

Delta Annex Chapter 4 RD 341

4.1 Introduction

This Annex details the hazard mitigation planning elements specific to the Reclamation District 341 (RD 341 or District), a previously participating jurisdiction to the 2021 Sacramento County Local Hazard Mitigation Plan (LHMP) Update. 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 the District. This Annex provides additional information specific to the District, with a focus on providing additional details on the planning process, risk assessment, and mitigation strategy for this jurisdiction.

4.2 Planning Process

As described above, the RD 341 followed the planning process detailed in Chapter 3 of the Base Plan. In addition to providing representation on the Sacramento County Hazard Mitigation Planning Committee (HMPC), the District formulated their own internal planning team to support the broader planning process requirements. Internal planning participants, their positions, and how they participated in the planning process are shown in Table 4-1. Additional details on Plan participation and District representatives are included in Appendix A.

Table 4-1 RD 341 – Internal Planning Team

Name	Position/Title	How Participated
Robert C. Wagner, P.E	District Engineer	Reviewed draft documents
Patrick W. Ervin, P.E	Engineer	Collected data, drafted text

Coordination with other community planning efforts is paramount to the successful implementation of this LHMP Update. This section provides information on how the District integrated the previously FEMA-approved 2021 LHMP into existing planning mechanisms and programs. Specifically, the District incorporated into or implemented the 2021 LHMP through other plans and programs shown in Table 4-2.

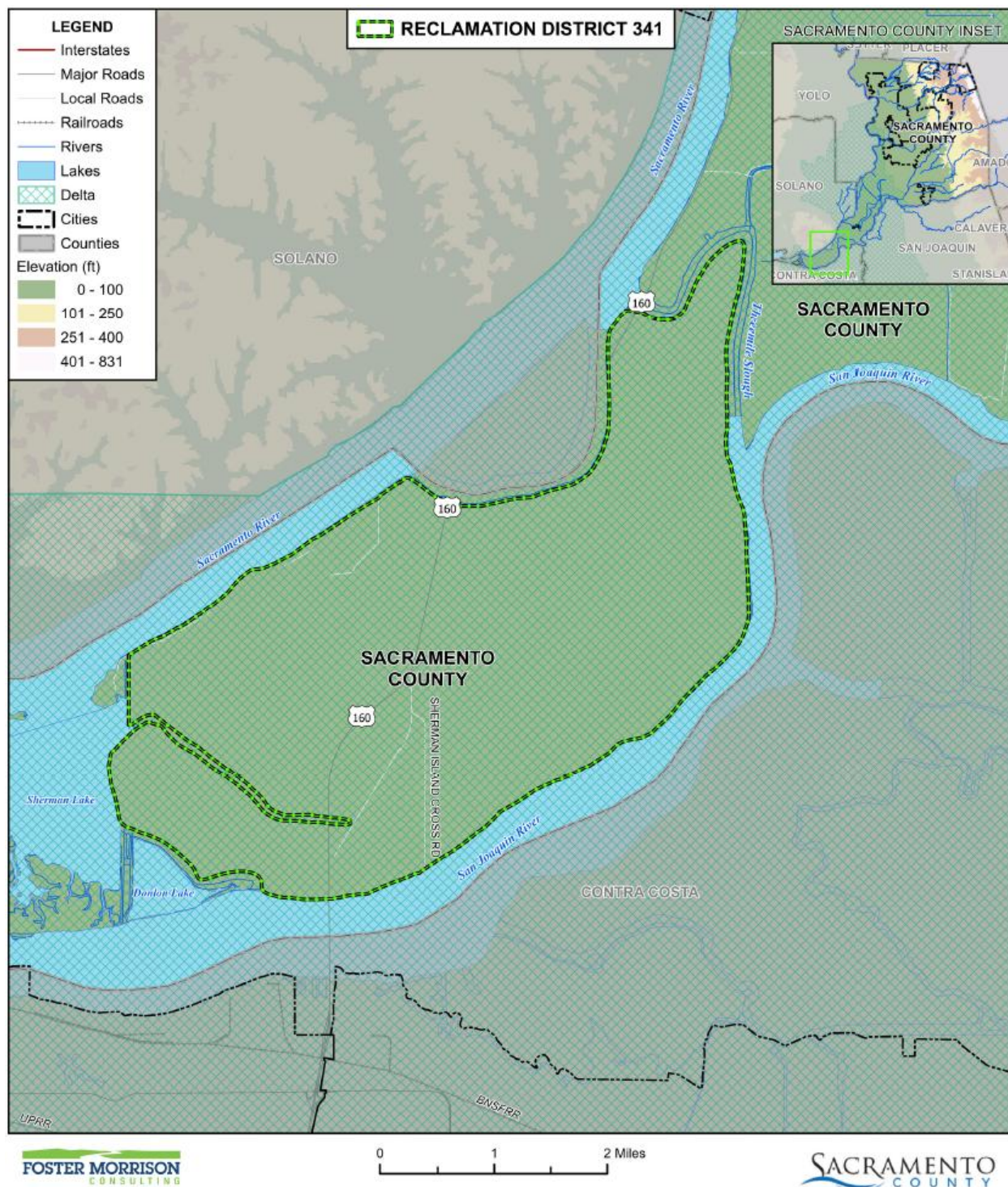
Table 4-2 2021 LHMP Incorporation

Planning Mechanism 2021 LHMP Was Incorporated/Implemented In.	Details: How was it incorporated?
None	The District Planning Team noted that the District did not directly incorporate or implement the 2021 LHMP into any existing planning mechanisms. However, the District has continued to implement projects that support its hazard mitigation strategy. The San Joaquin River Setback Levee Project (SH-17-1.0-SP) and the San Joaquin River Multi-Benefit Project (SH-24-1.0-SP) are currently ongoing and include levee rehabilitation to improve flood protection, along with habitat enhancement.

4.3 Community Profile

The community profile for the RD 341 is detailed in the following sections. Figure 4-1 displays a District map and the location of RD 341 within Sacramento County.

Figure 4-1 RD 341



Data Source: Sacramento County, Cal-Atlas; Map Date: 6/16/2026.

4.3.1. Overview and Background

In the Delta, for the last 5,000 years to the 1850s, relative sea-level rise was balanced by vertical marsh growth through biomass accumulation and sediment deposition. A transition from deposition of organic silt-clay to peat formation in the Delta largely reflects the decline in inundation frequency and the maturation of the marsh plain towards mean higher high water elevations. The resulting freshwater tidal marshes developed because a relatively large freshwater inflow compared to the size of the tidal prism sustained a low salinity, which supported highly productive organic peat formation through tule growth. The large roots of the tule created an organic fabric that supported and aided rapid vertical growth. The living surface was maintained within the intertidal zone (natural habitat), and marsh organic accretion (injection of roots and rhizomes, and incorporation of surface litter) was able to sustain vertical growth at rates in excess of relative sea-level rise. The gradual accumulation of the organic and inorganic sediment must have also offset the loss and compaction of existing peat.

The development of today's Delta began in late 1850 when the Swamp and Overflow Land Act conveyed ownership of tall swamp and overflow land, including Delta marshes from the federal government to the State of California. Reclamation of Sherman Island began shortly thereafter, and by 1859, local property owners had constructed small peat levees of three to four feet in height, with a base width of about eight feet, along the banks of the Sacramento River and Mayberry Slough.

Sherman Island is a 10,000-acre Sacramento – San Joaquin Delta (Delta) island located in southwestern Sacramento County. The island is bordered by the Sacramento River and Threemile Slough to the north, and the San Joaquin River and Mayberry Slough to the south. The island is north of the cities of Antioch and Oakley. Sherman Island was one of the first islands in the Delta to be reclaimed during the period 1868–1879. The island is primarily used as pasture area, although agricultural farming, mainly of corn, grains, and alfalfa, is also predominant in the central and northeastern parts of the island. Elevations within the island vary from 0 to -23 feet relative to sea level (as seen on Figure 4-1). The island has been identified as high priority in the Delta due to its geographical location, which influences the salinity and water quality within the Delta.

The Sherman Island levee system consists of approximately 19.5 miles of levee: 6.4 miles along the Sacramento River, 3.3 miles along Threemile Slough, 6.6 miles along the San Joaquin River, and 3.2 miles along Mayberry Slough. The levee system along the Sacramento River and Threemile Slough are project levees, constructed by the US Army Corps of Engineers (USACE), and the levee system along the San Joaquin River and Mayberry Slough are non-project levees. The entire levee system is maintained by Reclamation District No. 341 (District). The District also maintains 5 modern drainage pumping stations on Sherman Island: 3 on the San Joaquin River, 1 on the Sacramento River, and 1 on Mayberry Slough. The drainage pumps are part of a larger system of siphons, ditches and canals that are used to circulate water for irrigation and drainage.

4.4 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 RD 341 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 District'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 District Profile above, a risk assessment was performed for the District utilizing the existing District boundaries. This includes the following sections:

- 4.4.1 Assets Inventory and Growth and Development Trends
- 4.4.2 Hazard Identification
- 4.4.3 Hazard Profiles and Vulnerability to Specific Hazards

4.4.1. Assets Inventory and Growth and Development Trends

This section provides an inventory of the RD 341'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 RD 341'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 4.4.3 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.

Assets Inventory

The District's asset inventory is detailed in the following sections:

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

A discussion of each of these assets follows and serves as the template for the asset discussion for each hazard in Section 4.4.3.

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 District include both District staff and workers as well as those populations located within District boundaries and are served by the District. This section includes an inventory of past and current populations of the District and also discusses vulnerable populations and underserved communities as a subsection of people and populations located within the District and

potentially at risk to hazards. Information from the District and other sources as detailed below form the basis of this discussion.

Historic Population Trends and Current Population

The most important asset within any community are the people and populations that both work and reside in the District. For special districts, this generally includes District staff and contractors as well as those populations located within its boundaries. The District has 4 staff members. The District provides services to approximately 200 people, based on the 2010 Census. No specific vulnerable populations or at-risk population facilities have been identified within the District. Sherman Island is primarily agricultural and recreational in nature, with a relatively small residential population.

District Assets and Critical Facilities and Infrastructure

This section considers the RD 341's assets at risk, with a focus on key District assets such as structures, critical facilities and infrastructure, and other District assets and their values. With respect to District assets, the majority of these assets are considered critical facilities as defined for this Plan. Critical facilities are defined for this Plan 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.

Most of the District assets are considered Category 1 critical facilities, specifically essential services facilities. Table 4-3 lists critical facilities and other District assets identified by the District Planning Team as important to protect in the event of a disaster. RD 341's physical assets, valued at over \$65 million, consist of structures, critical facilities and infrastructure, and other District assets to support the District's operations.

Table 4-3 RD 341 Assets: Structures, Critical Facilities and Infrastructure, and Other Facilities.

Name of Asset	Facility Type	Replacement Value	Which Hazards Pose Risk
District Levees	District Infrastructure	\$54,000,000	Flood, Levee Failure
District Drain Ditches	District Infrastructure	\$5,000,000	Flood, Levee Failure
Pump Stations (5 Stations)	Critical Facility	\$3,000,000	Flood, Levee Failure
District Equipment (backhoe, tractors, pickups, etc.)	District Asset	\$1,000,000	Flood, Levee Failure
District Office/Workshops	District Asset	\$2,000,000	Flood, Levee Failure
Total		\$65,000,000	

Source: RD 341

The Sherman Island levee system protects non-local assets which provide a public benefit, including infrastructure, utilities, water quality and water supply reliability. Below is a list of the non-local assets protected by the levee system:

- Water Delivery System
 - ✓ State Water Project (SWP)
 - South Bay Aqueduct
 - North Bay Aqueduct
 - ✓ Federal Central Valley Water Project (CVP)
 - Delta Mendota Canal
 - California Aqueduct
 - Contra Costa Canal
 - ✓ Miscellaneous Diversions Directly from the Delta
 - Western Delta Industry
 - 1800+ Agricultural Diverters
 - City of Vallejo diversion
- Infrastructure
 - ✓ State Route 160
 - ✓ Highway 160 Drawbridge
 - ✓ Dam (forms Mayberry Canal)
- Utilities
 - ✓ Major 500kV Transmission Lines
 - WAPA California Oregon Transmission Project
 - PG&E Table Mountain-Tesla line
 - PG&E Vaca Dixon-Tesla line
 - ✓ Natural Gas Resources
 - Natural gas pipeline from Canada
 - Natural gas storage area
 - ✓ Telecommunication and fiber optic lines
 - ✓ US Geological Survey accelerometers

The County General Plan designates approximately 500 acres of recreational land and about 10,000 acres of agricultural cropland/resource conservation area. Sherman Lake is designated as natural preserve.

Community Lifelines

Assessing the vulnerability of the RD 341 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. Most all of the District's community lifelines overlap with the Planning Area's and include many of the critical facilities and infrastructure assets inventoried for this LHMP. As such, specific information on these community lifelines in the District and how they may be affected by a hazard event or disaster are discussed collectively for all jurisdictions in the Base Plan and in the Delta annex.

Natural, Historic, and Cultural Resources

Natural Resources

RD 341 has a variety of natural resources of value to the District. These natural resources parallel that of Sacramento County as a whole. Information can be found in Section 4.2.1 of the Base Plan.

The District has completed several projects which converted farmland into native habitat. The habitat areas on the Island include the following:

- Parcel 11, an approximately 14-acre riparian forest/scrub-shrub mitigation site,
- Mayberry Farms Subsidence Reversal Project, a 300-acre permanent wetland,
- Whale's Mouth Wetland Restoration Project, a 600-acre permanent wetland, and
- Whale's Belly Wetland Restoration Project, a 936-acre permanent wetland.

In addition to the on-island habitat areas, the levee system also supports waterside habitat. 8.5 acres of waterside habitat were constructed as part of the Mayberry Slough Setback Levee Project

Historic and Cultural Resources

RD 341 has a variety of historic and cultural resources of value to the District. These historic and cultural resources parallel that of Sacramento County as a whole. Information can be found in Section 4.2.1 of the Base Plan.

Economic Assets and Community Activities of Value

Assessing the vulnerability of the RD 341 to natural hazards and disasters also involves inventorying the economic assets and community activities of value in the District.

Economic Assets

After a disaster, economic resiliency is one of the major drivers of a speedy recovery. Each community has specific economic drivers. RD 341's major driver is agriculture. In addition to agricultural uses, several recreational vehicle parks and marinas for local and public use are located on Sherman Island including Rio Viento on the Sacramento River side, Eddos Harbor and RV park which includes a 70 berth marina on the San Joaquin River side, Sherman Lake Marina on Sherman Lake, and the Outrigger Marina located on the Island's northeast corner. In total, the Island provides 368 marina berths, a boat launch maintained by the County and one fishing access site.

Sherman Island also has 60 natural gas wells and approximately 1,082 acres of gas production fields. In addition, the levees protect 145,514 feet of a natural gas pipeline which originates in Canada and crosses Sherman Island. Failure of the Sherman Island levee system would interrupt gas service through the pipeline and gas production and storage occurring on Sherman Island.

Community Activities of Value

Inventorying economic assets in the District 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 or other activities that bring money into the communities such as sports tournaments and other recreational activities. Community Activities of Value for the County were discussed in Section 4.2.1 of the Base Plan and are assumed to be the same or similar for the District. There are no organized community activities within the District, however Sherman Island provides access to recreational activities such as fishing and windsurfing.

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. For Districts, this generally includes the following:

- Construction/development projects related to adding new District facilities, infrastructure, land acquisition, etc.

- Plans for expansion or build out of the District’s service area, including new service hookups, and other District functions related to where the District will be expanding services.

Population Trends and Projections

Population trends show the District to have a flat or slightly declining population. This is expected to occur going forwards.

Development since 2021 Plan

Since 2021, the District has completed the following projects:

- Highway 160 Levee Seepage Repair Project. Construction of a levee drain system from STA 870+00 to 940+00.
- Highway 160 Emergency Waterside Repair from STA 894+00 – 896+25 to repair a significant waterside levee slip due to an earthquake experienced in October 2023.
- Sherman Lake RSP – Repaired RSP loss and waterside levee erosion along Sherman Lake at STA 606+50–610+00 and STA 643+71–645+00 following high tides and strong winds.
- Pump No. 1 Discharge Pipe Repair – Reconstruction of the landside portion of a 24-inch steel discharge pipe.
- Pump No. 4 Sump Repair – Construction of a concrete sump bottom including replacement of the pump.

Since 2021 the District has not added new facilities. The District currently plans to rehabilitate its existing Pump Station No. 3 to improve the reliability and operation of the existing drainage infrastructure. The District has not expanded its service area and has no plans to do so. The number of people served by the District has remained unchanged. Land use within the District remains majority agriculture, however DWR plans to convert approximately 1,600 additional acres into wetland.

