3.4 GEOLOGIC CONDITIONS

3.4.1 Existing Conditions

Geological Setting

The San Diego region is underlain by three principle geologic provinces. The majority of the county is in the Peninsular Ranges province bounded by the coastal province to the west and the Salton Trough province to the east. The western edge of the Peninsular Ranges province corresponds with the eastern hills and mountains along the edge of Poway, Lakeside, and El Cajon. Extending east of Julian and Jacumba, the province abruptly ends along a series of faults. To the north, the Peninsular Ranges province continues into the Los Angeles basin area; to the south it makes up the peninsula of Baja California.

As the Peninsular Ranges province experienced uplifting and tilting, a series of large faults, such as the Elsinore and San Jacinto, developed along the edge of the province. The eastern area "dropped" down, creating what is now known as the Salton Trough-Gulf of California depression. The Salton trough province, being lower than the surrounding landscape, became an area of deposition with sediments being carried to the depressed area by drainages of the peninsular ranges. Occasionally, the Salton Trough was inundated with marine waters from the Gulf of California, adding marine deposits to the sediment (Peterson, 1977).

The City of San Diego lies in the coastal plain province which extends from the western edge of the Peninsular Ranges and runs roughly parallel to the coastline. The province is composed of dissected, mesa-like terraces that graduate inland into rolling hills. The terrain is underlain by sedimentary rocks composed mainly of sandstone, shale, and conglomerate beds, reflecting the erosion of the Peninsular Ranges to the east.

Seismic Activity

Southern California is considered one of the most seismically active regions in the United States, with numerous active faults and a history of destructive earthquakes (County of San Diego, 1975). Earthquakes are caused by the release of accumulated strain along fractures in the earth's crust. Several earthquake fault zones, as well as numerous smaller faults, exist in the City of San Diego and in Southern California, as depicted on **Figure 3.4-1**. Since high-magnitude shocks transmit energy over large areas, fault zones outside the City's boundaries are included in this discussion.

The source of most earthquakes felt in San Diego is from the Imperial Valley, east of San Diego, and offshore fault systems (Lee, 1977). The Imperial Valley area is the most active source of local earthquakes and is the location of portions of the San Andreas, San Jacinto, and Elsinore faults. The San Andreas Fault, approximately 100 miles east of the City of San Diego, is outside the City and county limits but poses a potential hazard to the San Diego region. It extends a total of 650 miles from Baja California to the California coast north of San Francisco. In the vicinity of the San Diego region, the San Andreas Fault follows the east side of Coachella and Imperial valleys. The nearest inhabited sections of the San Diego region are 30 miles away.

The San Jacinto fault is the largest of the active faults (faults that have moved in the last 11,000 years) in the San Diego region. The fault extends 125 miles from the Imperial Valley to San Bernardino. The maximum probable earthquake expected to occur along the San Jacinto fault would be a magnitude of 7.5 to 7.8 on the Richter scale. An earthquake of this magnitude would likely cause severe damage in nearby communities such as Borrego Springs and Ocotillo Wells, with the potential for moderate damage in the City of San Diego and coastal areas. Historical activity associated with the San Jacinto fault occurred in 1890, 1899, 1968, and 1979. The quake in 1968 had a recorded magnitude of 6.8 and was centered near Ocotillo Wells. The earthquake of 1979 was associated with a branch of the Imperial fault near the Mexican border and registered a magnitude of 6.4 on the Richter scale, causing extensive structural damage to Imperial Valley residences and businesses.

The Elsinore fault represents a serious earthquake hazard for most of the populated areas of the San Diego region. This fault is approximately 135 miles long, located approximately 40 miles north and east from Downtown San Diego. This fault can register earthquakes in the range of magnitude 6.9 to 7.0 on the Richter scale with an approximate recurrence interval of 100 years.

The Rose Canyon fault zone is an active offshore/onshore fault capable of generating an earthquake of magnitude 6.2 to 7.0 on the Richter scale. The fault zone lies partially offshore as part of the Newport/Inglewood fault zone and parallels the San Diego north county coastline within approximately two to six miles until coming ashore near La Jolla Shores. The onshore segment trends through Rose Canyon, through Old Town San Diego, and appears to die out in San Diego Bay (Abbott, 1989). Evidence of faulting in San Diego Bay is thought to be associated with this fault (county of San Diego, 1975). The fault zone is composed of a number of fault segments, including the Rose Canyon, Mount Soledad, and Country Club faults.

