Information contained in this section is summarized from the *Technical Background Report* to the Safety Element of the General Plan, City of Rancho Santa Margarita and Area of Interest (Earth Consultants International, January 2002) filed under separate cover and available for review at the City of Rancho Santa Margarita Planning Department.

ENVIRONMENTAL SETTING

Geology

The City of Rancho Santa Margarita is located in the southern portion of the Los Angeles Basin, within the Peninsular Ranges of southern California. This area is best exemplified by the series of faults associated with the San Andreas fault system, including the Newport-Inglewood faults in Los Angeles Basin, the Elsinore fault system, and by the Santa Ana Mountains, and the Puente, San Joaquin and Coyote Hills.

Topographically, the City consists of a series of low hills along the western drainages, rising to ridges of moderate to steep relief in the northern part of the City and areas east of the City. Elevations in the City range from approximately 200 feet above mean sea level (AMSL) in the southern areas to 800 feet AMSL near the northeastern areas.

The bedrock units that occur in the City, from oldest to youngest include, tonalite bedrock, Ladd Formation, Williams Formation, Santiago Peak volcanics, Topanga Formation, Santiago Formation, Vaqueros Formation, and Sespe Formation.

Surficial Deposits

Artificial Fill - Artificial fill occurs throughout the City, along roadways, and as canyon fills. These deposits typically consist of locally derived materials and are considered to be uncontrolled (no engineering observation and compaction testing).

Alluvium and Colluvium - Alluvial and colluvial sediments of Holocene age (less than 11,000 years old) are often present within the channels of the smaller tributaries and canyons in the City. Alluvial (stream-deposited) sediments typically consist of medium- to coarse-grained sand, locally with gravel to cobble, and silt to clay sections. In the smaller canyons, the alluvium is about 15 feet thick; whereas in larger canyons, such as Trabuco Canyon, the alluvium thickness can be 30 to 40 feet thick.

Alluvial deposits are generally compressible, of low density, and may contain organic matter. Therefore, in their natural condition, alluvial deposits are unsuitable to support structural loads.

Colluvium is the loose soil and weathered rock debris that typically erodes off ridges and hillsides in response to gravity, and accumulates along the lower flanks and at the base of slopes. These deposits typically consist of silty to clayey sand with varying amounts of rock fragments; these deposits are typically loose, poorly sorted, and often contain organic matter. The deposits are generally a few feet thick, but accumulations as thick as 14 feet have been observed. Colluvial sediments are typically of low density and are not suitable to support structures.

Landslide Debris - Landslides are typical on moderate to steep slopes in the City. Landslide deposits are similar to the underlying bedrock, except that they are broken up, and are less coherent and competent. The rupture surfaces are typically jumbled, chaotic zones several feet thick. Landslide deposits usually have a mixed, jumbled appearance, particularly around the margins. Surficial landslides commonly occur where natural slopes have been undercut by erosion or by man-made excavations.

Older Alluvium or Non-Marine Terrace Deposits - Older alluvium is generally comprised of sediments that were deposited more than 11,000 years ago by precursors to the present-day streams (ancesteral Trabuco Creek). These sediments consist of light brown to orange brown, unconsolidated to semi-consolidated, poorly sorted sand and silty sand, locally with lenses of coarse sand and gravel. Older alluvium is generally firm below the upper few feet, although deeply weathered and porous areas are present locally. The natural moisture content of these units may often be low. Locally, some ridges and elevated areas are mantled with a section of gravelly sand that could be interpreted as older alluvial sediments.

Fault Rupture

Seismicity and Groundshaking

Earthquake severity is normally classified according to magnitude (a measure of the amount of energy released when a fault ruptures), and seismic intensity (a qualitative estimate of the damage caused by an earthquake at a given location). Because the amount of destruction generally decreases with increasing distance away from the epicenter (the point at the Earth's surface directly above where the earthquake originated), earthquakes are assigned several intensities. The most commonly used seismic intensity scale, called the Modified Mercalli Intensity (MMI) scale, has 12 levels of damage. The higher the number, the greater the damage.

