

CHAPTER 13. FLOODING

13.1 GENERAL BACKGROUND

A floodplain is the area adjacent to a river, creek or lake that becomes inundated during a flood. Floodplains may be broad, as when a river crosses an extensive flat landscape, or narrow, as when a river is confined in a canyon.

13.1.1 Measuring Floods and Floodplains

The frequency and severity of flooding are measured using a discharge probability, which is a statistical tool used to define the probability that a certain discharge level will be equaled or exceeded within a given year. The discharge level is the volume of water that will flow into a stream or river and over its banks during a given time. Flood studies use historical records to determine the probability of occurrence for the different discharge levels. The flood frequency equals 100 divided by the discharge probability. For example, the 100-year discharge has a 1 percent chance of being equaled or exceeded in any given year. The “annual flood” is the greatest flood event expected to occur in a typical year.

The extent of flooding associated with a 1-percent annual probability of occurrence (the base flood or 100-year flood) is used as the regulatory boundary by many agencies. Also referred to as the special flood hazard area (SFHA), this boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities. Many communities have maps that show the extent and likely depth of flooding for the base flood. The base flood elevation is computed using discharge probabilities. The corresponding water-surface elevations describe the exact elevation of water that will result from a given discharge level, which is one of the most important factors used in estimating the potential flood damage in a given area.

13.1.2 Effects of Human Activities

Throughout history, humans have developed settlements in floodplains to take advantage of the benefits of being near the water bodies, but such settlements have always been susceptible to damage from flooding. Human activities concentrate in floodplains for a number of reasons: water is readily available;

DEFINITIONS

Flood—The inundation of normally dry land resulting from the rising and overflowing of a body of water.

Floodplain—The land area along the sides of a river that becomes inundated with water during a flood.

100-Year Floodplain—The area flooded by the flood that has a 1-percent chance of being equaled or exceeded each year. This is a statistical average only; in fact, a 100-year flood can occur more than once in a short period of time. The 1-percent annual chance flood is the standard used by most federal and state agencies.

Nolte Future Floodplain—A portion of the Roseville floodplain based on the floodplain analysis published by Nolte and Associates in August 1986. This analysis used hydrology based on observed flooding scenarios in Roseville and projected growth for the region. This approach generated a floodplain area larger than that identified by FEMA for some parts of the city. Although the study was never formally adopted, it is used by the City as the best available information for regulatory and land-use programs such as the specific plan program and improvement standards.

Regulatory Floodplain—An area regulated as a floodplain by the City of Roseville through land-use regulations and improvement standards. It includes areas identified by FEMA as well the Nolte Future Floodplain.

Return Period—The average number of years between occurrences of a hazard (equal to the inverse of the annual likelihood of occurrence).

Riparian Zone—The area along the banks of a natural watercourse.

land is fertile; transportation by water is easily accessible; and land is flatter and easier to develop. But human activity in floodplains frequently interferes with natural processes. It can affect the distribution and timing of drainage, thereby increasing flood problems. Human development creates local flooding problems by altering or confining drainage channels. This increases flood potential in two ways: it reduces the stream's capacity to contain flows, and it increases flow rates or velocities downstream during all stages of a flood event.

13.1.3 Floodplain Ecosystems

Floodplains can support ecosystems that are rich in biological quantity and diversity. Wetting of the floodplain soil releases a surge of nutrients: those left over from the last flood, and those that result from the rapid decomposition of organic matter that has accumulated since then. Microscopic organisms thrive and larger species enter a rapid breeding cycle. Opportunistic feeders—particularly birds—move in to take advantage. The production of nutrients peaks and falls away quickly, but the surge of new growth endures for some time. This makes floodplains particularly valuable for agriculture.

Riparian zone species have significant differences from those that grow outside of floodplains. For instance, riparian trees tend to be very tolerant of root disturbance and tend to be very quick-growing compared to non-riparian trees.

13.1.4 Federal Flood Programs

National Flood Insurance Program

The NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in participating communities. For most communities participating in NFIP, FEMA has prepared a detailed Flood Insurance Study (FIS). The study presents water surface elevations for floods of various magnitudes, including the 1-percent annual chance flood and the 0.2-percent annual chance flood (the 500-year flood). Base flood elevations and the boundaries of the 100- and 500-year floodplains are shown on Flood Insurance Rate Maps (FIRMs).

Roseville entered the regular phase of the NFIP on December 15, 1983. The current effective FIRM date is November 21, 2001. As a participant in the NFIP, the City must, at a minimum, regulate development in its floodplain areas in accordance with NFIP criteria. Before a permit to build in a floodplain area is issued, the City must ensure that two basic criteria are met:

- All new buildings and developments undergoing substantial improvements must, at a minimum, be elevated to protect against damage by the 100-year flood.
- New floodplain developments must not aggravate existing flood problems or increase damage to other properties.

Structures permitted or built in the City before the NFIP regulatory requirements were incorporated into the City's ordinances (before the effective date of the City's FIRM) are called "pre-FIRM" structures. For the City of Roseville, pre-FIRM structures are those permitted or built before December 15, 1983.

The Community Rating System

The Community Rating System (CRS) is a voluntary incentive program within the NFIP. The CRS encourages floodplain management activities that exceed the minimum NFIP requirements (FEMA 2002). Flood insurance premium rates are discounted to reflect the reduced flood risk resulting from community actions meeting the following three goals of the CRS:

- Reduce flood losses.

- Facilitate accurate insurance rating.
- Promote awareness of flood insurance.

For participating communities, flood insurance premium rates are discounted in increments of 5 percent. For example, a Class 1 community would receive a 45 percent premium discount, and a Class 9 community would receive a 5 percent discount. (Class 10 communities are those that do not participate in the CRS; they receive no discount.) The CRS classes for local communities are based on 18 creditable activities in the following categories:

- Public Information
- Mapping and Regulations
- Flood Damage Reduction
- Flood Preparedness

Figure 13-1 shows the nationwide number of CRS communities by class as of May 1, 2010, when there were 1,138 communities receiving flood insurance premium discounts under the CRS program. Although insurance premium discounts are one benefit of participation in the CRS, more important benefits result from activities that save lives and reduce property damage. Communities participating in the CRS represent a significant portion of the nation’s flood risk as evidenced by the fact that over 66 percent of the NFIP’s policy base is located in these communities. Communities receiving premium discounts through the CRS range from small to large and represent a broad mixture of flood risks, including both coastal and riverine flood risks.

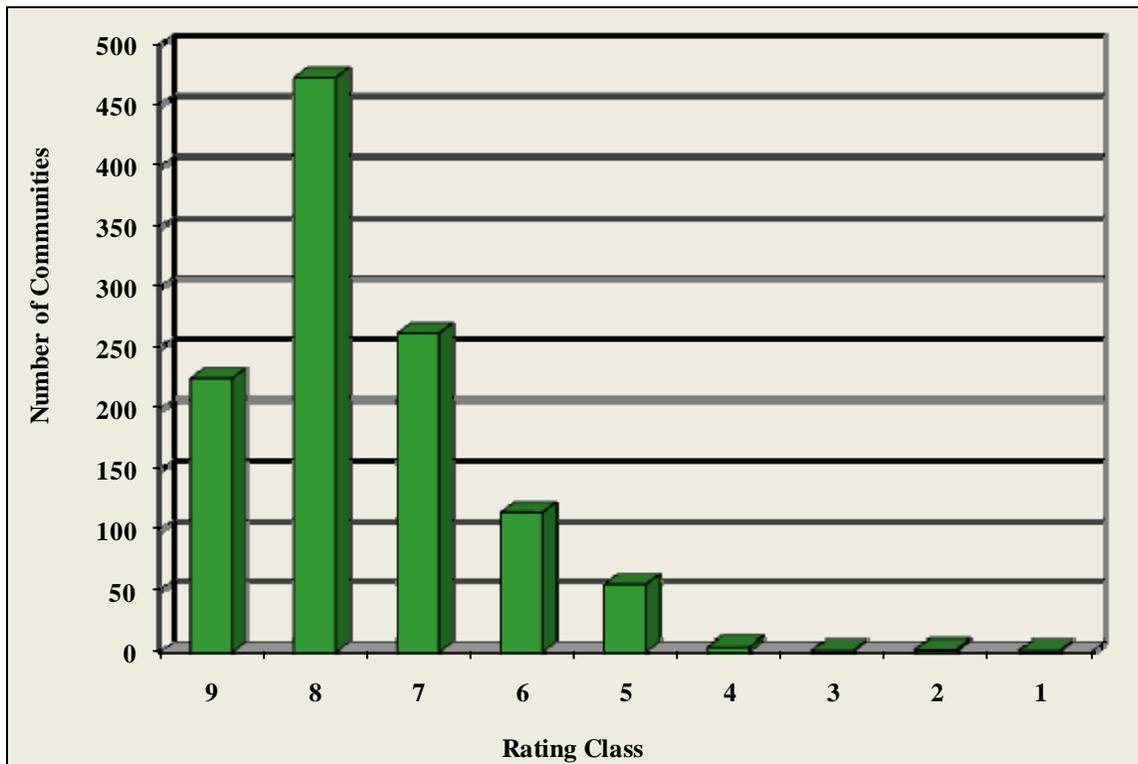


Figure 13-1. CRS Communities by Class as of May 1, 2010

The City of Roseville participated as a pilot-test community during CRS development in the late 1980s. The City began its official participation in the CRS program in 1991 and became the nation's first and only Class 1 community on October 1, 2006. This classification provides flood insurance policy holders in Roseville up to a 45-percent reduction in flood insurance premiums and represents an annual savings of \$76,885 in flood insurance premiums; an average of \$237 per year for each policy in force.

