4.5 GEOLOGY/SOILS AND MINERAL RESOURCES

This section of the EIR describes the existing geology, soils, seismicity, and mineral resources conditions at the project site and in the surrounding area. It analyzes the potential physical environmental effects related to seismic hazards, erosion, and loss of access to sand, gravel, and crushed rock resources.

Data used in preparation of this section were obtained from various sources, including the City of San Bernardino General Plan (City of San Bernardino 2005, November); the environmental impact report prepared for the City of San Bernardino General Plan (September 2005); data from the Preliminary Geotechnical Investigation prepared by LOR Geotechnical Group Inc. (August 2007); the *Update of Baseline Data for Geology, Soils, and Mineral Resources: Palm Avenue and Industrial Avenue, San Bernardino, California* (Burwasser 2010); the California Geological Survey (CGS); the United States Geological Survey (USGS); and other data sources. Full bibliographic entries for all referenced materials and communication are provided in Section 4.5.6 (References).

Because of the technical nature of this section, a glossary is provided in Section 4.5.5 to define commonly used geologic terms.

No comment letters related to geology/soils or mineral resources were received in response to the notice of preparation (NOP) circulated on August 3, 2007, for the proposed project.

4.5.1 Environmental Setting

Regional Geology

The City of San Bernardino is at the southern base of the San Bernardino Mountains in the upper Santa Ana River Valley, more specifically, the Santa Ana River Basin. The valley is surrounded by the San Bernardino Mountains to the northeast and east, Blue Mountain and Box Springs Mountain to the south and the San Gabriel Mountains and the Jurupa Hills to the northwest and southwest. The project site is near the boundary of two major physiographic provinces in California: the Transverse Ranges Geomorphic Province to the north, composed of numerous mountain ranges that extend from the Little San Bernardino Mountains and Pinto Mountains west across the southern end of California into the Pacific Ocean west of Ventura; and the Peninsular Ranges Province to the south characterized by a series of northwest trending small mountain ranges extending southward from the foothills of the San Gabriel and San Bernardino Mountains south into the Baja California Peninsula.

Regional and Local Faults

San Bernardino County is in a seismically active region of southern California with several active faults in the immediate vicinity of the project site. Perhaps the best known of these faults is the San Andreas, about 1.5 miles northeast of the project site. This fault offsets and separates the San Bernardino Mountains from the San Gabriel Mountains to the northwest of the Site. Another major active fault about one-half mile southwest of the site is the San Jacinto fault which extends from the Lytle Creek area

of the San Gabriel Mountains southeast into the Imperial Valley near the U.S./Mexico border. The active Cucamonga fault is about 4.5 miles northwest of the project site and is part of the Sierra Madre Fault System that marks the southern boundary of the San Gabriel Mountains.

Historic and Future Seismicity

All of southern California is seismically active. The region is crossed by a network of major regional faults and minor local faults. This faulting and seismicity are dominated by the San Andreas Fault System, which separates two of the major tectonic plates that represent part of Earth's continental and oceanic crust. The Pacific Plate is west of the San Andreas Fault System. This plate is moving northwester relative to the North American Plate, which is east of the San Andreas Fault System. The relative movement between the two plates is the driving force of fault ruptures in California. The San Andreas fault generally trends northwest-southeast; however, north of the Transverse Ranges Province, it trends more east/west, causing a north/south compression between the two plates. North-south compression in southern California has been estimated from 5 to 20 millimeters per year. This compression has produced the rapid uplift of many of the mountain ranges in southern California.

In addition to the San Andreas fault, there are numerous faults in southern California that are categorized as active, potentially active, and inactive by the California Geological Survey (CGS). A fault is classified as active if it has either moved during the Holocene epoch (during the last 11,000 years) or is included in an Alquist-Priolo Earthquake Fault Zone (as established by CGS). A fault is classified as potentially active if it has experienced movement within the Quaternary period (during the last 1.6 million years). Faults that have not moved in the last 1.6 million years generally are considered inactive. Surface displacement can be recognized by the existence of cliffs in alluvium, terraces, offset stream courses, fault troughs and saddles, the alignment of depressions, sag ponds, and the existence of steep mountain fronts.

An earthquake is an abrupt release of accumulated stress in the form of seismic waves created when movement occurs along a fault plane. The severity of an earthquake generally is expressed in two ways—magnitude and intensity. The energy released, measured on the Moment Magnitude (M_W) scale (see Glossary), represents the "size" of an earthquake. The Richter Magnitude (M) scale (see Glossary) has been replaced in most modern building codes by the M_W scale because the M_W scale provides more useful information to design engineers.

The intensity of an earthquake is measured by the Modified Mercalli Intensity (MMI) scale (see Glossary), which emphasizes the current seismic environment at a particular site and measures groundshaking severity according to damage done to structures, changes in the ground surface, and personal accounts. Table 4.5-1, (Modified Mercalli Intensity Scale), identifies the level of intensity according to the MMI scale and describes that intensity with respect to how it would be received or sensed by its receptors.

The terms Maximum Credible Earthquake (MCE) and Maximum Probable Earthquake (MPE) have been used for many years to describe the largest earthquake that would be likely to occur along a particular fault and within a given timeframe, respectively (see Glossary). Recent revisions incorporated by California into the California Building Code (CBC), based on recommendations identified by the

Seismology Committee of the Structural Engineers Association of California, have eliminated the use of these terms. The 2001 CBC revisions require that the M_W of the "characteristic earthquake" be used in geotechnical calculations for design purposes (see Glossary). The new criterion for describing the energy release (i.e., the "size" of an earthquake along a particular fault segment) was determined by the Seismology Committee to represent a more reliable descriptor of future fault activity than the MCE or the MPE. Although the M_W value may differ slightly from the MCE or MPE values reported in some of the older documents cited in this EIR, this current method for describing future fault activity does not alter the assumptions or conclusions of this EIR.

Table 4.5-1 Modified Mercalli Intensity Scale

Modified Mercalli Intensity	*Description*
I	Detected by only sensitive instruments
II	Felt by a few people at rest
III	Felt noticeably indoors, but not always recognized as a quake; vibration like a passing truck
IV	Felt indoors by many and outdoors by few
V	Felt by most people. Some breakage of windows, dishes, and plaster
VI	Felt by all; falling plaster and chimneys; damage small
VII	Damage to buildings varies; depends on quality of construction
VIII	Walls, monuments, chimneys fall; panel walls thrown out of frames
IX	Buildings shift off foundations; foundations crack; ground cracks; underground pipes break
X	Most masonry and frame structures destroyed; ground cracks; landslides
XI	Ground fissures; pipes break; landslides; rails bent; new structures remain standing
XII	Damage total; waves seen on ground surface; objects thrown into the air

SOURCE: *Nuclear Reactors and Earthquakes*, Atomic Energy Commission, TID7024.

Ground motions also are reported in terms of a percentage of the acceleration of gravity (percent g), where g = 32 feet per second per second. One hundred percent of gravity (1 g) is the acceleration a skydiver would experience during free-fall. An acceleration of 0.4 g is equivalent to accelerating from 0 to 60 miles per hour in about 7 seconds.

During the past 40 years, southern California has experienced 14 earthquakes in excess of M_W 6.0. the two most deadly earthquakes were the 1971 San Fernando earthquake (also known as the Sylmar earthquake, on the Sierra Madre fault), which registered as M_W 6.6, killed 65 people, injured 2000, and caused $505 million in losses; and the 1994 Northridge earthquake, which occurred on a previously unmapped blind thrust fault (see glossary), registered as M_W 6.7, killed 57 people, injured 9000, and caused $40 billion in losses.

The historical seismicity of the site entails numerous small to medium magnitude earthquake events occurring around the subject site, predominately associated with the presence of the San Jacinto fault and the San Andreas fault. Any future developments at the subject site should anticipate that a moderate to very large seismic event could occur very near the site along either one of these features.