The largest earthquake likely to occur on a fault or fault segment is termed the maximum credible (MCE) or characteristic earthquake. A maximum probable earthquake (MPE) is the earthquake most likely to occur in a specified period of time, (such as 30 to 500 years). In general, the longer the time period between earthquakes on a specific fault segment (recurrence interval), the larger the earthquake.

Alquist-Priolo Earthquake Fault Zone mapping has been completed by the State Geologist for Rancho Santa Margarita and no faults are zoned within the City.

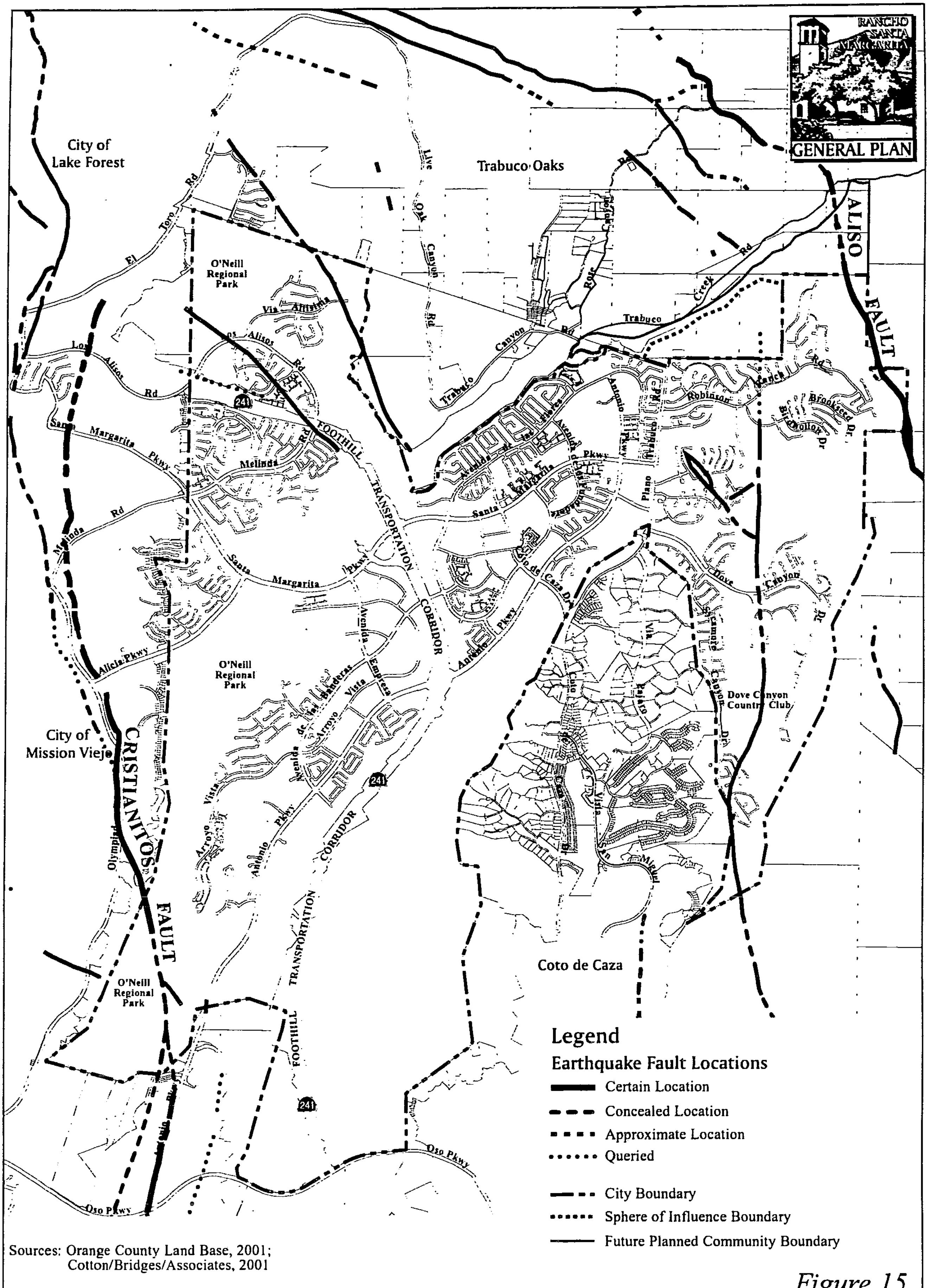
The Elsinore-Glen Ivey fault and the Chino fault are the closest faults to the City that are zoned as Alquist-Priolo Faults. The Elsinore–Glen Ivy Alquist-Priolo segment is located 10.1 miles away from Rancho Santa Margarita and is capable of producing a magnitude 6.8 earthquake. The Chino-Central Avenue fault, a northern extension of the Elsinore fault zone is located 11.1 miles away and is capable of producing a magnitude 6.7 earthquake. The Newport-Inglewood fault zone is considered one of the most prominent structural features of the western Pennisular Ranges. The closest Alquist-Priolo zone of this fault is 14.4 miles from the City. This fault is capable of producing a 6.9 magnitude earthquake.

