4.5 GEOLOGY/SOILS

This PEIR section analyzes the potential for adverse impacts on existing geologic and soil conditions within the project site resulting from implementation of the proposed Specific Plan. Data used to prepare this section were taken from the Seismic and Public Safety Element of the City of Laguna Niguel (General Plan 1992), reports published by the California Geological Survey (CGS) and the United States Geological Survey (USGS); and other geotechnical or environmental investigations pertinent to the conditions within the Specific Plan area. Full bibliographic entries for all reference materials are provided in Section 4.5.6 (References) at the end of this section.

All comments received in response to the Notice of Preparation (NOP) circulated for the proposed project were taken into consideration during preparation of the PEIR, and if relevant, have been addressed in this section or others within this document.

4.5.1 Environmental Setting

Regional and Local Geology and Seismic Setting

Most of the City and all of the Specific Plan area is located within the San Juan Capistrano (SJC) USGS quadrangle, which lies at the southeastern most portion of the Los Angeles basin. The topography of the City is typical of the stream-cut marine terraces of coastal orientation that characterize the southern exposure of the San Joaquin Hills. The San Joaquin Hills range, located just west of the Specific Plan area, is typical of the northwest trending mountain ranges that comprise the Peninsular Range Province of Southern California. Streams, such as Oso Creek, which dissects the Specific Plan area, have cut hills, forming arroyos, gullies, and steep canyons. Intermittent rains have created eroded hillsides and formed broad valleys. The Specific Plan area is located along the eastern flank of the San Joaquin Hills.

Local Soil and Groundwater Conditions

A geotechnical investigation has not been performed for the entire Specific Plan area, however according to a Geotechnical Investigation prepared by URS in 2005 for a project located on Crown Valley Parkway, within the Specific Plan area, the bedrock underlying the site consists of late Miocene to early Pliocene age Capistrano Formation. The Capistrano Formation is a marine deposit that is typically composed of light to dark gray siltstone that is typically a weak, poorly to moderately consolidated rock formation that is prone to creek and slope instability even in areas of low relief. Based on the 2005 Geotechnical Report and the EIR prepared for the City of Laguna Niguel General Plan, quaternary alluvium of Oso Creek and its tributaries overlie bedrock within the Specific Plan area. Groundwater was not encountered during site exploration for the Crown Valley Parkway project (URS 2005).

According to a soil survey map of the Specific Plan area generated by the National Resources Conservation Service various soil units underlie the project area. The dominant soil unit is ALO Clay, which underlies roughly 50 percent of the Specific Plan area. Other soil units identified include various types of clay, loam, clay loam, sandy loam, loamy sand, cobbly sandy loam, and riverwash (NRCS 2010).

Regional and Local Faults

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 is 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; the North American plate is to the east.

There are numerous faults in Southern California that are categorized as active, potentially active, and inactive by the 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.

According to the Seismic and Public Safety Element of the City's General Plan, there are no active or potentially active surficial faults in the City. However, it is suggested by Grant and Others (1999) that the San Joaquin Hills are a late Quaternary uplift that is the result of movement along a southwest dipping, blind thrust fault that they name the "San Joaquin Hills Blind Thrust" (SJHBT) (URS 2005). The precise location of the SJHBT is not known, but based on the model presented by Grant and others (1999), the SJHBT is estimated to be about 4 kilometers beneath the Specific Plan area (URS 2005). The SJHBT has been adopted as an active seismic source by both CGS and USGS.

Although not located in the City, there are two active faults located within Orange County. The Newport-Inglewood Fault angles from offshore near Dana Point, and passes through the northwestern portion of the county. The Whittier Fault roughly parallels the Newport-Inglewood Fault across the northeasterly edge of the County. The Newport-Inglewood Fault, located southwest of the Specific Plan area, is capable of producing a maximum credible earthquake of 7.5 magnitude. The maximum credible earthquake estimated for the Whittier fault, located northeast of the Specific Plan area is 7.0 magnitude (City of Laguna Niguel 1992).

Earthquakes occurring on faults located outside of Orange County also have the potential to cause damage within the City. Active faults that have the potential to impact the City include San Andreas; San Jacinto, Malibu-Coast, Palos Verdes, San Gabriel, and Sierra Madre–Santa Susana–Cucamonga faults

Seismic Hazards

Earthquakes create two types of hazards: primary and secondary. Primary seismic hazards include ground shaking, ground displacement, and subsidence. These events can, in turn, produce secondary hazards including ground failure, liquefaction, seiching and dam failure.

