

Annex R Delta Annex

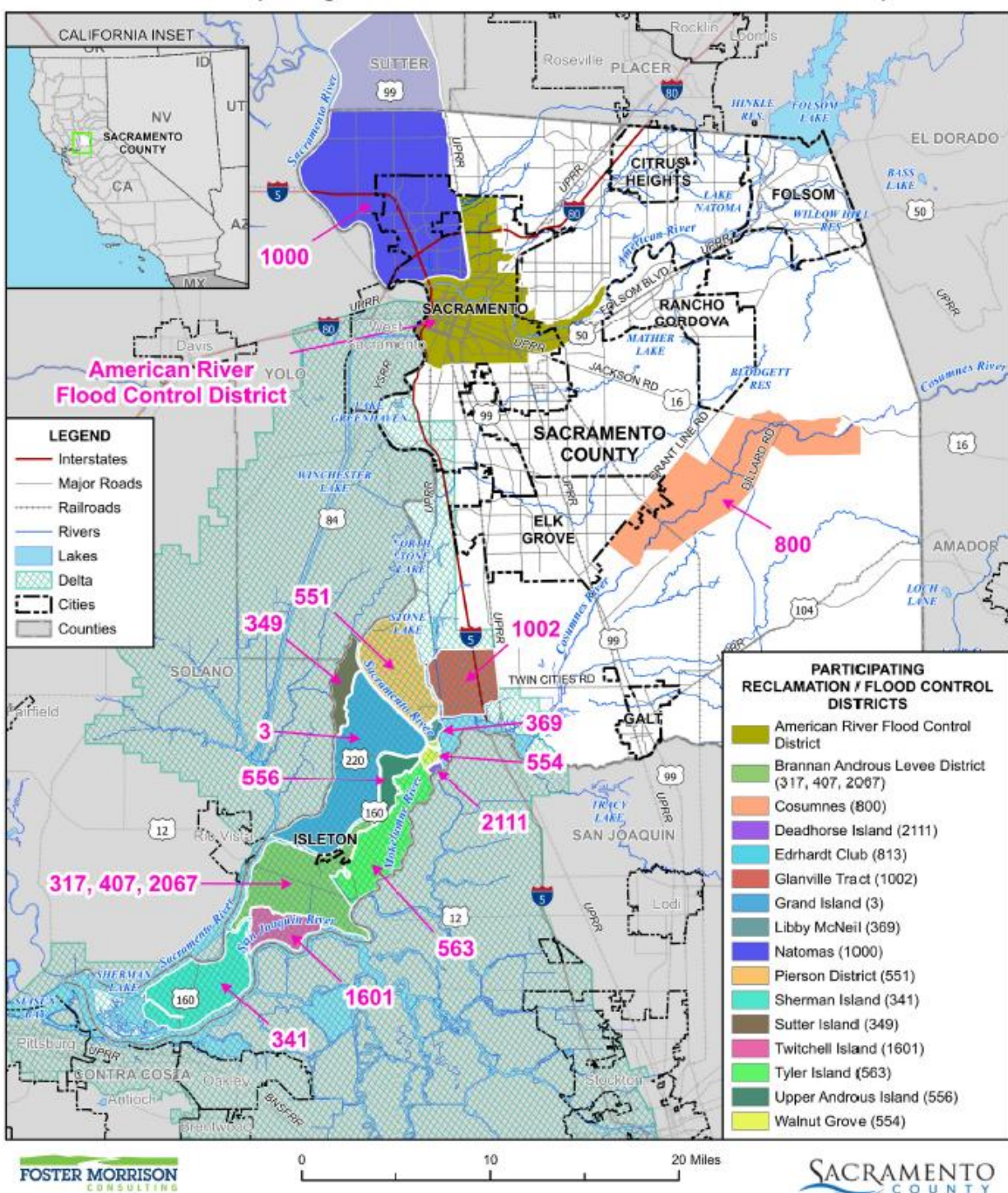
R.1 Introduction

This Delta Annex details the hazard mitigation planning elements specific to that portion of the Sacramento-San Joaquin River Delta located within unincorporated Sacramento County. This portion of the Delta includes six (6) unincorporated communities, known as legacy communities, and the City of Isleton (also defined as a legacy community) as well as various other reclamation Districts. The purpose of this Annex is to provide an umbrella document that includes descriptions, data, and information on the Delta common to all LHMP participating jurisdictions from this region. This Annex is not intended to be a standalone document, but appends to and supplements the information contained in the Base Plan document. As such, all sections of the Base Plan, including the planning process and other procedural requirements apply to and were met by all participating jurisdictions included in this Delta Annex. This Annex provides information specific to participating Delta jurisdictions, with a focus on the risk assessment and mitigation strategy for each jurisdiction.

R.2 Participating Jurisdictions

As described in the Base Plan document, the 2026 Sacramento LHMP Update is a multi-jurisdictional plan that geographically covers the entire area within Sacramento County's jurisdictional boundaries (i.e. the Sacramento County Planning Area). This Delta Annex provides a framework for the region's participating Delta jurisdictions to this 2026 LHMP Update. The following Delta jurisdictions participated in the overall planning process and are seeking FEMA approval of this 2026 LHMP Update. Figure R-1 shows the locations of the participating Delta Reclamation Districts (RDs). In addition to the 12 participating RDs, the City of Isleton and the Delta Region Geologic Hazard Abatement District (which mirrors the boundaries of Isleton) are also participating Delta jurisdictions, with Chapters to this Delta Annex.

Figure R-1 Sacramento County Delta – Participating Reclamation/Flood Control Districts



Data Source: Sacramento County, Cal-Atlas; Map Date: 3/31/2026.

It should be noted that while the legal boundary for the Delta also includes portions of the cities of Elk Grove and Sacramento, except to the extent their Delta area structures are included in this Delta Annex, the

complete Annexes for these two participating jurisdictions are included outside of this Delta Annex and can be found in Annex B and Annex F, respectively.

- City of Isleton
- Brannan Andrus Levee District (Reclamation Districts #317, #407, #2067)
- Reclamation District #3
- Reclamation District #341
- Reclamation District #349
- Reclamation District #369
- Reclamation District #551
- Reclamation District #554
- Reclamation District #556
- Reclamation District #563
- Reclamation District #1002
- Reclamation District #1601
- Reclamation District #2111
- Delta Region Geologic Hazard Abatement District

R.3 Community Profile

The community profile for the Sacramento Delta is further detailed in this section. Figure R-2 displays a map and the location of the Delta within Sacramento County.

SACRAMENTO COUNTY INSET

YOLO
SOLANO
SACRAMENTO COUNTY
AMADOR
CALAVERA
SAN JOAQUIN
CONTRA COSTA
STANISLAUS

LEGEND

- Interstates
- Major Roads
- Railroads
- Rivers
- Lakes
- Delta
- Cities
- Counties

Elevation (ft)

- 0 - 100
- 101 - 250
- 251 - 400
- 401 - 831

Map Labels:

West Sacramento
LAME GREEN LAKE
FLORIN RD
24TH ST
CITY OF SACRAMENTO
WINCHESTER LAKE
YOLO
ELK GROVE
SACRAMENTO COUNTY
TWIN CITIES RD
GALT
Mokelumne River
Dry Creek
TRACY LAKE
San Joaquin River
Sawenille Slough
Threemile Slough
Sacramento River
Sherman Lake
Pittsburg
Oakley
Stockton
Lodi

Scale: 0 5 10 Miles

Logos: FOSTER MORRISON CONSULTING, SACRAMENTO COUNTY

Sacramento County
Local Hazard Mitigation Plan Update
October 2026

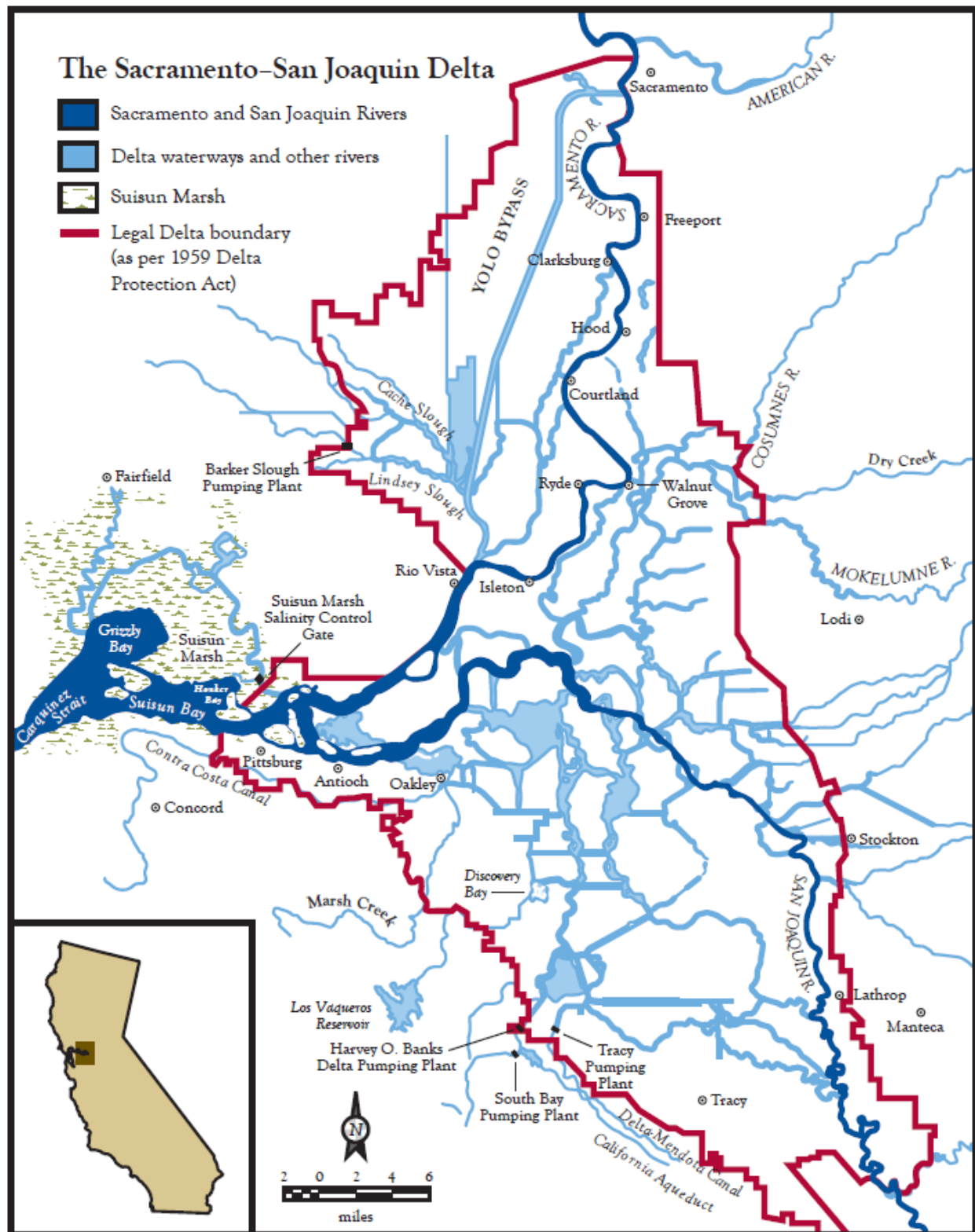
R.3.1. Geography and Climate

The Sacramento River Delta, in the southwest corner of Sacramento County, is interlaced with numerous tidal sloughs that include a number of peat islands reclaimed for agriculture by an extensive levee system. These waterways provide important fisheries and aquatic ecosystems, water for Delta farms and are important recreational areas. The climate of the Delta is much like the Mediterranean climate of Sacramento County. The Delta sits at or below sea level.

The Delta is located in Northern California, inland of the San Francisco Bay going towards Sacramento. Highways 80 and 5 run north-south, bordering the Delta and Highway 12 runs east to west crossing the Delta about midway. The Delta boundaries were legislatively defined by the Federal and State governments as part of the "New Deal" Central Valley Project after the Depression. The Primary and Secondary Zones of the legal Delta include land in six counties (although one area in Alameda County is very small), and portions of the cities of Sacramento, West Sacramento, Stockton and Antioch along the periphery of the Delta. The smaller cities of Rio Vista and Isleton along with unincorporated communities of Byron, Ryde, Hood, Locke, Walnut Grove, Freeport, Clarksburg, and Courtland are located in the heart of the Delta. Comprising over 700,000 acres, this region includes 62 major named islands and hundreds of smaller islands. (see Figure R-3).

As described in the County's floodplain management ordinance, that portion of the Delta located within unincorporated Sacramento includes that area south of the Delta of Sacramento to the tip of Sherman Island protected from flooding by levees as bound by Reclamation District numbers: 3, 317, 341, 349, 369, 407, 551, 554, 556, 563, 744, 746, 755, 813, 1002, 1601, 2067, 2110, and 2111. This legal boundary is the Delta region used throughout this Annex.

Figure R-3 Sacramento–San Joaquin Delta Legal Boundaries



Source: Delta Protection Commission

The Delta region is one of the County's most fertile areas and accounts for much of the agricultural production in the County. The Delta communities have a quiet rural lifestyle and is unique as a getaway from the hurried pace of much of the remainder of Sacramento County. This 162 square mile area (of Sacramento County) is crisscrossed by numerous waterways, which divide the land into distinct islands or tracts which includes the incorporated City of Isleton and the legacy communities of Locke, Ryde, Courtland, Freeport, Hood and Walnut Grove where roughly 6,000 residents live.

R.3.2. History

Originally, the Delta was a shallow wetland with water covering the area for many months of the year. Natural levees, created by deposits of sediment, allowed some islands to emerge during the dry summer months. Salinity would fluctuate, depending on the season and the amount of precipitation in any one year, and the species that comprised the Delta ecosystem had evolved and adapted to this unique, dynamic system.

The federal Swamp Land Act of 1850 set the stage for property ownership in the Delta. State legislation followed in 1861, which is approximately the same period in which the 1,000+ mile levee system began to take shape.

In 1933, the Legislature approved the California Central Valley Project Act, which relied upon the transfer of Sacramento River water south through the Delta and maintenance of a more constant salinity regime by using upstream reservoir releases of freshwater to create a hydraulic salinity barrier. As a result of the operations of state and federal water projects, the natural salinity variations in the Delta have been altered.

With the November 2009 enactment of the Sacramento-San Joaquin Delta Reform Act, the Act resulted in a lengthy list of changes to the Delta's regulatory and governance framework and specifically identified a key statutory objective of ensuring for a safe and reliable water supply for the State, while preserving and enhancing the Delta's ecosystem. These "coequal" goals are now defined in California Water Code section 85054.

Today

According to the Delta Conservancy (primary state agency in the implementation of ecosystem restoration in the Delta), the Delta, at 1,300 square miles, is the largest estuary and wetland ecosystem on the west coasts of both North and South America, and home to more than 500,000 people and 200,000 jobs. Further, the economic health of California, is heavily reliant on existing communications, energy, and transportation facilities/infrastructure that are located in and traverse the Delta.

In spite of acknowledged water system and ecosystem degradation, the Delta remains a unique and critically important natural resource for California, as well as the entire nation. It serves as the hub of California's water supply system, which plays a vital role in supporting the basic economies of several major regions within the State, which are dependent on the ability of water exporters to access and transport water from the Delta watershed. This is evidenced by the fact that more than two-thirds of the State's residents (25 of 39 million) and more than three million acres of highly productive farmland receive water exported from the Delta watershed.

R.4 Risk Assessment

As defined by 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 overall Delta risk assessment identifies and profiles relevant hazards and assesses the exposure of lives, property, infrastructure, and the environment to these hazards. The process allows for a better understanding of the Delta Area’s potential risk and vulnerability to hazards and provides a framework for developing and prioritizing mitigation actions to reduce risk from future hazard events.

Building on the Community Profile above, a risk assessment was performed for the Delta. This includes the following sections:

- R.4.1 Assets Inventory and Growth and Development Trends
- R.4.2 Hazard Identification
- R.4.3 Hazard Profiles and Vulnerability to Specific Hazards

R.4.1. Asset Inventory and Growth and Development Trends

This section provides an inventory of the Delta’s total assets potentially at risk to hazards and an overview of growth and development trends. This section is broken into two parts:

- **Asset Inventory** – The assets inventory identifies the Delta’s total assets, including the people and populations; structures; critical facilities and infrastructure; community lifelines; natural, historic, and cultural resources; and economic assets and community activities of value. This data is not hazard specific, but is representative of total assets within the District, potentially at risk to identified hazards as discussed in Section R.4.3 Hazard Profiles and Vulnerability to Specific Hazards.
- **Growth and Development Trends** – A discussion of growth and development trends in the District, both current and future, is presented.

Asset Inventory

The Delta’s asset inventory is detailed in the following sections:

- People and Populations
- Structures
- Critical Facilities and Infrastructure
- Community Lifelines
- Natural, Historic, and Cultural Resources
- Economic Assets and Community Activities of Value

People and Populations

The most important asset within any community are the people and populations that reside in the community. People and populations in the Delta include those who live and work in the region. This section

includes an inventory of past and current populations of the Delta and also discusses vulnerable populations and underserved communities as a subsection of people and populations located within the Delta and potentially at risk to hazards. As previously discussed, there are roughly 6,000 people who reside in the Delta, with just under 800 that reside in the City of Isleton; the rest residing in unincorporated areas of the Sacramento Delta. There are underserved population groups inside of the total population. These are discussed in each Chapter to this Annex.

Structures

This section inventories the parcels (and associated structures) that make up the built environment of the Delta. The 2025 Sacramento County Assessor's data and the associated parcel layer was used as the basis of this inventory. The methodology used to derive the number of total and improved parcels (i.e., those with an improved structure value), land and improved property values, (as well as content replacement values), follows the same methodology detailed in Section 4.2.1 of the Base Plan. This data should only be used as a guideline to overall values in the Delta, as the information has some limitations. The most significant limitations are created by Proposition 13 and the Williamson Act. With respect to Proposition 13, instead of adjusting property values annually, the values are not adjusted or assessed at fair market value until a property transfer occurs. As a result, overall value information is most likely low and does not reflect current market value of properties within the Delta. It is also important to note, in the event of a disaster, it is often the value of the infrastructure or improvements to the land that is of concern or at risk. Generally, the land itself is not a loss. However, depending on the type of hazard and impact of any given hazard event, land values may be adversely affected; thus, land values are included as appropriate.

Table R-1 shows the 2025 Assessor's values (e.g., the values at risk) broken down by jurisdiction for the Delta (both the incorporated and unincorporated areas). Table R-2 shows the 2025 Assessor's values (e.g., the values at risk) broken out by property use for the Delta and jurisdiction.

Table R-1 Sacramento Delta Total –Values at Risk by Jurisdiction

Jurisdiction	Total Parcel Count	Improved Parcel Count	Total Land Value	Structure Value	Total Value
Elk Grove	350	313	\$65,775,901	\$199,619,411	\$265,395,312
Isleton	527	330	\$31,604,337	\$59,856,684	\$91,461,021
Sacramento	17,732	16,360	\$2,191,896,758	\$5,620,708,643	\$7,812,605,401
Unincorporated Sacramento County	2,947	1,785	\$545,795,895	\$666,460,016	\$1,212,255,911
Grand Total	21,556	18,788	\$2,835,072,891	\$6,546,644,754	\$9,381,717,645

Source: Sacramento County 2025 Parcel/Assessor's Data

Table R-2 Sacramento Delta –Total Values at Risk by Property Use

Jurisdiction / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Structure Value	Total Value
Elk Grove					
Agricultural	0	0	\$0	\$0	\$0

Jurisdiction / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Structure Value	Total Value
Care / Health	0	0	\$0	\$0	\$0
Church / Welfare	2	2	\$1,701,566	\$9,131,932	\$10,833,498
Industrial	6	4	\$7,999,078	\$43,092,560	\$51,091,638
Miscellaneous	19	0	\$203	\$0	\$203
Office	41	34	\$9,609,056	\$43,990,535	\$53,599,591
Public / Utilities	0	0	\$0	\$0	\$0
Recreational	1	1	\$568,913	\$2,187,291	\$2,756,204
Residential	267	267	\$33,903,672	\$97,531,195	\$131,434,867
Retail / Commercial	5	5	\$1,685,984	\$3,685,898	\$5,371,882
Unknown	0	0	\$0	\$0	\$0
Vacant	9	0	\$10,307,429	\$0	\$10,307,429
Elk Grove Total	350	313	\$65,775,901	\$199,619,411	\$265,395,312
Isleton					
Agricultural	1	0	\$35,511	\$0	\$35,511
Care / Health	0	0	\$0	\$0	\$0
Church / Welfare	8	8	\$375,272	\$899,412	\$1,274,684
Industrial	6	6	\$2,984,575	\$2,013,050	\$4,997,625
Miscellaneous	22	0	\$962,699	\$0	\$962,699
Office	6	5	\$541,694	\$1,001,024	\$1,542,718
Public / Utilities	26	0	\$211	\$0	\$211
Recreational	0	0	\$0	\$0	\$0
Residential	251	249	\$18,644,115	\$45,167,681	\$63,811,796
Retail / Commercial	60	57	\$3,400,504	\$10,762,141	\$14,162,645
Unknown	0	0	\$0	\$0	\$0
Vacant	147	5	\$4,659,756	\$13,376	\$4,673,132
Isleton Total	527	330	\$31,604,337	\$59,856,684	\$91,461,021
Sacramento					
Agricultural	0	0	\$0	\$0	\$0
Care / Health	11	11	\$12,756,708	\$81,528,105	\$94,284,813
Church / Welfare	28	21	\$9,411,539	\$53,736,770	\$63,148,309
Industrial	5	3	\$5,538,757	\$20,367,990	\$25,906,747
Miscellaneous	494	0	\$187,078	\$0	\$187,078
Office	56	50	\$37,101,451	\$104,793,574	\$141,895,025
Public / Utilities	23	0	\$0	\$0	\$0
Recreational	11	4	\$2,050,561	\$3,549,647	\$5,600,208
Residential	16,426	16,188	\$1,816,919,824	\$5,032,991,131	\$6,849,910,955

Jurisdiction / Property Use	Total Parcel Count	Improved Parcel Count	Total Land Value	Structure Value	Total Value
Retail / Commercial	86	80	\$125,720,085	\$323,107,556	\$448,827,641
Unknown	2	0	\$0	\$0	\$0
Vacant	590	3	\$182,210,755	\$633,870	\$182,844,625
Sacramento Total	17,732	16,360	\$2,191,896,758	\$5,620,708,643	\$7,812,605,401
Unincorporated Sacramento County					
Agricultural	840	544	\$307,470,048	\$351,566,527	\$659,036,575
Care / Health	3	0	\$934	\$0	\$934
Church / Welfare	12	8	\$281,024	\$3,207,307	\$3,488,331
Industrial	44	35	\$15,789,579	\$12,243,532	\$28,033,111
Miscellaneous	295	5	\$1,709,434	\$28,728	\$1,738,162
Office	22	19	\$2,809,639	\$4,318,741	\$7,128,380
Public / Utilities	81	0	\$28	\$0	\$28
Recreational	95	44	\$14,674,092	\$20,845,942	\$35,520,034
Residential	1,078	1,019	\$167,608,861	\$248,959,371	\$416,568,232
Retail / Commercial	89	80	\$10,694,390	\$23,523,646	\$34,218,036
Unknown	0	0	\$0	\$0	\$0
Vacant	388	31	\$24,757,866	\$1,766,222	\$26,524,088
Unincorporated Sacramento County Total	2,947	1,785	\$545,795,895	\$666,460,016	\$1,212,255,911
Grand Total	21,556	18,788	\$2,835,072,891	\$6,546,644,754	\$9,381,717,645

Source: Sacramento County 2025 Parcel/Assessor's Data

Critical Facilities and Infrastructure

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 Facilities.

An inventory of critical facilities in the Delta from Sacramento County GIS is shown on Figure R-4 and in Table R-3.