Future Development Areas

It is important to review future development plans for the District. Future development should be sited in areas that are away from known hazard risks. If this is not possible, mitigation should be done to ensure that future development is protected against future hazards.

The District proposes to construct the following projects over the next five years:

- San Joaquin River Setback Levee - Rehabilitate San Joaquin River levee from Sta. 175+00 – 199+00 to the PL 84-99 Standard and reconstruct Sherman Island East Levee Road to County Rural Road Standards.
- San Joaquin River Multi- Benefit Project - Rehabilitate San Joaquin River levee from Sta. 330+00 – 368+00 to the PL 84-99 Standard and reconstruct Sherman Island East Levee Road to County Rural Road Standards.

The District noted that these projects will reduce risk for the existing populations who live in the District, and that new residential or commercial development in these areas over the next five years is unlikely.

4.4.2. Hazard Identification

The RD 341 identified the hazards that affect the District and summarized their location, extent, likelihood of future occurrence, potential magnitude, and significance (or priority of a hazard) specific to the District (see Table 4-4). Those hazards identified as a high or medium significance in Table 4-4 are considered District priority hazards for mitigation planning. Those hazards that occur infrequently or have little or no impact in the District were determined to be of low significance and not considered a priority hazard. Significance was determined based on the hazard profile, focusing on key criteria such as frequency, extent, and resulting damage, including deaths/injuries and property, natural and cultural resources, and economic damage. The ability of a jurisdiction to reduce losses through implementation of existing and new mitigation measures was also considered as to the significance of a hazard. This assessment was used to prioritize those hazards of greatest significance, enabling the District to focus resources where they are most needed.

Table 4-4 RD 341—Hazard Identification Assessment

Hazard	Geographic Extent	Likelihood of Future Occurrences	Magnitude/Severity	Significance	Climate Change Influence
Aquatic Nuisance Species (plant/animal)	Limited	Likely	Negligible	Low	Low
Climate Change	Extensive	Likely	Limited	Low	–
Dam Failure	Limited	Unlikely	Negligible	Low	Medium
Drought & Water Shortage (w/tree mortality)	Extensive	Likely	Negligible	Low	High
Earthquake (w/subhazards)	Extensive	Occasional	Limited	Medium	Low
Flood: 1%/0.5%/0.2% annual chance	Extensive	Occasional	Catastrophic	High	Medium
Flood: Localized Stormwater	Limited	Likely	Negligible	Low	Medium
Landslides, Mudslides, and Debris Flow	Limited	Unlikely	Negligible	Low	Medium
Levee Failure	Extensive	Occasional	Catastrophic	High	Medium
Sea Level Rise	Limited	Likely	Limited	Medium	High
Severe Weather: Extreme Cold and Freeze	Extensive	Likely	Negligible	Low	Medium
Severe Weather: Extreme Heat	Extensive	Likely	Negligible	Low	High
Severe Weather: Heavy Rains and Storms (Hail, Lightning, Wind)	Extensive	Likely	Limited	Medium	Medium
Severe Weather: High Winds and Tornadoes	Extensive	Likely	Limited	Medium	Low
Subsidence	Extensive	Likely	Negligible	Low	Medium
Wildfire (with smoke and air quality)	Limited	Unlikely	Negligible	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					

4.4.3. Hazard Profiles and Vulnerability to Specific Hazards

This section includes the hazard profiles and vulnerability assessment for the RD 341's priority hazards (i.e., those ranked of medium or high significance specific to the District as identified in the Significance column of Table 4-4). This section focuses on where and how the District is affected by their priority hazards. 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 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. NCEM events are also discussed. Other past occurrences data specific to the District follow the disaster declarations and NCEM 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 District 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.
- **Local Concerns** – This includes District provided information on how the District is uniquely affected by or vulnerable to each hazard.
- **Assets at Risk** – A discussion of the assets at risk follows, presented in the same order as in Section 4.4.1 above, with a few exceptions. This includes sections on: People and Populations; District Assets and 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 in the Sections below, as they are common to all jurisdictions and are fully covered in Section 4.4.1 above and in Chapter 4 of the Base Plan.
- **Impacts** – A discussion on hazard impacts follows. Impacts describe how each hazard can affect the 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. This considers both new District assets and improvements as well as any changes with the District’s boundaries.

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

An impact or vulnerability 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 the Sacramento County Planning Area - 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. Much of the Sacramento County Planning Area is served by Pacific Gas & Electric (PG&E) and Sacramento Municipal Utility District (SMUD). 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 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. PG&E noted no PSPS events in the Sacramento County Planning

Area since the 2021 LHMP. SMUD noted that it has had no PSPS events for its service territories since 2021.

Local Concerns

There have been no intentional (including PSPS events) or unintentional power outage issues associated with hazard events affecting the District since 2021. However, with an increase in climate change related issues (e.g., extreme heat conditions, atmospheric river storms) occurring in the Sacramento County Planning Area, the potential for future hazard related power outages remain a concern. The District office is the only District facility with backup power.

Hazard Profiles and Vulnerability Assessment by Hazards

The following sections provide the hazard profile and vulnerability assessments for each of the hazards identified in Section 4.4.2 Hazard Identification.

Earthquake (w/Subhazards)

Likelihood of Future Occurrence—Occasional (minor)/Unlikely (major)

Vulnerability—High

Hazard Profile

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 cause ground shaking, possible liquefaction, landslide, settlement, and can cause fires that follow the earthquake. Earthquakes can cause structural damage, injury, and loss of life, as well as damage to infrastructure networks, such as water, wastewater, 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.

Location and Extent

Since earthquakes are regional events, the whole of the District is at risk to earthquake. The RD 341, Sacramento County, and surrounding areas have some level of risk from seismic and geologic hazards. Regional faults were shown in Section 4.3.10 of the Base Plan. Geological literature indicates that no major active faults transect the County; however, there are several subsurface, likely inactive, faults in the Delta, such as the Midland fault. A second, presumably inactive, fault is in the vicinity of Citrus Heights near Antelope Road. To the east, the Bear Mountain fault zone trends northwest-southeast through Sacramento and El Dorado Counties. As noted in the Base Plan, there have been historically active faults outside the County. These include: San Andreas, Vaca, Concord, Greenville, Hayward, Calaveras, Foothill Fault System, Las Positas, Midland, and West Napa. A significant seismic event on any of these major faults could cause damage in the RD 341.

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 4.3.11 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 could occur, so both magnitude and intensity of earthquakes are expected to remain low to moderate. Seismic shaking maps for the area in Section 4.3.10 of the Base Plan show Sacramento County and the District fall within a low to moderate shake risk.

There is no scientific scale for earthquake related liquefaction. The speed of onset is short, as is the duration. The effects from liquefaction can last for days, weeks, months or even years as areas of the County are rebuilt or leveed areas are dewatered and the levees rebuilt. In Sacramento County, liquefaction zones were mapped by CGS for the first time in 2025. Geographic flood extent from the CGS Liquefaction Zones were shown in Section 4.3.10 of the Base Plan. It should be noted that not all of the County was mapped as part of CGS liquefaction mapping. The Delta area is not included in these maps. The Delta area may be prone to liquefaction, but that is not shown on these maps.

Past Occurrences

Disaster Declaration History

There have been no state or federal disaster declarations in Sacramento County from earthquake.

NCDC Events

The NCDC does not track earthquake events.

RD 341 Events

As shown in the Base Plan, no disaster declarations or other significant events causing significant damage have occurred in the County due to earthquake, including its subhazards such as liquefaction. The District Planning Team noted that the October 18, 2023, magnitude 4.2 earthquake centered in the Rio Vista/Isleton area resulted in a significant levee slip along the Sherman Island levee system between Stations 894+00 and 896+25. The District subsequently repaired the affected levee section. No other past earthquake occurrences were identified as having significantly affected the District.

Climate Change and Earthquake

Climate change is unlikely to increase earthquake frequency or strength. More information on future impacts can be found in the Future Conditions/Future Development section of the Vulnerability Assessment below.

Vulnerability to Earthquake

The combination of plate tectonics and associated California coastal mountain range building geology generates earthquakes as a result of the periodic release of tectonic stresses. Earthquake vulnerability is primarily based on population and the built environment. Urban areas in high seismic hazard zones are the most vulnerable, while more rural areas are less vulnerable. The primary impacts of concern are life safety and property damage. Although several active faults are near the Sacramento County Planning Area and the District, seismic hazard mapping indicates that the District has low to moderate seismic hazard potential. There is the potential for the District and Sacramento County Planning Area to be subject to some level of moderate seismic shaking during earthquake events occurring on these regional faults depending on the location and magnitude of the event. Some degree of structural damage due to strong seismic shaking could be expected in the District.

The Uniform Building Code (UBC) identifies four seismic zones in the United States. The zones are numbered one through four, with Zone 4 representing the highest level of seismic hazard. The UBC establishes more stringent construction standards for areas within Zones 3 and 4. All of California lies within either Zone 3 or Zone 4. The RD 341 is located within Zone 3.

Earthquake shaking can also cause liquefaction to occur. Areas with loose soil and high water tables are at risk from liquefaction. The levees are thought to be at risk to liquefaction. No mapping currently exists that shows the risk.

The whole of the District is at some measure of vulnerability to earthquake. An assessment of a community's vulnerability to earthquakes begins with an understanding of local exposure to earthquakes. This is included in the Local Concerns section below. After that section, assets at risk are discussed.

Local Concerns

The District has specific concerns and unique vulnerabilities regarding this hazard. These concerns form a portion of the basis for the mitigation strategy and mitigation actions that seek to reduce risk and vulnerability to this hazard.

The District is potentially affected by earthquake events from several active, regional faults as described above. As detailed in Section 4.3.10 of the Base Plan, Hazus deterministic analyses were performed on four different potential earthquake scenarios associated with four regional faults. Hazus is FEMA's loss estimation tool used to model earthquake damages for planning purposes. For deterministic Hazus scenarios, a single scenario event is selected based on a specific fault, the epicenter location, and the potential magnitude of the event. The faults and scenarios included the following: Calaveras (6.86M event), Concord (6.8M event), Hayward (7.58M event), and San Andreas (8.04M event). These scenarios likely affected the District in some way. A small portion of the damages from the Hazus analyses may also be attributed to the District.

The most significant vulnerability of RD 341 to earthquake is potential damage to or failure of the levees, including overtopping of levees, erosion, boils, seepage, and other damage to the levees compromising its function. This can result in significant inundation of areas protected by the levees creating life safety issues and damaging property, infrastructure and crops.

Assets at Risk

Many assets in the District are at risk to ground shaking and other earthquake related impacts. Assets at risk from earthquake include people and populations; District assets and critical facilities and infrastructure); and natural, historic, and cultural resources. These are discussed in the following sections.

People and Populations

All people and populations are at risk from earthquake events (including both District staff and the population within District boundaries). Those at heightened risk include: the unsheltered, individuals dependent on medical equipment, and individuals with impaired mobility.

The greatest risk to people and populations from earthquake is death and injury. More information on people and populations at risk to earthquake shaking events can be seen in the Hazus scenarios developed for this LHMP. More information on the Hazus scenarios and how the District and County is affected is included in Section 4.3.10 of the Base Plan.

District Assets and Critical Facilities and Infrastructure

All District assets and critical facilities and infrastructure in the District are vulnerable to earthquakes and its subhazards, depending on the severity and location of the event. The Hazus scenarios conducted for the entire Sacramento County Planning Area show how structures and critical facilities may be affected. Given the nature of earthquake events causing significant ground shaking among other issues, District levees and pumping stations and infrastructure would be uniquely vulnerable to damaging earthquakes.

District levees are at-risk from a seismic event, although the level of risk is still being studied. The District owns two steel buildings that are used as workshops, storage of materials and equipment, and equipment maintenance. Retrofitting of these buildings is likely not necessary due their low risk categorization as low-occupancy agriculture buildings. The District office sits adjacent to the main workshop at the toe of the levee. The office is a converted shipping container and since it is essentially a steel box, retrofitting would not be required. The largest risk to the District shops and office are likely flooding due to a levee

failure caused by an earthquake, not the structural failure of the buildings themselves. The District pump stations are also at risk, however two of the stations have been rehabilitated using seismically designed steel piles that should protect the pump stations during a seismic event.

Natural, Historic, and Cultural Resources

The 2023 State Hazard Mitigation Plan noted that environmental problems from earthquakes can be numerous. It is possible for earthquakes to reroute streams, which can change the water quality, possibly damaging habitat and feeding areas. Streams fed by groundwater and/or springs may dry up because of changes in underlying geology. Another threat to the environment from earthquakes is the potential release of hazardous materials into the natural environment causing contamination that can be difficult to contain. Historical and cultural resources are at risk, often due to their age and construction types. The Hazus scenarios in Section 4.3.10 of the Base Plan and included below are relatively silent on the vulnerability to natural, historic, and cultural resources, but impacts to these resources could be long lasting.

Impacts from Earthquake

Earthquakes can strike without warning and cause dramatic changes to the landscape of an area that can result in loss of life and injuries, and have devastating impacts on the built environment. The greatest impact is to life safety of the RD 341 staff, residents, and visitors. Other impacts to the District could include damages to infrastructure such as roads, bridges, and other transportation system infrastructure; damages and loss of services to utilities and critical infrastructure, including those related to gas, power, water, wastewater and communication systems; damages to structures and other development.

Earthquakes can also cause failure of dams, levees, and reservoirs. Facilities and land downslope from dams or water reservoirs or behind levees might be subject to flooding, if the dams, reservoirs, or levees fail as a result of an earthquake. The District has locations with significant flood risk that include facilities downslope from dams or reservoirs, levees, and other flood control structures that could be affected by a significant earthquake event.

Impacts that are not quantified, but can be anticipated in large future events, include:

- Injury and loss of life;
- Structural and property damage;
- 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

Impacts to identified assets at risk to this hazard and the overall vulnerability of the District may be affected in the future by climate change (which was discussed in the Likelihood of Future Occurrence discussion above), changes in population patterns (migration, density, or the makeup of socially vulnerable populations), and changes in land use and development. These are discussed below.

Future Conditions/Future Development

This section provides a discussion of how future conditions will influence or affect the hazard over time and also discusses future development relative to each hazard.

Future Conditions

Future conditions may be affected by climate change, changes in population patterns (migration, density, or the makeup of socially vulnerable populations), and changes in land use and development. Findings on this for the RD 341 include the following:

- Climate change is likely to have no effect on future earthquake conditions and associated impacts and vulnerability of the District. This was discussed in greater detail in the Climate Change and Earthquake section of the Hazard Profile above.
- Population projections for the area served by the District show the population to be flat or shrinking, which limits additional impacts to the District. The District may add staff, but this number would be small. The District noted it has no control over population changes within its District boundaries/service area, it merely reacts to them.
- Changes in land use and development in the District are expected to be limited in the near future and thus are not likely to affect earthquake and associated impacts to the District. In addition, adherence to protective building codes for new development will also assist in limiting future impacts and associated vulnerabilities of the District to this hazard.

Future Development

Although new growth and development corridors would fall in areas affected by earthquake, given the limited chance of major earthquake and the building codes in effect, development in areas prone to earthquakes will continue to occur. The County enforces the state building code, which mandates construction techniques that minimize seismic hazards. Future development in the District is subject to these building codes and land use planning.

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

Likelihood of Future Occurrence—Occasional (1%)/Unlikely (0.5/0.2%)

Vulnerability—High

Hazard Profile

This hazard discusses the FEMA DFIRM 1%, 0.5%, and 0.2% annual chance floods. These tend to be the larger floods that can occur in the District and have caused damage in the past. Flooding can be a significant problem in the District. Historically, the District has been at risk to flooding primarily during the winter and spring months when river systems in the District swell with heavy rainfall and snowmelt runoff. The District has also been at risk during atmospheric river flood events. Normally, storm floodwaters are kept within defined limits by a variety of storm drainage and flood control measures located throughout the Sacramento County Planning Area and the RD 341. Occasionally, extended heavy rains result in floodwaters that exceed normal high-water boundaries and cause damage. Flooding has occurred within

the 1% annual chance floodplains and in other localized areas in the District. The District has also been at risk during atmospheric river flood events. Rain on snow events occurring in upper elevations during the spring months can also be significant and contribute to greater downstream runoff and flooding during large storm events.

Location and Extent

The RD 341 has areas located in the 1% annual chance flood zones. This is seen in Figure 4-2.

