5.6 GEOLOGY AND SOILS

ENVIRONMENTAL SETTING

The City of Moreno Valley planning area is situated along a valley floor bounded by the hills and mountains of the Badlands to the east, State Route 215 to the west, the Box Springs Mountains to the north, and the mountains of the Lake Perris State Recreation Area to the south. The planning area slopes to the south.

Geology

The City lies primarily on bedrock known as the Perris Block. This structural unit is located within the Peninsular Range Geomorphic Province, one of the major geologic provinces of Southern California. The Perris Block is a large mass of granitic rock generally bounded by the San Jacinto Fault, the Elsinore Fault, the Santa Ana River and a non-defined southeast boundary. The Perris Block has had a history of vertical land movements of several thousand feet due to shifts in the Elsinore and San Jacinto Faults. **Figure 5.6-1** depicts the geology of the planning area.

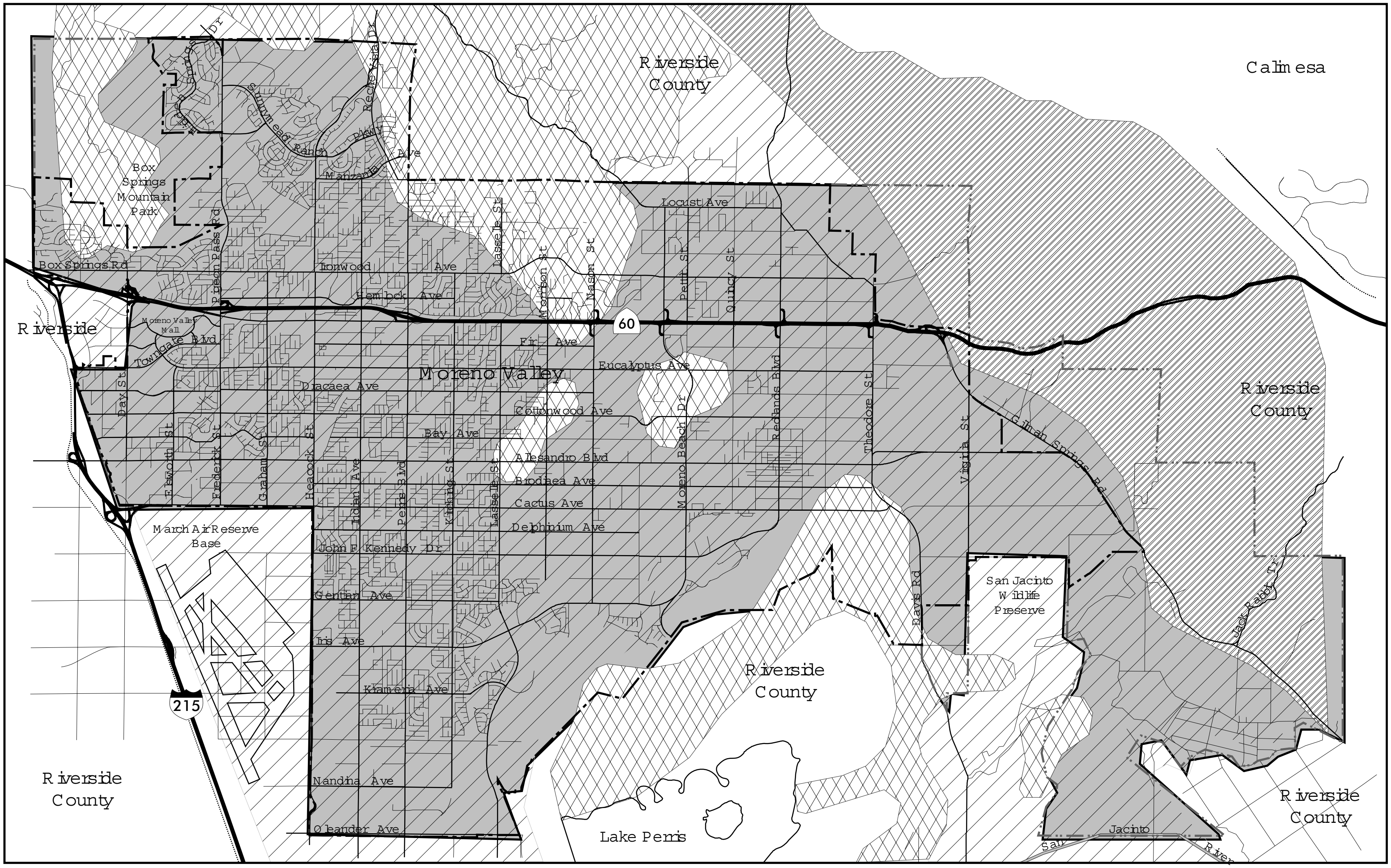
The materials within the valley area are characterized by Pliocene - Pleistocene alluvium ranging from relatively thin (20 feet to 200 feet) to intermediate thickness (up to 2,000 feet), overlaying the primarily granitic bedrock.