Seismic Hazards

The project site is in Seismic Zone 4. No active or potentially active faults are known to exist at the proposed site. In addition, the site does not lie within a California Earthquake Fault Zone. The closest known active fault to the site is the San Jacinto fault approximately 0.5 mile to the west. Other nearby active faults include the San Andreas fault approximately 1.5 mile northeast from the site and the Cucamonga fault approximately 4.5 miles to the northwest. Because of the site's proximity to the San Andreas and San Jacinto faults, it is reasonable to expect a violent ground motion seismic event to occur during the lifetime of the proposed development on the site. Large earthquakes could occur in the general area, but because of their lesser anticipated magnitudes and/or greater distance, they are considered less significant than the nearby segments of the San Andreas and San Jacinto faults.

Groundshaking

The major cause of structural damage from earthquakes is groundshaking. The intensity of ground motion expected at a particular site depends upon the magnitude of the earthquake, the distance to the epicenter, and the geology of the area between the epicenter and the property. Greater movement can be expected at sites on poorly consolidated material, such as loose alluvium, in proximity to the causative fault, or in response to an event of great magnitude.

Near-Source Factors (see Glossary) represent additional groundshaking safety factors required by the City Building Code to be incorporated in structural design equations for building sites within 15 kilometers (9.3 miles) of the ground surface projection of a known active fault plane. The Near-Source Factors and, therefore, the standards for seismic-resistant design, increase as the distance from a construction site to the fault trace decreases. Near-source factors are determined based on the distance to the nearest Type A or B seismic source (see Glossary). Once these are determined, near-source values can be obtained. Seismic sources types are classified as A, B, or C, based on description, maximum anticipated magnitude, and slip rate. Type C sources are not considered because they do not increase the standard near-source factor value of 1.0.

The San Jacinto fault, specifically the Glen Helen segment classified as a Type B fault is nearest the site (0.5 mile) and is believed to be capable of producing an estimated magnitude event of M_W 6.7. The nearest known Type A fault is the San Andreas fault, at a greater distance from the site (1.5 miles). The San Bernardino segment of this fault is capable of producing an estimated magnitude event of M_W 7.3. Another fault capable of producing groundshaking at the site is the Cucamonga fault (4.5 miles distant). Part of the Sierra Madre fault system, it is believed the fault is capable of producing an earthquake on the order of M_W 7.0 or greater.

Liquefaction

Liquefaction involves a sudden loss in strength of a saturated, cohesionless, uniformly particle-sized soil, typically caused by groundshaking activities, that causes temporary transformation of the soil to a fluid mass. In rare instances, groundborne vibrations can cause liquefaction from activities such as pile driving or tunnel boring. If the liquefying layer is near the ground surface, the effects may resemble those of

quicksand. If the layer is deep below the ground surface, it may provide a sliding surface for the material above it and/or cause differential settlement of the ground surface, which may damage building foundations by altering weight-bearing characteristics.

Liquefaction typically occurs when loose, cohesionless, water-saturated soils (generally uniformly sized fine-grained sand) are subjected to strong seismic ground motion of significant duration. These soils essentially behave similarly to liquids, losing bearing strength. Structures built on these soils may tilt or settle when the soils liquefy. Liquefaction more often occurs in earthquake-prone areas underlain by young sandy alluvium where the groundwater table is less than 50 feet below the ground surface.

Based on the Geotechnical Investigation, the lower lying areas of the site are underlain at depth by relatively dense alluvial materials and the depth to current groundwater levels is thought to be in excess of 50 feet. Therefore, the possibility of liquefaction in these portions of the site is not considered a hazard. Liquefaction hazard is nil within the elevated portions of the site, which are underlain by metamorphic bedrock.

Seismically Induced Settlement

Settlement can occur in areas that are prone to rates of ground surface collapse and densification (soil particle compaction) that are greater than those of the surrounding area. Such areas often are underlain by sediments that differ laterally in composition or degree of compaction. Differential settlement refers to areas that have more than one rate of settlement. Settlement can damage structures, pipelines, and other subsurface entities.

Strong groundshaking can cause soil settlement by vibrating sediment particles into more tightly compacted configurations, thereby reducing pore space between the particles. Unconsolidated, loosely packed alluvial deposits and sand are especially susceptible to this phenomenon. Poorly compacted artificial fills may experience seismically induced settlement.

Settlement generally occurs within areas of loose, granular soils with relatively low density. Because the low lying areas of the site are underlain by relatively dense alluvial materials at depth and hard metaphoric bedrock at the surface of the elevated portions of the site, the potential for settlement is considered low.

Site Location and Topography

The site is along the margin of the Cajon Wash, which is approximately 0.5 mile west-southwest of the site, and 1.25 mile northeast of the alluvial fans of the San Bernardino Mountains. The topography of the site is dominated by two, relatively small, roughly northwest-to-southeast trending hills, separated by infill valleys (see glossary). The topography rises steeply from the lower-lying valley areas of the site up to the hillside areas of the site on the order of 130 feet, with a gentle overall fall to the south-southeast. The larger hill comprises nearly half of the site in the east-southeast portion and the smaller of the onsite hills is in the northwestern portion of the site. Both hills have small, vertical cuts along the current roadways. Northwest of the larger hill, a small valley is present. Beyond the low-lying area, another hill exists.

Historic aerial photographs revealed that this hill was cut down from its original height at some time in the past.

Site Soil Types and Characteristics

The project site contains two hills; the lower-lying valley areas are underlain by materials of recent alluvial valley and wash deposits, whereas the hillsides expose units of Pelona Schist metamorphic bedrock. In addition to these materials, wind-blown sand (Aeolian) deposits and a landslide feature were identified. The lower-lying areas of the site contain a relatively thin, surficial layer of fill materials, a result of past and current weed abatement.

The soils at the project site are poorly graded, silty sand, gravel, boulder deposits and fill materials. These soils have a very low expansion potential: however, the potential for soil expansion still exists. The project would be required to comply with applicable provisions of the City Building Code (see below), with regard to soil hazard-related design.

Within the lower, flatter areas of the site, erosion of surrounding mountains has deposited relatively thick amounts of unconsolidated materials of poorly graded sand and silty sand. These units typically are brown to light brown in color, dry to damp and loose near the ground surface, becoming slightly denser with depth. Upper alluvial units are in a loose to medium dense state.

The hillsides of the site expose various units of a dark colored metamorphic rock that has been mapped by past geologic studies as the Miocene age Pelona Schist, noted to be gray to greenish gray, foliated, generally soft to moderately hard at the surface, becoming hard to very hard with depth. Although metamorphic rocks do not contain true bedding layers, they do tend to develop planar features by parallel alignment of mineral grains, called foliation. When well developed, these can have similar weakness as true bedding. At the project, the schist was noted to be typically foliated, in many areas strongly developed. The foliation of these units was generally noted to be dipping at relatively gentle angles to the east-southeast on the order of 20 to 30 degrees.

Soil Erosion

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 of vegetation or structures, or otherwise altered and left in a disturbed condition. Erosion can occur as a result of, and can be accelerated by, site preparation activities associated with development. Vegetation removal in pervious landscaped areas could reduce soil cohesion, as well as the buffer provided by vegetation from wind, water, and surface disturbance, which could render the exposed soils more susceptible to erosive forces.

Excavation or grading may result in erosion during construction activities, irrespective of whether hardscape previously existed at the construction site, because bare soils would be exposed and could be eroded by wind or water. The effects of erosion are intensified with an increase in slope (as water moves faster, it gains momentum to carry more debris), and the narrowing of runoff channels (which increases

the velocity of water). Surface structures, such as paved roads and buildings, decrease the potential for erosion. Once covered, soil is no longer exposed to the elements and erosion generally does not occur.

