2024

Fresno County, California

Hazard Mitigation Plan

1. Introduction

PURPOSE

Fresno County, along with 17 participating jurisdictions, prepared this local multi-jurisdictional hazard mitigation plan to better protect the people and property of the County from the effects of hazard events. This plan underwent a comprehensive update in 2023-2024 building upon the plan that was originally developed in 2009. This plan demonstrates the community's commitment to reducing risks from hazards and serves as a tool to help decision makers direct mitigation activities and resources. This plan was also developed to make Fresno County and participating jurisdictions eligible for certain federal disaster assistance, specifically, the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM) program, and Flood Mitigation Assistance (FMA), and Building Resilient Infrastructure and Communities (BRIC). This plan also meets the planning requirements of the National Flood Insurance Program's Community Rating System (CRS).

BACKGROUND AND SCOPE

Each year in the United States, natural disasters take the lives of hundreds of people and injure thousands more. Nationwide, taxpayers pay billions of dollars annually to help communities, organizations, businesses, and individuals recover from disasters. These monies only partially reflect the true cost of disasters because additional expenses to insurance companies and nongovernmental organizations are not reimbursed by tax dollars. Many natural disasters are predictable, and much of the damage caused by these events can be alleviated or even eliminated through planned mitigation.

Hazard mitigation is defined by FEMA as "any sustained action taken to reduce or eliminate long- term risk to human life and property from a hazard event." The results of a three-year, congressionally mandated independent study to assess future savings from mitigation activities provide evidence that mitigation activities are highly cost-effective. Natural hazard mitigation saves $6 on average for every $1 spent on federal mitigation grants, according to an analysis by the National Institute of Building Sciences. An earlier (2005) study by NIBS found a benefit-cost ratio (BCR) of 4:1. \

Hazard mitigation planning is the process through which hazards that threaten communities are identified, likely impacts of those hazards are determined, mitigation goals are set, and appropriate strategies to lessen impacts are determined, prioritized, and implemented. This plan documents Fresno County's hazard mitigation planning process identifies relevant hazards and vulnerabilities and provides strategies the County and participating jurisdictions will use to decrease vulnerability and increase resiliency and sustainability in Fresno County.

The Fresno County Multi-Jurisdictional Hazard Mitigation Plan is a multi-jurisdictional plan that geographically covers everything within Fresno County's jurisdictional boundaries (hereinafter referred to as the planning area). Unincorporated Fresno County and the following communities and special districts participated in the planning process:

- City of Clovis
- City of Coalinga
- City of Firebaugh
- City of Fowler
- City of Fresno
- City of Kerman
- City of Kingsburg
- City of Mendota
- City of Reedley
- City of San Joaquin
- City of Sanger
- City of Selma
- Fresno Metropolitan Flood Control District
- Kings River Conservation District
- Lower San Joaquin Levee District
- Sierra Resource Conservation District/Highway 168 Fire Safe Council
- Westlands Water District

1. Introduction

This plan was prepared pursuant to the requirements of the Disaster Mitigation Act of 2000 (PublicLaw 106-390) and the implementing regulations set forth by the Interim Final Rule published in the *Federal Register* on February 26, 2002, (44 CFR §201.6) and finalized on October 31, 2007. (Hereafter, these requirements, and regulations will be referred to collectively as the Disaster Mitigation Act.) While the act emphasized the need for mitigation plans and more coordinated mitigation planning and implementation efforts, the regulations established the requirements that local hazard mitigation plans must meet for a local jurisdiction to be eligible for certain federal disaster assistance and hazard mitigation funding under the Robert T. Stafford Disaster Relief and Emergency Act (Public Law 93-288). Because the Fresno County planning area is subject to many kinds of hazards, access to these programs is vital.

Information in this plan will be used to help guide and coordinate mitigation activities and decisions for local land use policy in the future. Proactive mitigation planning will help reduce thecost of disaster response and recovery to communities and their residents by protecting critical community facilities, reducing liability exposure, and minimizing overall community impacts anddisruptions. The Fresno County planning area has been affected by hazards in the past and is thuscommitted to reducing future impacts from hazard events and becoming eligible for mitigation- related federal funding.

PLAN ORGANIZATION

The Fresno County Multi-Jurisdictional Hazard Mitigation Plan is organized as follows:

- Chapter 1: Introduction
- Chapter 2: Community Profile
- Chapter 3: Planning Process
- Chapter 4: Risk Assessment
- Chapter 5: Mitigation Strategy
- Chapter 6: Plan Implementation and Maintenance
- Jurisdictional Annexes
- Appendices

JURISDICTONAL ANNEXES

Each jurisdiction participating in this plan developed its own annex, which provides a more detailed assessment of the jurisdiction's unique risks as well as their mitigation strategy to reduce long-term losses. Each jurisdictional annex contains the following:

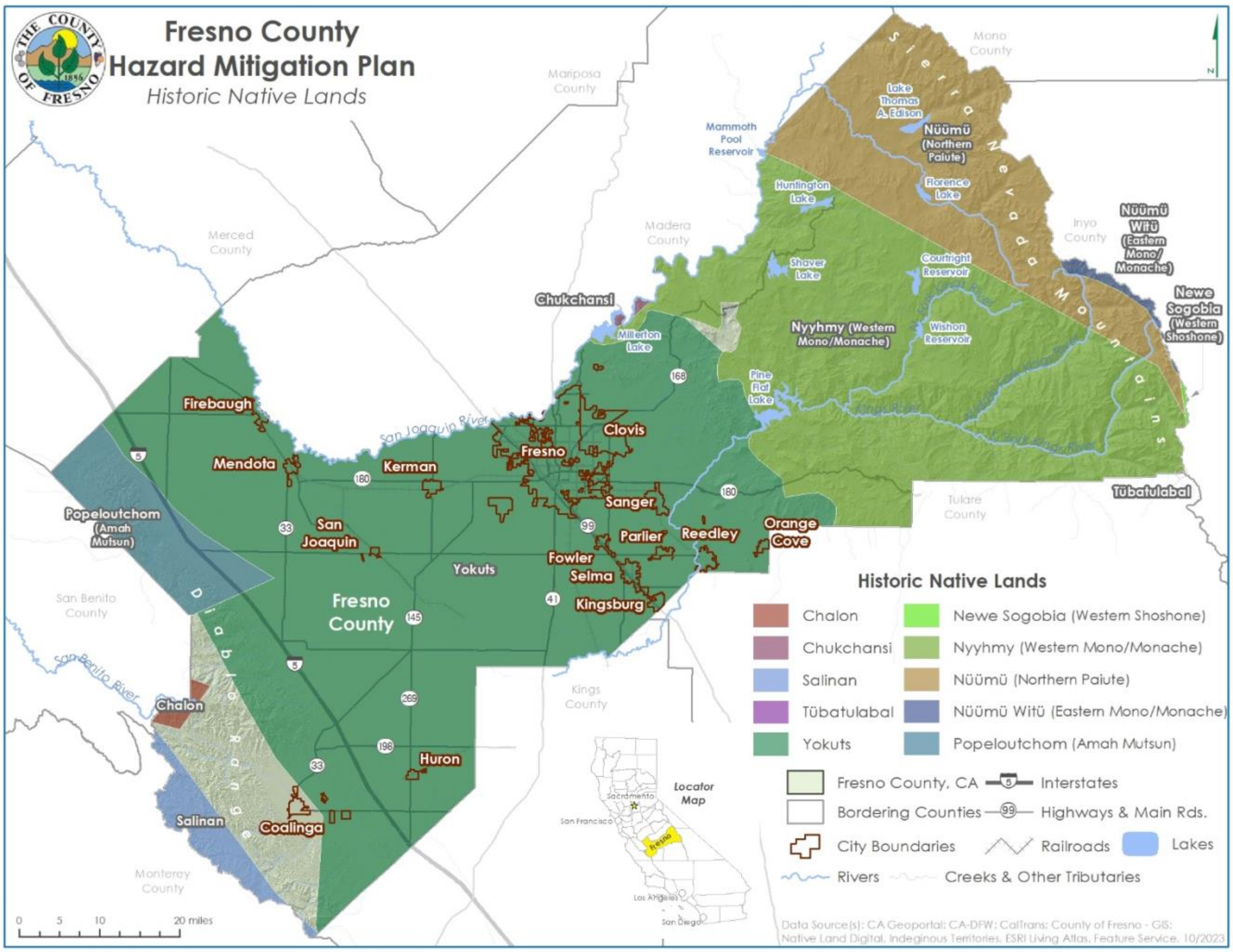
- Community profile summarizing geography and climate, history, economy, and population.
- Hazard risk information for geographically specific hazards or unique vulnerabilities.
- Hazard map(s) at an appropriate scale for the jurisdiction, if available.
- Number and value of buildings, critical facilities, and other community assets located in hazard areas, if available.
- Vulnerability information in terms of future growth and development in hazard areas.
- A capability assessment describing existing regulatory, administrative, technical, and fiscal resources and tools as well as outreach efforts and partnerships and past mitigation projects; and
- Mitigation actions specific to the jurisdiction.

2. Community Profile

HISTORY

When the first European settlers came to the Fresno area in the early 1800s, the Yokuts tribe was living on the valley floor and in the foothills along the San Joaquin and the Kings Rivers. The Monache tribe lived further up the rivers. **Map 1. Historic Tribal Map of Fresno County** provides a map of the historic location of these tribes in Fresno County.

Map 1. Historic Tribal Map of Fresno County



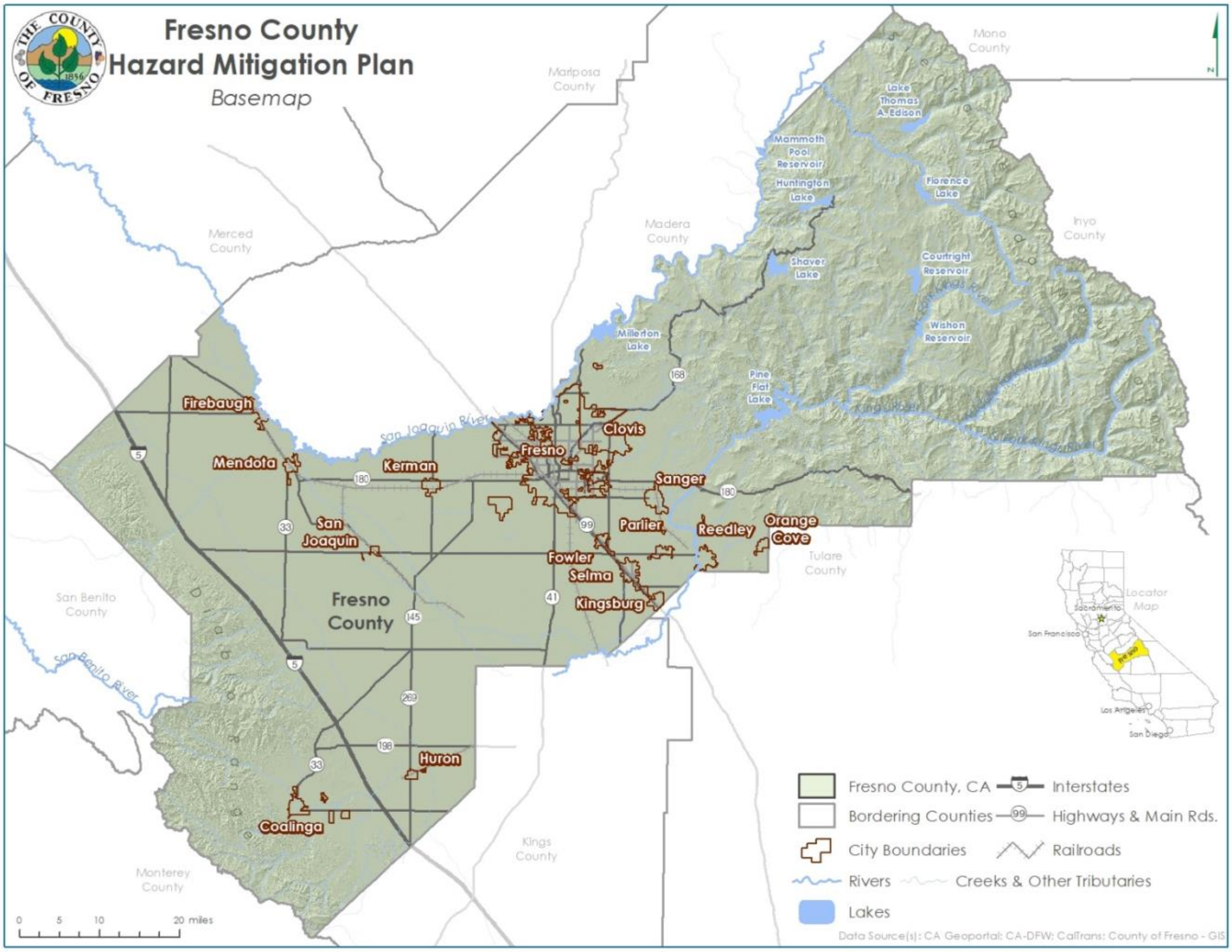
Source: Native Land Digital Indigenous Territories

After the initial Spanish explorers came, others began to arrive, including trappers, hunters, and miners. Kit Carson, the famous mountain man, explored the area during the 1840s. Named for the Spanish word for ash or ash tree, Fresno County was created in 1856, yet its present-day boundaries were not established until 1909. The County was a part of the mining boom of California from its early years until the mid-1860s. Once gold fever subsided, the County turned to livestock and general farming, which received its impetus from the arrival of the Central Pacific Railroad in 1872. As more water became available, the County shifted from general farming to orchards and vineyards.

GEOGRAPHY AND CLIMATE

One of California's largest counties, Fresno County covers an area of over 6,000 square miles in central California. A map of the county is shown in **Map 2. Fresno County Base Map**. It is approximately 200 miles north-northwest of Los Angeles and approximately 160 miles southeast of San Francisco. The county is home to 15 cities and approximately 35 unincorporated communities.

Map 2. Fresno County Base Map



Source: CA Geoportal: CA-DFW: Cal Trans; County of Fresno – GIS

Fresno County is large and geographically diverse. The County is located near the center of California's San Joaquin Valley and is part of the Great Central Valley, one of the state's distinct physical regions. The County's topography is characterized by broad, flat valley floors that generally slope from southeast to northwest; foothills and moderately high mountains (Coast Ranges) in the west; and foothills and high mountains (Sierra Nevada) in the east. Approximately 55 percent of the County is mountainous, and 45 percent is valley land. Elevations range from 100 to 400 feet on the valley floor to 4,000 feet in the Coast Ranges and more than 14,000 feet in the Sierra Nevada. There are two major rivers in Fresno County, both which originate in the Sierra Nevada: the San Joaquin and Kings rivers. Additionally, Fresno County is home to a variety of conifer and hardwood forests and woodlands. These tree-dominated habitats can support diverse wildlife populations as well as timber production.

The climate varies among the County's three regions. Summers are long, hot, and dry in the valley; moderate to hot in the Coast Ranges; and relatively cool in the high elevations of the Sierra Nevada. There is little precipitation in the County during the summer. Winters in the valley and Coast Ranges are short and mild with light rain in the valley and moderate rainfall in the Coast Ranges. In the Sierra Nevada, winters vary from short and mild with frequent rain and some snow to moderately severe with frequent snow. Most of the seasonal precipitation occurs between October and April. More specific information about Fresno County's climate can be found in Chapter 4 Risk Assessment.

The mountainous eastern region of the county receives on average up to 70 inches of precipitation annually, mostly in snowfall. Many small mountain lakes and streams in this region are tributaries to the San Joaquin and Kings Rivers which flow into the Central Valley. The valley and western portions of the county, by contrast, are extremely arid, receiving, on average, less than 10 inches of annual rainfall.

The Southern Central Valley Region is projected to increase in temperatures, decline in precipitation along with snowpack in the mountainous area, annual heat waves are projected to increase, and wildfire risk along the eastern edge is projected to experience an increase of 4 to 6 times current conditions according to the Cal-Adapt Climate projections. Detailed information on future climate projections is described in **Table 1. Climate Change Projections for Climate-Related Hazards**.

Table 1. Climate Change Projections for Climate-Related Hazards

Ranges	
Temperature Change (1990-2100)	January increases in average temperatures of 3 to 4 degrees Fahrenheit by 2050 and 7 to 10 degrees Fahrenheit by 2100. July increases in average temperatures of 5 degrees to 6 degrees in 2050 and 9 to 11 degrees Fahrenheit by 2100, with larger temperature increases in the mountainous regions to the east. (modeled high temperatures – average of all models; high carbon emissions scenario)
Precipitation	Low areas are projected to experience declines in annual precipitation of 1 or 2 inches by 2050 and up to 2.5 inches by 2100, while more elevated areas are projected to decline up to 10 inches (CCSM3 climate model; high carbon emissions scenario)
Heat Wave	The threshold temperature that defines a heat wave is over 100 degrees Fahrenheit in most of the region. In the mountains, a heat wave is defined by lower temperatures, 70 degrees to 90 degrees Fahrenheit. By 2050, the number of annual heat waves is projected to increase by three to five. An increase of seven to 10 heat waves is expected by 2100 in most of the region, with an increase of up to 14 expected in the mountain areas.
Snowpack	Snowpack in the eastern elevated regions is projected to decrease by approximately 9 inches, resulting in snowpack that is less than 4 inches by March 2090 (CCSM3 climate model; high emissions scenario)
Wildfire Risk	The eastern edge of the region is projected to experience an increase in wildfire risk of 4 to 6 times current conditions (GFDL model, high carbon emissions scenario)

Source: Public Interest Energy Research, 2011. Cal-Adapt

ECONOMY

Since the early 1950s, Fresno County has been one of the leading agriculture counties in the United States. Therefore, the agricultural industry is critical to protect and grow as it is an economic powerhouse and major source of employment for the county. Agriculture is Fresno County's primary industry and is a driving force in the County's economy. The County's farmland accounts for nearly half of the land base at 1.88 million acres. More than 300 different crops are grown in the jurisdiction supporting 20 percent of all jobs in the Fresno area. In 2021, Fresno County was the second ranking agricultural county in the state, with a total gross production value of over $8 billion. The leading county for gross production was Tulare County at $8.6 billion. However, over the years, Fresno, Kern, and Tulare, all in the San Joaquin Valley, tend to be the leading counties for produce production. The leading commodities in Fresno County include grapes, pistachios, milk, oranges, peaches, cattle, garlic, tomatoes, tangerines, and mandarins, as well as nectarines. [1]

The 2022 Fresno County Crop and Livestock Report ranks the top 10 crops as: [2]

1. Grapes
2. Almonds
3. Pistachios
4. Milk
5. Poultry
6. Cattle and calves
7. Tomatoes
8. Peaches
9. Garlic
10. Mandarins

Agriculture accounts for the largest portion of jobs in Fresno County; However, since 1990, the percentage of agriculture-related jobs has continuously fallen. In 1990 agriculture-related jobs accounted for over 50 percent of the total jobs within the top ten raking industries. By 2000, there was a decrease, with agriculture-related jobs falling to approximately 47 percent of those total jobs. By 2013, the percentage had decreased to approximately 36 percent and has continuously decreased to date. While the agricultural economy is improving, the industry struggles with labor shortages during peak harvest periods, increased production expenses, and climate hazard-related losses such as extreme heat and warm nights, drought, and wildfires. Additionally, climate and weather-related hazards pose a

[1] California Agriculture Statistics Review 2021-2022 https://www.cdfa.ca.gov/Statistics/PDFs/2022_Ag_Stats_Review.pdf
[2] AG Crop Report_1ST HALF OF BOOK (fresnocountyca.gov) https://www.fresnocountyca.gov/files/sharedassets/county/v/1/agricultural-commissioner/ag-crop-reports/2022-ag-crop-report-optimized.pdf

risk to the health and safety outdoor and farm workers within the industry [3] Beyond agriculture and farming, construction is additional sector of employment for the county as well as the healthcare field, showing robust growth in Fresno County.

Despite the success of the booming agriculture and construction industries, the unemployment rate in the county has remained high and the average minimum wage, while above the state's, remains low. As of November 2023, the unemployment rate in Fresno County was 7.6 percent up from 6.9 percent in October 2023 and above the 2022 rate of 6.3 percent. Compared to other San Joaquin Valley Counties, Fresno County's unemployment rate is average. San Joaquin and Stanislaus has an unemployment rate of 6.4 percent, Merced 8.5 percent, Kings 8 percent, Tulare 10.2 percent, Kern 7.8 percent. Between October and November 2023, total industry employment decreased by 1,600 jobs and farm employment down 9.7 percent. In fact, farm employment recorded the largest month-over decline with a drop of 3,900 jobs. Areas with seasonal economies, such as the County's agriculture industry, tend to have higher unemployment. Annual Employment by Industry compares the distribution of employment in Fresno County to the State of California. **Table 2. Employment in Fresno County and California, 2023** describes the employment statistics for Fresno County.

Table 2. Employment in Fresno County and California, 2023

	Fresno County		California	
	Nov 23 Prelim	Percent Change Year	Nov 23 Prelim	Percent Change Year
Civilian Labor Force (1)	461,000	0.7%	19,360,500	0.2%
Civilian Employment	426,200	-.6%	18,436,6000	-0.2%
Civilian Unemployment	34,800	20.0%	946,300	21.4%
Civilian Unemployment Rate	7.6%	*Unavailable*	4.9%	*Unavailable*
Civilian Unemployment	4.9%	*Unavailable*	*Unavailable*	*Unavailable*
(CA Unemployment Rate)	4.9%	*Unavailable*	4.9%	*Unavailable*
(U.S. Unemployment Rate)	3.5%	*Unavailable*	3.5%	*Unavailable*
Total, All Industries (2)	435,100	1.5%	18,769,300	1.5%
Total Farm	36,300	-2.4%	438,200	3.2%
Total Nonfarm	398,800	1.9%	18,331,100	1.4%
Total Private	317,900	1.4%	15,705,400	1.5%
Goods Producing	50,300	1.4%	2,306,900	1.1%
Mining, Logging, and Construction	23,000	2.7%	968,400	3.9%
Mining and Logging	200	0.0%	20,100	1.0%
Construction	22,800	2.7%	948,300	4.0%
Specialty Trade Contractors	15,500	4.0%	630,400	4.7%
Manufacturing	27,300	0.4%	1,338,500	-0.8%
Durable Goods	9,500	-1.0%	869,000	-1.1%
Non-Durable Goods	17,800	1.1%	469,500	-0.3%
Food Manufacturing	13,400	3.1%	171,600	2.9%

[3] fcgpr_general-plan_prd-county_redline_2024-01-12_1.pdf (fresnocountyca.gov) https://www.fresnocountyca.gov/files/sharedassets/county/v/1/public-works-and-planning/development-services/planning-and-land-use/general-plan-review-comments/fcgpr_general-plan_prd-county_redline_2024-01-12_1.pdf

	Fresno County		California	
	Nov 23 Prelim	Percent Change Year	Nov 23 Prelim	Percent Change Year
Service-Providing	348,500	2.0%	16,024,200	1.5%
Private Service Providing	267,600	1.4%	13,398,500	1.5%
Construction – Residual	7,300	0.0%	*Unavailable*	*Unavailable*
Trade, Transportation, and Utilities	79,100	0.5%	3,221,300	0.5%
Wholesale Trade	15,900	-1.2%	654,300	-2.5%
Retail Trade	41,600	0.5%	1,675,600	1.2%
Food and Beverage Retailers	8,500	2.4%	382,800	1.8%
General Merchandise Retailers	10,400	5.1%	331,300	2.2%
Transportation, Warehousing, and Utilities	21,600	1.9%	891,400	1.4%
Transportation and Warehousing	18,500	0.5%	827,400	1.4%
Information	3,400	3.0%	580,200	-5.4%
Financial and Insurance	8,300	2.5%	532,300	-1.2%
Insurance Carriers and Related Activities	4,200	0.0%	202,600	-0.4%
Real Estate and Rental and Leasing	5,300	2.5%	313,800	-0.1%
Professional and Business Services	36,000	1.1%	2,902,200	-1.1%
Professional, Scientific, and Technical Service	11,600	-4.1%	1,473,000	1.3%
Management of Companies and Enterprises	2,900	3.6%	251,900	0.3%
Administrative and Support and Waste Management	21,500	3.9%	1,177,300	-4.2%
Administrative and Support Services	19,900	3.6%	1,121,000	-4.4%
Waste Management and Remediation Services	1,600	6.7%	56,300	-1.1%
Private Education and Health Services	4,200	-0.1%	3,169,800	4.6%
Private Educational Services	4,200	-10.6%	419,200	2.6%
Health Care and Social Assistance	78,200	0.5%	2,750,600	4.9%
Ambulatory Health Care Services	22,600	-2.2%	988,400	3.3%
Hospitals	15,500	-0.6%	414,300	2.1%
Nursing and Residential Care Facilities	8,300	1.2%	320,800	7.2%
Social Assistance	31,800	2.9%	1,027,100	7.0%
Leisure and Hospitality	39,500	5.9%	2,081,600	4.9%
Accommodation and Food Services	35,000	6.4%	1,732,200	4.5%
Food Services and Drinking Places	33,000	7.1%	1,515,200	4.5%

	Fresno County		California	
	Nov 23 Prelim	Percent Change Year	Nov 23 Prelim	Percent Change Year
Other Services	13,600	3.0%	597,300	4.0%
Government	80,900	3.9%	2,625,700	1.2%
Federal Government	9,600	-2.0%	250,500	1.0%
Total State and Local Government	71,300	4.7%	2,375,200	1.2%
State Government	13,200	2.3%	550,200	-0.4%
State Government Educational Services	4,200	2.4%	251,900	-1.4%
Local Government	58,100	5.3%	1,825,000	1.7%

Source: California Employment Development Department, Employment by Industry Data, 2023

1) Civilian labor force data are by place of residence; include self-employed

individuals, unpaid family workers, household domestic workers, & workers on strike.

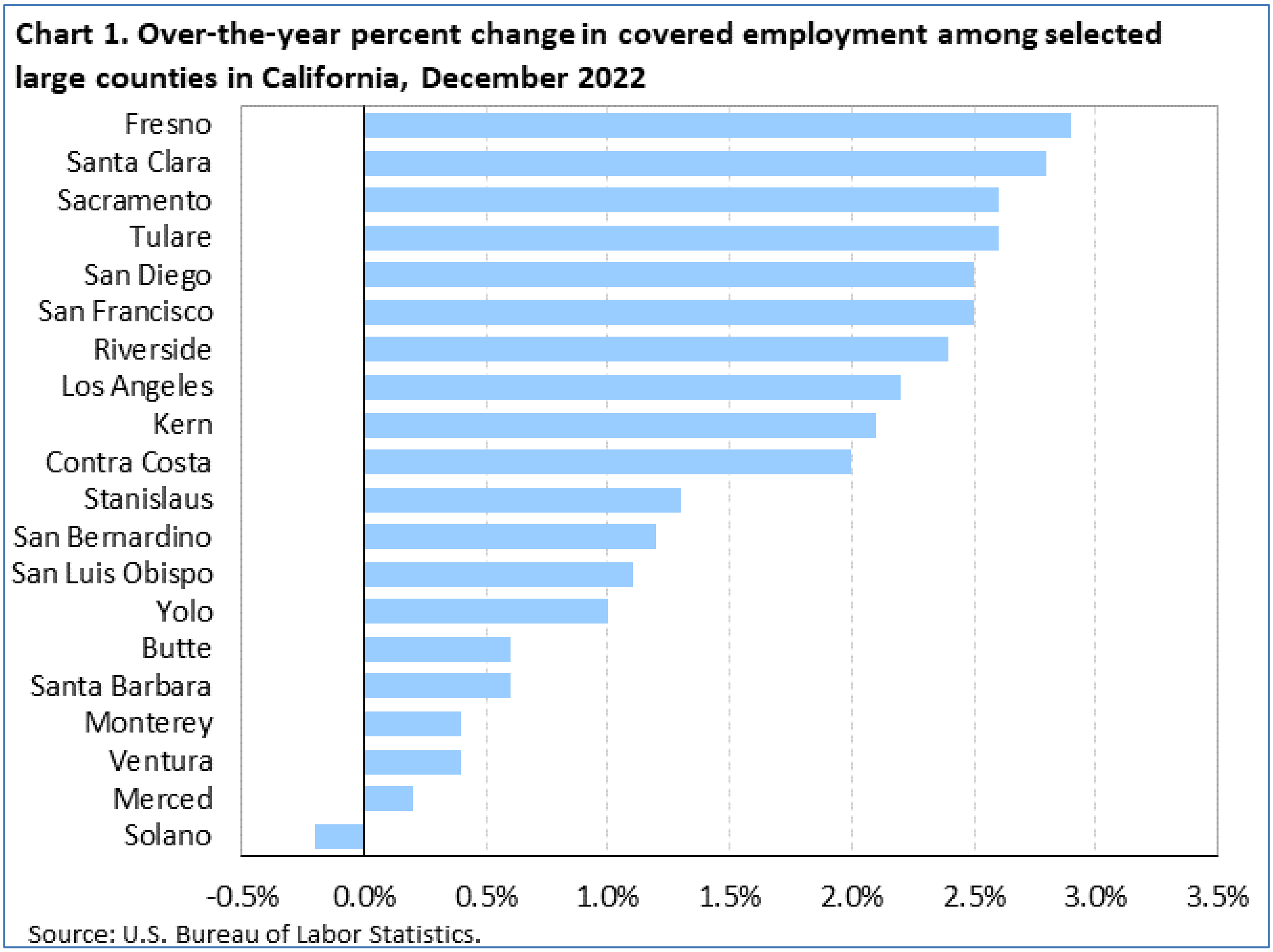
Data may not add due to rounding. The unemployment rate is calculated using unrounded data.

(2) Industry employment is by place of work; excludes self-employed individuals,

unpaid family workers, household domes

In 2022, Fresno County's employment rose and was the largest over-the-year percent change in covered employment among selected large counties in California at 2.9 percent shown in **Figure 1. Percent Change in Employment Among Large Counties in California, 2022.** Nationally, employment increased 2.6 percent over the year. [4]

Figure 1. Percent Change in Employment Among Large Counties in California, 2022



Source: U.S. Bureau of Labor Statistics

Comprehensive economic data available for Fresno County comes from the U.S. Census Bureau by way of the American Community Survey. Select estimates of economic characteristics for Fresno County are shown in **Table 3. Fresno County Economic Characteristics** and **Table 4. Fresno County Employment by Industry**.

[4] County Employment and Wages in California — Fourth Quarter 2022 : Western Information Office : U.S. Bureau of Labor Statistics (bls.gov) https://www.bls.gov/regions/west/news-release/countyemploymentandwages_california.htm

Table 3. Fresno County Economic Characteristics

Characteristic	Fresno County
In civilian labor force, total, percent of population age 16 years+	62.7
In civilian labor force, female, percent of population age 16 years+	383,402
Total accommodation and food services sales, 2017 ($1,000)	$1,783,383
Total health care and social assistance receipts/revenue, 2017 ($1,000)	$6,660,486
Total retail sales, 2017 ($1,000) (c)	11,346,970
Median household income (in 2022 dollars), 2018-2022	$67,756
Per capita income in past 12 months (in 2015 dollars), 2018-2022	$30,130
Persons in poverty, percent	18.6%
Total employer establishments, 2021	18,199
Total employment 2021	276,218
Total annual payroll ($1,000), 2021	14,367,074
Total employment, percent change 2020-2021	-2.8%

Source: U.S. Census Bureau, 2018-2022 American Community Survey 5-Year Estimates

Table 4. Fresno County Employment by Industry

Industry	# Employed	% Employed
Educational Services, and Health Care, and Social Assistance	105,214	23.5%
Retail Trade	44,105	9.9%
Agriculture, Forestry, Fishing and Hunting, and Mining	33,444	7.5%
Arts, Entertainment, and Recreation, and Accommodation, and Food Services	41,873	9.4%
Professional, Scientific, and Management, and Administrative and WasteManagement Services	41,376	9.2%
Manufacturing	29,670	6.6%
Public Administration	22,473	5%
Construction	29,222	6.5%
Other Services, Except Public Administration	22,473	5.0%
Transportation and Warehousing, and Utilities	33,307	7.4%
Finance and Insurance, and Real Estate and Rental and Leasing	20,222	4.5%
Wholesale Trade	12,255	2.7%
Information	4,844	1.1%

Industry	# Employed	% Employed
Total	**440,478**	**100.0**

Source: U.S. Census Bureau American Community Survey, 2023 Estimates, www.census.gov/

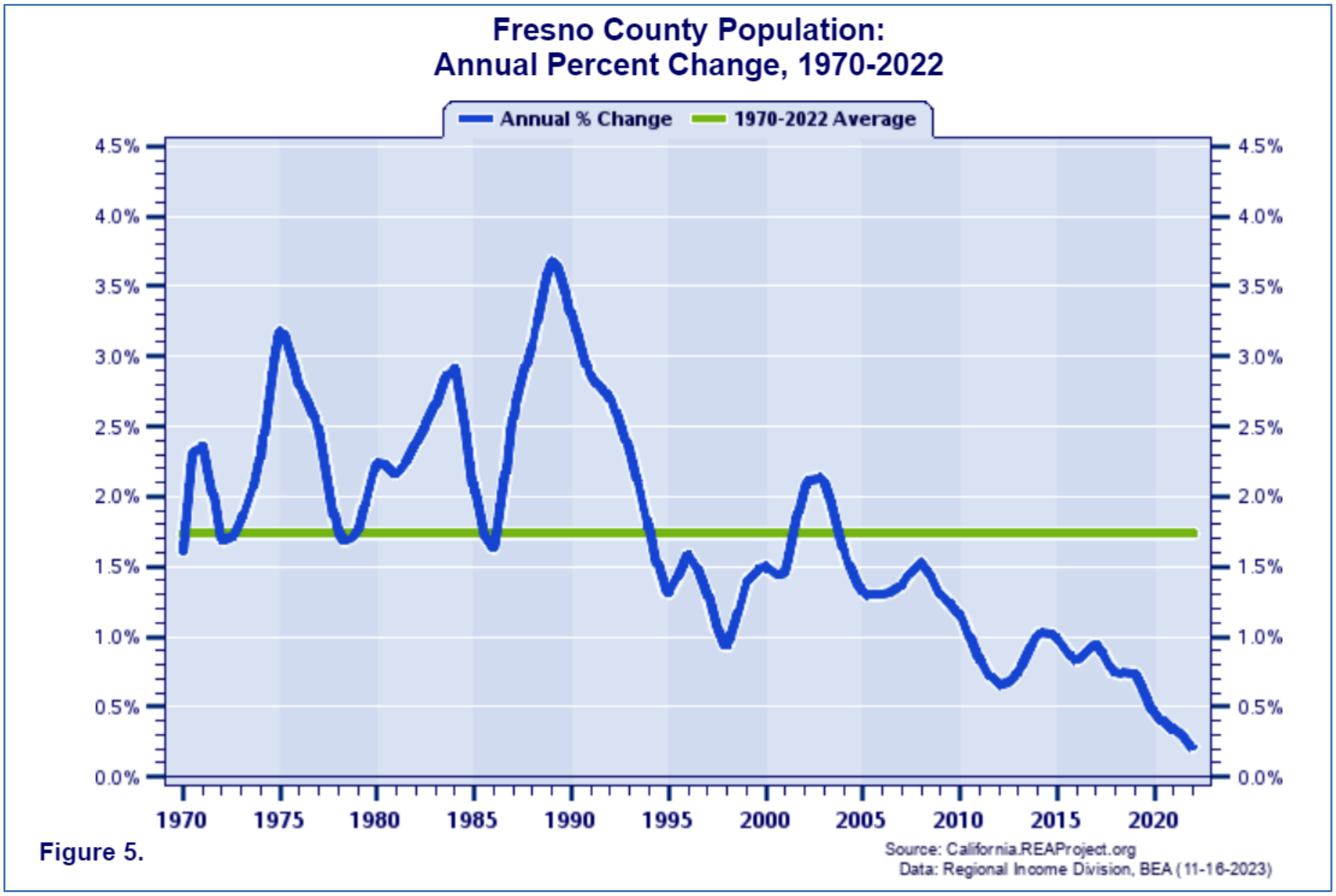
The median household income for Fresno County has increased over the past nine years, from about $41,900 in 2005 to $45,233 in 2015 and $69,571 in 2023. In comparison with other San Joaquin Valley counties, the median household income is somewhat low. The County falls significantly short of the state median household income $91,905, as well as other counties in the San Joaquin Valley $82,837 in San Joaquin County and $74,872 in Stanislaus County.

To address unemployment rates and loss of jobs, the county is working to expand, diversify, and strengthen the job base. New industrial sectors for the county include service and technology as well as light manufacturing. Business opportunities in areas such as information processing, water, energy, and health care have gained traction in the county and are projected to be pillars in the future regional economy.

POPULATION

Fresno County is one of the largest, fastest growing, and most diverse counties in California. It is the state's 10th most populous county according to the California Department of Finance. Based on the 2020 census, Fresno County has a population of 39,538,223. **Figure 2. Fresno County Population: Annual Percent Change (1970-2022)** displays the short-run pattern of Fresno County's population growth by tracking the year-to-year percent change over 1970-2022. The average annual percent change for the entire 53-year period is also traced on this chart to provide a benchmark for gauging periods of relatively high--and relatively low--growth against the backdrop of the long-term average.[5] **Table 5. Fresno County Population by Jurisdiction** displays the population among Fresno County and its municipalities. The City of Fresno encompasses most of the population while the City of San Joaquin is home is the least number of residents in the County.

Figure 2. Fresno County Population: Annual Percent Change (1970-2022)



Source: California REA Project

[5] Fresno County vs. California | Population Trends Report over 1969-2022 (reaproject.org) https://california.reaproject.org/analysis/comparative-trends-analysis/population/reports/60019/60000/

Table 5. Fresno County Population by Jurisdiction

Jurisdiction	Population 2020
Fresno County	1,008,654
Fresno	542,107
Clovis	120,124
Coalinga	17,590
Firebaugh	8,096
Fowler	6,700
Huron	6,206
Kerman	16,016
Kingsburg	12,380
Mendota	12,595
Reedley	25,227
San Joaquin	3,700
Sanger	26,617
Selma	24,674

Source: U.S. Census Bureau, 2020

Fresno County residents have completed less formal education than residents of California as a whole, with 78.3 percent of the population in Fresno County attaining education levels beyond a high school diploma, compared with 84.4 percent of the population in California. Select demographic and social characteristics for Fresno County from the 2023 estimates American Community Survey are shown in **Table 6. Fresno County Demographics.**

Table 6. Fresno County Demographics

Fresno County	
Population	
Population, 2022 estimate	1,015,190
Population, percent change-2020 (estimates base) to 2022	0.6%
Population, Census, 2020	1,008,654
Age and Sex	
Persons under 5 years, percent	6.9%
Persons under 18 years, percent	27.6%
Persons 65 years and over, percent	12.9%
Female persons, percent	49.7%
Race and Hispanic Origin	
White alone, percent	34.7%
Black or African American alone, percent	5.4%
American Indian and Alaska Native alone, percent	0.4%
Asian alone, percent	15.1%
Native Hawaiian and Other Pacific Islander alone, percent	0.3%

Two or More Races, percent	4.1%
Hispanic or Latino, percent	39.4%
White alone, not Hispanic, or Latino percent	34.7%
Education	
High school graduate or higher, percent of persons aged 25 years+ (2018-2022)	78.3%
Bachelor's degree or higher, percent of persons aged 25 years+ (2018-2022)	23.4%

Source: U.S. Census Bureau, 2022 5-Year American Community Survey (ACS)

VISITING POPULATION

Every year, millions of people visit Fresno County, more of half of which visit for leisure activities. Fresno County is the gateway to many recreational activities including national and state parks. The Yosemite, Kings Canyon, and Sequoia National Parks and other High Sierra sights attract visitors from all over the world. The Fresno/Clovis Convention and Visitors Bureau found that in 2022 travelers to Fresno County spent a combined $1.3 billion up 31.4 percent from 2021 which is very similar to the state's average at 31.7 percent. The boom in tourism added more than 15,000 jobs to the region. [6]

FARMWORKERS

Fresno County is one of the leading counties in agricultural production and provides produce and goods to nearly 100 countries across the world. As such, the level of production would not be possible without the labor of farmworkers. Disasters, such as the recent atmospheric rivers and subsequent flooding, have devastated communities in Fresno County, especially farmworkers. Flooded roads and farms for example, significantly impact farm workers due to lack of paychecks which can lead to or exacerbate financial hardships. Lost wages brought on by inequitable extreme weather events can increase the disparity within the farmworker community. It is important that mitigation goals and actions are working towards reducing risk to protect the agricultural industry, specifically the farm workers as the county's economy and success depends on the labor or these workers.

SOCIAL VULNERABILITY

Emergencies and disasters often highlight and intensify existing societal inequities, affecting groups based on socioeconomic status, race, age, disability, and other social factors. These events disproportionately impact certain populations, creating additional challenges in the preparedness, response, recovery, and mitigation stages. For instance, the COVID-19 pandemic shed light on pre-existing disparities such as limited healthcare access, leading to higher rates of emergency department visits, hospitalizations, and mortality among vulnerable groups. It is essential to recognize and understand these community-specific limitations and barriers to ensure equitable preparedness and response strategies for future incidents.

SOCIAL VULNERABILITY INDEX

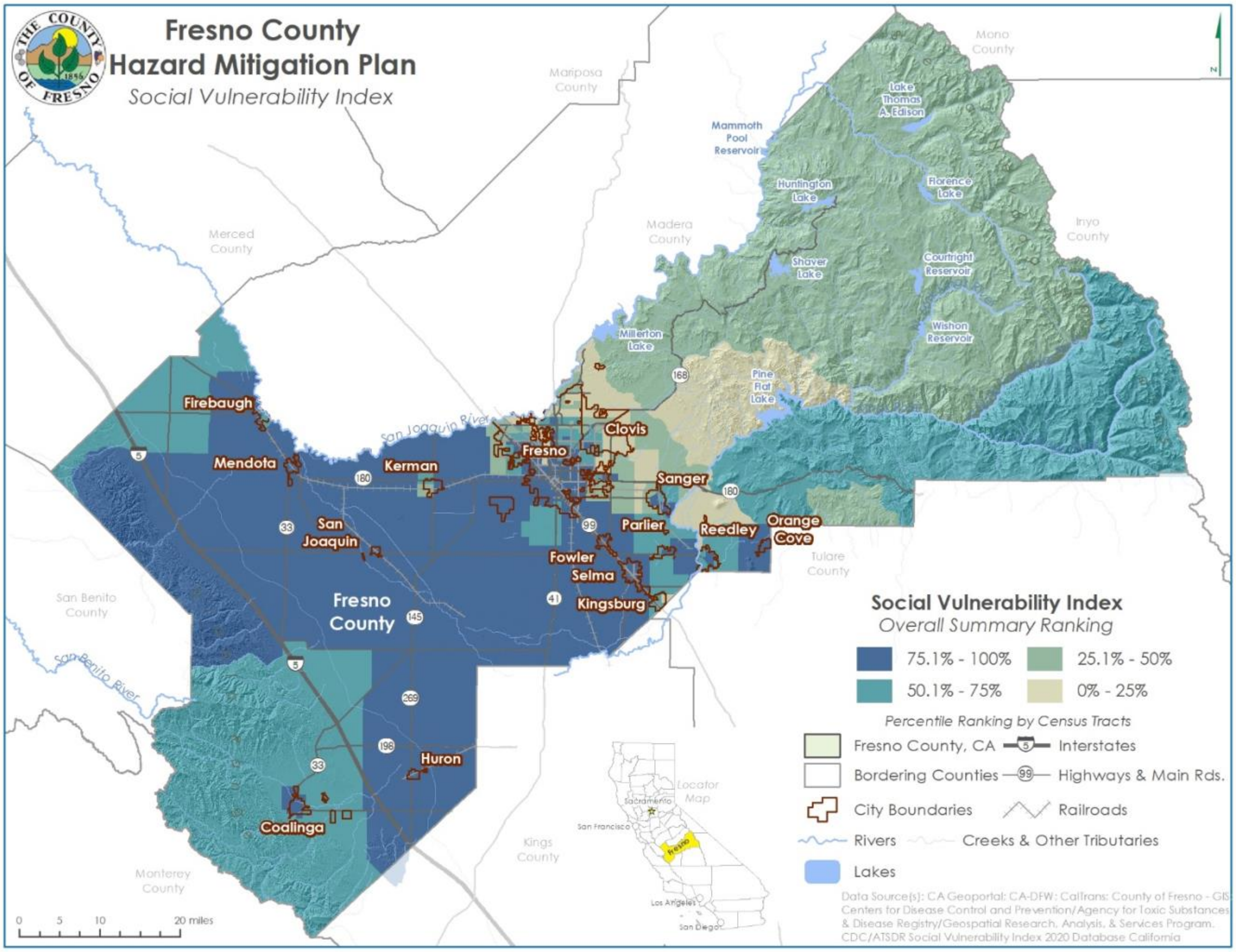
To aid in this, the Centers for Disease Control and Prevention (CDC) developed the Social Vulnerability Index (SVI), a comprehensive tool designed for emergency management planners and practitioners at

[6] Visitors to Fresno County spent big bucks last year; see how much tourism brings - The Business Journal https://thebusinessjournal.com/visitors-to-fresno-county-spent-big-bucks-last-year-see-how-much-tourism-brings/

state, local, and tribal levels. The SVI helps identify communities with high social vulnerability, potentially facing greater impacts during emergencies and disasters. This tool is instrumental in guiding targeted efforts in preparedness, response, and recovery, and in understanding the unique challenges certain communities may face, such as evacuation difficulties due to lack of transportation.

The SVI utilizes 16 variables, including factors like education level, presence of disabilities, and access to transportation, to calculate a community's vulnerability score. This score ranges from 0 to 1, where higher scores indicate increased vulnerability. The evaluation is percentile-based, with communities in the top 10 percent (above the 90th percentile) for a variable scoring a 1, denoting high vulnerability, and those in the bottom 10 percent scoring a 0. Additionally, the SVI categorizes these 16 variables into four distinct themes, providing deeper insights into specific vulnerability aspects. These themes and their constituent variables offer a nuanced understanding of a community's resilience and ability to handle disasters, both in terms of human impact and financial consequences. In Fresno County, the SVI index is .9649 which indicates a high level of social vulnerability, shown in **Map 3. Fresno County Social Vulnerability Index**.

Map 3. Fresno County Social Vulnerability Index

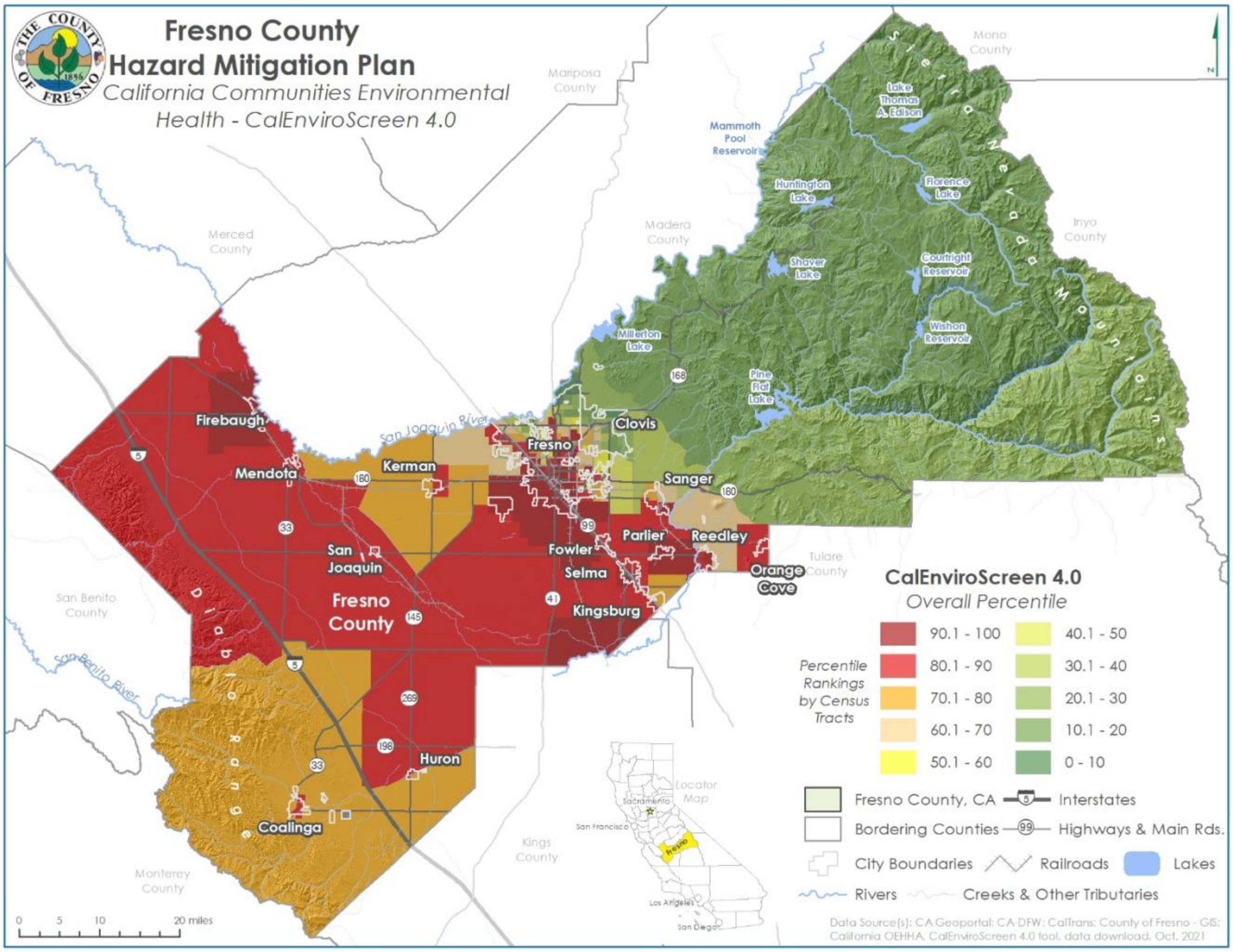


Source: CDC

DISADVANTAGED COMMUNITIES

The California Environmental Protection Agency developed a tool called CalEnviroScreen to identify communities most impacted by poverty and pollution. The Senate Bill 535 Disadvantaged Communities map identifies census tracts that have an overall CalEnviroScreen score of 75 or above, meaning they are among the top 25 percent most vulnerable and burdened by pollution in the state. In Fresno County, nearly all the census tracts in the eastern part of the county are identified as disadvantaged communities, shown in **Map 4. Fresno County Disadvantaged Communities**.

Map 4. Fresno County Disadvantaged Communities



Source: California OEHHA, CalEnviroScreen 4.0 Tool

DEVELOPMENT AND INFRASTRUCTURE

POPULATION

California has long been known for its significant population growth and has sustained its growth for a long period of time. Additionally, the state of California is home to many diverse populations and communities including immigrants from more than 60 nations. While growth rates have recently slowed, the state is still growing faster than the country. The state's growth and changing population will put pressure on infrastructure, service needs, future planning efforts should incorporate population changes to account for increased population growth. Fresno County has a projected population growth of about 88,000 people in the next 40 years. Population projections for the San Joaquin Valley counties are described in **Table 7. San Joaquin Valley Future Population Estimates**.

Table 7. San Joaquin Valley Future Population Estimates

Geography	Estimates 2020	Estimates 2030	Estimates 2040	Estimates 2050	Estimates 2060
Fresno County	1,007,344	1,047,382	1,083,901	1,098,206	1,095,205
Stanislaus County	553,706	558,565	577,523	593,396	609,615
Merced County	280,909	311,578	329,168	336,170	338,247
Madera County	156,141	161,980	163,345	161,937	159,048
Kings County	152,200	157,531	161,190	160,446	156,194
Tulare County	472,597	487,378	487,888	472,966	446,588
Kern County	905,241	940,257	966,310	969,968	954,655

Source: State of California Department of Finance

Since 1960, Fresno County's population has shifted from the county's unincorporated area to the county's cities. Fresno County's population and anticipated growth is mostly concentrated in and around the county's cities. The Fresno metropolitan area has absorbed much of the county's population growth, either through annexations or new development. On average, Fresno County's population grew at an annual rate of 1.74 percent over 1970-2022. The county posted its highest growth in 1989 (3.68 percent) and recorded its lowest growth in 2022 (0.22 percent). In 2022, Fresno County's population grew by 0.22 percent.

HOUSING

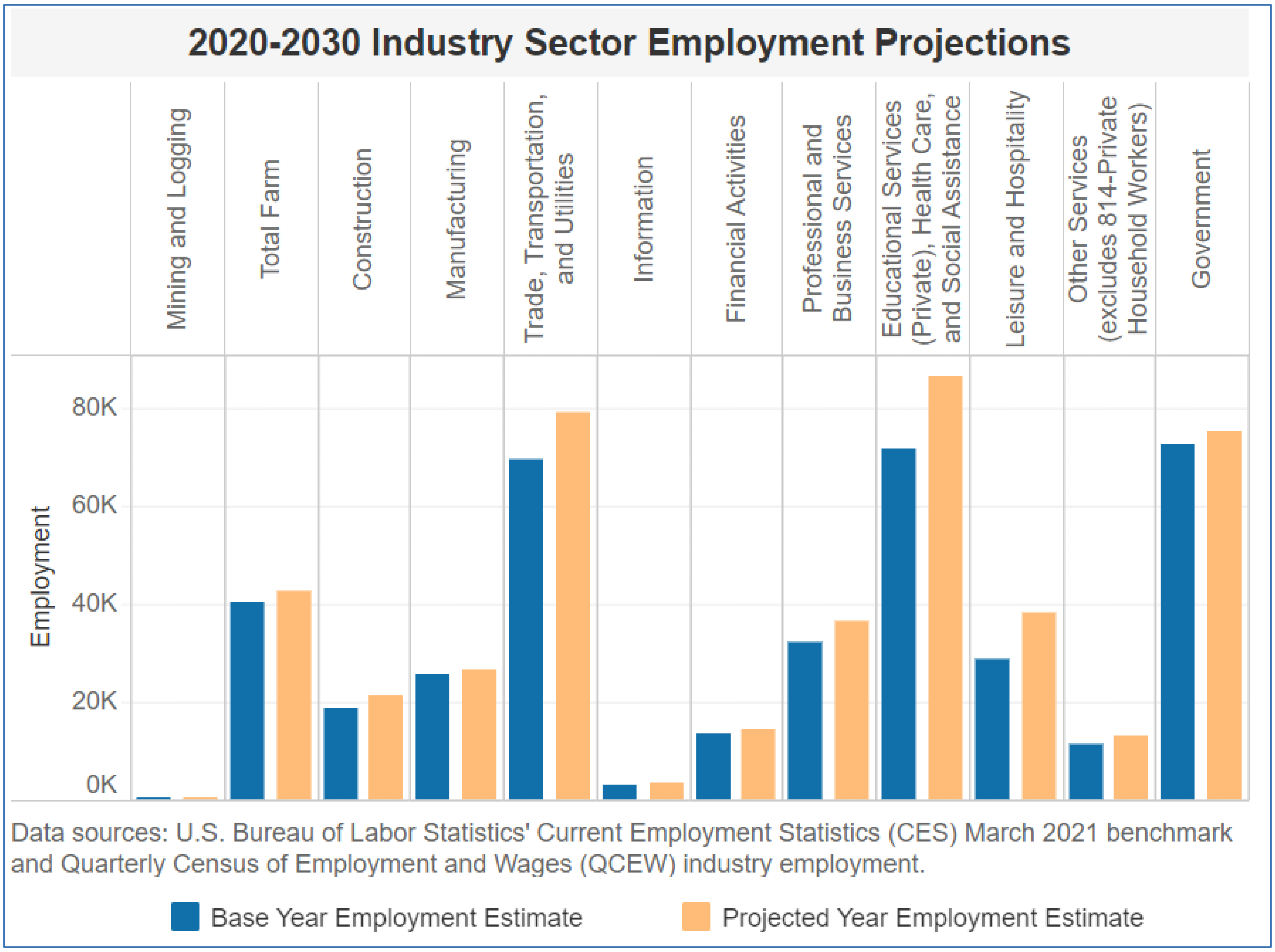
As the population increases, additional demand on infrastructure and services will follow including education, transportation corrections, water, health, welfare, and especially housing. The state of California struggles to house its growing population and as a result has a large, unhoused population. Fresno County faces similar struggles as the state and is working to address the ongoing housing crisis, which has recently been exacerbated by the COVID-19 pandemic. As of 2022, there are an estimated 4,200 individuals that are without housing in the Fresno-Madera region. Since the COVID-19 pandemic, there has been a 43 percent increase in the homeless population from the pre-pandemic estimated of 3,641 in the Fresno-Madera region. [7]

[7] Fresno leaders share plans to address homelessness - CalMatters https://calmatters.org/california-divide/2022/01/fresno-homelessness/

EMPLOYMENT

Employment projections according to the California Employment Development Department, are estimated to increase across all industries including Trade, Transportation, and Utilities, as well as Educational Services (private), Health Care, and Social Assistance, shown in **Figure 3. 2020-2030 Industry Sector Employment Projections**.

Figure 3. 2020-2030 Industry Sector Employment Projections

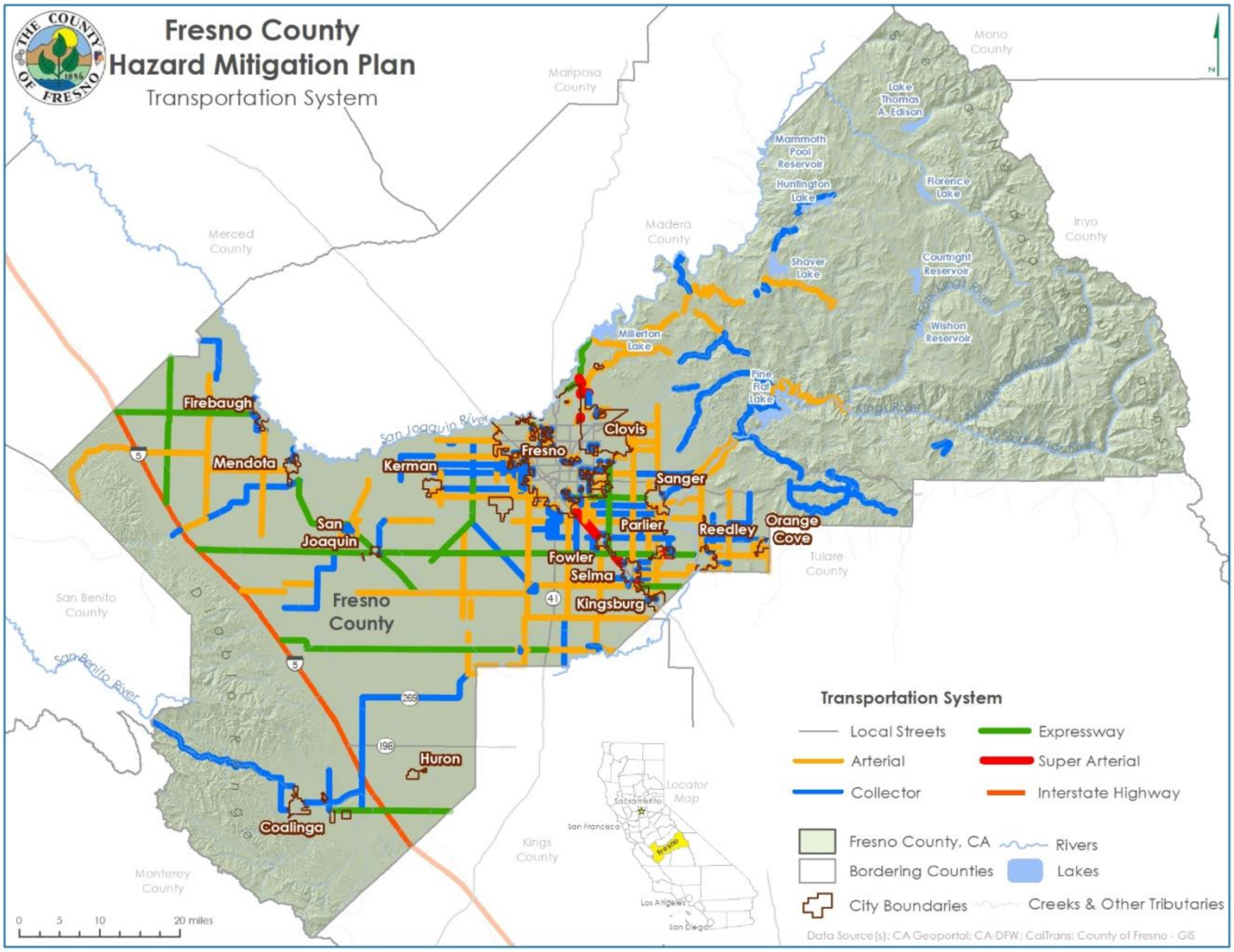


Source: U.S. Bureau of Labor Statistics' Current Employment Statistics (CES) March 2021 benchmark and Quarterly Census of Employment and Wages (QCEW) industry employment.

TRANSPORTATION

Fresno County is situated mostly west of Interstate 5, which is the major highway stretching across the West Coast from Southern California to Northern Washington State. Interstate 5 experiences heavy traffic due to local, regional, and national travel of people and goods. The map below shows the Fresno County transportation system.

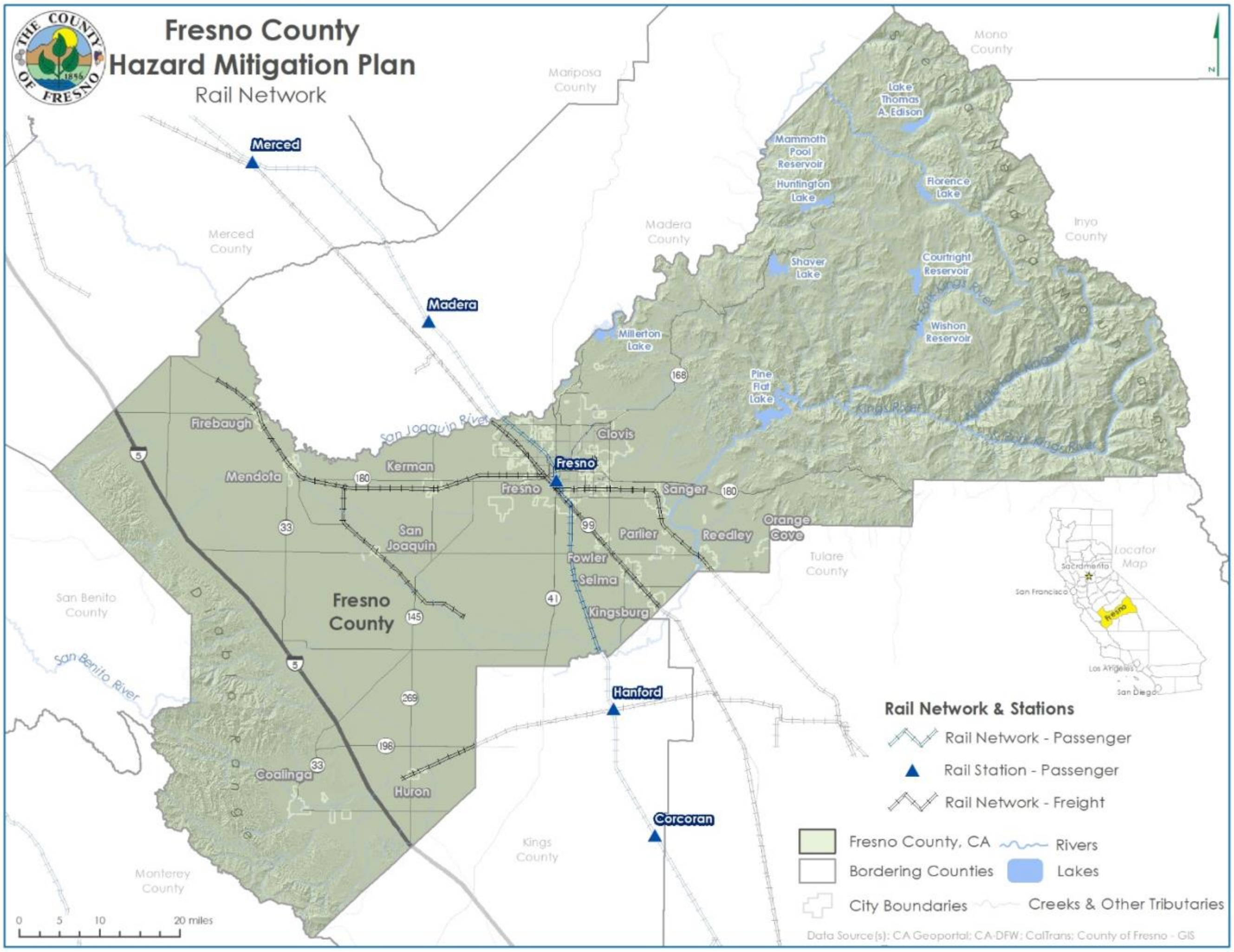
Map 5. Fresno County Transportation System



Source: CA Geoportal; CA-DFW; CalTrans; County of Fresno – GIS

The map below shows the rail network within Fresno County that includes passenger and freight rail across the region and state. New additions to the rail network are set to change by the next hazard mitigation plan update. In about five years, Fresno's core will be transformed into the first major hub on America's most ambitious active infrastructure project: a 500-mile bullet train shuttling people 200-plus mph from San Francisco to Los Angeles in under three hours. The high-speed rail will span 119 miles across Madera, Fresno, Kings, Tulare and Kern counties. The Authority plans to extend this 119-mile segment into Merced and Bakersfield. Unlike Interstate 5, the state's north-south connector, it'll run through the heart of the Central Valley. The infrastructure project could support the increase in

Map 6. Fresno County Rail Network



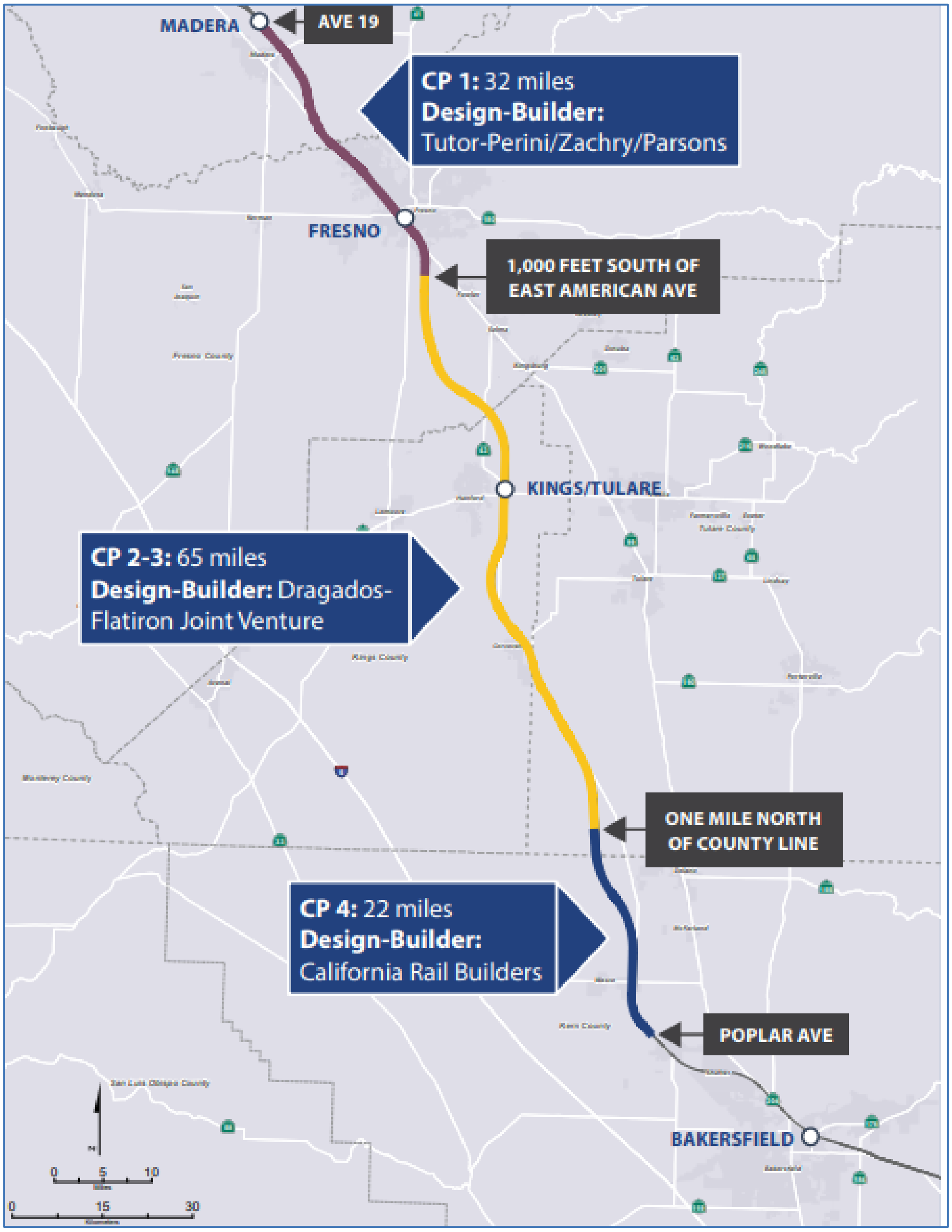
population over the next several decades as the Central Valley population is growing. [8]A map of the project in shown below. [9]

[8] From 'train to nowhere' to Fresno's dream: What high-speed rail means for the Central Valley - The Business Journal https://thebusinessjournal.com/from-train-to-nowhere-to-fresnos-dream-what-high-speed-rail-means-for-the-central-valley/

[9] High-Speed Rail: Central Valley at a Glance (ca.gov) https://www.hsr.ca.gov/wp-content/uploads/docs/communication/info_center/factsheets/Central-Valley-Factsheet.pdf

Source: CA Geoportal; CA-DFW; CalTrans; County of Fresno – GIS

Map 7. High Speed Rail: Central Valley



Source: California High Speed Rail Authority

3.Planning Process

Requirements §201.6(b) and §201.6(c)(1): An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planningprocess shall include:

An opportunity for the public to comment on the plan during the drafting stage andprior to plan approval;

An opportunity for neighboring communities, local and regional agencies involved inhazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia, and other private and nonprofit interests to be involved in the planning process; and

Review and incorporation, if appropriate, of existing plans, studies, reports, andtechnical information.

[The plan shall document] the planning process used to develop the plan, including howit was prepared, who was involved in the process, and how the public was involved.

BACKGROUND

Mitigation planning is critical to lessen impacts from hazards to the whole community. In order to achieve this, mitigation planning must encourage whole community involvement, assessing risk and using a range of resources to reduce risk to people, economies, and natural environments.

The primary purpose of the Fresno County Multi-Jurisdictional Hazard Mitigation Plan (LHMP) update is to reduce or eliminate long-term risk to people and property from natural hazards and their effects on the Fresno County, California planning area. Fresno County recognized the need for and importance of a Local Hazard Mitigation Plan (LHMP) and initiated its development in 2007 after receiving a grant from the Federal Emergency Management Agency (FEMA), which served as the primary funding source for this plan. The original LHMP was developed in 2007-2008 and received FEMA approval in 2009. Additional details on the original planning effort can be referenced in the 2009 Plan. The plan underwent a comprehensive update in 2017-2018 and was approved in 2018.

The most recent hazard mitigation plan update occurred in 2023-2024 and was approved in 2024. The planning process followed a similar update to that used in the last plan update, utilizing input from the Hazard Mitigation Planning Committee (HMPC). Witt O'Brien's was procured to support the update in 2023.

CHANGES SINCE PREVIOUS PLAN

Requirements §201.6(d)(3): A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and resubmit it for approval within 5 years in order to continue to be eligible for mitigation project grant funding.

The updated LHMP complies with Federal Emergency Management Agency (FEMA) guidance and California Office of Emergency Services guidelines for Local Hazard Mitigation Plans. The update followed the requirements noted in the Disaster Mitigation Act (DMA) of 2000 and the 2023 Local Hazard Mitigation Planning Handbook.

This HMP update involved a comprehensive review and update of each section of the 2018 plan and includes an assessment of the progress of the participating communities in evaluating, monitoring and implementing the mitigation strategy outlined in the initial plan. Only the information and data still valid from the 2018 plan was carried forward as applicable into this HMP update.

EQUITY

Additionally, the latest Local Mitigation Planning Handbook includes guidance on ensuring equity is embedded throughout the planning process and within the hazard mitigation plan itself. While disasters themselves do not discriminate, impacts from disasters can be disproportionately experienced across different communities and populations based on existing inequities. It is critical to involve all communities or organizations that represent such unserved and socially vulnerable communities to ensure that the plan is aware and works to reduce risk to the whole community. For example, the public survey was translated into Spanish to ensure that Spanish speaking residents were able to participate in the public survey and provide input as there is a large Spanish speaking population within the county. The steps to ensure equity into the planning process described in the FEMA Local Mitigation Planning Handbook is outlined below.

Procedural Equity: is committing to equity within the planning process.

- Making clear, fair and inclusive processes. Work with partners who represent underserved groups and socially vulnerable populations to design and implement outreach and engagement methods that will reach the most marginalized and/or vulnerable members of the community.
- Giving chances for meaningful input. Underserved groups should have a true voice in planning and prioritizing mitigation. Invite nonprofit and community-based organizations that support these groups to join the local mitigation planning team. Invite other representatives as well. Welcome them to share their input throughout the planning process.

Structural Equity: builds on the need for accountability. It supports learning the history that led to privilege. It also supports working to correct past harms. Plans can address this by:

- Talking about equity early and often with the planning team. Use the principles of equity in all decision-making processes, from initial outreach to publication of the plan.
- Recognizing and dealing with the societal systems that cause inequity.
- Forming organizational infrastructure to address inequities. This should happen both at the staff and leadership levels. If inequities are raised during the planning process, make sure there are tools and paths to fix them. Think about working with consultants who have expertise in diversity, equity, and inclusion.

Distributional Equity: ensures that communities that are disproportionately at risk of hazards and their impacts are benefitted by mitigation actions that work to reduce their risk. Communities disproportionately at risk the hazard impacts include:

- High poverty

- Limited access to a vehicle
- Age (very old or very young)
- Limited English proficiency
- Disability status
- Race
- Ethnicity

The HMPC is committed to working to address and remove physical, social, temporal, language, accessibility, and historically institutional barriers through the planning process to ensure that the plan works for the whole community.

FUTURE PLANNING UPDATES

Chapter 6 (Plan Implementation) identifies key requirements for updating future plans including:

- Ensure that the plan's mitigation strategy complies with all applicable legal requirements related to civil rights.
- Consider changes in vulnerability due to action implementation;
- Document success stories where mitigation efforts have proven effective;
- Document areas where mitigation actions were not effective;
- Document any new hazards that may arise or were previously overlooked;
- Document hazard events and impacts that occurred within the five-year period;
- Incorporate new data or studies on hazards and risks;
- Incorporate new capabilities or changes in capabilities;
- Incorporate documentation of continued public involvement;
- Incorporate documentation to update the planning process that may include new or additional stakeholder involvement;
- Incorporate growth and development-related changes to building inventories;
- Incorporate new project recommendations or changes in project prioritization;
- Include a public involvement process to receive public comment on the updated plan prior to submitting the updated plan to Cal OES/FEMA; and
- Include re-adoption by all participating entities following FEMA approval.

These requirements and others as detailed throughout this plan were addressed during the plan update process.

PLAN SECTION REVIEW AND ANALYSIS – 2024 UPDATE

During the 2024 plan update, the Hazard Mitigation Planning Committee (HMPC) updated each of the sections of the previously approved plan to include new information. Witt O'Brien's developed a power point presentation during the kick-off meeting to describe each step of the planning process and relevant updates based on the FEMA's local plan update guidance (2023) to ensure that the plan met the latest requirements. A summary of the changes in this plan update is highlighted in the table below.

Table 8. Fresno County Hazard Mitigation Plan Update Highlights

Plan Section	Summary of Plan Review, Analysis, and Updates
Introduction	Updated relevant dates and data
Community Profile	Updated with recent census data and current economy description
Planning Process	Updated relevant dates, data, and planning process pertaining the 2024 plan update
Risk Assessments	Revisited former hazards list for possible modifications. Reviewed the County and City of Fresno's CRS participation Updated list of disaster declarations to include recent data. Updated tables to include recent National Center for Environmental Information data. Updated past occurrences for each hazard to include recent data. Updated critical facilities list. Updated growth and development trends to include recent Census and local data sources. Updated historic and cultural resources using local/state/national sources. Updated property values for vulnerability and exposure analysis, using updated building information based on assessor's data. Updated estimate flood losses using the latest Fresno County Digital Flood Insurance Rate Map (DFIRM) and assessor's data. Updated National Flood Insurance Program (NFIP) data and Repetitive Loss structure data from the previous plan. Incorporated new hazard loss estimates since 2018, as applicable. Used updated GIS inventory data to assess wildfire threat to the County Updated HAZUS-MH Level I earthquake vulnerability analysis data Updated information regarding specific vulnerabilities to hazards, including maps and tables of specific assets at risk, specific critical facilities at risk, and specific populations at risk. Updated maps in plan where appropriate. Reviewed mitigation capabilities and update to reflect current capabilities
Mitigation Strategy	Indicated what projects have been implemented that may reduce previously identified vulnerabilities. Updated Chapter 5 based on the results of the updated risk assessment, completed mitigation actions, and implementation obstacles and opportunities since the completion of the 2018 plan. Reviewed and updated goals and objectives based on HMPC input. Revised to include more information on the Community Rating System (CRS) categories of mitigation measures (structural projects, natural resource protection, emergency services, etc.) and how they are reviewed when considering the options for mitigation. Included updated information on how actions are prioritized. Reviewed mitigation actions from the 2018 plan and develop a status report for each; identified if actions have been completed, deleted, or deferred/carried forward. Updated priorities on actions. Identified and detailed new mitigation actions proposed by the HMPC.
Plan Section	Summary of Plan Review, Analysis, and Updates
Plan Adoption	Plan will be re-adopted as part of the update process
Plan Maintenance	Reviewed and updated procedures for monitoring, evaluating, and updating the plan. Revised to reflect current methods. Updated the system for monitoring progress of mitigation activities by identifying additional criteria for plan monitoring and maintenance.
Jurisdictional Annexes	Updated previous participants' annexes with recent Census data. Updated past event history and hazard loss estimates. Added new maps and updated old maps as needed. Updated mitigation actions from 2018 and added new mitigation actions.
Appendices	Updated references.

Plan Section	Summary of Plan Review, Analysis, and Updates
	Updated planning process documentation. Updated mitigation alternatives analyzed in the process. Public participation plan updated Plan Adoption.

INCORPORATION OF EXISTING PLANS, STUDIES, AND DATA

The HMPC used technical data, reports, and studies from the following agencies and groups in the development and update of this plan:

- Bureau of Land Management
- California Department of Forestry and Fire Protection
- California Department of Parks and Recreation Office of Historic Preservation
- California Department of Transportation
- California Geological Survey
- Fresno County Agricultural Department
- Fresno County Health Department
- Fresno County Information Technology/Geographic Information Systems Department
- Fresno County Internal Services Department
- Fresno County Land Use Department
- Fresno County Public Works and Planning Department
- National Oceanic and Atmospheric Administration National Climatic Data Center
- National Register of Historic Places
- Natural Resource Conservation Service
- National Weather Service
- U.S. Fish and Wildlife Service
- U.S. Geological Survey
- US Sierra National Forest
- Western Regional Climate Center

PLAN PARTICIPATION

In the 2024 plan update, the following jurisdictions participated in the planning process and will be adopting the updated plan following FEMA approval.

- Fresno County
- City of Clovis
- City of Coalinga
- City of Firebaugh

- City of Fowler
- City of Fresno
- City of Kerman
- City of Kingsburg
- City of Mendota
- City of Reedley
- City of San Joaquin
- City of Sanger
- City of Selma
- Fresno Metropolitan Flood Control District
- Lower San Joaquin Levee District
- Sierra Resource Conservation District/Highway 168 Fire Safe Council
- Kings River Conservation District
- Westlands Water District

The DMA planning regulations and guidance stress that each local government seeking FEMA approval of their mitigation plan must participate in the planning effort in the following ways:

- Participate in the process as part of the HMPC
- Detail areas within the planning area where the risk differs from that facing the entire area
- Identify potential mitigation actions

Formally adopt the plan

For the Fresno County planning area's HMPC, "participation" meant the following:

- Attending and participating in the HMPC meetings
- Completing and returning worksheets or reviewing jurisdictional annexes
- Collecting and providing other requested data (as available)
- Identifying mitigation actions for the plan
- Reviewing and providing comments on plan drafts
- Informing the public, local officials, and other interested parties about the planning process and providing opportunity for them to comment on the plan
- Coordinating, and participating in, the public input process
- Coordinating the formal adoption of the plan by the governing boards

The County and all jurisdictions with annexes to this plan and seeking FEMA approval met all of these participation requirements. In most cases one or more representatives for each jurisdiction attended the multi-jurisdictional meetings Schedule of Planning Meetings, and also brought together a local planning team to help collect data, identify mitigation actions and implementation strategies, and review and provide data on annex drafts. In some cases, the jurisdictions had limited capacity to attend or had conflicts with HMPC meetings; in these cases, side-bar phone calls and emails were used to provide input into the process. Appendix B provides additional information and documentation of the planning process.

In addition to the jurisdictions adopting the plan, the HMPC included a wide variety of other stakeholders, including:

- American Red Cross of the Central Valley
- California State University, Fresno
- Cargill
- Central Valley Flood Protection Board
- City of Huron
- City of Orange Cove
- City of Parlier
- Clovis Community College
- Fresno Chamber of Commerce
- Fresno City College
- Fresno Madera Continuum Of Care (FMCoC)
- Inyo County Office of Emergency Services
- Kern County Fire
- Kings County Emergency Management
- Madera County Emergency Management
- Mariposa County Emergency Management
- Merced County Emergency Management
- Mono County
- Monterey County Emergency Management
- PG&E

- Pilot Power Group
- Reedley College
- San Benito County Emergency Management
- San Joaquin College of Law
- San Joaquin River Exchange Contractors Water Authority
- Southern California Edison
- Sun-Maid
- Tulare County OES
- United Way of Tular County
- West Hill College Coalinga

A complete list of the participants in the HMPC is included in Appendix B: Participation Documentation.

PLAN TIMELINE

The planning team met formally three times to discuss the planning process, share information, review draft plan components, and identify strategies and actions to include in the new plan. A timeline of the planning process is as follows:

- August 2023:
  - Fresno County contracted with Witt O'Brien's to complete this plan update
- October 2023:
  - Fresno County and Witt O'Brien's conducted a project kickoff meeting to discuss timeline, participation, and goals for the update.
  - Fresno County worked with participating jurisdictions to solicit participation and identify planning team members
  - Witt O'Brien's began conducting hazard analysis and mapping for inclusion in the HIRA
- November 2023:

- **November 17, 2023: Fresno County Multi-Jurisdictional Hazard Mitigation Plan Kickoff Meeting –** Virtual meeting, via Microsoft Teams. Discussion topics included:
  - Planning team introductions
  - Hazard mitigation overview
  - The mitigation planning process
  - Hazard identification data gathering exercises
  - Questions and next steps
- Critical facilities list was finalized

- December 2023:
  - Capability Assessment and Hazard Identification Exercise worksheets shared with planning team members
  - Participating jurisdictions provided feedback on the hazards causing the greatest challenges for their communities by completing Hazard Identification Exercise worksheets
  - Fresno County works with the planning team to identify critical facilities and assets to use in the plan update.
- January 2023:
  - Participating jurisdictions began cataloguing their capabilities and resources, as outlined in the Capability Assessment Worksheet
  - The public was given the opportunity to provide input on the plan via the "Fresno County Hazard Mitigation Plan – Public Opinion Survey", which was open from January 10, 2024, to January 30, 2024.
  - **January 16, 2024: Fresno County Multi-Jurisdictional Hazard Mitigation Plan – Public Meeting –** First of two virtual and in-person hybrid meetings open to the public. Discussion topics included:
    - Hazard mitigation and mitigation planning overview
    - Availability of public survey
    - Opportunity for input and open discussion

  - **January 17, 2024: Fresno County Multi-Jurisdictional Hazard Mitigation Plan – Public Meeting –** Second of two virtual and in-person hybrid meetings open to the public. Discussion topics included:
    - Hazard mitigation and mitigation planning overview
    - Availability of public survey
    - Opportunity for input and open discussion
- February 2023:
  - Mapping and modeling for the HIRA was substantively completed
- March 2023:
  - A wide variety of stakeholders (including non-government organizations, businesses, and neighboring communities) were invited to join the planning team, participate in future meetings, and comment on the draft plan.
  - **March 6, 2024: Fresno County Multi-Jurisdictional Hazard Mitigation Plan - HIRA Meeting –** Virtual meeting, via Microsoft Teams. Discussion topics included:
    - Plan process review
    - HIRA progress
    - Hazard maps developed to date
    - Results of the public survey
    - Brainstorming hazard mitigation actions
  - Strategy worksheets were shared with plan participants
  - Plan participants provided feedback on the goals and objectives for the plan, reviewed their actions from the previous plan, determined which to keep in the new plan, and identified new actions (via the Strategy Worksheet).
  - **March 28, 2024: Fresno County Multi-Jurisdictional Hazard Mitigation Plan – Strategy Meeting –** Virtual meeting, via Microsoft Teams. Discussion topics included:
    - Plan status

        - Review and discussion of the proposed goals for the plan
        - Mitigation action development updates, discussion, brainstorming, and problem-solving
        - Discussion of aligning mitigation actions with grant opportunities
        - Timeline, Next Steps, and Questions

- April 2023:
    - The Planning Team provided all remaining input, worksheets, and data, and the plan draft was finalized.
- May 2023:
    - The Planning Team provided all remaining input, worksheets, and data, and the plan draft was finalized.
    - The draft plan was made available for public review online on **May 3, 2024,** and remained available for public comment through **May 17, 2024.** An online form allowed plan participants to provide feedback on the draft, and on risk reduction in Fresno County in general.

Documentation of the planning process (including presentations, meeting participation, surveys and results, and relevant communications) is available in Appendix B: Process and Participation Documentation.

4. Risk Assessment

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

As defined by FEMA, risk is a combination of hazard, vulnerability, and exposure. Risk is the estimated impact that a hazard would have on people, services, facilities, and structures in a community. It refers to the likelihood of a hazard event resulting in an adverse condition that causes injury or damage.

The risk assessment process identifies and profiles relevant hazards and assesses the exposure of lives, property, and infrastructure to these hazards. The process allows for a better understanding of a jurisdiction's potential risk to hazards and provides a framework for developing and prioritizing mitigation actions to reduce risk from future hazard events.

This risk assessment followed the methodology described in the 2023 FEMA publication Local Mitigation Planning Handbook:

1. Describe hazards
2. Identify community assets
3. Analysis risks
4. Summarize vulnerability

Data collected through this process has been incorporated into the following sections of this chapter:

- **Hazard Identification Natural Hazards Section**: identifies the natural hazards that threaten the planning area and describes why some hazards have been omitted from further consideration.
- **Hazard Profiles Section**: discusses the threat to the planning area and describes previous occurrences of hazard events and the likelihood of future occurrences.
- **Vulnerability Assessment Section:** assesses the County's total exposure to natural hazards, considering assets at risk, critical facilities, and future development trends.
- **Human-Caused Hazards Section:** identifies the areas most susceptible to potential human-caused hazard events by evaluating the locations of hazardous materials facilities and transportation routes.
- **Capability Assessment Section**: inventories existing mitigation activities and policies, regulations, and plans that pertain to mitigation and can affect net vulnerability.

This risk assessment covers the entire geographical extent of Fresno County. Since this plan is a multi-jurisdictional plan, the HMPC was required to evaluate how the hazards and risks vary from jurisdiction to jurisdiction. While these differences are noted in this chapter, they are expanded upon in the annexes of the participating jurisdictions. If no additional data is provided in an annex, it should be assumed that the risk and potential impacts to the affected jurisdiction are similar to those described here for the entire Fresno County planning area.

HAZARD IDENTIFICATION

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type of all natural hazards that can affect the jurisdiction.

The Fresno County HMPC conducted a hazard identification study to determine the hazards that threaten the planning area.

METHODOLOGY AND RESULTS

Using existing hazards data and input gained through planning meetings during the 2024 plan update, the HMPC agreed to continue to profile the same 19 identified hazards in the 2018 plan, into the 2024 plan update. In order to update the profiled hazards, data from the California Governor's Office of Emergency Services (CA-OES), FEMA, the National Oceanic and Atmospheric Administration, and many other sources were examined to assess the significance of these hazards to the planning area. Significance was measured in general terms and focused on key criteria such as frequency and resulting damage, which includes deaths and injuries and property, economic, and crop damage as the county is one of the largest agricultural producers in the state. The hazards evaluated as part of this plan include those that occurred in the past or have the potential to cause significant human and/or monetary losses in the future. The potential for loss and impacts from the hazards are analyzed further in the Vulnerability Assessment section.

In alphabetical order, the natural hazards identified and investigated for the Fresno County Multi-Jurisdictional Hazard Mitigation Plan include:

- Agricultural Hazards
- Avalanche
- Dam Failures
- Drought
    - Tree Mortality
- Earthquake
- Flood
- Wildfire
- Volcano

Human Health Hazards

- Epidemic/Pandemic
- West Nile Virus
- Landslide

Severe Weather

- Extreme Temperatures
    - Extreme Cold/Freeze
    - Extreme Heat
- Fog
- Heavy Rain/Thunderstorm/Hail/Lightning/Wind
- Winter Storm
- Tornado

Soil Hazards

- Erosion
- Expansion Soils
- Land Subsidence
- Landslide

OVERALL HAZARD SIGNIFICANT SUMMARY

Overall hazard significance was based on a combination of Geographic Extent, Probability and Potential Magnitude/Severity as defined in **Table 9. Fresno County Hazard Significance**. The individual ratings are based on or interpolated from the analysis of the hazards in the sections that follow. During the 2024 Fresno County LHMP update, the individual ratings and significance of the hazards were revisited and updated. Subsidence, as a subset of soil hazards, has become more of an issue due to heavy groundwater withdrawal during the severe multi-year drought 2012-2017 and 2020-2023. It may also be exacerbating flood hazards by lowering levee heights in some areas. This hazard's significance was changed from low to medium during the 2017 update.

Table 9. Fresno County Hazard Significance

Hazard	0.3	0.3	0.2	0.1	0.1	Overall Risk
	Probability	Impact	Spatial Extent	Warning Time	Duration	
Agricultural Hazards	Highly Likely	Negligible	Limited	More than 24 hours	Less than 24 hours	3.5
Avalanche	Likely	Limited	Limited	Less than 6 hours	Less than 6 hours	2.4
Dam Failure	Occasional	Critical	Extensive	More than 24 hours	Less than 24 hours	2.6
Drought	Likely	Limited	Significant	More than 24 hours	More than 1 week	2.5
Earthquake	Occasional	Catastrophic	Significant	Less than 6 hours	Less than 6 hours	2.5
Flood/Levee Failure	Likely	Critical	Extensive	More than 24 hours	Less than 1 week	2.6
Human Health Hazards						

Hazard	0.3	0.3	0.2	0.1	0.1	Overall Risk
	Probability	Impact	Spatial Extent	Warning Time	Duration	
Epidemic/Pandemic	Occasional	Negligible	Extensive	More than 24 hours	More than 1 week	3.1
Hazardous Materials	Highly Likely	Limited	Significant	*Unavailable*	*Unavailable*	*Unavailable*
West Nile Virus	Occasional	Negligible	Limited	More than 24 hours	Less than 1 week	2.7
Severe Weather						
Extreme temperatures	Highly Likely	Negligible	Significant	More than 24 hours	Less than 1 week	3.3
Fog	Highly Likely	Limited	Extensive	More than 24 hours	Less than 24 hours	2.4
Heavy Rain/Thunderstorm/ Hail/Lightning	Highly Likely	Limited	Extensive	More than 24 hours	Less than 24 hours	2.4
Winter Storm	Highly Likely	Negligible	Limited	More than 24 hours	Less than 24 hours	2.2
Tornado	Occasional	Negligible	Extensive	More than 24 hours	Less than 6 hours	2.2
Soil Hazards						
Erosion	Likely	No Data	No Data	No Data	No Data	1.9
Expansive Soils	Occasional	No Data	No Data	No Data	No Data	1.3
Landslide	Occasional	Limited	Limited	12 to 24 hours	Less than 6 hours	2.0
Land Subsidence	Highly Likely	No data	Extensive	No Data	No Data	2.0
Volcano	Unlikely	Negligible	Extensive	Less than 6 hours	Less than 1 week	2.0
Wildfire	Highly Likely	Critical	Extensive	12 to 24 hours	Less than 1 week	3.65

Geographic Extent

Limited: Less than 10% of planning area

Significant: 10-50% of planning area

Extensive: 50-100% of planning area

Probability of Future Occurrences

Highly Likely: Near 100% chance of occurrence in next year, or happens every year

Likely: Between 10 and 100% chance of occurrence in next year, or has a recurrence interval of 11 to 100 years

Unlikely: Less than 1% chance of occurrence in the next 100 years, or has a recurrence interval of greater than every 100 years

Magnitude/Severity

Catastrophic-More than 50 percent of property severely damage; shutdown of facilities for more than 30 days; and/or multiple deaths

Critical-25-50 percent of property severely damaged; shutdown of facilities for at least two weeks; and/or injuries/or illnesses result in permanent disability

Limited-10-25 percent of property severely damaged; shutdown of facilities for more than a week; and/or injuries/illnesses treatable do not result in permanent disability

Negligible-Less than 10 percent of property severely damaged, shutdown of facilities and services for less than 24 hours; and/or injuries/illnesses treatable with first aid

Hazard	0.3	0.3	0.2	0.1	0.1	Overall Risk
	Probability	Impact	Spatial Extent	Warning Time	Duration	
Significance Low: minimal potential impact Medium: moderate potential impact High: widespread potential impact						

DISASTER DECLARATION HISTORY

Federal and/or state disaster declarations may be granted when the severity and magnitude of an event surpasses the ability of the local government to respond and recover. Disaster assistance is supplemental and sequential. When the local government's capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. Should the disaster be so severe that both the local and state governments' capacities are exceeded, a federal emergency or disaster declaration may be issued allowing for the provision of federal assistance.

The federal government may issue a disaster declaration through FEMA, the U.S. Department of Agriculture (USDA), and/or the Small Business Administration (SBA). FEMA also issues emergency declarations, which are more limited in scope and without the long-term federal recovery programs of major disaster declarations. The quantity and types of damage are the determining factors.

A USDA declaration will result in the implementation of the Emergency Loan Program through the Farm Services Agency. This program enables eligible farmers and ranchers in the affected county as well as contiguous counties to apply for low interest loans. A USDA declaration will automatically follow a major disaster declaration for counties designated major disaster areas and those that are contiguous to declared counties, including those that are across state lines. As part of an agreement with the USDA, the SBA offers low interest loans for eligible businesses that suffer economic losses in declared and contiguous counties that have been declared by the USDA. These loans are referred to as Economic Injury Disaster Loans.

Fresno is among the many counties in California that are susceptible to disaster. Details on federal and state disaster declarations were obtained by the FEMA, and CA-OES and compiled in chronological order in **Table 10. Fresno County Disaster Declaration: State and Federal Declarations, 1950-2024.** A review of state and federal declared disasters indicates that Fresno County received 51 state declarations between 1950 and January 2024, 33 of which also received federal disaster declarations. USDA declarations for the planning area are discussed in the Agricultural Hazards Section.

This disaster history (combined federal and state) suggests that Fresno County experiences a major event worthy of a disaster declaration every 1.5 years. The County has a 68 percent chance of receiving a disaster declaration in any given year, which is up nearly double from 39 percent in the previous plan update in 2018. Except for the declarations for earthquake, wildfire, and epidemic/pandemic due to the COVID-19 pandemic in 2019/2020, every declaration resulted directly or indirectly from severe weather. Most disaster-related injuries to people and damage to property and crops resulted from severe weather. However, the recent COVID-19 pandemic resulted in significant economic damage, hospitalizations, and loss of life compared to any other disaster related event. More information on the COVID-19 pandemic is summarized in the Pandemic/Epidemic hazard profile section.

Table 10. Fresno County Disaster Declaration: State and Federal Declarations, 1950-2024

Hazard Type	Disaster #	Year	State Declaration	Federal Declaration	Location	Damage*
Floods	CDO 50-01	1950	11/21/1950	N/A	Fresno County	9 deaths; $32,183,000
Floods	DR-47	1955	12/22/1955	12/23/55	Fresno County (statewide)	74. $200,000,000
Unseasonal and Heavy Rainfall	N/A	1957	5/20/1957	N/A	Fresno County (other cherry producing areas)	2 injuries. $6,000,000
Storm & Flood Damage	N/A	1958	4/2/1958	4/4/1958	Fresno County (statewide)	13. $24,000,000
Unseasonal and Heavy Rainfall	N/A	1959	9/17/1959	N/A	Fresno County (other Tokay grape producing areas)	2 deaths $100,000
Abnormally Heavy and Continuous Rainfall	N/A	1963	2/14/1964	N/A	Fresno County (and 50 other counties)	Unknown
1969 Storms	OEP 253-DR-CA	1969	1/25/1969	1/26/1969	Fresno County (and 39 other counties)	47 deaths 161 injuries $300,000,000
Freeze and Severe Weather Conditions	N/A	1972	4/17/1972	N/A	Fresno County (and 16 other counties)	$111,517,260
Drought	N/A	1976	2/9/1979	N/A	Fresno County (and 30 other counties)	$2,664,000,000
Rains Causing Agricultural Losses	N/A	1982	10/26/1982	N/A	Fresno County (and 10 other counties)	$345,195,974
Winter Storms	DR-682	1982/1983	3/15/1983	2/9/1983	Fresno County (and 43 other counties)	$523,617,032

Hazard Type	Disaster #	Year	State Declaration	Federal Declaration	Location	Damage*
Coalinga Earthquake	DR-682	1983	5/02/1983	5/3/1983	Fresno County	No deaths 47 injuries $31,076,300
Storms	DR-758	1986	2/26/1986	2/18/1986	Fresno County (and 38 counties)	13 deaths 67 injuries $407,538,904
Wildland Fires	N/A	1987	9/03/1987	N/A	Fresno County (and 23 other counties)	3 deaths 76 injuries $18,000,00
Freeze	DR-894	1990	1/11/1991	2/11/1991	Fresno County (and 32 counties)	$856,329,675
Late Winter Storms	DR-979	1992	1/21/1993	1/15/1993	Fresno County (and 23 other counties)	20 deaths 10 injuries $600,000,000
Severe Winter Storms	DR-1044	1995	1/17/1995	1/13/1995	Fresno County (and 44 other counties)	11 deaths $741,400,000
Late Winter Storms	DR-1046	1995	N/A	1/10/1995	Fresno County (and all other counties except Del Norte)	17 deaths $1,100,000,000
January 1997 Floods	DR-1155	1997	1/5/1997	1/4/1997	Fresno County (and 46 other counties)	8 deaths $1,800,000,000
Severe Winter Storms and Flooding	DR-1203	1998	N/A	2/9/1998	Fresno County (and 39 other counties)	17 deaths $550,000,000
Freeze	DR-1267	1998-1999	N/A	2/7/1999	Fresno County (and 7 other counties)	Unknown
Severe Freeze	DR-1689	2007	N/A	3/14/07	Fresno County (and 11 other counties)	$1,400,000,000

Hazard Type	Disaster #	Year	State Declaration	Federal Declaration	Location	Damage*
Goose Fire	FM-5140	2016	7/30/2016	8/8/2016	Fresno County	Unknown
Floods	CDO 50-01	1950	11/21/1950	N/A	Fresno County (statewide)	9 deaths $32,183,000
Floods	DR-47	1955	12/22/1955	12/23/1955	Fresno County (statewide)	74 deaths $200,000,000
Unseasonal and Heavy Rain	N/A	1957	5/20/1957	N/A	Fresno County (other cherry producing areas)	2 injuries $6,000,000
Storm & Flood Damage	N/A	1958	4/2/1958	4/4/1958	Fresno County (statewide)	13 deaths $24,000,000
Unseasonal and Heavy Rainfall	N/A	1959	4/2/1958	4/4/1958	Fresno County (statewide)	13 deaths $24,000,000
Unseasonal and Heavy Rainfall	N/A	1959	9/17/1959	N/A	Fresno County (other tokay grape producing areas)	2 deaths $100,000
Abnormally Heavy and Continuous Rainfall	N/A	1963	2/14/1964	N/A	Fresno County (and 50 other counties)	Unknown
969 Storms	OEP 253-DR-CA	1969	1/25/1969	1/26/1969	Fresno County (and 39 other counties)	47 deaths 161 injuries $300,000,000
Freeze and Severe Weather Conditions	N/A	1972	4/17/1972	N/A	Fresno County (and 16 counties)	$111,517,260
Drought	N/A	1976	2/9/1976	N/A	Fresno County (and 30 other counties)	$2,664,000,000
Rains Causing Agricultura Losses	N/A	1982	10/26/1982	N/A	Fresno County (and 10 other counties)	$345,195,974
Winter Storms	DR-682	1982-1983	3/15/1983	2/9/1983	Fresno County (and 43	$523,617,032

Hazard Type	Disaster #	Year	State Declaration	Federal Declaration	Location	Damage*
					other counties)	
Coalinga Earthquake	DR-682	1983	5/02/1983	5/3/1983	Fresno County	No deaths 47 injuries $31,076,300
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Freeze	DR-894	1990	1/11/1991	2/11/1991	Fresno County (and 32 other counties)	$856,329,675
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Severe Winter Storms	DR-1044	1995	1/17/1995	1/13/1995	Fresno County (and 44 other counties)	11 deaths $741,400,000
Late Winter Storms	DR-1046	1995	N/A	1/10/1995	Fresno County (and all other counties except Del Norte)	17 deaths $1,800,000,000
January 1997 Floods	DR-1155	1997	1/5/1997	1/4/1997	Fresno County (and 46 other counties)	8 deaths $1,800,000,000
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Freeze	DR-1689	2007	N/A	3/14/2007	Fresno County (and 7 other counties)	Unknown
Severe Freeze	DR-1689	2007	N/A	3/14/2007	Fresno County (and 11	$1,400,000,000

Hazard Type	Disaster #	Year	State Declaration	Federal Declaration	Location	Damage*
					other counties)	
Epidemic/Pandemic	DR-4482-CA	2020	N/A	3/22/20	Fresno County (statewide)	Unknown
Wildfires	DR-4569-CA	2020	N/A	10/16/20	Fresno County (and 7 other counties)	Unknown
Severe Winter Storms, Flooding, Landslides, Mudslides	DR-4683-CA	2023	N/A	N/A	Fresno County	Unknown
Severe Winter Storms, Straight-Line Winds, Flooding, Landslides	DR-4699-CA	2023	N/A	4/3/2023	Fresno County	Unknown

Source: California Governor's Office of Emergency Services, www.oes.ca.gov/

**Damage amount and deaths and injuries reflect totals for all impacted counties*

HAZARD PROFILES

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

The hazards identified in the Hazard Identification section are profiled individually in this section. In general, information provided by planning team members is integrated into this section with information from other data sources. These profiles set the stage for the Vulnerability Assessment section, where the vulnerability is quantified, where possible, for each of the priority hazards.

Each hazard is profiled in the following format:

- **Hazard/Problem Description**—This section gives a description of the hazard and associated issues followed by details on the hazard specific to the Fresno County planning area. Where known, this includes information on the hazard extent, seasonal patterns, speed of onset/duration, and magnitude and/or secondary effects.
- **Extent –** This section gives a description of the potential strength or magnitude of the hazard as it pertains to Fresno County. The geographic extent or location of the hazard is also discussed.
- **Past Occurrences**—This section contains information on historical incidents, including impacts where known. The extent or location of the hazard within or near the Fresno County planning area is also included here. Historical incident worksheets were used to capture information from participating jurisdictions on past occurrences.
- **Likelihood of Future Occurrence**—The frequency of past events is used in this section to gauge the likelihood of future occurrences. Where possible, frequency was calculated based on existing data. It was determined by dividing the number of events observed by the number of years on record and multiplying by 100. This gives the percent chance of an event happening in any given year (e.g., three droughts over a 30-year period equates to a 10 percent chance of a drought in any given year). The likelihood of future occurrences is categorized into one of the following classifications:
    - **Highly Likely**—Greater than 90 percent annual probability of occurrence
    - **Likely**—Between 50 and 90 percent annual probability of occurrence
    - **Occasional**—Between 1 and 49.9 percent annual probability of occurrence
    - **Unlikely**—Less than 1 percent annual probability of occurrence
- **Climate Change Considerations** - This describes the potential for climate change to affect the frequency and intensity of the hazard in the future.

The Vulnerability Assessment section has more detail on the County's total exposure to natural hazards, considering assets at risk, critical facilities, and future development trends. Where feasible the vulnerability of people, property, critical facilities, the natural environment, and future development are considered for each hazard.

The following sections provide profiles of the natural hazards that the HMPC identified in Identifying Hazards section. The hazards follow alphabetically.

SUMMARY OF CLIMATE CHANGE IMPACTS IN CALIFORNIA

Overall, the planet is warming faster than ever. Heat trapping gases—such as carbon dioxide and methane—are building up in our atmosphere, creating a blanket around the globe that traps heat, like a greenhouse. This is also known as global warming, even though many of its effects go far beyond temperature changes. Global warming pollution comes from the use of fossil fuels such as oil, coal, and natural gas, and from agricultural and industrial activities. We burn fossil fuels to generate energy, to power vehicles and other transportation such as planes, and to manufacture countless products. The extra trapped heat has been changing important aspects of our climate and the water cycle, which is the movement of water on our planet.

Summary of climate change trends and projections are listed below:

- Higher temperatures
- Increasing evapotranspiration (water that evaporates or is used by plants)
- Longer and more severe droughts
- Declining snowpack
- More intense rainstorms
- More frequent and extensive wildfires
- Sea level rise[1]

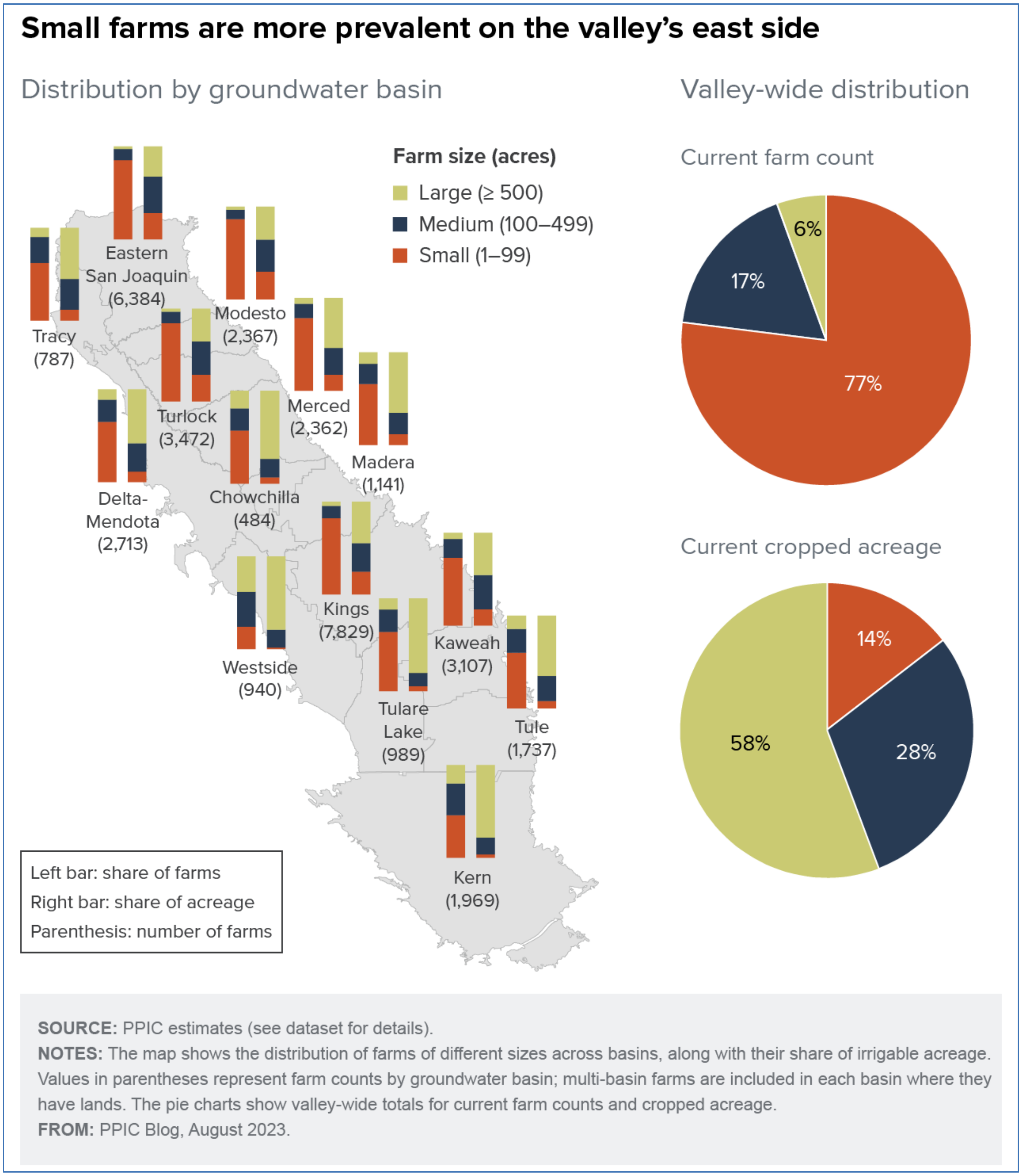
[1] https://www.ucsusa.org/sites/default/files/2020-10/climate-change-in-SJValley.pdf

AGRICULTURAL HAZARDS

HAZARD/PROBLEM DESCRIPTION

Located in the Central San Joaquin Valley, Fresno County's farming and agricultural industry is ranked as one of the top agriculture-producing counties in California and the country. Farming and agriculture-related businesses are a significant component of the local economy and are responsible for 20 percent of all jobs in the Fresno area. The following figure shows the type of farms across the San Joaquin Valley.

Figure 4. Farm Size in the San Joaquin Valley



Source: Public Policy Institute of California

In Fresno County, according to the USDA 2022 agricultural census, there were a total of 4,427 farms encompassing 1,659,451 acres of land, which brings the average size of a farm to approximately 375 acres. The market value of agricultural products sold reached a staggering $6,995,967,000, averaging $1,580,295 per farm. Out of the total farms, 3,823 were dedicated to cropland, covering 1,182,023 acres. According to the Fresno County Agricultural Commissioner the County has approximately 678,103 acres of prime agricultural land, 404,083 acres of farmland of statewide importance, and 825,276 acres of grazing land (see **Table 11. Fresno County's Farmland Inventory** below). An updated source for the information below was not available during the latest plan update.

Table 11. Fresno County's Farmland Inventory

Soil Category	Acres
Prime Farmland	678,103
Farmland of Statewide Importance	404,083
Unique Farmland	33,653
Farmland of Local Importance	131,341
Grazing Land	825,276
Urban and Built-Up Land	124,025
Water	4,915
Other Land	116,094

Source: Fresno County Agricultural Commissioner 2017

According to the 2022-2023 Fresno County Agricultural Crop and Livestock Report, the total gross value of agricultural commodities in Fresno County in 2021 was over $8 billion. The County's leading agricultural products included grapes, almonds, pistachios, milk, poultry, cattle and calves, tomatoes, peaches, garlic, and mandarins.

Fresno's top ten crops have seen a shift between 1995 and 2022. However, the crops have mostly remained constant, their ranks in the county have changed in the intervening 20 years. A list of Fresno County's top leading crops is described in **Table 12. Fresno County's Ten Leading Crops**.

Table 12. Fresno County's Ten Leading Crops

Crop	2022 Rank	2022 Dollar Value	2015 Rank	2014 Rank	2005 Rank	1995 Rank
Almonds	2	$1,141,308,000	1	1	2	7
Grapes	1	$1,241,178,000	2	2	1	2
Poultry	5	$538,305,000	3	3	7	3
Cattle and Calves	6	$488,665,000	4	5	5	8
Tomatoes	7	$429,263,000	5	6	4	4
Milk	4	$655,138,000	6	4	3	5
Peaches	8	$368,392,000	7	9	8	12

Crop	2022 Rank	2022 Dollar Value	2015 Rank	2014 Rank	2005 Rank	1995 Rank
Garlic	9	$351,875,000	8	8	14	11
Mandarins	10	$240,684,000	9	N/A	N/A	N/A
Oranges	N/A	N/A	10	11	10	10
Pistachios	3	$705,941,000	N/A	N/A	N/A	N/A

Source: State of California Department of Conservation Farmland Mapping and Monitoring Program, www.conservation.ca.gov/

According to the HMPC, agricultural losses occur on an annual basis and are usually associated with severe weather events, including heavy rains, floods, hail, freeze, drought or disease outbreaks. The State of California Hazard Mitigation Plan attributes most of the agricultural disasters statewide to drought, freeze, and insect infestations. Other agricultural hazards include fires, crops and livestock disease, noxious weeds, and contamination of animal food and water supplies.

Fresno County is threatened by several insects that, under the right circumstances, can cause severe economic and environmental harm to the agricultural industry. Insects of concern to plants and crops include the medfly, peach fruit fly, Mexican fruit fly, guava fruit fly, oriental fruit fly, melon fly, gypsy moth, Japanese beetle, glassy-winged sharpshooter, paper wasp, and Turkestan roach. Livestock disease can also cause large-scale economic losses in any area that raises large amounts of livestock.

Noxious weeds, which are any plant that is or is liable to be troublesome, aggressive, intrusive, detrimental, or destructive to agriculture, silviculture, or important native species and that is difficult to control or eradicate, are also of concern. Noxious weeds within the planning area include yellow starthistle, purple loosestrife, and Japanese dodder.

Noxious weeds have been introduced in the planning area by a variety of means, including through commercial nurseries. An absence of natural controls combined with the aggressive growth characteristics and unpalatability of many of these weeds allows these weeds to dominate and replace more desirable native vegetation. Negative effects of weeds include the following:

- Loss of wildlife habitat and reduced wildlife numbers
- Loss of native plant species
- Reduced livestock grazing capacity
- Increased soil erosion and topsoil loss
- Diminished water quality and fish habitat
- Reduced cropland and farmland production
- Reduced land value and sale potential

Another threat to the agricultural industry is the wild hogs that run free in the eastern and western foothills of the County. These wild hogs can cause extensive agricultural crops and property damage to farms and private land. Wild hogs are known to carry and transmit 30 different virulent and bacterial diseases, as well as at least 37 parasites both to humans and livestock. E. coli contamination of leafy vegetables has been linked to wild hogs foraging in vegetable fields.

In addition to issues associated with wild hogs, the proper management of other wildlife within the planning area is of significant concern to the County Department of Agriculture. Wildlife such as coyotes, ground squirrels, and others can cause extensive livestock, crop, and property damage. Such wildlife is also known to carry and transmit diseases (e.g., bubonic plague and rabies) to livestock and domestic animals as well as to humans.

According to the Fresno County Operational Area Master Emergency Services Plan, the consequences of agricultural disasters to the planning area include ruined plant crops, dead livestock, ruined feed and agricultural equipment, monetary loss, job loss, and possible multi-year effects (i.e., trees might not produce if damaged, loss of markets, food shortages, increased prices, possible spread of disease to people, and loss or contamination of animal products). When these hazards cause a mass die-off of livestock, other issues arise that include the disposal of animals, depopulation of affected herds, decontamination, and resource problems. Those disasters related to severe weather may also require the evacuation and sheltering of animal populations. Overall, any type of severe agricultural disaster can have significant economic impacts on the agricultural community as well as the entire Fresno County planning area.

EXTENT

Historically, Fresno County has received disaster declarations from the USDA for a variety of incident types, including drought, hail, rain, cold and wind. Fresno County's agriculture industry is a multi-billion-dollar enterprise; a long-term, widespread agricultural hazard could have impacts in the hundreds of millions of dollars, if not billions of dollars.

PAST OCCURRENCES

Based on information from the USDA, Fresno County received 11 USDA disaster declarations between 1991 and 2024 (see **Table 13. Fresno County's USDA Disaster Declarations**). Between January of 2018 and 2024, Fresno County received seven additional USDA Declaration for drought, frost and freeze, excessive rain, moisture, humidity, and hail. All the declarations were associated with drought or severe weather events; none were related to agricultural disease.

Table 13. Fresno County's USDA Disaster Declarations

Incident Type	Incident Date	Damage ($)
Short-term Drought	2009	$164,893,718
Severe Spring Storm: Rain, Hail, High Winds	6/4 & 5/2009	$4,533,107
Lack of Chill Hours	2014	$53,534,295
Severe Long-Term Drought	2012-2016	Not Quantified
Excessive Rain, Moisture, Humidity	2019	Not Quantified
Excessive Rain, Moisture, Humidity, Hail	2019	Not Quantified
Drought	2020	Not Quantified
Drought	2021	Not Quantified

Incident Type	Incident Date	Damage ($)
Frost, Freeze	2021	Not Quantified
Drought	2021	Not Quantified
Drought	2022	Not Quantified

Source: USDA, Farm Service Agency, Disaster Designation Information

Historical occurrences identified by the HMPC include the following:

Fresno County

- **1970s**: A local outbreak of scabies occurred.
- **1991**: There was an outbreak of bovine tuberculosis in Fresno County.
- **1997/1998**: One bird in downtown Fresno was discovered with exotic Newcastle disease, a contagious and fatal viral disease affecting all species of birds that does not affect humans. The bird and all chickens within a one-kilometer radius were destroyed.
- **1998**: Freeze resulted in almost $70 million in losses, including crop loss, broken water pipes and water damage, damaged water treatment plants, and damaged fire sprinkler systems. Other impacts included almost 18,000 applications for services and assistance and over 1,700 unemployment insurance claims filed.
- **1999**: Severe weather caused a crop loss of over $89 million.
- **2006**: Fresno County growers were impacted by adverse spring weather with $21 million in losses.
- **2006**: Twenty-one days of over 100 degrees, including three days over 113 degrees, caused crop, livestock, poultry, and milk production losses of $93 million.
- **2008**: A Fresno County dairy was quarantined after state and federal agriculture officials found bovine tuberculosis in five cows.
- **2009**: Short term drought with no or little allocation to the west side. Springtime hail brought damage to trees along the Kings River corridor.
- **2012 - 2016**: Long-term western states drought. Billions in losses.
- **2014**: Warm winter and spring brought a lack of chill hours affecting fruit set in cherry crop.
- **2019**: no description available
- **2020**: no description available
- **2021**: no description available
- **2022**: Highly Pathogenic Avian Influenza (HPAI) cases were confirmed in California commercial flock across the state including Fresno County. HPAI is a highly contagious and often datal disease in birds.
- **2023**: Highly Pathogenic Avian Influenza (HPAI) cases were detected in a commercial flock in Fresno County. Infected flocks were euthanized to prevent further spread and the location was under quarantine.

Neighboring Counties

- **2002**: Merced County had an outbreak of avian influenza H5 (which is different from the severe variety found in Asia).
- **2002/2003**: After more than 10 years without a case of bovine tuberculosis in California, two dairy herds in Tulare County and one in Kings County were infected with bovine tuberculosis. All three herds were quarantined, 152,000 cattle were tested, 8,000 cattle destroyed, and the affected premises were cleaned and disinfected.
- **2002/2003**: There was an outbreak of exotic Newcastle disease in Southern California.
- **2022**: Highly Pathogenic Avian Influenza (HPAI) cases were confirmed in California commercial flock.
- **2023**: Highly Pathogenic Avian Influenza (HPAI) cases were confirmed in California commercial flock.

According to data provided by the Farm Subsidy Database, total indemnities, and premium subsidies of the crop insurance program in the U.S., 1995-2022 include $172,457,906,536 total indemnities and $123,784,169,781 in total premium subsidies. The major cause behind crop yield or revenue that prompts an indemnity payment are largely due to natural hazard events such as drought, hail, or excessive rain. The top 10 national causes of loss with the largest indemnity payments from 1995 to 2022 are described in **Table 14. Fresno County Indemnities by Hazard (1995-2022)**.

Table 14. Fresno County Indemnities by Hazard (1995-2022)

Cause of Loss	Indemnities Paid 1995-2022	Percent of Total Indemnities
Drought	$60,391,798,966	35.0%
Excess Moisture/Precipitation	$42,820,224,318	24.8%
GRP/GRIP/ARPI/SCO/STAX/MP/HIPWI Crops Only*	$13,350,536,562	7.7%
Hail	$10,773,528,422	6.2%
Heat	$8,509,718,490	4.9%
Decline in Price	$7,797,184,357	4.6%
Freeze	$5,143,337,715	3.0%
Wind/Excess Wind	$3,546,363,004	2.1%
Cold Wet Weather	$3,284,833,480	1.9%
Hot Wind	$2,867,328,212	1.7%

Source: EWG, from USDA Risk Management Agency, Cause of Loss Historical Data Files.

** Types of insurance policies; details on the RMA website. Indemnities for GRP/GRIP crops between 1995-2013; indemnities for ARPI, SCO, STAX, MP, HIP, WI crops 2014-2022, indemnities for ECO crops 2021 and 2022.*

In Fresno County, the total amount of indemnities paid from 1995-2022 is 1,244,730,687. The breakdown of indemnities by crop and by cause are described in **Table 15. Fresno County**

Indemnities by Crops (1995-2022) and **Table 16. Fresno County Indemnities by Cause of Loss (1995-2022)**.

Table 15. Fresno County Indemnities by Crops (1995-2022)

Crops	Indemnities Percent from 1995-2022
Other Crops	37.42%
Cotton Ex Long Staple	27.02%
Almonds	17.83%
Grapes	6.59%
Pistachios	6.51%
Tomatoes	4.64%

Source: EWG Farm Subsidy Database || *Fresno County, California Crop Insurance Subsidies*

Table 16. Fresno County Indemnities by Cause of Loss (1995-2022)

Cause of Loss	Indemnities Percent from 1995-2022
Failure of Irrigation Supply	29.68%
Other Causes	20.37%
Heat	18.67%
Excess Moisture/Precipitation	16.49%
Freeze	8.81%
Cold Wet Weather	5.97%

Source: EWG Farm Subsidy Database || *Fresno County, California Crop Insurance Subsidies*

LIKELIHOOD OF FUTURE OCCURRENCES

Highly Likely—As long as the hazards discussed in this section continue to be an ongoing concern to the Fresno County planning area, the potential for agricultural losses remains.

CLIMATE CHANGE CONSIDERATIONS

As climate change has progressed, noticeable changes have occurred with the climate and weather patterns across the globe. Weather events have become more numerous and more severe. Changes in weather patterns can have dramatic impacts on the ecosystem, including agriculture systems; more severe impacts can be expected into the future.

AVALANCHE

HAZARD/PROBLEM DESCRIPTION

Avalanches occur when loading of new snow on a slope increases stress at a rate faster than strength develops, and the slope fails. Critical stresses develop more quickly on steeper slopes and where deposition of wind-transported snow is common. Most avalanches occur during and shortly after storms. This hazard generally affects a small number of people, such as snowboarders, skiers, and hikers, who venture into backcountry areas during or after winter storms. Roads and highway closures, damaged structures, and destruction of forests are also a direct result of avalanches. Avalanches typically occur above 8,000 feet and on slopes ranging between 25- and 50-degrees incline. The eastern portion of Fresno County is in the Sierra National Forest in a high alpine environment and has potential for areas above 8,000 on slopes ranging between 25- and 50-degrees incline. When avalanches occur, they can travel as fast as 200 miles per hour and can spontaneously. [2]The combination of steep slopes, abundant snow, weather, snowpack, and an impetus to cause movement creates avalanches. Areas prone to avalanche hazards include hard to access areas deep in the backcountry. Avalanche hazards exist in eastern Fresno County in the Sierras, where combinations of the above criteria occur.

EXTENT

Small - Based on this information, the geographic extent rating for avalanches in Fresno County is limited and only impacts the mountainous area within the eastern part of the county. Occasional death and injury might occur to persons in the backcountry.

PAST OCCURRENCES

Historically, avalanches occur within the County between the months of December and April, following snowstorms. According to the HMPC, there has been some historical avalanche activity involving people, but specific details are unknown.

LIKELIHOOD OF FUTURE OCCURRENCES

Likely—Injuries and loss of life from an avalanche are usually due to people recreating in remote areas during the time of the avalanche. Given the topography and amount of snow falling on an annual basis in eastern Fresno County, avalanches will continue to occur, but damage from avalanches should continue to be limited.

CLIMATE CHANGE CONSIDERATIONS

In the future, the likelihood and nature of avalanches may be affected by climate change. As winter is taking longer to descend, weaker snow accumulates at the very bottom of the snowpack. As more snow piles on top of the weak layer, and temperatures remain warm, the upper, moisture- laden layers

[2] Avalanches, facts and information (nationalgeographic.com)
https://www.nationalgeographic.com/environment/article/avalanches

become vulnerable to sliding and create a delicate situation. More extreme precipitation events that deposit large amounts of snow in a short period of time could also periodically increase the potential for large avalanches.

DAM FAILURE

Dams are manmade structures built for a variety of uses, including flood protection, power generation, agriculture, water supply, and recreation. When dams are constructed for flood protection, they usually are engineered to withstand a flood with a computed risk of occurrence. For example, a dam may be designed to contain a flood at a location on a stream that has a certain probability of occurring in any one year. If prolonged periods of rainfall and flooding occur that exceed the design requirements, that structure may be overtopped and fail. Overtopping is the primary cause of earthen dam failure in the United States.

Dam failures can also result from any one or a combination of the following causes:

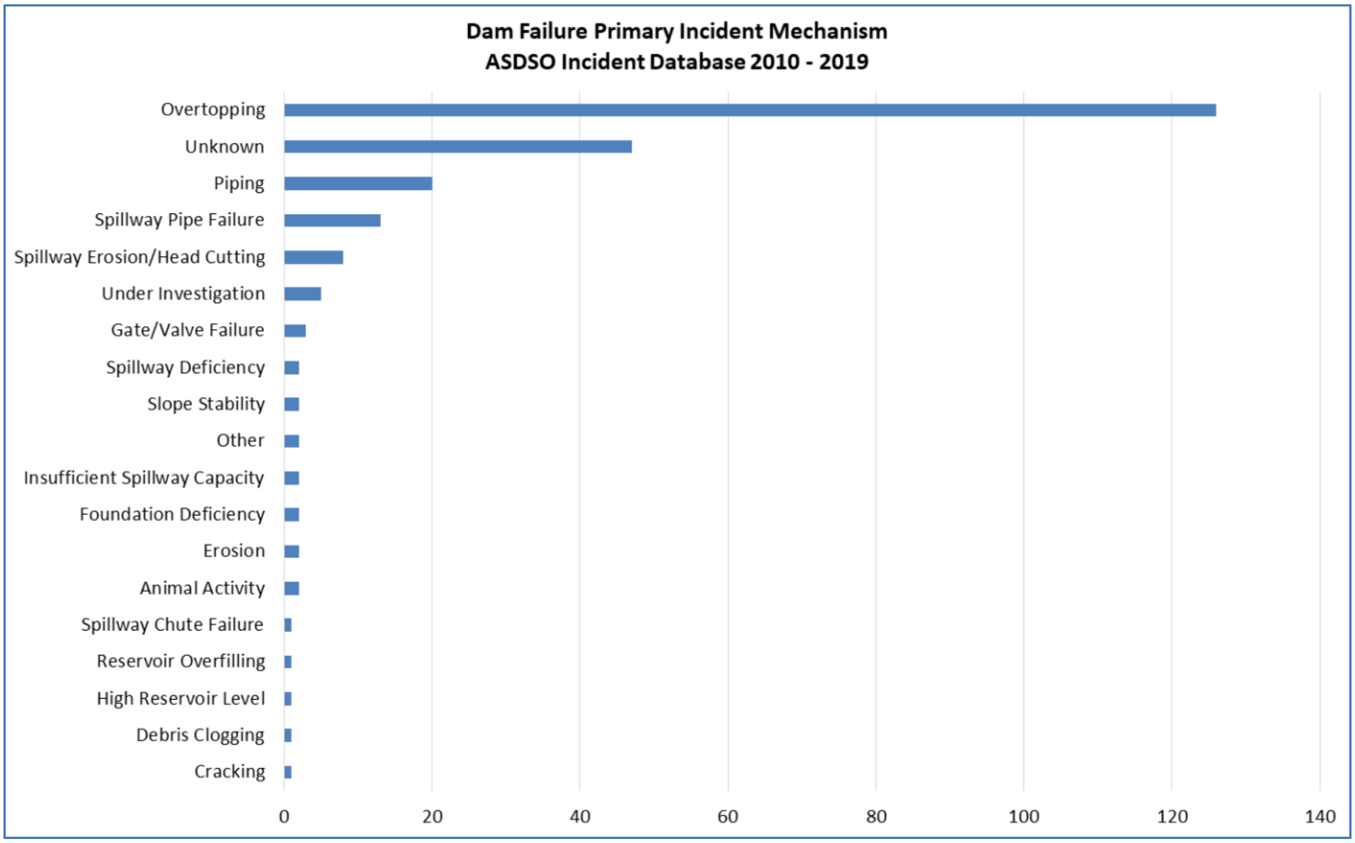
- Earthquake
- Inadequate spillway capacity resulting in excess overtopping flows
- Internal erosion caused by embankment or foundation leakage or piping or rodent activity
- Improper design
- Improper maintenance
- Negligent operation
- Failure of upstream dams on the same waterway

According to the Association of State Dam Safety Officials, the causes of dam failures are most likely due to one of five reasons:

1. **Overtopping**: caused by water spilling over the top of a dam. Overtopping of a dam is often a precursor of a dam failure. These account for approximately 34 percent of all U.S. dam failures.
2. **Foundation Defects**: including settlement and slope instability, cause about 30 percent of all dam failures.
3. **Cracking**: caused by movements like the natural settling of a dam.
4. **Inadequate** maintenance and upkeep.
5. **Piping**: when seepage through a dam is not properly filtered and soil particles continue to progress, and form sink holes in the dam. About 20 percent of U.S. dam failures have been caused by piping.

The percentage of dam failure causes is shown in **Figure 2. Dam Failure Primary Incident Mechanism, ASDSO Incident Database (2010-2019)**, with overtopping accounting for the majority of the incidents and cracking accounting for the least percentage of incidents.

Figure 5. Dam Failure Primary Incident Mechanism, ASDSO Incident Database (2010-2019)



Source: ASDSO Incident Database

Water released by a failed dam generates tremendous energy and can cause a flood that is catastrophic to life and property. A catastrophic dam failure could challenge local response capabilities and require evacuations to save lives. Impacts to life safety will depend on the warning time and the resources available to notify and evacuate the public. Major loss of life could result as well as potentially catastrophic effects to roads, bridges, and homes. Associated water quality and health concerns could also be issues. Factors that influence the potential severity of a full or partial dam failure are the amount of water impounded; the density, type, and value of development and infrastructure located downstream; and the speed of failure. In general, there are three types of dams with different failure characteristics, described below:

- **Concrete arch or hydraulic fill**: A concrete arch or hydraulic fill dam can fail almost instantaneously: the flood wave builds up rapidly to a peak then gradually declines.
- **Earth-rockfill**: earth-rockfill dam fails gradually due to erosion of the breach: a flood wave will build gradually to a peak and then decline until the reservoir is empty.
- **Concrete gravity**: concrete gravity dam can fail instantaneously or gradually with a corresponding buildup and decline of the flood wave.

EXTENT

Extensive - According to the Fresno County Operational Area Master Emergency Services Plan, there are several hundred dams in Fresno County constructed for flood control, irrigation storage, electrical generation, recreation, and stock watering purposes. The National Inventory of Dams identifies 52 dams (see **Table 17. Fresno County and Surrounding Areas Dams)** that are located in or are of significance to Fresno County. Of these dams, 32 are considered high hazard, 4 are significant hazard, and 14 are low hazard. Several are located within Madera County and Kern County; however, they pose a threat to Fresno County based on the topography and hydrological flow characteristics of the area. According to the Fresno County Flood Control District, in a worst-case scenario of a hypothetical failure of a dam or its critical structures, such as spillways or outlet gates, the areas that would be impacted by flooding would including areas eat of the Highway 168, Areas to the west of Highway 99, and any neighborhood or business touching Highway 41. [3]

Table 18. Fresno County Dams details the dams affecting Fresno County. The majority of these dams are in the San Joaquin River or Kings River watersheds in the eastern part of the county. Both incorporated and unincorporated areas are at risk of damage from flooding in the event of a dam failure, however, the City of Fresno, Clovis, Sanger and the eastern unincorporated county are at greater risk. Generally, the areas at risk are large urban and rural areas downstream and below the dams on the valley floor. There have not been any failures of major dams in Fresno County; future failures are more likely to occur with smaller dams, with minimal or no damage potential. Based on this information, the geographic extent rating for dam failure in Fresno County is extensive.

Table 17. Fresno County and Surrounding Areas Dams

Hazard	Dam Name	City	Owner Name	Dam Type	NID Storage (Acre-Feet)
High	Alluvial Drain Detention	Clovis	Fresno Metropolitan Flood Control District	Earth	832.7
High	Balsam Meadow Forebay Main	Big Creek	Southern California Edison Company	Rockfill	1,960
High	Big Creek Dam No.1	Big Creek	Southern California Edison Company	Concrete/Arch, Gravity	89,800
High	Big Creek Dam No.3	Big Creek	Southern California Edison Company	Concrete/Gravity/Rockfill	89,800
High	Big Creek Dam No.6	Big Creek	Southern California Edison Company	Concrete/Arch	1,726

[3] The areas of Fresno at risk of flooding if a dam breaks | YourCentralValley.com | KSEE24 and CBS47 Fresno CA https://www.yourcentralvalley.com/digital-exclusive/the-areas-of-fresno-at-risk-of-flooding-if-a-dam-breaks/

Hazard	Dam Name	City	Owner Name	Dam Type	NID Storage (Acre-Feet)
High	Big Creek Dam No.7	Auberry	Southern California Edison Company	Concrete/Gravity	35,000
High	Big Dry Creek	Clovis	Fresno Metropolitan Flood Control District	Earth	30,200
High	Courtright	Balch Camp	Pacific Gas and Electric Company	Rockfill	134,342
High	Crane Valley	North Fork	Pacific Gas and Electric Company		45,410
High	Fancher Creek	Clovis	Fresno Metropolitan Flood Control District	Earth	9,600
High	Fancher Creek Detention	Fresno	Fresno Metropolitan Flood Control District	Earth	1,891
High	Florence Lake	Mono Hot Springs	Southern California Edison Company	Concrete/Multi Arch	68,000
High	Fresh Water Pond**	Old River	CalMat	Earth	46
High	Friant	Fresno	U.S. Bureau of Reclamation	Concrete, Gravity	520,500
High	Friant Dike 3	Fresno	U.S. Bureau of Reclamation	Earth	555,500
High	Friant Millerton Road Embarkment A	Fresno	U.S. Bureau of Reclamation	Earth	555,500
High	Giffen Reservoir	Fresno	Harris Farms Inc	Earth	900
High	Hume Lake	Barton’s Resort	USDA Forest Service	Concrete	0
High	Little Panoche Detention	Oro Loma	U.S. Bureau of Reclamation	Earth	13,240
High	Mammoth Pool*	Big Creek	Southern California	Earth	122,175

Hazard	Dam Name	City	Owner Name	Dam Type	NID Storage (Acre-Feet)
			Edison Company		
High	Manzanita Diversion	North Fork	Pacific Gas and Electric Company	Concrete/Arch	168
High	Pine Flat Dam	Sanger	USACE-Sacramento District	Gravity	1,091,700
High	Red Bank	Clovis	Fresno Metropolitan Flood Control District	Earth	1,100
High	Redbank Creek Detention Basin	Fresno	Fresno Metropolitan Flood Control District	Earth	940
High	Sand Creek	Orosi	Tulare Co Resources Managemen t Agency	Earth	1,050
High	Sequoia Lake		YMCA Inc	Earth	1,370
High	Shaver Dike	Shaver Lake	Southern California Edison Company	Concrete/Arch/Gravity	135,568
High	Shaver Lake	Shaver Lake	Southern California Edison Company	Concrete/Earth	135,568
High	Silt Pond	Coalinga	Granite Construction	Earth	25
High	Vermillion Valley	Mono Hot Springs	Southern California Edison Company	Earth	140,000
High	Wishon Main	Wishon Village	Pacific Gas and Electric Company	Rockfill	133,600
High	Mendota Diversion*	Firebaugh	Central Calif Irrigation District	Buttress	3,000
Significant	Balch Afterbay	Balch Camp	Pacific Gas and Electric Company	Concrete/Arch	325
Significant	Blach Diversion	Balch Camp	Pacific Gas and Electric Company	Concrete/Arch	1,295
Significant	Big Creek Dam No.5	Big Creek	Southern California	Concrete/Arch	74

Hazard	Dam Name	City	Owner Name	Dam Type	NID Storage (Acre-Feet)
			Edison Company		
Significant	Wishon Auxiliary No.1	Wishon Village	Pacific Gas and Electric Company	Concrete/Gravity	133,600
Low	Balsam Meadow Forebay Dike	Big Creek	Southern California Edison Company	Earth	1,960
Low	Bear Creek Diversion	Mono Hot Springs	Southern California Edison Company	Concrete/Arch	103
Low	Big Creek Dam No.3a	Big Creek	Southern California Edison Company	Concrete/Gravity/Rockfill	89,800
Low	Big Creek Dam No.4	Big Creek	Southern California Edison Company	Concrete/Arch	100
Low	Chilkoot*	Bass Lake	Pacific Gas and Electric Company	Rockfill	308
Low	Kerckhoff	Friant	Pacific Gas and Electric Company	Concrete/Arch	4,252
Low	Lemoore Div Weir		Lemoore Canal and Irrigation Company	Buttress	50
Low	Mono Creek Diversion	Mono Hot Springs	Southern California Edison Company	Concrete/Arch	45
Low	Mud	San Joaquin	James Irrigation District	Earth	304
Low	Portal Forebay Dike	Mono Hot Springs	Southern California Edison Company	Earth	390
Low	Portal Forebay Main	Mono Hot Springs	Southern California Edison Company	Earth/Rockfill	390
Low	Reynolds Weir	None	Laguna Irrigation District	Buttress	260

Hazard	Dam Name	City	Owner Name	Dam Type	NID Storage (Acre-Feet)
Low	San Joaquin No.3 Forebay*	North Fork	Pacific Gas and Electric Company	Earth	20
Low	Stinson Weir		Stinson Canal and Irrigation Company	Buttress	50
Low	Wishon Forebay*	Friant	Pacific Gas and Electric Company	Earth	69

Source: 2024; National Inventory of Dams Note: 1 acre-foot=326,000 gallons

Hazard: H=High, S=Significant, L=Low

**Madera County*

***Kern County*

Table 18. Fresno County Dams

Dam No.[4]	Dam Number		Owner Name	Dam Height	Reservoir Capacity	Certified Status	Condition Assessment	County
National ID No.	Lat.	Long.	Owner Type	Crest Type	Dam Type	Downstream Hazard	Reservoir Restrictions	Year Built
1017-5	**Alluvial Drain Detention**		Fresno Metropolitan Flood Control District	12	833	Certified	Satisfactory	Fresno
CA01358	36.86	-119.67	Park, sanitation, utility, or water district	134	ERTH	High	No	1994
95-2	**Balch Afterbay**		Pacific Gas and Electric Company	139	1,295	Certified	Satisfactory	Fresno
CA00336	36.91	-119.09	Private company, corporation, LLC, partnership	235	CORA	High	No	1928
104-42	**Balsam Meadow**		Southern California Edison	127	2,040	Certified	Satisfactory	Fresno
CA01283	37.16	-119.25	Private company, corporation, LLC, partnership	1,325	ROCK	High	No	1986
104-0	**Bear Creek Diversion**		Southern California Edison	55	103	Certified	Satisfactory	Fresno
CA00428	37.34	-118.98	Private company, corporation, LLC, partnership	241	CORA	Low	No	1927

[4] DAMS WITHIN JURISDICTION OF THE STATE OF CALIFORNIA DAMS LISTED ALPHABETICALLY BY COUNTY SEPTEMBER 2022 https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/All-Programs/Division-of-Safety-of-Dams/Files/Publications/Dams-Within-Jurisdiction-of-the-State-of-California-Listed-Alphabetically-by-County-September-2022.pdf

Dam No.[4]	Dam Number		Owner Name	Dam Height	Reservoir Capacity	Certified Status	Condition Assessment	County
National ID No.	Lat.	Long.	Owner Type	Crest Type	Dam Type	Downstream Hazard	Reservoir Restrictions	Year Built
104-4	**Big Creek No.4**		Southern California Edison	75	100	Certified	Satisfactory	Fresno
CA00430	37.2	-119.24	Private company, corporation, LLC, partnership	220	CORA	Low	No	1913
104-5	**Big Creek No.5**		Southern California Edison	58	42	Certified	Satisfactory	Fresno
CA00431	37.2	-119.31	Private company, corporation, LLC, partnership	153	CORA	Significant	No	1921
104-6	**Big Creek No.6**		Southern California Edison	140	993	Certified	Satisfactory	Fresno
CA00432	37.21	-119.33	Private company, corporation, LLC, partnership	485	CORA	Low	No	1923
104-22	**Big Creek No.7**		Southern California Edison	223	35,000	Certified	Satisfactory	Fresno
CA00440	37.15	-119.45	Private company, corporation, LLC, partnership	893	GRAV	Extremely High	No	1951
1017-2	**Big Dry Creek**		Fresno Metropolitan Flood Control District	50	30,200	Certified	Satisfactory	Fresno
CA0175	36.89	-119.66	Park, sanitation, utility, or water district	25,300	ERTH	Extremely High	No	1948

Dam No.[4]	Dam Number		Owner Name	Dam Height	Reservoir Capacity	Certified Status	Condition Assessment	County
National ID No.	Lat.	Long.	Owner Type	Crest Type	Dam Type	Downstream Hazard	Reservoir Restrictions	Year Built
97-119	**Courtright**		Pacific Gas and Electric Company	315	123,300	Certified	Satisfactory	Fresno
CA00412	37.08	-118.97	Private company, corporation, LLC, partnership	862	ROCK	High	No	1958
1017-4	**Fancher Creek**		Fresno Metropolitan Flood Control District	46	9,600	Certified	Satisfactory	Fresno
CA01327	36.85	-119.54	Park, sanitation, utility, or water district	15,312	ERTH	Extremely High	No	1991
1017-6	**Fancher Creek Detention**		Fresno Metropolitan Flood Control District	16	1,891	Certified	Satisfactory	Fresno
CA01497	36.76	-119.61	Park, sanitation, utility, or water district	2,860	ERTH	Extremely High	No	2006
104-9	**Florence Lake**		Southern California Edison	149	64,406	Certified	Satisfactory	Fresno
CA00433	37.27	-118.97	Private company, corporation, LLC, partnership	3,106	MULA	Extremely High	No	1926
699-0	**Giffen Reservoir**		Harris Farms, Inc	29	900	Certified	Satisfactory	Fresno
CA00711	36.8	-119.44	Private company, corporation, LLC, partnership	1,250	ERTH	High	No	1971

Dam No.[4]	Dam Number		Owner Name	Dam Height	Reservoir Capacity	Certified Status	Condition Assessment	County
National ID No.	Lat.	Long.	Owner Type	Crest Type	Dam Type	Downstream Hazard	Reservoir Restrictions	Year Built
104-10	**Huntington Lake 1**		Southern California Edison	170	88,834	Certified	Satisfactory	Fresno
CA00434	37.23	-119.24	Private company, corporation, LLC, partnership	1,310	GRAV	Extremely High	No	1917
104-25	**Mammoth Pond**		Southern California Edison	406	123,000	Certified	Satisfactory	Fresno
CA00443	37.32	-119.32	Private company, corporation, LLC, partnership	820	ERTH	Extremely High	No	1960
1053-0	**Mendota Diversion**		Central California Irrigation District	23	3,000	Certified	Satisfactory	Fresno
CA00886	36.79	-120.37	Park, sanitation, utility, or water district	485	FLBT	Significant	No	1917
104-12	**Mono Creek Diversion**		Southern California Edison	50	45	Certified	Satisfactory	Fresno
CA00436	37.36	-119	Private company, corporation, LLC, partnership	112	CORA	Low	No	1927
1085-0	**Mud**		James Irrigation District	14	304	Certified	Satisfactory	Fresno
CA00913	36.56	-120.17	Park, sanitation, utility, or water district	127	ERTH	Low	No	1919
104-24	**Portal Powerhouse Forebay**		Southern California Edison	65	325	Certified	Satisfactory	Fresno

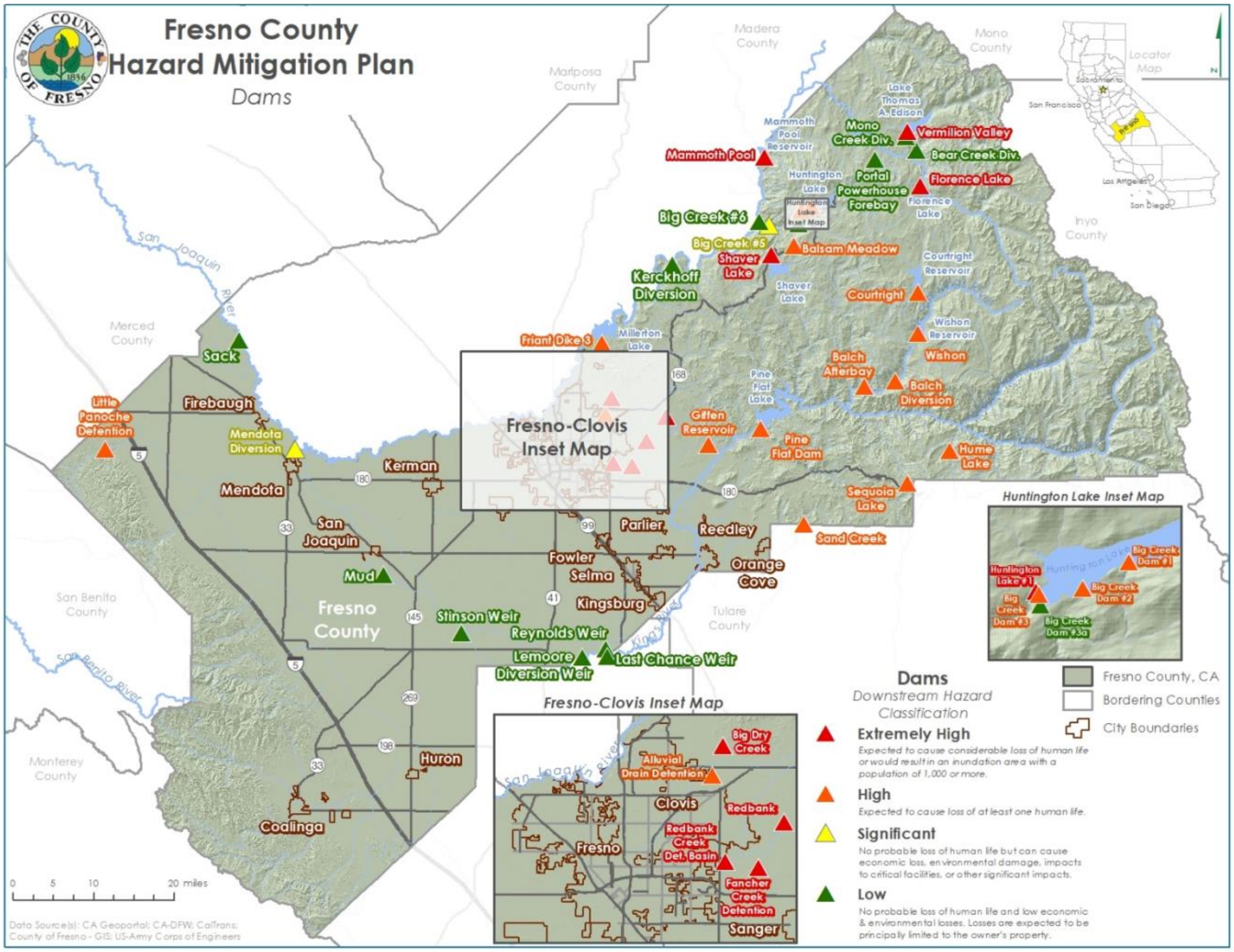
Dam No.[4]	Dam Number		Owner Name	Dam Height	Reservoir Capacity	Certified Status	Condition Assessment	County
National ID No.	Lat.	Long.	Owner Type	Crest Type	Dam Type	Downstream Hazard	Reservoir Restrictions	Year Built
CA00442	37.32	-119.07	Private company , corporation, LLC, partnership	792	ERTH	Low	No	1955
1017-0	**Redbank**		Fresno Metropolitan Flood Control District	33	1,100	Certified	Satisfactory	Fresno
CA00837	36.81	-119.58	Park, sanitation, utility, or water district	1,450	ERTH	Extremely High	No	1962
1017-3	**Redbank Creek Detention Basin**		Fresno Metropolitan Flood Control District	17	940	Certified	Satisfactory	Fresno
CA-1331	36.77	-119.66	Park, sanitation, utility, or water district	6,619	ERTH	Extremely High	No	1990
80-0	**Reynolds Weir**		Laguna Irrigation District	13	260	Certified	Satisfactory	Fresno
CA00302	36.43	-119.67	Park, sanitation, utility, or water district	130	FLBT	Low	No	1928
693-0	**Sequoia Lake**		Y.M.C.A., Inc.	51	1,370	Certified	Satisfactory	Fresno
CA00709	36.73	-119	Private company , corporation, LLC, partnership	225	ERRK	High	No	1888
104-18	**Shaver Lake**		Southern California Edison	180	135,283	Certified	Satisfactory	Fresno
CA00437	37.15	-119.3	Private company , corporati	2,169	GRAV	Extremely High	No	1927

Dam No.[4]	Dam Number		Owner Name	Dam Height	Reservoir Capacity	Certified Status	Condition Assessment	County
National ID No.	Lat.	Long.	Owner Type	Crest Type	Dam Type	Downstream Hazard	Reservoir Restrictions	Year Built
			on, LLC, partnership					
696-0	**Stinson Weir**		Stinson Canal and Irrigation Company	14	50	Certified	Satisfactory	Fresno
CA00710	36.46	-119.99	Private company, corporation, LLC, partnership	256	FLBT	Low	No	1910
104-23	**Vermillion Valley**		Southern California Edison	167	125,000	Certified	Satisfactory	Fresno
CA00441	37.37	-119	Private company, corporation, LLC< partnership	4,234	ERTH	Extremely High	No	1954
97-118	**Wishon**		Pacific Gas and Electric Company	265	118,000	Certified	Satisfactory	Fresno
CA00411	37.01	-118.97	Private company, corporation, LLC, partnership	3,328	ROCK	High	No	1958

Source: California Department of Water Sources, Division of Safety of Dams, Dams within Jurisdiction of the State of California, September 2022

Both unincorporated and incorporated areas of the County are identified on dam failure inundation maps included in the County's dam failure evacuation plan. The inundation areas for each of the dams are generally downstream and include large rural and urban areas on the valley floor below the dams. Adjacent jurisdictions could also be affected by a dam failure in Fresno County. These include, depending on the dam involved, the Counties of Tulare, Kings, Madera, and Merced. **Figure 3. Fresno County Dams by Hazard Classification** illustrates the locations of identified dams of concern within Fresno County. **Figure 4. Fresno County Dams by Capacity** shows a map of dams in Fresno County and their hazard class, while **Figure 5. Water Routes and Dams that Impact Fresno County** shows the water routes and the dams that impact Fresno County.