Figure 4-2 RD 341 – FEMA DFIRM Flood Zones

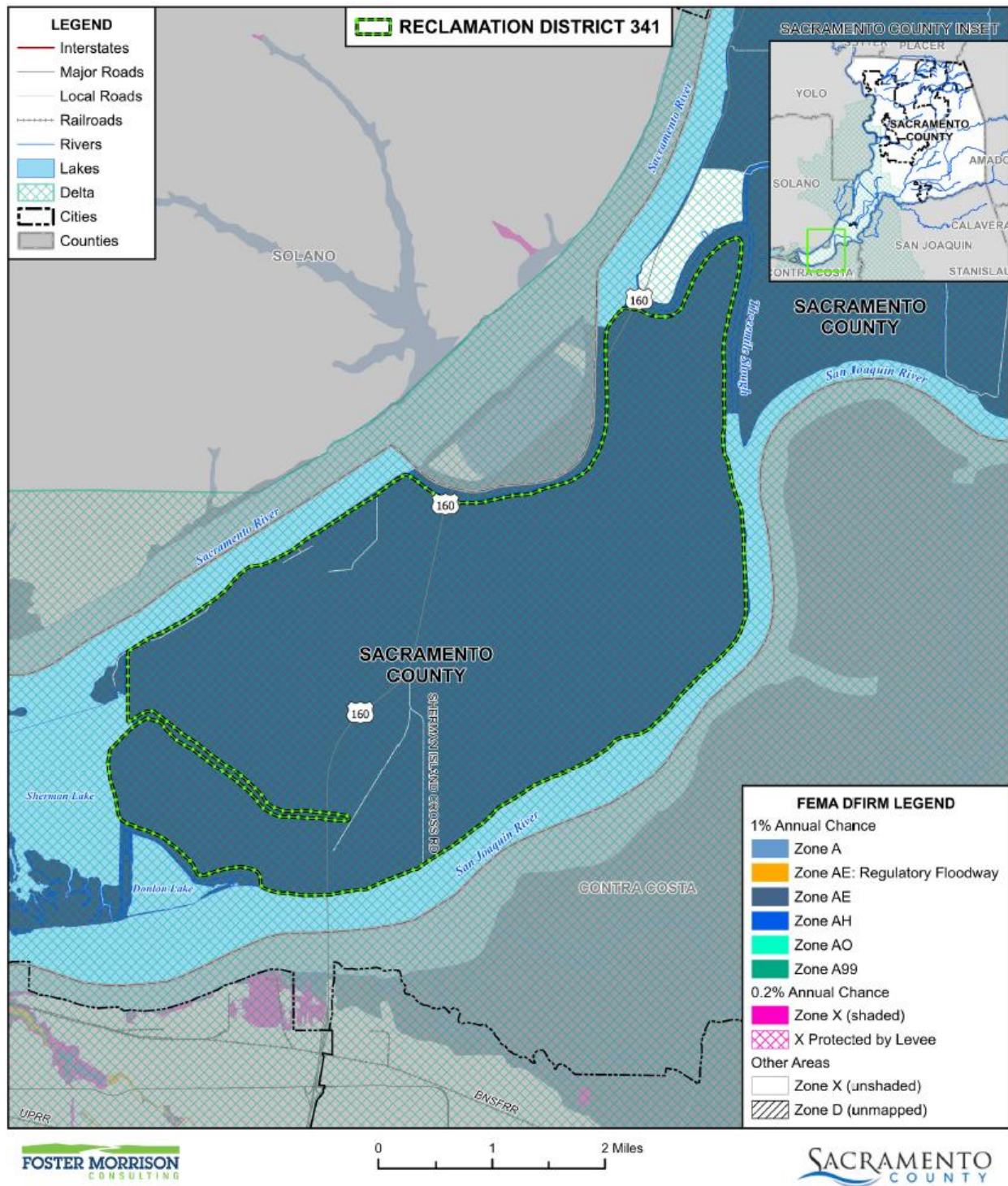


Table 4-5 details the DFIRM mapped flood zones located within the District.

Table 4-5 RD 341– DFIRM Flood Hazard Zones

Flood Zone	Description	Present in District
A	1% annual chance flooding; No base flood elevations provided	
AE Regulatory Floodway	1% annual chance flood: Regulatory floodway; Base flood elevations provided	
AE	1% annual chance flooding; Base flood elevations provided	X
AH	1% annual chance flood areas of shallow flooding between one to three feet deep. Regulatory floodway; Base flood elevations provided	
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.	
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.. No Base Flood Elevations (BFEs) or depths are shown.	
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	
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 (unshaded)	Areas of minimal flood hazard	
D	Unmapped areas	

Source: FEMA DFIRM 02/22/2024

Additionally, flood extents can generally be measured in volume, velocity, and depths of flooding. Expected flood depths in the District vary, depending on the nature and extent of a flood event; specific depths are unknown. Flood durations in the District 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 District tends to have a shorter speed of onset, due to the amount of water that flows through the District.

Geographical flood extents for the District from the FEMA DFIRMs are shown in Table 4-6.

Table 4-6 RD 341 – Geographical DFIRM Flood Zone Extents

Flood Zone	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
1% Annual Chance Flood Hazard	10,077	100%	480	100%	9,597	100%
0.2% Annual Chance Flood Hazard	0	0%	0	0%	0	0%
Other Areas	0	0%	0	0.0%	0	0%
Grand Total	10,077	100%	480	100%	9,597	100%

Source: FEMA DFIRM 02/22/2024

Past Occurrences

Disaster Declaration History

A list of state and federal disaster declarations for Sacramento County from flooding is shown on Table 4-7. These events also likely affected the District to some degree.

Table 4-7 Sacramento County – State and Federal Disaster Declarations 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.

NCDC Events

The NCDC tracks flood events for the County. Events have been tracked for flooding since 1993. Sacramento County has seen 174 events. These events most likely had some impact on the District.

RD 341 Events

Due to the nature of the District, flood past occurrences are discussed in the Levee Failure Past Occurrences section.

Climate Change and Flood

It is likely that climate change will increase the chance of future occurrence as well as future impacts associated with flood. More information on future impacts to the District can be found in the Future Conditions/Future Development section of the Vulnerability Assessment below.

According to the 2024 CAS, climate change may affect flooding in California, the Sacramento County Planning Area, and the District. 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.

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. Further,

more winter-time precipitation that falls as rain instead of snow, and higher temperatures that will cause earlier snowmelt, which could produce substantial surface water flows over a short period of time and may potentially affect dams and spillways and overwhelm levee systems designed for historical precipitation patterns. Historically, the County experienced an average of four extreme precipitation events per year (as shown in Section 4.3.4 of the Base Plan). Under the medium and high emissions scenarios, the County is expected to experience five to six extreme precipitation events per year by mid-century and six to seven extreme precipitation events per year by the late century.

The 2026 American, Bear, and Cosumnes Watersheds Resilience Plan noted that a key driver of climate vulnerability, adaptive capacity, and implementation readiness in the watershed group is flooding. An equity analysis was performed as part of this Plan. An Equity Analysis Technical Appendix demonstrates how social vulnerability aligns with the physical hazard environment across the watershed. It noted that flooding impacts are most severe downstream, where rising flows increasingly stress Sacramento's levee system; a modeled levee-breach scenario affects 12.5% of the watershed population, and 59% of those affected fall into the highest flood-sensitivity category.

Future flooding exacerbated by climate change will result in a range of potential impacts across the County. For populations, there is an array of social vulnerability factors that exacerbate flood-related risks, and those residing in floodplains are especially vulnerable to the direct impacts of flooding. Floodwaters can interact with sources of pollution and distribute hazardous pollutants locally and regionally, which may result in water contamination and a range of human health impacts. Additionally, flooding can disrupt transportation networks, cause economic losses through business and government facility closures, disrupt communications, disrupt the provision of utilities, and cause significant damage to buildings and critical infrastructure. Further, flooding may also threaten ecosystems and agricultural resources; unlike natural flooding regimes that deposit useful sediment resulting in increased soil fertility as well as groundwater recharge, catastrophic flooding from levee overtopping could lead to soil erosion and loss of viable cropland. It could also release sewage and hazardous materials into the environment if wastewater treatment plants are inundated, storage tanks are damaged, and pipelines are severed.

The June 2025 Delta Adapts Adaptation Plan noted that climate change will affect flooding in the Delta. Located at the confluence of the Sacramento and San Joaquin Rivers and San Francisco Bay, the Delta is a complex system whose water levels are influenced by riverine inflows, tides, storm surge, and in some locations, flood hazard management and water supply infrastructure. Climate change will affect many of these factors, increasing the risk of flooding. Riverine flows are the primary driver of high-water levels in the north and south Delta, where more frequent and stronger watershed precipitation events and a shift in winter precipitation from snow to rain will drive flood vulnerabilities. In contrast, higher sea levels will increase the likelihood of flooding in Suisun Marsh and the western and central Delta. Climate change is expected to increase the frequency of large runoff events across the Delta watershed. Most of the Delta's flood management infrastructure, including 1,100 miles of levees and upstream reservoirs, were designed to operate under historical conditions that did not consider climate change. Climate change will place greater stress on the flood management system, and Delta levees will become increasingly vulnerable to breaches, overtopping, or other types of failure if no action is taken.

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

Floods have been a part of the District'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 damage and potential loss of life and injury. Predominantly, the effects of 1%, 0.5%, and 0.2% annual chance flooding are generally confined to areas near the waterways of the District. As waterways grow in size from local drainages, so grows the threat of flood and dimensions of the threat.

The whole of the District is at some measure of vulnerability to floods. An assessment of a community's vulnerability to flood begins with an understanding of local exposure to flood. This is included in the Local Concerns section below followed by a discussion of the District's Assets at Risk to this hazard.

Local Concerns

The District has specific concerns and unique vulnerabilities regarding this hazard. These concerns form a portion of the basis for the mitigation strategy and mitigation actions that seek to reduce risk and vulnerability to this hazard.

The greatest local concern from a flood is from the accompanying levee failure and inundation of Sherman Island. More information can be found in the Levee Failure section below.

Assets at Risk

Assets at risk from flood include people and populations; District assets and critical facilities and infrastructure); and natural, historic, and cultural resources. These are discussed in the following sections.

People and Populations

All people and populations located in the 1% annual chance floodplains within the District (including both District staff and the population within District boundaries) are at some risk to flooding. Certain vulnerable populations located within areas prone to flooding may be at increased risk to this hazard, especially during a large event with minimal advance notice. These vulnerable populations include: the unsheltered, those with limited mobility, and those that lack the resources to leave the area.

Populations within District boundaries can be the most vulnerable. Not only are the residents at risk, but their homes and contents are all at risk, compounding the impacts associated with significant hazard events.

District Assets and Critical Facilities and Infrastructure

Certain District structures are at risk of DFIRM flooding and primarily include those structures located within the 1% and 0.2% annual chance floodplains. Flooding presents a threat to both critical facilities and infrastructure, as well as community lifelines. Critical infrastructure plays an immensely important role in the District and surrounding communities. District assets listed in Table 4-3 would be at risk to flooding.

Natural, Historic, and Cultural Resources

Large flood events can affect natural, historic, and cultural resources. There are a number of ways floodwaters can impact natural resources and the environment. Wildlife habitats can be destroyed by floodwaters. Contaminated floodwater can pollute rivers and habitats. Silt and sediment can destroy natural areas. Riverbanks and natural levees can be eliminated as rivers reach bankfull capacity. Rivers can be widened, and deposition can increase downstream. Trees can be uprooted by high-velocity water flow. Plants that survived the initial flood may die due to being inundated with water. Historic and cultural resources may also be affected. Generally, the impacts are associated with damage to structures within the flooded areas, but other cultural resources such as those associated with Native Americans and old tribal areas can also be disturbed, damaged and lost during extreme flood events. Any of these that fall in the flood zones shown on Figure 4-2 would be vulnerable.

Impacts from Flood: 1%, 0.5%, and 0.2% Annual Chance

Floods are among the costliest natural disasters in terms of human hardship and economic loss nationwide. Large flood events, including those associated with 1% and 0.2% annual chance floods, can cause substantial damage to structures, landscapes, and utilities as well as life safety issues. People may be swept away in floodwaters, causing injuries or deaths. 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. Direct impacts, such as drowning, can be limited with adequate warning and public education about what to do during floods. Floodwaters can transport large objects downstream which can damage or remove stationary structures. Structures can be damaged directly from floodwaters and can also be damaged from trees falling as a result of water-saturated soils. 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 causing power outages. The interruption of power causes major problems and can result in the 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.

Standing water can cause damage to crops, roads, foundations, and electrical circuits. Other problems connected with flooding and stormwater runoff include erosion, sedimentation, degradation of water quality, loss of environmental resources, and economic impacts.

Impacts to identified assets at risk to this hazard and the overall vulnerability of the District may be affected in the future by climate change (which was discussed in the hazard profile discussion above), changes in population patterns (migration, density, or the makeup of socially vulnerable populations), and changes in land use and development. These are discussed below.

Future Conditions/Future Development

This section provides a discussion of how future conditions will influence or affect the hazard over time and also discusses future development relative to each hazard.

Future Conditions

Future conditions may be affected by climate change, changes in population patterns (migration, density, or the makeup of socially vulnerable populations), and changes in land use and development. Findings on this for the RD 341 include the following:

- Climate change is likely to exacerbate future flood conditions and associated impacts and vulnerability of the District to 1% and 0.2% annual chance flooding. This was discussed in greater detail in the Climate Change and Flood section of the Hazard Profile above.
- Population projections within the jurisdictional boundaries of the District show the population to be flat or slightly declining. It is unknown how population patterns and demographics will change in the near future. The District may add staff, but this number would be small. The District noted that it has no control over population changes within its jurisdictional boundaries. With no notable changes in populations numbers and makeup, the vulnerability of the District to this hazard is unlikely to change.
- Changes in land use and development in the District are expected to be limited in the near future and thus are not likely to affect flooding and associated impacts to the District. Additional development traditionally leads to additional flooding. In addition, adherence to protective building codes for new development will assist in limiting future impacts and associated vulnerabilities of the District to this hazard.

Future Development

Future development in the District may be built in the floodplain, as long as it conforms to the standards of the floodplain ordinance. The County enforces their floodplain management ordinance on areas inside the District. More detail on the specifics of the floodplain ordinance can be found in Section 4.4.1 of the Base Plan. New District facilities and assets will be sited in such a way as to reduce the risk from flooding to District structures and assets.

Levee Failure

Likelihood of Future Occurrence—Occasional

Vulnerability—Extremely High

Hazard Profile

A levee is a raised area that runs along the banks of a stream or canal. Levees reinforce the banks and help prevent flooding by containing higher flow events to the main stream channel. By confining the flow to a narrower stream channel, levees can also increase the speed of the water. Levees can be natural or man-made. A natural levee is formed when sediment settles on the streambank, raising the level of the land around the stream.

Levees provide strong flood protection, but they are not failsafe. Levees are designed to protect against a specific flood level and could be overtopped during severe weather events or a release from or failure of a dam. Levees reduce, not eliminate, the risk to individuals and structures located behind them. A levee system failure or overtopping can create severe flooding and high-water velocities. It is important to

remember that no levee provides protection from events for which it was not designed, and proper operation and maintenance are necessary to reduce the probability of failure.

Over 518 miles of levees are located throughout the Sacramento County Planning Area. These include both accredited and unaccredited levees, as discussed in Section 4.3.14 of the Base Plan, all which pose a risk to adjacent communities should a levee fail or overtop. While the levee analysis included in this section focuses on the accredited levees and those with improvements in process based on the DFIRM A99 and X-Protected by Levee Flood Zones, there are many older, unaccredited levees located throughout the County Planning Area, including the District, that may have a greater potential for overtopping or breaching and pose a significant risk to communities should they fail.

Location and Extent

The entire District are at risk to levee failure flooding. There is not a scientific scale or measurement system in place for levee failure. It is usually measured in area covered and depth of flooding. A map of levees located in the Sacramento County Planning Area is shown in Section 4.3.14 of the Base Plan. Note, not all levees and levee inundation depths are depicted on these maps. The speed of onset is slow as the river rises, but if a levee fails the warning times are short for those in the inundation area. The duration of levee failure risk times can be hours to weeks, depending on the river flows that the levee holds back. Those levees accredited as providing protection against the 1% or greater annual chance flood and those in levees in the certification process are identified in the FEMA DFIRMs which also include those areas protected by the levees.

There are no DFIRM levee protected areas in the District, as the District sits outside of accredited levee areas. As such no mapping is shown and no tabular analysis is performed. While this gives the initial appearance of limited levee failure risk, it should be noted that these unaccredited levees may have a greater potential for failure or breach and can pose even a greater risk to those communities in which they are located.

Past Occurrences

Disaster Declaration History

There have been two state and two federal disasters declarations directly related to levee failure in Sacramento County, as shown on Table 4-8. Also, it is important to note that many of the flood disaster declarations included in Section 4.3.11 of the Base Plan (like the December 31, 2022, event near Wilton) also may include flooding associated with levee breach or failure events.