The proposed plan would include the removal of the larger onsite hill composed primarily of Pelona Schist bedrock. Excavation of the hill would become difficult at 7 feet in depth and special equipment would be needed to drill deeper. Blasting would occur to level the hillside. As a consequence of the blasting, the exposed soil may be susceptible to soil erosion.

Landslides

Landslides are the downhill movement of masses of earth and rock. Landsliding is a geological phenomenon that includes a wide range of ground movements, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on an over-steepened slope is the primary cause of landsliding, there are other contributing factors, such as (1) erosion by rivers, glaciers, or ocean waves; (2) rock and soil slopes that are weakened through saturation by snowmelt or heavy rains; (3) earthquakes that create stresses such that weak slopes fail; (4) volcanic eruptions that produce loose ash deposits, heavy rain, and/or debris flows; (5) vibrations from machinery, traffic, blasting, and even thunder; and (6) excess weight from accumulation of rain or snow, stockpiling of rock or ore from waste piles, or from man-made structures.

The eastern face of the southern portion of the larger on-site hill appears to be a landslide feature. There is evidence that that particular feature has experienced movement in the recent past. In the event of groundshaking, additional downslope activity is a possibility and the hillside would be especially vulnerable after a period of precipitation while enduring an earthquake. Only the east-southeast facing slopes of the site appear to be susceptible to landslide failures. Current standards of practice dictate that any slope higher than 30 feet and/or any cut slope steeper than 2 horizontal to 1 vertical would require a detailed slope stability analysis. The subject slope of 36 feet was analyzed using the computer program PCSTABLE 5. The analysis concluded that the static factor of safety was 1.55 and the pseudostatic factor of safety (se Glossary) was 1.15 for the slope. The proposed development would include the grading of all on-site hills.

Mineral Resources

Natural mineral deposits are nonrenewable resources that cannot be replaced once they are depleted. The primary mineral resources within the City of San Bernardino consist of construction aggregate. Mineral resources are often found in the natural sand and gravel deposits of the Cajon Wash, Lytle Creek, Warm Creek, City Creek and Santa Ana River, and their tributaries.

Because mineral resources vary in type, quality and quantity, they are identified according to the threshold values contained in the Surface Mining and Reclamation Act of 1975 (SMARA) and the following criteria for Mineral Resource Zones (MRZ), Scientific Resource Zones (SZ) and Identified Resource Areas (IRA).

- **MRZ-1**—Adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence; this zone shall be applied where well-developed lines of reasoning, based upon economic geologic principles and adequate data, demonstrate that the likelihood for occurrence of significant mineral deposits is nil or slight
- **MRZ-2**—Adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists; this zone shall be applied to known mineral deposits or where well developed lines of reasoning, based upon economic geologic principles and adequate data, demonstrate that the likelihood for occurrence of significant mineral deposits is high
- **MRZ-3**—Containing deposits whose significance cannot be evaluated from available data
- **MRZ-4**—Available information is inadequate for assignment to any other MRZ zone
- **SZ Areas**—Containing unique or rare occurrences of rocks, minerals, or fossils that are of outstanding scientific significance shall be classified in this zone

The project site is in an area that has been classified by the CGS of the California Department of Conservation as Mineral Resources Zone 2 (MRZ-2). As described above, MRZ-2 specifies areas where adequate information indicates that significant mineral deposits are present, or where it is judged a high likelihood for their presence. This provides for the use and management of mineral resources as an interim land use before final development. As mentioned in the City's General Plan, the Industrial Extractive (IE) land use designation is used to identify areas within MRZs in the City where sand and gravel mining is expected to occur. The IE designation is a refinement of, and more limited in area than, those areas depicted on the Mineral Resource Zone map included in the Natural Resources and Conservation Element. The project site is not zoned IE, therefore the project site is not subject to activities involving the mining of the land.

In order to protect the mineral resources of a particular city and region, the classification process for mineral resource conservation is implemented by the California Department of Conservation through the California State Mining and Geology Board, as decreed in SMARA. In the case of construction aggregates, the Board's designation identifies aggregate resources need for a region's supply for fifty years. The mineral resource information, in this case, MRZ-2, is tendered to local governments for the insertion in their General Plans and mineral resource or conservation policies. The process makes sure that aggregate resources are recognized and considered before land use decisions are made that would otherwise limit the accessibility of these resources.

Non-urbanized land mapped as MRZ-2 in the San Bernardino P-C Region has been divided into nine Mineral Resource Sectors for the purpose of making resource calculations: Sectors A through I, with numbered sub-sectors. Sectors A through F are alluvial areas generally within the Lytle Creek Fan. The Sectors have been subdivided by highways and other intervening developments. A small portion of the site is in Mineral Resource Sector C-9. Sector C, Cajon Wash extends from the confluence of Cajon Wash and Lytle Wash about 8 miles upstream. Little subsurface data are available for the Cajon Wash, but based on assumptions made to determine the extent of resources available in Sector C, 1.1 billion tons of resources are calculated to underlie Sector C without consideration of the other sectors. The total projected consumption of aggregate in the San Bernardino P-C Region to the year 2037 is estimated to

be 476 million tons, Sector C represents approximately 2.3 times more than the estimated consumption demand.

4.5.2 Regulatory Framework

Federal

There are no federal policies that would apply to geology/soils or mineral resources for the proposed project.

State

Alquist-Priolo Earthquake Fault Zoning Act

The state legislation protecting California's human population from fault-line rupture is the Alquist-Priolo Earthquake Fault Zoning Act. In 1972, the State of California began delineating Earthquake Fault Zones (called Special Studies Zones prior to 1994) as wide as 500 feet on either side of active and potentially active faults to reduce fault-rupture risks to structures for human occupancy. The Act has resulted in the preparation of maps delineating Earthquake Fault Zones to include, among others, recently active segments of the San Jacinto and San Andreas faults. The Act provides for special seismic design considerations if developments are planned in areas adjacent to active or potentially active faults, and no structures for human occupancy may be built across an identified active fault trace. Proposed construction within an Earthquake Fault Zone is permitted only following the completion of a fault location investigation prepared by a California-registered Professional Geologist. The Act defines "active" and "potentially active" faults using the same age criteria noted above in the Regional and Local Faults setting section. If an active fault is found, a structure for human occupancy must be set back from the fault trace (usually at least 10 feet, but generally 50 feet or more). Only those potentially active faults that have a relatively high potential for ground rupture are identified as Earthquake Fault Zones. Therefore, not all faults termed "potentially active" by the CGS are zoned under the Alquist-Priolo Act. A California-registered Professional Geologist must prepare an evaluation and written report of a specific site. The Act does not address power lines, water lines, or roads unless there are associated structures in which human occupancy would exceed 2,000 person-hours per year.

The project site is not in an Alquist-Priolo Earthquake Fault Zone so fault rupture hazards are not anticipated to result from the activities of an active fault.

California Building Code

The Uniform Building Code (UBC), published by the International Conference of Building Officials, forms the basis of about half the state building codes in the United States, including California's. On January 1, 2011, the UBC was adopted by the State Legislature together with Additions, Amendments, and Repeals to address the specific building conditions and structural requirements in California. 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. In the newly adopted 2010 CBC, Part 2 of Title 24 is based on the 2009 International Building Code. It Includes Title 24, Part 8 (State Historical Building Code),Title 24, Part 10 (California Existing Building Code), and Title 24, Part 11 (California Green Building Standards Code, also known as the CALGreen Code). Local codes are permitted to be more stringent than Title 24, but are required to be no less stringent.