The two known local faults, Aliso and the Cristianitos, shown on Figure 15, are thought to be inactive. Neither fault is zoned under the State's Alquist-Priolo Zone Act. However, both are prominent local geologic structures.

Geologic Hazards from Groundshaking

Liquefaction is a major secondary seismic hazard that causes various types of ground failure. Three general conditions need to be met for liquefaction to occur: (1) strong ground shaking of relatively long duration; (2) loose, or unconsolidated, recently deposited sediments consisting primarily of silty sand and sand; and (3) water saturated sediments within about 50 feet of the surface. Areas of liquefaction in the City are shown on Figure 16. Most of the lowlands in Rancho Santa Margarita have a high liquefaction potential because shallow ground water, within 50 feet of the ground surface, has been historically reported.

Under certain conditions, strong ground shaking can cause the densification of soils, resulting in local or regional settlement of the ground surface. During strong shaking, soil grains become more tightly packed due to the collapse of voids and pore spaces, resulting in a reduction of the thickness of the soil column. This type of ground failure typically occurs in loose granular, cohesion less soils, and can occur in either wet or dry conditions. Unconsolidated young alluvial deposits are especially susceptible to this hazard. Artificial fills may also experience seismically induced settlement. Damage to structures typically occurs as a result of local differential settlements.