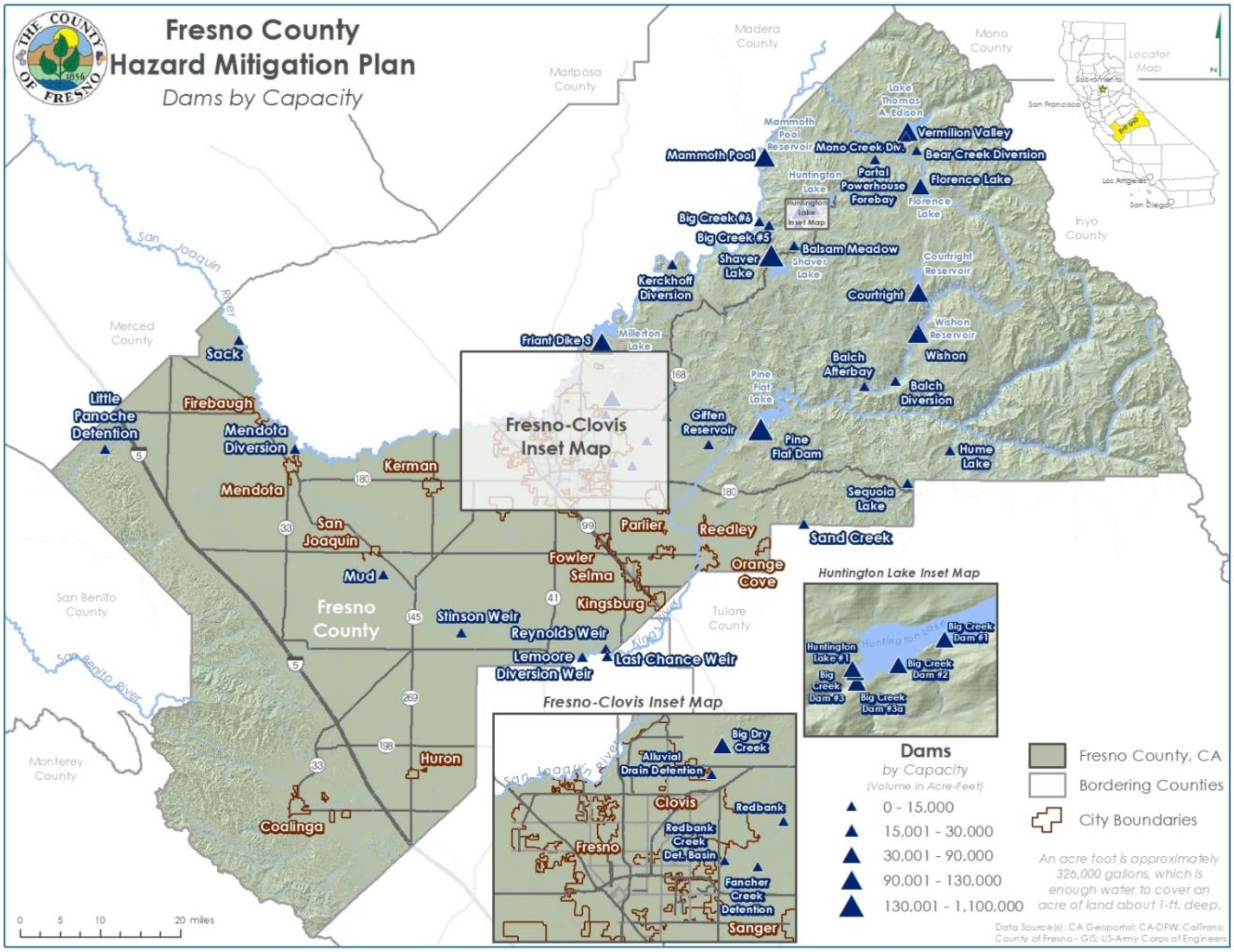
Figure 6. Fresno County Dams by Hazard Classification



Source: CA Geoportal; CA-DFW; CalTrans; County of Fresno – GIS; US Army Corps of Engineers

***Note**: California identifies 4 dam hazard classifications, while the NID identifies 3 dam hazard classifications.*

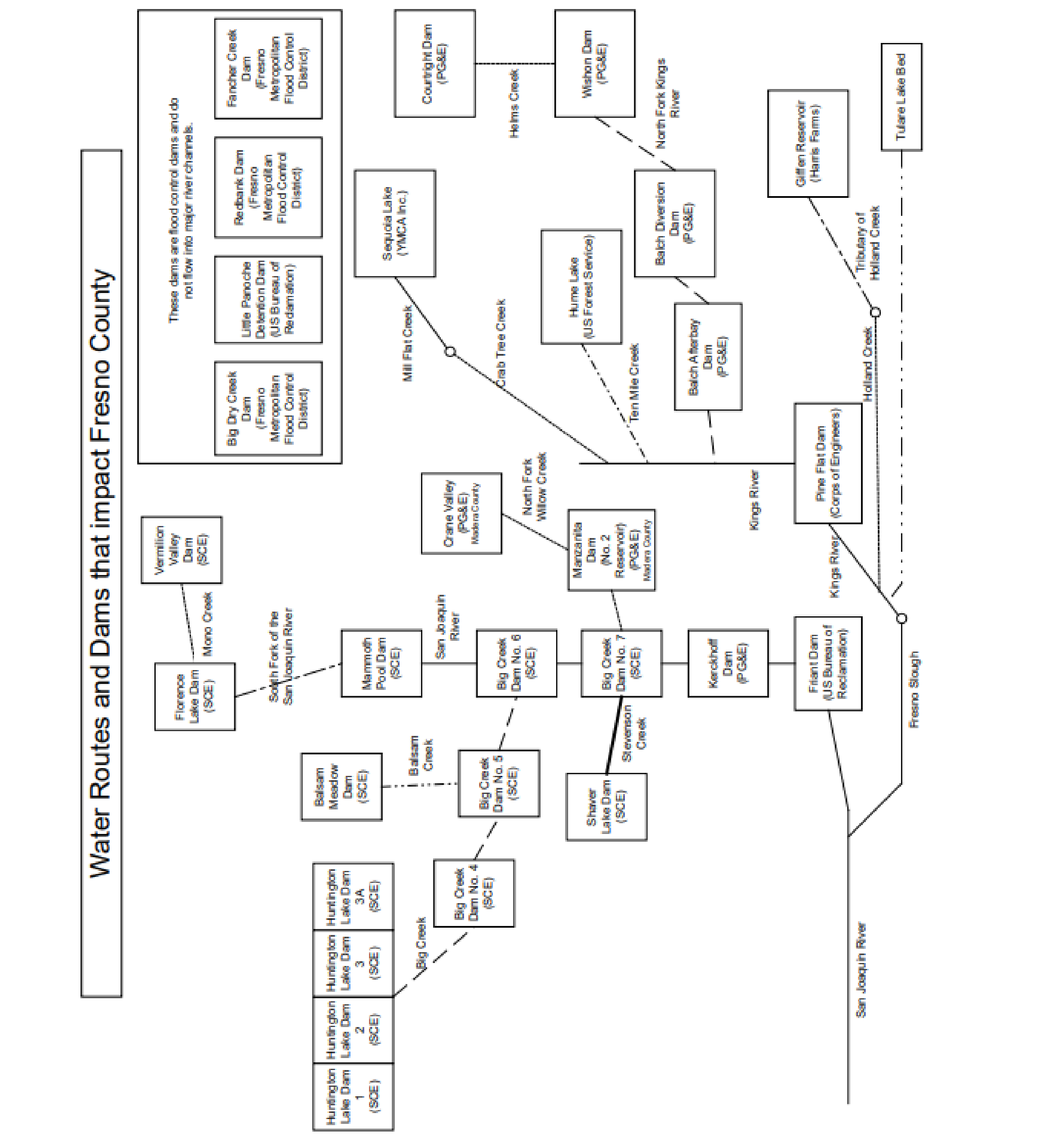
Figure 7. Fresno County Dams by Capacity



Source: CA Geoportal; CA-DFW; CalTrans; County of Fresno – GIS; US Army Corps of Engineers

Figure 8. Water Routes and Dams that Impact Fresno County

Source: Fresno County Operational Area Dam Failure Evacuation Plan, 2003



Source: Fresno County Operational Area Dam Failure Evacuation Plan, 2003

PAST OCCURRENCES

According to the National Performance of Dams Program at Stanford University, there have been 32 dam incidents based on the list of dams that impact Fresno County in **Table 19. Fresno County Previous Dam Incidents**. Two of the incidents were Uncontrolled Release of Reservoir (URR) which is an incident that involves damage to a dam and is an uncontrolled release. A few of the previous dam incidents were due to penstock leaks and ruptures, sinkholes, embarkment instability, earthquakes, inflow flooding, piping, unknown causes, or the cause was not documented. The incidents impacting Fresno County dates to January 1, 1916, to October 27, 2021. Based on past occurrences, there has been a dam incident about every 3 years. The majority of the incidents were dam types such as concrete, rockfill, and gravity. The dams with multiple incidents include Big Creek Dam 3a, 4, 5, and 6, Crane Valley, Florence Lake, Mammoth Pool, and Mud Lake. More information on dam incidents is described in the table below.

Table 19. Fresno County Previous Dam Incidents

Dam Name	Incident Date	Incident Type	Dam Type	Uncontrolled Release of Reservoir (URR)
Balch Diversion	6/8/1998	Earthquake	Arch	No
Bear Creek Diversion	8/6/2003	Penstock Rupture	Unknown	No
Big Creek Dam 5	10/27/2021	Unknown	Concrete	Unknown
Big Creek Dam No. 3a	6/8/1998	Earthquake	Gravity	No
Big Creek Dam No. 3a	6/14/1996	Penstock Rupture	Gravity	No
Big Creek Dam No. 4	6/14/1996	Unknown	Concrete	No
Big Creek Dam No. 4	1/5/2010	Unknown	Concrete; Arch	No
Big Creek Dam No. 4	6/8/1998	Earthquake	Concrete; Arch	No
Big Creek Dam No. 5	6/8/1998	Earthquake	Concrete; Arch	No
Big Creek Dam No. 5	3/10/1995	Unknown	Concrete; Arch	No
Big Creek Dam No. 6	1/3/1997	Unknown	Concrete	No
Big Creek Dam No. 6	1/2/1997	Unknown	Concrete	No
Big Creek Dam No. 6	6/8/1998	Earthquake	Concrete; Gravity	No
Big Creek Dam No. 7	6/8/1998	Earthquake	Gravity	No
Courtright	6/8/1998	Earthquake	Rockfill	No
Crane Valley	3/13/2012	Sinkhole	Rockfill	No
Crane Valley	12/17/2009	Unknown	Rockfill	No
Crane Valley	6/8/1998	Earthquake	Rockfill	No
Crane Valley	3/22/2011	Embankment Instability	Unknown	No
Florence Lake	5/12/2011	Unknown	Concrete	No
Florence Lake	5/15/1999	Not Known	Concrete	No
Florence Lake	6/8/1998	Earthquake	Concrete	No
Mammoth Pool	2/16/2016	Sinkhole	Rockfill	No

Dam Name	Incident Date	Incident Type	Dam Type	Uncontrolled Release of Reservoir (URR)
Mammoth Pool	6/8/1998	Earthquake	Rockfill	No
Mendota Diversion	1/1/1916	Piping	Unknown	Unknown
Mono Creek Diversion	6/8/1998	Earthquake	Concrete; Arch	No
Mud Lake	1/1/1982	Not Known	Rockfill	Yes
Mud Lake	1/1/1932	Inflow Flood - Hydrologic Event	Rockfill	Yes
Portal Forebay Dike	5/15/1999	Earthquake	Rockfill	No
San Joaquin No. 3 Forebay	12/17/2016	Penstock Leak	Unknown	No
Shaver Lake	6/8/1998	Earthquake	Gravity	No
Wishon Auxiliary No. 1	6/8/1998	Earthquake	Rockfill	No

Source: Stanford, NPDP Dam Incident Database

According to the Fresno County Operational Area Master Emergency Services Plan, there were 14 dam failures in Fresno County between 1976 and 1983, but all were earthen dams on private property. None of the County's 23 major dams were involved. The failures were due to inadequate rodent and vegetation control, unauthorized and inadequate construction, and failure to consult an engineer. The main impacts from these failures were silting of downstream waters, properties, and dams; flooded or undermined roadways; and eroded embankments. Main losses were flooding of a residence and construction lumber washed downstream. In 1986, Friant Dam experienced a small, uncontrolled release. The lock on the drum gate opened, releasing 3,000 cubic feet per second. No major flooding resulted. One incident that was not captured in the NPDP Dam Incident Database was the Friant Dam incident that occurred on January 3, 1997. Stormwater breached the Friant Dam sending a historic 59,000 cubic feet of water a second cascading down the San Joaquin River, laying waste to the bridge a few hundred feet downstream from the dam. [5]

- **4/02/2018**: At the Auberry Lumber Mill, the dam's spillway pipes became obstructed by overgrown vegetation, leading to water overtopping the structure. This overtopping resulted in erosion of the dam's downstream slope, a situation that had the potential to escalate to a dam failure. Fortunately, this event did not necessitate any evacuations, nor did it result in any reported damages.

Dam failures can occur very quickly depending on the severity of the event and what caused the failure to occur. Additionally, planned releases of dam can occur in order to mitigate flood risk from heavy rain events. For example, The Oroville Dam released billions of gallons of water in February 2024 to reduce flood risk from several recent atmospheric river events that produced heavy rain in California. This was

[5] In 1997, California was devastated by historic floods (sfgate.com) https://www.sfgate.com/bayarea/article/1997-historic-floods-devastated-california-17697232.php

an effort to protect downstream communities from flood risk. [6] Planned releases can occur over several hours or days depending on how much water is being released.

LIKELIHOOD OF FUTURE OCCURRENCES

Possible—The County remains at risk of dam failures from numerous dams under a variety of ownership and control and of varying ages and conditions. Given the high number of dams in the County and the history of past dam failures, the potential exists for future dam failures in the Fresno County planning area. Nonetheless, it should be noted that there have not been any failures of major dams in the County. Uncontrolled or controlled release flooding below dams due to excessive rain or runoff are more likely to occur than failures.

CLIMATE CHANGE CONSIDERATIONS

The potential for climate change to affect the likelihood of dam failure is not fully understood at this point in time. With a potential for more extreme precipitation events as a result of climate change, this could result in large inflows to reservoirs. However, this could be offset by generally lower reservoir levels if storage water resources become more limited or stretched in the future due to climate change, drought and/or population growth.

[6] California Reservoir 'Spectacular' Release of Billions of Gallons of Water (newsweek.com) https://www.newsweek.com/california-reservoir-spectacular-release-billions-gallons-water-1866518

DROUGHT

HAZARD/PROBLEM DESCRIPTION

Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Drought is a complex issue involving many factors—it occurs when a normal amount of moisture is not available to satisfy an area's usual water-consuming activities. Drought can often be defined regionally based on its effects:

- **Meteorological drought** is defined by a period of substantially diminished precipitation duration and/or intensity. The commonly used definition of meteorological drought is an interval of time, generally in the order of months or years, during which the actual moisture supply at a given place consistently falls below the climatically appropriate moisture supply.
- **Agricultural drought** occurs when there is inadequate soil moisture to meet the needs of a particular crop at a particular time. Agricultural drought usually occurs after or during meteorological drought, but before hydrological drought and can affect livestock and other dry-land agricultural operations.
- **Hydrological drought** refers to deficiencies in surface and subsurface water supplies. It is measured as stream flow, snowpack, and as lake, reservoir, and groundwater levels. There is usually a delay between lack of rain or snow and less measurable water in streams, lakes, and reservoirs. Therefore, hydrological measurements tend to lag behind other drought indicators.
- **Socio-economic drought** occurs when physical water shortages start to affect the health, well-being, and quality of life of the people, or when the drought starts to affect the supply and demand of an economic product.

One dry year does not normally constitute a drought in California. California's extensive system of water supply infrastructure—its reservoirs, groundwater basins, and inter- regional conveyance facilities—mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Hydrologic conditions constituting a drought for water users in one location may not constitute a drought for water users elsewhere, or for water users having a different water supply. Individual water suppliers may use criteria such as rainfall/runoff, amount of water in storage, or expected supply from a water wholesaler to define their water supply conditions.

The drought issue in California is further compounded by water-rights. Water is a commodity possessed under a variety of legal doctrines. The prioritization of water rights between farming and federally protected fish habitats in California is part of this issue.

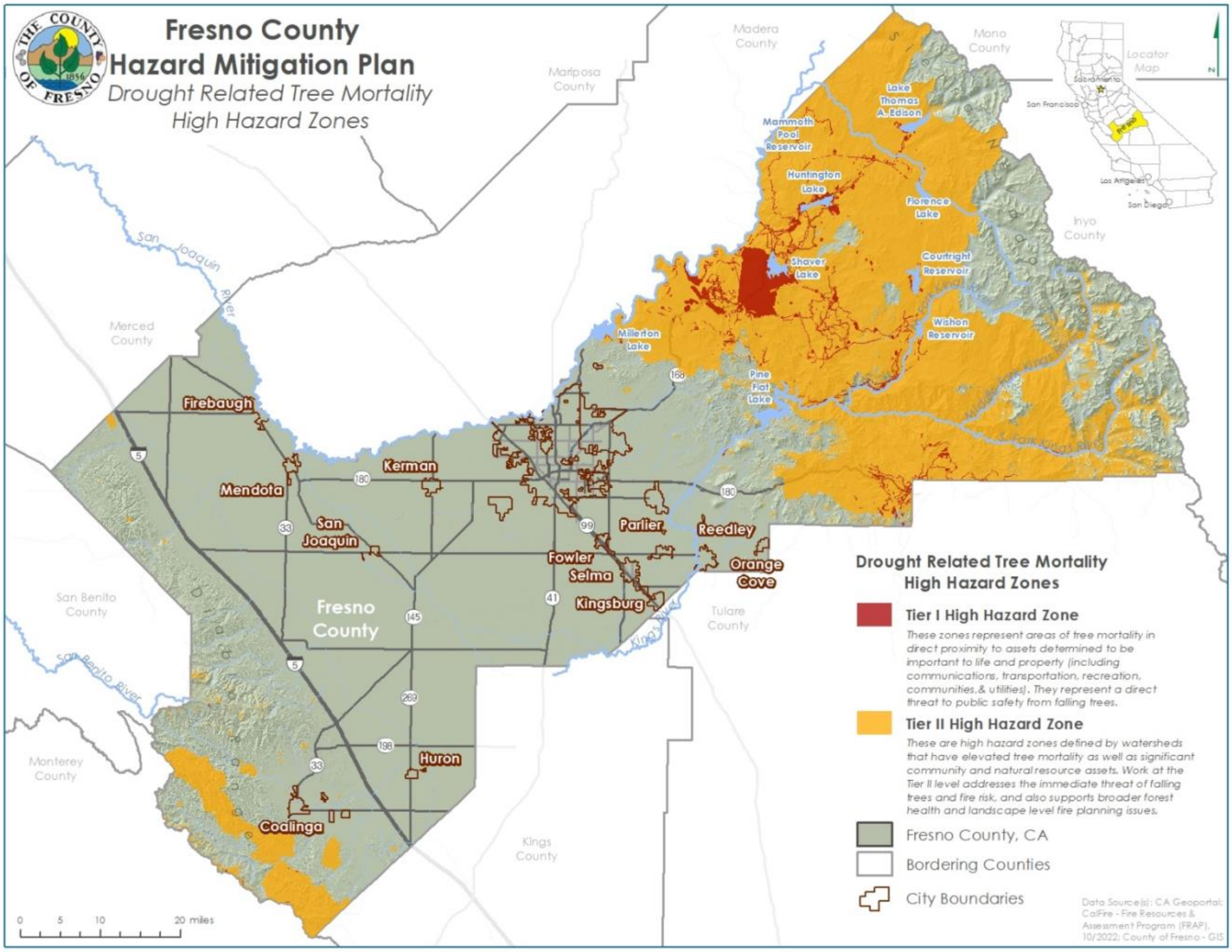
Drought impacts are wide-reaching and may be economic, environmental, and/or societal. The most significant impacts associated with drought in the planning area are those related to water intensive activities such as agriculture, wildfire protection, municipal usage, commerce, tourism, recreation, and wildlife preservation. Also, during a drought, allocations go down, which results in reduced water availability. Voluntary water conservation measures are typically implemented during extended droughts. A reduction of electric power generation and water quality deterioration are also potential problems. Drought conditions can also cause soil to compact which reduces its ability to absorb water, potentially making an area more susceptible to flooding.

TREE MORTALITY

The HMPC identified tree mortality as an additional drought impact of significance to Fresno County during the 2018 update. In recent years, due to the multi-year drought throughout the planning area and state-wide, a vast number of trees have been (and continue to be) impacted within Fresno County foothill and mountain communities and beyond. Standing dead trees could fall and pose a risk to people, buildings, power lines, roads, and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark beetle) further adding to the risk of tree mortality and related potential impacts.

The location, extent, and probability of occurrence for tree mortality can be viewed as sub-set to the drought hazard. Those areas of the natural environment susceptible to drought comprise a larger area, since tree mortality is related to other sub-factors specific to the species impacted such as tree age and soil composition**. Figure 6. Fresno County Drought Related Tree Mortality High Hazard Zones** shows the extent of the impact of drought and tree mortality in Fresno County. The Tier 1 High Hazard Zones (as indicated in red) depict areas where tree mortality directly coincides with critical infrastructure.

Figure 9. Fresno County Drought Related Tree Mortality High Hazard Zones



Source: CA Geoportal; CalFire – Fire Resources & Assessment Program (FRAP), 10/2022; County of Fresno - GIS

EXTENT

Given the historical occurrence of severe drought impacts throughout Fresno County and across the state, the HMPC understands that drought will continue to pose a high degree of risk to the entire planning area, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies. While drought affects the entire planning area equally, the potential impacts may be variable and specific to each jurisdiction, depending on contextual factors such as the degree of assets and activities historically impacted by drought within each jurisdiction, such as the agricultural and parks and tourism industries.

Figure 7. U.S. Drought Monitor: California (January 23, 2024) and **Figure 8. U.S. Drought Monitor: California (January 23, 2018)** below provide a “snapshot in time” of the drought conditions in California in January 2024 and January 2018 when the plan was last updated. The snapshots selected are instrumental in depicting both the historic and potential change in drought’s geographic range and severity in Fresno County. Compared to 2018, drought conditions across California state have significantly improved due to the increased precipitation in early 2023. The majority of the state experienced no drought conditions while some small areas in northern and southern California experienced abnormally dry conditions. These two figures alone show the duality of drought conditions over the span of a couple of years.

The magnitude or intensity of drought is measured by the U.S. Drought Monitor (USDM) through maps that are updated weekly to show the location and intensity of drought across the country. The USDM identifies areas in drought and labels them by intensity using four categories of drought, D1 (the least intense) to D4 (the most intense). It also describes areas with no drought and uses the D0 category to indicate abnormally dry areas that could be entering or recovering from drought, **Table 20. U.S. Drought Monitor Drought Categories**.

Table 20. U.S. Drought Monitor Drought Categories

Category	Description
None (Gray)	Normal or wet conditions
D0 (Light Yellow)	Abnormally Dry
D1 (Light Orange)	Moderate Drought
D2 (Orange)	Severe Drought
D3 (Red)	Extreme Drought
D4 (Maroon)	Exceptional Drought

Source: U.S. Drought Monitor

Other drought indices have been developed by the National Oceanic and Atmospheric Administration (NOAA) to measure impacts and severity of meteorological and hydrological drought and to map their extent and locations.

- **The Crop Moisture Index**: measures the short-term drought weekly to assess impacts on agriculture.
- **The Palmer Z Index**: measures the short-term drought on a monthly scale.
- **The Palmer Drought Severity Index**: is based on long-term weather patterns. The intensity of drought in each month is dependent on current weather plus the cumulative patterns of previous months.
- **The Palmer Hydrological Drought Index**: quantifies hydrological effects (reservoir levels, groundwater levels, etc.) which take longer to develop and last longer. This index responds more slowly to changing conditions than the Palmer Drought Index.
- **The Standardized Precipitation Index**: only considers precipitation.

To ensure that the State of California can maintain safe, clean, and reliable water service, Cal Water follows a set of drought severity stages to determine the level of water conservation and assess potential water-use restrictions described in **Table 21. California Drought Severity Stages**.

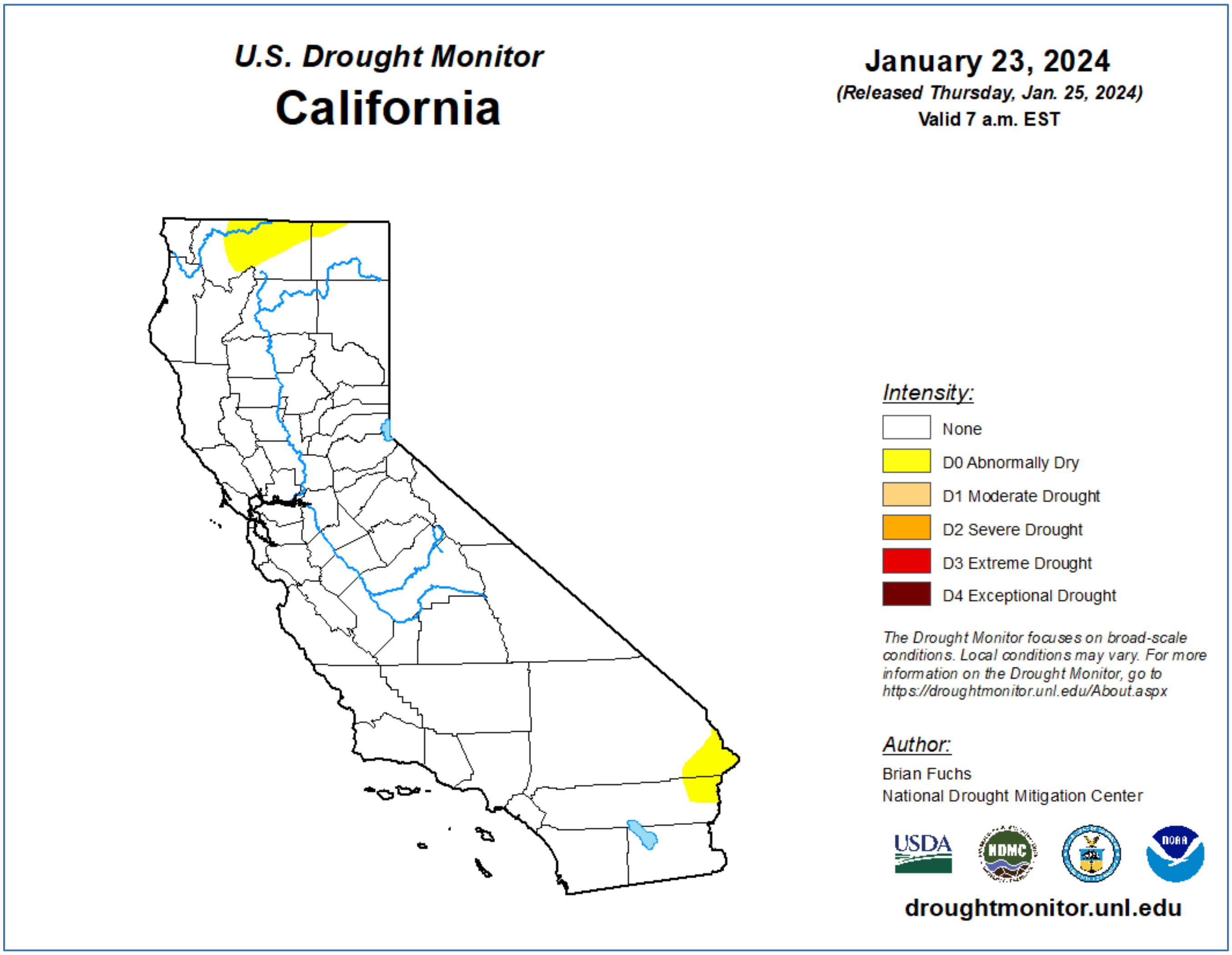
Table 21. California Drought Severity Stages

Stage	Description
1	• We implement policies and guidelines for reducing water usage by 10 percent. • Residential and business customers are subject to water-use restrictions • Outdoor irrigation is subject to limited times • Leak repairs must be made in a timely manner • Shut-off nozzles are required when using a hose to wash a car • Outdoor watering is prohibited within 48 hours of rain
2	• We implement policies and guidelines for reducing water usage by 20 percent • Residential and business customers are subject to additional water-use restrictions • Outdoor irrigation by residential and business customers is limited further to 1-3 days per week, depending on local ordinance • Use of non-recirculating systems in all new conveyer car wash and commercial laundry systems are prohibited • Use of single pass cooling systems in new connections is prohibited
3	• We implement policies and guidelines for reducing water usage by 30 percent • Residential and business customers are subject to additional water-use restrictions • Water usage for construction and dust control is prohibited • Irrigation of ornamental turf on public street medians is prohibited • Filling ornamental lakes or ponds is prohibited
4	• We implement policies and guidelines for reducing water usage by 40 percent • Residential and business customers are subject to additional water-use restrictions • Vehicle washing is prohibited, except with recirculated water or low-volume systems • Use of water for recreational purposes, such as water parks, is prohibited • Filling swimming pools is prohibited
5	• We implement policies and guidelines for reducing water usage by 50 percent • Residential and business customers are subject to additional water-use restrictions • Net zero demand increase is required on new water service connections • Single pass cooling systems are prohibited

Stage	Description
	• Swimming pool covers are required
6	• We implement policies and guidelines for reducing water usage by more than 50 percent • Residential and business customers are subject to additional water-use restrictions • All landscape irrigation is prohibited • New water service connections are prohibited

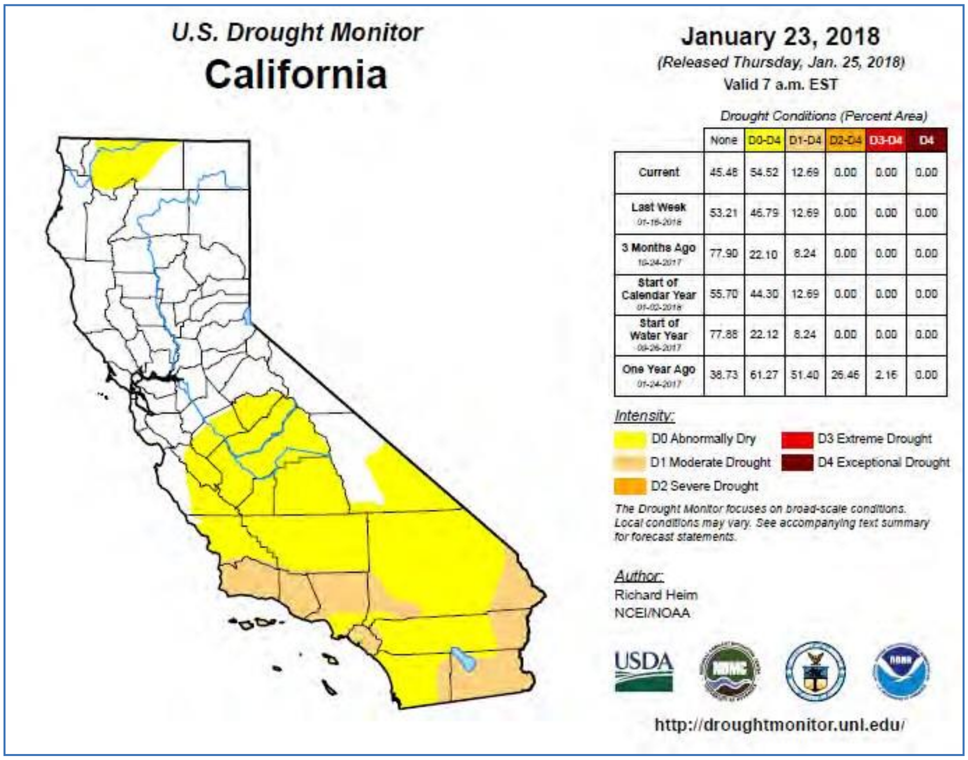
Source: California Water Service: https://www.calwater.com/help/drought-faqs/what-are-the-stages-of-drought/

Figure 10. U.S. Drought Monitor: California (January 23, 2024)



Source: U.S. Drought Monitor

Figure 11. U.S. Drought Monitor: California (January 23, 2018)



Source: U.S. Drought Monitor

TREE MORTALITY EXTENT

Extensive - The US Forest Service (USFS), Pacific Southwest Region, State and Private Forestry staff conduct annual aerial surveys throughout forested areas of California to detect tree mortality and tree damage (i.e., defoliation or branch flagging). The survey found approximately 39.6 million acres were surveyed during the 2022 flight season and 36.3 million dead trees. The majority of the trees killed were fir, followed by ponderosa pine, and Douglas fir. The elevated levels of tree mortality can be attributed to the ongoing drought period (2020-2023) and bark and engrave beetle attacks.[7]

The California/Shasta red fir, white fir, and grand fir mortality was attributed to fir engraver beetle increased in 2022. Approximately 28.1 million dead fir trees were recorded across 1.9 million acres, compared to approximately 6.1 million dead fir trees across 780,000 acres recorded in 2021. The central Sierra Nevada Region experienced the tree mortality that was most severe and widespread.

Within Fresno County, there are several national parks and forests. In fact, the Sequoia and Sierra forests have increased tree mortality in 2022 compared to 2021. **Table 22. Tree Mortality by National Forest** shows the National Forests and acres with mortality and estimated number of dead trees by Forest (2022).

[7] 2022 Aerial Survey Results: California (usda.gov) https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd1099786.pdf

- **Sequoia**: Mortality increased from an estimated 380,000 dead trees across 64,000 acres in 2021 to approximately 410,000 dead trees across 75,000 acres in 2022. Most of the mortality was light in severity except for moderate levels of mortality along southern Hume Lake District
    - California red fir mortality decreased from approximately 230,000 dead trees across 34,000 acres in 2021 to ~200,000 dead trees across 35,000 acres in 2022.
    - White fir mortality increased from approximately 100,000 dead trees across 17,000 acres in 2021 to ~110,000 dead trees across 19,000 acres in 2022.
- **Sierra**: Mortality increased from an estimated 860,000 dead across 91,000 acres in 2021 to approximately 1.7 million dead trees across 180,000 acres in 2022
    - California red fir mortality increased from approximately 790,000 dead trees across 75,000 acres in 2021 to ~1.5 million dead trees across 150,000 acres in 2022.
    - White fir mortality increased from approximately 13,000 dead trees across 5,500 acres in 2021 to ~130,000 dead trees across 26,000 acres in 2022.

Table 22. Tree Mortality by National Forest

National Forest	Acres	Dead Trees
Angeles National Forest	1,100	10,000
Cleveland National Forest	1,500	8,000
Eldorado National Forest	91,000	1,300,000
Humboldt-Toiyabe National Forest*	50,000	750,000
Inyo National Forest*	78,000	880,000
Klamath National Forest*	140,000	1,800,000
Lake Tahoe Basin Management Unit	58,000	1,400,000
Lassen National Forest	170,000	1,900,000
Los Padres National Forest	12,000	59,000
Mendocino National Forest	40,000	550,000
Modoc National Forest	180,000	2,200,000
Plumas National Forest	110,000	1,600,000
San Bernardino National Forest	3,900	13,000
Sequoia National Forest	75,000	410,000
Shasta-Trinity National Forest	290,000	4,400,000
Sierra National Forest	180,000	1,700,000
Six Rivers National Forest	24,000	150,000
Stanislaus National Forest	140,000	2,600,000
Tahoe National Forest	260,000	5,000,000

The numbers of acres and trees throughout this report have been rounded as appropriate.

**include acreage outside of California but within the National Forest Boundary.*

The Tree Mortality Task Force mapping effort (see previous map) identifies Tier 1 and Tier 2 risk zones to fully capture the extent of tree mortality risk to populations, buildings, infrastructure, and natural resources. Tier 1 are those areas that directly coincide with critical infrastructure, and which pose a direct threat to people and assets operating in these areas. Tier 2 are areas defined by watersheds and which have a significant degree of tree mortality coinciding with significant community and natural resource assets. [8]

Based on the mapping as well as input from the LHMPC, the extent of the Tree Mortality Tier I and II Hazard Areas in Fresno County comprises over 25 percent of the planning area and therefore covers an extensive area in Fresno County.

PAST OCCURRENCES

Historically, California has experienced multiple severe droughts. According to the DWR, droughts exceeding three years are relatively rare in Northern California, and the region is the geographic source of much of the state's developed water supply. According to the "Water Year 2023: Weather Whiplash, From Drought to Deluge" from the California Department of Water Resources, California Natural Resources Agency, stated in their report that 2023 demonstrated dramatic extremes of California's climate. At the beginning of the year, California had the three driest years on record that prompted the Governor to issue a proclamation of a state of emergency for Fresno County described in the table below. The storms from 2023 have provided relief from the water shortages of the prior drought years due to atmospheric rivers, tropical storms, and hurricane events.

The 1929-1934 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs. **Table 23. Severity of Extreme Droughts in the Sacramento and San Joaquin Valleys** below compares the 1929-34 drought in the Sacramento and San Joaquin Valleys to drought periods in 1976-77, and 1987-92, 2012-17, and 2020-2023. The driest single year of California's measured hydrologic record was 2022.[9]

Table 23. Severity of Extreme Droughts in the Sacramento and San Joaquin Valleys

Drought Period	Sacramento Valley Runoff		San Joaquin Valley Runoff	
	(maf*/yr)	(% Average 1901-96)	(maf*/yr)	(% Average 1906-96)
1929-34	9.8	55	3.3	57
1976-77	6.6	37	1.5	26
1987-92	10.0	56	2.8	47
2012-17	N/A	43	N/A	N/A
2020-23	N/A	N/A	N/A	N/A

Source: California Department of Water Resources, www.water.ca.gov/

**Million acre-feet*

The HMPC identified the following droughts as having significant impacts on the planning area:

[8] CAL FIRE

[9] 2022 Is California's Record Driest Year, So Far, NOAA Says | Weather.com https://weather.com/news/climate/news/2022-07-11-june-record-driest-noaa-climate-report

- **1928-1934**: This seven-year drought predated the construction of many of the water projects in California including the Federal Central Valley Project and State Water Project. Because the 1928-34 drought constituted the first major drought on record in California, it served as the basis for early reservoir operations planning and the development of shortage criteria for water supply contracts.
- **1976**: A federal disaster declaration was declared because of a drought affecting Fresno County and much of California.
- **1987-1992**: Fresno County also suffered adverse effects resulting from this statewide drought.
- **2002**: Abnormally dry to moderate drought conditions lingering from 2001 into 2002 reduced rangeland grasses and feed for cattle. Losses to rangeland and loss of feed were estimated at $2.5 million. An estimated 850,000 acres were affected in both the east and west side of the valley. A USDA disaster declaration on November 22 made low interest loans available to family-size operations.
- **2008**: Drought impacted Fresno County of most of the Central valley, resulting in significant crop damage. In addition, the drought not only impacted agriculture, but the economy of the planning area in general, where small towns were especially hard hit, including job loss and the need for food-supply assistance provided by the state.
- **2012-2017**: Drought produced severe impacts to water wells throughout the planning area, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in areas of the San Joaquin Valley including Fresno County. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to homeowners with dry wells. According to a report released by UC Davis Center for Watershed Sciences, the 2014 California drought cost the state's agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion. The 2014 drought, the report says, is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal. The report calls the groundwater situation in California "a slow-moving train wreck." Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow- water-equivalent value of only 5 percent of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has contributed to declines in Fresno County crop values, based on information from an article in the Fresno Bee. Fresno County's overall gross value fell 2.2 percent to $6.4 billion in 2013, and with the reduction lost its status as the number one agricultural county in California. The Fresno County Agricultural Commissioner noted the drought -- one of the worst in state history -- has pinched the production of several west side field crops including cotton, corn silage and barley. The field crop category fell by 42 percent [10]
- **2020-2023**: The three-year drought is the most recent drought period. The state ranked driest on record for much of 2022, including driest ever January-March, January-May, and January-October. Drought conditions started on February 11, 2020, and ended October 10, 2023. Overall, the state experienced 76 percent of its average precipitation in 2022. The beginning of 2022 was the direst January through April based on records dating back to 1895 and received only 25 percent of the average statewide precipitation. In addition to a lack of precipitation, a persistent heat dome settled over California in early September that was long-lasting and intense, setting numerous daily and

[10] California - State Climate Summaries 2022 (ncics.org) https://statesummaries.ncics.org/ca /

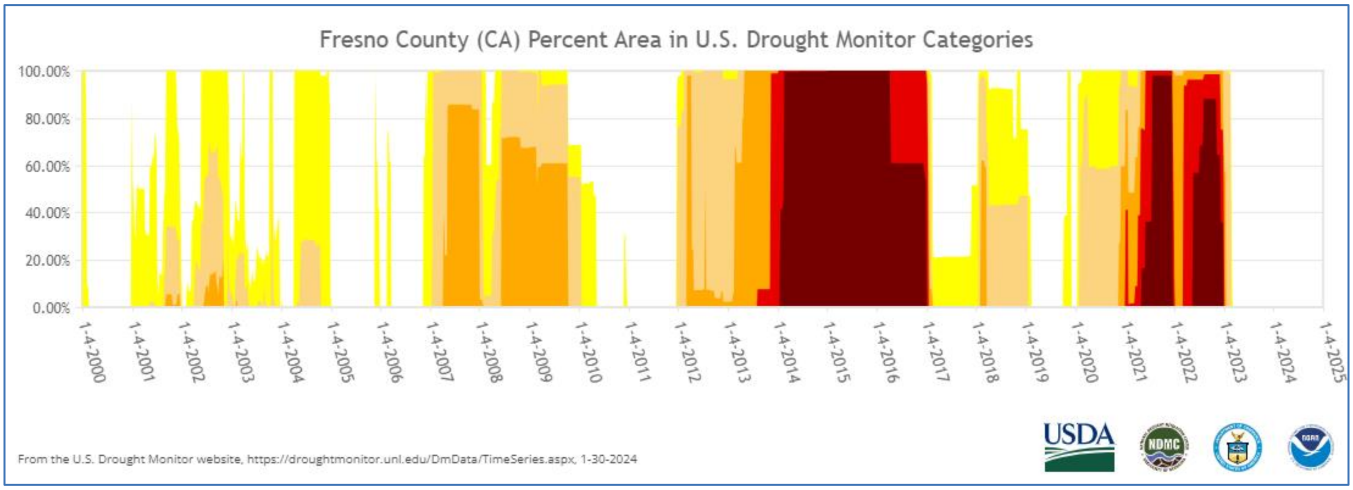
nightly high temperatures records. The majority of California did not receive any precipitation for a record-breaking 212 days. This drought period was the hottest and driest since at least 1895. [11]

LIKELIHOOD OF DROUGHT OCCURRENCES

Possible —Historical drought data for the Fresno County planning area and the Central Valley region indicate there have been six significant droughts and 26 years of were classified as a drought year in the last 96 years. This equates to a 27 percent chance of a drought in any given year. Based on this data, droughts will likely affect the planning area.

Using the data from the U.S. Drought Monitor from 2000-2024, Fresno County has experienced moderate (D1) to exceptional drought (D4) about 77 percent of the time, up from 60 percent from the last plan update. The U.S. Drought Monitor produces weekly reports and of the 1251 weekly reports that had been produced, when the data was pulled in on January 30th, 2024, 958 weekly reports indicated that Fresno County experienced some level of drought. **Figure 9. Fresno County Percent Area in U.S. Drought Monitor Categories (2000-2023)** depicts a drought time series from January 2000 to January 2024 for Fresno County.

Figure 12. Fresno County Percent Area in U.S. Drought Monitor Categories (2000-2023)



Source: U.S. Drought Monitor

LIKELIHOOD OF TREE MORTALITY OCCURRENCE

Highly Likely - Based on historical data in lack of precipitation and increased temperatures, it is a certainty that tree mortality resulting from drought and insect infestation will continue in the future, though the degree to which it occurs depends on future rainfall levels and other factors. Some of the current challenges include how to eradicate the bark beetle, dead tree removal strategies, how to utilize the wood once it is removed, and how to restore the forests to a sustainable ecosystem. [12]

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[11] Statewide Rankings | Climate at a Glance | National Centers for Environmental Information (NCEI) (noaa.gov) https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/statewide/rankings/4/pcp/202209

[12] http://frap.fire.ca.gov/projects/projects_drought

CLIMATE CHANGE CONSIDERATIONS

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. This is especially concerning as mountain snowpack provides as much as a third of California's water supply by accumulating snow during wet winters. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California's water supply because flood control rules require that water be allowed to flow downstream, and that water cannot be stored in reservoirs for use in the dry season. It is projected that by the end of the century, California's Sierra Nevada snowpack is projected to experience a 48 to 65 percent loss from the historical April 1 average and will have a significant decrease in snowpack impacting water supply and crop production.

WATERSHED AND ECOSYSTEMS

Climate change will likely adversely impact the ability of watersheds and ecosystems to deliver important ecosystem services such as clean water, fertile soil for crop production, and flood control. There is a broad range of climate change impacts that affect water resources in California which can be seen in **Table 24. Summary of Climate Change Impacts on Water Resources.** These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows.

Table 24. Summary of Climate Change Impacts on Water Resources

Resource	Type of Impact	Description
Sea Level	Direct	Sea level is rising and will likely impact coastal areas
Soil Moisture	Direct	Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation
Vegetation	Indirect	Longer and more intense fire season with increased extent of area burned
Stream Conditions	Direct	Increases in water temperature; potential effects on fish
Snowpack	Indirect	Increases in temperature will lead to decreases in snowpack
Runoff	Direct	Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer baseflow
Hydropower	Indirect	Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months
Precipitation	Direct	Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow
Groundwater	Indirect	Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater

Source : http://frap.fire.ca.gov/data/assessment2010/pdfs/3.1water.pdf p. 140

SNOWFALL AND SNOWPACK

In the southern portion of the Sierra Nevada, temperatures are generally cooler, and more precipitation falls as snow than the central and northern portions of the range due to higher elevations. However, average annual precipitation decreases gradually moving southward because of the position of the jetstream in northern California and the Pacific Northwest during winter. In general, precipitation varies greatly in the Sierra Nevada region with historical annual precipitation ranging from 50 to 200 percent of average. Weather phenomena such as the El Nino Southern Oscillation, contribute to these variabilities.

Increased winter temperatures have resulted in more precipitation falling as rain rather than snow and reduced snowpack in my parts of the Sierra Nevada. Reduce snowpack and earlier snowmelt have led to earlier timing of streamflow in the region. According to the Fourth California Climate Assessment report, by 2050 the average water supply from snowpack is projected to decline to two-thirds from historical levels. If emission reductions do not occur, water from snowpack could fall to less than one-third of historical levels by 2100 which will have significant impacts on California's water management system. However, during the 2022 water year the State of California experienced record-breaking precipitation with one of the largest snowpack years on record. The 2022 water year alleviated drought conditions however brought flooding concerns across the state, including in Fresno County. [13]

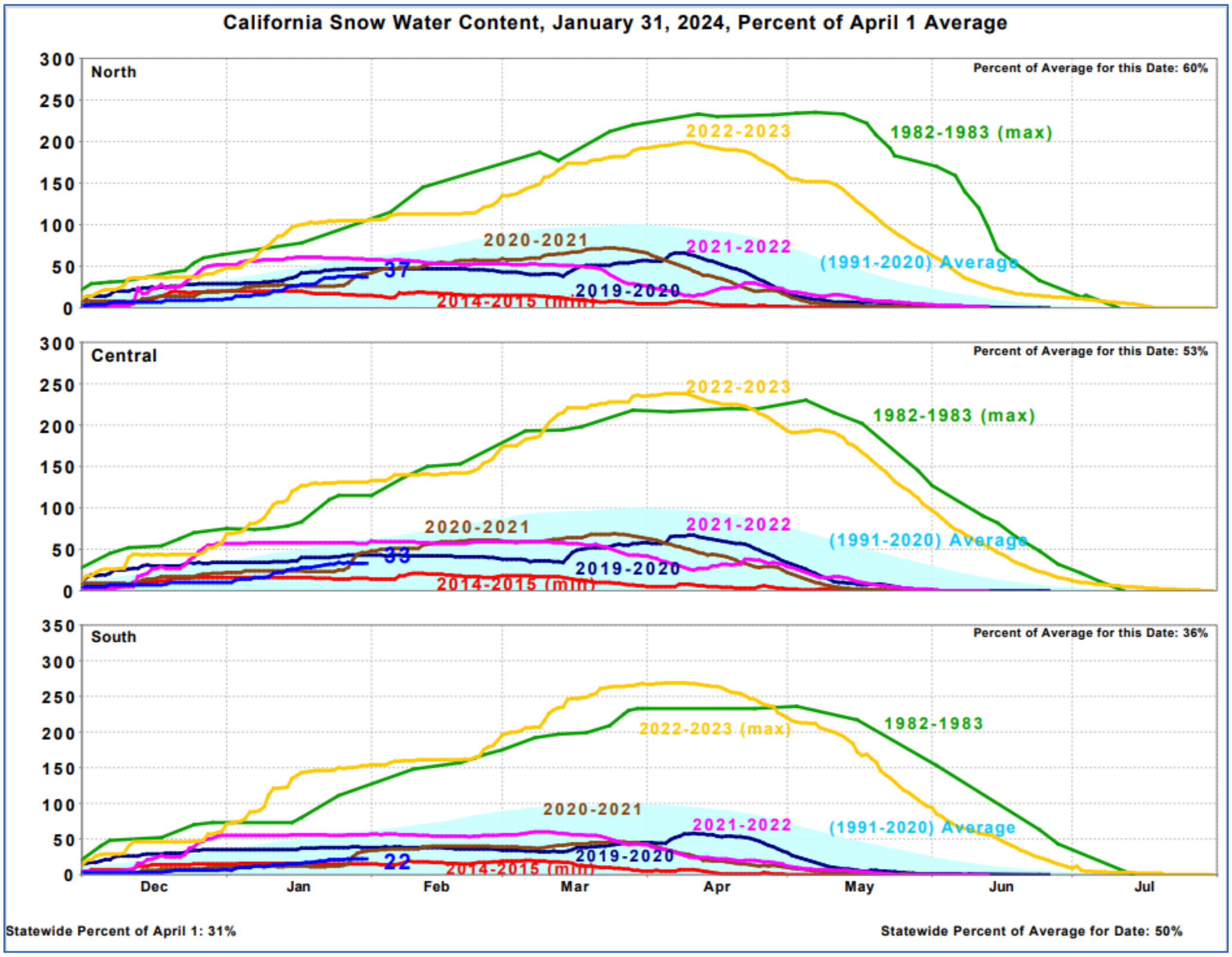
As such, Fresno County potentially has less capacity to address future drought (and wildfire) risk related to climate change due to projected temperature increases and shortages in water. About 85 percent of Californians depend on groundwater for some portion of their water supply. In fact, in some basins, groundwater withdrawal exceeds the amount is replenished long-term. [14] Groundwater overdraft in some agricultural regions averages about 2 million acre-feet annually, where the impacts of drought include decreased availability of water for agriculture and environmental uses. In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires.

California is the single most productive agricultural state with Fresno County and the San Joaquin Valley being a key factor to such productivity. The agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. California snowpack over the past several years is described in the figure below. The 2022-2023 season was one of the highest snowpack levels since the 1982-1983 season.

[13] https://water.ca.gov/News/News-Releases/2023/April-23/Snow-Survey-April-2023

[14] https://www.ppic.org/publication/groundwater-in-california/

Figure 13. California Snow Water Content Percent of April 1 Average (January 31, 2024)



Source: California Department of Water Resources, Historical Snowpack Comparison

As such, the HMPC understands that high degree of risk posed by drought will be exacerbated by greater climate variation in the future, which, in this case, means greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. The HMPC will continue to explore solutions for mitigating the drought hazard by accessing the best available data and resources on climate change and its relationship to drought.

EARTHQUAKE

HAZARD/PROBLEM DESCRIPTION

An earthquake occurs when two blocks of the earth suddenly slip past one another creating a vibration through the release of energy in the earth's crust. The vibrations that are generated are called "seismic waves". The surface where they slip is called the fault or fault plane. Earthquakes can result in ground shaking, soil liquefaction, landslides, fissures, avalanches, fires, and tsunamis. Additionally, earthquakes can cause buildings to collapse and cause heavy items to fall, resulting in injuries and property damage. They happen anywhere and at any time.

A fault is a fracture or zone of fractures between two blocks of rock. Faults allow blocks to move relative to each other. The movement may occur rapidly, in the form of an earthquake – may occur slowly, in the form of creep. There are major faults which include Normal, Reverse, Strike-Slip, and Oblique Slip Faults. Fresno County has major active or potentially active faults, including the Ortigalita Fault in the Panoche Valley and the Nunez Fault northwest of Coalinga. The Clovis Fault is a concealed fault near Clovis but is not considered to be active currently. Active faults zones outside of the county include the San Andreas Fault to the west and the Sierra Nevada Fault Zone to the east. Both of these faults present seismic ground shaking hazard throughout the county. [15]

SEISMIC HAZARDS

Earthquakes can cause structural damage, injury, and loss of life, as well as damage to infrastructure networks, such as water, power, gas, communication, and transportation. The degree of damage depends on many interrelated factors. Among these are the magnitude, focal depth, distance from the causative fault, source mechanism, duration of shaking, high rock accelerations, type of surface deposits or bedrock, degree of consolidation of surface deposits, presence of high groundwater, topography, and the design, type, and quality of building construction. The following analysis of seismic hazards from the Fresno County General Plan Background Report (2023) discusses some of these factors in more detail.

Ground Shaking

When movement occurs along a fault, the energy generated is released as waves, which cause ground shaking. Ground shaking intensity varies with the magnitude of the earthquake, the distance from the epicenter, and the type of rock or sediment through which the seismic waves move. The geological characteristics of an area thus can be a greater hazard than its distance to the earthquake epicenter.

Although most of Fresno County is situated within an area of relatively low seismic activity, the faults and fault systems that lie along the eastern and western boundaries of Fresno County, as well as other regional faults, have the potential to produce high-magnitude earthquakes throughout the County. A high-magnitude earthquake on one of these faults could cause moderate intensity ground shaking in Fresno County. The valley portion of Fresno County is located on alluvial deposits, which tend to experience greater ground shaking intensities than areas located on hard rock. Therefore, structures in the valley areas would tend to suffer greater damage from ground shaking than those located in the foothill and mountain areas.

Seismic Structural Safety

[15] Fresno County General Plan Background Report (2023)

Older buildings constructed before building codes were established, and even newer buildings constructed before earthquake-resistance provisions were included in the codes, are the most likely to be damaged during an earthquake. Buildings one or two stories high of wood-frame construction are considered to be the most structurally resistant to earthquake damage. Older masonry buildings without seismic reinforcement (unreinforced masonry) are the most susceptible to the type of structural failure that causes injury or death.

The susceptibility of a structure to damage from ground shaking is also related to the underlying foundation material. A foundation of rock or very firm material can intensify short-period motions, which affects low-rise buildings more than tall, flexible ones. A deep layer of water-logged soft alluvium can cushion low-rise buildings, but it can also accentuate the motion in tall buildings. The amplified motion resulting from softer alluvial soils can also severely damage older masonry buildings.

Other potentially dangerous conditions include, but are not limited to, building architectural features that are not firmly anchored, such as parapets and cornices; roadways, including column and pile bents and abutments for bridges and overcrossings; and above-ground storage tanks and their mounting devices. Such features could be damaged or destroyed during strong or sustained ground shaking.

LIQUEFACTION POTENTIAL

Liquefaction is a process whereby soil is temporarily transformed to a fluid form during intense and prolonged ground shaking. Areas most prone to liquefaction are those that are water saturated (e.g., where the water table is less than 30 feet below the surface) and consist of relatively uniform sands that are loose to medium density. In addition to necessary soil conditions, the ground acceleration and duration of the earthquake must be of sufficient energy to induce liquefaction. Scientific studies have shown that the ground acceleration must approach 0.3g before liquefaction occurs in a sandy soil with relative densities typical of the San Joaquin alluvial deposits.

Liquefaction during major earthquakes has caused severe damage to structures on level ground because of settling, titling, or floating. Such damage occurred in San Francisco on bay-filled areas during the 1989 Loma Prieta earthquake, even though the epicenter was several miles away. If liquefaction occurs in or under a sloping soil mass, the entire mass may flow toward a lower elevation. Also, of particular concern in terms of developed and newly developing areas are fill areas that have been poorly compacted.

No specific countywide assessments to identify liquefaction hazards have been performed. Areas where groundwater is less than 30 feet below the surface are primarily in the valley. However, soil types in the area are not conducive to liquefaction, because they are either too coarse or too high in clay content. Areas subject to 0.3g acceleration or greater are in a small section of the Sierra Nevada along the Fresno-Inyo border and along the Coast Range foothills in western Fresno County. However, the depth to groundwater in such areas is greater than in the valley, which would minimize liquefaction potential as well. Detailed geotechnical engineering investigations would be necessary to evaluate liquefaction potential more accurately in specific areas and to identify and map the areal extent of locations subject to liquefaction.

SETTLEMENT

Settlement can occur in poorly consolidated soils during ground shaking. During settlement, the soil materials are physically rearranged by the shaking to result in a less stable alignment of the individual minerals. Settlement of sufficient magnitude to cause significant structural damage is normally associated with rapidly deposited alluvial soils or improperly founded or poorly compacted fill. These areas are known to undergo extensive settling with the addition of irrigation water, but evidence is not available. The only urban area directly affected by settlement is the City of Coalinga. Fluctuating groundwater levels may have changed the local soil characteristics. Sufficient subsurface data is lacking to conclude that settlement would occur during a large earthquake; however, the data is sufficient to indicate that the potential exists.

Other Hazards

Earthquakes can also cause seiches, tsunamis, landslides, and dam failures. A seiche is a periodic oscillation of a body of water resulting from seismic shaking or other causes that can cause flooding. Earthquake-induced seiches and tsunamis are not considered a risk in Fresno County. Earthquakes may cause landslides, particularly during the wet season, in areas of high water or saturated soils. The most likely areas for earthquake-induced landslides are the same areas of high landslide potential discussed in Section 4.2.9 Landslide. Finally, earthquakes can cause dams to fail (see Section 4.2.3 Dam Failure).

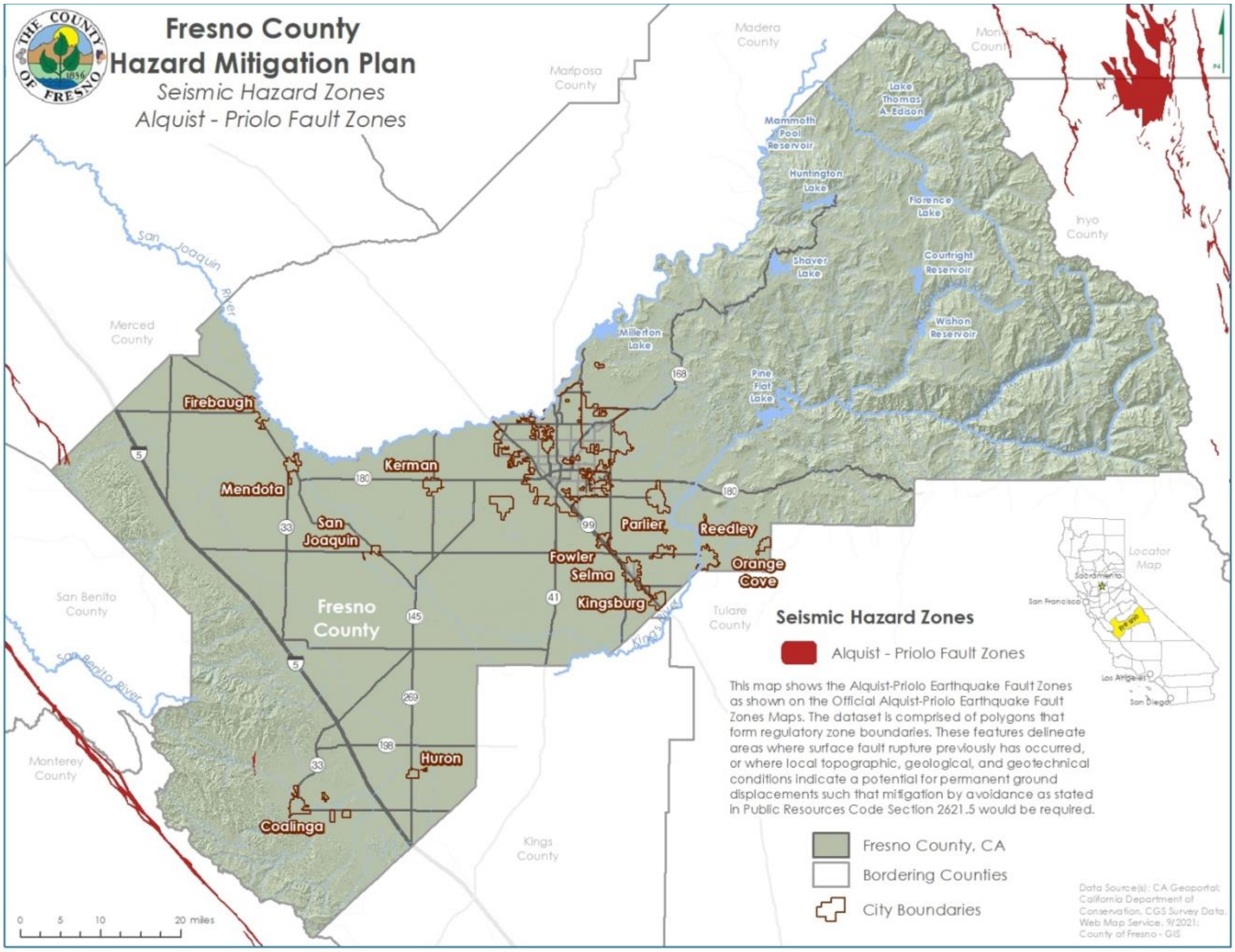
Hazardous material incidents following an earthquake represent a significant and complex challenge. Earthquakes, by their very nature, can cause extensive structural damage, leading to the disruption of systems and containers that store or transport hazardous materials. This disruption can result in leaks, spills, or even explosions of hazardous substances, such as chemicals, gases, and radioactive materials. The immediate aftermath of an earthquake often sees a chaotic environment, where the release of these materials can go undetected or unaddressed for a critical period. Earthquakes can also result in fires from ruptured gas or power lines.

FAULTS

An active fault is defined by the California Geological Survey as one that has had surface displacement within the last 11,000 years (Holocene). This does not mean, however, that faults having no evidence of surface displacement within the last 11,000 years are necessarily inactive. For example, the 1975 Oroville earthquake, the 1983 Coalinga earthquake, and the 1987 Whittier Narrows earthquake occurred on faults not previously recognized as active. Potentially active faults are those that have shown displacement within the last 1.6 million years (Quaternary). An inactive fault shows no evidence of movement in historic (last 200 years) or geologic time, suggesting that these faults are dormant. There are several active and potentially active faults within and adjacent to Fresno County.

Faults within Fresno County and major active and potentially active faults in the region are illustrated in **Figure 11. Alquist-Priolo Earthquake Fault (Hazards) Zones.**

Figure 14. Alquist-Priolo Earthquake Fault (Hazards) Zones



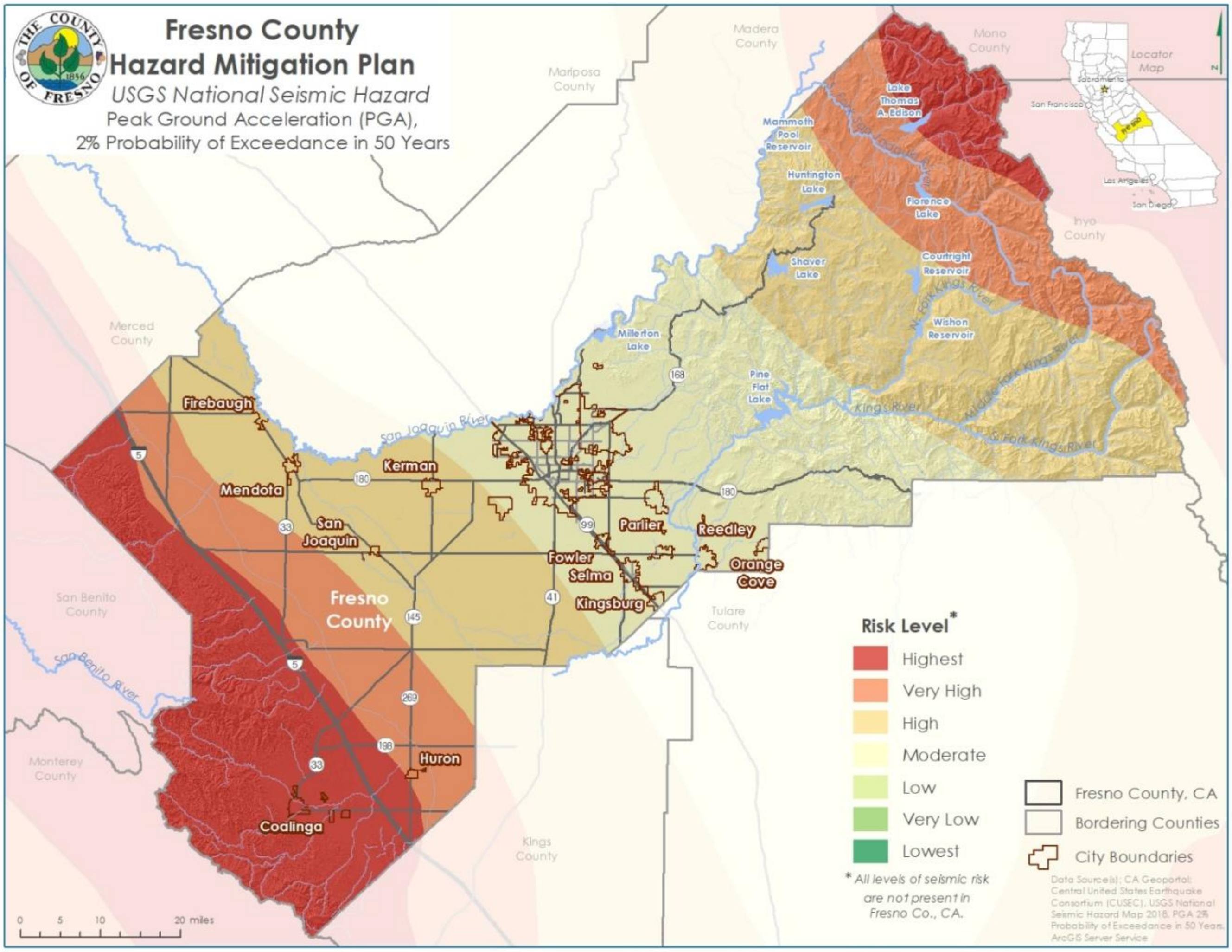
Source: California Department of Conservation

- **Clovis Fault—**The northwest-trending Clovis fault is believed to be approximately five to six miles east of the City of Clovis, extending from an area just south of the San Joaquin River to a few miles south of Fancher Creek. The Clovis fault is considered a pre-Quaternary fault or fault without recognized Quaternary displacement. This fault is not necessarily inactive.
- **Hartley Springs Fault, Silver Lake Fault (Parker Lake Fault), Unnamed Faults—** Holocene and Quaternary faults are present in the vicinity of Duck Lake in the northeastern part of Fresno County, a few miles south of Mammoth Lakes.
- **Unnamed Inferred Faults—**Relative or apparent upward and downward displacement, which are interpreted as inferred faults, occur in an area located a few miles south of Helm, extending southeast to approximately Lanare (between Fresno Slough and Crescent Ditch). As with the Clovis fault, there is no apparent Quaternary displacement; however, the possibility for fault movement in this area cannot be eliminated.
- **Nuñez Fault—**The Nuñez fault is located approximately six to seven miles northwest of Coalinga. The Nuñez fault experienced surface rupture during the 1983 Coalinga earthquake and is designated an earthquake fault zone under the Alquist-Priolo Earthquake Fault Zoning Act of 1994. No structure for human occupancy may be built within an earthquake fault zone until geologic investigations demonstrate that the site is free of fault traces that are likely to rupture with surface displacement. Special development standards associated with Alquist- Priolo requirements would be necessary for development in this area.
- **Ortigalita Fault—**The Ortigalita fault zone is approximately 50 miles long, originating near Crow Creek in western Stanislaus County and extending southeast to a few miles north of Panoche in western Fresno County. Most of the faults are considered active due to displacement during Holocene time and are designated an earthquake fault zone under the Alquist-Priolo Earthquake Fault Zoning Act of 1994. The southernmost extension of the fault lies in Fresno County.
- **The San Andreas Fault—**The San Andreas fault lies to the west and southwest of Fresno County. In the southwestern part of the County, the fault is roughly parallel to and a few miles west of the County line. This fault is considered active and is of primary concern in evaluating seismic hazards throughout western Fresno County, although effects of earthquakes along the San Andreas fault could occur farther east as well.
- **Sierra Nevada Fault Zone (Owens Valley Fault Zone)—**Approximately 12 miles east of the eastern Fresno County boundary lies the Owens Valley fault zone. This northwest-trending fault zone is a lengthy and complex system containing active and potentially active faults. Historically, this fault has been the source of seismic activity in Madera County to the north.
- **Foothills Fault System—**The southern part of the Foothills Fault System, located approximately 70-80 miles north of the City of Fresno, includes the Bear Mountains fault and the Melones fault zone, as well as numerous smaller, but related faults. According to the California Geological Survey data, these faults have not shown any activity during the last 1.6 million years; however, geologic investigations of the seismic safety of the Auburn Dam site suggest these faults are potentially active. Therefore, the possibility exists that earthquakes could occur on these faults.
- **White Wolf Fault—**The White Wolf fault is located approximately 100 miles south of western Fresno County. The fault was not considered active until 1952, when movement along it generated a series of damaging earthquakes in the Bakersfield (Kern County) area.
- **Coast Range-Sierran Block Boundary—**Recent evidence suggests that faults along the western boundary of the Central Valley may be more active than once believed. According to the California Geological Survey, asymmetrical folds have recently been identified on the eastern slopes of the

Coast Range, which includes western Fresno County. Such folds can hide faults that show no surface rupture. These faults and folds, which are part of a large system called the Coast Range-Sierran Block Boundary, are like the faults/folds identified as the cause of the 1983 Coalinga earthquake. Therefore, faults beneath the Central Valley once believed to be inactive are now believed to be active and capable of generating large magnitude earthquakes.

Figure 12. USGS National Seismic Hazard Peak Ground Acceleration (PGA), 2% Probability of Exceedance in 50 Years is an earthquake shaking map of Fresno County that is based on the 2 percent probability of occurrence in 50 years, based on analyses of these faults, soils, topography, groundwater, and the potential for earthquake shaking sufficiently strong to trigger landslide and liquefaction. It represents worst-case ground shaking and supports the conclusion that the Fresno County planning area is at risk of future damaging earthquake hazards, especially in the western and northeastern portions of the County.

Figure 15. USGS National Seismic Hazard Peak Ground Acceleration (PGA), 2% Probability of Exceedance in 50 Years



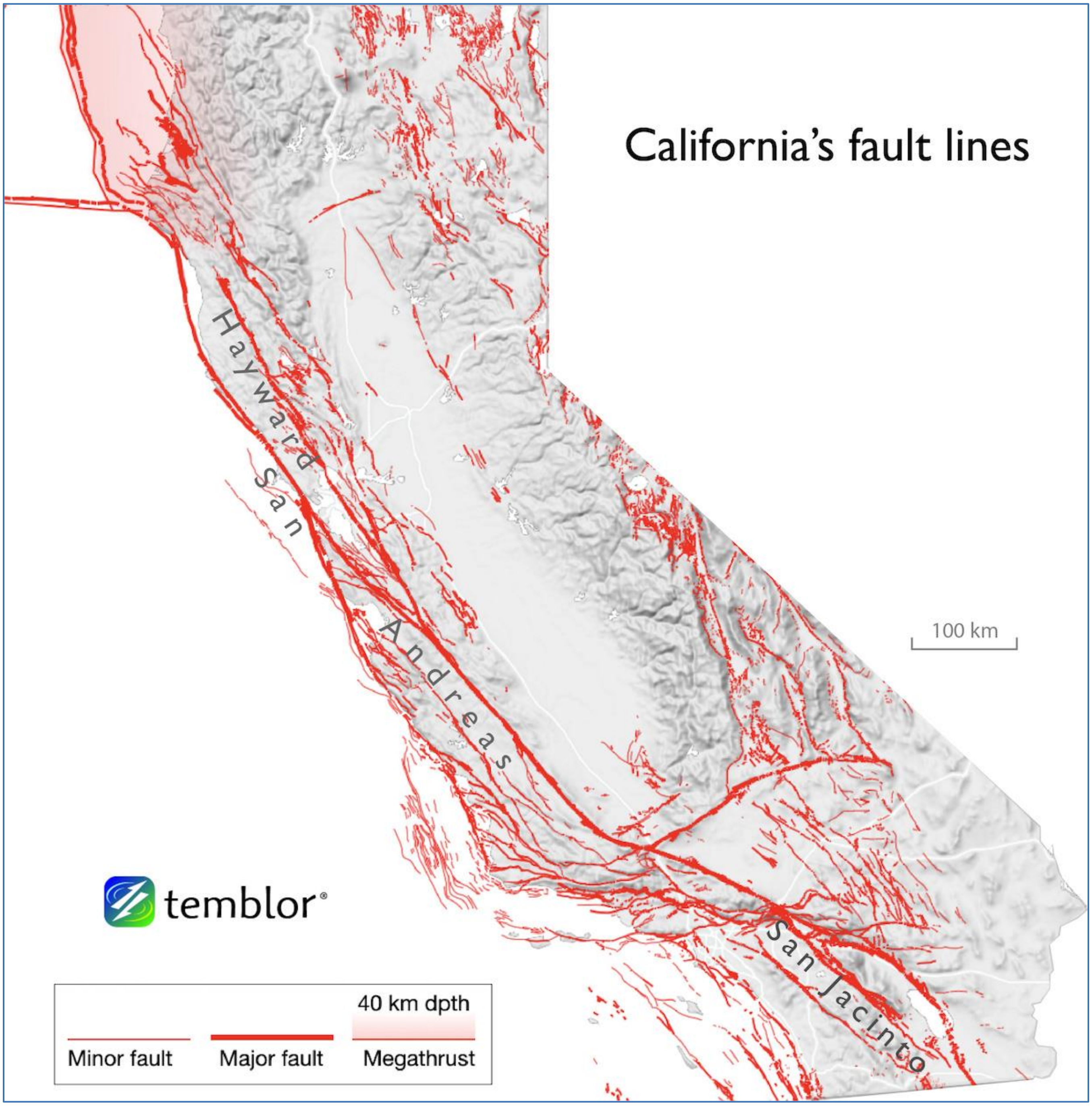
Source: Central United States Earthquake Consortium (CUSEC), USGS National Seismic Hazard Map 2018

Seismic risk is not limited to identified faults. A significant fraction of small to moderately large earthquakes occur on faults not previously recognized. Such earthquakes are characterized as "background seismicity" or "floating earthquakes," which means that the expected sources and locations of such earthquakes are unknown.

EXTENT

Large - Figure 16. California's Fault Lines shows the location of faults and past earthquake epicenters in Southern California. Since earthquakes affect large areas the earthquake hazard extent within city limits is considered significant, potentially impacting 50-100 percent of the planned area.

Figure 16. California's Fault Lines



Source: California Institute of Technology, Southern California Earthquake Data Center, 2017

The amount of energy released during an earthquake is usually expressed as a magnitude and is measured directly from the earthquake as recorded on seismographs. Seismologists have developed several magnitude scales; one of the first was the Richter Scale, developed in 1932 by the late Dr. Charles F. Richter of the California Institute of Technology.

The Moment Magnitude Scale is used to quantify the magnitude or strength of the seismic energy released by an earthquake. Another measure of earthquake severity is Intensity. Intensity is an expression of the amount of shaking at any given location on the ground surface based on felt or observed effects. Seismic shaking is typically the greatest cause of losses to structures during earthquakes. Intensity is measured with the Modified Mercalli Intensity (MMI) scale**. Table 25. Richter Scale Measurements and Associated Characteristics** below compares Magnitude and the felt effects associated with the MMI scale. Damage typically occurs in MMI VII or above, and some areas of the County are susceptible to this level of shaking.

Table 25. Richter Scale Measurements and Associated Characteristics

Magnitude	Mercalli Intensity	Effects	Frequency
Less than 2.0	I	Microearthquakes, not felt or rarely felt; recorded by seismographs.	Continual
2.0-2.9	I to II	Felt slightly by some people; damages to buildings.	Over 1M per year
3.0-3.9	II to IV	Often felt by people; rarely causes damage; shaking of indoor objects noticeable.	Over 100,000 per year
4.0-4.9	IV to VI	Noticeable shaking of indoor objects and rattling noises; felt by most people in the affected area; slightly felt outside; generally, no to minimal damage.	10K to 15K per year
5.0-5.9	VI to VIII	Can cause damage of varying severity to poorly constructed buildings; at most, none to slight damage to all other buildings. Felt by everyone.	1K to 1,500 per year
6.0-6.9	VII to X	Damage to a moderate number of well-built structures in populated areas; earthquake-resistant structures survive with slight to moderate damage; poorly designed structures receive moderate to severe damage; felt in wider areas; up to hundreds of miles/kilometers from the epicenter; strong to violent shaking in epicentral area.	100 to 150 per year
7.0-7.9	VIII <	Causes damage to most buildings, some to partially or completely collapse or receive severe damage; well- designed structures are likely to receive damage; felt across great distances with major damage mostly limited to 250 km from epicenter.	10 to 20 per year
8.0-8.9	VIII <	Major damage to buildings, structures likely to be destroyed; will cause moderate to heavy damage to sturdy or earthquake-resistant buildings; damaging in large areas; felt in extremely large regions.	One per year
9.0 and Greater	VIII <	At or near total destruction - severe damage or collapse to all buildings; heavy damage and shaking extends to distant locations; permanent changes in ground topography.	One per 10-50 years

Source: USGS

PAST OCCURRENCES

Earthquakes have occurred in Fresno County in the past. Earthquakes can be felt in Fresno County by earthquakes that occur within jurisdictional boundaries and outside of jurisdictional boundaries. In the last 10 years, Fresno County has experienced on average 30 earthquakes per year that are within 186 miles and at least magnitude 4.0 or greater. According to the Fresno County Operational Area Master Emergency Services Plan, the California Geological Survey has identified a minimum of four magnitude 5.0 or greater earthquakes that caused damaging shaking in Fresno County between 1800 and 1999. Details on some of these events follow.

- **1983**: In Coalinga, a surface rupture occurred along the Nuñez fault. The main shock was 6.7 on the Richter scale. The surface rupture was determined not to be the cause of the main shock; instead, a blind thrust fault concealed deep within a complex fold-and-thrust belt at the western end of the San Joaquin Valley was identified as the cause. Approximately 800 buildings were destroyed, and 1,000 people were left homeless. No deaths resulted, but 47 people were injured. Private homeowner losses exceeded $25 million. Public agency losses were roughly $6 million. The commercial section of Coalinga was heavily damaged; however, most schools and the hospital received only slight damage. Local, state, and federal declarations resulted.
- **August 4, 1985**: A magnitude 6.0 earthquake occurred, centered about 10.5 kilometers east of Coalinga. It is unknown to what extent earthquakes occurring outside of the planning area were felt by Fresno County residents.

LIKELIHOOD OF FUTURE OCCURRENCES

Highly Likely - Based on the past occurrences, Fresno County is likely to experience about 2 earthquakes a month. Not every earthquake is significant, and the majority of the earthquakes do not cause damage, but earthquakes do occur and can be felt in Fresno County on an annual basis.

According to the Fresno County Operational Master Emergency Services Plan, the faults and fault systems that lie along the eastern and western boundaries of Fresno County, as well as other regional faults, have the potential to produce high magnitude earthquakes throughout the County. Based on the Alquist-Priolo Earthquake Fault Zone chart, Fresno County would be affected by earthquake activity in the Alcalde Hills and Ortigalita Peak faults. There are also several faults in the vicinity of Coalinga that could cause problems in the future. These include the Nuñez fault, about ten kilometers northwest of Coalinga, the Coalinga fault, 5 kilometers northeast of Coalinga; and the New Idria fault, approximately 21 kilometers northwest of Coalinga. In addition, there are many faults in neighboring counties that could potentially affect Fresno County. Specifically, the U.S. Geological Survey is predicting an earthquake at the community of Parkfield in Monterey County, approximately 15 miles southwest of Coalinga.

In addition, according to the California Earthquake Authority (CEA) the Central Valley South region (which includes Fresno, Kern, Kings, Madera, Mariposa, Merced, and Tulare counties), has a 75 percent likelihood or one or more M7.0 or greater quakes striking Southern California based on a 30-yar period, beginning in 2014. The nearby San Andreas Fault system is the major geologic boundary between the North American and Pacific tectonic plates and passes through much of the state with the potential to create the biggest earthquakes. A study by the U.S. Geological Survey indicates that a portion of the San Andreas Fault near Tejon Pass could be overdue for a major earthquake. [16]

CLIMATE CHANGE CONSIDERATIONS

There is some evidence to suggest that weather and climate change impacts can affect seismic activity under the Earth's surface. Geologists have identified a relationship between rainfall rates and seismic activity in certain regions across the globe. In the Himalayas for example, the frequency of earthquakes is influenced by the annual rainfall cycle of the summer monsoon season. Research reveals that 48 percent of earthquakes in the Himalayas strike during the drier pre-monsoon months of March, April, and May while just 16 percent occur in the monsoon season. [17] According to the U.S. Geological Survey, the only correlation that's been noted between earthquakes and weather is that large changes in the atmosphere pressure caused by major storms like hurricane have been shown to occasionally trigger "slow earthquakes" which release energy over a comparatively long periods of time. However, these numbers are small and are not significantly significant. [18]

While climate change may have a connection to seismic activity, it is not expected to directly affect earthquake frequency or intensity as most earthquakes occur far beneath the Earth's surface and far from the influence of weather conditions. However, climate change impacts could exacerbate indirect impacts of earthquakes (e.g., climate change will increase the frequency and intensity of extreme precipitation events, increasing the probability of landslides and liquefaction events during an earthquake).

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[16] California Earthquake Authority https://www.earthquakeauthority.com/california-earthquake-risk/faults-by-county

[17] https://theconversation.com/how-climate-change-might-trigger-more-earthquakes-and-volcanic-eruptions-210841

[18] https://climate.nasa.gov/news/2926/can-climate-affect-earthquakes-or-are-the-connections-shaky/

FLOOD

HAZARD/PROBLEM DESCRIPTION

Floods are among the most frequent and costly natural disasters in terms of human hardship and economic loss and are usually caused by weather events. Floods can cause substantial damage to structures, landscapes, and utilities as well as life safety issues. Certain health hazards are also common to flood events. Standing water and wet materials in structures can become breeding grounds for microorganisms such as bacteria, mold, and viruses. This can cause disease, trigger allergic reactions, and damage materials long after the flood. When floodwaters contain sewage or decaying animal carcasses, infectious disease becomes a concern. Direct impacts, such as drowning, can be limited with adequate warning and public education about what to do during floods. Where flooding occurs in populated areas, warning and evacuation will be of critical importance to reduce life and safety impacts.

A floodplain is an area adjacent to a channel of water. Floodplains are illustrated on inundation maps, which show areas of potential flooding and water depths. In its common usage, the floodplain most often refers to the area that is inundated by the 100-year flood, the flood that has a one percent chance in any given year of being equaled or exceeded. The 100-year flood is the national minimum standard to which communities regulate their floodplains through the National Flood Insurance Program. The 500-year flood is a flood that has a 0.2 percent chance of being equaled or exceeded in any given year.

In addition to the standard 100-year and 500-year flood maps, the California Department of Water Resources (CA DWR) has initiated a program that covers areas at risk of a 200-year flood. After propositions IE and 84 were passed in 2006, funding became available to support the Central Valley Floodplain Evaluation and Delineation (CVFED) program. To assist DWR with fulfilling new California code requirements, the CVFED Program provides new maps delineating the 100-year, 200-year and 500-year floodplains for areas receiving protection from the State federal flood protection system in the Central Valley. The potential for flooding can change and increase through various land use changes and changes to land surface, which can result in a change to the floodplain. A change in environment can create localized flooding problems inside and outside of natural floodplains by altering or confining natural drainage channels. These changes are most often created by human activity.

The Fresno County planning area is susceptible primarily to three types of flooding: localized, riverine, and dam failure flooding.

- **Localized flooding**: Localized flooding problems are often caused by flash flooding, severe weather, or an unusual amount of rainfall. Flooding from these intense weather events usually occurs in areas experiencing an increase in runoff from impervious surfaces associated with development and urbanization as well as inadequate storm drainage systems. The term “flash flood” describes localized floods of great volume and short duration. This type of flood usually results from heavy rainfall on a relatively small drainage area. Precipitation of this sort usually occurs in the winter and spring. Flash floods often require immediate evacuation within the hour.
- **Riverine flooding:** Riverine flooding, defined as when a watercourse exceeds its “bank-full” capacity, generally occurs because of prolonged rainfall, or rainfall that is combined with already saturated soils from previous rain events. This type of flood occurs in river systems whose tributaries may drain large geographic areas and include one or more independent river basins. The onset and duration of riverine floods may vary from a few hours to many days. Factors that directly

affect the amount of flood runoff include precipitation amount, intensity and distribution, the amount of soil moisture, seasonal variation in vegetation, snow depth, and water-resistance of the surface due to urbanization. In the Fresno County planning area, riverine flooding is largely caused by heavy and continued rains, sometimes combined with snowmelt, increased outflows from upstream dams, and heavy flow from tributary streams. These intense storms can overwhelm the local waterways as well as the integrity of flood control structures. The warning time associated with slow rise floods assists in life and property protection.

- **Dam failure flooding:** Flooding from failure of one or more upstream dams is also a concern to the Fresno County planning area. A catastrophic dam failure could easily overwhelm local response capabilities and require mass evacuations to save lives. Impacts to life safety will depend on the warning time and the resources available to notify and evacuate the public. Major loss of life could result, and there could be associated health concerns as well as problems with the identification and burial of the deceased. Dam failure is further addressed in the Dam Failure section.

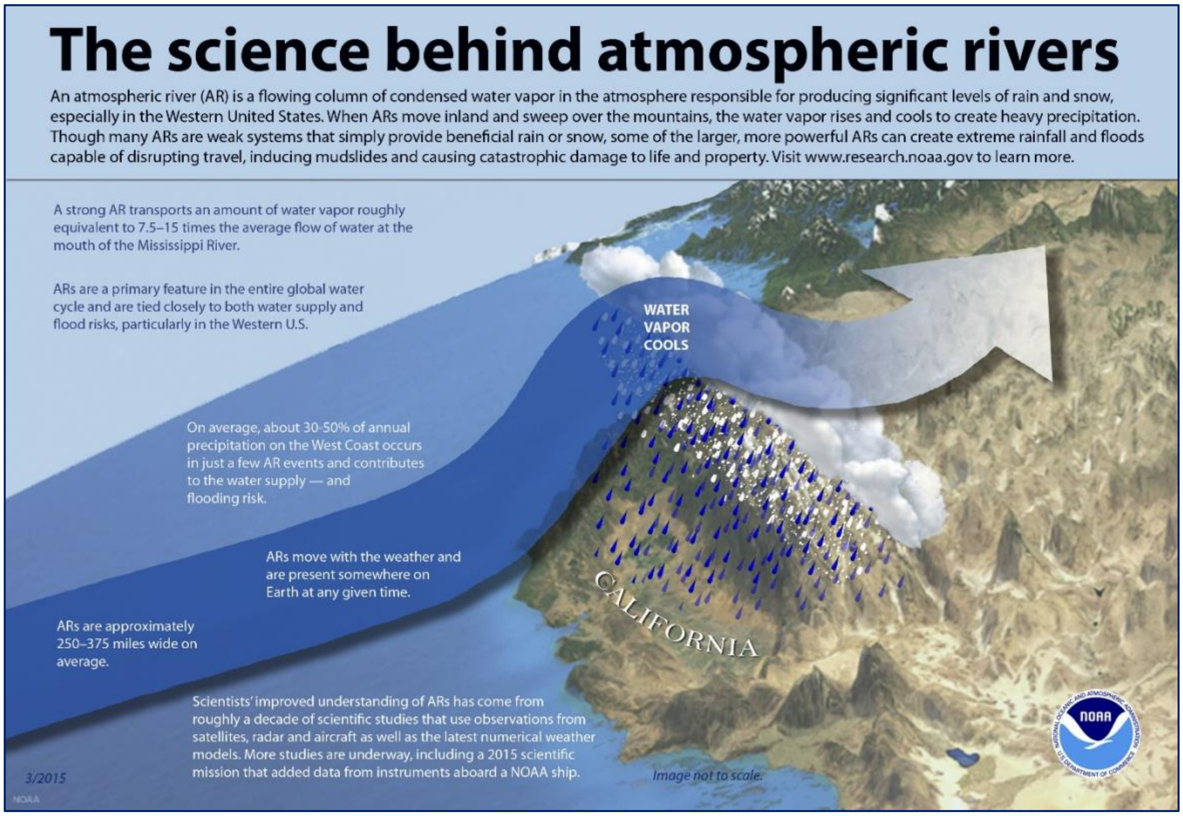
ATMOSPHERIC RIVER

California, including the location of the planning area, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics, shown in **Figure 14. The Science Behind Atmospheric Rivers**. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flowing at the mouth of the Mississippi River. As these atmospheric rivers arrive in California, they tend to generate significant rain and snow.

Atmospheric rivers can arrive in many different shapes and sizes. The larger events can generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as a “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow, adding to the water volume that will be in the flood runoff.

These events can produce heavy amounts of precipitation creating extensive damage. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.

Figure 17. The Science Behind Atmospheric Rivers

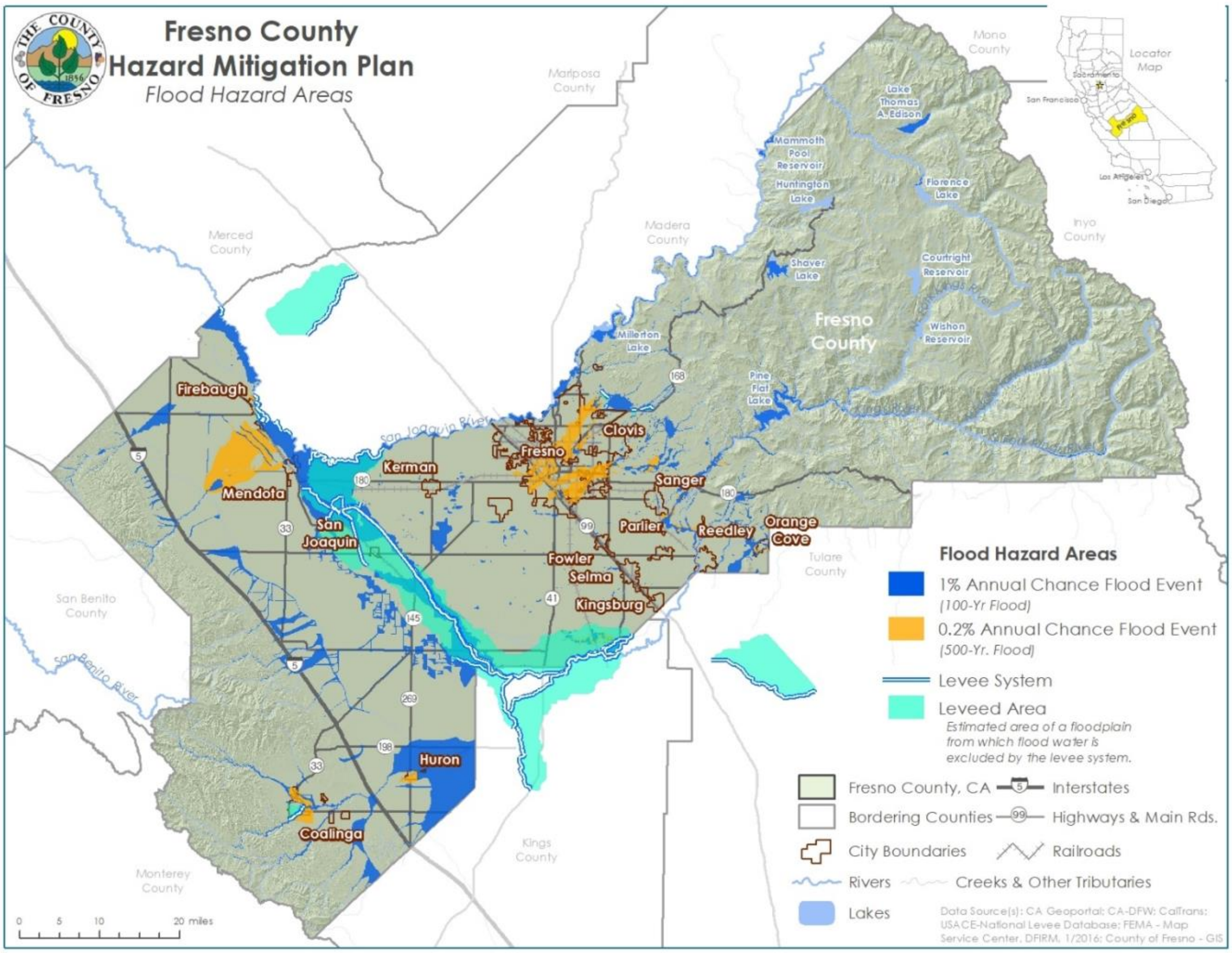


Source: NOAA

LOCATION

Flooding is a hazard which can impact virtually all of the planning area. Many communities in Fresno County have development in or near floodplains which are vulnerable to fluvial flooding. Additionally, there are several leveed areas in the County, and failures of these levees could result in extensive flooding. Flash flooding occur as result of intense rainfall, and this can occur practically anywhere in the County. **Figure 18. Fresno County Flood Hazard Areas and Leveed Areas** shows the extent of the 100-year and 500-year floodplains in the County as well as the leveed areas. Analysis of the flood hazard risk for individual communities in Fresno County is available in the community annexes.

Figure 18. Fresno County Flood Hazard Areas and Leveed Areas



Eastern and Central Fresno County

Eastern Fresno County extends from the Sierra Nevada foothills to the Great Western Divide. It is located primarily in the Sierra Nevada, where precipitation falls mainly as snow. The region is characterized by small local watersheds and draining to the reservoirs upstream of Millerton and Pine Flat reservoirs. Flows originating in the mountains and foothills contribute to the drainage and flooding problems on the valley floor.

Central Fresno County includes the area between the valley floor around Fresno Slough and eastward to the Sierra Nevada foothills, including Millerton Reservoir to Pine Flat Reservoir. The geographic area of central Fresno County runs along the Sierra Nevada foothills at elevations around 500 feet, slopes down to the Fresno Slough on the valley floor and drains gently to the north. This area is the population center of the County; thus, most storm drainage and flood control systems are largely designed to protect urban development. In central Fresno County, annual precipitation typically amounts to 6 inches in areas like Mendota, while in Fresno itself, the average is about 11.50 inches.

The western slope of the Sierra Nevada drains into central Fresno County via the San Joaquin and Kings rivers and small creeks and stream systems. The Fresno Slough, also known as the North Fork of the Kings River, is connected to the San Joaquin River by the James Bypass, a manmade canal. It directs floodwater from the Kings River to the San Joaquin River. Three dams have been constructed to control flows on the rivers. These dams are Friant and Mendota dams on the San Joaquin River and Pine Flat Dam on the Kings River. Pine Flat Dam is operated primarily for flood control purposes. Friant Dam was constructed and is managed by the U.S. Bureau of Reclamation as part of the Central Valley Project. Although Friant Dam does serve to reduce release volumes in the main San Joaquin River channel, it was not sited, designed, or engineered for the purpose of flood control. Mendota Dam is operated primarily for irrigation.

In addition to the flood control facilities on the San Joaquin and Kings rivers, several reservoirs and detention basins have been constructed on streams east of the Fresno-Clovis area to prevent urban flooding. These facilities include Redbank Dam and the Redbank-Fancher Creeks Flood Control Project. The Redbank-Fancher Creeks Flood Control Project consists of two dams (Big Dry Creek Dam and Fancher Creek Dam), three detention basins (Redbank Creek, Pup Creek, and Alluvial Drain detention basins), and various canals to convey discharges around developed areas. The Friant-Kern Canal draws water from Millerton Reservoir at Friant Dam and flows south along the foothills toward Bakersfield.

The rivers, streams, and flood control systems of eastern and central Fresno County are described in further detail below. **Table 26. Major Flood Control Facilities and Stream Systems in Eastern and Central Fresno County** summarizes the location, capacity, and managing agency for each steam system and flood control facility in eastern and central Fresno County.

Table 26. Major Flood Control Facilities and Stream Systems in Eastern and Central Fresno County

Facility/Water Body	Location	Capacity	Managing Agency
Millerton Reservoir*	17 miles northeast of SR 99 on the San Joaquin River in the north central part of the county	520,500 acre-ft[1]	U.S. Bureau of Reclamation
Pine Flat Reservoir	16 miles northeast of Sanger on the KingsRiver in the east central part of the county	1,000,000 acre-ft[1]	U.S. Army Corps of Engineers
Mendota Pool	On the San Joaquin River at Mendota wherethe river turns north, and Fresno Slough joinsthe river in the northwestern part of the country	5,000 acre-ft[2]	U.S. Bureau of Reclamation
Big Dry CreekReservoir	West of Friant-Kern Canal and north ofTollhouse Road on Big Dry Creek	30,200 acre-ft[1]	Fresno Metropolitan Flood Control District
Redbank Reservoir	7 miles east of Clovis, 3 miles southwest of the Friant-Kern Canal between Dog Creek and Fancher Creek in the central part of the county	1,030 acre-ft	Fresno Metropolitan Flood Control District

Facility/Water Body	Location	Capacity	Managing Agency
Fancher CreekReservoir	East of the Friant-Kern Canal at the confluence of Fancher and Hog creeks	9,712 acre-ft[1]	Fresno Metropolitan Flood Control District
Redbank CreekDetention Basin	On Redbank Creek north of McKinley Avenueand west of DeWolf Avenue	940 acre-ft[1]	Fresno Metropolitan Flood Control District
Pup Creek DetentionBasin	On Pup Creek south of Herndon Avenue andeast of Temperance Avenue	559 acre-ft[1]	Fresno Metropolitan Flood Control District
Alluvial Drain Detention Basin	On Alluvial Drain west of TemperanceAvenue and north of Nees Avenue	305 acre-ft[1]	Fresno Metropolitan Flood Control District
Eastern and Central Fresno County 1997	Flows from the Sierra Nevada southwest along the northern border of the county to Mendota where it turns to flow to the northwest. Forms the border between Fresnoand Madera counties	8,000 cfs[1**] (Friant Dam to Chowchilla)2,500 cfs[1,4] (to Mendota) 4,500 cfs[1,4] (Mendota Dam to Sand Slough)	U.S. Bureau of Reclamation, U.S.Army Corps of Engineers, and Local Irrigation Districts
Kings River	Flows from the Sierra Nevada to Sanger and Reedley and into Kings County boundary to Army Weir above Hwy 41 where the normal flow is diverted to the North Fork. Excess flows are diverted to Tulare Lakebed	13,000 cfs[3**]	Kings River Conservation District
Fresno Slough &James Bypass	A seasonal waterway system which connectsthe Kings River near Laton and Lemoore NAS to the San Joaquin River at MendotaPool during flood events	4,750 cfs[1]	U.S. Army Corps of Engineers
Friant-Kern Canal	Flows southeasterly from Millerton Lake through Orange Cove continuing on to Bakersfield. Crosses five feet below Kings River via a 24.5 ft diameter 3,000 ft siphon	5,000 cfs[1]	Friant-Kern WaterUsers' Authority, U.S. Bureau of Reclamation, U.S.Army Corps of Engineers
Millerton Reservoir*	17 miles northeast of SR 99 on the San Joaquin River in the north central part of the county	520,000 acre-ft[1]	U.S. Bureau of Reclamation
Holland Creek Diversion Channel	South of the Friant-Kern Canal where itcrosses Trimmer Springs Road	Peak channel capacity is 1,044 cfs	Fresno Metropolitan Flood Control District
Fancher Creek Detention Basin	Southwest corner of McKinley Avenue andMcCall Avenue	Ultimate capacity is1,802 ac/ft.	Fresno Metropolitan Flood Control District

Facility/Water Body	Location	Capacity	Managing Agency
Pup-Enterprise Detention Basin	East side of DeWolf Avenue, just south ofHerndon Avenue	Ultimate capacity is200 ac/ft.	Fresno Metropolitan Flood Control District
Big Dry Creek Detention Basin	North of Freeway 168 and Dakota Avenue	Ultimate capacity is251 ac/ft.	Fresno Metropolitan Flood Control District
Dry Creek Extension Basin	Northwest corner of Annadale Avenue and Brawley Avenue	Ultimate capacity is854 ac/ft.	Fresno Metropolitan Flood Control District
Facility/Water Body	Location	Capacity	Managing Agency
Millerton Reservoir*	17 miles northeast of SR 99 on the San Joaquin River in the north central part of the county	520,500 acre-ft[1]	U.S. Bureau of Reclamation

Source: Fresno County General Plan, 2017; Fresno Metropolitan Flood Control District

Note: The numbers provided in this table are design capacity and actual river capacity may vary significantly

**Friant Dam/Millerton Reservoir is not sited, designed, or operated to function as a flood control facility, and any such capability is incidental to its function as a diversion facility*

[1]U.S. Army Corps of Engineers

[2]Central California Irrigation District

[3]Kings River Conservation District

[4]River channel capacity is difficult to define due to significant changes in the river conditions over time, variance in channel conditions and geometry along a given river reach, and assumptions made in developing hydraulic models

San Joaquin River

The San Joaquin River forms the boundary between Fresno and Madera counties, shown in **Figure 19. San Joaquin River**. It flows from the Great Western Divide in the Sierra Nevada southwest along the northern border of Fresno County where it is joined by flows from the North Fork of the Kings River. From there, the river flows northwest up the San Joaquin Valley toward the Delta. Friant Dam, which serves to regulate river flows, is the most significant of the dams on the San Joaquin River. Several dams are located upstream of Friant Dam.

The storage capacity of **Millerton Reservoir (formed by Friant Dam)** is 520,500 acre-feet. The Central Valley Project Friant Unit consists of Friant Dam and Millerton Reservoir; the Friant-Kern Canal, which runs south to Kern County; and the Madera Canal, which runs northwesterly to Madera County. Releases from Friant Dam to the San Joaquin River and the Friant-Kern Canal provide service to water users within Fresno County.

This storage capacity of **Millerton Reservoir** is inadequate for full flood protection during wet years, and emergency releases may result in flooding problems downstream. The U.S. Army Corps of Engineers (the Corps) has evaluated the operational plans for all the dams in the San Joaquin River system to determine the possibility of coordinated releases to reduce the likelihood of coincident peak flows downstream with some success. However, in 1997, emergency releases from Friant Dam combined with large storm events and several levee breaks contributed to flooding along the San Joaquin River. Not designed for purposes of flood control, any flood control capability of the Friant Unit is incidental to its function as a diversion facility. The Madera Canal, also part of this unit, also serves to release runoff volumes from the San Joaquin River.

The **Friant-Kern Canal** carries irrigation water from Millerton Reservoir southeast to Kern County. The average annual delivery from the canal is about one million acre-feet with a design capacity of 5,000 cubic feet per second (cfs). There is a spillway into the Kings River just upstream of a double barrel 24 ½-foot diameter siphon under the river. Although the canal was constructed by the Bureau of Reclamation and is normally managed by the Friant-Kern Water Users Authority, floodwater in the canal is managed by the U.S. Army Corps of Engineers. During times of flooding, water from the Friant-Kern Canal may not be releasable to the Kings River since the Corps may not want additional flows on the river.

Mendota Pool is a 5,000-acre-foot reservoir created by Mendota Dam located just outside City of Mendota on the San Joaquin River. The primary function of the dam is storage of irrigation water for agriculture; however, the water level in the pool also functions to maintain water levels in the Mendota Wildlife Management Area. Mendota Pool provides little or no flood protection. Mendota Dam contains flow from the San Joaquin River as well as discharge and releases from the Kings River via the Fresno Slough and James Bypass. The Delta-Mendota Canal conveys Delta water to Mendota Pool from the north, and several irrigation channels divert flows from it. The Bureau of Reclamation, in coordination with the Central California Irrigation District, manages this system, which is part of the Central Valley Project.

Southern California Edison and Pacific Gas and Electric own and operate several dams and reservoirs on the San Joaquin River and its tributaries upstream of Friant Dam. The most notable of these are Edison Lake and Florence Lake. These upstream storage facilities are operated to produce electric energy and have a combined capacity of about 609,530 acre-feet. Their operation does affect the flow of water into Millerton Reservoir and subsequently the timing and availability of releases to Friant Unit contractors. None of these storage facilities are designed or operated for flood control, and the Corps currently has no jurisdiction over releases from these structures. Cumulative flood releases from the upper San Joaquin River dams could overwhelm Friant Dam.

From Friant to Gravelly Ford, the San Joaquin River is part of the Designated Floodway Program administered by the State Reclamation Board. Land use restrictions and river management practices allow the river to meander, flood the overbanks, and remain in a relatively natural state. Downstream of Gravelly Ford, the river is confined by levees. The design capacity of the San Joaquin River from Friant Dam to Chowchilla Bypass is in excess of 8,000 cfs, while the channel capacity downstream is reduced. The major San Joaquin River “choke point” in Fresno County is the reach near Mendota and Firebaugh, which has a channel capacity of 8,000 cfs. Beyond that point, San Joaquin River channel capacity continues to decrease for some distance due to lack of annual flooding and natural channel clearing since Friant Dam was constructed. Further downstream, the river channel has been deepened and widened by historical flows of the Merced and Tuolumne rivers and other tributaries.

In addition to releases from Friant Dam, two uncontrolled streams, Cottonwood Creek, and Little Dry Creek, add significantly to the river flows below Friant during heavy precipitation. Historically, large areas within the Central Valley were within the river’s floodplain. Development has encroached on the floodplain and the flow is now confined to a relatively narrow channel constrained by levees, which reduce the carrying capacity of the river. Most of the flow from Friant Dam is diverted to the Chowchilla Bypass, which branches off the San Joaquin River about 11 river miles upstream from Mendota Dam. Over time, encroachment of vegetation, substantial sedimentation, and land subsidence has considerably reduced channel capacity. Erosion, seepage, and prolonged high water compromise levee integrity. Downstream of the Chowchilla Bypass, the river is not confined by levees (within Fresno County) and generally carries no more than 2,500 cfs.

Flood control measures constructed along the main stem of the river have impacted riparian and wetland wildlife habitat areas. Levee construction and sediment and vegetation removal can damage streamside vegetation, divert floodwater from wetlands and riparian areas, and reclaim natural wetlands for other uses.

Figure 19. San Joaquin River

Source: American Rivers

Kings River

The Kings River originates high in the Sierra Nevada Mountains near the Inyo County line and flows southwest through the central part of Fresno County and into Tulare County at Reedley. It has a large drainage basin, which includes most of Kings Canyon National Park and most of the area between Shaver and Florence lakes in the north to the Fresno/Tulare County border in the south. North of Hanford, the river branches, and the south fork flows southward to the Tulare Lakebed. The north fork joins Fresno Slough, which conveys flows north to the San Joaquin River at Mendota Pool. Several sloughs and canals branch off the river and are used for water storage and to convey irrigation water.

The Kings River flows are regulated by Pine Flat Dam, completed in 1954 for flood control purposes. Pine Flat Reservoir has a storage capacity of approximately one million acre-feet. The flood control functions of the facility are managed by the Corps while the releases for irrigation diversion are managed by the Kings River Water Association. There are additional reservoirs upstream of Pine Flat that are owned and operated by Pacific Gas and Electric for the purpose of hydroelectric power generation. These facilities have a combined storage capacity of about 252,000 acre-feet. Two uncontrolled creeks, Hughes Creek and Mill Creek, flow into the Kings River below Pine Flat Dam. Pine Flat Reservoir has adequate storage capacity to avoid emergency releases in most storm events, but these downstream creeks can add significant flow to the river.

Downstream of Pine Flat Dam, the Kings River is managed for flood control by the Kings River Conservation District in cooperation with the Corps, the California Department of Water Resources (DWR), and local irrigation districts. Releases from Pine Flat Dam and flows from Hughes Creek and Mill Creek provide most of the river's flow. Numerous sloughs and irrigation canals branch off the Kings River. The capacity of the river is more than 13,000 cfs. The Kings River flood control facilities include many miles of levees in central Fresno County.

There are three weirs on the river: Army Weir, Crescent Weir, and Stinson Weir. Army Weir is located where the north and south forks branch off the natural river just upstream from State Route 41. Crescent Weir is located at the Crescent Bypass southwest of 22nd and Excelsior Avenues. The Crescent Bypass flows to Fresno Slough. Stinson Weir is located near the confluence of Murphy Slough and Fresno Slough at Elkhorn Avenue. Normal flows are held by these weirs in the main channel. During storm events, as much as 4,750 cfs is diverted to the North Fork and the San Joaquin River. As much as 3,200 cfs can then be diverted to the Crescent Bypass. Any flow above approximately 10,000 cfs is divided equally between the north and south forks.

In practice, the flow of the Kings River is carefully managed using analysis of anticipated weather, upstream flows, and ability of downstream users to receive the water. Significant adjustment may be necessary, and a variety of operations options are considered, including storing or routing water through alternate sloughs or requesting users to accept additional water. Fresno Slough and the James Bypass are normally dry except for groundwater seepage and irrigation returns. Flow is diverted to the South Fork only in very wet years.

Sand and gravel extraction has occurred along both the San Joaquin River and the Kings River in Fresno County, although most of this aggregate mining has occurred outside of the main river channels. The hydrologic effect of the mining and subsequent reclamation activity has generally been to increase the overall hydraulic capacity of the rivers to accommodate major flood events.

Eastern County Streams

There are many creeks and lakes in the high Sierra Nevada within Fresno County, all of which eventually feed into either the Kings River or the San Joaquin River. In addition, several creeks drain the foothill areas and flow into developed areas in central Fresno County. Most of these streams (i.e., Redbank, Fancher, Dry, and Dog creeks) have been controlled by efforts of the Corps and the Fresno Metropolitan Flood Control District to protect the City of Fresno from damage from flooding from a 200-year storm. Other creeks, such as Wahtoke Creek, are uncontrolled. Some streams in foothill areas of southeastern Fresno County are tributaries to the Orange Cove Stream Group and to Sand Creek, which is a tributary to the Kaweah River.

Flood control efforts along some of these eastern Fresno County streams include the following:

- **Redbank Reservoir—**Redbank Reservoir, formed by Redbank Dam, is located on Redbank Creek north of Shaw Avenue. The reservoir has a gross pool capacity of 1,030 acre-feet and receives water from the Redbank Creek watershed. The reservoir is operated for flood control by the Fresno Metropolitan Flood Control District.
- **Redbank-Fancher Creeks Flood Control Project**—This project consists of a system of two dams, three detention basins, and canals to protect developed areas in and around the City of Fresno from a 200-year storm. The project was built by the Corps and is managed and operated by the Fresno Metropolitan Flood Control District. Fancher Creek Reservoir has a capacity of 9,712 acre-feet and retains water from Fancher and Hog creeks and some flows from Redbank Creek. Fancher Dam diverts flows via canals around Fresno. Redbank Creek Detention Basin (940 acre-feet) contains local flows from Redbank Creek downstream from Redbank Dam. The Alluvial Drain and Pup Creek detention basins have capacities of 305 and 559 acre-feet, respectively, and can each regulate discharges into Dry Creek at 25 cfs.
- **Big Dry Creek Reservoir—**Big Dry Creek Reservoir, with a capacity of 30,200 acre-feet, retains flows from Big Dry Creek and Dog Creek and diverts flows via Little Dry Creek to the San Joaquin River at a rate of up to 700 cfs. During a flood event, water is not typically released from Big Dry Creek Dam; however, during a severe flood event, it may be necessary to do so.

Western County Streams

Western Fresno County consists of the Coast Range within which lies the County's western boundary with San Benito and Monterey counties and the San Joaquin Valley area between the Range and the Fresno Slough. Interstate 5 and the California Aqueduct pass in a north-south direction through western Fresno County. A complex system of streams drains the eastern slope of the Coast Range into the valley and the Fresno Slough. Western Fresno County is significantly different from the rest of the County in climate and character.

Western Fresno County is largely unpopulated. The major land uses are agriculture and grazing. The region is quite dry, with an average annual rainfall of only six to eight inches, yet the stream systems are prone to high flows and flooding because they drain very large watersheds. The soil in the Coast Range is subject to erosion. As a result, stormwater runoff typically carries large volumes of sediment and naturally occurring minerals, such as selenium, arsenic, boron, and asbestos, which is undesirable to downstream users.

Western Fresno County contains five major stream systems that flow from the Coast Range as described further below.

- **Little Panoche Creek—**Little Panoche Creek, located in the northwestern corner of Fresno County, is managed for flood control purposes by the DWR. The DWR operates and maintains a detention dam and reservoir (Little Panoche Reservoir) on the creek. The facility was constructed by the Bureau of Reclamation to provide flood protection for the California Aqueduct. It was designed for a 100-year storm and has a storage capacity of 820 acre-feet. When storage levels in the reservoir exceed 820 acre-feet, the dam's uncontrolled spillway releases water. The creek flows under Interstate 5 and the California Aqueduct. Little Panoche Creek ends at a retention basin on the east side of the aqueduct. When the retention basin fills with stormwater during high flows, stormwater is pumped into the aqueduct. The reservoir also serves as a wildlife preserve.

- **Panoche Creek—**Panoche Creek is located just south of Little Panoche Creek in northwestern Fresno County. It flows under Interstate 5and across the California Aqueduct. The estimated 100-year peak flow for Panoche Creek is 22,000 cfs. On the east side of the aqueduct, the water is not channelized and flows overland. During high creek flows, stormwater floods vast tracks of agricultural land and portions of the City of Mendota.
- **Tumey Gulch and Arroyo Ciervo—**Tumey Gulch and Arroyo Ciervo are in central western Fresno County and flow easterly from Ciervo Mountain. The estimated 100-year peak flow is 3,600 cfs for Tumey Gulch and is 900 cfs Arroyo Ciervo. No flood control facilities exist on the streams; however, the California Aqueduct obstructs their eastward flow. During periods of high stream flow, sediment laden floodwater may form ponds on the west side of the aqueduct. These ponds may spill stormwater and sediment into the aqueduct during storm events.
- **Cantua Creek System—**This creek system includes Arroyo Hondo, Cantua Creek, Salt Creek, Martinez Creek, and Domegine Creek in central western Fresno County. These creeks drain the east side of Joaquin Ridge, crossing Interstate 5 between Kamm Road and Fresno-Coalinga Road. The estimated 100-year peak flow from the Cantua Creek system is 8,300 cfs. As with Tumey Gulch and Arroyo Ciervo, stormwater from the Cantua Creek system ponds on the east side of the California Aqueduct during periods of high flow, dumping large quantities of sediment and storm runoff into the aqueduct. Cantua Creek has inundated Interstate 5 during large storm events.
- **Arroyo Pasajero Stream System—**The Arroyo Pasajero stream system encompasses the largest drainage area in the western San Joaquin Valley. The major creeks in the system are Los Gatos, Warthan, Jacalitos, and Zapato-Chino creeks. They flow through the City of Coalinga and under Interstate 5 to a small ponding basin on the west side of the California Aqueduct. Arroyo Pasajero carries large quantities of sediment containing naturally occurring asbestos. During flood events, the system may damage the aqueduct and Interstate 5. Floodwater may also wash asbestos fibers into the aqueduct.

Major Sources of Flooding/Problem Areas

Flooding is a natural occurrence in the Central Valley because it is a natural drainage basin for thousands of watershed acres of Sierra Nevada and Coast Range foothills and mountains. FEMA's Flood Insurance Study for the County, effective January 20, 2016, describes several types of primary flood problems.

- **General rainfall floods** can occur in Fresno County during winter and spring months. This type of flood results from prolonged heavy rainfall over tributary areas and is characterized by high peak flows of moderate duration. Flooding is more severe when antecedent rain has resulted in saturated ground conditions; when the ground is frozen, and infiltration is minimal; or when rain on snow in the high elevations on the east side adds snowmelt to rain flood runoff.
- **Snowmelt floods** on the San Joaquin and Kings rivers and their higher elevation tributaries can be expected to occur any time from April through June. Although snowmelt flooding is of much larger volume and longer duration than rain flooding, it does not have the high peak flows characteristic of rain floods. Snowmelt flood runoff is sometimes augmented by late spring rains on the snowfields or lower elevation tributary watersheds.
- **Cloudburst storms** sometimes lasting as long as three hours can occur any time from late spring to early fall and may occur as an extremely severe sequence within a general rainstorm. Cloudbursts are high-intensity storms that can produce floods characterized by high peak flows,

short duration of flood flows, and small volume of runoff. In some areas, especially where drainage basins are small, cloudbursts can produce peak flows substantially larger than those of general rainstorms. Cloudburst storms usually cover small areas and would not generally affect flood flows or flood stages on the San Joaquin or Kings rivers. Generally, only the upper reaches of the smaller streams are affected by cloudbursts.

In urban areas, flood problems intensify because open land available to absorb rainfall and runoff is being used for new development, which increases the number of paved areas (i.e., impervious surfaces). The decrease in the amount of open land increases the volume of water that must be carried away by waterways. Urban development in some areas of Fresno County has been substantial in recent years and is expected to continue.

Eastern and Central Fresno County Flood Problem Areas

Most flood issues in eastern and central Fresno County are associated with the San Joaquin River, Kings River, and several other stream systems. In Fresno County, there are 23 dams that could cause substantial flooding in the event of a failure. The majority of these dams are in the San Joaquin and Kings River watersheds in the eastern part of the county. Generally, the areas at risk are large urban and rural areas downstream and below the dams on the valley floor.

San Joaquin River System

The San Joaquin River from Gravelly Ford to the Chowchilla Bypass outside Fresno County is confined by a levee system. The design capacity of the river is 5,000 cfs, which is considered a safe carrying capacity with three feet of allowable freeboard. Over time, encroachment of vegetation, substantial sedimentation, and land subsidence has considerably reduced channel capacity. Erosion, seepage, and prolonged high water compromise levee integrity. Levee maintenance is generally under the jurisdiction of local reclamation districts. Uncontrolled flooding from the San Joaquin River between the Chowchilla Bypass and Dos Palos tends to flow into Madera County north of Mendota.

The Mendota Pool area has shown evidence of significant subsidence, possibly affecting levee height, river invert (i.e., bottom of low-flow channel), as well as the pool depth. The flooding hazards in the region are from Panoche Creek to the west into Madera County downstream from Mendota Pool. It was reported in 1997 (Fresno County General Plan Background Report) that the Mendota Dam is of limited usefulness for flood control purposes. Construction of a new dam at Mendota has been contemplated to improve flood control capabilities of the lower reaches of the San Joaquin.

The flooding potential from creeks and streams between the San Joaquin and Kings Rivers in the east has been substantially eliminated within the last few years by the completion of the Redbank- Fancher Creeks Flood Control Project. This has resulted in a decrease in the areas designated for the 100-year floodplain. However, as noted in the Fresno County General Plan Background Report, the 100-year storm event flows have increased from 18,000 cfs to 24,500 cfs in the San Joaquin River over last few decades (due to increasing intensity of storms and statistical analysis of the meteorologic/hydrologic database for the San Joaquin River).

Kings River System

Uncontrolled creeks within the Kings River system, notably Mill Creek, continue to challenge management of Pine Flat Dam and Kings River flood control during consecutive large storm events. In 1997, water was not released from Pine Flat due to large flows in Mill Creek, which pushed the limits of the system. If another large event had occurred before Pine Flat Reservoir releases could provide adequate storage space and the Mill creek watershed was still saturated, rapid runoff in Mill Creek and an emergency spill at Pine Flat would have overwhelmed the system. In the event of a major release from Pine Flat Dam, downstream flooding would occur over agricultural lands near the riverbanks and possibly within the Cities of Reedley and Kingsburg.

Western Fresno County Flood Problem Areas

Flood issues in western Fresno County are varied in scope and unique in nature. Many creeks prone to high flows and significant erosion are found in the area, but most of the region is unpopulated, so flooding in many areas poses little threat to life or personal property. Major facilities that are subject to flooding include Interstate 5 and the California Aqueduct. Urban areas subject to flooding include the communities of Coalinga, Huron, and Mendota. Important wetland habitat in the Mendota Wildlife Management Area is also subject to flooding and may be impacted by sediments carried by flood flows from these creeks.

During large storm events, the California Aqueduct is flooded by high flows from Arroyo Pasajero. Consequently, the Bureau of Reclamation, the Corps, and the DWR are coordinating efforts to relieve the threat of flooding from this stream system. Other stream systems obstructed by the aqueduct may pose a flooding hazard during periods of high flow when ponds form on the west side of the aqueduct. The streams carry large amounts of sediment. When ponds fill with sediment, water spills into the aqueduct.

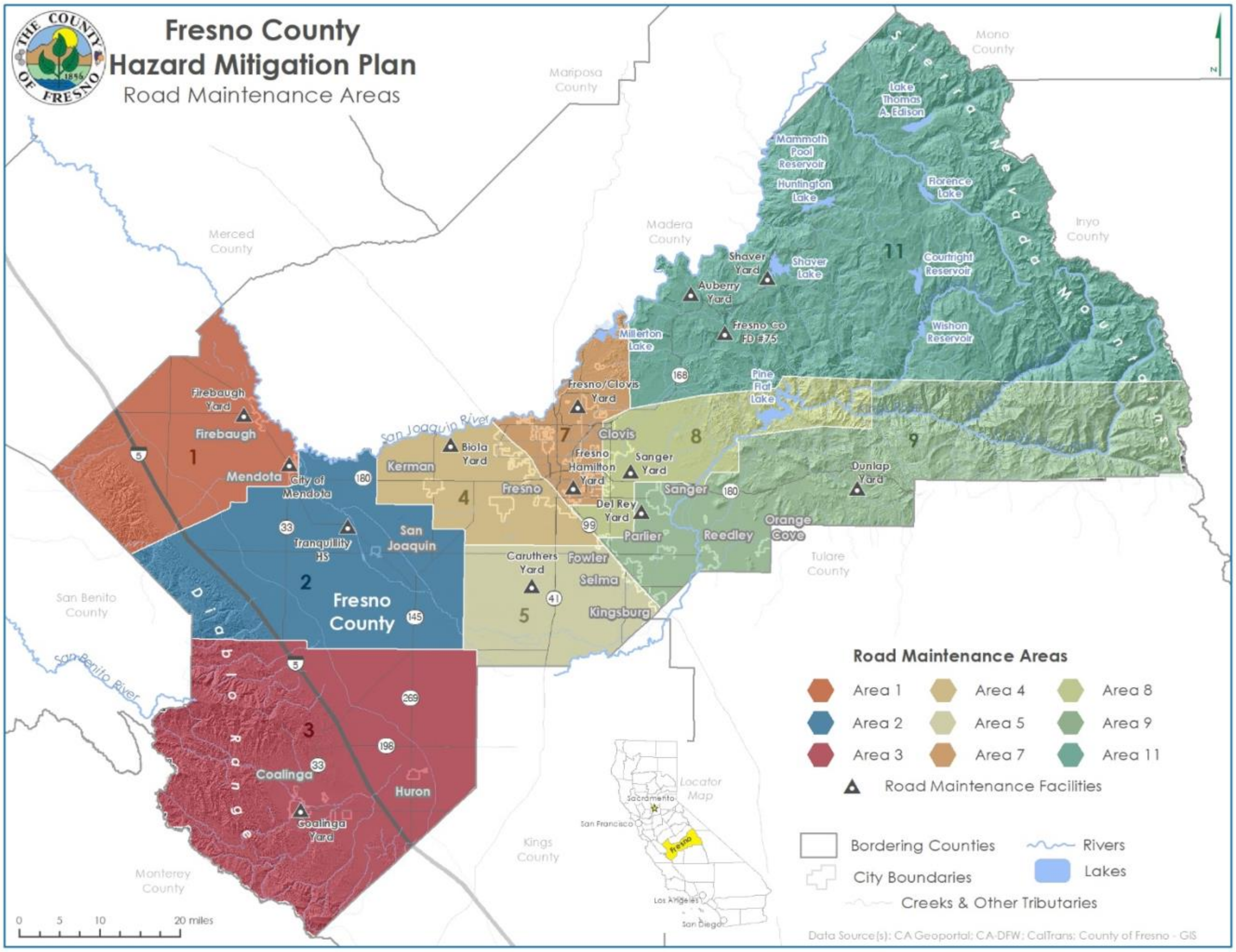
Various stream systems also flood developed areas in western Fresno County during storm events. Creeks that feed into Arroyo Pasajero flow through the City of Coalinga, creating flood hazards and preventing development in impacted areas. Downstream, Arroyo Pasajero is prone to flooding the road into the City of Huron. After crossing the California Aqueduct, Panoche Creek flows overland and floods both agricultural land and portions of the City of Mendota.

The Mendota Wildlife Management Area receives water from Panoche Creek, which drains into Mendota Pool. During storm events, the sediments carried in Panoche Creek contain high levels of selenium and arsenic, which may degrade the water quality in the Mendota Wildlife Management Area.

Localized Flooding Problem Areas

Localized flooding also occurs throughout the County with several areas of primary concern. According to the Fresno County Department of Public Works, numerous roads throughout the County are subject to flooding in heavy rains. In addition to flooding, damage to these areas during heavy storms includes pavement deterioration, washouts, landslides/mudslides, debris areas, and downed trees. The amount and type of damage or flooding that occurs varies from year to year, depending on the quantity of runoff. Flooding problems are tracked by road maintenance area (see **Figure 17. Fresno County Road Maintenance Areas**) and noted below.

Figure 20. Fresno County Road Maintenance Areas



Source: CA Geoportal; CA-DFW; CalTrans; County of Fresno - GIS

A1. Firebaugh Area

The following roads in Area #1 are subject to flooding in heavy rains and flooding signs are required.

- Washoe at Delta Mendota Canal southeast of Bridge
- Herndon at Russell
- Belmont from San Diego to Fairfax
- Shaw between Milux and Russell
- Washoe .01 miles north of California
- Shields at Fairfax southwest corner
- Russell 1.9 miles south of Shields
- Little Panoche, numerous areas 1.3 miles west of Interstate 5 to C/L
- Milux at Bullard, west side
- Bullard east of Milux numerous areas to Fairfax
- Althea 1 mile west of Russell
- Hudson at Merrill northeast corner
- Fairfax at Valeria southwest corner
- Fairfax .02 miles south of Valeria
- Oxalis .04 miles west of Ormsby

A.2 Tranquility

Areas that flood east of James Road:

- Butte, American to North
- American, Denver to El Dorado
- El Dorado, American to Colorado
- Marin, Adams South .2 miles
- Sumner, Colorado to Placer
- Yuba, Manning to Colorado
- Parilier, Placer to Yuba
- Springfield, Colorado to Plumas
- Springfield, Colusa to Sutter
- Huntsman, Colorado to El Dorado
- Floral, Colorado to Graham
- Rose, Colorado to Trinity
- Napa, at drain ditch crossing (Nebraska)?

- Kamm, Placer to Yuba

A.3 Coalinga

- Mt. Whitney

Areas that flood west of James Road:

- San Mateo north of State Route 180
- Sante Fe at San Benteo
- Jefferson Amador to Tuolumne
- Lincoln James Rd. to Calaveras
- Mt. View San Mateo to Monterey
- Clarkson San Mateo to Amador
- Amador Clarkson to Elkhorn
- Elkhorn Amador to Sonoma
- Sonoma Elkhorn to Mt. Whitney
- Kamm State Route 33 to Interstate 5
- Manning Aqua Duct to Interstate 5
- Douglas south of Manning .1 mile
- Douglas north of Manning 1 mile
- San Diego Adams to American
- Jensen San Diego to Washoe
- Coalinga-Mendota Road
- Parkfield
- Collwell east and west
- Boone
- Alcalde Road

A.3 Biola

- Dickenson Avenue, Herndon to Barstow
- Dickenson Avenue, south of North Avenue, east side
- Belmont Avenue, Grantland to Howard Avenue, various locations
- Shields Avenue, Westlawn to Bishop Avenue, various locations
- Shields Avenue west of State Route 145, various locations

- Shaw Avenue west of State Route 145, various locations
- Dower Avenue, Shields Avenue to Shaw Avenue, various locations
- Henderson north of South Avenue, east side
- Brawley south of Lincoln
- Elm Avenue between Morton and Clayton Avenue.
- Adams-Clovis Avenue to State Route 99
- Central at Blyth to Cornelia
- Grantland south of Shaw, east side
- Grantland south of Belmont to RXR tracks, east side

A.5 Caruthers

- Floral west of Temperance
- Fowler at Davis
- McCall south of Clarkson
- Fowler north of Elkhorn
- Temperance south of Conejo
- Dewolf north of Mt. View
- Clovis north of Nebraska
- Harlan between Maple and Chestnut

A.7 Fresno-Clovis

- Copper between Minnewawa and Fowler
- Copper near Armstrong
- Armstrong between Copper and International
- International between Flower and Armstrong
- Fowler between International and Shepherd
- Behymer between Willow and Minnewawa
- Behymer between Minnewawa and Fowler
- Sunnyside between Teague and Nees
- Teague between Fowler and Armstrong
- Marion between Teague and Nees
- Shaw between McCall and Leonard
- Academy between Herndon and Shaw

- Sierra between Academy and Del Rey
- Herndon between Academy and Madsen
- Madsen between Herndon and Shepherd
- Shepherd between SH 168 and Academy
- Shepherd between Fowler and Armstrong
- Gettysburg between Van Ness and Wishon
- Sierra between Forkner and Van Ness Extension
- College between Swift and Santa Ana

A.8 Fresno-Sanger

This is not a complete list as there are many locations that pool at the shoulder or just onto the road. Large or back-to-back storms can change all.

- Jensen at Sierra Vista
- Shields/Locan
- National east of Minnewawa
- Monticeto/Rogers
- Fowler at Princeton
- Butler east of Locan
- Gettysburg/Greenwood
- McKinley west of Bethel
- McKinley at Leonard
- Indianola south of Highway 180
- Dewolf/Church
- Bond/Mayfair Drive North
- Griffith east of Clovis
- Dakota east of Highland
- Fowler at Olive
- Walling north of Kings Canyon
- Olive east of Hornet
- Temperance north of Church
- Temperance north of Jensen
- Locan north of Church
- Highland north of Jensen

- Zediker south of Belmont
- Tulare west of Zediker
- Newmark north of Belmont
- Macdonough north of Belmont
- Newmark north of Highway 180
- California east of Dockery
- McCall/Tulare
- Tulare east of McCall
- Indianola at Jensen
- Olive/Zediker
- Thompson north of Dakota
- Rancho at Butler
- Illinois west of Villa
- Madison west of Clovis
- Grant west of Clovis
- Washington west of Clovis
- Easterby Drive Southwest of Minnewawa
- Easterby Drive Northwest of Minnewawa
- Brown at Jackson

A.9 Sanger-Del Rey

- American between Academy and Armstrong
- Central between McCall and Willow
- Bethel south of Adams 100-500 feet
- Bethel between Manning and Rose
- Willow between North and Jensen
- Nebraska from Academy to city limits and at intersection of Bethel

A.10 Reedley-Dunlap

- Alta at Manning
- Zediker south of Caruthers
- South at Zediker
- Reed at Floral

- Reed at South
- Adams between Zediker and Smith
- Smith at Dinuba
- Hill between Sumner and Adams
- Monson south of Parlier (this might be the City of Orange Cove)

LEVEE FAILURE

A levee is a raised area that runs along the banks of a river or canal. Levees reinforce the banks and help prevent flooding. By confining the flow, levees can also increase the speed of the water. Levees can be natural or man-made. A natural levee is formed when sediment settles on the riverbank, raising the level of the land around the river. To construct a man-made levee, workers pile dirt or concrete along the riverbanks, creating an embankment. This embankment is flat at the top, and slopes at an angle down to the water. For added strength, sandbags are sometimes placed over dirt embankments.

Levees provide strong flood protection, but they are not failsafe. Levees are designed to protect against a specific flood level and could be overtopped during severe weather events. Levees reduce, not eliminate, the risk to individuals and the structure behind them. A levee system failure or overtopping can create severe flooding and high-water velocities. It’s important to remember that no levee provides protection from events for which it was not designed, and proper operation and maintenance are necessary to reduce the probability of failure.

There are three primary risks to levee integrity in Fresno County:

- Earthquake failure
- High water failure
- Dry weather failure.

EARTHQUAKE FAILURE

Seismic risk in the Fresno area is characterized as moderate-to-high because of many active faults in the area. **Figure 16. California's Fault Lines** illustrates the locations of faults in and surrounding Fresno County. Seismic risk to levees stems from the risk of liquefaction, ground settlement, and cracking.

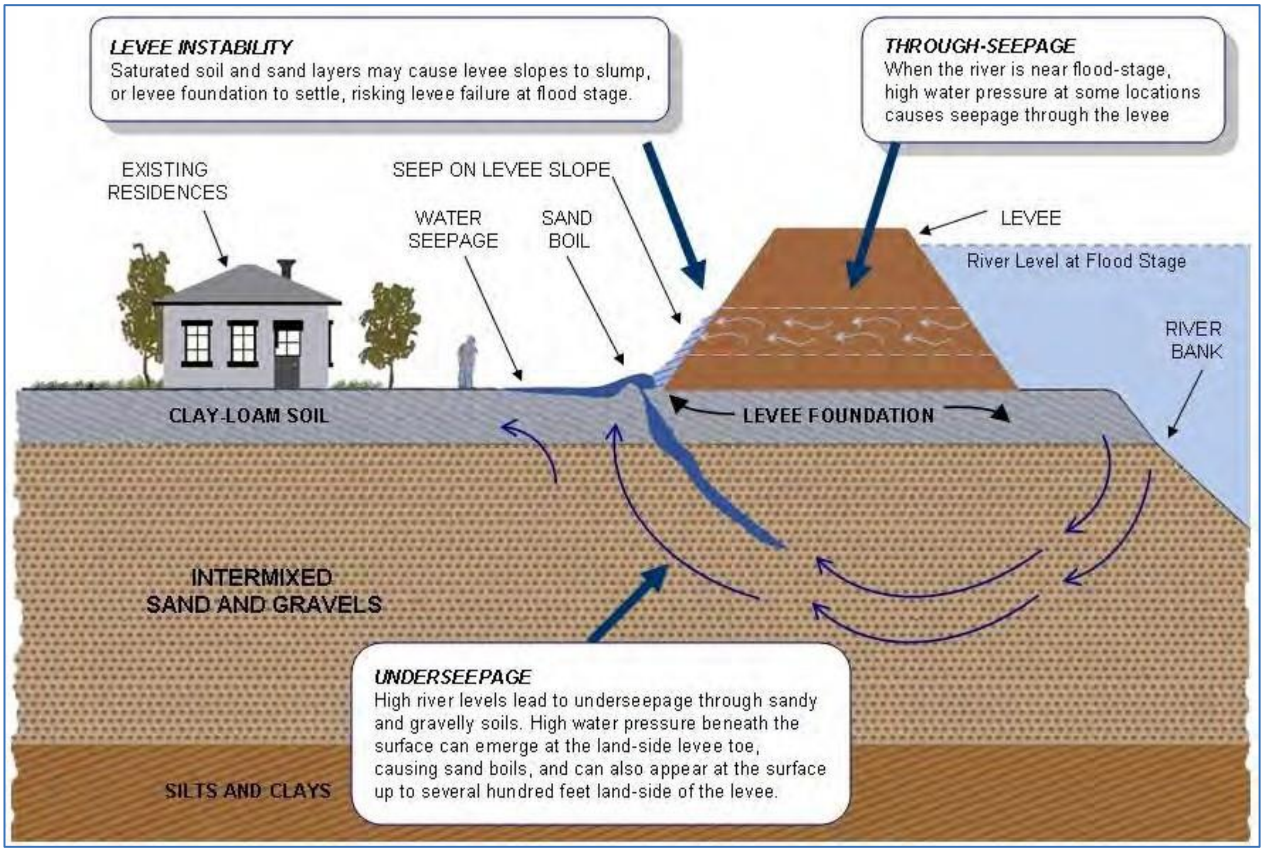
HIGH WATER FAILURE

High water in the County can overtop levees. High water also increases the hydrostatic pressure on levees and their foundations, causing instability, shown in **Figure 18. Levee Failure Process**. The risk of through-levee and under-levee seepage failures increases as well.

Under-seepage refers to water flowing under the levee through the foundation materials, often emanating from the bottom of the landside slope and ground surface and extending landward from the landside toe of the levee. Through-seepage refers to water flowing through the levee prism directly, often emanating from the landside slope of the levee. Both conditions can lead to failure by several mechanisms, including excessive water pressures causing foundation heave and slope instabilities, slow progressing internal erosion, and piping leading to levee slumping.

Overtopping failure occurs when the flood water level rises above the crest of a levee. The representation of the failure modes and the evaluation of the probability of levee failures for each mode are discussed in the remaining sections.

Figure 21. Levee Failure Process



Source: Reclamation District 1000

DRY WEATHER FAILURES

Dry weather, or sunny days, failures are levee breaches that are not flood or seismic related. These failures typically occur between the end of the late snowmelt from the Sierras, in late May, and the beginning of the rainy season, in early October. Sunny-day failures are addressed separately from flood-induced failures to differentiate between winter and summer events. Aside from seismic events, factors that can cause levee failures in the County in the summer period are different than the factors that can cause winter failures.

Burrowing animal activities and pre-existing weaknesses in the levees and foundation are the key weak links leading to levee failures. This is the case whether or not the failures occur during a high-tide condition. Burrowing animals can cause undue weaknesses by creating a maze of internal and interconnected galleries of tunnels. Tree growth on levees may cause weakness as well.

Under-seepage and through-levee seepage are slow processes that tend to work through time by removing fines from levee and foundation material during episodes of high river levels. Cumulative deterioration through the years can lead to foundations ultimately failing in dry weather by means of uncontrollable internal erosion that leads to slumping and cracking of levees.

FLOODPLAIN MAPPING

FEMA established standards for floodplain mapping studies as part of the National Flood Insurance Program (NFIP). The NFIP makes flood insurance available to property owners in participating communities adopting FEMA-approved local floodplain studies, maps, and regulations. Floodplain studies that may be approved by FEMA include federally funded studies; studies developed by state, city, and regional public agencies; and technical studies generated by private interests as part of property annexation and land development efforts. Such studies may include entire stream reaches or limited stream sections depending on the nature and scope of a study. A general overview of floodplain mapping is provided in the following paragraphs. Details on the NFIP and mapping specific to participating jurisdictions are in the jurisdictional annexes.

- **Flood Insurance Study (FIS)**: The FIS develops flood-risk data for various areas of a community that is used to establish flood insurance rates and to assist the community in its efforts to promote sound floodplain management. The current Fresno County FIS is dated January 20, 2016. This study covers both the unincorporated and incorporated areas of the County.
- **Flood Insurance Rate Map (FIRM):** The FIRM is designed for flood insurance and floodplain management applications. For flood insurance, the FIRM designates flood insurance rate zones to assign premium rates for flood insurance policies. For floodplain management, the FIRM delineates 100- and 500-year floodplains, floodways, and the locations of selected cross sections used in the hydraulic analysis and local floodplain regulation.
- **Letter of Map Revision (LOMR) and Map Amendment (LOMA):** LOMRs and LOMAs represent separate floodplain studies dealing with individual properties or limited stream segments that update the FIS and FIRM data between periodic FEMA publications of the FIS and FIRM.
- **Digital Flood Insurance Rate Maps (DFIRM):** As part of their Map Modernization program, FEMA is converting paper FIRMS to digital FIRMs (DFIRMS). These digital maps: incorporate the latest updates (LOMRs and LOMAs), utilize community supplied data, verify the currency of the floodplains and refit them to community supplied base maps, Upgrade the FIRMs to a GIS

database format to set the stage for future updates and to enable support for GIS analyses and other digital applications, and solicit community participation.

To describe the flood hazard areas for a specific area, FEMA uses flood zone designations which include Zone V, Zone VE and C 1-30, Zone A, Zone AE, Zone AH, Zone AO, Zone X (shaded), and Zone X (unshaded). The flood determinations and their descriptions used in floodplain mapping are described in the table below.

