SECTION 12 SEVERE WEATHER RISK ASSESSMENT

12.1 IDENTIFYING HAZARDS – DESCRIPTION OF SEVERE WEATHER HAZARDS

Under 44 CFR Section 201.6(c)(2)(i) of DMA2K, local mitigation plans are required to include a risk assessment with a description of the types of natural hazards that can affect the jurisdiction. This section identifies the risks faced by the City of Roseville from severe weather hazards that cause any destruction, including:

- Tornado
- Windstorm
- Fog
- Heavy Rains, Thunderstorms, Lightening, and Ice/Freeze

The organization of this section follows the general risk assessment methodology used throughout this mitigation plan and so provides subsections on severe weather hazard profiles and vulnerability assessments followed by a review of any existing programs, plans and ordinances as well as a review of mitigation alternatives to address severe weather hazards. Because the severe weather hazard is comprised of several categories or classes of weather hazards, a description for each of these categories is provided for each subsection as appropriate.

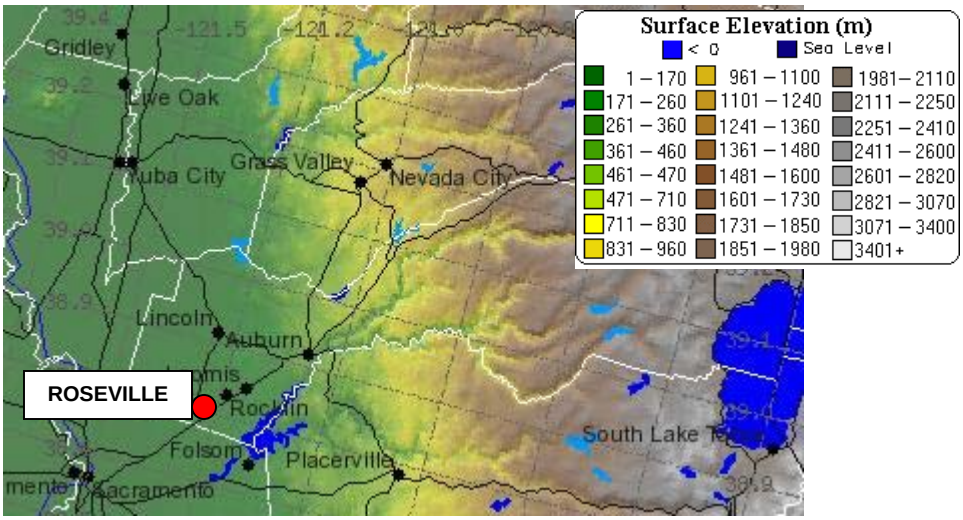
12.1.1 Sources of Severe Weather

Most of the federal and state disaster declarations declared in the Roseville area and Placer County are related to severe weather conditions. Severe weather conditions occur throughout the region and vary greatly from the western portion of the County to the Eastern portion primarily due to topographical changes and variance in elevation as the county extends towards the Sierra Nevada Range.

The City of Roseville sits in the rolling hills and grassland of southwestern Placer County just 16 miles northeast of Sacramento. Although the climate of Roseville is relatively nice with an average of 257 sunny days each year, the City sits in the shadow of the Sierra Nevada mountain range and as a result can experience severe weather conditions resulting from rapid changes in topography (Roseville California Resource Guide, http://www.usacitiesonline.com/cacountyroseville.htm).

Heavy rainfall and snowfall result when humid air masses blow in from the ocean and move up the mountain ranges. Moist air, traveling inland on prevailing westerly winds push up against the Sierra Nevada's, which wrings moisture out of the air as it rises, cools, and condenses. Precipitation generally increases 2 to 4 inches for each 300-foot rise in elevation. Because Roseville is in the western, low-lying portion of the county (approximately 165 feet above sea level and well below the 4,000 foot snowfall region), the City experiences less severe weather than eastern portions of the county (Roseville California Resource Guide). However, the City's proximity to the foothills ensures it is subject to periodic severe weather events. Figure 12.1 shows Roseville's elevation and demonstrates why the City avoids the harshest of winter conditions occurring to the east.