13.2 HAZARD PROFILE

13.2.1 Flooding Types

Flooding in Roseville is typically caused by high-intensity storms of relatively short duration (1 to 3 hours) concentrated on a stream reach with already saturated soil. In Roseville, two types of flooding typically occur:

- Flash floods that occur suddenly after a brief but intense and concentrated downpour. They move rapidly, end suddenly, and can occur in areas not generally associated with flooding (such as subdivisions not adjacent to a water body and areas serviced by underground drainage systems). Although the duration of these events is usually brief, the damage they cause can be severe. Flash floods cannot be predicted accurately and happen whenever there are heavy storms.
- Riverine floods described in terms of their extent (including the horizontal area affected and the vertical depth of floodwater) and the related probability of occurrence (expressed as the percentage chance that a flood of a specific extent will occur in any given year). Flood studies use historical records to determine probabilities of occurrence.

Some localized flooding not associated with creek or stream overflow occurs in Roseville when rainfall runoff volumes exceed the design capacity of drainage facilities or when there are no drainage facilities to control flows. The City has attempted to address this type of flooding with regulations that require an "overland release" of stormwater generated at a site to a recognized stormwater facility. The City also requires mitigation of any increase in runoff generated from new development. However, some developments and facilities in the City were put in place before these policies were adopted.

13.2.2 Past Events

Correspondence from the 1930s between the U.S. Army Corps of Engineers and the City of Roseville indicated a need for establishing flood control measures along Dry, Cirby, and Linda Creeks. The flood of February 1986 was the largest flood on record at its time. This flood caused substantial property damage and was considered to be a 70- to 100-year event, depending on location. In January 1995, the City was subject to flooding that exceeded the 1986 flood event in most streams in Roseville, and that flood is now considered to be the flood of record.

Based on data from the National Climactic Data Center and the University of South Carolina's Spatial Hazard Events and Losses Database for the United States, 16 major flood events were reported in Placer County between January 1950 and December 2009, with an estimated \$49,115,460 in property damage. Table 13-1 shows the estimated damage from flooding in Placer County that impacted Roseville from 1973 to 2009.

Significant flood events impacting the City of Roseville are discussed below with respect to damage, frequency, injuries and fatalities. Unreported injury or illness may be associated with each event. In addition to the events discussed below, flooding occurred during other storms in 1950, 1952 and 1963. However, little information is available to define the extent and impacts of these flooding events.

Date	Reported Damage (not adjusted for inflation)
January 1973	\$86,207
March 1983	Not Available
February 1986	\$5,000,000 (Roseville only)
January 1995	\$8,000,000 Total (\$4.4 million structural)
January 26,1997	\$43,600 (structural)
February 1998	\$20,000 (structural)
December 17, 2005	\$2,000,000 (county-wide)

December 1955

Flooding occurred primarily along Dry Creek. Homes in the Douglas Boulevard area were surrounded by floodwater, and one family was evacuated. Douglas Boulevard was impassable, and pavement was damaged. Royer Park was inundated, and floodwater extended across Park Drive. No injuries or fatalities were reported.

April 1958

This flood was the second largest event on record at the time. Flood conditions were most severe on Sunrise Avenue in the southeast portion of the City, on Douglas Boulevard, in the Royer Park area, and on Riverside Avenue at Dry Creek. Agricultural damage occurred along Dry Creek immediately west of the City. Many homes and businesses were surrounded by floodwater at the peak of the flood. Several families were evacuated by boat from homes in the Columbia Street and Douglas Boulevard areas. Royer Park became inundated, and floodwater covered the ball field and extended across Park Drive. Part of the sewage treatment plant was flooded, but the plant remained operational throughout the flood, which continued for at least 12 hours. No injuries or fatalities were reported.

October 1962

This flood was considered the flood of record at the time. Over 9 inches of rain fell during the storm. Creeks overflowed their banks throughout the City, but the areas most severely affected were along Linda Creek in the Sierra Gardens Subdivision and along Dry Creek. A number of families were evacuated from their homes on Lee Way and Douglas Boulevard. Royer Park was completely inundated for a time, and one deer in the zoo was drowned before animals could be evacuated. Other flood losses in the park included bank erosion, destruction of fencing, damage to a footbridge, and damage to the recreation building and the park office. Restoration of the park required two weeks. Water mains were damaged by flood flows in the Cresthaven and Atlantic Street areas. The Dry Creek Bridge on Riverside Avenue and the Antelope Creek Bridge on Atlantic Street were damaged. No injuries or fatalities were reported.

December 1964

During this flood event, the fire and police departments evacuated four families when floodwater from Linda Creek surrounded their homes on Champion Oaks Drive and Lee Way. Dry Creek overflowed its banks in several locations, and flood-borne debris was removed in an effort to keep the stream flowing at Booth Road and the Southern Pacific railroad tracks. Floodwater at this location was deep enough to

submerge a car stalled in the underpass. Stream-bank erosion occurred along the east bank of Dry Creek behind the Campfire Girls lodge on Sutter Avenue. No injuries or fatalities were reported.

January 1969

During a series of downpours beginning on January 16, 1969, flooding occurred in Roseville along Dry Creek, affecting Royer Park, the Champion Oaks area, and the intersection of Cirby Way and Old Auburn Road. Five homes were nearly evacuated on January 20 along Champion Oaks Drive after rising water from Linda Creek crested at the doorsteps of the homes at 1:00 a.m. before receding at 3:00 a.m. City crews stood watch prepared to load belongings into vehicles if flood water entered the homes.

A second severe storm during the week of January 25, 1969 swept through Placer County, downing trees and causing a brief power outage. Rising water in Linda Creek caused the evacuation of five homes on Champion Oaks Drive on January 25 and 26. Dry Creek Bridge on Douglas Boulevard at Royer Park was closed on January 25 for the second time in five days when swelling water in Dry Creek washed out the fill placed by City crews when the street gave way the week before. No injuries or fatalities were reported.

January 1970

Heavy rains and severe winds in mid-January caused flood conditions in Roseville and throughout northern California. High water levels were reported on Champion Oaks Way, Subway Road, and Royer Park. No injuries or fatalities were reported.

January 1973

Heavy rain and high winds impacted northern California to the Oregon border during the week of January 16, 1973. City crews kept watch on Linda Creek at Champion Oaks Drive and closed Subway Road because of flooding from January 16 through 18. Royer Park flooded after Dry Creek overflowed its banks. No injuries or fatalities were reported.

March 1983

This flood event damaged approximately 25 residences along Linda and Cirby Creeks. Portions of Royer Park were under water as well as areas in the Sierra Lakes Mobile Home Park. Dry Creek overflowed the Darling Way and Riverside Avenue bridges, disrupting traffic and flooding six businesses along Riverside Avenue. No injuries or fatalities were reported.

February 1986

This flood event caused widespread damage in most of the Dry Creek basin. Nearly all bridges and culverts were overtopped, with 30 sustaining embankment damage. In addition, the crossing at Rocky Ridge Drive washed out. Two bridges over Dry Creek were damaged, and street cave-ins occurred at a number of locations. Approximately 209 homes along Dry, Linda, and Cirby Creeks reported flood damage, with water levels up to 5 feet above finished floor levels. The Roseville City Library was temporarily closed due to flooding, and floodwaters reached the foundation of the Public Safety Building but did not cause any damage. One fatality associated with this flood event was reported.

January 1995

The January 1995 flood event (Figure 13-2) exceeded the flood event of 1986 on Cirby and Linda Creeks. This event is now considered the flood of record for Dry Creek based on flood heights. The flood was calculated to be a 100-year event. This flood resulted in 358 structures in the Dry Creek Basin being inundated by floodwaters. No injuries or fatalities were reported.



Figure 13-2. Dry Creek Flooding, January 1995

January 1997

Flood events in 1997 were some of the most severe on record for the region. An isolated storm event typical for the Roseville area occurred on soils saturated from repetitive storm events, causing a flash flood. This flooding resulted in 21 structures being inundated with floodwater. The impact of this event was significantly reduced by the partially completed Cirby, Linda, and Dry Creek flood control project. No injuries or fatalities were reported.

February 1998

A small flood occurred on February 3, 1998, resulting in eight structures being inundated by floodwater in the Dry Creek Basin (Figure 13-3). This event was caused by an isolated storm event centered over the basin. No injuries or fatalities were reported.

13.2.3 Location

Primary Flood Sources

Upstream flows generated in Placer County enter the City of Roseville's creeks and tributaries from the east and north. Picking up additional stormwater runoff, the creek systems flow west-southwest through Roseville. These flows continue to move west-southwest, passing through Placer, Sacramento, and Sutter Counties to their ultimate destination, the Sacramento and American Rivers.

Roseville is located in portions of two major drainage basins: the Pleasant Grove Creek Basin and the Dry Creek Basin. Pleasant Grove Creek and its tributaries drain most of the western and central areas of the City, and the Dry Creek Basin and its tributaries drain the rest of the City.



Figure 13-3. Riverside Flooding, February 1998

The Dry Creek system has year-round flow in its major water courses, and the Pleasant Grove system is intermittent, with only seasonal flow. Since 1950, there have been no reports of structural flood damage along Pleasant Grove Creek. Due to the City's floodplain management policies, no structures in the Pleasant Grove Creek Basin are presently subject to flooding. The focus of flood hazard management is the Dry Creek Basin.

Seven creeks and streams that drain the 80-square-mile Upper Dry Creek Basin pass through and join within the city limits of Roseville. Three of these creeks have primary flooding impacts on the City: Cirby, Dry, and Linda Creeks.

Regulatory Floodplain

The science available at the time that most of the City of Roseville was developed did not accurately project flood heights that could occur from typical rainfall events in the region. Development therefore occurred in areas needed for stormwater conveyance, with insufficient levels of flood protection. Development now exists in low-lying areas adjacent to creek or stream systems needed to convey the over-bank flooding that can occur during storm events.

The City eventually modeled flooding using the best available hydrologic and hydraulic science to better reflect actual rainfall events that can impact the City. This modeling generated a projection of flood heights and areas of inundation that is well supported by conditions observed during the 1986 flood. The City has since used this information to create and enhance its floodplain management program to minimize flood risk to all new developments.