Table 27. Floodplain Zone Designations

Zone Designation	Percent Annual Chance of Flood	Description
Zone V	1%	Areas along coasts subject to inundation by th e 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no base flood elevations (BFEs) or flood depths are shown.
Zones VE and V1-30	1%	Areas along coasts subject to inundation by th e 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is us ed on new and revised maps in place of Zones V1-30.)
Zone A	1%	Areas with a 1% annual chance of flooding an d a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or BFEs are shown within these areas.
Zone AE	1%	Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, BFEs derived from detailed analyses are shown at selected intervals within these zones.
Zone AH	1%	Areas with a 1% annual chance of flooding Where shallow flooding (usually areas of ponding) can occur with average depths between 1 – 3 feet.
Zone AO	1%	Areas with a 1% annual chance of flooding, w here shallow flooding average depths are bet ween 1 – 3 feet.

Zone Designation	Percent Annual Chance of Flood	Description
Zone X (shaded)	0.2%	Represents areas between the limits of the 1 % annual chance of flooding and 0.2% chance of flooding.
Zone X (unshaded)	Undetermined	Areas outside of the 1% annual chance floodplain and 0.2% annual chance floodplain; areas of 1% annual chance sheet flow flooding where average depths are less than one (1) foot; areas of 1% annual chance stream flooding where the contributing drainage area is less than one (1) square mile, or areas protected from the 1% annual chance flood by levees. No BFE or depths are shown within this zone.

Source: FEMA

COMMUNITY RATING SYSTEM

As part of the NFIP, the Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management practices that exceed the minimum requirements.

CRS communities have flood insurance premium rates discounted to reflect reduced flood risk resulting from the community's efforts that address the three goals of the program. With an updated hazard mitigation plan, lower flood insurance premiums will be provided for the jurisdictions that participate in the National Flood Insurance Program's Community Rating System.

According to the FEMA Community Status Book, accessed on March 27, 2024, Fresno County joined the CRS on May 1, 2016, and has a CRS class of 7 which provides a 15 percent SFHA discount and 0.05 percent non-SFHA discount. Additionally, the County joined the NFIP on October 1, 1991.

Table 28. Community Rating System (CRS) Credits and Discounts

CRS Class	CRS Discount	Credit Points Required
1	45%	4,500+
2	40%	4,000-4,499
3	35%	3,500-3,999
4	30%	3,000-3,499
5	25%	2,500-2,999

CRS Class	CRS Discount	Credit Points Required
6	20%	2,000-2,499
7	15%	1,500-1,999
8	10%	1,000-1,499
9	5%	500-999
10	0%	0-499

Source: FEMA

The flood mitigation activities and their points are listed below. The total number of points will equal to a CRS class and then determine the CRS discount for flood insurance for the community.

Table 29. Community Rating System (CRS) Mitigation Actions and Points

Series 300	Mitigation Actions	Maximum Points	Average Points
	This series of credits programs advise people about flood hazards, flood insurance, and ways to reduce flood damage. The activities also provide data insurance agents need for accurate flood insurance rating.		
310	**Elevation Certificates** • Have written procedures for managing floodplain-related certificates for new constructions in the floodplain. (at a minimum, a community must maintain certificates for buildings built after the date of its CRS application) • Maintain a rate of 90% accuracy	116	36
320	**Map Information Service** • Provide Flood Insurance Rate Map information to those who inquire, and publicize this service	90	78
330	**Outreach Projects** • Distribute outreach projects with messages about flood hazards, flood insurance, flood protection measures, and/or the natural and beneficial functions of floodplains	350	87
340	**Hazard Disclosure** • Real estate agents advise potential purchasers of flood-prone property about the flood hazard • Regulations require notice of the hazard	80	15
350	**Flood Protection Information** • The public library and/or community's website maintains references on flood insurance and flood protection	125	48

Series 300	Mitigation Actions	Maximum Points	Average Points
360	**Flood Protection Assistance** • Give inquiring property owners technical advice on protecting their buildings from flooding and publicize this service	110	59
370	**Flood Insurance Promotion** • Assess flood insurance coverage in the community; promote flood insurance through meetings, technical assistance, brochures, or other means • This series credits programs that limit floodplain development or provide increased protection to new and existing development	220	40
410	**Floodplain Mapping** • Develop new flood elevations, floodway delineations, wave heights, or other regulatory flood hazard data for an area not mapped in detail by the flood insurance study • Have a more restrictive mapping standard	850	78
420	**Open Space Preservation** • Guarantee that currently open public or private floodplain parcels will be kept free from development • Incentivize keeping the floodplain open with zoning restrictions, lot size requirements, or other regulations	2,870	471
430	**Higher Regulatory Standards** • Limit new buildings and/or fill in the floodplain • Require freeboard • Require soil tests or engineered foundations • Require compensatory storage • Require coastal construction standards in AE Zones • Have regulations tailored to protect critical facilities or areas subject to special flood hazards such as alluvial fans, ice jams, subsidence, coastal erosion	2,462	272
440	**Flood Data Maintenance** • Keep flood and property data on computer records • Use better base maps • Maintain elevation reference marks	222	127
450	**Stormwater Management** • Regulate new development throughout the watershed to ensure that post-development runoff is no greater than pre-development runoff. • Regulate new construction to minimize soil erosion and protect or improve water quality	755	110
510	**Floodplain Management Planning** • Using a standard process, prepare, adopt, implement, and update • A comprehensive flood hazard mitigation plan and/or	762	197

Series 300	Mitigation Actions	Maximum Points	Average Points
	• Plan to protect natural functions within the community's floodplain and/or • A plan for managing substantial flood damage to properties in the community and/or • A plan to serve and/or recover threatened and endangered species in the floodplain • Prepare an analysis of the repetitive flood loss areas within the community **** relates to hazard mitigation planning*		
520	**Acquisition and Relocation** • Acquire and/or relocate flood prone buildings so that they are out of the floodplain, and the floodplain remains open	2,250	176
530	**Flood Protection** • Protect existing floodplain development by floodproofing, elevation, or minor flood control projects.	1,600	64
540	**Drainage System Maintenance** • Have a program for and conduct annual inspections of all channels and detention basins; remove debris as needed	470	203
610	**Flood Warning and Response** • Provide early flood warning to the public, and have a detailed flood response plan keyed to flood crest predictions • Incorporate substantial damage assessment into flood operations	365	266
620	**Levees** • Annually inspect and maintain existing levees; have a system for recognizing the threat of levee failure and/or overtopping, disseminating warnings, and providing emergency response; and coordinate with operators of critical facilities	235	111
630	**Dams** • Have a high-hazard potential dam that could affect the community; have a system for recognizing the threat of dam failure, disseminating warnings, planning, and practicing emergency responses; and coordinating with operators of critical facilities.	160	38

Source: FEMA

LEVEE MAPPING

As part of FEMA's Map Modernization program, FEMA is mapping levees within communities, with a primary focus on maps determined to provide a 100-year level of flood protection. Most of the levees are privately owned, maintained, and operated. Because of the ownership and lack of enforcement for maintenance, most of the levee systems do not meet the current standards for flood protection and are mapped as such.

As part of the flood mapping process, the Federal Emergency Management Agency (FEMA), and its State and local mapping partners, review and evaluate levee system data and documentation. Any community and/or other party seeking recognition or continued recognition of a levee system on a Flood Insurance Rate Map (FIRM) must provide FEMA with data and documentation, certified by a registered professional engineer, showing that the levee system is expected to provide 1-percent-annual-chance (base) flood risk reduction. To be mapped on a FIRM as providing base flood risk reduction, levee systems must meet and continue to meet the NFIP minimum design, operation, and maintenance requirements described in Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44 CFR 65.10).[19]

Provisionally Accredited Levee System (PAL)

In Fresno County, similar to other locations in California, levees and flood control facilities have been built and are maintained variously by public and private entities, including water, irrigation and flood control districts, other state and local agencies, and private interests.

To best address the issue of levees in the DFIRM process, FEMA provided guidance for the issuance of PAL (provisionally accredited levee) agreements that would allow for identified levees to be provisionally accredited for purposes of mapping while communities/levee owners compile and submit data and documentation necessary for full accreditation. Communities have two years from the date of FEMA's initial coordination to submit to FEMA final accreditation data for all PALs. Levees for which such agreements were signed are shown on the final effective FIRM as providing protection from the flood that has a 1-percent-chance of being equaled or exceeded in any given year and labeled as a PAL. Following receipt of final accreditation data, FEMA will revise the FIS and FIRM as warranted.

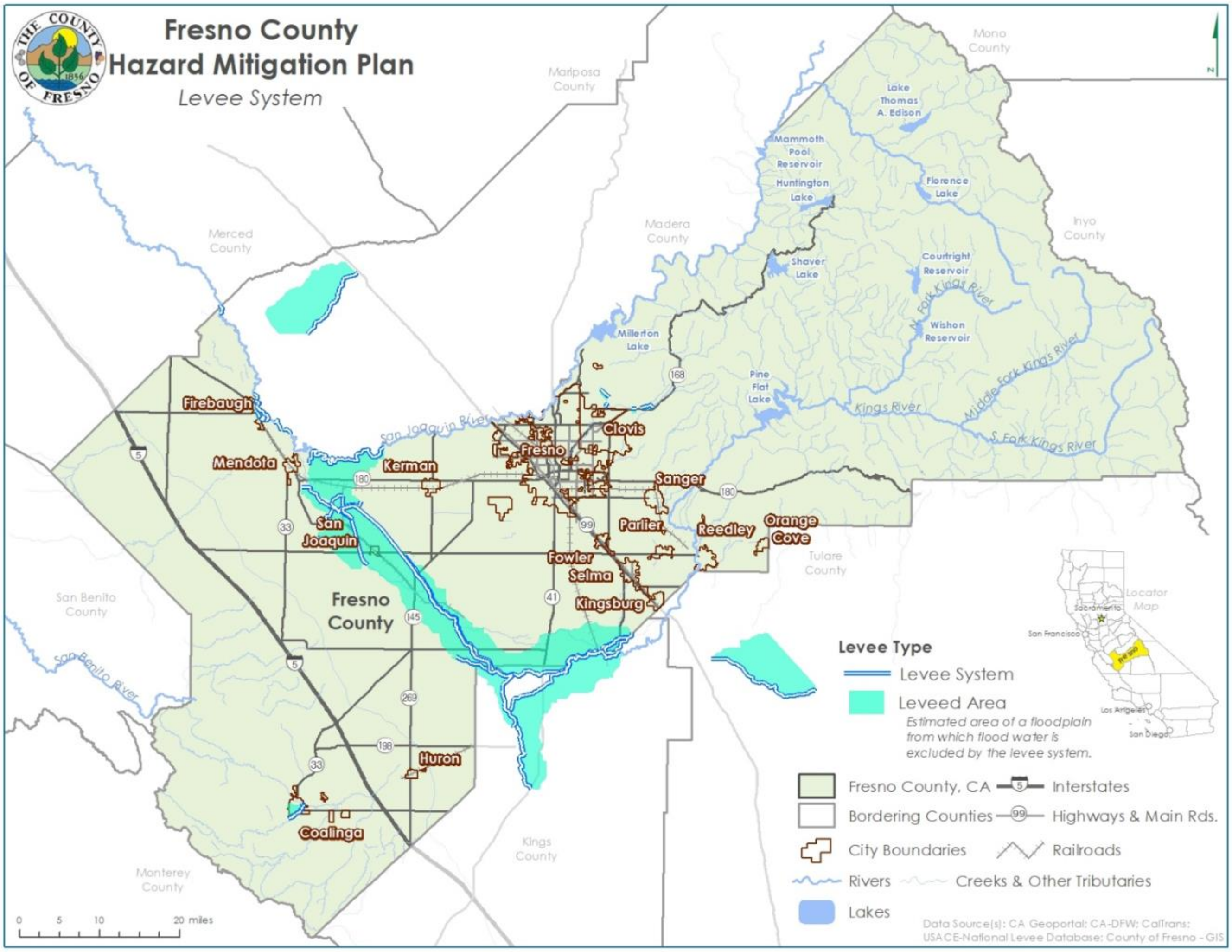
Levee Flood Protection Zone (LFPZ)

FEMA-designated 100-year and 500-year floodplains in Fresno County that were updated under the Map Modernization Program and became effective on January 20, 2016. The State of California (DWR) completed levee flood protection zone (LFPZ) maps in December 2008 of areas that may be inundated if a project levee fails (from water surface elevations at the top of the levee, which may be from a storm event even larger than the levee's design storm). The LFPZ map of the San Joaquin River shows a considerable area within Fresno County that may be inundated if the project levees fail.

A relatively broad levee flood protection zone (LFPZ) is identified along the San Joaquin River, with depths less than three feet indicated west of the river, but greater than three feet all along the east side of the river. Several areas protected by project levees in the east county would also have inundation areas that are primarily less than three feet but include some deeper areas. Fresno County's levee system can be seen in **Figure 19. Fresno County Levee System.**

[19] https://www.fema.gov/sites/default/files/documents/fema_meeting-criteria-accrediting.pdf

Figure 22. Fresno County Levee System



Source: CA Geoportal: CA-DFW; CalTrans; USACE-National Levee Database: County of Fresno - GIS

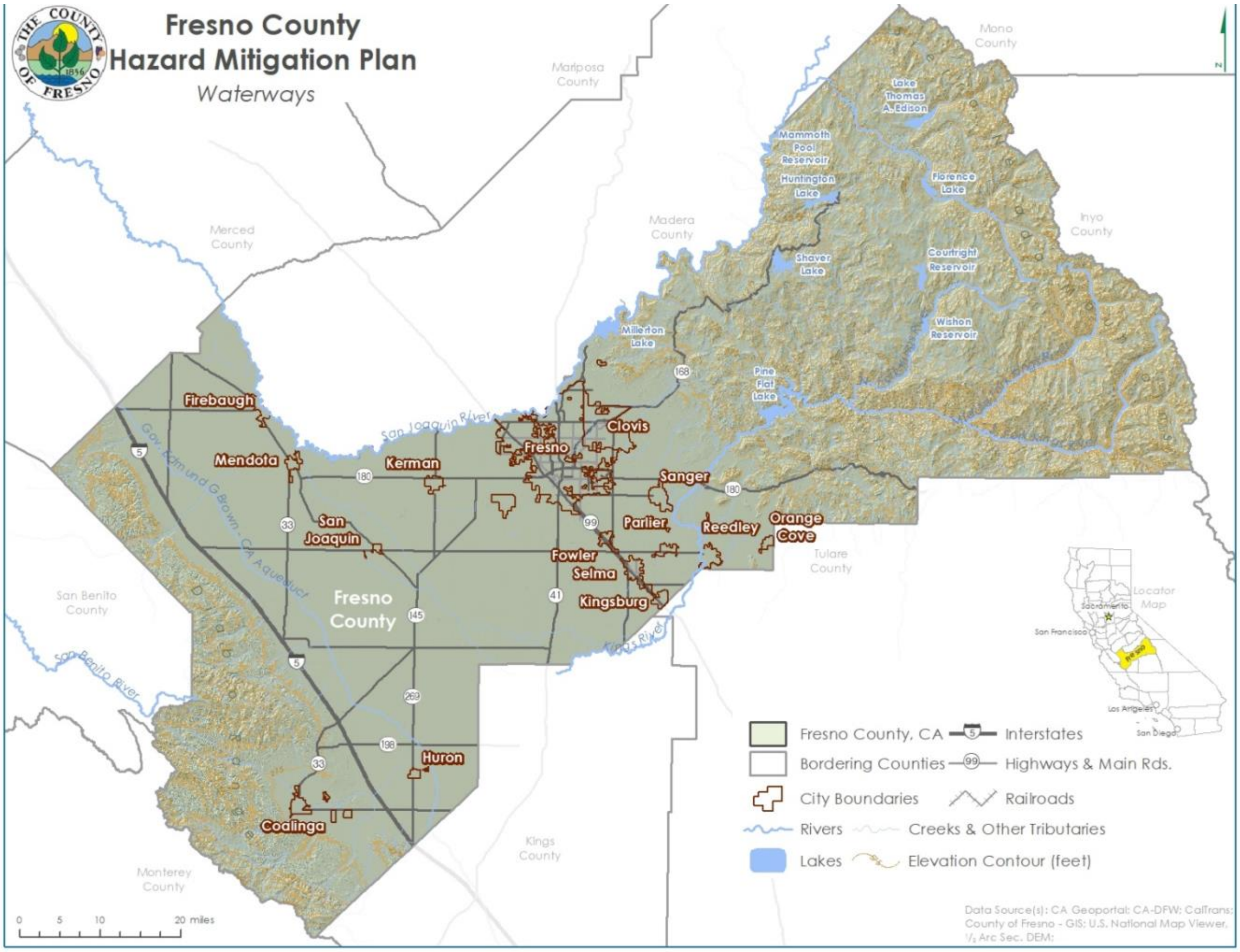
EXTENT

Small - Fresno County is large and geographically diverse. Water resources in the Fresno County planning area include several rivers and streams, artificial waterways, and groundwater sources located throughout the County. The mountainous eastern portion of Fresno County, located primarily in the Sierra Nevada, contains many small mountain lakes and streams that are tributaries to the San Joaquin and Kings rivers, which flow into the Central Valley. The arid western portion of Fresno County is characterized by larger watersheds in the Coast Range that drain stormwater eastward into the valley and the Fresno Slough. Flash floods with depths of several feet can occur in the valleys of the Sierras, while large areas of relatively shallow inundation can occur in the Central Valley.

During winter and spring months, river systems in Fresno County swell with heavy rainfall and snowmelt runoff. To prevent flooding, a wide variety of storm drainage and flood control measures are used throughout the County. These include flood control reservoirs, levee systems, and watershed treatments. In rural areas, the management of reservoir releases, canals, and levee systems reduces the likelihood of flooding and reroutes stormwater around urban areas. In developed areas, storm drainage systems composed of street gutters, inlets, underground storm drains, ponds, pumping stations, and open channels are used to collect and control stormwater runoff. The storm drainage and flood control systems are discussed further in the sections that follow.

Figure 20. Fresno County Waterways illustrates natural and manmade waterways in the County. Information on the County's more notable waterways and associated flood control facilities extracted from the Fresno County General Plan Background Report is included below by region.

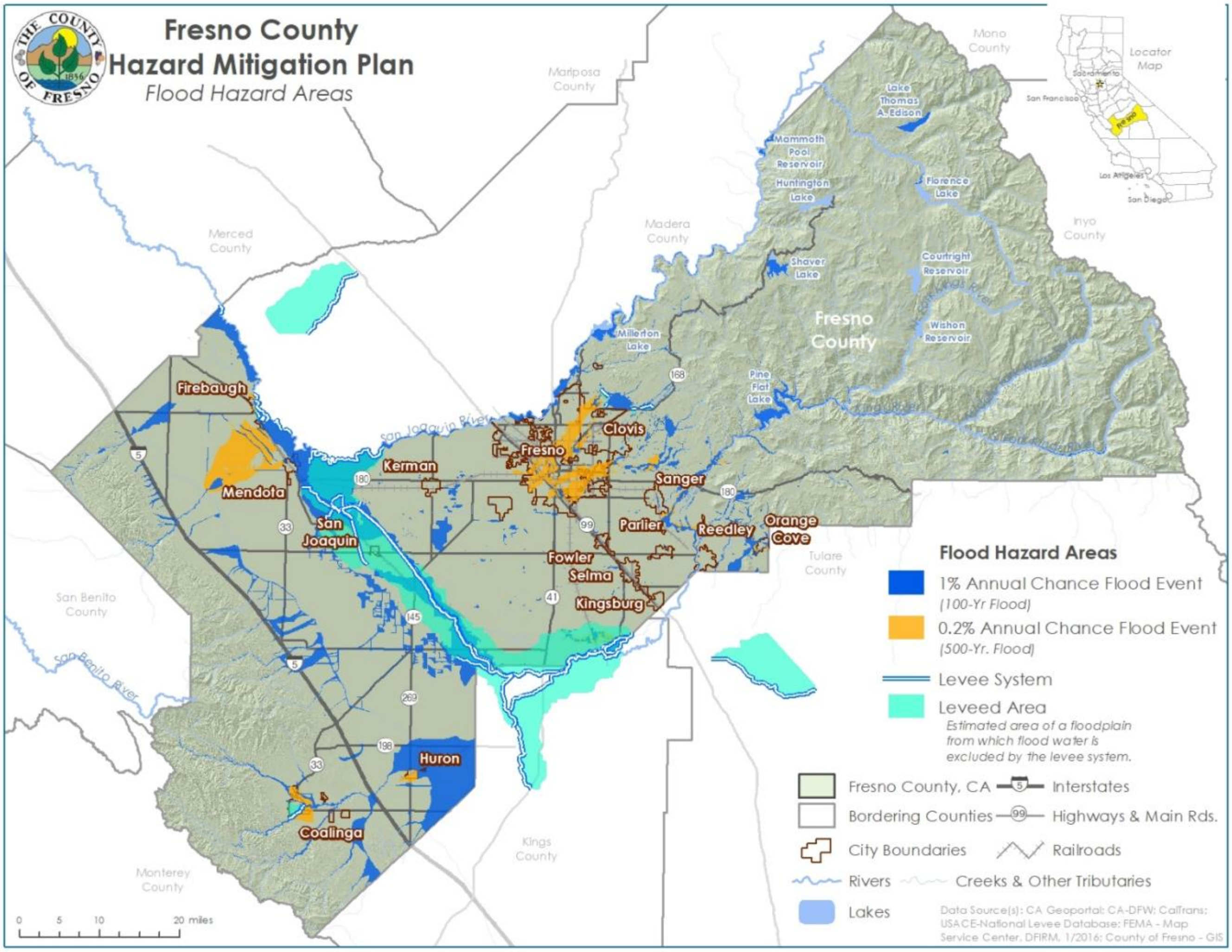
Figure 23. Fresno County Waterways



Source: CA Geoportal: CA-DFW; CalTrans: County of Fresno-GIS; U.S. National Map Viewer, ½ Arc Sec. FEMA

The map below illustrates the city's mapped flood hazard areas. Flood hazard areas periodically change to reflect improved and updated mapping techniques as well as areas that may have been altered by flood mitigation projects, typically reflected in the development of the Conditional Letters of Map Revision (CLOMR) or Letters of Map Revision (LOMR). More detailed flood hazard maps are included in this Chapter.

Figure 24. Fresno County Flood Hazard Areas



Source: CA Geoportal; CA-DFW; CalTrans; USACE-National Levee Database; FEMA-Map Service Center; DFIRM, 1/2016; County of Fresno - GIS

LEVEE FAILURE EXTENT

The geographic extent of the levee hazard is shown in **Figure 21. Fresno County Flood Hazard Areas** and explained further in the Vulnerability portion of this plan.

PAST OCCURRENCES

Fresno County has a long history of flooding, Historical records indicate that nine significant flood events occurred in Fresno County between the 1840s and 1900. A series of river floods during the 1980s and 1990s prompted FEMA to drastically revise its estimate of the 100-year flood flows in the San Joaquin River channel and to develop a new FIRM for the area. Construction of major detention structures in the eastern part of the County along the Fresno County Stream Group enabled FIRMs to be revised in the early 1990s to show a reduced 100-year flood risk from the San Joaquin River to the metropolitan area. Within the past 70 years, there have been 53 recorded flood incidents within Fresno County. Detailed information on each of the flood events is described below.

- **December 1955**: A rain on snow event caused local and downstream flooding in eastern Fresno County, ultimately affecting the entire valley region. Homes were lost and roads and bridges were damaged or destroyed. Damage to some dam facilities also resulted.
- **1995**: From January to March 1995, strong storms in the County led to severe flooding, road closures, a destroyed bridge on Interstate 5, hundreds displaced, and seven fatalities, particularly affecting the western region. Damages included twenty homes, $5 million to public facilities, over $8.6 million to agriculture, and $9 million in business impacts, with multiple infrastructure disruptions like road closures and compromised water systems. A local, state, and federal disaster was declared due to the extensive impact of the storms.
- **1997**: A regionwide rain on snow event in high elevations caused local flooding and flooding downstream in the valley. Homes, bridges, roads, and other infrastructure near waterways were damaged. A bridge on Interstate 5 over the Kings River was washed out. Losses to infrastructure were estimated in the hundreds of millions. Other impacts included damage to fisheries and wildlife.
- **1998 (El Niño rain event)**: In 1998, Fresno County was hit by extensive rainfall over 33 days within a six-month period, causing widespread flooding and prompting local, state, and federal emergency declarations. Property and public facility damage totaled nearly half a million dollars, while the farming industry suffered a $17 million loss, primarily impacting tree fruit and row crops. The community faced substantial economic impacts between $38-48 million, and the agricultural workforce experienced significant unemployment and reduced work hours.
- **April 28, 2005 (Parlier Flood)**: A cell of severe weather passed over the City of Parlier dropping up to three inches of rain in 20 minutes. The drainage system could not handle the flow, and approximately 25 homes and businesses were flooded. The City of Parlier declared a local disaster, as did Fresno County. Damage was estimated at $700,000. Homeowners had little or no insurance coverage. In addition, J Street was closed for one day.
- **2005-2006**: Above average rainfall occurred between December 19, 2005, and January 1, 2006. This resulted in flooding of low-lying areas throughout the County. Flood control basins were overflowing in several areas, including the Cities of Fresno and Clovis. Property damage included damage to approximately 180 businesses and homes estimated at $1.4 million within the unincorporated County. Damage to other jurisdictions was estimated at $611,307. Damage to crops

was minimal due to the time of year. Flooding further resulted in several road closures, which were one to two weeks in duration.

- **April 5, 2006**: Heavy rainfall and snowmelt caused high runoff into the San Joaquin and Kings River drainages, putting levees and river channels at risk, although they ultimately held. A flood fighting team from the Department of Water Resources (DWR) and construction crews worked to reinforce the system, resulting in minimal property and crop damage, except for 200 acres in the Tranquility Irrigation District affected by a levee break. Despite the damage to the levee, canal systems, and river channels, disaster declarations were made due to the potential for more severe consequences had there been system failures.
- **July 2006**: Flash floods from thunderstorms in drainages above the north end of Huntington Lake resulted in a variety of damage. This included an estimated $250,000 in damage to private boats and an estimated $200,000 in damage to local infrastructure (roads, boat docks, etc.). Other impacts included loss of power for three weeks in some areas, closure of a primary summer road for one week, and closure of Huntington Lake to recreational use for one week. Cleanup costs exceeded $150,000, and search and rescue costs were estimated at $25,000.
- **October 29, 2007**: Newspapers and broadcast meteorologists reported several roadways flooded in Northwest Fresno. Numerous vehicles were stranded, and water rescues occurred. Heavy rain caused a roof to collapse at an industrial plant on the northwest side of the city. Damage was estimated at 250,000 to the roof structure alone. Total property damage associated with the event amounted to over $500,000.
- **December 2007**: Heavy rain and snowstorms ravaged central California, including the San Juaquin Valley and Fresno metropolitan area. The combination of locally heavy rains and poor drainage areas within the urban and suburban land lead to over $175,000 in property damage between December 18th and 19th.
- **December 29, 2010**: On the morning of the 29th, heavy rain across the San Joaquin Valley caused widespread urban and poor drainage flooding. Especially hard hit were the metro areas of Fresno, Visalia, and Bakersfield, and the adjacent foothills. Fresno had a record rainfall of 0.92 inch on the 28th, breaking the old record of 0.72 inch, set in 2004. The two-day total at Fresno-Yosemite International Airport was 1.54 inch, which pushed the December rainfall to 5.92 inches for the second wettest December on record for Fresno; the wettest December was in 1955, with 6.73 inches. It was also the coldest low of the year for Fresno, with temperatures dropping below 32 degrees. Property damage amounted to $125,000.
- **November 30, 2011**: Fresno set record high minimum temperatures on the last day of the month, establishing the total record for the sixth warmest November. This was also the fourth consecutive month that Fresno ranked in the top 10 warmest months. Fresno had a record rainfall on November 30th of 0.62 inch; the old record was 0.50 inch. As a result of the heavy rainfall, some rock and mud slides occurred as the moisture weakened the soil. Law enforcement reported a rock and mud slide on Highway 168 about 15 miles northeast of Clovis, which closed the road for several hours while authorities cleaned up the debris.
- **1/07/2017**: A series of systems fed by a continued influx of very moist air was pushed into the central California interior through an atmospheric river set-up for several days. This created high snow levels between 9,000-10,000 feet and heavy rainfall for much of the San Joaquin Valley County Warning Area which in turn created flooding and flash flooding of area rivers, streams, and water supply canals. Also, debris flows, rockslides, and road ponding/flooding were reported.
- **1/20/2017**: A nearly stationary cold low-pressure system from the Pacific Northwest moved into central California and tropical moisture being fed from the Pacific with a continued atmospheric river

set-up, brought thunderstorms and heavy rainfall to the Sierra Nevada Mountains and Foothills and parts of the San Joaquin Valley over several days. Small pea-sized hail was also reported with some thunderstorms.

- **2/03/2017**: Tropical influx jet pushed into central California ahead of a cold front created heavy rains which were enhanced by orographically lifting with the Sierra Mountains.
- **2/07/2017**: Atmospheric River system brought heavy rainfall, flooding, debris flows, and high elevation snowfall to the central California region. Damages were over $100,000 and the California Highway Patrol reported road closure due to a bridge collapse from heavy rainfall near Sugarloaf Road and Auberry Road just northeast of Meadow Lakes.
- **2/20/2017**: A series of strong low-pressure systems accompanied with tropical moisture influxes brought strong winds, heavy rainfall, flooding, debris flows, funnel cloud reports, and high elevation snows to the central California region. Precipitation was enhanced at times by orographically lifting.
- **6/19/2017**: Between June 18 and June 29, significant water releases from Pine Flat Dam caused flooding along the Kings River, prompting evacuations and levee breaches near Kingsburg, affecting homes, and prompting a large-scale sandbagging operation. The second levee breach on June 24 threatened 90 homes in Tulare County, leading to the evacuation of 300 people and damaging 7 structures. Water levels receded by June 29 after releases from the dam were reduced on June 26, ending the immediate flood threat.
- **3/21/2018**: From March 20 to 22, a surge of tropical moisture led to heavy rainfall, causing widespread flooding, road closures from rockslides and debris flows, particularly in Mariposa and Springville near recent burn scars. Thunderstorms on March 22 exacerbated conditions, prompting flash flood emergencies, evacuations, and a tornado touchdown near Dinuba. While the Southern Sierra Nevada received 4 to 8 inches of rain, the San Joaquin Valley saw 1 to 3 inches, with several feet of snow accumulating above 9000 feet.
- **10/03/2018**: On October 2, an upper-level low pressure system brought light rainfall across the San Joaquin Valley and more significant rain in the Southern Sierra Nevada, followed by scattered thunderstorms on October 3 that led to moderate to heavy rainfall and numerous flooding reports. The Ferguson Fire burn scar experienced flash flooding with debris flows and washed-out roads, while the San Joaquin Valley and Southern Sierra received one to two inches of rain. The system moved east by October 4, ending the precipitation event with snow levels remaining high at above 11000 feet, limiting snowfall to the higher peaks.
- **11/21/2018**: Following a 45-day dry spell in central California, a low-pressure system on November 21 brought light to moderate precipitation, marking the first significant winter storm with 8 to 16 inches of snow above 7000 feet in the Southern Sierra Nevada. The San Joaquin Valley received a quarter to three-quarters of an inch of rain, ending its dry streak. This weather event resulted in minor nuisance flooding reports across the region.
- **12/16/2018**: A cold front that was associated with a moist upper trough pushed across central California on December 17. This system brought moderate to locally heavy rainfall from Fresno County northward the late evening of December through the morning of December 17 where several stations reported a half inch to an inch and a quarter of rainfall, and there were several reports of mainly nuisance flooding during this time. The precipitation mainly fell as snow above 6500 feet where several stations in the Southern Sierra Nevada north of Fresno County picked up between 3 and 6 inches of new snow. Further south the rainfall was less plentiful with most locations receiving between a few hundredths of an inch to a quarter of an inch of rain by the time the precipitation ended by early afternoon on December 17.

- **2/02/2019**: On February 2, a strong low-pressure system brought high winds to the Grapevine area, extending to Bakersfield, causing tree and wind damage, followed by moderate to heavy precipitation that led to roadway flooding. The San Joaquin Valley received over an inch of rain, while mountain areas got 2 to 5 inches, mainly as snow above 5000 feet, with SNOTEL stations reporting several feet of new snow. Additional thunderstorms later in the day produced hail, more rainfall, and a small tornado south of Maricopa.
- **2/14/2019**: Between February 13 and 17, a potent low-pressure system brought heavy rainfall, strong winds, and a drop in snow levels from nearly 9000 feet to 1500 feet, causing widespread flooding and road closures in central California. Thunderstorms with hail and a small tornado followed a cold front on February 15, while the Southern Sierra Nevada received up to 20 inches of new snowfall. Overall, the San Joaquin Valley accumulated up to an inch and a half of rain, and the Tehachapi Mountains saw 1 to 2 inches of liquid precipitation.
- **3/02/2019**: A strong storm system on March 2 brought light to heavy precipitation to central California, with thunderstorms causing flooding and a tornado near Mendota. The Southern Sierra Nevada received 1 to 3 inches of liquid precipitation, while the San Joaquin Valley and Kern County Mountains accumulated up to an inch of rain. The storm, which initially held snow levels above 8000 feet, exited the region by March 3 after dropping snow levels to around 5000 feet and leaving the Kern County Deserts with up to half an inch of rainfall.
- **5/26/2019**: On May 25, a strong upper low-pressure system moved southward, bringing instability and scattered thunderstorms to the San Joaquin Valley, with one storm producing nickel-sized hail and roadway flooding near Mettler and Maricopa. The system continued through California on May 26, causing widespread rainfall, mountain snow, and gusty winds, with the Sierra Nevada receiving 2 to 5 inches of snow and some areas experiencing heavy rainfall and wind gusts over 35 mph. Record-breaking daily precipitation was recorded on May 26 across the region, reflecting the system's significant impact.
- **5/29/2019**: Following cool temperatures, the area warmed up on May 28, leading to seasonable conditions and daily afternoon showers and thunderstorms due to abundant moisture. On May 31, storms in the mountains contributed to heavy rainfall, snowmelt, and significant runoff, causing river levels in the San Joaquin Valley to rise rapidly, notably along the Kings River due to Pine Flat Dam releases. This led to flooding at Lindy's Landing campground near Reedley and the Kings River Golf and Country Club near Kingsburg from May 29, continuing beyond month's end.
- **6/01/2019**: Because of continued increased releases at Pine Flat Dam. Runoff continued to produce flooding at Lindy's Landing campground near Reedley, and the Kings River Golf and Country Club near Kingsburg well into June. The releases were cut back during the middle of the month and the flood waters receded by the evening of June 19.
- **12/08/2019**: During December 7-8, a trough brought widespread rain to California, with 1-2 inches in the Sierra and up to an inch in the San Joaquin Valley, while areas further south received less. The snow levels stayed between 7000 and 8000 feet, leading to 8-12 inches of new snow in the higher elevations. Scattered thunderstorms also caused localized heavy rainfall, roadway flooding, and small hail before the system moved eastward, ending the precipitation by late evening.
- **12/22/2019**: On December 22 and 23, a frontal system brought strong winds and substantial precipitation across central California, with gusts over 50 mph in the foothills and mountains, and some areas near Lebec experiencing winds over 75 mph. The Sierra Nevada and adjacent foothills received 1 to 1.5 inches of rain, while the San Joaquin Valley had reduced totals due to rain shadowing, and central Tulare County saw moderate to heavy rainfall as the low-pressure center

moved north. Above 5000 feet, the precipitation turned into heavy snow, with 10 to 15 inches reported in the higher Sierra regions.

- **3/25/2020**: Between March 20 and March 29, central California experienced a series of weather systems, one of which brought heavy precipitation on March 22 and 23 with up to an inch of liquid precipitation and 8 to 12 inches of snow above 7000 feet in the Sierra Nevada. Another system on March 25 and 26 triggered strong winds, thunderstorms, hail, and localized flooding, with snowfall reaching down to 4000 feet. The final system on March 29 delivered lighter precipitation, capping off a period of significant weather activity across the region.
- **4/17/2020**: On April 16-17, a low-pressure system near California's coast moved inland, bringing widespread showers and thunderstorms, causing localized heavy rainfall and some flooding through April 18. While rainfall amounts varied, some areas received nearly an inch, and most saw up to half an inch. Above 7000 feet, snowfall ranged from 2 to 5 inches in the higher Sierra Nevada.
- **5/18/2020**: A low pressure system moving across central California on May 18 brought widespread precipitation, with the Sierra Nevada receiving up to 3.25 inches of rain and snow levels dropping to around 6000 feet, leading to new snowfall at higher elevations. Thunderstorms in the afternoon triggered nuisance flooding on roadways in several communities, while areas in the Kern County Deserts and surrounding mountains experienced strong wind gusts up to 70 mph. The storm and associated effects, including the strong winds, subsided by the late morning of May 19 as the system exited the region.
- **1/28/2021**: A powerful storm system swept through central California from January 27 to January 29, bringing heavy rainfall and strong winds that resulted in significant flooding, power outages, and downed trees. The system, energized by a deep moisture surge, unloaded 4 to 7 inches of rain in the Sierra foothills and 2.5 to 4 inches in the northern San Joaquin Valley, with the southern valley and Kern County receiving up to an inch, causing roadway flooding and triggering mudslides in burn scar areas. As the storm progressed, it also dumped 4 to 6 feet of snow in higher elevations of the Sierra Nevada, leading to travel restrictions and road closures before moving out of the area by the afternoon of January 29.
- **10/25/2021**: A significant low-pressure system, fueled by tropical moisture from Typhoon Namtheun, brought intense rainfall to central California, leading to moderate to heavy precipitation and resulting in widespread flooding across the region, particularly in the San Joaquin Valley and adjacent foothills. As the storm progressed inland on October 25, it unleashed heavy rains and caused flash flooding, with snow levels above 9000 feet initially, then dropping to 6000 to 7000 feet, leading to substantial snowfall in the higher elevations. The system's impact was compounded by strong winds and thunderstorms but concluded with the precipitation and wind diminishing by the morning of October 26 as it moved eastward.
- **12/14/2021**: In mid-December, a potent low-pressure system from the Gulf of Alaska brought significant moisture to central California, leading to 2 to 4 inches of rain in the Sierra Nevada and causing widespread minor flooding and rockslides in the San Joaquin Valley and adjacent foothills. The storm's intensity resulted in heavy snowfall above 5500 feet, with snow levels dropping to 1500 feet, and strong winds that led to road closures and travel restrictions. High winds with gusts over 50 mph, and up to 70 mph near Grapevine, exacerbated the hazardous conditions, adding to the storm's impact on infrastructure and travel.
- **12/23/2021**: In late December, a deep upper trough delivered rain and snow to central California, with the Sierra Nevada receiving 1 to 3 inches of liquid precipitation and snow levels hovering between 8000 to 9000 feet. Rain shadow effects resulted in varying rainfall in the San Joaquin Valley, while cooler air later introduced showery conditions and lowered snow levels to 5500 feet.

High elevation areas estimated 18 to 24 inches of new snow before the weather system gradually receded.

- **12/10/2022**: In December, central California experienced a strong low-pressure system that brought substantial snowfall, accumulating 18 to 30 inches above 5000 feet and significant rain in the Sierra Nevada and foothills. Snow levels dropped to 3000 feet, leading to 3 to 6 inches of fresh snow in higher elevations and up to 5 inches of rain in lower areas, with the San Joaquin Valley and Tehachapi Mountains receiving up to an inch of rain. The system abated by midday on December 12 after diminishing the previous evening.
- **12/27/2022**: A potent low-pressure system traversing California on December 27 drew in substantial tropical moisture, causing widespread heavy rainfall and triggering a fatal rockslide in Yosemite National Park. The storm blanketed the higher Sierra Nevada with 18 to 30 inches of snow above 7500 feet, while the foothills and valleys received 1 to 1.5 inches of rain, leading to reports of nuisance flooding. Accompanying the precipitation, strong winds gusted over 40 mph in mountainous areas, amplifying the storm's impact before it subsided early on December 28.
- **12/31/2022**: At the close of December, a strong upper trough carrying tropical moisture swept through California, culminating in significant rainfall and flooding on the 31st, with many areas experiencing road closures. High winds battered the region, particularly the West Side Hills and Tehachapi Mountains, where gusts surpassed 60 mph, while lower Sierra Nevada elevations and adjacent foothills received 2 to 7 inches of rain. The intense precipitation added substantially to the existing snowpack, with high-elevation areas recording up to 30 inches of new snow, exacerbating the already heightened winter conditions.
- **1/05/2023**: In early January, an atmospheric river brought significant rainfall and snow, with 18 to 30 inches of snow above 8000 feet in the Sierra Nevada and extensive flooding in the San Joaquin Valley. The Tehachapi Mountains saw powerful wind gusts over 60 mph, causing damage and leading to numerous weather advisories. These events disrupted infrastructure due to the combined impact of heavy precipitation and strong winds.
- **1/09/2023**: A strong low-pressure system traversed central California on January 9 and 10, delivering 3 to 6 inches of rain in the Sierra Nevada and causing widespread flooding, with over 150 incidents reported. High snow levels resulted in significant runoff, while strong downslope winds caused power outages and damage; evacuations and road closures were necessary, including the inundation of Planada. The storm subsided by January 11, but the aftermath of flooding and wind damage persisted, prompting extensive emergency responses.
- **1/14/2023**: The system that swept through central California on January 14 delivered heavy rain and snow, with the Sierra Nevada receiving 2 to 4 inches of liquid precipitation and the foothills getting 1.5 to 3 inches. Snowfall accumulated 1.5 to 3 feet above 6000 feet elevation, with snow levels dropping to 4500 feet by evening. Flooding became the primary concern as the heavy rains fell on already saturated soils, exacerbating runoff from previous storms.
- **1/16/2023**: A subsequent storm on January 15-16 brought less precipitation but more wind damage to Central California, with gusts over 60 mph in the Tehachapi Mountains and West Side Hills causing power outages and tree falls. The San Joaquin Valley and Sierra foothills experienced wind gusts exceeding 40 mph, toppling power infrastructure, and blocking roads. The storm's effects persisted until January 17, with gradual wind reduction but persistent rainfall due to the already saturated ground from prior storms.
- **2/24/2023**: A potent low-pressure system moved down the California coast on February 24-25, bringing heavy precipitation and causing snow levels to drop dramatically, leading to significant snowfall and road closures in the mountains. The Sierra Nevada and adjacent areas received 1.5 to

3 inches of rain, while the snowfall at higher elevations ranged between 2 to 4 feet, resulting in extensive road closures. As the system passed, it caused flooding in the San Joaquin Valley and lower foothills, with the weather clearing as the low moved out of the area by the morning of February 26.

- **2/27/2023**: Another cold upper trough moved across central California on February 27 and 28 which resulted in another period of widespread precipitation across the area. The snow level was between 3000 and 4000 feet or much of this event which resulted in heavy snowfall for the Sierra Nevada where several SNOTELs picked up an estimated 2 to 3 feet of new snowfall. Below the snow line, much of the San Joaquin Valley picked up between a quarter to a half inch of additional rainfall over already saturated soil while the Sierra foothills picked up between a half inch and an inch of combined liquid precipitation. Several roads in the mountains remained closed because of the continued snowfall across the area. The precipitation ended by the morning of March 1 as a colder and drier airmass pushed into central California.
- **3/10/2023**: A deep moisture surge from the Pacific led to 4-8 inches of rain in the Sierra Nevada and significant flooding across the San Joaquin Valley and nearby foothills on March 9 and 10, exacerbated by high snow levels and saturated ground. Flash flood emergencies were declared in Tulare and Kern counties as runoff from the mountains threatened communities. Evacuations were enacted, and roads were shut down due to the extensive flooding and damage necessitating substantial repairs.
- **3/11/2023**: Following the departure of the warm and moist storm which produced widespread flooding across the area on March 9 and 10, another moist system moved through central California on March 11 and 12. While precipitation amounts were generally much lower with this system with most of the Sierra Nevada picking up between 1 and 2 inches of liquid precipitation and adjacent foothills picking up between a half inch and an inch of rainfall, the cooler unstable airmass on the back side of this system produced afternoon and evening thunderstorms across the lower elevations resulting in widespread flooding and wind damage across the San Joaquin Valley.
- **4/17/2023**: Increased releases at Pine Flat dam due to heavy snow melt runoff resulted in flooding near the Kings River downstream of Pine Flat Dam. The increased runoff produced flooding at Lindy's Landing campground near Reedley, and the Kings River Golf and Country Club near Kingsburg.
- **5/09/2023**: An upper trough moved across Central California on May 9. This system provided for enough instability for scattered thunderstorms to break out along the West Side Hills and the Sierra Nevada during the afternoon. One thunderstorm produced heavy rainfall near Coalinga which resulted in a brief closure of SR 198 just to the southwest of Coalinga as rocks and mud impacted the highway.
- **6/10/2023**: A strong closed upper low-pressure system approached the southern California coast on June 10. This system pushed a surge of moisture northward into central California and provided for enough instability for showers thunderstorms to develop across the area during the afternoon. While precipitation was generally light with most locations receiving less than a tenth of an inch, a few thunderstorms produced locally heavy rainfall. One thunderstorm produced localized roadway flooding in western Fresno County.

Table 30. Fresno County Flood Previous Occurrences

Location	Date	Magnitude	Property Loss ($)	Crop Loss ($)	Deaths	Injuries
Eastern Fresno County	December 1955	0	0	0	0	0
Interstate 5 West Fresno County	January 1995	0	~14 M	~8.6 M	7	0
Interstate 5 Kings River	1997	0	0	0	0	0
Fresno County	2/01/1998 – June 1998	0	458,000	17 M	0	0
City of Parlier	4/28/2005	0	700,000	0	0	0
Fresno / Clovis	12/19/2005 – 1/01/2006	0	1.4 M	0	0	0
Fresno County	4/05/2006	0	0	0	0	0
Huntington Lake	July 2006	0	0	0	0	0
Northwest Fresno	10/29/2007	0	500,000	0	0	0
Fresno Metropolitan Area	12/18/2007	0	175,000	0	0	0
Fresno / Visalia / Bakersfield	12/29/2010	0	125,000	0	0	0
Fresno County	11/30/2011	0	0	0	0	0
Raisin City	1/07/2017	0	0	0	0	0
Panoche Junction	1/20/2017	0	0	0	0	0
Herndon	2/03/2017	0	0	0	0	0
Meadow Lakes	2/07/2017	0	100,000	0	0	0
Squaw Valley	2/20/2017	0	0	0	0	0
Belmont Ave.	6/19/2017	0	0	0	0	0
Lakeshore	3/21/2018	0	0	0	0	0
Ora	10/03/2018	0	0	0	0	0
Chandler	11/21/2018	0	0	0	0	0
Oxalis	11/16/2018	0	0	0	0	0
Parlier	2/02/2019	0	0	0	0	0
Huron	2/14/2019	0	0	0	0	0
Friant	3/02/2019	0	0	0	0	0
Selma	5/26/2019	0	0	0	0	0
Sanger	5/29/2019	0	0	0	0	0
Piedra	6/01/2019	0	0	0	0	0
Melvin	12/08/2019	0	0	0	0	0
Malaga	12/22/2019	0	0	0	0	0
Lacjac	3/25/2020	0	0	0	0	0

Location	Date	Magnitude	Property Loss ($)	Crop Loss ($)	Deaths	Injuries
Oro Loma	4/17/2020	0	0	0	0	0
Riverdale	5/18/2020	0	0	0	0	0
Oro Loma	1/28/2021	0	0	0	0	0
Old Fig Garden	10/25/2021	0	0	0	0	0
Clarks Corner	12/14/2021	0	0	0	0	0
Glorietta	12/23/2021	0	0	0	0	0
Clovis	12/10/2022	0	0	0	0	0
Big Creek	12/27/2022	0	0	0	0	0
Ockenden	12/31/2022	0	0	0	0	0
Coalinga	1/05/2023	0	0	0	0	0
Pine Ridge	1/09/2023	0	500,000	0	0	0
Herndon	1/14/2023	0	0	0	0	0
Alder Springs	1/16/2023	0	0	0	0	0
Three Forks	2/24/2023	0	1,000	0	0	0
Squaw Valley	2/27/2023	0	0	0	0	0
Hammond	3/01/2023	0	9,000	0	0	0
Squaw Valley	3/10/2023	0	0	0	0	0
Reedley	3/11/2023	0	0	0	0	0
Sanger	4/17/2023	0	0	0	0	0
Sanger	5/01/2023	0	0	0	2	0
Coalinga	5/09/2023	0	0	0	0	0
Coalinga	6/10/2023	0	0	0	0	0

Source: NOAA, National Centers for Environmental Information, Storm Events Database

LOCALIZED FLOODING

In addition to the major historical flood events described above, as previously described, the Fresno County planning area remains at risk of annual localized flooding.

LEVEE FAILURE PAST OCCURRENCE

- **February 18, 2017**: Dry weather debilitated a levee located in the Fresno Slough, where the San Joaquin River and Kings River meet. The levee experienced several small breaks for a few days, posing a danger to nearly 80 homes in the vicinity, forcing hundreds of people to evacuate. Repairs and monitoring led by Fresno County Public Works and Emergency Management stopped the levee breach.
- **June 22, 2017:** A 15-foot-wide breach opened along the Kings River, leading to mandatory evacuations. The Kings River began to flood 25 miles north of Fresno. The levee failure occurred after a prolonged period of warmer-than-average temperatures led to a surge in snowmelt from the nearby Sierra Nevada Mountains.

- **March 27, 2023:** A levee broke near Floral Avenue and Highway 145 south of Kerman Monday morning. According to a news report, no structures were threatened by the water and the land is all for agricultural use. [20]

LIKELIHOOD OF FUTURE OCCURRENCES

Likely - Based on historical data, it is likely that flood events will occur in the future.

CLIMATE CHANGE CONSIDERATIONS

Overall, Increasing, and warmer rainfall and less snow from major storms will result in decreasing and shifting snowmelt to earlier in the season and most snow melting by early spring are expected. Freezing elevations in the San Joaquin River will increase and snow accumulation decreasing.

Heavy precipitation events that lead to flooding occur at the short-term time scales of weather, rather than the multi-year time scales of climate that most climate models examine. However, extreme events are, by their very nature, uncommon. New research suggests that by the end of the century, due to climate change impacts, storms will generate 200 to 400 percent more water flow in the Sierra Nevada mountains due to increased precipitation in the form of rain and not snow. The study suggests that some locations could get over 100 inches of water in a month period plus the snow accumulation in higher elevations. This would have major impacts in Central Valley [21]According to the Central Valley Flood Protection Plan 2022, by 2072 climate change is predicated to increase peak flood flows up to five times in the Central Valley compared to past recorded events. The Central Valley already has one of the highest flood risks in the United States and is anticipated to increase, devastating properties, communities, and the agricultural industry. While the climate is warming, extreme weather events such as atmospheric rivers, the primary source of major flooding, will become more intense as they become wetter, longer, and wider, increasing their potential to cause catastrophic events.

Within the State of California, including the San Joaquin Valley, projections show that rainstorms during the wet winter months will likely become more extreme, with more water falling in shorter periods of time and potentially creating flood. Increased rainfall causes floods when rain falls on top of snow in the mountains. The resulting rapid snowmelt has historically been a reason for major floods. [22]

Globally, precipitation extremes and their hydrological impacts (e.g., the magnitude of 100-year floods) are expected to get larger because in most places, higher temperatures will result in increased atmospheric water vapor available to form precipitation. The 100-year flood of today might become a more frequent event in the future (i.e., a 50-year event), meaning that current design levels and regulatory practices might be less adequate in the future.

[20] https://kmph.com/news/local/levee-breaks-monday-morning-along-hwy-145-in-eastern-fresno-county-san-joaquin-helm-kerman

[21] https://www.yourcentralvalley.com/digital-exclusive/fresno-would-be-underwater-warns-ucla-catastrophic-flood-study/

[22] https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Flood-Management/Flood-Planning-and-Studies/Central-Valley-Flood-Protection-Plan/Files/CVFPP-Updates/2022/a0000-CVFPP_U22_layout_Highlights_vFINAL_online.pdf

HUMAN HEALTH HAZARDS: EPIDEMIC/PANDEMIC

HAZARD/PROBLEM DESCRIPTION

Epidemics occur when an infectious disease spreads beyond a local population, lasting longer and reaching people in a wider geographical area. When that disease reaches global proportions, it is considered a pandemic. Pandemics are large-scale outbreaks of infectious disease that can greatly increase morbidity and mortality over a wide geographic area and cause significant economic, social, and political disruption. The most recently pandemic, Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV-2) as known as COVID-19, resulted in an unprecedented global health crisis which significantly impacted all sectors and communities. Several factors determine whether an outbreak will explode into an epidemic or pandemic: the ease with which a microbe moves from person-to-person and the behavior of individuals and societies.

A pandemic flu occurs when a new influenza virus emerges for which people have little or no immunity, and for which there is no vaccine. This disease spreads easily person-to-person, causes serious illness, and can sweep across the country and around the world in a very short time. In continuation to the efforts made during the COVID-19 pandemic, the U.S. Centers for Disease Control and Prevention (CDC) has been working closely with other countries and the World Health Organization to strengthen systems to detect outbreaks of influenza that might cause a pandemic and to assist with future pandemic planning and preparation.

Pandemics can last for a long period of time, encompassing a several years, compared to other natural hazards. The recent COVID-19 pandemic lasted for 3 years, from January 2020-May 2023, with the ending of the emergency proclamation. While pandemics may end, the virus still circulates. For example, the Spanish Flu that caused a pandemic in early 1900s is now the seasonal flu. The COVID-19 and its variants are still persistent globally and new variations continue to evolve. The Pandemic Intervals Framework (PIF) describes the progression of an influenza pandemic using six intervals described in the table below.

AVIAN INFLUENZA

Due to the possibility that bird flu viruses could mutate and gain the ability to spread easily between people, avian influenza poses a significant pandemic threat to birds and humans. The U.S. Centers for Disease Control and Prevention (CDC) has been monitoring for illness among humans exposed to infected birds. Historical HPAI outbreaks have occurred all around the world since 1878 when it was first discovered in Northern Italy. HPAI continued to spread throughout the 20th century and in 1996 a new strain of HPAI subtype H5N1 was introduced to poultry in the Guangdong providence of China resulting a mortality of greater than 40 percent in aquatic birds. In 2003, two humans were diagnosed with HPAI H5N1 after returning from China and human cases continued to be reported resulting in hundreds of deaths. However, bird flu transmission from human-to-human is very rare and when it has occurred it has only spread to a few people. While the transmission from human to human is rare, the pandemic risk associated with HPAI is high due to the rapid mutations and increased risk of HPAI spillover from poultry to humans is a cause for significant concern. Recently, HPAI outbreaks have occurred in the United States in 2022 and 2023. While no human-to-human transmission has occurred with avian influenza that is currently circulating in the U.S., the CDC is closely monitoring to indicate increased risk of infection for the general public. [23]

[23] https://asm.org/articles/2022/july/avian-influenza-past,-present,-future

Table 31. CDC Pandemic Intervals Framework (PIF)

Interval Number	Interval Name	Description
1	**Investigation**	Investigation of cases of a novel influenza A virus infection in humans. Public health actions focus on targeted monitoring and investigation.
2	**Recognition**	Recognition of increased potential for ongoing transmission of a novel influenza A virus. public health actions focus on control of the outbreak, including treatment of sick persons.
3	**Initiation**	Initiation of a pandemic wave. A pandemic occurs when people are easily infected with a novel influenza A virus that has the ability to spread in a sustained manner from person-to-person
4	**Acceleration**	The acceleration (or "speeding up") is the upward epidemiological curve as the new virus infects susceptible people. Public health actions at this time may focus on the use of appropriate non-pharmaceutical interventions in the community (e.g. school and child-care facility closures, social distancing), as well the use of medications (e.g. antivirals) and vaccines, if available. These actions combined can reduce the spread of the disease and prevent illness or death.
5	**Deceleration**	The deceleration (or "slowing down") happens when pandemic influenza cases consistently decrease in the United States. Public health actions include continued vaccination, monitoring of pandemic influenza A virus circulation and illness, and reducing the use of non-pharmaceutical interventions in the community (e.g. school closures).
6	**Preparation**	When pandemic influenza has subsided, public health actions include continued monitoring of pandemic influenza A virus activity and preparing for potential additional waves of infection. It is possible that a 2nd pandemic wave could have higher severity than the initial wave.

Source: CDC

It has long been recognized that human influenza viruses and the like occur in temperate climate during the winter season and have low activity during the summer months. The onset of pandemics is likely to occur during the winter months as the weather becomes colder and more and more people congregate inside with poor indoor air quality. Additionally, ongoing pandemics are likely to increase in activity around the winter months for similar reasons as experienced with the COVID-19 pandemic.

Pandemics can occur relatively quickly, usually over several months, but comparatively to natural hazards, it can be a long time. However, the first deaths from a pandemic will not be known until perhaps weeks after infection, delaying response from public health and government leaders. The spread of disease can occur rather quickly due to international transportation such as air travel. The World Health Organization is responsible for closely monitoring infectious disease on a global scale, its activity, and spread. There are different thresholds that define the spread of disease by scale described in **Table 32. Infectious Disease Severity and Scale**.

Table 32. Infectious Disease Severity and Scale

Term	Definition
Outbreak	An outbreak is an occurrence of cases of disease that is more than expected, or cases clustered by time, space, or common behaviors.

Term	Definition
Epidemic	Epidemic is described as an unexpected increase in the number of disease cases in a specific geographical area.
Endemic	A disease outbreak is endemic when it is consistently present but limited to a particular region. This makes the disease spread and rates predictable.
Pandemic	An epidemic that has spread over several countries or continents and affects many people.

Source: WHO

Pandemics in nature are destructive, causing major disruptions to the economy, the public health and health care system, and population health. Pandemic impacts are not felt equally across populations, certain populations including people of color, children, the elderly, individuals with disabilities, and individuals with chronic health conditions. Previously, the magnitude of a pandemic was measured by the Pandemic Severity Index (PSI) which has been phased out by the Pandemic Severity Assessment Framework (PFAS). There are two main factors that can be used to determine the impact of a pandemic and guide decisions.

1. **Clinical Severity**: how serious is the illness associated with the infection.
2. **Transmissibility**: how easily the pandemic virus spreads from person-to-person.

Guidance from the CDC states that health officials should perform at least two assessments when using the PSAF. The first assessment is appropriately called an "initial assessment," and health officials should complete this assessment early on during a pandemic. At this point, activity may be detected in pockets or certain communities across the country so information and understanding about the pandemic virus may be limited. The initial assessment is intended to help health officials develop a preliminary understanding of the potential impact of the pandemic. Once quality data becomes available, health officials can perform a "refined assessment" which provides a more detailed and accurate picture of pandemic impact, including assessments of the impact by age group. **Table 33. CDC Pandemic Severity Assessment Framework (PFAS)** describes scaled measures of transmissibility and clinical severity for refined assessments of pandemic influenza effects.

Table 33. CDC Pandemic Severity Assessment Framework (PFAS)

Parameter No. and Description[24]	Scale						
	1	2	3	4	5	6	7
Transmissibility							
Symptomatic attack rate, community, %	<10	11-15	16-20	21-24	>25	-	-

[24] [24] Reed, Carrie, Matthew Biggerstaff, Lyn Finelli, Lisa M. Koonin, Denise Beauvais, Amra Uzicanin, Andrew Plummer, Joe Bresee, Stephen C. Redd, and Daniel B. Jernigan. "Novel Framework for Assessing Epidemiologic Effects of Influenza Epidemics and Pandemics - Volume 19, Number 1—January 2013 - Emerging Infectious Diseases Journal - CDC." Accessed August 28, 2023. https://doi.org/10.3201/eid1901.120124.

Parameter No. and Description[24]	Scale						
	1	2	3	4	5	6	7
Symptomatic attack rate, school, %	<20	21-25	26-30	31-35	>36	-	-
Symptomatic attack rate, workplace, %	<10	11-15	16-20	21-24	>25	-	-
Household secondary attack rate, symptomatic, %	<5	6-10	11-15	16-20	>21	-	-
R_0: basic reproductive number	<1.1	1.2-1.3	1.4-1.5	1.6-1.7	>1.8	-	-
Peak % outpatient visits for influenza-like illness	1-3	1-3	1-3	1-3	1-3	-	-
Clinical Severity							
Case-fatality ratio, %	<0.02	0.02-0.05	0.05-0.1	0.1-0.25	0.25-0.5	0.5-1	>1
Case-hospitalization ratio, %	<0.5	0.5-0.8	0.8-1.5	1.5-3	3-5	5-7	>7
Ratio, deaths: hospitalization, %	<3	4-6	7-9	10-12	13-15	16-18	>18

Source: CDC

Federal, state, and local public health agencies provide instructions to all organizations and individuals based on the severity of a pandemic and the infectious diseases' transmission methods. The worst-case scenario for the City of Carson would be a disease with high clinical severity (7) and high transmissibility (5) in the CDC's PSAF.

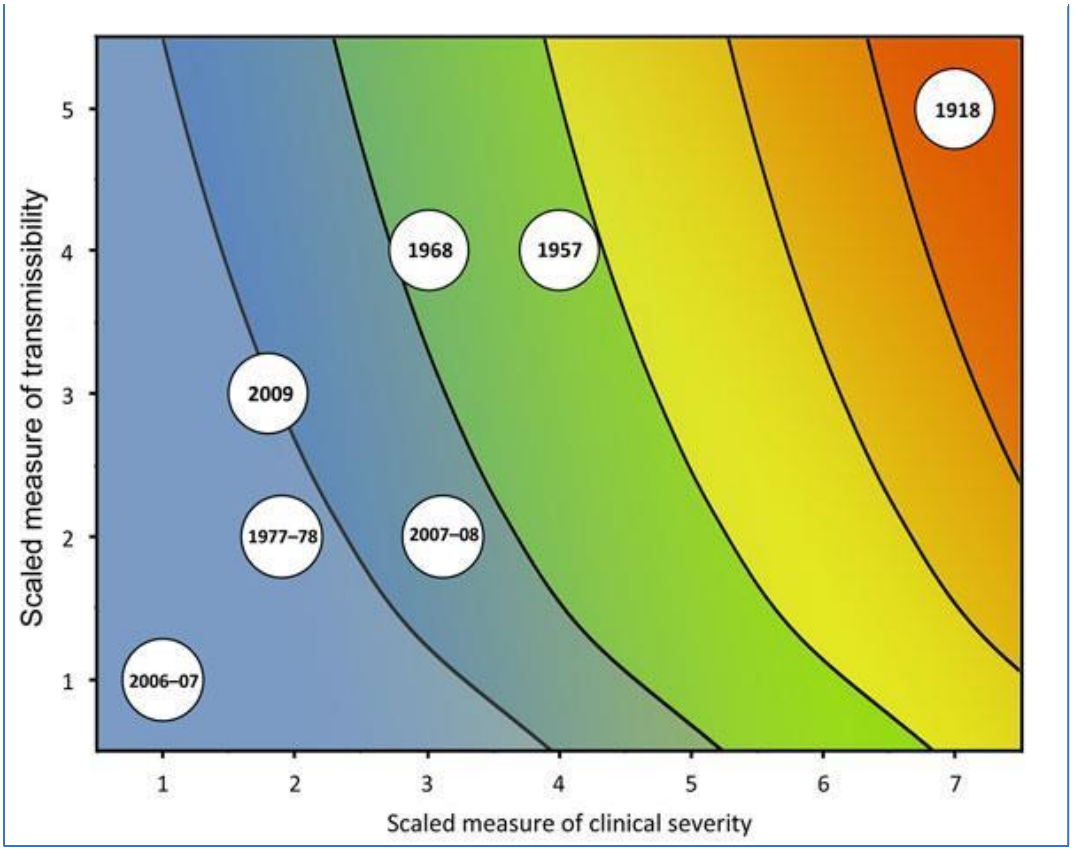
EXTENT

Large - An especially severe influenza pandemic could lead to high levels of illness, death, social disruption, and economic loss. Impacts could range from school and business closings to the interruption of basic services such as public transportation, health care, and the delivery of food and essential medicines. Since the hazard can affect 50-100 percent of the planning area it was given an extensive geographic extent rating.

PAST OCCURRENCES

Since 1918, there have been six epidemics or pandemics over the span of 105 years. Using the PSAF developed by the CDC, each prior epidemic or pandemic has been measured by their transmissibility and clinical severity score shown in **Figure 22. Previous Pandemics and Epidemics using PSAF** and text below.

Figure 25. Previous Pandemics and Epidemics using PSAF



Source: CDC

- **1918-19 Spanish flu (H1N1)**: This flu is estimated to have sickened 20-40 percent of the world's population. Over 20 million people lost their lives. Between September 1918 and April 1919, 500,000 Americans died. The flu spread rapidly; many died within a few days of infection, others from secondary complications. The attack rate and mortality were highest among adults 20-50 years old; the reasons for this are uncertain. By late September 1918, over 35,000 people throughout California had contracted influenza. According to state officials, influenza was most prevalent in the southern part of California, but the death toll was high across the state.
- **1957-58 Asian flu (H2N2)**: This virus was quickly identified due to advances in technology, and a vaccine was produced. Infection rates were highest among school children, young adults, and pregnant women. The elderly had the highest rates of death. A second wave developed in 1958. In

total, there were about 70,000 deaths in the United States. Worldwide deaths were estimated between 1 and 2 million.

- **1968-69 Hong Kong flu (H3N2)**: This strain caused approximately 34,000 deaths in the United States and more than 700,000 deaths worldwide. It was first detected in Hong Kong in early 1968 and spread to the United States later that year. Those over age 65 were most likely to die. This virus returned in 1970 and 1972 and still circulates today.
- **2009 H1N1 flu**: This new H1N1 virus was first detected in the United States and has genes not previously identified in people or animals. From April 2009 – April 2010, the CDC estimates about 60.8 million cases, 274,304 hospitalizations and 12,469 deaths in the United States. About 151,700 to 575,400 people worldwide are estimated to have died from the flu, and most deaths occurred in people under age 65. This is because younger people were less likely to have had prior exposure to a similar H1N1 virus, unlike older generations.
- **2019 COVID-19 Pandemic:** The coronavirus disease 2019 (COVID-19) pandemic is a global outbreak of coronavirus – an infectious disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The pandemic caused millions of deaths, hospitalizations, and infections across the United States and even more globally. Cases of novel coronavirus (nCoV) were first detected in China in December 2019, with the virus spreading rapidly to other countries across the world. This led WHO to declare a Public Health Emergency of International Concern (PHEIC) on January 30, 2020, and to characterize the outbreak as a pandemic on 11 March 2020. On March 13, 2020, the President declared the ongoing Coronavirus Disease 2019 (COVID-19) pandemic of sufficient severity and magnitude to warrant an emergency declaration for all states, tribes, territories, and the District of Columbia pursuant to section 501 (b) of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. 5121-5207 (the “Stafford Act”). The emergency declaration lasted until May 2023.

THE COVID-19 PANDEMIC

The most recent and notable pandemic that has occurred is the COVID-19 pandemic which has been the deadliest pandemic in history. On March 11, 2020, The World Health Organization (WHO) officially declaration the Coronavirus disease 2019 (COVID-19) outbreak a pandemic due to the global spread and the severity of the disease. COVID-19 is a respiratory illness that can spread from person to person and is highly contagious. Soon after, stay-at-home orders were issued across the country to keep people safe against contracting the virus, then COVID-19 testing sites opened and were a critical tool in informing individuals if they had COVID-19 or not in order to minimize and reduce the spread of the virus.

December 2020 marked a historical moment in the pandemic as COVID-19 vaccines were developed to be distributed under emergency use to protect people against adverse health effects from COVID-19, especially for older adults, who were passing at a higher rate than other age groups. The pandemic response efforts expanded into vaccine distribution and administration. In the beginning of the vaccine response, due to high demand and low supply, vaccine was prioritized for older adults, healthcare workers and other groups that were identified as high risk by state and local health departments.

Since 2020, the virus has mutated, and different variants have emerged throughout the three years since the beginning of the pandemic. Some symptoms of COVID-19 include cough, difficulty breathing, fever, fatigue, muscle pain, and loss of taste or smell. Severe cases resulted in hospitalizations, death, or chronic conditions from long-COVID. Individuals at high risk of adverse health outcomes included the elderly, people with underlying medical conditions and those who are immunocompromised.

The pandemic highlighted existing health disparities among communities resulting in disproportionate impacts in COVID-19 case rates, hospitalizations, and deaths. Those without health insurance and access to healthcare, people of color, people with disabilities, and low socioeconomic status bared the burden of COVID-19 from physical impacts in contracting the virus to financial burdens such as unemployment. [25]

Specifically in the state of California, people of color and low-income communities were disproportionately impacted by COVID-19 as case, hospitalizations, and deaths rates were significantly higher. According to the California's COVID-19 disparity data, death rate for Latino people is 8 percent higher than the rate for all Californians, case rate for Pacific Islander people is 82 percent higher, death rate for black people is 19 percent higher, and case rate for communities' median income less than $40,000 is 14 percent higher. [26]Due to the COVID-19 emergency declaration ending in May of 2023, there has been a sharp decrease in COVID-19 reporting and surveillance, especially at the local level. As of May 2023, there have been 12,251,820 COVID-19 cases and 111,554 deaths since the start of the pandemic in California State. Within Fresno County, as of May 2023, there have been 333,200 COVID-19 cases and 2,909 deaths.

LIKELIHOOD OF FUTURE OCCURRENCES

Possible— Due to the recent COVID-19 pandemic, there have been studies trying to understand and predict how likely a similar pandemic is to occur in the future and we can better prepare for the next one. According to one study, the probability of a pandemic similar to COVID-19 is about a two-percent chance of occurring in any year. Based on the increasing rate at which novel pathogens such as SARS-CoV-2 have broken loose in human populations in the past 50 years, the study estimates that the probability of novel disease outbreaks will likely grow three-fold in the next few decades.

Historical modeling suggests that the frequency and severity of epidemics caused by zoonotic disease are increasing, driven by human activities and their impact on the environment. They estimate that the probability of a future zoonotic event resulting in a pandemic of COVID-19 magnitude or larger is between 2.5-3.3 percent annually. In other words, there is a 22-28 percent chance that another outbreak on the magnitude of COVID-19 will occur within the next 10 years, and a 47-57 percent chance that it will occur within the next 25 years. It is likely for a future epidemic or pandemic occurring and impacting the planning area in a similar manner as the COVID-19 pandemic.

CLIMATE CHANGE CONSIDERATIONS

This is overwhelming evidence that climate change is fueling disease outbreaks and epidemics and that it is not a matter of if, but when. Climate change can influence the risk of disease outbreak through several ways both directly and indirectly. These include the slow rise in temperatures, changes in environmental conditions that increase the dispersal of disease vectors such as mosquitos, rodents, and ticks; and the sudden appearance of extreme events such as floods, which can contaminate drinking water sources and trigger the displacement of humans and animals, which can carry and transmit pathogens.

[25] Inequity and the Disproportionate Impact of COVID-19 on Communities of Color in the United States: The Need for a Trauma-Informed Social Justice Response - PMC (nih.gov) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8243721/
[26] https://covid19.ca.gov/equity/

Climate conditions can influence the spread of infectious diseases, and changes to these conditions can lead to new patterns. Temperature differences can affect where insect populations live and the diseases they may carry. Insects such as fleas, ticks, and mosquitoes can carry diseases like Lyme, West Nile, malaria, and Zika. Additionally, changes in climate can increase the likelihood of new viruses occurring or mutating in different animal species and infecting humans. Many countries across the world have experienced new outbreaks in infections varying from mosquito-borne dengue virus and chikungunya virus infection. In addition to the impacts from climate change, extreme climate events and disasters can increase the rise in epidemics. For example, a major flood event can cause the spread of infectious diseases such as cholera. [27]

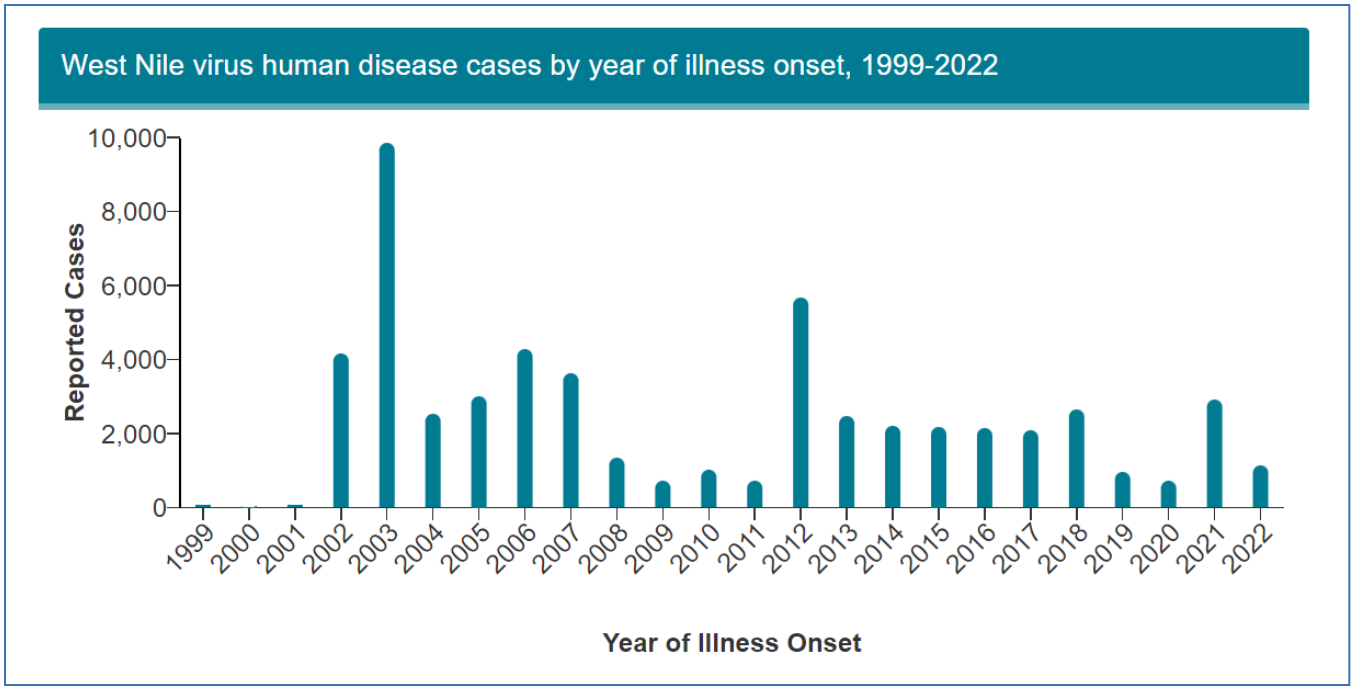
[27] https://www.science.org/doi/10.1126/science.adk4500#:~:text=However%2C%20there%20is%20overwhelming%20evidence,diseases%2C%20both%20directly%20and%20indirectly.

HUMAN HEALTH HAZARDS: WEST NILE VIRUS

HAZARD/PROBLEM DESCRIPTION

The impact to human health that wildlife, and more notably, insects, can have on an area can be substantial. Mosquitoes transmit the potentially deadly West Nile virus to livestock and humans alike. West Nile virus first struck the western hemisphere in Queens, New York, in 1999 and killed four people. Since then, the disease has spread across the United States. The highest number of reported cases were in 2003 and 2012 from 1999-2022. Since 1999, there have been 56,575 cases, 25,777 hospitalizations, and 2,776 deaths. West Nile Virus cases from 1999 to 2022 are described in **Figure 23. U.S. West Nile Reported Cases by Year**.

Figure 26. U.S. West Nile Reported Cases by Year



Source: CDC

In assessing this hazard, the HMPC also discussed Zika virus, which is recently invasive, with the first reported cases in the U.S. occurring in Florida during the summer of 2016, and 5102 Zika cases reported across all 50 states by the end of 2016.

Most humans infected by the West Nile virus have no symptoms. A small proportion develop mild symptoms that include fever, headache, body aches, skin rash, and swollen lymph glands. Less than 1 percent of those infected develop more severe illnesses such as meningitis or encephalitis, symptoms of which include headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, and paralysis. Of the few people who develop encephalitis, fewer than 1 out of 1,000 infected dies as a result. People over 50 and those with compromised immune systems are the most vulnerable to the virus. Those with Zika virus are highly unlikely to develop serious illness requiring a hospital visit, however Zika virus can cause severe brain defects in infants such as microcephaly along with other morbidity including miscarriage, stillbirth, and other types of birth defects.

There is no specific treatment for Zika or West Nile virus infection, nor a vaccine to prevent the viruses. Treatment of severe illness includes hospitalization, use of intravenous fluids and nutrition, respiratory support, prevention of secondary infections, and good nursing care. Medical care should be sought as soon as possible for people who have symptoms suggesting severe illness. People over 50 years of age appear to be at high risk for the severe aspects of the disease.

The West Nile virus is a concern in the Fresno County planning area in part because of the agricultural nature of the County and the large areas of standing water created through farming operations. Excess standing water provides a breeding area for mosquitoes. Also contributing to the mosquito population in the County are the beaver dams and ponds, which are large pools of standing water. The Zika virus is of minimal concern to the County given that there is no record of Zika virus being transmitted in or near Fresno County.

Within the Fresno County planning area, several mosquito abatement and control districts operate to prevent the spread of the virus through focused efforts on reducing the mosquito population and educating the public. Several types of preventive methods lower mosquito populations to levels that reduce chances for the spread of disease. The County also has an active surveillance program and maintains records for all identified cases of the virus.[28]

EXTENT

Large - An especially severe mosquito-borne illness outbreak could lead to high levels of illness, death, social disruption, and economic loss. Impacts could range from school and business closings to the interruption of basic services such as public transportation, health care, and the delivery of food and essential medicines. Since the hazard can affect 50-100 percent of the planning area it was given an extensive geographic extent rating.

PAST OCCURRENCES

The virus first appeared in California in 2002 with the identification of one human case. In 2003, three human cases occurred in California, and the virus was detected in six southern California counties. By 2004, the virus was in all 58 counties in California; 830 human infections were identified. Since 2003, there have been more than 7,500 human cases and over 300 deaths reported in California. Recently, the Fresno County Department of Public Health has confirmed its first human death this year caused by West Nile Virus in November 2023. [29] **Table 34. California West Nile Cases by Year** shows West Nile cases in humans, birds, mosquitos, horses, and sentinel flock.

Table 34. California West Nile Cases by Year

Year	Humans		Birds		Mosquitos		Horse		Sentinel Flock	
	CA	FC	CA	FC	CA	FC	CA	FC	CA	FC
2004	830	15	3,232	116	1,136	14	540	21	805	25
2005	935	68	3,046	97	1,242	71	456	33	1,053	85

[28] https://www.fresnocountyca.gov/Departments/Public-Health/Community-Health/Communicable-Disease-Investigation-Program/Mosquito-Borne-Illness

[29] https://abc30.com/west-nile-virus-death-fresno-county-mosquito-sickness/14003501/

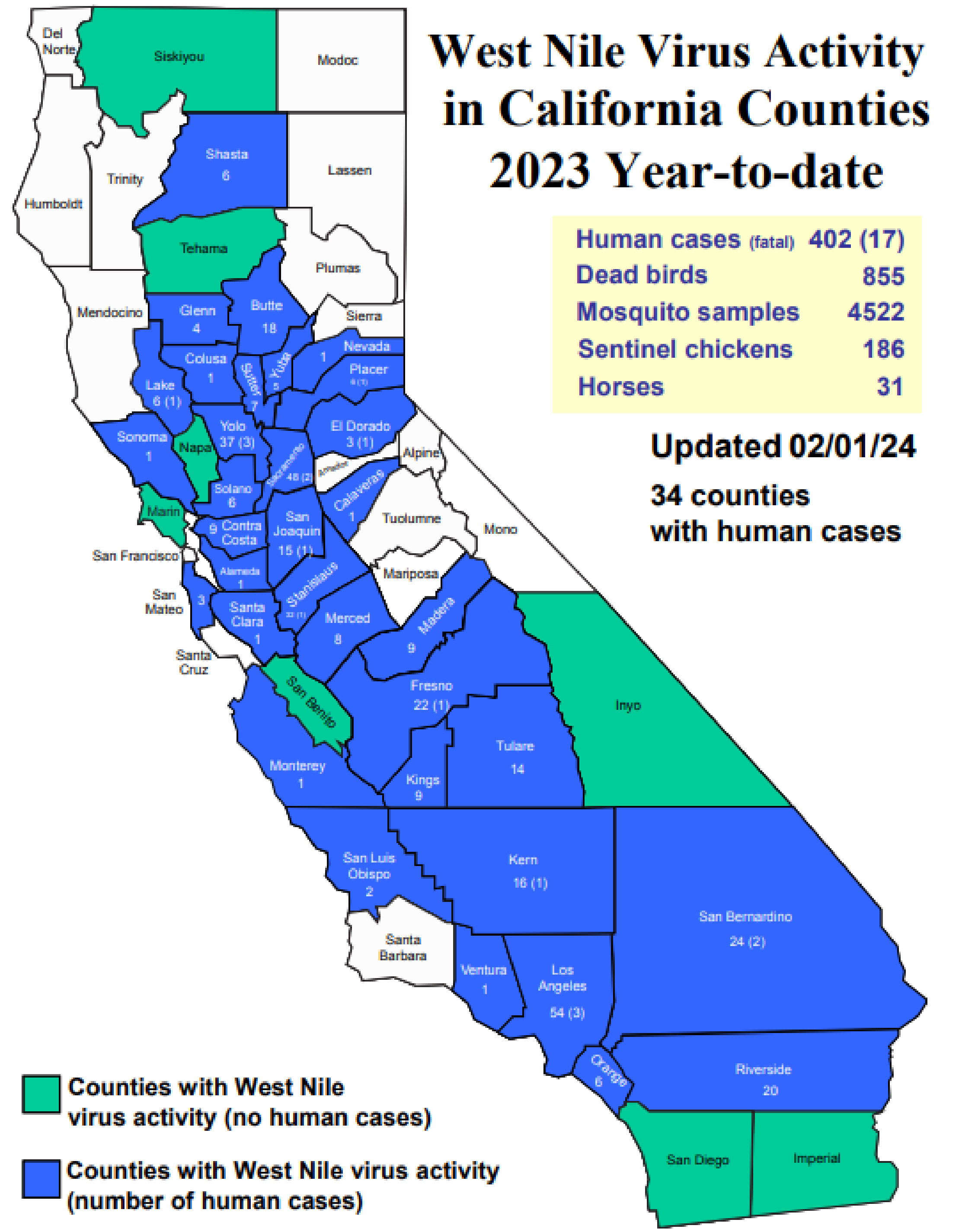
Year	Humans		Birds		Mosquitos		Horse		Sentinel Flock	
	CA	FC	CA	FC	CA	FC	CA	FC	CA	FC
2006	278	11	1,446	2	832	40	58	5	640	37
2007	380	17	1,395	114	1,007	61	28	1	510	46
2008	445	3	2569	44	2,003	53	32	1	585	24
2010	111	23	416	22	1,305	130	19	4	281	7
2011	158	9	688	15	2,087	123	15	5	391	0
2012	479	24	1,644	25	2,849	147	22	3	540	0
2013	379	7	1,251	12	2,528	66	23	N/A	458	0
2014	801	43	2,442	9	3,304	138	15	2	443	0
2015	782	8	1,349	3	3,329	108	19	N/A	449	0
2016	442	14	1,352	6	3,528	185	21	2	343	0
2017	87	1	264	3	2,545	136	21	1	155	0
2018	217	14	501	0	1,963	N/A	11	N/A	163	N/A
2019	225	51	226	10	3,288	N/A	15	N/A	139	N/A
2020	235	10	343	5	2,628	322	20	N/A	144	N/A
2021	129	14	210	0	2,263	219	13	2	90	N/A
2022	207	30	189	2	3,165	296	16	N/A	145	N/A
2023	397	22	855	1	4,512	232	31	2	186	N/A

Source: California West Nile Virus Web Site, www.westnile.ca.gov/

**As of January 25, 2024*

West Nile virus activity in California (and Fresno County) for 2023 year to date is illustrated in **Figure 24. California West Nile Cases by County.**

Figure 27. California West Nile Cases by County



Source: WestNile.ca.gov

The Zika Virus is another well-known virus that, along with the West Nile Virus, is a mosquito-borne disease. These viruses are transmitted to humans through mosquito bites. Unlike the West Nile Virus, the Zika virus is primarily transmitted by Aedes mosquitoes while the West Nile Virus is transmitted by Culex mosquitoes. From 2015 to March 2024, there have been 761 total Zika Virus infections in the State of California. **Table 35. Fresno County Zika Cases (2015-2024)** shows the number of cases for Fresno County from 2015 to 2024.

Table 35. Fresno County Zika Cases (2015-2024)

County	2015-2016	2017	2018	2019	2020	2021	2022	2023	2024
Fresno County	7	1	0	0	0	0	0	0	0

LIKELIHOOD OF FUTURE OCCURRENCES

Highly Likely—Based on historical data, the Fresno County planning area has experienced 384 human cases of West Nile virus since 2004. This is an average of 19 cases per year. The agricultural nature of much of the planning area combined with the great potential for standing water to be present throughout the County puts the planning area at future risk of West Nile virus.

Likelihood of Zika virus transmission is very low due to several factors, including mosquito abundance, number of travels associated cases, population, and distance from the U.S.-Mexico border. Taking these factors into consideration, CDPH concludes that current conditions in Fresno County present a very low risk for local transmission. As a result, vulnerability to Zika virus is not considered further.

CLIMATE CHANGE CONSIDERATIONS

In the aftermath of the 2015 pandemic of Zika virus (ZIKV), concerns over links between climate change and emerging arboviruses have become more pressing. Milder weather in the current “cold” seasons and warmer weather in the summer could make the county a more suitable habitat for new mosquito species, increasing the potential for additional cases of some mosquito-borne diseases that are already established in the county. At the same time, increases in the precipitation associated with extreme events could increase the habitat suitable for supporting mosquitoes. Drawing definitive conclusions about public health risk changes associated with vector-borne illnesses as a result of climate change are complicated by the need to also account for any associated changes in human behavior that would accompany the associated impacts to seasonal and daily weather conditions. For example, increased temperatures could result in more time spent indoors during extreme heat days, which could potentially reduce exposure to disease carrying vectors. In 2023, the World Health Organization (WHO) warned that climate change is causing a surge in Mosquito-Borne diseases. WHO cited a study which finds the incidence of infection caused by mosquito-borne illnesses which thrive in tropical and subtropical climates, have grown dramatically in recent decades. While globally, Zika cases are declining from its peak in 2015, 2016, and 2017, down to about 30-40,000 reported cases every year which occur mostly in the United States, Zika is still circulating and a threat as our climate changes. [30]

[30] https://www.voanews.com/a/who-warns-climate-change-causing-surge-in-mosquito-borne-diseases/7043700.html

LANDSLIDE

HAZARD/PROBLEM DESCRIPTION

Landslides refer to a wide variety of processes that result in the perceptible downward and outward movement of soil, rock, and vegetation under gravitational influence. Common names for landslide types include slump, rockslide, debris slide, lateral spreading, debris avalanche, earth flow, and soil creep. Landslides may be triggered by both natural and human-induced changes in the environment that result in slope instability.

The susceptibility of an area to landslides depends on many variables, including steepness of slope, type of slope material, structure and physical properties of materials, water content, amount of vegetation, and proximity to areas undergoing rapid erosion or changes caused by human activities. These activities include mining, construction, and changes to surface drainage areas.

Landslides often accompany other natural hazard events, such as floods, wildfires, or earthquakes. Landslides can occur slowly or very suddenly and can damage and destroy structures, roads, utilities, and forested areas and cause injuries and death.

Landslides are often triggered by precipitation and as a result are sensitive to local climate conditions. Due to climate change, precipitation patterns worldwide and therefore will likely have a strong influence on landslide activity in the next couple of decades. A study found that during 2015 to 2020 that landslides in both the wet regions in northwestern California and dry regions in southern California moved faster than average during wet years and slower than average during dry years. [31]The warning time for hazards such as landslides and debris flow are often very short and may occur very quickly. Identifying the area in which these events are likely to occur can assist with hazard preparedness when triggering types of events like heavy rainfall occurs. However, in some cases, landslides can occur very slowly, even extremely slowly and building on these landscapes may remain in use for hundreds of years with only minimal damage and repair costs. [32]

The severity of a landslide or mudflow depends on many factors including local bedrock, soil conditions, moisture content, slope, and vegetation. Landslide velocities vary over ten orders of magnitude from extremely slow (a few millimeters a year) to extremely rapid (more than 5 millimeters a second), shown in **Table 36. Landslide Velocity Class**. Many human activities can make the earth's materials less stable, therefore increasing the chance of ground failure. Human activities contribute to soil instability through grading of steep sloped or overloading them with artificial fill, by extensive irrigation, construction of impermeable surface, excessive groundwater, withdrawal, and removal of stabilizing vegetation. Some of the natural non-seismic causes of ground instability include heavy rainfall and poor-quality natural materials.

[31] Handwerger, Alexander L., et al. "Landslide sensitivity and response to precipitation changes in wet and dry climates." Geophysical Research Letters, vol. 49, no. 13, 2022, https://doi.org/10.1029/2022gl099499.
[32] Social and environmental impacts of landslides | Innovative Infrastructure Solutions (springer.com) https://link.springer.com/article/10.1007/s41062-018-0175-y

Table 36. Landslide Velocity Class

Velocity Class	Description	Velocity (mm/s)	Typical Velocity	Response
7	Extremely Rapid	5X10^3	5 m/s	N/A
6	Very Rapid	5X10^1	3 m/min	N/A
5	Rapid	5X10^-1	1.8 m/h	Evacuation
4	Moderate	5X10^-3	13 m/month	Evacuation
3	Slow	5X10^-5	1.6 m/year	Maintenance
2	Very	5X10^-7	16 mm/year	Maintenance
1	Extremely Slow			N/A

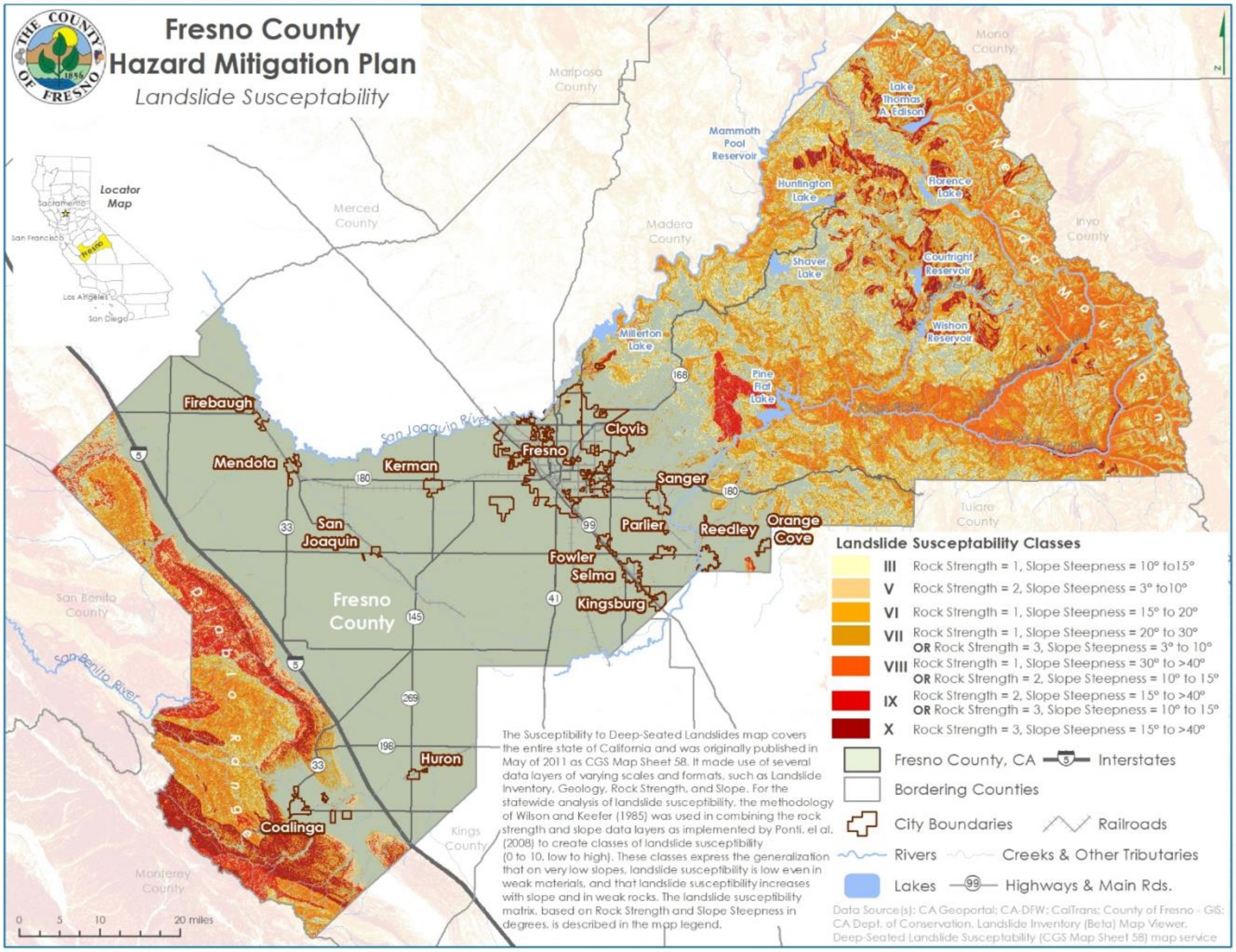
Source: WP/WLI 1995 and Cruden and Varnes 1996

EXTENT

The Fresno County General Plan Background Report describes areas in Fresno County that are particularly prone to landslides. Landslide hazard areas include foothill and mountain areas where fractured and steep slopes are present (i.e., the Sierra Nevada), areas where less consolidated or weathered soils overlie bedrock (e.g., the Coast Range), and areas where inadequate ground cover accelerates erosion (e.g., along the San Joaquin River). According to the background report, areas where steep slopes are present are not generally heavily populated and most are in federal or state lands. The report further identified State Route 168 in eastern Fresno County and State Route 198 in western Fresno County as areas that could be affected by landslides caused by earthquakes or heavy rains. It also concludes that there is no risk of large landslides in the valley area of the County due to its relatively flat topography. However, there is the potential for small slides and slumping along the steep banks of rivers and creeks.

Figure 25. Fresno County Landslide Susceptibility is a landslide hazard map from the background report. It indicates that the central and eastern portions of Fresno County are at low risk for landslides and the far west side of the County along the Coast Range is at moderate risk for landslides.

Figure 28. Fresno County Landslide Susceptibility



Source: California Department of Conservation, Landslide Inventory (Beta) Map Viewer

PAST OCCURRENCES

Landslides occur in every state and can occur in any area composed of very weak or fractured materials resting on a steep slope can and will likely experience landslides. Areas vulnerable to landslides include the following: [33]

Areas more prone to landslides

- On existing old landslides
- On or at the base of slopes
- In or at the base of minor drainage hollows
- At the bae or top of an old fill slope
- At the base or top of a steep cut slope
- Burn area and canyon, hillside, mountain, and other steep areas are vulnerable
- Develop hillsides where leach field septic systems are used

Areas less prone to landslides

- On hard, non-jointed bedrock that has not moved in the past
- On relatively flat-lying areas away from sudden changes in slope angle
- At the top or along the nose of ridges, set back from the tops of slopes

There have been no disaster declarations associated with landslides in Fresno County. Notable landslides of record are included in **Table 37. Notable Past Landslides Events** and described below:

- **1995**: Following a large storm event, a large landslide occurred on Los Gatos Road, a significant local access road west of Coalinga. State geologists determined that catastrophic failure was unlikely, but long-term road maintenance could be compromised due to undercutting of the slope by the creek below the road.
- **5/13/2019**: An area of Huntington Lake Road in Fresno County was subject to an extended closure because of a landslide, a recurring issue in that region known as the "beaver slide." This incident is part of a history of similar geological disturbances affecting the area.
- **12/30/2022 - 1/10/2023**: Fresno County experienced multiple landslide incidents due to rockslides and mudslides that impacted various roadways, including State Routes 168 and 180. The California Highway Patrol (CHP) reported significant obstructions from rockslides on SR-168, near lower vista and east of Prather, and mudslides at the junctions of SR180 with Silver Lane and Millwood Road. These incidents caused extensive road blockages with mud, dirt, rocks, and even large boulders, necessitating road closures and emergency responses.
- **March 2023**: California Highway Patrol dealt with landslides that led to road obstructions on Auberry Road and SR-63, while a significant rockfall on Trimmer Road caused extensive

[33] Landslide Basics | U.S. Geological Survey (usgs.gov) https://www.usgs.gov/programs/landslide-hazards/landslide-basics

blockages. By mid-March, Caltrans had to close an 8-mile section of State Route 180 due to multiple slides impeding the road, demonstrating the ongoing geological instability in the region.

Table 37. Notable Past Landslides Events

Location	Date	Magnitude	Property Loss ($)	Crop Loss ($)	Deaths	Injuries
Los Gatos Road	1995	N/A	N/A	N/A	N/A	N/A
Huntington Lake Road	5/13/2019	N/A	N/A	N/A	N/A	N/A
SR-168 and SR-180	12/30/2022 – 1/10/2023	N/A	N/A	N/A	N/A	N/A
Dunlap	March 2023	N/A	N/A	N/A	N/A	N/A

Source: CA Department of Conservation

LIKELIHOOD OF FUTURE OCCURRENCES

Possible--Based on data provided by the HMPC, minor landslides have occurred in the past, probably over the last several hundred years, as evidenced both by past deposits exposed in erosion gullies and recent landslide events. With significant rainfall, additional failures are likely within the identified landslide hazard areas. Given the nature of localized problems identified within the County, minor landslides will likely continue to impact the area when heavy precipitation occurs, as they have in the past.

CLIMATE CHANGE CONSIDERATIONS

Climate change projections for more intense precipitation events have the potential to increase landslide incidence. In fact, during extended drought periods, soil loses its ability to absorb water and when rain occurs landslide risk increases. During period of prolonged water crisis, soils dry out and lose their drainage capacity. California experiences long prolonged drought periods which can increase the risk and incidence of landslides when major rain events do occur. Additionally, California’s drought has also helped fuel major wildfires in recent years, and post-wildfire slopes are especially susceptible to mudslides. Plants destroyed by wildfires weaken the roots and therefore reduce soil stability.

SOIL HAZARD: EROSION

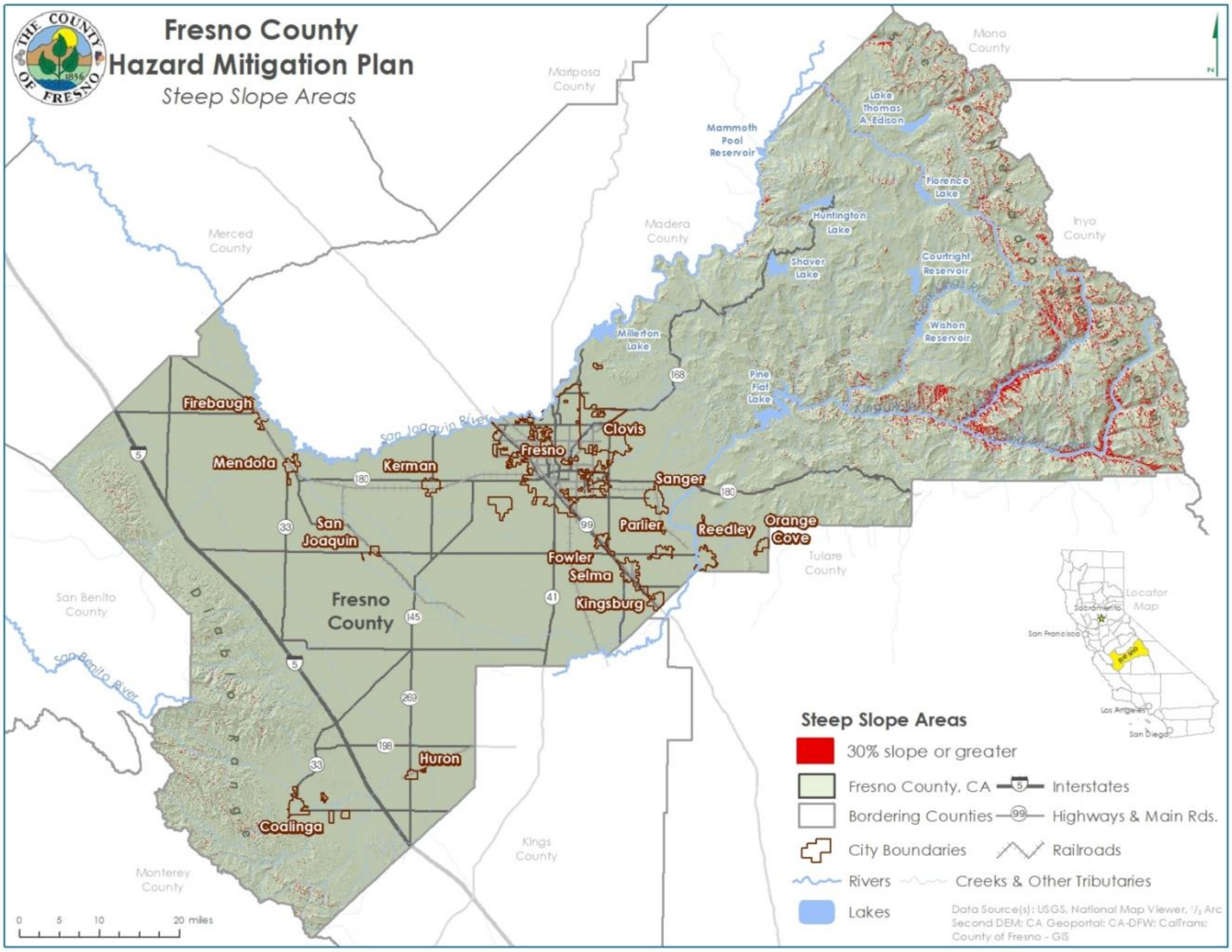
HAZARD/PROBLEM DESCRIPTION

Erosion is the general process whereby rocks and soils are broken down, removed by weathering, or fragmented and then deposited in other places by water or air. The rate of erosion depends on many variables, including the soil or rock texture and composition, soil permeability, slope, extent of vegetative cover, and precipitation amounts and patterns. Erosion increases with increasing slope and precipitation and with decreasing vegetative cover, which includes areas where protective vegetation has been removed by fire, construction, or cultivation. Significant erosion can cause degradation and loss of agricultural land, degradation of streams and other water habitats, and rapid silting of reservoirs.

EXTENT

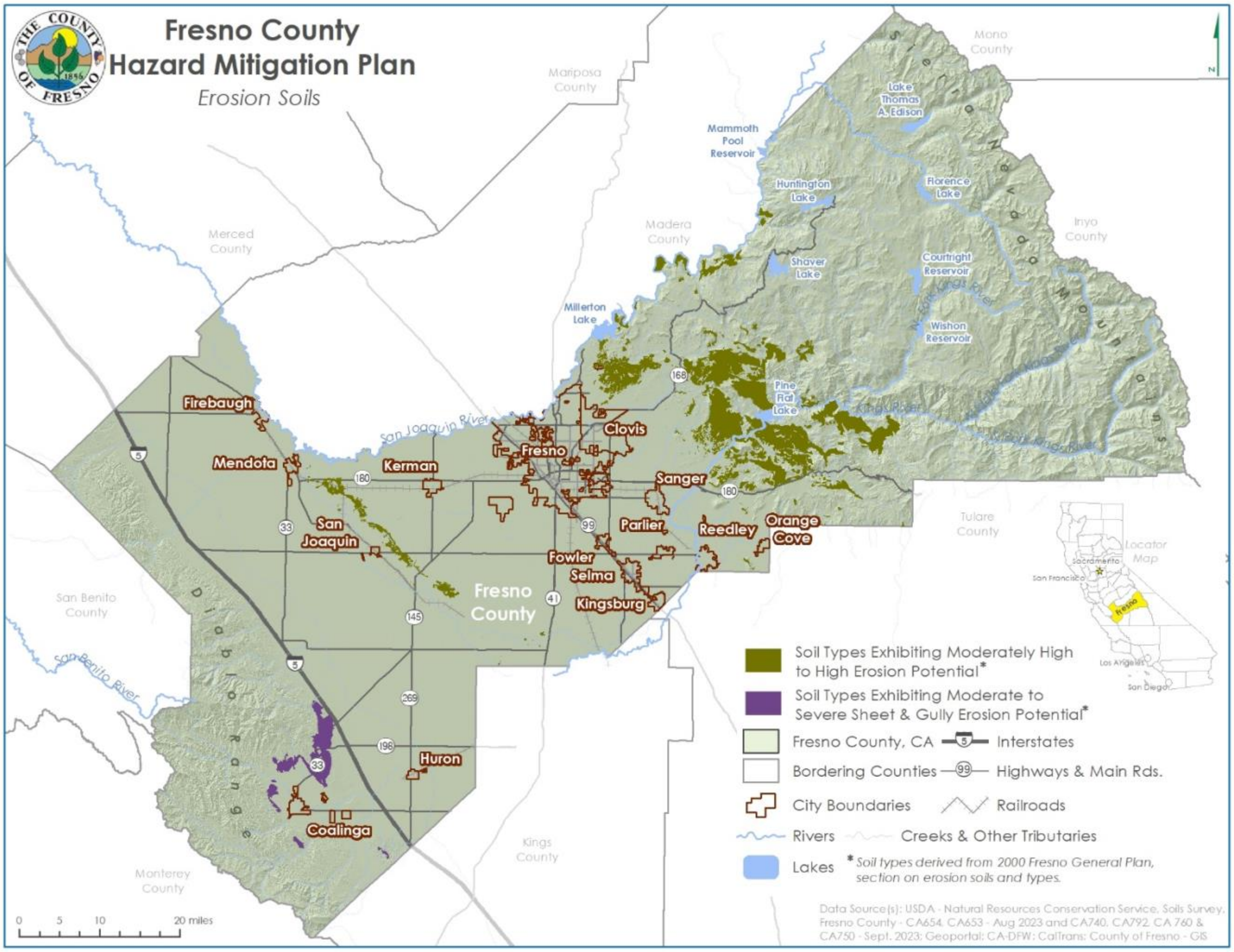
The Fresno County General Plan Background Report identifies those areas with moderately high to high erosion potential. These include areas of certain soil types in the Sierra Nevada and the foothills that generally coincide with slopes that exceed 30 percent (see **Figure 26. Fresno County Steep Slope Areas** and **Figure 27. Fresno County Erosion Soils**). However, many of these identified areas are located within the boundaries of the Sierra National Forest, Sequoia National Forest, or Kings Canyon National Park, which limits their availability for intensive development.

Figure 29. Fresno County Steep Slope Areas



Source: USGS, National Map Viewer, ½ Arc Second DEM: CA Geoportal; CA-DFW; CalTrans; County of Fresno - GIS

Figure 30. Fresno County Erosion Soils



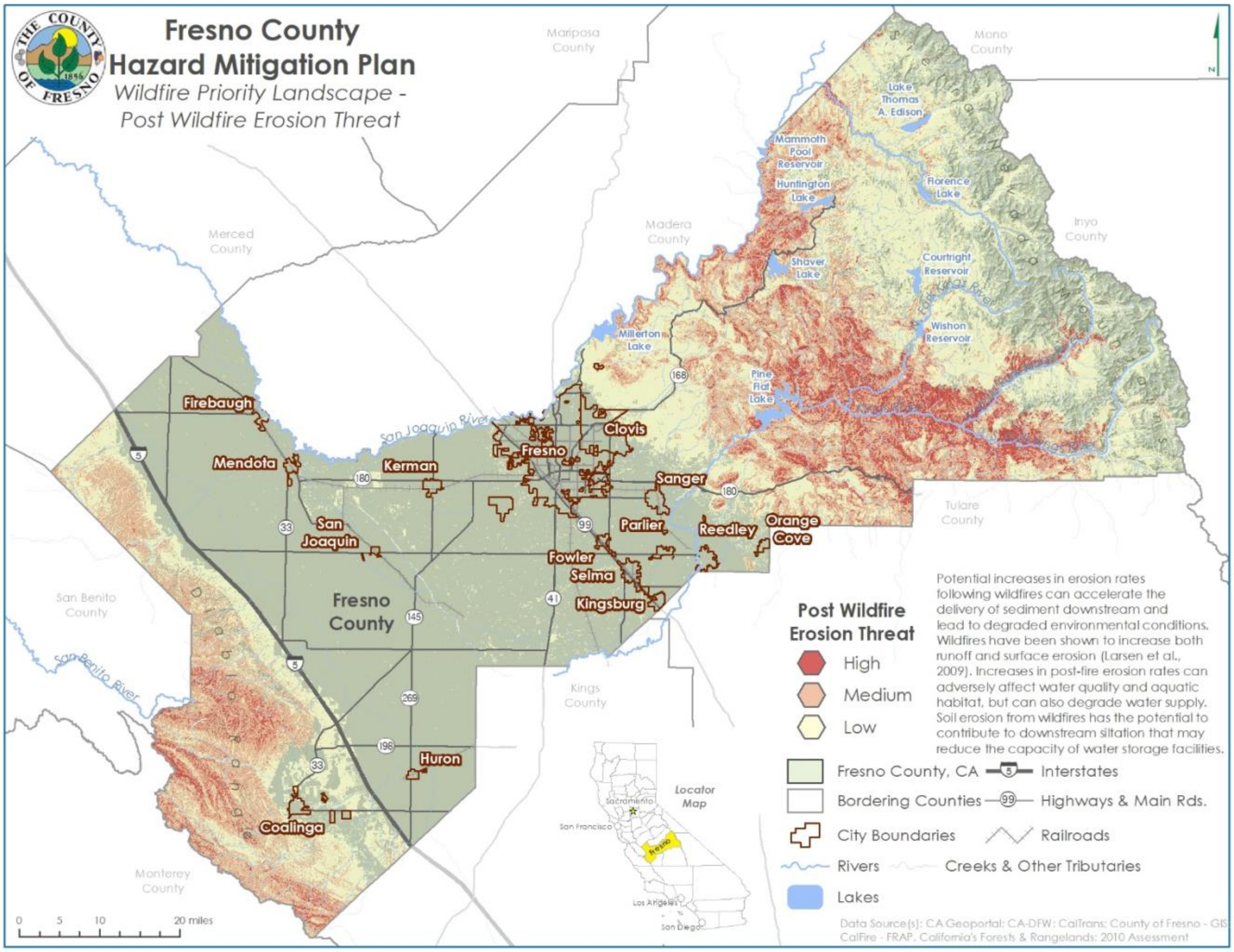
Source: USDA National Resources Conservation Service, Soils Survey

Erosion within the valley area is generally not a large concern, with the exception of areas containing Rossi soil east of the Fresno Slough from approximately Mendota to Fish Slough near Helm. Severe erosion potential has also been identified along the San Joaquin River Bluff. Also, along the main bypass floodway of the Fresno Slough, widely spaced gullies in a trellis pattern have eroded the soils where subsiding floodwaters drain back into the deeper main flood channel.

In western Fresno County, most soil associated with the Kettleman series appears to be subject to moderate to severe sheet and gully erosion potential. These include areas located primarily west of Interstate 5 in the Coast Range foothills. Also, in the western portion of the County, Panoche and Panhill soils, which under natural conditions do not exhibit erosion potential, are susceptible to erosion as a result of human activity. These soils are located extensively throughout the western part of the County and are prevalent in areas on recent alluvial fans in the central part of the region.

One of the main concerns associated with erosion is related to wildfire as a fire burns it destroys plant material. Plants such as shrubs, grasses, and trees provide roots that stabilize the soil. Fires destroy soil protection, leading to increased vulnerability to erosion, in addition to increased risk of flood hazard. The amount of erosion after a burn is determined by the severity of the burn, the slope, soil type and condition of the watershed before the burn. Using information provided by Cal Fire, **Figure 28. Fresno County Wildfire Priority Landscape - Post Wildfire Erosion Threat** outlines the post fire erosion threat for Fresno County.

Figure 31. Fresno County Wildfire Priority Landscape - Post Wildfire Erosion Threat



Source: CA Geoportal; CA-DFW; CalTrans; County of Fresno – GIS, CalFIRE – FRAP, California's Forests and Rangelands: 2010 Assessment

PAST OCCURRENCES

Historically, there have been no significant erosion events within the County. However, recently during the 2022-2023 season, the United States Forest Service warned visitors to the Sierra National Forest to avoid the Jose Basin Area. The Sierra National Forest officials reported roads in that area experiencing “significant erosion issues” caused primarily by local topography, erosive soils, and lingering effects of the Creek fire. [34] due to the increasing precipitation and flood events in the 2022 water year. Other areas in Fresno County experienced erosion as well during the same period of time.

LIKELIHOOD OF FUTURE OCCURRENCES

Highly Likely—Based on input from the HMPC, erosion does occur in the planning area. Given the nature of erosion problems identified within the County, erosion will continue to be an issue.

CLIMATE CHANGE CONSIDERATIONS

The primary climate related drivers affecting erosion, on both inland and coastal areas, are changes in temperature, water levels, precipitation, vegetation loss or changes, and weather. Climate is a major driver of erosion, however changes in land use and land cover, due to development and land management, can dramatically affect exposure of sediments to erosion. Erosion involves the breakdown, detachment, transport, and redistribution of soil particles by forces of water, wind, or gravity.

[34] https://www.yourcentralvalley.com/news/local-news/stay-out-of-the-jose-basin-area-warns-sierra-national-forest/

SOIL HAZARDS: EXPANSIVE SOILS

HAZARD/PROBLEM DESCRIPTION

Expansive (swelling) soils or soft bedrock are those that increase in volume as they get wet and shrink as they dry. They are known as shrink-swell, bentonite, expansive, or montmorillinitic soils. Swelling soils contain high percentages of certain kinds of clay particles that are capable of absorbing large quantities of water, expanding up to 10 percent or more as the clay becomes wet. The force of expansion is capable of exerting pressures of 20,000 pounds per square foot or greater on foundations, slabs, and other confining structures. Soils composed only of sand and gravel have no potential for volume changes. Soils are generally classified into three expansive soils classes with low, moderate, and high potential for volume changes:

- **Low**: This soils class includes sands and silts with relatively low amounts of clay minerals. Sandy clays may also have low expansion potential if the clay is kaolinite. Kaolinite is a common clay mineral.
- **Moderate**: This class includes silty clay and clay textured soils, if the clay is kaolinite, and includes heavy silts, light sandy clays, and silty clays with mixed clay minerals.
- **High**: This class includes clays and clay with mixed montmorillonite, a clay mineral which expands and contracts more than kaolinite.

Soils with relatively high clay content are considered expansive due to the capacity of clay minerals to take in water and expand to greater volumes. Highly expansive soils can cause structural damage to foundations and roads without proper structural engineering and require detailed geologic investigations and costlier grading applications. This makes highly expansive soil less suitable for development. Expansive soils can be found predominantly in the eastern part of the county in a northwest trending belt approximately parallel to the Friant-Kern Canal foothills in Kings Canyon National Park. Another expansive soil formation is located along the Fresno Slough from Madera County to Kings County [35]

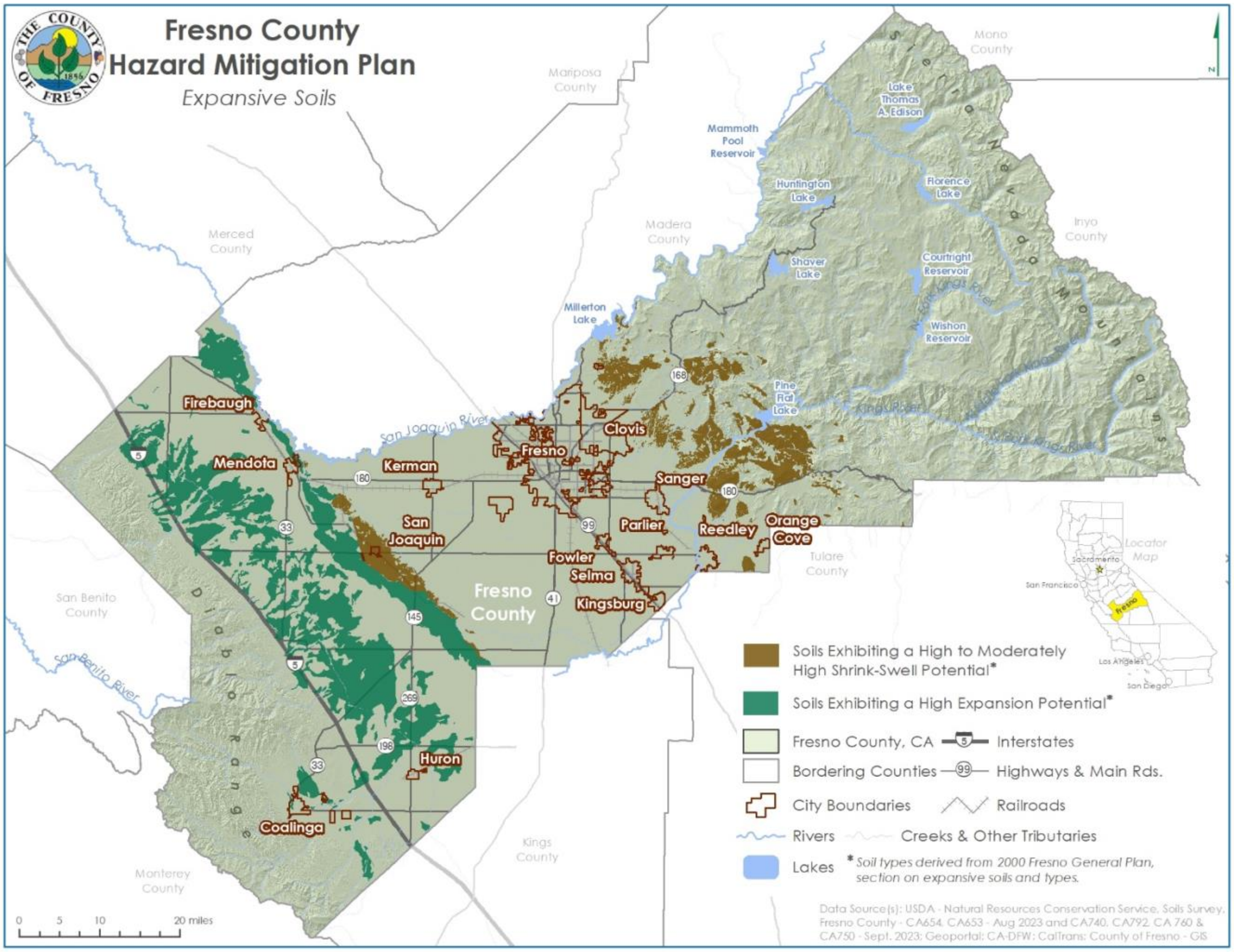
Damage can include severe structural damage, cracked driveways and sidewalks, heaving of roads and highway structures, and disruption of pipelines and other utilities. Destructive forces may be upward, horizontal, or both. Building in and on swelling soils can be done successfully, although more expensively, as long as appropriate construction design and mitigation measures are followed.

EXTENT

Small - According to the Fresno County General Plan Background Report, expansive soils within Fresno County generally occur in a northwest-trending belt approximately parallel to the Friant-Kern Canal foothills in Kings Canyon National Park in the Sierra Nevada, along the Fresno Slough from Madera County to Kings County, and roughly parallel to the San Luis Drain west of Tranquility and San Joaquin. **Figure 29. Fresno County Expansive Soils** from the Fresno County General Plan Background Report illustrates the area's most susceptible to expansive soils.

[35] Fresno County General Plan Background Report 2042

Figure 32. Fresno County Expansive Soils



Source: USDA – Natural Resources Conservation Service, Soils Survey, Fresno County – CA654, CA653 – August 2023 and CA740, CA792, CA760 & CA750 – September, 2023; Geoportal; CA-DFW; CalTrans; County of Fresno - GIS

PAST OCCURRENCES

Expansive soils are present in the County. However, due to the ability to successfully mitigate the hazard by adhering to sound design and construction practices, the HMPC was unable to find examples of historical expansive soil problems in the planning area.

LIKELIHOOD OF FUTURE OCCURRENCES

Possible—Based on the soil types found in Fresno County, the potential exists for expansive soil to be a future issue in the Fresno County planning area.

CLIMATE CHANGE CONSIDERATIONS

There is potential for more severe wet and dry cycles in future climate, which may have an effect on the frequency and intensity of expansive soils in Fresno County.

SOIL HAZARDS: LAND SUBSIDENCE

HAZARD/PROBLEM DESCRIPTION

Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids. Subsidence, usually as a direct result of groundwater withdrawal or oil and gas withdrawal is common in several areas of California, including parts of the Central Valley. Weight, including surface developments such as roads, reservoirs, and buildings, and manmade vibrations from such activities as blasting and heavy truck or train traffic can accelerate the natural processes of subsidence. According to the California State Hazard Mitigation Plan 2023, by 1970, significant land subsidence had affected about half of the San Joaquin Valley, covering around 5,200 square miles, with more than 1 foot of subsidence observed. In specific localized regions, the ground had subsided by as much as 28 feet.

Subsidence can result in serious structural damage to buildings, roads, irrigation ditches, canals, streams, underground utilities, and pipelines. It can disrupt and alter the flow of surface or underground water. Improper use of land subject to subsidence can result in excessive economic losses: direct economic losses as well as indirect losses (e.g., increased taxes and decreased property values).

In California, the floor of the arid Central Valley is sinking due to groundwater pumping for agricultural and drinking water. According to a Stanford University study, land subsidence will likely continue for decades to centuries. Reducing or slowing the rate of land subsidence may be difficult at points due to periods of drought straining the water supply and system. [36] Other research suggests that groundwater depletion has been mainly propelled by the rapidly expanding estates of perennial, water-intensive crops such as almonds, citrus, and wine grapes. Additionally, non-drought years and years where California experiences extensive rainfall, may not even cause significant changes in land subsidence as this issue has been going on for one hundred years. Much of the groundwater depletion has occurred in the San Joaquin Valley and over the past two decades, the central valley has consumed nearly 36 million acre-feet of groundwater, translating to 11.7 trillion gallons of our most precious resource. [37]

EXTENT

In the San Joaquin Valley, farmers rely heavily on surface-water diversions to meet irrigation water demand, but the recent droughts have induced substantial increases in groundwater pumping. Unfortunately, this excessive water extraction from the unconsolidated deposits of the San Joaquin Valley causes land subsidence.

According to the Fresno County Background Report 2000, in some areas along the valley trough and in parts of western Fresno County, groundwater pumping has caused subsidence of the land surface. Historically, this has occurred in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids.

One study suggests that land subsidence is located in areas where the water demand for agriculture and the density of groundwater wells is the highest, whereas the rate of subsidence is strongly affected the amount of local and imported surface water and by groundwater resources. [38]

There are two main subsidence bowls covering hundreds of square miles that grew wider and deeper between spring 2015 and fall 2016. The geographic extent and magnitude of subsidence in the San

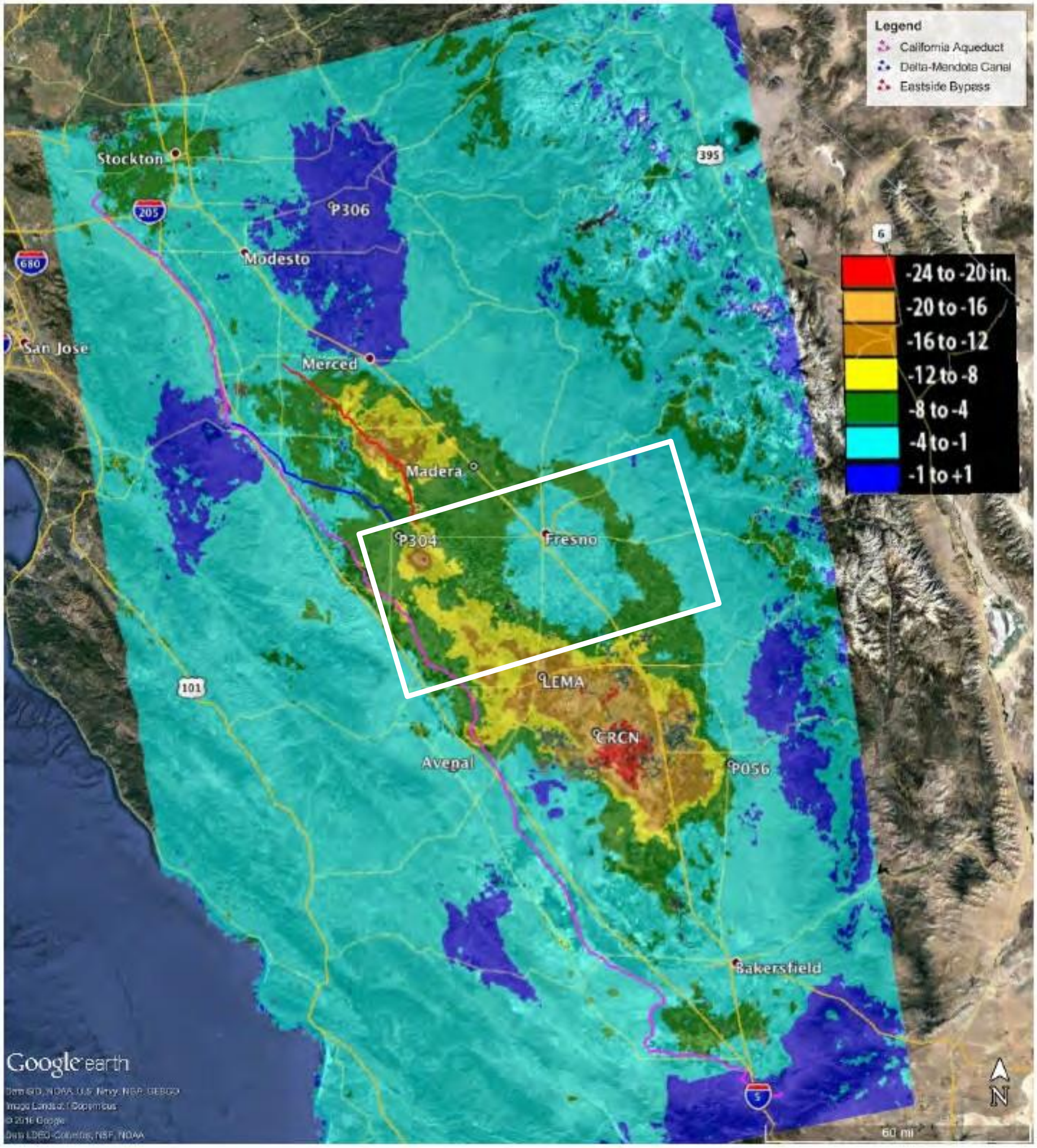
[36] https://news.stanford.edu/2022/06/02/will-californias-san-joaquin-valley-stop-sinking/

[37] https://fresnoalliance.com/central-valley-groundwater-sinking-faster-than-ever/

[38] https://www.sciencedirect.com/science/article/abs/pii/S0022169418309661

Joaquin Valley is displayed below in **Figure 30. Subsidence in the San Joaquin Valley, May 7, 2015 – September 10, 2016.**

Figure 33. Subsidence in the San Joaquin Valley, May 7, 2015 – September 10, 2016



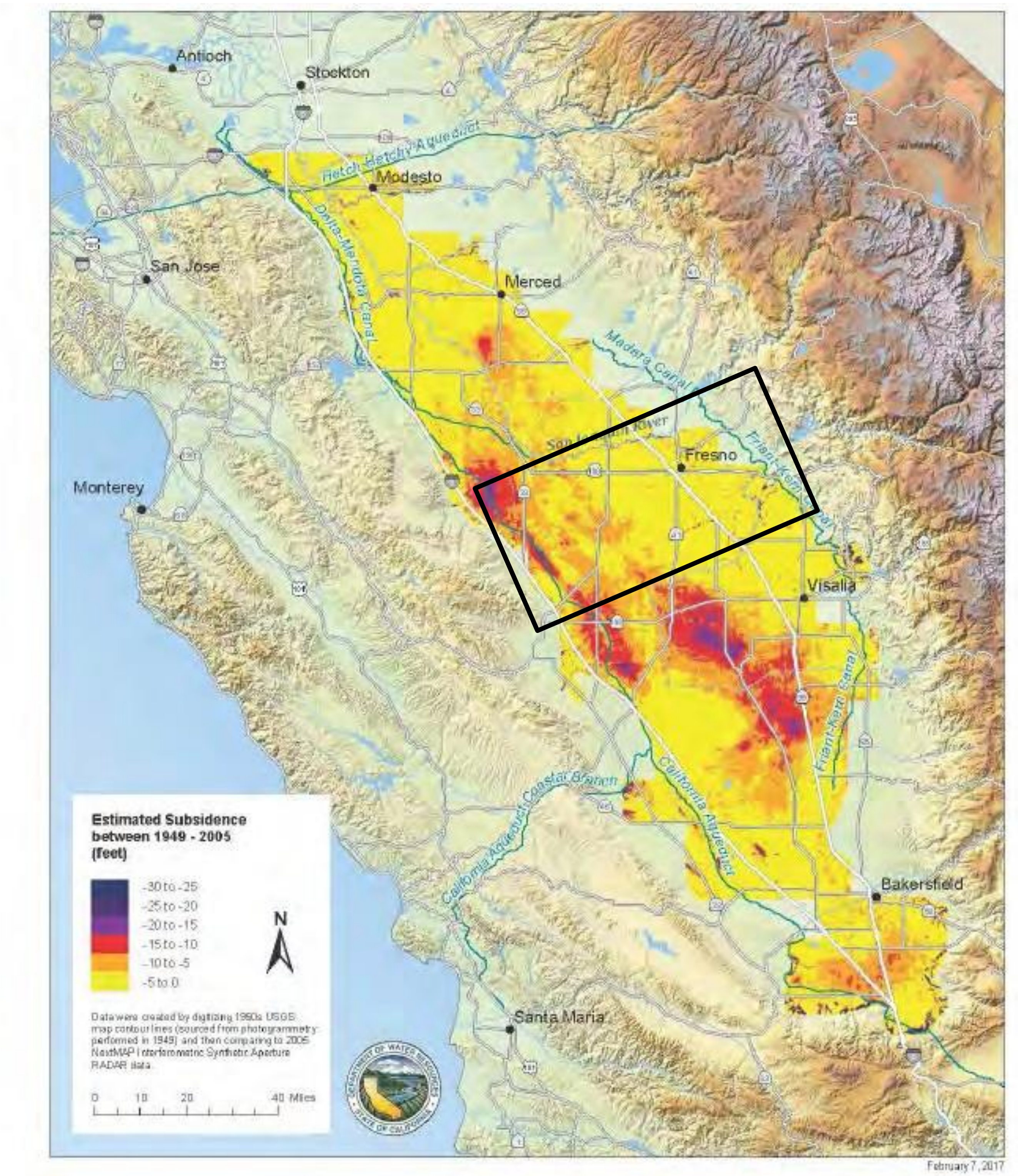
Geospatial analysis indicates that subsidence risk is concentrated in the western portion of the County. While subsidence rates fall in the -4 to -1-inch range in the east, NASA's survey technology shows subsidence reaching up to -16 inches in some pockets along the San Joaquin Valley corridor. Effected jurisdictions include Firebaugh, Mendota, Coalinga, and Huron.

Additionally, a significant area of concern is the Eastside Bypass, a system designed to carry flood flow off the San Joaquin River. Subsidence also intensified at a third area, near Tranquility, where the land surface has settled up to 20 inches in an area that extends seven miles. Specific areas where subsidence has been a problem include the Westlands Water District and the Pleasant Valley Water District. The increased subsidence rates have the potential to damage levees, bridges, and roads. Over time, subsidence can permanently reduce the underground aquifer's water storage capacity.

PAST OCCURRENCES

Subsidence caused by groundwater pumping in the Central Valley has been a problem for decades. Long-term subsidence already has destroyed thousands of public and private groundwater well casings in the San Joaquin Valley. NASA has been using radar satellite maps to document rates of subsidence in the San Joaquin Valley since 2014. The NASA analysis evaluated the Eastside Bypass system and found that the land surface had fallen between 16 inches and 20 inches since May 2015 – on top of several feet of subsidence measured between 2008 and 2012. Though recent technology and resources has brought this problem to light, the San Joaquin Valley subsidence due to groundwater extraction was observed as early as the 1920s. Extensive monitoring and research related to subsidence in the Valley was carried out in the 1950s through the 1970s because of concerns about subsidence-related damage to the state and federal water projects. **Figure 31. Estimated Subsidence Between 1949 and 2005** below documents 50-years of estimated subsidence rates in the San Joaquin Valley. Similar to the estimates, the eastern portion of the County has historically seen the most subsidence, potentially reaching up to 30-feet in the north-east.

Figure 34. Estimated Subsidence Between 1949 and 2005



In 1963, DWR initiated construction of the State Water Project's 444-mile-long California Aqueduct. Subsidence mitigation was integrated into the project design; however, subsidence has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct and on the Central Valley Project's Delta-Mendota and Friant-Kern canals. In recent years, a five-mile reach of the Eastside Bypass was raised in 2000 because of subsidence, and DWR estimates that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area.

LIKELIHOOD OF FUTURE OCCURRENCES

Occasional—Land subsidence has been a constant issue affecting Fresno County for decades. This hazard is ongoing and is certain to continue in the future. However, legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies. Groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. Though occurrence may be inevitable, the magnitude of subsidence rates is dependent on the mitigation actions and pumping regulations initiated by Fresno County. Excess groundwater pumping is more likely to occur during times of drought.

CLIMATE CHANGE CONSIDERATIONS

The most likely impact that climate change will have on land subsidence risk is the potential for extended and severe drought, which could likely result in more groundwater pumping and human-induced subsidence. During periods of drought, water levels may be drawn too low, which results in an irreversible compaction of aquitards. The water cannot recharge the layers, causing permanent subsidence and diminishment of groundwater storage capacity.

SEVERE WEATHER: GENERAL

Severe weather is generally any destructive weather event, but usually occurs in the Fresno County planning area as localized thunderstorms that bring heavy rain, hail, lightning, and strong winds.

The National Oceanic and Atmospheric Administration's National Center for Environmental Information (NCEI) has been tracking severe weather since 1950. The Storm Events Database contains data on the following: all weather events from 1993 to 2023. This database contains over 3,000 severe weather events that occurred in Fresno County between 1950 to 2023. **Table 38. NCEI Hazard Event Reports for Fresno County (1950-2023)** summarizes these events.

Table 38. NCEI Hazard Event Reports for Fresno County (1950-2023)

Type	# of Events	Property Loss ($)	Crop Loss ($)	Deaths	Injuries
Dense Fog*	1,509	24,136,000	0	24	72
Flash Floods	48	87,000	0	0	0
Floods	420	583,281,000	124,190,000	12	8
Funnel Clouds	47	0	0	0	0
Hail	73	1,020,000	2,100,500	0	4
Heavy Rain	151	2,179,000	95,690,000	0	0
High Winds**	111	402,518,000	30,000	1	0
Lightning	38	1,770,000	300,000	2	3
Severe Thunderstorms/Wind	73	4,224,500	43,085,000	2	15
Tornado**	35	6,480,050	26,000	0	3
Wildfires*	662	1,847,706,500	119,918,000	5	112

Source: National Center for Environmental Information Storm Events Database, www.ncdc.noaa.gov/stormevents/

**Hazards with wide extents have losses which reflect larger zones that extend beyond Fresno County*

***Source is NOAA Storm Events Database GIS data*

The NCEI table above summarizes severe weather events that occurred in Fresno County. A few of the events resulted in state and federal disaster declarations. It is further interesting to note that different data sources capture different events during the same time period, and often different information specific to the same events. While the HMPC recognizes these inconsistencies, they see the value this data provides in depicting the County's "big picture" hazard environment.

In the previous plan, all of Fresno County's state and federal disaster declarations have been a result of natural hazards, mostly caused by severe weather. Since the 2018 update, state and federal declarations resulted from the COVID-19 pandemic, which has been the exception for the county regarding causes of state and federal declarations. For this plan, severe weather is broken down as follows:

- Extreme Temperatures (Extreme Cold/Freeze and Extreme Heat)
- Fog
- Heavy Rain/Thunderstorm/Hail/Lightning/Wind
- Winter Storm
- Tornado

Due to the size of the County and changes in elevation and climate, weather conditions can vary greatly across the County. The profiles that follow provide information, where possible, from three weather stations in different parts of the County: Huntington Lake (elevation: 7,000 feet) in east Fresno County, Fresno WSO AP (elevation: 33 feet) in central Fresno County, and Coalinga (elevation: 66 feet), in west Fresno County.

SEVERE WEATHER: EXTREME TEMPERATURES

HAZARD/PROBLEM DESCRIPTION

Extreme temperature events, both cold and hot, can have severe impacts on human health and mortality, natural ecosystems, and agriculture and other economic sectors.

EXTREME COLD/FREEZE

Extreme cold or freeze is largely accompanied by a winter storm or weather system that produces cold temperatures. What is considered an excessively cold temperature varies according to the normal climate for that region. However, when temperatures are far below normal, with higher wind speeds, heat leaves the human body more rapidly, which increases the possibility of negative effects from these extreme temperatures. [39]

The greatest danger from extreme cold is to people, as prolonged exposure can cause frostbite or hypothermia, and can become life threatening. When someone is suffering from hypothermia, body temperatures can become so low that they affect the brain, making it difficult for the victim to think clearly or move well. In the case of frostbite, the frozen tissue becomes numb, and the victim may be unaware that anything is wrong until someone else notices. This makes hazards from extreme cold particularly dangerous, as people may not understand what is happening to them or what to do about it. [40]

The primary hazards from extreme cold are frostbite and hypothermia. Frostbite is caused by freezing of the skin and underly tissue. It causes a loss of feeling and color in the affected areas of the body, and most often affects the nose, chin, fingers, or toes. It can be permanently damaging if not treated promptly and can lead to infection, nerve damage, or amputation in severe cases. The risk of frostbite is increased in people with preexisting conditions, the elderly, people with reduced blood circulation, and people who are not dressed warmly enough for the conditions.

Hypothermia occurs when the body loses heat faster than it can produce heat, causing a dangerously low body temperature. A normal body temperature is around 98.6° F. Hypothermia occurs when your body temperature falls below 95° F.45 As this happens, the heart and other essential organs cannot work properly. If hypothermia is not treated, it can lead to heart failure, respiratory failure, and eventually to death. [41]

Excessive or extreme cold can accompany severe winter weather, or it can occur without severe weather. For this reason, extreme cold is considered a separate hazard from severe winter storms. The effects of freezing temperatures on agriculture in Fresno County are discussed further in the Agricultural Hazards section.

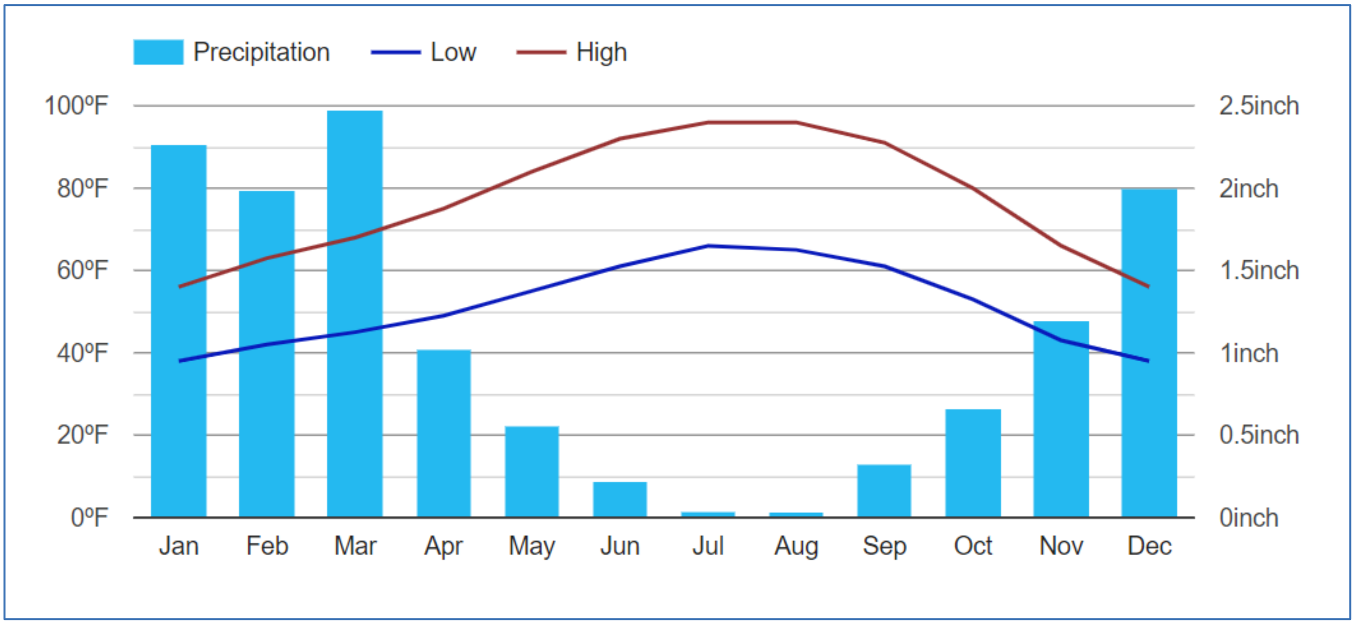
In Fresno County, the average low temperatures in the winter months range from 53 to 38 degrees. Therefore, it is likely that since the average low in the month of January specifically, is 38 degrees that there are days in which temperatures are below freezing.

[39] National Weather Service. *Stay Safe in the Extreme Cold.* Retrieved 12.07.23from: https://www.weather.gov/dlh/extremecold

[40] Centers for Disease Control and Prevention. *Extreme Cold: A Prevention Guide to Promote Your Personal Health and Safety.* Retrieved 12.07.23 from: https://www.cdc.gov/nceh/toolkits/winterweather/default.html

[41] Mayo Clinic. *Hypothermia: Overview.* Retrieved 12.07.23 from https://www.mayoclinic.org/diseases-conditions/hypothermia/symptoms-causes/syc-20352682

Figure 35. Fresno County Average Temperatures and Precipitation



Source NWS

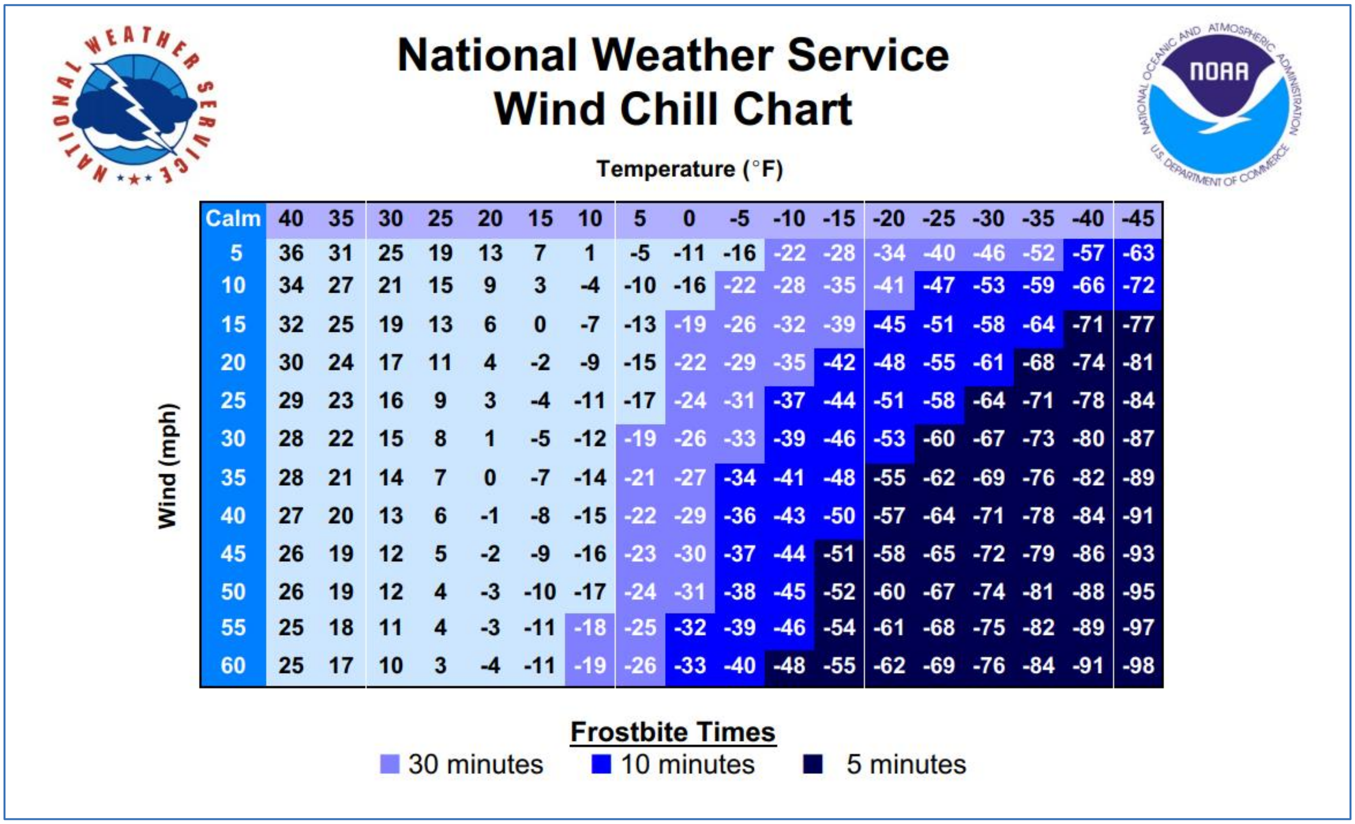
WIND CHILL

The National Weather Service Issues Extreme Cold Warnings when the temperature feels like it is -30° F or colder across a wide area for a period of at least several hours. When possible, these advisories are issued a day or two in advance of the conditions.

