seismic waves, which tend to die out quickly, will most often cause damage near the earthquake epicenter, damaging structures such as one-story and two-story buildings. Very short period waves are expected to cause structural damage, such as to equipment. Wave periods of 0.3 second and 1.0 second are the lengths of seismic waves that commonly damage structures. (GPA 960 DEIR, p. 4.12-3)

The United States Geological Survey (USGS) has developed an Instrumental Intensity scale which maps peak ground acceleration and peak ground velocity on an intensity scale which can be used to determine potential damage associated with earthquakes of given sizes. This scale is included as **Table 5.6-A – Instrumental Intensity Scale** (USGS)**.**

Table 5.6-A – Instrumental Intensity Scale

Instrumental Intensity	Acceleration (g)	Velocity (cm/s)	Perceived Shaking	Potential Damage
I	<0.0017	<0.1	Not Felt	None
II-III	0.0017-0.014	0.1-1.1	Weak	None
IV	0.014-0.039	1.1-3.4	Light	None
V	0.039-0.092	3.4-8.1	Moderate	Very Light
VI	0.092-0.18	8.1-16	Strong	Light
VII	0.18-0.34	16-31	Very Strong	Moderate
VIII	0.34-0.65	31-60	Severe	Moderate to Heavy
IX	0.65-1.24	60-116	Violent	Heavy
X+	>1.24	>116	Extreme	Very Heavy

Liquefaction

The major geologic hazards associated with ground shaking include liquefaction and ground failure. Liquefaction occurs when ground shaking causes water-saturated soils to become fluid and lose strength. Liquefaction historically has been responsible for significant damage, creating problems with bridges, buildings, buried pipes and underground storage tanks. The City is underlain by areas susceptible to varying degrees of liquefaction, ranging from moderate to very high. Liquefaction hazards are particularly significant along watercourses. The primary liquefaction areas are within the City limits including the area along the Santa Ana River, a broad area south and west of the Riverside Municipal Airport, a portion in western Riverside spanning La Sierra Avenue and a smaller area along the City's southern boundary. (GP 2025 FPEIR, pp. 5.6-5 – 5.6-6)

Liquefaction occurs when three general conditions exist: 1) shallow groundwater, 2) low-density silty or fine sandy soils, and 3) high intensity ground motion. As mentioned above, no groundwater was encountered during the exploratory borings, which achieved a maximum depth of 37 feet and exploratory trenches undertaken at the Project site. Moreover, the GP 2025 identifies the Project site and its immediate surrounding area with a very low susceptibility to liquefaction (GP 2025, Figure PS-2). The Project site is underlain at shallow depths by dense to very dense granitic bedrock; thus, due to the presence of shallow bedrock and absence of groundwater, liquefaction is not considered to be a hazard at the site (CHJ(c), p. 10).

Erosion and Slope Stability/Landslides

Soil erosion is the process by which soil particles are removed from a land surface by wind, water, or gravity. Most natural erosion occurs at slow rates; however, the rate of erosion increases when land is cleared or altered and left in a disturbed condition. The primary factors that influence erosion include soil characteristics, vegetative cover, topography, and climate. Soils with a high proportion of silt and very fine clays are generally the most erodible. Additionally, there is a higher likelihood for erosion the less permeable the soil. Vegetative cover assists in erosion control by shielding the soil surface from the impact of falling rain or blowing wind. Vegetation slows the velocity of runoff, permits greater infiltration, maintains the soil's capacity to absorb water, and holds soil particles in place. (GP 2025 FPEIR, pp. 5.6-11 – 5.6-12) The upper soils encountered within the Project site consist of silty sands that are moderately susceptible to erosion by wind and water (CHJ(c), p. 10).

The term “landslide” refers to deep-seated slope failures at least 15 feet deep. Landslides are typically related to the underlying structure of the parent material. Surficial failures refer to shallow failures that affect the upper weathered horizon of the parent material. No evidence for deep-seated landsliding was observed during the field reconnaissance or on the aerial photographs reviewed. The susceptibility of a geologic unit to landsliding is dependent upon various factors, primarily: 1) the presence and orientation of weak structures, such as fractures, faults, and joints; 2) the height and steepness of the pertinent natural or cut slope; 3) the presence and quantity of groundwater; and 4) the occurrence of strong seismic shaking. No adversely-oriented structures were observed at the Project site. (CHJ(c), p. 11)

Lateral Spreading

Seismically-induced lateral spreading involves primarily lateral movement of earth materials due to ground shaking. Lateral spreading is not the same as slope failure in that complete ground failure with ground movement does not occur due to the relatively smaller gradient of the initial ground surface. Lateral spreading is demonstrated by near vertical cracks with predominantly horizontal movement of the soil mass involved.