Based on the detailed modeling, the City identified a regulatory floodplain that exceeds the SFHA mapped by FEMA. Map 13-1 shows the regulatory area to which the Roseville general plan safety element will be applied, as authorized by the Roseville City Code. The regulatory floodplain is defined by

the City as the area susceptible to risk from flooding based on City-approved studies. These areas are based on detailed hydrologic and hydraulic floodplain modeling that meets or exceeds FEMA criteria for mapping and modeling floodplains. The flood event used to delineate these boundaries is referred to as “the regulatory flood” to differentiate it from the “base flood” used by FEMA.

In many portions of the City, the Nolte Future Floodplain has been used to designate floodplain boundaries. The Nolte Future Floodplain defines floodway and floodway fringe boundaries within the floodplain. The floodway fringe is an area along the boundary of the floodplain that, if totally obstructed, would not result in more than a 1-foot rise in the water surface elevation. The floodway constitutes the remainder of the floodplain area and is typically where floodwaters have the most velocity.

13.2.4 Frequency

Flood magnitude measurements reflect statistical averages only; it is possible for two or more rare floods (with a 100-year or higher recurrence interval) to occur within a short time period. Assigning recurrence intervals to historical floods on different streams can help indicate the intensity of a storm over a large area. For example, the 1995 flood event was determined to be a 100-year flood on Dry Creek and a 50-year flood on Linda Creek.

Recent history has shown that Roseville can expect an average of one episode of minor river flooding each winter. Recent flooding resulting in property damage has occurred about every 3 to 5 years since 1950, except for the period from 1973 to 1981, when no significant flooding occurred. The frequency of flood events that cause significant damage has decreased significantly over the past 10 years due to City efforts to mitigate flood risk. Exposure to events that could cause significant flooding can be expected every 5 to 10 years. Additionally, the City can expect what is often referred to as “nuisance” flooding annually in the historic core due to urban drainage issues.

13.2.5 Severity

Table 13-2 shows observed flooding characteristics for the Pleasant Grove and Dry Creek basins, the two drainage basins in which the City of Roseville lies. This table represents the range of measurements observed during past flood events. The City recently completed five phases of the seven-phase “Cirby-Linda-Dry Creek Flood Control Project.” The purpose of this project is to reduce stormwater back-up at constrictions and increase the overall capacity of the floodplain during storm conditions. Project structures were designed to provide 1 foot of freeboard above the projected 500-year flood elevation. This project significantly reduced the flood risk exposure for this area, but did not eliminate it.

11.2.6 Warning Time

Due to the extended precipitation needed to cause serious flooding, it is unusual for a flood to occur without warning. Flash flooding can be less predictable, but hazard areas can be warned in advanced of potential flash flooding. Typical warning times for Roseville range from 1 to 3 hours. The City’s flood warning system has four ways to warn the public of potential flooding:

- A comprehensive graphical display of stream levels, broadcast on Channel 14 or 73, with the status of the warning
- The “Stream Level” link on the City of Roseville home web page (www.roseville.ca.us)
- An automatic telephone dialing system to problem areas
- Flooding status broadcasted on radio station 530 AM

**TABLE 13-2.
OBSERVED CHARACTERISTICS OF FLOODING**

Parameter	Pleasant Grove Creek Basin	Dry Creek Basin
Approximate Base Flood Velocity (ft/s) ^{a, b}	0.5 to 8.0	2.0 to 14.0
Flow Rate (cfs) ^c	1,100 to 5,000	900 to 15,000
Base Flood Elevation (feet, National Geodetic Vertical Datum)		
Downstream limit	89.7	79.7
Upstream limit	150.0	210.0
Approximate Depth of Overbank Flooding (feet above existing grade)	0 to 2	0 to 3
Approximate Warning Time (hours)	3	3
<p>a. Higher velocities were observed in the channel; lower velocities were observed in the overbank area</p> <p>b. ft/s = feet per second</p> <p>c. cfs = cubic feet per second (1 cubic foot is about 7.5 gallons)</p>		

Numerous stream flow and rain gauges form the City’s stream monitoring system for the Upper Dry Creek Drainage Basin. These stations are placed at strategic locations throughout the drainage basin. For example, one is mounted on the floodwall just upstream from the pedestrian bridge that crosses between Tina Way and Marlin Drive and another is on Dry Creek at the Vernon Street Bridge. Each station transmits information via radio antenna to a central computer. Stream level information from five of the most critical stream level gauges is then broadcast on cable Channel 14/73 and on the City’s web page during significant storm events. City staff uses this information in deciding whether to advise residents to evacuate. The goal is to provide up to three hours advance warning. The continuously changing variables of precipitation, stream levels, and forecasts have a major effect on meeting this goal. The display shown on Channel 14/73 consists of a set of basic graphics shown in 15-second intervals:

- The first, which is shown only once for every complete cycle, is a City of Roseville map that includes major roadways (Vernon Street, Douglas Boulevard, Cirby Way, etc.), the three major streams (Dry Creek, Linda Creek, and Cirby Creek) and the five stream level gauge locations. Residents living in a designated floodplain can determine which of the five stream gauges best represents their neighborhood. Once this is established, it is important to focus on how the streams are reacting to the weather conditions.
- Following this display, a more specific map identifies a single stream gauge’s location in relation to nearby roadways and streams.
- Transmitted information from the gauges is presented in visual formats that include the current stream depth and the stream depth over the past six hours (see Figure 13-4).

The stream level graph is divided into four colored categories of flood depth stages:

- Blue (Normal Stage)—Stream level conditions are normal and safe.
- Green (Advisory Stage)—City staff is continuously monitoring creek levels and weather conditions. Residents should be closely watching for further information about flooding in their area.

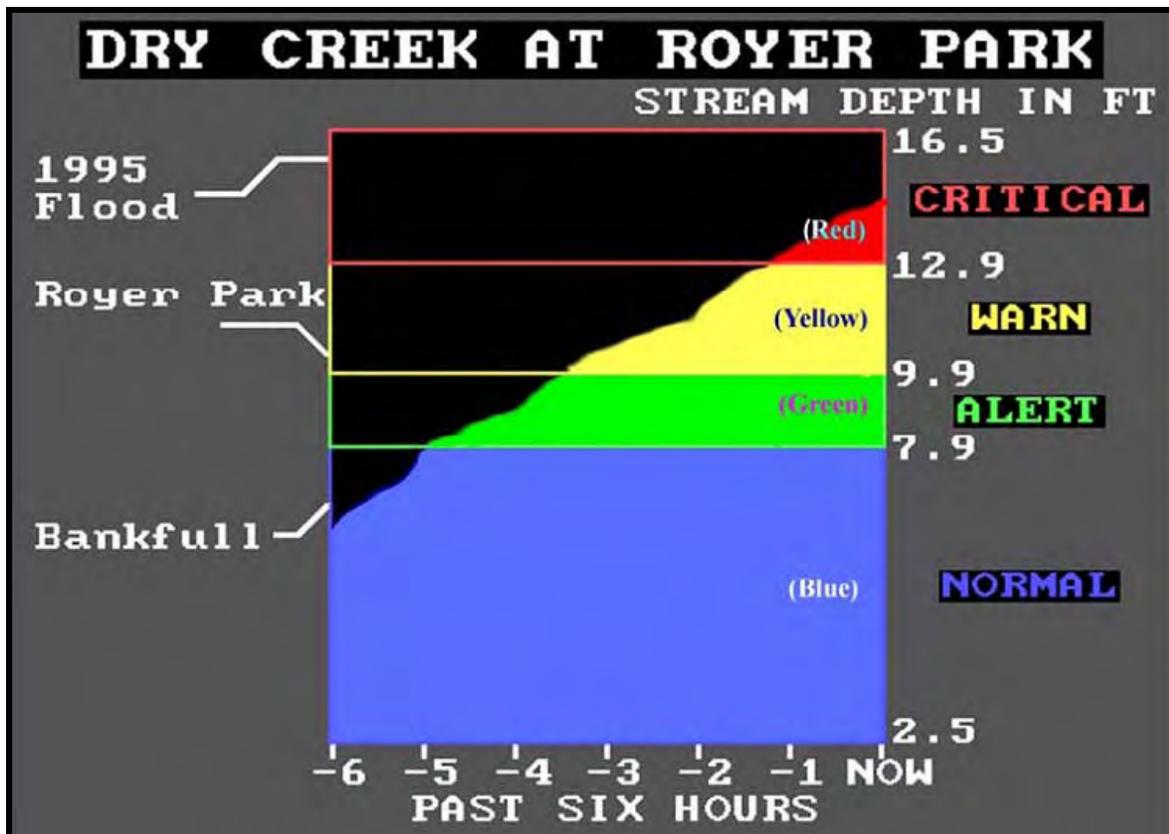


Figure 13-4. Example of Stream Gauge Graphic Display

- Yellow (Warning Stage)—There is a possibility of flooding in this area. Necessary precautions need to be taken to secure personal property and safety.
- Red (Critical Stage)—Flooding appears imminent in this area. Residents should evacuate their homes.

The numeric values of the stream depths associated with the flood depth stages are shown on the vertical bar graph for all five of the stream level gauges, and reference stream levels are identified for each gauge. For example, the stream level during the 1995 flood is marked for each location. Also identified are other reference points such as roadway surface, bridge and/or top of berm levels. This enables viewers to identify and understand the present stage of the stream in relation to known benchmarks.

The City of Roseville also has an automated telephone dialing system. During significant storm events, this system is used to phone residents and businesses in the floodplain and provide recorded messages containing important information. The message to be played will depend on the flood threat in the area at that time.

13.3 SECONDARY HAZARDS

The most significant secondary hazard for flooding in Roseville is bank erosion. The dangers of bank erosion often are greater than those of flooding. Flooding is responsible for landslides when high flows over-saturate soils on steep slopes, causing them to fail. Hazardous materials spills are also a secondary hazard of flooding if storage tanks rupture and spill into streams, rivers or drainage sewers.