Fault Rupture

There are no active or potentially active faults located in the City. Although there are speculations regarding the San Joaquin Blind Thrust described above, the existence of the thrust has not been confirmed, and its precise location is not known. Based on modeling, the San Joaquin Blind Thrust is

estimated to be about 4 kilometers beneath the Specific Plan area. However, the City is not included on a list of California cities affected by Alquist-Priolo Earthquake Fault Zones (CGS 2010). As such, the risk of damage due to ground rupture during an earthquake is minimal due to the absence of active surficial faults in the City.

Groundshaking

The major cause of structural damage from earthquakes is groundshaking. The intensity of ground motion expected at a particular site depends on the magnitude of the earthquake, the distance and direction to the epicenter, and the geology of the area between the epicenter and the affected site. 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 earthquake of great magnitude. The SJHBT seismic source has the potential to contribute to groundshaking in the City. Active faults that have the potential to cause groundshaking in the City include the Newport-Inglewood Fault and the Whittier Fault located in Orange County, and the San Andreas, San Jacinto, Malibu-Coast Raymond, Palos Verdes, San Gabriel, and Sierra Madre-Santa Susana-Cucamonga faults outside of Orange County.

Liquefaction

Liquefaction is the phenomenon in which uniformly sized, loosely deposited, saturated, granular soils with low clay contents undergo rapid loss of shear strength through the development of excess pore pressure during strong earthquake induced groundshaking of sufficient duration to cause the soil to behave as a fluid for a short period of time. Liquefaction generally occurs in saturated or near-saturated cohesionless soils at depths shallower than 50 feet below the ground surface. If the liquefying layer is near the surface, the effect for any structure supported on it is much like that of quicksand, resulting in sinking or tilting.

Liquefaction Induced Hazards

Liquefaction can induce: (1) Flow slides or large translation site failures mobilized by existing static stresses (i.e. the site static factor of safety drops below unity due to low strengths of liquefied soil layers); (2) Limited lateral spreads on the order of feet or less triggered and sustained by the earthquake ground shaking; (3) Ground settlement due to the reconsolidation of liquefied soils; and, (4) Surface manifestation of underlying liquefaction such as sand boils, etc. that can directly effect structures. In addition to the above hazards which occur only to coarse-grained soils, earthquake-induced strength loss resulting in slope instability can also occur in fine-grained soils such as silts and clays. All of these hazards are evaluated in all site-specific development geotechnical reports.

Static Settlement

Settlement is caused by the reduction of soil volume. It can result from static loading (placement of an earth embankment, foundation load, etc.), the withdrawal of groundwater, the injection of groundwater (i.e. causing hydro-collapse), or the decomposition of organic material. Settlements must be considered in the design of any proposed development and would be addressed in all site-specific development geotechnical reports. Soils testing to identify settlement characteristics and appropriate remediation measures are required routinely by the City's Grading and Excavation Code. Specific treatments to

eliminate settlement of soils include, but are not limited to, recompaction (watering and compressing the soils) and replacement with a non-compressible material (excavation of unsuitable soil followed by filling with suitable material).

Landslides

Landslides are the downhill movement of masses of earth and rock caused by gravity acting on oversteepened slopes; vibrations from earthquakes, machinery, blasting, etc., or other lateral or horizontal loading. According to the Seismic Hazard Zones map for the San Juan Capistrano Quadrangle, a small portion of the Specific Plan area is identified as an area where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacement such that mitigation as defined in Public Resource Code Section 2693(c) would be required. Further, the Seismic and Public Safety Element of the City's General Plan states that areas underlain by shale and siltstone are more prone to landslide when compared to other bedrock geology, and the Capistrano, Monterey, and Topanga Formations, prevalent through hillside areas in the City, are most prone to slow-developing, slump-type failure. Slope stability hazards in the City's Grading and Excavation Code are used to mitigate these hazards prior to development.

Expansive Soils

Expansive soils contain types of clays (principally montmorillonite, illite, and kaolinite) that can give up water (shrink) or take on water (swell) during changes in soil moisture content. The change in volume exerts stress on building foundations and other loads placed on these soils. The occurrence of these clays often is associated with geologic units of marginal stability. Slopes composed of expansive soils may be subject to slope creep and lateral fill extension. Expansive soils can be widely dispersed and are found in hillside areas as well as low-lying areas in alluvial basins. Soils testing to identify expansive characteristics and appropriate remediation measures are required by the City's Grading and Excavation Code.