The La Nacion fault zone runs parallel to the Rose Canyon fault zone and San Diego Bay, approximately five miles inland from the bay. This fault is considered potentially active (county of San Diego, 1975).

The major offshore fault zones are the San Clemente, San Diego Trough, and Coronado Bank. The San Clemente fault zone, located 40 miles off La Jolla, is the largest offshore fault. It is estimated that the maximum plausible quake along this fault would be between magnitude 6.7 and 7.7 (Kern, 1988). An earthquake in 1951 registered 5.9 and was centered near the San Clemente fault (County of San Diego 1975). The San Diego Trough and Coronado Bank fault zones are capable of seismic events of magnitude 6.0 to 7.7 (Demere, 1997).

The location of the City of San Diego in close proximity to large earthquake faults increases the potential of earthquake damage to structures and potentially endangers the safety of the City's inhabitants. Damage to structures and improvements caused by a major earthquake will depend on the distance to the epicenter, the magnitude of the event, the underlying soil, and the quality of construction. The severity of an earthquake can be expressed in terms of both intensity and magnitude. The magnitude of an earthquake is measured by the amount of energy released at the source of the quake. The Richter scale, developed in the 1930s for Southern California, is used to rapidly define earthquake size and estimate damage.

Table 3.4-1 describes the various hazards stemming from seismic activity in the City of San Diego. These seismic hazards include groundshaking, ground displacement, seismically induced settlement/subsidence, liquefaction, soil lurching, and tsunamis and seiches. **Figure 3.4-1** depicts areas of the City subject to the relative risk from various geotechnical forces described on **Table 3.4-1** below and slope failure described in the next section. The geotechnical and relative risk areas in the City are illustrated by the geographical inclusion of each area of the City into one of three risk areas: nominal to low, low to moderate, and moderate to high. The nominal to low category includes areas of the City with such geologic characteristics that may include: generally stable areas; level mesas underlain by terrace deposits and bedrock; favorable geologic structures; gently sloping terrain; and areas containing minor or no erosion potential. The low to moderate relative risk areas could include areas with such geologic characteristics as: possible or conjectured landslide areas; slide prone formations; unfavorable geologic structures such as Friars; level or sloping terrain; hydraulic fills; and/or local high erosion. The moderate to high relative risk areas could include such geologic conditions as: confirmed, known or highly suspected landslide areas; an active Alquist-Priolo fault zone; high erosion potential; steep bluffs; and/or unfavorable geologic structures. The categories illustrate the types of geotechnical risks that could be found in particular areas of the City and are not all inclusive of the geotechnical risks that may be present within a certain area. Additional analysis of geotechnical risks is required during the application review phase for development.

Soils and Slope Stability

Slope failure is the movement of soil and rock material downhill to a lower position. Landslides are the most common naturally occurring type of slope failure in San Diego. Block falls, slumps, and block glides are specific types of landslides. San Diego's landslides are commonly composite slides, a combination of block glides and slumps. Block falls are of concern primarily in coastal bluff areas (Ganus, 1977).

Earthquakes and their aftershocks can intensify or activate an unstable slope. Loosely and weakly consolidated soils, steepened slopes which are due to either human activities or natural causes, and saturated earth materials create a fragile situation easily affected by an earthquake. In the San Diego region, a major earthquake could cause the occurrence of landslides along sea cliffs, on mountain roadcuts, along the slopes of Palomar and Laguna Mountains, and in subdivisions where unprotected cut slopes occur in landslide-prone areas (county of San Diego, 1975).

Landslides in the San Diego region generally occur in sedimentary rocks such as sandstone, siltstone, mudstone, and claystone. When these fine-grained rocks are exposed to the erosional actions of air and water, they often turn into clay. Seams of saturated clays can be responsible for landslides even on gentle slopes.