Figure R-4 Sacramento County Delta– Critical Facilities

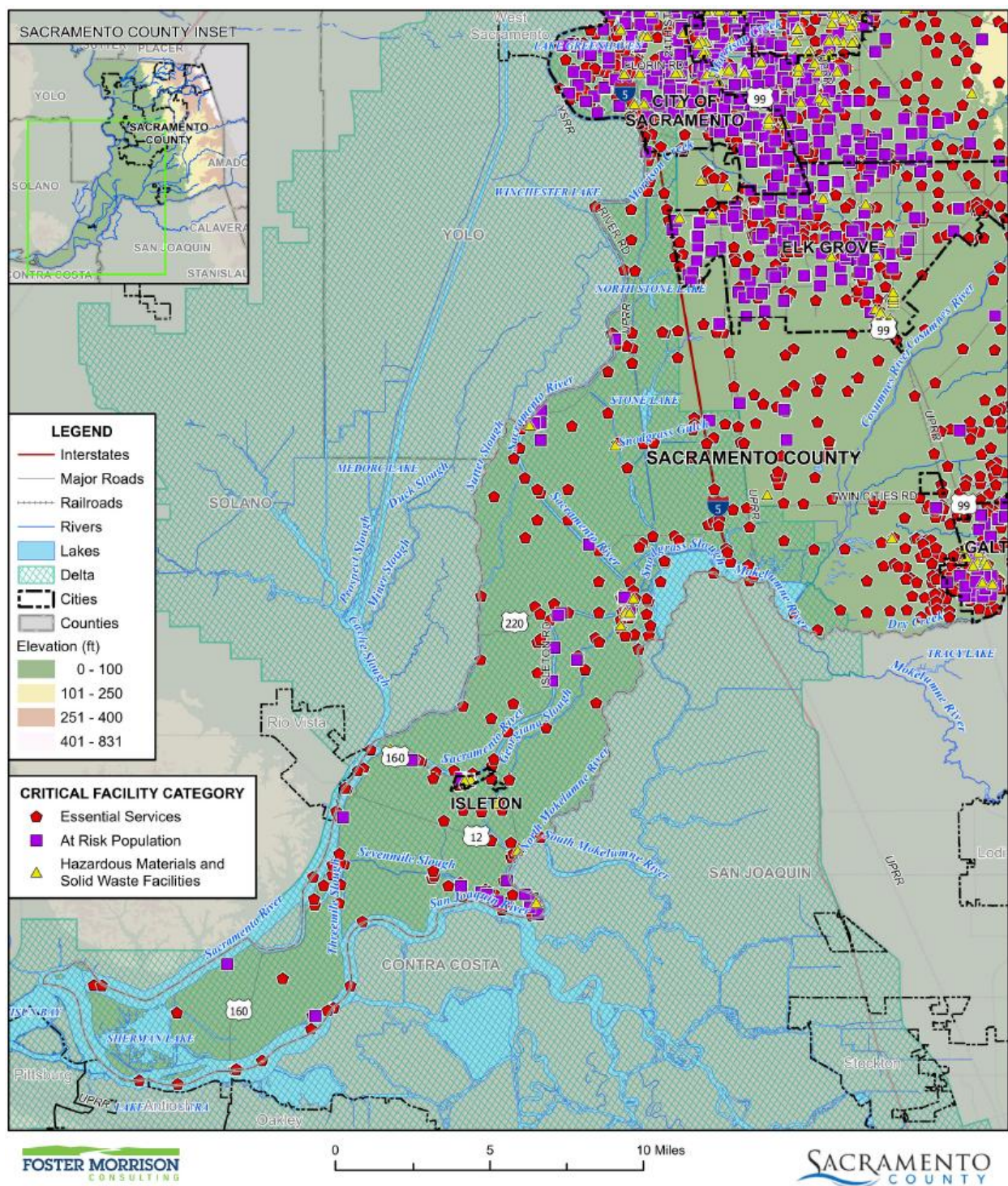


Table R-3 Sacramento County Delta - Critical Facilities by Jurisdiction and Category

Jurisdiction /Critical Facility Category	Facility Count
Delta (City of Isleton)	
Essential Services Facilities	9
At Risk Population Facilities	4
Hazardous Materials and Solid Waste Facilities	3
Delta (City of Isleton) Total	16
Delta (Unincorporated Sacramento County)	
Essential Services Facilities	540
At Risk Population Facilities	90
Hazardous Materials and Solid Waste Facilities	19
Delta (Unincorporated Sacramento County) Total	649
Grand Total	665

Source: Sacramento County GIS

Community Lifelines

Assessing the vulnerability of the Delta area to natural hazards and disasters also involves reviewing and inventorying the community lifelines in place that could be affected. It is important to include these items in hazard discussions as the continuous operation of critical government and business functions is essential to human health and safety, property protection, and economic security. The importance of community lifelines is discussed below:

- Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function.
- FEMA has developed a method for objectives-based response that prioritizes the rapid stabilization of Community Lifelines after a disaster.
- The integrated network of assets, services, and capabilities that provide lifeline services are used day-to-day to support the recurring needs of the community and enable all other aspects of society to function.
- When disrupted, decisive intervention (e.g., rapid re-establishment or employment of contingency response solutions) is required to stabilize the incident.

Community lifelines, as defined by FEMA, include the following:

- **Safety and Security** – Law Enforcement/Security, Fire Service, Search and Rescue, Government Service, Community Safety
- **Food, Hydration, Shelter** – Food, Water, Shelter, Agriculture
- **Health and Medical** – Medical Care, Public Health, Patient Movement, Medical Supply Chain, Fatality Management
- **Energy** – Power Grid, Fuel

- **Communications** – Infrastructure, Responder Communications, Alerts Warnings and Messages, Finance, 911 and Dispatch
- **Transportation** – Highway/Roadway/Motor Vehicle, Mass Transit, Railway, Aviation, Maritime
- **Hazardous Material** – Facilities, HAZMAT, Pollutants, Contaminants
- **Water Systems** – Potable Water Infrastructure, Wastewater Management

It should be noted that these community lifelines are all in place and functional as part of regular government operations in the Sacramento County Planning Area serving as a partnership between the cities, local special districts and agencies, and Sacramento County. Due to its more rural nature, there is an interplay in community lifelines between all jurisdictions in the County. Most all of the Delta community lifelines overlap with the Planning Area's. It should also be noted that these lifelines collectively include many of the critical facilities and infrastructure assets inventoried for this LHMP, including those assets owned by the Isleton or any of the Reclamation Districts. As such, specific information on these community lifelines in the Delta and how they may be affected by a hazard event or disaster are discussed in the Base Plan.

Natural, Historic, and Cultural Resources

The Delta ecosystem is the lower drainage area of the vast Central Valley of California. It is inextricably linked to the Sacramento and San Joaquin River watersheds as a recipient of flows and constituents from natural and man made activities and events upstream. It is distinguished by various aquatic ecosystems that host rare native fish, and by several distinct terrestrial and wetland habitats that support abundant bird and animal life. These key habitats include tidal marshes, managed freshwater wetlands, in-channel fresh and brackish water habitats, open water habitats, seasonal wetlands, riparian forest, and grasslands, among others. In all of these habitats there exist both resident and migratory species of great conservation value. This means that Delta ecosystem management must consider not only localized contexts but also the way that Delta habitats fit within regional, watershed, and even continental-scale ecosystems.

Importantly, Delta agricultural lands also provide rich seasonal wildlife habitat. Thousands of acres are shallowly flooded after harvest and provide feeding and resting areas for resident and migratory birds and other wildlife. This practice of seasonal flooding is one example of a management practice that supports both the Delta ecosystem and the economy.

The Delta is also the single most important link in California's water supply system. Two of the state's biggest water projects – the State Water Project and the federal Central Valley Project – depend on Delta waterways to convey water from Northern California rivers to pumping facilities in the southern Delta. Delta levees play a critical role in preventing salty water from San Francisco Bay from intruding into critical parts of the Delta and contaminating the fresh water that supplies communities and farms.

The California Water Fix (CWF) is a proposal to improve the California Department of Water Resources' (DWR) State Water Project (SWP) and the U.S. Bureau of Reclamation's (USBOR) Central Valley Project (CVP) joint freshwater storage and delivery system by creating an additional point of diversion along the Sacramento River. This change in the point of diversion is intended to protect the state's water supplies in the face of climate change, improve flows for threatened fish species, and allow for ecosystem restoration and conservation.

CA DWR estimated that about 27 million Californians relied on the Delta for drinking water during the 2015–2020 period. The Delta is an important source of water for millions of acres of agriculture and is the largest estuary on the West Coast. However, the Delta has experienced extensive habitat loss over the past 150 years, with some natural habitat types declining by more than 90%.

Another state initiative, California EcoRestore, launched in 2015 by the California Natural Resources Agency is an initiative to advance at least 30,000 acres of critical habitat restoration in the Sacramento-San Joaquin Delta by 2020. The program includes a broad range of habitat restoration projects, including aquatic, sub-tidal, tidal, riparian, flood plain, and upland ecosystem. As part of this effort, EcoRestore will develop an adaptive management program to achieve its habitat restoration goals and increase restoration success for the benefit of the long-term health of the Sacramento-San Joaquin Delta and Suisun Marsh's native fish and wildlife species.

As noted by CA DWR, the Delta is critical for drinking water and agriculture. The EcoRestore initiative targets habitat restoration, which includes significant projects like Lookout Slough, contributing vital resources for native fish while enhancing flood protection for local communities. Recently in 2024, California completed a 3,400-acre Delta restoration project that illustrates how habitat and flood protection can work together.

As well, the California Department of Fish and Wildlife is developing the “Delta Conservation Framework” that will work in tandem with EcoRestore. The Delta Conservation Framework serves as a comprehensive resource and guide for planning conservation in the Delta through 2050, including a vision for Delta-wide ecosystem conservation consistent with and in the context of the Delta as a place, and to backfill regional conservation measures that have been lost or significantly eroded in recent years.

In addition to the numerous ecosystems and habitat areas located in the Delta, there is also a rich historic and cultural heritage in the Delta. It is home to several historically significant legacy communities, including Bethel Island, Clarksburg, Courtland, Freeport, Hood, Isleton, Knightsen, Locke, Rio Vista, Ryde, and Walnut Grove. Locke, the largest remaining town built by early Chinese immigrants to the United States, is a National Historic Landmark District. More information can be found in the Base Plan, as well as in the City of Isleton's and each reclamation district's chapters of this Annex.

Economic Assets and Community Activities of Value

After a disaster, economic resiliency is one of the major drivers of a speedy recovery. Each community in the Delta has specific economic drivers. These include:

- Primary Economic Sectors
- Major employers
- Commercial Centers

Major economic assets in the Delta include a predominantly agricultural industry with extensive farmlands and associated farm products located throughout the region. The Delta area also supports a diverse range of recreational activities and tourism – all adding to local economies.

Inventorying economic assets in the Delta and their vulnerability to natural hazards and disasters also involves inventorying activities that have value to the community. This includes activities that are important to a community, like long-standing traditions such as a festival or fair. Some areas rely on seasonal industries to sustain them throughout the year. Many of these activities also provide economic benefits to the Delta. A hazard event that cancels or shortens these can affect a community's livelihood and can make disaster recovery more difficult or prolonged. This includes activities such as:

- Festivals and Fairs
- Sporting Events
- Tourism
- Local Pools
- Local Splash Pools

In the Delta, this includes numerous activities and events held year around and associated with the rich history and resources of the region such as those related to camping, water and recreational activities, tours, cycling, bird watching, farm stands, hunting, fishing, parks and recreation areas, art galleries, wineries, and organized activities and events with close ties to the legacy Delta communities. These range from fishing derbies, bike races, festivals, fairs, and others.

Growth and Development Trends

As part of the planning process, the District looked at changes in growth and development, both current and future, and examined these changes in the context of hazard-prone areas, and how the changes in growth and development affect loss estimates and vulnerability over time. This inventory section details future development/redevelopment projects that are likely to occur over the next five years covered by this 2026 LHMP.

Major planning activities are occurring in the Delta by local, state, and federal agencies related to water supplies and environmental issues. These multi-agency efforts are based on co-equal goals of water reliability and habitat restoration, while still protecting, enhancing and sustaining the unique cultural, historical, recreational, agricultural and economic values of the Delta, and addressing flood protection, continued socio-economic sustainability of agriculture and its infrastructure, and the legacy communities in the Delta. The outcomes of these planning actions are likely to shape the future of the County's Delta community, including any new development in the Delta.

More information on Growth and Development Trends specific to the participating Delta jurisdictions can be found in each jurisdiction's respective Chapter to this Annex.

Future Development

Growth in the Sacramento County Delta area has historically been very limited due to agricultural zoning, flood risks, levee constraints, environmental protections, and Delta policies that prioritize agriculture and ecosystem restoration over large-scale residential development. Future development activities are further discussed in each jurisdiction's respective Chapter to this Annex.

R.4.2. Hazard Identification

Based on information provided by the participating jurisdictions within the Delta, in conjunction with input from Sacramento County, hazards that affect the Delta are summarized, including information on their frequency of occurrence, spatial extent, potential magnitude, and significance specific to the Delta Area (see Table R-4). Additional hazard information specific to each of the participating Delta jurisdictions is included in the jurisdictional Chapters to this Annex.

Table R-4 Sacramento County Delta —Hazard Identification Assessment

Hazard	Geographic Extent	Likelihood of Future Occurrences	Magnitude/Severity	Significance	Climate Change Influence
Aquatic Nuisance Species (plant/animal)	Limited	Occasional	Limited	Low	Low
Climate Change	Significant	Likely	Significant	Medium	–
Dam Failure	Limited	Unlikely	Negligible	Low	Medium
Drought & Water Shortage (w/tree mortality)	Significant	Likely	Significant	Medium	High
Earthquake (w/subhazards)	Significant	Occasional	Limited	Medium	Low
Floods: 1%/0.2% annual chance	Limited	Unlikely	Critical	High	Medium
Floods: Localized Stormwater	Significant	Likely	Critical	Medium	Medium
Landslides, Mudslides, and Debris Flow	Limited	Unlikely	Negligible	Low	Medium
Levee Failure	Significant	Occasional	Critical	High	Medium
Sea Level Rise	Limited	Likely	Negligible	Medium	High
Severe Weather: Extreme Cold and Freeze	Extensive	Occasional	Critical	Low	Medium
Severe Weather: Extreme Heat	Extensive	Likely	Critical	Low	High
Severe Weather: Heavy Rains and Storms (Hail, Lightning, Wind)	Extensive	Likely	Limited	Medium	Medium
Severe Weather: High Winds and Tornadoes	Limited	Occasional	Negligible	Medium	Low
Subsidence	Significant	Likely	Critical	Medium	Medium
Wildfire (w/ smoke and air quality)	Limited	Occasional	Limited	Low	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					

R.4.3. Hazard Profiles and Vulnerability to Specific Hazards

This section includes the hazard profiles and vulnerability assessment for hazards ranked of medium or high significance specific to the Delta (as identified in the Significance column of Table R-4). Though rated low significance hazards by all participating Delta jurisdictions, due to their significance in California, dam failure and wildfire are also discussed briefly. This section focuses on where and how the Delta area is affected by their hazards of concern. Chapter 4 of the Base Plan provides more detailed information about these hazards and their impacts on the Sacramento County Planning Area. Methodologies for evaluating vulnerabilities and calculating loss estimates are the same as those described in Section 4.2 of the Base Plan.

Hazard Profiles and Vulnerability Assessment

Each hazard is profiled in the following format:

- **Hazard Profile** – A hazard profile is included for each hazard. This includes information on:
 - ✓ **Hazard Overview** – A general discussion of the hazard and related issues is detailed here.
 - ✓ **Location and Extent** – Location is the geographic area within the Delta that is affected by the hazard. Extent is the expected range of intensity for each hazard. These are discussed in specific detail for mapped hazards, and in more general detail for those hazards that do not have discrete mapped hazard areas.
 - ✓ **Past Occurrences** – Past occurrences are discussed for each hazard. A discussion of disaster declarations is included in each hazard section. NCDC events are also discussed. Other past occurrences data specific to the District follow the disaster declarations and NCDC events for each hazard.
 - ✓ **Climate Change** – This section contains the effects of climate change (as applicable). The possible influence of climate change on the hazard is discussed.

After the hazard profile, a vulnerability assessment is presented. As part of the vulnerability assessment, an estimate of the vulnerability of the Delta to each identified hazard, in addition to the estimate of risk of future occurrence, is provided in each of the hazard-specific sections. 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.

After this classification, a general discussion of hazard vulnerabilities occurs. This is done in the following format:

- **Vulnerability Overview** – A general discussion of the hazard vulnerability and related issues is detailed here.
- **Assets at Risk** – A discussion of the assets at risk follows. These are discussed in specific terms for mapped hazards, and in more general terms for those hazards that are unmapped. Sections on Community Lifelines and Economic Assets and Community Activities of Value are not included in the Sections below, as they are common to all jurisdictions and are fully covered in Section R.4.1 above and Chapter 4 of the Base Plan.
- **Future Development** – A general discussion of how future development will affect or influence each hazard over time is also included.

Power Interruption/Power Failure: A Common Vulnerability of all Hazards

An impact of almost all hazards evaluated as part of this LHMP Update relates to power shortage and/or power failures. There are two major power providers in Sacramento County - Sacramento Municipal Utility District (SMUD) and Pacific Gas and Electric (PG&E). 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 U.S. 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. More information on types of power disruptions can be found in Section 4.3 of the Base Plan.

Public Safety Power Shutoff (PSPS)

An intentional disruption type of power shortage/failure event has been recently implemented in California as a result of wildfires starting 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), at the direction of the California Public Utilities Commission (CPUC), are preparing all Californians for the threat of wildfires and power outages during times of extreme (fire) weather. To help protect customers and communities during extreme fire weather events, electric power may be shut off for public safety in an effort to proactively prevent wildfire. This is called a PSPS. More information on PSPS criteria can be found in Section 4.3 of the Base Plan.

It should be noted that to date, there have been no PSPS events in the Delta.

Climate Change

Likelihood of Future Occurrence–Likely
Vulnerability–High

Hazard Profile and Problem Description

Climate change adaptation is a key priority of the State of California. The 2023 State of California Multi-Hazard Mitigation Plan noted 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.

California's Adaptation Planning Guide: Understanding Regional Characteristics (from 2017) has divided California into 11 different regions based on political boundaries, projected climate impacts, existing environmental setting, socioeconomic factors and regional designations. The District falls in the North Central Valley Region. A map and climate projections for this region are shown in Section 4.3.7 of the Base Plan and include an increase in temperatures, moderate changes in rainfall, increase heat waves, and increased risk to wildfire.

Location and Extent

Climate change is a global phenomenon. It is expected to affect the whole of the Delta, Sacramento County, and State of California. There is no scale to measure the extent of climate change. 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.

Past Occurrences

Delta Events

Climate change has never been directly linked to any declared disasters. While the Delta noted that climate change is of concern, no specific impacts of climate change could be recalled. The Delta and HMPC members noted that the strength of storms does seem to be increasing and the temperatures are getting hotter. The Delta Stewardship Council (in their June 2021 Delta Adapts: Creating a Climate Resilient Future Vulnerability Assessment) noted that the Delta continues to experience its effects through hotter temperatures, more severe wildfires, and prolonged droughts. Events that had larger effects on the City of Isleton or individual participating Delta Districts can be found in their respective Chapters of this Delta Annex.

Vulnerability to Climate Change

The California Adaptation Planning Guide (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. California's 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. Sacramento County falls

within the North Central Valley Region. The region is rich in natural resources, biodiversity, and is the source for the majority of water used by the State. This information can be used to guide climate adaptation planning in the Delta and the Sacramento County Planning Area.

Impacts from Climate Change

The 2017 California Adaptation Planning Guide (APG) 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

The June 2025 Delta Adapts: Creating a Climate Resilient Future Adaptation Plan noted that Delta ecosystems are vulnerable to climate change. Over the past two centuries humans dramatically transformed the Delta landscape, resulting in the near total elimination of natural wetland, riparian, and floodplain ecosystems. This conversion has degraded the ecological health of the Delta. By 2085, rising sea levels will cause all critical remaining tidal wetland ecosystems to transition to different plant communities or drown, underscoring the need to improve the capacity of ecosystems to adapt to and thrive under future conditions.

It also noted that impacts are unevenly spread across the Delta community. Approximately 65 percent of the Delta's population that could be exposed to a 100-year flood event by 2050 reside in areas with high concentrations of socially vulnerable residents. Vulnerable residents may lack resources to prepare for floods and other hazards, vehicles for evacuation, and information on flood risks due to linguistic isolation. These factors make recovering from flood events challenging, perpetuating inequities and vulnerability and making improvements to flood emergency preparedness and response an important strategy. Extreme heat will also disproportionately affect certain populations, such as outdoor workers, people who are unhoused, older adults, children and infants, and individuals with chronic illnesses.

That report also noted that Delta water exports will be less reliable in the future. Climate change will reduce Delta exports and reservoir storage in all water year types, with greater impacts in dry years, increasing drought vulnerability. Projected reductions in Delta exports of approximately 10 to 20 percent annually by 2050 (or approximately 500,000 acre-feet per year) will have far-ranging consequences for water users throughout the state. It is critical for Delta water users to continue planning for future drought conditions, because when Delta water is needed the most, it will likely be less available.

Further, the existing water supply system lacks sufficient storage to capture anticipated increases in runoff due to more variable precipitation. As temperatures increase, more precipitation will fall as rain and less as snow in the Sierra Nevada, diminishing the snowpack and increasing runoff during core winter months. Greater variability in precipitation will increase the likelihood of extremely wet and extremely dry years,

but there is insufficient storage to capture the additional precipitation from a very wet year such as 2022-2023.

Future Development

Climate change can influence future development in the Delta over time. The Delta could see population fluctuations as a result of climate impacts relative to those experienced in other regions, and these fluctuations are expected to impact demand for housing and other development. While there are currently no formal studies of specific migration patterns expected to impact the Delta and County region, climate-induced migration was recognized within the UNFCCC Conference of Parties Paris Agreement and the California Fifth Climate Assessment (2026) and is expected to be the focus of future studies and will likely influence population centers and future development over time.

Dam Failure

Likelihood of Future Occurrence–Unlikely

Vulnerability–Low

Hazard Profile and 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 given 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 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, a total dam failure would most probably happen as a consequence of the natural disaster triggering the event, such as an earthquake.

Location and Extent

An inventory map of dams (both originating from inside and outside the County) that have inundation areas located within Sacramento County was shown in Section 4.3.8 in the Base Plan. Dams with an inundation area within the Delta are shown on Figure R-5.

Note: in addition, based on the Folsom dam inundation analyses included in the 2021 and 2016 Sacramento County LHMPs, areas of the Delta fall within previous dam inundation areas for Folsom. It is thus assumed that, while not quantified, the Delta remains at risk and vulnerable to a future Folsom dam incident.

There is no scale with which to measure dam failure. However, FEMA and CA DWR Division of Safety of Dams (DSOD) assign hazard potential classifications to dams within the State that provides information on the potential impact should a dam fail. The following two factors are considered when assigning hazard ratings: existing land use and land use controls (zoning) downstream of the dam. FEMA categorizes the downstream hazard potential into three categories in increasing severity: Low, Significant, and High.

DSOD adds a fourth category of Extremely High. Dams are classified in these four categories that identify the potential hazard to life and property. These were discussed in more detail in Section 4.3.8 of the Base Plan.

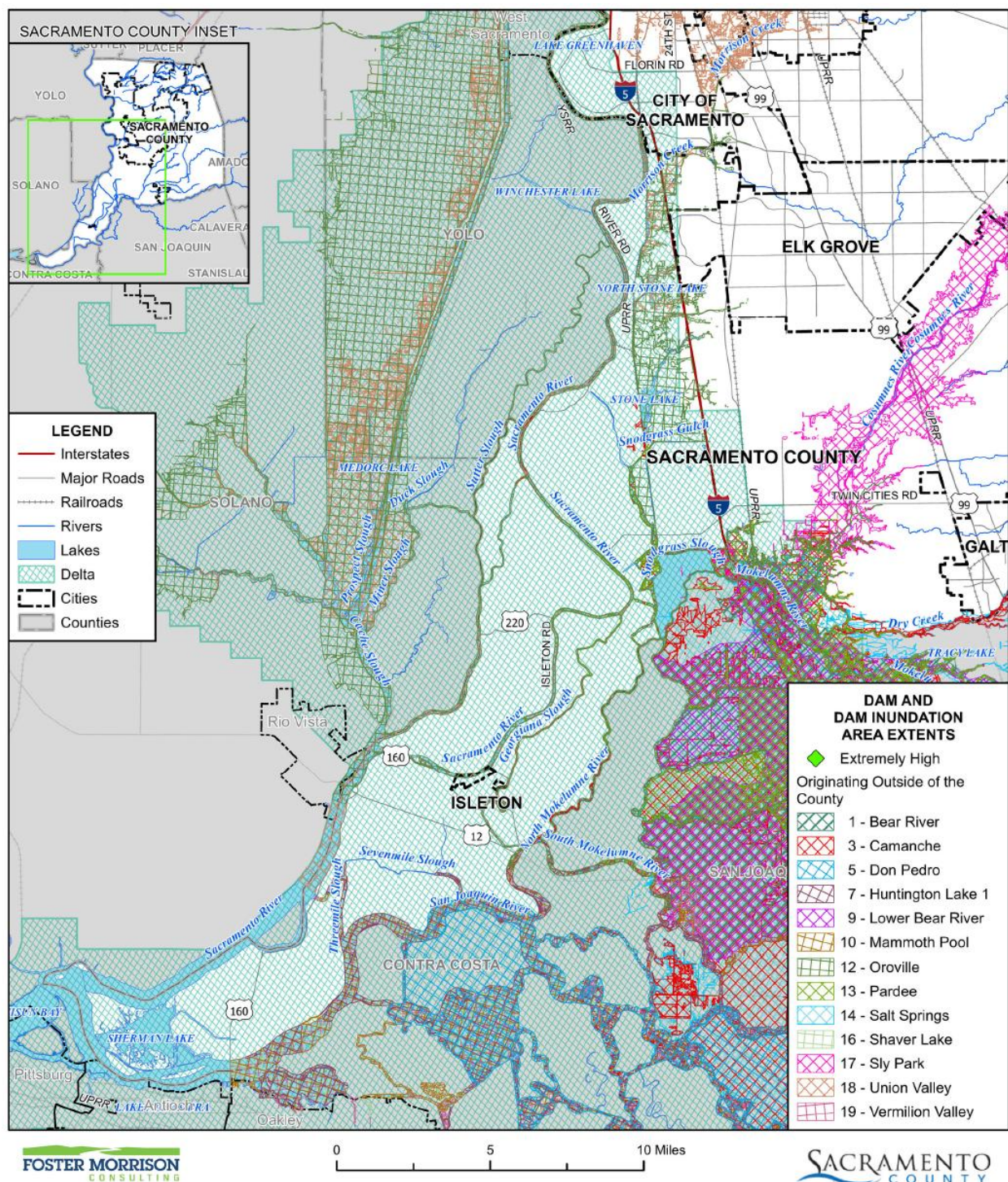
While a dam may fill slowly with runoff from winter storms, a dam break has a very quick speed of onset. The duration of dam failure is generally not long – only as long as it takes to empty the reservoir of water the dam held back. For dam overtopping, the speed of onset is somewhat slower than that of a dam break, and the duration is longer (as evidenced in the 2017 Oroville Dam spillway event). The District would be affected for as long as the flood waters from the dam failure took to drain downstream.