The most common extent/severity marker for extreme cold is the Wind Chill scale. **Figure 36. NWS National Weather Service Wind Chill Chart** depicts the National Weather Service's methodology for determining the wind chill, using wind speed and actual temperature. Although wind chill is not necessarily related to extreme cold as a single cause, the advisory system that the NWS currently uses relies on wind chill to relay warning and advisory information to the public. Extreme cold severity is a function of wind chill and other factors, such as precipitation amount (rain, sleet, ice, and/or snow). [42]

[42] Climate Fresno - California and Weather averages Fresno (usclimatedata.com) https://www.usclimatedata.com/climate/fresno/california/united-states/usca2234

Figure 36. NWS National Weather Service Wind Chill Chart



Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Source: NWS

EXTREME HEAT

Extreme heat, as per the guidance provided by the Fresno County Public Health, is considered a period of high heat and humidity with temperatures above 90 degrees for at least two to three days. In extreme heat your body works extra hard to maintain a normal temperature, which can lead to death. These episodes, often referred to as "heat waves," lack a universal definition but are typically delineated by the potential for dangerously hot weather conditions capable of causing heat-related illnesses and even fatalities. [30]

Remarkably, heat-related issues pose a significant threat and constitute one of the foremost weather-related causes of mortality in the United States. Annually, they claim the lives of over a thousand individuals. Those most susceptible to the adverse effects of extreme heat span a diverse spectrum and include, but are not limited to, vulnerable populations such as infants and young children, older adults, individuals with chronic medical conditions, pregnant women, and those with disabilities. [31]

Furthermore, the United States, with particular emphasis on the Los Angeles region, is confronting an ominous trajectory regarding extreme heat events. This trajectory is inexorably linked to the ongoing and anticipated shifts in our climate. As climate change continues to unfold, it is expected that both the frequency and severity of extreme heat events will escalate, heightening the urgency for proactive measures to protect communities and mitigate the associated risks. Therefore, it is imperative for regions like Los Angeles to prepare for these impending challenges and enact robust strategies to safeguard the health and well-being of their residents in the face of rising temperatures.

Heat Index

The Heat Index is a metric that considers both the actual air temperature and the relative humidity, providing a more accurate reflection of how hot it feels. Relative humidity represents the amount of moisture in the air compared to what it would contain if fully saturated, which depends on both moisture content and temperature. There exists a clear correlation between air temperature, relative humidity, and the heat index, such that as air temperature and relative humidity rise, the heat index follows suit, and conversely, it drops when they decrease. The National Weather Service has created a Heat Index Chart, denoted in **Figure 37. NWS Heat Index**, which illustrates how the Heat Index classifications change and intensify from "Caution" to "Extreme Danger" as both temperature and relative humidity increase.[34]

Figure 37. NWS Heat Index

NWS Heat Index — Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

Source: NWS

The classifications of the Heat Index describe the risk of heat disorders with prolonged exposure or strenuous activity. As the heat index increases the heat index classification increases as well and darkens from light yellow to red. This also increases the likelihood for individuals to experience adverse effects on the body. The description of the heat index can affect the body is described in **Table 39. Extreme Heat Health Impacts Using the Heat Index**.

Table 39. Extreme Heat Health Impacts Using the Heat Index

Classification	Heat Index	Effect on the Body
Caution (Light Yellow)	80F-90F	Fatigue possible with prolonged exposure and/or physical activity
Extreme Caution (Yellow)	90F-103F	Heat stroke, heat cramps, or heat exhaustion possible with prolonged exposure and/or physical activity
Danger (Orange)	103F-124F	Heat cramps or heat exhaustion likely, and heat stroke possible with prolonged and/or physical activity
Extreme Danger (Dark Red)	125F or higher	Heat stroke highly likely

Source: NWS

Wet Bulb Globe Temperature

The Wet Bulb Globe Temperature (WBGT) is a comprehensive meteorological metric that encompasses several vital weather parameters, including temperature, humidity, wind, solar radiation, and more. This multi-faceted index plays a pivotal role in assessing the risk of heat stress, particularly for populations engaging in outdoor activities, such as outdoor workers and athletes.

WBGT serves as a crucial tool for making informed decisions when its com/.']es to safeguard individuals or entire communities during hot and potentially hazardous weather conditions. Its application extends to various scenarios, where mitigating the effects of extreme heat is paramount.

For instance, in the context of outdoor work, WBGT can guide recommendations for necessary modifications. These may involve advising outdoor laborers to curtail strenuous activities during periods of elevated WBGT, suggesting shifts that begin earlier or later in the day when conditions are less oppressive, and ensuring the availability of shaded areas to allow for periodic relief from the heat.

By factoring in a comprehensive range of meteorological elements, the WBGT not only provides a more nuanced understanding of heat stress but also empowers decision-makers to proactively protect the well-being of those exposed to the elements, ultimately enhancing safety, and minimizing the risks associated with extreme heat.

Heat Risk

The National Weather Service (NWS) HeatRisk prototype is a color-numeric-based index that provides a forecast of the potential level of risk for heat-related impacts to occur over a 24-hour period. That level of risk is illustrated by a color/number along with identifying the groups potentially most at risk at that level. Each HeatRisk level is also accompanied by recommendations for heat protection and can serve as a useful tool for planning for upcoming heat and its associated potential risk. Based on the NWS high resolution national gridded forecast database, a daily HeatRisk value is calculated for each location from the current date through seven days in the future.

The HeatRisk prototype takes into consideration:

- How unusually above normal the temperatures are at your location (is it warmer than the top 5 percent of hottest days in the period of record for this date?)

- The time of the year (for example, is this early season heat that you likely haven't become used to, typical mid-summer heat, or late season heat that you may have become more used to?)
- The duration of unusual heat (for example, are temperatures overnight at levels that would lower heat stress, maintain it, or will unusually warm overnight low temperatures add to heat stress into the next day)
- If those temperatures are at levels that pose an elevated risk for heat complications, such as heat stress, based on peer-reviewed science and heat-health thresholds supported by the Centers for Disease Control and Prevention (CDC) national data sets.

The Heat Risk tool can be used to protect communities and individuals from potential risks of extreme heat. Adverse impacts from weather events generally affect historically underserved communities and the Heat Risk tool seeks to provide support for those communities and be better prepared. Groups that are heat-sensitive or heat vulnerable face a higher risk of heat-related illnesses and adverse impacts than others. This groups include:

- The elderly and very young
- People experiencing homelessness
- Individuals on certain medications and/or those with pre-existing conditions that increase heat sensitivity
- Outdoor workers, especially new workers, temporary workers, workers that are not yet accustomed to working outdoors, and those working in non-cooled spaces
- Individuals exercising or engaging in strenuous activities outdoors during the heat of day, especially those that are not accustomed to the level of heat, not drinking enough fluids, and those new to that type of activity.
- Individuals without adequate cooling mechanisms or proper hydration
- Individuals not acclimated to the level of heat expected, especially those that are new to a warmer climate
- Individuals sensitive to poor air quality, which can be exacerbated by heat waves
- Individuals living in low-income communities

Heat Tools and the National Weather Service Heat Products

The National Weather Service (NWS) uses the various tools described including the Wet Bulb Globe Temperature tool, Heat Risk tool, and the Heat Index to inform the issuance of NWS official heat watches, warnings, and advisories. Each tool provides a different perspective beyond what the actual air temperature is and can provide a deeper level of understanding.

EXTENT

Large - Both extreme heat and extreme cold cover greater than 25 percent of the planning area.

EXTREME HEAT

The NWS has in place a system to initiate alert procedures (advisories, watches, and warnings) when high temperatures are expected to have a significant impact on public safety. The expected severity of the heat determines which type of alert is issued, described in **Table 40. NWS Heat Related Product**.

Table 40. NWS Heat Related Product

Heat-Related Product	Description
Excessive Heat Warning (Dark Purple)	An Excessive Heat Warning is issued within 12 hours of the onset of extremely dangerous heat conditions. The general rule of thumb for this Warning is when the maximum heat index temperature is expected to be 105° or higher for at least 2 days and night-time air temperatures will not drop below 75°; however, these criteria vary across the country, especially for areas not used to extreme heat conditions. If you don't take precautions immediately when conditions are extreme, you may become seriously ill or even die.
Excessive Heat Watches (Dark Red)	Heat watches are issued when conditions are favorable for an excessive heat event in the next 24 to 72 hours. A Watch is used when the risk of a heat wave has increased but its occurrence and timing is still uncertain.
Heat Advisory (Orange)	A Heat Advisory is issued within 12 hours of the onset of extremely dangerous heat conditions. The general rule of thumb for this Advisory is when the maximum heat index temperature is expected to be 100° or higher for at least 2 days, and night-time air temperatures will not drop below 75°; however, these criteria vary across the country, especially for areas that are not used to dangerous heat conditions. Take precautions to avoid heat illness. If you don't take precautions, you may become seriously ill or even die.
Excessive Heat Outlooks (Light Yellow)	The outlooks are issued when the potential exists for an excessive heat event in the next 3-7 days. An Outlook provides information to those who need considerable lead-time to prepare for the event.

Source: NWS

A common guideline for the issuance of excessive heat alerts in Fresno County is when the maximum daytime high is expected to equal or exceed 110°F and a nighttime minimum high of 80°F or above is expected for two or more consecutive days.

Fresno County begins to experience hot weather in May or June of each year, and the heat continues throughout the summer months. The Fresno County Heat Emergency Contingency Plan provides a two-phase approach to mitigate and reduce the effects of extreme heat. Phase I calls for a heat awareness campaign to be initiated at the beginning of the heat season. Phase II calls for an operational area response to a heat emergency. The County Health Officer may determine that a Heat Emergency exists based on the threat to public health and safety. This may include:

- Excessive Heat Warning or Heat Wave issued by the NWS.
- Heat-related illnesses and deaths are above average.
- Abnormal amounts of heat related deaths occur in local animal populations.

- Successive days when daytime temperature exceeds normal ranges, and the nighttime heat index does not drop below 80 degrees.
- The California Independent System Operator (CALISO) issues a Stage 3 Electrical Emergency.
- High heat is accompanied by electrical blackouts or rotating power outages.
- Two or more jurisdictions within the County "declare" heat emergencies.
- The state "declares" a heat emergency.

EXTREME COLD

Similar to Extreme Heat, the National Weather Service (NWS) has in place a system to initiate alert procedures (advisories, watches, and warnings) when low temperatures are expected to have a significant impact on public safety. The expected severity of the cold determines which type of alert is issued, described in **Table 41. NWS Winter Storm Weather Products**.

Table 41. NWS Winter Storm Weather Products

Winter Storm Product	Description
Winter Weather Advisory (Light Purple)	Wintry weather expected. Light amounts of wintry precipitation or patchy amounts of wintry precipitation or patchy blowing snow will cause slick conditions and could affect travel if precautions are not taken.
Winter Storm Watch (Light Blue)	Snow, sleet, or ice possible. Confidence is medium that a winter storm could produce heavy snow, sleet, or freezing rain and cause significant impacts.
Winter Storm Warning (Pink)	Snow, sleet, or ice expected. Confidence is high that a winter storm will produce heavy snow, slight, or freezing rain and cause significant impacts.

Source: NWS

The National Weather Service (NWS) developed the Wind Chill Temperature (WTC) index to provide a formula to calculate the dangers from winter winds and freezing temperatures shown in **Table 42. NWS Extreme Cold Weather Products**. Additionally, the NWS produces frost and freeze advisory, watch, and warning to communicate when temperatures can pose a risk.

Table 42. NWS Extreme Cold Weather Products

NWS Product	Description
Frost Advisory (Light Blue)	A frost advisory means areas of frost are expected or occurring, posing a threat to sensitive vegetation.
Freeze Watch (Blue)	NWS issues a freeze watch when there is a potential for significant, widespread freezing temperatures within the next 24-36 hours. A freeze watch is issued in the autumn until the end of the growing season and in the spring at the start of the growing season.
Freeze Warning (Dark Blue)	When temperatures are forecasted to go below 32°F for a long period of time, NWS issues a freeze warning. This temperature threshold kills some types of commercial crops and residential plants.

NWS Product	Description
Hard Freeze Warning (Light Purple)	NWS issues a hard freeze warning when temperatures are expected to drop below 28°F for an extended period of time, killing most types of commercial crops and residential plants.

Source: NWS

Overall, extreme temperature impacts would likely be limited in the planning area, at least 25 percent of the planning area affected, which is extensive. Extreme cold can occasionally cause problems with communications facilities and utility transmission lines. Danger to people is highest when they are unable to heat their homes and when water pipes freeze. Extreme cold and extreme heat can also impact livestock and even crops if the event occurs during certain times of the year.

PAST OCCURRENCES

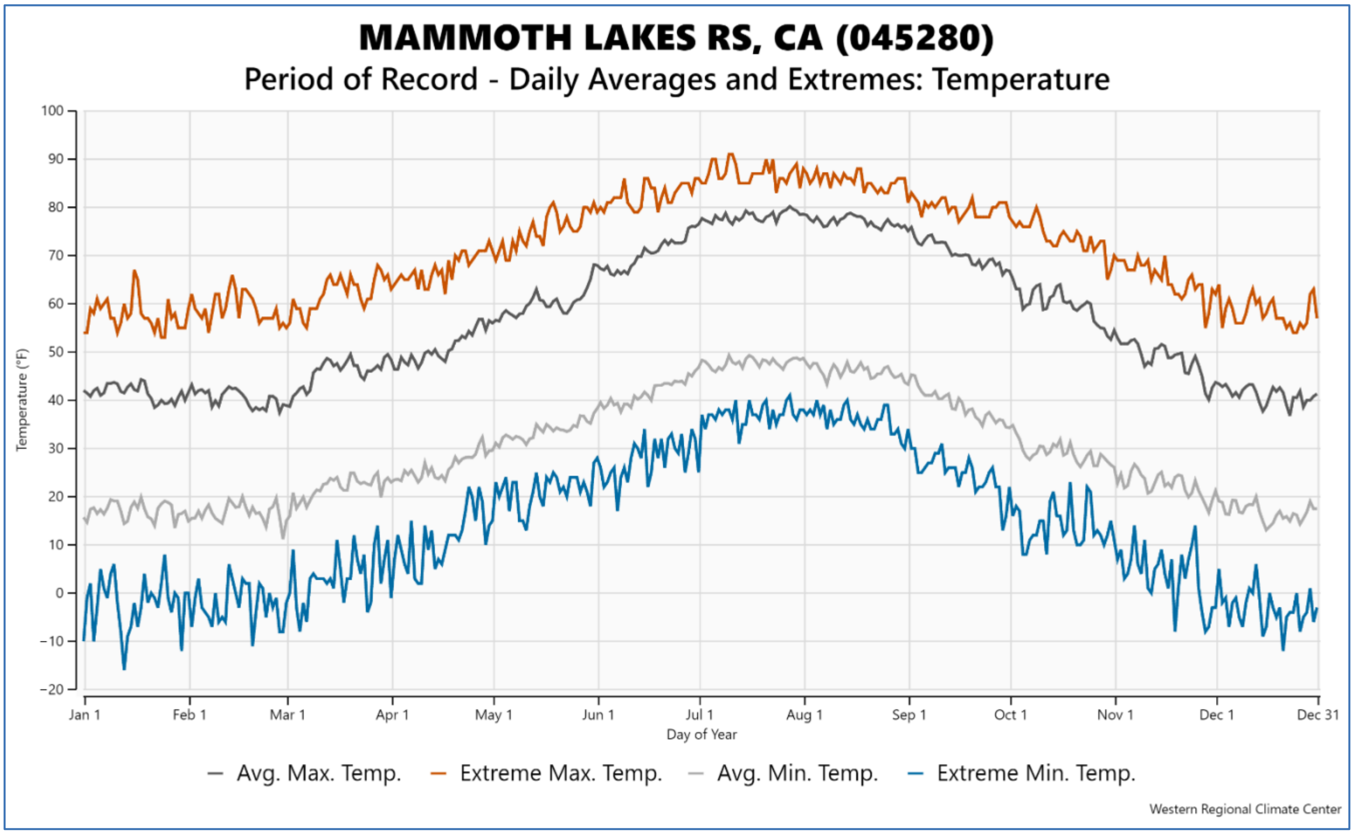
Information from the three representative weather stations introduced in the Severe Weather: General section, is summarized below.

FRESNO COUNTY—EAST (MAMMOTH LAKE, INYO COUNTY, PERIOD OF RECORD 12/01/1993 - 08/31/2020)

The previous plan included weather data from the Huntington Lake weather station, however data from that weather station has not been updated since 2016. Therefore, the Mammoth Lake weather station was used in Inyo County, which is just outside of the northeastern portion of Fresno County, to provide an understanding of averages for the eastern portion of the jurisdiction. While the period of record only captures up until August of 2020, it is the closest weather station to the eastern portion of Eastern Fresno County that has a similar environment.

Monthly average maximum temperatures in the warmest months (May through October) range from the mid-50s to low 80s. Monthly average minimum temperatures from November through April range from the high 20s to low 10s. July 11 had the highest extreme maximum temperature of 91 degrees. January 13 had the lowest extreme minimum temperature of -16 degrees.

Figure 38. Mammoth Lakes Daily Averages and Extremes: Temperatures

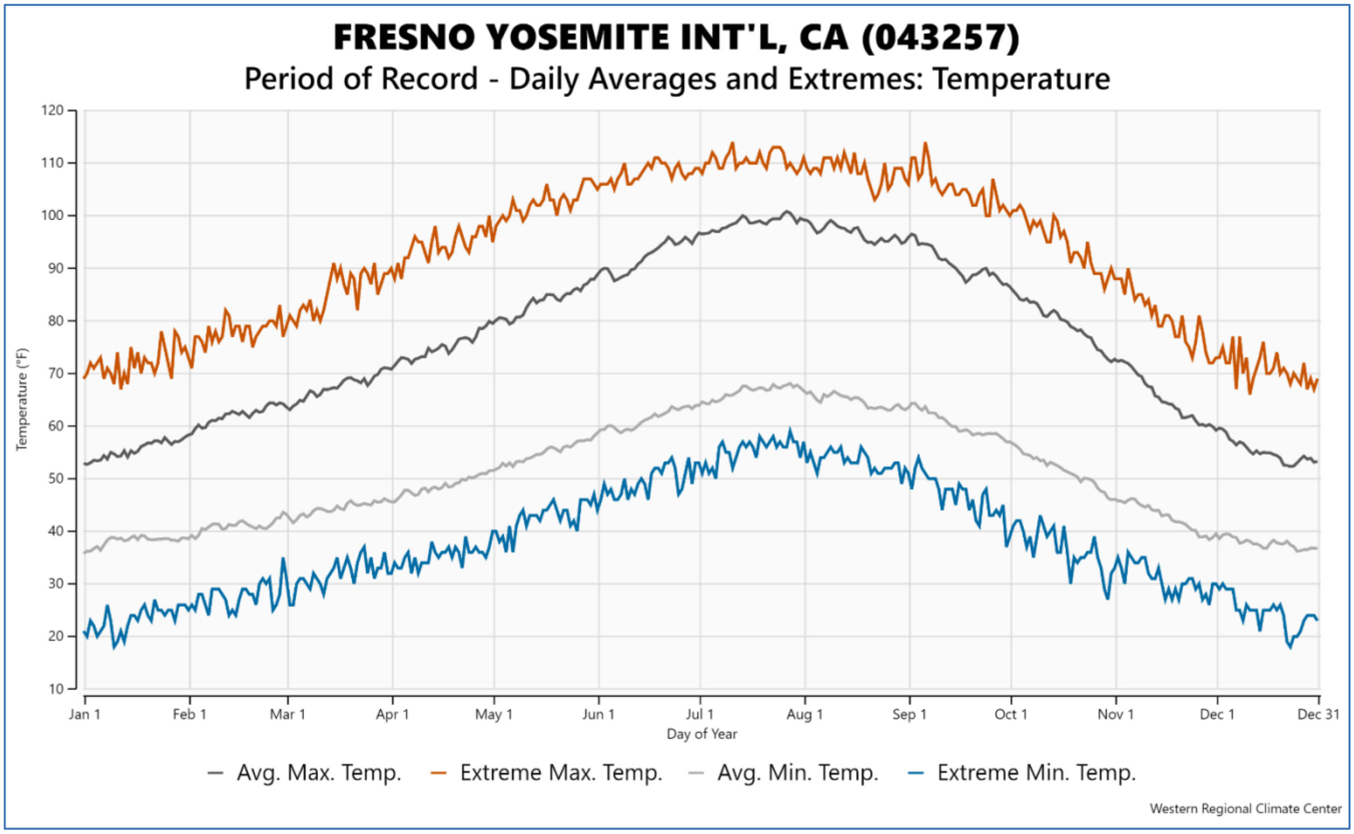


Source: Western Regional Climate Center, www.wrcc.dri.edu/

FRESNO COUNTY—CENTRAL (FRESNO YOSEMITE INTERNATIONAL, PERIOD OF RECORD 01/01/1948 - 02/04/2024

Monthly average maximum temperatures in the warmest months (May through October) range from the high 70s to low 100s. Monthly average minimum temperatures from November through April range from the mid-30s to mid-40s. September 6 had the highest extreme maximum temperature of 114 degrees. December 23 and January 10 had the lowest extreme minimum temperature of 18 degrees.

Figure 39. Fresno Yosemite International Daily Averages and Extremes: Temperatures

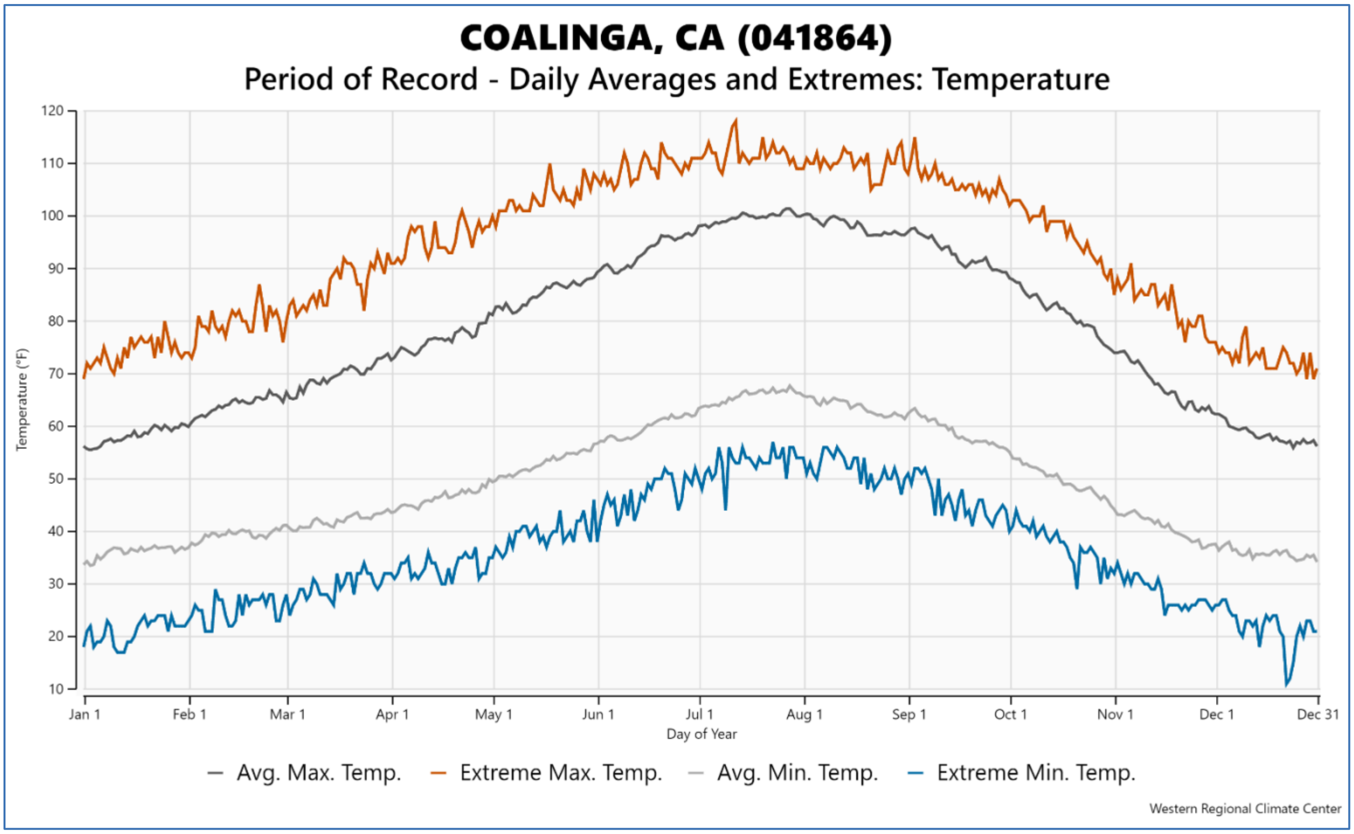


Source: Western Regional Climate Center, www.wrcc.dri.edu/

FRESNO COUNTY—WEST (COALINGA WEATHER STATION, PERIOD OF RECORD 1942 TO 2023)

Monthly average maximum temperatures in the warmest months (May through October) range from the high 70s to low 100s. Monthly average minimum temperatures from November through April range from the high 40s to 100s. July 12 had the highest extreme maximum temperature of 118 degrees. December 22 had the lowest extreme minimum temperature of 11 degrees.

Figure 40. Coalinga Daily Averages and Extremes: Temperature



Source: Western Regional Climate Center, www.wrcc.dri.edu/

The HMPC identified the following events related to extreme temperatures in the Fresno County planning area:

EXTREME COLD/FREEZE

- **1990**: This freeze event is on record as the most economically devastating freeze event to date due to the loss of production citrus trees, not just the loss of the fruit crop.
- **December 20-28, 1998**: Extreme low temperatures adversely affected agricultural crops in the County. Citrus crops were impacted the most, but winter vegetables were also damaged. Total crop damage was estimated at $74 million. The loss to crops also resulted in unemployment and loss of income to small towns and industry throughout the planning area. An estimated 14,000 or more agricultural workers were out of work. Estimated economic impacts to the community were $220 million. This freeze resulted in local, state, and federal declarations (2/9/99). The County also incurred $223,700 in damage to government facilities and roads. Statewide, $2.5 million was paid out in claims.
- **January 2007**: Freezing temperatures destroyed citrus crops and put many people out of work. Within the agricultural citrus belts, temperatures ranged from 19-24°F during the morning. Damage to County facilities was estimated at $15,000. Crop damage was estimated at roughly $128 million. Residual effects from loss of sales and resulting unemployment were three times the cost of the crop damage ($383 million). Local, state, and federal disasters were declared. The state provided monies for mortgage and rental assistance. Federal and state donations to local food banks were increased. Unemployment insurance benefits were also increased. Central and South Valley estimated combined property damage was $250,000, and agricultural damage was $710 million.

Table 43. Fresno County Previous Occurrences: Extreme Cold

Location	Date	Magnitude	Property Loss ($)	Crop Loss ($)	Deaths	Injuries
Fresno County	1990	0		0	0	0
Fresno County	12/20/1998 – 12/28/1998	0	223,700	74 M	0	0
Fresno County	January 2007	0	250,000	128 M	0	0

Source: NOAA, National Centers for Environmental Information, Storm Events Database

EXTREME HEAT

- **July 2006**: The planning area experienced six days of triple digit temperatures. The state declared a heat emergency for Fresno County. Cooling centers were opened by the state and some local jurisdictions. 24 people died between July 14 and August 1. 16,500-25,000 dairy cattle died in the Central Valley, and up to 700,000 poultry died. Milk production was down 30 percent, with dairy losses estimated to exceed $80 million. Residual effects from loss of sales and resulting unemployment were three times the cost to the livestock industry. A local declaration was also declared to dispose of dead livestock at the County landfill. Federal/state disaster relief included $16 million for lost milk production. Federal loans were made available to farmers.

- **July 2007**: Extreme, prolonged heat caused a mass die-off of farm animals such as dairy cattle and poultry. An estimated 50,000 turkeys, weighing up to 40 pounds each, died, which created a disposal issue. Zacky Farms was hit hardest, but other losses were incurred at various locations throughout the County. A local emergency was declared to legally dispose of these animals at the local landfill.
- **July 2008**: An intense heatwave gripped Interior Central California starting July 8 due to a high-pressure system, with temperatures soaring to 105-112 degrees and minimum heat index values staying above 80 degrees at night. Record-breaking minimum temperatures were observed in Bakersfield and Fresno, exacerbating conditions already critical due to concurrent wildfires which led to significant air quality issues and advisories. This extreme weather claimed the lives of two farm workers in Kern County, highlighted the vulnerability of sensitive groups, and resulted in substantial poultry losses in Kings County, prompting a local state of emergency.
- **August 2011:** In late August, a robust high-pressure system caused a severe heatwave in southeast California, with temperatures in Joshua Tree National Park surpassing 110 degrees from Tuesday through Saturday. The extreme conditions resulted in the tragic deaths of two European tourists, whose bodies were discovered near Black Eagle Mine Road, indicating they suffered from exposure after leaving their vehicle in a challenging area of the park. Authorities concluded that the victims, found a mile apart, had entered the park before noon and their vehicle was left in a location unsuitable for passenger vehicles.
- **July 2013**: A record-setting ridge of high pressure (600 dm over northern New Mexico) built in over the Great Basin and desert Southwest, beginning around June 29th, lasting through approximately July 7, when it hit another peak in temperatures. This resulted in extreme high temperatures, well above normal, across the region during this period. The hottest days in July were the 1st through the 3rd, during which several record high minimums were set, as well as highs well over 100 degrees. Prolonged heat in the higher terrain was a significant impact, like in San Diego County.
- **June 2016**: Strong high pressure over the four corners region retrograded westward over southern and central California bringing a period of high temperatures over the 110-degree mark to locations in the Kern County Desert.
- **June 2017:** A prolonged heatwave caused by a high-pressure ridge resulted in extreme temperatures, particularly in desert regions where Palm Springs hit 122 degrees on the 20th, 24th, and 25th of the month. The intense heat triggered Flex Alerts for energy conservation and led to a local emergency in Fresno County due to delays at a rendering facility that impacted livestock carcass processing. Measures were taken to implement alternative disposal methods as per Fresno County health and agricultural authorities.
- **August 2017**: Upper-level high pressure brought record heat to the area. A plume of subtropical moisture promoted the growth of isolated afternoon thunderstorms with large hail. A 13-year-old was hospitalized Tuesday after suffering heat stroke during tryouts for the freshman football team at Lincoln High School on August 1. Temperatures at Lincoln Airport reached 100 degrees between 4 and 7 pm PDT.
- **September 2017**: A persistent large upper ridge centered over the Great Basin provided the area with an extended period of much warmer than normal temperatures between August 26 and September 3. High temperatures ranged mainly from 106 to 112 degrees at many locations each day between August 26 and September 3 across the San Joaquin Valley, the southern Sierra foothills, and the Kern County Deserts while morning lows ranged from the mid 70's to the lower 80's.

- **June 2019**: A large area of high pressure prevailed over California between June 10 and June 12 which resulted in much warmer than normal temperatures across the area during the period. High temperatures generally ranged between 102 and 107 degrees each day across much of the San Joaquin Valley prompting the first Excessive Heat Warning of the season. As a result of the heat, emergency cooling centers were opened each afternoon in several municipalities in the San Joaquin Valley during this period.
- **May 2020**: A large area of high pressure built into California on May 25 and May 26. This resulted in much above normal daytime temperatures on both days with some locations setting new daily records on May 26. The high then strengthened on May 27 and May 28 resulting in widespread record heat over the region on both days with highs in the San Joaquin Valley mainly between 103 and 107 on both days. Triple digit heat was also observed across portions of the Sierra foothills and Kern County Deserts. Temperatures cooled by several degrees on May 29 and lowered to below seasonal averages by May 30 as the large area high pressure broke down, and a cold front pushed through the area.
- **August 2020**: On August 14, a dominant high-pressure system over the Desert Southwest extended its reach over central California, leading to extreme heat and triggering Excessive Heat Warnings for multiple regions, including the San Joaquin Valley and Kern County Deserts. Record-breaking temperatures were observed on August 16 and 17, exceeding 110 degrees F, prompting several local emergencies due to livestock fatalities and the opening of cooling centers. This prolonged heat event subsided on August 21 as a northwesterly flow ushered in cooler air, offering a respite from the searing temperatures.
- **June / July 2021:** In June 2021, a large upper ridge over the four corners area expanded westward, bringing extreme heat to central California from June 15 to 18, with Kern County Deserts feeling the surge by June 15 and temperatures climbing over 110°F in several areas by June 19. Relief came between June 20 and 22 as the ridge moved east, reducing the scorching temperatures. The following month, from July 7 to 13, another intense high-pressure system settled over the region, causing several days of near-record temperatures, and marking the most severe heat spell since July 2006, albeit with lower humidity levels that mitigated the overall impact. The heat moderated across the area by July 14 as the ridge shifted eastward.
- **September 2021**: A large upper high-pressure center strengthened over the Great Basin during the Labor Day weekend (September 4 to September 6) resulting in temperatures rising to much above normal levels over the San Joaquin Valley, West Side Hills, and Kern County Deserts on September 6. The dangerous heat remained prevalent over the area through September 9 prompting the issuance of heat highlights as the large upper high produced a pronounced southeast flow over the area. A trough moved into northern California during the morning of September 10 bringing an end to the dangerous heat as afternoon highs remained below the century mark at most stations.
- **September 2022**: A large area of high pressure that was centered over the Great Basin area built westward into California on August 31st and brought a period of hot and dry weather to the area which prevailed across the area through much of early September. An Excessive Heat Warning was issued for a large portion of the area including all the San Joaquin Valley, the West Side Hills, the Sierra Foothills, Yosemite Valley, The Kern River Valley, and the Kern County desert areas and remained in effect until the evening hours of September 9. The large high-pressure area finally broke down on September 9 and temperatures remained below dangerous levels on September 10.
- **July 2023**: California experienced multiple waves of high pressure, starting with record-high temperatures on the 1st and 2nd, which cooled slightly on the 3rd as the pressure system shifted eastward. Mid-month, from the 13th to the 17th, another high-pressure build-up over the Desert

Southwest pushed temperatures near record highs, prompting an Excessive Heat Warning across the region, sparing only the Sierra Nevada above 7000 feet where a Heat Advisory was declared. The pattern repeated with even stronger high pressure from the 21st to the 23rd, inducing a dangerous heat period until a diminishing ridge brought a mild cooling trend by the 25th, with temperatures staying above normal but below hazardous levels in the days following.

Table 44. Fresno County Previous Occurrences: Extreme Heat

Location	Date	Magnitude	Property Loss ($)	Crop Loss ($)	Deaths	Injuries
Fresno County	7/16/2006 – 7/22/2006	0	0	0	0	0
Fresno County	July 2007	0	0	0	0	0
Fresno County	July 2008	0	0	0	2	0
Joshua Tree National Park	August 2011	0	0	0	2	0
Fresno County	July 2013	0	0	0	0	0
Fresno County	June 2016	0	0	0	0	0
Fresno County	June 2017	0	0	0	0	0
Fresno County	August 2017	0	0	0	0	1
Clovis	9/01/2017	0	0	0	0	0
Coalinga, Mendota, Firebaugh	6/10/2019	0	0	0	0	0
Coalinga, Mendota, Firebaugh	5/26/2020	0	0	0	0	0
Coalinga, Mendota, Firebaugh	8/14/2020	0	4M	0	0	0
Tollhouse, Pine Ridge	6/17/2021	0	0	0	0	0
Coalinga, Mendota, Firebaugh	7/09/2021	0	0	0	0	0
Coalinga, Avenal	9/09/2021	0	0	0	0	0
Hanford, Corcoran, Lemoore	9/01/2022	0	0	0	0	0
Coalinga, Lemoore, Hanford	July 2023	0	0	0	0	0
Coalinga, Lemoore, Hanford	7/15/2023	0	0	0	0	0
Hanford, Corcoran, Lemoore	7/21/2023	0	0	0	0	0

Source: NOAA, National Centers for Environmental Information, Storm Events Database

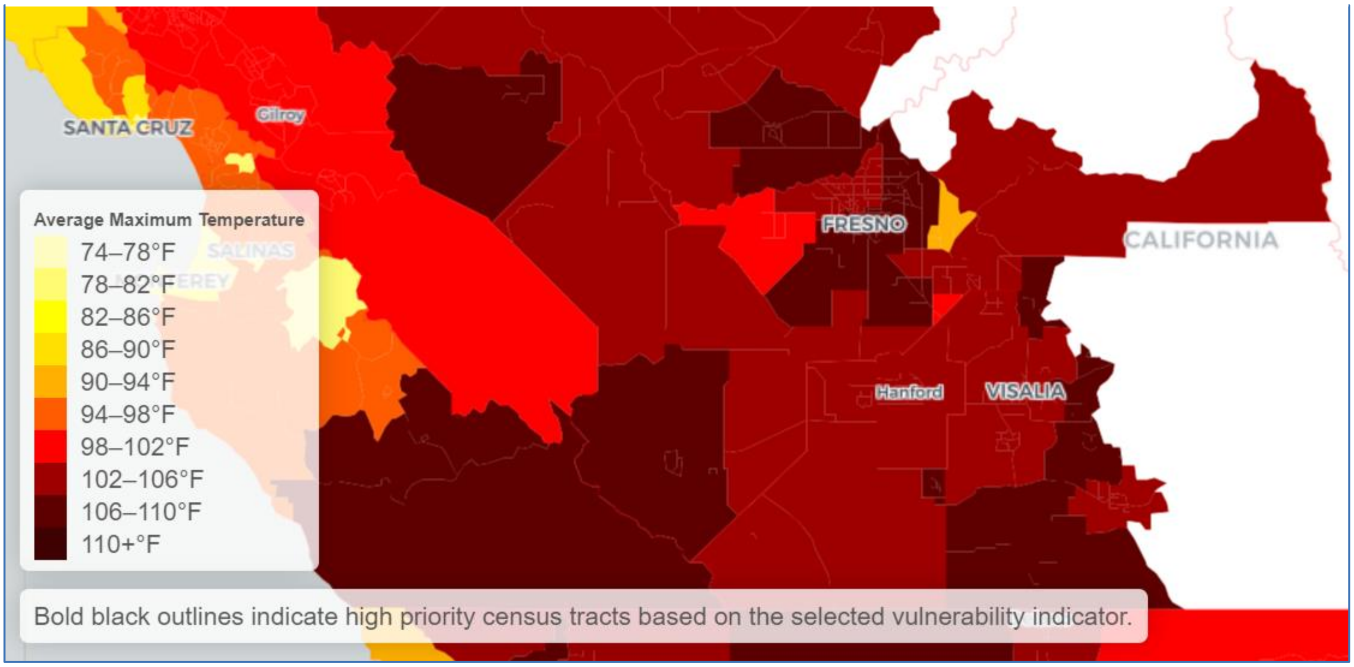
LIKELIHOOD OF FUTURE OCCURRENCES

Highly Likely—Temperature extremes are likely to continue to occur annually in the Fresno County planning area.

EXTREME HEAT

The California Heat Assessment Tool (CHAT) was funded and developed to better understand heat vulnerability driven by climate changes to support mitigating public health impacts of extreme heat events in the future. According to CHAT, the projected Average Maximum Temperature during future Heat Health Event (HHEs) for Fresno County, areas within the jurisdiction are projected to reach 90-94 to 106-110 degrees Fahrenheit are shown in **Figure 38. Fresno County California Heat Assessment Tool (CHAT) Heat Health Event Projections.**

Figure 41. Fresno County California Heat Assessment Tool (CHAT) Heat Health Event Projections



Source: California Heat Assessment Tool (CHAT)

CLIMATE CHANGE CONSIDERATIONS

Although heat waves will likely become more frequent, there is also the potential for continued cold outbreaks in winter, even in an overall warmer climate. This could have direct impacts on human health in terms of heat related illness. With the general trend of increased warming of average temperatures, extreme high temperatures will likely increase as well. Cascading impacts include increased stress on water quantity and quality, degraded air quality, and increased potential for more severe or catastrophic natural events such as heavy rain, droughts, and wildfire. Another cascading impact includes increased duration and intensity of wildfires with warmer temperatures.

Temperatures in the State of California are projected to increase overall. As a part of the California's Changing Climate 2018 report, by 2100 the average annual maximum daily temperature is projected to increase by 5.6-8.8 degrees Fahrenheit. As a result, heat waves are expected to increase in frequency, duration, and magnitude. Los Angeles County will experience an average of nine days of extreme heat per year, growing to 12 days per year, by the final decades of the century.

SEVERE WEATHER: FOG

HAZARD/PROBLEM DESCRIPTION

Fog results from air being cooled to the point where it can no longer hold all the water vapor it contains. For example, rain can cool and moisten the air near the surface until fog forms. A cloud- free, humid air mass at night can lead to fog formation, where land and water surfaces that have warmed up during the summer are still evaporating water into the atmosphere. This is called radiation fog. A warm moist air mass blowing over a cold surface also can cause fog to form, which is called advection fog.

TULE FOG

The interior California valleys have a unique fog problem called tule fogs. The tule fog is a radiation fog, which condenses when there is a high relative humidity, typically after a heavy rain, calm winds, and rapid cooling during the night. The longer nights during the winter months create this rapid ground cooling and results in a pronounced temperature inversion at a low altitude, creating a thick ground fog. Above the cold, foggy layer, the air is typically warm and dry. Once the fog has formed, turbulent air is necessary to break through the inversion. Daytime heating can also work to evaporate the fog in some areas. The tule fogs get their name from the tule reeds, which grew around the swamps and deltas of the great Tulare Lake that once covered the southern end of the San Joaquin Valley.

The tule fog season in Fresno County is typically in the late fall and winter (November through March) but can occur as late as May. Fog typically forms rapidly in the early morning hours. Tule fog can last for days, sometimes weeks. Fog can have devastating effects on transportation corridors in the County. Nighttime driving in the fog is dangerous and multi-car pileups have resulted from drivers using excessive speed for the conditions and visibility.

The San Joaquin Valley is hemmed in on three sides by mountain ranges, with resulting inversion layers trapping cooler air on the valley floor. This predisposes the Fresno area to severe episodes of fog in winter months, when barometric pressures are high, humidity is increased, and ambient temperatures are low. **Table 45. Average Number of Dense Fog Days (October-April)** shows the monthly and total average number of days with dense fog from 1910-2024. The number of dense fog days per year has decreased in the past several decades, **Figure 39. Average Number of Dense Fog Days Per Year (1910-2024)** shows the average number of dense fog days per year. [43]

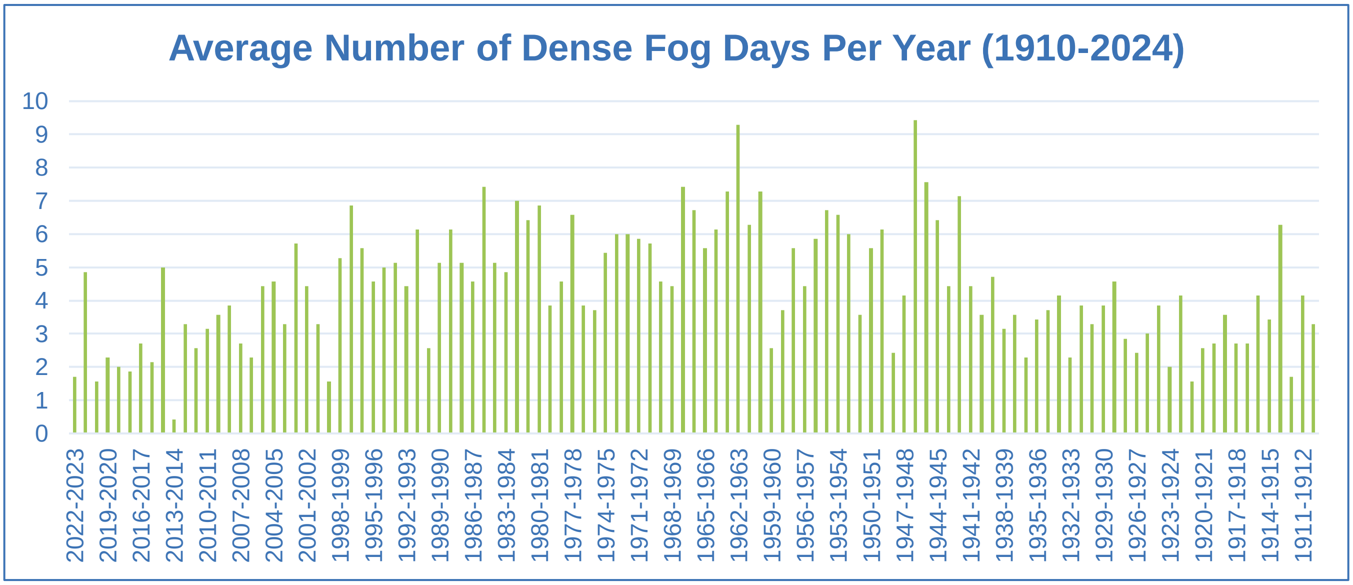
[43] Number of Days With Dense Fog by Cool Season FAT.pdf (weather.gov) https://www.weather.gov/media/hnx/

Table 45. Average Number of Dense Fog Days (October-April)

	October	November	December	January	February	March	April	Total
Average Number of Days with Dense Fog	2 days	5 days	10 days	10 days	5 days	2 days	1 day	31 days

Source: NOAA

Figure 42. Average Number of Dense Fog Days Per Year (1910-2024)



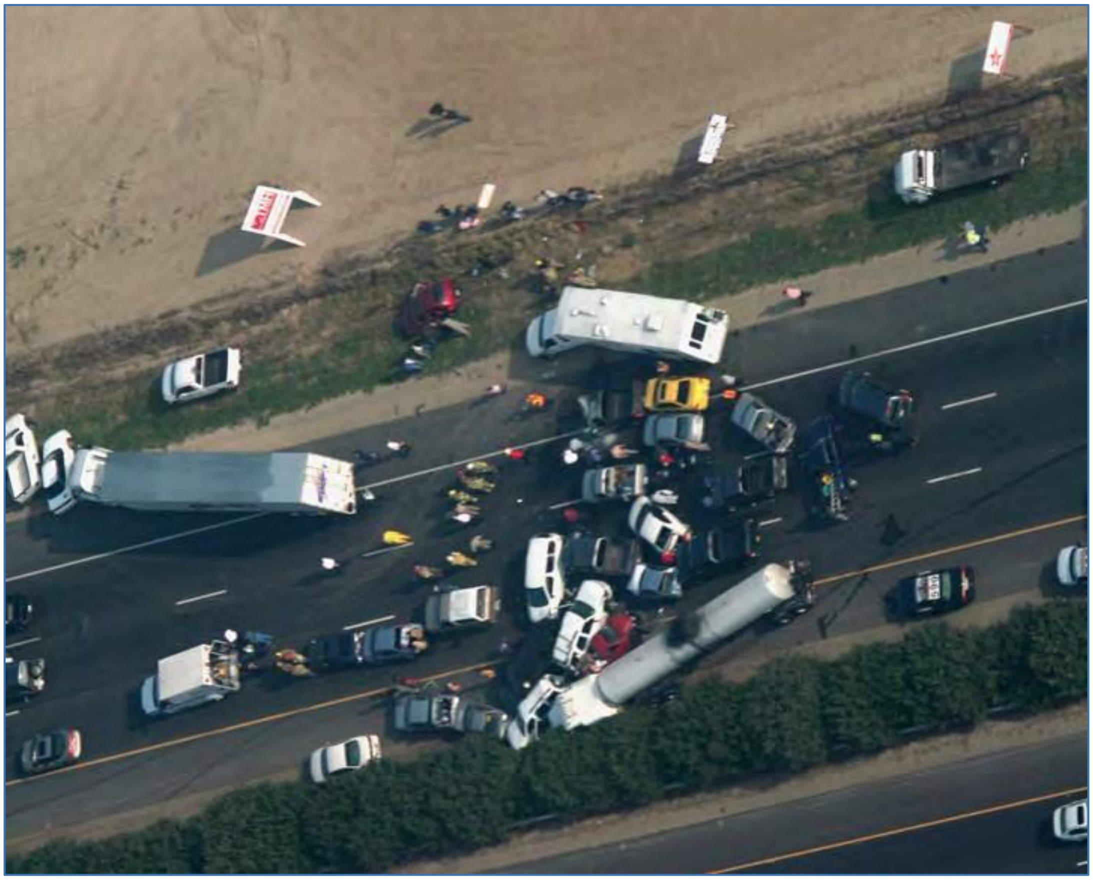
Source: NOAA

Fog contributes to transportation accidents and is a significant life safety hazard. These accidents can cause multiple injuries and deaths and could have serious implications for human health and the environment if a hazardous or nuclear waste shipment were involved. Other disruptions from fog include delayed emergency response vehicles and school closures.

EXTENT

Tule fog forms on clear nights when the ground is moist, and the wind is near calm. On nights like this, the ground cools rapidly. In turn, the moist air above it cools and causes water vapor to condense. Once it has formed, the air must be heated enough to either evaporate the fog or lift it above the surface so that visibilities improve. Common areas for tule fog to form include foothills and valleys. Visibility in tule fog is usually less than an eighth of a mile (about 600 ft or 200 m) but can be much lower. Visibility can vary rapidly; in only a few feet, visibility can go from 10 feet (3.0 m) to near zero. **Figure 40. November 2007 Fog Incident** shows an example of an incident caused by tule fog in Fresno County.

Figure 43. November 2007 Fog Incident



Source: Donavan, California Highway Patrol

Most of these notable fog-related accidents occurred on Highway 99, like the one pictured above. Traffic Accident Caused by Fog, November 2007. In addition to these events, other, less notable collisions occurred on other roads during foggy conditions. Of their most notable fog events, there have been over 20 deaths and hundreds of injuries.

PAST OCCURRENCES

According to the HMPC, severe fog is a recurring problem within the planning area, and most damage results from automobile accidents. Most of these incidents occurred between November and March; one was in October. There have been hundreds of reported fog incidents since 1950, the most notable fog incidents reported by the HMPC include in the following below and in **Table 46. Fresno County Past Occurrences: Fog**.

- **February 1991**: A series of accidents involving 74 vehicles occurred along a three-mile, fog-shrouded stretch of Highway 99 south of Fresno. Three people were killed and 30 were injured.

- **January 16, 1994**: Dense fog caused a 56-vehicle pileup on Highway 99 near Selma, killing two people and injuring 42 others.
- **November 1998**: Dense fog caused a chain-reaction accident involving 74 vehicles along a one-mile stretch of Highway 99 near Kingsburg. Two people were killed, 51 others injured.
- **February 2002**: Fog was a factor in a string of crashes on Highway 99 near Selma that killed two people. More than 30 others were injured in the accident, which involved 87 cars, trucks, and big rigs over a four-mile stretch.
- **November 20, 2002**: Fog was a major factor in a 50-vehicle collision on Highway 99 near Merced that resulted in 32 injuries.
- **February 7, 2006**: Fog was a factor in a 20-vehicle collision on Highway 99 near Tulare that resulted in one death and multiple injuries.
- **November 3, 2007**: Dense fog contributed to the worst traffic accident in Fresno County on Highway 99 just south of Fresno. At least two people were killed in the 108-car chain-reaction crash, which involved 18 big rigs, and 39 individuals were sent to local hospitals. Drunk driving was also cited as a contributing factor. Traffic Accident Caused by Fog, November 2007.
- **February 2008**: Two nights of dense fog resulted in a 10-15 car pileup on the morning of the 11th near Kerman west of Fresno, where there were no injuries, and newspaper accounts of only minor property damages. However, the fog was a major factor in a series of chain-reaction accidents on Highway 99 near Kingsburg during the morning of February 12th. At least four separate accidents occurred, involving at least 40 vehicles, and resulting in at an estimated 10 people being injured.
- **November 2012**: Patchy dense fog developed in the San Joaquin Valley following a storm on November 20th-21st, starting in the Los Banos area before spreading to the Reedley-Visalia area. This fog caused variable visibilities across the Valley, affecting most airports with fluctuations from near zero to a couple of miles. Persistent dense fog was implicated in a fatal chain reaction crash on Highway 152 near Chowchilla in Madera County on the morning of November 27th.
- **January 2013**: January began with the central and southern San Joaquin Valley under a cold, dry airmass that moved into the region. Dense fog continued its reputation as the main winter weather hazard for the central and southern San Joaquin Valley, as a fatal collision occurred 3 miles southeast of Chowchilla in dense fog during the morning of January 4th. These conditions continued through the morning of the 5th, and then a strong upper-level low brought the first precipitation of the year that evening.
- **January 2017**: High pressure with clearing skies over the region coupled with recent heavy precipitation created ideal conditions for dense nighttime and morning radiational fog to develop. Fresno police and California Highway Patrol reported a 2-vehicle accident during dense fog causing one fatality at Jensen Avenue and Chateau Fresno Avenue in the city of Fresno in Fresno County. It also appeared alcohol was a factor.
- **1/31/2017**: High pressure with clearing skies over the region coupled with recent heavy precipitation created ideal conditions for dense nighttime and morning radiational fog to develop. Damages totaled thousands of dollars and resulted in 1 death.
- **1/10/2019**: An upper ridge pushed inland into California on the evening of January 9th and morning of January 10. As a result, skies cleared out and winds diminished across the San Joaquin Valley during the early morning hours which led to the development of widespread dense fog across much of the valley on the morning of the 10th and several locations reported visibility of an eighth of a mile or less. The dense fog was responsible for a fatal auto accident near Atwater. Several school

districts in the valley opened late that morning. The fog lifted into a low cloud deck by late morning and dissipated by early afternoon.

- **1/27/2019**: The fog reformed in much of the valley not long after midnight and persisted until late morning. Fog reduced visibility to below an eighth of a mile for 5 to 10 hours at several locations. There were several fog related accidents during the morning of January 27 and California Highway Patrol paced traffic on several highways until the fog lifted by late morning.
- **12/11/2019**: Fog settled back into the San Joaquin Valley north of Kern County during the evening of December 10 and reduced visibility to below a quarter mile at several locations during the morning of December 11. Once again, several school districts in the valley either opened late or delayed bus service. The fog lifted into a status deck by late morning which eroded by afternoon as an upper-level trough moved to the north of the area and mixed out the near surface airmass.
- **1/24/2020**: High pressure continued to strengthen over the area on January 24, although some high clouds pushed through the area, light winds and inversion conditions allowed for an area of dense fog to form in the center of the San Joaquin Valley north of Kern County where low-level moisture has persisted. The fog reduced visibility to less than an eighth of a mile at several locations and resulted in several school districts either opening late or delaying or cancelling bus service as it persisted until late morning when it lifted into a low cloud deck. The low stratus deck slowly dissipated during the afternoon. The fog also contributed to two multi-vehicle accidents near Caruthers.
- **1/06/2021**: High pressure built over central California on January 5. With mainly clear skies and light winds, areas of dense fog formed in the San Joaquin Valley during the early morning hours of January 6. The fog did cause a few automobile accidents as it formed over a widespread area. The fog lifted into a stratus deck by late morning as a weak system moved through northern California then dissipated by midday.
- **11/21/2021** - Another night of clear skies, light winds and inversion conditions resulted in widespread dense fog forming in the San Joaquin Valley during the evening of November 21 into the early morning of November 22. The fog persisted over a widespread area until late morning when it lifted into a low clouds deck which eroded during the afternoon. The fog resulted in at least three major vehicular accidents in the San Joaquin Valley during the morning of November 22.
- **12/03/2021** - Little change in the upper air pattern occurred from the previous day. Clear skies, light winds and inversion conditions in the San Joaquin Valley allowed for areas of dense fog to form in Merced, Madera, and Fresno Counties in the central San Joaquin Valley during the early morning hours and the fog resulted in several multi-vehicle accidents including two which had fatalities. Traffic was packed during the morning commute on SR 99 north of Madera and several school districts had delayed openings. The fog lifted into a low cloud deck by late morning and dissipated during the afternoon.
- **January 2022**: Persistent dense fog affected parts of the central San Joaquin Valley, particularly between Merced and Madera, from the evening of January 14 until midday on January 16. Intermittent fog was present in other areas of the San Joaquin Valley during this time. The fog, influenced by a low-pressure system off the Southern California coast, lifted by January 16 and was a contributing factor in a fatal multi-car accident near Biola in Fresno County.

Table 46. Fresno County Past Occurrences: Fog

Location	Date	Magnitude	Property Loss ($)	Crop Loss ($)	Deaths	Injuries
Highway 99 Fresno	February 1991	0	0	0	3	30
Highway 99 Selma	1/16/1994	0	0	0	2	42
Highway 99 Kingsburg	November 1998	0	0	0	2	51
Highway 99 Selma	February 2002	0	0	0	2	30
Highway 99 Merced	11/20/2002	0	0	0	0	32
Highway 99 Tulare	2/07/2006	0	0	0	1	0
Highway 99 Fresno	11/03/2007	0	0	0	2	39
Highway 99 Kingsburg	February 2008	0	0	0	0	10
Los Banos Area	November 2012	0	0	0	3	0
Southern San Joaquin Valley	January 2013	0	0	0	0	0
Fresno County	January 2017	0	33,000	0	1	0
Between Merced and Madera	1/14/22	0	630,000	0	0	0
Fresno, Madera, Merced, and Atwater	1/10/2019	0	10,000	0	1	3
San Joaquin Valley	1/27/2019	0	20,000	0	0	0
Fresno and Reedley	12/03/2019	0	10,000	0	0	0
Hanford	12/11/2019	0	10,000	0	0	0
Hanford	1/24/2020	0	50,000	0	0	0
Hanford and Visalia	1/06/2021	0	150,000	0	1	0
Hanford, Visalia, and Porterville	11/21/2021	0	65,000	0	0	0
San Joaquin Valley	11/22/2021	0	15000	0	0	0
San Joaquin Valley	12/03/2021	0	400,000	0	2	3
Between Selma and Fresno Highway 99	1/14/2022	0	630,000	0	1	1

Source: NOAA, National Centers for Environmental Information, Storm Events Database

LIKELIHOOD OF FUTURE OCCURRENCES

Likely—Based on the NCEI, since 1991 there have been 28 major fog incidents over a 32-year period equates to a major fog event about once a year and an 87.5 percent chance of a major fog event in any given year. Based on input from the HMPC, it is likely that minor fog events will continue to occur annually in the Fresno County planning area.

CLIMATE CHANGE CONSIDERATIONS

California's winter tule fog has declined dramatically over the past three decades, raising a red flag for the state's multibillion dollar agricultural industry, according to researchers at UC Berkeley. Crops such as almonds, pistachios, cherries, apricots, and peaches go through a necessary winter dormant period brought on and maintained by colder temperatures. Tule fog, a thick ground fog that descends upon the state's Central Valley between late fall and early spring, helps contribute to this winter chill. "The trees need this dormant time to rest so that they can later develop buds, flowers and fruit during the growing season," said biometeorologist and study lead author Dennis Baldocchi. "An insufficient rest period impairs the ability of farmers to achieve high quality fruit yields." The findings have implications for the entire country since many of these California crops account for 95 percent of U.S. production, the authors noted. The researchers paired NASA and National Oceanic and Atmospheric Administration satellite records with data from a network of University of California weather stations, covering 32 consecutive winters. There was a great deal of variability from year to year, but on average, the researchers found a 46 percent drop in the number of fog days between the first of November and the end of February. Climate forecasts suggest that the accumulation of winter chill will continue to decrease in the Central Valley. Tule fog was also less prevalent in recent years in part due to the multi-year drought.

SEVERE WEATHER: HEAVY RAIN/THUNDERSTORM/HAIL/LIGHTNING/WIND

HAZARD/PROBLEM DESCRIPTION

Storms in the Fresno County planning area are generally characterized by heavy rain often accompanied by strong winds and sometimes lightning and hail. Thunderstorms are one of the most common natural hazards in the U.S., with approximately 100,000 thunderstorms recorded per year nationwide. Approximately 10 percent of the thunderstorms that occur each year in the United States are classified as severe. A thunderstorm is classified as severe when it can produce wind gusts greater than 58 mph, or hail that is one inch or larger in diameter, which is about the size of a quarter. Hail that size and larger can destroy crops, roofs, and vehicles, and even cause human casualties. Descriptions of hail, lightning, and high winds, commonly accompanied by severe thunderstorms, are listed below.

- **Hail**: is formed when water droplets freeze and thaw as they are thrown high into the upper atmosphere by the violent internal forces of thunderstorms. Hail is usually associated with severe storms within the Fresno County planning area. Hailstones are usually less than two inches in diameter and can fall at speeds of 120 miles per hour (mph). Hail events are usually brief, lasting on average 10 to 20 minutes but may last longer with some thunderstorms depending on conditions. Severe hailstorms can be quite destructive, causing damage to roofs, buildings, automobiles, vegetation, and crops.
- **Lightning**: is defined as all the various forms of visible electrical discharge caused by thunderstorms. Thunderstorms and lightning are usually (but not always) accompanied by rain. Cloud-to-ground lightning can kill or injure people by direct or indirect means. Objects can be struck directly, which may result in an explosion, burn, or destruction. Or, damage may be indirect, when the current passes through or near an object, which generally results in less damage.
- **High winds**: often accompanying severe thunderstorms, can cause significant property and crop damage, threaten public safety, and have adverse economic impacts from business closures and power loss. Windstorms in Fresno County are typically straight-line winds. Straight-line winds are generally any thunderstorm wind that is not associated with rotation (i.e., is not a tornado). It is these winds, which can exceed 100 mph, that represent the most common type of severe weather and are responsible for most wind damage related to thunderstorms. These winds can overturn mobile homes, tear roofs off houses, topple trees, snap power lines, shatter windows, and sandblast paint from cars. Other associated hazards include utility outages, arcing power lines, debris blocking streets, dust storms, and an occasional structure fire. Tornadoes (see Section 4.2.18 Tornado) and funnel clouds can also occur during these types of storms.
- **Downslope Winds**: occur when warm/dry air descends rapidly down a mountain side. These types of winds may commonly occur just west of the Sierras. These winds can blow over 40 mph and can occur in sudden gusts that are even stronger, which can make driving hazardous. In addition, their dry conditions increase the risk of wildfires in the area.
- **Santa Ana Winds**: occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California closer to Los Angeles and San Diego but may occasionally influence Fresno County. These winds are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. These

strong winds can cause major property damage. They also increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape.

EXTENT

The National Weather Service classifies hail by diameter size, and corresponding everyday objects to help relay scope and severity to the population. **Table 47. Hail Measurements** indicates the hailstone measurements utilized by the National Weather Service.

Table 47. Hail Measurements

Average Diameter	Corresponding Household Object
Pea	0.25
Marble or Mothball	0.50
Penny or Dime	0.75
Nickle	0.88
Quarter	1.00
Half-Dollar	1.25
Walnut or Ping Pont Ball	1.50
Golf Ball	1.75
Hen's Egg	2.00
Tennis Ball	2.50
Baseball	2.75
Teacup	3.00
Grapefruit	4.00
Softball	4.50

Source: National Weather Service

The largest hailstones recorded in Fresno County had a diameter of 1.75 inches in 1957. Lightning is measured by the Lightning Activity Level (LAL) scale, created by the National Weather Service to define lightning activity into a specific categorical scale. The LAL is a common parameter that is part of fire weather forecasts nationwide. The LAL is reproduced in **Table 48. Lightning Activity Level Scale**.

Table 48. Lightning Activity Level Scale

Lightning Activity Level	
LAL1	No thunderstorms
LAL2	Isolated thunderstorms. Light rain will occasionally reach the ground. Lightning is very infrequent, 1 to 5 cloud to ground strikes in a five-minute period
LAL3	Widely scattered thunderstorms. Light to moderate rain will reach the ground. Lightning is infrequent, 6 to 10 cloud to ground strikes in a five-minute period.
LAL4	Scattered thunderstorms. Moderate rain is commonly produced. Lightning is frequent, 11 to 15 cloud to ground strikes in a five-minute period.

Lightning Activity Level	
LAL5	Numerous thunderstorms. Rainfall is moderate to heavy. Lightning is frequent and intense, greater than 15 cloud to ground strikes in a five-minute period.
LAL6	Dry lightning (same as LAL 3 but without rain). This type of lightning has the potential for extreme fire activity and is normally highlighted in fire weather forecasts with a Red Flag warning

Source: National Weather Service

High winds or a windstorm are especially dangerous in areas with significant tree stands and areas with exposed property, poorly constructed buildings, manufactured housing units, major infrastructure, and above-ground utility lines. High winds can cause downed trees and power lines, flying debris and building collapses, which may lead to power outages, transportation disruptions, damage to buildings and vehicles, and injury or death. There are several types of high winds events described in **Table 49. Types of High Winds**.

Table 49. Types of High Winds

Type	Description
Straight-line winds	Used to describe any thunderstorm wind that is not associated with rotation and is used mainly to differentiate from tornadic winds.
Downdraft	Is a small-scale column of air that rapidly sinks toward the ground.
Macroburst	An outward burst of strong winds at or near the surface with horizontal dimensions larger than 4 km and occurs when a strong downdraft reaches the surface.
Microburst	A small, concentrated downburst that produces an outward burst of strong winds at or near the surface. There are small and short-lived, lasting only 5-10 minutes, with maximum speeds sometimes exceeding 100 miles per hour.
Downburst	Used to broadly describe macro and microbursts. It is a general term for all localized strong wind events that are caused by a strong downdraft within a thunderstorm while microburst simply refers to a small downburst that is less than 4 km across.
Gust Front	Is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. Gust fronts are characterized by a wind shift, temperature drop, and gusty winds out ahead of a thunderstorm.
Derecho	A widespread, long-lived storm that is associated with a band of rapidly moving showers or thunderstorms. A typical derecho event consists of numerous microbursts, downbursts, and downburst clusters. A derecho event is classified when damage extends more than 240 miles and includes wind gusts of at least 58 miles per hour.

Source: NOAA

The Beaufort Wind Scale was one of the first scales to estimate wind speed and effects. It was originally developed to help sailors estimate the winds via visual observations. The scale starts with 0 and goes to a force of 12. The Beaufort scale is still used today to estimate wind strengths shown in the table below. **Table 50. Beaufort Wind Scale** outlines the Beaufort scale, describing the damaging effects of wind speed.

Table 50. Beaufort Wind Scale

Wind Speed (mph)	Description-Visible Condition
0	Calm: smoke rises vertically
1-4	Light air; direction of wind shown by smoke but not by wind vanes
4-7	Light breeze: wind felt on face; leaves rustle; ordinary wind vane moved by wind
8-12	Gentle breeze; leaves and small twigs in constant motion; wind extends light flag
13-18	Moderate breeze; raises dust and loose paper; small branches are moved
19-24	Fresh breeze: small trees in leaf begin to sway; crested wavelets form on inland water
25-31	Strong breeze; large branches in motion; telephone wires whistle; umbrellas used with difficulty
32-38	Moderate gale whole trees in motion; inconvenience in walking against wind
39-46	Fresh gale breaks twigs off trees; generally, impedes progress
47-54	Strong gale slight structural damage occurs; chimney pots and slates removed
55-63	Whole gale trees uprooted; considerable structural damage occurs
64-72	Storm very rarely experienced; accompanied by widespread damage
73+	Hurricane devastation occurs

Source: NOAA

Fresno County is at risk of experiencing events in any of these categories.

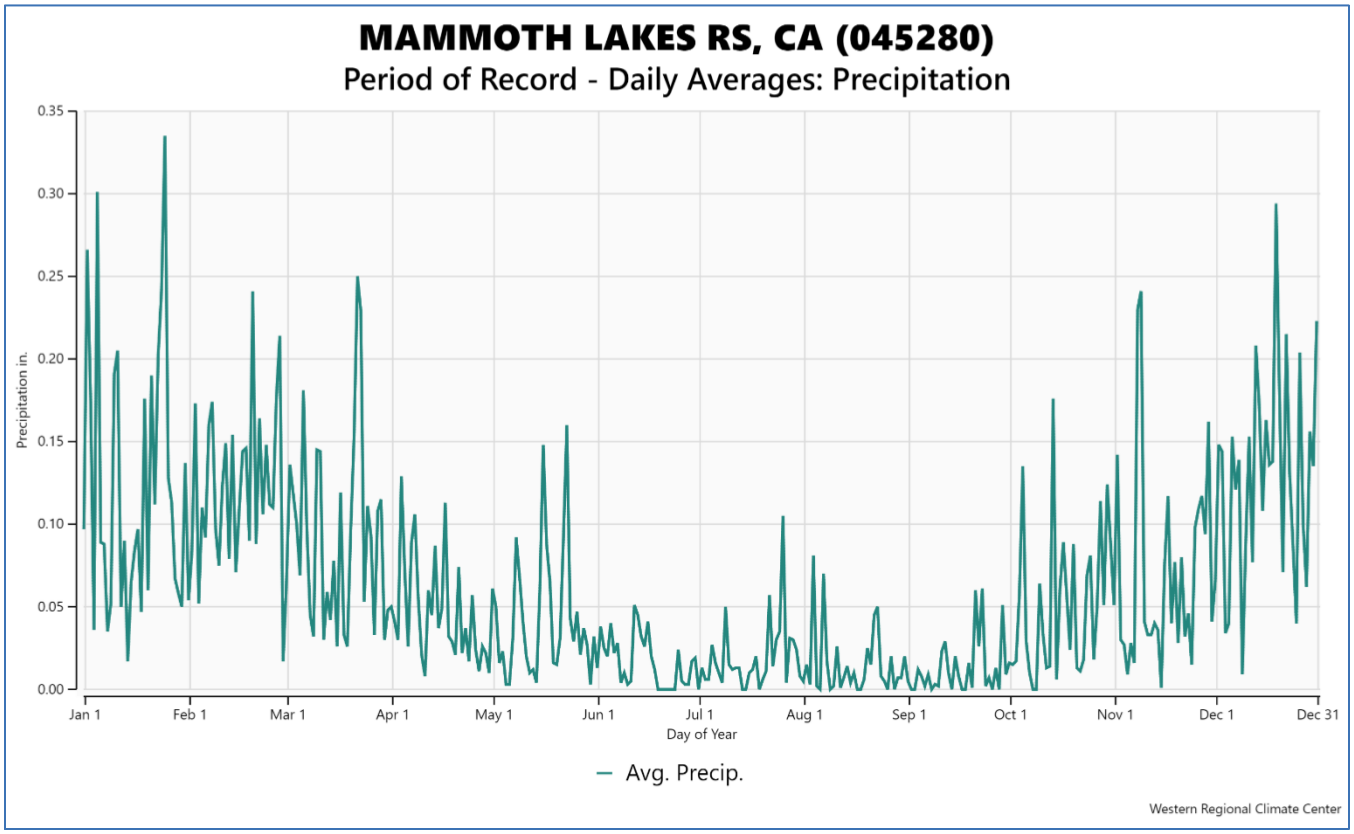
PAST OCCURRENCES

Heavy rains and severe storms occur in the Fresno County planning area primarily during the late fall, winter, and spring, but have been documented in every month of the year. According to the Fresno County General Plan Background Report, the majority of precipitation is produced by storms during the winter months. Precipitation during the summer months is in the form of convective rain showers and is rare. Fresno County receives about 10 inches of rain per year. Snowstorms, hailstorms, and ice storms occur infrequently in the San Joaquin Valley and severe occurrences of any of these are very rare. Damaging winds often accompany winter storm systems moving through the area. Although summer winds are a frequent occurrence, with afternoon winds of 10 to 20 mph being common, it is the winds experienced during the winter storms that result in the most wind-related damage.

According to the HMPC, short-term, heavy storms can cause both widespread flooding as well as extensive localized drainage issues. With the increased growth of the area, the lack of adequate drainage systems has become more of an issue. In addition to the flooding that often occurs during these storms, strong winds, when combined with saturated ground conditions, can down very mature trees.

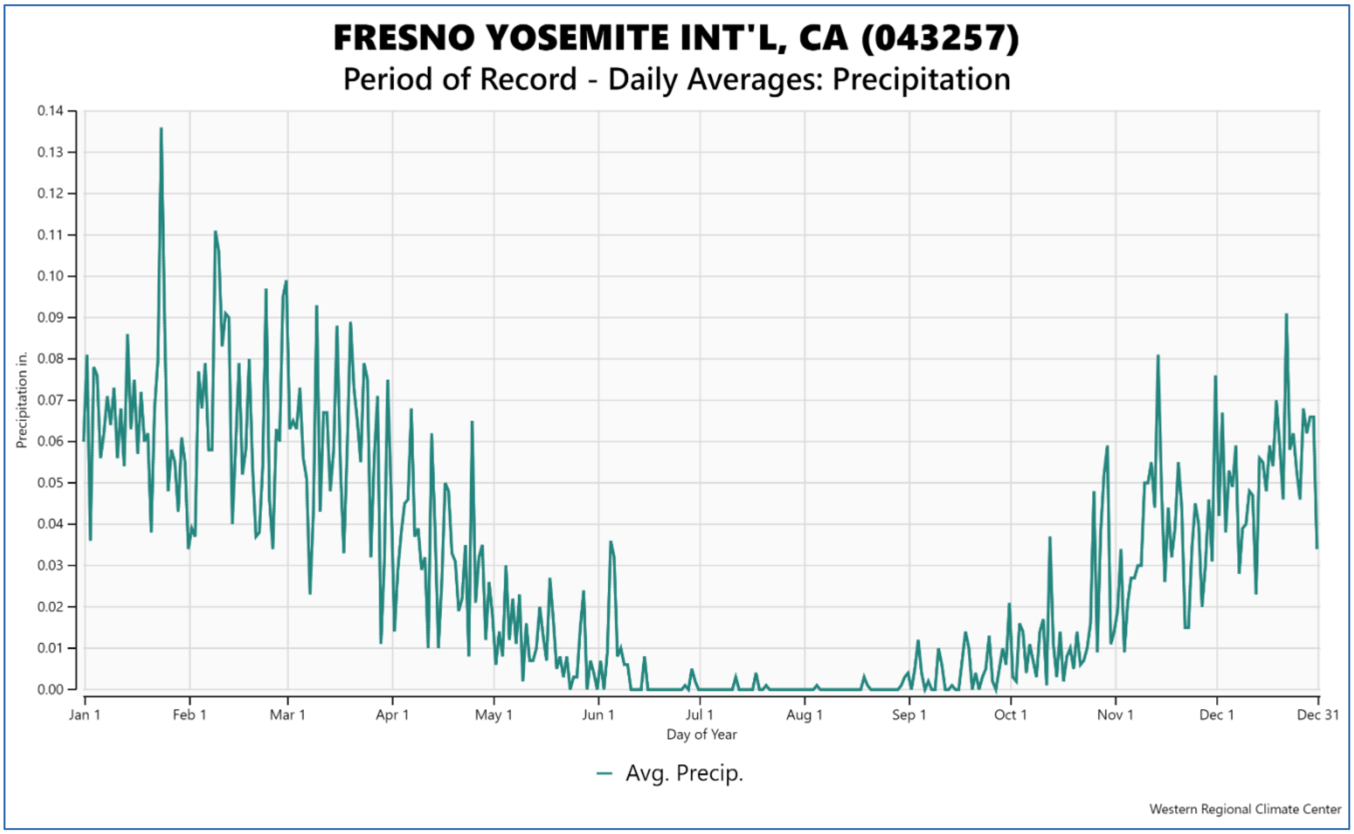
Information from the three representative weather stations introduced in Section 4.2.13 Severe Weather: General is summarized below and in **Figure 41. Mammoth Lakes Daily Averages: Precipitation**, **Figure 42. Central (Fresno WSO AP Weather Station, Period of Record 1948 to 2024),** and **Figure 43. West (Coalinga Weather Station, Period of Record 1942 to 2023)**.

Figure 44. Mammoth Lakes Daily Averages: Precipitation



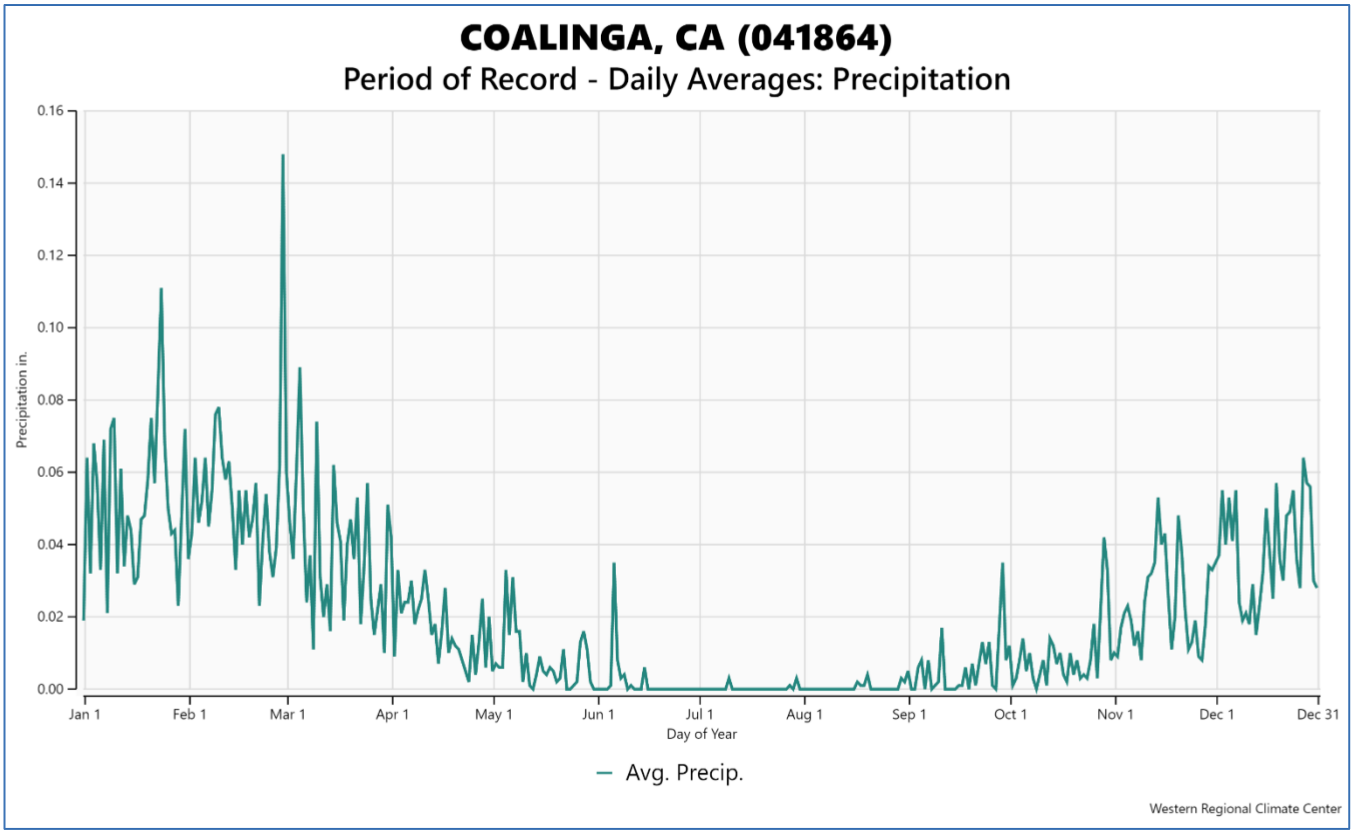
Source: Western Regional Climate Center, www.wrcc.dri.edu/

Figure 45. Central (Fresno WSO AP Weather Station, Period of Record 1948 to 2024)



Source: Western Regional Climate Center, www.wrcc.dri.edu/

Figure 46. West (Coalinga Weather Station, Period of Record 1942 to 2023)



Source: Western Regional Climate Center, www.wrcc.dri.edu/

SEVERE WEATHER EVENTS

Also related to severe weather is the issue of dust storms caused by blowing dust during high wind events. Like foggy conditions, blowing dust can cause extreme visibility problems resulting in traffic accidents. Given the agricultural nature of much of the planning area, recently plowed fields can create the potential for blowing dust and debris. A list of severe weather events is provided in **Table 51. Fresno County Past Occurrences: Severe Weather.** A list of high wind event is mapped in **Figure 44. Fresno County Historic Wind Events** and detailed in **Table 52. Fresno County Previous Occurrences: High Wind**. The following tables describe other severe weather specific events in **Table 53. Fresno County Past Occurrences: Thunderstorm Wind**, **Table 54. Fresno County Past Occurrences: Hailstorm**, **Table 55. Fresno County Past Occurrences: Lightning Storm**, and **Table 56. Fresno County Past Occurrences: Heavy Rain**. The HMPC provided the following information:

- **11/29/1991**: The day after Thanksgiving, furious winds stoked a huge dust storm on Interstate 5 in western Fresno County, reducing visibility to zero and causing multiple traffic collisions. At least 164 vehicles were involved in 33 collisions clustered along a two- mile segment of the highway. A total of 349 people were involved in the collisions; 17 were killed and 151 were injured.
- **4/14/2009:** California experienced a sequence of weather events starting with an upper-level ridge on April 11th -12th, followed by a mostly dry system on the 13th. This transition led to a cold front on April 14th, causing strong winds and dust storms in the San Joaquin Valley, particularly affecting Coalinga, and Avenal with near-zero visibility. Wind gusts reached 41 mph in Bakersfield and 35 mph in Fresno, closely approaching April wind records. The dust storms led to a traffic collision on Interstate 5 due to poor visibility, resulting in several injuries but no fatalities. Winds persisted into April 15th, spreading to Merced and Atwater, with a notable gust of 40 mph in Fresno on April 16th. The event concluded with minimal rainfall, highlighting the dry conditions of the period.
- **4/14/2015**: An upper-level trough of low pressure moved onshore on April 14th resulting in wind gusts of 45-60 MPH. An area of dust and dirt was lifted into the atmosphere, reducing visibility to near zero across Highway 180 near Fresno. The reduced visibility led to a seven- car crash causing minor injuries and the closure of the roadway for a few hours. Blowing dust reduced visibility to nearly zero along Highway 180, near Fresno, causing two multi-car accidents.
- **2/17/2017**: A series of strong low-pressure systems accompanied with tropical moisture influxes brought strong winds, heavy rainfall, flooding, debris flows, funnel cloud reports, and high elevation snows to the central California region. Precipitation was enhanced at times by orographically lifting.
- **4/06/2017:** A low pressure center moved into northern California on the 6th and spread precipitation into central California by late afternoon. This system brought a period of cool, windy, and unsettled conditions to the area which continued through the 8th. There were several reports of 10-20 inches of new snow over the Southern Sierra Nevada above 8000 feet while thunderstorms during the afternoon of April 8 produced heavy rainfall in some areas. There were numerous reports of heavy rainfall over the Southern Sierra Nevada and adjacent foothills where 2 to 4 inches of rain fell. There were also strong winds across much of the area during this event with several locations reporting wind gusts above 50 mph.
- **11/26/2017:** A swift-moving upper trough brought rain to central California and snow to higher elevations starting late on November 26, with a cold front intensifying the precipitation the following morning. The Southern Sierra Nevada received up to an inch of rain, while the San Joaquin Valley saw lighter rainfall; snow levels, initially high, dropped to 4000 feet post-frontal, resulting in modest snow accumulation. The system's most pronounced effect was the robust winds it generated across

the southern Sierra Nevada, Tehachapi Mountains, and Kern County deserts from the evening of November 26 through the next day's early afternoon.

- **12/16/2017:** An upper trough that had very little moisture with it dropped southeast out of the Gulf of Alaska and pushed into northern California on December 15. This system pushed through central California on the morning of December 16 pushing a cold front through the region. Strong post-frontal winds developed in the San Joaquin Valley behind the front by late morning and continued well into the afternoon hours before the winds diminished by evening. Several stations in the San Joaquin Valley measured peak wind gusts between 35 mph and 55 mph.
- **11/29/2018:** A strong upper trough reached California's coast on November 28, bringing significant rainfall that triggered mudslides, particularly in the burn scar areas, and forced the closure of Highway 140. On November 29, as the system advanced inland, it delivered intense precipitation, with 2 to 5 inches in the Southern Sierra Nevada and foothills, and snowfall accumulating up to 3 feet above 5500 feet. Accompanying the system were strong winds, with gusts surpassing 55 mph, and post-frontal thunderstorms that produced localized heavy showers and gusty winds until the weather system exited the region early on November 30.
- **12/28/2018:** A dry shortwave dropped southward just to the east of the Sierra crest as an upper trough deepened over the Desert Southwest during the morning of December 28. Meanwhile, an upper ridge pushed inland into northern California setting up a period of strong offshore Mono type winds along the crest of the Southern Sierra Nevada. This resulted in a closure of the China Peak ski resort as winds gusted around 55 mph at the top of the lifts. Meanwhile the center of the San Joaquin Valley was sheltered form the winds and clear skies overnight some locally dense fog formed and impacted traffic along State Route 99.
- **12/31/2018:** A strong shortwave trough dropped down through the Great Basin during the morning of December 31. With high pressure pushing inland into northern California behind the trough, offshore Mono type winds developed over the higher elevations of the southern Sierra Nevada which down sloped into the foothills. This resulted in several drought weakened trees being knocked down in the foothills near North Fork and Oakhurst where locally strong wind gusts exceeding 60 mph were reported.
- **1/06/2019:** The second of a series of winter storms moved through central California from the afternoon of January 6 through the early morning of January 7. While this storm produced another round of rain and higher elevation snow across the area with many locations in the southern Sierra Nevada picking up between 1 to 2 inches of liquid precipitation, the main impact from this storm was strong winds were most noticed across the San Joaquin Valley where several trees and power lines were blown down or knocked over.
- **1/17/2019:** As a potent low-pressure system surged into central California on January 16, it delivered not only moderate to heavy precipitation but also spawned strong winds, with several reports of gusts over 50 mph in the Kern County Mountains and Deserts. The storm prompted flash flooding, notably in the Ferguson Fire burn area of Mariposa County and produced a tornado east of Clovis rated as EF-1. While the San Joaquin Valley and Kern County Deserts received up to an inch of rain, the Southern Sierra Nevada saw 2 to 4 inches of liquid precipitation, predominantly as snow above 7000 feet, with some locations accumulating 10 to 20 inches.
- **2/02/2019:** As a potent upper low-pressure system neared the central California coast on the morning of February 2, it generated strong southerly winds that disrupted the Grapevine area and extended into Bakersfield, causing downed trees and damage. The ensuing inland movement of the low ushered in moderate to heavy precipitation, triggering numerous flooding events and thunderstorms that produced hail and a brief tornado south of Mariposa. The San Joaquin Valley

received over an inch of rain, while mountain areas accumulated 2 to 5 inches of liquid precipitation, with the higher elevations above 5000 feet experiencing significant snowfall.

- **2/13/2019:** A low-pressure system brought a surge of moisture to central California on February 13 and 14, unleashing heavy rain and strong winds, with gusts over 60 mph and snow levels rising to nearly 9000 feet, causing widespread flooding and multiple road closures due to flooding and debris flows. A subsequent cold front on February 15 drastically lowered snow levels to 5000 feet, sparking thunderstorms with small hail in the San Joaquin Valley and an EF0 tornado near Yosemite Lakes. The ensuing days saw snow levels drop to 1500 feet, resulting in significant snowfall accumulation and travel disruptions across the Southern Sierra Nevada, with total rainfall reaching up to 7 inches in higher elevations.
- **3/06/2019:** A potent upper low-pressure system brought intense winds and heavy rains to central California on March 5, causing extensive damage. Gusts escalated as a strong southwest upper jet streamed overhead, leading to widespread flooding and the evacuation of several communities due to a potential levee breach near Lake Isabella. The storm's forceful winds, alongside substantial rainfall, prompted road closures and thunderstorms, further exacerbating the severe weather conditions and infrastructure disruptions.
- **3/19/2019:** Strong southerly winds developed over the area during the evening of March 19 as a low-pressure system deepened off the California coast and interacted with an amplifying inland ridge. Several locations along the west side of the San Joaquin Valley and in the Kern County Mountains reported wind gusts exceeding 40 mph during the evening. The winds diminished overnight as cooler air settled in over the area.
- **11/26/2019:** A cold low-pressure system from the Gulf of Alaska reached the Pacific Northwest on November 26, bringing widespread precipitation to central California through November 28, affecting Thanksgiving travel with road closures due to snow. Snow levels dropped to 2000-2500 feet, leading to 5-10 inches of snow in the southern Sierra foothills and 3-8 inches in the Kern County Deserts, while the higher Sierra regions accumulated 18-36 inches. The San Joaquin Valley received a quarter to half an inch of rain, with localized heavier falls from thunderstorms, and significant closures occurred on Interstate 5 and State Route 58 due to snow and accidents.
- **12/22/2019:** A frontal system crossing central California on December 22 and 23 generated strong winds, especially in the Fort Tejon area and Bakersfield, where gusts surpassed 50 mph and some locations near Lebec experienced gusts over 75 mph, causing minor damage. After the winds eased on December 22, the region received widespread rain, with the Sierra Nevada and foothills accumulating 1 to 1.5 inches of precipitation, and higher elevations above 5000 feet gaining 10 to 15 inches of snow. The San Joaquin Valley recorded lower rainfall amounts due to rain shadowing, with most places receiving a quarter to half an inch.
- **1/16/2020:** A cold front connected to an upper trough swept through California on January 16, bringing 6 to 8 hours of precipitation, and depositing a quarter to a full inch of rain across the San Joaquin Valley and adjacent areas, with higher elevations above 4000 feet receiving 5 to 14 inches of snow. Strong winds followed, especially in the southern San Joaquin Valley and Kern County Mountains and Deserts, where gusts surpassed 40 mph and some areas experienced brief gusts over 70 mph, causing minor wind damage. The intense conditions eased by the morning of January 17 as the system moved on.
- **2/09/2020:** A upper-level low pressure system dropped southward along the crest of the Sierra Nevada on the evening of February 8 and morning of February 9 then strengthened over southern California during the afternoon of February 9 through the morning of February 10. This system produced a very strong offshore gradient which resulted in damaging northeast winds over the

Sierra Nevada, mainly over Yosemite Park and Sierra National Forest as well as over the adjacent foothills. The winds knocked down many droughts killed trees over the Sierra and produced widespread property damage over the Sierra foothills in Madera County. There were also several reports of wind gusts between 60 and 70 mph over the Kern County Mountains and Deserts between the evening of February 8 and morning of February 10.

- **3/01/2020:** A cold upper low-pressure system moved south off the California coast on March 1, causing mountain showers and dropping snow levels to 3000 feet, with up to four inches of snow accumulating in areas like Pine Mountain Club. Northeast winds gusted between 35 and 45 mph in the Sierra Nevada, with a peak gust of 83 mph reported near North Fork, while the Kern County Deserts experienced northerly gusts over 60 mph. The gusty conditions persisted until the evening of March 2 before diminishing.
- **12/28/2020:** A low pressure system moving along the central California coast brought significant precipitation and snowfall to the region on December 27-28, with the Sierra Nevada receiving up to three-quarters of an inch of rain and high-elevation areas accumulating several inches of snow. The Tehachapi Mountains also experienced snowfall and precipitation, leading to paced travel and chain restrictions on major routes like Interstate 5 and State Route 168. Gusty winds accompanied the storm, with some areas recording wind gusts exceeding 50 mph.
- **1/18/2021:** A low-pressure system off Southern California's coast and a secondary low moving through Nevada produced destructive northeast winds, with gusts over 60 mph, damaging structures and causing extended power outages in the Sierra foothills. The winds, which also caused the loss of ancient sequoias and necessitated major power line repairs in Mariposa County, prompted disaster declarations. By January 20, the winds subsided as the low pressure moved southward away from the coast.
- **1/27/2021:** A very potent storm system swept through central California, causing heavy rainfall, flooding, and strong winds, with gusts over 45 mph and peak winds reaching 60 mph in the Fort Tejon and West Side Hills areas. This led to power outages and additional trees downed, especially in the Sierra Nevada which had recently experienced a severe wind event. The storm generated heavy precipitation throughout the region, with up to 7 inches of rain in the Sierra foothills and 4 inches in the San Joaquin Valley, while the mountains received 4 to 6 feet of snow, disrupting travel, and closing roads until the system exited on January 29.
- **10/11/2021:** A deep upper low-pressure system dropped from the Pacific Northwest into the Great Basin during the morning of October 11. This resulted in a period of strong winds from the late morning hours until the evening as a very strong pressure gradient developed. Several stations reported wind gusts exceeding 58 mph with the strongest winds most noticeable on the Mojave Desert Slopes of the Tehachapi Mountains. A few low impact indicator sites reported gusts exceeding 80 mph. The winds diminished by the morning of October 12 as the low moved east of the Great Basin and pressure gradients relaxed.
- **10/17/2021:** A strong cold front pushed through central California from the evening of October 17 through the early morning of October 18 as a low-pressure system dropped southward through the Great Basin. While this system did bring some light precipitation to the Sierra Nevada with several stations measuring 1 to 3 tenths of an inch of liquid precipitation and 1 to 3 inches of new snowfall above 6000 feet, the main impact from this system was a period of gusty winds across the West Side Hills as well as across the Kern County Mountains. Several stations reported wind gusts exceeding 45 mph with a few low impact indicator sites measuring gusts exceeding 60 mph.
- **10/25/2021:** A significant upper-level low from the Gulf of Alaska, fueled by Typhoon Namtheun's remnants, brought intense moisture and heavy precipitation to Central California, with areas north

of Kern County receiving up to 5 inches of rain and snow levels dropping to 6000 feet by October 25 evening. The storm also generated high winds, with gusts hitting 58 to 70 mph, and fostered scattered thunderstorms, one of which formed a funnel cloud in southwestern Kings County. This system concluded with snow accumulations of 9 to 30 inches in the higher elevations and rainfall tapering off late on October 25, with diminished winds by the next morning.

- **12/13/2021:** A strong low-pressure system from the Gulf of Alaska brought heavy moisture to central California, resulting in 2 to 4 inches of rain in the Sierra Nevada and significant snowfall above 5500 feet. The system also caused substantial snowfall, with high-elevation SNOTELs recording 2 to 4 feet of new snow, and snow levels dropping to 1500 feet in some areas. Accompanying the precipitation were strong winds, particularly over the West Side Hills and through the Grapevine and Tehachapi areas of Kern County, with gusts surpassing 50 mph and some exceeding 70 mph.
- **3/27/2022:** An upper low-pressure system off the southern California coast brought strong winds, with gusts over 45 mph in the West Side Hills and Tehachapi Mountains. Precipitation followed, yielding a quarter to half an inch of rain in the San Joaquin Valley and foothills, and 0.40 to 0.80 inches in the Sierra Nevada, where elevations above 5500 feet saw 3 to 8 inches of new snow. Thunderstorms developed in the afternoon but moved quickly, preventing significant flooding.
- **11/08/2022:** A deep upper low-pressure system from the Gulf of Alaska introduced widespread precipitation to central California, with the Sierra Nevada receiving 2-4 inches of rain and 20-30 inches of snow above 6000 feet. Strong southerly winds were prominent in Kern County's higher elevations on November 8, with gusts surpassing 50 mph, and some areas experiencing over 75 mph. These conditions led to power outages across the San Joaquin Valley and Sierra foothills, attributed to wind damage, accidents on wet roads, and thunderstorms.
- **12/31/2022:** A large trough brought tropical moisture to California, causing moderate to heavy precipitation and flooding, with the Sierra Nevada receiving up to 7 inches of rain. Strong winds also affected the region, particularly the West Side Hills and Tehachapi Mountains, where gusts surpassed 60 mph. Additionally, higher elevations saw substantial snow accumulation, with SNOTEL stations recording 18 to 30 inches, adding to the already heavy snowpack from earlier in December.
- **1/04/2023:** A significant low-pressure system with an atmospheric river caused moderate to heavy precipitation and strong winds, leading to widespread flooding and snow levels between 7000 to 8000 feet. High elevation areas received up to 30 inches of snow, while the Sierra Nevada and foothills saw up to 3 inches of rain, exacerbating the effects of previously saturated soils. Additionally, the system generated intense winds, with gusts over 60 mph in the Kern County Mountains and West Side Hills, resulting in numerous reports of wind damage.
- **1/07/2023:** A low-pressure system traversed northern California, delivering light to moderate precipitation and strong wind gusts, with some areas experiencing gusts over 60 mph. Precipitation varied, with the Sierra Nevada near Yosemite Park receiving up to an inch of rain and the San Joaquin Valley getting up to half an inch, while Kern County saw less than a tenth of an inch. The snow level dropped to around 5000 feet, leading to significant snow accumulation of 5 to 10 inches at higher elevations.
- **1/09/2023:** A strong low-pressure system brought intense precipitation and high winds to central California, with the Sierra Nevada receiving 3 to 6 inches of rain, exacerbating runoff from existing snowpack and causing extensive flooding, including the inundation of Planada and a record flood at Bear Creek. Strong downslope winds, exceeding 60 mph in areas like the Tehachapi Mountains and Sierra foothills, led to power outages and fallen power lines. The storm system moved east by

January 11, with winds abating, but the significant rainfall resulted in continued flooding from the accumulated runoff.

- **1/16/2023:** Following the January 14 storm, another system on January 15-16 unleashed less rainfall but more destructive winds, with gusts over 40 mph in the San Joaquin Valley and Sierra foothills, and over 60 mph in the Tehachapi Mountains and West Side Hills. These strong winds caused widespread power outages and toppled trees, leading to road closures. The storm's impact lingered with slow subsiding precipitation, not fully clearing until January 17.
- **2/21/2023:** A cold upper trough pushed into central California between the afternoon of February 21 and the early morning of February 22. A cold front associated with this trough produced strong winds throughout much of the area. Several stations in the wind prone areas of the West Side Hills and in the Mountains and Deserts of Kern County measured gusts exceeding 60 mph with a few low impact indicator stations reporting gusts above 80 mph. There were also several reports of downed trees in the San Joaquin Valley.
- **2/24/2023:** On February 24 and 25, a cold upper low-pressure system near California's coast generated powerful winds, as snow levels plunged to 1500 feet, resulting in 2 to 4 feet of snow at higher elevations and subsequent road closures. The San Joaquin Valley and lower Sierra foothills faced both flooding and wind-related disruptions. As the system advanced across southern California on the evening of February 25, it continued to produce strong winds before moving eastward by the morning of February 26.
- **3/14/2023:** Following the recent events which produced widespread flooding across the central California Interior, another atmospheric river plunged through the region on March 14 and 15 producing heavy precipitation, flooding and strong winds with several stations measuring gusts exceeding 60 mph. Much of the Sierra Nevada picked up another 3 to 6 inches of liquid precipitation with snow levels above 8500 feet while the adjacent foothills picked up 2 to 4 inches of rainfall while the San Joaquin Valley and West Side Hills generally picked up between 0.5 to 1.5 inches of rainfall.
- **3/21/2023:** A strong upper trough passed through, bringing intense winds that exceeded 60 mph across the West Side Hills, Sierra Nevada, and Kern County Mountains and Deserts. The Sierra Nevada experienced heavy snowfall, with high elevation SNOTEL stations recording 18 to 30 inches, while the San Joaquin Valley received additional rain on saturated ground. Thunderstorm outflow winds also caused tree damage in and around Fresno on March 21.

Table 51. Fresno County Past Occurrences: Severe Weather

Date	Location	Magnitude (mph)	Fatality	Injury	Property Loss	Crop Loss
3/04/1954	Fresno	0	0	0	$0	$0
7/28/1958	Fresno	0	0	0	$0	$0
7/28/1958	Unincorporated	0	0	0	$0	$0
5/29/1984	Fresno	0	0	0	$0	$0
5/30/1994	Fresno	0	1	0	$0	$0
5/01/1995	Unincorporated	0	0	0	$500,000	$0
5/01/1995	Unincorporated	0	0	0	$500,000	$0
5/13/1995	Unincorporated	0	0	0	$0	$0
6/15/1995	Unincorporated	0	0	0	$500,000	$0

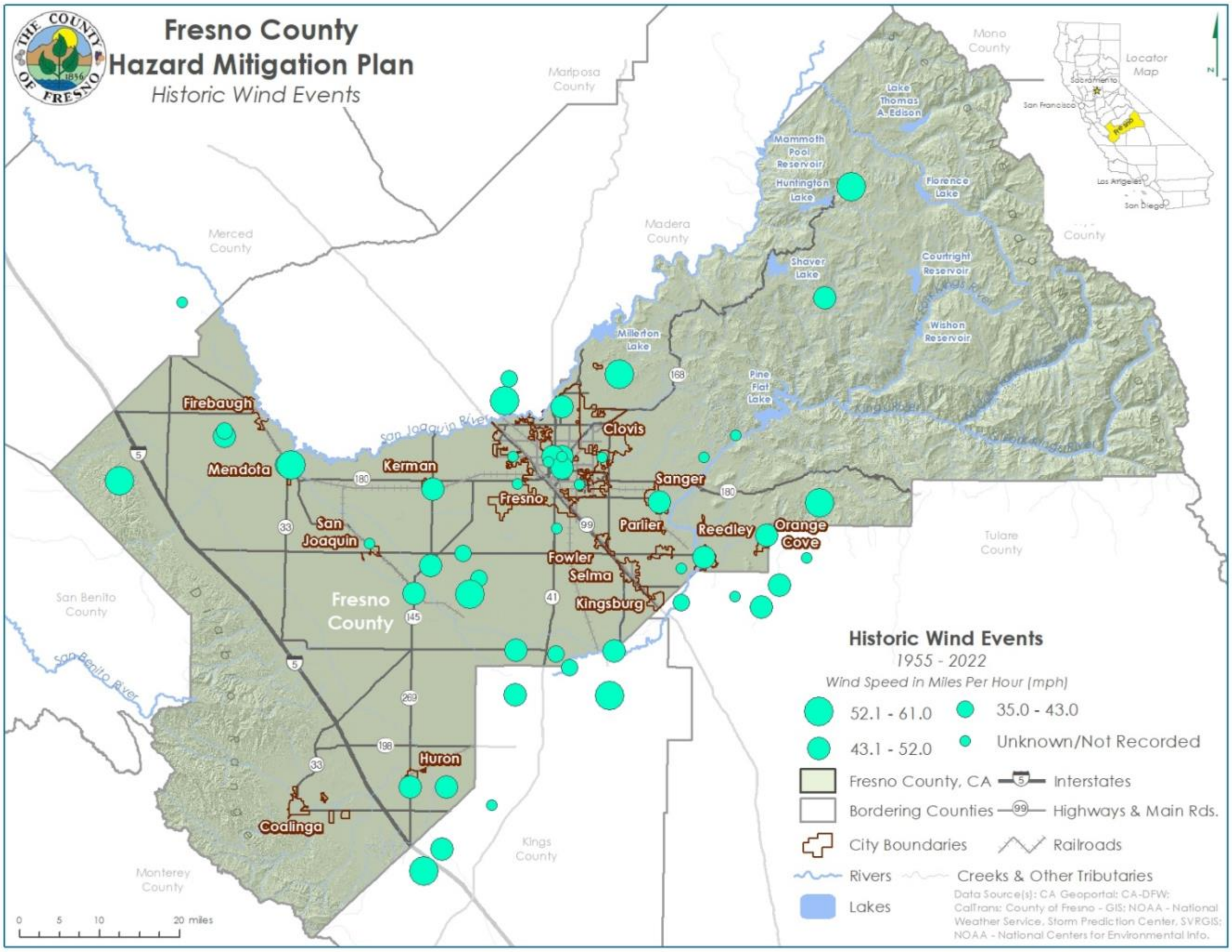
Date	Location	Magnitude (mph)	Fatality	Injury	Property Loss	Crop Loss
10/30/1996	Unincorporated	0	0	0	$10,000	$0
2/14/1998	Fresno	57.5	0	0	$0	$0
2/23/1998	Fresno	0	0	0	$100,000	$0
4/20/2001	Fresno	57.5	0	0	$0	$0
5/31/2002	Unincorporated	0	0	0	$50,000	$0
5/31/2002	Unincorporated	0	0	0	$50,000	$0
7/21/2006	Unincorporated	69	0	0	$0	$0
10/29/2007	Fresno	57.5	0	0	$30,000	$0
10/29/2007	Fresno	57.5	0	0	$50,000	$0
10/29/2007	Fresno	57.5	0	0	$10,000	$0
1/27/2008	Unincorporated	64.4	0	0	$50,000	$0
3/15/2008	Mendota	57.5	0	0	$10,000	$0
5/28/2009	Fresno	57.5	0	0	$0	$0
5/28/2009	Reedley	57.5	0	0	$0	$0
5/28/2009	Sanger	57.5	0	0	$0	$0
5/28/2009	Unincorporated	57.5	0	0	$60,000	$0
5/28/2009	Unincorporated	57.5	0	0	$0	$0
6/05/2009	Unincorporated	59.8	0	0	$0	$0
6/05/2009	Unincorporated	59.8	0	0	$0	$0
2/28/2014	Unincorporated	64.4	0	0	$500,000	$0
2/17/2017	Fresno, Clovis, Visalia	57	0	0	0	0
4/06/2017	Fresno, Clovis, Visalia	73	0	0	0	0
11/26/2017	Auberry, Prather, Shaver Lake	52	0	0	0	0
12/16/2017	Fresno, Clovis, Visalia	51	0	0	0	0
11/29/2018	Fresno, Clovis, Visalia	55	0	0	0	0
12/28/2018	South Sierra Mountains Zone	58	0	0	0	0
12/31/2018	Auberry, Prather, Shaver Lake	59	0	0	0	0
1/06/2019	Fresno, Sanger, Reedley	53	0	0	0	0
1/17/2019	South Sierra Mountains Zone	57	0	0	0	0

Date	Location	Magnitude (mph)	Fatality	Injury	Property Loss	Crop Loss
2/02/2019	South Sierra Mountains Zone	52	0	0	0	0
2/13/2019	South Sierra Mountains Zone	51	0	0	0	0
3/06/2019	Fresno, Clovis, Visalia	56	0	0	0	0
3/19/2019	Fresno, Clovis, Visalia	56	0	0	0	0
11/26/2019	Firebaugh, Coalinga, Mendota	56	0	0	0	0
12/22/2019	Firebaugh, Coalinga, Mendota	53	0	0	0	0
1/16/2020	Shaver Lake, Huntington Lake, Lakeshore	51	0	0	0	0
2/09/2020	Auberry, Shaver Lakes	81	0	0	22,000	0
3/01/2020	Auberry, Shaver Lakes	72	0	0	0	0
12/28/2020	Coalinga, Mendota, Firebaugh	55	0	0	0	0
1/18/2021	Shaver Lake, Huntington Lake, Lakeshore	87	0	0	200,002,000	0
1/27/2021	Auberry, Shaver Lakes	56	0	0	0	0
10/11/2021	Coalinga, Avenal	53	0	0	0	0
10/17/2021	West Side Mountains North of Highway 198 (Zone)	55	0	0	0	0
10/25/2021	Friant, Auberry, Shaver Lake	58	0	0	0	0
12/13/2021	West Side Mountains South of Highway 198 (Zone)	54	0	0	0	0
3/27/2022	West Side Mountains North of	52	0	0	0	0

Date	Location	Magnitude (mph)	Fatality	Injury	Property Loss	Crop Loss
	Highway 198 (Zone)					
11/08/2022	West Side Mountains South of Highway 198 (Zone)	52	0	0	0	0
12/31/2022	West Side Mountains South of Highway 198 (Zone)	54	0	0	0	0
1/04/2023	West Side Mountains North of Highway 198 (Zone)	51	0	0	0	0
1/07/2023	West Side Mountains North of Highway 198 (Zone)	57	0	0	0	0
1/09/2023	West Side Mountains North of Highway 198 (Zone)	50	0	0	0	0
1/16/2023	West Side Mountains South of Highway 198 (Zone)	63	0	0	0	0
2/21/2023	Coalinga, Avenal	54	0	0	0	0
2/24/2023	West Side Mountains North of Highway 198 (Zone)	52	0	0	0	0
3/14/2023	West Side Mountains North of Highway 198 (Zone)	56	0	0	0	0
3/21/2023	West Side Mountains South of Highway 198 (Zone)	52	0	0	0	0

Source: NOAA, National Centers for Environmental Information, Storm Events Database

Figure 47. Fresno County Historic Wind Events



Source: CA Geoportal: CA-DFW; CalTrans; County of Fresno – GIS; NOAA – National Weather Service, Storm Prediction Center, SVRGIS; NOAA – National Centers for Environmental Info.

STRONG WIND EVENTS

- **2/01/2017**: A weak cold frontal passage brought breezy to gusty winds for parts of the San Joaquin Valley and caused minor damage.
- **3/05/2017**: A cold upper trough delivered widespread rain, with 0.75 to 1.5 inches in the Southern Sierra Nevada and adjacent foothills, and 6 to 12 inches of snow above 6000 feet. The San Joaquin Valley received less than a quarter of an inch of rain due to rain shadowing. Post-frontal gusty winds affected the Kern County Mountains and Deserts, with gusts exceeding 45 mph reported on the afternoon and evening of March 5.
- **3/30/2017**: A upper-level trough moved southeast along the Sierra Nevada range on the day of the 30th. Upper-level northwest flow helped increase the surface wind as the pressure gradient at the surface tightened. This resulted in strong and gusty winds across most of the area. Several reports of wind gusts above 40 mph were reported in the San Joaquin Valley while several reports of winds gusts above 50 mph were reported in the Kern County Mountains and Deserts while some indicator ridge tops had gusts exceeding 90 mph. The strong winds produced blowing dust across portions of the southern San Joaquin Valley and Kern County Deserts. In addition, there were several reports of downed trees and power lines which resulted power outages across parts of the San Joaquin Valley.
- **12/04/2017**: A large upper ridge built into the Pacific Northwest on December 4 behind a trough which pushed through California the previous day. This resulted in a strong gradient over the southern Sierra Nevada producing Mono type winds over the Southern Sierra Nevada on the evening of December 4 through the late morning of December 5.
- **1/09/2018**: Central California experienced a series of low-pressure systems, with the most significant arriving between January 8 and 9, bringing heavy rain and strong winds, including a peak gust of 94 mph at Grapevine Peak. This system resulted in street flooding in Bakersfield, mudslides in Kern County, and snowfall above 5500 feet. By the morning of January 10, the precipitation had ceased, but dense fog affected visibility and traffic across the San Joaquin Valley and nearby highways.
- **5/11/2018**: High pressure built over Central California on May 3 and kept warm temperatures, dry conditions, and generally light winds over the area. However, an upper-level low pressure system moved into the Pacific Northwest on May 10 then dropped into the Great Basin on May 11. This resulted in increased surface pressure gradients which produced strong winds over portions of the area during the afternoon of May 11. There were a few reports of minor wind damage in the San Joaquin Valley and some low impact indicator stations in the Kern County Mountains and Deserts reported winds gusts exceeding 70 mph.
- **10/14/2018**: A low pressure system moved into southern California on October 13 and moved slowly inland on October 14. While the precipitation with this system mainly stayed to the south of our area, it interacted with an upper ridge that was building into the Pacific Northwest to produce a strong offshore gradient over central California which resulted in a brief period of strong mono-type northeast winds over the Southern Sierra Nevada during the late evening of October 14 and the early morning of October 15. Several dead trees were blown down near North Fork and Bass Lake in Madera County resulting in some brief road closures and some damage to a few structures.
- **12/31/2018**: A strong shortwave trough dropped down through the Great Basin during the morning of December 31. With high pressure pushing inland into northern California behind the trough, offshore Mono type winds developed over the higher elevations of the southern Sierra Nevada which down sloped into the foothills. This resulted in several drought weakened trees being

knocked down in the foothills near North Fork and Oakhurst where locally strong wind gusts exceeding 60 mph were reported.

- **1/06/2019**: The second of a series of winter storms moved through central California from the afternoon of January 6 through the early morning of January 7. While this storm produced another round of rain and higher elevation snow across the area with many locations in the southern Sierra Nevada picking up between 1 to 2 inches of liquid precipitation, the main impact from this storm was strong winds were most noticed across the San Joaquin Valley where several trees and power lines were blown down or knocked over.
- **1/17/2019**: A strong low-pressure system delivered moderate to heavy rain and strong winds to central California, leading to flash flooding and roadway closures, especially in the Ferguson Fire burn area. The storm system caused a tornado rated EF-1 east of Clovis on January 17, and the Southern Sierra Nevada received 2 to 4 inches of rain, translating to 10 to 20 inches of snow above 7000 feet. Additionally, post-frontal wind gusts in the Kern County Mountains and Deserts exceeded 50 mph, with some areas experiencing gusts over 65 mph.
- **1/20/2019**: A strong cold front swept through central California on January 20-21, causing moderate to heavy precipitation and strong wind gusts. The San Joaquin Valley experienced widespread wind damage, with gusts over 35 mph, while gusts in the Kern County Mountains and Deserts reached up to 90 mph. The Southern Sierra Nevada received up to 1.5 inches of rain and 5 to 10 inches of snow above 7000 feet before the system exited the region by the evening of January 21.
- **2/02/2019**: A strong southerly winds ahead of an upper low-pressure system caused damage in the Grapevine and Bakersfield areas, with reports of downed trees and wind damage. The system brought moderate to heavy rain and thunderstorms to the San Joaquin Valley and southern Sierra foothills, with over an inch of rain in the valley and 2 to 5 inches in the mountains, and a brief tornado near Mariposa. Above 5000 feet, heavy snowfall accumulated, adding to the snow from another storm on February 4 and 5.
- **4/09/2019**: a strong low-pressure system entered the Pacific Northwest and moved southeast, bringing a cold front that caused strong wind gusts across the San Joaquin Valley, Lake Isabella, and Tehachapi areas. These gusts, exceeding 40 mph in the valley and 60 mph in the mountain areas, led to several power outages due to downed lines. Some locations even reported gusts surpassing 70 mph, underscoring the system's strength despite limited moisture affecting central California.
- **11/29/2019**: The cold low-pressure system which brought widespread rain and lower elevations snow during the previous two days moved east of the area on November 29, but brisk northwest winds behind the departing system produced several gusts exceeding 40 mph in the Kern County Mountains and Deserts. A few low impact indicator sites measured gusts exceeding 60 mph.
- **2/02/2020**: The cold front which moved into the area during the morning of February 2 brought strong winds to the area by late afternoon as pressure gradients increased. Winds gusts exceeding 40 mph were reported in the San Joaquin Valley and several gusts exceeding 60 mph were reported across the Kern County Mountains and Deserts with a few low impact indicator sites measuring gusts above 80 mph. The winds downed several trees and power poles and flipped over two big rigs near Mojave during the evening. The winds decreased during the morning of February 3 as pressure gradients diminished.
- **2/08/2020**: An upper-level low pressure system moved along the Sierra Nevada on February 8-9 and strengthened over southern California, causing damaging northeast winds. These winds downed drought-stricken trees in Yosemite Park and the Sierra National Forest, causing

widespread property damage, especially in Madera County's foothills. Gusts between 60 and 70 mph were also reported in the Kern County Mountains and Deserts during this period.

- **1/18/2021**: An upper low off the southern California coast and a secondary system from Nevada generated destructive northeast winds across the Sierra Nevada, with gusts over 60 mph causing extensive damage and power outages. The severe winds led to disaster declarations in Mariposa and Madera Counties, with over 30 miles of power lines replaced in Mariposa County and fifteen ancient giant sequoias felled. The winds, which also affected the Tehachapi Mountains and the San Joaquin Valley with gusts over 50 mph, subsided by the morning of January 20 as the low moved towards the Baja coast.
- **5/20/2021**: A cold low-pressure system brought strong winds, with gusts over 60 mph in Kern County and up to 90 mph in certain areas, prompting road closures. As the system moved on the following day, it left behind a cool airmass and instability that resulted in rain and snow showers over the Sierra Nevada. The precipitation was mostly light, but areas above 6000 feet received up to 2 inches of new snow.
- **6/22/2022**: Tropical Storm Celia's moisture, coupled with a hot, unstable airmass over central California, triggered scattered thunderstorms on June 22, ending a two-month dry spell. These storms varied in intensity but generally brought one to two tenths of an inch of rain to the San Joaquin Valley and more to the Tehachapi Mountains and southern Sierra. Strong outflow winds and dry microbursts from the storms caused damage, downing several trees and power lines.
- **12/31/2022**: A trough with tropical moisture caused moderate to heavy precipitation and significant flooding in California, with reports of road closures due to debris flows. Strong winds with gusts over 60 mph affected the West Side Hills and Tehachapi Mountains, while the Sierra Nevada and foothills received substantial rainfall, contributing to an already heavy snowpack from earlier storms. The San Joaquin Valley and Tehachapi Mountains received less rain due to rain shadow effects.
- **1/04/2023**: An intense low-pressure system with an atmospheric river brought heavy precipitation and strong winds to the area, leading to flooding and heavy snowfall above 8000 feet. The San Joaquin Valley experienced significant rainfall, exacerbating the flooding from previously saturated soils. The system's powerful winds, surpassing 60 mph in places, caused widespread wind damage.
- **1/07/2023**: A low pressure system passed through northern California from January 7 to 8, bringing light to moderate precipitation and wind gusts exceeding 60 mph in some areas. The Sierra Nevada near Yosemite received up to an inch of rain and 5 to 10 inches of snow at higher elevations, while the San Joaquin Valley saw up to a half inch of rain. Despite being less intense than the previous storm, the system still affected the region with notable wind and precipitation.
- **1/09/2023**: A powerful low-pressure system unleashed strong winds exceeding 60 mph in the Tehachapi Mountains, West Side Hills, and Sierra foothills of central California, leading to extensive power outages as lines were downed. The tropical moisture within the system also produced significant rain, contributing to widespread flooding, but the most disruptive force was the wind, which caused the evacuation of towns like Planada and a record flood along Bear Creek. Though the precipitation ceased, and the winds subsided by January 11, the impact of the winds, alongside the heavy rains, left a lasting imprint with ongoing flooding and damage control.
- **1/16/2023**: Following the storm on January 14, a subsequent system on January 15-16 brought less rain but caused damaging wind gusts in the San Joaquin Valley and the Sierra foothills, with gusts over 60 mph in the Tehachapi Mountains. These winds led to power outages and road closures from fallen trees and power lines, compounding the flooding from already saturated grounds. The storm's effects lingered until January 17, although winds diminished by the afternoon of January 16.

- **2/21/2023**: A cold upper trough pushed into central California between the afternoon of February 21 and the early morning of February 22. A cold front associated with this trough produced strong winds throughout much of the area. Several stations in the wind prone areas of the West Side Hills and in the Mountains and Deserts of Kern County measured gusts exceeding 60 mph with a few low impact indicator stations reporting gusts above 80 mph. There were also several reports of downed trees in the San Joaquin Valley.
- **8/20/2023**: Moisture from Hurricane Hillary prompted thunderstorms and significant outflow winds in the San Joaquin Valley on August 19, and as the storm weakened, it brought 3 to over 5.5 inches of rain to Kern County's mountains and deserts on August 20. The southern Sierra Nevada received 1 to 3 inches of rain, setting new daily rainfall records. Flash flooding and road closures followed, with conditions stabilizing as the moisture dissipated and an offshore trough moved northeast by August 22.

Table 52. Fresno County Previous Occurrences: High Wind

Location	Date	Magnitude	Property Loss ($)	Crop Loss ($)	Deaths	Injuries
Fresno, Coalinga, Mendota	02/01/2017	30	1000	0	0	0
Shaver Lake, Squaw Valley, Auberry	03/05/2017	26	0	0	1	0
Fresno, Sanger, Reedley	03/30/2017	43	200000	0	0	0
Auberry, Shaver Lake, Prather	12/04/2017	43	100000	0	0	0
Shaver Lake, Squaw Valley, Auberry	01/09/2018	43	1000	0	0	0
Fresno, Coalinga, Mendota	05/11/2018	30	1000	0	0	0
Auberry, Shaver Lake, Prather	10/14/2018	39	10000	0	0	0
Auberry, Shaver Lake, Prather	12/31/2018	43	1000	0	0	0
Fresno, Sanger, Reedley	1/06/2019	39	1000	0	0	0
Auberry, Shaver Lake, Prather	1/17/2019	35	1000	0	0	0
Fresno, Sanger, Reedley	1/20/2019	39	5000	0	0	0

Location	Date	Magnitude	Property Loss ($)	Crop Loss ($)	Deaths	Injuries
Auberry, Shaver Lake, Prather	2/02/2019	43	5000	0	0	0
Fresno	4/09/2019	35	1000	0	0	0
Sequoia Kings Zone	11/29/2019	43	100000	0	0	0
Fresno, Kerman, Mendota	2/02/2020	39	5000	0	0	0
Shaver Lake, Auberry, Tollhouse	2/08/2020	43	5000	0	0	0
Shaver Lake, Auberry, Tollhouse	1/18/2021	43	1000	0	0	0
Foggy Bottom Zone	5/20/2021	26	1500	0	0	0
Fresno, Clovis	6/22/2022	48	10000	0	0	0
Los Banos, Dos Palos	12/31/2022	35	1000	0	0	0
Merced, Madera, Mendota	1/04/2023	35	1000	0	0	0
Fresno, Clovis	1/07/2023	30	1000	0	0	0
Visalia, Porterville, Reedley	1/09/2023	30	1000	0	0	0
Fresno, Clovis	1/16/2023	43	50000	0	0	0
Fresno, Clovis	2/21/2023	35	1000	0	0	0
Merced, Madera, Mendota	8/20/2023	30	1000	0	0	0

Source: NOAA, National Centers for Environmental Information, Storm Events Database

THUNDERSTORM WIND EVENTS

- **9/11/2017**: A stationary upper low off the California coast drew tropical moisture into central California, triggering a severe thunderstorm outbreak on September 11 with downburst winds over 60 mph, causing damage to structures and knocking down power lines. Rainfall was light, with most areas receiving less than a quarter inch, but parts of the Southern Sierra Nevada and Tehachapi Mountains saw up to half an inch.

- **5/19/2019**: A strong low-pressure system delivered heavy rainfall to central California, breaking several daily records, and depositing 8 to 14 inches of snow above 6000 feet in the Sierra Nevada. The unstable weather also sparked thunderstorms in the San Joaquin Valley, leading to reports of small hail, heavy rain, and a small EF0 tornado with accompanying wind damage near Huron.
- **6/29/2021**: A strong high-pressure center over the Pacific Northwest pulled in moisture from the east which produced thunderstorms over the Sierra Nevada during the afternoon of June 29. Although the thunderstorms on the previous day were mainly dry with very little rainfall, the moisture surge the following day was deeper and as a result some of the thunderstorms produced locally heavy rainfall, damaging outflow winds and small hail during the afternoon and early evening hours of June 29.
- **6/22/2022**: Moisture from Tropical Storm Celia combined with a hot, unstable airmass over central California, triggering scattered showers and thunderstorms on June 22, marking the region's first significant rain in two months. Rainfall varied due to the storms' convective nature, with the San Joaquin Valley receiving up to two-tenths of an inch, while the Tehachapi Mountains and southern Sierra saw up to three-quarters of an inch. Some storms generated strong winds and dry microbursts, toppling trees and power lines.
- **2/05/2023**: A strong low-pressure system swept through northern to central California, dropping 0.75 to 1.5 inches of rain and reducing snow levels to 4000 feet, leaving 9 to 15 inches of snow above 6500 feet in the Sierra Nevada. Strong wind gusts hit the Mohave Desert, and the system’s unstable conditions led to scattered thunderstorms in the San Joaquin Valley, causing wind damage and hail. The weather affected travel, pacing traffic on Interstate 5, and accumulating light snow across the Tejon Pass.
- **3/12/2023**: Following the departure of the warm and moist storm which produced widespread flooding across the area on March 9 and 10, another moist system moved through central California on March 11 and 12. While precipitation amounts were generally much lower with this system with most of the Sierra Nevada picking up between 1 and 2 inches of liquid precipitation and adjacent foothills picking up between a half inch and an inch of rainfall, the cooler unstable airmass on the back side of this system produced afternoon and evening thunderstorms across the lower elevations resulting in widespread flooding and wind damage across the San Joaquin Valley.
- **3/21/2023**: A strong upper trough moved across the region on March 21 and 22. This system produced strong winds across the West Side Hills, the Sierra Nevada and across the Kern County Mountains and Deserts where several stations measured gusts exceeding 60 mph. In addition, heavy snow fell in the Sierra Nevada where several high elevation SNOTEL stations picked up between 18 and 30 inches of new snow while liquid precipitation totals were generally between 1 and 2 inches. Much of the San Joaquin Valley picked up between a quarter and three quarters of an inch of additional rainfall over an already saturated ground while thunderstorm outflow winds knocked down several trees in and around Fresno during the afternoon of March 21.
- **8/19/2023**: Hurricane Hillary's moisture caused showers and thunderstorms with notable outflow winds in the San Joaquin Valley on August 19, and as it weakened, it brought 3 to over 5.5 inches of rain to Kern County on August 20. The Sierra Nevada south of Kings Canyon and the southern San Joaquin Valley received 1 to 3 inches and a half inch to an inch of rain, respectively, with new daily records set in the northern areas. Flash flooding and road closures followed in Kern County, but by August 22, an offshore trough moved the moisture out, leading to drier conditions for the rest of the week.

Table 53. Fresno County Past Occurrences: Thunderstorm Wind

Location	Date	Magnitude	Property Loss ($)	Crop Loss ($)	Deaths	Injuries
Caruthers	9/11/2017	61	120,000	0	0	0
Huron	5/19/2019	52	75,000	25000	0	0
Pine Logging Camp	6/29/2021	52	0	0	0	0
Friant	6/22/2022	60	0	0	0	0
Wahtoke	2/05/2023	35	1000	0	0	0
Monmouth	3/12/2023	35	1000	0	0	0
Highway City	3/21/2023	40	25000	0	0	0
Sunnyside	8/19/2023	48	50000	0	0	0

Source: NOAA, National Centers for Environmental Information, Storm Events Database

HAILSTORM EVENTS

- **5/19/2019**: An upper-level low brought heavy rain to central California, breaking daily records, and delivering 0.75 to 2 inches of precipitation, with snowfall of 8 to 14 inches above 6000 feet in the Sierra Nevada. The following day, thunderstorms caused small hail, heavy rain, and an EF0 tornado with some wind damage near Huron.
- **3/11/2023**: After a storm caused extensive flooding on March 9 and 10, another system passed through central California on March 11 and 12, bringing less precipitation, with the Sierra Nevada receiving 1 to 2 inches and foothills about half an inch to an inch. However, afternoon and evening thunderstorms in the cool, unstable air mass led to widespread flooding and wind damage across the San Joaquin Valley.

Table 54. Fresno County Past Occurrences: Hailstorm

Location	Date	Magnitude	Property Loss ($)	Crop Loss ($)	Deaths	Injuries
Westhaven	5/19/2019	0.5	0	1 M	0	0
Ingle	3/11/2023	1	0	0	0	0

Source: NOAA, National Centers for Environmental Information, Storm Events Database

LIGHTNING STORM EVENTS

- **7/30/2021**: Subtropical moisture continued to stream into central California on July 30. Once again, afternoon thunderstorms developed over the Sierra Nevada. One thunderstorm produced a fatal lightning strike over the Sierra Nevada during the early afternoon.
- **8/12/2023**: An upper-level low pressure system which contained the remnant moisture from former Tropical Storm Eugene was situated off the California coast on August 12. This moisture helped fuel scattered thunderstorms during the afternoon and evening hours over the Sierra Nevada. A

lightning strike from one of the thunderstorms downed a large tree and started a small fire near Shaver Lake during the evening.

Table 55. Fresno County Past Occurrences: Lightning Storm

Location	Date	Magnitude	Property Loss ($)	Crop Loss ($)	Deaths	Injuries
Mono Hot Springs	7/30/2021	0	0	0	1	0
Shaver Lake Heights	8/12/2023	0	1,000	0	0	0

Source: NOAA, National Centers for Environmental Information, Storm Events Database

HEAVY RAINSTORM EVENTS

- **1/12/2017**: A series of systems fed by a continued influx of very moist air was pushed into the central California interior through an atmospheric river set-up for several days prior and a colder low-pressure system moved into central California. This created thunderstorms that produced heavy rainfall for parts of the San Joaquin Valley. Reports of road ponding/flooding were reported along with a few reports of funnel clouds.
- **1/21/2017**: A nearly stationary cold low-pressure system from the Pacific Northwest moved into central California and tropical moisture being fed from the Pacific with a continued atmospheric river set-up, brought thunderstorms and heavy rainfall to the Sierra Nevada Mountains and Foothills and parts of the San Joaquin Valley over several days. Small pea-sized hail was also reported with some thunderstorms.
- **2/03/2017**: Tropical influx jet pushed into central California ahead of a cold front created heavy rains which were enhanced by orographically lifting with the Sierra Mountains.
- **4/13/2017**: a large low-pressure system moved through central California, generating strong wind gusts and moderate rainfall, with the San Joaquin Valley experiencing winds over 35 mph and the Kern County Mountains and Deserts over 45 mph. Merced and Mariposa Counties and Yosemite National Park received up to half an inch of rain. Fresno was hit by a nearly stationary thunderstorm that set a record for April rainfall since the 1880s with 2.04 inches at the airport. Thunderstorm outflow also caused blowing dust and reduced visibility, leading to vehicular accidents near Lemoore.
- **11/17/2017**: A strong upper trough pushed through the Pacific Northwest on November 16 and 17. A fetch of deep moisture of tropical origin was pulled up ahead of this trough and brought moderate to heavy precipitation to Merced and Mariposa Counties as well as to Yosemite National Park. Several locations in Yosemite National Park measured between 2 and 4 inches of rainfall while several mountain and foothill stations in Madera, Fresno and Tulare Counties picked up over an inch of rain. Snow was basically confined to elevations above 8000 feet as a warm airmass prevailed over the region. Several SNOTELs above 9000 feet did pick up between 1 and 2 feet of fresh snowfall as this was the first significant storm of the season at the higher elevations.
- **3/21/2018**: A tropical air mass brought heavy rain to central California, causing widespread flooding, road closures due to rockslides and debris flows, particularly in burn scar areas around Mariposa and Springville. Thunderstorms on March 22 led to flash flooding and funnel clouds, prompting a

Flash Flood Emergency in western Mariposa County, including building floods and evacuations. A tornado was also reported near Dinuba in Tulare County. The Southern Sierra Nevada received 4 to 8 inches of rain, while the San Joaquin Valley recorded 1 to 3 inches, with several feet of snow above 9000 feet.

- **9/04/2018**: A low pressure system centered over southern Nevada provided for a shallow surge of mid-level moisture into central California on September 3 and 4. During the afternoon of the 4th, several thunderstorms developed over the higher elevations of the Southern Sierra Nevada from Yosemite National Park southward to the Lake Isabella area where the atmosphere was unstable. Heavy rainfall was produced by thunderstorms near Kings Canyon and near Lake Isabella which over an inch of rainfall between 100 pm PDT and 5 pm PDT. In addition, isolated thunderstorms brought some light rainfall to the southern Sierra foothills and to the Kern County Deserts.
- **5/18/2019**: An upper-level low pressure system entered central California, delivering between 0.75 and 2 inches of rain, and setting new daily records. Above 6000 feet, the Sierra Nevada received 8 to 14 inches of fresh snow. On May 19, thunderstorms in the San Joaquin Valley caused small hail and heavy rainfall, and an EF0 tornado along with wind damage was reported near Huron.
- **12/01/2019**: A large upper low-pressure system brought moderate to heavy rain to central California, mainly north of Fresno County, with 1 to 3 inches of rainfall. The Sierra Nevada and the central San Joaquin Valley were significantly impacted, while snow levels over the Southern Sierra Nevada dropped to 7000 feet, resulting in 6 to 12 inches of new snow. Less rain fell further south, with up to half an inch. This weather caused nuisance flooding and a multi-vehicle accident on State Route 99 north of Fresno.
- **12/08/2019**: An upper trough brought widespread precipitation to California, with the heaviest in the northern regions where the Sierra recorded 1 to 2 inches and the valley got up to an inch of rain. Southern areas saw less, with Kings and Tulare Counties receiving up to half an inch, and Kern County less than a quarter inch. Snow levels stayed between 7000 and 8000 feet, with the higher Sierra getting 8 to 12 inches of new snow. The event also included scattered thunderstorms that led to local heavy rain, roadway flooding, and small hail before the precipitation ceased by the evening of December 8 as the trough moved east.
- **10/08/2021**: A Pacific cold frontal system pushed through the area during the morning of October 8 spreading widespread precipitation across the area. Several stations in the eastern portion of the San Joaquin Valley and the Sierra Nevada range measured between a tenth and four tenths of an inch of rainfall with portions of Fresno and Madera Counties picking up locally heavy showers which produced higher precipitation amounts. Several high elevation SNOTELs picked up an estimated one to three inches of new snowfall. The precipitation ended by late afternoon as the storm moved east of the area.
- **2/24/2023**: A cold low-pressure system off California's coast brought 1.5 to 3 inches of rain and significant snowfall, with snow levels dropping to near 1000 feet. Higher elevations in the Sierra Nevada and adjacent areas received 2 to 4 feet of snow, leading to extended closures of mountain roads. Flooding in the San Joaquin Valley and lower Sierra foothills caused additional road closures. The system moved out of the area by the morning of February 26.

Table 56. Fresno County Past Occurrences: Heavy Rain

Location	Date	Magnitude	Property Loss ($)	Crop Loss ($)	Deaths	Injuries
Glorietta	1/12/2017	0	0	0	0	0

Location	Date	Magnitude	Property Loss ($)	Crop Loss ($)	Deaths	Injuries
Melvin	1/21/2017	0	0	0	0	0
Glorietta	2/03/2017	0	0	0	0	0
(FAT) Air Terminal	4/13/2017	0	0	0	0	0
Clovis	11/17/2017	0	0	0	0	0
Melvin	3/21/2018	0	0	0	0	0
Cedar Grove	9/04/2018	0	0	0	0	0
Fresno	5/18/2019	0	0	15M	0	0
Herndon	12/01/2019	0	50,000	0	0	0
Clovis	12/08/2019	0	0	0	0	0
Melvin	10/08/2021	0	0	0	0	0
Melvin	2/24/2023	0	0	0	0	0

Source: NOAA, National Centers for Environmental Information, Storm Events Database

LIKELIHOOD OF FUTURE OCCURRENCES

Highly Likely—Heavy rain, thunderstorms, hail, lightning, and wind are well-documented seasonal occurrences that will continue to occur annually in the Fresno County planning area.

CLIMATE CHANGE CONSIDERATIONS

Atmospheric Rivers - Atmospheric rivers account for up to 50 percent of California's total annual precipitation. Climate change can drive conditions to be conducive to an increase and greater intensity of atmospheric rivers due to warmer temperatures. Additional moisture from atmospheric rivers could increase the frequency of thunderstorms and severe storms to occur.

Heavy Rain - California's variable precipitation is also characterized by multi-year wet or dry periods. Future average precipitation is difficult to predict and unlikely to change substantially when focusing on annual precipitation. Even if heavy rain were to increase in future decades, it is likely that warmer air temperatures will increase moisture loss from soils and lead to drier seasonal conditions. [44]

Hail - According to some scientists, it is predicted that severe convective storms are becoming more likely in our warming climate. Storms with the right mixture of atmospheric ingredients for hail are more likely to form. Because the planet is getting warmer, the odds are generally higher that a hailstone will melt before making its way to the ground. However, the hailstones that do make it down may be larger and cause more damage. [45]Overall, the future probability of hail events occurring in the future is unlikely unless significant changes in the atmosphere increase the chance of hail events impacting the planning area.

Lightning - On a large scale, lightning strikes nationwide are projected to increase by 12 percent per every degree Celsius of global warning and about 50 percent over the 21st century if greenhouse gases increase at their current pace. However, so far scientists have not yet seen an increase in lightning events. When looking at the past 25 years, there hasn't been a noticeable increase in global lightening or U.S. lightning. [46]In future decades, it is uncertain if lightning events will increase or decrease in frequency within the planning area.

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[44] Summary of Projected Climate Change Impacts on California - California Climate Adaptation Strategy https://climateresilience.ca.gov/overview/impacts.html

[45] Severe Hailstorms Are Costly and Hard to Predict - Eos https://eos.org/articles/severe-hailstorms-are-costly-and-hard-to-predict

Severe Hailstorms Are Costly and Hard to Predict - Eos https://eos.org/articles/severe-hailstorms-are-costly-and-hard-to-predict

[46] Lightning could spark more California fires as world warms - CalMatters https://calmatters.org/environment/2021/09/california-fires-lightning/

SEVERE WEATHER: WINTER STORM

HAZARD/PROBLEM DESCRIPTION

Winter snowstorms can include heavy snow, ice, and blizzard conditions. Heavy snow can immobilize a region, stranding commuters, stopping the flow of supplies, and disrupting emergency and medical services. Accumulations of snow can collapse roofs and knock down trees and power lines. In rural areas, homes and farms may be isolated for days, and unprotected livestock may be lost. The cost of snow removal, damage repair, and business losses can have a tremendous impact on cities and towns.

Winter weather can vary by types including blizzards, ice storms, snow squalls, heavy snow, and sleet or freezing rain, described in more detail below:

Winter Weather Types

- **Blizzards:** defined by the National Weather Service, blizzards are a combination of sustained winds or frequent gusts of 35 mph or greater and visibilities of less than a quarter mile from falling or blowing snow for 3 hours or more. A blizzard, by definition, does not indicate heavy amounts of snow, although they can happen together. The falling or blowing snow usually creates large drifts from the strong winds. The reduced visibilities make travel, even on foot, particularly treacherous. The strong winds may also support dangerous wind chills. Ground blizzards can develop when strong winds lift snow off the ground and severely reduce visibilities.
- **Ice Storm:** occurs when a layer of warm (above freezing), moist air aloft coincides with a shallow cold (below freezing) pool of air at the surface. As snow falls into the warm layer of air, it melts to rain, and then freezes on contact when hitting the frozen ground or cold objects at the surface, creating a smooth layer of ice. This phenomenon is called freezing rain. Similarly, sleet occurs when the rain in the warm layer subsequently freezes into pellets while falling through a cold layer of air at or near the Earth’s surface. The U.S. National Weather Service defines an ice storm as a storm which results in the accumulation of at least .25 inch of ice on exposed surfaces. Extended periods of freezing rain can lead to accumulations of ice on roadways, walkways, power lines, trees, and buildings. Almost any accumulation can make driving and walking hazardous. Ice accumulations can lead to downed trees, utility poles and communication towers. Ice can disrupt communications and power while utility companies repair significant damage. Even small accumulations of ice can be extremely dangerous to motorists and pedestrians. Bridges and overpasses are particularly dangerous because they freeze before other surfaces.
- **Snow Squalls:** often associated with strong cold fronts, are a key wintertime weather hazard. They move in and out quickly, and typically last less than an hour. The sudden white-out conditions combined with falling temperatures produce icy roads in just a few minutes. Squalls can occur where there is no large-scale winter storm in progress and might only produce minor accumulations. Snow squalls can cause localized extreme impacts to the traveling public and to commerce for brief periods of time. Unfortunately, there is a long history of deadly traffic accidents associated with snow squalls. Although snow accumulations are typically an inch or less, the added combination of gusty winds, falling temperatures and quick reductions in visibility can cause extremely dangerous conditions for motorists.
- **Heavy Snow:** in large quantities, may fall during winter storms. Six inches or more in 12 hours or eight inches or more in 24 hours constitute conditions that may significantly hamper travel or create hazardous conditions. The National Weather Service issues warnings for such events. Smaller amounts can also make travel hazardous, but in most cases, only results in minor inconveniences.

Heavy wet snow before the leaves falls from the trees in the fall or after the trees have leafed out in the spring may cause problems with broken tree branches and power outages.

- **Sleet or Freezing Rain:** sleet is defined as pellets of ice composed of frozen or mostly frozen raindrops or refrozen partially melted snowflakes. These pellets of ice usually bounce after hitting the ground or other hard surfaces. Heavy sleet is a relatively rare event, defined as ice pellets covering the ground to a depth of a one- half inch or more. Freezing rain falls as a liquid but freezes into glaze upon contact with the ground.

Heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days until the damage can be repaired. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians.

Some winter storms are accompanied by strong winds, creating blizzard conditions with blinding wind-driven snow, severe drifting, and dangerous wind chills. Strong winds with these intense storms and cold fronts can knock down trees, utility poles, and power lines. Blowing snow can reduce visibilities to only a few feet in areas where there are no trees or buildings. Serious vehicle accidents can result in and cause injuries and deaths.

The central and western portions of the Fresno County planning area generally do not experience snowfall on a seasonal basis; however, the higher elevations in the eastern portion of the County receive an abundance of snow, mostly between the months of November through April. Winter snowstorms in this part of the County, including strong winds and blizzard conditions, can result in localized power and phone outages and closures of streets, highways, schools, business, and nonessential government operations. People can also become isolated from essential services in their homes and vehicles. Snow removal costs can impact budgets significantly. Heavy snowfall during winter can also lead to flooding or landslides during the spring if the area snowpack melts too quickly.

EXTENT

The extent of winter storms and cold that cause issues in Fresno County includes storms forecasted to be Winter Storm Warnings, Wind Chill Warnings or Blizzard Warnings. These storms would be confined to the Sierra Mountains within Fresno County. Heavy snows, or a combination of snow, freezing rain or extreme wind chill due to strong wind, may bring widespread or lengthy road closures and hazardous travel conditions, plus threaten temporary loss of community services such as power and water. Deep snow and additional strong wind chill or frostbite may be a threat to even the appropriately dressed individual or to even the strongest person exposed to the frigid weather for only a short period.

Depending on the magnitude of the winter storm, the National Weather Service will issue either a Winter Weather Advisory, Winter Storm Watch, or a Winter Storm Warning, shown in the table below.

Table 57. NWS Winter Storm Weather Product

Winter Storm Product	Description
Winter Weather Advisory (Light Purple)	Wintry weather expected. Light amounts of wintry precipitation or patchy amounts of wintry precipitation or patchy blowing snow will cause slick conditions and could affect travel if precautions are not taken.
Winter Storm Watch (Light Blue)	Snow, sleet, or ice possible. Confidence is medium that a winter storm could produce heavy snow, sleet, or freezing rain and cause significant impacts.

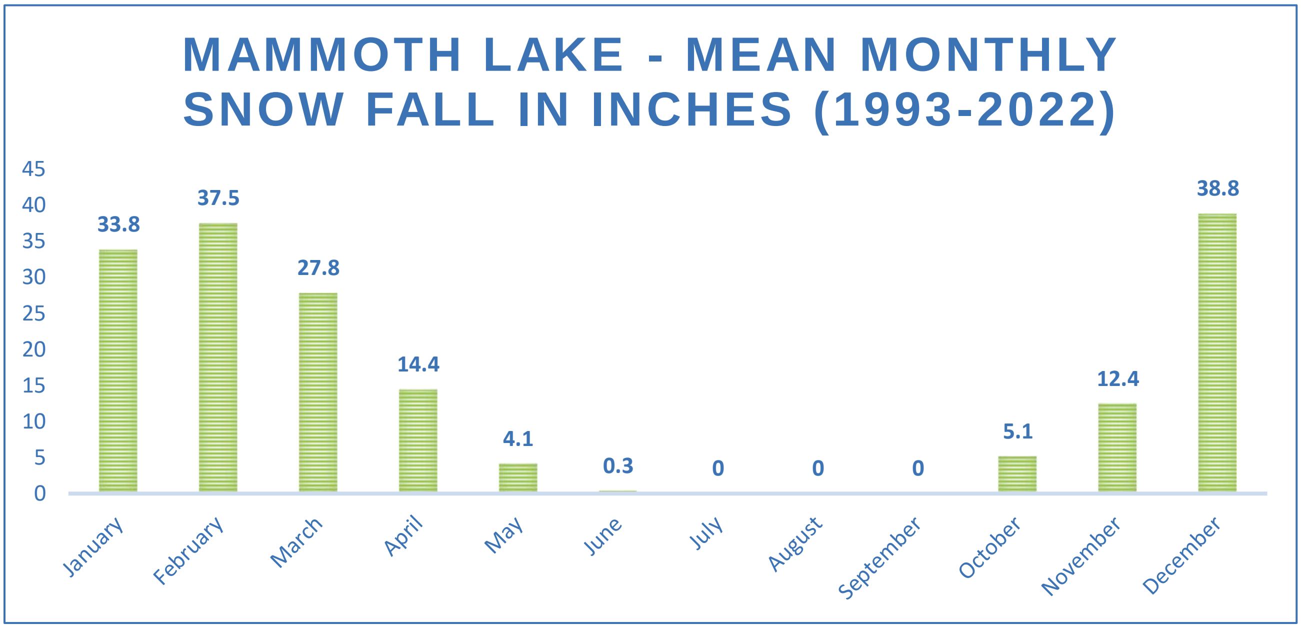
Winter Storm Product	Description
Winter Storm Warning (Pink)	Snow, sleet, or ice expected. Confidence is high that a winter storm will produce heavy snow, slight, or freezing rain and cause significant impacts.

Source: NWS

PAST OCCURRENCES

Information from the three representative weather stations introduced in the Severe Weather: General section is summarized below. There was no mean monthly snow fall for the central and eastern weather stations across the county. **Figure 45. Mammoth Lake Mean Monthly Snow (1993-2022)** shows the monthly mean snow fall in inches for the Mammoth Lake Weather Station.

Figure 48. Mammoth Lake Mean Monthly Snow (1993-2022)



Source: Western Regional Climate Center, www.wrcc.dri.edu/

The Fresno County Office of Emergency Services is not aware of any incidents where snow caused enough damage to declare a countywide emergency. The following winter snow event impacted the eastern portion of the Fresno County planning area shown in **Table 58. Fresno County Past Occurrences: Snow** and listed below.

- **January 2005**: Heavy wet snow fell in eastern Fresno County above 4,000 feet resulting in a regionwide closure of roads and loss of power for up to three weeks in three communities. Eight injuries were reported due to vehicle accidents from poor road conditions. Property damage was estimated at $3.5 million from trees falling on homes, cabins, and outbuildings. Infrastructure damage was estimated at $2.5 million to the power distribution grid and $250,000 to the road system. An estimated 10-15,000 merchantable trees were damaged or destroyed. Most roads in the area were closed for three weeks; schools were closed for two weeks.