Table 4-8 Sacramento County – State and Federal Disaster Declarations Summary 1950-2025

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

Source: Cal OES, FEMA

NCDC Events

There have been no NCDC levee failure events in Sacramento County, as the NCDC does not track levee failure flooding as a stand-alone hazard.

RD 341 Events

Events Since 2021 LHMP

On **December 12, 2024**, the Sacramento River peaked at 9.13 feet which is 1.73 feet above monitor stage of 7.4 feet. Winds out of the southeast with gusts exceeding 40 miles per hour. RD 341 levees were damaged at 13 locations totaling 893 linear feet. Emergency repairs were necessary (an example is shown on Figure 4-3). Sacramento County closed Sherman Island County Park in response to the emergency declaration. Repairs were completed by Reclamation District No. 341 and were submitted for partial reimbursement under DWR's Delta Levees Subventions Program. The levees did hold, and did not allow Sherman island to be submerged.

Figure 4-3 December 2024 – Emergency Repairs on Levee Before and After



Source: RD 341

Events prior to 2021

The first significant flooding affecting Sherman Island agriculture occurred during the **1861/62** season and caused wide-spread damage throughout the Delta, and Sherman Island farmers lost most of their livestock as a result when the Sacramento River breached the low levees constructed along its banks. After completion of the levee system in 1869, Sherman Island suffered several floods. Sherman Island levees failed during the winters of **1871/72, 1874/75, 1876, and 1878**. Several crevasses cut through the north and south levees west of Mayberry Slough in the **1874** levee failure, resulting in the loss of all but 100 acres of cropland in the western portion of the island. The subsequent levee reconstruction featured a 12-foot-high peat levee with 120 feet widths at the base. Even so, the **1876** flood covered the western portion of the island again. The flood of **1878** devastated the entire island.

Subsequent levee breaks on the San Joaquin River submerged most of the land and Sherman Island's 700 inhabitants fled to higher ground. The beleaguered reclamation districts were faced with underwriting

thousands of dollars in assessments to replace most of the levee system. Landowners regrouped, and in March 1878, Reclamation District 252 formed out of a portion of RD 54. Sherman Island landowners reorganized again, and RD 54 and RD 252 combined to form Reclamation District No. 341 on June 17, 1879. Although reclamation efforts continued in RD 50 west of Mayberry Slough for several years after the 1879 floods, landowners eventually dropped reclamation efforts, and after the land flooded during the 1940s, ownership of the land reverted to the State for taxes.

By spring 1880, most of the new RD 341 was again under cultivation until high waters collapsed levee sections again in August later that year. Although an assessment of \$13,141 was made for levee repair following the **1880** break, most of the land remained under water until 1894 when reclamation efforts were renewed.

In 1894, RD 341 encompassed 10,303.71 acres of land east of Mayberry Slough and the 3,000-foot cross-levee between Sacramento River and Mayberry Slough. The Sacramento and San Joaquin rivers are connected by Threemile Slough, which forms the eastern and northern boundary of the Island. The district included 24.76 miles of levee, much of it at the time destroyed by previous floods. At the time, much of Sherman Island had been underwater for fifteen years. Although some stretches of levee were intact, much of the levee had sunk to the ground level of the island or below. The Horseshoe Bend area of the Sacramento River had several breaks; one about 500 feet in width, with resulting scar holes measuring about 75 feet deep. The San Joaquin River levees on the south side of the island were essentially destroyed from Gallagher Slough, near the modern-day location of Eddo's Resort, to the mouth of Mayberry Slough.

During the first decade of the twentieth century, RD 341 conducted frequent levee upgrading and restoration projects on Sherman Island. RD 341 leased four dredges in 1900 that worked in tandem around Sherman Island. Flooding occurred in some section of the Delta almost annually during the period from **1900** to **1910**, and serious levee breaks and major flooding of RD 341 occurred during **1904** when a crevasse opened on Mayberry Slough, and in **1906** and **1909**, when water again inundated the island. RD 341 trustees contracted with Franks Dredging Company for levee construction and repair work between 1908 and 1920.

The southern levee on the San Joaquin River side failed and flooded the island on **January 20, 1969** at approximate levee Sta. 520+00. Upon finding the break, a large quantity of rock was placed on the upstream and downstream ends of the levee to protect against further erosion from high velocities into and out of the break due to tide. Without placement of the rock, the break which was approximately 275 feet wide and about 45 feet below mean sea level, would have been greatly enlarged. After the break, the water inside the island and in the San Joaquin River was at the same level. The flooding created a deep hole in the channel on the waterside and a deep lake on the landside toe of the levee at the site of the break. Pumps to dewater the Island were rented (District pumps were entirely submerged). Pumping with the rented equipment commenced February 28, 1969 and continued through August 9, 1969, at which point District pumps continued to remove the remaining water from the island. All 93,000 feet of District drainage ditches were cleaned and/or excavated, primarily by drag line and ditcher operations before District ditches were operable. USACE spent approximately \$600,000 in emergency funds to repair, reslope, and regrade the levee break area after the 1969 break. Seepage and settlement in the area of the break have been ongoing issues requiring constant levee improvements.

The 1986 flood event in the Delta resulted in the passage of Senate Bill 34 (SB34) by the State legislature in 1988 providing \$120 million over a ten-year period for the California Department of Water Resources (DWR) to rebuild levees in the Delta and help reclamation districts improve levees. Subsequent voter approved bond measures have provided funding for reclamation district levee improvement projects. No levee failure happened in 1986 in RD 341.

Due to the large fetch on the San Joaquin River in the vicinity of Sherman Island, the San Joaquin River levee experienced severe wind wave erosion in the **1998** and **2006** flood events. The levee section has since been rehabilitated and armored with riprap slope protection on the waterside. Additionally, the levee section features a riprap splash cap on the waterside hinge for protection against wind wave runoff.

On **January 13, 2017**, the District was contacted by the California Department of Transportation (Caltrans) regarding the sighting of boils on a portion of the levee system that supports Highway 160. The boils were located behind the District Office at approximate Sta. 960+00. The District contacted the County Office of Emergency Services and DWR State-Federal Flood Operations Center requesting assistance in containing the boils which were increasing in number and size. However, the District was unable to attain assistance from either. As a result, the District contacted the Rio Vista Fire Department, and with the assistance of the Fire Department, the District constructed sandbag rings around the boils. A trench drain was installed properly and by the end of the fourth day of construction, all cover material was in place, with water flowing from the drain as expected.

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. 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. 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.

In general, California exhibits “booms and busts,” which refers to the existence of both very wet years and very dry years. The amount of precipitation that falls in any particular year is largely influenced by occurrences of large, discrete winter storms, also known as atmospheric rivers, which often provide a substantial fraction of the region’s annual precipitation, inclusive of the county. In California, atmospheric rivers vary in intensity; some are beneficial for water supply and replenish snowpack that naturally melts during the summer, serving as the water supply for people and agriculture, while others are responsible for widespread and adverse impacts (NOAA 2023). Extreme precipitation from these atmospheric rivers in the future may prove to be more variable, volatile, and potentially more severe. 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.

The June 2025 Delta Adapts Adaptation Plan noted that climate change will affect levee failure flooding in the Delta. The Delta’s 1,300 miles of levees protect more than 800,000 acres of land and play a critical

role in conveying water supply through the Delta. By mid-century, overtopping of Delta levees by an event with a 1-percent annual chance of occurrence may result in the exposure of over \$1.8 billion in annual agricultural and commercial economic activity and \$10.5 billion in agricultural, residential, commercial, and infrastructure assets. Most of the Delta's flood management infrastructure, including levees and upstream reservoirs, are designed to operate under historical sea level and hydrologic conditions that do not consider potential future climate change. Changing climatic conditions will place greater stress on the flood management system in the future.

Vulnerability to Levee Failure

According to historical hazard data and levee mapping, levee failures can occur in or near the District. All of the District are at some measure of vulnerability to levee failure floods, including failure or breach of accredited levees, those in the certification process, and unaccredited levees. An assessment of a community's vulnerability to levee failure flooding begins with an understanding of local exposure to levees. This is included in the Local Concerns section below followed by a discussion of the District's Assets at Risk to this hazard.

Local Concerns

The District has specific concerns and unique vulnerabilities regarding this hazard. These concerns form a portion of the basis for the mitigation strategy and mitigation actions that seek to reduce risk and vulnerability to this hazard.

General Concerns

According to the 2010 census, Sherman Island has a population of 190 people, with 100 occupied dwelling units. The County General Plan designates approximately 500 acres of recreational land and about 10,000 acres of agricultural cropland/resource conservation area. Sherman Lake is designated as natural preserve. In addition to agricultural uses, several recreational vehicle parks and marinas for local and public use are located on Sherman Island including Rio Viento on the Sacramento River side, Eddos Harbor and RV park which includes a 70 berth marina on the San Joaquin River side, Sherman Lake Marina on Sherman Lake, and the Outrigger Marina located on the Island's northeast corner. In total, the Island provides 368 marina berths, a boat launch maintained by the County and one fishing access site.

The Sherman Island levee system also protects non-local assets which provide a public benefit, including infrastructure, utilities, water quality and water supply reliability. These were listed in Section 4.4.1 above.

Dewatering Concerns

The 2021 RD 341 Five-Year Plan noted island pumping concerns. In addition to the costs incurred to repair or replace the assets destroyed by a Sherman Island levee failure, an immediate cost would be pumping out the island. To estimate the cost of restoring Sherman Island, we considered the 2004 failure of the Upper Jones Tract, an island of 6,259 acres which cost approximately \$120 million to restore. This equates to about \$19,100 per acre. Accounting for inflation, the per acre cost would be \$23,800. Accordingly, it would cost approximately \$238 million to pump out and restore Sherman Island (10,000 acres X \$23,800 per/acre = \$238,000,000). This estimate is conservative in that it does not account for the elevations on the interior

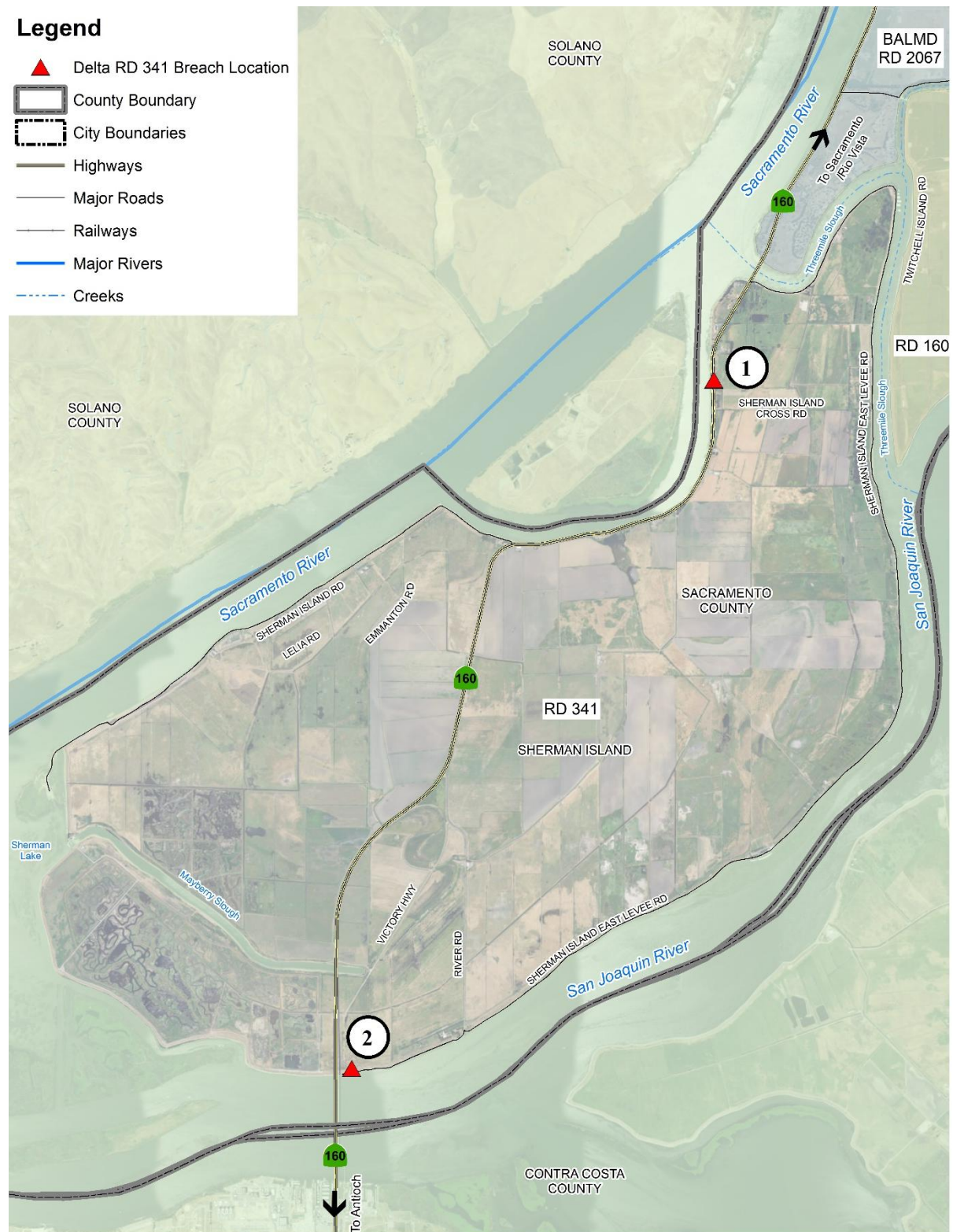
of Sherman Island, which are up to 20 feet below sea level. Sherman Island would likely impound a greater volume of water per acre than Upper Jones Tract, and per acre restoration costs will therefore be greater.

StormReady Flood Scenarios and Evacuation Routes

The County of Sacramento and the City of Sacramento have prepared various detailed maps showing hypothetical levee breaks, inundation levels and the time it would take for waters to rise in affected neighborhoods, and rescue and evacuation zones. It is important to note that these maps deal with potential scenarios. These are to help Sacramento County citizens think of how to escape before an emergency occurs. It should be noted that it would be incorrect to assume that the evacuation routes shown on the maps will necessarily be citizens only way out in a flood. Escape routes could be affected by localized flooding, traffic accidents, and different flooding situations occurring at the time. Emergency officials will monitor roads and let the public know through radio stations and other media if alternate routes should be taken.

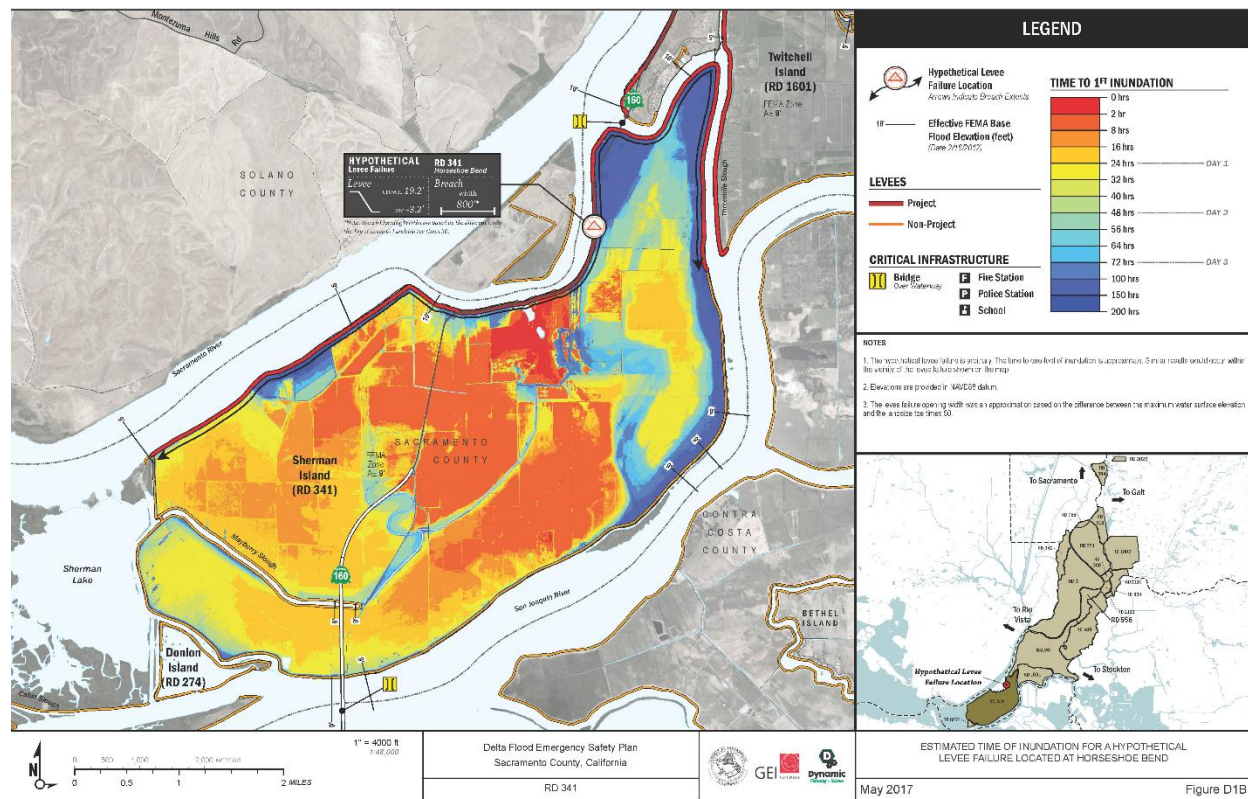
For RD 341, Figure 4-4 details the locations in the Delta within Reclamation District 341 where flooding could occur. The red triangles denote potential levee breach locations. RD 341 has two potential levee break scenarios. Maps for Scenario 1 regarding time to one foot inundation (Figure 4-5), estimated flood depths (Figure 4-6), and suggested evacuation routes (Figure 4-7) are displayed below. Maps for Scenario 2 can be found on the Sacramento County stormready.org website.