Sources: Orange County Land Base, 2001; Cotton/Bridges/Associates, 2001

Figure 15
Seismic Hazards

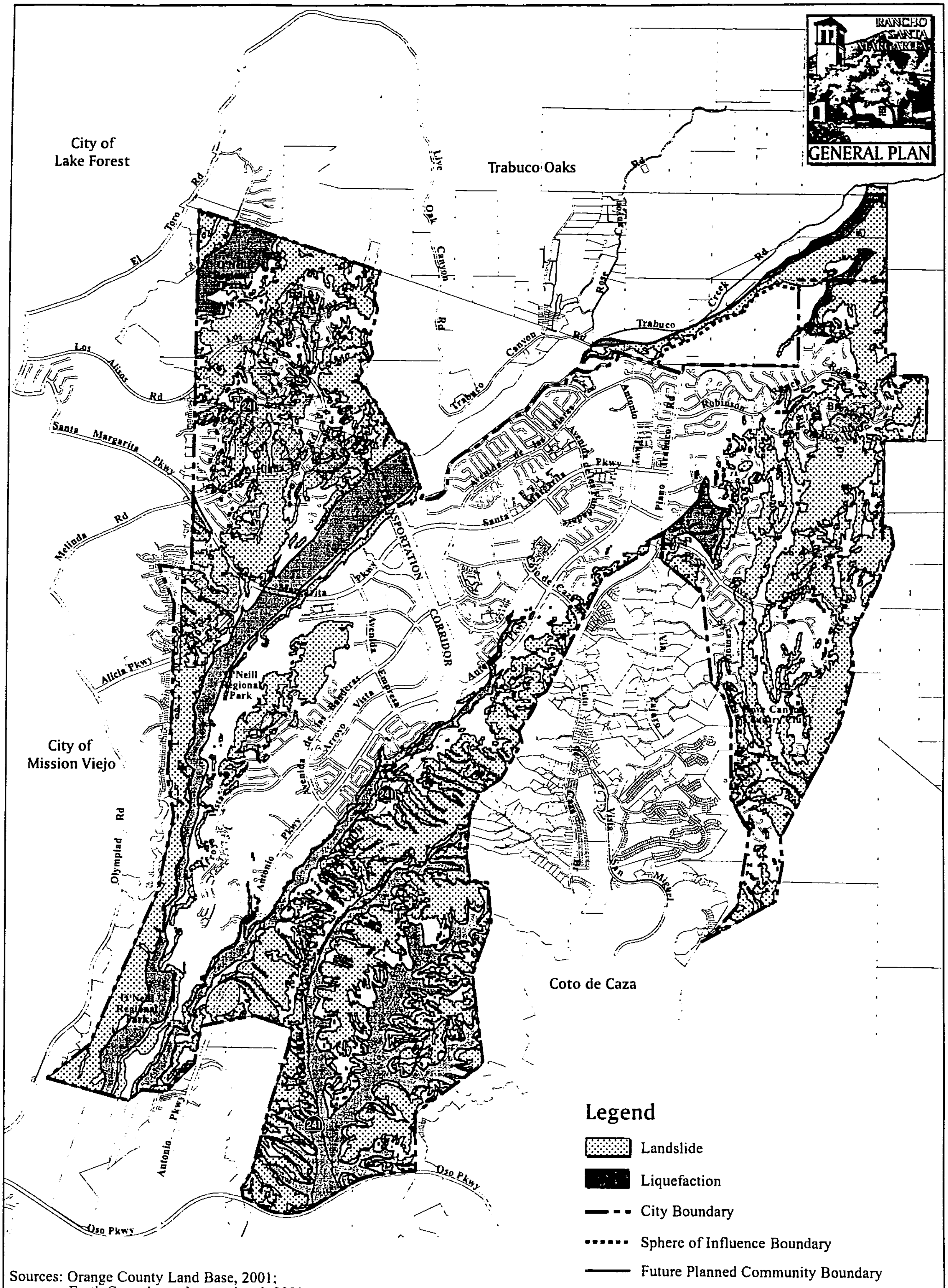


Figure 16

Seismic-Induced Geologic Hazards

Those portions of Rancho Santa Margarita that may be susceptible to seismically induced settlement are generally the floodplains and larger drainages that are underlain by late Quaternary alluvial sediments (similar to the liquefaction-susceptible areas).

Other Geologic Hazards

Geologic hazards include landslides and various other forms of mass wasting as well as expansive soils, subsidence and collapsible soils.

Landslides

Strong ground motions can worsen existing unstable slope conditions, particularly if coupled with saturated ground conditions. Seismically induced landslides can overrun structures, people or property, sever utility lines, and block roads, thereby hindering rescue operations after an earthquake. Figure 16 shows areas mapped by the State as having a potential for seismically-induced landsliding.

