6.0 RISK ASSESSMENT

The purpose of this section is to identify the hazards that can affect the City of Paso Robles, profile the major hazards, assess the risk of such hazards, describe the City's vulnerability, and estimate potential losses from the hazards. Each of these tasks is described in detail below. It is notable that this is the first time that a comprehensive effort of this kind has been undertaken for the City.

Information is provided here on the City of Paso Robles and, when appropriate, San Luis Obispo County. This integrated information-gathering method was employed because many hazard events are likely to affect numerous jurisdictions within such a consolidated urban area. However, evaluation of hazard event scenarios is complicated because information is not always available at the jurisdictional level for many hazards and may only be available at the county or state level. Because of this inconsistency, hazard and community information has been provided at the most localized level possible.

6.1 DMA 2000 REQUIREMENTS

The overall requirements for the risk assessment according to *DMA 2000* are shown in Table 6-1 and detailed further in subsequent tables. While technically only natural hazards must be addressed, most human-caused hazards are included in this plan in at least a preliminary manner. In order to meet these requirements, the City of Paso Robles used the step-wise approach to the risk assessment detailed in *Understanding Your Risks: Identifying Hazards and Estimating Losses* (FEMA 2001). This approach consists of the following major steps:

- Identify and screen hazards
- Profile hazards
- Inventory assets
- Estimate losses
- Identify future risks

TABLE 6-1
DMA 2000 REQUIREMENTS – RISK ASSESSMENT – OVERALL

RISK ASSESSMENT: *§201.6(c)(2): The plan* ***shall*** *include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.*

Source: FEMA, March 2004.

6.2 IDENTIFY AND SCREEN HAZARDS

The first step in the risk assessment process is the identification and screening of hazards, as shown in Table 6-2. Hazards identified include natural and human-caused hazards that might affect persons and property in the City of Paso Robles. This includes hazards that have occurred in the past as well as those that may occur in the future (even if they have not yet occurred). The list of all possible hazards is screened to focus on the most likely or most damaging hazards.

TABLE 6-2
DMA 2000 REQUIREMENTS – RISK ASSESSMENT – IDENTIFYING HAZARDS

Identifying Hazards	
*Requirement §201.6(c)(2)(i): [The risk assessment **shall** include a] description of the type … of all natural hazards that can affect the jurisdiction.*	
Element	
A.	Does the plan include a description of the types of all natural hazards that affect the jurisdiction? If the hazard identification omits (without explanation) any hazards commonly recognized as threats to the jurisdiction, this part of the plan cannot receive a Satisfactory score. Consult with the State Hazard Mitigation Officer to identify applicable hazards that may occur in the planning area.

Source: FEMA, March 2004.

At the first meeting of the Paso Robles Hazard Mitigation Planning Team (in June, 2004), a comprehensive list of potential hazards affecting communities in California was reviewed. The hazards considered for identification and screening are shown in Table 6-3. The hazards on the list were evaluated and screened by the team for profiling and vulnerability assessment. This hazard list was developed by URS and the HMPT based on hazards known to affect the region. The "why or why not?" column in Table 6-3 briefly explains why each hazard was (or was not) chosen for profiling in this Plan. In making screening decisions, the Team considered a range of factors, including the following:

- Prior knowledge or perception of the relative risk presented by the hazards
- The ability to mitigate the hazard
- The known or expected availability of information on the hazard

6.3 HAZARD PROFILES

The DMA 2000 requirements for profiling the hazards are shown in Table 6-4. The intention is to present significant information on the location, extent (magnitude/severity), history, and probability of the hazards.

It is important for a community's risk mitigation and preparedness efforts to be founded on accurate information about the types and scale of damage that hazards could cause to the community. This section contains a description of the major hazards that threaten Paso Robles – drought, earthquakes, expansive soils, extreme heat, floods, hazardous materials accidents, landslides, subsidence and wildfires – and the exposure and vulnerability of elements of the City to these hazards. It presents descriptions of potential damage and consequences.

The best available data and technical methods were used to estimate possible losses caused by these various hazards. City and County databases, which include information about building types, natural features, and important property uses, were extensively used to characterize the city's hazards. HAZUS-MH, a natural hazard loss-estimation program developed by FEMA, was also used to estimate the values of some critical facilities and infrastructure in the City.

The City of Paso Robles is exposed to a number of natural hazards that vary in their potential intensity and impact on the City. This mitigation plan assesses the City's vulnerability to these hazards, which were selected because of their likelihood of occurrence and potential consequences. These hazards are of great concern because they can occur independently, or in combinations, and can trigger secondary hazards.

TABLE 6-3
HAZARD IDENTIFICATION AND SCREENING FOR PASO ROBLES

Hazard	Include?	Why or why not?	Other Comments
Avalanche	No	City not located in snow and mountain area.	
Airplane Crash	No	No experience / low probability.	
Coastal Erosion	No	City not located on coast.	
Coastal Storm	No	City not located on coast.	
Dam Failure	No	Failure of San Luis Dam on Santa Margarita Lake will not affect City.	City's General Plan confirms that the City is outside of the Dam's inundation zone
Disease	No	No experience / low probability.	
Drought	Yes	Water storage and supply currently affected by drought conditions.	Could also affect ability to fight fires
Earthquake (Seismic)	Yes	Recent and historic earthquakes. Proximity to San Andreas fault.	Major historic earthquakes include 1983 Coalinga, 2003 San Simeon (Presidential disaster declaration), 2004 Parkfield
Expansive Soils	Yes	Currently affects some City areas.	
Extreme Heat	Yes	Historic events experienced by City.	110 degrees plus experienced
Flood	Yes	Historic events experienced by City.	Major historic floods include 1969 100-year flood, 1995 flood/landslide
Hailstorm	No	Low experience / low probability	
Hazardous (Hazmat)	Yes	Hazmat facilities located within and near City. Major hazmat transportation routes transect City.	
Hurricane	No	No experience / low probability	
Land Subsidence	Yes	Experienced following earthquakes.	
Landslide	Yes	Experienced following heavy rains.	1995 flood/landslide
Tornado	No	No experience / low probability.	
Tsunami	No	City not located on coast.	
Volcano	No	City not located near volcanic area.	
Wildfire	Yes	Historic events experienced by City.	

TABLE 6-3 (CONTINUED)
HAZARD IDENTIFICATION AND SCREENING FOR PASO ROBLES

Hazard	Include?	Why or why not?	Other Comments
Windstorm	No	No significant historic events experienced by City.	
Winter Storm	No	No significant historic events experience by City	

Source: Paso Robles Hazard Mitigation Team, URS, June 2004.

TABLE 6-4
DMA 2000 REQUIREMENTS – RISK ASSESSMENT – PROFILING HAZARDS

Profiling Hazards
Requirement §201.6(c)(2)(i): *[The risk assessment **shall** include a] description of the … location and extent of all natural hazards that can affect the jurisdiction. The plan **shall** include information on previous occurrences of hazard events and on the probability of future hazard events.*
Element
A. Does the risk assessment identify the **location** (i.e., geographic area affected) of each natural hazard addressed in the plan?
B. Does the risk assessment identify the **extent** (i.e., magnitude or severity) of each hazard addressed in the plan?
C. Does the plan provide information on **previous occurrences** of each hazard addressed in the plan?
D. Does the plan include the **probability of future events** (i.e., chance of occurrence) for each hazard addressed in the plan?

Source: FEMA, March 2004.

The natural hazards included in this plan were identified through a community-based process just a few months after the San Simeon earthquake in December 2003, when the awareness of the potential for natural hazards was heightened.

The worst potential disaster that Paso Robles could face involves multiple hazards occurring at the same time. A major earthquake could trigger significant landslides, spark wildfires and release hazardous materials. If an earthquake occurred during the rainy winter season, landslides would be worsened and flooding could occur, exacerbated by damaged stream culverts and storm drains. The City's fire chief and council members recently updated and revised their *Multi Hazard Emergency Response Plan* (Fall 2003) as well as the appendices of the plan, which specifically address response procedures for storms and floods, earthquakes, fires, multi-casualties, hazardous materials incidents, and terrorist attacks.

The specific hazards selected by the City for profiling have been examined in a methodical manner based on the following three factors, with each factor considered in detail for the hazards profiled:

- **Nature**: This topic provides basic information about the hazard that is sufficient to enable a user of the plan to comprehend its nature and distinguish it from other hazards. It also provides a basis for leaders to understand the subsequent vulnerability assessment and loss estimates. The information for this section is drawn mainly from FEMA and other national agencies.

- **History**: Background information about previous occurrences of the hazard is provided. The focus is on disasters and other events that have occurred in Paso Robles and, where Paso Robles information is lacking, on major occurrences elsewhere in San Luis Obispo County, California or the United States. The information in this section is drawn mainly from databases of historical hazard events. Figures that display historical occurrences of the hazards in the City are referenced, where available.
- **Future Events**: The focus of this topic is the probability of the hazard as well its magnitude. The information in this section is drawn from a combination of FEMA and other national sources, San Luis Obispo County expertise, and the hazard event databases. Where possible, figures have been produced to display the susceptibility of areas to the hazards.

In an effort to provide as much information as possible about each hazard, extensive text analysis as well as associated tables and graphics have been included for each of the hazard profiles below. These hazard profiles should be considered introductory, with additional and more detailed analysis available via the many sources cited below and at the end of this document.

6.3.1 Drought

6.3.1.1 Nature

Drought is different from normal aridity, which is a permanent characteristic of the climate in areas of low rainfall. Drought is the result of a natural decline in the expected precipitation over an extended period of time, typically one or more seasons in length. Drought may occur in any climate, including in areas of normally high or low rainfall. The severity of drought can be aggravated by other climatic factors, such as prolonged high winds and low relative humidity (FEMA, 1997).

Drought is a complex natural hazard that is reflected in the following four definitions commonly used to describe it:

- Meteorological drought is defined solely on the degree of dryness, expressed as a departure of actual precipitation from an expected average or normal amount based on monthly, seasonal, or annual time scales.
- Hydrological drought is related to the effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels.
- Agricultural drought is defined principally in terms of soil moisture deficiencies relative to water demands of plant life, usually crops.
- Socioeconomic drought associates the supply and demand of economic goods or services with elements of meteorological, hydrologic, and agricultural drought. Socioeconomic drought occurs when the demand for water exceeds the supply as a result of weather-related supply shortfall. This may also be called a water management drought.

A drought's severity depends on numerous factors, including duration, intensity, and geographic extent as well as regional water supply demands by humans and vegetation. Due to its multi-dimensional nature, drought is difficult to define in exact terms and poses difficulties in terms of comprehensive risk assessments.

Drought differs from other natural hazards in three ways. First, the onset and end of a drought are difficult to determine due to the slow accumulation and lingering effects of an event after its apparent end. Second, the lack of an exact and universally accepted definition adds to the confusion of its existence and severity. Third, in contrast with other natural hazards, the impact of drought is less obvious and may be spread over a larger geographic area. These characteristics have hindered the preparation of drought contingency or mitigation plans by many governments.

Droughts may cause a shortage of water for human and industrial consumption, hydroelectric power, recreation, and navigation. Water quality may also decline and the number and severity of wildland fires may increase. Severe droughts may result in the loss of agricultural crops and forest products, undernourished wildlife and livestock, lower land values, and raise unemployment.

6.3.1.2 History

During the 20th century, nine notable droughts have occurred in the United States. While damage estimates are not available for most, estimates suggest that the Great Plains Drought of the 1930's, precipitating the Oklahoma Dust Bowl, and lasting approximately a decade, cost $475 million in federal funds. However, not figured into this cost is the loss of at least five inches of topsoil from nearly 10 million acres and by 1938 nearly ten percent of the State of Oklahoma's population had left. In 1976-1977 drought again hit the Great Plains, the Upper Midwest, and the far western portion of the United States causing direct losses of $10-15 billion. Furthermore, the drought in the Central and Eastern States during 1987-89 caused an estimated $39 billion in damages (FEMA, 1997, Oklahoma Department of Libraries, State of Oklahoma History and Culture).

Droughts in California typically occur gradually over several years. The driest single year of California's measured hydrologic record was in 1977. California's most recent multi-year drought was 1987-92 although severe droughts have also occurred in 1929-1934 and 1976-1977 (DWR, 2004). However, California is currently in its fifth year of below-average rainfall conditions (NCDC, 2004).

The average annual precipitation in the City of Paso Robles (calculated over a period of three decades; 1961-1990) has only been 10-14 inches per year (see Figure 5-4, San Luis Obispo Precipitation). This reflects a relatively dry recent history in regards to rainfall, especially in comparison to the nearby cities of Atascadero and San Luis Obispo, which average anywhere from 16 to 20 inches per year.

6.3.1.3 Future Events

No commonly accepted approach exists to assessing risks associated with drought. The Palmer Drought Severity Index (PSDI) is a commonly used index that measures the severity of drought for agriculture and water resource management. It is calculated from observed temperature and precipitation values and estimates soil moisture. However, the Palmer Index is not considered to be consistent enough to characterize the risk of drought on a nationwide basis (FEMA, 1997).