Figure 4-4 RD 341 – Potential Levee Breach Location



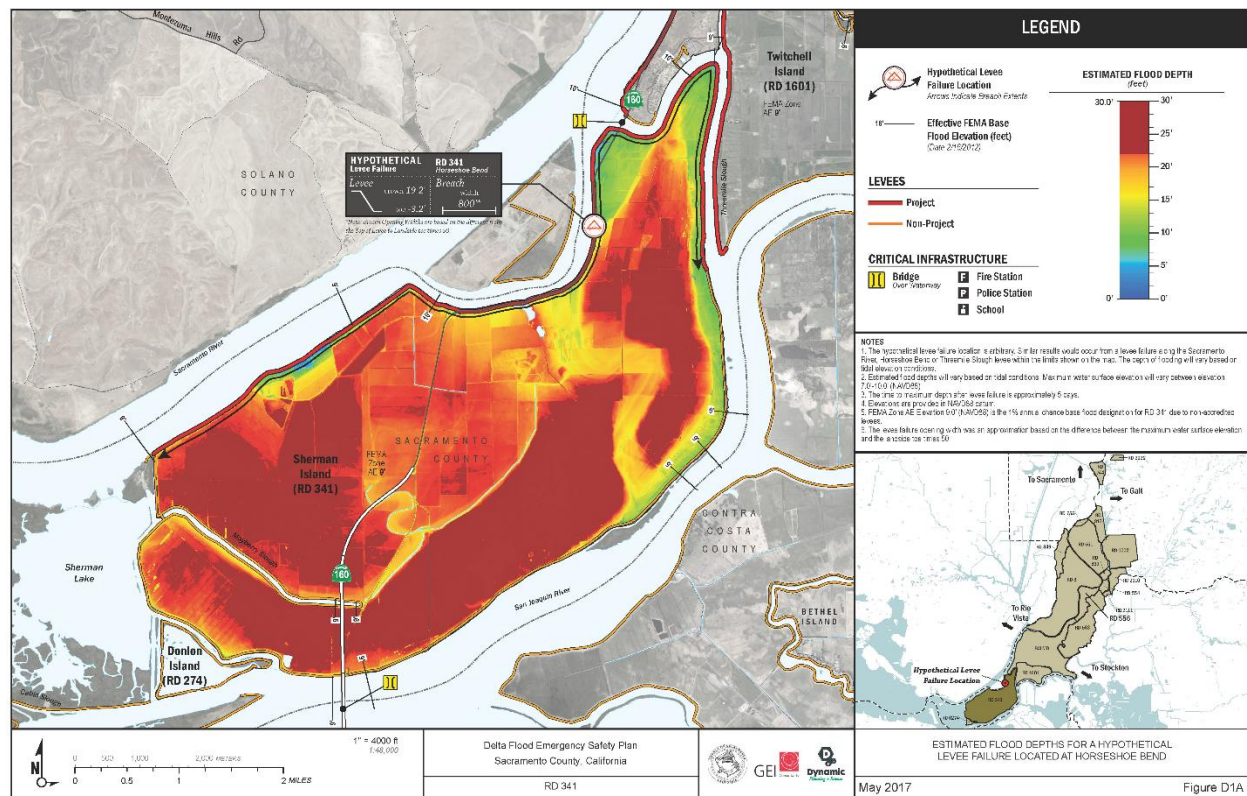
Source: Sacramento County Storm Ready – retrieved July 28, 2026

Figure 4-5 RD 341 – Time to One Foot Inundation after Levee Breach



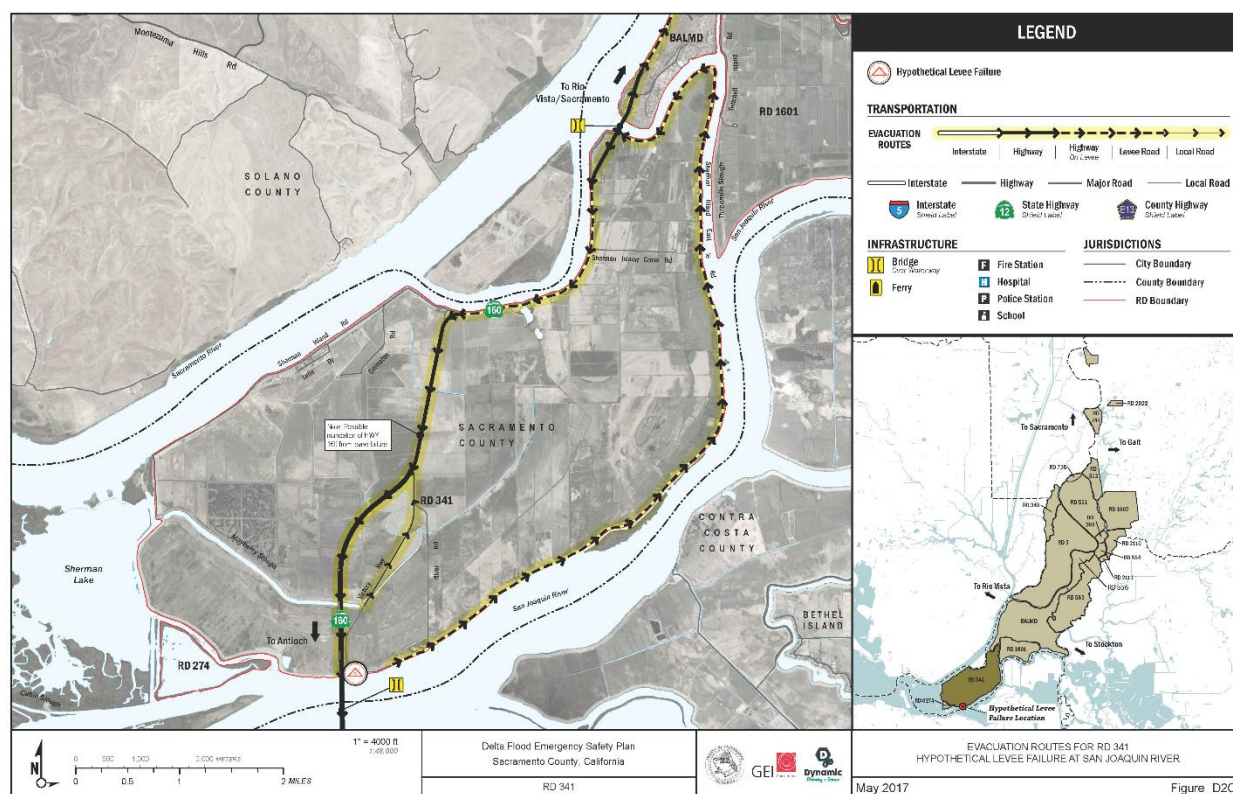
Source: Sacramento County Storm Ready – retrieved July 28, 2026

Figure 4-6 RD 341 – Estimated Flood Depth from Levee Breach Scenario



Source: Sacramento County Storm Ready – retrieved July 28, 2026

Figure 4-7 RD 341 – Levee Breach Scenario Evacuation Routes



Source: Sacramento County Storm Ready – retrieved July 28, 2026

Assets at Risk

Assets at risk from levee failure include people and populations; District assets and critical facilities and infrastructure); and natural, historic, and cultural resources. These are discussed in the following sections.

People and Populations

All people and populations (including both District staff and the population within District boundaries) located in leveed areas are at some risk to levee failure flooding. Certain vulnerable populations located within areas prone to levee failure flooding may be at increased risk to this hazard, especially during a large event with minimal advance notice. These vulnerable populations include: the unsheltered, those with limited mobility, and those that lack the resources to leave the area.

District Assets and Critical Facilities and Infrastructure

All District assets listed in Table 4-3 are at risk from a levee failure with the least vulnerable being the fish release facilities and pump stations. The fish release facilities are all located on the levee crest and a failure would have to happen at, or directly adjacent to, their location to cause serious damage. Most of the District pump stations are built on piles at the approximately the same elevation as the levee crest. However, if levee failures or severe storms cause widespread power outages, the pump stations may be disabled, as they are powered by electric motors.

In addition to the costs incurred to repair or replace the assets destroyed by a Sherman Island levee failure, an immediate cost would be pumping out the island. To estimate the cost of restoring Sherman Island, we considered the 2004 failure of the Upper Jones Tract, an island of 6,259 acres which cost approximately \$120 million to restore. This equates to about \$19,100 per acre. Accounting for inflation, the per acre cost would be \$23,800. Accordingly, it would cost approximately \$238 million to pump out and restore Sherman Island (10,000 acres X \$23,800 per/acre = \$238,000,000). This estimate is conservative in that it does not account for the elevations on the interior of Sherman Island, which are up to 20 feet below sea level. Sherman Island would likely impound a greater volume of water per acre than Upper Jones Tract, and per acre restoration costs will therefore be greater.

Electrical Infrastructure Affected

In addition to the dewatering costs, three major electric transmission lines (greater than 500kV) cross Sherman Island: the California Oregon Transmission Project, operated by the Western Area Power Administration, the Pacific Gas and Electric Company (PG&E) Table Mountain-Tesla line, and the PG&E Vaca-Dixon-Tesla line. These lines work mainly to interconnect California loads and generation with loads and generation in the Pacific Northwest. The three lines through the Delta are operated as a coordinated grouping, with maximum imports or exports limited to provide some joint redundancy to help ensure reliability.

The combined load on these three lines is typically around 4,000 MW, though under some circumstances it can be as high as 4,800 MW (Mirzadeh 2006). This is approximately ten percent of statewide summer loads, which is less than the required planning reserve margin of 15 percent. However, other outages may occur at the same time as this disruption, so under some circumstances the loss of all three lines due to the failure of the Sherman Island levee system could cause operating problems.

PG&E also operates two other lines with less than 500kV capacity to provide local service to Sherman Island and nearby Delta Islands. Failure of the Sherman Island levee system would impact the ability of PG&E to serve the local delta community. The DRMS report estimates the cost of a two-month outage of two 500 kV lines to be \$42,000,000, which equates to \$46,300,000 in 2016 dollars.

Oil and Gas Production Affected

Sherman Island has 60 natural gas and oil wells, and approximately 1,082 acres of gas and oil production fields. In addition, the levees protect 145,514 feet of a natural gas pipeline which originates in Canada and crosses Sherman Island. Failure of the Sherman Island levee system would interrupt gas service through the pipeline and gas production and storage occurring on Sherman Island.

Civil Infrastructure Affected

Sherman Island levees also protect State Highway 160 and the drawbridge at Three Mile Slough. State Route 160 connects Sherman Island to the mainland Sacramento County on the northeast corner via Threemile Slough Bridge (Bridge 24-0121), and to Contra Costa County on the island's west side, via the Antioch Bridge (Bridge 28-0009). Failure of the Sherman Island levee system and resulting loss of State Route 160 and access to the Antioch Bridge would severely impact truck and vehicular traffic relying on

this roadway. The Sherman Island Five Year Plan (2009) estimated that the closure of State Highway 160 would cost approximately \$70,000 per day.

Sherman Island levees also provide a public benefit by maintaining water quality and water supply reliability for cities and farms in the San Francisco Bay area, San Joaquin Valley, and Southern California. Sherman Island is situated where fresh river water and salty bay water meet and mix. Under typical summer salinity conditions in the lower Sacramento River, salinity rises sharply in the area of Sherman Island. Consequently, the island's levees are critical to controlling salinity intrusion to the interior Delta. A levee break would increase the rate and area of mixing and would allow the saline bay water to move further upstream, jeopardizing the fresh water supply taken from the Delta for the Central Valley Project water supply, the State Water Project and the Contra Costa intake.

The presence of the western Delta islands, Sherman Island in particular, is believed to effectively inhibit the inland migration of the salinity interface between the Bay and Delta. If Sherman Island were to become permanently inundated with saline water, the water available to the massive pumping facilities near the Clifton Court Forebay might become too saline to use. The timing of levee breaks and flooding is critical in this regard. Fortunately, most flooding occurs in winter and spring when major saltwater intrusion is less likely. However, there are occasional levee failures under low-flow conditions. These failures can cause major short-term water-quality problems, even if the flooded areas are later reclaimed. During one such incident, which occurred in summer of 1972, the Andrus Island levee failed, flooding an area slightly larger than Sherman Island. Salt concentrations in the central and western Delta quickly showed an increase up to six hundred percent. It took a large volume of extra reservoir releases to flush the salty water from the west Delta. The Andrus Island levee break may also have been a contributing factor in high mortality of juvenile bass that year. Similar impact could occur if one of Sherman Island's levees were to fail under low flow conditions.

Natural, Historic, and Cultural Resources

Large flood events, such as those occurring as a result of a levee failure, can affect natural, historic, and cultural resources. There are a number of ways floodwaters can impact natural resources and the environment. Wildlife habitats can be destroyed by floodwaters. Contaminated floodwater can pollute rivers and habitats. Silt and sediment can destroy natural areas. Riverbanks and natural levees can be eliminated as rivers reach bankfull capacity. Rivers can be widened, and deposition can increase downstream. Trees can be uprooted by high-velocity water flow. Plants that survived the initial flood may die due to being inundated with water. Historic and cultural resources may also be affected. Generally, the impacts are associated with damage to structures within the flooded areas, but other cultural resources such as those associated with Native Americans and old tribal areas can also be disturbed, damaged and lost during extreme flood events.

Impacts from Levee Failure

Floods and their impacts vary by location, including impacts associated with a levee failure flood event, and will only affect certain areas of the District that are in areas protected by levees. Based on the areas of the District surrounded by levees, it is evident that levee failure floods could potentially have significant

impacts to the District, depending on the location, timing, and severity of the event. Impacts that are not quantified, but could be anticipated in large levee failure event, include:

- Injury and loss of life
- Structural and property damage
- Crop damage
- Disruption of and damage to public critical infrastructure and services
- Health hazards associated with mold and mildew, contamination of drinking water, etc.
- Impacts to natural resource areas, including stream bank erosion
- Damage to roads/bridges resulting in loss of mobility

In addition to flood related levee failures, the levees in the District are potentially at risk to failure during an earthquake event. Levee failure flooding could accompany an earthquake and could be compounded further if a dam or storage reservoir fails. Channels and water courses with earthen banks and levees are particularly vulnerable and could collapse in a major earthquake resulting in partial or complete blockage of channels causing flooding upstream of the impoundment. Levees are especially susceptible to rapid settlement due to liquefaction or horizontal spreading of underlying soils.

Impacts to identified assets at risk to this hazard and the overall vulnerability of the District may be affected in the future by climate change (which was discussed in the hazard profile section above), changes in population patterns, and changes in land use and development. The influencing effects of these factors on this hazard are discussed further in the Future Conditions/Future Development discussion below.

Future Conditions/Future Development

This section provides a discussion of how future conditions will influence or affect the hazard over time and also discusses future development relative to each hazard.

Future Conditions

Future conditions may be affected by climate change, changes in population patterns (migration, density, or the makeup of socially vulnerable populations), and changes in land use and development. Findings on this for the RD 341 include the following:

- Climate change is likely to exacerbate future flood and levee failure conditions and associated impacts and vulnerability of the District to levee failure flooding. This was discussed in greater detail in the Climate Change and Levee Failure section of the Hazard Profile above.
- Population projections within the jurisdictional boundaries of the District show the population to be flat or slightly declining. It is unknown how population patterns and demographics will change in the near future. The District may add staff, but this number would be small. The District noted that it has no control over population changes within its jurisdictional boundaries. With no notable changes in populations numbers and makeup, the vulnerability of the District to this hazard is unlikely to change.
- Changes in land use and development in the District are expected to be limited in the near future and thus are not likely to affect levee failure flooding and associated impacts to the District. Additional development traditionally leads to additional flooding, especially in levee protected areas. However,

adherence to protective building codes for new development will assist in limiting future impacts and associated vulnerabilities of the District to this hazard.