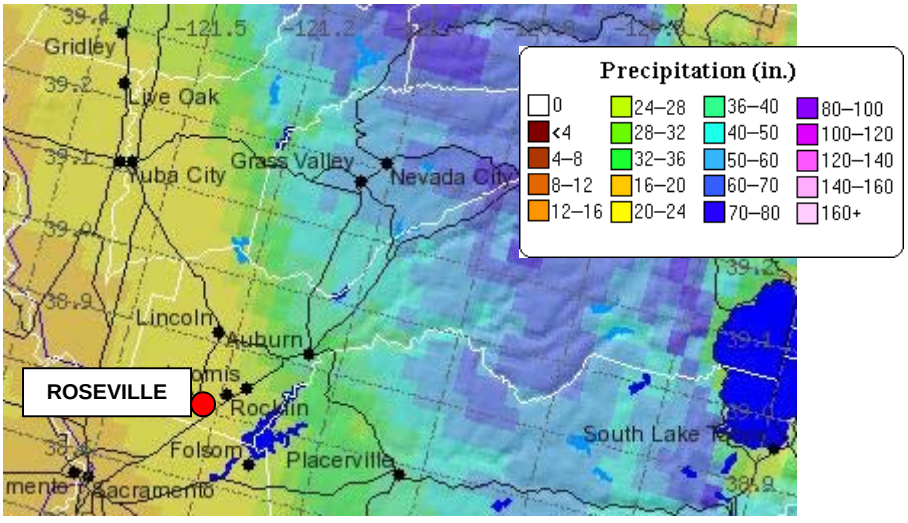
Figure #.1
Roseville Regional Surface Elevation



(Source: Spatial Climate Analysis Service. Oregon Climate Service. Accessed November 2004 online at http://www.ocs.orst.edu/prism/)

Figure 12.2 illustrates regional average precipitation ranges from 1971 to 2000. Digital climate maps created using Parameter-elevation Regression on Independent Slopes Model (PRISM) available through the Spatial Climate Analysis Service (SCAS) indicate that annual precipitation for the Roseville area averages between 16 and 20 inches.

Figure #.2
Roseville Regional Average Annual Precipitation, 1971 to 2000



(Source: Spatial Climate Analysis Service. Oregon Climate Service. Accessed November 2004 online at http://www.ocs.orst.edu/prism/)

12.2 SEVERE WEATHER HAZARD PROFILE FOR TORNADOES

A tornado is a violently rotating column of air extending between, and in contact with, a cloud and the surface of the earth. Tornadoes are often (but not always) visible as a funnel cloud. On a local-scale, tornadoes are the most intense of all atmospheric circulations and wind speeds can reach destructive speeds of more than 300 miles per hour. A tornado's vortex is typically a few hundred meters in diameter, and damage paths can be up to one mile wide and 50 miles long.