13.4 CLIMATE CHANGE IMPACTS

Climate change could result in an increase in flooding due to changes in the frequency, duration and intensity of storm events. Rising snowlines caused by climate change will allow additional mountain areas to contribute to peak storm runoff. High frequency flood events (e.g. 10-year floods) will likely increase with a changing climate. Along with reductions in the amount of the snowpack and accelerated snowmelt, scientists project greater storm intensity, resulting in more direct runoff and flooding. Changes in watershed vegetation and soil moisture conditions will likewise change runoff and recharge patterns. As stream flows and velocities change, erosion patterns will also change, altering channel shapes and depths, possibly increasing sedimentation behind dams, and affecting habitat and water quality. With potential increases in the frequency and intensity of wildfires due to climate change, there is potential for more floods following fire, which increase sediment loads and water quality impacts. As hydrology changes, what is currently considered a 100-year flood may occur more often, leaving many communities at greater risk.

As peak flows and precipitation change over time, planners will need to factor a new level of safety into the design, operation, and regulation of flood protection facilities such as dams, floodways, bypass channels and levees, as well as the design of local sewers and storm drains. Use of historical data has long been the standard of practice for designing and operating flood protection projects, developing flood forecasting models, and forecasting snowmelt runoff. The use of past data for forecasting assumes that the climate of the future will be similar to that of the period of historical record. However, the historical hydrologic record cannot be used to predict increases in the frequency and severity of extreme events such as floods and droughts. National resource managers have concluded the following:

- Historical hydrologic patterns can no longer be solely relied upon to forecast the water future.
- Precipitation and runoff patterns are changing, increasing the uncertainty for water supply and quality, flood management and ecosystem functions.
- Extreme climate events will become more frequent, necessitating improvement in flood protection, drought preparedness and emergency response.

In light of these conclusions, model calibration or statistical relation development in the future must happen more frequently, new forecast-based tools must be developed, and a standard of practice that explicitly considers climate change must be adopted.

13.5 EXPOSURE

The Level 2 HAZUS-MH protocol was used to assess the risk and vulnerability to flooding in the planning area. HAZUS-MH uses census data at the block level and FEMA floodplain data, which has a level of accuracy acceptable for planning purposes. Where possible, the HAZUS-MH data for this risk assessment was enhanced using GIS data from the City and from county, state and federal sources. The City of Roseville has mapped and regulates 1,493 acres as floodplain, which includes the 1,098 acres of floodplain identified by FEMA on the current effective FIRM for the city. The following sections describe risk exposure and vulnerability of the general building stock, critical facilities and infrastructure, land use, and environment within the City's mapped regulatory floodplain.

13.5.1 Population

Estimates of the population living in the floodplain in the planning area were generated by analyzing census blocks that intersect with the City's regulatory floodplain. Census blocks do not follow the same boundaries as the floodplain. Therefore, the methodology used to generate these estimates counted census block groups whose centers are in the floodplain or where the majority of the population most likely lives

in or near the floodplain. HAZUS-MH estimated the number of buildings within the floodplain in each block, and then estimated the total population by multiplying the number of residential structures by the City average of 2.54 persons per household. Using this approach, the exposed population within the regulatory floodplain was estimated to be 330 (0.41 percent of the total city population).

13.5.2 Property

Structures in the Floodplain

Table 13-3 summarizes the number and type of structures in the floodplain, as calculated from the Level 2 HAZUS-MH analysis. There are 154 structures in the City of Roseville regulatory floodplain. This represents less than 1 percent of the total structures in the city. It includes the 143 buildings identified within FEMA’s SFHA.

TABLE 13-3. STRUCTURES WITHIN THE SFHA AND THE ROSEVILLE REGULATORY FLOODPLAIN							
	# of Structures in Mapped Floodplain						Total
	Residential	Commercial	Industrial	Religion	Government	Education	
FEMA-Mapped SFHA	119	17	1	2	4	0	143
Regulatory Floodplain	130	17	1	2	4	0	154

Exposed Value

The value of exposed buildings within the City’s regulated floodplain area was generated using HAZUS-MH and is summarized in Table 13-4. This methodology estimated \$62.9 million worth of building-and-contents exposure, representing 0.29 percent of the total building-and-contents value in the city.

TABLE 13-4. VALUE OF EXPOSED BUILDINGS WITHIN THE ROSEVILLE REGULATORY FLOODPLAIN				
	Value of Exposed Property in the Regulatory Floodplain			% of Total Value in the City
	Buildings	Contents	Total	
Residential	\$26,263,080	\$18,384,156	\$44,647,236	0.1%
Commercial	\$7,327,796	\$7,751,967	\$15,079,763	0.2%
Industrial	\$202,520	\$303,780	\$506,300	0.0%
Religion	\$834,233	\$834,233	\$1,668,466	0.8%
Government	\$541,412	\$541,412	\$1,082,824	1.7%
Education	\$0	\$0	\$0	0%
Total	\$35,169,041	\$27,815,548	\$62,984,589	0.29%

Land Use in the Floodplain

To preserve the natural and beneficial functions of open space resource areas adjacent to the floodplain areas of Roseville, the City has adopted policies under the open space element of its general plan that include the following:

- Preserve and rehabilitate continuous riparian corridors and adjacent habitat along the City’s creeks and waterways.
- Require dedication of the 100-year floodplain or comparable mechanism to protect habitat and wildlife values in perpetuity.
- Require preservation of contiguous areas outside the 100-year floodplain as merited by special resources or circumstances, which may include, but are not limited to, sensitive wildlife or vegetation, wetland habitat, oak woodland areas, grassland connections in association with other habitat areas, slope or topographical considerations, recreation opportunities, and maintenance access requirements.
- Limit recreation activities within the 100-year floodplain and require additional setback areas for trails and other recreation uses so that natural resource areas are not adversely impacted.
- Provide protection and enhancement of fishery resources, including continued coordination with the California Department of Fish and Game to release water to Linda Creek.

Because of these policies, a large portion of the floodplains within Roseville is held for open space use, much of it in a natural or beneficial state. Currently, 1,336.28 acres (90 percent) of the regulatory floodplain within Roseville is designated for open space use as defined in the open space element of the general plan.

13.5.3 Critical Facilities and Infrastructure

Flooding poses numerous risks to critical facilities and infrastructure:

- Roads or railroads that are blocked or damaged can prevent access throughout the area and can isolate residents and emergency service providers needing to get to vulnerable populations or to make repairs.
- Bridges washed out or blocked by floods or debris from floods also can cause isolation.
- Creek or river floodwaters can back up drainage systems, causing localized flooding.
- Culverts can be blocked by debris from flood events, also causing localized urban flooding.
- Floodwaters can get into drinking water supplies, causing contamination.
- Sewer systems can be backed up, causing waste to spill into homes, neighborhoods, rivers and streams.
- Underground utilities can also be damaged.

Tables 13-5 and 13-6 summarize the number of critical facilities that are within Roseville’s regulatory floodplain.

TABLE 13-5. CRITICAL FACILITIES WITHIN THE CITY OF ROSEVILLE FLOODPLAIN								
Basin	Medical & Health Services	Government Function	Protective Function	Schools	Societal Function	Hazmat	Other Critical Function	Total
Dry Creek	0	1	0	1	0	0	0	2
Pleasant Grove Creek	0	0	0	0	0	0	0	0
Total	0	1	0	0	0	0	0	2

TABLE 13-6. CRITICAL INFRASTRUCTURE WITHIN THE CITY OF ROSEVILLE FLOODPLAIN							
Basin	Water Supply	Wastewater	Power	Fuel storage	Communications	Bridges	Total
Dry Creek	0	0	0	0	0	1	2
Pleasant Grove Creek	0	0	0	0	0	1	1
Total	0	0	0	0	0	2	3

The City of Roseville has determined that the following major roadways and stream crossings (bridges or culverts) would be impassable during a 100-year flood event:

- Dry Creek Road Crossings
 - Vernon Street
 - Riverside Avenue
 - Darling Way
 - Douglas Boulevard
 - Folsom Road
- Linda Creek Road Crossings
 - Rocky Ridge Drive
 - Champion Oaks Drive
 - Sierra Collage (College) Boulevard
- Cirby Creek Road Crossings
 - Sunrise Avenue
 - Coloma Way
 - Oakridge Road
 - Sierra Gardens Drive
 - Huntington Drive
- Miners Ravine
 - Sierra Collage (College) Boulevard

13.5.4 Environment

Flooding is a natural event, and floodplains provide many natural and beneficial functions. Nonetheless, with human development factored in, flooding can impact the environment in negative ways:

- Migrating fish can wash into roads or over dikes into flooded fields, with no possibility of escape.
- Pollution from roads, such as oil, and hazardous materials can wash into rivers and streams.
- Pollutants carried by floodwaters can settle onto normally dry soils, polluting them for agricultural uses.
- Human development, such as bridge abutments and levees, and logjams from timber harvesting can increase streambank erosion, causing rivers and streams to migrate into non-natural courses.

With much of Roseville’s regulatory floodplain zoned for open space use, the City has taken significant steps to preserve the natural and beneficial functions of the floodplain, while at the same time reducing the risk exposure to the built environment. Still, all vegetation and wildlife resources and corridors in the floodplain open space system—grasslands, oak woodlands, riparian areas, and seasonal wetlands—are exposed to the flood risk.

13.6 VULNERABILITY

13.6.1 Population

Flooding can be a deadly hazard. Roads running through low-lying areas prone to sudden and frequent flooding are a serious threat. Motorists often attempt to drive through barricaded or flooded roadways. Because only 18 to 24 inches of water moving across a roadway can carry away most vehicles, floods can present significant potential safety risks. The second largest potential for injuries from flooding results from people walking or playing in or near flooded areas. Generally, floods kill people in one of two situations: when people ignore basic safety precautions (such as evacuations and warnings), and when a flash flood hits an area with no warning.