Future Development

Future development considerations should be ongoing and proactive. Ensuring that comprehensive land use planning is conducted, regulatory requirements, such as building codes and the floodplain ordinance, are followed, and levee improvements, inspections, and maintenance is ongoing will help reduce impacts to future development.

Sea Level Rise

Likelihood of Future Occurrence–Likely

Vulnerability–Medium

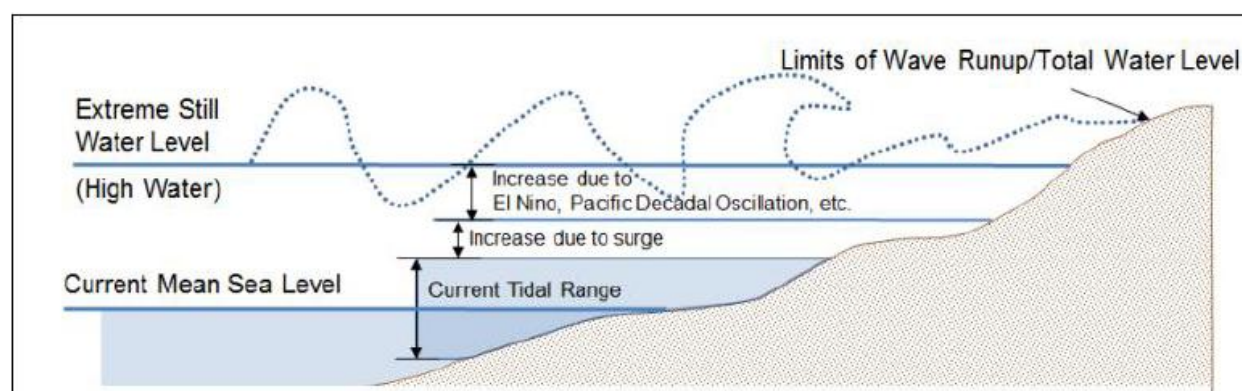
Hazard Profile

Historically, cities, towns and villages were often settled around ports and waterways along the nation's coastlines, providing individuals and families opportunities for trade, jobs and transportation, and recreation. These areas are extremely important to our nation, with great economic, historic and cultural significance. Although the coastal areas of the United States comprise only one-fifth of the land area of the contiguous 48 states, they account for more than half of the nation's population and housing supply. In 1990, over 133 million Americans lived in the 673 counties along the Atlantic and Pacific Oceans, the Gulf of Mexico and the Great Lakes. Since 1960, population in these areas have increased by 41 percent. The continued increase in coastal population leads to increased coastal development, which places greater numbers of people and structures at risk from coastal hazards including sea level rise.

While Sacramento is not typically considered a coastal community, 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.

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 other affected areas. El Niño events exacerbate storms and coastal inundation that is already occurring due to sea-level rise and normal coastal weather and tidal patterns. The additive effects of high tides, storm surge, atmospheric patterns (e.g., El Niño) and sea-level rise are shown in Figure 4-8.

Figure 4-8 Additive Effects of Sea-Level Rise



Source: 2023 California State Hazard Mitigation Plan

King Tides may also affect sea level rise. This was discussed in detail in Section 4.3.15 of the Base Plan.

Location and Extent

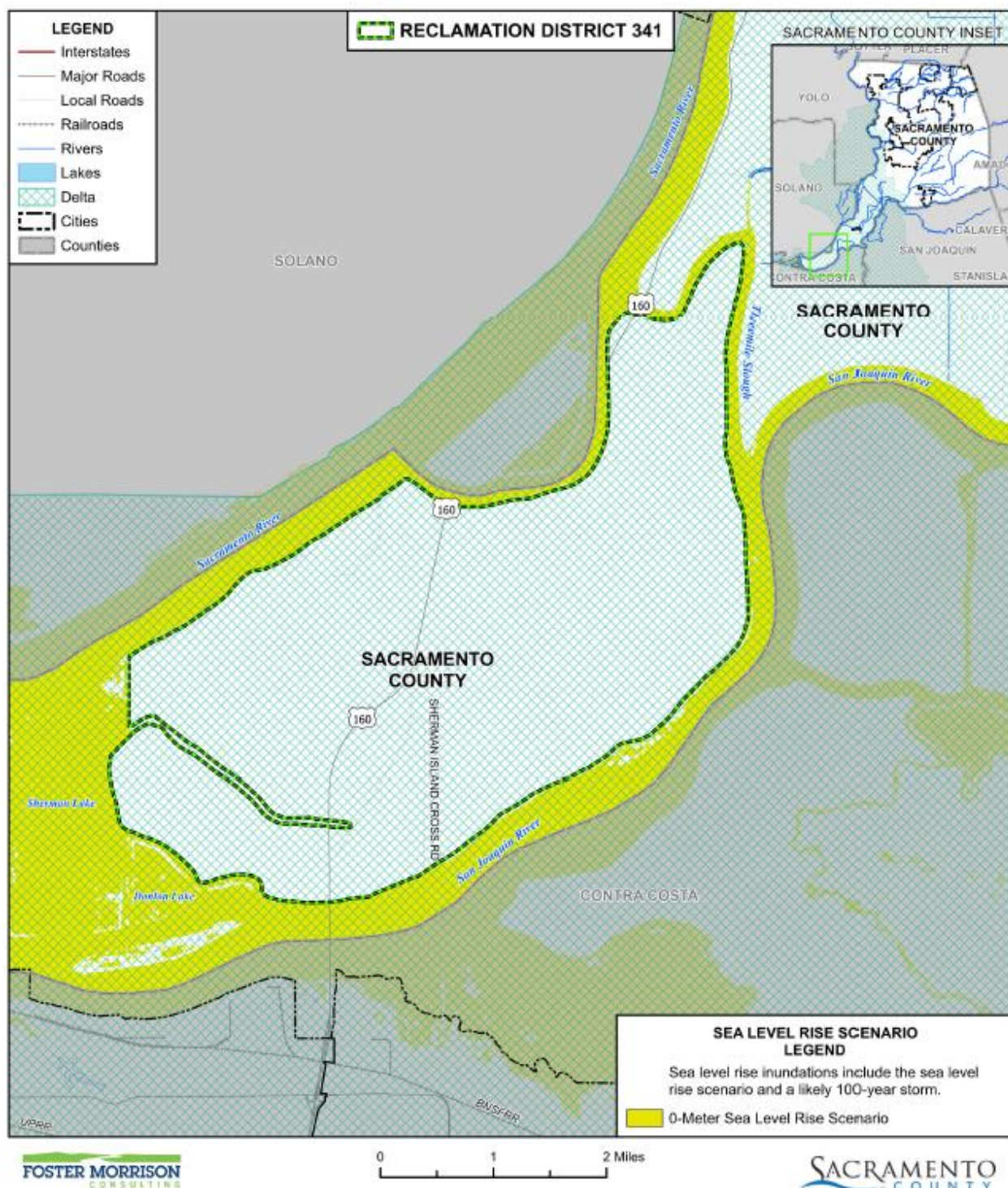
The coastally influenced areas of the Sacramento Planning Area are at risk from sea level rise (especially during periods of extreme tides and as compounded by storm events). Sacramento County is located inland within the Central Valley of California. The southwestern portion of the County follows the 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 identified in the Sacramento County Climate Action Plan (2024) and the Sacramento County Climate Change Vulnerability Assessment (2017) based on SLR GIS mapping from Cal-Adapt, and California Coastal Inundation Depth Layer Mosaics (2016) were utilized for this assessment. Three sea level rise scenarios were selected based on guidance from the State of California Sea Level Rise Guidance 2024 Science and Policy Update that includes available Cal-Adapt SLR GIS data providing coverage for the Sacramento County area. It should be noted that the SLR scenarios include both the SLR combined with a likely 100-year storm. The scenarios are:

- 0-meter scenario – reflects existing conditions (no SLR) with a 100-year storm
- 0.5 meter scenario – with a 100-year storm is roughly equal to the median projection for 2060 (mid century) and was selected to be representative of plausible 2060 intermediate to high conditions
- 1.41 meter scenario– with a 100-year storm is roughly equal to the median projection for 2100 (end of century) and was selected to be representative of plausible 2100 intermediate to high conditions

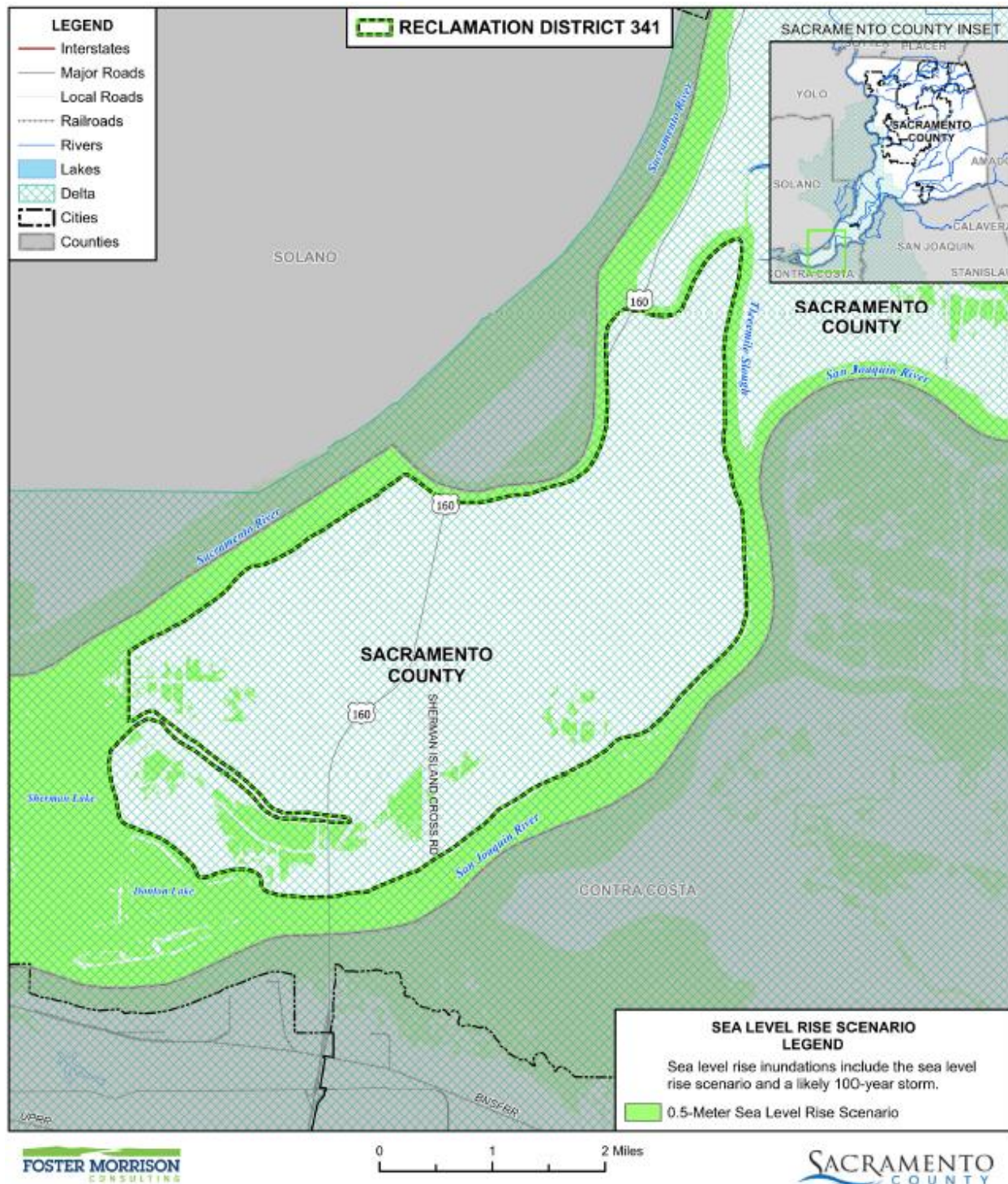
Inundations for these three scenarios are shown on the three maps below. They are broken out for the 0-meter (Figure 4-9), 0.5 meter (Figure 4-10), and 1.41 meter (Figure 4-11) scenarios individually. Geographical extents by scenario for the District are detailed in Table 4-9.

Figure 4-9 RD 341 – Sea Level Rise 0-meter Scenario



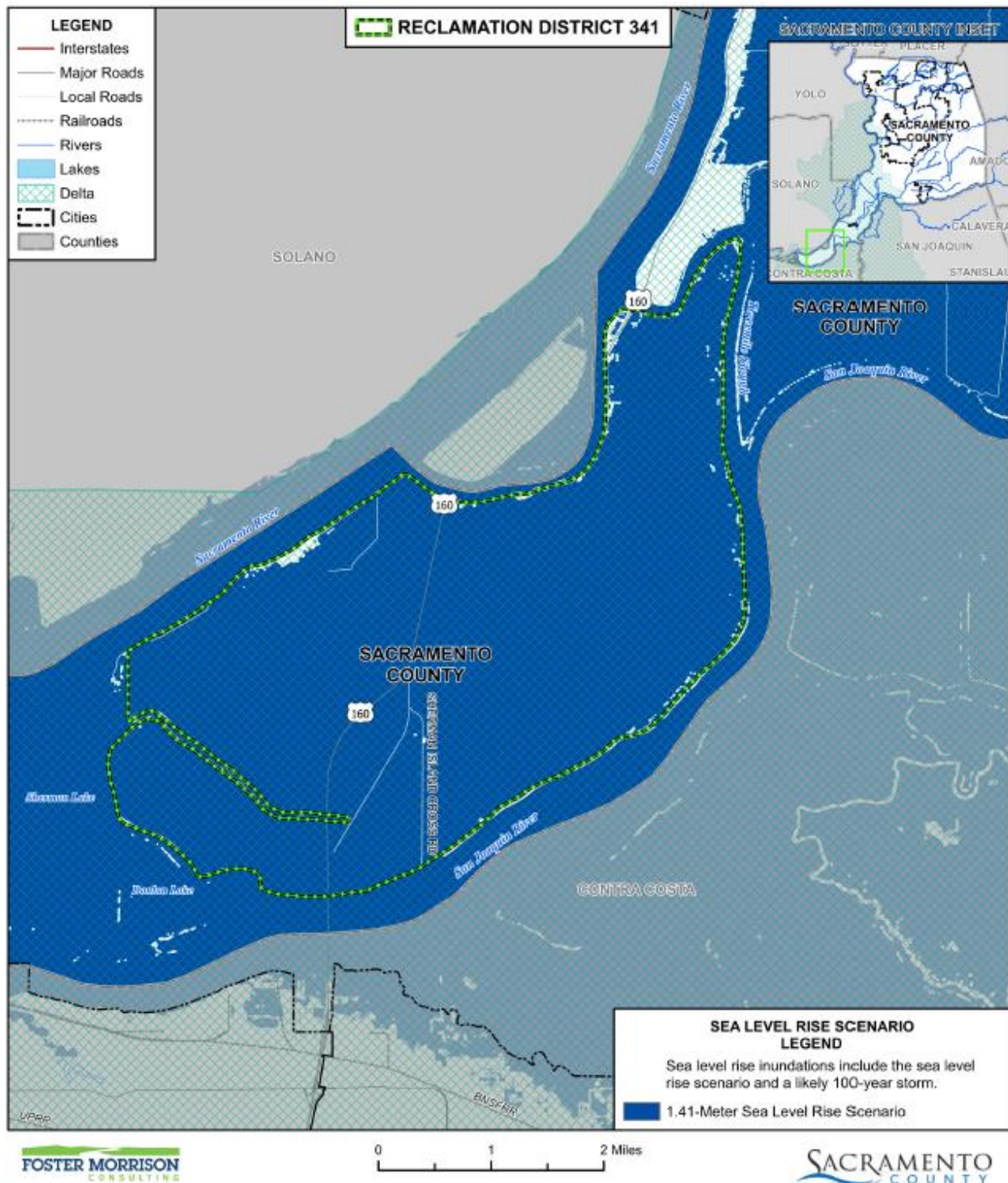
Data Source: Sacramento County Climate Action Plan 2024,
 Climate Change Vulnerability Assessment 2017,
 Cal-Adapt Sea Level Rise <https://cmip5.cal-adapt.org/tools/slr-califlod-3d/>,
 San Francisco Bay, Sacramento-San Joaquin Delta and California Coastal Inundation Depth Layer Mosaics 2016
 (Datasets: Bay_10m, 0.5m, 1.41m|slr_max_bilinear_snap_float)
 Sacramento County, Cal-Atlas; Map Date: 7/25/2026.

Figure 4-10 RD 341 – 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-calflod-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: 7/25/2026.