NPDES Phase I (General Construction Activity Stormwater Permit)

As explained in further detail in Section 4.7 (Hydrology/Water Quality), a Stormwater Pollution Prevention Plan (SWPPP) would be prepared for the proposed project in compliance with a National Pollutant Discharge Elimination System (NPDES) Phase I Permit. The SWPPP must describe the project, erosion and sediment controls, runoff water quality monitoring, means of waste disposal, implementation of approved local plans, and non-stormwater management controls. Dischargers are required to inspect construction sites before and after storms to identify stormwater discharge from the construction activity and to identify and implement controls, where necessary.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act went into effect in 1991 to identify and map seismic hazard zones for the purpose of assisting cities and counties in preparing the safety elements of their general plans and to encourage land use management policies and regulations that reduce seismic hazards. The Act has resulted in the preparation of maps delineating Liquefaction Zones and Earthquake-Induced Landslide Zones of Required Investigation. The United States Geological Survey (USGS) San Bernardino, CA, 7.5-minute series topographic quadrangle which encompasses the project site in the City of San Bernardino has not been mapped, nor are there plans to map it in the foreseeable future. This does not mean that there are no seismically induced liquefaction or landslide hazards in the quadrangle, only that such hazards, if they exist, have not reached the CGS threshold of concern. The CGS provides guidance with regard to seismic hazards through its website (http://gmw.consrv.ca.gov/shmp/) and CGS Special Publication 117, *Guidelines for Evaluating and Mitigating Seismic Hazards in California*, for earthquake-related hazards associated with projects in designated zones of required investigations.

Surface Mining and Reclamation Act

The State adopted the Surface Mining and Reclamation Act (SMARA) in 1975, with the primary objectives being the assurance of adequate supplies of mineral resources important to California's economy and the reclamation of mined lands. The agencies responsible for administering this program at the state level are the California Geological Survey and the State Mining and Geology Board. The objectives of SMARA are implemented by local government agencies, with the assistance of the state, through land use planning and regulatory programs.

The SMARA's mineral resource conservation objective is achieved through a mineral inventory and land use planning process termed classification/designation, which jointly involves the California Geological Survey (CGS), the State Mining and Geology Board (Board), and local government. Information on the location of important mineral deposits is developed by the CGS through a process of mineral land

classification. The classification report is then used by the Board in designating deposits that are of economic significance to a region, the state, or the nation (California Geologic Survey 2005).

Regional

Santa Ana Regional Water Quality Control Board Water Quality Control Plan

The City of San Bernardino is in the Santa Ana River Basin. The Santa Ana Regional Board's Water Quality Control Plan (Basin Plan), adopted in 1984 and amended in 1994, is designed to preserve and enhance water quality and protect the beneficial uses of all regional waters. Specifically, the Basin Plan *(i)* designates beneficial uses for surface and ground waters, *(ii)* sets narrative and numerical objectives that must be attained or maintained to protect the designated beneficial uses and conform to the state's anti-degradation policy, and *(iii)* describes implementation programs to protect all waters in the region. In addition, the Basin Plan incorporates (by reference) all applicable state and Regional Board plans and policies and other pertinent water quality policies and regulations.

Standard Urban Stormwater Mitigation Plan (SUSMP)

The SUSMP requires installation of permanent stormwater Best Management Practices (BMPs) on the project site to capture and treat surface runoff from development before it can be discharged to public rights-of-way to reduce erosion effects. The design of permanent BMPs must be incorporated into the design plans for review by the City prior to issuance of any construction-related permit.

Local

City of San Bernardino Uniform Building Code

The City has adopted the 1998 CBC as the City's Uniform Building Code (Title 15, Building and Construction; Ord. 3974 Section 1, 1980 of the San Bernardino Municipal Code, Rev. August 17, 2006). Chapter 16 of the Code deals with General Design Requirements, including (but not limited to) regulations governing seismically resistant construction (Chapter 16, Division IV). Chapters 18 and A33 deal with excavations, foundations, retaining walls, and grading, including (but not limited to) requirements for seismically resistant design, foundation investigations, stable cut and fill slopes, and drainage and erosion control.

Among other things, the CBC defines different building regions in the state and ranks them according to their seismic hazard potential. There are three regions in California: Seismic Zones 2 through 4, with Zone 2 having the least seismic potential and Zone 4 having the highest seismic potential. The project site is in Seismic Zone 4, as is about 45 percent of California. Accordingly, any future development would be required to comply with all design standards applicable to Seismic Zone 4, the most stringent in the state. Because the project site is in CBC Seismic Zone 4 and about 0.5 mile (0.8 km) from the ground surface projection of the closest known active trace of the San Jacinto fault and 1.5 mile (2.4 km) from a similar trace of the San Andreas fault, Section 1629, Criteria Selection, of the City's Codes requires Near-

Source Factors (see Glossary) for Seismic Source Types A and B (see Glossary) to be applied to the design of structures in those areas.

City of San Bernardino General Plan

Goal 2.8 Protect the life and property of residents, businesses and visitors to the City of San Bernardino from crime and the hazards of flood, fire, seismic risk, and liquefaction.

Policy 2.8.1 Ensure that all structures comply with seismic safety provisions and building codes.

Goal 10.7 Protect life, essential lifelines, and property from damage resulting from seismic activity.

Policy 10.7.1 Minimize the risk to life and property through the identification of potentially hazardous areas, establishment of proper construction design criteria, and provision of public information.

Policy 10.7.2 Require geologic and geotechnical investigations for new development in areas adjacent to known fault locations and approximate fault locations as part of the environmental and/or development review process and enforce structural setbacks from faults identified through those investigations.

Policy 10.7.3 Enforce the requirements of the California Seismic Hazards Mapping Act and Alquist-Priolo Earthquake Fault Zoning Act when siting, evaluating, and constructing new projects within the city.

Policy 10.7.4 Determine the liquefaction potential at a site prior to development, and require that specific measures be taken, as necessary, to prevent or reduce damage in an earthquake.

Policy 10.7.5 Evaluate and reduce the potential impacts of liquefaction on new and existing lifelines.

Goal 10.8 Prevent the loss of life, serious injuries, and major disruption caused by the collapse of or severe damage to vulnerable buildings in an earthquake.

Policy10.8.1 Enforce the requirements of the California Seismic Hazards Mapping Act and Alquist-Priolo Earthquake Fault Zoning Act when siting, evaluating, and constructing new projects within the city.

Policy 10.8.2 Require that lifelines crossing a fault be designed to resist the occurrence of fault rupture.

Goal 10.9 Minimize exposure to and risks from geologic activities.

Policy 10.9.1 Minimize risk to life and property by properly identifying hazardous areas, establishing proper construction design criteria, and distribution of public information.

Policy 10.9.2 Require geologic and geotechnical investigations in areas of potential geologic hazards as part of environmental and/or development review process for all new structures.

Policy 10.9.3 Require that new construction and significant alterations to structures located within potential landslide areas be evaluated for site stability, including potential impact to other properties during project design and review.

Goal 12.4 Properly manage designated areas for mineral extraction to meet the needs of the area.

Policy 12.4.4 Require that any applications to permit uses other than mineral extractions or the interim uses defined in areas designated IE, Industrial Extractive, include findings to be prepared by the project proponent outlining the reasons why mining is not a feasible use and how the deletion of the area as a potential mineral resource supply impacts the regional supply of aggregate resources.

Consistency Analysis

Goal 10.7 addresses the need to protect life, lifelines, and property from damage resulting in seismic activity. A geotechnical technical report was prepared by LOR Geotechnical Group that described the project site as being in an area not susceptible to liquefaction. All development and construction activities included in the proposed project would adhere to the California Building Standards. Therefore, the proposed project would not conflict with this policy.

Goal 10.9 includes policies to minimize exposure and risk from geological activities, the project site is not located in either the San Jacinto Fault Zone or the San Andreas Fault Zone. The project site is in an area subject to high levels of strong seismic activity. The effects caused by seismic and geologic hazards on development can be reduced if the buildings are constructed according to the California Building Standards, as described below. Therefore, the proposed project would not conflict with this policy.