The principal objective of the *National Study of Water Management During Drought* was to develop strategies for improving water management to reduce the nation's vulnerability to drought (USACE, September 1995*)*. An outcome of this study was the *National Drought Atlas*, which was managed by the United States Army Corps of Engineers and was the first nationwide study of drought frequency. The *Atlas* provides a useful tool for answering questions about the likely duration, timing, and severity of drought in a region (Willeke et al, 1994). It is based on precipitation, stream flow, and Palmer Drought Severity Index data from 1,119 sites (grouped into 111 regions) in the National Climate Data Center's Historical Climate Network (with an average record length of 85 years).

While there is no commonly accepted return period or non-exceedance probability for defining the risk from hydrological drought (such as the 100-year or 1 percent annual chance of flood), as noted above, the *National Drought Atlas* can be used to answer questions on drought at the regional level (FEMA, 1997). The estimated mean stream flow in Paso Robles during the dry season (July-to-January) is normally (95% of the time) less than 0.1 feet^3/second/mile^2, which is the lowest measure of stream flow calculated by the U.S. Army Corps of Engineers for national hydrologic studies (see Figure 6-1, Hydrologic Drought Map). The map indicates that the City of Paso Robles will be subject to a drought every twenty years in which mean stream flows are 0.1 cubic feet per second per square mile or less. The recent history of very low rainfall and mean stream flow reflects the City's high potential for drought.

When attempting to evaluate the probability and magnitude of drought in San Luis Obispo County, it is helpful to remember that potable water in Paso Robles is derived from the Salinas River alluvial flow and the Paso Robles Ground Water Basin (PRGB), which is a regional aquifer. A drought's greatest impact will be on the City's water supply. In the Paso Robles area, the two sources are replenished primarily from uncontrolled runoff originating from several major and minor stream tributaries of the Salinas River, from wastewater treatment plant discharge of effluent into the Salinas River, and to a lesser extent, direct infiltration from precipitation and irrigation. The State allocates 8 cubic feet of water per second from the Salinas River to the City of Paso Robles. Wells furnish nearly all of the water supply for urban use, and a limited number of private wells serve agricultural uses within the city limits. The City owns 14 active wells and one standby well. The 14 active wells combined generate an average of 11 million gallons per day (*Paso Robles General Plan, 2003*).

Water stored in reservoirs is used to provide water to the City during peak demand periods. Storage also serves as an emergency source of water for firefighting and periods when pumping facilities are out of service. The City has one reservoir and three holding tanks, as follows: the 4 million gallon West Side Reservoir, located on 21st Street; two 4 million gallon tanks, located on the east side of town; and a 150,000 gallon tank, which is known as the West Side Pressure Zone (*Paso Robles General Plan, 2003*).

An evaluation of the PRGB aquifer storage, water quality, and hydrologic budget, titled the *Paso Robles Groundwater Basin Study*, was conducted by Fugro West Inc. and Cleath and Associates in 2002. According to this study, the sum of all components of outflow from the PRGB exceeded the sum of all the components of inflow by an estimated 2,700 acre-feet per year (AFY) between 1980 and 1997. Total net groundwater pumpage in the basin declined steadily from 1984 through 1998. However, groundwater production data since 1998 shows that groundwater pumpage may again be increasing. Pumpage in 2000 was higher than at any previous time since 1992. It should also be noted that groundwater pumpage exceeded the perennial yield from the start of the base period in 1980 through 1990. Depending on new trends or pressures in the agricultural industry, it is likely that basin pumpage will approach or exceed the perennial yield in the near future. The *San Luis Obispo County Master Water Plan Update* projects future water demands for the area to be 120,620 AFY by the year 2020, which suggests that future water demands may soon exceed the 94,000 AFY perennial yield of the basin (*Paso Robles General Plan, 2003*).

The population of the City will continue to grow. To mitigate for potential overdraft of the aquifer in the future, supplementary water supplies and groundwater recharge systems will be needed to put more water into the aquifer. Recycling water by using stored rainwater, reclaimed water, or water reuse for irrigation will reduce the need for groundwater pumping. Water conservation efforts will further reduce the water demand for the City of Paso Robles (*Paso Robles General Plan, 2003*).

It is notable that temperatures in the Western U.S. rose 2-5°F during the 20th century. While this increase was accompanied by precipitation increases of up to 50 percent in some areas of the West, some places have become drier and experienced more droughts. Figure 6-8 (Summer Heat Severity) displays that the City of Paso Robles' "summer heat index" (extreme summer weather based on the NWS heat index) is 100-105°F. The two major climate change models, the Canadian Model and the Hadley Model, both forecast continued temperature increases in the West of 5-11°F during the 21st century. However, both models also forecast significant increases in rainfall in much of the West. These increases may lead to elevated water supplies, although current reservoir systems may be inadequate to control earlier spring runoff and to maintain supplies for the summer (National Assessment Synthesis Team, May 2001).

6.3.2 Earthquake

6.3.2.1 Nature

An earthquake is "…a sudden motion or trembling caused by an abrupt release of accumulated strain from the tectonic plates that comprise the earth's crust." These rigid plates, known as tectonic plates, are between 50 to 60 miles in thickness and move slowly and continuously over the earth's interior. The plates meet along their edges, where they move away, past or under each other at rates varying from less than a fraction of an inch up to five inches per year. While this sounds small, at a rate of two inches per year, a distance of 30 miles would be covered in approximately one million years (FEMA, 1997).

The tectonic plates continually bump, slide, catch, and hold as they move past each other which causes stress that accumulates along faults. When this stress exceeds the elastic limit of the rock, an earthquake occurs, immediately causing sudden ground motion and seismic activity. Secondary hazards may also occur, such as surface faulting, ground failure, and tsunamis. While the majority of earthquakes occur near the edges of the tectonic plates, earthquakes may also occur at the interior of plates.

The vibration or shaking of the ground during an earthquake is described by ground motion. The severity of ground motion generally increases with the amount of energy released and decreases with distance from the fault or epicenter of the earthquake. Ground motion causes waves in the earth's interior, also known as seismic waves, and along the earth's surface, known as surface waves. The following are the two kinds of seismic waves:

- P (primary) waves are longitudinal or compressional waves similar in character to sound waves that cause back-and-forth oscillation along the direction of travel (vertical motion), with particle motion in the same direction as wave travel. They move through the earth at approximately 15,000 mph.
- S (secondary) waves, also known as shear waves, are slower than P waves and cause structures to vibrate from side-to-side (horizontal motion) due to particle motion at right-angles to the direction of wave travel. Unreinforced buildings are more easily damaged by S waves.

There are also two kinds of surface waves, Raleigh waves and Love waves. These waves travel more slowly and typically are significantly less damaging than seismic waves.

Seismic activity is commonly described in terms of magnitude and intensity. Magnitude (M) describes the total energy released and intensity (I) subjectively describes the effects at a particular location. Although an earthquake has only one magnitude, its intensity varies by location. Magnitude is the measure of the amplitude of the seismic wave and is expressed by the Richter scale. The Richter scale is a logarithmic measurement, where an increase in the scale by one whole number represents a tenfold increase in measured amplitude of the earthquake. Intensity is a measure of how strong the shock felt at a particular location, expressed by the Modified Mercalli Intensity (MMI) scale.

Another way of expressing an earthquake's severity is to compare its acceleration to the normal acceleration due to gravity. If an object is dropped while standing on the surface of the earth (ignoring wind resistance), it will fall towards earth and accelerate faster and faster until reaching terminal velocity. The acceleration due to gravity is often called "g" and is equal to 9.8 meters per second squared (980 cm/sec/sec). This means that every second something falls towards earth, it velocity increases by 9.8 meters per second. Peak ground acceleration (PGA) measures the rate of change of motion relative to the rate of acceleration due to gravity. For example, acceleration of the ground surface of 244 cm/sec/sec equals a PGA of 25.0 percent.

It is possible to approximate the relationship between PGA, the Richter scale, and the MMI, as shown in Table 6-5. The relationships are, at best, approximate, and also depend upon such specifics as the distance from the epicenter and depth of the epicenter. An earthquake with 10.0 percent PGA would roughly correspond to an MMI intensity of V or VI, described as being felt by everyone, overturning unstable objects, or moving heavy furniture.

One of the secondary hazards from earthquakes is surface faulting, the differential movement of two sides of a fault at the earth's surface. Linear structures built across active surface faults, such as railways, highways, pipelines, and tunnels, are at high risk to damage from earthquakes. Displacement along faults, both in terms of length and width, varies but can be significant (e.g., up to 20 feet), as can the length of the surface rupture (e.g., up to 200 miles).

Earthquake-related ground failure, due to liquefaction, is another secondary hazard. Liquefaction occurs when seismic waves pass through saturated granular soil, distorting its granular structure, and causing some of the empty spaces between granules to collapse. Pore-water pressure may also increase sufficiently to cause the soil to behave like a fluid (rather than a soil) for a brief period and causing deformations. Liquefaction causes lateral spreads (horizontal movement commonly 10-15 feet, but up to 100 feet), flow failures (massive flows of soil, typically hundreds of feet, but up to 12 miles), and loss of bearing strength (soil deformations causing structures to settle or tip).

6.3.2.2 History

The City of Paso Robles is considered to be part of the Coast Range Physiographic Province. The Paso Robles area is exposed to seismic hazards from movement along several regional faults. The identified active fault zones in this area are the San Andreas (northeast of the City), Rinconada (south of the City), and Hosgri "Offshore Fault" (the Offshore Fault is seismically active, but available marine geophysical data indicate that future surface rupture is improbable along this fault). See Figure 6-2 (Fault Map). Also, a broad set of short, discontinuous faults between Santa Maria and Big Sur occur near the Paso Robles area, often referred to as the Nacimiento fault zone.

Historically, most of the earthquakes that have occurred near Paso Robles have originated from movement along the San Andreas Fault, which lies approximately 38 miles northeast of the City (see Figure 6-3, Historic Earthquakes Map). An additional fault known as segments of the Jolon Fault transects the southwestern portion of the City, but converges with the Rinconada Fault to form one fault or fault zone near Mountain springs Road. Regional data regarding the activity of the Rinconada and Jolon Faults indicate that these faults may have been active as recently as the late Pleistocene (1.8 million to 11,000 years ago) in the vicinity of Paso Robles. However, there is no evidence that either fault has moved during the Holocene (approximately the last 11,000 years). It is estimated that the Rinconada Fault may be capable of producing a maximum credible earthquake (MCE) of 7.0. Neither of these faults are active with respect to fault rupture. Until recently, the largest historical earthquake in the vicinity was the magnitude 6.2 Bryson earthquake of November 1952. The location of the Bryson earthquake is not well determined, owing to the sparseness of instrumentation at that time. Recently, an earthquake of magnitude M_w 6.5 struck the area at 11:15:56 a.m. PST on Monday, December 22, 2003. The epicenter was 11 km NE of San Simeon, at a depth of 7.6 km (35.706N 121.102W). The earthquake struck in San Luis Obispo County. The 1952 Bryson epicenter was generally believed to have been located less than 10 miles northwest of this San Simeon earthquake. The San Simeon earthquake was a reverse event, where one side of the fault overrides the other side on an inclined fault plane, whereas the Bryson earthquake was a strike-slip first-motion mechanism. (California Integrated Seismic Network).

The earthquake was felt as far north as the San Francisco Bay area, and as far east as the San Joaquin Valley. Located 39 km from the epicenter, two people were killed in the City of Paso Robles, 47 people were reported injured, one building collapsed, and 20 buildings were severely damaged. Countywide, 290 homes and 190 commercial structures were damaged. Structural damage was also noted in the City of Atascadero and in unincorporated areas of the county. The hospital in Templeton had the largest recorded ground motion of 0.48g, indicating rupture directivity to the SE from this earthquake. Local, state and federal disasters were declared.

TABLE 6-5
EARTHQUAKE PGA, MAGNITUDE, AND INTENSITY COMPARISON

PGA (%g)	Magnitude (Richter)	Intensity (MMI)	Description (MMI)
<0.17	1.0 - 3.0	I	I. Not felt except by a very few under especially favorable conditions.
0.17 - 1.4	3.0 - 3.9	II - III	II. Felt only by a few persons at rest, especially on upper floors of buildings.
			III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing automobiles may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
1.4 - 9.2	4.0 - 4.9	IV - V	IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing automobiles rock noticeably.
			V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
9.2 - 34	5.0 - 5.9	VI - VII	VI. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
			VII. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
34 - 124	6.0 - 6.9	VII - IX	VIII. Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
			IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
>124	7.0 and higher	VIII or higher	X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
			XI. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
			XII. Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Source: Wald, Quitoriano, Heaton, and Kanamori, 1999.