Based on the dam inventory and inundation analysis, the Delta is in the inundation area of 15 Extremely High Hazard dams (Bear River, Camanche, Camp Far West, Don Pedro, Huntington Lake 1, Lower Bear River, Mammoth Pool, New Bullards Bar, Oroville, Pardee, Salt Springs, Shaver Lake, Sly Park, Union Valley, and Vermilion Valley) originating from outside the County, 1 High Hazard (Nimbus) dam originating from inside the County, and 1 High Hazard (Jackson) dam originating from outside the County.

Geographic flood extent from the DSOD dam inundation areas is shown: on Figure R-5 and in Table R-5 for Extremely High Hazard dams originating outside the County; on Figure R-6 and in Table R-6 for High Hazard dams originating inside the County, and Source: DSOD

Figure R-7 and in Table R-8 for High Hazard dams originating outside the County.

Figure R-5 Sacramento Delta – Extremely High Hazard Dam (Outside the County) Inundation Areas



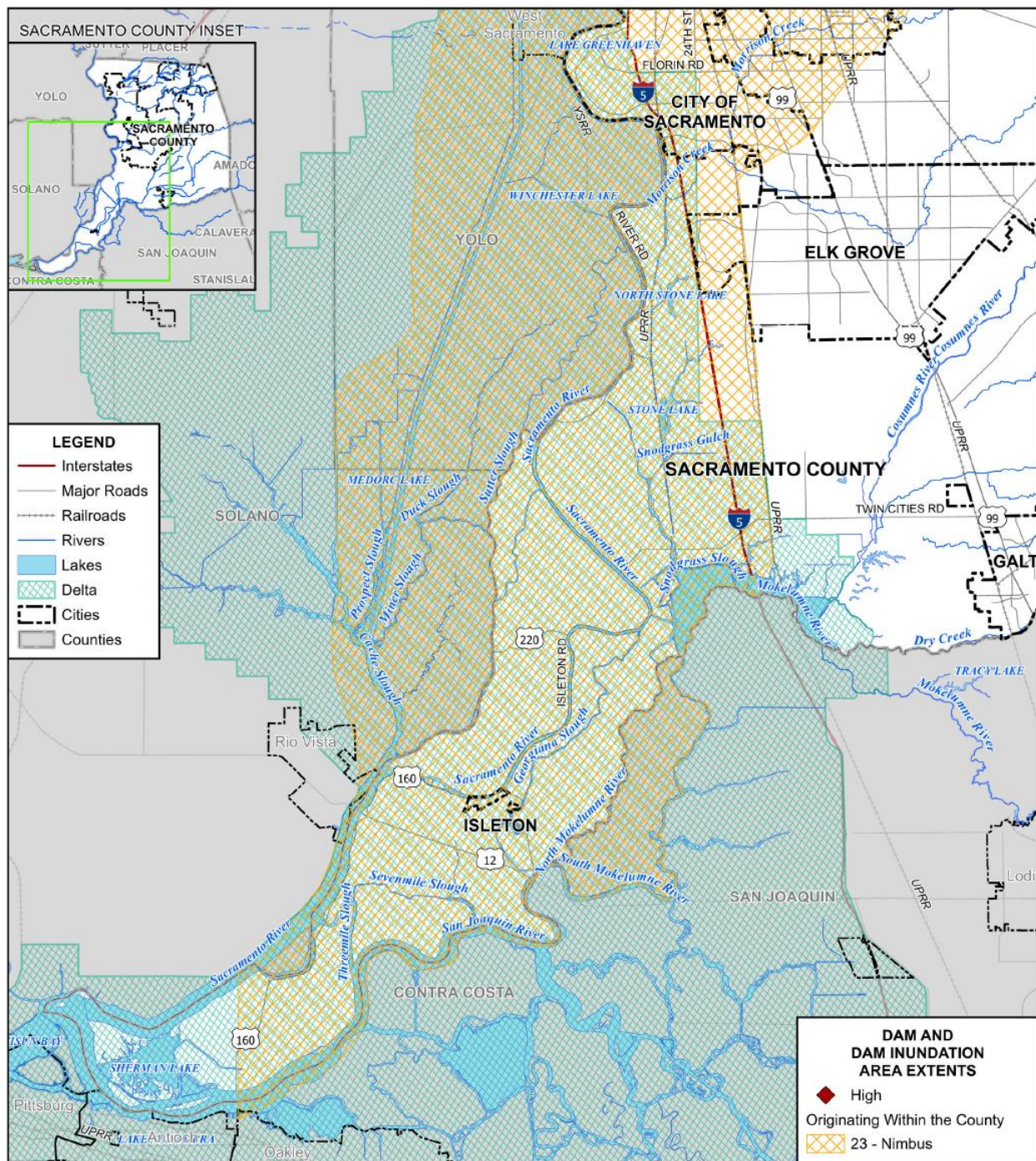
Data Source: DWR DSOD dam inundations (updated 7/2025; data downloaded 10/2025),
 NID dam inventory and inundation data (updated 11/6/2025; data downloaded 11/6/2025),
 Sacramento County, Cal-Atlas; Map Date: 4/21/2026.

**Table R-5 Sacramento Delta – Extremely High Hazard Dam (Outside the County)
Inundation Areas Geographical Extents by Delta Jurisdiction**

Jurisdiction / Dam Inundation Area	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Elk Grove						
Oroville	2	0.002%	1	0.001%	2	0.003%
Isleton						
Camanche	0.1	0.0001%	0	0%	0.1	0.0002%
Oroville	10	0.01%	2	0.004%	8	0.02%
Union Valley	9	0.01%	2	0.003%	7	0.01%
Sacramento						
Camp Far West	1	0.001%	0.03	0.0001%	1	0.001%
New Bullards Bar	76	0.1%	0.03	0.0001%	76	0.1%
Oroville	125	0.1%	11	0.02%	114	0.2%
Union Valley	138	0.1%	13	0.02%	125	0.2%
Unincorporated Sacramento County						
Bear River	1,389	1%	824	2%	565	1%
Camanche	4,400	4%	1,215	2%	3,186	6%
Don Pedro	81	0.1%	3	0.01%	77	0.2%
Huntington Lake 1	136	0.1%	23	0.04%	113	0.2%
Lower Bear River	1,152	1%	642	1%	510	1%
Mammoth Pool	154	0.1%	26	0.05%	128	0.2%
Oroville	9,325	9%	2,506	5%	6,819	13%
Pardee	3,807	4%	974	2%	2,833	6%
Salt Springs	1,401	1%	570	1%	831	2%
Shaver Lake	154	0.1%	26	0.05%	128	0.2%
Sly Park	2,643	2%	502	1%	2,141	4%
Union Valley	1,284	1%	303	1%	981	2%
Vermilion Valley	186	0.2%	31	0.1%	155	0.3%

Source: DSOD

Figure R-6 Sacramento Delta – High Hazard Dam (Inside the County) Inundation Areas



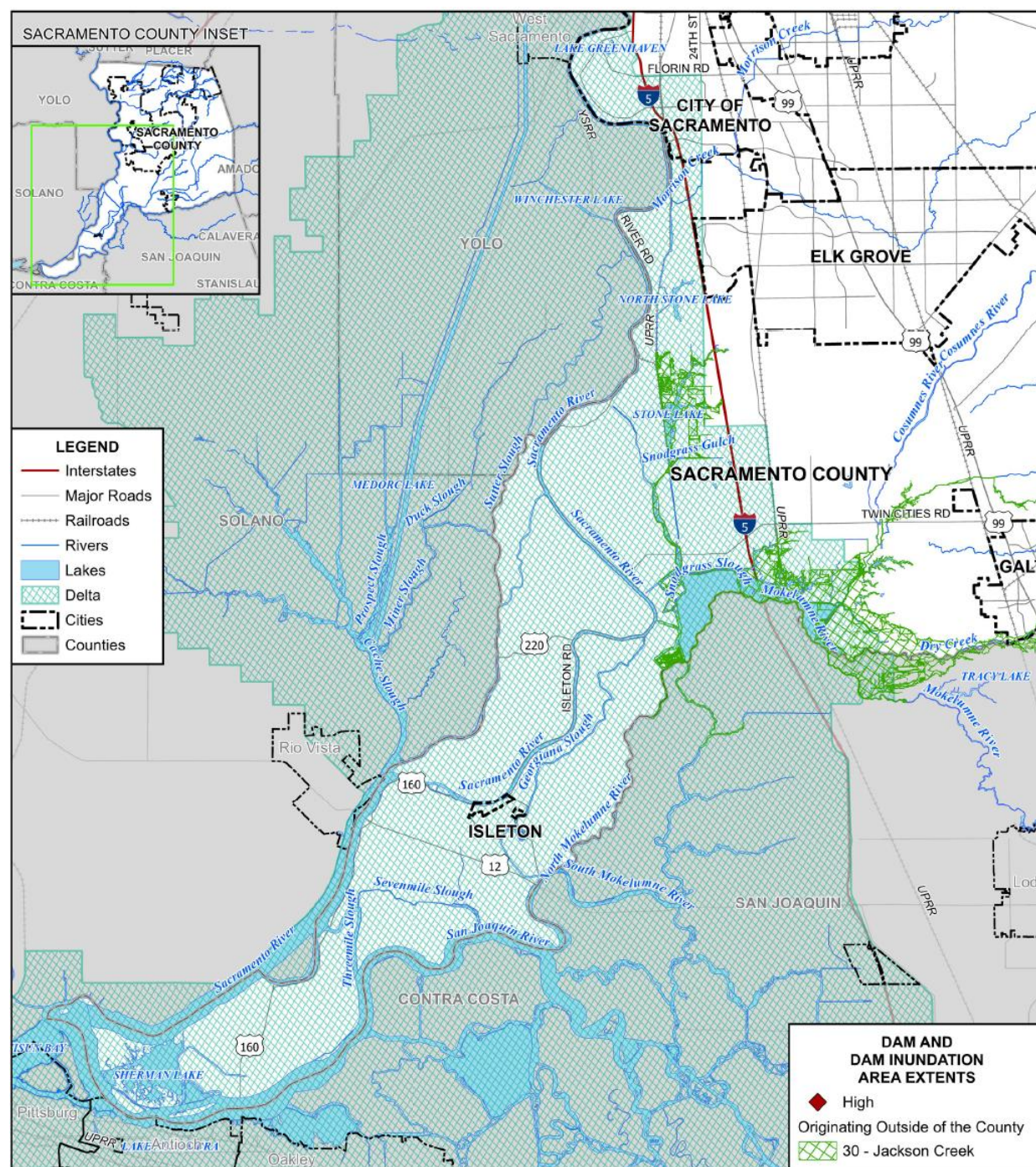
Data Source: DWR DSOD dam inundations (updated 7/2025; data downloaded 10/2025),
 NID dam inventory and inundation data (updated 11/6/2025; data downloaded 11/6/2025),
 CalOES CIP dam inundation data (3/2017),
 Sacramento County, Cal-Atlas; Map Date: 4/21/2026.

Table R-6 Sacramento Delta – High Hazard Dam (Inside the County) Inundation Areas Geographical Extents by Delta Jurisdiction

Jurisdiction / Dam Inundation Area	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Elk Grove						
Nimbus	137	0.1%	81	0.1%	56	0.1%
Isleton						
Nimbus	233	0.2%	66	0.1%	167	0.3%
Sacramento						
Nimbus	4,733	4%	3,416	6%	1,316	3%
Unincorporated Sacramento County						
Nimbus	88,484	84%	49,181	90%	39,303	76%

Source: DSOD

Figure R-7 Sacramento Delta – High Hazard Dam (Outside the County) Inundation Areas



FOSTER MORRISON
CONSULTING

0 5 10 Miles

SACRAMENTO
COUNTY

Data Source: DWR DSOD dam inundations (updated 7/2025; data downloaded 10/2025),
NID dam inventory and inundation data (updated 11/6/2025; data downloaded 11/6/2025),
CalOES CIP dam inundation data (3/2017),
Sacramento County, Cal-Atlas; Map Date: 4/21/2026.

Table R-7 Sacramento Delta – High Hazard Dam (Outside the County) Inundation Areas Geographical Extents by Delta Jurisdiction

Jurisdiction	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Unincorporated Sacramento County						
Jackson Creek	6,066	6%	1,973	4%	4,093	8%

Source: DSOD

Drought & Water Shortage

Likelihood of Future Occurrence–Likely

Vulnerability–Medium

Hazard Profile and Problem Description

Drought is a complex issue involving 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. 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 and is critical for agriculture, manufacturing, tourism, recreation, and commercial and domestic use. As the population in the area continues to grow, so will the demand for water.

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. This is the case for the Delta.

Location and Extent

Drought and water shortage are regional phenomenon. The whole of the County, as well as the whole of the Delta, is at risk. The US Drought Monitor categorizes drought conditions with the following scale:

- None
- D0 – Abnormally dry
- D1 – Moderate Drought
- D2 – Severe Drought
- D3 – Extreme drought
- D4 – Exceptional drought

Drought has a slow speed of onset and a variable duration. Drought can last for a short period of time, which does not usually affect water shortages and for longer periods. Should a drought last for a long period of time, water shortage becomes a larger issue. Current drought conditions in the Delta and the County are shown in Section 4.3.9 of the Base Plan.

Past Occurrences

Delta Events

Since drought is a regional phenomenon, past occurrences of drought for the Delta are the same as those for the County and includes 5 multi-year droughts since 1950. Details on past drought occurrences can be found in Section 4.3.9 of the Base Plan. Events that had larger effects on the City of Isleton or individual Delta Districts can be found in their respective Chapters of this Delta Annex.

Climate Change and Drought and Water Shortage

It is likely that climate change will increase the chance of future occurrence as well as future impacts associated with drought and water shortage.

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 2024 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.

The June 2025 Delta Adapts Climate Adaptation Plan noted that Delta water exports will be less reliable in the future. Climate change will reduce Delta exports and reservoir storage in all water year types, with greater impacts in dry years, increasing drought vulnerability. Projected reductions in Delta exports of approximately 10 to 20 percent annually by 2050 (or approximately 500,000 acre-feet per year) will have far-ranging consequences for water users throughout the state. It is critical for Delta water users to continue planning for future drought conditions, because when Delta water is needed the most, it will likely be less available.

Cal Adapt scenarios for modeled future drought scenarios were shown in Section 4.3.9 of the Base Plan.

Vulnerability to Drought and Water Shortage

Based on historical information, the occurrence of drought in California, including the Delta, 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 can be 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.

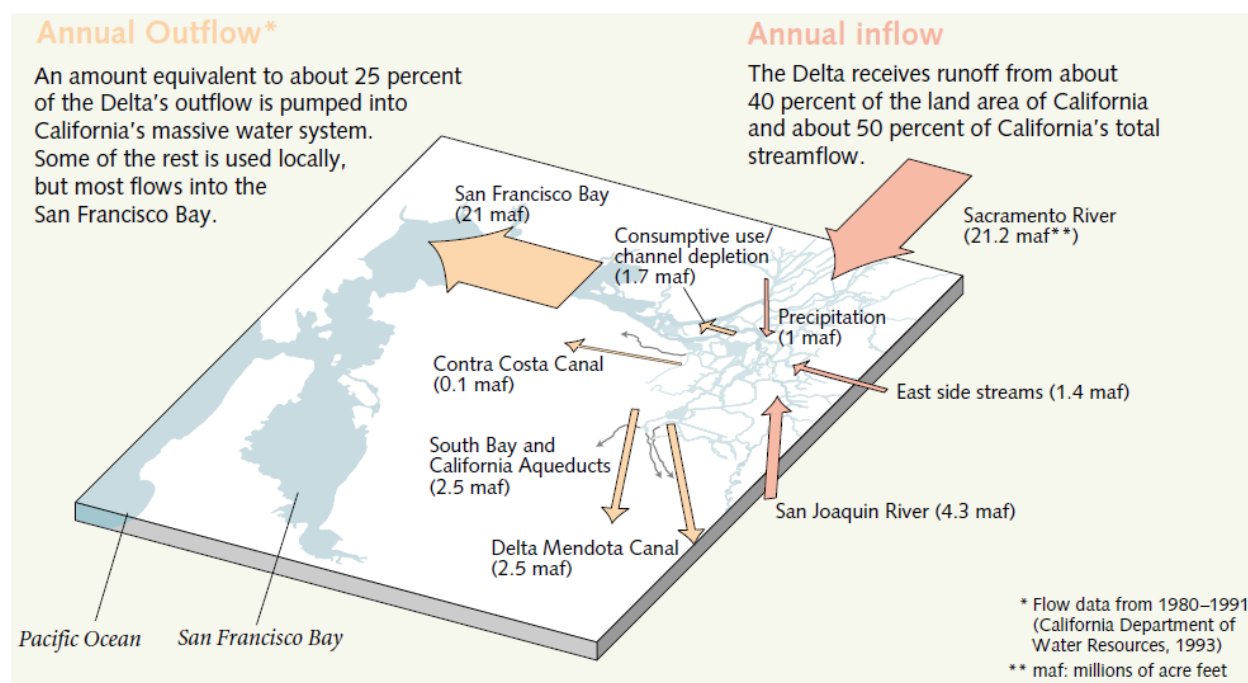
The vulnerability of the Delta to drought is Delta-wide, but impacts may vary and may include reduction in water supply and an increase in dry fuels. The potential for a reduction in water supply during drought conditions generally leads to both mandated and voluntary conservation measures during extended droughts. During these times, the costs of water can also increase. Other qualitative impacts associated with drought in the Delta and Sacramento County Planning Area are those related to water intensive

activities such as, municipal usage, commerce, tourism, recreation and agricultural use. Drought conditions can also cause soil to compact and not absorb water well, potentially making an area more susceptible to flooding.

Impacts

There are also issues posed to the State of California from drought in the Delta. 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 R-8. 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) get at least part of its drinking water from the Delta.

Figure R-8 The Delta and California's Water System



Source: USGS Publication "Sacramento-San Joaquin Delta: The Sinking Heart of the State." Report FS-005-00. Retrieved 4/30/2021

With more precipitation likely falling as rain instead of snow in the Sierra's, and warmer temperatures causing decreased snowfall to melt faster and earlier, water supply is likely to become more unreliable. In addition, drought and water shortage is predicted to become more common. This means less water available for use over the long run, and additional challenges for water supply reliability, especially during periods of extended drought.

In the Delta, drought has multiple effects. It has an economic effect on the agricultural industry, as high value crops are raised on many of the Delta islands. Prolonged drought can also exacerbate subsidence in the Delta.

The 2025 Delta Adapts Climate Adaptation Plan noted that pervasive reductions in carryover storage are expected under future climate conditions across all water year types, especially during abnormally dry years. Under current conditions, simulations demonstrate that 8 million acre-feet of water are typically carried over from September into the first year of a water supply drought (as defined in the Water Supply Technical Memorandum). Projected carryover storage prior to the first year of the drought would be reduced by nearly 10 percent in 2050. These reductions will contribute to increasing drought severity and reduced Delta exports in the future. For example, Delta exports during a drought like 2012 to 2016 would be approximately 20 percent less were that drought to occur in 2050.

Municipal and industrial water users outside the Delta that rely on CVP and SWP exports may experience economic losses due to future droughts above and beyond the annual losses discussed above due to average changes in climate conditions. Additional economic losses during a drought similar to 2012 to 2016, were it to occur under 2050 climate conditions, may cost urban agencies an additional \$17 billion due to curtailment of economic activities as a result of water restrictions and conservation during the latter years of the drought. Reductions in CVP and SWP water deliveries to agricultural water users outside the Delta during such a drought, may result in an additional 243,000 acres of croplands being fallowed relative to projected 2050 production, resulting in exposure of an additional \$762 to \$921 million per year in agricultural production to water supply vulnerabilities due to reduced water supply and costs of groundwater replacement during and after the drought.

Future Development

The Delta has large amounts of surface water available. However, population growth in the area and larger County will add additional pressure to water companies during periods of drought and water shortage. The June 2025 Delta Adapts Climate Adaptation Plan noted that rarely occurring drought events – such as the drought that occurred between 2012 to 2016 – will become more frequent and severe in the future. Reductions in Delta exports during future similar droughts will have considerable impacts to municipal, industrial, and agricultural activities throughout the State.

Earthquake (w/subhazards)

Likelihood of Future Occurrence–Occasional

Vulnerability–Extremely High

Hazard Profile and 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.

Liquefaction Potential

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 of levees in the Delta could occur, due to the nature of the makeup of the soil used in the Delta levees.

Location and Extent

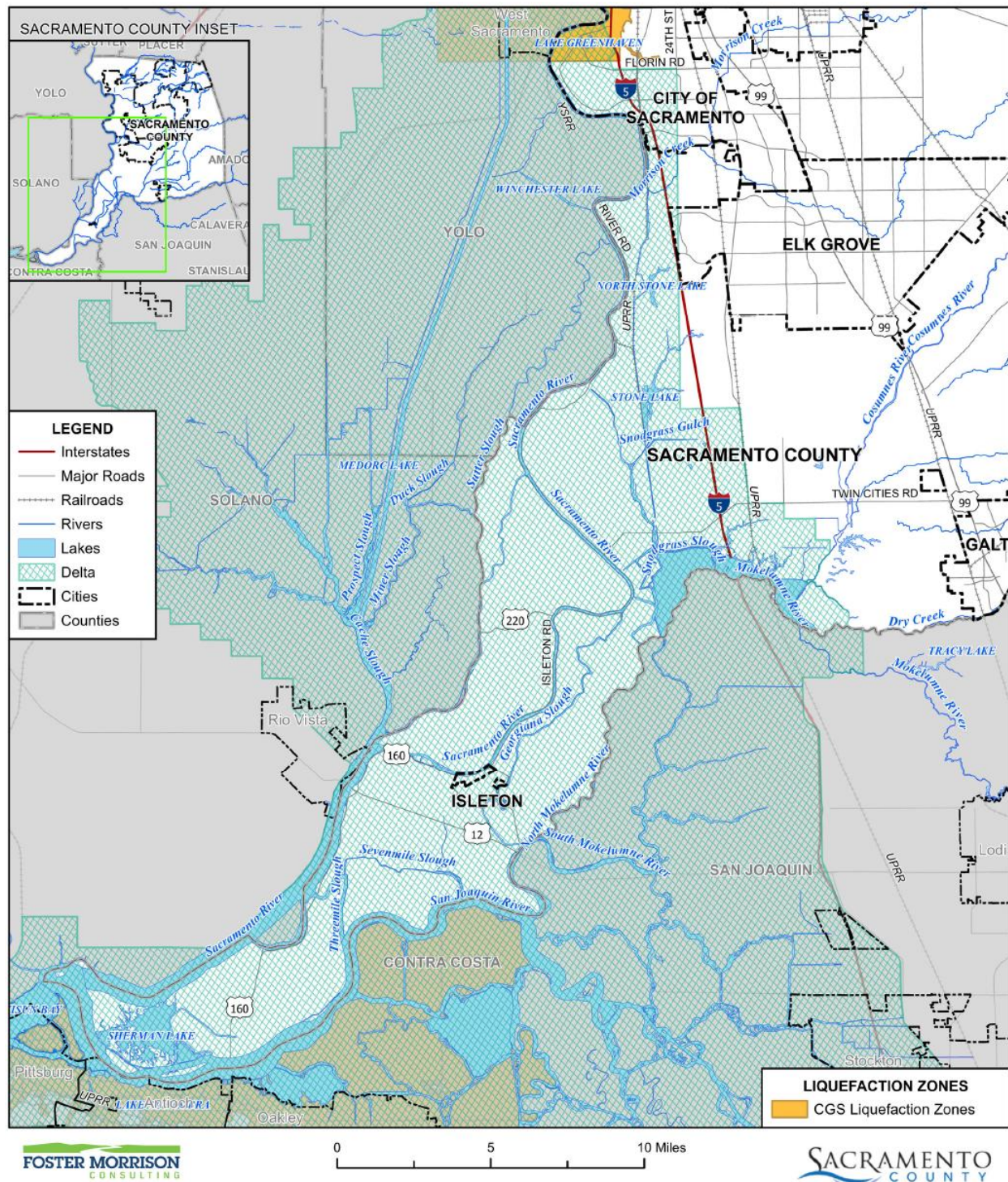
Since earthquakes are regional events, the whole of the Delta is at risk to earthquake. The amount of energy released during an earthquake is usually expressed as a magnitude and is measured directly from the earthquake as recorded on seismographs. An earthquake's magnitude is expressed in whole numbers and decimals (e.g., 6.8). Seismologists have developed several magnitude scales, as discussed in Section 4.3.10 of the Base Plan. Another measure of earthquake severity is intensity. Intensity is an expression of the amount of shaking at any given location on the ground surface. Seismic shaking is typically the greatest cause of losses to structures during earthquakes. The District is located in an area where earthquakes of some magnitude occur, so both magnitude and intensity of earthquakes are expected to remain moderate. Seismic shaking maps for the area in Section 4.3.10 of the Base Plan show Plumas County and the District fall within a low to moderate shake risk.