The potential for lateral spreading at the Project site is considered low because the site is underlain by dense subsurface soil and bedrock (CHJ(c), p. 4).

5.6.2 Related Regulation

Federal Regulations

There are no federal regulations applicable to geology and soils with regard to the proposed Project.

State Regulations

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act was signed into state law in 1972. Its primary purpose is to mitigate the hazard of fault rupture by prohibiting the location of structures for human occupancy across the trace of an active fault. The Act requires the State Geologist to delineate “Earthquake Fault Zones” along faults that are “sufficiently active” and “well defined.” The Act also requires that cities and counties withhold development permits for sites within an Earthquake Fault Zone until geologic investigations demonstrate that the sites are not threatened by surface displacement from future faulting. Pursuant to this Act, structures for human occupancy are not allowed within 50 feet of the trace of an active fault. Therefore, if a project site is located in an Earthquake Fault Zone, the City must withhold development permits for sites within the fault zones until geologic investigations demonstrate that the sites are not threatened by surface displacement from future faulting.

Seismic Hazard Mapping Act

California Geological Survey (CGS) provides guidance with regard to seismic hazards. Under CGS Seismic Hazards Mapping Act, seismic hazard zones are identified and mapped to assist local governments in land use planning. The intent of this Act is to protect the public from the effects of strong ground shaking, liquefaction, landslides, ground failure, or other hazards caused by earthquakes. In addition, CGS Special Publication 117, Guidelines for Evaluating and Mitigating Seismic Hazards in California, provides guidance for the evaluation and mitigation of earthquake-related hazards for projects within designated zones of required investigations.

Uniform Building Code

The Uniform Building Code (UBC) is published by the International Conference of Building Officials. It forms the basis of about half the state building codes in the United States, including California’s, and has been adopted by the state legislature together with additions, amendments, and repeals to address the specific building conditions and structural requirements in California.

California Building Code

California Code of Regulations (CCR), Title 24, Part 2, the California Building Code (CBC), provides minimum standards for building design in the state, consistent with or more stringent than UBC requirements. Local codes are permitted to be more restrictive than Title 24, but are required to be no less restrictive. Chapter 16 of the CBC deals with General Design Requirements, including regulations governing seismically resistant construction (Chapter 16, Division IV) and construction to protect people and property from hazards associated with excavation cave-ins and falling debris or construction materials. Chapter 18 and Appendix Chapter 33 deal with site demolition, excavations, foundations, retaining walls, and grading, including requirements for seismically resistant design, foundation investigations, stable cut and fill slopes, and drainage and erosion control.

Natural Hazards Disclosure Act

The Natural Hazards Disclosure Act requires that sellers of real property and their agents provide prospective buyers with a “Natural Hazard Disclosure Statement” when the property being sold lies within one or more state-mapped hazard areas. If a property is in a Seismic Hazard Zone, as shown on a map issued by the State Geologist, the seller or the seller’s agent must disclose this fact to potential buyers. California law also requires that when houses built before 1960 are sold, the seller must give the buyer a completed earthquake hazards disclosure report and a booklet titled, "The Homeowners Guide to Earthquake Safety." This publication was written and adopted by the California Seismic Safety Commission.

California Civil Code Section 1103-1103.4

California Civil Code Section 1103-1103.4 applies to the transfers of real property between private parties, as defined therein, and requires notification upon transfer if the property is affected by one or more natural hazards. The following potential hazards must be disclosed, if known: FEMA flood hazard areas, dam failure inundation areas, very high fire hazard severity zone, wildland area with forest fire risks, earthquake fault zone, and seismic hazard zones including landslide and liquefaction on a standardized "Natural Hazard Disclosure Statement" (Section 1103.2).