The rocky, mountainous areas of the planning area, including the Box Springs Mountains and the Mount Russell/Lake Perris State Recreation area, have an underlying granitic bedrock that consists essentially of quartz diorite, and displays granite rock outcrops and large boulders.

The Badlands range, at the eastern end of the planning area comprises deposits of what was once an inland sea, later elevated and deformed by geologic processes, before becoming severely eroded to its present state. This area consists of folded semi-consolidated sedimentary sandstone, siltstone, and shale.

Soils and Slope Stability

Five soil associations occur within the planning area. The five soil types are: Monserate-Arlington-Exeter; Hanford-Tujunga-Greenfield; Cieneba-Rock Land-Fallbrook; San Emigdio-Grangeville-Metz; and the Badlands-San Timoteo.



Source: Generalized Geologic Map of Part of the Northern Peninsular Ranges, 1985. University of California Riverside, Campus Museum Contributions No. 1, page 64.

Note: This map is not a substitute for detailed Alquist-Priolo Special Studies Maps or Riverside County Hazard Management Zone Maps. For Accurate sitings refer to California State and Riverside County Geologists.

Perris Bedrock

Quarternary Alluvium

Semi Consolidated Sandstone, Siltstone and beds of gravel

Granite Rocks of the Southern California Batholith

0 6,000 12,000 ft

North

Figure 5.6-1 Geology

Monserate-Arlington-Exeter. This soil association is found adjacent to and within the eastern half of the March Air Reserve Base. It consists of well-drained soils that developed in alluvium from predominantly granitic materials. Soil stability is considered fair to good with minimal erosion potential.

Hanford-Tujunga-Greenfield. This soil association is found within the central portion of the study area, generally extending northeast to southeast of March Air Reserve Base. It consists of well drained to somewhat excessively drained soils, developed in granitic alluvium. Soil stability is considered poor to fair with significant erosion potential.

Cieneba-Rock Land-Fallbrook. This soil association is found on uplands located in the Box Springs Mountains area, and extends east to Reche Canyon, and into the Mount Russell area. It consists of somewhat excessively drained soils on undulating steep slopes. Soil stability is generally considered fair with marginal potential for erosion.

San Emigdio-Grangeville-Metz. This soil association is found along the western side of Gilman Springs Road. It consists of well-drained soils on nearly level to steep slopes. Soil stability is considered poor to fair with significant potential for erosion.

Badlands-San Timoteo. This soil association if found along the northern portion of Gilman Springs Road into the Badlands region. It consists of well-drained soils on steep to very steep slopes. The soils are variable consisting of soft sandstone, siltstone, and beds of gravel. Soil stability is considered poor to fair with significant potential for erosion.

Some of these soils have poor to fair stability and are considered to be potentially expansive. Soils prone to collapse are commonly associated with wind-laid sands and silts, and alluvial fan and mudflow sediments deposited during flash floods. The collapse potential of the soils identified above ranges from minimal to significant. The Monserate-Arlington-Exeter soil association has minimal collapse potential and the Cienega-Rock Land-Fallbrook association has marginal potential for collapse.

The primary factors that determine an area's susceptibility to slope instability are the underlying geologic and soils characteristics. The abundant shales and siltstones underlying the Badlands are highly porous and do not hold together well when wet, which can lead to slope instability and landslides. Secondary factors contributing to slope instability and landslides include rainfall and earthquakes. A "slow moving" landslide reportedly exists along Gilman Springs Road in the eastern portion of the planning area.[1]

[1] Michael A. McKibben, Ph.D., September 28, 2000 comment letter.

Existing Regulations

Existing grading regulations require permit applications to include soils engineering reports and, where necessary, engineering geology reports. The recommendations contain in the reports must be included in the grading plans and specifications. The reports typically include recommendations concerning cuts, fills, compaction and foundation design to ensure stable development.