The Delta, Sacramento County, and surrounding areas have some level of risk from seismic and geologic hazards. Faults in and around the Delta are shown in Section 4.3.10 of the Base Plan. 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 and silt in the levees and their foundations indicate that liquefaction is also a possibility.

Liquefaction mapping has begun in Sacramento County (released in 2025) by the California Geological Survey. This mapping does not yet extend fully into the Delta area. Geographical liquefaction extents

(from the 2025 mapping) are shown on Figure R-9 and detailed in Table R-8. Thus, based on the available CGS mapping, only the City of Sacramento has areas within the legal Delta boundary mapped within a CGS liquefaction zone. This may change as additional areas within the Sacramento Delta are mapped.

Figure R-9 Sacramento County Delta – Liquefaction Zones



Data Source: CGS Liquefaction Zones 2015 (Sacramento West and East Quads updated 11/20/2025), Sacramento County. Cal-Atlas: Map Date: 4/21/2026.

Table R-8 Sacramento County Delta – Geographical Liquefaction Zone Extents by Jurisdiction

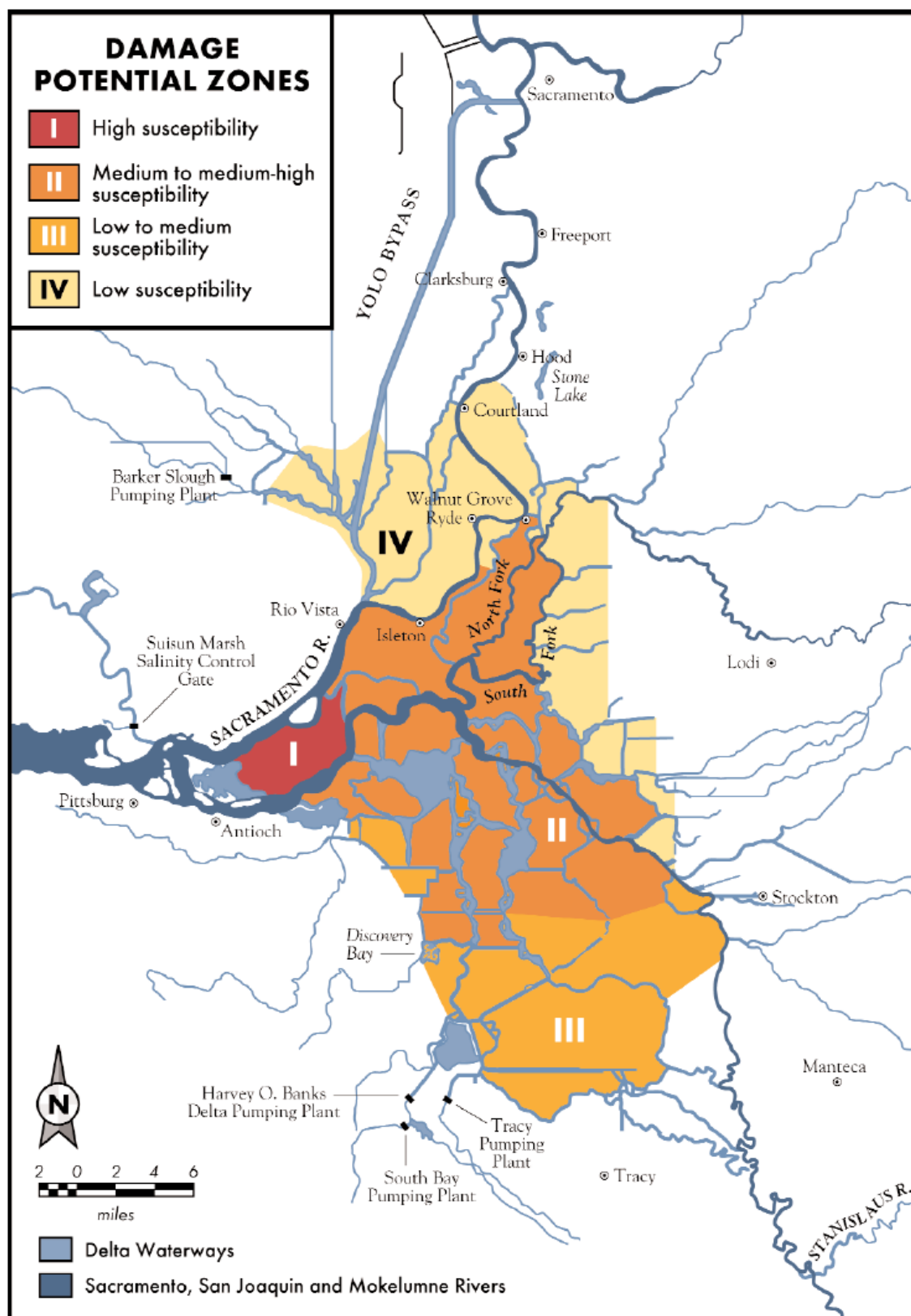
Within a Liquefaction Zone	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
City of Sacramento	1,134	1.1%	796	1.5%	338	0.7%

Source: CGS Liquefaction Zones 2015 (Sacramento East and West Quads updated 11/20/2025).

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.

A preliminary analysis of the risk of levee failure due to seismicity was prepared for the CALFED Levee System Integrity Program in 2014. Based on standard methods and local expertise, it 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 R-10). 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 R-10 Delta Area – Potential Damage Due to Liquefaction and Levee Collapse



Source: CALFED, 2014

The CALFED 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 0.01 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 recent nearby 1989 and 2014 events); 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.

Past Occurrences

Although no historic examples of seismically induced levee failure are known in the Delta, the modern levee network has not been subjected to strong shaking. Levees were either smaller or non-existent in 1906 when the region was strongly shaken by the great San Francisco earthquake. In addition, the levees performed well during the 1989 earthquake in San Francisco and the 2014 earthquake in south Napa. Neither earthquake caused liquefaction problems to Delta levees. Events that had larger effects on the City of Isleton or individual Delta Reclamation Districts can be found in their respective Chapters of this Delta Annex.

Climate Change and Earthquake

Climate change is unlikely to increase earthquake frequency or strength. As such, liquefaction is also not expected to be exacerbated by climate change.

Vulnerability to Earthquake (w/subhazards)

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.

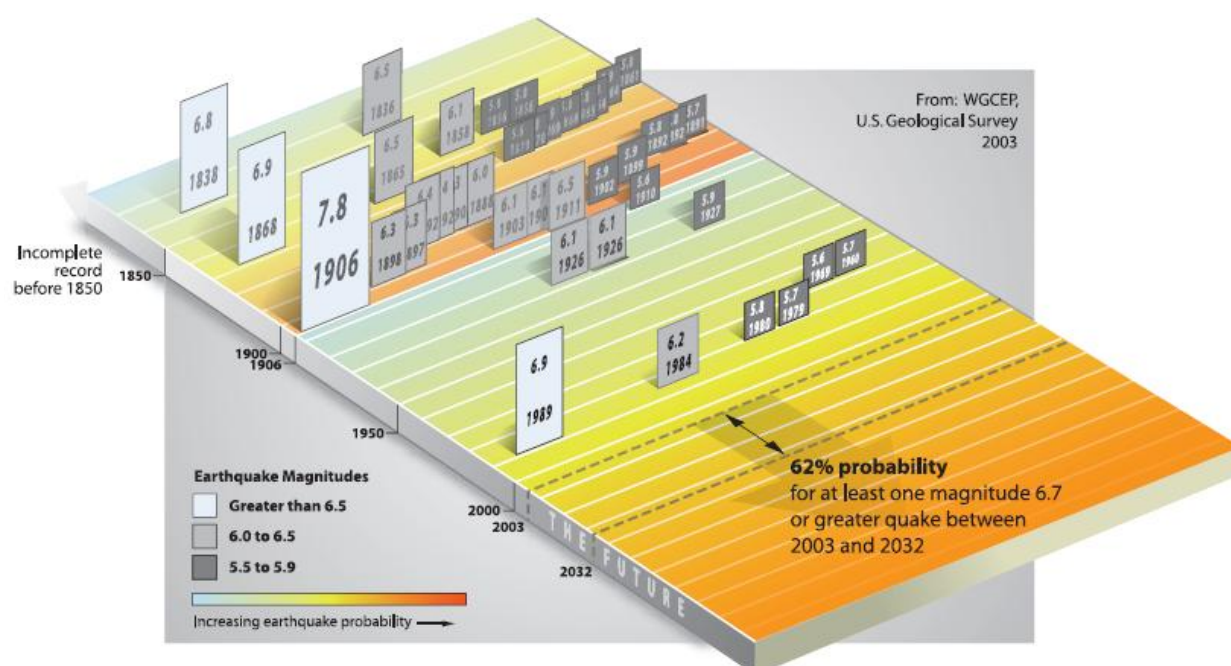
The June 2021 Delta Adapts Climate Vulnerability Assessment noted that while seismic risk is not evaluated by Delta Adapts, the Delta Levee Investment Strategy (Council 2017) evaluated the probability of hydraulic and seismic flooding of Delta levees and found that islands in the western and central Delta

tend to have the highest probability of seismically induced flooding. Flood exposure of contaminants and hazardous materials can also result in secondary impacts to humans and the natural ecosystem.

Impacts

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 (see Figure R-11). 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 R-11 Past and Future Earthquakes in the San Francisco Bay Area and the Delta



Source: DRMS Risk Report (URS/JBA 2008c) Figure 13-8. Retrieved 4/30/2021

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, the DRMS report also noted recent smaller and closer earthquakes were also evaluated. They include: the 1980 Livermore Earthquake (M 5.8) and the 1984 Morgan Hill Earthquake (M 6.2). 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.

Flooding Risk

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 R-9. This is not only due to the extensive amount 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 R-9 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 2009

In addition to dewatering costs, the Delta contains improved parcels at risk to flooding.

Water Quality Risk

Earthquake damage to levees and to the islands they protect could take years to repair following a major earthquake. One significant impact of levee failures would be to the state's water supply. For example, if 20 islands were flooded as a result of a major earthquake, the export of fresh water from the Delta could be interrupted for about a year and a half. Water supply losses of up to 8 million acre-feet would be incurred by State and federal water contractors and local water districts.

If subsided Delta islands are flooded due to levee breaches, significant amounts of dissolved organic carbon [DOC] would be released into Delta waters from the highly organic peat soils on these islands. Disinfectants used during the drinking water treatment process react with DOC to produce disinfection byproducts in treated water. Many of these chemical byproducts can increase cancer risks or cause other health effects.

Other water quality problems resulting from island flooding include increased algae blooms. Algae blooms can complicate drinking water treatment processes and can adversely affect some aquatic species.

Some soils in the Delta Region contain moderate levels of mercury due, among other things, to historical gold mining activities that occurred upstream of the Delta during the Gold Rush. Mercury in soils can, under certain circumstances, be converted to the highly toxic methylated form when islands are flooded. Methylated mercury can accumulate in the food chain potentially affecting fish. Humans and animals that consume fish contaminated with methylated mercury are at risk of poisoning.

Natural Resources at Risk

In all seismic levee failure scenarios, the area of vegetation impacted increases with the area flooded. The degree of impact depends on the type of vegetation flooded. Results of the DRMS Project indicate potential losses of up to 39 percent of herbaceous wetland, seasonal grasses and low-lying vegetation, 29 percent of non-native trees, and 24 percent of shrub wetland due to an event where multiple islands are flooded. In addition, in Sacramento County, the Delta Area at risk to liquefaction contains highly productive farmland. Should a levee fail, loss of crops would have a large economic impact. Information specific to the losses in Sacramento County were not available.

Population at Risk

The Delta levees most likely to fail due to earthquakes and earthquake liquefaction are generally located in the central-west area of the Delta, some of which is likely to be in the Sacramento County portion of the Delta. Their failure will cause rapid flooding and leave little time for evacuation.

The greatest immediate public safety concern is for the people working and living on Delta islands, and for people traveling through the Delta on various roads and highways. According to the DRMS report, there is a 40 percent probability of 90 or more fatalities in the Delta from levee failures due to a seismic event in the 25-year period from 2005 through 2030. The expected fatalities from earthquake-related island flooding are high due to the lack of warning for earthquakes and because of the rapid rate of flooding likely to occur

after an earthquake. It should be noted that these fatality figures are for the Delta as a whole, and not limited to those areas of the Delta lying within Sacramento County.

Future Development

The consequences of a major earthquake in the Delta 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. According to the DRMS report, total expected economic losses are anticipated to increase by about 200 percent by 2050 and by about 500 percent by 2100. The risk of fatalities is expected to increase, on average, by about 250 percent from 2005 to 2050. It should be noted that these economic figures are for the Delta as a whole and not limited to those areas of the Delta lying within Sacramento County.

Flood: 1%/0.5%/0.2% Annual Chance

Likelihood of Future Occurrence—Occasional/Unlikely

Vulnerability—Extremely High

Hazard Profile and Problem Description

This hazard analyzes the FEMA DFIRM 1%, 0.5%, and 0.2% annual chance floods. These tend to be the larger floods that can occur in the County or in the Delta, and have caused damages in the past. Flooding is a significant problem in Sacramento County and the Delta. Historically, the Delta has been at risk to flooding primarily during the winter and spring months when river systems in the County swell with heavy rainfall and snowmelt runoff. Normally, storm floodwaters are kept within defined limits by a variety of storm drainage and flood control measures. Occasionally, extended heavy rains result in floodwaters that exceed normal high-water boundaries and cause damage. Flooding has occurred both within the 1%, 0.5%, and 0.2% annual chance floodplains and in other localized areas.

As previously described in Section 4.3.11 of the Base Plan, the Sacramento County Planning Area and the Delta have been subject to historical flooding.

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, long-term solutions often involve much more than just bank stabilization.

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.

Addressing the problem of streambank erosion requires an understanding of both stream dynamics and the management of streamside vegetation. 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.

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 did 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.

Location and Extent

The Delta Region lies within a floodplain and is faced with a major flooding problem because of an aging levee system and issues associated with subsidence, seepage, erosion and seismicity. Flooding has occurred in some parts of the Delta on the average of once every three and one-half to four years. While construction of upstream reservoirs has reduced the threat of flooding and levee overtopping, Delta area flooding and the potential for levee failures continue to be a serious problem. Since 1950, levee failures and associated flooding have been twice as likely to be caused by foundation or levee instability than by overtopping. The condition of Delta levees has been deteriorating over time and flooding frequency increasing. Although there are currently efforts to improve levee infrastructure throughout the Delta region, flood protection is generally inadequate except in some areas protected by federally built or “project” levees. However, with the increase in greater intensity storms, sea level rise, and other climate change issues, combined with older levees built to often outdated standards, flooding, including levee failure flooding will continue to be a significant concern in the Delta.

The Delta has areas located in the 1%, and 0.2% annual chance flood zones. This is seen in Figure R-12. In accordance with the Central Valley Flood Protection Project, a 0.5% annual chance flood zone (i.e., 200-year) map is shown for the Sacramento County Planning Area in section 4.3.11 of the Base Plan and includes areas in the 200-year floodplain for the cities of Elk Grove, Isleton, Rancho Cordova, and Sacramento and Unincorporated Sacramento County. Utilizing the 200-year map for the Planning Area, portions of the Delta fall within the 0.5% annual chance flood zone. No additional analysis was conducted on the 0.5% annual chance flood zones as part of this LHMP.

Figure R-12 Sacramento County Delta – FEMA DFIRM Flood Zones

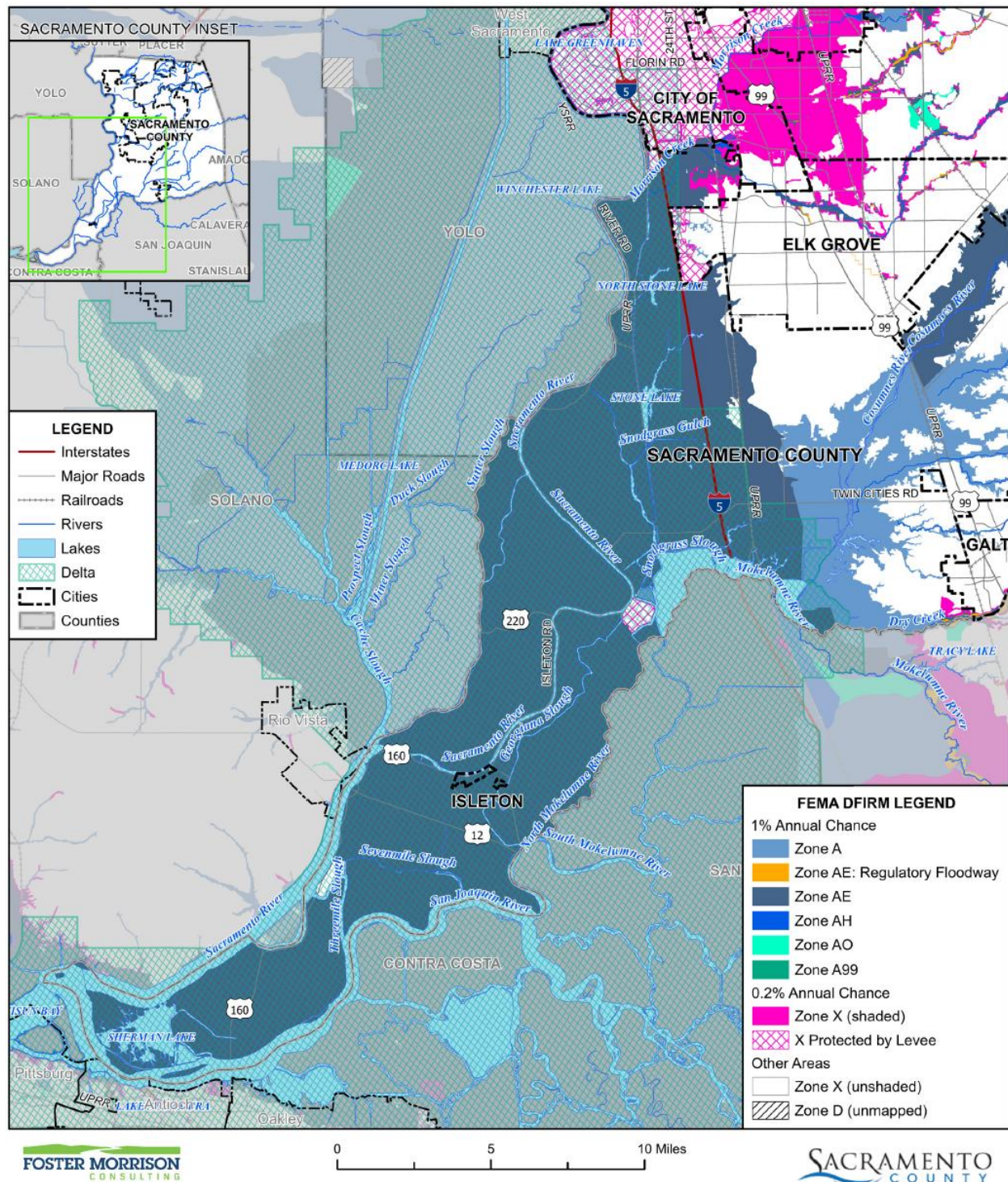


Table R-10 details the 1% and 0.2% annual chance DFIRM mapped flood zones located within the Delta.

Table R-10 Sacramento County Delta– DFIRM Flood Hazard Zones

Flood Zone	Description	Flood Zone Present in the Delta
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.	
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.	
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)	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)	Areas of minimal flood hazard	X
D	Unmapped areas	

Source: FEMA

Additionally, flood extents can generally be measured in volume, velocity, and depths of flooding. Expected flood depths in the Delta vary, depending on the nature and extent of a flood event; specific depths are unknown. Flood durations in the Delta tend to be short to medium term, or until either the storm drainage system can catch up or flood waters move downstream. Flooding in the Delta tends to have a shorter speed of onset, due to the amount of water that flows through the Delta.

Geographical flood extents for the Delta from the FEMA DFIRMs are shown in Table R-11.

Table R-11 Sacramento County Delta – Geographical DFIRM Flood Zone Extents by Jurisdiction

Jurisdiction / Flood Zone	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Elk Grove						
1% Annual Chance Flood Hazard	12	0.01%	1	0.00%	11	0.02%
0.2% Annual Chance Flood Hazard	119	0.11%	74	0.14%	45	0.09%
Other Areas	6	0.01%	6	0.01%	0	0.00%
Elk Grove Total	137	0.13%	81	0.15%	56	0.11%
Isleton						
1% Annual Chance Flood Hazard	220	0.21%	61	0.11%	159	0.31%
0.2% Annual Chance Flood Hazard	0	0%	0	0%	0	0%
Other Areas	13	0.01%	5	0.01%	9	0.02%
Isleton Total	233	0.22%	66	0.12%	167	0.33%
Sacramento						
1% Annual Chance Flood Hazard	266	0.25%	20	0.04%	246	0.48%
0.2% Annual Chance Flood Hazard	4,452	4%	3,395	6%	1,057	2%
Other Areas	15	0.01%	1	0.00%	13	0.03%
Sacramento Total	4,733	4%	3,416	6%	1,316	3%
Unincorporated Sacramento County						
1% Annual Chance Flood Hazard	99,634	94%	50,308	92%	49,326	96%
0.2% Annual Chance Flood Hazard	662	1%	442	1%	220	0.4%
Other Areas	453	0.4%	94	0.2%	359	1%
Unincorporated Sacramento County Total	100,749	95%	50,844	93%	49,905	97%

Jurisdiction / Flood Zone	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Grand Total	105,852	100%	54,407	100%	51,445	100%

Source: FEMA DFIRM 02/22/2024

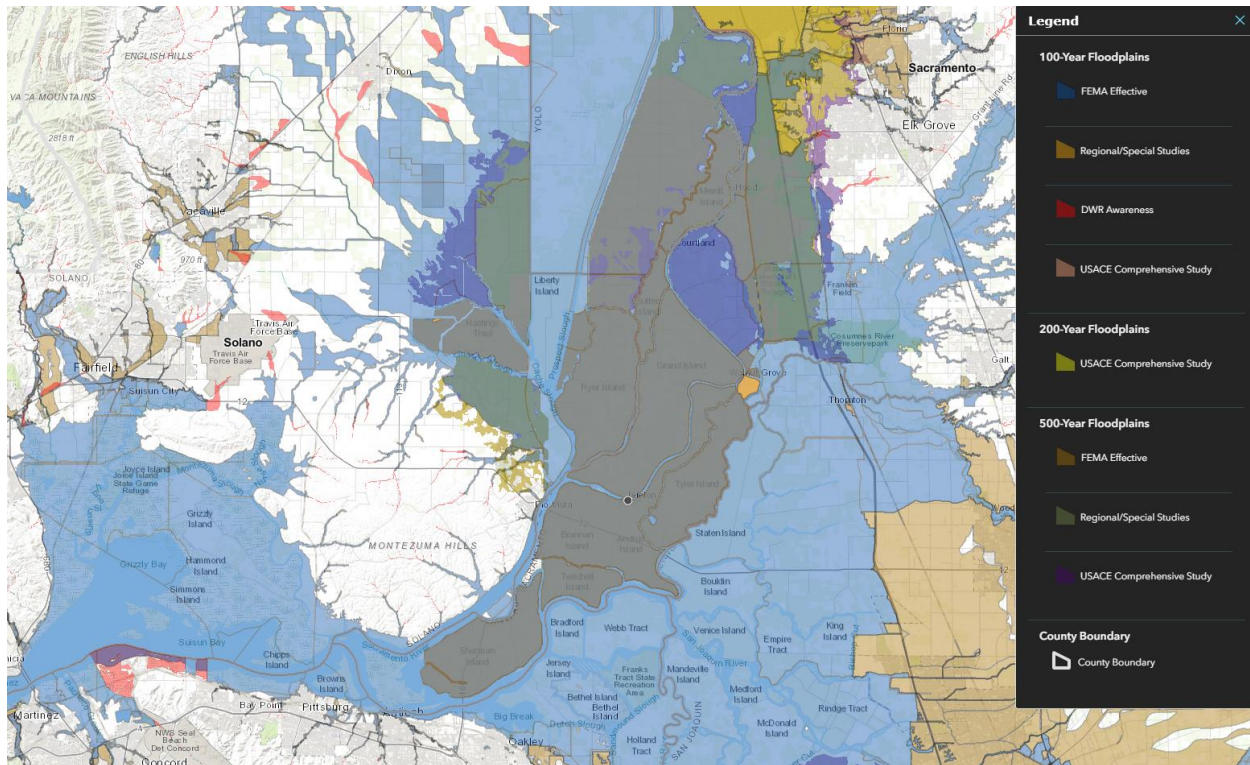
California Department of Water Resources Best Available Maps (BAM)

The FEMA regulatory maps provide just one perspective on flood risks in Sacramento County. Senate Bill 5 (SB 5), enacted in 2007, authorized the California DWR to develop the Best Available Maps (BAM) displaying 100- and 200-year floodplains for areas located within the Nevada-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 500-year floodplains.