Table 3.4-1
Seismic Hazards

Seismic Hazard	
Groundshaking	When a break or rapid relative displacement occurs along the two sides of a fault, the tearing and snapping of the earth's crust creates seismic waves which are felt as a shaking motion at the ground surfaces. The most useful measure of severity of groundshaking for planning purposes is the Modified Mercalli Intensity scale. This scale, ranging from Intensities I to XII, judges shaking severity by the amount of damage it produces. Intensity VII marks the point at which damage becomes significant. Intensity VIII and above correspond to severe damage and problems that are of great community concern. For comparison, the Rose Canyon Fault, capable of producing a 7.0 magnitude earthquake, would have an intensity of VII-IX. Intensity IX earthquakes are characterized by great damage to structures including collapse.
Ground Displacement	Ground displacement is characterized by slippage along the fault, or by surface soil rupture resulting from displacement in the underlying bedrock. Such displacement may be in any direction and can range from a fraction of an inch to tens of feet. In San Diego, exposures are generally poor and most faults are either potentially active or inactive. However, if ground displacement were to occur locally, it would most likely be on an existing fault. Failure of the ground beneath structures during an earthquake is a major contributor to damage and loss of life. Many structures would experience severe damage from foundation failures resulting from the loss of supporting soils during the earthquake.
Seismically Induced Settlement/ Subsidence	Settlement of the ground may come from fault movement, slope instability, and liquefaction and compaction of the soil at the site. Settlement is not necessarily destructive. It is usually differential settlement that damages structures. Differential or uneven settlement occurs when the subsoil at a site is of non-uniform depth, density, or character, and when the severity of shaking varies from one place to another.
Liquefaction	Liquefaction is a process by which water-saturated granular soils transform from a solid to a liquid state during strong groundshaking. Primary factors controlling development of liquefaction include intensity and duration of ground accelerations, characteristics of the subsurface soil, in situ stress conditions, and depth of groundwater. Sites underlain by relatively loose, saturated deposits of fill, such as those found along the San Diego Bay, Mission Valley, and Downtown San Diego are susceptible to liquefaction. Lateral spreading is a lateral ground movement that takes place when liquefaction occurs adjacent to a slope or open face. The loss of strength in the liquefied material near the base of a slope can result in a slope failure. These kinds of failure have occurred adjacent to rivers and streams and along waterfronts and beaches during seismic events.
Soil Lurching	Soil lurching is the movement of land at right angles to a cliff, stream bank, or embankment due to the rolling motion produced by the passage of surface waves. It can cause severe damage to buildings because of the formation of cracks in the ground surface. The effects of lurching are likely to be most significant near the edge of alluvial valleys or shores where the thickness of soft sediments varies appreciably under a structure.
Tsunamis and Seiches	A tsunami is a sea wave generated by a submarine earthquake, landslide, or volcanic action. A major tsunami from either of the latter two events is considered to be remote for the San Diego area. However, submarine earthquakes are common along the edge of the Pacific Ocean, and all of the Pacific coastal areas are therefore exposed to the potential hazard of tsunamis to a greater or lesser degree. A seiche is an earthquake-induced wave in a confined body of water, such as a lake, reservoir, or bay.

Bentonite clay is a component of many San Diego soils. It is expandable clay randomly interbedded with sandstone strata. The resistant beds of sandstone can assume a slick surface along with the heavy, waterlogged clays can “slide” down the unstable slope. A slope can be made potentially unstable by grading operations involving: (a) removing material from the bottom of the slope, thus, increasing the angle of the slope; (b) raising the height of the slope above the previous level; (c) saturating the slope with water from septic tank, gutter runoff, or diverted drainage from another part of the slope; or (d) adding fill to the top of the slope, creating additional weight (county of San Diego, 1973). In addition, earth-moving activities can reactivate an old slide.

Areas of the county which have experienced sliding are commonly underlain by the Ardath Shale, Friars, Mission Valley, San Diego, and Otay rock formations. The Ardath Shale Formation extends from Torrey Pines State Park to Mission Bay and is composed of Bentonite-rich clay (county of San Diego, 1973). The Friars Formation occurs from Mission Valley to beyond Rancho Bernardo. The formation is composed of expandable clays with properties similar to those of bentonite. The Mission Valley Formation is found from Mission Valley to Rancho Bernardo and consists of a mix of shale, bentonite, and sandstone (SDSU, 2004). The San Diego Formation occurs throughout the coastal mesas from Mission Valley southward to the Mexican border and consists of fine to medium sandstone. The Otay Formation is found in the southwestern portion of the San Diego region and is composed of slide-resistant sandstone with occasional thin interbedding of bentonite clay (county of San Diego, 1973).

Erosion

Erosion is defined as a combination of processes in which the materials of the earth’s surface are loosened, dissolved, or worn away, and transported from one place to another by natural agents. There are two types of soil erosion: wind erosion and water erosion. Erosion potential in soils is influenced primarily by loose soil texture and steep slopes. Loose soils can be eroded by water or wind forces, whereas soils with high clay content are generally susceptible only to water erosion. The potential for erosion generally increases as a result of human activity, primarily through the development of structures and impervious surfaces and the removal of vegetative cover.

