Chapter 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 the Federal Emergency Management Agency (FEMA), risk is a combination of hazard, vulnerability, and exposure. "It is the impact that a hazard would have on people, services, facilities, and structures in a community and 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 natural hazards and assesses the exposure of lives, property, and infrastructure to these hazards. The process allows for a better understanding of a community's potential risk to natural 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 FEMA publication Understanding Your Risks—Identifying Hazards and Estimating Losses (FEMA 386-2, 2002), which breaks the assessment down to a four-step process:

1. Identify Hazards;
2. Profile Hazard Events;
3. Inventory Assets; and
4. Estimate Losses.

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

- **Section 4.1: Hazard Identification** identifies the natural hazards that threaten the Sacramento County Planning Area and describes why some hazards have been omitted from further consideration.
- **Section 4.2:**. **Sacramento County Assets at Risk** identifies the property values; populations; critical facilities; and cultural, historical, and natural resources at risk. This information is not hazard specific and covers the entire Sacramento County Planning Area.
- **Section 4.3: Hazard Profiles and Vulnerability Assessment** provides an overview of each hazard, its location and extent, and discusses the risk, vulnerability, and impacts of each natural hazard to the Planning Area. The hazard profile also describes previous occurrences of hazard events and the likelihood of future occurrences. The vulnerability assessment evaluates the Planning Area's and the unincorporated County's exposure to natural hazards; considering assets at risk, populations at risk, critical facilities, future development trends, and, where possible, estimates potential hazard losses.
- **Section 4.4: Capability Assessment** inventories existing local mitigation activities and policies, regulations, plans, and projects that pertain to mitigation and can affect net vulnerability.

This risk assessment covers the entire geographical extent of the Sacramento County Planning Area, including the incorporated communities and other participating jurisdictions. In accordance with FEMA requirements, this risk assessment describes how the hazards and risks vary across the Planning Area and 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 Sacramento County Planning Area.

This LHMP Update involved a comprehensive review and update of each section of the 2016 risk assessment. Information from the 2016 LHMP was used in this Plan Update where valid and applicable. As part of the risk assessment update, new data was used, where available, and new analyses were conducted. Where data from existing studies and reports was used, the source is referenced throughout this risk assessment. Refinements, changes, and new methodologies used in the development of this risk assessment update are summarized in Chapter 2 What's New and are also detailed in this risk assessment portion of this Plan.

4.1 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 Sacramento County Hazard Mitigation Planning Committee (HMPC) conducted a hazard identification assessment to determine the natural hazards that threaten the Planning Area. This section details the methodology and results of this effort.

Data Sources

The following data sources were used for this Hazard Identification portion of this Plan:

- California Office of Emergency Services (CAL OES)
- HMPC input
- National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC) Storm Events Database
- 2016 Sacramento County LHMP
- 2018 State of California Hazard Mitigation Plan
- FEMA Disaster Declaration Database

4.1.1. Results and Methodology

Using existing hazards data and input gained through planning meetings, the HMPC agreed upon a list of natural hazards that could affect the Sacramento County Planning Area. Hazards data from Cal OES, FEMA, the NOAA NCDC database, and many other sources were examined to assess the significance of these hazards to the Planning Area.

The following hazards in Table 4-1, listed alphabetically, were identified and investigated for this LHMP Update. As a starting point, the 2018 California State Hazard Mitigation Plan was consulted to evaluate the applicability of hazards of concern to the State, to the Sacramento County Planning Area. Building upon this effort, hazards from the 2016 Sacramento County Local Hazard Mitigation Plan (LHMP) were also identified, and comments explain how hazards were updated from the 2016 Plan. Most hazards from the 2016 plan were profiled in this LHMP Update. Fog was dropped for this 2021 Plan Update. The agricultural hazard and streambank erosion hazard were incorporated into other hazards. Pandemic was added to the Plan Update.

Table 4-1 Sacramento County Hazard Identification and Comparison from 2016 LHMP

2021 Hazards	2016 Hazards	Comment
–	Agricultural Hazards	This hazard was not a standalone hazard for this Plan Update. It is dealt with in multiple relevant hazard sections.
Climate Change	Climate Change	Additional data was added from the finalized Climate Action Plan. Data was added from the Climate Action Plan to this section as well as to other hazard sections.
Dam Failure	Dam Failure	Additional dams were added to the analysis using Cal OES and CA DWR Division of Safety of Dams inundation analysis.
Drought & Water Shortage	Drought & Water Shortage	Additional data was added from the droughts that occurred since the 2016 LHMP.
Earthquake	Earthquake	Additional data was added. New Hazus runs were completed and added to the vulnerability assessment.
Earthquake Liquefaction	Earthquake Liquefaction	Similar analysis was performed.
Floods: 1%/0.2% annual chance	Floods: 1%/0.2% annual chance	New DFIRM data was used to determine values at risk, populations at risk, and critical facilities at risk.
Floods: Localized Stormwater	Floods: Localized Stormwater	Similar analysis was performed.
Landslides, Mudslides, and Debris Flow	Landslides, Mudslides, and Debris Flow	Similar analysis was performed.
Levee Failure	Levee Failure	New DFIRM data was used to determine values at risk, populations at risk, and critical facilities at risk.
Pandemic	–	New Hazard
–	River/Stream/Creek Bank Erosion	This hazard was not a standalone hazard for this Plan Update. It is dealt with in the flood, dam failure, and levee failure hazards.
Severe Weather: Extreme Cold and Freeze	Severe Weather: Extreme Cold and Freeze	Similar analysis was performed.
Severe Weather: Extreme Heat	Severe Weather: Extreme Heat	Similar analysis was performed. PSPS discussion wase added.
–	Severe Weather: Fog	This hazard was dropped due to the limited mitigation efforts available to the County.
Severe Weather: Heavy Rains and Storms	Severe Weather: Heavy Rains and Storms	Similar analysis was performed.
Severe Weather: Wind and Tornado	Severe Weather: Wind and Tornado	Similar analysis was performed. PSPS discussion wase added.
Subsidence	Subsidence	Similar analysis was performed.

2021 Hazards	2016 Hazards	Comment
Volcano	Volcano	Similar analysis and research were performed.
Wildfire	Wildfire	Similar analysis was performed.

Certain hazards were excluded from consideration for this LHMP Update. They are shown in Table 4-2.

Table 4-2 Sacramento County – Excluded Hazards

Hazard Excluded	Why Excluded
Fog	This hazard was dropped due to the limited mitigation efforts available to the County
Tsunami	The County is not on the coast.
Air Pollution	The County did consider this a hazard for this Plan, it is dealt with in other planning mechanisms in the County. Smoke is discussed in the wildfire hazard.
Coastal Flooding, Erosion, and Sea Level Rise	The County is not on the coast.
Energy Shortage and Energy Resilience	The County did consider this a hazard, it is dealt with in other planning mechanisms in the County.
Natural Gas Pipeline Hazards	The County did not consider this a hazard due to the low number of gas pipelines traversing the County.
Oil Spills	The County did not consider this a hazard, as there are few pipelines or oil wells in the County.
Radiological Accidents	There are no areas in the County at risk to this hazard.
Subsidence	There are few areas of the County where subsidence is a risk. In addition, most subsidence is related to drought and water shortage, and will be discussed in that hazard profile and vulnerability assessment.
Cyber Threats	The County did consider this a hazard, but it is dealt with in other planning mechanisms in the County.
Airline Crashes	There have been few past occurrences in the County of airplane crashes. This is not a hazard to be included in the LHMP
Civil Disturbance	The County did consider this a hazard, but it is dealt with in other planning mechanisms in the County.
Well Stimulation and Hydraulic Fracking	This is not occurring in the County.

Table 4-3 was completed by the County and HMPC to identify, profile, and rate the significance of identified hazards. Those hazards identified as a high or medium significance are considered priority hazards for mitigation planning. Those hazards that occur infrequently or have little or no impact on the Planning Area were determined to be of low significance and not considered a priority hazard. Significance was determined based on the hazard profile, focusing on key criteria such as frequency, extent, and resulting damage, including deaths/injuries and property, crop, and economic damage. The ability of a community to reduce losses through implementation of existing and new mitigation measures was also considered as to the significance of a hazard. This assessment was used by the HMPC to prioritize those hazards of greatest significance to the Sacramento County Planning Area, enabling the County to focus resources where they are most needed.

Table 4-3 Sacramento County Hazard Assessment

Hazard	Geographic Extent	Likelihood of Future Occurrences	Magnitude/ Severity	Significance	Climate Change Influence
Climate Change	Extensive	Likely	Limited	Medium	–
Dam Failure	Significant	Occasional	Catastrophic	High	Medium
Drought & Water Shortage	Extensive	Likely	Limited	Medium	High
Earthquake	Extensive	Occasional	Catastrophic	Medium	Low
Earthquake Liquefaction	Limited	Occasional	Critical	Medium	Low
Floods: 1%/0.2% annual chance	Significant	Likely	Catastrophic	High	Medium
Floods: Localized Stormwater	Extensive	Highly Likely	Limited	Medium	Medium
Landslides, Mudslides, and Debris Flow	Limited	Occasional	Limited	Low	Medium
Levee Failure	Extensive	Occasional	Critical	High	Medium
Pandemic	Extensive	Likely	Catastrophic	Medium	Medium
Severe Weather: Extreme Cold and Freeze	Extensive	Highly Likely	Limited	Medium	Medium
Severe Weather: Extreme Heat	Extensive	Highly Likely	Limited	Medium	High
Severe Weather: Heavy Rains and Storms	Extensive	Highly Likely	Limited	Medium	Medium
Severe Weather: Wind and Tornado	Extensive	Highly Likely	Limited	Medium	Low
Subsidence	Significant	Highly Likely	Limited	Medium	Medium
Volcano	Extensive	Unlikely	Negligible	Low	Low
Wildfire	Significant	Highly Likely	Critical	High	High

Geographic Extent
Limited: Less than 10% of planning area
Significant: 10-50% of planning area
Extensive: 50-100% of planning area

Likelihood 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 10 years or less.
Occasional: Between 1 and 10% chance of occurrence in the next year, or has a recurrence interval of 11 to 100 years.
Unlikely: Less than 1% chance of occurrence in next 100 years, or has a recurrence interval of greater than every 100 years.

Magnitude/Severity
Catastrophic—More than 50 percent of property severely damaged; 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 and/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

Significance
Low: minimal potential impact
Medium: moderate potential impact
High: widespread potential impact

Climate Change Influence
Low: minimal potential impact
Medium: moderate potential impact
High: widespread potential impact

4.1.2. Disaster Declaration History

One method the HMPC used to identify hazards was the researching of past events that triggered federal and/or state emergency or disaster declarations in the Sacramento County Planning Area. 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.

Based on the disaster declaration history provided in Table 4-4, Sacramento County is among the many counties in California susceptible to disaster. Details on federal and state disaster declarations were obtained by FEMA and Cal OES and compiled in chronological order in Table 4-4. A review of state declared disasters indicates that Sacramento County received 28 state declarations between 1950 and 2020. Of the 28 state declarations: 19 were associated with severe winter storms, heavy rains, or flooding; 3 were for drought; 2 were from levee failure; 1 was from economic disasters, 1 was from earthquake, and 1 was from pandemic; and 1 was from fire. A review of federal disasters shows 21 federal disaster declarations. Of these 21 federal declarations: 14 were associated with severe winter storms, heavy rains, or flooding, 2 were from earthquake, 2 from levee break, 1 was from drought, 1 was from pandemic, and 1 was for hurricane (a nationwide declaration for Katrina evacuations). A summary of these events by disaster type is shown in Table 4-5.

Table 4-4 Sacramento County State and Federal Disaster Declarations, 1950-2020

Year	Disaster Name	Disaster Type	Disaster Cause	Disaster #	State Declaration #	Federal Declaration #
2021	Drought	Drought	Drought	–	4/10/2021	–
2020	Covid-19	Pandemic	Pandemic	DR-4482	3/4/2020	1/20/2020
2017	California Severe Winter Storms, Flooding, Mudslides	Flood	Storms	DR-4308	3/7/2017	4/1/2017
2017	California Severe Winter Storms, Flooding, And Mudslides	Flood	Storms	DR-4305	2/10/2017	3/16/2017

Year	Disaster Name	Disaster Type	Disaster Cause	Disaster #	State Declaration #	Federal Declaration #
2017	California Severe Winter Storms, Flooding, Mudslides	Flood	Storms	DR-4301	–	2/14/2017
2014	Napa Earthquake	Natural	Earthquake	EM-4193	–	9/17/2014
2014	California Drought	Drought	Drought	GP 2014-13	1/17/2014	–
2008	Central Valley Drought	Drought	Drought	GP 2008-03	6/12/2008	–
2008	2008 January Storms	Flood	Storms	GP 2008-01	1/5/2008	–
2005/2006	2005/06 Winter Storms	Flood	Storms	DR-1628	–	2/3/2006
2005	Hurricane Katrina Evacuations	Economic	Hurricane	EM-3248 2005	–	9/13/2005
2001	Energy Emergency	Economic	Greed	GP 2001	1/1/2001	–
1998	1998 El Nino Floods	Flood	Storms	DR-1203	Proclaimed	2/19/1998
1997	1997 January Floods	Flood	Storms	DR-1155	1/2/97-1/31/97	1/4/1997
1996	Torrential Winds and Rain	Flood	Storms	GP 96-01	1/21/1996	–
1995	1995 Late Winter Storms	Flood	Storms	DR-1046	Proclaimed	1/10/1995
1995	1995 Severe Winter Storms	Flood	Storms	DR-1044	1/6/95-3/14/95	1/13/1995
1989	Loma Prieta Earthquake	Earthquake	Earthquake	DR-845	10/18/89-10/30/89	10/18/1989
1986	1986 Storms	Flood	Storms	DR-758	2/18-86-3/12/86	2/18/1986
1983	Winter Storms	Flood	Flood	DR-677	12/8/82-3/21/83	2/9/1983
1982	High Tides and Rains	Flood	Storms	-	12/8/1982	–
1982	Heavy Rains and Flooding	Flood	Storms	DC 82-03	4/1/1982	–
1980	Delta Levee Break	Flood	Levee break	EM-3078	1/23/1980	1/23/1980
1977	1977 Drought	Drought	Drought	EM-3023	–	1/20/1977

Year	Disaster Name	Disaster Type	Disaster Cause	Disaster #	State Declaration #	Federal Declaration #
1973	Southern Pacific Railroad Fires and Explosions (Roseville)	Fire	Explosion	–	4/30/1973	–
1972	Andrus Island Levee Break	Flood	Levee break	DR-342	6/21/1972	6/27/1972
1969	1969 Storms	Flood	Storms	DR-253	1/23/69-3/12/69	1/26/1969
1964	1964 Late Winter Storms	Flood	Storms	DR-183	–	12/24/1964
1963	1963 Floods	Flood	Storms	–	2/14/1964	–
1958	1958 April Storms and Floods	Flood	Storms	DR-52	4/5/1958	4/4/1958
1958	1958 February Storms and Floods	Flood	Storms	CDO 58-03	2/26/1958	–
1955	1955 Floods	Flood	Flood	DR-47	12/22/1955	12/23/1955
1950	1950 Floods	Flood	Flood	OCD 50-01	11/21/1950	–

Source: Cal OES, FEMA

Table 4-5 Sacramento County – State and Federal Disaster Declarations Summary 1950-2020

Disaster Type	State Declarations		Federal Declarations	
	Count	Years	Count	Years
Drought	3	2008, 2014, 2021	1	1977
Economic	1	2001	0	–
Earthquake	1	1989	2	1989, 2014
Flood (including heavy rains and storms)	19	1950, 1955, 1958 (twice), 1963, 1969, 1982 (twice), 1983, 1986, 1995 (twice), 1996, 1997, 1998, 2008, 2017 (three times)	14	1955, 1958, 1964, 1969, 1983, 1986, 1995 (twice), 1997, 1998, 2006, 2017 (three times)
Hurricane	0	–	1	2005
Levee Break	2	1972, 1980	2	1972, 1980
Pandemic	1	2020	1	2020
Fire	1	1973	0	–
Totals	**28**	–	**21**	**–**

Source: Cal OES, FEMA

Disasters since 2016 Plan

As detailed above, there have been four federal disaster declarations and four state disaster declarations since the 2016 plan:

- 2017 Floods (three federal and two state)
- 2020 Pandemic (state and federal)
- 2021 Drought (state only)

4.2 Sacramento County Assets at Risk

As a starting point for analyzing the Sacramento County Planning Area's vulnerability to identified hazards, the HMPC used a variety of data to establish a baseline against which all disaster impacts could be compared. If a catastrophic disaster were to occur, this section describes significant assets at risk in the Planning Area. This baseline assessment included:

- Values at risk;
- Critical facility inventory;
- Cultural, historical, and natural resources; and
- Growth and development trends.

Data Sources

Data used to support this assessment included the sources listed below. Where data and information from these studies, plans, reports, and other data sources were used, the source is referenced as appropriate throughout this vulnerability assessment.

- CalAtlas
- California Department of Finance
- California Department of Fish and Game
- California Department of Parks and Recreation Office of Historic Preservation
- California Natural Diversity Database
- Hazus MH 4.2
- State of California Department of Conservation
- US Census Bureau

4.2.1. Values at Risk

Parcel Inventory and Assessed Values

This analysis captures the values associated with assessed values located within Sacramento County. The 2020 Sacramento County Parcel/Assessor's data, obtained from Sacramento County, was used for as the basis of this analysis. This data provided by Sacramento County represents best available data.

Understanding the total assessed value of Sacramento County is a starting point to understanding the overall value of identified values at risk in the County. When the total assessed values are combined with potential values associated with other community assets such as public and private critical infrastructure, historic and cultural resources, and natural resources, the big picture emerges as to what is potentially at risk and vulnerable to the damaging effects of natural hazards within the County.

Methodology

Sacramento County's 2020 Assessor Data and the County's GIS parcel data were used as the basis for the inventory of assessed values for both improved and unimproved parcels within the County. This data provides the land, improved, and property values assessed for each parcel, along with key information such as property use. Other GIS data, such as jurisdictional boundaries, roads, streams, and area features, was also obtained from Sacramento County and CalAtlas to support countywide mapping and analysis of values at risk. The Sacramento County GIS parcel data contained 480,365 parcels for the County and the jurisdictions in the County.

Data Limitations & Notations

Although based on best available data, the resulting information should only be used as an initial guide to overall values in the County. In the event of a disaster, structures and other infrastructure improvements are at the greatest risk of damage. Depending on the type of hazard and resulting damages, the land itself may not suffer a significant loss. For that reason, the values of structures and other infrastructure improvements are of greatest concern. As such, it is critical to note a specific limitation to the assessed values data within the County, created by Proposition 13. Instead of adjusting property values annually, no adjustments are made until a property transfer occurs. As a result, overall property value information is most likely low and may not reflect current market or true potential loss values for properties within the County.

Another limitation to this data is found in the Williamson Act, also known as the California Land Conservation Act of 1965, that enables local governments to enter into contracts with private landowners for the purpose of restricting specific parcels of land to agricultural or related open space use. When the County enters into a contract with the landowners under the Williamson Act, the landowner agrees to limit the use of the land to agriculture and compatible uses for a period of at least ten years and the County agrees to tax the land at a rate based on the agricultural production of the land rather than its real estate market value. This further affects the County's overall values for assessed taxable lands.

The 2020 GIS parcel and Assessor data was obtained to perform the spatial analysis. GIS was used to convert the parcel polygons into centroids representing each record in the assessor database. For the purposes of this analysis, the centroids which were not coincident in locations were re-positioned to overlay on the corresponding polygons so that each assessor record (with a unique assessor parcel number) was spatially positioned on the corresponding parcel. In addition, multiple parcels polygons in the GIS data were constructed as multi-part features, of which only one centroid was representative of each parcel polygon. The position of the centroids may result in less accurate hazard analysis overlay results.

Property Use Categories

Sacramento County's GIS data contained land use designations which provide detailed descriptive information about how each property is generally used, such as agricultural, commercial, government, industrial, institutional, recreational, residential, and right of way. The land use codes from County assessor data were refined and categorized into ten property use categories and linked back to the Sacramento County Assessor data. The final property use categories for Sacramento County are:

- Agricultural
- Care/Health
- Church/Welfare
- Industrial
- Miscellaneous
- Office
- Public/Utilities
- Recreational
- Residential
- Retail / Commercial
- Unknown
- Vacant

Once the land use descriptions were grouped into categories, the number of total and improved parcels, as well as land, improved, and personal property values were inventoried for the County by property use.

Estimated Content Replacement Values

Sacramento County's assigned property use categories were used to develop estimated content replacement values (CRVs) that are potentially at loss from hazards. FEMA's standard CRV factors were utilized to develop more accurate loss estimates for all mapped hazard analyses. FEMA's CRV factors estimate value as a percent of improved structure value by property use. Table 4-6 shows the breakdown of the different property uses in the County and their estimated CRV factors.

Table 4-6 Sacramento County – Content Replacement Factors by Property Use

Sacramento County Property Use Categories	Hazus Property Use Categories	Hazus Content Replacement Values
Agricultural	Agricultural	100%
Care / Health	Commercial	100%
Church / Welfare	Agriculture	100%
Industrial	Industrial	150%
Miscellaneous	Commercial	100%
Office	Commercial	100%
Public / Utilities	Commercial	100%
Recreational	Commercial	100%
Residential	Residential	50%

Sacramento County Property Use Categories	Hazus Property Use Categories	Hazus Content Replacement Values
Retail / Commercial	Commercial	100%
Unknown	–	0%
Vacant	–	0%

Source: Hazus

Sacramento County Values at Risk Results

Values associated with land, and improved structures were identified and summed in order to determine assessed values at risk in the Sacramento County Planning Area. Together, the land and improved structure values make up the majority of assessed values associated with each identified parcel or asset. Improved parcel counts were based on the assumption that a parcel was improved if a structure value was present. Content replacement values were then added to the assessed values, as described below, to provide an estimate of values at risk in the Planning Area.

Table 4-7 shows the values or exposure for the Sacramento County Planning Area (using CRV multipliers from Table 4-6). This table is important as potential losses to the County include structure contents. In addition, loss estimates contained in the hazard vulnerability sections of this Chapter will use calculations based on these values, including content replacement values. The values for unincorporated Sacramento County are broken out by property use and are provided in Table 4-8. Value by property use for each jurisdiction are shown in their respective annexes to this LHMP Update.

Table 4-7 Sacramento County Planning Area – Values at Risk by Jurisdiction

Jurisdiction	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Citrus Heights	26,777	25,821	$2,277,237,402	$5,468,554,811	$3,145,021,676	$10,890,813,812
City of Sacramento	155,590	142,896	$16,332,022,285	$43,393,435,771	$29,079,630,819	$88,805,089,586
Elk Grove	55,584	51,809	$6,262,511,293	$16,354,975,148	$9,440,010,477	$32,057,496,894
Folsom	27,058	23,614	$4,438,593,844	$10,586,357,670	$6,529,539,035	$21,554,490,501
Galt	7,986	7,448	$644,457,481	$1,729,332,844	$1,012,152,850	$3,385,943,179
Isleton	536	338	$22,717,211	$41,268,279	$26,053,556	$90,039,044
Rancho Cordova	23,785	21,532	$2,696,956,614	$6,828,148,604	$4,998,621,168	$14,523,726,265
Unincorporated Sacramento County	183,049	169,427	$19,422,480,231	$43,355,681,994	$26,570,892,145	$89,349,054,509
Grand Total	**480,365**	**442,885**	**$52,096,976,361**	**$127,757,755,121**	**$80,801,921,726**	**$260,656,653,790**

Source: Sacramento County 2020 Parcel/Assessor's Data

Table 4-8 Unincorporated Sacramento County – Values at Risk by Property Use

Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Agricultural	2,613	1,449	$801,660,657	$658,862,428	$658,862,428	$2,119,385,513
Care / Health	216	198	$131,900,158	$614,090,007	$614,090,007	$1,360,080,172
Church / Welfare	459	397	$145,947,373	$661,326,743	$661,326,743	$1,468,600,859
Industrial	1,592	1,235	$719,553,030	$1,947,938,284	$2,921,907,432	$5,589,398,729
Miscellaneous	3,718	24	$12,701,744	$693,587	$693,587	$14,088,918
Office	1,379	1,239	$506,954,191	$1,473,664,075	$1,473,664,075	$3,454,282,341
Public / Utilities	662	1	$1,229,203	$1,483,565	$1,483,565	$4,196,333
Recreational	222	132	$65,013,903	$114,175,555	$114,175,555	$293,365,013
Residential	163,880	162,310	$14,776,101,762	$35,445,531,283	$17,722,765,349	$67,944,398,550
Retail / Commercial	2,248	2,097	$1,286,423,724	$2,401,923,404	$2,401,923,404	$6,090,270,532
Unknown	9	7	$85,000	$517,602	$0	$602,602
Vacant	6,051	338	$974,909,486	$35,475,461	**$0**	$1,010,384,947
Unincorporated Sacramento County Total	**183,049**	**169,427**	**$19,422,480,231**	**$43,355,681,994**	**$26,570,892,145**	**$89,349,054,509**

Source: Sacramento County 2020 Parcel/Assessor's Data

4.2.2. Critical Facility Inventory

Sacramento County continues to utilize their critical facility definition initially developed for their 2010 LHMP. However, this critical facility dataset has been recently updated and may not in all cases align with the definition; it is included here as the critical facility dataset continues to be updated and refined for the Sacramento County Planning Area with the intent to include all facilities that meet this definition.

For purposes of this plan, a critical facility is defined as:

> ***Any facility, including without limitation, a structure, infrastructure, property, equipment or service, that if adversely affected during a hazard event may result in severe consequences to public health and safety or interrupt essential services and operations for the community at any time before, during and after the hazard event.***

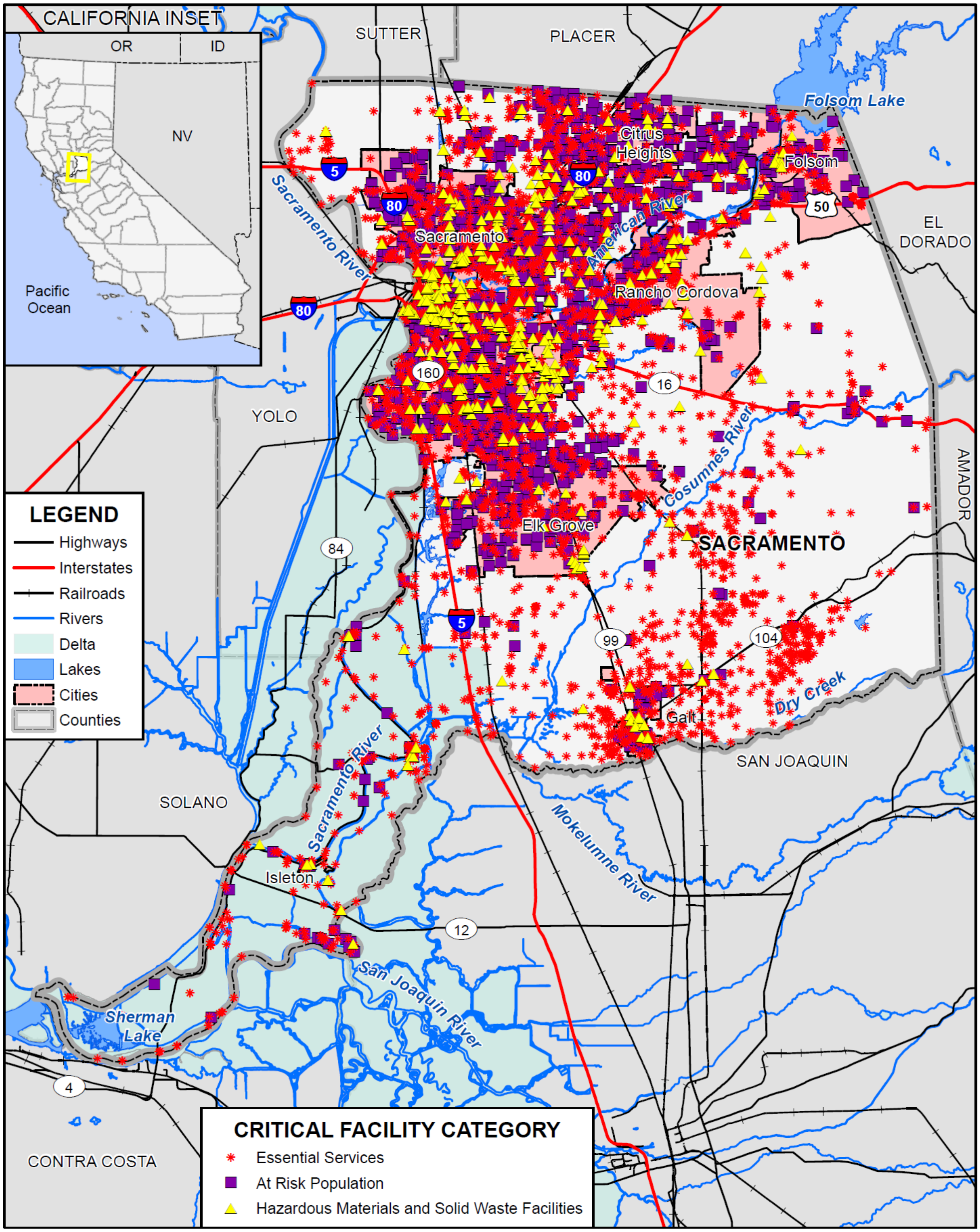
A critical facility is classified by the following categories: (1) Essential Services Facilities, (2) At-risk Populations Facilities, (3) Hazardous Materials and Solid Waste Facilities,

- Essential Services Facilities include, without limitation, public safety, emergency response, emergency medical, designated emergency shelters, communications, public utility plant facilities and equipment, and government operations facilities.

- At Risk Population Facilities include, without limitation, pre-schools, public and private primary and secondary schools, before and after school care centers with 12 or more students, daycare centers with 12 or more children, group homes, and assisted living residential or congregate care facilities with 12 or more residents.
- Hazardous Materials and Solid Waste Facilities include, without limitation, any facility that could, if adversely impacted, release of hazardous materials or waste in sufficient amounts during a hazard event that would create harm to people, the environment and property.

A summary of critical facilities in the Sacramento County Planning Area can be found in Figure 4-1 and Table 4-9. Table 4-10 details critical facilities by category. Additional details of individual critical facilities can be found in Appendix F of this Plan Update.

Figure 4-1 Sacramento County Planning Area – Critical Facilities



Data Source: Sacramento County GIS, Cal-Atlas; Map Date: 08/2021.

Table 4-9 Sacramento County Planning Area – Critical Facility Summary by Jurisdiction

Jurisdiction/Critical Facility Category	Facility Count
Citrus Heights	
Essential Services Facilities	76
At Risk Population Facilities	108
Hazardous Materials and Solid Waste Facilities	12
Citrus Heights Total	**196**
City of Sacramento	
Essential Services Facilities	1,284
At Risk Population Facilities	843
Hazardous Materials and Solid Waste Facilities	250
City of Sacramento Total	**2,377**
Elk Grove	
Essential Services Facilities	318
At Risk Population Facilities	171
Hazardous Materials and Solid Waste Facilities	18
Elk Grove Total	**507**
Folsom	
Essential Services Facilities	152
At Risk Population Facilities	89
Hazardous Materials and Solid Waste Facilities	10
Folsom Total	**251**
Galt	
Essential Services Facilities	111
At Risk Population Facilities	38
Hazardous Materials and Solid Waste Facilities	11
Galt Total	**160**
Isleton	
Essential Services Facilities	9
At Risk Population Facilities	4
Hazardous Materials and Solid Waste Facilities	3
Isleton Total	**16**
Rancho Cordova	
Essential Services Facilities	225
At Risk Population Facilities	153
Hazardous Materials and Solid Waste Facilities	20
Rancho Cordova Total	**398**

Jurisdiction/Critical Facility Category	Facility Count
Unincorporated Sacramento County	
Essential Services Facilities	2,552
At Risk Population Facilities	952
Hazardous Materials and Solid Waste Facilities	176
Unincorporated Sacramento County Total	**3,680**
Grand Total	**7,585**

Source: Sacramento County GIS

Table 4-10 Sacramento County Planning Area – Critical Facilities by Jurisdiction and Facility Type

Jurisdiction/Critical Facility Category	Critical Facility Type	Facility Count
Citrus Heights		
Essential Services Facilities	Emergency Evacuation Center	8
	EMS Stations	4
	FDIC Insured Banks	13
	Fire Station	5
	Law Enforcement	2
	Microwave Service Towers	17
	Water Well	27
	Total	**76**
At Risk Population Facilities	Colleges, Universities, and Professional Schools	3
	Day Care Center	27
	Mobile Home Parks	10
	Places of Worship	37
	School	31
	Total	**108**
Hazardous Materials and Solid Waste Facilities	Leaky Underground Storage Tank	12
	Total	**12**
Citrus Heights Total		**196**
City of Sacramento		
Essential Services Facilities	Airport	1
	Bridge	26
	Cellular Tower	2
	Emergency Evacuation Center	91
	EMS Stations	26

Jurisdiction/Critical Facility Category	Critical Facility Type	Facility Count
	FDIC Insured Banks	82
	Fire Station	22
	Floodgate	43
	Hospital or Urgent Care	16
	Law Enforcement	27
	Microwave Service Towers	501
	Port Facilities	6
	Power Plants	7
	Public Transit Stations	41
	Pump Station	200
	Sewage Treatment Plant	9
	State Government Buildings	33
	Water Well	151
	Total	**1,284**
At Risk Population Facilities	Colleges, Universities, and Professional Schools	11
	Community Center	2
	Day Care Center	140
	Major Sports Venues	3
	Mobile Home Parks	22
	Places of Worship	427
	School	238
	Total	**843**
Hazardous Materials and Solid Waste Facilities	EPA ER FRP Facility	2
	EPA ER TRI Facility	39
	EPA ER TSCA Facility	3
	Leaky Underground Storage Tank	174
	Solid Waste Facility	23
	Tank Farm	4
	Waste Transfer Station	5
	Total	250
City of Sacramento Total		**2,377**
Elk Grove		
Essential Services Facilities	Cellular Tower	2
	Emergency Evacuation Center	8
	EMS Stations	7
	FDIC Insured Banks	26

Jurisdiction/Critical Facility Category	Critical Facility Type	Facility Count
	Fire Station	6
	Hospital or Urgent Care	1
	Law Enforcement	2
	Microwave Service Towers	107
	Sewage Treatment Plant	1
	Water Well	158
	Total	**318**
At Risk Population Facilities	Day Care Center	36
	Mobile Home Parks	1
	Places of Worship	89
	School	45
	Total	**171**
Hazardous Materials and Solid Waste Facilities	EPA ER TRI Facility	6
	EPA ER TSCA Facility	3
	Leaky Underground Storage Tank	4
	Solid Waste Facility	4
	Waste Transfer Station	1
	Total	**18**
Elk Grove Total		**507**
Folsom		
Essential Services Facilities	Bridge	1
	Cellular Tower	7
	Emergency Evacuation Center	4
	FDIC Insured Banks	19
	Fire Station	5
	Hospital or Urgent Care	4
	Law Enforcement	4
	Microwave Service Towers	86
	Power Plants	5
	Public Transit Stations	3
	Water Well	14
	Total	**152**
At Risk Population Facilities	Colleges, Universities, and Professional Schools	1
	Community Center	1
	Day Care Center	13
	Mobile Home Parks	6

Jurisdiction/Critical Facility Category	Critical Facility Type	Facility Count
	Places of Worship	40
	School	28
	Total	**89**
Hazardous Materials and Solid Waste Facilities	EPA ER TRI Facility	2
	Leaky Underground Storage Tank	8
	Total	**10**
Folsom Total		**251**
Galt		
Essential Services Facilities	Cellular Tower	2
	Emergency Evacuation Center	5
	EMS Stations	2
	FDIC Insured Banks	6
	Fire Station	3
	Law Enforcement	2
	Microwave Service Towers	55
	Sewage Treatment Plant	1
	Water Well	35
	Total	**111**
At Risk Population Facilities	Day Care Center	6
	Mobile Home Parks	4
	Places of Worship	14
	School	14
	Total	**38**
Hazardous Materials and Solid Waste Facilities	EPA ER TRI Facility	3
	Leaky Underground Storage Tank	7
	Waste Transfer Station	1
	Total	**11**
Galt Total		**160**
Isleton		
Essential Services Facilities	Emergency Evacuation Center	1
	EMS Stations	1
	Fire Station	2
	Law Enforcement	1
	Microwave Service Towers	2
	Water Well	2
	Total	**9**

Jurisdiction/Critical Facility Category	Critical Facility Type	Facility Count
At Risk Population Facilities	Day Care Center	1
	Mobile Home Parks	1
	School	2
	Total	**4**
Hazardous Materials and Solid Waste Facilities	Leaky Underground Storage Tank	3
	Total	**3**
Isleton Total		**16**
Rancho Cordova		
Essential Services Facilities	Bridge	16
	Cellular Tower	14
	City Facility	5
	Drainage Pump Station	6
	Emergency Evacuation Center	6
	EMS Stations	6
	FDIC Insured Banks	11
	Fire Station	4
	Hospital or Urgent Care	4
	Law Enforcement	4
	Microwave Service Towers	77
	Power Plants	1
	Public Transit Stations	4
	State Government Buildings	1
	Water Well	66
	Total	**225**
At Risk Population Facilities	Colleges, Universities, and Professional Schools	3
	Community Center	5
	Day Care Center	23
	Mobile Home Parks	8
	Places of Worship	77
	School	34
	Senior Living or Other Living	3
	Total	**153**
Hazardous Materials and Solid Waste Facilities	EPA ER FRP Facility	1
	EPA ER TRI Facility	2
	Leaky Underground Storage Tank	12
	Solid Waste Facility	2

Jurisdiction/Critical Facility Category	Critical Facility Type	Facility Count
	Tank Farm	2
	Waste Transfer Station	1
	Total	**20**
Rancho Cordova Total		**398**
Unincorporated Sacramento County		
Essential Services Facilities	Airport	3
	Bridge	51
	Cellular Tower	23
	Emergency Evacuation Center	54
	EMS Stations	49
	FDIC Insured Banks	58
	Fire Station	57
	Hospital or Urgent Care	4
	Law Enforcement	26
	Microwave Service Towers	1,018
	Port Facilities	46
	Power Plants	40
	Public Transit Stations	7
	Pump Station	7
	Sandbag Site	3
	Sewage Treatment Plant	4
	State Government Buildings	3
	Water Well	1,099
	Total	**2,552**
At Risk Population Facilities	Colleges, Universities, and Professional Schools	12
	Community Center	4
	Day Care Center	140
	Mobile Home Parks	65
	Places of Worship	414
	School	317
	Total	**952**
Hazardous Materials and Solid Waste Facilities	EPA ER FRP Facility	2
	EPA ER TRI Facility	23
	EPA ER TSCA Facility	1
	Leaky Underground Storage Tank	127
	Solid Waste Facility	22

Jurisdiction/Critical Facility Category	Critical Facility Type	Facility Count
	Waste Transfer Station	1
	Total	**176**
Unincorporated Sacramento County Total		**3,680**
Grand Total		**7,585**

Source: Sacramento County GIS

4.2.3. Cultural, Historical, and Natural Resources

Assessing Sacramento County's vulnerability to disasters also involves inventorying the cultural, historical, and natural resource assets of the area. This information 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.
- In the event of a disaster, an accurate inventory of cultural, historical and natural resources allows for more prudent care in the disaster's immediate aftermath when the potential for additional impacts is 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 and sensitive habitats which help absorb and attenuate floodwaters and thus support overall mitigation objectives.

Cultural and Historical Resources

Sacramento County has a large stock of historically significant homes, public buildings, and landmarks. To inventory these resources, information was collected from a number of 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, 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 and 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 or 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 or 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 4-11.

Table 4-11 Sacramento County Planning Area – Historical Resources

Name (Landmark Plaque Number)	National Register	State Landmark	California Register	Point of Interest	Date Listed	City/Area
A. W. Clifton House, Compton Mansion (C17)			X		2/1/2002	Sacramento
Adams And Company Building (607)		X			5/22/1957	Sacramento
Alkali Flat Central Historic District (N1294)	X				7/26/1984	Sacramento
Alkali Flat North Historic District (N1279)	X				4/19/1984	Sacramento
Alkali Flat West Historic District (N1295)	X				7/26/1984	Sacramento
Alta Mesa Farm Bureau Hall (N1476)	X				1/7/1987	Wilton
American River Grange Hall #172 (P823)	X			X	5/15/1996	Rancho Cordova
Archway, The (P614)				X	5/18/1983	Rio Linda
B. F. Hastings Building (606)		X			5/22/1957	Sacramento
Blue Anchor Building (N1171)	X				2/3/1983	Sacramento
Brewster Building (N2099)	X				8/16/2000	Galt
Brewster House (N638)	X				6/23/1978	Galt
Brighton School (N952)	X				4/3/1981	Sacramento
Brown, John Stanford, House (N2252)	X				7/28/2004	Walnut Grove
Business & Professional Building, Consumer Affairs Building (C8)			X		2/10/2000	Sacramento
California Almond Growers Exchange Processing Facility (967)		X			10/1/1985	Sacramento

Name (Landmark Plaque Number)	National Register	State Landmark	California Register	Point of Interest	Date Listed	City/Area
California Governor's Mansion (N60)	X				11/10/1970	Sacramento
California State Capitol (N222)	X				4/3/1973	Sacramento
California's Capitol Complex (872)	X	X			5/6/1974	Sacramento
California's First Passenger Railroad (526)		X			3/7/1955	Sacramento
Calpak Plant No. 11 (N1285)	X				5/17/1984	Sacramento
Camp Union, Sacramentoville (666)		X			11/5/1958	Sacramento
Capitol Extension District (N1288)	X				5/24/1984	Sacramento
Chevra Kaddisha (Home of Peace Cemetery) (654)		X			7/28/1958	Sacramento
Chinese Diggings, Natoma Station Ground Sluice (P712)				X	11/22/1988	Folsom
Chung Wah Cemetery (N1918)	X				8/21/1995	Folsom
Cohn House (N1001)	X				1/21/1982	Folsom
Coloma Road at Nimbus Dam (746)		X			7/5/1960	Folsom
Coloma Road at Sacramento's Fort (745)		X			7/5/1960	Sacramento
Coolot Company Building (N671)	X				9/20/1978	Sacramento
Cranston--Geary House (N2010)	X				1/23/1998	Sacramento
Crocker, E. B., Art Gallery (N86)	X	X			5/6/1971	Sacramento
Curran Farmhouse (P666)				X	12/17/1985	Sacramento
D. O. Mills Bank Building (609)		X			5/22/1957	Sacramento
Delta Meadows Site (N130)	X				11/5/1971	Locke
Dunlap's Dining Room (N1764)	X				4/2/1992	Sacramento
Eagle Theater (595)		X			5/22/1957	Sacramento
Eastern Star Hall (P754)	X			X	8/8/1991	Sacramento
Ebner's Hotel (602)		X			5/22/1957	Sacramento
Ehrhardt, William, House (N2209)	X				7/10/2003	Elk Grove
Elk Grove Grammar School / Elk Grove Unified School Distr (P717)				X	6/12/1989	Elk Grove
Elk Grove Historic District (N1553)	X				3/1/1988	Elk Grove
Fifteen Mile House-Overland Pony Express Route in California (698)		X			9/11/1959	Rancho Cordova
Fire Station No. 6 (N1686)	X				4/25/1991	Sacramento
Firehouse No. 3 (N1743)	X				10/29/1991	Sacramento
First Transcontinental Railroad (780)		X			11/20/1962	Sacramento

Name (Landmark Plaque Number)	National Register	State Landmark	California Register	Point of Interest	Date Listed	City/Area
First Transcontinental Railroad-Western Base of The Sierra Nevada (780)		X			11/20/1962	Sacramento
Five Mile House-Overland Pony Express Route in California (697)		X			9/11/1959	Sacramento
Folsom Depot (N1035)	X				2/19/1982	Folsom
Folsom Powerhouse (N258)	X				10/2/1973	Folsom
Folsom-Overland Pony Express Route in California (702)		X			9/11/1959	Folsom
Galarneaux, Mary Haley, House (N2121)	X				2/12/2001	Sacramento
George Hack House (P800)				X	8/5/1994	Sacramento
Goethe House (N1036)	X				2/19/1982	Sacramento
Governor's Mansion (823)		X			6/7/1968	Sacramento
Grave of Alexander Hamilton Willard (657)		X			9/26/1958	Franklin
Grave of Elitha Cumi Donner Wilder (719)		X			12/2/1959	Elk Grove
Greene, John T., House (N1092)	X				4/15/1982	Sacramento
Headquarters of The Big Four (600)		X			5/22/1957	Sacramento
Heilbron House (N462)	X				12/12/1976	Sacramento
Hotel Regis (N1147)	X				10/29/1982	Sacramento
Hotel Senator (N782)	X				5/30/1979	Sacramento
Howe, Edward P., Jr., House (N1037)	X				2/19/1982	Sacramento
Hubbard-Upson House (N543)	X				12/2/1977	Sacramento
I Street Bridge (N1094)	X				4/22/1982	Sacramento
Imperial Theatre (N1148)	X				10/29/1982	Walnut Grove
Indian Stone Corral (N349)	X				4/16/1975	Orangevale
Isleton Chinese And Japanese Commercial Districts (N1674)	X				3/14/1991	Isleton
J Street Wreck (N1692)	X				5/16/1991	Sacramento
Jean Harvie School, Walnut Grove Community Center (P665)				X	8/20/1985	Walnut Grove
Joe Mound (N121)	X				10/14/1971	Sacramento
Johnson, J. Neely, House (N438)	X				9/13/1976	Sacramento
Joseph Hampton Kerr Homesite (P126)				X	6/6/1969	Sacramento
Judah, Theodore, School (N1985)	X				7/25/1997	Sacramento
Kuchler Row (N1121)	X				6/25/1982	Sacramento

Name (Landmark Plaque Number)	National Register	State Landmark	California Register	Point of Interest	Date Listed	City/Area
Lady Adams Building (603)		X			5/22/1957	Sacramento
Lais, Charles, House (N1350)	X				2/28/1985	Sacramento
Libby Mcneil And Libby Fruit and Vegetable Cannery (N1050)	X				3/2/1982	Sacramento
Liberty Schoolhouse (P579)				X	12/21/1981	Galt
Locke Historic District (N87)	X				5/6/1971	Locke
McClatchy, C.K., Senior High School (N2148)	X				11/2/2001	Sacramento
Merchants National Bank of Sacramento (N1936)	X				2/16/1996	Sacramento
Merrium Apartments (N1654)	X				9/13/1990	Sacramento
Mesick House (N1002)	X				1/21/1982	Sacramento
Michigan (468)		X			8/30/1950	Sacramento
Motor Vehicle Building, Department of Food & Agriculture (C4)			X		11/5/1999	Sacramento
Murphy's Ranch (680)		X			5/11/1959	Elk Grove
Negro Bar (P798)				X	5/31/1994	Folsom
New Helvetia Cemetery (592)		X			5/22/1957	Sacramento
Nisenan Village Site (N562)	X				3/21/1978	Carmichael
Nisipowinan Village Site (900)	X	X			6/16/1976	Sacramento
Old Elk Grove Hotel Site (P532)				X	6/29/1979	Sacramento
Old Fair Oaks Bridge (N2342)	X				9/25/2006	Fair Oaks
Old Folsom Powerhouse (633)		X			3/3/1958	Folsom
Old Folsom Powerhouse-Sacramento Station A (633)		X			3/3/1958	Sacramento
Old Sacramento (812)	X	X			12/30/1965	Sacramento
Old Tavern (N1242)	X				9/15/1983	Sacramento
Original Sacramento Bee Building (611)		X			5/22/1957	Sacramento
Overton Building (610)		X			5/22/1957	Sacramento
Pioneer Telegraph Station (366)		X			10/9/1939	Sacramento
Pony Express Terminal (N66000220)	X				10/15/1966	Sacramento
Prairie City (464)		X			8/30/1950	Prairie City
Public Works Office Building, Caltrans Building (C5)			X		11/5/1999	Sacramento
Rae House (P743)				X	5/8/1991	Galt
River Mansion (P149)				X	11/3/1969	Sacramento

Name (Landmark Plaque Number)	National Register	State Landmark	California Register	Point of Interest	Date Listed	City/Area
Rosebud Ranch (N846)	X				12/31/1979	Hood
Ruhstaller Building (N1003)	X				1/21/1982	Sacramento
Runyon House (N2109)	X				10/27/2000	Courtland
Rusch Home (P737)				X	2/11/1991	Citrus Heights
Sacramento Air Depot Historic District (N1747)	X				1/21/1992	North Highlands
Sacramento Bank Building (N1004)	X				1/21/1982	Sacramento
Sacramento City Cemetery (566)		X			2/25/1957	Sacramento
Sacramento City Library (N1784)	X				7/30/1992	Sacramento
Sacramento Hall of Justice (N2067)	X				9/24/1999	Sacramento
Sacramento Junior College Annex and Extensions (N1874)	X				8/22/1994	Sacramento
Sacramento Masonic Temple (N2131)	X				5/17/2001	Sacramento
Sacramento Memorial Auditorium (N566)	X				3/29/1978	Sacramento
Site of China Slough (594)		X			5/22/1957	Sacramento
Site of Congregational Church (613)		X			5/22/1957	Sacramento
Site of First and Second State Capitols at Sacramento (869)		X			1/11/1974	Sacramento
Site of First County Free Library Branch in California (817)		X			6/1/1967	Elk Grove
Site of Grist Mill Built by Jared Dixon Sheldon (439)		X			6/2/1949	Slough house
Site of Home of Newton Booth (596)		X			5/22/1957	Sacramento
Site of Orleans Hotel (608)		X			5/22/1957	Sacramento
Site of Sacramento Union (605)		X			5/22/1957	Sacramento
Site of Sam Brannan House (604)		X			5/22/1957	Sacramento
Site of Stage and Railroad (First) (598)		X			5/22/1957	Sacramento
Site of The First African American Episcopal Church Established on The Pacific Coast (1013)		X			5/5/1994	Sacramento
Site of The First Jewish Synagogue Owned by A Congregation on The Pacific Coast (654)		X			7/28/1958	Sacramento
Site of Pioneer Mutual Volunteer Firehouse (612)		X			5/22/1957	Sacramento
Slocum House (N744)	X				1/31/1979	Fair Oaks
Sloughhouse (575)		X			5/17/1957	Sloughhouse

Name (Landmark Plaque Number)	National Register	State Landmark	California Register	Point of Interest	Date Listed	City/Area
Southern Pacific Railroad Company's Sacramento Depot (N353)	X				4/21/1975	Sacramento
Southern Pacific Railroad Superintendent House (N2411)	X				6/13/2008	Folsom
St. Elizabeth's Church (P611)				X	3/2/1983	Sacramento
Stanford-Lathrop House (614)		X			5/22/1957	Sacramento
Sacramento's Fort (525)		X			11/1/1954	Sacramento
Sacramento's Landing (591)		X			5/22/1957	Sacramento
Sacramentoville (593)		X			5/22/1957	Sacramento
Temporary Detention Camps for Japanese Americans-Sacramento Assembly Center (934)		X			5/13/1980	Sacramento
Terminal of California's First Passenger Railroad (558)		X			12/31/1956	Folsom
The Villa (Serve Our Seniors, Incorporated) (P764)				X	2/14/1992	Orangevale
Tower Bridge (N1116)	X				6/24/1982	Sacramento
Travelers' Hotel (N680)	X				10/19/1978	Sacramento
U.S. Post Office, Courthouse and Federal Building (N855)	X				1/25/1980	Sacramento
Utah Condensed Milk Company Plant (N650)	X				8/3/1978	Galt
Van Voorhies House (N535)	X				11/17/1977	Sacramento
Wagner, Anton, Duplex (N923)	X				11/10/1980	Sacramento
Walnut Grove Chinese-American Historic District (N1630)	X				3/22/1990	Walnut Grove
Walnut Grove Commercial/Residential Historic District (N1634)	X				4/12/1990	Walnut Grove
Walnut Grove Gakuen Hall (N882)	X				6/17/1980	Walnut Grove
Walnut Grove Japanese-American Historic District (N1631)	X				3/22/1990	Walnut Grove
Western Hotel (601)		X			5/22/1957	Sacramento
Westminster Presbyterian Church (N2203)	X				5/22/2003	Sacramento
Wetzlar, Julius, House (N1183)	X				3/31/1983	Sacramento
What Cheer House (597)		X			5/22/1957	Sacramento
Whitter Ranch (Originally Saylor Ranch), Witter Ranch (P744)				X	5/8/1991	Sacramento
Winters House (N2046)	X				1/25/1999	Sacramento

Name (Landmark Plaque Number)	National Register	State Landmark	California Register	Point of Interest	Date Listed	City/Area
Witter, Edwin, Ranch (N1675)	X				3/14/1991	Sacramento
Woodlake Site (N88)	X				5/6/1971	Sacramento
Yeong Wo Cemetery (P810)				X	5/30/1995	Folsom

Source: California Department of Parks and Recreation Office of Historic Preservation, http://ohp.parks.ca.gov/

It should be noted that these lists may not be complete, as they may not include those 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, in the event that 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 cost/benefit 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 reducing the force of and storing floodwaters.

Sacramento County is home to a variety of important vegetation and wildlife. Natural habitats in the County include vernal pools, wetlands, special status species habitats, riparian, oak woodland and grassland prairies. Wetland and riparian areas in the County include historic backwater basins along the Sacramento River, the American River Parkway, and the nationally significant valley oak riparian forest along the lower Cosumnes River.

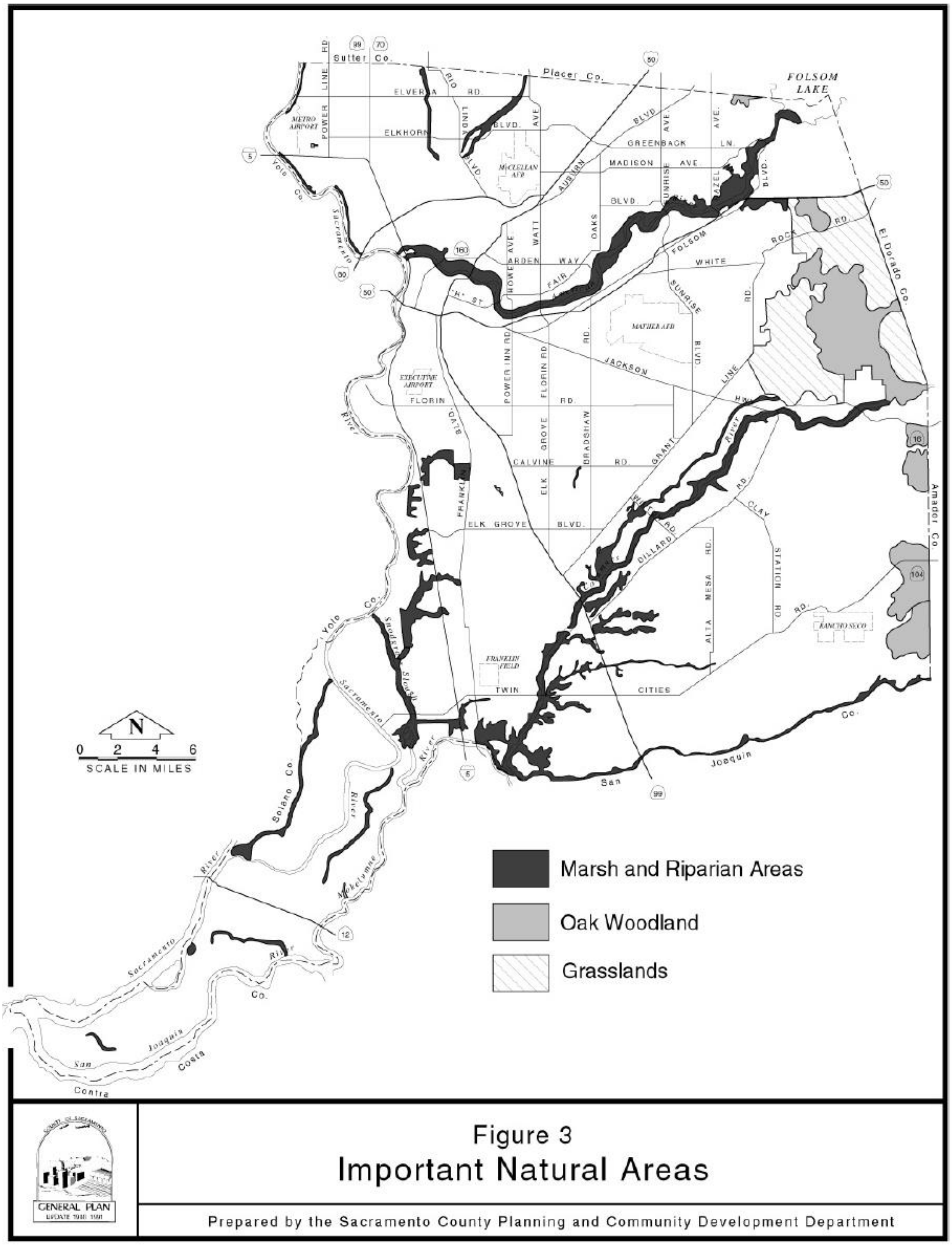
The Beach/Stone Lakes area, a designated National Wildlife Refuge, hosts thousands of waterfowl migrating along the Central Valley leg of the Pacific Flyway. The area is a dynamic and vigorous habitat supporting, among other species, American white pelican, great blue heron, northern harrier, coyote, grey fox, beaver, and possibly bobcat. The County's American River Parkway, bisecting the urban environs, has protected a vibrant riparian forest stretching along the lower American River. The undammed Cosumnes, exemplary of what was once expansive woodlands, represents a comparatively unaltered Central Valley ecosystem with slough, wetland, and riparian habitats, each slightly different in its ecological balance. Other significant wetland and riparian areas exist along Delta sloughs and seasonal creeks flowing into the major drainages.

Sacramento County is home to a variety of native tree and grassland habitats. The native tree habitats are defined as oak woodlands, oak savannah, and mixed riparian woodlands and the dominant grassland habitat being that of the California Prairie. These vegetative habitats are very important to the future of Sacramento County; however, due to the combined effects of urbanization, agricultural conversion, overgrazing, the introduction of invasive plant and wildlife species, climatic changes, and fuel wood harvesting, California's native vegetation have been unable to maintain existing populations.

Sacramento County once supported limited oak savannah and riparian woodland, with an herbaceous layer of perennial grasses and both annual and perennial wildflowers. These woodland areas were centered on the County's three main rivers: Sacramento, American and Cosumnes. Expansive native valley grassland, also referred to as California prairie, stretched out from the edge of these woodlands and blanketed the bulk of the County's landscape. Vernal pools were scattered in both low and high density clusters throughout the valley grassland habitat. After European settlement of the County, many of the native perennial grasses were replaced by Mediterranean annual grasses. However, within the vernal pools native vegetation uniquely suited to springtime inundation survived. Today these vernal pools harbor a number of listed plant and animal species. In addition to vernal pools, other seasonal and emergent wetlands occurred, mostly in association with the many natural drainage systems that previously flowed through the County, but which are now either channelized or confined within a system of artificial levees.

The County of Sacramento is fortunate to have several locations where vestiges of the once vast and diverse Central Valley natural habitat areas still exist. Habitat areas include riparian zones, riverine habitats, wetlands, woodlands, and grasslands. These are shown in Figure 4-2. This map delineates areas considered primarily natural such as riparian zones, marshlands, and oak woodlands. The boundaries are drawn based on review of reports and maps of public and private agencies including the U.S. Fish and Wildlife Service's (USFWS) National Wetlands Inventory maps, the State Department of Water Resource's Delta Atlas, the California Department of Fish and Game's Natural Diversity Database, and aerial photography.

Figure 4-2 Important Natural Areas in Sacramento County



Source: Sacramento County General Plan Open Space Element Background

Remaining marsh and riparian areas in the County include backwater basins and riparian woodlands along the Sacramento, American, and Cosumnes Rivers and other smaller waterways, and in the Delta. These biologically dynamic areas host thousands of waterfowl migrating along the Central Valley leg of the Pacific Flyway. In addition, numerous other migratory and resident species, some of which are listed as threatened or endangered, inhabit the County's natural areas. Species include majestic colony birds such as the American egret and great blue heron, the opportunistic coyote, the industrious beaver, deer, and elusive grey fox and bobcat.

The wetland and riparian areas are regarded as the County's most important resource. Such habitat becomes all the more significant when viewed against the acreage lost since the time of European settlement. Approximately 95 percent of the Central Valley's wetlands have disappeared in the last 100 years, reducing habitat for millions of migratory waterfowl. Riparian habitat has suffered a similar fate. In the Sacramento River Valley only 25,000 of the estimated 500,000 acres of the riparian habitat existing in 1850 exists today.

The aquatic environment of the County supports tens of thousands of anadromous fish and rears a comparable number of resident species. Anadromous fish include salmon, bass, shad, and sturgeon. Resident fish include trout, catfish, sunfish, and bullhead. With the development of urban areas and water projects, fisheries have declined. This loss has been generated by habitat destruction, water diversion, and temperature increases.

Extending out from the riparian zone are the distinctive upland habitats of the Central Valley, scattered with oak, blanketed with grazing lands, and dotted with vernal pools. Native oaks, signature trees of the Central Valley have declined in population over the years to accommodate agriculture and development. Concentrated efforts will need to be undertaken if the County is to preserve the isolated groves and diminishing woodlands. Native grasslands have virtually disappeared due to grazing and development. The once prolific and well adapted bunchgrass has been displaced by invasive weeds from the Mediterranean region. The vernal pools which once dotted vast areas of the Central Valley landscape, are found only in concentrations in the southern section of the County. The pools sustain flora and fauna adapted to the ephemeral nature of these small yet vibrant habitats.

The preservation and restoration of the diverse habitats located throughout the County is extremely important to help support ecosystem processes and functions. Each habitat type or plant community must be conserved to maintain a viable, self-perpetuating ecosystem. For instance, not only do nesting sites need to be preserved for the Swainson's Hawk, but foraging habitat must also be protected to provide a viable food source. A full range of native biodiversity, maintained in an integrated manner, helps promote sustainable habitat and wildlife populations. Large landscape level preserves interconnected by habitat corridors are increasingly recognized as the most effective method to protect species by preserving ecological landscapes.

Significant Natural Areas of Sacramento County

Sourced from information provided in the Sacramento County General Plan Background Report, Table 4-12 below outlines the location and rationale for listing of significant natural areas in Sacramento County.

Table 4-12 Description of Significant Natural Areas in Sacramento County

Location	Comments
Mokelumne/Cosumnes Drainage	
Lower Cosumnes River	Support more than 100,000 waterfowl; sandhill crane here; important and unique natural area; variety of hydrological conditions in small area at merging of Valley River and Delta systems; undammed, represents unaltered valley ecosystem; system of sloughs and marshes each slightly different in its ecological balance; intermixing of habitats enhances ecological diversity.
Deer Creek - Cosumnes Riparian Corridor	Good riparian woodland cover along most of both banks of both water courses; occasional clear spots; generally is narrow band along each watercourse, occasionally widens to hardwood forest in valley portion.
Badger Creek	Wetlands, riparian and valley oaks amid valley grassland. Excellent example of historical Sacramento Valley habitat. Especially scenic from Highway 99.
Lower Mokelumne, Dry Creek, Grissley and Bear Sloughs	Riparian vegetation along all water courses; excellent grassland, riparian, woodland mix along Bear Slough; some of grassland and woodland along Mokelumne has been leveled since 1973.
Mokelumne River	Riparian vegetation on levee side of river.
Dry Creek	Riparian corridor occasionally widening to woodland areas.
Laguna Creek	Intermittent stream with riparian habitat; two miles of riparian woodland with large trees; lower reaches include seasonal marsh along creek and tributaries.
Stones Lake/Delta	
Beach Lake/ Morrison Creek*	Permanent and seasonal marsh in what used to be Beach Lake; riparian forest along Morrison Creek, essentially intact since 1937, dominated by cottonwood and willow; a riparian area abundantly rich in wildlife and plant communities.
Lower Laguna Creek*	Seasonal wetland, ponds and vernal pools with adjacent grassland; channel modifications in conjunction with upstream improvements along Laguna Creek.
North Stone Lake*	Morrison Creek levee on north, I-5 on east, Hood-Franklin Road on south and Southern Pacific Railroad on west.
South Stone Lake	Includes 93 acres riparian, 446 acres marsh, 186 acres upland, 121 acres water; rest of 3,480 acres is agriculture; supports excellent warm water fishery; supplements North Stone Lake as important wildlife area; part of number one ranked site for new western National Wildlife Refuge; with North Stone Lake, is one of the most important ecological complexes in Delta.
Snodgrass Slough	Shrub brush and occasional riparian woodland along northernmost Delta slough in Sacramento.
Delta Meadows*	Significant prime natural resource area; remnant of valley oak woodland; in excess of 110 bird species, abounds with small mammals; state park acquisition project.
Lost Slough	Waterway and adjacent riparian habitat linking Lower Cosumnes and Delta Meadows, Snodgrass Slough and the Delta river system.
Steamboat Slough	Riparian shrub-brush and woodland at south end near Howard Landing and along north portion.
Grand Island Tip	Mason's lilaeopsis, Delta tule pea, and Sacramento anthacid beetle found here; state designated significant natural area.
Georgiana Slough	Shrub-brush and occasional woodland riparian along open slough.
Seven Mile Slough	Riparian trees and shrub-brush along a little-used slough.

Location	Comments
Brannan Island*	Site of Antioch Dunes evening primrose, very rare plant; state designated significant nature area.
Mayberry Slough	Deadend slough, isolated for wildlife habitat.
Southwest Tip of County	Upland habitat; blue heron rookery; several rare and endangered species.
Chain Island	Isolated island, formerly diked with coastal brackish marsh habitat; Mason's ilaeopsis and Suisun marsh aster; state designated significant natural area.
Eastern Sacramento County	
Upper Laguna Creek	Dense stand of riparian vegetation listed as one of three most important sections on Laguna Creek (the other two are now urban creek sections).
Sloughhouse South	One of best sites of valley elderberry longhorn beetle habitat; state designated significant natural area.
Meiss-Ione Road Overlook	Only lesser nighthawks in Sacramento County; vernal pools with unusual dwarf plant.
Scott Road Raptor Area	Open shortgrass prairie with sparse to dense valley and blue oak thickets, mostly in southern area; dense cottonwood-willow riparian vegetation along stream courses; habitat for one of largest concentrations of raptoral birds in Sacramento region; grand wildflower displays in spring.
Sloughhouse Vernal Pools	Concentrations of vernal pools; very rare Sacramento orcutt grass found near County dump; state designated significant natural area.
Rancho Seco Lake*	About 500 plants of Sacramento orcutt grass; state designated significant natural area.
Jackson Highway Oak Woodland	None
Twin Cities Road Oak Woodland	None
South Area Vernal Pools	Quality of pools is unknown; may contain rare and endangered plants.
North Sacramento	
Garden Highway	Greatest concentration of riparian woodland in Sacramento County along Sacramento River; riparian woodlands are seven times greater in extent than disturbed riprap areas to south; coexists with several homes; Swainson's hawk nests.
Alder Creek	Excellent riparian area; diverse vegetation and wildlife; spillway and marsh; upstream ponds add diversity; good beaver and muskrat habitat.
Fair Oaks Bald Spot*	Excellent examples of vernal pools with Sacramento orcutt grass; state designated significant natural area.
Lake Natoma*	American River bluffs, 100 feet high, cut by several small canyons; rich foothill woodland plant community; some of most varied and dense floral displays in Sacramento County; cottonwood dredger tailing riparian at Negro Bar with jungle-like mixture of oak, buckeye, elderberry, et al on higher ground.
East Main Drain*	Waterfowl habitat; year round habitat; much disturbance, dumping.
Dry Creek*	Dual channel with grassland/farming in between creates good wildlife habitat. Good riparian cover along creek channels.
American River Parkway*	Mix of riparian, freshwater marsh, oak woodland, grassland, inhabited by great variety of plant and wildlife species.

Source: Sacramento General Plan Background Report

* indicates all or a major part of the area is in public or quasi-public ownership

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.

The California Natural Diversity Database, a program that inventories the status and locations of rare plants and animals in California, was queried to create an inventory of special status species in Sacramento County. A summary list of these species is found below in Table 4-13. Appendix E list the name, federal status, state status, California Department of Fish and Wildlife status, and the California Rare Plant rank of species in Sacramento County.

Table 4-13 Sacramento County Planning Area – Summary of Special Status Species

Type	Number
Animals - Amphibians	2
Animals - Birds	52
Animals – Crustaceans	5
Animals - Fish	18
Animals - Insects	8
Animals - Mammals	10
Animals – Mollusks	2
Animals – Reptiles	3
Community – Terrestrial	9
Plants – Vascular	36

Source: California Natural Diversity Database

Wetlands

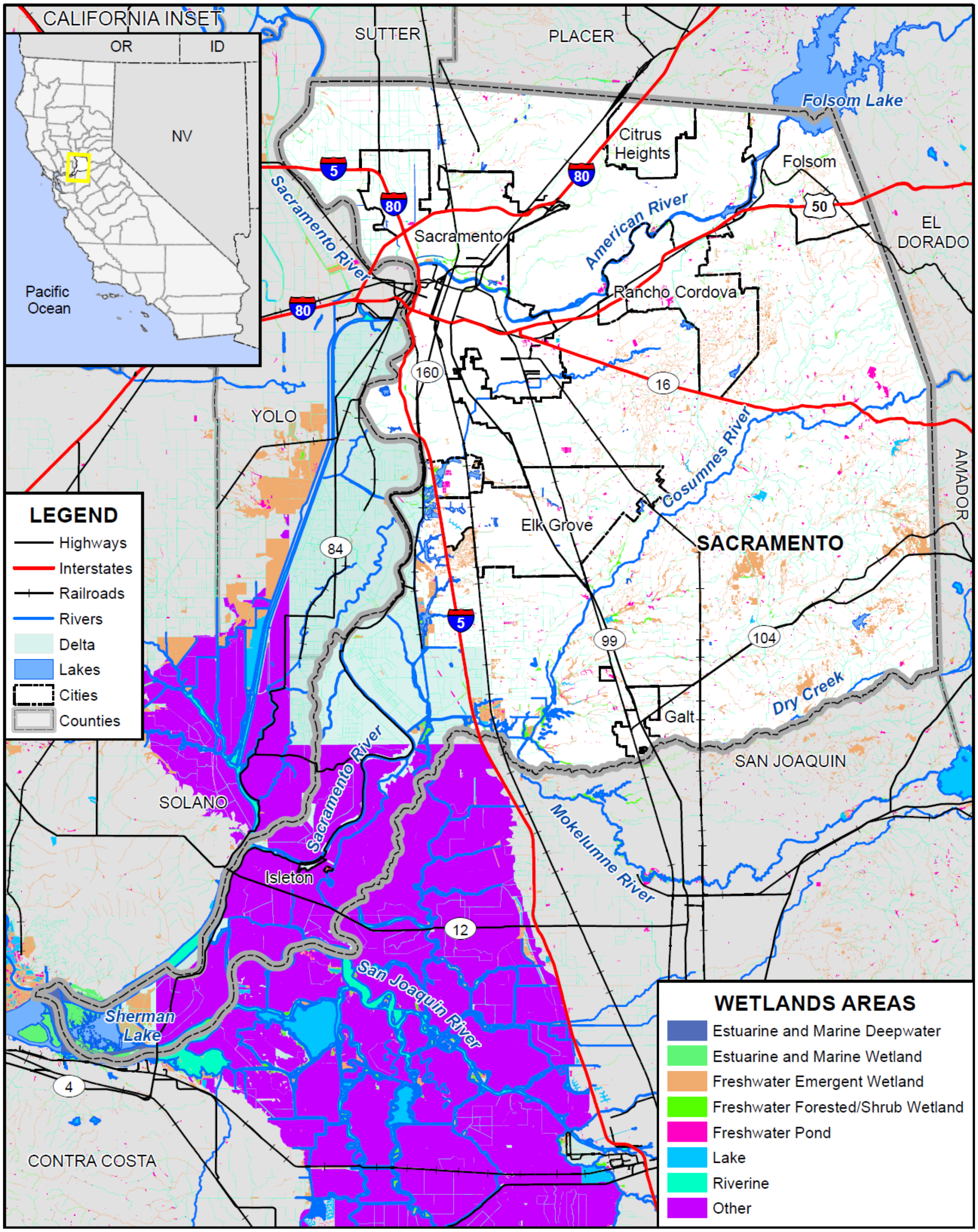
Wetlands are habitats in which soils are intermittently or permanently saturated or inundated. Wetland habitats vary from rivers to seasonal ponding of alkaline flats and include swamps, bogs, marshes, vernal pools, and riparian woodlands. Wetlands are considered to be waters of the United States and are subject to the jurisdiction of the U.S. Army Corps of Engineers as well as the California Department of Fish and Wildlife. Where the waters provide habitat for federally endangered species, the USFWS may also have authority.

Wetlands function as natural sponges that trap and slowly release surface water, rain, snowmelt, groundwater and flood waters. Trees, root mats, and other wetland vegetation also slow the speed of floodwaters and distribute them more slowly over the floodplain. This combined water storage and braking action lowers flood heights and reduces erosion. Wetlands within and downstream of urban areas are particularly valuable, counteracting the greatly increased rate and volume of surface- water runoff from pavement and buildings. The holding capacity of wetlands helps control floods and prevents water logging of crops. Preserving and restoring wetlands, together with other water retention, can often provide the level of flood control otherwise provided by expensive dredge operations and levees.

Wetlands are a valuable natural resource for communities providing beneficial impact 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 is 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.

The USFWS has mapped wetlands areas throughout the United States. Figure 4-3 shows the wetlands areas in the County. These areas are detailed in Table 4-14 by wetland type.

Figure 4-3 Sacramento County – Wetlands Areas



FOSTER MORRISON CONSULTING

SACRAMENTO COUNTY

Data Source: U.S. Fish and Wildlife Service National Wetlands Inventory 10/2017, Sacramento County GIS, Cal-Atlas; Map Date: 05/2021.

Table 4-14 Unincorporated Sacramento County – Wetlands Areas by Area Type

Wetlands Area Type	Wetlands Area (in Acres)
Estuarine and Marine Deepwater	1
Estuarine and Marine Wetland	104
Freshwater Emergent Wetland	5,945
Freshwater Forested/Shrub Wetland	940
Freshwater Pond	1,686
Lake	34
Riverine	2,390
Other	50
Unincorporated Sacramento County Total	**11,150**

Source: USFWS

Wetlands: Natural and Beneficial Functions

Wetlands are often found in floodplains and depressional areas of a watershed. Many wetlands receive and store floodwaters, thus slowing and reducing downstream flow. Wetlands perform a variety of ecosystem functions including food web support, habitat for insects and other invertebrates, fish and wildlife habitat, filtering of waterborne and dry-deposited anthropogenic pollutants, carbon storage, water flow regulation (e.g., flood abatement), groundwater recharge, and other human and economic benefits.

Wetlands, and other riparian and sensitive areas, provide habitat for insects and other invertebrates that are critical food sources to a variety of wildlife species, particularly birds. There are species that depend on these areas during all parts of their lifecycle for food, overwintering, and reproductive habitat. Other species use wetlands and riparian areas for one or two specific functions or parts of the lifecycle, most commonly for food resources. In addition, these areas produce substantial plant growth that serves as a food source to herbivores (wild and domesticated) and a secondary food source to carnivores.

Wetlands slow the flow of water through the vegetation and soil, and pollutants are often held in the soil. In addition, because the water is slowed, sediments tend to fall out, thus improving water quality and reducing turbidity downstream.

These natural floodplain functions associated with the natural or relatively undisturbed floodplain that moderates flooding, such as wetland areas, are critical for maintaining water quality, recharging groundwater, reducing erosion, redistributing sand and sediment, and providing fish and wildlife habitat. Preserving and protecting these areas and associated functions are a vital component of sound floodplain management practices for the Sacramento County Planning Area.

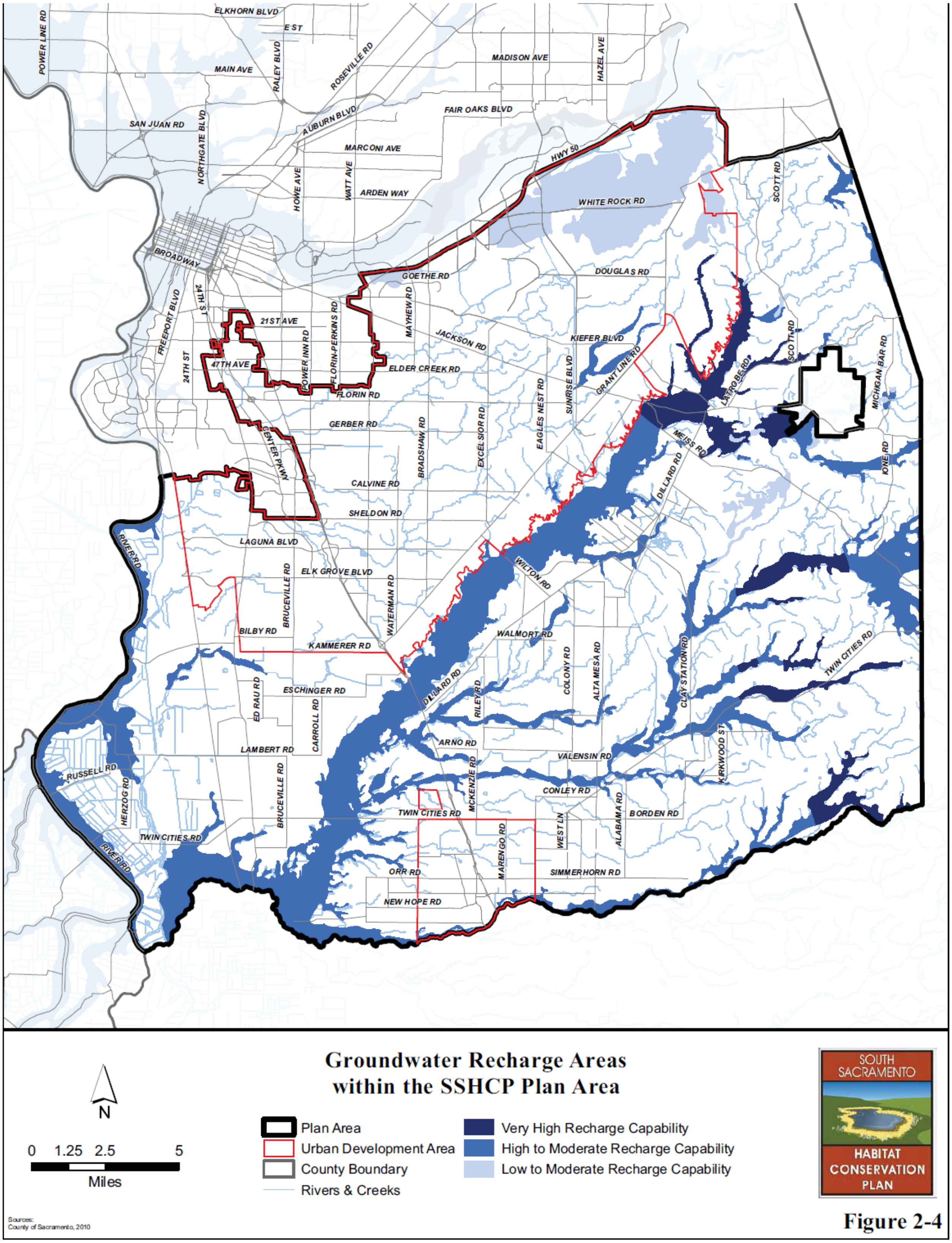
A prime example of a natural floodplain functions in Sacramento is the American River Parkway. American River Parkway provides 23-miles of fishing, boating, guided natural and historic tours, bike paths, and much more.

Groundwater Recharge

The South Suburban Habitat Conservation Plan (SSHCP) Plan Area is entirely within the 20,000-square-mile Central Valley Aquifer System, but is split between two basins, the Sacramento Valley Groundwater Basin and the San Joaquin Valley Groundwater Basin. Precipitation that does not run off, or is not lost through evaporation and transpiration, travels beneath the surface as subsurface water. The pattern of movement of water, from the time it enters the ground to the time it emerges either naturally or by pumping from a well, is controlled by the subsurface conditions encountered. Upon entering the ground, water moves downward until it reaches a zone of saturation. This happens whenever water from precipitation, stream flow, applied irrigation, and various other water sources sinks into the ground through the open spaces in permeable materials. The size of these open spaces ranges from minute pores in clays to intergranular openings in deposits of sand and gravel, and open crevices along bedrock fractures. The area over which this is accomplished is called a recharge area.

Within the SSHCP Plan Area, most recharge occurs in locations along river channel deposits where they cross exposures of water-transmitting rocks. Here the channel deposits are very permeable, allowing for rapid infiltration of water down to water-bearing materials. Water flows over these recharge areas during the entire year and affords partial replenishment of the groundwater body (Figure 4-4). In addition to river channel recharge, recharge can occur through percolation of precipitation, percolation of irrigation return flows, and subsurface boundary inflow from adjacent aquifers.

Figure 4-4 Groundwater Recharge in Sacramento County



Source: South Sacramento Habitat Conservation Plan

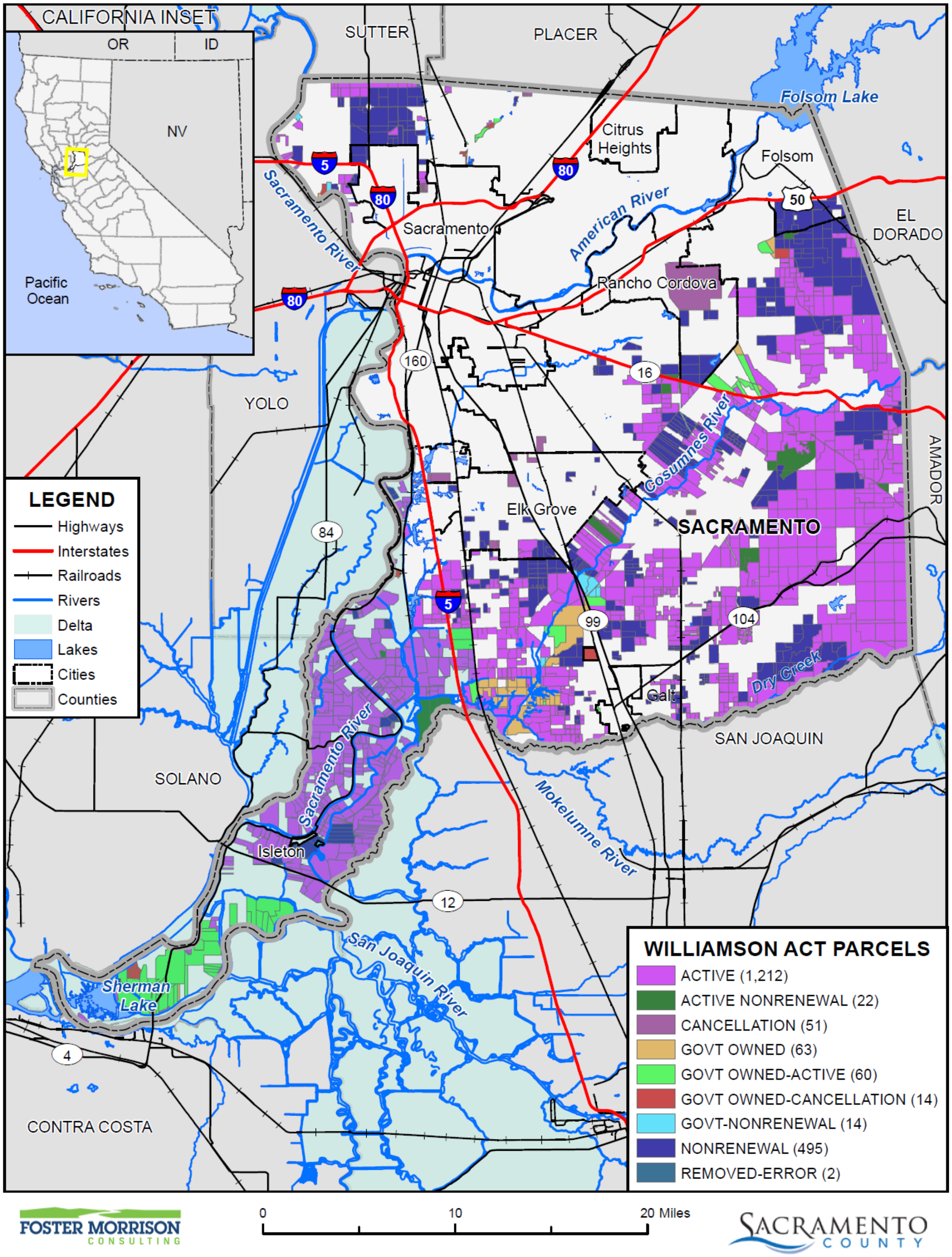
Farmlands

Farmlands are important considerations in many counties in California. Sacramento County is located within the northern portion of California's Central Valley in the area known as the Sacramento Valley. It contains some of the richest soils in the State. These soils make the County's agricultural resources very productive.

Williamson Act

The Williamson Act, also known as the California Land Conservation Act of 1965, enables local governments to enter into contracts with private landowners for the purpose of restricting specific parcels of land to agricultural or related open space use. When the County enters into a contract with the landowners under the Williamson Act, the landowner agrees to limit the use of the land to agriculture and compatible uses for a period of at least ten years and the County agrees to tax the land at a rate based on the agricultural production of the land rather than its real estate market value. This affects the County's overall values for assessed taxable lands. The County has designated areas as agricultural preserves within which the county will enter into contracts for the preservation of the land in agriculture. These are shown on Figure 4-5.

Figure 4-5 Sacramento County – Williamson Act Lands



Data Source: Sacramento County GIS, Cal-Atlas; Map Date: 05/2021.

Source: California Department of Conservation

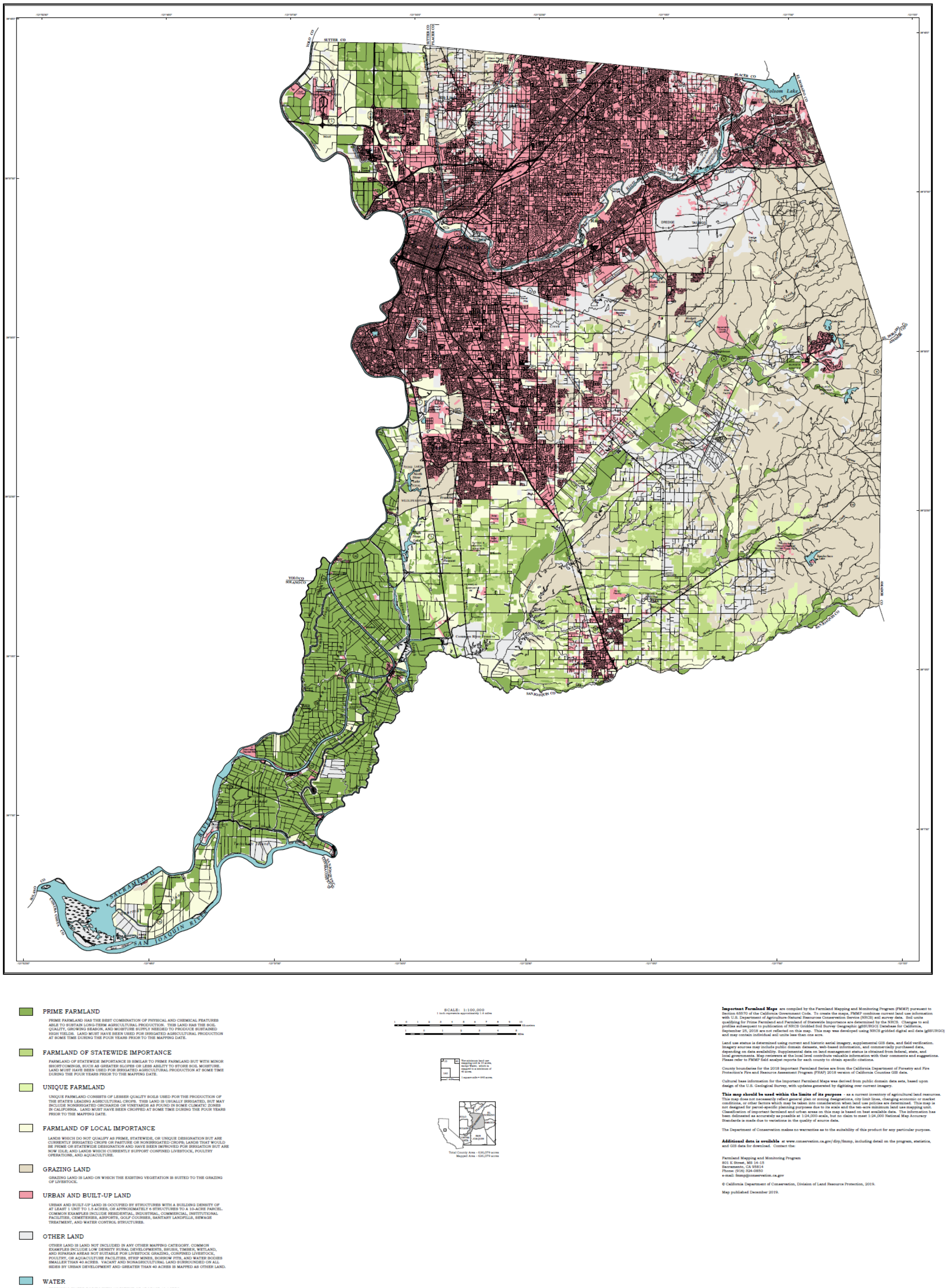
State Inventory of Important Farmland

The Farmland Mapping and Monitoring Program was established in 1984 to document the location, quality, and quantity of agricultural lands and conversion of those lands over time. The program provides impartial analysis of agricultural land use changes throughout California. For inventory purposes, several categories were developed to describe the qualities of land in terms of its suitability for agricultural production. The State Department of Conservation utilizes the following classification system:

- The Prime Farmland category describes farmland with the best combination of physical and chemical features able to sustain long term agricultural production. This land has the soil quality, growing season, and moisture supply needed to produce sustained high yields. Land must have been used for irrigated agricultural production at some time during the four years prior to the mapping date.
- Farmland of Statewide Importance is farmland similar to Prime Farmland but with minor shortcomings, such as greater slopes or less ability to store soil moisture. Land must have been used for irrigated agricultural production at some time during the four years prior to the mapping date.
- Unique Farmland is farmland of lesser quality soils used for the production of the state's leading agricultural crops. This land is usually irrigated, but may include non-irrigated orchards or vineyards as found in some climatic zones in California. Land must have been cropped at some time during the four years prior to the mapping date.
- Farmland of Local Importance is either currently producing crops or has the capability of production. This farmland category is determined by each county's board of supervisors and a local advisory committee.

The 2018 maps are the most recent versions. These lands are shown in Figure 4-6.

Figure 4-6 Sacramento County – Farmland of Importance



Source: California Department of Conservation

4.2.4. Growth and Development Trends

As part of the planning process, changes in growth and development, both past and future were identified and examined the context of hazard-prone areas, and how the changes in growth and development affect vulnerability over time. Information from the Sacramento County General Plan Housing Element, the California Department of Finance, and the US Census Bureau form the basis of this discussion.

Current Status and Past Populations

The estimated population of Sacramento County (both incorporated communities and the unincorporated County) for January 1, 2020 was 1,555,365 (of which 593,801 were in the unincorporated County), representing an eleven-fold increase from 141,199 people in 1930. Table 4-15 illustrates the pace of population growth in Sacramento County dating back to 1930. Growth in the County has been steady, with smaller growth coming in the last decade. Table 4-16 shows the recent growth in the County and its incorporated jurisdictions.

Table 4-15 Sacramento County Planning Area – Population Growth 1930-2020

Year	Population	Percent Change
1930	141,199	–
1940	170,333	20.0%
1950	277,140	62.7%
1960	502,778	81.4%
1970	631,498	25.6%
1980	783,381	24.1%
1990	1,041,219	32.9%
2000	1,223,499	17.5%
2010	1,445,327	18.1%
2020	1,555,365	7.6%

Sources: California Department of Finance, US Census Bureau

Table 4-16 Population Growth for Jurisdictions in Sacramento County, 2000-2020

Area	2000	2010	2020	% Change 2000 to 2020
Citrus Heights	85,071	87,752	87,811	3.2%
Elk Grove*	0	121,803	176,154	–
Folsom	51,884	66,242	81,610	57.3%
Galt	19,472	22,856	25,849	32.7%
Isleton	828	822	828	0.0%
Rancho Cordova*	0	55,099	78,381	–
Sacramento	407,018	453,592	510,931	25.5%
Unincorporated	659,226	560,483	593,801	-9.9%**

Area	2000	2010	2020	% Change 2000 to 2020
Total	**1,223,499**	**1,445,327**	**1,555,365**	**20.2%**

Source: US Census Bureau, California Department of Finance

*Elk Grove was incorporated in 2000; Rancho Cordova was incorporated in 2002

**This number is misleading, as two current cities were part of the unincorporated County in 2000.

Special Populations and Disadvantaged Communities

The County noted multiple special populations and disadvantaged communities within the County. These are captured in the following sections:

- Sacramento Homeless/Transient Populations Tracking
- Center for Disease Control Social Vulnerability Index
- CA DWR Special Population and Disadvantaged Community Mapping
- Climate Change and Health Profile Report – Sacramento County

Sacramento Homeless/Transient Populations Tracking

The County provided data from homeless "heat maps." Location of these areas (Address or Cross Streets) include:

- 21st Ave and Stockton Blvd, Sacramento
- 65th St and Stockton Blvd
- 7010 Auburn Blvd, Citrus Heights
- 6483 Watt Ave, North Highlands
- Elk Horn Blvd and Linda Lane, Rio Linda
- Antelope and Roseville Road
- Marconi between Fair Oaks Blvd & Walnut
- Madison and Hwy 80
- 5700 Stockton Blvd.
- 3534 51st Ave.
- Florin and East Parkway
- Florin and 65th
- 7171 Bowling Drive
- Roseville Road
- McDonalds on Alhambra
- Trinity Cathedral
- St Johns

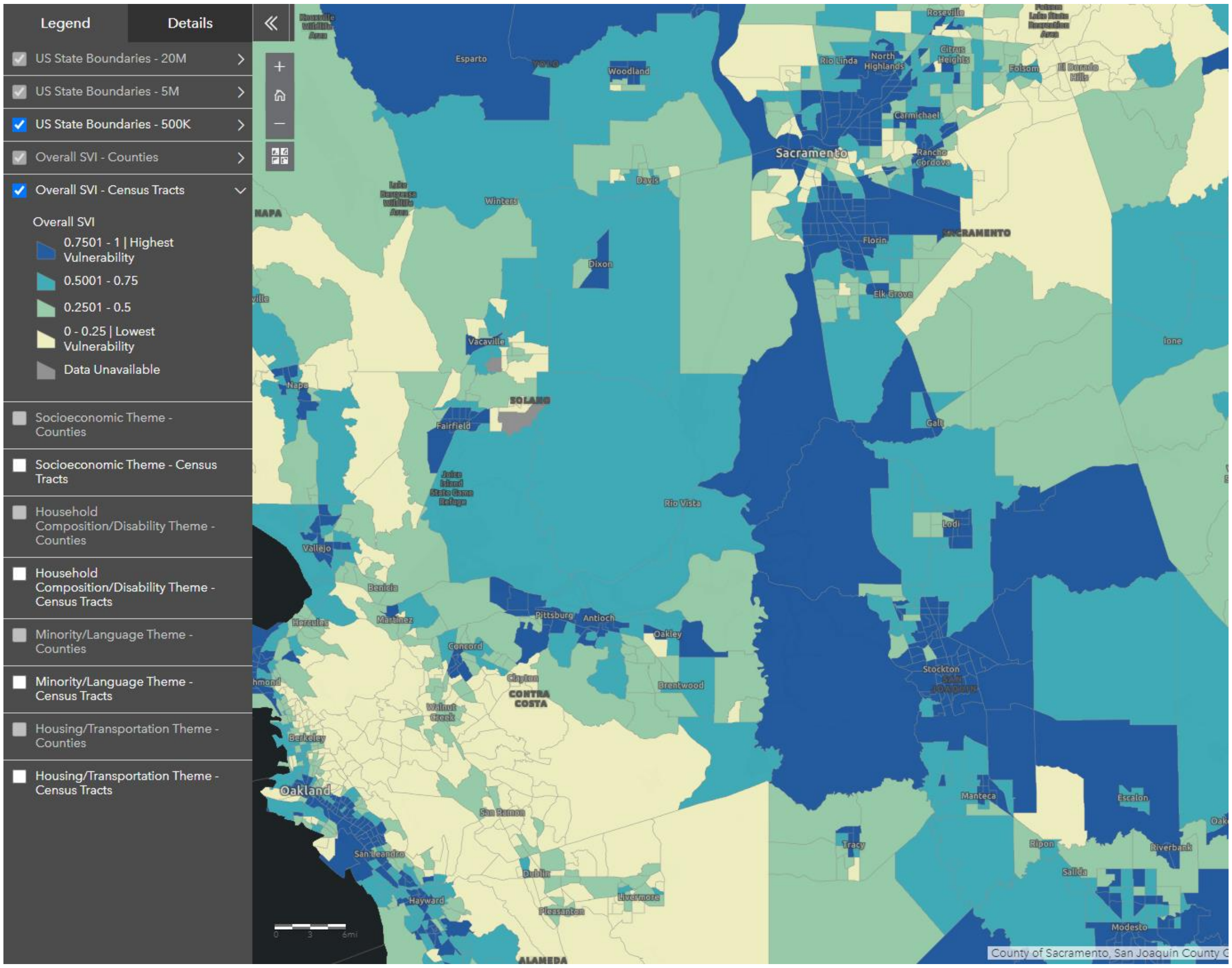
Center for Disease Control Social Vulnerability Index

Every community must prepare for and respond to hazardous events, whether a natural disaster like a tornado or disease outbreak, or a human-made event such as a harmful chemical spill. A number of factors, including poverty, lack of access to transportation, and crowded housing may weaken a community's ability to prevent human suffering and financial loss in a disaster. These factors are known as social vulnerability.

Social vulnerability refers to the potential negative effects on communities caused by external stresses on human health. Such stresses include natural or human-caused disasters, or disease outbreaks. Reducing social vulnerability can decrease both human suffering and economic loss. CDC Social Vulnerability Index (CDC SVI) uses 15 U.S. census variables to help local officials identify communities that may need support before, during, or after disasters.

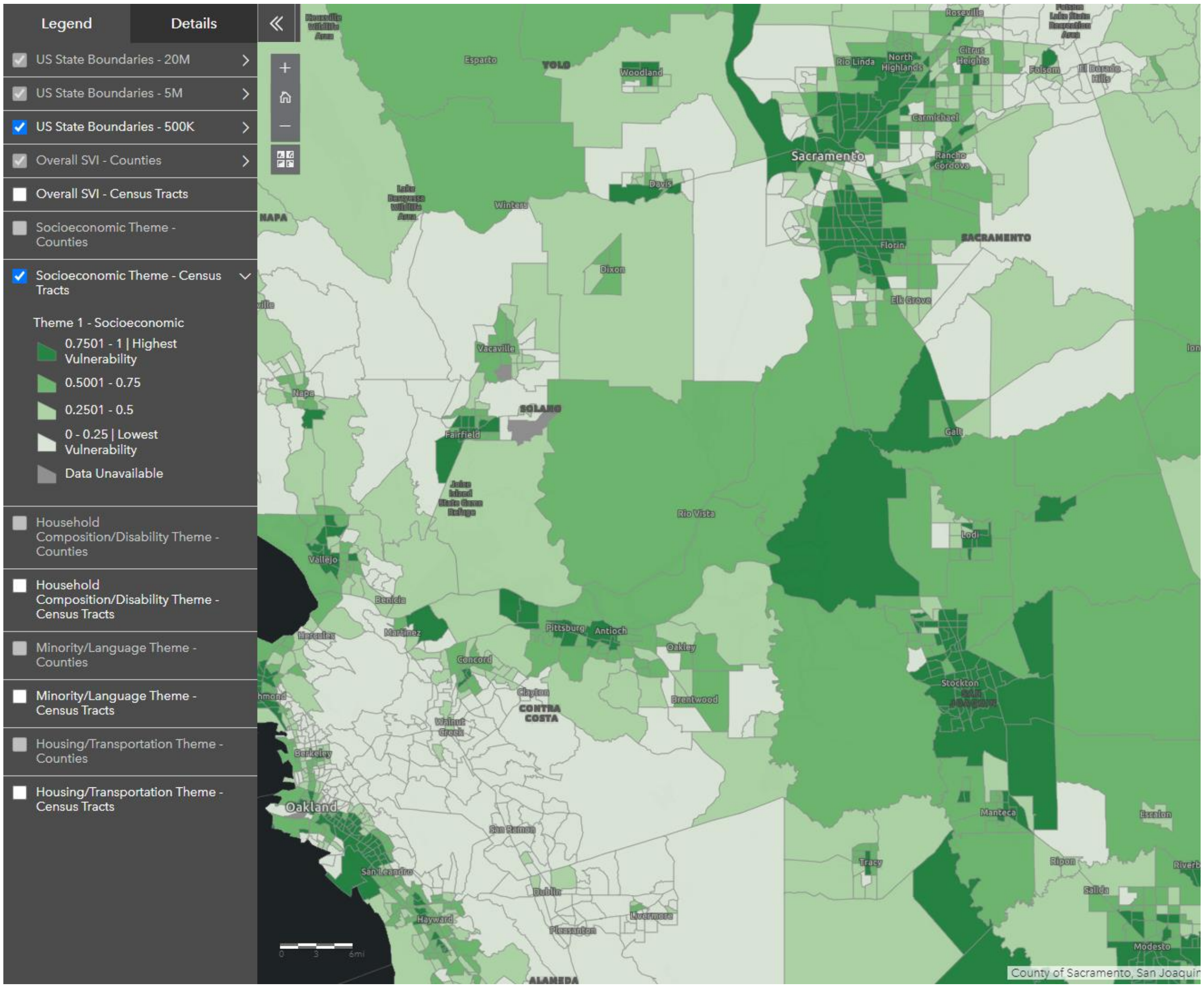
ATSDR's Geospatial Research, Analysis & Services Program (GRASP) created databases to help emergency response planners and public health officials identify and map communities that will most likely need support before, during, and after a hazardous event. CDC SVI uses U.S. Census data to determine the social vulnerability of every census tract. Census tracts are subdivisions of counties for which the Census collects statistical data. The CDC SVI ranks each tract on 15 social factors, including poverty, lack of vehicle access, and crowded housing, and groups them into four related themes. Each tract receives a separate ranking for each of the four themes, as well as an overall ranking. Maps of the four themes are shown in the figure below. The overall SVI map is shown in Figure 4-7; the socioeconomic SVI for the County is shown in Figure 4-8; the household composition SVI for the County is shown in Figure 4-9; the minority and language SVI for the County is shown in Figure 4-10; and the housing and transportation SVI for the County is shown in Figure 4-11.

Figure 4-7 Sacramento County – Overall Social Vulnerability



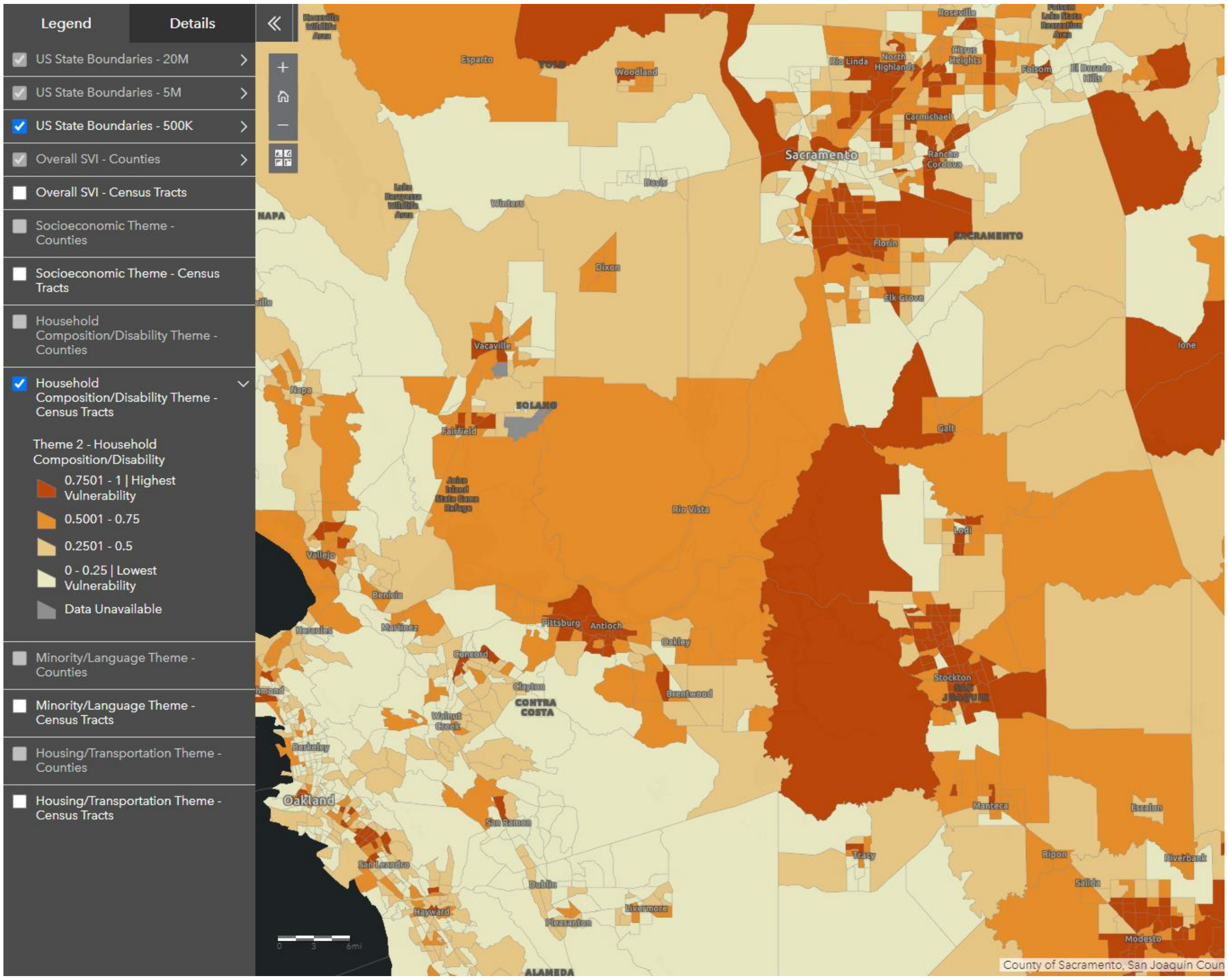
Source: CDC Social Vulnerability Index – map retrieved 5/18/2021

Figure 4-8 Sacramento County – Socioeconomic Status Vulnerability



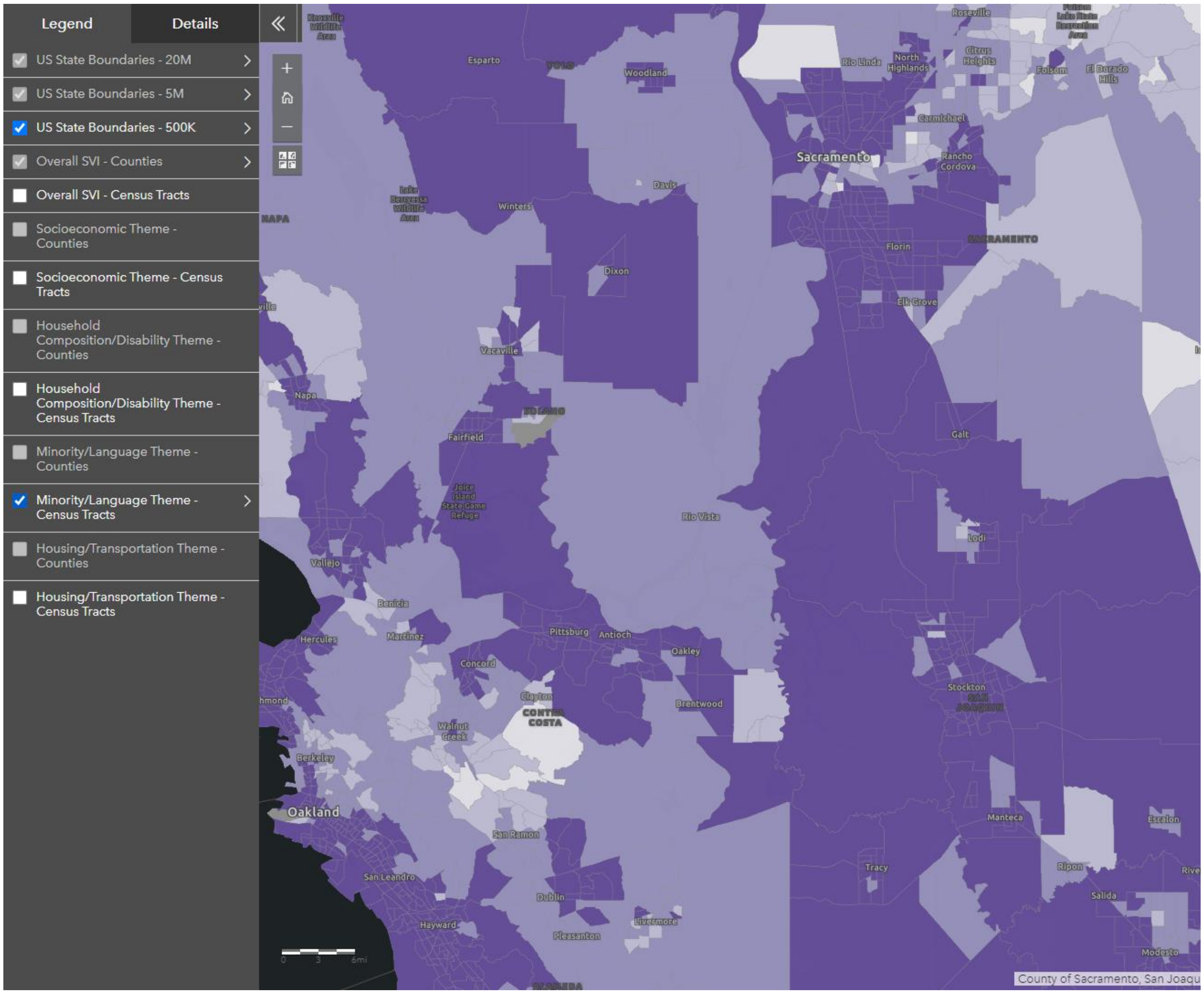
Source: CDC Social Vulnerability Index – map retrieved 5/18/2021

Figure 4-9 Sacramento County – Household Composition and Disabilities Social Vulnerability



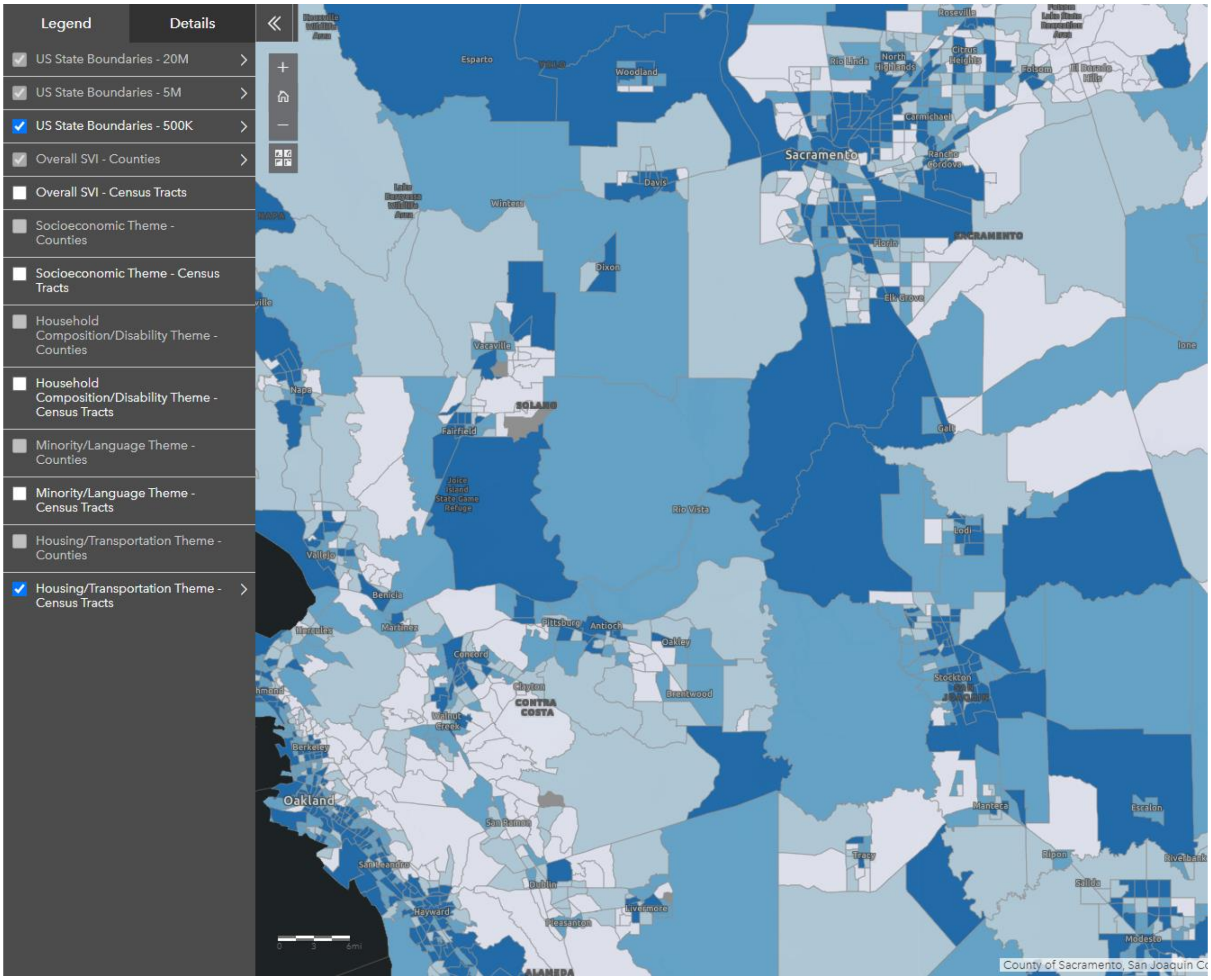
Source: CDC Social Vulnerability Index – map retrieved 5/18/2021

Figure 4-10 Sacramento County – Minority/Language Social Vulnerability



Source: CDC Social Vulnerability Index – map retrieved 5/18/2021

Figure 4-11 Sacramento County – Housing/Transportation Social Vulnerability



Source: CDC Social Vulnerability Index – map retrieved 5/18/2021

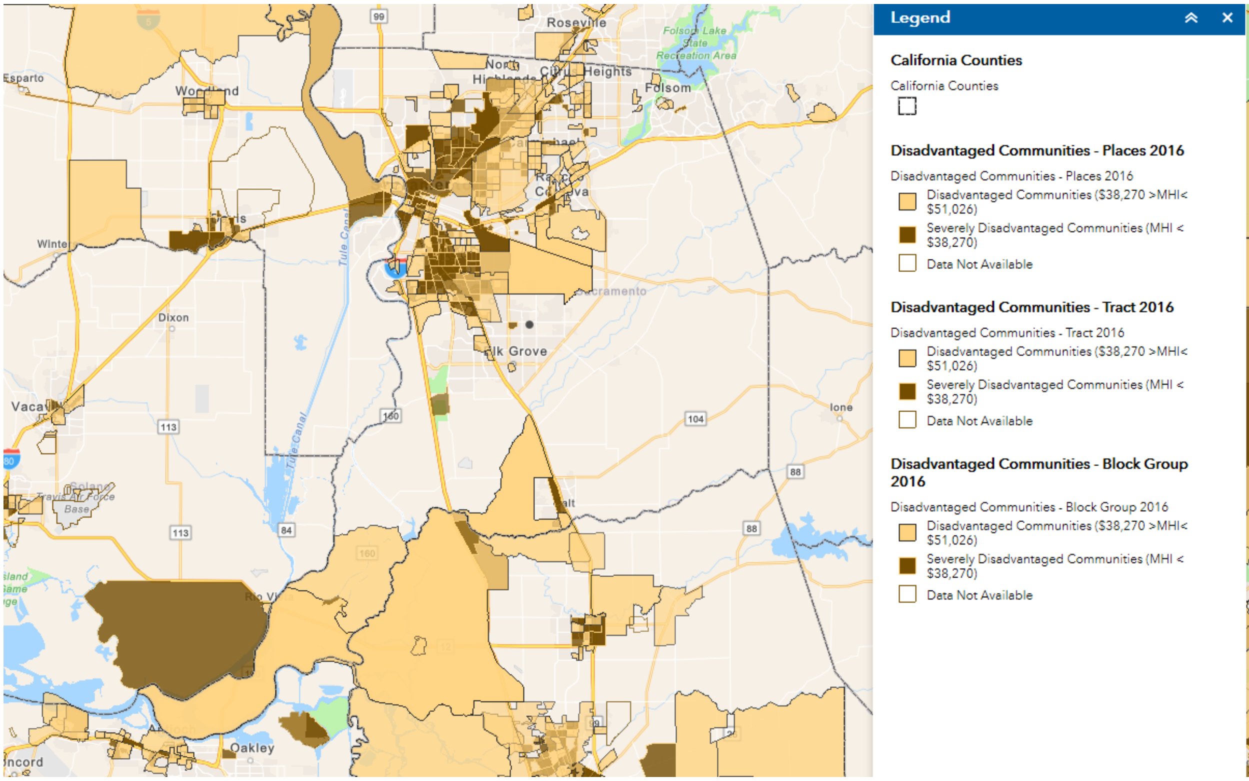
CA DWR Special Population and Disadvantaged Community Mapping

CA DWR has developed a web-based application to assist local agencies and other interested parties in evaluating disadvantaged community (DAC) status throughout the State, using the definition provided by Proposition 84 Integrated Regional Water Management (IRWM) Guidelines (2015). The DAC Mapping Tool is an interactive map application that allows users to overlay the following three US Census geographies as separate data layers:

- Census Place
- Census Tract
- Census Block Group

Only those census geographies that meet the DAC definition are shown on the map (i.e., only those with an annual median household income (MHI) that is less than 80 percent of the Statewide annual MHI (PRC Section 75005(g)). In addition, those census geographies having an annual MHI that is less than 60 percent of the Statewide annual MHI are shown as "Severely Disadvantaged Communities" (SDAC). The DAC map for Sacramento County is shown in Figure 4-12.

Figure 4-12 Sacramento County – Disadvantaged Communities



Source: CA DWR, retrieved 1/10/2021

Climate Change and Health Profile Report – Sacramento County

The 2017 Climate Change and Health Profile Report for Sacramento County was done by the California Department of Public Health and the University of California-Davis. The report noted that there are special populations in the County.

> ***Climate change affects the social and environmental drivers of health outcomes. The effects of climate change can exacerbate existing health conditions and compound the risks of adverse health outcomes. The age-adjusted death rate, which takes into account the effect of the population's age distribution, is a basic indicator of the health status of communities.***
>
> ***In 2010, the age-adjusted death rate in Sacramento County was higher than the state average. Disparities in death rates among race/ethnicity groups highlight how certain populations disproportionately experience health impacts. Within the county, the highest death rate occurred among Pacific Islanders and the lowest death rate occurred among Asians.***

In 2012, nearly 43% of adults (460,358) reported one or more chronic health conditions including heart disease, diabetes, asthma, severe mental stress or high blood pressure. In 2012, 15% of adults reported having been diagnosed with asthma. In 2012, approximately 28% of adults were obese (statewide average was 25%). In 2012, nearly 13% of residents aged 5 years and older had a mental or physical disability (statewide average was 10%).

In 2005-2010, there was an annual average of 188 heat-related emergency room visits and an age-adjusted rate of 13 emergency room visits per 100,000 persons (the statewide age-adjusted rate was 10 emergency room visits per 100,000 persons).

Among climate-vulnerable groups in 2010 were 101,063 children under the age of 5 years and 158,551 adults aged 65 years and older. In 2010, there were approximately 23,787 people living in nursing homes, dormitories, and other group quarters where institutional authorities would need to provide transportation in the event of emergencies.

Social and demographic factors and inequities affect individual and community vulnerability to the health impacts of climate change. In 2010, 7% of households (37,143) did not have a household member 14 years or older who spoke English proficiently (called linguistically isolated; statewide average was 10%). In 2010, approximately 15% of adults aged 25 years and older had less than a high school education (statewide average was 19%).

In 2010, 14% of the population had incomes below the poverty level (the statewide average was 14%). Nineteen percent of households paid 50% or more of their annual income on rent or a home mortgage (statewide average was 22%). In 2012, approximately 163,000 (44%) low-income residents reported they did not have reliable access to a sufficient amount of affordable, nutritious food (called food insecurity; statewide average was 42%).

In 2010, Sacramento County had approximately 35,847 outdoor workers whose occupation increased their risk of heat illness. In 2010, roughly seven percent of households did not own a vehicle that could be used for evacuation (statewide average was 8%). In 2012, approximately 81% of residents did not live within a half mile to frequent public transit. In 2009, approximately 0% of households were estimated to lack air conditioning, a strategy to counter adverse effects of heat (statewide average was 36%). In 2011, tree canopy, which provides shade and other environmental benefits, was present on 13% of the county's land area (statewide average was 8%).

Social capital is embedded in social relationships and networks and refers to the existence of trust and mutual aid among the members of society. These relationships are important in building resilience when confronted with extreme climates. There is evidence that populations with higher levels of political participation also have greater social capital. Sixty-two percent of registered voters voted in the 2010 general election (statewide average was 58%).

Natural disasters worsened by climate change increase the displacement of victims, which in turn increases population densities and tensions over resources. Violent crime also increases during heat events.32 Safe neighborhoods that are free of crime and violence are an integral component of healthy neighborhoods and community resilience. In 2010, Sacramento County experienced approximately 6 violent crimes per 1,000 residents (statewide rate was 4 per 1,000 residents).

Development since 2016 Plan

The Sacramento County Building Department tracks total building permits issued since 2016 for unincorporated Sacramento County. A summary of this development is shown in Table 4-17. All development in the identified hazard areas, including the 1% annual chance floodplains and high wildfire risk areas, were completed in accordance with all current and applicable development codes and standards and should be adequately protected. Thus, with the exception of more people living in the area potentially exposed to natural hazards, this growth should not cause a significant change in vulnerability of the County to identified priority hazards.

Table 4-17 Sacramento County Development 2016-2020 Summary

Property Use	2016	2017	2018	2019	2020
Residential					
Improvement Plan	13	160	42	20	43
Grading Plan	15	21	7	6	8
Commercial					
Improvement Plan	22	20	30	51	22
Grading Plan	0	1	0	0	9
Subdivision					
Improvement Plan	349	463	546	664	377
Grading Plan	0	0	0	0	0
Total	**399**	**665**	**625**	**741**	**459**

Source: Sacramento County Building Department

With respect to development within hazard areas, the County does not collectively track development in these areas after the fact. However, all development is subject to development standards and requirements specific to permitting development in hazard areas such as in the 1% annual chance floodplain or in Very High Fire Hazard Severity Zones. Thus it should be assumed that this recent development was done in accordance with these requirements to mitigate the affects of hazards. Further, given the hazard environment Sacramento County, it should be assumed that much of this development occurred in areas protected by levees and in dam inundation areas, especially those associated with Folsom Dam.

While the data shows changes in development in the County since the 2016 Plan, including likely development in mapped hazard areas, all development is subject to current building standards to include any requirements for building in hazard areas which act to mitigate hazard exposure. Further, development in hazard areas is only one factor of many that contribute to an overall change in hazard vulnerability. Based on these considerations, it cannot be definitively stated as to whether the development or even lack of development in areas contributed to an increase or decrease in vulnerability for Sacramento County.

Future Development

Future development in the County is discussed in the sections below.

Future Population Projections

As indicated in the previous section, Sacramento County had been steadily growing from 1930 to 2010, with a recent slowing in population growth. Long term forecasts by the California Department of Finance project population growth in Sacramento County continuing through 2060. Table 4-18 shows the population projections for the County as a whole through 2060. Based on this data, population growth continues steadily through 2060.

Table 4-18 Population Projections for Sacramento County (incorporated and unincorporated), 2020-2060

	2020	2030	2040	2050	2060
Sacramento County	1,567,975	1,697,555	1,799,258	1,876,422	1,939,608

Source: California Department of Finance P-1 Report

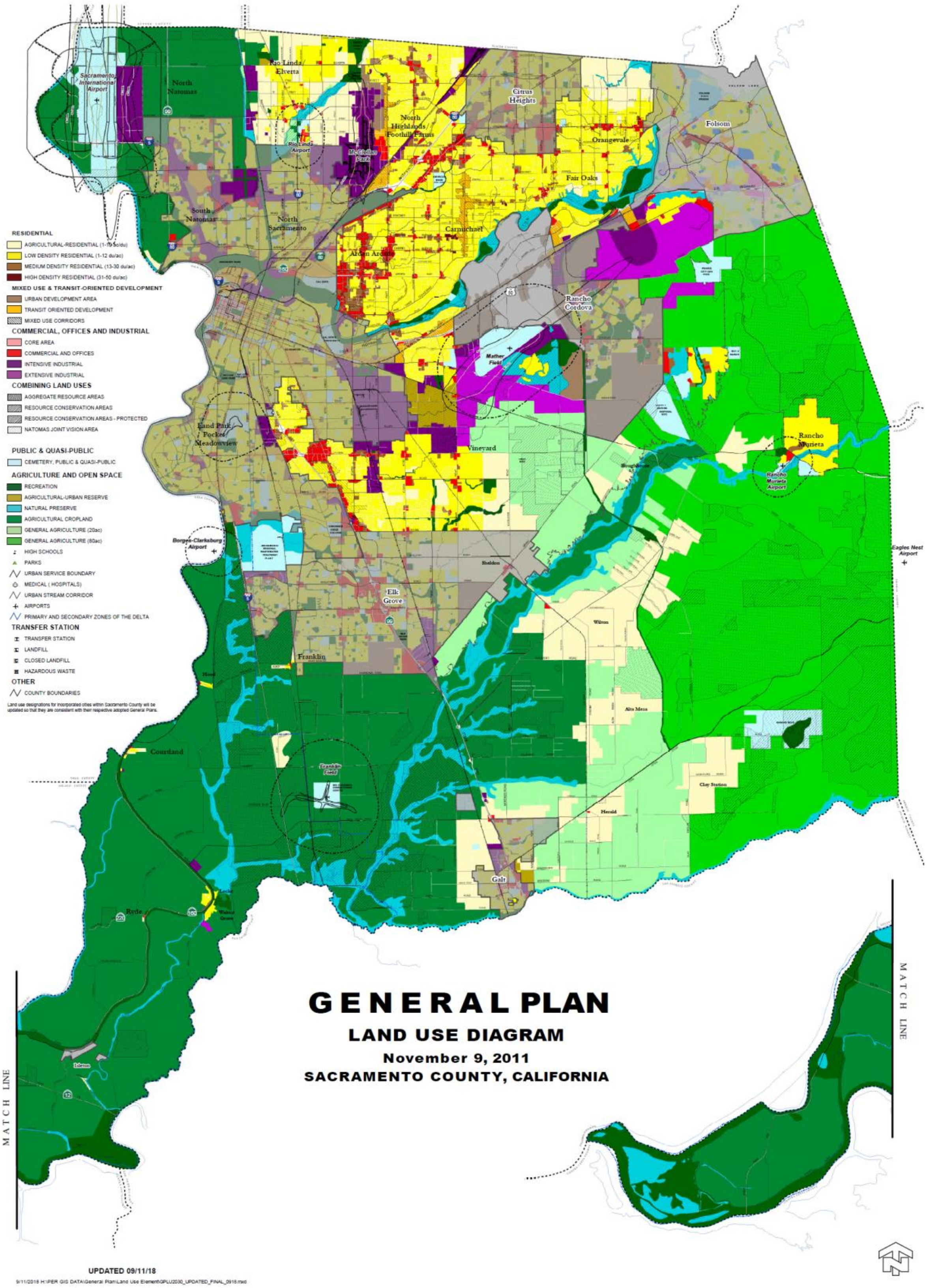
Future Land Use

Future land use and growth management strategies in Sacramento County aim to concentrate future development into and toward existing communities through various policies relating to zoning and minimum development standards and requirements. Zoning designations prescribe allowed land uses and minimum lot sizes for the purpose of supporting efficient infrastructure design, conservation of natural resources, and to avoid conflicting uses.

Descriptions of allowed uses for each classification are detailed in the Sacramento County General Plan Land Use Element. Figure 4-13 is sourced from this section. The Diagram provides a broad outline of future land use patterns in the unincorporated county. It graphically illustrates the existing and potential locations for a number of uses, including residential, transit-oriented development, commercial and offices, public and quasi-public, open space and disposal facilities. The uses allowed within each of the basic categories are detailed in the land use summary table and are governed by policies contained in the Land Use Element.

Land uses shown for other jurisdictions, including the cities of Sacramento, Citrus Heights, Elk Grove, Folsom, Galt, Isleton, and Rancho Cordova, are taken from their adopted General Plans. Although the County has no control over land uses in other jurisdictions, including them emphasizes the County's role as a leader in countywide planning and regional collaboration efforts. Showing all of the land uses within the County on a single map allows for a comprehensive look at development patterns and transportation systems within the metropolitan area, facilitating regional planning efforts.

Figure 4-13 Sacramento County General Plan Land Use

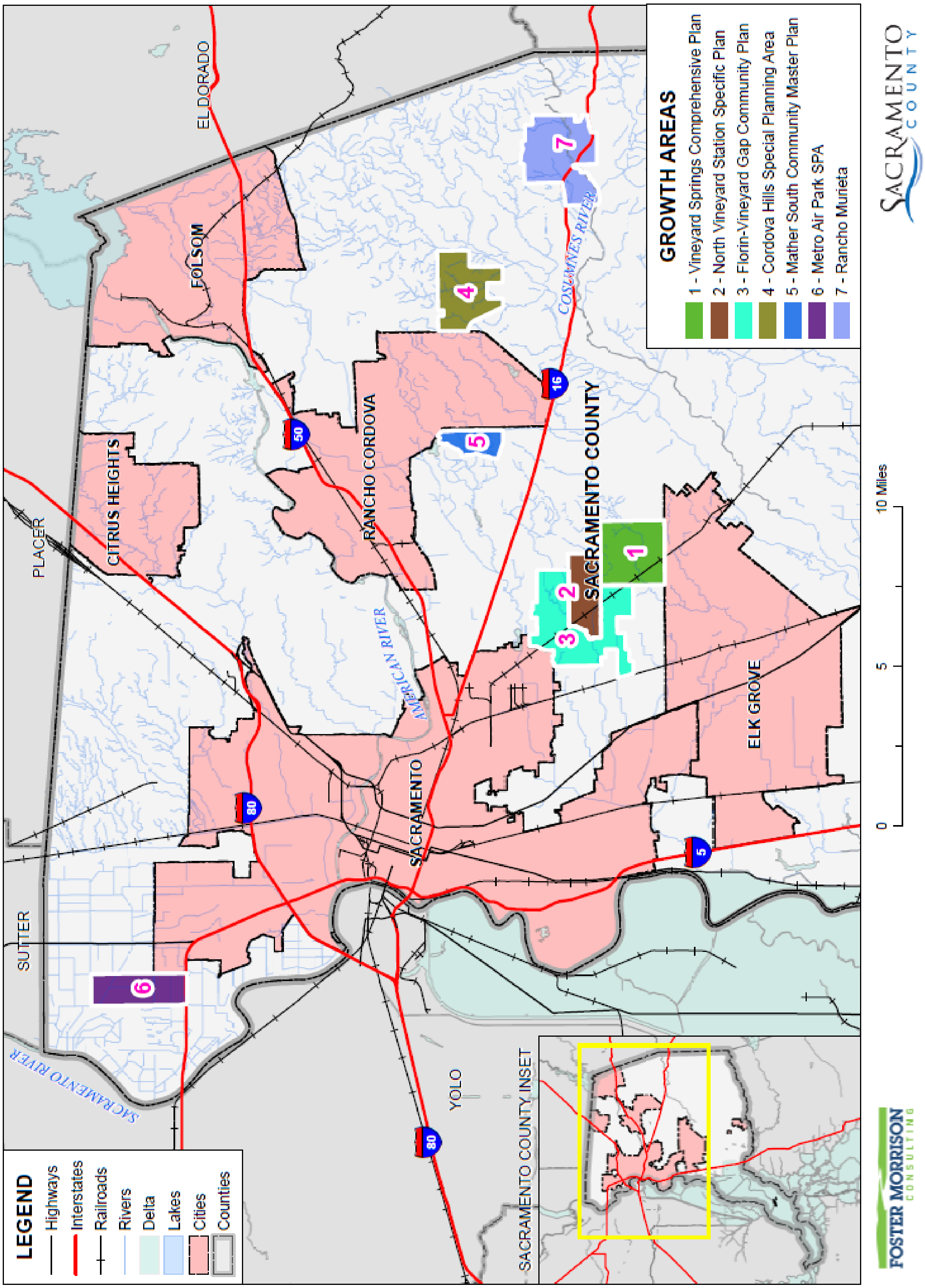


Source: Sacramento County 2030 General Plan Land Use Element

Future Development GIS Analysis

Unincorporated Sacramento County has defined seven future growth areas. These areas were provided by Sacramento County and were mapped into GIS format. Using GIS, the following methodology was used in determining parcel counts and acres associated with future development in the unincorporated Sacramento County Planning Area. Sacramento County's 2020 Parcel/Assessor's data and data from the County planning department were used as the basis for the unincorporated County's inventory of parcels and acres of future development areas. Using the GIS parcel spatial file and the APNs, the seven future development projects were mapped. These areas can be seen on Figure 4-14 and detailed in Table 4-19. Analysis of future developments for each City in the County can be found in their respective annexes to this Plan Update.

Figure 4-14 Unincorporated Sacramento County – Future Development Areas



Data Source: Growth Areas (SacCo_Growth_Areas_0621), Sacramento County GIS, Cal-Atlas; Map Date: 09/2021.

Table 4-19 Unincorporated Sacramento County – Future Development Areas

Map Number	Future Development Area	Total Parcel Count	Improved Parcel Count	Total Acres
1	Vineyard Springs Comprehensive Plan	2,784	2,591	2,354
2	North Vineyard Station Specific Plan	1,850	1,466	1,497
3	Florin-Vineyard Gap Community Plan	1,036	821	3,699
4	Cordova Hills Special Planning Area	14		2,406
5	Mather South Community Master Plan	4		1,007
6	Metro Air Park SPA	74	4	1,807
7	Rancho Murieta	2,943	2,592	3,223
Grand Total		**8,705**	**7,474**	**15,994**

Source: Sacramento County GIS

4.3 Hazard Profiles and Vulnerability Assessment

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.

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.

The hazards identified in Section 4.1 Hazard Identification, are profiled individually in this section. These hazard profiles set the stage for the Vulnerability Assessment, where the vulnerability is quantified for each of the hazards.