Different than the FEMA DFIRMs which have been prepared to support the NFIP and reflect only the 100-year event risk, the BAMs are provided for informational purposes and are intended to reflect current 100-, 200-(as applicable), and 500-year event risks using the best available data. The 100-year floodplain limits on the BAM are a composite of multiple 100-year floodplain mapping sources. It is intended to show all currently identified areas at risk for a 100-year flood event, including FEMA's 100-year floodplains. The BAM are comprised of different engineering studies performed by FEMA, Corps, and DWR for assessment of potential 100-, 200-, and 500-year 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 Delta than that provided in the FEMA DFIRMs. The BAM map for the Delta is shown in Figure R-13.

Figure R-13 Sacramento County Delta – Best Available Map



Source: California DWR, Retrieved 12/1/2025

Legend explanation: **Blue** - FEMA 100-Year, **Orange** – Local 100-Year (developed from local agencies), **Red** – DWR 100-year (Awareness floodplains identify the 100-year flood hazard areas using approximate assessment procedures.), **Pink** – USACE 100-Year (2002 Sac and San Joaquin River Basins Comp Study), **Yellow** – USACE 200-Year (2002 Sac and San Joaquin River Basins Comp Study), **Tan** – FEMA 500-Year, **Grey** – Local 500-Year (developed from local agencies), **Purple** – USACE 500-Year (2002 Sac and San Joaquin River Basins Comp Study).

Past Occurrences

A list of federal and state disaster declarations for Sacramento County from flooding (including heavy rains and storms) is shown on Table R-12.

Table R-12 Sacramento County – Federal and State Disaster Declaration from Flood 1950-2025

Disaster Type	State Declarations		Federal Declarations	
	Count	Years	Count	Years
Flood (including heavy rains and storms)	26	1950, 1955, 1958 (twice), 1963, 1969, 1982 (twice), 1983, 1986, 1995 (twice), 1996, 1997, 1998, 2008, 2017 (three times), 2022*, 2023 (three), 2024 (twice)	18	1955, 1958, 1964, 1969, 1983, 1986, 1995 (twice), 1997, 1998, 2006, 2017 (three times), 2023 (three times)*, 2024*

Source: Cal OES, FEMA

*included a landslide component.

Flooding is a frequent occurrence in the Delta area during extreme rain and storm events. The 2024 FIS noted that the Sacramento-San Joaquin Delta area has a long history of flooding. That information is included in Appendix I.

Due to the presence of numerous levees in the Delta Area and their role in flooding, flooding past occurrences associated with levee failure are discussed in the Past Occurrence section in Levee Failure section below. Events that had larger effects on the City of Isleton or individual Delta Districts can be found in their respective Chapters of this Delta Annex.

Climate Change and Flood: 1%, 0.2%, and 0.5% annual chance

It is likely that climate change will increase the chance of future occurrence as well as future impacts associated with flood.

According to the 2024 CAS, climate change may affect flooding in California, the Sacramento County Planning Area, and the Delta. 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. Cal Adapt future precipitation projections were shown in Section 4.3.4 of the Base Plan.

Vulnerability to Flood: 1%, 0.5%, and 0.2% Annual Chance

The June 2021 Delta Adapts Climate Vulnerability Assessment noted that the Delta is an inherently flood prone area and low-lying rural and urban communities are protected from flooding by a complex system of levees within the Delta and by multipurpose reservoirs in upstream tributaries. Approximately 1,330 miles of levees in the Delta and Suisun Marsh reduce flood risk for approximately 740,000 acres of land, including residential, commercial, industrial, agricultural, and ecological uses. In addition to reducing flood risk, some Delta levees provide a critical role in maintaining conveyance channels and hydrodynamic conditions suitable for the operation of the State and Federal water projects and maintenance of Delta salinity conditions, which allow freshwater to be withdrawn from the central and south Delta. Delta levees also protect wildlife habitat areas for waterfowl and other species that depend on the levees for effective habitat management.

The 2024 Flood Insurance Study (FIS) noted that 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.

Impacts from Flood

Floods have been a part of the Delta's historical past and will continue to be so in the future. During winter months, long periods of precipitation and the timing of that precipitation are critical in determining the

threat of flood, and these characteristics further dictate the potential for widespread structural and property damages. 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. Public 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 are among the costliest natural disasters in terms of human hardship and economic loss nationwide. 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. 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. 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. Other problems connected with flooding and stormwater runoff include erosion, sedimentation, degradation of water quality, loss of environmental resources, and economic impacts.

Future Development

The potential for flooding may increase as floodwaters are channeled due to land development. Such changes can exacerbate flooding problems inside and outside of natural floodplains by altering or confining natural drainage channels. Floodplain modeling and master planning for future development should be based on build out property use to ensure that all new development remains safe from future flooding. While local floodplain management, stormwater management, and water quality regulations and policies address these changes on a site-by-site basis, their cumulative effects can have a negative impact on the overall floodplain.

The 2025 Delta Adapts: Climate Adaptation Plan noted that future flooding will continue to get worse. Flood risk is one of the most pressing threats to the Delta and will continue to worsen in the future. The central and southern Delta will face the greatest impacts. This risk underscores the importance of investment in levee maintenance and flood related improvements over the coming decades.

Flood: Localized Stormwater Flooding

Likelihood of Future Occurrence—Highly Likely

Vulnerability—Medium

Hazard Profile and Problem Description

Flooding occurs in areas other than the FEMA mapped 1% and 0.2% (as well as the DWR 0.5%) annual chance 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.

Location and Extent

The Sacramento County Delta is subject to localized flooding throughout the region. Flood extents are usually measured in areas affected, velocity of flooding, and depths of flooding. Expected flood depths in the Delta vary by location. Flood durations in the Delta tend to be short to medium term, or until either the storm drainage system can catch up or flood waters move downstream. Localized flooding in the Delta tends to have a shorter speed of onset, especially when antecedent rainfall has soaked the ground and reduced its capacity to absorb additional moisture.

Past Occurrences

Past occurrences to localized flooding varies by area. Events that had larger effects on the City of Isleton or individual Delta Districts can be found in their respective Chapters of this Delta Annex.

Climate Change and Flood: Localized Stormwater Flooding

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 to Localized Flooding

Historically, much of the growth in the Delta and 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.

Impacts

Primary concerns associated with stormwater flooding include impacts to infrastructure that provides a means of ingress and egress throughout the community. Ground saturation can result in instability, collapse, or other damage to trees, structures, roadways and other critical infrastructure. Objects can also be buried or destroyed through sediment deposition. Floodwaters can break utility lines and interrupt services. Standing water can cause damage to crops, roads, and foundations. Other problems connected with flooding and stormwater runoff include erosion, sedimentation, degradation of water quality, losses of environmental resources, and certain health hazards.

Future Development

The risk of localized flooding to future development can also be minimized by accurate recordkeeping of repetitive localized flooding. Mitigating the causes of the localized stormwater flooding will reduce future risks of losses. Similar to the rest of the Sacramento County Planning Area, future events of atmospheric

river flooding are expected to affect the Delta both in the near term and the long term, compounding the issues associated with localized flooding.

Levee Failure

Likelihood of Future Occurrence—Occasional

Vulnerability—Extremely High

Hazard Profile and 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 channel of a stream. By confining the flow to a narrower stream channel, levees can also increase the speed of the water. Levees can be natural or man-made.

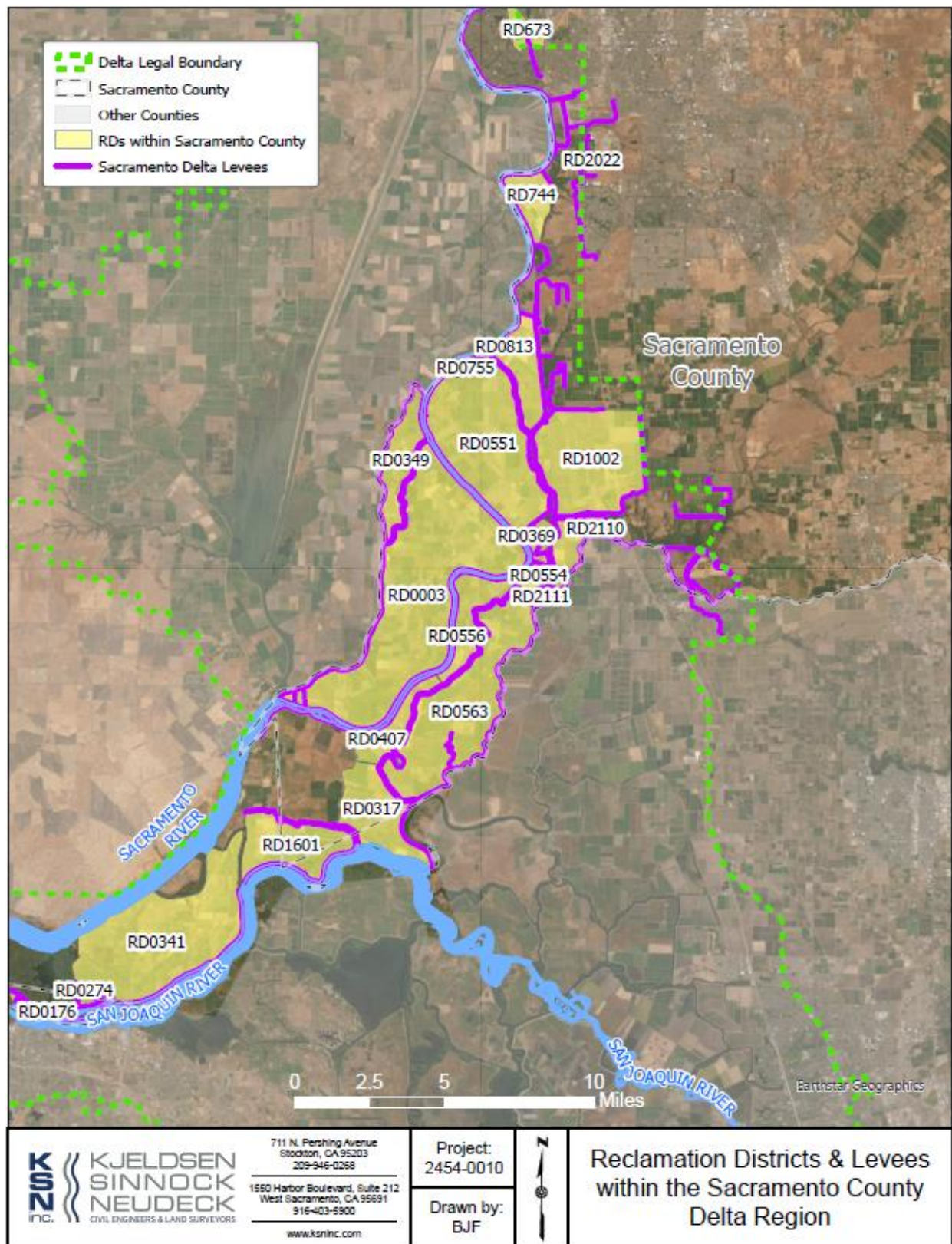
Levees provide strong flood protection, but they are not failsafe. Levees are designed to protect against a specific flood level and could be overtopped during severe weather events or dam failure. For example, levees can be certified to provide protection against the 1% and 0.2% annual chance flood. 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. Levee failure can occur through overtopping or from seepage issues resulting from burrowing rodents, general erosion, excessive vegetation and root systems and other factors that compromise the integrity of the levee. 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.

Approximately 1,115 miles of levees in the Delta and 230 miles of levees in Suisun Marsh define the configuration of the waterways and landforms of the area. Most of these levees hold back water (i.e., prevent water from flowing onto the adjacent land) for 365 days per year, not just during floods. Over the years, many state and federal agencies and stakeholders have voiced concern over the condition of the Delta and Suisun Marsh levees and the consequences should they fail.

Location and Extent

There is not a scientific scale or measurement system in place for levee failure. Expected flood depths from a levee failure in the Delta are not known. The speed of onset is slow as the river rises, but if a levee fails the warning times are generally 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. The HMPC noted that when northern California reservoirs are nearing maximum capacity, they release water through the river systems, causing additional burdens on County levees. Levees in the Delta are shown on Figure R-14.

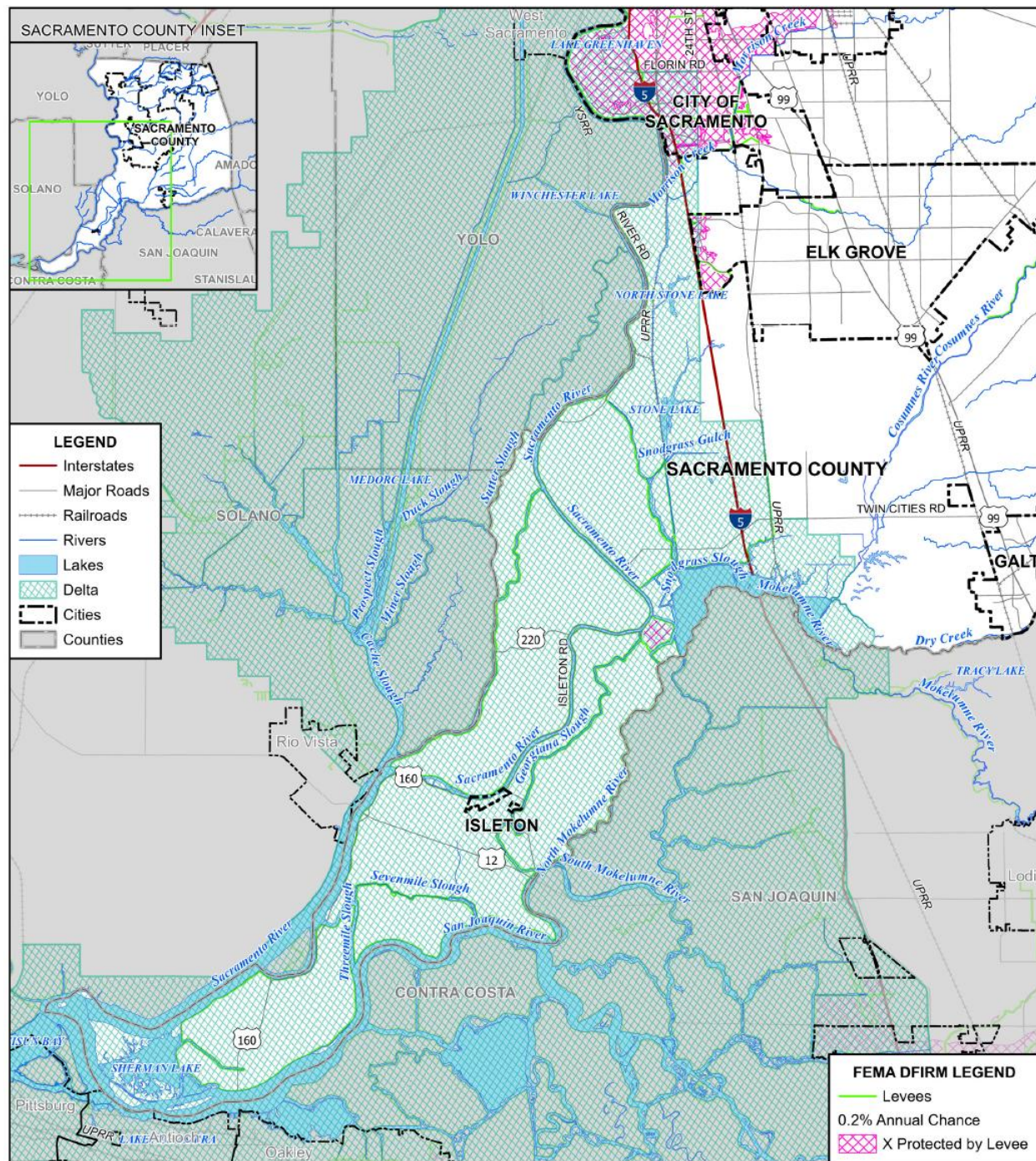
Figure R-14 Delta Levees



Source: KSN

Figure R-15 shows the FEMA DFIRM X Protected by Levee areas in the Delta. X Protected by Levee areas are those which FEMA has determined that the levee meets the standards for providing protection from the 1% Annual Chance Flood. These include only a few locations found in the northern portion of the Delta area and one location further south, located between the Snodgrass and Georgianna Sloughs. Numerous other levees exist throughout the Delta that are not yet certified as providing protection against the 1% annual chance flood. Geographical levee failure flood extents for the Delta from the FEMA DFIRM X Protected by Levee Zone is shown in Table R-13. Much of the rest of the Delta falls in other leveed areas that are not accredited as providing protection from the 1% annual chance flood.

Figure R-15 Sacramento County Delta – DFIRM X Protected by Levee Areas



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CONSULTING

0 5 10 Miles

SACRAMENTO
COUNTY

Data Source: FEMA Effective DFIRM 02/22/2024 (NFHL 10/13/2025 database),
Sacramento County, Cal-Atlas; Map Date: 4/21/2026.

Table R-13 Sacramento County Delta – Geographical DFIRM X-Protected by Levee Extents by Jurisdiction

Jurisdiction / Flood Zone	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Elk Grove						
1% Annual Chance Flood Hazard	12	0.01%	1	0.00%	11	0.02%
0.2% Annual Chance Flood Hazard	119	0.11%	74	0.14%	45	0.09%
Other Areas	6	0.01%	6	0.01%	0	0.00%
Elk Grove Total	137	0.13%	81	0.15%	56	0.11%
Isleton						
1% Annual Chance Flood Hazard	220	0.21%	61	0.11%	159	0.31%
0.2% Annual Chance Flood Hazard	0	0%	0	0%	0	0%
Other Areas	13	0.01%	5	0.01%	9	0.02%
Isleton Total	233	0.22%	66	0.12%	167	0.33%
Sacramento						
1% Annual Chance Flood Hazard	266	0.25%	20	0.04%	246	0.48%
0.2% Annual Chance Flood Hazard	4,452	4%	3,395	6%	1,057	2%
Other Areas	15	0.01%	1	0.00%	13	0.03%
Sacramento Total	4,733	4%	3,416	6%	1,316	3%
Unincorporated Sacramento County						
1% Annual Chance Flood Hazard	99,634	94%	50,308	92%	49,326	96%
0.2% Annual Chance Flood Hazard	662	1%	442	1%	220	0.4%
Other Areas	453	0.4%	94	0.2%	359	1%
Unincorporated Sacramento County Total	100,749	95%	50,844	93%	49,905	97%

Jurisdiction / Flood Zone	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Grand Total	105,852	100%	54,407	100%	51,445	100%

Source: FEMA DFIRM 02/22/2024

*Percentage of total acres is the percent of total acres of the entire County Planning Area, not the total acres of the jurisdiction

Past Occurrences

There have been two state and two federal disaster declaration from levee failure. This can be seen in Table R-14. Also, it is important to note that many of the flood disaster declarations included in the Flood: 1%/0.5%/0.2% Annual Chance Section above (like the December 31, 2022, event near Wilton) also may include flooding associated with levee breach or failure events.

Table R-14 Sacramento County – State and Federal Levee Failure Disaster Declarations 1950-2020

Disaster Type	State Declarations		Federal Declarations	
	Count	Years	Count	Years
Levee Break	2	1972, 1980	2	1972, 1980

Source: Cal OES, FEMA

The 2024 FIS noted that the Sacramento-San Joaquin Delta area has a long history of flooding associated with levee failure. That information is included in Appendix I.

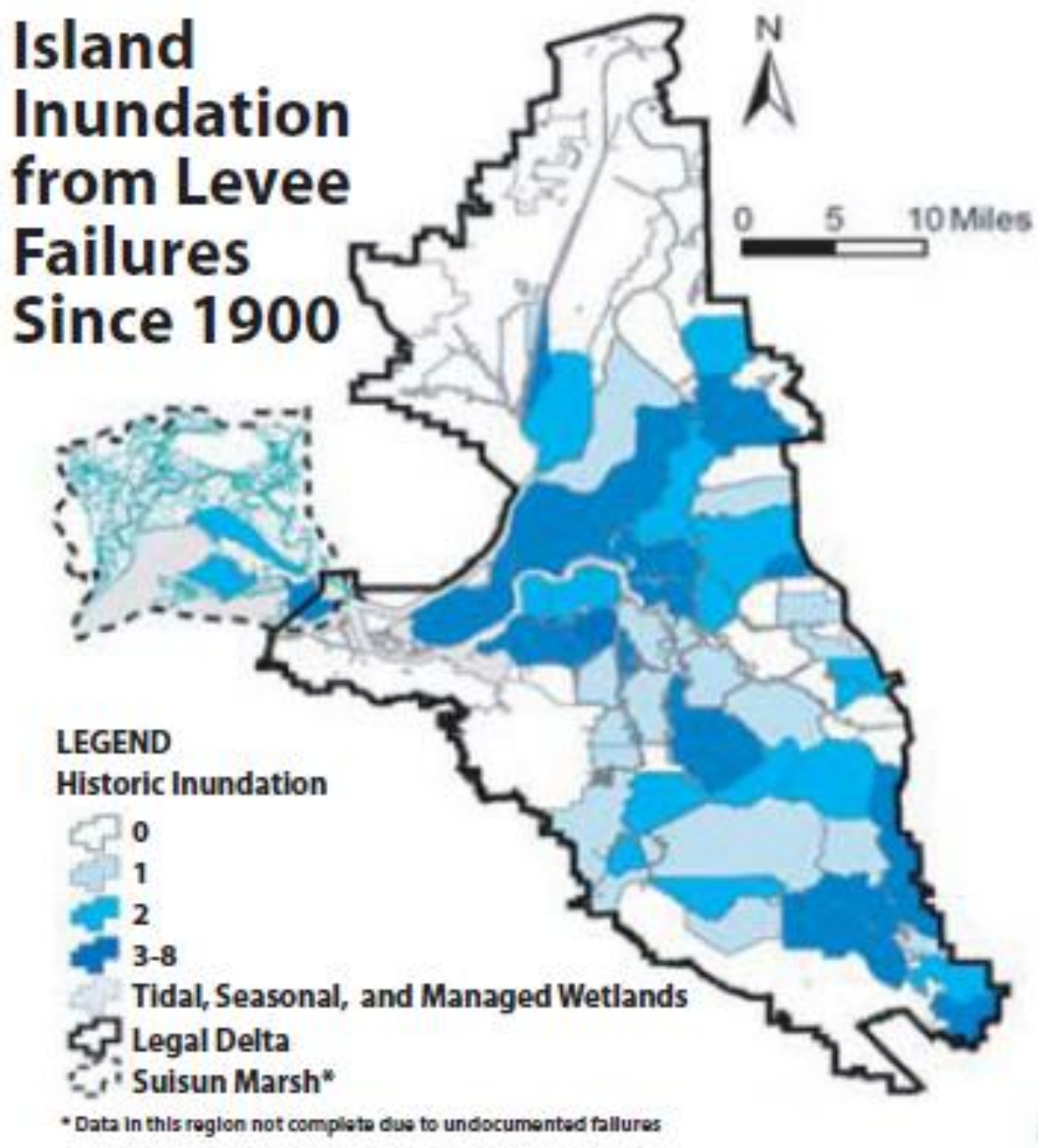
Events since 2021 LHMP

December 2024 (Sherman Island Levee Erosion): Sacramento County declared a local state of emergency after storm damage caused significant erosion to a levee on Sherman Island (south of Rio Vista, near the Sacramento/Solano County line and in the Delta region). The island is inhabited, but the threat of full failure was assessed as low. Repairs were prioritized to protect the island from flooding.

Events prior to 2021

Since the early 1900's. There have been about 100 levee failures and over 165 levee breaches since the early 1900s. However, most of these failures occurred throughout the larger Sacramento-San Joaquin 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 larger Delta region. These historic numbers are not representative of future occurrences within the County, since much work has been done to the levees to decrease their flood risk. Figure R-16 shows the levee failures from 1900 to 2010.

Figure R-16 Island Inundation from Levee Failures from 1900-2010



Source: Levee Failures in the Sacramento-San Joaquin River Delta. URS 2011. Retrieved 3/24/2026.

Some islands have been flooded and recovered multiple times. A few islands, such as Franks Tract in San Joaquin County, have never recovered. Some of the more major levee breaks in Sacramento County are detailed below.