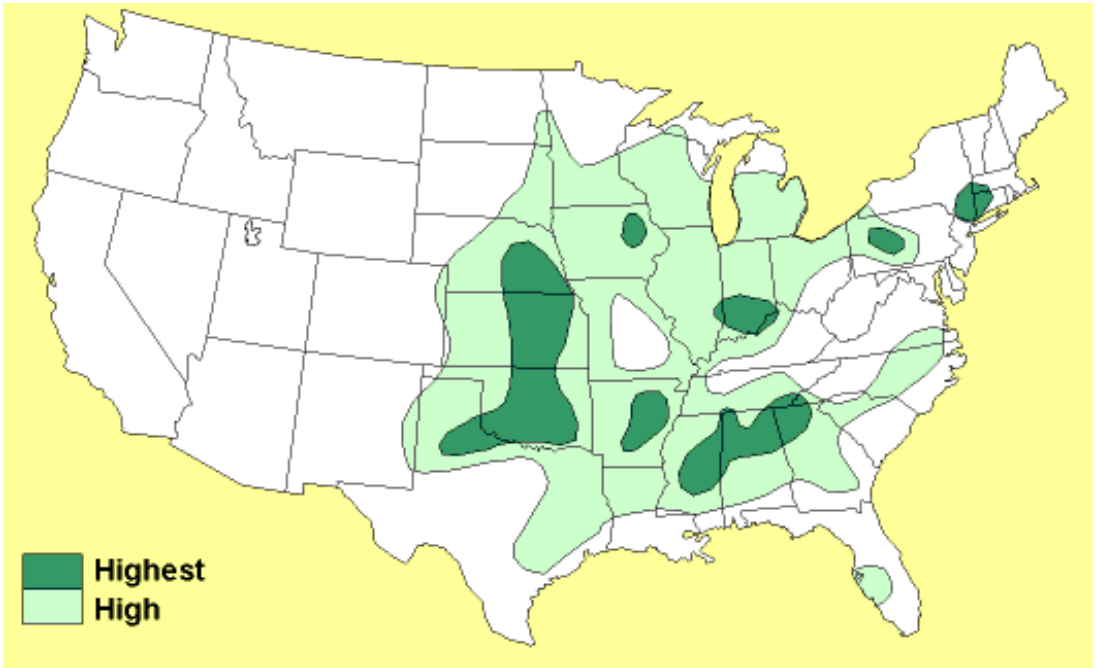
INSERT PHOTOS

PHOTO TITLE
MONTH YEAR

12.2.1 Tornadoes – Location and Extent

While California does have tornadoes, it is relatively low-risk compared to states in the Midwestern (central plains) and Southern United States (see Figure 12.3 for a map of U.S. areas most at risk for tornadoes). Tornadoes can occur throughout the year at any time of day but in the Central Plains they are most frequent in the spring during the late afternoon.

Figure 12.3
Tornado Risk Areas in the Coterminous United States



(Source: USGS. Risk based on database of 800 significant tornadoes in the U.S. from 1954 to 1992. Accessed November 2004 online at http://www.usgs.gov/themes/map6.html)

Since 1950, 292 tornadoes have occurred in 42 counties throughout California, resulting in 103 injuries, and $NEED DATA in damages. However, since 1950, no deaths caused by tornadoes have been recorded in California. The Roseville area has experienced several recorded tornado events in the past but none that have caused injury or serious property damage. A search of FEMA and ESRI's hazard mapping online tool for tornado strikes in the Roseville area show no significant observed tornadoes on record in the City (http://mapserver2.esri.com).

The impact of tornados can be severe. Tornados can cause death, injury, and major property damage. In the United States, 69% of all tornados are considered weak (wind speed less than 110 mph) and result in less than 5% of related deaths; 29% are considered strong (wind speed between 110 to 205 mph) and result in nearly 30% of related deaths; and 2% are considered violent (wind speed greater than 205 mph) and result in 70% of related deaths.

12.2.2 Tornadoes – Event History

None of the tornadoes in California have been rated stronger than F2 on the *Fujita Scale*. Of the 292 tornadoes in California, only 8 percent reached F2, 39 percent were classified as an F1, and 53 percent were classified as an F0 (the least severe).

The biggest risks of tornadoes in California include light to moderate damage to homes, destruction of mobile homes, slight damage to crops, and injuries caused by flying projectiles during an F2 tornado.

Since 1950 there have been four recorded tornadoes in Placer County. These events are detailed in the Table 12.1

Fujita Scale – Tornado wind speeds are sometimes estimated on the basis of wind damage using the Fujita Scale. The measure is used to rate the intensity or severity of tornado events. It uses numeric values from F0 to F5 based on tornado wind speed and the damage sustained.

An F0 (wind speed less than 73 mph) indicates minimal damage such as broken tree limbs or other signs, while an F5 (wind speeds of 261 to 318 mpg) indicated severe damage sustained.

Table 12.1
Tornadoes Recorded for Placer County (1950 to 2004)

Date	Magnitude	Deaths or Injury	Property Damage	Crop Damage
10/15/1972	F0	0	$0K	$0K
3/3/1983	F0	0	$0K	$0K
3/22/1983	F1	0	$250K	$0K
4/23/1990	F0	0	$3K	$0K

SOURCE: National Oceanic and Atmospheric Administration, National Climatic Data Center, U.S. Local Storm Events Data query accessed November 2004 at http http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms

NOTE: Magnitude measured using the Fujita Scale as described above.