Corrosive Soils

Bedrock materials as well as native and fill soils derived from bedrock materials may be corrosive to both ferrous metals and concrete. Soils testing to identify corrosive characteristics and appropriate remediation measures are required by the City's Grading and Excavation Code.

4.5.2 Regulatory Framework

Federal

Installation of any underground utility lines are required to comply with industry standards specific to the type of utility (e.g., National Clay Pipe Institute for sewers; American Water Works Association for water lines, etc.) and the discharge of contaminants is required to be controlled through the National Pollutant Discharge Elimination System (NPDES) permitting program for management of construction and municipal stormwater runoff, as described in Section 4.7 (Hydrology and Water Quality) of this PEIR.

These standards contain specifications for installation, design, and maintenance to reflect site-specific geotechnical conditions.

State

Alquist-Priolo Earthquake Fault Zoning Act

The state legislation protecting the population of California from the effects of fault-line ground-surface rupture is the Alquist-Priolo Earthquake Fault Zoning Act (California *Public Resources Code* [PRC] 1972, 1997). The Act provides for special seismic design considerations if developments are planned in areas adjacent to active or potentially active faults. The Act was passed in response to the 1971 Sylmar Earthquake (also known as the San Fernando Earthquake), which was associated with extensive surface fault ruptures that damaged numerous homes, commercial buildings, and other structures. At the direction of the Act, in 1972 the State Geologist became responsible for delineating Earthquake Fault Zones (called Special Studies Zones prior to 1994) around active and potentially active fault traces to reduce fault-rupture risks to structures for human occupancy. The zones are revised periodically, and extend 200 to 500 feet on either side of identified active fault traces. The CGS has prepared nearly 600 maps delineating Earthquake Fault Zones. No Alquist-Priolo Fault zones are located in the City of Laguna Niguel.

Seismic Hazards Mapping Act

One of the state legislations protecting the public from geo-seismic hazards, other than surface faulting, is the Seismic Hazards Mapping Act (California 1991). The Act's regulations apply to public buildings intended for human occupancy and a large percentage of private buildings intended for human occupancy. The Act became effective in 1991 with the purpose of identifying and mapping seismically hazardous areas to assist 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. Under the terms of the Act, cities and counties must require a geotechnical report defining and delineating any seismic hazard prior to the approval of a project in a state-identified seismic hazard zone. The local jurisdiction is required to submit one copy of the approved geotechnical report to the State Geologist within 30 days of approval of the report.

Seismic Hazard Zone Reports

The hazards recognized in the Act include strong groundshaking, liquefaction, landslides, and other ground failure. These effects account for approximately 95 percent of economic losses caused by earthquakes. At the direction of the Act, the State Geologist became responsible for preparing maps delineating Liquefaction Zones of Required Investigation and Earthquake-Induced Landslide Zones of Required Investigation in the Los Angeles Basin and San Francisco Bay areas. Evaluation and mapping have been completed for the San Juan Capistrano quadrangle, which includes the Specific Plan Area. According to the Seismic Hazard Zone map, portions of the Specific Plan area are identified as having the potential for liquefaction or earthquake induced landslides.

California Building Code

California Code of Regulations (CCR), Title 24, Part 2, the California Building Code (CBC), provides minimum standards for building design in the state. Until January 1, 2008, the CBC was based on the then current Uniform Building Code and contained Additions, Amendments and Repeals specific to building conditions and structural requirements in California. The 2010 CBC, effective January 1, 2011, is based on the current (2009) International Building Code (IBC) (CBSC 2011). Each jurisdiction in California may adopt its own building code based on the 2010 CBC. Local codes are permitted to be more stringent than the 2010 CBC, but, at a minimum, are required to meet all state standards and enforce the regulations of the 2010 CBC beginning January 1, 2011. Chapter 16 of the CBC deals with structural design requirements governing seismically resistant construction (Section 1604), including (but not limited to) factors and coefficients used to establish seismic site class and seismic occupancy category for the soil/rock at the building location and the proposed building design (Sections 1613.5 through 1613.7). Chapter 18 includes (but is not limited to) the requirements for foundation and soil investigations (Section 1803); excavation, grading, and fill (Section 1804); allowable load-bearing values of soils (Section 1806); and the design of footings, foundations, and slope clearances (Sections 1808 and 1809), retaining walls (Section 1807), and pier, pile, driven, and cast-in-place foundation support systems (Section 1810). Chapter 33 includes (but is not limited to) requirements for safeguards at work sites to ensure stable excavations and cut or fill slopes (Section 3304). Appendix J of the CBC includes (but is not limited to) grading requirements for the design of excavations and fills (Sections J106 and J107) and for erosion control (Sections J109 and J110). Construction activities are subject to occupational safety standards for excavation, shoring, and trenching as specified in Cal-OSHA regulations (CCR, Title 8).