There was a surprising amount of liquefaction and related ground damage due to the 2003 San Simeon earthquake for what were relatively low levels of ground shaking. A directional preference of ground shaking was evident in the observed ground damage patterns and strong motion recordings. Besides liquefaction, geotechnical effects included lateral spreading, seismic compression, and potential basin effects. Repair costs from ground displacements were related mainly to the damage to highways from seismic compression, and to houses and infrastructure from lateral

spreading. There was significant damage to structures in the historic downtown area of Paso Robles. One building collapsed, and more than 40 were damaged, many of which were "unreinforced masonry structures" (URMs), see Figure 5-9.

After the earthquake, the California State Office of Emergency Services (OES) dispatched certified inspectors to examine all buildings that are used by the public, and closed some with "red-tags" and ordered them to be retrofitted. The majority of the buildings in Paso Robles that were "red-tagged" to be closed were within a three-block area of the historic downtown district of the City, delineated by 12th Street between Spring and Pine Streets, and Park Street between 12th and 13th Streets.

The City also updated its Seismic Safety Ordinance to accelerate the compliance schedule for the owners of the identified URMs and to update the strengthening standards (more details regarding the City's revised seismic code is provided in Section 6.3.2.3, below).

Even more recently, On September 28, 2004 a magnitude 6.0 earthquake struck Central California near the town of Parkfield (approximately 30 miles northeast of Paso Robles). The quake caused no injuries or property damage in Paso Robles or Parkfield. However, in 1984 the United States Geological Survey predicted that a Magnitude 6 earthquake would occur on the San Andreas Fault near Parkfield within five years of 1988. The prediction was based on a sequence of 6 similar earthquakes that occurred every 22 years (on average) from 1857 to 1966. Although the 2004 Parkfield earthquake occurred over a decade later than predicted, its magnitude and behavior fulfilled the prediction.

6.3.2.3 Future Events

Probabilistic ground motion maps are typically used to assess the magnitude and frequency of seismic events. These maps measure the probability of exceeding a certain ground motion, expressed as PGA, over a specified period of years (Figure 6-4). For example, displays the probability of exceeding a certain ground motion, expressed as PGA, in 50 years in the Western United States. This is a common earthquake measurement that shows three things: the geographic area affected, all colored areas on the map; the probability of an earthquake of each level of severity, 10.0 percent chance in 50 years; and the severity, the PGA as indicated by color. Note that this map expresses a 10.0 percent probability of exceedance and, therefore, there is a 90.0 percent chance that the peak ground acceleration displayed will not be exceeded during 50 years. The use of a 50-year period to characterize the percent chance of exceedance is arbitrary and does not imply the structures are thought to have a useful life of only 50 years. Similar maps exist for other measures of acceleration, probabilities, and time periods.

It is useful to note that, according to the US Geological Survey (USGS), a PGA of approximately 10.0 percent gravity is the approximate threshold of damage to older (pre-1965) dwellings or dwellings not made resistant to earthquakes. The 10.0 percent measure was chosen because, on average, it corresponds to the Modified Mercalli Intensities of VI to VII levels of threshold damage in California within 25 km of an earthquake epicenter. The earthquake hazard maps combine near and distant ground motions indiscriminately and should not be used for particular buildings (USGS, February 7, 2003).

Figure 6-5 (Peak Acceleration Map), displays the City's estimated probability of exceeding a 20-40% PGA in 50 years. With intensity ranges defined through Table 6-5, the City of Paso Robles demonstrates MMI scale levels of VI-IX. In general, these MMI levels indicate earthquake damage in the City of Paso Robles that potentially could be substantial.

Figure 6-6 (Ground Shaking Map) measures the potential intensity of ground shaking in and around the City of Paso Robles. Ground shaking is a measure calculated by the California Geological Survey (CGS) and USGS seismic hazards model considering amplification in near surface soils using the amplification factors recommended by the building Seismic Safety Council (1997). The areas within and around the City are color-coded on the map as having

a moderate or medium potential for ground shaking. The ground shaking potential drastically increases to the northeast, towards the active San Andreas Fault. Areas of highest ground shaking potential within the City include along the Salinas River corridor, either side of Highway 46 in north central Paso Robles, and the area in northeast Paso Robles, which includes the airport.

The City consequently revised their seismic code in 2004 after the 2003 San Simeon earthquake, in an effort to protect lives during major seismic events in the future. The City's seismic code was previously based upon the 1994 Uniform Code for Building Conservation. The revised seismic code adopted the 2003 International Existing Building Code, which incorporates newer standards, including structural lessons learned from the 1994 Northridge Earthquake. The current, updated seismic code has established deadlines for compliance that include: (a) One year (from the date of the letter sent by the City's Building Official to all owners of URM buildings) for owners of URM buildings to submit structural analyses and construction plans to the City for seismic strengthening of their buildings, and (b) two years (from the date of the letter sent by the City's Building Official to all owners of URM buildings) for owners to complete construction of those improvements necessary to strengthen URM buildings. This has translated to a deadline of May 2005 for submitting plans to the City for retrofit work, and August 2005 is the deadline for obtaining a building permit to construct retrofit improvements. Additionally, the deadline for completing retrofit work is February 2007.

6.3.3 Expansive Soils

6.3.3.1 Nature

Expansive soils are naturally occurring materials found in low-lying regions and flood plains. Expansive soils are easily recognized by large surface cracks that form when they are dry and contracted. Expansive soils can cause damage to structure foundations. The effects can be dramatic if expansive soils supporting structures are allowed to become too wet or too dry. Patios, driveways and walkways may crack and heave as the underlying expansive soils become wet and swell. Sometimes the cracking and heaving appear temporary as the soils dry and shrink back to their original position. However, footings can behave differently. The concentrated weight of the structure will inhibit the soil's upward expansion. Outward expansion on the other hand may continue. The footings will not be returned to their original position as the soils dry and shrink. Instead, they can "ooze" down to a slightly lower level. This process can accumulate if the wetting and drying is allowed to continue season after season, year after year.

Summer or drought conditions can cause expansive soil problems around homes. Expansive soils can affect homes with suspended wood floors as well as those with concrete slab floors. Most of the movement occurs at the outside walls of a building, but the inside of a house can move if water finds its way under the house when it rains, through landscape watering or through a plumbing leak.

Much of California is underlain by expansive soils. However, expansive soil doesn't cause problems unless poorly designed structures are built on it. A house built on expansive soil will probably move if the foundation was not designed to take this soil type into account. Movement occurs because the soils expand so forcefully, the foundation actually moves. Different parts of the house can move at different rates and distances, thus cracking the foundation. Significant cracks often appear at the corners of windows and doors, in walls, garage slabs, walkways, and driveways. Doors and windows may become jammed. The integrity, design, value and use of a home could be affected. During extreme drought conditions, even homes that are not normally affected by expansive soil problems may experience slight cracking.

6.3.3.2 History

Each year in the United States, expansive soils cause billions of dollars in damage to buildings, roads, pipelines, and other structures. This is more damage than that caused by floods, hurricanes, tornadoes, and earthquakes combined (FEMA 1997).

There are three basic types of soil naturally occurring in and around the City of Paso Robles: sand, silt and clay. Clay soils are generally classified as "expansive." This means that a given amount of clay will tend to expand (increase in volume) as it absorbs water and it will shrink (lessen in volume) as water is drawn away. One of the most expansive of the clay soils is called “adobe.”

6.3.3.3 Future Events

Paso Robles is an area of moderately-highly expansive soils. A shrink-swell potential exists within the City, on the surrounding hillsides, and in areas along the Salinas River, Huerhuero Creek, and several unnamed creeks. The shrink-well characteristics of soils can vary widely within short distances, depending on the relative amount and type of clay (General Plan, 2003).

The potential for soil settlement could result in significant impacts to new development in the aforementioned areas. Detailed geologic studies are required prior to development to evaluate the potential for expansive soils, and it is required that these conditions are minimized or corrected during construction. Large-scale settlement problems should not be an issue provided that adequate soils and foundation studies are performed prior to construction and that Building Code guidelines are followed (General Plan, 2003).

Figure 6-7 (Expansive Soils Map) displays the concentration of expansive soils with “high shrink-swell potential,” mainly within the eastern portion of the City. The soil types that correspond to the high shrink-swell potential are mainly the Arbuckle-Positas complex (soil type 104), Arbuckle-San Ysidro complex (soil type 106), and Rincon clay loam (soil types 187 and 188), (see Figure 5-2, Soils Map). All of these soils are defined as having severe limitations for building sites and roads and streets. It is recommended that foundations and footings should be designed to prevent structural damage caused by shrinking and swelling of the subsoil (Paso Robles Soil Survey, U.S. Department of Agriculture, Soil Conservation Service).

6.3.4 Extreme Heat

6.3.4.1 Nature

Extreme summer heat is the combination of very high temperatures and exceptionally humid conditions. If such conditions persist for an extended period of time, it is called a heat wave (FEMA, 1997). The major human risks associated with extreme heat are as follows:

- Heatstroke: Considered a medical emergency, heatstroke is often fatal. It occurs when the body’s responses to heat stress are insufficient to prevent a substantial rise in the body’s core temperature. While no standard diagnosis exists, a medical heatstroke condition is usually diagnosed when the body’s temperature exceeds 105°F due to environmental temperatures. Rapid cooling is necessary to prevent death, with an average fatality rate of 15 percent even with treatment.
- Heat Exhaustion: While much less serious than heatstroke, heat exhaustion victims may complain of dizziness, weakness, or fatigue. Body temperatures may be normal or slightly to moderately elevated. The prognosis is usually good with fluid treatment.
- Heat Syncope: This refers to sudden loss of consciousness and is typically associated with people exercising who are not acclimated to warm temperatures. Causes little or no harm to the individual.
- Heat Cramps: May occur in people unaccustomed to exercising in the heat and generally ceases to be a problem after acclimatization.

In addition to affecting people, severe heat places significant stress on plants and animals. The effects of severe heat on agricultural products may include reduced yields and even loss of crops (Brown and Zeiher, 1997). Similarly, cows may become overheated, leading to reduced milk production and other problems. (Garcia, September 2002).

6.3.4.2 History

Extreme summer heat occurs with some regularity in the U.S. and in other countries. Major historic events have included the following:

- In 1980, summer temperatures reached all time highs in Central and Southern States, with over 1,700 deaths identified as heat related (FEMA, 1997).
- In July and August 2003, a heat wave across Europe caused thousands of deaths, including at least 11,000 in France alone. Again, a high proportion of the victims were elderly (Brock, September 14, 2003).

The climate of northern San Luis Obispo County is strongly influenced by its proximity to the Pacific Ocean and the location of the semi-permanent high-pressure cell in the northeastern Pacific. With a Mediterranean-type climate, Paso Robles is characterized by warm, dry summers and cool winters with occasional rainy periods (General Plan, 2003). Maximum summer temperatures average in the mid to high 90's although it is not uncommon for temperatures to reach into the 100's. The record high temperature in Paso Robles was tied in June 2000, reaching 115° F.

While summer temperatures in San Luis Obispo County often reach levels during the summer that would be considered extreme in many parts of the country, no extreme heat events affecting Paso Robles were recorded by the National Oceanic and Atmospheric Administration (NOAA), although arguably the June 2000 115° F temperature was an extreme event.

6.3.4.3 Future Events

The probability and frequency of heat hazards may be characterized by a heat index using temperature and humidity readings. Such an index has been developed for the entire U.S., and the City of Paso Robles portion is shown in Figure 6-8. The map was prepared using hourly readings between 2 PM and 5 PM for June, July, and August (based on the assumption that the annual maximum temperature and relative humidity occurs during summer afternoons). The data was used to conduct a frequency analysis from which the heat index map was prepared (with a 5.0 percent chance of exceedance in any given year).

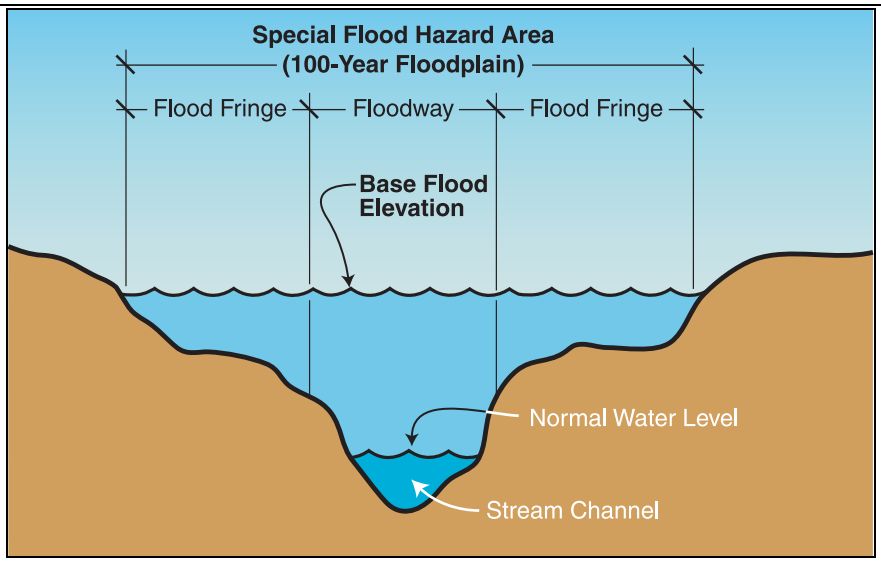
As illustrated in Figure 6-8, the City of Paso Robles is indexed as having 100-105° F during the summer. The National Weather Service (NWS) and the National Ocean and Atmospheric Administration (NOAA) defines these temperatures as having the probable effects of "sun stroke, heat cramps and heat exhaustion." The NWS also identifies heat stroke as a possibility when temperatures reach 105° F or more.