- **3/24/2011**: The last major storm of the month arrived on March 24th. This storm brought gusts to 45 mph to the west side of the San Joaquin Valley, and gusts to 65 mph in the Kern County mountains and deserts. Convective activity was limited to near Merced, with several reports of road flooding due to the already saturated ground. Thunderstorms and showers moved east into the foothills of Madera and Mariposa Counties, where the heavy rains triggered rock and mud slides. Mainly light showers occurred southward. The trough moved east of the region on the 25th, with residual light showers in its wake. Additionally, light snow fell in the Southern Sierra Nevada measuring around 5 inches or less. Local media reported that the roof of a vacant store at Shaver Lake collapsed on March 26th due to 6 feet of snow accumulation on the roof.
- **4/12/2012**: An upper-level short-wave moved into California on April 10th, flattening the ridge. This set the stage for back-to-back strong storms to move through the central California interior on the 11th, 12th, and 13th. Each storm triggered severe thunderstorms over the central and southern San Joaquin Valley with hail up to 1.75 inches in diameter. Tallies of agricultural and crop loss approached 100 million dollars due to the extensive hail damage across Kings, Tulare, Fresno, and Merced counties. Funnel clouds were observed, although none touched down. The first storm brought up to a foot of snow to the Southern Sierra Nevada, and the second colder storm dropped up to 30 inches of snow at Lodgepole in Sequoia National Park.
- **2/18/2019**: Showers and winds diminished across the area during the evening of February 17 as skies cleared out. This resulted in the freezing of leftover rain and melted snow on several roads which resulted in several roads in the Kern County Mountains being closed for several hours overnight and into the morning hours of February 18. Black ice also resulted in a fatal two vehicle accident near Oakhurst on State Route 49 during the morning of February 18.
- **1/09/2023**: Central California was struck by a low-pressure system that swept in with a tropical moisture surge, causing widespread heavy precipitation and record-breaking flooding. The snow levels at about 7500 feet led to significant runoff, exacerbating the flooding that shut down numerous roads and necessitated evacuations, including the entire inundated town of Planada. Additionally, the storm caused power outages due to high winds, with a record 26.2-foot crest at Bear Creek, before diminishing on January 11.

Table 58. Fresno County Past Occurrences: Snow

Location	Date	Magnitude	Property Loss ($)	Crop Loss ($)	Deaths	Injuries
Eastern Fresno County	January 2005	0	3.5 M	0	0	8
Fresno County	3/24/2011	0	0	0	0	0
Fresno County	4/10/2012	0	0	100 M	0	0
Oakhurst	2/18/2019	0	80,000	0	0	0
Planada	1/09/2023	0	8,900,000	0	0	0

Source: NOAA, National Centers for Environmental Information, Storm Events Database

LIKELIHOOD OF FUTURE OCCURRENCES

Highly Likely—Snow in the eastern region of the County is a well-documented seasonal occurrence that will continue to occur annually.

CLIMATE CHANGE CONSIDERATIONS

Historically, California has relied heavily on the Sierra Nevada snowpack. Runoff from melting mountain snow is captured and distributed throughout the state via an extensive network of aqueducts. Observations over recent warmer decades reveal a decline in California's lower elevation snowpack, and climate models indicate considerably greater loss of mountain snowpack as temperatures continue to warm. Overall, precipitation will fall as rain instead of snow. However, snow that does manage to accumulate will melt earlier in the spring. As spring snowpack decreases in the future decades, the state's water storage capacity will be reduced as well. Researchers found that winters are becoming increasing shorter in the mountainous western United States, as snow is disappearing earlier in the year. By 2050, the average water supply from snowpack is projected to decline to two-thirds of historical levels, some studies project. If greenhouse gas emissions do not reduce, water from snowpack could fall less than one-third of historical levels by the year 2100.[47]

[47] https://scripps.ucsd.edu/research/climate-change-resources/faq-climate-change-california

SEVERE WEATHER: TORNADO

HAZARD/PROBLEM DESCRIPTION

Tornadoes are another severe weather hazard that can affect the Fresno County planning area, primarily during the rainy season. Tornadoes form when cool, dry air sits on top of warm, moist air. Tornadoes are rotating columns of air marked by a funnel-shaped downward extension of a cumulonimbus cloud whirling at destructive speeds of up to 300 mph, usually accompanying a thunderstorm. Tornadoes are the most powerful storms that exist. They can have the same pressure differential that fuels 300-mile-wide hurricanes across a path only 300-yards wide or less. With additional heat in the atmosphere storms are projected to become more severe in the future, and thus lightning may become more prevalent. Tornadoes typically occur during the “tornado season” from April through June. Tornadoes usually occur in the spring and summer months, however the tornadoes that have occurred in the planning area and in neighboring communities have occurred in the spring but also in the winter months (December and January). Tornadoes can last from several seconds to more than an hour as they are rolling through communities. However, most tornadoes usually last less than 10 minutes. Typically, tornadoes will gradually lose intensity as the condensation funnel decreases in size, the tornado becomes tilted with height before it completely dissipates.

The size of the tornado does not necessarily equate to the severity of the tornado. Occasionally, small tornadoes can do major damage and some very large tornadoes, over a quarter-mile wide, have produced only light damage. The measure of the magnitude and intensity of a Tornado, the Enhanced Fujita Scale or EF Scale, which became operational in 2007, is used to categorize tornadoes based on estimated wind speeds and related damage, shown in **Table 59. Fujita Scale** and **Table 60. Enhanced Fujita Scale**. The EF scale is based off wind estimates (not measurements) from the relevant damage. The scale uses three-second gusts estimated at the point of damage. Additionally, the National Weather Service is the only federal agency with authority to provide an “official” tornado EF Scale rating.

Table 59. Fujita Scale

Fujita (F) Scale	Fujita Scale Wind Estimate (mph)	Typical Damage
F0	< 73	Light damage. Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
F1	73-112	Moderate damage. Peels surface off roofs; mobile homes pushed off foundations oroverturned; moving autos blown off roads.
F2	113-157	Considerable damage. Roofs torn off frame houses; mobile homes demolished;boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	158-206	Severe damage. Roofs and some walls torn off well-constructed houses; trainsoverturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	207-260	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.

Fujita (F) Scale	Fujita Scale Wind Estimate (mph)	Typical Damage
F5	261-318	Incredible damage. Strong frame houses leveled off foundations and swept away;automobile-sized missiles fly through the air in excess of 100 meters (109 yards); trees debarked; incredible phenomena will occur.

Source: National Oceanic and Atmospheric Administration Storm Prediction Center, www.spc.noaa.gov/faq/tornado/f-scale.html

Table 60. Enhanced Fujita Scale

Enhanced Fujita (EF) Scale	Enhanced Fujita Scale Wind Estimate (mph)
EF0	65-85
EF1	86-110
EF2	111-135
EF3	136-165
EF4	166-200
EF5	Over 200

Source: National Oceanic and Atmospheric Administration Storm Prediction Center, www.spc.noaa.gov/faq/tornado/ef-scale.html

Tornadoes can cause damage to property and loss of life. While most tornado damage is caused by violent winds, most injuries and deaths result from flying debris. Property damage can include damage to buildings, fallen trees and power lines, broken gas lines, broken sewer and water mains, and the outbreak of fires. Agricultural crops and industries may also be damaged or destroyed. Access roads and streets may be blocked by debris, delaying necessary emergency response.

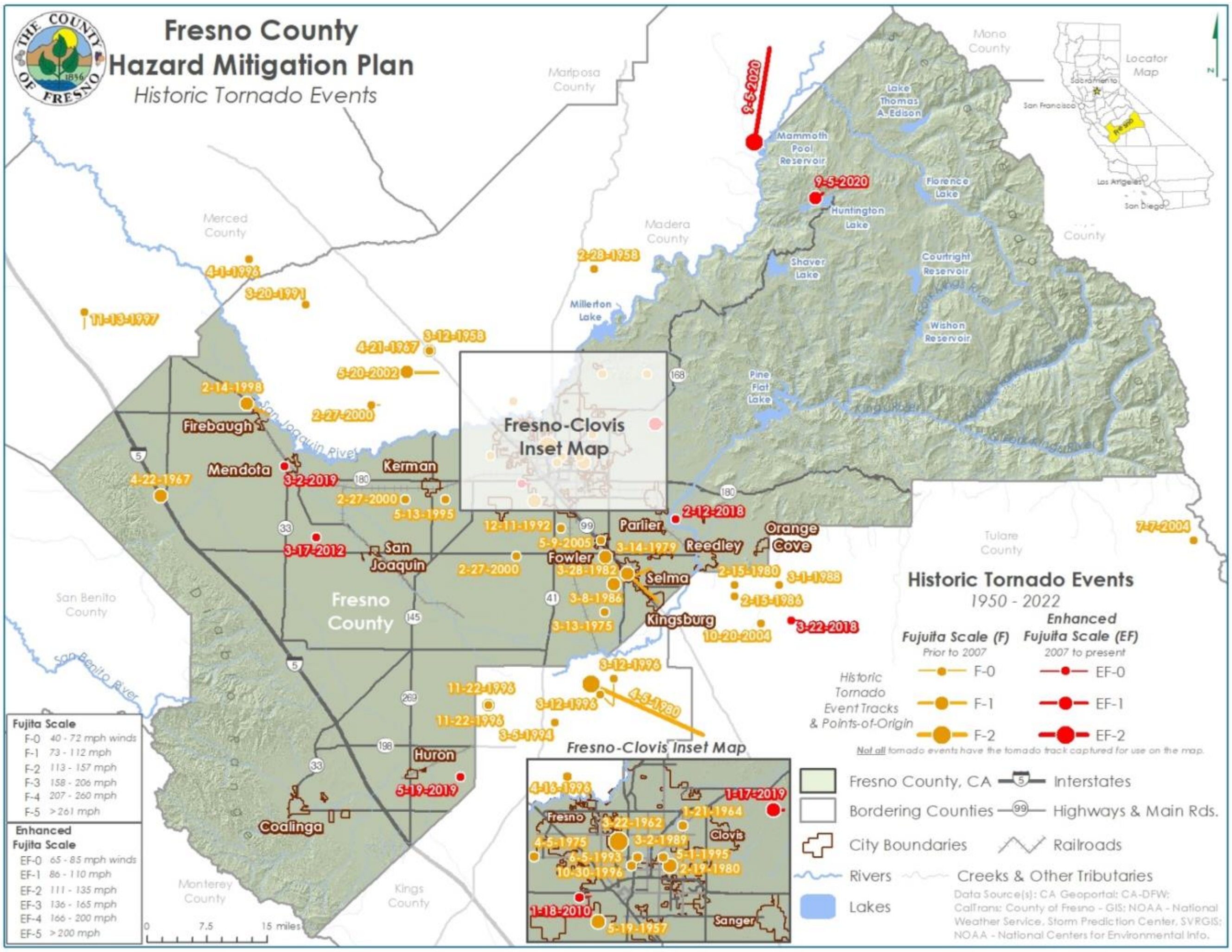
EXTENT

The majority of tornadoes in the past in Fresno County have been F0 and F1. Large tornadoes are possible, however. Should the County be hit by an EF-4 or EF-5 tornado, it can be extrapolated that because of its relative size and the potential size and length of a tornado's path a significant portion of the County could be impacted, resulting in property and crop damage and loss of life.

PAST OCCURRENCES

Based on data from 1950 to1995, California ranks 32nd among the 50 states for frequency of tornadoes, 36th for injuries, and 31st for cost of damage. When compared to other states by frequency per square mile, California ranks 44th for frequency and injuries per area and 40th for cost of damage per area. **Figure 46. Fresno County Historic Tornado Events** shows tornadoes that have affected the County using NOAA data from 1950 to 2022.

Figure 49. Fresno County Historic Tornado Events



Source: CA Geoportal; CA-DFW; CalTrans; County of Fresno – GIS; NOAA – National Weather Service, Storm Prediction Center, SVRGIS; NOAA – National Centers for Environmental Info.

According to the HMPC, during the rainy season, the Fresno County planning area is prone to relatively strong thunderstorms, sometimes accompanied by funnel clouds and tornadoes. While tornadoes do occur occasionally, most often they are of F0 or F1 intensity. Documented incidents of tornadoes in the Fresno County planning area from the NCEI Storm Events Database are listed in **Table 61. Fresno County Past Occurrences: Tornadoes** and **Table 62. Recent Fresno County Past Occurrences by City: Tornado**.

Table 61. Fresno County Past Occurrences: Tornadoes

Type	# of Events	Property Loss ($)	Deaths	Injuries
Tornado: F0	20	250,000	0	0
Tornado: F1	9	5,705,050	0	3
Tornado: F2	1	5,000	0	0
Totals	**30**	**5,960,050**	**0**	**3**

Source: NOAA, National Centers for Environmental Information, Storm Events Database

A summary of the most recent tornadoes is described below.

- **2/12/2018 -** Warm temperatures were followed by a low-pressure system that led to strong winds in the Kern County area. This weather system also resulted in a weak tornado touching down near Sanger on the morning of February 12th.
- **1/16/2019 -** Intense storms brought heavy rain and strong winds to central California, leading to an EF-1 tornado east of Clovis, alongside significant snowfall above 7000 feet in the Southern Sierra Nevada. The storm affecting the region on January 16 and 17, also caused extensive roadway flooding and forced the closure of State Route 140 due to flash flooding and debris flows.
- **3/02/2019 -** A Pacific storm system brought moderate to heavy precipitation to central California, culminating in thunderstorms that led to a tornado near Mendota causing minor roof damage. The Southern Sierra Nevada received 1 to 3 inches of rain, while snow levels, initially above 8000 feet, dropped to around 5000 feet after the cold front. The storm passed by March 3rd.
- **5/18/2019** - An intense low-pressure system led to record-breaking rainfall in central California with significant snowfall in the Sierra Nevada. The system also sparked thunderstorms across the San Joaquin Valley, producing small hail, heavy rain, and an EF0 tornado near Huron.

Table 62. Recent Fresno County Past Occurrences by City: Tornado

Location	Date	Magnitude	Property Loss ($)	Crop Loss ($)	Deaths	Injuries
Parlier	2/12/2018	EF0	0	0	0	0
Academy	1/17/2019	EF1	500,000	0	0	0
Mendota	3/02/2019	EF0	20,000	0	0	0
Huron	5/18/2019	EF0	0	0	0	0

Source: NOAA, National Centers for Environmental Information, Storm Events Database

LIKELIHOOD OF FUTURE OCCURRENCES

Possible—Thirty tornadoes have occurred in Fresno County over 73 years of record keeping, which equates to one tornado every 2.4 years, on average, and a 40 percent chance of a tornado occurring in any given year. Historical tornadic activity within the planning area indicates that the area will likely continue to experience the formation of funnel clouds and low intensity tornadoes during adverse weather conditions. The actual risk to the County is dependent on the nature and location of any given tornado.

CLIMATE CHANGE CONSIDERATIONS

The total number of U.S. tornadoes observed each year roughly doubled from the 1950s to the 1990s with the advent of more storm spotters and chasers. Most of these “extra” tornadoes were on the weak side that were not originally detected prior. Climate change typically plays out through broad regional shifts, such as depleted sea ice, warmer oceans, and drier landscapes. Sometimes these shifts are distinct enough from natural variation to signal clearly that human-caused climate change is likely involved. In contrast, tornadoes are brief and episodic, and they normally vary a great deal over time and space, so it’s difficult to distill long-term trends in their behavior and distinguish those from normal ups and downs. [48]Therefore, scientists must attempt to predict how climate change might affect the individual weather “ingredients” that support the development of supercell thunderstorms. The weather ingredients include warm, moist air, an unstable atmosphere, and wind at different levels moving in different directions at different speeds, a phenomenon known as wind shear. As global temperatures increase, the hotter atmosphere is able to hold more moisture. This increases atmospheric instability, an important supercell ingredient. On the other hand, as the earth warms, wind shear is likely to decrease.

Some studies predict that climate change could provide the opportunity for more severe thunderstorms to form. However, this does not necessarily mean that more tornadoes will occur, especially in light of the fact that only about 20 percent of supercell thunderstorms produce tornadoes. While there have been no long-term trends in the frequency of tornadoes, there have been changes in tornado patterns in recent years. Research has shown that there are fewer days with at least one tornado but more days with over thirty, even as the total number of tornadoes per year has remained relatively stable. In other words, tornado events are becoming more clustered. There is speculation that some of these changes are linked to climate change and its effect on the jet stream. Tornado outbreaks have also coincided with rising ocean temperatures. But no one can say for certain that climate change is a contributing factor in these events. [49]

[48] https://yaleclimateconnections.org/2021/07/climate-change-and-tornadoes-any-connection/

[49] https://education.nationalgeographic.org/resource/tornadoes-and-climate-change/

VOLCANO

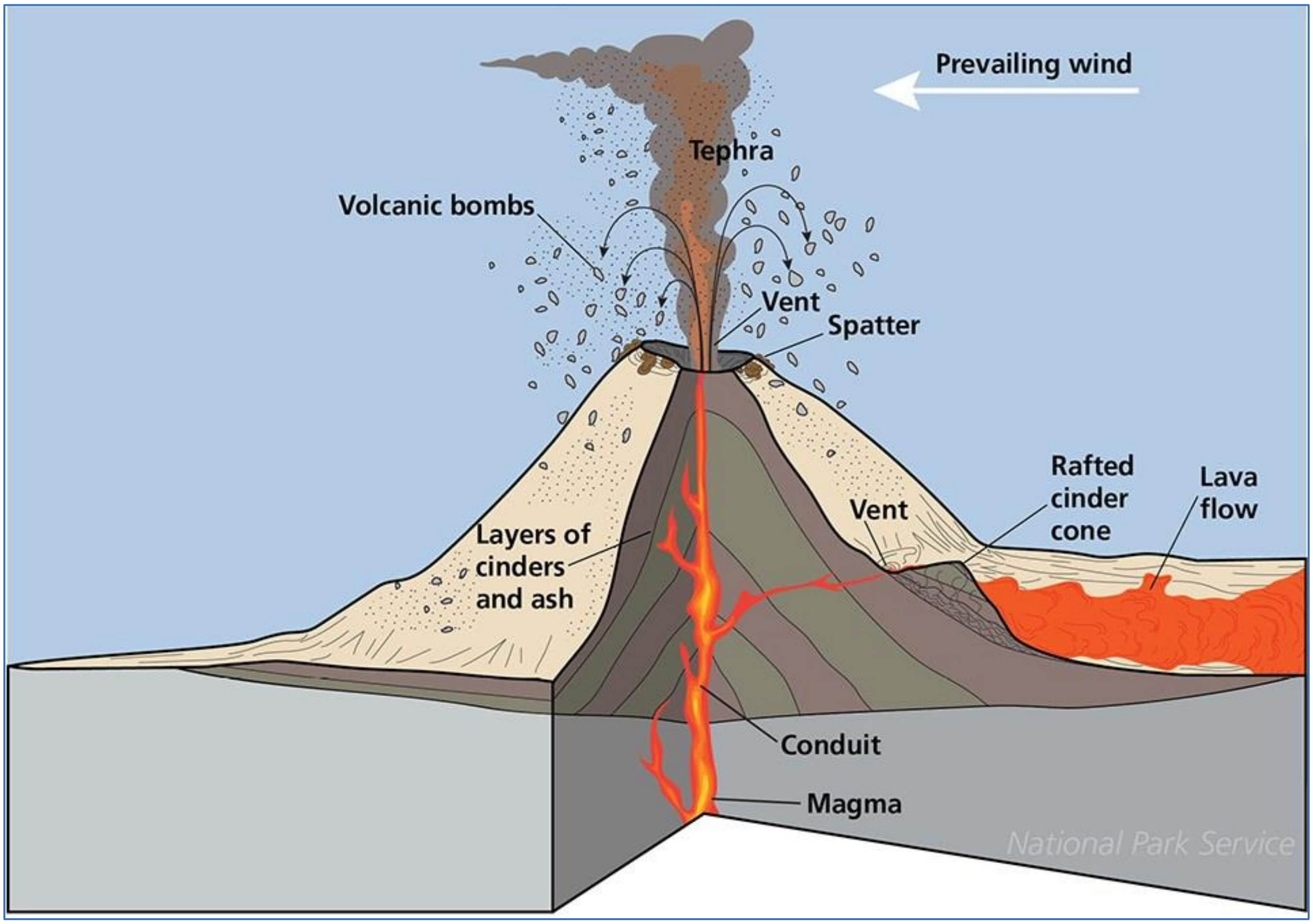
HAZARD/PROBLEM DESCRIPTION

Of the almost 70 active and potentially active volcanoes in the United States, more than 50 have erupted one or more times in the past 200 years. Volcanic eruptions occur in the state about as frequently as the largest San Andreas Fault Zone earthquakes; at least ten eruptions have occurred in California in the last 1,000 years and the likelihood of renewed volcanism in the state is on the order of 1 in a few 100 to 1 in a few thousand annually. Volcano hazards are the greatest in five western states: Alaska, Hawaii, California, Oregon, and Washington. Volcanoes create a wide variety of hazards that can kill people and destroy property. [50]

Populations living near volcanoes are most vulnerable to volcanic eruptions and lava flows; although, large explosive eruptions can endanger people and property hundreds of miles away and even affect global climate. Volcanic ash can also travel and affect populations many miles away. The ash from the 1980 eruption of Mount St. Helens in Washington fell over a large area of the western United States. Heavy ash fall can collapse buildings, and even minor ash fall can damage crops, electronics, and machinery. Some volcanic hazards, such as landslides, can occur even when a volcano is not erupting. **Figure 47. Components of a Volcanic Eruption** depicts a volcano typical of those found in the western United States.

[50] California State Hazard Mitigation Plan

Figure 50. Components of a Volcanic Eruption



Source: National Park Service

The State of California Multi-Hazard Mitigation Plan identifies volcanoes as one of the hazards that can adversely impact the state. However, there have been few losses in California from volcanic eruptions. Of the approximately 20 volcanoes in the state, only a few are active and pose a threat. According to the USGS California Volcano Observatory, there are six volcanos that pose a high risk and 4 volcanos that pose a moderate risk to the state of California. The six volcanoes include Mount Shasta, Medicine Lake Volcano, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, and Salton Buttes. The volcanoes that pose a moderate risk include Soda Lakes, Long Valley Volcanic Region, Ubehebe Craters, Coso Volcanic Field.

EXTENT

The Fresno County General Plan Background Report identifies the Mono Lake-Long Valley area located adjacent to the north and east of the northernmost areas of Fresno County as the only known volcanic hazard to Fresno County. The Long Valley area is an active volcanic region of California and includes features such as the Mono-Inyo Craters, Long Valley Caldera, and numerous active and potential faults. **Figure 48. Volcanoes In or Near California** shows volcanoes in or near California and the location of the Long Valley area relative to the Fresno County planning area.

Figure 51. Volcanoes In or Near California

Source: USGS

Populations living near volcanoes are most vulnerable to volcanic eruptions and lava flows, although volcanic ash can travel and affect populations many miles away and cause problems for aviation. Based on information in the background report, the Fresno County planning area is susceptible to various hazards associated with its proximity to the Long Valley area as further described below.

VOLCANIC FLOWS

Two mildly explosive volcanic vents are located three to four miles from northernmost Fresno County, northwest of Duck Lake. In the event of an eruption, flows or debris from the vents would likely flow predominantly southwest approximately parallel to the North Fork of the San Joaquin River in Madera County. Lava flows, steam blasts, or base surges could occur in the northernmost tip of Fresno County. The northern portions of the Silver Divide (including Duck Lake and Fish Creek) could be subject to lava flows. However, this area of the County is mostly unpopulated and not easily developable as it is situated on the high peaks of the Sierra Nevada. Thus, potential safety hazards would be limited to backcountry visitors.

PYROCLASTIC FLOW

Pyroclastic flows are sudden eruption of hot (400- 1300°F), gas-pressurized flows of ash and lava fragments that rush outward from the volcano with great force at ground speeds greater than 50 miles per hour (mph). Pyroclastic flows typically follow valleys but can overtop ridges and travel 30 miles or more from the volcano. Due to the fast nature of these flows, they are the main cause of eruption-related fatalities. Flows can knock down, shatter, bury, or carry away nearly all objects and structures in its path and extreme temperatures can burn forests, crops, buildings, furnishings, and vehicles.

ASH

With most volcanic eruptions, a significant amount of ash is released into the atmosphere. The location and thickness of ash in any given area is generally a function of the volume erupted and wind speed and direction. Based on historical wind directions and wind speeds, most volcanic ash from a volcanic eruption of Long Valley would be deposited east of the volcano. Looking at historical data from past ash falls, most ash beds from volcanic eruptions in California lie east of their source vents. Other studies of Mount Rainier and Mount St. Helens show that more than 90 percent of the ash beds deposited from volcanic eruptions during the last 10,000 years lie to the east of those volcanoes. This data suggests that most ashfall from future eruptions, including those from Long Valley, would also be deposited to the east of the source.

According to a worst-case scenario provided in the background report, geologists estimate that the South Fork of the San Joaquin River, Mono Creek, Margaret Lakes, Duck Lake, Fish Creek, Lake Thomas A. Edison, Bear Creek, Lake Italy, and the town of Mono Hot Springs could be subject to eight inches or more of compacted ash from an eruption at Long Valley. It only takes up to five inches of ash to stop an automobile engine. These areas, in addition to Kaiser Creek and Three Island Lake, could also be affected by hot pyroclastic flows. It is further estimated that up to two inches of ash could fall within a 50-mile radius of the eruption, potentially affecting the areas of Auberry, Prather, Meadow Lakes, Pine Ridge, Tollhouse, Dinkey Creek, Humphreys Station, Courtright Reservoir, Pine Flat Reservoir, and numerous small lakes, creeks, and streams.

LAHARS

Lahars are slurry-like floods of volcanic ash, rock, and water that look like wet concrete. Debris flows gain momentum during travel by eroding and entraining soil and loose rock debris from channels. Large debris flows may carry boulders 30 feet across and travel through valleys and stream channels at speeds of 20 to 40 mph. Debris flows can be hot, with temperatures close to boiling. They occur during an eruption due to melting snow or ice, or after an eruption due to remobilization of loose volcanic deposits during intense rainfall. Debris flows have the ability to destroy buildings and bridges and bury vast areas with deposits of mud and rock to 160 feet thick as far as 65 miles from the volcano.

RESULTING FLOODS AND MUDFLOWS

An eruption on the western slope of Mammoth Mountain (on the rim of the Long Valley Caldera) in the winter could also cause hot mudflows to mix with melting snow and rock debris, creating the possibility of severe flood conditions in the San Joaquin River drainage system, endangering people, dams, and other property as it moves downstream.

Figure 49. California Volcano Hazard Zones illustrates areas subject to potential volcanic hazards from future eruptions in California and supports the conclusion that the planning area is potentially at risk to volcanic activity from the Long Valley area. The hazard zone for the Long Valley Volcanic Region is right outside of the Fresno County's jurisdictional boundaries but would still pose a threat to the planning area. The ash dispersion map that follows (**Figure 50. Volcanic Hazards Ash Dispersion Map for the Long Valley Caldera**) also illustrates the extent to which the planning area may be affected by ash fallout in the event of renewed volcanic activity in the area.

Figure 52. California Volcano Hazard Zones

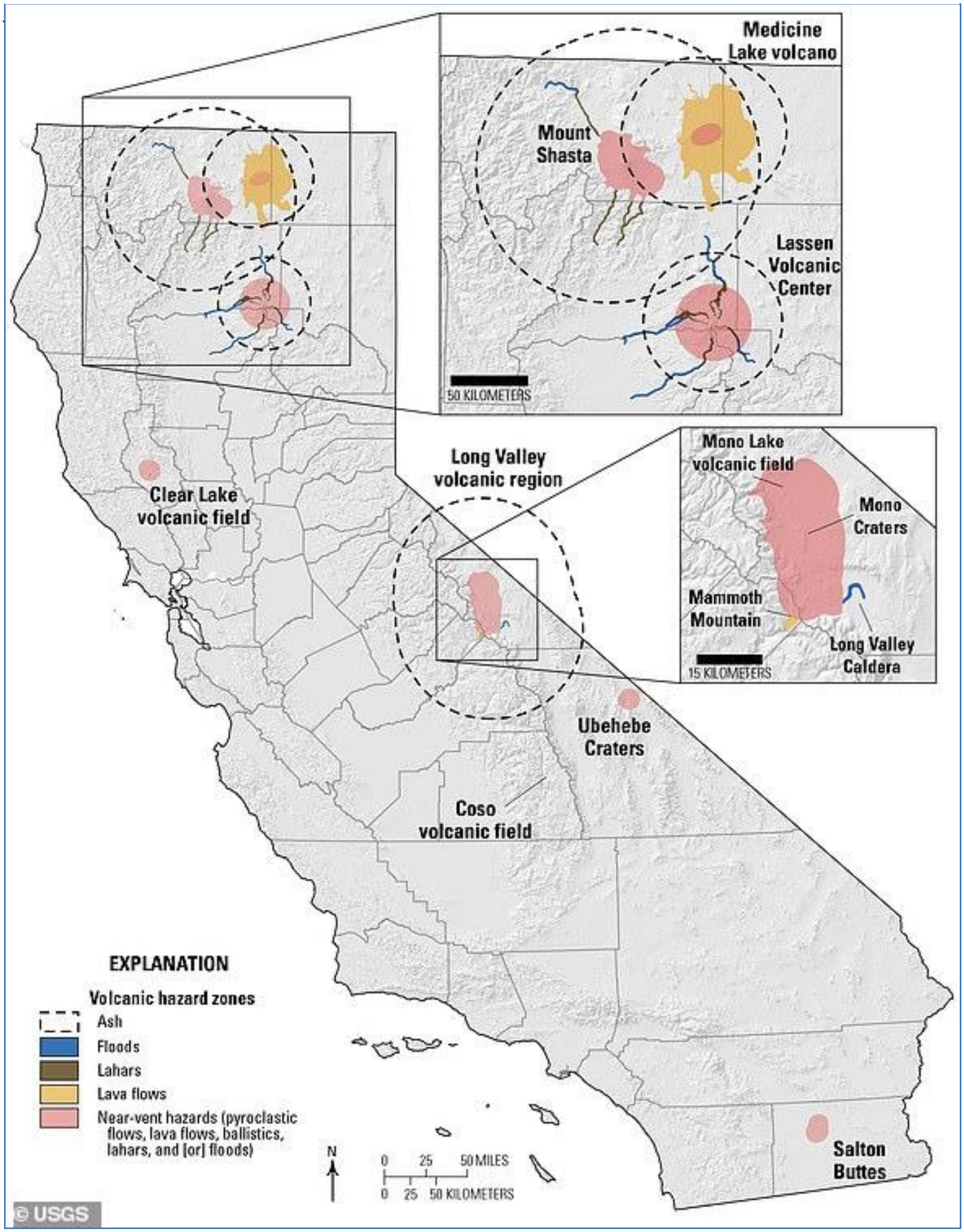
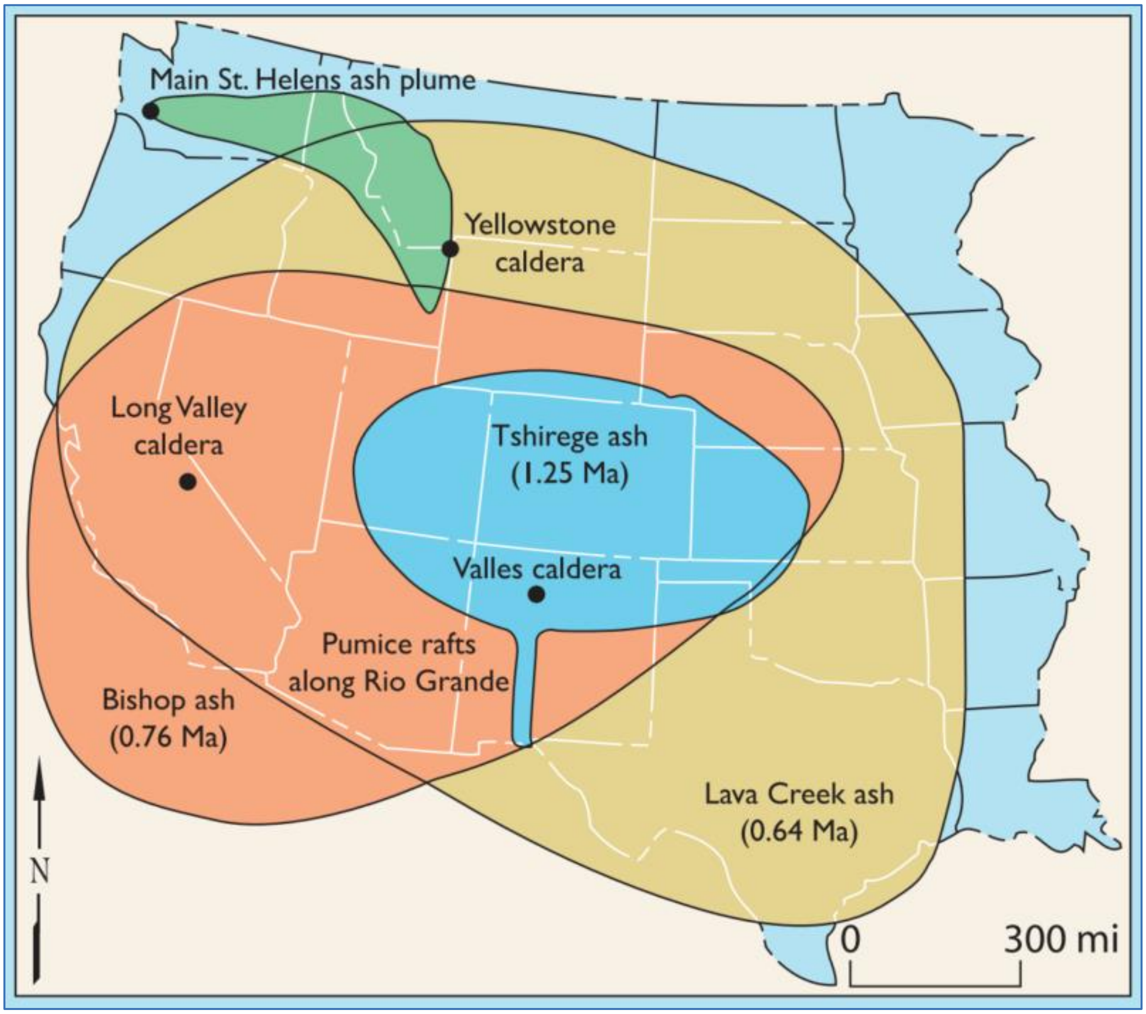


Figure 53. Volcanic Hazards Ash Dispersion Map for the Long Valley Caldera



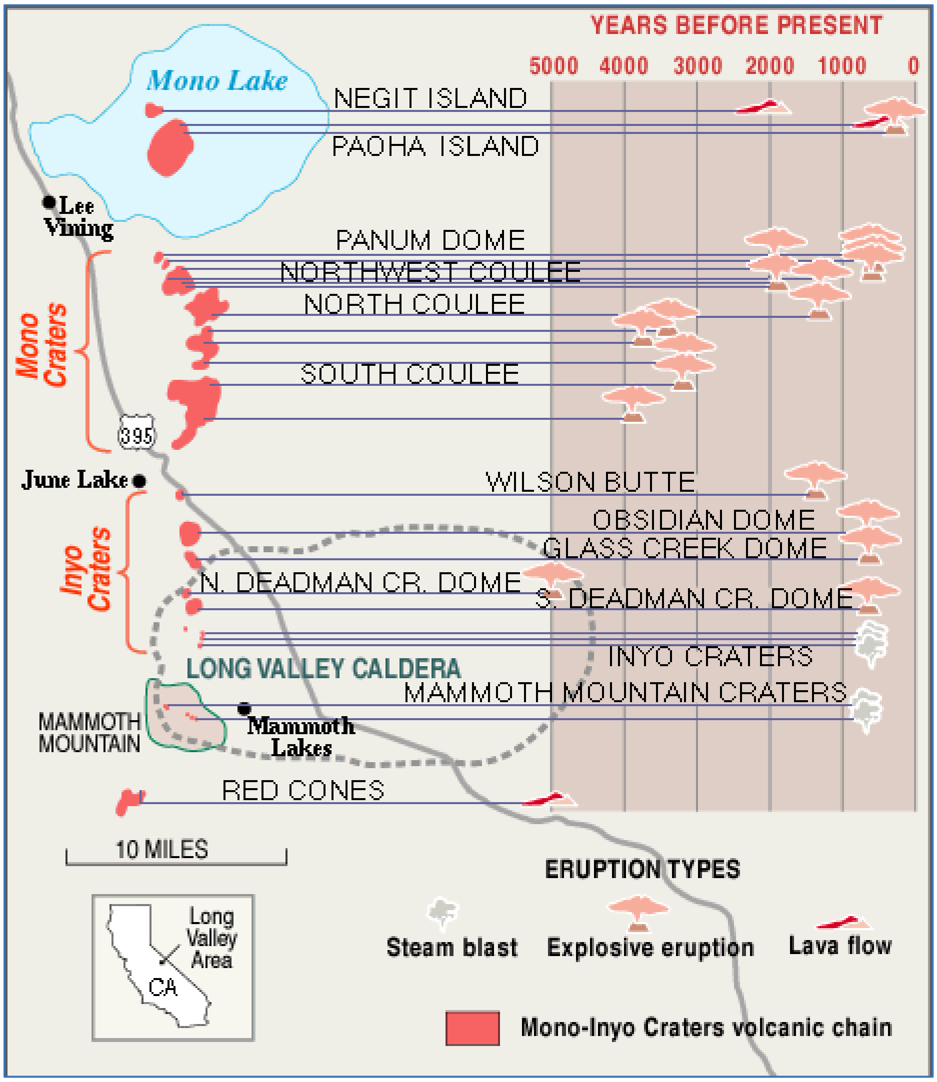
Source: National Parks Service

Note: Ma = Million Years Ago

PAST OCCURRENCES

During the past 1,000 years there have been at least 12 volcanic eruptions in the Long Valley area. Volcanoes in the Mono-Inyo Craters volcanic chain, which extends from just south of Mammoth Mountain to the north shore of Mono Lake, have erupted often over the past 40,000 years. Over the past 5,000 years, small to moderate eruptions have occurred at various sites along the Mono- Inyo Craters volcanic chain at intervals ranging from 250 to 700 years (see **Figure 51. Volcanic Activity in the Mono-Inyo Craters Volcanic Chain of the Past 5,000 Years**). According to the California State Hazard Mitigation Plan, the most recent eruption in California occurred at Lassen Park within the Lassen Volcanic National Park about 100 years ago, from 1914- to 1917, about 55 miles east of the town of Redding.

Figure 54. Volcanic Activity in the Mono-Inyo Craters Volcanic Chain of the Past 5,000 Years



Source: U.S. Geological Survey

In 1980, four large earthquakes (greater than magnitude 6 on the Richter Scale) and numerous relatively shallow earthquakes occurred in the area. Since then, earthquakes and associated uplift and deformation in the Mammoth Lakes Caldera have continued. Because such activities are common precursors of volcanic eruptions, the U.S. Geological Survey closely monitors the unrest in the region.

LIKELIHOOD OF FUTURE OCCURRENCES

Unlikely—According to the U.S. Geological Survey, the pattern of volcanic activity over the past 5,000 years suggests that the next eruption in the Long Valley area will most likely happen somewhere along the Mono-Inyo volcanic chain. However, the probability of such an eruption occurring in any given year is less than 1 percent. Most likely, the next eruption will be small and like previous eruptions along the

Mono-Inyo volcanic chain during the past 5,000 years. Based on available data and the location of the County relative to the Long Valley area, there is a remote potential for volcanic activity of sufficient magnitude to adversely impact the Fresno County planning area. Researchers have long thought the risk of a super volcanic eruption in the Long Valley Caldera in our lifetime is extremely low, given that overall, the magma underneath the area is clearly cooling—essentially continuing to calm down, but the cooling process may release enough gas and liquid to cause earthquakes and small eruptions. Other scientists suggest that scientists suspect the Long Valley Caldera as a volcano is moribund—essentially dead— and the increased seismic activity, when it happens, is being generated by fluids that are not magma, but are still hot and moving to the surface as the magma cools and solidifies. [51]

CLIMATE CHANGE CONSIDERATIONS

There presently is not enough data or research to quantify the magnitude of potential change that climate change may have on volcanic activity.

[51] https://phys.org/news/2023-10-california-riskiest-volcanoes-eruption.html

WILDFIRE

HAZARD/PROBLEM DESCRIPTION

Three classes of fires exist in the planning area: understory fires, crown fires, and ground fires. Naturally induced wildfires burn at relatively low intensities, consuming grasses, woody shrubs, and dead trees. These understory fires often play an important role in plant reproduction and wildlife habitat renewal and self-extinguish by low fuel loads or precipitation. Crown fires, which consist of fires consuming whole living tress, are low probability but high consequence type events. Crown fires typically match perceptions of wildfires. In areas with high concentrations of organic materials in the soil, ground fires may burn, sometimes persisting undetected for long periods until the surface is ignited.

Potential losses from wildfire include human life, structures, critical infrastructure, natural and cultural resources, quality and quantity of water supplies, cropland, timber, and recreational opportunities. Economic losses could also result due to damages to natural resources, grazing lands, tourism, and local businesses do not mention the loss of revenue to businesses during a wildfire event. Smoke and air pollution from wildfires can be a severe health hazard to local communities and the greater San Joaquin Valley air basin. In addition, catastrophic wildfire can create favorable conditions for other hazards such as flooding, landslides, and erosion during the rainy season impacting communities and downstream reservoirs.

To better address wildfire threats, California has updated its approach to land and fire management. This includes advanced techniques for managing vegetation to lower fuel levels, employing controlled burns to restore natural fire cycles and mitigate risks, and enforcing tighter building regulations alongside thoughtful land use strategies to enhance the resilience of communities to wildfires. This comprehensive approach integrates the latest scientific insights, technological innovations, and traditional practices, aiming for a more effective mitigation of wildfire impacts throughout the state.

Generally, there are three major factors that sustain wildfires and predict a given area’s potential to burn. These factors are fuel, topography, and weather.

- **Fuel—**Fuel is the material that feeds a fire and is a key factor in wildfire behavior. Fuel is generally classified by type and by volume. Fuel sources are diverse and include everything from dead tree leaves, twigs, and branches to dead standing trees, live trees, brush, and cured grasses. Also, to be considered as a fuel source are manmade structures, such as homes and other associated combustibles. The type of prevalent fuel directly influences the behavior of wildfire. Fuel is the only factor that is under human control. Fuel types within the Fresno County planning area include annual grasses, deciduous oaks, and heavy brush in the Coast Range of western Fresno County, seasonal grasses, deciduous and evergreen oaks, brush, and grass in the lower and mid-elevations of central and eastern Fresno County, and conifers in the higher elevations of eastern Fresno County.
- **Topography—**An area’s terrain and slopes affect its susceptibility to wildfire spread. Both fire intensity and rate of spread increase as slope increases due to the tendency of heat from a fire to rise via convection. The arrangement and types of vegetation throughout a hillside can also contribute to increased fire activity on slopes.
- **Weather—**Weather components such as temperature, relative humidity, wind, and lightning also affect the potential for wildfire. High temperatures and low relative humidity dry out fuels that feed wildfires, creating a situation where fuel will more readily ignite and burn more intensely. Thus,

during periods of drought, the threat of wildfire increases. Wind is the most influential weather factor of the three and its influence can increase rates of spread regardless of temperature and relative humidity. The Fresno County planning area has a diverse normal wind pattern. The western side of the planning area is influenced more by the coastal range and weather patterns along the coast. The east side of the valley is more influenced by the normal heating and cooling of the valley floor and the influence along the river drainages, this area is also susceptible to foehn winds from the high Sierra. Lightning during the summer monsoonal moisture season also ignites wildfires, often in difficult terrain with limited access for firefighters.

- Wildfire is an ongoing concern for the Fresno County planning area. Historically, the fire season extends from June through October of each year during the hot, dry months. Since 2010 the fire season throughout California and Fresno County has been getting longer, typically starting in May, and extending into November, but wildfires can occur any time of year. Fire conditions arise from a combination of high temperatures, intense sunlight, low rainfall and humidity, dry vegetation, and high winds. Down slope winds, such as the Santa Ana winds of southern California which can gust to 80 mph, are often associated with the most destructive wildfires. Since they usually occur in the fall and winter after the summer dry season when there is ample dry vegetation for fuel, they can cause small fires to quickly burn out of control. Between 1948 and 2017, a recent study found, 22 percent of Southern California's fires started under Santa Ana-like wind conditions, but those fires were more destructive and extensive than fires that started in calmer conditions, responsible for nearly half of the total area burned in the region and 80 percent of the fire-related economic damage incurred between 1990 and 2009.

WILDLAND URBAN INTERFACE (WUI)

Throughout California, communities are increasingly concerned about wildfire safety as increased development in the foothills and mountain areas and subsequent fire control practices have affected the natural cycle of the ecosystem. While wildfire risk is predominantly associated with wildland- urban interface (WUI) areas, significant wildfires can also occur in heavily populated areas and across non WUI landscapes in the forest. The wildland-urban interface is a general term that applies to development adjacent to or within large watershed landscapes that support wildfire. Wildfires affect grass, forest, and brush lands, as well as any structures located within them. Where there is human access to wildland areas, such as the Sierra Nevada and Coast Range foothills, the risk of fire increases due to a greater chance for human carelessness as 90 percent of wildland fires are human caused.

EXTENT

In terms of geographic extent, the wildfire hazard potentially impacts the entire planning area, but the most intense fires will be in the forested areas of the county. While **Figure 52. Fresno County's Wildfire Severity Zones** depicts potential severity across the planning area, the history of occurrence table (**Table 64. Fresno County Past Occurrences: Wildfire**) and **Figure 53. Fresno County Historic Wildfires** indicates that even moderate and low risk areas have experienced wildfires, and potentially will continue to do so. However, with regard to the severity or potential impact of the wildfire hazard two facts should be considered: first, both maps demonstrate that the areas of greatest risk correspond to the locations with the greatest number of historical events; second, the Medium, High, and Very High hazard areas correspond to heavily forested areas and urban wildland interface areas, where fuel loads for wildfire are highest, are periodically exacerbated by drought conditions, and further complicated by a widespread incidence of tree mortality adding additional fuel load risk (see drought and tree mortality sections for more information). Finally, to understand the extent of wildfire severity, the variable risk (Low, Medium, High, Very High) across the planning area identified on the wildfire risk map must be viewed in relation to the location of each jurisdiction participating in the plan. Most of the risk is in the unincorporated areas and on the fringes of municipalities that include Coalinga, Fresno, and Firebaugh. The Sierra Resource Conservation District has considerable area at risk of wildfires. For additional information on each jurisdiction's wildfire risk, please consult the jurisdictional Annexes and the Vulnerability Section.

The Fire Rating System is defined in **Table 63. The Fire Danger Rating System** describes the characteristics and potential intensity of fires, including the effect on the ability to manage and suppress fires. Such characteristics should be understood considering the wildfire risks and history of occurrence in Fresno County, as identified and in the narrative descriptions of wildfire history previously discussed. Fire conditions up through Class 5 are possible in Fresno County, primarily in the unincorporated areas.

Table 63. The Fire Danger Rating System

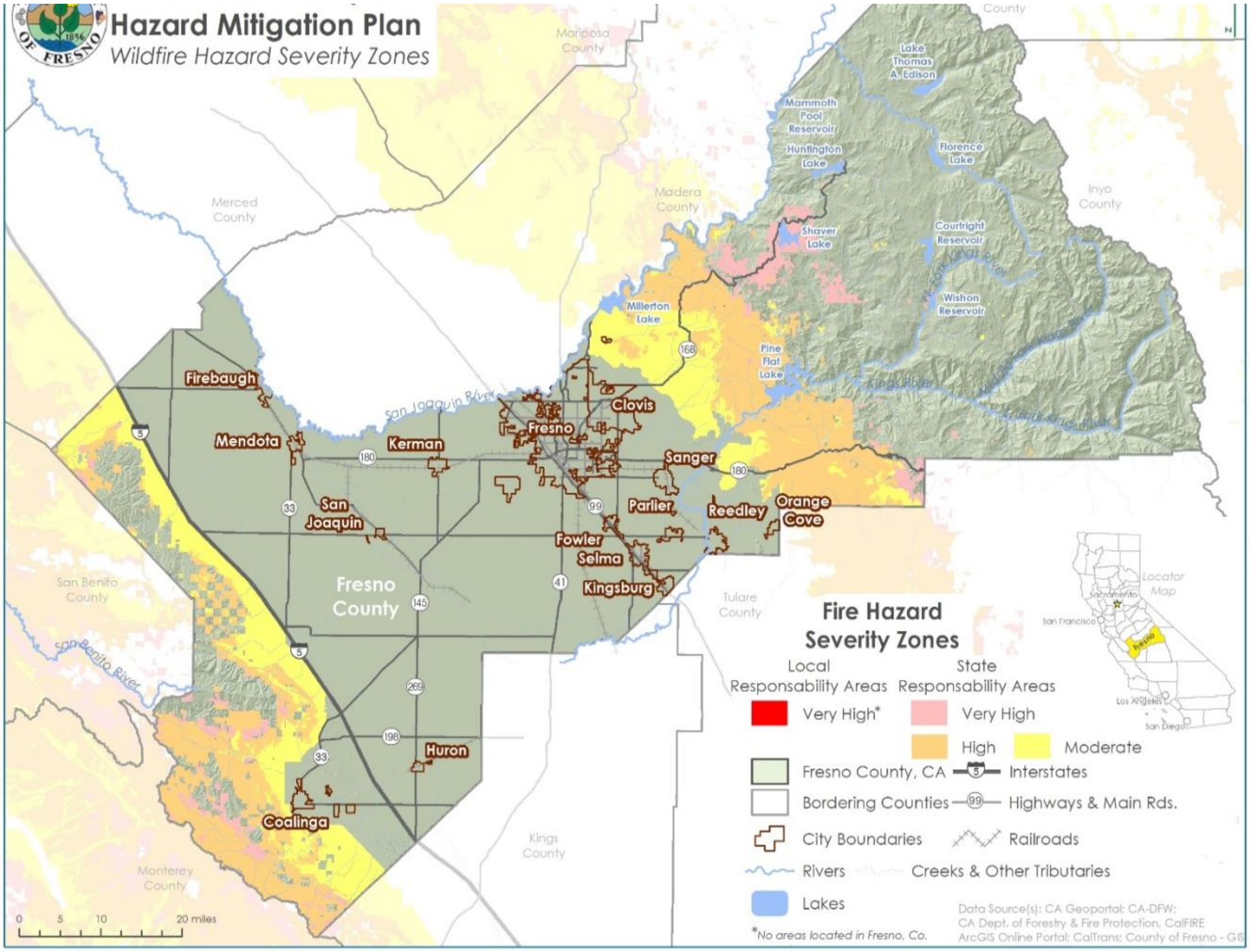
Rating	Basic Description	Detailed Description
CLASS 1: Low Danger (L) COLOR CODE: Green	fires not easily started	Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.
CLASS 2: Moderate Danger (M) COLOR CODE: Blue	fires start easily and spread at a moderate rate	Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel – especially draped fuel -- may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to occur. serious and control is relatively easy.
CLASS 3: High Danger (H) COLOR CODE: Yellow	fires start easily and spread at a rapid rate	All fine dead fuels ignite readily, and fires start easily from most causes. Unattended bushes and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.
CLASS 4: Very High Danger (VH) COLOR CODE: Orange	fires start very easily and spread at a very fast rate	Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have. been burning more than a few minutes.
CLASS 5: Extreme (E) COLOR CODE: Red	fire situation is explosive and can result in extensive property damage	Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.

Source : http://www.wfas.net

Within the County there are three principal areas that have large damaging fire history: West of Interstate 5, the San Joaquin River Watershed, and the Kings River Watershed. Each of these areas have unique vegetation and topography types, fire weather and communities. West of Interstate 5 is best described as an area with low rainfall (average of less than 10 inches) and a vegetation type consisting of annual grass, oak woodlands, and brush. This area is predominantly used as rangeland for livestock grazing, mining, oil and gas production and underground transportation.

The San Joaquin River and the Kings River Watersheds have a diverse vegetation type ranging from annual grasslands, oak woodlands, brush, and timber. These vegetation types of transition from the valley floor to the Sierra Nevada's. The topography ranges from rolling foothills, steep river canyons to high Sierra mountains. This area has numerus communities and homes on small parcels intermixed within the larger landscape. The San Joaquin River and Kings River have numerous hydroelectric facilities and critical power infrastructure located from the foothills to the high Sierra. Recreation in the Sierra and Sequoia National Forests areas along with group camps increases the population and ignition potential during fire season. The drought that started in 2012 has left an abundance of dead brush, oaks, and timber in the upper elevations of these watersheds. The impacts to the vegetation will carry on for many years into the future making fire suppression more difficult and increasing the chance for large catastrophic fires across the landscape.

Figure 55. Fresno County's Wildfire Severity Zones



Source: CA Geoportal; CA-DFW; CA Department of Forestry & Fire Protection, CalFIRE ArcGIS Online Portal; CalTrans; County of Fresno - GIS

PAST OCCURRENCES

Wildfires are of significant concern throughout California. According to the California Department of Forestry and Fire Protection (CAL FIRE), vegetation fires occur within their jurisdiction on a regular basis; most are controlled and contained early with limited damage. For those ignitions that are not readily contained and become major incidents, damage can be extensive. There are many causes of wildfire, from naturally caused lightning fires to human-caused fires linked to activities such as smoking, campfires, debris burning, equipment use, and arson. Recent studies conclude that the greater the population density in an area, the greater the chance of an ignition. The recent major wildland fires are the Powerhouse Fire in 1989 and the Valerie Meadows Fire in 1979. Most of the lands at the upper elevations have experienced fire within the past fifty years. Fires at the lower elevations generally do not offer fuel reduction benefits in following year(s) due to re-growth of annual grasses. With population continuing to grow throughout California and the Fresno County planning area, the risk posed by wildfire also continues to grow.

According to the 2005 Prefire Management Plan for CAL FIRE's Fresno-Kings Unit, an ignition analysis for 2004 was determined to be very similar to that of years past. The four primary ignition sources continue to be other and undetermined (535 fires), arson (311 fires), equipment use (315 fires), and debris burning (158 fires). The remaining causes, which are almost insignificant in number, are lightning, campfires, smoking, vehicles, electrical power, and playing with fire. The unit, which encompasses all of Fresno and Kings counties, experiences 120 to 200 fires a year in the state responsibility area and 1,400 to 1,600 fires in the local responsibility area is a fire history map for the Fresno-Kings Unit. During the drafting of the 2009 Fresno County HMP, the Unit, which encompasses all of Fresno and Kings counties, experienced 120 to 200 fires a year in the state responsibility area and 1,400 to 1,600 fires in the LRA.

In 2017, the Fresno County Fire Protection District reports a dramatic increase in fire incidents, with 1,283 reported as of July 31, 2017. That said, of the total number, 470 were categorized as Vegetation fires (wildfires), while the remaining fires related to vehicles (221), structures (197), refuse (331), industrial (33), improvement/controlled burns (21), and agricultural products (10). However, as has been noted previously, wildfires occur from both natural and human-made causes. Therefore, given the recent frequency increase in vegetation fires, and the fact that other types of fires have the potential to spread into a wildfire scenario, the wildfire hazard risk seems to be growing, and the LHMPC will remain vigilant in its efforts to mitigate the risks, although an increase in frequency does not necessarily translate to an increase in the extent (range) of wildfires or their severity.

Previous wildfire events are detailed in the table and map below for Fresno County. The HMPC identified the following as notable wildfires in the Fresno County planning area:

- **1933:** The Tollhouse Fire started when a local resident was burning brush in late August. The fire got out of hand and burned across fields and grazing lands and encircled the Town of Tollhouse, a large hub for the timber industry in eastern Fresno County. It burned portions of the flume that carried logs and boards from Shaver Lake to the valley floor. The fire raced up the hill and burned into Jose Basin and over Burrough Mountain into Blue Canyon. The fire burned very hot, destroying conifers in the area, which never grew back. Tollhouse was evacuated for safety, but no losses were incurred.
- **1987:** The state declared a disaster for Fresno County and 32 other counties during the 1987 wildfires. Collectively, the fires resulted in 3 deaths, 76 injuries, and $18 million in damage. The eastern side of Fresno County was primarily affected. Property damage was estimated at $1 million. Damage to roads, bridges, and power distribution also occurred. Timber production in the area was also impacted.
- **August 2-21, 1989:** The Powerhouse Fire, suspected to be caused by arson, ignited near the Fresno and Madera County line, and burned through 21,000 acres, affecting the areas from Auberry to Meadow Lakes. Although no fatalities occurred and no homes were destroyed, the fire caused minor injuries to firefighters and the loss of several outbuildings, as well as damage to infrastructure. The fire's impact was particularly severe on the local watershed and wildlife, signaling a significant ecological and community disturbance.
- **August 24, 1994:** The Big Creek Wildland Fire in eastern Fresno County burned 9,000 acres of national forest land, threatened hundreds of homes, and led to the evacuation of the Big Creek community. Costs included $2 million in damage to national forest infrastructure, $500,000 to power distribution, and recovery expenses for the land were estimated at $2 million. The firefighting effort exceeded $50 million, and a subsequent mudslide incurred an additional $50,000 in damages.
- **September 21, 2000:** The Millwood Fire burned 283 acres; 363 personnel responded. Highway 180 was closed until 8:00 p.m. that evening. A shelter was prepared in the City of Orange Cove but was not used.
- **August 17, 2001:** The Highway fire located near the community of Dunlap, burned 4,152 acres, and destroyed five outbuildings, a cabin, two travel trailers, and a miscellaneous number of cars.
- **August 17, 2001**: The Musick Fire, located between Shaver Lake and Big Creek, burned 193 acres. No structures were damaged in this fire caused by downed power lines. The cost was estimated at $800,000.
- **July 2013:** The Aspen Fire took place in the Kaiser Wilderness area of the Sierra National Forest, North of Huntington Lake. The fire burned over 150,000 acres with a suppression cost of $22.8 million dollars. The fire posed imminent danger to people within the National Forest, resulting in the evacuation of multiple campsites.
- **July 30, 2015**: The Rough Fire, sparked by lightning in the Sierra National Forest, spread to encompass 151,000 acres, affecting nearby national parks, and causing the evacuation of multiple communities. The blaze led to poor air quality, the closure of schools and summer camps, and the destruction of buildings, while also severely reducing local tourism revenue. Suppression efforts for this massive wildfire cost $119 million.

- **July 1, 2016:** The Curry Fire was a major wildland fire that burned 2,944 acres in Coalinga, CA. Though no crop, property or infrastructure damage or personal injury occurred, it did result in several road closures.
- **July 2016**: The Goose Fire began at or around the intersection of Gooseberry Lane and Morgan Canyon Road, South of the town of Prather. The fire consumed 2,241 acres and destroyed 4 residences and 5 outbuildings. The fire posed an imminent threat to 400 homes, and residents were issued evacuation orders.
- **August 8, 2016**: The Mineral Fire was a major wildland fire which burned 7,05 acres in Coalinga, CA. Though no crop, property or infrastructure damage or personal injury occurred, it did result in several road closures.
- **October 11, 2016**: The Sacata Fire started near Sacata Ridge above Pine Flat in the Sierra National Forest. The fire was contained after burning over 1,500 acres. Active for 9 days, it was fully contained by October 20, 2016.
- **July 9, 2017**: The Garza Fire was a major wildland fire igniting in Monterey County (Coalinga, CA), and spreading to Kings and Fresno Counties. Although the fire burned 48,888 acres, no personal injuries or damage to crops, buildings or infrastructure were reported. However, it did result in several road closures.
- **June 25, 2017**: The Creek fire began off Los Gatos Creek Rd, west of Derrick, or 13 miles northwest of Coalinga, CA in Fresno County. The cause is under investigation. It burned 357 acres before being contained on June 28, 2017. There was one residence and 3 sheds destroyed. The cost of containment was $1.5 million.
- **July 16, 2017**: The Detwiler Fire began 15 miles northwest of Mariposa, CA. It was human caused. It burned 81,826 acres, resulting in 63 residences, 67 minor structures and 1 commercial structure being destroyed with another 13 residences and 8 minor structures damaged. The fire forced the evacuation of several small rural communities for as long as 10 days and the entire town of Mariposa (population 18,000) for 3 days. Parts of Highways 41, 49, and 140 were closed at times during the fire. The fire was 90 percent contained on July 31, 2017, but no additional growth occurred before it was completely contained on August 24, 2017. The cost of containment was $87 Million.
- **August 13, 2017**: The South Fork Fire started near Wawona in Yosemite National Park, prompting the closure of trails and the evacuation of Wawona due to the spread of the fire caused by thunderstorm downdrafts. Although containment reached 44 percent by the end of August, the fire was allowed to burn to the east into more rugged terrain. The fire, managed as it moved into the wilderness, was expected to continue burning into October.
- **August 29, 2017**: The Railroad Fire started near Sugar Pine, just south of Yosemite National Park, and led to the closure of Highway 41 and evacuations, including the Tenaya Lodge. It burned 12,407 acres, including part of the Nelder Grove of Giant Sequoias, and was contained by September 15, 2017, with costs reaching $20.8 million. Seventeen structures were destroyed, notably historical railroad items from the Yosemite Mountain Sugar Pine Railroad.
- **September 3, 2017**: Two fires started within a short time of each other both in the foothills of the Sierra Nevada. The Mission fire began 2 miles east of North Fork in Madera County and burned 1035 acres and destroyed three residences and damaged 4 other structures before being contained on September 13, 2017. The Peak fire began 9 miles southeast of Mariposa in Mariposa County and burned 680 acres and destroyed 2 structures before being contained on September 9, 2017. The cause of both fires is unknown.

- **July 13, 2018**: The Ferguson Fire began on July 13 near Mariposa, CA, and grew under difficult conditions including steep terrain and heavy beetle-killed trees, leading to road closures and evacuations. Smoke from the fire caused significant air quality issues, prompting the closure of parts of Yosemite National Park, and impacting the broader Sierra Nevada region. By the end of July, the fire had consumed 57,041 acres and incurred costs of $64.3 million, with the firefighting effort marred by the deaths of two firefighters.
- **July 13, 2020**: The Mineral fire was first spotted around 5 PM, with nearly 1000 acres burned by days end. The next several days resulted in significant fire growth and numerous evacuation notices within the region. Highway 198 between Coalinga and Monterey County was closed which impacted commerce, though the greatest impact was the loss of seven structures. Full containment of the fire was seen on 26th, though growth ended days prior.
- **July 24, 2020**: The Blue Jay fire began due to a lightning strike near the White Wolf Campground. The fire burned in general wilderness, though did close several trails within the park.
- **August 15, 2020**: The Hills Fire started in the foothills about 9 miles south of Coalinga, CA. It grew to 2,121 acres before being contained on 8/25/2020. The cause was under investigation. The cost of containment was $3.9 million. No structures were destroyed or damaged. Tragically, a helicopter pilot was killed on August 18 when his helicopter crashed while making water drops over the fire.
- **August 19, 2020**: The Castle Fire, ignited by lightning on August 19, 2020, near the Giant Sequoia National Monument, grew from 2,000 to 35,674 acres by the end of August, prompting evacuations and road closures. Merging with the Shot Gun Fire to form the SQF Complex on August 29, the fire had zero containment and costs reached $5.6 million by August 31st. The fire persisted into September, challenging firefighting efforts in the Sequoia National Forest.
- **September 4, 2020**: The Creek Fire, which started near Big Creek, California on September 4th, rapidly expanded to 73,278 acres by September 6th due to extreme heat and low humidity. Despite the slowing effects of extensive smoke, by September 9th the fire had reached nearly 153,000 acres, necessitating the evacuation of about 45,000 people and the destruction of 853 structures by the end of the month. Persistent hot and dry conditions under strong high pressure allowed the fire to continue burning into November, with containment costs reaching $106 million.
- **2021**: The Blue Fire, Fish Fire, Slope Fire, and Vulcan Fire, all occurring in 2021, collectively burned 442 acres of land in Fresno County, California. The Blue Fire was the largest, scorching 277 acres near Shaver Lake, while the Fish and Slope Fires were quickly contained, affecting 75 and 25 acres, respectively. The Vulcan Fire consumed 140 acres near Friant Road and was managed by both CAL FIRE and Fresno City Fire Department. Despite the varied sizes and locations, effective firefighting efforts led to the successful containment of each incident without significant damage to communities or infrastructure.
- **2022**: In 2022, Fresno County in California experienced several wildfires that tested the mettle of firefighting teams. Near Shaver Lake, the House Fire in May necessitated significant resource deployment and evacuation measures but was quickly brought under control, covering an area of 171 acres. The Pebble Fire, which emerged east of Fresno in late July, consumed 55 acres and was swiftly contained, showcasing the effectiveness of local firefighting efforts. The Power Fire in September posed a threat to 130 acres near Aubery Rd but was contained within a week by the diligent efforts of the Fresno-Kings Unit. Finally, the Table Fire, which occurred in early July on Table Mountain, was the most quickly addressed, with 52 acres contained in a mere two days.
- **2023**: Throughout 2023, Fresno County in California faced a series of wildfires across various locations, each notable for their swift containment. The Crane Fire and Rodeo Fire, both near Squaw Valley, and the Juniper Fire to the west of Coalinga were among the smaller incidents,

affecting areas of 24 and 15 acres each. Larger fires like the Orange Fire near Orange Cove and the Panoche Fire north of Little Panoche Rd, burned through 108 and 65 acres, respectively. The Pistol Fire near Auberry Road, and the extensive Slough Fire near San Joaquin, which spanned a vast 640 acres, were also brought under control promptly. Meanwhile, the Wildcat Fire occurred around Forest Service Road 10S069 and Trimmer Springs Road, near Pine Flat, and was managed by the US Forest Service-Sierra National Forest. The investigation into the causes of these wildfires was ongoing as the fire season progressed.

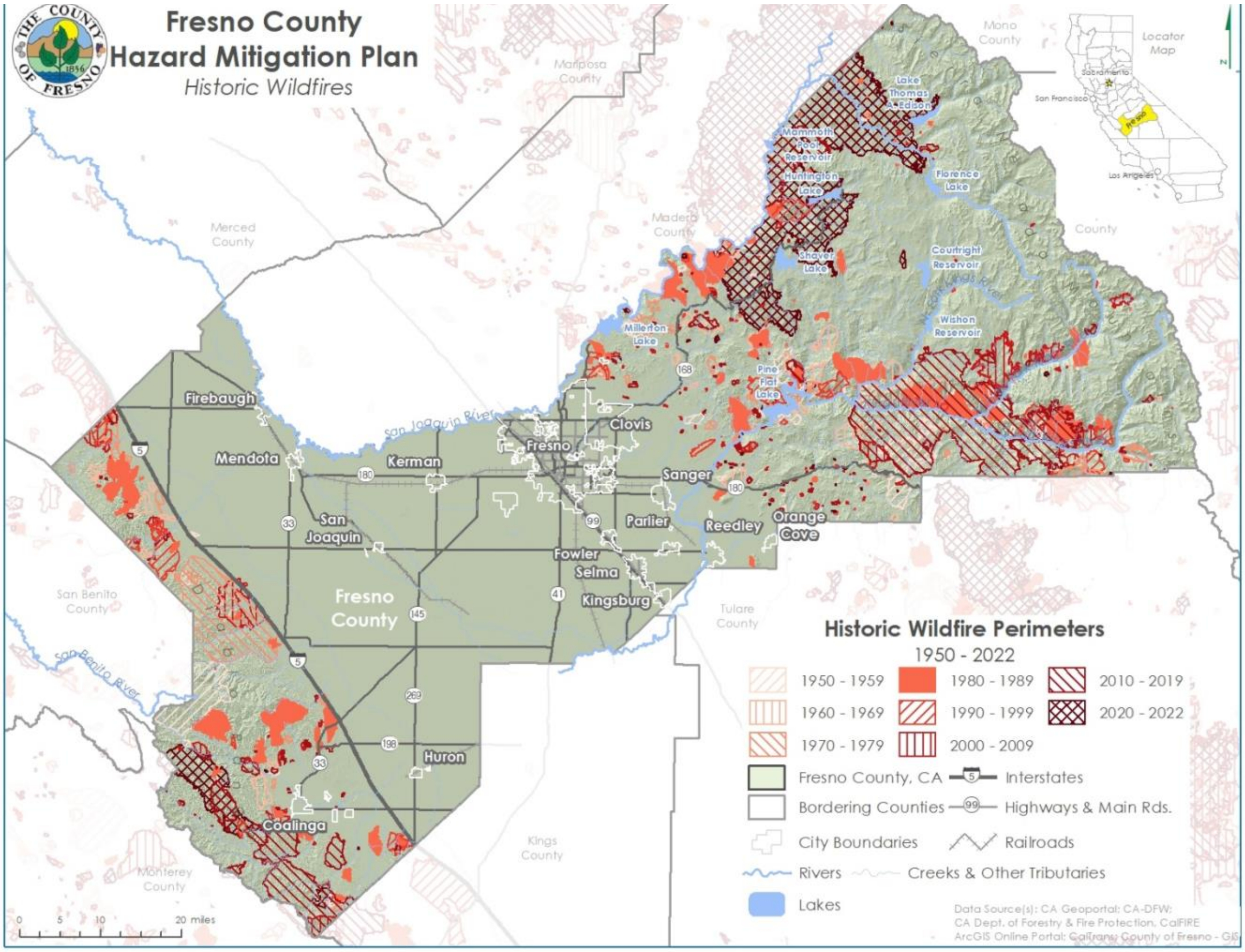
Table 64. Fresno County Past Occurrences: Wildfire

Location	Date	Magnitude	Property Loss ($)	Crop Loss ($)	Deaths	Injuries
Town of Tollhouse	1933	0	0	0	0	0
Eastern Fresno County	1987	0	1 M	0	3	76
Auberry Road and Meadow Lane	8/2/1989 – 8/21/1989	0	0	0	0	0
Big Creek	8/24/1994	0	0	0	0	12
Big Creek	9/21/2000	0	0	0	0	0
Dunlap	8/17/2001	0	0	0	0	0
Shaver Lake and Big Creek	8/17/2001	0	0	0	0	0
Kaiser Wilderness	July 2013	0	0	0	0	0
Sierra National Forest	7/30/2015	0	0	0	0	0
Coalinga	7/01/2016	0	0	0	0	0
Gooseberry Lane and Morgan Canyon Road	July 2016	0	0	0	0	0
Coalinga	8/08/2016	0	0	0	0	0
Coalinga	7/09/2017	0	0	0	0	0
Los Gatos Creek Road	6/23/2017	0	0	0	0	0
Mariposa	7/16/2017	0	0	0	2	19
Wawona	8/13/2017	0	0	0	0	0
Sugar Pine	8/29/2017	0	0	0	0	6
Sierra Nevada Foothills	9/03/2017	0	0	0	0	0
Mariposa	7/13/2018	0	0	0	2	19
Highway 198 Coalinga	7/13/2020	0	0	0	0	0
White Wolf Campground	7/24/2020	0	0	0	0	0
Coalinga	8/15/2020	0	0	0	1	0
Giant Sequoia National Monument	8/19/2020	0	0	0	0	15
Big Creek	9/04/2020	0	0	0	0	29
Shaver Lake, Friant Road	2021					
Shaver Lake, Table Mountain	2022					

Location	Date	Magnitude	Property Loss ($)	Crop Loss ($)	Deaths	Injuries
Squaw Valley, Orange Cove	2023					

Source: NOAA, National Centers for Environmental Information, Storm Events Database, California Department of Forestry and Fire Protection CAL FIRE

Figure 56. Fresno County Historic Wildfires



Source: CA Geoportal; CA-DFW; Ca Department of Forestry & Fire Protection, CalFIRE ArcGIS Online Portal; CalTrans; County of Fresno - GIS

LIKELIHOOD OF FUTURE OCCURRENCES

Highly Likely—Within the Fresno-Kings Unit, fire occurrences range from 120 to 200 fires a year in the SRA and 1,400 to 1,600 fires in the LRAs. Fires will continue to occur on an annual basis in the Fresno County planning area.

Other statistical measures to be considered in assessing the extent of the wildfire hazard include data on frequency (and severity): According to the Fire and Resource Assessment Program (FRAP), having compiled and analyzed a variety of measures for fire activity, such as the influence of time and fuel types, although fire activity across the state varies from year to year, the annual average since 2000 is 598,000 acres, or almost twice that of the preceding 50-year period from 1950-2000 (264,000 acres).

It should be noted that many ecosystems in the state that previously adapted to frequent low to moderate severity fires have seen shifts in reduced fire frequency (missed fire cycles), associated fuel build-up, and subsequent increases in fire severity when wildfires eventually occur. That said, other ecosystems appear to be burning too frequently – a situation facilitated by exotic invasive species that cause fundamental changes to post-fire fuel dynamics. These changes facilitate early seral phases to re-burn within a matter of only a couple years and may reduce or eliminate native species that require time to develop to maturity and assure regeneration. And, in areas such as Fresno County, where ecosystems are commingled across various regimes, there is more uniformity of mixed-and high-severity effects that are not as clearly linked to basic ecosystem function. Therefore, in many mixed conifer systems, while the modern trend indicates an increase in fire rates, the type of fire and its typical interval are still significantly departed from the frequent low and mixed-severity fires that dominated low and mid-elevation confer forests throughout California[52]

CLIMATE CHANGE

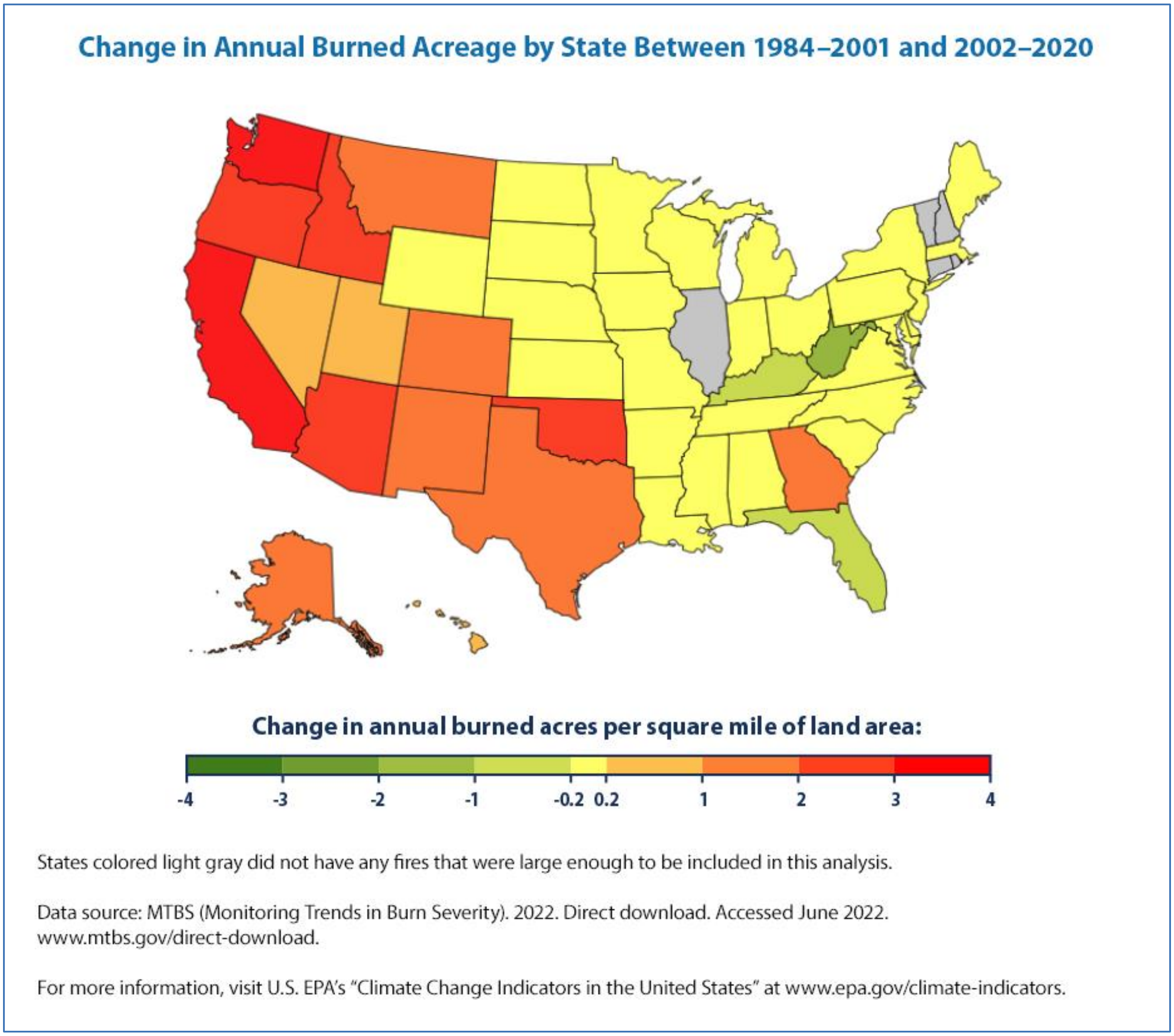
Over the past four decades, annual area burned has increased significantly in California and across the western United States. This trend reflects a confluence of intersecting factors that affect wildfire regimes. It is correlated with increasing temperatures and atmospheric vapor pressure deficit. Anthropogenic climate change is the driver behind much of this change, in addition to influencing other climate-related factors, such as compression of the winter wet season. These climatic trends and associated increases in fire activity are projected to continue into the future. Additionally, factors related to the suppression of the Indigenous use of fire, aggressive fire suppression and, in some cases, changes in logging practices or fuel management intensity, collectively have produced large build-ups of vegetative fuels in some ecosystems. [53]

According to the Environmental Protection Agency (EPA) the change in burned area has increased from 1984-2001 and 2002-2020 by 3.62 acres per square mile. Most of the western states have also seen an increase in burned acreage from similar time intervals, shown in **Figure 57. Change in Annual Burned Acreage by State Between 1984-2001 and 2002-2020**.

[52] 2010 Assessment Chapter 2.1: Wildfire Threat to Ecosystem Health and Community Safety

[53] Drivers of California's changing wildfires a state-of-the-knowledge synthesis (nwfirescience.org) nwfirescience.org/sites/default/files/publications/Drivers of California's changing wildfires- a state-of-the-knowledge synthesis.pdf

Figure 57. Change in Annual Burned Acreage by State Between 1984-2001 and 2002-2020



Source: MTBS (Monitoring Trends in Burn Severity) 2022

Even under a pathway of lower greenhouse gas emissions, average annual temperatures are projected to exceed historical record levels most likely by the middle of the 21st century. Overall, warming will lead to increased heat wave intensity but decreased cold wave intensity. Future heat waves signify a potential increase in the wildfire hazard intensity and severity in Fresno County, as well as a year-long fire season. According to the California's Fourth Climate Change Assessment, by 2100 if greenhouse gas emissions continue to rise, one study found that the frequency of extreme wildfires would increase, and the average area burned statewide would increase by 77 percent. [54]

[54] State Key Findings - California Climate Change Assessment

Finally, it should be noted that Fresno County potentially has less capacity to address future wildfire risk related to climate change due to shortages in water, vital to combating wildfires. In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack.

FRESNO COUNTY'S MITIGATION CAPABILITIES

Thus far, the planning process has identified the hazards posing a threat to Fresno County and described, in general, the vulnerability of the County to these risks. The next step is to assess what risk reduction mechanisms are already in place. These mechanisms include e laws, policies, programs, staff, funding and other resources on hand to carry out the plan and increase resilience. This part of the planning process is the mitigation capability assessment. Combining the risk assessment with the mitigation capability assessment results in the County's "net vulnerability" to disasters and more accurately focuses the goals, objectives, and proposed actions of this plan. The capability assessment also informs the mitigation strategy. The chosen actions should either match the community's resources or support strengthening or building capacity where resources might not exist.

As such, this section presents Fresno County's mitigation capabilities: programs and policies currently in use to reduce hazard impacts or that could be used to implement hazard mitigation activities. It also identifies capabilities specific to the other participating jurisdictions can be found in the jurisdictional annexes.

The HMPC used a two-step approach to originally conduct this assessment for the County. First, an inventory of common mitigation activities was made through the use of a matrix. The purpose of this effort was to identify policies and programs that were either in place, needed improvement, or could be undertaken, if deemed appropriate. Second, the HMPC reviewed existing policies, regulations, plans, and programs to determine if they contributed to reducing hazard-related losses or if they inadvertently contributed to increasing such losses. During the 2024 update this section was reviewed by County and Witt O' Brien's consultant team staff to update information where applicable. This included revising sections to align with changes that will be reflected in the updated General Plan.

This update process afforded the County and its participating jurisdictions the opportunity to review their previous capabilities and note the ways in which these capabilities have improved or expanded since the adoption of the previous plan. Additionally, in summarizing their current capabilities and identifying gaps, plan participants also considered their ability to expand or improve upon existing policies and programs as potential new mitigation strategies. Chapter 5 Mitigation Strategy includes mitigation actions aimed at improving community capability to reduce hazard risk and vulnerability. An overview of Fresno County's capabilities is described in **Table 65. Fresno County Capability Summary**.

Table 65. Fresno County Capability Summary

Area	Degree of Capability		
	Limited	Moderate	High
Planning and Regulatory Capability			X
Administrative and Technical Capability			X
Fiscal Capability			UNKNOWN
Available Staff			UNKNOWN
Political Support/Interest			UNKNOWN
Community Support			UNKNOWN

FRESNO COUNTY'S REGULATORY MITIGATION CAPABILITIES

Table 66. Fresno County's Regulatory Mitigation Capabilities regulatory mitigation capabilities, including planning and land management tools, typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in Fresno County. Excerpts from applicable policies, regulations, and plans and program descriptions follow to provide more detail on existing mitigation capabilities.

Table 66. Fresno County's Regulatory Mitigation Capabilities

Plans	In Place		Adopted/Updated	Under Development		Expected Completion
	Yes	No		Yes	No	
Building Codes (please indicate UCC or IBC + year)						UNKNOWN
Community Emergency Response Team (CERT)						UNKNOWN
Community Rating System (CRS Program of the NFIP)						UNKNOWN
Emergency Management Accreditation Program (EMAP)						UNKNOWN
Fire Code						UNKNOWN
Firewise Community						UNKNOWN
Floodplain Management/Flood Damage Prevention Ordinance						UNKNOWN
Land Use/Development Planning						UNKNOWN
National Flood Insurance Program (NFIP)						UNKNOWN
Post Disaster Redevelopment/Reconstruction Plan/Ordinance						UNKNOWN
Storm Ready						UNKNOWN
Stormwater Management Plan/Ordinance						UNKNOWN
Subdivision Regulations/Ordinance						UNKNOWN
Two Weeks Ready						UNKNOWN
Unified Development Ordinance						UNKNOWN
Zoning Ordinance						UNKNOWN

As indicated in the table above, Fresno County has several plans and programs that guide the County's development in hazard-prone areas. Starting with the Fresno County General Plan, which is the most comprehensive of the County's plans when it comes to mitigation, some of these are described in more detail below.

FRESNO COUNTY GENERAL PLAN

The Fresno County General Plan consists of multiple documents: the countywide General Plan Background Report, the countywide General Plan Policy Document, and over 40 regional, community, and specific plans. This discussion is derived primarily from the Fresno County General Plan Policy Document, from which the text that follows is largely extracted.

The Fresno County General Plan is a comprehensive, long-term framework for the protection of the county's agricultural, natural, and cultural resources and for development in the county. Designed to meet State general plan requirements, it outlines goals, policies, and programs and sets out plan proposals to guide day-to-day decisions concerning Fresno County's future. The County sees its primary role to be the protector of prime agricultural lands, open space, recreational opportunities, and environmental quality, and the coordinator of countywide efforts to promote economic development.

- Economic Development
- Agricultural Land Use
- Transportation and Circulation
- Public Facilities and Services
- Open Space and Conservation
- Health and Safety
- Environmental Justice
- Housing

Each of these elements includes goal statements relating to different aspects of the issues addressed in the element. Under each goal statement, the plan sets out policies that amplify the goal statement. Implementation programs are listed in a separate Administration and Implementation Section and describe briefly the action proposed by the program, the County agencies or departments with primary responsibility for carrying out the program, and the time frame for accomplishing the program.

The County is conducting a comprehensive review of its current General Plan. Based on the review, County staff has proposed revisions to the Plan's goals, policies, and programs.

Following is an element-by-element summary of the General Plan goals and policies that are most relevant to the Hazard Mitigation Plan Update. The summary tracks the organization of each element, with topically focused goals followed by related policies. Note that the summaries reflect policies as proposed by the County as a result of its ongoing review, including deletions and revisions.

STATE OF CALIFORNIA SAFETY ELEMENT

The state of California requires General Plans to address nine elements which include land use, circulation, housing, conservation, open space, noise, safety, environmental justice, and air quality. The safety elements aim to reduce the potential short and long-term risk of death, injuries, property damage, and economic and social dislocation resulting from fires, floods, droughts, earthquakes, landslides, climate change, and other hazards. The safety elements should contain general hazard and risk reduction strategies complementary to the local hazard mitigation plan. In order to support the Fresno County General Plan's Safety Element, the local hazard mitigation plan must address parts of the state's safety element requirements. **Table 67. California State Safety Element Requirements** includes the state's Safety Element requirements.

Table 67. California State Safety Element Requirements

Statutory Citation	Brief Description of Requirements
Gov. Code 65302(g)(1)	Identification of unreasonable risks and policies for the protection of the community from such risks.
Gov Code 65302(g)(1)	**Slope Instability** Slope instability leading to mudslides and landslides.

Gov. Code 65302(g)(1)	**Seismic risks, including:**
	Seismically induced surface rupture, ground shaking, ground failure, tsunami, seiche, and dam failures; subsidence, liquefaction, and other seismic hazards identified to Chapter 7.8 (commencing with Section 2690) of Division 2 of the Public Resources Code, and other geologic hazards known to the legislative body
	
	• Mapping known seismic and other geologic hazards
	• Address
	  ○ Evacuation routes
	  ○ Military installations
	  ○ Peak load water supply requirements and
	  ○ Minimum road widths and clearances around structures

Gov. Code 65302(g)(2)	Flooding **Identify** • Flood Hazard Zones • FEMA Flood Insurance Maps • Army Corps of Engineer Flood Information • Flood maps from the Central Valley Flood Protection Board • Dam Failure Maps (Office of Emergency Services) • DWR Floodplain Maps • Maps of Levee Protection Zones • Areas subject to inundation in the event of the failure of levees and floodwalls • Historic flood information • Existing and planned development in flood hazard areas • Agencies with responsibility for flood protection **Mandatory Goals, Policies, and Objectives** • Avoid and minimize flood risks for new development • Should new development be located in flood hazard zones? If so, what are appropriate mitigation measures? • Maintain the integrity of essential public facilities • Locate, when feasible, new essential public facilities outside of flood hazard zones, including hospitals and health care facilities, emergency shelters, fire stations, emergency command centers, and emergency communications facilities, or identifying mitigation measures. • Establishing cooperative working relationships among public agencies with responsibility for flood protection Feasible Mitigation Measures, to implement the policies above.
Gov. Code 65302(g)(3)	**Wildland and Urban Fires**

Statutory Citation	Brief Description of Requirements
	Identification of, and policies for, the protection of the community from, unreasonable risks associated with wildland and urban fires. State Responsibility Areas and Very High Fire Hazard Severity Zones Consider advice in OPR's Fire Hazard Technical Advisory Identify • CalFIRE Fire Hazard Severity Zone Maps • Historical data on wildfires • USGS wildfire hazard areas • Existing and planned development within these areas • Agencies with responsibility for fire protection in these areas **Mandatory Goals, Policies and Objectives** • Protect the community from unreasonable risks • See mitigation measures below **Feasible Mitigation** • Avoid and minimize fire risks for new development • Should new development be located in fire hazard zones? If so, what are appropriate mitigation measures? • Maintain the integrity of essential public facilities • Locate, when feasible, new essential public facilities outside of fire hazard zones, including hospitals and health care facilities, emergency shelters, fire stations, emergency command centers, and emergency communications facilities. • If essential facilities are located in high fire zones, identify mitigation measures, such as safe access for emergency response vehicles, visible street signs, and water supplies for structural fire suppression • Establishing cooperative working relationships among public agencies with responsibility for fire protection
Gov. Code 65302(g)(4)	**Climate Change Adaptation and Resilience** Address climate change adaptation and resiliency strategies by using the process in the Adaptation Planning Guide and reflected in referenced tools such as Cal-Adapt **Vulnerability Assessment (Gov Code 65302(g)(4)(A)** Create a vulnerability assessment that identifies the risks that climate change poses to the local jurisdiction and the geographic areas at risk from climate change impacts, the following: • Information that may be available from federal, state, regional, and local agencies that will assist in developing the vulnerability assessment and the adaptation policies and strategies, including, but not to, all of the following (I) Information from the Internet based Cal-Adapt tool (II) Information from the most recent version of the California Adaptation Planning Guide (III) Information from local agencies on the types of assets, resources, and populations that will be sensitive to various climate change exposures (IV) Information from local agencies on their current ability to deal with the impacts of climate change (V) Historical data on natural events and hazards, including locally prepared maps of areas subject to previous risk, areas that are vulnerable, and sites that have been repeatedly damaged (VI) Existing and planned development in identified at-risk areas, including structures, roads, utilities, and essential public facilities

<table>
<tr><th>Statutory Citation</th><th>Brief Description of Requirements</th></tr>
<tr><td></td><td>(VII) Federal, state, regional, and local agencies with responsibility for the protection of public health and safety and the environmental, including special districts and local offices of emergency services

Mandatory Goals, Policies, and Objectives (Gov. Code 65302(g)(4)(B))
• Crete a set of adaptation and resilience goals, policies, and objectives based on the information above for the protection of the community</td></tr>
<tr><td>Gov. Code 65302(g)(4)

CONTINUED</td><td>Feasible Mitigation (Gov. Code 65302(g)(4)(C))
• Create a set of feasible implementation measures designed to carry out the goals, policies, and objectives identified above, including but not limited to, all of the following:
(i) Feasible methods to avoid or minimize climate change impacts associated with new uses of land
(ii) The location, when feasible, of new essential public facilities outside of at-risk areas, including, but not limited to, hospitals and health care facilities, emergency shelters, emergency command centers, and emergency communications facilities, or identifying construction methods or other methods to minimize damage if these facilities are located in at-risk areas.
(iii) The designation of adequate and feasible infrastructure located in an at-risk area
(iv) Guidelines for working cooperatively with relevant local, regional, state, and federal agencies
(v) The identification of natural infrastructure that may be used in adaptation projects, where feasible. Where feasible, the plan shall use existing natural features and ecosystem processes, or the restoration of natural features and ecosystem processes, when developing alternatives for consideration. For the purposes of the clause, “natural infrastructure” means preservation or restoration of ecological systems, or utilization of engineered systems that use ecological processes, to increase resiliency to climate change, manage other environmental hazards, or both. This may include but is not limited to floodplain and wetlands restoration or preservation, combining levees with restored natural systems to reduce flood risk, and urban tree planting to mitigate high heat days.

Other documents (Gov. Code 65302(g)(4)(D)(i), 65302(g)(4)(D)(ii)
• If a city or county has adopted the local hazard mitigation plan, or other climate adaptation plan or document that fulfills commensurate goals and objectives and contains the information required pursuant to this paragraph, separate from the general plan, an attachment of, or reference to, the local hazard mitigation plan or other climate adaptation plan or document
• Cities or counties that have an adopted hazard mitigation plan, or other climate adaptation plan or document that substantially complies with this section or have substantially equivalent provisions to this subdivision in their general plans, may use with this section, or have substantially equivalent provisions, climate adaptation plan or document, specifically showing how each requirement of this subdivision has been met.</td></tr>
<tr><td>Gov Code 65302(g)(5)-(g)(8)</td><td>Other Considerations

• Cities and counties that have floodplain management ordinances that have been approved by FEMA that substantially comply with this section, or have substantially equivalent provisions to this subdivision in their general plans, may use that information in the safety element to comply with this subdivision, and shall summarize and incorporate by reference into the safety element the other general plan provisions or the flood plain ordinance, specifically showing how each requirement of this subdivision has been met.
• Prior to the periodic review of its general plan and prior to preparing or revising its safety element, each city and county shall consult the California Geological Survey of the Department of Conservation, the Central Valley Flood Protection Board, if the city or county is located within the boundaries of the Sacramento and San Joaquin Drainage District, as set forth in Section 8501 of the Water Code, and the Office of Emergency Services for the</td></tr>
</table>

Statutory Citation	Brief Description of Requirements
	purpose of including information known by and available to the department, the agency, and the board required by this subdivision. • To the extent that a county's safety element is sufficiently detailed and contains appropriate policies and programs for adoption by a city, a city may adopt that portion of the county's safety element that pertains to the city's planning area in satisfaction of the requirement imposed by this subdivision. • Review the safety element for fire and flood impacts upon each Housing Element update. • Review the safety element for climate change at each update to the Local Hazard Mitigation Plan, Jurisdiction may also choose to do a comprehensive review of the safety element upon each housing element update to streamline review.

HEALTH AND SAFETY ELEMENT

Planning for growth and development requires the consideration of a wide range of public safety issues. Many of the health and safety risks associated with development, including risks to buildings and infrastructure, can be avoided through siting decisions made at the planning stages of development, while others may be lessened through the use of mitigation measures in the planning and land use review process. This element outlines Fresno County's strategy for ensuring the maintenance of a healthy and safe physical environment. Applicable goals and policies are presented below.

Emergency Management and Response

Policies listed in the table below seek to create an effective emergency response and management system by ensuring that vital public infrastructure is designed to remain operational during and after a major disaster event, by siting critical emergency response facilities as far from potential disaster impact areas as is practical, and through continuing public education and outreach on emergency preparedness and disaster response programs.

Table 4. Fresno County Emergency Management and Response Goals

Goal or Policy	Description
Goal HS-A	To protect public health and safety by preparing for, responding to, and recovering from the effects of natural or technological disasters.
Policy A.1	The County shall, through the Fresno County Operational Area Master Emergency Services Plan and the Fresno County Multi-Hazard Mitigation Plan, maintain the capability to effectively respond to emergency incidents, including maintenance of an emergency operations center.
Policy HS-A.2	In coordination with cities, special districts, and other State and Federal agencies, the County shall maintain the Fresno County Multi- Jurisdictional Hazard Mitigation Plan to identify and mitigate, to the extent feasible, natural, and human-made hazards within the county.
Policy HS-A.3:	The County shall, within its authority and to the best of its ability, ensure that emergency dispatch centers, emergency operations centers, communications systems, vital utilities, and other essential public facilities necessary for the continuity of government are designed in a manner that will allow them to remain operational during and following an earthquake or other disaster.
Policy HS-A.4:	The County shall ensure that the siting of critical emergency response facilities such as hospitals, fire stations, sheriff's offices and substations, dispatch centers, emergency operations centers, and other emergency service facilities and utilities are sited and designed to minimize their exposure and susceptibility to flooding, seismic and geological effects, fire, landslides, avalanche, and explosions as required by State regulations. This includes locating new essential public facilities outside of Very High Fire Hazard Severity Zones, if feasible. Exception to this policy shall be allowed on the condition that

Goal or Policy	Description
	the only alternative location would be so distant as to jeopardize the safety of the community, given that precautions are taken to protect the facility.
Policy HS-A.5	The County shall maintain coordination with other local, State, and Federal agencies to provide coordinated disaster response, especially to the most impacted populations in the County.
Policy HS-A.6:	The County shall support local fire agencies through distribution of information during the permit process, through links on County websites, and by providing assistance at public meetings, in promoting the education of County residents concerning emergency preparedness, defensible space, and safety, as described in the Fresno-King Unit Fire-Plan information and public education outreach programs, focusing on the most vulnerable at-risk communities such as those in the Very High Fire Hazard Severity Zone.
Policy HS-A.7	The County shall review the design of all buildings and structures in the Very High Fire Hazard Severity Zones and State Responsibility Areas to ensure they are designed and constructed to State and local regulations and standards as part of the building permit plan check process.
Policy HS-A.8	The County shall continue to improve community transportation corridors to allow for effective evacuation routes for the public and effective access for emergency responders, including in areas that lack more than two emergency access routes.
Policy HS-A.9	The County shall prevent and control the spread of vector-borne diseases through best practice vector control techniques on County properties and will encourage use of these practices on other properties.
Policy HS-A.10	The County, as part of its five-year Capital Improvement Plan, shall conduct an evaluation of all County facilities including those operated by County first responders to determine retrofits that may be needed for long-term resilience to climate change hazards including wildfire and drought.
Policy HS-A.11	The County shall invest in sustainable backup power sources as funding becomes available to provide redundancy and continued services for critical facilities in the event of a power outage triggered by a climate event.
Policy HS-A.12	Establish minimum standards for evacuation, including in the Very High Fire Hazard Severity areas, in the Emergency Operations Plan and continuously reassess access and evacuation route capacity and put mitigation measures and improvement plans in place if needed.
Policy HS-A.13	The County shall periodically evaluate the ability of County facilities to function after a major disaster as well as project and assess future emergency needs.

FIRE HAZARDS

Policies in this section and in **Table 68. Fresno County Fire Hazard Goals and Policies** are designed to ensure that new developments are constructed to minimize potential fire hazards, minimize the risk of fire in already developed areas, and to provide public education concerning fire prevention.

Table 68. Fresno County Fire Hazard Goals and Policies

Goal or Policy	Description
Goal HS-B:	To minimize the risk of loss of life, injury, and damage to property and natural resources resulting from fire hazards.
Policy HS-B.1:	The County shall review project proposals to identify potential fire hazards and to evaluate the effectiveness of preventive measures to reduce the risk to life and property.
Policy HS-B.2:	The County shall ensure that development in high fire hazard areas is designed and constructed in a manner that minimizes the risk from fire hazards by increasing resistance of structures to heat, flames, and embers. The County shall review current building code standards and other applicable statutes, regulations, requirements, and guidelines regarding construction, and specifically the use and maintenance of non-flammable materials (both residential and commercial) and consider adopting

Goal or Policy	Description
	amendments to Title 15 of the County Ordinance Code (Building and Construction) to implement appropriate standards. Special consideration shall be given to the use of fire- resistant construction in the underside of eaves, balconies, unenclosed roofs and floors, and other similar horizontal surfaces in areas of steep slopes.
Policy HS-B.3:	The County shall coordinate with telecommunication service entities to fire-harden communications.
Policy HS-B.4:	The County shall require that new discretionary development including residential subdivisions and large commercial proposals in high-fire- hazard areas have fire-resistant vegetation, cleared fire breaks separating communities or clusters of structures from native vegetation, or a long-term comprehensive vegetation and fuel management program. Fire hazard reduction measures shall be incorporated into the design development projects in fire hazard areas.
Policy HS-B.5:	In consultation with the local fire agency and CalFire, the County shall require structures to be sited to maximize low-flammability landscape features to buffer against wildfire spread. Consultation with the local fire agency will be necessary to make this determination.
Policy HS-B.6:	The County shall require that new foothill and mountain subdivisions and residential areas in Very High Fire Hazard Severity Zones provide for safe and ready access for fire and other emergency equipment, for routes of escape that will safely handle evacuations, and for roads and streets designed to be compatible with topography while meeting fire safety needs.
Policy HS-B.7:	The County shall require new discretionary development projects to have adequate access for fire and emergency vehicles and equipment. All major subdivisions shall have a minimum of two (2) points of ingress and egress. The County shall implement feasible recommendations in AB2911 Office of the State Fire Marshall Subdivision Survey Reports, which survey subdivisions without a secondary means of egress routes for evacuation and other fire safety factors.
Policy HS-B.8:	The County shall work with local fire protection agencies, local wildfire mitigation groups, the California Department of Forestry and Fire Protection, and the U.S. Forest Service to promote the maintenance of existing fuel breaks and emergency access routes for effective fire suppression and in managing wildland fire hazards.
Policy HS-B.9:	The County shall require that community fire breaks be coordinated with overall fire break plans developed by CalFire and local foothill and mountain fire agencies for Very High Fire Hazard Severity Zones and State Responsibility Areas. Firebreak easements in subdivisions of more than four parcels or in built-up areas shall include access for firefighting personnel and motorized equipment. Easements shall be dedicated for this purpose.
Policy HS-B.10:	The County shall refer development proposals in the Very High Fire Hazard Severity Zones and State Responsibility Areas of the unincorporated county to the appropriate local fire agencies for review of compliance with fire safety standards. If dual responsibility exists, both agencies shall review and comment relative to their area of responsibility. If standards are different or conflicting, the more stringent standards shall apply.
Policy HS-B.11:	The County shall work with Cal Fire and local fire agencies to establish development requirements for year-round fire protection in foothill and mountain areas having existing or proposed population concentrations that need structural fire protection, and for agricultural land uses located in and bordering fire hazard zones.
Policy HS-B.12:	The County shall work to design new and modify existing County buildings of public assembly to incorporate adequate fire protection measures to reduce potential loss of life and property in accordance with State and local codes and ordinances and include consideration for filtration systems that improve air quality.
Policy HS-B.13:	The County shall permit development only within areas that have adequate water resources available, to include water pressure, onsite water storage, or fire flows.
Policy HS-B14:	The County shall require new discretionary development to have water systems that meet fire flow requirements as determined by applicable California Fire Code requirements and/or National Fire Protection Association (NFPA) standards under the authority of the Chief Fire Code Official and as referenced in County Ordinance Code. Where minimum fire flow is not available to meet these standards, alternate fire protection measures, including sprinkler systems and on-site water supply or storage, shall be identified, and may be incorporated into development if approved by the appropriate fire protection agency. The County shall require that all public water providers maintain the long-term integrity of adequate water supplies and flow to meet fire suppression needs.

Goal or Policy	Description
Policy HS-B15:	The County shall ensure that any new development will have adequate fire protection, including proximity to adequate emergency services, adequate provisions for fire flow and emergency vehicle access and fire hardened communication, including high speed internet service.
Policy HS-B16:	The County shall restrict or require mitigation for new discretionary development along steep slopes and amidst rugged terrain to limit rapid fire spread and increase accessibility for firefighting.
Policy HS-B17:	The County shall promote installation and maintenance of smoke detectors in existing residences and commercial facilities that were constructed prior to the requirement for their installation.
Policy HS-B18:	The County shall work with local fire agencies to develop high-visibility fire prevention programs, including education programs and voluntary home inspections.
Policy HS-B19:	The County shall require all new discretionary development consisting of major residential subdivisions and large commercial projects in the Very High Fire Hazard Severity Zone and State Responsibility Areas to develop site- specific fire management plans to maintain adequate access for emergency vehicles, including two points of access for subdivisions and multifamily developments, address fuel modification and/or incorporation of open space or other defensible space areas, maintain vegetation clearance on public and private roads, and include disclosure requirements to future property owners or residents as required by state law. Require ongoing maintenance and upkeep to be incorporated or recorded as part of building covenants or homeowner covenants, conditions, and restrictions.
Policy HS-B20:	As part of the next update to the Fresno County Multi-Hazard Mitigation Plan, the County, working with emergency service agencies, shall evaluate evacuation route capacity, safety, and viability under a range of emergency scenarios to facilitate fire, law enforcement, and ambulance access and resident egress, consistent with the existing goals and objective of the Fresno County Multi-Hazard Mitigation Plan.
Policy HS-B21:	The County shall collaborate with federal agencies to better manage fuel loads and hazards that could impact County owned/operated infrastructure on federally owned or managed lands.
Policy HS-B22:	The County shall make available and promote educational materials for defensible space standards, or vegetation “clear zones,” and vegetation compliance for all existing and new structures in areas that are designated by the California Department of Forestry and Fire Protection and Local Ordinance 15.60 as State Responsibility Areas or Very High Fire Hazard Severity Zones.
Policy HS-B23:	The County, working with applicable fire agencies, shall make reasonable effort to minimize the risk to existing developments in Very High Fire Hazard Severity Zones and State Responsibility Areas by educating property owners and responsible entities of the benefits of improving such developments to contemporary fire safe standards, in terms of road standards and vegetative hazard, and require all development to meet or exceed the County’s Title 15 – Building and Construction, Chapter 15.60 State Responsibility Area Fire Safe Regulations of the County under the County’s Code of Ordinances and applicable updates.
Policy HS-B24:	The County shall require all new discretionary development consisting of major residential subdivisions and large commercial projects to provide, and existing development to maintain, adequate access for emergency vehicles, including two points of access for subdivisions and multifamily developments.
Policy HS-B25:	Require development to adhere to standards that meet or exceed Title 14, CCR, Division 1.5, Chapter 7, Subchapter 2, Articles 1-5 (commencing with Section 1299.01) (Fire Hazard Reduction Around Buildings and Structures Regulations) for State Responsibility Areas and/or Very High Fire Hazard Severity Zones.
Policy HS-B26:	The County shall maintain and update its Master Emergency Services Plan, as necessary, to include an assessment of current emergency service and projected emergency service needs, and goals or standards for emergency service training for County staff and volunteers.
Policy HS-B27:	In the event of a large fire, the County shall evaluate re-development within the impacted fire zone to conform to contemporary fire safe standards and require all development to meet or exceed the County's Title 15 - Building and Construction, Chapter 15.60 State Responsibility Area Fire Safe Regulations of the County under the County's Code of Ordinances, and applicable updates.
Policy HS-B28:	The County shall coordinate with local and state fire agencies to ensure that all new developments and applicable re-constructions (as defined by state law) in the very high fire hazard severity zone and State Responsibility Areas, comply with defensible space regulations, home and street addressing and

Goal or Policy	Description
	signage, the latest fire-safe standards, Board of Forestry and Fire Protection fire safe regulations and the most current version of the California Building Code and California Fire Code.
Policy HS-B29:	Coordinate with Southern California Edison and Pacifica Gas and Electric Company to implement an electrical undergrounding plan with a focus on critical evacuation roadways and areas with highest wildfire risk.
Policy HS-B30:	The County shall, if necessary, revise the Health and Safety Element upon each revision of the Housing Element or Fresno County Multi- Hazard Mitigation Plan, but not less than once every eight years, to identify new information relating to flood and fire hazards and climate adaptation and resiliency strategies applicable to the county.
Policy HS-B31:	The County shall work with relevant agencies such as CAL FIRE, Fresno County Sheriff's Office, Caltrans, Fresno County Public Works and Planning, and private Homeowners Associations, to restrict parking periodically (e.g., on red flag days) along critical evacuation routes.

FLOOD HAZARDS

Policies in this section and in **Table 69. Fresno County Flood Hazard Goals and Policies** are designed to minimize flood hazards by restricting development in flood- prone areas, requiring development that does occur in floodplains to be designed to avoid flood damage, and through public education about flood hazards.

Table 69. Fresno County Flood Hazard Goals and Policies

Policy or Goal	Description
Goal HS-C	To minimize the risk of loss of life, injury, and damage resulting from flood hazards.
Policy HS-C.1	The County shall coordinate with the cities in Fresno County to develop and maintain a countywide flood emergency plan that is consistent with the Fresno County General Plan and city general plans.
Policy HS-C.2	The County shall prohibit new development in existing undeveloped areas (i.e., areas devoted to agriculture or open space that are not designated for development) protected by a State flood control project without appropriately considering significant known flooding risks and taking reasonable and feasible action to mitigate the potential property damage to the new development resulting from a flood.
Policy HS-C.3	The County shall not enter into a development agreement, approve any building permit or entitlement, or approve a tentative or parcel map unless it finds one of the following: a. The flood control facilities provides 200-year level of protection in urban and non- urban areas consistent with the current Central Valley Flood Protection Plan. b. Conditions imposed on the development will protect the property at a 200-year level of protection in urban and non-urban areas consistent with the current Central Valley Flood Protection Plan; or c. The local flood management agency has made "adequate progress" on the construction of a flood protection system which will result in protection equal or greater than the 200-year flood event in urban and non-urban areas consistent with the current Central Valley Flood Protection Plan.
Policy HS-C.4	The County shall require new flood control projects or developments within areas subject to 100- and 200-year frequency floods are designed and constructed in a manner that will not cause floodwaters to be diverted onto adjacent property or increase flood hazards to property located elsewhere.
Policy HS-C.5	The County shall encourage all agencies that operate public facilities, such as wastewater treatment plants, gas, electrical, and water systems, located within areas subject to 100- and 200-year frequency floods to locate and construct facilities to minimize or eliminate potential flood damage.
Policy HS-C.6	The County shall encourage, as applicable, expansion of stormwater and flood protection infrastructure capacity to accommodate changes in precipitation and extreme weather events including the establishment or expansion of recharge basins.

Policy or Goal	Description
Policy HS-C.7	The County shall support State and local flood management agencies to provide relocation assistance or other cost-effective strategies for reducing flood risk to existing economically- disadvantaged communities located in non- urbanized areas.
Policy HS-C.8	The County shall work with local, regional, State, and Federal agencies to maintain an adequate information base, prepare risk assessments, and identify strategies to mitigate flooding impacts.
Policy HS-C.9:	The County shall encourage the Fresno Metropolitan Flood Control District to control stormwater flows originating in the streams of the Fresno County Stream Group and the stormwater resulting from urban development by means of construction of dams or joint-use flood control and recharge facilities at appropriate locations.
Policy HS-C.10:	The County shall require that the design and location of dams and levees be in accordance with applicable design standards and specifications and accepted design and construction practices.
Policy HS-C.11:	The County shall require that the design and location of dams and levees be in accordance with applicable design standards and specifications and accepted design and construction practices.
Policy HS-C.12:	The County shall encourage the performance of appropriate investigations to determine the 200- year water surface elevations for the San Joaquin River, considering recent storm events and existing channel conditions, to identify the potential extent and risk of flooding. New development, including public infrastructure projects, shall not be allowed along the river until the risk of flooding at the site has been determined and appropriate flood risk reduction measures identified.
Policy HS-C.13:	Where existing development is in a flood hazard area, the County shall require that construction of flood control facilities proceed only after a complete review of the environmental effects and a project cost/benefit analysis.
Policy HS-C.14:	The County shall promote flood control measures that maintain natural conditions within the 200-year floodplain of rivers and streams and, to the extent possible, combine flood control, recreation, water quality, and open space functions. Existing irrigation canals shall be used to the extent possible to remove excess stormwater. Retention-recharge basins should be located to best utilize natural drainage patterns.
Policy HS-C.15:	The County shall continue to participate in the Federal Flood Insurance Program by ensuring compliance with applicable requirements.
Policy HS-C.16:	The County shall continue to implement and enforce its Floodplain Management Ordinance. During the building permit review process, the County shall ensure project compliance with applicable Federal Emergency Management Agency (FEMA) standards pertaining to residential and non-residential development in the floodplain, floodway, or floodway fringe.
Policy HS-C.17:	The County shall prohibit the construction of essential facilities (e.g., hospitals, police and fire facilities) in the 100- and 200-year floodplains, unless it can be demonstrated that the facility can be safely operated and accessed during flood events.
Policy HS-C.18:	The County shall encourage open space uses in all flood hazard areas. Land Conservation contracts and open space and scenic easements should be made available to property owners.
Policy HS-C.19:	The County shall consider dam failure inundation maps of all reservoirs in making land use and related decisions.
Policy HS-C. 20:	The County shall continue public awareness programs to inform the general public and potentially affected property owners of flood hazards and potential dam failure inundation.

SEISMIC AND GEOLOGICAL HAZARDS

Policies in this and in **Table 70. Fresno County Seismic and Geological Hazard Goals and Policies** section seek to ensure that new buildings and facilities are designed to withstand seismic and geologic hazards.

Table 70. Fresno County Seismic and Geological Hazard Goals and Policies

Policy or Goal	Description
Goal HS-D:	To minimize the loss of life, injury, and property damage due to seismic and geologic hazards.
Policy HS-D.1:	The County shall continue to support scientific geologic investigations that refine, enlarge, andimprove the body of knowledge on active fault zones, unstable areas, severe ground shaking, avalanche potential, and other hazardous geologic conditions in Fresno County.
Policy HS-D.2:	The County shall ensure that the General Plan and/or County Ordinance Code is revised, as necessary, to incorporate geologic hazard areas formally designated by the state geologist (e.g., earthquake fault zones and seismic hazard zones). Development in such areas, including public infrastructure projects, shall not be allowed until compliance with the investigation and mitigation requirements established by the state geologist can be demonstrated.
Policy HS-D.3:	The County shall require that a soils engineering and geologic-seismic analysis be prepared by a California-registered engineer or engineering geologist prior to permitting development, including public infrastructure projects, in areas prone to geologic or seismic hazards (i.e., fault rupture, ground shaking, lateral spreading, lurchcracking, fault creep, liquefaction, subsidence, settlement,landslides, mudslides, unstable slopes, or avalanche).
Policy HS-D.4:	The County shall require all proposed structures, additions to structures, utilities, or public facilities situated within areas subject to geologic-seismic hazards as identified in the soils engineering and geologic-seismic analysis to be sited, designed, and constructed in accordancewith applicable provisions of the Uniform Building Code (Title 24 of the California Code of Regulations) and other relevant professional standards to minimize or prevent damage or loss and to minimize the risk to public safety.
Policy HS-D.5:	Pursuant to the Alquist-Priolo Earthquake Fault Zoning Act (Public Resources Code, Chapter 7.5), the County shall not permit any structure for human occupancy to be placed within designated earthquake fault zones unless the specific provisions of the act and Title 14 of theCalifornia Code of Regulations have been satisfied.
Policy HS-D.6:	The County shall ensure compliance with state seismic and building standards in the evaluation, design, and siting of critical facilities, including police and fire stations, school facilities, hospitals, hazardous material manufacture and storage facilities, bridges, large public assembly halls, and other structures subject to special seismic safety design requirements.
Policy HS-D.7:	The County shall require a soils report by a California-registered engineer or engineering geologist for any proposed development, including public infrastructure projects, that requires a County permit and is located in an area containing soils with high "expansive" or "shrink-swell" properties. Development in such areas shall be prohibited unless suitable design and constructionmeasures are incorporated to reduce the potential risks associated with these conditions.
Policy HS-D.8:	The County shall seek to minimize soil erosion by maintaining compatible land uses, suitable building designs, and appropriate construction techniques. Contour grading, where feasible, andrevegetation shall be required to mitigate the appearance of engineered slopes and to control erosion.
Policy HS-D.9:	The County shall require the preparation of drainage plans for development or public infrastructure projects in hillside areas to direct runoff and drainage away from unstable slopes.
Policy HS-D.10:	The County shall not approve a County permit for new development, including public infrastructure projects where slopes are over 30 percent unless it can be demonstrated by a California-registered civil engineer or engineering geologist that hazards to public safety will bereduced to acceptable levels.
Policy HS-D.11:	In known or potential landslide hazard areas, the County shall prohibit avoidable alteration of landin a manner that could increase the hazard, including concentration of water through drainage, irrigation, or septic systems, undercutting the bases of slopes, removal of vegetative cover, and steepening of slopes.
Policy HS-D.12:	The County shall not approve a County permit for new development, including public infrastructure projects, in known or potential avalanche hazard areas unless it can be demonstrated by a California-registered engineer or engineering geologist that the structures willbe safe under anticipated snow loads and avalanche conditions.
Policy HS-D.13:	Whenever zoning is employed to restrict the use of land subject to severe geologic hazards (e.g., landslides), the County shall designate parcels so restricted for open space uses.

HAZARDOUS MATERIALS

Policies in this section and in **Table 71. Fresno County Hazardous Materials Goals and Policies** are designed to ensure that development projects minimize public risks associated with both intended and unintended exposure to hazardous materials and wastes.

Table 71. Fresno County Hazardous Materials Goals and Policies

Goal or Policy	Description
Goal HS-F	To minimize the risk of loss of life, injury, serious illness, and damage to property resulting from the use, transport, treatment, and disposal of hazardous materials and hazardous wastes.
Policy HS-F.1:	The County shall require that facilities that handle hazardous materials or hazardous wastes be designed, constructed, and operated in accordance with applicable hazardous materials and waste management laws and regulations.
Policy HS-F.2:	The County shall require that applications for discretionary development projects that will use hazardous materials or generate hazardous waste in large quantities include detailed information concerning hazardous waste reduction, recycling, and storage.

ADAPTATION AND RESILIENCY

Goals and policies in this section set climate change adaptation and resiliency standards and seek to protect life and property from the effects of climate change. This element is new and has been updated in the County's General Plan since the 2018 plan update, described in **Table 72. Fresno County Adaptation and Resiliency Goals and Policies**.

Table 72. Fresno County Adaptation and Resiliency Goals and Policies

Goal or Policy	Description
Goal HS-G	To improve the sustainability and resiliency of the County through continued efforts to reduce the causes of adapt to climate change.
Policy HS-G.1:	The county shall support plans, standards, regulation, incentives, and investments to reduce the impacts of climate change.
Policy HS-G.2:	The county shall monitor information from Federal, State, and regional agencies on the effects of climate change to determine if the County should implement additional adaptation strategies
Policy HS-G.3	The County shall continue to collaborate with Federal, State, and regional, and local agencies, business and property owners, and residents to reduce generation of GHG and other emissions that contribute to climate change and adapt to potential effects of climate change
Policy HS-G.4	The County shall support programs to provide financial assistance for the retrofitting of low-income homes (such as energy efficiency upgrades, improved insulation, renewable energy upgrades, and use of electric appliances).

AGRICULTURE AND LAND USE ELEMENT

Applicable goals and policies from the Agriculture and Land Use Element are presented below.

RESOURCE LANDS

This section and addresses land that will remain primarily open in character. The goals, policies, and implementation programs for these topics reflect a basic commitment to preserve the existing open rural character of the County and its natural and managed resources. While necessarily protective and restrictive, the policies also recognize the need to maintain economic productivity and allow for urban growth. The intent of the policies is not to preclude intensive development but to direct it to minimize loss of valuable open space.

AGRICULTURE

Policies in this section and in **Table 73. Fresno County Agricultural Goals and Policies** seek to sustain agriculture by protecting agricultural activities from incompatible land uses, promoting agricultural land preservation programs, developing programs to preserve or maintain soil conditions or improve soil productivity, facilitating agricultural production by supplying adequate land for support services, and controlling expansion of nonagricultural development onto productive agricultural lands.

Table 73. Fresno County Agricultural Goals and Policies

Goal or Policy	Description
Goal LU-A:	To promote the long-term conservation of productive and potentially- productive agricultural lands and to accommodate agricultural-support services and agriculturally- related activities that support the viability of agriculture and further the County's economicdevelopment goals.
Policy LU-A.13:	The County shall protect agricultural operations from conflicts with nonagricultural uses by requiring buffers between proposed non-agricultural uses and adjacent agricultural operations.
Policy LU-A.14:	The County shall ensure that the review of discretionary permits includes an assessment of the conversion of productive agricultural land and that mitigation be required where appropriate.
Policy LU-A.20:	The County shall adopt and support policies and programs that seek to protect and enhance surface water and groundwater resources critical to agriculture.
Policy LU-A.22	The County shall adopt and support policies and programs that seek to minimize the impact of reoccurring drought conditions on ground water supply and the agricultural industry.

WESTSIDE RANGELANDS

Policies in this section and in **Table 74. Fresno County Rangelands Goals and Policies** seek to preserve rangelands by maintaining their open space character, minimizing grading and erosion, maintaining grazing and agricultural operations, accommodating mineral resource recovery, and protecting biological resources from development.

Table 74. Fresno County Rangelands Goals and Policies

Goal or Policy	Description
Goal LU-B:	To preserve the unique character of the Westside Rangelands, which includes distinctivegeologic and topographic landforms, watersheds, important agricultural activities, and significant biological resources, while accommodating agriculture, grazing, recreation, resource recovery, and other limited uses that recognize the sensitive character of the area.
Policy LU-B.12:	The County shall require a preliminary soils report for discretionary development projects when the project site is subject to moderate or high-risk landslide potential and has slopes in excess of 15

Goal or Policy	Description
	percent. If the preliminary soil report indicates soil conditions could be unstable, a detailed geologic report by a registered geologist and registered civil engineer, or a registered engineeringgeologist, shall be required indicating the suitability of any proposed or additional development.

RIVER INFLUENCE AREAS

Policies in this section and in **Table 75. Fresno County River Influence Areas Goals and Policies** seek to preserve and enhance the County's River influence areas by avoiding adverse impacts from development and encouraging environmentally friendly recreational and agricultural activities.

Table 75. Fresno County River Influence Areas Goals and Policies

Goal or Policy	Description
Goal LU-C:	To preserve and enhance the value of the river environment as a multiple use, open space resource; maintain the environmental and aesthetic qualities of the area; protect the quality and quantity of the surface and groundwater resources; provide for long term preservation of productive agricultural land; conserve and enhance natural wildlife habitat; and maintain the flood-carrying capacity of the channel at a level equal to the 1 percent flood event (100-year flood).
Policy LU-C.7:	Fresno County shall take into consideration the presence of the regulatory floodway or other designated floodway, the FEMA-designated 100-year floodplain, estimated 250-year floodplain, the Standard Project Flood, and the Fresno Metropolitan Flood Control District (FMFCD) Riverine Floodplain Policy in determining the location of future development within the San Joaquin River Parkway area. Any development sited in a designated 100-year floodplain shall comply with regulatory requirements at a minimum and with the FMFCD Riverine Floodplain Policy criteria, or requirements of other agencies having jurisdiction, where applicable.

RURAL DEVELOPMENT

This section guides development in areas designated Rural Residential, Rural Settlement Area, and Planned Rural Community. The policies provide for the continued development of areas within these designations in a manner that minimizes environmental impacts and public infrastructure investments, but generally limits expansion of these designations.

NONAGRICULTURAL RURAL DEVELOPMENT

Policies in this section and in **Table 76. Fresno County Non-Agricultural Rural Development Goals** and Policies provide for appropriate development in rural areas by directing development away from productive and potentially productive agricultural areas, limiting expansion of existing designated rural residential areas, and minimizing the environmental and service impacts of continued development within areas already designated for rural development.

Table 76. Fresno County Non-Agricultural Rural Development Goals

Goal or Policy	Description
Goal LU-E:	To provide for the continued development of areas already designated for rural-residential development in a manner that minimizes environmental impacts and public infrastructure and service costs while restricting designation of new areas for such development.
Policy LU-E.1:	The County shall allow by right in areas designated Rural Residential single-family dwellings and limited agricultural uses related to the production of food and fiber. The County may allow by discretionary permit certain other agricultural uses and non-agricultural uses, including rural commercial centers. For proposed rural commercial centers, the following criteria shall apply: a. Commercial uses should be clustered in centers instead of single uses. b. The use shall provide a needed service to the surrounding rural residential community which cannot be provided more efficiently within urban centers. c. To minimize proliferation of commercial centers and overlapping of trade areas, commercial centers shall be located a minimum of two (2) miles from a city sphere of influence. d. New commercial uses should be located within or adjacent to existing centers. e. Commercial centers should not encompass more than one-quarter (1/4) mile of road frontage, or one-eighth (1/8) mile if both sides of the road are involved, and should not provide potential for development exceeding ten (10) separate business activities, exclusive of caretakers' residences. f. The center shall be a minimum of four (4) miles from any agricultural commercial center, or designated rural settlement area, or the nearest existing or designated commercial area, or newly established rural residential commercial centers. g. The center should be located at the corner of an intersection where at least one of the roads is classified as an arterial road on the Transportation and Circulation Element of the General Plan. h. Distance from other existing commercial zoning and uses should be considered when siting commercial centers.
Policy LU-E.2:	The County shall permit the Rural Commercial (RCC) zone district to remain in areas designated Rural Residential if the land was so zoned prior to September 20, 1990. Commercial uses legally established prior to that date shall be deemed conforming, but expansion or addition of new commercial uses shall require a discretionary permit subject to the criteria in Policy LU-E.1.
Policy LU-E.3:	The County shall maintain two (2) acres as the minimum permitted lot size, exclusive of all road and canal rights-of-way, recreation easements, permanent water bodies, intermittent stream easements, and public or quasi-public common use areas, except as provided for in policies LU-E.6 and LU-E.7.
Policy LU-E.4:	The County shall recognize legal lots of less than two (2) acres that existed under separate ownership at the time of zone adoption within the rural residential zone districts.
Policy LU-E.5:	The County may allow planned residential developments in areas designated Rural Residential subject to Policies LU-H.6 and LU- H.7b (for developments permitted under Policy LU-E.7), and Policies LU-H.7e through LU- H7k.
Policy LU-E.6:	The County shall allow planned residential developments in areas that are currently designated for rural residential development subject to the following conditions: a. The minimum lot area shall be two (2) acres. b. The buildable portion of the lot shall be a minimum of thirty-six thousand (36,000) square feet. c. Dwellings shall be limited to single family structures. d. The ratio of lot depth to width shall not exceed four (4) to one (1). e. Individual wells and septic systems, or community water and sewer systems may be used. f. The size and configuration of the buildable portion of the lot shall be based on sufficient geological and hydrological investigations. g. Common open space areas that provide a portion of the two-acre lot should not include road and canal rights-of-way, reservations, permanent water bodies, intermittent stream easements, and common use areas that are occupied by buildings, streets, maintenance sheds, tennis courts, parking lots, and similar uses that are not of an open character. h. Common open space areas that provide a portion of the two-acre lot shall be vested in fee title ownership to each individual property owner, but may be used for common use purposes.
Policy LU-E.7:	In existing Rural Residential Areas, the County may allow, by a Conditional Use Permit, planned residential developments of at least one hundred (100) acres that incorporates drought- tolerant open

Goal or Policy	Description
	space (active and passive) where the minimum lot size is thirty-six thousand (36,000) square feet and the overall project density is one (1) dwelling unit per two (2) acres. The following standards shall apply: a. Community water and sewer systems may be used. b. Drought-tolerant open space (active and passive) may be included in the calculation of the required one (1) unit per two (2) acre density. c. Drought-tolerant open space (active and passive) shall be considered as common area and maintained through means acceptable to the County. The lake(s) or pond(s) shall be permanently filled with water, except for periods when surface water is not available, or maintenance requires temporary drainage. d. Drought-tolerant open space (active and passive) shall constitute a minimum of twenty- five (25) percent of the open space of the project. e. Common open space areas that provide a portion of the two- (2) acre density shall be designated as open space and zoned to the Open Conservation (O) District. f. Use of a permanent water body shall only be approved consistent with the water policies of this plan.
Policy LU-E.8:	The County shall not allow further parcelization of uncommitted (designated) Rural Residential areas lying northeast of the Enterprise Canal due to potential groundwater supply problems. These areas shall be zoned to a Limited Agricultural Zone District. However, rezoning and development for Rural Residential use may be permitted subject to the following criteria: a. The parcel to be developed is not productive agricultural land, and agricultural use of the property is not feasible. b. The County shall make a determination of the availability of an adequate water supply to serve the proposed development. If surface water is proposed, it must come from a reliable source and the supply must be made "firm" by water banking or other suitable arrangement. If groundwater is proposed, a "hydrogeologic investigation" or other information acceptable to the County shall be required to confirm the availability of groundwater in amounts necessary to meet project demand. c. The County shall make a determination of the impact that the use of the proposed water supply will have on other water users in Fresno County. If use of surface water is proposed, its use must not have a significant impact on agriculture or other water users within Fresno County. If use of groundwater is proposed, a hydrogeologic investigation shall be required. Should the hydrogeologic investigation determine that significant pumping-related impacts will extend beyond the boundary of the property in question, those impacts shall be mitigated. d. The County shall make a determination that the proposed water supply is sustainable or that there is an acceptable plan to achieve sustainability. The plan must be structured such that it is economically, environmentally, and technically feasible. In addition, its implementation must occur prior to long-term and/or irreversible physical impacts, or significant economic hardship, to surrounding water users.
Policy LU-E.9:	The County shall limit development of the thirty (30)-acre Friant Rural Residential area to twelve (12) housing units.
Policy LU-E.10:	The County shall require new subdivisions within areas designated Rural Residential be designed to use individual on-site sewer and water systems. All proposals shall be reviewed by the County to determine the appropriate minimum lot size based on local hydro- geological conditions. Community systems and lots less than two (2) acres may be permitted only in conjunction with a Planned Residential Development pursuant to Policy LU-E.7; where consistent with the policies of the Sierra-North and Sierra-South Regional Plans; or where a graduated transition of density is needed to protect existing rural residential developments from land use conflicts at the interface with urban development on land outside and adjacent to the sphere-of-influence of a city.
Policy LU-E.11:	The County shall require subdividers of rural residential lots to install, provide, or participate in an effective means for utilization of available surface water entitlements for the area included in the subdivision, such as: a. Facilities to deliver surface water to each parcel; b. To develop a single recharge basin for the entire development (with necessary arrangements for its operation and maintenance); or c. To participate in the activities of a public agency to recharge the available supplies for the beneficial use of the properties within the development and the FCMA. The division shall not render inoperative any existing canal.
Policy LU-E.12:	The County shall ensure through discretionary permit approvals and other development regulations that development within areas designated Rural Residential does not encroach upon natural water channels

Goal or Policy	Description
	or restrict natural water channels in such a way as to increase potential flooding damage. Land divisions shall not render inoperative any existing channel.
Policy LU-E.13:	The Special Commercial designation comprising approximately 150 acres on the south side of Shaw Avenue at the Indianola alignment recognizes an existing recreational facility and provides for consideration of potential future expansion of the facility and the development of additional compatible commercial recreational uses. Application of consistent zoning, which may include conditional zoning, and approval of any subsequent discretionary permit(s) shall include a finding that expansion of the facility will be compatible with the surrounding land uses.
Policy LU-E.14:	The County shall not designate additional land for Rural Residential or Foothill Rural Residential development, except for unique circumstances to be determined by the Board of Supervisors.
Policy LU-E.15:	Except as provided in this section, development within areas designated Foothill Rural Residential shall comply with the policies and standards of the Sierra-North Regional Plan and the Sierra-South Regional Plan.
Policy LU-E.16:	The County shall apply the Rural Settlement Area designation only to those areas where a small concentration of housing and commercial or industrial uses serves the surrounding agricultural area. The following locations are designated as Rural Settlements: Bowles, Centerville, Monmouth, and Cantua Creek.
Policy LU-E.17:	The County shall allow by right in areas designated Rural Settlement Area, single-family dwellings and limited agricultural uses related to the production of food and fiber. The County may allow by discretionary permit non- agricultural uses that provide a needed service to the surrounding rural area. Other uses consistent with the intent and purpose of these rural settlement policies may be added by amendment of the Rural Settlement Area zone district.
Policy LU-E.18:	The County may approve land divisions in areas designated Rural Settlement Area when the following criteria are met: a. The minimum net lot size shall be two (2) acres, except as allowed by LU-E.23c below. b. The ratio of lot depth width shall not exceed four (4) to one (1). c. A minimum of thirty-six thousand (36,000) square feet per lot shall be permitted if community water facilities are available and soils are suitable for individual septic systems.
Policy LU-E.19:	The County may allow expansion of existing Rural Settlement Areas to include vacant parcels, parcels wholly or partially committed to existing industrial uses, or parcels currently devoted to agricultural use if all of the following conditions are satisfied: a. The parcel is less than eighty (80) acres in area; b. The parcel is contiguous to properties in the Rural Settlement Area; the Rural Settlement Area; c. Productive agricultural use of the parcel is not economically feasible because incompatible non-agricultural uses on contiguous properties severely restrict normal agricultural practices; and d. The parcel is needed for the expansion of an existing use within the Rural Settlement Area or to establish an essential service for the Settlement and/or the surrounding agricultural area.
Policy LU-E.20:	The County shall require that the development of new commercial uses in Rural Settlement Areas be guided by the following criteria: a. The total number of existing and proposed commercial uses should not exceed fifteen (15), exclusive of caretakers' residence. b. The development should be designed to be compatible with existing uses on adjacent properties. c. The location of the proposed development shall satisfy one of the following conditions: d. The development should be on a major street or an intersection. e. The development should front on a road with existing commercial activity and should be within six hundred and sixty (660) feet of the nearest commercial use. f. Building height should not exceed the height of adjacent structures. g. Off-street parking should be sufficient for the proposed use.
Policy LU-E.21:	The County shall require that industrial zone districts within the Monmouth Rural Settlement Area be consistent with the following criteria: a. Parcels shall be wholly or partially committed to existing industrial uses; and b. Industrial zoning shall be conditioned to permit only agriculturally related industry.

Goal or Policy	Description
Policy LU-E.22:	The County shall allow development within the designated Quail Lakes Planned Rural Community to proceed in accordance with the Specific Plan adopted at the time the designation was granted by the County. The County may grant amendments to the Specific Plan provided the overall density of development is not increased and the plan continues to demonstrate the following: a. The development will have no significant adverse impacts on groundwater; b. Public improvements within a Planned Rural Community shall be designed and constructed in a manner that is not growth inducing but would not preclude future annexation to a city; c. Impacts on Fresno County for the provision of services including, but not limited to, police, fire protection, schools, and other essential public services are adequately mitigated; d. The development will not have a net adverse fiscal effect on Fresno County; e. Provide a service delivery plan and a maintenance and operation program which will assure appropriate delivery of services and funding measures for the development; and f. Provide for monitoring of mitigation measures established by the required Environmental Impact Report.
Policy LU-E.23:	The County shall not approve expansion of the existing Planned Rural Community designation or designate additional areas for such development.
Policy LU-E.24:	The Rural Residential designation comprising an approximate 481-acre area generally bounded by Friant Road/Willow Avenue to the west, Garonne Avenue to the south, those parcels immediately east and adjacent to Auberry Road to the east and generally the Birkhead Road alignment to the north and encompassing those parcels immediately to the west, northeast, and east of the full length of Willow Bluff Avenue. This is an area committed to rural-sized parcels. The Limited Agricultural zoning reflects potential water resource constraints in the general vicinity. Future rezoning of this area to the implementing Rural Residential zoning district shall maintain a minimum five-acre parcel size and shall be subject to a determination of adequate water supply per Agriculture and Land Use Policy LU-E.8, and adequate road access and road maintenance as determined by the Director of the Department of Public Works and Planning

PUBLIC FACILITIES AND SERVICES ELEMENT

Applicable goals and policies from the Public Facilities and Services Element are presented below.

WATER SUPPLY AND DELIVERY

Policies in this section and in **Table 77. Fresno County Water Supply and Delivery Goals and Policies** seek to ensure an adequate water supply for both domestic and agricultural users by providing necessary facility improvements, ensuring water availability, and utilizing water conservation measures.

Table 77. Fresno County Water Supply and Delivery Goals and Policies

Goal or Policy	Description
Goal PF-C:	To ensure the availability of an adequate and safe water supply for domestic andagricultural consumption.
Policy PF-C.1:	The County shall engage in and support the efforts of others within Fresno County to retainexisting water supplies and develop new water supplies.
Policy PF-C.2:	The County shall actively engage in efforts and support the efforts of others to import flood,surplus, and other available waters for use in Fresno County.

Goal or Policy	Description
Policy PF-C.3:	To reduce demand on the County's groundwater resources, the County shall encourage the useof surface water to the maximum extent feasible.
Policy PF-C.4:	The County shall support efforts to expand groundwater and/or surface water storage thatbenefits Fresno County.
Policy PF-C.5:	The County shall support water banking when the program has local sponsorship andinvolvement and provides new benefits to the County.
Policy PF-C.6:	The County shall recommend to all cities and urban areas within the County that they adopt the most cost-effective urban best management practices published and updated by the California Urban Water Agencies, California Department of Water Resources, or other appropriate agenciesas a means of meeting some of the future water supply needs.
Policy PF-C.7:	The County shall require preparation of water master plans for areas undergoing urban growth.
Policy PF-C.8:	The County shall work with local irrigation districts to preserve local water rights and supply.
Policy PF-C.10:	The County shall actively participate in the development and implementation of Sustainable Groundwater Management Plans to ensure an on-going water supply to help sustain agricultureand accommodate future growth.
Policy PF-C.11:	The County shall approve new development only if an adequate sustainable water supply to servesuch development is demonstrated.
Policy PF-C.12:	In those areas identified as having severe groundwater level declines or limited groundwater availability, the County shall limit development to uses that do not have high water usage or thatcan be served by a surface water supply.
Policy PF-C.13:	The County shall require that water supplies serving new development meet U.S. Environmental Protection Agency and California Department of Public Health and other water quality standards.
Policy PF-C.15:	If the cumulative effects of more intensive land use proposals are detrimental to the water supplies of surrounding areas, the County shall require approval of the project to be dependent upon adequate mitigation. The County shall require that costs of mitigating such adverse impactsto water supplies be borne proportionately by all parties to the proposal.
Policy PF-C.16:	The County shall, prior to consideration of any discretionary project related to land use, undertakea water supply evaluation.
Policy PF-C.17:	In the case of lands entitled to surface water, the County shall approve only land use-relatedprojects that provide for or participate in effective use of the surface water entitlement.
Policy PF-C.21:	The County shall promote the use of surface water for agricultural use to reduce groundwatertable reductions.
Policy PF-C.23:	The County shall require that all new development within the county use water conservationtechnologies, methods, and practices as established by the County.
Policy PF-C.24:	The County shall encourage the use of reclaimed water where economically, environmentally,and technically feasible.
Policy PF-C.25	The County shall require that all new development within the county use water conservation technologies, methods, and practices as established by the County.

Goal or Policy	Description
Policy PF-C.24:	The County shall encourage the use of reclaimed water where economically, environmentally,and technically feasible.
Policy PF-C.25:	The County shall participate in integrated Regional Water Management Planning efforts with other local and regional water stakeholders to plan for the efficient use, enhancement, and management of surface and groundwater supplies.
Policy PF-C.29:	The County shall encourage agricultural water conservation where economically, environmentally,and technically feasible.
Policy PF-C.28	The County shall participate in integrated Regional Water Management Planning efforts with otherlocal and regional water stakeholders to plan for the efficient use, enhancement, and management of surface and groundwater supplies.
Policy PF-C.29:	The County shall encourage agricultural water conservation where economically, environmentally,and technically feasible.

STORM DRAINAGE AND FLOOD CONTROL

Policies in this section and in **Table 78. Fresno County Storm Drainage and Flood Control Goals and Policies** seek to ensure safe, efficient, and environmentally sound means to drain, divert and retain stormwater and provide flood control by providing necessary facility improvements, ensuring adequate funding, providing a means to detain/retain runoff, and ensuring the facilities meet state environmental regulations. This includes retention strategies that could lessen the county's vulnerability to drought and wildfire.

Table 78. Fresno County Storm Drainage and Flood Control Goals and Policies

Goal or Policy	Description
Goal PF-E:	To provide efficient, cost-effective, and environmentally sound storm drainage and floodcontrol facilities that protect both life and property and to divert and retain stormwater runoff for groundwater replenishment.
Policy PF-E.1:	The County shall coordinate with the agencies responsible for flood control or storm drainage toassure that construction and acquisition of flood control and drainage facilities are adequate forfuture urban growth authorized by the County General Plan and city general plans.
Policy PF-E.2:	The County shall encourage the agencies responsible for flood control of storm drainage to coordinate the multiple use of flood control and drainage facilities with other public agencies.
Policy PF-E.3:	The County shall encourage the Fresno Metropolitan Flood Control District to spread the cost of construction and acquisition of flood control and drainage facilities in the most equitable manner consistent with the growth and needs of this area.
Policy PF-E.4:	The County shall encourage the local agencies responsible for flood control or storm drainage torequire that storm drainage systems be developed and expanded to meet the needs of existing and planned development.

Goal or Policy	Description
Policy PF-E.5:	The County shall only approve land use-related projects that will not render inoperative any existing canal, encroach upon natural channels, and/or restrict natural channels in such a way asto increase potential flooding damage.
Policy PF-E.6:	The County shall require that drainage facilities be installed concurrently with and as a conditionof development activity to ensure the protection of the new improvements as well as existing development that might exist within the watershed.
Policy PF-E.7:	The County shall require new development to pay its fair share of the costs of Fresno Countystorm drainage and flood control improvements within unincorporated areas.
Policy PF-E.8:	The County shall encourage the local agencies responsible for flood control or storm drainage to precisely locate drainage facilities well in advance of anticipated construction, thereby facilitating timely installation and encouraging multiple construction projects to be combined, reducing the incidence of disruption of existing facilities.
Policy PF-E.9:	The County shall require new development to provide protection from the 100-year flood as aminimum.
Policy PF-E.10:	In growth areas within the jurisdiction of a local agency responsible for flood control or storm drainage, the County shall encourage that agency to design drainage facilities as if the entire areas of service were developed to the pattern reflected in the adopted general plans to assurethat the facilities will be adequate as the land use intensifies.
Policy PF-E.11:	The County shall encourage project designs that minimize drainage concentrations and maintain,to the extent feasible, natural site drainage patterns.
Policy PF-E.12:	The County shall coordinate with the local agencies responsible for flood control or storm drainage to ensure that future drainage system discharges comply with applicable State andFederal pollutant discharge requirements.
Policy PF-E.13:	The County shall encourage the use of natural stormwater drainage systems to preserve andenhance natural drainage features.
Policy PF-E.14:	The County shall encourage the use of retention-recharge basins for the conservation of waterand the recharging of the groundwater supply.
Policy PF-E.15:	The County should require that retention-recharge basins be suitably landscaped to complement adjacent areas and should, wherever possible, be made available to the community to augment open space and recreation needs.
Policy PF-E.16:	The County shall minimize sedimentation and erosion through control of grading, cutting of trees, removal of vegetation, placement of roads and bridges, and use of off-road vehicles. The Countyshall discourage grading activities during the rainy season, unless adequately mitigated, to avoid sedimentation of creeks and damage to riparian habitat.
Policy PF-E.17:	The County shall encourage the local agencies responsible for flood control or storm drainage retention-recharge basins located in soil strata strongly conducive to groundwater recharge to develop and operate those basins in such a way as to facilitate year-round groundwater recharge.
Policy PF-E.18:	The County shall encourage the local agencies responsible for flood control or storm drainage toplan retention-recharge basins on the principle that the minimum number will be the most economical to acquire, develop, operate, and maintain.
Policy PF-E.19:	In areas where urbanization or drainage conditions preclude the acquisition and use of retention-recharge basins, the County shall encourage the local agencies responsible for flood control or

Goal or Policy	Description
	stormwater drainage to discharge storm or drainage water into major canals and other natural water courses subject to established conditions.
Policy PF-E.20:	The County shall require new development of facilities near rivers, creeks, reservoirs, or substantial aquifer recharge areas to mitigate any potential impacts of release of pollutants infloodwaters, flowing rivers, streams, creeks, or reservoir waters.
Policy PF-E.21:	The County shall require the use of feasible and practical best management practices (BMPs) to protect streams from the adverse effects of construction activities and shall encourage the urbanstorm drainage systems and agricultural activities to use BMPs.
Policy PF-E.22:	The County shall encourage the local agencies responsible for flood control or storm drainage tocontrol obnoxious odors or mosquito breeding conditions connected with any agency facility by appropriate measures.

FIRE PROTECTION AND EMERGENCY MEDICAL SERVICES

Policies in this section and in **Table 79. Fresno County Fire Protection and Emergency Medical Service Goals and Policies** seek to ensure the prompt and efficient provision of fire and emergency medical facility and service needs, ensure adequate funding is available in new development areas, and protect the life and property of residents of and visitors to Fresno County.

Table 79. Fresno County Fire Protection and Emergency Medical Service Goals and Policies

Goal or Policy	Description
Goal PF-H:	To ensure the prompt and efficient provision of fire and emergency medical facility and service needs, to protect residents of and visitors to Fresno County from injury and loss oflife, and to protect property from fire.
Policy PF-H.1:	The County shall work cooperatively with local fire protection districts to ensure the provision ofeffective fire and emergency medical services to unincorporated areas within the County.
Policy PF-H.2:	Prior to the approval of a development project, the County shall determine the need for fire protection services. New development in unincorporated areas of the county shall not be approved until such time that fire protection facilities and services acceptable to the Public Worksand Planning Director in consultation with the appropriate fire district are provided.
Policy PF-H.3:	The County shall require that new fire stations be located to achieve and maintain a service level capability consistent with services for existing land uses.
Policy PF-H.4:	The County shall reserve adequate sites for fire and emergency medical facilities inunincorporated locations in the County.
Policy PF-H.5:	The County shall require that new development be designed to maximize safety and minimize fire hazard risks to life and property.
Policy PF-H.6:	The County shall limit development to very low densities in areas where emergency responsetimes will be more than 20 minutes.
Policy PF-H.7:	The County shall encourage local fire protection agencies in the County to maintain the followingas minimum fire protection standards (expressed as Insurance Service Organization (ISO) ratings): ISO 4 in urban areas; ISO 6 in suburban areas; and ISO 8 in rural areas.

Goal or Policy	Description
Policy PF-H.10:	The County shall ensure that all proposed developments are reviewed for compliance with fire safety standards by responsible local fire agencies per the California Fire Code and other State andlocal ordinances.

OPEN SPACE AND CONSERVATION ELEMENT

The Open Space and Conservation Element is concerned with protecting and preserving natural resources, preserving open space areas, managing the production of commodity resources, protecting and enhancing cultural resources, and providing recreational opportunities. Applicable goals and policies are presented below.

PRODUCTIVE RESOURCES

WATER RESOURCES

Policies in this section and in **Table 80. Fresno County Water Resources Goals and Policies** seek to protect and enhance the surface water and groundwater resources in the County. The policies address broad water planning issues, groundwater recharge, the relationship of land use decisions to water issues, and water quality problems.

Table 80. Fresno County Water Resources Goals and Policies

Goal or Policy	Description
Goal OS-A:	To protect and enhance the water quality and quantity in Fresno County's streams, creeks, and groundwater basins.
Policy OS-A.1:	The County shall provide active leadership in the regional coordination of water resource management efforts affecting Fresno County and shall continue to monitor and participate in, as appropriate, regional activities affecting water resources, groundwater, and water quality.
Policy OS-A.2:	The County shall provide active leadership in efforts to protect, enhance, monitor, and manage groundwater resources within its boundaries.
Policy OS-A.3	The County shall support efforts to create additional storage that benefits Fresno County, and is economically, environmentally, and technically feasible.
Policy OS-A.4:	The County shall support public education programs designed to increase public participation in water conservation and water quality awareness.
Policy OS-A.5:	The County shall permit and encourage, where economically, environmentally, and technically feasible, overirrigation of surface water as a means to maximize groundwater recharge.
Policy OS-A.6	The County shall ensure that new development does not limit the capacity or function of groundwater recharge areas.
Policy OS-A.7	The County shall direct, to the extent feasible, its available water resources to groundwater recharge areas.
Policy OS-A.8	The County should, in cooperation with respective groundwater sustainability agencies, develop and maintain an inventory of sites within the County that are suitable for groundwater recharge.
Policy OS-A.9:	The County shall support and/or engage in water banking (i.e., recharge and subsequent extraction for direct and/or indirect use on lands away from the recharge area) based on criteria.

Goal or Policy	Description
Policy OS-A.14:	The County shall require the protection of floodplain lands and, where appropriate, acquire public easements for purposes of flood protection, public safety, wildlife preservation, groundwater recharge, access, and recreation.
Policy OS-A.15:	The County shall support the policies of the San Joaquin River Parkway Master Plan to protect the San Joaquin River as an aquatic habitat, recreational amenity, aesthetic resource, and water source.