12.2.3 Tornadoes – Probability of Occurrence

Based on data evaluated by the Disaster Center from 1950 to 1995, California is not at severe risk from tornado hazards. Based on the frequency of tornados per square mile, California ranks 44th for frequency of tornadoes, 40th for losses (cost) per area, 44th for injuries per area, and none for fatalities (Disaster Center accessed December 2004 at http://www.disastercenter.com/californ/tornado.html).

Tornado damages listed for Placer County in the Table 12.1 are not considered severe; however, tornadoes are likely to occur in the Roseville area in the future, possibly at an average rate of one every 14 years (or 4 in the 54-year period recorded by NOAA).

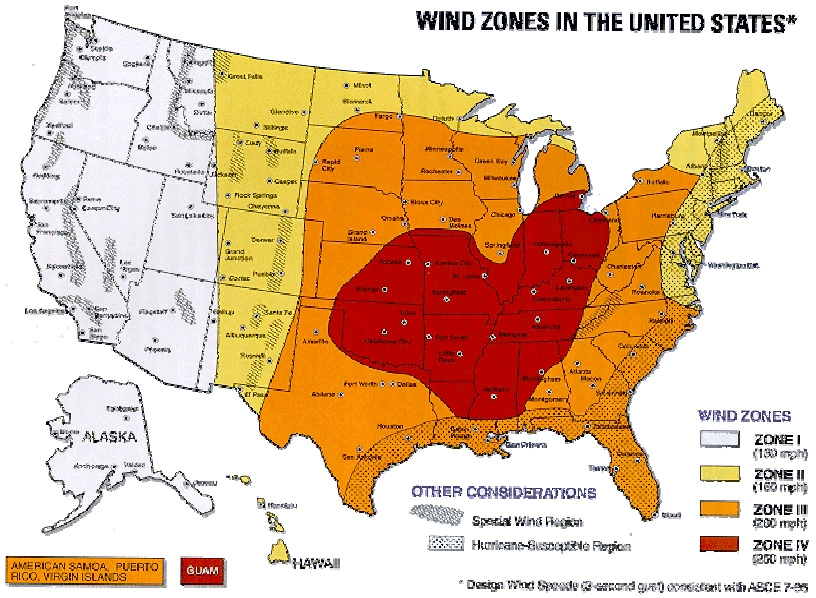
12.3 SEVERE WEATHER HAZARD PROFILE FOR WINDSTORMS

Windstorms are generally short-duration events involving straight-line winds or gusts in excess of 50 miles per hour (mph) and can therefore produce winds of sufficient strength to cause property damage. Windstorms are especially dangerous in those areas with significant tree stands, and areas with exposed property, major infrastructure, and above ground utility lines. A windstorm can topple trees and power lines, cause damage to residential, commercial, critical facilities, and leave tons of debris in its wake.

12.3.1 Windstorm – Location and Extent

ADD TEXT MAY ULTIMATELY MAKE SENSE TO INCORPORATE DISCUSSION OF WINDSTORMS AS PART OF TORNADO HAZARD SO SECTION 12.2 WOULD READ TORNADO AND WINDSTORM HAZARD… MUCH OF THE IMPACTS AND LOSSES WOULD BE CLOSELY RELATED.

Figure 12.4
Wind Zones in the United States



(SOURCE: http://www.shelters-of-texas.com/images/windzone.gif)

12.3.2 Windstorm – Event History

ADD TEXT

12.3.3 Windstorm – Probability of Occurrence

ADD TEXT

12.4 SEVERE WEATHER HAZARD PROFILE FOR FOG

Fog is a cloud (or condensed water droplets) near the ground. Fog forms when air close to the ground can no longer hold all the moisture it contains. This occurs either when air is cooled to its dew point, or the amount of moisture in the air increases.