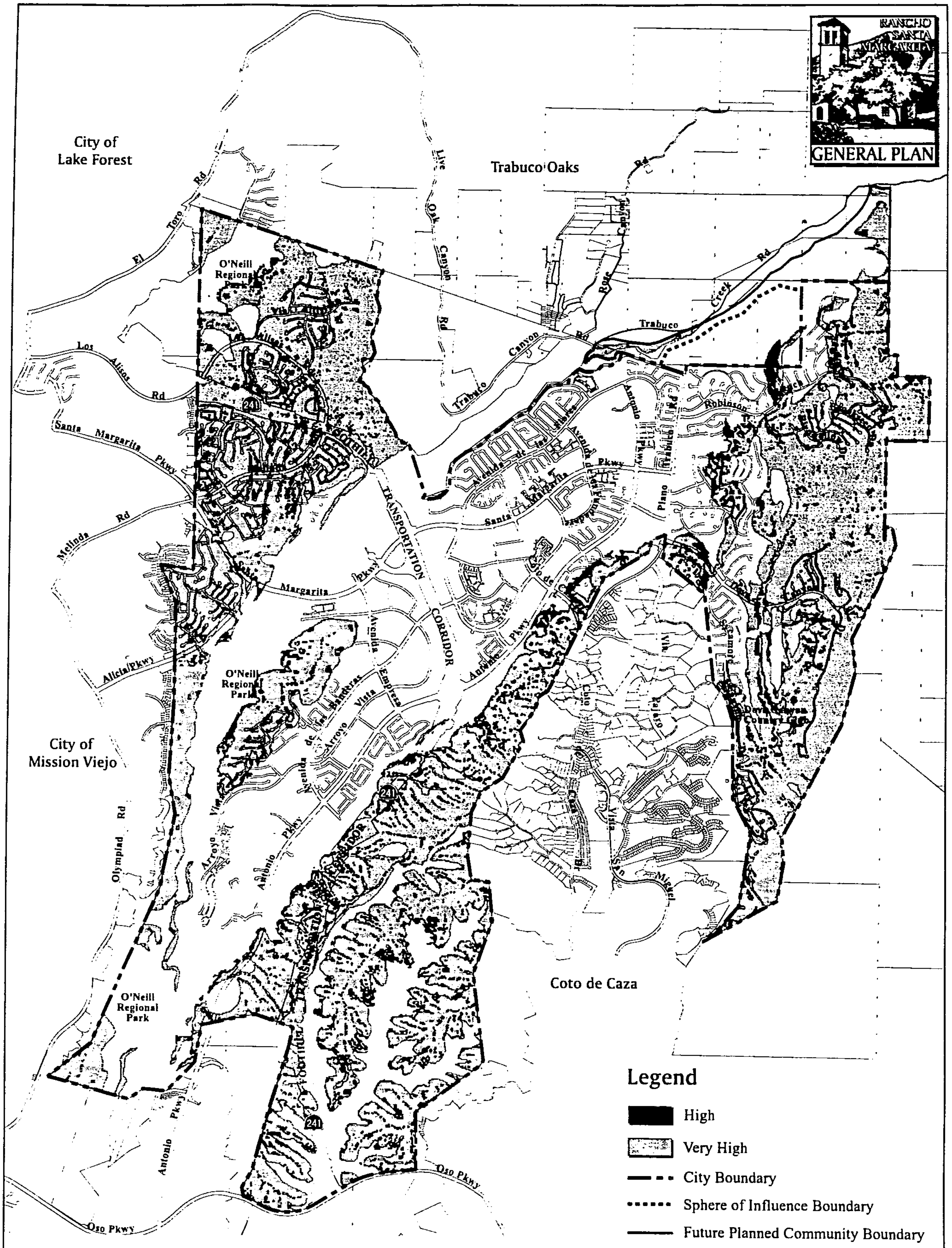
Landslides are typical on moderate to steep slopes. The potential for slope failure is dependent of many factors and their interrelationships. Some of the most important factors include slope height, slope steepness, shear strength, and orientation of weak layers in the underlying geologic unit, as well as pore water pressures. Figure 16 shows landslide susceptibility in the project area, as well as mapped landslides.

Early hazard mapping by the DMG (1971) placed most of the hillsides of Rancho Santa Margarita in a high mudslide risk zone. More recently, this mapping was revised for the western and southeastern parts of the area (Irvine 1990, 1995), where most of the hillside areas have been reclassified as marginally susceptible to debris flows. This classification is defined as gently sloping to moderately steep terrain with potential source areas, but with minor areas classified as "most susceptible" based on relatively common evidence for past debris flows.

Collapse of soils occurs when saturated, collapsible soils undergo a rearrangement of their grains and a loss of cementation, resulting in substantial and rapid settlement under relatively low loads. An increase in surface water infiltration, such as from irrigation, or a rise in the groundwater table, combined with the weight of a building or structure, can initiate rapid settlement and cause foundations and walls to crack. The areas in the project area susceptible to collapsible soils are similar to the liquefaction hazard areas shown in Figure 16.

Expansive Soils and Subsidence

Most of Rancho Santa Margarita is underlain by sedimentary units (both bedrock and alluvium) that are composed primarily of granular soils (silty sand, sand, and gravel). Such units are typically in the low to moderately-low range for expansion potential. However, every sedimentary unit in the area contains layers of fine-grained soils that are



Sources: Orange County Land Base, 2001;
Earth Consultants International, 2001.