Figure 4-11 RD 341 – 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: 7/25/2026.

Table 4-9 RD 341 – Sea Level Rise Scenario Geographical Extents by Scenario

Sea Level Rise Scenario	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
0-Meter Sea Level Rise Scenario	3	0.03%	0	0.06%	3	0.03%
0.5-Meter Sea Level Rise Scenario	1,028	9%	15	3%	1,012	10%
1.41-Meter Sea Level Rise Scenario	9,936	91%	433	97%	9,502	90%
Grand Total	10,967	100%	449	100%	10,518	100%

Source: Sacramento County Climate Action Plan (CAP) 2024, Climate Change Vulnerability Assessment 2017, Cal-Adapt Sea Level Rise, UC Berkeley, San Francisco Bay, Sacramento-San Joaquin Delta and California Coastal Inundation Depth Layer Mosaics 2016

Past Occurrences

Disaster Declaration History

No disaster declarations have occurred specific to sea level rise.

NCDC Events

The NCDC does not track sea level rise.

RD 341 Events

The District noted that no standalone sea level flood rise events have been documented in the District. Instead, sea level rise has acted as a background amplifier during other flood related hazards. These were discussed in Section 4.3.15 of the Base Plan.

Climate Change and Sea Level Rise

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. 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.

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 levels along the California coastline, and other areas affected by sea level rise, 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.

Vulnerability to Sea Level Rise

According to historical hazard data and hazard mapping, sea level rise is occurring in the Sacramento County Planning Area. The whole of the District is at some measure of vulnerability to increased flooding and inundation of land areas from sea level rise.

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.

Sea level rise can be exacerbated during king tides. King tides are simply the very highest tides. They are naturally occurring, predictable events. King tides of today may give an idea of future normal conditions that may occur due to sea level rise. High tides may coincide with heavy rain causing increased flooding, bluff erosion, and landslides, such as were experienced during the 1998 and 2016 El Niño storms. The 2023 California State Hazard Mitigation Plan noted that 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 other affected areas. These events may expose coastal and other areas to severe flooding and erosion; damage to structures, real estate, public access, and habitat areas; and seawater intrusion into Delta areas and coastal aquifers. El Niño events exacerbate storms and sea level rise inundation above that already occurring due to sea-level rise and normal coastal weather and tidal patterns.

An assessment of a community's vulnerability to levee failure flooding begins with an understanding of local exposure to sea level rise. This is included in the Local Concerns section below followed by a discussion of the District's Assets at Risk to this hazard.

Local Concerns

The District has specific concerns and unique vulnerabilities regarding this hazard. These concerns form a portion of the basis for the mitigation strategy and mitigation actions that seek to reduce risk and vulnerability to this hazard.

The greatest risk to the District is sea level rise contributing to levee failure of District levees (discussed above in greater detail in the Levee Failure section). Climate change-related sea level rise will likely increase pressure on fragile levees.

In addition, the District noted that the 2017 Sacramento County Climate Vulnerability Assessment noted that that sea level rise will likely affect the salinity of the Sacramento-San Joaquin Delta waters. The salinity of the Sacramento-San Joaquin Delta has historically been extremely changeable. The salt content of the Delta ebbs and flows depending on the function of a variety of variables such as tides, storms, and river outflow. As California has developed, the freshwater demand has introduced an additional strain on the Delta that has affected water quality and ecosystem health. The Delta provides a freshwater source for the State Water Project and the Central Valley Project, which diverts approximately two thirds of the State's freshwater supply for agricultural and municipal purposes in Southern California.

Assets at Risk

Assets at risk from sea level rise include people and populations; District assets and critical facilities and infrastructure); and natural, historic, and cultural resources. These are discussed in the following sections.

People and Populations

All people and populations (including both District staff and the population within District boundaries) that live or work in areas prone to sea level rise are often the most vulnerable to future impacts from this hazard. Not only are the residents at risk, but their homes and contents are all at risk, compounding the impacts associated with this hazards. Certain vulnerable populations might be at greater risk to this hazard and include low income populations that cannot afford to relocate. Due to the very slow progression of this hazard, most populations located within sea level rise inundation areas should have sufficient advance notice to relocate to other areas, but not without economic impact.

District Assets and Critical Facilities and Infrastructure

Certain District assets and critical facilities in the District are at risk to sea level rise and primarily include those structures located in areas in and around the Delta area. Sea level rise presents a threat to critical facilities and infrastructure. Critical infrastructure plays an immensely important role in our communities. Damage to any one of these systems can threaten public safety, wreak havoc on daily life, impact properties far from flood zones, and result in economic impacts that cascade throughout California.

Natural, Historic, and Cultural Resources

According to the 2024 CAP, rising sea levels can disrupt coastal wetlands by drowning plant species, increasing salt levels in the soil and water, and outpacing wetland's migration further inland. This puts important ecosystems in danger, threatens habitats, and leaves communities exposed to dangerous storm surge. Without wetlands and other critical ecosystems, many species could lose their homes or become extinct. Large flood events exacerbated by sea level rise can affect natural, historic, and cultural resources. Any of these resources that fall in the sea level rise scenarios shown on Figure 4-9, Figure 4-10, or Figure 4-11 would be vulnerable.

Future Conditions/Future Development

This section provides a discussion of how future conditions will influence or affect the hazard over time and also discusses future development relative to each hazard.

Future Conditions

Future conditions may be affected by climate change, changes in population patterns (migration, density, or the makeup of socially vulnerable populations), and changes in land use and development. Findings on this for the District include the following:

- Climate change is likely to exacerbate future sea level rise conditions and associated impacts and vulnerability of the County. This was discussed in greater detail in the Climate Change and Sea Level Rise section of the Hazard Profile above
- Population projections within the jurisdictional boundaries of the District show the population to be flat or slightly declining. It is unknown how population patterns and demographics will change in the near future. The District may add staff, but this number would be small. The District noted that it has no control over population changes within its jurisdictional boundaries. With no notable changes in populations numbers and makeup, the vulnerability of the District to this hazard is unlikely to change.
- Changes in land use and development in the District are expected to be limited in the near future and thus are not likely to affect sea level rise flooding and associated impacts to the District. Additional development in coastally influenced areas traditionally leads to additional flooding. However, adherence to protective building codes for new development will assist in limiting future impacts and associated vulnerabilities of the District to this hazard.

Future Development

The 2024 CAP noted that guiding development out of areas vulnerable to sea level rise will reduce future flooding impacts to people and property. The District should work closely with the County and cities in which it is located to determine how and where to expand District assets to avoid placing future development in harms way. In addition, levee improvements, including levee setbacks and levee modernization efforts will need to be consider to mitigate sea level impacts to the District.

Severe Weather: Heavy Rains and Storms

Likelihood of Future Occurrence–Likely

Vulnerability–Medium

Hazard Profile

Storms in the District 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 District falls mainly in the fall, winter, and spring months. Wind often accompanies these storms; hail and lightning are rare in the District. In recent years, heavy rain and storms have been compounded by more frequent and higher intensity atmospheric river events. Rain on snow events occurring in the upper elevations can also be significant and contribute to greater downstream runoff and flooding during large storm events.

Location and Extent

Heavy rain events occur on a regional basis. Rains and storms can occur in any location of the District. All portions of the District are at risk to heavy rains and storms. Most of the severe rains occur during the fall, winter, and spring months in the District as discussed below (with problem flooding areas associated with heavy rains and storms shown in the past occurrences of the Flood: Localized Stormwater section). 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 rarer in the District and Sacramento County. Duration of severe storms in the District 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

Disaster Declaration History

According to historical hazard data, severe weather, including heavy rains and storms, is an annual occurrence in the District. This contributes to many of the federal disaster declarations related to flooding. Disaster declarations from flooding are shown on Table 4-10, many of which likely affected the District.

Table 4-10 Sacramento County – State and Federal Disaster Declarations from Flood (Heavy Rain and Storms) 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

NCDC Events

The NCDC data recorded 9 hail, 29 heavy rain, 1 lightning, and 2 winter storm weather incidents for Sacramento County since 1950. Winter weather events tend to be rain in the County.

RD 341 Events

The District noted that heavy rains and storms are an annual occurrence often resulting in flooding or levee failure. Other events causing issues are listed in the Past Occurrences section of the Levee Failure discussions above.

Climate Change and Heavy Rains and Storms

It is likely that climate change will increase the chance of future occurrence as well as future impacts from heavy rains and storms. More information on future impacts to the District can be found in the Future Conditions/Future Development section of the Vulnerability Assessment below.

According to the 2024 CAS, while average annual rainfall may increase or decrease slightly, the intensity of individual rainfall events is likely to increase during the 21st century. It is unlikely that hail will become more common in Sacramento County and the RD 341. The amount of lightning is not projected to change.

Cal-Adapt noted that, on average, the projections show little change in total annual precipitation in California. Furthermore, among several models, precipitation projections do not show a consistent trend during the next century. Cal-Adapt modeled scenarios are shown in Section 4.3.4 of the Base Plan.

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.

June 2025 Delta Adapts Adaptation Plan noted that climate change will affect heavy rains and storms in the Delta. By mid-century, climate models show a reduction in the total number of rainy days and decreases in both fall and spring precipitation. These changes will likely be accompanied by an increase in the intensity and frequency of large storm and atmospheric river events during the winter. Decreases in spring and fall precipitation may impact freshwater availability, increase competition for limited water supply, and shift the phenology of species who are dependent on seasonal rainfall for reproduction, growth, and survival (Mauger et al. 2015). Although the ecosystem response to changes in intra- and inter-annual precipitation variability remains uncertain, data suggests that increased variability in precipitation will likely favor less diverse species assemblages and invasion of non-native species (Liu et al. 2020, Parton et al. 2012).

The Delta's growing season is determined by its Mediterranean climate – rains in late fall, winter, and spring followed by dry summers. As the climate changes and the rainfall season becomes shorter, freshwater and groundwater availability may be diminished. As a result, species adapted to a longer growing season and available freshwater sources may be negatively impacted. If species cannot tolerate or adapt to new precipitation patterns, they may experience increased mortality rates.

Vulnerability to Heavy Rain and Storms

Heavy rain and severe storms are among the most frequent type of severe weather occurrences in the District. These events can cause both significant and localized flooding. Flooding can be worse during times where the ground is already saturated. Wind often accompanies these storms and has caused damage in the past. Hail and lightning are rare in the District, but also can cause damage, with lightning occasionally igniting wildfires.

The whole of the District is at some measure of vulnerability to heavy rain and storms. An assessment of a community's vulnerability to heavy rains and storms begins with an understanding of local exposure to heavy rain and storms. This is included in the Local Concerns section below followed by a discussion of the District's Assets at Risk to this hazard.

Local Concerns

The District has specific concerns and unique vulnerabilities regarding this hazard. These concerns form a portion of the basis for the mitigation strategy and mitigation actions that seek to reduce risk and vulnerability to this hazard.

Heavy rains can cause localized flooding on the interior of the island. Typically, the water from localized flooding finds its way into one of the District drains where it can be pumped off-island by one of the five District pump stations. If severe weather were to cause District-wide power outages, the pump stations would be unable to pump water. Localized flooding could affect Highway 160, agriculture operations and local residents living on the interior of the island.

Assets at Risk

Assets at risk from heavy rain and storms include people and populations; District assets and critical facilities and infrastructure); and natural, historic, and cultural resources. These are discussed in the following sections.

People and Populations

All populations (including vulnerable populations) in the District (including District staff and those within its boundaries) have some measure of risk to heavy rains and storms. Those populations that work or recreate outside and unhoused individuals are more vulnerable to impacts from heavy storm events. Heavy rains and storms occur every year and do not generally cause significant adverse impacts to individuals; it is the secondary hazard, flooding, which poses the biggest impact to people. Populations at risk to flooding resulting from heavy rains and storm events include those who live in floodplains (discussed in further detail in the Flood: 1%/0.2% Annual Chance and Levee Failure section above) and those who live in and near localized flooding areas.

District Assets and Critical Facilities and Infrastructure

District assets have some risk to heavy rains and storms. Heavy rain and storms can affect critical facilities and infrastructure during large events. District structures built to modern building codes are built to withstand heavy rains and storms (including thunderstorm winds and lightning); older structures may be more vulnerable. During a heavy storm, localized flooding may cause water intrusion into buildings from the outside. Trees can be downed causing impacts to structures. Older homes and buildings may be at increased risk to heavy rains and storms. Power outages during severe storm events can occur, impacting the use of structures until the power is back online. Local roads, streets, and bridges can be impacted resulting in closures restricting traffic flow in the District. In certain areas, large storms can cause erosion and localized landslides which can impact affected facilities.

Natural, Historic, and Cultural Resources

Large rain and storm events and associated flooding can affect natural, historic, and cultural resources. Silt and sediment can damage natural areas. Trees can be uprooted and downed by high winds. Extended periods of rainfall can erode natural banks along waterways and degrade soil stability for terrestrial species.

While some natural systems can be adversely impacted during these large storms, heavy rain events can also provide benefits. Groundwater and wetland areas can be recharged and water supplies replenished. Historic and cultural resources may also be affected. Generally, the impacts are associated with damage to structures affected by large storm events, but other cultural resources such as those associated with Native Americans and old tribal areas can also be disturbed, damaged, and lost during extreme rain and storm and events.

Impacts from Heavy Rain and Storms

Impacts from heavy rains and storms include damage to property, critical facilities and infrastructure, and the natural landscape. This includes: erosion; downed trees; damaged utility structures and infrastructure; power outages; road damage and blockages; and even lightning strikes to critical infrastructure and people. Lightning can also cause wildfires and urban fires to occur. Landsliding and erosion occur when the soil on slopes becomes oversaturated and fails. Climate change may cause these impacts to worsen.

Actual damage associated with the primary effects of severe storms and heavy rains has been somewhat limited. It is the secondary hazards caused by these severe weather events, such as floods, landslides, and erosion that would likely have the greatest impact.

Impacts to identified assets at risk to this hazard and the overall vulnerability of the District may be affected in the future by climate change (which was discussed in the hazard profile section above), changes in population patterns, and changes in land use and development. The influencing effects of these factors on this hazard are discussed further in the Future Conditions/Future Development discussion below.

Future Conditions/Future Development

This section provides a discussion of how future conditions will influence or affect the hazard over time and also discusses future development relative to each hazard.

Future Conditions

Future conditions may be affected by climate change, changes in population patterns (migration, density, or the makeup of socially vulnerable populations), and changes in land use and development. Findings on this for the District include the following:

- Climate change is likely to exacerbate future heavy rain and storm conditions and associated impacts and vulnerability of the District to flooding. This was discussed in greater detail in the Climate Change and Heavy Rains and Storms section of the Hazard Profile above.
- Population projections within the jurisdictional boundaries of the District show the population to be flat or slightly declining. It is unknown how population patterns and demographics will change in the near future. The District may add staff, but this number would be small. The District noted that it has no control over population changes within its jurisdictional boundaries. With no notable changes in populations numbers and makeup, the vulnerability of the District to this hazard is unlikely to change.
- Changes in land use and development in the District are expected to be limited in the near future and thus are not likely to affect heavy rains and storm and associated impacts to the District. In addition,

adherence to protective building codes for new development will assist in limiting future impacts and associated vulnerabilities of the District to this hazard.

Future Development

Building codes in the District ensure that new development is built to current building standards, which should reduce the risk to future development in the District from heavy rains and storms. New critical facilities such should be built to withstand hail damage, lightning, and thunderstorm winds. New and existing critical facilities and infrastructure should also consider adding backup power systems to limit impacts associated with power outages. With adherence to development standards, future losses to new development should be minimal. Changes in land use may also amplify the impacts of heavy rains and storms, as additional impervious surfaces can cause additional runoff and localized flooding throughout the District.

Severe Weather: High Winds and Tornado

Likelihood of Future Occurrence–Likely

Vulnerability–Medium

Hazard Profile

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 damage, threaten public safety, and have adverse economic impacts from business closures and power loss. High winds, when combined with high temperatures and low humidity can also lead to PSPS events (though rare in Sacramento County). Winds can cause wave actions near levees, causing erosion to occur. Winds can also drive fires in and near the District.

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, can affect areas of the District, primarily during the rainy season in the late fall, winter, and early spring.

Location and Extent

The entire District is subject to significant, non-tornadic (straight-line), winds. Each area of the District is at risk to high winds. Magnitude of winds is measured often in speed and damages. These events are often part of a heavy rain and storm event but can occur outside of storms. The speed of onset of winds can be short, but accurate weather prediction mechanisms often let the public know of upcoming events. Duration of winds in California is often short, ranging from minutes to hours. The Beaufort scale is an empirical 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 District. 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

Disaster Declarations

There have been no federal or state disaster declarations in the County for winds and tornadoes.