Subsidence

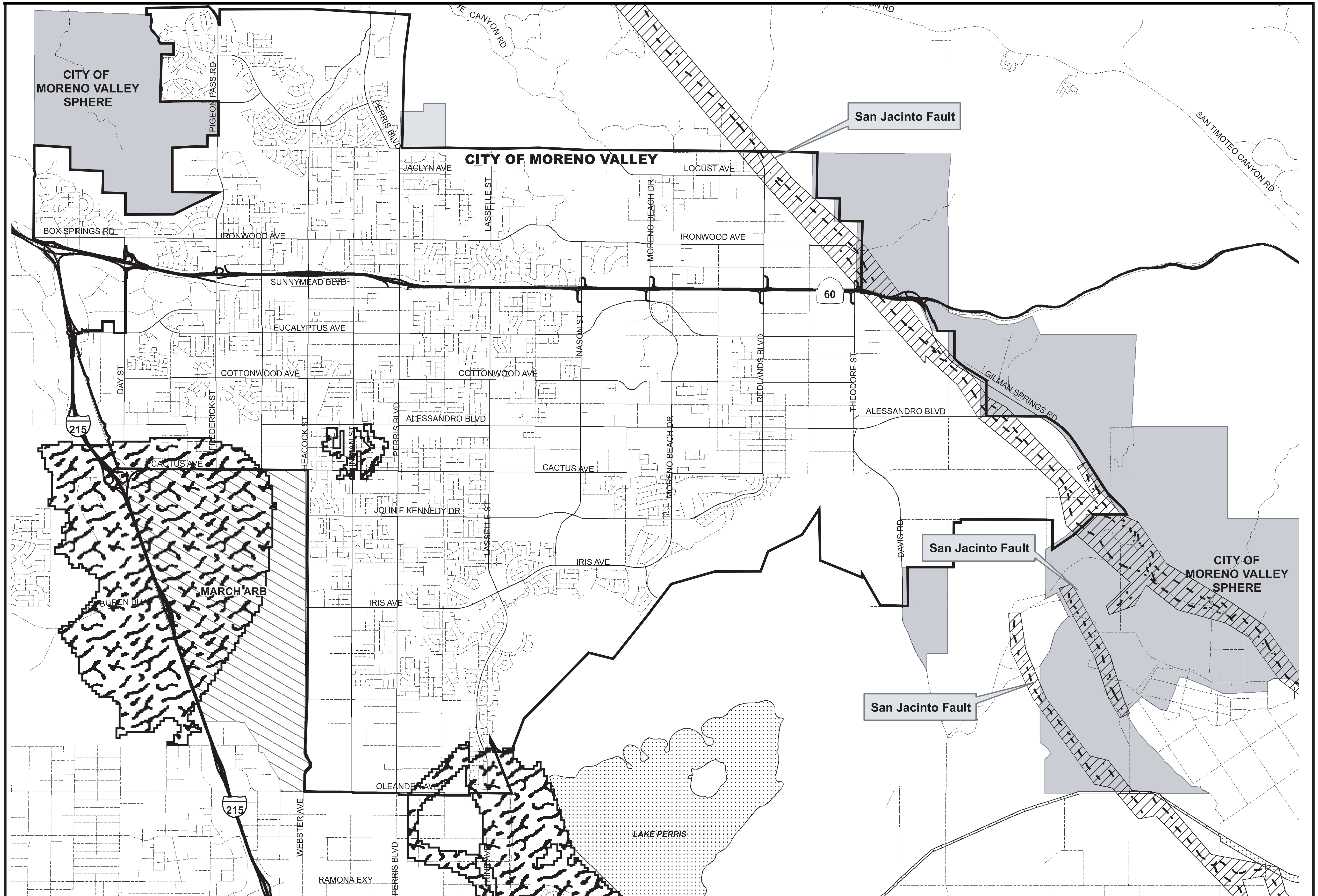
The low-lying areas in the southeast corner of the planning area have experienced tectonic subsidence, as well as subsidence as a result of groundwater withdrawal for agricultural use. The southeast corner of the planning area is within the San Jacinto Wildlife Area and/or within the designated floodplain.

Fault Rupture

The San Jacinto fault passes through the eastern portion of the planning area. The San Jacinto fault is considered to be the most active fault in Southern California. An Alquist-Priolo Special Fault Zone has been established for the San Jacinto fault. The Casa Loma fault (a fault strand of the San Jacinto fault) lies 1.5 miles southwest of the San Jacinto fault in the southeast corner of the planning area. It had been speculated that the Casa Loma strand might extend northwest of the Alquist-Priolo Special Fault Zone, but geologic studies to date have been unable to show that the fault extends beyond the Special Fault Zone. The fault strand that lies to the northeast of the Casa Loma fault is known as the Claremont Fault. **Figure 5.6-2** depicts the location of these faults. Another fault, known as the Farm Road Fault, was identified in 1992 in the far southeast corner of the planning area. Insufficient information is available to determine whether it is an active fault.