Because much of the City of San Diego is characterized as having slopes greater than 25 percent in grade, there are many areas subject to erosion. **Figure 3.16-1 (see Visual Effects section)** depicts areas of the City with such slopes. Development on slopes greater than 25 percent tends to require engineering applications, which act to reduce development potential.

Table 3.4-2 identifies and summarizes the principal geologic hazards within the City, which include landslides, coastal bluffs, and debris flow or mudslide prone areas.

Table 3.4-2
Geologic Hazards

Geologic Hazard	
Landslide and Slope Stability	Old landslides and landslide-prone formations are the principal non-seismic geologic hazards within the City. Conditions which should be considered in regard to slope instability include inclination, characteristics of the soil and rock orientation of the bedding, and the presence of groundwater. The causes of classic landslides start with the preexisting condition inherent within the rock body itself that can lead to failure. The actuators of landslides can be both natural events such as earthquakes, rainfall and erosion and human activities such as grading and filling. Some of the areas where landslides have occurred are: Otay Mesa; the east side of Point Loma; the vicinities of Mount Soledad, Rose Canyon, Sorrento Valley, and Torrey Pines; portions of Rancho Bernardo and Los Peñasquitos; and along Mission Gorge in the vicinity of the second San Diego Aqueduct.
Coastal Bluffs	Coastal bluffs are land features that have resulted from the actions of sea wave forces on geologic formations and soil deposits. Geologic factors that affect the stability of bluffs include rock type, jointing and fracturing, faulting and shear zones, and base erosion. Where bluffs are eroding quickly, measures to reduce bluff degradation may be necessary in order to preserve the bluff line. In the Torrey Pines area, the coastal bluffs have experienced sizeable landslides where oversteepening of the seacliff has resulted in unstable conditions. In addition, rock falls have occurred in the Sunset Cliffs area due to undermining of the sandstone.
Debris Flows or Mudslides	A debris flow or mudslide is a form of shallow landslide involving soils, rock, plants, and water forming a slurry that flows downhill. This type of earth movement can be very destructive to property and cause significant loss during periods of heavy rainfall. The City of San Diego is susceptible to mudslides due to abundant natural, hilly terrain and steep manufactured slopes. Steeply-graded slopes tend to be difficult to landscape and are often planted with shallow-rooted vegetation on a thin veneer of topsoil. When saturated, these loose soils behave like a liquid and fail.

Regulatory Setting

Administrative actions have been implemented by local, state and federal agencies to reduce the effects of such geologic hazards as earthquakes and landslides.

The City uses the San Diego Seismic Safety Study, a set of geologic hazard maps and associated tables, as a guideline to correlate the acceptable risk of various land uses with seismic (and geologic) conditions identified for the site. Large and complex structures, and places attracting large numbers of people, are the most restricted as to geographic location based on site conditions. These facilities include dams, bridges, emergency facilities, hospitals, schools, churches, and multistory office and residential structures. Low- and medium-density residential development is considered land use of a lesser sensitivity and is therefore “suitable” or “provisionally suitable” (requiring site stabilization) under most geologic conditions. Uses with only minor or accessory structures can be located on sites with relatively greater risk due to lower user intensity associated with activities such as parks and open space, agriculture, and most industrial land uses. Geotechnical investigations are required to be performed prior to site development. The scope of investigations can range from feasibility surveys to extensive field exploration and engineering/geologic/seismic analyses depending upon the complexity of site conditions and the intensity of the proposed land use.

San Diego has been required to enforce the State Earthquake Protection Law (Riley Act of 1933) since its enactment in 1933. However, the seismic resistance requirements of the law were minimal for many years and San Diego did not embrace more restrictive seismic design standards until the adoption of the 1952 Uniform Building Code. Other applicable state regulations include the Alquist-Priolo Earthquake Fault Zoning Act of 1972, the Seismic Hazards Mapping Act of 1997, and the Unreinforced Masonry Law of 1986.

The California Earthquake Loss Reduction Plan was developed by the California Seismic Safety Commission in fulfillment of a mandate enacted by the Legislature in the California Earthquake Hazards Reduction Act of 1986. The plan is a comprehensive strategic document that sets forth the vision for a safer California and provides guiding policies. Incorporating lessons learned from all previous earthquakes, the plan is periodically updated for approximately five-year timeframes to continue to support new and ongoing efforts to protect California residents and the built environment. Such efforts are effective in reducing damage and injury from succeeding earthquakes. The City's development guidelines are consistent with state regulations and requirements.