The CBC is revised every three years. Effective January 2, 2011, California requires compliance with the 2010 CBC.

California Geological Survey Special Publications

The California Geological Survey produces a variety of on-line and hard copy publications that provide guidance for individuals and municipalities addressing issues related to geology and geologic hazards including fault rupture, seismic groundshaking, liquefaction, landsliding, settlement, etc. With the exception of Official Maps, such as Earthquake Fault Zones and Seismic Hazard Zones, these publications represent compendia of state legislation, professional judgment, and Best Management Practices recognized by the State of California as appropriate methods for investigating and mitigating geologic hazards. Although many of the guidelines have been adopted by the State for advisory purposes, none has the force of law in itself unless adopted specifically by a municipality as its "official" procedure. Most municipalities have not adopted any of these documents as official procedures, but expect their consultants to use them as intended – as the most practical and widely accepted guides for addressing issues arising from geologic conditions within the municipality's jurisdiction. The City has not codified any of these guidelines in its Municipal Code.

General Groundwater Extraction Waste Discharge Permit

The General Groundwater Extraction Waste Discharge Permit would apply to all construction activities within the Specific Plan area that would require groundwater dewatering. Conformance with the noted

Groundwater Permit is required by the RWQCB prior to disposal of extracted groundwater (pursuant to Order No. R9-2008-0002, NPDES Permit No. CAG919002 for the Specific Plan area). This requirement is generally applicable to all groundwater discharge regardless of volume, with certain exceptions as noted in the permit text. Specific requirements for permit conformance include (1) submitting a Notice of Intent to the RWQCB; (2) implementing an appropriate sampling and analysis/monitoring program; (3) providing at least 30 days notification to the appropriate local agency prior to discharging to a municipal separate storm sewer system (MS4); (4) conforming with applicable water quality standards (e.g., through appropriate treatment best management practices [BMPs]), including, but not limited to, the Basin Plan, CWA, state Antidegradation and Implementation policies, Porter-Cologne Water Quality Control Act, and Ocean Plan; and (5) submittal of applicable monitoring reports. Because each future project would have site-specific geotechnical considerations, it is possible that future development under the proposed Specific Plan could require groundwater dewatering during construction and/or operation, which would be subject to the requirements of this General Groundwater Extraction Waste Discharge Permit.

Local

City of Laguna Niguel Grading and Excavation Code

Title 8, Article 8 (Grading and Excavation Code) of the City's Municipal Code sets forth rules and regulations to control excavation, grading and earthwork construction, including fills and embankments, site drainage and relevant water quality requirements, and established administrative requirements for issuance of permits and approvals of plans and inspection of grading construction in accordance with the requirements for grading and excavation as contained in the 2010 CBC then in effect as adopted and modified by city ordinance. All project's requiring a grading permit, shall be required to prepare a Soil Engineering and Engineering Geology Report that includes recommendations to be incorporated in the grading plans or specifications as a condition of project approval.

City of Laguna Niguel General Plan Seismic and Public Safety Element

Policy 1.1 Mitigate potential adverse impacts of geologic and seismic hazards

Action 1.1.1 Require site-specific geologic soil studies as part of the approval process for new development. This analysis must identify on-site geologic hazards, determine risk potential and provide mitigation measures for all pertinent geologic hazards.

Consistency Analysis

All future development within the Specific Plan area requiring a grading permit would be required by the City's Grading and Excavation Code to prepare a site-specific Soil Engineering and Engineering Geology Report that identifies on-site geologic hazards, determines risk potential and includes recommendations to be incorporated in the project's grading plans or specifications as a condition of project approval. As such, future development permitted under the proposed Specific Plan would not conflict with General Plan policies relating to geologic and seismic hazards.

4.5.3 Project Impacts and Mitigation

Analytic Method

Information regarding regional geology and seismically induced hazards was researched in various sources of the CGS and the USGS. Estimated earthquake magnitudes resulting from potential seismic activity on various active faults in the area were obtained from the General Plan Seismic and Public Safety Element. Where potential geological hazards are identified, such hazards would be expected to affect any proposed development in the hazard area.