Goal 12.4 is intended to protect nonrenewable mineral resources that may be found within a project site. Although the project site has been zoned MRZ-2, it has not been zoned by the City of San Bernardino as IE, Industrial Extractive. Therefore, the proposed project will not conflict with any relevant policies outlined under Goal 12.4.

4.5.3 Project Impacts and Mitigation Measures

Analytic Method

Widely available industry sources were examined to document regional and local geology. Information regarding regional geology and seismically induced hazards was taken from various sources of the CGS and the USGS. Project-specific geologic information, soil characteristics, and liquefaction potential were obtained from the *Preliminary Geotechnical Study 682K Distribution Building*. Estimated earthquake magnitudes resulting from potential seismic activity on various active faults in the area were obtained

from various analyses included with the Geotechnical Study. Where potential geological hazards are identified, such hazards would be expected to affect any proposed development in the hazard area. Adherence to design and construction standards, as required by state and local regulations, would ensure maximum practicable protection for users of the buildings and associated infrastructure.

The following analysis considers the potential effects of the proposed project described in Chapter 3 (Project Description). Construction-related impacts are considered for the project as a whole. Operational-related impacts of the project site are considered within the context of seismic or other geological impacts to residents, employees, or visitors.

Thresholds of Significance

The following thresholds of significance are based on Appendix G to the 2011 CEQA Guidelines and City-specific thresholds, where applicable. For purposes of this EIR, implementation of the proposed project may have a significant adverse impact if it would:

- Be located within an area subject to landslides, mudslides, subsidence or other similar hazards such as liquefaction or strong seismic groundshaking
- Result in substantial erosion, dust, or unstable soil conditions from construction or operation
- Involve earth movement (cut and/or fill) on slopes of 15 percent or more that could result in landslides, mudslides, flooding, siltation, or severe scarring
- Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state
- Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan
- Be located in a Mineral Resource Zone as adopted by the State Mining Geology Board and identified in the City's General Plan

Effects related to the following thresholds were found to have "no impact," and are discussed in Section 4.14 (Effects Not Found to Be Significant):

- Expose people or structures to substantial adverse effects, including the risk of loss, injury, or death involving development within the Alquist-Priolo Earthquake Fault Zone
- Be located within and Alquist-Priolo Earthquake Fault Zone
- Modify any unique geologic or physical feature based on field review
- Modify a channel, creek or river based on a field review or review of USGS Topographic Map

Less-Than-Significant Impacts

Threshold	Would the project be located within an area subject to landslides, mudslides, subsidence, or other similar hazards such as liquefaction or strong seismic groundshaking?

Impact 4.5-1 **Development of the proposed project would not expose people and/or structures to potentially substantial adverse effects, including the risk of loss, injury, or death, involving landslides and/or slope instability, liquefaction or strong seismic groundshaking. Compliance with applicable federal, state, and local regulations would ensure this impact is *less than significant.***

Impacts related to liquefaction are addressed in Section 4.14 (Effects Not Found to Be Significant). This analysis addresses impacts related to strong seismic groundshaking, and landslides.

As described above in Section 4.5.1 (Environmental Setting), the project site is in a seismically active area. Active and potentially active faults in Southern California are capable of producing seismic groundshaking in the project vicinity, and the area would experience ground acceleration caused by these earthquakes. As stated previously, the project site is 0.5 mile east of the Glen Helen segment of the San Jacinto fault and 1.5 mile southwest of the San Bernardino segment of the San Andreas fault. The design earthquake for the vicinity of the project site is estimated by the U.S. and California Geological Surveys to be an Mw 7.3 earthquake on the San Andreas fault, creating peak horizontal ground accelerations that could be greater than 0.8g because the project site is within the 5 km (3.1 miles) near-source area of the fault. Although the San Jacinto fault is closer to the project site, the higher magnitude capability of the nearby San Andreas fault probably would produce more severe groundshaking. The resulting vibration would damage buildings, roads and infrastructure (primary effects), and could cause ground failures such as liquefaction or settlement in alluvium and poorly compacted fill (secondary effects). Because the project site area is 1.5 miles from known traces of the fault, violent seismically induced groundshaking would occur at the project site.

To reduce the primary and secondary risks associated with seismically induced groundshaking, which could include the risk of loss, injury, or death, the design of foundations and structures must consider the location and type of subsurface materials underlying the project site. Residential, commercial, and institutional buildings in the City of San Bernardino and all associated infrastructure are required to reduce the exposure to potentially damaging seismic vibrations through seismic-resistant design, in conformance with Chapter 16 (Structural Design Requirements), Division IV (Earthquake Design), of the California Building Code, as adopted by the City in its Uniform Building Code. Because the project site area is in the closest near-source area of the San Andreas and San Jacinto faults, Section 1629 (Criteria Selection), of the Building Code requires special seismic design factors be applied to the project including:

- The use of California Building Code Seismic Zone 4 Standards as the minimum seismic-resistant design for all proposed facilities

- Additional seismic-resistant earthwork and construction design criteria, based on the site-specific recommendations of a California Certified Engineering Geologist in cooperation with the project's California-registered geotechnical and structural engineers
- An engineering analysis that demonstrates satisfactory performance of alluvium or fill where either forms part or all of the support, especially if potentially liquefiable soils are discovered on site
- An analysis of soil expansion potential and appropriate remediation (compaction, removal and replacement, etc.) as necessary prior to using any expansive soils for foundation support

Based on a comparison of the project as proposed with the geo-seismic conditions outlined in the Setting portion of this section of the EIR showing that a regulatory framework exists to address earthquake safety issues, seismically induced groundshaking would not be a substantial hazard at the project site. Consequently, there would be no significant adverse impact regarding strong seismic groundshaking.

The probability of encountering unstable geologic units or soils, including expansive, compressible, and collapsible soils, at the project site is relatively low. Nonetheless, the relatively high probability of the occurrence of damaging earthquakes in the area makes it necessary to ensure the soils used for foundation support are sound. Using unsuitable and unstable soils would have the potential to create future problems of building settlement and utility line disruption. When weak soils are re-engineered specifically for stability prior to use, these potential effects can be reduced or eliminated. An acceptable degree of soil stability can be achieved by the required incorporation of soil treatment programs (grouting, compaction, drainage control, etc.) in the excavation and construction plans to address site-specific soil conditions. The site-specific analysis is the mainstay of foundation support design in areas where unsuitable conditions are suspected. Such analyses contain recommendations for ground preparation and earthwork specific to the site that become an integral part the construction design.

As part of the construction permitting process, the City requires completed reports of soil conditions at the specific construction sites to identify potentially unsuitable soil conditions. The evaluations must be conducted by registered soil professionals, and measures to eliminate inappropriate soil conditions must be applied, depending on the soil conditions. The design of foundation support must conform to the analysis and implementation criteria described in the City's Uniform Building Code, Chapters 16, 18, and A33. Adherence to the City's codes and policies ensures the maximum practicable protection available for users of buildings and infrastructure and their associated trenches, slopes, and foundations.

Based on a comparison of the project as proposed with the conditions outlined in the Setting portion of this section of the EIR showing that a regulatory framework exists to address weak soils issues, unstable geologic and soil units would not be a substantial hazard at the project site. Consequently, there would be no significant adverse impact regarding unstable or expansive soils.

The eastern face of the southern portion of the larger on-site hill appears to be a landslide feature: there is evidence that it has experienced movement in the recent past. If this part of the site were used by the proposed project a site-specific slope stability design would be required to ensure adherence to the standards contained in the City's Uniform Building Code and General Plan guidelines, as well as by California Division of Occupational Safety and Health (DOSH, CAL/OSHA) requirements for shoring and stabilization. Downslope activity is possible and the hillside would be especially vulnerable after a

period of precipitation while enduring an earthquake. Only the east-southeast facing slopes of the site appear to be susceptible to landslide failures. The proposed development would include the grading of all on-site hills and slopes; including some up to 36 feet in height with minor cut slopes up to 8 feet in height. The removal of all hills and slopes on site will eliminate all impacts associated with landslide features initially present on the project site.