Slope instability or erosion problems in the City are primarily regulated through the California Building Code (CBC) and the City's grading ordinance. The CBC requires special foundation engineering and investigation of soils on proposed development sites located in geologic hazard areas. These reports must demonstrate either that the hazard presented by the project will be eliminated or that there is no danger for the intended use. To reduce slide danger and erosion hazards, a grading permit must be obtained for all projects involving the process of moving soil and rock from one location to another. Grading ordinances are designed in part to assure that development in earthquake- or landslide-prone areas does not threaten human life or property. The CBC contains design and construction regulations pertaining to seismic safety for buildings (Bonneville and Huissain, 1997). These regulations cover issues such as the conversion of working stress to strength basis, ground motions, soil classifications, redundancy, drift and deformation compatibility, and designs of nonbuilding structures and nonstructural components. Recent improvements have been incorporated into the CBC in order to prevent structural collapse. One concept which has been utilized to improve upon conventional designs is that of increasing a structure's ductility, which is the ability of a structure to absorb energy. Another key concept is inelastic response, in which engineers calculate the maximum inelastic response displacement to determine a structure's drift and deformation compatibility with a seismic event. New soil profile classifications have also been adopted to ensure that structural designs are compatible with the soil subsurface on which they are constructed. While these regulations and improvements are intended to reduce the potential for loss of life, they cannot prevent all damage during a seismic event. However, these designs can greatly reduce the likelihood of a structural collapse during a seismic event.

Many of the City's most slide-prone or erosion-prone areas occur along the coastal bluffs which are within the jurisdiction of the California Coastal Commission. In addition to protecting unique recreational and natural resources, the Coastal Commission requires the evaluation of the geologic hazards associated with coastal development. The local geologic background and potential for geologic impacts are important components of the San Diego Local Coastal Program, which guides development in the coastal zone.

3.4.2 Thresholds of Significance

A significant impact could occur if implementation of the Draft General Plan:

- Results in the exposure of people or property to geologic hazards such as groundshaking, fault rupture, landslides, mudslides, ground failure, or similar hazards.
- Results in a substantial increase in wind or water erosion of soils.
- Results in allowing structures to be located on a geological unit or soil that is unstable or that would become unstable and potentially result in on-site or off-site landslides, lateral spreading, subsidence, liquefaction or collapse.

3.4.3 Impact Analysis

Could implementation of the Draft General Plan result in the exposure of people or property to geologic hazards such as groundshaking, fault rupture, landslides, mudslides, ground failure, or similar hazards?

Seismic Activity

The entire San Diego region is susceptible to impacts from seismic activity, including earthquakes and ground-shaking events. Numerous active faults are known to exist in the City and region that could potentially generate seismic events capable of significantly affecting existing and proposed development. The Draft General Plan calls for future growth to be focused in compact, mixed-use activity areas. As the Draft General Plan is implemented over time in association with community plans and regulations, the associated development may result in an increase in the number of people and buildings exposed to seismic ground-shaking. Potential effects from surface rupture and severe groundshaking could cause damage ranging from minor to catastrophic. Groundshaking could also cause secondary geologic hazards such as slope failures and seismically-induced settlement. This is considered a potentially significant impact.

Although seismic activity can cause damage to substandard construction, new designs can substantially reduce potential damage. Earthquake-resistant designs employed on new structures reduce the risk to public safety from seismic events. All proposed development projects are required to adhere to design standards, grading, and construction practices to avoid or reduce geologic hazards. Regulatory agencies with oversight of development associated with the Draft General Plan apply regulations and engineering design specifications to consider and compensate for site-level geologic and seismic conditions.

Numerous structures throughout the City pre-date the most recent and more stringent seismic and geologic regulations currently in place, and expose people to increased risk. Although the City maintains regulations to identify potential hazards from unreinforced masonry bearing wall buildings, the regulations are largely voluntary and exempt many residential structures. Until those structures are replaced or substantially rehabilitated, existing risks from seismic and geologic hazards will remain.

The Draft General Plan contains policies in the Public Facilities, Services and Safety Element which address geologic hazards. These policies call for maintaining geologic hazard narrative and mapped information, adhering to state laws for seismic and geologic hazards, abating structures that present dangers during seismic events, and consultation with qualified geologists and seismologists on development projects.

