IV.G GEOLOGY AND SOILS

INTRODUCTION

This section identifies the potential for geological and seismic hazards to occur in or around the Specific Plan area. Issues of concern include suitability of soil for development; geologic faults; and direct and indirect seismic hazards such as floods, subsidence, liquefaction, and landslides. This section was prepared utilizing documents and maps published by the United States Geological Survey (USGS), California Department of Conservation, California Geological Survey (CGS), the City of Los Angeles, and the Phase I and Phase II Environmental Site Assessments prepared for the Specific Plan area by Andersen Environmental. The Phase I and Phase II ESAs referenced in this section are included as Appendix C.

ENVIRONMENTAL SETTING

Geologic Setting

The Specific Plan area is part of the South Los Angeles Subregion which lies within the Los Angeles Basin. The basin is bounded on the north by the Santa Monica Mountains and Puente Hills, on the east by the Santa Ana Mountains and San Joaquin Hills, and on the west and south by the Palos Verdes Hills and the Pacific Ocean. The basin is made up of a great thickness of sediments that was deposited on an ancient sea floor. Three major groups of rocks are represented: older igneous and metamorphic bedrock (100 to 75 million years old), older sedimentary rocks (about 65 to 15 million years old) and younger sedimentary rocks (15 to 1 million years old). The sedimentary rock layers contain shale, siltstone, sandstone, and conglomerates, as well as some interbedded volcanic rocks. The Specific Plan area is underlain by poorly consolidated Holocene to late Pleistocene alluvial fan and valley deposits, generally consisting of poorly sorted clay, sand, gravel, and cobbles.[1] Native soils observed within the Specific Plan area generally consist of light brown silty sand with small to medium grain size.[2]

Seismicity

The Specific Plan area is within the seismically-active Southern California region and, as such, earthquakes and seismically-induced effects are constant potential hazards. Issues of concern relating to earthquakes include fault rupture, strong ground shaking, liquefaction, and landslides, as described below.

Fault Rupture. Fault rupture is defined as surface displacement caused by an earthquake. A fault is a fracture in the Earth's crust along which rocks on one side have moved relative to rocks on the other side. Most faults are the result of repeated displacement over long periods of time.[3] Faults are characterized by CGS as active, potentially active, or inactive, according to the last seismic activity of the fault. Active faults are faults that show evidence of surface displacement within Holocene time (i.e., the past 11,000 years). Potentially active faults are those that show evidence of surface displacement during the Pleistocene time (i.e., the past 1.6 million years). Faults showing no evidence of surface displacement within the last 1.6 million years are considered inactive.

The City of Los Angeles is designated as a city affected by earthquake fault zones under the Alquist-Priolo Earthquake Fault Zoning Act (Alquist-Priolo Act). The Alquist-Priolo Act was passed as a direct

[1]Andersen Environmental, *Phase I Environmental Site Assessment Report Performed at Jordan Downs Redevelopment Project Area – Jordan Downs Housing Development*, March 24, 2010.

[2]Andersen Environmental. *Environmental Sampling Report; Site: 9901 South Alameda Street*, April 13, 2010.

[3]California Geological Survey, *Alquist-Priolo Earthquake Fault Zones* (2007), available at www.consrv.ca.gov/.CGS/RGHM/AP/Pages/Index.aspx, accessed February 26, 2009.

result of the 1971 San Fernando Earthquake. The primary purpose of the Alquist-Priolo Act is to mitigate the hazards associated with fault rupture by "preventing construction of buildings used for human occupancy on the surface trace of active faults."[4] The Alquist-Priolo Act has been revised eleven times, most recently in 2007, to reflect changes and additions of affected cities. The City of Los Angeles also designates Fault Rupture Study Zones around potentially active and active faults to establish hazard potential.[5] A review of the fault systems of Southern California revealed that no active nor potentially active faults traverse the Specific Plan area. However, the Specific Plan area is located within the range of influence of several fault systems that are considered active or potentially active. One fault, the Newport-Inglewood Rose Canyon Fault, is located approximately three miles southwest of the Specific Plan area. **Figure IV.G-1** identifies active and potentially active faults in the region and in the vicinity of the Specific Plan area.