The following analysis considers the potential effects of the proposed project described in Chapter 3 of this PEIR. Construction-related impacts are considered for the project as a whole. Operational-related impacts of the Specific Plan area are considered in the context of seismic and/or other geological hazards to residents, employees, and visitors.

Thresholds of Significance

The following thresholds of significance are based on Appendix G of the 2010 CEQA Guidelines. For purposes of this PEIR, implementation of the proposed project may have a significant adverse impact on geology/soils if it would do any of the following:

- 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
 - > Strong seismic groundshaking
 - > Seismic-related ground failure, including liquefaction
 - > Landslides
- Result in substantial soil erosion or the loss of topsoil
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in 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
- Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater

Adverse impacts in any of the above categories would be considered unavoidable significant effects of the proposed project, if they could not be *(a)* reduced to a level of risk consistent with the standards established by the Laguna Niguel Building Code, *(b)* eliminated, or *(c)* avoided by using generally accepted geotechnical methods applied in California.

Adherence to design and construction standards, as required by state and City regulations and codes described previously, would ensure maximum practicable protection for users of the buildings and

associated infrastructure. All aspects of seismic-related hazards, other geotechnical hazards, and erosion and sedimentation issues are regulated by City of Laguna Niguel and/or the State of California. All potential geotechnical impacts are required by these codes and regulations to be rendered less-thansignificant as part of proposed project designs.

Effects Found to Have No Impact

Threshold Would the proposed project 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?

There are no active or potentially active surficial faults in the City. As such, the potential for damage caused by surface fault rupture is not considered an impact. There are no known active or potentially active surficial faults trending toward or through the proposed development area. Consequently, implementation of the proposed project would have *no impact* associated with the exposure of people or structures to a rupture of a known earthquake fault, and no further analysis is required in this PEIR.

Threshold	Would the proposed project have soils incapable of adequately supporting the
	use of septic tanks or alternative wastewater disposal systems where sewers are
	not available for the disposal of wastewater?

The Specific Plan Area is currently provided sanitary sewer service by the Moulton Niguel Water District. The District would continue to provide these services to development in the Specific Plan area. No septic tanks or alternative wastewater systems are proposed. Therefore, *no impact* would occur and no further analysis of this issue is required.

Impacts and Mitigation Measures

Threshold Would the proposed project expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving strong seismic groundshaking or seismic-related ground failure, including liquefaction?

Impact 4.5-1 Future development under the proposed project could expose people and/or structures to potentially substantial adverse effects, including the risk of loss, injury, or death, strong seismic groundshaking and/or seismicrelated ground failure, including liquefaction. Although seismic groundshaking would occur during major earthquakes, with compliance with applicable state and City regulations, this impact is considered *less than significant*.

The Specific Plan is located in a seismically active region. During the design life of existing and future development, strong seismic groundshaking will occur throughout the project site. According to the Seismic and Public Safety Element of the City's General Plan, there are no active or potentially active faults in the City. However, the SJHBT has been adopted as an active seismic resource and has the potential to contribute to groundshaking in the City. In addition, there are two active faults located

within Orange County, the Newport-Inglewood Fault, and the Whittier Fault. Additionally, earthquakes occurring on faults located outside of Orange County also have the potential to cause damage within the City. Active faults that have the potential to impact the City include San Andreas; San Jacinto, Malibu-Coast, Palos Verdes, San Gabriel, and Sierra Madre-Santa Susana-Cucamonga faults.

The proposed Specific Plan is a navigational tool to guide development in the area; no specific development plans have been submitted. As required by the City's Grading and Excavation Code, all future development requiring a grading permit must prepare a site specific Soil Engineering and Engineering Geology Report which includes design and foundation recommendations to be incorporated into grading plans and specifications as a condition of project approval. Section 1613 (Earthquake Loads) of the 2010 CBC, adopted by Title 8 Article 2 of the City's Municipal Code, requires the seismic-resistant design for future buildings to factor in a design earthquake that would create average peak ground accelerations of at least 1.0g. Damage resulting from a design earthquake could include general damage to foundation, active and potentially active regional faults are capable of producing seismic groundshaking throughout the Specific Plan area. It is anticipated that existing and future development in the Specific Plan area. It is anticipated that existing and future development in the Specific Plan area would experience ground acceleration periodically as a result of small and moderate magnitude earthquakes occurring on active nearby and distant faults. Future development and improvements could be adversely affected by seismic groundshaking if required design measures were not implemented.

According to Seismic Hazard Zones map for the San Juan Capistrano Quadrangle much of the Specific Plan area is identified as an area where historic occurrence of liquefaction or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacements such that mitigation as defined by Public Resources Code Section 2693(c) would be required (CDOC 2001).