Heavy fog is particularly hazardous because restricts surface visibility. Severe fog incidents can close roads, cause vehicle accidents, cause airport delays, and impair the effectiveness of emergency responders. The financial losses associated with transportation delays caused by fog has not been calculated in the United States, but it is substantial.

12.4.1 Fog – Location and Extent

Fog can occur almost anywhere during any season and is classified based on how it forms which is related to where it forms. Certain seasons are more likely to have foggy days or nights based on a number of factors including the process for fog formation and the topography.

In Placer County, heavy fog occurs mostly during the midwinter. However, a low-lying, early morning "tule fog" can occur anytime during the wet, cold season. Tule fog or radiation (ground) fog is common on clear nights with little or no wind and is caused by the rapid cooling of the Earth and corresponding air temperature dropping to its dew point. This type of fog is also know as "valley fog" when it persists throughout the day and is thick.

12.4.2 Fog – Event History

The National Climatic Data Center (NCDC) shows no severe fog incidents for Roseville or Placer County from 1950 to 2004. However, a query of the Natural Disaster Database also known as the Spatial Hazard Events and Losses Database for the United States (SHELDUS) maintained by the University of South Carolina's Hazard Research Lab indicates two major fog events in Placer County. Losses for those two events totaling more than six injuries, at least one fatality, almost $400,000 in property damage. The December 1997 fog event was county-wide and had more substantial losses; the location of the December 1998 fog event was not specified in the database and caused less damage.

12.4.3 Fog – Probability of Occurrence

Given the nature of fog in the Roseville area and evidence of at least two fog events causing injury and loss in the recent past, future severe fog events are likely to occur on a regular basis. CAN WE ADD STATISTICS ON PROBABILITY?

12.5 SEVERE WEATHER HAZARD PROFILE FOR HEAVY RAINS, THUNDERSTORMS, LIGHTENING, AND ICE/FREEZING STORMS

Severe storms in the City of Roseville generally include heavy rains and are often accompanied by strong winds, lightening, hail, or icing. Heavy rains or snowfall, coupled with low temperatures, can result in increases in traffic accidents, disruptions in transportation, commerce, government, and education. Utility outages due to falling

trees or other debris as well as injuries can also occur as a result of severe winter storms.

NOAA classifies a thunderstorm as a storm with lightening and thunder, produced by cumulonimbus clouds, usually producing gusty winds, heavy rain, and sometimes hail. Thunderstorms are usually short in duration (seldom more than two hours). Heavy rains associated with thunderstorms can lead to flash flooding. According to the American Meteorological Society Glossary of Meteorology, thunderstorms are reported as light, medium, or heavy according to:

1) the nature of the lightening and thunder,

2) the type and intensity of the precipitation, if any,

3) the speed and gustiness of the wind,

4) the appearance of the clouds, and

5) the effect upon surface temperature.

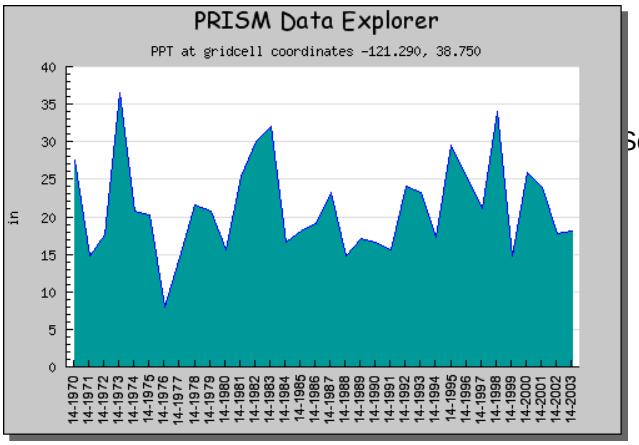
Lightning is a major threat during a thunderstorm. In the United States, between 75 and 100 Americans are struck and killed by lightning each year (http://www.fema.gov/hazard/thunderstorms/thunder.shtm). Lightning is an electrical discharge that results from the buildup of positive and negative charges within a thunderstorm. When the buildup becomes strong enough, lightning appears as a "bolt." This flash of light usually occurs within the clouds or between the clouds and the ground. A bolt of lightning reaches temperatures approaching 50,000 degrees Fahrenheit instantaneously. The rapid heating and cooling of air near the lightning causes thunder.