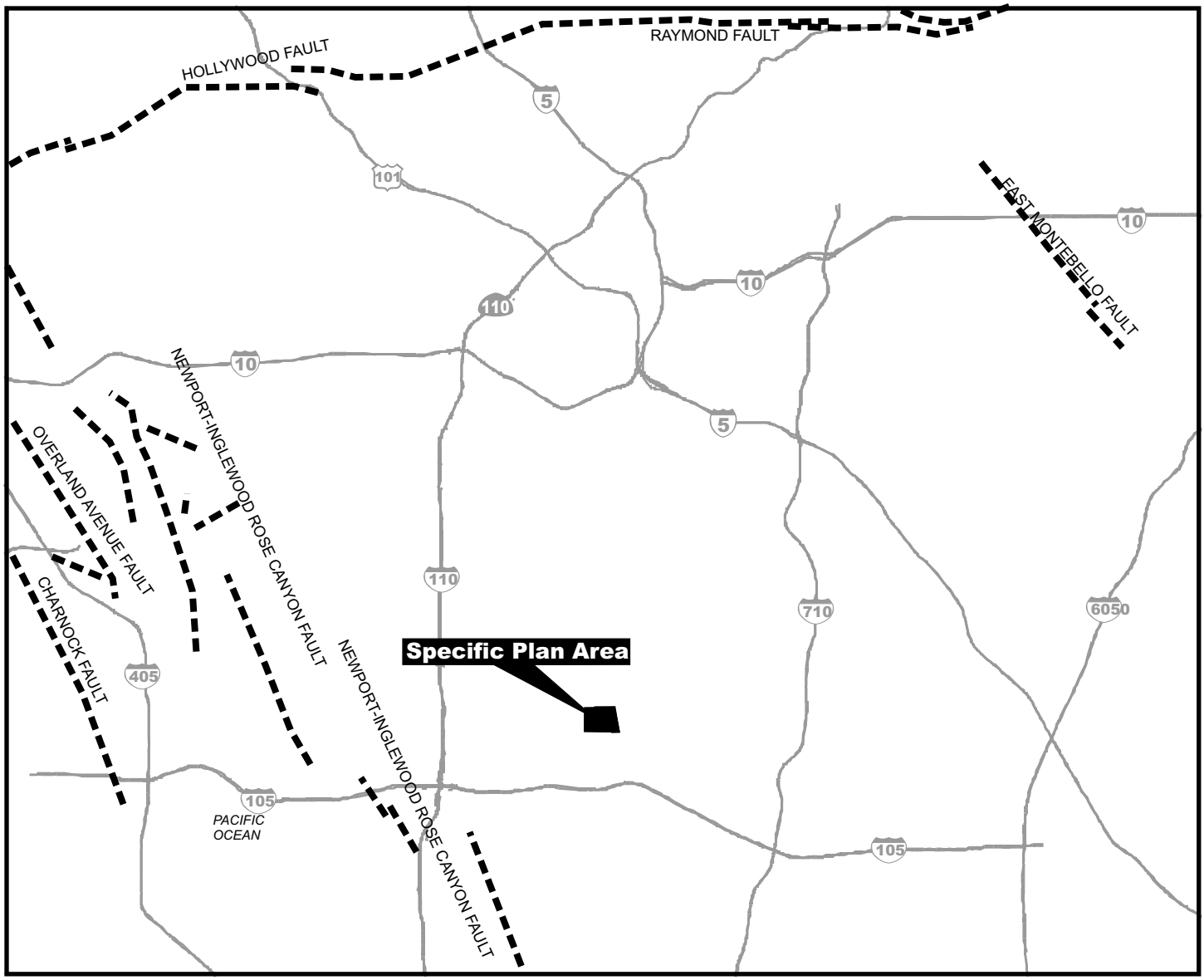
Ground Shaking. Ground shaking is the actual trembling or jerking motion of the ground during an earthquake. The most widespread damaging effects of earthquakes are caused by strong ground shaking and can vary widely across an area and depend on such factors as earthquake intensity and fault mechanism, duration of shaking, soil conditions, type of building, and other factors.

As with all properties in the seismically-active Southern California region, the Specific Plan area is susceptible to strong seismic ground shaking. Earthquakes generally occur on faults, which are the planar features within the earth. Numerous regional and local faults are capable of producing severe earthquakes of magnitude 6.0 or greater. Usually, the effect of an earthquake originating from any given fault will depend upon its distance from a particular site and the size of the earthquake the fault generates. The more distant the fault or the smaller the earthquake is, the less the effect of the event on the Specific Plan area.