6.3.5 Flood

6.3.5.1 Nature

Flooding is the accumulation of water where there usually is not any or the overflow of excess water from a stream, river, lake, reservoir, or coastal body of water onto adjacent floodplains. As illustrated in Figure 6-9, floodplains are lowlands, adjacent to water bodies that are subject to recurring floods. Floods are natural events that are considered hazards only when people and property are affected. Floods occur in all 50 US states and territories, with an estimated four percent of the total area of the United States subject to the 1-percent annual chance floodplain (also known as the 100-year floodplain). An estimated nine million US households and $390 billion in property are at risk within the 1-percent annual chance floodplain.

FIGURE 6-9
FLOODPLAIN DEFINITION SKETCH



Source: FEMA, August 2001.

Nationwide damage from flooding has increased from $902 million annually during the period 1916-1950 to $2.15 billion annually, an increase of almost two-and-a-half times. The worst flood disaster in US history was caused by a series of storms from April to September of 1993 in the Upper Mississippi Basin. Nationwide there were 38 to 47 flood-related deaths and damage was estimated at $12 to $16 billion, including $4 to $5 billion in agricultural losses (FEMA, 1997).

There are a number of categories of floods in the U.S., including the following:

- Riverine flooding, including overflow from a river channel, flash floods, alluvial fan floods, ice-jam floods, and dam break floods
- Local drainage or high groundwater levels
- Fluctuating lake levels
- Coastal flooding, including storm surges
- Debris flows

The most common type of flooding event is riverine flooding, also known as overbank flooding. Riverine floodplains range from narrow, confined channels in the steep valleys of mountainous and hilly regions, to wide, flat areas in plains and coastal regions. The amount of water in the floodplain is a function of the size and topography of the contributing watershed, the regional and local climate, and land use characteristics. Flooding in steep, mountainous areas is usually confined, strikes with less warning time, and has a short duration; while larger rivers typically have longer, more predictable flooding sequences and broad floodplains.

The cause of flooding in large rivers is typically prolonged periods of rainfall from weather systems covering large areas (e.g., tropical storms). These systems may saturate the ground and overload the rivers and reservoirs in numerous smaller basins that drain into larger rivers. Localized weather systems (e.g., thunderstorms), may cause

intense rainfall over smaller areas, leading to flooding in smaller rivers and streams. Annual spring floods, due to the melting of snow pack, may affect both large and small rivers and areas.

While there is no sharp distinction between riverine floods, flash floods, alluvial fan floods, ice jam floods, and dam-break floods, these types of floods are widely recognized and may be helpful in considering the range of flood risk and appropriate responses:

- Flash flood is a term in wide use by experts and the general population, but there is no single definition or clear means of distinguishing flash floods from other riverine floods. Flash floods involve a rapid rise in water level, high velocity, and large amounts of debris, which can lead to significant damage that includes the tearing out of trees, undermining of buildings and bridges, and scouring new channels. The intensity of flash flooding is a function of the intensity and duration of rainfall, steepness of the watershed, stream gradients, watershed vegetation, natural and artificial flood storage areas, and configuration of the streambed and floodplain. Dam failure and ice jams may also lead to flash flooding. Urban areas are increasingly subject to flash flooding due to the removal of vegetation, covering of ground cover with impermeable surfaces, and construction of drainage systems. Wildfires that strip hillsides of vegetation and alter soil characteristics may also create conditions that lead to flash floods and debris flows. Debris flows, which are described in detail in Section 6.3.7, are particularly dangerous due to the fact that they generally strike without warning and are accompanied by extreme velocity and momentum.

  Flash floods are the top weather-related killer in the United States, resulting in about 150 deaths every year, and are a significant hazard in California. Most, if not all, of these fatalities could have been avoided if those involved would have recognized the dangers of flash floods and taken a few simple actions to protect themselves (National Weather Service).

- As indicated by the name, alluvial fan floods occur in the deposits of rock and soil that have eroded from mountainsides and accumulated on valley floors in the pattern of a fan. Alluvial fan floods often cause greater damage than straightforward riverine flooding due to the high velocity of the flow, amount of debris, and broad area affected. Alluvial fan flooding is most prevalent in arid western states, such as California. Human activities may exacerbate flooding and erosion on alluvial fans via increased velocity along roadway acting as temporary drainage channels or changes to natural drainage channels from fill, grading, and structures. Alluvial fan floods are a significant hazard in California. Floods on alluvial fans are dangerous because they are unpredictable. Channels may migrate quickly, for example, and the water flow often travels at high velocity–much higher than usually found in rivers or streams. This velocity is usually much more of a problem than the depth of the flow. Such action on alluvial fans is often characterized as “sheet flow” because of the high speed and shallow depth. In contrast to other flood hazards (i.e. riverine situations), FEMA puts an average velocity on the Flood Insurance Rate Map (FIRM) when mapping an alluvial fan to draw attention to the additional hazard posed by velocity.

Local drainage floods may occur outside of recognized drainage channels or delineated floodplains due to a combination of locally heavy precipitation, a lack of infiltration, inadequate facilities for drainage and stormwater conveyance, and increased surface runoff. Such events frequently occur in flat areas, particularly during winter and spring in areas with frozen ground, and also in urbanized areas with large impermeable surfaces. High groundwater flooding is a seasonal occurrence in some areas, but may occur in other areas after prolonged periods of above-average precipitation. Losses associated with local drainage are most significant when they occur with other hazards described in this document, such as widespread flooding and thunderstorms; therefore, they are not analyzed as a distinct hazard.

Many urban areas that have historically been flood prone have been removed from the floodplain through the application of two construction types: (1) flood control dams, which reduce peak discharges; and, (2) levees, which redirect floods away from areas that would otherwise be inundated.

6.3.5.2 History

The greatest flood events in Paso Robles on record occurred during storms in the early months of 1969, 1973, and 1995. During these storm events, both storm drain and natural river channel capacities were exceeded resulting in substantial damage to public and private property throughout San Luis Obispo County. The Salinas River has a "flood stage" of 19 feet. The flood stage is the stage at which overbank flows are of sufficient magnitude to cause considerable inundation of land and roads and/or threat of significant hazard to life and property (California Department of Water Resources, Division of Flood Management).

The 1969 flood was one of the most severe flood years in San Luis Obispo County. There were two distinct floods, one at the end of January and the second a month later at the end of February. During the January flood, the Salinas River reached a discharge of over 28,000 ft^3/s and reached a stage of 23.8 feet from floodmarks (almost 5 feet above the river's flood stage), which resulted in water flooding into the 50-year and 100-year flood zone. (The USGS "flood peak data" estimates the Salinas River to inundate the Paso Robles 50-year flood zone when discharges reach approximately 27,000 ft^3/s.) The San Luis Obispo Telegram-Tribune of January 25, 1969 described the Salinas River as "on a rampage." Hundreds of people were evacuated and homes were destroyed along the North and South River Roads. This flood was later studied by FEMA in 1981 and used as the basis for FIRM Maps that the City still uses today.

On January 18, 1973, rainstorms flooded Paso Robles again. High winds cut the City's power, and the water in Lake Nacimiento approached the maximum capacity. Streets were flooded and sewer pump lift stations were inundated. Sand bagging the culvert at 23rd and Vine Streets required a full crew to prevent flooding damages to nearby homes. City street crews kept constantly on the move unclogging drains and barricading some areas (Daily Press, Paso Robles).

The flood of March 10,1995 also peaked at a maximum discharge of over 28,000 ft^3/s and reached a gage height of 22.99 feet, thereby inundating the 50-year flood zone once again (USGS Flood Peak Data). The City filed for FEMA public assistance to repair damage that occurred to settling ponds at the wastewater treatment plan adjacent to the Salinas River.

Local residents reported that, with the March 1995 rains, there was some flooding on North River Road that exceeded the 100-year flood levels identified by FEMA as part of their 1981 Flood Insurance Study.

6.3.5.3 Future Events

Floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and the related probability of occurrence. Flood studies often use historical records, such as stream flow gages, to determine the probability of occurrence for floods of different magnitudes. The probability of occurrence is expressed in percentages as the chance of a flood of a specific extent occurring in any given year.

The most widely adopted design and regulatory standard for floods in the United States is the 1-percent annual chance flood and this is the standard formally adopted by FEMA. The 1-percent annual flood, also known as the base flood, has a 1 percent chance of occurring in any particular year. It is also often referred to as the "100-year flood," leading to the misconception that it should only occur once every 100 years. In fact, a 100-year flood may occur in any year, regardless of the time that has passed since the last one. Smaller floods occur more often than larger (deeper and more widespread) floods. Thus, a "10-year" flood has a greater likelihood of occurring than a "100-year" flood. Table 6-6 shows a range of flood recurrence intervals and their probabilities of occurrence.

TABLE 6-6
FLOOD PROBABILITY TERMS

Flood Recurrence Intervals	Percent Chance of Occurrence Annually
10 years	10.0%
50 years	2.0%
100 years	1.0%
500 years	0.2%

Source: FEMA, August 2001.

The San Luis Obispo County Planning Department has prepared maps delineating areas of known flood hazard (General Plan, 2003), which include:

- All areas along Huerhuero Creek, which flows approximately to the southeast.
- The area south of the airport is subject to flooding from Dry Creek, a tributary to Huerhuero Creek.
- The area along Linne Road is subject to flooding from Huerhuero Creek.
- Flooding may occur in the vicinity of Marquita Road, east of Route 101.
- The area bounded by Herdsman Way to the south, West Bethel Road to the west, and Highway 46 West to the north, is subject to flooding.
- Flooding may occur in an area north of Highway 46 West, west of Arbor Road, and south of Live Oak Road.

Additionally, FEMA has published a FIRM for the city, dated September 16, 1981. Figure 6-10 shows the 100-year floodplain areas within Paso Robles as determined by FEMA. The total Paso Robles area within the 100-year floodplain is shown in Table 6-7. As illustrated in this figure and table, the City of Paso Robles contains 1.38 square miles of identified floodplains. This represents 8 percent of the 17.34 total square miles that comprise Paso Robles. The majority of the flood prone areas within the City are associated with the Salinas River (which runs south-to-north through the center of the City) and its tributaries. Areas along the Huerhuero Creek and Dry Creek are also within the 100-year floodplain. Local flooding results when culverts become temporarily clogged during storms.

TABLE 6-7
100-YEAR FLOODPLAINS

Jurisdiction	Total Area in Square Miles	Area Within 100-Year Floodplain	
		Sq. Mi.	Percent
Paso Robles	17.34	1.38	7.9

Note: Floods may still occur outside of identified flood prone areas.

Source:FEMA, URS, July 2004.

The Salinas Dam, located on the Salinas River upstream of Paso Robles in the Vicinity of the City of san Luis Obispo, has reduced the threat of flooding from smaller, more frequent flood events on the river, but is not designed to provide protection from the 100-year flood (FEMA, 1981).

Figure 6-11 displays the 100-Year 24-hour Probable Maximum Precipitation (PMP) in Paso Robles. The PMP in Paso Robles over a 24-hour period is 5-6 inches in the west portion of the City, and 4-5 inches in the east portion. Note that this map displays an event with a 1 percent chance of being exceeded in any year, not an event that is expected to occur once every 100 years. The map was developed using multiple methods, including judgments based on record storms and related meteorological processes, with the results of the studies considered estimates because changes are likely to occur as understanding increases. The studies assumed that storm records for the preceding 80 years were representative and no allowance was made for climate change.

The hazard data provided above are based on currently available flood hazard data and mapping. Future flood hazards, and the mapping used to define them, may be affected by changing conditions, such as increased runoff due to development, construction of flood control facilities, and climatic factors. While increased precipitation in the Western U.S. is likely due to global warming, the greatest threat of increased flooding in Paso Robles can be expected to come from the nearly 50 percent increase in population forecasted for the coming twenty years. This is likely to lead to a significant increase in impervious surfaces and, hence, flooding.

Presently the City requires new development projects to detain the runoff they create and meter its outflow so as not to exceed historic flows. Detention basins are designed to accommodate runoff commensurate with 100-year storms.

Furthermore, a 66-mile pipeline project has been proposed to increase water availability to San Luis Obispo County. The $190 million pipeline project would transport 17,000 acre-feet of water from Nacimiento Lake (northeast of the City of Paso Robles) to San Luis Obispo, serving several communities along the way, including Paso Robles. It is a concern for some that this pipeline may introduce a potential flooding hazard to the City, if the pipeline were to break. Therefore, this potential issue will be assessed in future updates of this Plan.