ADD TEXT

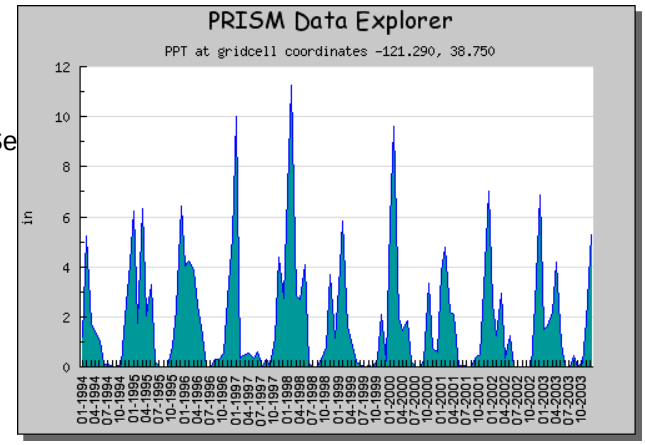
12.5.1 Heavy Rains, Thunderstorms, Lightening, and Ice/Freezing Storms – Location and Extent

ADD TEXT

Figures 12.5
Average Annual Precipitation, 1970 to 2003
(Indicates variations between years)



Figures 12.6
Monthly Precipitation Totals, 1994 to 2003
(Indicates variations by season)



(Spatial Climate Analysis Service. Oregon Climate Service. Accessed November 2004 online at http://www.ocs.orst.edu/prism/)

12.5.2 Heavy Rains, Thunderstorms, Lightening, and Ice/Freezing Storms – Event History

ADD TEXT

12.5.3 Heavy Rains, Thunderstorms, Lightening, and Ice/Freezing Storms – Probability of Occurrence

While thunderstorms and lightning can be found throughout the United States, they are most likely to occur in the central and southern states.

ADD TEXT

12.6 ASSESSING VULNERABILITY – ESTIMATING SEVERE WEATHER LOSSES

Under 44 CFR Section 201.6(c)(2)(ii) of DMA2K, risk assessments are required to include a description of the jurisdiction's vulnerability to the hazards and its impact on the community. This description *should* also describe Roseville's vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical

facilities located in the floodplain hazard area and estimate potential dollar losses to vulnerable structures as well as analyze development trends. This sub-section presents the results of the severe weather vulnerability assessment for Roseville.

12.6.1 Impact of Severe Weather on Life, Safety, and Health

ADD TEXT

12.6.2 Impact of Severe Weather on Critical Facilities

ADD TEXT

12.6.3 Impact of Severe Weather on Existing Structures At Risk

ADD TEXT

12.6.4 Economic Impact of Severe Weather

ADD TEXT

12.6.5 Impact of Severe Weather on Development and Redevelopment Trends

ADD TEXT

12.7 ANALYSIS OF EXISTING SEVERE WEATHER MITIGATION PROGRAMS, PLANS, AND ORDINANCES

ADD TEXT To be prepared in consultation with City of Roseville staff

12.8 REVIEW OF MITIGATION ALTERNATIVES FOR SEVERE WEATHER HAZARDS

ADD TEXT To be completed after Risk Assessment results for severe weather are available.

References

To be relocated to the end of the document.

American Meteorological Society. Glossary of Meteorology, accessed December 2004 online at http://amsglossary.allenpress.com/glossary.

Carle, David. 2004. Introduction to Water in California; A California Natural History Guide. Berkeley. University of California Press.

ESRI/FEMA Hazard Mapping site http://mapserver2.esri.com

Roseville California Resource Guide, accessed November 2004 online at http://www.usacitiesonline.com/cacounty roseville.htm

http://www.shelters-of-texas.com/images/windzone.gif

Spatial Climate Analysis Service. Oregon Climate Service. Accessed November 2004 online at http://www.ocs.orst.edu/prism/

USA Cities Online. Accessed December 2004 online at http://www.usacitiesonline.com/cacountyroseville.htm