Existing Regulations

Existing state law and city regulations and practices require most development applications within the Alquist-Priolo Zone to include geologic reports addressing potential surface rupture due to faulting. No structure for human occupancy is permitted to placed across the trace of an active fault, nor generally within 50 feet of any active fault trace.



MORENO VALLEY
People • Pride • Progress

- Streets
- Major Streets
- Highways
- Faults
- Fault Zones
- Potential Liquefaction
- Moreno Valley
- Moreno Valley Sphere
- March ARB
- Waterbodies

5,000 2,500 0 5,000 Feet

0.5 0.25 0 0.5 1 Miles

Date: March 24, 2006
State Plane NAD83 Zone 6
File: G:\arcmap\planning\gen_plan_updates\geologic.mxd

GEOGRAPHIC INFORMATION SYSTEMS

North

Figure 5.6-2
Seismic Hazards

TABLE 5.6-1
POTENTIAL EARTHQUAKE SCENARIOS
FOR MORENO VALLEY

Fault Name	Distance from Moreno Valley	Type Per UBC	Slip Rate (mm/year)	Maximum Credible Earthquake
San Jacinto	0	A	12.0	7.2
Elsinore	12 to 18 miles	B	4.0	6.8
San Andreas	15 to 20 miles	A	24.0	7.4

Source: City of Moreno Valley, General Plan, September 20, 1988.
[1] A = Faults that are capable of producing large magnitude events that have a highs rate of seismicity.

Seismicity and Groundshaking

Earthquake-generated groundshaking is the most critical and potentially damaging earthquake effect in the planning area. Three potential sources of strong seismic groundshaking in the planning area include the San Jacinto fault, the San Andreas Fault and the Elsinore Fault. The major source of potential earthquake damage to the planning area is from activity along the San Jacinto fault. The San Andreas fault is an active fault that is located approximately 15 to 20 miles northeast of the planning area. The Elsinore fault is located approximately 12 to 18 miles southwest of the planning area. A major earthquake associated with any of these faults could result in moderate to severe groundshaking in the planning area. Damage to buildings and infrastructure could be expected as a result of groundshaking during a seismic event.

Table 5.6-1 depicts the seismic data for regional faults that could affect the planning area. As depicted, the maximum credible earthquake from these faults ranges from 6.8 to 7.4.

Most loss of life and injuries that occur during an earthquake are related to the collapse of buildings and secondary damage. Seismic groundshaking can also result in substantial structural damage and loss of income.

Existing Regulations

All buildings in the region are required to resist seismic groundshaking in accordance with the Uniform Building Code (UBC). However, the UBC does not provide 100 percent protection against seismic damage.

Liquefaction

Liquefaction is a process by which clay-free soil deposits, primarily sands and silts, temporarily lose strength during severe groundshaking and behave as a sticky liquid rather than a solid. Liquefaction occurs primarily in areas of recently deposited sands and silts and in areas of high groundwater levels. Poorly consolidated sediment and high groundwater levels occur most frequently in creekbeds and floodplains. Although the City has seen no evidence of liquefaction events occurring in the community nor has any geotechnical report recently submitted to the City identified liquefaction hazards, the Riverside County General Plan has identified a range of liquefaction susceptibility in Moreno Valley from very low with deep groundwater in the northern and eastern portions of the community to very high with shallow groundwater generally west of Perris Boulevard.

Moreno Valley General Plan

The proposed Moreno Valley General Plan Safety Element Objective 6.1 is to "minimize the potential for loss of life and protect residents, workers, and visitors to the City from physical injury and property damage due to seismic ground shaking and secondary effects." Based on this objective, the Element provides the following Policy Statements applicable to this section:

6.1.1 Reduce fault rupture hazards to a level of acceptable risk through the identification and recognition of potentially hazardous conditions and areas as they relate to the San Jacinto fault zone and the high and very high liquefaction hazard zones. Require geologic studies and mitigation for fault rupture hazards in accordance with the Alquist-Priolo Special Study Zones Act. Additionally, future geotechnical studies shall contain calculations for seismic settlement on all alluvial sites identified as having high or very high liquefaction potential. Should the calculations show a potential for liquefaction, appropriate mitigation shall be identified and implemented.

6.1.2 Require all new developments, existing critical and essential facilities and structures to comply with the most recent Uniform Building Code seismic design standards.