NATURAL RESOURCES

WETLAND AND RIPARIAN AREAS

Policies in this section and in **Table 81. Fresno County Wetland and Riparian Areas Goals and Policies** seek to protect riparian and wetland habitats in the County while allowing compatible uses where appropriate.

Table 81. Fresno County Wetland and Riparian Areas Goals and Policies

Goal or Policy	Description
Goal OS-D:	To conserve the function and values of wetland communities and related riparian areas throughout Fresno County while allowing compatible uses where appropriate. Protection of these resource functions will positively affect aesthetics, water quality, floodplain management, ecological function, and recreation/tourism.
Policy OS-D.1:	The County shall support the “no-net-loss” wetlands policies of the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, and the California Department of Fish and Game. Coordination with these agencies at all levels of project review shall continue to ensure that appropriate mitigation measures and the concerns of these agencies are adequately addressed.
Policy OS-D.2:	The County shall require new development to fully mitigate wetland loss for function and value in regulated wetlands to achieve "no-net-loss" through any combination of avoidance, minimization, or compensation. The County shall support mitigation banking programs that provide the opportunity to mitigate impacts to rare, threatened, and endangered species and/or the habitat that supports these species in wetland and riparian areas.
Policy OS-D.3:	The County shall require development to be designed in such a manner that pollutants and siltation do not significantly degrade the area, value, or function of wetlands. The County shall require new developments to implement the use of best management practices to aid in this effort.
Policy OS-D.7:	The County shall support the management of wetland and riparian plant communities for passive recreation, groundwater recharge, nutrient storage, and wildlife habitats.

VEGETATION

Policies in this section and in **Table 82. Fresno County Vegetarian Goals and Policies** seek to protect native vegetation resources primarily on private land within the County.

Table 82. Fresno County Vegetarian Goals and Policies

Goal or Policy	Description
Goal OS-F:	To preserve and protect the valuable vegetation resources of Fresno County.
Policy OS-F.1:	The County shall encourage landowners and developers to preserve the integrity of existing terrain and natural vegetation in visually-sensitive areas such as hillsides and ridges, and along important transportation corridors, consistent with fire hazard and property line clearing requirements.
Policy OS-F.2:	The County shall require developers to use native and compatible nonnative plant species, especially drought-resistant species, to the extent possible, in fulfilling landscaping requirements imposed as conditions of discretionary permit approval or for project mitigation.
Policy OS-F.6:	The County shall require that development on hillsides be limited to maintain valuable natural vegetation, especially forests and open grasslands, and to control erosion.
Policy OS-F.7:	The County shall require developers to take into account a site's natural topography with respect to the design and siting of all physical improvements in order to minimize grading.
Policy OS-F.9:	The County shall support the continued use of prescribed burning to mimic the effects of natural fires to reduce fuel volumes and associated fire hazards to human residents and to enhance the health of biotic communities.

RECREATION AND CULTURAL RESOURCES

PARKS AND RECREATION

Policies in this section and in **Table 83. Fresno County Parks and Recreation Goals and Policies** seek to enhance recreational opportunities in the County by encouraging the further development of public and private recreation lands and requiring development to help fund additional parks and recreation facilities.

Table 83. Fresno County Parks and Recreation Goals and Policies

Goal or Policy	Description
Goal OS-H:	To designate land for and promote the development and expansion of public and privaterecreational facilities to serve the needs of residents and visitors.
Policy OS-H.10:	The County shall support the policies of the San Joaquin River Parkway Master Plan to protect the San Joaquin River as an aquatic habitat, recreational amenity, aesthetic resource, and watersource.
Policy OS-H.12:	The County shall require that structures and amenities associated with the San Joaquin River Parkway be designed and sited to ensure that such features do not obstruct flood flows, do not create a public safety hazard, or result in a substantial increase in off-site water surface elevations, and that they conform to the requirements of other agencies having jurisdiction. For permanent structures, such as bridge overcrossings, the minimum level of flood design protectionshall be the greater of the Standard Project Flood (which is roughly equivalent to a 250-year event) or the riverine requirements of other agencies having jurisdiction to ensure flood flows are not dammed and to prevent flooding on surrounding properties.

HISTORIC, CULTURAL, AND GEOLOGICAL RESOURCES

Policies in this section and in **Table 84. Fresno County Historical, Cultural, and Geological Resources Goals and Policies** seek to preserve the historic, archeological, paleontological, geological, and cultural resources of the County through development review, acquisition, encouragement of easements, coordination with other agencies and groups, and other methods.

Table 84. Fresno County Historical, Cultural, and Geological Resources Goals and Policies

Goal or Policy	Description
Goal OS-J:	To identify, protect, and enhance Fresno County's important historical, archeological, paleontological, geological, and cultural sites and their contributing environment.
OS-J.1	The County shall encourage preservation of any sites and/or buildings identified as having historical significance pursuant to the list maintained by the Fresno County Historic Landmarks and Records Advisory Commission.
OS-J.2	The County shall consider historic resources during preparation or evaluation of plans and discretionary development projects.
OS-J.3	Whenever a historical resource is known to exist on a proposed project site, the County (i.e., Fresno County Historic Landmarks and Records Advisory Commission) shall evaluate and make recommendations to minimize potential impacts to said resource.
Policy OS-J.4:	The County shall require that discretionary development projects, as part of any required CEQA review, identify and protect important historical, archeological, paleontological, and cultural sites and their contributing environment from damage, destruction, and abuse to the maximum extent feasible. Project-level mitigation shall include accurate site surveys, consideration of project alternatives to preserve archeological and historic resources, and provision for resource recovery and preservation when displacement is unavoidable.

FRESNO COUNTY ORDINANCES

The Fresno County General Plan provides policy direction for land use, development, open space protection, and environmental quality, but this policy direction must be carried out through numerous ordinances, programs, and agreements. The following ordinances are among the most important tools for implementing the general plan and/or are critical to the mitigation of hazards identified in this plan.

EMERGENCY ORGANIZATION (TITLE 2, CHAPTER 2.44)

The declared purposes of this chapter are to provide for the preparation and carrying out of plans for the protection of persons and property within the County in the event of an emergency; the direction of the emergency organization; and the coordination of the emergency functions of the County with all other public agencies, corporations, organizations, and affected private persons.

FRESNO-KINGS-MADERA REGIONAL HEALTH AUTHORITY (TITLE 8, CHAPTER 8.75)

This health authority is a three-county regional health authority representing Fresno, Kings, and Madera Counties. The health authority shall design and operate a program or programs that:

1. Delivers primary care via a contracted provider network which significantly improves access to primary care and related specialty and ancillary services for enrolled Medi-Cal recipients.
2. Includes mechanisms for assuring that health authority financed medical care services meet appropriate quality of care standards.
3. Incorporates a plan of service delivery and implements reimbursement mechanisms which will promote the long-term viability of a locally operated Medi-Cal managed care system and participating "safety net" providers herein defined as Medi-Cal disproportionate share hospitals, county clinics, and licensed community and rural clinics.

4. Implements a financial plan which includes the creation of a prudent reserve within three years of commencing operations and which provides that if additional surplus funds accrue, they shall be used to expand access, improve benefits, and augment provider reimbursement.
5. Gives a high priority to increasing prevention, education, and early intervention services for enrolled recipients.
6. Ensures that all statutory, contractual, or other program obligations shall be the obligations solely of the health authority and shall not be the obligations of Fresno County, Kings County, Madera County, or the State.
7. Implements programs and procedures to ensure that a high level of member satisfaction is maintained. The health authority shall also be authorized to contract with public insurers, payors, or plan sponsors to offer and/or administer their health care programs and to contract with private insurers or plan sponsors to administer their health care programs. The purpose of the health authority is to negotiate a contract with the California Department of Health Care Services and to provide a "Medi-Cal Managed Care Program" (the "program") and to arrange for the provision of health care services to qualifying individuals under such program in Fresno County, Kings County, and Madera County pursuant to Chapter 7 (commencing with Section 14000) of Part 3 of Division 9 of the Welfare and Institutions Code.

GROUNDWATER MANAGEMENT (TITLE 14, CHAPTER 14.03)

This chapter protects the County's important groundwater resources by requiring a permit from the County to extract, on a long-term basis, groundwater for transfer outside the County, including groundwater extracted to replace a surface water supply that has been, is being, or will be transferred for long-term use outside of Fresno County. This chapter is limited to requiring a permit for the long-term direct or indirect transfer of groundwater outside the County and is not intended to regulate groundwater in any other way.

BUILDING CODE (TITLE 15, CHAPTER 15.08)

This chapter adopts the 2022 California Building Code, including the Appendices as referenced in the 2022 California Building Code Standards and the Uniform International Building Code Standards is adopted by reference.

FIRE CODE (TITLE 15, CHAPTER 15.10)

This chapter adopts the 2022 California Fire Code as referenced in the 2022 California Building/Residential Code, is adopted by reference.

GRADING AND EXCAVATION (TITLE 15, CHAPTER 15.28)

This chapter establishes that Chapter 18, Chapter 33, Chapter 33, and Appendix J of the 2022 California Building Code and Chapter 4, Division 4.1 of the California Green Building Standards Code are adopted by reference and except as herein otherwise provided are applicable to and shall cover all grading and excavation within the unincorporated area of the County of Fresno.

FLOOD HAZARD AREAS (TITLE 15, CHAPTER 15.48)

It is the purpose of this chapter to promote the public health, safety, and general welfare and to minimize public and private losses due to flood conditions in specific areas by provisions designed to:

- Protect human life and health
- Minimize expenditure of public money for costly flood control projects
- Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public
- Minimize prolonged business interruptions
- Minimize damage to public facilities and utilities such as water and gas mains; electric, telephone, and sewer lines; and streets and bridges located in areas of special flood hazard
- Help maintain a stable tax base by providing for the sound use and development of areas of special flood hazard so as to minimize future blighted areas caused by flood damage
- Ensure that potential buyers are notified that property is in an area of special flood hazard; and
- Ensure that those who occupy the areas of special flood hazard assume responsibility for their actions.

This chapter includes methods and provisions to:

- Restrict or prohibit uses which are dangerous to health, safety, and property due to water or erosion hazards, or which result in damaging increases in erosion or flood heights or velocities
- Require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction
- Control the alteration of natural floodplains, stream channels, and natural protective barriers, which help accommodate or channel floodwaters
- Control filling, grading, dredging, and other development that may increase flood damage
- Prevent or regulate the construction of flood barriers that will unnaturally divert floodwaters or that may increase flood hazards in other areas

Requirements of this chapter apply to all new developments, substantial improvements, minor improvements, and conversions of existing nonresidential structures to residential uses within flood hazard areas. Notably, it requires that a development permit be obtained before start of construction or beginning of development within any area of special flood hazard. It appoints the director of the Public Works and Planning Department to administer and implement the chapter by granting or denying development permit applications in accordance with its provisions.

This chapter addresses the following for construction in areas of special flood hazard:

- Standards of construction

- Standards for storage of materials and equipment
- Standards for utilities
- Standards for subdivisions
- Standards for manufactured homes and manufactured home parks and subdivision
- Provisions for floodway development

CALIFORNIA DEPARTMENT OF FORESTRY STATE RESPONSIBILITY AREA FIRE SAFE REGULATIONS OF THE COUNTY (TITLE 15, CHAPTER 15.60)

This chapter provides for basic emergency access, perimeter wildfire protection measures, signing and building numbering, private water supply reserves for emergency fire use, and vegetation modification.

Development requirements in this chapter address setbacks for structures, road improvements, road width, cul-de-sacs and dead-end roads, one-way roads, driveways, gates, road signs, building signs, flammable vegetation and fuels, water supply, and hydrant locations.

FIRE DISTRICT DEVELOPMENT IMPACT MITIGATION FEES (TITLE 15, CHAPTER 15.64)

The purpose of this chapter is to implement the Fresno County General Plan policy providing for the adoption of development impact mitigation fees and for the collection of such fees at the time of the issuance of building permits or other permits. Subject to the requirements of this chapter, such fees are to be allocated to a fire district within the Fresno County for the acquisition of capital facilities to ensure the provision of the capital facilities necessary to maintain current levels of fire protection services necessitated by new development.

SUBDIVISIONS (TITLE 17, CHAPTERS 17.01-17.60)

Chapters 17.04 through 17.60 makeup Fresno County's subdivision ordinance, which is deemed necessary to protect the public health, safety, and general welfare. It addresses orderly growth and development of the County; beneficial use of land in the public interest; and conservation, stabilization, and protection of property values and assures adequate provision for necessary utilities, public roads, and other public conveniences in subdivided areas. The subdivision ordinance regulates the design and improvement of land divisions and the dedication of public improvements needed in connection with land divisions. All land divisions must by law be consistent with the general plan and the zoning ordinance.

DRAINAGE OF LAND (TITLE 17, CHAPTER 17.64)

Since the development of land for urban uses substantially accelerates the concentration of surface water and stormwater, it is necessary to require the construction of, and to establish and collect fees to defray the actual or estimated cost of, planned local drainage facilities for the control and safe disposal of surface water and stormwater from local drainage areas to promote and protect the public welfare, safety, peace, comfort, convenience, and the general welfare.

FRESNO COUNTY ZONING ORDINANCE

The purpose of the zoning ordinance is to regulate the use of land in each zoning district. The ordinance typically establishes a list of land uses permitted in each district plus a series of specific standards governing lot size, building height, and required yard and setback provisions in the unincorporated area of Fresno County in a manner consistent with the Fresno County General Plan. This ordinance incorporates zoning regulations implementing the Fresno County General Plan and all of its elements.

One of the zones created by the ordinance is the Open Space Conservation District (Section 815). This zone is intended to provide for permanent open spaces in the community and to safeguard the health, safety, and welfare of the people by limiting developments in areas where police and fire protection, protection against flooding by stormwater, and dangers from excessive erosion are not possible without excessive costs to the community.

PLANNING MITIGATION CAPABILITIES

The table below identifies the plans related to mitigation and loss prevention in Fresno County.

Table 85. Fresno County Planning Capabilities

Regulatory Tool	In Place Yes/No	Under Development Yes/No	Comments
Capital Improvement Plan (CIP)			Unknown
Climate Resiliency or Adaptation Plan			Unknown
Community Wildfire Protection Plan (CWPP)			Unknown
Comprehensive Emergency Management Plan			Unknown
Comprehensive Land Use Plan (or General, Master, or Growth Management Plan)			Unknown
Continuity of Operations Plan (COOP)			Unknown
Disaster Recovery Plan		Yes	
Economic Development Plan			Unknown
Emergency Operations Plan (EOP)			Unknown
Evacuation Plan			Unknown
Flood Response Plan			Unknown
Floodplain Management Plan/Flood Mitigation Plan			Unknown
Hazard Mitigation Plan		Yes	
Historic Preservation Plan			Unknown
Natural Resources Protection Plan (NRPP)			Unknown
Open Space Management Plan (Parks and Rec/Greenway Plan)			Unknown
Threat Hazard Identification and Risk Assessment			Unknown

FRESNO AREA REGIONAL GROUNDWATER MANAGEMENT PLAN

The Fresno Area Regional Groundwater Management Plan is a comprehensive strategy to enhance and maintain the quantity and quality of local groundwater resources. It provides a vehicle for future groundwater management actions. As part of a regional effort, other basin- specific plans have also been developed for the Kings River and San Joaquin River basins. There are also efforts to create a statewide water management plan. All plans are coordinated for the County through the Public Works and Planning departments.

FRESNO COUNTY HAZARDOUS WASTE MANAGEMENT PLAN

The Fresno County Hazardous Waste Management Plan is designed to ensure that safe, effective, and economical facilities for the management of hazardous wastes are available when they are needed. To attain this goal, the plan establishes goals, policies, and programs to encourage the safe handling, storage, and transportation of hazardous materials. The Fresno County Environmental Health Department administers this plan.

SPECIAL DISTRICTS

There are numerous special districts that provide a variety of public services in Fresno County. Special districts can provide one or more types of public services, facilities, or infrastructure within a prescribed boundary, and they play an important role in growth management because the availability of their services can encourage or discourage new development. Special districts can tax the properties within their boundaries to pay for the services they provide. Monthly fees may also be assessed. Some of the special districts that provide mitigation-related services in Fresno County are presented below.

FRESNO METROPOLITAN FLOOD CONTROL DISTRICT

The Fresno Metropolitan Flood Control District is a special act district. It was created to provide fully coordinated and comprehensive stormwater management and related services on a regional basis through a quasi-joint powers' relationship between the Cities of Fresno and Clovis and the County of Fresno. The district service area includes most of the Fresno-Clovis metropolitan area (excluding the community of Easton), and unincorporated lands to the east and northeast.

The mission of the district is to provide to the citizens living within its boundaries the ability to control and manage the water resources of the area so as to prevent damage, injury, and inconvenience; to conserve such waters for local, domestic, and agricultural use; and to maximize the public use and benefit of the district's programs and infrastructure. The district maintains a services plan that presents district goals, program objectives, current program descriptions, and implementation strategies.

(See Annex M: Fresno Metropolitan Flood Control District for more information.)

LOWER SAN JOAQUIN LEVEE DISTRICT

The Lower San Joaquin Levee District is a special act district. It was created to operate, maintain, and repair levees, bypasses, and other facilities built in connection with the Lower San Joaquin River Flood Control Project. The district encompasses approximately 468 square miles in Fresno, Madera, and Merced counties, of which 94 square miles are in Fresno County.

(See Annex N: Lower San Joaquin Levee District for more information.)

KINGS RIVER CONSERVATION DISTRICT

The Kings River Conservation District is a special act district. It is responsible for planning for the proper management of water within its service area, including essential flood control and groundwater management services. The district contains about 2,049 square miles in Fresno, Kings, and Tulare counties. The Fresno County portion has 1,001 square miles. It encompasses the Cities of Clovis, Fresno, Fowler, Kerman, Kingsburg, Parlier, Reedley, San Joaquin, Sanger, and Selma and intervening agricultural lands.

FRESNO COUNTY FIRE PROTECTION DISTRICTS

Fire protection districts provide a variety of services, which may include fire protection, rescue, emergency medical, hazardous material emergency response, and ambulance services.

- Bald Mountain Fire Protection District
- Fig Garden Fire Protection District
- Fresno County Fire Protection District
- North Central Fire Protection District
- Orange Cove Fire Protection District

FRESNO COUNTY IRRIGATION DISTRICTS

Irrigation districts provide water for irrigation to users within their boundaries. They may also use water under their control for other beneficial purposes and provide flood protection measures.

- Alta Irrigation District
- Central California Irrigation District
- Consolidated Irrigation District
- Fresno Irrigation District
- Hills Valley Irrigation District
- James Irrigation District
- Laguna Irrigation District
- Orange Cove Irrigation District
- Riverdale Irrigation District
- Tranquility Irrigation District

FRESNO COUNTY DRAINAGE DISTRICTS

Drainage districts control storm and other waste waters within a district’s boundaries, protect property and infrastructure within a district from damage by stormwater or wastewater, and conserve stormwater and wastewater for beneficial purposes.

- Camp 13 Drainage District
- Dos Palos Drainage District

- Panoche Drainage District
- Silver Creek Drainage District

FRESNO COUNTY MOSQUITO ABATEMENT DISTRICTS

Mosquito abatement districts provide mosquito surveillance and control.

- Coalinga-Huron Mosquito Abatement District
- Consolidated Mosquito Abatement District
- Fresno Mosquito and Vector Control District
- Fresno-Westside Mosquito Abatement District

FRESNO COUNTY PEST CONTROL DISTRICTS

Pest control districts are comprised of local growers to control, eradicate, or respond to the effects of pests and/or diseases affecting crops.

- Central Valley Pest Control District
- West Fresno County Red Scale Protective District

RECLAMATION DISTRICTS

Reclamation districts reclaim and protect anybody of swampland and overflowed salt marsh, tidelands, or other lands subject to overflow to irrigate lands inside or outside their boundaries. Services include drainage, levee maintenance, and irrigation services.

- No. 1606
- Zalda No. 801

FRESNO COUNTY RESOURCE CONSERVATION DISTRICTS

Resource conservation districts address a wide variety of conservation issues such as forest fuel management, water and air quality, wildlife habitat restoration, soil erosion control, conservation education, and much more.

- Excelsior/Kings River Resource Conservation District
- Firebaugh Resource Conservation District
- James Resource Conservation District
- Los Banos Resource Conservation District

- Panoche Resource Conservation District
- San Luis Resource Conservation District
- Sierra Resource Conservation District (See Annex P)
- Tranquility Resource Conservation District
- Westside Resource Conservation District

FRESNO COUNTY WATER DISTRICTS (CALIFORNIA)

Water districts provide water services. Powers may include the acquisition and operation of works for the production, storage, transmission, and distribution of water for irrigation, domestic, industrial, and municipal purposes and any related drainage or reclamation works.

- Broadview Water District
- Eagle Field Water District
- Farmers Water District
- Firebaugh Canal Water District
- Fresno Slough Water District
- Garfield Water District
- International Water District
- Kings River Water District
- Liberty Water District
- Mercy Springs Water District
- Mid-Valley Water District
- Oro Loma Water District
- Pacheco Water District
- Panoche Water District
- Pleasant Valley Water District
- Raisin City Water District
- San Luis Water District
- Stinson Water District
- Tri-Valley Water District
- Westlands Water District
- Wildren Water District

FRESNO COUNTY WATER DISTRICTS (COUNTY)

County water districts furnish imported water.

- Freewater County Water District
- Malaga County Water District
- Pinedale County Water District

FRESNO COUNTY LOCAL BOARDS, COMMISSIONS, AND COMMITTEES

There are several local boards, commissions, and committees in Fresno County. Those that have responsibilities related to hazard mitigation are described briefly below.

- **Agricultural Land Conservation Committee**: This committee reviews cancellation of land conservation contracts and makes recommendations to the Board of Supervisors.
- **Association of Metropolitan Water Agencies**: This organization is charged with providing sufficient quality water to satisfy future requirements for municipal, industrial, and agricultural uses within the areas served by the member agencies.
- **Planning Commission**: This commission is charged with the review and approval or denial of discretionary land use permits. The Commission is also advisory to the Board of Supervisors on proposed amendments to the General Plan and the Zoning Ordinance.

FIRE SAFE COUNCILS

The Fire Safe Council provides resources for establishing and maintaining local fire safe councils to mobilize Californians to protect their homes, communities, and environments from wildfire. These councils serve as forums for stakeholders to share and validate fire safety and fire planning information. There are two fire safe councils in Fresno County:

- Highway I-168 Fire Safe Council (northeastern Fresno County)
- Highway I-80 Oak to Timberline Fire Safe Council (southeastern Fresno County)

FRESNO COUNTY'S ADMINISTRATIVE/TECHNICAL MITIGATION CAPABILITIES

Table 86. Fresno County's Administrative and Technical Mitigation Capabilities identifies the County personnel responsible for activities related to mitigation and loss prevention in Fresno County.

Table 86. Fresno County's Administrative and Technical Mitigation Capabilities

Staff or Personnel Resources	Yes	No	Department or Single Staff Member	Comments

Emergency Manager	X		OES DEPT	
Engineers or professionals trained in construction practices related to buildings and/or infrastructure				UNKNOWN
Fiscal Management or Procurement Specialists				UNKNOWN
Floodplain Manager				UNKNOWN
Land Surveyors				UNKNOWN
Land Use/Management/Development Planning				UNKNOWN
Planners or engineers with an understanding of natural and/or human-caused hazards				UNKNOWN
Resource Development Staff or Grant-writing	X		OES & PUBLIC WORKS	
Scientists familiar with the hazards of the community				UNKNOWN
Staff experienced with Geographic Information Systems (GIS) or HAZUS	X		PUBLIC WORKS	
Staff with education or expertise to assess the community's vulnerability to hazards				UNKNOWN

FRESNO COUNTY DEPARTMENT OF PUBLIC HEALTH

A number of important mitigation and emergency management programs and services are located in the Fresno County Department of Public Health, which provides health promotion, surveillance, and disease prevention services to protect public health.

OFFICE OF EMERGENCY SERVICES AND ITS MISSION

The Fresno County Office of Emergency Services (OES) is a program located within the Department of Public Health, Environmental Health Division. Fresno County OES coordinates planning and preparedness, response and recovery efforts for disasters occurring within the unincorporated area of the County. The mission of the Fresno County Office of Emergency Services is to develop and maintain the capability to prepare for, mitigate, respond to, and recover from emergencies and disasters, and to ensure the most effective use of all available resources. To accomplish this mission OES communicates and coordinates with all levels of government and many other entities in order to minimize the impact of disasters and enable affected communities to return to pre-disaster conditions as soon as possible.

On November 14, 1995, the Fresno County Board of Supervisors adopted the State's Standardized Emergency Management System (SEMS), established the geographic area of the County of Fresno as the Fresno County Operational Area, and designated Fresno County as the Operational Area Lead Agency. Fresno County OES is mandated by the California Emergency Services Act (Chapter 7, Division 1, Title 2 of Government Code) to serve as the liaison between the State and all the local government political subdivisions comprising Fresno County. As the Operational Area lead agency, Fresno County OES maintains ongoing communication with local government agencies (County Departments, Incorporated Cities, Special Districts, and Public School Districts) as well as many state and federal agencies and nonprofit organizations to maintain and enhance the capability to respond to and recover from disasters.

During a Disaster

The Office of Emergency Services provides the initial staffing and coordination of the County's Emergency Operations Center (EOC), which is the primary coordination point for response to major emergencies and disasters. During a disaster event OES staff gathers information from the affected jurisdictions and determines the level of response required. OES acts as the link between local government agencies and the State to transmit emergency related information and to request necessary State and Federal assistance.

Between Disasters

The Office of Emergency Services coordinates a wide variety of emergency management functions including developing and updating response plans, maintaining and enhancing the emergency operations center and related equipment, administering emergency preparedness grants, assisting county agencies and local jurisdictions with emergency related activities, and identifying and coordinating appropriate emergency training activities.

FRESNO COUNTY OPERATIONAL AREA MASTER EMERGENCY SERVICES PLAN

The program coordinates the development and maintenance of the Fresno County Operational Area Master Emergency Services Plan, which serves as a guide for the County's response to emergencies/disasters in the Fresno County Operational Area, and to coordinate and assist with disaster response in jurisdictions both within and outside of the Fresno County Operational Area.

Certified Unified Program Agency

The Certified Unified Program Agency (CUPA) is responsible for implementing a unified hazardous materials and hazardous waste management regulatory program. The agency provides oversight of businesses that require hazardous materials business plans, require California accidental release prevention plans or federal risk management plans, operate storage tanks, generate hazardous waste(s), and have onsite treatment of hazardous waste(s)/tiered permits.

Land Use Program

Land Use program staff are responsible for reviewing proposed land use development applications submitted to the various planning agencies in the County and providing comments regarding project compliance with the appropriate environmental health standards relative to the staff's areas of expertise. The Land Use Program evaluates proposed land developments for compliance with laws and regulations pertaining to domestic and public water supplies, sewage and solid waste disposal, community noise and vector control.

Water Surveillance Program

The Water Surveillance Program permits, monitors, and inspects small public water systems and state small water systems within Fresno County and permits new water well construction, reconstruction of existing wells, and destruction of abandoned wells within unincorporated Fresno County. These activities are designed to help assure that a reliable supply of pure, wholesome, and potable water is provided to small public and state small water systems within Fresno County. In addition, the water well permitting program helps assure that private water wells are constructed to minimize the potential for contamination of the groundwater supply and eliminate safety hazards associated with abandoned wells.

Communicable Disease Division

The Communicable Disease Division of the Public Health Department participates in hazard mitigation in several ways, including immunizations, education, and preventive medication to prevent and/or control the spread of disease. The ultimate result is a reduction in human suffering, medical costs, and lost productivity.

In the case of a pandemic influenza or bio-terrorism event, the division would mobilize to mitigate the effects on the general population as well as first responders and essential personnel by administering antivirals, antibiotics, and immunizations. The County has a pandemic response plan that is implemented by this division.

Education and Prevention Services

Education and Prevention Services supports the public health objectives of the Department of Public Health. It conducts research on current health issues and, where appropriate, develops and implements programs to provide information, education, and services that promote and improve the public health and safety within the Fresno community. Staff also participate in a variety of public health partnerships with schools, community-based organizations, health and safety coalitions, public health agencies, managed care, medical institutions, and community members. Activities include:

- Conducting research and development on identified unmet public health needs;
- Developing, implementing, and evaluating primary prevention interventions intended to address targeted health needs of children, youth, and families;
- Providing consumer, youth, and employer health and wellness education;
- Creating and implementing informational marketing campaigns on health and safety topics;
- Coordinating selected training, assessment, and evaluation activities for the department.

Public Health Laboratory

The Public Health Laboratory provides surveillance and detects the presence of disease producing agents that have the potential to adversely affect the health of an entire community. The information generated by this testing is furnished to other agencies and departments to be used for the purpose of monitoring infectious disease outbreaks and environmental threats to the public's health. The information can then be used to plan containment strategies and assess the effectiveness of various health education programs.

Fresno County Heat Emergency Contingency Plan

Administered by a number of departments within the Department of Public Health, the Fresno County Heat Emergency Contingency Plan was developed to reduce the incidence of morbidity and mortality associated with local extreme heat events. The plan describes County operations during heat-related emergencies and provides guidance for County departments and personnel.

FRESNO COUNTY DEPARTMENT OF PUBLIC WORKS AND PLANNING

The Fresno County Department of Public Works and Planning is responsible for a wide variety of programs and activities related to planning, zoning, permits, water, community service districts, housing, community and economic development, and roads and bridges for the unincorporated portion of Fresno County. Most of the department's mitigation activities take place in the Development Services Division, which consists of the following sections:

- **Building and Safety Section**—Responsibilities include administration of building codes and regulations to ensure the public's safety.
- **Land Development, Policy Planning, and Environmental Analysis Units** - Responsibilities include processing of land use applications, land division, administration of the County's general plan, Regional, Community and specific plans, urban growth management, and project-related amendments to General Plan and the Zoning Ordinance.
- **Development Engineering** – Responsibilities include processing grading permits, processing parcel maps and lot line adjustments.

Development Engineering is also responsible for floodplain administration and administers the National Flood Insurance Program (NFIP) for unincorporated areas of the County. The NFIP is a FEMA program that makes flood insurance available to communities that have enacted local ordinances restricting development within the 100-year floodplain. Fresno County has been an NFIP participant since 1982.

Floodplain management in Fresno County is based on mapping associated with the 2016 FEMA Flood Insurance Study, which contains revised and updated information on flood hazards in the geographic area of Fresno County, including the Cities of Clovis, Coalinga, Firebaugh, Fowler, Fresno, Huron, Kerman, Kingsburg, Mendota, Orange Cover, Parlier, Reedley, Sanger, San Joaquin, and Selma and the unincorporated areas of Fresno County. This study developed flood- risk data for various areas of the community that will be used to establish actuarial flood insurance rates and to assist the community in its efforts to promote sound floodplain management.

COMMUNITY DEVELOPMENT

The Community Development Division is responsible for implementing a variety of grants and programs to develop and promote viable communities by improving housing, providing a suitable living environment, and expanding economic opportunities.

Community Development Programs are provided solely through the use of grant funds such as the Community Development Block Grant, HOME Investment Partnerships Program, Neighborhood

Stabilization Program and other Federal and State grants. Agritourism funding is provided by the Fresno County Board of Supervisors. The programs the department provides include:

- Affordable Housing Programs
- Community Development Grants
- Economic Development
- Housing Element and Community Plans

FRESNO COUNTY DEPARTMENT OF AGRICULTURE

The Fresno County Department of Agriculture, under direction of the California Department of Food and Agriculture, is responsible for conducting regulatory and service functions pertaining to the multi-billion-dollar agricultural industry in Fresno County. The primary purpose and objective of the department is the promotion and protection of the County agricultural industry and the general public. The services the department provides across its offices include:

Main Office

- Pesticide Regulatory Program office
- Fruit and Vegetable Program office
- Certified Producers Certificates
- Public information requests
- ACP Bulk Citrus Compliance Agreement Issuance
- Weights and Measures Program Office

Administrative Office

- Plant Quarantine office
- Administration staff
- Business Services Division
- Entomologist/Pest Identification

District Offices

- Phytosanitary Certification of export commodities
- Restricted Materials Permit and Operator Identification Number Issuance
- ACP Bulk Citrus Compliance Agreement Issuance
- Disposal Orders
- Regulatory Guidance

COUNTY ADMINISTRATIVE OFFICE

The County Administrative Office functions as the operations arm of the Board of Supervisors to deliver the highest quality public services to Fresno County residents. There are 21 Departments with 7,200 employees dedicated to finding better and more effective ways to meet the needs of our community.

We administer the County's $4.1 billion dollar budget that funds services in public safety, law enforcement, agriculture, public works, human services, libraries and elections. The CAO office takes the lead in activities to improve the quality of life in Fresno County, including economic development, capital improvements, and tourism.

FRESNO COUNTY PUBLIC LIBRARY

The Fresno County Public Library provides collections and services through its Central Resource Library and 34 branches. It is part of the San Joaquin Valley Library System, a cooperative network of ten public library jurisdictions in the counties of Fresno, Kern, Kings, Madera, Mariposa, and Tulare. The library is an excellent resource for information about hazards and emergency preparedness.

STATE AND FEDERAL PROGRAMS

A number of state and federal programs exist to provide technical and financial assistance to local communities for hazard mitigation. Some of the primary agencies/departments that are closely involved with local governments in the administration of these programs include:

- California Governor's Office of Emergency Services
- State of California Multi-Hazard Mitigation Plan
- California Department of Water Resources (San Joaquin District)*
- San Joaquin River Management Plan
- California Department of Forestry and Fire Protection (Fresno King's Unit)*
- California Environmental Protection Agency
- California Department of Fish and Game*
- California Department of Transportation (Caltrans)
- California Highway Patrol
- California State Parks and Recreation Department*
- California State Lands Commission*
- San Joaquin River Conservancy*
- Federal Emergency Management Agency (Region IX)
- U.S. Army Corps of Engineers (South Pacific Division/Sacramento District)*
- Bureau of Reclamation (Mid-Pacific Region, Hollister planning area)*
- USDA Forest Service (Pacific Southwest Region)*
- National Parks Service (Pacific West Region)*

- USDA Natural Resources Conservation Service (Fresno Service Center)*
- U.S. Environmental Protection Agency (Region IX)
- American Red Cross (Fresno/Madera)

*Owns and/or manages land and/or facilities (or has some sort of administrative role, e.g., fire protection) in the County, potential partner for mitigation activities

SERVICE PROVIDERS FOR PEOPLE WITH ACCESS AND FUNCTIONAL NEEDS

A number of local organizations provide services and support to people with Access and Functional Needs in Fresno County. These include:

- Central Valley Regional Center (CVRC)
    - Serves clients with intellectual deficits, autism, cerebral palsy, epilepsy, and other conditions requiring similar services (including brain injuries). Many of their clients experience behavioral challenges, mobility issues, vision and hearing deficits, cognitive deficits, and health conditions that require special equipment.
    - They estimate that there are 13,389 people residing in Fresno County with this type of disability as of March 2024, and serve 28,000 clients across six counties.
    - CVRC can provide disaster-related assistance to their large population of clients, and has staff that speak a variety of languages (including English, Spanish, and Hmong)
- American Red Cross
    - Serves hundreds of clients with mobility issues and who are hard of hearing during disasters.
    - Provides sheltering, feeding, and wrap-around services (recovery, damage assessments, and disaster emergency supplies)
- The Fresno-Madera Area Agency on Aging
    - Serves older clients who frequently experience vision and hearing impairments, cognitive impairment, and mobility challenges.
    - Serves approximately 1,000 clients per month between MSSP, Linkages, and HDM programs, in addition to serving approximately 5,800 meals at congregate sites.
    - Can provide support in identifying clients that need evacuation assistance and provide emergency meals and durable medical equipment.
- Amputees of Central California
    - Serves clients who have lost one or more limbs, many of whom do not use prosthetics and need additional support in ambulating during an emergency.
    - Serves 400-500 clients, of the estimated 700-800 amputees in Fresno County.
- Loyd's Liberty Homes
    - Provides housing services to clients who blind and visually impaired, deaf and hard of hearing, non-ambulatory, elderly, non-verbal, and with behavioral health issues.
    - Houses 38 clients across two facilities

FRESNO COUNTY'S FISCAL MITIGATION CAPABILITIES

Table 87. Fresno County's Fiscal Mitigation Capabilities identifies financial tools or resources that the County could potentially use to help fund mitigation activities.

Table 87. Fresno County's Fiscal Mitigation Capabilities

Staff or Personnel Resources	Never Used	Previously Used	Currently Used	Comments
Capital Improvement Programming				UNKNOWN
Community Development Block Grants (CDBG)				UNKNOWN
Special Purpose Taxes (or taxing districts)				UNKNOWN
Gas/Electric Utility Fees				UNKNOWN
Water/Sewer Fees				UNKNOWN
Stormwater Utility Fees				UNKNOWN
Development Impact Fees				UNKNOWN
General Obligation, Revenue, and/or Special Tax Bonds				UNKNOWN
Partnering Agreements or Intergovernmental Agreements				UNKNOWN
FEMA Hazard Mitigation Assistance Grants (HMGP, FMA, PDM)				UNKNOWN
Homeland Security Grants (HSGP)			X	
USDA Rural Development Agency Grants				UNKNOWN
US Economic Development Administration Grants				UNKNOWN
Infrastructure Investment and Jobs Act (IIJA)				UNKNOWN

VULNERABILITY ASSESSMENT

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

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas.

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

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

With Fresno County's hazards identified and profiled, the HMPC conducted a vulnerability assessment to describe the impact that each hazard would have on the County. The vulnerability assessment quantifies, to the extent feasible using best available data, assets at risk to natural hazards and estimates potential losses. This section focuses on the risks to the County as a whole. Data from the individual participating jurisdictions was also evaluated and is integrated here and in the jurisdictional annexes and noted where the risk differs for a particular jurisdiction within the planning area.

Data used to support this assessment included the following:

- County GIS data (hazards, base layers, and assessor's data)
- Statewide GIS datasets compiled by the California Governor's Office of Emergency Services to support mitigation planning
- California Department of Forestry and Fire Protection GIS datasets including tree mortality data
- FEMA's HAZUS-MH for earthquake modelling
- Written descriptions of inventory and risks provided by participating jurisdictions
- A refined flood loss estimation by jurisdiction with the use of geospatial analysis 1% and 0.2% annual chance flooding as well as the 200-year floodplain.
- Existing plans and studies
- Personal interviews with planning team members and staff from the County and participating jurisdictions

FRESNO COUNTY VULNERABILITY AND ASSESTS AT RISK

As a starting point for analyzing the planning area's vulnerability to identified hazards, the HMPC used a variety of data to define a baseline against which all disaster impacts could be compared. This section describes significant assets at risk in the planning area. Data used in this baseline assessment included:

- Total values at risk
- Critical facility inventory
- Historic, cultural, and natural resources
- Growth and development trends
- Social vulnerability

TOTAL VALUES AT RISK

The following data from the Fresno County Assessor's Office is based on the certified roll values as of February 2024. This data should only be used as a guideline to overall values in the County, as the information has some limitations. The most significant limitation is created by Proposition 13. Instead of adjusting property values annually, the values are not adjusted or assessed at fair market value until a property transfer occurs. As a result, overall value information is likely low and does not reflect current market value of properties within the County. It is also important to note, in regard to a disaster, it is generally the value of the infrastructure or improvements to the land that is of concern or at risk. Generally, the land itself is not a loss. **Figure 80. Fresno County Exposure by Jurisdiction** shows the building values for the entire Fresno County planning area (e.g., the total values at risk) by jurisdiction. The values for unincorporated Fresno County are provided in **Figure 81. Building Exposure for Unincorporated County, by Property Type** by property type. For more information on building exposure for each jurisdiction, see the appropriate annex.

Table 88. Assets at Risk

Jurisdiction	Parcel Count	Building Count	Improved Value	Land Value	Total Value
Clovis	42,692	37,893	$14,224,851,294	$3,332,745,410	$17,565,413,960
Coalinga	3,762	4,807	$40,376,700	$11,159,350	$51,536,050
Firebaugh	2,201	2,077	$24,317,302	$13,330,297	$41,994,899
Fowler*	2,381	2,296			
Fresno	156,104	152,956	$74,325,635,573	$14,859,345,930	$89,998,576,963
Huron*	1,142	1,066			
Kerman	4,043	4,045	$289,394,719	$94,670,178	$392,488,007

Jurisdiction	Parcel Count	Building Count	Improved Value	Land Value	Total Value
Kingsburg	4,166	4,393	$195,880,186	$77,170,690	$277,098,036
Mendota	2,361	2,331	$5,429,577	$2,154,143	$7,593,820
Orange Cove*	1,718	2,126			
Parlier	2,813	3,102	$7,642,462	$1,930,661	$9,573,123
Reedley	7,153	7,132	$4,566,516,130	$313,583,124	$4,890,722,514
San Joaquin*	795	854			
Sanger	7,513	7,870	$340,931,729	$91,625,847	$432,668,326
Selma	6,558	7,149	$141,103,950	$68,244,144	$209,749,314
Unincorporated	82,580	94,849	$2,990,240,616	$2,155,125,277	$5,399,450,613

**Tax Parcel Ownership Value table for Fresno County does not contain valuations for these 4 jurisdictions*

Source: Based on information from Fresno County Assessor 2/28/2024 and Microsoft-Bing Building Footprints U.S. Dataset, 2019

Table 89. Assets at Risk by Parcel Type

Property Type	Parcel Count	Building Count	Improved Value	Land Value	Total Value
Agricultural	4,867	4,594	$1,614,009,984	$1,414,695,221	$3,128,491,075
Commercial	2,425	1,109	$6,571,839,262	$1,967,206,317	$8,604,594,489
Government	23	3	$240,514	$1,333,289	$1,573,803
Industrial	730	899	$1,475,735,060	$522,248,712	$2,922,628,472
School	29	43	$28,202,029	$7,365,482	$35,612,811
Hospital	16	3	$341,363,536	$17,708,710	$359,072,246
Multi-Residential *(Apartments or Condos)*	12,554	3,438	$78,143,455,036	$13,343,869,743	$91,487,380,379
Group Housing/Lodging	27	62	$123,195,002	$27,027,675	$152,511,457
Mobile/Manufactured Home	379	1,007	$219,791,066	$337,554,097	$557,363,573
Open Space	1,194	395	$1,624,248,027	$473,461,965	$2,107,438,892
Single-Family Residential	34,844	33,773	$6,783,498,693	$2,510,390,338	$9,293,925,341
Recreation	53	29	$23,510,572	$10,083,948	$33,645,020
Utilities	22	42	$7,711,634	$19,469,825	$27,181,459
Unknown or Vacant	6,742	289,027	$56,529,540	$343,157,723	$400,037,763
Total	**63,905**	**334,424**	**$97,013,329,955**	**$20,995,573,045**	**$119,111,456,780**

Source: Based on information from Fresno County Assessor 2/28/2024 and Microsoft-Bing Building Footprints U.S. Dataset, 2019

CRITICAL FACILITY INVENTORY

Of significant concern with respect to any disaster event is the location of critical facilities in the planning area. Critical facilities are often defined as those services and facilities essential during a major emergency and that, if damaged, would result in severe consequences to public health and safety or facilities that, if unusable or unreachable because of a major emergency, would seriously and adversely affect the health, safety, and welfare of the public. Critical facilities include, but are not limited to:

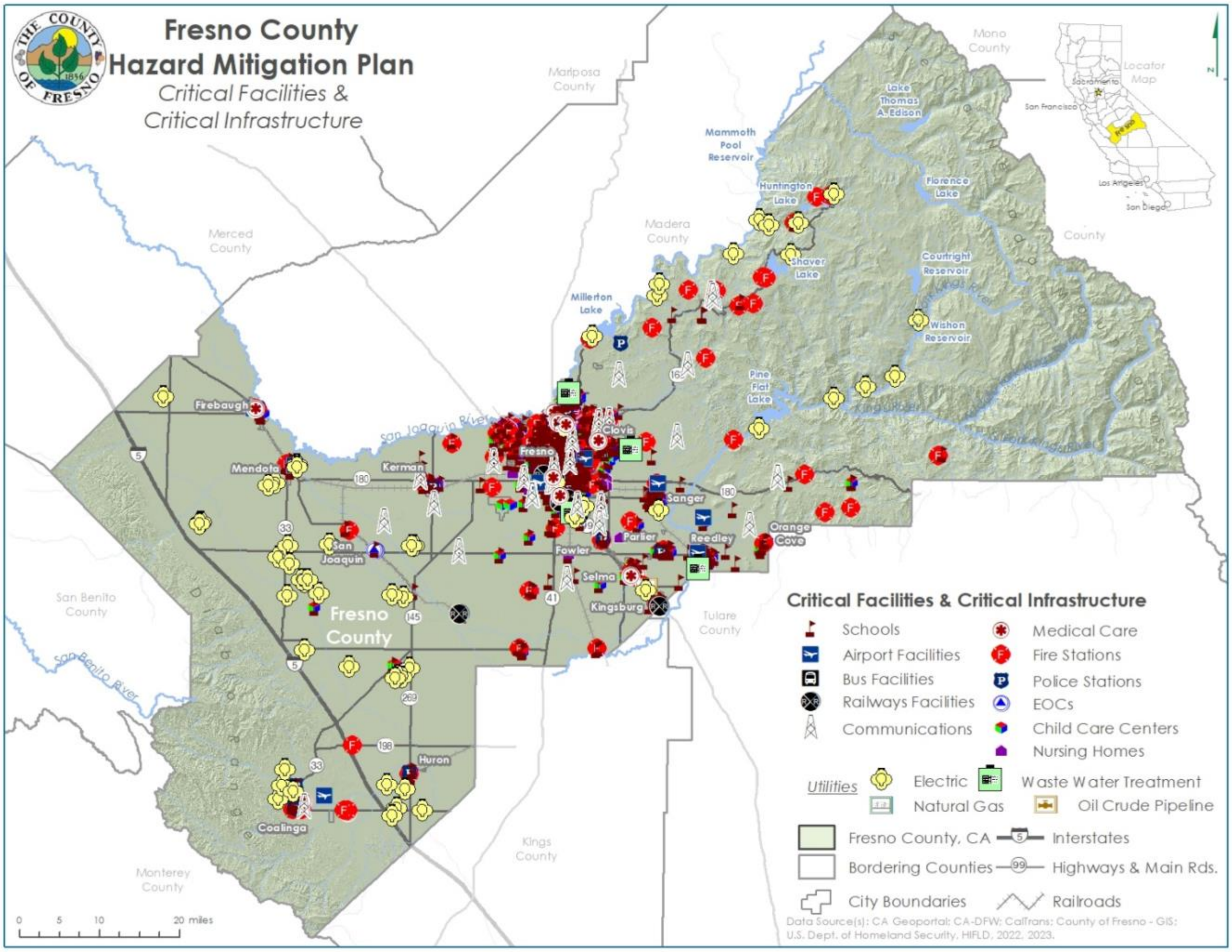
- Schools and other publicly owned facilities.
- Hospitals, nursing homes, and housing likely to have occupants who may not be sufficiently mobile to avoid injury or death during a major disaster.
- Police stations, fire stations, vehicle and equipment storage facilities, and emergency operations centers that are needed for response activities before, during, and after an event.
- Public and private utility facilities that are vital to maintaining or restoring normal services to damaged areas before, during, and after an event; and
- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic, and/or water-reactive materials.

An updated inventory of critical facilities in the planning area based on data from a combination of Fresno County GIS and the Homeland Infrastructure Foundation-Level Data (HIFLD 2022; 2023) is provided in Figure 82. Fresno County Planning Area's Critical Facilities A noted limitation is the lack of facilities for water and power which was not available in the County or HIFLD datasets. Critical facilities in the County are illustrated in Figure 83. Critical Facilities in Fresno County, with more detail shown in Figure 84, Figure 85, and Figure 86. More information on critical facilities in the participating jurisdictions can be found in the jurisdictional annexes.

Table 90. Critical Facilities in Fresno County

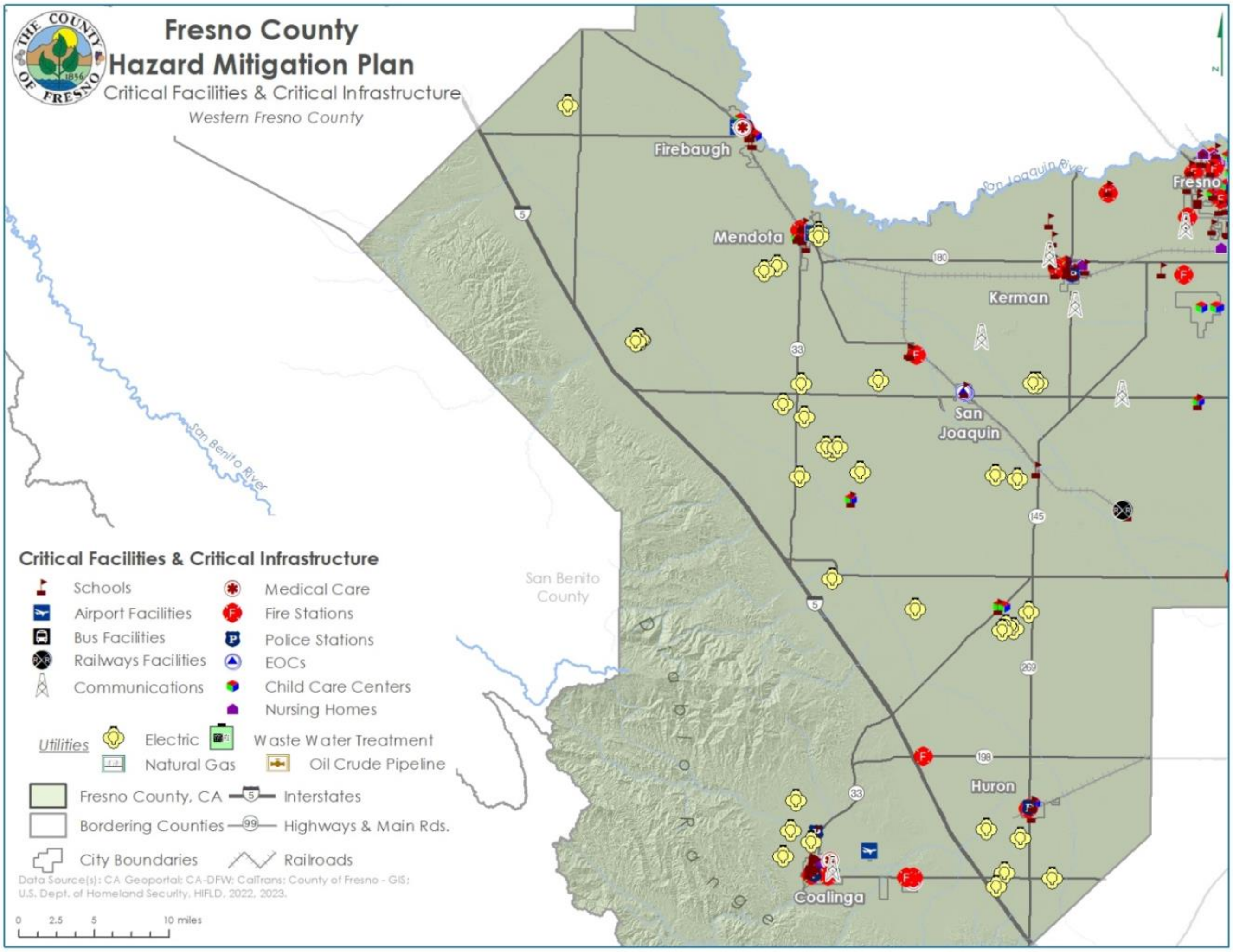
Jurisdiction	Airport Facilities	Bus Facilities	Comms. Facilities	Electric Power Facilities	EOCs	Fire Stations	Natural Gas Facilities	Medical Care Facilities	Oil Crude Pipeline Facilities	Police Stations	Railways Facilities	Schools	Waste water Treatment Facilities	Total
Clovis	0	0	2	0	0	6	0	1	0	2	0	39	1	51
Coalinga	1	0	1	0	1	3	0	2	0	3	0	10	0	21
Firebaugh	1	0	0	0	2	1	0	0	0	1	0	6	0	11
Fowler	0	0	0	0	1	1	0	0	0	1	0	8	0	11
Fresno	2	1	5	2	1	21	0	13	0	11	4	182	1	243
Huron	0	0	0	0	0	1	0	0	0	1	0	3	0	5
Kerman	0	0	0	0	1	1	0	0	0	1	0	6	0	9
Kingsburg	0	0	0	1	0	1	0	0	1	1	1	10	0	15
Mendota	1	0	0	2	0	1	0	0	0	0	0	7	0	11
Orange Cove	0	0	0	0	0	1	0	0	0	0	0	5	0	6
Parlier	0	0	0	0	0	1	0	0	0	1	0	7	0	9
Reedley	2	0	0	0	0	1	0	1	0	1	0	14	1	20
San Joaquin	0	0	0	0	2	0	0	0	0	0	0	1	0	3
Sanger	1	0	0	1	0	3	0	0	0	1	0	14	0	20
Selma	0	0	0	0	0	2	0	1	0	1	0	11	0	15
Unincorporated	0	0	34	54	0	33	1	0	0	1	4	71	1	199

Figure 58. Fresno County Critical Facilities and Critical Infrastructure



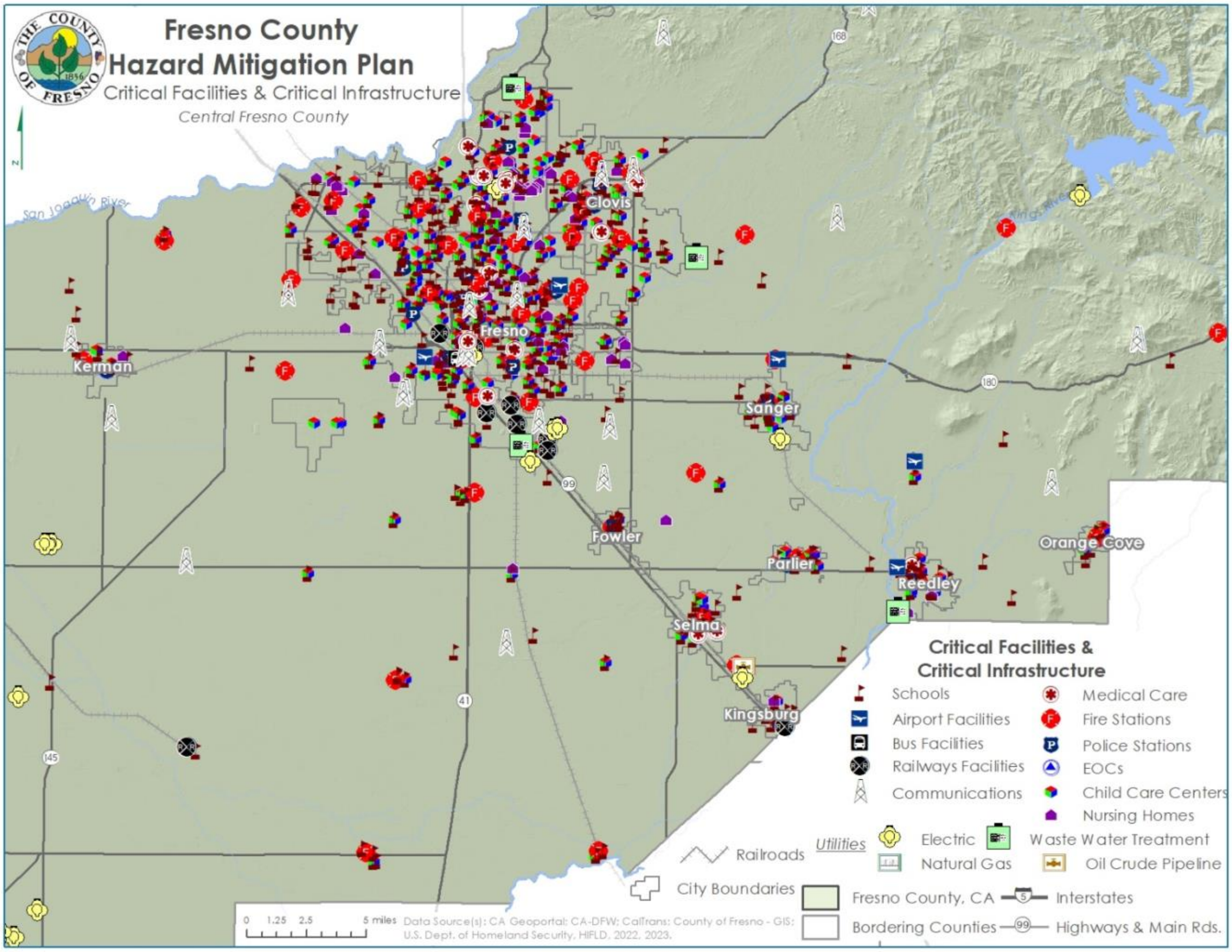
Source: CA Geoportal; CA-DFW; CalTrans; County of Fresno – GIS; U.S. Department of Homeland Security, HIFLD, 2022, 2023

Figure 59. Western Fresno County Critical Facilities and Critical Infrastructure



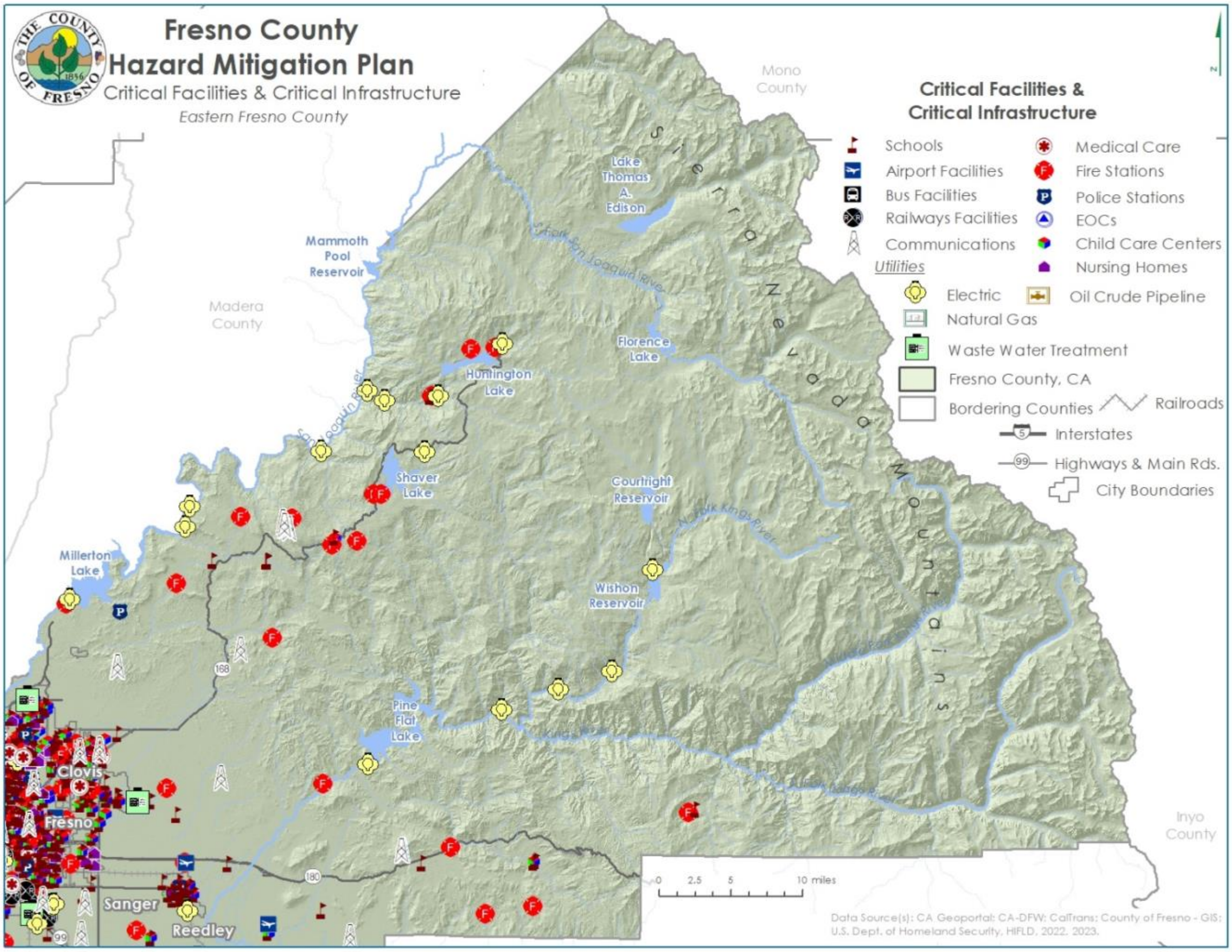
Source: CA Geoportal; CA-DFW; CalTrans; County of Fresno – GIS; U.S. Department of Homeland Security, HIFLD, 2022, 2023

Figure 60. Central Fresno County Critical Facilities and Critical Infrastructure



Source: CA Geoportal; CA-DFW; CalTrans; County of Fresno – GIS; U.S. Department of Homeland Security, HIFLD, 2022, 2023

Figure 61. Western Fresno County Critical Facilities and Critical Infrastructure



Source: CA Geoportal; CA-DFW; CalTrans; County of Fresno – GIS; U.S. Department of Homeland Security, HIFLD, 2022, 2023

HISTORIC, CULTURAL, AND NATURAL RESOURCES

Assessing the vulnerability of Fresno County to disaster also involves inventorying the historic, cultural, and natural assets of the area. This step is important for the following reasons:

- The community may decide that these types of resources warrant a greater degree of protection due to their unique and irreplaceable nature and contribution to the overall economy.
- If these resources are impacted by a disaster, knowing so ahead of time allows for more prudent care in the immediate aftermath, when the potential for additional impacts are higher.
- The rules for reconstruction, restoration, rehabilitation, and/or replacement are often different for these types of designated resources.
- Natural resources can have beneficial functions that reduce the impacts of natural hazards, for example, wetlands and riparian habitat help absorb and attenuate floodwaters.

HISTORIC AND CULTURAL RESOURCES

Fresno County has a large stock of historically significant homes, public buildings, and landmarks. To inventory these resources, the HMPC collected information from several sources. The California Department of Parks and Recreation Office of Historic Preservation (OHP) was the primary source of information. The OHP is responsible for the administration of federally and state mandated historic preservation programs to further the identification, evaluation, registration, and protection of California's irreplaceable archaeological, and historical resources. OHP administers the National Register of Historic Places, the California Register of Historical Resources, the California Historical Landmarks, and the California Points of Historical Interest programs. Each program has different eligibility criteria and procedural requirements.

- The **National Register of Historic Places** is the Nation's official list of cultural resources worthy of preservation. The National Register is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect historic and archeological resources. Properties listed include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archeology, engineering, and culture. The National Register is administered by the National Park Service, which is part of the U.S. Department of the Interior.
- The **California Register of Historical Resources** program encourages public recognition and protection of resources of architectural, historical, archeological and cultural significance; identifies historical resources for state and local planning purposes; determines eligibility for state historic preservation grant funding; and affords certain protections under the California Environmental Quality Act. The register is the authoritative guide to the state's significant historical and archeological resources.
- **California Historical Landmarks** are sites, buildings, features, or events that are of statewide significance and have anthropological, cultural, military, political, architectural, economic, scientific, technical, religious, experimental, or other value. Landmarks #770 and above are automatically listed in the California Register of Historical Resources.
- **California Points of Historical Interest** are sites, buildings, features, or events that are of local (city or county) significance and have anthropological, cultural, military, political, architectural,

economic, scientific, technical, religious, experimental, or other value. Points designated after December 1997 and recommended by the State Historical Resources Commission are also listed in the California Register.

Historical resources included in the programs above are identified in **Table 91. Fresno County Historical Resources.**

Table 91. Fresno County Historical Resources

Name (Landmark Plaque Number)	National Register	State Landmark	Point of Interest	Date Listed	City
Arroyo De Cantua (344)		X		8/8/1939	Coalinga
Azteca Theater	X			4/05/2017	Fresno
Bank of Italy (N1140)	X			10/29/1982	Fresno
Ben Gefvert Rank Historic District	X			1/01/2011	Fresno
Big Creek Hydroelectric System Historic District	X			7/26/2016	Big Creek
Birdwell Rock Petroglyph Site (N2193)	X			3/12/2003	Coalinga
Brix, H.H., Mansion (N1235, P438)	X		X	9/15/1983 (N) 10/1/1975 (P)	Fresno
Coaling Station A (P7)			X	12/16/1966	Coalinga
Coalinga Polk Street School (N1099)	X			5/6/1982	Coalinga
Dinkey Creek Bridge (N1957)	X			9/5/1996	Dinkey Creek
Einstein House (N554, P440)	X		X	1/31/1978 (N) 10/1/1975 (P)	Fresno
Fig Garden Woman's Club (P799)			X	7/18/1994	Fresno
Forestiere Underground Gardens (N524, 916)	X	X		10/28/1977 (N) 1/31/1978	Fresno
Fort Miller (584)		X		5/22/1957	Friant
Fowler's Switch (P299)			X	5/2/1973	Fowler

Name (Landmark Plaque Number)	National Register	State Landmark	Point of Interest	Date Listed	City
Fresno Bee Building (N1158)	X			11/1/1982	Fresno
Fresno Brewing Company Office and Warehouse (N1260)	X			1/5/1984	Fresno
Fresno City (488)		X		8/7/1951	Tranquility
Fresno County Hall of Records	X			12/22/2011	Fresno
Fresno Memorial Auditorium (N1867)	X			5/10/1994	Fresno
Fresno Republican Printery Building (N738)	X			1/2/1979	Fresno
Fresno Sanitary Landfill (N2140)	X			8/7/2001	Fresno
Gamlin Cabin (N471)	X			3/8/1977	Wilsonia
Holy Trinity Armenian Apostolic Church (N1450)	X			7/31/1986	Fresno
Hotel Californian (N2235)	X			4/21/2004	Fresno
John Muir Memorial Shelter	X			8/15/2016	Grant Cove
Kearney, M. Theo, Park and Mansion (N335, P5)	X		X	3/13/1975 (N) 8/5/1966 (P)	Fresno
Kindler, Paul, House (N1141)	X			10/29/1982	Fresno
Kingsburg Railroad Depot (P694)			X	3/30/1988	Kingsburg
Knapp Cabin (N727)	X			12/20/1978	Cedar Grove
Maulbridge Apartments (N1100)	X			5/6/1982	Fresno
Meux House (N324, P437)	X		X	1/13/1975 (N) 10/1/1975 (P)	Fresno
Milwood Townsite (P4)			X	8/5/1966	Miramonte
Old Administration Building, Fresno City College (N282)	X			5/1/1974	Fresno

Name (Landmark Plaque Number)	National Register	State Landmark	Point of Interest	Date Listed	City
Old Fresno Water Tower (N114)	X			10/14/1971	Fresno
Orange Cove Santa Fe Railway Depot (N658)	X			8/29/1978	Orange Cove
Pantages, Alexander, Theater (N559)	X			2/23/1978	Fresno
Physicians Building (N701)	X			11/20/1978	Fresno
Reedley National Bank (N1344)	X			2/28/1985	Reedley
Reedley Opera House Complex (N1276)	X			4/5/1984	Reedley
Rehorn House (N982)	X			1/8/1982	Fresno
Romain, Frank, House (N986)	X			1/11/1982	Fresno
San Joaquin Light & Power Corporation Building (N2310)	X			1/3/2006	Fresno
Santa Fe Hotel (N1673)	X			3/14/1991	Fresno
Santa Fe Passenger Depot (N443)	X			11/7/1976	Fresno
Settlement of Academy (P45)			X	9/22/1967	Toll House
Shorty Lovelace Historic District (N555) *	X			1/31/1978	Pinehurst
Site of First Junior College in California (803)		X		6/28/1965	Fresno
Site of the Fresno Free Speech Fight of the Industrial Workers of the World (873)		X		7/19/1974	Fresno
Southern Pacific Passenger Depot (N561)	X			3/21/1978	Fresno
Stoner House (N1390)	X			10/17/1985	Sanger
Sycamore Point (P226)			X	10/5/1971	Friant

Name (Landmark Plaque Number)	National Register	State Landmark	Point of Interest	Date Listed	City
Temporary Detention Camps for Japanese Americans-Fresno Assembly Center (934)		X		5/13/1980	Fresno
Temporary Detention Camps for Japanese Americans-Pinedale Assembly Center (934)		X		5/13/1980	Pinedale
Tollhouse (P145)			X	11/3/1969	Toll House
Tower Theatre (N1795)	X			9/24/1992	Fresno
Twining Laboratories (N1681)	X			3/26/1991	Fresno
Warehouse Row (N564)	X			3/24/1978	Fresno
YWCA Building (N673, P439)	X		X	9/21/1978(N) 10/1/1955 (P)	Fresno

Source: National Park Service, National Register of Historic Places

The National Park Service administers two programs that recognize the importance of historic resources, specifically those pertaining to architecture and engineering. While inclusion in these programs does not give these structures any sort of protection, they are valuable historic assets. Note: Since these structures are not protected, it is possible that they no longer exist.

The Historic American Buildings Survey (HABS) documents America's architectural heritage. The following are the HABS structures in Fresno County:

- Albert G. Wishon House, 340 North Fulton Street, Fresno, Fresno County, CA
- Burnett Nurse's Home, 120 North Howard Street, Fresno, Fresno County, CA
- Charles H. Cobb House, 271 North Yosemite Avenue, Fresno, Fresno County, CA
- Dinkey Ranger Station, Warehouse, Dinky-Shaver Road at Dinky Creek, Shaver Lake, Fresno County, CA
- George H. Larsen House, 486 North Poplar Avenue, Fresno, Fresno County, CA
- Ira H. Brooks House, 350 North Fulton Avenue, Fresno, Fresno County, CA

- Ivan Carter McIndoo House, 310 North Fulton Street (Moved from 410 North Van Ness Avenue), Fresno, Fresno County, CA
- John G. Porter House, 316 North Fulton Street (Moved from 420 North Van Ness Avenue), Fresno, Fresno County, CA
- Lamb Townhouse, 254 North Roosevelt Avenue, Fresno, Fresno County, CA
- Matthew McIndoo House, 345 North Van Ness Avenue, Fresno, Fresno County, CA
- Newman J. Levinson House, 1636 Broadway Street (moved from 439 North Van Ness Avenue), Fresno, Fresno County, CA
- O'Brien House, 136-138 North Roosevelt Avenue, Fresno, Fresno County, CA
- William W. Hangar House, 6118 Greenwood Avenue (Moved from 425 North Van Ness Avenue, Fresno, CA), Clovis, Fresno County, CA

The Historic American Engineering Record documents historic sites and structures related to engineering and industry. The following are the HAER structures in Fresno County:

- Hume Lake Dam, Sequoia National Forest, Hume
- Belmont Avenue Subway, Traffic Circle, and Bridge, Belmont Avenue, Fresno, Fresno County, CA
- Big Creek Hydroelectric System, Bear Creek Diversion Dam, Sierra National Forest, Big Creek, Fresno County, CA
- Big Creek Hydroelectric System, Big Creek Town, Operator House Garage, Orchard Avenue south of Huntington Lake Road, Big Creek, Fresno County, CA
- Big Creek Hydroelectric System, Big Creek Town, Operator House, Orchard Avenue south of Huntington Lake Road, Big Creek, Fresno County, CA
- Big Creek Hydroelectric System, Cottage 112, 53996 Huntington Lake Road, Big Creek, Fresno County, CA
- Big Creek Hydroelectric System, Cottage 113, 53934 Huntington Lake Road, Big Creek, Fresno County, CA
- Big Creek Hydroelectric System, Cottage 115, 54347 Cedar Street, Big Creek, Fresno County, CA
- Big Creek Hydroelectric System, Florence Lake Dam, Sierra National Forest, Big Creek, Fresno County, CA
- Big Creek Hydroelectric System, Powerhouse 1, North Bank of Big Creek, 100 feet from Big Creek Road, Big Creek, Fresno County, CA
- Big Creek Hydroelectric System, Powerhouse 2 and 2A, South Bank of Big Creek, approximately 3.5 miles west of Big Creek, Big Creek, Fresno County, CA
- Big Creek Hydroelectric System, Powerhouse 3 Penstock Standpipes, Big Creek, Big Creek, Fresno County, CA
- Big Creek Hydroelectric System, Powerhouse 3, San Joaquin River, near confluence of Italian Bar Road and Million Dollar Road, Big Creek, Fresno County, CA

- Big Creek Hydroelectric System, Powerhouse 8, Confluence of Big Creek and San Joaquin River, about 4.8 miles west of Big Creek, Big Creek, Fresno County, CA
- Big Creek Hydroelectric System, Powerhouse 8, Operator Cottage, Big Creek, Big Creek, Fresno County, CA
- Big Creek Hydroelectric System, Vincent 220kV Transmission Line, 224-mile transmission line extending from Big Creek to Antelope Substation, Big Creek, Fresno County, CA
- Hume Lake Dam, Sequioa National Forest, Hume, Fresno County, CA
- Weber Avenue Overcrossing, Weber Avenue above East Belmont Avenue, Fresno, Fresno County, CA

The Fresno County General Plan Background Report identifies the following, some of which are already mentioned above, as historic properties in Fresno County:

- Azteca Theater (836-840 F Street)
- Lake Moon Company Building (914-920 F Street)
- Industrial Bank of Fresno/Bank of Italy Building (947-951 F Street)
- Basque Hotel (1102 F Street)
- Gundelfinger Home (2201 Calaveras Street)
- Temple Beth Israel (2336 Calaveras Street)
- Bolitho Home (33 N. Calaveras Street)
- McGee-Macias Home (115 N. Calaveras Street)
- John C. Fox Home (128 N. Calaveras Street)
- Ernest J. Huntzicker Memorial Hall (245 N. Calaveras Street)
- Eugene Mathewson Home (319 N. Calaveras Street)
- Shipp-Selland Home (1919) 1002 E. Cambridge Avenue
- George Riddell Miller Home (617 E. Carmen Ave.)
- Deacon-Eilert Home (660 E. Carmen Ave.)
- Bates Home (718 E. Carmen Ave.)
- Frank Chance Field Site (1935) Southwest corner of Cedar Avenue and Ventura Street
- Fresno Trolley Cars/Standard Diner (1731 S. Cherry Avenue)
- Holt Lumber Company (1916 S. Cherry Avenue)
- Shuttera Home (ca. 1904) 320 S. Chestnut Avenue
- Bing Kong Association Building (921-929 China Alley)
- Bow On Tong Association Building (935 China Alley)
- McKay Home (201 N. Clark Street)

- Shipp Home (305 N. Clark Street)
- Anderson Home (329 N. Clark Street)
- Wild Home (1929) 567 E. Clinton Avenue
- George W. Smith Home (109 N. College Avenue)
- Henry & Emily Banta Home (228 N. College Avenue)
- John B. Frinchaboy Home (243 N. College Avenue)
- Moore-Koop Home (258 N. College Avenue)
- Alfred and Minnie Cherin Home (1949) 233 E. Cornell Avenue
- Hewitt Home (175 N. Diana Street)
- E. E. Wyman/Santa Fe Land Improvement Co. Boarding House (209 N. Diana Street)
- Graff Home (916 E. Divisadero Street)
- Flora Montague Bungalow Court (950 E. Divisadero Street)
- Ohannesian Home (1225 E. Divisadero Street)
- Mary Matson Home (1440 E. Divisadero Street)
- Hopkins Home (1458 E. Divisadero Street)
- J. R. Turner Home (ca. 1910) 815 E. Dudley Avenue
- Free Evangelical Lutheran Cross Church (208 E Street)
- Legler Home (305 E Street)
- First Mexican Baptist Church (1061 E Street)
- John B. Marshall Homes (164 N. Echo Avenue)
- Whitney-Huntting Home (1105 N. Echo Avenue)
- George & Adelphia Rowell Home (1903) 153 N. Effie Street
- Weems Home (3121 E. El Monte Way)
- William Saroyan Home (3204 E. El Monte Way)
- Vartanian Home (362 F Street)
- Gibbs Home (369 N. Ferger Avenue)
- Solorio Home (415 N. Ferger Avenue)
- Hughes Home (1917) 743 S. Fourth Street
- William F. Jones Home (1911) 1112 E. Franklin Avenue)
- Fresno Fire Department No. 3 (1406-1430 Fresno Street)
- Fresno City Hall (2326 Fresno Street)
- Fresno Memorial Auditorium (2425 Fresno Street)
- Old Fresno Water Tower (2444 Fresno Street)
- Twining Laboratories (2527 Fresno Street)

- Physicians Building (2607 Fresno Street)
- H. H. Brix Mansion (2844 Fresno Street)
- City Fire Alarm Station (2945 Fresno Street)
- Eaton Flats Apartments (126 N. Fresno Street)
- San Joaquin Grocers Wholesale Warehouse (104 Fulton Street)
- J. M. Menend/Murray Ice Cream Co. Building (175 Fulton Street)
- Sham's Rio Grande Service Station (205 Fulton Street)
- White Company Trucks/Electric Motor Company Building (245 Fulton Street)
- Rustigian Building (701-723 Fulton Street)
- Sun Stereo Warehouse (736 Fulton Street)
- Fresno Photo Engraving Building (748-752 Fulton Street)
- Radin-Kamp Department Store (959 Fulton Mall)
- Bank of Italy Building (1001 Fulton Mall)
- Fresno Daily Expositor Building (1029-1031 Fulton Mall)
- Mason Building (1044 Fulton Mall)
- Pacific Southwest Building (1060 Fulton Mall)
- Helm Building (1101 Fulton Mall)
- Mattei Building (1177 Fulton Mall)
- Pantages Theatre (1400-1430 Fulton Street)
- San Joaquin Light & Power Company (1401 Fulton Street)
- Wilson Theater (1445-1463 Fulton Street)
- P. G. & E. Building (1544 Fulton Street)
- Kutner Home (174 N. Fulton Street)
- Ira Brooks Home (226 N. Fulton Street)
- Alexander Home (235 N. Fulton Street)
- Farr Home (245 N. Fulton Street)
- McIndoo-Phillips Home (310 N. Fulton Street)
- Sample Sanitarium (311 N. Fulton Street)
- Porter-Bernard Home (320 N. Fulton Street)
- Amazon S. Hays Home (330 N. Fulton Street)
- A. G. Wishon Home (340 N. Fulton Street)
- Ridge Electric Motor Company Building (1968) 1235 G Street)
- Henry C. Offutt Home (227 N. Glenn Avenue)
- Thompson Home (274 N. Glenn Avenue)

- Cardwell Home (357 N. Glenn Avenue)
- John H. Fearon / Efren J. Diaz-Muñoz Home (1906) 2540 E. Grant Avenue)
- William Saroyan Home (1963) 2729 W. Griffith Way)
- Hobbs Parsons Produce Company (903 H Street)
- Dale Bros. Coffee Company Sign (1420 H Street)
- Benham Ice Cream/Dale Bros. Coffee Company (1420-1432 H Street)
- Jacob Parret Home (1900) 2069 E. Harvey Avenue)
- Old Barn (ca. 1900) 2919 E. Heaton Avenue)
- Cearley-Twining Home (625 E. Home Avenue)
- Old Saint Agnes Hospital (603 W. Home Avenue)
- Ray & Jessie Prior Home (1921) 458 N. Howard Avenue)
- Dr. Oliver Howard Home (3263 E. Huntington Boulevard)
- Fred J. & Mary Dow Home (3369 E. Huntington Boulevard)
- Clarence & Bessie Bernhauer Home (3428 E. Huntington Boulevard)
- A. G. & Henrietta Wishon Home (3555 E. Huntington Boulevard)
- Fred & Virginia Billings Home (3650 E. Huntington Boulevard)
- F. Rex & Vera Sporleder Home (3702 E. Huntington Boulevard)
- C. M. & Gertrude Prescott Home (3707 E. Huntington Boulevard)
- Bekins-McClatchy Home (3729 E. Huntington Boulevard)
- Blum Home (3870 E. Huntington Boulevard)
- Eugene & Elsie Brinker Home (3965 E. Huntington Boulevard)
- Johnson Home (1907) 3811 E. Illinois Avenue)
- Liberty Laundry Building (1928) 1830 Inyo Street)
- Kearney Boulevard Gateway (Kearney Boulevard & Fresno Street)
- Thomas Arrioto Home (505 E. Kearney Boulevard)
- St. Alphonsus Catholic Church (307 E. Kearney Boulevard)
- Teilman Home (919 W. Kearney Boulevard)
- Clovis M. Cole Home (1914) 3615 E. Kerckhoff Avenue)
- Fresno Buddhist Temple (1340 Kern Street)
- Komoto's Department Store and Hotel (1536-1542 Kern Street)
- Hotel Virginia (2125-2139 Kern Street)
- Fresno Republican Printery (2130 Kern Street)
- Old Post Office Substation (2404 Kern Street)
- Scottish Rite Temple (1455 L Street)

- Harvey Swift Home (1605 L Street)
- Montgomery Thomas Home (1642 L Street)
- Kutner Home (1651 L Street)
- Bean Home (1705 L Street)
- Towne Apartments (1717 L Street)
- Long (Black) Home (1727 L Street)
- Helm Home (1749 L Street)
- Fresno Brewing Company (100 M Street)
- Squirt Bottling Company Building (152 M Street)
- Neverman Home (309 M Street)
- Hoonanian Home (496 M Street)
- Valley Lahvosh Baking Company (502 M Street)
- Louis Einstein Home (1600 M Street)
- Y.W.C.A. Residence Hall (1660 M Street)
- Fresno Unified School District Office (2348 Mariposa Street)
- Fresno Unified School District Office (2348 Mariposa Mall)
- St. John's Hall School (2811 Mariposa Street)
- St. John's Cathedral Catholic Church (2814 Mariposa Street)
- St. John's Rectory (2814 Mariposa Street)
- Normandy Village Apartments (ca. 1935) 840-852 E. Brown Avenue/2617-2645 N. Maroa Avenue
- Edward B. Waterman Home (2535 E. McKenzie Avenue)
- Mrs. C. C. S. Tufts Home (2635 E. McKenzie Avenue)
- George & Jessie Hare Home (1918) 815 E. McKinley Avenue
- Thomas & Sadie Elliott Home (ca. 1904) 934 E. Mildreda Avenue
- Proffitt Home (1911) 5218 N. Millbrook Avenue
- Senator Ray W. & Marie Hays Home (1937) 1616 S. Minnewawa Avenue
- Fresno Planing Mill Company (1917) 1820 Monterey Street
- Mink Home (344 N Street)
- McVey Homes (1322-1326 N Street)
- Walley Residence (1338 N Street)
- First Church of Christ Scientist (1615 N Street)
- Lewis Insurance Company Office (431 E. Olive Avenue)
- Smith/Staniford Home (437 E. Olive Avenue)
- Kindler Home (1520 E. Olive Avenue)

- Robinson Home (1900) 1003 S. Orange Avenue
- United Grocers Inc. Wholesale Grocery Building (414 P Street)
- Berven Rug Mills Inc./Wellman-Peck & Company (616 P Street)
- Fresno Consumers Ice Company (702 P Street)
- Western Meat Company (754 P Street)
- Wormser Building (764 P Street)
- Frank J. Craycroft Home (1927) 6545 N. Palm Avenue
- Donahoo Home (103 N. Park Avenue)
- Waller Home (306 N. Park Avenue)
- Cowdrey Home (330 N. Park Avenue)
- John Euless Home (1913) 373 S. Peach Avenue
- Nis Johnson Home (601 E. Pine Avenue)
- Gustav & Edith Manheim Home (617 E. Pine Avenue)
- Gates-Twining Home (640 E. Pine Avenue)
- Mosgrove Home (660 E. Pine Avenue)
- Main Home (1914) 520 W. Princeton Avenue
- State Center Warehouse (747 R Street)
- United Grocers Inc. Warehouse & Distribution Center (801 R Street)
- Thomas R. Meux Home (1007 R Street)
- Collins Home (1107 R Street)
- C. W. Harlow Home (1913) 986 N. Roosevelt Avenue)
- Aten Home (1133 S Street)
- Central Packaging Supply Company (1920) 2534 San Benito Street)
- Romain Home (1905) 2055 San Joaquin Street)
- First Congregational Church (11 N. San Pablo Avenue)
- Woolfolk Home (267 N. San Pablo Avenue)
- C. Jarman Home (385 N. Pablo Avenue)
- Spencer Home (395 N. San Pablo Avenue)
- W. H. Spencer Home (401-403 N. San Pablo Avenue)
- Vincent Home (921 N. San Pablo Avenue)
- Schmidt Home (1908) 2320 Santa Clara Street)
- Santa Fe Hotel (1913) 935 Santa Fe Avenue)
- Martin Home (1002 T Street)
- Gundelfinger Home (1020 T Street)

- Goodman Home (1060 T Street)
- Anderson Home (1120 T Street)
- Van Valkenburgh Home (1125 T Street)
- Albert C. Wilke Home (532 E. Terrace Avenue)
- C. J. Ryland Home (573 E. Terrace Avenue)
- St. Genevieve's Catholic Church (1127 Tulare Street)
- Southern Pacific Depot (1713 Tulare Street)
- Southern Pacific Lines Pullman Shed (1713 Tulare Street)
- T. W. Patterson Building (2014 Tulare Street)
- Rowell Building (2100 Tulare Street)
- Fresno County Hall of Records (2281 Tulare Street)
- U.S. Post Office (2309 Tulare Street)
- Maubridge Apartments (2344 Tulare Street)
- Santa Fe Depot (2650 Tulare Street)
- F. K. Prescott Home (2983 Tulare Street)
- Theodore Roosevelt High School (4250 E. Tulare Street)
- Emmanuel Lutheran Church (1115 U Street)
- Gerlitz Home (121 North U Street)
- Frank L. Smith Home (245 North U Street)
- Fresno City College Old Administration Building (1101 E. University Avenue)
- Fresno City College Library (1122 E. University Avenue)
- Roessler Home (4881 E. University Avenue)
- Van Ness Gate Entrance (2208 S. Van Ness Avenue)
- Judy Tobacco Building (155 Van Ness Avenue)
- Bekins Van and Storage (301 Van Ness Avenue)
- Elia Home (634/640 Van Ness Avenue)
- James Phelan Building (700 Van Ness Avenue)
- Pilibos Building (830 Van Ness Avenue)
- Hotel California (851 Van Ness Avenue)
- Kern Kay Hotel (906-912 Van Ness Avenue)
- Liberty Theater (944 Van Ness Avenue)
- Fresno Bee Building (1545 Van Ness Avenue)
- Sadler Office Supply Company (1717 Van Ness Avenue)
- Adam Baird Home (136 N. Van Ness Avenue)

- Barkalew Home (153 N. Van Ness Avenue)
- McAlpine Home (171 N. Van Ness Avenue)
- Eugene & Eleanor Risley Home (243 N. Van Ness Avenue)
- John Fairweather Home (248 N. Van Ness Avenue)
- W. D. Coates Home (264 N. Van Ness Avenue)
- Fathy Home (844 N. Van Ness Avenue)
- Maracci Home (985 N. Van Ness Avenue)
- Porteous Home (1095 N. Van Ness Avenue)
- Russ Clements Service Station (2740 N. Van Ness Avenue)
- Holy Trinity Armenian Apostolic Church (2226 Ventura Street)
- J. B. Inderrieden Co. Packing Plant (2721 Ventura Street)
- Frank Chance Field Site (Southwest corner of Cedar Avenue and Ventura Street)
- Owen Home (1902) 2631 E. Washington Avenue)
- Floyd W. Cowan Home (642 E. Weldon Avenue)
- W. P. Stanton Home (650 E. Weldon Avenue)
- Nystrom Home (725 N. Wilson Avenue)
- A. Emory & Cora Wishon Home (1287 N. Wilson Avenue)
- Roessler Winery (1893) 1902 N. Winery Avenue)
- Tower Theatre (1201 N. Wishon Avenue)
- William & Helen Sutherland Home (1460 N. Wishon Avenue)
- Alice & John Williams Home (1525 N. Wishon Avenue)
- Herbert C. Gundelfinger Home (1919) 1038 E. Yale Avenue)
- Thomas Cowan Home (153 N. Yosemite Avenue)
- John Humiston Home (229 N. Yosemite Avenue)
- Christian L. Samuelson Home (232 N. Yosemite Avenue)
- Cobb Home (271 N. Yosemite Avenue)
- Wilbur F. & Edna Marie Chandler Home (520 N. Yosemite Avenue)
- Homer A. Allen Home (548 N. Yosemite Avenue)

A 1988 publication from the state's Office of Historical Preservation identified 16 "ethnic historic sites" in Fresno County. Five Views: An Ethnic Historic Site Survey for California was originally conceived to broaden the spectrum of ethnic community participation in historic preservation activities and to provide better information on ethnic history and associated sites. The 16 sites are as follows:

- Burr Ranch/Smith Brothers Ranch (Black American)

- Fowler City Park (Black American)
- Gabriel Moore Ranch (Black American)
- Young's Place (Black American)
- First Mexican Baptist Church (Mexican American)
- Fresno Buddhist Church (Japanese American)
- Fresno Nihonmachi (Japanese American)
- H. Sumida Company (Japanese American)
- Iseki Labor Camp (Japanese American)
- Kamikawa Brothers (Japanese American)
- Nihin Byoin-Hashiba Sanitarium (Japanese American)
- Okonogi Hospital Site (Japanese American)
- Reedley Kyogi-Kai Hall (Japanese American)
- Bowles (Japanese American)
- Selma Japanese Mission Church (Japanese American)
- KGST (Mexican American)

The Fresno County General Plan Background Report also identifies 13 museums in Fresno County, most of which are in the City of Fresno. They are all privately owned and operated nonprofit organizations.

- African American Historical And Cultural Museum Of The San Joaquin Valley, Fresno
- Armenian Heritage Museum, Fresno
- Arte Americas, Fresno
- Clovis Museum, Clovis
- Community Heritage Center, Fresno
- Downing Planetarium, Fresno
- Forestiere Underground Gardens, Fresno
- Fresno Art Museum, Fresno
- Fresno County Historical Museum, Fresno
- Fresno Historical Society, Fresno
- Kearney Mansion Museum, Fresno
- Meux Home Museum, Fresno
- Reedley City Museum, Reedley
- Sanger Depot Museum, Sanger

- Veterans Memorial Museum Inc, Fresno
- William Saroyan House-Museum, Fresno

It should be noted that these lists may not be complete, as they may not include those properties currently in the nomination process and not yet listed. Additionally, as defined by the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA), any property over 50 years of age is considered a historic resource and is potentially eligible for the National Register. Thus, if the property is to be altered, or has been altered, as the result of a major federal action, the property must be evaluated under the guidelines set forth by CEQA and NEPA. Structural mitigation projects are considered alterations for the purpose of this regulation.

NATURAL RESOURCES

Natural resources are important to include in benefit-cost analyses for future projects and may be used to leverage additional funding for mitigation projects that also contribute to community goals for protecting sensitive natural resources. Awareness of natural assets can lead to opportunities for meeting multiple objectives. For instance, protecting wetlands areas protects sensitive habitat as well as stores and reduces the force of floodwaters.

CENTRAL COAST RANGE REGION

Only a small portion of the far western edge of Fresno County lies in the central Coast Range region. This area supports a mosaic of summer dry grassland, blue oak and blue oak-foothill pine woodland, and chaparral habitat types. Western Fresno County transitions from the grasslands and agriculture of the Central Valley to the inner coast region. Mostly intermittent streams flow from the inner Coast Range to the valley floor. Some can support riparian habitat that provides additional value to both resident and migratory wildlife.

SAN JOAQUIN VALLEY FLOOR REGION

More than 50 percent of Fresno County lies in the southern San Joaquin Valley subregion of the Central Valley. This southern subregion is generally hotter and drier than the subregion to the north and supports some desert elements. The valley floor region has undergone extensive conversion of native habitats that existed before European settlement of the state. Presently, this region supports extensive amounts of agriculture and urban development around the Fresno, Clovis, and Sanger areas.

In the few remaining areas not converted to urban or agriculture use, unique biological features persist. Mixed in with areas of grassland habitat are freshwater and alkaline vernal pools that support unique native flora and fauna. A few small, isolated areas of sodic vernal pools occur in the northwestern part of the County, primarily at the Kerman reserve. Concentrations of freshwater vernal pools occur in a belt along the northeast edge of the valley floor region north of the Kings River. In the highly modified Central Valley, vernal pool areas are often grazed but remain a unique biological relic of native California species in the natural landscape.

The rivers and streams that flow from the mountains in the east historically meandered through broad floodplain. Because of urbanization and agriculture, these broad floodplains have been restricted to narrower belts along the rivers and streams or otherwise modified for flood control. In the upper San

Joaquin River, the floodplains are naturally constrained by high bluffs bordering the river. Within this modified landscape, the remaining riparian habitat provides corridors and linkages to and from the biotic regions of the County and is of great value to resident and migratory wildlife. The San Joaquin and Kings River systems and the Fresno Slough are the major waterways in the County.

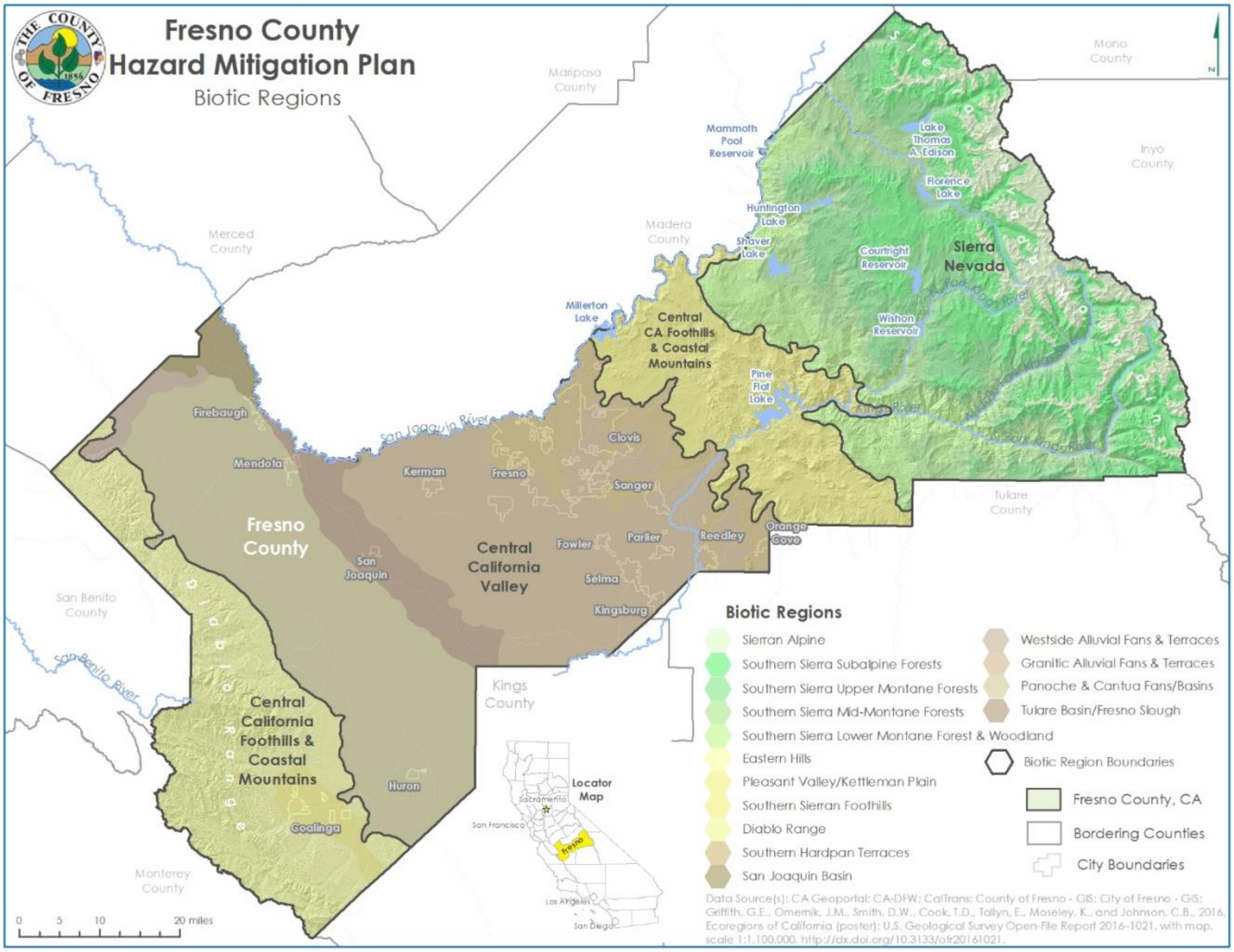
CENTRAL SOUTHERN SIERRA NEVADA FOOTHILLS

Fresno County includes a portion of the central and southern subregions of the Sierra Nevada Mountains that can be further divided into a central/southern Sierra Nevada foothill and central/southern high Sierra Nevada district. The foothill district is best differentiated from the high Sierra and the San Joaquin Valley areas by habitat types that change with topography. The foothills that are the transition from the valley floor to the high Sierra can be characterized by blue oak and blue oak-foothill pine woodlands and chaparral habitats dotted with areas of serpentine soils. Density and canopy coverage of tree species is highly variable depending on natural conditions such as soils, topography, slope and aspect, and human influences from grazing, hardwood harvesting, and other land clearing activities. Moderate gradient perennial and intermittent streams and rivers support a varied amount of riparian habitat that provide valuable habitat for wildlife.

CENTRAL/SOUTHERN HIGH SIERRA NEVADA

The transition from the foothills to the high Sierra Nevada can be characterized by the addition of ponderosa pine at low elevations into the dominant plant species composition (from around 2,000 feet). The foothills to high Sierra biotic regions make a transition through a mixed hardwood conifer habitat to those habitats dominated by conifers, such as ponderosa pine, white fir, and giant sequoia. In the higher elevations, Jeffrey pine, lodgepole pine, and treeless alpine communities dominate. Rivers and streams are at a higher gradient than their foothill or valley floor reaches and support a montane riparian habitat that, like the others, provides valuable habitat for resident and migratory wildlife. The majority of the high Sierra region in Fresno County is included in the Sequoia and Sierra National Forests and Kings Canyon National Park and managed by their respective federal agencies for recreational, timber, tourism, and wilderness values.

Figure 62. Fresno County Biotic Regions



Source: CA Geoportal; CA-DFW; CalTrans; County of Fresno-GIS; City of Fresno-GIS; Griffith, G.E., Omernik, J.M., Smith D.D., Tallyn, E., Moseley, K., and Johnson, C.B., 2016, Ecoregions of California (poster): U.S. Geological Survey Open-File Report 2016-2021

Each region hosts specific habitats that together support a wide variety of vegetation and wildlife (Table 92. Fresno County's Generalized Biotic Regions and Habitat Mosaic), and each region has different susceptibilities to hazards such as wildfire, flood, and drought. Fresno County recognizes the importance of protecting, preserving, conserving, and restoring this biodiversity.

Table 92. Fresno County's Generalized Biotic Regions and Habitat Mosaic

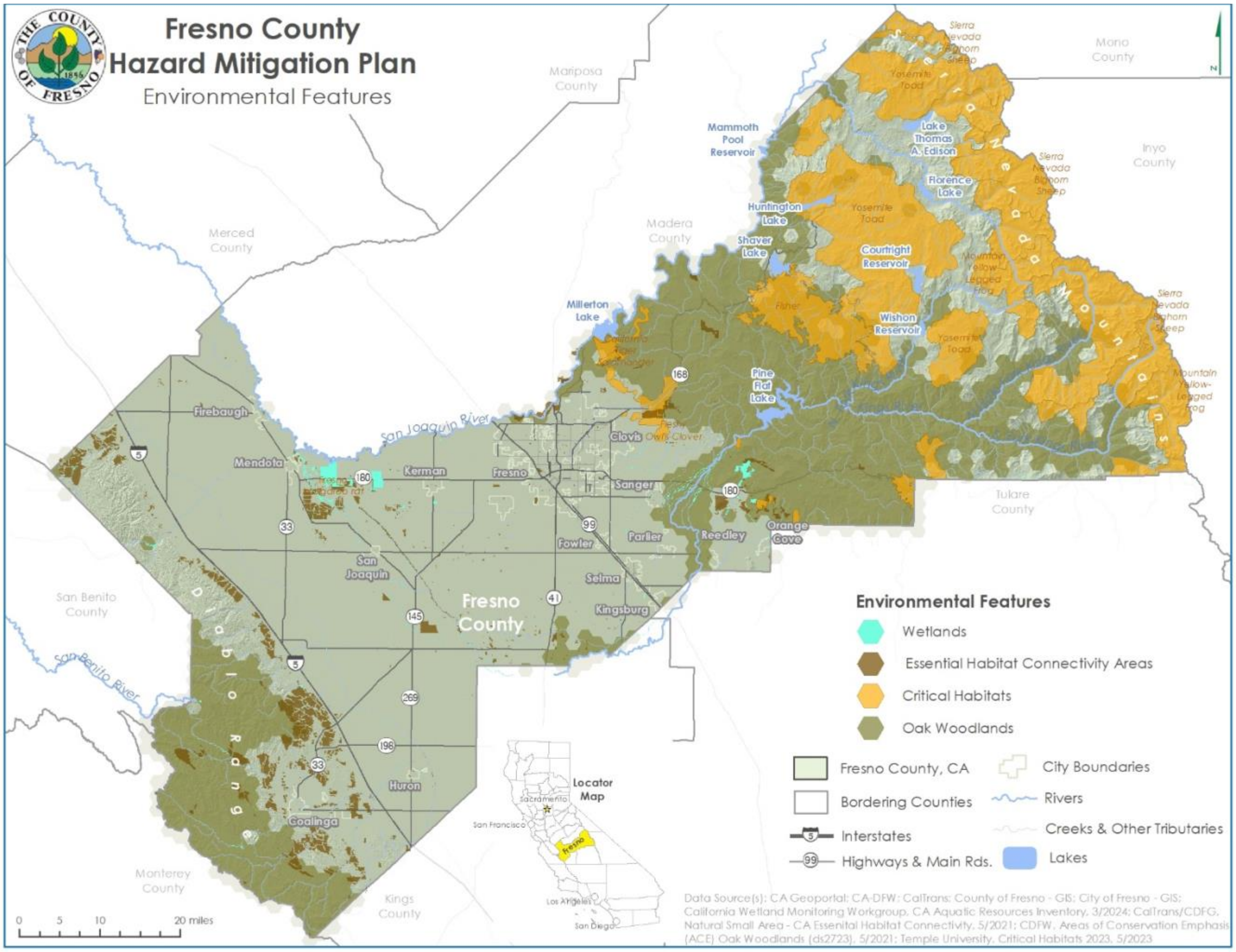
Central Western California Region	Great Central Valley	Sierra Nevada Foothills	High Sierra Nevada
• Chaparral • Blue Oak-Foothill Pine Woodland • Annual/Ruderal Grassland • Riparian Woodlands • Oak Woodlands • Juniper Woodland • Desert and Alkali Scrub	• Grasslands • Marshes • Vernal Pools • Alkali Scrubs • Riparian Woodlands • Eucalyptus Forest	• Grassland • Chaparral • Serpentine Chaparral • Blue Oak Woodlands • Blue Oak-Foothill Pine Woodlands • Riparian Woodlands • Hardwood Stands • Juniper Woodland	• Montane Conifer and Hardwood Forest • Montane Riparian Woodlands • Montane Chaparral • Alpine Scrub • Hardwood Stands • Aspen Stands • Conifer Forests

Source: Fresno County General Plan, 2024

Approximately one third of the County lies within land under federal jurisdiction. The USDA Forest Service and National Parks Service manage these lands for recreation, biology, wilderness, tourism, timber, and mining under federal guidelines, policies, and laws. The biotic regions that are outside of federal ownership and, therefore, most subject to development are the Central Coast Range, San Joaquin Valley Floor, and the lower Sierra Nevada foothills.

For purposes of this plan, natural resources include special-status species, sensitive habitats, wetlands, and other natural resources identified by the HMPC. **Figure 63. Fresno County Environmental Features** illustrates Fresno County's environmental features.

Figure 63. Fresno County Environmental Features



Source: CA Geoportal; CA-DFW; CalTrans; County of Fresno – GIS; City of Fresno – GIS; California Wetland Monitoring Workgroup; CA Aquatic Resources Inventory, 3/2024; CalTrans/CDFG, Natural Small Area – CA Essential Habitat Connectivity, 5/2021; CDFW, Areas of Conservation Emphasis (ACE) Oak Woodlands, 5/2021; Temple University, Critical Habitats 2023, 5/2023

SPECIAL-STATUS SPECIES

To further understand natural resources that may be particularly vulnerable to a hazard event, as well as those that need consideration when implementing mitigation activities, it is important to identify at-risk species (i.e., endangered species) in the planning area. An endangered species is any species of fish, plant life, or wildlife that is in danger of extinction throughout all or most of its range. A threatened species is a species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Both endangered and threatened species are protected by law and any future hazard mitigation projects are subject to these laws. Candidate species are plants and animals that have been proposed as endangered or threatened but are not currently listed.

Information from the U.S. Fish and Wildlife Service and the California Natural Diversity Data Base, a program that inventories the status and locations of rare plants and animals in California, was combined to create an inventory of special-status species in Fresno County. The full inventory, along with information about habitat requirements and distribution where available from the Fresno County General Plan Background Report, is available in Appendix B: Special-Status Species in Fresno County. **Table 93. Endangered, Threatened, Rare, and Candidate Species in Fresno County** lists national and state endangered, threatened, rare, and candidate species in Fresno County by species type.

Table 93. Endangered, Threatened, Rare, and Candidate Species in Fresno County

Common Name	Scientific Name	Federal Status	California Status
Amphibians			
California tiger salamander	Ambystoma californiense	Threatened	Threatened
Yosemite toad	Anaxyrus canorus	Threatened	None
foothill yellow-legged frog	Rana boylii	None	Endangered
California red-legged frog	Rana draytonii	Threatened	None
southern mountain yellow-legged frog	Rana muscosa	Endangered	Endangered
Sierra Nevada yellow-legged frog	Rana sierrae	Endangered	Threatened
Birds			
tricolored blackbird	Agelaius tricolor	None	Threatened
Swainson's hawk	Buteo swainsoni	None	Threatened
western yellow-billed cuckoo	Coccyzus americanus occidentalis	Threatened	Endangered
willow flycatcher	Empidonax traillii	None	Endangered
bald eagle	Haliaeetus leucocephalus	Delisted	Endangered
bank swallow	Riparia	None	Threatened
great gray owl	Strix nebulosa	None	Endangered
least Bell’s vireo	Vireo bellii pusillus	Endangered	Endangered
Fish			
Lahontan cutthroat trout	Oncorhynchus clarkii henshawi	Threatened	None

Common Name	Scientific Name	Federal Status	California Status
Paiute cutthroat trout	Oncorhynchus clarkii seleniris	Threatened	None
steelhead - Central Valley DPS	Oncorhynchus mykiss irideus	Threatened	None
Invertebrates			
Crotch bumble bee	Bombus crotchii	None	Candidate
western bumble bee	Bombus occidentalis	None	Candidate
longhorn fairy shrimp	Branchinecta longiantenna	Threatened	None
vernal pool fairy shrimp	Branchinecta lynchi	Threatened	None
valley elderberry longhorn beetle	Desmocerus californicus dimorphus	Threatened	None
vernal pool tadpole shrimp	Lepidurus packardi	Endangered	None
Mammals			
Nelson's antelope squirrel	Ammospermophilus nelsoni	None	Threatened
giant kangaroo rat	Dipodomys ingens	Endangered	Endangered
Fresno kangaroo rat	Dipodomys nitratoides exilis	Endangered	Endangered
California wolverine	Gulo	None	Threatened
Sierra Nevada bighorn sheep	Ovis canadensis sierra	Endangered	Endangered
fisher – Southern Sierra Nevada ESU	Pekania pennant	Candidate	Threatened
San Joaquin kit fox	Vulpes macrotis mutica	Endangered	Threatened
Sierra Nevada red fox	Vulpes necator	Proposed Listing	Threatened
Plants			
Mariposa pussypaws	Calyptridium pulchellum	Threatened	None
San Benito evening-primrose	Camissonia benitensis	Threatened	None
Tompkins' sedge	Carex tompkinsii	None	Rare
tree-anemone	Carpenteria californica		Threatened
succulent owl's-clover	Castilleja campestris var. succulenta	Threatened	Endangered
California jewelflower	Caulanthus californicus	Endangered	Endangered
palmate-bracted salty bird's-beak	Chloropyron palmatum	Endangered	Endangered
Hoover's eriastrum	Eriastrum hooveri	Delisted	None
Tracy's eriastrum	Eriastrum tracyi	None	Rare
Boggs Lake hedge-hyssop	Gratiola heterosepala	None	Endangered
Congdon's lewisia	Lewisia congdonii	None	Rare
San Joaquin woollythread	Monolopia congdonii	Endangered	None

Common Name	Scientific Name	Federal Status	California Status
San Joaquin Valley Orcutt grass	Orcuttia inaequalis	Threatened	Endangered
Hartweg's golden sunburst	Pseudobahia bahiifolia	Threatened	Endangered
San Joaquin adobe sunburst	*Pseudobahia peirsonii*	Endangered	None
Keck's checkerbloom	Sidalcea keckii	Endangered	None
Greene's tuctoria	Tuctoria greenei	Endangered	Rare
Reptiles			
blunt-nosed leopard lizard	Gambelia sila	Endangered	Endangered
giant garter snake	Thamnophis gigas	Threatened	Threatened

Sources: Fresno County General Plan 2024

SENSITIVE HABITATS

The California Department of Fish and Game Natural Diversity Data Base identifies 12 sensitive habitat types in Fresno County:

- Big tree forest
- Coastal and valley freshwater marsh
- Great valley mesquite scrub
- Great valley mixed riparian forest
- Monvero residual dunes
- Northern basalt flow vernal pool
- Northern claypan vernal pool
- Northern hardpan vernal pool
- Northern vernal pool
- Sycamore alluvial woodland
- Valley needlegrass grassland
- Valley sink scrub

WETLANDS

Wetlands are habitats in which soil is intermittently or permanently saturated or inundated. Wetland habitats vary from rivers to seasonal ponding of alkaline flats and include swamps, bogs, marshes, vernal pools, and riparian woodlands. Wetlands are waters of the United States and are subject to the jurisdiction of the U.S. Army Corps of Engineers as well as the California Department of Fish and Game (CDF&G). Where the waters provide habitat for federally endangered species, the U.S. Fish and Wildlife Service may also have authority.

Wetlands are a valuable natural resource for communities due to their benefits to water quality, wildlife protection, recreation, and education and play an important role in hazard mitigation. Wetlands provide drought relief in water-scarce areas where the relationship between water storage and streamflow regulation are vital and reduce flood peaks and slowly release floodwaters to downstream areas. When surface runoff is dampened, the erosive powers of the water are greatly diminished. Furthermore, the reduction in the velocity of inflowing water as it passes through a wetland helps remove sediment being transported by the water.

Notable categories of wetlands found in Fresno County include wet meadows in the mountainous region, vernal pools in the foothills, marshes in the valley trough, and reclaimed agricultural lands in western Fresno County. The CDF&G manages several of the major identified wetlands in Fresno County, including the Mendota Wildlife Management Area, Kerman Ecological Reserve, Alkali Sink Ecological Reserve, and smaller wetlands management units along the San Joaquin River. While these lands are currently being adequately protected, environmental concern is primarily focused on wetlands that are not yet identified and protection of remaining vernal pools. Several vernal pool complexes are located near Friant between Friant Road and the Friant-Kern Canal and in the area south of Academy and east of Red Mountain. A large concentration of very high-quality vernal pools is found in these areas, and they are some of the best examples of vernal pools in the state. The County's vernal pools are threatened by urban development and conversion to intensive agriculture.

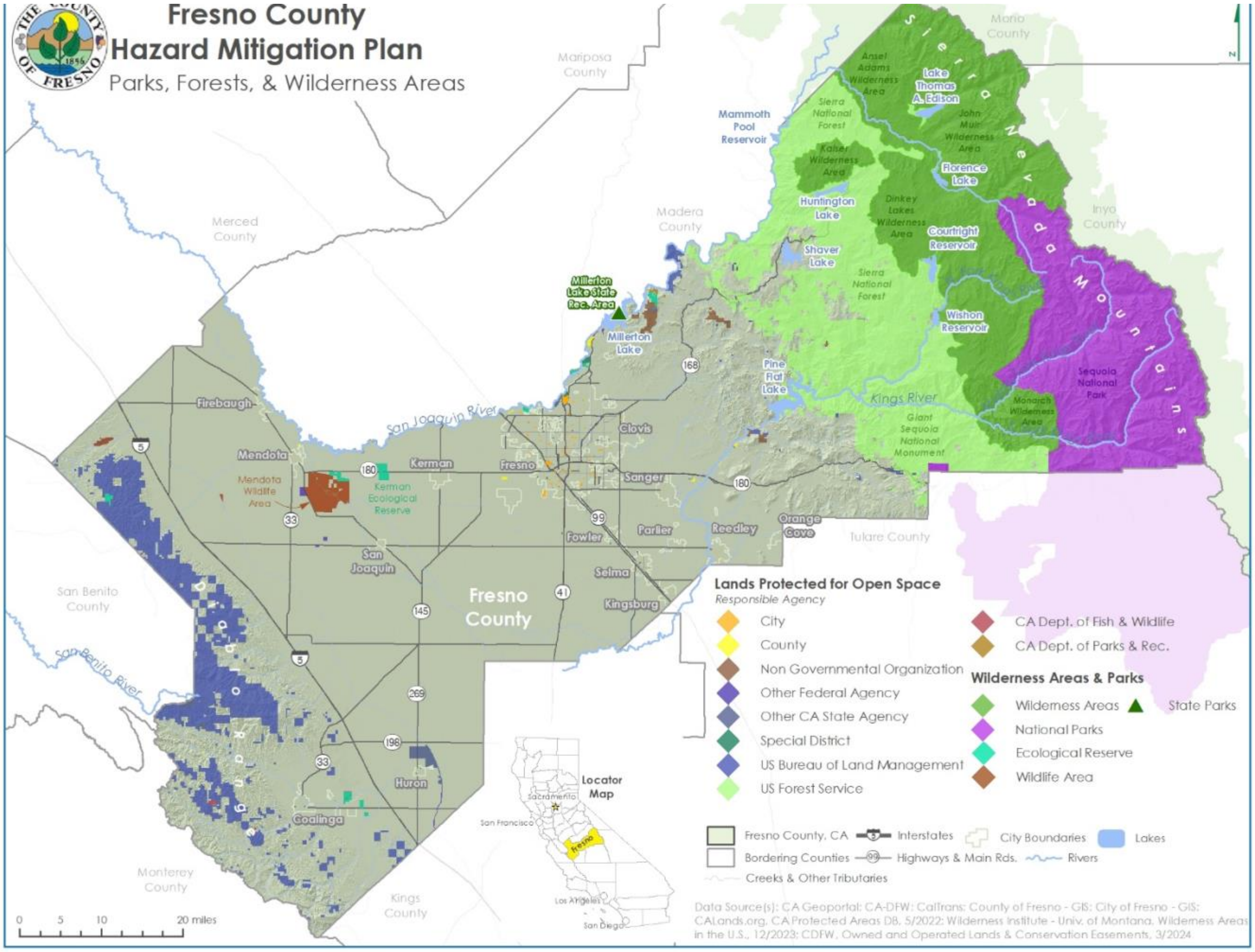
OTHER NATURAL RESOURCES

While some of these resources are not owned or managed by the County, they are important assets for the County (**Figure 64. Fresno County Parks, Forests, and Wilderness Areas**).

- Kings Canyon National Park
- Sequoia National Park & Forest
- Sierra National Forest
- Avocado Lake Park - 3625 N. Piedra Rd. Piedra, CA 93649
- China Creek Park – Sanger, CA 93657
- Choinumni Park - 26501 Pine Flat Road Piedra, CA 93649
- County Cemetery / Potter's Field - 242 N. Hughes Avenue Fresno, CA 93706
- Courthouse Park - 1100 Van Ness Avenue Fresno, CA 93721
- Kearney Park - 6725 W. Kearney Blvd. Fresno, CA 93706
- Kings River Green Belt Park - 769 N Piedra Rd, Sanger, CA 93657
- Laton-Kingston Park - 20055 S. Fowler Ave., Laton, CA 93242
- Los Gatos Creek Park - 46240 Los Gatos Creek Rd. Coalinga, CA 93210
- Lost Lake Recreation Area - 16385 N. Friant Road. Friant, CA 93626
- Pine Flat Handicap Fishing Access
- Shaver Lake Launch Ramp - 45795 Tollhouse Road Shaver Lake, CA 93664
- Skaggs Bridge Park - 5901 N. Madera Avenue Kerman, CA 93630

- Thorburn Access Park - CA-180 & N Rio Vista Ave, Sanger, CA 93657
- Three Rocks Fishing Access
- Veteran's Liberty Cemetery - 1831 W. Belmont Ave. Fresno, CA 93728
- Winton Park - 25314 E Trimmer Springs Road, Sanger, CA 93657

Figure 64. Fresno County Parks, Forests, and Wilderness Areas



Source: CA Geoportal; CA-DFW; County of Fresno – GIS; City of Fresno – GIS; CALands.org, CA Protected Areas DB, 5/2022; Wilderness Institute – University of Montana, Wilderness Areas in the U.S., 12/2023; CDFW, Owned and Operated Lands & Conservation Easements, 3/2024

GROWTH AND DEVELOPMENT TRENDS

As part of the planning process, the HMPC looked at changes in growth and development, both past and future, and examined these changes in the context of hazard-prone areas, and how the changes in growth and development affect loss estimates and vulnerability. According to the Fresno County General Plan, Fresno County is investing in efforts to facilitate the creation of higher paying jobs to account for a high population growth. More specific information on growth and development for each participating jurisdiction can be found in the jurisdictional annexes.

CURRENT STATUS AND PAST DEVELOPMENT

The 2022 estimated population of Fresno County was 1,015,190. This was an increase of 8.9 percent from the 2010 census population of 932,450. In terms of population, Fresno County is the 5th most populous county by populations. The following tables show past growth in Fresno County in terms of population, housing units, and density.

Table 94. Fresno County Population Change by Decade

	1960	1970	1980	1990	2000	2010	2022
Total	**365,945**	**415,599**	**517,717**	**672,302**	**801,288**	**932,011**	**1,015,190**
Change	--	49,654	102,118	154,585	128,986	130,723	83,179
Percent Change (%)	--	13.5	24.6	29.9	19.2	16.3	8.9

Sources: Social Science Data Analysis Network, www.censusscope.org/; California Department of Finance, www.dof.ca.gov/Research/

Table 95. Fresno County Population Change by Jurisdiction

City	Population 2010	Population 2022	% Change	# Change	% of County	% of Total Growth
Clovis	95,631	124,556	30.25%	28,925	12.27%	30.06%
Coalinga	13,380	17,024	27.23%	3,644	1.68%	3.79%
Firebaugh	7,549	8,418	11.51%	869	0.83%	0.90%
Fowler	5,570	7,154	28.44%	1,584	0.70%	1.65%
Fresno	494,665	545,567	10.29%	50,902	53.74%	52.90%
Huron	6,754	6,240	-7.61%	-514	0.61%	-0.53%
Kerman	13,544	16,208	19.67%	2,664	1.60%	2.77%
Kingsburg	11,382	12,613	10.82%	1,231	1.24%	1.28%
Mendota	11,014	12,618	14.56%	1,604	1.24%	1.67%
Orange Cove	9,078	9,525	4.92%	447	0.94%	0.46%
Parlier	14,494	14,554	0.41%	60	1.43%	0.06%
Reedley	24,194	25,441	5.15%	1,247	2.51%	1.30%
San Joaquin	4,001	4,021	0.50%	20	0.40%	0.02%
Sanger	24,270	26,600	9.60%	2,330	2.62%	2.42%

City	Population 2010	Population 2022	% Change	# Change	% of County	% of Total Growth
Selma	23,219	24,430	5.22%	1,211	2.41%	1.26%
All Cities	758,745	854,969	12.68%	96,224	84.22%	100.00%
Unincorporated	171,705	160,221	6.69%	-11,484	15.78%	-11.93%
County Totals	930,450	1,015,190	9.11%	87,740	100%	100%

*Source: US Census Bureau. http://factfinder.census.gov/ *Estimate based on 2020 Census*

Table 96. Fresno County Housing Units Change by Jurisdiction

Jurisdiction	Housing Units 2010	Housing Units 2020	%Change	#Change	% of County	% of Total Growth
Clovis	35,306	43,954	24.49	8,648	37.75	33.67
Coalinga	4,344	4,658	7.23	314	1.37	1.22
Firebaugh	2,096	2,225	6.15	129	0.56	0.50
Fowler	1,842	2,133	15.80	291	1.27	1.13
Fresno	171,288	184,226	7.55	12,938	56.47	50.38
Huron	1,602	1,610	0.50	8	0.03	0.03
Kerman	3,908	4,512	15.46	15.46	2.64	2.35
Kingsburg	4,069	4,415	8.50	8.50	1.51	1.35
Mendota	2,556	2,875	12.48	319	1.39	1.24
Orange Cove	2,231	2,481	11.21	250	1.09	0.97
Parlier	3,494	3,853	10.27	359	1.57	1.40
Reedley	6,867	7,247	5.53	380	1.66	1.48
San Joaquin	934	937	0.32	3	0.01	0.01
Sanger	7,104	7,787	9.61	683	2.98	2.66
Selma	6,813	7,224	6.03	411	1.79	1.60
All Cities	254,454	280,137	10.09	25,683	100	--
Unincorporated	61,077	58,304	-4.54	-2,773	---	--
County Totals	**315,531**	**338,441**	**7.26**	**22,910**	**100**	**--**

Source: US Census Bureau. httsp://factfinder.census.gov/

Table 97. Fresno County Population and Housing Density Change by Jurisdiction

City	Area in Square Miles	2010 Population Density	2010 Housing Unit Density	2020 Population Density*	2020 Housing Unit Density*
Clovis	25.42	4,108.2	1389	4,726.5	1729
Coalinga	6.85	2,186.7	634	2,569.7	680
Firebaugh	3.52	2,180.4	595	2,302.0	632
Fowler	2.53	2,200.3	728	2,646.1	843

City	Area in Square Miles	2010 Population Density	2010 Housing Unit Density	2020 Population Density*	2020 Housing Unit Density*
Fresno	115.18	4,418.4	1487	4,706.8	1599
Huron	1.60	4,245.0	1001	3,878.8	1006
Kerman	3.27	4,189.9	1195	4,903.4	1380
Kingsburg	3.72	4,024.3	1094	3,330.6	1187
Mendota	3.39	3,359.6	754	3,712.1	848
Orange Cove	1.79	4,748.6	1246	5,384.5	1386
Parlier	2.14	6,606.9	1633	6,050.6	1800
Reedley	5.51	4,759.2	1246	4,579.2	1315
San Joaquin	1.1	3,637.3	849	3,655.5	852
Sanger	5.77	4,393.7	1231	4,615.4	1350
Selma	5.81	4,520.6	1173	4,248.3	1243
All Cities	162.18	4,678.7	1,569	5,274.7	1726
Unincorporated	5796.20	29.6	11	27.6	10
County Totals	**5958.38**	**156.2**	**52.96**	**169.3**	**56.8**

Source: US Census Bureau. http://factfinder.census.gov/

FUTURE DEVELOPMENT

As indicated in the previous section, Fresno County has been steadily growing over the last four decades, and this growth is projected to continue through the middle of the century. **Table 98. Population Projections for Fresno County** shows the population projections for the County as a whole through 2060.

Table 98. Population Projections for Fresno County

	2020	2030	2040	2050	2060
Population	1,007,344	1,047,382	1,083,901	1,098,206	1,095,205
Percent Change %	--	3.97%	3.49%	1.32%	0.27%

Source: California Department of Finance, www.dof.ca.gov/Research/

Table 99. Detailed Population Projections for Fresno County shows the population projections for each jurisdiction and the unincorporated area through 2050.

Table 99. Detailed Population Projections for Fresno County

City	2019	2020	2025	2030	2035	2040	2045	2050
Clovis	134,210	134,780	141,700	147,760	153,420	158,370	162,660	166,160
Coalinga	13,530	13,690	14,570	15,210	15,800	16,320	16,770	17,140

City	2019	2020	2025	2030	2035	2040	2045	2050
Firebaugh	7,720	7,720	8,790	9,200	9,580	9,920	10,210	10,450
Fowler	6,380	6,580	6,930	7,200	7,460	7,680	7,870	8,030
Fresno	592,350	596,060	621,540	647,980	672,650	694,240	712,960	728,200
Huron	5,700	5,700	5,930	6,200	6,460	6,680	6,880	7,030
Kerman	14,220	14,290	15,660	16,340	16,980	17,540	18,020	18,420
Kingsburg	13,350	13,410	14,360	14,960	15,510	15,990	16,410	16,750
Mendota	11,170	11,220	11,830	12,330	12,790	13,200	13,560	13,850
Orange Cove	9,170	9,170	9,660	10,070	10,450	10,780	11,070	11,310
Parlier	14,040	14,140	14,740	15,380	15,980	16,500	16,950	17,320
Reedley	25,170	25,170	26,100	27,240	28,300	29,230	30,040	30,700
Sanger	28,660	28,770	30,090	31,370	32,560	33,600	34,510	35,240
San Joaquin	3,500	3,500	3,610	3,750	3,880	3,990	4,090	4,170
Selma	26,960	27,000	29,130	30,360	31,510	32,520	33,390	34,100
Subtotal Cities	**906,130**	**911,200**	**954,640**	**995,350**	**1,033,330**	**1,066,560**	**1,095,390**	**1,118,870**

Source: Fresno County Council of Governments, 2020

FUTURE DEVELOPMENT SUMMARY

According to the projections all areas of the County will continue to grow, but the percentage of growth will decrease over time, through 2050. The Fresno County General Plan assumes that 92.6 percent of the population growth experienced in Fresno County through the year 2020 will be directed to incorporated cities and 7 percent will be absorbed in the unincorporated area. Fresno County recognizes, however, that because of state-mandated directives, including the Regional Housing Needs Allocation, the County may be forced to consider approval of urban development in areas that are not currently planned for such uses. Careful consideration and Board policy direction will be necessary if Fresno County needs to designate new areas for urban development. The Land Resources Inventory verifies that there is no shortage of potentially developable land in Fresno County. Consistent with the County's urban development policy, intensive housing development will be directed to residentially zoned urban areas and established communities where infrastructure and services are available. This policy reflects the commitment to conserve natural and managed resources and to minimize the loss of valuable agriculture land and open space.

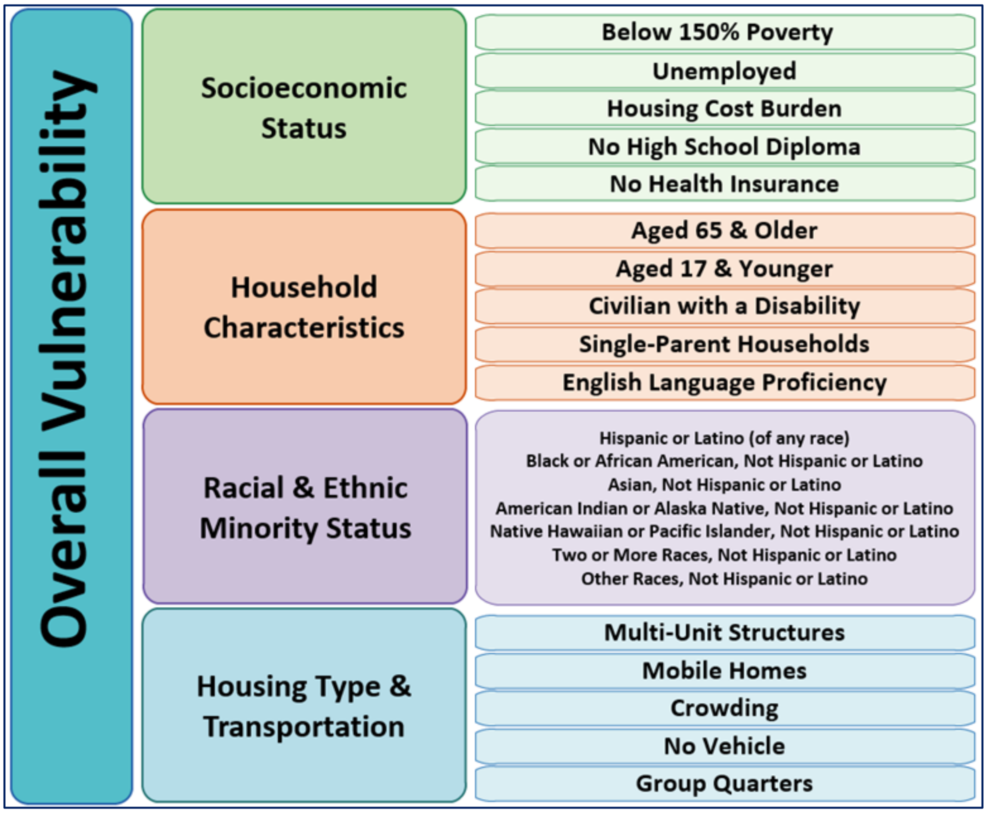
SOCIAL VULNERABILITY

Emergencies and disasters often highlight and intensify existing societal inequities, affecting groups based on socioeconomic status, race, age, disability, and other social factors. These events disproportionately impact certain populations, creating additional challenges in preparation, response, and recovery phases. For instance, the COVID-19 pandemic shed light on pre-existing disparities such as limited healthcare access, leading to higher rates of hospitalizations and mortality among vulnerable groups. It's essential to recognize and understand these community-specific limitations and barriers to ensure equitable preparedness, mitigation, and response strategies for future incidents.

To aid in this, the Centers for Disease Control and Prevention (CDC) developed the Social Vulnerability Index (SVI), a comprehensive tool designed for emergency management planners and practitioners at state, local, and tribal levels. The SVI helps identify communities with high social vulnerability, potentially facing greater impacts during emergencies and disasters. This tool is instrumental in guiding targeted efforts in preparedness, response, and recovery, and in understanding the unique challenges certain communities may face, such as evacuation difficulties due to lack of transportation.

The SVI utilizes 16 variables, including factors like education level, presence of disabilities, and access to transportation, to calculate a community's vulnerability score. This score ranges from 0 to 1, where higher scores indicate increased vulnerability. The evaluation is percentile-based, with communities in the top 10% (above the 90th percentile) for a variable scoring a 1, denoting high vulnerability, and those in the bottom 10% scoring a 0. Additionally, the SVI categorizes these 16 variables into four distinct themes, providing deeper insights into specific vulnerability aspects, shown in the figure below. These themes and their constituent variables offer a nuanced understanding of a community's resilience and ability to handle disasters, both in terms of human impact and financial consequences.

Figure 65. CDC Social Vulnerability Index



Source CDC

Fresno County has one of the highest Social Vulnerability Index in the state of California at .9649, which is very high. These factors of social vulnerability hold many implications for disaster response and recovery and are important considerations when identifying and prioritizing mitigation actions and overall goals and objectives of the plan. The table below describes how disasters can disproportionately impact communities that identify with the SVI indicators and SVI themes described above.

Table 100. Measures of Fresno County's Social Vulnerability

SVI Themes	Inequities in Disasters[1]
Socioeconomic Status	Economically disadvantaged populations are disproportionately affected by disasters. The poor are less likely to have the income or assets needed to prepare for a possible disaster or to recover after a disaster Although the monetary value of their property may be less than that of other households, it likely represents a larger proportion of total household assets. For these households, lost property is proportionately more expensive to replace, especially without homeowner's or renter's insurance. Moreover, unemployed persons do not have employee benefits plans that provide income and health cost assistance in the event of personal injury or death. High-income populations, on the other hand, may suffer higher household losses in absolute terms, yet find their overall position mitigated by insurance policies, financial investments, and stable employment.
Household Characteristics	Household composition is defined here to include dependent children less than 18 years of age, persons aged 65 years and older, and single-parent households. Also included are people with disabilities. People in any of these categories are more likely to require financial support, transportation, medical care, or assistance with ordinary daily activities during disasters. Children and elders are the most vulnerable groups in disaster events. Children, especially in the youngest age groups, cannot protect themselves during a disaster because they lack the necessary resources, knowledge, or life experiences to effectively cope with the situation. Perhaps because parental responsibility for children is assumed, children are rarely incorporated into disaster-scenario exercises. Thus, local authorities are not adequately prepared to provide specific goods or services for children. Elders living alone and people of any age having physical, sensory, or cognitive challenges are also likely to be more vulnerable to disasters. Many older or disabled people have special needs that require the assistance of others. Family members or neighbors who would ordinarily look in on an elder, or a caretaker responsible for the welfare of a disabled person, might be less able to do so during a crisis or may find the magnitude of the task beyond their capability. The number of traditional households of two parents and children has decreased in the United States. In addition to the usually lower socioeconomic status of single-parent households, such households are especially vulnerable in a disaster because all daily caretaker responsibility falls to the one parent.
Racial & Ethnic Minority Status	The social and economic marginalization and discrimination of certain racial and ethnic groups, including real estate discrimination, has rendered these populations more vulnerable at all stages of disaster. African Americans; Native Americans; and populations of Asian, Pacific Islander, or Hispanic origin are correlated with higher vulnerability rates. In recent decades, the numbers of persons immigrating to the United States from Latin America and Asia have substantially increased. Many immigrants are not fluent in English, and literacy rates for some groups are lower. Communities that have limited English proficiency, disaster communication is made increasingly difficult. This difficulty is especially true in communities whose first language is neither English nor Spanish and for whom translators and accurate translations of advisories may be scarce. Immigrants are likelier to rely on relatives and local social networks (i.e., friends and neighbors) for information.
Housing Type & Transportation	Housing quality is an important factor in evaluating disaster vulnerability. It is closely tied to personal wealth; that is, people in poverty often live in more poorly constructed houses or mobile homes that are especially vulnerable to natural hazards such as strong storms or earthquakes. Mobile homes are not designed to withstand severe weather or flooding, high wind, and typically do not have basements. They are frequently found outside of metropolitan areas and, therefore, may not be readily accessible by interstate highways

[1] A Social Vulnerability Index for Disaster Management (cdc.gov) https://www.atsdr.cdc.gov/placeandhealth/svi/img/pdf/Flanagan_2011_SVIforDisasterManagement-508.pdf

SVI Themes	Inequities in Disasters[1]
	or public transportation. Also, because mobile homes are often clustered in communities, their overall vulnerability is increased. Multi-unit housing in densely populated urban areas also poses a heightened risk for tenants. Population densities of cities are much higher than those of suburban or rural areas. People living in high-rise apartments are particularly vulnerable to overcrowding when funneled into a limited number of exit stairwells. Furthermore, large numbers of people exiting in the street can make safe and orderly evacuation of everyone difficult and dangerous. Crowding within housing units exacerbates these difficulties. Rates of automobile ownership are generally lower in urban areas, especially among inner city poor populations. Thus, transportation out of an evacuation zone is difficult for people who do not have access to a vehicle. For some people, fuel costs may prevent vehicle use. At the same time, lower urban auto-ownership rates do not necessarily translate into easy evacuation for people with vehicles because the high-population densities of cities can cause severe traffic congestion on interstate highways and other major roads. Populations residing in group quarters such as college dormitories, farm workers' dormitories, psychiatric institutions, and prisons also present special concerns during evacuation. Residents of nursing homes and long-term care facilities are especially vulnerable because of their special and timely needs and because of understaffing in these institutions in emergencies. Moreover, many institutions can be unprepared to quickly remove their entire staff and residents under conditions that require specialized vehicles

Source: CDC, SVI

Table 101. Fresno County Social Vulnerability Demographic Information by City

	Total Population 2022 Estimate*	Total Housing Units 2020	% Females	% Under Age 18	% Age 65 and Over	% Speak Language Other than English in Home**	% Individuals Below Poverty Level**	Median Value ($), Single-Family Owner-Occupied
United States	333,271,411	143,786,655	50.4	21.7	17.3	21.7	11.5	281,900
California	39,040,616	14,627,460	49.9	21.8	15.8	43.9	12.2	659,300
Fresno County	1,015,190	345,493	49.7	27.6	12.9	44.1	18.6	338,200
Clovis	124,556	43,954	51.3	28.9	13.1	24.0	8.4	420,700
Coalinga	17,024	4,658	40.3	23.6	10.9	46.8	18.7	226,000
Firebaugh	8,418	2,225	49.9	35.0	12.6	80.0	43.3	221,000
Fowler	7,154	2,133	53.5	29.6	13.8	43.8	21.0	339,700
Fresno	545,567	184,226	50.1	27.8	11.9	43.2	22.1	321,800
Huron	6,240	1,610	48.9	34.1	2.9	89.5	32.1	234,500
Kerman	16,208	4,512	50.6	32.9	7.6	72.7	21.9	297,900
Kingsburg	12,613	4,415	53.3	25.9	17.4	19.6	9.6	335,300
Mendota	12,618	2,875	48.3	38.5	6.5	87.3	32.7	236,700
Orange Cove	9,525	2,481	48.3	37.8	6.1	84.1	46.5	208,000

	Total Population 2022 Estimate*	Total Housing Units 2020	% Females	% Under Age 18	% Age 65 and Over	% Speak Language Other than English in Home**	% Individuals Below Poverty Level**	Median Value ($), Single-Family Owner-Occupied
Parlier	14,554	3,853	49.6	32.4	8.2	80.9	27.4	216,200
Reedley	25,441	7,247	51.0	30.3	10.3	62.5	16.0	268,900
San Joaquin	3,701	937	52.2	42.5	5.4	82.1	33.2	103,100
Sanger	26,600	7,787	47.4	29.2	10.7	52.0	15.9	325,200
Selma	24,430	7,224	48.5	26.8	11.6	51.3	21.2	251,300

Source: U.S. Census Bureau

The California Environmental Protection Agency developed a tool called CalEnviroScreen to identify communities most impacted by poverty and pollution. The Senate Bill 535 Disadvantaged Communities map identifies census tracts that have an overall CalEnviroScreen score of 75 or above, meaning they are among the top 25 percent most vulnerable and burdened by pollution in the state. In Fresno County, most of the western portion of the county's census tracts are identified as disadvantaged communities, shown in the figure below.

VULNERABILITY OF FRESNO COUNTY TO SPECIFIC HAZARDS

The Disaster Mitigation Act regulations require the HMPC to evaluate the risks associated with each of the hazards identified in the planning process. This section summarizes the possible impacts and quantifies, where data permits, the County's vulnerability to each of the hazards. Where specific hazards vary across the County vulnerability is broken out by jurisdiction where feasible; additional information can be found in the jurisdictional annexes. The hazards evaluated further as part of this vulnerability assessment include, in alphabetical order:

- Agricultural Hazards
- Avalanche
- Dam Failure
- Drought
    - Tree Mortality
- Earthquake
- Flood
    - Levee Failure

Human Health Hazards

- Pandemic
- West Nile Virus

Soil Hazards

- Erosion
- Expansive Soil
- Land Subsidence
- Landslide
- Volcano
- Wildfire

Severe Weather

- Extreme Temperatures
- Extreme Cold/Freeze
- Extreme Heat
- Fog
- Heavy Rain/Thunderstorm/Hail/Lightning
- Windstorm
- Winter Storm
- Tornado

Prioritizing hazards plays a crucial role in helping communities establish objectives and mitigation strategies based on their vulnerabilities. Fresno County employed the Risk Factor (RF) methodology, as described below, to assess and rank hazards according to their threat levels. This ranking underwent scrutiny and evaluation by the HMPC and all stakeholders during the Draft Plan Review phase.

The RF methodology generates numerical values that facilitate the comparison of identified hazards. These values reflect the relative risk posed by each hazard, with higher RF values indicating a greater level of hazard risk. RF values are determined by attributing varying degrees of risk to five categories for each hazard: probability, impact, spatial extent, warning time, and duration. Each degree of risk within these categories is assigned a value ranging from 1 to 4, accompanied by a corresponding weighting factor. The RF approach is summarized in the table below. To calculate the RF value for a particular hazard, one must multiply the assigned risk value for each category by its respective weighting factor. The summation of these values across all five categories yields the final RF value, as illustrated in the following example equation:

Table 102. Risk Factor Methodology

Risk Assessment Category	Degree of Risk			Weight Value
	Level	Criteria	Index	
Probability: What is the likelihood of a hazard event occurring in a given year?	Unlikely Possible Likely Highly Likely	Less than 1% annual probability Between 1% and 49.9% annual probability Between 50% and 90% annual probability Greater than 90% annual probability	1 2 3 4	30%
Impact: In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs?	Minor Limited Critical Catastrophic	Very few injuries, if any. Only minor property damage and minimal disruption on quality of life. Temporary shutdown of critical facilities. Minor injuries. More than 10% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one day. Multiple deaths / injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than a week. High number of deaths / injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for 30 days or more.	1 2 3 4	30%

Risk Assessment Category	Degree of Risk				Weight Value
	Level	Criteria		Index	
Spatial Extent: How large of an area could be impacted by a hazard event? Are impacts localized or regional?	Negligible Small Moderate Large	Less than 1% of area affected Between 1% and 10.9% of area affected Between 11% and 25% of area affected Greater than 25% of area affected		1 2 3 4	20%
Warning Time: Is there usually some lead-time associated with the hazard event? Have warning measures been implemented?	More than 24 hours 12 to 24 hours 6 to 12 hours Less than 6 hours	Self-Defined Self-Defined Self-Defined Self-Defined	Note: Levels of warning time and criteria that define them may be adjusted based on the hazard addressed.	1 2 3 4	10%
Duration: How long does the hazard event usually last?	Less than 6 hours Less than 24 hours Less than 1 week More than 1 week	Self-Defined Self-Defined Self-Defined Self-Defined	Note: Levels of warning time and criteria that define them may be adjusted based on the hazard addressed.	1 2 3 4	10%

A summary of the vulnerability of the County to each identified hazard is provided in each of the hazard-specific sections that follow. Vulnerability generally reflects the hazard significance rating which is also summarized in Section 4.1.1 Table 4.1. Vulnerability/Significance is measured in a summary of the potential impact based on past occurrences, spatial extent, likelihood of future occurrences and impacts (damage and casualty potential). It is categorized into the following classifications:

- **Low**: Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.
- **Medium**: Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. The potential damage is more isolated and less costly than a more widespread disaster.
- **High**: Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread. Hazards in this category may have occurred in the past.

VULNERABILITY TO AVALANCHES (LOW)

PEOPLE

Although future avalanches are likely to occur, the spatial extent is limited, and the magnitude is low. Therefore, avalanches are a low significance hazard in the County. It is public safety that is most threatened by this hazard. Outdoor recreationalists who travel into backcountry areas are most at risk. Additionally, while road closures help to mitigate impacts to travelers in avalanche-prone areas, snowplow drivers can still be exposed while clearing roads of snow or avalanche debris.

PROPERTY

In general, structures located below an area at high risk to avalanches are likely to be exposed to the impacts of an avalanche, but no instances of this were known based on available data.

CRITICAL FACILITIES

There are not any known critical facilities likely to be exposed to the impacts of an avalanche.

NATURAL ENVIRONMENT

Avalanches can erode topsoil, cover the environment with debris, and damage surrounding vegetation. For the most part the environment is resilient and would be able to rebound from whatever damages occurred, though this process could take years.

FUTURE DEVELOPMENT

Avalanche vulnerability could increase somewhat with future development and population growth as there will be a higher number of people driving on roadways and taking part in backcountry recreation. It is unlikely that risk to structures will increase as long as future development is planned outside of mapped or suspected avalanche hazard zones. As such, the County holds a policy, Policy HS-A.4: Critical Emergency Response Facility Siting, to ensure that critical emergency response facilities such as hospitals, fire stations, sheriff's offices and substations, dispatch centers, emergency operations centers, and other emergency service facilities and utilities are sites and designed to minimize their exposure and susceptibility to hazards like fire and avalanche. Policy HS-D.12 ensure that new development is not located in avalanche hazard areas.

VULNERABILITY TO AGRICULTURAL HAZARDS (HIGH)

Given the importance of agriculture to Fresno County, agricultural hazards continue to be an ongoing concern. The primary causes of agricultural losses are severe weather events, such as drought and freeze, excessive rain, moisture, and humidity, and hail. According to the HMPC, agricultural losses occur on an annual basis throughout the County and are usually associated with these severe weather events. Recently, the COVID-19 caused massive interruptions to farms based on the spread of the virus, social distancing measures, and other non-pharmaceutical interventions. Farms lost millions of dollars due to disruptions in the whole supply chain system.

PEOPLE

The largest impact to people from a widespread crop loss is pressure on the food supply and distribution. Impacts to the local economy could be substantial as Fresno County is one of the top agricultural producing counties in California, exporting across the United States and internally. Agricultural jobs account for about 20 percent of all jobs in the Fresno area. Natural hazards causing losses to the agricultural industry will impact agricultural employment and cause secondary impacts to income, housing, and food security. Some animal diseases can be transmitted to people which could pose a public health concern as well. In the case of natural hazards and epidemics/pandemics, farmworkers can be exposed and be at risk for injury and death due to high heat events, poor air quality, and infectious diseases.

PROPERTY

The greatest impact to property from an agricultural hazard is crop damage and loss. In the latest Fresno County Agricultural Crop and Livestock Report, the total gross value of agricultural commodities in 2021 was over $8 billion. Loss of livestock and poultry can also be significant. The economic value of total damaged or lost crops could range in the hundreds of millions of dollars.

NATURAL ENVIRONMENT

Agricultural hazards including fires, crops, and livestock disease, noxious weeds, and contamination of animal food and water supply can significantly alter the natural environment. Fresno County is particularly threatened by several insects that can cause severe economic and environmental harm to the agricultural industry. Noxious weeds can have negative effects on the natural environment including loss of wildlife habitat and reduced wildfire numbers, loss of native plant species, increased soil erosion and topsoil loss, and diminished water quality and fish habitat.

CRITICAL FACILITIES

Agricultural hazards would most likely not have an impact on critical facilities. However, mass mortality of animals could stress local rendering plants.

FUTURE DEVELOPMENT

Fresno County recognizes the importance of reducing the conversion of productive agricultural land, therefore the county has enacted policies to sustain agriculture and its activities to preserve and maintain productivity, while also controlling expansion of non-agricultural development onto productive agricultural lands. Details on the policies that Fresno County has adopted to protect agricultural lands are described in more detail within the Fresno County General Plan.