N

0 2,000 4,000
1,000 3,000 5,000 Feet

Figure 17

High Slope Instability in the Project Area

typically in the moderate to highly expansive range. The areas most susceptible to expansive soils are located along the western boundary of the City.

Ground subsidence is the gradual settling or sinking of the ground surface with little or no horizontal movement. Most ground subsidence is man-induced and is usually associated with the extraction of oil, gas or ground water from below the ground surface in valleys filled with recent alluvium. No regional subsidence as a result of either groundwater pumping or oil extraction has been reported for the Santa Margarita area.

THRESHOLDS USED TO DETERMINE LEVEL OF IMPACT

Implementation of the General Plan will result in a significant impact if it 1) exposes people or structures to potential substantial adverse effects involving strong seismic ground shaking; seismic-related ground failure, including liquefaction and landslides, 2) results in substantial soil erosion, 3) is located on a geologic unit or soil that is unstable and potentially results in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse or 4) is located on expansive soil.

ENVIRONMENTAL IMPACT

The potential for seismic and geologic hazards to occur in Rancho Santa Margarita exists throughout the life of the Plan. To minimize potential impacts on people and structures in the City, the General Plan includes a Safety Element that addresses natural hazards. This Element includes the following goal and policy:

Goal 1: ***Reduce the risk to the community from hazards related to geologic conditions, seismic activity, wildfires, structural fires, and flooding.***

Policy 1.1: Reduce the risk of impacts from geologic and seismic hazards by applying and enforcing development standards and building construction codes.

Seismicity and Groundshaking

The City of Rancho Santa Margarita has been developed with strong seismic building codes in force, and as a result, development in the community is anticipated to experience little structural impact should earthquakes occur on nearby faults. Development pursuant to General Plan policy over the life of the Plan will result in the addition of approximately 687 net new units to the City's housing stock, for a total of 17,608 units, and an additional 698,000 square feet of nonresidential development (see Table 1 in the Project Description of this EIR), for a total of 13.64 million square feet.

The General Plan establishes the review of proposals for new development and redevelopment to include the most up-to-date structural codes to continue to protect the public safety of residents in the city. With implementation of this development review and structural standards, impact that would otherwise be potentially significant, can be reduced or avoided.

Another component of seismic safety addressed in the General Plan is earthquake preparedness. Providing education materials about what to do in the event of an earthquake helps to inform residents and businesses about emergency preparedness and response (Also refer to Section 3.12, Public Services, regarding emergency preparedness).

Geologic Hazards from Groundshaking

As shown on Figure 15, most of the lowlands in Rancho Santa Margarita have a high liquefaction potential due to shallow ground water. Most of the areas within the City subject to liquefaction are located in designated open space. However, a few developed areas in the Robinson Ranch and Dove Canyon areas are within the liquefaction boundaries. The geological impacts on these developments were evaluated in the plans prepared for the communities and no further impact is anticipated to occur. Since the location of future development in the Northeast Future Planned Community is not known, the area may be subject to liquefaction.

Areas subject to seismically induced settlement are generally the floodplains (refer to Section 3.10, Hydrology for information on flooding) and larger drainages that are underlain by late Quaternary alluvial sediments (similar to the liquefaction-susceptible areas). These include areas in Trabuco Canyon, Live Oak Canyon and especially the flatter areas along these drainages. Also included are the areas along Tijeras Canyon.

Figure 16 shows the areas in the project area that could be susceptible to seismically induced landslides. The area east of Rancho Santa Margarita and some steep slopes within the City would be most vulnerable to this type of failure, due to the steep terrain and the presence of weak sedimentary rock units. Areas on the gentler slopes may also be susceptible where slopes have been undercut by streams or roadcuts.

Appropriate geotechnical review is needed for projects located in potential liquefaction areas, seismically induced areas, or on unstable slopes, including areas within a State-delineated Seismic Hazard Zone (refer to Figure 16), to minimize potential hazards. With implementation of these requirements, an otherwise potentially significant impact can be reduced or avoided.