Adherence to the 2010 CBC and the City's Grading and Excavation Code would ensure the maximum practicable protection available for all future development throughout the Specific Plan area. Design of all future development under the Specific Plan would be required to include the application of CBC seismic standards as the minimum seismic resistance. The applicable code requirements include seismic-resistant earthwork and construction design criteria, based on site-specific recommendations of the project's California-registered geotechnical and structural engineers; engineering analyses that demonstrate satisfactory performance of any unsupported cut or fill slopes, and of alluvium and/or fill where they form part or all of the support for structures, foundations and underground utilities; and analyses of soil expansion, collapse, and subsidence potential and appropriate remediation (compaction, removal-and-replacement, etc.) prior to using any soils for foundation support, as explained below.

Adherence to the seismic design and construction parameters of the CBC, as required by state law, would ensure protection of occupants and visitors within the project site. Compliance with the CBC includes the following procedures to ensure protection of structures and occupants from geo-seismic hazards:

- The 2010 design criteria for protection of structures and earthworks at the project site from groundshaking and ground failure would be review and updated, as necessary, by a California Certified Engineering Geologist, or California-licensed Civil Engineer (Geotechnical) to ensure compliance with the 2010 CBC standards of performance.
- During site preparation, a registered geotechnical professional must be on the site to supervise implementation of the recommended criteria.

- A California Certified Engineering Geologist, or California-licensed Civil Engineer (Geotechnical), for the Applicant must prepare an "as built" map/report to be filed with the City showing details of the site geology, the location and type of seismic-restraint facilities, and documenting the following requirements, as appropriate.
 - > Engineering analyses demonstrating satisfactory performance of compacted fill or natural unconsolidated sediments where either forms part or all of the support for any structures, especially where the possible occurrence of liquefiable, compressible, or expansive soils exists.
 - > Engineering analyses demonstrating accommodation of settlement or compaction estimates by the site-specific Geotechnical Report for access roads, foundations, and underground utilities in fill or alluvium.

Implementation of the Specific Plan would not result in specific projects in the area, rather the Specific Plan is a planning document which would guide future development and provide policy framework for development. As all future development would be built in compliance with the seismic safety requirements of the 2010 CBC and the City's Grading and Excavation Code, and site-specific design recommendations contained in a Soil Engineering and Engineering Geology Report would be incorporated into grading plans and specifications as a condition of project approval, the proposed Specific Plan's impact on exposure to seismically induced groundshaking and seismic-related ground failure would be *less than significant*.

Threshold	Would the proposed project expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving landslides?
Impact 4.5-2	Future development under the proposed project could expose people or structures to risk of loss, injury, or death involving landslides. However, with compliance with soil stability standards required by the City of

less than significant.

Laguna Niguel Grading and Excavation Code, this impact is considered

According to the Seismic Hazard Zones map for the San Juan Capistrano Quadrangle, a small portion of the Specific Plan area is identified as an area where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacement such that mitigation as defined in Public Resource Code Section 2693(c) would be required. Further, the Seismic and Public Safety Element of the City's General Plan states that areas underlain by shale and siltstone are more prone to landslide when compared to other bedrock geology, and the Capistrano, Monterey, and Topanga Formations, which are prevalent through hillside areas in the City, are most prone to slow-developing, slump-type failure. Slope stability hazards in the City relate to undeveloped hillside areas, as grading activities and soil remediation techniques required by the City's Grading and Excavation Code are used to mitigate these hazards prior to development. Further, a site-specific Soil Engineering and Engineering Geology Report, which would be required for future development requiring a grading permit, would include design recommendations to reduce impacts associated with slope instability. As such, compliance with applicable regulations would ensure that future development results in a *less-than-significant* impact from landslides and no further analysis is required.

Threshold Would the proposed project result in substantial soil erosion or the loss of topsoil?

Impact 4.5-3 Construction and operation of future development under the proposed project could result in substantial soil erosion, loss of top soil, changes in topography or unstable soil conditions. However, with compliance with slope stability, soil stability, and seismic-resistant design standards required by the 2010 CBC and The City of Laguna Niguel's Grading and Excavation Code, this impact is considered *less than significant*.