VULNERABILITY TO DAM FAILURE (HIGH)

A dam failure can range from a small, uncontrolled release to a catastrophic failure. Vulnerability to dam failures is confined to the areas subject to inundation downstream of the facility. Secondary losses would include loss of the multi-use functions of the dam itself and associated revenues that accompany those functions.

PEOPLE

Persons located underneath or downstream of a dam are at risk of a dam failure, though the level of risk can be tempered by topography, amount of water in the reservoir and time of day of the breach. Injuries and fatalities can occur from debris, bodily injury and drowning. Once the dam has breached, standing water presents all the same hazards to people as floodwater from other sources. People in the inundated area may need to be evacuated, cared for, provided temporary shelter, and possibly permanently relocated. Specific population impacts are noted in the following section.

PROPERTY

In general, communities located below a dam and along a waterway are potentially exposed to the impacts of a dam failure. Specific inundation maps and risk information are included in the dam-specific emergency action plans. Due to the sensitive nature of this information, it is not included in this plan. Inundation maps that identify anticipated flooded areas (which may not coincide with known floodplains) are produced for all high hazard dams and are contained in the Emergency Action Plan (EAP) required for each dam. However, the information contained in those plans is considered sensitive and is not widely distributed. For reference, high hazard dams threaten lives and property, significant hazard dams threaten property only.

The potential impacts from a dam failure in the County and its municipalities are largely dependent on the specific dam or area in question. Generally, any buildings or other infrastructure located in a dam inundation area is vulnerable to the impacts from rising waters.

Dam failure flooding can occur as the result of partial or complete collapse of an impoundment. Dam failures often result from prolonged rainfall and flooding causing overtopping of the structure. The primary danger associated with dam failure is the high velocity flooding of those properties downstream of the dam.

According to the Fresno County Operational Area Dam Failure Evacuation Plan, of the 23 dams with a potential to impact the planning area four of them pose the greatest threat should a failure occur: Big Dry, Fancher Creek, Friant, and Pine Flat. According to the plan, a catastrophic failure of any of these dams could have a significant impact on Fresno County. Some jurisdictions are more at risk to dam failure than others. The City of Clovis and the City of Fresno are the most vulnerable, with three and five high hazard dams respectively. Centerville, Firebaugh, Friant, and Sanger also have a high hazard dam located within their boundaries. The failure of any of these dams would cause downstream flooding and would likely result in loss of life and property. The potential magnitude of a dam failure depends on the time of year and the base flow of the river when the failure occurs. During the winter months, when the river flows are higher, the impact to the area would be much greater and evacuation times much less. A list of dams that have the potential to impact Fresno County is described in Figure 100. Major Dams with Potential to Impact the Fresno County Planning Area

Dam	Stream	Capacity (Acre-Feet)	Population Threatened
Balch Afterbay	North Fork Kings River	318	20
Balch Diversion	North Fork Kings River	1,295	20
Balsam Meadow	West Fork Balsam Creek	2,040	319
Big Creek No. 4	Big Creek	100	244
Big Creek No. 6	San Joaquin River	993	104
Big Creek No. 7	San Joaquin River	35,000	713
Big Dry 1017	Big Dry Creek/ Dog Creek	30,200	266,502
Courtright	Helms Creek	123,300	20
Crane Valley	North Fork Willow Creek	45,410	142
Fancher Creek	Fancher Creek & Hog Creek	9,600	134,775
Florence Lake	South Fork San Joaquin River	64,406	822
Friant	San Joaquin River	520,500	75,184
Giffen Reservoir	Tributary Holland Creek	900	98
Hume Lake	Ten Mile Creek	1,410	57
Huntington Lake	Big Creek	88,834	1,018
Little Panoche	Little Panoche Creek	5,580	459
Mammoth Pool	San Joaquin River	123,000	817
Pine Flat	Kings River	1,000,000	143,678
Redbank	Redbank Creek	1,100	947
Sequoia Lake	Mill Flat Creek	1,370	27
Shaver Lake	Stevenson Creek	135,283	863
Vermilion Valley	Mono Creek	125,000	822
Wishon	North Fork Kings River	118,000	20

Source: Fresno County Operational Area Dam Failure Evacuation Plan, 2003

Dam failure flooding would vary by community depending on which dam fails and the nature and extent of the dam failure and associated flooding. Based on the risk assessment, it is apparent that a major dam failure could have a devastating impact on the planning area. Dam failure flooding presents a threat to life and property, including buildings, their contents, and their use. Large flood events can affect crops and livestock as well as lifeline utilities (e.g., water, sewerage, and power), transportation, jobs, tourism, the environment, and the local and regional economies.

NATURAL ENVIRONMENT

Dam failure effects on the environment would be similar to those caused by flooding from other causes. Water could erode stream channels and topsoil and cover the environment with debris. For the most part the environment is resilient and would be able to rebound from whatever damages occurred, though this process could take years.

CRITICAL FACILITIES

A total dam failure can cause catastrophic impacts to areas downstream of the water body, including critical infrastructure. Any critical asset located under the dam in an inundation area would be susceptible to the impact of a dam failure. Of particular risk would be roads and bridges that could be vulnerable to washouts, further complicating response, and recovery by cutting off impacted areas. Risk to specific facilities is considered sensitive information but is detailed in the Fresno County Operational Area Dam Failure Evacuation Plan.

FUTURE DEVELOPMENT

Areas slated for future development should take into consideration potential impacts from dam failure risk upstream. Policy HS-C.20 states that the County shall consider dam failure inundation maps of all reservoirs in making land use and related decisions. In the case of a dam failure, inundation would likely follow some existing FEMA mapped floodplains, which contains development restrictions for areas in the 1 percent annual chance floodplain, but it could exceed those floodplains and affect areas that are not regulated for flood hazards. Also of note is that development below a low hazard dam could increase its hazard rating.

VULNERABILITY TO DROUGHT (HIGH)

Drought is a common hazard in the state of California. California has experienced significant dry periods. Drought is a gradual process, occurring slowly over a period. A drought is a period of drier-than-normal conditions that results in water-related problems. When rainfall is less than normal for several weeks, months, or years, the flow of streams and rivers declines, water levels in lakes and reservoirs fall, and the depth to water in wells increases. If dry weather persists and water-supply problems develop, the dry period can become a drought.

PEOPLE

The historical and potential impacts of drought on populations include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. During 2021, many residents in the Fresno area owed over $15 million on late water bills. More than 76,000 customers in the central San Joaquin Valley were behind on their bills. Systems serving population with higher rates of poverty and more people of color often have higher number of past-due accounts. For example, 96 percent of households in the majority-Latino town of Mendota are behind on their water bill compared to 6 percent in Clovis, which is predominately non-Latino and white. [2]

Drought can affect population health and can pose health implications. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. Due to the long duration in which drought can form, health implications from drought can be seen both in the short-term and in the long-term such as:

- **Water Quality and Quantity**
    - Drought can reduce the water supply impacting not only households and businesses but especially disproportionately impacted communities. Water quality can be compromised due to increased salinity, increased algal production, less dilution, and reduced oxygen levels in the water system.
- **Food and Nutrition**
    - Drought can create dry conditions and impact the food quality, supply, and distribution to communities which can cause malnutrition.
- **Air Quality**
    - Drought increases the risk for wildfires and dust storms. Particulate matter from these poor air quality events and particulate matter can irritate the lungs and exacerbate chronic heart and lung conditions.
- **Sanitation and Hygiene**
    - Water shortage due to drought can impact available clean water for cleaning, sanitation, and hygiene which can reduce or control disease.
- **Recreational Risks**

[2] Residents in Fresno CA area owe $15 million in water debt | Fresno Bee https://www.fresnobee.com/fresnoland/article249129100.html

- Individuals who engage with water-related recreational activities during drought can be at increased risk for waterborne disease caused by bacteria, protozoa, and other contaminants such as chemicals and heavy metals.

- **Infectious Disease**
  - Drought often creates drier conditions which can increase the risk of disease (i.e., Valley Fever)
- **Chronic Disease**
  - Drought can cause adverse health impacts for individuals with certain chronic health conditions such as asthma and some immune disorders.

The burden of drought impacts on communities varies depending on age, socioeconomic status, access to health care, and gender. [3] Especially water shortage as the cost of water will increase based on the lower supply and higher demand, which can be very difficult for low-income communities for example.

Regarding tree mortality, in particular, Fresno County's tree mortality risk and fallen tree occurrences has resulted in the closure of numerous roads most notably in parks, forest land, and outdoor recreation areas: In 2016, 20 to 30 campgrounds were closed as well as Kings Canyon National Park due to tree mortality risks to public safety. The risk is especially high between May and October, due to a dramatic influx of campers and other outdoor enthusiasts.

PROPERTY

The historical and potential impacts of drought on property include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. As a related drought impact, tree mortality has resulted in potentially vulnerable critical infrastructure property as these trees become more susceptible to falling with time. The following tables show the results of analysis for tree mortality related to property exposure. In both the incorporated and unincorporated parts of the county, there are 6,657 structures, valued at close to $360 million, with $112 million in contents located within the Tier I tree mortality hazard area. Tier II tree mortality only effects the unincorporated parts of Fresno County, with 11,799 buildings and $467 million in exposure.

Table 103. Fresno County Assets in Tier I Tree Mortality Hazard Areas

Jurisdiction	Property Type	Parcel Count	Building Count	Improved Value	Content Value	Total Value
Coalinga	Unknown	20	11	$0	$0	$0
Unincorporated	Agricultural	40	3	$594,727	$3,180,922	$3,775,649
	Church	1	1	$245,547	$115,092	$360,639
	Outlot & Common Area	6	7	$0	$762	$762

[3] Health Implications of Drought | CDC https://www.cdc.gov/nceh/drought/implications.htm

Jurisdiction	Property Type	Parcel Count	Building Count	Improved Value	Content Value	Total Value
	Primary Use Not Designated	5,766	4,217	$0	$0	$0
	Recreation	4	4	$248,607	$94,419	$343,026
	Single-Family Residence	472	213	$245,127,811	$74,719,520	$319,847,311
	Vacant	348	109	$822,809	$34,652,188	$35,679,397
	Grand Total	6,657	4,560	$247,039,501	$112,762,903	$360,006,804

Table 104. Fresno County Assets in Tier II Tree Mortality Hazard Areas

Jurisdiction	Property Type	Parcel Count	Building County	Improved Value	Content Value	Total Value
Unincorporated	Agricultural	394	232	$12,244,091	$20,801,500	$33,051,391
	Apartments	1	2	$15,767	$68,235	$84,092
	Church	3	6	$842,791	$212,837	$1,055,628
	Commercial	5	3	$2,172,891	$698,766	$2,871,657
	Industrial	3	0	$0	$1,193,862	$1,193,862
	Office/ Professional Space	2	8	$201,468	$21,246	$222,714
	Primary Use Not Designated	223	10,604	$0	$0	$0
	Recreation	6	5	$296,685	$463,558	$760,243
	Single-Family Residence	760	752	$284,554,609	$94,077,864	$378,632,473
	Vacant	629	179	$1,712,710	$47,372,288	$49,289,398
	Total	2,034	11,799	$302,041,012	$164,911,258	$467,162,470

In addition to tree mortality hazards, several examples of agricultural impacts shape drought vulnerability and potential losses. Drought is linked to declines in crop yields, increasing costs, and decreasing crop profitability. Drought can result in regional losses of crops and can stress the statewide water supply. Crops such as rice, alfalfa, almonds, and pistachios are dependent on high depths of water and subsequently higher water intensity needs. Almonds and pistachios account for two of the top three most economically productive crops within Fresno County. According to Fresno County asset managers, recent drought led to a decrease in agricultural productivity in the county, as water scarcity has increased. [4]

In the 2021 crop year, California's farms, ranches and plant nurseries earned $51.1 billion in cash receipts, representing a 3.6 percent increase over the prior year. However, due to supply chain

[4] fcgpr_general-plan_prd-county_redline_2024-01-12_1.pdf (fresnocountyca.gov)
https://www.fresnocountyca.gov/files/sharedassets/county/v/1/public-works-and-planning/development-services/planning-and-land-use/general-plan-review-comments/fcgpr_general-plan_prd-county_redline_2024-01-12_1.pdf

disruptions that have increased the cost of farm inputs, this gain in cash receipts does not necessarily equate to margins – they have been squeezed by higher costs.[5]

NATURAL ENVIRONMENT

The historical and potential impacts of drought on the natural environment are widespread throughout public and private lands within the County, including tree mortality, impacts to all flora and fauna, and destabilization (erosion, subsidence) of land along streams and rivers, and within watersheds.

One of the core issues shaping the long-term impacts of drought in Fresno County and throughout California is water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. In the State 2022 Annual Water Supply and Demand Assessment Summary Report, released November 2022, the Tulare Lake Hydrologic Region, which encompasses Fresno County, reported 78 percent of urban water suppliers reporting no shortages (21 suppliers), 22 percent shortage addressed fully by actions (6 supplies). However, 18 percent of urban water suppliers (6 suppliers) in the hydrologic region did not report their status. Overall, most of the hydraulic regions report no water shortages or are taking actions to address shortages, which is encouraging to reducing drought impacts to the region. In fact, this report was part of the first-year annual water shortage assessment reporting requirements to strive for successful water management planning and effect water shortage contingency planning in ensuring water supply reliability and drought resiliency.[6]

While the State of California struggled with water supply and demand due to a three-year drought (2020-2023), in the past year, drought conditions have alleviated across much of the state due to heavy precipitation from winter storms and atmospheric rivers. In order to continue to mitigate drought impacts, the state has committed more than 8.6 billion dollars in expanding water storage capacity, reducing water demand, improving forecasting, data, and water management, and developing new water supplies. [7]

CRITICAL FACILITIES

Drought impacts to critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence. As a related drought impact, tree mortality has resulted in potentially vulnerable critical infrastructure as these trees become more susceptible to falling with time. The unincorporated county is the only area with critical facilities at risk to tree mortality. Table 105. Critical Facilities within the Tree Mortality Tier I Summary below summarizes the types of facilities at-risk while **Table 106. Critical Facilities within the Tree Mortality Tier I in the Unincorporated County** provides more details. In addition to the schools and fire stations in Tier I, there is one public works facility and two buildings of the Sheriff's Office located in the Tier II hazard areas shown in **Table 107. Critical Facilities within the Tree Mortality Tier II Summary**.

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[5] California Agriculture Statistics Review 2021-2022 https://www.cdfa.ca.gov/Statistics/PDFs/2022_Ag_Stats_Review.pdf

[6] 2022 ANNUAL WATER SUPPLY AND DEMAND ASSESSMENT SUMMARY REPORT (ca.gov) https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency/Annual-Water-Supply-and-Demand-Assessment/FINAL-DWR-2022-AWSDA-Report-to-SWB_11-22-22.pdf

[7] California Continues Progress to Boost Water Supplies and Build Resilience Amid Extreme Weather | California Governor https://www.gov.ca.gov/2023/10/16/california-continues-progress-to-boost-water-supplies-and-build-resilience-amid-extreme-weather/

Table 105. Critical Facilities within the Tree Mortality Tier I Summary

Jurisdiction	Facility Type	Counts
Unincorporated	Fire	8
	School	7
	Total	**15**

Table 106. Critical Facilities within the Tree Mortality Tier I in the Unincorporated County

Jurisdiction	Facility Type	Name
Unincorporated	Fire Station	Bald Mountain Volunteer Fire Department
	Fire Station	Big Creek Volunteer Fire Department
	Fire Station	Fresno County Fire Protection District - Shaver Lake
	Fire Station	Hume Lake Volunteer Fire and Rescue Company
	Fire Station	Huntington Lake Volunteer Fire Department
	Fire Station	Huntington Lake Volunteer Fire Department Station 2
	Fire Station	Pine Ridge Volunteer Fire Department
	Fire Station	Shaver Lake Volunteer Fire Department
	School	Big Creek Elementary
	School	Hammer Mountain School
	School	Hume Lake Charter
	School	Pine Ridge Elementary
	School	Pole Corral Elementary School

Table 107. Critical Facilities within the Tree Mortality Tier II Summary

Jurisdiction	Facility Type	Counts
Unincorporated	School	19
	Fire Station	13
	Department of Public Works	1
	Sheriff	2
	Total	**35**

FUTURE DEVELOPMENT

Because future development encompasses all forms of property, buildings, infrastructure, critical facilities and all related populations and their functions, drought impacts to future development align with the historical and potential impacts to populations, property, natural environment, and critical facilities discussed (above). Additionally, the Fresno County general plan outlines policies that encourage overall drought mitigation, adaptation, and resiliency to reduce risk to the community. Some policies include EJ-A.13 which states that landscaping for new industrial development shall use drought tolerant species with low biogenic emissions.

VULNERABILITY TO EARTHQUAKE (MEDIUM)

An earthquake occurs when two blocks of the earth suddenly slip past one another creating a vibration through the release of energy in the earth's crust. The vibrations that are generated are called "seismic waves". The surface where they slip is called the fault or fault plane. Earthquakes can result in ground shaking, soil liquefaction, landslides, fissures, avalanches, fires, and tsunamis. Additionally, earthquakes can cause buildings to collapse and cause heavy items to fall, resulting in injuries and property damage. Earthquakes can occur anywhere and at any time.

PEOPLE AND PROPERTY

Earthquake vulnerability is primarily based on population and the built environment. Urban areas in high seismic hazard zones are the most vulnerable, while uninhabited areas are less vulnerable. The California Geological Survey and U.S. Geological Survey have done considerable work using GIS to identify populations in high seismic hazard zones in every California County.

Ground shaking is the primary earthquake hazard. Many factors affect the survivability of structures and systems from earthquake-caused ground motions. These factors include proximity to the fault, direction of rupture, epicentral location and depth, magnitude, local geologic and soils conditions, types and quality of construction, building configurations and heights, and comparable factors that relate to utility, transportation, and other network systems. Ground motions become structurally damaging when average peak accelerations reach 10 to 15 percent of gravity, average peak velocities reach 8 to 12 centimeters per second, and when the Modified Mercalli Intensity Scale is about VII (18-34 percent peak ground acceleration), which is considered to be very strong (general alarm; walls crack; plaster falls).

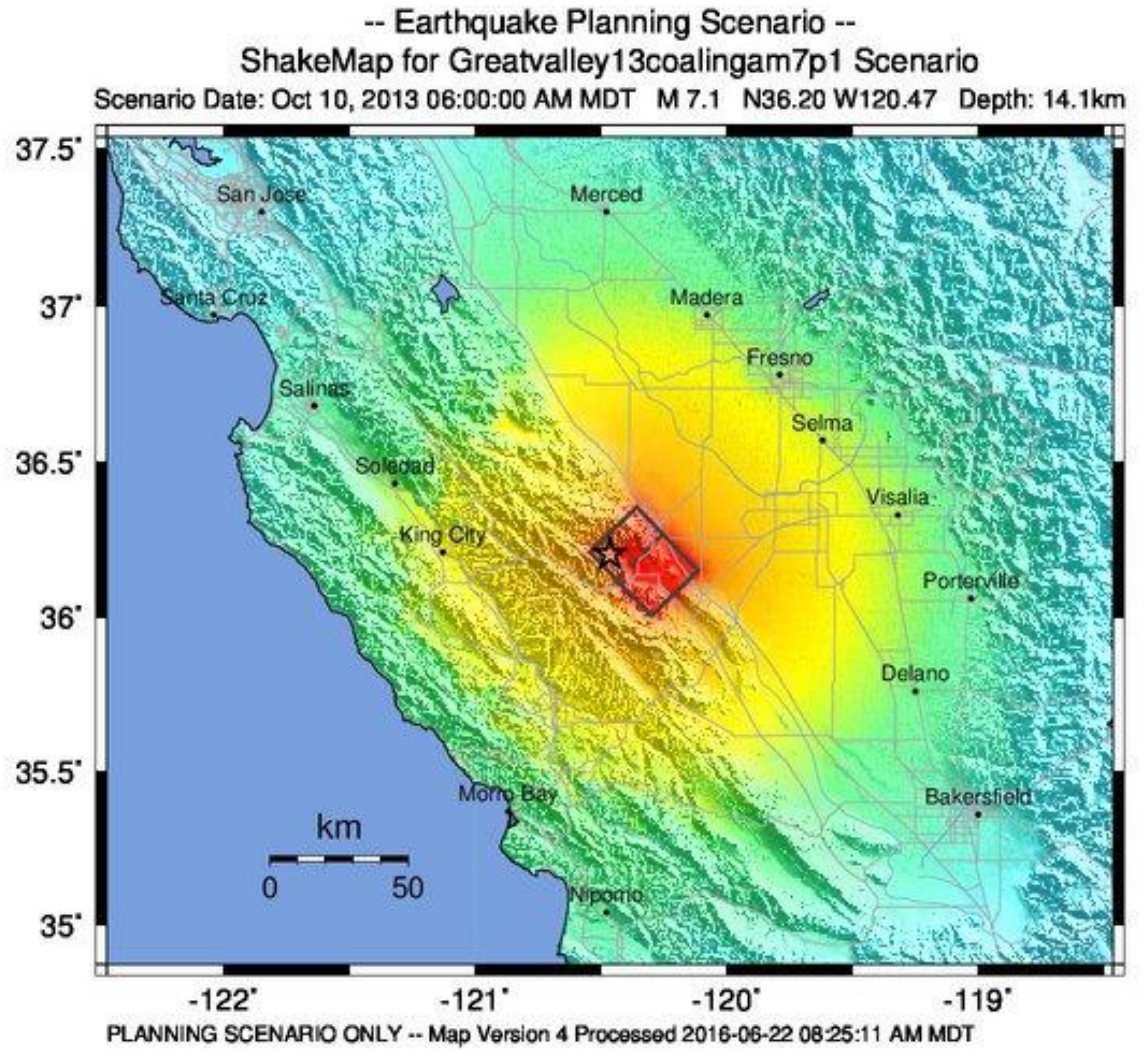
Fault rupture itself contributes very little to damage unless the structure or system element crosses the active fault. In general, newer construction is more earthquake resistant than older construction because of improved building codes and their enforcement. Manufactured housing is very susceptible to damage because rarely are their foundation systems braced for earthquake motions. Locally generated earthquake motions, even from very moderate events, tend to be more damaging to smaller buildings, especially those constructed of unreinforced masonry, as was seen in the Oroville, Coalinga, Santa Cruz, and Paso Robles earthquakes.

Common impacts from earthquakes include damage to infrastructure and buildings (e.g., crumbling of unreinforced masonry, failure of architectural facades, rupturing of underground utilities, and road closures). Earthquakes also frequently trigger secondary hazards, such as dam failures, landslides and rock falls, explosions, and fires that can become disasters themselves.

HAZUS

Earthquake losses will vary across the Fresno County planning area depending on the source and magnitude of the event. Three earthquake scenarios were used for the planning area. The three earthquake scenarios include The Great Valley M7.1, Round Valley M7.1, and White Mountain M7.4. The earthquake shake maps for each scenario are described in the maps below.

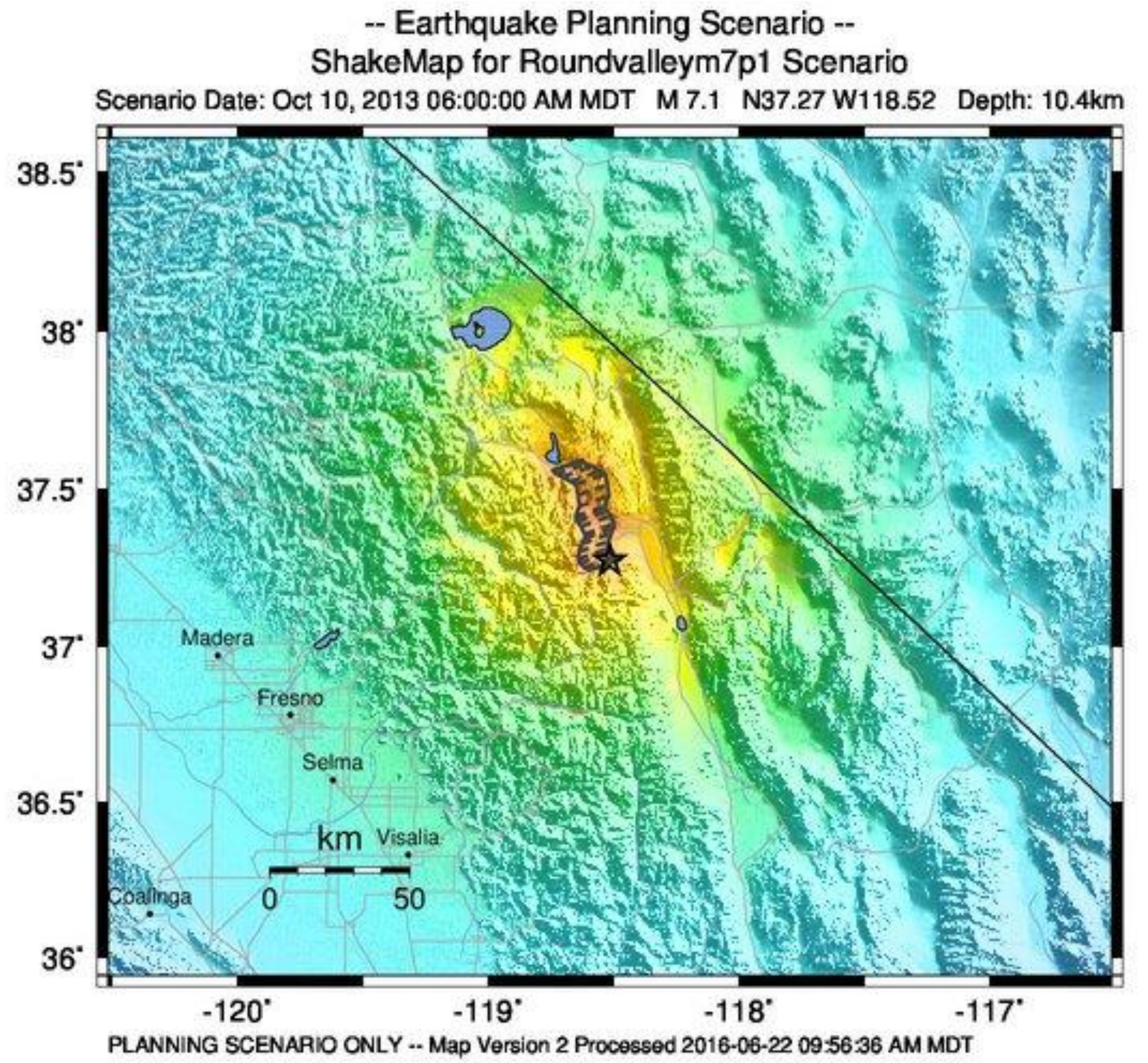
Figure 66. Shake Map for Great Valley Coalinga M7.1 Scenario



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.1	0.5	2.4	6.7	13	24	44	83	>156
PEAK VEL.(cm/s)	<0.07	0.4	1.9	5.8	11	22	43	83	>160
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Scale based upon Wald, et al.; 1999

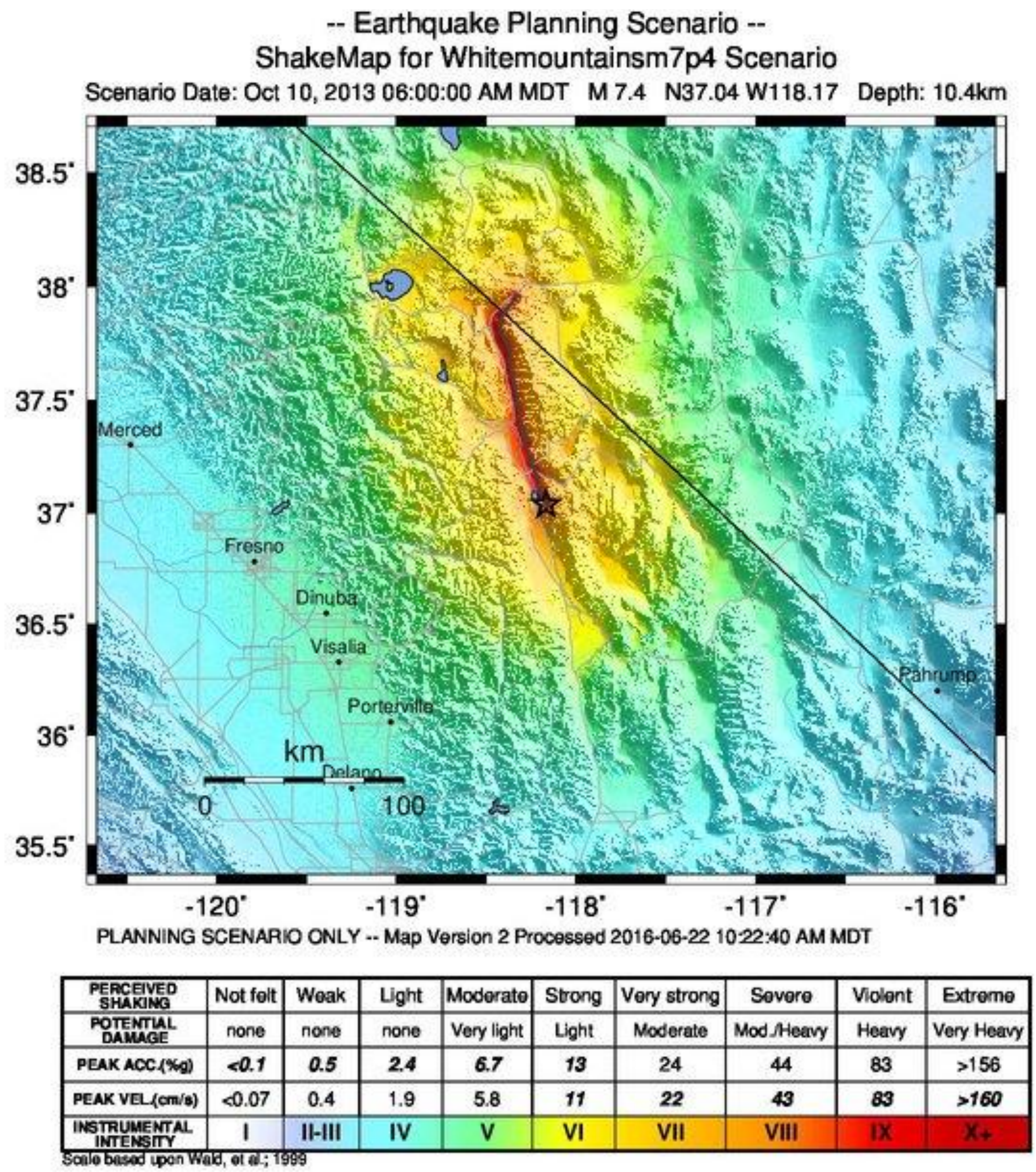
Figure 67. Shake Map for Round Valley M7.1 Scenario



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.1	0.5	2.4	6.7	13	24	44	83	>156
PEAK VEL.(cm/s)	<0.07	0.4	1.9	5.8	11	22	43	83	>160
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Scale based upon Wald, et al.; 1999

Figure 68. Shake Map for White Mountain M7.4 Scenario



The geographical size of the planning area is 6,013,58 square miles and contains 225 census tracts. There are over 319,000 households in the region which has a population of 1,008,654 people. There are an estimated 299 thousand buildings in the region with a total building replacement value (excluding contents) of $160,304,000. Approximately 89 percent of the buildings (and 61 percent of the building value) are associated with residential housing. The replacement value of the transportation and utility lifeline systems are estimated to be $12,169,000 and $27,843,000.

Building Inventory

HAZUS estimates that there are 299,000 buildings in the region that have an aggregate replacement value of $160,304,000. Regarding building construction types found in the region, wood frame construction makes up 86 percent of the building inventory. The remaining percentage is distributed between the other general building types.

Transportation and Utility Lifeline Inventory

There are seven transportation systems that include highways, railways, light rail, bus, ports, ferry, and airports. There are six utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in the table below. The total value of the lifeline inventory is over $40,012,000. This inventory includes over 813.13 miles of highways, 897 bridges, 21.321.72 miles of pipes.

Table 108. Transportation System Lifeline Inventory

System	Component	Number of Locations & Segments	Replacement value (millions of dollars)
Highway	Bridges	897	2645.6197
	Segments	362	6637.6252
	Tunnels	0	0
		Subtotal	**9283.2449**
Railways	Bridges	96	546.2400
	Facilities	9	23.9670
	Segments	126	2128.1232
	Tunnels	0	0
		Subtotal	**2698.3302**
Light Rail	Bridges	0	0
	Facilities	0	0
	Segments	0	0
	Tunnels	0	0
		Subtotal	**0**
Bus	Facilities	1	2.1666
		Subtotal	**2.1666**
Ferry	Facilities	0	0
		Subtotal	**0**
Port	Facilities	0	0
		Subtotal	**0**
Airport	Facilities	8	118.3667
	Runways	11	67.2396

System	Component	Number of Locations & Segments	Replacement value (millions of dollars)
		Subtotal	**185.6063**
		Total	**12,169.3**

Source: HAZUS

Table 109. Transportation System Lifeline Inventory

System	Component	Number of Locations & Segments	Replacement value (million of dollars)
Portable Water	Distribution Lines	N/A	424.2406
	Facilities	0	0
	Pipelines	0	0
		Subtotal	**424.2406**
Waste Water	Distribution Lines	N/A	254.5444
	Facilities	4	687.8072
	Pipelines	0	0
		Subtotal	**942.3516**
Natural Gas	Distribution Lines	N/A	169.6962
	Facilities	1	18.2016
	Pipelines	62	1321.0466
		Subtotal	**1508.9444**
Oil Systems	Facilities	1	0.1180
	Pipelines	0	0
		Subtotal	**0.1180**
Electrical Power	Facilities	60	24962.9942
		Subtotal	**24962.9942**
Communication	Facilities	42	4.9560
		Subtotal	**4.9560**
		Total	**27,843.60**

Source: HAZUS

Great Valley (Coalinga) M7.1

The social impact from earthquakes can be catastrophic and wide ranging. HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 1 household to be displaced due to the earthquake. Of these zero people out of 1,008,654 will seek temporary shelter in public shelters. The table below describes the casualty estimates from the earthquake scenario based on different time periods and type of properties, spaces, or activities.

Table 110. Casualty Estimates for the Great Valley (Coalinga) M7.1

		Level 1	Level 2	Level 3	Level 4
2AM	Commercial	0.03	0.00	0.00	0.00
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.03	0.00	0.00	0.00
	Other-Residential	1.23	0.08	0.00	0.00
	Single Family	0.71	0.01	0.00	0.00
	Total	**2**	**0**	**0**	**0**
2PM	Commercial	1.85	0.12	0.00	0.00
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.64	0.04	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.23	0.02	0.00	0.00
	Other-Residential	0.38	0.03	0.00	0.00
	Single Family	0.20	0.00	0.00	0.00
	Total	**3**	**0**	**0**	**0**
5PM	Commercial	1.31	0.09	0.00	0.00
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.10	0.01	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.15	0.01	0.00	0.00
	Other-Residential	0.44	0.03	0.00	0.00
	Single Family	0.25	0.00	0.00	0.00
	Total	**2**	**0**	**0**	**0**

Source: HAZUS

The total economic loss estimated for the earthquake is $233,340,000 which includes building and lifeline related losses based on the region's availability inventory. HAZUS estimates that about 3,007 buildings will be at least moderately damaged. This is over one percent of the buildings in the region. There are an estimated 99 buildings that will be damaged beyond repair. The tables below summarize the expected damage by general building type and estimated damage to utility and transportation systems.

Table 111. Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
Occupancy	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	2777.97	0.97	367.00	3.45	206.12	8.27	57.09	13.74	12.81	12.81
Commercial	19748.99	6.91	844.85	7.94	352.38	14.14	85.06	20.48	22.72	22.73
Education	568.78	0.20	21.95	0.21	8.50	0.34	2.22	0.53	0.56	0.56
Government	267.98	0.09	13.98	0.12	6.74	0.27	2.28	0.55	0.73	0.73
Industrial	4877.02	1.71	277.51	2.61	145.90	5.86	38.19	9.19	9.38	9.38
Religion	38195.11	13.36	1899.92	17.86	693.98	27.85	150.38	36.20	33.61	33.62
Residential	1418.90	0.50	59.83	0.56	21.70	0.87	5.12	1.23	1.45	1.45
Total	**218123.08**	**76.27**	**7151.69**	**67.24**	**1056.45**	**42.40**	**75.05**	**18.07**	**18.71**	**18.72**
Subtotal	**285,978**		**10,636**		**2,492**		**415**		**100**	

Source: HAZUS

Table 112. Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
Occupancy	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	247212.84	86.44	8473.68	79.67	1284.86	51.56	90.02	21.67	24.20	24.20
Steel	6868.73	2.40	419.18	3.94	251.32	10.09	74.07	17.83	19.47	19.47
Concrete	6646.89	2.32	308.27	2.90	114.0	4.58	33.36	8.14	9.76	9.76
Precast	5891.61	2.06	330.66	3.11	198.50	7.97	49.36	11.88	10.18	10.19
RM	10114.34	3.54	321.17	3.02	185.56	7.45	51.24	12.34	8.50	8.51
URM	2107.52	0.74	167.38	1.57	76.35	3.06	21.02	5.06	9.60	9.60
MH	7135.90	2.50	615.68	5.79	381.18	15.30	95.86	23.08	18.26	18.27
Total	**285,978**		**10,636**		**2,492**		**415**		**100**	

Source: HAZUS

RM: Reinforced Masonry

URM: Unreinforced Masonry

MH: Manufactured Housing

Table 113. Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations and Segments	With at least Moderate Damage	With Complete Damage	With Functionality >50%	
					After Day 1	After Day 7
Highway	Segments	362	0	0	362	362
	Bridges	897	3	0	894	897
	Tunnels	0	0	0	0	0
Railways	Segments	126	0	0	126	126
	Bridges	96	0	0	96	96
	Tunnels	0	0	0	0	0
	Facilities	9	0	0	9	9
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	1	0	0	1	1
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	8	1	0	8	8
	Runways	11	0	0	11	11

Source: HAZUS

Table 114. Expected Utility System Facility Damage

System	Number of Location				
	Total Number	With at Least Moderate Damage	With Complete Damage	With Functionality >50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	4	0	0	4	4
Natural Gas	1	0	0	1	1
Oil Systems	1	0	0	1	1
Electrical Power	60	21	0	44	52
Communication	42	1	0	41	42

Source: HAZUS

Table 115. Expected utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	13,181	1436	359
Waste Water	7,908	721	180
Natural Gas	233	0	0
Oil	0	0	0

Source: HAZUS

Table 116. Expected Potable Water and Electric Power System Performance

	Total Number of households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	319,296	4,764	2,905	675	0	0
Electric Power		5,267	3,647	1,678	190	7

Source: HAZUS

Round Valley M7.1

The social impact from earthquakes can be catastrophic and wide ranging. HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodation in temporary public shelters. The model estimates 1 household to be displaced due to the earthquake. Of these zero people out of 1,008,654 will seek temporary shelter in public shelters. The table below describes the casualty estimates from the earthquake scenario based on different time periods and type of properties, spaces, or activities.

Table 117. Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2AM	Commercial	0.03	0.00	0.00	0.00
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.03	0.00	0.00	0.00
	Other-Residential	1.23	0.08	0.00	0.00
	Single Family	0.71	0.01	0.00	0.00
	Total	**2**	**0**	**0**	**0**
2PM	Commercial	1.85	0.12	0.00	0.00
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.64	0.04	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.23	0.02	0.00	0.00
	Other-Residential	0.38	0.03	0.00	0.00
	Single Family	0.20	0.00	0.00	0.00
	Total	**3**	**0**	**0**	**0**
5PM	Commercial	1.31	0.09	0.00	0.00
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.10	0.01	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.15	0.01	0.00	0.00
	Other-Residential	0.44	0.03	0.00	0.00
	Single Family	0.25	0.00	0.00	0.00
	Total	**2**	**0**	**0**	**0**

Source: HAZUS

The total economic loss estimated for the earthquake is $233,340,000 which includes building and lifeline related losses based on the region's available inventory. HAZUS estimates that about 127 buildings will be at least moderately damaged. This is over zero percent of the buildings in the region. There are an estimate zero buildings that will be damaged beyond repair. The tables below summaries the expected damage by general building type.

Table 118. Expected Building Damage by Occupancy

Occupancy	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	3410.74	1.14	8.18	0.91	1.96	1.60	0.12	2.28	0.00	4.98
Commercial	20934.25	7.01	97.93	10.85	20.88	17.05	0.94	18.10	0.00	25.03
Education	599.79	0.20	1.88	0.21	0.33	0.27	0.01	0.17	0.00	0.23
Government	289.48	0.10	1.26	0.14	0.25	0.20	0.01	0.17	0.00	0.23
Industrial	5311.20	1.78	28.93	3.21	7.46	6.10	0.40	7.78	0.00	4.61
Religion	40611.40	13.60	275.56	30.54	82.41	67.31	3.62	69.84	0.01	57.63
Single Family	1498.27	0.50	7.24	0.80	1.43	1.17	0.06	1.19	0.00	7.39
Total	**225935.90**	**75.67**	**481.35**	**53.35**	**7.72**	**6.30**	**0.02**	**0.46**	**0.00**	**0.00**

Source: HAZUS

Table 119. Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
Occupancy	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	256532.40	85.91	546.50	60.57	6.70	5.47	0.00	0.01	0.00	0.00
Steel	7585.10	2.54	37.45	4.15	9.82	8.02	0.40	7.72	0.00	2.27
Concrete	7073.90	2.37	33.72	3.74	5.02	4.10	0.10	1.97	0.00	0.11
Precast	6436.30	2.16	32.67	3.62	10.72	8.76	0.62	11.99	0.00	6.04
RM	10637.09	3.56	33.38	3.70	10.09	8.24	0.25	4.90	0.00	0.00
URM	2349.10	0.79	25.92	2.87	6.33	5.17	0.51	9.83	0.00	49.25
MH	7977.14	2.67	192.69	21.36	73.75	60.24	3.29	63.57	0.00	42.33
Total	**298,591**		**902**		**122**		**5**		**0**	

Source: HAZUS

RM: Reinforced Masonry

URM: Unreinforced Masonry

MH: Manufactured Housing

Table 120. Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations and Segments	With at least Moderate Damage	With Complete Damage	With Functionality >50%	
					After Day 1	After Day 7
Highway	Segments	362	0	0	362	362
	Bridges	897	0	0	897	897
	Tunnels	0	0	0	0	0
Railways	Segments	126	0	0	126	126

System	Component	Number of Locations				
		Locations and Segments	With at least Moderate Damage	With Complete Damage	With Functionality >50%	
					After Day 1	After Day 7
	Bridges	96	0	0	96	96
	Tunnels	0	0	0	0	0
	Facilities	9	0	0	9	9
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	1	0	0	1	1
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	8	0	0	8	8
	Runways	11	0	0	11	11

Source: HAZUS

Table 121. Expected Utility System Facility Damage

System	Number of Location				
	Total Number	With at Least Moderate Damage	With Complete Damage	With Functionality >50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	4	0	0	4	4
Natural Gas	1	0	0	1	1
Oil Systems	1	0	0	1	1
Electrical Power	60	0	0	60	60
Communication	42	0	0	42	42

Source: HAZUS

Table 122. Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	13,181	17	4
Waste Water	7,908	9	2
Natural Gas	233	0	0
Oil	0	0	0

Source: HAZUS

Table 123. Expected Potable Water and Electric Power System Performance

	Total Number of households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	319,296	0	0	0	0	0
Electric Power		0	0	0	0	0

Source: HAZUS

The total building-related losses were $26,360,000 for the earthquake scenario and 16 percent of the estimated losses were related to the business interruption of the region. By far, the largest loss were sustained by the residential occupancies which made up over 39 percent of the total loss. The table below provides a summary of the losses associated with the building damage.

Table 124. Building-Related Economic Loss Estimates

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses	Wage	0.00	0.0326	0.9021	0.0409	0.0946	1.0702
	Capital-Related	0.00	0.0138	0.8267	0.0243	0.0292	0.8940
	Rental	0.0454	0.1675	0.6026	0.0316	0.0294	0.8765
	Relocation	0.0540	0.2641	0.6660	0.1777	0.2453	1.4071
Subtotal		**0.0994**	**0.4780**	**2.9974**	**0.2745**	**0.3985**	**4.2478**
Capital Stock Losses	Structural	0.8561	0.6113	1.4114	0.5372	0.5331	3.9491
	Non-Structural	4.6481	2.5130	4.0524	1.2348	1.8442	14.3025
	Content	0.8333	0.3050	1.1546	0.6171	0.5534	3.4634
	Inventory	0.00	0.00	0.2172	0.1058	0.0757	0.3987
Subtotal		**6.3375**	**3.493**	**6.8456**	**2.4949**	**3.0064**	**22.1137**
Total		**6.44**	**3.91**	**9.84**	**2.77**	**3.40**	**26.36**

Source: HAZUS

Table 125. Transportation System Economic Losses

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Bridges	6637.6252	0.00	0.00
	Segments	2645.6197	0.0006	0.00
	Tunnels	0.00	0.00	0.00
	Subtotal	**9283.2449**	**0.0006**	
Railways	Segments	2128.1232	0.00	0.00
	Bridges	546.2400	0.00	0.00

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
	Tunnels	0.00	0.00	0.00
	Facilities	23.9670	0.0831	0.35
	Subtotal	**2698.3302**	**0.0831**	
Light Rail	Segments	0.00	0.00	0.00
	Bridges	0.00	0.00	0.00
	Tunnels	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	2.1666	0.0076	
	Subtotal	**2.166**	**0.0076**	
Ferry	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	118.3667	0.5499	0.46
	Runways	67.2396	0.00	0.00
	Subtotal	**185.6063**	**0.5499**	
	Total	**12,169.35**	**0.64**	

Source: HAZUS

Table 126. Utility System Economic Losses

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Portable Water	Pipelines	0.00	0.00	0.00
	Facilities	0.00	0.00	0.00
	Distribution	424.2406	0.0778	0.02
	Subtotal	**424.2406**	**0.0778**	
Waste Water	Pipelines	0.00	0.00	0.00
	Facilities	18.2016	0.0004	0.00
	Distribution Lines	169.6962	0.0134	0.01
	Subtotal	**1508.9444**	**0.0138**	
Oil Systems	Pipelines	0.00	0.00	0.00
	Facilities	0.1180	0.00	0.00
	Subtotal	**0.1180**	**0.00**	
Electrical Power	Facilities	24962.9942	206.0104	0.83
	Subtotal	**24962.9942**	**206.0104**	
Communication	Facilities	4.9560	0.0039	0.08
	Subtotal	**4.9560**	**0.0039**	
	Total	**27,843.60**	**206.34**	

Source: HAZUS

White Mountain M7.4

The social impact from earthquakes can be catastrophic and wide ranging. HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodation in temporary public shelters. The model estimates 1 household to be displaced due to the earthquake. Of these zero people out of 1,008,654 will seek temporary shelter in public shelters. The table below describes the casualty estimates from the earthquake scenario based on different time periods and type of properties, spaces, or activities.

Table 127. Transportation System Lifeline Inventory

		Level 1	Level 2	Level 3	Level 4
2AM	Commercial	0.02	0.00	0.00	0.00
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.03	0.00	0.00	0.00
	Other-Residential	1.10	0.07	0.00	0.00
	Single Family	0.55	0.00	0.00	0.00
	Total	**2**	**0**	**0**	**0**
2PM	Commercial	1.60	0.11	0.00	0.00
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.52	0.03	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.19	0.01	0.00	0.00
	Other-Residential	0.34	0.02	0.00	0.00
	Single Family	0.16	0.00	0.00	0.00
	Total	**3**	**0**	**0**	**0**
5PM	Commercial	1.15	0.08	0.00	0.00
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.08	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.000
	Industrial	0.12	0.01	0.00	0.00
	Other-Residential	0.40	0.03	0.00	0.00
	Single Family	0.20	0.00	0.00	0.00
	Total	**2**	**0**	**0**	**0**

Source: HAZUS

HAZUS estimates that about 114 buildings will be at least moderately damaged. This is over zero percent of the buildings in the region. There are an estimated zero buildings that will be damaged beyond repair. The table below summarizes the expected damage by general building type.

Table 128. Expected Building Damage by Occupancy

Occupancy	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	3409.19	1.14	9.41	1.27	2.26	2.06	0.14	3.04	0.00	14.49
Commercial	20955.42	7.01	81.08	10.90	16.80	15.32	0.70	15.57	0.00	33.17
Education	600.19	0.20	1.54	0.21	0.26	0.24	0.01	0.14	0.00	0.21
Government	289.69	0.10	1.09	0.15	0.21	0.19	0.01	0.18	0.00	0.69
Industrial	5317.22	1.78	24.33	3.27	6.14	5.60	0.31	6.99	0.00	7.44
Other Residential	40641.45	13.60	251.27	33.79	77.05	70.28	3.23	71.96	0.00	21.73
Religion	1498.15	0.50	7.27	0.98	1.50	1.37	0.08	1.69	0.00	22.28
Single Family	226051.95	75.66	367.62	49.44	5.41	4.93	0.02	0.44	0.00	0.00
Total	**298,763**		**744**		**110**		**4**		**0**	

Source: HAZUS

Table 129. Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
Occupancy	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	3409.19	1.14	9.41	1.27	2.26	2.06	0.14	3.04	0.00	14.49
Commercial	20955.42	7.01	81.08	10.90	16.80	15.32	0.70	15.57	0.00	33.17
Education	600.19	0.20	1.54	0.21	0.26	0.24	0.01	0.13	0.00	0.21
Government	289.69	0.10	1.09	0.15	0.21	0.19	0.01	0.18	0.00	0.69
Industrial	5317.22	1.78	24.33	3.27	6.14	5.60	0.31	6.99	0.00	7.44
Other Residential	40641.45	13.60	251.27	33.79	77.05	70.28	3.23	71.96	0.00	21.73
Religion	1498.15	0.50	7.27	0.98	1.50	1.37	0.08	1.69	0.00	22.28
Single Family	226051.95	75.66	367.62	49.44	5.41	4.93	0.02	0.44	0.00	0.00
Total	**298,763**		**744**		**110**		**4**		**0**	

Source: HAZUS

Table 130. Expected Building Damage by Building Type (All Design Levels)

Occupancy	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	256660.13	85.91	420.81	56.59	4.66	4.25	0.00	0.00	0.00	0.00
Steel	7590.95	2.54	32.95	4.43	8.53	7.78	0.34	7.56	0.00	15.50
Concrete	7079.95	2.37	28.64	3.85	4.16	3.80	0.08	1.83	0.00	0.00
Precast	6443.66	2.16	27.37	3.68	8.79	8.02	0.48	10.79	0.00	14.27
RM	10644.32	3.56	28.04	3.77	8.25	7.53	0.19	4.34	0.00	0.00
URM	2353.79	0.79	22.31	3.00	5.35	4.88	0.41	9.18	0.01	70.22

Occupancy	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
MH	7990.55	2.67	183.47	24.67	69.89	63.75	2.98	66.30	0.00	0.00
Total	**298,763**		**744**		**110**		**4**		**0**	

Source: HAZUS

RM: Reinforced Masonry

URM: Unreinforced Masonry

MH: Manufactured Housing

Table 131. Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations and Segments	With at least Moderate Damage	With Complete Damage	With Functionality >50%	
					After Day 1	After Day 7
Highway	Segments	362	0	0	362	362
	Bridges	897	0	0	897	897
	Tunnels	0	0	0	0	0
Railways	Segments	126	0	0	126	126
	Bridges	96	0	0	96	96
	Tunnels	0	0	0	0	0
	Facilities	9	0	0	9	9
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	1	0	0	1	1
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	8	0	0	8	8
	Runways	11	0	0	11	11

Source: HAZUS

Table 132. Expected Utility System Facility Damage

System	Number of Location				
	Total Number	With at Least Moderate Damage	With Complete Damage	With Functionality >50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0

System	Number of Location				
	Total Number	With at Least Moderate Damage	With Complete Damage	With Functionality >50 %	
				After Day 1	After Day 7
Waste Water	4	0	0	4	4
Natural Gas	1	0	0	1	1
Oil Systems	1	0	0	1	1
Electrical Power	60	0	0	60	60
Communication	42	0	0	42	42

Source: HAZUS

Table 133. Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	13,181	47	12
Waste Water	7,908	24	6
Natural Gas	233	0	0
Oil	0	0	0

Source: HAZUS

Table 134. Expected Potable Water and Electric Power System Performance

	Total Number of households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	319,296	0	0	0	0	0
Electric Power		0	0	0	0	0

Source: HAZUS

NATURAL ENVIRONMENT

An earthquake could cause cascading effects, including dam failure or rockslide that would impact the natural environment in different ways, depending on the scope of the cascading hazard. Other types of ground deformation could result as well.

CRITICAL FACILITIES

An earthquake could have major impacts on critical infrastructure. HAZUS estimates impacts to critical facilities including hospitals, schools, Emergency Operations Centers (EOCs), police stations and fire stations. The following tables displays the expected damage to essential facilities for the three earthquake scenarios (Great Valley Coalinga M7.1, Round Valley M7.1, White Mountain M7.4) that was generated by HAZUS.

Table 135. Expected Damage to Essential Facilities for Great Valley Coalinga M7.1

Classification	Total	Number of Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on Day 1
Hospitals	18	0	0	16
Schools	394	10	0	382
EOCs	8	0	0	7
Police Stations	26	0	0	23
Fire Stations	77	0	0	72

Source: HAZUS-MH

Table 136. Expected Damage to Essential Facilities for Round Valley M7.1

Classification	Total	Number of Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on Day 1
Hospitals	18	0	0	18
Schools	394	0	0	394
EOCs	8	0	0	8
Police Stations	26	0	0	26
Fire Stations	77	0	0	77

Source: HAZUS-MH

Table 137. Expected Damage to Essential Facilities for White Mountain M7.4

Classification	Total	Number of Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on Day 1
Hospitals	18	0	0	18
Schools	394	0	0	394
EOCs	8	0	0	26
Police Stations	26	0	0	26
Fire Stations	77	0	0	77

Source: HAZUS-MH

In addition to the exposure analysis generated through HAZUS, information provided by the California Geological Survey, and USGS was utilized to generate estimates of critical facilities within the 55% g or greater ground shaking potential area.

Table 138. Critical Facilities in Earthquake Hazard Areas shows the critical facilities affected in the earthquake hazard areas.

Table 138. Critical Facilities in Earthquake Hazard Areas

Jurisdiction	Facility Type	Count
Coalinga	Airport	1
	Colleges & Universities	2
	Communications	1
	Department of Public Works	1
	Fire Station	3
	Health Care	1
	Police	3
	School	10
	Total	**22**
Firebaugh		
	Airport	1
	CalARP	2
	Fire Station	1
	Police	1
	School	9
	Urgent Care	1
	Total	**15**
Huron	CalARP	7
	Fire Station	1
	Police	1
	School	3
	Total	**12**
Mendota	Airport	1
	CalARP	1
	Fire Station	1
	School	7
	Total	**10**
San Joaquin	CalARP	1
	School	2
	Sheriff	1
	Total	**4**
Unincorporated	Airport	5
	CalARP	35

Jurisdiction	Facility Type	Count
	Department of Agriculture	1
	Department of Public Works	2
	Fire Station	5
	Nursing Home	1
	School	17
	Total	**66**
	Grand Total	**129**

Source: California Geological Survey, USGS

FUTURE DEVELOPMENT

Future development in the county is not anticipated to significantly affect vulnerability to earthquakes but will result in a slight increase in exposure of the population and building stock due to population increases over the next several decades. Additionally, the County has adopted policies to curb damage from earthquake hazard areas. For example, the Alquist Priolo Earthquake Fault Act states that the County shall not permit any structure for human occupancy to be placed within designated Earthquake Fault Zones.

VULNERABILITY TO FLOOD/LEVEE FAILURE (HIGH)

Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry floodplain. A floodplain is a lowland area downstream and adjacent to water bodies that are subject to flood events. Flooding is a naturally occurring event that becomes hazardous when populations and property are affected. A flood occurs when the existing channel of a stream, river, canyon, or other watercourse cannot contain excess runoff from rainfall or snowmelt, resulting in overflow onto adjacent lands. Man-made levees can fail in a number of ways. The most frequent (and dangerous) form of levee failure is a breach. A levee breach is when part of the levee actually breaks away, leaving a large opening for water to flood the land protected by the levee. A breach can be a sudden or gradual failure that is caused either by surface erosion or by a subsurface failure of the levee.

PEOPLE

The number of people living in the 100-year and 500-year floodplains was determined by multiplying the percent area of coverage for the floodplains in each census tract by the total population of that tract. Census tracts do not always adhere to local boundaries; if a census tract was completely within a city boundary or unincorporated Fresno County it was labeled as such in the following tables. If a tract intersected more than one jurisdiction, all jurisdictions within the tract were labeled in the following tables. Based on this analysis, there are 44,905 residents living in the 100-year flood zones throughout Fresno County. **Table 139. Population Living in 1% Annual Chance Flood Hazard Zones** below details population estimates by census tract, followed by a similar table for the 500-year floodplain.

Table 139. Population Living in 1% Annual Chance Flood Hazard Zones

Jurisdiction(s)	Population
Clovis	**640**
Clovis; Fresno; Unincorporated Fresno Co.	**1,736**
Clovis; Unincorporated Fresno Co.	**3,171**
Coalinga; Unincorporated Fresno Co.	**2,148**
Firebaugh; Unincorporated Fresno Co.	**2,860**
Fowler; Kingsburg; Selma; Unincorporated Fresno Co.	**75**
Fowler; Selma; Unincorporated Fresno Co.	**59**
Fowler; Unincorporated Fresno Co.	**115**
Fresno	**3,446**
Fresno; Kerman; Unincorporated Fresno Co.	**1,222**
Fresno; Unincorporated Fresno Co.	**10,984**
Huron; Unincorporated Fresno Co.	**1,930**
Kerman; Unincorporated Fresno Co.	**272**
Kingsburg; Selma; Unincorporated Fresno Co.	**15**
Kingsburg; Unincorporated Fresno Co.	**10**

Mendota; Unincorporated Fresno Co.	**5,498**
Orange Cove; Unincorporated Fresno Co.	**2,397**
Parlier; Reedley; Unincorporated Fresno Co.	**102**
Parlier; Unincorporated Fresno Co.	**42**
Reedley; Unincorporated Fresno Co.	**1,813**
San Joaquin; Unincorporated Fresno Co.	**1,709**
Sanger	**11**
Sanger; Unincorporated Fresno Co.	**1,686**
Selma; Unincorporated Fresno Co.	**234**
Unincorporated Fresno Co.	**2,731**
Total	**44,905**

Source: Fresno County Assessor's Office; FEMA, US Census Bureau

The same analysis determined that there are 195,454 residents living in the 500-year flood zones throughout Fresno County. The results of this analysis are shown in **Table 140. Population Living in 0.2% Annual Chance Flood Hazard Zones.**

Table 140. Population Living in 0.2% Annual Chance Flood Hazard Zones

Jurisdiction(s)	Population
Clovis	**11,704**
Clovis; Fresno; Unincorporated Fresno Co.	**17,015**
Clovis; Unincorporated Fresno Co.	**2,216**
Coalinga; Unincorporated Fresno Co.	**3,835**
Firebaugh; Unincorporated Fresno Co.	**2,292**
Fowler; Kingsburg; Selma; Unincorporated Fresno Co.	**0**
Fowler; Selma; Unincorporated Fresno Co.	**0**
Fowler; Unincorporated Fresno Co.	**7**
Fresno	**104,996**
Fresno; Kerman; Unincorporated Fresno Co.	**0**
Fresno; Unincorporated Fresno Co.	**48,361**
Huron; Unincorporated Fresno Co.	**43**
Kerman; Unincorporated Fresno Co.	**0**
Kingsburg; Selma; Unincorporated Fresno Co.	**0**
Kingsburg; Unincorporated Fresno Co.	**0**
Mendota; Unincorporated Fresno Co.	**2,504**

Orange Cove; Unincorporated Fresno Co.	**200**
Parlier; Reedley; Unincorporated Fresno Co.	**45**
Parlier; Unincorporated Fresno Co.	**0**
Reedley; Unincorporated Fresno Co.	**851**
San Joaquin; Unincorporated Fresno Co.	**0**
Sanger	**7**
Sanger; Unincorporated Fresno Co.	**1,003**
Selma; Unincorporated Fresno Co.	**0**
Unincorporated Fresno Co.	**375**
Total	**195,454**

Source: Fresno County Assessor's Office; FEMA, US Census Bureau

Population estimates were conducted using the USACE Comprehensive Study and the CA DWR for the 200 year floodplain. However, there is not an updated study for the analysis and therefore has been omitted in the 2024 plan update.

HAZUS

The geographical size of the region is approximately 184 square miles and contains 14,708 census blocks. The region contains over 319,000 households and has a total population of more than one million people. There are an estimated 299,621 buildings in the region with a total building replacement value (excluding contents) of $160,289,000,000. Approximately 89.25 percent of the buildings (and 61.47 percent of the building value) are associated with residential housing.

Based on the 100-Year Flood Event Scenario generated by HAZUS, it is estimated that 927 people will seek shelter and 9,513 will be displaced. Displacements may occur due to evacuations from the flood area and damage to homes. Due to the damage, individuals may seek public shelters. The model estimates that 3,171 households may be displaced due to the flood event.

PROPERTY

Flooding is a natural occurrence in the Central Valley because it is a natural drainage basin for thousands of watershed acres of Sierra Nevada and Coast Range foothills and mountains. Historically, the Fresno County planning area has been at risk to flooding primarily during the winter and spring months when river systems in the County swell with heavy rainfall and snowmelt runoff. Normally, storm floodwaters are kept within defined limits by a variety of storm drainage and flood control measures. But, occasionally, extended heavy rains result in floodwaters that exceed normal high-water boundaries and cause damage.

Flooding has occurred in the past: within the 100-year floodplain and in other localized areas. Recent digital flood insurance rate maps (DFIRMs) dated January 2016 placed additional areas within the 100-year or greater floodplain. This is primarily due to the inability of the old and inadequate levees to be certified in accordance with current FEMA standards. As such, these levees no longer provide protection from the 100-year flood. It should be noted, however, that all levees, whether certified or not, provide some level of protection to the planning area and remain a critical factor in floodplain management for the communities.

The continued need to rely on these flood control structures is an ongoing concern. The history of the area, beginning with hydraulic gold mining techniques and through the continuing conversion of agricultural lands to commercial and residential uses, makes it impossible to reverse the planning area's dependence on structural flood control protection. Levee maintenance is a continuous effort due to erosion and scour brought on by the channelization itself.

Additional improvements to strengthen the levees and make them less susceptible to seepage-induced failures are a priority of local and state agencies. Once these improvements are made, certification may be possible. Nevertheless, while these improvements may mitigate the impacts of flooding due to levee failure, the levees will remain subject to overtopping by flood events larger than their design capacity.

The likelihood of flooding increases with the heavy rains that occur annually between November and May. In addition to damage to area infrastructure, other problems associated with flooding include erosion, sedimentation, degradation of water quality, loss of environmental resources, and certain health hazards.

HAZUS

A flood vulnerability assessment was performed for Fresno County using GIS. The county's parcel layer and associated assessor's building improvement valuation data were provided by the county and were used as the basis for the inventory. Fresno County's effective DFIRM was used as the hazard layer. DFIRM is FEMA's flood risk data that depicts the 1% annual chance (100-year) and the 0.2% annual chance (500-year) flood events. Fresno County's effective FEMA DFIRM, dated January 20, 2016, was determined to be the best available floodplain data. **Table 141. Fresno County Flood Zones** summarize the flood zones included on these maps.

Table 141. Fresno County Flood Zones

Zone Designation	Percent Annual Chance of Flood	Description
Zone V	1%	Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no base flood elevations (BFEs) or flood depths are shown.
Zones VE and V1-30	1%	Areas along coasts subject to inundation by the 1% annual chanc e of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within t hese zones. (Zone VE is used on new and revised maps in place of Zones V1-30.)

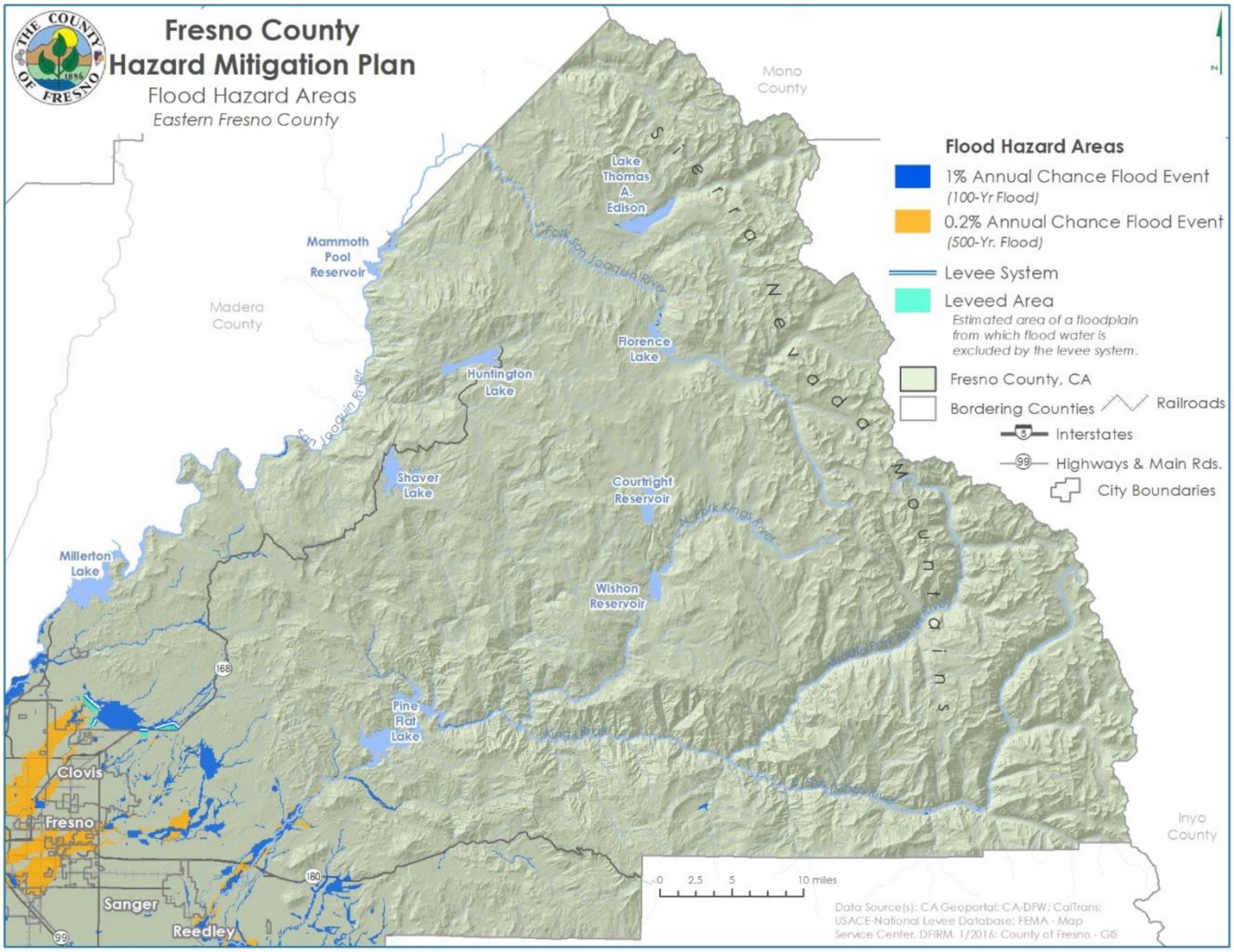
Zone Designation	Percent Annual Chance of Flood	Description
Zone A	1%	Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or BFEs are. shown within these areas.
Zone AE	1%	Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, BFEs derived from detailed analyses are shown at selected intervals within these zones.
Zone AH	1%	Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between 1 – 3 feet.
Zone AO	1%	Areas with a 1% annual chance of flooding, where shallow flooding average depths are between 1 – 3 feet.
Zone X (shaded)	0.2%	Represents areas between the limits of the 1% annual chance of flooding and 0.2% chance of flooding.
Zone X (unshaded)	Undetermined	Areas outside of the 1% annual chance floodplain and 0.2% annual chance floodplain; areas of 1% annual chance sheet flow flooding where average depths are less than one (1) foot; areas of 1% annual chance stream flooding where the contributing drainage area is less than one (1) square mile, or areas protected from the 1% annual chance flood by levees. No BFE or depths are shown within this zone.

Source: FEMA

GIS was used to intersect the parcel boundaries with a master address point layer to obtain number of buildings per parcel. The parcel layer was then converted into a centroid, or point, representing the center of each parcel polygon.

Only parcels with improvement values greater than zero and address points were used in the analysis, this method assumes that improved parcels have a structure of some type. The DFIRM flood zones were overlaid in GIS on the address points and parcel centroid data to identify structures that would likely be inundated during a 1 percent annual chance and 0.2 percent annual chance flood event. These overlays can be seen graphically in the regional maps in the following figures and in more detail in the jurisdictional annexes.

Figure 69. Fresno County Flood Hazard Areas – Eastern Fresno County



Source: CA-DFW, CalTrans, USACE-National Levee Database, FEMA – Map Service Center, DFIRM 1/2016

Figure 70. Fresno County Flood Hazard Areas – Central Fresno County

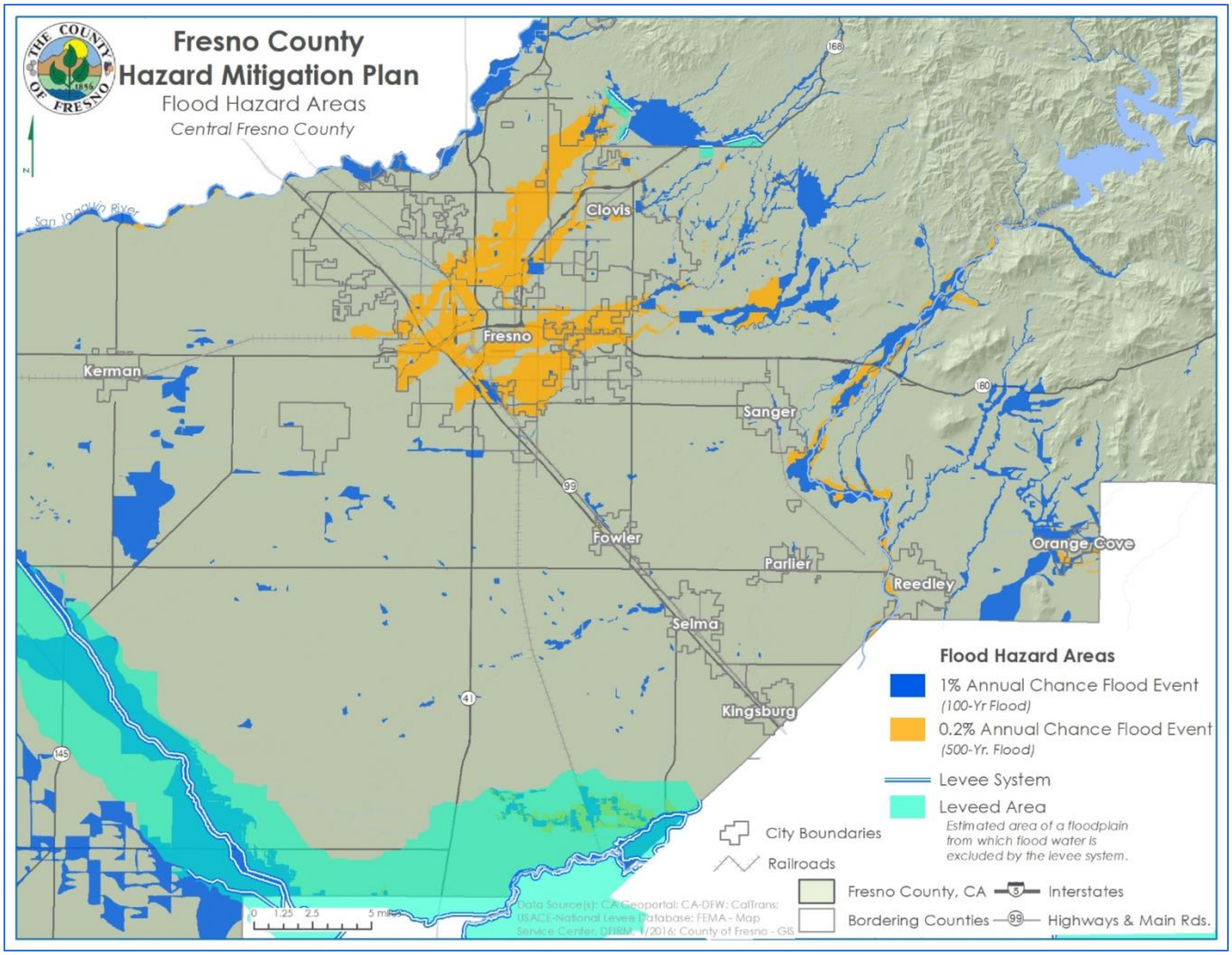
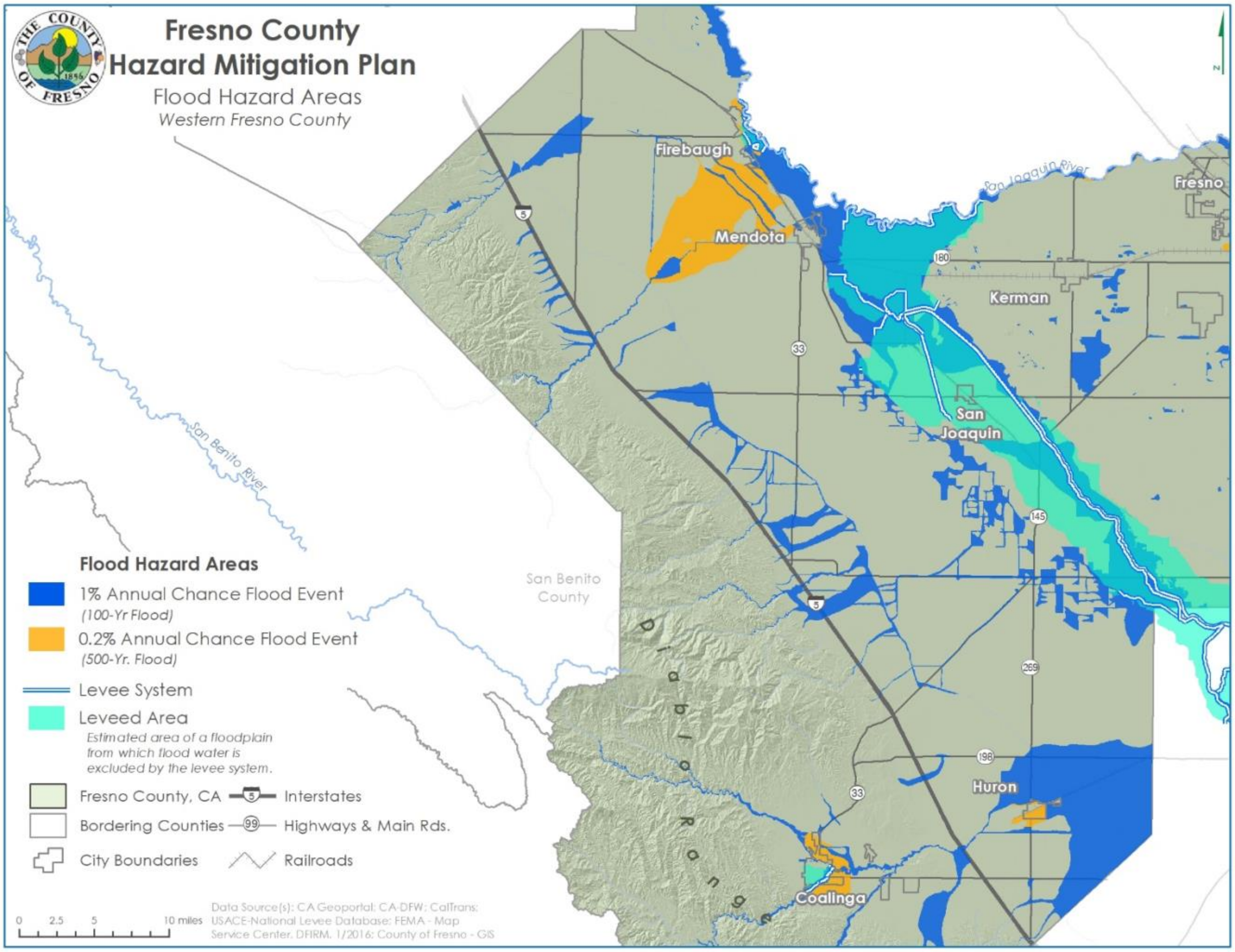


Figure 71. Fresno County Flood Hazard Areas - Western Fresno County



Source: CA-DFW, CalTrans, USACE-National Levee Database, FEMA – Map Service Center, DFIRM 1/2016

Results of the overlay analysis area are provided in the following tables. The jurisdictional annexes provide more detailed information based on property type. Property type refers to the land use of the parcel. Where possible, parcel and structure counts were separated in the analysis. Detailed tables show counts of parcels by jurisdiction and land use type (agricultural, commercial, industrial, residential, open space, etc.). The flood loss analyses do not account for business disruption, emergency services, environmental damages, or displacement costs, thus actual losses could exceed the estimates shown.

The geographical size of the region is approximately 184 square miles and contains 14,708 census blocks. The region contains over 319,000 households and has a total population of 1,007,944 people. HAZUS estimates that there are 299,621 buildings in the region with a total building replacement value (excluding contents) of $160,289,000,000. Approximately 89.25 percent of the buildings (and 61.47 percent of the total exposure value) are associated with residential housing. The tables below represent the relative distribution of the value to the general occupancies by Study Region and Scenario respectively.

Table 142. Building Exposure by Occupancy Type for the Study Region 1% Floodplain

Occupancy	Exposure ($1000)	Percent of Total
Residential	98,523,386	61.5%
Commercial	32,127,603	20.0%
Industrial	11,799,356	7.4%
Agricultural	4,086,209	2.5%
Religion	2,853,221	1.8%
Government	868,453	0.5%
Education	10,030,538	6.3%
Total	**160,288,766**	**100%**

Source: HAZUS

HAZUS estimates that about 911 buildings will be at least moderately damaged (defined as damage level 11 or above). This is over 59 percent of the total number of buildings in the scenario. There are an estimated 46 buildings that will be completely destroyed. The table below summarizes the expected damage by general occupancy for the buildings in the region.

Table 143. Expected Building Damage by Occupancy for the Study Region 1% Floodplain

	1-10		11-20		21-30		31-40		41-50		>50	
Occupancy	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	7	39	11	61	0	0	0	0	0	0	0	0
Commercial	7	58	3	25	2	17	0	0	0	0	0	0
Education	3	100	0	0	0	0	0	0	0	0	0	0
Government	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	1	100	0	0	0	0	0	0	0	0
Religion	7	44	9	56	0	0	0	0	0	0	0	0
Residential	258	23	468	41	174	15	130	11	67	6	46	4
Total	**282**		**492**		**176**		**130**		**67**		**46**	

Source: HAZUS

Table 144. Expected Building Damage by Building Type (All Design Levels)

	1-10		11-20		21-30		31-40		41-50		>50	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	3	50	3	50	0	0	0	0	0	0	0	0
Manufactured Housing	5	25	2	10	1	5	0	0	0	0	12	60
Masonry	4	57	3	43	0	0	0	0	0	0	0	0
Steel	3	43	4	57	0	0	0	0	0	0	0	0
Wood	255	23	467	42	173	15	130	12	66	6	34	3

Source: HAZUS

Table 145. Building Exposure in the 100-Year Floodplain

Jurisdiction	Parcel Count	Building Count	Improved Value	Land Value	Total Value
Clovis	1,028	147	$2,243,518,271	$395,015,237	$2,638,652,708
Coalinga	201	215	$2,599,806	$1,358,556	$3,958,362
Firebaugh	592	656	$13,454,662	$5,635,994	$19,090,656
Fowler	74	64	$0	$0	$0
Fresno	1,520	455	$460,869,587	$153,917,812	$618,041,399
Huron	38	8	$0	$0	$0
Kerman	2	0	$0	$0	$0
Kingsburg	0	0	$0	$0	$0
Mendota	171	98	$833,583	$511,649	$1,345,232
Orange Cove	379	318	$0	$0	$0
Parlier	82	52	$52,101	$692,304	$744,405
Reedley	62	16	$0	$9,066	$9,066
San Joaquin	0	0	$0	$0	$0
Sanger	296	206	$2,485,504	$1,045,731	$3,531,235
Selma	27	18	$0	$0	$0
Unincorporated	9,167	3,178	$468,803,571	$385,320,333	$885,563,114
Total	**13,639**	**5,431**	**$3,192,617,085**	**$943,506,682**	**$4,170,936,177**

Source: Fresno County Assessor's Office; National Flood Hazard Layer Effective date 01/20/2016, FEMA

Table 146. Building Exposure in the 500-Year Floodplain

Jurisdiction	Parcel Count	Building Count	Improved Value	Land Value	Total Value
Clovis	2,814	7,149	$9,200,833,909	$2,002,816,583	$11,206,145,592
Coalinga	217	868	$37,362,500	$10,261,060	$47,623,560
Firebaugh	173	818	$489,560	$1,740,991	$2,230,551
Fowler	-	6	-	-	-
Fresno	10,685	49,144	$17,978,613,870	$3,890,079,524	$21,908,534,084

Jurisdiction	Parcel Count	Building Count	Improved Value	Land Value	Total Value
Huron	-	747	-	-	-
Kerman	-	-	-	-	-
Kingsburg	-	-	-	-	-
Mendota	7	105	$1,457,645	$335,832	$1,793,477
Orange Cove	-	78	-	-	-
Parlier	-	0	-	-	-
Reedley	157	177	$39,218,838	$13,541,001	$52,759,839
San Joaquin	-	0	-	-	-
Sanger	35	59	$4,916,474	$1,637,528	$6,554,002
Selma	-	0	-	-	-
Unincorporated	464	5,828	$101,640,999	$93,426,960	$195,068,859
Total	14,552	64,979	$27,364,533,795	$6,013,839,479	$33,420,809,964

Source: Fresno County Assessor's Office; National Flood Hazard Layer Effective date 01/20/2016, FEMA

Looking at the flood risk for the entire Fresno County planning area, in general, Clovis, Firebaugh, Coalinga, Fresno, and Reedley are predominantly inundated by the 500-year flood. Orange Cove, San Joaquin, and Sanger are predominantly inundated by the 100-year flood. Fowler, Huron, Mendota, Parlier, and Selma are just barely affected by the floodplain. Kerman and Kingsburg are not in floodplains. This analysis does not take localized flooding into account.

According to this information, the Fresno County planning area has 13,639 parcels valued at roughly $4.17 billion in the 100-year floodplain. An additional 14,552 parcels valued at roughly $33.42 billion fall within the 500-year floodplain. As a result, total structural exposure exceeds $37 billion. The end of this section provides more discussion on vulnerability in leveed areas.

The tables below provide further analysis that shows the count and improved value of parcels that fall in a floodplain by property type for the 100- and 500-year annual chance flood zones. It should be noted that the model may have included structures in the floodplains that are elevated at or above the level of the base-flood elevation, which will likely mitigate flood damage. Also, it is important to remember that the assessed values are well below the actual market values. Thus, the actual value of assets at risk may be significantly higher than those included herein.

Table 147. Building Exposure in the 100-Year Floodplain by Property Type

Property Type	Parcel Count	Improved Value	Land Value	Total Value
Agricultural	878	$358,153,138	$318,496,610	$683,541,058
Apartments	374	$2,071,722,176	$246,745,111	$2,318,467,287
Church	1	$173,970	$45,877	$219,847
Commercial	66	$339,833,649	$180,132,311	$520,360,260
Condominium	9	$2,946,834	$1,001,664	$3,948,498
Government	3	$3,327	$572,628	$575,955
Group Housing/Lodging	2	$1,005,835	$1,865,208	$2,871,043
Industrial	92	$276,238,213	$109,597,919	$413,352,932

Property Type	Parcel Count	Improved Value	Land Value	Total Value
Mobile/ Manufactured Home	2	$2,880,436	$3,951,834	$6,832,270
Office/ Professional Space	1	$300,900	$81,600	$382,500
Primary Use Not Designated	340	$0	$0	$0
Recreation	25	$330,626	$3,724,131	$4,054,757
School	2	$2,134,198	$169,598	$2,303,796
Single Family Residence	694	$134,072,705	$59,474,922	$193,557,627
Unknown	10,971	$0	$0	$0
Utilities	4	$394,535	$1,784,659	$2,179,194
Vacant	175	$2,426,543	$15,862,610	$18,107,083
Total	$13,639	$3,192,617,085	$943,506,682	$4,170,936,177

Source: Fresno County Assessor's Office; National Flood Hazard Layer Effective date 01/20/2016, FEMA
**Includes Zones A, AE, AH, and AO*
***Includes Shaded Zone X (500-year) and all 100-year flood zones*

Table 148. Building Exposure in the 500-Year Floodplain by Property Type

Type	Parcel Count	Improved Value	Land Value	Total Value
Agricultural	130	$35,660,282	$65,664,460	$101,325,642
Apartments	4,260	$20,216,231,280	$4,078,176,352	$24,294,407,632
Church	37	$30,688,088	$4,036,415	$34,941,503
Commercial	1,066	$4,482,800,800	$999,249,972	$5,515,263,522
Communications	1	$0	$3,458	$3,458
Condominium	14	$34,466,814	$6,779,664	$41,246,478
Group Housing/Lodging	27	$79,244,013	$18,354,847	$99,707,160
Hospital	16	$341,363,536	$17,708,710	$359,072,246
Industrial	191	$164,740,952	$42,739,517	$296,343,750
Mobile/ Manufactured Home	53	$33,019,701	$75,522,199	$108,541,900
Office/ Professional Space	371	$804,948,104	$244,371,695	$1,052,660,999
Outlot & Common Area	1	$9	$14	$23
Primary Use Not Designated	516	$0	$0	$0
Recreation	3	$3,997,372	$979,715	$4,977,087
School	12	$14,390,928	$3,649,028	$18,078,556

Type	Parcel Count	Improved Value	Land Value	Total Value
Single Family Residence	7,389	$1,119,808,599	$401,867,956	$1,521,692,855
Vacant	461	$3,173,317	$54,735,477	$58,054,894
Total	14,552	$27,364,533,795	$6,013,839,479	$33,420,709,964

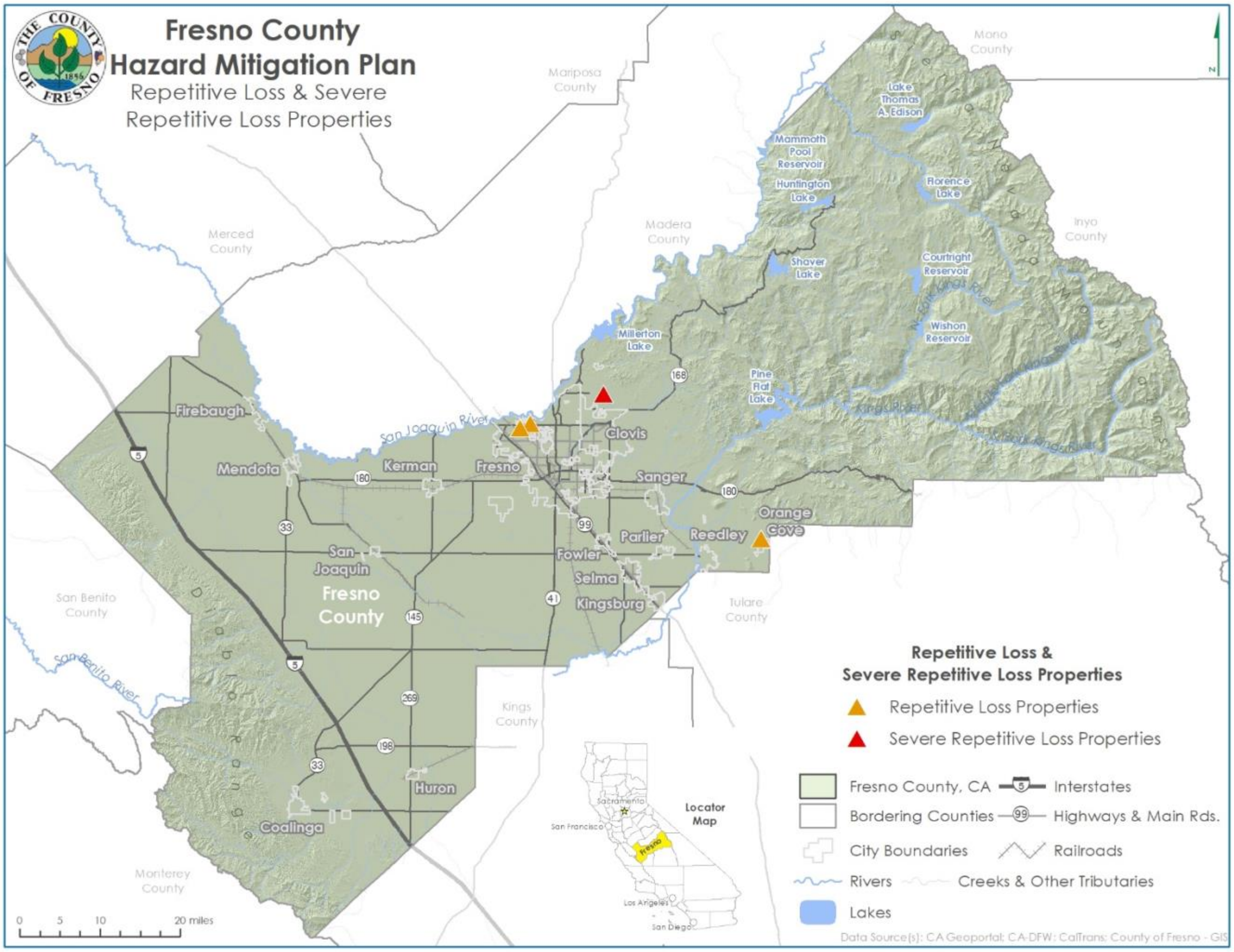
Source: Fresno County Assessor's Office; National Flood Hazard Layer Effective date 01/20/2016, FEMA
**Includes Zones A, AE, AH, and AO*
***Includes Shaded Zone X (500-year) and all 100-year flood zones*

Insurance Coverage, Claims Paid, and Repetitive Losses

Unincorporated Fresno County joined the National Flood Insurance Program (NFIP) on December 12, 1982, and the Community Rating System (CRS) on October 1, 1991. According to Fresno County, the current Community Rating System (CRS) score of seven, which is lower than the 2007 rating (8).

Within Fresno County, there are 247 policies in force. There are four repetitive loss properties within Fresno County, three of which are located in the City of Fresno and City of Clovis, and one located in Unincorporated Fresno County (Orange Cove). Three of the four are repetitive loss properties and one is a severe repetitive loss property. There are 163 claims within incorporated Fresno County and 84 claims within unincorporated. According to FEMA, accessed information on March 19, 2024, there are no Severe Repetitive Loss properties located in the unincorporated Fresno County. **Figure 72. Fresno County Repetitive Loss and Severe Repetitive Loss Properties** displays where the Severe Repetitive Loss properties are located within the County.

Figure 72. Fresno County Repetitive Loss and Severe Repetitive Loss Properties



Source: CA Geoportal; CA-DFW; CalTrans; County of Fresno - GIS

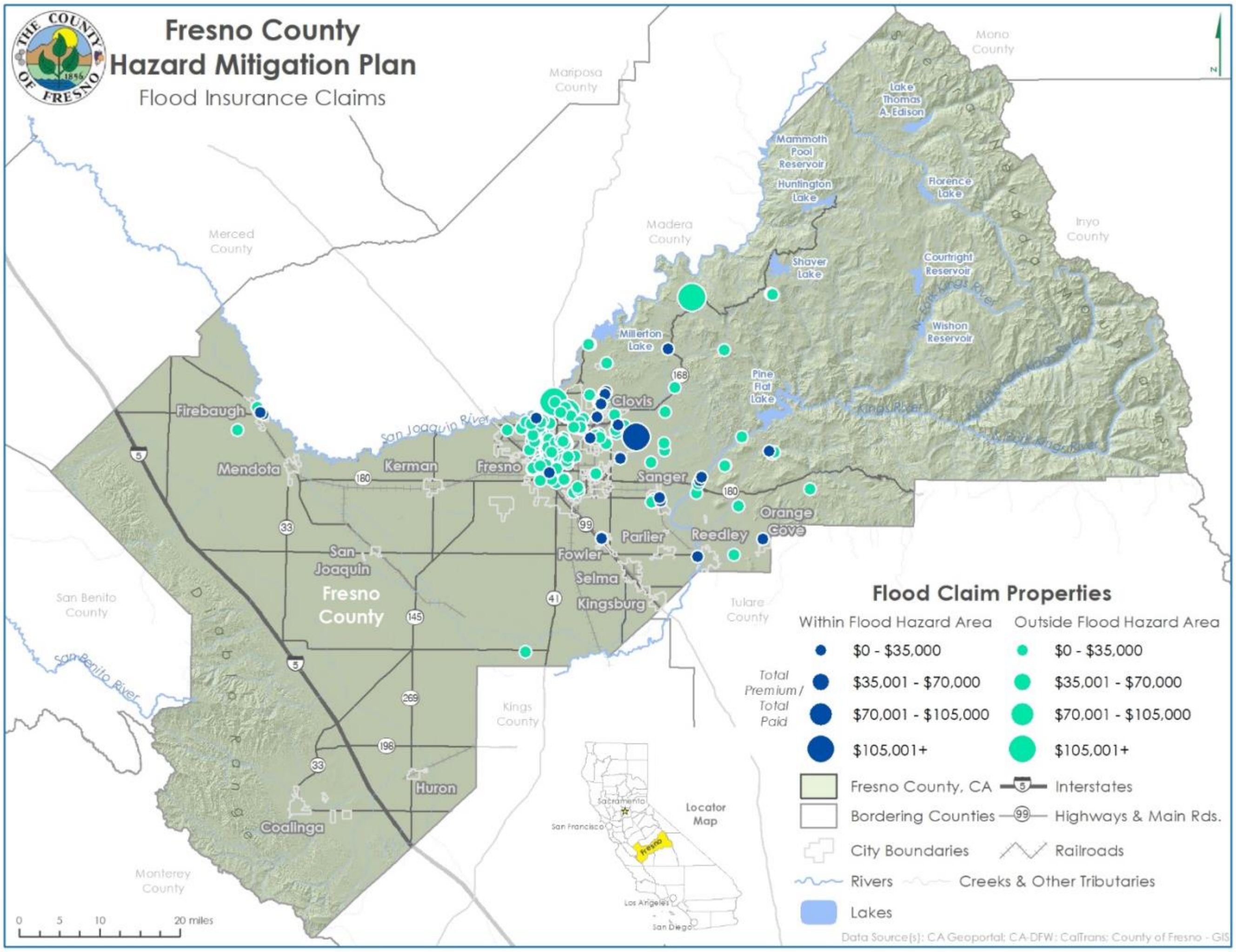
NFIP data indicates that there are 247 active insurance policies in Fresno County. **Table 149. Fresno County NFIP Information** provides more details on NFIP policies and paid losses for each jurisdiction participating in the NFIP**. Figure 73. Fresno County Flood Insurance Claims** shows where flood claims are being submitted across the County.

Table 149. Fresno County NFIP Information

Jurisdiction	Policies	Total Premium/Total Paid	No. of Paid Losses
Clovis	24	$176,106.79	16
Firebaugh	4	$0	0
Fowler	3	$3,197.94	1
Fresno	128	$711,909.74	77
Sanger	4	$6,220.92	2
Unincorporated Fresno Co.	84	$571,029.69	41
Total	**247**	**$1,468,465.08**	**137**

Source: FEMA National Flood Insurance Program Community Information System

Figure 73. Fresno County Flood Insurance Claims



Source: CA Geoportal; CA-DFW; CalTrans; County of Fresno - GIS

HISTORIC, CULTURAL, AND NATURAL RESOURCES AT RISK

The Fresno County planning area has significant historic, cultural, and natural resources located throughout the County as previously described. Risk analysis of these resources was not possible due to data limitations. However, natural areas within the floodplain often benefit from periodic flooding as a naturally recurring phenomenon. These natural areas often reduce flood impacts by allowing absorption and infiltration of floodwaters.

OVERALL COMMUNITY IMPACT

Floods and their impacts will vary by location and severity and will likely only affect certain areas of the County at any one time. Based on the risk assessment, it is evident that floods will continue to have potentially devastating economic impacts to certain areas of the County. However, many of the floods in the County are minor, localized flood events that are more of a nuisance than a disaster. Impacts that are not quantified, but can be anticipated in large future events, include:

- Injury and loss of life;
- Commercial and residential structural damage;
- Disruption of and damage to public infrastructure;
- Health hazards associated with mold and mildew;
- Damage to roads/bridges resulting in loss of mobility;
- Significant economic impact (jobs, sales, tax revenue) upon the community;
- Negative impact on commercial and residential property values; and
- Significant disruption to students and teachers as temporary facilities and relocations would likely be needed.

NATURAL ENVIRONMENT

Natural resources are generally resistant to flooding except where natural landscapes and soil compositions have been altered for human development or after periods of previous disasters such as drought and fire. Wetlands, for example, exist because of natural flooding incidents. Areas that are no longer wetlands may suffer from oversaturation of water, as will areas that are particularly impacted by drought. Areas recently suffering from wildfire damage may erode because of flooding, which can permanently alter an ecological system.

CRITICAL FACILITIES

Critical facilities are those community components that are most needed to withstand the impacts of disaster as previously described. An analysis was performed using GIS software to determine critical facilities in Fresno County's floodplain. The DFIRM flood layer previously discussed was used to identify the 100- and 500-year floodplains. For more information on the spatial distribution and location of critical facilities, see the Critical Facility overview. The impact to the community could be great if these critical facilities were damaged or destroyed during a flood event. Similar data is available for the other participating jurisdictions in the jurisdictional annexes.

As described earlier, critical facilities are located throughout Fresno County. Critical facilities in the floodplain are summarized in **Table 150. Critical Facilities in the 100-Year Floodplain** and **Table 151. Critical Facilities in the 500-year Floodplain.** In total, there are 34 facilities in the 100-year flood zone, 209 facilities in the 500-year flood zone, and 9 critical facilities in the 200-year floodplain. Information regarding critical facilities in the floodplain for each jurisdiction is outlined in the jurisdictional annexes.

Table 150. Critical Facilities in the 100-Year Floodplain

Jurisdiction	Facility Type	Total Facilities	Replacement Cost
Coalinga	Communications Facilities	1	$118,000
	Schools	1	$10,203,670
Firebaugh	Schools	4	$35,277,520
Mendota	Electric Power Facilities	2	$135,892,580
	Fire Stations	1	$1,306,580
Orange Cove	Fire Stations	1	$1,306,580
Reedley	Airport Facilities	1	$5,300,00
Sanger	Schools	1	$1,070,310
Unincorporated Fresno County	Electric Power Facilities	4	$2,238,656,990
	Schools	1	$5,244,180
Totals		**17**	**$2,434,376,410**

Fresno County Assessor's Office; National Flood Hazard Layer Effective date 01/20/2016, FEMA

Table 151. Critical Facilities in the 500-year Floodplain

Jurisdiction	Facility Type	Total Facilities	Replacement Cost
Clovis	Schools	6	$156,373,660
Coalinga	Medical Care Facilities	1	$110,720,100
Firebaugh	Airport Facilities	1	$5,300,000
	EOCs	1	$3,438,840
	Schools	1	$8,873,840
Fresno	Airport Facilities	1	$13,356,000
	Bus Facilities	1	$2,166,680
	Communications Facilities	4	$472,000
	Electric Power Facilities	1	$40,533,900
	EOCs	1	$7,997,200
	Fire Stations	6	$10,752,960
	Medical Care Facilities	4	$803,905,150
	Police Stations	5	$46,895,200
	Railway Facilities	1	$2,663,000

	Schools	66	$2,618,520,760
Huron	Schools	1	$9,830,260
Reedley	Wastewater Treatment Facilities	1	$171,951,800
Unincorporated Fresno County	Electric Power Facilities	1	$11,036,810
	Fire Stations	2	$3,098,740
	Schools	1	$11,183,000
Totals		**106**	**$4,039,069,900**

Source: Fresno County Assessor's Office; National Flood Hazard Layer Effective date 01/20/2016, FEMA

HAZUS

For essential facilities, there are 18 hospitals in the region with a total bed capacity of 3,621 beds. There are 394 schools, 77 fire stations, 26 police stations, and 8 emergency operation centers. The table below describes the severity of damage to essential facilities for the flood scenario.

Table 152. Critical Facilities in the 100-Year Floodplain

Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Emergency Operations Centers	8	0	0	0
Fire Station	77	0	0	0
Hospitals	18	0	0	0
Police Stations	26	0	0	0
Schools	394	0	0	0

Source: HAZUS

this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a businesses because for those people displaced from their homes because of the flood. The total building-related losses were $412,620,00 million dollars. 39 percent of the estimated losses were related to the business interruption of the region. The residential occupancies made up about 39 percent of the total loss. The table below provides a summary of the losses associated with the building damage.

Table 153. Building-Related Economic Loss Estimates (in $ millions)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss	Building	133	14.62	6.64	16.71	170.97
	Content	72	43.49	16.57	82.50	214.75

	Inventory	0	5.92	3.14	17.84	26.90
	Subtotal	205.20	64.03	26.35	117.05	412.62
Business Interruptions	Income	0.56	33.24	0.55	32.51	66.85
	Relocation	40.85	7.82	0.66	17.12	66.44
	Rental Income	15.92	5.71	0.15	1.07	22.85
	Wage	1.33	35.60	0.94	70.77	108.64
Subtotal		**58.67**	**82.36**	**2.30**	**121.47**	**164.79**
Total		**263.86**	**146.39**	**28.64**	**238.52**	**677.41**

Source: HAZUS

FUTURE DEVELOPMENT

Flooding and floodplain management are significant issues for Fresno County. The potential or likelihood of a flood event in the city increases with the annual onset of heavy rains in April combined with snowmelt runoff from May through June. Much of the historical growth in the problems connected with flooding and stormwater runoff include erosion, sedimentation, degradation of water quality, losses of environmental resources, and certain health hazards. Future annexations of unincorporated areas could significantly add to the number of flood-prone structures in Fresno County.

For NFIP participating communities, floodplain management practices implemented through local floodplain management ordinances should mitigate the flood risk to new development in floodplains. The development trend in the Fresno County planning area is steady, significant growth. Much of this growth is occurring in the urban areas, which causes a significant increase in peak flow and stormwater runoff. Census projections from the California Department of Finance expect the County's population to grow to 1,201,792 by 2020. This is an increase of 271,342 people from the 2010 census estimate of 930,450. Such growth will consume previously undeveloped acres, and the impacts may overwhelm existing drainage and flood control facilities.

The potential for flooding may increase as stormwater is channelized due to land development. Such changes can create localized flooding problems inside and outside of natural floodplains by altering or confining natural drainage channels. Floodplain modeling and master planning should be based on buildout land use to ensure that all new development remains safe from future flooding. While local floodplain management, stormwater management, and water quality regulations and policies address these changes on a site-by-site basis, their cumulative effects can have a negative impact on the floodplain.

Local floodplain management ordinances require that new construction be built with the lowest floor elevated a minimum of one foot above the base flood (100-year) elevation. New development that adheres to the elevation requirements in addition to other requirements for maintaining elevation certificates and implementing stormwater program elements and erosion or sediment controls for all new development in the floodplain should help protect development from 100-year floods. The amount of growth in the County and nearby communities can also strain the limits of the entire water management system, which includes water supply in addition to water control. When flood control structures are overwhelmed, the result is not only severe flooding. Significant losses to the water supply system may also occur. The following policies are a few policies preventing loss from flood damage.

- Policy PF-E.9 100-year Flood Protection requires new development to provide protection from the 100-year flood as a minimum.

- Policy PF-E.20 requires that the County's new development of facilities near rivers, creeks, reservoirs, or substantial aquifer recharge areas to mitigate any potential impacts of release of pollutants in flood waters, flowing rivers, streams, creeks, or reservoir waters.
- Policy HS-C.2 requires the County prohibit new development in existing undeveloped areas (i.e., areas devoted to agriculture or open space that are not designated for development) protected by a State flood control project without appropriately considering significant known flooding risks and taking reasonable and feasible action to mitigate the potential property damage to the new development resulting from a flood.

VULNERABILITY TO LEVEE FAILURE

A levee failure can range from a small, uncontrolled release to a catastrophic failure. Vulnerability to levee failures is generally confined to the areas subject to inundation downstream of the facility. Secondary losses would include loss of the multi-use functions of the facility and associated revenues that accompany those functions.

VULNERABILITY TO HUMAN HEALTH: EPIDEMIC/PANDEMIC (HIGH)

Based on historical occurrences, the risk to the Fresno County planning area is occasional, but the vulnerability is high due to the recent COVID-19 pandemic and the devastating impacts the pandemic had across the globe. The majority of the impacts from epidemics and pandemics will likely be on public health. It is critical that future planning and preparedness activities for pandemic and epidemics account for the existing disparities in Fresno County and potential barriers communities may face to mitigate adverse health outcomes and other impacts such as unemployment and the subsequent impacts (i.e., food and housing insecurity). Such efforts will assist in reducing the health disparities often seen in pandemic and epidemics as well as improving health outcomes and the livelihoods of disproportionately impacted communities.

PEOPLE

All residents and visitors of the County could be susceptible to exposure from an infectious disease and subsequent impacts from a pandemic or epidemic. However, based on existing inequities, some populations and communities will continue to bear the burden of those impacts, similar to previous occurrences. Disproportionately impacted communities include but are not limited to:

- Rural communities
- Black, Indigenous, People of Color (BIPOC) Communities
- LGBTQ+ communities
- Incarcerated/detained populations
- Individuals with disabilities
- Individuals with chronic health conditions
- Individuals with no health insurance or lack of access to healthcare services
- Low socioeconomic status
- People experiencing homelessness
- Individuals with limited English proficiency

Disease spread and mortality is affected by a variety of factors, including virulence, ease of spread, aggressiveness of the virus and its symptoms, resistance to known antibiotics and environmental factors. While every pathogen is different, diseases normally have the highest mortality rate among the very young, the elderly or those with compromised immune systems. Additionally, as seen during the COVID-19 pandemic, those populations with increased exposure to the virus, especially those living and working in congregate settings such as hospitals and health care facilities are at greater risk. During the 1918 H1N1 influenza pandemic an estimated 50 million people died, which is a crude mortality rate of 2.7 percent. The crude mortality rate calculates if someone is infected how likely are they to die . During the COVID-19 pandemic, the number of deaths peaked during the 2021 winter season, with a 7-day average of over 3,000 deaths. Since the start of the pandemic in early 2020, there have been over 1,000,000 deaths in the United States as of February 2024[8]. It is likely that if a new epidemic or pandemic were to occur, few people, if any, would have immunity to a new virus.

[8] CDC COVID Data Tracker: Maps by Geographic Area https://covid.cdc.gov/covid-data-tracker/#maps_deaths-total

PROPERTY

For the most part, property itself wouldn't be physically destroyed or damaged by a human disease epidemic or pandemic. However, as concerns about contamination increase, property may be quarantined or destroyed as a precaution against spreading illness. As seen during the COVID-19 pandemic, businesses can be damaged through disrupting supply chains and the distribution of goods which can slow or force businesses to close. Industry and commerce are also likely to suffer losses which occurred during the COVID-19 pandemic.

Good ventilation and indoor air quality are critical in reducing airborne exposure to viruses and other disease vectors. Buildings and their ventilation and air conditioning (HVAC) systems can pose a higher risk for disease spread through lack of adequate ventilation and air filtration. Adjustments can be made to improve indoor air filtration. During the COVID-19 pandemic, public health recommendations included adding portable high efficiency particulate air (HEPA) cleaners to reduce the number of airborne infectious particles, especially in congregate settings. [9]

NATURAL ENVIRONMENT

A widespread pandemic would not likely have an impact on the natural environment unless the disease was transmissible between humans and animals. However, during the beginning of the COVID-19 pandemic when the whole world recommended to quarantine into their homes to prevent and reduce the spread of the virus, many social, economic, industrial, and urbanization activities suddenly shut off. This nonpharmaceutical intervention to reduce the spread of the virus and ultimately reduce infection rates, hospitalizations, and deaths, allowed nature in certain areas of the world to become less polluted. [10] While these activities have returned since the lockdown days of the pandemic, such catastrophic events as the COVID-19 pandemic can have a domino effect to all aspects of life including the natural environment.

CRITICAL FACILITIES

The COVID-19 pandemic rapidly escalated demands on the health care system, medical infrastructure, and health care workforce. Unlike a one-time disaster event, the COVID-19 pandemic disease spread had many surges repeatedly stressing hospitals, EMS, and healthcare settings causing ripple effects throughout the community. In order for the healthcare system to cope with surge of patients seeking medical care and attention, many hospitals cancelled non-emergency (but still needed) procedures and were not prioritizing people with non-COVID needs which increased all-cause and COVID-19 specific mortality in the subsequent weeks after the start of the pandemic. Additionally, hospitals were already operating close to capacity and the pandemic pushed the entire healthcare system to the brink. Educational settings faced many challenges in barriers in continuing to provide education to students which caused disruptions to learning and critical learning milestones for K-12 students. Many schools, for the first time, explore virtual schooling options, which posed challenges. Rural communities with

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[9] Efficacy of Portable Air Cleaners and Masking for Reducing Indoor Exposure to Simulated Exhaled SARS-CoV-2 Aerosols — United States, 2021 | MMWR (cdc.gov) https://www.cdc.gov/mmwr/volumes/70/wr/mm7027e1.htm

[10] Coronavirus lockdown helped the environment to bounce back - PMC (nih.gov) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7323667/

limited access to the internet struggled to connect and participate in virtual classrooms. These hardships create a difficult environment for the school, teachers, students, and parents to navigate.

FUTURE DEVELOPMENT

Future development is not like to be impacted by a pandemic, however pandemics offer an opportunity to implement lessons learned to prevent or reduce harm from future pandemics. As the COVID-19 virus is an airborne disease it is important to have clean air to reduce transmission. Improving indoor air quality won't singlehandedly stopped transmission but will likely reduce the spread of COVID-19 and other viruses such as the fly, RSV, and other allergens and pollutants. Interventions such as air purifiers can improve indoor air quality especially in older buildings and small spaces. [11]

[11] Indoor air quality improvement in COVID-19 pandemic: Review - PMC (nih.gov) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8049211/

VULNERABILITY TO HUMAN HEALTH: WEST NILE VIRUS (LOW)

While the likelihood of occurrence of West Nile virus in the Fresno County planning area is likely, the County's vulnerability is low, based on the percentage of total population that actually comes down with the disease. Since the discovery of West Nile virus in California in 2003, Fresno County has had 384 confirmed human cases.

Although the potential for exposure does exist in Fresno County, the vulnerability should be considered in terms of adverse effects due to exposure. The County already has an active vector control program in place for mosquitoes, and protective measures to prevent exposure are relatively simple and cost-effective. Given the nature of protective measures, such as wearing long- sleeved clothing and using bug spray, the responsibility for protection can and should be an individual responsibility. Fresno County's current public education program should give the community the knowledge as well as access to resources to effectively counter the risk and impact from the virus.

PEOPLE

Approximately twenty percent of people exposed to West Nile Virus through a mosquito bite develop symptoms related to the virus; it is not transmissible from one person to another. In the state of California, there have been more than 7,500 cases and over 300 deaths reported since 2003. In Fresno County, there have been 402 cases, 17 of which were fatal. Preventive steps can be taken to reduce exposure to mosquitos carrying the virus; these include insect repellent, covering exposed skin with clothing and avoiding the outdoors during twilight periods of dawn and dusk, or in the evening when the mosquitos are most active. [12]

PROPERTY

Property would not be significantly affected by West Nile Virus.

NATURAL ENVIRONMENT

While birds are the species primarily affected by West Nile Virus, bats, horses, cats, dogs, chipmunks, skunks, squirrels, domestic rabbits and alligators can all be infected with the virus.

CRITICAL FACILITIES

Should a widespread outbreak of West Nile Virus occur, medical facilities could be stressed.

FUTURE DEVELOPMENT

Future development would not be impacted by West Nile Virus.

[12] West Nile Virus (WNV) Fact Sheet (cdc.gov) https://www.cdc.gov/westnile/resources/pdfs/wnvFactsheet_508.pdf

VULNERABILITY TO LANDSLIDE (LOW)

Landslides and mudflows can destroy properties and cause injuries and deaths. A landslide refers to a wide range of ground movement, such as rock falls, deep failure of slopes and shallow debris flow. The figure below illustrates the different types of landslide movement. The primary driving force of landslides is gravity but other contributing factors such as rainfall, earthquakes, volcanic eruptions, groundwater pressure, erosion, destabilization of slopes (because of deforestation, cultivation and construction, snow, and glacial melt) can drive a landslide to occur as well.

PEOPLE

On average, 25 to 50 people are killed by landslides each year in the United States and even more worldwide. In the state of California, more than 100 residents have been killed by debris flows during the past 25 years. Most of the fatalities occurred due to debris flow burying individuals sleeping in lower-floor bedrooms adjacent to hazardous slopes. [13] Health and safety concerns due to landslides and mudflow include rapidly moving water and debris, broken electrical, water, gas, and sewage lines that can result in injury and illness, and disrupted roadways and railways endangering motorists and impeding on transport and access to healthcare. People are susceptible if they are caught in a landslide or rockfall; falling debris can cause injury or death. There is also a danger to drivers operating vehicles, as rocks and debris can strike vehicles passing through the hazard area or cause dangerous shifts in roadways. Based on previous occurrences, there have been no recorded injuries or deaths from landslides in Fresno County.

PROPERTY

Landslides and mudslides are one of the most destructive hazard processes that can cause tremendous damage to the built environment. This hazard can drastically alter the physical landscape and destroy buildings and homes. Landslide risk is minimal in the highly developed valley area of the County due to the relatively flat topography, and most structures concentrated in the central and eastern portion of the County are not at risk to landslides. However, the Fresno County General Plan identifies State Route 168 in eastern Fresno County and State Route 198 in western Fresno County as areas that could be affected by landslides caused by earthquakes or heavy rains. Current data is limited, and future studies should evaluate the geologic conditions throughout the planning area. Other general impacts to property include road closures. Previous landslides have closed Los Gatos Road west of Coalinga, Huntington Lake Road, State Routes 168 and 180, SR-180, SR-168, SR-63, and Auberry Road.

NATURAL ENVIRONMENT

Landslide susceptibility directly overlaps with most natural resource areas across the County. The likelihood of landslides occurring is determined by precipitation and wildfire occurring sequentially. In the event of a landslide there is potential for loss of lands, habitat, and disruption of waterbodies in areas of debris flow. The susceptibility of natural resource lands in Fresno County to landslides is less than other hazards such as wildfire but the risks around loss of topsoil and habitat conversions create a

[13] Landslide | Impact (fema.gov) https://community.fema.gov/ProtectiveActions/s/article/Landslide-Impact

high scope of impact. Wildlife and plants face a compounding risk when presented with landslide events. Landslide susceptibility Is highest within the Sierra Nevada in the eastern portion of the county.

While susceptibility would be the highest in the eastern part of the County, landslides and rockfalls have minimal impacts to the natural environment; these impacts would be confined to a small area. There is a slight chance that a rockfall or landslide in the drainages above people and property could cause blockage and water backup from temporary landslide dams.

CRITICAL FACILITIES

Landslides and mudslides have the power to disrupt vital utilities and communication lines as well are damage critical infrastructure. Based on nearby previous occurrences there is no reported damage to critical facilities. Pipelines for water, electrical distribution lines, and roadways are vulnerable to landslide impacts which could occur in sloped areas that extend into wildfire zones. With high landslide susceptibility along roadways in the Sierra Nevada as well as several fire stations there is a risk of emergency service disruption and impacts to evacuation.

However, there is not enough available data to determine whether there are any critical facilities located in landslide susceptible areas.

FUTURE DEVELOPMENT

The severity of landslide problems is directly related to the extent of human activity in hazard areas. Human activities such as property development and road construction can also exacerbate the occurrence of landslides. Future development should be done carefully to prevent landslide damage to property or people. Adverse effects can be mitigated by early recognition and avoiding incompatible land uses in these areas or by corrective engineering. Improving mapping and information on landslide hazards and incorporating this information into the development review process could prevent siting of structures and infrastructure in identified hazard areas. For example, Policy HS-D.11 Landslide Hazard Areas, states that in known or potential landslide hazard areas, the County shall prohibit avoidable alteration of land in a manner that could increase the hazard, including concentration of water through drainage, irrigation, or septic systems, undercutting the bases of slopes, removal of vegetative cover, and steepening of slopes.

VULNERABILITY TO SEVERE WEATHER: EXTREME TEMPERATURES (EXTREME COLD/FREEZE AND EXTREME HEAT) (LOW)

Extreme temperatures, both extreme heat and extreme cold, can pose a significant threat to people by causing health related illnesses and hypothermia. Populations without adequate housing will be exposed to these temperature extremes and be at increased risk of illness. Prolonged extreme temperatures can disrupt vital services and infrastructure. In Fresno County, extreme heat is more likely to occur west of the mountains and extreme cold within the mountainous areas of the county.

PEOPLE

Extreme Cold

Extreme cold pose significant health risks to the residents of Fresno County, particularly to vulnerable groups such as the elderly, young children, and individuals with pre-existing health conditions. The drop in temperatures can lead to an increase in respiratory problems, hypothermia, and frostbite, especially for those without adequate heating or shelter. Homeless individuals are particularly at risk, as they may not have access to warm, indoor spaces during cold spells.

Severe winter weather can disrupt the daily life of residents. Power outages, often caused by heavy snowfall or ice accumulation on power lines, can lead to loss of heating and lighting in homes. This not only makes staying warm a challenge but can also disrupt communication and access to online resources. Transportation can be severely impacted, with icy roads and reduced visibility leading to hazardous driving conditions, public transport delays, and school closures. Businesses might face challenges during extreme cold events, including reduced foot traffic, difficulties in maintaining regular operations, and potential damage to premises and inventory. These disruptions can have a ripple effect on the local economy, affecting both business owners and employees. Additionally, increased heating costs during cold spells can strain household budgets, particularly for low-income families.

Extreme Heat

Exposure to extreme heat is a critical health hazard, leading to illnesses, hospitalizations, and deaths. Conditions like heat exhaustion and heat stroke are direct threats, while extreme temperatures also contribute to cardiovascular diseases, causing heart attacks and strokes. The U.S. Centers for Disease Control and Prevention (CDC) indicates that heat exhaustion contributed to approximately 4.2 deaths per 1 million Californians last year, making extreme heat the deadliest weather hazard in the United States. This risk affects diverse populations disproportionately.

Athletes are particularly vulnerable due to their exposure to high temperatures, physical exertion, and often wearing heat-trapping gear, especially in direct sunlight or areas with poor air quality. Children, reliant on adults for their safety, may lack access to adequate cooling in places like schools or daycares, increasing their risk. Older adults, especially those with cardiovascular issues or other medical conditions, are more susceptible to the effects of extreme heat. This group is also at a disadvantage during power outages that accompany heat events, particularly those reliant on life-sustaining devices or who are socially isolated.

Workers, both outdoor[14] (like those in agriculture, construction, and emergency response) and indoor workers without access to cooling, face heightened risks of heat-related illnesses and injuries. Pregnant women are at an increased risk of complications like preterm birth, low birth weight, fetal death, and

[14] National Integrated Heat Health Information System (NIHHIS) Who is most at risk to extreme heat?

infant mortality due to extreme heat.[15] About one in four adults in the United States has a disability. Therefore, there is a large population that can experience significant adverse impacts, even death, from extreme heat. They may also face challenges in accessing emergency warnings and accessible cooling shelters.

People experiencing homelessness are at a higher risk for heat-related issues due to a lack of reliable shelter, the risks are exacerbated by high living costs and insufficient affordable housing. In Fresno County, there as 4,216 people that are experiencing homelessness which is a 15.8 percent increase in 2020. Additionally, people with chronic health conditions, such as heart disease, mental illness, poor blood circulation, and obesity, are more susceptible to heat-related illnesses, with certain medications potentially worsening the effects of extreme heat.

Since agriculture is one of the top employment industries in the County, there are many farm workers who are exposed to extreme temperatures such as extreme heat. While there are some protections at the state level, California is one of a few states with laws that mandate employers provide water breaks, shade and rest for outdoor workers once temperatures reach certain levels, farmworkers are vulnerable to the weather conditions and are disproportionately impacted by heat. In fact, The Washington Center for Equitable Growth study estimates hot temperatures have caused at least 360,000 workplace injuries in California from 2001 to 2018, or about 20,000 injuries a year.[16] Since the county has a high farmworker population and there have been previous farmwork deaths during extreme heat events, mitigation actions should work to mitigate future risk to the population.

PROPERTY

The risks of extreme temperatures are often profiled as part of larger hazards, such as severe winter storms or drought. However, as temperature variances may occur outside of larger hazards or outside of the expected seasons but still incur large costs, it is important to examine them as stand-alone hazards. Extreme heat may overload demands for electricity to run air conditioners in homes and businesses during prolonged periods of exposure and presents health concerns to individuals outside in the temperatures. Extreme heat may also be a secondary effect of droughts or may cause temporary drought-like conditions. For example, several weeks of extreme heat increases evapotranspiration and reduces moisture content in vegetation, leading to higher wildfire vulnerability for that time period even if the rest of the season is relatively moist.

Extreme heat can cause infrastructure damage to roads. Vulnerable factors can include building materials, insulation, and roofing that may not be adequately designed to withstand prolonged high temperatures. This can lead to increased energy consumption for cooling, potential structural damage, and even health risks for occupants. Moreover, properties lacking sufficient vegetation or green spaces may experience amplified heat effects, contributing to the urban heat island effect and exacerbating local temperature disparities.

Extreme cold impacts structures when pipes or water mains freeze and burst, causing damage. Extreme cold may also lead to higher electricity and natural gas demands to maintain appropriate indoor heating levels combined with damage caused to the delivery infrastructure such as frozen lines and pipes. Cold may impact transportation as well. Exposed populations may be at risk while waiting for public transportation, particularly when combined with wind-chill, and some vehicles may not start

[15] Kuehn, L., and S. McCormick, 2017: Heat Exposure and Maternal Health in the Face of Climate Change. Int. J. Environ. Res. Public Health, 14(8), 853, doi:10.3390/ijerph14080853.

[16] The Hidden Cost Of California's Hot Workplaces: 20,000 Job Injuries A Year | LAist https://laist.com/news/climate-environment/the-hidden-cost-of-californias-hot-workplaces-20-000-job-injuries-a-year

which impacts the commute of the workforce and, in worst case scenarios, the movement of emergency services personnel.

Based on previous extreme cold events, aside from millions of dollars in agricultural losses, the County has experienced over 500,000 million dollars in property losses and about 4 million dollars for extreme heat.

NATURAL ENVIRONMENT

Extreme heat may cause temporary drought-like conditions. For example, several weeks of extreme heat increases evapotranspiration and reduces moisture content in vegetation, leading to higher wildfire vulnerability for that time period even if the rest of the season is relatively moist. Extreme cold has the same impacts on exposed wildlife as it does on exposed people. Changing heating and cooling patterns globally can have destructive secondary impacts, intensifying a variety of weather-related disasters that directly impact jurisdictions.

CRITICAL FACILITIES

Extreme temperatures can impact pipe (extreme cold) and road infrastructure (extreme heat), but direct impacts to critical infrastructure is expected to be minimal. Critical infrastructure that relies on public utility systems that could be overloaded may see impacts during extreme temperature events. For extreme multi-day extreme heat or cold events, jurisdictions may need to open cooling or warming shelters to support those populations who are unable to seek relief from the temperature extremities.

FUTURE DEVELOPMENT

Since structures are not usually directly impacted by severe temperature fluctuations, continued development is less impacted by this hazard than others in the plan. However, pre-emptive cautions such as construction of green buildings that require less energy to heat and cool, use of good insulation on pipes and electric wirings, and smart construction of walkways, parking structures, and pedestrian zones that minimize exposures to severe temperatures may help increase the overall durability of the buildings and the community to the variations. Continued development also implies continued population growth, which raises the number of individuals potentially exposed to variations. Public education efforts should continue to help the population understand the risks and vulnerabilities of outdoor activities, property maintenance, and regular exposures during periods of extreme heat and cold.

VULNERABILITY TO SEVERE WEATHER: FOG (MEDIUM)

Fog issues are well documented in the Fresno County planning area. In recent years, there have been several large-scale accidents during periods of heavy fog. However, it should be noted that while fog is present, driver error is usually a significant contributory factor to these accidents. Fog is driven by weather patterns in the Central Valley that will continue to occur annually. According to the California Department of Transportation, nearly three in four fog-related traffic collisions are connected to motorists driving too fast. These collisions resulted in the highest fatality rates. Methods to prevent fog-related traffic collisions include reducing speed, driving with headlights on low beam, and use extra caution, use windshield wipers.[17]

PEOPLE

Reduced visibility is the greatest risk to people when heavy fog is prevalent. Particularly when fog is dense, it can be hazardous to drivers, mariners and aviators and contributes to numerous accidents each year. To reduce injury and harm, people should avoid driving when dense fog is prevalent, if possible. If driving is pertinent, emergency services advise driving with lights on low beam, watching for CHP pace vehicles to guide through fog, avoiding stopping on highways, and avoiding crossing traffic lanes.

PROPERTY

Based on historical information, the primary effect of fog has not resulted in significant damage to property, or the losses are typically covered by insurance.

NATURAL ENVIRONMENT

As referred to in the Climate Change Considerations section of the Fog hazard profile, California's winter tule fog has declined dramatically over the past three decades, raising a red flag for the state's multibillion dollar agricultural industry. Crops such as almonds, pistachios, cherries, apricots and peaches go through a necessary winter dormant period brought on and maintained by colder temperatures. Tule fog, a thick ground fog that descends upon the state's Central Valley between late fall and early spring, helps contribute to this winter chill.

CRITICAL FACILITIES

Fog can have devastating effects on transportation corridors in the County. Multi-car pileups have resulted from drivers using excessive speed for the conditions and visibility.

These accidents can cause multiple injuries and deaths and could have serious implications for human health and the environment if a hazardous or nuclear waste shipment were involved. Other disruptions from fog include delayed emergency response vehicles and school closures.

[17] Safe Driving Tips for Foggy Conditions | Caltrans https://dot.ca.gov/caltrans-near-me/district-3/d3-news/d3-news-release-23-137

FUTURE DEVELOPMENT

Population and commercial growth in the County will increase the potential for complications with traffic accidents and commerce interruptions associated with dense fog.

VULNERABILITY TO SEVERE WEATHER: HEAVY RAIN/THUNDERSTORM/HAIL/LIGHTNING/WIND (LOW)

Many hazardous weather events are associated with thunderstorms. Under the right conditions, rainfall from thunderstorms causes flash flooding, killing more people each year than hurricanes, tornadoes or lightning. Lightning is responsible for many fires around the world each year, and it can cause fatalities. Hail up to the size of softballs damages cars and windows and kills crops and livestock caught out in the open. Strong (up to more than 120 mph) straight-line winds associated with thunderstorms knock down trees, power lines and mobile homes.[18]

PEOPLE

Exposure is the greatest danger to people from severe thunderstorms. People can be hit by lightning, pelted by hail, and caught in rising waters. Serious injury and loss of human life is rarely associated with hailstorms.

While national data shows that lightning causes more injuries and deaths than any other natural hazard except extreme heat, there doesn't seem to be any trend in the data to indicate that one segment of the population is at a disproportionately high risk of being directly affected. Anyone who is outside during a thunderstorm is at risk of being struck by lightning. Aspects of the population who rely on constant, uninterrupted electrical supplies may have a greater, indirect vulnerability to lightning. As a group, the elderly or disabled, especially those with home health care services relying on rely heavily on an uninterrupted source of electricity. Resident populations in nursing homes, residential facilities, or other special needs housing may also be vulnerable if electrical outages are prolonged. If they do not have a back-up power source, rural residents, and agricultural operations reliant on electricity for heating, cooling, and water supplies are also especially vulnerable to power outages. Thunderstorms have the potential energy and strong winds to topple dead trees and injure people.

PROPERTY

Based on historical information, the primary effect of these storms has not resulted in significant injury or damage to people and property, or the losses are typically covered by insurance. It is the secondary hazards caused by weather, such as floods, that have had the greatest impact on the County.

NATURAL ENVIRONMENT

Severe thunderstorms are a natural environmental process. Environmental impacts include the sparking of potentially destructive wildfires by lightning and localized flattening of plants and crops by hail. As a natural process, the impacts of most severe thunderstorms by themselves are part of the overall natural cycle and do not cause long-term consequential damage.

CRITICAL FACILITIES

Because of the unpredictability of severe thunderstorm strength and path, most critical infrastructure that is above ground is equally exposed to the storm's impacts. Secondary impacts from these storms may include power outages which could significantly impact critical facilities and emergency services.

[18] Severe Weather 101: Thunderstorm Basics (noaa.gov) https://www.nssl.noaa.gov/education/svrwx101/thunderstorms/

FUTURE DEVELOPMENT

New critical facilities, such as communication towers should be built to withstand heavy rain, monsoon, and hail damage. Future development projects should consider severe weather hazards at the planning, engineering and architectural design stage with the goal of reducing vulnerability. Stormwater master planning and site review should be considered for all new development. Thus, development trends in the County are not expected to increase overall vulnerability to the hazard, but population growth will increase potential exposure to hazards such as lightning.

VULNERABILITY TO SEVERE WEATHER: WINTER STORM (MEDIUM)

Winter storms can be dangerous from high winds, frigid temperatures, and precipitation (snow, sleet or freezing rain). These conditions can cause dangerous conditions on roads, physical illnesses such as hypothermia, and cause other weather-related injuries. Additionally, such extreme winter storms can disrupt critical facilities and services for a period of time.

PEOPLE

While virtually all aspects of the population are vulnerable to severe winter weather, there are segments of the population that are more vulnerable to the potential indirect impacts of a severe winter storm than others, particularly the loss of electrical power. If they do not have a back-up power source, rural residents reliant on electricity for heating and water supplies are also especially vulnerable to power outages. As a group, the elderly or disabled, especially those with home health care services that rely heavily on an uninterrupted source of electricity. Resident populations in nursing homes, residential facilities, or other special needs housing may also be vulnerable if electrical outages are prolonged. Additionally, those populations experiencing homelessness are at greater risk of winter storms due to the exposure from lack adequate shelter. Supportive services for these populations should be provided during a winter storm event.

Public education efforts may help minimize the risks to future populations by increasing knowledge of appropriate mitigation behaviors, clothing, sheltering capacities, and decision-making regarding snow totals, icy roads, driving conditions, and outdoor activities (all of which are contributors to decreased public safety during severe winter storms.) Previous winter storm events have caused a number of fatalities and injuries.

New establishments or increased populations who are particularly vulnerable to severe winter storms (such as those with health concerns or those who live in communities that may be isolated for extended periods of time due to the hazard) should be encouraged to maintain at least a 72-hour self-sufficiency as recommended by FEMA. Encouraging contingency planning for businesses may help alleviate future economic losses caused by such hazards while simultaneously limiting the population exposed to the hazards during commuting or commerce-driven activities.

PROPERTY

Winter storms can cause significant impacts to property from buildings to homes from snowfall and ice. Extreme temperatures from a winter storm can cause damage to pipes and can lead to leaks and flooding within interior spaces. Depending on the amount of snow and structural quality of roofs, snowfall can cause damage to roofs and in severe cases, collapse. Loose branches can drainpipes and damage guttering and roofs as well. In attention to homes, vehicles can be damaged from winter storms from car crashes and debris if storms are accompanied by strong winds. Previous winter storm events have caused vehicle accidents, and damage from fallen trees on homes, cabins, and outbuildings totaling over couple hundred thousand dollars.

NATURAL ENVIRONMENT

Natural resources may be damaged by the severe winter weather, including broken trees and death of wildlife. Unseasonable storms may damage or kill plant, crops, and wildlife, which may impact natural food chains until the next growing season. Most of these impacts would be short-term.

CRITICAL FACILITIES

Because of the unpredictability of severe winter storm strength and path, most critical infrastructure that is above ground is equally exposed to the storm's impacts. However, it is important that critical facilities are prepared and braced for disruption from winter storms. For example, winter storms can cause power outages and critical facilities should have backup power sources for such events to continue operations and services. Additionally, roads are especially susceptible to the effects of a winter storm and can be significantly damaged, causing car accidents and road closures.

FUTURE DEVELOPMENT

Future residential or commercial buildings in locations that receive large amounts of snow each year should be built to be able to withstand snow loads from severe winter storms. Jurisdictions within Sierra National Forest like Lakeshore, Big Creek, Cedar Grover and Rock Haven may benefit from taking these precautions. Population growth in these areas and growth in visitors will increase problems with road, business, and school closures, and increase the need for snow removal and emergency services related to severe winter weather events. Development in the County will increase the number of vehicles and persons vulnerable to this hazard.

VULNERABILITY TO SEVERE WEATHER: TORNADOES (MEDIUM)

PEOPLE

Populations are the most vulnerable to tornados. The availability of sheltered locations such as basements, buildings constructed using tornado-resistant materials and methods, and public storm shelters, all reduce the exposure of the population. However, there are also segments of the population that are especially exposed to the indirect impacts of tornadoes, particularly the loss of electrical power. These populations include the elderly or disabled, especially those with medical needs and treatments dependent on electricity. Nursing homes, Community Based Residential Facilities, and other special needs housing facilities are also vulnerable if electrical outages are prolonged since backup power generally operates only minimal functions for a short period of time.

Based on previous occurrences, there have been 60 recent tornadoes events in Fresno County ranging from EF0-EF2. According to the NOAA Storm Events Database, there have been zero deaths and six injuries.

PROPERTY

General damages are both direct (what the tornado physically destroys) and indirect, which focuses on additional costs, damages and losses attributed to secondary hazards spawned by the tornado, or due to the damages caused by the tornado. Depending on the size of the tornado and its path, a tornado is capable of damaging and eventually destroying almost anything. Construction practices and building codes can help maximize the resistance of the structures to damage.

Secondary impacts of tornado damage often result from damage to infrastructure. Downed power and communications transmission lines, coupled with disruptions to transportation, create difficulties in reporting and responding to emergencies. These indirect impacts of a tornado put tremendous strain on a community. In the immediate aftermath, the focus is on emergency services. Based on previous occurrences, there have been over 10 million dollars in property damage.

There are over eight million mobile homes in the United States and according to a 2018 study, mobile home residents are at increased risk to tornado impacts, injury, and mortality partly because these structures are inadequate to withstand tornadic winds. The likelihood of a tornado-related fatality in a mobile home is 15 to 20 times greater than in permanent homes. In Fresno County, there are several mobile homes in the jurisdiction and would be an increased risk for tornado impacts. [19] Recently, in March 2024, An EF3 tornado pummeled through Indian Lakes, Ohio, which is heavily occupied by mobile homes. Several deaths and injuries occurred, and a Mass Casualty Incident (MCI) was declared. Nationwide, about 53% of all people killed at home by a tornado between 1996 and 2023 were killed in mobile and manufactured homes according to an AP analysis National Oceanic and Atmospheric and Administration data. [20]

[19] Severe Storm, Supercell, and Tornado Trends | Climate Central https://www.climatecentral.org/climate-matters/severe-storm-supercell-and-tornado-trends-2023

[20] Indian Lake tornadoes expose vulnerability of mobile homes (desmoinesregister.com) https://www.desmoinesregister.com/story/news/state/2024/03/17/indian-lake-tornados-expose-vulnerability-of-mobile-homes/72984880007/

NATURAL ENVIRONMENT

Tornadoes can cause massive damage to the natural environment, uprooting trees and other debris. This is part of a natural process, however, and the environment will return to its original state in time.

CRITICAL FACILITIES

Public gathering places including (but not limited to) schools, community centers, shelters, nursing homes and churches, may have increased impacts at certain times of day if struck by a tornado. Tornados have the potential to cause major disruptions to critical facilities and services, all critical facilities are at risk as the direction and path of a tornado is not particularly more likely to occur in one area of the city to another. Tornado can cause power outages, disrupt communications, damage schools, and government facilities. Debris from the tornado can block and damage major highways and roads, which can make it difficult for emergency services to reach people in need of medical assistance.

FUTURE DEVELOPMENT

As the County continues to increase in population, the number of people and housing developments exposed to the hazard increases. Proper education on building techniques and the use of sturdy building materials, basements, attached foundations, and other structural techniques may minimize the property vulnerabilities. Public shelters at parks and open spaces may help reduce the impacts of tornadoes on the recreational populations exposed to storms.

VULNERABILITY TO SOIL HAZARDS: EROSION (LOW)

Erosion is the geological process in which earthen materials are worn away and transported by natural forces such as wind or water.

PEOPLE

Erosion generally only damage structures, with no direct impacts on people.

PROPERTY

While impacts are slow to accumulate, costly damage to residences, facilities, roads, and other infrastructure could occur. Erosion occurs over a long period of time, though weather and other climatic factors can catalyze the magnitude of impact. Properties near construction sites are the most vulnerable to erosion, followed by structures on/near steep slopes, disturbed pits/quarries, and runoff channels.

NATURAL ENVIRONMENT

There are generally no significant impacts to the natural environment associated with erosion.

CRITICAL FACILITIES

Roads, pipelines and facilities can be impacted but significant impacts are not anticipated.

FUTURE DEVELOPMENT

Erosion controls such as silt fences, netting, and vegetative coverage can be utilized to minimize soil erosion around at-risk properties. During construction, erosion risk can be reduced through the use of paved roads and runoff control features, while vegetation removal should be minimized, and drainage ditches constructed only where necessary.

VULNERABILITY TO SOIL HAZARDS: EXPANSIVE SOILS (LOW)

Expansive soils are those with excessive swelling clay minerals such as montmorillonite. The presence of expansive clay minerals in soils can cause excessive swelling when the soil comes into contact with water and also shrinkage when it undergoes drying.

PEOPLE

No direct impacts on people are anticipated. Should an impact occur, it is anticipated to be localized.

PROPERTY

While impacts are slow to accumulate, costly damages property could occur. The majority of the hazard's significance is drawn from the exposure of existing development to this hazard. Older construction may not be resistant to the swelling soil conditions and, therefore, may experience expensive and potentially extensive damages. This includes heaving sidewalks, structural damage to walls and basements, the need to replace windows and doors, or dangers and damages caused by ruptured pipelines. Newer construction may have included mitigation techniques to avoid most damage from the hazard, but the dangers continue if mitigation actions are not supported by homeowners. For example, the maintenance of grading away from foundations and the use of appropriate landscaping near structures must be continued to prevent an overabundance of water in vulnerable soils near structures. While continued public education efforts may help increase compliance for landscaping and interior finishing mitigation actions, physical reconstruction of foundations is probably not feasible in all but the most heavily impacted of existing development. Therefore, damages may be expected into the future for existing structures.

CRITICAL FACILITIES

Roads, pipelines and facilities can be impacted but significant impacts are not anticipated.

NATURAL ENVIRONMENT

No significant impacts are anticipated.

FUTURE DEVELOPMENT

The recognition of expansive soils typically allows it to be mitigated in future development.

VULNERABILITY TO SOIL HAZARDS: LAND SUBSIDENCE (MEDIUM)

The majority of land subsidence is caused by groundwater pumping, which has been a significant within Fresno County and the greater San Joaquin Valley for decades. In fact, this area has one of the largest land subsidence rates, with more than 1 foot of land subsidence per year.

PEOPLE

Typically, this hazard results in property damage, not risk to human life.

PROPERTY

Subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. It can disrupt and alter the flow of surface or underground water. Weight, including surface developments such as roads, reservoirs, and buildings and manmade vibrations from such activities as blasting or heavy truck or train traffic can accelerate natural processes of subsidence, or incur subsidence over manmade voids. Fluctuations in the level of underground water caused by pumping or by injecting fluids into the earth can initiate sinking to fill the empty space previously occupied by water or soluble minerals. Available data prevented further estimation of loss potential.

CRITICAL FACILITIES

Linear infrastructure (roads, buried pipelines) tends to have the most risk of land subsidence. Infrastructure at risk includes levees (which can lower their ability to contain flood flows), the California Aqueduct, and Interstate 5. Other buried infrastructure on the west side of the Valley could be at risk as well. Canals such as the mighty Friant-Kern, delivering water to farms along the valley's eastside, and the California Aqueduct to the westside farms and onto southern California, can shift, stopping water from following the designs of gravity downhill and preventing its efficient delivery.

NATURAL ENVIRONMENT

Typically, there is little impact to the natural environment from this hazard.

FUTURE DEVELOPMENT

The areas with the highest susceptibility to subsidence include the western edge of the Central Valley, where development trends have been slower than the more urbanized areas of the County. As such, vulnerability to this hazard is not anticipated to increase with new development, provided that land use planning and engineering practices are followed. Increased efforts to monitor and manage groundwater pumping, increased accuracy of mapping, and emphasis on appropriate grading and ground compaction during development will help alleviate vulnerability for future development in unknown areas of risk.

VULNERABILITY TO VOLCANOES (LOW)

The Mono Lake-Long Valley area located adjacent to the north and east of the northernmost areas of Fresno County is the only known volcanic hazard to Fresno County (shown in X). Because of the limited area affected and remote potential of an eruption, the significance is rated low. A more likely scenario would involve ash from a regional event which result in 2 or more inches across much of the mountainous region including Millerton Lake, Pine Flat Lake to the Sierra Nevada Mountains.

PEOPLE

While a remote possibility for Fresno County, volcanoes could have significant impacts on people. These include ash accumulation on the ground and in the air, that can affect the ability to breathe. More significant, though remote, could be the need to evacuate the area entirely, and a temporary or permanent relocation of large segments of the population.

PROPERTY

Volcanoes can cause two major types of impacts to the built environment. One type of impact has to do with the accumulation of ash and eruption debris on infrastructure, which needs to be removed. The other type of impact is direct impacts from lava flows and lahars, which can destroy buildings and infrastructure in their path. Due to the remote possibility of occurrence damage is not anticipated to be significant in the near future.

NATURAL ENVIRONMENT

Volcanoes can have significant impacts on the natural environment. The direct impacts of volcanoes can also destroy the landscape around the eruption – flattening trees, starting fires, moving debris and contaminating water sources. Volcanic eruptions can even affect the global climate. According to research conducted by NASA, after Mount Pinatubo in the Philippines erupted in 1991, strong winds spread the aerosol particles from the plume around the globe. The result was a measurable cooling of the Earth’s surface for a period of almost two years.

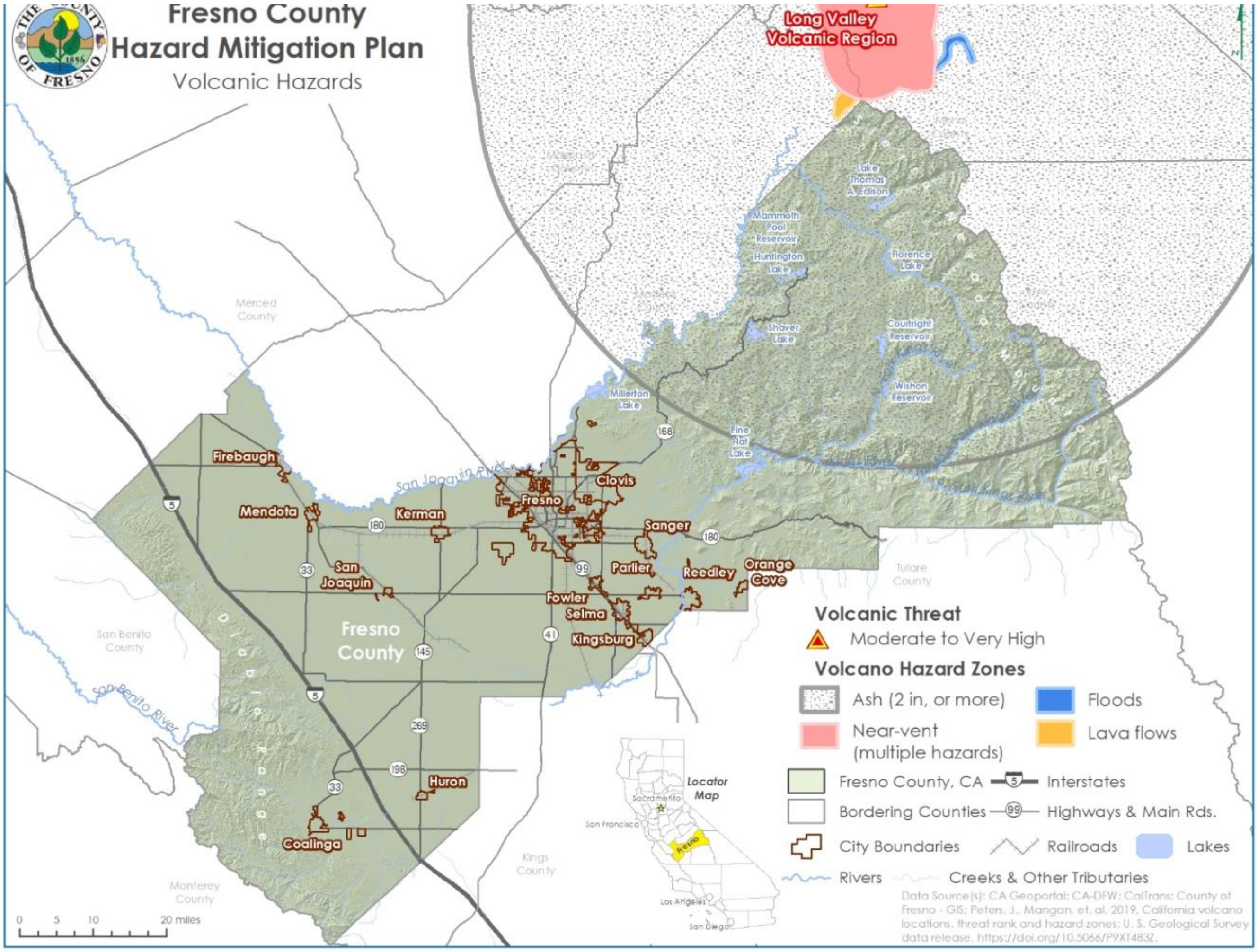
CRITICAL FACILITIES

Due to the low probability of this hazard and Mono Lake Valley Hazard Area stopping short of Fresno County jurisdictional boundaries, there are no critical facilities that are impacted. However, ash from the volcanic eruption could cause damage or disruption to critical services on the eastern side of the County.