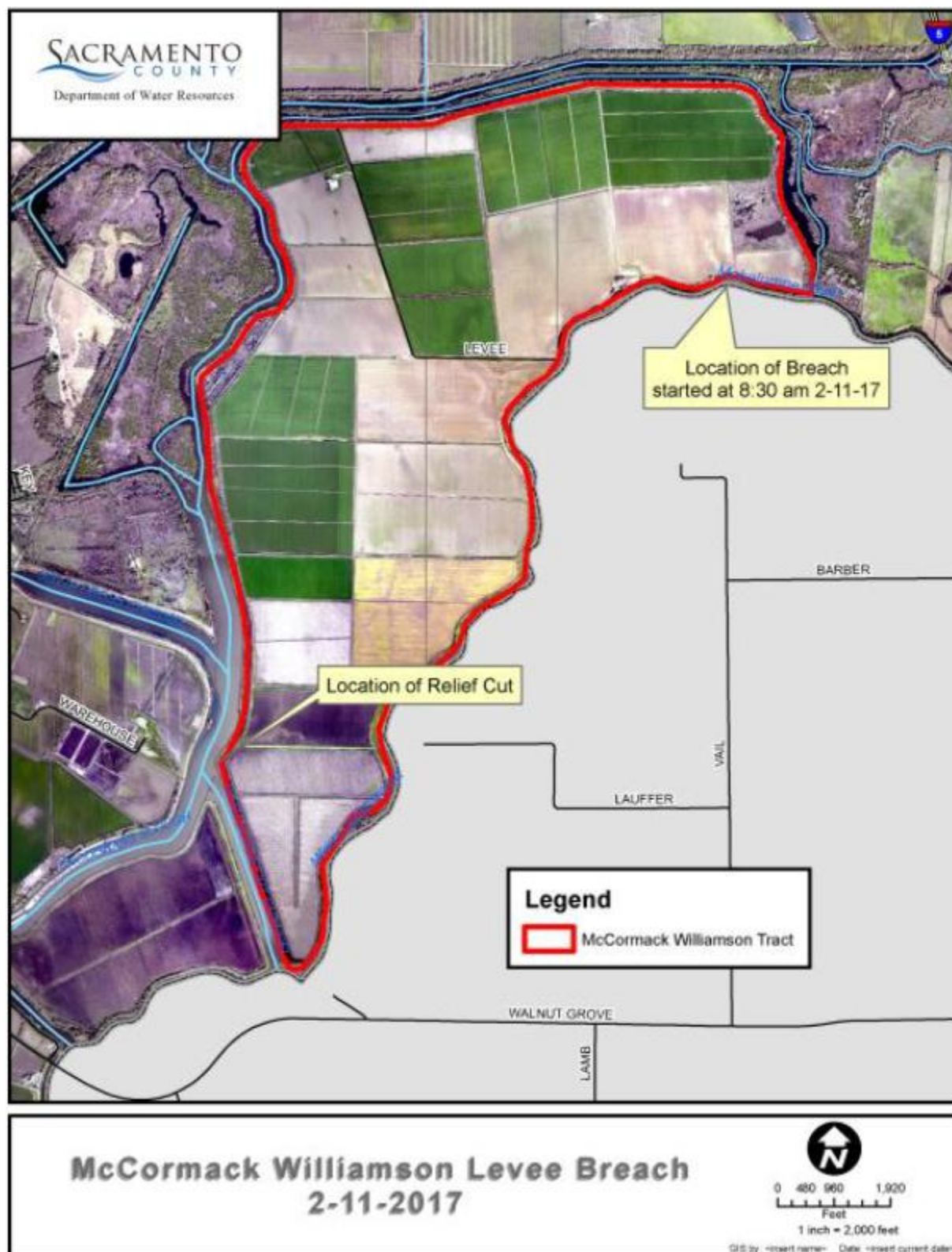
February 18, 2017: The United States Coast Guard Auxiliary provided photos of a levee with scouring in the Pearson Tract. Contacts to MBK Engineers were made regarding identifying the issue and making the necessary repair.

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 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 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 R-17). 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 R-17 Sacramento County – McCormack Williamson Levee Breach



Source: 2017 February Winter Storm After Action Report from Sacramento County OES

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 R-18 New Hope Levee Break



Source: 2017 January Winter Storms After Action Report

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.

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 R-19). 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 R-19 1986 Tyler Island Levee Breach



Source: California Department of Water Resources

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.

Events that had larger effects on the City of Isleton or individual Delta Districts can be found in their respective Chapters of this Delta Annex.

Climate Change and Levee Failure

The 2024 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. In addition, 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.

Vulnerability to Levee Failure

A levee failure can range from a small, uncontrolled release to a catastrophic failure. Levee failure flooding can occur as the result of prolonged rainfall and flooding. The primary danger associated with levee failure is the high velocity flooding of those properties outside and downstream of the breach.

Generally, overtopping can be predicted based on river stages and the warning given depending on the source of the flood waters. On the Sacramento River system, depending on which dams are releasing the flows, advance warning of river stages may be as much as 24 hours.

The 2024 FIS noted that 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.

Impacts

Should a levee fail, some or all of the area protected by the levees would be at risk to flooding. Impacts from a levee failure include property damage, critical facility damage, and life safety issues. Business and economic losses could be large as facilities could be flooded and services interrupted. School and road closures could occur. Road closures would impede both evacuation routes and ability of first responders to quickly respond to calls for aid. Other problems connected with levee failure flooding include erosion, sedimentation, degradation of water quality, losses of environmental resources, and certain health hazards.

Future Development

The Delta serves as a saltwater barrier to maintain the State’s drinking water supply, and provides for rich agricultural production, natural gas fields, recreational facilities, legacy Delta Communities; all which provide an economic base from which the public benefits in the form of jobs, tax revenues, and other economic benefits.

According to the Delta Protection Commission’s “Economic Sustainability Plan for the Sacramento-San Joaquin Delta,” nearly eighty percent of the Delta is classified as Prime Farmland, the California Farmland Mapping and Monitoring Program’s highest designated tier, meaning that it meets the most stringent requirements for good farmland, including various water measurements, soil temperature, soil acid-alkali balance, erodibility, and more. The remainder of farmland in the Delta is classified as Farmland of Statewide Importance, Unique Farmland, or Farmland of Local Importance, and is divided nearly evenly between those classifications. These are the top four tiers available for agricultural land classification, out of nine possible land classifications. This indicates that every reclamation district in the Delta with any agricultural production protects a portion of the most valuable farmland in the State of California, regardless of the crops planted at any given time. While the cost of land might be less than that of urban lands, the continued usability of the land for agricultural production is critical to agricultural output of the State, regardless of the amount of land protected by any given Delta island.

The June 2025 Delta Adapts Climate Adaptation Plan noted that Climate change will not impact Delta residents equally. Approximately 65 percent of the Delta’s population that could be exposed to a 100-year flood event (including levee failure events) by 2050 reside in areas with high concentrations of socially vulnerable residents. Vulnerable residents may lack resources to prepare for floods and other hazards, vehicles for evacuation, and information on flood risks due to linguistic isolation. These factors make recovering from flood events challenging, perpetuating inequities and vulnerability and making improvements to flood emergency preparedness and response an important strategy.

New development should take levee failure areas into account during the construction of new homes and commercial properties. The County and incorporated communities within the Delta area will continue to enforce the zoning, subdivision, and development ordinances in the Delta region, including the flood management ordinances to reduce flood related impacts to future development activities in the Delta.

Sea Level Rise

Likelihood of Future Occurrence–Likely
Vulnerability–Medium

Hazard Profile and Problem Description

Historically, cities, towns and villages were often settled around ports and waterways along the nation’s coastlines and waterways, providing individuals and families opportunities for trade, jobs and transportation, recreation and relaxation. These areas are extremely important to our nation, with great economic, historic and cultural significance. The continued increase in these population leads to increased development along coastlines and waterways, which places greater numbers of people and structures at risk from coastal hazards, such as sea level rise. The 2017 Sacramento County Climate Vulnerability

Assessment noted that sea-level rise is an increase in the average level of the ocean. Global sea level rise is primarily caused by thermal expansion of warming ocean water and melting of land ice as air temperatures increase. Regional rates of sea level rise are variable, depending on vertical land motion (i.e., uplift and subsidence), winds, and large-scale ocean circulation patterns.

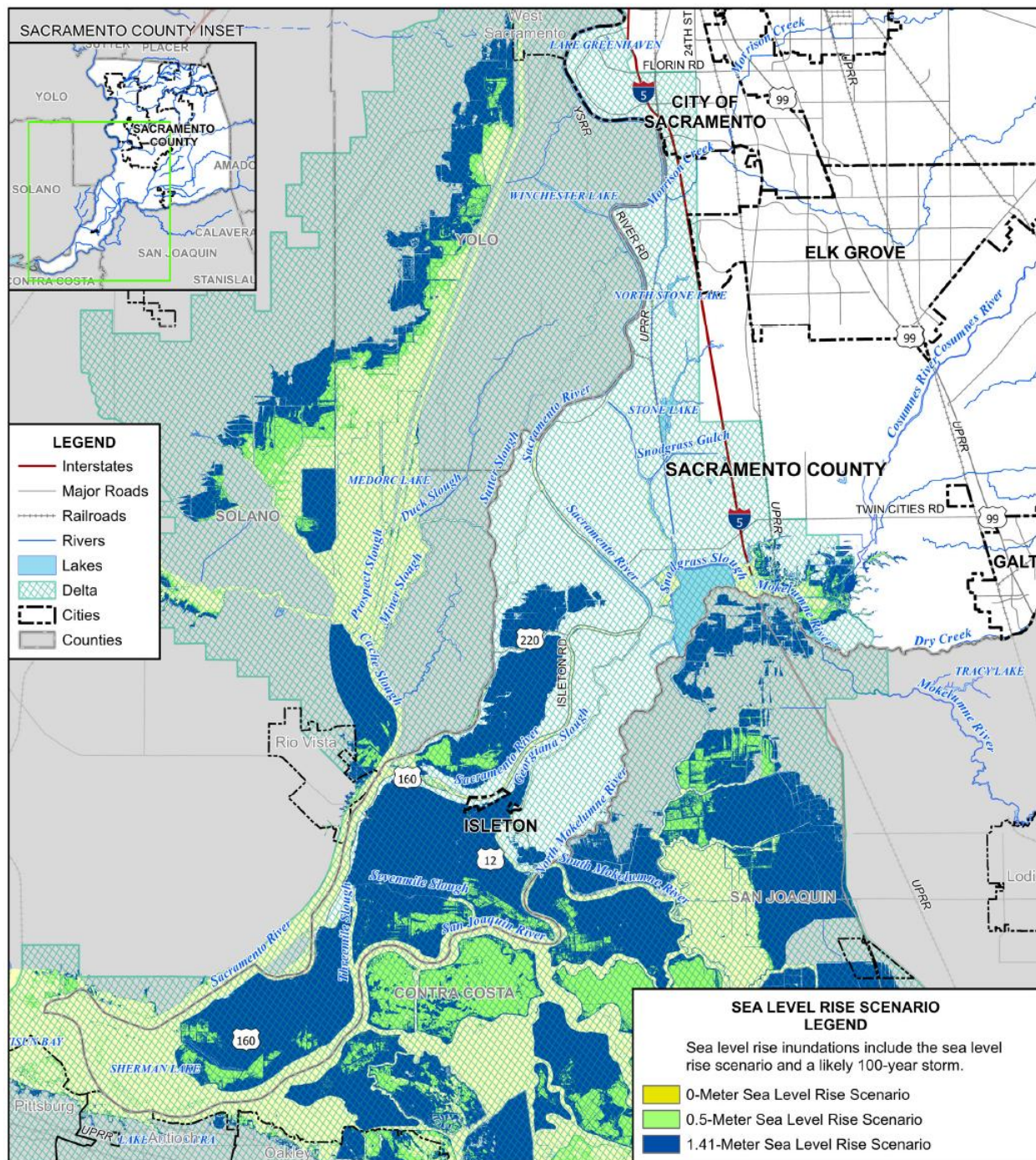
The 2023 California State Hazard Mitigation Plan noted that sea-level rise generally progressively worsens the impact of high tides and wind-driven waves associated with severe storms. Coupled with increased frequency, severity, and duration of high tide and storm events related to climate change, sea-level rise will exacerbate these extreme events along the coast and affected waterways. It is projected that sea levels will continue to rise as precipitation continues to increase and ice caps continue to melt. There are number of areas in the Sacramento County Planning Area that are at risk of coastal-like flooding and could be dramatically impacted by sea level rise over time.

Location and Extent

Much of the Delta region of the Sacramento Planning Area is at risk from sea level rise (especially during periods of extreme tides). The southwestern portion of the County follows the course of the Sacramento River as it flows into the Sacramento-San Joaquin Delta. The area of Sacramento County near the Delta is vulnerable to the influences of sea-level rise. Duration of sea level rise is thought to be long. The speed of onset is slow. There is no scientific scale for sea level rise, other than the actual physical measurement of sea level and depth.

Sea level rise scenarios were sourced from multiple sources including the Sacramento County Climate Action Plan (2024), the Sacramento County Climate Change Vulnerability Assessment (2017), Cal-Adapt, and California Coastal Inundation Depth Layer Mosaics (2016). Three sea level rise scenarios were derived from these sources for the County: a 0-meter scenario, a 0.5 meter scenario, and a 1.41 meter scenario. It should be noted for all of these scenarios that the extents discussed include the assumption of a 100-year storm occurring. Extents for these three scenarios are collectively shown on Figure R-20. They are broken out for the 0-meter (Figure R-21), 0.5 meter (Figure R-22), and 1.41 meter (Figure R-23) scenarios individually. Geographical extents by scenario are detailed in Table R-15. More information on these scenarios can be found in the Section 4.3.15 of the Base Plan.

Figure R-20 Sacramento County Delta – Sea Level Rise Scenarios (All)



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0 5 10 Miles

SACRAMENTO
COUNTY

Data Source: Sacramento County Climate Action Plan 2024,
Climate Change Vulnerability Assessment 2017,
Cal-Adapt Sea Level Rise <https://cmip5.cal-adapt.org/tools/slr-califod-3d/>,
San Francisco Bay, Sacramento-San Joaquin Delta and California Coastal Inundation Depth Layer Mosaics 2016
(Datasets: Bay_10m, 0.5m, 1.41m|slr_max_bilinear_snap_float)
Sacramento County, Cal-Atlas; Map Date: 4/21/2026.

SEA LEVEL RISE SCENARIO

LEGEND

Sea level rise inundations include the sea level rise scenario and a likely 100-year storm.

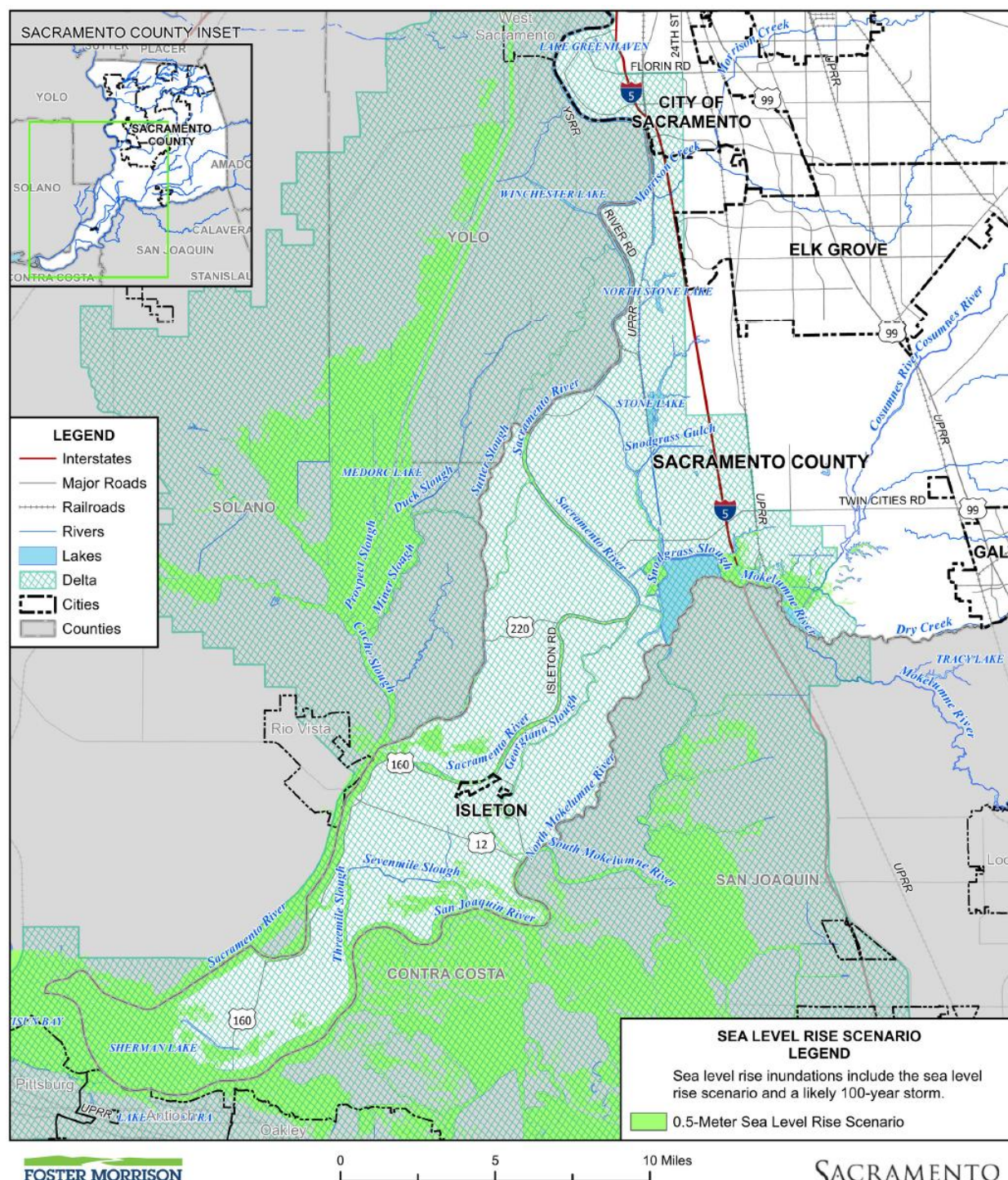
0-Meter Sea Level Rise Scenario

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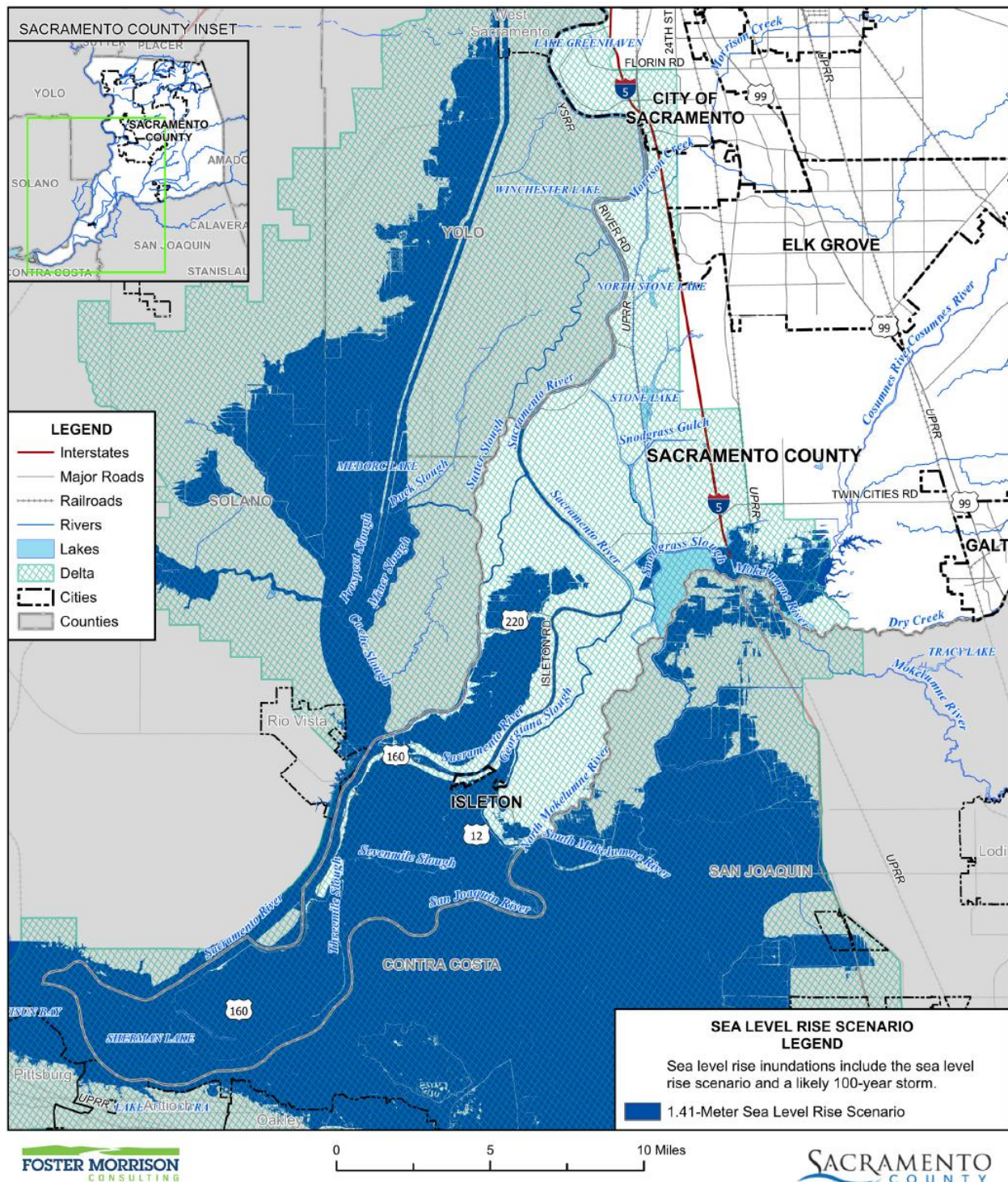
Sacramento County
Local Hazard Mitigation Plan Update
October 2026

Figure R-22 Sacramento County Delta – Sea Level Rise 0.5-meter Scenario



Data Source: Sacramento County Climate Action Plan 2024,
 Climate Change Vulnerability Assessment 2017,
 Cal-Adapt Sea Level Rise <https://cmip5.cal-adapt.org/tools/slr-califod-3d/>,
 San Francisco Bay, Sacramento-San Joaquin Delta and California Coastal Inundation Depth Layer Mosaics 2016
 (Datasets: Bay_10m, 0.5m, 1.41m]slr_max_bilinear_snap_float)
 Sacramento County, Cal-Atlas; Map Date: 4/21/2026.

Figure R-23 Sacramento County Delta – Sea Level Rise 1.41-meter Scenario



Data Source: Sacramento County Climate Action Plan 2024,
 Climate Change Vulnerability Assessment 2017,
 Cal-Adapt Sea Level Rise <https://cmip5.cal-adapt.org/tools/slr-califlod-3d/>,
 San Francisco Bay, Sacramento-San Joaquin Delta and California Coastal Inundation Depth Layer Mosaics 2016
 (Datasets: Bay_0m, 0.5m, 1.41m)slr_max_bilinear_snap_float)
 Sacramento County, Cal-Atlas; Map Date: 4/21/2026.

Table R-15 Sacramento County Delta Area – Sea Level Rise Scenario Geographical Extents by Jurisdiction

Jurisdiction / Sea Level Rise Scenario	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Isleton						
0-Meter Sea Level Rise Scenario	6	0.01%	0.3	0.001%	6	0.01%
0.5-Meter Sea Level Rise Scenario	7	0.01%	1	0.001%	6	0.01%
1.41-Meter Sea Level Rise Scenario	86	0.1%	9	0.02%	77	0.1%
Isleton Total	99	0.1%	10	0.02%	89	0.2%
Unincorporated Sacramento County						
0-Meter Sea Level Rise Scenario	5,785	5%	393	0.7%	5,392	10%
0.5-Meter Sea Level Rise Scenario	9,466	9%	1,263	2%	8,203	16%
1.41-Meter Sea Level Rise Scenario	41,064	39%	13,382	25%	27,682	54%
Unincorporated Sacramento County Total	56,315	53%	15,038	28%	41,277	80%

Source: Sacramento County Climate Action Plan (2024), the Sacramento County Climate Change Vulnerability Assessment (2017), Cal-Adapt, and California Coastal Inundation Depth Layer Mosaics (2016)

Past Occurrences

It was noted that no standalone “sea level rise flooding events” (e.g., clear high-tide inundation without storms) have been widely documented in Sacramento County proper. Instead, sea level rise has acted as a background amplifier during other hazards. This was discussed in Section 4.3.15 of the Base Plan. Events that had larger effects on the City of Isleton or individual Delta Districts can be found in their respective Chapters of this Delta Annex.

Climate Change and Sea Level Rise

The 2017 Sacramento County Climate Vulnerability Assessment noted that an effect of global climate change is sea level rise. The average global sea level rose approximately seven inches during the last century. Assuming that it continues to reflect global trends, sea level along the California coastline could be 10-18 inches higher in 2050 than 2000 levels, and 31-55 inches higher than 2000 levels by the end of this century.

The 2023 California State Hazard Mitigation Plan noted that coastal areas may be impacted by climate change in different ways. A warmer atmosphere means storms have the potential to be more intense and occur more often. Climate change also will result in sea level rise. Sea level rise is driven by climate change. As the planet warms, land ice melts and flows into the ocean. Ocean temperatures rise and thermal expansion takes place.

Vulnerability to Sea Level Rise

The 2017 Sacramento County Climate Vulnerability Assessment noted that the low-lying land near the Sacramento River in the southwest corner of the County, including areas in the Delta and portions north near the City of Sacramento, are the primary at-risk areas. Considering a 100-year flood event, a 1.41-m rise in sea level, and other hydrodynamic factors, the land at increased risk for sea-level related flooding encompasses 51,019 acres.

Local sea level trends for the Delta region are further complicated by regional and local land subsidence. Decomposition of drained and converted marsh and peat soils within diked Delta islands have caused much of the Delta region to lie below sea level—in some places by as much as 15 to 20 feet. Continued land subsidence may increase the relative rate of locally observed sea level change for the Delta area when comparing water levels to local land elevations.