6.3.6 Hazardous Material (HAZMAT) Event

6.3.6.1 Nature

Hazardous materials (HAZMAT) may include hundreds of substances that pose a significant risk to humans. These substances may be highly toxic, reactive, corrosive, flammable, radioactive or infectious. They are present in nearly every community in the U.S., where they may be manufactured, used, stored, transported, or disposed. Because of their nearly ubiquitous presence, there are hundreds of HAZMAT release events annually in the U.S. that contaminate air, soil, and groundwater resources, potentially triggering millions of dollars in clean-up costs, human and wildlife injuries, and occasionally cause human deaths (FEMA, 1997).

Hazardous material releases may occur from any of the following:

- Fixed site facilities (e.g., refineries, chemical plants, storage facilities, manufacturing, warehouses, wastewater treatment plants, swimming pools, dry cleaners, automotive sales/repair, gas stations, etc.)
- Highway and rail transportation (e.g., tanker trucks, chemical trucks, railroad tankers)
- Air transportation (e.g., cargo packages)
- Pipeline transportation (liquid petroleum, natural gas, other chemicals)

In response to concerns over the environmental and safety hazards posed by the storage and handling of toxic chemicals in the U.S., Congress passed the Emergency Planning and Community Right to Know Act (EPCRA) in 1986. These concerns were triggered by the 1984 disaster in Bhopal, India, in which more than 2,000 people died or

were seriously injured from the accidental release of methyl isocyanate from an American owned Union Carbide plant. To reduce the likelihood of such a disaster in the U.S., EPCRA established specific requirements on federal, state and local governments, Indian tribes, and industry to plan for hazardous materials emergencies.

EPCRA's Community Right-to-Know provisions help increase the public's knowledge and access to information on chemicals at individual facilities, their uses, and releases into the environment. States and communities working with facilities can use the information to improve chemical safety and protect public health and the environment (EPA, May 2003). Under EPCRA, hazardous materials must be reported to the Environmental Protection Agency (EPA), even if they do not result in human exposure. Such releases may include the following:

- Air emissions (e.g., pressure relief valves, smokestacks, broken pipes, water or ground emissions with vapors)
- Discharges into bodies of water (e.g., outflows to sewers, spills on land, water runoff, contaminated groundwater)
- Discharges onto land
- Solid waste disposals in onsite landfills
- Transfer of wastewater to public sewage plants
- Transfers of waste to offsite facilities for treatment or storage

In addition to accidental human-caused hazardous material events, natural hazards may cause the release of hazardous materials and complicate response activities. The impact of earthquakes on fixed facilities may be particularly bad due to the impairment of the physical integrity or even failure of containment facilities. The threat of any hazardous material event may be magnified due to restricted access, reduced fire suppression and spill containment, and even complete cut-off of response personnel and equipment. In addition, the risk of terrorism involving hazardous materials is considered a major threat due to the location of hazardous material facilities and transport routes throughout communities and the frequently limited anti-terrorism security at these facilities.

Due to the high level of risk posed by hazardous materials, numerous federal, state and local agencies are involved in their regulation, including the EPA, U.S. Department of Transportation (DOT), National Fire Protection Association (NFPA), FEMA, U.S. Army, and the International Maritime Organization.

Unless exempted, facilities that use, manufacture, or store hazardous materials in the U.S. fall under the regulatory requirements of EPCRA, enacted as Title III of the federal Superfund Amendments and Reauthorization Act (SARA) 42 U.S.C. §§11001-11050 (1988)). EPCRA has four major provisions:

- Emergency Planning (Section 301-303) is designed to help communities prepare for and respond to emergencies involving hazardous substances. It requires every community in the United States to be part of a comprehensive emergency response plan.
- The Governor of California has designated a State Emergency Response Commission (SERC) responsible for implementing EPCRA provisions within California. The SERC oversees Local Emergency Planning Committee (LEPC) districts. Emergency Release Notification (Section 304) includes a list of chemicals that if spilled must be reported, including Extremely Hazardous Substances (EHS). The SERC supervises and coordinates activities of each LEPC, establishes procedures for receiving and processing public requests for information collected under EPCRA, and reviews LEPC developed local emergency response plans. Facilities with an EHS at quantities exceeding the Threshold Planning Quantities (TPQ) must notify the SERC and LEPC and provide a representative to participate in the county emergency planning process.

- Hazardous chemical storage reporting requirements (Sections 311-312) that requires facilities possessing a threshold reporting quantity of a hazardous material under EPCRA (Section 311/312, 40 CFR Part 370) to submit an annual chemical inventory report (Tier II Hazardous Chemical Inventory Form) to the SERC, LEPC and local fire department; and
- Toxic chemical release inventory (Section 313).

Of the hundreds of hazardous materials, under the EPCRA regulatory scheme, those hazardous materials that pose the greatest risk for causing catastrophic emergencies are identified as an EHS. As noted above, the presence of EHSs in quantities at or above TPQ require additional emergency planning and mitigation activities. These chemicals are identified by the US EPA in the *List of Lists – Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-To-Know Act (EPCRA) and Section 112 of the Clean Air Act* (EPA, October 2001).

Releases of EHSs can occur during transport and from fixed facilities. Transportation related releases are generally more troublesome because they may occur anywhere, including close to human populations, critical facilities, or sensitive environmental areas. Transportation related EHS releases are also more difficult to mitigate due to the variability of locations and distance from response resources.

It should be noted that while comprehensive and readily accessible information is available on hazardous material release and facilities subject to EPCRA, there are numerous other sources of information on hazardous material facilities and incidents that are beyond the scope of this plan. A more in-depth analysis of potential hazardous material events would include the following:

- Risk Management Plan (RMP) facilities
- Tier II Hazardous Chemical Inventory Form facilities
- Toxic Release Inventory (TRI) facilities
- Pipelines and related facilities
- Railroad transportation facilities
- Explosive storage, sales, use, and manufacturing facilities
- Hazardous Materials Management Plan (HMMP) permit and Hazardous Materials Inventory Statement (HMIS) facilities
- Hazardous waste facilities (RCRA information and RMS databases)
- National Response Center Emergency Response Notification System (ERNS)
- U.S. Department of Transportation (DOT) Hazardous Materials Information Reporting System (HMIRS)
- California Hazardous Material Incident Reporting System (CHMIRS)
- California Department of Transportation (Caltrans)
- Trucking terminal facilities
- U.S. Office of Occupational Safety and Health Administration (OSHA) Injury, Illness, and Fatality Database
- 911 regional dispatch centers
- EPA Envirofacts and Window to My Environment
- EPA Enforcement and Compliance History Online (ECHO)

6.3.6.2 History

Some of the worst hazardous material events have occurred outside of the U.S., such the 1984 incident in Bhopal, India. Within the U.S., the National Response Center (NRC) reported an average of 280 hazardous material releases and spills occurred at fixed sites annually during the period 1987-1990. The US Department of Transportation reported an average of 6,774 hazardous material events annually during the period 1982-1991, with highways accounting for 81.4 percent, railroads 14.7 percent, and other events 6.6 percent. Additionally, highway transportation hazardous material events have caused more than 100 deaths, 2,800 injuries, and $22.4 million in damages (FEMA, 1997).

HAZMAT releases are a major concern for communities in San Luis Obispo County. The San Luis Obispo County Environmental Health Department (EHD) provided information on the hazardous material events within the City. In addition, hazardous material release reports were gathered from the NRC for the period 1990-2002 and screened to include only releases reported to the NRC of EHSs that met the Reportable Quantity (RQ) test under Section 304 of EPCRA (see *EPA List of Lists,* Section 304 EHS RQ). These materials pose the greatest risk for causing catastrophic emergencies.

A total of two significant HAZMAT release events (reported by the NRC) occurred within the City from 1987 to 2003, none of which prompted a state or federal disaster declaration. These release events are shown as red triangles on Figure 6-12. One event (located by the airport) was a CO_2 release into the atmosphere. The amount is unknown, however there was no reported damage, injury, fatality or evacuation of nearby facilities. The other event, which occurred in the southeast portion of the City at 1740 Commerce Drive, was a release of 500 gallons of caustic soda, spilled from a pump due to a seal failure. Local, county or state agencies responded to these incidents.

Seven releases within Paso Robles have been recorded by the U.S. Environmental Protection Agency, two of which occurred at the same site (see Figure 6-12). Of these releases none were incidents that were reported to the NRC. Three occurred within close proximity to residential neighborhoods, one occurred within an agricultural zoned area and the remaining three incidents occurred near the Paso Robles Municipal Airport, which is a substantial distance from residential property. Of the seven incidents, only two of the facilities are still in operation. No reportable incidents have occurred within a transportation corridor.

6.3.6.3 Future Events

In California the majority of hazardous materials incidents are handled prior to becoming a disaster. Nevertheless, the City's emergency organization needs to be flexible and evolutionary in its response to a developing incident in order to accommodate both the large number of relatively routine minor releases to truly disastrous hazardous materials releases. Paso Robles is considered by most to be rural in nature and therefore, does not include large industrial facilities which house or manufacture large quantities of hazardous materials that could potentially cause a devastating release.

Comprehensive information on the probability and magnitude of hazardous material events across all types of sources (e.g., fixed facility, transport vehicle) is not available. Wide variations in the characteristics of hazardous material sources and between the materials themselves make such an evaluation very difficult.

The US Department of Transportation's Hazardous Materials Transportation Program is one of the most advanced probability and magnitude estimation programs. The program collects information on unintentional releases of hazardous materials, including the consequences, and analyzes them. One of the major efforts of the program is to identify low probability, high consequence events (which may not be apparent from incident data) and providing appropriate levels of protection (DOT, September 2003).

Areas of concern in Paso Robles are the Union Pacific Railroad and Highway 101, which are major interstate transportation routes that pass through Paso Robles. In addition, Highway 46 East and West support relatively high traffic volumes. Trains and trucks commonly carry a variety of hazardous materials, including gasoline and various crude oil derivatives, and other chemicals known to cause human health problems. The City is exposed to the effects of a major catastrophic hazardous material emergency due to the proximity of these transportation routes to densely populated areas of the city. However, when properly contained, these materials present no hazard to the community. But in the event of an accident or derailment, such materials may be released, either in solid, liquid or gas form. In the case of some chemicals (such as chlorine), highly toxic fumes may be carried far from the accident site. Although standard accident and hazardous materials recovery procedures are enforced by the state and followed by private transportation companies, the City of Paso Robles is at relatively high risk because of its location along interstate rail and highway corridors (General Plan, 2003).

Informal surveys conducted by the County Office of Emergency Services have indicated the presence of the following classifications of hazardous materials: explosives, poisons, corrosives, flammable liquids, combustible liquids, cryogenics, compressed gasses (flammable and non-flammable), radioactive materials, and oxidizers. Large pressurized natural gas pipelines traverse the City. Pesticides are stored at several sites around the City, due to the number of vineyards and wineries in the vicinity of the City. Other small fixed facilities have varying uses of hazardous chemicals, but in general these do not pose a significant risk to the City. Air transportation of hazardous materials involves the smallest quantity, but still poses a potential hazard (Multi-Hazard Response Plan, 2003).

While it is beyond the scope of this plan to evaluate the probability and magnitude of hazardous material events in the City of Paso Robles in detail, it is possible to determine the exposure of population, buildings, and critical facilities should such an event occur. Of the facilities that were required to file an annual Tier II Material Inventory Report (under EPCRA) in San Luis Obispo County because of the presence of hazardous materials, seven were identified as having Extremely Hazardous Substance (EHS). The locations of these facilities are shown on Figure 6-13. The substances recorded at these facilities include common hazardous substances, such as nitric acid, sulfuric acid, acetone, hydrocarbons, cadmium, etc. EHSs pose the greatest risk for causing catastrophic emergencies. Therefore, facilities with EHSs are considered a greater threat than situations where non-EHSs are involved.

6.3.7 Landslide

6.3.7.1 Nature

Landslides are the downward and outward movement of slopes. The term is commonly used to refer to a number of types of events, including mudflows, mudslides, debris flows, rock falls, rock slides, debris avalanches, debris slides, and earth flows. Landslides may be any combination of natural rock, soil, or artificial fill. The type of movement and the type of material classifies landslides. The types of movement are slides, flows, lateral spreads, and falls and topples (FEMA, 1997).

Below is a brief discussion of the various types of landslide movements. A combination of two or more landslide movements is referred to as a complex movement.

- Slides are downward displacement along one or more failure surfaces of soil or rock. The material may be a single, intact mass or a number of pieces. The sliding may be rotational (turning about a point) or translational (movement roughly parallel to the failure surface).
- Flows are distinguished from slides by high water content and velocities that resemble those of viscous liquids. Flows are a form of rapid mass movement by loose soils, rocks and organic matter, together with air and water, which form a slurry flowing rapidly downhill.

- Lateral spreads are large movements of rock, fine-grained soils (e.g., quick clays), or granular soils, distributed laterally. Liquefaction may occur in loss, granular soils, which may occur spontaneously due to changes in pore-water pressure or due to earthquake vibrations.
- Falls and topples are masses of rocks or material that detach from a steep slope or cliff that free fall, roll, or bounce, with movements typically rapid to extremely rapid. Earthquakes commonly trigger rock falls.