Although it is possible to analyze life and safety impacts resulting from the flood hazard, injuries and casualties were not estimated for this hazard. One flood-related fatality in Roseville has been recorded, but the flood hazard is not generally considered to pose a serious risk to life in this area, for the following reasons:

- Flooding in Roseville tends to be rapid in terms of the rise and fall of floodwaters. Because of the City's geographical location in the watershed, floods tend to come and go quickly as they move toward their drainage endpoints, thereby decreasing the threat that people become trapped by floodwaters.
- The City has made it a priority to warn and educate its citizens on the dangers and impacts of flooding. The City implements public outreach programs that provide information on flood warnings, property protection, flood safety, and flood insurance. The City also has developed a comprehensive flood warning program that can deliver real-time data to citizens and emergency management personnel through cable television and the Internet. The program can provide a warning up to 3 hours before a flood event occurs in the 100-year floodplain. The City's approach has resulted in an educated and well-informed constituency.

The City of Roseville Emergency Operations Plan (EOP), adopted in June of 2004, directs the City of Roseville Emergency Management Organization, coordinates the actions of the Emergency Operations Center (EOC) staff, establishes operational priorities, ensures development and implementation of strategies to meet the needs of the emergency, works with local elected officials on issues related to emergency response and recovery, identifies procedures for evacuation, communicates with the media, coordinates response with outside agencies, and ensures the safety of the responders. The EOP follows the Standardized Emergency Management System (SEMS) format required under Government Code § 8607. SEMS is a standardized system that enhances the ability of local jurisdictions to coordinate emergency response activities. City and special district EOCs are required to use the same SEMS management functions (management, operations, planning, logistics, and finance) in order to facilitate interagency communication and coordination.

Regarding health concerns, one of Roseville's sewage treatment facilities is located on the downstream end of Dry Creek. This facility is located above the 100-year floodplain but has overflow ponds within the floodplain. When plant influent loads exceed the plant capacity, untreated sewage is discharged to the overflow ponds. If this scenario occurred simultaneous with a 100-year flood event, floodwaters could be contaminated. The probability of occurrence for this type of scenario is considered low. This situation has not occurred during past flood events. Therefore, its potential impacts on health were not estimated as part of this assessment.

13.6.2 Property

Flood Insurance

Flood insurance statistics help identify vulnerability by showing where there is claim activity, where there is a high rate of flood insurance in force, and where flooding may be occurring in areas not identified as flood-prone. Table 13-7 lists flood insurance statistics for the City of Roseville. The total of \$9.9 million paid on 292 claims though July 31, 2010 represents an average of \$33,923 per claim.

TABLE 13-7. FLOOD INSURANCE STATISTICS FOR THE CITY OF ROSEVILLE	
Date of Entry Initial FIRM Effective Date	December 15, 1983
Current FIRM Effective Date	November 21, 2001
Number of flood insurance policies in force as of 7/31/2010	324
Total annual premium	\$182,225
Average policy cost	\$562 (national average = \$412)
Total insurance coverage	\$89,049,900
Total claims filed (1978 to 11/30/2009)	292
Value of claims paid	\$9,905,478
Average claim paid	\$33,923
Number of flood insurance policies in force within the SFHA.....	96
Number of flood insurance policies in force outside the SFHA	228

Properties constructed after a FIRM has been adopted are eligible for reduced flood insurance rates. Such structures are less vulnerable to flooding since they were constructed after regulations and codes were adopted to decrease vulnerability. Properties built before the FIRM was adopted may be more vulnerable to flooding and related damage because they do not meet code or are located in hazardous areas. The first FIRMs for Roseville were available at the end of 1983. According to Placer County Assessor records, 131 of the 154 structures located in the City’s regulated floodplain were constructed prior to January 1984 and are therefore considered pre-FIRM under the NFIP. The number of post-FIRM structures in the regulatory floodplain is extremely low because of the City’s proactive floodplain management policy of not allowing new development in the floodplain. Flood insurance statistics relevant to reducing flood hazard are as follows:

- Approximately 67.1 percent of the insurable structures in the SFHA are currently covered by a flood insurance policy. This is well above the national average. According to a study conducted for the NFIP, about 49 percent of single-family homes in special flood hazard areas nationwide are covered by flood insurance.
- 70.3 percent of the current policies in force are for properties located outside the SFHA.
- The high percentage of policies outside the SFHA is probably due to the impact of the Kirby-Linda-Dry Creek Flood Control Project and resulting remapping.

Flood Loss Potential of Structures

The HAZUS-MH program calculates losses to structures from flooding by looking at depth of flooding and type of structure. Using historical flood insurance claim data, HAZUS-MH estimates the percentage of damage to structures and their contents by applying established damage functions to an inventory. This

inventory comes pre-loaded within the HAZUS-MH model and is based on data from the U.S. Census, state databases, the U.S. Highway Administration, and other sources. Default values can be overridden with locally generated data if available. For this analysis, local data on facilities was used to assess flood risk in the City of Roseville. The City has created a flood inventory database of pertinent, site-specific information for each property in the regulatory floodplain. This database includes information for the following basic categories:

- Buildings in the Regulatory Floodplain
- Building Use
- Building Area
- Building Value
- Permit History
- Flood Loss History
- Regulatory Flood Elevation
- Base Flood Elevation
- Pre- and Post-FIRM Structures
- Elevation of Lowest Adjacent Grade
- Finished Floor elevation

The HAZUS-MH analysis is summarized in Table 13-8. It is estimated that there would be up to \$5.6 million of flood loss in the City’s regulated floodplain from a 100-year flood event. This represents 8.9 percent of the total value exposed to the flood hazard in the regulatory floodplain and 0.03 percent of the total assessed value of the City. It is estimated that there would be \$7.59 million of flood loss from a 500-year flood event, representing 12 percent of the total value exposed to the flood hazard in the regulatory floodplain and 0.03 percent of the total assessed value for the City.

TABLE 13-8. ESTIMATED FLOOD LOSS FOR THE 100-YEAR AND 500-YEAR FLOOD EVENTS								
	Estimated Flood Loss						% of Total assessed Value	
	Buildings		Contents		Total		100-year	500-year
	100-year	500-year	100-year	500-year	100-year	500-year		
Residential	\$1,907,066	\$2,544,728	\$995,339	\$1,390,701	\$2,902,405	\$3,935,430	0.02%	0.02%
Commercial	\$635,545	\$968,714	\$1,581,292	\$2,564,005	\$2,216,837	\$3,532,720	0.05%	0.08%
Industrial	\$0	\$1,235	\$0	\$0	\$0	\$1,235	0.00%	0.00%
Religion	\$61,573	\$0	\$406,955	\$0	\$468,528	\$0	0.47%	0.00%
Government	\$4,615	\$14,842	\$27,693	\$101,112	\$32,308	\$115,953	0.10%	0.36%
Education	\$0	\$0	\$0	\$0	\$0	\$0	0%	0%
Total	\$2,608,799	\$3,529,519	\$3,011,279	\$4,055,818	\$5,620,078	\$7,585,338	0.03%	0.03%

Repetitive Loss

Several federal government programs encourage communities to identify and mitigate “repetitive loss” properties. Nationwide, repetitive loss properties make up only 1 to 2 percent of the flood insurance policies currently in force, yet they account for 40 percent of the flood insurance claim payments. A report on repetitive loss structures recently completed by the National Wildlife Federation found that 20 percent of these structures are listed as outside the 100-year floodplain. In 1998, FEMA reported that the NFIP’s 75,000 repetitive loss structures have already cost \$2.8 billion in flood insurance payments.

FEMA identifies repetitive loss structures based on flood insurance payments. A repetitive loss area is the portion of the floodplain where numerous buildings have been subject to repetitive flooding. The purpose of identifying repetitive loss areas is to identify structures that are subject to the same risk but are not on FEMA's list because a flood insurance policy was not in force at the time of loss.

According to the list of repetitive loss properties maintained by FEMA, as of July 31, 2008, Roseville has 4 identified repetitive loss properties. All 4 of these properties are in the City's regulatory floodplain. Map 13-2 illustrates areas associated with repetitive flooding. Roseville is required to address its repetitive loss areas as a condition of its participation in the CRS program. This mitigation plan meets this CRS requirement. When Roseville first began its participation in the CRS program in 1991, the list of repetitive loss properties totaled 27 locations. Since then, flood protection and mitigation projects (including purchase and relocation of structures) have occurred at 23 repetitive loss locations and all 23 locations are no longer subject to repetitive flood losses. This represents an 85 percent reduction in exposure of insured properties to repetitive flood losses. This reduction is a prime example of how the City of Roseville's proactive flood mitigation practices have decreased the exposure of its citizens to the flood hazard, reduced the number of repetitive loss properties, and minimized reliance on post-disaster assistance provided by the federal government and the nation's taxpayers.

13.6.3 Critical Facilities and Infrastructure

HAZUS-MH was used to estimate the flood loss potential of critical facilities exposed to the flood risk. The model uses depth/damage function curves to estimate the percent of damage to a building and its contents and correlates that with an estimate of functional downtime (the time it will take to restore a facility to 100 percent of its functionality). The findings were as follows:

- On average, critical facilities would receive 5 percent damage to the structure and 19 percent damage to the contents during a 100-year flood event, and the estimated time to restore these facilities to full functionality would be 90 days.
- On average, critical facilities would receive 8 percent damage to the structure and 31 percent damage to the contents during a 500-year flood event, and the estimated time to restore these facilities to full functionality would be 160 days.

Six critical facilities are exposed and vulnerable to flooding in Roseville. A detailed vulnerability analysis of all critical facilities is on file with appropriate City staff and will not be published for public review. Of these six critical facilities, two have sufficient vulnerability to flooding to warrant mitigation strategies. Flood protection has been provided to the two churches identified, although it is not 100-year flood protection. The estimated depth of flooding for these two facilities is minimal and there have been no reports of flood damage. The County courthouse has been elevated to above the 100-year flood level. Mitigation strategies outline in this plan will mitigate the impact of flooding on the remaining facilities. These strategies include:

- Retrofit the floodwall that protects the library and public safety building.
- Retrofit the sewage treatment plant.

Of Roseville's two wastewater treatment plants, only the Dry Creek Plant is partially located in the floodplain. The storm sewer system is separate from the sanitary sewer system, so the sanitary sewers are not significantly affected by storm events.