FUTURE DEVELOPMENT

The Mono Lake-Long Valley area located adjacent to the north and east of the northernmost areas of Fresno County is the only known volcanic hazard to Fresno County. Development near the Valley is more at risk to volcanic ash than lava flow based on the lahar zone for the volcano. Destructive impacts of a volcanic eruption cannot be easily mitigated by building codes or smart construction.

Figure 74. Fresno County Long Valley Volcanic Region



Source: CA Geoportal; CA-DFW; CalTrans; County of Fresno – GIS; Peters, J., Mangan, et al, 2019, California volcano locations, threat rank and hazard zones: U.S. Geological Survey data release, https://doi.org//10.5066/P9XT483X

VULNERABILITY TO WILDFIRE (HIGH)

Fresno County planning area's wildfire risk and vulnerability is of significant concern, with some areas of the planning area being at greater risk than others as described further in this section. High fuel loads in the planning area, along with geographical and topographical features create the potential for both natural and human-caused fires that can result in loss of life and property. These factors, combined with natural weather conditions common to the area, including periods of drought, low relative humidity, and periodic winds, can result in frequent and sometimes catastrophic fires. Even the relatively flat and more urbanized area of central Fresno is not immune from fire. During the fire season, the dry vegetation and hot and sometimes windy weather combined with a denser population result in an increase in the number of ignitions.

Fresno County's wildfire vulnerability is the result of increased development encroaching into forested and annual grassland areas, typically referred to as the wildland-urban interface. As development continues throughout the planning area, especially in the interface, the risk and vulnerability to wildfires will likely increase. Two fire safe councils have been created to address this increased wildfire threat in the wildland-urban interface: Highway 168 and Oak to Timberline fire safe councils.

PEOPLE

Wildfires can be deadly to populations and pose a risk to public health. However, in the planning area, it is more likely that the planning area will be impacted by poor air quality driven by wildfire smoke from near wildfires in the county or state. However, if a wildfire were to impact the planning area, the below section outlined possible impacts to the population.

Public Health

Evacuation

Communities may need to evacuate their homes in order to remove themselves from the direct path of the wildfire. However, some individuals may not have the resources or access to emergency information in order to evacuate. Unfortunately, in some cases, there may not be enough warning time for communities to evacuate even if they have the resources to evacuate before the wildfire burns through. Populations that may have difficulty, may not have the resources, or may experience barriers to evacuation, include but are not limited to:

- Rural communities
- Individuals with disabilities
- Individuals with limited English proficiency
- Individuals with limited or no access to the internet or emergency information
- Individuals with no access to personal transportation
- Older adults

Additionally, individuals and communities may not be aware of shelters to evacuate to or have friends or family to stay with during the evacuation.

Wildfire Smoke and Poor Air Quality

Particulate matter from wildfire smoke can worsen air quality and cause adverse health effects to population health. Wildfire exposes communities to multiple environmental hazards from combustion due to the fire itself to air pollution from smoke and byproducts of combustion and ash. Approximately 90 percent of total particle mass emitted from wildfires consists of fine particles (i.e., PM2.5). Impacts of poor air quality from wildfire smoke include the following:

- Eye and respiratory tract irritation
- Reduced lung function
- Bronchitis
- Exacerbation of asthma
- Heart failure
- Premature death
- Aggravation of pre-existing respiratory and cardiovascular disease
- Persistent cough, phlegm, wheezing, and difficulty breathing

The Air Quality Index (AQI) measures the severity of air quality and is broken down into 6 categories to communicate the level of health concern for public health, shown in the table below.

Table 154. Air Quality Index

Air Quality Index Levels of Health Concern	Numerical Value	Description
Good (Green)	0 to 50	Air quality is considered satisfactory, and air pollution poses little or no risk.
Moderate (Yellow)	51 to 100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups (Orange)	101 to 150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy (Red)	151 to 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy (Light Purple)	201 to 300	Health alert; everyone may experience more serious health effects.
Hazardous (Dark Red)	301 to 500	Health warnings of emergency conditions. The entire population is more likely to be affected.

Source: AQI

The majority of healthy adults and children will recover quickly from wildfire smoke exposure and poor air quality and will not experience long-term health consequences. However, certain at-risk populations may be at greater risk of experiencing severe acute and chronic symptoms which include individuals with asthma and other lung disease, children, older adults, individuals experiencing homelessness and outdoor workers. [21]

Air pollution in and around western parts of Fresno County are already elevated due to cars, trucks, factories, and other activities in the area. Based on the CalEnviroScreen, Western Fresno County has the highest percentile in PM2.5 and ozone.

Wildfire Vulnerability on Population

The historical and potential impacts of wildfire on populations include threat of injury or death, possible agricultural sector job loss, secondary economic losses to businesses located in the wildland-urban interface and within or near wildland resources like parks and national forests, and loss of public access to recreational resources. Fire suppression may also require increased cost to local and state government for water acquisition and delivery, especially during periods of drought when water resources are scarce. With the population moving to the foothills, road and home construction is increasing, therefore, more people will be at risk to wildfires.

The data and mapping demonstrate variations in vulnerability (population, population growth and density) across jurisdictions, and enables the analysis to identify the location of each jurisdiction relative to its risk zone on the wildfire risk map. Other at-risk populations include the location of the County's wildland recreational areas where persons might be located during a wildfire event, such as state and national parks and forests.

Wildfire risk is of greatest concern to populations residing in the moderate, high, and very high wildfire threat zones. GIS was used to estimate populations within the hazard zones, based on the residential parcels with improvements in the wildfire threat zones. Results are shown by census tract in **Table 155. Populations at Risk of Wildfire: Fresno County Planning Area.** Census tracts do not always adhere to local boundaries; if a census tract was completely within a city boundary or unincorporated Fresno County it was labeled as such in the following tables. If a tract intersected more than one jurisdiction, all jurisdictions within the tract were labeled in the following tables.

Table 155. Populations at Risk of Wildfire: Fresno County Planning Area

Jurisdiction(s)	Wildfire Hazard Severity Zones		
	Moderate	High	Very High
Clovis; Fresno; Unincorporated Fresno County	167	0	0
Clovis; Unincorporated Fresno County	2,494	2,070	827
Coalinga; unincorporated Fresno County	1,411	4,064	1,935

[21] WILDFIRE SMOKE: A GUIDE FOR PUBLIC HEALTH OFFICIALS (airnow.gov) https://www.airnow.gov/sites/default/files/2021-05/wildfire-smoke-guide-revised-2019-chapters-1-3.pdf

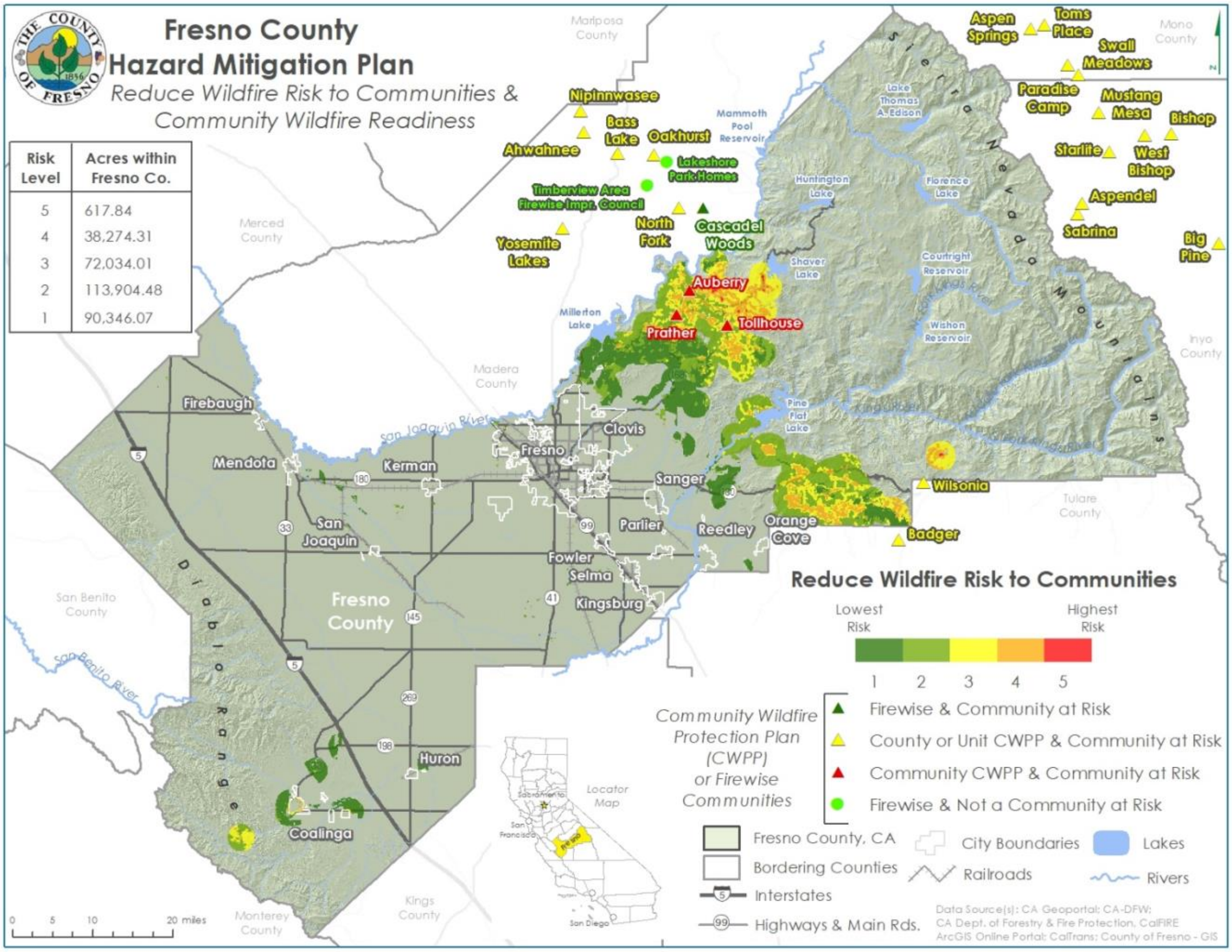
Huron; Unincorporated Fresno County	168	267	0
Mendota; Unincorporated Fresno County	316	762	67
Reedley; Unincorporated Fresno County	135	68	0
Unincorporated Fresno County	687	4,125	2,947
Totals	**5,378**	**11,356**	**5,775**

Sources: California Department of Forestry and Fire Protection and Fresno County data

In another assessment of community vulnerability, the 2010 FRAP assessment utilized the Priority Landscape unit of analysis and defined it as the convergence of areas with high wildfire threat and human infrastructure assets. The analytical framework follows the same pattern of aligning threats with key assets to define the priority landscape. In this case, the threat is specific to the nature of fire that can cause significant losses to human infrastructure, personal property and pose a risk to public safety. These risk areas are shown in **Figure 75. Fresno County Wildland Urban Interface (WUI) Zones.**

Source: CA Geoportal; CA-DFW; CA Department of Forestry and Fire Protection, CalFIRE ArcGIS Online Portal; CalTrans; County of Fresno - GIS

Figure 75. Fresno County Wildland Urban Interface (WUI) Zones



Source: CA Geoportal; CA-DFW; CA Department of Forestry and Fire Protection, CalFIRE ArcGIS Online Portal; CalTrans; County of Fresno - GIS

PROPERTY

The historical and potential impacts of wildfire on property include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings located throughout the wildfire risk area, with greatest potential impact on property, buildings and infrastructure located within high and very high hazard zones including the urban-wildland interface, and buildings and infrastructure located within forested lands, including (but not limited to) national forests and parks. With the population moving to the foothills, road and home construction is increasing, therefore, more properties and structures are likely at risk and will continue to be at risk if wildfire mitigation actions are not initiated.

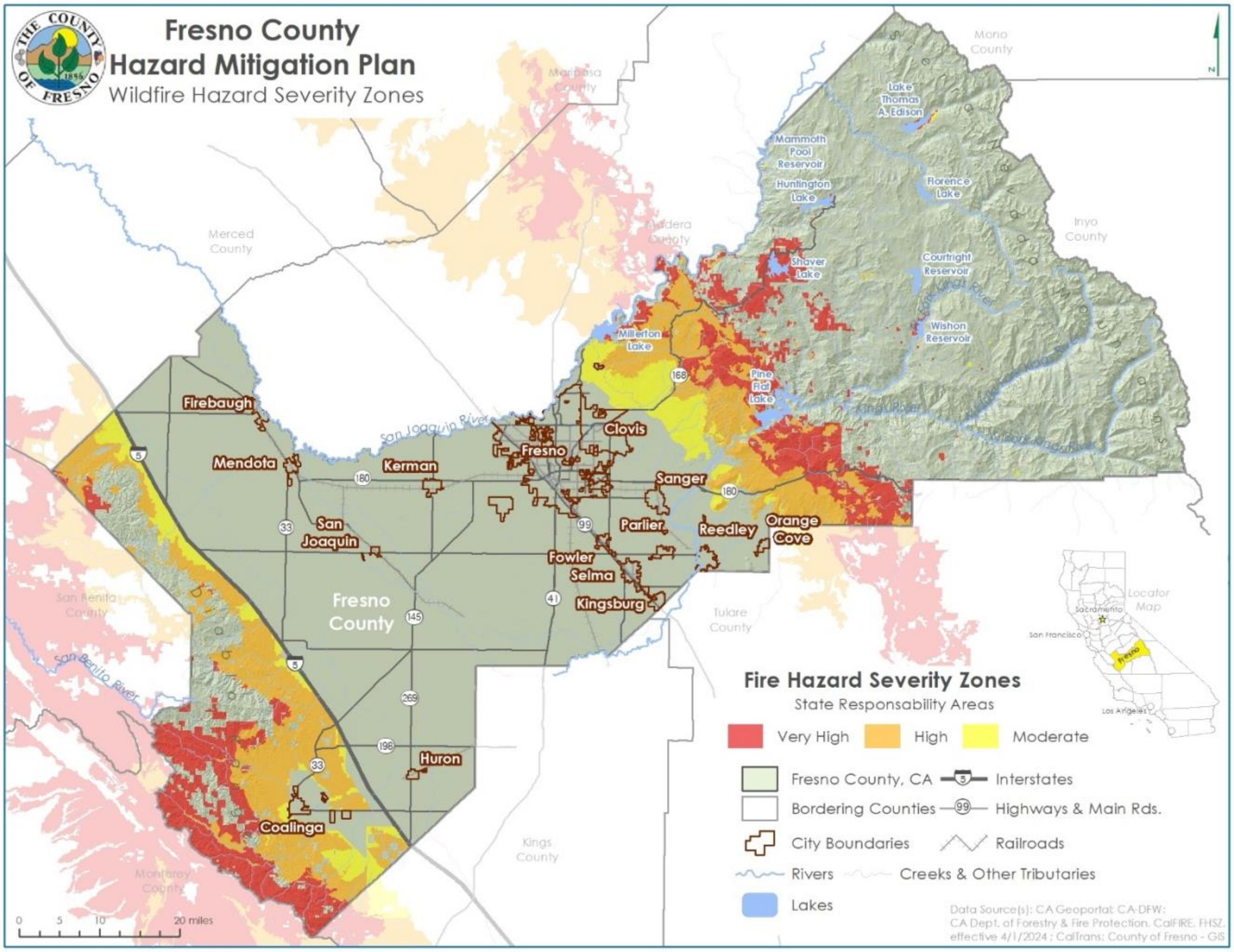
METHODOLOGY

Using CAL FIRE's Fire Hazard Severity Zones (FHSZ), an assessment of wildfire risk in the Fresno County planning area. GIS was used to create a centroid, or point, representing the center of each parcel polygon, which was overlaid on the wildfire layer. For the purposes of this analysis, the wildfire hazard zone that intersected the centroid was assigned as the hazard zone for the entire parcel. For purposes of this analysis, it was assumed that every parcel with an improved value greater than zero was developed in some way. Only improved parcels and the value of their improvements were analyzed. The wildfire data was acquired from the CAL FIRE Fire and Resource Assessment Program; the layer used was the Fire Hazard Severity Zones, Very High zones in LRA.

The results are summarized in the tables and maps that follow. The Community Wildfire Threat used in this analysis was derived from a new and unique spatial dataset, Fire Hazard Severity Zones (FHSZ). This dataset was explicitly built for adopting new ignition-resistant building code standards and adopted by the California Building Commission in 2007. It is constructed to describe the nature and probability of fire exposure to structures, including those lands that are highly urbanized, but in close proximity to open wildlands (WUI). Details of the FHSZ mapping project are available on the FRAP website.

As the following **Figure 76. Fresno County Wildfire Hazard Severity Zones** illustrates that there is a significant fire hazard in the eastern and far western portions of the County. The majority of the structures in the WUI are in the Sierra foothills region.

Figure 76. Fresno County Wildfire Hazard Severity Zones



Source: CA Geoportal; CA-DFW; CA Department of Forestry and Fire Protection, CalFIRE, ArcGIS Online Portal; CalTrans; County of Fresno - GIS

Once the number of parcels and their values were determined, contents values were estimated (based on HAZUS inventory data) to determine total values at risk by hazard zone. Overlaying the fire hazard severity zone map with the County parcel layer, it is evident that the Fresno County planning area has significant assets at risk to wildfire. Further information on the parcels, buildings, and values at risk to wildfire are provided in **Table 156. Parcels, Buildings, and Values at Risk from Wildfire by Severity** and **Table 157. Parcels, Buildings, and Values at Risk from Wildfire by Property Type**.

Table 156. Parcels, Buildings, and Values at Risk from Wildfire by Severity

Fire Severity Type	Parcel Count	Building Count	Improved Value	Content Value	Total Value
Very High	10,500	7,010	$274,775,201	$143,167,719	$418,147,320
High	9,416	8,481	$129,022,493	$164,156,078	$293,277,381
Moderate	2,947	1,717	$49,694,149	$35,718,516	$85,412,665
Total	**22,863**	**17,208**	**$453,491,843**	**$343,042,313**	**$796,837,366**

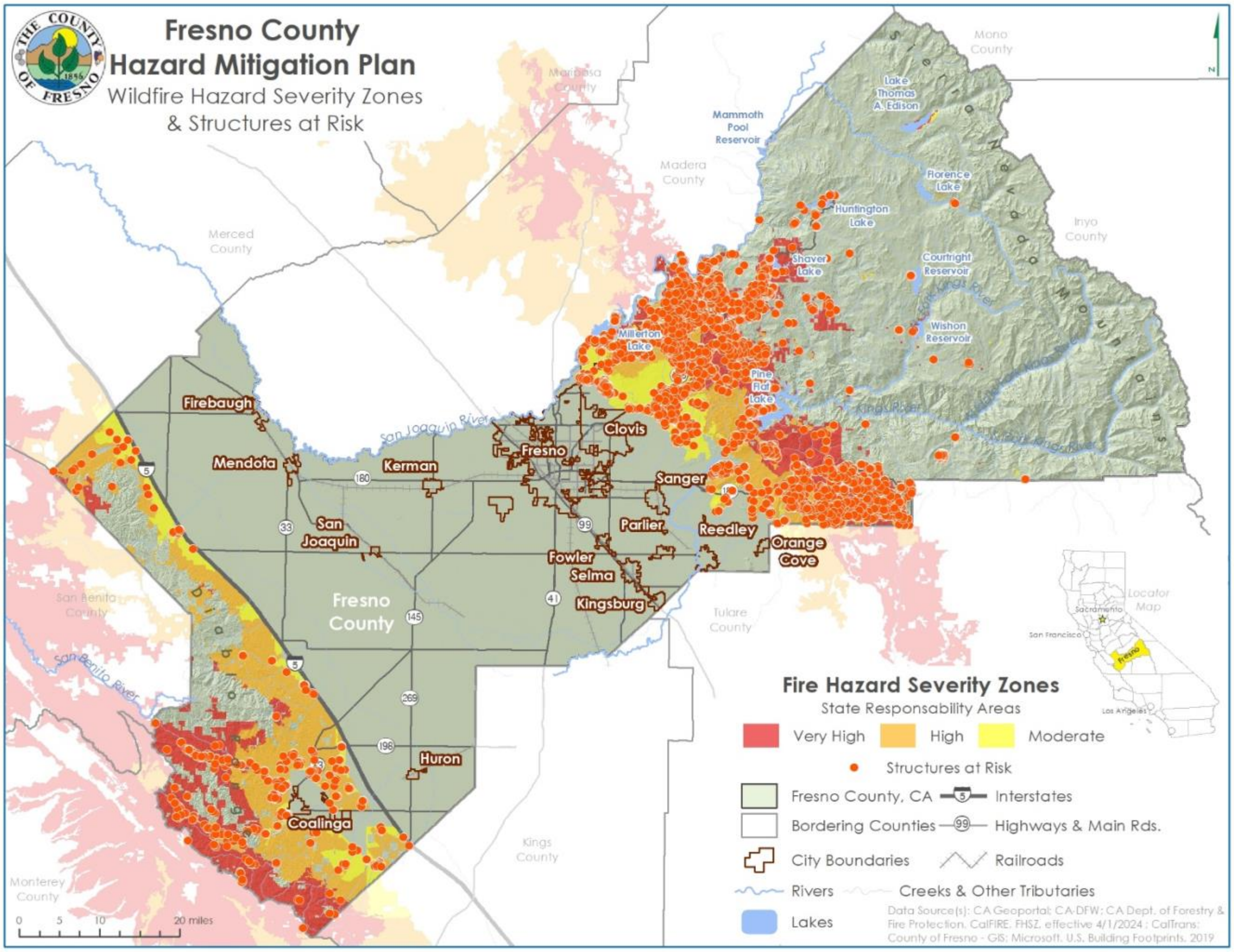
Table 157. Parcels, Buildings, and Values at Risk from Wildfire by Property Type

Fire Severity Type	Property Type	Parcels	Building Count	Improved Value ($)	Land Value ($)	Total Assessor Value ($)
Moderate	Agricultural	160	14	$17,741,004	$17,391,307	$35,132,311
	Apartments	0	0	$0	$0	$0
	Church	0	0	$0	$0	$0
	Commercial	0	0	$0	$0	$0
	Industrial	0	0	$0	$0	$0
	Office/ Professional Space	0	0	$0	$0	$0
	Outlot & Common Area	0	0	$0	$0	$0
	Primary Use Not Designated	35	4	$0	$0	$0
	Recreation	0	0	$0	$0	$0
	Single-Family Residence	95	160	$31,619,174	$14,726,259	$46,345,433
	Vacant	220	4	$333,971	$3,600,950	$3,934,921
	Unknown	2,437	1,535	$0	$0	$0
	Total	**2,947**	**1,717**	**$49,694,149**	**$35,718,516**	**$85,412,665**
High	Agricultural	305	146	$29,695,292	$22,652,828	$52,391,620
	Apartments	1	2	$15,767	$68,325	$84,092
	Church	2	5	$597,244	$97,745	$694,989
	Commercial	6	6	$6,088,420	$1,052,563	$7,144,393
	Industrial	30	32	$47,971,460	$104,774,399	$152,797,759

Fire Severity Type	Property Type	Parcels	Building Count	Improved Value ($)	Land Value ($)	Total Assessor Value ($)
	Office/ Professional Space	2	4	$201,468	$21,246	$222,714
	Outlot & Common Area	0	0	$0	$0	$0
	Primary Use Not Designated	90	36	$0	$0	$0
	Recreation	1	1	$12,734	$15,664	$28,398
	Single-Family Residence	395	674	$43,729,477	$23,564,953	$67,294,430
	Vacant	993	65	$710,631	$11,908,355	$12,618,986
	Unknown	7,591	7,510	$0	$0	$0
	Total	**9,416**	**8,481**	**$129,022,493**	**$164,156,078**	**$293,277,381**
Very High	Agricultural	486	235	$8,353,374	$17,806,161	$26,159,535
	Apartments	0	0	$0	$0	$0
	Church	1	1	$245,547	$115,092	$360,639
	Commercial	1	1	$25,506	$11,295	$36,801
	Industrial	3	0	$)	$30,501	$30,501
	Office/ Professional Space	0	0	$0	$0	$0
	Outlot & Common Area	8	8	$0	$1,012	$1,012
	Primary Use Not Designated	201	68	$0	$0	$0
	Recreation	5	4	$283,951	$447,894	$731,845
	Single-Family Residence	577	311	$264,346,339	$82,162,231	$346,508,570
	Vacant	547	132	$1,520,484	$42,593,533	$44,318,417
	Unknown	8,671	6,250	$0	$0	$0
	Total	10,500	7,010	$274,775,201	$143,167,719	$418,147,320

Sources: Fresno County Assessor's Office; California Department of Forestry and Fire Protection

Figure 77. Fresno County Wildfire Hazard Severity Zones & Structure at Risk



Source: CA Geoportal; CA-DFW; CA Department of Forestry & Fire Protection, CalFIRE, FHSZ, effective 4/1/2024; CalTrans; County of Fresno —GIS; Microsoft, U.S. Building Footprints, 2019

NATURAL ENVIRONMENT: WILDFIRE POTENTIAL IMPACT TO ECOSYSTEMS

Natural resources are important to include in benefit-cost analyses for future projects and may be used to leverage additional funding for mitigation projects that also contribute to community goals for protecting natural resources. Awareness of natural assets can lead to opportunities for meeting multiple objectives. For instance, protecting watersheds will help maintain the quantity and quality of water, timber production and promote carbon sequestration.

Given the previous discussion on wildfire frequency and severity, research conducted as part of the 2010 FRAP Assessment brings to light the factors that shape the potential impact of wildfire events, namely the vulnerability characteristics of ecosystems, populations, buildings and infrastructure that lie within wildfire risk areas within the planning area and beyond.

With regard to ecosystems, **Figure 78. Defining Wildfire Priority Landscapes** shows the analytical framework for identifying the Priority Landscape to assess the risk and feed the mitigation strategy for dealing with preventing damage to ecosystems as a result of wildfire.

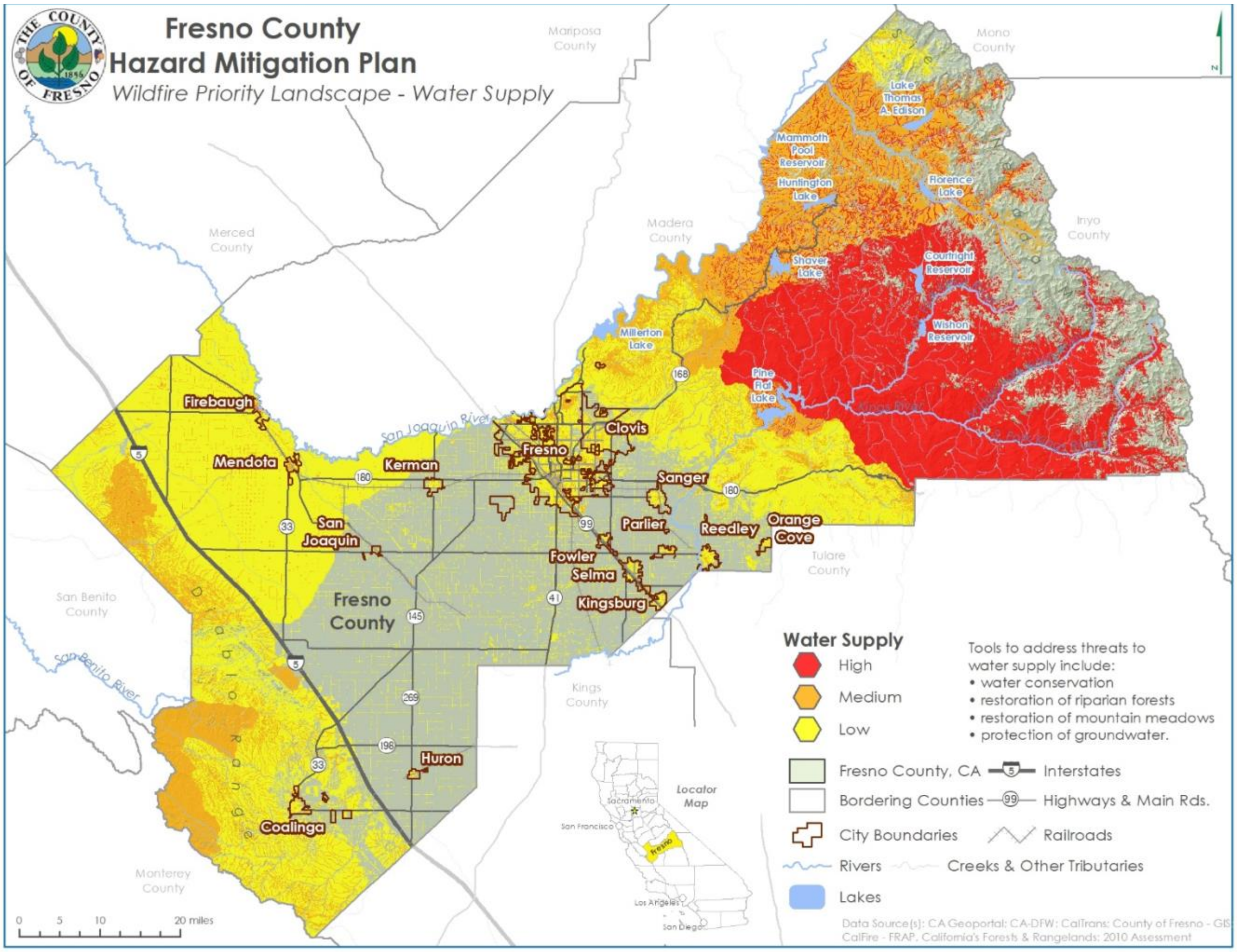
Figure 78. Defining Wildfire Priority Landscapes

In analyzing the threats, the Assessment defined a particular small area as a Stand-Level threat and is derived from FRAP's fire threat data compiled in 2004. It is based on fuel conditions, observed fire frequency and expected fire weather conditions.

The Landscape-Level wildfire threat attempts to capture the threat of damage to ecosystems at the landscape scale. This is derived by calculating the percentage of each vegetation type in each unique tree seed zone that is "unhealthy", based on being in a condition class that indicates significant deviation from historical fire regimes–specifically the proportion of a given ecosystem that is in either condition class two or three. This approach recognizes that stand-level threats have elevated importance if cumulatively they have potential to damage broader landscape-level ecosystems. A detailed discussion of the metrics can be found on the FRAP website (http://frap.fire.ca.gov/assessment2003/Chapter3_Quality/wildfire.html).

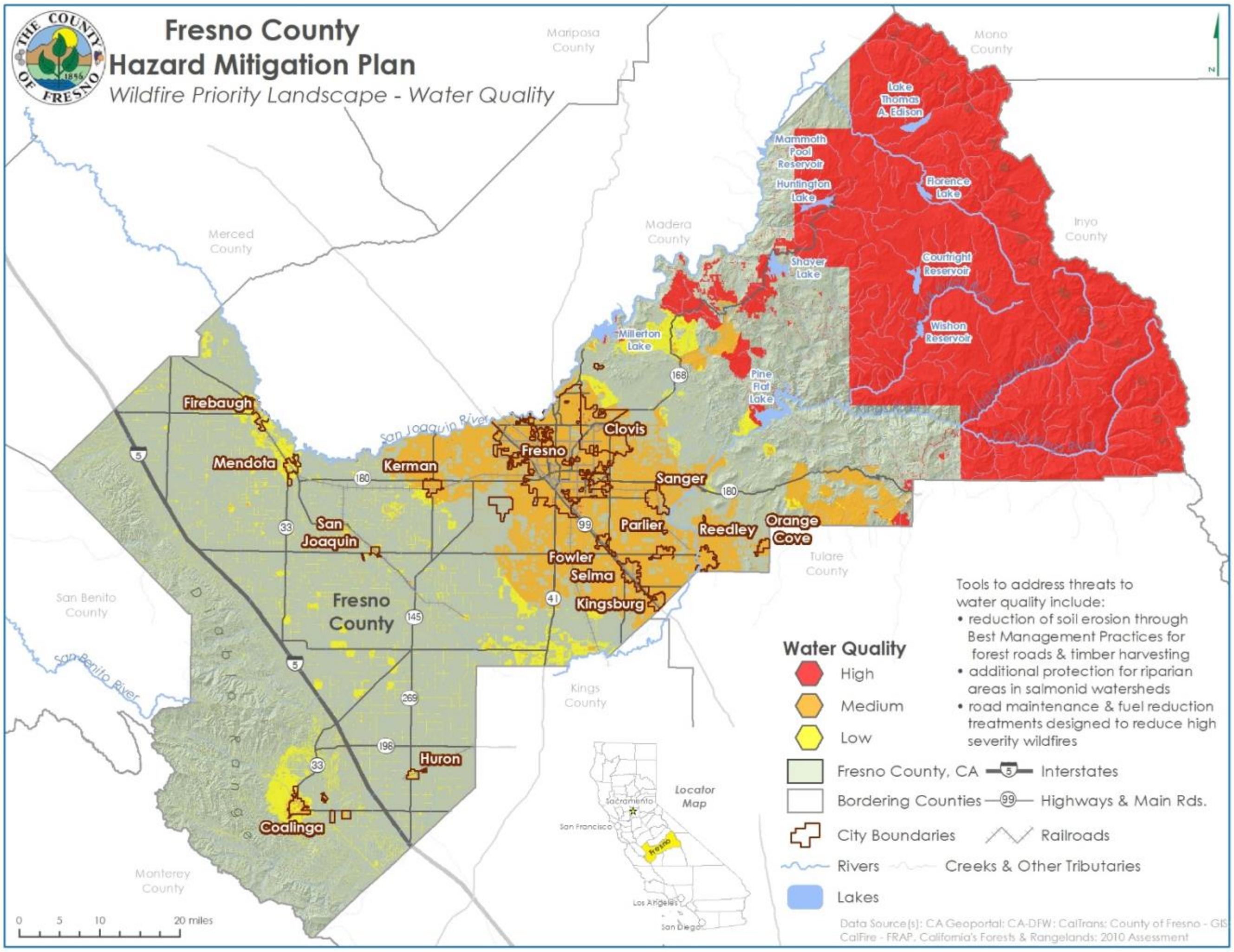
Overall, results of the Assessment indicate that Priority Landscape identifies priority areas within ecosystems that have high levels of threat from future fires, and should be viewed as a basic assessment of need for strategies and adoption of tools to protect these key areas in the future. It is constructed by combining stand- and landscape-level threats to create a composite threat map, and classifying the final product into low, medium, and high priority landscapes. The following maps depict the Assessment findings, showing Fresno County Wildfire Priority Landscapes based on threats to water supply and water quality. Trends in landscape characteristics indicate high threats to water quality and supply in the eastern portion of the County, in the Sierra Nevada region.

Figure 79. Fresno County Wildfire Priority Landscape - Water Supply



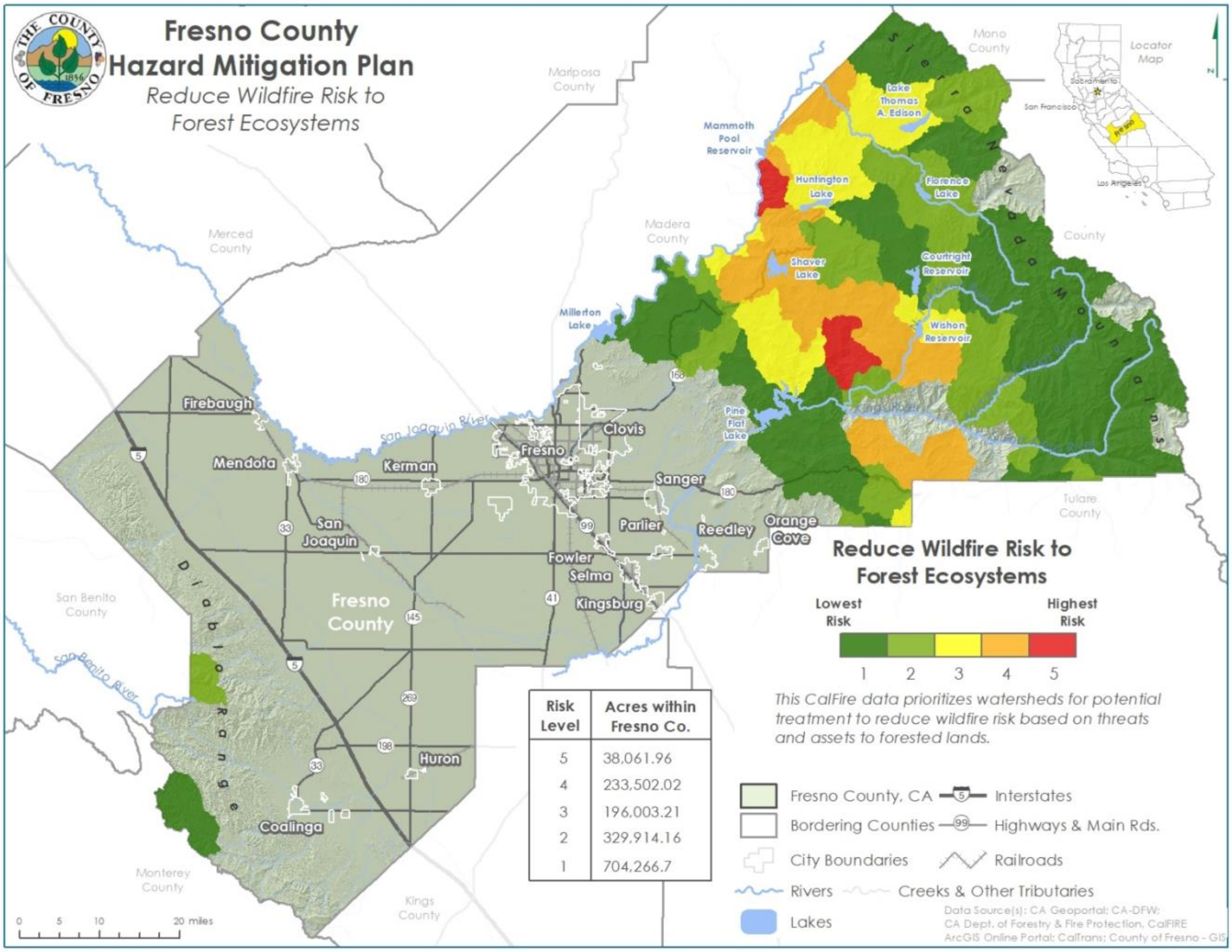
Source: CA Geoportal; CA-DFW; CalTrans; County of Fresno – GIS, CalFIRE – FRAP, California's Forests & Rangelands: 2010 Assessment

Figure 80. Fresno County Wildfire Priority Landscape - Water Quality



Source: CA Geoportal; CA-DFW; CalTrans; County of Fresno – GIS CalFire – FRAP, California's Forests and Rangelands: 2010 Assessment

Figure 81. Fresno County Reduce Wildfire Risk to Forest Ecosystems



Source: CA Geoportal; CA-DFW; CA Department of Forestry and Fire Protection, Cal FIRE ArcGIS Online Portal; CalTrans; County of Fresno - GIS

The Fresno County planning area has substantial cultural and natural resources located throughout the County as previously described. Wildfires also cause watershed and ecosystem losses. These losses include impacts to water supplies and water quality as well as air quality. Another loss is to the aesthetic value of the area. Major fires that result in visible damage detract from that value. Other natural resources at risk from wildfire include wildland recreation areas, wildlife and habitat areas, rangeland, and timber resources. The loss to these natural resources would be significant.

The historical and potential impacts of wildfire on the natural environment are widespread throughout public and private lands within the County, exacerbated by drought and tree mortality, with impacts to all flora and fauna, and the destabilization (erosion, subsidence) of land dependent on healthy plants and trees for stability.

The data and mapping captures the full range of vulnerable species, habitat types, biotic regions, parks and forests, and other environmental features within Fresno County. Also provided is each jurisdiction's location within these natural areas, and the location of both jurisdictions and natural areas/species relative the wildfire risk zones on the wildfire risk map. It should be noted that those species and natural zones most greatly affected by drought appear to be most vulnerable to wildfire. The history of drought and (pine) tree mortality locations (section 4.2.4, p. 25, 26) in the County highly correlates with the Very High hazard zone on the Wildfire Severity Map (Source: http://frap.fire.ca.gov/projects/projects_drought).

CRITICAL FACILITIES

Wildfire impacts to critical facilities include structural damage or destruction, risk to persons located within facilities, and interruption of facility operations and critical functions. Critical facilities are those community components that are most needed to withstand the impacts of disaster as previously described in Section 4.3.1. An analysis was performed using GIS software to determine where critical facilities are located within the wildfire threat zones. **Table 158. Critical Facilities at Risk to Wildfire by Hazard Class: Fresno County Planning Area** lists the critical facilities in the different wildfire hazard zones for the entire Fresno County planning area.

Table 158. Critical Facilities at Risk to Wildfire by Hazard Class: Fresno County Planning Area

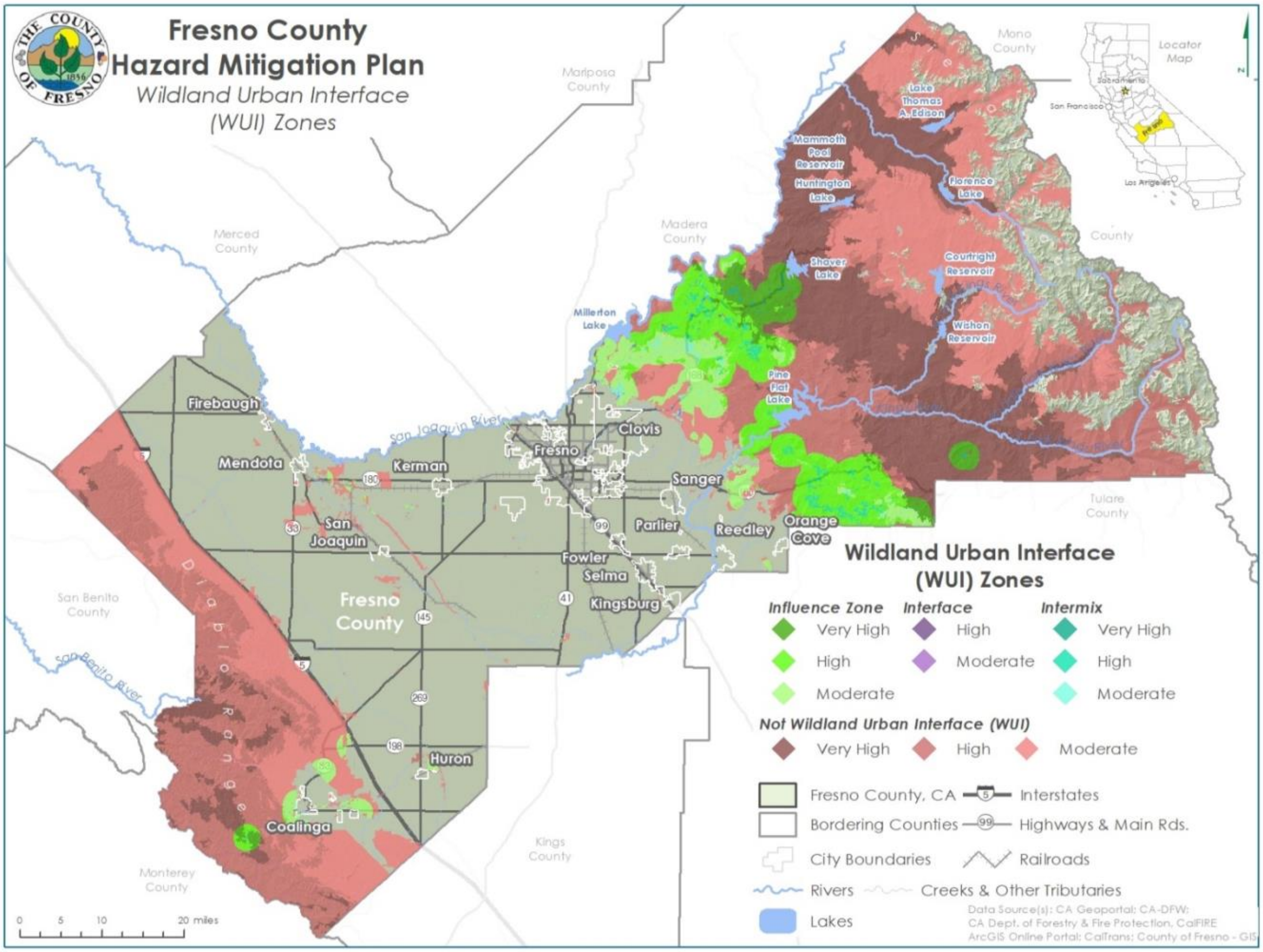
Jurisdiction	Fire Severity	Facility Type	Counts
Unincorporated	Very High	Communications Facilities	16
		Fire Stations	6
		Electric Power Facilities	4
		Schools	2
	High	Communications Facilities	2
		Fire Stations	7
		Electric Power Facilities	3
		Schools	**9**
	Moderate	Communications Facilities	3

Sources: Fresno County GIS, California Department of Forestry and Fire Protection

FUTURE DEVELOPMENT

Given that large, destructive fires continue to plague California communities (and Fresno County), recent research points out that such impacts are related to growth/land-use development and federal, state and local policy makers continue to expand the demarcations of the Wildland Urban Interface (WUI). Because future development encompasses all forms of property, buildings, infrastructure, critical facilities and all related populations and their functions, drought impacts to future development align with the historical and potential impacts to populations, property, natural environment, and critical facilities discussed (above). Population growth and development in Fresno County is on the rise. Additional growth and development within the WUI interface will continue to increase the risk and vulnerability of the planning area to damaging wildfires. However, the County has adopted policies to try and reduce damage to structures and people including, HS-A.G which states that new development should have adequate fire protection, including proximity to adequate emergency services, adequate provision for fire flow and emergency vehicle access and fire hardened communication, including high speed internet service.

Figure 82. Fresno County Wildland Urban Interface (WUI) Zones



Source : CA Geoportal ; CA-DFW ; CA Department of Forestry and Fire Protection, CalFIRE, ArcGIS Online Portal ; CalTrans ; County of Fresno - GIS

In general, continuing past trends, much development in Fresno County is projected on land currently used for agriculture.

Overall Community Impact

The overall impact to the community from a severe wildfire includes:

- Injury and loss of life;
- Commercial and residential structural damage;
- Decreased water quality in area watersheds;
- Increase in post-fire hazards such as flooding, sedimentation, and mudslides;
- Damage to natural resource habitats and other resources, such as timber and rangeland;
- Loss of water, power, roads, phones, and transportation, which could impact, strand, and/or impair mobility for emergency responders and/or area residents;
- Economic losses (jobs, sales, tax revenue) associated with loss of commercial structures;
- Negative impact on commercial and residential property values;
- Loss of churches, which could severely impact the social fabric of the community;
- Loss of schools, which could severely impact the entire school system and disrupt families and teachers, as temporary facilities and relocations would likely be needed; and
- Impact on the overall mental health of the community.

HUMAN-CAUSED HAZARDS

This risk assessment differs from the risk assessment for natural hazards in that it does not include an assessment of potential losses from human-caused hazards. Such an assessment is very difficult, primarily because of how unpredictable and complex such events are. Human-caused hazard events are often measured in terms such as human lives and economic disruption as well as the value of the facilities actually impacted. The value of impacted facilities is often negligible as compared to public health and human impacts as well as the and the economic impact of affected local, regional, national, and world markets. The unpredictability of human-caused hazard events creates a level of complexity in modeling potential losses which is often covered in other planning mechanisms and is well beyond the scope of this DMA planning effort.

The risk assessment process for human-caused hazards identifies the areas most susceptible to potential hazard events by evaluating which populations and facilities are most vulnerable to human-caused hazards. It is presented in two sections: Hazard Identification and Profiles: Human Caused-Hazards and Asset Inventory and Vulnerability Assessment.

HAZARD IDENTIFICATION AND PROFILES: HUMAN-CAUSED

Natural hazards, while essentially uncontrollable events, do follow the fundamental laws of earth science and physics. Therefore, the types, frequencies, and locations of many natural hazards can be identified and often predicted with a certain level of confidence. For example, within floodplains, it can be stated that in any given year there is a 1 percent chance of a flood event at a given discharge and flood depth that will be equaled or exceeded. These predictions are based on historical flood records combined with hydrologic and hydraulic modeling. In many cases, warning systems are in place to notify the public of a pending natural event. The same is not usually true for human-caused hazards.

With human-caused hazards, the recurrence interval cannot be predicted and human behaviors, such as incompetence, carelessness or malice cannot be forecast with any level of accuracy. While some warning systems have been established to notify at risk populations of impending threats from human-caused hazards, these types of hazards usually do not follow a predictable pattern. The potential exists for most types of human-caused hazards to occur anywhere at any time. Due to their unpredictability, human-caused hazards can pose great danger to public health and safety. Education, warning, and response capability are particularly important in preparing for human- caused incidents.

Human-caused hazards are hazards that directly result from human activity. These hazards can be accidental or intentional. FEMA guidance generally separates human-caused hazards into two broad categories: technological hazards (accidental) and terrorism hazards (intentional). The HMPC chose to only address technological hazards associated with a hazardous materials release in this plan.

HAZARDOUS MATERIALS INCIDENTS (LOW/MEDIUM/HIGH)

Hazardous Material Incidents usually result from accidents or system failures. These hazards are largely unforeseen and therefore are difficult to predict with any level of accuracy. Hazards of concern in Fresno County include fixed facility incidents and transportation incidents (these are discussed further below); in other words, facilities and operations that produce, transport, store, and/or use hazardous materials.

Hazardous materials are substances that are flammable or combustible, explosive, toxic, noxious, corrosive, reactive, an oxidizer, an irritant, carcinogenic, or radioactive. These materials can harm people through skin contact, inhalation, ingestion, or pharmaceutical action. Hazardous materials have the potential to be released into the environment during use, processing, storage, and transport or when improperly disposed. The release of a hazardous material can pose a risk to life safety, public health, and property and can result in the evacuation of a few people, a portion of a facility, or an entire area. Other concerns include impacts to air quality, water quality, and other short- and long-term impacts to the natural environment. As a result of these risks, the use, storage, transport, and disposal of hazardous materials is highly regulated at the federal, state, and local levels.

Hazardous materials are everywhere, and spills or releases occur in this nation on a daily basis. According to FEMA, the impact to life and property from any given release depends on a number of factors:

- Application Mode describes the human act(s) or unintended event(s) necessary to cause the hazard to occur.
- Duration is the length of time the hazard is present on the target.
- The dynamic/static characteristic of a hazard describes its tendency, or that of its effects, to either expand, contract, or remain confined in time, magnitude, and space.
- Mitigating conditions are characteristics of the target and its physical environment that can reduce the effects of a hazard.
- Exacerbating conditions are characteristics that can enhance or magnify the effects of a hazard

Additional factors contribute to the impact of hazardous materials releases from a fixed facility or transportation incident: Cal A

- Solid, liquid, and/or gaseous hazardous materials can be released from fixed or mobile containers either accidentally or on purpose
- The resulting release can last for hours or for days.
- The substances released may be corrosive or otherwise damaging over time, and they may cause an explosion and/or fire.
- Contamination may be carried out of the incident area by people, vehicles, water, and/or wind.
- Weather conditions will directly affect how the hazard develops.
- The micrometeorological effects of buildings and terrain can alter travel and duration of agents.
- Shielding in the form of sheltering in place can protect people and property from harmful effects.

- Noncompliance with fire and building codes as well as failure to maintain existing fire protection and containment features can substantially increase the damage from a hazardous materials release.

FIXED FACILITY INCIDENTS

Industrial accidents occur due to inadequate human oversight, or the failure of systems used to move or store materials, such as pipes and storage tanks. Numerous facilities in the Fresno County region have been identified as sites that store hazardous materials as part of their daily operations. The threat that these sites pose to the region depends on the type of material present and the proximity of these facilities to populations and whether or not these materials are transported.

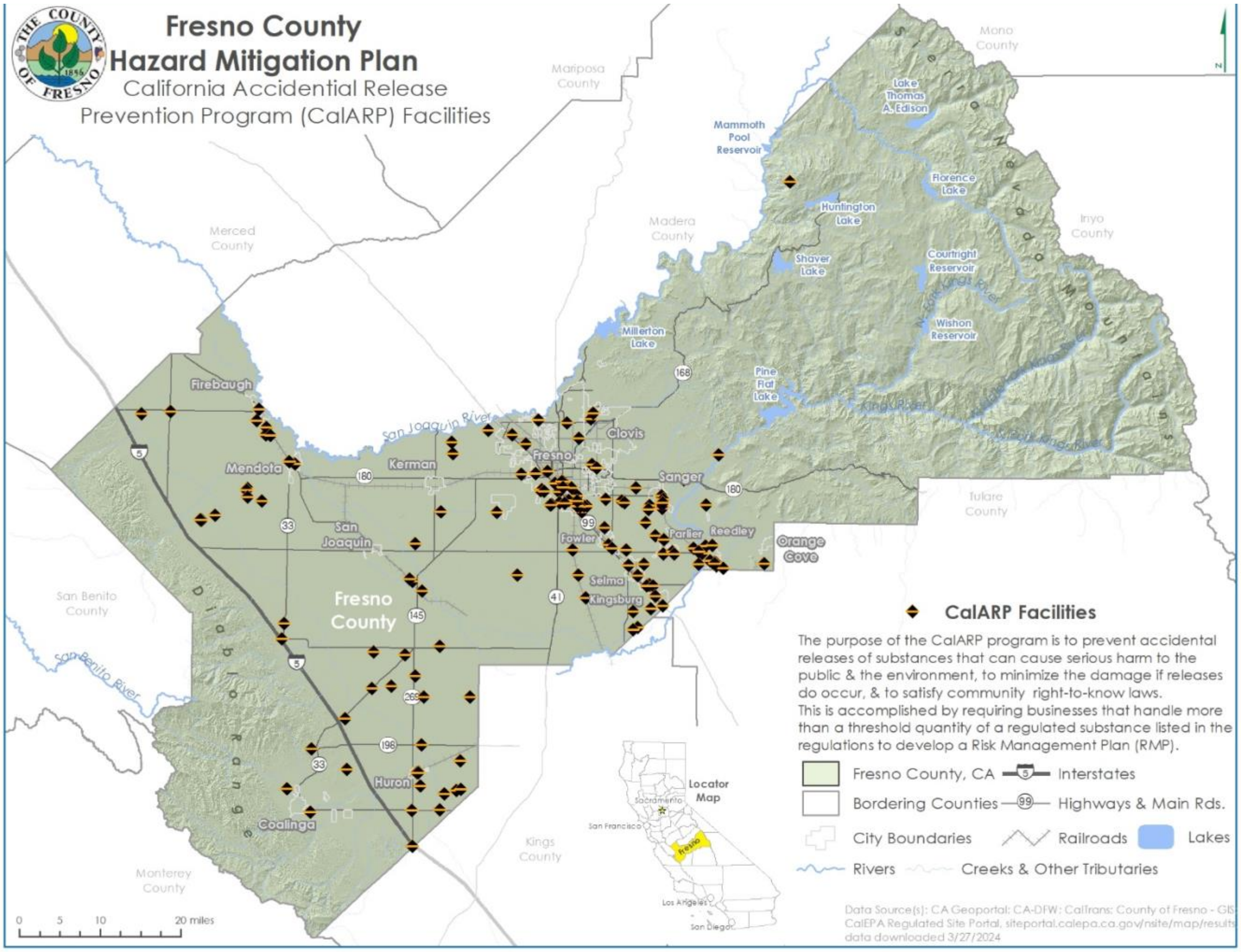
In order to identify those facilities with the greatest potential for a hazardous materials release that could adversely impact communities within the Fresno County planning area, the HMPC took an initial inventory of potential sites by utilizing data from the California Accidental Release Prevention Program (CalARP). The program was implemented on January 1, 1997, and replaced the California Risk Management and Prevention Program (RMPP). The purpose of the CalARP program is to prevent accidental releases of substances that can cause serious harm to the public and the environment, to minimize the damage if releases do occur, and to satisfy community right- to-know laws. This is accomplished by requiring businesses that handle more than a threshold quantity of a regulated substance listed in the regulations to develop a Risk Management Plan (RMP). An RMP is a detailed engineering analysis of the potential accident factors present at a business and the mitigation measures that can be implemented to reduce this accident potential. The RMP contains:

- Safety information
- A hazard review
- Operating procedures
- Training requirements
- Maintenance requirements
- Compliance audits
- Incident investigation procedures

The CalARP program is implemented at the local government level by Unified Program Agencies (UPAs). Of benefit to the HMPC's efforts to address hazardous materials incidents is the fact that the CalARP program is designed so that UPA's work directly with regulated facilities.

Figure 83. Fresno County California Accidental Release Prevention Program (CalARP) Facilities (below) identifies all CalARP regulated facilities within the planning area, as well as the location and density of such facilities in relation to jurisdictions (at risk population centers), and critical infrastructure such as railways and major transportation routes. The mapped sites below represent those most critical (CalARP) sites as determined by the HMPC for the purposes of the plan update.

Figure 83. Fresno County California Accidental Release Prevention Program (CalARP) Facilities



Source: CA Geoportal; CA-DFW; CalTrans; County of Fresno – GIS CalEPA Regulated Site Portal, sitepotal.calpa.ca.gov/nsite/map/results data downloaded 3/27/2024

- In addition to the Cal ARP sites mapped (above), the following sites are identified in the Fresno County 2040 General Plan, Environmental Impact Report or from other federal sources:
- As of June 2020, there are 45 active Leaking Underground Storage Tanks (LUST) sites.
- According to the U.S. Environmental Protection Agency (EPA) there are 7 National Priorities List and Superfund Alternative Approach Sites in Fresno County.[22]
- There are 1,678 small quantity hazardous waste generators and 150 large quantity hazardous waste generators in Fresno County.
- There are several hazardous waste disposal locations in Fresno County for Household Hazardous Waste Disposal (HHW)[23]
- Agriculture operations in proximity to urbanized areas, particularly near residential uses, present some risks associated with agricultural chemicals (pesticides and fertilizers). As more residential development is built close to existing agricultural uses, risks associated with agricultural chemicals may increase

Table 159. Hazmat Facilities by Jurisdiction identifies the number of hazardous materials facilities within each jurisdiction and in unincorporated Fresno County. It is useful as a cross-reference to illustrate how the risk varies by jurisdiction.

Table 159. Hazmat Facilities by Jurisdiction

Jurisdiction	Counts
Clovis	2
Coalinga	1
Firebaugh	1
Fowler	2
Fresno	28
Huron	3
Kingsburg	5
Mendota	2
Orange Cove	2
Reedley	8
Sanger	6
Selma	2
Unincorporated	107
Total	169

Source: CalARP

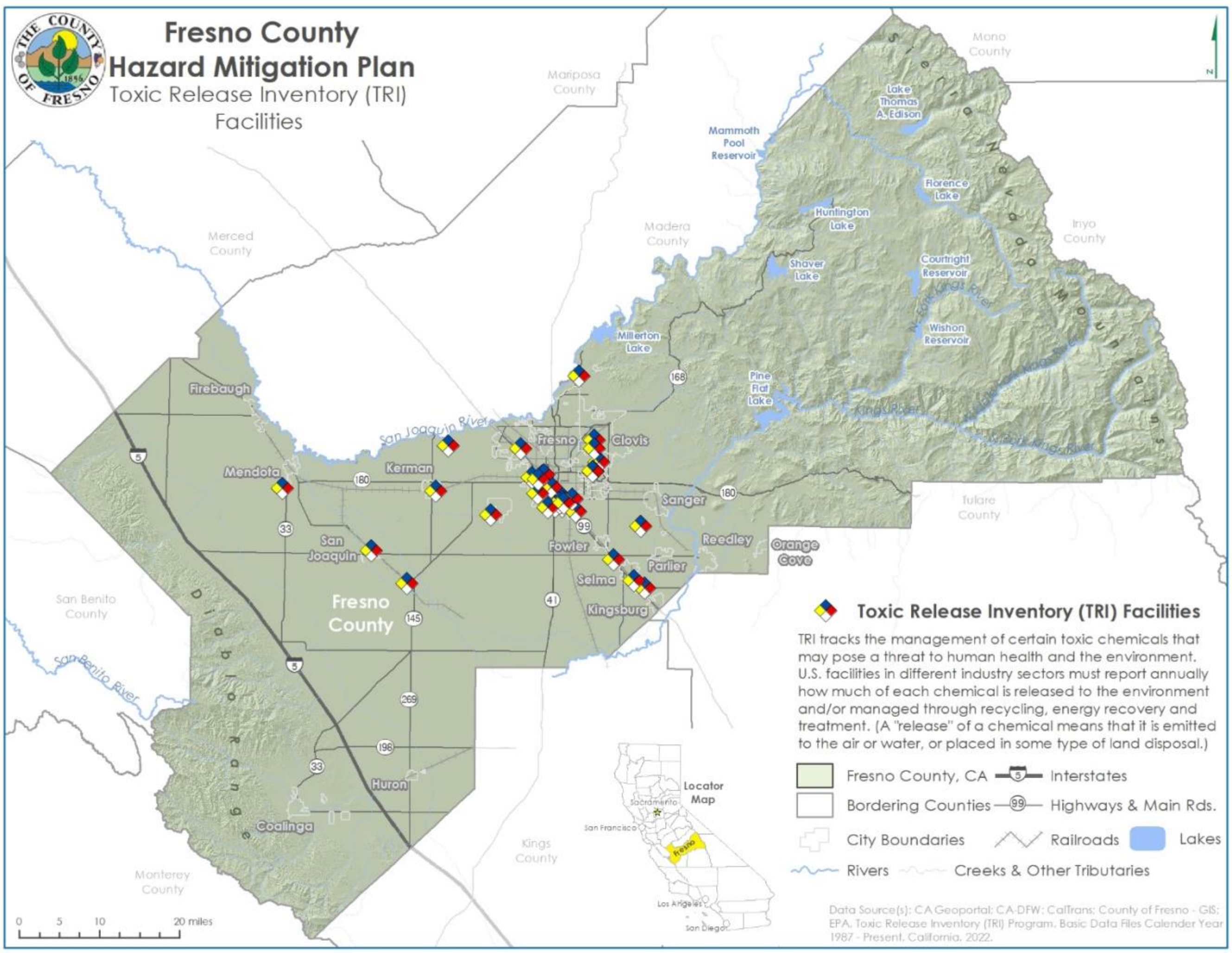
[22] Search for Superfund Sites Where You Live | US EPA https://www.epa.gov/superfund/search-superfund-sites-where-you-live

[23] Landfill Operations - County of Fresno (fresnocountyca.gov) https://www.fresnocountyca.gov/Departments/Public-Works-and-Planning/divisions-of-public-works-and-planning/resources-and-parks-division/landfill-operations

The Toxics Release Inventory (TRI) Program tracks the industrial management of toxic chemicals that may cause harm to human health and the environment. TRI data are reported by certain industrial and federal facilities. TRI tracks the management of certain toxic chemicals that may pose a threat to human health and the environment. U.S. facilities in different industry sectors must report annually how much of each chemical is released to the environment and/or managed through recycling, energy recovery and treatment. (A "release" of a chemical means that it is emitted to the air or water or placed in some type of land disposal.). The information submitted by facilities is compiled in the Toxics Release Inventory. TRI helps support informed decision-making by companies, government agencies, non-governmental organizations, and the public.

In Fresno County, there are 33 TRI sites across Clovis, Fresno, Kerman, Kingsburg, San Joaquin, Selma, and Unincorporated Fresno County, shown in map x. There are two facilities in Clovis, 18 in

Figure 84. Fresno County Toxic Release Inventory (TRI) Facilities



Fresno, one in Kerman, one in Kingsburg, one in San Joaquin, one in Selma, and nine unincorporated.

Source: CA Geoportal; CA-DFW; CalTrans; County of Fresno – GIS; EPA, Toxic Release Inventory (TRI) Program, Basic Data Files Calendar Year 1987 – Present, California, 2022

TRANSPORTATION INCIDENTS (E.G., RAIL, HIGHWAY)

Transportation incidents can occur during the transportation of hazardous materials to and from storage facilities. The most likely routes for the transportation of hazardous materials are major roadways and railroads. Two major north-south roadways are located in Fresno County. Highway 99 runs through the central part of the County and provides a north-south corridor through several counties. Most of the County's industrial and residential activity is positioned along Highway 99. In western Fresno County, Interstate 5 traverses the County at the base of the Coast Range foothills. State Routes 33, 41, 43, 63, 145, 168, 180, 198, and 269 provide local service to urban and rural areas in the County. A network of County roads connects the various communities to these major arteries. Major rail lines include Union Pacific, Burlington Northern and Santa Fe Company, Port Railroads, Inc., and San Joaquin Valley Railroad. The major transportation corridors and rail lines are illustrated in **Figure 85. Fresno County Transportation System** and **Figure 86. Fresno County Rail Network**.

The United States Department of Transportation (USDOT) has established nine hazardous materials classifications: explosive, compressed gases, flammable/combustible liquids, flammable solids, oxidizers, poisons, corrosive, radioactive, and miscellaneous, shown in the table below.

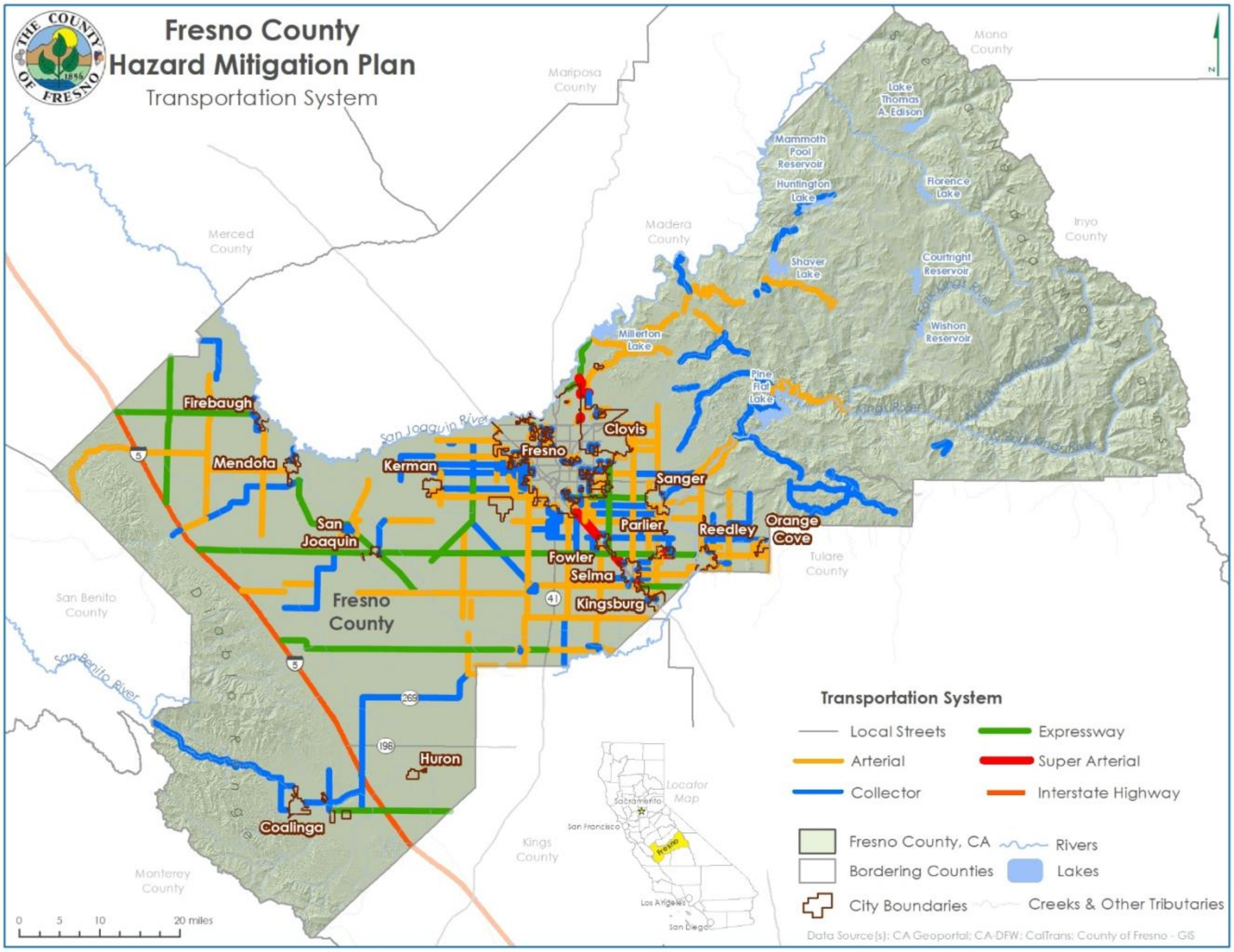
Table 160. DOT Hazardous Materials Classifications

Class Number	Description
Class 1	Explosives
Class 2	Gases
Class 3	Flammable Liquids (and combustible liquids)
Class 4	Flammable solids; substances liable to spontaneous combustion; substance which, on contact with water, emit flammable gases
Class 5	Oxidizing substances and Organic substances
Class 6	Toxic (poisonous) substances
Class 7	Radioactive materials
Class 8	Corrosive substances
Class 9	Miscellaneous dangerous goods/hazards materials and articles

Source: USDOT

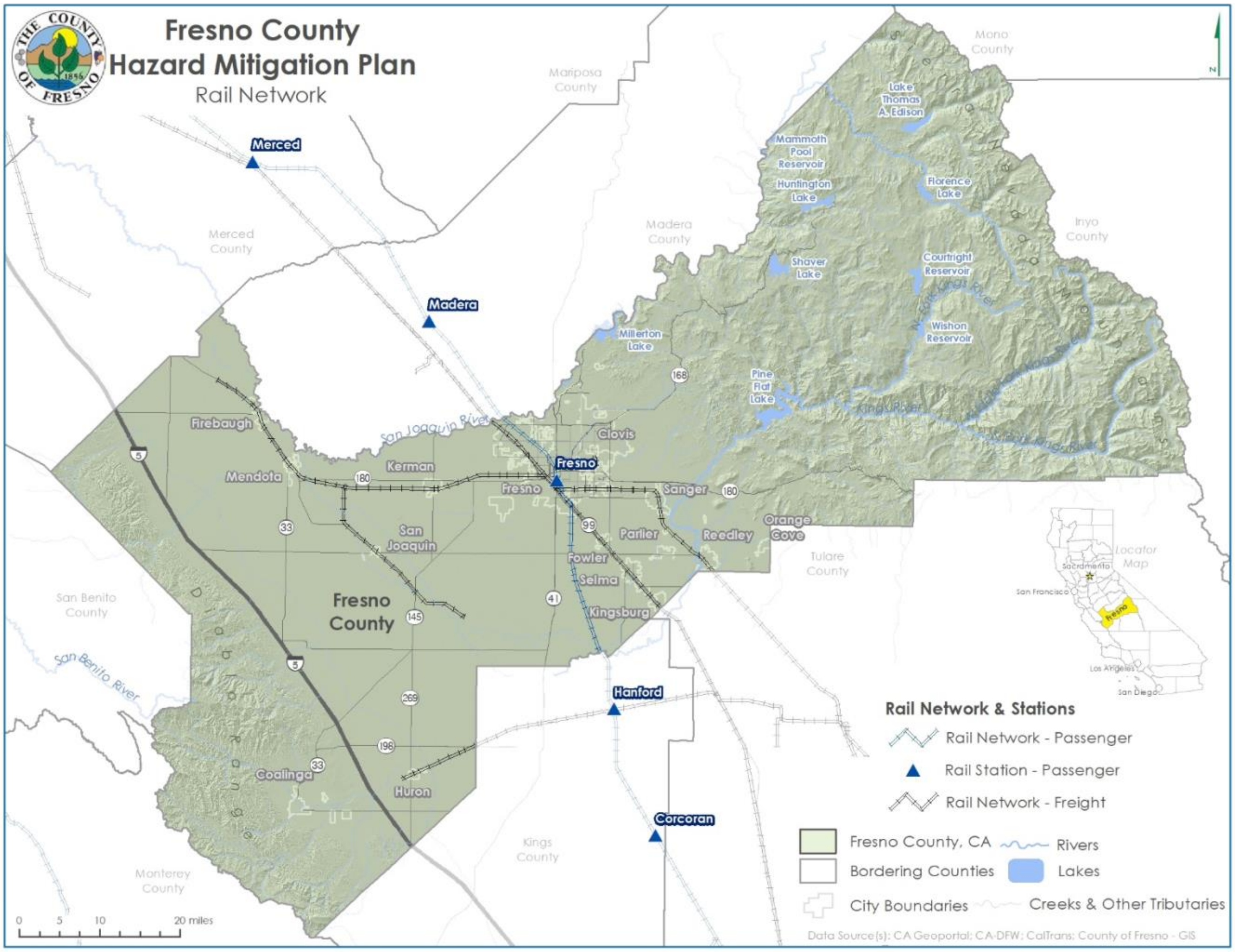
Transporters of such materials must adhere to routing requirements that are enforced by the California Highway Patrol. Transportation must take the most direct route, utilizing State or interstate highways whenever possible, and only roadways with sufficient width and load bearing capacity. All nine classes of hazardous materials, including hazardous waste, may be transported on Interstate 5. Materials that are poisonous by inhalation, explosives or high level radioactive may be transported on certain State Routes, including SR 33, 41, 63, 99, 180, and 198, but are subject to restrictions.

Figure 85. Fresno County Transportation System



Source: CA Geoportal; CA-DFW; CalTrans; County of Fresno - GIS

Figure 86. Fresno County Rail Network



Source: CA Geoportal; CA-DFW; CalTrans; County of Fresno - GIS

Of the County's transportation corridors, Interstate 5, Highway 99, and State Route 41 are the most significant because they provide direct links between the County transportation system, the surrounding regions, and beyond.

According to the Fresno County General Plan Background Report, truck transportation, followed by rail, air, and pipeline, provides the majority of goods movement in Fresno County, including the transportation of hazardous materials. Fresno County has considerable long-distance trucking activity due to the presence of Interstate 5, State Route 198, and Highway 99. According to the background report, Highway 99 carries the greatest volume of truck traffic in Fresno County.

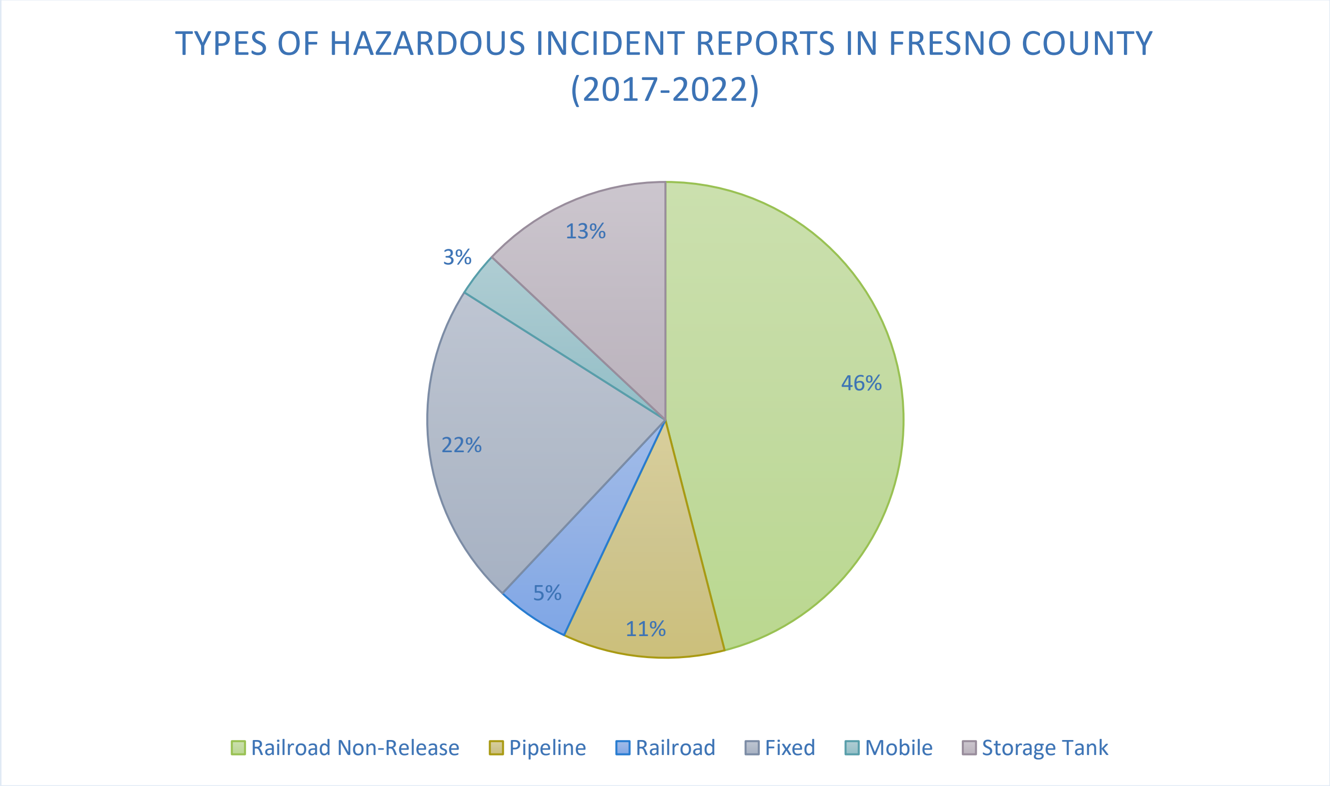
There are two mainline rail lines that run north-south through Fresno County. The first, owned by the Burlington Northern and Santa Fe Company, connects the County to Sacramento and the San Francisco Bay Area to the north and Bakersfield to the south. The second, owned by Union Pacific Railways, parallels the Highway 99 corridor and connects the County to Sacramento and the Bay Area to the north and Bakersfield to the south. Both lines service the City of Fresno. Other lines provide rail service primarily to communities within the County and to adjacent counties. According to the HMPC, approximately 40 trains travel through the City of Fresno each day, and sometimes the trains carry hazardous materials very close to schools and residential areas.

PAST OCCURRENCES

Hazardous materials incidents in Fresno County are frequent events. Statistics from the National Response Center, which serves as the sole national point of contact for reporting all oil, chemical, radiological, biological, and etiological discharges into the environment anywhere in the United States and its territories, indicate that between 2009 and the end of 2022, 553 incidents were reported in Fresno County. Of these, 64 included fatalities, 92 included injuries, 62 included hospitalizations. The incidents required 2,265 people to be evacuated, and it caused nearly $900,000 in property damage.

Figure 87. Reports of Hazardous Materials Incidents in Fresno County, 2017-2022 shows the breakdown of the types of incidents that occurred in Fresno County in this time period. Of the incidents, 46 percent were railroad non-release, 22 percent fixed, 13 percent storage tank, 11 percent pipeline, 5 percent railroad, 3 percent railroad.

Figure 87. Reports of Hazardous Materials Incidents in Fresno County, 2017-2022



Source: National Response Center, www.nrc.uscg.mil/

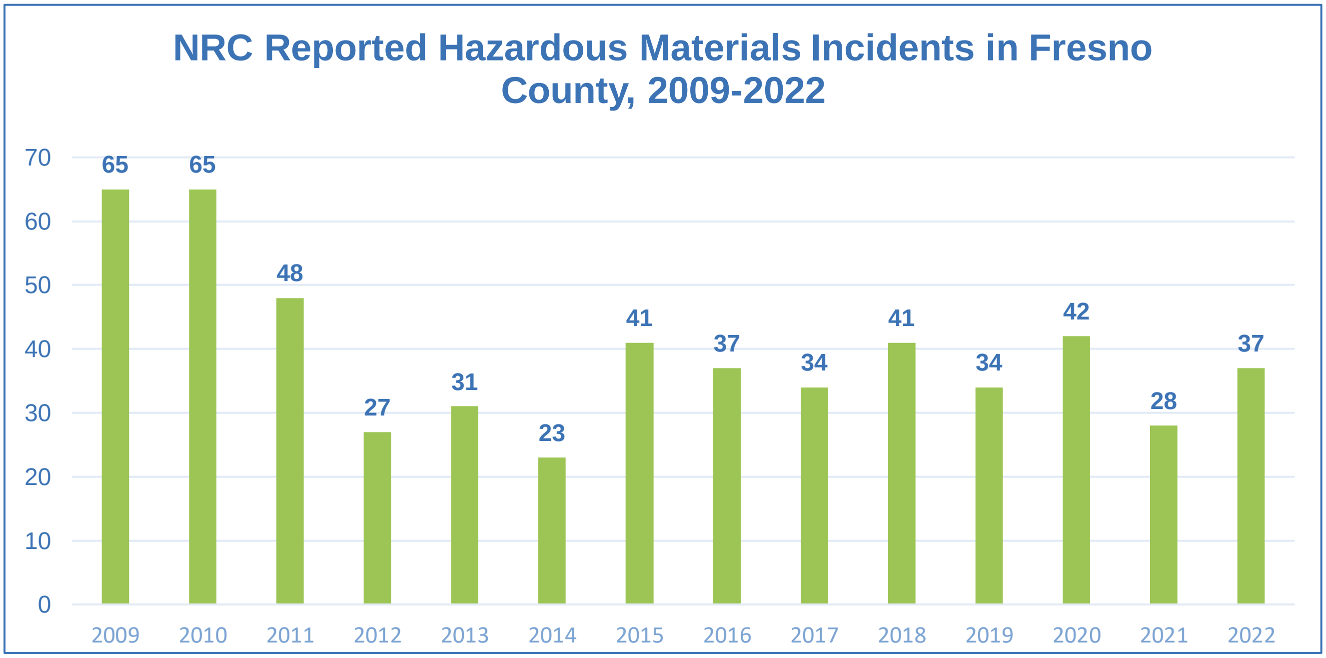
Table 161. Reports of Hazardous Materials Incidents in Fresno County, 2017-2022

Incident Type	Number of Incidents
Air Craft	1
Unknown	1
Railroad	5
Pipeline	11
Mobile	15
Storage Tank	15
Fixed	68
Railroad Non-Release	89

Source: National Response Center, www.nrc.uscg.mil/

Trend data between 2009 and 2016 shows a high of 65 incidents reported to the NRC per year (2009, 2010), and a low of 23 incidents per year (2014). The data shows a gradual decline in number of incidents per year until 2015, and since then has remain relatively stable. The number of incidents per year since 2009 is shown in **Figure 88. NRC Reported Hazardous Materials Incidents in Fresno County, 2009-2022**, with 338 reported.

Figure 88. NRC Reported Hazardous Materials Incidents in Fresno County, 2009-2022



Source : National Response Center, www.nrc.uscg.mil/

Table 162. NRC-Reported Hazardous Materials Incidents by Jurisdiction 2009-2022 shows total number of incidents reported to the NRC for Fresno County by jurisdiction.

Table 162. NRC-Reported Hazardous Materials Incidents by Jurisdiction 2009-2022

Cities	Incidents
Auberry	12
Avenale	1
Balch Camp	2
Big Creek	7
Bowles	2
Calwa	2
Canejo	1
Cantua Creek	2
Caruthers	1
Clovis*	12
Coalinga*	16
Conejo	3
Corcoran	1

Cities	Incidents
Del Rey	3
Firebaugh*	6
Five Points	1
Fowler*	12
Fresno*	338
Hammond	2
Helm	5
Huron*	3
Kerman*	5
Kingsburg*	10
Lake Shore	1
Laton	4
Lemoore	2
Mendota*	1
NAS Lemoore	1
North Fork	1
Not Identified	7
Old Fig Garden	16
Pickley	1
Pinedale	1
Pitdria	1
Reedley*	8
Riverdale	1
San Joaquin	4
Sanger*	28
Selma*	10
Shaver Lake	7
Shirley	1
Sigarden	1
Squaw Valley	2
Sunmaid	1
Tranquility	2
Traver	1
Trigo	1

*Note: Municipalities are noted with an **

Source: National Response Center, www.nrc.uscg.mil/

The County's emergency response team receives numerous calls each year related to hazardous materials releases. Since 2004, the team has received over 1,000 reports. The majority of incidents in Fresno County were fuel spills and characterized as relatively minor. As such, it is just a response/cleanup issue that generally does not pose a significant impact to the community. However, other incidents can and have occurred in the County. More detailed information about hazard materials incidents in each jurisdiction is described in the annexes.

ASSET INVENTORY AND VULNERABILITY ASSESSMENT

The probability and potential losses of human-caused technological hazards are difficult to quantify due to the "human" element. These hazards can occur at any time and virtually any place with little or no warning. However, they can often be inventoried because they typically occur in conjunction with a particular facility/business that produces, transports, stores, or uses substances that present a specific hazard to the local community or environment, or the hazard is present due to the shipment of potentially harmful substances from outside the region across various transportation arteries that bisect Fresno County communities.

The facilities and transportation corridors identified in the previous figures are those that the HMPC has identified as potential sites for hazardous materials releases that may adversely affect the Fresno County planning area.

ASSET INVENTORY

Section 4.3 Vulnerability Assessment and the jurisdictional annexes identify the total assets at risk in the Fresno County planning area to both natural and human-caused hazards. Also included in those sections are inventories of critical facilities. These critical facilities, as previously defined, are considered vital to the daily continuity of life, unobstructed flow of commerce, and the continued health and welfare of the planning area as a whole.

VULNERABILITY ASSESSMENT

As previously stated, it is often quite difficult to quantify the potential losses from human-caused hazards. While the facilities themselves have a tangible dollar value, loss from a human-caused hazard often inflicts an even greater toll on a community, both economically and emotionally. The impact to identified assets will vary from event to event and depend on the type, location, and nature of a specific technological hazard event.

Given the difficulty in quantifying the losses associated with technological hazards, this section focuses on analyzing key assets and populations relative to the hazardous materials sites identified previously.

FIXED FACILITY INCIDENTS

As discussed above, there are over 157 fixed facilities (CalARP sites) identified in the Fresno County planning area with the potential to cause a hazardous materials release of sufficient type and magnitude to adversely impact surrounding areas. These sites are regulated, and most have emergency action plans in place. The impact to surrounding areas would depend on the nature and quantity of any release as well as the time of the event and prevailing weather conditions.

Critical Facilities at Risk

Table 163. Critical Facilities Within a ½ Mile Buffer from Hazmat Facilities is derived from a GIS analysis on the CalARP data and focuses on the number and types of critical facilities within each jurisdiction that are located within a half-mile of a hazardous materials facility. The analysis indicates the City of Fresno having the highest number of critical facilities within a half-mile mile of CalARP designated facilities.

Table 163. Critical Facilities Within a ½ Mile Buffer from Hazmat Facilities

Jurisdiction	Facility Type	Counts
Clovis	Fire Stations	1
	Child Care Facilities	1
	Total	**2**
Firebaugh	Fire Station	1
	Police Stations	1
	Schools	2
	EOCs	2
	Medical Care Facilities	1
	Child Care Facilities	3
	Total	**10**
Fresno	Bus Facilities	1
	Communication Facilities	2
	Electric Power Facilities	1
	Fire Stations	5
	Medical Care Facilities	3
	Police Stations	1
	Railway Facilities	3
	Schools	7
	Nursing Homes	3
	Child Care Facilities	18
	Total	**46**
Huron	Schools	1
	Child Care Facilities	1
	Total	**2**
Kingsburg	Electric Power Facilities	1
	Fire Stations	1
	Oil Crude Pipeline Facilities	1
	Police Stations	1
	Railway Facilities	1
	Schools	1
	Child Care Facilities	6
	Total	**14**
Mendota	Airport Facilities	1
	Fire Stations	1
	Schools	6

Jurisdiction	Facility Type	Counts
	Child Care Facilities	2
	Total	**10**
Parlier	Police Stations	1
	Schools	1
	Child Care Facilities	3
	Total	**5**
Reedley	Airport Facilities	1
	Schools	4
	Nursing Homes	1
	Child Care Facilities	10
	Total	**16**
Sanger	Electric Power Facilities	1
	Fire Stations	1
	Schools	4
	Nursing Homes	1
	Child Care Facilities	6
	Total	**13**
Selma	Schools	1
	Medical Care Facilities	1
	Nursing Homes	1
	Child Care Facilities	1
	Total	**4**
Unincorporated	Communication Facilities	1
	Electric Power Facilities	8
	Fire Stations	3
	Railway Facilities	2
	Schools	6
	Nursing Homes	1
	Child Care Facilities	4
	Total	**25**
	Grand Total	**147**

5. Mitigation Strategy

Requirement §201.6(c)(3): [The plan shall include] a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.

This section describes the mitigation strategy process and mitigation action plan for the Fresno County Multi-Jurisdictional Hazard Mitigation Plan. The results of the planning process, the risk assessment, the goal setting, the identification of mitigation actions, and the hard work of the HMPC led to the action plan provided in this chapter. Taking all the above into consideration, the HMPC developed the following overall mitigation strategy:

- Communicate the hazard information collected and analyzed through this planning process as well as HMPC success stories so that the community better understands what can happen where and what they themselves can do to be better prepared.
- Implement the action plan recommendations of this plan.
- Use existing rules, regulations, policies, and procedures already in existence. Given the flood hazard in the planning area, an emphasis should be placed on continued compliance with the National Flood Insurance Program and participation by all communities in the Community Rating System.
- Monitor multi-objective management opportunities so that funding opportunities may be shared and packaged, and broader constituent support may be garnered.

GOALS AND OBJECTIVES

Requirement §201.6(c)(3)(i): [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

Up to this point in the planning process, the HMPC has organized resources, assessed hazards and risks, and documented mitigation capabilities. The resulting goals, objectives, and mitigation actions were developed based on these tasks.

Goals were defined for the purpose of this mitigation plan as broad-based public policy statements that:

- Represent basic desires of the community;
- Encompass all aspects of community, public and private;
- Are nonspecific, in that they refer to the quality (not the quantity) of the outcome;
- Are future-oriented, in that they are achievable in the future; and
- Are time-independent, in that they are not scheduled events.

Goals are stated without regard to implementation. Implementation cost, schedule, and means arenot considered. Goals are defined before considering how to accomplish them so that they are not dependent on the means of achievement. Goal statements form the basis for objectives and actionsthat will be used as means to achieve the goals. Objectives define strategies to attain the goals andare more specific and measurable.

Based on a review of the risk assessment and a conversation about changes in the last five years, the HMPC identified the following goals and objectives, which provide the direction for reducing future hazard-related losses within the Fresno County planning area. These are the same goals and objectives as were listed in the previous plan, with a small change to reflect FEMA's transition from the PDM to BRIC program.

GOAL 1: PROVIDE PROTECTION FOR PEOPLE'S LIVES FROM HAZARDS

Objective 1.1: Provide timely notification and direction to the public of imminent and potential hazards

Objective 1.2: Protect public health and safety by preparing for, responding to, and recovering from the effects of natural or technological disasters

Objective 1.3: Improve community transportation corridors to allow for better evacuation routes for the public and better access for emergency responders

GOAL 2: IMPROVE ALL COMMUNITIES' RESILIENCE AND CAPABILITIES TO MITIGATE HAZARDS ANDREDUCE EXPOSURE TO HAZARD-RELATED LOSSES

Objective 2.1: Reduce wildfires/protect life, property, and natural resources from damaging wildfires

Objective 2.2: Reduce flood and storm-related losses

Objective 2.3: Reduce hazards that adversely impact the agricultural industry

Objective 2.4: Minimize the impact to the communities due to recurring drought conditions that impact both ground water supply and the agricultural industry

Objective 2.5: Minimize the risk/loss to endangered species, native plants, land (erosion), and native wildlife

GOAL 3: IMPROVE COMMUNITY AND AGENCY AWARENESS ABOUT HAZARDS AND ASSOCIATEDVULNERABILITIES THAT THREATEN FRESNO COUNTY PLANNING AREA COMMUNITIES

Objective 3.1: Increase public awareness about the nature and extent of hazards they are exposedto, where they occur, what is vulnerable, and recommended mitigation and preparedness for identified hazards

GOAL 4: PROVIDE PROTECTION FOR CRITICAL FACILITIES, UTILITIES, AND SERVICES FROM HAZARDIMPACTS

GOAL 5: MAINTAIN COORDINATION OF DISASTER PLANNING

Objective 5.1: Coordinate with changing U.S. Department of Homeland Security/FEMA needs

Objective 5.2: Coordinate with other community plans

Objective 5.3: Maximize the use of shared resources between jurisdictions and special districts for mitigation/communication

Objective 5.4: Standardize systems among agencies to provide for better interoperability

GOAL 6: MAINTAIN/PROVIDE FOR FEMA ELIGIBILITY AND WORK TO POSITION JURISDICTIONS FOR GRANTFUNDING

Objective 6.1: Provide County departments and other jurisdictions with information regarding mitigation opportunities

Objective 6.2: As part of plan implementation, review actions in this plan on an annual basis to be considered for annual FEMA Building Infrastructure and Resilient Communities (BRIC) grant allocations or after a presidential disaster declaration in California for Hazard Mitigation Grant Program funding as well as for otherlocal, state, and federal funding opportunities.

PROGRESS TOWARDS 2018 PLAN ACTIONS

The mitigation strategy update included a thorough review and status update of the existing actions. The table below provides a summary of the number of actions that each jurisdiction identified in the previous plan.

Table 164: Summary of Number of Actions in Previous Plan

Jurisdiction	Actions in Previous Plan
Multi-Jurisdictional	1
Fresno County	13
Clovis	12
Coalinga	2
Firebaugh	2
Fowler	2
Fresno (City)	6
Kerman	3
Kingsburg	4
Mendota	2
Reedley	1
San Joaquin	1
Sanger	7
Selma	5
Fresno Metropolitan Flood Control District	7
Lower San Joaquin Levee District	2
Sierra Resource Conservation District	18
Westlands Water District	1
Kings River Conservation District	1
Total	**90**

Of the 90 actions in the previous plan, NUMBER were deleted or combined with other actions, and NUMBER were continued in the plan update. The table below provides a summary of the status of these 90 actions.

Table 165 – Status of 2018 Plan Actions

Status of 2018 Plan Actions			
Action ID	Mitigation Project / Activity Description	Action Status (Continuing or Deleted)	Notes and Status Updates
Multi-Jurisdictional 1	Develop and Conduct a Multi-Hazard Seasonal Public Awareness Program	Continuing	This is an ongoing action
County 1	Identify Critical Facilities and Inspect for Vulnerability to Major Hazards		
County 2	Upgrade or Replace Critical County Facilities Found to be Vulnerable to Major Hazards		
County 3	Enhance the County Emergency Operations Center		
County 4	Control Bubonic Plague through Coyote and California Ground Squirrel Population Management		
County 5	Minimize Flood Events by Exercising Reclamation’s Emergency Action Plan and Provide an Early Warning System to Downstream Emergency Response Agencies		
County 6	Update Dam Failure Evacuation Plan		

Status of 2018 Plan Actions			
Action ID	Mitigation Project / Activity Description	Action Status (Continuing or Deleted)	Notes and Status Updates
County 7	Compliance including Groundwater Sustainability Planning and Implementation		
County 8	Conduct Feasibility Study for Panoche -Silver Creek Flood Detention Facility (see Mendota)		
County 9	Investigate and Construct Water Shortage-Options for the Upper San Joaquin River Basin		
County 10	Analyze System, Condition, and Management of Flood Water Conveyance Facilities		
County 11	Prepare Stormwater Drainage Master Plan		
County 12	Control West Nile Virus through Beaver Population Management		
County 13	Wildfire Defensible Fuel Modification Zones in Areas of Tree Mortality		

Status of 2018 Plan Actions			
Action ID	Mitigation Project / Activity Description	Action Status (Continuing or Deleted)	Notes and Status Updates
Clovis 1	Construct a Water Intertie between the Cities of Clovis and Fresno	Continuing	The Southern intertie is complete. City of Fresno is holding up the northern intertie.
Clovis 2	Modernize Information Technology Backup Infrastructure	Continuing	No Updates
Clovis 3	Improve the City's Capabilities for Sheltering Animals in a Disaster	Continuing	No Updates
Clovis 4	Purchase Hazard Mitigation Public Notification Boards	Continuing	No Updates
Clovis 5	Improve Emergency Evacuation and Emergency Vehicle Routes	Continuing	No Updates
Clovis 6	Conduct a Seismic Vulnerability Assessment of City-Owned Critical Facilities	Continuing	On hold – focusing on water, sewer and well facilities.
Clovis 7	Construct Channel Improvements for Dog Creek Stream, South of Gettysburg-Ashlan	Continuing	No Updates

Status of 2018 Plan Actions			
Action ID	Mitigation Project / Activity Description	Action Status (Continuing or Deleted)	Notes and Status Updates
Clovis 8	Improve Flow Design Parameters for Big Dry Creek and the Enterprise Canal	Continuing	In progress. FID has been removing channel obstructions in the Big Dry Creek. Flow rate and channel capacity has been improved.
Clovis 9	Improve City's Floodplain Management Program and Apply to Community RatingSystem	Continuing	No Updates
Clovis 10	Enforce Master Drainage Plan Requirements	Continuing	No Updates
Clovis 11	Install a System of Surface Water Hazard Detection	Continuing	No Updates
Clovis 12	Sustainable Groundwater Management Act Compliance including Groundwater Sustainability Planning and Implementation	Continuing	The Groundwater Sustainability Plan (GSP) for the NKGSA has been approved by DWR. The city is working toward sustainability by the year 2040.
Coalinga 1	Plan for Alternative Water Sources for the Water System	Continuing	No Updates
Coalinga 2	Plan for Water System Sustainability in the Event of Long-Term Power Failure	Continuing	No Updates

Status of 2018 Plan Actions			
Action ID	**Mitigation Project / Activity Description**	**Action Status (Continuing or Deleted)**	**Notes and Status Updates**
Firebaugh 1	Assess Levee System for Necessary Improvements	Continuing	Substantive work completed, but continuing to assess
Firebaugh 2	Sustainable Groundwater Management Act Compliance including Groundwater Sustainability Planning and Implementation	Continuing	Substantive work completed, but continuing to work on sustainability
Fowler 1	Install Back-up Power System for City Critical Facilities	Continuing	In progress for wells, generators, power wall
Fowler 2	Sustainable Groundwater Management Act Compliance including Groundwater Sustainability Planning and Implementation	Continuing	The City of Fowler is part of the SKGSA plan and a member of the Groundwater Sustainability Plan.
Fresno 1	Establish Post-Disaster Action Plan for City Continuity of Operations Plan	Continuing	No Updates
Fresno 2	Improve the City's Capabilities for Sheltering Animals in a Disaster	Continuing	Working with local NGO to provided concurrent shelter for small animals and people
Fresno 3	Train and Certify City Inspectors to Conduct Post-Disaster Damage Assessment	Continuing	The SAP program should be something that multiple agencies should accomplish together

Status of 2018 Plan Actions			
Action ID	Mitigation Project / Activity Description	Action Status (Continuing or Deleted)	Notes and Status Updates
Fresno 4	Implement a Flood Awareness Program for the Public	Continuing	Work would include the Fresno Metropolitan Flood Control District
Fresno 5	Southwest Fresno - Recycled Water Distribution System Construction	Continuing	Ongoing program
Fresno 6	Sustainable Groundwater Management Act Compliance including Groundwater Sustainability Planning and Implementation	Continuing	Ongoing program
Kerman 1	Construct California Avenue Parallel Storm Drain Line	Continuing	Unknown; Need to review Storm Water Management Plan and Capital projects associated with this item.
Kerman 2	Install Warning Lights for the Intersection of State Route 145 and Highway 180	Deleted	Fully signalized intersection
Kerman 3	Sustainable Groundwater Management Act Compliance including Groundwater Sustainability Planning and Implementation	Continuing	On-going
Kingsburg 1	Enhance Traffic Diversion System	Continuing	Phase 1 is complete and working with COG and Measure C funding on Phase 2

Status of 2018 Plan Actions			
Action ID	Mitigation Project / Activity Description	Action Status (Continuing or Deleted)	Notes and Status Updates
Kingsburg 2	Create Emergency Evacuation Plan for Large Scale Incident	Continuing	Still in progress.
Kingsburg 3	Identify High Risk and High Value Target Areas	Continuing	As part of the city's 2024 EOP update all current high risk target hazards have been identified.
Kingsburg 4	Sustainable Groundwater Management Act Compliance including Groundwater Sustainability Planning and Implementation	Continuing	The city is working with the appropriate water basin to become compliant with SGWA.
Mendota 1	Build a Stormwater Detention/Desilting Basin		
Mendota 2	Sustainable Groundwater Management Act Compliance including Groundwater Sustainability Planning and Implementation		
Reedley 1	Develop Stormwater Detention Basin	Deleted	The city has opted out due to partnership and funding reasons
San Joaquin 1	Construct Water Storage Tank and Booster Pump Station including emergency generators	Continuing	Water storage tank and booster pump station work completed; adjusting action in new plan to only reflect emergency generators

Status of 2018 Plan Actions			
Action ID	Mitigation Project / Activity Description	Action Status (Continuing or Deleted)	Notes and Status Updates
Sanger 1	Establish Post-Disaster Action Plan for City Continuity of Operations Plan	Continuing	Will seek consultant assistance summer 2025.
Sanger 2	Add Potable Water Storage Capacity (500,000 Gallon above Ground Tank) to the City of Sanger's Water System	Deleted	Completed in 2020 – increased capacity to 750,000
Sanger 3	Provide Backup Power to City Pumps/Wells	Continuing	No significant progress has been made at this time. New well sites that are in planning process have redundant systems in place
Sanger 4	Replace Old Drainage System to Prevent Flooding	Continuing	Continues to be addressed with road projects on a case-by-case basis
Sanger 5	Provide Fire Department Office Security	Continuing	Renovation of Fire Station completion date scheduled for early winter 2025
Sanger 6	Provide Compound Security for Police and Fire Departments	Deleted	Completed in 2022
Sanger 7	Sustainable Groundwater Management Act Compliance including Groundwater Sustainability Planning and Implementation	Continuing	SGMA Plan adopted in 2020, requires implementation

Status of 2018 Plan Actions			
Action ID	Mitigation Project / Activity Description	Action Status (Continuing or Deleted)	Notes and Status Updates
Selma 1	Institute a Disaster Preparedness Education Program for the Public	Continuing	Ongoing
Selma 2	Install Back-up Power for Storm Drain Pumps	Continuing	Ongoing, Progress dependent on funding availability
Selma 3	Sheridan Street Pump Station	Continuing	Ongoing, Progress dependent on funding availability
Selma 4	Construct New Police and Fire Department Headquarters	Continuing	Police Department Headquarters completed. Fire Department Headquarters ongoing
Selma 5	Sustainable Groundwater Management Act Compliance including Groundwater Sustainability Planning and Implementation	Continuing	Ongoing, Progress dependent on funding availability
FMCD 1	Construct the Gould Canal to Fancher Creek Detention Basin Pipeline	Deleted	Project completed in 2020
FMCD 2	Construct the Fancher Creek Detention Basin Pump Station and Telemetry System	Deleted	Project completed in 2023

Status of 2018 Plan Actions			
Action ID	**Mitigation Project / Activity Description**	**Action Status (Continuing or Deleted)**	**Notes and Status Updates**
FMCD 3	Provide for Local Stormwater Drainage System Infrastructure	Continuing	Perpetually ongoing task, successful
FMCD 4	Retain 200-Year Flood Control Protection	Continuing	Perpetually ongoing task, successful
FMCD 5	Retrofit Areas with Surface Outlets to Protect Existing Structures	Continuing	Not completed
FMCD 6	Install Back-up Generators for Pump Only Facilities	Continuing	Not completed
FMCD 7	Big Dry Creek Diversion Additional Drop Structure	Continuing	Not completed
LSJLD 1	Institute a Dredging Management Program for the Purpose of Flood Damage Reduction	Continuing	Still in planning stage
LSJLD 2	Institute an Invasive Vegetation Management Program for the Purpose of Flood Damage Reduction	Continuing	Still in planning stage

Status of 2018 Plan Actions			
Action ID	Mitigation Project / Activity Description	Action Status (Continuing or Deleted)	Notes and Status Updates
SRCD 1	Strengthen Non-Native Noxious Weed Control Efforts	Continuing	SRCD has partnered with the San Joaquin River Conservancy and Parkway Trust for the removal of invasive species along the San Joaquin River. Sierra RCD has also implemented non-native noxious weed control for watershed restoration on the upper San Joaquin river watershed.
SRCD 2	Strengthen Dam Failure/Flood Planning, Coordination, and Training	Deleted	No updates.
SRCD 3	Improve Alternate Emergency Access Roads	Continuing	Up to a dozen alternate emergency access roads have been improved in the Wildland Urban Interface. Plans are being developed within Firewise Communities to improve additional emergency access roads.
SRCD 4	Conduct Community Fuel Break Construction and Maintenance on a Landscape Scale	Continuing	Highway 168 FireSafe Council, Oak to Timberline FireSafe Council, and Fresno County have partnered with CalFire to develop community fire breaks.
SRCD 5	Create a Fuel Break Along Highway 168	Continuing	No updates.
SRCD 6	Implement a Neighborhood Chipper Program	Continuing	Sierra RCD successfully launched a community chipper program and have done several dozen community chipper workdays in the effort to reduce post fire fuels and improve defensible space within communities along highway 168 and highway 180

Status of 2018 Plan Actions			
Action ID	**Mitigation Project / Activity Description**	**Action Status (Continuing or Deleted)**	**Notes and Status Updates**
SRCD 7	Conduct Prescribed Fires	Continuing	Sierra RCD has successfully launched a prescribed fire program for small acre and low severity fire. To date, the Sierra RCD has completed two burn units.
SRCD 8	Establish a System of Fire Pumper/Tanker Fill Stations and Water Storage	Continuing	Due to the Creek Fire, the Creek Fire Recovery Collaborative has assisted approximately 10 landowners with repairing their water system and/or replacing water storage containers. Firewise Communities are being educated on the importance of establishing fire suppression systems in their communities.
SRCD 9	Implement a Public Fire Prevention, Survival, and Mitigation Education Program	Continuing	Sierra RCD's Forestry and Watershed Program has provided over the past 5 years 496 Fire Risk Evaluations to private landowners living in the Wildland Urban Interface. These Evaluations focus on Home Hardening, Defensible Space, and Forest Stewardship. Completed approximately 9000 hours of outreach to local landowners through community events.
SRCD 10	Update Highway 168 FireSafe Council's Community Wildfire Protection Plan through CA FireSafe Council Funding	Deleted	The Highway 168 FireSafe Council's CWPP was completed in 2018. The Highway 168 FireSafe Council plan needs to be updated to reflect changes post the 2020 Creek Fire.
SRCD 11	Develop Wildfire Protection Plan with Oak to Timberline FireSafe Council through CA FireSafe Council Funding	Deleted	The Highway 180 Oak to Timberline FireSafe Council's CWPP was completed in 2018. The Oak to Timberline FireSafe Council is in the process of updating their plan as of 2024.

Status of 2018 Plan Actions			
Action ID	**Mitigation Project / Activity Description**	**Action Status (Continuing or Deleted)**	**Notes and Status Updates**
SRCD 12	Implement a biomass utilization and dispositioning program for excessive forest and rangeland vegetation	Continuing	Sierra RCD has completed a feasibility study for a biomass to biofuel utilization campus for Fresno County.
SRCD 13	Partner with U.S. Forest Service to reduce fire risk in Wildland Urban Interface (WUI)	Continuing	Sierra RCD received a USFS Community Wildfire Defense Grant in 2023 to reduce the wildfire risk for 9 Firewise Communities in Fresno County. In 2024, the Sierra Nevada Conservancy funded Sierra RCD to continue to develop WUI projects on the Sierra National Forest
SRCD 14	Removal of Illegal marijuana grows to reduce fire risk in Wildland Urban Interface (WUI)	Deleted	No Updates
SRCD 15	Burns Flat Fuel Break	Deleted	No Updates
SRCD 16	Whispering Springs Fuel Break	Deleted	Sierra RCD is working to establish a Firewise Community for this community. We completed a 9-acre ingress egress project for seven properties benefitting 21 landowners.
SRCD 17	The Beal Fire Road Fuel Break	Continuing	Working to establish a FireWise community. CalFire is working on this fuel break project.
SRCD 18	Peterson Road Fuel Break	Continuing	Working to establish a FireWise community. County is doing a fuel break.

Status of 2018 Plan Actions			
Action ID	**Mitigation Project / Activity Description**	**Action Status (Continuing or Deleted)**	**Notes and Status Updates**
WWD 1	Institute a Groundwater Replenishment and Drought Resiliency Project		
KRCD 1	Analysis of Levee Integrity and Improvement Project	Continuing	Analysis of the system occurs twice a year.

NFIP PARTICIPATION AND COMPLIANCE

The National Flood Insurance Program (NFIP) provides flood insurance to property owners, renters, and businesses in flood prone areas across the country. NFIP participating communities agree to adopt, implement, and enforce local flood plain regulations to protect lives and reduce the risk from future flooding. Participation in the NFIP is voluntary; the following communities in Fresno County currently do not participate in the NFIP due to funding, logistical, administrative, or other constraints:

- Kerman (the City of Kerman is not subject to floodwaters from a 100-year storm and thus is not required to participate in the NFIP
- Selma

The following plan participants are not municipal governments and do not have residents, and thus are ineligible to participate in the NFIP:

- Fresno Metropolitan Flood Control District
- Kings River Conservation District
- Lower San Joaquin Levee District
- Sierra Resource Conservation District
- Westlands Water District

The table below addresses participating jurisdictions continued compliance with NFIP requirements:

Table 166- NFIP Participation and Compliance

Jurisdiction	Has your community adopted a floodplain management ordinance that meets NFIP Minimum criteria?	Has your community adopted the latest effective Flood Insurance Rate Map (FIRM)?	Do you regulate/ permit development in the Special Flood Hazard Area (SFHA)?	Which position or agency is in charge of NFIP compliance for your community?	How do you implement the substantial improvement / substantial damage provisions of your floodplain management ordinance?
Fresno County	Yes	Yes	Yes	County Building Official	Via permit process
Clovis	Yes	Yes	Yes	City Building Official	Via permit process
Coalinga	Yes	Yes	Yes	City Manager	Via permit process
Firebaugh	Yes	Yes	Yes	City Manager	Via permit process
Fowler	Yes	Yes	Yes	Community Development Director	Via permit process
Fresno	Yes	Yes	Yes	City Building Official	Via permit process
Kingsburg	No	Yes	Not Specified	Not Specified	Not Specified
Mendota	Yes	Yes	Yes	City Manager	Via permit process

Jurisdiction	Has your community adopted a floodplain management ordinance that meets NFIP Minimum criteria?	Has your community adopted the latest effective Flood Insurance Rate Map (FIRM)?	Do you regulate/ permit development in the Special Flood Hazard Area (SFHA)?	Which position or agency is in charge of NFIP compliance for your community?	How do you implement the substantial improvement / substantial damage provisions of your floodplain management ordinance?
Reedley	Yes	Yes	Yes	City Building Official	Via permit process
San Joaquin	No	Yes	Not Specified	Not Specified	Not Specified
Sanger	Yes	Yes	Yes	City Manager	Via permit process

2024 MITIGATION ACTIONS

Only those actions where the County is the lead jurisdiction, or are multi-jurisdictional, are detailed further in this section. Actions specific to other participating jurisdictions, or where other jurisdictions are taking the lead, are detailed in the jurisdictional annexes.

PRIORITIZATION OF MITIGATION ACTIONS

As noted above, the mitigation actions included in the 2024 Fresno County Hazard Mitigation Plan does not represent a commitment by participating communities to take on every listed action. Rather, this is a list of *potential* actions that they may wish to pursue, depending in the availability of funding. When determining how to use available hazard mitigation funding, or identifying (during annual plan reviews) which actions to pursue in the coming year, the HMPC will consider the following factors when identifying priority actions:

- The benefit-cost ratio (BCR) of proposed projects
  - BCR is a measure of the return on investment the community can expect to receive, and one of the most important factors in determining whether or not to implement an action
  - Communities may opt to conduct a full benefit-cost analysis, or may consider the relative costs and benefits qualitatively, depending on the availability of detailed project cost information.
- Degree to which the project impacts or protects life safety
- Degree to which the project reduces the need for response actions
- Size of the population who would benefit from the action
- Benefit to the county's economy overall
- Useful life of project, taking into consideration the expected impacts of climate change
- Benefits to underserved communities
- Other non-monetary benefits not specified here

MULTI-JURISDICTION MITIGATION ACTIONS

DEVELOP AND CONDUCT A MULTI-HAZARD SEASONAL PUBLIC AWARENESS PROGRAM

Hazards Addressed: Agricultural Hazards, Avalanche, Dam Failure, Drought, Earthquake Flood/Levee Failure, Epidemic/Pandemic, Erosion, Expansive Soils, Extreme Temperatures, Fog, Heavy Rain/Thunderstorm/Hail/Lightning/wind, Landslide, Land Subsidence, Tornado, Volcano, West Nile Virus, Wildfire, Winter Storm,

Issue/Background: The jurisdictions within Fresno County are at risk to the natural hazards identified in this plan. Each hazard poses a different degree of risk and associated vulnerability, depending on the location within the County, but drought, flooding, wildfire and earthquake represent some of the most significant hazards. Some hazards such as flooding, have a high likelihood of occurrence, a specific location that would likely be impacted, and proven approaches that could reduce the impact. For other hazards, where either the likelihood of occurrence is very low, the area of likely impact is not specifically known, or there is very little that can be done to reduce the impacts. The public needs to be made aware of the hazards so they can take action to reduce potential impacts to their own personal property and safety. The County and HMPC, including participating jurisdictions and special districts involved in the plan, have determined that public awareness is a key component of the overall mitigation strategy for this plan. People should have information describing historical events and losses, the likelihood of future occurrences, the range of possible impacts, appropriate actions to save lives and minimize property damage, and where additional information can be found. Any information provided through this effort should be accurate, specific, timely, and consistent with current and accepted local emergency management procedures as promoted by the California State Office of Emergency Services and the American Red Cross. This public outreach effort will be conducted annually and will include:

- Using a variety of information outlets, including local news media, social media, and web- based information;
- Creating and printing (where applicable) brochures, leaflets, water bill inserts, websites, and public service announcements;
- Displaying current brochures and flyers in County and City office buildings, libraries, and other public places;
- Developing public-private partnerships and incentives to support public education activities;
- Provide information on priority hazards including Agricultural Hazards, Dam Failure, Drought, Earthquake, Flood/Levee Failure, Human Health, Severe Weather, Soil Hazards (subsidence), Wildfire;
- Provide information on water conservation, particularly during times of drought;
- Participation in statewide events such as The 2018 Great California ShakeOut earthquake awareness drill

Other Alternatives: Continue public information activities currently in place

Responsible Office: Fresno County Office of Emergency Services, Department of Public Works and Planning, and Chamber of Commerce; American Red Cross. All municipalities and special districts will be partners including:

- City of Clovis
- City of Coalinga
- City of Firebaugh
- City of Fowler
- City of Fresno
- City of Kerman
- City of Kingsburg

- City of Mendota
- City of Reedley
- City of San Joaquin
- City of Sanger
- City of Selma
- Fresno Metropolitan Flood Control District
- Lower San Joaquin Levee District
- Sierra Resource Conservation District (including Highway 168 Fire Safe Council and Oak to Timberline Fire Safe Council)
- Kings River Conservation District
- Westlands Water District

Priority (High, Medium, Low): High

Cost Estimate: $5,000-20,000 annually, depending on printing and mailing costs, level of volunteer participation, and scope and frequency of events

Potential Funding: FEMA's Hazard Mitigation Grant Program, Fresno County funds, other available grants

Benefits (Avoided Losses): Heightened awareness that can lead to enhanced life safety, reduction in property losses; relatively low cost

Schedule: Part of seasonal multi-hazard public awareness campaign

Status: 2009 project, implementation ongoing at County level but revised in 2018 to make it more of a multi-jurisdictional effort.

FRESNO COUNTY MULTI-HAZARD MITIGATION ACTIONS

IDENTIFY CRITICAL FACILITIES AND INSPECT FOR VULNERABILITY TO MAJOR HAZARDS

Hazard(s) Addressed: Multi-Hazard: dam failure, earthquake, flood, severe weather, wildfire, volcano, hazardous materials

Issue/Background: The County has various facilities that may need to function in times of crisis and/or emergency.

- The facilities should be identified.
- The identified facilities should be reviewed and inspected to determine if the infrastructure can withstand and operate under critical conditions.
- Required upgrades to each of the facilities should be identified and prioritized.

Other Alternatives: No action

Responsible Office: Internal Services Department in coordination with Fresno County Department of Public Works and County OES

Priority (High, Medium, Low): High

Cost Estimate: Up to $3 million, depending on the number of facilities identified for review

Potential Funding: Annual budgets

Benefits (Avoided Losses): The County will be able to develop a plan to methodically upgrade the infrastructure and systems necessary to operate in times of emergency.

Schedule: 1-5 years

Status: 2009 project, implementation in progress

UPGRADE OR REPLACE CRITICAL COUNTY FACILITIES FOUND TO BE VULNERABLE TO MAJOR HAZARDS

Hazard(s) Addressed: Multi-Hazard: dam failure, earthquake, flood, severe weather, wildfire, volcano, hazardous materials

Issue/Background: The County has various facilities that may need to function in times of crisis and/or emergency. The County should upgrade or replace those facilities found to be vulnerable in accordance with a developed prioritized schedule.

Other Alternatives: Contact other jurisdictions to determine if capacity exists to accommodate County critical functions within facilities they control.

Responsible Office: Fresno County Department of Public Works and Planning Capital Projects Division

Priority (High, Medium, Low): High

Cost Estimate: Unknown at this time, will depend on the number of facilities identified, total cost could approach $100 million or more

Potential Funding: FEMA's Hazard Mitigation Grant Program and Building Resilient Infrastructure and Communities (BRIC) Programs, state funds, Fresno County budgets

Benefits (Avoided Losses): The County will have reliable infrastructure and systems necessary to operate in times of emergency

Schedule: 2-10 years

Status: 2009 project, implementation in progress

ENHANCE THE COUNTY EMERGENCY OPERATIONS CENTER

Hazard(s) Addressed: Multi-Hazard: dam failure, earthquake, flood, human health hazards, severe weather, wildfire, volcano, hazardous materials

Issue/Background: The Emergency Operations Center (EOC) for Fresno County is located in multiple rooms on multiple floors within the Public Health Department. Because the EOC sections are isolated, communications are limited, and section staff are unable to interact well. A centralized modern day EOC in a single location would greatly enhance communications and improve the effectiveness of those who work in it.

Other Alternatives: Enhance the EOCs of other jurisdictions and activate them in the event of an emergency

Responsible Office: Fresno County Office of Emergency Services

Priority (High, Medium, Low): High

Cost Estimate: $2.5 million

Potential Funding: Fresno County General Fund, grants

Benefits (Avoided Losses): A modern EOC in one location would decrease emergency response time and the public notification process, reducing potential loss of life and damage. The more time people are given to prepare for a potential emergency, the better chance they have of avoiding the effects of that event. The benefits would reduce set-up time currently needed. This would result in greater efficiencies that could leverage current technologies and result in improved communication and save time, money and lives through a faster response

Schedule: within 5-10 years

Status: 2009 project, implementation in progress; Some improvements are in place. A centralized EOC is not yet in place.

CONTROL BUBONIC PLAGUE THROUGH COYOTE AND CALIFORNIA GROUND SQUIRREL POPULATION MANAGEMENT

Issue/Background: Bubonic plague is endemic to parts of Fresno County. Coyotes and the California ground squirrel are free ranging wildlife that are present in all of Fresno County. Coyotes and ground squirrels cause extensive agricultural livestock, crop, and property damage. Coyotes are very mobile and can travel 20 to 25 miles in a day. Coyotes are known to carry and transmit diseases to humans, domestic animals, and livestock. Coyotes are carriers of the bubonic plague bacteria, which they receive from the bite of an infected flea. Coyotes can spread the disease to various California ground squirrel colonies. Human interaction with ground squirrels in open spaces, parks, and recreational areas can potentially result in bubonic plague infection through flea bites. Blood samples from coyotes can be tested for the presence of bubonic plague.

Other Alternatives: No action

Responsible Office: Fresno County Department of Agriculture Wildlife Damage Management

Priority (High, Medium, Low): High

Cost Estimate: $100,000

Potential Funding: Fresno County General Fund, California Department of Public Health, unrefunded gas tax

Benefits (Avoided Losses):

- One human life saved is $3.1 million
- Avoids disease transmission to humans
- Reduces the discomfort and adverse effects of flea bites

Schedule: Annually, June through October

Status: 2009 project, continuing implementation on an as needed basis

MINIMIZE FLOOD EVENTS BY EXERCISING RECLAMATION'S EMERGENCY ACTION PLAN AND PROVIDE AN EARLY WARNING SYSTEM TO DOWNSTREAM EMERGENCY RESPONSE AGENCIES

Issue/Background: Friant Dam was constructed in 1942 and is located 20 miles northeast of the City of Fresno. It serves as a water conservation and flood control facility. The dam has a structural height of 319 feet with a top of crest elevation of 581.25 feet. Millerton Lake reservoir has a storage capacity of 520,500 acre-feet.

The Bureau of Reclamation has the ability to divert water to the Friant Kern Canal, Madera Canal, and the San Joaquin River. During unforeseen events, the Bureau of Reclamation may be required to release water into the San Joaquin River that may exceed the river channel capacity.

Other Alternatives: Divert flood water to the Friant Kern Canal and the Madera Canal, reduce encroachment of development in the San Joaquin River floodplain, construct a new storage facility

Responsible Office: Bureau of Reclamation, South Central California Area Office-Fresno; U.S. Army Corps of Engineers Sacramento Branch

Priority (High, Medium, Low): High

Cost Estimate: $5,000-10,000 to exercise and update emergency action plan

Potential Funding: FEMA's Hazard Mitigation Grant Program, state funding, other available grants

Benefits (Avoided Losses): Minimized risk of loss of life and property damage

Schedule: 1-3 years

Status: 2009 project, continuing ongoing implementation

UPDATE DAM FAILURE EVACUATION PLAN

Issue/Background: New statues in the California Water code will require dam operators to update inundation maps. Development of new inundation maps will need to be incorporated into the County's dam failure evacuation plans. This will impact at least 23 dams within the County.

Other Alternatives: None

Responsible Office: County OES, PW and Sheriff's Office

Priority (High, Medium, Low): Medium Cost Estimate: $150,000-$200,000 Potential Funding: Annual budget, grants

Benefits (Avoided Losses): This plan will provide updated information that will enable an effective method for warning and evacuating downstream residents if a dam were to fail. This will enable the lives of many residents to be saved.

Schedule: 1-3 years depending on when updated inundation maps are completed

Status: New project

SUSTAINABLE GROUNDWATER MANAGEMENT ACT COMPLIANCE INCLUDING GROUNDWATER SUSTAINABILITY PLANNING AND IMPLEMENTATION

Issue/Background: Like many groundwater basins throughout the State, all four of the groundwater subbasins that underlay Fresno County are in overdraft condition and three (Kings, Westside, and Delta-Mendota) have been prioritized by DWR as critical, meaning, underground aquifers adversely impacted by overuse. Such impacts include significant decline in water storage and water levels, degradation of water quality, and land subsidence resulting in the permanent loss of storage capacity. Recognizing the importance of groundwater and the consequences of overuse, the Sustainable Groundwater Management Act (SGMA) was signed into law in 2014, to address the sustainable management of groundwater in California. The Sustainable Groundwater Management Act (SGMA) provides for the establishment of local Groundwater Sustainability Agencies (GSAs) to manage groundwater sustainability within groundwater subbasins defined by the California Department of Water Resources (DWR). Each GSA is required to develop and implement, no later than January 31, 2020, a Groundwater Sustainability Plan (GSP) to ensure a sustainable yield of groundwater, without causing undesirable results. Failure to comply with that requirement could result in the State asserting its power to manage local groundwater resources. Fresno County is working cooperatively with multiple GSAs within the four subbasins located within Fresno County towards the preparation and implementation of required GSPs. Maintaining sustainable groundwater supplies will provide insurance against periods of long-term drought and assist in the mitigating the potential for land subsidence.

As required in §10724(a) of the Water Code, the areas within the priority basins that underlay Fresno County that are not within the management area of one of these GSAs, the County is presumed to be the GSA for that area. There are nineteen (19) GSAs that have been formed within Fresno County, of these the County is the Authority for two GSAs (Management Area 'B', and Management Area 'A'). The Westside Subbasin is covered by two GSAs, as such the County and Westlands Water District work cooperatively through an MOU. Other jurisdictions in Fresno County have formed their own GSAs (City of Firebaugh and City of Mendota) for the portions of the Delta-Mendota Subbasin that underlay each jurisdictions boundary. While other jurisdictions have formed a GSA along with other local agencies as a joint powers authority, listed below. These jurisdictions have similar mitigation actions and can be found in their respective jurisdictional annexes. North Kings GSA: City of Fresno, City of Clovis and City of Kerman South Kings GSA: City of Fowler, City of Kingsburg, City of Sanger Central Kings GSA: City of Selma

Other Alternatives: None, compliance required by law, failure to meet requirements will result in State intervention and oversight.

Responsible Office: Responsibilities for compliance with the Sustainable Groundwater Management Act have been assumed through the formation of Groundwater Sustainability Agencies within the four Fresno County groundwater subbasins recognized by the California Department of Water Resources. Fresno County is generally party to each of the GSAs within Fresno County by agreement or memorandum of understanding.

Priority (High, Medium, Low): High

Cost Estimate: Varies by GSA for preparation of the required GSP. Further expenses are anticipated to be accrued for the planning and construction of groundwater recharge projects.

Potential Funding: Property owner assessments along with grant funding opportunities from the State.

Benefits (Avoided Losses): Preparation and implementation of the GSP by the respective GSAs will result in the management of groundwater in a manner that is sustainable and avoids undesirable results as defined by the California State Department of Water Resources.

Schedule: GSAs must complete and submit the required GSP to DWR by January 31, 2020, which is to be fully implemented and result in sustainability of the groundwater basin, with no undesirable effects, by the year 2040.

Status: New project in 2018

CONDUCT FEASIBILITY STUDY FOR PANOCHE-SILVER CREEK FLOOD DETENTION FACILITY

Issue/Background: Panoche-Silver Creek downstream of the California Aqueduct causes frequent flooding of Belmont Avenue, a major transportation corridor connecting west Fresno County to I-5, the future Route 180 alignment, and the City of Mendota, a downstream community. Flooding occurs during normal-intensity storm events. High-intensity events result in extended road closures in an area of the County with limited transportation corridors. A feasibility study is needed to assess feasibility and location of facilities to route flood flows to a detention reservoir.

Other Alternatives: None identified

Responsible Office: Joint, possible partners include California Department of Water Resources, Bureau of Reclamation, Fresno County, City of Mendota, Westlands Water District

Priority (High, Medium, Low): High

Cost Estimate: $1.2 million

Potential Funding: State or federal grant sources

Benefits (Avoided Losses): Finding potential solution to reduce traffic disruptions

Schedule: 2-5 years

Status: 2009 project; Deferred. As of March 2018, Project has not started but a need for the project remains.

INVESTIGATE AND CONSTRUCT WATER STORAGE OPTIONS FOR THE UPPER SAN JOAQUIN RIVER BASIN

Issue/Background: The Upper San Joaquin River Storage Investigation will investigate feasibility and cost to provide on- or off-stream storage in the upper San Joaquin River Basin. The objectives are conjunctive beneficial uses, including restoration of the San Joaquin River, increased management and exchange opportunities to secure and stabilize deliveries to urban and agricultural uses, flood control, recreation, reduced groundwater overdraft, and potentially hydropower.

Other Alternatives: No action

Responsible Office: California Department of Water Resources, Bureau of Reclamation

Priority (High, Medium, Low): High

Cost Estimate: Study—to be determined; resulting project—$1-1.5 billion

Potential Funding: State or federal sources

Benefits (Avoided Losses): Reduction of flood risk downstream of Friant Dam

Schedule: 5-10 years

Status: 2009 project; As of March 2018, a draft Environmental Impact Statement has been completed and funding is being sought for implementation

ANALYZE SYSTEM, CONDITION, AND MANAGEMENT OF FLOOD WATER CONVEYANCE FACILITIES

Issue/Background: Flood water conveyance occurs over a disparate system of natural and manmade channels, levees, irrigation canals, and ad-hoc structures whose primary function may be for purposes other than flood management. A systemwide inventory and analysis is needed to develop priorities across many jurisdictions, both public and private, for rehabilitation and upgrade of critical flood management facilities, including public and private levees.

Other Alternatives: No action

Responsible Office: Potentially San Joaquin Valley-wide, possible lead or joint lead entities include California Department of Water Resources; Bureau of Reclamation; irrigation, water, and conservation districts; regional partners through integrated regional water management plans; Fresno County

Priority (High, Medium, Low): High

Cost Estimate: $5 million (Fresno County)

Potential Funding: State and federal grant funding

Benefits (Avoided Losses): Reduced flood risk and flood losses

Schedule: 10-20 years

Status: 2009 project; Deferred. Implementation of this project has not started but a study is still needed.

PREPARE STORMWATER DRAINAGE MASTER PLANS

Issue/Background: Some unincorporated communities in Fresno County do not have master plans for stormwater drainage, which provide for flow, collection, and diversion of stormwater from public streets to detention or recharge facilities. Lacking appropriate drainage, stormwater may flood streets and/or property, and standing water may persist, leading to health or traffic safety concerns.

Other Alternatives: No action

Responsible Office: Special or community service districts or County service area zones of benefit

Priority (High, Medium, Low): Medium

Cost Estimate: $150,000-500,000 per community

Potential Funding: Undetermined

Benefits (Avoided Losses): Reduced property damage and adverse impacts on health and traffic safety

Schedule: 3-5 years

Status: 2009 project; Continuing

CONTROL WEST NILE VIRUS THROUGH BEAVER POPULATION MANAGEMENT

Issue/Background: Between 2003 and 2016, there were over 6,000 cases of West Nile virus in California; 248 of those cases resulted in fatalities. On August 2, 2007, the governor of California declared a disaster in three California counties because of deaths related to the virus. Fresno County had 242 cases with 10 fatalities between the years of 2003 and 2016. Fresno County has averaged one virus-related death and 17 virus cases per year since 2003.

West Nile virus is transmitted by mosquitoes. One breeding area for mosquitoes is beaver ponds. Beavers are native to Fresno County, and their dams create ponds in waterways. Beaver dams cause streams and waterways to overflow, which causes flooding of farm and private land. The resulting excess standing water provides another breeding source for mosquitoes. The Mosquito Abatement District estimates that removing the beaver ponds from waterways near residential areas will reduce mosquito populations, thus potentially reducing the number of West Nile virus infections.

Other Alternatives: No action

Responsible Office: Fresno County Department of Agriculture Wildlife Damage Management

Priority (High, Medium, Low): High

Cost Estimate: $10,000-25,000

Potential Funding: California Department of Public Health, Fresno County general fund

Benefits (Avoided Losses):

- Reduction of incidence of infection and resulting fatalities: .5 human lives saved is $1.55 million
- Reduction in the number of cases, resulting in improved human health and reduced medical costs
- Reduction in discomfort and adverse effects of mosquito bites
- Reduction in treatments to suppress mosquito population by the Mosquito Abatement District and related jurisdictions
- Reduction of future costs associated with mosquito control
- Repeated removal of beaver dams

Schedule: Annually, February through June

Status: 2009 project, continuing implementation on an as needed basis

WILDFIRE DEFENSIBLE FUEL MODIFICATION ZONES IN AREAS OF TREE MORTALITY

Issue/Background: The foothill and mountain areas of Fresno County have been severely impacted by the drought and subsequent bark beetle outbreak since 2014. This has caused tree mortality across 216,000 acres and over 21 million trees have died. Not only have the trees died but the brush and shrubs throughout the County have died back creating an additional fuel load. All the communities in these areas are at an increased risk of a damaging wildland fire due to the mortality and fuel loading. Much of this mortality is on open land, both private and public, that will not get removed causing an increased ground fuel loading that will persist for decades to come. The Communities, businesses and local infrastructure will need increased Defensible Fuel Modification Zones (DFZ's) and hazard tree removal to reduce the damaging effects of a wildland fire. In addition, this project would help mitigate wind-fall hazards on property and people.

Other Alternatives: In the past CAL FIRE, United State Forest Service and local fire safe councils have been creating DFZ's throughout the County in high fire prone areas. Due to the change in the fuels and health of the forest all communities in the affected areas are at high risk and need to implement integrated community DFZ's. These community DFZ's need to tie into existing DFZ's, roads, designated escape routes and homeowner defensible space to create a network that allows for increased community protection. Ingress and egress corridors need to be created by removing both dead trees and brush for the public to evacuate safely and allow emergency response personnel safe access. These DFZ's will need to be created using heavy equipment, masticators, hand crews and prescribed fire to remove dead trees, reduce understory brush and remove ground fuels. This network will need to be maintained over time and retreatment of the fuels will need to occur every 3 to 7 years for them to be effective. Community education related to fire safety, building construction, evacuation procedures and fuels management is a main part of this plan to be successful.

Responsible Office: CAL FIRE, County (Public Works, OES), USFS; partner agencies include Fire Safety Councils, PG&E, Cal Trans

Priority (High, Medium, Low): High

Cost Estimate: $10,000,000

Potential Funding: CAL FIRE grants, CAL OES funds, FEMA grants, County funds, CAL FIRE Unit funds, USDA Forest Service funds, Private funds and other funds not currently identified

Benefits (Avoided Losses): By completing these types of projects, it is estimated to reduce the impacts of fire to over 4,816 residences, numerous businesses and critical infrastructure directly affected by the tree mortality.

Schedule: September 1, 2015, until completed through 2020

Status: New project in 2018

6. Plan Implementation and Maintenance

Requirement §201.6(c)(4): [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.

Implementation and maintenance of the plan is critical to the overall success of hazard mitigation planning. This chapter provides an overview of the overall strategy for plan implementation and maintenance and outlines the method and schedule for monitoring, updating, and evaluating the plan. The chapter also discusses incorporating the plan into existing planning mechanisms and how to address continued public involvement.

ADOPTION

The purpose of formally adopting this plan is to secure buy-in from Fresno County and participating jurisdictions, raise awareness of the plan, and formalize the plan's implementation. The adoption of this plan completes Planning Step 9 of the 10-step planning process: Adopt the Plan, in accordance with the requirements of DMA 2000. This adoption also establishes compliance with AB 2140 requiring adoption by reference or incorporation into the safety element of the general plan. The governing board for each participating jurisdiction has adopted this multi- hazard mitigation plan by passing a resolution. A copy of the generic resolution and the executed copies are included in Appendix A: Adoption Resolutions.

IMPLEMENTATION

Once adopted, the plan faces the truest test of its worth: implementation. While this plan contains many worthwhile actions, the participating jurisdictions will need to decide which action(s) to undertake first. Two factors will help with making that decision: the priority assigned the actions in the planning process and funding availability. Low or no-cost actions most easily demonstrate progress toward successful plan implementation.

Implementation will be accomplished by adhering to the schedules identified for each action (see Chapter 5 Mitigation Strategy for the County and the actions detailed in the jurisdictional annexes) and through constant, pervasive, and energetic efforts to network and highlight the multi-objective, win-win benefits of each project to the Fresno County community and its stakeholders. These efforts include the routine actions of monitoring agendas, attending meetings, and promoting a safe, sustainable community. The three main components of implementation are:

- Monitoring: Tracking implementation of the plan over time
- Evaluating: Assessing how well the plan meets its stated purpose and goals

Mitigation is most successful when it is incorporated into the day-to-day functions and priorities of government and development. Implementation will be accomplished by adhering to the schedules identified for each action and through constant, pervasive, and energetic efforts to network and highlight the multi-objective, win-win benefits to each program and the Fresno County community and its stakeholders. This effort is achieved through the routine actions of monitoring agendas, attending meetings, and promoting a safe, sustainable community. Additional mitigation strategies could include consistent and ongoing enforcement of existing policies and vigilant review of programs for coordination and multi-objective opportunities.

One example of an important implementation mechanism that is highly effective and low-cost is incorporation of the hazard mitigation plan recommendations and their underlying principles into other plans and mechanisms, such as the general plans for Fresno County and the participating jurisdictions. The County and participating jurisdictions already implement policies and programs to reduce losses to life and property from hazards. This plan builds upon the momentum developed through previous and related planning efforts and mitigation programs and recommends implementing actions, where possible, through these other program mechanisms.

Simultaneously to these efforts, it is important to maintain a constant monitoring of funding opportunities that can be leveraged to implement some of the more costly recommended actions. This will include creating and maintaining a bank of ideas on how to meet local match or participation requirements. When funding does become available, the participating jurisdictions will be in a position to capitalize on the opportunity. Funding opportunities to be monitored include special pre- and post-disaster funds, special district budgeted funds, state and federal earmarked funds, and other grant programs, including those that can serve or support multi-objective applications.

ROLE OF HAZARD MITIGATION PLANNING COMMITTEE IN IMPLEMENTATION AND MAINTENANCE

With adoption of this plan, the participating jurisdictions will be tasked with plan implementation and maintenance. The participating jurisdictions, led by the Fresno County Office of Emergency Services, agrees to:

- Act as a forum for hazard mitigation issues;
- Disseminate hazard mitigation ideas and activities to all participants;
- Pursue the implementation of high-priority, low/no-cost recommended actions;
- Keep the concept of mitigation in the forefront of community decision making by identifying plan recommendations when other community goals, plans, and activities overlap, influence, or directly affect increased community vulnerability to disasters;
- Maintain a vigilant monitoring of multi-objective cost-share opportunities to help the community implement the plan's recommended actions for which no current funding exists;
- Monitor and assist in implementation and update of this plan;
- Report on plan progress and recommended changes to the Fresno County Board of Supervisors and the governing boards of the other participating jurisdictions; and
- Inform and solicit input from the public.

The primary duty of the participating jurisdictions is to see the plan successfully carried out and to report to their community governing boards and the public on the status of plan implementation and mitigation opportunities. Other duties include reviewing and promoting mitigation proposals, considering stakeholder concerns about hazard mitigation, passing concerns on to appropriate entities, and posting relevant information on the County website (and others as appropriate).

MAINTENANCE/MONITORING

Plan maintenance implies an ongoing effort to monitor and evaluate plan implementation and to update the plan as progress, roadblocks, or changing circumstances are recognized.

MAINTENANCE/MONITORING SCHEDULE

The Emergency Manager in the Fresno County Office of Emergency Services within the Department of Public Health is responsible for initiating plan reviews and will consult with the heads of participating departments and other participating jurisdictions. In order to monitor progress and update the mitigation strategies identified in the action plan, the Fresno County Office of Emergency Services will revisit this plan annually and after a hazard event. The annual review will be conducted by re-convening the HMPC each year.

This plan will be updated, approved and adopted within a five-year cycle as per Requirement §201.6(c)(4)(i) of the Disaster Mitigation Act of 2000 unless disaster or other circumstances (e.g., changing regulations) require a change to this schedule. With the initial approval of this plan occurring in mid-2024, the plan will need to be updated, reviewed by Cal OES and FEMA Region IX, and re-adopted by all participating jurisdictions by mid-2029. The County will monitor planning grant opportunities from Cal OES and FEMA for funds to assist with the update. These grants should be pursued as early as 2026, as some grants have a three-year performance period to expend the funds. In addition, there is no guarantee that the grant will be awarded when initially submitted. This allows time to resubmit the grant in 2027 if needed.

MAINTENANCE EVALUATION PROCESS

The planning team will continually observe the incorporation process, evaluation method, updating method, continued public participation, and completion of the action/projects to assure that the planning team and the plan itself are performing as anticipated. By monitoring these processes, the planning team will then be able to evaluate them at the time of the plan update, determining if any changes are needed.

Evaluation of progress can be achieved by monitoring changes in vulnerabilities identified in the plan. Changes in vulnerability can be identified by noting:

- Decreased vulnerability as a result of implementing recommended actions,
- Increased vulnerability as a result of failed or ineffective mitigation actions, and/or
- Increased vulnerability as a result of new development (and/or annexation).

The HMPC will use the following process to evaluate progress and any changes in vulnerability as a result of plan implementation.

- A representative from the responsible entity identified in each mitigation measure will be responsible for tracking and reporting on an annual basis to the HMPC on project status and provide input on whether the project as implemented meets the defined objectives and is likely to be successful in reducing vulnerabilities.
- If the project does not meet identified objectives, the HMPC will determine what alternate projects may be implemented, and an assigned individual will be responsible for defining action scope, implementing the action, monitoring success of the action, and making any required modifications to the plan.

- New projects identified will require an individual assigned to be responsible for defining the project scope, implementing the project, and monitoring success of the project.
- Projects that were not ranked high priority but were identified as potential mitigation strategies will be reviewed as well during the monitoring and update of this plan to determine feasibility of future implementation.
- Changes will be made to the plan to accommodate for projects that have failed or are not considered feasible after a review for their consistency with established criteria, the time frame, priorities, and/or funding resources.

Updating of the plan will be by written changes and submissions, as the Fresno County Office of Emergency Services deems appropriate and necessary, and as approved by the Fresno County Board of Supervisors and the governing boards of the other participating jurisdictions. Updates to this plan will:

- Consider changes in vulnerability due to action implementation;
- Document success stories where mitigation efforts have proven effective;
- Document areas where mitigation actions were not effective;
- Document any new hazards that may arise or were previously overlooked;
- Document hazard events and impacts that occurred within the five-year period;
- Incorporate new data or studies on hazards and risks;
- Incorporate new capabilities or changes in capabilities;
- Incorporate documentation of continued public involvement;
- Incorporate documentation to update the planning process that may include new or additional stakeholder involvement;
- Incorporate growth and development-related changes to building inventories;
- Incorporate new project recommendations or changes in project prioritization;
- Include a public involvement process to receive public comment on the updated plan prior to submitting the updated plan to Cal OES/FEMA; and
- Include re-adoption by all participating entities following Cal OES/FEMA approval.

INCORPORATION INTO EXISTING PLANNING MECHANISMS

Another important implementation mechanism that is highly effective and low-cost is incorporation of the hazard mitigation plan recommendations and their underlying principles into other County and City plans and mechanisms. Where possible, plan participants will use existing plans and/or programs to implement hazard mitigation actions. As previously stated in Section 7.1 of this plan, mitigation is most successful when it is incorporated into the day-to-day functions and priorities of government and development. This point is re-emphasized here. As described in this plan's capability assessment, the County and participating jurisdictions already implement policies and programs to reduce losses to life and property from hazards. This plan builds upon the momentum developed through previous and related planning efforts and mitigation programs and recommends implementing actions, where possible, through these other program mechanisms.

These existing mechanisms include (but not limited to) the following:

- County and city general and master plans
- County and city emergency operations plans
- County and city ordinances
- Flood/stormwater management/master plans
- Community Wildfire Protection plans
- Drought management and response plans
- Capital improvement plans and budgets
- Other plans and policies outlined in the capability assessments in the jurisdictional annexes
- Other plans, regulations, and practices with a mitigation focus

HMPC members involved in the updates to the planning mechanisms will be responsible for integrating the findings and recommendations of this plan with these other plans, programs, etc, as appropriate. As an action step to ensure integration with other planning mechanisms the County Office of Emergency Services Manager or designee will discuss this topic at the annual meeting of the HMPC previously described in the Maintenance Schedule. The HMPC will discuss if there are opportunities to incorporate the plan into other planning mechanisms and who would be responsible for leveraging those opportunities. HMPC members representing local jurisdictions will work with their jurisdictional planning teams to integrate their identified mitigation actions into their own local plans and programs. Efforts to integrate the hazard mitigation plan into local plans, programs, and policies will be reported on at the annual HMPC plan review meeting, and a record of successful integration efforts will be kept.

Examples of a process for incorporation of the LHMP into existing planning mechanisms include:

- As recommended by Assembly Bill (AB) 2140, each community should adopt (by reference or incorporation) this LHMP into the Safety Element of their General Plan(s). Evidence of such adoption (by formal, certified resolution) shall be provided to Cal OES and FEMA.
- Integration of wildfire actions identified in this mitigation strategy with the actions and implementation priorities established in existing Community Wildfire Protection Plans (CWPPs). This has already occurred and will continue to occur as the CWPPs are updated and implemented. Specifically, key people responsible for development of the Highway 168 Fire Safe Council CWPP and Oak to Timberline Fire Safe Council CWPP participated as a member of the HMPC in the original development and 2017-2018 update of this LHMP. They identified key projects in the CWPPs and integrated them into the Mitigation Strategy of this LHMP. Likewise, actual implementation of these wildfire projects will likely occur through the CWPP implementation process through the efforts of these same individuals.
- Using the risk assessment information to update the hazard analysis in the Fresno County Operational Area Master Emergency Services Plan.

Efforts should continuously be made to monitor the progress of mitigation actions implemented through these other planning mechanisms and, where appropriate, their priority actions should be incorporated into updates of this hazard mitigation plan.

CONTINUED PUBLIC INVOLVEMENT

Continued public involvement is imperative to the overall success of the plan's implementation. Efforts will be made to involve the public in the plan maintenance, evaluation, and review process. This includes maintaining a digital version of the plan on the County Office of Emergency Services website for public review. In addition, information on who to contact within the Office of Emergency Services will be posted with the plan. The Emergency Manager in the Fresno County Office of Emergency Services will maintain a file of comments received for reference during the next five-year update. Any revisions to the plan that may occur as a result of a disaster will also be made public and posted on the County website.

The next five-year update process also provides an opportunity to solicit participation from new and existing stakeholders and to publicize success stories from the plan implementation and seek additional public comment. A public hearing(s) or survey to receive public comment on the plan will be held during the plan update period. When the HMPC reconvenes for the update, they will coordinate with all stakeholders participating in the planning process, including those who joined the HMPC after the initial effort, to update and revise the plan. Public notice will be posted and public participation will be invited, at a minimum, through available website postings and press releases to the local media outlets as well as email and social media announcements.

Continued public outreach and education is also an aspect of the mitigation strategy in Chapter 5 of this plan through inclusion of an action to develop and conduct a multi-hazard seasonal public awareness program on an annual basis.

THE COUNTY OF FRESNO 1856