National Pollutant Discharge Elimination System

A Stormwater Pollution Prevention Plan (SWPPP) prepared in compliance with a National Pollutant Discharge Elimination System (NPDES) Phase I Permit describes the project area, erosion and sediment controls, runoff water quality monitoring, means of waste disposal, implementation of approved local plans, control of post construction sediment and erosion control measures and maintenance responsibilities, and non-stormwater management controls. Discharges are also required to inspect construction sites before and after storms to identify stormwater discharge from construction activity, and to identify and implement controls where necessary.

In 2010, the Santa Ana Regional Water Quality Control Board issued municipal separate storm sewer system (MS4) permits (Permit R8-2010-0033 and NPDES No. CAS 618033) to the Riverside County Permittees. This incorporates programs developed since 1993. These are the fourth MS4 permits issued by each Regional Board and are referred to as the "Fourth-term" MS4 Permits. In this region, the City of Riverside is a permittee under the Fourth-term MS4 Permits. Under this Permit, the City is required to enforce and comply with storm water discharge requirements. The City has to maintain and control discharges to the MS4s.

Local Regulations

Riverside General Plan 2025

The GP 2025 contains objectives and policies related to erosion, grading, and changes in topography as well as seismic hazards relevant to the Project in its Land Use and Urban Design Element, Public Safety Element, and Open Space and Conservation Element. Appendix M of this DEIR summarizes the Project's consistency with the applicable GP 2025 policies.

Riverside Municipal Code

Title 14 of the City's Municipal Code, in Section 14.08.030 (Connection to Public Sewer Required), states all homes and any other structures must be properly connected to a public sewer whenever the property abuts upon a right-of-way in which there exists a public sewer to which connection may be made. (RMC)

Title 17 of the City's Municipal Code contains the Grading Code, which sets forth rules and regulations placed on grading to control erosion, grading, and earthwork construction, including fills and embankments. One of the purposes of this code is to regulate grading in a manner that minimizes the adverse effects of grading on natural landforms, soil erosion, dust control, water runoff, and construction equipment emissions. The basic aim of the Grading Code is set forth in Section 17.04.010 and provides for the following (RMC):

- Ensure that significant natural characteristics such as land form, vegetation, wildlife communities, scenic qualities, and open space can substantially be maintained; to preserve unique and significant geologic; biologic and hydrologic features of public value; to encourage alternative approaches to conventional hillside construction practices by achieving land use patterns and intensities that are consistent with the natural characteristics of hill areas such as slope, landform vegetation, and scenic quality.
- Maintain the identity, image and environmental quality of the City; and to achieve land use densities that are in keeping with the General Plan.
- Minimize the visual impact of grading.
- Minimize grading which relates to the natural contour of the land, and which will round off, in a natural manner, sharp angles at the top and ends of cut and fill slopes, and which does not result in a staircase or padding affect.
- Stabilize steep hillsides, retain moisture, prevent erosion, and enhance the natural scenic beauty and, where necessary, require additional landscaping to enhance the scenic and safety qualities of the hillsides. This could include the retention of trees or replacement of trees and other vegetation.
- Encourage a variety of building types and design, when appropriate, to materially reduce grading and disturbance of the natural character of the area.
- Preserve and enhance existing community character, as defined by such factors as visual appearance, density, road widths and vegetation.
- Preserve prominent landforms within the community, including, but not limited to ridgelines, knolls, valleys, creeks, rock outcroppings or other unique topographic features or viewscapes.
- Preserve major hillsides viewscapes visible from points within the city so that they are not detrimentally altered by the intrusion of highly visible cut and/or fill slopes, building lines and/or road surfaces.
- Scrutinize development in areas of exposure to high fire risk and develop reasonable mitigation measures to reduce such risk.