Seismically induced groundshaking and landsliding would not present a substantial adverse hazard to people working at or visiting the project site due to the existing regulations that address earthquake safety issues. As stipulated by LOR Technical Group (refer to Appendix G [Geotechnical Study]), over-excavation of potentially compressible soils underlying the project site would occur during grading to minimize seismic-related settlement potential. These recommendations would be implemented as required by the City's building Code. Adherence to the Uniform Building Code, as required by state and City law, would ensure that the proposed project provides an acceptable level of protection against seismic-related hazards according to current geotechnical engineering standards. The proposed project would have a ***less-than-significant*** impact associated landslide and strong seismic groundshaking. No mitigation is required.

Threshold	Would the project result in substantial soil erosion, dust, or unstable soil conditions from construction or operation?
Threshold	Would construction activities involve earth movement (cut and/or fill) on slopes of 15 percent or more that could result in landslides, mudslides, flooding, siltation, or severe scarring?

Impact 4.5-2 **Construction and operation of the proposed project would not result in substantial soil erosion, dust, unstable soil conditions, or landslides, mudslides, flooding, siltation, or severe scarring from earth-moving activities on slopes of 15 percent or more. This would be a *less-than-significant* impact because slope stability, soil stability, and seismic-resistant design of structures proposed for human occupancy are required by the City of San Bernardino General Plan and Building Code and are enforced by City and state regulations.**

Impacts related to unstable soils as a result of collapse, subsidence, differential settlement, lateral spreading or heaving, as well as earth movement resulting from cut and/or fill activities have been analyzed in this section. The soils at the site consist generally of sand and a thin layer of surficial fill materials, the hillsides are made up of bedrock units of Pelona Schist metamorphic bedrock which are generally soft to moderately hard at the surface, becoming hard to very hard with depth. The upper alluvial units on the site are typically in a loose to a medium dense state, becoming denser with depth. Consolidation testing (see Glossary) of samples taken from the project site indicates normal soil strength and stability for the natural materials. Settlement could occur in the existing or new fill if it were improperly compacted during site grading. Settlement can be reduced by over-excavation and recompaction of the affected soils during grading. Using unsuitable materials for fill and/or foundation support would have the potential to create future heaving, subsidence, spreading, or collapse problems

leading to building settlement and/or utility line and pavement disruption. Using such materials exclusively for landscaping would not cause these problems.

The soils at the project site have an Expansion Index of 0, meaning a very low expansion potential. Nonetheless, the potential for soil expansion still exists. The project would be required to comply with the previously described provisions of the Building Code dealing with soil stability. Adherence to Building Code standards would ensure that the proposed project would have a ***less-than-significant*** impact regarding the exposure of people or structures to hazards related to expansive soils. No mitigation is required.

The existing fill materials, landslide feature and the upper portions of the native alluvial and wind blow sand materials would not, in their present condition, provide uniform and/or adequate support for the proposed structure. An acceptable degree of soil stability can be achieved for expansive or compressible material by the incorporation of soil treatment programs (replacement, grouting, compaction, drainage control, etc.) in the excavation and construction plans that will be prepared to address site-specific soil conditions. A site-specific evaluation of soil conditions would be required and must contain recommendations for ground preparation and earthwork specific to the site.

Topsoil is the uppermost layer of soil, usually the top 6 to 8 inches. It has the highest concentration of organic matter and microorganisms, and is where most biological soil activity occurs. Plants generally concentrate their roots in, and obtain most of their nutrients from, this layer. Topsoil erosion is of concern for two reasons: when the topsoil layer is blown or washed away plant life or agricultural production is reduced or eliminated; the soil particles eroded from a site cause turbidity in the drainage ways, creeks and ponds where the soil is deposited, reducing water quality and endangering aquatic habitat. Generally, in a developed environment, topsoil erosion is not an issue because there is no existing and exposed topsoil or any agricultural or biological production that would be affected. However, in areas such as the project site, the potential for soil erosion is generally higher because of a relative lack of impermeable/stabilized surfaces.

As stated previously, soils at the project site have a low to moderate susceptibility to erosion in their natural condition. These soils would be susceptible to erosion during construction activities, such as excavation. Under the NPDES permit, which applies to grading activities of more than 1 acre, and is administered under the Regional Water Quality Control Board (RWQCB), the developer would be required to prepare and implement a SWPPP, including a Best Management Practices (BMP) program to address construction-related discharges. Preparation of the SWPPP is described in detail in Section 4.7 (Hydrology/Water Quality). BMPs include, but are not limited to, the implementation of erosion and sediment controls. Because construction would occur throughout the year, erosion control BMPs must be implemented to ensure that sediment is confined to the construction area and not transported off site.

Soil erosion after construction would be controlled by implementation of an approved landscape and irrigation plan.

Adherence to the NPDES permit requirements and adherence to the Uniform Building Code would ensure maximum practicable protection available for soils excavated during the construction of buildings

and associated infrastructure. Compliance with the Uniform Building Code and the NPDES permit would minimize effects from erosion and ensure consistency with the RWQCB Water Quality Control Plan. In view of these requirements, the proposed project would have a ***less-than-significant*** impact associated with soil erosion, dust, or unstable soil conditions. No mitigation is required.

As part of the construction permitting process, the City requires completed reports of soil conditions at specific construction sites to identify potentially unsuitable soil conditions including liquefaction, subsidence, and collapse. The evaluations must be conducted by registered soil professionals, and measures to eliminate inappropriate soil conditions must be applied, depending on the soil conditions. The design of foundation support must conform to the analysis and implementation criteria described in the City's Building Code (Chapters 16, 18, and A33).

Adherence to the City's codes and policies as required by the Uniform Building Code and General Plan would ensure the maximum practicable protection available for users of buildings and infrastructure and associated trenches, slopes, and foundations. In view of these requirements, the proposed project would have a ***less-than-significant*** impact associated with the exposure of people or structures to hazards associated with unstable geologic units or soils. No mitigation is required.

Construction of the proposed project would involve the grading of all on-site hills, including earth moving of slopes of 15 percent or greater, which has the potential to create unstable slopes resulting in landslides, mudslides, flooding, siltation, or severe scarring. This would be a ***less-than-significant*** impact because slope stability, soil stability, and seismic-resistant design of structures proposed for human occupancy are required by the City of San Bernardino General Plan and Building Code and are enforced by City and state regulations.

In addition, all construction activities would comply with Chapter 33 of the Uniform Building Code, which regulates excavation activities and the construction of foundations and retaining walls; Appendix Chapter 33 of the Uniform Building Code, which regulates grading activities, including drainage and erosion control; and Title 15 of the City of San Bernardino Municipal Code, which governs all grading and on-site improvement plans, requirements, and processes for the preparation and approval of a grading plan. Compliance with the NPDES permit process, the Uniform Building Code requirements, and the City Codes would minimize the effects from erosion. Therefore, such compliance would ensure that erosion and other soil instability impacts resulting from project construction would be ***less than significant***.

Threshold	Would the project result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state.
Threshold	Would the project result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan?
Threshold	Would the project be located in a Mineral Resource Zone as adopted by the State Mining Geology Board and identified in the City's General Plan?