Hazard Profiles

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 Sacramento County Planning Area and the unincorporated County. Where known, this includes information on the hazard location, extent, seasonal patterns, speed of onset/duration, and magnitude and/or any secondary effects.
- **Past Occurrences**—This section contains information on historical hazard events, including location, impacts, and damages where known. Hazard research, historical incident worksheets and other input from the HMPC were used to capture information on past occurrences.
- **Frequency/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 the event happening in any given year (e.g., three droughts over a 30-year period equates to a 10 percent chance of experiencing a drought in any given year). The likelihood of future occurrences is categorized into one of the following classifications:
  - ✓ **Highly Likely**—Near 100 percent chance of occurrence in next year or happens every year

- ✓ **Likely**—Between 10 and 100 percent chance of occurrence in next year or has a recurrence interval of 10 years or less
- ✓ **Occasional**—Between 1 and 10 percent chance of occurrence in the next year or has a recurrence interval of 11 to 100 years
- ✓ **Unlikely**—Less than 1 percent chance of occurrence in next 100 years or has a recurrence interval of greater than every 100 years.

- **Climate Change**—This section contains the effects of climate change (if applicable). The possible ramifications of climate change on each hazard are discussed.

Vulnerability Assessment

With Sacramento County's hazards identified and profiled, a vulnerability assessment was conducted to describe the vulnerability and 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 identified hazards and estimates potential losses. This section focuses on the vulnerabilities of the Sacramento County Planning Areas (i.e., unincorporated Sacramento County) as a whole.

An estimate of the vulnerability of the Sacramento County Planning Area and the unincorporated County to each identified hazardis provided in each of the hazard-specific sections that follow. Vulnerability is measured in general, qualitative terms and is a summary of the potential impact based on past occurrences, spatial extent, and damage and casualty potential. It is categorized into the following classifications:

- **Extremely Low**—The occurrence and potential cost of damage to life and property is very minimal to nonexistent.
- **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. Here 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.
- **Extremely High**—Very widespread with catastrophic impact.

Vulnerability can be quantified in those instances where there is a known, identified hazard area, such as a mapped floodplain. In these instances, the numbers and types of buildings subject to the identified hazard can be counted and their values tabulated. Other information can be collected in regard to the hazard area, such as the location of critical community facilities, historic structures, and valued natural resources. Together, this information conveys the impact, or vulnerability, of the Sacramento County Planning Area to that hazard.

The vulnerability assessment identified five hazards in the Planning Area for which specific geographical hazard areas have been defined and for which sufficient data exists to support a quantifiable vulnerability analysis. These five hazards are dam failure, earthquake, flood, levee failure, and wildfire. The vulnerability of the flood dam failure, (1%/0.2% annual chance), levee failure, and wildfire hazards were analyzed using GIS and County parcel and assessor data.

FEMA's loss estimation software, HAZUS-MH, was used to analyze the County's vulnerability to earthquakes.

For dam failure, flood (1%/0.2% annual chance), levee failure, and wildfire, the following elements were inventoried for each community, to the extent possible, to quantify vulnerability in identified hazard areas:

- General vulnerability and hazard-related impacts, including impacts to life, safety, and health
- Values at risk (i.e., types, numbers, and value of land and improvements)
- Population at risk
- Critical facilities at risk
- Overall community impact
- Future development/development trends within the identified hazard area

The vulnerability and potential impacts from priority hazards that do not have specific mapped areas nor the data to support additional vulnerability analysis are discussed in more general terms. These include:

- Climate Change
- Drought & Water Shortage
- Floods: Localized Stormwater
- Landslides, Mudslides, and Debris Flow
- Pandemic
- Severe Weather: Extreme Cold and Freeze
- Severe Weather: Extreme Heat
- Severe Weather: Heavy Rains and Storms
- Severe Weather: Wind and Tornado
- Subsidence
- Volcano

The following sections provide the hazard profile and vulnerability assessments for each of the hazards identified in Section 4.1 Hazard Identification. The severe weather hazards are discussed first to paint the picture of the County's climate and hazard environment which often lead to other hazards such as flood and wildfire. The remainder of the hazards follow alphabetically.

Power Shortage/Failure

An impact of almost all hazards below relates to power outage and/or power failures. The US power grid crisscrosses the country, bringing electricity to homes, offices, factories, warehouses, farms, traffic lights and even campgrounds. According to statistics gathered by the Department of Energy, major blackouts are on the upswing. Incredibly, over the past two decades, blackouts impacting at least 50,000 customers have increased 124 percent. The electric power industry does not have a universal agreement for classifying disruptions. Nevertheless, it is important to recognize that different types of outages are possible so that plans may be made to handle them effectively. In addition to blackouts, brownouts can occur. A brownout is an intentional or unintentional drop in voltage in an electrical power supply system. Intentional brownouts are used for load reduction in an emergency. Electric power disruptions can be generally grouped into two categories: intentional and unintentional.

Intentional Disruptions

There are four types of intentional disruptions:

- **Planned**: Some disruptions are intentional and can be scheduled based maintenance or upgrading needs
- **Unscheduled**: Some intentional disruptions must be done "on the spot." in response to an emergency
- **Demand-Side Management**: Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads
- **Load Shedding**: When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing, resulting in rolling blackouts

The California Independent System Operator (CAISO) is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities. CAISO is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of stage alerts to the media based on system conditions. The alerts are:

- Stage 1 – reserve margin falls below 7 percent
- Stage 2 – reserve margin falls below 5 percent
- Stage 3 – reserve margin falls below 1.5 percent

Rotating blackouts become a possibility when Stage 3 is reached. Rotating outages and/or blackouts such as those experienced in 2000/2001 and 2006 can occur due to losses in transmission or generation and/or extremely severe temperatures that lead to heavy electric power consumption.

On January 17, 2001, CAISO declared a Stage 3 Emergency and notified the then Governor's Office of Emergency Services (Cal OES) that PG&E was dropping firm load of 500 megawatts (MW) in Northern California leading to rolling black-outs. Cal OES, in turn, issued an Electrical Emergency Message to all Emergency Services Agencies to prepare for rolling blackouts. This scenario was repeated the following day, January 18, 2001, and again on March 19, 2001.

A July 2006 heat storm event affected the entire state as well as most of the West, producing record energy demand levels in California. The state was able to avoid rotating outages due to a combination of favorable factors that included no major transmission outages, lower than typical generator outages, significant customer response to pleas for energy conservation, high imports from the Pacific Northwest despite unusually high loads, outstanding cooperation among western control area operators, and prompt response to fires that potentially threatened major interties. However, the event brought to light the vulnerability of the electric distribution system, as over 3,500 distribution transformers failed, leaving over two million customers without power at various times over the ten-day event, many for several hours and a small minority for up to three days.

In 2020, the state battled both extreme heat and wildfires. As a result of extreme heat, the CAISO declared a Stage 3 emergency. PG&E initiated rotating outages in August at the request of California's grid operator. The outages, which impacted 220,000 customers, occurred during periods of high heat. These rolling blackouts lasted less than a week. During this time, SMUD issued no PSPS outages.

Unintentional Disruptions

Unintentional or unplanned disruptions are outages that come with essentially no advance notice. This type of disruption can be the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others
- Malfunction or equipment failure
- Equipment overload (utility company or customer)
- Reduced capability (equipment that cannot operate within its design criteria)
- Tree contact other than from storms
- Vandalism or intentional damage
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines
- Wildfire that damages transmission lines

Climate Change and Energy Shortage

Changing climate is expected to bring more frequent and intense natural disasters. Key climate parameters are starting to move outside of historically observed variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, 2016, and 2019. 2020 is on pace to be a remarkably hot year as well. In addition, the 2016-2017 year broke the record as the wettest ever recorded in the northern Sierra Nevada Mountains.

Changes in temperatures, precipitation patterns, extreme events, and sea level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in "cooling-degree days") needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

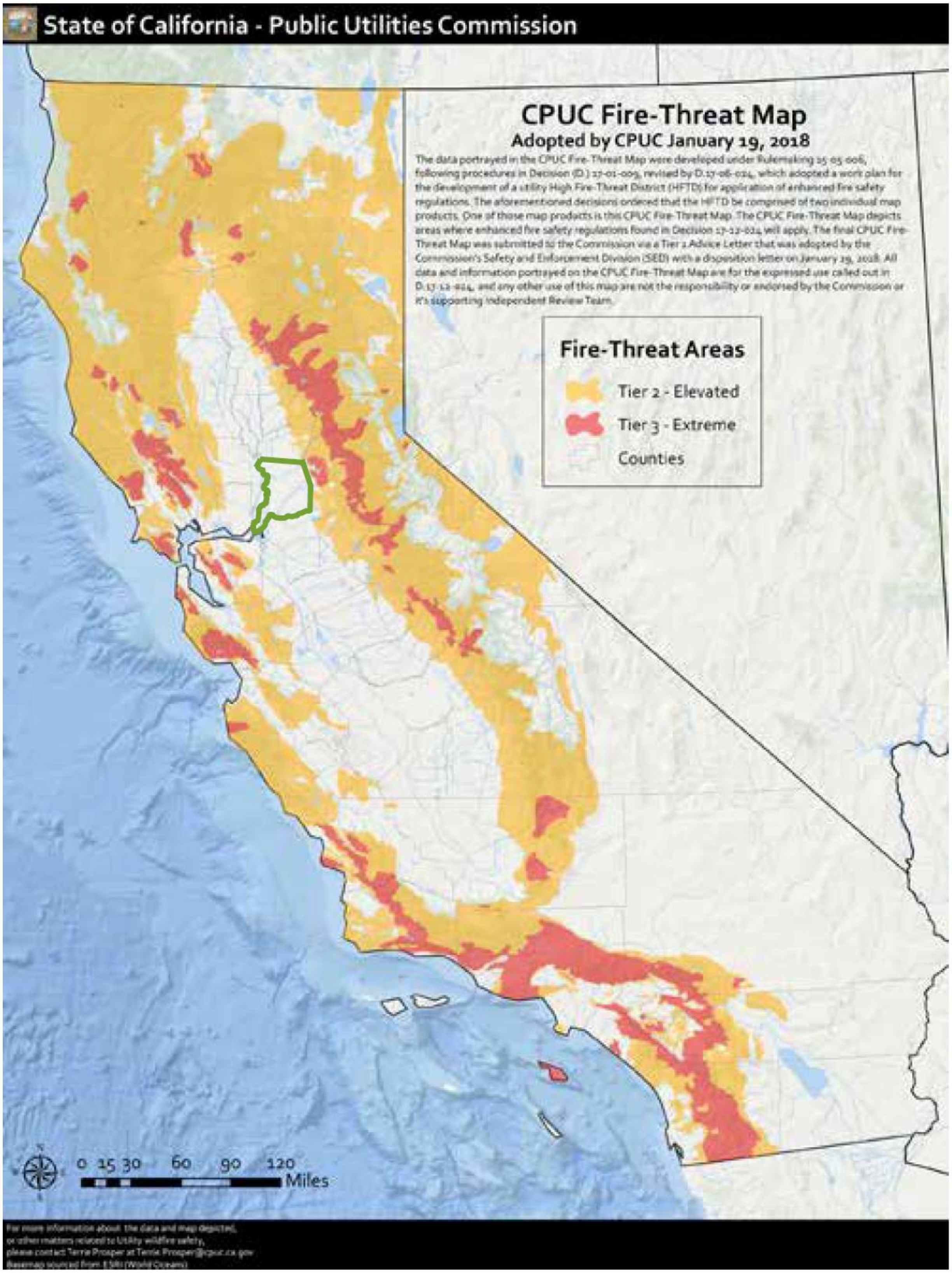
Additional impacts from a power disruption affect remote areas. This includes evacuation messaging and coordination difficulties, and a reduction in firefighting capabilities due to lack of water access in more remote areas (especially for those on wells).

Public Safety Power Shutoff (PSPS)

A new intentional disruption type of power shortage/failure event has recently occurred in California. In recent years, several wildfires have started as a result of downed power lines or electrical equipment. This was the case for the Camp Fire in 2018. As a result, California's three largest energy companies (including PG&E and SMUD), at the direction of the California Public Utilities Commission (CPUC), are coordinating to prepare all Californians for the threat of wildfires and power outages during times of extreme weather. To help protect customers and communities during extreme weather events, electric power may be shut off for public safety in an effort to prevent a wildfire. This is called a Public Safety Power Shutoff (PSPS).

Power in the County is provided by PG&E and SMUD. Only a portion of the Delta south of Locke and Walnut Creek is supplied by PG&E. The remainder of the County lies in SMUDs service territory (see Figure 4-15). SMUD directly participated in the development of the CPUC's Fire-Threat Map, which defines a Statewide high fire threat district (HFTD). SMUD has incorporated the HFTD map into its construction, inspection, maintenance, repair and clearance practices, where applicable.

Figure 4-15 SMUD Service Territory



Source: SMUD

SMUD has never experienced a catastrophic wildfire involving its facilities. SMUD's service area has a much lower wildfire risk profile than other areas in the State that have suffered destructive wildfires in recent years. When ignition events occur they have historically been limited in scope. This is largely due to SMUD's more urban environment, flatter terrain, grasslands and other fuel sources outside forested areas and fewer wind events.

No SMUD or PG&E PSPS events have occurred in the County.

Public Safety Power Shutoff Criteria

The Wildfire Safety Operations Center (WSOC) monitors fire danger conditions across PG&E and SMUD service area and evaluates whether to turn off electric power lines in the interest of safety. While no single factor will drive a Public Safety Power Shutoff, some factors include:

- A Red Flag Warning declared by the National Weather Service
- Low humidity levels generally 20% and below
- Forecasted sustained winds generally above 25 mph and wind gusts in excess of approximately 45 mph, depending on location and site-specific conditions such as temperature, terrain and local climate
- Condition of dry fuel on the ground and live vegetation (moisture content)
- On-the-ground, real time observations from PG&E's WSOC and field observations from PG&E crews

The most likely electric lines to be considered for shutting off for safety will be those that pass through areas that have been designated by the CPUC as at elevated (Tier 2) or extreme (Tier 3) risk for wildfire (seen on Figure 4-15). This includes both distribution and transmission lines. The specific area and number of affected customers will depend on forecasted weather conditions and which circuits PG&E and/or SMUD needs to turn off for public safety. Although a customer may not live or work in a high fire-threat area, their power may also be shut off if their community relies upon a line that passes through an area experiencing extreme fire danger conditions. This means that any customer who receives electric service from PG&E and/or SMUD, especially those located in Tier 2 or 3 boundaries, should be prepared for a possible PSPS.

PG&E and SMUD noted that extreme weather threats can change quickly. When possible, PG&E/SMUD will provide customers with advance notice prior to turning off the power, as well as updates until power is restored. Timing of notifications (when possible) are:

- Approximately 48 hours before power is turned off
- Approximately 24 hours before power is turned off
- Just before power is turned off
- During the public safety outage
- Once power has been restored

Data Sources

In general, information provided by the County and HMPC members is integrated into this section with information from other data sources. The data sources listed below formed the basis for this Hazard Profiles and Vulnerability section of this Plan. Where data and information from these studies, plans, reports, and other data sources were used, the source is referenced as appropriate throughout this risk assessment.

- 2018 California State Hazard Mitigation Plan
- ArkStorm at Tahoe - Stakeholder Perspectives on Vulnerabilities and Preparedness for an Extreme Storm Event in the Greater Lake Tahoe, Reno and Carson City Region. 2014.
- Bureau of Land Management
- CA DWR Best Available Maps
- CAL FIRE GIS datasets
- Cal OES
- Cal-Adapt
- Cal-Adapt – Annual Average of Acres Burned
- Cal Adapt – Extended Drought Scenarios
- Cal-Adapt – Number of Extreme Heat Days by Year
- Cal-Adapt – Precipitation: Decadal Averages Map
- California Adaptation Planning Guide
- California Climate Adaptation Strategy (CAS) – 2014
- California Department of Water Resources
- California Department of Water Resources (CA DWR) Division of Safety of Dams
- California Department of Water Resources Best Available Maps
- California Division of Mines and Geology
- California Geological Survey
- California Office of Emergency Services – Dam Inundation Data
- California's Drought of 2007-2009, An Overview. State of California Natural Resources Agency, California Department of Water Resources.
- Climate Change and Health Profile Report – Sacramento County
- Existing plans and studies
- FEMA
- FEMA: Building Performance Assessment: Oklahoma and Kansas Tornadoes
- FEMA's HAZUS-MH 4.2 GIS-based inventory data
- Integrated Regional Water Management Plan
- IPCC Fifth Assessment Synthesis Report (2014)
- Kenward, Alyson PhD, Adams-Smith, Dennis, and Raja, Urooj. Wildfires and Air Pollution – The Hidden Health Hazards of Climate Change. Climate Central. 2013.
- Levees in History: The Levee Challenge. Dr. Gerald E. Galloway, Jr., P.E., Ph.D., Water Policy Collaborative, University of Maryland, Visiting Scholar, USACE, IWR.
- Liu, J.C., Mickley, L.J., Sulprizio, M.P. et al. Climatic Change. 138: 655. doi:10.1007/s10584-016-1762-6. 2016.
- Multi-Hazard Identification and Risk Assessment, FEMA 1997
- National Drought Mitigation Center
- National Drought Mitigation Center – Drought Impact Reporter
- National Integrated Drought Information System
- National Levee Database
- National Oceanic and Atmospheric Administration's National Climatic Data Center
- National Weather Service
- Natural Resource and Conservation Service

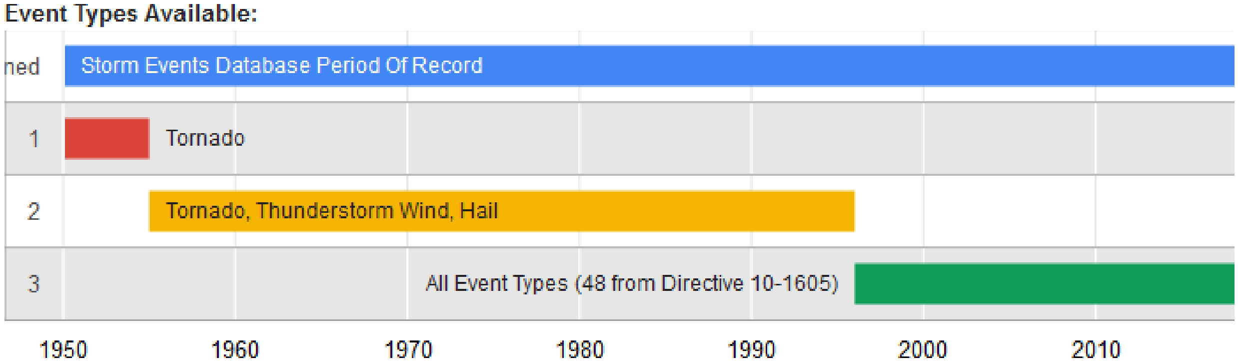
- NOAA Storm Prediction Center
- Pacific Gas and Electric Company
- Personal interviews with planning team members and staff from the County
- Sacramento County Climate Adaptation Plan (2017 Final and 2021 Draft Update)
- Sacramento County 2035 General Plan
- Sacramento County Department of Water Resources
- Sacramento County General Plan Environmental Impact Report
- Sacramento County General Plan Open Space Element Background
- Sacramento Bee
- Sacramento County Airport System
- Sacramento County Agricultural Commissioner's Reports, 2010-2014
- Sacramento County Flood Insurance Study, June 16, 2015
- Sacramento County Department of Water Resources – 2011 to 2015 Storm Reports
- Sacrament County 2035 General Plan
- Sacramento County General Plan Background Report
- Sacramento County Watershed Management Plan
- Sacramento County WMA Strategic Plan
- Proceedings of the National Academy of Sciences
- Public Health Alliance of Southern California
- Public Policy Institute of California
- Science Magazine
- Statewide GIS datasets from other agencies such as Cal OES, FEMA, USGS, CGS, Cal Atlas, and others
- U.S. Census Bureau 2010 Household Population Estimates
- U.S. Fish and Wildlife Service
- U.S. Fish and Wildlife Service's National Wetlands Inventory maps
- U.S. Forest Service GIS datasets
- U.S. Geological Survey
- U.S. Occupational Safety and Health Administration
- United States Geological Survey Open File Report 2015-3009
- University of California
- US Army Corps of Engineers
- US Department of Agriculture
- US Farm Service Agency
- US Fish and Wildlife Service
- USDA Forest Service Region 5
- USGS Bulletin 1847
- USGS National Earthquake Information Center
- USGS Publication 2014-3120
- Vaisala National Lightning Detection Network
- Western Regional Climate Center
- World Health Organization
- Written descriptions of inventory and risks provided by Sacramento County

4.3.1. Severe Weather: General

Severe weather is generally any destructive weather event, but usually occurs throughout the Sacramento County Planning Area as localized storms that bring heavy rains and floods; severe cold, and winter weather; extreme heat, and strong winds. The NOAA's NCDC has been tracking severe weather since 1950. Their Storm Events Database contains data on the following events shown on Figure 4-16.

Figure 4-16 NCDC Storm Events Database Period of Record

Event Types Available:



Event Types Available:
Add more info about event types here. Link to collections page/tab when referencing data collection source.

1. Tornado: From 1950 through 1954, only tornado events were recorded.

2. Tornado, Thunderstorm Wind and Hail: From 1955 through 1992, only tornado, thunderstorm wind and hail events were keyed from the paper publications into digital data. From 1993 to 1995, only tornado, thunderstorm wind and hail events have been extracted from the Unformatted Text Files.

3. All Event Types (48 from Directive 10-1605): From 1996 to present, 48 event types are recorded as defined in NWS Directive 10-1605.

Source: NCDC

The NCDC's Storm Events Database contains data on the following: all weather events from 1993 to current (except from 6/1993-7/1993); and additional data from the Storm Prediction Center, which includes tornadoes (1950-1992), thunderstorm winds (1955-1992), and hail (1955-1992). This database contains 338 severe weather events that occurred in Sacramento County between January 1, 1950, and May 31, 2020. Table 4-20 summarizes these events.

*Table 4-20 NCDC Severe Weather Events for Sacramento County 1950-5/31/2020**

Event Type	Number of Events	Deaths	Deaths (indirect)	Injuries	Injuries (indirect)	Property Damage	Crop Damage
Cold/Wind Chill	14	0	1	0	0	$0	$0
Dense Fog	6	6	1	38	0	$2,120,000	$0
Dense Smoke	2	0	0	0	0	$0	$0
Drought	32	0	0	0	0	$0	$0

Event Type	Number of Events	Deaths	Deaths (indirect)	Injuries	Injuries (indirect)	Property Damage	Crop Damage
Excessive Heat	5	6	2	1	0	$0	$0
Extreme Cold/Wind Chill	1	0	0	0	0	$0	$0
Flash Flood	4	1	0	0	0	$4,400,000	$0
Flood	80	1	0	1	0	$8,877,000	$7,800,000
Frost/Freeze	8	0	0	0	0	$200,000	$5,000,000
Funnel Cloud	7	0	0	0	0	$0	$0
Hail	9	0	0	0	0	$111,030	$0
Heat	33	0	1	30	1	$0	$0
Heavy Rain	28	0	0	1	0	$365,000	$50,000
Heavy Snow	1	0	0	0	0	$0	$0
High Surf	1	0	0	0	0	$0	$0
High Wind	40	1	0	0	0	$8,957,000	$39,000
Lightning	1	0	0	0	0	$150,000	$0
Strong Wind	26	0	2	2	1	$3,651,000	$0
Thunderstorm Winds	9	0	0	0	0	$50,000	$0
Tornado	13	0	0	0	0	$1,480,000	$0
Wildfire	7	0	1	2	0	$5,000,000	$0
Winter Storm	2	0	0	0	0	$0	$0
Total	**329**	**15**	**8**	**75**	**2**	**$35,361,030**	**$12,889,000**

Source: NCDC

*Note: Losses reflect totals for all impacted areas, some of which fell outside of Sacramento County

The NCDC table above summarize severe weather events that occurred in Sacramento County. Only a few of the events actually 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 display different information specific to the same events. The value in this data is that it provides data depicting the County's "big picture" hazard environment.

As previously mentioned, many of Sacramento County's state and federal disaster declarations have been a result of severe weather. For this plan, severe weather is discussed in the following subsections:

- Extreme Cold and Freeze
- Extreme Heat
- Heavy Rains and Storms
- High Winds and Tornadoes

For purposes of this Plan, the City of Sacramento co-op weather station (elevation: 70 feet above mean sea level (msl)) was used to illustrate and inform the severe weather hazards. This station was chosen due to its length of record (1877 to 2016).

4.3.2. Severe Weather: Extreme Cold and Freeze

Hazard Profile

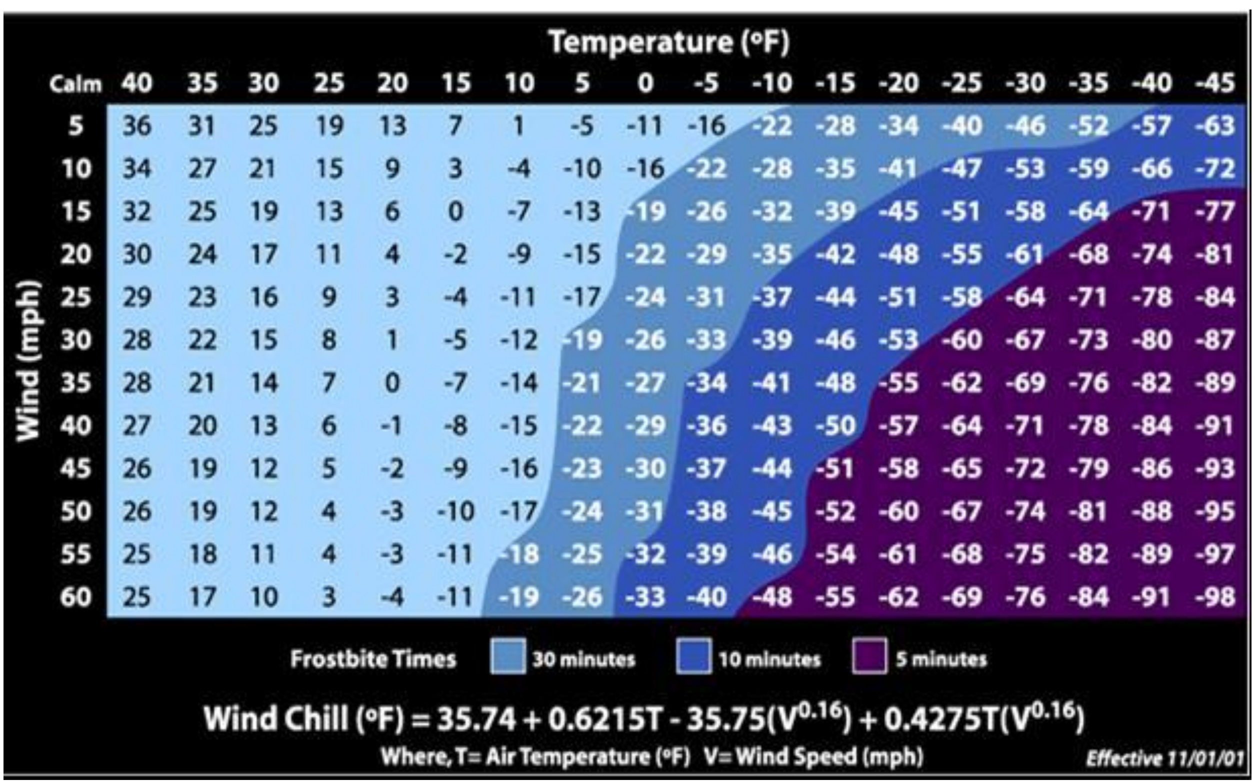
This hazard profile contains multiple sections that detail how this hazard can affect Sacramento County. These sections include a hazard/problem description; description of location and extent; past occurrences of this hazard; and how climate change can affect this hazard.

Hazard/Problem Description

According to the National Weather Service (NWS) and the Western Regional Climate Center (WRCC), extreme cold often accompanies a winter storm or is left in its wake. Prolonged exposure to cold can cause frostbite or hypothermia and can be life-threatening. Infants and the elderly are most susceptible. Pipes may freeze and burst in homes or buildings that are poorly insulated or without heat. Freezing temperatures can cause significant damage to the agricultural industry.

In 2001, the NWS implemented an updated Wind Chill Temperature index (shown in Figure 4-17), which is reproduced below. This index was developed to describe the relative discomfort/danger resulting from the combination of wind and temperature. Wind chill is based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature.

Figure 4-17 Wind Chill Temperature Chart



Temperature (°F)

Wind (mph) / 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

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

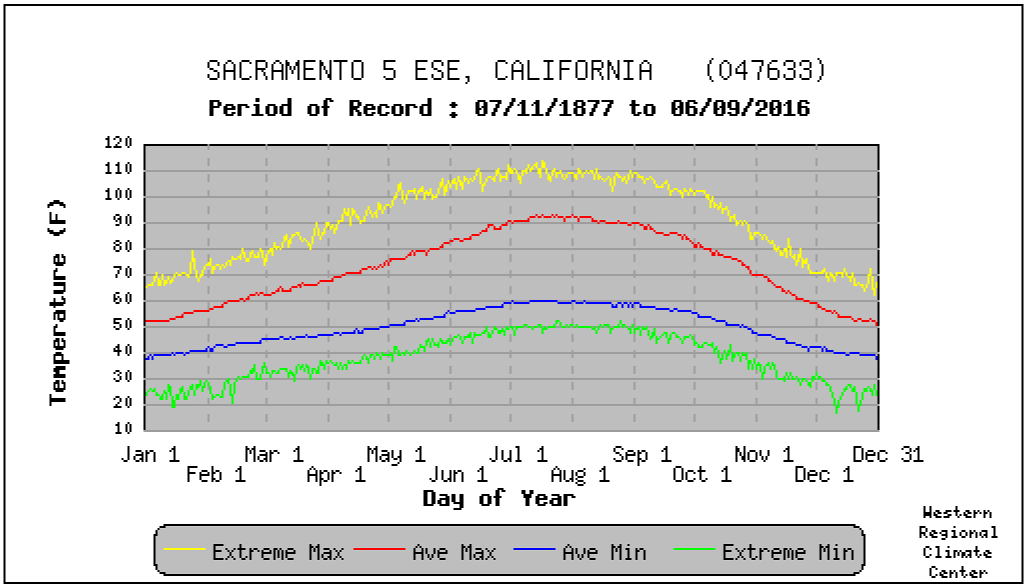
Source: National Weather Service

Information on extreme cold and freeze from the WRCC coop station for the County is shown below.

Sacramento County— Sacramento 5 ESE Weather Station, Period of Record 1877 to 2016

According to the WRCC, monthly average minimum temperatures in the County from November through April range from the upper-30s to the upper-50s. The lowest recorded daily extreme was 17°F on December 11, 1932. In a typical year, minimum temperatures fall below 32°F on 8.3 days with no days falling below 0°F. Average daily temperatures for Sacramento County are shown in Figure 4-18. Table 4-21 shows the record low temperatures by month for Sacramento County.

Figure 4-18 Sacramento County— Daily Temperature Averages and Extremes



Source: Western Regional Climate Center

Table 4-21 Sacramento County – Record Low Temperatures 1877 to 2016

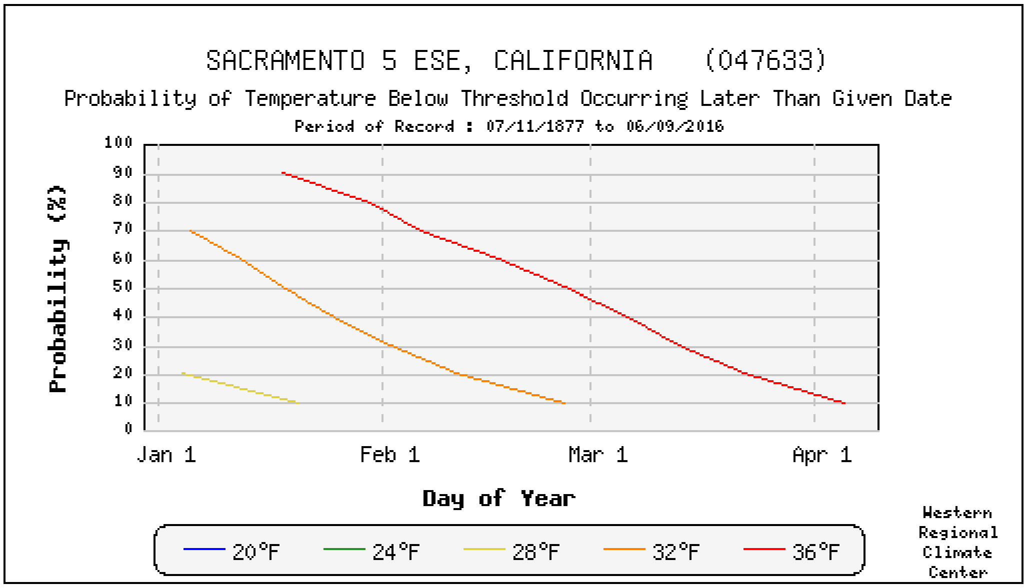
Month	Record Low	Date	Month	Record Low	Date
January	19°	1/14/1888	July	47°	7/3/1901
February	21°	2/13/1884	August	48°	8/30/1887
March	29°	3/15/1880	September	44°	9/18/1882
April	34°	4/10/1927	October	34°	10/30/1935
May	37°	5/3/1950	November	27°	11/28/1880
June	43°	6/1/1929	December	17°	12/11/1932

Source: Western Regional Climate Center

Location and Extent

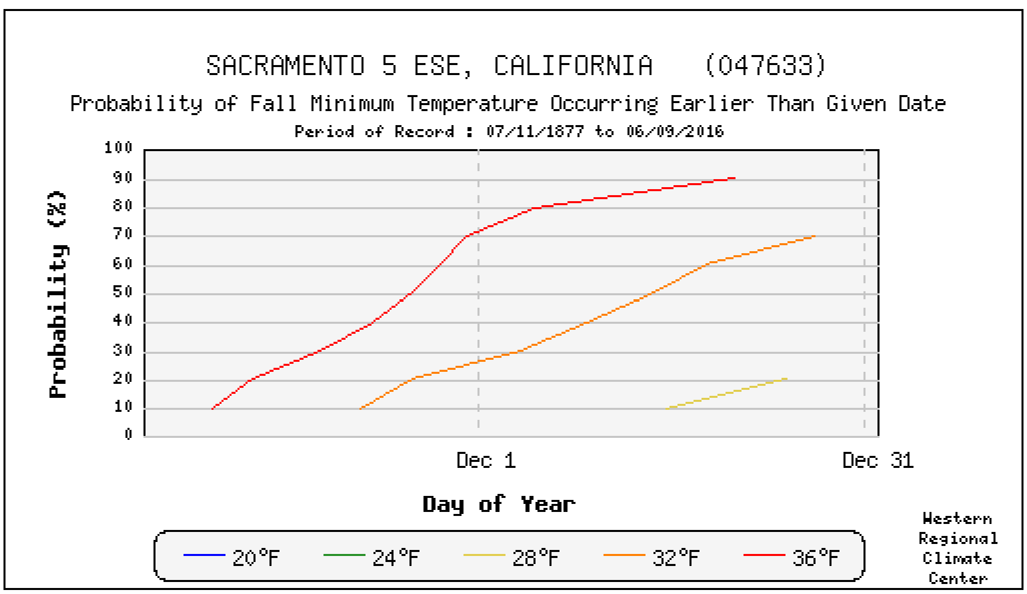
Extreme cold and freeze events occur on a regional basis. Extreme cold can occur in any location of the County. All portions of the County are at risk to extreme cold. While there is no scale (i.e. Richter, Enhanced Fujita) to measure the effects of freeze, temperature data for the County from the WRCC indicates that there are 8.3 days that fall below 32°F. Freeze has a slow onset and can generally be predicted in advance for the County. Freeze events can last for hours (in a cold overnight), or for days to weeks at a time. Figure 4-19 and Figure 4-20 show the probabilities in the County of freeze for both spring and fall.

Figure 4-19 Sacramento County – Spring Freeze Probabilities



Source: Western Regional Climate Center

Figure 4-20 Sacramento County – Fall Freeze Probabilities



Source: Western Regional Climate Center

Past Occurrences

Disaster Declaration History

The County has had no past federal or state disaster declarations for extreme cold and freeze, as shown on Table 4-4.

NCDC Events

The NCDC reports 26 events of past extreme cold and freeze for Sacramento County since 1996 as shown on Table 4-22. Specific events from the NCDC database that caused injuries, deaths, or damages in Sacramento County are discussed below the table.

*Table 4-22 NCDC Winter Storm and Freeze Events for Sacramento County 1996-5/31/2020**

Event Type	Number of Events	Deaths	Deaths (indirect	Injuries	Injuries (indirect)	Property Damage	Crop Damage
Cold/Wind Chill	14	0	1	0	0	$0	$0
Extreme Cold/Wind Chill	1	0	0	0	0	$0	$0
Frost/Freeze	8	0	0	0	0	$200,000	$5,000,000
Heavy Snow	1	0	0	0	0	$0	$0
Winter Storm	2	0	0	0	0	$0	$0
Total	**26**	**0**	**1**	**0**	**0**	**$200,000**	**$5,000,000**

Source: NCDC

*Note: Losses reflect totals for all impacted areas, some of which fell outside of Sacramento County

- **December 4, 1998** – A substantial freeze occurred as valley temperatures dropped into the middle to upper 20s.
- **December 6, 1998** – The second Arctic blast in a five-day period produced well below normal temperatures. The cold air not only affected the Northern Sacramento Valley, but also seeped south into the Northern San Joaquin Valley. Record low temperatures as well as low maximum temperatures were recorded at the Sacramento Executive Airport. The City of Sacramento reported a low of 27°.
- **December 29, 1998** – The third Arctic airmass of the month to spread into the Central California interior was the coldest of the three and produced large amounts of crop damage/loss. Downtown Sacramento experienced 6 consecutive days with low temperatures at or below freezing. The lowest temperature recorded downtown was 26°. $2.4 million in crop damages were reported in Sacramento and surrounding counties. A USDA disaster declaration was declared for the County.
- **December 6, 2005 –** Morning temperatures dropped into the 20s across the Sacramento and Northern San Joaquin Valleys. A record low temperature was tied in Sacramento. The temperature at Sacramento Executive Airport dropped to 28°, which tied the record set in 1980.
- **November 30, 200**6 – Clear skies and a cold arctic airmass led to freezing temperatures across the Planning Area. Temperatures dropped to the mid to upper 20s, which was near record values for the date.
- **January 14-23, 2007** – A very cold arctic airmass settled over the region and temperatures in the Central Valley of California dropped sharply for a relatively prolonged period of time. Many

temperature records were tied and broken during the episode and the damage to area crops was extensive.

- **April 20-24, 2008** – A cool and dry airmass coupled with light winds resulted in cold morning temperatures from April 20th to the 24th in the Planning Area. Record low temperatures were set in several locations. Frost and freezing temperatures caused significant damage to young walnuts, prunes, peaches, pears, and wine grapes across the area.
- **December 4, 2008** – High pressure over the area brought light winds and clear skies. This allowed the unusual case of a record minimum and a record maximum both being tied on the same day in the northern Sacramento Valley. Light winds and clear skies brought cold morning temperatures to the northern Sacramento Valley.
- **December 6-10, 2009** – A very cold airmass brought a hard freeze and record cold to the northern Central Valley. Many pipes in homes and businesses froze and burst, including those for fire sprinkler systems. Some crop damage in orchards was also reported. A hard freeze caused pipes and sprinkler systems to burst throughout the southern Sacramento Valley, causing water damage to homes and businesses. There were nine water main breaks reported in Sacramento, with eighty-two customers reporting problems with leaking pipes.
- **February 19, 2018** – Almond trees were in critical bloom and early nutlet stage during the freeze/frost event. Damage has been projected as significant, but it is too early for specific details. Temperatures at Sacramento International Airport reached 26 on the 20th, 27 at Sacramento Mather Airport and at McClellan Airfield. Vacaville Nut Tree Airport reached 28 on the 20th and 21st.

Hazard Mitigation Planning Committee Events

County Office of Emergency Services (OES) and other departments provided input and After Action Reports that noted that extreme cold events continue to occur on an annual basis. Past events of note include:

- An extreme cold event took place in 2014:
  - ✓ The Sacramento region experienced an extreme cold event beginning Tuesday evening, December 30^{th}, 2014 and extending through Friday morning, January 2^{nd}, 2015. During that time, Sacramento experienced sustained cold indices ranging from 50-56 degree highs with associated low temperatures ranging from 27-36 degrees.
  - ✓ In preparation for the cold event, the County OES initiated a daily conference call, which began December 29th and included all of the community stakeholders and partnering agencies, to advise them of the situation and to plan for the event. The forecasted temperatures were expected to reach the temperature thresholds established in the Severe Weather Guidance Plan (SWG) beginning on Tuesday evening, December 30th at which time additional actions may be needed.
  - ✓ At the onset of the conference calls, the County and City of Sacramento made the decision to open a joint warming center located in the City of Sacramento at the Southside Park Pool Building at 2107 6th Street. At the same time, the City of Elk Grove and the City of Galt decided to open warming centers in their jurisdictions as well; the Wackford Community Center on Bruceville Rd. in Elk Grove and the Chabolla Community Center on Chabolla Ave. in Galt opened on December 31st. Sacramento County OES and Sacramento City OES opened and maintained the Southside Park warming center for three days, beginning Tuesday evening, December 30th and ending on Friday morning, January 2nd. The warming center was closed at 7:00 a.m. on January 2nd ending the County/City response to the cold event. At total of 36 people stayed at the warming center

during this cold weather event. While vouchers were available for families or for people with significant disabilities, no vouchers were issues.
    - ✓ Both the City and County OES, along with the City Parks & Recreation, County Department of Human Assistance (DHA) Hands on Sacramento (HOS) Sacramento Medical Reserve Corp. (SMRC) and others worked cooperatively in activating and managing the warming center in order to provide a warm environment for the community including the homeless. Other services provided included light snacks and hot beverages. In addition to the County and City warming operations, the homeless providers continued to operate their independent facilities thereby providing a warm environment for the homeless.
- ➢ It was noted by the Sacramento County OES that due to environmental exposure due to extreme cold events:
    - ✓ 6 deaths occurred in 2018
    - ✓ Another six occurred in 2019
    - ✓ 2 deaths occurred in 2021

Likelihood of Future Occurrence

Highly Likely—Extreme cold and freeze are likely to continue to occur annually in the Sacramento County Planning Area. In a typical year, minimum temperatures fall below 32°F on 18.3 days in the County. This equates to a likelihood of future occurrences being considered highly likely.

Climate Change and Extreme Cold and Freeze

Climate change and extreme cold and freeze future occurrences are discussed in the following two sections:

- ➢ California Climate Adaptation Strategy (2014)
- ➢ Sacramento County Climate Action Plan, (2017/2021)

California Climate Adaptation Strategy

According to the CAS, freezing spells are likely to become less frequent in California as climate temperatures increase; if emissions increase, freezing events could occur only once per decade in large portion of the State by the second half of the 21st century. According to a California Natural Resources Report in 2014, it was determined that while fewer freezing spells would decrease cold related health effects, too few freezes could lead to increased incidence of disease as vectors and pathogens do not die off.

2017 Sacramento County Climate Action Plan (CAP)/2021 Draft Climate Action Plan Update

According to the 2017 CAP and the Draft 2021 CAP, which utilized Cal Adapt to model potential climate change impacts to Sacramento County, annual average low temperatures in Sacramento County of 49.8°F (from 1961-1990) would increase under the low admissions scenario by 1.6°F to 51.4°F. Under the high emissions scenario, the average annual low temperature is projected to increase by 6.0°F to 55.8°F by 2099.

Vulnerability Assessment

Vulnerability—Medium

Extreme cold and freeze events happen in Sacramento County each year. It can impact both populations and structures in the County.

Impacts

Extreme cold and freeze events happen in Sacramento County each year. Extreme cold often accompanies a winter storm or is left in its wake. Prolonged exposure to cold can cause frostbite or hypothermia and can be life-threatening. Vulnerable populations to cold and freeze include:

- Homeless
- Infants and children under age five
- Elderly (65 and older)
- Individuals with disabilities
- Individuals dependent on medical equipment
- Individuals with impaired mobility

Of significant concern is the impact to populations with special needs such as the elderly and those requiring the use of medical equipment. The residents of nursing homes and elder care facilities are especially vulnerable to extreme temperature events. It is encouraged that such facilities have emergency plans or backup power to address power failure during times of extreme cold and freeze. In addition to vulnerable populations, pets and livestock are at risk to freeze and cold.

Impacts to the County as a result of extreme cold and freeze include damage to infrastructure, utility and power outages, road closures, traffic accidents, and interruption in business and school activities. Pipes may freeze and burst in homes or buildings that are poorly insulated or without heat. Freezing temperatures and ice can cause accidents and road closures and can cause significant damage to the agricultural industry. Extreme cold can affect agricultural products and cattle in the County. Freeze damages reduce the values of agricultural crops. Delays in emergency response services can also occur.

Future Development

Future development built to code should be able to withstand extreme cold and freeze. Pipes at risk of freezing should be mitigated be either burying or insulating them from freeze as new facilities are improved or added. Current County codes provide such provisions for new construction. Vulnerability to extreme cold will increase as the average age of the population in the County shifts resulting in a larger number of senior citizens in the Planning Area.

4.3.3. Severe Weather: Extreme Heat

Hazard Profile

This hazard profile contains multiple sections that detail how this hazard can affect Sacramento County. These sections include a hazard/problem description; description of location and extent; past occurrences of this hazard; and how climate change can affect this hazard.

Hazard/Problem Description

According to information provided by FEMA, extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks. Heat kills by taxing the human body beyond its abilities. In a normal year, about 175 Americans succumb to the demands of summer heat. In the 40-year period from 1936 through 1975, nearly 20,000 people were killed in the United States by the effects of heat and solar radiation. In the heat wave of 1980, more than 1,250 people died.

Heat disorders generally have to do with a reduction or collapse of the body's ability to shed heat by circulatory changes and sweating or a chemical (salt) imbalance caused by too much sweating. When heat gain exceeds a level at which the body can remove it, or when the body cannot compensate for fluids and salt lost through perspiration, the temperature of the body's inner core begins to rise, and heat-related illness may develop. Elderly persons, small children, chronic invalids, those on certain medications or drugs, and persons with weight and alcohol problems are particularly susceptible to heat reactions.

Extreme heat can also affect agriculture in Sacramento County. During times of high heat, low humidity, and winds, PSPS may also be issued for areas of the County. Other power outages are also a concern during extended heat events that occasionally overwhelm the utility companies, leading to temporary outages. Extreme heat conditions can also compound the effects of other hazards, such as drought and wildfire and can contribute to increases in tree mortality.

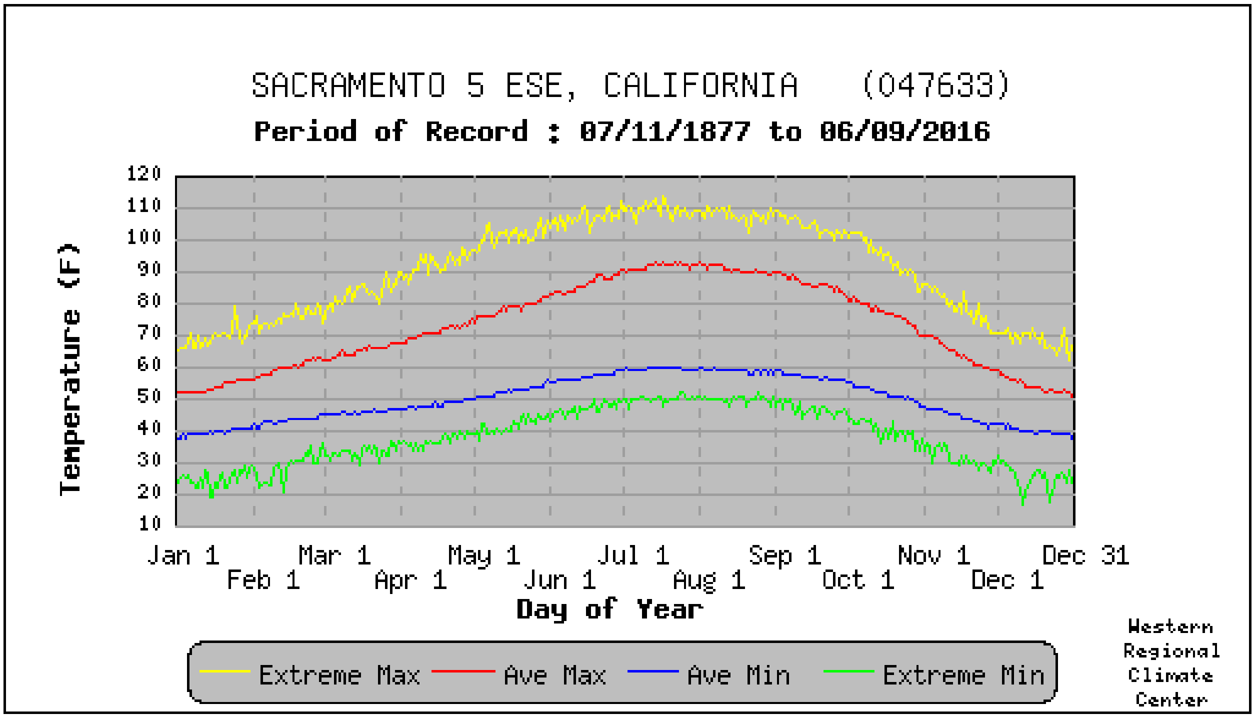
Location and Extent

Extreme heat events occur on a regional basis. Extreme heat can occur in any location of the County. All portions of the County are at some risk to extreme heat. Extreme heat occurs throughout the Planning Area primarily during the summer months. The WRCC maintains data on weather normal and extremes in the western United States. Information from the representative weather station introduced in Section 4.3.1 is summarized below.

Sacramento 5 ESE Weather Station, Period of Record 1877 to 2016 (Elevation of 70 feet above msl)

According to the WRCC, in Sacramento County, monthly average maximum temperatures in the warmest months (May through October) range from the upper-70s to the low-90s. The highest recorded daily extreme was 114°F on July 17, 1925. In a typical year, maximum temperatures exceed 90°F on 65.4 days. Figure 4-21 shows the average daily high temperatures and extremes for the County. Table 4-23 shows the record high temperatures by month for the County.

Figure 4-21 Sacramento County—Daily Temperature Averages and Extremes



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

Table 4-23 Sacramento County – Record High Temperatures

Month	Record High	Date	Month	Record High	Date
January	74°	1/31/1976	July	114°	7/17/1925
February	80°	2/18/1899	August	111°	8/13/1933
March	90°	3/31/1966	September	109°	9/1/1950
April	98°	4/26/2004	October	102°	10/2/1952
May	107°	5/28/1984	November	86°	11/1/1966
June	112°	6/30/1934	December	72°	12/15/1958

Source: Western Regional Climate Center

Heat emergencies are often slower to develop, taking several days of continuous, oppressive heat before a significant or quantifiable impact is seen. Heat waves do not strike victims immediately, but rather their cumulative effects slowly take the lives of vulnerable populations. Heat waves do not generally cause damage or elicit the immediate response of floods, fires, earthquakes, or other more "typical" disaster scenarios. While heat waves are obviously less dramatic, they are potentially deadlier. According to the 2018 California State Hazard Mitigation Plan, the worst single heat wave event in California occurred in Southern California in 1955, when an eight-day heat wave resulted in 946 deaths.

The NWS has in place a system or scale to initiate alert procedures (advisories or warnings) when extreme heat is expected to have a significant impact on public safety. The expected severity of the heat determines whether advisories or warnings are issued. The NWS HeatRisk forecast provides a quick view of heat risk potential over the upcoming seven days. The heat risk is portrayed in a numeric (0-4) and color (green/yellow/orange/red/magenta) scale which is similar in approach to the Air Quality Index (AQI) or the UV Index. This can be seen in Table 4-24.

Table 4-24 National Weather Service HeatRisk Categories

Category	Level	Meaning
Green	0	No Elevated Risk
Yellow	1	Low Risk for those extremely sensitive to heat, especially those without effective cooling and/or adequate hydration
Orange	2	Moderate Risk for those who are sensitive to heat, especially those without effective cooling and/or adequate hydration
Red	3	High Risk for much of the population, especially those who are heat sensitive and those without effective cooling and/or adequate hydration
Magenta	4	Very High Risk for entire population due to long duration heat, with little to no relief overnight

Source: National Weather Service

The NWS office in Sacramento can issue the following heat-related advisory as conditions warrant.

- **Heat Advisories** are issued during events where the HeatRisk is on the Orange/Red threshold (Orange will not always trigger an advisory)
- **Excessive Heat Watches/Warnings** are issued during events where the HeatRisk is in the Red/Magenta output

Past Occurrences

Disaster Declaration History

There have been no FEMA or Cal OES disasters related to extreme heat, as shown in Table 4-4.

NCDC Events

The NCDC data showed 38 extreme heat incidents for Sacramento County since 1993. Events that caused specific injuries or damage are discussed below the table.

*Table 4-25 NCDC Heat Events for Sacramento County 1950-5/31/2020**

Event Type	Number of Events	Deaths	Deaths (indirect	Injuries	Injuries (indirect)	Property Damage	Crop Damage
Excessive Heat	5	6	2	1	0	$0	$0
Heat	33	0	1	30	1	$0	$0
Total	**38**	**6**	**3**	**31**	**1**	**$ 0**	**$ 0**

Source: NCDC

*Note: Losses reflect totals for all impacted areas, some of which fell outside of Sacramento County

- **July 11, 1999** – Afternoon high temperatures averaged 10 to 20 degrees above normal across the central and northern interior. No fatalities or severe heat related injuries were noted by area hospitals, although there was an increase in lesser heat related illnesses caused by prolonged dehydration. Area utilities indicated that facilities were stressed during the event and the voluntary brown out program had to be utilized. SMUD also indicated they broke an all-time record on the 12th for electrical production and distribution. No injuries or fatalities were reported.

- **May 21, 2000** – Daily maximum temperatures across the area reached record levels for three consecutive days and most official reporting sites were fifteen to twenty degrees above normal readings. Sacramento tied or broke records on one or more days. The normal maximum temperature for Sacramento for this period is 82°, yet temperatures reached 100°, 103°, and 99°, all new daily records. No injuries or fatalities were reported.
- **June 13, 2000** – Very hot weather persisted across interior Northern California for three days, resulting in record and near record temperatures at most reporting sites. Sixteen people were treated for heat stroke in Sacramento and Solano counties and one, a 16-year-old male in West Sacramento, died. A heavily used portion of I-80 between Sacramento and San Francisco was closed for several hours to repair three lanes in which the asphalt had buckled due to the sustained heat. Power outages were suffered by more than 100,000 customers during the event. Maximum temperatures were fifteen to twenty degrees above normal throughout the valley and foothills, but what made the weather especially difficult to handle was that the minimum temperatures were also ten to twenty degrees above normal for the period. The hottest day across the area was the 14th, with maximum temperatures of 107°F in Sacramento. The maximum temperatures on the 8th, less than a week earlier, were 71°. Sacramento set a daily high minimum temperature record by dropping only to 68° on the 13th. No injuries or fatalities were reported.
- **July 29, 2000** – Excessive heat impacted the Sacramento and northern San Joaquin Valleys during the last few days of July. Temperatures reached and exceeded 100° in many areas before peaking on the 31st at 104° in Sacramento. No injuries or fatalities were reported.
- **September 18, 2000** – Daily maximum temperature records were tied and broken across the Sacramento and northern San Joaquin valleys. The Sacramento temperature reached 101°, which tied the record previously set in 1984. No injuries or fatalities were reported.
- **September 20, 2000** – The daily high maximum temperature record was set in Sacramento when it reached 102°, breaking the previous record of 101° set in 1994. No injuries or fatalities were reported.
- **July 1, 2005** – July 2005 set a new record for heat in Sacramento. The average temperature in Sacramento was 81.8° for the month. This was the hottest average temperature ever recorded in Sacramento. The old record was 81.6° set in July 2003. In addition, the average low temperature for the month of July was 65.2°, breaking the old record of 65.1° set in July 2003. However, the average high temperature record was not broken. The average for July 2005 was 98.4°, which is well below the record average high of 99.6° set in 1988.
- **July 4-5, 2007** – High pressure over the western United States brought record heat to Northern California on July 4th and 5th. New daily high temperature records were set today at the Downtown Sacramento and the Sacramento Executive Airport sites. At Downtown Sacramento, the temperature reached 108°, which broke the old record of 107° set in 1931. At Sacramento Executive Airport, the temperature reached 107°, which broke the old record of 105° set in 1968.
- **August 23, 2007** – High pressure over California resulted in hot conditions in the Planning Area. Temperatures in excess of 100° were recorded at many locations in the Planning Area.
- **May 15-18, 2008** – A strong high pressure ridge over the region produced hot temperatures across interior Northern California from May 14th to May 17th, with many triple digit daily high temperature records set. Record daily high minimum temperatures were also set as clouds and northerly winds

maintained the heat overnight. The hot temperatures lingered into the 19th, especially for the northern San Joaquin Valley.

- **July 9, 2008** – A strong upper level ridge brought hot weather to much of the Planning Area from July 6th to the 10th. High temperatures well over the century mark were recorded, with records tied or set across the northern Central Valley on the 9th. Overnight temperatures also remained very warm, with several record high minimums set or tied.
- **August 15, 2008** – A strong high pressure ridge allowed high temperatures to reach triple digits across the northern Central Valley. In the Planning Area, temperatures of 102° to 108° were recorded.
- **August 26-29, 2008** – A strong upper level ridge brought hot weather to much of the area from the 26th to the 28th. High temperatures well over the century mark were recorded, with records tied or set across the northern Central Valley. A daily maximum temperature record of 104° was set at Sacramento Executive Airport. This broke the previous record of 103° set in 1950.
- **June 28, 2013** – Max temperatures in the Southern Sacramento Valley reached 100-107 degrees on Friday, and 105-110 degrees on Saturday. Minimum temperatures were approximately in the mid to upper 60s. The heat sickened at least 15 people, two critically, at a morning graduation ceremony Saturday at Del Oro High School in Loomis, which forced the cancellation of the event and sent several people to the local hospitals. Many of those stricken suffered heat exhaustion and heat stroke and ranged in age from 15 to 80 years of age and older. No deaths or damages were reported.
- **June 18, 2017** – The Sacramento County Coroner reported a total of 6 heat related deaths in the county. One victim was an 88-year-old woman found outside her home in Elk Grove on June 16th. She had been doing yard work. Her air conditioner was on inside her residence. Another decedent was a 36 year old male found collapsed behind his residence in the City of Sacramento on June 19th. Cause of death was hyperthermia due to environmental heat exposure in combination with acute methamphetamine intoxication. He died at Sacramento Medical Center. Another decedent was a 53 year old male found unresponsive on Two Rivers Trail at N. 7th Street in the City of Sacramento on June 21st. Cause of death was hyperthermia due to environmental heat exposure in combination with acute methamphetamine intoxication. He died at Sacramento Medical Center. Another decedent was a 56 year old male that collapsed in his home on June 22nd in the City of Sacramento. it is unknown if his air conditioner was broken, but no air was on when he was found. He made statements to family that he was hot, but refused to accept help. He died at Kaiser Hospital South. Another decedent was an 89 year old female with extensive medical history that was found unresponsive in her home on June 20th in the City of Sacramento. Decedent had an air conditioner. It is unknown if it was broken or just turned off. She died after an extended stay at Kaiser Hospital South from heat stroke. Another decedent was an 83 year old female with extensive medical history that was found unresponsive on June 20th in her home in the City of Sacramento. She had air conditioning, but it was turned off. She died after an extensive stay at Sacramento Medical Center. Cause of death was hyperthermia due to heat stroke. An Excessive Heat Warning was in effect for the area through the period. High temperatures in downtown Sacramento were 106° on the 18th (record), 107° on the 19th (record), 106° on the 20th, 106° on the 21st, and 108° on the 22nd (record).
- **August 1, 2017** – 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.
- **June 22, 2018** – The NWS Experimental HeatRisk reached High readings that prompted a heat warning for the southern Sacramento Valley. PG&E activated their Emergency Operations Center in support of the June Heat Event. No damages, injuries, or deaths were reported.

- **July 24, 2018** – The NWS Experimental Heat Risk reached Moderate to High readings for several days prompting a Heat Advisory for the southern Sacramento Valley. Downtown Sacramento peaked at 109 on the 25th. Lows were in the mid-60s. No damages, injuries, or deaths were reported.

Hazard Mitigation Planning Committee Events

Members of the HMPC recalled the following events:

- **June 7 & 8 2013–** 100°-112°F
- **June 28-30, again July 1, 2013**– over 100°F for 7 days
- **July 1-4, 2013** – A strong high pressure ridge built over Northern California, keeping max temperatures in the Central Valley above 100 for at least 7 days. Overnight temperatures failed to recover, reaching generally down to the mid-60s to 90. The heat wave felt warmer due to the moisture in the air from the previous rainfall on June 26th, as well as from the intrusion of subtropical moisture from the south.
- **January 2014** – January was an abnormally dry and warm month for interior Northern California. Many record high temperatures were broken, and a state-wide drought was declared on January 17th.
- **June 2017** – Extreme heat began on the 13th and lasted through the 23rd. On June 19th, Mercy Folsom Hospital reported a power failure at 10:59 pm and closed to all ambulance traffic. Power was restored at approximately 5:30 am the next morning and the hospital was back to normal operations. Two days later, the hospital lost power again. Initial evacuation planning was conducted along with a regional bed poll in the event of an evacuation. Power was restored by SMUD at 11:45 pm and the hospital anticipated reopening at 2:00 am or once the temperature was low enough to open. The same day, Eskaton Village in Carmichael lost power and air conditioning affecting 200 units, 250 people and 20-30 pets. They had service to a common room and were making accommodations for residents. Eskaton stated that they were comfortable with their plan for the night and that they had plenty of water and ice on hand to distribute. They were making calls to family members if residents wanted to stay with family in more comfortable climate controlled environments. Briarwood Post Acute contacted and stated their facility has lost partial air conditioning in their patient care areas and are considering a partial evacuation. EMS was ready with bed polls and transfers; enough beds were available. They canceled their evacuation at 4:00 pm. Cooling centers were opened in the County during this time. 6 deaths were attributed to this heat wave in the County.
- **August/September 2020** – Extreme heat struck the County. Cooling centers were opened in 8 locations in the County. 4 deaths occurred from the extreme heat conditions. As the heat event ended, multiple wildfires around northern California were ignited by dry lightning. Sacramento County received smoke into the valley that was not pushed out by light winds. The cities of Folsom and Sacramento converted their cooling centers to cleaner air spaces to serve the public unable to get into an indoor space to escape the smoke.
- **July/August 2020** – Extreme heat struck the County. Multiple cooling centers were opened in locations throughout the County.

Likelihood of Future Occurrence

Highly Likely—Temperature extremes are likely to continue to occur annually in the Sacramento County Planning Area. Temperatures at or above 90°F are common most summer days in the County.

Climate Change and Extreme Heat

Climate change and its effect on extreme heat in the County has been discussed utilizing four sources:

- 2017 Sacramento County CAP/2021 Draft Climate Action Plan Update
- California Climate Adaptation Strategy (CAS) – 2014
- Climate Change and Health Profile Report – Sacramento County
- Cal-Adapt

2017 Sacramento County CAP/2021 Draft Climate Action Plan Update

According to the 2017 and Draft 2021 CAP, which utilized Cal Adapt to model potential climate change impacts to Sacramento County, it concluded that annual average high temperatures in Sacramento County of 73.1°F would increase under the low emissions scenario by 3.1°F to 76.2°F. Under the high emissions scenario, the average annual high temperature is projected to increase by 7.2°F to 80.3°F by 2099.

In addition, research published by California Environmental Protection Agency suggests that heat impacts are felt disproportionately in the northern portions of Sacramento County and the surrounding areas, due to prevailing wind patterns. This phenomenon is likely be exacerbated by climate change.

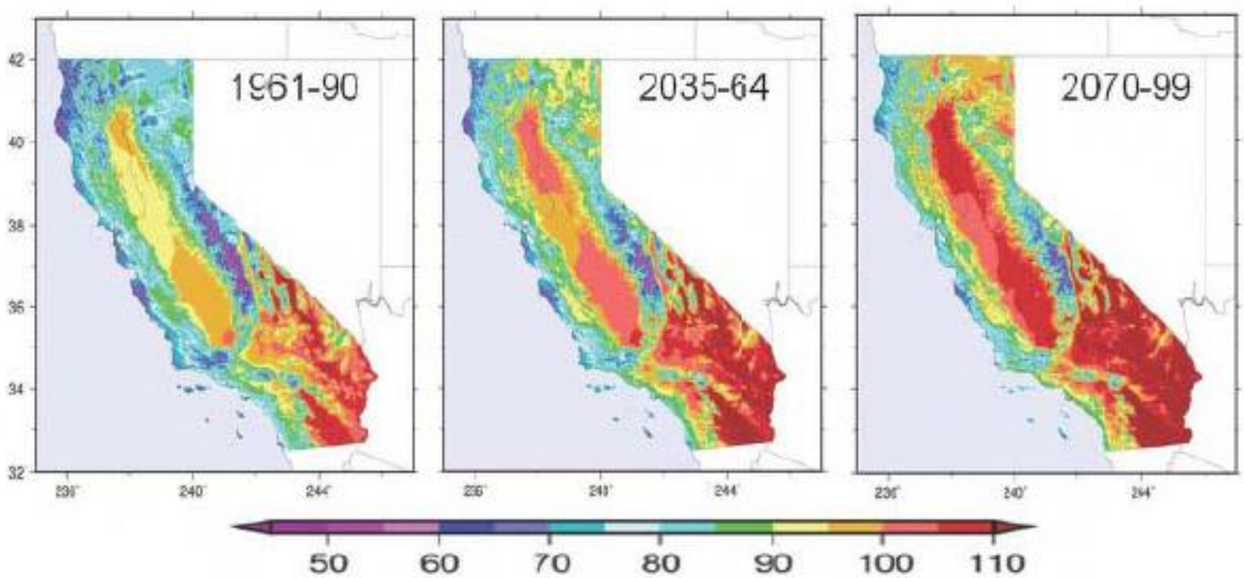
Extreme Heat Days. Extreme heat days are defined by Cal-Adapt for Sacramento County as 100°F or higher. From 1961 to 1990, Sacramento County has a historical average of four extreme heat days a year. From 2010 to 2016, extreme heat days increase in Sacramento County with a current average of 8 to 9 extreme heat days per year. Utilizing Cal-Adapt, the projected average annual number of extreme heat days under the low emissions scenario is approximately 15 days per year in 2050 and between 19 to 45 days per year at the end of the century. Under the high emissions scenario, Cal-Adapt predicts that Sacramento County will experience 25-31 extreme heat days per year in 2050 and 50 to 67 days per year by 2099. Also to be considered are warm nights. A warm night is defined as a day between April and October where the minimum temperature exceeds the historical minimum temperatures between 1961 and 1990. Historically, Sacramento County has an average of four warm nights a year, with a threshold of 65°F. Under the low- and high-emissions scenarios, the number of warm nights is expected to increase to an average of 12-33 nights by 2050 and 23 to 90 nights by 2099.

Frequency and Timing of Heat Waves. When these extreme temperatures are experienced over a period of several days or more, they are considered heat waves. Cal-Adapt defines a heat wave for Sacramento County as an event where the extreme heat day threshold of 100°F is exceeded for five days or more. Based on this analysis, heat waves consisting of a five-day period have occurred in Sacramento County at a rate of about one to two heat waves per decade between 1950 and 2000. The Cal-Adapt model projects an increase in heat waves as the century progresses. Under the low emissions scenario, Sacramento County is expected to experience approximately three heat waves per year around 2050 and up to four per year by 2099. Under the high emissions scenario, an average of three to five heat waves per year by 2050 are projected and up to 12 per year by the end of the century. Also to be noted, as shown in both emissions scenarios, the model projects that the occurrence of these heat waves will occur both earlier and later in the season.

Climate Adaptation Strategy

The 2014 CAS, citing a California Energy Commission study, states that "over the past 15 years, heat waves have claimed more lives in California than all other declared disaster events combined." This study shows that California is getting warmer, leading to an increased frequency, magnitude, and duration of heat waves. These factors may lead to increased mortality from excessive heat, as shown in Figure 4-22.

Figure 4-22 California Historical and Projected Temperature Increases – 1961 to 2099



Source: Dan Cayan; California Climate Adaptation Strategy 2014

As temperatures increase, California and Sacramento County will face increased risk of death from dehydration, heat stroke, heat exhaustion, heart attack, stroke and respiratory distress caused by extreme heat. According to the 2014 CAS report and the 2018 State of California Hazard Mitigation Plan, by 2100, hotter temperatures are expected throughout the state, with projected increases of 3-5.5°F (under a lower emissions scenario) to 8-10.5°F (under a higher emissions scenario). These changes could lead to an increase in deaths related to extreme heat in Sacramento County.

Climate Change and Health Profile Report – Sacramento County

The Climate Change and Health Profile Report (CCHPR) noted for Sacramento County that increased temperatures manifested as heat waves and sustained high heat days directly harm human health through heat-related illnesses (mild heat stress to fatal heat stroke) and the exacerbation of pre-existing conditions in the medically fragile, chronically ill, and vulnerable. Increased heat also intensifies the photochemical reactions that produce smog and ground level ozone and fine particulates (PM2.5), which contribute to and exacerbate respiratory disease in children and adults. Increased heat and carbon dioxide enhance the growth of plants that produce pollen, which are associated with allergies. Increased temperatures also add to the heat load of buildings in urban areas and exacerbate existing urban heat islands adding to the risk of high ambient temperatures.

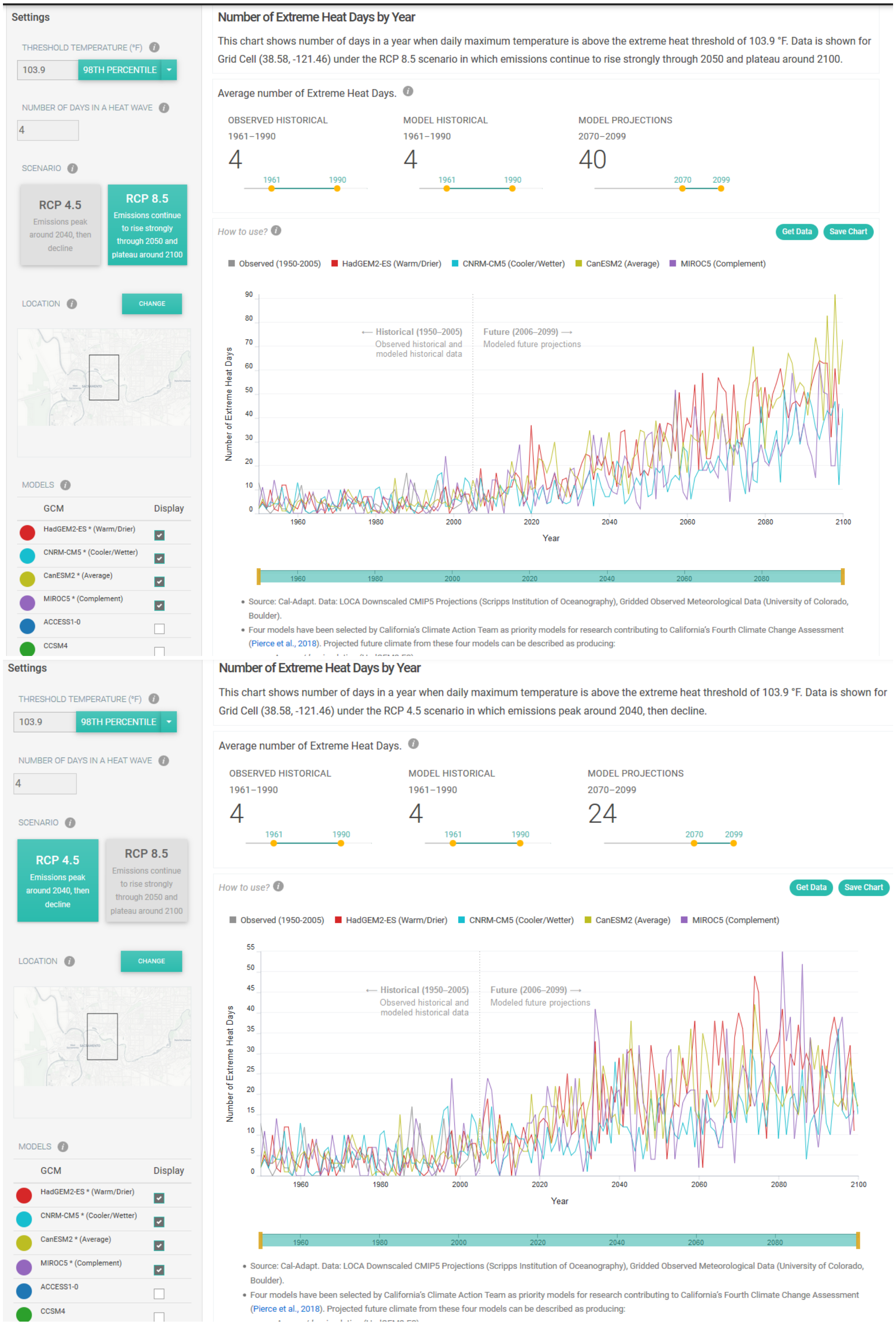
Cal-Adapt

Cal Adapt also noted that overall temperatures are expected to rise substantially throughout this century. During the next few decades, scenarios project average temperature to rise between 1 and 2.3°F; however, the projected temperature increases begin to diverge at mid-century so that, by the end of the century, the temperature increases projected in the higher emissions scenario (Representative Concentration Pathways (RCP) 8.5) are approximately twice as high as those projected in the lower emissions scenario (RCP 4.5).

These projections also differ depending on the time of year and the type of measurement (highs vs. lows), all of which have different potential effects to the state's ecosystem health, agricultural production, water use and availability, and energy demand. Future temperature estimates from Cal-Adapt for the Sacramento County Planning (using the quad that contains the City of Sacramento) are shown in Figure 4-23. It shows the following:

- The upper chart shows number of days in a year when daily maximum temperature is above the extreme heat threshold of 90.0°F. Data is shown for Sacramento County under the RCP 8.5 scenario in which emissions continue to rise strongly through 2050 and plateau around 2100.
- The lower chart shows number of days in a year when daily maximum temperature is above the extreme heat threshold of 90.0 °F. Data is shown for Sacramento County under the RCP 4.5 scenario in which emissions peak around 2040, then decline.

Figure 4-23 Sacramento County – Future Temperature Estimates in Low and High Emission Scenarios



Source: Cal-Adapt – Number of Extreme Heat Days by Year

Vulnerability Assessment

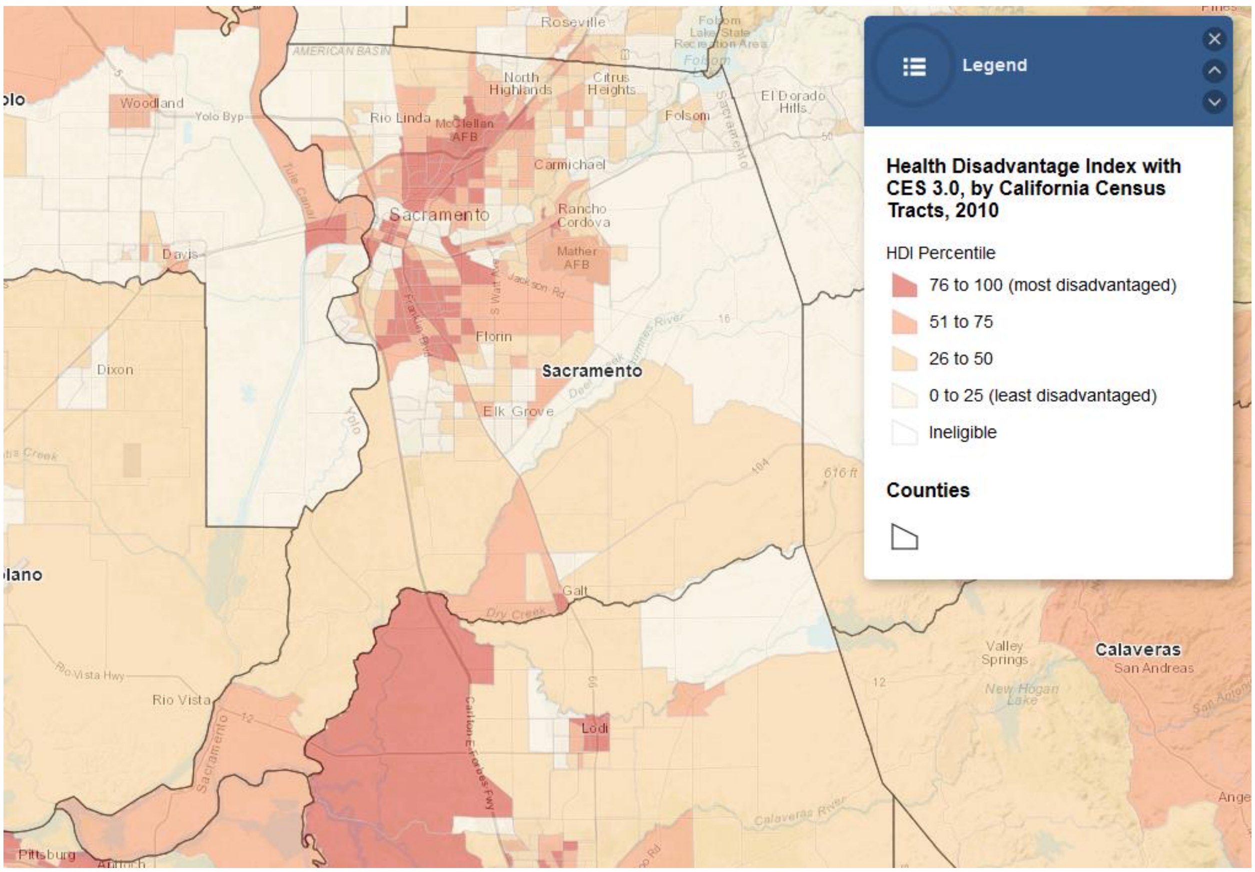
Vulnerability—Medium

Extreme heat happens in Sacramento County each year. Extreme heat rarely affects buildings in the County, but affects the population inside the County as well as the County's agricultural industry.

Impacts from Extreme Heat

Vulnerable populations are at the greatest risk to the effects of extreme heat. The Public Health Alliance has developed a composite index to identify cumulative health disadvantage in California. Factors such as those bulleted above were combined to show what areas are at greater risk to hazards like extreme heat. This is shown on Figure 4-24.

Figure 4-24 Health Disadvantage Index by California Census Tract



Source: Public Health Alliance of Southern California - retrieved 11/6/2020

Vulnerable populations to extreme heat include:

- Homeless
- Infants and children under age five
- Elderly (65 and older)

- Individuals with disabilities
- Individuals dependent on medical equipment
- Individuals with impaired mobility

In addition to vulnerable populations, pets and livestock are at risk to extreme heat. Heat can cause stress to agricultural crops and livestock in the County. Extreme heat dries out vegetation in the County, creating greater risks from wildfires, which is discussed in Section 4.3.16. Further, extreme heat, combined with low humidity and high winds, can cause a PSPS event to be issued for areas of the County as the risk of wildfire increases.

Future Development

As the County shifts in demographics, more residents will become senior citizens. The residents of nursing homes and elder care facilities are especially vulnerable to extreme temperature events. It is encouraged that such facilities have emergency plans or backup power to address power failure during times of extreme heat and in the event of a PSPS. Low income residents and homeless populations are also vulnerable. Cooling centers for these populations should be utilized when necessary.

4.3.4. Severe Weather: Heavy Rains and Storms

Hazard Profile

This hazard profile contains multiple sections that detail how this hazard can affect Sacramento County. These sections include a hazard/problem description; description of location and extent; past occurrences of this hazard; and how climate change can affect this hazard.

Hazard/Problem Description

Storms in the Sacramento County Planning Area are generally characterized by heavy rain often accompanied by strong winds and sometimes lightning and hail. 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 contains one or more of the following phenomena: hail that is three-quarters of an inch or greater, winds in excess of 50 knots (57.5 mph), or a tornado. Heavy precipitation in the Sacramento County area falls as rain, mainly in the fall, winter, and spring months.

The severe weather hazard is broken down in the following sections into:

- Heavy Rain and Storms
- Hail
- Lightning

Heavy Rain and Storms

The NWS reports that storms and thunderstorms result from the rapid upward movement of warm, moist air. They can occur inside warm, moist air masses and at fronts. As the warm, moist air moves upward, it cools, condenses, and forms cumulonimbus clouds that can reach heights of greater than 35,000 ft. As the rising air reaches its dew point, water droplets and ice form and begin falling the long distance through the clouds towards earth's surface. As the droplets fall, they collide with other droplets and become larger. The falling droplets create a downdraft of air that spreads out at Earth's surface and causes strong winds associated with thunderstorms.

Short-term, heavy storms can cause both widespread flooding as well as extensive localized drainage issues in the Sacramento County Planning Area. As storms continue to increase in intensity, the limited drainage infrastructure has become an increasingly important 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 and cause power outages.

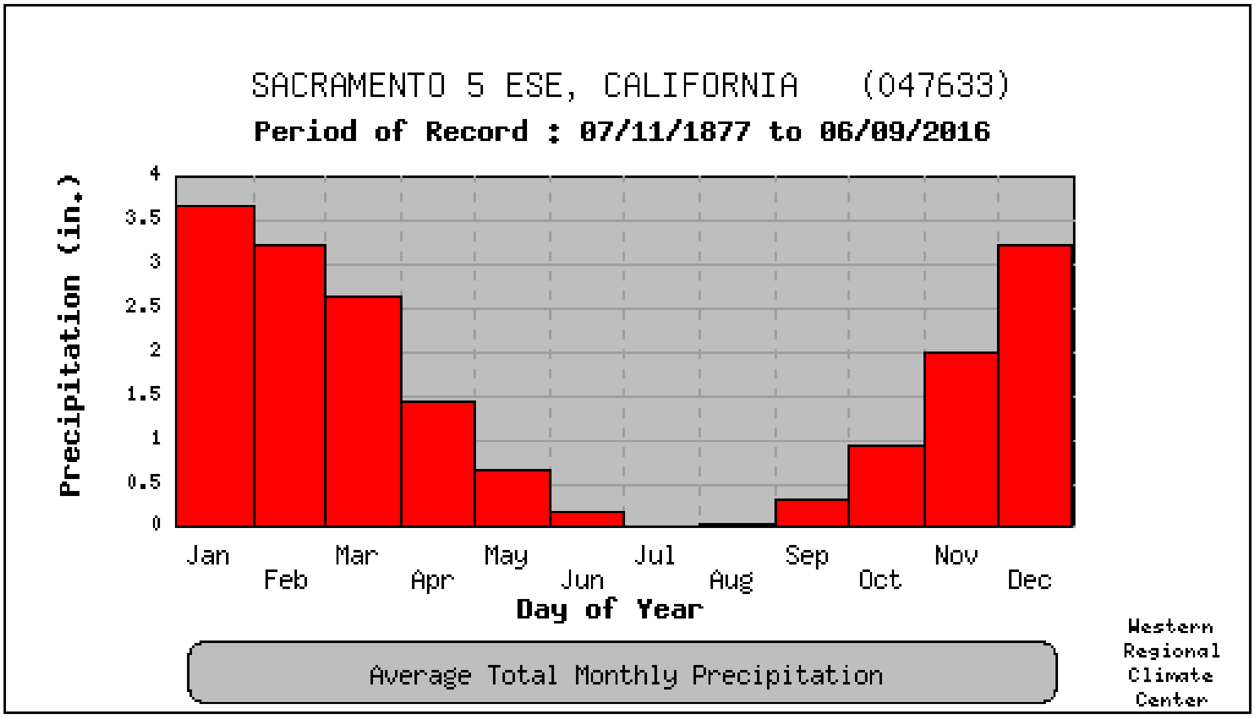
Location and Extent

Heavy rains in Sacramento County vary by season and location, but can occur anywhere in the County. There is no scale by which heavy rains are measured – usually it is measured in terms of rainfall amounts. Magnitude of storms is measured often in rainfall and damages. The speed of onset of heavy rains can be short, but accurate weather prediction mechanisms often let the public know of upcoming events. Duration of thunderstorms in California is often short, ranging from minutes to hours. Information from the WRCC weather station in Sacramento County previously discussed in Section 4.3.1 is summarized below.

Sacramento 5 ESE Weather Station, Period of Record 1877 to 2016 (Elevation of 70 feet above msl)

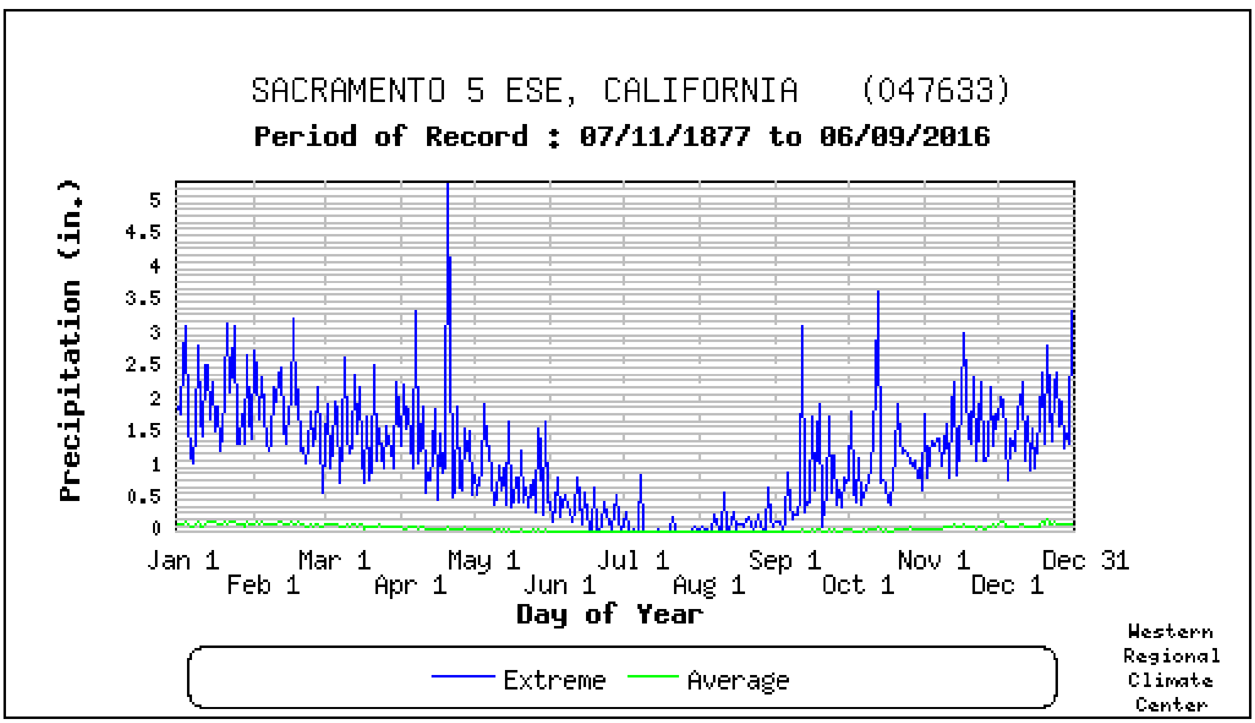
According to the WRCC, average annual precipitation in the County is 18.15 inches per year. The highest recorded annual precipitation is 37.62 inches in 1983; the highest recorded precipitation for a 24-hour period is 5.28 inches on April 20, 1962. The lowest recorded annual precipitation was 11.76 inches in 1976. Average monthly precipitation for Sacramento County is shown in Figure 4-25. Daily average and extreme precipitations are shown in Figure 4-26.

Figure 4-25 Sacramento County—Monthly Average Total Precipitation



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

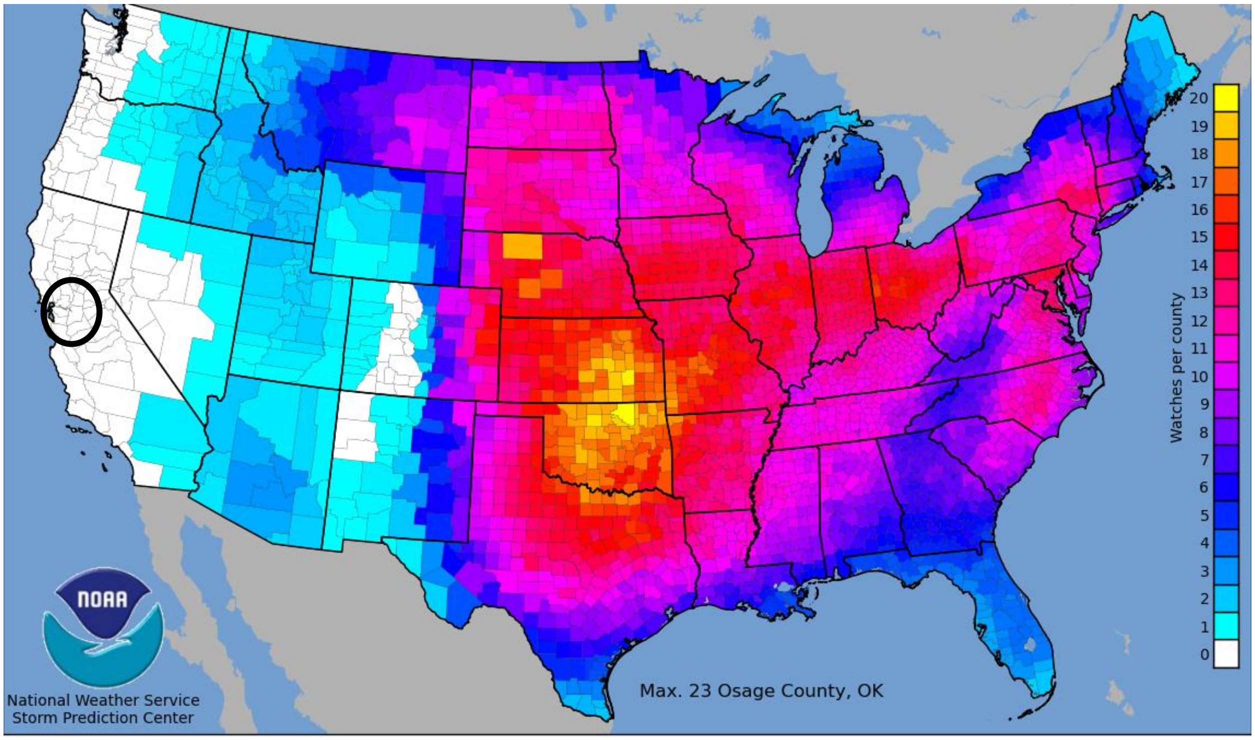
Figure 4-26 Sacramento County—Daily Average and Extreme Precipitation



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

The NOAA Storm Prediction Center tracks thunderstorm watches on a county basis. Figure 4-27 shows thunderstorm watches in Sacramento County and the United States for a 20-year period between 1993 and 2012, the most recent map available.

Figure 4-27 Sacramento County – Average Thunderstorm Watches per Year (1993 to 2012)



Source: NOAA Storm Prediction Center, map retrieved 9/23/2020

Hail

Hail can occur throughout the Sacramento County Planning Area during storm events, though it is rare. 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 sometimes associated with severe storms within the Sacramento County Planning Area. Hailstones are usually less than two inches in diameter and can fall at speeds of 120 miles per hour (mph). Severe hailstorms can be quite destructive, causing damage to roofs, buildings, automobiles, vegetation, and crops.

The National Weather Service classifies hail by diameter size, and corresponding everyday objects to help relay scope and severity to the population. Table 4-26 indicates the hailstone measurements utilized by the National Weather Service.

Table 4-26 Hailstone Measurements

Average Diameter	Corresponding Household Object
.25 inch	Pea
.5 inch	Marble/Mothball

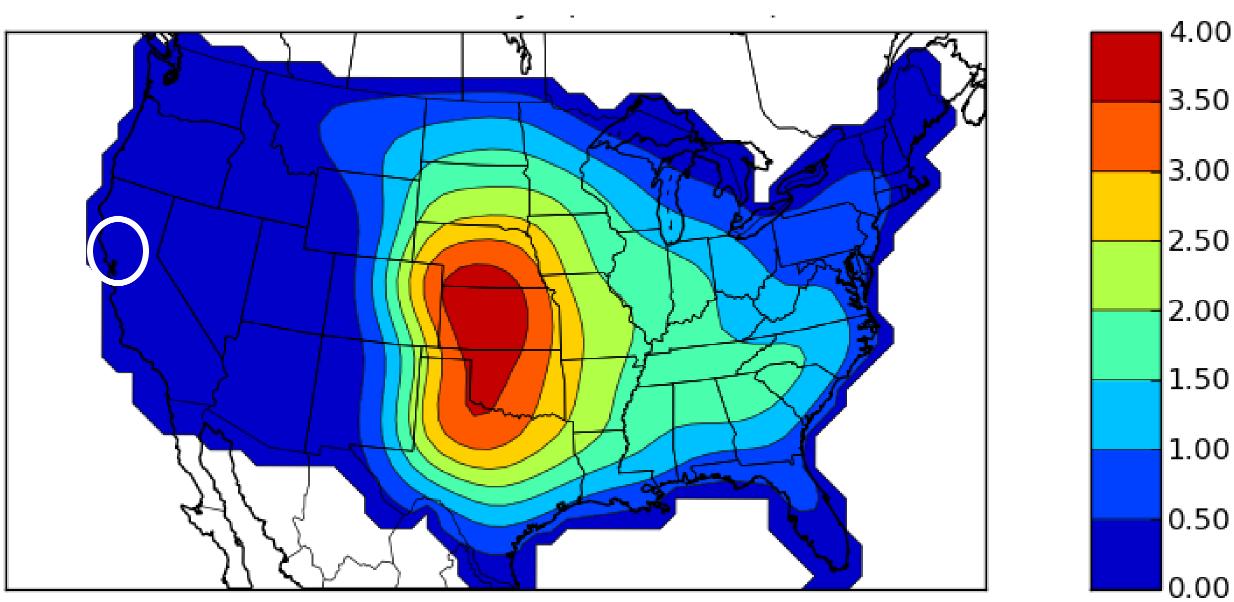
Average Diameter	Corresponding Household Object
.75 inch	Dime/Penny
.875 inch	Nickel
1.0 inch	Quarter
1.5 inch	Ping-pong ball
1.75 inch	Golf-Ball
2.0 inch	Hen Egg
2.5 inch	Tennis Ball
2.75 inch	Baseball
3.00 inch	Teacup
4.00 inch	Grapefruit
4.5 inch	Softball

Source: National Weather Service

Location and Extent

While rare, hail events can occur in any location of the County. All portions of the County are at risk to hail. There is no scale in which to measure hail, other than hail stone size as detailed above. The speed of onset of hail can be short, but accurate weather prediction mechanisms often let the public know of upcoming events. Duration of thunderstorms that can cause hail in California is often short, ranging from minutes to hours. Hail events last shorter than the duration of the total thunderstorm. The National Weather Service tracks hail events. Figure 4-28 shows the average days each year where hail of greater than 1" in diameter occurred during a 20-year period from 1990 to 2009. The most recent map available.

Figure 4-28 Sacramento County – Average Hail Days per Year (1990 to 2009)



Source: National Weather Service, map retrieved 9/23/2020

Lightning

Lightning can occur throughout the County both during and outside of storm events. Lightning is defined by the NWS as any and all of 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 total destruction. Or, damage may be indirect, when the current passes through or near an object, which generally results in less damage.

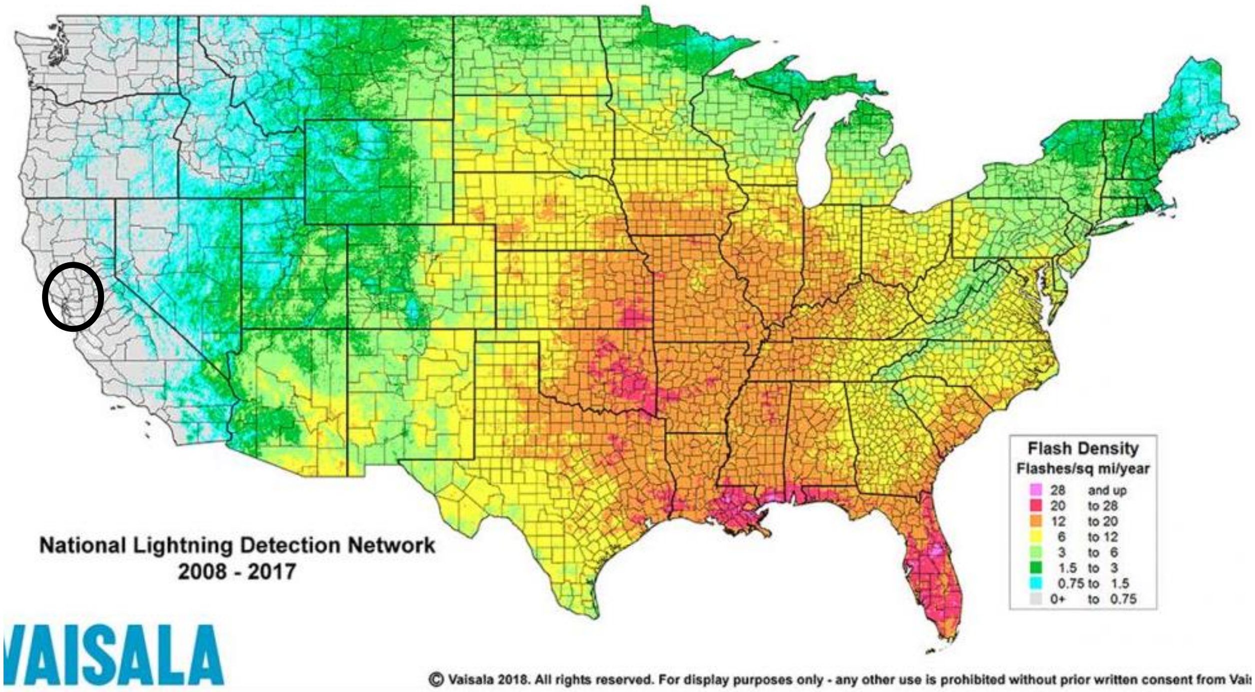
Intra-cloud lightning is the most common type of discharge. This occurs between oppositely charged centers within the same cloud. Usually it takes place inside the cloud and looks from the outside of the cloud like a diffuse brightening that flickers. However, the flash may exit the boundary of the cloud, and a bright channel, similar to a cloud-to-ground flash, can be visible for many miles.

Cloud-to-ground lightning is the most damaging and dangerous type of lightning, though it is also less common. Most flashes originate near the lower-negative charge center and deliver negative charge to earth. However, a large minority of flashes carry positive charge to earth. These positive flashes often occur during the dissipating stage of a thunderstorm's life. Positive flashes are also more common as a percentage of total ground strikes during the winter months. This type of lightning is particularly dangerous for several reasons. It frequently strikes away from the rain core, either ahead or behind the thunderstorm. It can strike as far as 5 or 10 miles from the storm in areas that most people do not consider to be a threat. Positive lightning also has a longer duration, so fires are more easily ignited. And, when positive lightning strikes, it usually carries a high peak electrical current, potentially resulting in greater damage.

Location and Extent

Lightning events can occur in any location of the County and are often associated with thunderstorms. All portions of the County are at risk to lightning. Lightning in the County can occur both during and outside of thunderstorms; the latter often referred to as dry lightning events. The speed of onset of thunderstorms that can cause lightning can be short, but accurate weather prediction mechanisms often let the public know of upcoming events. Duration of thunderstorms in California is often short, ranging from minutes to hours. Thunderstorms and lightning are rare in the County. Vaisala maintains the National Lightning Detection Network. It tracks cloud to ground lightning incidences in the United States. Figure 4-29 shows lightning incidences in the County and the rest of the United States from 2008 to 2017, the most recent map date available.

Figure 4-29 Sacramento County – Lightning Incidence Map 2008 to 2017



Source: Vaisala National Lightning Detection Network, map retrieved 8/14/2020

Past Occurrences

Disaster Declaration History

A search of FEMA and Cal OES disaster declarations turned up multiple events. Heavy rains and storms have caused flooding in the County. Events where flooding resulted in a state or federal disaster declaration are shown in Table 4-27.

Table 4-27 Sacramento County – Disaster Declarations from Heavy Rain and Storms (and Floods) 1950-2020

Disaster Type	Federal Declarations		State Declarations	
	Count	Years	Count	Years
Flood (including heavy rains and storms)	19	1950, 1955, 1958 (twice), 1963, 1969, 1982 (twice), 1983, 1986, 1995 (twice), 1996, 1997, 1998, 2008, 2017 (three times)	14	1955, 1958, 1964, 1969, 1983, 1986, 1995 (twice), 1997, 1998, 2006, 2017 (three times)

Source: FEMA, Cal OES

NCDC Events

The NCDC data recorded 38 hail, heavy rain, and lightning incidents for Sacramento County since 1950. A summary of these events is shown in Table 4-28. Additional events of heavy rain and storms are also discussed in the NCDC table in the flood profile in Section 4.3.10. Specific events in the NCDC database showing damages, deaths, or injuries are detailed below the table.

*Table 4-28 NCDC Hail, Heavy Rain, and Lightning Events in Sacramento County 1950–5/31/2020**

Event Type	Number of Events	Deaths	Deaths (indirect)	Injuries	Injuries (indirect)	Property Damage	Crop Damage
Hail	9	0	0	0	0	$111,030	$0
Heavy Rain	28	0	0	1	0	$365,000	$50,000
Lightning	1	0	0	0	0	$150,000	$0
Total	**38**	**0**	**0**	**1**	**0**	**$626,030**	**$50,000**

Source: NCDC

*Note: Losses reflect totals for all impacted areas, some of which fell outside of Sacramento County

- **March 24, 1994** – A strong upper low pressure system and cold front moved over the area, where rainfall amounts of 0.75 to 1.33 inches were common. Numerous reports of street flooding were reported.
- **January 22, 2000** – In about a 48-hour span, downtown Sacramento more than doubled its seasonal precipitation climbing from 3.91 inches to 8.21 inches. Officially for the event, downtown Sacramento received 4.30 inches. On the 24th, Sacramento easily established a new daily precipitation record with 3.11 inches. The previous record for the date was 1.76 inches. Saturated grounds along with breezy conditions were responsible for a tree's collapse which critically injured a Sacramento resident. The same uprooted tree damaged two passenger vehicles and a residence. SMUD reported that the extreme weather caused 1,871 customers to lose power. Over $15,000 in property damage was attributed to this storm.
- **February 11, 2000** – Heavy rain inundated a sewage pump along Greenback Lane in Folsom. This caused water and raw sewage to sweep downhill and into an impoundment on the American River. Over $100,000 in property damage was attributed to this storm.
- **October 9, 2000** – Lightning struck a television antenna, setting the roof ablaze in the City of Elk Grove. Over $150,000 was attributed to this lightning strike.
- **May 9, 2005** – Hail struck 10 miles north of the City of Sacramento. Hail accumulation on Highway 99 resulted in several accidents. Over $10,000 was attributed to this hailstorm.
- **April 2, 2006** – Prolonged heavy precipitation with high snow levels resulted in excessive runoff into area river basins. Hardest hit was the San Joaquin River system and the Delta region. Many area reservoirs had minimal flood storage space as per seasonal norms and the large inflows had to be balanced very carefully with downstream releases to protect the fragile San Joaquin levee system. While the bulk of the flooding affected agricultural and rural properties, some local areas adjacent to waterways experienced flooding of homes and many roads were impassable. However, through the efforts of advance flood-fight measures, careful monitoring of levees, and critical water management coordination among federal, state, and local agencies, the system performed as designed and more serious flooding was averted. Over $250,000 in property damage and $50,000 in crop damage were attributed to this storm.
- **February 26, 2018** – Large amounts of small hail blanketed downtown and northern Sacramento, Natomas, and adjacent portions of I5, causing major traffic problems during the afternoon commute. Hail fell 2 to 4 inches deep in portions of north Sacramento and Natomas. Snowplows were required to

remove hail in some areas. Some damage was done to awnings and parking lot covers. The California State Library roof suffered damage and leaked, with hundreds of rare books soaked with water. $100,000 in damages were reported.

- **December 16, 2018 –** Downtown Sacramento set a daily record for rainfall, 1.17 inches of rain, breaking the old record of 0.95 inches set in 2002.
- **March 20**, **2019** – There were multiple reports by the public of pea to nickel sized accumulating hail.

Hazard Mitigation Planning Committee Events

The HMPC noted that the all-time record for rainfall during any 24-hour period in Sacramento is 7.24 inches on April 19-20, 1880. Streets were described as "having the appearance of miniature rivers." The rainstorm was also reported (colorfully) in such terms as "steady and business-like", "a perfect torrent", and "more like a cataract than an April shower."

The record maximum one-hour rainfall is 1.65 inches, which fell during the evening of April 7, 1935. Thunderstorms in the area were responsible for the downpour with considerable street flooding reported. (Note: Hourly rainfall records are only available after 1903).

January 1862, with 15.04 inches, is the wettest month on record. This took place before official government observations began. Precipitation records at that time were kept by two physicians, Dr. F.M. Hatch, a retired Army Surgeon, and his associate, Dr. T.M. Logan. Their records are believed to be reliable.

The most rainfall ever recorded in one season in Sacramento is 37.62 inches, set during the 1982-83 rainy season, under the influence of a strong El Niño. This followed the wet season of 1981-82 (32.65 inches), making it the wettest two-year period on record in Sacramento. The most recent El Niño outbreak to saturate the Sacramento area was the 1997-98 water year, which received a whopping 32.25 inches of precipitation. Since rainfall records began in 1849-50, only eight other water years have received more.

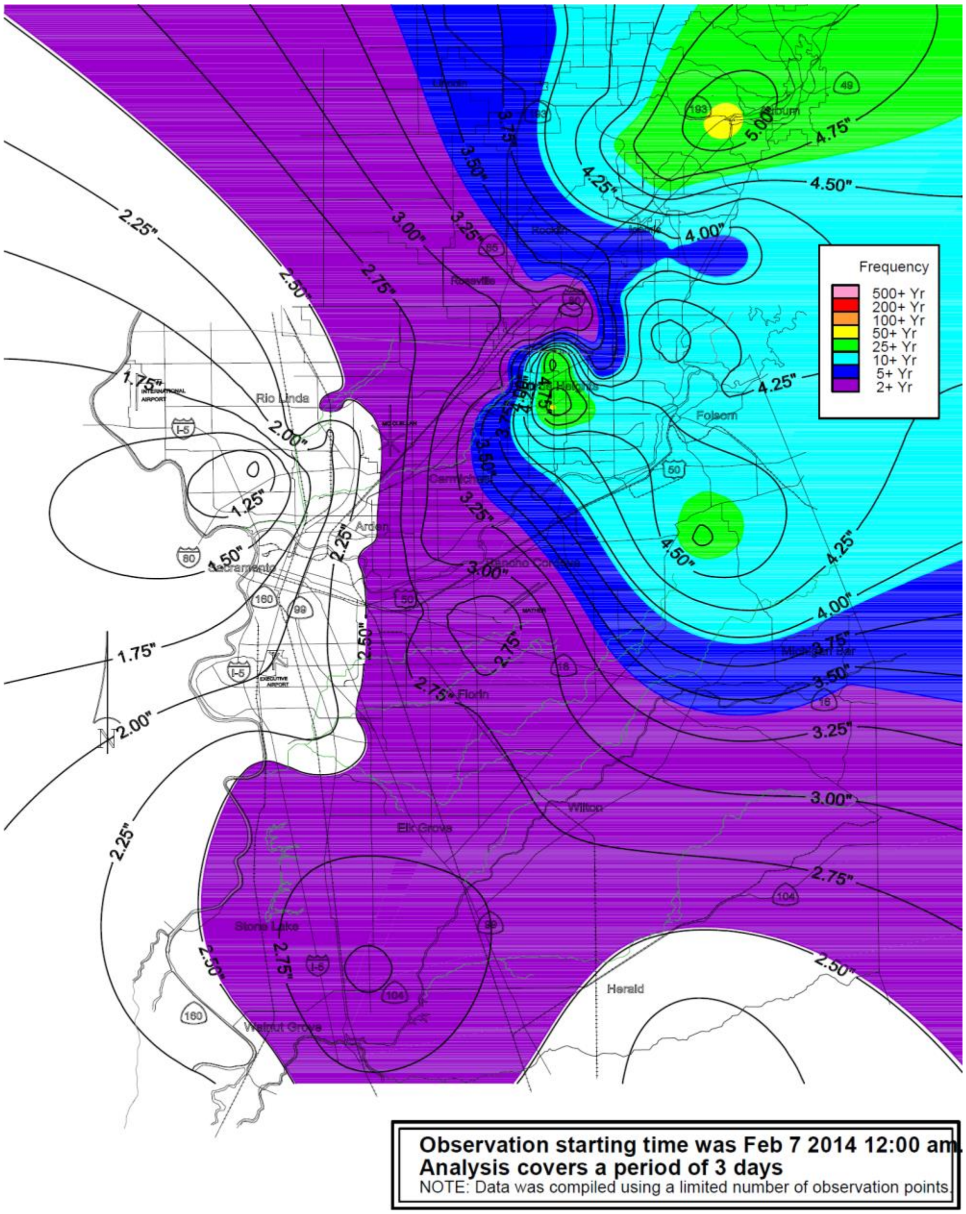
The HMPC also provided storm reports from 2011 to 2015. Reports are triggered for the following reasons: 1) 75 drainage complaints Countywide, or 25 complaints in any one County Supervisor's District; 2) any structure flooding; and 3) coverage on the news about impending storms or during the storm. Information from those reports is included below.

- **March 2011** – Rain fell continually throughout the week, but the significant storm event began on the 24th. Rainfall totals only reached approximately 1" to 1.5" countywide on the 24th, but fell with high intensities at times on saturated watersheds which exacerbated impacts on stream levels. High winds helped dislodge debris to clog drain inlets. There were a total of 90 service request calls between 11 am on the 24th to 11 am on the 25th. Most calls were for plugged storm drains. There was one report of a flooded structure, but that was not confirmed.
- **December 2, 2012** – A series of consecutive heavy rainfall events caused creeks and streams to rise rapidly due to ground saturation. Reports of a trailer park flooded on Sunday due to rising creek levels along Arcade Creek. Winding Way (road) was reported as flooded in low lying areas as well. Damages included:
  - ✓ 12 homes (6 - homes confirmed, 6 - homes high probability)
  - ✓ 15 garages (8 - garages confirmed, 5 - garages high probability)
  - ✓ 4 duplexes (eight residences)

- ✓ 29 apartments (2 within Auburn Villa MHP)
- ✓ 4 mobile/manufactured homes within Auburn Villa MHP
- ✓ 16 RVs within Auburn Villa MHP
- ✓ 30 vehicles

- **May 5-6, 2013** – Redevelopment of thunderstorms that were producing torrential rainfall over the urban areas of Sacramento caused several instances of roadway flooding across the area. Law enforcement reported roadway flooding at Exposition Blvd and Heritage Lane with a vehicle stuck in the roadway, two vehicles stuck in water near Arden and Hwy 160, roadway flooding near Watt Ave and Marconi Ave, as well as roadway flooding at H Street and 37th Street.
- **February 7-9, 2014** – A large storm occurred in the County. Rainfall totals of up to 3.5" occurred. Upstream of Folsom Dam, 5" fell in the City of Auburn in Placer County. Storm totals and an estimate frequency interval for the storm are shown on Figure 4-30. 73 calls were handled by the County for service requests.

Figure 4-30 February 7-9th 2014 Storm Rainfall Totals and Storm Interval



Source: Sacramento County Department of Water Resources 2014 Storm Report

- **February 5 to 9, 2015** – Countywide rainfall totaled approximately 1 inch to 3 inches and the rainfall intensity was equivalent to the 3-year storm event or less. The Department of Water Resources received 47 drainage service requests. The majority of calls were for localized street flooding and plugged drain inlets. No structure flooding was reported at this time. Three self-service sandbag sites were opened for the storm event; however no sandbags were distributed. Arcade Creek hit monitor stage at Winding Way near the American River College, Cosumnes River hit monitor stage at Michigan Bar (stages in the river are still raising but are not expected to reach flood stage), and the Natomas East Main Drain Canal hit monitor stage at pump station D15. Deer Creek hit flood stage at Scott Road.
- **December 21 and 22, 2015** – Countywide rainfall totaled approximately 0.1 inch to 0.95 inches, and the rainfall intensity was less than a 2-yr event. The Department of Water Resources received 12

drainage service requests. No structure flooding was reported at this time. Cosumnes River hit monitor stage at Michigan Bar and is receding. The Natomas East Main Drain Canal hit monitor stage at pump station D15. Deer Creek hit monitor stage at Scott Road.

- **October 14 to 16, 2016** – 3-day rainfall depth countywide was 0.7" to 4.1". There was a 3-hour intense downpour on 10/16/2016 at about 11:00AM. The 3-hour downpour caused the greatest recurrence intervals. The recurrence interval in most places was a 5-year or less event. In a few locations, the recurrence interval ranged from a 9.6 to 48.3-year event. The most intense areas were near the American River corridor. Arcade Creek at ARC hit flood stage. There were 94 service requests calls consisting mostly of plugged inlets and street flooding. There was one report of residential flood damage.
- **December 15, 2016** – The event was an approximately 12-hour event that took place during the latter half of the day. Peak 12-hour rainfall countywide was 0.7" to 2.4". Peak 6-hour rainfall countywide was 0.6" to 2.1". The 6-hour duration caused the greatest recurrence intervals. Most locations reflected recurrence intervals between a 2-year and 10-year event, with some locations experiencing a greater recurrence interval. Recurrence interval for the peak 6-hour duration was 0.3 to 35.8 years. The lower South Sacramento Streams Group area saw the highest recurrence intervals of 8.2 - 35.8 year, followed by the D-05 watershed with recurrence intervals of 7.4 - 14.4 year. Arcade Creek at ARC hit flood stage.
- **January 2017 sequence of storms**; 1/2/2017 - 1/12/2017 – A series of rainfall events occurred in early January 2017. Average rainfall countywide for the 10-day period was approximately 4.7". Based on rainfall, the overall recurrence interval within the County for the 10-day period was about a 2-year event. For shorter durations (less than 24-hrs.), average recurrence intervals were in the 5-year to 9-year range. However, rainfall and snow melt outside of the County in the Cosumnes River watershed caused the Cosumnes River at Michigan Bar to exceed monitor stage on January 4th, followed by flood stage twice (January 9th and 10th respectively) during the 10-day period. Peak flow at Michigan Bar on January 11th was 31,600-cfs, which correlates to an approximate 9-year event. Impacted areas included the North Delta, Point Pleasant, Wilton, and Dry Creek. Locations that exceeded flood stage included Cosumnes River at Michigan Bar, Mokelumne River at Benson's Ferry, Lambert Road at Snodgrass Slough, and Dry Creek at Elkhorn Blvd. Lambert Road was over-topped, causing flooding in the Point Pleasant area. RD 800 flood fought a boil near Wilton Road. Service requests exceeded 360 during the sequence of storms. Structure flooding damage in the North Delta and Dry Creek areas was estimated at approximately $300,000.
- **February 2017 sequence of storms**; 2/2/2017 - 2/11/2017 – A series of rainfall events occurred in early February 2017. Average rainfall countywide for the 10-day period was approximately 4.5". Based on rainfall, the overall recurrence interval within the County for the 10-day period was about a 2-year event. For shorter durations (less than 2-day), average recurrence intervals were in the 3-year to 11-year range. However, rainfall outside of the County in the Cosumnes River watershed caused the Cosumnes River at Michigan Bar to approach or exceed flood stage three times during the event, on February 7th, 8th, and 10th. Michigan Bar had a peak flow on Feb. 10th of 49,700-cfs which correlates to an approximate 25-year event. Similar to the January event, impacted areas were in the North Delta, Point Pleasant, and Dry Creek. Locations that exceeded flood stage included Cosumnes River at Michigan Bar, Mokelumne River at Benson's Ferry, and Lambert Road at Snodgrass Slough. Dry Creek at Elkhorn exceeded monitor stage twice during the event. Lambert Road was over-topped. Structure flooding damage in the North Delta and Dry Creek areas was estimated at approximately $270,000.
- **January 8 and 9, 2018** – The event was greater than a 2-year event, with many locations in the 10-year to 25-year range. Urban watersheds received 2 to 4 inches of rain, equating to annual recurrence of 20 to 80 years. Peak 24-hour rainfall countywide was 2.0" to 3.8". The 24-hour duration caused the

greatest recurrence intervals. Recurrence interval for the peak 24-hour duration was 1.7 to 47.4 years. Shorter durations saw recurrence intervals generally less than a 10-year event. Locations with greater recurrence intervals included Arcade Creek, the D-05 watershed, and the lower portion of the South Sacramento Streams Group watershed. Arcade Creek at ARC hit flood stage.

- **December 16, 2018** – Downtown Sacramento set a daily record for rainfall, 1.17 inches of rain, breaking the old record of 0.95 inches set in 2002.
- **February 25 to 27, 2019** – The event was forecast to be an intense event but rainfall ended up being more gradual. Total 2-day rainfall countywide was 0.4" to 4.4". The 2-day duration caused the greatest recurrence intervals. Recurrence interval for the peak 2-day duration was 0.2 to 17.3 years. Areas within the urban part of the county saw the greatest recurrence intervals, above 5-years. Areas in the south and southeast part of the county saw recurrence intervals below 5-year. Arcade Creek at ARC hit flood stage. Dry Creek at Elkhorn hit flood stage.
- **April 4 to 5, 2020** – The event was a 2-year event or less for most locations, with a few isolated locations with higher intensity. Total 2-day rainfall countywide was 0.8" - 3.0". Peak 24-hour rainfall countywide was 0.7" to 2.9". The 2-hour duration caused the greatest recurrence intervals, while the 6-hour duration gave the greatest recurrence intervals of the longer durations. Recurrence interval for the peak 6-hour duration was 0.3 to 13.9 years. Recurrence interval for the peak 2-hour duration was 0.4 to 44.3 years. Locations with greater recurrence intervals included Arcade Creek, the D-05 watershed, and part of the South Sacramento Streams Group watershed. Arcade Creek at ARC hit flood stage. Cosumnes River at Michigan Bar hit monitor stage. BOS District 3 saw the most service request calls with 93. Most calls were for street flooding and plugged Dis. There were a few reports of garage and home flooding.

Likelihood of Future Occurrence

Highly Likely – Based on NCDC data and HMPC input, 38 heavy rain and storm incidents over a 71-year period (1950-2020) equates to a severe storm event every 1.8 years. As noted, this database likely does not capture all heavy rain, hail, and lightning events. Severe weather is a well-documented seasonal occurrence that will continue to occur often in the Sacramento County Planning Area.

Climate Change and Heavy Rains and Storms

Climate change and its effect on heavy rain and storms near the County has been discussed by three sources:

- CAS – 2014
- 2017 Sacramento County Climate Action Plan (CAP)/2021 Draft Climate Action Plan Update
- Cal-Adapt

Climate Adaptation Strategy

According to the CAS, while average annual rainfall may increase or decrease slightly, the intensity of individual rainfall events is likely to increase during the 21st century. It is unlikely that hail will become more common in the County. The amount of lightning is not projected to change.

2017 Sacramento County Climate Action Plan (CAP)/2021 Draft Climate Action Plan Update

According to the 2017 and 2021 Draft CAP, which utilized Cal Adapt to model potential climate change impacts to Sacramento County, historic precipitation patterns could be altered. The 2017 Cap noted that depending on the location, precipitation events may increase or decrease in intensity and frequency. However, while the projections in California show little change in total annual precipitation, even modest changes could significantly affect California ecosystems that are conditioned to historical precipitation timing, intensities, and amounts. Also noted, reduced precipitation could lead to higher risk of drought and increased precipitation could cause flooding and soil erosion. Based on the Cal-Adapt model, the historical annual average rate of precipitation in Sacramento County is 18 inches. Under the high emission scenario, overall precipitation in Sacramento County is expected to decline over the next century, with annual averages decreasing more substantially under the high emissions scenario. Further, changes in weather patterns resulting from increases in global average temperature could result in a decrease in total amount of precipitation falling as snow. Based on historical data and modeling, under both low- and high-emissions scenarios, CA DWR projects that the Sierra Nevada snowpack will decrease by 25-40 percent from its historic April 1st average of 28 inches of water content by 2050 and 48 to 65 percent by 2100, respectively.

The 2021 Draft CAP noted that although annual precipitation figures in the Sacramento Valley region are expected to increase only slightly, climate change is likely to increase the intensity of extreme storms. Dry years are likely to become even drier, while wet years will become even wetter in the next several decades. Most critically, future wet seasons will have more precipitation as rain than snow, due to higher temperatures. The Northern Sierras, a primary water source for the Sacramento Valley, are expected to have almost no annual snowpack by the end of this century under the scenarios modeled for the paper. This shift will affect the timing of streamflow into the Sacramento Valley from spring to winter (Houlton and Lund 2018).

Cal Adapt

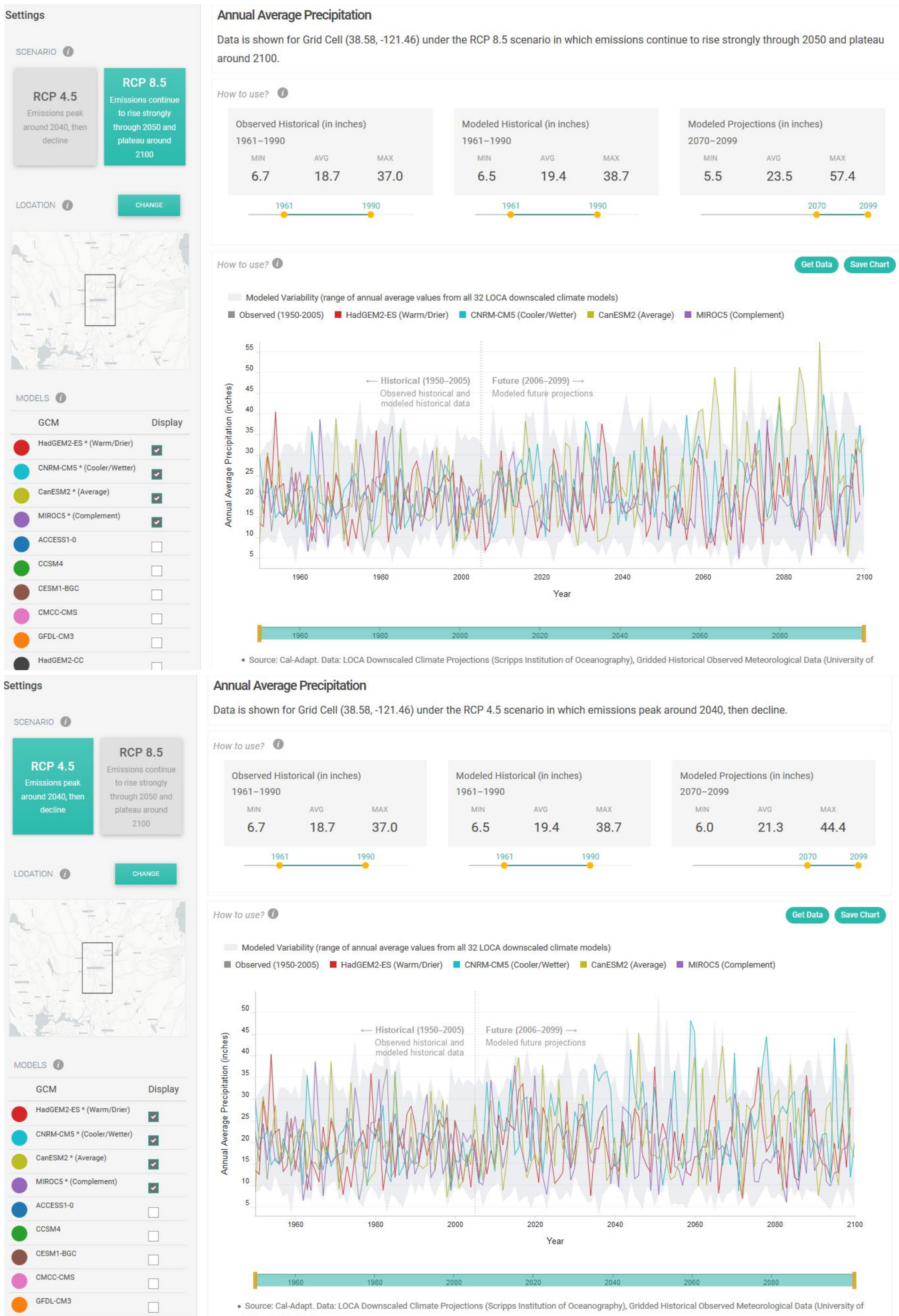
Cal-Adapt noted that, on average, the projections show little change in total annual precipitation in California. Furthermore, among several models, precipitation projections do not show a consistent trend during the next century. The Mediterranean seasonal precipitation pattern is expected to continue, with most precipitation falling during winter from North Pacific storms. One of the four climate models projects slightly wetter winters, and another projects slightly drier winters with a 10 to 20 percent decrease in total annual precipitation. However, even modest changes would have a significant impact because California ecosystems are conditioned to historical precipitation levels and water resources are nearly fully utilized.

These projections also differ depending on the time of year and the type of measurement (highs vs. lows), all of which have different potential effects to the state's ecosystem health, agricultural production, water use and availability, and energy demand. Future precipitation estimates from Cal-Adapt for the Sacramento County Planning (using the quad that contains the City of Sacramento) are shown in Figure 4-31.. It shows the following:

- The upper chart shows annual averages of observed and projected precipitation values for the selected area on map under the RCP 8.5 scenario in which emissions continue to rise strongly through 2050 and plateau around 2100. The gray line (1950 – 2005) is observed data. The colored lines (2006 – 2100) are projections from 10 LOCA downscaled climate models selected for California. The light gray band in the background shows the least and highest annual average values from all 32 LOCA downscaled climate models.

- The lower chart shows annual averages of observed and projected Precipitation values for the selected area on map under the RCP 4.5 scenario in which emissions peak around 2040, then decline. The gray line (1950 – 2005) is observed data. The colored lines (2006 – 2100) are projections from 10 LOCA downscaled climate models selected for California. The light gray band in the background shows the least and highest annual average values from all 32 LOCA downscaled climate models.

Figure 4-31 Sacramento County – Future Precipitation Estimates: High and Low Emission Scenarios



Source: Cal-Adapt – Precipitation: Decadal Averages Map 11/15/2020

Vulnerability Assessment

Vulnerability—Medium

According to historical hazard data, severe weather from heavy rain and storms is an annual occurrence in Sacramento County. Impacts can be felt by both the population of the County as well as the structures that have been built in the County. Many of the impacts from heavy rains and storms are discussed in other sections of this Plan (Section 4.3.7 Dam Failure, Section 4.3.10 Flood, Section 4.3.12 Localized Flood, Section 4.3.13 Landslide, and Section 4.3.13 Levee Failure).

Impacts

Impacts from heavy rains and storms include damages to property and infrastructure. This includes downed trees, damaged utility structures and infrastructures; road damages and blockages; hail damage to crops, buildings, and automobiles, and lightning damages to homes, critical infrastructure, and people. During periods of heavy rains and storms, power outages can occur. These power outages can affect pumping stations and lift stations that help alleviate flooding. However, actual damage associated with the primary effects of severe weather have been somewhat limited. It is the secondary hazards caused by severe weather, such as floods and agricultural losses that have had the greatest impact on the County. The risk and vulnerability associated with these secondary hazards are discussed in other sections of this plan (Section 4.3.10 Flood: 1%/0.2% Annual Chance, Section 4.3.12 Flood: Localized Stormwater, Section 4.3.7 Dam Failure, and Section 4.3.13 Levee Failure).

Future Development

Homes built in the County are built to existing building codes that generally withstand heavy rains and storms. New critical facilities such as communications towers and others should be built to withstand lightning, hail and thunderstorm winds. Backup power sources for all critical facilities should be incorporated into all new facilities. Properly located, designed, and constructed, future losses to new development should be minimal.

4.3.5. Severe Weather: High Winds and Tornadoes

Hazard Profile

This hazard profile contains multiple sections that detail how this hazard can affect Sacramento County. These sections include a hazard/problem description; description of location and extent; past occurrences of this hazard; and how climate change can affect this hazard.

Hazard/Problem Description

This section includes a description and location and extent discussion for both high winds and tornadoes, respectively.

High Winds

High winds, as defined by the NWS glossary, are sustained wind speeds of 40 mph or greater lasting for 1 hour or longer, or winds of 58 mph or greater for any duration. These winds may occur as part of a seasonal climate pattern or in relation to other severe weather events such as thunderstorms.

Location and Extent

The entire Sacramento County Planning Area is subject to significant, non-tornadic (straight-line), winds. Each area of the County is at risk to high winds. Magnitude of winds is measured often in speed and damages. These events are often part of a heavy rain and storm event, but can occur outside of storms. The speed of onset of winds can be short, but accurate weather prediction mechanisms often let the public know of upcoming events. Duration of winds in California is often short, ranging from minutes to hours. The Beaufort scale is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale. Figure 4-32 shows the Beaufort wind scale.

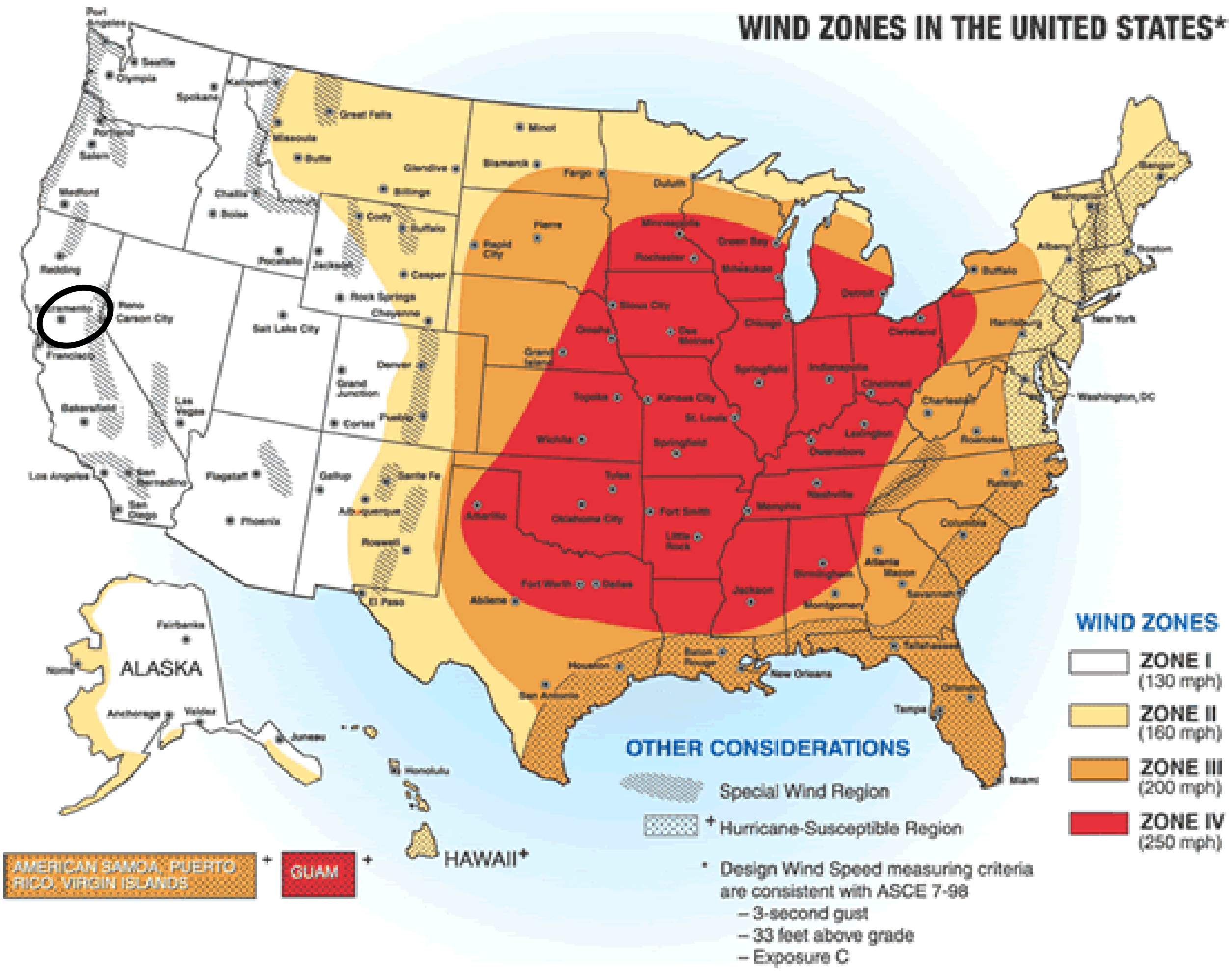
Figure 4-32 Beaufort Wind Scale

Beaufort Number	Wind Speed (miles/hour)	Wind Speed (km/hour)	Wind Speed (knots)	Description	Wind Effects on Land
0	< 1	< 1	< 1	Calm	Calm. Smoke rises vertically.
1	1-3	1-5	1-3	Light Air	Wind motion visible in smoke.
2	4-7	6-11	4-6	Light Breeze	Wind felt on exposed skin. Leaves rustle.
3	8-12	12-19	7-12	Gentle Breeze	Leaves and smaller twigs in constant motion.
4	13-18	20-28	11-16	Moderate Breeze	Dust and loose paper are raised. Small branches begin to move.
5	19-24	29-38	17-21	Fresh Breeze	Small trees begin to sway.
6	25-31	39-49	22-27	Strong Breeze	Large branches are in motion. Whistling is heard in overhead wires. Umbrella use is difficult.
7	32-38	50-61	28-33	Near Gale	Whole trees in motion. Some difficulty experienced walking into the wind.
8	39-46	62-74	34-40	Gale	Twigs and small branches break from trees. Cars veer on road.
9	47-54	75-88	41-47	Strong Gale	Larger branches break from trees. Light structural damage.
10	55-63	89-102	48-55	Storm	Trees broken and uprooted. Considerable structural damage.
11	64-72	103-117	56-63	Violent Storm	Widespread damage to structures and vegetation.
12	> 73	> 117	> 64	Hurricane	Considerable and widespread damage to structures and vegetation. Violence.

Source: National Weather Service

Figure 4-33 depicts wind zones for the United States. The map denotes that Sacramento County falls into Zone I, which is characterized by high winds of up to 130 mph.