For the purposes of this analysis, erosional effects consider whether implementation of projects under the Specific Plan would accelerate natural erosional processes. Future development under the proposed Specific Plan would result in ground-disrupting activities such as excavation and trenching for foundations and utilities; soil compaction and site grading; and the erection of new structures, all of which would temporarily disturb soils. The exposure of previously covered soils during these activities could lead to increased on-site erosion and off-site sediment transport because disturbed soils are susceptible to higher rates of erosion from wind, rain, and runoff of dewatering discharge or dust control water than undisturbed soils. The State Water Resources Control Board (SWRCB) and the City's Grading and Excavation Code require erosion and sediment controls for construction projects with land disturbance. CBC Appendix Section J110, Erosion Control, addresses the issue of soil loss for construction periods. The requirements include preparation and implementation of a Storm Water Pollution Prevention Plan (SWPPP), with both construction-period and permanent erosion and sediment controls; preparation and implementation of an erosion and sediment control plan, describing both construction-period and permanent erosion and sediment controls; and construction site inspection by the City. Future development under the Specific Plan would be required to comply with these existing regulations. Adherence to these requirements would prevent substantial on-site erosion and would reduce impacts to a less-than-significant level from the perspective of soil loss at the construction site.

Off-site erosion and sedimentation could occur if increased stormwater runoff were conveyed over unstable off-site soil surfaces or to a susceptible creek or channel where the higher erosive forces associated with increased flow rates could contribute to off-site erosion, including streambed and bank erosion. Earth-disturbing activities associated with construction would be temporary. Specific erosion impacts would depend largely on the areas affected and the length of time soils are subject to conditions that would be affected by erosion processes. Any project sites 1 acre in size or larger are subject to the provisions of the General Construction Activity Stormwater Permit adopted by the SWRCB. Pursuant to the City's Local Implementation Plan (LIP) for its Jurisdictional Runoff Management Program (JRMP) in compliance with Order No. R9-2009-0002, NPDES Permit No. CAS0108740. (See Section 4.8.2 of this PEIR for details.) Applicants for specific development projects must submit a Notice of Intent (NOI) to the SWRCB for coverage under the Statewide General Construction Activity Stormwater Permit and must comply with all applicable requirements, including the preparation of a SWPPP, applicable NPDES Regulations, and BMPs. The SWPPP must describe the site, the facility, erosion and sediment controls, runoff water quality monitoring, means of waste disposal, implementation of approved local plans, control of sediment and erosion control measures, maintenance responsibilities, and stormwater management controls. Inspection of construction sites before and after storms would be required to identify stormwater discharge from the construction activity and to identify and implement controls

where necessary. Such compliance would ensure that erosion and other soil instability impacts resulting from future construction within the project site would be *less than significant*.

Threshold Would the proposed project be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?

Impact 4.5-4 A portion of the Specific Plan area would be located on subsidence-prone and potentially liquefiable soils. However, with compliance with slope and soil stability standards required by the City of Laguna Niguel General Plan, Building Code, and Grading and Excavation Code, and implementation of code requirements and mitigation measures, this impact is considered *less than significant*.

The potential for landslides are addressed under Impact 4.5-2 and liquefaction is addressed under Impact 4.5-1. As explained in Section 4.5.1 (Environmental Setting), subsidence could be caused by the weight of large earthmoving equipment used during the construction phases of future development. In addition, shallow groundwater table may affect the stability of the soils during construction and operation of the proposed project.

Future development would be designed, constructed, and operated in conformance with Section 1802.2.1 Questionable Soils, of the 2010 CBC and the City's Grading and Excavation Code. Therefore, potential risks to life and property from unstable soil conditions caused by settlement would be *less than significant*.

Subsidence

Subsidence could result in the settlement of in-place subgrade soils caused by loads generated by large earthmoving equipment. Subsidence that could potentially occur would depend on the types of earthmoving equipment used. Due to the timeframe of the proposed Specific Plan with buildout estimated in 2030, the potential extent of settlement that could occur during this time is currently unknown. However, future development would be designed, constructed, and operated in conformance to Section 1802.2.1 (Questionable Soils) of the 2010 CBC and the City's Grading and Excavation Code. Therefore, potential risks to life and property from unstable soil conditions caused by subsidence would be *less than significant*.

Shallow Groundwater

Depth of groundwater in the Specific Plan area is currently unknown. However, if shallow groundwater is encountered, dewatering activities in the Specific Plan area could be needed during construction of any subterranean levels, such as for parking. The removal of groundwater to create a dry construction pit could cause porous soils to collapse when the support provided by the water was withdrawn. Temporary shoring, dewatering wells, storage tanks, filters, and erosion control measures would be required to comply with the City's Grading and Excavation Code. Dewatering activities would be required to comply with the NPDES Permit for Groundwater Discharge from the San Diego Regional Water Quality Control Board. Impacts associated with dewatering as a result of construction and operation activities are addressed further in Impact 4.8-2 in Section 4.8 (Hydrology/Water Quality).