Almost any steep or rugged terrain is susceptible to landslides under the right conditions. The most hazardous areas are canyon bottoms, stream channels, areas near the outlets of canyons, and slopes excavated for buildings and roads. Slide potentials are enhanced where slopes are destabilized by construction or river erosion. Road cuts and other altered or excavated area of slopes are particularly susceptible to landslides and debris flows. Rainfall and seismic shaking by earthquakes or blasting can trigger them.

Debris flows (also referred to as mudslides) generally occur during intense rainfall on water saturated soil. They usually start on steep hillsides as soil slumps or slides that liquefy and accelerate to speeds as great as 35 miles per hour. Multiple debris flows that start high in canyons commonly funnel into channels. Beginning in swales on steep slopes, they merge, gain volume, and travel long distances from their source, making areas down slope from swales particularly hazardous. Surface runoff channels, such as along roadways and below culverts, are common sites of debris flows and other landslides (USGS, 2000).

Landslides often occur together with other major natural disasters, such as the following, thereby exacerbating relief and reconstruction efforts:

- Landslides may occur simultaneously with widespread flooding. Both involve precipitation, runoff, and ground saturation, which may be the result of prolonged rainfall, such as during winter storms.
- Earthquakes may cause landslides ranging from rock falls and topples, to massive slides and flows.
- Wildfires may remove vegetation from hillsides, significantly increasing runoff and landslide potential.
- Landslides into a reservoir may indirectly compromise dam safety or a landslide may even affect the dam itself.

6.3.7.2 History

Landslides are a major geologic hazard because they are widespread, occurring in all 50 states. The Appalachian Mountains, the Rocky Mountains and the Pacific Coastal Ranges and some parts of Alaska and Hawaii have severe landslide problems. Any area composed of very weak or fractured materials resting on a steep slope can and will likely experience landslides.

On average, landslides cause $1-2 billion in damages annually and more than 25 fatalities. Landslides pose serious threats to highways and structures that support fisheries, tourism, timber harvesting, mining, and energy production as well as general transportation Expanding urban development and other land uses have increased the incidence of landslide disasters in the U.S. (USGS, June 7, 2002). Examples of major landslides in the U.S. include the following:

- Rains accompanying the El Nino effect triggered numerous landslides across Southern California in 1983-84 and 1995. In Paso Robles, two homes were damaged and there was major dirt slippage on River Road.
- The Northridge earthquake in 1994 in the San Fernando Valley triggered thousands of landslides in the Santa Susanna Mountains north of the epicenter.
- A massive landslide occurred on April 22, 1998, near Aromas, California, 15 miles north of Salinas. The slide severed two Pacific Gas And Electric (PG&E) natural-gas pipelines, cutting off gas service to 60,000 customers in Santa Cruz County and parts of Monterey County.

In 1995 there was a landslide in Paso Robles in which the hillside west of Olive Street, just north (and northeast) of Hilltop Drive slid into the back of 2-3 homes. The hillside area that slid was approximately 150 wide by 40 feet high, and the slope of the hillside was about 30%. Also, the cut slope on the east side of River Road (north of Niblick Road to the northern City boundary) tends to slide occasionally, dumping dirt and rocks onto River Road (see Figure 6-14, Landslide Susceptibility Map).

The earthquake that occurred in December 2003 resulted in numerous small landslides, particularly noticeable along Sate Routes 46 and 41, east and west of downtown. The larger surficial slides were observed in the Franciscan Formation along SR 46. Surficial slides were also observed along river Road in Paso Robles.

6.3.7.3 Future Events

A component of the USGS study titled *Landslide Overview of the Conterminous United States* (1997) is the mapping of landslide susceptibility. To prepare the map, individual formations or groups of formations were evaluated and classified as having high, medium, or low landslide susceptibility. This map builds on the previous landslide incidence map, with the assumption that anomalous precipitation or changes in the existing conditions could initiate movement in rocks and soils that have numerous landslides incidence in parts of their outcrop areas. If 15.1 percent or more of an area may be involved in a landslide, it is classified as having a high susceptibility to landslides. If 1.5-15.0 percent of an area may be involved in a landslide, it is classified as having a medium susceptibility to landslides. Note that the study authors acknowledge that the susceptibility categories are largely subjective due to the lack of data for precise determinations. Assigning an area the lowest susceptibility categories does not mean that landslides may not occur in that area. Also, due to the highly generalized nature of the map, it is unsuitable for local planning or site selection purposes.

In general, young sedimentary and poorly consolidated rocks of Pleistocene and Pliocene age in upslope areas are more susceptible to erosion and landsliding than older igneous and sedimentary rocks. Accordingly, the low hills east and west of the Salinas River that are underlain by Pliocene and Pleistocene sands and gravels of the Paso Robles Formation are susceptible to potential landslides. The weak sandstones and shale of the Monterey Formation, which outcrop in the steep elevations west of the City, are subject to the greatest landslide potential.

Many factors contribute to the instability of hill slopes; precipitation, soil and rock lithology and induration, seismic ground shaking, steepness of slope, and manmade grading. Steep slopes and occasional wet and intensive storm conditions increase the potential for mudslides, landslides, and debris flows. Moderate to strong earthquakes may initiate landslides and other types of slope failure. Wildfires remove vegetation, increasing unstable slope conditions and the likelihood of debris/mudflow events. Paso Robles land development near or at the base of canyons, cliffs, or landslides should take these hazards into consideration during the planning, construction and estimated life of the development.

The Landscape Architecture GIS Lab of San Luis Obispo County and California Polytechnic State University has produced maps of areas susceptible to landslides (Figure 6-14). The map portrays the main area with the highest potential to slide just west of the City boundary along Peachy Canyon, Fern Canyon and Mountain Springs Roads. This area corresponds to a population density index of 100-500 (see Figure 5-6), which indicates there is a significant amount of houses/people along those roads that would be potentially impacted. The remainder of Paso Robles is defined as having low to moderate susceptibility to landslides.

6.3.8 Subsidence

6.3.8.1 Nature

Land subsidence is the loss of surface elevation and affects nearly every U.S. state. Land subsidence has numerous causes, although the primary causes are underground coal mining, groundwater and petroleum withdrawal, and the

drainage of organic soils. Due to the diversity of causes and wide range of impacts, land subsidence has been analyzed primarily by federal, state, and local agencies independently, with comparatively little focus nationally (FEMA, 1997).

Land subsidence is caused by numerous human activities and natural processes including the following: mining of coal, metallic ores, limestone, salt, and sulfur; withdrawal of groundwater, petroleum, and geothermal fluids; dewatering of organic soils; wetting of dry, low-density deposits known as hydrocompaction; natural sediment compaction; melting of permafrost; liquefaction; and crustal deformation. Land subsidence takes three major forms:

- Collapse Into Voids: The collapse of surface materials into underground voids is the most dramatic form of land subsidence and is most frequently caused by coal mining. While typically collapses are human-caused, some cavities may be natural, such as in limestone or halite. Catastrophic subsidence is most commonly caused by lowering of the water table, rapid water table fluctuation, diversion of surface water, construction, use of explosives, or impoundment of water.
- Sediment Compaction: Typically causing broad regional subsidence or a few millimeters per year, total subsidence due to sediment compaction may reach several meters over decades. Sediment compaction is the result of underground fluid withdrawal (water or petroleum), natural compaction, or hydrocompaction,
- Drainage of Organic Soils: The draining of organic soils, such as peat and muck, causes a series of processes that reduce the volume of soil. This primarily affects large wetlands or river delta areas.

Subsidence is primarily an economic hazard, threatening buildings and infrastructure, as opposed to a threat to life. It may also lead to cracks in the earth's surface called fissures, which themselves are also hazardous.

Concurrent with the preparation of this Local Hazard Mitigation Plan had been drafted, the County of San Luis Obispo prepared a draft updated Paso Robles Groundwater Basin Study. This document should be consulted for the most current information on subsidence and will be used in the next update to this Local Hazard Mitigation Plan.

6.3.8.2 History

More than 17,000 square miles of land throughout the U.S. has been lowered due to subsidence, an area roughly the size of New Hampshire and Vermont combined. More than 80 percent of the identified subsidence nationally has been due to the removal of underground water. In 1991, the National Research Council (NRC) estimated that the cost of flooding and structural damage from land subsidence in the U.S. exceeded $125 million annually. The estimation of less direct or hidden costs is complicated by difficulties identifying and mapping affected areas, establishing cause and affect relationships, assigning economic values to environmental resources, and inherent legal system conflicts. As a result, the annual total cost of subsidence is probably significantly larger (USGS, 1999).

In 1991, the NRC estimated cumulative damages from subsidence by type for U.S. states. While broad ranges were used for these estimates, they provide an indication of the relative hazard level posed by different types of subsidence. According to the NRC, underground fluvial withdrawal (i.e., withdrawal of underground water) and drainage of organic soils are clearly the largest subsidence hazards in California, with greater than $100 million in estimated cumulative damages each in 1991, as shown in Table 6-8. Moderately high subsidence damage was posed by hydrocompaction, with $10-100 million in cumulative damage. Relatively minor subsidence damage was posed by mining and sinkholes, with $0-1 million in cumulative damages each.

During the 1990's, the population of San Luis Obispo County grew steadily, and some land use has been converted from dry farming and grazing to irrigated vineyards and urban areas. Because surface water supplies are insufficient to meet the growing demand for water, groundwater pumpage has increased and the resulting water level declines have raised concern that this water resource may become overstressed. According to a study conducted in 1999 by the U.S. Geological Survey (USGS), Interferometric Synthetic Aperture Radar (InSAR) was used to help locate

subsurface structures in groundwater basins by determining seasonal and historical land surface changes. Spaceborne InSAR has been used to identify displacements of the land surface caused by aquifer system compaction in groundwater basins.

InSAR displacement maps of the Paso Robles area (based on images collected in March and August 1997) were compared with maps of seasonal changes in groundwater levels to detect the presence of aquifer system compaction. The USGS study detected the presence of three areas of subsidence, located generally in the northeast portion of the City, indicating ground surface displacement from 0.6 to 2.1 inches, as indicated in Figure 6-15. The southern and northeastern areas appeared to coincide with an area of water level decline of over 60 feet (USGS, 2001).

TABLE 6-8
ESTIMATED CUMULATIVE DAMAGE
FROM SUBSIDENCE BY TYPE IN CALIFORNIA, 1991

Subsidence Type	Cumulative Damage ($million)
Mining	$0-1
Sinkholes	$0-1
Underground Fluid Withdrawal	$>100
Hydrocompaction	$10-100
Drainage of Organic Soils	$>100

Note: Costs not converted into constant dollars. Figures can be used as a general measure of risk associated with land subsidence, but do not indicate probability or magnitude of land subsidence.

Source: FEMA, 1997 (from National Research Council, 1991).

6.3.8.3 Future Events

Standard procedures to determine the probability and magnitude of land subsidence have not been developed. However, the areas of historic subsidence in Paso Robles identified by the USGS (shown in Figure 6-15) can generally be considered to be susceptible to subsidence in the future. The City of Paso Robles is portrayed by USGS as having moderate to very high subsidence susceptibility, with concentrations of very high subsidence areas along the Salinas River and Huerhuero Creek, as well as in the east and, especially, southeast portions of the City. The magnitude of subsidence is difficult to determine in advance, however Figure 6-15 defines the range of magnitude of subsidence by color. Each “fringe,” or one color cycle, represent 1.1 inches of vertical displacement.

6.3.9 Wildland Fire

6.3.9.1 Nature

A wildland fire is an uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures. They often begin unnoticed, spread quickly, and are usually signaled by dense smoke that may fill the area for miles around. Wildfires can be human-caused through acts such as arson or campfires, or can be caused by natural events such as lightning. Wildfires can be categorized into four types:

- **Urban fires** are primarily those associated with structures and the activities in and around them. Most urban fires are caused by human activity.

- **Wildland fires** occur in forests or other generally uninhabited areas and are fueled primarily by natural vegetation.
- **Interface or intermix fires** occur where development and forest interface, with both vegetation and structures providing fuel. These are also referred to as urban-wildland interface fires.
- **Prescribed fires and prescribed natural fires** are intentionally set or natural fires that are allowed to burn for beneficial purposes.

Over the years, development standards have become more stringent to reduce the frequency and severity of urban fires. These are greatest in areas containing older buildings that do not meet current building codes. Utility facilities also present a potential urban fire hazard. Earthquakes or floods may rupture buried gas lines, while high winds or accidents could cause overhead electric lines to break. Either condition could result in a fire. Catastrophic earthquakes could cause widespread urban fires, as multiple gas and electrical lines could be broken or disrupted.