Figure 4-33 Wind Zones in the United States

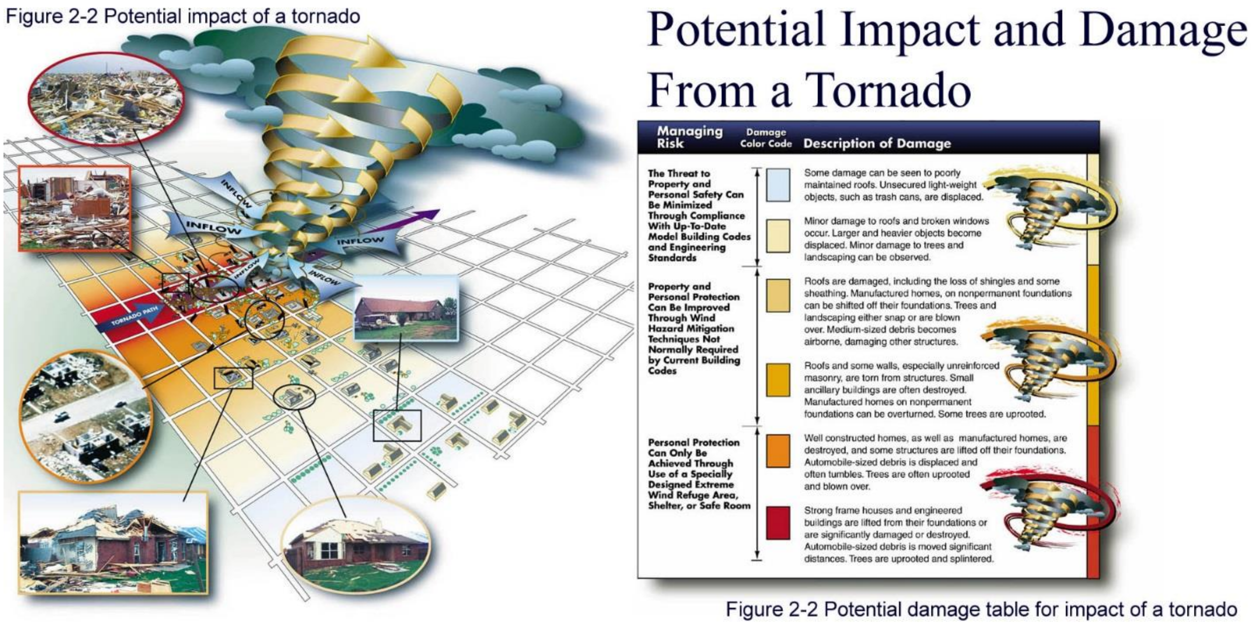


Source: FEMA

Tornadoes

Tornadoes and funnel clouds, while rare, can also occur during these types of severe storms. Tornadoes are another severe weather hazard that, though rare, can affect anywhere within the Sacramento County Planning Area, primarily during the rainy season in the late fall and early spring. 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 across a path only 300 yards wide or less as 300-mile-wide hurricanes. Figure 4-34 illustrates the potential impact and damage from a tornado.

Figure 4-34 Potential Impact and Damage from a Tornado



Source: FEMA: Building Performance Assessment: Oklahoma and Kansas Tornadoes

Location and Extent

Tornadoes, while rare, can occur in any location of the County. Prior to February 1, 2007, tornado intensity was measured by the Fujita (F) scale. This scale was revised and is now the Enhanced Fujita scale. Both scales are sets of wind estimates (not measurements) based on damage. The new scale provides more damage indicators (28) and associated degrees of damage, allowing for more detailed analysis and better correlation between damage and wind speed. It is also more precise because it considers the materials affected and the construction of structures damaged by a tornado. Table 4-29 shows the wind speeds associated with the original Fujita scale ratings and the damage that could result at different levels of intensity. Table 4-30 shows the wind speeds associated with the Enhanced Fujita Scale ratings.

Table 4-29 Original 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 or overturned; 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; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.

Fujita (F) Scale	Fujita Scale Wind Estimate (mph)	Typical Damage
F4	207-260	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown, and large missiles generated.
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 4-30 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

It is difficult to predict a tornado or the conditions that preclude a tornado far in advance. Tornadoes can strike quickly with very little warning. In California it is rare for tornadoes to exceed EF3 magnitude. Most tornadoes that touch down are not long lived.

Past Occurrences

Disaster Declaration History

There have been no past federal or state disaster declarations due to high winds or tornadoes, according to Table 4-4.

NCDC Events

The NCDC data recorded 95 high wind incidents for Sacramento County since 1955. A summary of these events is shown in Table 4-31. Some of the tornado events in this database included touchdown points and tracks. These, where available, were mapped in GIS. These mapped tornado tracks are shown on Figure 4-35. More detail on these events can be found below the table and figure. Due to the high number of high wind events, only those events that were identified as causing damages in the County were included.

*Table 4-31 NCDC High Wind and Tornado Events in Sacramento County 1955-5/31/2020**

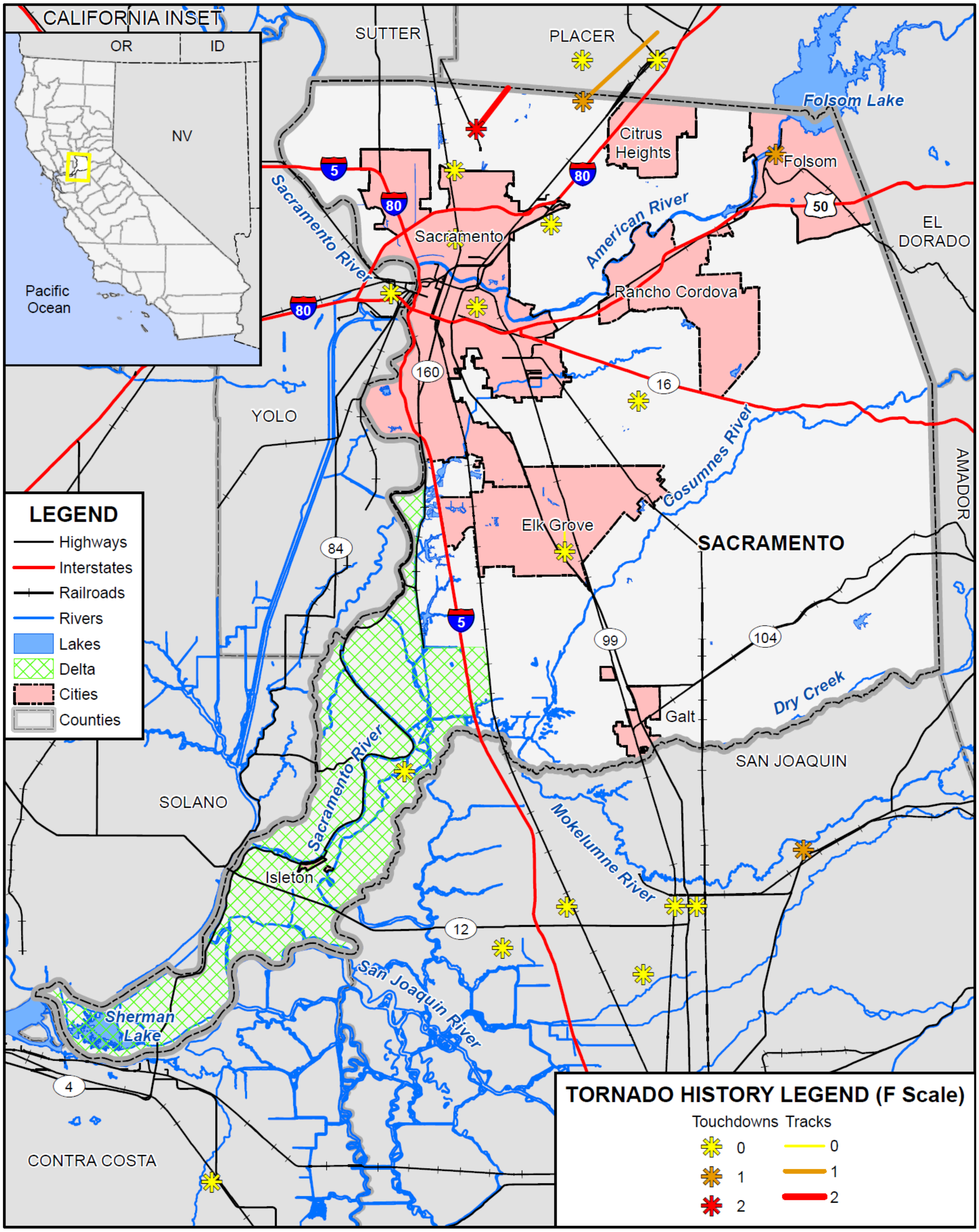
Event Type	Number of Events	Deaths	Deaths (indirect)	Injuries	Injuries (indirect)	Property Damage	Crop Damage
Funnel Cloud	7	0	0	0	0	$0	$0
High Wind	40	1	0	0	0	$8,957,000	$39,000

Event Type	Number of Events	Deaths	Deaths (indirect)	Injuries	Injuries (indirect)	Property Damage	Crop Damage
Strong Wind	26	0	2	2	1	$3,651,000	$0
Thunderstorm Winds	9	0	0	0	0	$50,000	$0
Tornado	13	0	0	0	0	$1,480,000	$0
Total	**95**	**1**	**2**	**2**	**1**	**$14,138,000**	**$39,000**

Source: NCDC

*Note: Losses reflect totals for all impacted areas, some of which fell outside of Sacramento County

Figure 4-35 Sacramento County – NCDC Tornado Events and Tracks



FOSTER MORRISON CONSULTING

SACRAMENTO COUNTY

Data Source: NOAA Storm Prediction Center, Sacramento County GIS, Cal-Atlas; Map Date: 09/2020.

- **February 7, 1978** – An F2 tornado was reported in Sacramento County. The tornado was 20 yards wide and was on the ground for approximately 1.9 miles. No deaths, no injuries, and $250,000 in damages were attributed to this tornado.
- **March 22, 1983** – An F1 tornado was reported in Sacramento County. The tornado was 50 yards wide and was on the ground for approximately 1 mile. No deaths, no injuries, and $250,000 in damages were attributed to this tornado.
- **April 9, 1988** – An F1 tornado was reported in Sacramento County. The tornado was 30 yards wide and was on the ground for approximately 1 mile. No deaths, no injuries, and $500,000 in damages were attributed to this tornado.
- **February 7, 1998** – Strong winds blew for a second day in a row in the Sacramento and Northern San Joaquin Valleys. The winds were strong enough to push a floating restaurant upstream on the swollen Sacramento River near Sacramento. Power outages left 60,000 customers in Sacramento and 15,000 Solano County customers in the dark for hours. 118 city trees were damaged in Sacramento. In total, $300,000 in property damage was attributed to this windstorm. No injuries or deaths were recorded.
- **April 24, 1998** – A weak tornado (F0) touched down near a large mall in the Sacramento metro area, severely damaging a tree and damaging two cars. No deaths, no injuries, and $10,000 in damages were attributed to this tornado.
- **November 7, 1998** – Post-frontal winds exceeding 50 mph downed over 400 power lines and trees. Over 125,000 SMUD and PG&E customers temporarily lost power with 90,000 of them in Sacramento County. In addition, $700,000 of damages were reported. No injuries or deaths were recorded.
- **April 3, 1999** – Pre-frontal winds of 40 mph disrupted electrical service for 3,500 PG&E customers. In addition, $59,000 of damages were reported. $20,000 of it was property damage, while $39,000 of crop damage was recorded. No injuries or deaths were recorded.
- **June 17, 2000 –** Sustained winds of 30-40 mph blew through the Carquinez Strait during the afternoon and early evening hours. A motorcyclist traveling on I-680 in nearby Solano County was pushed off the highway near Marshview Road by a stronger gust at approximately 5:25 pm and died of his injuries.
- **October 24, 2000 –** Strong north winds exceeded 40 mph across the interior valley and foothills. More than 20,000 Sacramento Metropolitan Utility District (SMUD) and Pacific Gas & Electric (PG&E) customers were temporarily without power. The winds uprooted trees damaging several homes and vehicles. $40,000 in property damage was attributed to this windstorm. No injuries or deaths were recorded.
- **February 21, 2005** – On 21 February 2005 Presidents' Day, three tornadoes and several funnel clouds (see Figure 4-36) occurred in the Sacramento valley, including two weak (F0) tornadoes in the Sacramento, CA metropolitan area. The Southport, CA and Natomas, CA tornadoes caused nearly $1 million of damage to residential and commercial property. Amazingly, there were no fatalities or serious injuries despite the number of flying debris, air-borne projectiles, toppled trees, and an over-turned semi-trailer truck.

Figure 4-36 Images from the President's Day Tornado Outbreak in Sacramento County

Source: Sacramento Bee

- **April 8, 2005** – An F0 made two brief touchdowns in Sacramento County, one 8 miles north of the City of Sacramento and another near the Sacramento Metro Airport. The brief touchdown north of the City caused damage to a church roof, residential property fences, and to tree branches. The brief touchdown near the airport was in an open field and caused no damages. In all, no deaths, no injuries, and $25,000 in damages were attributed to this tornado.
- **February 25, 2007** – Clearing skies over an unstable airmass left in the wake of a very cold winter storm provided an environment favorable for weak convective activity. A very weak tornado (EF0) skimmed a residential area just south of downtown Elk Grove shortly after noon. Damage was minimal but consistent in a narrow one mile path. Most of the damage was to small tree branches but also included two power lines tipped, a rooftop solar heating unit damaged, and there was minor damage to fence panels at two locations. No structural damage was noted. No deaths or injuries were attributed to this tornado.
- **January 4, 2008** – A 71 mph gust was measured 4 miles west northwest of Elk Grove. A 69 mph wind gust was measured at Sacramento Executive Airport and a 66 mph wind gust was measured at Sacramento International Airport. The State Legislature building had several windows broken and proceedings were forced to be suspended. Many trees were reported down, including an 80 foot oak tree near the intersection of Elm and Hazel in Sacramento. PG&E reported many power poles down throughout the area and thousands of residents and businesses were without power for up to seven days. Several big rigs were reported down by the California Highway Patrol (CHP), including one on I-5 south of River Rd. in Woodland, and another on I-80 east of State Route 113. $7.4 million in property damages were recorded, though not all of them occurred in Sacramento County. No injuries or deaths were recorded.
- **February 25, 2011** – An EF0 tornado touched down at the Mather Field Industrial Park, immediately north of Mather Field. The maximum wind speed of the tornado was estimated at 75 mph with a damage path of one third of a mile. The damage path was in a northeast direction. No injuries nor fatalities have been reported. Damage was to a few trees including a large evergreen tree, broken road signs, and broken windows to multiple cars.
- **October 27, 2013** – Strong onshore winds brought down large trees for the Southern Sacramento Valley. Sacramento Executive AP peaked at 41mph, Sacramento International AP peaked at 46mph, and Vacaville/Nut Tree peaked at 36mph. Broadcast media reported several large trees down in Sacramento which hit houses, powerlines, and cars. A tree fell on a home near Sac State that caused significant roof damage. $50,000 in property damage was attributed to this windstorm. No injuries or deaths were recorded.
- **December 11, 2014** – Law enforcement, media, and the public reported numerous trees and large branches downed by winds in Sacramento and adjacent suburbs, such as Rosemont, Carmichael, and

Florin. These caused local power outages to spread across the area. There was a 38 mph gust measured at 7 am at Sacramento Executive Airport, a 40 mph gust at Sacramento International Airport. $500,000 in property damage was attributed to this windstorm. No injuries or deaths were recorded.

- **December 30, 2014 –** Multiple fallen trees caused damage to homes in the Motherlode foothills and in the Sacramento metro area. Trees were reported falling on homes and business in Sacramento, Elk Grove, and Folsom. Fallen trees and branches also caused power outages, with 344,000 customers across northern California impacted. $1,600,000 in property damage was attributed to this windstorm, though not all in Sacramento County. No injuries or deaths were recorded.
- **October 22, 2015** – A tornado touched down in the City of Elk Grove. Supercells developed behind the cold front along a north-south boundary in the middle of the Central Valley, where both instability and shear were large. Reports of tornado damage were at approximately 3:45pm (PST) near Waterman and Grand Line Roads. The estimated damage path length was about a mile with wind speeds estimated at 90-100mph. A sturdy metal roof was bent back, tree trunks that were several feet in diameter were snapped. Dozens of houses were mildly damaged.
- **January 19, 2016** – A large tree fell blocking the courtyard of the Capitol Towers apartments in downtown Sacramento. $40,000 in damages.
- **January 11, 2017** – An NWS survey determined an EF0 tornado touched down in the southern Natomas area of Sacramento- South Natomas Tornado. The path length was 3/8 of a mile. Several trees and fences were downed. Two metal awnings were twisted and torn down. Numerous trees were stripped of limbs and deposited in the roadway. $25,000 in damages were reported. No injuries or deaths were reported.
- **February 17, 2017** – Wind brought down trees and tree branches, knocking down power lines and causing outages. There was a 44 mph wind gust reported at Sacramento Executive Airport, with strong winds through the morning and afternoon. $100,000 in damages was reported.
- **December 16, 2017** – Winds brought down trees and branches causing power outages. Nearly 13,000 customers were without power in the Sacramento area, about 5,000 in Davis. $100,000 in damages were reported.
- **December 26, 2018** – At least one funnel cloud was reported near Sacramento International Airport. No touchdown or damage was observed.
- **January 7, 2019** – A wind gust to 60 mph was measured at McClellan Airfield. Numerous trees were reported down in the area. $100,000
- **February 27, 2019** – CHP reported numerous trees down across the area due to strong winds and wet ground, causing road blockages and power outages. A gust to 49 mph was measured at Sacramento International Airport. Examples include downed power lines in roadway which were reported near Pleasant Grove Rd. A tree was down across roadway 4 NW Latrobe. A pole was down across lanes at Best Ranch Rd 2 ESE Yolo. A downed tree was near Loop Rd/Krosens Rd. 1 WNW Loma Rica. A light pole was down in the roadway 3 NNE Laguna. A downed tree blocked all lanes of Auburn Folsom Road at King Road 3 S Newcastle. $1,000,000 in damages were reported.
- **May 18, 2020** –. A member of the public reported a brief tornado near Ione from 12:21 pm to 12:26pm on May 18, 2020. Location and timing are approximate. No damages, injuries, or deaths were reported.

Hazard Mitigation Planning Committee Events

The Planning Team for the County noted the following events since 2011:

- **October 22nd @ 3:45 2012 –** A tornado occurred in Elk Grove, which caused winds of 90-100 mph.

- **April 8th and 9th 2013** – A strong trough that had brought rain and snow to interior northern California, had moved eastward of the area on Monday, April 8th. This brought strong, gusty northerly winds in its wake across the area, mainly the Central Valley, ridge tops, and wind prone mountain canyons. The strongest periods of winds were on Monday, April 8th from late morning into mid-afternoon. Breezy conditions occurred again on Tuesday, April 9th, though winds were not quite as strong. Sustained winds on Monday reached 25-35 mph with gusts as high as around 50 mph. Sustained winds on Tuesday were 20-30 mph with gusts as high as around 40 mph. Over 20,000 people were reported to have lost power due to falling trees and wind (though not all in Sacramento County).
- **Oct 3rd & 27th 2013** – High winds occurred. Gusts of 35 – 50 mph.
- **March 29, 2014** – A Pacific front moved through interior Northern California March 28-30th which brought rain and heavy snow to the area. A supercell strengthened in the Central Sacramento Valley that afternoon that eventually produced an EF0 tornado near Nord, CA that evening.
- **Dec 11th**, 2014 **–** Heavy rainfall & winds of about 50-60 mph.
- **Dec 30th**, 2014 **–** High winds occurred, causing a power outage to about 344,000 people.
- **December 2015 –** there was a tornado that formed over Folsom Lake and impacted El Dorado County
- **January 19th**, **2016 –** Part of a tree fell onto Saverien Drive, blocking the right turn lane. This was a result of rainfall and 40 mph winds.

Likelihood of Future Occurrence

Highly Likely/Occasional – Based on NCDC data and HMPC input, 329 wind incidents over a 66-year period (1955-2020) equates to a severe wind event every year. High winds are a well-documented seasonal occurrence that will continue to occur annually in the Sacramento County Planning Area. Tornadoes tend to be rare in the County, and warrant a likelihood of future occurrence rating of occasional.

Climate Change and High Winds

According to the CAS, while average annual rainfall may increase or decrease slightly, the intensity of individual thunderstorm events is likely to increase during the 21st century. This may bring stronger thunderstorm winds. The CAS does not discuss non-thunderstorm winds.

Vulnerability Assessment

Vulnerability—Medium

Sacramento County is subject to potentially destructive straight-line winds and tornadoes. High winds are common throughout the area and can happen during most times of the entire year and outside of a severe storm event. Tornadoes are rare. Straight line and tornadoes winds are primarily a public safety and economic concern. Structures, agriculture (crops and livestock), and the citizens of the County are at risk to high winds and tornadoes.

Impacts

High winds, often accompanying severe storms and thunderstorms, can cause significant property and crop damage, threaten public safety, and have adverse economic impacts from business closures and power loss.

Straight-line winds may also exacerbate existing weather conditions by increasing the effect on temperature and decreasing visibility due to the movement of particulate matters through the air, as in dust and snowstorms. The winds may also exacerbate fire conditions by drying out the ground cover, propelling embers around the region, and increasing fire severity. These winds may damage crops, push automobiles off roads, damage roofs and structures, and cause secondary damage due to flying debris.

Tornadoes can cause damage to property and loss of life. While most tornado damage is caused by violent winds, the majority of injuries and deaths generally 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.

Impacts from straight line winds and tornadoes include:

- Increased wildfire risk
- Increased chance of PSPS event
- Erosion (soil loss)
- Dry land farming seed loss
- Windblown weeds
- Downed trees
- Downed crops and ag damage
- Power line impacts and economic losses from power outages
- Occasional building damage, primarily to roofs

Campers, mobile homes, barns, and sheds and their occupants are particularly vulnerable as windstorm events in the region can be sufficient in magnitude to overturn these lighter structures. Livestock that may be contained in these structures may be injured or killed, causing economic harm to the rancher who owns both the structure and the livestock. Overhead power lines are vulnerable and account for the majority of historical damages. State highways can be vulnerable to high winds and dust storms, where high profile vehicles may be overturned by winds and lowered visibility can lead to multi-car accidents.

Future Development

Future development projects should consider windstorm and tornado hazards at the planning, engineering and architectural design stage with the goal of reducing vulnerability. Utilities at risk to high winds should be undergrounded as new facilities are improved or added. Development trends in the County are not expected to increase vulnerability to this hazard.

4.3.6. Climate Change

Hazard Profile

This hazard profile contains multiple sections that detail how this hazard can affect Sacramento County. These sections include a hazard/problem description; description of location and extent; past occurrences of this hazard; and how climate change can affect this hazard.

Hazard/Problem Description

Climate change is the distinct change in measures of weather patterns over a long period of time, ranging from decades to millions of years. More specifically, it may be a change in average weather conditions such as temperature, rainfall, snow, ocean and atmospheric circulation, or in the distribution of weather around the average. While the Earth's climate has cycled over its 4.5-billion-year age, these natural cycles have taken place gradually over millennia, and the Holocene, the most recent epoch in which human civilization developed, has been characterized by a highly stable climate – until recently.

This LHMP Update is concerned with human-induced climate change that has been rapidly warming the Earth at rates unprecedented in the last 1,000 years. Since industrialization began in the 19th century, the burning of fossil fuels (coal, oil, and natural gas) at escalating quantities has released vast amounts of carbon dioxide and other greenhouse gases responsible for trapping heat in the atmosphere, increasing the average temperature of the Earth. Secondary impacts include changes in precipitation patterns, the global water cycle, melting glaciers and ice caps, and rising sea levels. According to the Intergovernmental Panel on Climate Change (IPCC), climate change will "increase the likelihood of severe, pervasive and irreversible impacts for people and ecosystems" if unchecked.

Through changes to oceanic and atmospheric circulation cycles and increasing heat, climate change affects weather systems around the world. Climate change increases the likelihood and exacerbates the severity of extreme weather – more frequent or intense storms, floods, droughts, and heat waves. Consequences for human society include loss of life and injury, damaged infrastructure, long-term health effects, loss of agricultural crops, disrupted transport and freight, and more. Climate change is not a discrete event but a long-term hazard, the effects of which communities are already experiencing.

Climate change adaptation is a key priority of the State of California. The 2018 State of California Multi-Hazard Mitigation Plan stated that climate change is already affecting California. Sea levels have risen by as much as seven inches along the California coast over the last century, increasing erosion and pressure on the state's infrastructure, water supplies, and natural resources. The State has also seen increased average temperatures, more extreme hot days, fewer cold nights, a lengthening of the growing season, shifts in the water cycle with less winter precipitation falling as snow, and earlier runoff of both snowmelt and rainwater in the year. In addition to changes in average temperatures, sea level, and precipitation patterns, the intensity of extreme weather events is also changing.

In Sacramento County, the HMPC noted that each year it seems to get a bit warmer. California's Adaptation Planning Guide (APG): Understanding Regional Characteristics has divided California into 11 different regions based on political boundaries, projected climate impacts, existing environmental setting, socioeconomic factors and regional designations. California's Adaptation Planning Guide: Understanding Regional Characteristics has divided California into 11 different regions based on political boundaries, projected climate impacts, existing environmental setting, socioeconomic factors and regional designations. Sacramento County falls within the Northern Central Valley Region characterized as an agricultural, inland region with over 3.7 million people, with substantial cities, the largest being the state capitol, Sacramento. Agriculture is the predominant economic activity. The agricultural operations in this region include rice, dairy, and nut trees (almond and walnut). The region's agricultural activity is one of the most productive in the nation. Table 4-32 provides a summary of Cal-Adapt Climate Projections for the North Central Valley Region.

Table 4-32 North Central Valley Region and Sacramento County – Cal Adapt Climate Projections

Effect	Ranges
Temperature Change, 1990-2100	January increase in average temperature of 4°F to 6°F and between 8°F and 12°F by 2100. July increase in average temperature of 6°F to 7°F in 2050 and 12°F to 15°F by 2100. (Modeled average temperatures; high emissions scenario)
Precipitation	Annual precipitation is projected to decline by approximately one to two inches by 2050 and three to six inches by 2100. (Community Climate System Model Version 3 (CCSM3) climate model; high carbon emissions scenario)
Heat wave	Heat wave is defined as five days over 102°F to 105°F, except in the mountainous areas to the east. Two to three more heat waves per year are expected by 2050 with five to eight more by 2100.
Wildfire	By 2085, the north and eastern portions of the region will experience an increase in wildfire risk, more than 4 times current levels in some areas. (Geophysical Fluid Dynamics Laboratory (GFDL) climate model; high carbon emissions scenario)

Source: Cal-Adapt

Location and Extent

Climate change is a global phenomenon. It is expected to affect the whole of the County. Climate change exacerbates other hazards, such as drought, extreme heat, flooding, wildfire, and others. The speed of onset of climate change is very slow. The duration of climate change is not yet known, but is feared to be tens to hundreds of years.

During the creation of the 2017 Sacramento County Climate Action Plan (CAP), an analysis scale to measure the extent and impacts of climate change was assembled. For the purposes of this analysis, risk was determined by a combination of the estimated certainty of the science projecting the climate change impact and the certainty of the sector sensitivity. Certainty rankings were based on percent probability of global models created by the IPCC (CNRA 2012a: 29). The timeframe in which the impact is most likely to occur (based on risk) can be categorized as:

- Current: Impacts currently or imminently occurring (2016-2020)
- Near-term: 2020-2040
- Mid-term: 2040-2070
- Long-term: 2070-2100

Risk certainty has been provided based on the certainty of exposures estimated in Figure 4-46 below. Onset designations have also been assigned.

Table 4-33 Risk and Onset for Sacramento County Climate Change Impacts

Impact	Risk Certainty Rating	Onset Timeframe
Increased Temperature	High	Current

Impact	Risk Certainty Rating	Onset Timeframe
Increased Frequency of Extreme Heat Days	High	Near-term
Increased Frequency in Heat Waves	High	Near-term
Sea-Level Rise	High	Long-term
Changes to Precipitation Patterns	Medium	Current
Increased Wildfire Risk	Medium	Mid-term
Increased Flooding	High	Current

Source: 2017 Sacramento County CAP

Past Occurrences

Disaster Declaration History

Climate change has never been directly linked to any declared disasters, as shown in Table 4-4.

NCDC Events

The NCDC does not track climate change events.

Hazard Mitigation Planning Committee Events

HMPC members noted that the strength of storms does seem to be increasing and the temperatures seem to be getting hotter. The HMPC also noted that the winter rains of 2017 and 2019 were more intense.

On December 17, 2020, the Sacramento County Board of Supervisors has adopted a resolution declaring a climate emergency and identifying the County's efforts to mobilize and contribute towards a safe climate. The resolution declared climate change an emergency requiring urgent action to achieve carbon neutrality by 2030. The resolution also states the County will establish, within 60 days of approval, a permanent Climate Emergency Mobilization Task Force. The task force will be composed of climate experts, including representatives of the scientific and academic communities, to oversee the development and implementation of a climate emergency response plan.

Likelihood of Future Occurrence

Likely – Climate change is virtually certain to continue without immediate and effective global action. According to NASA, 2017 and 2019 were two of the hottest years on record. Without significant global action to reduce greenhouse gas (GHG) emissions, the IPCC concludes in its Fifth Assessment Synthesis Report (2014) that average global temperatures are likely to exceed 1.5°C by the end of the 21st century, with consequences for people, assets, economies and ecosystems, including risks from heat stress, storms and extreme precipitation, inland and coastal flooding, landslides, air pollution, drought, water scarcity, sea level rise and storm surges.

Climate Scenarios

The United Nations IPCC developed several GHG emissions scenarios based on differing sets of assumptions about future economic growth, population growth, fossil fuel use, and other factors. The emissions scenarios range from "business-as-usual" (i.e., minimal change in the current emissions trends) to more progressive (i.e., international leaders implement aggressive emissions reductions policies). Each of these scenarios leads to a corresponding GHG concentration, which is then used in climate models to examine how the climate may react to varying levels of GHGs. Climate researchers use many global climate models to assess the potential changes in climate due to increased GHGs.

Key Uncertainties Associated with Climate Projections

Climate projections and impacts, like other types of research about future conditions, are characterized by uncertainty. Climate projection uncertainties include but are not limited to:

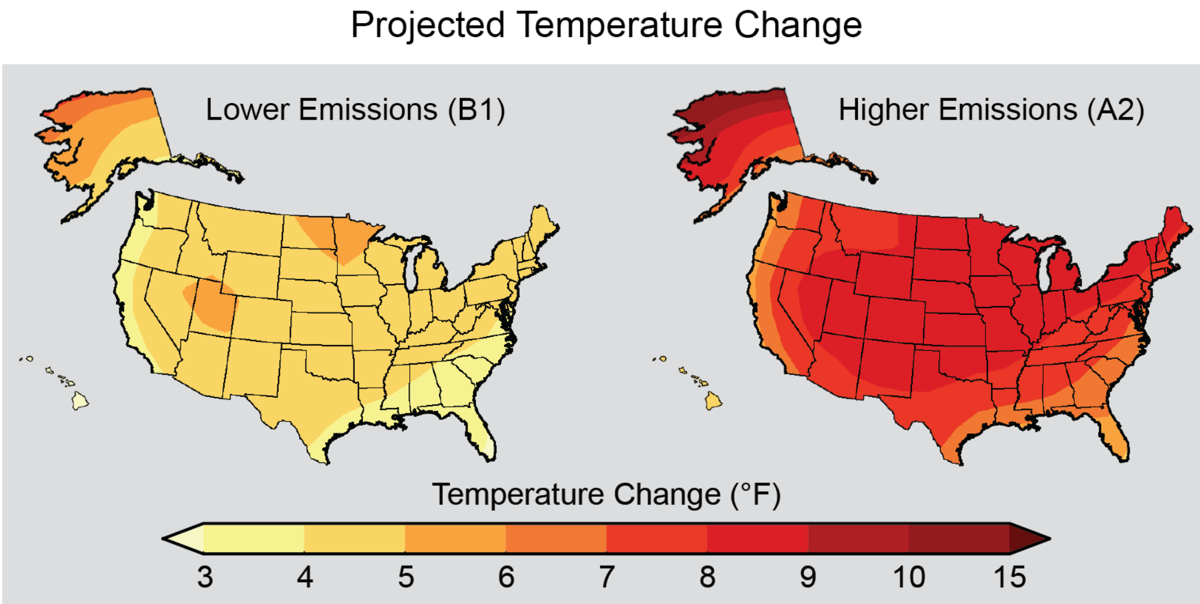
- Levels of future greenhouse gas concentrations and other radiatively important gases and aerosols,
- Sensitivity of the climate system to greenhouse gas concentrations and other radiatively important gases and aerosols,
- Inherent climate variability, and
- Changes in local physical processes (such as afternoon sea breezes) that are not captured by global climate models.

Even though precise quantitative climate projections at the local scale are characterized by uncertainties, the information provided can help identify the potential risks associated with climate variability/climate change and support long term mitigation and adaptation planning.

National Climate Center Scenarios

Maps show projected change in average surface air temperature in the later part of this century (2071-2099) relative to the later part of the last century (1970-1999) under a scenario that assumes substantial reductions in heat trapping gases and a higher emissions scenario that assumes continued increases in global emissions. These are shown in Figure 4-37.

Figure 4-37 Projected Temperature Change – Lower and Higher Emissions Scenario



Source: National Climate Assessment

2014 Climate Adaptation Scenarios

According to the California Natural Resource Agency (CNRA), climate change is already affecting California and is projected to continue to do so well into the foreseeable future. Current and projected changes include increased temperatures, sea level rise, a reduced winter snowpack altered precipitation patterns, and more frequent storm events. Over the long term, reducing greenhouse gases can help make these changes less severe, but the changes cannot be avoided entirely. Unavoidable climate impacts can result in a variety of secondary consequences including detrimental impacts on human health and safety, economic continuity, ecosystem integrity and provision of basic services.

The CNRA's 2014 CAS delineated how climate change may impact and exacerbate natural hazards in the future, including wildfires, extreme heat, floods, and drought:

- Climate change is expected to lead to increases in the frequency, intensity, and duration of extreme heat events and heat waves in Sacramento County and the rest of California, which are likely to increase the risk of mortality and morbidity due to heat-related illness and exacerbation of existing chronic health conditions. Those most at risk and vulnerable to climate-related illness are the elderly, individuals with chronic conditions such as heart and lung disease, diabetes, and mental illnesses, infants, the socially or economically disadvantaged, and those who work outdoors.
- Higher temperatures will melt the Sierra snowpack earlier and drive the snowline higher, resulting in less snowpack to supply water to California users.
- Droughts are likely to become more frequent and persistent in the 21st century.
- Intense rainfall events, periodically ones with larger than historical runoff, will continue to affect California with more frequent and/or more extensive flooding.

- Storms and snowmelt may coincide and produce higher winter runoff from the landward side, while accelerating sea-level rise will produce higher storm surges during coastal storms. Together, these related to saltwater intrusion.
- Warmer weather, reduced snowpack, and earlier snowmelt can be expected to increase wildfire through fuel hazards and ignition risks. These changes can also increase plant moisture stress and insect populations, both of which affect forest health and reduce forest resilience to wildfires. An increase in wildfire intensity and extent will increase public safety risks, property damage, fire suppression and emergency response costs to government, watershed and water quality impacts, vegetation conversions and habitat fragmentation.

2017 Sacramento County CAP/2021 Draft Climate Action Plan Update

The Sacramento County CAP contained information on multiple hazards (such as extreme temperatures, droughts, wildfires, etc.) that are exacerbated by climate change issues. Those are discussed in their respective hazard profiles in each section of this Plan Update.

Vulnerability Assessment

Vulnerability—Medium

Climate change is the distinct change in measures of weather patterns over a long period of time, ranging from decades to millions of years. More specifically, it may be a change in average weather conditions such as temperature, rainfall, snow, ocean and atmospheric circulation, or in the distribution of weather around the average.

Sacramento County Climate Change Impacts

This section sources multiple documents that focus on Sacramento County's climate change vulnerability:

- California Adaptation Planning Guide
- 2017 Sacramento County CAP/2021 Draft Climate Action Plan Update
- Proceedings of the National Academy of Sciences

California Adaptation Planning Guide

The APG prepared by California OES and CNRA was developed to provide guidance and support for local governments and regional collaboratives to address the unavoidable consequences of climate change. The APG: Defining Local and Regional Impacts focuses on understanding the ways in which climate change can affect a community. According to this APG, climate change impacts (temperature, precipitation, sea level rise, ocean acidification, and wind) affect a wide range of community structures, functions and populations. These impacts further defined by regional and local characteristics are discussed by secondary impacts and seven sectors found in local communities: Public Health, Socioeconomic, and equity impacts; Ocean and Coastal Resources; Water Management; Forest and Rangeland; Biodiversity and Habitat; Agriculture; and Infrastructure.

The APG: Understanding Regional Characteristics identified the following impacts specific to the North Central Valley region in which the Sacramento County Planning Area is part of:

- Temperature increases – particularly nighttime temperature
- Reduced precipitation
- Flooding – increase flows, snowmelt, levee failure in the Delta
- Reduced agricultural productivity (e.g., nut trees, dairy)
- Reduced water supply
- Wildfire in the Sierra foothills
- Public health and heat
- Reduced tourism

California's Adaptation Guide: Understanding Regional Characteristics provides input on adaptation considerations for the Northern Central Valley Region. As detailed in this guide, climate change has the potential to disrupt many features that characterize the region, including ecosystems health, snowpack, and the tourist economy. Specific regional impacts include the following:

Flooding. The eastern part of the Northern Central Valley contains the foothills of the Sierra Nevada mountain range. The mountainous areas of the state are projected to have less precipitation falling as snow and to be subject to rapid melt events. This will result in extreme, high-flow events and flooding in the Central Valley. Communities should evaluate local floodplains and recognize areas where a small increase in flood height would inundate large areas and potentially threaten structures, infrastructure, agricultural fields, and/or public safety. As the rivers of the region flow toward San Francisco Bay, the land decreases in elevation and is protected by levees, many of which are vulnerable, particularly to seismic events.

Agriculture. The Northern Central Valley is one of the largest agricultural producing regions, not only in California, but in the United States. Between climate change impacts on water availability and seasonal temperature regimes, the health of livestock, and productivity of trees and crops are likely to be affected. Agriculture in this region is varied, with rice, nuts (almonds, walnuts, pistachios), and dairy being three of the most predominant products. Others include pears, cattle, wine grapes, chicken, sweet potatoes, and plums. Each crop is likely to react slightly differently to alteration in seasonal temperature regimes and water availability. Rice is projected to experience a moderate loss in productivity (less than 10%). In the case of nut trees, it is the reduction in nighttime cooling that may have the most impact. Jurisdictions reliant on almonds, walnuts, pistachios, or other nuts should specifically evaluate projected changes in daily low temperatures and/or loss of nighttime chill hours. It is difficult to specifically project the production impact on crops because this relates to many factors in addition to temperature and precipitation, including pest regimes, availability of imported or groundwater irrigation water, and management practices. As with crops, climate change impacts on dairy cows can occur and depend on a variety of factors.

The impact of climate change on agricultural productivity has the potential to alter a community's economic continuity, including its employment base.

Public Health, Socioeconomic, and Equity Impact. Increased temperatures and more frequent heat waves are expected in the region. Impervious surfaces are increasing in the Central Valley, increasing the potential impacts of heat islands. Farm employment or lodging and food services are among the top five employment sectors in several of the counties in this region. Agricultural workers and employees in the tourist industry are more susceptible to heat events. Regardless of their occupation, the poor are less likely to have the adaptive capacity to prevent and address impacts for reasons stated above.

Water Supply. Shorter rainfall events and rapid snowmelt will reduce the region's water supply by making water more difficult to capture in reservoirs or retain for groundwater recharge. Recreation and tourism in the region are also likely to suffer due to lower water levels in waterways and reservoirs and declining snowpack. Agriculture will also be impacted due to reduced or altered precipitation. Water supply (for irrigation) can alleviate some of the other climate stresses (altered temperature or precipitation) or, in the case of reduced water supply, exacerbate them. The challenge of climate change is that water supply is projected to be reduced and water that is available will be more costly for users. Employees of water-reliant industries such as agriculture may become more economically vulnerable because of unstable working conditions.

Fire. Fire risk is projected to increase in the foothills lining the eastern edge of the region. The areas northeast of Sacramento, due to population density and fire risk, are projected to have large property loss. Jurisdictions should pay careful attention to the wildland-urban interface and enforcement of mitigation measures such as residential vegetation and setbacks.

2017 Sacramento County CAP/2021 Draft Climate Action Plan Update

According to the Climate Change Vulnerability Assessment for the Sacramento County Climate Adaptation Plan (CAP), climate change is already affecting and will continue to alter the physical environment throughout the Central Valley and Sacramento County; however, specific implications of climate change effects vary with differing physical, social, and economic characteristics within the County.

This section presents a vulnerability assessment for the County, focusing on direct and indirect climate change effects. The direct, or primary, effects analyzed for the County include changes in average temperature and annual precipitation amounts. Secondary effects, which can occur because of individual changes or a combination of changes in the primary effects, are also assessed. These include extreme heat, wildfire, drought, flooding, and sea-level rise.

Methodology

The vulnerability assessment follows the process outlined in Phase 2 of the APG and is composed of the following four steps:

- **Exposure**: The first step in the vulnerability assessment is to identify what climate change effects Sacramento County will experience in the future. To assess potential effects from climate change the APG 2.0 recommended Cal-Adapt tool is used. Results are based on two Representative Concentration Pathways (RCPs), 4.5 which represents a medium emissions scenario and 8.5 which represents a high emissions scenario. Because the efficacy of future global GHG reduction strategies is unknown, a discussion of both emissions scenarios, and their associated impacts, is included in this vulnerability assessment (Bedsworth et al. 2018).
- **Sensitivity and Potential Impacts**: This step identifies and assesses how population groups, community functions, and physical assets may be affected by localized climate change effects.

There are two Primary Effect changes listed in the 2021 CAP:

- Increased Temperatures
- Changes in Precipitation Patterns

Results – Increased Temperatures

According to Cal-Adapt, the historic (1961-1990) annual average maximum temperature for the County was 74 degrees Fahrenheit (°F), and the historic annual average minimum temperature was 48.4 °F. As shown in Table 4-34 and Figure 4-38 and Figure 4-39, both are projected to increase by mid-century (2035-2064) and further increase by late century (2070-2099) under the medium and high emissions scenarios.

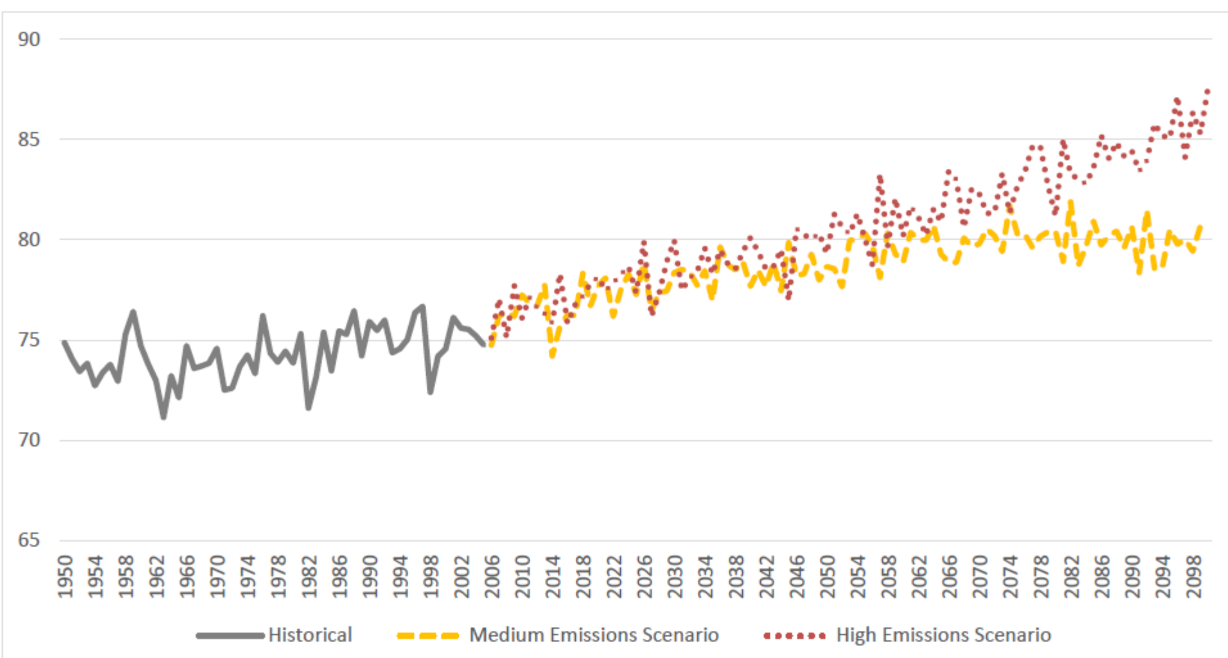
Table 4-34 Changes in Annual Average Temperature in Sacramento County

Annual Average Temperature (°F)	Historic Annual Average Temperature (1961-1990)	Medium Emissions Scenario (RCP 4.5)		High Emissions Scenario (RCP 8.5)	
		Mid-Century (2035-2064)	Late Century (2070-2099)	Mid-Century (2035-2064)	Late Century (2070-2099)
Maximum Temperature	74.0	78.3	79.8	79.4	82.7
Minimum Temperature	48.4	52.2	53.4	53.2	56.8

Notes: °F = degrees Fahrenheit, RCP = Representative Concentration Pathway

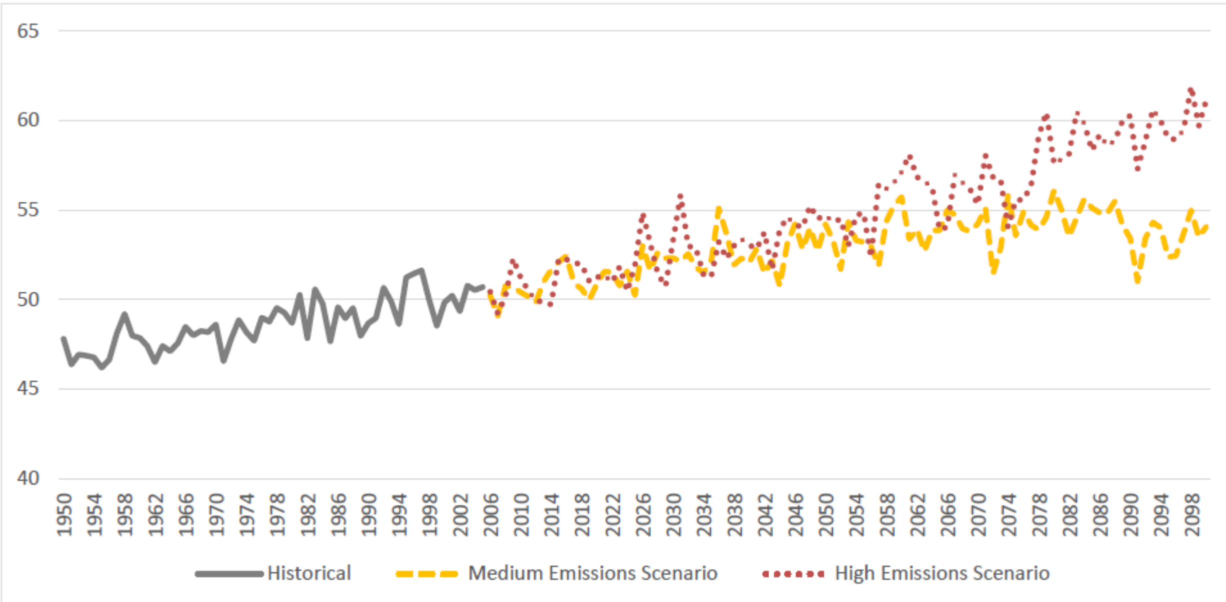
Source: 2021 Draft Sacramento County CAP

Figure 4-38 Historical and Projected Annual Average Maximum Temperature in Sacramento County



Source: 2021 Draft Sacramento County CAP

Figure 4-39 Historical and Projected Annual Average Minimum Temperature in Sacramento County



Source: 2021 Draft Sacramento County CAP

Increased temperature in unincorporated county will influence secondary climate effects including extreme heat events, wildfires, and drought. These are discussed in Section 4.3.3, 4.3.18, and 4.3.8 respectively.

Results – Changes in Precipitation Patters

According to California's Fourth Climate Change Assessment Sacramento Valley Region report, precipitation patterns in California oscillate between extremely dry and wet periods. Although annual precipitation figures in the Sacramento Valley region are expected to increase only slightly, climate change is likely to increase the intensity of extreme storms. Dry years are likely to become even drier, while wet years will become even wetter in the next several decades. Most critically, future wet seasons will have more precipitation as rain than snow, due to higher temperatures. The Northern Sierras, a primary water source for the Sacramento Valley, are expected to have almost no annual snowpack by the end of this century under the scenarios modeled for the paper. This shift will affect the timing of streamflow into the Sacramento Valley from spring to winter (Houlton and Lund 2018).

According to Cal-Adapt, the historic annual average precipitation in the County has been 18.3 inches. As shown in Table 4-35 and Figure 4-40, the total annual precipitation in the County is projected to increase slightly by mid-century and late century under the medium and high emissions scenarios.

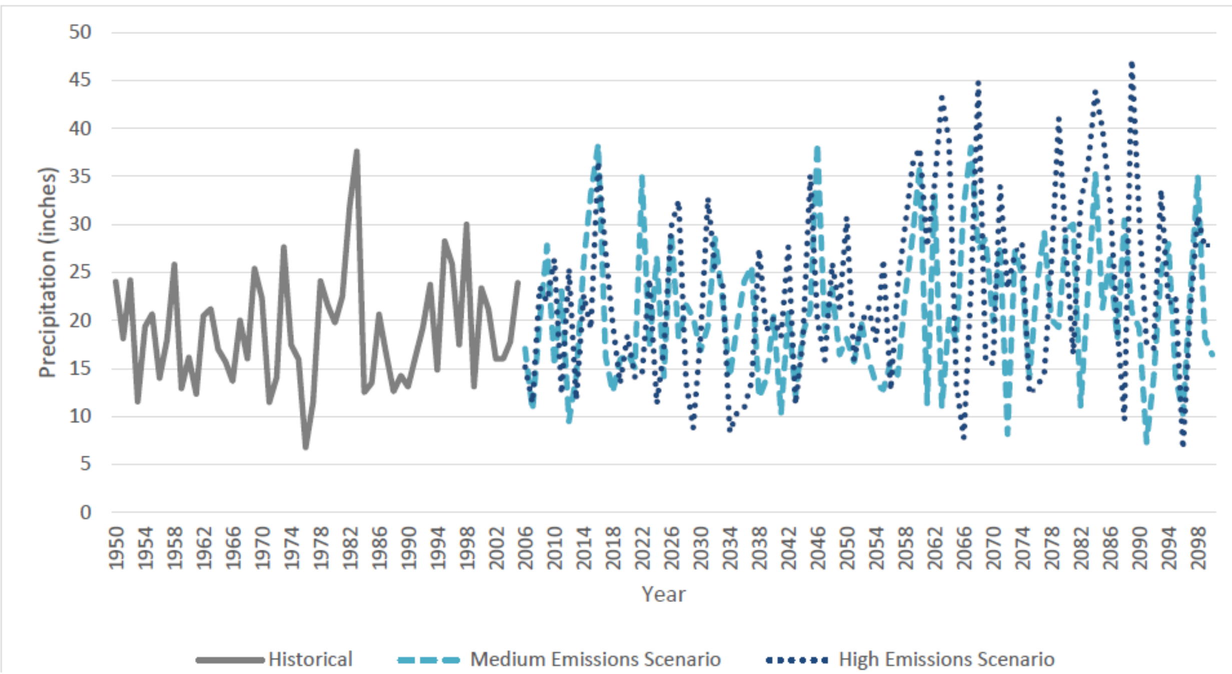
Table 4-35 Changes in Annual Average Precipitation in Sacramento County

Annual Average Precipitation	Historic Annual Average Precipitation (1961-1990)	Medium Emissions Scenario (RCP 4.5)		High Emissions Scenario (RCP 8.5)	
		Mid-Century (2035-2064)	Late Century (2070-2099)	Mid-Century (2035-2064)	Late Century (2070-2099)
Annual Average Precipitation (in)	18.3	20.3	20.3	20.5	22.1

Notes: in = inches, RCP = Representative Concentration Pathway

Source: 2021 Sacramento County CAP

Figure 4-40 Historical and Projected Precipitation in Sacramento County



Source: 2021 Sacramento County CAP

Changes in precipitation patterns will affect secondary climate effects including extreme heat, wildfires, drought, flooding. These are discussed in Section 4.3.3, 4.3.18, 4.3.8, and 4.3.11, respectively.

Proceedings of the National Academy of Sciences (2014)

In addition to the APG, a report from the Proceedings of the National Academy of Sciences (PNAS) states that some of the recent fire impacts may have been attributed to climate change. The PNAS report posits that climate influences wildfire potential primarily by modulating fuel abundance in fuel-limited environments, and by modulating fuel aridity in flammability-limited environments. Increased forest fire activity across the western United States in recent decades has contributed to widespread forest mortality, carbon emissions, periods of degraded air quality, and substantial fire suppression expenditures. Those most vulnerable to high levels of ozone and particulate matter include people who work or spend a lot of time outdoors, such as residents of this region who are employees of the tourist industry. Households eligible for energy utility financial assistance programs are an indicator of potential impacts. These households may be more at risk of not using cooling appliances, such as air conditioning, due to associated energy costs.

Future Development

Sacramento County in general could see population fluctuations as a result of climate impacts relative to those experienced in other regions, and these fluctuations could be expected to impact demand for housing and other development. For example, sea level rise may disrupt economic activity and housing in coastal communities, resulting in migration to inland urban areas. Other interior western states may experience an exodus of population due to challenges in adapting to heat even more extreme than that which is projected to occur here. While there are currently no formal studies of specific migration patterns expected to impact the Sacramento County region, climate-induced migration was recognized within the UNFCCC Conference of Parties Paris Agreement of 2015 and is expected to be the focus of future studies.

Climate change, coupled with shifting demographics and market conditions, could impact both the location of desired developments and the nature of development. Demand may increase for smaller dwellings that are less resource intensive, more energy efficient, easier to maintain and can be more readily adapted or even moved in response to changing conditions. Compact, mixed-use and infill developments that can help residents avoid long commutes and vulnerabilities associated with the transportation system will likely continue to grow in popularity. The value of open space and pressure to preserve it will likely increase, due in part to its restorative, recreational, environmental and habitat benefits but also for its ability to sequester carbon, help mitigate the accumulation of greenhouse gas in the atmosphere and slow down the global warming trend. Higher flood risks, especially if coupled with increased federal flood insurance rates, may decrease market demand for housing and other types of development in floodplains, while increased risk of wildfires may do the same for new developments in the urban-wildland interface. Flood risks may also inspire new development and building codes that elevate structures while maintaining streetscapes and neighborhood characteristics.

Climate change will stress water resources. Water is an issue in every region, but the nature of the potential impacts varies. Drought, related to reduced precipitation, increased evaporation, and increased water loss from plants, is an important issue in many U.S. regions, especially in the West. Floods, water quality problems, and impacts on aquatic ecosystems and species are likely to be amplified by climate change. Declines in mountain snowpack are important in Sacramento County the Sierra Nevada Mountains and across the state, where snowpack provides vital natural water storage and supply. The ability to secure and provide water for new development requires on-going monitoring and assurances. It is recommended that the ability to provide a reliable water supply from the appropriate water purveyor, continue to be in the conditions for project approval, and such assurances shall be verified and in place prior to issuing building permits.

Similarly, protecting and enhancing water supply will also need to be addressed. California's Sustainable Groundwater Management Act (SGMA) will contribute to addressing groundwater and aquifer recharge needs. Good groundwater management will provide a buffer against drought and climate change, and contribute to reliable water supplies regardless of weather patterns. California depends on groundwater for a major portion of its annual water supply, and sustainable groundwater management is essential to a reliable and resilient water system. Protection of critical recharge areas should be addressed across the

County in the respective Groundwater Management Plans. Further, these plans should include provisions that guide development or curtail development in areas that would harm or compromise recharge areas.

Climate change will affect transportation. The transportation network is vital to the County and the region's economy, safety, and quality of life. While it is widely recognized that emissions from transportation have impacts on climate change, climate will also likely have significant impacts on transportation infrastructure and operations Examples of specific types of impacts include softening of asphalt roads and warping of railroad rails; damage to roads; flooding of roadways, rail routes, and airports from extreme events; and interruptions to flight plans due to severe weather. Climate change impacts considered in the plan include extreme temperatures; increased precipitation, runoff and flooding; increased wildfires; and landslides. Although landslides are not a direct result of climate change, these events are expected to increase in frequency due to increased rainfall, runoff, and wildfire. These events have the potential to cause injuries or fatalities, environmental damage, property damage, infrastructure damage, and interruption of operations. During flood events, these trails serve as secondary transportation facilities when roadways are blocked or otherwise impassible. During Hurricane Sandy, bicycles were one of the primary modes used to deliver food and water to residents stranded in their homes due to flood. Including dual or multi-purpose facilities and amenities as part of all new development provides not just desirable community amenities but critical infrastructure for climate resiliency.

Climate change will affect land uses and planning. Climate change coupled with shifting demographics and market conditions, could impact both the location of desired developments and the nature of development. Demand may increase for smaller dwellings that are less resource intensive, more energy efficient, easier to maintain and can be more readily adapted or even moved in response to changing conditions. Compact, mixed-use and infill developments that can help residents avoid long commutes and vulnerabilities associated with the transportation system will likely continue to grow in popularity. The value of open space, urban greening, green infrastructure, tree canopy expansion and pressure to preserve it will likely increase, due in part to its restorative, recreational, environmental, and habitat, and physical and mental health benefits but also for its ability to sequester carbon and cool the surrounding environment.

Climate change will affect Utilities. California is already experiencing impacts from climate change such as an increased number of wildfires, sea level rise and severe drought. Utility efforts to deal with these impacts range from emergency and risk management protocols to new standards for infrastructure design and new resource management techniques. Utilities are just beginning to build additional resilience and redundancy into their infrastructure investments from a climate adaptation perspective, but have been doing so from an overall safety and reliability perspective for decades. Significant efforts are also being made in those areas that overlap with climate change mitigation such as diversification of resources, specifically the addition of more renewables to the portfolio mix, as well as implementation of demand response efforts to curb peak demand. Efforts are also under way to upgrade the distribution grid infrastructure, which should add significant resilience to the grid as well. Next, they will issue a guidance document that expands upon the vulnerability assessments phase and includes plans for resilience solutions including cost/benefit analysis methodologies. The outcomes of this work will help to inform next steps on how infrastructure, the grid and other related operations will be modified to address climate change. New development will have to adapt and incorporate these new approaches as they evolve. Existing and new development will be affected from impacts that includes not only diminished capacity from all of the utility assets from generation to transmission and distribution, but also the cost consequences resulting from prevention, replacement, outage, and energy loss. These have the potential for greatly impacting not just residential development but commercial and industrial and all utility users.

4.3.7. Dam Failure

Hazard Profile

This hazard profile contains multiple sections that detail how this hazard can affect Sacramento County. These sections include a hazard/problem description; description of location and extent; past occurrences of this hazard; and how climate change can affect this hazard.

Hazard/Problem Description

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 are usually 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 or 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; and/or
- Failure of upstream dams on the same waterway.

In general, there are three types of dams: concrete arch or hydraulic fill, earth and rockfill, and concrete gravity. Each type of dam has different failure characteristics. A concrete arch or hydraulic fill dam can fail almost instantaneously; the flood wave builds up rapidly to a peak then gradually declines. An 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. And a concrete gravity dam can fail instantaneously or gradually with a corresponding buildup and decline of the flood wave.

Dams and reservoirs have been built throughout California to supply water for agriculture and domestic use, to allow for flood control, as a source of hydroelectric power, and to serve as recreational facilities. The storage capacities of these reservoirs range from a few thousand acre feet to five million acre-feet. The water from these reservoirs eventually makes its way to the Pacific Ocean by way of several river systems.

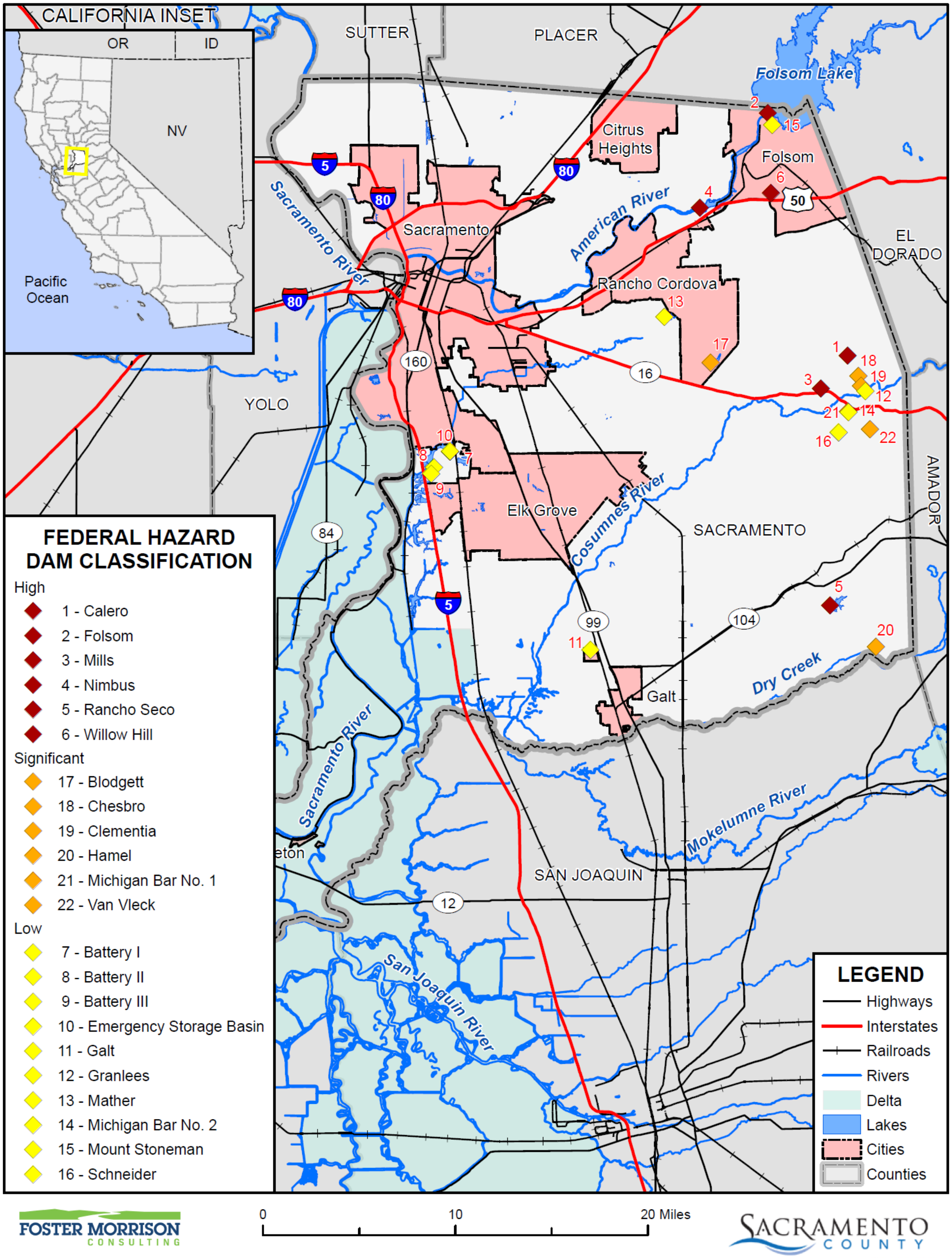
The California Department of Water Resources (CA DWR) Division of Safety of Dams (DSOD) has jurisdiction over impoundments that meet certain capacity and height criteria. Embankments that are less than six feet high and impoundments that can store less than 15 acre-feet are non-jurisdictional. Additionally, dams that are less than 25 feet high can impound up to 50 acre-feet without being jurisdictional. CA DWR, DOSD assigns hazard ratings to large dams within the State. The following two factors are considered when assigning hazard ratings: existing land use and land use controls (zoning) downstream of the dam. Dams are classified in four categories that identify the potential hazard to life and property:

- **Extremely High Hazard** – Expected to cause considerable loss of human life or would result in an inundation area with a population of 1,000 or more
- **High Hazard** – Expected to cause loss of at least one human life.
- **Significant Hazard** – No probable loss of human life but can cause economic loss, environmental damage, impacts to critical facilities, or other significant impacts.
- **Low Hazard** – No probable loss of human life and low economic and environmental losses. Losses are expected to be principally limited to the owner's property.

Location and Extent

According to data provided by Sacramento County, CA DWR, and Cal OES, there are 27 dams in Sacramento County that were constructed for flood control, storage, treatment impoundments, electrical generation, and recreational purposes that fall under the jurisdiction of the DSOD (jurisdictional dams described above). Of the 27 dams, 11 are rated as High Hazard, 6 as Significant Hazard, and 10 as Low Hazard. Figure 4-41 identifies the dams located in the Sacramento County Planning Area and those outside the County that threaten the County. Table 4-36 gives information on each of the dams in the County that fall under DSOD jurisdiction. There are also 25 dams outside the County that have mapped inundation areas inside the County. These are shown on Figure 4-42. Table 4-37 details the 25 dams outside of Sacramento County that could affect areas inside Sacramento County.

Figure 4-41 Sacramento County Dam Inventory



Data Source: DWR DSOD Data 2020 and Cal OES Dam Status 10/2017, Sacramento County GIS, Cal-Atlas; Map Date: 9/2020.

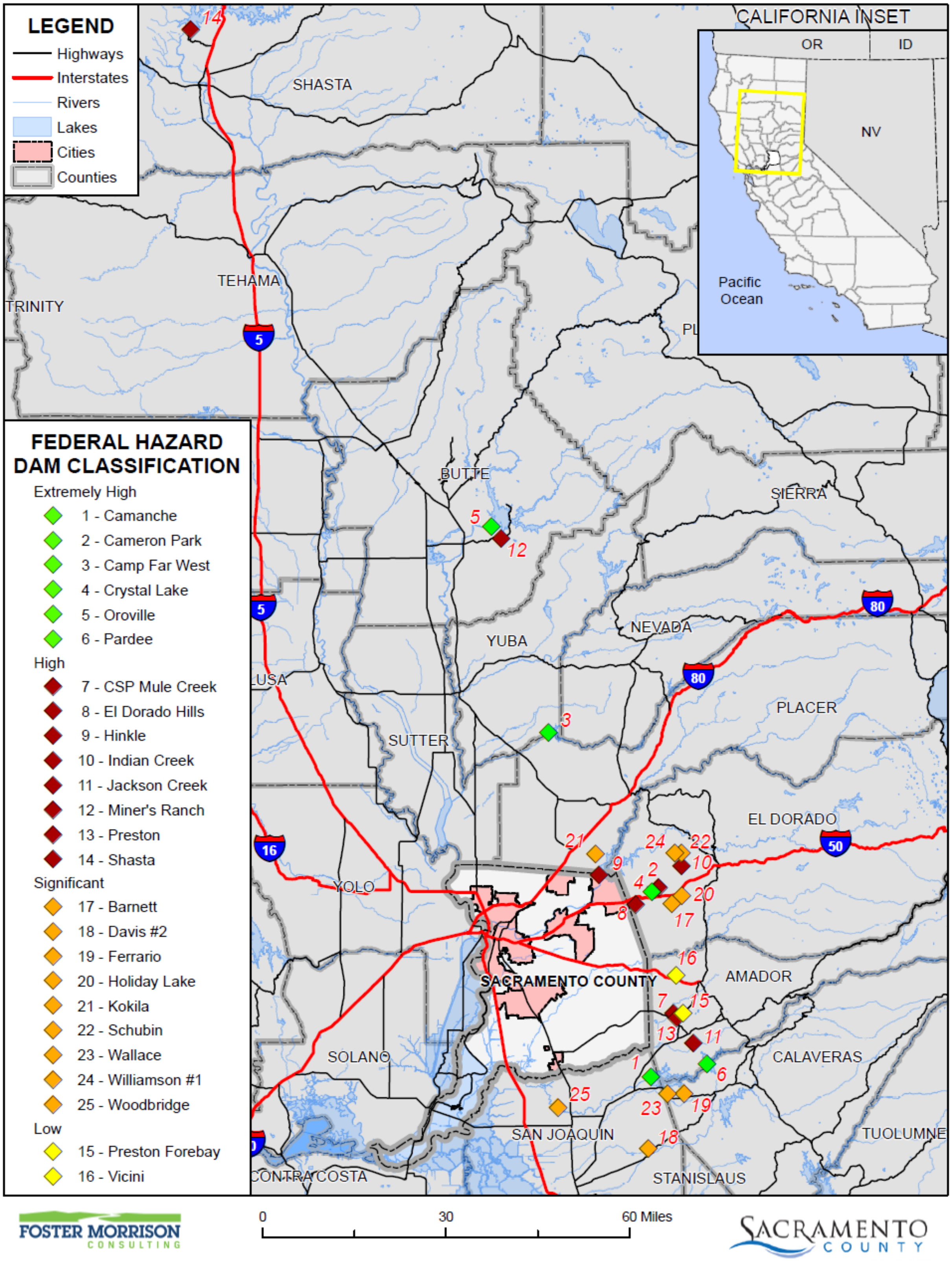
Table 4-36 Sacramento County – Inventory of Dams under DSOD Jurisdiction

Name	Significance	Owner	River	Nearest City/ Distance (mi)	Mapped	Structural Height (ft)	Maximum Storage (acre-ft)
Battery I	Low	Sacramento Regional County Sanitation District	Unnamed	N/A	Y	N/A	N/A
Battery II	Low	Sacramento Regional County Sanitation District	Unnamed	N/A	Y	15	315
Battery III	Low	Sacramento Regional County Sanitation District	Unnamed	N/A	Y	12	847
Blodgett	Significant	Private	Laguna Creek	Mather AFB 2 miles	Y	24	599
Calero	High	Private	Crevis Creek	Rancho Murieta 3 miles	Y	55	3,375
Chesbro	Significant	Private	Consumnes River	Rancho Murieta 2 miles	Y	79	1,500
Clementia	Significant	Private	Tributary of Consumnes River	Rancho Murieta 0 miles	Y	33	1,510
Emergency Storage Basin	Low	Sacramento Regional County Sanitation District	Laguna Creek	N/A	Y	13	629
Folsom	High	Department of Interior	American River	Folsom 1 mile	Y	340	1,120,000
Folsom Mormon Island Auxiliary Dam	High	Department of Interior	Blue Ravine	Folsom 2 miles	N	110	1,120,000
Folsom Dike 7	High	Department of Interior	Green Valley	Folsom 1 mile	N	25	1,120,000
Folsom Dike 8	High	Department of Interior	Green Valley	Folsom 1 mile	N	15	1,120,000
Folsom Left Wing	High	Department of Interior	American River	Folsom 1 mile	N	145	1,120,000

Name	Significance	Owner	River	Nearest City/ Distance (mi)	Mapped	Structural Height (ft)	Maximum Storage (acre-ft)
Folsom Right Wing	High	Department of Interior	American River	Folsom 1 mile	N	145	1,120,000
Galt	Low	City of Galt	Consumnes River	Rancho Murieta 2 miles	Y	16	155
Granlees	Low	Consumnes Irrigation Association	Tributary of Dry Creek	N/A	Y	17	75
Hamel	Significant	Private	Morrison Creek	N/A	Y	26	350
Mather	Low	USAF	Tributary of Consumnes River	Rancho Murieta 2 miles	Y	N/A	N/A
Michigan Bar No. 1	Significant	Private	Tributary of Consumnes River	Rancho Murieta 2 miles	Y	17	897
Michigan Bar No. 2	Low	Private	Consumnes River	Rancho Murieta 1 mile	Y	36	56
Mills	High	Private	Consumnes River	Rancho Murieta 2 miles	Y	23	315
Mount Stoneman	Low	Folsom Prison	Tributary of American River	Folsom 2 miles	Y	73	40
Nimbus	High	Department of Interior	American River	Fair Oaks 3 miles	Y	87	8,800
Rancho Seco	High	Sacramento Municipal Utilities	Hadselville Creek	Clay 4 miles	Y	58	4,350
Schneider	Low	Private	Tributary of Arkansas Creek	Rancho Murieta 4 miles	Y	22	226
Van Vleck	Significant	Private	Arkansas Creek	Rancho Murieta 7 miles	Y	30	2,600
Willow Hill	High	City of Folsom	American River	Folsom 3 miles	Y	24	175

Source: Cal OES and the National Performance of Dams Program
*One Acre Foot=326,000 gallons

Figure 4-42 Sacramento County – Dams Inventory Outside the County



Data Source: DWR DSOD Data 2020 and Cal OES Dam Status 10/2017, Sacramento County GIS, Cal-Atlas; Map Date: 9/2020.

Table 4-37 Dams of Concern Outside Sacramento County

Dam Name Dam ID County	Hazard Class	Owner	Dam Height	Storage (acre-feet)*	Stream	Nearest Community/Distance
Oroville CA00035 Butte	High	California Department of Water Resources	770	3,540,000	Feather River	Oroville 3 miles
Miner's Ranch CA00275 Butte	High	Oroville Wyandotte Irrigation District	90	815	Kelly Ridge Canal	Kelly Ridge 1 mile
Camanche Main CA00 73 San Joaquin	High	East Bay Municipal Utility District	171	431,000	Mokelumne River	Clements 4 miles
Shasta CA10186 Shasta	High	Department of the Interior	602	4,661,860	Sacramento River	Redding 9 miles
Pardee CA00164 Border of Calaveras and Amador Counties	High	East Bay Municipal Utility District	350	198,000	Mokelumne River	Jackson 8 miles
CSP Mule Creek CA01195 Amador	High	State Department of Corrections	51	630	Offstream	Ione 2 miles
Jackson Creek CA00867 Amador	High	Jackson Valley Irrigation District	168	24,000	Jackson Creek	Buena Vista 1 mile
Camp Far West CA00227 Yuba	High	South Sutter Water District	185	104,000	Bear River	Sheridan 5 miles
Preston CA00012 Amador	Significant	Amador Reg. Sanit. Authority	40	37	Tributary of Mule Creek	Ione 1 mile
Preston Forebay CA00006 Amador	Significant	Amador Reg. Sanit. Authority	40	37	Offstream	Ione 2 miles
Wallace CA01314 Calaveras	Significant	Private	19	700	Tributary of Bear Creek	Wallace 0 miles
Ferrario CA00626 Calaveras	Significant	Private	25	384	Tributary of Bear Creek	Wallace 4 miles

Dam Name Dam ID County	Hazard Class	Owner	Dam Height	Storage (acre-feet)*	Stream	Nearest Community/Distance
Cameron Park CA01199 El Dorado	Significant	Cameron Park Community Services District	29	880	Deer Creek	Cameron Park 1 mile
Barnett CA00998 El Dorado	Significant	Private	18	187	Barnett Creek	Shingle Springs 2 miles
Williamson #1 CA00608 El Dorado	Significant	Private	42	260	Tributary of Weber Creek	Shingle Springs 6 miles
Holiday Lake CA00910 El Dorado	Significant	Holiday Lake Community Service District	39	220	Sawmill Creek	Frenchtown 2 miles
Crystal Lake CA01282 El Dorado	Significant	Private	32	296	Tributary of Deer Creek	Shingle Springs 4 miles
Schubin CA01045 El Dorado	Significant	Private	55	315	Tributary of Webber Creek	Shingle Springs 7 miles
Indian Creek CA00997 El Dorado	Significant	Private	36	757	Indian Creek	Rescue 4 miles
Hinkle CA01192 Placer	Significant	San Juan Suburban Water District	20	200	Tributary of American River	Orangevale 2 miles
Kokila CA00544 Placer	Significant	Pacific Gas and Electric	42.5	1,520	Tributary of South Yuba River	Washington 25 miles
Vicini CA01093 Amador	Significant	Private	19	290	Tributary of Willow Creek	Indian Hill 8 miles
Woodbridge CA00285 San Joaquin	Significant	Woodbridge Irrigation District	35	5,064	Mokelumne River	Woodbridge 0 miles
Davis #2 CA00656 San Joaquin	Significant	Private	26	2,220	Tributary of Calaveras River	Linden 4 miles

Source: Cal OES and the National Performance of Dams Program

*One Acre Foot=326,000 gallons

Dam failure is a natural disaster from two perspectives. First, the inundation from released waters resulting from dam failure is related to naturally occurring floodwaters. Second, dam failure would most probably happen in consequence of the natural disaster triggering the event. However, DOSD assigns hazard ratings to dams within the State that provides information on the potential impact should a dam fail: Low, Significant, High, and Extremely High, as detailed above. There is no scale with which to measure dam failure. While a dam may fill slowly with runoff from winter storms, a dam break can have a very quick speed of onset. The duration of dam failure is not long – only as long as it takes to empty the reservoir of water the dam held back. Dam inundation flood geographic extents are discussed in Table 4-47 (for extremely high hazard dams) and Table 4-48 (for high hazard dams) in the flooded acres analysis in the vulnerability assessment of this section.

Past Occurrences

Disaster Declaration History

There have been no disasters declaration related to dam failure in Sacramento County, as shown in Table 4-4.

NCDC Events

There have been no NCDC dam failure events in Sacramento County.

Hazard Mitigation Planning Committee Events

A search of the National Performance of Dams database data shows two dam failure incidents for Sacramento County since 1994, both related to the Folsom Dam. However, these incidents were not actually dam failures, were quite limited in scope, and since the incidents occurred, improvements to the Folsom Dam system have been made and are continuing. These two events are further described below:

July 17, 1995 – At the Folsom Dam, a spillway gate (gate #3 – see Figure 4-43) of Folsom Dam failed, increasing flows into the American River significantly. The spillway was repaired and the U.S. Bureau of Reclamation carried out an investigation of the water flow patterns around the spillway using numerical modeling. No flooding occurred as a result of the partial failure, but due to the location of the dam in proximity to the City of Folsom, possible flooding was a major concern.

Figure 4-43 July 17, 1995 Folsom Dam Incident

Source: US Bureau of Reclamation

May 15, 1997 – Cavitation damage to river outlet works occurred at Folsom Dam. Damage was discovered just downstream of gate #3. The damage consisted of a hole in the floor of the conduit measuring approximately 42 feet long, 15 feet wide, and 6 feet deep. Subsequent inspections of the other conduits revealed similar damage downstream of gate #4. Also, the beginning of cavitation damage was found downstream of gate #2. Minor damage was found in the other five conduits. No flooding was associated with this damage.

2017 Oroville Spillway Incident – February On Feb. 7, the California Department of Water Resources temporarily suspended flows from the Oroville Dam spillway to investigate concrete erosion on the bottom half of the spillway. On Feb. 8, to help determine an appropriate level of flow down the damaged spillway at Oroville Dam, the California Department of Water Resources released up to 20,000 cubic feet per second (cfs), then ramped down the flows to assess any further damage to the eroded spillway. On Feb. 9, the California Department of Water Resources personnel and a host of collaborating agencies continued to monitor Lake Oroville spillway flows through the night. As expected, the overnight flow rate of 20,000 cubic feet per second (cfs) caused additional lower spillway erosion. Spillway flow was stopped again for a few hours to allow engineers to evaluate the integrity of the structure. On Feb. 11, a relatively light flow of water that began washing into Lake Oroville's emergency spillway was expected to continue flowing for the next few days. The lake exceeded the elevation of 901 feet above sea level shortly after 8 a.m., at which point water slowly began to flow over the concrete weir of the auxiliary spillway, down a hillside, and into the Feather River. On Feb. 12, the Lake Oroville Dam emergency spillway structure suffered potentially catastrophic damage as a result of erosion secondary to water flow. The California Department of Water Resources increased exhaust water flow from the Gated Spillway to 100,000 cubic feet per second in an attempt to decrease Lake Oroville water levels. In response, the California Governor's Office of Emergency Services activated the State Operations Center in Sacramento in support of the Oroville Dam emergency spillway incident. Immediate evacuations were ordered for counties and cities near Lake Oroville, and Governor Brown issued state of emergency to help mobilize disaster response resources and support the local evacuations. In Sacramento County, the County prepared for high water levels and the possible collapse of the dam. There was worry about levee erosions from high water flows. Ultimately, the dam held and no damages occurred in the County.

Likelihood of Future Occurrence

Occasional—No dam failure events have occurred in the County, but the County was affected by the Oroville Spillway incident. Thus, based on historical data and input from the HMPC, it is occasional that major dam failure event will occur in Sacramento County.

Climate Change and Dam Failure

Increases in both precipitation and heat causing snow melt in areas upstream of dams could increase the potential for dam failure and uncontrolled releases in Sacramento County.

The 2021 Draft Sacramento CAP noted that climate change is likely to lead to changes in the frequency, intensity, and duration of extreme weather events, such as sustained periods of heavy precipitation, increased rainfall intensity during precipitation events, and increased risk of rain-on-snow events. Further, more winter-time precipitation that falls as rain instead of snow, and higher temperatures that will cause earlier snowmelt, which could produce substantial surface water flows over a short period of time and may potentially affect dams and spillways and overwhelm levee systems designed for historical precipitation patterns.

Vulnerability Assessment

Vulnerability—High

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. The primary danger associated with dam failure is the high velocity flooding of those properties downstream of the dam. 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 facility and associated revenues that accompany those functions. Dam failure flooding would vary by community depending on which dam fails and the nature and extent of the dam failure and associated flooding.

Impacts

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. Electric generating facilities and transmission lines could also be damaged and affect life support systems in communities outside the immediate hazard area. Associated water supply, water quality and health concerns could also be an issue. 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.

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 critical utilities (e.g., water, sewerage, and power), transportation, jobs, tourism, the environment, and the local and regional economies.

Mapped Dams of Concern

As detailed in Table 4-36, the County is vulnerable to the multiple dams. The following dams have mapped inundation areas that intersect the County:

Dams Inside the County

- Calero
- Folsom
- Rancho Seco
- Willow Hill

Dams Outside the County

- Cameron Park
- Camp Far West
- El Dorado Hills
- Hinkle
- Jackson Creek
- Oroville
- Shasta

Folsom Dam 235,000 cfs Scenario

The County provided the mapping of a Folsom Dam 235,000 cfs Scenario. This is considered a "super release" scenario. This scenario has the dam holding (and not failing) by releasing a theoretical maximum of 235,000 cubic feet per second of water. This release would be done under extreme circumstances to relieve the dam of an enlarged reservoir of water occurring simultaneously with additional inflows from upstream. This release would inundate areas below Folsom Dam, and would only be undertaken to save the dam from failure.

Values at Risk

Dam inundation areas were available for multiple dams, as obtained from CA DWR, DSOD were used as the basis of this dam inundation analysis. Dams were grouped by location (inside or outside the County) and hazard rating in order to perform analysis. The depth of flooding due to the failure of these dams is unknown.

Methodology and Results

The same methodology was used for the dams inside and outside the County. Sacramento County's 2020 Parcel/Assessor Data, obtained from Sacramento County, were used for the County inventory of parcels and values. GIS was used to for analysis on the parcel layer. The dam inundation areas, obtained from DSOD, were then overlaid on the parcel layer. The dam inundation areas, obtained from DSOD, were then overlaid on the polygon parcel layer unlike the assets at risk analysis which was performed by centroid analysis. For the purposes of this analysis, if the dam inundation layer intersected any part of the polygon parcel, the entire parcel was considered to be in the dam inundation area. The parcels were segregated and analyzed in this fashion for the entirety of Sacramento County. Once completed, the parcel boundary layer was joined to the centroid layer and values were transferred based on the identification number in the Assessors database and the GIS parcel layer.

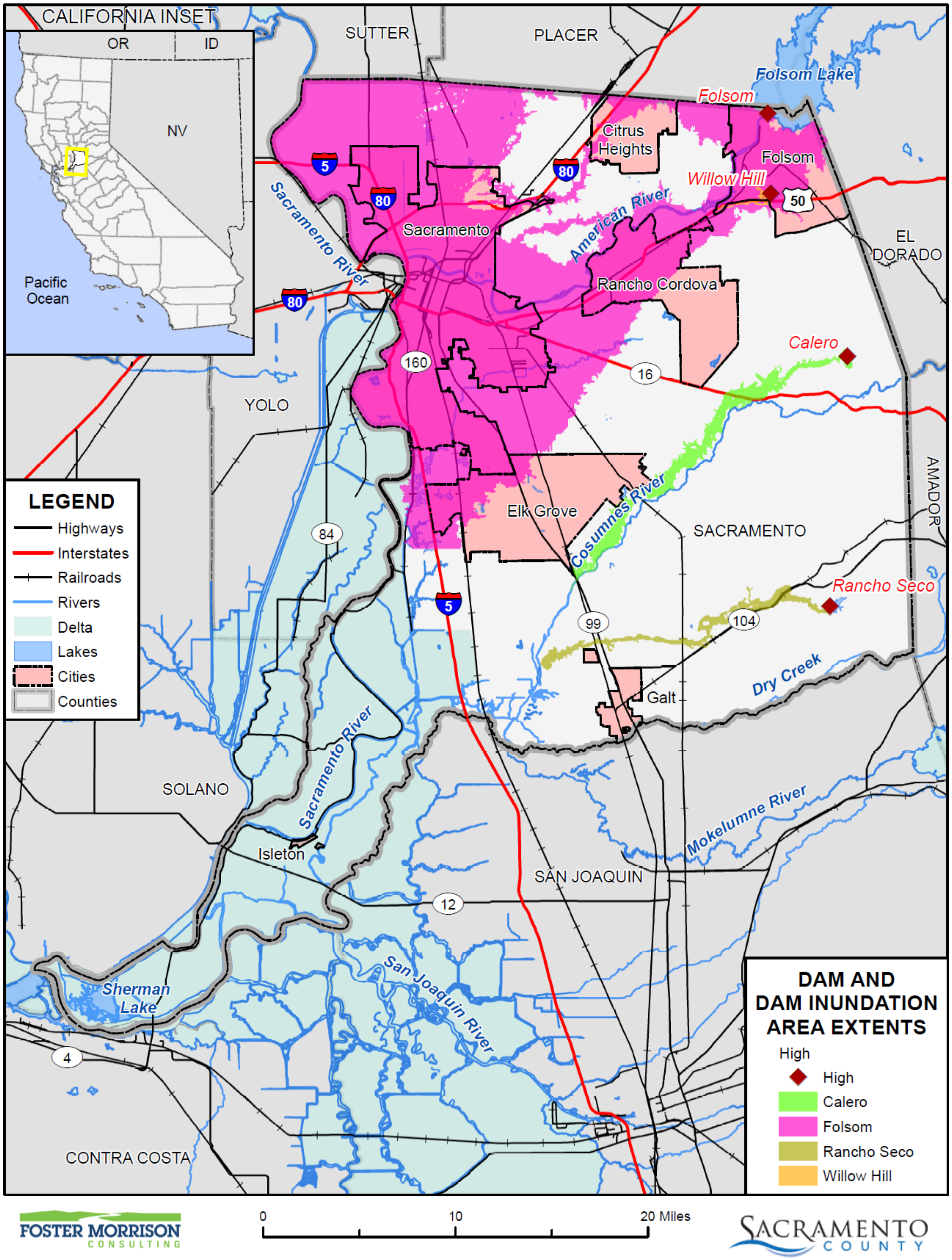
Also, it is important to keep in mind that these assessed values may be well below the actual market value of improved parcels located within the dam inundation areas due primarily to Proposition 13 and to a lesser extent properties falling under the Williamson Act.

Dams Inside the County

Dam analysis was performed for the mapped high hazard dams in the County with available inundation data. Figure 4-44 shows the dam inundation areas of these dams inside the County. The depth of flooding due to the failure of a dam is unknown. Table 4-38 the total parcel counts, improved parcel counts, their improved structure and land values in each dam inundation areas. Table 4-39 breaks down Table 4-38 to show the jurisdictions affected by each dam inundation area. Table 4-40 details the property uses in the unincorporated County in each dam inundation area. Property uses affected by each dam inundation area in the incorporated communities in the County are detailed in their respective annexes to this Plan Update.

It is important to note that there are no extremely high hazard dams located inside Sacramento County. Therefore, no analysis is performed on these dams.

Figure 4-44 Sacramento County –Dam Inundation Areas from Dams Inside County



Data Source: County-provided dam inundation data (FOLSOM_DAM_INUNDATION_AREA.shp 2016), DWR DSOD Data 2020 and Cal OES Dam Status 10/2017, Sacramento County GIS, Cal-Atlas; Map Date: 2/2021.

Table 4-38 Sacramento County Planning Area – Summary Count and Value of Parcels in the High Hazard Dam Inundation Areas

Dam Inundation Areas	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Calero	186	121	$77,487,364	$89,943,593	$85,593,089	$253,024,050
Folsom	310,069	286,482	$53,080,410,667	$111,779,756,530	$70,029,815,914	$234,889,983,292
Rancho Seco	151	78	$36,677,678	$38,207,607	$37,089,274	$111,974,559
Willow Hill	42	19	$46,124,255	$446,593,668	$416,826,784	$909,544,707

Source: Sacramento County 2020 Parcel/Assessor's Data, Cal OES, DSOD

Table 4-39 Sacramento County Planning Area – Count and Value of Parcels in the High Hazard Dam Inundation Areas of Dams Inside the County

Dam Inundation/ Jurisdiction	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Calero Dam Inundation Area						
Elk Grove	16	13	$2,869,457	$5,415,691	$2,707,844	$10,992,995
Unincorporated Sacramento County	170	108	$74,617,907	$84,527,902	$82,885,245	$242,031,055
Folsom Dam Inundation Area						
Citrus Heights	8,555	8,246	$12,255,404,308	$13,678,780,639	$6,880,277,314	$32,814,462,221
Elk Grove	18,141	17,172	$1,807,628,600	$5,172,659,324	$2,912,714,908	$9,893,002,716
Folsom	22,290	20,638	$3,870,588,630	$9,452,361,980	$5,863,790,696	$19,186,741,224
Rancho Cordova	18,469	17,609	$3,973,310,963	$6,896,716,789	$4,927,028,278	$15,797,055,987
City of Sacramento	156,848	143,642	$19,302,703,646	$51,321,198,849	$33,664,345,577	$104,288,248,771
Unincorporated Sacramento County	85,766	79,175	$11,870,774,520	$25,258,038,949	$15,781,659,141	$52,910,472,373
Rancho Seco Dam Inundation Area						
Galt	1	0	$0	$0	$0	$0
Unincorporated Sacramento County	150	78	$36,677,678	$38,207,607	$37,089,274	$111,974,559
Willow Hill Dam Inundation Area						
Folsom	36	19	$45,935,048	$446,593,668	$416,826,784	$909,355,500
Unincorporated Sacramento County	6	0	$189,207	$0	$0	$189,207

Source: Sacramento County 2020 Parcel/Assessor's Data, Cal OES, DSOD

Table 4-40 Unincorporated Sacramento County – Count and Value of Parcels in the High Hazard Dam Inundation Areas of Dams Inside the County by Property Use

Dam Inundation Area/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Calero Dam Inundation Area						
Agricultural	123	90	$70,030,633	$80,320,269	$80,320,269	$230,671,171
Care / Health	1	0	$164	$0	$0	$164
Miscellaneous	8	0	$11,352	$0	$0	$11,352
Public / Utilities	3	0	$0	$0	$0	$0
Recreational	1	1	$504,672	$336,440	$336,440	$1,177,552
Residential	17	15	$2,245,516	$3,285,311	$1,642,654	$7,173,482
Retail / Commercial	2	2	$69,212	$585,882	$585,882	$1,240,976
Vacant	15	0	$1,756,358	$0	$0	$1,756,358
Unincorporated Sacramento County	**170**	**108**	**$74,617,907**	**$84,527,902**	**$82,885,245**	**$242,031,055**
Folsom Dam Inundation Area						
Agricultural	227	56	$94,041,389	$12,202,315	$12,202,315	$118,446,019
Care / Health	103	97	$66,307,595	$233,055,928	$233,055,928	$532,419,451
Church / Welfare	246	216	$83,107,816	$381,139,882	$381,139,882	$845,387,580
Industrial	1,088	870	$533,006,127	$1,586,271,028	$2,379,406,549	$4,498,683,694
Miscellaneous	1,885	16	$9,210,021	$664,951	$664,951	$10,539,923
Office	744	662	$349,890,757	$1,075,111,141	$1,075,111,141	$2,500,113,039
Public / Utilities	391	0	$131	$0	$0	$131
Recreational	100	56	$34,222,157	$61,232,163	$61,232,163	$156,686,483
Residential	76,840	75,939	$9,416,527,232	$20,503,678,639	$10,251,839,253	$40,172,044,897
Retail / Commercial	1,206	1,117	$733,273,970	$1,387,006,959	$1,387,006,959	$3,507,287,888
Unknown	5	4	$40,717	$299,068	$0	$339,785
Vacant	2,931	142	$551,146,608	$17,376,875	$0	$568,523,483
Unincorporated Sacramento County Total	**85,766**	**79,175**	**$11,870,774,520**	**$25,258,038,949**	**$15,781,659,141**	**$52,910,472,373**
Rancho Seco Dam Inundation Area						
Agricultural	87	63	$34,027,330	$35,978,223	$35,978,223	$105,983,776
Industrial	2	0	$0	$0	$0	$0
Miscellaneous	22	0	$1,395	$0	$0	$1,395

Dam Inundation Area/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Public / Utilities	4	0	$0	$0	$0	$0
Residential	14	14	$1,972,943	$2,222,098	$1,111,051	$5,306,092
Vacant	21	1	$676,010	$7,286	$0	$683,296
Unincorporated Sacramento County Total	**150**	**78**	**$36,677,678**	**$38,207,607**	**$37,089,274**	**$111,974,559**
Willow Hill Dam Inundation Area						
Miscellaneous	2	0	$5,518	$0	$0	$5,518
Public / Utilities	1	0	$0	$0	$0	$0
Vacant	3	0	$183,689	$0	$0	$183,689
Unincorporated Sacramento County Total	**6**	**0**	**$189,207**	**$0**	**$0**	**$189,207**

Source: Sacramento County 2020 Parcel/Assessor's Data, Cal OES, DSOD

In addition to the Cal OES and DSOD provided inundation areas, Sacramento County noted a study done regarding a Folsom Dam super release. Using a 235,000 cfs release scenario, maps were created to show an expected inundation area under that scenario. This can be seen in Figure 4-45. Using the same methodology as above, tabular analysis was created. A summary table of values at risk in the Sacramento County Planning Area in the Folsom Dam 235,000 cfs scenario can be seen in Table 4-41. Table 4-42 breaks Table 4-41 to show the values at risk in each jurisdiction. Table 4-43 shows the values at risk in the unincorporated County from the Folsom Dam 235,000 cfs release. The County noted that the area labeled Folsom 235,000 cfs Release Riverine Inundation is the American River corridor and the backwater of the Natomas East Main Drainage Channel (aka Steelhead Creek) to the flood control pump station.

Figure 4-45 Sacramento County – Folsom Dam 235,000 cfs Scenario Inundation Areas

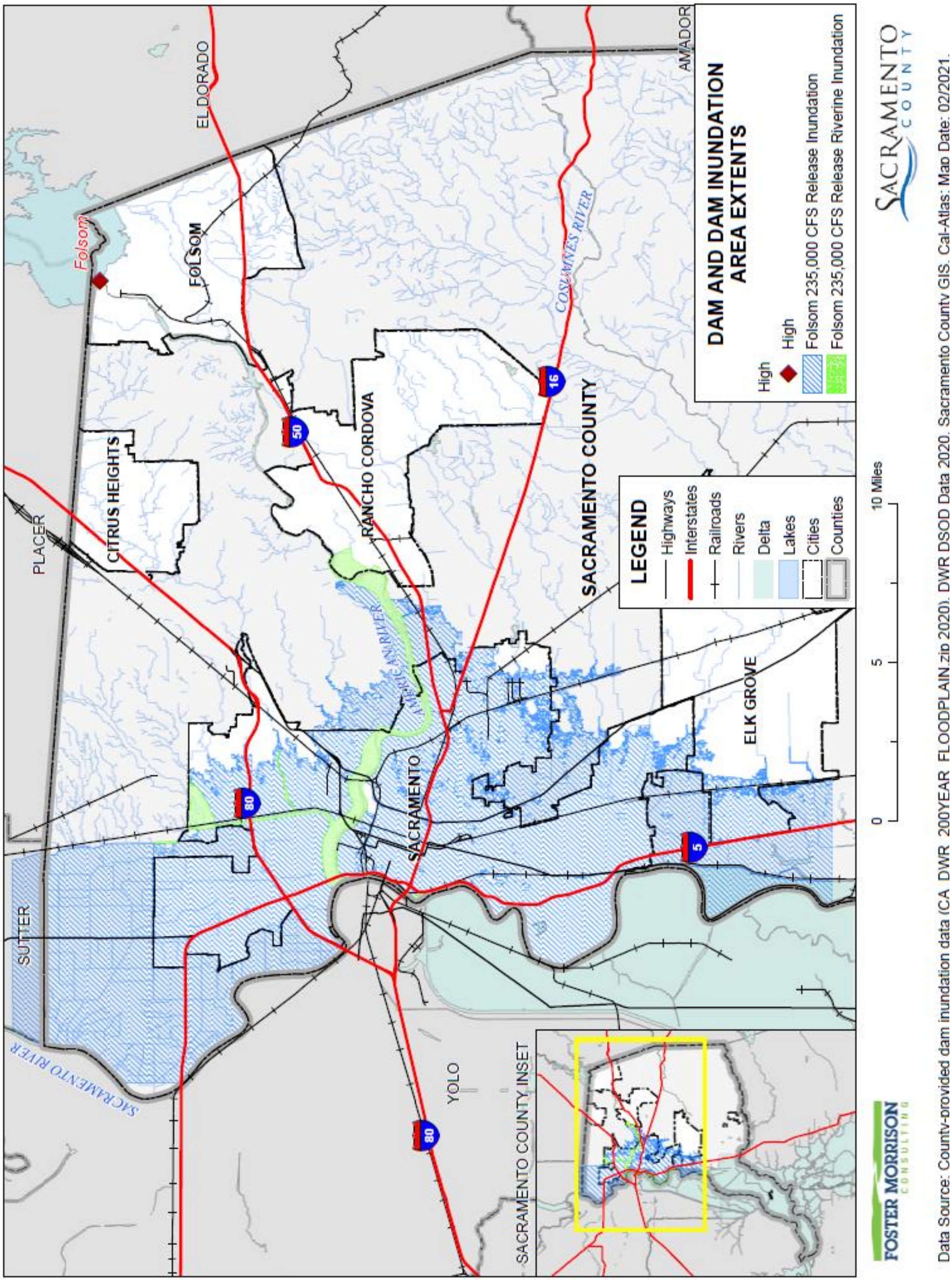


Table 4-41 Sacramento County Planning Area – Summary of Parcels and Values in Folsom Dam 235,000 cfs Scenario

Dam Inundation Areas	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Folsom 235,000 CFS Release	187,228	171,865	$23,366,779,385	$60,380,930,368	$39,487,017,929	$123,234,728,193

Source: Sacramento County 2020 Parcel/Assessor's Data, CA DWR

Table 4-42 Sacramento County Planning Area – Count and Value of Parcels in Folsom Dam 235,000 cfs Scenario by Jurisdiction

Jurisdiction	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Elk Grove	9,814	9,277	$1,076,336,037	$3,151,585,836	$1,798,131,188	$6,026,052,974
Rancho Cordova	40	24	$5,871,864	$12,428,695	$6,214,348	$24,514,907
City of Sacramento	149,885	137,271	$18,549,178,060	$49,163,674,037	$31,945,584,881	$99,658,437,646
Unincorporated Sacramento County	27,489	25,293	$3,735,393,424	$8,053,241,800	$5,737,087,512	$17,525,722,666

Source: Sacramento County 2020 Parcel/Assessor's Data, CA DWR

Table 4-43 Unincorporated Sacramento County – Count and Value of Parcels in Folsom Dam 235,000 cfs Scenario by Property Use

Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Agricultural	217	56	$100,071,498	$18,921,962	$18,921,962	$137,915,422
Care / Health	34	31	$23,873,064	$184,953,311	$184,953,311	$393,779,686
Church / Welfare	96	87	$28,566,484	$123,724,535	$123,724,535	$276,015,554
Industrial	401	371	$250,753,869	$917,950,259	$1,376,925,392	$2,545,629,523
Miscellaneous	671	12	$5,923,419	$572,961	$572,961	$7,069,341
Office	340	299	$200,658,030	$553,755,429	$553,755,429	$1,308,168,888
Public / Utilities	171	0	$45	$0	$0	$45
Recreational	54	23	$10,025,825	$8,209,991	$8,209,991	$26,445,807
Residential	24,019	23,817	$2,523,254,098	$5,545,133,462	$2,772,566,770	$10,840,954,257
Retail / Commercial	609	561	$344,599,527	$697,457,161	$697,457,161	$1,739,513,849
Vacant	877	36	$247,667,565	$2,562,729	$0	$250,230,294

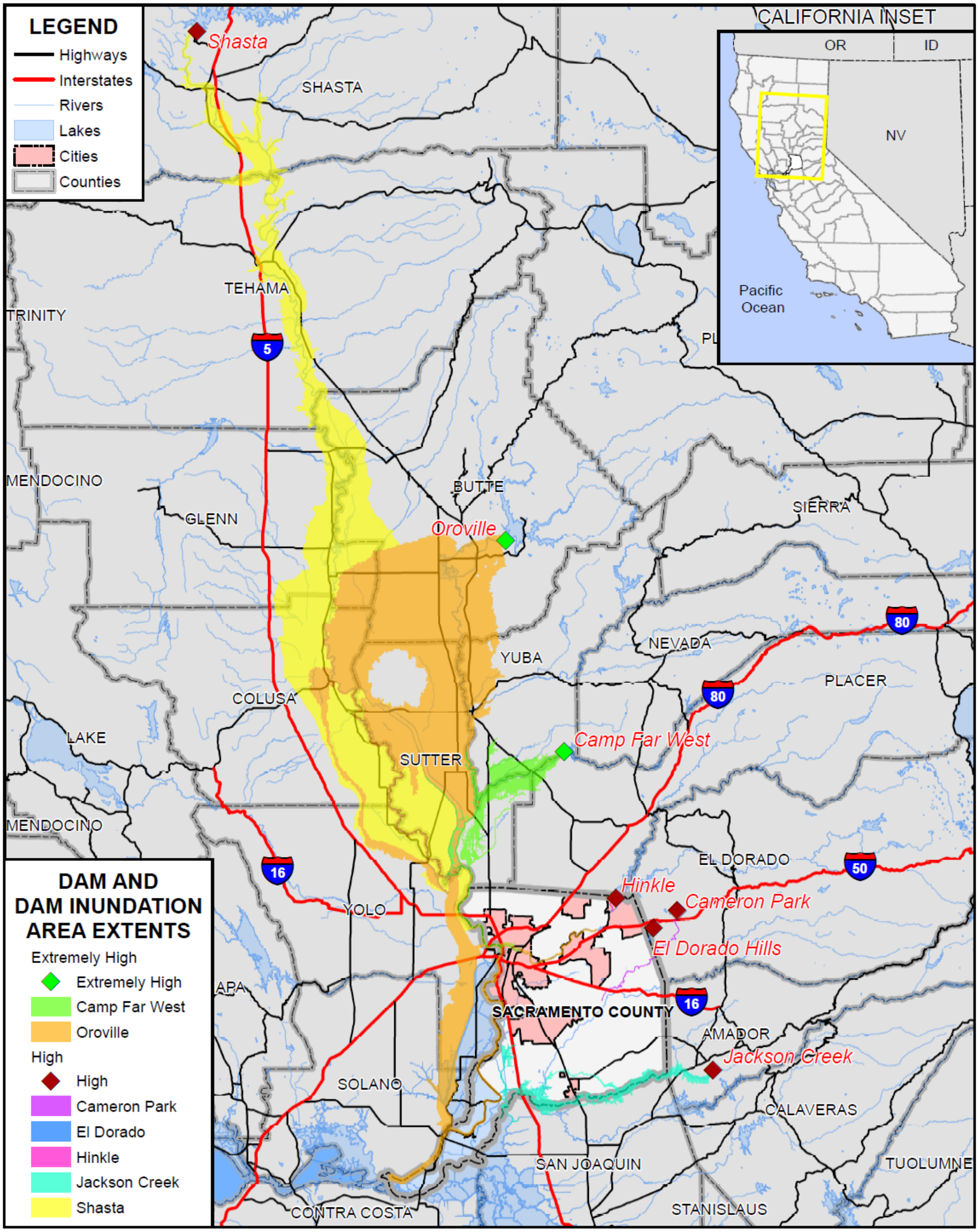
Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Unincorporated Sacramento County Total	**27,489**	**25,293**	**$3,735,393,424**	**$8,053,241,800**	**$5,737,087,512**	**$17,525,722,666**

Source: Sacramento County 2020 Parcel/Assessor's Data, CA DWR

Dams Outside the County

Dam analysis was performed for the mapped extremely high and extremely high hazard dams outside the County with inundation areas inside the County. Figure 4-46 shows the dam inundation areas of these dams of concern for the County. Table 4-44 the total parcel counts, improved parcel counts, their improved structure and land values in each high hazard dam inundation areas. Table 4-45 breaks down Table 4-44 to show the which jurisdictions are affected by each dam inundation area. Table 4-46 details the property uses in the unincorporated County in each dam inundation area. Property uses affected by each dam inundation area in the incorporated communities in the County are detailed in their respective annexes to this Plan Update.

Figure 4-46 Sacramento County –Dam Inundation Areas from Dams Outside County



Data Source: DWR DSOD Data 2020 and Cal OES Dam Status 10/2017, Sacramento County GIS, Cal-Atlas; Map Date: 9/2020.

Table 4-44 Sacramento County Planning Area– Summary Count and Value of Parcels in the Dam Inundation Areas from Dams Outside the County

Dam Inundation Areas	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Extremely High Hazard Dams						
Camp Far West	414	190	$64,583,854	$104,745,932	$60,238,929	$229,568,707
Oroville	3,179	2,141	$526,316,249	$1,156,028,355	$766,016,092	$2,448,360,716
High Hazard Dams						
Cameron Park	133	55	$82,693,121	$9,057,582	$9,057,582	$100,808,285
El Dorado	12	12	$1,114,668	$216,108	$216,108	$1,546,884
Hinkle	179	159	$192,807,585	$208,536,005	$109,171,285	$510,514,874
Jackson Creek	345	161	$81,249,563	$82,788,464	$78,557,106	$242,595,133
Shasta	220	76	$24,219,642	$35,768,653	$18,041,883	$78,030,179

Source: Sacramento County 2020 Parcel/Assessor's Data, Cal OES, DSOD

Table 4-45 Sacramento County Planning Area – Count and Value of Parcels in the Dam Inundation Areas of Dams Outside the County

Dam Inundation/ Jurisdiction	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Camp Far West (Extremely High Hazard Dam)						
City of Sacramento	113	20	$9,035,924	$25,269,061	$20,399,528	$54,704,513
Unincorporated Sacramento County	301	170	$55,547,930	$79,476,871	$39,839,401	$174,864,194
Oroville Dam (Extremely High Hazard Dam)						
Isleton	111	83	$5,547,065	$10,955,235	$7,102,979	$23,605,281
Rancho Cordova	79	36	$4,225,670	$10,953,529	$5,476,761	$20,655,962
City of Sacramento	1,246	864	$246,504,620	$675,337,203	$460,240,301	$1,382,082,142
Unincorporated Sacramento County	1,743	1,158	$270,038,894	$458,782,388	$293,196,051	$1,022,017,331
Cameron Park Dam (High Hazard Dam)						
Unincorporated Sacramento County	133	55	$82,693,121	$9,057,582	$9,057,582	$100,808,285

Dam Inundation/ Jurisdiction	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
El Dorado Dam (High Hazard Dam)						
Unincorporated Sacramento County	12	12	$1,114,668	$216,108	$216,108	$1,546,884
Hinkle Dam (High Hazard Dam)						
Folsom	179	159	$192,807,585	$208,536,005	$109,171,285	$510,514,874
Jackson Creek Dam (High Hazard Dam)						
Galt	19	5	$6,672,896	$1,895,709	$1,176,520	$9,745,125
Unincorporated Sacramento County	326	156	$74,576,667	$80,892,755	$77,380,586	$232,850,008
Shasta Dam (High Hazard Dam)						
Unincorporated Sacramento County	220	76	$24,219,642	$35,768,653	$18,041,883	$78,030,179

Source: Sacramento County 2020 Parcel/Assessor's Data, Cal OES, DSOD

Table 4-46 Unincorporated Sacramento County – Count and Value of Parcels in the Dam Inundation Areas of Dams Outside the County by Property Use

Dam Inundation Area/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Camp Far West Dam (Extremely High Hazard Dam)						
Agricultural	2	0	$20	$0	$0	$20
Miscellaneous	10	0	$5,894	$0	$0	$5,894
Public / Utilities	68	0	$18	$0	$0	$18
Recreational	4	1	$280,231	$212,967	$212,967	$706,165
Residential	172	167	$45,701,407	$79,252,857	$39,626,434	$164,580,690
Unknown	1	0	$5,576	$0	$0	$5,576
Vacant	44	2	$9,554,784	$11,047	$0	$9,565,831
Unincorporated Sacramento County Total	**301**	**170**	**$55,547,930**	**$79,476,871**	**$39,839,401**	**$174,864,194**
Oroville Dam (Extremely High Hazard Dam)						
Agricultural	237	184	$52,227,644	$74,072,612	$74,072,612	$200,372,868
Church / Welfare	3	2	$114,491	$8,642,469	$8,642,469	$17,399,429
Industrial	19	9	$1,485,480	$3,217,306	$4,825,958	$9,528,745
Miscellaneous	234	1	$425,998	$5,740	$5,740	$437,478
Office	10	8	$3,566,252	$9,165,507	$9,165,507	$21,897,266

Dam Inundation Area/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Public / Utilities	96	0	$9	$0	$0	$9
Recreational	47	29	$23,818,018	$26,725,908	$26,725,908	$77,269,834
Residential	919	890	$168,053,864	$332,590,151	$166,295,077	$666,939,089
Retail / Commercial	25	23	$2,089,416	$3,462,780	$3,462,780	$9,014,976
Unknown	1	0	$5,576	$0	$0	$5,576
Vacant	152	12	$18,252,146	$899,915	$0	$19,152,061
Unincorporated Sacramento County Total	**1,743**	**1,158**	**$270,038,894**	**$458,782,388**	**$293,196,051**	**$1,022,017,331**
Cameron Park Dam (High Hazard Dam)						
Agricultural	112	52	$70,383,526	$8,469,486	$8,469,486	$87,322,498
Industrial	2	0	$2,402,082	$0	$0	$2,402,082
Retail / Commercial	3	3	$131,728	$588,096	$588,096	$1,307,920
Vacant	16	0	$9,775,785	$0	$0	$9,775,785
Unincorporated Sacramento County Total	**133**	**55**	**$82,693,121**	**$9,057,582**	**$9,057,582**	**$100,808,285**
El Dorado Dam (High Hazard Dam)						
Agricultural	12	12	$1,114,668	$216,108	$216,108	$1,546,884
Unincorporated Sacramento County Total	**12**	**12**	**$1,114,668**	**$216,108**	**$216,108**	**$1,546,884**
Jackson Creek Dam (High Hazard Dam)						
Agricultural	180	120	$66,810,403	$73,937,915	$73,937,915	$214,686,233
Miscellaneous	53	0	$13,114	$0	$0	$13,114
Public / Utilities	12	0	$10	$0	$0	$10
Recreational	3	2	$418,688	$76,097	$76,097	$570,882
Residential	28	27	$4,795,052	$6,577,059	$3,288,528	$14,660,639
Retail / Commercial	1	1	$78,046	$78,046	$78,046	$234,138
Vacant	49	6	$2,461,354	$223,638	$0	$2,684,992
Unincorporated Sacramento County Total	**326**	**156**	**$74,576,667**	**$80,892,755**	**$77,380,586**	**$232,850,008**
Shasta Dam (High Hazard Dam)						
Agricultural	15	0	$77	$0	$0	$77
Miscellaneous	25	0	$6,704	$0	$0	$6,704

Dam Inundation Area/ Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Public / Utilities	73	0	$18	$0	$0	$18
Recreational	4	2	$550,453	$321,058	$321,058	$1,192,569
Residential	76	73	$20,607,081	$35,441,648	$17,720,825	$73,769,555
Vacant	27	1	$3,055,309	$5,947	$0	$3,061,256
Unincorporated Sacramento County Total	**220**	**76**	**$24,219,642**	**$35,768,653**	**$18,041,883**	**$78,030,179**

Source: Sacramento County 2020 Parcel/Assessor's Data, Cal OES, DSOD

Dam Inundation - Flooded Acres

In addition to the centroid analysis used to obtain numbers of parcels and values at risk to the dam failure hazard, parcel boundary analysis was performed to obtain total acres and flooded acres by dam inundation area. The following is an analysis of inundated or flooded acres associated with dam failures and inundation areas in the County.

Methodology

GIS was used to calculate acres flooded by each Cal OES dam inundation area. The parcel layer was intersected with the Cal OES and DWR DSOD dam inundation area data to obtain the acres inundated by dam. The Sacramento County parcel layer and inundation areas were intersected, and each segment divided by the intersection of inundation area and parcels was calculated for acres.

Limitations

One limitation created by this type of analysis is that with respect to the improved acres analysis, improvements are uniformly found throughout the parcel, while in reality, only portions of the parcel are improved, and improvements may or may not fall within the inundated portion of a parcel; thus, areas of improvements inundated, calculated through this method, may be higher or lower than those actually seen in a similar real-world event.

Analysis Results

The following tables represent a summary analysis of total acres for each dam inundation area in the Planning Area. Table 4-47 shows the flooded acres of the Sacramento County Planning Area in the inundation areas of each high hazard dam located inside the County. Table 4-48 shows the flooded acres of the Sacramento County Planning Area in the inundation areas of each extremely high and high hazard dam located outside the County.

Table 4-47 Sacramento County Planning Area – Flooded Acres from Dams Inside of the County

Dam Inundation Areas	Jurisdiction	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
High Hazard Dams							
Calero	Elk Grove	20.11	0.00%	18.89	0.01%	1.22	0.00%
	Unincorporated Sacramento County	6,568.66	1.02%	5,498.48	1.52%	1,070.18	0.37%
Folsom	Citrus Heights	2,360.07	0.36%	2,053.12	0.57%	306.95	0.11%
	Elk Grove	6,834.83	1.06%	5,297.04	1.47%	1,537.79	0.54%
	Folsom	15,025.46	2.32%	9,759.53	2.70%	5,265.93	1.85%
	Rancho Cordova	10,507.97	1.62%	6,010.88	1.66%	4,497.09	1.58%
	City of Sacramento	72,486.45	11.21%	47,239.98	13.08%	25,246.47	8.85%
	Unincorporated Sacramento County	94,865.55	14.67%	48,367.38	13.39%	46,498.16	16.29%
Rancho Seco	Galt	1.50	0.00%	0.0	0.00%	1.50	0.00%
	Unincorporated Sacramento County	3,279.52	0.51%	2,430.82	0.67%	848.70	0.30%
Willow Hill	Folsom	84.84	0.01%	56.66	0.02%	28.19	0.01%
	Unincorporated Sacramento County	73.07	0.01%	0.0	0.00%	73.07	0.03%
Folsom Dam 235,000 cfs Scenario							
Folsom Dam 235,000 cfs scenario	Elk Grove	3,726.59	0.58%	2,923.81	0.81%	802.78	0.28%
	Rancho Cordova	429.60	0.07%	7.18	0.00%	422.42	0.15%
	City of Sacramento	66,339.94	10.26%	43,402.39	12.01%	22,937.55	8.04%
	Unincorporated Sacramento County	47,934.35	7.41%	19,276.52	5.34%	28,657.83	10.04%

Source: Cal OES, DSOD

Table 4-48 Sacramento County Planning Area – Flooded Acres from Dams Outside of the County

Dam Inundation Areas	Jurisdiction	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Extremely High Hazard Dams							
Camp Far West	City of Sacramento	110.08	0.02%	5.86	0.00%	104.22	0.04%
	Unincorporated Sacramento County	24.13	0.00%	10.58	0.00%	13.55	0.00%
Oroville	Isleton	23.87	0.00%	12.61	0.00%	11.25	0.00%
	Rancho Cordova	477.28	0.07%	11.22	0.00%	466.06	0.16%
	City of Sacramento	1,727.40	0.27%	256.54	0.07%	1,470.86	0.52%
	Unincorporated Sacramento County	5,176.96	0.80%	3,119.38	0.86%	2,057.57	0.72%
High Hazard Dams							
Cameron Park	Unincorporated Sacramento County	451.49	0.07%	159.11	0.04%	292.38	0.10%
El Dorado	Unincorporated Sacramento County	10.39	0.00%	10.39	0.00%		
Hinkle	Folsom	102.20	0.02%	70.41	0.02%	31.79	0.01%
Jackson Creek	Galt	111.28	0.02%	12.53	0.00%	98.75	0.03%
	Unincorporated Sacramento County	11,704.20	1.81%	6,591.01	1.82%	5,113.20	1.79%
Shasta	Unincorporated Sacramento County	334.61	0.05%	74.72	0.02%	259.88	0.09%

Source: Cal OES, DSOD

Population at Risk

A separate analysis was performed to determine population in dam inundation areas for dams with available inundation maps. Using GIS, the dam inundation area dataset was overlayed on the improved residential parcel data. Those parcel centroids that intersect an inundation area were counted and multiplied by the Census Bureau average household size for Sacramento County. Table 4-49 shows the populations at risk to dam failure flooding dams inside the County. Table 4-50 shows the populations at risk to dam failure flooding for extremely high hazard dams outside the County, while Table 4-51 shows the population at risk to dam failure for high hazard dams outside the County. Table 4-52 shows the populations at risk in the Folsom Dam 235,000 cfs Scenario.

Table 4-49 Sacramento County Planning Area – Residential Population at Risk in High Hazard Dam Inundation Areas Inside the County

Jurisdiction	Calero		Folsom		Rancho Seco		Willow Hill	
	Imp. Res. Parcels	Pop.	Imp. Res. Parcels	Pop.	Imp. Res. Parcels	Pop.	Imp. Res. Parcels	Pop.
Citrus Heights	0	0	6,807	17,290	0	0	0	0
Elk Grove	3	10	16,650	53,280	0	0	0	0
Folsom	0	0	19,525	51,351	0	0	1	3
Galt	0	0	0	0	0	0	0	0
Isleton	0	0	0	0	0	0	0	0
Rancho Cordova	0	0	15,558	33,294	0	0	0	0
City of Sacramento	0	0	134,294	357,222	0	0	0	0
Unincorporated Sacramento County	1	3	73,131	196,322	14	39	0	0
Total	**4**	**13**	**265,965**	**708,759**	**14**	**39**	**1**	**3**

Source: Cal OES Dam Inundation Data, DSOD, US Census Bureau Average Household Sizes: Citrus Heights (2.54); Sacramento City (2.66); Elk Grove (3.20); Folsom (2.63), Galt (3.16); Isleton (2.7), Rancho Cordova (2.14): and unincorporated Sacramento County (2.76)

Table 4-50 Sacramento County Planning Area– Residential Population at Risk in Extremely High Hazard Dam Inundation Areas Outside the County

Jurisdiction	Camp Far West		Oroville	
	Imp. Res. Parcels	Pop.	Imp. Res. Parcels	Pop.
Citrus Heights	0	0	0	0
Elk Grove	0	0	0	0
Folsom	0	0	0	0
Galt	0	0	0	0
Isleton	0	0	51	138
Rancho Cordova	0	0	36	77
City of Sacramento	15	40	789	2,099
Unincorporated Sacramento County	167	461	890	2,456
Total	**182**	**501**	**1766**	**4,770**

Source: Cal OES Dam Inundation Data, DSOD, US Census Bureau Average Household Sizes: Citrus Heights (2.54); Sacramento City (2.66); Elk Grove (3.20); Folsom (2.63), Galt (3.16); Isleton (2.7), Rancho Cordova (2.14): and unincorporated Sacramento County (2.76)

Table 4-51 Sacramento County Planning Area– Residential Population at Risk in High Hazard Dam Inundation Areas Outside the County

Jurisdiction	Cameron Park		El Dorado		Hinkle		Jackson Creek		Shasta	
	Imp. Res. Parcels	Pop.	Imp. Res. Parcels	Pop.	Imp. Res. Parcels	Pop.	Imp. Res. Parcels	Pop.	Imp. Res. Parcels	Pop.
Citrus Heights	0	0	0	0	0	0	0	0	0	0
Elk Grove	0	0	0	0	0	0	0	0	0	0
Folsom	0	0	0	0	154	405	0	0	0	0
Galt	0	0	0	0	0	0	3	9	0	0
Isleton	0	0	0	0	0	0	0	0	0	0
Rancho Cordova	0	0	0	0	0	0	0	0	0	0
City of Sacramento	0	0	0	0	0	0	0	0	0	0
Unincorporated Sacramento County	0	0	0	0	0	0	27	75	73	201
Total	**0**	**0**	**0**	**0**	**154**	**405**	**30**	**84**	**73**	**201**

Source: Cal OES Dam Inundation Data, DSOD, US Census Bureau Average Household Sizes: Citrus Heights (2.54); Sacramento City (2.66); Elk Grove (3.20); Folsom (2.63), Galt (3.16); Isleton (2.7), Rancho Cordova (2.14): and unincorporated Sacramento County (2.76)

Table 4-52 Sacramento County Planning Area – Residential Population at Risk to Folsom Dam 235,000 cfs Scenario

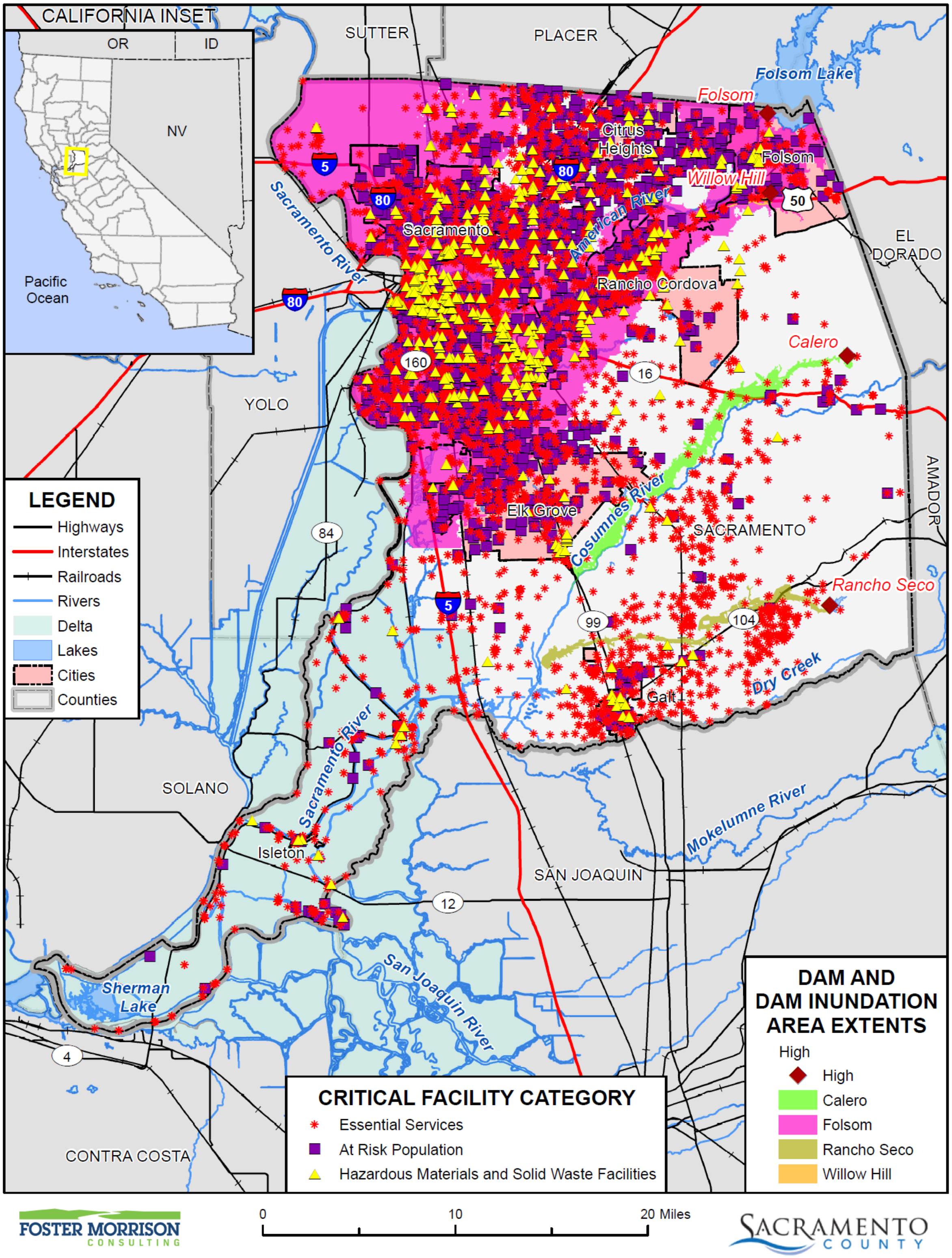
Jurisdiction	Folsom Dam 235,000 cfs Scenario	
	Imp. Res. Parcels	Pop.
Citrus Heights	0	0
Elk Grove	7,752	24,806
Folsom	0	0
Galt	0	0
Isleton	0	0
Rancho Cordova	1	2
City of Sacramento	124,262	330,537
Unincorporated Sacramento County	20,552	56,724
Total	**152,567**	**412,069**

Source: Cal OES Dam Inundation Data, DSOD, US Census Bureau Average Household Sizes: Citrus Heights (2.54); Sacramento City (2.66); Elk Grove (3.20); Folsom (2.63), Galt (3.16); Isleton (2.7), Rancho Cordova (2.14): and unincorporated Sacramento County (2.76)

Critical Facilities at Risk

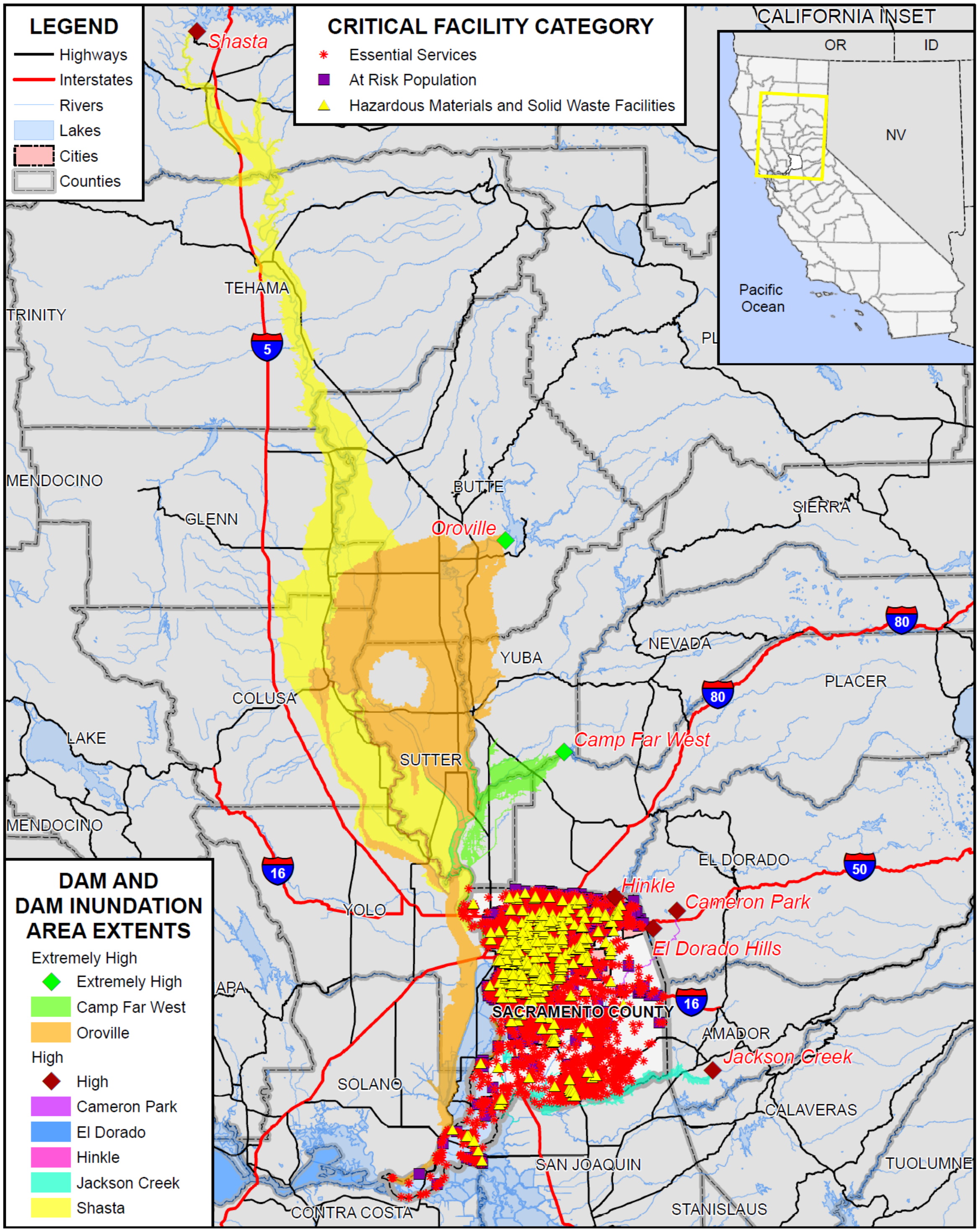
A separate analysis was performed on the critical facility inventory in Sacramento County and all jurisdictions to determine critical facilities in the dam inundation areas from dams inside the County, outsid the County, and in the Folsom 235,000 cfs Scenario. Using GIS, the dam inundation areas were overlayed on the critical facility GIS layer. Figure 4-47 shows critical facilities inside dam inundation zones from dams inside the County. Figure 4-48 shows critical facilities inside dam inundation zones from dams outside the County. Figure 4-49 shows the critical facilities inside the Folsom Dam 235,000 cfs Scenario areas. Table 4-53 summarizes the critical facilities in the County by dam inundation area. Table 4-54 details critical facilities by facility type and count inside dam inundation areas for the unincorporated County. Details of critical facility definition, type, name and address by flood zone are listed in Appendix F.

Figure 4-47 Sacramento County Planning Area – Critical Facilities in Dam Inundation Areas from Dams Inside the County



Data Source: County-provided dam inundation data (FOLSOM_DAM_INUNDATION_AREA.shp 2016), DWR DSOD Data 2020 and Cal OES Dam Status 10/2017, Sacramento County GIS, Cal-Atlas; Map Date: 8/2021.

Figure 4-48 Sacramento County Planning Area – Critical Facilities in Dam Inundation Areas from Dams Outside the County



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SACRAMENTO COUNTY

Data Source: DWR DSOD Data 2020 and Cal OES Dam Status 10/2017, Sacramento County GIS, Cal-Atlas; Map Date: 8/2021.