13.6.4 Environment

The environment vulnerable to the flood hazard is the same as the environment exposed to the hazard. While flood events have historically caused significant damage to the environment, estimating damage

can be difficult. Loss estimation platforms such as HAZUS-MH are not currently equipped to measure environmental impacts of flood hazards. The best gauge of vulnerability of the environment would be a review of damage from past flood events. Loss data that segregates damage to the environment were not available at the time of this plan update. Capturing this data from future events could be beneficial in measuring the vulnerability of the environment for future updates to this plan.

13.7 FUTURE TRENDS IN DEVELOPMENT

Increased urbanization of western Placer County within the Pleasant Grove and Dry Creek Basins has resulted in the potential for increased flooding problems in Roseville. Land development typically results in increased hard surfaces and decreased vegetation, conditions that limit infiltration opportunities and, without adequate mitigation, can increase stormwater runoff rates and volumes and decrease the time required to reach peak discharge.

Recognizing that typical growth patterns in California would impact and exacerbate the flood hazard problem, the City of Roseville took an aggressive, proactive approach to managing its floodplains through the development of its general plan in 1992. Land-use categories are defined in the general plan, with information on general uses, development, intensity, siting, and compatibility standards in relation to the flood hazard. City actions, such as land-use allocation, annexations, zoning, subdivision and design review, redevelopment and capital improvements, must be consistent with the general plan.

Only three parcels in Roseville's regulatory floodplain are in the current "buildable" lands inventory. These parcels were all created before the City's flood-protection policies were enacted and were "grandfathered" in. Any development on these parcels would be subject to strict regulations.

Because of policies, activities and mitigation measures in place in Roseville, it can be concluded that future land development trends will not impact or be impacted by flooding in Roseville as long as existing policies remain in force.

13.8 REVIEW OF EXISTING ORDINANCES, PROGRAMS, AND PLANS

The City of Roseville has established a long-standing policy to proactively manage its floodplains. Under the guidance of the general plan and its safety element, Roseville has been able to decrease the exposure of its citizens to flooding with a comprehensive approach that includes the following measures:

- Structural mitigation (flood control)
- Non-structural mitigation (elevation or acquisition)
- Regulations
- Stormwater management
- Flood warning
- Outreach and public education.

This section discusses each element (except flood warning, which is discussed in Section 13.3.5) to identify strengths and weaknesses to be addressed by this plan.

13.8.1 Structural Mitigation

The following major flood control improvements have been accomplished by the City of Roseville since the January 1995 flood event:

- **Tina Way/Elisa Way Area**—Completed in 1996 at the cost of \$3 million (100 percent City-funded), this project included channel excavation and construction of berms and floodwalls. The project removed 40 structures from the floodplain. Based on the pre-project location and construction of these structures, the entire area would have flooded during the 1997 flood if the improvements had not been implemented.
- **Riverside Avenue/Vernon Street Area**—Completed in 1996 at the cost of \$2 million (90 percent funded by the Union Pacific Railroad and 10 percent funded by the City), the construction project included replacing culverts with a new bridge over Dry Creek. The net effect of this project lowered flood elevations for the reach by 5 to 7 feet and removed 150 structures from the floodplain.
- **Sunrise Avenue/Oakridge Drive and Champion Oaks Areas**—Completed in 2001 at the cost of \$16.1 million (\$8.7 million from FEMA and \$7.4 million from the City), this construction project included several elements. Culverts were replaced with a new bridge over Linda Creek at Sunrise Avenue. Twin 9-foot-diameter bypass pipes were installed in the Oakridge Drive Area. The project also included channel excavation and berm and floodwall construction. Benefits from this project include the removal of 233 structures from the floodplain; 44 structures remained in the floodplain after the project, but these structures were less likely to be flooded. Key project features included maintaining a channel in as natural a state as possible; planting of over 500 new oak trees; assigning biologists, ornithologists, and arborists to minimize environmental impacts; and monitoring for fish passage and plantings for 5 years.

The City has spent more than \$22 million on flood mitigation since the January 1995 flood event and has eliminated 445 flood-prone structures from the floodplain.

13.8.2 Non-Structural Mitigation

Structural mitigation projects reduced the flood exposure of property by 91 percent. Roseville offered mitigation through acquisition or home elevation to the remaining 9 percent of properties exposed to flooding. Completed in 2001 at the cost of \$1 million (50 percent funded by FEMA, 40 percent funded by the property owners, and 10 percent funded by the City), the project included elevating 27 homes and acquiring (buying out) 4 homes. This effort resulted in 22 flood-prone homes with post-project floor levels higher than the floodplain level.

13.8.3 Regulations

The City of Roseville regulates its floodplain areas through land use, zoning, and other development restrictions, including a policy that requires the dedication of and prohibits most development within the 100-year floodplain area. The regulation of development in floodplain areas in Roseville is restricted by the following:

- 2025 General Plan, Safety Element, Flood Protection Component
- Improvement Standards
- Flood Damage Prevention Ordinance (Roseville Municipal Code [RMC] Chapter 9.80)
- Zoning Ordinance (RMC Chapter 19.18)

2025 General Plan, Safety Element, Flood Protection Component

Roseville’s general plan includes a safety element, which addresses community safety concerns and sets forth goals and policies essential for their resolution. The flood protection component identifies nine flood protection policies and 12 implementation measures to achieve the following goals:

- Minimize the potential for loss of life and property due to flooding.
- Pursue flood control solutions that are cost-effective and minimize environmental impacts.

The policies and implementation measures are incorporated into the area-specific plans and are legally enforceable. Key to the City’s flood-protection effort is the clear definition and application of floodplain boundaries. The flood protection component of the safety element established policies prohibiting new development in an identified floodplain or requiring an appropriate level of flood protection in design and construction for any development that does occur in the floodplain:

- Infill Areas—No development is permitted within the future floodway. However, development may be permitted by the City within the future floodway fringe. In accordance with the Nolte Future Floodplain definition, such development is limited to areas falling within the assumed cumulative 1-foot rise in water surface elevation, provided that it can be demonstrated that the development will not impact flood levels. (See Figure 13-5.)
- Remainder of the City (specific plans and north industrial area)—No development is permitted within the future floodplain (floodway and floodway fringe). Exceptions may be considered by the City on a case-by-case basis if encroachment is limited to only the future floodway fringe and would not result in any off-site increase in the water surface elevation. (See Figure 13-6.)

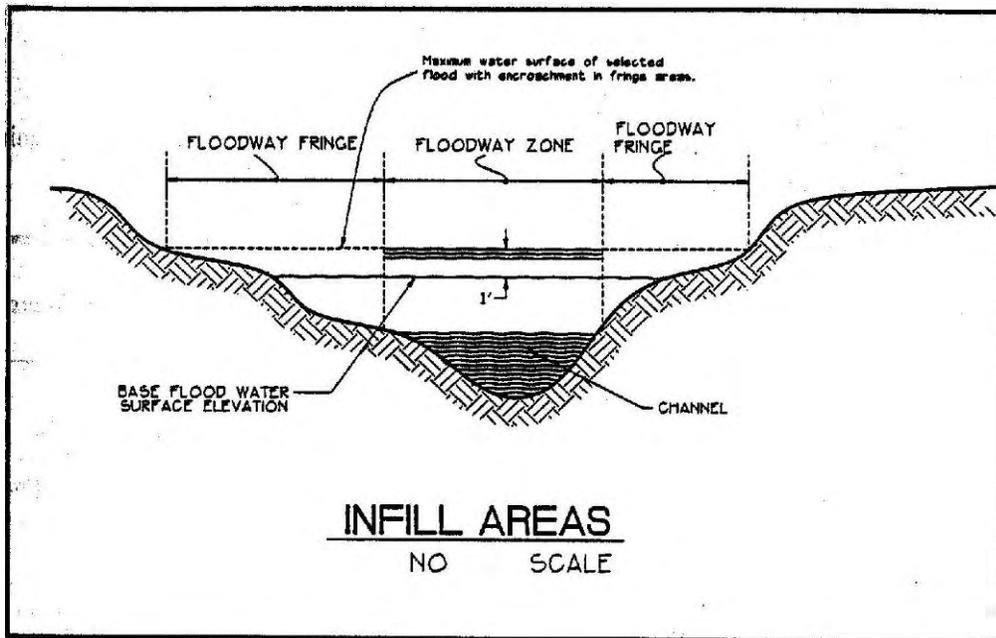


Figure 13-5. Floodplain Designation Cross-Sections for Infill Areas

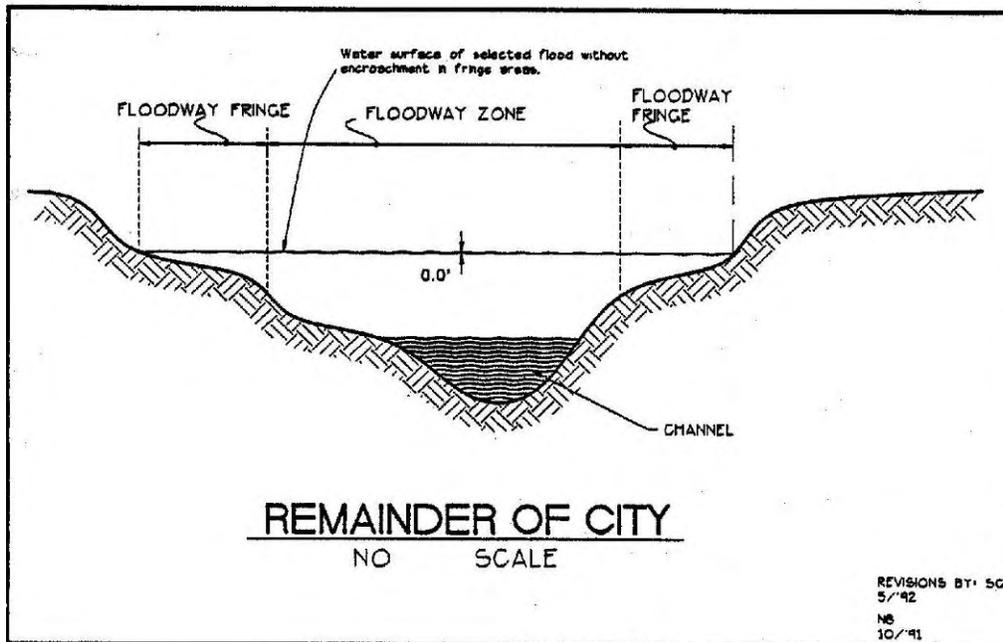


Figure 13-6. Floodplain Designation Cross-Sections for Areas Other Than Infill Areas

The City is committed to exploring environmentally sensitive flood control solutions, so this component is intended to be used in combination with the goals, policies, and implementation measures contained in the open space and conservation element of the general plan. Emphasis is placed on protecting floodplain areas and on pursuing regional cooperation on flooding issues.