Section 17.28.020 of the Grading Code applies to any parcel having an average natural slope of 10 percent or greater, or that is located within or adjacent to a delineated arroyo or a blue-line stream identified on USGS map. Although the Project site does not contain any designated arroyos and its average natural slope is less than 10 percent, it is subject to Section 17.28.020 because the site contains a blue-line stream. Therefore, grading must be confined to the minimum amount necessary and the ungraded terrain must be left in its natural form on the remainder of the site. This section also requires the use of contour grading such as rounded and blended slopes; grading that fits into the natural terrain; structures designed to fit with the contours of the hillside; pad size limitations; and grading in blue-line streams limited to the minimum necessary for access or drainage. (RMC) To accommodate the proposed grading plan, exceptions to RMC Section 17.28.020 are proposed. These grading exemptions are described below:

1. To permit a 2:1 and 3:1 slope with a bench, between 20-feet and 35-feet along the westerly property line adjacent to Sycamore Canyon Wilderness Park;
2. To permit a 3-1 slope between 30-feet and 34-feet long the southerly property line adjacent to the proposed Park trail; and
3. To permit a 2:1 slope between 20-feet and 24-feet adjacent to the proposed driveway at the knuckle of Lance Drive and Dan Kipper Drive.

5.6.3 Thresholds of Significance

The City has not established local CEQA significance thresholds as described in Section 15064.7 of the State *CEQA Guidelines*. Therefore, significance determinations utilized in this section are from Appendix G of the State *CEQA Guidelines*. A significant impact will occur if implementation of the proposed Project will:

- (Threshold A) expose people or structures to 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; and/or iv) landslides;
- (Threshold B) result in substantial soil erosion or the loss of topsoil;
- (Threshold C) be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse;
- (Threshold D) be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property; and/or
- (Threshold E) 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 waste water.

5.6.4 Project Design Features

The Project's design features regarding geology and soils include an on-site Conservation Area for biological resources, a drainage network of storm drains and gutters to convey water to a new off-site storm drain in Lance Avenue, which will become part of the a municipal storm sewer system to avoid on-site ponding. The Project also proposes landscaped areas and groundcovers to reduce erosion potential. Project design and construction will incorporate the geotechnical recommendations provided by CHJ Consultants.

5.6.5 Environmental Impacts before Mitigation

Threshold A: *Would the Project expose people or structures to 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; and/or iv) landslides?*

i) Fault Rupture

Unlike damage from ground shaking, which can occur at great distances from the fault, impacts from fault rupture are limited to the immediate area of the fault zone where the fault breaks along the surface. The Project site does not lie within or adjacent to an Alquist-Priolo Earthquake Fault Zone and no evidence for active faulting on the site was observed during the geologic field reconnaissance or the aerial photographs review (CHJ(c), p. 6). The nearest known active or potentially active fault, San Jacinto Fault, is approximately six miles northeast of the Project site (CHJ(c), p. 6), with the other known active or potentially faults as described in Section 5.6.1 are further away from the Project site. Thus, the potential for damage due to fault rupture is considered remote. Even so, the Project is required to comply with the building design standards of the CBC for construction of new buildings related to seismicity. Therefore, the potential hazards associated with fault rupture are considered **less than significant**.

ii) Strong Seismic Ground Shaking

The Project site is located within the seismically active region of Southern California, and may be subject to ground-shaking events. While no known active faults traverse the City, several faults in the region have the potential to produce seismic impacts within the City. The three significant faults that pass within 20 miles of the City include the San Andreas Fault (approximately 16 miles northeast of the Project site), San Jacinto Fault (approximately 6 miles northeast of the Project site), and Elsinore Fault (approximately 17 miles southwest of the Project site). (GP 2025, p. PS-3; CHJ(c), pp. 6-7)

The expected ground motion characteristics of future earthquakes in the region would depend on the characteristics of the generating fault, the distance to the epicenter, the magnitude of the earthquake, and the site-specific geologic conditions. A maximum horizontal ground acceleration of 0.62 g may occur within the Project site from a magnitude 6.9 earthquake along the San Jacinto Fault, which is the maximum moment magnitude assigned to a rupture of this fault (CHJ(c), pp. 6, 9). As shown in **Table 5.6-A,** this severity may result in moderate structural damage. However, ground shaking originating from earthquakes along other active faults in the region is expected to induce lower horizontal accelerations due to smaller anticipated earthquakes and/or greater distances to other faults.