Figure 4-49 Sacramento County Planning Area – Critical Facilities in Folsom Dam 235,000 cfs Release Scenario

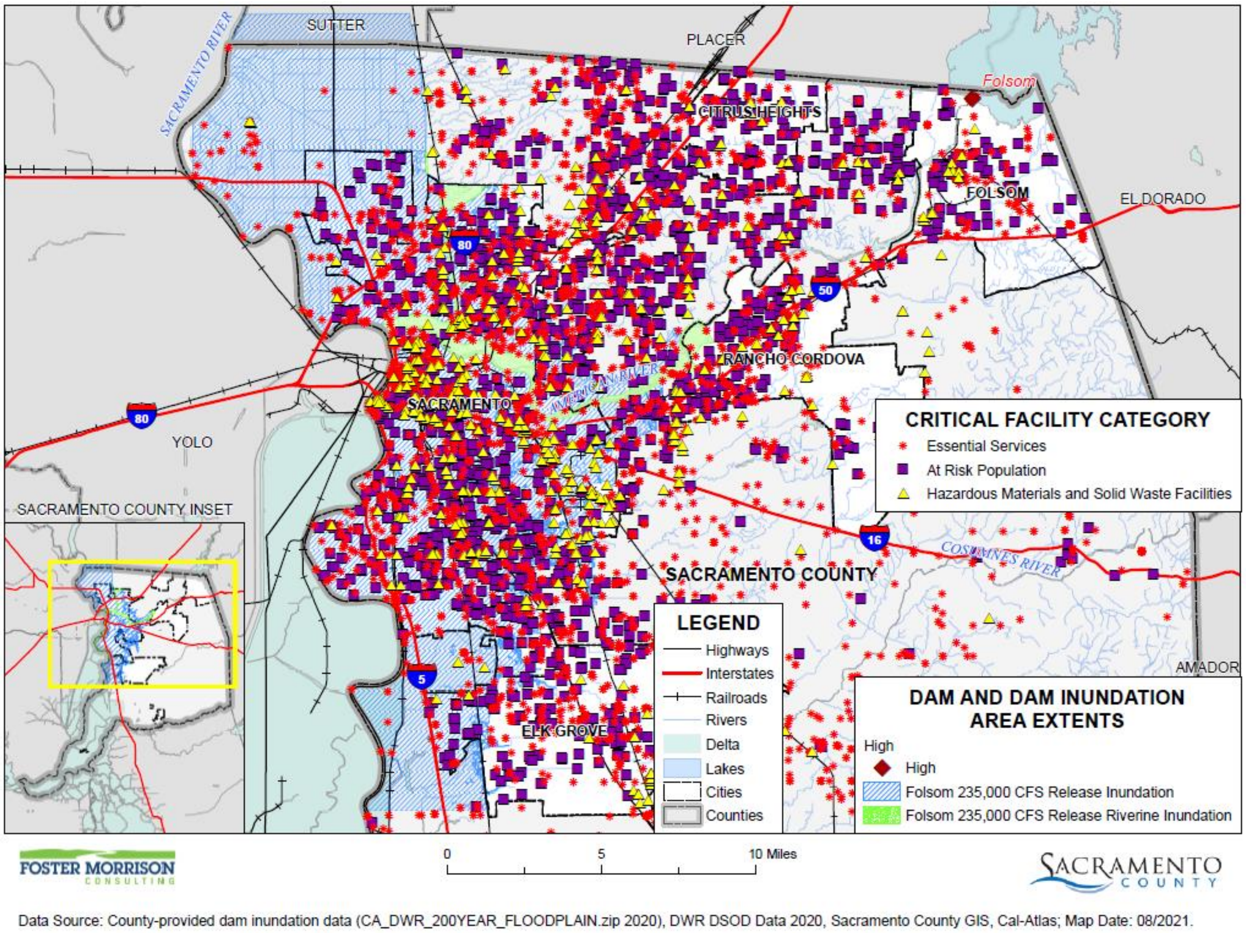


Table 4-53 Sacramento County Planning Area – Critical Facilities in Dam Inundation Areas Summary

Dam Inundation Areas/ Jurisdiction	Facility Count
Calero Dam (High Hazard Dam Inside the County)	
Unincorporated Sacramento County	7
Folsom Dam (High Hazard Dam Inside the County)	
Citrus Heights	45
City of Sacramento	2,337
Elk Grove	124
Folsom	203
Rancho Cordova	349
Unincorporated Sacramento County	1,286

Dam Inundation Areas/ Jurisdiction	Facility Count
Rancho Seco (High Hazard Dam Inside the County)	
Unincorporated Sacramento County	4
Willow Hill (High Hazard Dam Inside the County)	
Folsom	3
Camp Far West (Extremely High Hazard Dam Outside the County)	
City of Sacramento	5
Unincorporated Sacramento County	5
Oroville (Extremely High Hazard Dam Outside the County)	
City of Sacramento	40
Isleton	5
Rancho Cordova	1
Unincorporated Sacramento County	87
Cameron Park (High Hazard Dam Outside the County)	
Unincorporated Sacramento County	2
Hinkle Dam (High Hazard Dam Outside the County)	
Folsom	1
Jackson Creek (High Hazard Dam Outside the County)	
Galt	1
Unincorporated Sacramento County	29
Shasta (High Hazard Dam Outside the County)	
Unincorporated Sacramento County	3
Folsom Dam 235,000 cfs Release	
City of Sacramento	2,102
Elk Grove	55
Rancho Cordova	4
Unincorporated Sacramento County	495

Source: Sacramento County GIS, Cal OES, DSOD

Table 4-54 Unincorporated Sacramento County– Critical Facilities in Dam Inundation Areas by Dam Inundation Area and Facility Category and Type

Dam Inundation Areas/Critical Facility Category	Critical Facility Type	Facility Count
Calero (High Hazard Dam Inside the County)		
Essential Services Facilities	Water Well	1
	Total	**7**
At Risk Population Facilities	–	–
	Total	**0**
Hazardous Materials and Solid Waste Facilities	–	–

Dam Inundation Areas/Critical Facility Category	Critical Facility Type	Facility Count
	Total	**0**
Calero Dam Total		**7**
Folsom Dam (High Hazard Dam Inside the County)		
Essential Services Facilities	Airport	2
	Bridge	9
	Cellular Tower	3
	Emergency Evacuation Center	26
	EMS Stations	23
	FDIC Insured Banks	28
	Fire Station	26
	Hospital or Urgent Care	1
	Law Enforcement	10
	Microwave Service Towers	211
	Power Plants	9
	Public Transit Stations	7
	Pump Stations	7
	Sandbag Site	2
	Sewage Treatment Plan	2
	State Government Building	3
	Water Well	366
	Total	**738**
At Risk Population Facilities	Colleges, Universities, and Professional Schools	11
	Community Center	2
	Day Care Center	64
	Mobile Home Park	22
	Places of Worship	224
	School	128
	Total	**451**
Hazardous Materials and Solid Waste Facilities	EPA ER FRP Facility	1
	EPA ER TRI Facility	15
	Leaky Underground Storage Tank	74
	Solid Waste Facility Total	7
	Total	**97**
Folsom Dam Total		**1,286**
Rancho Seco Dam (High Hazard Dam Inside the County)		
Essential Services Facilities	Microwave Service Towers	2

Dam Inundation Areas/Critical Facility Category	Critical Facility Type	Facility Count
	Water Well	2
	Total	**4**
At Risk Population Facilities	–	–
	Total	**0**
Hazardous Materials and Solid Waste Facilities	–	–
	Total	**0**
Rancho SecoDam Total		**4**
Camp Far West (Extremely High Hazard Dam Outside the County)		
Essential Services Facilities	Port Facilities	4
	Water Well	1
	Total	**5**
At Risk Population Facilities	–	–
	Total	**0**
Hazardous Materials and Solid Waste Facilities	–	–
	Total	**0**
Camp Far West Dam Total		**5**
Oroville Dam (Extremely High Hazard Dam Outside the County)		
Essential Services Facilities	Bridge	7
	Cellular Tower	2
	Emergency Evacuation Center	2
	EMS Stations	1
	Fire Station	1
	Microwave Service Towers	14
	Port Facilities	23
	Water Well	3
	Total	**79**
At Risk Population Facilities	Mobile Home Park	4
	Places of Worship	1
	Total	**5**
Hazardous Materials and Solid Waste Facilities	Leaky Underground Storage Tank	2
	Solid Waste Facility Total	1
	Total	**3**
Oroville Dam Total		**87**
Cameron Park (High Hazard Dam Outside the County)		
Essential Services Facilities	Water Well	2
	Total	**2**
At Risk Population Facilities	–	–

Dam Inundation Areas/Critical Facility Category	Critical Facility Type	Facility Count
	Total	**0**
Hazardous Materials and Solid Waste Facilities	–	–
	Total	**0**
Cameron Park Dam Dam Total		**2**
Jackson Creek Dam (High Hazard Dam Outside the County)		
Essential Services Facilities	Bridge	10
	Microwave Service Towers	3
	Port Facilities	2
	Power Plant	1
	Water Well	13
	Total	**29**
At Risk Population Facilities	–	–
	Total	**0**
Hazardous Materials and Solid Waste Facilities	–	–
	Total	**0**
Jackson Creek Dam Total		**29**
Shasta Dam (High Hazard Dam Outside the County)		
Essential Services Facilities	Port Facilities	3
	Total	**3**
At Risk Population Facilities	–	–
	Total	**0**
Hazardous Materials and Solid Waste Facilities	–	–
	Total	**0**
Shasta Dam Total		**40**
Folsom Dam 235,000 cfs Scenario		
Essential Services Facilities	Airport	1
	Bridge	5
	Emergency Evacuation Center	7
	EMS Stations	6
	FDIC Insured Banks	11
	Fire Station	8
	Law Enforcement	6
	Microwave Service Towers	108
	Power Plants	6
	Public Transit Stations	4
	Pump Stations	7
	Sewage Treatment Plan	1

Dam Inundation Areas/Critical Facility Category	Critical Facility Type	Facility Count
	State Government Building	2
	Water Well	126
	Total	**298**
At Risk Population Facilities	Colleges, Universities, and Professional Schools	8
	Day Care Center	26
	Mobile Home Park	10
	Places of Worship	80
	School	234
	Total	**158**
Hazardous Materials and Solid Waste Facilities	EPA ER FRP Facility	1
	EPA ER TRI Facility	5
	Leaky Underground Storage Tank	32
	Solid Waste Facility Total	1
	Total	**39**
Folsom Dam 235,000 cfs Scenario Total		**495**

Source: Sacramento County GIS, Cal OES, DSOD

Overall Community Impact

Dam failure floods and their impacts vary by location and severity of any given dam failure event and will likely only directly affect certain areas of the Sacramento County Planning Area during specific times. Based on the risk assessment, it is evident that dam failure floods have the potential for devastating life safety, property, environmental, and economic impacts to certain areas of the County. Impacts that are not always quantified, but can be anticipated in a large dam failure event, include:

- Injury and loss of life;
- Impacts to agricultural;
- Commercial and residential structural and property damage;
- Disruption of and damage to critical infrastructure and services;
- Health hazards associated with mold and mildew, contamination of drinking water, etc.;
- Damage to roads/bridges resulting in loss of mobility;
- Significant economic impact (jobs, sales, tax revenue) to 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.
- Impact on the overall mental health of the community.

Future Development

Although new growth and development corridors would fall in the area flooded by a dam failure, given the limited potential of total dam failure and the large area that a dam failure would affect, development in the dam inundation area will continue to occur.

GIS Analysis

In order to ascertain if future development areas fall in dam inundation areas, a GIS analysis was performed. Using GIS, the following methodology was used in determining parcel counts and values associated with future development in the unincorporated Sacramento County Planning Area. Sacramento County's 2020 Parcel/Assessor's data and data from the County planning department were used as the basis for the unincorporated County's inventory of parcels and acres of future development areas. Using the GIS parcel spatial file and the APNs, the seven future development projects were mapped, and overlayed on the Cal OES and DSOD dam inundation areas. This can be seen on Figure 4-50 for dam inundation areas from dams inside the County, Figure 4-51 for dam inundation areas from outside the County, Figure 4-52 for dam inundations from the Folsom Dam 235,000 cfs Scenario. Table 4-55 details the future development areas that fall in each dam inundation areas. Maps of future development and dam inundation areas in each City in the County are presented in their respective annexes to this Plan Update.

Figure 4-50 Sacramento County – Future Development in Dam Inundation Areas from Dams Inside the County

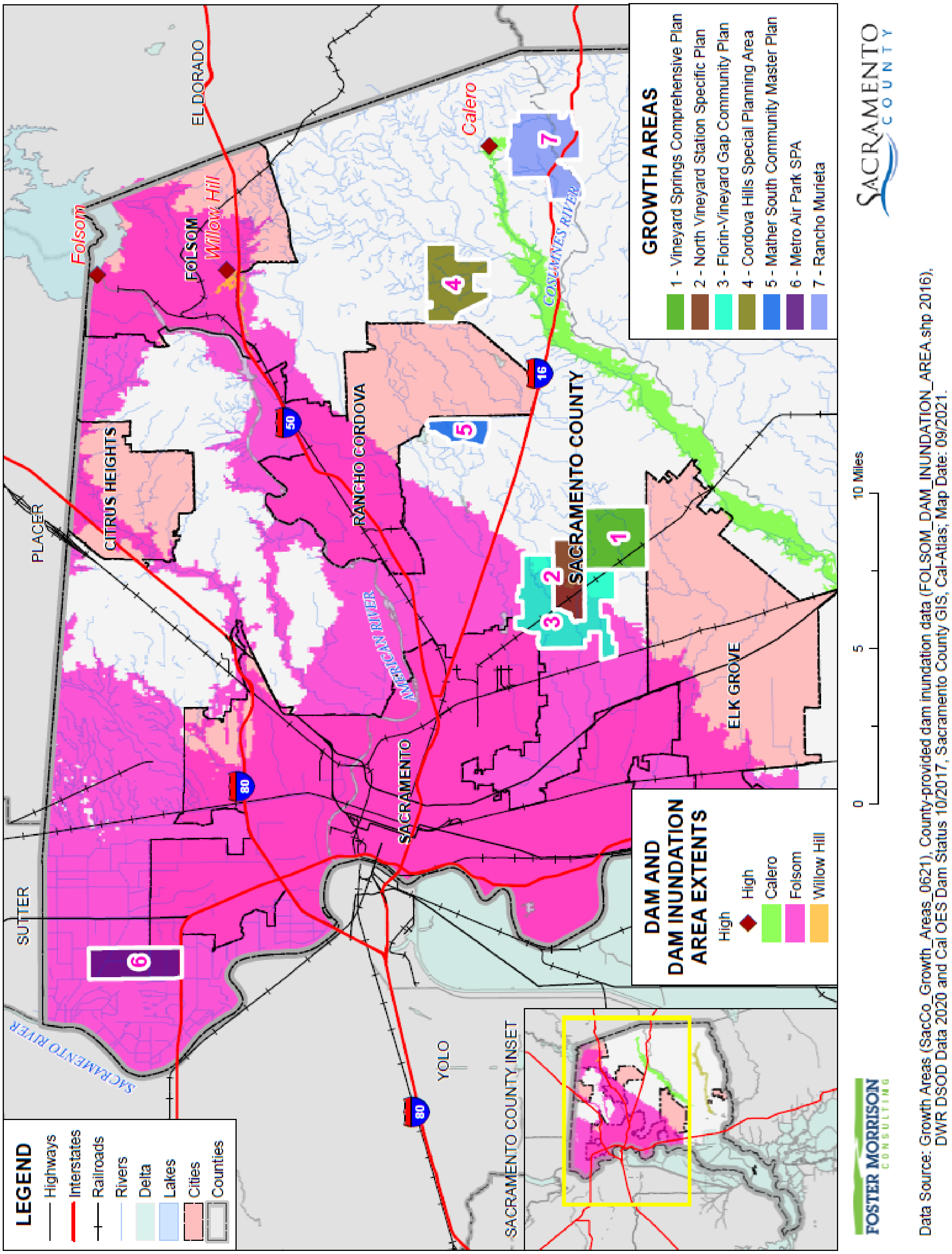


Figure 4-51 Sacramento County – Future Development in Dam Inundation Areas from Dams Outside the County

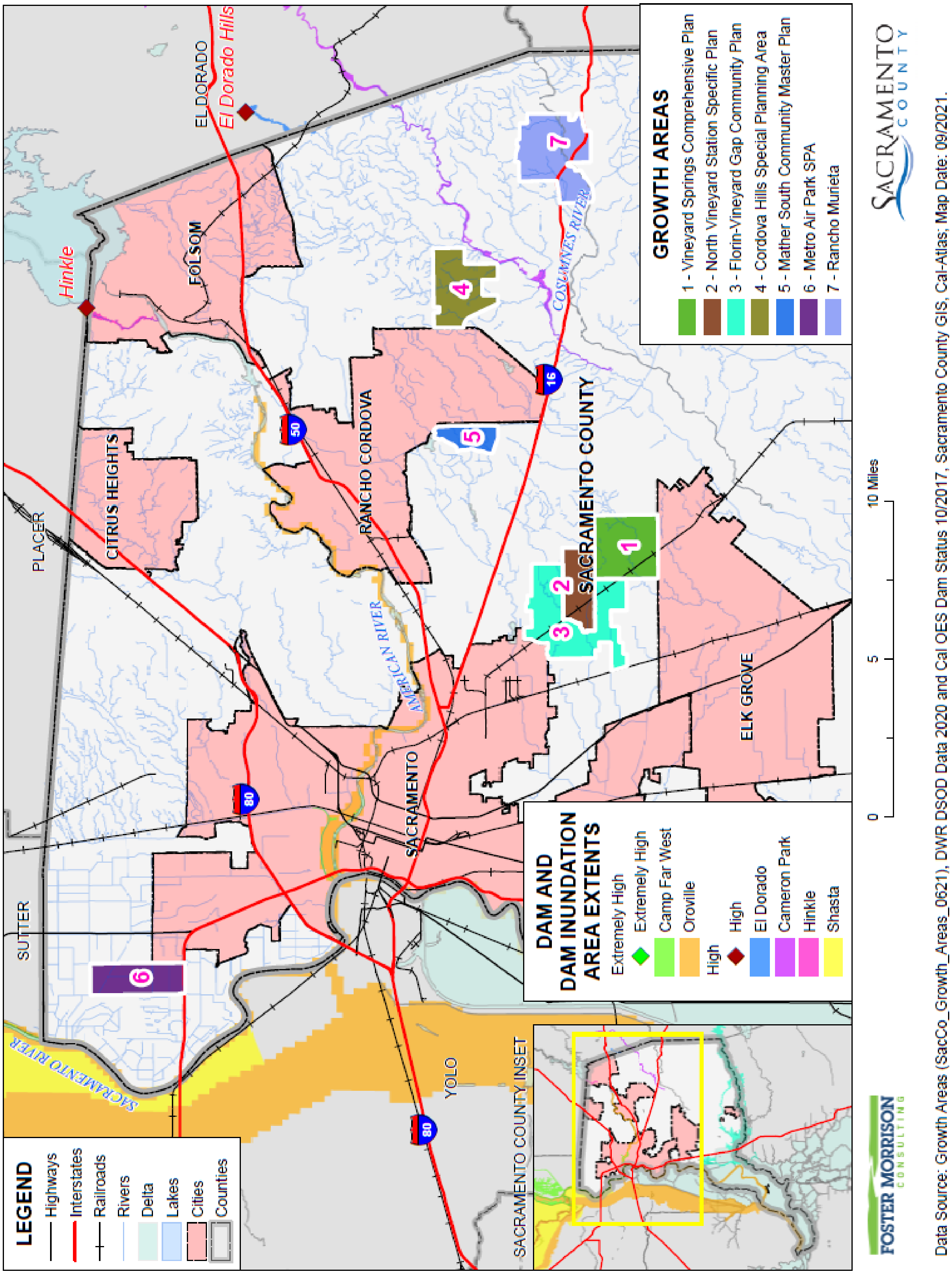


Figure 4-52 Sacramento County – Future Development in Folsom Dam 235,000 cfs Scenario Inundation Areas

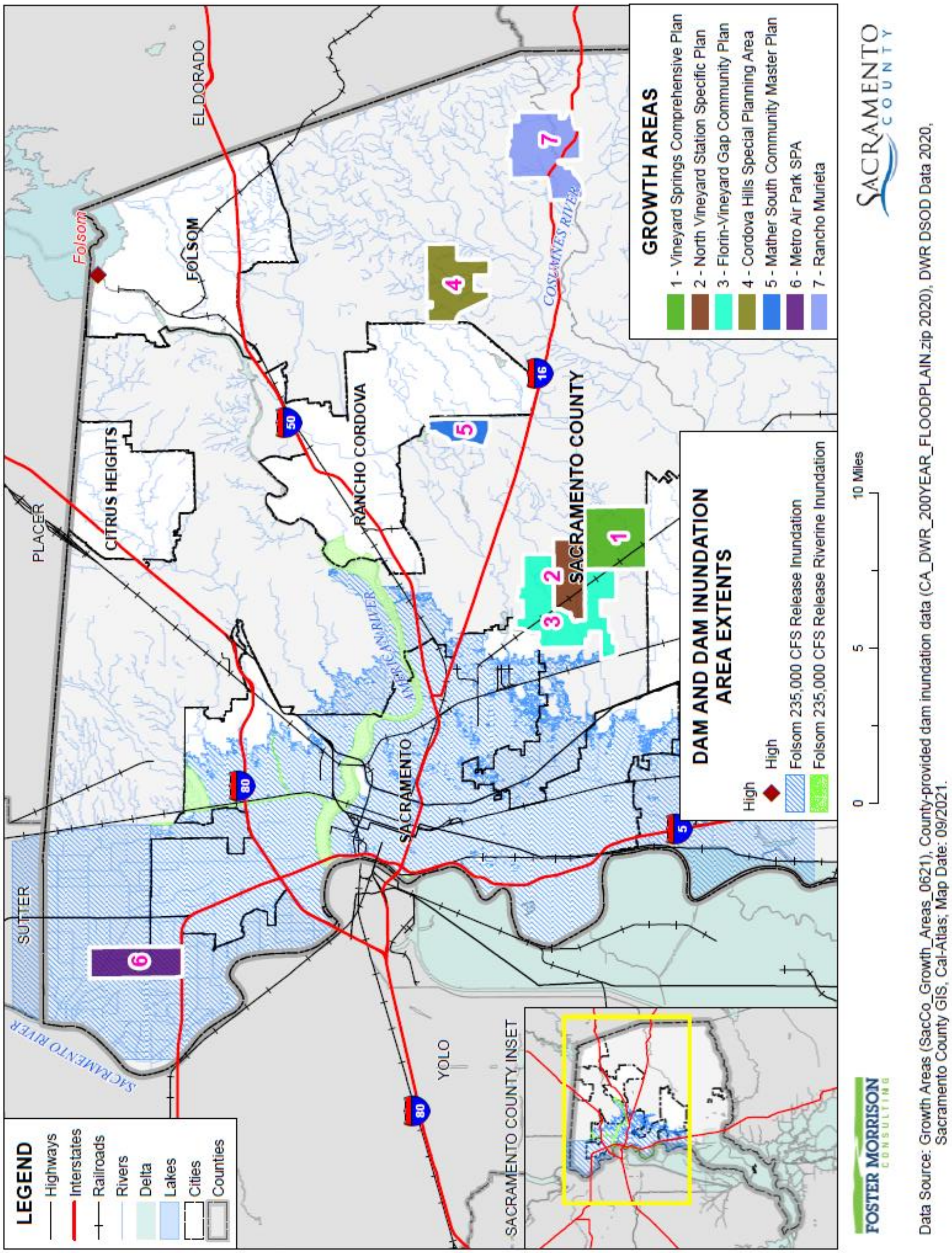


Table 4-55 Unincorporated Sacramento County – Future development Areas in Dam Inundation Areas

Future Development Area / Dam Inundation Area	Total Parcel Count	Improved Parcel Count	Total Acres
Folsom			
Florin-Vineyard Gap Community Plan	914	730	2,970
Metro Air Park SPA	74	4	1,807
North Vineyard Station Specific Plan	1,160	848	587
Folsom Total	**2,148**	**1,582**	**5,365**
Folsom 235,000 CFS Release Inundation			
Florin-Vineyard Gap Community Plan	3	1	28
Metro Air Park SPA	74	4	1,807
Folsom 235,000 CFS Release Inundation Total	**77**	**5**	**1,836**

Source: Sacramento County, Cal OES, DSOD

4.3.8. Drought and Water Shortage

Hazard Profile

This hazard profile contains multiple sections that detail how this hazard can affect Sacramento County. These sections include a hazard/problem description; description of location and extent; past occurrences of this hazard; and how climate change can affect this hazard.

Hazard/Problem Description

Drought

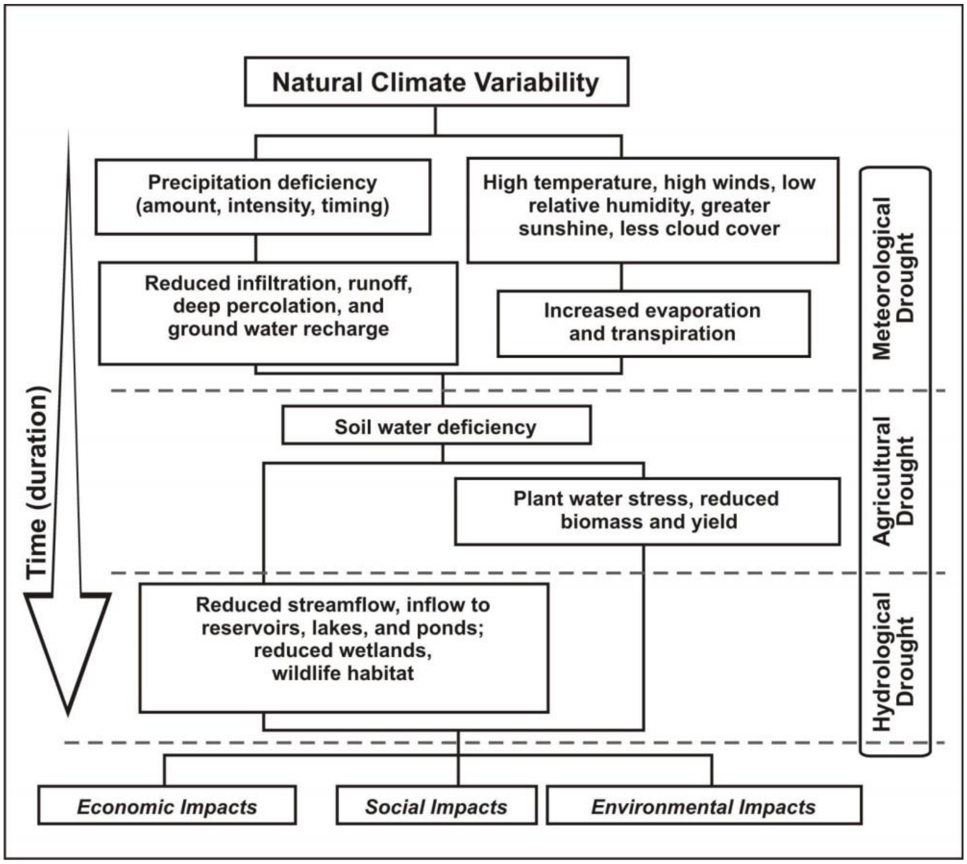
Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends. Water districts normally require at least a 10-year planning horizon to implement a multiagency improvement project to mitigate the effects of a drought and water supply shortage.

Drought is a complex issue involving (see Figure 4-53) many factors—it occurs when a normal amount of precipitation and snow 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 usually defined by a period of below average water supply.
- **Agricultural drought** occurs when there is an inadequate water supply to meet the needs of the state's crops and other agricultural operations such as livestock.
- **Hydrological drought** is defined as deficiencies in surface and subsurface water supplies. It is generally measured as streamflow, snowpack, and as lake, reservoir, and groundwater levels.

- **Socioeconomic drought** occurs when a drought impacts health, well-being, and quality of life, or when a drought starts to have an adverse economic impact on a region.

Figure 4-53 Causes and Impact of Drought

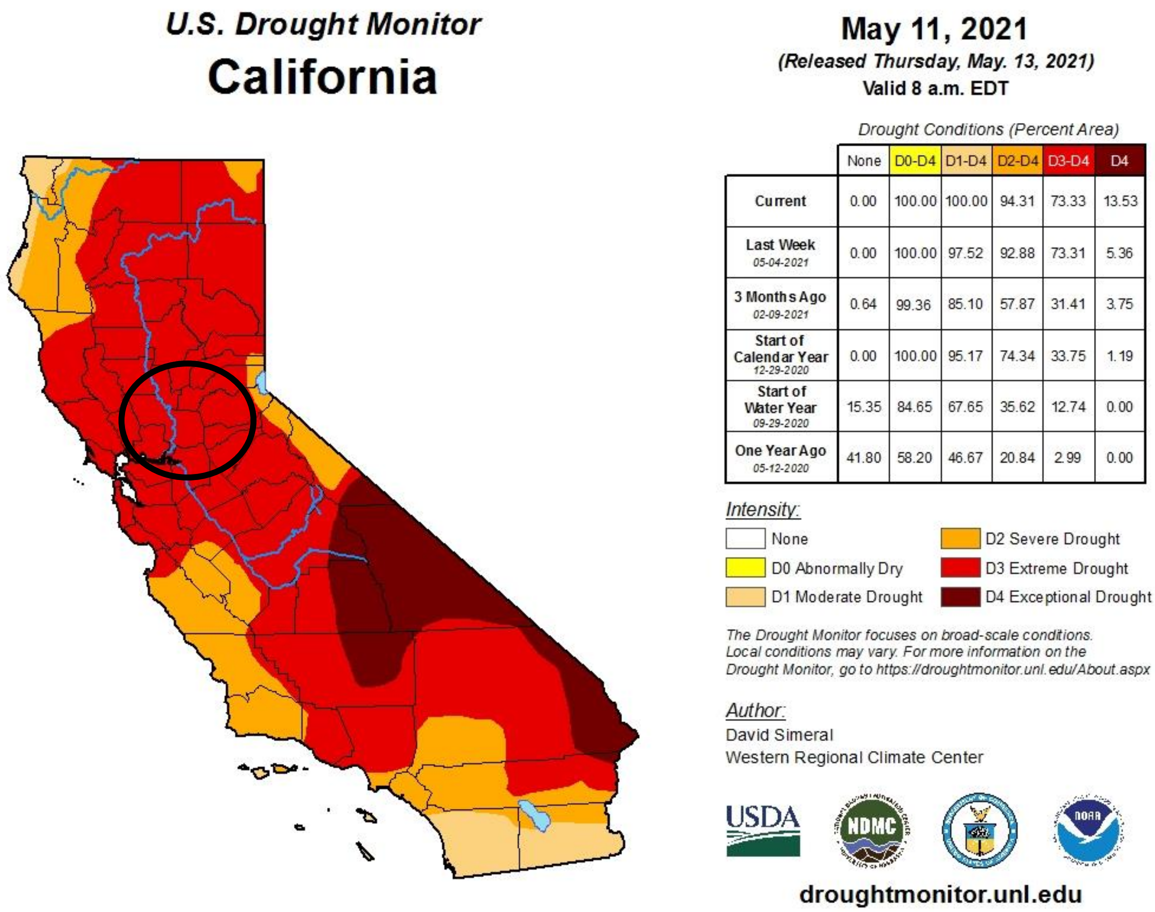


Source: National Drought Mitigation Center (NDMC)

Location and Extent

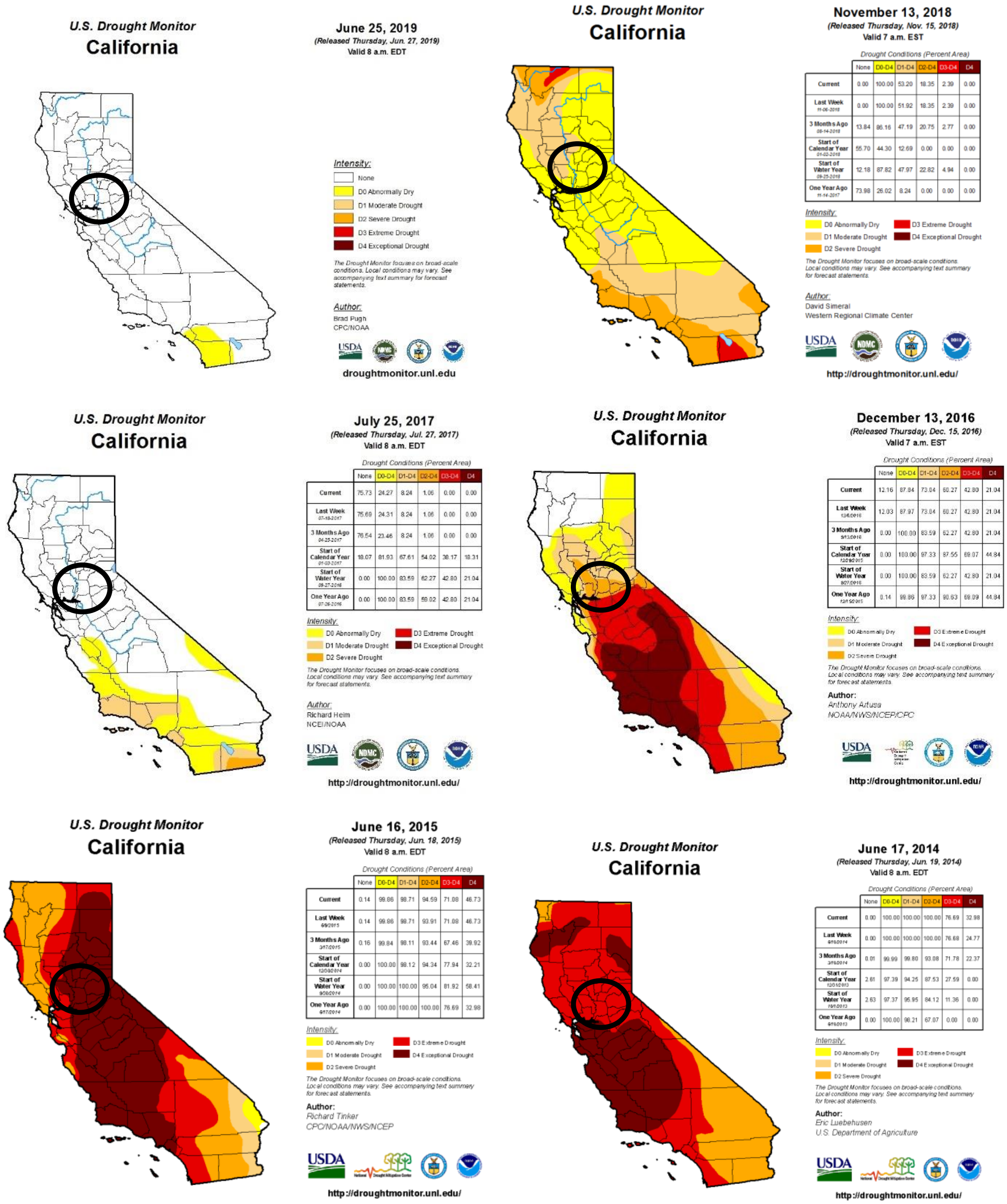
Since drought is a regional phenomenon, it affects the whole of the County. Speed of onset of drought is slow, while the duration varies from short (months) to long (years). Drought in the United States is monitored by the National Integrated Drought Information System (NIDIS). A major component of this portal is the U.S. Drought Monitor. The Drought Monitor concept was developed jointly by the NOAA's Climate Prediction Center, the NDMC, and the USDA's Joint Agricultural Weather Facility in the late 1990s as a process that synthesizes multiple indices, outlooks and local impacts, into an assessment that best represents current drought conditions. The final outcome of each Drought Monitor is a consensus of federal, state, and academic scientists who are intimately familiar with the conditions in their respective regions. A snapshot of the drought conditions in California and Sacramento County (2020) can be found in Figure 4-54. Snapshots from 2014 through 2019, when California's most recent multi-year drought started, is shown in Figure 4-55.

Figure 4-54 Sacramento County – Current Drought Status



Source: US Drought Monitor

Figure 4-55 Previous Drought Status in Sacramento County



Source: US Drought Monitor

CA DWR says the following about drought:

> ***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 contributes to this issue.

As shown on the previous figures, drought is tracked by the US Drought Monitor. The Drought Monitor includes a scale to measure drought intensity:

- None
- D0 (Abnormally Dry)
- D1 (Moderate Drought)
- D2 (Severe Drought)
- D3 (Extreme Drought)
- D4 (Exceptional Drought)

Water Shortage

Sacramento County relies on a combination of surface and groundwater for their water supply. Snowmelt originating from the Sierra Nevada Mountains is a key source of surface water for the Sacramento Planning Area. The Sacramento, American, Consumnes, and Mokelumne rivers provide municipal, agricultural, and recreational uses to Sacramento County and depend on the spring and summer snowmelt in the Sierra Nevada for their flows. The network of dams constructed in Northern California to support the State Water Project and the Central Valley Project help provide California and Sacramento with water security during droughts. Sacramento County also sits over the north central portion of the California's Great Valley Groundwater Basin, which provides approximately 50 percent of all municipal and agricultural water supply in the County. Groundwater recharge occurs primarily from the American and Cosumnes rivers, with additional recharge from the Sacramento River and local streams. Groundwater stores are directly linked to surface water in the County and snowmelt in the Sierra Nevada.

Thus, Sacramento County, generally has sufficient groundwater and surface water supplies to mitigate even the severest droughts of the past century. Many other areas of the State, however, also place demands on these water resources during severe drought. For example, Northern California agencies, including those from Sacramento County, were major participants in the Governor's Drought Water Bank of 1991, 1992 and 1994.

Location and Extent

Since water shortage happens on a regional scale, the entirety of the County is at risk. There is no established scientific scale to measure water shortage. The speed of onset of water shortage tends to be lengthy. The duration of water shortage can vary, depending on the severity of the drought that accompanies it.

Past Occurrences

Disaster Declaration History

There has been one federal disaster related to drought and water shortage in Sacramento County issued in 1977. There have been two state disasters related to drought and water shortage in Sacramento County issued in 2008 and 2014. This can be seen in Table 4-56.

Table 4-56 Sacramento County – Disaster Declarations from Drought 1950-2020

Disaster Type	State Declarations		Federal Declarations	
	Count	Years	Count	Years
Drought	3	2008, 2014, 2021	1	1977

Source: FEMA, Cal OES

NCDC Events

There have been 32 NCDC drought events in Sacramento County, related to events in the 2014 to 2016 drought. No deaths, injuries, or property damages were reported to the NCDC from these events.

*Table 4-57 NCDC Drought Events for Sacramento County 1996–5/31/2020**

Event Type	Number of Events	Deaths	Deaths (indirect)	Injuries	Injuries (indirect)	Property Damage	Crop Damage
Drought	32	0	0	0	0	$0	$0

Source: NCDC

*Note: Losses reflect totals for all impacted areas, some of which fell outside of Sacramento County

CA DWR and Hazard Mitigation Planning Committee Events

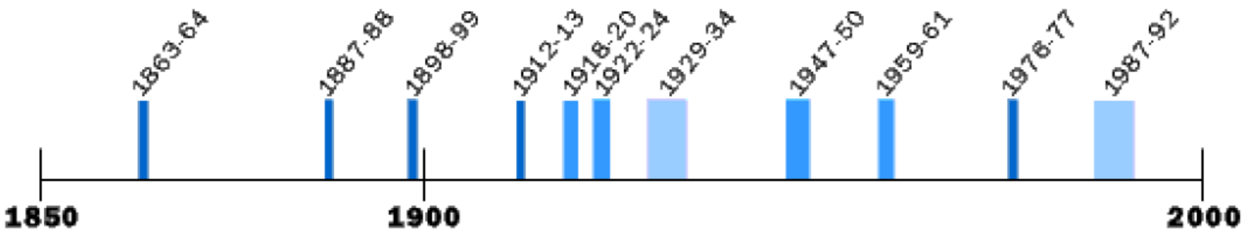
Historically, California has experienced multiple severe droughts. According to the CA DWR, droughts exceeding three years are relatively rare in Northern California, the source of much of the State's developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large northern California reservoirs. Table 4-58 compares the 1929-34 drought in the Sacramento and San Joaquin Valleys to the 1976-77, 1987-92, and 2007-09 droughts. Figure 4-56 depicts California's Multi-Year Historical Dry Periods, 1850-2000.

Table 4-58 Severity of Extreme Droughts in the Sacramento and San Joaquin Valleys

Drought Period	Sacramento Valley Runoff		San Joaquin Valley Runoff	
	(maf*/yr)	(percent Average 1901-96)	(maf*/yr)	(percent 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
2007-09	11.2	64	3.7	61

Source: California's Drought of 2007-2009, An Overview. State of California Natural Resources Agency, California Department of Water Resources.
*maf=million acre feet

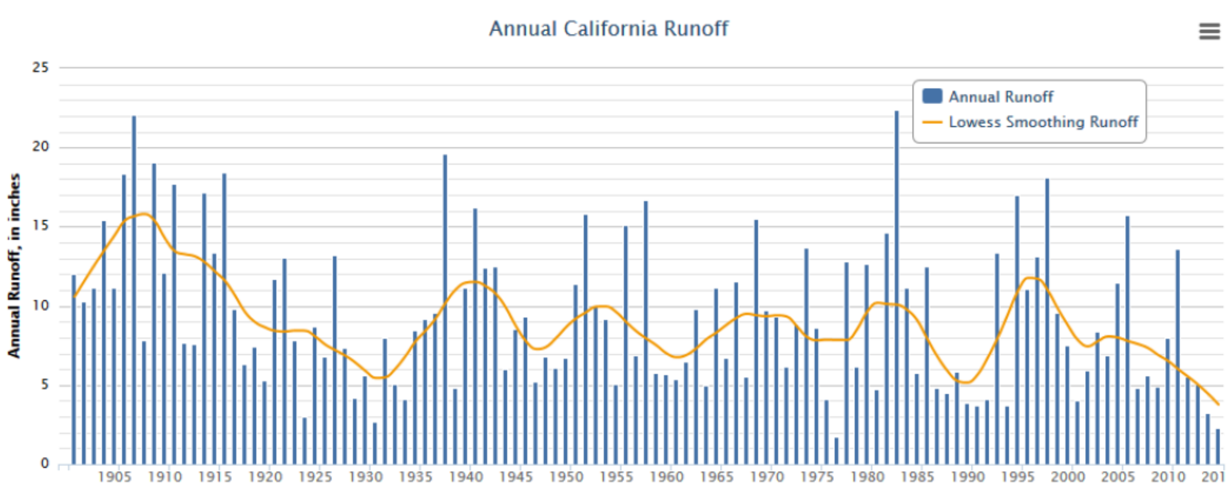
Figure 4-56 California's Multi-Year Historical Dry Periods, 1850-2000



Source: California Department of Water Resources, www.water.ca.gov/
Notes: Dry periods prior to 1900 estimated from limited data; covers dry periods of statewide or major regional extent

Figure 4-57 depicts runoff for the State from 1900 to 2015. This gives a historical context for the 2014-2015 drought to compare against past droughts.

Figure 4-57 Annual California Runoff –1900 to 2015



Source: California DWR

The 2018 California State Hazard Mitigation Plan fleshed out the major droughts from 1900 to 2017. This discussion below appends to the tables and figures above.

The 1975-1977 Drought

From November 1975 through November 1977, California experienced one of its most severe droughts. Although people in many areas of the state are accustomed to very little precipitation during the growing season (April to October), they expect it in the winter. In 1976 and 1977, the winters brought only one-half and one-third of normal precipitation, respectively. Most surface storage reservoirs were substantially drained in 1976, leading to widespread water shortages when 1977 turned out to be even drier. 31 counties were affected, resulting in $2.67 billion in crop damages.

The 1987-1992 Drought

From 1987 to 1992, California again experienced a serious drought due to low precipitation and run-off levels. The hardest-hit region was the Central Coast, roughly from San Jose to Ventura. In 1988, 45 California counties experienced water shortages that adversely affected about 30 percent of the state's population, much of the dry-farmed agriculture, and over 40 percent of the irrigated agriculture. Fish and wildlife resources suffered, recreational use of lakes and rivers decreased, forestry losses and fires increased, and hydroelectric power production decreased. In February 1991, DWR and Cal OES surveyed drought conditions in all 58 California counties and found five main problems: extremely dry rangeland, irrigated agriculture with severe surface water shortages and falling groundwater levels, widespread rural areas where individual and community supplies were going dry, urban area water rationing at 25 to 50 percent of normal usage, and environmental impacts.

Storage in major reservoirs had dropped to 54 percent of average, the lowest since 1977. The shortages led to stringent water rationing and severe cutbacks in agricultural production, including threats to survival of permanent crops such as trees and vines. Fish and wildlife resources were in critical shape as well. Not since the 1928-1934 drought had there been such a prolonged dry period. In response to those conditions, the Governor established the Drought Action Team. This team almost immediately created an emergency drought water bank to develop a supply for four critical needs: municipal and industrial uses, agricultural uses, protection of fish and wildlife, and carryover storage for 1992. The large-scale transfer program, which involved over 800,000 acre-feet of water, was implemented in less than 100 days with the help and commitment of the entire water community and established important links between state agencies, local water interests, and local governments for future programs.

The 2007-2009 Drought

Water years 2007-2009 were collectively the 15th driest three-year period for DWR's eight-station precipitation index, which is a rough indicator of potential water supply availability to the State Water Project (SWP) and Central Valley Project (CVP). Water year 2007 was the driest single year of that drought, and fell within the top 20 percent of dry years based on computed statewide runoff. In June 2008, a state emergency proclamation was issued due to water shortage in selected Central Valley counties. In February 2009, for the first time in its history, the State of California proclaimed a statewide drought. The state placed unprecedented restrictions on CVP and SWP diversions from the Delta to protect listed fish species, a regulatory circumstance that exacerbated the impacts of the drought for water users.

The greatest impacts of the 2007–2009 drought were observed in the CVP service area on the west side of the San Joaquin Valley, where hydrologic conditions combined with reduced CVP exports resulted in substantially reduced water supplies (50 percent supplies in 2007, 40 percent in 2008, and 10 percent in 2009) for CVP south-of Delta agricultural contractors. Small communities on the west side highly dependent on agricultural employment were especially affected by land fallowing due to lack of irrigation supplies, as well as by factors associated with current economic recession. The coupling of the drought and economic recession necessitated emergency response actions related to social services, such as food banks and unemployment assistance.

The 2012-2017 Drought

The statewide drought of 2012-2017 will be remembered as one of the most severe and costliest droughts of record in California. The drought that spanned water years 2012 through 2017 included the driest four-year statewide precipitation on record (2012-2015) and the smallest Sierra-Cascades snowpack on record (2015, with 5 percent of average). It was marked by extraordinary heat: 2014, 2015, and 2016 were California's first, second, and third warmest years in terms of statewide average temperatures. By the time the drought was declared officially over in April 2017, the state had expended $6.6 billion in drought response and mitigation programs, and had been declared a federal disaster area. The immediate cause of California's 2014 drought can be traced to the altered route of atmospheric water vapor, which is necessary for strong winter precipitation in the state. Ordinarily, water evaporates from the ocean in the warm Tropical Pacific Ocean and winds carry that water vapor to the U.S. west coast. However, in 2014 the water vapor transport split into two branches and ended up going either north or south of California.

In Sacramento County, it was noted that the following issues were experienced in past drought events:

- **2011 through 2017.** Significant crop loss and loss of jobs related to agriculture.
- Construction of a $40 million temporary barrier at West False River in the Sac-San Joaquin Delta was installed to keep salt water from contaminating drinking water to Bay Area residents.
- **2014** – On January 17, 2014 the governor declared a State of Emergency for drought throughout California. This declaration came on the heels of a report that stated that California had the least amount of rainfall in its 163-year history. Californians were asked to voluntarily reduce their water consumption by 20 percent. Drought conditions worsened through 2014 and into 2015. On April 1, 2015, following the lowest snowpack ever recorded, Governor Brown announced actions that will save water, increase enforcement to prevent wasteful water use, streamline the State's drought response, and invest in new technologies that will make California more drought resilient. The Governor directed the State Water Resources Control Board to implement mandatory water reductions in cities and towns across California to reduce water usage by 25 percent. This savings amounts to approximately 1.5 million acre-feet of water through the end of 2015.
- **2015 –** An extremely dry March followed a below normal February for most areas. By the end of March, the snowpack was only about 5 percent of normal levels. Melting snowpack supplies about a third of the annual water supply for California. Reservoirs across the area by the end of March were already well below normal levels. By the end of April, the snowpack was only about 4 percent of normal levels. As a result, reservoirs across the area by the end of April remained well below normal levels with little or no spring rise, due to the lack of snow melt. In June, as a result of continuing drought, emergency legislation appropriated over $1 billion in additional funds for drought related projects". The long-term drought continued through August with little change. Without a snowpack

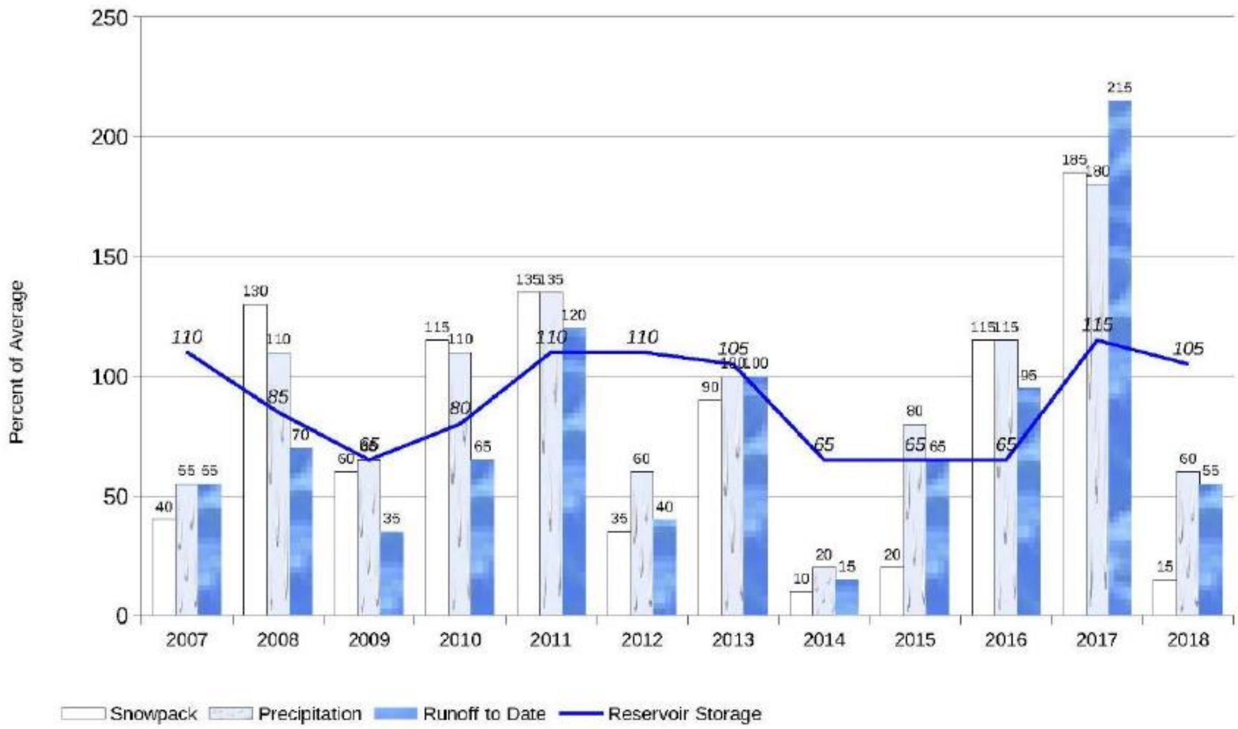
for late spring/early summer, reservoirs across the area by the end of the month were continuing to drop well below normal levels. All major reservoirs across the state were less than 40% of capacity by the end of the month. Folsom Lake was down to 20% of capacity, approaching near-record low levels for August, seen last in 1977. A UC Davis Center for Watershed Sciences report – (due to drought) showed statewide drought impact in 2015 at $2.7 Billion and loss of more than 21,000 jobs. Approx. 743,642 boxes of food distributed to 300k households that suffered unemployment from the drought. The long-term drought continued through September with little change. Folsom Lake was down to 18% of capacity, approaching near-record low levels for September, seen last in 1977. By November, Folsom Lake was down to 14% of capacity, breaking the all-time record low set in 1977. Lake Oroville came close to a record low, but did not reach it.

- **2021** – Prolonged droughts affected the County. The County was affected by shrinking reservoirs of water. Lake Oroville — the state's second-largest reservoir — is on the Feather River, which feeds into the Sacramento River and delivers water to Sacramento residents. Meanwhile, Folsom Lake, which feeds the Lower American River and is another one of the city's primary surface water reservoirs, is also seeing tragically low water levels. The river is also a critical habitat for salmon and steelhead fish. The State Water Resources Control Board also sent out a notice last week about the lack of water availability to thousands of water rights holders in the Sacramento-San Joaquin region. The notice urged water users in the agriculture, municipal, recreation and environmental protection sectors to preserve the rapidly declining water supply to meet demands for the current and following year. The Sacramento City Council on Aug. 24 voted to declare a "Water Alert," which increases fines for wasting water, restricts car washing and asks residents to voluntarily reduce their water use by 15 percent – an increase from the 10-percent reduction already in place. A Water Alert is the second of six stages in the City's plan to reduce overall water usage during a water shortage.

Water Shortage

Figure 4-58 illustrates several indicators commonly used to evaluate water conditions in California. The percent of average values are determined by measurements made in each of the ten major hydrologic regions. The chart describes water conditions in California between 2007 and 2018. The chart illustrates the cyclical nature of weather patterns in California.

Figure 4-58 Water Supply Conditions, 2007 to 2018



Source: 2018 State of California Hazard Mitigation Plan

Beginning in 2012, snowpack levels in California dropped dramatically. 2015 estimates placed snowpack as 5 percent of normal levels. Snowpack measurements have been kept in California since 1950 and nothing in the historic record comes close to 2015's severely depleted level. The previous record for the lowest snowpack level in California, 25 percent of normal, was set both in 1976-77 and 2013-2014. In "normal" years, the snowpack supplies about 30 percent of California's water needs, according to the California Department of Water Resources. Snowpack levels began to increase in 2016, and in 2017 snowpack increased to the largest in 22 years, according to the State Department of Water Resources. In late 2017 and early 2018, drought conditions began to return to California but were dampened by periods of above average rainfall in the first part of 2019. Sacramento County has been in and out of drought conditions since 2019, with drought conditions returning in 2021.

Likelihood of Future Occurrence

Drought

Likely—Historical drought data for the Sacramento County Planning Area and region indicate there have been 5 significant droughts in the last 85 years. This equates to a drought every 17 years on average or a 5.9 percent chance of a drought in any given year. However, based on this data and given the multi-year length and cyclical nature of droughts, future drought occurrences in the Planning Area are likely.

Water Shortage

Occasional — Recent historical data for water shortage indicates that Sacramento County may at some time be at risk to both short and prolonged periods of water shortage. Based on this it is possible that water shortages will affect the County in the future during extreme drought conditions. Water supply has not been a significant issue in Sacramento County in years past due to the extensive surface and groundwater supplies in the region; the County's senior water rights; and their ability to maximize water resources through conjunctive use.

Climate Change and Drought and Water Shortage

Climate change and its effect on extreme heat in the County has been discussed utilizing four sources:

- 2021 Draft Climate Action Plan Update
- California Climate Adaptation Strategy (CAS) – 2014
- Public Policy Institute
- Cal-Adapt

2021 Draft Sacramento County CAP

Sacramento County is not located in an area where snow accumulates; however, major water districts and utilities in the County receive and depend on a substantial amount of water from watersheds that rely upon spring and early-summer snowmelt in the Sierra Nevada mountain range. The Sierra Nevada snowpack, which serves as a natural water supply reservoir for California during the dry months, is predicted to decline in area covered and water volume stored, as average temperatures rise and precipitation falls more frequently as rain instead of snow at mountain elevations. Further, increased temperatures will affect the timing of historical snowmelt such that the snowpack will typically melt earlier reducing late spring/summer flows.

Approximately 50 percent of Sacramento County is served by groundwater supplies. Changes in surface water flow will have a direct impact on groundwater recharge, including decreased periods of recharge when late spring/summer stream flows diminish. Further, groundwater usage is higher in periods of drought; therefore, groundwater supplies may be reduced during and after periods of limited surface water flows.

California (including Sacramento County) is prone to prolonged drought. The State experienced severe drought in 1973, 1976 through 1977, 1987 through 1991, 2007 through 2009, and 2012 through 2016. During the most recent severe drought period in June of 2015, statewide reservoir storage levels were between 18 and 67 percent of normal (State Water Resources Control Board [SWRCB] 2017). Climate change is expected to increase the number, duration, and severity of future droughts. Exacerbated drought conditions, early snowmelt, and reduced snowpack size, combined with increased demand as population and development increases, could result in water supply constraints in future years.

2014 CAS

Climate scientists studying California find that drought conditions are likely to become more frequent and persistent over the 21st century due to climate change. The experiences of California during recent years underscore the need to examine more closely the state's water storage, distribution, management, conservation, and use policies. The 2014 CAS stresses the need for public policy development addressing long term climate change impacts on water supplies. The CAS notes that climate change is likely to significantly diminish California's future water supply, stating that: California must change its water management and uses because climate change will likely create greater competition for limited water supplies needed by the environment, agriculture, and cities.

Public Policy Institute

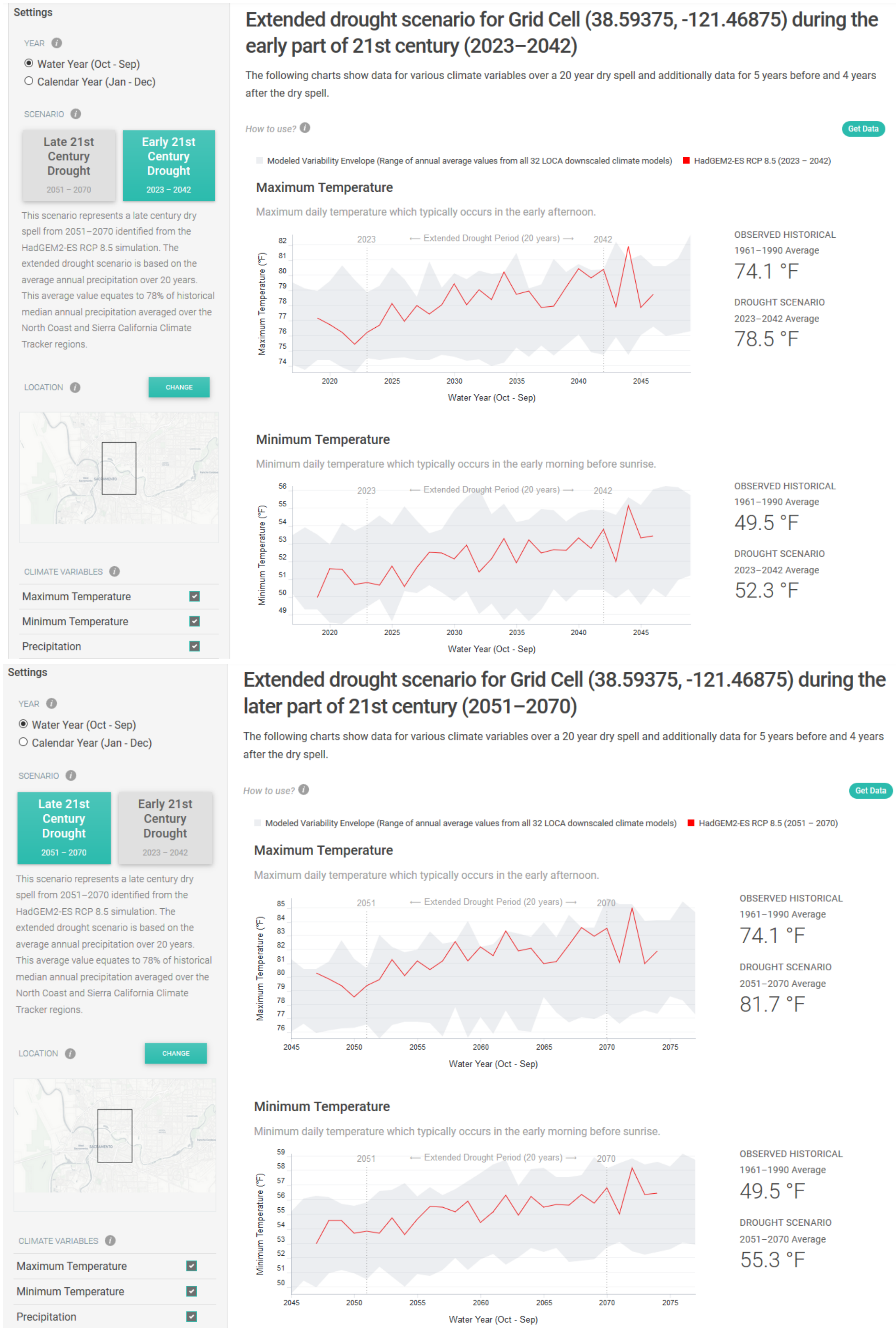
A report from the Public Policy Institute of California noted that thousands of Californians – mostly in rural, small, disadvantaged communities – already face acute water scarcity, contaminated groundwater, or complete water loss. Climate change would make these effects worse.

Cal-Adapt

Cal-Adapt has modeled future risk of drought. Recent research suggests that extended drought occurrence ("mega-drought") could become more pervasive in future decades. This tool explores data for two 20-year drought scenarios (using the quad that contains the City of Sacramento) derived from LOCA downscaled meteorological and hydrological simulations (Figure 4-59) – one for the earlier part of the 21st century, and one for the latter part:

- The upper chart represents a mid-century dry spell from 2023-2042 identified from the HadGEM2-ES RCP 8.5 simulation. The extended drought scenario is based on the average annual precipitation over 20 years. This average value equates to 78% of historical median annual precipitation averaged over the North Coast and Sierra California Climate Tracker regions.
- The lower chart represents a late century dry spell from 2051–2070 identified from the HadGEM2-ES RCP 8.5 simulation. The extended drought scenario is based on the average annual precipitation over 20 years. This average value equates to 78% of historical median annual precipitation averaged over the North Coast and Sierra California Climate Tracker regions.

Figure 4-59 Sacramento County – Future Extended Drought Scenarios



Source: Cal Adapt – Extended Drought Scenarios

Vulnerability Assessment

Vulnerability—Medium

Based on historical information, the occurrence of drought in California, including Sacramento County, is cyclical, driven by weather patterns. Drought has occurred in the past and will occur in the future. Periods of actual drought with adverse impacts can vary in duration, and the period between droughts is often extended. Although an area may be under an extended dry period, determining when it becomes a drought is based on impacts to individual water users.

Impacts

Drought is different than many of the other natural hazards in that it is not a distinct event and usually has a slow onset. Drought can severely impact a region both physically and economically. Drought affects different sectors in different ways and with varying intensities. Adequate water is the most critical issue for agricultural, manufacturing, tourism, recreation, and commercial and domestic use. As the population in the area continues to grow, so will the demand for water.

Tracking drought impacts can be difficult. The Drought Impact Reporter from the NDMC is a useful reference tool that compiles reported drought impacts nationwide. Table 4-59 show drought impacts for the Sacramento County Planning Area from 1850 to August 2020. The data represented is skewed, with the majority of these impacts from records within the past ten years.

Table 4-59 Sacramento County Drought Impacts

Category	Number of Impacts
Agriculture	416
Business and Industry	104
Energy	13
Fire	263
Plants & Wildlife	367
Relief, Response, and Restrictions	640
Society and Public Health	418
Tourism and Recreation	127
Water Supply and Quality	926

Source: National Drought Mitigation Center, 1/1/1850-11/1/2020

The most significant qualitative 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. Mandatory conservation measures are typically implemented during extended droughts. Drought conditions can also cause soil to compact and not absorb water well, potentially making an area more susceptible to flooding.

With a reduction in water, water supply issues based on water rights becomes more evident. Some agricultural uses are severely impacted through limited water supply, especially those with livestock. Drought and water supply issues will continue to be a concern to the Planning Area. The drawdown of the groundwater table is one factor that has been recognized to occur during repeated dry years. Lowering of groundwater levels results in the need to deepen wells, which subsequently lead to increased pumping costs. These costs are a major consideration for residents relying on domestic wells and agricultural producers that irrigate with groundwater and/or use it for frost protection. Land subsidence can also occur when the groundwater table is depleted.

Climate change may create additional impacts to drought and water shortage in the County. This was discussed in detail in Section 4.3.6. Drought can also increase the wildfire risk in the County. This is discussed in Section 4.3.18.

Future Development

Sacramento County, primarily through the Sacramento County Water Agency, has access to large quantities of water through surface water, groundwater, and recycled water. Population in the County in the future is expected to increase (see Table 4-18), which increases pressure on water companies during periods of drought and water shortage. Water companies will need to continue to plan for and add infrastructure capacity to replace aging systems and accommodate additional users.

4.3.9. Earthquake

Hazard Profile

This hazard profile contains multiple sections that detail how this hazard can affect Sacramento County. These sections include a hazard/problem description; description of location and extent; past occurrences of this hazard; and how climate change can affect this hazard.

Hazard/Problem Description

An earthquake is caused by a sudden slip on a fault. Stresses in the earth's outer layer push the sides of the fault together. Stress builds up, and the rocks slip suddenly, releasing energy in waves that travel through the earth's crust and cause the shaking that is felt during an earthquake. 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. Earthquakes may also cause collateral emergencies including dam and levee failures, seiches, hazmat incidents, fires, avalanches, and landslides. 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. This section briefly discusses issues related to types of seismic hazards.

Ground Shaking

Ground shaking is motion that occurs as a result of energy released during faulting. The damage or collapse of buildings and other structures caused by ground shaking is among the most serious seismic hazards. Damage to structures from this vibration, or ground shaking, is caused by the transmission of earthquake vibrations from the ground to the structure. The intensity of shaking and its potential impact on buildings is determined by the physical characteristics of the underlying soil and rock, building materials and workmanship, earthquake magnitude and location of epicenter, and the character and duration of ground motion.

Actual ground breakage generally affects only those buildings directly over or nearby the fault. Ground shaking generally has a much greater impact over a greater geographical area than ground breakage. The amount of breakage and shaking is a function of earthquake magnitude, type of bedrock, depth and type of soil, general topography, and groundwater.

Seismic Structural Safety

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 buildings [URM]) and soft story buildings 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 affect 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, which can occur in earthquakes with strong ground shaking, is mostly found in areas with sandy soil or fill and a high water table located 50 feet or less below the ground surface. Liquefaction can cause damage to property with the ground below structures liquefying making the structure unstable causing sinking or other major structural damage. Evidence of liquefaction may be observed in "sand boils," which are expulsions of sand and water from below the surface due to increased pressure below the surface.

Liquefaction during an earthquake requires strong shaking and is not likely to occur in most areas of the County due to the relatively low occurrence of seismic activity in the area. However, due to the damage liquefaction poses to the levees in Sacramento County, a separate, more detailed discussion of liquefaction can be found in Section 4.3.10.

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 due to ground shaking is not available.

Location and Extent

California is seismically active because it sits on the boundary between two of the earth's tectonic plates. Most of the state - everything east of the San Andreas Fault - is on the North American Plate. The cities of Monterey, Santa Barbara, Los Angeles, and San Diego are on the Pacific Plate, which is constantly moving northwest past the North American Plate. The relative rate of movement is about two inches per year. The San Andreas Fault is considered the boundary between the two plates, although some of the motion is taken up on faults as far away as central Utah.

Faults

A fault is defined as "a fracture or fracture zone in the earth's crust along which there has been displacement of the sides relative to one another." For the purpose of planning there are two types of faults, active and inactive. Active faults have experienced displacement in historic time, suggesting that future displacement may be expected. Inactive faults show no evidence of movement in recent geologic time, suggesting that these faults are dormant. 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.

Two types of fault movement represent possible hazards to structures in the immediate vicinity of the fault: fault creep and sudden fault displacement. Fault creep, a slow movement of one side of a fault relative to the other, can cause cracking and buckling of sidewalks and foundations even without perceptible ground shaking. Sudden fault displacement occurs during an earthquake event and may result in the collapse of buildings or other structures that are found along the fault zone when fault displacement exceeds an inch or two. The only protection against damage caused directly by fault displacement is to prohibit construction in the fault zone.

Geological literature indicates that no major active faults transect the County; however, there are several subsurface faults in the Delta. The Midland fault, buried under alluvium, extends north of Bethel Island in the Delta to the east of Lake Berryessa and is considered inactive but possibly capable of generating a near

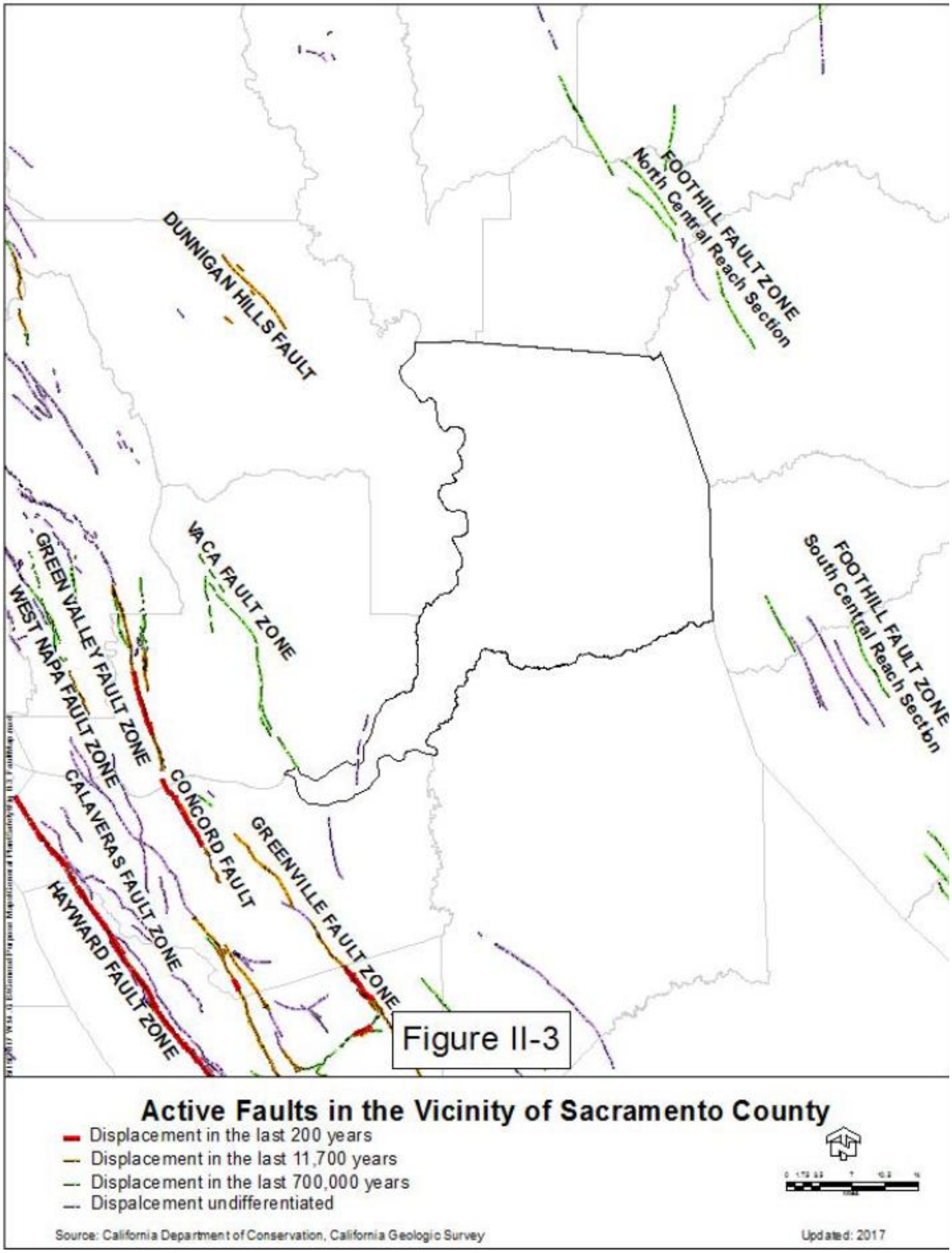
7.0 (Richter Scale) earthquake. This magnitude figure is speculative based on an 1895 earthquake measuring 6.9 on the Richter Scale with an epicenter possibly in the Midland Fault vicinity. However, oil and gas companies exploring the area's energy potential have identified several subsurface faults, none of which show any recent surface rupture. A second, presumably inactive, fault is in the vicinity of Citrus Heights near Antelope Road. This fault's only exposure is along a railroad cut where offsetting geologic beds can be seen. Neither the lateral extent of the trace, the magnitude of the offset, nor the age of faulting has been determined. To the east, the Bear Mountain fault zone trends northwest-southeast through Amador and El Dorado Counties. Geologists believe this series of faults has not been active in historic time. Potential earthquakes on the Hayward, Calaveras or San Andreas faults pose the highest risk to Delta Region levees. Table 4-60 and Figure 4-60 identify the faults in close proximity to Sacramento County.

Table 4-60 Historically Active Faults in the Vicinity of Sacramento County

Fault	Approximate Distance from Sacramento County Border (Miles)	Earthquake Date	Magnitude (Richter)
San Andreas	46	1906, 1989, 2014	7.8; 7.1, 6.0
Vaca	5	1892	6.6
Concord	12	1955	5.4
Greenville	17	1980	5.1
Hayward	26	1868	7.0
Calaveras	21	1861; 1979; 2007	5.8; 5.74; 5.44
Foothill Fault System	48	1975 (Oroville)	5.7
Las Positas	24	1980	5.4
Midland	0	1892	5.6
West Napa	22	2014	6.02

Source: Sacramento County General Plan Safety Element Background Report (2017)

Figure 4-60 Active Faults in and near Sacramento County



Source: Sacramento County General Plan Safety Element Background Report (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. An earthquake's magnitude is expressed in whole numbers and decimals (e.g., 6.8). 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 Richter 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 (see Table 4-61). Seismic shaking is typically the greatest cause of losses to structures during earthquakes.

Table 4-61 Modified Mercalli Intensity (MMI) Scale

MMI	Felt Intensity
I	Not felt except by a very few people under special conditions. Detected mostly by instruments.
II	Felt by a few people, especially those on upper floors of buildings. Suspended objects may swing.
III	Felt noticeably indoors. Standing automobiles may rock slightly.
IV	Felt by many people indoors; by a few outdoors. At night, some people are awakened. Dishes, windows, and doors rattle.
V	Felt by nearly everyone. Many people are awakened. Some dishes and windows are broken. Unstable objects are overturned.
VI	Felt by everyone. Many people become frightened and run outdoors. Some heavy furniture is moved. Some plaster falls.
VII	Most people are alarmed and run outside. Damage is negligible in buildings of good construction, considerable in buildings of poor construction.
VIII	Damage is slight in specially designed structures, considerable in ordinary buildings, and great in poorly built structures. Heavy furniture is overturned.
IX	Damage is considerable in specially designed buildings. Buildings shift from their foundations and partly collapse. Underground pipes are broken.
X	Some well-built wooden structures are destroyed. Most masonry structures are destroyed. The ground is badly cracked. Considerable landslides occur on steep slopes.
XI	Few, if any, masonry structures remain standing. Rails are bent. Broad fissures appear in the ground.
XII	Virtually total destruction. Waves are seen on the ground surface. Objects are thrown in the air.

Source: Multi-Hazard Identification and Risk Assessment, FEMA 1997

Other Hazards

Earthquakes can also cause landslides and dam failures. Earthquakes may cause landslides (discussed in Section 4.3.13), particularly during the wet season, in areas of high water or saturated soils. Finally, earthquakes can cause dams to fail (see Section 4.3.7 Dam Failure).

Past Occurrences

Disaster Declaration History

There have been no disaster declarations in the County related to earthquakes, as shown on Table 4-4.

NCDC Events

Earthquake events are not tracked by the NCDC database.

USGS Events

The USGS National Earthquake Information Center database contains data on earthquakes in the Sacramento County area. Table 4-62 shows the approximate distances earthquakes can be felt away from the epicenter. According to the USGS data, a magnitude 5.0 earthquake could be felt up to 90 miles away. The USGS database was searched for magnitude 5.0 or greater on the Richter Scale within 90 miles of the City of Sacramento in Sacramento County. There are 40 results that are detailed in Table 4-63.

Table 4-62 Approximate Relationships between Earthquake Magnitude and Intensity

Richter Scale Magnitude	Maximum Expected Intensity*	Distance Felt (miles)
2.0 - 2.9	I – II	0
3.0 - 3.9	II – III	10
4.0 - 4.9	IV – V	50
5.0 - 5.9	VI – VII	90
6.0 - 6.9	VII – VIII	135
7.0 - 7.9	IX – X	240
8.0 - 8.9	XI – XII	365

*Modified Mercalli Intensity Scale.

Source: United State Geologic Survey, Earthquake Intensity Zonation and Quaternary Deposits, Miscellaneous Field Studies Map 9093, 1977.

*Table 4-63 Magnitude 5.0 Earthquakes or greater within 90 Miles of Sacramento County**

Date	Richter Magnitude	Location
12/14/2016	5.01	8km NW of The Geysers, California
8/10/2016	5.09	20km NNE of Upper Lake, California
8/24/2014	6.02	South Napa
10/31/2007	5.45	San Francisco Bay area, California
6/13/1988	5.3	San Francisco Bay area, California
3/31/1986	5.7	Northern California
4/24/1984	6.2	Northern California
11/28/1980	5.1	Northern California
1/27/1980	5.4	San Francisco Bay area, California
1/24/1980	5.1	San Francisco Bay area, California
1/24/1980	5.8	San Francisco Bay area, California
8/2/1975	5.2	Northern California
8/2/1975	5.1	Northern California
8/1/1975	5.7	0km WSW of Palermo, California

Date	Richter Magnitude	Location
10/2/1969	5.1	Northern California
4/29/1968	5	Northern California
9/12/1966	5.91	Northern California
3/22/1957	5.3	San Francisco Bay area, California
10/24/1955	5.4	San Francisco Bay area, California
9/5/1955	5.5	San Francisco Bay area, California
3/22/1953	5	Northern California
3/30/1943	5.3	Northern California
12/17/1942	5.1	Northern California
7/1/1911	6.6	San Francisco Bay area, California
6/23/1909	5.7	Northern California
3/3/1909	5	Northern California
4/18/1906	7.9	The 1906 San Francisco Earthquake
8/3/1903	5.8	San Francisco Bay area, California
6/11/1903	5.8	San Francisco Bay area, California
5/19/1902	5.4	Northern California
06/02/1899	5.4	San Francisco Bay area, California
03/31/1898	6.2	San Francisco Bay area, California
08/09/1893	5.1	Northern California
04/30/1892	5.5	Northern California
04/21/1892	6.2	Northern California
04/19/1892	6.4	Northern California
10/12/1891	5.5	Northern California
01/02/1891	5.5	San Francisco Bay area, California
07/31/1889	5.2	San Francisco Bay area, California
05/19/1889	6	San Francisco Bay area, California
04/29/1888	5.9	Northern California
04/10/1881	6.3	Southwest of Modesto, California
07/10/1877	5.5	Lake Tahoe area, California-Nevada border
04/02/1870	5.8	Near Berkeley, California
10/21/1868	6.8	The 1868 Hayward Fault Earthquake, California
07/15/1866	6	Southwest of Stockton, California
05/21/1864	5.8	Alameda County, California
03/05/1864	6.1	Alameda County, California
07/04/1861	5.8	San Francisco Bay area, California
11/26/1858	6.1	San Francisco Bay area, California
02/15/1856	5.5	San Mateo County, California
01/02/1856	5.3	San Mateo County, California
01/25/1855	5.5	Sierra County, California

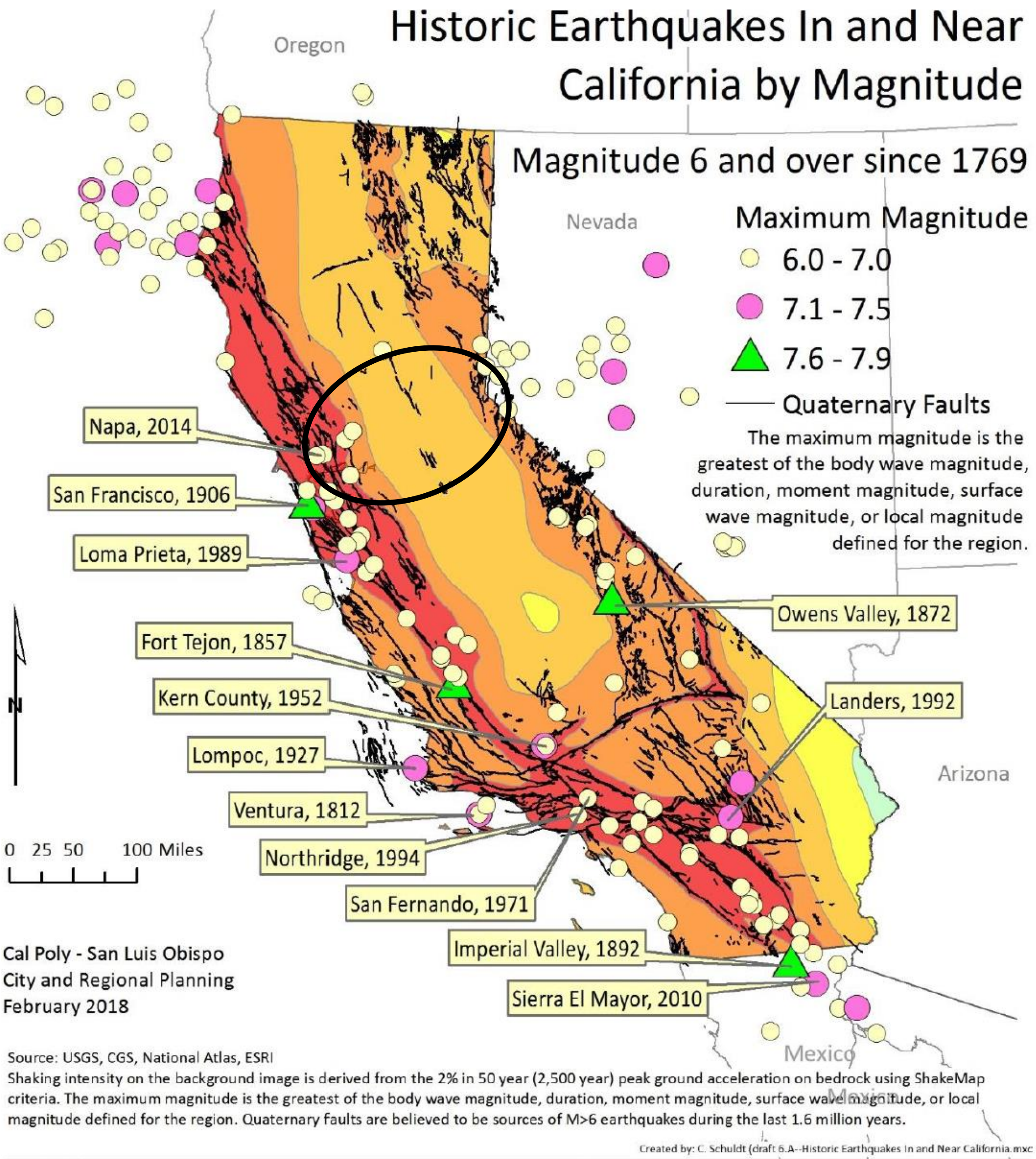
Date	Richter Magnitude	Location
05/15/1851	5	San Francisco Bay area, California

Source: USGS

*Search dates 1/1/1850 – 11/1/2020

Figure 4-61 shows major historical earthquakes in California from 1769 to 2017.

Figure 4-61 Historic Earthquakes in California 1769 to 2017



	MMI	Damage	Effects
	X	Very Heavy	Some well-built, wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
	IX	Heavy	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
	VIII	Moderate to Heavy	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
	VII	Moderate	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly-built or badly designed structures; some chimneys broken.
	VI	Light	Felt by all, many frightened. Some heavy furniture moved; a few instance of fallen plaster. Damage slight.
	V	Very Light	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.

Source: 2018 State of California Multi-Hazard Mitigation Plan

Hazard Mitigation Planning Committee Events

Historically, major earthquakes have not been an issue for Sacramento County. However, minor earthquakes have occurred in or near the County in the past. The HMPC has identified several earthquakes that were felt by area residents and/or caused damaging shaking in the County. Details on some of these events follow.

- The greatest amount of ground shaking experienced in the County occurred on **April 21, 1892**, when an earthquake shook Yolo County between Winters and Vacaville. While the damage in Yolo County was severe, the damage in Sacramento County was substantially less. Damage to buildings in Sacramento was limited to statuary falling from building tops and cracks in chimneys.
- The **1906** San Francisco earthquake generated little shaking in Sacramento County and damage locally was limited to minor cracks in a local post office and jail.
- A **December 16, 1954** earthquake near Fairview Peak, Nevada measured 7.1 on the Richter Scale. The earthquake caused some damage in Sacramento, while virtually no damage occurred in Reno, Nevada.
- On **August 1, 1975**, a moderate earthquake (magnitude 5.7) occurred near Oroville on the Cleveland Hills fault. This earthquake was felt in Sacramento County, although no direct damage was reported.
- Sacramento County suffered little damage from the **October 17, 1989** Loma Prieta earthquake, which was felt over an area covering 400,000 square miles from Los Angeles to the California-Oregon border. The earthquake measured 7.1 on the Richter Scale; the epicenter was located along the San Andreas fault beneath the Santa Cruz Mountains, about 60 miles southeast of San Francisco. In contrast to Sacramento County, the San Francisco Bay region suffered over $6 billion in property damage and 62 lives were lost. The Loma Prieta earthquake resulted in a federal disaster declaration (DR-845) for the area around San Francisco, including Sacramento County.
- **2014 Napa Earthquake** – A magnitude 6.0 earthquake occurred 51.1 miles west/southwest of the City of Sacramento. Damage estimates in the County were negligible. No damage was observed on the Delta levees.
- **July 9, 2021** – Two earthquakes struck near Sacramento County. A 6.0 magnitude earthquake with an epicenter in Antelope Valley, Ca and a 5.2 magnitude with an epicenter near Walker, Ca both caused shaking in Sacramento County. Residents noted felt effects in areas throughout the County.

Likelihood of Future Occurrence

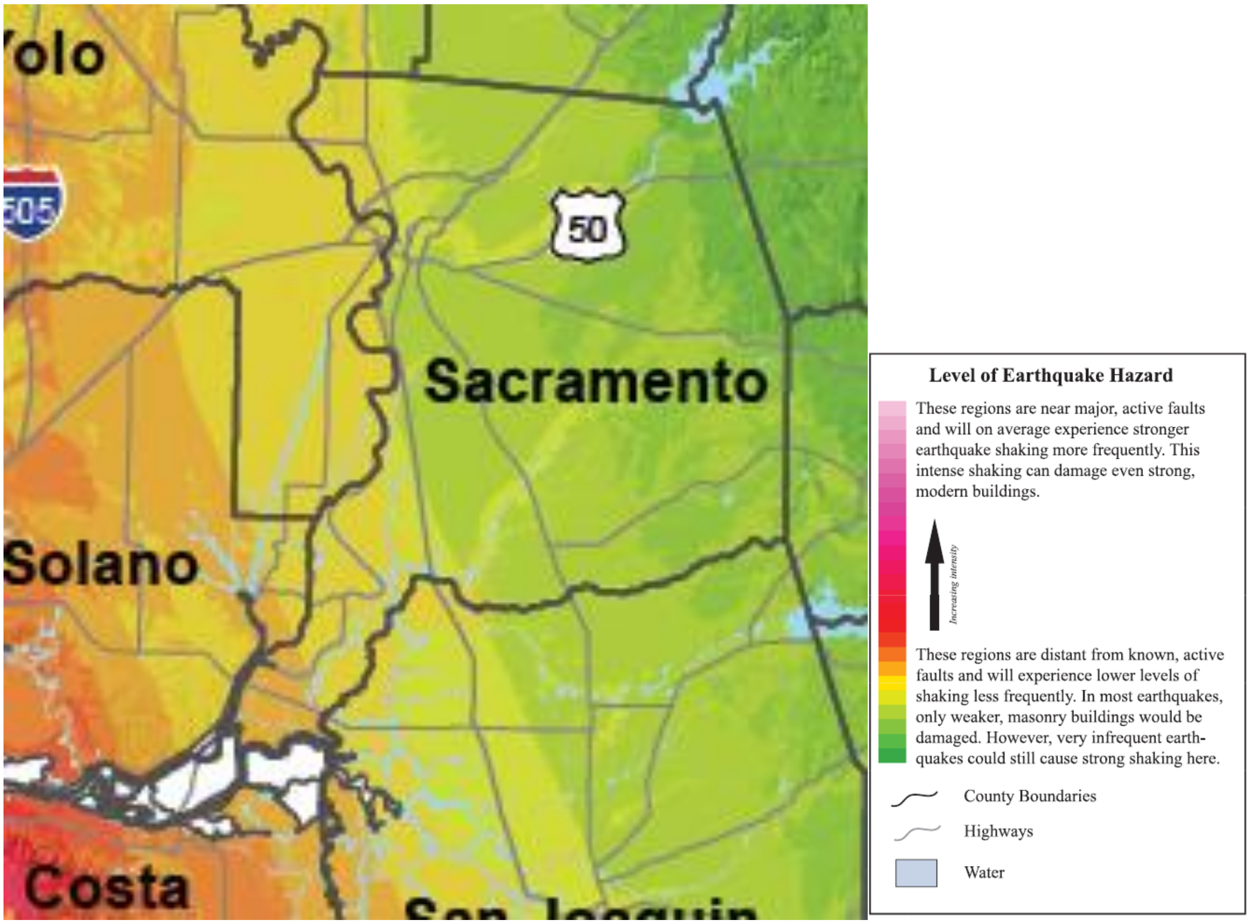
Occasional—No major earthquakes have been recorded within the County; although the County has felt ground shaking from earthquakes with epicenters located elsewhere. Based on historical data and the location of the Sacramento County Planning Area relative to active and potentially active faults, the County will experience an earthquake occasionally.

Mapping of Future Occurrences

Maps indicating the maximum expectable intensity of ground shaking for the County are available through several sources. Figure 4-62, prepared by the California Division of Mines and Geology, shows the expected relative intensity of ground shaking and damage in California from anticipated future earthquakes. The shaking potential is calculated as the level of ground motion that has a 2% chance of being exceeded in 50 years, which is the same as the level of ground-shaking with about a 2,500-year average repeat time.

This data shows that Sacramento County falls within an area of mostly low seismic risk. As seen in Figure 4-62, the Delta area of the County is at greater risk to earthquakes than the rest of the County.

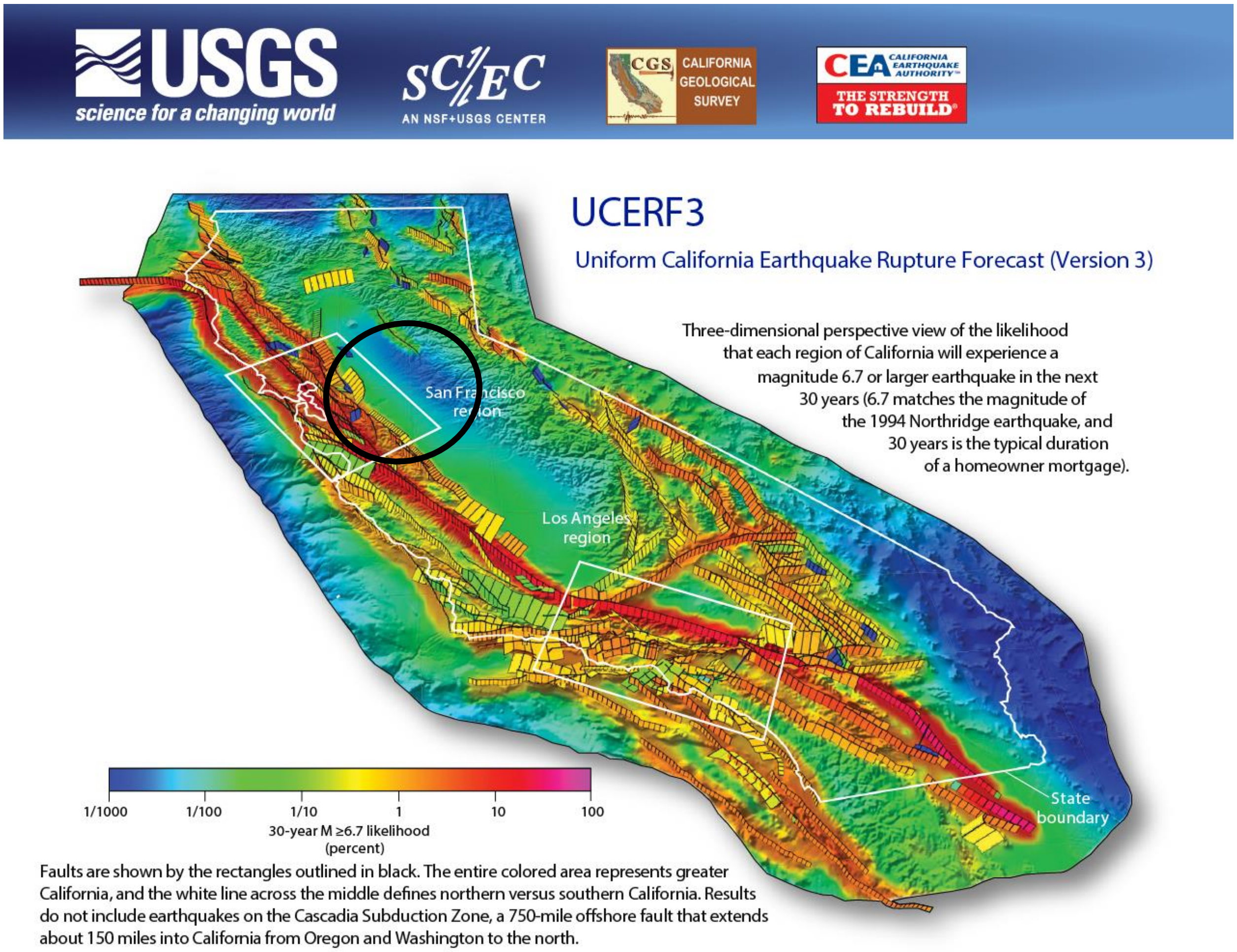
Figure 4-62 Maximum Expectable Earthquake Intensity – 2% Chance in 50 Years



Source: California Division of Mines and Geology (2016)

In 2014, the USGS and the California Geological Survey (CGS) released the time-dependent version of the Uniform California Earthquake Rupture Forecast (UCERF III) model. The UCERF III results have helped to reduce the uncertainty in estimated 30-year probabilities of strong ground motions in California. The UCERF map is shown in Figure 4-63 and indicates that Sacramento County has a low to moderate risk of earthquake occurrence, which coincides with the likelihood of future occurrence rating of occasional.

Figure 4-63 Probability of Earthquake Magnitudes Occurring in 30 Year Time Frame



Source: United States Geological Survey Open File Report 2015-3009

Climate Change and Earthquake

Climate changes is unlikely to increase earthquake frequency or strength.

Vulnerability Assessment

Vulnerability—Extremely High

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 primary impacts of concern are life safety and property damage. Although several faults are within and near the County, seismic hazard mapping indicates that the County has low seismic hazard potential. Additionally, the County is not located within a delineated Alquist-Priolo Earthquake Fault Zone. The risks associated with earthquakes, such as surface fault rupture, within the County are considered low.

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 ruptures 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 due to enforcement of improved building codes. Manufactured housing is very susceptible to damage because their foundation systems are rarely 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. This was seen to a certain extent in the Lake Almanor earthquake.

Seismic events can have particularly negative effects on older buildings constructed of URM, including materials such as brick, concrete and stone. The Uniform Building Code (UBC) identifies four seismic zones in the United States. The zones are numbered one through four, with Zone 4 representing the highest level of seismic hazard. The UBC establishes more stringent construction standards for areas within Zones 3 and 4. All of California lies within either Zone 3 or Zone 4. Sacramento County is within the less hazardous Zone 3.

Impacts

While a large earthquake event in the County is not likely, should one occur, impacts could be catastrophic. Impacts to the County would include damages to infrastructure (roads, bridges, railroad tracks, etc.), damages to utilities (and loss of services) and critical infrastructure, damages to residential and commercial buildings, and possible loss of life and injuries. Rebuilding efforts would be substantial and could take years. The biggest concern associated with a large earthquake event would be the failure of area levees and which provide protection for much of the existing built environment throughout the County. More information can be found in the levee profile in Section 4.3.14.

Estimating Potential Losses

Earthquake losses will vary across the Sacramento County Planning Area depending on the source and magnitude of the event. To further evaluate potential losses associated with earthquake activity in the Planning Area, a HAZUS-MH probabilistic 7.0 earthquake event earthquake scenarios was run for this 2021 LHMP Update:

This event was chosen from data gathered from the General Plan Safety Element. The probabilistic event is a “worst case” event, and assumes an earthquake takes place on an unknown fault that lies inside the County.

Probabilistic 7.0 Earthquake Event

HAZUS-MH 4.2 was utilized to model earthquake losses for the County. Specifically, the probabilistic magnitude used for Sacramento County utilized a 7.0 magnitude earthquake. Level 1 analyses were run, meaning that only the default data was used and not supplemented with local building inventory or hazard data. There are certain data limitations when using the default data, so the results should be interpreted accordingly; this is a planning level analysis. The represents a “worst case” scenario.

The methodology for running the probabilistic earthquake scenario used seismic hazard contour maps developed by the U.S. Geological Survey (USGS) for the 2002 update of the National Seismic Hazard Maps that are included with HAZUS-MH. The USGS maps provide estimates of potential ground acceleration and spectral acceleration at periods of 0.3 second and 1.0 second, respectively. The 2,500-year return period analyzes ground shaking estimates with a 2 percent probability of being exceeded in 50 years, from the various seismic sources in the area. The International Building Code uses this level of ground shaking for building design in seismic areas and is more of a worst-case scenario.

The results of the probabilistic scenario are captured in Table 4-64 and shown on Figure 4-64. Key losses included the following:

- Total economic loss estimated for the earthquake was $18.177 billion, which includes building losses and lifeline losses based on the HAZUS-MH inventory.
- Building-related losses, including direct building losses and business interruption losses, totaled $16.043 billion.
- 66,898 buildings in the County were at least moderately damaged. 4,700 buildings were completely destroyed.
- Over 59 percent of the building- and income-related losses were residential structures.
- 15 percent of the estimated losses were related to business interruptions.
- The mid-day earthquake had the highest number of casualties at 472.
- 287,466 households experienced a loss of potable water the first day after the earthquake.
- 30,902 households experienced a loss of electricity the first day after the earthquake.

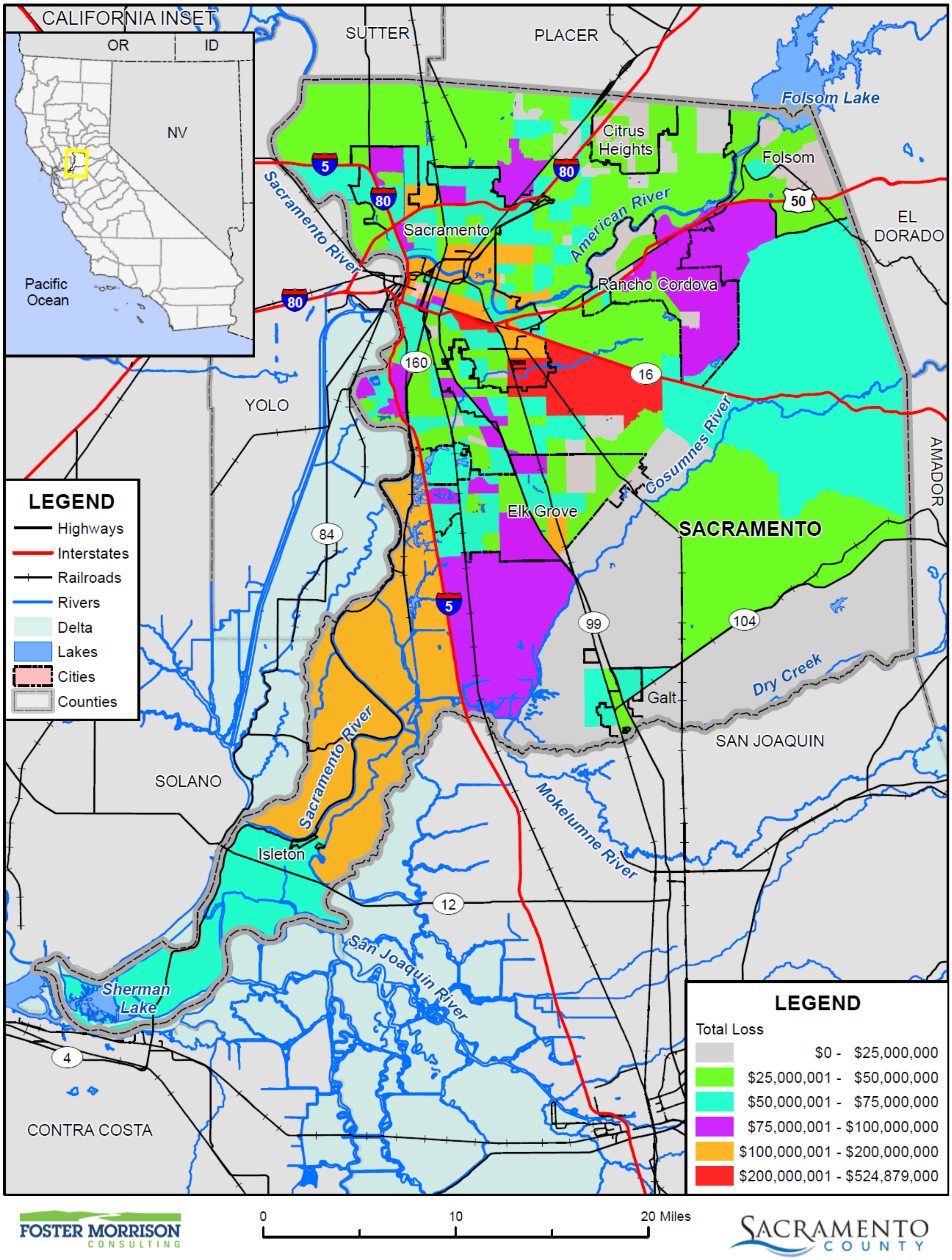
Table 4-64 HAZUS-MH Earthquake Loss Estimation Probabilistic 2,500-Year Scenario Results

Type of Impact	Impacts to County from 7.0 Probabilistic San Andreas Earthquake
Total Buildings Damaged (based on 458,000 buildings)	Slight: 151,601 Moderate: 66,898 Extensive: 12,532 Complete: 4,700
Building and Income Related Losses	$16,043,310,000
Total Economic Losses (Includes building, income and lifeline losses)	$18,177,150,000
Casualties (Based on 2 a.m. time of occurrence)	Without requiring hospitalization: 1,868 Requiring hospitalization:352 Life threatening: 37 Fatalities: 69

Type of Impact	Impacts to County from 7.0 Probabilistic San Andreas Earthquake	
Casualties (Based on 2 p.m. time of occurrence)	Without requiring hospitalization: 5,863 Requiring hospitalization: 1,548 Life threatening: 247 Fatalities: 472	
Casualties (Based on 5 p.m. time of occurrence)	Without requiring hospitalization: 3,811 Requiring hospitalization: 1,011 Life threatening: 256 Fatalities: 296	
Damage to Transportation Systems	31 highways, 2 bus facilities, and 16 port facilities, and 3 airports with at least moderate damage	
Damage to Essential Facilities	11 hospital, 219 schools, 21 police stations, and 25 fire stations with at least moderate damage	
Damage to Utility Systems	49 facilities with at least moderate damage 1,810 potable water line breaks and 909 wastewater line breaks	
Households without Power/Water Service (Based on 31,437 total households)	Power loss, Day 1: 30,902 Power loss, Day 3: 16,686 Power loss, Day 7: 5,601 Power loss, Day 30: 893 Power loss, Day 90: 50	Water loss, Day 1: 287,466 Power loss, Day 3: 280,676 Power loss, Day 7: 266,413 Water loss, Day 30: 165,234 Water loss, Day 90: 0
Displaced Households	10,592 displaced households	
Shelter Requirements	7,009 persons	
Debris Generation	2,869,000 tons	

Source: HAZUS-MH 4.2, 2020

Figure 4-64 Sacramento County – Total Loss Map from 7.0 Magnitude Probabilistic Hazus Earthquake Scenario



Data Source: Hazus-MH 4.2, Sacramento County GIS, Cal-Atlas; Map Date: 03/2021.

Future Development

Although new growth and development corridors would fall in the area affected by earthquake, given the small chance of major earthquake and the building codes in effect, development in the earthquake area will continue to occur. This development will be subject to local building codes that take earthquake shaking into account when siting and building new residential, commercial, and industrial properties.

4.3.10. Earthquake: Liquefaction

Hazard Profile

This hazard profile contains multiple sections that detail how this hazard can affect Sacramento County. These sections include a hazard/problem description; description of location and extent; past occurrences of this hazard; and how climate change can affect this hazard.

Hazard/Problem Description

Liquefaction can be defined as the loss of soil strength or stiffness due to a buildup of pore-water pressure during a seismic event and is associated primarily with relatively loose, saturated fine- to medium-grained unconsolidated soils. Seismic ground shaking of relatively loose, granular soils that are saturated or submerged can cause the soils to liquefy and temporarily behave as a dense fluid. If this layer is at the surface, its effect is much like that of quicksand for any structure located on it. If the liquefied layer is in the subsurface, the material above it may slide laterally depending on the confinement of the unstable mass. Liquefaction is caused by a sudden temporary increase in pore-water pressure due to seismic densification or other displacement of submerged granular soils. Liquefiable soil conditions are not uncommon in alluvial deposits in moderate to large canyons and could also be present in other areas of alluvial soils where the groundwater level is shallow (i.e., 50 feet below the surface). Bedrock units, due to their dense nature, are unlikely to present a liquefaction hazard.

Liquefaction during major earthquakes has caused severe damage to structures on level ground as a result 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.

Typical effects of liquefaction include:

- **Loss of bearing strength**—the ground can liquefy and lose its ability to support structures.
- **Lateral spreading**—the ground can slide down very gentle slopes or toward stream banks riding on a buried liquefied layer.
- **Sand boils**—sand-laden water can be ejected from a buried liquefied layer and erupt at the surface to form sand volcanoes; the surrounding ground often fractures and settles.
- **Flow failures**—earth moves down steep slope with large displacement and much internal disruption of material.
- **Ground oscillation**—the surface layer, riding on a buried liquefied layer, is thrown back and forth by the shaking and can be severely deformed.

- **Flotation**—light structures that are buried in the ground (like pipelines, sewers and nearly empty fuel tanks) can float to the surface when they are surrounded by liquefied soil.
- **Settlement**—when liquefied ground re-consolidates following an earthquake, the ground surface may settle or subside as shaking decreases and the underlying liquefied soil becomes denser.

Location and Extent

There is no scientific scale for earthquake related liquefaction. The speed of onset is short, as is the duration. The effects from liquefaction can last for days, weeks, months or even years as areas of the county are rebuilt or leveed areas are dewatered and the levees rebuilt. In Sacramento County, the Delta and areas of downtown Sacramento are at risk to liquefaction. The Delta sits atop a blind fault system on the western edge of the Central Valley. Moderate earthquakes in 1892 near Vacaville and in 1983 near Coalinga demonstrate the seismic potential of this structural belt. The increasing height of the levee system has prompted growing concern about the seismic stability of the levees. The concern is based on the proximity of faulting, the nature of the levee foundations, and the materials used to build the levees. Many levees consist of uncompacted weak local soils that may be unstable under seismic loading. The presence of sand pockets and silt in the levees and their foundations indicates that liquefaction is also a possibility.

Although there have been no significant quakes in or closely adjacent to the Delta since high levees were originally constructed, there are at least five major faults within the vicinity of the Delta capable of generating peak ground acceleration values that would likely lead to levee failures. More information on earthquakes and the faults affecting the Sacramento County area can be found in Section 4.3.9.

Past Occurrences

Disaster Declaration History

There have been no disaster declarations in the County related to earthquakes, as shown on Table 4-4.

NCDC Events

Earthquake liquefaction events are not tracked by the NCDC database.

Hazard Mitigation Planning Committee Events

There have been no tracked liquefaction events that have caused damages in the County.

Likelihood of Future Occurrence

Occasional – Due to the presence of faults in the area, and the ever increasing height of levees protecting the Delta, there is concern that liquefaction could be a cause of levee failure. Embankment and foundation materials for most Delta levees are substandard, adding to the risk of failure during seismic events. The U.S. Geological Survey estimates that an earthquake of magnitude 6.7 or greater has a 62 percent probability of occurring in the San Francisco Bay Area between 2003 and 2032. Such an earthquake is capable of causing multiple levee failures in the Delta Region which could result in fatalities, extensive property damage and the interruption of water exports from the Delta for an extended period of time.

Climate Change and Earthquake: Liquefaction

Climate changes is unlikely to increase earthquake frequency or strength.

Vulnerability Assessment

Vulnerability—Medium

Earthquake is discussed in the Section 4.3.9, but is primarily focused on the vulnerability of buildings and people from earthquake shaking. This section deals with a secondary hazard associated with earthquake – the possible collapse of structural integrity of the ground underneath liquefaction prone areas. In Sacramento County, the HMPC identified two of these areas: downtown Sacramento and the Delta area, which could lead to a possible collapse of delta levees. This levee failure differs from the levee failure discussion in Section 4.3.14 which generally focuses on levee failure due to high water conditions or other types of structural failure. These two areas are described further below.

Downtown

A geological and seismological study in 1972 indicated that the Housing and Redevelopment Agency building site located downtown at the intersection of 7th and I Streets has a potential for liquefaction. This study also concluded that potential liquefaction problems may exist throughout the downtown area where loose sands and silts are present below the ground water table. Exact property value estimates are not available. Due to the fact that downtown Sacramento is located away from active faults, there may be limited vulnerability to damage from liquefaction.

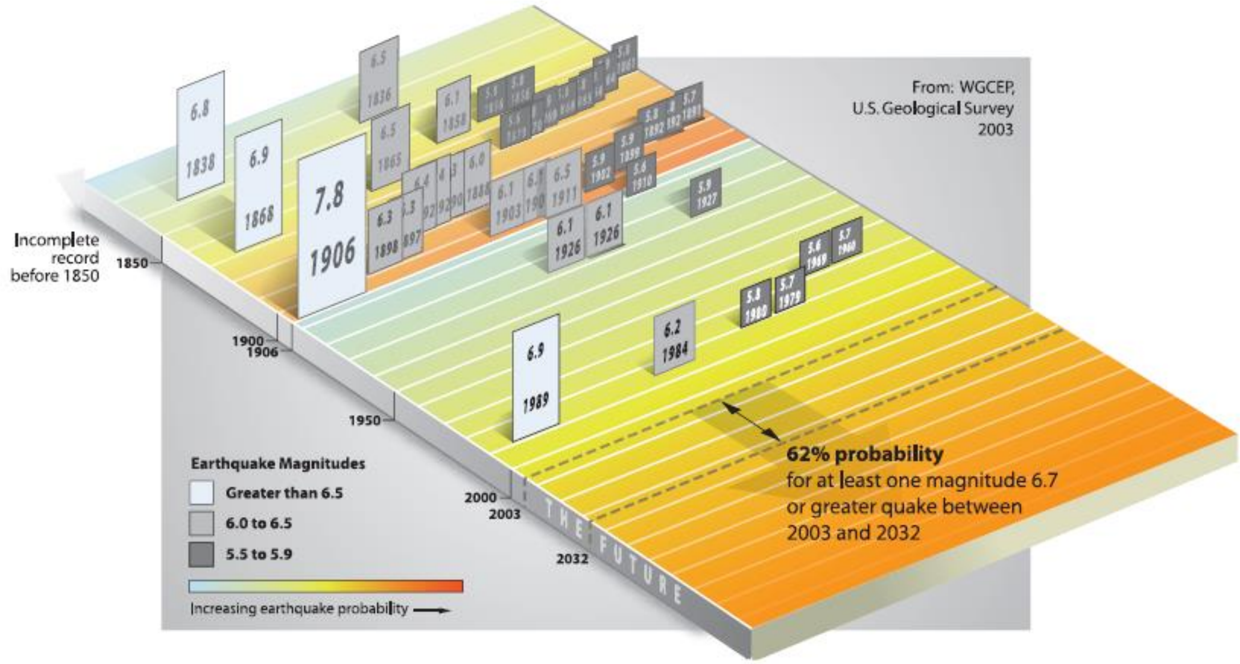
Delta

Historically, there have been 165 Delta and Suisun Marsh flood-induced levee failures leading to island inundations since 1900. Most of these failures occurred prior to 1990. Also, many of these failures were outside of Sacramento County. Since that time, there have been few levee failures due to improvements on the levee system in Sacramento as a whole.

No reports could be found to indicate that seismic shaking had ever induced significant damage or were the cause of the levee failures mentioned above. However, the lack of historical damage is not a reliable indicator that Delta levees are not vulnerable to earthquake shaking. Furthermore, the present-day Delta levees, at their current size, have not been significantly tested by moderate to high seismic shaking.

The USGS estimates that an earthquake of magnitude 6.7 or greater has a 62 percent probability of occurring in the San Francisco Bay Area between 2003 and 2032 (see Figure 4-65). Such an earthquake is capable of causing multiple levee failures in the Delta Region which could result in fatalities, extensive property damage and the interruption of water exports from the Delta for an extended period of time. Potential earthquakes on the Hayward, Calaveras or San Andreas faults pose the highest risk to Delta Region levees.

Figure 4-65 Past and Future Earthquakes in the San Francisco Bay Area and the Delta



Source: DRMS Risk Report (URS/JBA 2008c) Figure 13-8

The largest earthquakes experienced in recent history in the region include the 1906 Great San Francisco Earthquake and the 1989 Loma Prieta Earthquake. The 1906 earthquake occurred while the levees were in their early stages of construction. They were much smaller than they are today, and were not representative of the current configuration. The epicenter of the 1989 Loma Prieta earthquake was too distant and registered levels of shaking in the Delta too small to cause perceptible damage to the levees. In 2009, the California Department of Water Resources, in their document titled Delta Risk Management Strategy, performed a special simulation analysis of the 1906 Great San Francisco Earthquake to evaluate the potential effects of that event on the current levees.

In addition to the simulation of these largest regional earthquakes, recent smaller and closer earthquakes were also evaluated. They include: the 1980 Livermore Earthquake (M 5.8), the 1984 Morgan Hill Earthquake (M 6.2), and the 2014 South Napa Earthquake (M 6.0). Except for the 1906 earthquake, which would have caused deformations of some of the weakest levees, the other earthquakes were either too small or too distant to cause any significant damage to the Delta levees. These results are consistent with the seismic vulnerability prediction model developed for this study.

General seismic performance observations were:

- The areas most prone to liquefaction potential are in the northern region and the southeastern region of the Delta. The central and western regions of the Delta and Suisun Marsh show discontinuous areas of moderate to low liquefaction potential.
- The vulnerability classes 1 through 4 are the most vulnerable levees to seismic loading. These include islands with liquefiable levee fill, and peat/organic soil deposits and potentially liquefiable sand

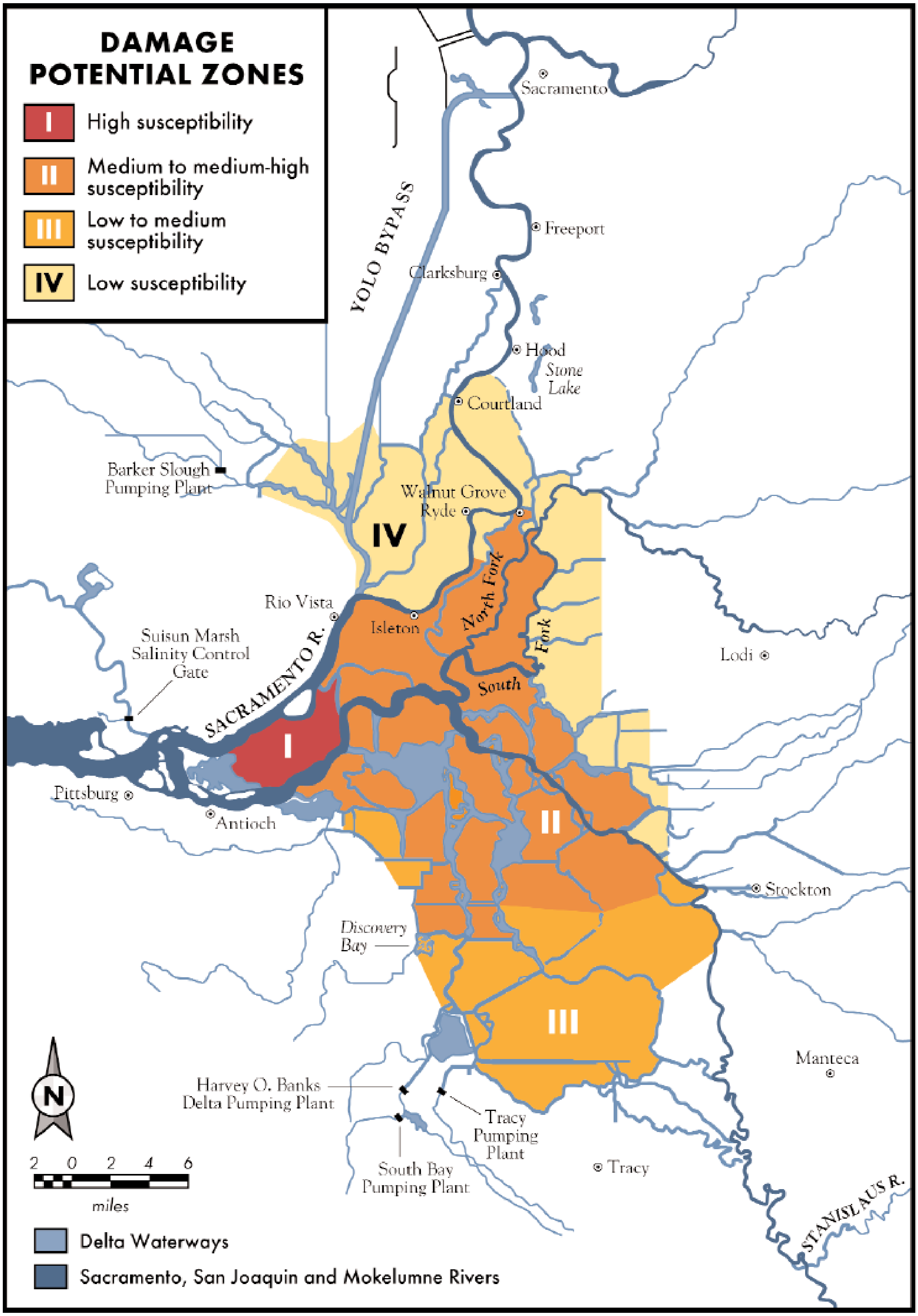
deposits in the foundation. Such islands include but are not limited to Sherman, Brannan-Andrus, Twitchel, Webb, Venice, Bouldin, and many others.

- The majority of the islands have at least one levee reach in vulnerability classes 1 to 4.
- Levees composed of liquefiable fill are likely to undergo extensive damage as a result of a moderate to large earthquake in the region.
- The median probabilities of failure for classes with no liquefiable foundation sand and no liquefiable levee fill increase with peat thickness under the levee. When peat is absent, generally the probabilities of failure are small (less than 22 percent) for the largest ground motions of 0.5g. However, the probabilities of failure at the locations of the thickest peat (more than 25 feet) range from 30 percent to 60 percent for a PGA of 0.5g.
- Levees founded on liquefiable foundations are expected to experience large deformations (in excess of 10 feet) under a moderate to large earthquake in the region.

Assets at Risk – Flooding

A preliminary analysis of the risk of levee failure due to seismicity was prepared for the CALFED Levee System Integrity Program. Based on standard methods and local expertise, it was estimated the magnitude and recurrence intervals of peak ground accelerations throughout the Delta. Two competing fault models were evaluated for this study, producing a wide range of potential accelerations. Then, based on local knowledge and limited geotechnical information, Damage Potential Zones were established for the Delta (Figure 4-66). The zones of highest risk lie in the central and west Delta where tall levees are constructed on unstable soils that are at high risk of settling or liquefaction during an earthquake.

Figure 4-66 Delta Area – Potential Damage Due to Liquefaction and Levee Collapse



This report estimated recurrence intervals for ground accelerations and the number of potential levee failures in each Damage Potential Zone. It is useful to examine their estimates of the number of failures that might occur during a 100-year event, or an event with a 1% annual chance probability of being equaled or exceeded in any given year. Based on their estimates, it is a roughly 50-50 chance that 5 to 20 levee segments will fail during a 100-year event in the Delta. This does not imply that 5 to 20 islands will flood, but just that 5 to 20 levee segments will fail. The loss of 5 to 20 levee segments in the Delta constitutes considerable and abrupt landscape change, since island flooding is likely to be widespread and persistent for a long period of time.

In sum, liquefaction has not been observed as a result of recent seismic activity (including 1989 and 2014); however, it is recognized as a potential risk. In the event it does occur, liquefaction may pose a serious threat to levees, especially as levees are built larger and higher to deal with continuing island subsidence. Levee failure, depending on the extent, could have disastrous effects on agriculture, natural gas supply, fisheries, and saltwater intrusion of the San Francisco Bay. Water supply to California could be affected for years. A greater discussion of levee failure can be found in Section 4.3.14.

A major earthquake can cause extensive damage to large sections of levees on multiple islands at the same time. As a result, many islands could be flooded simultaneously. For example, the DRMS report indicated that there is a 40 percent probability of a major earthquake causing 27 or more islands to flood at the same time in the 25-year period from 2005 to 2030. It is not specified which islands in Sacramento County would be included in this flooding.

The duration and cost of levee repairs increases with the number of islands that are flooded due to an earthquake, as shown in Table 4-65. This is not only due to the extensive number of repairs required, but also to the availability of labor and materials to make the repairs. These numbers from the DRMS report are applicable to Sacramento County.

Table 4-65 Duration and Cost of Repairs for Earthquake-Induced Levee Failures

Number of flooded islands	Estimated range of cost of repair and dewatering*	Estimated range of time to repair breaches and dewater [days]
1	$43,000,000 – $240,000,000	136 – 276
3	$204,000,000 – $490,000,000	270 – 466
10	$620,000,000 – $1,260,000,000	460 – 700
20	$1,400,000,000 – $2,300,000,000	750 – 1,020
30	$3,000,000,000 – $4,200,000,000	1,240 – 1,660

Source: DRMS Risk Report [URS/JBA 2008c], Table 13-9

*These represent 2008 values. Using the Bureau of Labor Statistics CPI Inflation calculator, these values would be 23.4% higher in 2020 when adjusted for inflation.

In addition to dewatering costs, the Delta contains improved parcels at risk to flooding. More information about the Delta and its risk may be found in the Delta annex to this Plan Update.

Future Development

The consequences of a major earthquake in the Delta Region will also increase with time. Because of increasing water demand and the state's growing population and economy, the economic consequences of an interruption in Delta water supply operations due to an earthquake will increase. Consequences to the Delta Region will also increase due to additional development. The risks for future development in the areas in the City of Sacramento are unknown.

4.3.11. Flood: 1%/0.2% Annual Chance

Hazard Profile

This hazard profile contains multiple sections that detail how this hazard can affect Sacramento County. These sections include a hazard/problem description; description of location and extent; past occurrences of this hazard; and how climate change can affect this hazard.

Hazard/Problem Description

Flooding is the rising and overflowing of a body of water onto normally dry land. History clearly highlights floods as one of the primary natural hazards impacting Sacramento County. Floods are among the costliest natural disasters in terms of human hardship and economic loss nationwide. The Sacramento County Planning Area is susceptible to various types of flood events as described below.

- **Riverine flooding** – Riverine flooding, defined as when a watercourse exceeds its "bank-full" capacity, generally occurs as a result of prolonged rainfall, or rainfall that is combined with snowmelt and/or 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 and is often characterized by high peak flows combined with a large volume of runoff. 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 Sacramento County Planning Area, riverine flooding can occur anytime from November through April and 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. Flooding is more severe when antecedent rainfall has resulted in saturated ground conditions. The warning time associated with slow rise riverine floods assists in life and property protection
- **Flash flooding** – Flash flooding describes localized floods of great volume and short duration. This type of flood usually results from a 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 and thus early threat identification and warning is critical for saving lives.
- **Localized/Stormwater 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.

According to the 2018 Flood Insurance Study for Sacramento County, general rain floods can occur in the study area anytime during the period from November through April. This type of flood results from prolonged heavy rainfall and is characterized by high peak flows of moderate duration and by a large volume of runoff. Flooding is more severe when antecedent rainfall has resulted in saturated ground conditions. The severity of flooding on all the streams studied is intensified by backwater conditions between stream systems. Floodwater elevations are increased in the lower portions of tributary streams due to the backwater effect from main streams reducing hydraulic gradients and flow-storage areas. During this time there will be a high degree of coincidental l-percent-annual-chance floodflows on all the study area waterways.

The area is also at risk to flooding resulting from levee failures and dam failures. Dam failure flooding is discussed separately in Section 4.3.7 of this document; Levee failure flooding are discussed separately in Section 4.3.14 of this document. Regardless of the type of flood, the cause is often the result of severe weather and excessive rainfall, either in the flood area or upstream reach.

Streambank Erosion

In addition to the damages to people and property from the above flooding issues, Sacramento County's waterways often experience streambank erosion. Streambank erosion is a natural process, but acceleration of this natural process leads to a disproportionate sediment supply, stream channel instability, land loss, habitat loss and other adverse effects. Streambank erosion processes, although complex, are driven by two major components: streambank characteristics (erodibility) and hydraulic/gravitational forces. Many land use activities can affect both of these components and lead to accelerated bank erosion. The vegetation rooting characteristics can protect banks from fluvial entrainment and collapse, and also provide internal bank strength. When riparian vegetation is changed from woody species to annual grasses and/or forbs, the internal strength is weakened, causing acceleration of mass wasting processes. Streambank aggradation or degradation is often a response to stream channel instability. Since bank erosion is often a symptom of a larger, more complex problem, the long-term solutions often involve much more than just bank stabilization. Numerous studies have demonstrated that streambank erosion contributes a large portion of the annual sediment yield.

Determining the cause of accelerated streambank erosion is the first step in solving the problem. When a stream is straightened or widened, streambank erosion increases. Accelerated streambank erosion is part of the process as the stream seeks to re-establish a stable size and pattern. Damaging or removing streamside vegetation to the point where it no longer provides for bank stability can cause a dramatic increase in bank erosion. A degrading streambed results in higher and often unstable, eroding banks. When land use changes occur in a watershed, such as clearing land for agriculture or development, runoff increases. With this increase in runoff the stream channel will adjust to accommodate the additional flow, increasing streambank erosion. Addressing the problem of streambank erosion requires an understanding of both stream dynamics and the management of streamside vegetation.

Approximately 150 years ago, the levees of the Sacramento-San Joaquin Delta were raised to prevent flooding on what remains some of the most fertile farmland in the nation. While the peat soils were excellent for agriculture, they do not create strong foundations for levee barriers meant to contain a constant flow of river water. Nevertheless, it was these native soils that were primarily used to create the levee system.

As farmers settled the valleys, the Gold Rush drew prospectors to the hills. As mining in the Sierra Nevada turned to the more "efficient" methods of hydraulic mining, the use of environmentally destructive high-pressure water jets washed entire mountainsides into local streams and rivers. Hydraulic gold mining in the northern Sierra Nevada foothills produced 1.1 billion cubic meters of sediment. As a result, the enormous amounts of silt deposited in the riverbeds of the Central Valley increased flood risk. As a remedy to these rising riverbeds, levees were built very close to the river channels to keep water velocity high and thereby scour away the sediment.

However, the design of these narrow channels has been too successful. While the Gold Rush silt is long gone, the erosive force of the constrained river continues to eat away at the levee system. In addition, the peat soils of the Delta have subsided, gradually lowering the elevations of Delta islands. As a result, some of these parcels are now more than 20 feet below sea level.

Erosion and deposition are occurring continually at varying rates over the Planning Area. Swiftly moving floodwaters cause rapid local erosion as the water carries away earth materials. Severe erosion removes the earth from beneath bridges, roads and foundations of structures adjacent to streams. By undercutting it can lead to increased rockfall and landslide hazard. The deposition of material can block culverts, aggravate flooding, destroy crops and lawns by burying them, and reduce the capacity of water reservoirs as the deposited materials displace water.

Streambank erosion increases the sediment that a stream must carry, results in the loss of fertile bottomland and causes a decline in the quality of habitat on land and in the stream.

Location and Extent

Major Sources of Flooding

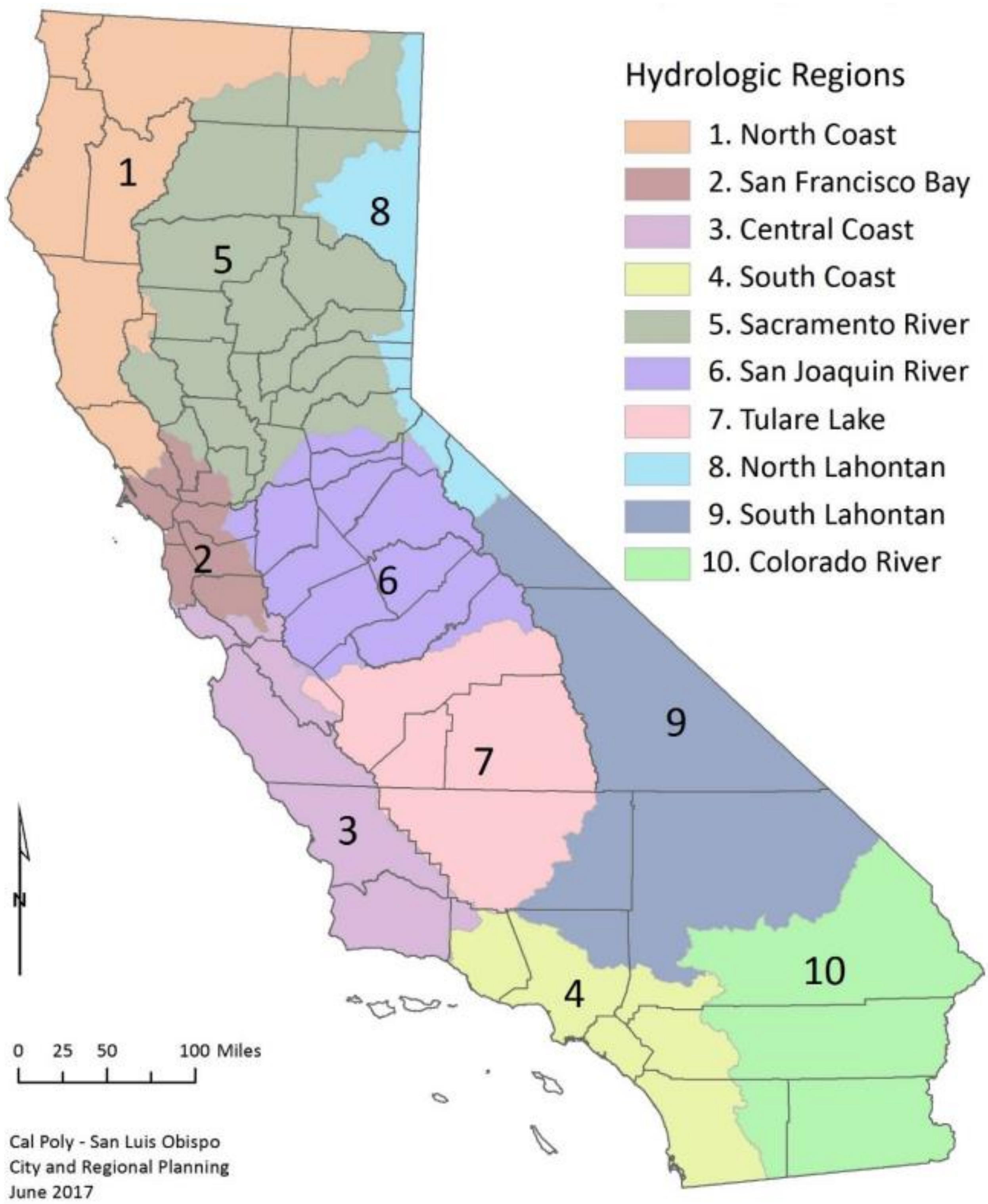
California has 10 hydrologic regions. Sacramento County sits in the Sacramento and San Joaquin hydrologic region.

- The Sacramento River hydrologic region covers approximately 17.4 million acres (27,200 square miles). The region includes all or large portions of Modoc, Siskiyou, Lassen, Shasta, Tehama, Glenn, Plumas, Butte, Colusa, Sutter, Yuba, Sierra, Nevada, Placer, Sacramento, El Dorado, Yolo, Solano, Lake, and Napa counties. Small areas of Alpine and Amador counties are also within the region. Geographically, the region extends south from the Modoc Plateau and Cascade Range at the Oregon border to the Sacramento-San Joaquin Delta. The Sacramento Valley, which forms the core of the region, is bounded to the east by the crest of the Sierra Nevada and southern Cascades and to the west by the crest of the Coast Range and Klamath Mountains. The Sacramento metropolitan area and surrounding communities form the major population center of the region. With the exception of Redding, cities and towns to the north, while steadily increasing in size, are more rural than urban in nature, being based in major agricultural areas.
- The San Joaquin River hydrologic region covers approximately 9.7 million acres (15,200 square miles) and includes all of Calaveras, Tuolumne, Mariposa, Madera, San Joaquin, and Stanislaus counties, most of Merced and Amador counties, and parts of Alpine, Fresno, Alameda, Contra Costa, Sacramento, El Dorado, and San Benito counties. Significant geographic features include the northern half of the San

Joaquin Valley, the southern part of the Sacramento-San Joaquin Delta, the Sierra Nevada and Diablo Range. The region is home to about 1.6 million people.

A map of the California's hydrological regions is provided in Figure 4-67.

Figure 4-67 California Hydrologic Regions



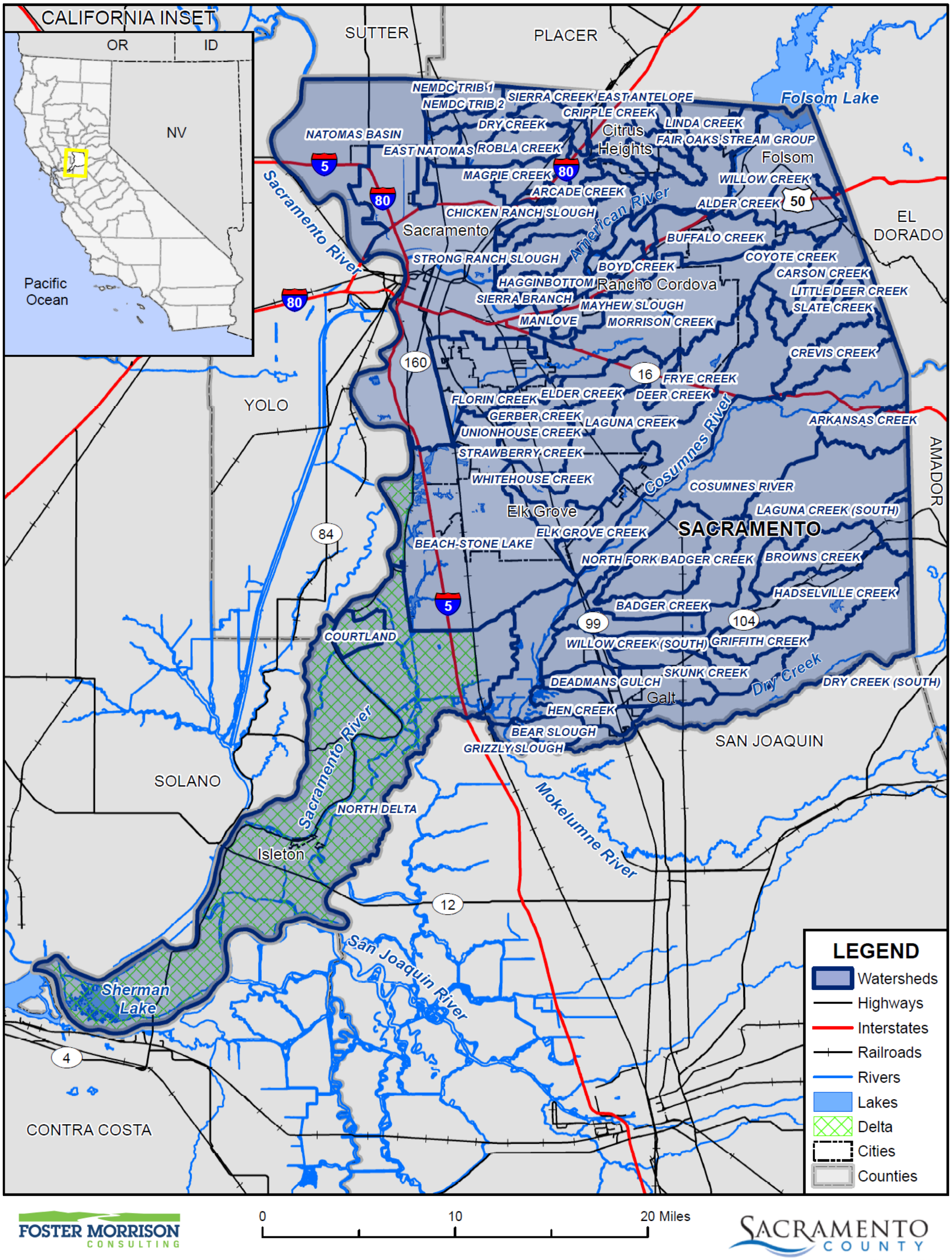
Source: 2018 State of California Hazard Mitigation Plan

The Sacramento County Waterway System

In the Sierra Nevada Mountains, small creeks and high streams are fed by underground springs, storm run-off, and melting snow. Descending from the upper watershed, these creeks and streams form large rivers such as the Sacramento, American, Feather, Yuba, San Joaquin, Mokelumne, and Consumnes. These waterways are characterized by small riverbeds conveying normal flow from the mountains and wide overbank floodplains carrying flood flows cause by heavy mountain rainfall. The Sacramento River Watershed, which includes the American River, encompasses some 27,000 square miles and drains most of Northern California.

The watersheds of Sacramento County include numerous watersheds contained within the County as well as several watersheds that drain into Sacramento County from Placer, El Dorado, or Amador Counties. Figure 4-68 illustrates the watersheds of Sacramento County. Table 4-66 details the watersheds in Sacramento County.

Figure 4-68 Sacramento County Watersheds



Data Source: Sacramento County GIS, Cal-Atlas; Map Date: 09/2020.