The following three factors contribute significantly to wildland fire behavior and, as detailed more fully later, they can be used to identify wildland fire hazard areas:

- **Topography**: As slope increases, the rate of wildland fire spread increases. South facing slopes are also subject to greater solar radiation, making them drier and thereby intensifying wildland fire behavior. However, ridgetops may mark the end of wildland fire spread, since fire spreads more slowly or may even be unable to spread downhill.
- **Fuel**: Weight and volume are the two methods of classifying fuel, with volume also referred to as fuel loading (measured in tons of vegetative material per acre). Each fuel is assigned a burn index (the estimated amount of potential energy released during a fire), an estimate of the effort required to contain a wildland fire, and an expected flame length. The fuel's continuity is also an important factor, both horizontally and vertically.
- **Weather**: Variations in weather conditions have a significant effect on the occurrence and behavior of wildfires. Short term conditions, such as high heat, low humidity, and high winds, facilitate the ignition and rapid spread of fires. Conversely, cool temperatures, high humidity, and little to no wind reduce the risk of fires and allow fires to be contained more readily. Long-term conditions, such as prolonged drought, also play a major role in fire susceptibility.

The frequency and severity of wildland fires is also dependent upon other hazards, such as lightning, drought, and infestations (e.g., Pine Bark Beetle). In California, these hazards combine with the three other wildland fire contributors noted above (topography, fuel, weather) to present an on-going and significant hazard across much of California.

If not promptly controlled, wildland fires may grow into an emergency or disaster. Firestorms occur during extreme weather (e.g., high temperatures, low humidity, and high winds) with such intensity that fire suppression is virtually impossible. These events typically burn until the conditions change or the fuel is exhausted.

Even small fires can threaten lives and resources, and destroy improved properties. It is also important to note that in addition to affecting people, wildland fires may severely affect livestock and pets. Such events may require the emergency watering/feeding, shelter, evacuation, and even burying of animals.

The indirect effects of wildland fires can also be catastrophic. In addition to stripping the land of vegetation and destroying forest resources, large, intense fires can harm the soil, waterways and the land itself. Soil exposed to intense heat may lose its capability to absorb moisture and support life. Exposed soils erode quickly and enhance siltation of rivers and streams thereby enhancing flood potential, harming aquatic life and degrading water quality.

Lands stripped of vegetation are also subject to increased landslide hazards. The result may be catastrophic debris flows, such as occurred in Southern California following in the wildfires in summer 2003.

6.3.9.2 History

Historically, wildland fires have burned thousands of acres in San Luis Obispo County, as shown in Figure 6-16. On average, 58 percent of these wildland fires are human caused, while 42 percent are lightning caused. Information on the location and size of wildland fire events in San Luis Obispo County were collected from a variety of sources. However, most of the information came from the following two sources:

- The USDA Forest Service has published a study titled *Development of Coarse-Scale Spatial Data for Wildland Fire and Fuel Management* (April 2002). This study describes and makes available seven coarse-scale (1 square kilometer) resolution spatial data layers for the conterminous U.S. to support national-level fire planning and risk assessments. One of the layers, National Fire Occurrence, 1986 to 1996, contains information on Federal and non-Federal wildland fire occurrence, including date, location, area burned, and cause. Information for wildland fires in California was retrieved from this layer. These events were screened to include only fires 100+ acres in size.
- The Fire and Resource Assessment Program (FRAP), which is part of the California Department of Forestry and Fire Protection (CDF). This data consists of CDF fires 300 acres and greater in size and USFS fires 10 acres and greater throughout California from 1950 to 2003. Some fires before 1950, and some CDF fires smaller than 300 acres are also included. BLM fires are complete since 2002 for fires greater than 10 acres in size.

TABLE 6-9
SIGNIFICANT WILDFIRES, 1968-2002 (USFS, CA DEPT. OF FORESTRY)

Jurisdiction	Wildfire Size			
	100-400 acres	400-999 acres	1,000+ acres	Total
Paso Robles	1	0	1 (just outside City boundary)	2
San Luis Obispo County Total	11	1	2	14

Note: Only those wildland fires that could be accurately located (geocoded) are counted above.

Source: USDA Forest Service, CA Department of Forestry; URS, July 2004.

While Paso Robles has had urban fires, most have been relatively small and easily contained. Paso Robles contains many older structures and the City requires that such buildings be brought up to code when made aware of such buildings. Despite these activities, one larger fire occurred east of the City boundary in 1968. The fire burned approximately 1,067 acres (see Figure 6-16).

No catastrophic fires have been recorded in recent history, particularly since emergency response and building codes have been improved. During the years 1997 through 1999 Paso Robles experienced $910,151 in cumulative fire loss in property valued at $17,632,226. This equates to an average fire loss to the value figure of $51.61 loss per $1,000 of value at risk.

6.3.9.3 Future Events

Paso Robles faces two types of fire hazards that threaten lives and property: urban and wildland fires. Wildland fire may also result in the loss of natural vegetation, loss of agricultural crops, and soil erosion. The outbreak and spread of wildland fires within the planning area is a potential danger, particularly during the dry summer and fall months. The buildup of understory brush, which under natural conditions would be periodically burned off, provides fuel to result in larger, more intensive fires.

The topography, climate, and vegetation of much of the Paso Robles are conducive to the spread of wildfires. According to the California Department of Forestry and Fire Protection San Luis Obispo County Fire Hazard Map, almost all of the hillsides south of Highway 46 East, and the areas of the City north of Highway 46 East are located within "Wildland Areas that may contain substantial fire hazards and risks" (GIS Solutions Group, January 6, 2000).

Depending upon the needs of the user and the availability of data, there are many different approaches to fire modeling. However, nationally accepted or utilized wildland fire models have not been developed for the evaluation of wildland fire risk or conducting vulnerability analysis. In addition, most wildland fire modeling conducted to date has been focused on wildland fire behavior, not true probability and magnitude modeling. This is because the probability of ignition and the probable wildland fire size has generally not been considered. In addition, there have been major limitations in terms of software systems, data availability, and data coverage/resolution.

These limitations aside, with improving Geographic Information Systems (GIS) programs and data availability, there are a growing number of wildland fire hazard assessment models. In addition, as a part of the National Fire Plan, communities have also been identified across the U.S. that are at risk to wildland fires. The Fire and Resource Assessment Program (FRAP), prepared by the California Department of Forestry and Fire Protection, offers a statewide GIS layer (GRID format) of potential fire behavior rankings derived from wildland fuels and topography. The fuel ranking methodology assigns ranks based on expected fire behavior for unique combinations of topography and vegetative fuels under a given severe weather condition (wind speed, humidity, and temperature). The fuel ranking procedure makes an initial assessment of rank based on an assigned fuel model (based on surface fuels) and slope, then raises ranks based on the amount of ladder and/or crown fuel present to arrive at a fuel rank.

The fuel ranks for Paso Robles fall within three degrees of hazard: extreme, high and medium. In Figures 6-17 and 6-18, it is apparent that fire hazard increases where the slope increases. The surface fuels are displayed in Figure 5-4 (Vegetation Map). The areas delineated as grassland and oak woodland corresponds to areas of high and extreme hazard designations in the Wildfire Hazard Areas map.

Generally, the City is defined as a medium to high hazard area, with more extreme hazard areas located west of the City, within the steeper terrain and canyons and east of the Salinas River, as slopes and vegetation increases (see Figure 6-17 Slope Model Map and 6-18 Wildfire Hazard Area). The areas in and around the City that pose the highest fire hazard have steep slopes of 10-15% or greater and dense or tall vegetation, consisting of oak woodlands, Freemont cottonwood, and grassland (see Figure 5-3, Vegetation Map). These occur primarily on hilltops and hillsides surrounding the developed areas of the City.

6.4 INVENTORY ASSETS

The third step in the risk assessment process is the identification of assets that may be affected by hazard events. The inventory of assets is divided into the following five major categories, each of which is analyzed in detail below:

- Population
- Buildings
- Critical facilities and infrastructure

Detailed information on these assets was provided in Section 5: Community Description. This information was from a variety of sources, including the US Census Bureau, Barclay Maps, and HAZUS-MH.

6.5 VULNERABILITY ASSESSMENT

Vulnerability refers to the susceptibility to physical injury, harm, damage, or economic loss of the exposed people, buildings and infrastructure. City elements (or "assets") exposed to each hazard have been listed and mapped, and their vulnerability is discussed below. The specific requirements for the vulnerability assessment are shown in Table 6-10 to Table 6-13.

TABLE 6-10
DMA 2000 REQUIREMENTS – RISK ASSESSMENT – ASSESSING VULNERABILITY – OVERVIEW

Assessing Vulnerability: Overview
Requirement §201.6(c)(2)(ii): *[The risk assessment **shall** include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description **shall** include an overall summary of each hazard and its impact on the community.*
Element
A. Does the plan include an **overall summary** description of the jurisdiction's **vulnerability** to each hazard?
B. Does the plan address the **impact** of each hazard on the jurisdiction?

Source: FEMA, March 2004.

The fourth step of the risk assessment and its primary intent is the vulnerability assessment. This provides an approximation of vulnerability and potential losses from hazards, typically based on a commonly accepted methodology and event type. Wherever possible, a quantitative and comparable assessment of vulnerability to hazards was made. A summary of the vulnerability assessment is provided in Table 6-14.

TABLE 6-11
DMA 2000 REQUIREMENTS – RISK ASSESSMENT – ASSESSING VULNERABILITY – IDENTIFYING STRUCTURES

Assessing Vulnerability: Identifying Structures
Requirement §201.6(c)(2)(ii)(A): *The plan **should** describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area .*
Element
A. Does the plan describe vulnerability in terms of the **types and numbers** of **existing** buildings, infrastructure, and critical facilities located in the identified hazard areas?
B. Does the plan describe vulnerability in terms of the **types and numbers** of **future** buildings, infrastructure, and critical facilities located in the identified hazard areas?

Source: FEMA, March 2004.

TABLE 6-12
DMA 2000 REQUIREMENTS – RISK ASSESSMENT – ASSESSING VULNERABILITY – ESTIMATING POTENTIAL LOSSES

Assessing Vulnerability: Estimating Potential Losses
Requirement §201.6(c)(2)(ii)(B): *[The plan **should** describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate … .*
Element
A. Does the plan estimate **potential dollar losses** to vulnerable structures?
B. Does the plan describe the **methodology** used to prepare the estimate?

Source: FEMA, March 2004.

TABLE 6-13
DMA 2000 REQUIREMENTS – RISK ASSESSMENT – ASSESSING VULNERABILITY – ANALYZING DEVELOPMENT TRENDS

Assessing Vulnerability: Analyzing Development Trends
Requirement §201.6(c)(2)(ii)(C): *[The plan **should** describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.*
Element
A. Does the plan describe land uses and development trends?

Source: FEMA, March 2004.

Note that the loss estimates provided herein use the best data currently available and the methodologies applied result in an approximation of risk. These estimates may be used to understand relative risk from hazards and potential losses. However, uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific knowledge concerning hazards, their effects on the built environment, as well as approximations and simplifications that are necessary for a comprehensive analysis.

It is also important to note that the quantitative vulnerability assessment results are limited to the exposure of people, buildings, and critical facilities and infrastructure to hazards. It is beyond the scope of this first City of Paso Robles Hazard Mitigation Plan to analyze other types of hazard impacts (e.g., people injured or killed, shelter requirements, loss of facility/system function, and economic losses). The data necessary for this detailed level of analysis is also not currently available. Such impacts may be addressed as possible with future updates of the plan.

An important detail to note for the Vulnerability Assessment summarized in Table 6-14 below, is that the earthquake hazard considers liquefaction, ground shaking and fault proximity. Several GIS maps were created to assess the earthquake hazard (see Figures 6-2 through 6-6), and therefore all the data displayed in these maps were considered in assessing the City's vulnerability to earthquakes. The hazard zones identified in the figures were combined (a "layering effect" used in GIS analyses), creating a composite earthquake map that enables a more thorough analysis of the hazard.