Proposals for development are required to be reviewed by appropriate regulatory agencies prior to construction. Developments that occur in the City of San Diego are required to meet design standards that address seismically active areas and comply with the CBC. Mitigation measures would reduce the risks associated with seismic activity. However, since the Draft General Plan does not include specific development projects, it is infeasible at the Program EIR level to provide specific mitigation that would reduce impacts to a less than significant level. Therefore, there is potential for a significant and unavoidable impact associated with seismic activity.

Slope Failure

Slope failure results in landslides and mudslides from unstable soils or geologic units. Given that future development would occur in the course of implementing the Draft General Plan, it is anticipated that some of this development would be constructed on geologic formations susceptible to slope failure, thereby increasing the risk to people and structures. This is considered a potentially significant impact. However, site-specific geotechnical investigations would be required prior to construction in order to properly design any proposed development. Additionally, all projects are required to adhere to state of California design standards and all standard design, grading, and construction practices to avoid or reduce geologic hazards.

In addition, regulatory agencies with oversight of development within the City of San Diego have regulations and engineering design specifications to address and compensate for site-level geologic and seismic conditions. All site designs must be reviewed and approved by the appropriate agencies. Mitigation measures would reduce the risks associated with slope failure. However, since the Draft General Plan does not include specific development projects, it is infeasible at the Program EIR level to provide specific mitigation that would reduce impacts to a less than significant level. Therefore, there is potential for a significant and unavoidable impact associated with slope failure.

Could implementation of the Draft General Plan result in a substantial increase in wind or water erosion of soils?

High erosion potential in soils is primarily caused by loose soils and steep slopes. The potential for erosion generally increases as a result of human activity, primarily through the development of structures and impervious surfaces and the removal of vegetative cover. As stated above, future development will occur through implementation of the Draft General Plan. Future development that is on or in proximity to areas with steep slopes could increase erosion potential. Adherence to the City's grading ordinance would reduce potential impacts. However, since the Draft General Plan does not include specific development projects, it is infeasible at the Program EIR level to provide specific mitigation that would reduce impacts to a less than significant level. Therefore, there is potential for a significant and unavoidable impact associated with erosion.

Could implementation of the Draft General Plan result in allowing structures to be located on a geological unit or soil that is unstable or that would become unstable and potentially result in on-site or off-site landslides, lateral spreading, subsidence, liquefaction or collapse?

Future development may be proposed in areas prone to landslides or where soil limitations (i.e. those prone to liquefaction, subsidence, collapse, etc.) present a hazard to people. This is considered a potentially significant impact. Implementation of mitigation measures would reduce potential impacts. However, since the Draft General Plan does not include specific development projects, it is infeasible at the Program EIR level to provide specific mitigation that would reduce impacts to a less than significant level. Therefore, there is potential for a significant and unavoidable impact associated with unstable geology and soils.

3.4.4 Mitigation Framework

Adherence to regulations and engineering design specifications are generally considered to preclude significant geologic impacts, and no mitigation is proposed at this program level of review. Goals, policies, and recommendations enacted by the City combined with the federal state and local regulations described above provide a framework for developing project level measures for future projects. Through the City's project review process compliance with standards is required of all projects and is not considered to be mitigation. However, it is possible that for certain projects, adherence to the regulations may not adequately protect against geologic impacts and such projects would require additional measures to avoid or reduce impacts. These additional measures would be considered for each future project requiring mitigation (i.e., measures that go beyond what is required by existing regulations).

Site-specific measures will be identified that reduce significant project-level impacts to less than significant, or the project level impact may remain significant and unavoidable where no feasible mitigation exists. Where mitigation is determined to be necessary and feasible, these measures will be included in a Mitigation Monitoring and Reporting Program (MMRP) for the project. These measures may be updated, expanded and refined when applied to specific future projects based on project-specific design and changes in existing conditions, and local, state and federal laws. General measures that may be implemented to preclude or reduce impacts include:

- Preparation of soil and geologic conditions surveys to determine site specific impacts and mitigation designed to mitigate survey recommendations;

- Implementation of state seismic and structural design requirements;

- Implementation of regulations designed to minimize erosion of cliffs, hillsides, and shorelines during and after construction; and

- Innovative grading techniques that reduce landslide and erosion hazard impacts to a greater degree than typically achieved through implementation of grading regulations.

3.4.5 Significance of Impact with Mitigation Framework

Since the Draft General Plan does not include specific development projects, it is infeasible at the Program EIR level to provide specific mitigation that would reduce any future impacts to a less than significant level. Therefore, at this program level of review, significant and unavoidable impacts associated with seismic and geologic hazards, erosion, and unstable geology and soils remains.

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