Table 4-66 Watersheds in Sacramento County

Watershed Name	Area (acres)	Watershed Name	Area (acres)
Alder Creek	7,226	Hadselville Creek	11,759
Antelope Creek	973	Hagginbottom	2,571
Arcade Creek	6,508	Hagginwood Creek	885
Arcade Creek South Branch	1,657	Hen Creek	4,759
Arkansas Creek	4,768	Laguna Creek	21,176
Badger Creek	11,109	Laguna Creek (South)	32,471
Beach-Stone Lake	40,118	Linda Creek	3,580
Bear Slough	2,699	Little Deer Creek	1,040
Boyd Creek	2,201	Magpie Creek	3,789
Brooktree Creek	1,180	Manlove	1,987
Browns Creek	8,077	Mariposa Creek	812
Buffalo Creek	9,167	Mayhew Slough	2,954
Carmichael Creek	2,726	Minnesota Creek	1,095
Carson Creek	6,811	Morrison Creek	34,502
Chicken Ranch Slough	3,722	Natomas Basin	26,449
Cordova/Coloma Stream Group	1,728	Negro Slough	285
Cosumnes River	45,130	NEMDC Trib 1	865
Courtland	3,099	NEMDC Trib 2	2,744
Coyle Creek	987	NEMDC Trib 3	1,567
Coyote Creek	4,625	North Delta	100,143
Crevis Creek	5,940	North Fork Badger Creek	10,423
Cripple Creek	4,327	Robla Creek	5,141
Date Creek	694	Rolling Draw Creek	1,128
Deadmans Gulch	8,641	San Juan Creek	1,334
Deer Creek	26,125	Sierra Branch	978
Diablo Creek	893	Sierra Creek	1,743
Dry Creek	4,138	Skunk Creek	6,744
Dry Creek (South)	20,158	Slate Creek	510
East Antelope	1,118	Strawberry Creek	5,588
East Natomas	1,816	Strong Ranch Slough	4,573
Elder Creek	7,632	Sunrise Creek	636
Elk Grove Creek	4,019	Unionhouse Creek	2,194
Fair Oaks Stream Group	7,819	Unnamed	51,157
Florin Creek	2,857	Verde Cruz Creek	1,226
Frye Creek	1,286	Whitehouse Creek	1,585

Watershed Name	Area (acres)	Watershed Name	Area (acres)
Gerber Creek	2,579	Willow Creek	15,207
Griffith Creek	4,806	Willow Creek (Middle)	359
Grizzly Slough	1,374	Willow Creek (South)	3,843

Source: Sacramento County GIS

Sacramento County encompasses multiple rivers, streams, creeks, and associated watersheds. Figure 4-69 illustrates the major waterways of Sacramento County. The following streams in Table 4-67, listed by stream groups, are found in Sacramento County.

Figure 4-69 Sacramento County Major Waterways

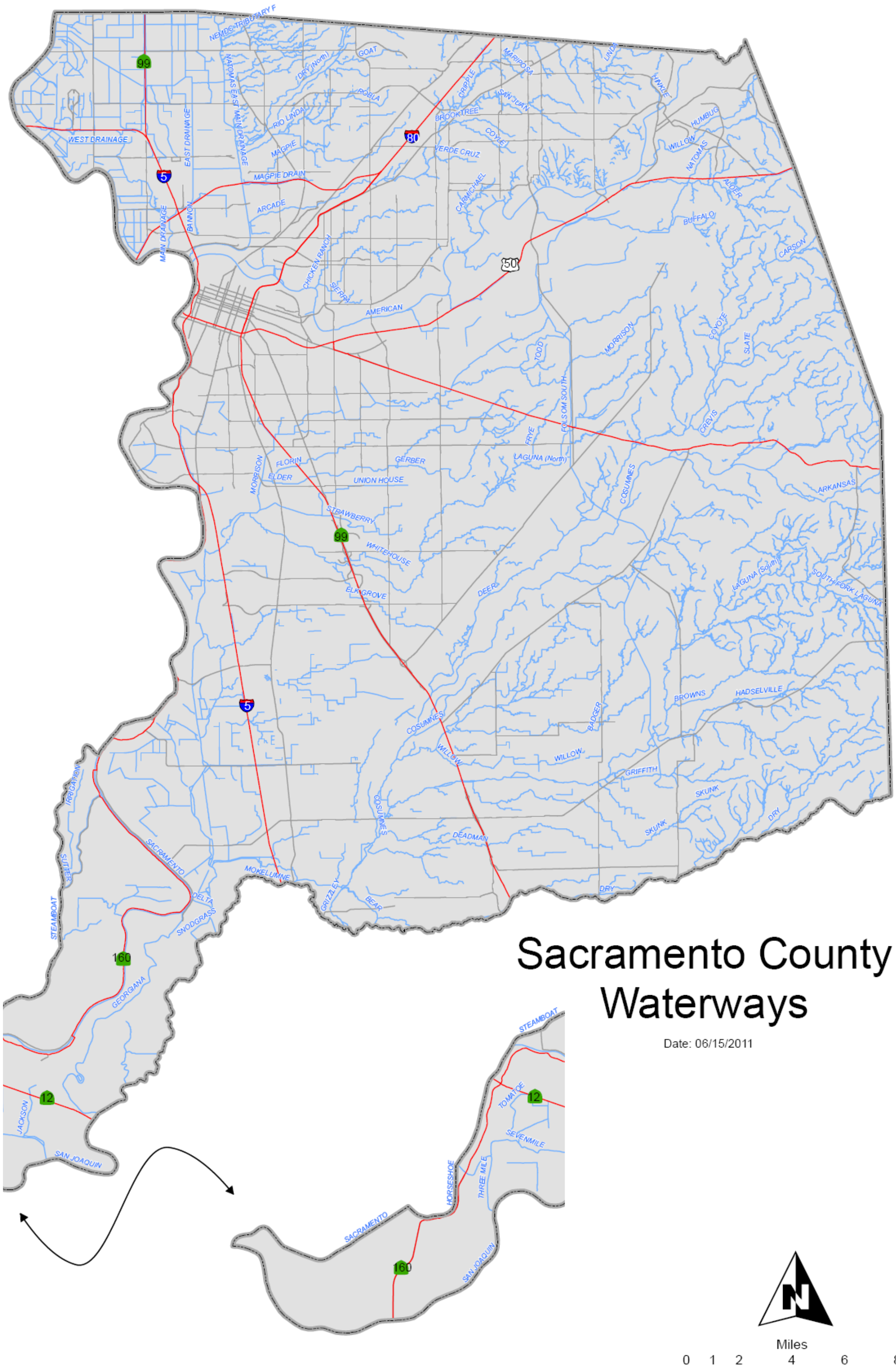


Table 4-67 Waterways and Streams in Sacramento County

Stream Group and Stream	
American River Stream Group	
American River	Magpie Creek
Arcade Creek	Mariposa Creek
Arcade Creek (South Branch)	Natomas East Main Drainage Canal
Brooktree Creek	Natomas East Main Drainage Canal Tributary 1
Carmichael Creek	Natomas East Main Drainage Canal Tributary 2
Chicken Ranch Slough	Natomas East Main Drainage Canal Tributary 3
Cripple Creek	Robla Creek
Coyle Creek	San Juan Creek
Dry Creek	Sierra Creek
Dry Creek (North Branch)	Strong Ranch Slough
Linda Creek	Verde Cruz Creek
Morrison Creek Stream Group	
Elder Creek	Morrison Creek
Elk Grove Creek	North Fork Laguna Creek
Florin Creek	Strawberry Creek
Gerber Creek	Unionhouse Creek
Laguna Creek	Whitehouse Creek
Laguna Creek Tributary 1	
Sacramento River and Delta Slough Group	
Georgiana Slough	Steamboat Slough
Sacramento River	Sutter Slough
Sevenmile Slough	Three Mile Slough
San Joaquin River Stream Group	
Delta Cross Canal	San Joaquin River
Mokelumne River	Snodgrass Slough
North Mokelumne River	
Natomas Area Stream Group	
Natomas East Drainage Canal	Deer Creek
Natomas Main Drainage Canal	Dry Creek
Natomas North Drainage Canal	Hadselville Creek
Natomas West Drainage Canal	Hen Creek
Arkansas Creek	Laguna Creek
Badger Creek	North Fork Badger Creek
Browns Creek	North Stone Lake Tributary

Stream Group and Stream	
Carson Creek	Skunk Creek
Cosumnes River	South Stone Lake-North Tributary
Cosumnes River Overflow	South Stone Lake-South Tributary
Crevis Creek	Willow Creek
Deadman Gulch	

Source: Sacramento County Flood Insurance Study, 2008

In Sacramento County, there are three main rivers, the Sacramento, American and Cosumnes Rivers. The Sacramento and American Rivers and several tributaries to the east, north, and west all flow toward the City of Sacramento. The watersheds of these two main rivers drain most of northern California and part of southern Oregon for a total of some 26,000 square miles. The third, the Cosumnes River, flows southwesterly through the southern portion of the County and into the Delta.

The Sacramento River extends north to Mount Shasta and the Shasta Reservoir. Many other rivers are tributary to the Sacramento, including (immediately north of Sacramento) the Bear and Feather Rivers. The American River extends to the Sierra Nevada foothills in three branches (South, North and Middle). Folsom Reservoir is at the eastern boundary of Sacramento County and serves to control the American River.

The Cosumnes River is a wild and natural river originating in the Sierra Nevada foothills, flowing into southern Sacramento County. This area is mostly rural farmland. Levees were constructed by agricultural interests, and they are inadequate for containing record storm flows such as those experienced in February 1986 and again in January 1997. These two storms left the levee system sorely damaged. Each time, the levee breaks were repaired, but the overall system sits in wait of another flood event.

Another river, the Mokelumne River is the southernmost river in the County and is controlled by a dam in the neighboring county and a series of levees.

All of the watersheds converge at the Sacramento River Delta, the flood issues in the Delta are of concern as the agricultural interests continue to farm the land which is subsiding annually, making the levee systems more vulnerable to breaching.

When the Sacramento River reaches its peak capacity, the American River and other tributaries that flow into the Sacramento River, cannot flow at a normal rate. These conditions result in "backflows' which cause tributaries to overflow and flood local areas. The Sacramento River is also affected by ocean tides that periodically raise and lower the water level. High tides that occur simultaneously with flooding conditions could increase the rate of flooding.

All surface water originating in or passing through Sacramento County discharges to the ocean via the Sacramento and San Joaquin Rivers, which join at the head of Suisun Bay, the easternmost arm of San Francisco Bay. With a combined tributary drainage area of approximately 60,000 square miles, these rivers provide most of the freshwater inflow to San Francisco Bay.

High water levels along the Sacramento and American Rivers are a common occurrence in the winter and early spring months due to increased flow from storm runoff and snowmelt. An extensive system of dams, levees, overflow weirs, drainage pumping plants, and flood control bypass channels strategically located on the Sacramento and American Rivers has been established to protect the area from flooding. These facilities control floodwaters by regulating the amount of water passing through a particular reach of the river. The amount of water flowing through the levee system can be controlled by Folsom Dam on the American River and the reserve overflow area of the Yolo Bypass on the Sacramento River. However, flood problems in Sacramento County are still quite a concern, especially since the flood of 1986. Numerous areas of the county are still subject to flooding by the overtopping of rivers and creeks, levee failures, and the failure of urban drainage systems that cannot accommodate large volumes of water during severe rainstorms. However, with the implementation of multiple improvements to the area's flood control structures, including those designed to provide a 200+ level of flood protection, flood risk is being reduced including the potential for devastating floods in the Planning Area.

High flows on the Cosumnes River are less frequent, as the river is essentially dam free and has little in the way of flow regulation. Flooding along the river, such as in 1997, has been due to high water coupled with the failure of non-standard, poorly constructed private levees.

The Sacramento County Flood Control System and Associated Flood Issues

Sacramento County is protected from the American River and Sacramento River by a comprehensive system of dams, levees, overflow weirs, and flood bypasses. Local creeks are often controlled by detention basins that attenuate peak flow by allowing flood water to spill over a weir, detained, and released when the creek subsides. Sacramento County maintains a system of ALERT Flood Warning gages throughout the County that provide real time monitoring information on current flood conditions (www.stormready.org).

In the aftermath of the 1986 and 1997 floods, multiple flood control projects were identified to address flood risks in the Sacramento area. Many of these projects were designed to correct structural deficiencies, others to address levee conditions, while additional projects were intended to increase the level of flood protection provided by the system. The Sacramento River improvements would focus predominantly on rehabilitating the existing system, while the American River required a significant increase in the system's flood control capacity.

Established in 1989, Sacramento Area Flood Control Agency (SAFCA) is a regional joint-exercise-of-powers agency consisting of Sacramento and Sutter counties, the City of Sacramento, Reclamation District 1000, and the American River Flood Control District. SAFCA's long-term goal is to provide the urbanized portions of Sacramento with a minimum 200-year level of flood protection in order to reduce the risk of catastrophic damages and loss of life associated with a failure of the flood control system in the Sacramento area. SAFCA initiated a number of studies to determine the best implementable approach to address the area's flood problems. These flood control projects are in various stages of implementation; some have been completed, others are under construction, and a number are still being planned.

American River Flood Control System

The American River flood control system consists of the Folsom Dam, an auxiliary dam at Mormon Island, eight earth-filled dikes, Nimbus Dam, and levees on either side of the downstream river. The system receives runoff from the American River watershed, which is about 2,100 square miles of the western slope in the Sierra Nevada.

An initial reconnaissance report, "American River Investigation, January 1988" concluded that Folsom Dam and the American River levees were only capable of handling a 70-year flood event. Recommendations were to increase the carrying capacity of the American River below Nimbus Dam, modifying the Folsom Dam outlets, increasing storage capacity at Folsom Lake, and for greatest protection (200-year level), construct a new upstream storage facility. Immediately after the Folsom Dam was completed in 1956, a huge flood filled the reservoir, saving Sacramento. The dam protected the County from at least four potentially catastrophic floods in 1986, 1995, 1997, and 2005. The dam continues to protect the County an estimated 4 years out of every 10, and it stores water and generates electricity, protects fisheries and provides for recreation.

American River Common Features and Folsom Dam

SAFCA and the Central Valley Flood Protection Board (CVFPB), working with US Army Corp of Engineers (USACE), identified an American River project to address the low level of flood protection provided by the existing system. Unable to gain support for construction of an expandable flood control dam near Auburn, SAFCA identified a series of American River Common Features and Folsom Dam improvement projects. The Common Features projects focused on the identification of features that were "common" to any project associated with controlling flood flows at Folsom Dam. These projects focused on the conveyance of higher flood flows through the leveed portion of the American River. Currently, with the new spillway, the 0.5 percent annual recurrence (200-year) flood discharge from Folsom Dam is calculated to be 160,000 cubic feet per second (cfs). The Folsom Dam Raise Project will increase the height of the wing dams and dikes at Folsom Lake an additional 3.5 feet to match the height of the main dam. When this project is completed, the 200-year release will be substantially less, approximately equal to the current 100-year flow rate or about 115,000 cfs. The lower American River levees are being improved to a standard that is calculated to safely convey flood flows up to 160,000 cfs. Thus, upon completion of the Folsom Dam Raise Project there will be an added factor of safety to the system. The Folsom Dam improvements are scheduled for completion in 2025 and are an important component of an adequate progress finding.

American River-Related Projects

Additional projects have significantly improved the capacity and flows of the American River levee system. These include:

- Mayhew levee Improvements – This entailed raising and widening the levee and constructing a slurry wall, providing for 160,000 cfs to pass and providing greater than 100-year level of protection. The Mayhew Drain Closure Structure project completed in 2009 prevents water from the American River from backing up the drain and putting additional strain on drain levees.
- Upper Levee Slope Protection – Levee slope protection measures were implemented in the area between Cal Expo to Rio Americano High School, the narrowest portion of the American River Parkway to prevent high scour velocities on the upper face of the levee during flood events.
- Slurry Wall Construction – Approximately 23 miles of slurry walls were constructed to prevent underseepage from affecting the levee foundation due to sand layers under the levee.

- Bank Protection – Portions of the American River are subject to extremely high velocities during a major flood event, eroding banks and levee toes, leading to levee failure. Several projects have been completed preserving levee integrity and providing additional protection during floods.
- Regional Sanitation Perimeter Levee – In order to protect the regional sanitation plan from flooding, a perimeter levee was required.
- American River North Levee upstream of Natomas East Main Drainage Canal and American River South Levee upstream of H Street – SAFCA has been instrumental in orchestrating levee improvement projects on the American River downstream of Folsom Dam. Adequate progress is being made. FEMA Is already reviewing the levee certification reports for reaches of the levee improvements. This levee accreditation program is slated for completion in 2023. Full certification to the ULOP standard will require completion of the Folsom Dam raise in 2025.
- American River South (downstream of H-Street) and Sacramento River East Levee (downstream of the American River confluence) to Freeport – This flood control system greatly affects the City of Sacramento, yet there are some areas in unincorporated Sacramento County protected by this levee reach. The work that is needed to bring this levee system up to ULOP standard includes construction to address seepage, stability, erosion, and freeboard issues. This levee accreditation program is slated for completion in 2023. Full certification to the ULOP standard will require completion of the Folsom Dam Raise Project in 2025.

The Sacramento River Flood Control System

The Sacramento River flood control system consists of the several dams including Shasta and Oroville (on the Feather River), the Fremont Weir, Sacramento Weir, Yolo Bypass, and levees along the Sacramento River, and the Sacramento Bypass Channels. The Corps report "Sacramento River System Evaluation, June 1988" revealed that levees on both the Sacramento and American Rivers have inadequate freeboard and/or stability problems.

Sacramento River Projects

Several projects have been identified to rehabilitate the existing flood control system and work towards providing a minimum of 200-year level of flood protection in the urbanized portions of the Sacramento County Planning Area. Key projects include:

- Sacramento Urban Area Levee Reconstruction Project (SUALRP) – This project addressed through-levee seepage problems (i.e., landside sloughing of the levee in Natomas and seepage boils along the landside toe in the Pocket) within the Sacramento River Flood Control System (SRFCS) due to porous levee materials and poor compaction. This project improved flood protection but did not increase the design level of flood protection.
- The Sacramento Riverwall - A project feature of the SRFCS, is a concrete floodwall adjacent to old Sacramento. Due to erosion issues on the waterside toe and design deficiencies found with original construction, reconstruction of the Riverwall was addressed and improves flood protection to Old Sacramento, downtown, and portions of Interstate 5.
- Levee Slump on Garden Highway south of I-6 – To correct settling in an area of the levee near an agricultural well, a Slurry cutoff wall was constructed to prevent levee seepage and to raise the levee back to its original height. This seepage fix was designed to provide 200-year level of protection.
- Little Pocket and Sump 132 Underseepage Remediation – This project entailed construction of an approximately 2,400 feet of a levee underseepage cutoff wall in the Little Pocket area and 400-feet of

levee underseepage cutoff wall construction at Sump 132 in the Pocket area. To address know underseepage problems. The project was designed to protect against the 200-year storm event.

- Pocket Underseepage – Reach 2 and Reach 9 – This project entailed construction of an approximately 2,500 feet of cutoff wall to address underseepage issues. Completion of this project along with erosion repairs provided a minimum of 100-year level of flood protection.
- Sacramento River Bank Protection Program (Sac bank) – this is an ongoing effort to address systematic erosion issues along the Sacramento River and its tributaries, including the American River. Erosion, primarily caused by high water events, which lead to scour and high bank erosion and summer boat traffic, which creates wave induced erosion at the levee toe.
- Pioneer Reservoir – Pioneer Reservoir is located along the Sacramento River just upstream of the California Auto Museum. This project constructed a seepage berm and six relief wells to address high seepage pressures in the area.

South Sacramento Streams Group (SSSG)

USACE, in cooperation with SAFCA and the City and County of Sacramento completed a study of alternatives, including both upstream detention and modifications to the downstream levee system. Results of the study supported work to be done to the existing Morrison Creek levees as well as to the Unionhouse, Florin, and Elder Creek levees. The County is also collecting development impact fees from upstream developers, which will be used to build detention basins to hold the additional run-off generated as new development occurs.

The Morrison Creek System

In 1987, the USACE in a study concluded that the levees and channels lacked adequate capacity to handle the 100-year storm. In 2005, USACE completed construction of nearly four miles of levee from Freeport Boulevard/Sacramento River Levee on the west to the Union Pacific Railroad to the east, raising the existing levee system to protect against a 200-year storm. USACE also constructed floodwalls along the four creeks (Elder, Unionhouse Florin, and Morrison) up to Franklin Boulevard.

Unionhouse Creek Channel Improvements

Channel improvements completed in 2012 increased the amount of water that can be contained in the channel, resulting in 100-year flood protection.

Florin Creek Improvements

Channel improvements in this area, combined with plans to construct a detention basin along Florin Creek will provide FEMA level of flood protection along much of Florin Creek.

The Natomas Area

After the 1986 flood demonstrated the inadequacy of the levee system in this area, efforts ensued to implement a series of levee improvements and other flood control improvements designed to address through-levee seepage and work in tandem with increased storage on the American River to provide affected areas with increased flood protection. This project provided a minimum 100-year level of flood protection to the Natomas Basin and to the lower Dry and Arcade Creek watersheds, including portions of Rio Linda and North Sacramento.

A huge development effort followed including residential in the incorporated City and commercial/industrial in the unincorporated County of Sacramento. The Natomas area includes about 70,000 residents, both Interstates 5 and 80, Sacramento Airport, and significant commercial and industrial development. Natomas is protected from flooding by levees on all sides. Some believe Natomas to be threatened by high probability flood events, but the fact remains that the area has never suffered a levee breach.

December 2008, FEMA remapped the Natomas Area as not having protection from the 1% annual recurrence flood event, and SAFCA kicked off a massive effort to improve the levees. SAFCA's efforts have been to restore at a minimum a 100-year level of protection, while working toward 200-year level of protection. This is still in progress.

The Natomas Basin's effective FEMA flood zone, Zone A99, is a special flood hazard designation identifying an area protected by decertified levees where a plan with associated funding is in place to achieve the required level of protection. The Natomas Basin qualified for this designation effective June 16, 2015. Zone A99 designation provides a local agency the opportunity to allow building permits subject to its determination that an area is reasonably safe and to allow development that would not otherwise be allowed in an area with flood protection that does not meet FEMA requirements.

Flood Zone A99 is an area of undefined flood risk, thus, pursuant to the Code of Federal Regulations, 44CFR60.3(a)(3), the local agency must determine if the area is reasonably safe from flooding. This assures FEMA that the land use agency is taking an active interest in public safety when allowing development in this flood zone designation even while levees are being improved to the required standards.

The Board of Supervisors Report from May 19, 2015, Item 76 (Resolution 2015-0392), described the ULOP, the FEMA flood zone A99, and the importance of finding an area to be reasonably safe from flooding before permitting new construction on existing entitled land. The Board allowed for a limited, measured approach to the issuance of building permits and development approvals in the Natomas Basin allowing issuance of Floodplain Management Permits (required for building permit approvals) for only:

- Substantial repairs or improvements for existing structures,
- Construction on previously entitled lots, and
- Entitlement and land division consistent with the Zoning Code.

Further, all building permits in the Natomas Basin, except on County owned land, are conditioned upon recordation by the property owner of an instrument that includes notice and acknowledgment of the flood hazard, insurance requirements, and levee project uncertainties.

The Sacramento County Zoning Code SZC-2016-0023, known as the Floodplain Management Ordinance (search at www.Saccounty.net) dated January 13, 2017, provides some direction on new development in the Natomas Basin. Section 902-57.1 defines where ULOP standards apply for a development project and/or new construction. Section 906-06(0) indicates how the County must find that development projects subject to ULOP 200-year flood protection requirement.

The Natomas Levee Improvement Project work on the north side and the west side of the Natomas Basin is completed to the 200-year flood control standard. This accounts for about 43 percent of the Natomas perimeter levee system. The SAFCA report describes the substantial amount of work required to complete the Natomas levee improvements. The schedule for the remainder of the Natomas levee work is being implemented by the U.S. Army Corps of Engineers and expected to be completed in 2025.

The 200-year flood protection plan for the Natomas Basin will make it one of the most flood-safe areas in the 1,600 mile Central Valley flood control system. The RD 1000 Natomas perimeter levees have never failed, are better than ever, and the current plan describes accomplishing ULOP by 2025; however, there is much remaining work. The ULOP criteria, and Zoning Code Section 5.11, would not allow building permits for new construction in the Natomas Basin if at any time the County is unable to make an adequate progress finding toward achieving the required level of flood protection by 2025.

SAFCA's 2019 Report describes that adequate progress is being made on improvements to protect the Natomas Basin to a 200-year level of protection by 2025 pursuant to the Central Valley Flood Protection Act Urban Level of Flood Protection Criteria (ULOP). However, the work that remains in order to meet 200-year protection in Natomas is substantial. As there are numerous variables and uncertainty with a construction project of this magnitude a current determination of adequate progress does not imply 100% certainty that the project will continue to stay on track with the 2025 deadline. Therefore staff's recommendation is that the County continue to allow limited development in the Natomas Basin, consistent with the Board's limited and measured approach adopted on May 19, 2015, until such time as 200-year flood protection is certain.

The Delta Region

In the Delta, for the last five thousand years to the 1850s, relative sea-level rise was balanced by vertical marsh growth through biomass accumulation and sediment deposition. A transition from deposition of organic silt-clay to peat formation in the Delta largely reflects the decline in inundation frequency and the maturation of the marsh plain towards mean higher high water elevations. The resulting freshwater tidal marshes developed because a relatively large freshwater inflow compared to the size of the tidal prism sustained a low salinity, which supported highly productive organic peat formation through plant growth. As plants such as tules began to grow in the silt deposits, organic sediments such as peat from decomposed roots and rhizomes and other organic soils began to accumulate above these deposits due to plant material decaying and accumulating under anaerobic conditions as the sea level rose. Once the plants were firmly established, their growth and decay lead to accumulations of peat that kept pace with the rising sea levels and basin subsidence. Organic deposit thickness ranges from less than three feet in the eastern, northern, and southern margins of the Delta, to over thirty feet in the western delta. These thicker deposits of peat accumulated in the areas that had the lowest elevation during the final low sea levels. These low basin areas were the first areas receiving deposits and growing plants, allowing the peat buildup to match that of the shallower surrounding areas.

The peat accumulations eventually formed peat islands, with river channels and sloughs established around them and within some of the larger islands. During floods, rivers would overtop the banks of the peat islands, and as the water receded, would leave deposits of sand and silt that formed natural levees along the edges of the islands. Many of the levees currently in the Delta are founded on these natural levees.

For over a century, subsidence of the organic soils in portions of the Delta has led to an increasing need for subsurface drainage. Aerobic oxidation of organic carbon, the primary cause of subsidence, began in the late 1800s as the nutrient-rich organic soils were cleared and farming began. Peat fires, lit to level agricultural fields prior to 1950, and wind erosion are also significant causes of subsidence throughout the Delta. Since reclamation of the island began, elevations have fallen to as much as twenty feet below sea level, requiring protection by over 1,125 miles of man-made levees throughout the Delta. Drainage is provided by a network of ditches that collect and transport shallow groundwater, irrigation runoff, and levee seepage to pump stations that discharge back into the Delta waterways. These ditches create an unsaturated root zone for crops, and provide a more stable levee foundation.

Historically, flooding in the Delta has resulted from levee failures caused by the separate or coincidental occurrence of very high tides, and high runoff and river outflow through the Delta region. Strong onshore winds associated with low barometric pressure storms aggravate flood potential by causing an additional rise of the water surface elevations, and can cause severe erosion on levees in a short period of time. Flood events resulting from high tides and/or high river outflow must be expected to occur in the future.

Levee failures from collapse of rodent dens, seepage, falling trees, or some other mechanical failure are unpredictable and relatively uncommon. Routine levee inspections are the primary preventative measure to identify potential threats that could result in these types of levee failure events.

It should be noted that since 1986, significant improvements have been made to the levee system within the Legal Delta, which has resulted in an overall reduction in the number of flooded islands since the 1986 Delta high water events. Flood events prior to the inception of the Delta Levees Programs in 1973 are not a reliable indicator of current levee condition or flood threat.

Ongoing and Planned Improvements to the Existing Flood Control Systems

Individual reclamation districts, in charge of levee maintenance, are pursuing individual projects that are funded by local and/or State assistance. These are further described in their respective chapters in the Delta Annex.

There are currently six federally authorized projects by the US Army Corps of Engineers (USACE) that are being implemented to reduce flood risk to the Sacramento area:

- Natomas Levee Improvement Project
- American River Common Features - WRDA 96/99 and WRDA 2016
- Folsom Dam Modifications/Join Federal Project
- Folsom Dam Raise project
- South Sacramento Streams Group Project
- Sacramento River Bank Protection Program

Other ongoing projects include:

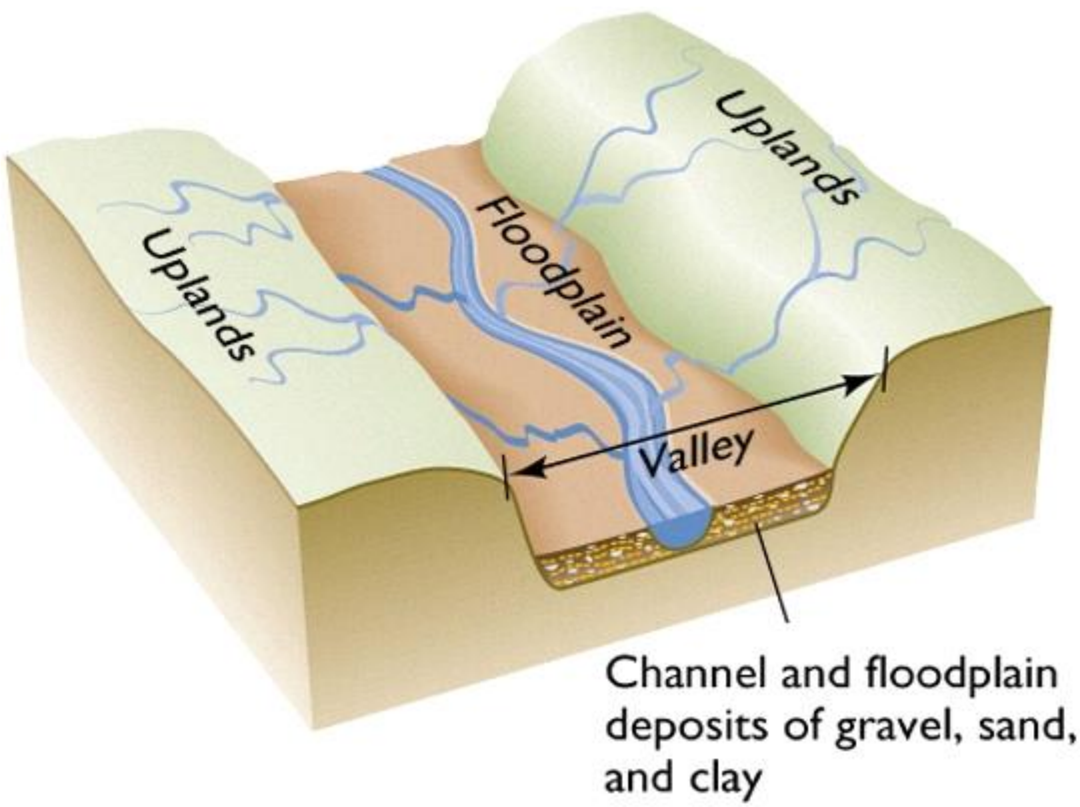
- SAFCA levee accreditation for FEMA level of protection
- Regional planning as part of the Central Valley Flood Protection Plan

- USACE-CVFPB-SAFCA General Reevaluation Report (GRR) planning for 200-year flood protection for Sacramento area
- SAFCA and local community plan development for 200-year flood protection to meet state requirements for urban Level of Protection and Urban Levee Design Criteria.

Floodplains

The area adjacent to a channel is the floodplain (see Figure 4-70). 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 that area that is inundated by the 1% annual chance (or 100-year) flood, the flood that has a one percent chance in any given year of being equaled or exceeded. The 1% annual chance flood is the national minimum standard to which communities regulate their floodplains through the National Flood Insurance Program. The 200-year flood is the flood that has a 0.5% chance of being equaled or exceeded in any given year. The 500-year flood is the flood that has a 0.2% chance of being equaled or exceeded in any given year. The potential for flooding can change and increase through various land use changes and changes to land surface, which 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.

Figure 4-70 Floodplain Schematic



Source: FEMA

Sacramento County Flood Mapping

As part of the County's ongoing efforts to identify and manage their flood prone areas, Sacramento County relies on a variety of different mapping efforts. What follows is a brief description of FEMA and DWR mapping efforts covering the Sacramento County Planning Area.

FEMA 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. The FEMA floodplain are lands subject to the 1% annual chance (100-year) flood. FEMA mapping also includes areas subject to the .02% annual chance (500-year) flood. The State Senate Bill 5 (SB5) required all communities to map their communities. SB5 requires levee protection in urban areas to a 200-year (or 0.5% annual chance flood. A general overview of floodplain mapping is provided in the following paragraphs.

Flood Insurance Study (FIS)

The FIS develops flood-risk data for various areas of the community that will be used to establish flood insurance rates and to assist the community in its efforts to promote sound floodplain management. The current Sacramento County FIS is dated July 19, 2018. 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 1% and 0.2% annual chancer floodplains, floodways, and the locations of selected cross sections used in the hydraulic analysis and local floodplain regulation. The County FIRMs have been replaced by digital flood insurance rate maps (DFIRMs) as part of FEMA's Map Modernization program, which is discussed further below.

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.

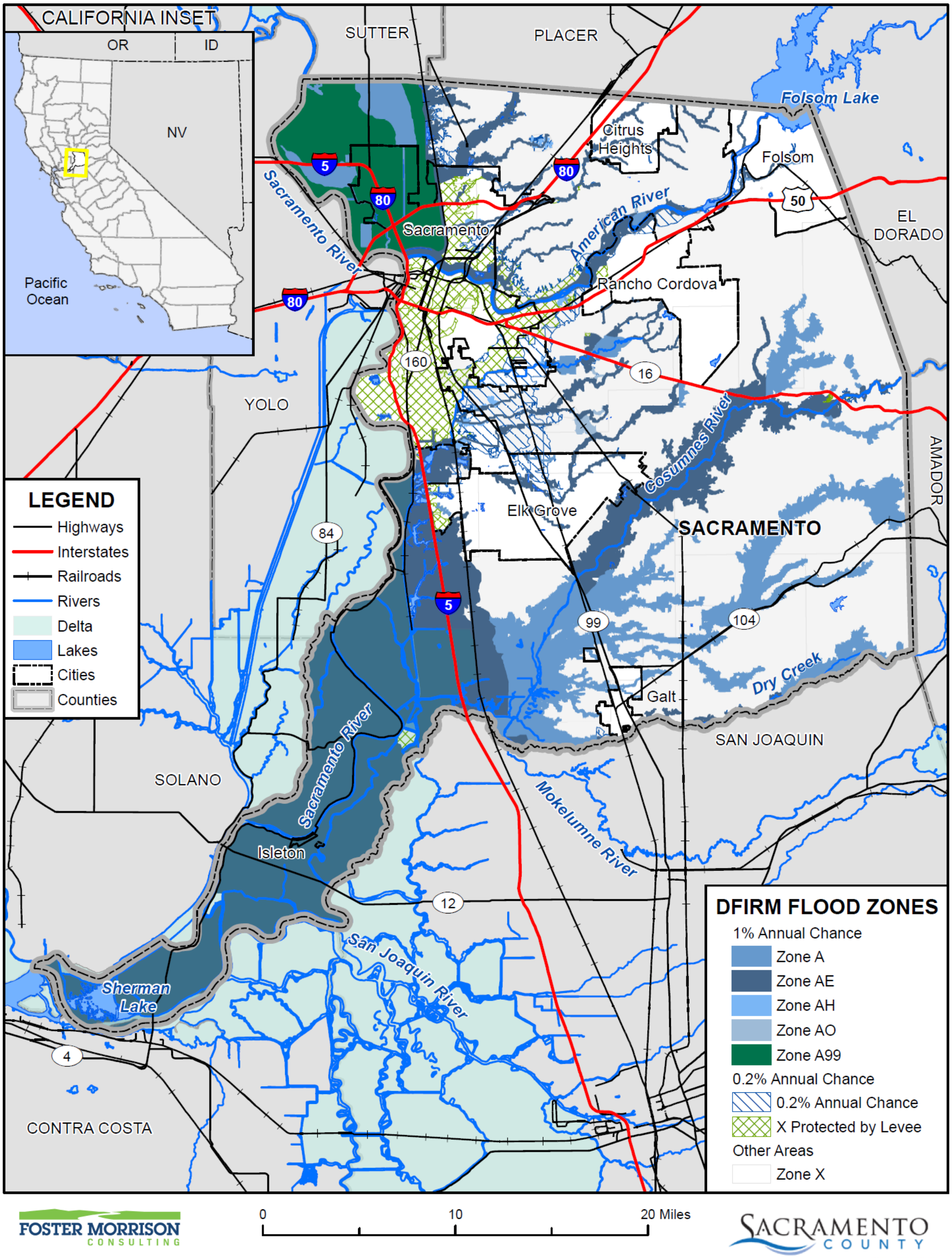
Digital Flood Insurance Rate Maps (DFIRM)

As part of its 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 basemaps;
- Incorporate levee accreditation status in accordance with FEMA requirements at 44 CFR 65.10;
- 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.

DFIRMs for Sacramento County have been developed, are dated July 19, 2015, and are being used for the flood analysis for this LHMP Update. The DFIRM is shown in Figure 4-71.

Figure 4-71 Sacramento County DFIRM Flood Zones



Data Source: FEMA NFHL 07/19/2018, Sacramento County GIS, Cal-Atlas; Map Date: 09/2020.

Mapping of Levees

Also 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.

In August of 2005, FEMA Headquarters' issued Memo 34 Interim Guidance for Studies Including Levees. This memo recognizes the risk and vulnerability of communities with levees. The memo mandates the inclusion of levee evaluations for those communities that are undergoing map changes such as the conversion to DFIRMs. No maps can become effective without an evaluation of all levees within a community against the criteria set forth in 44 CFR 65.10 Mapping of Areas Protected by Levee Systems. Generally, these levee certification requirements include evaluations of freeboard, geotechnical stability and seepage, bank erosion potential due to currents and waves, closure structures, operations and maintenance, and wind wet and wave run-up. In short, these guidelines require certification of levees before crediting any levee with providing protection from the 1 percent annual event (e.g., the 100-year flood).

In Sacramento 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. Some of these facilities were constructed with flood control as secondary or incidental to their primary purpose, so are not considered as providing protection from the 100-year or greater flood. Levees in the County are discussed in Section 4.3.14 of this Plan Update.

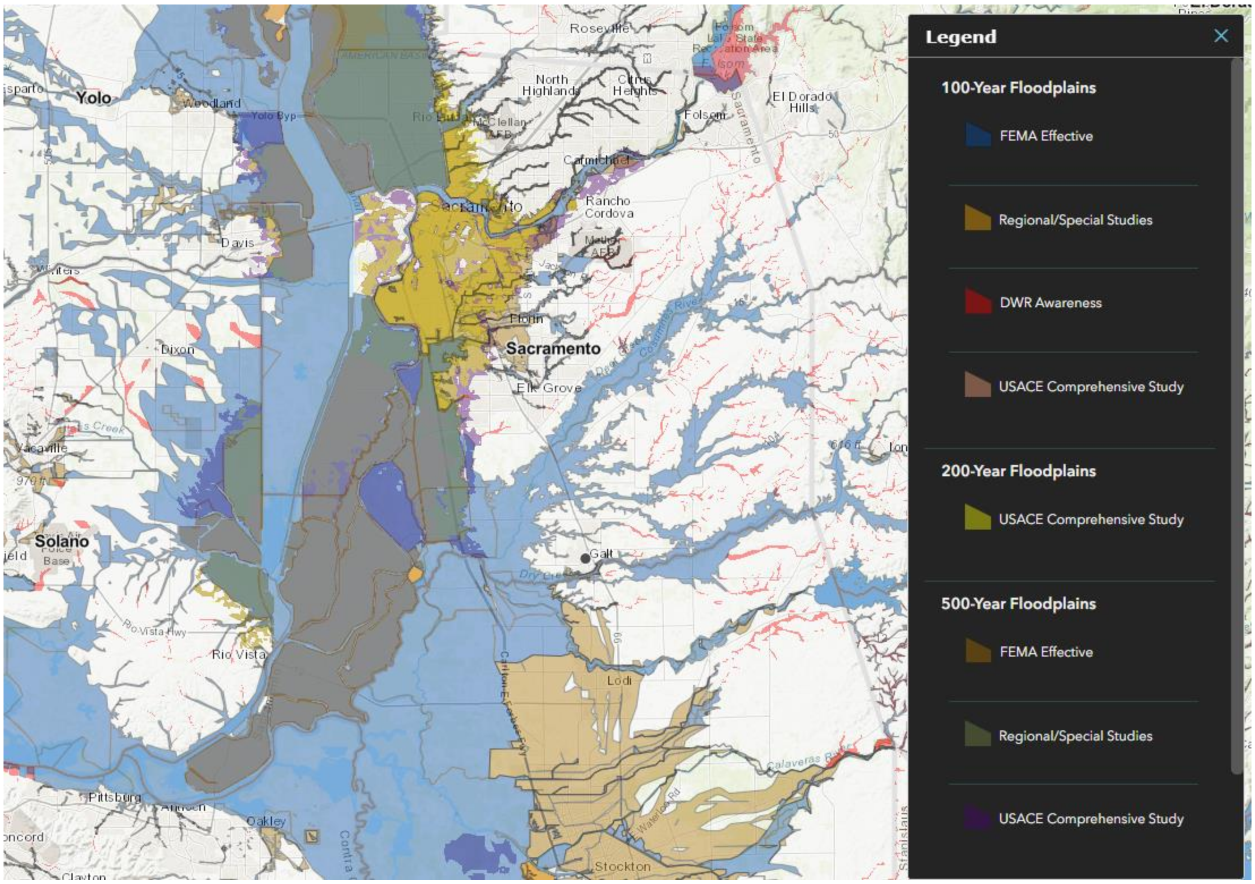
California Floodplain Mapping

Also to be considered when evaluating the flood risks in Sacramento County are various floodplain maps developed by the California DWR for various areas throughout California, and in the Sacramento-San Joaquin Valley cities and counties. The FEMA regulatory maps provide just one perspective on flood risks in Sacramento County. Senate Bill 5 (SB 5), enacted in 2007, authorized Cal-DWR to develop the Best Available Maps (BAM) displaying 1% and 0.5% (200-year) annual chance floodplains for areas located within the Sacramento-San Joaquin (SAC-SJ) Valley watershed. This effort was completed by DWR in 2008. DWR has expanded the BAM to cover all counties in the State and to include 0.2% annual chance flood zones.

Different than the FEMA DFIRMs which have been prepared to support the NFIP and generally reflect only the 1% and 0.2% annual chance flood risks, the BAMs are provided for informational purposes and are intended to reflect current 1%, 0.5% (200-year) as applicable, and 0.2% annual chance flood risks using the best available data. The 100-year floodplain limits on the BAM are a composite of multiple 1% annual chance floodplain mapping sources. It is intended to show all currently identified areas at risk for a 100-year flood event, including FEMA's 1% annual chance flood zones. The BAM are comprised of different engineering studies performed by FEMA, Corps, and DWR for assessment of potential 1%, 0.5%, and 0.2% annual chance floodplain areas. These studies are used for different planning and/or regulatory applications, and for each flood frequency may use varied analytical and quality control criteria depending on the study type requirements.

The value in the BAMs is that they provide a bigger picture view of potential flood risk to the County than that provided in the FEMA DFIRMs. This provides the community and residents with an additional tool for understanding potential flood hazards not currently mapped as a regulated floodplain. Improved awareness of flood risk can reduce exposure to flooding for new structures and promote increased protection for existing development. Informed land use planning will also assist in identifying levee maintenance needs and levels of protection. By including the FEMA 1% annual chance flood zone, it also supports identification of the need and requirement for flood insurance. Figure 4-72 shows the BAM for the Sacramento County Planning Area.

Figure 4-72 Sacramento County– Flood Awareness (Best Available) Map



Source: California DWR, Retrieved 1/29/2021

Legend explanation: Blue - FEMA 1%, Orange – Local 1% (developed from local agencies), Red – DWR 1%r (Awareness floodplains identify the 1% annual chance flood hazard areas using approximate assessment procedures.), Pink – USACE 1% (2002 Sac and San Joaquin River Basins Comp Study), Yellow – USACE 0.5% (2002 Sac and San Joaquin River Basins Comp Study), Tan – FEMA 0.2%, Grey – Local 0.2% (developed from local agencies), Purple – USACE 0.2% (2002 Sac and San Joaquin River Basins Comp Study).

Geographical Flood Extents

Flood extents are usually measured in depths of flooding, geographical extent of the floodplain, as well as flood zones that a location falls in (i.e. 1% or 0.2% annual chance flood). Expected flood depths in the County vary and are not well defined. Flood durations in the County tend to be short to medium term, or until either the storm drainage system can catch up or flood waters move downstream. Geographical flood extent from the FEMA DFIRMs is shown in Table 4-68.

Table 4-68 Sacramento County Planning Area – Geographical Flood Hazard Extents in FEMA DFIRM Flood Zones

Flood Zone	Total Acres	% of Total Acres*	Improved Acres	% of Total Improved Acres*	Unimproved Acres	% of Total Unimproved Acres*
1% Annual Chance	240,861	37.38%	122,572	33.95%	118,288	41.74%
0.2% Annual Chance	55,867	8.67%	4,1050	11.37%	14,817	5.23%
Other Areas	347,691	53.95%	197,381	54.68%	150,309	53.04%
Total	**644,418**	**100.00%**	**361,003**	**100.00%**	**283,415**	**100.00%**

Source: 7/19/2018 DFIRM

Streambank erosion occurs on rivers, streams, and other moving waterways, including leveed areas, in the County Planning Area. The speed of onset of this erosion is slow, as the erosion takes place over periods of years. Duration of erosion is extended. Greater erosion occurs during periods of high stream flow and during storm and wind events when wave action contributes to the extent and speed of streambank erosion.

Past Occurrences

Disaster Declaration History

A list of state and federal disaster declarations for Sacramento County from flooding, (including heavy rains and storms) is shown on Table 4-69. No disasters were related to streambank erosion.

Table 4-69 Sacramento County – State and Federal Disaster Declaration from Flood 1950-2020

Disaster Type	State Declarations		Federal Declarations	
	Count	Years	Count	Years
Flood (including heavy rains and storms)	19	1950, 1955, 1958 (twice), 1963, 1969, 1982 (twice), 1983, 1986, 1995 (twice), 1996, 1997, 1998, 2008, 2017 (three times)	14	1955, 1958, 1964, 1969, 1983, 1986, 1995 (twice), 1997, 1998, 2006, 2017 (three times)

Source: Cal OES, FEMA

NCDC Events

The NCDC tracks flooding events for the County. Events have been tracked for flooding since 1993. Table 4-70 shows events in Sacramento County since 1993. Other heavy rain and storm events can be found in the Past Occurrences of the Severe Weather: Heavy Rains and Storms in Section 4.3.4. More information from the NCDC on some of the flooding is woven into the discussion of HMPC events below. The NCDC does not track streambank erosion.

*Table 4-70 NCDC Flood Events in Sacramento County 1993 to 5/31/2020**

Event Type	Number of Events	Deaths	Deaths (indirect)	Injuries	Injuries (indirect)	Property Damage	Crop Damage
Flash Flood	4	1	0	0	0	$4,400,000	$0
Flood	80	1	0	1	0	$8,877,000	$7,800,000
Heavy Rain	28	0	0	1	0	$365,000	$50,000
Total	**112**	**2**	**0**	**2**	**0**	**$13,642,000**	**$7,850,000**

Source: NCDC

*Note: Losses reflect totals for all impacted areas, much of which fell outside of Sacramento County

January 2, 1997 – The heavy rains brought the Cosumnes River to record flows above designed limits for the protective levees. Twenty breaks occurred, with the largest near the town of Wilton in the southern end of the County. The surging floodwaters inundated 33,000 acres of cropland and 84 homes. Emergency workers effected several roof-top and car-top rescues by boat and helicopter. The single death occurred at the Cosumnes River bridge near the town of McConnel.

January 22, 1997 – Localized heavy rain brought Chicken Ranch Slough out of its banks, flooding the Arden-Arcade area of the city. At least 1,000 homes and apartment buildings were flooded.

January 26, 1997 – Heavy showers and thunderstorms moved over the metro area, re-flooding the neighborhoods surrounding Chicken Ranch Slough, which had just experienced flooding the previous 22^{nd}. The flooding was higher and caused additional damage to 500 more homes.

February 2, 1998 – In Sacramento County, the Consumnes River threatened the town of Wilton, where levees broken by the January 1997, flooding had not been repaired. Fortunately, flooding impact was minor.

January 23, 2000 – Persistent rains which measured for 34 continuous hours swelled Dry Creek over its banks in Rio Linda. Cherry Lane, 6th Street, as well as Curved Bridge Road were flooded. Twelve homeowners had water over their property. Two of them sustained interior flooding while another five sustained flooded garages. The Grant Joint Union High School District closed Rio Linda junior and senior high schools in fear that students would not get home safely. Approximately 2,500 students were sent home early

January 1, 2006 – A series of warm winter storms brought heavy rain, mudslides, flooding, and high winds to Northern California. Levee overtopping, breaching, and river flooding occurred along the Feather and Sacramento mainstem rivers as well as along numerous smaller rivers, creeks, and streams. Several urban areas had significant street flooding. The Sacramento weir was opened for the first time since 1997 with twenty gates opened. Transportation throughout the area was difficult during the course of the storms as airports were closed due to the high winds and major road closures resulted from flooding and mudslides. Interstate 80...the main artery between Sacramento and the San Francisco Bay area...was closed near Fairfield in Solano County for several hours due to severe flooding. Additionally, Interstate 80 eastbound between Sacramento and Reno, NV, was closed for more than a day due to a massive mudslide, as was both directions of U.S. Highway 50 between Sacramento and South Lake Tahoe.

December 3, 2014 – Heavy rain showers and thunderstorms brought record rainfall and flooding issues to portions of the Central Valley and foothills. There were 2 berm levees which failed in Tehama County, flooding over 200 homes and damaging farms and orchards. Significant traffic delays were caused by road flooding across interior Northern California. Snow levels remained above 7500 feet, so snowfall was limited to higher Sierra peaks and Lassen Peak. Watt Ave. and Roseville Rd. number 1 lane flooded with 2 feet of water due to clogged drain.

December 15-16, 2016 – Heavy rain fell in the County. Multiple homeless people were trapped in encampments along the Arden Garden Connector, by Acoma Street. Extensive rescue operations by the Sacramento Fire Department were needed. Folsom police closed White Rock Road, between Placerville and Scott roads, Thursday night and into the Friday morning commute because of flooding and debris in the road. Flooding caused a road closure on Eastern Road between Marconi and Robertson in Carmichael. Deer Creek flooded, forcing the closure of Scott Road near Rancho Murieta.

January 7-10, 2017 – Flooding of Deer Creek reported at Scott Rd. in Sloughhouse. A driver was rescued when his truck got stuck as he drove across the flooded road. Heavy rainfall brought street flooding to Wilton on Green Rd. Kiefer Boulevard north of Jackson Rd. was closed due to flooding. Heavy rainfall and water over topping a levee along the Cosumnes brought street flooding to Wilton on Green Rd and Dillard Rd, and into adjacent properties. There were voluntary evacuations of about 7000 to 10000 people, due to the levee over topping and the threat of possible levee failure.

February 6-20, 2017 – Deer Creek overflowed and floodwaters surrounded Sloughouse Inn. Discovery Park in Sacramento was flooded, with water about 8 feet deep. Green Rd. in Wilton flooded due to levee over topping. Evacuations were ordered for low lying portions of Wilton and Point Pleasant. A freight train carrying food products derailed Friday afternoon near Elk Grove in Sacramento County, sending 22 train cars into the Cosumnes River near Highway 99, according to the Cosumnes Fire Department. A levy on the river nearby had broken, eroding the material under the railroad trestle the train went over, apparently causing the derailment. Three levees along the Cosumnes River were breached Friday night at Pear Lane, allowing flood waters into the Wilton area. Localized flooding closed Green Road and others nearby roads as waters into Dillard Road. Several roads remained closed through the night, according to the Sacramento County Office of Emergency Services. At 08:00 on 2/11, a levee breach on McCormack-Williamson Tract occurred at Station 28+00 on the Mokelumne River. The 150 foot wide breach was located approximately half a mile downstream of the upstream end of McCormack-Williamson Tract. Flooding from Dry Creek in Rio Linda from around 6th St. to Cherry Lane to Rio Linda Blvd, causing road closures. Voluntary evacuation of homes in the area. Winding Way closed from Valhalla Dr. to Walnut Ave. due to flooding of Arcade Creek.

March 17-21, 2017 – Ethel Way was flooded between Fruitridge Rd. and 28th Ave., Sacramento. Roadway flooding reported in eastern Sacramento at Folsom Blvd and 47th St. More than half an inch of rain fell within 15 minutes, flooding roadway at Madison Ave. and I80. Lots of freeway spin-outs. CHP reported roadway flooding at US 50E and 34th Street off-ramp. Roadway flooding reported by CHP at Exposition and Response Rd., Sacramento. Roadway flooding reported by CHP at Watt Ave. and Arden Way, Sacramento. CHP reported roadway flooding at Fulton Ave and Arden Way, Sacramento. CHP reported flooding on on-ramp to SR 51 by Auburn Blvd. Standing water in lane, bottom of the cloverleaf was flooded. Flooded roadways reported in Tahoe Park, Sacramento. Street flooding on Dean Way east of Wales Dr. in Folsom. Vehicle stuck in a flooded roadway on Scott Rd. and Latrobe Rd.

January 6-17, 2017 – California Highway Patrol reported heavy rain caused flooding of Highway 99 in Galt. California Highway Patrol reported heavy rain caused flooding of the southbound lane of Interstate 5 in downtown Sacramento. Stockton Blvd was impassable due to flooding. Local media shared a video of law enforcement rescuing a stranded motorist in Sloughhouse near Kiefer Blvd and Jackson Rd. Road was completely flooded.

February 12-25, 2019 – California Highway reported county roads closed due to flooding. California Highway Patrol reported road flooding with #1 lane blocked on highway 160 s and del paso boulevard on ramp. On twitter the public information officer from Metro fire of Sacramento posted about a swift water rescue that occurred on Feb 13 at 4:44 pm. on Kiefer Blvd north of Jackson Rd. On Twitter the public information officer from Metro Fire of Sacramento posted pictures of a second swift water rescue that occurred on Kiefer Blvd. north of Jackson Road. CHP reported Roseville Road north and southbound just north of Antelope Rd. closed due to flooding. Roadway flooding from arcade creek reported at Winding Way and Walnut Ave. CHP reports roadway flooding on I80 W at Truxel Rd. off-ramp. CHP reports roadway flooding with 8 inches of water affecting north and southbound Stockton Blvd north of Elsie Ave. E I80 BY Longview Dr. flooded. On ramp at I-80 and Watt Ave. completely flooded. There were 6 inches of water in lane number 1 of Capitol City Freeway.

April 5, 2020 ––California Highway Patrol reported 2 feet of water flooding between I80 W and Madison Avenue near North Highlands, CA. California Highway Patrol reported 8 inches of water flooding the roadway between Eastern Ave and Marconi Ave. California Highway Patrol reported 1 1/2 feet of water flowing across all lanes between Interstate 80 East and Auburn Boulevard near North Highlands. California Highway Patrol reported roadway flooding between Sacramentos Gold Drive and Manlove Road in Rosemont, CA. California Highway Patrol reported roadway flooding near Whitney Avenue in Carmichael, CA. California Highway Patrol reported roadway flooding between Roseville Road and Antelope Road in Antelope, CA. California Highway Patrol reported roadway flooding between Kiefer Blvd and Rosemont Drive in Rosemont, CA. California Highway Patrol reported roadway flooding between Sunrise Blvd and Wildridge Dr in Fair Oaks, CA.

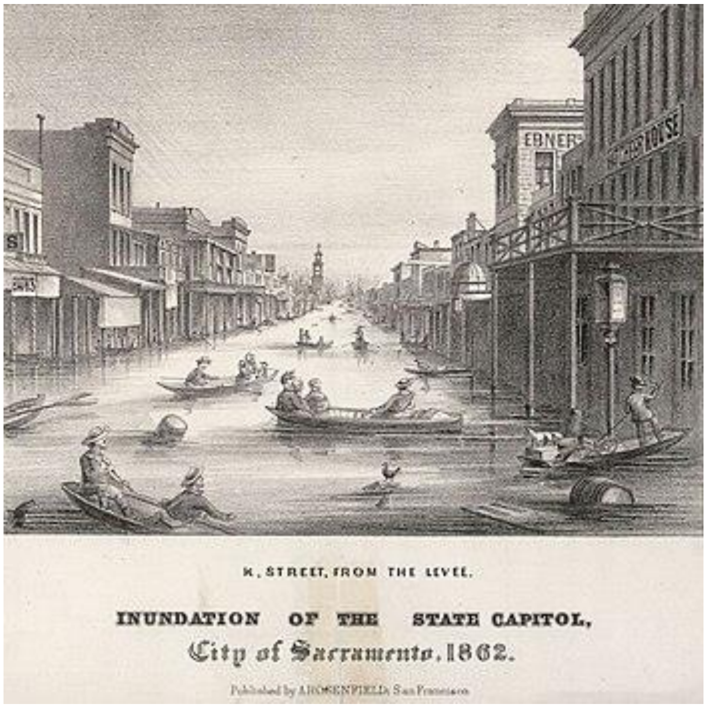
FIS Events

The latest Flood Insurance Study for Sacramento County was released on June 19, 2018. The following discussion is sourced from this discussion.

In urbanizing areas, flood problems are intensified because rooftops of homes and other structures, streets, driveways, parking lots, and other paved areas all decrease the amount of open land available to absorb rainfall and runoff, thus increasing the volume of water that must be carried away by streams. As indicated earlier, the northern portion of the county is urbanizing at a fairly rapid rate.

Native American legends and historical records indicate that at least nine major floods occurred in the Sacramento River basin during the 19th century. A great flood (described in Native American legend as having swamped the entire Sacramento River basin) occurred in 1805. Indians also described floods that occurred in 1825 and 1826 as widespread in the basin. Extensive flooding in northern California took place in 1839, 1840, 1847, 1849-1850, 1852, 1861-1862, 1881, and 1890. The flood of 1861-1862 was the largest known flood in Sacramento County.

Figure 4-73 1862 Flooding



Source: Great Flood of 1862 (Wikipedia.org)

One of the earliest reports of flooding in Sacramento County was the graphic account of Professor William H. Brewer of Yale University, who described the floods of January-March 1862 in the Sacramento area:

> ***"Nearly every house and farm over this immense region is gone. There is such a body of water-250 to 300 miles long and 20 to 60 miles wide, the water ice cold and muddy--that the winds high waves which beat the farmhouses in pieces… The new Capitol is far out in the water—the Governor's house stands as in a lake— churches, public buildings, private buildings, everything is wet or in water. Not a road leading from the city is passable, business is at a dead standstill,"***

Substantial flooding in the County also occurred in 1928, 1937, 1938, 1940, 1943, 1945, 1950, 1952, 1955, 1956, 1958, 1962, 1963, 1964-1965, 1967 and 1969, 1972, 1980, 1982, 1983 and 1997. Newspaper accounts, rainfall and stream gage records and previous studies, indicate that the City of Sacramento has experienced significant flooding in 1928, 1950, 1962, 1967, 1986 and 1997.

In February 1986 a vigorous low pressure system drifted east out of the Pacific, creating a Pineapple Express that lasted through February 24 and unleashed unprecedented amounts of rain on northern California. In Sacramento, nearly 10 inches of rain fell in an 11-day period. The overwhelming floodwaters tore bridges from their foundations and punched through levees. The Northern California flood resulted in 13 deaths, 50,000 people evacuated and over $400 million in property damage.

In 1995, heavy rains hit the Sacramento area causing wide-spread localized flooding, in particular in the Arcade, Morrison, Florin, Union and Dry Creeks.

Two years later in 1997, a series of tropical storms hit the valley, causing the Cosumnes River to crash through levees in 24 places. Most recently, the 2005/2006 event earned the name "New Year's Eve Storm" because it soaked the region and caused widespread, localized flooding during the first days on New Year's Eve 2005 through the first few days of 2006. And although this flood event was not of the magnitude of those in the past, it did cause residents to be vigilant and question their individual storm readiness (Storm Ready, 2015). Newspaper accounts, rainfall and stream gage records and previous studies, indicate that the City of Sacramento has experienced significant flooding in 1928, 1950, 1962, 1967, 1986 and 1997.

Moderate agricultural damages estimated at $104,000 were caused by the 1966-67 flooding, even though more acres were flooded (approximately 8,070 acres), particularly on Laguna Creek which again overflowed into its floodplain, than during the flooding of 1963 and 1964.

The majority of flooding in January 1969, occurred on agricultural lands in the City of Sacramento, predominantly on lands that lay west of the Union Pacific Railroad (UPRR) tracks in the Beach-Stone Lakes area. Minor flood losses (principally to farmland, crops, and improvements) were incurred east of the UPRR tracks. Floodwaters covered approximately 10,500 acres, and damages were estimated at $159,000.

Detailed flood damage surveys were not conducted after the 1973, 1983, 1986 and 1997 floods. However, it is estimated that approximately $500,000 in damages occurred in 1983. Only negligible damages occurred during the February 1986 flood. Peak flows in the last ten years may have been higher partly because of channel improvement work, enlarged channel capacity, and levee construction by local interests in that period.

The severity of flooding on all the streams studied during the July 6, 1998, restudy in the City of Sacramento, is intensified by backwater conditions between stream systems. Floodwater elevations are increased in the lower portions of tributary streams due to the backwater effect from main streams reducing hydraulic gradients and flow-storage areas. During this time, there will be a high degree of coincidental 1-percent annual chance flood flows on all the study area waterways.

The high flow of floodwaters on some channels within the City of Sacramento has a great impact (causing backwater conditions) on the hydraulic regimen of other channels. High flows on the Sacramento River generate backwater conditions on the lower reaches of the American River and the Cross Canal. The American River peak 1-percent annual chance flows induce backwater conditions in the lower reach of the Natomas East Main Drainage Canal. Coincidentally, high flows on the Natomas East Main Drainage Canal cause backwater conditions on the lower reaches of Arcade and Dry Creeks.

American River Stream Group Flooding

The FIS reviewed flood problems in the American River Stream Group. This consists of American River, Arcade Creek Brooktree Creek, Carmichael Creek, Chicken Ranch Slough, Coyle Creek, Cripple Creek, Dry Creek, Dry Creek (near Galt), Hinkle Creek, Humbug Creek, Linda Creek, Linda Creek (South Branch), Lower Magpie Creek, Magpie Creek, Magpie Creek Diversion, Mariposa Creek, Natomas East Main Drainage Canal, Natomas East Main Drainage Canal Tributary F, Natomas East Main Drainage Canal Tributary G, Natomas East Main Drainage Canal Tributary I, and Robla Creek.

The American River near the City of Sacramento overflowed in 1928, causing extensive flooding in the River Park and Industrial Park areas on the south bank. In 1950, the American River inundated extensive areas on the north bank, including the area in the vicinity of Fulton Avenue and Fair Oaks Boulevard.

Floods on Dry Creek (American River Stream Group) have occurred with regularity since 1937. Flooding also occurred on Dry and Robla Creeks near the Natomas East Main Drainage Canal. The October 1962 floods on Dry and Robla Creeks spread from approximately 800 feet to approximately 1 mile wide. The flood of October 1962, was the largest that has been recorded at the Roseville gaging station, located on Dry Creek upstream of Sacramento County. Damage in the October 1962 flood was on the order of approximately $50,000. The resultant high water was within 2 feet of the top of the levee on the southern side of Robla Creek and along the Magpie Creek diversion channel. Floodwaters from Magpie Creek bypassed the upper portion of the diversion levee and flowed into lower Magpie Creek. Similar, less-severe floods, occurred in 1955, 1958, February 1962, 1967, 1969, 1970 and 1973.

Other creeks in the American River Stream Group have floodplain boundaries similar to that of Dry Creek. The largest flood on Arcade and Cripple Creeks occurred in October 1962, with resulting damages of approximately $10,000.

The largest recent floods on Strong Ranch and Chicken Ranch Sloughs occurred in February 1962. No damage estimates are available; however, runoff was too large for the channels and bridges, resulting in local flooding. The capacity of the American River pumping plant was exceeded for a short time, and floodwaters backed up and inundated areas in the vicinity of the nearby sewage treatment plant.

The most recent flooding on the American River occurred in February 1986. The peak flow during this flood has been estimated to exceed the current 1-percent annual chance flood peak of 115,000 cubic feet per second (cfs).

Floods on the Cosumnes River occurred in 1950, 1955, 1958, 1962 and 1964, with the events of 1955, 1958 and 1964, being most severe. In 1958, an estimated 38,000 acres of land were inundated along the Cosumnes River and the lower portions of Dry, Deer, and Laguna Creeks. In 1964, an estimated 30,000 acres of land were inundated.

The floodplain areas of Willow, Humbug, and Hinkle Creeks near the City of Folsom have little existing structural development. The current and past land uses have been agricultural and open space. A thorough search of records has not uncovered any record of past floods. No records have been kept due to the past and current land uses and short duration of flood flows. The flooding events have not been considered significant problems, and the flood damages have not been recorded.

The higher elevation tributary area of the Dry Creek watershed, near the City of Galt, subject to snowfall is too small to generate snowmelt flooding. Snowmelt during a flood-producing rainstorm would not increase runoff significantly. Due to the largely rural nature of the Dry Creek floodplain, and because flood damage has been predominantly agricultural, historical floods have not been documented in much detail. The earliest major flood flow of record, 13,200 cfs, approximately an 11.1- percent annual chance (9-year) flood, occurred on February 2, 1945.

From high-water marks known to long-time residents of the area, an estimated flood flow of 18,700 cfs (approximately a 5.8- percent annual chance [17-year] flood) occurred in February 1936 and a flood flow estimated to be approximately 24,000 cfs (approximately a 2.9-percent annual chance [35-year] flood) occurred in March 1907.

In December 1955, a 17,000 cfs flow (approximately a 7.1-percent annual chance [14-year] flood) on Dry Creek resulted from approximately 7 inches of antecedent rainfall over the tributary drainage. Although there was no Dry Creek overflow into the City of Galt, there was flooding from Hen Creek in the west-central part of the City where water was nearly knee deep along Lois Avenue, and at the Myrtle Avenue-Palin Street and Myrtle Avenue-Oak Avenue intersections. Damage, however, was minor and floodwater receded within 1 day. On April 3, 1958, the largest flood of record, 24,000 cfs (approximately a 2.9-percent annual chance flood), occurred on Dry Creek. Although approximately 9,000 acres of land were flooded along the creek, there was no overflow into the City of Galt. Antecedent rainfall, which was 12.5 inches over a period of several days, had created very wet ground conditions that influenced the magnitude of runoff. Rainfall on January 31 and February 1, 1963, a total of approximately 32 percent of the normal annual precipitation over the Dry Creek drainage, resulted in a flow of 9,800 cfs (approximately a 20-percent annual chance [5-year] flood) on Dry Creek. A small dam at one end of the golf course, which was under construction on the south side of the City of Galt, was breached, and part of the facility was inundated for a short time. During the height of the storm, many streets in the City of Galt were submerged due to lack of adequate storm drainage. In December 1964, approximately 8,200 acres were flooded by Dry Creek; however, overflow near the City of Galt was limited to a portion of the golf course, which was caused when a low levee was overtopped. The flow recorded at the Dry Creek stream gage was 14,500 cfs (approximately a 10-percent annual chance flood). Antecedent rainfall was not significant (USACE, 1955 et cetera; The Galt Herald, 1955 et cetera).

The severity of two areas within the unincorporated areas where the high flow of floodwaters on some channels has a great impact (causing backwater conditions) on the hydraulic regimen of other channels. High flows on the Sacramento River generate backwater conditions on the lower reaches of the American River and the Cross Canal. The American River peak 1-percent annual chance flows induce backwater conditions in the lower reach of the Natomas East Main Drainage Canal.

Coincidentally, high flows on the Natomas East Main Drainage Canal cause backwater conditions on the lower reaches of Arcade and Dry Creeks. In December 1964 and January 1965, the coincidental occurrence of very high tides and heavy inflow resulted in unusually high stages on all delta waterways. Concurrent strong onshore winds generated high waves that created very perilous conditions for many islands. Several hundred acres were flooded and damages, mainly flood fighting and repair of levees and levee roads, were a little less than $1 million. In January and February 1969, high tides and adverse wave action in the delta, combined with large river inflow and rain-soaked levees, caused the flooding of several islands and the endangerment of many other islands. Approximately 11,400 acres were inundated and flood damages amounted to about $9.2 million. The levee separating Andrus Island and the San Joaquin River failed from unknown causes in June 1972, resulting in the flooding of Andrus and Brannan Islands (including the City of Isleton). High winds had occurred prior to the break, but there had been no antecedent rainfall and the tidal cycle was not on the higher side. About 15,000 acres were inundated and flood damages for the event approximated $30 million.

The American River near the City of Sacramento overflowed in 1928, causing extensive flooding in the River Park and Industrial Park areas on the south bank.

In 1950, the American River inundated extensive areas on the north bank, including the area in the vicinity of Fulton Avenue and Fair Oaks Boulevard.

In December 1955, Arcade Creek overflowed its banks, inundating portions of Del Paso Park as well as areas upstream along Winding Way and portions of the Hagginwood District downstream. Flooding also occurred on Dry and Robla Creeks near the Natomas East Main Drainage Canal.

Floods occurred twice in 1962. The February 1962 floods caused inundation along Arcade Creek in the vicinity of Del Paso Park. The park and the Haggin Golf Course were flooded, and the floodwaters forced the closing of Roseville Road. Dry and Robla Creeks caused flooding in the vicinity of the Natomas East Main Drainage Canal where Rio Linda Boulevard was threatened. Laguna Creek spread out over its floodplain.

A severe, early season rainstorm occurred in October 1962, resulting in widespread flooding in the City of Sacramento. Arcade Creek overflowed from Marysville Road to past Del Paso Park. Six families on Verno Street had to evacuate because the flood threat was particularly severe in this area. Damages were estimated at $10,000 along Arcade Creek. Excess floodwaters from Dry Creek flowed southerly along the eastern side of the Western Pacific Railroad to Robla Creek and the Magpie Creek Diversion. The resultant high water was within 2 feet of the top of the southern levee of the diversion. Portions of floodwaters from Magpie Creek bypassed the upper portion of the diversion's levee and flowed into Lower Magpie Creek, causing flooding in the area between Dry Creek Road and Raley Boulevard. Dry and Robla Creeks again spread out over their common floodplain near the Natomas East Main Drainage Canal. An estimated $50,000 in flood-related damages was caused by the flood on Dry Creek. Many of these damages were caused in areas along Dry Creek upstream of the City of Sacramento.

Flooding in January 1967 was less severe than flooding in 1962. Arcade Creek overflowed its banks upstream of the City of Sacramento and flooding in the City was restricted to minor inundation in Del Paso Park. Flooding that occurred in February 1973 on Arcade Creek had a recurrence interval of approximately 10- percent annual chance flood. Dry and Robla Creeks, however, overflowed inside the City.

Morrison Stream Group Flooding

The FIS reviewed flood problems in the Morrison Stream Group. This consists of Cosumnes River, Cosumnes River Above Dillard Road, Cosumnes River Above State Highway 99, Cosumnes River Overflow North of Lambert Road, Elder Creek, Elk Grove Creek, Florin Creek, Gerber Creek, Laguna Creek, Laguna Creek Bypass Channel, Laguna Creek Tributary No. 1, Mather Field Main Drain, Mather Field Main Drain Tributary, Mather Field West Drain, Mather Lake Tributary, Morrison Creek, Strawberry Creek, Unionhouse Creek, And Whitehouse Creek.

Large portions of the Morrison Creek Stream Group area in Sacramento County were flooded in 1952, 1955, 1958, 1962-64, 1966-67 and 1969. During the 1955 flood, overflow from the Cosumnes and Mokelumne Rivers caused inundation of the Beach-Stone Lake area, thus creating high backwater conditions on streams of the Morrison Creek Stream Group. Damage was estimated at $213,000 in the Morrison Creek Stream Group area as a result of the 1955 floods and at $204,000 from the 1958 flood. The estimated damage for 1969 was $159,000.

Floods on the Cosumnes River occurred in 1950, 1955, 1958, 1962 and 1964, with the events of 1955, 1958 and 1964, being most severe. In 1958, an estimated 38,000 acres of land were inundated along the Cosumnes River and the lower portions of Dry, Deer, and Laguna Creeks. In 1964, an estimated 30,000 acres of land were inundated.

In October 1962, the Morrison Creek Basin was again flooded. A local newspaper called the Fruitridge-Florin area "the worst hit," with water "up to the tops of doors on cars" (Sacramento Bee, 1962). Floodwaters escaped from Morrison Creek near the Sacramento Army Depot. This overflow, along with other overflows from Morrison Creek upstream of Stockton Boulevard, caused widespread inundation of a primarily residential area east of Stockton Boulevard from the City of Sacramento corporate limits north to Fruitridge Road. The Glen Elder section east of Stockton Boulevard and south of Elder Creek Road, was the most severely flooded portion in the Morrison Creek Stream Group area. Laguna, Elder, Florin and Unionhouse Creeks, also overflowed their banks during this flood, adding to the flood problems in the area. A total of $161,000 in flood-related damages was estimated to have occurred in the entire Morrison Creek Stream Group area during the October 1962 flood.

In 1964, Morrison Creek flooded a large region west of the Western Pacific Railroad tracks and south of Meadowview Road. Laguna Creek flooded an area adjacent to the stream that extended for about six miles from near the City of Elk Grove westerly to the Union Pacific Railroad tracks. The 1964 flooding in the basin inundated about 7,700 acres and caused an estimated $156,000 in damages.

Moderate agricultural damages estimated at $104,000 were caused by the 1966-67 flooding, even though more acres were flooded (approximately 8,070 acres), particularly on Laguna Creek which again overflowed into its floodplain, than during the flooding of 1963 and 1964.

The most recent flooding occurred in February 1986. That flood had the largest peak flow recorded on Morrison Creek (slightly higher than the January 1982 peak flow). Both the 1982 and 1986 floods have recurrence intervals of approximately a 4-percent-annual-chance flood. The estimated damage for 1982 was $500,000. Flooding had also occurred in February 1973 and has a recurrence interval of approximately a 10- percent-annual-chance flood.

There are five main areas of floodwater intermingling in the Morrison Creek Stream Group basin. Between the Central California Traction Company Railroad (CCTCRR) tracks and Florin-Perkins Road, Morrison Creek overflows its south bank, and the floodwaters continue to the south for about one mile and mingle with Florin Creek overflows. Laguna Creek floodwaters overtop the creek's north bank just east of the CCTCRR tracks, flow into the east embankment of the tracks, and then continue northwesterly parallel to the embankment for about one and one-half miles and join Gerber Creek flows. Combined flood flows from Laguna and Gerber Creeks overtop the north bank of Gerber Creek just east of the CCTCRR tracks and flow northwesterly along the east embankment of the tracks for about one mile and then unite with Elder Creek flows. Gerber Creek flood flows overtop the creek's south bank about one-half mile west of the CCTCRR tracks, extend southwesterly for about one mile and mix with Unionhouse Creek flood flows. In the western part of the basin between Franklin Boulevard and the Western Pacific Railroad tracks, floodwaters from various streams commingle.

Sacramento River and the Delta Slough

The FIS reviewed flood problems in the Sacramento River and the Delta Slough. This consists of Georgiana Slough, Sacramento River, Sevenmile Slough, Steamboat Slough, Sacramento Slough, and Three Mile.

The lower reaches/delta of the Sacramento and San Joaquin Rivers are under the influence of the tides. The most severe flood conditions in the delta would result when very high tides and large volume of stream outflow occur coincidentally, and strong onshore winds generate wave action. It should be noted that precipitation over the delta does not materially affect local flood conditions.

A fundamental flood problem in the delta results from the fact that for every square mile of land reclaimed, there is one square mile less of floodplain to contain the volume of the rising tide and outflow from the rivers of the Central Valley. Furthermore, the substructure of much of the Delta is overlain by a 20- to 50-foot thick layer of peat soil, which is ideal for agriculture but very poor as foundation or building material for levees. Peat soil dried out and exposed to air constantly oxidizes and subsides. As islands subside, water pressure in adjoining channels may become too great for levees to withstand and a section may fail. Also, levees are continually being eroded by stream outflow, tidal flow, and wave wash from winds and boat wakes. Increasing levee fill creates compression that may force underlying materials to rupture into the adjoining waterway or toward the land side of the levee. If one island is flooded and its levees are lost, the levees protecting an adjacent island becomes more vulnerable to the forces of waves and wind.

The Sacramento-San Joaquin delta area has a long history of flooding. Since construction of levees started in the early 1860s, every island has been flooded at least once due to levee overtopping or failure. Prior to 1950, most of the failures were due to levee overtopping. However, since the construction of many upstream dams, that flood factor has been reduced and now the major cause of flooding is levee instability. Approximately 12 levee failures have occurred since 1980.

In mid-January 1980, severe rainstorms over central California precipitated high river outflow through the delta, which, coinciding with gale force winds over the delta and high tides, resulted in the levee failure and flooding of two tracts (placing approximately 9,600 acres under water). Continued high inflow to the delta and wind-generated waves increased erosion on all delta levees, necessitating intensive flood fighting and the temporary curtailment of boat traffic. Then in late February 1980, three islands at the lower end of the Yolo Bypass and one additional tract were inundated.

Heavy inflow and strong winds caused by a major storm over California in late November 1982, in combination with high tides, resulted in widespread levee erosion and overtopping in the delta and the flooding of an island and a tract. A succession of intense storms continued to batter the State until March 1983, establishing rainfall records for the delta and tributary regions.

Upstream reservoir releases were larger and sooner than anticipated due to the heavy rainfall and a deep snowpack, worsening an already critical levee situation. Concurrently, extremely high tides prevailed in the delta along with wind-driven waves.

Several levee failures occurred and eight islands/tracts were under water by late March 1983. More than 16,000 acres were flooded and the estimated associated damages amounted to more than $20 million.

The lower reaches/delta of the Sacramento and San Joaquin Rivers are under the influence of the tides. The most severe flood conditions in the delta would result when very high tides and large volume of stream outflow occur coincidentally, and strong onshore winds generate wave action. It should be noted that precipitation over the delta does not materially affect local flood conditions. More information about past occurrences of flooding in the Delta can be found in the levee failure discussion in Section 4.3.14.

San Joaquin River Stream Group Flooding

The FIS reviewed flood problems in the San Joaquin River Stream Group. This consists of Delta Cross Canal, Mokelumne River, North Fork Mokelumne River, North Fork Mokelumne River Overflow Channel, San Joaquin River, and Snodgrass Slough.

Historically, flooding along the Mokelumne River has been caused by general rainstorms in late fall and winter, and by snowmelt runoff in spring and early summer. The effects of cloudburst storms on an area as large as the Mokelumne River basin is negligible.

Flooding on the detailed study reach of the Mokelumne River has occurred in 1907, 1909, 1911, 1914, 1921, 1925, 1928, 1937, 1950, 1952, 1955-1956, 1963, 1964, 1967, 1969 and 1970. The most disastrous flood was that of November 1950, which caused about $1.1 million in damages. The December 1955-January 1956 floodwaters caused an estimated $750,000 in damages. The flood of December 1964 is the largest of record on the Mokelumne River. However, due to the completion of Camanche Dam in April 1964, most damages in the later flood had been prevented. Contemporary accounts of floods on the Mokelumne River are essentially nonexistent. Streamflow recorded for the study reach of the Mokelumne River were begun in 1904.

Hazard Mitigation Planning Committee Events

February 1986 - A resident in the area noted that flooding occurred in South Sacramento County. A 35-year flood event flooded 15,000 acres, including areas around I-5. I-5 was closed for 4 weeks and was under 3' of water in areas. Substantial damages to homes and businesses in the area. No deaths or injuries were reported.

January 2017 – Sacramento County was impacted by a series of Atmospheric River and storm systems starting January 3, 2017 through January 24, 2017. These storm systems cumulatively impacted the region causing worsening damage throughout the month. Sacramento continued to respond to levee issues and emergency work and the county continued to see flooded areas even though river levels dropped slightly.

Water from storm systems, king tides, releases, and runoff into the watershed impacted several areas of Sacramento County, specifically: Rio Linda, Point Pleasant, Glanville tract, Wilton and the southern portions of the County in which voluntary evacuations were called. Rescues took place in Point Pleasant assisting people from their homes to safe areas. Water damaged levees with breaks and overtopping. Additionally, several roadways were flooded. A private levee failure within San Joaquin County continues to cause flooding to New Hope Road through March 2017. Heavy soil saturation weakened the ground near trees and power poles and significant high winds caused numerous outages throughout the county, some lasting as long as 48 hours. Public utility crews spent excessive man hours responding to downed trees and limbs, and fire crews and equipment were completely tasked either on standby or response to downed power lines. Volunteer fire crews were brought in to supplement.

On January 25, 2017, the County was still actively engaged in emergency responses to levee erosion, boils, and repairs due to high water conditions caused by the weather systems and dam releases. Cosumnes River was flooded from levee failures at Twin Cities Road and roads in the area were closed on January 24, 2017. It took days before damage and debris assessments were completed.

The Emergency Operations Center and field crews were active throughout the month coordinating response to the storms and providing communication to the public about the risks and actions they should take to maintain their safety. Forty-six different agencies and departments came together for successful EOC operations.

February 2017 – Sacramento County was impacted by a series of Atmospheric River and storm systems starting February 2, 2017 and continuing through February 23, 2017. These storm systems followed a series of Atmospheric Rivers in January 2017 and cumulatively impacted the region causing worsening damage throughout the month. Sacramento continued to respond to levee issues and emergency work and the county continued to see flooded areas even though river levels dropped slightly.

Figure 4-74 Sacramento County 2017 Flooding

Source: CA DWR Pixel website

Water from storm systems, king tides, releases, and runoff into the watershed impacted several areas of Sacramento County, specifically: Rio Linda, Point Pleasant, Glanville tract, Wilton and the southern portions of the County in which voluntary evacuations were called. Rescues took place in Point Pleasant assisting people from their homes to safe areas. Water damaged levees with breaks and overtopping (discussed in further detail in the Past Occurrences of Section 4.3.14). Additionally, several roadways were flooded. A private levee failure within San Joaquin County continued to cause flooding to New Hope Road through March 2017. Heavy soil saturation weakened the ground near trees and power poles and significant high winds caused numerous outages throughout the county, some lasting as long as 48 hours. Public utility crews spent excessive man hours responding to downed trees and limbs, and fire crews and equipment were completely tasked either on standby or response to downed power lines. Volunteer fire crews were brought in as a supplement.

The Sacramento County Emergency Operations Center (EOC) and field crews were active throughout the month coordinating response to the storms and providing communication to the public about the risks and actions they should take to maintain their safety. Forty-six different agencies and departments came together for successful EOC operations.

Likelihood of Future Occurrence

1% Annual Chance Flood

Occasional— The 1% annual chance flood (100-year) is the flood that has a 1 percent chance of being equaled or exceeded in any given year. This, by definition, makes the likelihood of future occurrence occasional. However, the 100-year flood could occur more than once in a relatively short period of time.

0.5% Annual Chance Flood

Unlikely—The 0.5% annual chance flood (200-year) is the flood that has a 0.5 percent chance of being equaled or exceeded in any given year. This, by definition, makes the likelihood of future occurrence unlikely.

0.2% Annual Chance Flood

Unlikely—The 0.2% annual chance flood (500-year) is the flood that has a 0.2 percent chance of being equaled or exceeded in any given year. This, by definition, makes the likelihood of future occurrence unlikely.

Climate Change and Flood

Climate change and its effect on flooding in the County has been discussed by two sources:

- 2021 Draft Sacramento County CAP
- CAS – 2014

2021 Draft Sacramento County CAP

The 2021 Draft Sacramento County CAP noted that climate change is likely to lead to changes in the frequency, intensity, and duration of extreme weather events, such as sustained periods of heavy precipitation, increased rainfall intensity during precipitation events, and increased risk of rain-on-snow events. Further, more winter-time precipitation that falls as rain instead of snow, and higher temperatures that will cause earlier snowmelt, which could produce substantial surface water flows over a short period of time and may potentially affect dams and spillways and overwhelm levee systems designed for historical precipitation patterns. Historically, the County experienced an average of three extreme precipitation events per year. Under both the medium and high emissions scenarios, the county is expected to experience four extreme precipitation events per year by mid-century and five extreme precipitation events per year by the late century.

Increased flooding due to climate change will most adversely affect vulnerable populations living in floodplains. Low-income populations suffer higher mortality rates, and their homes sustain greater damage due to the housing stock, location, and inability to afford structural upgrades or flood insurance to mitigate the effects of flooding. Low-income households may also lack transportation and other resources to respond to or evacuate during a flood event. Race, class, ethnicity, and immigration status are also drivers of flood-related social vulnerability, as these may impose cultural and language barriers that affect emergency communications and access to post-disaster resources for recovery. Additionally, floodwater can interact with sources of pollution and distribute hazardous pollutants locally and regionally, resulting in water contamination and human health impacts.

Floods can disrupt transportation networks, cause economic losses through closure of businesses and government facilities, disrupt communications, disrupt the provision of utilities such as water and sewers, result in excessive expenditures for emergency response, and generally disrupt the normal function of a community. Roadway closures due to extended periods of flooding could prevent residents from accessing key supplies, such as food, electricity, fuel, and potable water. Flooding may also threaten ecosystem functioning and agricultural resources: unlike natural flooding regimes that deposits useful sediment resulting in increased soil fertility as well as groundwater recharge, catastrophic flooding from levee overtopping could lead to soil erosion and loss of viable cropland. It could also release sewage and hazardous materials into the environment if wastewater treatment plants are inundated, storage tanks are damaged, and pipelines severed.

Lastly, severe flooding is capable of destroying building and infrastructure such as bridges, roadways, electrical boxes, drainage systems, and levees. Extreme weather events could weaken or collapse levees in the Delta and could breach Sacramento and American river levees especially where they have not yet been upgraded or do not meet the minimum National Flood Insurance Program requirements.

CAS

According to the CAS, climate change may affect flooding in Sacramento County. While average annual rainfall may increase or decrease slightly, the intensity of individual rainfall events is likely to increase during the 21st century. It is possible that average soil moisture and runoff could decline, however, due to increasing temperature, evapotranspiration rates, and spacing between rainfall events. Reduced snowpack and increased number of intense rainfall events are likely to put additional pressure on water infrastructure which could increase the chance of flooding associated with breaches or failures of flood control structures such as levees and dams. Future precipitation projections were shown in Figure 4-31 in Section 4.3.4. Also according to the National Center for Atmospheric Research in Boulder, Colorado, Atmospheric Rivers are likely to grow more intense in coming decades, as climate changes warms the atmosphere enabling it to hold more water.

Vulnerability Assessment

Vulnerability—Extremely High

Historically, Sacramento County has always been vulnerable to flooding because of its relatively flat terrain and the number of water courses that traverse the County. Flood zones in Sacramento County are quite extensive. High water levels are a common occurrence in winter and spring months due to increased flow from stormwater runoff and snowmelt. Several areas of the County are subject to flooding by the overtopping of rivers and creeks, levee failures, and the failure of urban drainage systems that cannot accommodate large volumes of water during severe rainstorms.

River flooding is the most significant natural hazard that Sacramento County faces. Sacramento is not just at high risk of flooding, but is at high risk of catastrophic flooding. When the 100-year event is exceeded, the consequences could be great as flood depths behind levees can range up to many feet deep in some urban areas.

In addition to the major rivers, there are many streams, channels, canals, and creeks that serve the drainage needs of the County. There is significant threat of flooding in large areas of the county from several of these streams. Many of these streams are prone to rapid flooding with little notice.

According to SAFCA, Sacramento's risk of flooding is the greatest of any major city in the country. Sacramento's flood risk is exceptionally high for two reasons:

1. The cores of today's levees are often the levees built by farmers and settlers as much as 150 years ago. Early levees were not constructed to current engineering standards, and little care was given to the suitability of foundation soils. It was believed prior to 1986 that the levees containing the Sacramento River and the American River were of sufficient height and stability to protect the county from 100-year or greater storms. The storms that occurred in February 1986 demonstrated that those levees are not always sufficient.
2. The quantity of water flowing out of the Sierra Nevada Mountains during large floods appears to be increasing. Folsom Dam was designed, based on historical data, to reduce flood flows in the American River to a flow rate that could be safely contained by the downstream levees. The first storm that occurred after beginning the construction of Folsom Dam was larger than any occurring in the prior 45 years. Since that 1951 storm, Sacramento has experienced four more 'record floods' each somewhat larger than the previous. A comparative analysis run on the two periods (1905 to 1950 and 1950 to 2000) shows that a storm with one chance in 500 of occurring in any year based on the earlier period is approximately the same size as a storm with one chance in 50 of occurring using the entire 95-year period.

Historically, much of the growth in the County has occurred adjacent to streams, resulting in significant damages to property, and losses from disruption of community activities when the streams overflow. Additional development in the watersheds of these streams affects both the frequency and duration of damaging floods through an increase in stormwater runoff. Other problems connected with flooding and stormwater runoff include erosion, sedimentation, degradation of water quality, losses of environmental resources, and certain health hazards.

Impacts

Predominantly, the effects of flooding are generally confined to areas near the waterways of the County. As waterways grow in size from local drainages, so grows the threat of flood and dimensions of the threat. This threatens structures in the floodplain. Structures can also be damaged from trees falling as a result of water-saturated soils. Electrical power outages happen, and the interruption of power causes major problems. Loss of power is usually a precursor to closure of governmental offices and community businesses. Schools may also be required to close or be placed on a delayed start schedule. Roads can be damaged and closed, causing safety and evacuation issues. People may be swept away in floodwaters, causing injuries or deaths.

Floods can cause substantial damage to structures, landscapes, and utilities as well as life safety issues. Floods can be extremely dangerous, and even six inches of moving water can knock over a person given a strong current. A car will float in less than two feet of moving water and can be swept downstream into deeper waters. This is one reason floods kill more people trapped in vehicles than anywhere else. During a flood, people can also suffer heart attacks or electrocution due to electrical equipment short outs. Floodwaters can transport large objects downstream which can damage or remove stationary structures, such as dam spillways. Ground saturation can result in instability, collapse, or other damage. Objects can also be buried or destroyed through sediment deposition. Floodwaters can also break utility lines and interrupt services. Standing water can cause damage to crops, roads, foundations, and electrical circuits. 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 from any type of flooding.

Impacts from streambank erosion include greater levee maintenance and increased risk of levee failure. Should the levees fail, the area protected by the levees would be flooded.

Health Hazards from Flooding

Certain health hazards are also common to flood events. While such problems are often not reported, three general types of health hazards accompany floods. The first comes from the water itself. Floodwaters carry anything that was on the ground that the upstream runoff picked up, including dirt, oil, animal waste, and lawn, farm and industrial chemicals. Pastures and areas where cattle and hogs are kept or their wastes are stored can contribute polluted waters to the receiving streams.

Floodwaters also saturate the ground, which leads to infiltration into sanitary sewer lines. When wastewater treatment plants are flooded, there is nowhere for the sewage to flow. Infiltration and lack of treatment can lead to overloaded sewer lines that can back up into low-lying areas and homes. Even when it is diluted by flood waters, raw sewage can be a breeding ground for bacteria such as e. coli and other disease-causing agents.

The second type of health problems arise after most of the water has gone. Stagnant pools can become breeding grounds for mosquitoes, and wet areas of a building that have not been properly cleaned breed mold and mildew. A building that is not thoroughly cleaned becomes a health hazard, especially for small children and the elderly.

Another health hazard occurs when heating ducts in a forced air system are not properly cleaned after inundation. When the furnace or air conditioner is turned on, the sediments left in the ducts are circulated throughout the building and breathed in by the occupants. If a city or county water system loses pressure, a boil order may be issued to protect people and animals from contaminated water.

The third problem is the long-term psychological impact of having been through a flood and seeing one's home damaged and irreplaceable keepsakes destroyed. The cost and labor needed to repair a flood-damaged home puts a severe strain on people, especially the unprepared and uninsured. There is also a long-term problem for those who know that their homes can be flooded again. The resulting stress on floodplain residents takes its toll in the form of aggravated physical and mental health problems.

Mercury in Waterways in Sacramento County

As a result of historical releases of mercury associated with gold mining in Sacramento County, as well as in areas throughout watersheds upstream of Sacramento County, mercury contamination is a significant hazard to County residents and visitors, as well as wildlife. The State Resources Agency, as well as Cal EPA and US EPA, have recognized this contamination. The Sacramento-San Joaquin Delta, the American River, Lake Natoma, and numerous water bodies that are tributaries to them, are designated through the Clean Water Act 303d listing process as impaired water bodies due to mercury levels found in fish that so high that they are hazardous both to the human population and to wildlife. Additional water bodies in and near Sacramento are likely to be added to the 303d list in the future due to mercury contamination. Fish consumption advisories developed by the State Dept. of Public Health and the Office of Environmental and Health Hazard Assessment warn people not to eat certain types of fish caught in these waters.

Various factors in the Sacramento region can affect the amount of mercury that enters the food chain and poses a hazard to human health and the environment. Some of these factors may be subject to some level of influence by human activity. Factors that affect the hazard caused by mercury include but are not limited nutrient levels, sediment transport, streambed modification, food chain and ecological effects, fish consumption practices, management of water levels, water exports and diversions, irrigation practices, salinity, oxygen concentrations, wetland restoration and management practices, flooding of Delta islands, dredging, reservoir management, stormwater and wastewater discharges and treatment processes, source control and pollution prevention activities, and levels of mercury in sediments, water bodies, and discharges.

Warning and Evacuation Procedures

Sacramento County and its incorporated communities have a variety of systems and procedures established to protect its residents and visitors to plan for, avoid, and respond to a hazard event including those associated with floods and wildfires. This includes Pre-Disaster Public Awareness and Education information which is major component in successfully reducing loss of life and property in a community when faced with a potentially catastrophic incident. Much of this information is not specific to a given hazard event and is always accessible to the public on local County and City websites. Specific warning and evacuation systems and procedures include information relative to: Flood Forecasting (e.g., California Data Exchange Center), ALERT System, Warning Systems, dam protocols, evacuation procedures, and sheltering in place. Additional information on these warning and evacuation procedures as well as post-disaster mitigation policies and procedures can be found in Section 4.4, Capabilities, of this Risk Assessment and in the Emergency Management discussions in Appendix C.

Flood Hazard Assessment

Flooding has been frequent in the Sacramento County Planning Area and the vulnerability to flood damages is high. This section quantifies the vulnerability of the Planning Area to floods.

This risk assessment for the Sacramento County LHMP Update assessed the flood hazard specific to Sacramento County. This included an evaluation of multiple flood hazards including the Special Flood Hazard Area (SFHA) shown on the DFIRM; Repetitive Loss (RL) Areas; localized, stormwater flooding areas; other areas that have flooded in the past, but not identified on the DFIRM; other areas of shallow flooding identified through other studies and sources; levee failure flooding; dam failure flooding; and mudflow flooding especially in significant post-burn areas. This comprehensive flood risk assessment included an assessment of less-frequent flood hazards, areas likely to be flooded, and flood problems that are likely to get worse in the future as a result of changes in floodplain development and demographics, development in the watershed, and climate change. Existing studies, maps, historical data, and federal, state, and local community expertise and knowledge contributed to this current flood assessment for Sacramento County. An evaluation of the success of completed and ongoing flood control projects and associated maintenance aspects contributed to this flood hazard assessment and the resulting flood mitigation strategy for the Sacramento County Planning Area. This flood risk assessment for this LHMP Update also includes an assessment of future flooding conditions based on historic development in the floodplains and proposed future development as further described throughout this plan. The flood vulnerability assessment that follows focuses on the flood hazard based on FEMA DFIRMs.

Flood Analysis

The Sacramento County Planning Area has mapped FEMA flood hazard areas. This section of the vulnerability assessment focuses on the Sacramento County Planning Area (the seven incorporated communities and the unincorporated County). GIS was used to determine the possible impacts of flooding within the County and how the risk varies across Planning Area.

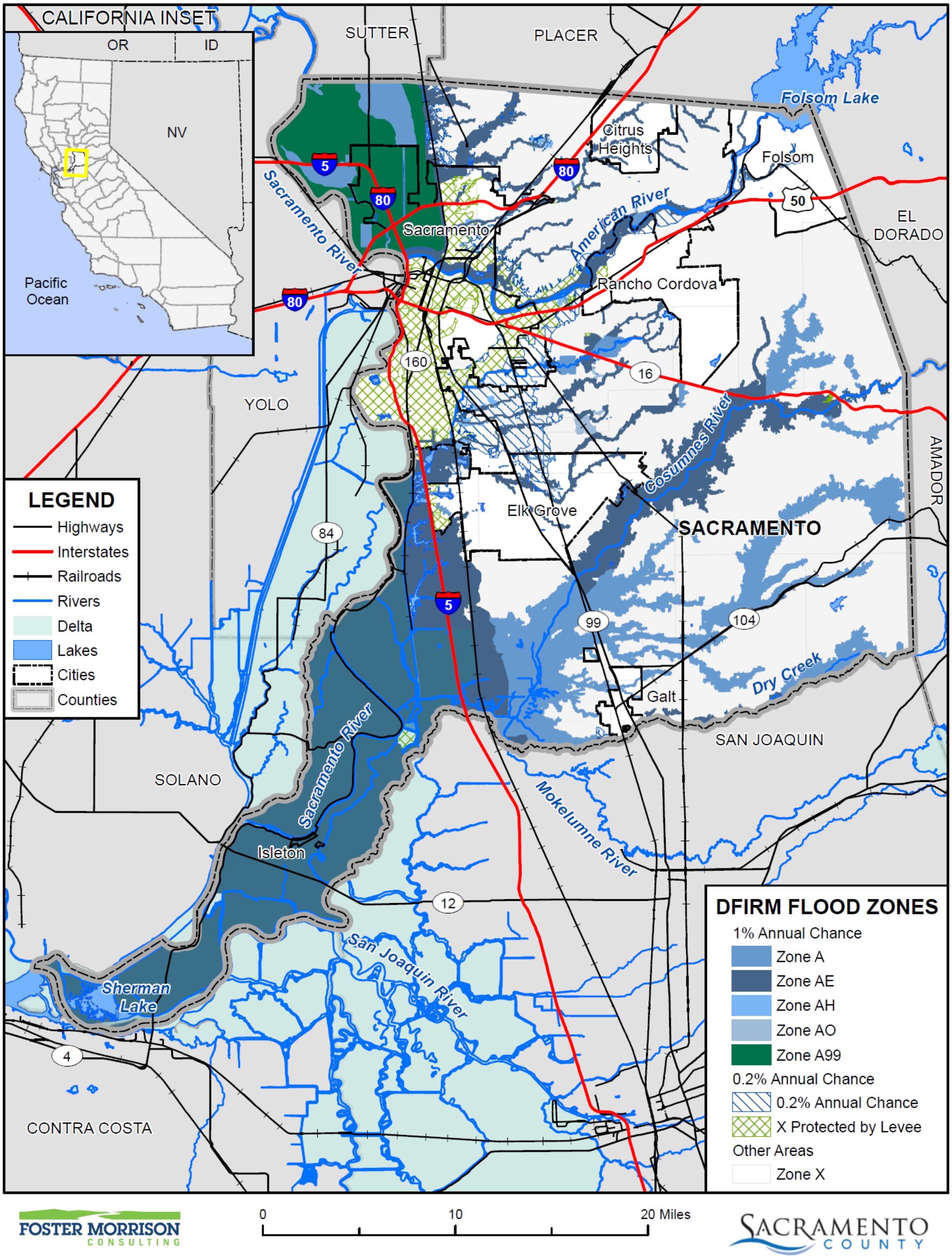
Sacramento County has a FEMA effective DFIRM dated 7/19/2018, which was obtained from the National Flood Hazard Layer to perform the flood analysis. Each of the DFIRM flood zones that begins with the letter 'A' depict the Special Flood Hazard Area, or the 1% annual chance flood event (commonly referred to as the 100-year flood). Table 4-71 explains the difference between DFIRM mapped flood zones within the 1% annual chance flood zone as well as other flood zones located within the County. The effective DFIRM maps for the Sacramento County Planning Area are shown on Figure 4-75.

Table 4-71 Sacramento County Planning Area – DFIRM Flood Hazard Zones

Flood Zone	Description	Flood Zone Present in Unincorporated County
A	1% annual chance flooding: No base flood elevations provided. Mandatory flood insurance purchase requirements and floodplain management standards apply.	X
AE	1% annual chance flooding: Base flood elevations provided. Mandatory flood insurance purchase requirements and floodplain management standards apply.	X
AH	Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually areas of ponding) where average depths are between one and three feet. Base Flood Elevations (BFEs) derived from detailed hydraulic analyses are shown in this zone. Mandatory flood insurance purchase requirements and floodplain management standards apply.	X
AO	Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between one and three feet. Average flood depths derived from detailed hydraulic analyses are shown in this zone. Mandatory flood insurance purchase requirements and floodplain management standards apply.	X
A99	Areas subject to inundation by the 1-percent-annual-chance flood event, but which will ultimately be protected upon completion of an under-construction Federal flood protection system. These are areas of special flood hazard where enough progress has been made on the construction of a protection system, such as dikes, dams, and levees, to consider it complete for insurance rating purposes. Zone A99 may only be used when the flood protection system has reached specified statutory progress toward completion. No Base Flood Elevations (BFEs) or depths are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply.	X
Shaded X	0.2% annual chance flooding: The areas between the limits of the 1% annual chance flood and the 0.2-percent-annual-chance (or 500-year) flood. Flood insurance is not mandatory but is available.	X
X Protected by Levee	Areas protected by levees from 1% annual chance flood event. Levee protection places these areas in the 0.2% annual chance flood zone. Flood insurance is not mandatory but is available.	X
X (unshaded)	No flood hazard	X

Source: FEMA

Figure 4-75 Sacramento County – DFIRM Flood Zones



Data Source: FEMA NFHL 07/19/2018, Sacramento County GIS, Cal-Atlas; Map Date: 09/2020.

Values at Risk and Flood Loss Estimates Analysis

Quantifying the values at risk and estimating losses within mapped FEMA floodplains in the County is an important element in understanding the risk and vulnerability of the Sacramento County Planning Area to the flood hazard.

Methodology

Sacramento County's 2020 Parcel and Assessor Data, obtained from Sacramento County, was used as the basis for the county inventory of parcels, values, and acres. Sacramento County has a FEMA DFIRM dated 7/19/2018 which was utilized to perform the flood analysis.

In some cases, there are parcels in multiple flood zones, such as Zone A, Zone X, or Shaded X. GIS was used to create a centroid, or point representing the center of the parcel polygon. DFIRM flood data was then overlaid on the parcel layer. For the purposes of this analysis, the flood zone that intersected a parcel centroid was assigned the flood zone for the entire parcel. The parcels were segregated and analyzed in this fashion for Sacramento County. Once completed, the parcel boundary layer was joined to the centroid layer and values were transferred based on the identification number in the Assessors database and the GIS parcel layer.

Analysis on values at risk to floods in the County is provided for Sacramento County Planning Area and the unincorporated County in the below results section.

Limitations

It also should be noted that the resulting flood analysis estimates may actually be more or less than that presented in the below tables as the County may include structures located within the 1% or 0.2% annual chance floodplain that are elevated at or above the level of the base flood elevation, according to local floodplain development requirements. Also, it is important to keep in mind that these assessed values may be well below the actual market value of improved parcels located within the floodplain due primarily to Proposition 13, and to a lesser extent, properties falling under the Williamson Act.

Flood Loss Estimate

The loss estimate for flood is based on the total of improved and contents value. Improved parcels include those with improved structure values identified in the Assessor's database. Only improved parcels and the value of their structure improvements were included in the flood loss analysis. The value of land is not included in the loss estimates as generally the land is not at loss to floods, just the value of improvements and structure contents. The land value is represented in the detailed flood tables, but are only present to show the value of the land associated with each flood zone.

The property use categories for the County (derived from zoning code descriptions) were used to develop estimated content replacement values (CRVs) that are potentially at loss from hazards, using FEMA Hazus methodologies as previously described in Section 4.3.1. The CRVs were added to the improved parcel values.

Once the potential value of affected parcels was calculated, a damage factor was applied to obtain loss estimates by flood zone. When a flood occurs, seldom does the event cause total loss of an area or building. Potential losses from flooding are related to a variety of factors including flood depth, flood velocity, building type, and construction. The percent of damage is primarily related to the flood depth. FEMA's flood benefit/cost module uses a simplified approach to model flood damage based on building type and flood depth. The values at risk in the flood analysis tables were refined by applying an average damage estimation of 20% of the total building value. The 20% damage estimate utilized FEMA's Flood Building Loss Table based on an assumed average flood depth of 2 feet. The end result of the flood hazard analysis is an inventory of the numbers, types, and values of parcels subject to the flood hazard.

The end result of the values at risk and flood loss estimates analysis is an inventory of the numbers, types, and values of parcels and estimated losses subject to the flood hazard by flood zone. Results are presented here first for the Sacramento County Planning Area and secondly for unincorporated County. Results for the incorporated jurisdictions are presented in their annexes to this Plan.

Sacramento County Planning Area

Table 4-72 and Table 4-73 contain flood analysis results for Sacramento County Planning Area. These tables show the number of parcels and values at risk to the 1% and 0.2% annual chance event for Sacramento County. Table 4-72 shows a summary of the value of improved parcels by 1% and 0.2% annual chance flood zones in the Planning Area. Table 4-73 shows the values in each flood zone by jurisdiction for the Planning Area.

Table 4-72 Sacramento County Planning Area – Count and Value of Parcels by 1% and 0.2% Flood Zone*

Flood Zone	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
1% Annual Chance Flood Hazard	43,527	36,296	$5,019,573,512	$12,442,434,550	$8,106,627,064	$25,568,635,272
0.2% Annual Chance Flood Hazard	137,934	129,287	$14,763,527,691	$37,854,488,676	$25,752,277,684	$78,370,294,206
Other Areas	298,904	277,302	$32,313,875,158	$77,460,831,895	$46,943,016,978	$156,717,724,312
Grand Total	**480,365**	**442,885**	**$52,096,976,361**	**$127,757,755,121**	**$80,801,921,726**	**$260,656,653,790**

Source: FEMA 7/19/2018 DFIRM, Sacramento County February Parcel/Assessor's Data

*With respect to improve parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

**This parcel count only includes those parcels in the 0.2% annual chance flood zone, exclusive of the 1% annual chance flood zone. The 0.2% annual chance flood, in actuality, also includes all parcels in the 1% annual chance flood zone.

Table 4-73 Sacramento County Planning Area – Count and Value of Parcels by 1% and 0.2% Flood Zone by Property Use*

Flood Zone/ Jurisdiction	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
City of Citrus Heights						
1% Annual Chance Flood Hazard	264	171	$16,613,142	$39,944,477	$25,347,062	$81,904,679
0.2% Annual Chance Flood Hazard	372	344	$45,438,707	$69,451,717	$42,174,438	$157,064,851
Other Areas	26,141	25,306	$2,215,185,553	$5,359,158,617	$3,077,500,176	$10,651,844,282
City of Citrus Heights Total	**26,777**	**25,821**	**$2,277,237,402**	**$5,468,554,811**	**$3,145,021,676**	**$10,890,813,812**
City of Elk Grove						
1% Annual Chance Flood Hazard	403	269	$61,274,181	$135,476,549	$92,047,967	$288,798,693
0.2% Annual Chance Flood Hazard	7,021	6,737	$785,686,811	$2,248,156,539	$1,315,971,218	$4,349,814,522
Other Areas	48,160	44,803	$5,415,550,301	$13,971,342,060	$8,031,991,292	$27,418,883,679
City of Elk Grove Total	**55,584**	**51,809**	**$6,262,511,293**	**$16,354,975,148**	**$9,440,010,477**	**$32,057,496,894**
City of Folsom						
1% Annual Chance Flood Hazard	35	12	$5,281,096	$4,537,463	$2,523,630	$12,342,190
0.2% Annual Chance Flood Hazard	314	246	$77,965,503	$226,093,495	$207,922,441	$511,981,447
Other Areas	26,709	23,356	$4,355,347,245	$10,355,726,712	$6,319,092,964	$21,030,166,864
City of Folsom Total	**27,058**	**23,614**	**$4,438,593,844**	**$10,586,357,670**	**$6,529,539,035**	**$21,554,490,501**
City of Galt						
1% Annual Chance Flood Hazard	36	9	$16,234,029	$1,836,738	$2,169,686	$20,240,454
0.2% Annual Chance Flood Hazard	2	-	$537,317	$0	$0	$537,317
Other Areas	7,948	7,439	$627,686,135	$1,727,496,106	$1,009,983,164	$3,365,165,408
City of Galt Total	**7,986**	**7,448**	**$644,457,481**	**$1,729,332,844**	**$1,012,152,850**	**$3,385,943,179**
City of Isleton						
1% Annual Chance Flood Hazard	515	329	$21,145,419	$39,144,051	$24,482,767	$84,772,235
0.2% Annual Chance Flood Hazard	-	-	$0	$0	$0	$0
Other Areas	21	9	$1,571,792	$2,124,228	$1,570,789	$5,266,809

Flood Zone/ Jurisdiction	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
City of Isleton Total	**536**	**338**	**$22,717,211**	**$41,268,279**	**$26,053,556**	**$90,039,044**
City of Rancho Cordova						
1% Annual Chance Flood Hazard	58	19	$6,117,986	$10,358,719	$5,179,359	$21,656,064
0.2% Annual Chance Flood Hazard	1,972	1,920	$134,045,116	$382,757,390	$199,010,254	$715,812,763
Other Areas	21,755	19,593	$2,556,793,512	$6,435,032,495	$4,794,431,555	$13,786,257,438
City of Rancho Cordova Total	**23,785**	**21,532**	**$2,696,956,614**	**$6,828,148,604**	**$4,998,621,168**	**$14,523,726,265**
City of Sacramento						
1% Annual Chance Flood Hazard	34,612	30,884	$3,473,949,831	$10,066,624,818	$5,878,442,788	$19,419,017,610
0.2% Annual Chance Flood Hazard	90,649	84,438	$10,037,993,408	$26,076,921,127	$18,395,244,253	$54,510,159,160
Other Areas	30,329	27,574	$2,820,079,046	$7,249,889,826	$4,805,943,778	$14,875,912,816
City of Sacramento Total	**155,590**	**142,896**	**$16,332,022,285**	**$43,393,435,771**	**$29,079,630,819**	**$88,805,089,586**
Unincorporated Sacramento County						
1% Annual Chance Flood Hazard	7,604	4,603	$1,418,957,828	$2,144,511,735	$2,076,433,805	$5,639,903,347
0.2% Annual Chance Flood Hazard	37,604	35,602	$3,681,860,829	$8,851,108,408	$5,591,955,080	$18,124,924,146
Other Areas	137,841	129,222	$14,321,661,574	$32,360,061,851	$18,902,503,260	$65,584,227,016
Unincorporated County Total	**183,049**	**169,427**	**$19,422,480,231**	**$43,355,681,994**	**$26,570,892,145**	**$89,349,054,509**
Grand Total	**480,365**	**442,885**	**$52,096,976,361**	**$127,757,755,121**	**$80,801,921,726**	**$260,656,653,790**

Source: FEMA 7/19/2018 DFIRM, Sacramento County February Parcel/Assessor's Data

*With respect to improve parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

**This parcel count only includes those parcels in the 0.2% annual chance flood zone, exclusive of the 1% annual chance flood zone. The 0.2% annual chance flood, in actuality, also includes all parcels in the 1% annual chance flood zone.

Table 4-74 shows a summary table of loss estimates by 1% and 0.2% annual chance flood zone for the Sacramento County Planning Area. The loss ratio is the loss estimate divided by the total potential exposure (i.e., total of improved and contents value for all parcels located in the Planning Area) and displayed as a percentage of loss. FEMA considers loss ratios greater than 10% to be significant and an indicator that a community may have more difficulties recovering from a flood. The County should keep in mind that the loss ratio could increase with additional development in the 1% and 0.2% annual chance flood zone, unless development is elevated in accordance with the local floodplain management ordinance.

Table 4-74 Sacramento County Planning Area – Flood Loss Estimate

Flood Zone	Total Parcel Count	Improved Parcel Count	Improved Structure Value	Estimated Contents Value	Total Value	Loss Estimate	Loss Ratio
1% Annual Chance Flood Hazard	50,145	42,764	$14,555,114,540	$9,330,550,315	$23,885,664,855	$4,777,132,971	2.66%
0.2% Annual Chance Flood Hazard	179,073	167,353	$49,577,674,197	$32,468,297,758	$82,045,971,955	$16,409,194,391	9.12%
Grand Total	**229,218**	**210,117**	**$64,132,788,737**	**$41,798,848,073**	**$105,931,636,810**	**$21,186,327,362**	**11.78%**

Source: FEMA 7/19/2018 DFIRM, Sacramento County February Parcel/Assessor's Data

*With respect to improve parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

**This parcel count only includes those parcels in the 0.2% annual chance flood zone, exclusive of the 1% annual chance flood zone. The 0.2% annual chance flood, in actuality, also includes all parcels in the 1% annual chance flood zone.

According to the information in Table 4-72 through Table 4-74, the Sacramento County Planning Area has 42,674 improved parcels and roughly $23.9 billion of structure and contents value in the 1% annual chance flood zone. There are an additional 167,353improved parcels and roughly $82 billion of structure and contents value in the 0.2% annual chance flood event. These values can be refined a step further. Applying the 20 percent damage factor as previously described, there is a 1% chance in any given year of a flood event causing roughly $4.78 billion in damage in the Sacramento County Planning Area. Applying the same factor, there is a 0.2% chance of a flood event causing approximately $16.4 billion in damage in the Sacramento County Planning Area. A loss ratio of 2.66 and 9.12% indicates that Sacramento County Planning Area has sizable values at risk in the floodplain, and a major flood would be difficult to recover from.

Unincorporated Sacramento County

Table 4-75, Table 4-76, and Table 4-77 contain information for unincorporated Sacramento County only. Table 4-75 is a summary table which shows improved parcels and structure values summarized by DFIRM flood type. Table 4-76 breaks down Table 4-75 and shows the number of improved parcels and associated structure and other improved values at risk to the each of the FEMA flood zones using the DFIRM data by property use type. Table 4-77 shows potential losses summarized by 1% and 0.2% annual chance flood events with loss estimates and loss ratios.

Table 4-75 Unincorporated Sacramento County – Count and Value of Parcels by 1% and 0.2% Flood Zone*

Flood Zone	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
1% Annual Chance Flood Hazard	7,604	4,603	$1,418,957,828	$2,144,511,735	$2,076,433,805	$5,639,903,347
0.2% Annual Chance Flood Hazard	37,604	35,602	$3,681,860,829	$8,851,108,408	$5,591,955,080	$18,124,924,146
Other Areas	137,841	129,222	$14,321,661,574	$32,360,061,851	$18,902,503,260	$65,584,227,016
Unincorporated County Total	**183,049**	**169,427**	**$19,422,480,231**	**$43,355,681,994**	**$26,570,892,145**	**$89,349,054,509**

Source: FEMA 7/19/2018 DFIRM, Sacramento County February Parcel/Assessor's Data

*With respect to improve parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

**This parcel count only includes those parcels in the 0.2% annual chance flood zone, exclusive of the 1% annual chance flood zone. The 0.2% annual chance flood, in actuality, also includes all parcels in the 1% annual chance flood zone.

Table 4-76 Unincorporated Sacramento County – Count and Value of Parcels by 1% and 0.2% Flood Zone by Property Use*

Flood Zone / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
1% Annual Chance Flood Hazard						
Zone A						
Agricultural	294	148	$117,680,096	$69,617,323	$69,617,323	$256,914,742
Care/Health	0	0	$0	$0	$0	$0
Church/Welfare	0	0	$0	$0	$0	$0
Industrial	33	0	$7,076,362	$0	$0	$7,076,362
Miscellaneous	79	0	$283,507	$0	$0	$283,507
Office	0	0	$0	$0	$0	$0
Public/Utilities	27	0	$0	$0	$0	$0
Recreational	1	0	$21,265	$0	$0	$21,265
Residential	178	171	$24,094,856	$43,714,056	$21,857,022	$89,665,937
Retail/ Commercial	0	0	$0	$0	$0	$0
Unknown	0	0	$0	$0	$0	$0
Vacant	95	8	$28,605,056	$157,289	$0	$28,762,345
Zone A Total	**707**	**327**	**$177,761,142**	**$113,488,668**	**$91,474,345**	**$382,724,158**
Zone AE						
Agricultural	1,057	671	$293,917,292	$289,772,193	$289,772,193	$873,461,678
Care/Health	4	3	$1,793,658	$6,310,194	$6,310,194	$14,414,046

Flood Zone / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Church/Welfare	25	18	$4,424,822	$39,244,048	$39,244,048	$82,912,918
Industrial	90	39	$24,329,959	$30,900,951	$46,351,426	$101,582,336
Miscellaneous	752	5	$2,930,655	$13,642	$13,642	$2,957,939
Office	39	37	$19,340,780	$33,804,422	$33,804,422	$86,949,624
Public/Utilities	185	0	$101	$0	$0	$101
Recreational	98	56	$18,802,057	$24,639,272	$24,639,272	$68,080,601
Residential	3,016	2,902	$382,804,594	$722,336,691	$361,168,372	$1,466,309,631
Retail/ Commercial	66	62	$19,915,571	$23,468,280	$23,468,280	$66,852,131
Unknown	3	2	$42,042	$139,696	$0	$181,738
Vacant	676	45	$67,388,115	$6,240,012	$0	$73,628,127
Zone AE Total	**6,011**	**3,840**	**$835,689,646**	**$1,176,869,401**	**$824,771,849**	**$2,837,330,870**
Zone AH						
Agricultural	0	0	$0	$0	$0	$0
Care/Health	0	0	$0	$0	$0	$0
Church/Welfare	0	0	$0	$0	$0	$0
Industrial	0	0	$0	$0	$0	$0
Miscellaneous	10	0	$41	$0	$0	$41
Office	1	1	$70,998	$79,191	$79,191	$229,380
Public/Utilities	1	0	$0	$0	$0	$0
Recreational	0	0	$0	$0	$0	$0
Residential	58	58	$3,625,248	$9,163,336	$4,581,671	$17,370,248
Retail/ Commercial	0	0	$0	$0	$0	$0
Unknown	0	0	$0	$0	$0	$0
Vacant	6	0	$78,301	$0	$0	$78,301
Zone AH Total	**76**	**59**	**$3,774,588**	**$9,242,527**	**$4,660,862**	**$17,677,970**
Zone AO						
Agricultural	0	0	$0	$0	$0	$0
Care/Health	0	0	$0	$0	$0	$0
Church/Welfare	3	3	$594,059	$3,867,671	$3,867,671	$8,329,401
Industrial	0	0	$0	$0	$0	$0
Miscellaneous	0	0	$0	$0	$0	$0
Office	0	0	$0	$0	$0	$0
Public/Utilities	3	0	$0	$0	$0	$0
Recreational	0	0	$0	$0	$0	$0

Flood Zone / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Residential	67	67	$12,250,865	$12,155,741	$6,077,870	$30,484,478
Retail/ Commercial	0	0	$0	$0	$0	$0
Unknown	0	0	$0	$0	$0	$0
Vacant	13	0	$3,493,579	$0	$0	$3,493,579
Zone AO Total	**86**	**70**	**$16,338,503**	**$16,023,412**	**$9,945,541**	**$42,307,458**
Zone A99						
Agricultural	126	25	$48,934,916	$7,281,538	$7,281,538	$63,497,992
Care/Health	0	0	$0	$0	$0	$0
Church/Welfare	3	3	$478,455	$1,854,197	$1,854,197	$4,186,849
Industrial	182	165	$155,546,474	$658,818,056	$988,227,081	$1,802,591,615
Miscellaneous	59	0	$1,774,446	$0	$0	$1,774,446
Office	39	33	$29,933,225	$119,342,519	$119,342,519	$268,618,263
Public/Utilities	59	0	$0	$0	$0	$0
Recreational	9	5	$5,347,298	$3,102,376	$3,102,376	$11,552,050
Residential	65	59	$10,375,832	$24,803,246	$12,401,622	$47,580,703
Retail/ Commercial	12	10	$10,342,876	$13,371,875	$13,371,875	$37,086,626
Unknown	0	0	$0	$0	$0	$0
Vacant	170	7	$122,660,427	$313,920	$0	$122,974,347
Zone A99 Total	**724**	**307**	**$385,393,949**	**$828,887,727**	**$1,145,581,208**	**$2,359,862,891**
1% Annual Chance Flood Hazard Total	**7,604**	**4,603**	**$1,418,957,828**	**$2,144,511,735**	**$2,076,433,805**	**$5,639,903,347**
0.2% Annual Chance Flood Hazard						
0.2% Annual Chance						
Agricultural	11	8	$1,997,426	$1,331,266	$1,331,266	$4,659,958
Care/Health	16	16	$5,866,927	$35,732,539	$35,732,539	$77,332,005
Church/Welfare	52	48	$25,951,622	$97,486,485	$97,486,485	$220,924,592
Industrial	230	205	$135,906,539	$346,687,712	$520,031,569	$1,002,625,821
Miscellaneous	387	2	$2,876,882	$46,920	$46,920	$2,970,722
Office	90	76	$32,754,655	$90,100,564	$90,100,564	$212,955,783
Public/Utilities	37	0	$9	$0	$0	$9
Recreational	17	14	$10,084,201	$7,786,763	$7,786,763	$25,657,727
Residential	23,223	22,853	$1,652,531,551	$4,307,656,378	$2,153,828,255	$8,114,015,978
Retail/ Commercial	350	327	$239,099,068	$462,122,133	$462,122,133	$1,163,343,334

Flood Zone / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Unknown	0	0	$0	$0	$0	$0
Vacant	562	21	$93,447,636	$1,065,847	$0	$94,513,483
0.2% Annual Chance Total	**24,975**	**23,570**	**$2,200,516,516**	**$5,350,016,607**	**$3,368,466,494**	**$10,918,999,412**
X Protected by Levee						
Agricultural	7	7	$2,053,347	$1,998,179	$1,998,179	$6,049,705
Care/Health	14	9	$7,589,097	$41,048,396	$41,048,396	$89,685,889
Church/Welfare	30	26	$12,088,693	$33,980,411	$33,980,411	$80,049,515
Industrial	101	96	$28,279,980	$75,737,635	$113,606,457	$217,624,069
Miscellaneous	159	6	$667,769	$396,867	$396,867	$1,461,503
Office	193	169	$112,716,926	$310,101,549	$310,101,549	$732,920,024
Public/Utilities	38	0	$0	$0	$0	$0
Recreational	19	5	$850,517	$1,605,937	$1,605,937	$4,062,391
Residential	11,537	11,403	$1,102,912,551	$2,628,200,830	$1,314,100,401	$5,045,213,819
Retail/ Commercial	322	298	$182,671,715	$406,650,389	$406,650,389	$995,972,493
Unknown	0	0	$0	$0	$0	$0
Vacant	209	13	$31,513,718	$1,371,608	$0	$32,885,326
X Protected by Levee Total	**12,629**	**12,032**	**$1,481,344,313**	**$3,501,091,801**	**$2,223,488,586**	**$7,205,924,734**
0.2% Annual Chance Flood Hazard Total	**37,604**	**35,602**	**$3,681,860,829**	**$8,851,108,408**	**$5,591,955,080**	**$18,124,924,146**
Other Areas						
Zone X						
Agricultural	1,118	590	$337,077,580	$288,861,929	$288,861,929	$914,801,438
Care/Health	182	170	$116,650,476	$530,998,878	$530,998,878	$1,178,648,232
Church/Welfare	346	299	$102,409,722	$484,893,931	$484,893,931	$1,072,197,584
Industrial	956	730	$368,413,716	$835,793,930	$1,253,690,899	$2,457,898,526
Miscellaneous	2,272	11	$4,168,444	$236,158	$236,158	$4,640,760
Office	1,017	923	$312,137,607	$920,235,830	$920,235,830	$2,152,609,267
Public/Utilities	312	1	$1,229,093	$1,483,565	$1,483,565	$4,196,223
Recreational	78	52	$29,908,565	$77,041,207	$77,041,207	$183,990,979
Residential	125,736	124,797	$11,587,506,265	$27,697,501,005	$13,848,750,136	$53,133,757,756
Retail/ Commercial	1,498	1,400	$834,394,494	$1,496,310,727	$1,496,310,727	$3,827,015,948
Unknown	6	5	$42,958	$377,906	$0	$420,864
Vacant	4,320	244	$627,722,654	$26,326,785	$0	$654,049,439

Flood Zone / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Zone X Total	**137,841**	**129,222**	**$14,321,661,574**	**$32,360,061,851**	**$18,902,503,260**	**$65,584,227,016**
Other Areas Total	**137,841**	**129,222**	**$14,321,661,574**	**$32,360,061,851**	**$18,902,503,260**	**$65,584,227,016**
Unincorporated Sacramento County Total	**183,049**	**169,427**	**$19,422,480,231**	**$43,355,681,994**	**$26,570,892,145**	**$89,349,054,509**

Source: FEMA 7/19/2018 DFIRM, Sacramento County February Parcel/Assessor's Data

*With respect to improve parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

**This parcel count only includes those parcels in the 0.2% annual chance flood zone, exclusive of the 1% annual chance flood zone. The 0.2% annual chance flood, in actuality, also includes all parcels in the 1% annual chance flood zone.

Table 4-77 Unincorporated Sacramento County – Flood Loss Estimates

Flood Zone	Total Parcel Count	Improved Parcel Count	Improved Structure Value	Estimated Contents Value	Total Value	Loss Estimate	Loss Ratio
1% Annual Chance Flood Hazard	7,604	4,603	$2,144,511,735	$2,076,433,805	$4,220,945,540	$844,189,108	0.47%
0.2% Annual Chance Flood Hazard	37,604	35,602	$8,851,108,408	$5,591,955,080	$14,443,063,488	$2,888,612,698	1.61%
Grand Total	**45,208**	**40,205**	**$10,995,620,143**	**$7,668,388,885**	**$18,664,009,028**	**$3,732,801,806**	**2.08%**

Source: FEMA 7/19/2018 DFIRM, Sacramento County February Parcel/Assessor's Data

*With respect to improve parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

**This parcel count only includes those parcels in the 0.2% annual chance flood zone, exclusive of the 1% annual chance flood zone. The 0.2% annual chance flood, in actuality, also includes all parcels in the 1% annual chance flood zone.

According to Table 4-75, Table 4-76, and Table 4-77, unincorporated Sacramento County has 4,603 improved parcels and roughly $4.2 billion of structure and contents value in the 1% annual chance flood zone. The unincorporated County has 35,602 improved parcels and roughly $14.4 billion in structure and contents values in the 0.2% annual chance flood zone. These values can be refined a step further. Applying the 20 percent damage factor as previously described, there is a 1% chance in any given year of a flood event causing roughly $844.2 million in damage in the unincorporated areas of Sacramento County. Applying the same factor, there is a 0.2% chance of a flood event causing $2.8 billion in damage to the unincorporated County. A loss ratio of 0.47% and 1.61% indicates that while the unincorporated County has values at risk in the floodplain, flood losses would be somewhat limited compared to the total built environment and the community would likely be able to recover.

Flooded Acres

In addition to the centroid analysis used to obtain numbers of parcels and values at risk to flood hazards, parcel boundary analysis was performed to obtain total acres and flooded acres by flood zone for each parcel. The parcel layer was intersected with the FEMA DFIRM data to obtain the acres flooded. The following is an analysis of flooded acres in the County.

Methodology

GIS was used to calculate acres flooded by FEMA flood zones and property use categories. The Sacramento County parcel layer and FEMA DFIRM were intersected, and each segment divided by the intersection of flood zone and parcels was calculated for acres. This process was conducted for 1% and 0.2% annual chance floodplain areas, with each segment being defined by zone type (A, AE, 0.2% Annual Chance, and X) and acres. The resulting data tables with flooded acreages were then imported into a database and linked back to the original parcels, including total acres by parcel number. Once this was completed, each parcel contained acreage values for flooded acre by zone type within the parcel. In the tables below, the 1% and 0.2% annual chance flood zones are summarized and then split out by property use, their total flooded acres, total improved acres, and percent of improved acres that are flooded.

Limitations

One limitation created by this type of analysis is that improvements are uniformly found throughout the parcel, while in reality, only portions of the parcel are improved, and improvements may or may not fall within the flood zone portion of a parcel; thus, areas of improvements flooded calculated through this method may be higher or lower than those actually seen in a similar real-world event.

The following tables represent a summary and detailed analysis of total acres for each FEMA DFIRM flood zone in the Planning Area. Table 4-78 gives summary information for the Planning Area by 1% and 0.2% annual chance flood zone for the entire Sacramento County Planning Area. Table 4-79 shows the specific DFIRM flood zone designations that make up the 1% and 0.2% annual chance flood zones for the unincorporated County. Details on flooded acres by detailed flood zone for the incorporated jurisdictions in the County are shown in their respective annexes to this Plan Update. In all of these tables, the Other Areas are areas (Zone X Unshaded – areas outside mapped flood hazard areas) where there is no mapped flood hazard area.