Impacts

Sea level rise (both with and without storm surge) and its impacts vary by location and severity of event and will likely only affect certain areas of the County. Based on the risk assessment, it is evident that sea level rise has the potential to put lives and property at risk and could include devastating life safety, property, and economic impacts to certain areas of the Sacramento Planning Area. Impacts that are not always quantified, but can be anticipated, include:

- Injury and loss of life;
- Commercial and residential structural and property damage;
- Health hazards associated with mold and mildew, contamination of drinking water, etc.;
- Disruption of and damage to public infrastructure, utilities, and services;
- Damage to roads/bridges resulting in loss of mobility;
- Significant economic impact (jobs, sales, tax revenue) to the community; and
- Negative impact on commercial and residential property values

The 2024 Sacramento County CAP noted that while many of the potential impacts associated with sea level rise are similar to those with flooding, sea level rise presents additional potential impacts, such as saltwater intrusion, which can affect the quality of the region's water supplies, especially when coupled with increased municipal and agricultural demand for freshwater.

The 2025 Delta Adapts Climate Adaptation Plan noted higher temperatures, changing precipitation and runoff patterns, and sea level rise all make maintaining Delta water quality more challenging. Decreased flows from upstream reservoirs during drought years may increase salinity intrusion in the Delta, affecting water quality. In-Delta water uses, such as agriculture, may be threatened by episodic water quality declines.

These threats necessitate careful review and possible modification of Delta water quality standards using best available science

Future Development

The June 2021 Delta Adapts Climate Vulnerability Assessment noted that the State Water Project and Central Valley Project pumping plants in the South Delta, as well as other public and private diversions located throughout the Delta, depend on the conveyance of freshwater through the Delta. Sea level rise and changes in watershed hydrology will increase the risk of levee failure and flooding of Delta islands in the future that may result in temporary or permanent changes to Delta hydrodynamics and salinity regimes. In addition, increased frequency and severity of drought conditions and salinity intrusion may impact the functioning of these assets in the future.

The 2025 Delta Adapts Climate Adaptation Plan noted that In-Delta water users will likely face reduced reliability of diversions in the future due to climate change, primarily due to low inflow conditions coupled with sea level rise, which may allow salinity intrusion into the Delta. While these events have been rare under current water system operations, they may become more common in the future, and when they do occur, the shortages will be significantly larger than historical conditions.

Future development considerations need to be made, as having more or less residents in sea level rise areas affects the overall hazard vulnerability that can impact both the Delta and larger Sacramento County. Delta levees may have to be raised to factor in rising sea levels. Considerations should also be made to protect the future of water supply in the Delta.

Severe Weather: Heavy Rains and Storms

Likelihood of Future Occurrence–Likely
Vulnerability–Medium

Hazard Profile and Problem Description

Storms in the Delta occur annually and 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 Delta falls mainly in the fall, winter, and spring months. Wind often accompanies these storms; hail and lightning are rare in the Delta.

Location and Extent

Heavy rain events occur on a regional basis. Rains and storms can occur in any location of the Delta. All portions of the Delta are at risk to heavy rains. Most of the severe rains occur during the fall, winter, and spring months. There is no scale by which heavy rains and severe storms are measured. 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. Hail and lightning are rare in the Delta and Sacramento County. Duration of severe storms in California, Sacramento County,

and the Delta can range from minutes to hours to days. According to the WRCC, average annual precipitation in the County is 18.15 inches per year. Information on precipitation extremes can be found in Section 4.3.4 of the Base Plan.

Past Occurrences

According to historical hazard data, severe weather, including heavy rains and storms, is an annual occurrence in the Delta. This is the cause of many of the federal disaster declarations related to flooding. Past occurrences for the County were discussed in Section 4.3.4 of the Base Plan and in the Levee Failure section above. Events that had larger effects on the City of Isleton or individual Delta Reclamation Districts can be found in their respective Chapters of this Delta Annex.

Climate Change and Severe Weather: Heavy Rain and Storms

According to the 2024 CAP, the County is projected to experience a steady increase in average annual precipitation through the end of the century, with much of that precipitation likely to occur during extreme precipitation events, which can lead to flood impacts. According to Cal-Adapt, the historic average annual precipitation in Sacramento County is 18.3 inches, and the historic average annual number of extreme precipitation events is four. As shown in Section 4.3.4 of the Base Plan, the average annual precipitation across the County may rise upwards of 22 inches, with the number of extreme precipitation events potentially exceeding 7 per year by the end of the century, depending on the level of current and future GHG emissions.

Vulnerability to Heavy Rain and Storms

Heavy rain and severe storms are the most frequent type of severe weather occurrences in the Delta. These events can cause significant and localized flooding. Elongated events, or events that occur during times where the ground is already saturated can cause 1%, 0.5%, and 0.2% annual chance flooding and can lead to levee failure flooding. Wind often accompanies these storms and has caused damage in the past. Hail and lightning are rare in the Delta, but also can cause damage..

Impacts

Actual damage associated with the effects of severe weather include impacts to property, critical facilities (such as utilities), and life safety. Power outages may also occur. Heavy rains and storms often result in flooding creating significant issues. Roads can become impassable and ground saturation can result in instability, collapse, or other damage to trees, structures, roadways and other critical infrastructure. Floodwaters and downed trees can break utilities and interrupt services.

Future Development

Building codes in the Delta ensure that new development is built to current building standards, which should reduce the risk to future development in the Delta from heavy rains and storms. New critical facilities and infrastructure should be built to withstand hail damage, lightning, and thunderstorm winds, and should have backup power in place. With adherence to development standards, future losses to new development from heavy rain and storms should be minimal.

Severe Weather: High Winds and Tornadoes

Likelihood of Future Occurrence—Occasional

Vulnerability—Medium

Hazard Profile and Problem Description

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

The Delta Breeze is the local name for a wind coming from the southwest, off of the Delta of the Sacramento River and San Joaquin River. This wind carries with it cooler, more humid air from off of the Pacific Ocean. The effects of this wind are very noticeable during the summer, as this sea breeze can cool the air by more than 10°F. According to the National Weather Service, the wind is primarily driven by a sea breeze circulation, which can often become coupled with a mountain breeze to form one large (mesoscale) circulation of air from the Farallon Islands up into the Sierra Nevada.

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 form when cool, dry air sits on top of warm, moist air. Tornadoes are the most powerful storms that exist. Tornadoes, though rare, are another severe weather hazard that can affect areas of the Sacramento County Planning Area, primarily during the rainy season in the late fall, winter, and early spring.

Location and Extent

The entire Delta is subject to significant, non-tornadic (straight-line), winds. All areas of the County are 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 12 category scale that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort Wind Force Scale. The Beaufort Scale was shown in Section 4.3.5 of the Base Plan.

Tornadoes, while rare, can occur at any location in the County and Delta. 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 (EF) 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. The F Scale and EF Scale are shown in Section 4.3.5 of the Base Plan.

Past Occurrences

Winds events, especially those accompanying severe thunderstorms, are generally larger events. As such, events that affected the County have affected the Delta. Past occurrences for the County are detailed in Section 4.3.5 of the Base Plan. Often the more significant issue occurring during high winds within the Delta are related to increased wave action on the levees causing erosion and leading to increased flooding in some areas. Events that had larger effects on the City of Isleton or individual Delta Reclamation Districts can be found in their respective Chapters of this Delta Annex.

Climate Change and Severe Weather: High Winds and Tornadoes

According to the 2024 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. The 2024 Sacramento County CAP did not include information on climate change and high winds.

Vulnerability to Severe Weather: High Winds and Tornadoes

High winds are common occurrences in the Delta throughout the entire year. Straight line winds are primarily a public safety and economic concern. Windstorm can cause damage to structures and power lines which in turn can create hazardous conditions for people. Debris flying from high wind events can shatter windows in structures and vehicles and can harm people that are not adequately sheltered. High winds can impact critical facilities and infrastructure and can lead to power outages. Wind can also drive wildfire flames, spreading wildfires quickly. During periods of high winds and dry vegetation, wildfire risk increases. High winds that occur during periods of extreme heat can cause PSPS events to be declared in the County (while rare); although these are unlikely to occur in the Delta area where the wildfire risk is low. More information on power shortage and failure can be found in the in Section 4.3.4 of the Base Plan.

In the Delta, levees are vulnerable to wave action from both thunderstorm winds and from the Delta Breeze that causes excess erosion, and can threaten the levee integrity in each Reclamation District. Wind action, especially when coupled with high water events, leads to scour and high bank erosion, which creates wave induced erosion at the levee toe.

Impacts

Impacts from high winds in the Delta will vary. Future losses from straight line winds include:

- Downed trees
- Increased wave action on streambanks and levees
- Increased power outage events
- Power line impacts and economic losses from power outages
- Occasional building damage, primarily to roofs

Future Development

New critical facilities and infrastructures should be built to withstand high winds and tornadoes. While minimal damages have occurred to critical facilities in the past due to high winds and tornadoes, there still

remains future risk. With development occurring in the region, future losses to new development may occur. Reclamation Districts will need to continue to armor levees against wind induced wave action that causes excess erosion. New critical facilities should also consider adding generators for times of power outages.

Subsidence

Likelihood of Future Occurrence–Likely
Vulnerability–High

Hazard Profile and 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. Subsidence is worsened when groundwater drawdown exceeds the ability of the ground to naturally recharge. This is more common during periods of drought.

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. The Delta 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.

Compaction of Unconsolidated Soils by Earthquake Shaking (Liquefaction)

Compaction of unconsolidated soils by earthquake shaking is also known as liquefaction. Liquefaction is discussed further in the earthquake hazard above.

Compaction by Heavy Structures

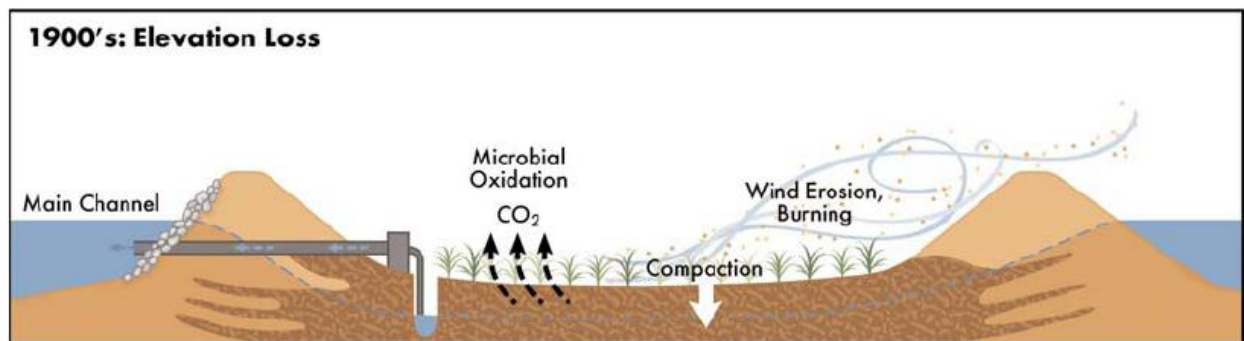
Land development pressures are forcing the building of structures on top of fine grained water saturated sediments. Unfortunately, the weight of the structures presses the water out of the soils. To mitigate the

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 buildings 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 R-24). 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 R-24 Causes of Subsidence in the Delta during the 20th Century

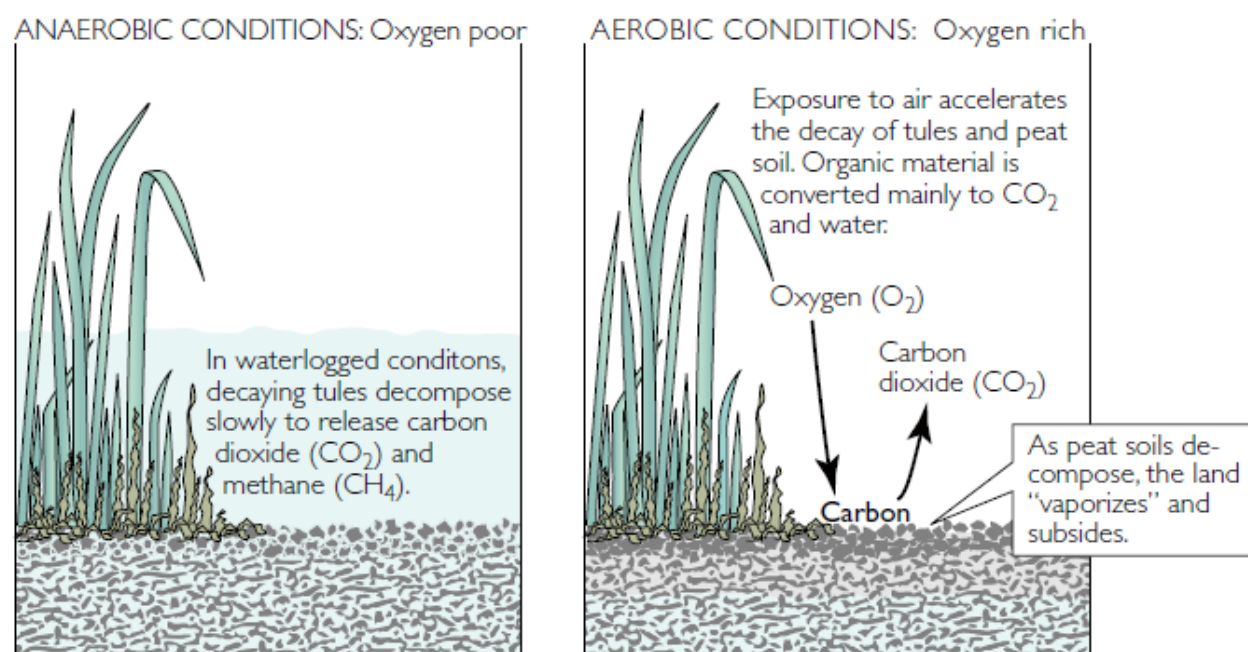


Source: Mount J, Twiss R. 2005. Subsidence, sea level rise, seismicity in the Sacramento-San Joaquin Delta. San Francisco Estuary and Watershed Science. Vol. 3, Issue 1 (March 2005), Article 5.

Peat Oxidation

The dominant cause of land subsidence in the Delta is decomposition of organic carbon in the peat soils. As shown in Figure R-25, 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. The potential for oxidation of organic soils still exists within the County, where farming practices still require annual operations to prepare fields for planting and harvest. Many land use practices have changed due to new cropping types, patterns, and farming practices, which are changing rates of subsidence, or stopping subsidence altogether. Lands that no longer have organic peat are no longer subsiding; lands that are permanent crops, wetlands, rice, and livestock pasture lands have also stopped subsiding at historic rates, or in some cases are slowly growing biomass in the case of restoration projects, and some rice operations.

Figure R-25 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.

Location and Extent

The Delta is highly at risk to subsidence. The June 2021 Delta Adapts Climate Vulnerability Assessment noted that subsidence of Delta islands creates height differences between the land and adjacent water surface elevations in channels. These height differences amplify forces against the levees and drive flow through and underneath levees into the subsided islands. Irrigation water further contributes to the accumulation of water in island drainage ditches, where it is routed to pumps and returned to adjacent channels. In the past, subsidence of Delta lands had been reported to be a major risk to Delta levees; however, subsidence is now more 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.

There is no scientific scale to measure subsidence. Subsidence is measured in inches or feet of elevation change over time. Subsidence has a long speed of onset, as it occurs over many years. The duration of subsidence is long, as it is rare for subsidence to be reversed.

Past Occurrences

Subsidence has occurred over the years throughout the Delta area. The June 2021 Delta Adapts Climate Vulnerability Assessment noted that subsidence is a key aspect of the Delta landscape's vulnerability to climate change. Since the initiation of intense land management practices in the 1850s, half of the volume of organic peat soils in the Delta has been lost due to disturbance and oxidation (Deverel and Leighton 2010; Mount and Twiss 2005), resulting in substantial greenhouse gas emissions and the lowering of some Delta islands by as much as 25 feet below sea level. Subsidence rates have decreased substantially from early 20th century values and range from a few tenths of an inch per year to approximately 0.8 inches per year today. Events that had larger effects on the City of Isleton or individual Delta Districts can be found in their respective Chapters of this Delta Annex.

Climate Change and Subsidence

Changes in precipitation, reduced snowpack, and more frequent droughts are likely to increase the demand on groundwater sources, risking overdraft, ground subsidence, and decreased water quality. 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 to Subsidence

As noted, subsidence has historically been a significant issue in the Delta; although more recently the rate of subsidence has been decreasing. Sacramento costs of levee construction and maintenance are generally borne by the State of California and the Federal government, as well as by local reclamation districts. These costs also increase as subsidence progresses, forcing levees to be built higher and stronger. Back in the 1980s when subsidence in the Delta was significant, levee improvements and maintenance was an ongoing priority. In 1981 to 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. Thus, the annual cost of repair and maintenance of Delta levees in the 1980s, from subsidence and other factors, averaged about \$20 million per year. Note that these costs reflect the larger Delta Area. Repair and maintenance costs for the Delta Area located in Sacramento County would be proportionately less. Today, subsidence remains an issue in the Delta area, but to a lesser extent.

The management issues raised by land subsidence range in scale from those faced by individual farmers to the possible global-scale issue posed by the carbon-dioxide flux, with its possible link to climate change. At the most local level, individual farmers or reclamation districts must maintain drainage networks on the islands and pump the agricultural drainage back into waterways. These costs increase gradually as subsidence progresses.

Members of the HMPC did note that although tremendous subsidence of islands has occurred since their original reclamation, recent LiDAR survey data indicates that very few areas of the Delta are actively subsiding. In addition, surveys and geotechnical evaluations show that subsidence rarely occurs close enough to a levee to cause instability. In the few areas that this may be a problem, the “toe berm” design, used to meet the Federal PL 84-99 and State Bulletin 192-82, caps the peat and effectively stops subsidence.

Local farmers have changed farming practices to help limit and mitigate the issues related to subsidence. This is especially true in the Delta Area.

The statewide water-transfer system in California is so interdependent that decreased water quality in the Delta might lead to accelerated subsidence in areas discussed elsewhere in this document. 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 pumpage and arrest or slow subsidence. Degradation of the Delta source water could well lead to increased ground-water use, and renewed subsidence, in these and other areas in California.

Impacts

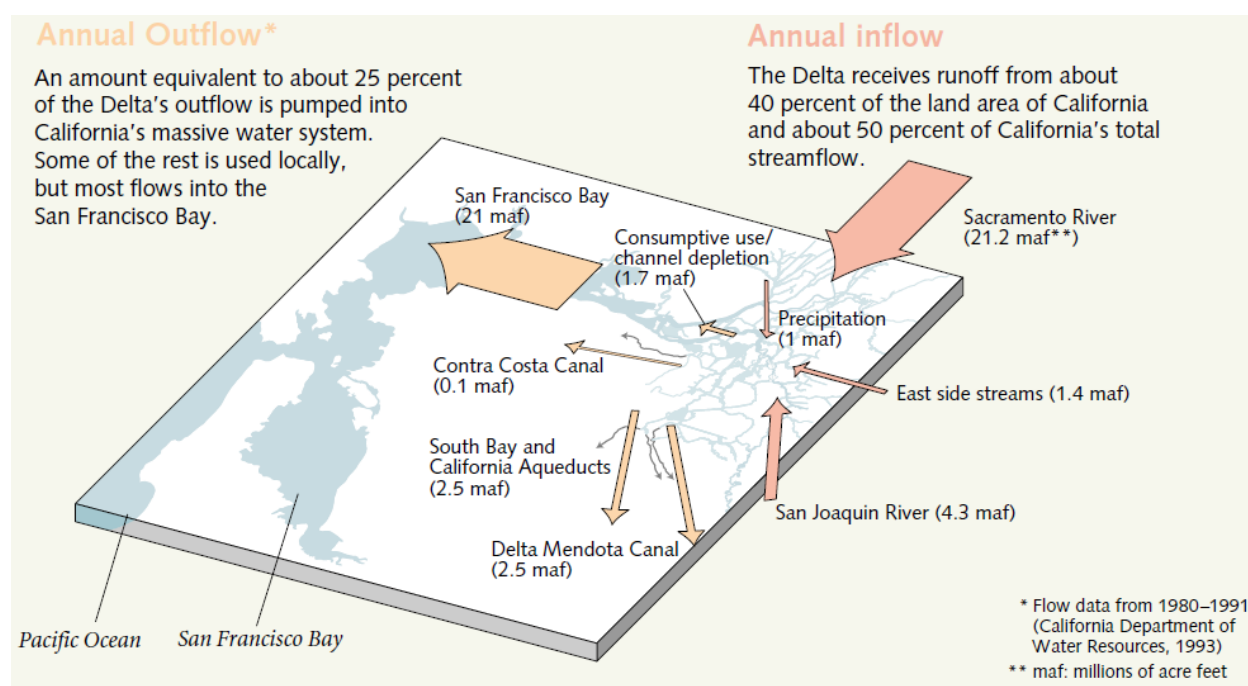
Impacts to the County, Central California, and the State could occur from subsidence. Impacts are discussed below regarding:

- 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 R-8. 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) obtains at least part of its drinking water from the Delta.

Figure R-26 The Delta and California's Water System



Source: USGS Publication "Sacramento-San Joaquin Delta: The Sinking Heart of the State." Report FS-005-00

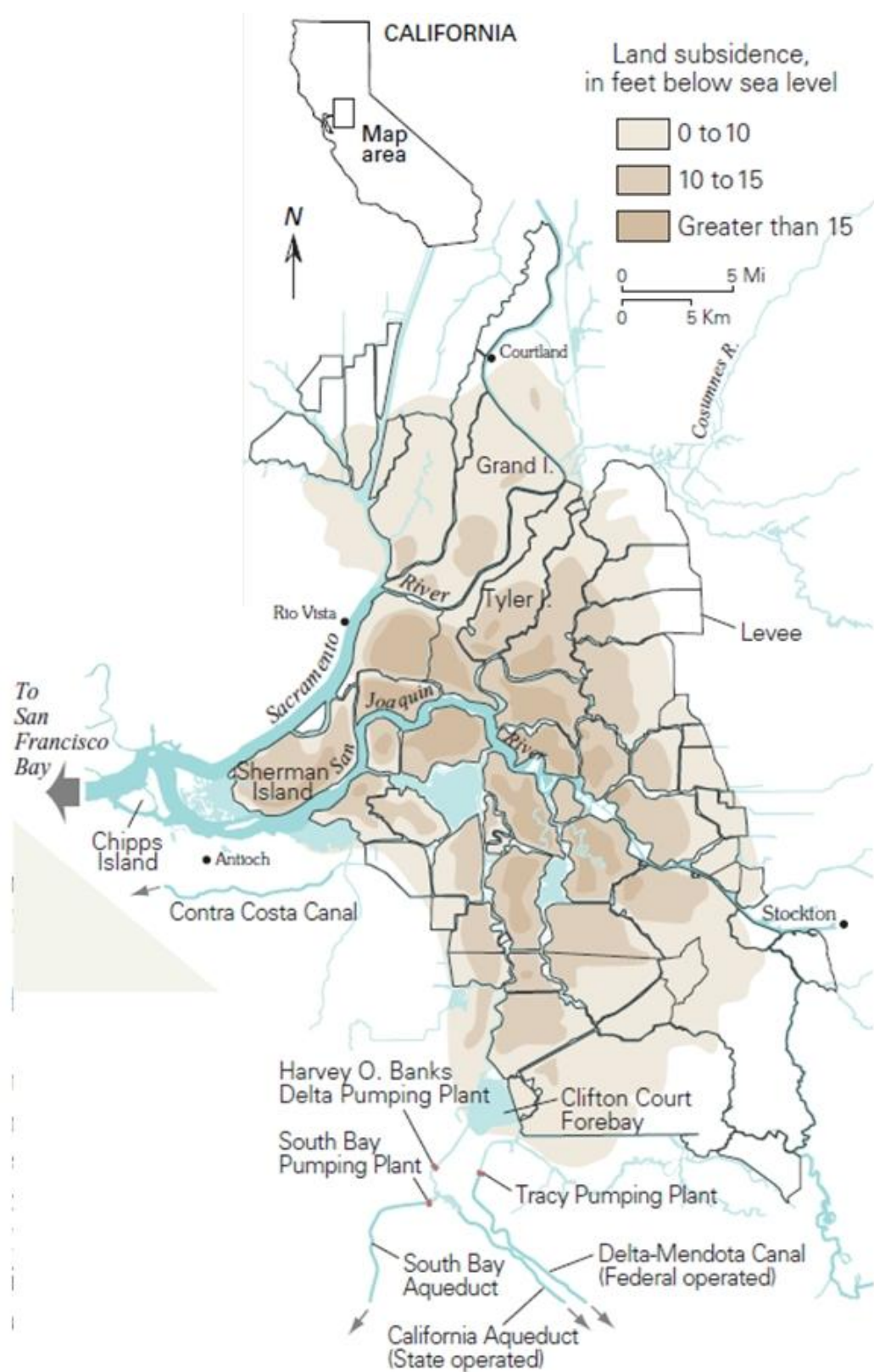
Land subsidence of Delta islands indirectly affects the north-to-south water transfer system, which is predicated on the available water supply (annual inflows to the Delta), the viability of aquatic species populations, and acceptable water quality in the southern Delta. The statewide water-transfer 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.