Impact 4.5-3 **The proposed project would not result in the loss of availability of a known valuable mineral resource or of a locally-important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan. The proposed project would be located in a Mineral Resource Zone as adopted by the State Mining Geology Board and identified in the City's General Plan, but has not been designated as an IE land use zone. Impacts would be *less-than-significant*.**

As stated above in the Mineral Resources section of the Environmental setting, to protect the mineral resources of a particular city and region, the classification process for mineral resource conservation is implemented by the California Department of Conservation through the California State Mining and Geology Board, as decreed in SMARA. The project site is in an area that has been classified as Mineral Resources Zone 2 (MRZ-2). Land classified as MRZ-2 specifies areas where adequate information indicates that significant mineral deposits are present, or where it is judged a high likelihood for their presence. However, inclusion of these areas in the General Plans does not represent a commitment to mineral extraction for these areas, only to respond to SMARA's mandate to recognize these mineral resource areas in the General Plan. Additionally, a small portion of the project site is included in Sector C-9. Sector C is the Cajon Wash and extends from the confluence of Cajon Wash and Lytle Wash about 8 miles upstream. The sector has been subdivided by highways and other intervening developments. Sector C contains approximately 2.3 times more than the estimated consumption demand of aggregate resources in the San Bernardino P-C Region to the year 2037. This number does not take into consideration the other eight mineral resource sectors with available aggregate resources to satisfy the consumption demand.

In the City's General Plan, the Industrial Extractive (IE) land use designation is used to identify areas within MRZs where sand and gravel mining is expected to occur. The IE designation is a refinement of, and more limited in area than those areas depicted on the Mineral Resource Zone map included in the Natural Resources and Conservation Element of the City's General Plan. The project site is currently designated as Light Industrial (LI) and not zoned IE, therefore the project site is not subject to activities involving the mining of the land. Although the project site is in a mineral resource zone, there is no conflict regarding the use of the site for purposes other than mining. The proposed project would not result in the loss of availability of a locally-important mineral resource recovery site. Loss of availability of these resources contained on the project site would only represent a loss of a minute percentage of all available resources in the region. Therefore the impacts are determined to be ***less than significant***.

4.5.4 Cumulative Impacts

A cumulative impact analysis is only provided for those thresholds that result in a less-than-significant or significant and unavoidable impact. A cumulative impact analysis is not provided for Effects Found Not to Be Significant, which result in no project-related impacts.

The geographic context for the analysis of cumulative impacts resulting from geologic hazards is generally site-specific, because each project site has a different set of geologic considerations that would

be subject to specific site development and construction standards. Soil and geologic conditions are site-specific and there is little, if any, cumulative relationship between this project and other areas in the City.

Threshold	Would the project be located within an area subject to landslides, mudslides, subsidence, or other similar hazards such as liquefaction or strong seismic groundshaking?

Impacts associated with potential geologic hazards related to groundshaking, seismic-related ground failure, or expansive soils would occur at individual building sites. These effects are site-specific, and impacts would not be compounded by additional development. Buildings and facilities in the City of San Bernardino would be sited and designed in accordance with appropriate geotechnical and seismic guidelines and recommendations, consistent with the requirements of the Uniform Building Code. Adherence to all relevant plans, codes, and regulations with respect to project design and construction would provide adequate levels of safety, and the cumulative impact would be ***less than significant.*** Because the proposed project would be in compliance with applicable project requirements, there are limited potential risks associated with expansive soils would not be cumulatively considerable.

Threshold	Would the project result in substantial soil erosion, dust, or unstable soil conditions from excavation, grading, fill or other construction activities or from operation?

Impacts associated with potential geologic hazards related to landslides and/or soil failure occurs at individual sites. These effects are site-specific, and impacts would not be compounded by additional development. As discussed previously in this section, the probability that landslides would occur as a result of the project, or affecting the project, is remote. Because development in the City of San Bernardino would be required to be sited and designed in accordance with appropriate geotechnical and seismic guidelines and recommendations consistent with the standards of the City's Uniform Building Code, the cumulative impact would be less than significant. Adherence by the Concept Plan to all relevant plans, codes, and regulations with respect to project design and construction would provide adequate levels of safety, which would ensure that the Concept Plan would not result in a cumulative impact regarding landslides and/or slope instability. Therefore, the cumulative impact of the Concept Plan would be ***less than significant***.

The impacts from erosion and loss of topsoil from site development and operation can be cumulative in effect within a watershed. The Santa Ana Watershed forms the geographic context of cumulative erosion impacts.

Development throughout San Bernardino County and the City of San Bernardino is subject to runoff, erosion, and sedimentation prevention requirements, including the applicable provisions of Phases I and II of the NPDES permit process, as well as implementation of fugitive dust control measures in accordance with SCAQMD Rule 403 (refer to Section 4.2 [Air Quality] of this EIR). These requirements would be implemented as conditions of approval of project development and subject to continuing enforcement.

Implementation of the proposed project would modify soil and topographic conditions at the site to accommodate development and to provide a stable and safe physical environment. The construction phase of the proposed project could expose soil to erosion by wind or water. Development of other cumulative projects in the vicinity of the project site could also expose soil surfaces, and further alter soil conditions. To minimize the potential for cumulative impacts that could cause erosion, the proposed project and cumulative projects in the adjacent area are required to be developed in conformance with the provisions of applicable federal, state, County, and City laws and Codes. As a result, it is anticipated that cumulative impacts on the Santa Ana Watershed caused by runoff and erosion from cumulative development activity would be ***less than significant***.

As with seismic groundshaking impacts, the geographic context for analysis of impacts on development from unstable soil conditions including landslides, liquefaction, subsidence, collapse, or expansive soil generally is site-specific. Because all development in Seismic Zone 4 is required to undergo analysis of geological and soil conditions applicable to the project site, and because restrictions on development would be applied in the event that geological or soil conditions posed a risk to safety, it is anticipated that cumulative impacts from development on soils subject to instability, subsidence, collapse, and/or expansive soil would be ***less than significant***.

Cumulative development within the region could interfere with the availability of a locally-important mineral resource. It could also occur within areas designated by the state, or a local general plan, specific plan or other land use plan as areas containing mineral resources that are of local and/or state importance. Because urban uses, such as residential and commercial development, would generally be considered inconsistent with mineral extraction activities, development of these uses in the vicinity of mineral resource sites could hinder or preclude mineral extraction activities. Therefore, cumulative development within the region could result in the loss of availability of some mineral resources, which would be considered a potentially significant cumulative impact. The City has identified lands suitable for mineral extraction in its General Plan. The site is not designated for such uses. Consequently, the project's contribution to the cumulative loss of available mineral resources or of a known mineral resource that would be of value to the region and/or the residents of the state would not be cumulatively considerable. Impacts would be ***less than significant***.

4.5.5 Glossary

- **Alquist-Priolo Earthquake Fault Zone**—In 1972 the state of California began delineating special studies zones (called Earthquake Fault Zones since January 1994) around active and potentially active faults in the state. The zones are revised periodically, and extend 200 to 500 feet on either side of identified fault traces. No structures for human occupancy may be built across an identified active fault trace. An area of 50 feet on either side of an active fault trace is assumed to be underlain by the fault, unless proven otherwise. Proposed construction within the Earthquake Fault Zone is permitted only following the completion of a fault location report prepared by a California Registered Geologist.
- **Blind Thrust Fault**—A seismic rupture plane that is not visible at the ground surface and is at a low to moderate angle.