Table 4-78 Sacramento County Planning Area – Flooded Acres Summary

Jurisdiction/ Flood Zone	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
City of Citrus Heights						
1% Annual Chance Flood Hazard	432	0.07%	248	0.07%	184	0.07%

Jurisdiction/ Flood Zone	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
0.2% Annual Chance Flood Hazard	209	0.03%	169	0.05%	40	0.01%
Other Areas	8,308	1.29%	7,352	2.04%	956	0.34%
Citrus Heights Total	**8,950**	**1.39%**	**7,770**	**2.15%**	**1,180**	**0.42%**
City of Elk Grove						
1% Annual Chance Flood Hazard	1,266	0.20%	477	0.13%	789	0.28%
0.2% Annual Chance Flood Hazard	3,176	0.49%	2,607	0.72%	569	0.20%
Other Areas	22,114	3.43%	15,912	4.41%	6,202	2.19%
Elk Grove Total	**26,556**	**4.12%**	**18,996**	**5.26%**	**7,560**	**2.67%**
City of Folsom						
1% Annual Chance Flood Hazard	340	0.05%	50	0.01%	290	0.10%
0.2% Annual Chance Flood Hazard	387	0.06%	128	0.04%	259	0.09%
Other Areas	19,395	3.01%	10,812	3.00%	8,583	3.03%
Folsom Total	**20,122**	**3.12%**	**10,990**	**3.04%**	**9,132**	**3.22%**
City of Galt						
1% Annual Chance Flood Hazard	409	0.06%	174	0.05%	235	0.08%
0.2% Annual Chance Flood Hazard	10	0.00%	1	0.00%	9	0.00%
Other Areas	3,442	0.53%	2,218	0.61%	1,224	0.43%
Galt Total	**3,861**	**0.60%**	**2,393**	**0.66%**	**1,467**	**0.52%**
City of Isleton						
1% Annual Chance Flood Hazard	220	0.03%	61	0.02%	159	0.06%
0.2% Annual Chance Flood Hazard	0	0.00%	0	0.00%	0	0.00%
Other Areas	13	0.00%	5	0.00%	9	0.00%

Jurisdiction/ Flood Zone	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Isleton Total	**233**	**0.04%**	**66**	**0.02%**	**168**	**0.06%**
City of Rancho Cordova						
1% Annual Chance Flood Hazard	1,149	0.18%	23	0.01%	1,125	0.40%
0.2% Annual Chance Flood Hazard	973	0.15%	660	0.18%	313	0.11%
Other Areas	19,264	2.99%	9,368	2.59%	9,896	3.49%
Rancho Cordova Total	**21,386**	**3.32%**	**10,051**	**2.78%**	**11,334**	**4.00%**
City of Sacramento						
1% Annual Chance Flood Hazard	34,002	5.28%	20,537	5.69%	13,465	4.75%
0.2% Annual Chance Flood Hazard	30,304	4.70%	21,078	5.84%	9,226	3.26%
Other Areas	9,649	1.50%	6,496	1.80%	3,154	1.11%
City of Sacramento Total	**73,956**	**11.48%**	**48,110**	**13.33%**	**25,845**	**9.12%**
Unincorporated Sacramento County						
1% Annual Chance Flood Hazard	203,042	31.51%	101,002	27.98%	102,040	36.00%
0.2% Annual Chance Flood Hazard	20,807	3.23%	16,406	4.54%	4,402	1.55%
Other Areas	265,505	41.20%	145,219	40.23%	120,287	42.44%
Unincorporated Sacramento County Total	**489,355**	**75.94%**	**262,627**	**72.75%**	**226,728**	**80.00%**
Grand Total	644,418	100.00%	361,003	100.00%	283,415	100.00%

Source: FEMA 7/19/2018 DFIRM

*Percentage of each jurisdiction in the flooded area

Table 4-79 Unincorporated Sacramento County – Flooded Acres by Detailed DFIRM Flood Zones and Property Use

Flood Zone/ Property Use	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
1% Annual Chance Flood Hazard						
Zone A						
Agricultural	38,793.2	6.02%	21,781.9	6.03%	17,011.3	6.00%
Care/Health	0	0.00%	0	0.00%	0	0.00%
Church/Welfare	0.3	0.00%	0.3	0.00%	0	0.00%
Industrial	1,000.3	0.16%	0.3	0.00%	1,000.0	0.35%
Miscellaneous	927.9	0.14%	0	0.00%	927.9	0.33%
Office	0	0.00%	0	0.00%	0	0.00%
Public/Utilities	1,792.0	0.28%	0	0.00%	1,792.0	0.63%
Recreational	11.6	0.00%	0.5	0.00%	11.2	0.00%
Residential	1,652.4	0.26%	1,395.1	0.39%	257.3	0.09%
Retail/ Commercial	0.2	0.00%	0.2	0.00%	0	0.00%
Unknown	0	0.00%	0	0.00%	0	0.00%
Vacant	4,589.6	0.71%	114.5	0.03%	4,475.1	1.58%
Zone A Total	**48,767.6**	**7.57%**	**23,292.8**	**6.45%**	**25,474.8**	**8.99%**
Zone AE						
Agricultural	92,965.3	14.43%	64,095.4	17.75%	28,869.9	10.19%
Care/Health	15.0	0.00%	13.3	0.00%	1.7	0.00%
Church/Welfare	103.2	0.02%	85.6	0.02%	17.6	0.01%
Industrial	1,561.4	0.24%	328.5	0.09%	1,232.9	0.44%
Miscellaneous	11,048.8	1.71%	45.8	0.01%	11,003.0	3.88%
Office	85.4	0.01%	65.4	0.02%	19.9	0.01%
Public/Utilities	3,627.9	0.56%			3,627.9	1.28%
Recreational	867.7	0.13%	507.9	0.14%	359.8	0.13%
Residential	8,245.2	1.28%	8,044.3	2.23%	200.9	0.07%
Retail/ Commercial	103.9	0.02%	98.7	0.03%	5.2	0.00%
Unknown	0.9	0.00%	0.5	0.00%	0.4	0.00%
Vacant	18,100.7	2.81%	550.3	0.15%	17,550.4	6.19%
Zone AE Total	**136,725.2**	**21.22%**	**73,835.7**	**20.45%**	**62,889.6**	**22.19%**
Zone AH						
Agricultural	0	0.00%	0	0.00%	0	0.00%
Care/Health	0	0.00%	0	0.00%	0	0.00%

Flood Zone/ Property Use	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Church/Welfare	0.0	0.00%	0.0	0.00%	0	0.00%
Industrial	0	0.00%	0	0.00%	0	0.00%
Miscellaneous	109.2	0.02%	0	0.00%	109.2	0.04%
Office	0.3	0.00%	0.3	0.00%	0	0.00%
Public/Utilities	2.9	0.00%	0	0.00%	2.9	0.00%
Recreational	0	0.00%	0	0.00%	0	0.00%
Residential	27.5	0.00%	27.5	0.01%	0.1	0.00%
Retail/ Commercial	4.1	0.00%	4.1	0.00%	0	0.00%
Unknown	0	0.00%	0	0.00%	0	0.00%
Vacant	5.4	0.00%	0	0.00%	5.4	0.00%
Zone AH Total	**149.4**	**0.02%**	**31.9**	**0.01%**	**117.6**	**0.04%**
Zone AO						
Agricultural	0	0.00%	0	0.00%	0	0.00%
Care/Health	1.3	0.00%	1.3	0.00%	0	0.00%
Church/Welfare	13.7	0.00%	12.5	0.00%	1.2	0.00%
Industrial	14.7	0.00%	0	0.00%	14.7	0.01%
Miscellaneous	10.1	0.00%	0	0.00%	10.1	0.00%
Office	10.1	0.00%	0	0.00%	10.1	0.00%
Public/Utilities	10.8	0.00%	0	0.00%	10.8	0.00%
Recreational	0	0.00%	0	0.00%	0	0.00%
Residential	288.9	0.04%	288.1	0.08%	0.8	0.00%
Retail/ Commercial	0	0.00%	0	0.00%	0	0.00%
Unknown	0	0.00%	0	0.00%	0	0.00%
Vacant	96.7	0.02%	2.9	0.00%	93.8	0.03%
Zone AO Total	**446.4**	**0.07%**	**304.9**	**0.08%**	**141.5**	**0.05%**
Zone A99						
Agricultural	7,207.9	1.12%	2,092.0	0.58%	5,115.9	1.81%
Care/Health	0	0.00%	0	0.00%	0	0.00%
Church/Welfare	2.4	0.00%	2.4	0.00%	0	0.00%
Industrial	1,571.9	0.24%	816.5	0.23%	755.4	0.27%
Miscellaneous	772.3	0.12%	0	0.00%	772.3	0.27%
Office	136.9	0.02%	105.0	0.03%	31.9	0.01%
Public/Utilities	3,297.6	0.51%	0	0.00%	3,297.6	1.16%
Recreational	283.4	0.04%	129.5	0.04%	154.0	0.05%

Flood Zone/ Property Use	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Residential	377.5	0.06%	336.4	0.09%	41.1	0.01%
Retail/ Commercial	30.0	0.00%	28.9	0.01%	1.1	0.00%
Unknown	0	0.00%	0	0.00%	0	0.00%
Vacant	3,273.8	0.51%	26.4	0.01%	3,247.4	1.15%
Zone A99 Total	**16,953.6**	**2.63%**	**3,537.0**	**0.98%**	**13,416.7**	**4.73%**
1% Annual Chance Flood Hazard Total	**203,042.2**	**31.51%**	**101,002.2**	**27.98%**	**102,040.1**	**36.00%**
0.2% Annual Chance Flood Hazard						
0.2% Annual Chance						
Agricultural	518.6	0.08%	385.6	0.11%	133.0	0.05%
Care/Health	30.4	0.00%	30.4	0.01%	0	0.00%
Church/Welfare	195.2	0.03%	164.8	0.05%	30.4	0.01%
Industrial	1,020.4	0.16%	778.6	0.22%	241.8	0.09%
Miscellaneous	1,106.1	0.17%	0.2	0.00%	1,105.9	0.39%
Office	185.9	0.03%	126.1	0.03%	59.8	0.02%
Public/Utilities	274.9	0.04%			274.9	0.10%
Recreational	180.2	0.03%	89.0	0.02%	91.2	0.03%
Residential	7,022.1	1.09%	6,754.6	1.87%	267.5	0.09%
Retail/ Commercial	633.2	0.10%	615.8	0.17%	17.4	0.01%
Unknown	0.0	0.00%	0.0	0.00%	0	0.00%
Vacant	1,292.6	0.20%	93.6	0.03%	1,199.1	0.42%
0.2% Annual Chance Total	**12,459.7**	**1.93%**	**9,038.7**	**2.50%**	**3,421.0**	**1.21%**
X Protected by Levee						
Agricultural	376.9	0.06%	376.9	0.10%	0	0.00%
Care/Health	29.9	0.00%	20.3	0.01%	9.6	0.00%
Church/Welfare	96.1	0.01%	71.0	0.02%	25.1	0.01%
Industrial	470.6	0.07%	466.5	0.13%	4.1	0.00%
Miscellaneous	211.4	0.03%	0.4	0.00%	211.0	0.07%
Office	340.7	0.05%	266.9	0.07%	73.7	0.03%
Public/Utilities	221.6	0.03%			221.6	0.08%
Recreational	132.8	0.02%	32.1	0.01%	100.8	0.04%
Residential	5,924.3	0.92%	5,825.5	1.61%	98.8	0.03%
Retail/ Commercial	317.8	0.05%	298.3	0.08%	19.6	0.01%

Flood Zone/ Property Use	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Unknown	0	0.00%	0	0.00%	0	0.00%
Vacant	225.8	0.04%	9.5	0.00%	216.3	0.08%
X Protected by Levee Total	**8,347.8**	**1.30%**	**7,367.3**	**2.04%**	**980.6**	**0.35%**
0.2% Annual Chance Flood Hazard Total	**20,807.5**	**3.23%**	**16,405.9**	**4.54%**	**4,401.5**	**1.55%**
Other Areas						
Zone X						
Agricultural	130,322.9	20.22%	54,752.1	15.17%	75,570.8	26.66%
Care/Health	505.2	0.08%	481.0	0.13%	24.2	0.01%
Church/Welfare	1,170.2	0.18%	931.1	0.26%	239.2	0.08%
Industrial	14,696.6	2.28%	7,590.6	2.10%	7,106.0	2.51%
Miscellaneous	8,311.5	1.29%	3.0	0.00%	8,308.4	2.93%
Office	1,657.6	0.26%	1,134.3	0.31%	523.3	0.18%
Public/Utilities	2,694.5	0.42%	3.3	0.00%	2,691.2	0.95%
Recreational	2,349.6	0.36%	908.3	0.25%	1,441.3	0.51%
Residential	77,637.3	12.05%	76,023.4	21.06%	1,613.9	0.57%
Retail/ Commercial	1,911.0	0.30%	1,811.3	0.50%	99.7	0.04%
Unknown	1.3	0.00%	0.3	0.00%	1.0	0.00%
Vacant	24,247.8	3.76%	1,580.1	0.44%	22,667.7	8.00%
Zone X Total	**265,505.5**	**41.20%**	**145,218.8**	**40.23%**	**120,286.7**	**42.44%**
Other Areas Total	**265,505.5**	**41.20%**	**145,218.8**	**40.23%**	**120,286.7**	**42.44%**
Unincorporated Sacramento County Total	**489,355.2**	**75.94%**	**262,626.9**	**72.75%**	**226,728.3**	**80.00%**

Source: FEMA 7/19/2018 DFIRM

Insurance Coverage, Claims Paid, and Repetitive Losses

Standard property insurance does not include flood coverage because of the relatively high risk. The National Flood Insurance Program (NFIP) provides flood insurance to residents in those communities that participate in the NFIP. Federal financial assistance requires the purchase of flood for structures located within a 100-year floodplain – a requirement that affects nearly all mortgages financed through commercial lending institutions. Flood insurance is also recommended for all structures protected by levees, even if not mapped within a floodplain.

Unincorporated Sacramento County joined the NFIP on March 15, 1979. The County participates in the CRS, and is one of the very few Class 2 communities in the United States. NFIP insurance data provided by DWR indicates that as of March 24, 2020, there were 7,497 policies in force in the unincorporated County, resulting in $2,169,765,000 of insurance in force. Of these policies, 6,878 are for residential and 619 are for non-residential properties. There have been 1,747 closed paid losses totaling $24,741,813.70. Of these losses,1,178 were parcels in A zones and 544 parcels were in B, C, or X zone, with 25 claim unknown. Of the 1,747 claims, 1,352 claims were associated with pre-FIRM structures and 370 with post-FIRM structures, with 25 claims unknown. There have been 390 repetitive loss (RL) structures, and 1 severe repetitive loss (SRL) structure in the County with 606 paid losses totaling $14,987,148.49. Of these RL buildings, 187 are in the A zones and 103 are in the B, C, or X zone. The NFIP considers a property a Repetitive Loss Property if two or more flood insurance claims of more than $1,000 have been paid within any 10-year period since 1978. A severe repetitive loss property is defined by the NFIP as a residential property with at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000.

There have been 137 substantial damage claims since 1978.

Based on this analysis of insurance coverage, unincorporated County has values at risk to the 1% and 0.2% annual chance and greater floods. Of the 4,603 improved parcels within the 1% annual chance flood zone, 2,815 (or 61.2 percent) of those parcels maintain flood insurance. This can be seen on Table 4-80.

Table 4-80 Sacramento County Planning Area – Percentage of Policy Holders to Improved Parcels in the 1% Annual Chance Floodplain

Jurisdiction	Improved Parcels in SFHA (1% Annual Chance) Floodplain*	Insurance Policies in the SFHA (1% Annual Chance) Floodplain	Percentage of 1% Annual Chance Floodplain Parcels Currently Insured
City of Citrus Heights	171	130	76.0%
City of Elk Grove	269	33	12.3%
City of Folsom	12	21	100.0%
City of Galt	9	3	33.3%
City of Isleton	329	107	32.5%
City of Rancho Cordova	19	13	68.4%
City of Sacramento	30,884	26,596	86.1%
Unincorporated County	4,603	2,815	61.2%

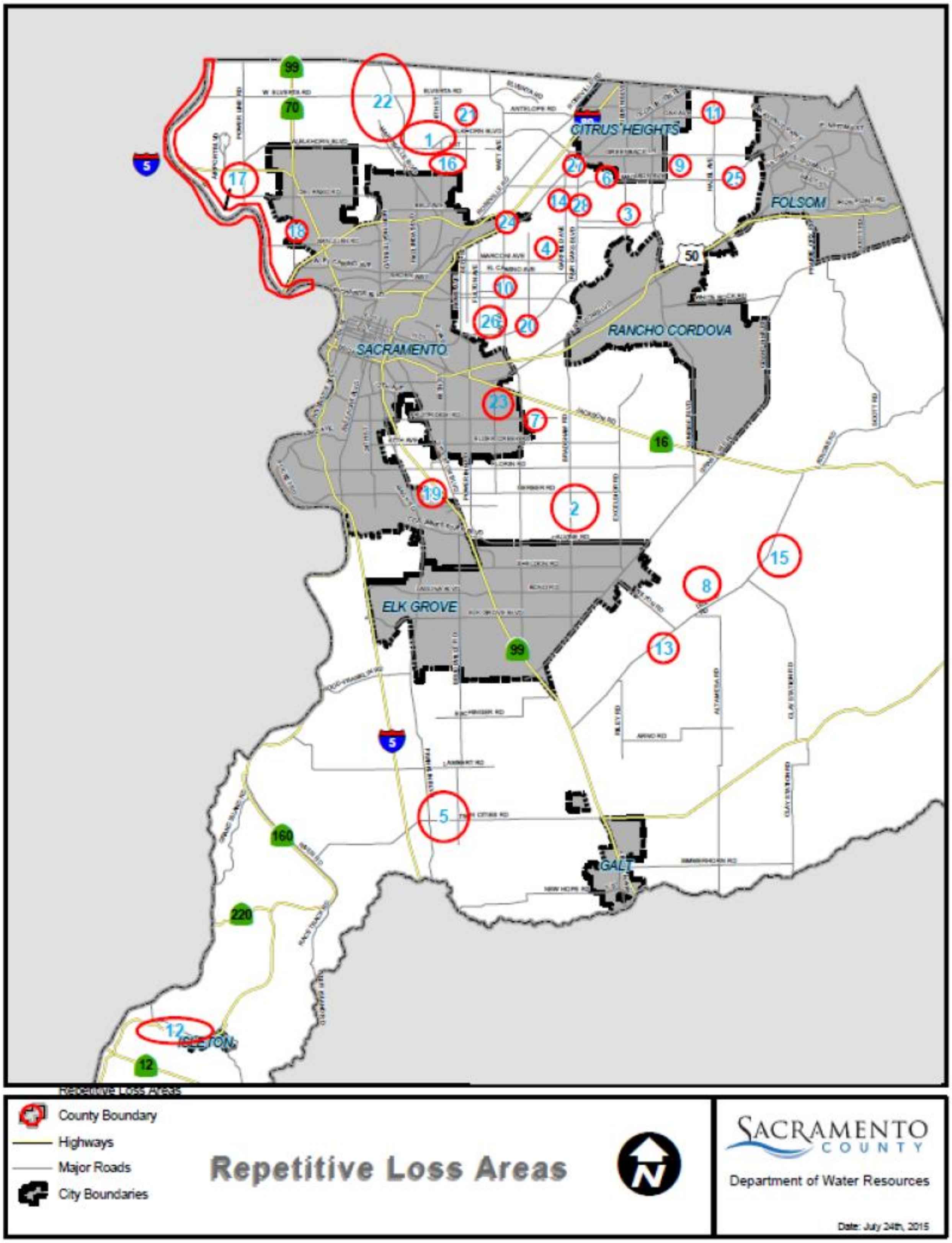
Source: FEMA DFIRM 11/2/2018, Sacramento County 2020 Parcel/Assessor's Data

In 2012, the Biggert-Waters Flood Insurance Reform Act (BW-12) was passed putting into motion substantial annual increases to flood insurance costs until premiums are rated based on the elevation certificate. The unfortunate oversite in this is that when a levee does not meet FEMA levee accreditation standards of 44 CFR §65.10, the premiums don't recognize that there is a levee system that has stood the test of time. Instead, the DFIRMs map the floodplain into the SFHA and flood insurance premiums are rated as if there were no levees present. Consequently, whether one believes the flood hazard to be of concern, the cost of flood insurance administered by FEMA under the current NFIP has made the cost of insurance out of reach of many local homeowners.

2015 Repetitive Loss Analysis and 2021 Repetitive Loss Annual Progress Report

Unincorporated Sacramento County's vulnerability to flooding can be seen in the number of Repetitive Loss properties as detailed above. The Repetitive Loss properties can further be grouped into Repetitive Loss Areas (RLAs). A RLA consists of Repetitive Loss Properties and the surrounding properties that experience the same or similar flooding conditions, whether or not the buildings on those surrounding properties have been damaged by flooding. Figure 4-76 shows the 28 RLAs in Sacramento County based on an analysis of the location of the RL properties for the July 2015 Repetitive Loss Area Analysis (RLAA) Report. Due to the storms of 2017, there were eight structures added to the repetitive loss list and two areas added to the RLAA. Thus the 2021 RLAA Annual Progress Report details the now 30 repetitive loss areas with 108 repetitive unmitigated flood loss structures, as listed by FEMA as of May 31, 2018. However, included in the list there are 3 houses that have been mitigated, thus the current number of unmitigated repetitive loss structures is 105. Considering that some of the structures are multi-unit residential, it may be appropriate to say that there are 139 unmitigated homes on the repetitive flood loss list. The Sacramento County Department of Water Resources Floodplain Management Section annually reaches out to property owners and is happy to seek FEMA grants to assist with the cost of mitigation. Successes include FEMA recognition of 42 mitigated repetitive loss structures and there are 3 more that will be added to the mitigated list in September 2021 as well as several more that will be added in coming years. Much greater detail can be found in the July 2015 RLAA Report, and the 2021 Annual Progress Report, as shown in Appendix G.

Figure 4-76 Unincorporated Sacramento County – Repetitive Loss Areas



Population at Risk

A separate analysis was performed to determine populations that reside in flood zones. Using GIS, the DFIRM Flood dataset was overlayed on the improved residential parcel data. Those parcel centroids that intersect a flood zone were counted and multiplied by the Census Bureau average household size; and tabulated by flood zone (see Table 4-81). According to this analysis, there is a population of 91,746 in the 1% annual chance flood zone, and 107,282 in the 0.2% annual chance flood zone for the entire Sacramento County Planning Area. Of these, in unincorporated Sacramento County, there is a population of 1,613 and 6 respectively in the 1% and 0.2% annual chance floodplains.

Table 4-81 Sacramento County Planning Area – Residential Population at Risk to 1% and 0.2% Annual Chance Flooding

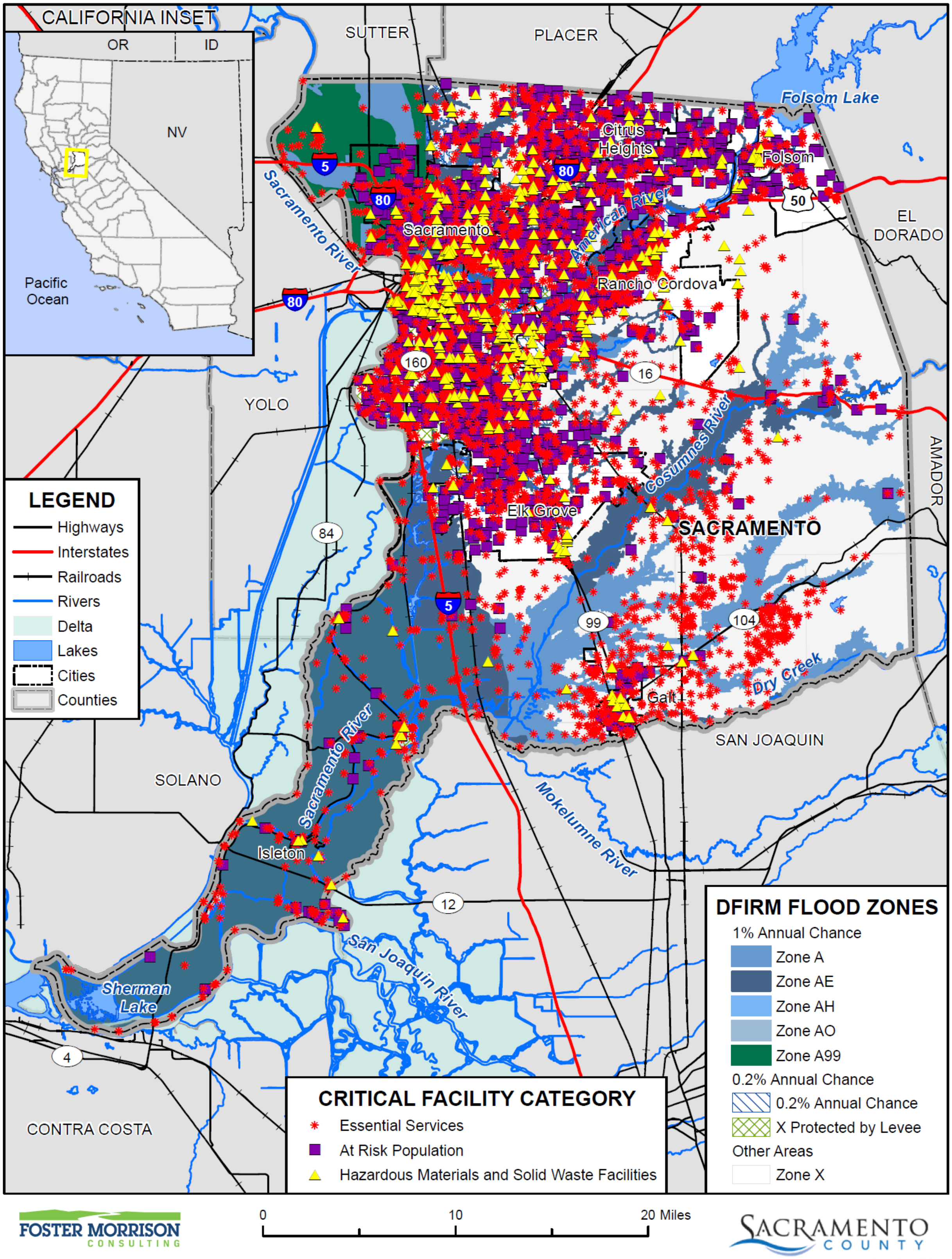
Jurisdiction	1% Annual Chance		0.2% Annual Chance	
	Improved Residential Parcels	Population at Risk	Improved Residential Parcels	Population at Risk
Citrus Heights	160	406	329	836
City of Sacramento	30,360	80,757	10,361	27,560
Elk Grove	254	813	4,033	12,906
Folsom	10	26	197	518
Galt	4	13	0	0
Isleton	254	701	0	0
Rancho Cordova	19	41	1,116	2,388
Unincorporated Sacramento County	3,257	8,989	22,853	63,074
Total	**34,318**	**91,746**	**38,889**	**107,282**

Source: FEMA DFIRM 7/19/2018, US Census Bureau Average Household Sizes: Citrus Heights (2.54); Sacramento City (2.66); Elk Grove (3.20); Folsom (2.63), Galt (3.16); Isleton (2.7), Rancho Cordova (2.14): and unincorporated Sacramento County (2.76)
*With respect to improve parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

Critical Facilities at Risk

A separate analysis was performed on the critical facility inventory in Sacramento County and all jurisdictions to determine critical facilities in the 1% and 0.2 annual chance flood zones. Using GIS, the DFIRM flood zones were overlayed on the critical facility GIS layer. Figure 4-77 shows critical facilities, as well as the DFIRM flood zones. Table 4-82 summarizes the critical facilities in the County by DFIRM flood zone. Table 4-83 details critical facilities by facility type and count for the unincorporated County. Details of critical facility definition, type, name and address by flood zone are listed in Appendix F.

Figure 4-77 Sacramento County Planning Area– Critical Facilities in DFIRM Flood Zones



Data Source: FEMA NFHL 07/19/2018, Sacramento County GIS, Cal-Atlas; Map Date: 08/2021.

Table 4-82 Sacramento County Planning Area– Summary of Critical Facilities in DFIRM Flood Zones

Jurisdiction / Flood Zone	Facility Count
Citrus Heights	
1% Annual Chance Flood Hazard	1
0.2% Annual Chance Flood Hazard	11
Other Areas	184
Citrus Heights Total	**196**
City of Sacramento	
1% Annual Chance Flood Hazard	288
0.2% Annual Chance Flood Hazard	1,544
Other Areas	545
City of Sacramento Total	**2,377**
Elk Grove	
1% Annual Chance Flood Hazard	4
0.2% Annual Chance Flood Hazard	54
Other Areas	449
Elk Grove Total	**507**
Folsom	
1% Annual Chance Flood Hazard	6
0.2% Annual Chance Flood Hazard	1
Other Areas	244
Folsom Total	**251**
Galt	
1% Annual Chance Flood Hazard	1
Other Areas	159
Galt Total	**160**
Isleton	
1% Annual Chance Flood Hazard	15
Other Areas	1
Isleton Total	**16**
Rancho Cordova	
1% Annual Chance Flood Hazard	3
0.2% Annual Chance Flood Hazard	11
Other Areas	384
Rancho Cordova Total	**398**

Jurisdiction / Flood Zone	Facility Count
Unincorporated Sacramento County	
1% Annual Chance Flood Hazard	778
0.2% Annual Chance Flood Hazard	492
Other Areas	2,410
Unincorporated Sacramento County Total	**3,680**
Grand Total	**7,585**

Source: Sacramento County GIS, FEMA 7/19/2018 DFIRM

Table 4-83 Unincorporated Sacramento County – Critical Facilities in DFIRM Flood Zones by Facility Category

Flood Zone Critical Facility Category	Critical Facility Type	Facility Count
1% Annual Chance Flood Hazard		
Essential Services Facilities	Airport	1
	Bridge	48
	Cellular Tower	8
	Emergency Evacuation Center	4
	EMS Stations	5
	Fire Station	7
	Law Enforcement	4
	Microwave Service Towers	284
	Port Facilities	46
	Power Plants	6
	Pump Station	2
	Sewage Treatment Plant	2
	State Government Buildings	1
	Water Well	279
	Total	**697**
At Risk Population Facilities	Colleges, Universities, and Professional Schools	1
	Community Center	1
	Day Care Center	2
	Mobile Home Parks	22
	Places of Worship	19
	School	14
	Total	**59**
Hazardous Materials and Solid Waste Facilities	EPA ER FRP Facility	1
	EPA ER TRI Facility	1

Flood Zone Critical Facility Category	Critical Facility Type	Facility Count
	Leaky Underground Storage Tank	17
	Solid Waste Facility	3
	Total	**22**
1% Annual Chance Flood Hazard Total		**778**
0.2% Annual Chance Flood Hazard		
Essential Services Facilities	Cellular Tower	2
	Emergency Evacuation Center	12
	EMS Stations	8
	FDIC Insured Banks	15
	Fire Station	8
	Law Enforcement	5
	Microwave Service Towers	69
	Power Plants	3
	Public Transit Stations	4
	Pump Station	3
	State Government Buildings	1
	Water Well	124
	Total	**254**
At Risk Population Facilities	Colleges, Universities, and Professional Schools	7
	Day Care Center	38
	Mobile Home Parks	13
	Places of Worship	88
	School	50
	Total	**196**
Hazardous Materials and Solid Waste Facilities	EPA ER TRI Facility	9
	Leaky Underground Storage Tank	32
	Solid Waste Facility	1
	Total	**42**
0.2% Annual Chance Flood Hazard Total		**492**
Other Areas		
Essential Services Facilities	Airport	2
	Bridge	3
	Cellular Tower	13
	Emergency Evacuation Center	38
	EMS Stations	36
	FDIC Insured Banks	43

Flood Zone Critical Facility Category	Critical Facility Type	Facility Count
	Fire Station	42
	Hospital or Urgent Care	4
	Law Enforcement	17
	Microwave Service Towers	665
	Power Plants	31
	Public Transit Stations	3
	Pump Station	2
	Sandbag Site	3
	Sewage Treatment Plant	2
	State Government Buildings	1
	Water Well	696
	Total	**1,601**
At Risk Population Facilities	Colleges, Universities, and Professional Schools	4
	Community Center	3
	Day Care Center	100
	Mobile Home Parks	30
	Places of Worship	307
	School	253
	Total	**697**
Hazardous Materials and Solid Waste Facilities Total	EPA ER FRP Facility	1
	EPA ER TRI Facility	13
	EPA ER TSCA Facility	1
	Leaky Underground Storage Tank	78
	Solid Waste Facility	18
	Waste Transfer Station	1
		112
Other Areas Total		**2,410**
Unincorporated Sacramento County Total		**3,680**

Source: Sacramento County GIS, FEMA 7/19/2018 DFIRM

Overall Community Impact

Floods and their impacts vary by location and severity of any given flood event and will likely only affect certain areas of the County during specific times. Natural areas, such as wetlands and riparian 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. Preserving and protecting these areas and associated functions are a vital component of sound floodplain management practices for Sacramento County. 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 and property damage;
- Disruption of and damage to public infrastructure and services;
- Health hazards associated with mold and mildew, contamination of drinking water, etc.;
- Damage to roads/bridges resulting in loss of mobility;
- Significant economic impact (jobs, sales, tax revenue) to 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.
- Impact on the overall mental health of the community.

Future Development and Future Flood Conditions

This section provides an analysis of the flood hazard and proposed future development within the County based on FEMA DFIRMs and also discusses considerations in evaluating future flooding conditions.

Future Development: General Considerations

Communities that participate in the NFIP adopt regulations and codes that govern development in special flood hazard areas and enforce those requirements through their local floodplain management ordinances through the issuance of permits. Sacramento County's floodplain management ordinance provides standards for development, subdivision of land, construction of buildings, and improvements and repairs to buildings that meet the minimum requirements of the NFIP.

The International Residential Code (IRC) and International Building Code (IBC), by reference to ASCE 24, include requirements that govern the design and construction of buildings and structures in flood hazard areas. FEMA has determined that the flood provisions of the I-Codes are consistent with the requirements of the NFIP (the I-Code requirements shown either meet or exceed NFIP requirements). ASCE 24, a design standard developed by the American Society of Civil Engineers, expands on the minimum NFIP requirements with more specificity, additional requirements, and some limitations.

With the adoption of the 2015, and later, International Codes, communities will be moving towards a more stringent approach to regulatory floodplain management, beyond the minimum requirements of the NFIP. The adoption and enforcement of disaster-resistant building codes is a core community action to promote effective mitigation. When communities ensure that new buildings and infrastructure are designed and constructed in accordance with national building codes and construction standards, they significantly increase local resilience now and in the future. With continued advancements in building codes, local ordinances should be reviewed and updated to meet and exceed standards as practicable to protect new development from future flood events and to further promote disaster resiliency.

One of the most effective ways to reduce vulnerability to potential flood damage is through careful land use planning that fully considers applicable flood management information and practices. Master planning will also be necessary to assure that open channel flood flow conveyances serving the smaller internal streams and drainage areas are adequately prepared to accommodate the flows. Preservation and maintenance of natural and riparian areas should also be an ongoing priority to realize the flood control benefits of the natural and beneficial functions of these areas. Also to be considered in reducing flooding in areas of existing and future development is to promote implementation of stormwater program elements and erosion and sediment controls, including the clearing of vegetation from natural and man-made drains that are critical to flood protection. Both native and invasive species can clog drains, and reduce flows of floodwaters, which slow that natural drainage process and can exacerbate flooding.

California's 2007 flood legislation (Senate Bill 5) directly linked system-wide flood management planning to local land use planning, requiring local jurisdictions to demonstrate an urban level of flood protection before approving new development in urban and urbanizing areas. "Urban level of flood protection" means the level of protection necessary to withstand flooding that has a 1-in-200 chance of occurring in any given year (California Government Code Section 65007). DWR has been developing criteria to guide local jurisdiction compliance with the new requirements. In addition to developing criteria to help local jurisdictions in their land use planning, DWR is preparing criteria for use in the design of levees protecting urban and urbanizing areas. DWR is also working with local partners to develop guidance related to nonurban flood protection levels.

Once these standards become effective, cities and counties within the Sacramento-San Joaquin Valley cannot enter into development agreements or issue a permit to construct a new structure in areas located within a flood hazard zone unless the following is established:

- Find that existing facilities protect urban and urbanizing areas to a 1-in 200 chance of flooding in any given year or the FEMA standard of flood protection in non-urbanized areas, or
- Find that the local flood management agency has made adequate progress on the construction of the flood protection system to provide the required level of protection, or
- Impose conditions on the development agreement that will provide the required level of protection.

Future Development and Streambank Erosion

Planned developments should take erosion risk areas into account during the construction of new homes and commercial properties. Erosion to streambanks may increase as development increases the amount of impervious surface that would normally hold or slow rainwaters. The County will continue to enforce the zoning and subdivision ordinances that are discussed in Section 4.4.1.

GIS Analysis

Sacramento County's 2020 Parcel/Assessor's data and data from the County planning department were used as the basis for the unincorporated County's inventory of parcels and acres of future development areas. Using the GIS parcel spatial file and the APNs, the seven future development projects were mapped. For the flood analysis of future development areas, the parcel data was converted to a point layer using a centroid conversion process, in which each parcel was identified by a central point and linked to the

Assessor's data. Utilizing the future development project spatial layer, the parcel centroid data was intersected to determine the parcel counts and acreage within each FEMA flood zone. DFIRM flood zones and future development areas are shown on Figure 4-78 and parcels and acreages in those areas are shown in Table 4-84.

Figure 4-78 Unincorporated Sacramento county – Future Development and DFIRM Flood Zones

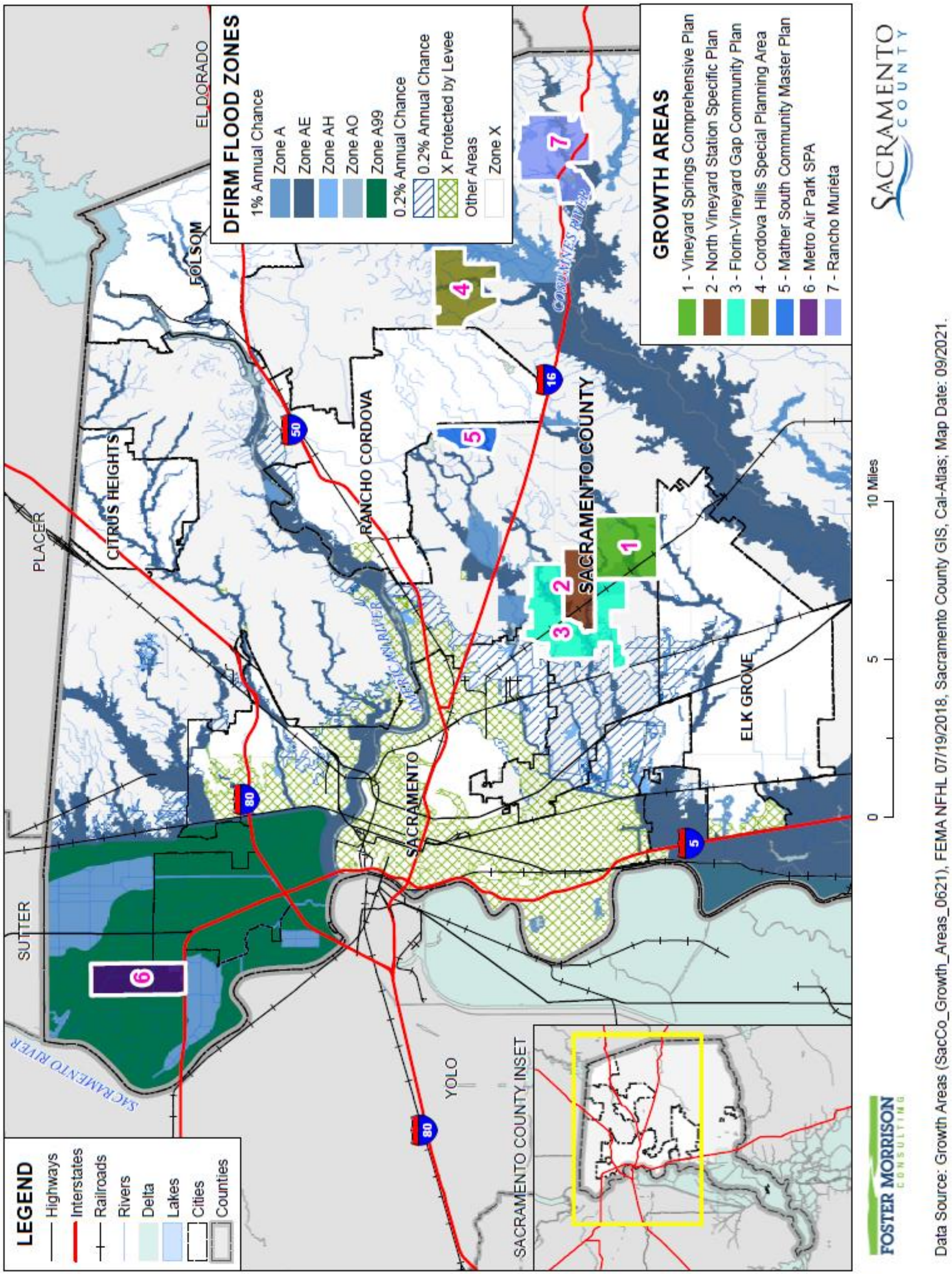


Table 4-84 Unincorporated Sacramento County – Future Development in FEMA DFIRM Flood Zones

Flood Zone/Future Development Area	Total Parcel Count	Improved Parcel Count	Total Acres
1% Annual Chance Flood Hazard			
Zone A			
Metro Air Park SPA	6	0	36
Rancho Murieta	3	0	84
Zone A Total	**9**	**0**	**120**
Zone AE			
Florin-Vineyard Gap Community Plan	70	39	374
North Vineyard Station Specific Plan	40	11	127
Rancho Murieta	8	1	562
Vineyard Springs Comprehensive Plan	58	43	241
Zone AE Total	**176**	**94**	**1,305**
Zone AH			
North Vineyard Station Specific Plan	1	0	12
Zone AH Total	**1**	**0**	**12**
Zone AO			
Florin-Vineyard Gap Community Plan	40	33	186
North Vineyard Station Specific Plan	2	1	15
Vineyard Springs Comprehensive Plan	42	34	185
Zone AO Total	**84**	**68**	**387**
Zone A99			
Metro Air Park SPA	68	4	1,771
Zone A99 Total	**68**	**4**	**1,771**
1% Annual Chance Flood Hazard Total	**338**	**166**	**3,595**
0.2% Annual Chance Flood Hazard			
Florin-Vineyard Gap Community Plan	329	295	499
North Vineyard Station Specific Plan	14	7	33
Rancho Murieta	120	114	368
Vineyard Springs Comprehensive Plan	23	19	41
0.2% Annual Chance Total	**486**	**435**	**941**
X Protected by Levee			
Rancho Murieta	178	132	64
X Protected by Levee Total	**178**	**132**	**64**
0.2% Annual Chance Flood Hazard Total	**664**	**567**	**1,006**
Other Areas			
Zone X			

Flood Zone/Future Development Area	Total Parcel Count	Improved Parcel Count	Total Acres
Cordova Hills Special Planning Area	14	0	2,406
Florin-Vineyard Gap Community Plan	597	454	2,640
Mather South Community Master Plan	4	0	1,007
North Vineyard Station Specific Plan	1,793	1,447	1,309
Rancho Murieta	2,634	2,345	2,145
Vineyard Springs Comprehensive Plan	2,661	2,495	1,886
Zone X Total	**7,703**	**6,741**	**11,393**
Other Areas Total	**7,703**	**6,741**	**11,393**
Grand Total	**8,705**	**7,474**	**15,994**

Source: Sacramento County, FEMA 7/19/2018 DFIRM

Future Flood Conditions: The Effects of Climate Change

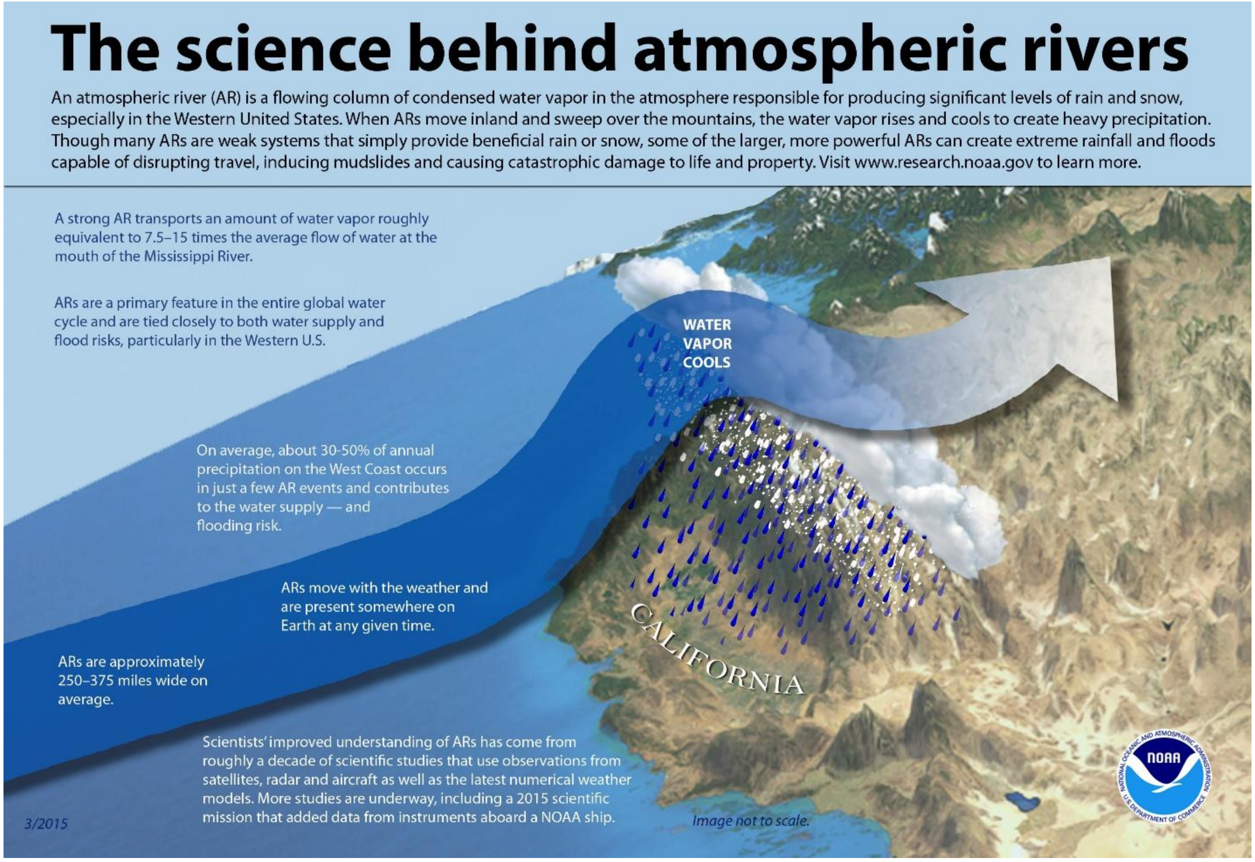
The effects of climate change on future flood conditions should also be considered. While the risk and associated short and long-term impacts of climate change are uncertain, experts in this field tend to agree that among the most significant impacts include those resulting from increased heat and precipitation events that cause increased frequency and magnitude of flooding. Changes associated with climate change and flooding could be significant given the higher elevations in the County where winter snow could turn to more significant rain events. Increases in damaging flood events will cause greater property damage, public health and safety concerns displacement, and loss of life. In addition, an increase in the magnitude and severity of flood events can lead to potential contamination of potable water and contamination of food crops given the agricultural industry in the County. Displacement of residents can include both temporary and long-term displacement, increase in insurance rates or restriction of coverage in vulnerable areas.

Sacramento County will continue to study the risk and vulnerability associated with future flood conditions, both in terms of future growth areas and other considerations such as climate change, as they evaluate and implement their flood mitigation and adaptation strategy for the Sacramento County Planning Area.

Future Flood Conditions: Atmospheric Rivers

Sacramento County and the rest of Northern California can be affected by a phenomenon known as an atmospheric river. According to the NOAA, atmospheric rivers are relatively long, narrow regions in the atmosphere – like rivers in the sky – that transport most of the water vapor outside of the tropics. These columns of vapor move with the weather, carrying an amount of water vapor roughly equivalent to the average flow of water at the mouth of the Mississippi River. When the atmospheric rivers make landfall, they often release this water vapor in the form of rain or snow. This can be seen in Figure 4-79.

Figure 4-79 Atmospheric Rivers



Source: NOAA

Although atmospheric rivers come in many shapes and sizes, those that contain the largest amounts of water vapor and the strongest winds can create extreme rainfall and floods, often by stalling over watersheds vulnerable to flooding. These events can disrupt travel, induce mudslides and cause catastrophic damage to life and property. A well-known example is the "Pineapple Express," a strong atmospheric river that is capable of bringing moisture from the tropics near Hawaii over to the U.S. West Coast.

Not all atmospheric rivers cause damage; most are weak systems that often provide beneficial rain or snow that is crucial to the water supply. Atmospheric rivers are a key feature in the global water cycle and are closely tied to both water supply and flood risks — particularly in the western United States.

While atmospheric rivers are responsible for great quantities of rain that can produce flooding, they also contribute to beneficial increases in snowpack. A series of atmospheric rivers fueled the strong winter storms that battered the U.S. West Coast from western Washington to southern California from Dec. 10–22, 2010, producing 11 to 25 inches of rain in certain areas. These rivers also contributed to the snowpack in the Sierras, which received 75 percent of its annual snow by Dec. 22, the first full day of winter.

Future Flood Conditions: ARkStorm Scenario

Also to be considered in evaluating potential "worst case" future flood conditions, is the ARkStorm Scenario. Although much attention in California's focuses on the "Big One" as a high magnitude earthquake, there is the risk of another significant event in California – a massive, statewide winter storm. The last such storms occurred in the 19th century, outside the memory of current emergency managers, officials, and communities. However, massive storms are a recurring feature of the state, the source of rare but inevitable disasters. The USGS Multi Hazards Demonstration Project's (MHDP) developed a product called ARkStorm, which addressed massive U.S. West Coast storms analogous to those that devastated California in 1861-1862. Over the last decade, scientists have determined that the largest storms in California are the product of phenomena called Atmospheric Rivers, and so the MHDP storm scenario is called the ARkStorm, for Atmospheric River 1000 (a measure of the storm's size).

Scientific studies of offshore deposits in northern and southern California indicate that storms of this magnitude and larger have occurred about as often as large earthquakes on the southern San Andreas Fault. Such storms are projected to become more frequent and intense as a result of climate change. This scientific effort resulted in a plausible flood hazard scenario to be used as a planning and preparation tool by hazard mitigation and emergency response agencies.

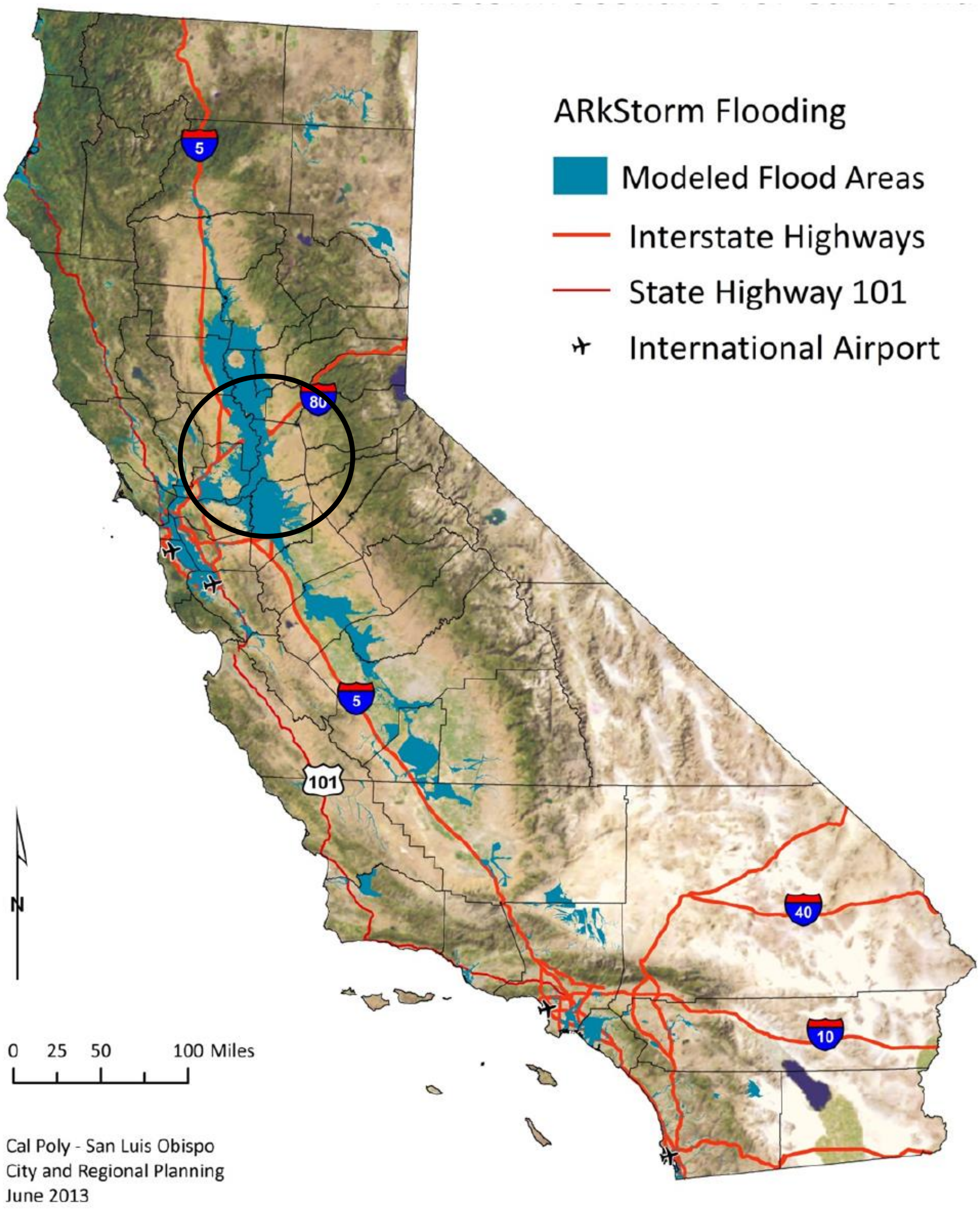
For the ARkStorm Scenario, experts designed a large, scientifically realistic meteorological event followed by an examination of the secondary hazards (e.g., landslides and flooding), physical damages to the intense winter storms of 1861-62 that left California's Central Valley impassible. Storms far larger than the ARkStorm, dubbed megastorms, have also hit California at least six times in the last two millennia.

The ARkStorm produces precipitation in many places exceeding levels experienced on average every 500 to 1,000 years. Extensive flooding in many cases overwhelms the state's flood protection system, which is at best designed to resist 100- to 200-year runoffs (many flood protection systems in the state were designed for smaller runoff events). The Central Valley experiences widespread flooding. Serious flooding also occurs in Orange County, Los Angeles County, San Diego, the San Francisco Bay Area, and other coastal communities. In some places, winds reach hurricane speeds, as high as 125 miles per hour. Hundreds of landslides occur, damaging roads, highways, and homes. Property damage exceeds $300 billion, most of it from flooding. Agricultural losses and other costs to repair lifelines, dewater flooded islands, and repair damage from landslides brings the total direct property loss to nearly $400 billion, of which only $20 to $30 billion would be recoverable through public and commercial insurance. Power, water, sewer, and other lifelines experience damage that takes weeks or months to restore. Flooding evacuation could involve over one million residents in the inland region and Delta counties.

A storm of ARkStorm's magnitude has important implications: 1) it raises serious questions about the ability of existing national, state, and local disaster policy to handle an event of this magnitude; 2) it emphasizes the choice between paying now to mitigate, or paying a lot more later to recover; 3) innovative financing solutions are likely to be needed to avoid fiscal crisis and adequately fund response and recovery costs; 4) responders and government managers at all levels could be encouraged to conduct self-assessments and devise table-top exercises to exercise their ability to address a similar event; 5) the scenario can be a reference point for application of FEMA and Cal OES guidance connecting federal, state, and local natural hazards mapping and mitigation planning under the NFIP and Disaster Mitigation Act of 2000; and 6) common messages to educate the public about the risk of such an extreme event could be developed and consistently communicated to facilitate policy formulation and transformation.

Figure 4-80 depicts an ARkStorm modeled scenario showing the potential for flooding primarily in the Central Valley as the result of a large storm. In Sacramento County, the modeled scenario suggests the County could be inundated on the western portion of the County and in the Delta in this ARkStorm model scenario.

Figure 4-80 Projected ARkStorm Flooding in California



Source: USGS ArkStorm

4.3.12. Flood: Localized Flooding

Hazard Profile

This hazard profile contains multiple sections that detail how this hazard can affect Sacramento County. These sections include a hazard/problem description; description of location and extent; past occurrences of this hazard; and how climate change can affect this hazard.

Hazard/Problem Description

Flooding occurs in areas other than the FEMA mapped floodplains. Flooding may be from drainages not studied by FEMA, lack of or inadequate drainage infrastructure, or inadequate maintenance. Localized, stormwater flooding occurs throughout the County during the rainy season from November through April. Prolonged heavy rainfall contributes to a large volume of runoff resulting in high peak flows of moderate duration. Flooding is more severe when previous rainfall has created saturated ground conditions. Urban storm drainpipes and pump stations have a finite capacity. When rainfall exceeds this capacity, or the system is clogged, water accumulates in the street until it reaches a level of overland release. This type of flooding may occur when intense storms occur over areas of development.

Location and Extent

According to Sacramento County, numerous parcels and roads throughout the County not included in the FEMA 1% and 0.2% annual chance floodplains are subject to flooding in heavy rains. In addition to flooding, damage to these areas during heavy storms includes pavement deterioration, washouts, mudslides, debris areas, and downed trees. The frequency and type of damage or flooding that occurs varies from year to year, depending on the quantity of runoff.

Table 4-85 identifies the number of parcels and roads by watersheds affected by localized flooding throughout the unincorporated County. Parcels were identified by the County based on those parcels historically affected by localized flooding issues. Affected roads are estimated based on those roads fully within 50 feet of a parcel with historical flooding problems. The Watershed Management Plan included as Appendix H to this LHMP Update also addresses these flood prone areas falling outside of the established 1% and 0.2% annual chance floodplains.

Table 4-85 Unincorporated Sacramento County Localized Flooding Areas

Watershed	# of Parcels Affected	# of Road Segments Affected
Alder Creek	18	82
American River	4	9
Antelope Creek	19	60
Arcade Creek	724	348
Arcade Creek South Branch	74	75
Arkansas Creek	15	4
Badger Creek	115	45

Watershed	# of Parcels Affected	# of Road Segments Affected
Beach Stone Lake	37	31
Bear Slough	0	0
Boyd Creek	0	0
Brooktree Creek	8	7
Browns Creek	12	1
Buffalo Creek	100	681
Carmichael Creek	460	270
Carson Creek	30	5
Chicken Ranch Slough	512	285
Cordova Coloma Stream Group	0	0
Cosumnes River	277	264
Courtland	0	0
Coyle Creek	138	60
Coyote Creek	47	5
Crevis Creek	17	8
Cripple Creek	53	50
Date Creek	51	38
Deadman's Gulch	136	68
Deer Creek	42	27
Diablo Creek	238	108
Dry Creek	241	161
Dry Creek South	68	38
East Antelope	37	58
East Natomas	224	98
Elder Creek	59	63
Elk Grove Creek	1	1
Fair Oaks Stream Group	1082	628
Florin Creek	1300	274
Frye Creek	15	9
Gerber Creek	19	47
Griffith Creek	103	25
Grizzly Slough	1	0
Hadselville Creek	55	15
Hagginbottom	587	178
Hagginwood Creek	202	82
Hen Creek	74	34
Hood	0	0

Watershed	# of Parcels Affected	# of Road Segments Affected
Laguna Creek	127	104
Laguna Creek South	68	41
Linda Creek	395	179
Little Deer Creek	2	1
Magpie Creek	230	470
Manlove	70	33
Mariposa Creek	0	0
Mayhew Slough	69	72
Minnesota Creek	246	155
Morrison Creek	802	274
Natomas Basin	16	5
Negro Slough	59	24
NEMDC Trib 1	91	26
NEMDC Trib 2	170	55
NEMDC Trib 3	186	106
North Delta	0	0
North Fork Badger Creek	98	65
Robla Creek	664	259
Rolling Draw Creek	8	10
San Juan Creek	51	27
Sierra Branch	167	95
Sierra Creek	93	210
Skunk Creek	60	45
Slate Creek	0	0
Strawberry Creek	165	83
Strong Ranch Slough	837	348
Sunrise Creek	0	0
Unionhouse Creek	626	161
Verde Cruz Creek	109	93
Whitehouse Creek	0	0
Willow Creek Middle	0	0
Willow Creek South	22	11
Total	**12,626**	**7,194**

Source: Sacramento County, 2021

Past Occurrences

Disaster Declarations

There are no identified state or federal disaster declarations for localized flooding, as shown in Table 4-4. However, localized flooding was likely an issue during previous declarations for severe storms, heavy rains and floods.

NCDC Events

The past occurrences of localized flooding are included in the 1% and 0.2% annual chance flood hazard profile in Section 4.3.12.

Hazard Mitigation Planning Committee Events

The Planning Team for the County noted the following localized flooding events that have occurred in the County since 2011.

- **Mar 24**, 2011 – High winds & 1 – 1.5" rain. 90 service calls, most for plugged drains. 1 structure flooded.
- **Nov 30, 2012** – Dec 3. – High winds & 4" -6" rain. 800 service calls w/ 474 drainage service requests. 24 Mobile homes flooded at Auburn Blvd. & 15 other structures Countywide.
- **February 10, 2014 -** 2.5" – 4.5" rain. 72 drainage service calls.
- **Dec 2 – 4, 2014** – 1.1 -5.5" rain. 321 drainage service calls. No structural flooding. Watt Ave. and Roseville Rd. number 1 lane flooded with 2 feet of water due to clogged drain. Roadway flooding in Sacramento on southbound Highway 99 near Sacramentoville Rd. Water was as deep as car doors and traffic was backed up. I-80 at Watt Ave. Eastbound Underpass had significant flooding due to heavy rain and pump failure. This resulted in major traffic backup, lasting several hours during evening rush hour.
- **Dec 11 -12, 2014** – 2.3" – 3.5" rain. 179 drainage service calls.
- **Feb 5 – 9, 2015** – 1"-3" rain. 47 drainage service calls.
- **January 5th & 19th, 2016** – A cool winter storm brought moderate rain, 1-2 inches across the Valley, with ponding on roads and small stream rises. There was roadway flooding with partial lane blockage reported on I80 and also on US Highway 50.
- **January and February 2017** – Heavy rains caused multiple areas of localized flooding in both unincorporated Sacramento County, as well as in cities in the County.
- **January 17, 2019** – Stockton Blvd was impassable due to flooding. Local media shared a video of law enforcement rescuing a stranded motorist in Sloughhouse near Kiefer Blvd and Jackson Rd. Road was completely flooded. Areas of the County received up to 2.3 inches of rainfall.
- **February 25, 2019** – CHP reported Roseville Road north and southbound just north of Antelope Rd. closed due to flooding, roadway flooding from arcade creek reported at Winding Way and Walnut Ave, roadway flooding on I80 W at Truxel Rd. off-ramp, and roadway flooding with 8 inches of water affecting north and southbound Stockton Blvd north of Elsie Ave. The rainfall record (2/25/19 10am to 2/27/19 10am) shows 2.6 to 2.7 inches of rainfall in 24 hours
- **April 5, 2020** – California Highway Patrol reported 2 feet of water flooding between I80 W and Madison Avenue near North Highlands, CA, 8 inches of water flooding the roadway between Eastern

Ave and Marconi Ave, 1 1/2 feet of water flowing across all lanes between Interstate 80 East and Auburn Boulevard near North Highlands, roadway flooding between Sutters Gold Drive and Manlove Road in Rosemont, CA, roadway flooding near Whitney Avenue in Carmichael, CA, roadway flooding between Roseville Road and Antelope Road in Antelope, CA, roadway flooding between Kiefer Blvd and Rosemont Drive in Rosemont, C, and roadway flooding between Sunrise Blvd and Wildridge Dr in Fair Oaks, CA. Several rain gauges recorded intense rainfall over a short duration, some reaching 20 to 80 year storm return frequency for 1 hour intensity.

Likelihood of Future Occurrence

Highly Likely— With respect to the localized, stormwater flood issues, the potential for flooding may increase as storm water is channelized due to land development. Such changes can create localized flooding problems in and outside of natural floodplains by altering or confining natural drainage channels. Urban storm drainage systems have a finite capacity. When rainfall exceeds this capacity or systems clog, water accumulates in the street until it reaches a level of overland release. With increasing urbanization of the Sacramento County Planning Area, combined with older infrastructure, this type of flooding will continue to occur during heavy rains. Based on historical data, localized, stormwater flooding events less severe than a 1% annual chance flood and those outside of the floodplain occur frequently (on an annual basis) during periods of heavy rains.

Climate Change and Localized Flood

While it is uncertain exactly how climate change will affect flooding events in Sacramento County, and to what extent, any increase in flooding is highly likely to have serious ramifications, because the area is already considerably vulnerable. Even if average annual rainfall may decrease slightly, the intensity of individual rainfall events is likely to increase during the 21st century, increasing the likelihood of overwhelming stormwater systems built to historical rainfall averages. This makes localized flooding more likely.

Vulnerability Assessment

Vulnerability—Medium

Historically, the Sacramento County Planning Area has been at risk to flooding primarily during the winter and spring months when stream systems in the County swell with heavy rainfall. Localized flooding also occurs throughout the Planning Area at various times throughout the year with several areas of primary concern unique to each community. Sacramento County tracks localized flooding areas as shown above.

Impacts

Localized flooding can cause damage to roads, infrastructure and utilities, as well as to buildings in the County. Temporary road closures due to localized flooding can be a significant issue in the County. In addition to flooding and road closures, damage to these areas during heavy storms includes, pavement deterioration, washouts, landslides/mudslides, debris areas, and downed trees. Impacts to property and life safety from localized flooding would be more limited. Local community service districts have seen infiltration and inflow into sewer systems during heavy rain and localized flooding events.

Values at Risk

Areas in Sacramento County vulnerable to localized flooding were identified by the County and analysis was performed for the 2011 and 2016 Plan Update. That analysis was updated here, using 2021 mean values of structures in the County. Parcel and road segments vulnerable to these areas were tabulated by watershed, and are shown in Table 4-85 above. Road segments were initially selected if they were within 50 feet of an affected parcel. For the purposes of this analysis, parcels and road segments that overlapped watershed boundaries were counted for each of the watersheds. Parcels and road segments that intersect the 1% or.2% annual flood events (see DFIRM flood analysis, Section 4.3.10) were eliminated from these counts. It is important to note that localized flooding may also occur within those DFIRM zones, making this analysis a conservative approach.

There are 12,626 parcels affected by localized flooding (and outside of the DFIRM flood zones) in Sacramento County, as shown above in Table 4-85. According to the County Assessor data, the mean (average) structure value of improved residential parcels county-wide is $386,000 (it was $295,000 in 2016 and $158,665 in 2010). Assuming that the parcels listed in Table 4-85 are improved residential parcels, there is a total structure value of $4.87 billion at risk to localized flooding. Assuming contents value is 50% of residential structure value, there is a total value of $7.3 billion at risk. Applying the 20% loss due to flooding, the loss estimate for the Planning Area is $1.46 billion. Total values at risk are shown in Table 4-86. Total population at risk to localized flooding is 34,848 (based on Census 2020 household factor of 2.76).

Table 4-86 Sacramento County Planning Area – Vulnerability to Localized Flooding

Parcel Count	Improved Value/Parcel*	Structure Value	Contents Value	Total Value	Loss Estimate
12,626	$386,000	$4,873,636,000	$2,436,818,000	$7,310,454,000	$1,462,090,800

Source: Sacramento County, 2021

*mean value of an improved residential structure

Future Development

The risk of stormwater/localized flooding to future development can be minimized by accurate recordkeeping of repetitive localized storm activity. Mitigating the root causes of the localized stormwater flooding or choosing not to develop in areas that often are subject to localized flooding will reduce future risks of losses due to stormwater/localized flooding.

4.3.13. Landslide/Mudslide/Debris Flows

Hazard Profile

This hazard profile contains multiple sections that detail how this hazard can affect Sacramento County. These sections include a hazard/problem description; description of location and extent; past occurrences of this hazard; and how climate change can affect this hazard.

Hazard/Problem Description

According to the California Geological Survey (CGS), 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. Landslide events can be determined by the composition of materials and the speed of movement. A rockfall is dry and fast while a debris flow is wet and fast. Regardless of the speed of the slide, the materials within the slide, or the amount of water present in the movement, landslides are a serious natural hazard. Another type of landslide, debris flows, also occur in some areas of the County. These debris flows generally occur in the immediate vicinity of existing drainage swales or steep ravines. Debris flows occur when near surface soil in or near steeply sloping drainage swales becomes saturated during unusually heavy precipitation and begins to flow downslope at a rapid rate. Debris flows also occur in post-wildfire burn areas.

Landslides often accompany or follow other natural hazard events, such as floods, wildfires, or earthquakes. A discussion on the effects of wildfire on landslides and debris flows is included in the wildfire profile in Section 4.3.16. Landslides can occur slowly or very suddenly and can damage and destroy structures, roads, utilities, and forested areas, and can cause injuries and death.

Soil erosion is another common form of soil instability. Erosion is a function of soil type, slope, rainfall intensity, and groundcover. It accounts for a loss in many dollars of valuable soil, is aesthetically displeasing, and often induces even greater rates of erosion and sedimentation. Sedimentation is simply the accumulation of soil as a result of erosion. Construction activities often contribute greatly to erosion and sedimentation. Besides being a pollutant in its own right, sediment acts as a transport medium for other pollutants, especially nutrients, pesticides, and heavy metals, which adhere to the eroded soil particles. As the sediment drains into watercourses, the combination of these pollutants adversely affects water quality.

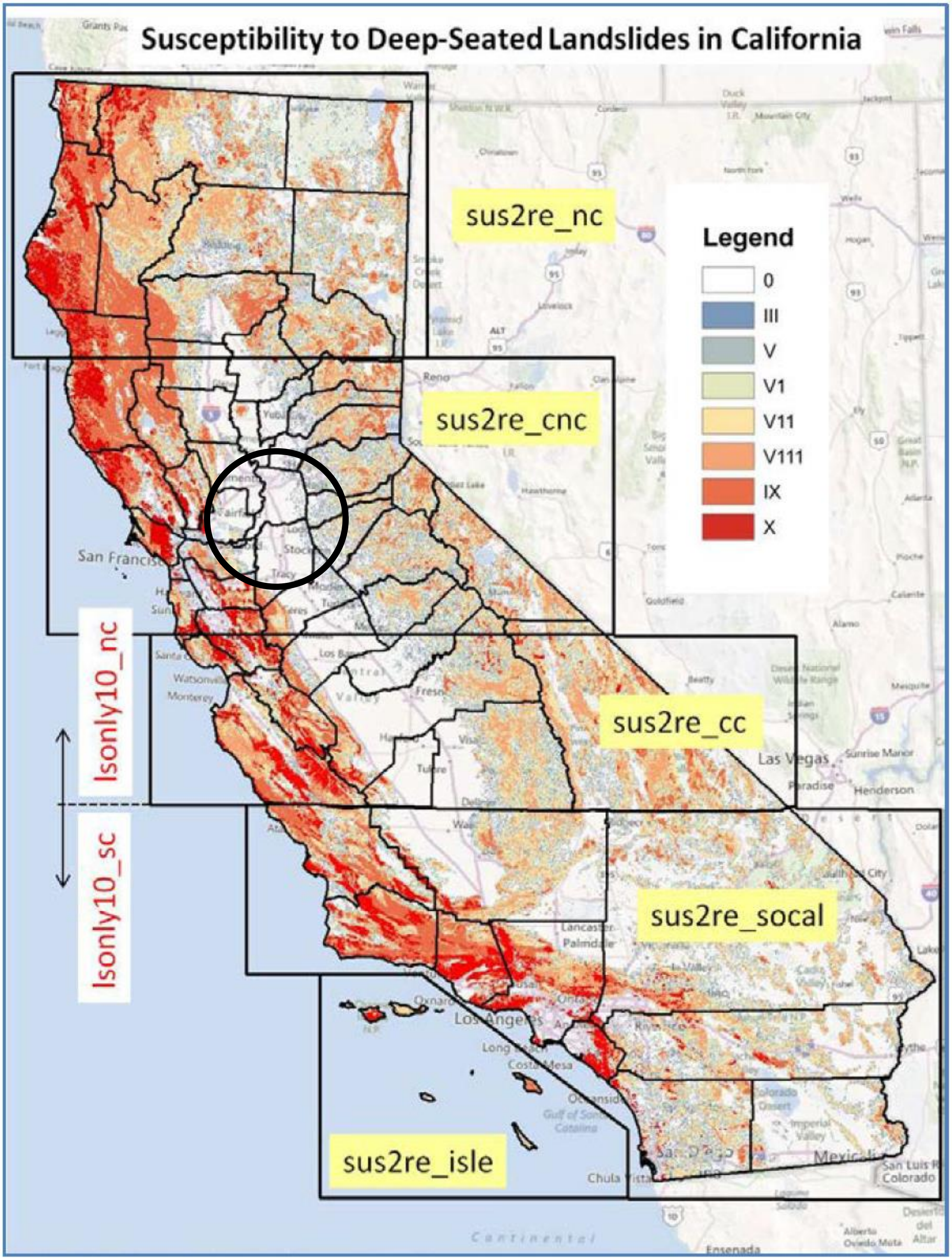
Location and Extent

The Sacramento County General Plan Background Report describes areas in the County that are particularly prone to landslides. In Sacramento County, only a narrow strip along the eastern boundary, from the Placer County line to the Cosumnes River, is considered to have landslide potential. However, future slides on these slopes are expected to be minor in nature and do not pose a large-scale threat to life or property. The American River Bluffs downstream from Folsom and in Fair Oaks and Carmichael are considered stable and are generally not subject to fracture or landslides.

Landslides, or ground failure, are dependent on slope, geology, rainfall, excavation or seismic activity. Mud slides are often caused by heavy rainfall. Areas that have recently been subject to wildfire are susceptible to mud slides. The CGS maps areas of landslide susceptibility. Figure 4-81 shows the CGS Landslide

Susceptibility areas in the County. most likely to generate landslides. The map uses detailed information on the location of past landslides, the location and relative strength of rock units, and steepness of slope to estimate susceptibility to deep-seated landsliding (0 to X, low to high).

Figure 4-81 Deep-seated Landslides, Landslide Susceptibility, Landslide Hazard



Source: CGS, 2011

The legend on Figure 4-81 shows the measurement system that the CGS uses to show the possible magnitude of landslides. It is a combination of slope class and rock strength. The speed of onset of landslide is often short, especially in post-wildfire burn scar areas, but it can also take years for a slope to fail. Landslide duration is usually short, though digging out and repairing landslide areas can take some time.

Past Occurrences

Disaster Declaration History

There have been no disaster declarations associated with landslides in Sacramento County, as shown in Table 4-4.

NCDC Events

The NCDC contains no records for landslides in Sacramento County.

Hazard Mitigation Planning Committee Events

No landslide incidents were reported since the 2016 Plan Update.

Likelihood of Future Occurrence

Unlikely – The topography of the majority of Sacramento County is relatively flat and not subject to landslide. In Sacramento County, only a narrow strip along the eastern boundary, from the Placer County line to the Cosumnes River, is considered to have landslide potential. However, future slides on these slopes are expected to be minor in nature and do not pose a large-scale threat to life or property. The American River Bluffs downstream from Folsom and in Fair Oaks and Carmichael are considered stable and are generally not subject to fracture or landslides; most land movement in this area is attributed to natural processes. This small portion, coupled with a lack of previous occurrences, equates to a likelihood of future occurrence of unlikely.

Climate Change and Landslide and Debris Flows

According to the CAS, climate change may result in precipitation extremes (i.e., wetter wet periods and drier dry periods). More information on precipitation increases can be found in Section 4.3.4. While total average annual rainfall may decrease only slightly, rainfall is predicted to occur in fewer, more intense precipitation events. The combination of a generally drier climate in the future, which will increase the chance of drought and wildfires, and the occasional extreme downpour is likely to cause more mudslides, landslides, and debris flows. However, with the lack of sloped areas in the County, increase in landslides due to climate change will be limited.

Vulnerability Assessment

Vulnerability—Low

Landslides in Sacramento County include a wide variety of processes resulting in downward and outward movement of soil, rock, and vegetation. Although landslides are primarily associated with slopes greater than 15 percent, they can also occur in relatively flat areas and as cut-and-fill failures, river bluff failures, lateral spreading landslides, collapse of wine-waste piles, failures associated with quarries, and open-pit mines.

Although this hazard also includes related issues such as mudslides and debris flows, available mapped hazard data was limited to landslides; thus, the remainder of this section is focused on the landslide vulnerability.

Impacts

Impacts from landslides in the County can vary greatly. In unpopulated areas, landslides have little effect. However, if landslides occur in populated areas, damages can be sustained by buildings, critical facilities, infrastructure, and injuries, and in extreme cases deaths, can occur. Landslide can affect ingress and egress routes.

Future Development

Although new growth and development corridors could fall in the area affected by moderate risk of landslide, given the small chance of a major landslide and the building codes and erosion ordinance in effect, development in the landslide areas will continue to occur.

4.3.14. Levee Failure

Hazard Profile

This hazard profile contains multiple sections that detail how this hazard can affect Sacramento County. These sections include a hazard/problem description; description of location and extent; past occurrences of this hazard; and how climate change can affect this hazard.

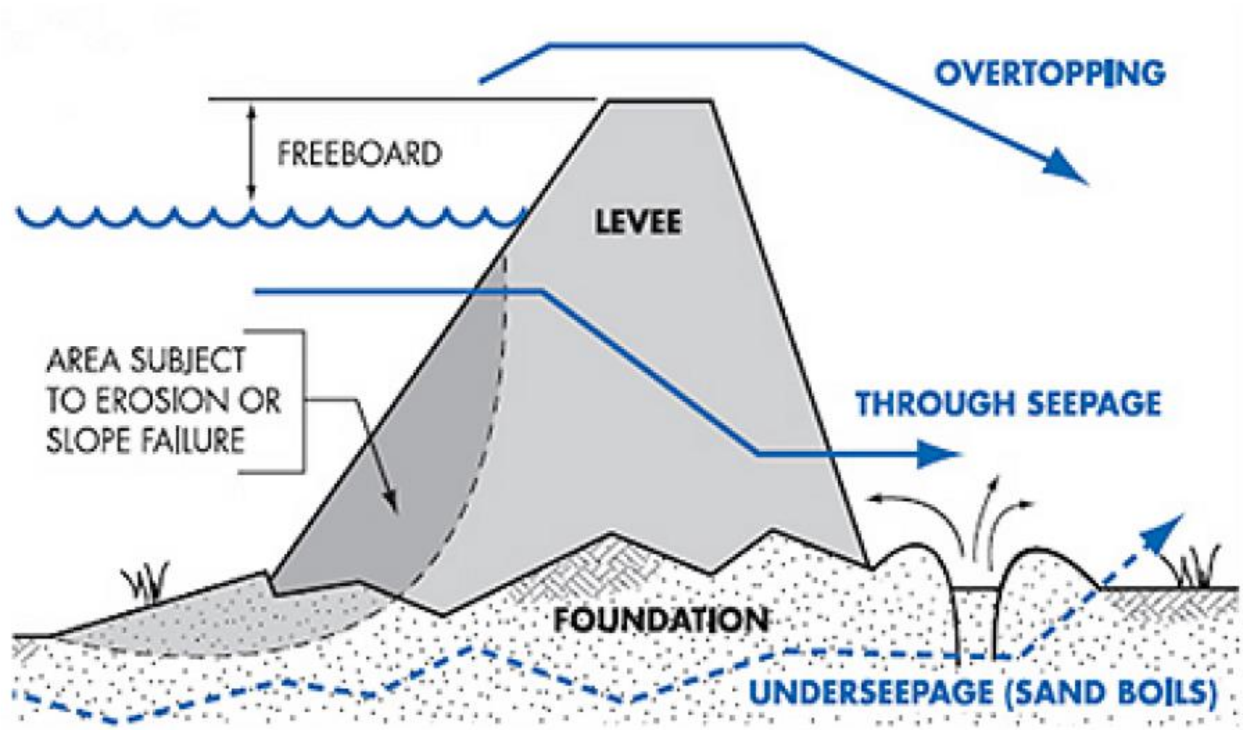
Hazard/Problem Description

A levee is a raised area that runs along the banks of a stream or canal. Levees reinforce the banks and help prevent flooding by containing higher flow events to the main stream channel. By confining the flow to a narrower steam channel, 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 streambank, raising the level of the land around the stream.

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 or dam failure. Levees reduce, not eliminate, the risk to individuals and structures located behind them. A levee system failure or overtopping can create severe flooding and high-water velocities. It is 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.

In addition to overtopping, levee systems can fail or be compromised in a variety of ways. Under-seepage refers to water flowing under the levee through the levee 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. Rodents can burrow into and compromise the levee system. Erosion can also lead to levee failure. Figure 4-82 depicts many causes of levee failure.

Figure 4-82 Potential Causes of Levee Failure

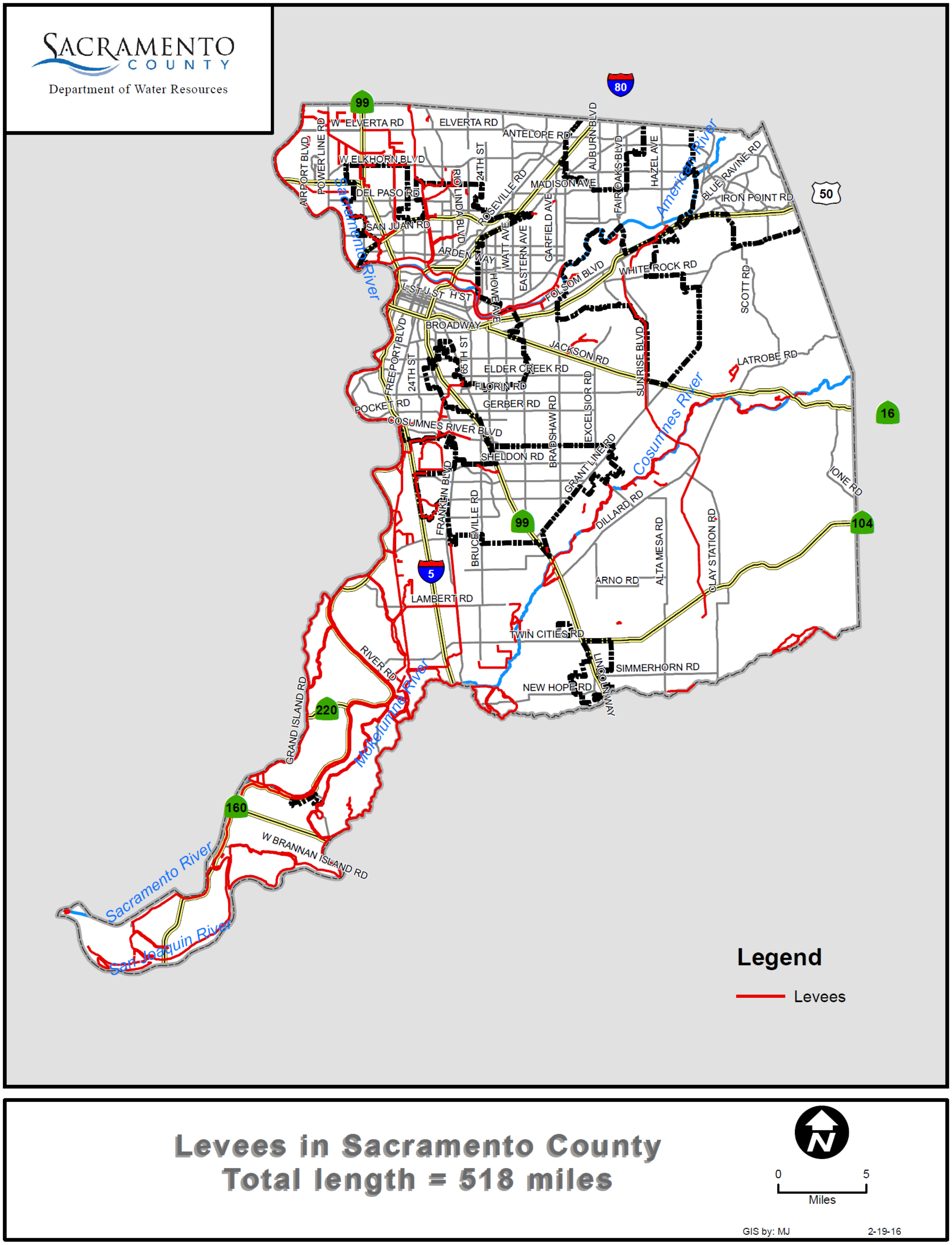


Source: USACE

Location and Extent

Approximately 150 years ago, the levees of the Sacramento-San Joaquin Delta were raised to prevent flooding on what remains some of the most fertile farmland in the nation. While the peat soils were excellent for agriculture, they do not create strong foundations for levee barriers meant to contain a constant flow of river water. Nevertheless, it was these native soils that were primarily used to create the levee system. Sacramento County's levee system can be seen in Figure 4-83.

Figure 4-83 Sacramento Planning Area – Levee Map



There is not a scientific scale or measurement system in place for levee failure. It us usually measured in area covered and depth of flooding. Maps showing inundation depths due to a levee failure in the County do not exist. The speed of onset is slow as the river rises, but if a levee fails the warning times are short for those in the inundation area. The duration of levee failure risk times can be hours to weeks, depending on the river flows that the levee holds back. Geographical X Protected by Levee extent from the FEMA DFIRMs is shown in Table 4-87.

Table 4-87 Sacramento County Planning Area – Geographical Flood Hazard Extents in FEMA X Protected by Levee DFIRM Flood Zones

X Protected by Levee/ Jurisdiction	Total Acres	% of Total Acres*	Improved Acres	% of Total Improved Acres*	Unimproved Acres	% of Total Unimproved Acres*
Citrus Heights	0	0.00%	0	0.00%	0	0.00%
City of Sacramento	24,355	69.85%	16,745	64.25%	7,610	86.43%
Elk Grove	1,966	5.64%	1,774	6.81%	192	2.18%
Folsom	0	0.00%	0	0.00%	0	0.00%
Galt	0	0.00%	0	0.00%	0	0.00%
Isleton	0	0.00%	0	0.00%	0	0.00%
Rancho Cordova	197	0.56%	175	0.67%	22	0.25%
Unincorporated Sacramento County	8,348	23.94%	7,367	28.27%	981	11.14%
Grand Total	**34,865**	**100.00%**	**26,061**	**100.00%**	**8,804**	**100.00%**

Source: 7/19/2018 DFIRM

Past Occurrences

Disaster Declaration History

There have been two federal and two state disasters declarations related to levee failure in Sacramento County, as shown on Table 4-88. Also it is important to note that many of the flood disaster declarations included in Section ??? also may include flooding associated with levee breach or failure events.

Table 4-88 Sacramento County – State and Federal Disaster Declarations Summary 1950-2020

Disaster Type	State Declarations		Federal Declarations	
	Count	Years	Count	Years
Levee Break	2	1972, 1980	2	1972, 1980

Source: Cal OES, FEMA

NCDC Events

There have been no NCDC levee failure events in Sacramento County.

FIS Events

The FIS reported the following regarding levee failure flooding:

> ***Past flooding in the City of Isleton area has been due to levee failures caused by the separate or coincidental occurrence of very high tides and high stream outflow through the delta region, or from unexplained levee failures apparently not related from high tides and/or high stream outflow can reasonably be expected, such failures cannot be reliably predicted. A detailed field inspection of levees protecting Andrus, Brannan and Twitchell Islands, was made to determine levee conditions insofar as it is possible to do so without subsurface exploration. The report on the inspection identifies problem areas susceptible to failure and requires exploratory borings and testing of core materials to definitively determine levee stability (USACE, 1976). Because 2-percent annual chance flooding would overtop levees, stability analysis was deemed unnecessary, and this study is concerned only with levee overtopping and disintegration of levee sections subsequent to overtoppings.***
>
> ***The Delta has a long history of flooding, but little definitive data on specific flood events are available. Andrus, Brannan and Twitchell Islands, have all experienced historical floods. Large areas of the delta were inundated during floods, and it is probable that the City of Isleton was damaged or seriously threatened.***
>
> ***The 1950 and 1955 floods were outstanding in peak outflows through the delta and several islands were flooded. The City of Isleton, however, was not affected. In December 1965 and January 1965, the coincidental occurrence of very high tides and heavy inflow resulted in unusually high stages on all delta waterways. Concurrent strong onshore winds generated high waves that created very perilous conditions for many islands. Levees protecting Twitchell Island were seriously threatened by erosion and overtopping, but a massive flood fighting effort prevented overflow, destruction of levees and inundation of the City of Isleton.***
>
> ***In December 1964 and January 1965, the coincidental occurrence of very high tides and heavy inflow resulted in unusually high stages on all delta waterways. Concurrent strong onshore winds generated high waves that created very perilous conditions for many islands. Several hundred acres were flooded and damages, mainly flood fighting and repair of levees and levee roads, were a little less than $1 million. In January and February 1969, high tides and adverse wave action in the delta, combined with large river inflow and rain-soaked levees, caused the flooding of several islands and the endangerment of many other islands. Approximately 11,400 acres were inundated and flood damages***

amounted to about $9.2 million. The levee separating Andrus Island and the San Joaquin River failed from unknown causes in June 1972, resulting in the flooding of Andrus and Brannan Islands (including the City of Isleton). High winds had occurred prior to the break, but there had been no antecedent rainfall and the tidal cycle was not on the higher side. About 15,000 acres were inundated and flood damages for the event approximated $30 million.

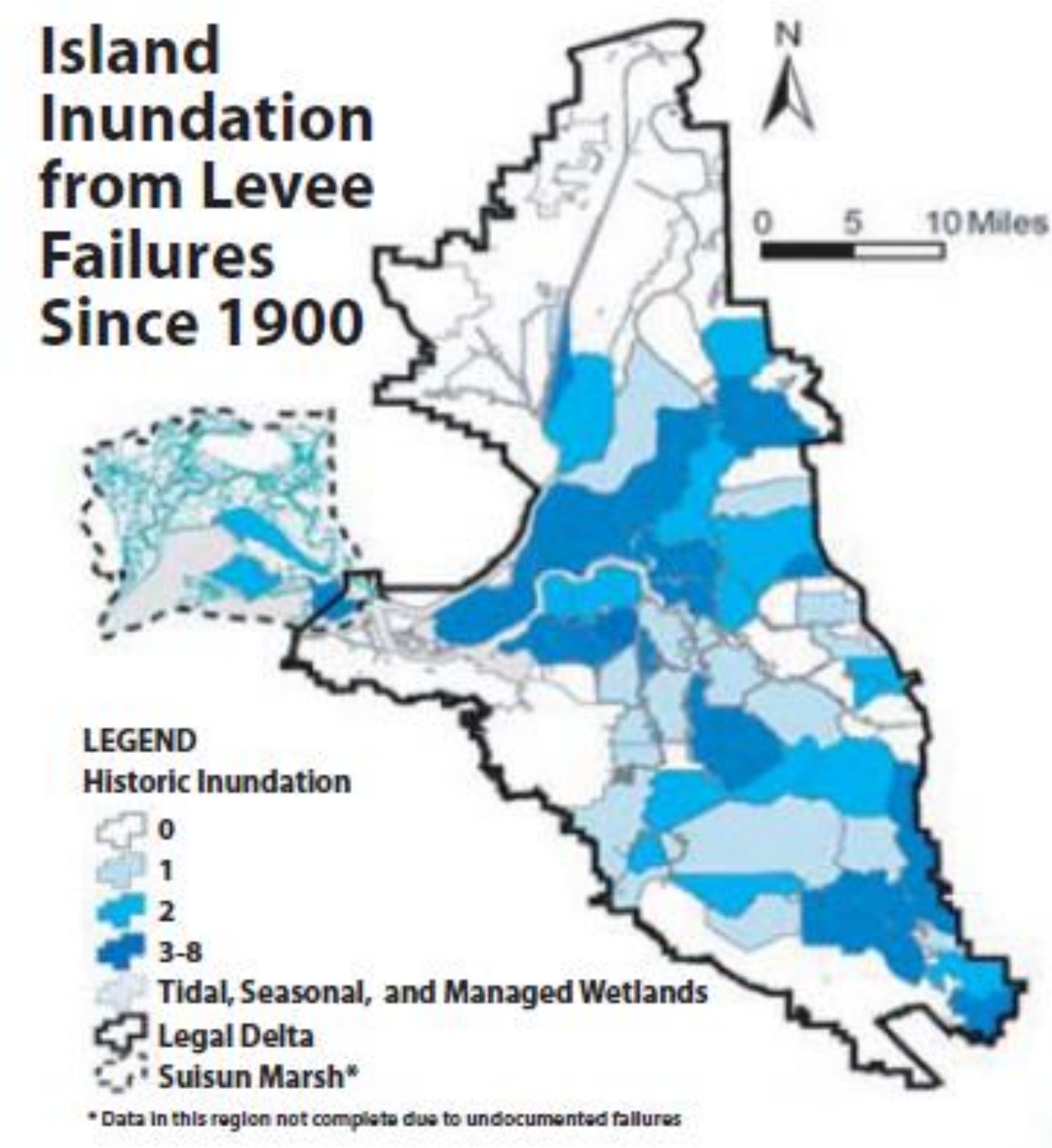
The most devastating and recent flooding of the City of Isleton resulted from failure of a levee at the southern end of Andrus Island. The levee failed from unknown causes during the night of June 21, 1972. There had not been any antecedent rainfall and the tidal cycle was not on the higher side, but high winds had been occurring prior to the break. Approximately 200,000 acre-feet of water from the San Joaquin River inundated Andrus and Brannan Islands. Activities to fight floods to protect the City of Isleton proved to be a losing battle, and almost all of the City was flooded. The entire population was evacuated, with some residents not being able to return to their homes for 4 months. Approximately one-half of the housing units in the City were damaged or destroyed. Damage from the flood event on the islands and in the City of Isleton totaled approximately $30 million.

Due to the size of the delta region, and the complexity of its stream and tidal regimen, flood frequency varies from location to location. In general, the 1950, 1955 and 1964 tidal stages in the central delta, had frequencies of 10, 30 and 5 years, respectively. Stage during the 1955 and 1964 flood periods was strongly influenced by onshore winds. The 1972 flood event cannot be assigned a frequency because the levee failure that caused the flooding cannot be attributed to tidal stage or streamflow conditions.

Hazard Mitigation Planning Committee Events

There have been about 100 levee failures and over 165 levee breaches since the early 1900. However, most of these failures occurred in the Delta area and are not specific to portions of the Delta located inside of Sacramento County. Only 17 failures and 20 breaches occurred after 1990 due to overall improvements in the levee systems throughout the Delta. These historic numbers are not representative of future occurrences within the County. Figure 4-84 shows the levee failures since 1900.

Figure 4-84 Island Inundation from Levee Failures from 1900-Present



Some islands have been flooded and recovered multiple times. A few islands, such as Franks Tract in San Joaquin County, have never been recovered. Some of the more major levee breaks in Sacramento County are detailed below.

June 21, 1972 – A levee in the Brannan-Andrus Levee Maintenance District broke. 35% of the City of Isleton was inundated. A national disaster was declared June 27, and the breach was closed on July 26. Estimated damages in 2011 dollars were $234 million. The USACE repaired the break.

February 19, 1986 – Heavy rains and flooding affected Sacramento County and the surrounding area. 6 months of precipitation fell in 10 days in mid-February. High water content caused multiple levee failures. Two levee breaks in the same general area occurred on the 8,800 acre Tyler Island in Sacramento County. These two levee breaks were approximately 300 feet in length (see Figure 4-85). A FEMA disaster declaration was declared on February 21. The approximate cost to repair the breaks was $6 million in 2011 dollars. Details on damages to structures and crops on the islands was not available.

Figure 4-85 1986 Tyler Island Levee Breach

Source: California Department of Water Resources

December 1996 was one of the wettest Decembers on record. Watersheds in the Sierra Nevada were already saturated by the time three subtropical storms added more than 30 inches of rain in late December 1996 and Early January 1997. The third and most severe of these storms lasted from December 31, 1996 through January 2, 1997. Rain in the Sierra Nevada caused record flows that stressed the flood management system to capacity in the Sacramento River Basin and overwhelmed the system in the San Joaquin River Basin. Levee failures due to breaks or overtopping in the Sacramento River Basin resulted in extensive damages. In the San Joaquin River Basin, dozens of levees failed throughout the river system and produced widespread flooding. The Sacramento-San Joaquin River Delta also experienced several levee breaks and levee overtopping. Affected Delta islands within Sacramento County included McCormack-Williamson Tract, Dead Horse Island and Glanville Tract.

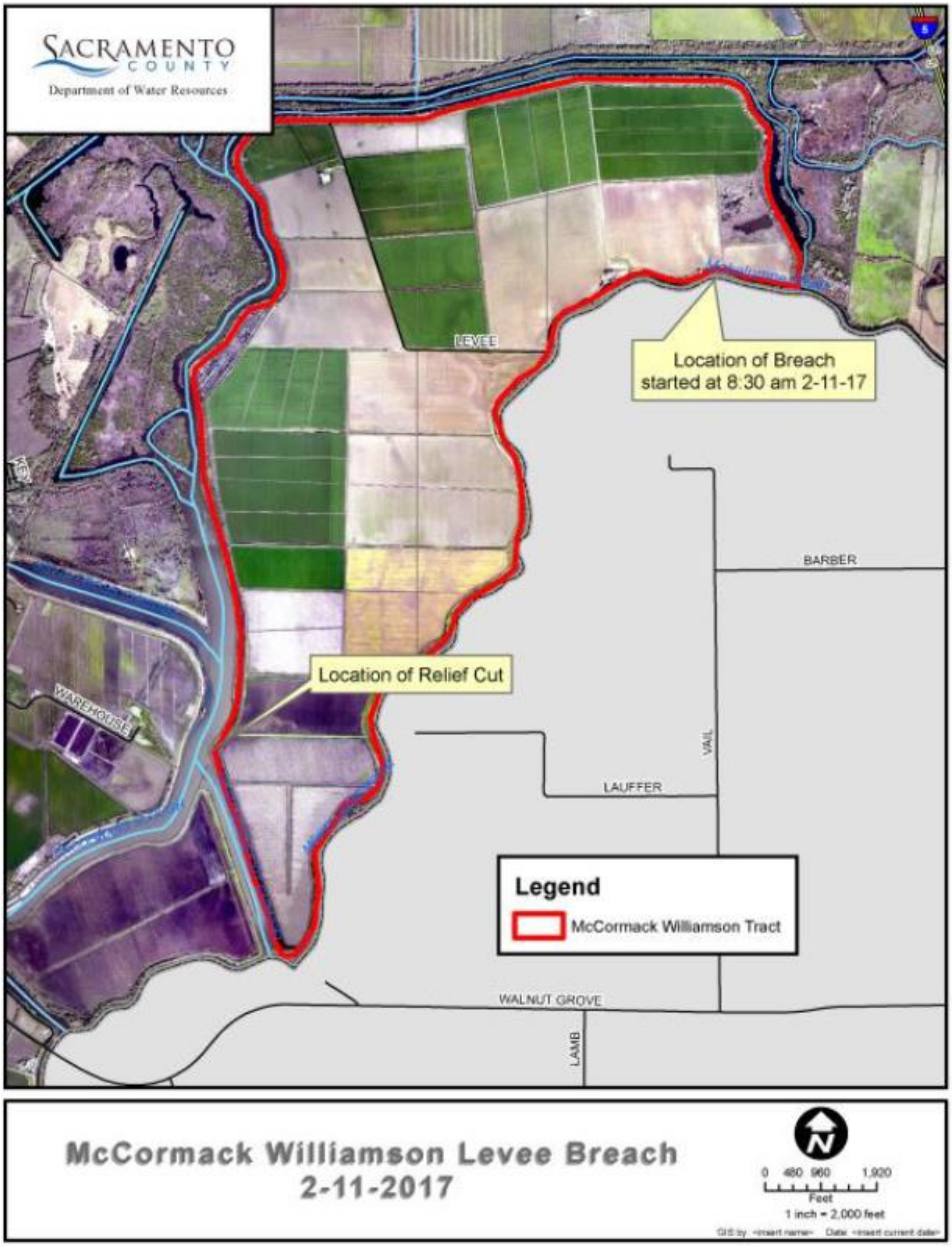
January 11, 2017 – After atmospheric river rains struck Sacramento County and the surrounding area, flooding occurred. Independent reports from San Joaquin and Sacramento County Sheriff Deputies identified a breach in the Mokelumne River. A private levee failure within San Joaquin County continued to cause flooding to New Hope Road through March 2017.

Figure 4-86 New Hope Levee Break

Source: 2017 January Winter Storms After Action Report

February 11, 2017 – The McCormack Williamson Tract levee overtopped and failed starting at 8:30 am. The levee failed at River Mile 28 near the northeast section of the tract (see Figure 4-87). According to the RD, at the time, it could have taken at least 9 hours for the Island to fill. The RD was planning to helicopter in equipment to construct a relief cut at the southwest end of the Island. The relief cut was intended to mitigate a surge of water into the Mokelumne River/ Snodgrass Slough that would result when the downstream levee breaks. A surge had the potential to impact several of the levees in the area that protect Tyler Island, Dead Horse Island and East Walnut Grove. The RDs had staged equipment and supplies in the event of a flood fight. Tyler Island RD monitored a small levee seepage problem along the North Fork of the Mokelumne at Sta 46000. The RD had planned to work on the repair starting that Monday when the tides were lower and all repair equipment/ material was in place. Beyond that, Tyler Island was experiencing higher waters due to the McCormack Williamson relief cut and had continuous levee patrols.

Figure 4-87 Sacramento County – McCormack Williamson Levee Breach



Source: 2017 February Winter Storm After Action Report from Sacramento County OES

February 12, 2017 – Road closures included 21 distinct areas throughout the southern portion of the county. RD800 reported significant damage to their levees and were able to conduct damage assessments. Results of those assessments were provided to the EOC along with any other resource requests. SMUD also reported that they had 6 homes without power in Point Pleasant area. Power was de-energized to those homes due to flooding. The Snodgrass Slough Levee was inspected for seepage and water continued to overtop Lambert Road flowing north toward Point Pleasant.

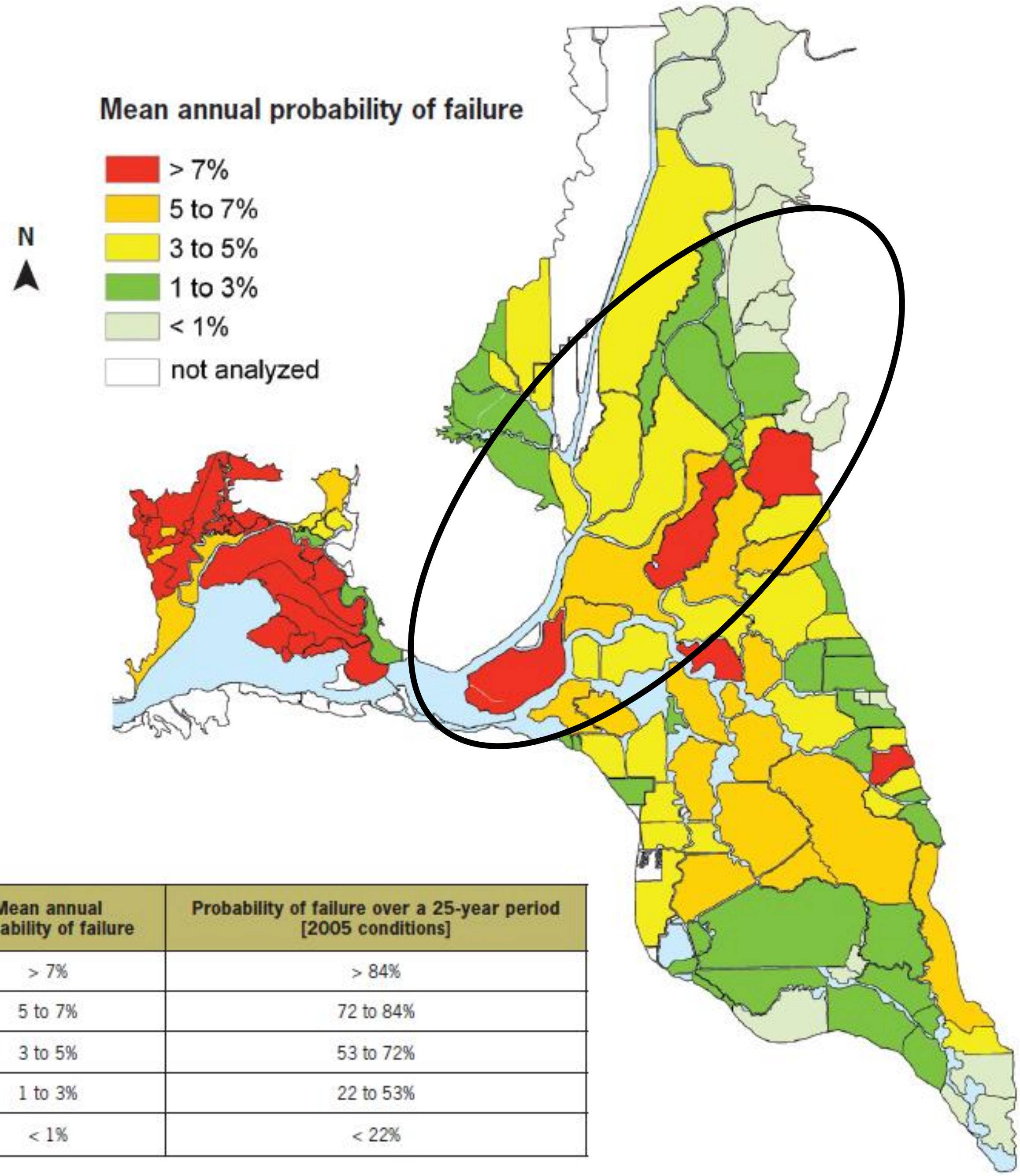
February 13, 2017 – Mandatory evacuations were ordered due to a compromised levee at Tyler Island Bridge Road. Land between Mokelumne and Georgiana Slough had been evacuated; 645 contacts within the Sacramento Alert system. Walnut Grove was under an advisory for the possibility of an evacuation and rock was brought in by barge crane to begin repairs on the levee. Advance plans for a relief cut were identified should the levee have failed.

February 18, 2017 – The United States Coast Guard Auxiliary provided photos of a levee with scouring in the Pearson Tract. Contacts to MBK Engineers were made regarding identifying the issue and making the necessary repair.

Likelihood of Future Occurrence

Occasional – Due to the high number of past events, increasing subsidence, and the deteriorating conditions of the levees in Sacramento, future levee failures will occur occasionally. This can be seen for the Delta area in Figure 4-88. However, it is important to note that numerous levee improvement projects are ongoing throughout the Sacramento County area, which will make the future occurrence of levee failure less likely.

Figure 4-88 Estimated Frequency of Levee Overtopping Under Current Conditions



Mean annual probability of failure	Probability of failure over a 25-year period [2005 conditions]
> 7%	> 84%
5 to 7%	72 to 84%
3 to 5%	53 to 72%
1 to 3%	22 to 53%
< 1%	< 22%

Source: Delta Risk Management Strategy

Climate Change and Levee Failure

Though a decrease in flood frequency in California is a predicted consequence of climate change, the floods are expected to be longer and more severe. Mechanisms whereby climate change leads to an elevated flood risk include more extreme precipitation events and shifts in the seasonal timing of river flows. This threat may be particularly significant because recent estimates indicate the additional force exerted upon the levees is equivalent to the square of the water level rise. These extremes are most likely to occur during storm events, leading to more severe damage from waves and floods, thus possibly leading to more levee failure events.

More information on climate change and flooding can be found in Section 4.3.11.

Vulnerability Assessment

Vulnerability—Extremely High

Levee failure flooding can occur as the result of partial or complete collapse of an impoundment, and often results from prolonged rainfall and resulting higher water elevations in the river. The primary danger associated with dam or levee failure is the high velocity flooding of those properties downstream of the breach. Impacts from this include property damage, critical facility damage, and life safety issues. 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 a flood protection facility. Secondary losses would include loss of the multi-use functions of the facility and associated revenues that accompany those functions.

Impacts

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

- Earthquake failure
- High water failure
- Dry weather failure

Earthquake Failure

Seismic risk in the Delta Region is characterized as moderate-to-high because of many active faults in the San Francisco Bay Area. Figure 4-60 in Section 4.3.9 Earthquake, illustrates the locations of faults in and near the San Francisco Bay Area and the Delta Region. Area seismic activity during the last 100 years is significantly less than what was experienced during the 1800s and the first part of the 1900s. Seismic experts predict increased seismic activity in the future similar to that which occurred up to the first part of the 1900s. Seismic risk to levees stems from the risk of liquefaction. Liquefaction is discussed as a stand-alone hazard in Section 4.3.10. A more in depth discussion may be found there.

High Water Failure

The primary threats to Delta levees are high water surface elevations from floods or high tides, wave action due to high winds or boat wakes, and rodent damage, either as individual actions or in combination. High water levels can be produced by storm events, spring snowmelt, and/or releases from upstream reservoirs. Levees can become vulnerable to through and underseepage, as well as overtopping. Levees that may have structural issues involving poor foundations, inadequate geometry or other geotechnical issues can be at a higher risk of failure from any of the primary threats.

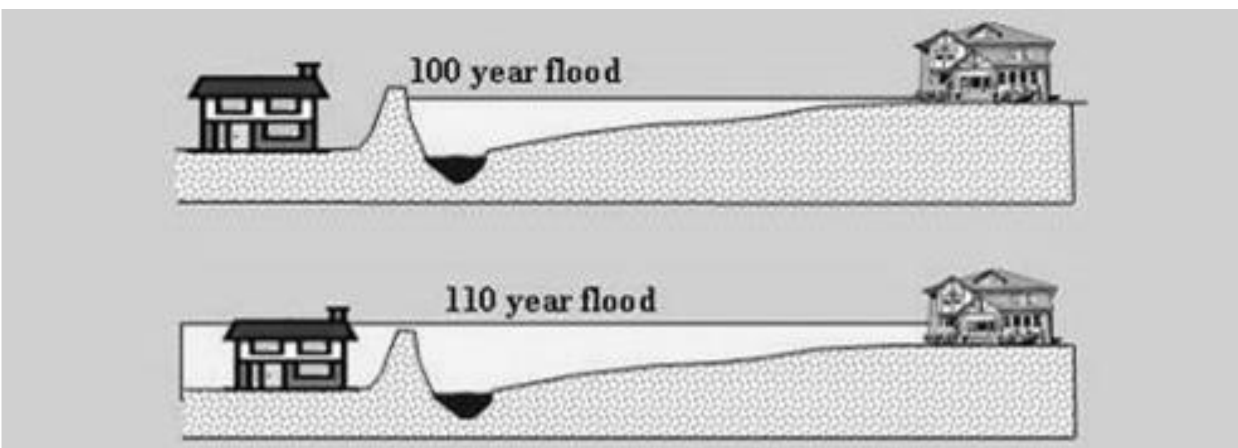
Under-seepage refers to water flowing under the levee through the levee foundation materials, often emanating from the bottom of the landside slope and ground surface and extending landward from the landside toe of the levee. Through-seepage refers to water flowing through the levee prism directly, often 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. Delta levee may seep 'clear water' indicating that material is not being removed from the levee or levee foundation. Inspections are the primary means by which this is inspected.

Levees are vulnerable to high-water conditions not only while the river stages are high, but also when water levels fall at a rapid rate (rapid withdrawal). Rapid withdrawal is common when upstream releases from a reservoir stop or are reduced at a rapid rate. This sudden release in pressure from the waterside levee slopes can cause levees to slough.

Rivers that are not controlled by an upstream reservoir, such as the Cosumnes River, may be more vulnerable to overtopping.

Overtopping failure occurs when the flood water level rises above the crest of a levee. As shown in Figure 4-89, overtopping of levees can cause greater damage than a traditional flood due to the often lower topography behind the levee.

Figure 4-89 Flooding from Levee Overtopping



Source: Levees in History: The Levee Challenge. Dr. Gerald E. Galloway, Jr., P.E., Ph.D., Water Policy Collaborative, University of Maryland, Visiting Scholar, USACE, IWR.

Most levee failures in the Delta Region have occurred during winter storms and related high water conditions, often in conjunction with high tides and strong winds.

Dry Weather Failures

Dry weather, or sunny-day, 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 Sacramento–San Joaquin River Delta (Delta) 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 regardless of whether the failures occur during a high-tide condition or not. Most practicing engineers, scientists, and maintenance personnel in the Delta and Suisun Marsh believe that rodents are prolific in the Delta and use levees for burrowing. As a result, they cause undue weaknesses by creating a maze of internal and interconnected galleries of tunnels. 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.

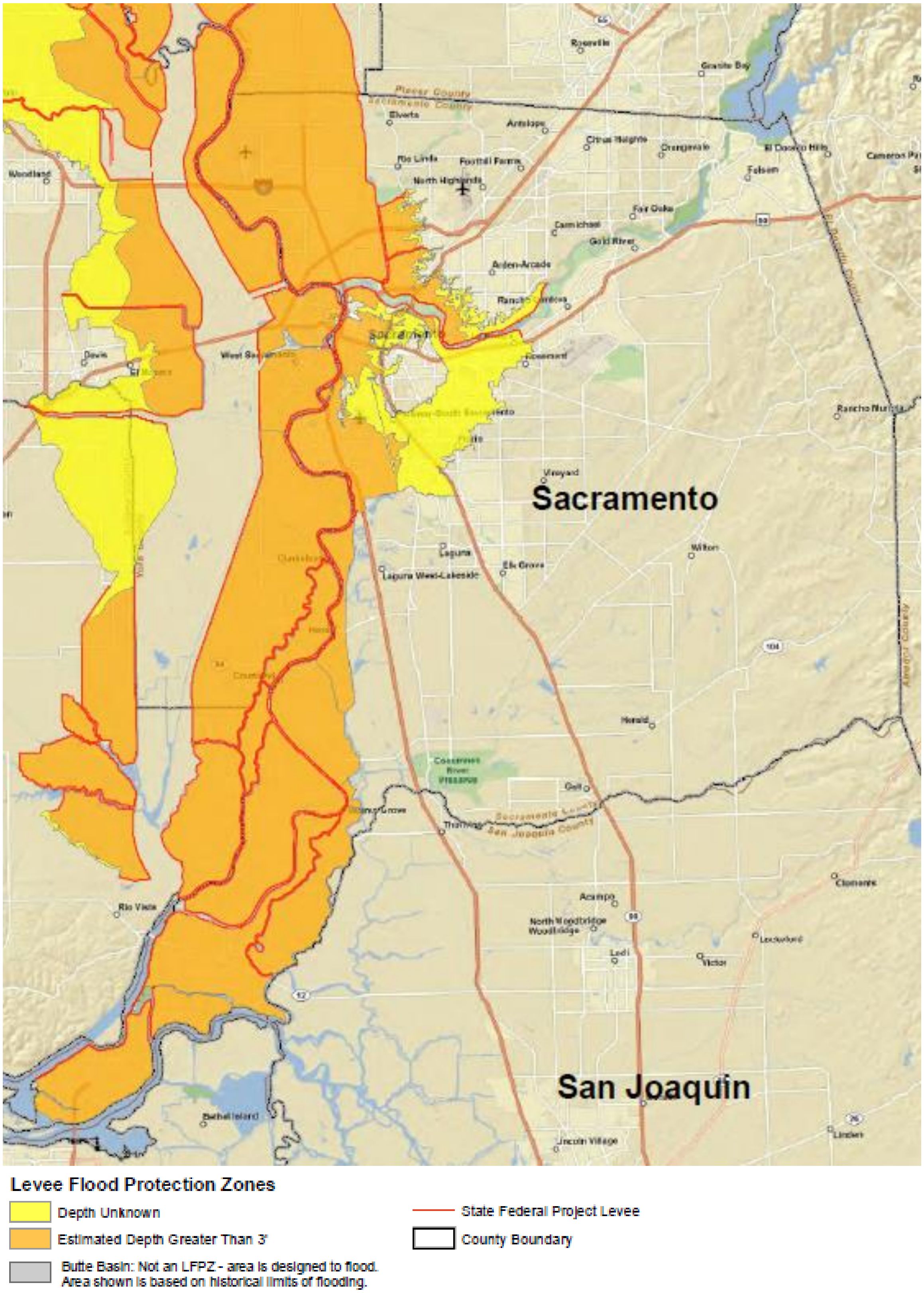
Streambank Erosion

In addition to the above levee failure causes, streambank erosion can cause levees to fail. When flood waters are high, there is greater erosive capabilities of water. In addition, high winds during times of flooding can cause additional erosive pressures on levees. Streambank erosion was discussed in more detail in Section 4.3.11.

Levee Flood Protection Zones (LFPZ) Maps

LFPZ maps represent floodplain areas protected by Central Valley State-Federal Project Levees. Under Water Code Section 9110(b), "LFPZ" means the area, as determined by the Central Valley Flood Protection Board or DWR, that is protected by a project levee. These maps were developed based on the best available information as required by Assembly Bill 156. This Bill requires DWR to prepare LFPZ maps to identify the areas where flood levels would be more than three feet deep if a project levee were to fail. DWR delineated the LFPZs by estimating the maximum area that may be flooded if a project levee fails with flows at maximum capacity that may reasonably be conveyed. DWR is using information from several sources, including FEMA floodplain maps, FEMA Q3 data, USACE's 2002 Sacramento and San Joaquin River Basins Comprehensive Study, and local project levee studies. Using this data, DWR is implementing a multi-year program to evaluate and delineate detailed floodplains for areas protected by project levees. This effort includes new topography, hydrology, hydraulic models, and floodplain maps. This information will be used to update the initial LFPZ maps. Figure 4-90 is the most recent LFPZ map for the Sacramento County Planning Area.

Figure 4-90 Sacramento County - Levee Flood Protection Zones



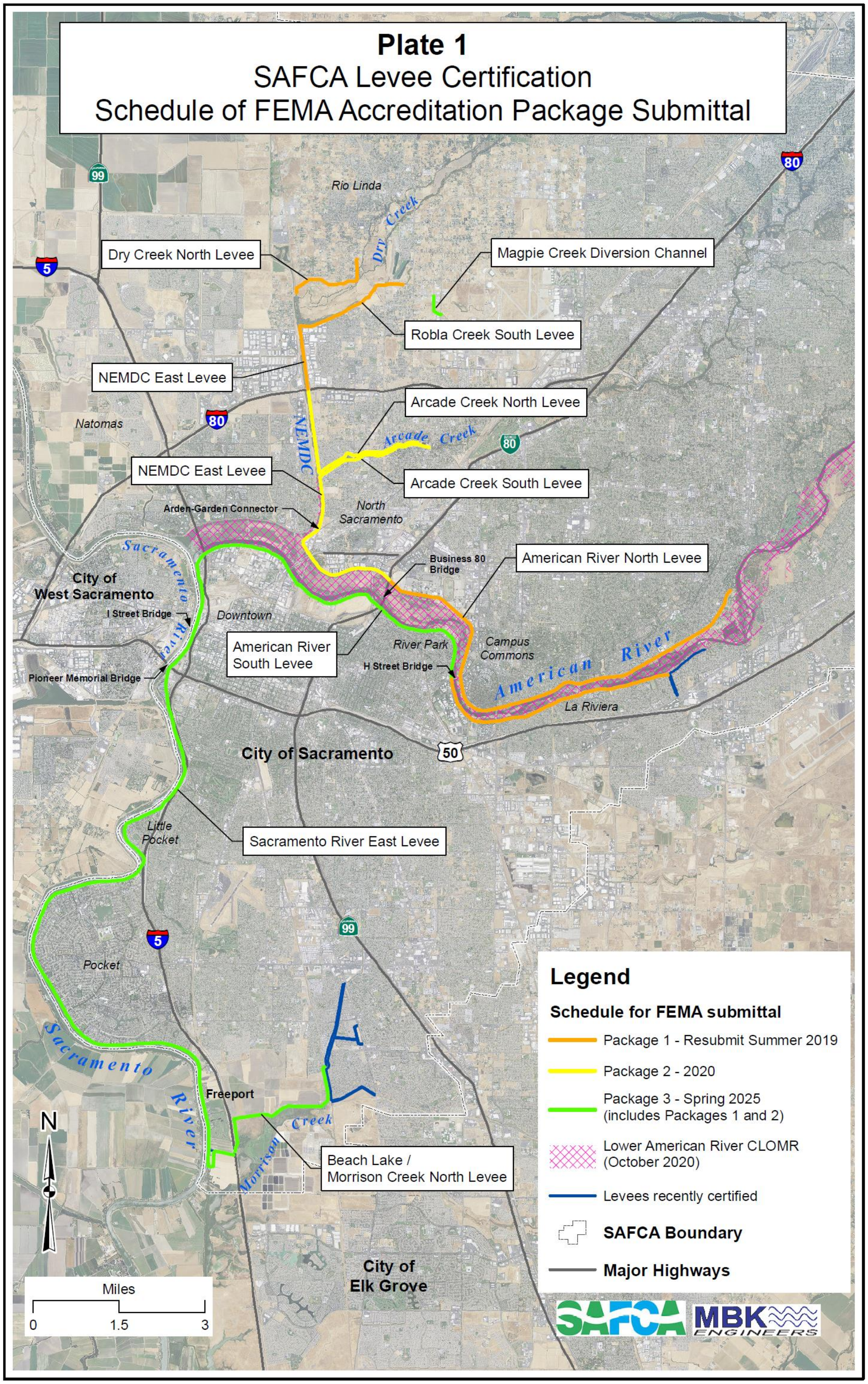
Source: California Department of Water. Retrieved 2/5/2021

Vulnerability Analysis

Unincorporated Sacramento County and its incorporated jurisdictions have mapped flood hazard areas. This includes areas protected by levees. GIS was used to determine the the areas protected by levee within the County, and how the risk varies across the Planning Area. The following methodology was followed in determining improved parcel counts and values at risk in X Protected by Levee areas. This analysis was performed based on the most current 2018 DFIRMs which still reflect some levees as providing 100-year level of protection. According to the County, with the exception of areas undergoing levee improvements to certify levees to the 100-year and 200-year level of protection; all levees have since been decertified as not providing a 100-year level of protection, so this analysis is based solely on the information presented in the DFIRMs. Thus, this analysis reflects a moment in time and while it does provide information on areas developed behind levees, the X Protected by Levee flood zone will continue to change as these projects are completed and new levee certifications obtained.

The County noted that the Sacramento Area Flood Control Agency is working on FEMA certification of levees. A submission schedule for leveed areas in the County is shown on Figure 4-91.

Figure 4-91 Sacramento County – Schedule of FEMA Accreditation for Levees



It also should be noted that while this analysis shows areas protected by a certified levee based on the most current DFIRMs, the levee risk within the Sacramento County Planning Area is actually greater behind all the levees that are not certified as providing a certain level of protection. Thus, it could be inferred that all the other areas built behind levees are actually more at risk then the areas protected by a certified levee.

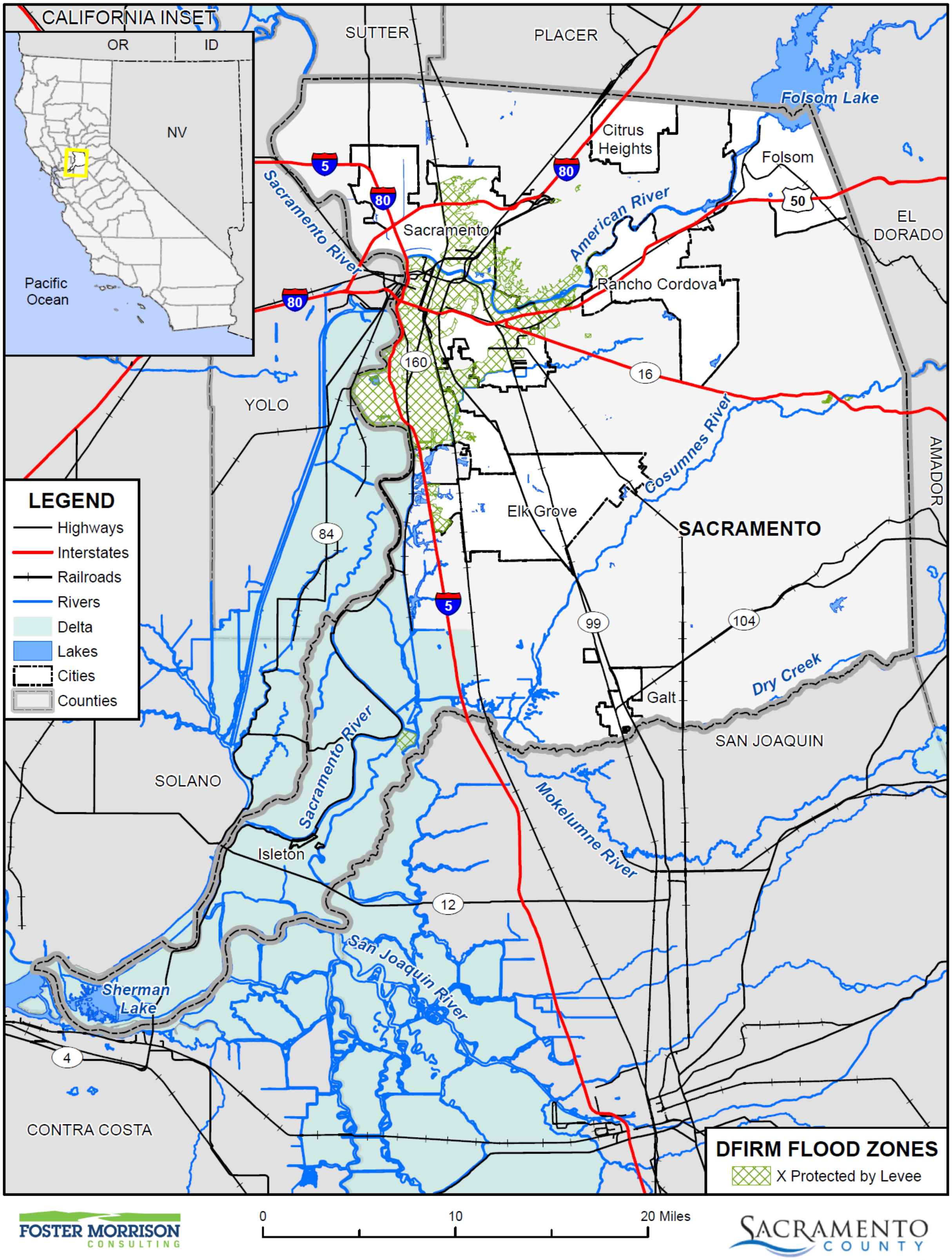
Methodology

Quantifying the values at risk and estimating losses within mapped FEMA X Protected by Levee DFIRM floodplains in the County is an important element in understanding the risk and vulnerability of the Sacramento County Planning Area to the levee hazard. The methodology and limitations for this analysis are the same as those found in the flood vulnerability in Section 4.3.11 above.

The end result of the values at risk and flood loss estimates analysis is an inventory of the numbers, types, and values of parcels and estimated losses subject to the flood hazard by flood zone. Results are presented here first for the Sacramento County Planning Area and secondly for unincorporated County. Results for the incorporated jurisdictions are presented in their annexes to this Plan.

Figure 4-92 contains flood analysis results for area protected by a levee (i.e. designation of X Protected by Levee) for the entire Sacramento County Planning Area. Note this analysis is based on the current 2018 DFIRMs in effect and is best available information, but may not reflect the most current levee certification status for the Sacramento County Planning Area. It should also be noted that the X Protected by Levee Zone shows only those areas protected by levees from the 1% annual chance flood. There are large areas of the County and the Delta at risk to flooding outside of the X Protected by Levee areas.

Figure 4-92 Sacramento County DFIRM X Protected by Levee Areas



Data Source: FEMA NFHL 07/19/2018, Sacramento County GIS, Cal-Atlas; Map Date: 09/2020.

Values at Risk and X Protected by Levee Areas

Sacramento County Planning Area

Table 4-89 contains DFIRM X Protected by Levee analysis results for the entire Sacramento County Planning Area. This includes unincorporated Sacramento County and the incorporated jurisdictions. This table shows the number of parcels and assets at risk in levee protected areas. Table 4-89 shows the value of improved parcels by jurisdiction. It should be noted that the X Protected by Levee Zone shows only those areas protected by levees from the 1% annual chance flood. There are large areas of the County and the Delta at risk to flooding outside of the X Protected by Levee areas.

Table 4-89 Sacramento County Planning Area – Count and Value of Parcels in X Protected by Levee DFIRM Flood Zone*

Jurisdiction	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Citrus Heights	0	0	$0	$0	$0	$0
Elk Grove	2,764	2,652	$339,935,388	$1,026,035,692	$609,999,906	$1,975,970,955
Folsom	0	0	$0	$0	$0	$0
Galt	0	0	$0	$0	$	$0
Isleton	0	0	$0	$0	$0	$0
Rancho Cordova	827	796	$57,421,834	$169,663,044	$85,780,542	$312,865,432
City of Sacramento	78,765	73,364	$9,114,550,673	$22,956,197,204	$15,639,035,020	$47,709,783,168
Unincorporated Sacramento County	12,629	12,032	$1,481,344,313	$3,501,091,801	$2,223,488,586	$7,205,924,734
Total	**94,985**	**88,844**	**$10,993,252,208**	**$27,652,987,741**	**$17,948,304,148**	**$57,204,544,289**

Source: FEMA 7/19/2018 DFIRM, Sacramento County February Parcel/Assessor's Data

*With respect to improve parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

Unincorporated Sacramento County

Table 4-90 contains the X Protected by Levee analysis results for unincorporated Sacramento County. These tables show the number of parcels and assets at risk in X Protected by Levee areas. Table 4-90 shows the value of improved parcels by land use. Information on DFIRM X Protected by Levee flood zones and property use for each jurisdiction in the County are shown in their respective annexes to this Plan Update.

Table 4-90 Unincorporated Sacramento County – Count and Value of Parcels by in X Protected by Levee DFIRM Flood Zone by Property Use*

Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Agricultural	7	7	$2,053,347	$1,998,179	$1,998,179	$6,049,705
Care/Health	14	9	$7,589,097	$41,048,396	$41,048,396	$89,685,889
Church/Welfare	30	26	$12,088,693	$33,980,411	$33,980,411	$80,049,515
Industrial	101	96	$28,279,980	$75,737,635	$113,606,457	$217,624,069
Miscellaneous	159	6	$667,769	$396,867	$396,867	$1,461,503
Office	193	169	$112,716,926	$310,101,549	$310,101,549	$732,920,024
Public/Utilities	38	0	$0	$0	$0	$0
Recreational	19	5	$850,517	$1,605,937	$1,605,937	$4,062,391
Residential	11,537	11,403	$1,102,912,551	$2,628,200,830	$1,314,100,401	$5,045,213,819
Retail/ Commercial	322	298	$182,671,715	$406,650,389	$406,650,389	$995,972,493
Unknown	0	0	$0	$0	$0	$0
Vacant	209	13	$31,513,718	$1,371,608	$0	$32,885,326
X Protected by Levee Total	**12,629**	**12,032**	**$1,481,344,313**	**$3,501,091,801**	**$2,223,488,586**	**$7,205,924,734**

Source: FEMA 7/19/2018 DFIRM, Sacramento County February Parcel/Assessor's Data

*With respect to improve parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

Populations at Risk

A separate analysis was performed to determine populations that reside in the X Protected by Levee flood zone. Using GIS, the DFIRM Flood dataset was overlayed on the improved residential parcel data. Those parcel centroids that intersect the X Protected by Levee flood zone were counted and multiplied by the Census Bureau average household size; and tabulated by flood zone (see Table 4-91). According to this analysis, there is a population of 226,619 in the X Protected by Levee flood zone for the entire Sacramento County Planning Area. In unincorporated Sacramento County, there is a population of 31,472.

Table 4-91 Sacramento County Planning Area – Populations at Risk in X Protected by Levee DFIRM Flood Zone

Jurisdiction	Improved Residential Parcels*	Population at Risk
Citrus Heights	0	0
City of Sacramento	69,537	184,968
Elk Grove	2,567	8,214
Folsom	0	0
Galt	0	0

Jurisdiction	Improved Residential Parcels*	Population at Risk
Isleton	0	0
Rancho Cordova	792	1,965
Unincorporated Sacramento County	11,403	31,472
Total	**84,299**	**226,619**

Source: FEMA DFIRM 7/19/2018, US Census Bureau Average Household Sizes: Citrus Heights (2.54); Sacramento City (2.66); Elk Grove (3.20); Folsom (2.63), Galt (3.16); Isleton (2.7), Rancho Cordova (2.14): and unincorporated Sacramento County (2.76)
*With respect to improve parcels within the floodplain, the actual structures on the parcels may not be located within the actual floodplain, may be elevated and or otherwise outside of the identified flood zone

Critical Facilities at Risk

A separate analysis was performed on the critical facility inventory in Sacramento County and all jurisdictions to determine critical facilities in the 1% and 0.2 annual chance flood zones. Using GIS, the DFIRM X Protected by Levee flood zones were overlayed on the critical facility GIS layer. Figure 4-93 shows critical facilities, as well as the DFIRM flood zones. Table 4-92 summarizes the critical facilities in the County by DFIRM X Protected by Levee flood zone. Table 4-93 details critical facilities by facility type and count for the unincorporated County. Details of critical facility definition, type, name and address by flood zone are listed in Appendix F.

Figure 4-93 Sacramento County Planning Area– Critical Facilities in DFIRM X Protected by Levee Flood Zones

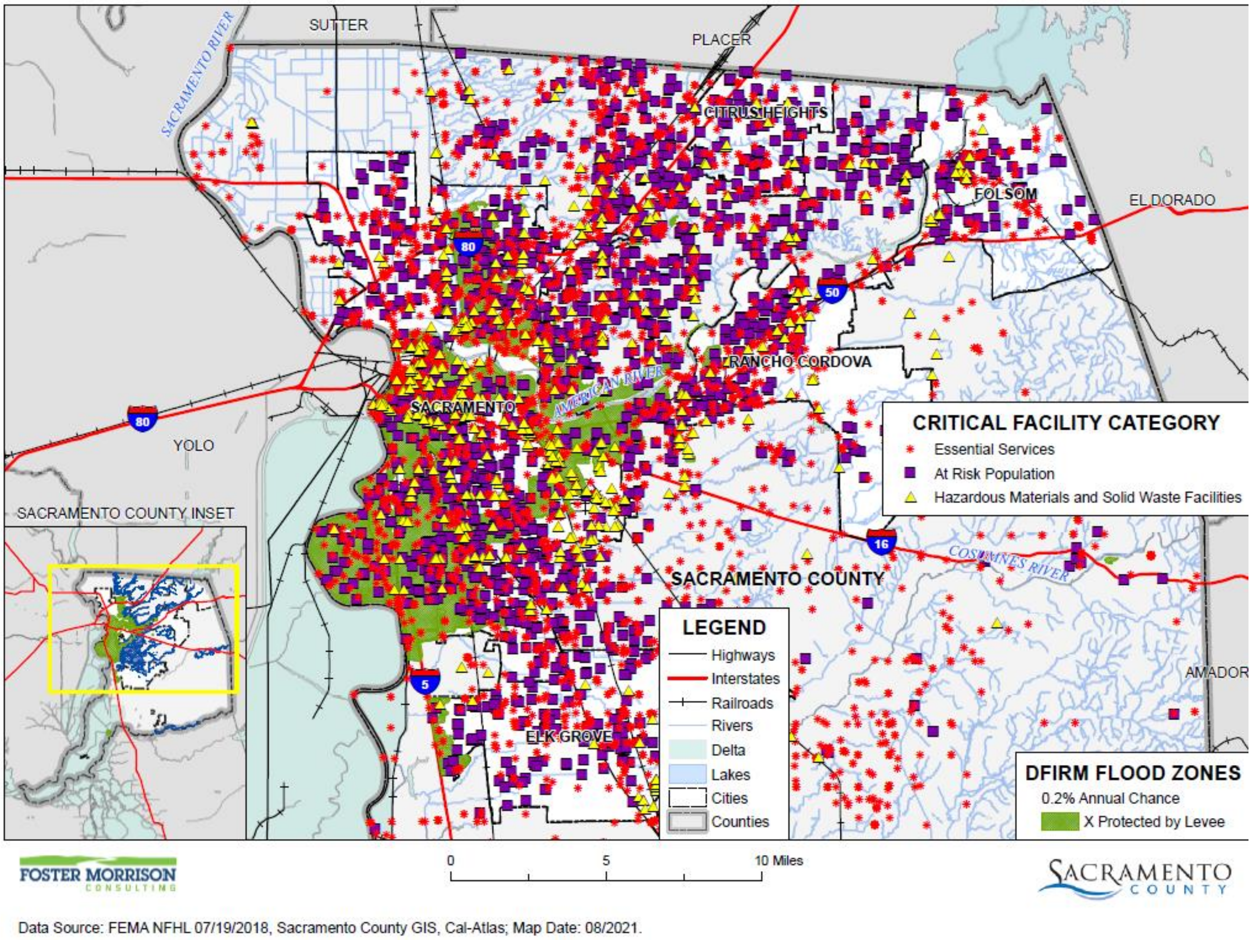


Table 4-92 Sacramento County Planning Area– Summary of Critical Facilities in DFIRM Flood Zones

Jurisdiction Critical Facility Category	Facility Count
Citrus Heights	
Essential Services Facilities	0
At Risk Population Facilities	0
Hazardous Materials and Solid Waste Facilities	0
Total	**0**
Elk Grove	
Essential Services Facilities	11
At Risk Population Facilities	7
Hazardous Materials and Solid Waste Facilities	1
Total	**19**

Jurisdiction Critical Facility Category	Facility Count
Galt	
Essential Services Facilities	0
At Risk Population Facilities	0
Hazardous Materials and Solid Waste Facilities	0
Total	**0**
Isleton	
Essential Services Facilities	0
At Risk Population Facilities	0
Hazardous Materials and Solid Waste Facilities	0
Total	**0**
Rancho Cordova	
Essential Services Facilities	0
At Risk Population Facilities	0
Hazardous Materials and Solid Waste Facilities	0
Total	**0**
City of Sacramento	
Essential Services Facilities	729
At Risk Population Facilities	481
Hazardous Materials and Solid Waste Facilities	151
Total	**1,361**
Unincorporated Sacramento County	
Essential Services Facilities	98
At Risk Population Facilities	81
Hazardous Materials and Solid Waste Facilities Total	20
Total	**199**

Source: Sacramento County GIS, FEMA 7/19/2018 DFIRM

Table 4-93 Unincorporated Sacramento County – Critical Facilities in DFIRM X Protected by Levee Flood Zones by Facility Category

Critical Facility Category	Critical Facility Type	Facility Count
Essential Services Facilities	Emergency Evacuation Center	7
	EMS Stations	3
	FDIC Insured Banks	9
	Fire Station	4
	Law Enforcement	2
	Microwave Service Towers	28
	Power Plants	1

Critical Facility Category	Critical Facility Type	Facility Count
	Public Transit Stations	4
	Pump Station	2
	State Government Buildings	1
	Water Well	37
	Total	**98**
At Risk Population Facilities	Colleges, Universities, and Professional Schools	7
	Day Care Center	15
	Mobile Home Parks	3
	Places of Worship	32
	School	24
	Total	**81**
Hazardous Materials and Solid Waste Facilities	EPA ER TRI Facility	4
	Leaky Underground Storage Tank	16
	Total	**20**
X Protected by Levee Total		**199**

Source: Sacramento County GIS, FEMA 7/19/2018 DFIRM

Overall Community Impact

Levee failures and their impacts would vary by location and severity of any given levee failure or breach event and will likely only affect certain areas of the County during specific times. Based on the number of levees located throughout the County and population in leveed areas, future levee failure events would have potentially devastating economic impacts to the County. Impacts that are not quantified, but can be anticipated in large future events, include:

- Commercial and residential structural and property damage;
- Costs incurred due to post-flood clean up and repair of buildings and infrastructure;
- Damage to roads/bridges resulting in loss of mobility;
- Decreased revenue due to loss of income, sales, tourism, and property taxes;
- Deterioration of homes and neighborhoods as floods recur;
- Disruption of and damage to public infrastructure and services;
- Health hazards associated with mold and mildew, contamination of drinking water, etc.;
- Impact on the overall mental health of the community;
- Injury and loss of life, including first responders rescuing those who did not evacuate or are stranded;
- Loss of historical or unique artifacts;
- Loss of jobs due to businesses closing or cutting back on operating hours;
- Loss of programs or services that are cut to pay for flood recovery;
- Mental health and family impacts, including increased occurrence of suicides and divorce
- Negative impact on commercial and residential property values;
- Significant disruption to students and teachers as temporary facilities and relocations would likely be needed; and

- Significant economic impact (jobs, sales, tax revenue) to the community.