The magnitude of an earthquake is measured on the Moment Magnitude Scale (MMS), which has replaced the Richter scale (though values at lower magnitudes are essentially the same). The MMS is a logarithmic scale of base ten that calculates the amplitude of the largest seismic wave recorded. The intensity of an earthquake is measured by the Modified Mercalli Intensity scale, which ranges from I to XII. An earthquake has only one magnitude but can have many intensity values depending on the distance from the epicenter. **Table IV.G-1** shows intensities that are typically observed near the epicenter of earthquakes of different magnitudes.

Liquefaction. Liquefaction is a phenomenon where soil, saturated with water, behaves like liquid when shaken by an earthquake. Liquefaction results in lateral spreading, ground settlement, sand boils, and soil falls. Liquefaction typically occurs in areas with a high groundwater table and low-density, fine sandy soils. Liquefaction also occurs with high-density ground motion. The Specific Plan area is potentially subject to liquefaction in the event of an earthquake.[6]

[4] *Ibid.*
[5] City of Los Angeles, *General Plan Safety Element, Exhibit A*, November 26, 1996.
[6] California Department of Conservation, *Seismic Hazard Zones, South Gate Quadrangle* (1999), available at http://www.conservation.ca.gov/cgs/shzp/Pages/Index.aspx, accessed March 30, 2010.



LEGEND:

Specific Plan Area

Fault

SOURCE: USGS, 2010

APPROX. SCALE

0 1.3 2.6 MILES

N

taha 2008-079

Jordan Downs Specific Plan
Environmental Impact Report

CITY OF LOS ANGELES DEPARTMENT OF CITY PLANNING

FIGURE IV.G-1

ACTIVE FAULTS

TABLE IV.G-1: MODIFIED MERCALLI INTENSITY SCALE

Magnitude	Intensity	Description
1.0-3.0	**I**	I. Not felt except by a very few.
3.0-3.9	**II-III**	II. Felt only by a few persons at rest, especially on upper floors of buildings. III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Vibrations similar to the passing of a truck.
4.0-4.9	**IV-V**	IV. Felt indoors by many, outdoors by few during the day. Dishes, windows, doors disturbed. Sensation like heavy truck striking building. V. Felt by nearly everyone. Some windows broken. Pendulum clocks may stop.
5.0-5.9	**VI-VII**	VI. Felt by all, many frightened. Some heavy furniture moved. Damage slight. VII. Damage negligible in buildings of good design and construction; considerable damage in poorly built or badly designed structures.
6.0-6.9	**VII-IX**	VIII. Damage slight in specifically designed structures. Damage great in poorly built structures. Fall of chimneys and walls. Heavy furniture overturned. IX. Damage considerable in specifically designed structures; Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
7.0 and Higher	**VIII or Higher**	X. Most masonry and frame structures destroyed with foundations. Rails bent. XI. Few structures remain standing. Bridges destroyed. Rails bent greatly. XII. Damage total. Lines of sight and level are distorted. Objects airborne.

SOURCE: California Department of Conservation, 1998.

Landslides. Landslides include a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Landslides begin as a result of rainfall, earthquakes, volcanic activity, changes in groundwater, disturbance and change of a slope by man-made construction activities, or any combination of these factors. Landslides occur in hillside areas with unstable geological conditions or soil types that would be susceptible to failure when saturated. The Specific Plan area is relatively flat with an elevation of approximately 110 feet above sea level.[7] There are no major hills or land forms within the Specific Plan area, and no designated landslide areas are mapped in the vicinity of the Specific Plan area.[8]

Regulatory Framework

State of California

Alquist-Priolo Earthquake Fault Zoning Act. The Alquist-Priolo Earthquake Fault Zoning Act (Alquist-Priolo Act) provides policies and criteria to assist cities, counties, and State agencies in the development of structures for human occupancy across the trace of active faults. The Alquist-Priolo Act was intended to provide the citizens of the State with increased safety and to minimize the loss of life during and immediately following earthquakes by facilitating seismic retrofitting to strengthen buildings, including historical buildings, against ground shaking.