Because future structures would be designed, constructed and operated in conformance with Section 1802.2.1 Questionable Soils, of the 2010 CBC and the City's Grading and Excavation Code., potential risks to life and property from unstable soils caused by groundwater saturation or withdrawal would be *less than significant*.

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

Impact 4.5-5 Future development in the Specific Plan area could be located on expansive soil. However, with compliance with soil stability standards required by the 2010 CBC and the City of Laguna Niguel's Grading and Excavation Code, this impact is considered *less than significant*.

It is unknown at this time if future development would be located on expansive soil, however if future development occurs on sites with underlying expansive soils, development would be subject to the above-mentioned treatments as required by the 2010 CBC and the City's Grading and Excavation Code. Site-specific Soil Engineering Report, as required by the City's Grading and Excavation Code, would identify expansive characteristics and recommend appropriate remediation measures to be incorporated into grading plans as a condition of approval. Because future structures would be designed, constructed and operated in conformance with the City's Grading and Excavation Code potential risks to life and property associated with expansive soil would be reduced to a *less-than-significant* level.

4.5.4 Cumulative Impacts

The geographic context for the analysis of impacts resulting from geologic hazards generally is sitespecific, rather than cumulative in nature. Each project site has unique geologic considerations that would be subject to uniform site-development policies and construction standards imposed by the City of Laguna Niguel. Restrictions on development would be applied in the event that geologic or soil conditions posed a risk to public safety. A regional context must be considered for the analysis of the cumulative effects of exposure of people or structures to seismic hazards other than surface rupture of a fault because the hazard generators (earthquakes) and the direct effects (groundshaking, ground failure) tend to be region wide in nature. Additionally, a watershed-wide context must be considered for the analysis of the cumulative effects of potential erosion and siltation because the direct effects (turbidity, reduction of water quality, channel-bed sedimentation) can affect all downstream reaches of a waterway system. Nonetheless, the potential for cumulative impacts to occur is limited.

Impacts associated with potential geologic hazards related to soil or other conditions 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 Laguna Niguel would be sited and designed in accordance with the geotechnical and seismic guidelines and recommendations of the City's Grading and Excavation 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. Adherence by the project to all relevant plans, codes, and regulations would ensure that the proposed project would not result in a cumulatively considerable contribution to cumulative impacts

regarding geologic hazards, and therefore, the cumulative impact of the project would be *less than significant*.

Impacts from erosion and loss of topsoil from site development and operation can be cumulative in effect within a watershed. The San Juan (Oso) Creek Watershed forms the geographic context of cumulative erosion impacts. Development throughout Orange County and the City of Laguna Niguel is subject to state and local runoff and erosion control requirements, including applicable provisions of the general construction permit, BMPs, and 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 PEIR). These measures are implemented as conditions of approval of project development and subject to continuing enforcement. As a result, it is anticipated that cumulative impacts on the San Juan Creek Watershed District caused by runoff and erosion from cumulative impacts would not be cumulatively considerable and, therefore, also would be *less than significant*.

Implementation of the proposed project would result in the modification of site conditions to accommodate future development and to provide a stable and safe development. During construction, areas of soil could be exposed to erosion by wind or water. Development of other cumulative projects in the vicinity of the proposed project could expose soil surfaces, and further alter soil conditions, subjecting soils to erosional processes during construction. 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 ordinances. The City's Grading and Excavation Code implements the requirements of CBC Appendix Section J110 (Erosion Control) for construction periods. Adequate protection in the form of BMPs and erosion and sediment control plans must be incorporated into individual projects to address current legal requirements for control of erosion caused by stormwater discharges. Project sites of more than 1 acre in size would be required to comply with the provisions of the NPDES permitting process and local implementation strategies, which would minimize the potential for erosion during construction and operation of the facilities. Compliance with this permit process, in addition to the legal requirements related to erosion control practices, would minimize cumulative effects from erosion. Therefore, cumulative impacts on erosion would be less than significant. The project would not result in a cumulatively considerable contribution to this impact and, therefore, would be *less than significant*.

4.5.5 References

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- URS. 2005. Preliminary Geotechnical Investigation, 25891 Crown Valley Parkway, Laguna Niguel, California, September 20.