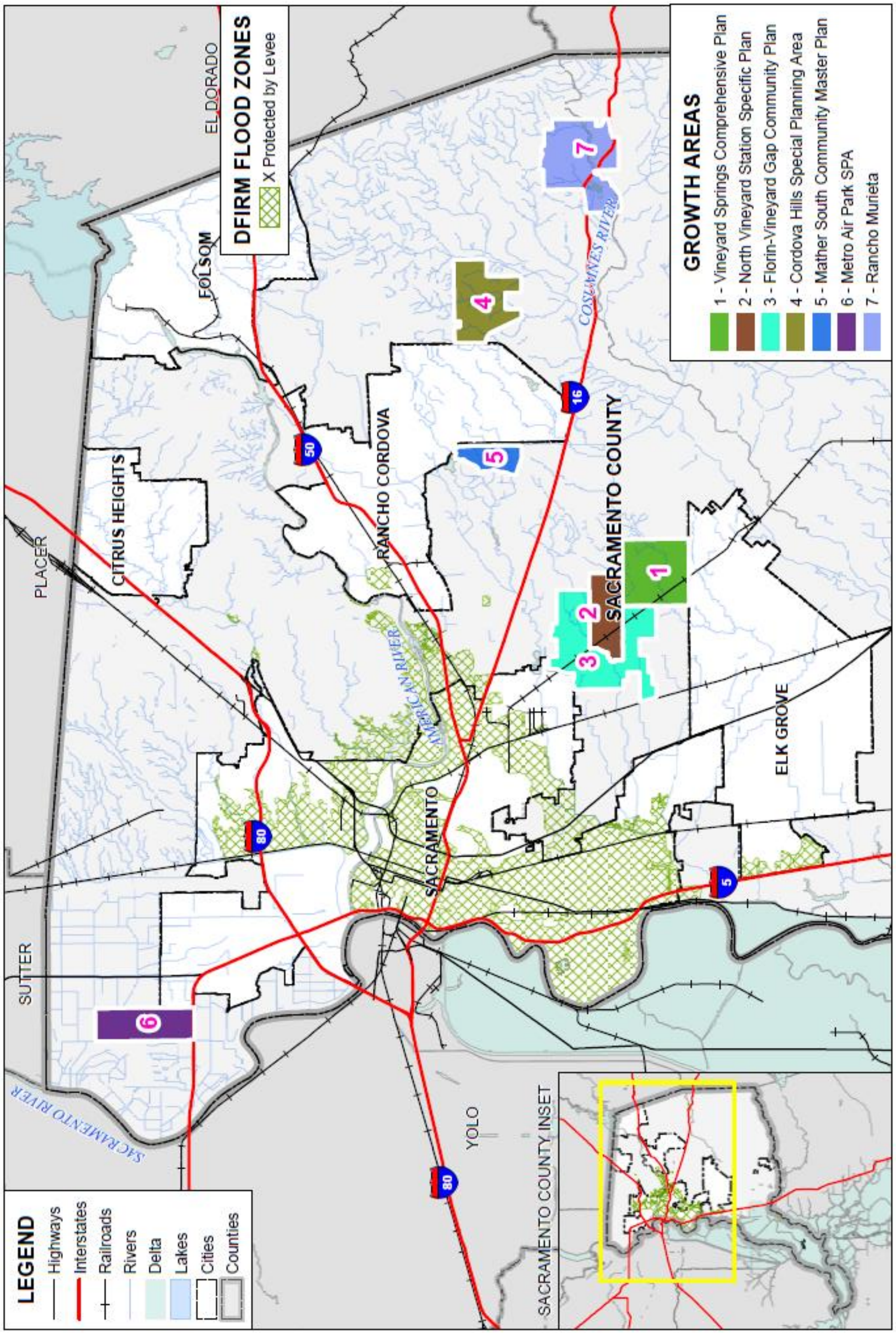
Future Development

SB 5 and levee improvement projects are underway in the County that will provide 200-year level of protection for urbanizing areas, as well as levee improvement projects to provide 100-year level in non-urban areas. These improvements will allow development in leveed areas to continue. For those areas where 100 and 200 cannot be met to certify these levees, then development standards associated with their Flood Ordinance will apply.

GIS Analysis

Sacramento County's 2020 Parcel/Assessor's data and data from the County planning department were used as the basis for the unincorporated County's inventory of parcels and acres of future development areas. Using the GIS parcel spatial file and the APNs, the seven future development projects were mapped. For the flood analysis of future development areas, the parcel data was converted to a point layer using a centroid conversion process, in which each parcel was identified by a central point and linked to the Assessor's data. Utilizing the future development project spatial layer, the parcel centroid data was intersected to determine the parcel counts and acreage within each FEMA flood zone. DFIRM X Protected by Levee flood zones and future development areas are shown on Figure 4-94 and parcels and acreages in those areas are shown in Table 4-94.

Figure 4-94 Unincorporated Sacramento County – Future Development in DFIRM X Protected by Levee Flood Zones



FOSTER MORRISON CONSULTING

SACRAMENTO COUNTY

Data Source: Growth Areas (SacCo_Growth_Areas_0621), FEMA NFHL 07/19/2018, Sacramento County GIS, Cal-Atlas; Map Date: 09/2021.

Table 4-94 Unincorporated Sacramento County – Future Development in FEMA DFIRM X Protected by Levee Flood Zones

Flood Zone/Future Development Area	Total Parcel Count	Improved Parcel Count	Total Acres
X Protected by Levee			
Rancho Murieta	178	132	64
X Protected by Levee Total	**178**	**132**	**64**

Source: Sacramento County, FEMA 7/19/2018 DFIRM

4.3.15. Pandemic

Hazard Profile

This hazard profile contains multiple sections that detail how this hazard can affect Sacramento County. These sections include a hazard/problem description; description of location and extent; past occurrences of this hazard; and how climate change can affect this hazard.

Hazard/Problem Description

According to the World Health Organization (WHO), a disease epidemic occurs when there are more cases of that disease than normal. A pandemic is a worldwide epidemic of a disease. A pandemic may occur when a new virus appears against which the human population has no immunity.

A pandemic occurs when a new 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. The U.S. Centers for Disease Control (CDC) and Prevention has been working closely with other countries and the WHO to strengthen systems to detect outbreaks of that might cause a pandemic and to assist with pandemic planning, preparation, and response. An especially severe a pandemic could lead to high levels of illness, death, social disruption, and economic loss.

Location and Extent

During a pandemic, the whole of the County is at risk, as pandemic is a regional, national, or international event. The speed of onset of pandemic is usually short, while the duration is variable, but can last for more than a year as shown in the 1918/1919 Spanish Flu. There is no scientific scale to measure the magnitude of pandemic. Pandemics are usually measured in numbers affected by the pandemic, and by number who die from complications from the pandemic.

Past Occurrences

Disaster Declaration History

There has been one state and federal disaster declaration due to pandemic, as shown in Table 4-95.

Table 4-95 Sacramento County – State and Federal Pandemic Disaster Declarations 1950-2020

Disaster Type	Federal Declarations		State Declarations	
	Count	Years	Count	Years
Pandemic	1	2020	1	2020

Source: Cal OES, FEMA

NCDC Events

The NCDC does not track pandemic.

WHO Events

The 20th century saw three outbreaks of pandemic flu.

- The **1918-1919 Influenza Pandemic (H1N1),** (aka the Spanish Flu**),** is the catastrophe against which all modern pandemics are measured. It is estimated that approximately 20 to 40 percent of the worldwide population became ill and that over 50 million people died. Approximately 675,000 deaths from the flu occurred in the U.S. alone.
- The **February 1957-1958 Influenza Pandemic (H2N2)** (aka the Asian Flu) was first identified in the Far East. Immunity to this strain was rare in people less than 65 years of age, and a pandemic was predicted. In preparation, vaccine production began in late May 1957, and health officials increased surveillance for flu outbreaks. Unlike the virus that caused the 1918 pandemic, the 1957 pandemic virus was quickly identified, due to advances in scientific technology. Vaccine was available in limited supply by August 1957. The virus came to the U.S. quietly, with a series of small outbreaks over the summer of 1957. When U.S. children went back to school in the fall, they spread the disease in classrooms and brought it home to their families. Infection rates were highest among school children, young adults, and pregnant women in October 1957. Most influenza-and pneumonia-related deaths occurred between September 1957 and March 1958. The elderly had the highest rates of death. By December 1957, the worst seemed to be over. However, during January and February 1958, there was another wave of illness among the elderly. This is an example of the potential "second wave" of infections that can develop during a pandemic. The disease infects one group of people first, infections appear to decrease and then infections increase in a different part of the population. Although the Asian flu pandemic was not as devastating as the 1918-1919 flu, about 69,800 people in the U.S. died.
- The **1968 Influenza Pandemic (H3N2)** was first detected in Hong Kong (aka the Hong Kong Flu). The first cases in the U.S. were detected as early as September of that year, but illness did not become widespread in the U.S. until December. Deaths from this virus peaked in December 1968 and January 1969. Those over the age of 65 were most likely to die. The same virus returned in 1970 and 1972. The number of deaths between September 1968 and March 1969 for this pandemic was 33,800, making it the mildest pandemic in the 20th century.

To date, the 21st century has seen two acknowledged pandemics.

- **2009 Swine Flu (H1N1)**— 2009 H1N1 (sometimes called "swine flu") was a new influenza virus causing illness in people. This virus was originally referred to as "swine flu" because laboratory testing showed that many of the genes in this new virus were very similar to influenza viruses that normally occur in pigs (swine) in North America. But further study showed that this virus was very different from what normally circulates in North American pigs. It had two genes from flu viruses that normally circulate in pigs in Europe and Asia and bird (avian) genes and human genes. Scientists call this a “quadruple reassortant” virus. This virus spread from person-to-person worldwide, probably in much the same way that regular seasonal influenza viruses spread. On June 11, 2009, the WHO signaled that a pandemic of 2009 H1N1 flu was underway. It was first detected in the United States in early 2009 and spread to the world later that year. About 70 percent of people who were hospitalized with this 2009 H1N1 virus had one or more medical conditions previously recognized as placing people at “high risk” of serious seasonal flu-related complications. This included pregnancy, diabetes, heart disease, asthma, and kidney disease. Young children were also at high risk of serious complications from 2009 H1N1, just as they are from seasonal flu. And while people 65 and older were the least likely to be infected with 2009 H1N1 flu, if they got sick, they were also at “high risk” of developing serious complications from their illness. Some studies estimated that 11 to 21 percent of the global population at the time—or around 700 million to 1.4 billion people (of a total 6.8 billion)—contracted the illness. This was more than the number of people infected by the Spanish flu pandemic, but only resulted in about 150,000 to 575,000 fatalities for the 2009 pandemic. A follow-up study done in September 2010 showed that the risk of serious illness resulting from the 2009 H1N1 flu was no higher than that of the yearly seasonal flu. For comparison, the WHO estimates that 250,000 to 500,000 people die of seasonal flu annually.

- **2019/2020** COVID 19 – During the creation of this LHMP Update, the world was under various forms of lockdown due to COVID-19 (known also as coronavirus). Coronaviruses are a large family of viruses which may cause illness in animals or humans. In humans, several coronaviruses are known to cause respiratory infections ranging from the common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS). The most recently discovered coronavirus causes coronavirus disease COVID-19. COVID-19 is the infectious disease caused by the most recently discovered coronavirus. This new virus and disease were unknown before the outbreak began in Wuhan, China, in December 2019. The most common symptoms of COVID-19 are fever, tiredness, and dry cough. Some patients may have aches and pains, nasal congestion, runny nose, sore throat or diarrhea. These symptoms are usually mild and begin gradually. Some people become infected but do not develop any symptoms and do not feel unwell. Most people (about 80%) recover from the disease without needing special treatment. Around 1 out of every 6 people who gets COVID-19 becomes seriously ill and develops difficulty breathing. Older people, and those with underlying medical problems like high blood pressure, heart problems or diabetes, are more likely to develop serious illness. People with fever, cough and difficulty breathing should seek medical attention. As of the beginning of December 2020, there had been roughly 60 million cases worldwide, with 1.4 million deaths.

Hazard Mitigation Planning Committee Events

As of mid-May 2021, there were 105,234 cases of Covid-19, with 1,693 deaths due to Covid.

Likelihood of Future Occurrence

Likely – The calculation for future occurrence of pandemic must first be considered in light of circumstances. The diseases are naturally occurring in the populations that reside in the County. In addition, this Plan is not examining the pandemic potential of these diseases, but instead examines when these diseases manifest in severe injury or fatalities among humans. Given these assumptions and the five outbreaks since 1900, the likelihood of future occurrence is considered likely.

Climate Change and Pandemic

According to the WHO, there are three categories of research into the linkages between climatic conditions and infectious disease transmission. The first examines evidence from the recent past of associations between climate variability and infectious disease occurrence. The second looks at early indicators of already-emerging infectious disease impacts of long-term climate change. The third uses the above evidence to create predictive models to estimate the future burden of infectious disease under projected climate change scenarios. Based on this type of assessment, there is much evidence of associations between climatic conditions and infectious diseases. Likewise, changes in infectious disease transmission patterns are a likely major consequence of climate change.

Vulnerability Assessment

Vulnerability—High

Pandemic has and will continue to have impacts on human health in the region. A pandemic occurs when a new virus emerges for which there is little or no immunity in the human population; the virus causes serious illness and spreads easily from person-to-person worldwide. There are several strategies that public health officials can use to combat pandemic flu. Constant surveillance regarding current pandemic, use of infection control techniques, and administration of vaccines once they become available. Citizens can help prevent spread of pandemic flu by staying home, or “self-quarantining,” if they suspect they are infected. Pandemic does not affect the buildings, critical facilities, and infrastructure in the County. Pandemic can have varying levels of impact to the citizens of the County, depending on the nature of the pandemic.

Impacts

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. Hospitalizations and deaths can occur, especially to the elderly or those with pre-existing underlying conditions. As seen with Covid-19, multiple businesses were forced to close temporarily (some permanently) and unemployment rose significantly. Economic impacts were significant. Supply chains for food can be interrupted. Prisons may need to release prisoners to comply with social distance standards.

Future Development

Future development is not expected to be significantly impacted by this hazard, though population growth in the County could increase exposure to a pandemic, and increase the ability of each disease to be transmitted among the population of the County. If the median age of County residents continues to increase, vulnerability to pandemic diseases may increase, due to the fact that these diseases are often more deadly to senior citizens.

4.3.16. Subsidence

Hazard Profile

This hazard profile contains multiple sections that detail how this hazard can affect Sacramento County. These sections include a hazard/problem description; description of location and extent; past occurrences of this hazard; and how climate change can affect this hazard.

Hazard/Problem Description

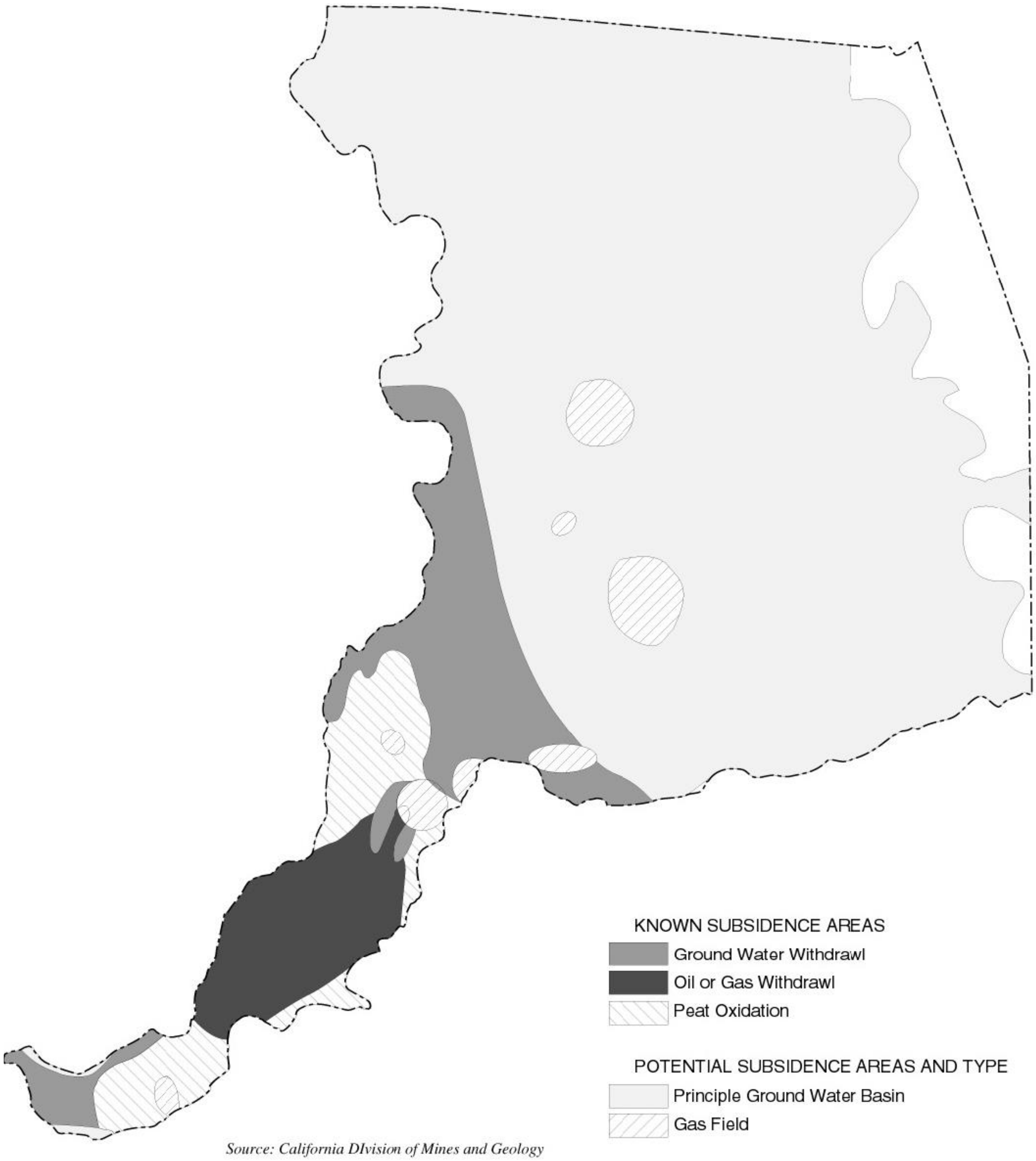
Subsidence is the gradual settling or sinking of the earth's surface over manmade or natural underground voids with little or no horizontal motion. Subsidence occurs naturally and also through man-driven or technologically exacerbated circumstances.

Location and Extent

In Sacramento County, the Delta in the southeast portion of the County is highly at risk to subsidence

These areas are shown in Figure 4-95. There is no scientific scale used to measure subsidence. Subsidence is measured in inches or feet of elevation over time Speed of onset of subsidence is slow, with rates of change of often less than 1" to 2" per year. The duration of subsidence is long, as it is rare for subsidence to be reversed.

Figure 4-95 Known and Potential Subsidence Areas in Sacramento County



Source: Sacramento County General Plan Background Report, 2011

Past Occurrences

Disaster Declaration History

There have been no disaster declarations related to subsidence in Sacramento County.

NCDC Events

The NCDC database shows no past occurrences of subsidence.

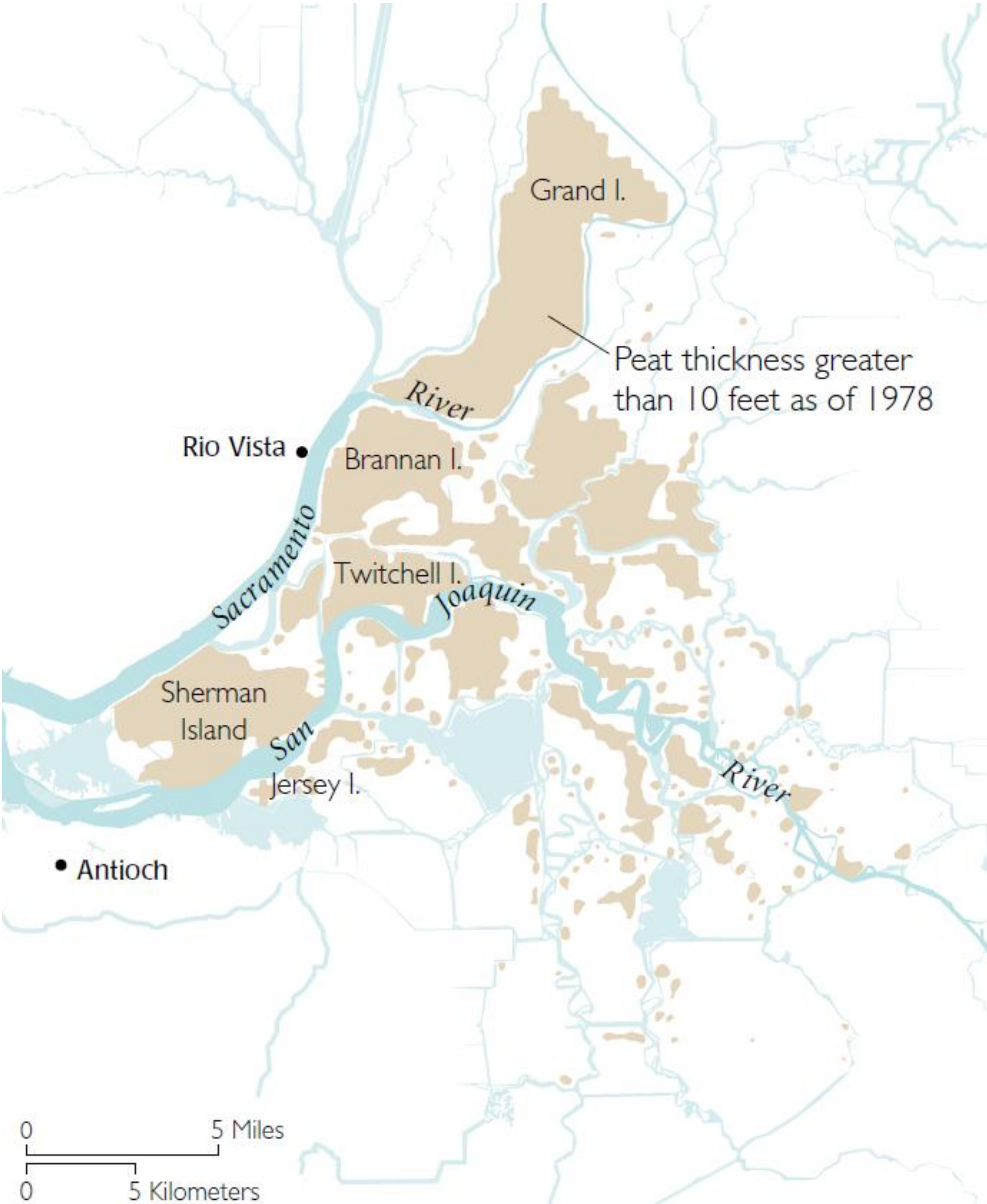
Hazard Mitigation Planning Committee Events

Subsidence has been occurring since the late 1800s, when the land in the Delta region first was converted to farmland. Reclamation projects continued, and by the 1930s the levee system was complete. The best evidence for long-term rates of subsidence comes from two sources—measurements of the exposure of transmission-line foundations on Sherman and Jersey Islands in the western Delta and repeated leveling surveys on Mildred and Bacon Islands and Lower Jones Tract in the southern Delta. The transmission lines in the western Delta were installed in 1910 and 1952. They are founded on pylons driven down to a solid substrate, so that comparison of the original foundation exposure with the current exposure allows estimates of soil loss. The southern Delta transect was surveyed 21 times between 1922 and 1981; in 1983 further surveys were precluded when Mildred Island flooded. Both data sets indicate long-term average subsidence rates of 1 to 3 inches per year, but also suggest a decline in the rate of subsidence over time, probably due to a decreased proportion of readily oxidizable peat in the near surface. In fact, rates of elevation loss measured at three selected sites in 1990 to 1992 were less than 0.4 inches per year, consistent with the inferred slowing of subsidence. However, all of these sites were near island edges, and likely underestimate the average island-wide elevation loss.

Likelihood of Future Occurrences

Highly Likely—Subsidence in the Delta has been a historical problem, occurring on an annual basis. Although changes in farming techniques and improved land use practices have slowed levels of subsidence, subsidence continues to occur. This is unlikely to change in the near future. Areas with peat thickness over 10 feet have a great potential for continued subsidence. These areas are shown in Figure 4-96.

Figure 4-96 Peat Thickness Estimates



Source: California Department of Water Resources, 1998

Climate Change and Subsidence

Climate change may further contribute to subsidence in the County, by increasing evapotranspiration rates for agriculture and other vegetation and by increasing periods of drought, both of which can increase demand for water, accelerate groundwater pumping and the drilling of new groundwater wells and lead to further lowering of the groundwater table and increasing subsidence.

Vulnerability Assessment

Vulnerability—Medium

Historically, the County has been at risk from subsidence, primarily in the Delta region in the southeast portion of the County.

The Delta, located at the confluence of the Sacramento and San Joaquin Rivers, is blanketed by peat and peaty alluvium deposited where streams, originating in the Sierra Nevada, Coast Ranges, and southern Cascade Range, enter the San Francisco Bay system. In the late-1800s, large-scale agricultural development in the Delta required levee-building to prevent frequent flooding. The leveed marshland tracts then had to be drained, cleared of wetland vegetation, and tilled. Levees and drainage systems were largely complete by 1930 and the Delta had taken on its current appearance, with most of its 1,150-squaremile area reclaimed for agricultural use. Today the Delta includes about 57 islands or tracts that are imperfectly protected from flooding by more than 1,100 miles of levees. In the Delta, subsidence affects the islands as well as the levees.

Sacramento County is affected by five types of subsidence. They are:

- compaction of unconsolidated soils by earthquake shaking (liquefaction)
- compaction by heavy structures
- the erosion of peat soils
- peat oxidation
- fluid withdrawal

While subsidence of Delta lands has been reported to be a major risk to Delta levees, subsidence is limited or non-existent under and adjacent to the levees as those areas have consolidated over the last fifty years and oxidation of the peat foundations is limited because it is not farmed.

Sacramento County's five types of subsidence is discussed below.

Compaction of Unconsolidated Soils by Earthquake Shaking (Liquefaction)

Compaction of unconsolidated soils by earthquake shaking is also known as liquefaction. Liquefaction is profiled as a separate hazard in Section 4.3.10. Refer to that section for more detail.

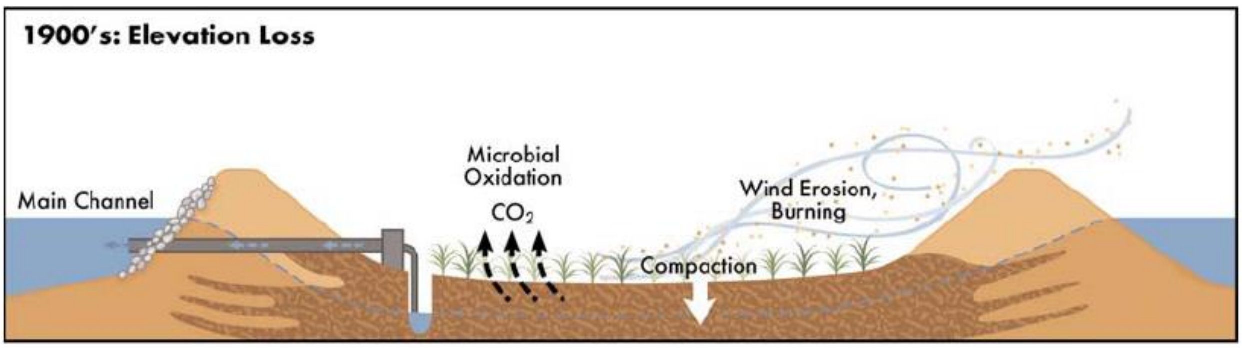
Compaction by Heavy Structures

Land development pressures are forcing the building of structures on top of fine grained water saturated sediments. Unfortunately, the weight of the structures presses the water out of the soils. To mitigate the problem, piles are installed from the footings of the heavy structures to a subsurface zone that will support the structural footing loads. The utilities, travel ways, and smaller building will be constructed to rest on the soil surface. As surface loading causes subsidence, the footings and pile support systems of the heavy structures will be exposed. In extreme situations, it may be necessary to build up the area to gain access into the pile supported structure as the area subsides. Structures that are not supported on piles will have a high probability of damage as the area subsides.

The Erosion of Peat Soils

Prior to 1950, poor land use practices, including burning of peat soils and wind erosion, exacerbated soil losses due to microbial oxidation (discussed in the next section and shown in Figure 4-97). Peat soils, being much less dense than mineral soils, are more easily eroded by wind. Peat soils are frequently wet either at, or close to, the surface thus limiting the amount of material which can be lost. Nevertheless, peat soils do blow causing spectacular dust clouds and degradation of this valuable resource.

Figure 4-97 Causes of Subsidence in the Delta during the 20th Century

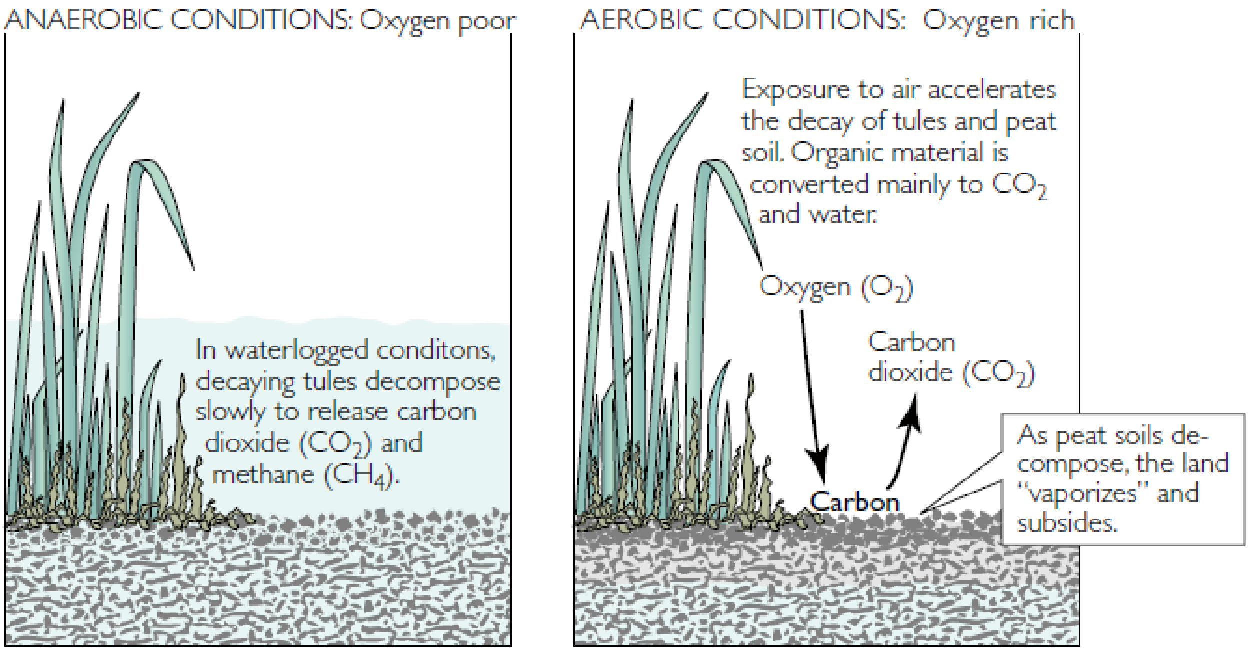


Source: Mount J, Twiss R. 2005. Subsidence, sea level rise, seismicity in the Sacramento-San Joaquin Delta. San Francisco Estuary and Watershed Science. Vol. 3, Issue 1 (March 2005), Article 5.

Peat Oxidation

The dominant cause of land subsidence in the Delta is decomposition of organic carbon in the peat soils. As shown in Figure 4-98, prior to agricultural development, the soil was waterlogged and anaerobic (oxygen-poor). Organic carbon accumulated faster than it could decompose. Drainage for agriculture led to aerobic (oxygen-rich) conditions that favor rapid microbial oxidation of the carbon in the peat soil. Most of the carbon loss is emitted as carbon dioxide gas to the atmosphere.

Figure 4-98 Peat Oxidation in Anaerobic and Aerobic Conditions



Source: USGS Publication "Sacramento-San Joaquin Delta: The Sinking Heart of the State." Report FS-005-00

Fluid Withdrawal

In the late-1800s, large-scale agricultural development in the Delta required levee-building to prevent frequent flooding. The leveed marshland tracts then had to be drained, cleared of wetland vegetation, and tilled. Levees and drainage systems were largely complete by 1930 and the Delta had taken on its current appearance, with most of its 1,150-square mile area reclaimed for agricultural use. As oxidation, erosion, and burning continued to cause subsidence of the land, more water needed to be withdrawn to maintain a constant water table to ensure agricultural plant growth. Water levels in the depressed islands are maintained 3 to 6 feet below the land surface by an extensive network of drainage ditches, and the accumulated agricultural drainage is pumped through or over the levees into stream channels. Without this drainage the islands would become waterlogged.

Groundwater Pumping

Central Sacramento County Groundwater Management Plan discussed groundwater pumping in the County.

> ***Historical benchmark elevation data for the period from 1912 through the late 1960s obtained from the National Geodetic Survey (NGS) were used to evaluate land subsidence in north Sacramento County. From 1947 to 1969, the magnitude of land subsidence measured at benchmarks north of the American River ranged from 0.13 feet to 0.32 feet, with a general decrease in subsidence in a northeastward direction. This decrease is consistent with the geology of the area: formations along the eastern side of the Sacramento Valley are older***

than those on the western side and are subject to a greater degree of pre-consolidation, making them less susceptible to subsidence. The maximum documented land subsidence of 0.32 feet was measured at both benchmark L846, located approximately two miles northeast of the former McClellan AFB, and benchmark G846, located approximately one mile northeast of the intersection of Greenback Lane and Elkhorn Boulevard. Another land subsidence evaluation was performed in the Arden-Arcade area of Sacramento County from 1981 to 1991. Elevations of nine wells in the Arden-Arcade area were surveyed in 1981, 1986, and 1991. The 1986 results were consistently higher than the 1981 results; this was attributed to extremely high rainfall totals in early 1986 that recharged the aquifer and caused a rise in actual land surface elevations. The 1991 results were consistently lower than the 1986 results; this was attributed to five years of drought immediately preceding the 1991 measurements which caused depletion of the aquifer and resulting land surface subsidence. Comparison of eight of the locations indicates that seven benchmarks had lower elevations in 1991 than in 1981 and one benchmark had a higher elevation in 1991. Of the seven benchmarks with lower elevations in 1991, the maximum difference is 0.073 feet (less than one inch). Whether this is inelastic subsidence is indeterminate from the data, but it is clear that the magnitude of the potential subsidence in the benchmarks between 1981 and 1991 was negligible.

Impacts

According to Sacramento County, the subsided islands of the Sacramento-San Joaquin Delta are perpetually at risk of flooding in the event of levee breaks or overtopping and many have flooded in the past, causing millions of dollars in damage. As subsidence progresses, the levees must be regularly maintained and periodically raised and strengthened to support the increasing stresses on their banks. Delta island flooding can also interfere with freshwater exports from the Delta. The statewide water-transfer system in California is so interdependent that decreased water quality in the Delta might lead to accelerated subsidence in other areas. Both the Santa Clara and San Joaquin Valleys rely, in part, on imported water from the Delta to augment local supplies and thereby reduce local ground-water extraction and arrest or slow subsidence. Degradation of the Delta source water could result in increased ground-water use and renewed subsidence.

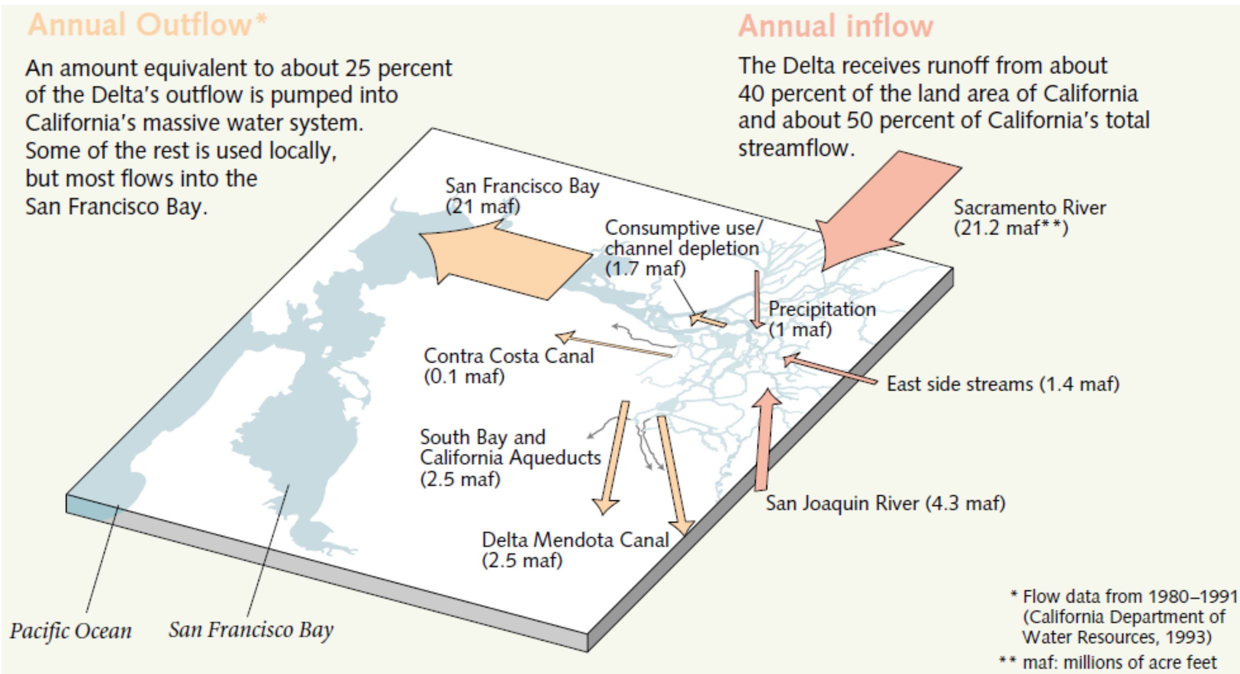
Impacts to the County, Central California, and the State could occur from subsidence. Impacts are discussed below regarding:

- Subsidence and the Delta Water Supply Impacts
- Subsidence and Levee Failure Impacts
- Subsidence and Natural Resource Protection Impacts

Subsidence and Delta Water Supply Impacts

The Delta receives runoff from about 40 percent of the land area of California and about 50 percent of California's total streamflow, as shown in Figure 4-99. It is the heart of a massive north-to-south water-delivery system whose giant engineered arterials transport water southward. State and Federal contracts provide for export of up to 7.5 million acre-feet per year from two huge pumping stations in the southern Delta near the Clifton Court Forebay. About 83 percent of this water is used for agriculture and the remainder for various urban uses in central and southern California. Two-thirds of California's population (more than 20 million people) gets at least part of its drinking water from the Delta.

Figure 4-99 The Delta and California's Water System



Source: USGS Publication "Sacramento-San Joaquin Delta: The Sinking Heart of the State." Report FS-005-00

Land subsidence of Delta islands indirectly affects the north-to-south water transfer system, which is predicated on the available water supply (annual inflows to the Delta), the viability of aquatic species populations, and acceptable water quality in the southern Delta. The statewide water-transfer system in California is so interdependent that decreased water quality in the Delta, whether due to droughts or levee failures, might lead to accelerated subsidence in areas dependent on imported water from the Delta.

The waterways of the Delta are subject to tidal action. Ocean tides propagating into San Francisco Bay are observed 5–6 hours later along the Cosumnes River in the eastern Delta. The position of the interface between the saline waters of the Bay and the freshwaters of the Delta depends upon the tidal cycle and the flow of freshwater through the Delta. Before major dams were built on rivers in the Delta watershed, the salinity interface migrated as far upstream as Courtland along the Sacramento River. Today, releases of freshwater from dams far upstream help reduce the maximum landward migration of the salinity interface during the late summer. In the spring, however, reservoirs and Delta exports consistently act in concert to increase the landward migration of the salinity interface over that expected under conditions of unimpaired flows.

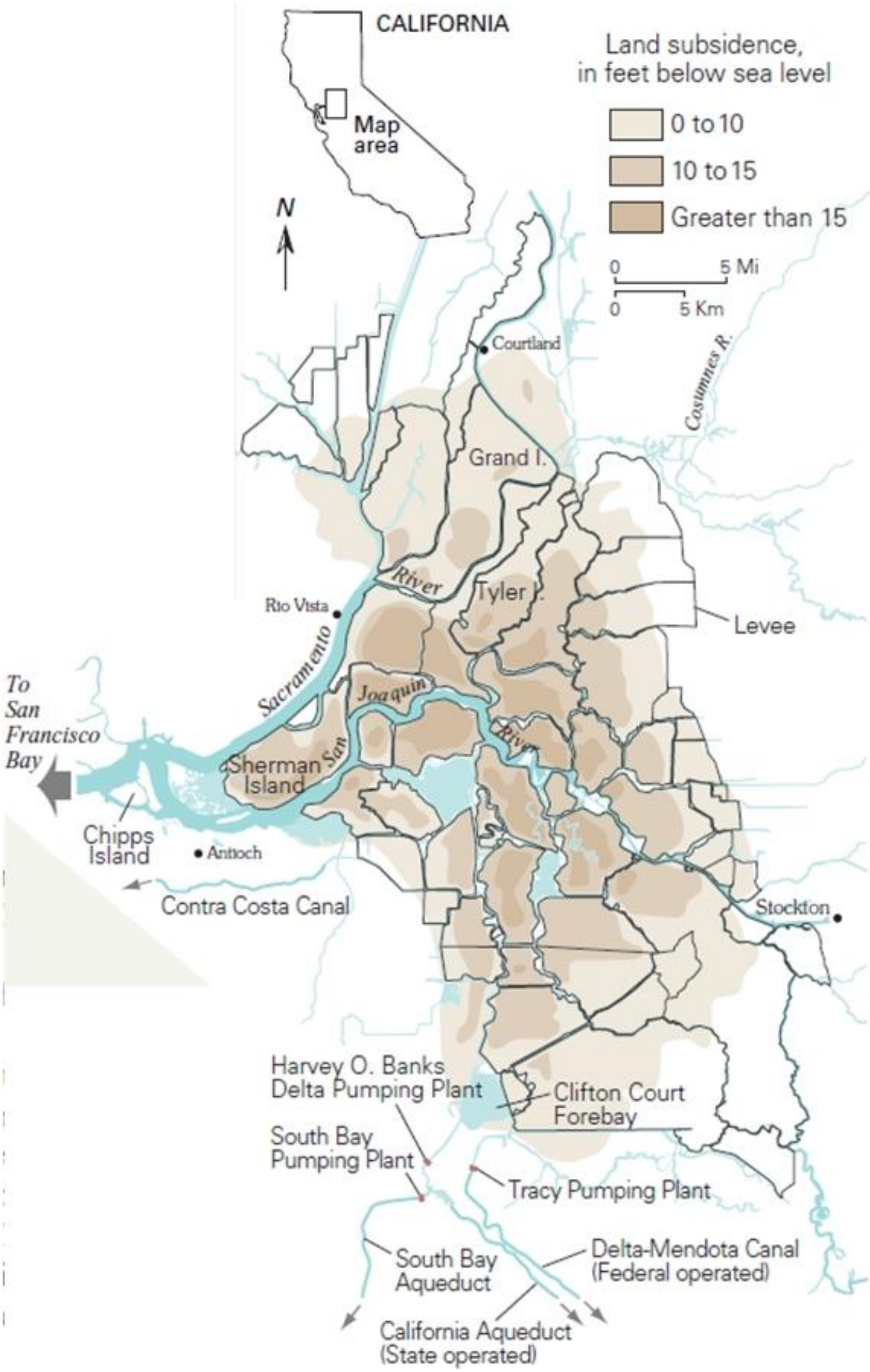
A less significant, terms of acreage effected, but no less severe problem arising from subsidence of bayward Delta islands is saltwater intrusion of subsurface fresh water. River water runoff during years of comparatively normal precipitation has been sufficient to retard salt water from intruding into the freshwater table. However, the rate of saltwater intrusion of west Delta islands increases during years of below normal precipitation, causing damage to crops irrigated with subsurface water contaminated with salt water. Efforts to develop salt tolerant crops and a reduction in the subsidence rate might enable farming to continue on west Delta islands for a limited time. However, continuing crop production accelerates peat oxidation and potentially lessens irrigation water quality from saltwater intrusion of subsurface fresh water sources.

Subsidence and Levee Failure

Island subsidence has reduced the stability of Delta levees, increasing the risk of failure. Embankment and foundation materials for most Delta levees are substandard, adding the risk of failure during seismic events. Subsidence of levees and crop covered islands is occurring, though levees subside at a significantly lower at a slower rate due primarily to a slow oxidation of peat foundations process and from reduced tillage and irrigation. Subsidence in general is limited to a very small percentage of the Delta.

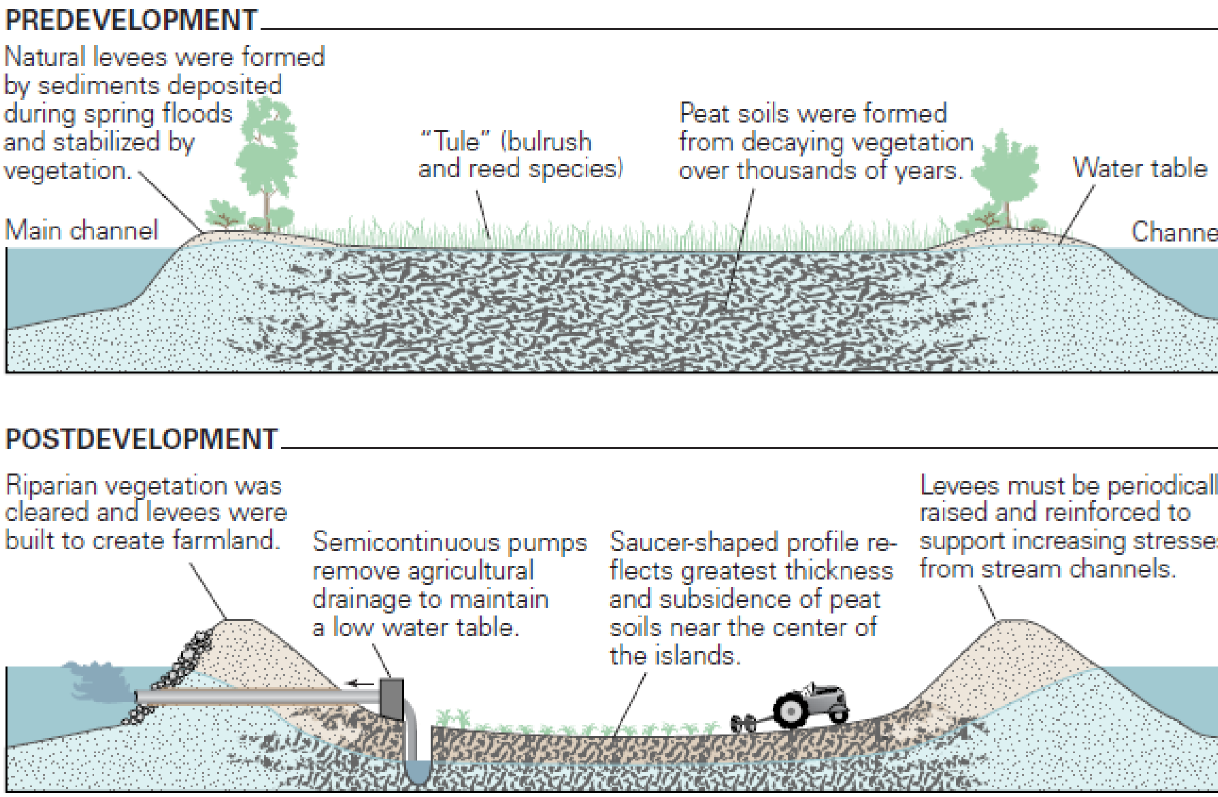
As shown in Figure 4-100, many of the islands in the central Delta are presently 10 to nearly 25 feet below sea level. The land surface profile of many islands is somewhat saucer-shaped, because subsidence is greater in the thick peat soils near their interior than in the more mineral-rich soils near their perimeter. As subsidence progresses, the levees themselves must be regularly maintained and periodically raised and strengthened to support the increasing stresses on their banks.

Figure 4-100 Land Subsidence in the Sacramento-San Joaquin Delta



Source: USGS Publication "Sacramento-San Joaquin Delta: The Sinking Heart of the State." Report FS-005-00

Figure 4-101 Subsidence in Peat Soils on the Delta Islands



Source: USGS Publication "Sacramento-San Joaquin Delta: The Sinking Heart of the State." Report FS-005-00

When levee breaches occur on deeply-subsided islands, rapid filling draws brackish water into the Delta, temporarily degrading water quality over a large region. Known colloquially as the "Big Gulp," the water quality impact of island filling is principally a function of the magnitude and location of anthropogenic accommodation space (vertical space once filled by peat but that has now subsided). Island flooding directly affects tidal prism dynamics within the Delta, with the potential for long-term degradation of water quality. The magnitude of the impact depends upon the location of flooded islands, the volume of water within the island, and the geometry of breach openings.

The costs of levee construction and maintenance are borne by local reclamation districts with assistance by the State of California and the Federal government, as well as by local reclamation districts. These costs increase as subsidence progresses, albeit at a slow rate. Increasing the footprint of the levee by flattening the landside slope will reduce subsidence near the levee and consolidate foundations under the levee. Agricultural operations will consequently move further away from the levee, thus limiting both oxidation and further subsidence near the levee in areas affecting the long-term stability of the levee. forcing levees to be built higher and stronger.

Between 1981 and 1986, the total amount spent on emergency levee repairs related to flooding was about $97 million, and in 1981 to 1991 the amount spent on routine levee maintenance was about $63 million. Annual cost of repair and maintenance of Delta levees in the 1980s averaged about $20 million per year. It is important to note that the cost of levee maintenance and repairs significantly dwarf against long term impacts and costs of damages prevented to residential, critical State emergency evacuation and transport routes, high-value agricultural land, habitats, state-wide water quality, critical utility crossings (power, water, etc.) throughout the Delta.

Subsidence and Natural Resources Protection

The largest of California's drinking water sources is the Sacramento-San Joaquin Delta and its tributaries. The Delta provides at least a portion of the water supply for about two-thirds of California's population, and provides a migratory pathway for four fish that are listed as endangered or threatened pursuant to the federal Endangered Species Act.

Future Development

Future development in the County is at risk in the Delta. More information on that can be found in Annex G (Delta Annex) and the accompanying chapters.

4.3.17. Volcano

Hazard Profile

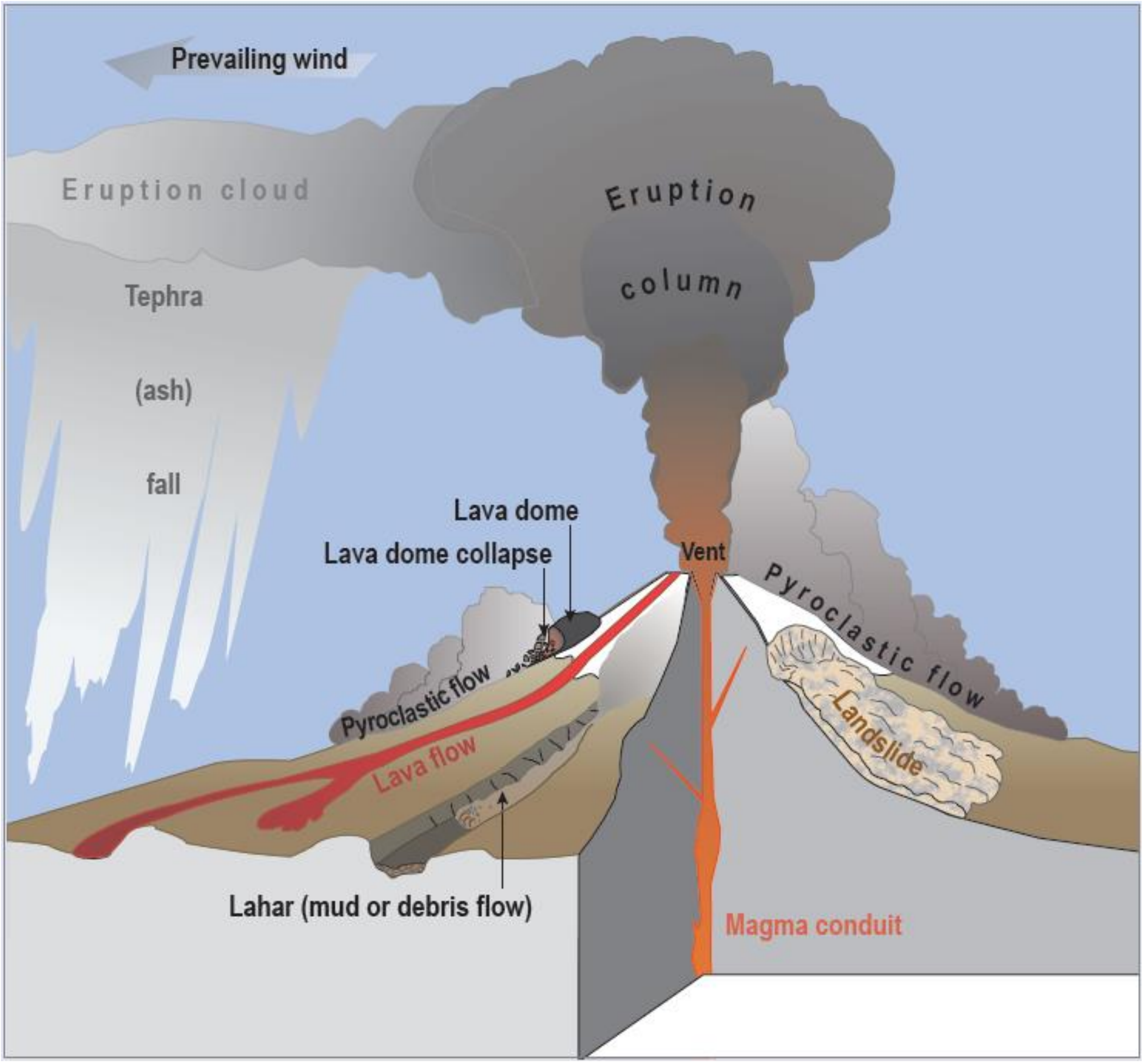
This hazard profile contains multiple sections that detail how this hazard can affect Sacramento County. These sections include a hazard/problem description; description of location and extent; past occurrences of this hazard; and how climate change can affect this hazard.

Hazard/Problem Description

The California State 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.

As shown in Figure 4-102, active volcanoes pose a variety of natural hazards. Explosive eruptions blast lava fragments and gas into the air with tremendous force. The finest particles (ash) billow upward, forming an eruption column that can attain stratospheric heights in minutes. Simultaneously, searing volcanic gas laden with ash and coarse chunks of lava may sweep down the flanks of the volcano as a pyroclastic flow. Ash in the eruption cloud, carried by the prevailing winds, is an aviation hazard and may remain suspended for hundreds of miles before settling to the ground as ash fall. During less energetic effusive eruptions, hot, fluid lava may issue from the volcano as lava flows that can cover many miles in a single day. Alternatively, a sluggish plug of cooler, partially solidified lava may push up at the vent during an effusive eruption, creating a lava dome. A growing lava dome may become so steep that it collapses, violently releasing pyroclastic flows potentially as hazardous as those produced during explosive eruptions.

Figure 4-102 Volcanoes and Associated Hazards

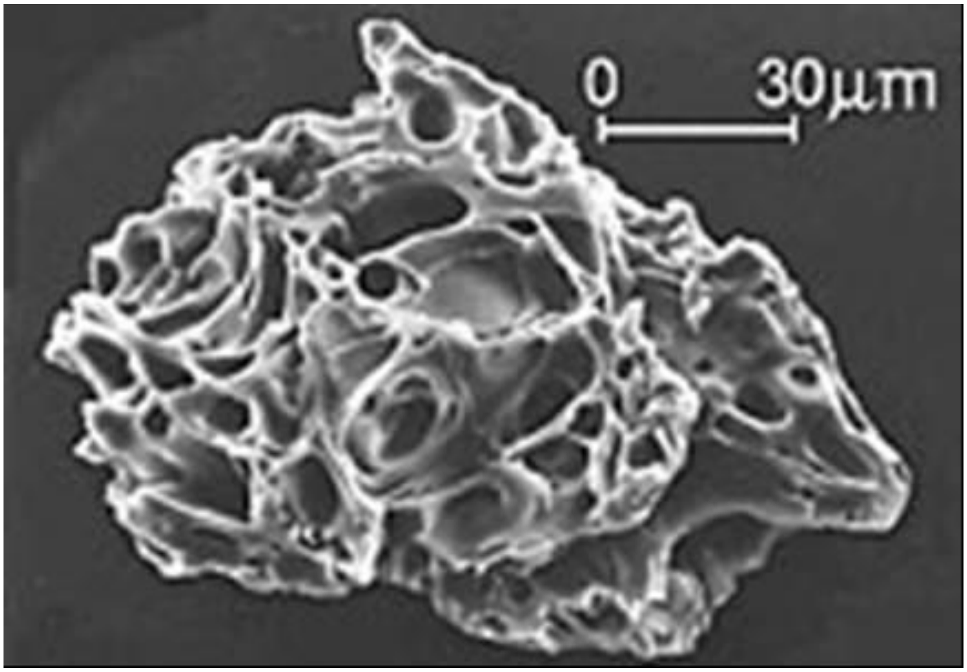


Source: USGS Publication 2014-3120

During and after an explosive or effusive eruption, loose volcanic debris on the flanks of the volcano can be mobilized by heavy rainfall or melting snow and ice, forming powerful floods of mud and rock (lahars) resembling rivers of wet concrete. These can rush down valleys and stream channels as one of the most destructive types of volcano hazards.

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. The USGS notes specific characteristics of volcanic ash. Volcanic ash is composed of small, jagged pieces of rocks, minerals, and volcanic glass the size of sand and silt, as shown in Figure 4-103. Very small ash particles can be less than 0.001 millimeters across. Volcanic ash is not the product of combustion, like the soft fluffy material created by burning wood, leaves, or paper. Volcanic ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet.

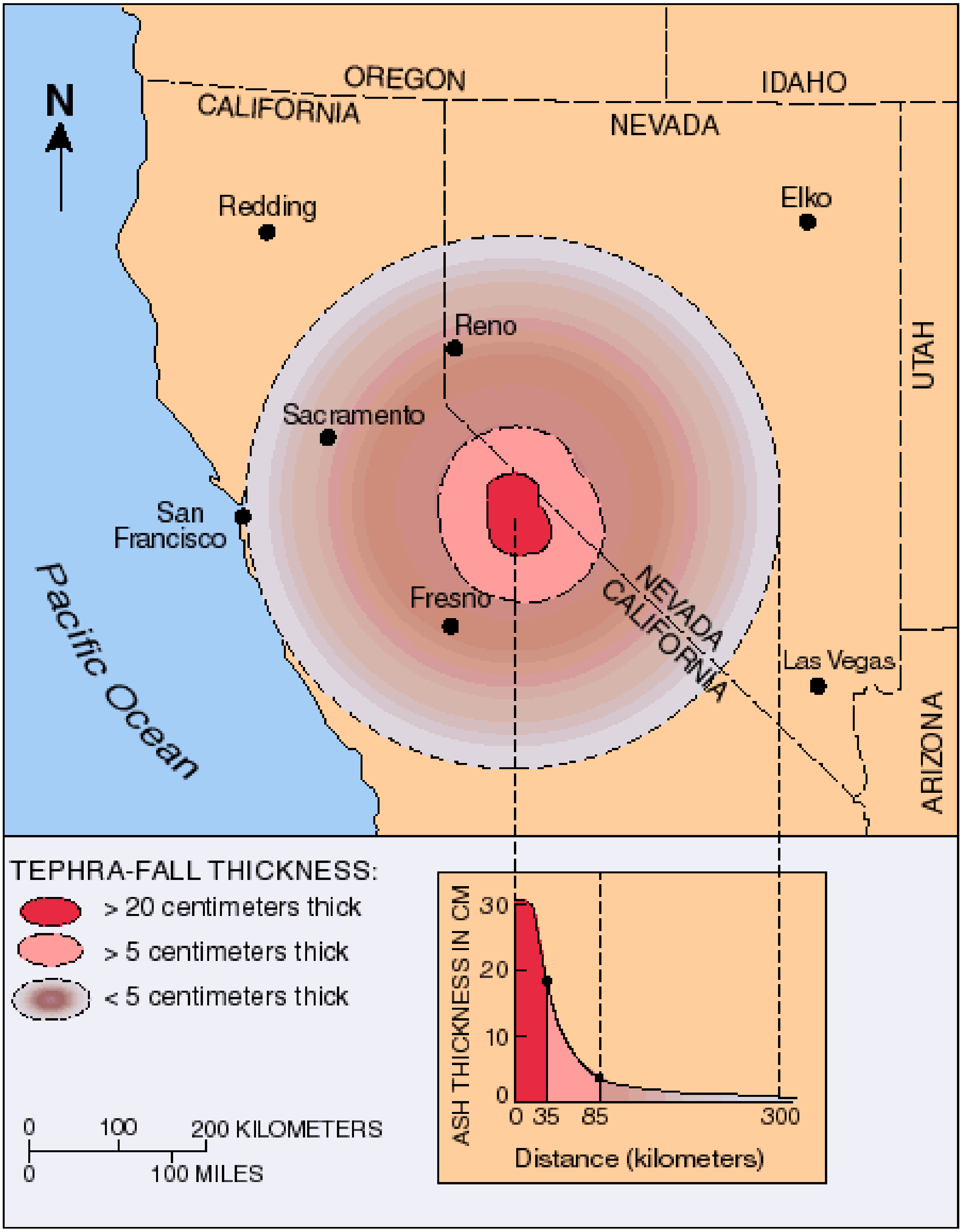
Figure 4-103 Ash Particle from 1980 Mt. St Helens Eruption Magnified 200 Times



Source: US Geological Survey: Volcanic Ash: Effect & Mitigation Strategies. http://volcanoes.usgs.gov/ash/properties.html.

Volcanic ash is formed during explosive volcanic eruptions. Explosive eruptions occur when gases dissolved in molten rock (magma) expand and escape violently into the air, and also when water is heated by magma and abruptly flashes into steam. The force of the escaping gas violently shatters solid rocks. Expanding gas also shreds magma and blasts it into the air, where it solidifies into fragments of volcanic rock and glass. Once in the air, wind can blow the tiny ash particles tens to thousands of miles away from the volcano. Figure 4-104 is a volcanic hazard's ash dispersion map for the Long Valley Caldera, which could possibly affect Sacramento County.

Figure 4-104 Volcanic Hazards Ash Dispersion Map for the Long Valley Caldera



Source: US Geological Survey

The average grain-size of rock fragments and volcanic ash erupted from an exploding volcanic vent varies greatly among different eruptions and during a single explosive eruption that lasts hours to days. Heavier, large-sized rock fragments typically fall back to the ground on or close to the volcano and progressively smaller and lighter fragments are blown farther from the volcano by wind. Volcanic ash, the smallest particles (2 mm in diameter or smaller), can travel hundreds to thousands of kilometers downwind from a volcano depending on wind speed, volume of ash erupted, and height of the eruption column.

The size of ash particles that fall to the ground generally decreases exponentially with increasing distance from a volcano. Also, the range in grain size of volcanic ash typically diminishes downwind from a volcano (becoming progressively smaller). At specific locations, however, the distribution of ash particle sizes can vary widely. Based on Figure 4-104, the USGS estimated that ash of up to 2" could fall in areas of Sacramento County.

Location and Extent

Of the approximately 20 volcanoes in the State, only a few are active and pose a threat. Of these, Long Valley Caldera and Lassen Peak are the closest to Sacramento County. The Long Valley area is considered to be 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 4-105 shows volcanoes in or near California and the location of the Lassen Peak and the Long Valley area relative to the Sacramento County Planning Area. The duration of volcano eruptions is short for the eruption, though ash can stay in the air for a long period of time afterwards. There is no scientific scale to measure volcano eruption.

Figure 4-105 Active Volcanoes in California and in the Sacramento County Area

Source: 2013 State of California Hazard Mitigation Plan

Past Occurrences

Disaster Declarations

There have been no disaster declarations related to volcano.

NCDC Events

The NCDC does not track volcanic activity.

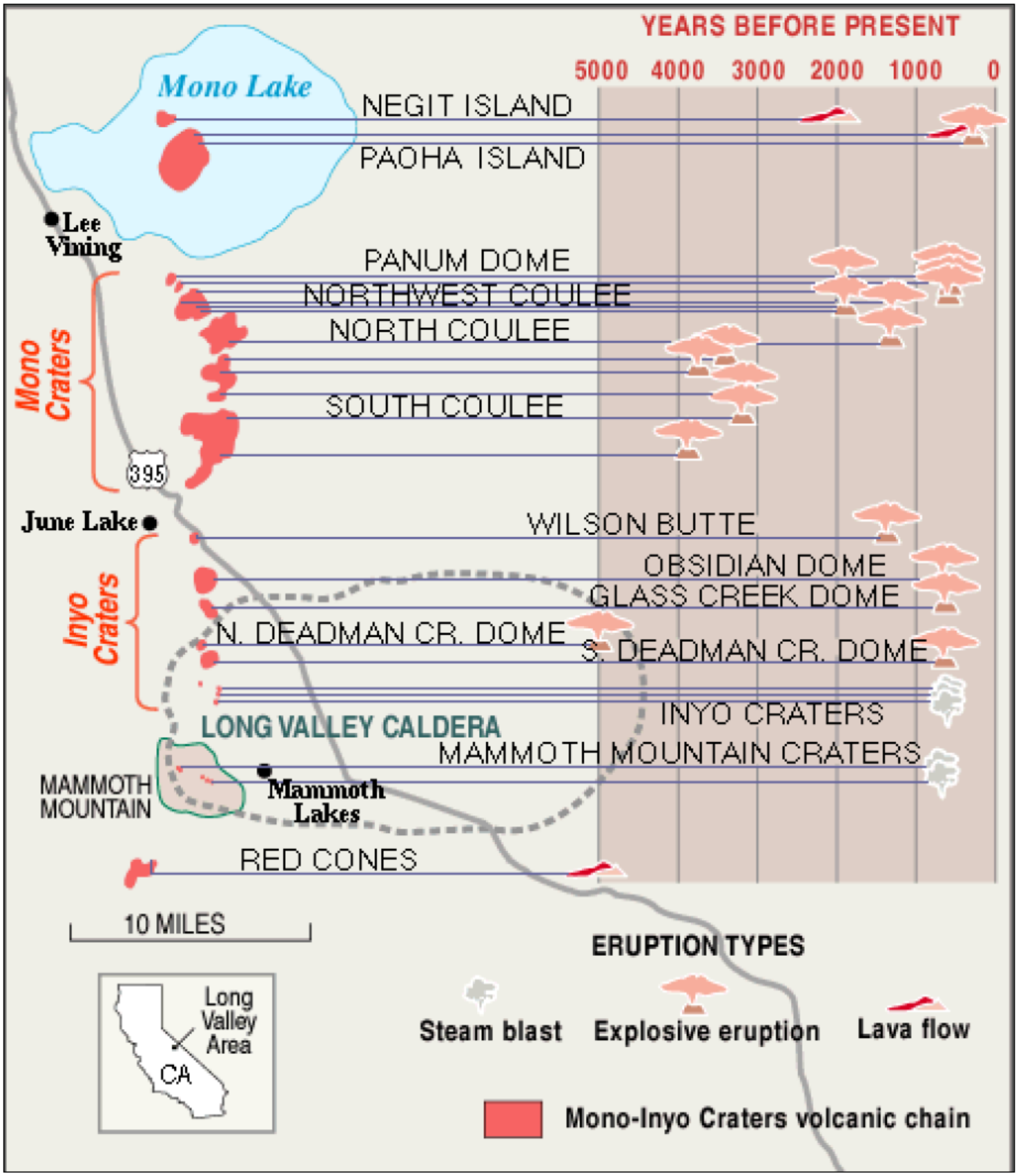
Hazard Mitigation Planning Committee Events

The HMPC noted no volcanic events.

USGS Events

During the past 1,000 years there have been at least 12 volcanic eruptions in the Long Valley area. This activity is likely to continue long into the future. The Long Valley Caldera and Mono-Inyo Craters volcanic chain has a long history of geologic activity that includes both earthquakes and volcanic eruptions. Volcanoes in the Mono-Inyo Craters volcanic chain have erupted often over the past 40,000 years. As shown in Figure 4-106. 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.

Figure 4-106 Volcanic Activity in the Mono-Inyo Craters Volcano Chain in the Past 5,000 Years



Source: U.S. Geological Survey

As recently as 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. There are no records of past impacts from volcanic eruptions to the Sacramento County Planning Area.

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. The next eruption will most likely be small and similar to previous eruptions along the Mono-Inyo volcanic chain during the past 5,000 years (see Figure 4-106 above). According to the State Multi-Hazard Mitigation Plan, only Medicine Lake, Mount Shasta, Lassen Peak, and the Long Valley Caldera are considered active and pose a threat of future activity. However, due to the location of the Planning Area relative to the active volcanoes, the State Plan does not consider Sacramento County to be vulnerable to eruption and/or ash from these volcanoes.

Climate Change and Volcano

Climate change is unlikely to influence volcanic eruptions.

Vulnerability Assessment

Vulnerability—Low

The USGS has ranked the volcanic threat at all U.S. volcanoes using volcano age, types of potential hazards, and estimates of the societal exposure to those hazards. Sixteen volcanoes are on California's watch list to monitor. Research suggests that partially molten rock (magma) lies beneath seven of these volcanoes—Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, the Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes. At these volcanoes, earthquakes (seismicity), hot springs, volcanic gas emissions, and (or) ground movement (deformation) attest to their restless nature. Information on the Long Valley Volcanic Region threat is shown in Table 4-96.

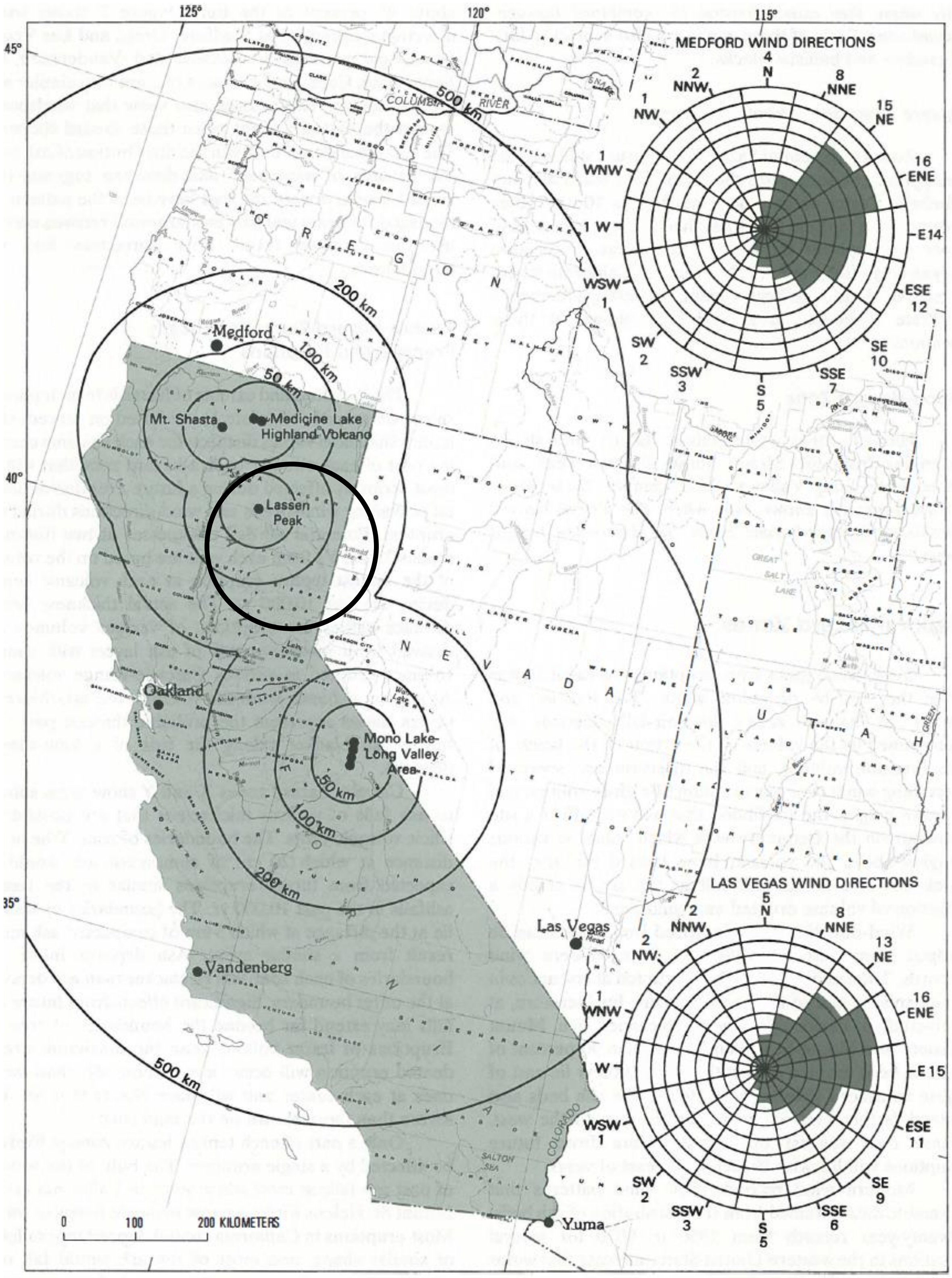
Table 4-96 Volcano Threat near Sacramento County

Volcano	Long Valley Volcanic Region
Threat	Moderate to Very High Threat
	A cataclysmic "super volcano" eruption about 760,000 years ago left behind a depression 20 miles long and 10 miles wide known as Long Valley Caldera, located about 30 miles southeast of Yosemite National Park.

Source: USGS Fact Sheet 2014-3120

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. The USGS, in Bulletin 1847, described the nature and probable distribution of potentially hazardous volcanic phenomena and their threat to people and property. It included hazard zonation maps that depicted areas relatively likely to be affected by future eruptions in California. Affected areas fall in Sacramento County. This is shown on Figure 4-107.

Figure 4-107 Potential Ashfall Areas for California Volcanoes



Source: USGS Bulletin 1847

Low-level volcanic unrest can persist for decades or even hundreds of years without an eruption. Although steady, low-level unrest is normal for many young volcanoes, rapidly accelerating unrest is cause for concern. At California's most threatening volcanoes, monitoring sensors are in place to continuously track levels of unrest. Such monitoring is necessary to determine the baseline, or background level, of activity at a volcano to help volcanologists know what is normal. An uptick in unrest may be a sign of increased volcanic threat.

Impacts

The impact of coarse air fall is limited to the immediate area of the volcanic vent. Structures may be damaged by accumulation of falling lava fragments or burnt by their high heat. Wildfires may be ignited by coarse ash. Although generally non-lethal, fine ash fall is the most widespread and disruptive volcanic hazard. People exposed to fine ash commonly experience various eye, nose, and throat symptoms. Short-term exposures are not known to pose a significant health hazard. Long-term health effects have not been demonstrated conclusively. Ash deposited downwind of the volcano covers everything like a snowfall, but also infiltrates cracks and openings in machinery, buildings, and electronics. Falling ash can obscure sunlight, reducing visibility to zero. When wet, it can make paved surfaces slippery and impassable. Fine ash is abrasive, damaging surfaces and moving parts of machinery, vehicles, and aircraft. Life-threatening and costly damage can occur to aircraft that fly through fine ash clouds. Newly fallen volcanic ash may result in short-term physical and chemical changes in water quality. Close to the volcano, heavy ash fall may cause roofs to collapse, wastewater systems to clog, and power systems to shut down. In agricultural areas, fine ash can damage crops, and sicken livestock. Resuspension of ash by human activity and wind cause continuing disruption to daily life.

Future Development

Future development in the County may be at risk to volcanic activity; however, future development is at no greater risk to volcanic activity than current development. Further, given the uncertainties with regard to volcanic activity, it is unlikely that future development activities would be constrained in any manner.

4.3.18. Wildfire

Hazard Profile

This hazard profile contains multiple sections that detail how this hazard can affect Sacramento County. These sections include a hazard/problem description; description of location and extent; past occurrences of this hazard; and how climate change can affect this hazard.

Hazard/Problem Description

California is recognized as one of the most fire-prone and consequently fire-adapted landscapes in the world. The combination of complex terrain, Mediterranean climate, and productive natural plant communities, along with ample natural and aboriginal ignition sources, has created conditions for extensive wildfires. Wildland fire is an ongoing concern for the Sacramento County Planning Area. Generally, the fire season extends from June through October of each year during the hot, dry months, though in recent years of drought the fire season has expanded to be almost a year around hazard. Fire conditions arise from a combination of high temperatures, an accumulation of vegetation, low humidity, and high winds. These conditions when combined with high winds and years of drought increase the potential for a wildfire to occur. Urban wildfires often occur in those areas where development has expanded into the rural areas. A fire along this urban/rural interface can result in major losses of property and structures.

Location and Extent

Wildfire risk in Sacramento County varies by location. Maps showing the CAL FIRE Fire Hazard Severity Zones (see Figure 4-115) and Fire Threat (see Figure 4-116) are shown in the Vulnerability Assessment below. In some areas of the County, large concentrations of highly flammable brush located in flat open spaces are also quite susceptible to wildland fire. Also at risk are the "river bottoms" or those areas along the American River Parkway. Wildland fires that burn in natural settings with little or no development are part of a natural ecological cycle and may actually be beneficial to the landscape. Century old policies of fire exclusion and aggressive suppression have given way to better understanding of the importance fire plays in the natural cycle of certain forest types. In the County, there are eucalyptus groves where increased fire risk occurs. Some problem areas include fires coming down from Placer County into Sacramento County. There are often light flashy fires that can burn quickly but resolve themselves when fuels burn themselves out.

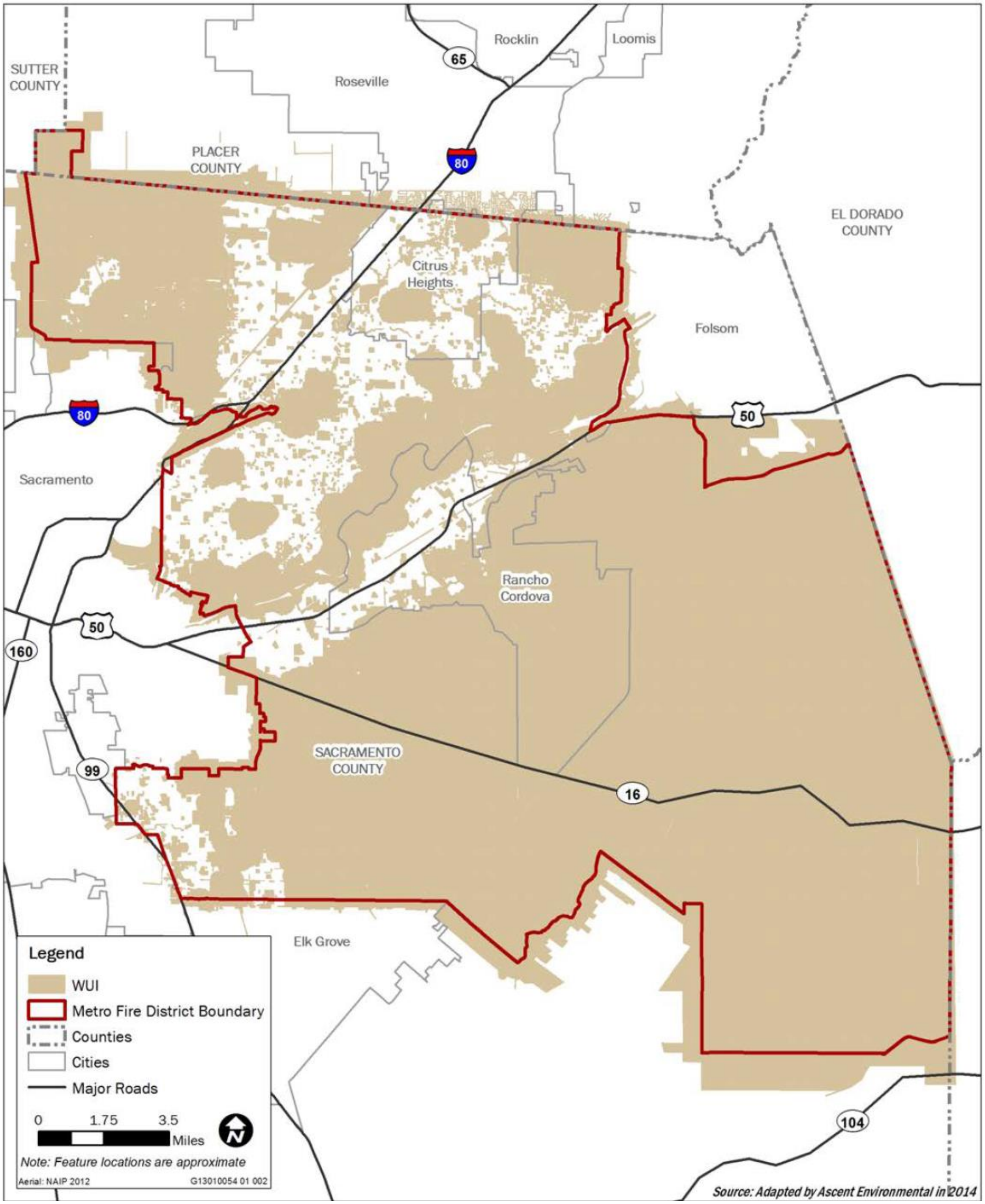
Wildland Urban Interface

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. The WUI is a general term that applies to development adjacent to landscapes that support wildland fire. The WUI defines the community development into the foothills and mountainous areas of California. The WUI describes those communities that are mixed in with grass, brush and timbered covered lands (wildland). These are areas where wildland fire once burned only vegetation but now burns homes as well. The WUI for Sacramento County consists of communities at risk as well as the area around the communities that pose a fire threat.

WUI fires are often the most damaging. WUI fires occur where the natural and urban development intersect. Even relatively small acreage fires may result in disastrous damages. The damages are primarily reported as damage to infrastructure, built environment, loss of socio-economic values and injuries to people.

A WUI Map was created for the 2014 Sac Metro Fire CWPP. It is shown in Figure 4-108.

Figure 4-108 Sacramento County – Wildland Urban Interface Areas



Source: Sacramento Metropolitan Fire District 2014 Community Wildfire Protection Plan

Sacramento County Wildfire Setting

As previously stated, there are areas in the County that are prone to wildfire. Wildland fires affect grass, forest, and brushlands, as well as any structures located within them. Where there is human access to wildland areas the risk of fire increases due to a greater chance for human carelessness and historical fire management practices. Generally, there are four major factors that sustain wildfires and allow for predictions of a given area's potential to burn. These factors include fuel, topography, weather, and human actions.

- **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 needles and leaves, twigs, and branches to dead standing trees, live trees, brush, and cured grasses. Also to be considered as a fuel source, are man-made structures and other associated combustibles. The type of prevalent fuel directly influences the behavior of wildfire. Light fuels such as grasses burn quickly and serve as a catalyst for fire spread. The volume of available fuel is described in terms of Fuel Loading. Certain areas in and surrounding Sacramento County are extremely vulnerable to fires as a result of dense grassy vegetation combined with a growing number of structures being built near and within rural lands. In the northern portion of the County, such as Folsom, an increase in forested areas increase the risk and vulnerability of wildfire.
- **Topography** – An area's terrain and land slopes affect its susceptibility to wildfire spread. Fire intensities and rates of spread increase as slope increases due to the tendency of heat from a fire to rise via convection. The natural arrangement of vegetation throughout a hillside can also contribute to increased fire activity on slopes. Most of the Sacramento area is relatively flat, thus limiting the influence of this factor on wildfire behavior.
- **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 the fuels that feed the wildfire creating a situation where fuel will more readily ignite and burn more intensely. Wind is the most treacherous weather factor. The greater a wind, the faster a fire will spread, and the more intense it will be. Winds can be significant at times in Sacramento County. However, it should be noted that the winds generally occur during the winter storm season, not during the summer, fire season. In addition to high winds, wind shifts can occur suddenly due to temperature changes or the interaction of wind with topographical features such as slopes or steep hillsides. Related to weather is the issue of recent drought conditions contributing to concerns about wildfire vulnerability. During periods of drought, the threat of wildfire increases.
- **Human Actions** – Most wildfires are ignited by human action, the result of direct acts of arson, carelessness, or accidents. Many fires originate in populated areas along roads and around homes, and are often the result of arson or careless acts such as the disposal of cigarettes, use of equipment or debris burning. Recreation areas that are located in high fire hazard areas also result in increased human activity that can increase the potential for wildfires to occur.

Wildfires tend to be measured in structure damages, injuries, and loss of life as well as on acres burned and the intensity of the burn. CAL FIRE measures fuels in the areas as part of their Fire Hazard Severity maps. Extents are measured in the following Fire Hazard Severity Zones (FHSZ) categories (discussed in more detail below):

- Very High

- High
- Moderate
- Non-Wildland/Non-Urban
- Urban/Unzoned

CAL FIRE also developed maps using a Fire Threat dataset. This dataset is a combination of fire frequency, or the likelihood of a given area to burn, and potential fire behavior. This dataset ranks extent in the following categories:

- Extreme (none of which exists in Sacramento County)
- Very High
- High
- Moderate
- Low
- No Threat

Geographical extents of these FHSZs in the County can be found on Table 4-97.

Table 4-97 Sacramento County Planning Area– Geographical Extents of FHSZs

Fire Hazard Severity Zone	Total Acres	% of Total Acres*	Improved Acres	% of Total Improved Acres*	Unimproved Acres	% of Total Unimproved Acres*
Very High	1,026	0.16%	865	0.24%	160	0.06%
High	2,500	0.39%	1,335	0.37%	1,165	0.41%
Moderate	230,983	35.84%	84,676	23.46%	146,307	51.62%
Non-Wildland/Non-Urban	222,032	34.45%	128,273	35.53%	93,759	33.08%
Urban Unzoned	187,877	29.15%	145,853	40.40%	42,024	14.83%
Unincorporated Sacramento County Total	**644,418.0**	**100.00%**	**361,003.2**	**100.00%**	**283,414.8**	**100.00%**

Source: CAL FIRE

*Percentage of total acres is the percent of total acres of the entire County Planning Area

Geographical extents of these Fire Threat Areas in the County can be found on Table 4-98.

Table 4-98 Sacramento County Planning Area – Geographical Extent of Fire Threat Areas

Fire Hazard Severity Zone	Total Acres	% of Total Acres*	Improved Acres	% of Total Improved Acres*	Unimproved Acres	% of Total Unimproved Acres*
Very High	14,711	2.28%	2,769	0.77%	11,942	4.21%
High	82,651	12.83%	16,209	4.49%	66,442	23.44%
Moderate	82,062	12.73%	21,816	6.04%	60,245	21.26%
Low	21,609	3.35%	5,766	1.60%	15,843	5.59%

Fire Hazard Severity Zone	Total Acres	% of Total Acres*	Improved Acres	% of Total Improved Acres*	Unimproved Acres	% of Total Unimproved Acres*
No Threat	443,385	68.80%	314,443	87.10%	128,942	45.50%
Unincorporated Sacramento County Total	**644,418.0**	**100.00%**	**361,003.2**	**100.00%**	**283,414.8**	**100.00%**

Source: CAL FIRE

*Percentage of total acres is the percent of total acres of the entire County Planning Area

Fires can have a quick speed of onset, especially during periods of drought. Fires can burn for a short period of time, or may have durations lasting for a week or more.

Post-Wildfire Landslides and Debris Flows

Post-wildfire landslides and debris flows are not generally a concern in Sacramento County due to its relatively flat topography. Fires that burn in sloped areas remove vegetation that holds hillsides together during rainstorms. Once that vegetation is removed, the hillside may be compromised, resulting in landslides and debris flows. Mapping of these areas has begun to occur, though none exist in Sacramento County.

Past Occurrences

Disaster Declaration History

A search of FEMA and Cal OES disaster declarations turned up no federal and one state disaster declaration, as shown on Table 4-4. It was noted that this was for an explosion of a train near Roseville and not for a wildfire.

NCDC Events

The NCDC has tracked wildfire events in the County dating back to 1993. Events in Sacramento County in the database are shown in Table 4-99.

*Table 4-99 NCDC Wildfire Events in Sacramento County 1993 to 5/31/2020**

Event Type	Number of Events	Deaths	Deaths (indirect)	Injuries	Injuries (indirect)	Property Damage	Crop Damage
Wildfire	7	0	1	2	0	$5,000,000	$0

Source: NCDC

*Deaths, injuries, and damages are for the entire event, and may not be exclusive to the County.

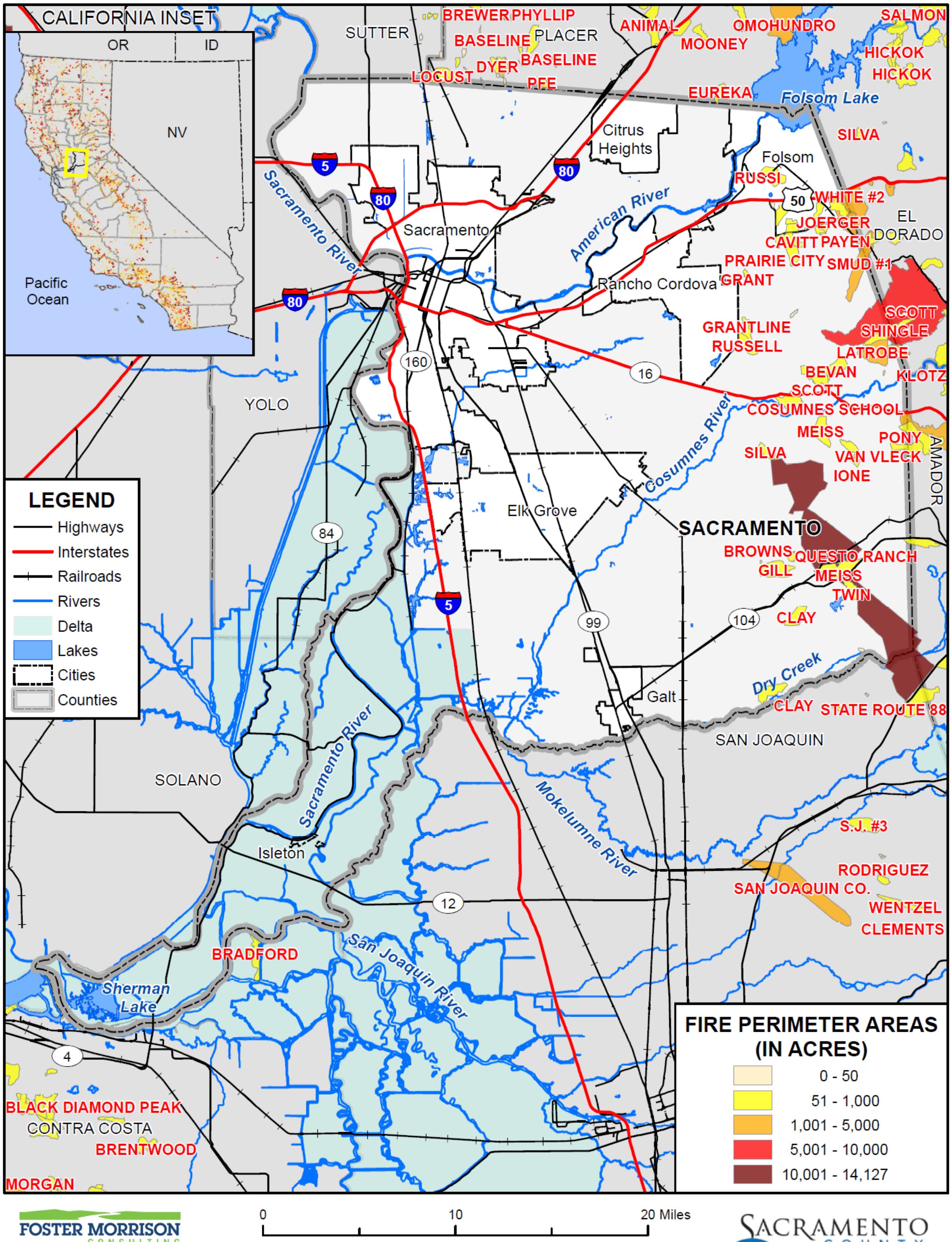
CAL FIRE Events

CAL FIRE, USDA Forest Service Region 5, Bureau of Land Management (BLM), the National Park Service (NPS), Contract Counties and other agencies jointly maintain a comprehensive fire perimeter GIS layer for public and private lands throughout the state. The data covers fires back to 1878 (though the first recorded incident for the County was in 1917). For the National Park Service, Bureau of Land Management, and US Forest Service, fires of 10 acres and greater are reported. For CAL FIRE, timber fires greater than 10 acres, brush fires greater than 50 acres, grass fires greater than 300 acres, and fires that destroy three or more residential dwellings or commercial structures are reported. CAL FIRE recognizes the various federal, state, and local agencies that have contributed to this dataset, including USDA Forest Service Region 5, BLM, National Park Service, and numerous local agencies.

Fires may be missing altogether or have missing or incorrect attribute data. Some fires may be missing because historical records were lost or damaged, fires were too small for the minimum cutoffs, documentation was inadequate, or fire perimeters have not yet been incorporated into the database. Also, agencies are at different stages of participation. For these reasons, the data should not be used for statistical or analytical purposes.

The data provides a reasonable view of the spatial distribution of past large fires in California. Using GIS, fire perimeters that intersect Sacramento County since 1950 were extracted and are listed in Table 4-100 (in alphabetical order of fire name). Each of them was tracked by CAL FIRE. Figure 4-109 shows the fires in the CAL FIRE database for the County from 1950 to 2020, colored by the size of the acreage burned.

Figure 4-109 Sacramento County – Wildfire History CAL FIRE 1950 to 2020



Data Source: CAL FIRE Fire History (firep19_1) 5/2020, Sacramento County GIS, Cal-Atlas; Map Date: 09/2020.

Table 4-100 Sacramento County – Wildfires by Acres Burned 1950-2020

Wildfire Name	Date	Cause Description	GIS Acres	Acres Burned in County
Baseline	7/3/2018	Unknown / Unidentified	20	6
Bevan	6/23/2001	Equipment Use	687	687
Boys	9/11/2016	Equipment Use	40	40
Browns	8/2/2019	Miscellaneous	84	84
Cavitt	9/13/1950	Unknown / Unidentified	339	339
Clay	7/31/2001	Arson	526	526
Clay	7/6/1983	Equipment Use	405	405
Clay	6/3/2016	Equipment Use	32	32
Cosumnes School	6/7/1974	Unknown / Unidentified	582	582
Dillard WF2	7/4/2001	Playing with Fire	11	11
Gill	6/20/1976	Unknown / Unidentified	715	715
Grant	6/29/2018	Vehicle	51	51
Grantline	6/7/1974	Unknown / Unidentified	311	311
Indio	6/8/2018	Vehicle	13	13
Ione	7/2/2015	Arson	358	358
Joerger	7/10/1964	Unknown / Unidentified	1,514	680
Joerger Series	6/18/1981	Equipment Use	1,676	570
Largo	7/30/2017	Arson	238	238
Latrobe	7/26/2017	Debris	1,268	1,074
Locust	7/27/2015	Arson	644	54
Meiss	6/14/1981	Miscellaneous	14,126	11,404
Meiss	8/28/1983	Equipment Use	603	603
Michigan #4	7/31/2001	Arson	55	55
Michigan Bar	7/29/1980	Unknown / Unidentified	848	157
Pony	6/12/2002	Powerline	702	59
Prairie City	9/21/1981	Arson	593	593
Puerto	9/16/2002	Arson	17	17
Questo Ranch	6/19/1950	Unknown / Unidentified	878	878
Rancho	6/28/2016	Vehicle	372	20
Roadside #31 Series	10/4/1962	Unknown / Unidentified	352	349
Russell	6/18/1973	Unknown / Unidentified	408	408
Russi	6/6/1950	Unknown / Unidentified	534	534
Scott	(blank)	Unknown / Unidentified	87	87
Scott	8/2/1996	Arson	8,828	2,451
Scott	4/4/2004	Unknown / Unidentified	609	609

Wildfire Name	Date	Cause Description	GIS Acres	Acres Burned in County
Shingle	7/4/2018	Arson	316	84
Silva	6/20/1981	Arson	248	248
SMUD #1	6/21/1992	Powerline	1,179	752
Twin	9/26/2005	Vehicle	104	104
Twin	6/8/2002	Arson	322	322
Van Vleck	6/22/1968	Unknown / Unidentified	2,665	146
White	7/1/2002	Vehicle	81	81
White #2	10/10/2002	Unknown / Unidentified	170	170
White Rock	7/14/1983	Miscellaneous	169	169
White Rock Series	7/20/1986	Arson	566	566
Grand Total			**44,344**	**27,639**

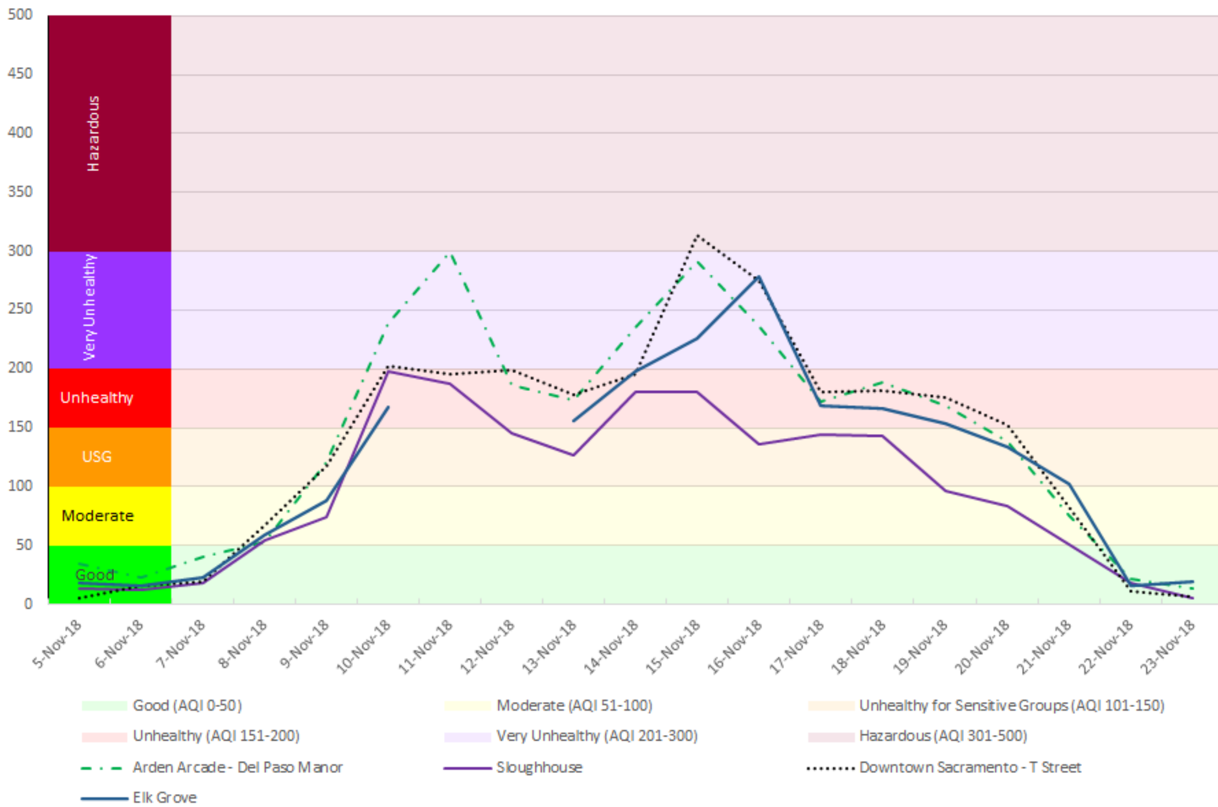
Source: CAL FIRE

Hazard Mitigation Planning Committee Events

The HMPC noted the following fires to affect the County:

- **Late 1850s**: The worst fire in Sacramento history leveled nine-tenths of the City.
- **September/October 2014** – King Fire. While the King Fire did not burn ground in Sacramento County, it did affect the County. Production from the Upper American River Hydroelectric Power Plant was disrupted for 2 weeks, requiring an additional unbudgeted $37 million for replacement power, by far the largest cost compared to the approximately $4M in immediate physical damage.
- **July 2015 NOAA** (fires regional to Sacramento County) – Rocky Fire burned 69,000 acres in Lake, Yolo & Colusa Counties. 43 homes and 53 outbuildings were destroyed.
- **June 9, 2015 –** A 25-acre fire in Elk Grove occurred. A grass fire that started about 1:30 p.m. at Bond and Waterman roads was driven by high, shifting winds. It quickly spread toward homes that border the field to the east and south. The fire damaged one Elk Grove home and prompted evacuation of several other residences before it was contained.
- **2018 Camp Fire** – Though the Camp Fire burned in Butte County, wildfire smoke affected Sacramento County. Air Quality Index figures for the County during and after the Camp Fire can be seen in Figure 4-110.

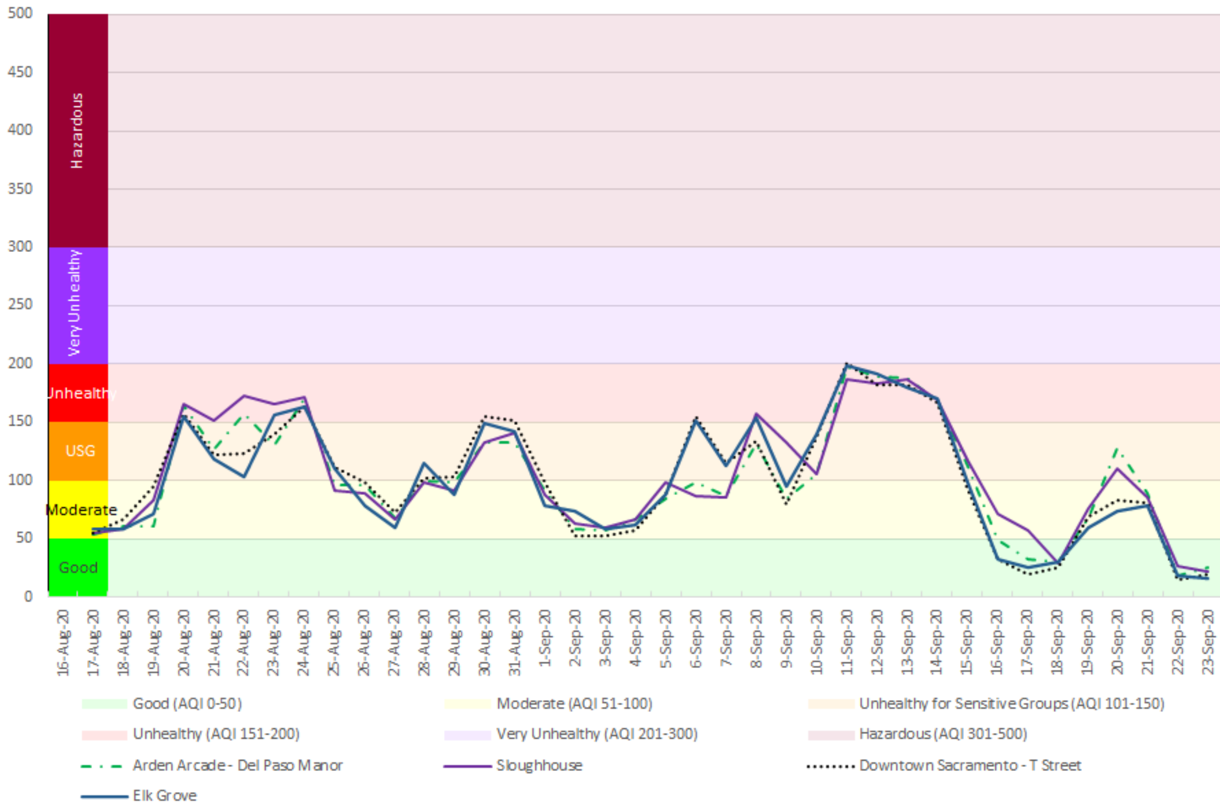
Figure 4-110 Sacramento County – 2018 Wildfire Smoke Air Quality Readings at Sacramento Stations



Source: Sacramento County OES

- **August/September 2020** – Extreme heat struck the County. As the heat event ended, multiple wildfires around northern California were ignited by dry lightning. Sacramento County received smoke into the valley that was not pushed out by light winds. The cities of Folsom and Sacramento converted their cooling centers to cleaner air spaces to serve the public unable to get into an indoor space to escape the smoke. Air quality during this time can be seen in Figure 4-111.

Figure 4-111 Sacramento County – 2020 Wildfire Smoke Air Quality Readings at Sacramento Stations



Source: Sacramento County OES

June 2021 – A wildfire charred Bushy Lake Restoration Project outside Cal Expo not long after it burned earlier this month. According to a June 23, 2021 article from the Sacramento Bee, the 130-acre fire started at one of the American River Parkway's many homeless camps. The fire at Bushy Lake points to a troubling rise in fires caused by homeless people in the parkway. The fires associated with homeless camps are a growing statewide problem that firefighters warn is only going to get more dangerous as California and the Sacramento region enter one of the driest fire seasons in modern history. Just a few weeks into fire season, park rangers say close to 60 fires have started in the parkway this year. That's more than half the number of fires that started in the parkway all of last year, a season that already saw an alarming rise in the number of parkway fires.

August 2021 – Wildfires occurred in the area. The Dixie Fire burned to the northeast of the County, torching almost 1,000,000 acres. While no wildfires affected Sacramento County, wildfire smoke from the fires affected the County. An example can be seen on Figure 4-112.

Figure 4-112 Dixie Fire Wildfire Smoke in Sacramento County

Source: Sacramento County DWR

Likelihood of Future Occurrence

Highly Likely — From May to October of each year, Sacramento County faces a wildfire threat. Fires will continue to occur on an annual basis in the Sacramento County Planning Area. The threat of wildfire and potential losses constantly increase as human development and population increase in the wildland urban interface area in the County. This results in a highly likely rating for future occurrence.

Climate Change and Wildfire

Climate change and its effects on wildfire is discussed by three sources for Sacramento County:

- 2017 Sacramento County CAP/2021 Draft Climate Action Plan Update
- Sacramento Metro Fire District CWPP (2012)
- Cal-Adapt

2017 Sacramento County CAP/2021 Draft Climate Action Plan Update

Wildfires affect the functioning of transportation systems, emergency services, recreation and tourism, and healthy ecosystems. Roadway closures during a wildfire may result in poor emergency vehicle access and the isolation of rural and remote populations throughout the County (Valley Vision 2014). Hospitals may incur additional strain on their resources to accommodate an influx in emergency room visits during wildfire events. Wildfires impede recreational uses as well as the associated tourism revenue (Valley Vision 2014). Damage to ecological functions may also result due to catastrophic wildfire. When rain falls in burn scarred areas, there is a higher potential for soil erosion and mud flows into roads, ditches, and streams, which reduces water quality.

Lastly, wildfires can damage and destroy physical assets and infrastructure. In particular, critical transmission lines and hydroelectric infrastructure may be vulnerable to damage or temporary shutdown caused by wildfires.

Wildfires and Air Quality. The 2017 CAP noted that in addition to a probable increase in wildfire risk, wildfires within the Sierra Nevada and areas outside the County affect air quality in Sacramento County and across the Sacramento Valley. Particulate matter from wildfire dissipates throughout the Central Valley degrading air quality conditions for short or extended periods of time. An increase in air pollutants can cause or exacerbate health conditions. The duration of wildfire-related particulate matter in the County's air is further linked to wind patterns (i.e., the Delta Breeze) originating from the Sacramento-San Joaquin Delta that disperse air pollutants north of the Sacramento Valley. However, during about half of the days from July to September (high fire season), a phenomenon called the "Schultz Eddy" prevents this from occurring. All of these factors will affect the severity of wildfire-related air pollution in Sacramento County. Climate change has already significantly lengthened California's fire season, as well as the intensity, frequency and size of individual wildfires around the state, and this trend is likely to continue without further mitigation. It is likely that Sacramento County will experience worsened air quality from increased wildfires throughout Northern California and even Oregon.

Increased frequency and intensity of wildfires will directly affect the safety of populations living within or near wildland areas (i.e., wildland-urban interface) prone to wildfire. Wildfires also result in the release of harmful air pollutants into the atmosphere, which dissipate and can affect the respiratory health of residents across a broad geographical scope.

Sacramento Metro Fire District CWPP

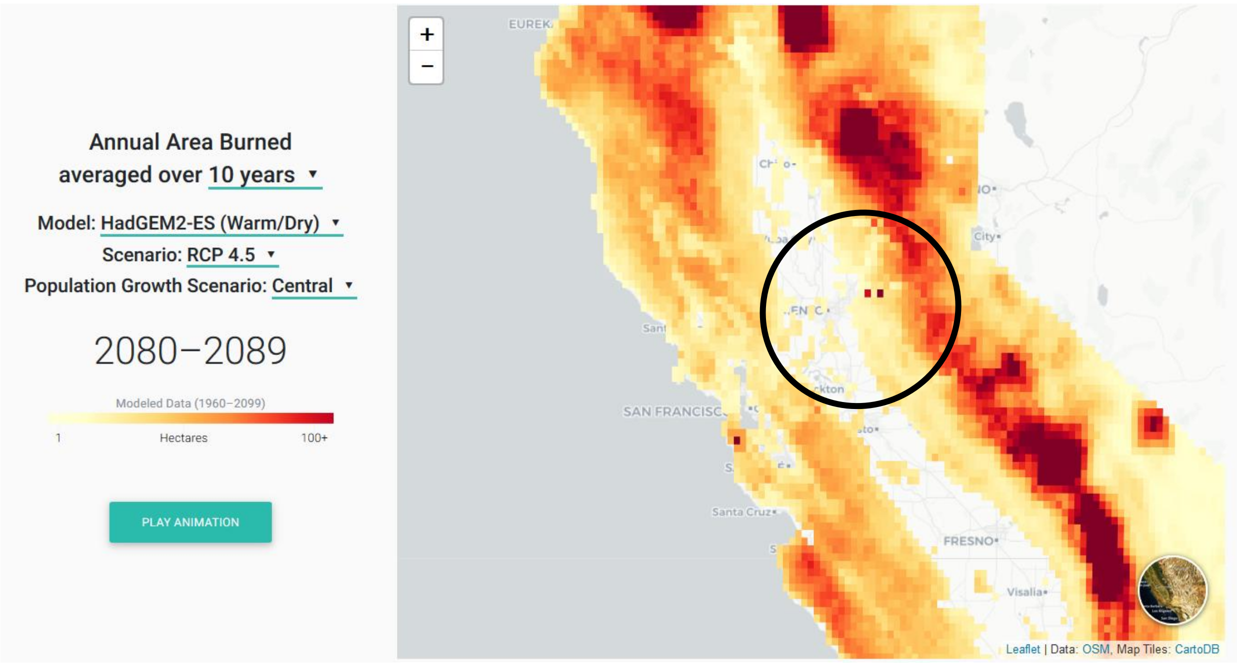
The 2014 Sacramento Metropolitan Fire District's CWPP also predicts an overall increase in the frequency and intensity of wildfires as a result of the changes associated with climate change.

Cal Adapt

Warmer temperatures can exacerbate drought conditions. Drought often kills plants and trees, which serve as fuel for wildfires. Warmer temperatures could increase the number of wildfires and pest outbreaks, such as the western pine beetle. Cal-Adapt's wildfire tool predicts the potential increase in the amount of burned areas for the year 2080-2089, as compared to recent (2010) conditions. This is shown in Figure 4-113.

Based on this model, Cal-Adapt predicts that wildfire risk in Sacramento County will increase slightly (and much less than other California counties) in the near term and subside during mid-to late-century. However, wildfire models can vary depending on the parameters used. Cal-Adapt does not take landscape and fuel sources into account in their model. In all likelihood, in Sacramento County, precipitation patterns, high levels of heat, topography, and fuel load will determine the frequency and intensity of future wildfire.

Figure 4-113 Sacramento County – Projected Increase in Wildfire Burn Areas



Source: Cal-Adapt

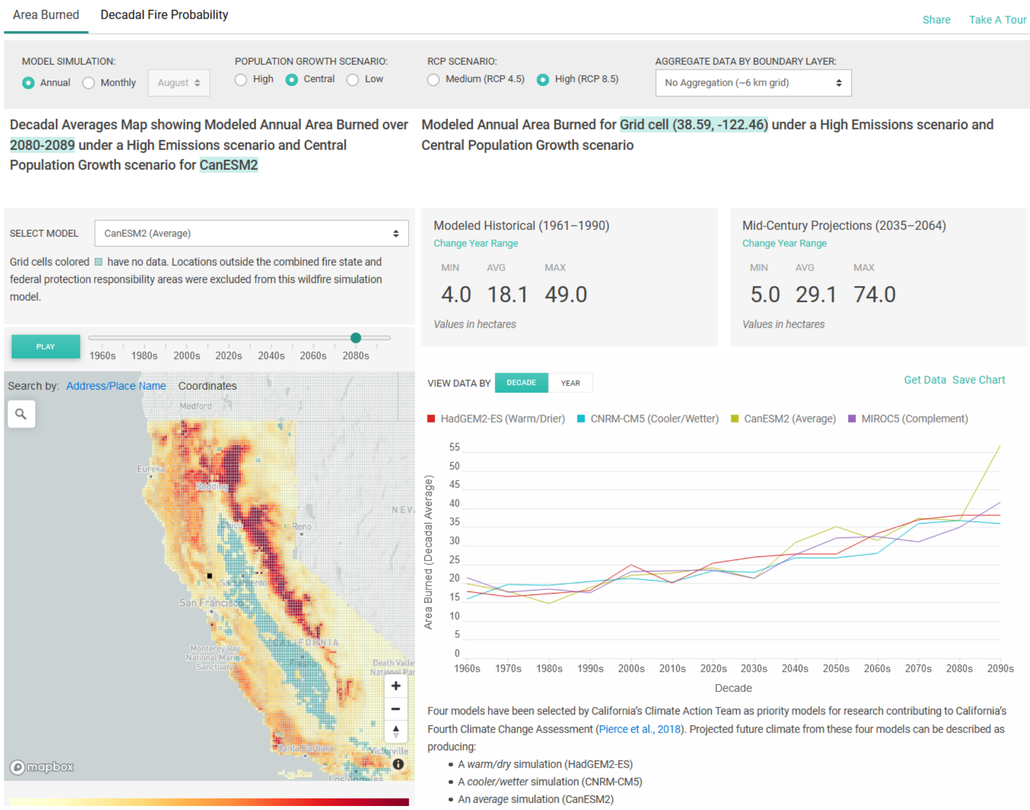
Cal-Adapt has also sought to model annual averages of area burned in the State. Four models have been selected by California's Climate Action Team Research Working Group as priority models for research contributing to California's Fourth Climate Change Assessment. Projected future climate from these four models can be described as producing:

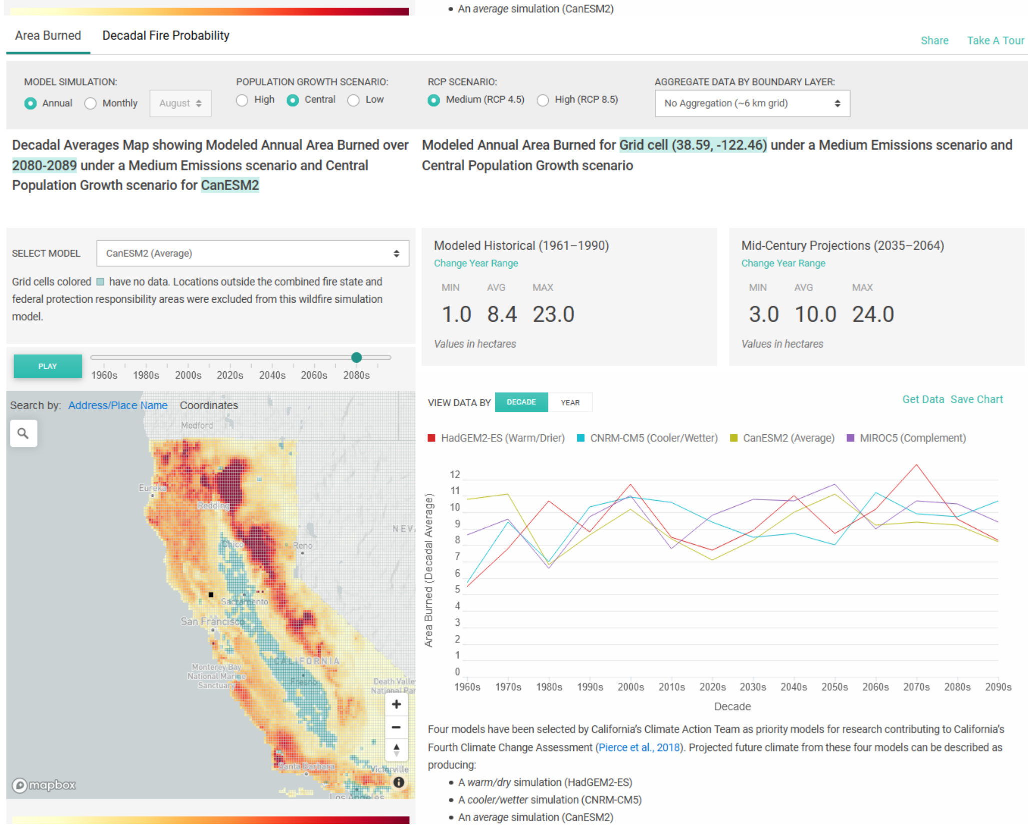
- A warm/dry simulation (HadGEM2-ES) – shown by the red line on the below charts
- A cooler/wetter simulation (CNRM-CM5) – shown by the blue line on the below charts
- An average simulation (CanESM2) – shown by the green line on the below charts
- The model simulation that is most unlike the first three for the best coverage of different possibilities (MIROC5) – shown by the purple line on the below charts

Future modeled annual averages of area burned from Cal-Adapt for the Sacramento County Planning (using the quad that contains Sacramento) are shown in Figure 4-114. It shows the following:

- The upper chart shows modeled annual averages of area burned for the selected area on map under the RCP 8.5 scenario in which emissions continue to rise strongly through 2050 and plateau around 2100.
- The lower chart shows modeled annual averages of area burned for the selected area on map under the RCP 4.5 scenario in which emissions peak around 2040, then decline.

Figure 4-114 Sacramento County – Future Acreage Burned: High and Low Emission Scenarios





Source: Cal-Adapt – Annual Average of Acres Burned

Vulnerability Assessment

Vulnerability—Medium

Risk and vulnerability to the Sacramento County Planning Area from wildfire 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, combined with a large built environment and population, 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, high temperatures, low relative humidity, and periodic winds, can result in frequent and potentially catastrophic fires. During the May to October fire season, the dry vegetation and hot and sometimes windy weather, combined with continued growth in the WUI areas, results in an increase in the number of ignitions. Any fire, once ignited, has the potential to quickly become a large, out-of-control fire. As development continues throughout the Planning Area, especially in these interface areas, the risk and vulnerability to wildfires will likely increase.

A major concern in the urbanized area is the American River Parkway that adjoins the American River from its headwaters at Folsom Dam and travels approximately twenty-three miles through a heavily urbanized area to the Sacramento River. One of the major firefighting problems in the parkway is the lack of access for fire-fighting equipment. Parts of the parkway can only be accessed by helicopter, boat, or land-based hand crews. Once a fire starts in the parkway, the structures next to the parkway become part of the fire problem. Other areas of concern include the Fair Oaks area, Folsom, and areas where eucalyptus trees are prevalent.

Sacramento County Communities at Risk to Wildfire

The National Fire Plan is a cooperative, long-term effort between various government agency partners with the intent of actively responding to severe wildland fires and their impacts to communities while ensuring sufficient firefighting capacity for the future. For purposes of the National Fire Plan, CAL FIRE generated a list of California communities at risk for wildfire. The intent of this assessment was to evaluate the risk to a given area from fire escaping off federal lands. Three main factors were used to determine the wildfire threat in the wildland-urban interface areas of California: fuel hazards, probability of fire, and areas of suitable housing density that could create wildland urban interface fire protection strategy situations. The preliminary criteria and methodology for evaluating wildfire risk to communities is published in the Federal Register, January 4, 2001. The National Fire Plan identifies 13 "Communities at Risk" in Sacramento County. These are shown in Table 4-101.

Table 4-101 Sacramento County Communities at Risk to Wildfire

Communities at Risk to Wildfire				
Fair Oaks	Folsom	Galt	Isleton	La Riviera
Mather Air Force Base	North Highlands	Orangevale	Rancho Cordova	Rancho Murieta

Communities at Risk to Wildfire				
Rio Lino	Rosemont	Sacramento		

Source: CAL FIRE

Impacts

Wildfires can result in loss of life, injuries, damage to structures, and can cause short-term and long-term disruption to the County. Loss of transportation and utility services may include traffic delays/detours from road and bridge closures and loss of electric power, potable water, and wastewater services. Smoke and air pollution from wildfires can be a severe health hazard. School closures also may occur during wildfires. Economic impacts can be significant to a community.

Fires can have devastating effects on watersheds through loss of vegetation and soil erosion, which may impact the County by changing runoff patterns, increasing sedimentation, reducing natural and reservoir water storage capacity, and degrading water quality. Loss of grazing and agricultural lands may also occur. Other assets at risk include recreation areas, wildlife and habitat areas, and rangeland resources. The loss to these natural resources can be significant. In addition, large wildfires can create favorable conditions for other hazards such as flooding, landslides and mudflows, and erosion during the rainy season.

In addition, there are natural resources at risk when wildland-urban interface fires occur. One is the watershed and ecosystem losses that occur from wildland fires. Fires can have devastating effects on

Tree Mortality

Also a factor in increased wildfire conditions is the degree of tree mortality occurring in a community. Drought can weaken trees, making them less resistant to bark beetles and other pests and diseases. These types of infestations attack trees, weaken them, and can kill them. These trees then become fuel for wildfires. Recent aerial mapping conducted between 2012 and 2018 indicates the County has very little incidence of tree mortality. However with continued drought conditions in California, tree mortality could become more of an issue in the County.

On October 30, 2015, Governor Brown proclaimed a State of Emergency and included provisions to expedite the removal and disposal of dead and dying hazardous trees. As a result, costs related to identification, removal, and disposal of dead and dying trees caused from drought conditions may be eligible for California Disaster Assistance Act (CDAA) reimbursement.

Wildfire (Smoke) and Air Quality

During many summer months in past years, Sacramento County residents have had to breathe wildfire smoke, from fires both within and outside of the County. Smoke from wildfires is made up of gas and particulate matter, which can be easily observed in the air. Air quality standards have been established to protect human health with the pollutant referred to as PM2.5 which consists of particles 2.5 microns or less in diameter. These smaller sizes of particles are responsible for adverse health effects because of their ability to reach the lower regions of the respiratory tract.

During the summers of 2013 through 2015, several wildfire incidents occurred in Northern California that increased PM2.5 concentration within Sacramento County. These types of concentrations were also experienced during the 2018-2020 regional northern California fires. When Sacramento air quality is affected by wildfire smoke, whether from fires within the County or from throughout Northern California, the Sacramento County Air Pollution Control Officer works with the County health department to issue health advisories to residents. These advisories are sent to the media, including newspapers, TV, radio, the community, and posted on county websites and the regional Spare the Air website.

While Sacramento-specific projections on future wildfire risk are limited, overall wildfire risk in California is expected to increase as a result of reduced precipitation, rising temperatures, deteriorating forest health due to drought, heat, and tree disease and pests; and logging dead trees. According to a study by *Climate Central*, wildfires burning within 50-100 miles of a city generally caused air quality to be 5-15 times worse than normal. On average, in the U.S. West there are now twice as many fires burning each year as there were in the 1970s. A recent Yale University study published in Climatic Change predicts a significant increase in the number of days that people in the western U.S. will be exposed to wildfire smoke by 2050. The number of people exposed to "smoke waves," or consecutive days with poor air quality due to wildfires, will also increase from 57 million today to 82 million by 2050, the majority of whom will be in northern California, western Oregon, and the Great Plains.

Cal-Adapt is an online tool put together by the California Energy Commission that downscales global climate models to the California level with projections for sea-level rise, drought, temperature increase, heat, and wildfire, from 2020 out to 2085. Figure 4-113 showed the 2085 wildfire projection for Sacramento County. Air quality in these areas of the County could be greatly reduced due to wildfire if the scenario projected is accurate.

Public Safety Power Shutoff Events

During extreme wildfire conditions, usually resulting from high winds, high temperatures, and and low humidity a PSPS may be initiated by local utility companies, as discussed at the beginning of Section 4.3. However, given the overall low to moderate wildfire risk in the County, with limited areas of high or very high risk, no PSPS events have occurred; although, this remains a possibility given the right conditions.

Wildfire Analysis

The Sacramento County Planning Area has mapped CAL FIRE Fire Hazard Severity Zones (FHSZs) and Fire Threat Areas based on fire responsibility areas as further described below. The wildfire analysis for the County is broken down in the following manner:

- Fire Responsibility Area Analysis is presented for:
  - ✓ Sacramento County Planning Area
- Fire Hazard Severity Zone Analysis is presented for:
  - ✓ Sacramento County Planning Area
  - ✓ Unincorporated Sacramento County
- Fire Threat Zone Analysis is presented for:
  - ✓ Sacramento County Planning Area

- ✓ Unincorporated Sacramento County

GIS was used to determine the possible impacts of wildfire within the County and how the wildfire risk varies across the Planning Area. The wildfire analysis includes an analysis of affected parcels and values by Fire Responsibility areas and by CAL FIRE's FHSZs.

Fire Responsibility Area Analysis

There are numerous wildland fire protection agencies that have responsibility within the County, including the USFS, the BLM, the BIA, and CAL FIRE. There are also numerous fire departments and fire protection districts that serve local areas, many of whom have mutual aid agreements with each other as well as state and federal agencies for fire suppression and protection. Fire Responsibility areas are generally categorized by Federal Responsibility Areas (FRA), State Responsibility Areas (SRA) and Local Responsibility Areas (LRA).

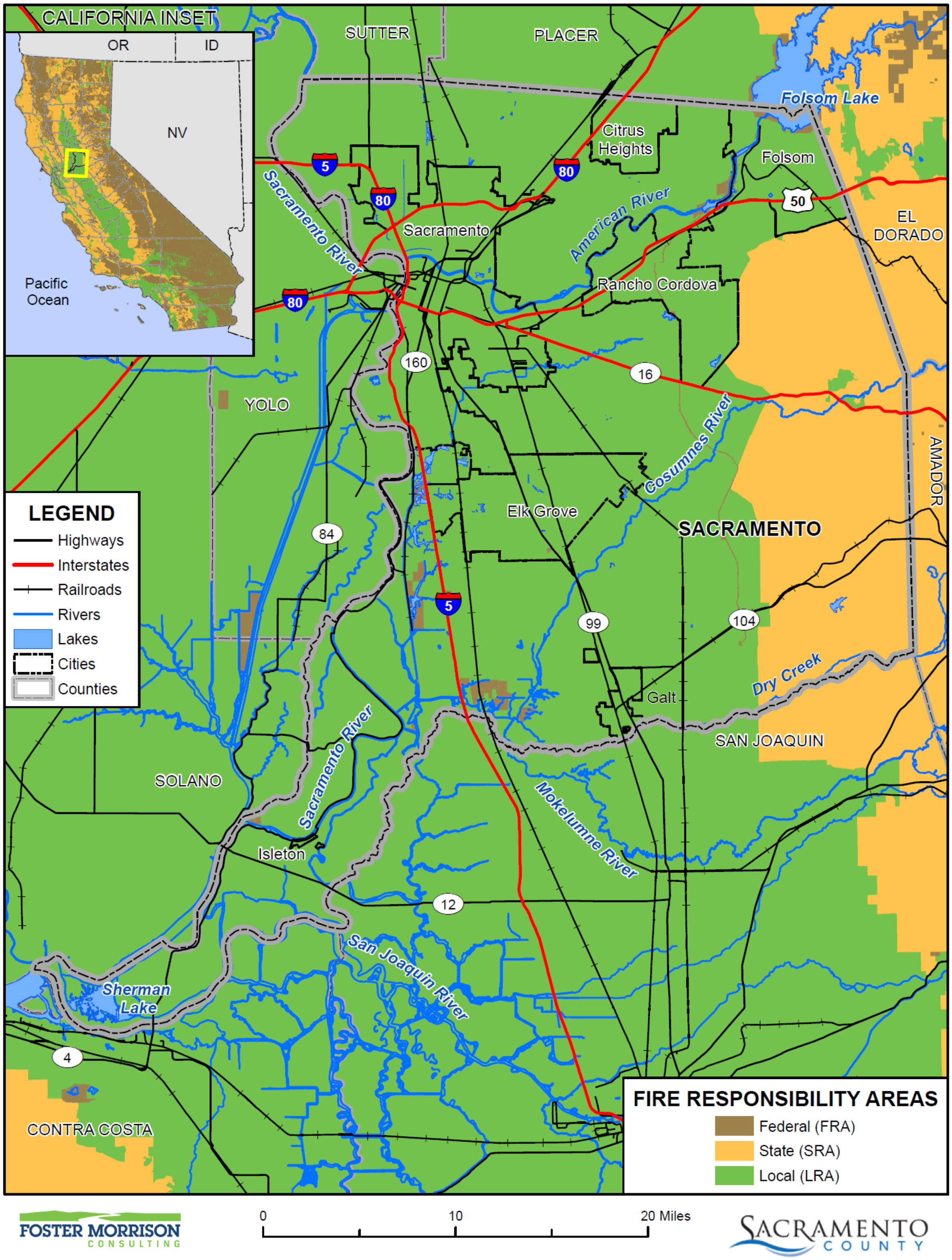
The CAL FIRE data, detailing Fire Responsibility Areas within the County Planning Area, was utilized to determine the locations, numbers, types, and values of land and structures falling within each Fire Responsibility Area. The following sections provide details on the methodology and results for this analysis.

Methodology

CAL FIRE has a legal responsibility to provide fire protection on all SRA lands, which are defined based on land ownership, population density and land use. CAL FIRE's State Responsibility Area layer was used in this analysis to show Sacramento County's parcel counts and values by FRA, SRA, and LRA.

The fire responsibility area layer was overlaid with the parcel data. Since it is possible for any given parcel to intersect with multiple fire responsibility areas, for purposes of this analysis, the parcel centroid was used to determine which fire responsibility area to assign to each parcel. Once completed, the parcel boundary layer was joined to the centroid layer and values were transferred based on the identification number in the Assessor's database and the FIS parcel layer. Based on this approach, the fire responsibility areas for the Sacramento County Planning Area were determined and further broken out by property use and included information on both land and improved values. Locations of each responsibility area are shown in Figure 4-115.

Figure 4-115 Sacramento County Planning Area – Fire Responsibility Areas by FRA, SRA, LRA



Data Source: CAL FIRE (SRA 20_3) 11/2020, Sacramento County GIS, Cal-Atlas; Map Date: 09/2020.

Fire Responsibility Areas and Values at Risk Results

As shown in Figure 4-115, most of the physical area of Sacramento County falls in the LRA. The County parcel inventory and associated values by fire responsibility area are provided in Table 4-102 for the entire Sacramento County Planning Area, as described in the Values at Risk in Section 4.2. It should be noted that fire does not just affect structural values, fire can also affect land values. As such the Assessor's land values and all parcels were accounted for in this analysis to represent total county values at risk. However, it is highly unlikely the whole County will ever be on fire at once. Also, it is important to keep in mind that these assessed values may be well below the actual market value of improved parcels located within the fire hazard severity zones due primarily to Proposition 13 and to a lesser extent properties falling under the Williamson Act.

Table 4-102 Sacramento County Planning Area – Count and Value of Parcels by Local, State, and Federal Responsibility Areas by Jurisdiction

Jurisdiction / Fire Responsibility Area	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Total Value
Citrus Heights					
LRA	26,777	25,821	$2,277,237,402	$5,468,554,811	$7,745,792,213
Citrus Heights Total	**26,777**	**25,821**	**$2,277,237,402**	**$5,468,554,811**	**$7,745,792,213**
Elk Grove					
FRA	4	0	$40		$40
LRA	55,580	51,809	$6,262,511,253	$16,354,975,148	$22,617,486,401
Elk Grove Total	**55,584**	**51,809**	**$6,262,511,293**	**$16,354,975,148**	**$22,617,486,441**
Folsom					
FRA	30	1	$239,321	$299,635	$538,956
LRA	27,028	23,613	$4,438,354,523	$10,586,058,035	$15,024,412,558
Folsom Total	**27,058**	**23,614**	**$4,438,593,844**	**$10,586,357,670**	**$15,024,951,514**
Galt					
LRA	7,986	7,448	$644,457,481	$1,729,332,844	$2,373,790,325
Galt Total	**7,986**	**7,448**	**$644,457,481**	**$1,729,332,844**	**$2,373,790,325**
Isleton					
LRA	536	338	$22,717,211	$41,268,279	$63,985,490
Isleton Total	**536**	**338**	**$22,717,211**	**$41,268,279**	**$63,985,490**
Rancho Cordova					
FRA	6	0			
LRA	23,779	21,532	$2,696,956,614	$6,828,148,604	$9,525,105,218
Rancho Cordova Total	**23,785**	**21,532**	**$2,696,956,614**	**$6,828,148,604**	**$9,525,105,218**

Jurisdiction / Fire Responsibility Area	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Total Value
City of Sacramento					
LRA	155,590	142,896	$16,332,022,285	$43,393,435,771	$59,725,458,056
City of Sacramento Total	**155,590**	**142,896**	**$16,332,022,285**	**$43,393,435,771**	**$59,725,458,056**
Unincorporated Sacramento County					
FRA	140	0	$61,040		$61,040
SRA	1,723	963	$404,385,304	$394,281,577	$798,666,881
LRA	181,186	168,464	$19,018,033,887	$42,961,400,417	$61,979,434,304
Unincorporated Sacramento County Total	**183,049**	**169,427**	**$19,422,480,231**	**$43,355,681,994**	**$62,778,162,225**
Grand Total	**480,365**	**442,885**	**$52,096,976,361**	**$127,757,755,121**	**$179,854,731,482**

Source: CAL FIRE, Sacramento County 2020 Parcel/Assessor's Data

Fire Hazard Severity Zone Analysis

As part of the Fire and Resource Assessment Program (FRAP), CAL FIRE was mandated to map areas of significant fire hazards based on fuels, terrain, weather, and other relevant factors. These zones, referred to as FHSZs, then define the application of various mitigation strategies to reduce risk associated with wildland fires.

Fire hazard is a way to measure the physical fire behavior so that people can predict the damage a fire is likely to cause. Fire hazard measurement includes the speed at which a wildfire moves, the amount of heat the fire produces, and most importantly, the burning fire brands that the fire sends ahead of the flaming front.

The fire hazard model developed by CAL FIRE considers the wildland fuels. Fuel is that part of the natural vegetation that burns during the wildfire. The model also considers topography, especially the steepness of the slopes. Fires burn faster as they burn up-slope. Weather (temperature, humidity, and wind) has a significant influence on fire behavior. The model recognizes that some areas of California have more frequent and severe wildfires than other areas. Finally, the model considers the production of burning fire brands (embers) how far they move, and how receptive the landing site is to new fires.