Other Geologic Hazards

Landslides

The sedimentary bedrock units that underlie the hillside areas appear to be stable in their natural conditions, as remarkably few landslides have been mapped in the project area (see Figure 17). However, an earthquake on a nearby seismic source could trigger landslides and the stability of these slopes can also be negatively impacted by development. As shown on Figure 17, the vacant land adjacent to the Robinson Ranch Planned Community is within the very high category for landslide susceptibility. This very high category also applies to areas within the Northeast Future Planned Community, as well as mapped landslides.

Expansive Soils and Subsidence

Locations of expansive soils are limited to the western portion of the City in the previously developed Rancho Trabuco Planned Community or as open space in O'Neill Regional Park. The geological impacts on this existing development were evaluated in the Rancho Trabuco Planned Community documents, and no further impact is anticipated. Areas susceptible to collapsible soils and ground subsidence are similar to the liquefaction hazard areas shown on Figure 16. These areas include portions of the Northeast Future Planned Community. Since the location of future development in the Northeast Future Planned Community is not known, this area may be subject to collapsible soils and ground subsidence hazards.

Implementation of the General Plan will include development in areas susceptible to landslides, collapsible soils, expansive soils and ground subsidence. Appropriate geologic review is needed for projects located in these areas to minimize potential hazards. With implementation of these requirements, an otherwise potentially significant impact can be reduced or avoided.

MITIGATION MEASURES

Seismicity and Groundshaking

The City will implement Implementation Programs S-1 through S-3 and S-5 that work to reduce impacts associated with seismic and groundshaking activities. Implementation Program S-1 requires development proposals to be assessed pursuant to the California Environmental Quality Act, including measures to mitigate potential faulting hazards. Utilizing open space easements and other regulatory techniques, as called for in Implementation Program S-2, prohibits development and avoids public safety hazards where the presence of faulting is identified. Implementation Program S-3 requires the most recent state and seismic requirements to be used for structural design of new development and redevelopment. Promoting earthquake preparedness in the community with periodic earthquake awareness programs is required by Implementation Program S-5 including coordinating programs with emergency service providers and school districts to maximize public participation.

Geologic Hazards from Groundshaking

The City will implement Implementation Programs S-1 through S-3 (as described above) S-4 and S-6 to reduce impacts associated with geologic hazards from groundshaking. Implementation Program S-4 requires surveys of soil and geologic conditions by state licensed Engineering Geologists and Civil Engineers where appropriate during the review of development and redevelopment proposals. Examples of when these surveys are required are (1) prior to the development of any area with slopes more than 10 feet high at a gradient equal to or steeper than 2:1 and (2) for projects within a State-delineated Seismic Hazard Zone for liquefaction and seismically induced landsliding, in accordance with the California Division of Mines and Geology. The development of informational overlays that augment the City's zoning ordinance is required in Implementation Program S-6. These overlays will assist to (1) identify those areas where more detailed geotechnical studies should be carried out as part of a liquefaction-susceptibility investigation, (2) restrict development in liquefaction-prone areas, or (3) establish specific building design standards aimed at reducing the risk of liquefaction.

Other Geologic Hazards

The City will implement Implementation Programs S-1 through S-4 (as described above) to reduce impacts associated with other geologic hazards (landslides, collapsible soils, expansive soils and ground subsidence) in the project area.

LEVEL OF IMPACT AFTER MITIGATION

Seismicity and Groundshaking

Through the use of the Implementation Programs S-1 through S-3 and S-5, the potential for substantial adverse effects from seismicity and groundshaking will be reduced to a less-than-significant level.

Geologic Hazards from Groundshaking

Implementation Programs S-1 through S-3, S-4 and S-6 will reduce the potential for substantial adverse effects from liquefaction, seismically induced settlement or seismically induced landslides to a less-than-significant level.

Other Geologic Hazards

Through the use of Implementation Programs S-1 through S-4, the potential for substantial adverse effects from landslide susceptibility, expansive soils, collapsible soils and ground subsidence will be reduced to a less-than-significant level.

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