- **Characteristic Earthquake**—Characteristic earthquakes are repeat earthquakes that have the same faulting mechanism, magnitude, rupture length, location, and, in some cases, the same epicenter and direction of rupture propagation as earlier shocks. As used in this report, the M_W of the "characteristic earthquake" indicates the scale of the seismic event considered representative of a particular fault segment, based on seismologic observations and statistical analysis of the probability that a larger earthquake would not be generated during a given time frame (often 50 or 100 years). The term "characteristic earthquake" replaces the term "maximum credible earthquake" as a more reliable descriptor of future fault activity.
- **Consolidation Testing**—Excess water is removed from the pores of a soil sample to identify the actual volume of the soil skeleton versus the volume of water drained from the sample. Stress is applied to the soil sample to determine the rate and amount of settlement. Results indicate the severity of deformation or collapse to which the soil is subject.
- **Geomorphic Provinces**—California's geomorphic provinces are naturally defined geologic regions that display a distinct landscape or landform. Earth scientists recognize eleven provinces in California. Each region displays unique, defining features based on geology, faults, topographic relief, and climate. These geomorphic provinces are remarkably diverse. They provide spectacular vistas and unique opportunities to learn about earth's geologic processes and history.
- **Horizontal Ground Acceleration**—The speed at which soil or rock materials are displaced by seismic waves. It is measured as a percentage of the acceleration of gravity (0.5g = 50 percent of 32 feet per second squared, expressed as a horizontal force). Peak horizontal ground acceleration is the maximum acceleration expected from the characteristic earthquake predicted to affect a given area. Repeatable acceleration refers to the acceleration resulting from multiple seismic shocks. Sustained acceleration refers to the acceleration produced by continuous seismic shaking from a single, long duration event.
- **Infill Valley**—A low-lying linear topographic feature, usually created by flowing-water erosion, and subsequently buried by a process of deposition in which sediment falls or is washed into depressions, cracks, or holes to such an extent that the feature becomes difficult to distinguish from the surrounding landscape except through subsurface investigation.
- **Maximum Credible Earthquake (MCE)**—The largest Richter magnitude (M) seismic event that appears to be reasonably capable of occurring under the conditions of the presently known geological framework. This term has been replaced by "characteristic earthquake," which is considered a better indicator of probable seismic activity on a given fault segment within a specific time frame.
- **Modified Mercalli Intensity (MMI) Scale**—A twelve-point scale of earthquake intensity based on local effects experienced by people, structures, and earth materials. Each succeeding step on the scale describes a progressively greater amount of damage at a given point of observation. Effects range from those that are detectable only by seismicity recording instruments (I) to total destruction (XII). Most people would feel Intensity IV ground motion indoors and Intensity V outside. Intensity VII frightens most people, and Intensity IX causes alarm approaching panic. The scale was developed in 1902 by Giuseppi Mercalli for European conditions, adapted in 1931 by American seismologists Harry Wood and Frank Neumann for conditions in North America, and modified in 1958 by Dr. Charles F. Richter to accommodate modern structural design features.
- **Moment Magnitude (M_W)**—A logarithmic scale introduced by Hiroo Kanamori in 1977 that is used by modern seismologists to measure the total amount of energy released by an earthquake.

For the purposes of describing this energy release (i.e., the "size" of an earthquake on a particular fault segment for which seismic-resistant construction must be designed) the M_W of the characteristic earthquake for that segment has replaced the concept of a MCE of a particular M. This has become necessary because the Richter scale "saturates" at the higher magnitudes; that is, the Richter scale has difficulty differentiating among the sizes of earthquakes above M 7.5. To correct for this effect, the formula used for the M_W scale incorporates parameters associated with the rock types at the seismic source and the area of the fault surface involved in the earthquake. Thus, the M_W is related to the length and width of the fault rupture. It reflects the amount of "work" (in the sense of classical physics) done by the earthquake. The relationship between M and M_W is not linear (i.e., M_W is not a set percentage of M): the two values are derived using different formulae. The four well-know earthquakes listed below exemplify this relationship.

Location	*Date*	*Richter Magnitude*	*Moment Magnitude*
New Madrid MO	1812	8.7	8.1
San Francisco CA	1906	8.3	7.7
Anchorage AK	1964	8.4	9.2
Northridge CA	1994	6.4	6.7

Although some of the values shown on the moment magnitude scale (M_W)appear lower than those of the Richter magnitude scale (M), they convey more precise (and more useable) information to geologic and structural engineers.

- **Pseudostatic Factor of Safety**—A measure of the vulnerability of slopes to seismic instability simulated by applying a seismic coefficient of 15 percent of the force of gravity (0.15g) to the static (i.e., gravitational) forces promoting landsliding. The standard for new development in California is to assure a minimum Factor of Safety greater than or equal to 1.1 in the pseudostatic case. A Factor of Safety greater than or equal to 1.5 is the industry standard for new development under static conditions. As the Factor of Safety increases, the probability of slope instability decreases.
- **Richter Magnitude Scale (M)**—A logarithmic scale developed in 1935 and 1936 by Dr. Charles F. Richter and Dr. Beno Gutenberg to measure earthquake magnitude (M) by the amount of energy released, as opposed to earthquake intensity as determined by local effects on people, structures, and earth materials (for which, see Modified Mercalli Intensity Scale, above). Each whole number on the Richter scale represents a 10-fold increase in amplitude of the waves recorded on a seismogram and about a 32-fold increase in the amount of energy released by the earthquake. Because the Richter scale tends to saturate above about M 7.5, it is being replaced in modern seismologic investigations by the M_W scale (see above).
- **Near-Source Factors**—Two Near-Source Factors are identified in the California Building Code (CBC): $N\alpha$ and $N\gamma$. These factors reflect the proximity of a proposed structure to known faults with magnitudes and slip rates as listed in CBC Tables 16-S, Near-Source Factor $N\alpha$, and 16-T, Near-Source Factor $N\gamma$. The factors are used to determine the seismic coefficients $C\alpha$ and $C\gamma$ (listed in CBC Table 16-Q, Seismic Coefficient $C\alpha$, and CBC Table 16-R, Seismic Coefficient $C\gamma$), which are required to be applied to the site-specific type of ground (listed in CBC Table 16-J, Soil Profile Types) that would form the foundation support of a proposed structure. Values for Near-Source Factor $N\alpha$ range from 1.0 to 1.5. The lowest factor applies to sites in the broadest regulated zone ($\geq$ 10 kilometers [6.2 miles]) from the fault trace and/or sites near the least active type of

seismic source (Type C, explained below). The highest factor applies to sites in the narrowest regulated zone (≤ 2 kilometers [1.2 miles]) from the fault trace and/or sites near the most active type of seismic source (Type A, explained below). Values for Near-Source Factor Nγ range from 1.0 to 2.0. The lowest factor applies to sites in the broadest regulated zone (≥ 15 kilometers [9.3 miles]) and/or sites near the least active type of seismic source (Type C). The highest factor applies to sites in the narrowest regulated zone (≤ 2 kilometers [1.2 miles]) and/or sites near the most active type of seismic source (Type A). Because the Project Site is 0.8 kilometer (0.5 mile) from the San Jacinto fault (a Type B seismic source) and 2.4 kilometers (1.5 mile) from the San Andreas fault (a Type A seismic source), Near-Source Factor Nα would be between 1.3 and 1.2; Near-Source Factor Nγ would be 1.6.

- **Seismic Source Type A** is defined in CBC Table 16-U as "Faults that are capable of producing large magnitude events and that have a high rate of seismic activity," a maximum moment magnitude of $M_W \geq 7.0$, and a slip rate of SR ≥ 5 millimeters/year. Seismic Source Type C is defined as "Faults that are not capable of producing large magnitude events and that have a relatively low rate of seismic activity," a maximum moment magnitude of $M_W < 6.5$, and a slip rate of SR ≤ 2 millimeters/year. Seismic Source Type B is defined as "All faults other than Types A and C," having maximum moment magnitudes between $M_W \geq 6.5$ and MW ≥ 7.0, and slip rates between SR< 2 millimeters/year and SR < 5 millimeters/year.
- **Site Soil Profile Type**—Site soil profiles of S_A to S_E are based on the average shear wave velocity in the top 30.5 meters (100 feet) of soil (see Figure 4.2 or UBC-97, Table 16-J). This velocity varies from under 180 meters/second (590 feet/second) for the soft soils (S_E) to over 1500 meters/second (4921 feet/second) for the hard rock profile (S_A). Another class of soil profile type (S_F) requires site-specific evaluation and is not classified based on average shear wave velocity and constitutes very poor site soil conditions prone to liquefaction problems.

4.5.6 References

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