Additionally, the Project will be designed to resist seismic impacts in accordance with the applicable Municipal Code Title 16 – Buildings and Construction standards. Such building code compliance is required for development of all structures in the City. Project plans will be reviewed during the plan check process to confirm seismic safety measures are incorporated. Moreover, there is nothing unique about the Project site that would require additional measures beyond compliance with the adopted building code. Therefore, potential impacts associated with seismic ground shaking will be **less than significant**.

iii) Seismic-Related Ground Failure, Including Liquefaction

The Project site is underlain at shallow depths by dense to very dense granitic bedrock, and thus, due to the presence of shallow bedrock and absence of groundwater, liquefaction is not considered to be a hazard at the site (CHJ(c), p. 10). Moreover, the GP 2025 identifies the Project site and its immediate surrounding area with a very low susceptibility to liquefaction (GP 2025, Figure PS-2). The Project will be designed to resist seismic impacts in accordance with RMC Title 16 – Buildings and Construction standards. Such building code compliance is required for development of all structures in the City. Project plans will be reviewed during the plan check process, which will ensure that these seismic safety measures are incorporated. These measures take into account ground shaking hazards that are typical to Southern California. Therefore, potential impacts associated with seismic ground failure, including liquefaction, will be **less than significant**.

iv) Landslides

Seismically induced landslides and other slope failures are common occurrences during or soon after earthquakes. The susceptibility of a geologic unit to landslides is dependent upon various factors, primarily: 1) the presence and orientation of weak structures, such as fractures, faults, and joints; 2) the height and steepness of the pertinent natural or cut slope; 3) the presence and quantity of groundwater; and 4) the occurrence of strong seismic shaking. No adversely-oriented structures, such as fractures or joints, were observed on or near the Project site during exploratory trenching studies conducted at the site (CHJ(c), p. 11). Additionally, no groundwater was encountered within any of the exploratory trenches (CHJ(c), p. 5). As discussed in *Threshold A ii),* above, there are no active faults within the City and the strength of seismic shaking at the site will be lessened due to the site's distance to faults that may produce an earthquake.

The Project site does not contain steep slopes in excess of 30 percent, which would be areas of high susceptibility to seismically induced landslides (GP 2025 FPEIR, p. 5.6-6). However, as discussed in the Project Description, the Project proposes grading exceptions to RMC

Sections 17.28.020.10 and 17.28.020.11 at the locations shown on **Figure 3-9 – Grading Exception** as follows:

1. To permit a 2:1 and 3:1 slope with a bench, between 20-feet and 35-feet along the westerly property line adjacent to Sycamore Canyon Regional Park;
2. To permit a 3:1 slope between 30-feet and 34-feet long the southerly property line adjacent to the proposed Park trail; and
3. To permit a 2:1 slope between 20-feet and 24-feet adjacent to the proposed driveway at the knuckle of Lance Drive and Dan Kipper Drive.;

Therefore, the Project site generally has a low potential for landslides because no weak structures or groundwater were encountered on-site and the site is not located directly adjacent to or upon an active fault. Although three grading exemptions will be required to allow for steeper slopes, because these slopes will be engineered to RMC Title 16 – Building and Construction and Title 17 – Grading standards, potential impacts associated with seismically induced landslides will be **less than significant**.

Threshold B: *Would the Project result in substantial soil erosion or the loss of topsoil?*

The upper soils encountered within the Project site consist of silty sands that are moderately susceptible to erosion by wind and water (CHJ(c), p. 10). Construction activities such as grading may have the potential to cause soil erosion or the loss of topsoil. Short-term erosion effects during the construction phase of the Project will be prevented through the required implementation of a SWPPP in compliance with the NPDES program as well as the incorporation of best management practices (BMPs) intended to reduce soil erosion. The SWPPP includes standard construction methods such as temporary detention basins to control on-site and off-site erosion. The SWPPP is required by the City during plan review and approval of Project improvement plans. Additionally, a drainage network of storm drains and gutters will be provided throughout the developed site to convey water appropriately and to avoid on-site ponding outside any detention basins. Landscaped areas and groundcovers, which reduce erosion potential, will also be provided. With implementation of an approved SWPPP as well as the Project's design considerations, potential impacts from erosion during construction or operation will be **less than significant**.