In 2007, CAL FIRE updated its FHSZ maps for the State of California to provide updated map zones, based on new data, science, and technology that will create more accurate zone designations such that mitigation strategies are implemented in areas where hazards warrant these investments. The zones will provide specific designation for application of defensible space and building standards consistent with known mechanisms of fire risk to people, property, and natural resources. The program is still ongoing with fire hazard severity zone maps being updated based on designated responsibility areas: FRA, SRA, and LRA.

The CAL FIRE data, detailing FHSZs within the Sacramento County Planning Area, was utilized to determine the locations, numbers, types, and values of land and structures falling within each FHSZ. The following sections provide details on the methodology and results for this analysis.

Methodology

CAL FIRE mapped the SRA FHSZs, or areas of significant fire hazard, based on fuels, terrain, weather, and other relevant factors. Zones are designated with Very High, High, Moderate, Non-Wildland/Non-Urban and Urban Unzoned hazard classes. The goal of this mapping effort is to create more accurate fire hazard zone designations such that mitigation strategies are implemented in areas where hazards warrant these investments. The FHSZs will provide specific designation for application of defensible space and building standards consistent with known mechanisms of fire risk to people, property, and natural resources.

The "Draft" LRA FHSZ (c6fhszl06_1) dated September 2007 layer and the Adopted SRA FHSZ (fhszs06_3_6) dated November 2007 were used to get a complete coverage of Fire Hazards.

Analysis was performed using the FHSZ datasets, and using GIS, the parcel layer was overlaid on the Draft and Adopted FHSZ layers. For the purposes of this analysis, if the parcel centroid intersects the zone's area, it will be assumed that the entire parcel is in that area. This analysis illustrates the FHSZs specific to the Planning Area and the unincorporated County.

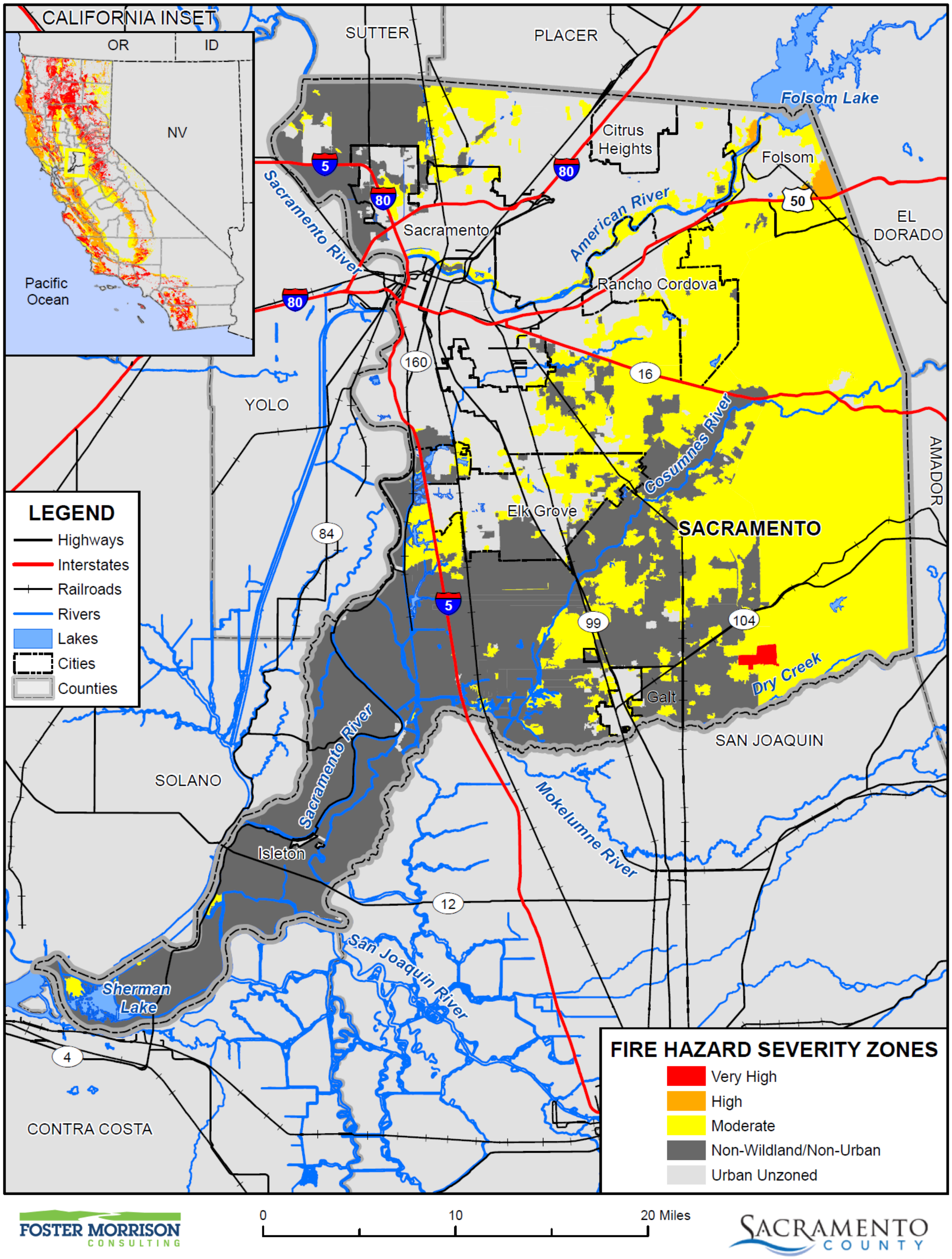
Fire Hazard Severity Zones Analysis Results: Values at Risk

Results are presented in this section for the Sacramento County Planning Area and the unincorporated County. Detail tables for the incorporated communities are included in their respective annexes to this LHMP Update.

Sacramento County Planning Area

The FHSZs in Sacramento County are shown in Figure 4-116. Analysis results for the entire Sacramento County Planning Area are summarized in Table 4-103 and broken out by jurisdiction in Table 4-104. These tables summarize total parcel counts, improved parcel counts, and their improved and land values, other values, and the estimated contents replacement values based on the CRV factors detailed in Table 4-6.

Figure 4-116 Sacramento County Planning Area – Fire Hazard Severity Zones



Data Source: Cal-Fire 2017 (Draft 9/2007 - c34fhszl06_1, Adopted 11/2007 - fhsz06_3_34, Recommended 10/2008 - c34fhszl06_3), Sacramento County GIS, Cal-Atlas; Map Date: 09/2020.

Table 4-103 Sacramento County Planning Area – Count and Value of Parcels in Fire Hazard Severity Zones

Fire Hazard Severity Zone	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Very High	101	87	$14,857,296	$20,046,967	$9,948,981	$44,853,241
High	3,153	2,738	$639,852,655	$1,639,767,622	$1,026,226,584	$3,305,846,828
Moderate	37,157	28,629	$5,358,836,460	$10,086,862,461	$6,104,416,952	$21,550,115,976
Non-Wildland/Non-Urban	17,489	12,362	$2,908,144,650	$5,249,465,634	$3,404,209,047	$11,561,819,483
Urban Unzoned	422,465	399,069	$43,175,285,300	$110,761,612,437	$70,257,120,162	$224,194,018,262
Total	**480,365**	**442,885**	**$52,096,976,361**	**$127,757,755,121**	**$80,801,921,726**	**$260,656,653,790**

Source: CAL FIRE, Sacramento County 2020 Parcel/Assessor's Data

Table 4-104 Sacramento County Planning Area – Count and Value of Parcels in Fire Hazard Severity Zones by Jurisdiction

Jurisdiction / Fire Hazard Severity Zone	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Citrus Heights						
Urban Unzoned	26,777	25,821	$2,277,237,402	$5,468,554,811	$3,145,021,676	$10,890,813,812
Citrus Heights Total	**26,777**	**25,821**	**$2,277,237,402**	**$5,468,554,811**	**$3,145,021,676**	**$10,890,813,812**
Elk Grove						
Moderate	4,626	4,096	$706,051,086	$1,660,424,981	$1,009,598,054	$3,376,074,109
Non-Wildland/Non-Urban	5,579	4,199	$824,296,197	$1,706,112,600	$931,174,201	$3,461,583,045
Urban Unzoned	45,379	43,514	$4,732,164,010	$12,988,437,567	$7,499,238,222	$25,219,839,740
Elk Grove Total	**55,584**	**51,809**	**$6,262,511,293**	**$16,354,975,148**	**$9,440,010,477**	**$32,057,496,894**
Folsom						
High	3,153	2,738	$639,852,655	$1,639,767,622	$1,026,226,584	$3,305,846,828
Moderate	5,544	3,619	$1,068,214,044	$1,638,882,317	$998,944,800	$3,706,041,180
Non-Wildland/Non-Urban	10	4	$11,822,351	$66,472,063	$33,236,032	$111,530,446
Urban Unzoned	18,351	17,253	$2,718,704,794	$7,241,235,668	$4,471,131,619	$14,431,072,047
Folsom Total	**27,058**	**23,614**	**$4,438,593,844**	**$10,586,357,670**	**$6,529,539,035**	**$21,554,490,501**

Jurisdiction / Fire Hazard Severity Zone	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Galt						
Moderate	515	450	$55,943,481	$153,171,395	$118,098,793	$327,213,685
Non-Wildland/Non-Urban	60	39	$27,392,033	$13,676,004	$6,986,499	$48,054,537
Urban Unzoned	7,411	6,959	$561,121,967	$1,562,485,445	$887,067,558	$3,010,674,957
Galt Total	**7,986**	**7,448**	**$644,457,481**	**$1,729,332,844**	**$1,012,152,850**	**$3,385,943,179**
Isleton						
Non-Wildland/Non-Urban	70	4	$717,781	$1,041,625	$520,813	$2,280,218
Urban Unzoned	466	334	$21,999,430	$40,226,654	$25,532,743	$87,758,826
Isleton Total	**536**	**338**	**$22,717,211**	**$41,268,279**	**$26,053,556**	**$90,039,044**
Rancho Cordova						
Moderate	6,018	4,547	$717,507,511	$1,392,960,061	$795,178,643	$2,905,646,250
Non-Wildland/Non-Urban	11	2	$6,904,882	$428,132	$214,066	$7,547,080
Urban Unzoned	17,756	16,983	$1,972,544,221	$5,434,760,411	$4,203,228,459	$11,610,532,935
Rancho Cordova Total	**23,785**	**21,532**	**$2,696,956,614**	**$6,828,148,604**	**$4,998,621,168**	**$14,523,726,265**
City of Sacramento						
Moderate	3,966	3,052	$476,852,476	$1,381,070,910	$948,198,494	$2,806,121,933
Non-Wildland/Non-Urban	5,208	3,798	$766,099,910	$1,882,990,400	$1,136,701,772	$3,785,792,130
Urban Unzoned	146,416	136,046	$15,089,069,899	$40,129,374,461	$26,994,730,553	$82,213,175,523
City of Sacramento Total	**155,590**	**142,896**	**$16,332,022,285**	**$43,393,435,771**	**$29,079,630,819**	**$88,805,089,586**
Unincorporated Sacramento County						
Very High	101	87	$14,857,296	$20,046,967	$9,948,981	$44,853,241
Moderate	16,488	12,865	$2,334,267,862	$3,860,352,797	$2,234,398,168	$8,429,018,819
Non-Wildland/Non-Urban	6,551	4,316	$1,270,911,496	$1,578,744,810	$1,295,375,664	$4,145,032,027
Urban Unzoned	159,909	152,159	$15,802,443,577	$37,896,537,420	$23,031,169,332	$76,730,150,422
Unincorporated Sacramento County Total	**183,049**	**169,427**	**$19,422,480,231**	**$43,355,681,994**	**$26,570,892,145**	**$89,349,054,509**

Jurisdiction / Fire Hazard Severity Zone	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Grand Total	**480,365**	**442,885**	**$52,096,976,361**	**$127,757,755,121**	**$80,801,921,726**	**$260,656,653,790**

Source: CAL FIRE, Sacramento County 2020 Parcel/Assessor's Data

Unincorporated Sacramento County

Table 4-105 summarized parcel counts and values in the unincorporated County by FHSZ using the CRVs described in Table 4-6. Table 4-106 breaks out Table 4-105 into greater details and shown the FHSZ by property use for the unincorporated County.

Table 4-105 Unincorporated Sacramento County – Parcels and Values at Risk in Fire Hazard Severity Zones

Fire Hazard Severity Zone	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Very High	101	87	$14,857,296	$20,046,967	$9,948,981	$44,853,241
Moderate	16,488	12,865	$2,334,267,862	$3,860,352,797	$2,234,398,168	$8,429,018,819
Non-Wildland/Non-Urban	6,551	4,316	$1,270,911,496	$1,578,744,810	$1,295,375,664	$4,145,032,027
Urban Unzoned	159,909	152,159	$15,802,443,577	$37,896,537,420	$23,031,169,332	$76,730,150,422
Unincorporated Sacramento County Total	**183,049**	**169,427**	**$19,422,480,231**	**$43,355,681,994**	**$26,570,892,145**	**$89,349,054,509**

Source: CAL FIRE, Sacramento County 2020 Parcel/Assessor's Data

Table 4-106 Unincorporated Sacramento County – Parcels and Values at Risk in Fire Hazard Severity Zones by Property Use

Fire Hazard Severity Zone / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Very High						
Agricultural	0	0	$0	$0	$0	$0
Care/Health	0	0	$0	$0	$0	$0
Church/Welfare	0	0	$0	$0	$0	$0
Industrial	0	0	$0	$0	$0	$0
Miscellaneous	1	0	$2,721	$0	$0	$2,721
Office	0	0	$0	$0	$0	$0
Public/Utilities	1	0	$0	$0	$0	$0
Recreational	0	0	$0	$0	$0	$0

Fire Hazard Severity Zone / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Residential	86	85	$13,583,909	$19,897,961	$9,948,981	$43,430,848
Retail / Commercial	0	0	$0	$0	$0	$0
Unknown	0	0	$0	$0	$0	$0
Vacant	13	2	$1,270,666	$149,006	$0	$1,419,672
Very High Total	**101**	**87**	**$14,857,296**	**$20,046,967**	**$9,948,981**	**$44,853,241**
Moderate						
Agricultural	781	239	$234,747,954	$146,288,697	$146,288,697	$527,325,348
Care/Health	21	17	$8,737,989	$33,878,492	$33,878,492	$76,494,973
Church/Welfare	27	21	$8,927,462	$69,800,229	$69,800,229	$148,527,920
Industrial	180	89	$87,652,767	$148,354,054	$222,531,082	$458,537,899
Miscellaneous	782	1	$1,185,344	$5,854	$5,854	$1,197,052
Office	31	19	$10,631,430	$20,430,988	$20,430,988	$51,493,406
Public/Utilities	118	0	$66	$0	$0	$66
Recreational	35	14	$9,098,322	$10,807,098	$10,807,098	$30,712,518
Residential	12,628	12,351	$1,614,550,347	$3,391,634,555	$1,695,817,264	$6,702,002,162
Retail / Commercial	32	29	$21,530,474	$34,838,464	$34,838,464	$91,207,402
Unknown	1	0	$5,576	$0	$0	$5,576
Vacant	1,852	85	$337,200,131	$4,314,366	$0	$341,514,497
Moderate Total	**16,488**	**12,865**	**$2,334,267,862**	**$3,860,352,797**	**$2,234,398,168**	**$8,429,018,819**
Non-Wildland/Non-Urban						
Agricultural	1,805	1,197	$565,182,770	$510,806,234	$510,806,234	$1,586,795,238
Care/Health	6	2	$481,533	$640,321	$640,321	$1,762,175
Church/Welfare	12	10	$2,104,850	$12,080,753	$12,080,753	$26,266,356
Industrial	74	38	$75,456,176	$235,740,592	$353,610,886	$664,807,656
Miscellaneous	479	4	$3,083,888	$12,802	$12,802	$3,109,492
Office	3	1	$1,501,275	$4,830,000	$4,830,000	$11,161,275
Public/Utilities	198	0	$63	$0	$0	$63
Recreational	46	24	$11,848,945	$9,773,727	$9,773,727	$31,396,399
Residential	3,013	2,944	$391,456,726	$793,857,071	$396,928,505	$1,582,242,357
Retail / Commercial	27	26	$1,822,851	$6,692,436	$6,692,436	$15,207,723
Unknown	1	1	$36,466	$131,696	$0	$168,162
Vacant	887	69	$217,935,953	$4,179,178	$0	$222,115,131

Fire Hazard Severity Zone / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Non-Wildland/Non-Urban Total	**6,551**	**4,316**	**$1,270,911,496**	**$1,578,744,810**	**$1,295,375,664**	**$4,145,032,027**
Urban Unzoned						
Agricultural	27	13	$1,729,933	$1,767,497	$1,767,497	$5,264,927
Care/Health	189	179	$122,680,636	$579,571,194	$579,571,194	$1,281,823,024
Church/Welfare	420	366	$134,915,061	$579,445,761	$579,445,761	$1,293,806,583
Industrial	1,338	1,108	$556,444,087	$1,563,843,638	$2,345,765,464	$4,466,053,174
Miscellaneous	2,456	19	$8,429,791	$674,931	$674,931	$9,779,653
Office	1,345	1,219	$494,821,486	$1,448,403,087	$1,448,403,087	$3,391,627,660
Public/Utilities	345	1	$1,229,074	$1,483,565	$1,483,565	$4,196,204
Recreational	141	94	$44,066,636	$93,594,730	$93,594,730	$231,256,096
Residential	148,153	146,930	$12,756,510,780	$31,240,141,696	$15,620,070,599	$59,616,723,183
Retail / Commercial	2,189	2,042	$1,263,070,399	$2,360,392,504	$2,360,392,504	$5,983,855,407
Unknown	7	6	$42,958	$385,906	$0	$428,864
Vacant	3,299	182	$418,502,736	$26,832,911	$0	$445,335,647
Urban Unzoned Total	**159,909**	**152,159**	**$15,802,443,577**	**$37,896,537,420**	**$23,031,169,332**	**$76,730,150,422**
Unincorporated Sacramento County Total	**183,049**	**169,427**	**$19,422,480,231**	**$43,355,681,994**	**$26,570,892,145**	**$89,349,054,509**

Source: CAL FIRE, Sacramento County 2020 Parcel/Assessor's Data

Fire Threat Zone Analysis

Cal Fire develops and maintains datasets related to wildland fire threat and risk. The Fire Threat dataset, created in 2004, was used for analysis on unincorporated Sacramento County and for the county's seven incorporated areas including Citrus Heights, Elk Grove, Folsom, Galt, Isleton, Rancho Cordova and Sacramento. This fire threat layer was used for loss estimation purposes based on its comprehensive coverage of the Planning Area. Sacramento County's parcel and associated assessor data was used as the basis for the countywide inventory of developed parcels, or structures.

The Fire Threat dataset is a combination of fire frequency, or the likelihood of a given area to burn, and potential fire behavior. Fire rotation is calculated using fifty years of fire history, as well as climate, vegetation, and land ownership information. Fuel rank is calculated based on expected fire behavior for unique combinations of topography and vegetative fuels under given weather conditions (wind speed, humidity, temperature, and fuel moistures). Fuel rank and fire rotation are then combined to create the 5 threat classes in the Fire Threat dataset, ranging from Little or No Threat to Extreme Threat. There are no areas of Extreme Threat in Sacramento County.

Methodology

GIS was used to create a centroid, or point representing the center of the Sacramento County parcel polygon. Fire Threat was then overlaid on the parcel centroids. For the purposes of this analysis, the wildfire threat zone (Little or No Threat | Moderate | High | Very High | Extreme) that intersected a parcel centroid was assigned as the threat zone for the entire parcel.

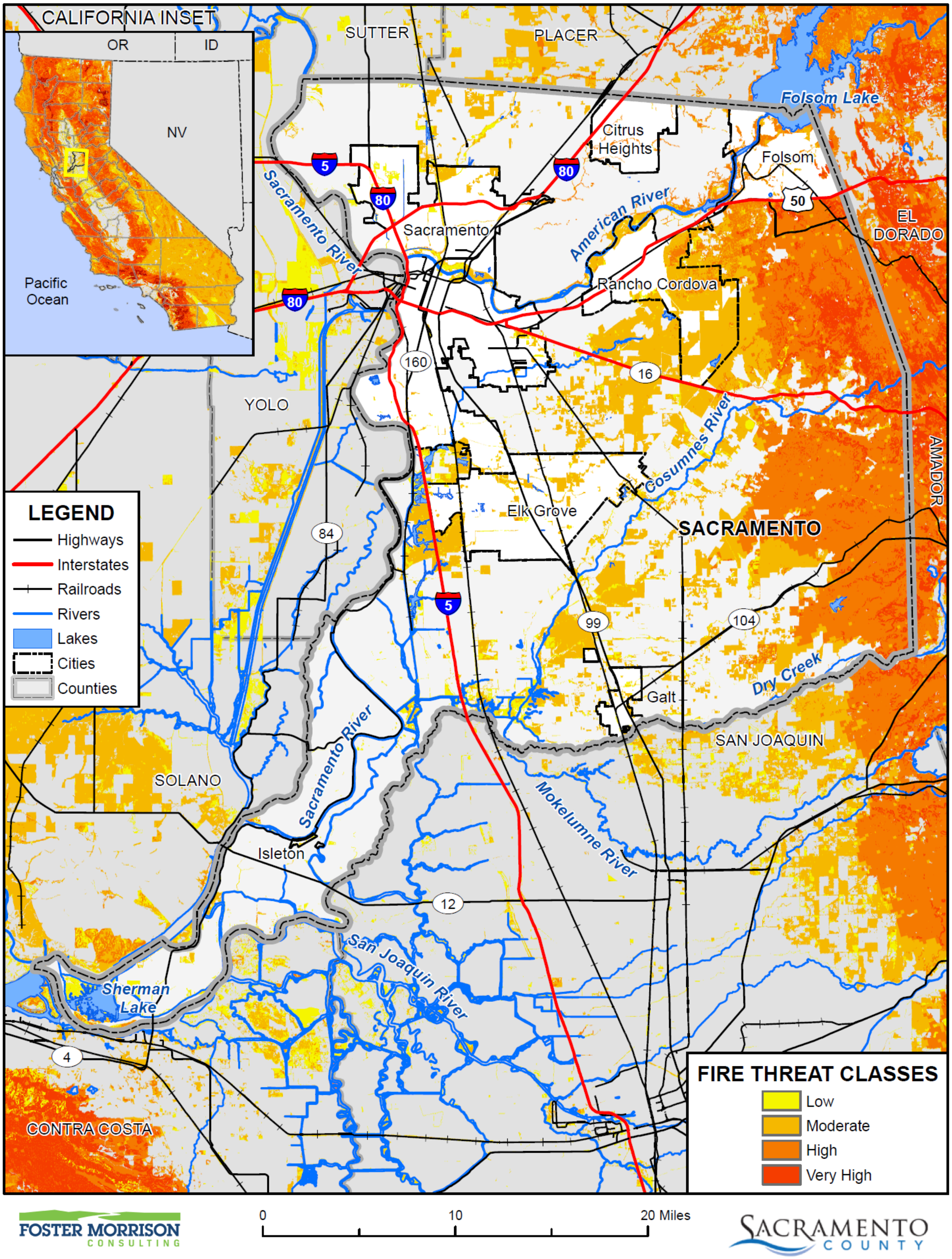
Assets at Risk

Results are presented by total Planning Area, unincorporated county, and for the participating jurisdictions (in their respective annexes to the plan), and detailed tables show improved parcel counts and their land and structure values by property use (residential, industrial, etc.) within each fire threat zone.

Sacramento County Planning Area

Fire Threat Zones in the County are shown on Figure 4-117. Analysis results for the entire Sacramento County Planning Area are summarized in Table 4-107. Table 4-108 summarizes total parcel counts, improved parcel counts, and their improved and land values by jurisdiction in each Fire Threat Zone.

Figure 4-117 Sacramento County – Fire Threat Zones



Data Source: Cal-Fire 2017 Fire Threat Data (fthrt14_2), Sacramento County GIS, Cal-Atlas; Map Date: 09/2020.

Table 4-107 Sacramento County Planning Area – Parcels and Values at Risk in the Fire Threat Areas

Fire Hazard Severity Zone	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Very High	883	87	$161,574,920	$45,458,503	$23,710,224	$230,743,645
High	3,328	1,543	$708,173,329	$628,820,187	$367,818,109	$1,704,811,656
Moderate	6,587	2,835	$1,124,068,935	$1,257,783,918	$809,982,222	$3,191,835,136
Low	2,058	792	$232,020,537	$369,804,777	$258,929,114	$860,754,428
No Threat	467,509	437,628	$49,871,138,640	$125,455,887,736	$79,341,482,057	$254,668,508,925
Total	**480,365**	**442,885**	**$52,096,976,361**	**$127,757,755,121**	**$80,801,921,726**	**$260,656,653,790**

Source: CAL FIRE, Sacramento County 2020 Parcel/Assessor's Data

Table 4-108 Sacramento County Planning Area – Parcels and Values at Risk in the Fire Threat Areas by Jurisdiction

Jurisdiction / Fire Threat Class	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Citrus Heights						
Very High	0	0	$0	$0	$0	$0
High	154	83	$10,944,958	$21,098,428	$11,115,363	$43,158,746
Moderate	26	15	$3,862,157	$3,279,905	$1,639,955	$8,782,013
Low	20	17	$1,456,037	$3,126,388	$1,563,197	$6,145,619
No Threat	26,577	25,706	$2,260,974,250	$5,441,050,090	$3,130,703,161	$10,832,727,434
Citrus Heights Total	**26,777**	**25,821**	$2,277,237,402	$5,468,554,811	$3,145,021,676	$10,890,813,812
Elk Grove						
Very High	0	0	$0	$0	$0	$0
High	3	1	$64,995	$154,762	$77,381	$297,138
Moderate	552	275	$164,149,216	$255,300,118	$194,070,862	$613,520,201
Low	192	113	$38,024,306	$74,113,140	$55,684,179	$167,821,621
No Threat	54,837	51,420	$6,060,272,776	$16,025,407,128	$9,190,178,055	$31,275,857,934
Elk Grove Total	**55,584**	**51,809**	**$6,262,511,293**	**$16,354,975,148**	**$9,440,010,477**	**$32,057,496,894**
Folsom						
Very High	788	63	$131,919,565	$37,185,086	$18,611,485	$187,716,135
High	1,737	706	$441,821,634	$327,213,052	$181,478,986	$950,513,693
Moderate	389	273	$51,523,132	$147,125,846	$86,757,208	$285,406,188
Low	52	31	$5,126,140	$14,542,079	$7,271,039	$26,939,258
No Threat	24,092	22,541	$3,808,203,373	$10,060,291,607	$6,235,420,317	$20,103,915,227

Jurisdiction / Fire Threat Class	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Folsom Total	**27,058**	**23,614**	**$4,438,593,844**	**$10,586,357,670**	**$6,529,539,035**	**$21,554,490,501**
Galt						
Very High	0	0	$0	$0	$0	$0
High	0	0	$0	$0	$0	$0
Moderate	117	76	$19,244,497	$26,116,639	$14,330,175	$59,691,317
Low	83	7	$9,060,926	$1,236,367	$618,184	$10,915,477
No Threat	7,786	7,365	$616,152,058	$1,701,979,838	$997,204,491	$3,315,336,385
Galt Total	**7,986**	**7,448**	**$644,457,481**	**$1,729,332,844**	**$1,012,152,850**	**$3,385,943,179**
Isleton						
Very High	0	0	$0	$0	$0	$0
High	1	0	$45,900	$0	$0	$45,900
Moderate	9	0	$539,519	$0	$0	$539,519
Low	27	6	$1,846,908	$990,414	$494,473	$3,331,796
No Threat	499	332	$20,284,884	$40,277,865	$25,559,083	$86,121,829
Isleton Total	**536**	**338**	**$22,717,211**	**$41,268,279**	**$26,053,556**	**$90,039,044**
Rancho Cordova						
Very High	0	0	$0	$0	$0	$0
High	12	2	$1,063,212	$1,129,950	$1,564,925	$3,758,087
Moderate	1,275	268	$203,019,166	$89,618,589	$61,131,735	$353,769,501
Low	175	71	$17,185,898	$35,417,063	$41,930,608	$94,533,581
No Threat	22,323	21,191	$2,475,688,338	$6,701,983,002	$4,893,993,900	$14,071,665,096
Rancho Cordova Total	**23,785**	**21,532**	**$2,696,956,614**	**$6,828,148,604**	**$4,998,621,168**	**$14,523,726,265**
City of Sacramento						
Very High	0	0	$0	$0	$0	$0
High	109	67	$15,788,630	$38,303,420	$28,104,152	$82,196,206
Moderate	820	354	$142,451,051	$214,897,344	$149,835,830	$507,184,233
Low	693	245	$74,272,287	$129,795,580	$80,617,834	$284,685,707
No Threat	153,968	142,230	$16,099,510,317	$43,010,439,427	$28,821,073,003	$87,931,023,440
City of Sacramento Total	**155,590**	**142,896**	**$16,332,022,285**	**$43,393,435,771**	**$29,079,630,819**	**$88,805,089,586**
Unincorporated Sacramento County						
Very High	95	24	$29,655,355	$8,273,417	$5,098,739	$43,027,510
High	1,312	684	$238,444,000	$240,920,575	$145,477,302	$624,841,886
Moderate	3,399	1,574	$539,280,197	$521,445,477	$302,216,457	$1,362,942,164

Jurisdiction / Fire Threat Class	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Low	816	302	$85,048,035	$110,583,746	$70,749,600	$266,381,369
No Threat	177,427	166,843	$18,530,052,644	$42,474,458,779	$26,047,350,047	$87,051,861,580
Unincorporated Sacramento County Total	**183,049**	**169,427**	**$19,422,480,231**	**$43,355,681,994**	**$26,570,892,145**	**$89,349,054,509**
Grand Total	**480,365**	**442,885**	**$52,096,976,361**	**$127,757,755,121**	**$80,801,921,726**	**$260,656,653,790**

Source: CAL FIRE, Sacramento County 2020 Parcel/Assessor's Data

Unincorporated Sacramento County

Analysis results for the entire Sacramento County Planning Area are summarized in Table 4-109. Table 4-110 summarizes total parcel counts, improved parcel counts, and their improved and land values in the unincorporated County in each Fire Threat Zone.

Table 4-109 Unincorporated Sacramento County – Parcels and Values at Risk in the Fire Threat Areas

Jurisdiction / Fire Threat Class	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Very High	95	24	$29,655,355	$8,273,417	$5,098,739	$43,027,510
High	1,312	684	$238,444,000	$240,920,575	$145,477,302	$624,841,886
Moderate	3,399	1,574	$539,280,197	$521,445,477	$302,216,457	$1,362,942,164
Low	816	302	$85,048,035	$110,583,746	$70,749,600	$266,381,369
No Threat	177,427	166,843	$18,530,052,644	$42,474,458,779	$26,047,350,047	$87,051,861,580
Unincorporated Sacramento County Total	**183,049**	**169,427**	**$19,422,480,231**	**$43,355,681,994**	**$26,570,892,145**	**$89,349,054,509**

Source: CAL FIRE, Sacramento County 2020 Parcel/Assessor's Data

Table 4-110 Unincorporated Sacramento County – Parcels and Values at Risk in the Fire Threat Areas by Property Use

Fire Threat Class / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Very High						
Agricultural	61	7	$24,871,475	$1,721,235	$1,721,235	$28,313,945
Care/Health	0	0	$0	$0	$0	$0
Church/Welfare	0	0	$0	$0	$0	$0
Industrial	3	1	$1,378,549	$101,415	$152,122	$1,632,086

Fire Threat Class / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Miscellaneous	4	0	$788	$0	$0	$788
Office	0	0	$0	$0	$0	$0
Public/Utilities	0	0	$0	$0	$0	$0
Recreational	1	0	$0	$0	$0	$0
Residential	17	16	$2,194,006	$6,450,767	$3,225,382	$11,870,154
Retail/ Commercial	0	0	$0	$0	$0	$0
Unknown	0	0	$0	$0	$0	$0
Vacant	9	0	$1,210,537	$0	$0	$1,210,537
Very High Total	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
High						
Agricultural	285	40	$73,092,647	$9,756,705	$9,756,705	$92,606,057
Care/Health	0	0	$0	$0	$0	$0
Church/Welfare	1	1	$94,477	$1,211,521	$1,211,521	$2,517,519
Industrial	13	1	$11,927,895	$20,349,950	$30,524,925	$62,802,770
Miscellaneous	135	1	$466,076	$3,376	$3,376	$472,828
Office	0	0	$0	$0	$0	$0
Public/Utilities	10	0	$0	$0	$0	$0
Recreational	5	0	$14,598	$0	$0	$14,598
Residential	675	635	$96,089,343	$207,961,576	$103,980,775	$408,031,703
Retail/ Commercial	0	0	$0	$0	$0	$0
Unknown	0	0	$0	$0	$0	$0
Vacant	188	6	$56,758,964	$1,637,447	$0	$58,396,411
High Total	**1,312**	**684**	**$238,444,000**	**$240,920,575**	**$145,477,302**	**$624,841,886**
Moderate						
Agricultural	298	64	$77,228,002	$28,294,489	$28,294,489	$133,816,980
Care/Health	5	5	$715,645	$2,036,455	$2,036,455	$4,788,555
Church/Welfare	9	4	$2,304,453	$1,179,176	$1,179,176	$4,662,805
Industrial	47	5	$28,102,451	$20,332,359	$30,498,539	$78,933,348
Miscellaneous	330	0	$785,850	$0	$0	$785,850
Office	2	1	$1,152,536	$495,720	$495,720	$2,143,976
Public/Utilities	55	0	$19	$0	$0	$19
Recreational	11	5	$696,776	$1,017,294	$1,017,294	$2,731,364
Residential	1,523	1,462	$228,986,830	$454,425,889	$227,212,932	$910,625,685

Fire Threat Class / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Retail/ Commercial	7	5	$9,297,261	$11,481,852	$11,481,852	$32,260,965
Unknown	1	0	$5,576	$0	$0	$5,576
Vacant	1,111	23	$190,004,798	$2,182,243	$0	$192,187,041
Moderate Total	**3,399**	**1,574**	**$539,280,197**	**$521,445,477**	**$302,216,457**	**$1,362,942,164**
Low						
Agricultural	92	27	$14,207,044	$10,872,297	$10,872,297	$35,951,638
Care/Health	1	0	$10			$10
Church/Welfare	2	2	$1,467,640	$8,515,081	$8,515,081	$18,497,802
Industrial	8	4	$1,340,467	$827,643	$1,241,464	$3,409,575
Miscellaneous	184	1	$212,655	$2,878	$2,878	$218,411
Office	1	0	$1,020	$0	$0	$1,020
Public/Utilities	78	0	$27	$0	$0	$27
Recreational	15	7	$2,054,596	$941,538	$941,538	$3,937,672
Residential	264	249	$42,843,997	$80,294,602	$40,147,311	$163,285,897
Retail/ Commercial	4	4	$2,351,344	$9,029,031	$9,029,031	$20,409,406
Unknown	0	0	$0	$0	$0	$0
Vacant	167	8	$20,569,235	$100,676	$0	$20,669,911
Low Total	**816**	**302**	**$85,048,035**	**$110,583,746**	**$70,749,600**	**$266,381,369**
No Threat						
Agricultural	1,877	1,311	$612,261,489	$608,217,702	$608,217,702	$1,828,696,893
Care/Health	210	193	$131,184,503	$612,053,552	$612,053,552	$1,355,291,607
Church/Welfare	447	390	$142,080,803	$650,420,965	$650,420,965	$1,442,922,733
Industrial	1,521	1,224	$676,803,668	$1,906,326,917	$2,859,490,382	$5,442,620,950
Miscellaneous	3,065	22	$11,236,375	$687,333	$687,333	$12,611,041
Office	1,376	1,238	$505,800,635	$1,473,168,355	$1,473,168,355	$3,452,137,345
Public/Utilities	519	1	$1,229,157	$1,483,565	$1,483,565	$4,196,287
Recreational	190	120	$62,247,933	$112,216,723	$112,216,723	$286,681,379
Residential	161,401	159,948	$14,405,987,586	$34,696,398,449	$17,348,198,949	$66,450,585,111
Retail/ Commercial	2,237	2,088	$1,274,775,119	$2,381,412,521	$2,381,412,521	$6,037,600,161
Unknown	8	7	$79,424	$517,602	$0	$597,026
Vacant	4,576	301	$706,365,952	$31,555,095	$0	$737,921,047
No Threat Total	**177,427**	**166,843**	**$18,530,052,644**	**$42,474,458,779**	**$26,047,350,047**	**$87,051,861,580**

Fire Threat Class / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Improved Structure Value	Estimated Contents Value	Total Value
Unincorporated Sacramento County Total	**183,049**	**169,427**	**$19,422,480,231**	**$43,355,681,994**	**$26,570,892,145**	**$89,349,054,509**

Source: CAL FIRE, Sacramento County 2020 Parcel/Assessor's Data

Population at Risk

A separate analysis was performed to determine population that reside in both FHSZs and Fire Threat Zones. Using GIS, the CAL FIRE FHSZ and Fire Threat datasets were overlayed on the improved residential parcel data. Those parcel centroids that intersect each FHSZ were counted and multiplied by the Census Bureau average household size; results were tabulated by FHSZ (see Table 4-111). According to this analysis, there is a population of 74,473 in the Moderate FHSZ, 6,988 in the High FHSZ, and 235 in the Very High FHSZ in the County.

Table 4-111 Sacramento County Planning Area – Residential Populations at Risk in Moderate or Higher FHSZs

Jurisdiction	Very High		High		Moderate	
	Improved Residential Parcels	Population at Risk	Improved Residential Parcels	Population at Risk	Improved Residential Parcels	Population at Risk
Citrus Heights	0	0	0	0	0	0
Elk Grove	0	0	0	0	3,991	12,771
Folsom	0	0	2,657	6,988	3,494	9,189
Galt	0	0	0	0	430	1,359
Isleton	0	0	0	0	0	0
Rancho Cordova	0	0	0	0	4,437	9,495
City of Sacramento	0	0	0	0	2,846	7,570
Unincorporated Sacramento County	85	235	0	0	12,351	34,089
Total	**85**	**235**	**2,657**	**6,988**	**27,549**	**74,473**

Source: CAL FIRE, US Census Bureau Average Household Sizes: Citrus Heights (2.54); Sacramento City (2.66); Elk Grove (3.20); Folsom (2.63), Galt (3.16); Isleton (2.7), Rancho Cordova (2.14): and unincorporated Sacramento County (2.76)

Results were also tabulated by Fire Threat Zone (see Table 4-112). According to this analysis, there is a population of 7,284 in the Moderate, 3,897 in the High, and 207 in the Very High Fire Threat Zones in the County.

Table 4-112 Sacramento County Planning Area – Residential Populations at Risk in Moderate or Higher Fire Threat Areas

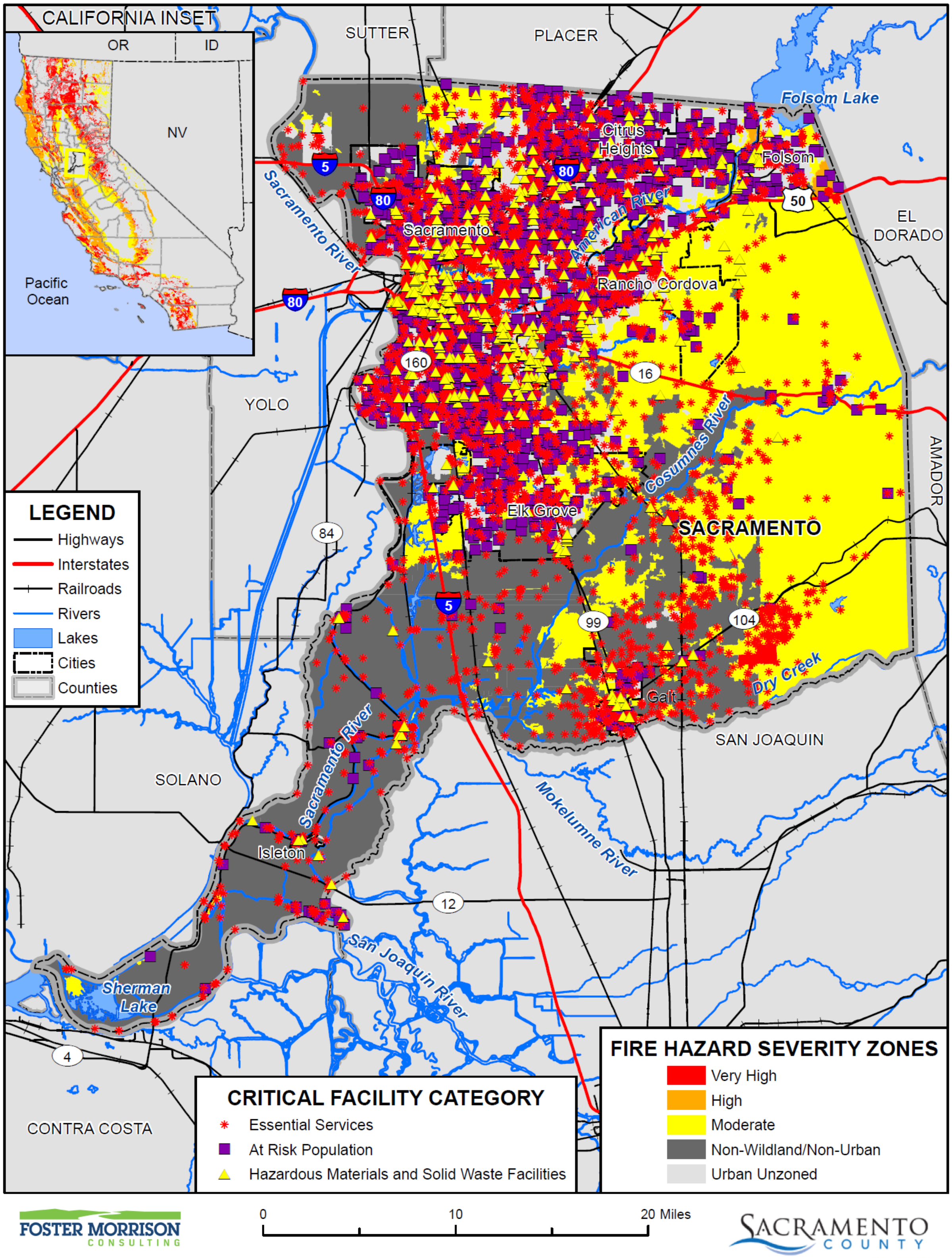
Jurisdiction	Very High		High		Moderate	
	Improved Residential Parcels	Population at Risk	Improved Residential Parcels	Population at Risk	Improved Residential Parcels	Population at Risk
Citrus Heights	0	0	81	130	15	38
Elk Grove	0	0	1	3	260	832
Folsom	62	163	698	1,836	269	707
Galt	0	0	0	0	75	237
Isleton	0	0	0	0	0	0
Rancho Cordova	0	0	1	2	254	544
City of Sacramento	0	0	65	173	335	891
Unincorporated Sacramento County	16	44	635	1,753	1,462	4,035
Total	**78**	**207**	**1481**	**3,897**	**2,670**	**7,284**

Source: CAL FIRE, US Census Bureau Average Household Sizes: Citrus Heights (2.54); Sacramento City (2.66); Elk Grove (3.20); Folsom (2.63), Galt (3.16); Isleton (2.7), Rancho Cordova (2.14): and unincorporated Sacramento County (2.76)

Critical Facilities at Risk

A separate analysis was performed on the critical facility inventory in Sacramento County to determine critical facilities in both the FHSZs and Fire Threat Zones. Using GIS, the CAL FIRE, FHSZ and Fire Threat Zones were overlayed on the critical facility GIS layer. Figure 4-118 shows critical facilities, as well as the FHSZs. Table 4-113 details critical facilities by facility type and count for the Sacramento County Planning Area, while Table 4-114 details the critical facilities by facility type and count for unincorporated Sacramento County. Details of critical facility definition, type, name and address by FHSZ are listed in Appendix F.

Figure 4-118 Sacramento County– Critical Facilities in FHSZs



Data Source: Cal-Fire 2017 (Draft 9/2007 - c34fhszl06_1, Adopted 11/2007 - fhsz06_3_34, Recommended 10/2008 - c34fhszl06_3), Sacramento County GIS, Cal-Atlas; Map Date: 08/2021.

Table 4-113 Sacramento County Planning Area– Critical Facilities in FHSZs

FHSZ/Critical Facility Class	Facility Count
Very High	
Essential Services Facilities	24
At Risk Population Facilities	0
Hazardous Materials and Solid Waste Facilities	0
Total	**24**
High	
Essential Services Facilities	31
At Risk Population Facilities	4
Hazardous Materials and Solid Waste Facilities	0
Total	**35**
Moderate	
Essential Services Facilities	932
At Risk Population Facilities	100
Hazardous Materials and Solid Waste Facilities	37
Total	**1,069**
Urban Unzoned	
Essential Services Facilities	2,928
At Risk Population Facilities	2,195
Hazardous Materials and Solid Waste Facilities	447
Total	**5,570**
Non-Wildland/Non-Urban	
Essential Services Facilities	**812**
At Risk Population Facilities	**958**
Hazardous Materials and Solid Waste Facilities	**16**
Total	**1,789**
Grand Total	**7,585**

Source: Sacramento County GIS, CAL FIRE

Table 4-114 Unincorporated Sacramento County– Critical Facilities in FHSZs

Fire Hazard Severity Zone/Critical Facility Category	Critical Facility Type	Facility Count
Very High		
Essential Services Facilities	Microwave Service Towers	20
	Water Well	4
	Total	**24**

Fire Hazard Severity Zone/Critical Facility Category	Critical Facility Type	Facility Count
Very High Total		**24**
Moderate		
Essential Services Facilities	Bridge	3
	Cellular Tower	11
	Emergency Evacuation Center	4
	EMS Stations	10
	FDIC Insured Banks	1
	Fire Station	12
	Law Enforcement	3
	Microwave Service Towers	340
	Power Plants	9
	Pump Station	1
	Sewage Treatment Plant	3
	Water Well	320
	Total	**717**
At Risk Population Facilities	Colleges, Universities, and Professional Schools	1
	Day Care Center	6
	Mobile Home Parks	1
	Places of Worship	20
	School	30
	Total	**58**
Hazardous Materials and Solid Waste Facilities	EPA ER TRI Facility	2
	EPA ER TSCA Facility	1
	Leaky Underground Storage Tank	10
	Solid Waste Facility	8
	Total	**21**
Moderate Total		**796**
Non-Wildland/Non-Urban		
Essential Services Facilities	Bridge	38
	Cellular Tower	7
	Emergency Evacuation Center	1
	EMS Stations	2
	Fire Station	2
	Law Enforcement	1
	Microwave Service Towers	329
	Port Facilities	46

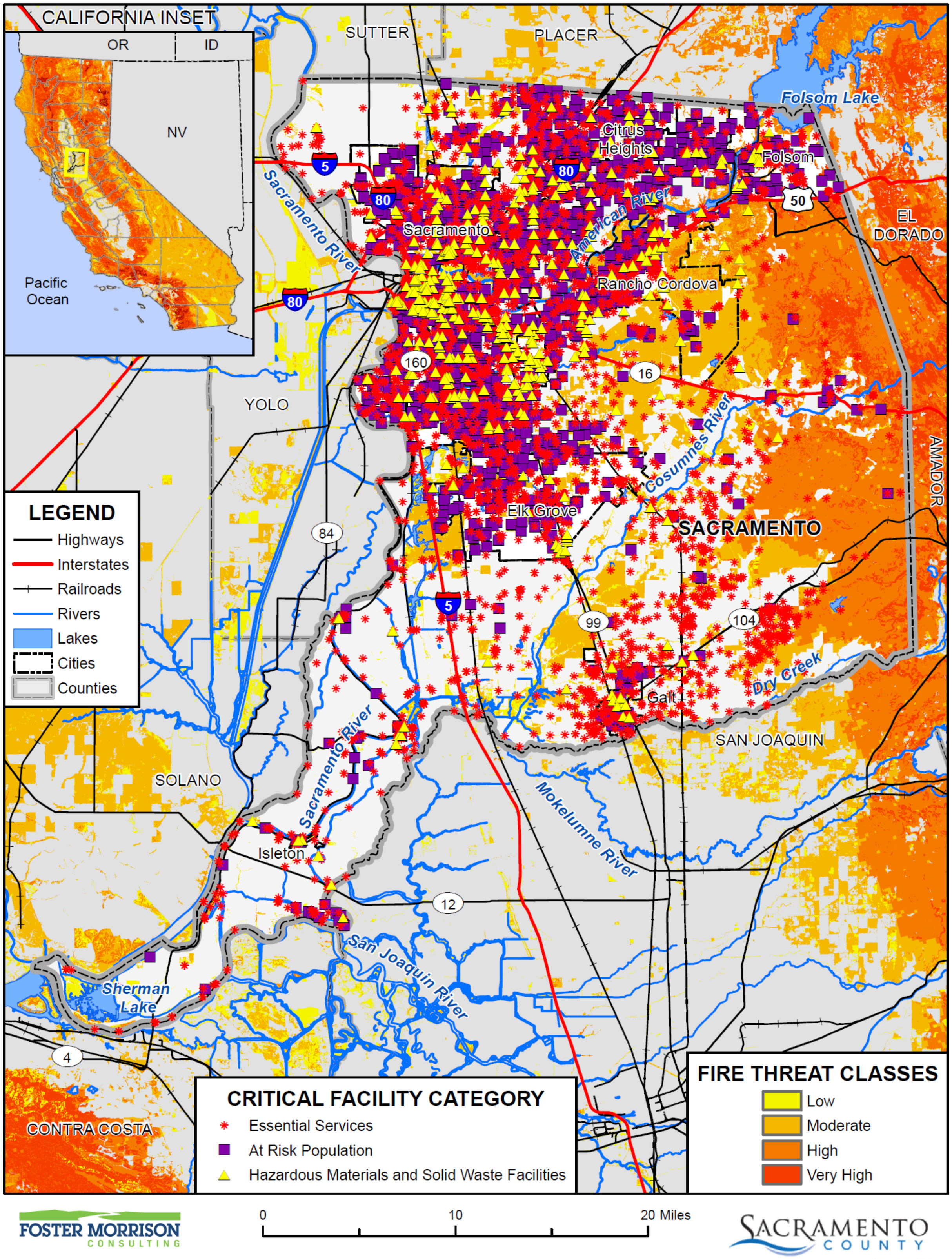
Fire Hazard Severity Zone/Critical Facility Category	Critical Facility Type	Facility Count
	Power Plants	22
	Water Well	303
	Total	**751**
At Risk Population Facilities	Day Care Center	1
	Mobile Home Parks	13
	Places of Worship	8
	School	12
	Total	**34**
Hazardous Materials and Solid Waste Facilities	Leaky Underground Storage Tank	5
	Solid Waste Facility	8
	Total	**13**
Non-Wildland/Non-Urban Total		**798**
Urban Unzoned		
Essential Services Facilities	Airport	3
	Bridge	10
	Cellular Tower	5
	Emergency Evacuation Center	49
	EMS Stations	37
	FDIC Insured Banks	57
	Fire Station	43
	Hospital or Urgent Care	4
	Law Enforcement	22
	Microwave Service Towers	329
	Power Plants	9
	Public Transit Stations	7
	Pump Station	6
	Sandbag Site	3
	Sewage Treatment Plant	1
	State Government Buildings	3
	Water Well	472
	Total	**1,060**
At Risk Population Facilities	Colleges, Universities, and Professional Schools	11
	Community Center	4
	Day Care Center	133
	Mobile Home Parks	51
	Places of Worship	386

Fire Hazard Severity Zone/Critical Facility Category	Critical Facility Type	Facility Count
	School	275
	Total	**860**
Hazardous Materials and Solid Waste Facilities Total	EPA ER FRP Facility	2
	EPA ER TRI Facility	21
	Leaky Underground Storage Tank	112
	Solid Waste Facility	6
	Waste Transfer Station	1
		142
Urban Unzoned Total		**2,062**
Unincorporated Sacramento County Total		**3,680**

Source: Sacramento County GIS, CAL FIRE

Figure 4-119 shows critical facilities, as well as the Fire Threat Zones in the County. Table 4-115 details critical facilities by facility type and count for the Fire Threat Zones in the Sacramento County Planning Area, while Table 4-116 details the critical facilities by facility type and count for unincorporated Sacramento County. Details of critical facility definition, type, name and address by Fire Threat Zone are listed in Appendix F

Figure 4-119 Sacramento County– Critical Facilities in Fire Threat Zones



Data Source: Cal-Fire 2017 Fire Threat Data (fthrt14_2), Sacramento County GIS, Cal-Atlas; Map Date: 08/2021.

Table 4-115 Sacramento County Planning Area– Critical Facilities in Fire Threat Zones

Fire Threat Area/Critical Facility Class	Facility Count
Very High	
Essential Services Facilities	6
At Risk Population Facilities	0
Hazardous Materials and Solid Waste Facilities	0
Total	**6**
High	
Essential Services Facilities	92
At Risk Population Facilities	6
Hazardous Materials and Solid Waste Facilities	4
Total	**102**
Moderate	
Essential Services Facilities	197
At Risk Population Facilities	6
Hazardous Materials and Solid Waste Facilities	13
Total	**216**
Essential Services Facilities	158
At Risk Population Facilities	7
Hazardous Materials and Solid Waste Facilities	15
Total	**180**
No Threat	
Essential Services Facilities	4,347
At Risk Population Facilities	2,339
Hazardous Materials and Solid Waste Facilities	480
Total	**7,166**
Grand Total	**7,585**

Source: Sacramento County GIS, CAL FIRE

Table 4-116 Unincorporated Sacramento County– Critical Facilities in Fire Threat Zones

Jurisdiction / Fire Threat/ Critical Facility Category	Critical Facility Type	Facility Count
High		
Essential Services Facilities	Cellular Tower	4
	Microwave Service Towers	42
	Power Plants	2

Jurisdiction / Fire Threat/ Critical Facility Category	Critical Facility Type	Facility Count
	Water Well	34
	Total	**82**
At Risk Population Facilities	Day Care Center	1
	Mobile Home Parks	1
	Places of Worship	1
	School	3
	Total	**6**
Hazardous Materials and Solid Waste Facilities	EPA ER TRI Facility	1
	EPA ER TSCA Facility	1
	Solid Waste Facility	2
	Total	**4**
High Total		**92**
Low		
Essential Services Facilities	Bridge	7
	Cellular Tower	2
	Emergency Evacuation Center	1
	Microwave Service Towers	18
	Sewage Treatment Plant	1
	Water Well	27
	Total	**56**
At Risk Population Facilities	Mobile Home Parks	3
	Places of Worship	3
	Total	**6**
Hazardous Materials and Solid Waste Facilities	Leaky Underground Storage Tank	1
	Solid Waste Facility	1
	Total	**2**
Low Total		**64**
Moderate		
Essential Services Facilities	Bridge	2
	EMS Stations	1
	Fire Station	1
	Microwave Service Towers	37
	Power Plants	2
	Sewage Treatment Plant	1
	Water Well	101
	Total	**145**
At Risk Population Facilities	School	3

Jurisdiction / Fire Threat/ Critical Facility Category	Critical Facility Type	Facility Count
	Total	**3**
Hazardous Materials and Solid Waste Facilities	EPA ER TRI Facility	1
	Leaky Underground Storage Tank	2
	Solid Waste Facility	5
	Total	**8**
Moderate Total		**156**
No Threat		
Essential Services Facilities	Airport	3
	Bridge	42
	Cellular Tower	17
	Emergency Evacuation Center	53
	EMS Stations	48
	FDIC Insured Banks	58
	Fire Station	56
	Hospital or Urgent Care	4
	Law Enforcement	26
	Microwave Service Towers	921
	Port Facilities	46
	Power Plants	36
	Public Transit Stations	7
	Pump Station	7
	Sandbag Site	3
	Sewage Treatment Plant	2
	State Government Buildings	3
	Water Well	933
	Total	**2,265**
At Risk Population Facilities	Colleges, Universities, and Professional Schools	12
	Community Center	4
	Day Care Center	139
	Mobile Home Parks	61
	Places of Worship	410
	School	311
	Total	**937**
Hazardous Materials and Solid Waste Facilities	EPA ER FRP Facility	2
	EPA ER TRI Facility	21
	Leaky Underground Storage Tank	124

Jurisdiction / Fire Threat/ Critical Facility Category	Critical Facility Type	Facility Count
	Solid Waste Facility	14
	Waste Transfer Station	1
	Total	**162**
No Threat Total		**3,364**
Very High		
Essential Services Facilities	Water Well	4
	Total	**4**
Very High Total		**4**
Unincorporated Sacramento County Total		**3,680**

Source: Sacramento County GIS, CAL FIRE

Overall Community Impact

The overall impact to the community from a severe wildfire includes:

- Injury and loss of life;
- Commercial and residential structural and property damage;
- Decreased water quality in area watersheds;
- Increase in post-fire hazards such as flooding, sedimentation, and debris flows/mudslides;
- Damage to natural resource habitats and other resources, such as crops, timber and rangelands;
- 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.

Future Development

Population growth and development in Sacramento County is on the rise. Additional growth and development within the WUI or high fire risk areas of the County would place additional assets at risk to wildfire. County building codes are in effect to reduce this risk.

GIS Analysis

Sacramento County's 2020 Parcel/Assessor's data and data from the County planning department were used as the basis for the unincorporated County's inventory of parcels and acres of future development areas. Using the GIS parcel spatial file and the APNs, the seven future development projects were mapped. For the wildfire analysis of future development areas, the parcel data was converted to a point layer using a centroid conversion process, in which each parcel was identified by a central point and linked to the

Assessor's data. Utilizing the future development project spatial layer, the parcel centroid data was intersected to determine the parcel counts and acreage within each FHSZ. FHSZs and future development areas are shown on Figure 4-120 and parcels and acreages in those areas are shown in Table 4-117. Fire threat areas and future development areas are shown on Figure 4-121 and parcels and acreages in those areas are shown in Table 4-118.

Figure 4-120 Unincorporated Sacramento County – Future Development in FHSZs

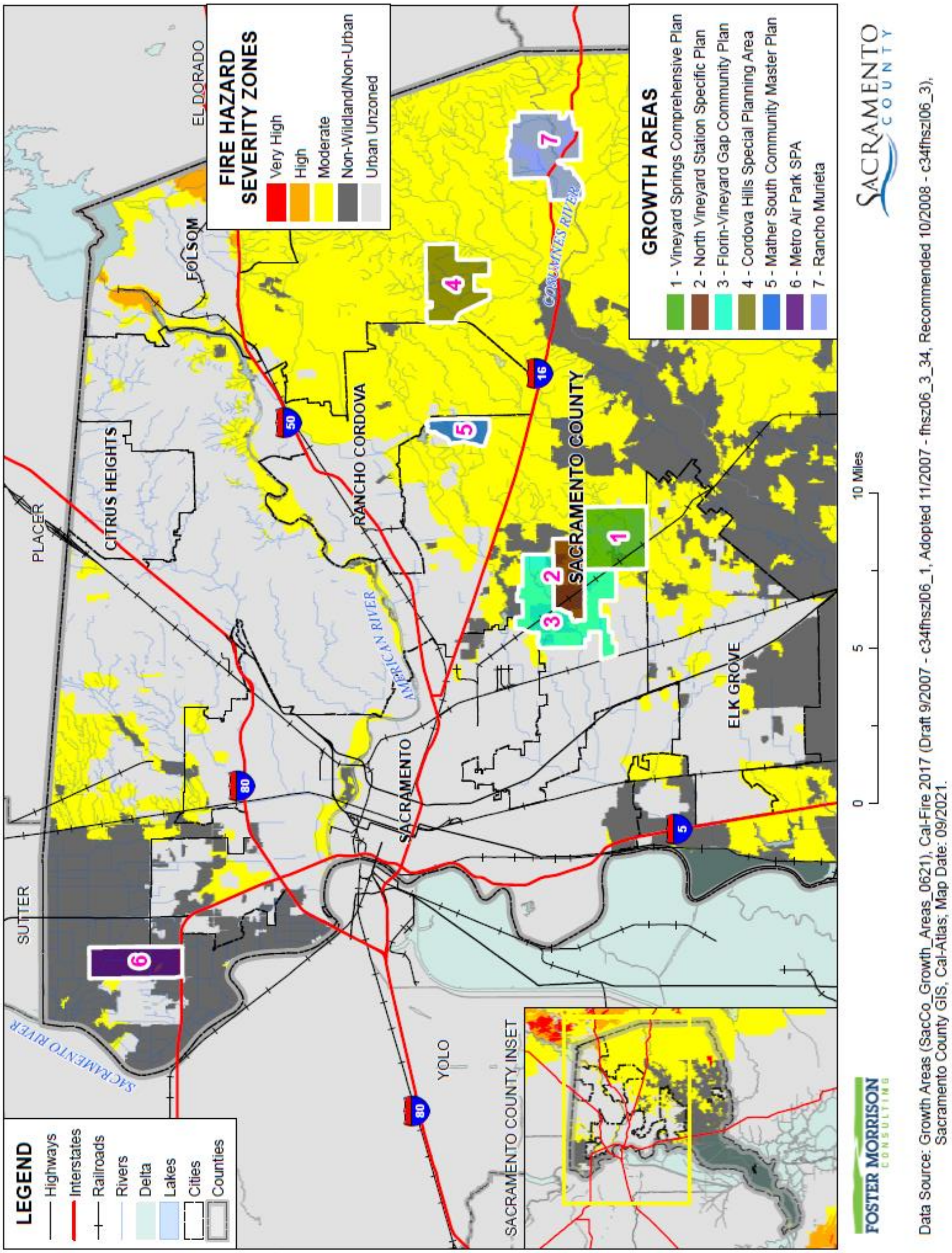


Table 4-117 Unincorporated Sacramento County – Future Development in FHSZs

Fire Hazard Severity Zone/ Future Development Area	Total Parcel Count	Improved Parcel Count	Total Acres
Moderate			
Cordova Hills Special Planning Area	14	0	2,406
Florin-Vineyard Gap Community Plan	774	610	2,580
Mather South Community Master Plan	4	0	1,007
Metro Air Park SPA	2	0	27
North Vineyard Station Specific Plan	395	305	896
Rancho Murieta	1,445	1,171	2,627
Vineyard Springs Comprehensive Plan	927	833	1,380
Moderate Total	**3,561**	**2,919**	**10,923**
Non-Wildland/Non-Urban			
Florin-Vineyard Gap Community Plan	103	68	782
Metro Air Park SPA	70	4	1,780
North Vineyard Station Specific Plan	1,455	1,161	601
Vineyard Springs Comprehensive Plan	149	140	120
Non-Wildland/Non-Urban Total	**1,777**	**1,373**	**3,284**
Urban Unzoned			
Florin-Vineyard Gap Community Plan	159	143	338
Metro Air Park SPA	2		1
Rancho Murieta	1,498	1,421	596
Vineyard Springs Comprehensive Plan	1,708	1,618	853
Urban Unzoned Total	**3,367**	**3,182**	**1,788**
Grand Total	**8,705**	**7,474**	**15,994**

Source: Sacramento County, CAL FIRE

Figure 4-121 Unincorporated Sacramento County – Future Development in Fire Threat Areas

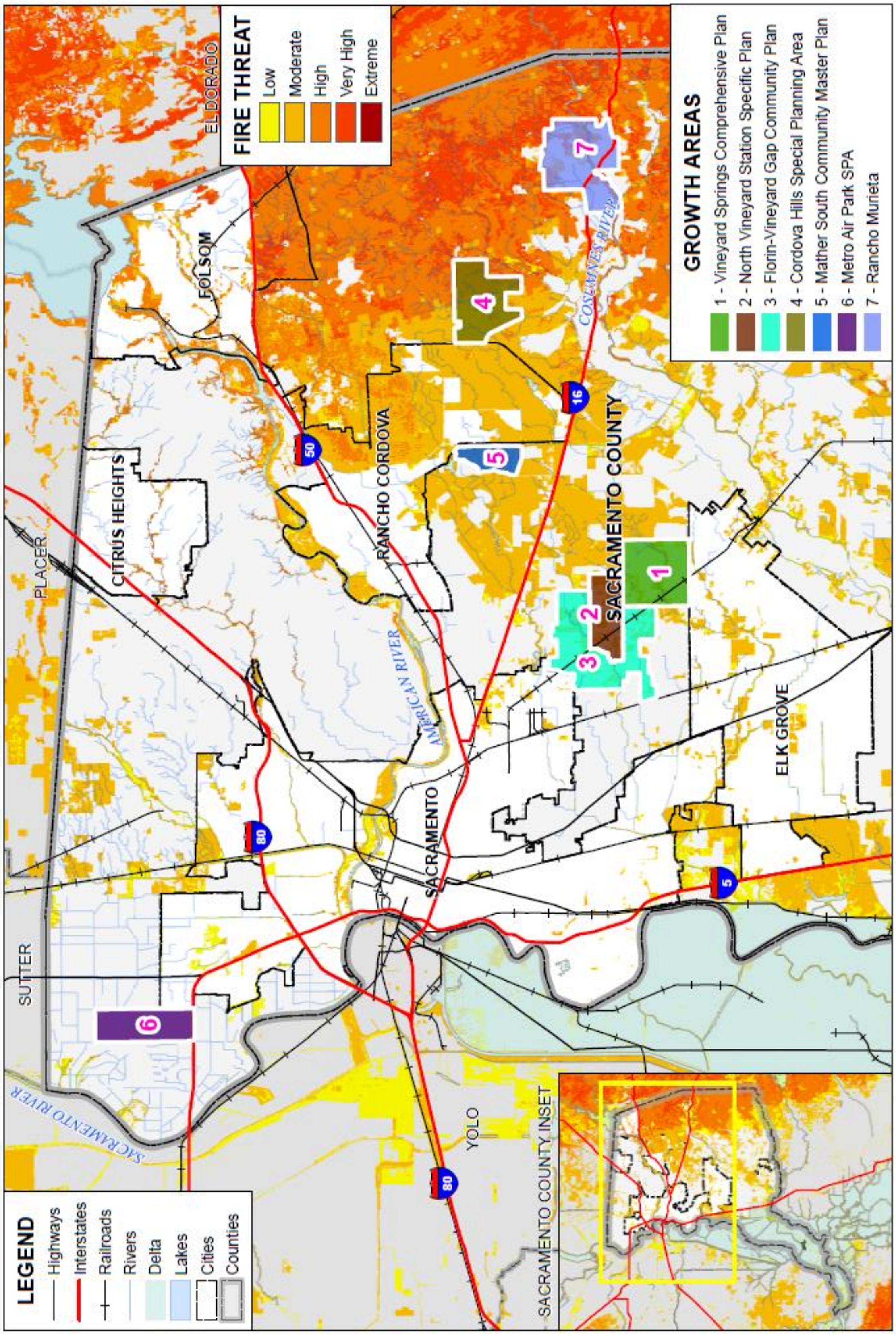


Table 4-118 Unincorporated Sacramento County – Future Development in Fire Threat Areas

Fire Threat/Future Development Area	Total Parcel Count	Improved Parcel Count	Total Acres
Very High			
Rancho Murieta	21	15	157
Very High Total	**21**	**15**	**157**
High			
Cordova Hills Special Planning Area	7	0	1,299
Rancho Murieta	215	152	897
High Total	**222**	**152**	**2,196**
Moderate			
Cordova Hills Special Planning Area	7	0	1,107
Florin-Vineyard Gap Community Plan	112	53	945
Mather South Community Master Plan	4	0	1,007
North Vineyard Station Specific Plan	357	239	818
Rancho Murieta	113	109	225
Vineyard Springs Comprehensive Plan	183	154	505
Moderate Total	**776**	**555**	**4,607**
Low			
Florin-Vineyard Gap Community Plan	10	7	28
North Vineyard Station Specific Plan	44	26	41
Rancho Murieta	32	28	13
Vineyard Springs Comprehensive Plan	17	16	36
Low Total	**103**	**77**	**118**
No Threat			
Florin-Vineyard Gap Community Plan	914	761	2,726
Metro Air Park SPA	74	4	1,807
North Vineyard Station Specific Plan	1,449	1,201	638
Rancho Murieta	2,562	2,288	1,932
Vineyard Springs Comprehensive Plan	2,584	2,421	1,813
No Threat Total	**7,583**	**6,675**	**8,917**
Grand Total	**8,705**	**7,474**	**15,994**

Source: Sacramento County, CAL FIRE

4.3.19. Natural Hazards Summary

Table 4-119 summarizes the results of the hazard identification, hazard profile, and vulnerability assessment for the Sacramento County Planning Area based on hazards data and input from the HMPC. For each hazard profiled in Section 4.3, this table includes the likelihood of future occurrence and whether the hazard is considered a priority hazard for mitigation actions (as discussed in Chapter 5 of this Plan Update) in the Sacramento County Planning Area.

Priority Hazards

As detailed in the hazard identification section, those hazards identified as a high or medium significance in Table 4-3 are considered priority hazards for mitigation planning. Those hazards identified as a high or medium significance are considered priority hazards for mitigation planning. Those hazards that occur infrequently or have little or no impact on the Planning Area were determined to be of low significance and not considered a priority hazard. Significance was determined based on the hazard profile, focusing on key criteria such as frequency, extent, and resulting damage, including deaths/injuries and property, crop, and economic damage. The ability of a community to reduce losses through implementation of existing and new mitigation measures was also considered as to the significance of a hazard. This assessment was used by the HMPC to prioritize those hazards of greatest significance to the Sacramento County Planning Area, enabling the County to focus resources where they are most needed.

Table 4-119 Hazard Identification/Profile Summary and Determination of Priority Hazards

Hazard	Likelihood of Future Occurrence	Priority Hazard
Climate Change	Likely	Y
Dam Failure	Occasional	Y
Drought & Water Shortage	Likely	Y
Earthquake	Occasional	Y
Earthquake Liquefaction	Occasional	Y
Floods: 1%/0.2% annual chance	Likely	Y
Floods: Localized Stormwater	Highly Likely	Y
Landslides, Mudslides, and Debris Flow	Occasional	N
Levee Failure	Occasional	Y
Pandemic	Likely	Y
Severe Weather: Extreme Cold and Freeze	Highly Likely	Y
Severe Weather: Extreme Heat	Highly Likely	Y
Severe Weather: Heavy Rains and Storms	Highly Likely	Y
Severe Weather: Wind and Tornado	Highly Likely	Y
Subsidence	Highly Likely	Y
Volcano	Unlikely	N
Wildfire	Highly Likely	Y

4.4 Capability Assessment

Thus far, the planning process has identified the natural hazards posing a threat to the Sacramento County Planning Area and described, in general, the vulnerability of the County to these risks. The next step is to assess what loss prevention mechanisms are already in place. 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 LHMP Update.

A two-step approach was used to conduct this assessment for the County. First, an inventory of common mitigation activities was made through the use of matrixes. 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, an inventory and review of existing policies, regulations, plans, and programs was conducted to determine if they contributed to reducing hazard-related losses or if they inadvertently contributed to increasing such losses.

This section presents the County's mitigation capabilities that are applicable to the County. These are in addition to, and supplement, the many plans, reports, and technical information reviewed and used for this LHMP Update as identified in Chapter 3 and in Chapter 4.

Similar to the HMPC's effort to describe hazards, risks, and vulnerability of the County, this mitigation capability assessment describes the County's existing capabilities, programs, and policies currently in use to reduce hazard impacts or that could be used to implement hazard mitigation activities. This assessment is divided into four sections: regulatory mitigation capabilities are discussed in Section 4.4.1; administrative and technical mitigation capabilities are discussed in Section 4.4.2; fiscal mitigation capabilities are discussed in Section 4.4.3; mitigation education, outreach, and partnerships are discussed in Section 4.4.4, and other mitigation efforts are discussed in Section 4.4.5.

4.4.1. Sacramento County's Regulatory Mitigation Capabilities

Table 4-120 lists planning and land management tools typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in Sacramento County. Excerpts from applicable policies, regulations, and plans and program descriptions follow to provide more detail on existing mitigation capabilities.

Table 4-120 Sacramento County Regulatory Mitigation Capabilities

Plans	Y/N Year	Does the plan/program address hazards? Does the plan identify projects to include in the mitigation strategy? Can the plan be used to implement mitigation actions?
General Plan	Y 2017	Plan addresses hazards and identifies projects and mitigation actions for them. See the discussion below this table.

Capital Improvements Plan	Y	The County has a Five-Year Capital Improvement Plan (CIP) that is prepared by the County Executive's Office. It is updated annually. New projects added to the CIP are examined for consistency with the General Plan including the LHMP which will be adopted by reference into the Safety Element. The projects contained within the CIP are dependent upon the individual departments. Water Resources has a storm drain system capital improvement plan
Economic Development Plan	Y	The Planning and Environmental Review Division maintains the General Plan which has an Economic Development Element, but many of the items identified within the Element are the responsibility of the Office of Economic Development & Marketing. The Element does not address hazards.
Local Emergency Operations Plan	Y 2017	County Emergency Operations. This plan contains numerous annexes for hazards, support and function.
Operational Area Plan	Y 2019	
Continuity of Operations Plan	Y 2020	Plan addresses natural and man-made hazards.
Transportation Plan	Y	The Planning and Environmental Review Division maintains the General Plan which has Circulation Element (including a Transportation Plan), but many of the items identified within the Element are the responsibility of SACDOT. The Element does not address hazards, but does include a policy to reduce the heat island effect.
Stormwater Management Plan/Program	Y	Hydrology Standards 1996; update in process to consider recent historic storms and climate change Stormwater Guidance Manual
Engineering Studies for Streams	Y	
Community Wildfire Protection Plan	Y 2014	Sacramento Metropolitan Fire District Community Wildfire Protection Plan
Other special plans (e.g., brownfields redevelopment, disaster recovery, coastal zone management, climate change adaptation)	Y 2011 Y	The Climate Action Plan Strategy and Framework Document was adopted with the General Plan update in 2011. Chapter 2 discusses the County's vulnerability to climate change and identified potential impacts to human, natural and built systems. It also proposed actions to address climate change. In 2017, the County published a vulnerability assessment (https://planning.saccounty.net/PlansandProjectsIn-Progress/Pages/CAP.aspx) as part of the preparation of a Communitywide Climate Action Plan (CAP). A public review draft CAP has been released and adoption is expected in early 2022. The CAP includes an adaptation plan. This LHMP will be the 4th multi-jurisdictional LHMP developed by Sacramento County as the lead, since 2005.
Building Code, Permitting, and Inspections	**Y/N**	**Are codes adequately enforced?**
Building Code	Y	Version/Year: 2019 CBC
Building Code Effectiveness Grading Schedule (BCEGS) Score	Y	Score: 3/3

Fire department ISO rating:	Y	Rating: 2/9 Class 2 applies to all risks that are both: I) within 5 road miles of a recognized fire station AND II) within 1000 feet of a recognized fire hydrant. Class 9 would apply to those risks that are: I) within 5 road miles of a recognized fire station, but without a fire hydrant within 1000 feet.
Site plan review requirements	Y	The County operates a public counter for review of all development applications. DWR drainage division staff evaluates new development proposals for compliance with County standards, drainage ordinances, and floodplain development policies and provide flood zone information.
Land Use Planning and Ordinances		
Zoning ordinance	Y	Generally, the zoning ordinance separates hazardous land uses from sensitive land uses and addresses risks e.g. flood, erosion and traffic. The zoning ordinance contains a Flood (F) Combining Zoning District and Tributary Standards, and Natural Streams (NS) Combining Zoning District to reduce the impacts of flood hazards. Additionally, the ordinance contains a Parkway Corridor (PC) Combining Zoning District to ensure that bluff development does not create erosion or geologic instability.
Subdivision ordinance	Y	County Code Title 22 Land Development is the County's subdivision ordinance. The ordinance does not address hazards.
Floodplain ordinance	Y	Minor revisions in 2010 and 2014, major in 2007 reviewed by FEMA Region 9. Additional revisions were completed in 2017. The floodplain ordinance can be found at www.stormready.org.
Natural hazard specific ordinance (stormwater, steep slope, wildfire)	Y	Improvement Standards
Flood insurance rate maps	Y	County maintains a library of past and current FIRMS.
Elevation Certificates	Y	Comprehensive record of elevation certificates
Acquisition of land for open space and public recreation uses	Y	Land acquisition is on-gong for purposes of flood control, species conservation, open space preservation and recreation.
Erosion or sediment control program	Y	County Improvement Standards, 2010
Other	Y Y Y	Evacuation Plan, The South Sacramento Habitat Conservation Plan is a regional approach to addressing issues related to urban development, habitat conservation and agricultural protection. Regional Watershed Management plan recently updated and appended to this LHMP.
How can these capabilities be expanded and improved to reduce risk?		
Complete the CAP, begin new General Plan Update which integrates a Carbon Neutral CAP for 2030 and beyond. Other areas identified for improvement include: Keeping the County GIS layers updated; keeping the Ordinances and Codes updated; Conduct cross-training between County Departments related to hazard mitigation; Encourage others to become certified floodplain managers – a certificate from the Association of State Floodplain Managers.		

As indicated in the tables above, Sacramento County has several plans and programs that guide the County's mitigation of development of hazard-prone areas. Starting with the Sacramento 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.

Sacramento County General Plan (2011 – many sections amended in 2017)

A general plan is a legal document, required by state law, that serves as a community's "constitution" for land use and development. The plan must be a comprehensive, long-term document, detailing proposals for the "physical development of the county or city, and of any land outside its boundaries which in the planning agency's judgment bears relation to its planning" (Government Code §65300 et seq.). Time horizons vary, but the typical general plan looks 10 to 20 years into the future. The law specifically requires that the general plan address seven topics or "elements." These are land use, circulation (transportation), housing, conservation, open space, noise, and safety. The plan must analyze issues of importance to the community, set forth policies in text and diagrams for conservation and development, and outline specific programs for implementing these policies.

Goals and policies related to mitigation from the General Plan include the following:

Conservation Element

The County recognizes the need for effective conservation practices which allow for the maintenance and preservation of its natural environment and efficient use of its resources. The State mandates that the County's General Plan include a Conservation Element which will enable the County to analyze its resources and determine policies for their use and conservation. State law requires that the element address the management and protection of specific resources:

- The Water Resources section addresses the County's objectives with respect to the use of ground, surface, and recycled water for residential, commercial, industrial, agricultural, and recreational purposes. The section assesses how and from where the County intends to secure its future water supply and provides guidelines for the County's policies on water quality, ground and surface water use, and water conservation.
- The Mineral Resources section delineates the County's policies on the protection of mineral resources for economic extraction while providing guidelines on how, when, and where mineral resources can be extracted to avert adverse impacts on the environment.
- The Materials Recycling section specifies the County's plan of reducing the amount of solid waste that is produced. It includes policies and programs which will encourage participation in the recycling of materials and supports a sustainable market for recycled materials.
- The Soil Resources section discusses the management and protection of county soils for purposes of maintaining its resource value and agricultural potential. The section deliberates on the County's future plans in dealing with the loss of agriculturally productive soils and discusses policies and programs which will encourage the utilization of effective soil conservation practices.
- The Vegetation and Wildlife section consist of four main subsections, each of which discusses the preservation and management of biotic resources. The Habitat Protection and Management subsection includes many overarching policies that address habitat mitigation; habitat preserves and management; and habitat protection and project review. The Special Status Species and their Respective Habitats

subsection includes policies and measures to protect and manage habitats for the protection of special status species. Aquatic Resources, the third subsection, covers the protection of vernal pools, rivers and streams and fisheries. Lastly, the Terrestrial Resources subsection addresses the protection and preservation of native vegetation, landmark and heritage trees and the urban forest while also promoting new trees in the urban landscape.

- The Cultural Resources section discusses County objectives with respect to the protection and preservation of important cultural resources and plans for increasing public awareness and appreciation of them.

Water Resources

GOAL:	**Ensure that a safe, reliable water supply is available for existing and planned urban development and agriculture while protecting beneficial uses of Waters of the state of California, including important associated environmental resources.**
Objective:	Optimize the use of available surface water in all types of water years (wet/normal, dry and driest);
Objective:	Manage groundwater to preserve sustainable yield.
Objective:	Ensure the most efficient use of water in urban and agricultural areas.
Objective:	Manage water supply to protect valuable water-supported ecosystems.
Objective:	Manage the quality and quantity of urban runoff to protects the beneficial uses of surface water and groundwater.
Objective:	Manage municipal and industrial (M&I) water supplies efficiently to serve existing and proposed development within the Urban Policy Area.

Soil Resources

GOAL:	**Preserve and protect long-term health and resource value of agricultural soils.**
Objective:	Agriculturally productive Delta soils protected from the effects of oxidation, shrinkage, and erosion.
Objective:	Mining of topsoil to have minimal effect on soil productivity.

Aquatic Resource

Aquatic resources in Sacramento County include vernal pools, wetlands, rivers, streams, creeks, riparian habitat, in-channel habitat, fisheries and their macroinvertebrate food sources. Protection of these resources from impacts related to development is critical due to their importance to wildlife habitat, water purification, scenic values, and unique and sensitive plant life. Many preservation efforts are currently underway to protect and restore aquatic resources and include the South Sacramento Habitat Conservation Plan, the American River Parkway Plan, the Dry Creek Master Plan, the Sacramento River Floodway Corridor Planning Forum, the Cosumnes River Preserve and the Upper Laguna Creek Collaborative. However, as the County continues to see growth and development, expanded and new preservation measures must be achieved to ensure the health and integrity of these valuable resources. The following goals are ou

GOAL:	Preserve, protect, and enhance natural open space functions of riparian, stream and river corridors.
Objective:	Manage riparian corridors to protect natural, recreational, economic, agricultural and cultural resources as well as water quality, supply and conveyance.
Objective:	Maintain the natural character of the 100-year floodplain by limiting fill and excavation.
Objective	Maintain levee protection, riparian vegetation, function and topographic diversity by stream channel and bank stabilization projects. AND Stabilize riverbanks to protect levees, water conveyance and riparian functions.
Objective	Conserve and protect the Sacramento, Cosumnes, Mokelumne and American Rivers to preserve natural habitat and recreational opportunities.
Objective	Protect and restore natural stream functions.
Objective	Land uses within and development adjacent to stream corridors are to be consistent with natural values.
Objective	Properly manage and fund the maintenance of rivers and streams to protect and enhance natural functions.
Objective	Restore concrete sections of rivers and streams to increase natural functions.

Delta Protection Element

Recognizing the threats to the Primary Zone of the Delta from potential urban and suburban encroachment and the need to protect the area for agriculture, wildlife habitat, and recreation uses, the California Legislature passed and the Governor signed into law on September 23, 1992, the Delta Protection Act of 1992 (SB 1866). The Act directs the Delta Protection Commission to prepare a comprehensive resource management plan for land uses within the Primary Zone of the Delta (Plan).

The planning conducted by the Delta Protection Commission involved preparation and public review of nine background reports: Environment; Utilities and Infrastructure; Land Use and Development; Water; Levees; Agriculture; Recreation and Access; Marine Patrol, Boater Education, and Safety Programs; and Implementation. These reports provided the information base for the Plan findings and policies, as well as allowing opportunities for public review and comment through circulation and public hearings before the Commission.

Land Use

- Goal: Protect the unique character and qualities of the Primary Zone by preserving the cultural heritage and strong agricultural base of the Primary Zone. Direct new residential, commercial, and industrial development within the existing communities as currently designated and where appropriate services are available.

Agriculture

- Goal: To support long-term viability of commercial agriculture and to discourage inappropriate development of agricultural lands.

Natural Resources

- Goal: Preserve and protect the natural resources of the Delta, including soils. Promote protection of remnants of riparian habitat. Encourage compatibility between agricultural practices and wildlife habitat.

Recreation and Access

- Goal: To promote continued recreational use of the land and waters of the Delta; to ensure that needed facilities that allow such uses are constructed, maintained, and supervised; to protect landowners from unauthorized recreational uses on private lands; and to maximize dwindling public funds for recreation by promoting public-private partnerships and multiple use of Delta lands.

Water

- Goal: Protect long-term water quality in the Delta for agriculture, municipal, industrial, water-contact recreation, and fish and wildlife habitat uses, as well as all other designated beneficial uses.

Levees

- Goal: Support the improvement, emergency repair, and long-term maintenance of Delta levees and channels. Promote levee rehabilitation and maintenance to preserve the land areas and channel configurations in the Delta as consistent with the objectives of the Delta Protection Act.

Utilities and Infrastructure

- Goal: Protect the Delta from excessive construction of utilities and infrastructure facilities, including those that support uses and development outside the Delta. Where construction of new utility and infrastructure facilities is appropriate, ensure the impacts of such new construction on the integrity of levees, wildlife, and agriculture are minimized.

Land Use Element

The Land Use Element is the central focus of the General Plan. This Element sets policy for land uses in the unincorporated county for the next 25 years, establishing the foundation for future land use and development. The Land Use Element designates the distribution of land uses, such as residential, commercial, industrial, agricultural, open space, recreation and public uses. It also addresses the permitted density and intensity of the various land use designations as reflected on the County's General Plan Land Use Diagram. The overall goal of the land use element is:

- An orderly pattern of land use that concentrates urban development, enhances community character and identity through the creation and maintenance of neighborhoods, is functionally linked with transit, promotes public health and protects the County's natural, environmental and agricultural resources.

The County's land use strategy is illustrated in four sections. Each section contains objectives and policies that are intended to guide the County toward a more compact urban character by concentrating growth within existing urbanized areas and strategically-located new growth areas, thereby utilizing land resources as efficiently as possible.

Section 1: Logical Progression of Urban Development

GOAL:	Direct new growth to previously urbanized areas, planned growth areas and strategically located new growth areas to promote efficient use of land, to reduce urban sprawl and its impacts, to preserve valuable environmental resources, and to protect agricultural and rangeland operations.
Objective:	Reserve the land supply to amounts that can be systematically provided with urban services and confines the ultimate urban area within limits established by natural resources.
Objective:	Coordinated near- and long-term planning efforts for the development of the greater Jackson Highway area that creates cohesive and complete communities while protecting environmental resources.

Section 2: Growth Accommodation

GOAL:	Accommodate projected population and employment growth in areas where the appropriate level of public infrastructure and services are or will be available during the planning period.
Objective:	On average, achieve buildout of vacant and underutilized infill parcels at existing zoned densities, while recognizing that individual projects may be approved or denied at higher or lower densities based on their community and site suitability.
Objective:	Buildout of planned communities consistent with their approved plans.
Objective:	New retail and employment opportunities in targeted corridors to support community economic health and vitality, and additional residential dwelling units to support these stores and jobs.
Objective:	New communities that feature a mix of housing, jobs and retail development configured in a compact and transit supportive manner, that incorporate mixed use development (both vertical and horizontal), and that protect environmental resources and preserve open space.
Objective:	Historical rate of Agricultural-Residential development accommodated through build-out and limited expansion of existing Agricultural-Residential communities.

Section 3: Growth Management and Design

GOAL:	Land use patterns that maximize the benefits of new and existing development while maintaining the quality, character, and identity of neighborhood and community areas.
Objective:	Urban design that is functional, aesthetically pleasing, and distinctive.
Objective:	New development that maintains and/or enhances community identity while remaining compatible with existing neighborhoods.
Objective:	Neighborhoods with a mix of employment opportunities, commercial amenities, neighborhood services, and a variety of housing types and sizes.
Objective:	Compact, mixed use developments concentrated in nodes around transit stops, in community centers, and along commercial and transportation corridors.
Objective:	New development in existing communities, in new growth areas and improvements to existing buildings and housing stock that are designed and constructed to be energy efficient and incorporate renewable energy technologies where cost-effective and feasible.
Objective:	Reduced levels of light pollution in both new and existing communities.

GOAL:	Land use patterns that maximize the benefits of new and existing development while maintaining the quality, character, and identity of neighborhood and community areas.
Objective:	A community wide pattern of development with the most intensive land uses in close proximity to transit stops.
Objective:	High intensity, mixed use neighborhoods that provide a pedestrian environment and are closely linked to transit.
Objective:	Communities, neighborhoods, and single projects that promote pedestrian circulation and safety through amenities, good design, and a mix of different land uses in close proximity.
Objective:	A sufficient, yet efficient supply of parking.
Objective:	Improved housing affordability for residents earning below median incomes, and a continued supply of affordable housing units.
Objective:	Viable commercial services and a diversity of employment opportunities located in proximity to residents.
Objective:	Efficient build-out of existing Agricultural-Residential areas within the USB to meet rural residential demand without contaminating or overdrafting groundwater aquifers.
Objective:	Coordinate private development with the provision of adequate public facilities and services.
Objective:	Limited urban growth in rural towns consistent with infrastructure capacity, natural constraints, and the economic base.
Objective:	Limited agricultural-residential land use expansion outside the USB that does not compromise objectives for protecting prime agricultural lands and open space, and avoids groundwater overdraft and contamination.
Objective:	Important farmlands protected to ensure the continuation of agricultural production and to preserve open space.

Section 4: Built Environment Preservation and Enhancement

Sacramento County is unique in being a county that has a large percentage of urbanized and built out land under its jurisdiction, along with vast areas of open space, agriculture and rural development. Urban areas, ranging from new peripheral development to older existing communities, serve as the County's economic and employment backbone and are home to the majority of residents living in the unincorporated areas.

GOAL:	Reinvestment in and revitalization of existing communities through comprehensive and coordinated planning strategies and public participation that addresses housing, economic development, commercial development, employment opportunities, public facilities and infrastructure improvements.
Objective:	Revitalized commercial corridors that will enhance community image and stimulate private reinvestment, that support provision of enhanced public transit, and that will encourage new economic and commercial development and improvements to housing and infrastructure.
Objective:	Targeted planning efforts that focus on distinct districts within existing communities.
Objective:	Maximize compact, mixed use development opportunities along transportation corridors.
Objective:	Preserve and enhance the quality and character of the County's unique communities.
Objective:	Decentralized municipal services that will improve services, enhance and localize service delivery, and increase public involvement and authority in the planning process.
Objective:	Create and maintain a diversity of housing within existing communities, varying in terms of type, cost, design, size and tenure.

GOAL:	Reinvestment in and revitalization of existing communities through comprehensive and coordinated planning strategies and public participation that addresses housing, economic development, commercial development, employment opportunities, public facilities and infrastructure improvements.
Objective:	Promote development in established communities that integrates well into the community and minimizes impacts to surrounding neighborhoods.
Objective:	Create and enhance dynamic, identifiable places unique to each community.
Objective:	Enhance the quality of life and economic vitality of each community area through strategic redevelopment, infill development and revitalization.
Objective:	Habitat enhancement, open space protection, and cohesive urban design accomplished by local, state, and federal agency coordination.
Objective:	Zoning consistent with the adopted General Plan Land Use Diagram.
Objective:	Accommodate land use proposals which are in the interest of the public health, safety, and welfare of the residents of Sacramento County.

Open Space Element

The Open Space Element is in many ways a plan for implementing other Elements of the General Plan. For example, maintaining intact habitat, productive soils, and mineral resource availability as open space is essential to resource conservation. Keeping floodplains undeveloped is likewise an important way to implement flood protection goals in the Safety Element. And preserving open space areas within the fabric of urban development can address Land Use Element policies relating to neighborhood identity and land use conflicts. Indeed, the key role that open space plays in synthesizing land use objectives lends it the distinction as the only Element where an action plan is specifically required by state law.

GOAL:	Open space lands in Sacramento permanently protected through coordinated use of regulation, education, acquisition, density transfer and incentive programs.
Objective:	Effective open space preservation strategy that supports the Open Space Vision Diagram.
Objective:	Establishment of trails and greenbelts to provide for recreational opportunities and community separators.
Objective:	Appropriate urban and rural development clustered to provide open space resource protection.

Public Facilities Element

The Water Facilities Section addresses how future water supply facilities might be financed and provided for in an equitable fashion, while minimizing impacts on ground and surface water resources, as well as riverine and wetland environments. These facilities are a vital part of ensuring that enough public water is available to serve both existing residents as well as anticipated growth through 2030. This section describes policies and programs under two objectives:

- Environmentally sensitive and cost efficient placement of water treatment and distribution facilities.
- Timely and equitable financing of new water facilities

Safety Element

The purpose of the Safety Element is to identify and assess the potential for hazards to occur in Sacramento County and to formulate measures that provide adequate public protection. Sacramento County's physical setting and the projected rate of urban expansion create a potential for the residents of the County to be greatly affected by several hazards. Hazards can result from the action of nature, as in the case of earthquakes and floods; they can be man-made, as in the case of fires caused by arson or through carelessness. They can also originate from a combination of both natural and man-made causes, such as dam failure that results from an earthquake. This element examines both natural and man-made hazards, including seismic events, flooding, and fires. Minimizing and preventing these hazards are the focus of this Element.

Seismic and Geologic Hazards

- Goal: Minimize the loss of life, injury, and property damage due to seismic and geological hazards.

Flooding

- Goal: Minimize the loss of life, injury, and property damage due to flood hazards.

Fire Hazards

- Goal: Minimize the loss of life, injury, and property damage due to fire hazards.

Emergency Response

- Goal: An Emergency Preparedness System that can effectively respond in the event of a natural or manmade disaster.

Other Sacramento County Plans/Studies/Programs

Sacramento County Emergency Operations Plan (April 2017)

The purpose of the County of Sacramento EOP and its Functional Annexes is to provide the basis for a coordinated response before, during and after a disaster incident affecting the County of Sacramento.

This plan is the principal guide for the County's response to, and management of real or potential emergencies and disasters occurring within its designated geographic boundaries. Specifically, this plan is intended to:

- Facilitate multi-jurisdictional and interagency coordination in emergency operations, particularly between local government, private sector, operational area (geographic county boundary), and state response levels, and appropriate federal agencies.
- Serve as a county plan, a reference document, and when possible, may be used for pre-emergency planning in addition to emergency operations.
- To be utilized in coordination with applicable local, state and federal contingency plans.

- Identify the components of an Emergency Management Organization (EMO), and establish associated protocols required to effectively respond to, manage and recover from major emergencies and/or disasters.
- Establish the operational concepts and procedures associated with field response to emergencies, and EOC activities.
- Establish the organizational framework of the California Standardized Emergency Management System (SEMS), and the National Incident Management System (NIMS), within the County of Sacramento.

Sacramento Operational Area Alert and Warning Annex (2017)

Emergency communications to the public, commonly known as Alert and Warning continues to change with advancements in technology. Essential to all jurisdictions is an effective alert and warning strategy to support the distribution of information to the public. In an emergency/disaster, the strategies and systems used become critical. The magnitude of a particular emergency situation will determine the degree to which systems are utilized.

The Sacramento Operational Area (OA) contains many jurisdictions such as cities, numerous special districts, state and private agencies which support a number of systems including the unincorporated areas of the county. The various Alert & Warning systems and methods used together during a disaster/emergency can ensure widespread distribution of information to a greater number of residents than could be reached by any one system.

The Sacramento OA Alert and Warning Annex establishes guidelines for use in partnership with the jurisdictions within the Sacramento OA and the surrounding counties. The alert and warning program provides public notification of protective actions to take before, during, and after threats or emergencies and to disseminate other kinds of messages to community members who have opted in to receive such messages.

Sacramento County Drought and Climate Change Hazard Annex (January 2020)

It is the purpose of this annex to:

- Define drought and climate change-related implications for the County, including the interrelationships of associated hazards.
- Identify hazard vulnerability and response issues for high-risk populations, in particular to climate-related events.
- Define target capabilities potentially needed for hazard response.
- Provides action checklists to monitor and respond within the County of Sacramento.
- Provides sample communication message templates.
- Identify key partners and roles within County of Sacramento.

This annex supports the County of Sacramento in preparedness and response to drought and climate hazards and references the interface with community- and faith-based organizations and private sector. This annex specifically addresses drought and other climate-induced hazards in the County of Sacramento, specifically in the following five areas:

- Drought
- Flood, storm and water quality
- Wildfire, smoke and air quality
- Extreme heat
- Public health, agriculture, economic and natural eco-system health

This annex builds upon many key findings detailed in the Sacramento County Climate Action Plan (CAP). It uses using the CAP data as a key foundation and starting point. The Annex builds upon expanded research and conceptual approaches specific to climate change-related threats and hazards for which climate change is considered to be a root cause. This Annex further integrates new data and perspectives supplied through stakeholder contributions, and importantly, builds distinctly new hazard interrelationships and social intersectionality of root-cause climate impacts for crafting response approaches and considerations.

Sacramento County Operational Area Evacuation Annex (2018)

The purpose of this Sacramento Operational Area (OA) Evacuation Annex is to provide strategies and procedures to document the agreed upon strategy for the Operational Area's response to emergencies that involve the evacuation of people from an impacted area. This involves coordination and support for the safe and effective evacuation of the population, including people with disabilities and access and functional needs who may need additional support to evacuate. Focus areas within this evacuation annex include public alert and warning, transportation, and evacuation triggers. Organizations, operational concepts, responsibilities, and a documented process to accomplish an evacuation are defined within this Annex. The Annex outlines local government (Cities and Special Districts), the Sacramento Operational Area, and State responsibilities for the managed movement of people.

This Annex was developed as a functional support document to the Sacramento County Emergency Operations Plan (EOP); and is consistent with the Standardized Emergency Management System (SEMS) and the National Incident Management System (NIMS). It is coordinated with the County Emergency Support Function (ESF) – 13 Law Enforcement and works in conjunction with other functional Annexes. It is also consistent with the State's emergency plans and is applicable to all locations and to all agencies, organizations, and personnel with evacuation and evacuation support function responsibilities.

The Sacramento OA Evacuation Annex applies to mass evacuation preparedness, response, and recovery operations during local emergencies or major disasters and to all Sacramento OA public, private, and nongovernmental organizations (NGOs) with operational responsibilities in a mass evacuation event. The Operational Area is defined as an intermediate level of the state emergency services organization, consisting of a county and all political subdivisions within the county area. Each county geographic area is designated as an operational area as defined in Government Code s8559(b) & s8605.

This document is intended to provide evacuation strategies and protocols for medium to high-level (catastrophic) evacuation events in the OA, and is developed with consideration to predominant threats and hazards impacting Sacramento County. This Annex is intended to support activation of the Sacramento County OA EOC and other county Departmental Operations Centers (DOCs) and can be used by other jurisdictions within the OA, such as the Cities, if warranted. This plan also provides overall operational guidance for public alert and warning, movement of evacuees; it provides a concept of operations and provides the roles of key departments and agencies during an evacuation. It does not provide or replace operational plans for specific departments or specific functions, such as shelter management.

In small-scale evacuations, such as those occurring during local fires, at crimes scenes, or due to a localized hazardous materials spill. This annex assumes that such events will be managed by local first responders in the field Incident Command Post (ICP), typically without an activation of the OA EOC and without an activation of this Annex.

Sacramento County Healthcare Evacuation Coordination Annex (October 2018)

This Healthcare Facility Evacuation Coordination Plan has been developed as an annex to the Sacramento County Evacuation Annex, which is itself an annex to the Sacramento County Emergency Operations Plan. As such, the intended end-user for the Healthcare Facility Evacuation Coordination Plan is County emergency management staff and other departmental officials who have the responsibility to support the evacuation of persons from healthcare facilities (HCFs) located in Sacramento County.

The scope of this plan includes identifying roles and responsibilities of, and strategies for, officials from the Department of Health Services, Division of Public Health (including the Emergency Medical Services), the County Office of Emergency Services, and others who will be coordinating evacuations from the County's Emergency Operations Center (EOC), from various Departmental Operations Centers (DOC), and other potential control points.

Sacramento County Operational Area Power Outage Hazard Annex (July 2020)

The Severe Power Outage Hazard Annex supports the Sacramento County Emergency Operations Plan (EOP). This annex outlines Sacramento County's planned response to a severe power outage (defined as a power outage in all or part of the county of a duration of seven days or longer). It is the intent of this annex to create a framework for preparations and response within existing statutory obligations and limitations. This annex does not apply to normal day-to-day emergencies; rather, it focuses on long-lasting power outages (due to any cause) that can generate unique situations requiring unusual responses.

Since this annex outlines responses to power outages that can be caused by any number of disasters (earthquakes, high winds, cyber-attack, etc.) it is envisioned that 106 this annex will often be implemented alongside an annex dealing with the specific type of disaster that causes the power outage. Therefore, this annex focuses on specific activities and concerns that relate to the lack of electrical power ONLY.

Sacramento County Operational Area Draft 2019 Novel Coronavirus Event (June 2020)

Sacramento County Public Health began tracking the Novel Coronavirus in early January 2020 after the World Health Organization first reported a novel virus strain presenting as pneumonia cases in Wuhan, Hubei Province, China. A WebEOC incident was opened by Sacramento County Office of Emergency Services to ensure shared resources and information.

Following the first travel-related case within Sacramento County on February 21, 2020 the County proclaimed both a Local Public Health Emergency and Local Emergency on March 5, 2020 which was later ratified on March 10, 2020.

This document continues to be updated.

Sacramento County Climate Change and Health Profile Report (2017)

The Climate Change and Health Profile Report seeks to provide a county-level summary of information on current and projected risks from climate change and potential health impacts. This report represents a synthesis of information on climate change and health for California communities based on recently published reports of state agencies and other public data.

The content of this report was guided by a cooperative agreement between CDPH and the CDC Climate-Ready States and Cities Initiative's program Building Resilience Against Climate Effects (BRACE). The goals of BRACE are to assist state health departments to build capacity for climate and health adaptation planning. This includes using the best available climate science to project likely climate impacts, identifying climate-related health risks and populations vulnerable to these impacts, assessing the added burden of disease and injury that climate change may cause, identifying appropriate interventions, planning more resilient communities, and evaluating to improve the planning effort. Communities with economic, environmental, and social disadvantages are likely to bear disproportionate health impacts of climate change.

This Climate Change and Health Profile Report is intended to inform, empower, and nurture collaboration that seeks to protect and enhance the health and well-being of all California residents. This report is part of a suite of tools that is being developed by the California Department of Public Health to support local, regional, and statewide efforts of the public health sector to build healthy, equitable, resilient, and adaptive communities ready to meet the challenges of climate change. Along with a county-level climate change and health vulnerability assessment and state guidance documents, such as Preparing California for Extreme Heat: Guidance and Recommendations, the profile provides a knowledge base for taking informed action to address climate change.

4.4.2. Sacramento County's Administrative/Technical Mitigation Capabilities

Table 4-121 identifies the County personnel responsible for activities related to mitigation and loss prevention in the County.

Table 4-121 Sacramento County Administrative/Technical Mitigation Capabilities

Administration	Y/N	Describe capability Is coordination effective?
Planning Commission	N	
Mitigation Planning Committee	Y	Every five years hazards are reviewed by committee of officials from Countywide departments Planning, Stormwater, Agriculture, Transportation and more. Mitigation is planned and recorded.

Maintenance programs to reduce risk (e.g., tree trimming, clearing drainage systems)	Y	Drainages throughout the County are cleared during routine maintenance, and inspected and cleared immediately before storms. Fire fuel (vegetative litter) is cleared though a grant funded program to prevent wildfires.
Mutual aid agreements	Y	Multiple mutual aid agreements between county and state and local entities.
Other		
Staff	**Y/N FT/PT**	**Is staffing adequate to enforce regulations? Is staff trained on hazards and mitigation? Is coordination between agencies and staff effective?**
Chief Building Official	Y FT	
Floodplain Administrator	Y FT	There are five CFM in DWR and all staff are knowledgeable with the Floodplain Ordinance. Coordination between departments is effective and is ongoing for all permitted uses in the floodplain.
Chief of Emergency Services	Y FT	The Office of Emergency Services shall be headed by the Chief of Emergency Services which position is designated as the Deputy Director of Emergency Services. There are two Emergency Operations Coordinators and one Assistant Emergency Operations Coordinator assigned to the office.
Community Planner	Y FT	The Office of Planning and Environmental Review has multiple planners assigned to maintenance of the General Plan and plan checking. One management level planner is qualified as a Cal OES Type II Planning and Intelligence Chief for work in Emergency Operations Centers and is a member of the Sacramento Regional Incident Management Team.
Civil Engineer	Y FT	County DWR –drainage unit has six staff that are licensed Civil Engineers who are all educated in hazards & mitigation. Staffing is adequate. There are currently five certificed floodplain managers in the County.
GIS Coordinator	Y FT	
Other	Y	Sacramento County is a large County with multiple staff from numerous departments all playing a role, to different degrees, in natural hazard mitigation.
Technical	**Y/N**	**Describe capability Has capability been used to assess/mitigate risk in the past?**
Emergency Alert System: Sacramento-Alert	Y	A tri-county system comprised of Sacramento, Placer and Yolo Counties is available as a subscription based alerting system. Wireless Emergency Alert (WEA) messages may be disseminated with this system. This system is used regularly for alerting, evacuation and other needs. The Office of Emergency Services is the primary Alert Originator for Sacramento County. The County currently uses the Everbridge system.
Hazard data and information	Y	Documented through this LHMP, and the County's EOP and annexes. Also as on file with County OES.

Grant writing	Y FT	
Hazus analysis	N	Hazus runs are not an inhouse capability. The LHMP consultant has used this tool in the LHMP earthquake analysis.
Other	Y	Dam Failure
How can these capabilities be expanded and improved to reduce risk?		
These capabilities can be expanded through the establishment of a County sustainability office/manager responsible for overseeing the measures contained in the draft CAP expected to be approved early 2022. The sustainability manager would be responsible for not only assuring the implementation of the CAP but also for the periodic updating of CO2 inventories and the re-evaluation of measures. This would also include developing a new CAP to to achieve carbon neutrality consistent with the Board Adopted Climate Emergency. Both the Climate Action plan and Environmental Justice Element of the General Plan call for enhanced communication plans to target the County's diverse and sometimes disenfranchised communities. Emergency communication and coordination could be enhanced by culturally competent and pre-established interpreters and translators who are already trained and imbedded with our communities and who will be received as trusted spokespeople. Other areas identified for improvement include: Conducting emergency management exercises, Providing incident management training, Educate staff on the value and mindset of pre-disaster mitigation; Conduct evacuation planning, Continue planning for better public outreach and disaster warning systems; train and educate newer staff.		

4.4.3. Sacramento County's Fiscal Mitigation Capabilities

Table 4-122 identifies financial tools or resources that the County could potentially use to help fund mitigation activities.

Table 4-122 Sacramento County Fiscal Mitigation Capabilities

Funding Resource	Access/ Eligibility (Y/N)	Has the funding resource been used in past and for what type of activities? Could the resource be used to fund future mitigation actions?
Capital improvements project funding	Y	Sacramento County has a Storm Water Utility that serves to make improvements to the existing storm drainage systems. The Sacramento County Water Agency has trunk drainage developer impact fee programs that fund installation of drainage systems serving 30(+) acre watershed.
Authority to levy taxes for specific purposes	Y	
Fees for water, sewer, gas, or electric services	Y	
Impact fees for new development	Y	
Storm water utility fee		
Incur debt through general obligation bonds and/or special tax bonds	Y	
Incur debt through private activities	Y	
Community Development Block Grant	Y	

Funding Resource	Access/ Eligibility (Y/N)	Has the funding resource been used in past and for what type of activities? Could the resource be used to fund future mitigation actions?
Other federal funding programs	Y	FEMA mitigation grants have been used to mitigate flood risk through home elevations and acquisitions. These programs have been successful and will be applied in the future when available.
State funding programs	Y	Cal DWR provided funding for the Small Communities Grant Projects to identify flood risk reduction measures for these communities.
Other		
How can these capabilities be expanded and improved to reduce risk?		
The County could develop a county-wide grant coordinator training office to take advantage of the multiple new grant opportunities available due to climate and social equity initiatives. or combine with the duties of new sustainability manager. Other areas for improvement include: Update and maintain fee plans; Seek state and federal grants, create mitigation related local funding districts, cooperate in the multi-agency Silver Jackets program.		

4.4.4. Sacramento County Mitigation Education, Outreach, and Partnerships

Table 4-123 identifies education and outreach programs and methods already in place that could be/or are used to implement mitigation activities and communicate hazard-related information.

Table 4-123 Sacramento County Mitigation Education, Outreach, and Partnerships

Program/Organization	Yes/No	Describe program/organization and how relates to disaster resilience and mitigation. Could the program/organization help implement future mitigation activities?
Local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, access and functional needs populations, etc.	Yes	Non-profits such as La Familia, WIC (Dept of Public Health) and food programs exist that could be used to implement mitigation activities or communicate hazard information. They currently are not being used in this capacity. Other groups such as the Environmental Justice Coalition for Water could assist.
Ongoing public education or information program (e.g., responsible water use, fire safety, household preparedness, environmental education)	Yes.	Non-profit organizations and government agencies Countywide do ongoing public education for preparedness on the topics of fire, flood and water use.
Natural disaster or safety related school programs	N	
StormReady certification	Yes	The County maintains a StormReady program and does public outreach regularly though radio, website, local events and the County's public counter.

Program/Organization	Yes/No	Describe program/organization and how relates to disaster resilience and mitigation. Could the program/organization help implement future mitigation activities?
Firewise Communities certification	N	
Public-private partnership initiatives addressing disaster-related issues	Yes	Capital Region Climate Readiness Collaborative could be used to inform mitigation activities and communicate hazard-related information.
Other		
How can these capabilities be expanded and improved to reduce risk?		
Social media to connect with most vulnerable populations in various languages (some rural areas do not have broadband, many do not watch tv/cable to get messages) Coordinate with public and mental health departments, service providers and organizations in providing information and utilizing their communication tools to connect with clients 2-1-1 is an effective resource in some areas but not all. Need to make it more robust so people know to use it and that it has reliable and timely information. Utilize neighborhood associations, schools, community watch groups to distribute information. Utilize "NextDoor" site to convey information Develop a county-wide communications and outreach program consistent with Policy EJ-2 and its supporting implementation measure: EJ-2. The County supports an equitable and comprehensive approach to civic engagement and public outreach on all aspects of County governance and delivery of services. Implementation Measures (Countywide) The County of Sacramento will create a comprehensive Community Outreach Strategy that serves as a framework for all departments to participate in meaningful two-way communication with the public on all aspects of County governance and delivery of services. (PUBLIC INFORMATION OFFICE, PLANNING AND ENVIRONMENTAL REVIEW WITH SUPPORT FROM ALL OPERATING DEPARTMENTS) Other areas for improvement include: Conducting more emergency management exercises; Continue local hazard mapping efforts; Conduct more creative outreach efforts such as hazard warning signs – "if the levee breaks – water will be this high".		

4.4.5. Other Mitigation Efforts

The County is pursuing multiple other mitigation efforts not captured in this plan. These include:

Climate Change Mitigation Efforts

The 2017 Sacramento County CAP and the 2021 Draft Sacramento County CAP noted many efforts to adapt to and mitigation climate change. On a planning level, Sacramento County addresses current and future impacts related to existing natural hazards, as evidenced by the County's LHMP adopted in December 2004 and recently updated in December 2016. The 2016 LHMP identifies current hazard risks and mitigation strategies for climate change, flooding, levee failure, drought/water shortage, severe weather, and wildfires. Furthermore, the County's General Plan 2005-2030 includes policies aimed at reducing local contributions to global climate change and encourages sustainable building practices (e.g., Cool Communities programs, which emphasize building practices to reduce UHIE through incorporation of urban forests, rooftop gardens, and cool roofs and pavements), efficient use of resources (i.e., water, land, and energy), and ecological stewardship. The Human Services Element also includes goals to ensure that human services are available to all residents, and policies aimed to protect its aging population, which are more vulnerable to health-related effects of climate change impacts and require better access to public services and housing (Sacramento County 2011a). Further, effective September 2015 and updated in 2016, sustainable building practices were codified in the Sacramento County Zoning Code and apply to all land, buildings, structures, and uses thereof located within the unincorporated County.

In addition to planning efforts, other climate adaptation-related work is ongoing in Sacramento County. These efforts are discussed in detail in the following sections.

Adaptive Efforts Related to Increased Temperature

Efforts occurring in Sacramento County to adapt to or reduce the impacts of extreme heat days and waves are summarized below:

- In 2012, Sacramento County adopted the Sacramento Operational Area Severe Weather Guidance as an annex to the Sacramento Emergency Operations Plan. The guidance describes operations during severe weather conditions such as excessive heat. The guidance defines excessively hot weather for 3 days accompanied by nighttime temperatures of 75 ºF or more as a severe weather alert (Phase III), and a heat index of over 105 ºF for more than 3 days with similar nighttime criteria as a severe weather emergency (Phase IV). Phase VI conditions initiate deployment of emergency services including mobilization of cooling centers, issuance of a Health Emergency, and increased public outreach to inform citizens of the availability of resources (Sacramento County 2012).
- The Sacramento County Office of Emergency Services (SacOES) provides community-wide information for how to stay safe during periods of extreme heat through their Sacramento Ready Program. The Program also designates public cooling centers in the event of a heat emergency. Cooling centers can include senior centers, community centers, shopping malls, churches, public pools, and other places that fit the appropriate criteria.
- Sacramento County is participating in several Property Assessed Clean Energy (PACE) financing programs, including Ygrene and the Home Energy Renovation Opportunity (HERO). PACE programs help homeowners finance home energy and water efficiency upgrades and save money on energy and water bills through special financing options, while also creating jobs for registered contractors in the County. By enabling homeowners to retrofit their homes and install upgrades, this program helps to build adaptive capacity by increasing home comfort and mitigating higher energy costs associated with increasing temperatures and extreme heat events and heat waves. It should be noted that PACE programs are only available to homeowners and cannot be used by renters or occupants of multi-family housing.
- The regional leadership organization, Valley Vision, has launched the Business Resiliency Initiative (BRI) to help reduce risks and economic impacts of potential disasters related to extreme weather, including extreme heat. BRI aids SMBs in preparing for the effects of natural disasters by helping develop adaptive capacity and manage risks from weather-related disaster threats. Through the BRI, Valley Vision and its partners stimulate wide-ranging leadership support from cross-sector stakeholders to aid SMBs build the capacity to handle weather-related crisis. BRI provides a toolkit of interventions, including five steps geared to developing a comprehensive plan to understand risk, assess your readiness, take action, test and update plans, and engage community partners.
- The U.S. Department of Energy (DOE) Weatherization Assistance Program (WAP) provides grants to states, territories, and Indian tribes to improve the energy efficiency of low-income homes. Recipients then contract with local governments and nonprofit agencies to provide weatherization services to low-

income homes in need of energy upgrades. The California WAP program allocates funds to various local governments, which provide grants to the entities that apply for them. WAP-related upgrades (e.g., replacing windows, weather-stripping, insulating attics and water heaters) in Sacramento County are provided by various organizations such as the Community Resource Project, Inc. and GRID Alternatives. Increasing the affordability of energy appliances provides low-income residents the financial capacity to air condition their homes during times of high heat. The State Greenhouse Gas Reduction Fund (GGRF) also provided funding for weatherization, residential rooftop solar and tree planting in disadvantaged communities.

- Urban greening and urban forestry in Sacramento County are supported by numerous organizations and agencies. The planting of trees in urban areas reduces the impacts of the UHIE. Urban forestry involves the planting of trees to mitigate these impacts. Trees provide shade for homes, roadways, parking lots, and provide relief during periods of extreme heat. Further, ground-level ozone produced from excessive heat can filtered by certain tree species, which improves local air quality. Tree coverage also reduces energy demand; the Sacramento Tree Foundation estimates that Sacramento County's current tree canopy saves 11.6 percent of the County's total annual energy usage. Efforts to plant trees are supported by the County, PG&E, SMUD, the Sacramento Tree Foundation, and other organizations. In 2015, the Sacramento Tree Foundation's Sacramento Shade program, funded by SMUD, delivered more than 10,000 shade trees to property owners, planted 2,537 replacement trees, enhanced 43.7 acres of habitat, and monitored and cared for 5,633 native trees totaling $1,744,390 in expenses. Further, Sacramento County's 30K Trees Campaign has received funding from PG&E to promote the region's goal of planting 30,000 trees.
- The County completed construction on its first green complete street in 2013. The County advanced climate resiliency in the 2015 update of the Zoning Code and Countywide Design Guidelines. Cool roofs, energy efficiency, walking and biking and urban greening were measures and elements included in the design guidelines. Urban greening measures include landscaping elements that improve air and water quality, provide shade during summer months and lowers temperatures reducing urban heat island effects (UHIE), which occur when city or metropolitan areas are significantly warmer than the general region due to land use and development patterns.
- Through their Cool Roof Incentive program, PG&E and SMUD offer rebates to their customers that qualify. The program uses a point system to evaluate the price of rebates, and incentives costumers to upgrade their homes with cool roof measures (e.g., efficient insulation, water heaters). The rebates are not available for commercial land uses, but may be applied to single-family homes and multi-family buildings.
- The SMUD 2016 Climate Readiness Report lists several on-going or planned climate change-related initiatives that target increased resiliency to periods of extreme heat. Several initiatives will serve to improve Sacramento County's adaptive capacity across all sectors; however, specific initiatives, such as the Regional Urban Heat Island Initiative (to commence in 2017), will focus on reducing UHIE through identification of areas prone to UHIE and projected impacts on electrical load and health. The effort will enable adaptive efforts (e.g., cool roofs and pavements, urban greening) to be targeted more effectively yielding the greatest benefit. The Initiative will be managed by CRCRC, SMAQMD, the Sacramento Tree Foundation, and local roofing industries and local governments.

Adaptive Efforts Related to Changes in Precipitation Patterns

Efforts occurring in Sacramento County to adapt to or reduce the impacts of changes in precipitation patterns are summarized below:

- Sacramento County adopted a Water Efficient Landscape Ordinance to the Sacramento County Code in 1990 consistent with the California Water Conservation in Landscaping Act of 1990. The Ordinance is intended to promote the conservation and efficient use of water in landscaping-related activities while recognizing that landscaping enhances quality of life in California. The County is currently in the process of updating the Ordinance to reflect the goals of Assembly Bill (32), the California Global Warming Solutions Act of 2006 (Sacramento County 2016d). As part of the Countywide Design Guidelines, all development must adhere to the landscaping guidelines that among many things require use of the River Friendly Landscape Guidelines.
- The Sacramento County Water Agency (SCWA), as well several of the other 21 active water purveyors operating within the county (e.g., California-American Water Company, Golden State Water Company), support programs and conservation activities intended to help water customers voluntarily conserve approximately 10 percent over time. These water agencies use incentive programs (i.e., turf rebates, water efficiency rebates, and home water audits) to aid customers in identifying ways to reduce water use. SCWA also enforces State Water Resources Control Board prohibited activities for water use and recommends a watering schedule for landscaping. On May 5, 2015 the State Water Resources Control Board (SWRCB) approved their framework for achieving a 25 percent statewide reduction in urban water use. SCWA reduced its water use over 32 percent from June 2015 through February 2016 when compared to 2013. Sacramento County also recently implemented water metering to incentivize water conservation throughout the County. SCWA also runs a water waste prohibition program which increases customer awareness of wasteful water practices. County staff investigate public complaints and look for cases of water waste.
- SCWA participates in the Sacramento Area Water Forum (Water Forum), a consensus-based, stakeholder process involving over 40 representatives of water purveyors, businesses, and environmental, and public interest groups in the region. The co-equal objectives of the Water Forum are to provide a reliable and safe water supply for the region's economic health and planned development through the year 2030 and to preserve the fishery, wildlife, recreational, and aesthetic values of the lower American River.
- The Sacramento Groundwater Authority (SGA) oversees groundwater in Sacramento County north of the American River, and adopted a revised groundwater management plan in December 2014 in compliance with Water Code Section 10753.7. SGA has the authority to regulate groundwater within the County and the cities of Citrus Heights, Folsom, and Sacramento. The plan contains components of a Groundwater Sustainability Plan consistent with the Sustainable Groundwater Management Act (SGMA) of 2014 (SGA 2014). SGMA went into effect in January 2016, and is California's new comprehensive statewide groundwater management law designed to provide for local management of groundwater resources. Sacramento Central Groundwater Authority (SCGA) oversees the portion of Sacramento County from south of the American River to mid-stream of the Cosumnes River. SGA and SCGA are currently working on developing groundwater management plans that are tailored to the resources and needs of their communities that meet the requirements of SGMA and must be adopted by 2022. These plans will provide a buffer against drought and climate change, and contribute to reliable water supplies regardless of weather patterns. California depends on groundwater for a major portion of its annual water supply, and sustainable groundwater management is essential to a reliable and resilient water system. Groundwater in Sacramento County is also being regulated by other recently formed Groundwater Sustainability Agencies, such as Omochumne Hartnell Water District and Sloughhouse Resource Conservation District.
- Sacramento County is also part of the Sacramento Stormwater Quality Partnership (SSWQP). The SSWQP is a multi-jurisdictional program made of Sacramento County and the incorporated cities of

Sacramento, Citrus Heights, Elk Grove, Folsom, Galt, and Rancho Cordova whose purpose is to educate and inform the public about urban runoff pollution, work with industries and businesses to encourage pollution prevention, require construction activities to reduce erosion and pollution and require developing projects to include pollution controls that will continue to operate after construction is complete. SSWQP supports River-Friendly Landscaping, which entail gardening strategies to reduce water consumption, yard waste, and pollution. Another effort of SSWQP is to promote River-Friendly Carwashing and educate car-owners of the impacts of carwash runoff in residential areas.

- Sacramento County is participating in several Property Assessed Clean Energy (PACE) financing programs, including the county-wide Ygrene program and the Home Energy Opportunity (HERO) program. PACE programs help homeowners and business owners finance home energy and water efficiency upgrades and save money on energy and water bills through special financing options, while also creating jobs for registered contractors in the County.
- Sacramento Regional County Sanitation District (SRCSD) has been providing a recycled water fill station since 2015. Residential and commercial customers can obtain recycled water from Regional San's Recycled Water Fill Station during the dry season (spring through early fall). Recycled water produced at the Sacramento Regional Wastewater Treatment Plant in Elk Grove can be used for watering lawns, gardens and landscaping, as well as dust control, and is available free of charge. Additionally, SRCSD is undertaking a monumental effort—called the EchoWater Project—to take our region's wastewater treatment to a whole new level. In 2010, Regional San was issued stringent new treatment requirements from the State of California required them to make the most significant upgrade to the wastewater treatment plant since its original construction. This new system, which must be in place by 2021-2023, will produce cleaner water for discharge to the Sacramento River, as well as expanded opportunities for recycled water (e.g., for landscape, park and agricultural irrigation).
- The SMUD 2016 Climate Readiness Report list several on-going or planned climate change-related initiatives that target increased resiliency to periods of drought and extreme storm events. For example, in 2016, SMUD began the permitting, design, and construction of a recycled water interconnection and appropriate plant facilities at the Sacramento Power Authority (SPA) cogeneration plant through the County Recycled Water Reclamation Contract. The project will allow for the use of the Sacramento Regional County Sanitations District's Title 22 recycled water for plant cooling and fire protection, saving millions of gallons of potable water per day.

Drought

As listed above, Sacramento County has several programs in place to conserve municipal water supply. Sacramento County citizens can engage in rebate programs provided by SCWA and other water purveyors (e.g., Golden State Water Company, California-America Water Company), SMUD, and PG&E to improve the water efficiency of home appliances and replace water-demanding landscapes. Further, PACE financing programs can also help homeowners finance upgrades to their homes and landscapes to improve water efficiency along with energy efficiency. Deployment of these efforts can help to lower Sacramento County's overall municipal water usage thereby helping ensure that Sacramento County residents continue to have a reliable source of potable water in the face of future dry years. Additionally, through the SCWA, citizens can report wasteful water usage.

Sacramento County's involvement in the Water Forum provides an ongoing discussion of water demand and supply in the County. This process promotes the development of an integrated water system that functions on private and public stakeholder input. The Water Forum focuses on surface water diversion, groundwater management, habitat conservation and restoration, and adaptation to drier years. The efforts of the Water Forum provide Sacramento County with proactive actions to adapt to deviations in precipitation patterns. The Water Forum Agreement (WFA) was signed in April 2000, and contains the objectives of providing a reliable and safe water supply for the region's economic health and planned development through the year 2030 and to preserve the fishery, wildfire, recreational, and aesthetic values of the lower American River (SFA 2014).

Water Forum 2.0 has recently started, which will update the 2000 agreements.

Further, groundwater in Sacramento County is regulated by SGA. The most recent groundwater management plan, adopted in 2014, details the SGA's goals, objectives, and policies to sustainably manage groundwater in the County. The in-process Sustainable Groundwater Management Plans will further inform and adopt policies and actions that will provide a buffer against drought and climate change, and contribute to reliable water supplies. With the potential for precipitation patterns to become more erratic and less predictable, groundwater may become a more significant resource for County residents currently relying on surface water resources. To function in drier years, groundwater resources must be reliable and quantity and quality.

The Sacramento County Water Efficient Landscaping Ordinance also reduces municipal water use associated with irrigation (e.g., lawns), and is currently in the process of being updated to reflect the water conservation goals contained in AB 32. Further, Sacramento County recently implemented a water metering system, which acts as a financial incentive to reduce municipal water use on a customer-by-customer basis. The reductions from these efforts reduces demand on water supplies which will support the overall goal of maintaining adequate water supplies for the County in the event of a dry year or a period of dry years.

Adaptive Efforts Related to Increased Wildfires

Efforts occurring in Sacramento County to adapt to or reduce the impacts of wildfire are summarized below:

- Sacramento County has adopted the 2013 California Fire Code, which incorporates the 2012 edition of the International Fire Code, which includes provisions to help prevent the accumulation of combustible vegetation or rubbish that can be found to create fire hazards and potentially impact the health, safety, and general welfare of the public. Provisions include ensuring that defensible spaces, which are adjacent to each side of a building or structure, are cleared of all brush, flammable vegetation, or combustible growth (Sacramento County Municipal Code Title 17 Chapter 17.04).
- Metro Fire's CWPP provides the Sacramento area with a comprehensive plan that results in the protection of human life and reduction in loss of property, critical infrastructure, and natural resources associated with wildfire. Through the CWPP, Metro Fire implements strategies to prevent and combat wildfire within its jurisdictional boundaries.
- The American River Parkway (ARP) Plan, a legislatively adopted document, guides all uses and activities allowed in the 22-mile long American River Parkway. This Plan was adopted by the County, the City of Sacramento, and the City of Rancho Cordova, the Sacramento Area Flood Control District, and the State of California Legislature. Currently fire resilient landscape planting is occurring in the Bushy Lake area and star thistle removal is being done by the American River Parkway Foundation and their partners. The American River Parkway Foundation in collaboration with the County Regional

Parks Department has proposed a project to develop an ARP Resource Management Plan (RMP). With funding, this RMP will support General Plan policies, and advances climate adaptation and greenhouse gas reductions. This RMP will coordinate with County and City departments and partners in reducing fire fuels, sustaining habitat, removing invasive species (in particular star thistle), advance fire resilient plantings/landscape, and amend the Parkway Plan as needed to support resource management and wildfire prevention.

- The SMUD 2016 Climate Readiness Report list several on-going or planned climate change-related initiatives that target increased resiliency to wildfire impacts. Commencing in 2017, SMUD will oversee a Forest Thinning, Stream and Revenue Flows Program in the Upper American River Project (UARP) reservoir system to establish specific forest thinning study areas for data collection, document baseline and post-treatment conditions, and evaluate results. The results will inform future cost/benefits associating with remote sensing technologies and forest management regimes.

Reduced Air Quality

Wildfires occurring outside of the County can impair air quality in the Sacramento and San Joaquin Valley. Actions to reduce wildfire-related air pollution would need to be executed by state (e.g., CAL FIRE, California Air Resources Board) and local agencies (e.g., air quality management districts) with the authority to do so. SMAQMD takes actions to reduce exposure to harmful pollutants related to wildfire (e.g., PM) by implementing no-burn days during periods of poor air quality. SMAQMD also provides resources to educate the public on the status of air quality on a daily basis, provides alerts on poor air quality days, and provides educational material on the health effects of air pollution. CRCRC is working with Sierra Climate Action and Mitigation Partnership (CAMP) and others statewide on the urban-rural interface (Alliance of Regional Collaboratives for Climate Adaptation 2016). Sierra CAMP's mission is to bring communities and decision-makers from a wide range of regions throughout California to make decisions regarding the future of the Sierra Nevada. Wildfires and forest management are critical components of this work that will help to protect and preserve the forests and contribute to improve water storage and management. The outcome of this work will inform where the State should make investments that will yield the greatest benefit.

Adaptive Efforts Related to Increased Flooding

Efforts occurring in Sacramento County to adapt to or reduce the impacts of flooding are summarized below:

- SAFCA provides regional flood control for the Sacramento region including Sacramento County, the City of Sacramento, Sacramento County, the American River Flood Control District, and Reclamation District 1000. Structures to control flooding (e.g., levees, dams, weirs, detention basins) have been built throughout Sacramento County along the Sacramento and American Rivers and their tributaries to protect against catastrophic flooding (SAFCA No Date). In August 2013, USACE judged the existing levee system as inadequate to meet the minimum NFIP requirements. SAFCA reviewed the affected levees and identified 10 miles of levees in need of improvements. In response, SAFCA established the Levee Accreditation Project as a means to meet the NFIP requirements and is engaged in upgrading levees along the Sacramento and American Rivers to achieve a valid status (SAFCA 2015).

- Several projects are underway to improve the capacity and flow of the American and Sacramento River levee systems. These include, but are not limited to, Mayhew Levee Improvement, Upper Levee Slope Protection, Sacramento Urban Area Levee Reconstruction Project, Folsom Dam spillway, and Sacramento Riverwall.
- In 2007, SAFCA formed a Consolidated Capital Assessment District (CCAD) to fund the local cost share for projects to protect Sacramento from extreme floods. Since then new Federal and State flood protection standards have been adopted that require additional improvements not anticipated by the CCAD. These additional improvements would address underseepage, erosion and encroachment issues that Federal studies have shown to be the most likely cause of levee failures. Without these improvements, the U. S. Army Corps of Engineers (Corps) has determined that many levees in Sacramento do not meet the current design standards to provide at least a 100-year level of flood protection. In order to fund the additional improvements, SAFCA proposed replacing the existing CCAD with a new assessment district (CCAD 2) that will increase annual assessments on homeowners by an average of about $42 in order to meet the state's 200-year flood protection requirements by 2025; and improve the resiliency and structural integrity of the flood control system to provide more than 200-year protection over time. Property owners voted via a mail balloting process and approved in May 2016 the formation of CCAD 2 and the new assessment.
- The County is completing its first concrete-lined creek naturalization project on Cordova Creek, which flows into the American River. This project removed the concrete lined channel, pulled back the banks and added naturalization features, water quality plants, floodplain enhancements and habitat restoration. This urban greening project will serve as an example of how new community development will provide similar features that will add to climate resiliency.
- The Central Valley Flood Protection District (CVFPD) adopted a Central Valley Flood Protection Plan (CVFPP) in June 2012. The CVFPP guides California's participation in managing flood risk along the Sacramento River and San Joaquin river systems. The CVFPP proposes a system-wide investment approach for sustainable, integrated flood management in areas currently protected by facilities of the State Plan of Flood Control. The CVFPP must be updated every 5 years (CVFPD 2012).
- The Sacramento Countywide Design Guidelines require flood protection and drainage facilities to be designed to provide multiple public benefits wherever possible. Facilities shall include multi-purpose improvements consisting of recreation, the environment, storm water runoff, water reclamation, flood control, etc. Attractive joint use basins, such as parks (in addition to Quimby land dedication requirements) or parkways with trails that also convey stormwater to water quality basins or similar facilities and provide some water quality treatment are examples of desired multiple public benefit facilities.
- SacOES coordinates the overall countywide response to large scale incidents and disasters through its Sacramento Ready Program. The Sacramento County Evacuation Plan contains measures and strategies to ensure evacuations are handled smoothly. The Plan outlines the appropriate procedures for handling potential catastrophic flooding in the County and provides specific recommendations depending on location in the floodplain (Sacramento County 2008).
- The Urban Level of Flood Protection Criteria was developed in response to the requirements from the Central Valley Flood Protection Act of 2008, enacted by SB 5. "Urban level of flood protection" means the level of protection necessary to withstand a 200-year flood in any given year. The criteria were developed by DWR as a systematic approach to assist affected cities and counties within the Sacramento-San Joaquin Valley in making findings related to an urban level of flood protection before approving certain land-use decisions. In response to the passage of SB 5, Sacramento County adopted the Floodplain Management Amendments to their General Plan and Zoning Code on December 13,

2016. These amendments ensure compliance with SB 5 and establishing setback along levees, developing a flood emergency response plan, building design standards, and enhancing natural floodplain management.

- The USBR Sacramento and San Joaquin Basins Climate Impact Assessment evaluates the potential effects climate change may have on the Sacramento and San Joaquin river basins. The report uses a menu of models of varying parameters to project future water supply and demand combined with the effects of climate change to predict potential future conditions within the basins. These projections can be used to inform the decision-making process and enhance adaptation planning.
- USACE has been implementing the Joint Federal Project at Folsom Dam and Reservoir. This includes an increased-capacity emergency spillway, flood gate improvements, and a three-foot dam and embankment raise for greater flood storage capacity. When completed, the flood protection capability of Folsom Dam and Reservoir will be enhanced for the lower American River (USACE 2007). Other planned or ongoing federally authorized projects include the Natomas Levee Improvement Project, American River Common Features, South Sacramento Streams Group Projects, and Sacramento River Bank Protection Program.
- The SMUD 2016 Climate Readiness Report list several on-going or planned climate change-related initiatives that target increased resiliency to flooding. For example, SMUD is executing a contract with DOE to receive grant funds from the REDI (Resilient Electricity Deliver Infrastructure) initiative as part of the Sacramento Resilient Initiative to improve grid resiliency by implementing smart grid technologies and strategies in the 100-year floodplain. The project includes installation and commissions of eight to ten automated 69 kilovolt (kV) switches within reinforced poles and supervisory control and data acquisition (SCADA) in selected flood prone areas and up to 20 low-voltage correction devices to demonstrate advanced conservation voltage reduction for peak load reduction on a select number of SCADA enabled substations.

Wildfire Efforts

For its 2021 Fire Fuel Reduction Action Plan, the Department of Regional Parks has lined up cattle, sheep and goat grazing contracts; is utilizing maintenance crews to maintaining fire breaks; and is issuing fuel break maintenance permits to properties bordering Park properties.

To decrease the number and size potential of wildfires in our parks system, the techniques used will be applicable for each area and will include:

Firebreaks – A combination of mowing, soil discing and targeted herbicides will be used where appropriate to create perimeters around open fields, along fence lines and behind neighborhoods. This work is scheduled to be completed by end of June.

Ladder Fuel Hand-Crews – In limited, hard to reach areas, hand-crews will remove vegetation that allows the potential for a fire to climb up or move into urban areas.

Grazing – There are hundreds of acres of undeveloped or protected land in our Regional Parks. This vegetation can be a costly and deadly fire hazard. Goats and sheep are ideal for vegetation management and are great at eating down weeds, bushes and grass that manned crews cannot get to. Grazing is expected to occur between May and the end of June.

Annual Encroachment Permits – Residents who live adjacent to Regional Parks properties are able to apply for free annual encroachment permits to maintain a fire break behind their property line. These allow residents to string-trim grass and weeds for up to 50 feet beyond their private property line.

Additionally, the Sacramento Metro Air Quality Management District has released new wildfire smoke guidance. This guidance goes into effect during times of high wildfire smoke (mostly from outside the County).