Improvement Standards

Roseville's improvement standards provide minimum standards for the following:

- Improvements dedicated to the public and accepted by the City for maintenance or operation
- Certain private works
- Improvements to be installed within existing rights-of-way and easements.

Improvement standards to provide coordinated development of required facilities used by and for the protection of the public. They apply to, regulate, and guide preparation of traffic impact studies and the design and preparation of plans for construction of streets, highways, alleys, drainage systems, sewage systems, traffic signals, site access structures, water supply facilities and related public improvements. The standards also set guidelines for private works that involve drainage, grading, tree removal, and related improvements.

Section 10 of the improvement standards deals with drainage as follows:

- Requires residential lots developed in and adjacent to a designated floodplain to have a pad elevation a minimum of 2 feet above the regulatory flood elevation.
- Establishes stormwater management provisions that require mitigation of the increase in runoff generated by new development.
- Establishes provisions that require the building pads of structures built outside of the regulatory floodplain to be a minimum of 1 foot above the 100-year water surface elevation for the site, assuming total blockage of drainage facilities.

Flood Damage Prevention Ordinance (RMC Chapter 9.80)

The flood damage prevention ordinance provides regulatory provisions for the floodplains of Roseville and is a requirement for participation in the NFIP. Chapter 9.80 of the RMC meets requirements established under 44CFR, Section 60.3, and includes the following standards that exceed federal requirements:

- Adoption of a regulatory floodplain that includes areas not mapped by FEMA for application
- Requirement for elevation to 2 feet above the regulatory flood elevation for all structures within the flood hazard area
- Provisions to track substantial improvements to structures over a period of 10 years.

Zoning Ordinance (RMC Chapter 19.18)

Updated in September 2010, the zoning ordinance implements the City's general and specific plans and establishes regulations governing the use, placement, spacing and size of land and buildings. The zoning ordinance describes permits available through the Planning Department, when permits are needed, and the process for obtaining permits. This ordinance includes policy that prohibits most development within the 100-year floodplain. Exceptions to this policy exist primarily within the infill area and for the maintenance of essential services. Where encroachments may be permitted, improvements are required to minimize cumulative upstream and downstream effects.

The zoning ordinance identifies floodway and floodway fringe zoning districts. The floodway zoning district is not synonymous with FEMA's defined floodway. Development is generally prohibited in the floodway zone, with some level of development allowed in the floodway fringe zones with restrictions. The floodway fringe and floodway zone boundaries are based on previous hydraulic modeling conducted by the U.S. Army Corps of Engineers. The floodplain boundaries have changed over time since this modeling, but the zone district boundaries have not changed. The zone boundaries can be and are updated on a parcel-by- parcel basis at a landowner's request using best available data.

13.8.4 Stormwater Management

The City of Roseville uses a number of adopted documents to address stormwater management and system planning. Stormwater management in the City of Roseville is accomplished through a multi-tiered approach. The City uses a combination of regional development impact studies, sub-regional impact studies, the City of Roseville improvement standards, the City of Roseville grading ordinance, and the Placer County stormwater management manual. All of these tools manage the City's stormwater system at different levels. The Roseville general plan is the principal planning document that lays out goals for managing the flooding hazard. Each update to the general plan reviews these goals to determine their effectiveness in managing watershed characteristics. Regional master planning, sub-regional master planning, and project drainage design are discussed below.

Regional Master Planning

City ordinances establish developer fees to pay for mitigation projects that will reduce development impacts on flooding on major streams in the Dry Creek and Pleasant Grove Creek basins. Regional master planning for each basin has been conducted through the Placer County Flood Control District (PCFCD). Seven communities, including the City of Roseville, are members of this district.

The Dry Creek and Pleasant Grove Creek basins each have a detailed hydrology report that calculates the 5-, 10-, 50-, and 100-year storm frequencies based on total buildout of the basin:

- **Dry Creek Basin Report**—The report for the Dry Creek Basin is entitled *Final Report For the Dry Creek Flood Control Plan* and was adopted by the Roseville City Council in April 1992. This document was co-sponsored, supported, and approved by the PCFCD and the Sacramento County flood control agency that oversees floodplains downstream of Placer County.
- **Pleasant Grove Creek Basin Report**—The report for the Pleasant Grove Creek Basin is entitled, *Cross Canal Study*. Pleasant Grove Creek is one of several major streams that flow to a reclamation district canal and overflow is stored behind levees during Sacramento River flooding. Except for the PCFCD, this report was supported, sponsored, and approved by all agencies within the basin, in particular Sutter County and the State Reclamation Board Districts 1001 and 1000.

Each report defines development impacts on the basin and specifies mitigation procedures and improvements to developers' mitigation. Both reports indicate a strategy for mitigation of floods resulting from new development on a regional scale. The reports indicate that most of Roseville is in the part of the watershed where detention is not recommended. These studies have been submitted to FEMA for approval, and FEMA is currently using the hydrology and hydraulics information provided in the reports to update FIRMs for the region.

Sub-Regional Master Planning

Besides the two regional master planning reports, the City requires each sub-region to develop a master plan and mitigation strategy in a specific plan. Specific plans currently exist for Southeast Roseville, Northeast Roseville, Stoneridge, North Central Roseville, Northwest Roseville Plan, North Roseville, Del Webb, and the In-Fill Area. Before zoning and development rights are issued for these newly developing areas, a detailed hydrology and hydraulic study dealing with that sub-region's concerns is required, in order to examine local drainage problems, define flood levels based on total buildout of the watershed, and set aside floodplain areas as open space. Floodplains are defined on swales with drainage areas greater than 300 acres. The City of Roseville and PCFCD review and approve each specific plan.

Major drainage infrastructure in the specific plans is designed as part of the infrastructure of the sub-regions and is constructed prior to development in the area; this eliminates the need for on-site detention requirements because regional detention, if required, is built into the infrastructure for the entire specific plan and not on a project-by-project basis. This approach allows for more control of the design and easier maintenance of the facility. In addition, in newly developing areas, hydraulic requirements used to define floodplains assume well-vegetated swales and creeks, which reduces the need to provide constant cleaning of these streams by maintenance crews.

Project Drainage Design

As each project in the specific plan is developed, the City requires the project to meet drainage improvement standards. The standards require storm drain systems that support more than one parcel to be dedicated to the City for maintenance or that project owners maintain the system. In both cases, the storm drain system is reviewed by the City's Public Works Department to meet the same hydraulic standards. Project owners must demonstrate that in the case of total system failure, surface water would be able to exit the project area without causing damage. For example, if drain inlets are not maintained on a commercial site and water ponds, surface water should be able to discharge into the public drainage system without entering any on- or off-site buildings. This requirement eliminates the need for the City to monitor private storm drain systems to verify that they are adequately maintained.

13.8.5 Outreach and Public Education

The City of Roseville makes a concerted effort to educate and inform its citizens on the impacts of flooding and how to prepare for flooding impacts. The ongoing outreach and public education program uses multiple media:

- Floodplain information is published in “Roseville Reflections,” a City-sponsored newsletter sent to all citizens.
- Flood information is published on the City’s website and includes real-time flood warning and flood threat recognition information. The website is roseville.ca.us/alert/floodalert.html.
- On-line surveying is used to identify public perception of flood risk and support of mitigation.
- An informational brochure, “Weathering the Storm,” is available to the public.
- Literature on flood warning, property protection, and flood safety is mailed annually to Roseville residents.

13.9 SCENARIO

The City of Roseville has made great strides to reduce the risk from flooding. Events like those that caused past flooding will continue to occur, but the impacts of these events will be significantly less than observed in the past. Intense isolated rainstorms centered over the region will cause creeks and streams to overflow their banks, causing road closures and power outages. However, structure damage to personal property will be limited to the few properties that have exposure to significant depths of flooding. Flash flooding caused by rainfall runoff exceeding the capacity of stormwater systems will also continue to occur. However, the potential personal property damage will be limited to structures constructed prior to building and stormwater standards adopted by the City to remediate these impacts.