Seismic Hazards Mapping Act. In order to address the effects of strong ground shaking, liquefaction, landslides, and other ground failures due to seismic events, the State of California passed the Seismic Hazards Mapping Act of 1990. Under the Seismic Hazards Mapping Act, the State Geologist is required to delineate "seismic hazard zones." Cities and counties must regulate certain development projects within these zones until the geologic and soil conditions of the Specific Plan area are investigated and appropriate mitigation measures, if any, are incorporated into development plans. The State Mining and Geology Board provides additional regulations and policies to assist municipalities in preparing the

[7]Andersen Environmental, *Phase I Environmental Site Assessment Report Performed at Jordan Downs Redevelopment Project Area – Jordan Downs Housing Development*, March 24, 2010.

[8]City of Los Angeles, *General Plan Safety Element, Exhibit* C, accessed March 30, 2010.

Safety Element of their General Plan and encourage land use management policies and regulations to reduce and mitigate those hazards to protect public health and safety. Under Public Resources Code Section 2697, cities and counties shall require, prior to the approval of a project located in a seismic hazard zone, a geotechnical report defining and delineating any seismic hazard. Each city or county shall submit one copy of each geotechnical report, including mitigation measures, to the State Geologist within 30 days of its approval.

California Building Code. The California Building Code (CBC) Title 24 is a compilation of building standards, including seismic safety standards for new buildings. CBC standards are based on building standards that have been adopted by state agencies without change from a national model code; building standards based on a national model code that have been changed to address particular California conditions; and building standards authorized by the California legislature but not covered by the national model code. Given the State's susceptibility to seismic events, the seismic standards within the CBC are among the strictest in the world. The CBC applies to all occupancies in California, except where stricter standards have been adopted by local agencies.

City of Los Angeles

City of Los Angeles General Plan Safety Element. The City of Los Angeles General Plan provides growth and development policies by providing a comprehensive long-range view of the City as a whole. The General Plan provides a comprehensive strategy for accommodating long-term growth, should it occur as projected. Applicable goals and policies that apply to all development within the City of Los Angeles include a balanced distribution of land uses, adequate housing for all income levels, and economic stability. The Safety Element of the General Plan addresses the issues of protection of people from unreasonable risks associated with natural disasters, fires, floods, and earthquakes. The Safety Element provides a contextual framework for understanding the relationship between hazard mitigation, response to a natural disaster and initial recovery from a natural disaster.

City of Los Angeles Emergency Operations Organization. The City's Emergency Operations Organization (EOO) helps to administer certain policies and provisions of the Safety Element. The EOO is a City department comprising all City agencies. The EOO Master Plan and associated EOO plans establish the chain of command, protocols and programs for integrating all of the City's emergency operations into one unified operation. Each City agency in turn has operational protocols, as well as plans and programs, to implement EOO protocols and programs. A particular emergency or mitigation triggers a particular set of protocols that are addressed by implementing plans and programs. The City's emergency operations program encompasses all of these protocols, plans and programs.

City of Los Angeles Building Code. Earthwork activities, including grading, are governed by the Los Angeles Building Code, which is contained in Los Angeles Municipal Code, Chapter IX, Article 1. Specifically, Section 91.7006.7 includes requirements regarding import and export of material; Section 91.7010 includes regulations pertaining to excavations; Section 91.7011 includes requirements for fill materials; Section 91.7013 includes regulations pertaining to erosion control and drainage devices; Section 91.7014 includes general construction requirements as well as requirements regarding flood and mudflow protection; and Section 91.7016 includes regulations for areas that are subject to slides and unstable soils.

Additionally, the Los Angeles Building Code includes specific requirements addressing seismic design, site grading, foundation design, cut and fill slope design, soil expansion, geologic investigations and reports before and during construction, retaining walls, soil and rock testing, basement walls, shoring of adjacent properties, and potential primary and secondary seismic effects and groundwater. The Los Angeles Building Code incorporates by reference the 2007 CBC, with City amendments for additional

requirements, and the City Department of Building and Safety is responsible for implementing the provisions of the Los Angeles Building Code.

ENVIRONMENTAL IMPACTS

Significance Thresholds

In accordance with Appendix G of the State CEQA Guidelines, the proposed project would have a significant impact on geology and soils if the proposed project were to:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
  - Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault. Refer to Division of Mines and Geology Special Publication 42;
  - Strong seismic ground shaking;
  - Seismic-related ground failure, including liquefaction; or
  - Landslides;
- Result in substantial soil erosion or the loss of topsoil;
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse;
- Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property; and/or
- 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.