A less significant issue, in 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

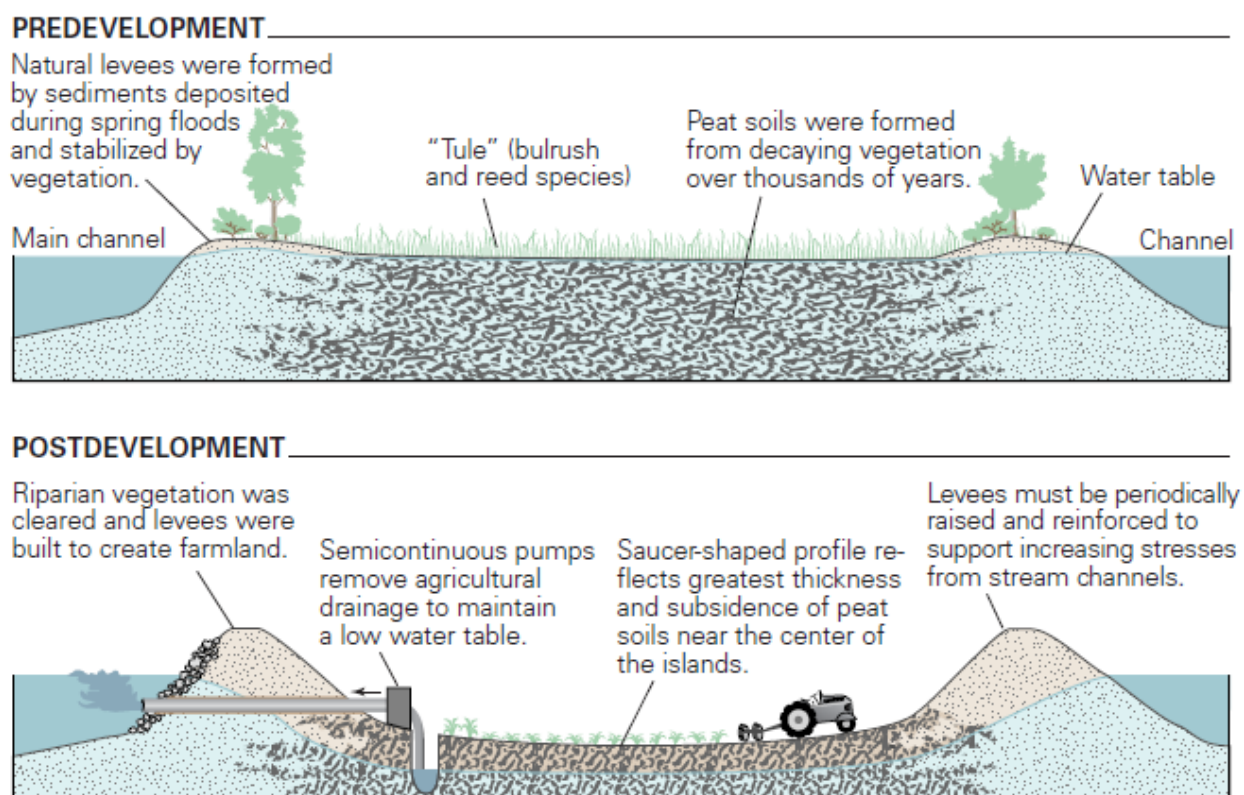
As shown in Figure R-27, many of the islands in the central Delta are presently 10 to nearly 25 feet below sea level. The land surface profile of many islands is somewhat saucer-shaped, because subsidence is greater in the thick peat soils near their interior than in the more mineral-rich soils near 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 R-27 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 R-28 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,

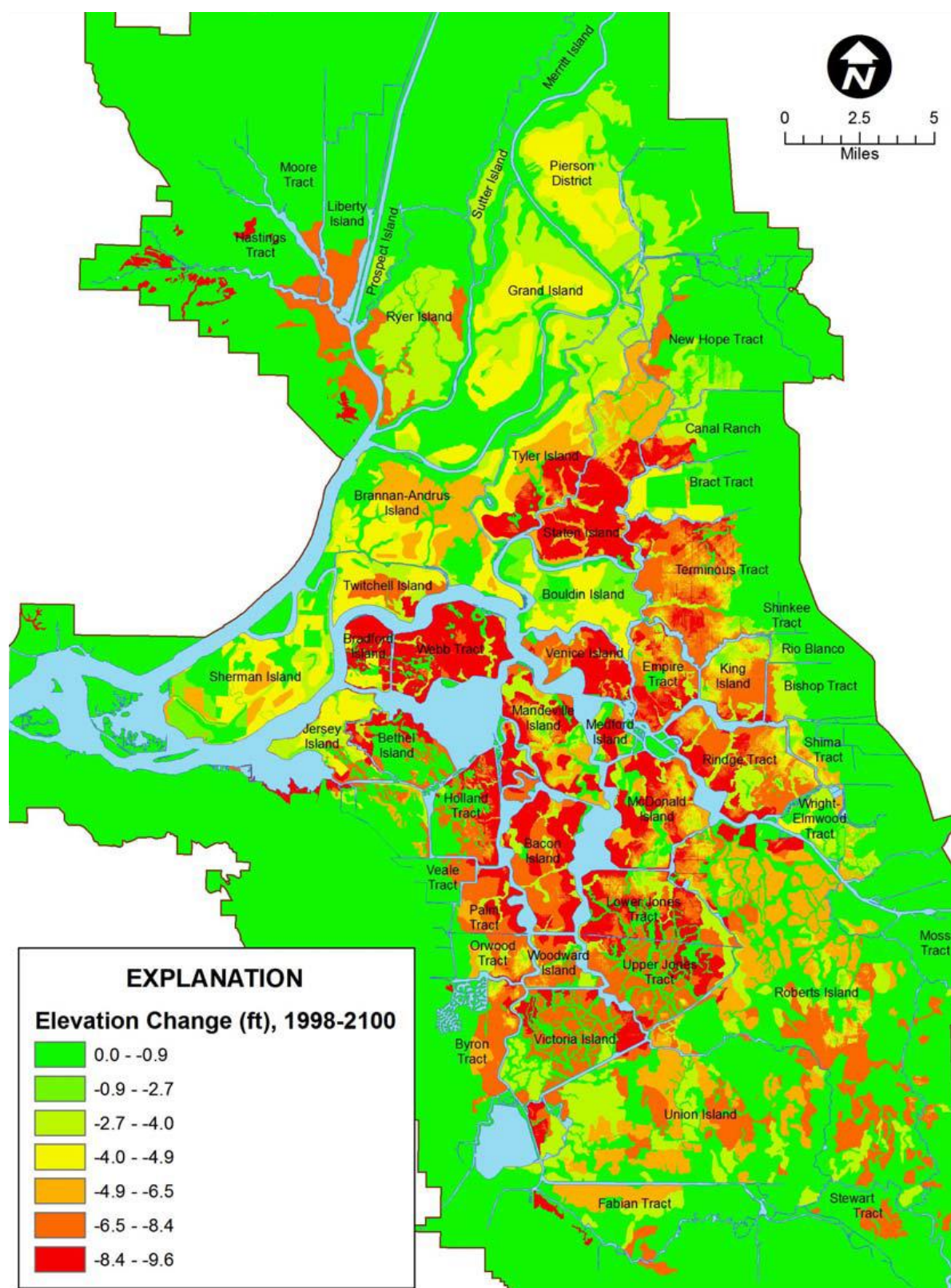
The costs of levee construction and maintenance are borne by local reclamation districts with assistance by the State of California and the federal government, as well as by local reclamation districts. These costs increase as subsidence progresses, albeit at a slow rate.

Future Development

The June 2021 Delta Adapts Climate Vulnerability Assessment noted that subsidence of Delta islands due to continued agricultural practices will increase the Delta's overall vulnerability to climate change. Increasing water surface elevations due to sea level rise, hydrological changes, subsidence, and drainage ditch deepening will increase pressure on levees and increase rates of seepage onto Delta islands. These effects will increase the probability of levee failure over time. While levees may consolidate (subside) in some locations, this is often a separate process than subsidence due to oxidation. Regardless, permanent flooding of Delta islands, if they occur, will alter circulation and salinity dynamics in the Delta and create deep, open water habitats that do not resemble any historical state of the ecosystem.

The Delta Risk Management Strategy noted that as subsidence progresses (see Figure R-29), the levee system will likely become increasingly vulnerable to catastrophic failure during floods and earthquakes. Areas for future development will become more limited. The interrelated issues of Delta land subsidence, water quality, and wildlife habitat will continue to pose a major dilemma for California water managers.

Figure R-29 Additional Expected Subsidence from 1998 to 2100



Source: Delta Risk Management Strategy, 2009

Future development considerations should be ongoing and proactive.

Wildfire (w/ Smoke and Air Quality)

Likelihood of Future Occurrence—Occasional

Vulnerability—Low

Hazard Profile and Problem Description

Wildland fire and the risk of a conflagration is a concern for the Delta. Throughout California, communities are increasingly concerned about wildfire safety. Wildland fires affect grass, forest, and brushlands, as well as structures. 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. Historically, the fire season extends from early spring through late fall of each year during the hotter, dryer months; however, in recent years, the risk of wildfire has become a year around concern.

Fire conditions arise from a combination of high temperatures, low moisture content in the air and fuel, accumulation of vegetation, and high winds. These weather conditions can result in red flag (e.g., fire weather) days in the Delta. While wildfire risk has predominantly been associated with more remote forested areas and wildland urban interface (WUI) areas, significant wildfires also occur in more populated areas. There is also the concern of wildfires occurring in these more remote, forested areas, that under certain weather conditions, can extend into areas not generally considered at a high risk to wildfire. Smoke and air quality also become an issue, both from fires occurring inside and outside of the Sacramento County Planning Area and the Delta.

Wildfire Smoke and Air Quality

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.

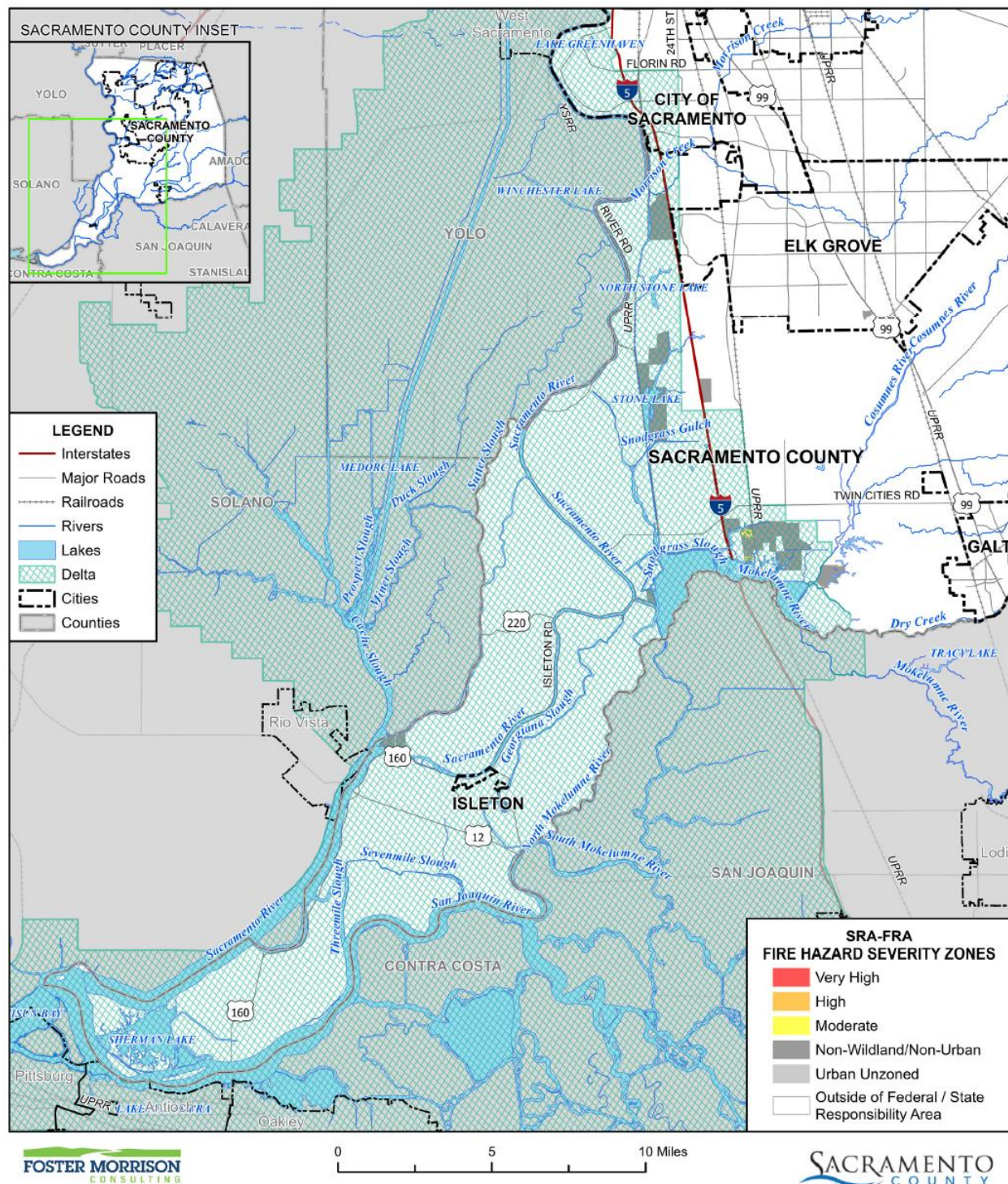
Wildfire smoke can have negative effects to those who live in or near a fire burn area. Smoke and air pollution from wildfires can be a severe health hazard. Significant wildfires occurring in both Sacramento County, nearby northern California communities, and elsewhere have created significant air pollution affecting area residents. This was the case during the multiple fires that occurred in 2020, as well as other more recent events that affected the Sacramento County Planning Area.

Location and Extent

Wildfire can affect areas of the Delta. CAL FIRE has estimated that the risk varies across the Delta and has created maps showing risk variance. Following the methodology described in Section 4.3.16 of the Base Plan, wildfire maps for the Delta were created. Figure R-30 shows the CAL FIRE State Responsibility Areas (SRA) and Federal Responsibility Areas (FRA) and their associated Fire Hazard Severity Zones (FHSZ) in the District. Figure R-31 shows the CAL FIRE Local Responsibility Areas (LRA) and their associated Fire Hazard Severity Zones (FHSZ) in the District. As shown on the maps, FHSZs within the

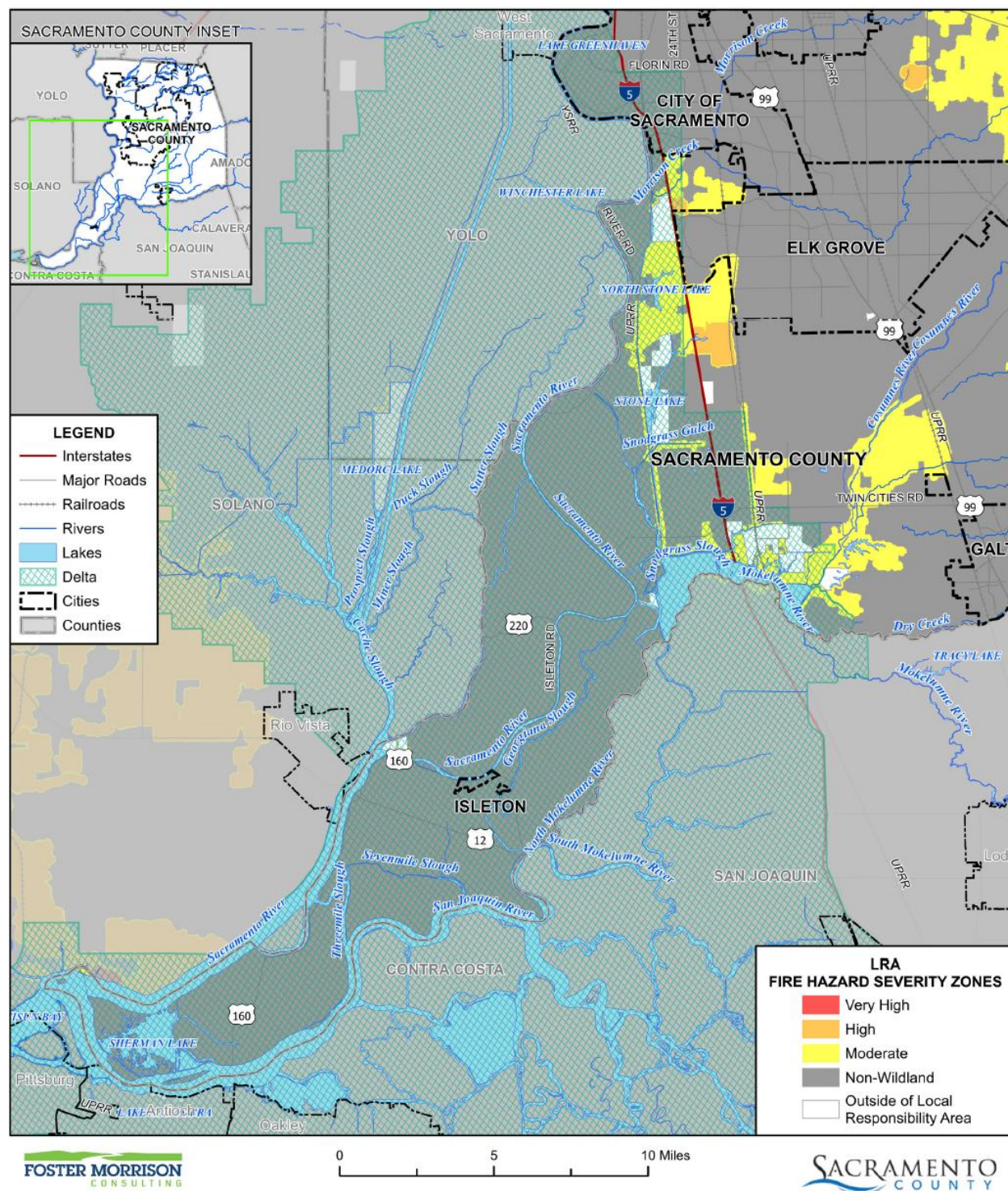
District range from Non-Wildland/Non-Urban to Urban/Unzoned to Moderate in the SRA/FRA, and from Non-Wildland to High in the LRA.

Figure R-30 Sacramento Delta – CAL FIRE SRA/FRA Fire Hazard Severity Zones



Data Source: CAL FIRE (State Responsibility Area: FHSZSRA_23_3) April 2024,
CAL FIRE (Federal Responsibility Area: Draft c20fhszl06_1), September 2007,
Sacramento County, Cal-Atlas: Map Date: 4/21/2026.

Figure R-31 Sacramento Delta – CAL FIRE LRA Fire Hazard Severity Zones



Data Source: CAL FIRE (Local Responsibility Area FHSZ 3/2025 FHSZLRA25_v1_All),
Sacramento County, Cal-Atlas; Map Date: 4/21/2026.

Wildfires tend to be measured in structure damages, injuries, and loss of life as well as on acres burned. Fires can have a quick speed of onset, especially during periods of drought or during hot dry summer

months. Fires can burn for a short period of time or may have durations lasting for a week or more. Geographical FHSZ extents in the SRA/FRA are shown in Table R-16, while extents in the LRA are shown on Table R-17.

Table R-16 Sacramento Delta – CAL FIRE SRA/FRA Fire Hazard Severity Zone Geographical Extents

Jurisdiction / Fire Hazard Severity Zone	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Elk Grove						
Outside of Federal / State Responsibility Area	137	0.1%	81	0.1%	56	0.1%
Elk Grove Total	137	0.1%	81	0.1%	56	0.1%
Isleton						
Outside of Federal / State Responsibility Area	233	0.2%	66	0.1%	167	0.3%
Isleton Total	233	0.2%	66	0.1%	167	0.3%
Sacramento						
Outside of Federal / State Responsibility Area	4,733	4%	3,416	6%	1,316	2.6%
Sacramento Total	4,733	4%	3,416	6%	1,316	2.6%
Unincorporated Sacramento County						
Moderate	63	0.1%	0	0%	63	0.1%
Non-Wildland/Non-Urban	3,857	4%	0	0%	3,857	7%
Urban Unzoned	11	0.01%	0.5	0.001%	11	0.02%
Outside of Federal / State Responsibility Area	96,818	91%	50,843	93%	45,975	89%
Unincorporated Sacramento County Total	100,749	95%	50,844	93%	49,905	97%
Grand Total	105,852	100%	54,407	100%	51,445	100%

Source: CAL FIRE

Table R-17 Sacramento Delta – CAL FIRE LRA Fire Hazard Severity Zone Geographical Extents

Jurisdiction / Fire Hazard Severity Zone	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
Elk Grove						
High	10	0.01%	9	0.02%	1	0.002%
Moderate	37	0.03%	19	0.04%	18	0.03%
Non-Wildland	90	0.1%	52	0.1%	38	0.1%
Elk Grove Total	137	0.1%	81	0.1%	56	0.1%
Isleton						
Non-Wildland	233	0.2%	66	0.1%	167	0.3%
Isleton Total	233	0.2%	66	0.1%	167	0.3%
Sacramento						
Moderate	26	0.02%	10	0.02%	16	0.03%
Non-Wildland	4,707	4%	3,406	6%	1,301	3%
Outside of Local Responsibility Area	2	0.002%	0	0%	2	0.005%
Sacramento Total	4,735	4%	3,416	6%	1,319	3%
Unincorporated Sacramento County						
High	98	0.1%	0	0%	98	0.2%
Moderate	7,670	7%	1,738	3%	5,932	12%
Non-Wildland	89,051	84%	49,106	90%	39,945	78%
Outside of Local Responsibility Area	3,941	4%	1	0.002%	3,940	8%
Unincorporated Sacramento County Total	100,759	95%	50,844	93%	49,915	97%
Grand Total						
Grand Total	105,864	100%	54,407	100%	51,457	100%

Source: CAL FIRE

R.5 Delta Annex Chapters

R.5.1. Introduction

This Delta Annex contains separate Chapters that presents data specifically related to each Delta Area jurisdiction – the City of Isleton and each Delta area district that is a participating jurisdiction to this LHMP

Update. Each Delta Annex Chapter is structured with the same format. The intent of the Chapters is to demonstrate how the risk varies across the Delta and specific to each participating jurisdiction, beyond that provided above in this umbrella Delta Annex which provides Delta area hazard information common to all participating Delta jurisdictions. The following is a description of the format and what is included in each section.

Planning Team

This section begins with a list of each City/District Planning Team members that participated in the LHMP planning process. A table of names, positions, and how each person participated are included in each Chapter.

Community Profile

A general description, overview, background, and history for each Delta Area jurisdiction. Maps of each jurisdiction's location in the Delta are included.

Risk Assessment

Each participating jurisdiction identifies the hazards that affect their jurisdiction and summarized their geographic extent, frequency of occurrence, special extent, and significance specific to Isleton or the participating Districts. This information is presented in a table in each Chapter.

This section assesses each jurisdiction's risk and vulnerability separate from that of the Planning Area as a whole, which has already been assessed in Section 4.3 of the Base Plan and also within this umbrella Delta Annex. This vulnerability assessment analyzes the population, property, and other assets at risk to hazards ranked of medium or high significance that may vary from other parts of the planning area. Each hazard is profiled in the following format:

- **Hazard Profile** – A hazard profile is included for each hazard. This includes information on:
 - ✓ **Hazard Overview** – A general discussion of the hazard and related issues is detailed here.
 - ✓ **Location and Extent** – Location is the geographic area within the City or District that is affected by the hazard. Extent is the expected range of intensity for each hazard. These are discussed in specific detail for mapped hazards, and in more general detail for those hazards that do not have discrete mapped hazard areas.
 - ✓ **Past Occurrences** – Past occurrences are discussed for each hazard. A discussion of disaster declarations is included in each hazard section. National Climactic Data Center (NCDC) events are also discussed. Other past occurrences data specific to the City follow the disaster declarations and NCDC events for each hazard.
 - ✓ **Climate Change** – This section contains the effects of climate change (as applicable). The possible influence of climate change on the hazard is discussed.

After this classification, a general discussion of hazard vulnerabilities occurs. This is done in the following format:

- **Local Concerns** – This includes City or District provided information on how the participating City or District is uniquely affected by or vulnerable to each hazard.
- **Assets at Risk** – This includes sections on: People and Populations; Structures; Critical Facilities and Infrastructure, and Natural, Historic, and Cultural Resources. These are discussed in specific terms for mapped hazards, and in more general terms for those hazards that are unmapped. Sections on Community Lifelines and Economic Assets and Community Activities of Value are not included, as they are fully covered in the Asset Inventory for each jurisdiction and in Chapter 4 of the Base Plan.
- **Impacts** – A discussion on hazard impacts follows. Impacts describe how each hazard can affect the City or District and its assets. The type and severity of impacts reflect both the potential magnitude of the hazard and the vulnerability of the asset.
- **Future Conditions/Future Development** – A discussion of how future conditions and future development may affect the hazard is also included.

Capability Assessment

This section identifies the policies, programs, regulations, and other mechanisms Isleton or the participating Delta area districts already have in place that either contribute to the ability to mitigate the effects of natural hazards.

Mitigation Strategy and Actions

The final section of each Chapter acknowledges concurrence with the overall 2026 LHMP Goals and Objectives and puts forth the recommended mitigation actions of all participating Delta jurisdictions.