THRESHOLD FOR DETERMINING SIGNIFICANCE

For the purposes of this EIR, a significant impact would occur if implementation of General Plan Alternatives 1, 2, or 3 would:

- *Expose people or structures to unacceptable risks of major geologic, seismic or soils hazards that could not be overcome by using reasonable construction and/or maintenance practices.*

ENVIRONMENTAL IMPACT

General Plan Land Use Alternatives 1, 2, and 3

The impact analysis provided in this section addresses the three General Plan Alternatives. The geology and soils impacts will be similar for each General Plan Land Use Alternative.

Geology

Development according to any of the General Plan Land Use Alternatives is not anticipated to result in a significant impact associated with the geologic formation underlying the planning area. The Perris Bedrock is considered to be relatively stable. No mitigation is required.

Soil and Slope Stability

Some of the soils that occur within the planning area are susceptible to collapse which may pose a hazard to new development. This is considered a significant impact. Implementation of Mitigation Measures GS1 and GS2 will reduce this impact to a level less than significant.

Subsidence

An area in the southeastern portion of the planning area has experienced subsidence in the past. However, the area is located within the San Jacinto Wildlife Area and/or within the designated floodplain, where the risk for injury or loss of life due to subsidence is considered low. Therefore, no significant impact associated with subsidence is anticipated to occur.

Fault Rupture

An Alquist-Priolo Special Fault Zone has been established for the San Jacinto fault. The major source of potential damage due to fault rupture is from activity along the San Jacinto fault.

The San Jacinto Fault Zone underlies portions of General Plan Land Use Alternatives 1, 2, and 3, planned for residential, business park, commercial, and public land uses. Schools are strictly prohibited by the State Department of Education and Title 5 from locating on an active fault or within an Alquist-Priolo Zone.

This issue is considered a significant impact. Implementation of Mitigation Measures GS1 and GS2 will reduce this impact to a level less than significant.

Seismicity and Groundshaking

The planning area is located in a region with several active fault lines. The entire area is at risk for damage caused by groundshaking and seismic activity. The seismic risk in the planning area is similar to other portions of Riverside County.

With the increase of development and population allowed under the General Plan Alternatives, the number of people and buildings exposed to seismic groundshaking will increase. This is considered a significant impact. Implementation of Mitigation Measures GS1 and GS2 will reduce the impact to a level less than significant.

Liquefaction

As described above, the Riverside County General Plan identifies a range of liquefaction susceptibility in Moreno Valley ranging from very low with deep groundwater in the northern and eastern portions of the community to very high with shallow groundwater generally west of Perris Boulevard. The area subject to high and very high liquefaction potential according to the County's mapping is largely developed, and the new General Plan policies and land uses will not affect this existing development. Although no new residential development is expected in this area, new non-residential development may occur in the vacant lands in this area. Because development will be allowed in the high susceptibility areas, this is considered a significant impact. Currently, the City Engineer routinely requires project proponents to evaluate the potential for land settlement when conducting foundation investigations, which would address this potential impact. Additionally, implementation of Mitigation Measures GS1 and GS2 will reduce the impact to a level less than significant. Therefore, potential impacts to new homes and residents will not occur.

MITIGATION MEASURES

GS1. The City shall reduce the fault rupture hazards through the identification and recognition of potentially hazardous conditions and areas as they relate to the San Jacinto fault zone and the high and very high liquefaction hazard zones. During the review of future development projects, the City shall require geologic studies and mitigation for fault rupture hazards in accordance with the Alquist-Priolo Special Study Zones Act. Additionally, future geotechnical studies shall contain calculations for seismic settlement on all alluvial sites identified as having high or very high liquefaction potential. Should the calculations show a potential for liquefaction, appropriate mitigation shall be identified and implemented (**Policy 6.1.1**).

GS2. The City shall require all new developments, existing critical and essential facilities and structures to comply with the most recent Uniform Building Code seismic design standards (**Policy 6.1.2**).

IMPACT AFTER MITIGATION

Soil and Slope Stability

Less than significant.

Subsidence

Less than significant.

Fault Rupture

Less than significant.

Seismicity and Groundshaking

Less than significant.

Liquefaction

Less than significant.

NOTES AND REFERENCES

1. Earth Consultants International. *Slope and Soil Instability Hazards-County of Riverside*, August 1, 2000.

2. Morton, Douglas "Subsidence and Ground Fissures I the San Jacinto Basin Area, Southern California" U.S. Geological Survey Open File Report 94532 (1992)

3. Martin, Jay and Reeder, Wessly (Gary S. Rasmussen and Associates) "Engineering Geology Investigation; Tentative Tract No. 24721; South of Eucalyptus Avenue, east of Redlands Boulevard; Moreno Valley, CA (1989).

4. Park, Stephen and Pendergraft, Darin "Interim Technical Report of the San Jacinto Shallow Seismic Reflection Survey (1992).

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