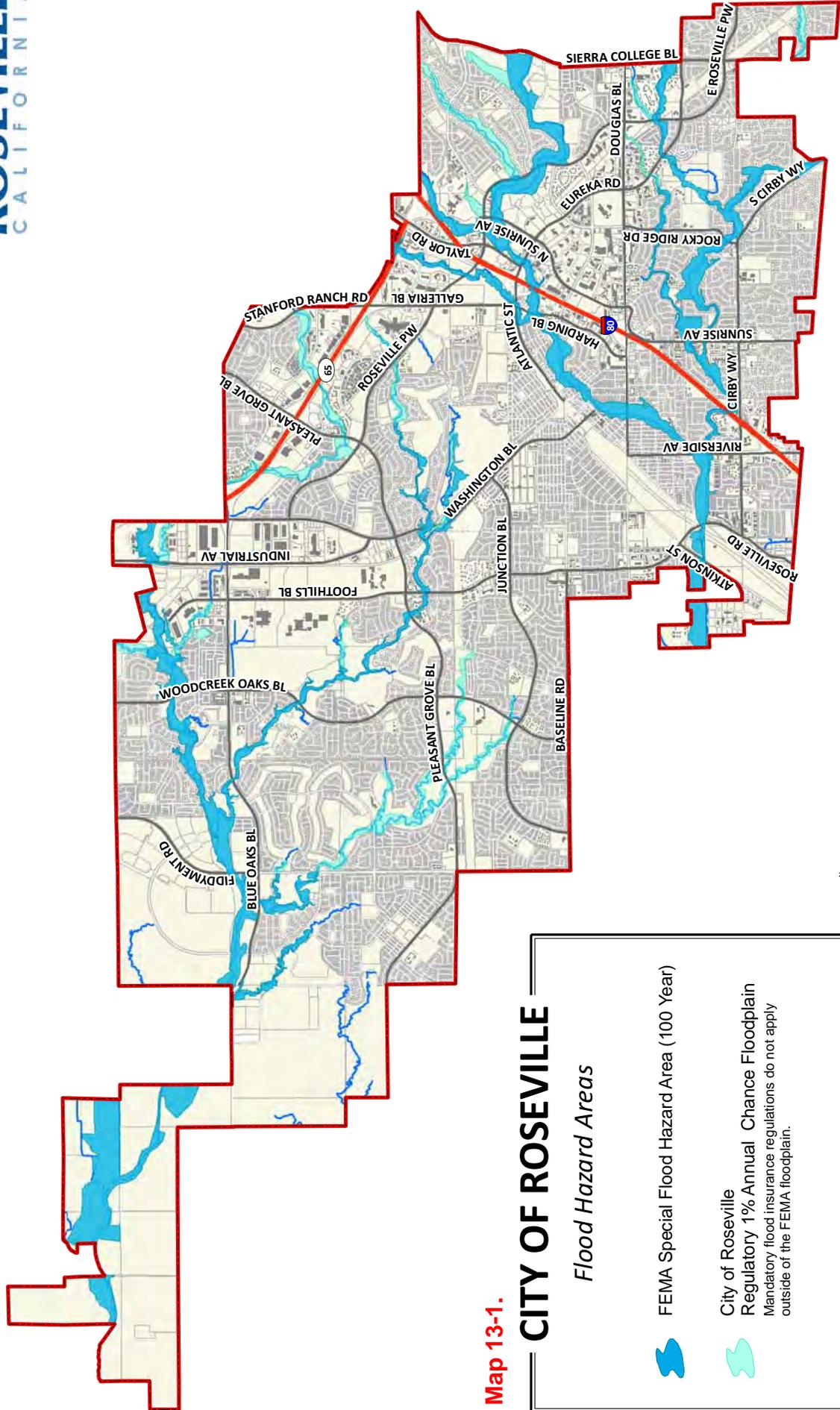
13.10 ISSUES

Important issues associated with flood hazards in Roseville include but are not limited to the following:

- The boundaries of the 100-year floodplain could be as specified in the floodplain designations section of the flood-protection component of the City’s general plan. Floodplain areas shall be preserved as specified in the open space and conservation element. Preservation may include required dedication to the City. If needed, the City’s ordinances can be modified to include floodplain use regulations consistent with the goals, policies, and implementation measures of the safety, land use, open space and conservation, and parks and recreation elements of the City’s general plan. This effort would be overseen by the Planning Department and would require no special funding.
- The development, implementation, and expansion of the Flood Alert and Early Warning Program systems should be continued, and the systems should be integrated with other local jurisdictions to form a regional warning program. This effort is overseen by the Public Works Department. Annual funding is provided through the City’s General Fund and is about \$100,000 per year.
- By remaining actively involved in the PCFCD, the City of Roseville should continue to pursue a regional approach to flood issues. Involvement includes cooperation in the development of a comprehensive regional database. Regional drainage planning and design for all individual developments in the Placer County Flood Control District should be encouraged to address cumulative flooding impacts. The City should also continue to participate in regional flooding studies, including the Auburn Creek/Coon Creek/Pleasant

Grove Creek flood mitigation plan and the Dry Creek Basin flood control plan. Efforts would be overseen by the Public Works Department. Annual funding for membership to the PCFCD is currently provided by the City's General Fund and is about \$90,000 per year.

- The City should continue coordination with other agencies on issues of flood control. Coordination between the City and adjacent jurisdictions occurs through several mechanisms, including the distribution of development proposals for review and comment. The City should also continue its cooperation with federal, state, and local agencies, including the U.S. Army Corps of Engineers, California Reclamation Board, FEMA, California Department of Fish and Game, Placer County Resource Conservation District, and PCFCD. This effort would be overseen by the Community Development Department, Planning Department, and Public Works Department as appropriate and should not require special funding.
- The final two phases of the Cirby-Linda-Dry Creek Flood Control Project should be completed. Five of the seven phases of this project have been completed at a cost of about \$18,000,000. This project is overseen by the Public Works Department. The cost for the last two phases would be about \$3,000,000. Funding could be from City, state, federal, or private developer sources.
- Alternative improvements to the Cirby-Linda-Dry Creek Flood Control Project could be analyzed. These improvements may be cost-effective in the following flood-prone areas of Roseville:
 - Dry Creek from Darling Way to Riverside Avenue
 - The area on Dry Creek upstream of Folsom Road in the Columbia Avenue, Marilyn Avenue, Bonita Street area
 - The Linda Creek area near Champion Oaks Drive, Samoa Way, and Hurst Way
 - Cirby Creek in the Trimble Way and Zien Court area.
- The existing wood flood wall along Dry Creek that is protecting the City's Main Library and Public Safety Building could be replaced. The wood wall allows floodwater to leak through, and constant pumping is required. This effort would be overseen by the Public Works Department and cost about \$300,000. Funding could be from City, state, federal, private developer, property owner sources.
- How will the potential impacts of climate change impact flood conditions in the City of Roseville?

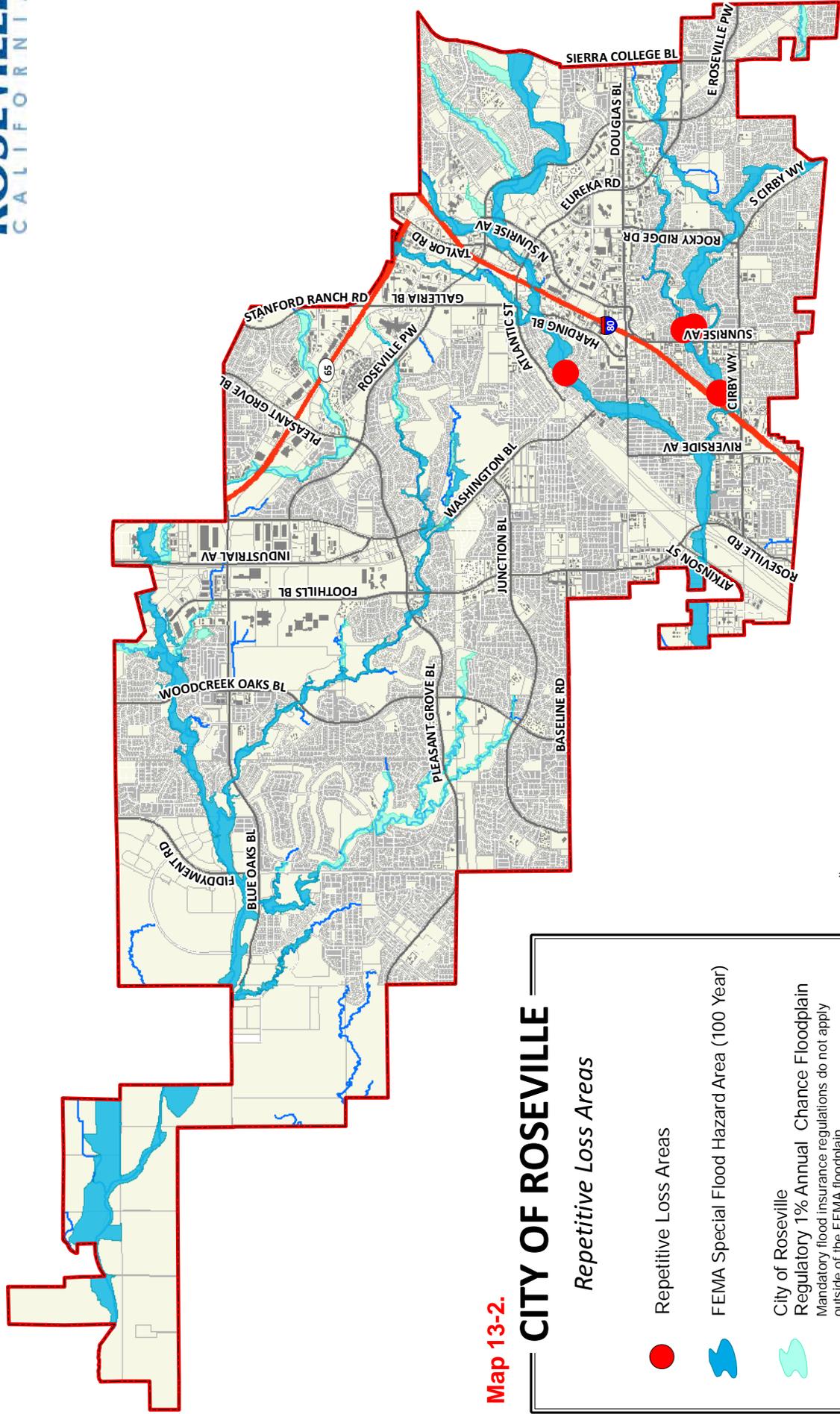


Map 13-1.

CITY OF ROSEVILLE

Flood Hazard Areas

-  FEMA Special Flood Hazard Area (100 Year)
-  City of Roseville Regulatory 1% Annual Chance Floodplain
Mandatory flood insurance regulations do not apply outside of the FEMA floodplain.



Map 13-2.

CITY OF ROSEVILLE

Repetitive Loss Areas

- Repetitive Loss Areas
- FEMA Special Flood Hazard Area (100 Year)
- City of Roseville Regulatory 1% Annual Chance Floodplain
Mandatory flood insurance regulations do not apply outside of the FEMA floodplain.