Project Design Features

Earthwork activities associated with the grading and export of soil would occur in accordance with City requirements, as specified in the Los Angeles Building Code and through the grading plan review and approval process. Similarly, building design and construction within the Specific Plan area would conform to the current building and safety design provisions of the CBC and the Los Angeles Building Code. In addition, individual developments within the Specific Plan area would comply with the construction and design recommendations provided within site-specific geotechnical reports. The Los Angeles Building Code also addresses grading, excavation, and fills and requires a local Storm Water Pollution Prevention Plan (SWPPP) and a Wet Weather Erosion Control Plan (WWECP) to be developed for the project. The SWPPP would require implementation of an erosion control plan to reduce the potential for wind or waterborne erosion during the construction process.

Analysis of Proposed Project Impacts

Seismicity

Fault Rupture. The City of Los Angeles is designated as a city affected by earthquake fault zones under the Alquist-Priolo Act. The City of Los Angeles also designates Fault Rupture Study Zones around potentially active and active faults to establish hazard potential, and the Specific Plan area is not located in an Alquist-Priolo Fault Study Zone. No active nor potentially active faults traverse the Specific Plan area.[9] Since no active fault zones are located within or adjacent to the Specific Plan area, the potential for

[9]City of Los Angeles, *General Plan Safety Element, Exhibit A*, November 26, 1996.

surface ground rupture is considered remote. Therefore, impacts related to fault rupture would be less than significant.

Ground Shaking. As with all properties in the seismically-active Southern California region, the Specific Plan area is susceptible to strong seismic ground shaking. However, as with any new development in the State of California, building design and construction would be required to conform to the current seismic design provisions of the CBC. The 2007 CBC incorporates the latest seismic design standards for structural loads and materials, as well as provisions from the National Earthquake Hazards Reduction Program to mitigate losses from an earthquake and provide for the latest in earthquake safety. Construction of the proposed project would be required to adhere to the seismic safety requirements contained in the Los Angeles Building Code, and the proposed buildings would be designed to resist ground shaking through modern construction techniques. In addition, the proposed project would comply with the California Department of Conservation, Division of Mines and Geology (CDMG) Special Publications 117, Guidelines for Evaluating and Mitigating Seismic Hazards in California (1997), which provides guidance for the evaluation and mitigation of earthquake-related hazards. The proposed project would neither cause nor accelerate geologic hazards that could result in substantial damage to structures or infrastructure or expose people to substantial risk of injury impacts from strong seismic ground shaking. Therefore, impacts related to ground shaking would be less than significant with mitigation.

Liquefaction. Liquefaction involves the sudden loss in strength of a saturated, cohesionless soil (predominantly sand) caused by the build-up of pore water pressure during cyclic loading such as produced by an earthquake. This increase in pore water pressure can temporarily transform the soil into a fluid mass, resulting in vertical settlement and can also cause lateral ground deformations. Typically liquefaction occurs in areas where there are loose sands and the depth of groundwater is less than 50 feet from the surface. Seismic shaking can also cause soil compaction and ground settlement without liquefaction occurring including settlement of dry sands above the water table.

As discussed above, the Specific Plan area is located within an area potentially subject to liquefaction in the event of an earthquake.[10] However, the Los Angeles Building Code requires that construction activities be subject to the approval of a site-specific geotechnical study, which would specifically address liquefaction and include measures to address liquefaction. Therefore, compliance with the City's established building standards, as well as adherence to the requirements contained in a site-specific geotechnical investigation, would ensure that potential impacts related to liquefaction would be less than significant.

Landslides. The Specific Plan area is relatively flat and is not located near any foothills or mountains, meaning the probability of seismically-induced landslides occurring on the Specific Plan area is considered to be low due to the general lack of elevation difference slope geometry across or adjacent to the site. Furthermore, the Specific Plan area is not located within a City-designated landslide area. [11] Therefore, the proposed project would not result in substantial damage to structures or infrastructure, or expose people to substantial risk of injury involving landslides. Impacts related to landslides would be less than significant.

Excavation and Development

Erosion. Implementation of the proposed project has the potential to result in the erosion of soil during site preparation and construction activities; however, erosion would be reduced by implementation of appropriate erosion control measures during excavation and grading activities. During the construction

[10]California Department of Conservation, *Seismic Hazard Zones, South Gate Quadrangle* (1999), available at http://www.conservation.ca.gov/cgs/shzp/Pages/Index.aspx, accessed March 30, 2010.