Threshold C: *Would the Project 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?*

As discussed above, the nearest active or potentially active fault is approximately six miles from the Project site and the Project site is not susceptible to liquefaction or landslides. The Project site is not within an area with soils identified as having a high shrink-swell potential (GP 2025, Figure PS-3), and the Project's geological investigation tested on-site soils and determined that the soils have a "very low" expansion potential and are underlain by granitic bedrock (CHJ(c), p. 5); thus, collapse is unlikely. Additionally, the potential for lateral spreading at the Project site is considered low because the site is underlain by dense subsurface soil and bedrock (CHJ(c), p. 4). The Project site is also not within an area susceptible to subsidence (RCMMC). Thus, the Project site is not considered to be susceptible or located on a site or unit that is unstable. Even so, the Project will incorporate the Project-specific geotechnical recommendations provided by CHJ Consultants and will conform to the adopted building code; potential impacts associated with seismically induced landslides will be **less than significant**.

Threshold D: *Would the Project be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?*

Expansive soils are soils with a significant amount of clay particles that have the ability to give up water (shrink) or take on water (swell). Fine-grained soils, such as silts and clays, may contain variable amounts of expansive clay minerals. When these soils swell, the change in volume exerts significant pressures on loads that are placed on them. This shrink/swell movement can adversely affect building foundations, often causing them to crack or shift, with resulting damage to the buildings they support. Based on Figure 5.6-5 of the GP 2025 FPEIR, the Project site is not located on or near soil types with high shrink-swell potential. Moreover, the Project's geological investigation testing on-site soils and determined that the soils have a "very low" expansion potential and are underlain by granitic bedrock (CHJ(c), p. 5). Even so, the Project will incorporate the Project-specific geotechnical recommendations provided by CHJ Consultants and will conform to the adopted building code; thus, impacts will be **less than significant**.

Threshold E*: Would the Project 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 waste water?*

The proposed Project will be served by existing sewer infrastructure at the Sycamore Canyon Business Park. Because the Project will connect to a sanitary sewer system, septic tanks or alternative waste disposal systems are not proposed. **No impact** will occur.

5.6.6 Proposed Mitigation Measures

An EIR is required to describe feasible mitigation measures which could minimize significant adverse impacts (State *CEQA Guidelines*, Section 15126.4). Implementation of the proposed Project will not result in any potentially significant impacts to geology and soils, and therefore, no mitigation measures are necessary.

5.6.7 Environmental Impacts after Mitigation Measures are Implemented

No mitigation measures are necessary regarding the Project's impacts to geology and soils. Impacts were found to be **less than significant**.

5.6.8 References

In addition to other documents, the following references were used in the preparation of this section of the DEIR:

CHJ(a) CHJ Consultants, *Report of Geophysical Investigation, Proposed 950,000 Square Foot Distribution Center, Sycamore V Project, Riverside, California*, May 14, 2014. (Appendix E.1.)

CHJ(b) CHJ Consultants, *Phase I Environmental Site Assessment Update, 17 Vacant Parcels, ±75 Acres Northwest of Sierra Ridge Drive and Lance Drive, Riverside, California*, September 16, 2014. (Appendix G.2.)

CHJ(c) CHJ Consultants, *Geotechnical Investigation, Proposed Industrial Development, Lance and Sierra Ridge Drives, Riverside, California*, July 20, 2007. (Appendix G.3.)

GP 2025 City of Riverside, *General Plan 2025,* certified November 2007 with subsequent amendments to various elements. (Available at http://www.riversideca.gov/planning/gp2025program/general-plan.asp, accessed May 27, 2015.)

GP 2025 FPEIR City of Riverside, *General Plan 2025 Program Environmental Impact Report* (SCH# 2004021108), certified November 2007. (Available at http://www.riversideca.gov/planning/gp2025program/, accessed May 27, 2015.)

GPA 960 DEIR County of Riverside, *County of Riverside Draft Environmental Impact Report No. 521*, February 2015. (Available at http://planning.rctlma.org/Portals/0/genplan/general_plan_2015/DEIR%20521/04-12_GeologyAndSoils.pdf, accessed July 14, 2016.)

RCMMC Riverside County Information Technology, Geographic Information Services, Map My County, online GIS database. (Available at http://mmc.rivcoit.org/MMC_Public/Custom/disclaimer/Default.htm, accessed June 22, 2015.)

RMC City of Riverside, *Municipal Code*. (Available at http://www.riversideca.gov/municode/, accessed June 22, 2015.)

USGS United States Geological Survey, *Shakemap Scientific Background*, March 2011. (Available at http://earthquake.usgs.gov/earthquakes/shakemap/background.php, accessed July 14, 2016.)