TABLE 6-14
POTENTIAL HAZARD VULNERABILITY ASSESSMENT

Hazard	Methodology	Population (approximate)	Residential Parcels		Nonresidential Parcels		Critical Buildings, Facilities and Infrastructure		Development Trends: Future Development Areas Affected? Which?
			No.	Estimated Improvement Value (x$1000)	No.	Estimated Improvement Value (x$1000)	No.	Estimated Improvement Value (x$1000)	
Drought	Descriptive		NA	NA	NA	NA	NA	NA	
Earthquake identified zones (liquefaction, shaking, fault proximity)	Exposure: High	2,478	1,113	3,195,532	313	214,321	7	133,775	C1, C7
	Exposure: Moderate	23,464	7,915	7,992,245	903	316,559	28	177,223	C1, C2, C3, C4, C5, C6, C7, C12, C14, C15, C16, C17, C18, C19
Expansive Soils	Exposure: High	8,312	4,248	5,162,690	205	171,240	18	98,347	C1, C2, C4, C5, C7, C16, C17, C19
	Exposure: Moderate	7,689	2,363	4,808,385	653	173,242	19	82,301	C1, C6, C7, C12, C16, C18
Extreme Heat	Descriptive		NA	NA	NA	NA	NA	NA	
Flood	Exposure: 100-year flood zone	570	205	422,830	170	89,735	9	86,517	C1, C6, C7, C16
HazMat	Exposure: 1-mile radius EHS facilities	22,892	7,451	4,759,843	941	307, 975	28	168,147	C1, C2, C3, C5, C6, C7, C12, C14, C16, C18, C19
	Exposure: 1-mile buffer transport corridors	9,164	2,296	3,687,424	896	299,559	27	216,405	C1, C3, C4, C6, C7, C12, C16, C18
Landslide	Exposure: High/Historic	99	6	34,534	0	0	1	940	None
	Exposure: Moderate	10,306	4,842	7,939,067	155	123,327	18	34,420	C1, C2, C3, C4, C7, C15, C17, C18, C19
Subsidence	Exposure: identified zones	2,875	1,130	1,485,798	145	126,472	7	67,661	C1, C14, C17, S2
Wildland Fire	Exposure: High	19	68	351,088	17	14,495	7	49,017	C7, C17
	Exposure: Medium	3,026	2,880	7,282,822	373	264,399	29	121,138	C1, C2, C3, C4, C5, C6, C7, C12, C14, C15, C16, C17, C18, C19
	Exposure: Low	14,441	7,437	8,493,538	1,081	434,927	36	212,320	C1, C2, C3, C4, C5, C6, C7, C12, C14, C15, C16, C17, C18, C19

In addition, several of the hazards that are profiled in the preceding sections may not include corresponding exposure and loss data and are, therefore, not included in the vulnerability assessment which follows. Drought and winter-storms, for example, are wide-ranging, unpredictable and often long-term hazards to humans, animals, and plants. This variability in historic occurrence of these phenomena prevents meaningful predictability. Due to these factors the Drought and Extreme Heat hazards, though creating vulnerability for the residents and structures in Paso Robles, do not include a quantitative analysis in the vulnerability assessment.

6.5.1 Methodology

Most of the hazards analyzed in this Plan, except for Drought and Extreme Heat, have associated boundaries and/or levels of impact that represent the potential area and severity in which the hazard may occur. In most cases, the impact boundaries are divided into areas that reflect different levels or zones of impact. Within these areas are assets, which are vulnerable to damage or harm from the hazards. These assets are grouped into five major categories for the purpose of the vulnerability assessment:

- Population
- Residential parcels
- Nonresidential parcels
- Critical buildings, facilities and infrastructure
- Areas planned for future development

Population information was obtained for the City of Paso Robles from census block data. Using an integrated Geographic Information System (GIS) platform, each specific hazard and degree of impact (when applicable) was overlaid (using a “grid” method) on the census block data and impact was determined based on whether the hazard area intersected any portion of the census block. Affected census blocks were selected this way and the total population affected was summarized. Parcel data was obtained through a consultant for the City (Barclay Maps). Land use was assigned to the parcels as defined in the City’s General Plan. The Assessor’s improvement value was used to determine dollar value for buildings for each residential and nonresidential parcel. Where the assessor’s improvement value was not available, the average cost per residential/nonresidential acre for the City was used to estimate approximate values.

Critical facilities were identified by the City and by downloading national data from FEMA’s HAZUS-MH program. The critical facilities provided by HAZUS-MH were reconciled and joined with the critical facilities provided by the City. These facilities were then incorporated into the GIS parcel layer, yielding one layer to indicate locations of residential, nonresidential and critical facilities. The City supplied URS with values for the critical facilities. When values were not available, facility values estimated by HAZUS-MH were used.

Each specific hazard and degree of hazard, when applicable (i.e. wildfire hazard was analyzed for extreme, high and moderate risks), was overlaid onto the GIS parcel layer. Impact was determined based on whether the hazard boundary intersected any portion of a specific parcel. These selected parcels were then summarized based on what types of structures are on the parcel: residential, nonresidential and/or critical facility. Numbers of parcels affected and dollar amounts for each category were summarized for each hazard and degree of hazard.

Future development was created from the City’s parcel layer and the General Plan. Impact on future development was determined by overlaying each hazard boundary with the parcels marked for future development according to the General Plan (refer to Table 6-15). Impact was determined based on whether the hazard area intersected any portion of a specific parcel designated for future development.

6.5.2 Earthquake

Of all the hazards assessed in this section, an earthquake poses the greatest exposure and potential loss for the City of Paso Robles, as shown in Table 6-14. All of the city's population, residential and nonresidential structures, and critical buildings, facilities, and infrastructure are exposed to either high or moderate ground shaking zones.

Figures 6-2 through 6-6 clearly display the City's vulnerability to earthquakes. The City's close proximity to the active San Andreas Fault and the affiliated potential for intense ground shaking, as calculated by CGS and USGS, results in a potential hazard that could impact the entirety of the City. The City is defined by CGS and USGS as having a probable peak ground acceleration (PGA) of 20 - 40 percent (Figure 6-5). Table 6-5 defines this PGA as corresponding to an earthquake somewhere around a magnitude 5.0 to 7.0 on the Richter scale.

The City falls within two designated zones of ground shaking (another earthquake measurement, similar to peak ground acceleration), also defined by CGS and USGS (Figure 6-6). The northeast end of the City has potential for high ground shaking intensity, as well as small areas along the east side of Highway 101 and the southeast end of the City. Fortunately, these areas are not as highly populated as other portions of the city, although they do include 2,478 people, 1,113 residential parcels (worth $3.2 billion), 313 non-residential (worth $214.3 million), and 7 critical facilities (worth $133.8 million).

The remainder of the city is in an area of moderate ground shaking. This includes 23,464 people, 7,915 residential parcels (worth $7.9 billion), 903 non-residential parcels (worth $316.6 million), and 28 critical buildings (worth $177.2 million). Included in this is a cluster of approximately 30 structures in the main downtown area, west of Highway 101, which the City has designated as unreinforced masonry structures (URMs). These buildings have a high potential for damage if an earthquake occurred, especially an earthquake of a magnitude 5.0 or greater.

The risk from earthquakes will continue to increase as the city's population grows and residential and nonresidential structures are built. The occurrence of the San Simeon earthquake in 2003 has heightened awareness of the hazard among city officials as well as the population, providing opportunity for appropriate planning for future events.

6.5.3 Expansive Soils

Expansive soils pose a moderate risk to Paso Robles, particularly given the slow nature of the hazard. Figure 6-7 shows that the expansive soils in the City are fairly evenly distributed between highly expansive soils and moderately expansive soils.

The highly expansive soils mainly occur in the southeast and northeast portions of the City, which are only moderately populated. This includes approximately 8,312 people, 4,248 residential parcels (worth $5.2 billion), 205 non-residential (worth $171.2 million), and 18 critical facilities (worth $98.3 million).

The moderately expansive soils occur mostly on the west end of the City, which is also moderately populated. This includes 7,689 people, 2,363 residential parcels (worth $4.8 billion), 653 non-residential (worth $173.2 million), and 19 critical facilities (worth $82.3 million).

The main area of concern, relative to population, is the center and western portions of the City where the population density is the densest, per square mile (see Figure 5-6). This area displays some low potential shrink-swell soils, but mostly moderate and high shrink-swell soils. There is also a large amount of highly expansive soils in the southeast section of the City, which displays a population density of 10,000 – 69,000 people per square mile in a few small areas.

In regards to structures, the majority of the unreinforced masonry structures and the critical facilities fall within the moderate hazard designation for shrink-swell potential. Many schools are built on soils that are highly expansive (refer to Figures 5-7 and 6-7).

6.5.4 Flood

The risk posed by stream and riverine flooding to Paso Robles is moderate, as shown by Table 6-14 and Figure 6-10. Exposed within the 100-year flood zone are 570 people, 205 residential parcels (worth $422.8 million), 170 nonresidential buildings (worth $89.7 million), and 9 critical facilities (worth $86.5 million).

The 100-year flood zone is comprised of a relatively small portion of the City. However, the floodplain of the Salinas River affects a significant portion of the city's downtown area. The Salinas Dam, located on the Salinas River upstream of Paso Robles in the vicinity of the City of San Luis Obispo, has reduced the threat of flooding from smaller, more frequent flood events on the river, but is not designed to provide protection from the 100-year flood (FEMA, 1981). However, the Salinas River floodplain is not densely occupied. Tributaries to the Salinas River, such as Huerhuero Creek, are more likely to flood during smaller, more frequent storms, and the risk of flood damage to structures along these streams is likely to be greater.

In addition to identified flood hazards along riverine flooding sources, the city is at risk from locally heavy runoff and slope failures during heavy rainfall, such as the 1998 El Nino event.

Furthermore, a 50-mile pipeline project has been proposed to increase water availability to San Luis Obispo County. The $190 million pipeline project would transport 17,000 acre-feet of water from Nacimiento Lake (northeast of the City of Paso Robles) to San Luis Obispo, serving several communities along the way, including Paso Robles. It is a concern for some that this pipeline may introduce a potential flooding hazard to the City, if the pipeline were to break. Mitigation of this concern was addressed in the Environmental Impact Report for the Nacimiento Pipeline (2003). This potential issue will be assessed in future updates of this Plan.

6.5.5 Hazardous Materials

Overall, the City of Paso Robles faces a moderate risk from exposure to hazardous materials incidents, as shown in Table 6-14. This exposure was determined via two methods, the first of which is a one-mile buffer around the seven Extremely Hazardous Substance (EHS) sites and the second of which is a 1-mile buffer around the major transportation corridors (Highway 101 and 46 East, and the railroad line, which is predominantly parallel to Highway 101).

Within the one-mile buffer around the seven EHS sites, exposed are 22,892 people, 7,451 residential parcels (worth $4.8 billion), 941 nonresidential parcels (worth $308.0 million), and 28 critical facilities (worth $168.1 million). These figures are for all seven EHS facilities (Figure 6-13) and, therefore, overstate the exposure since the probability of all seven facilities having an event simultaneously is very low. These facilities are predominantly located within industrial and public facility zoned areas within the City (e.g., near the airport and along Highway 101). However, three EHS facilities are located in downtown Paso Robles adjacent to residential neighborhoods.

Within the one-mile buffer around the transportation facilities, exposed are 9,164 people, 2,296 residential parcels (worth $3.7 billion), 896 nonresidential parcels (worth $299.6 million), and 27 critical facilities (worth $216.4 million). As above, these figures are for the entirety of the transportation corridors and, therefore, overstate the exposure since a hazmat event along the corridors is unlikely to affect all of the area within the one-mile buffer.

6.5.6 Landslide

Overall, Paso Robles faces a moderate risk from landslides. The low hills east and west of the Salinas River have a moderate risk from landslides (see Figure 6-14). In this area are 10,306 people, 4,842 residential parcels (worth $7.9 billion), 155 nonresidential buildings (worth $123.3 million), and 18 critical facilities (worth $34.4 million).

The steep elevations west of the city, as well as a steep ridge along the east side of the Salinas River, are subject to the greatest landslide potential. These areas of high landslide risk area include 99 people and 6 residential parcels (worth $34.5 million), and 1 critical facility (worth $940 thousand).

6.5.7 Subsidence

The data for subsidence in Paso Robles is largely unrefined. Figure 6-15 (Subsidence Susceptibility Map) is a pixilated map, which is difficult to read, however, the available data does generally demonstrate areas with higher potential for subsidence. These areas are mainly along the south side of Huerhuero Creek and in the southeast portion of the City where a tributary of the Salinas River branches to the east.

In these areas demonstrated as having a relatively high subsidence potential (Figure 6-15), there are 2,875 people, 1,130 residential parcels (worth $1.5 billion), 145 non-residential parcels (worth $126.5 million), and 7 critical facilities (worth $67.7 million).

Concurrent with the preparation of this Local Hazard Mitigation Plan had been drafted, the County of San Luis Obispo prepared a draft updated Paso Robles Groundwater Basin Study. This document should be consulted for the most current information on subsidence and will be used in the next update to this Local Hazard Mitigation Plan.

6.5.8 Wildland Fire

Much of the densely populated areas within the City (see Figure 5-6) have wildfire hazard designations of medium or low, with a smaller portion of the city designated as having high wildfire hazard (see Figure 6-18). Within this area of high wildfire exposure are 19 people, 68 residential parcels (worth $351.1 million), 17 nonresidential parcels (worth $14.5 million), and 7 critical facilities (worth $49.0 million). The high wildfire hazard exists mainly in the hills west of the City along Mountain Springs Road and Peachy Canyon Road, as well as south of the City in areas along Spanish Camp Road and Prospect Avenue (see Figure 6-18).

Of less danger, but much greater exposure, are areas of medium wildfire hazard. This includes 3,026 people, 2,880 residential parcels (worth $7.3 billion), 373 nonresidential parcels (worth $264.4 million), and 29 critical facilities (worth $121.1 million).

Again of lesser danger, but of even greater exposure, are areas of low wildfire hazard. This includes 14,441 people, 7,437 residential parcels (worth $8.5 billion), 1,081 nonresidential parcels (worth $435.0 million), and 36 critical facilities (worth $212.3 million).