[11]City of Los Angeles, *General Plan Safety Element, Exhibit* C, accessed March 30, 2010.

phases of the proposed project, activities are subject to requirements of the National Pollutant Discharge Elimination System (NPDES) Construction Permit. Compliance with the NPDES permit includes the implementation of Best Management Practices (BMPs), some of which are specifically implemented to reduce soil erosion or loss of topsoil. In addition to the NPDES permit, the Los Angeles Building Code also addresses grading, excavation, and fills and requires a local Storm Water Pollution Prevention Plan (SWPPP) and a Wet Weather Erosion Control Plan (WWECP) to be developed for the proposed project. The SWPPP would require implementation of an erosion control plan to reduce the potential for wind or waterborne erosion during the construction process. Any potential for erosion would be further controlled as mandated by SCAQMD Rule 403 dust prevention measures, and regulatory requirements as imposed by other responsible agencies, including the Los Angeles Regional Water Quality Control Board and conditions of the grading permits. No continued erosion potential would exist after completion of construction. Soil erosion after construction would be controlled by implementation of an approved landscape and irrigation plan. Therefore, impacts related to erosion would be less than significant with mitigation.

Expansive Soils. Expansive soils are typically associated with fine-grained clayey soils that have the potential to shrink and swell with repeated changes in the moisture content. As discussed above, construction activities are subject to requirements of the Los Angeles Building Code. The Building Code requires that construction activities be subject to the approval of a design-level geotechnical study, which would specifically address whether expansive soils are present in the development area and include measures to address these soils where they occur. Improvements, as directed by the soils engineer, may involve replacing the material under foundations and slabs-on-grade with "non-expansive" material, or modifying the expansive soil by compaction control, pre-wetting and the installation of moisture barriers. Therefore, with adherence to the requirements contained in a site-specific geotechnical investigation, potential impacts related to expansive soils would be less than significant.

Septic Tanks

The Specific Plan area is located in an urbanized area extensively served by existing sewer infrastructure. Implementation of the proposed project would not require the use of septic tanks nor alternative wastewater disposal systems. Therefore, no impact related to septic systems and alternative wastewater disposal would occur.

CUMULATIVE IMPACTS

Geotechnical hazards are site-specific, and there is little, if any, cumulative geological relationship between the proposed project and the related projects. Nevertheless, cumulative development in the area would increase the overall population and number of structures, thus, increasing the risk of exposure to seismically-induced hazards. As with the proposed project, related projects and other future development projects would be subject to the same local, regional, State, and federal regulations pertaining to geology and soils, including CBC and Los Angeles Building Code requirements. Therefore, with adherence to such regulations, impacts related to geology and soils would not be cumulatively considerable.

MITIGATION MEASURES

Seismicity

GS1 Seismic design for structures and foundations shall comply with the most current seismic building code standards for site-specific soil conditions.

GS2 The proposed project shall demonstrate compliance with specific recommendations for grading guidelines, foundation design, retaining wall design, temporary excavations, slabs on grade, site

drainage, design review, construction monitoring and geotechnical testing to the satisfaction of the City of Los Angeles Department of Building and Safety, as conditions to issuance of any grading and building permits.

Excavation and Development

GS3 During inclement periods of the year, when rain is threatening (between November 1 and April 15 per the Los Angeles Building Code, Sec. 7002.), an erosion control plan that identifies BMPs shall be implemented to the satisfaction of the City of Los Angeles Department of Building and Safety to minimize potential erosion during construction. The erosion control plan shall be a condition to issuance of any grading permit.

GS4 To the extent feasible, grading shall be scheduled for completion prior to the start of the rainy season (between November 1 and April 15 per the Los Angeles Building Code, Sec. 7002), or detailed temporary erosion control plans shall be implemented in a manner satisfactory to the City of Los Angeles Department of Building and Safety.

GS5 Appropriate erosion control and drainage devices shall be incorporated to the satisfaction of the City of Los Angeles Department of Building and Safety. Such measures include interceptor terraces, berms, vee-channels, and inlet and outlet structures.

GS6 Provisions shall be made for adequate surface drainage away from the areas of excavation as well as protection of excavated areas from flooding. The grading contractor shall control surface water and the transportation of silt and sediment.

Septic Tanks

No mitigation measures are necessary.

LEVEL OF SIGNIFICANCE AFTER MITIGATION

With implementation of Mitigation Measures **GS1** through **GS6**, impacts related to geology and soils would be reduced to a less-than-significant level.