NCDC Events

The NCDC data recorded 109 high wind, 7 funnel cloud, and 15 tornado incidents for Sacramento County since 1950. Many of these wind events likely affected the District.

RD 341 Past Occurrences

The District noted that high winds are an annual event. Tornadoes are rare. As discussed in the levee failure section above, the 1998 high winds caused damages to the levees from wind action.

Climate Change and High Winds and Tornado

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 or tornadoes.

Vulnerability to Severe Weather: High Wind and Tornadoes

The District is subject to potentially destructive high winds and tornadoes. High winds are common throughout the area and can happen during most times of the entire year and outside of a severe storm event. Tornadoes are rare. High winds and tornadoes can be a significant public safety and economic concern. The whole of the District is at some measure of vulnerability to wind and tornadoes.

An assessment of a community's vulnerability to high winds begins with an understanding of local exposure to wind and tornadoes. This is included in the Local Concerns section below followed by a discussion of the District's Assets at Risk to this hazard.

Local Concerns

The District has specific concerns and unique vulnerabilities regarding this hazard. These concerns form a portion of the basis for the mitigation strategy and mitigation actions that seek to reduce risk and vulnerability to this hazard.

The District's waterside levee slopes are protected with rock slope protection (riprap) to prevent erosion. In some areas, the levee has a "splash cap" made of riprap specifically design to protect the levee crest from

overtopping waves. Severely high winds, combined with a high river stage, high tide, or both, can cause large waves that hit the levee so hard they remove the rock slope protection and splash cap. Once the riprap is gone, the waves can cause severe erosion.

Assets at Risk

Assets at risk from winds and tornadoes include people and populations; District assets and critical facilities and infrastructure); and natural, historic, and cultural resources. These are discussed in the following sections.

People and Populations

All populations are at some vulnerability to high winds and tornadoes. Certain vulnerable populations are at the greatest risk to the effects of high winds and tornadoes. These include: the unsheltered, those with access and functional needs, the medically fragile experiencing power outages as a result of wind events, and those working or caught outdoors during a wind or tornado event.

District Assets and Critical Facilities and Infrastructure

All structures and critical facilities and infrastructure in the District have some measure of risk from high wind and tornadoes. Though rare, a tornado could cause damage to virtually all facilities in the tornado touchdown path. This would affect District structures and critical facilities. During a wind or tornado event, power lines in the District can be damaged by falling trees caused by wind. High winds are a cause for PSPS events to be declared, causing power outages to occur. High winds and tornadoes could cause sparks from electric wires and other sources, which could lead to wildfire ignition. Once ignited, high winds can also cause wildfires to rapidly spread and become out of control. High wind conditions can cause wildfires to move into more urban areas destroying structures and whole communities, as seen in recent wildfire events in the West.

Natural, Historic, and Cultural Resources

Natural resources, such as trees, are vulnerable to winds. Increased levee and streambank erosion can occur during periods of high water and high winds. High wave action during significant wind events can impact marsh lands and habitat areas. Soil erosion can also occur during high winds. Most all natural, historic, or cultural resources are at risk to tornadoes. Tornadoes can tear apart habitats, causing fragmentation across ecosystems and can damage and destroy historic structures and cultural resources.

Impacts from Severe Weather: High Wind and Tornado

Wind and tornadoes can cause damage to property and loss of life. While most tornado damage is caused by violent winds, the majority of injuries and deaths generally result from flying debris. Property damage can include damage to buildings, fallen trees, and power lines. Local industries may also be damaged or destroyed. Access roads and streets may be blocked by debris, delaying necessary emergency response. Winds can push automobiles off roads, damage roofs and structures, cause power outages, and cause secondary damage due to flying debris and hazardous trees. High winds can also contribute to the spread and intensity of wildfires. High winds during periods of high water can cause impacts to levees and

streambanks from accelerated erosion. Climate change may affect this hazard and cause winds to increase in velocity and more tornadoes to affect the District.

Impacts to identified assets at risk to this hazard and the overall vulnerability of the District may be affected in the future by climate change (which was discussed in the hazard profile section above), changes in population patterns, and changes in land use and development. The influencing effects of these factors on this hazard are discussed further in the Future Conditions/Future Development discussion below.

Future Conditions/Future Development

This section provides a discussion of how future conditions will influence or affect the hazard over time and also discusses future development relative to each hazard.

Future Conditions

Future conditions may be affected by climate change, changes in population patterns (migration, density, or the makeup of socially vulnerable populations), and changes in land use and development. Findings on this for the District include the following:

- Climate change is likely to exacerbate future wind conditions and associated impacts and vulnerability of the District. Climate change is not likely to affect future tornado conditions. This was discussed in greater detail in the Climate Change and Winds and Tornadoes section of the Hazard Profile above.
- Population projections within the jurisdictional boundaries of the District show the population to be flat or slightly declining. It is unknown how population patterns and demographics will change in the near future. The District may add staff, but this number would be small. The District noted that it has no control over population changes within its jurisdictional boundaries. With no notable changes in populations numbers and makeup, the vulnerability of the District to this hazard is unlikely to change.
- Land use planning should be proactive to address future hazard conditions. Building codes in the County ensure that new development is built to current building standards to withstand high winds, which should reduce the risk to future development in the County from high winds and tornadoes. With adherence to development standards, future losses to new development should be minimal. Changes in land use and increased development may amplify the impacts of high winds and tornadoes, as additional structures in the County increase the number of buildings at risk to high winds and tornadoes.

Future Development

Future development considerations should be ongoing and proactive. The District relies on the County to enforce the local building codes which includes standards for new development to minimize damage from windstorms. New District facilities are built to state and local codes. New critical facilities and infrastructure should also consider adding backup power systems to limit impacts associated with power outages.

4.5 Capability Assessment

Capabilities are the programs and policies currently in use to reduce hazard impacts or that could be used to implement hazard mitigation activities. This capabilities assessment is divided into five sections:

regulatory mitigation capabilities, administrative and technical mitigation capabilities, fiscal mitigation capabilities, mitigation education, outreach, and partnerships, and other mitigation efforts.

4.5.1. Regulatory Mitigation Capabilities

Table 4-11 lists regulatory mitigation capabilities, including planning and land management tools, typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in the RD 341.

Note: The District does not have the authority to regulate land use and development within its jurisdiction. Authority for promulgating and enforcing zoning, land use, and development requirements falls to counties and incorporated communities. As such development within the District’s jurisdictional boundaries will conform to the zoning and land use development ordinances and building codes of the county or incorporated community in which the District is located.

Table 4-11 RD 341’s Regulatory Mitigation Capabilities

Plans	In Place Y/N	Does the plan address hazards? Can the plan be used to carry out mitigation actions? When was it last updated??
Capital Improvements Plan	N	
Climate Change Adaptation Plan	N	
Community Wildfire Protection Plan	N	
General Plan/Comprehensive Plan/Master Plan	N	
Continuity of Operations Plan	N	
Economic Development Plan	N	
Land Use Plan	N	
Local Emergency Operations Plan	Y	Emergency Response and Evacuation Plan Plan addresses hazards, does not include projects, can be used for mitigation action. Flood Preparedness Report Plan addresses hazards, does not include projects, can be used for mitigation action.
Stormwater Management Plan	N	
Transportation Plan	N	
Other	Y	5-year plan, California DWR Emergency Safety Plan Plan addresses hazards, identifies projects, and can be used for mitigation actions.
Land Use Planning and Ordinances	Y/N	Is the ordinance an effective way to reduce hazard impacts? Is the ordinance adequately administered and enforced?
Acquisition of land for open space and public recreation use	N	District relies on the County for this.
Building code	N	District relies on the County for this.

Flood insurance rate maps	N	District relies on the County for this.
Floodplain ordinance	N	District relies on the County for this.
Natural hazard-specific ordinance (stormwater, steep slope, wildfire)	Y	Erosion control measures on levee and canal slopes as necessary
Subdivision ordinance	N	District relies on the County for this.
Zoning ordinance	N	District relies on the County for this.
Other		
How can these capabilities be expanded and improved to reduce risk?		
Pursuant to Sacramento County General Plan Safety Element Policies, SA-18a&b, written approval must be obtained from the applicable Reclamation District to build any structure or grade any soil within 300 feet of the land side toe of levee. This applies to anyone who wants to fill, excavate, or construct a structure within 50 feet of the toe of a Sacramento County river levee and anyone who wants to develop land within 300 feet of the toe. To ensure this requirement is met, every parcel located near a levee is tagged in the building department database. The District does not have control over most of the areas tabulated above, as they are the responsibility of other agencies. The most effective way to expand the capabilities of the District would be increased funding for levee projects, reducing flood risk.		

Source: RD 341

4.5.2. Administrative/Technical Mitigation Capabilities

Table 4-12 identifies the District department(s) responsible for activities related to mitigation and loss prevention in the RD 341.

Table 4-12 RD 341's Administrative and Technical Mitigation Capabilities

Administration	In Place Y/N	Describe capability Is coordination effective?
Staff		Is staffing adequate to enforce regulations? Is staff trained on hazards and mitigation? Is coordination between agencies and staff effective?
Chief Building Official	N	District relies on the County for this.
Civil Engineer, including dam and levee safety	Y	Engineering staffing is adequate, trained and coordination is effective.
Community Planner	N	District relies on the County for this.
Emergency Manager	N	District relies on the County for this.
Floodplain Administrator	N	District relies on the County for this.
GIS Coordinator	N	District relies on the County for this.
Planning Commission	N	District relies on the County for this.
Other		
Technical	Y/N	Has capability been used to assess/mitigate risk in the past?
Grant writing	N	

Hazard data and information	N
GIS analysis	N
Mutual aid agreements	N
Other	
How can these capabilities be expanded and improved to reduce risk?	
More funding would allow the District to increase maintenance programs, as well as possibly add additional staff.	

Source: RD 341

4.5.3. Fiscal Mitigation Capabilities

Table 4-13 identifies financial tools or resources that the District could potentially use to help fund mitigation activities.

Table 4-13 RD 341's Fiscal Mitigation Capabilities

Funding Resource	In Place Y/N	Has the funding resource been used in past and for what type of activities? Could the resource be used to fund future mitigation actions?
Capital improvements project funding	N	
Community Development Block Grant	N	
Federal funding programs (non-FEMA)	N	
Fees for water, sewer, gas, or electric services	N	
Impact fees for new development	N	
State funding programs	Y	The District utilizes a variety of State funding programs to fund mitigation.
Stormwater utility fee	N	
Other	Y	Landowners are assessed annually; it is specifically used for mitigation.
How can these capabilities be expanded and improved to reduce risk?		
Additional funding will be sought from local, state, and federal sources. This will help the District to perform levee related activities.		

Source: RD 341

4.5.4. Mitigation Education, Outreach, and Partnerships

Table 4-14 identifies education and outreach programs and methods already in place that could be/or are used to implement mitigation activities and communicate hazard-related information.

Table 4-14 RD 341's Mitigation Education, Outreach, and Partnerships

Program/Organization	In Place Y/N	How widespread are each of these in your community?
Community newsletters	N	
Hazard awareness campaigns (such as Firewise, Storm Ready, Severe Weather Awareness Week, school programs, public events)	N	
Local news	N	
Organizations that interact with underserved and vulnerable communities	N	
Social media	N	
How can these capabilities be expanded and improved to reduce risk?		
The District may choose to seek partners on mitigation education for those in the District. This would expand capabilities and help reduce risk in RD 341.		

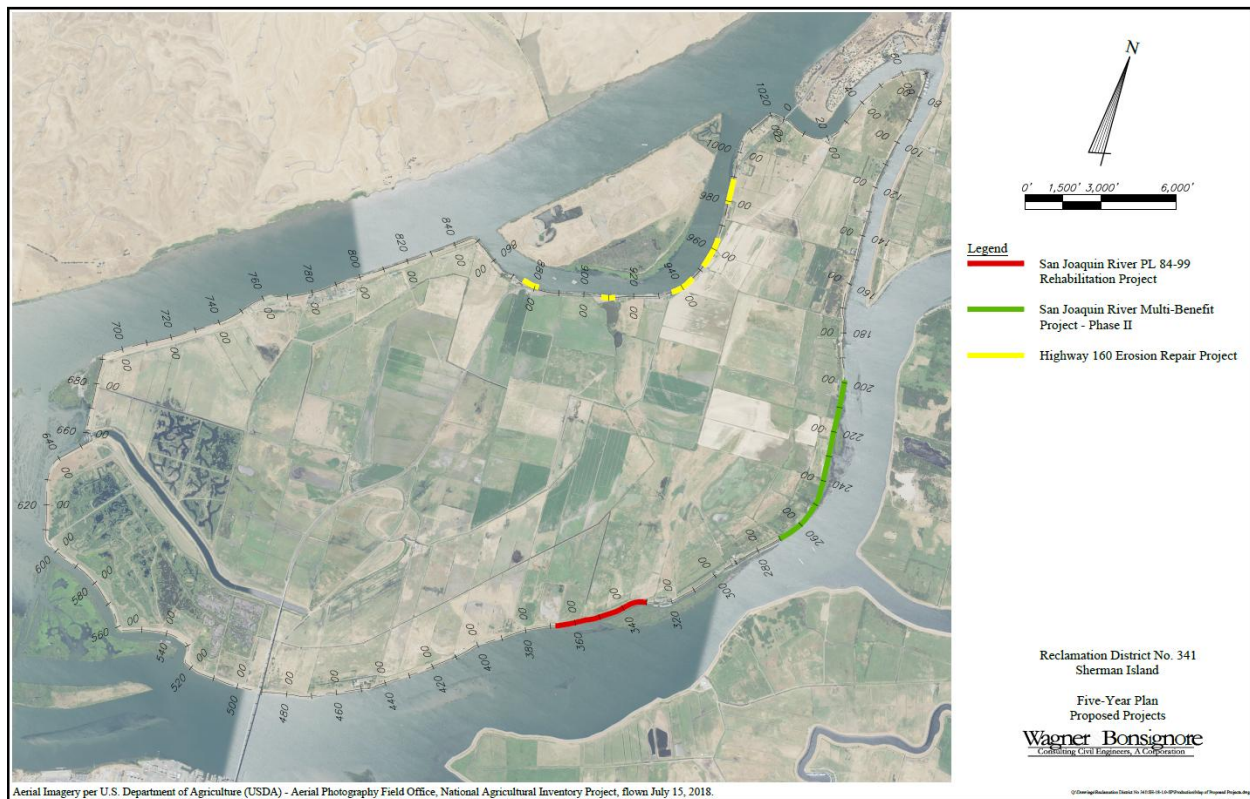
Source: RD 341

4.5.5. Other Mitigation Efforts

DWR constructed a Fish Release Facility as a court ordered mitigation for water exports to Southern California. The Fish Release Facility project was implemented to comply with the National Marine and Fisheries Services' 2009 Biological Opinion on the Long-term Operations of the CVP, SWP, and CDFW's Longfin Smelt Incidental Take Permit for the SWP's Delta Facilities and Operations. Specific requirements are to reduce predation of salvaged fish at the fish release sites and increase salvaged fish survivals rates. The project consists of two separate fish release sites: Little Baja and Manzo Ranch (Figure 11). Also, as part of the project, the District rehabilitated the levee section from Sta. 700+00 – 740+00. The project was completed in 2018.

The 2021 Five-Year Plan noted there are proposed projects in the District. These are shown on Figure 4-12.

Figure 4-12 Proposed Projects from 2021 Five-Year Plan



Completed projects include:

- **Flood / Levee Failure**
 - ✓ **Flood System Repair Project (FSRP)** – Repaired erosion along the Highway 160 levee at various sections from Sta. 875+00 to 990+00.
 - ✓ **Highway 160 Levee Seepage Repair Project** – Constructed a levee drain system from Sta. 870+00 to 940+00
 - ✓ **Emergency Waterside Slope Protection (2024)** – Repaired RSP loss and waterside levee erosion along Sherman Lake at Sta. 606+50–610+00 and Sta. 643+71–645+00 following high tides and strong winds.
- **Earthquake / Levee Failure**
 - ✓ **Highway 160 Emergency Waterside Repair, Sta. 894+00–896+25** – Repaired a significant levee slip resulting from the October 2023 earthquake.

4.6 Mitigation Strategy

4.6.1. Mitigation Goals and Objectives

The RD 341 adopts the hazard mitigation goals and objectives developed by the HMPC and described in Chapter 5 Mitigation Strategy.

4.6.2. NFIP Mitigation Strategy

The District does not participate in the NFIP, as it is not an eligible participant. Many of the District's projects work to reduce impacts from flooding thus furthering the objectives of the NFIP.

4.6.3. Mitigation Actions

The Planning Team for the RD 341 identified and prioritized the following mitigation actions based on the risk assessment. Background information and information on how each action will be implemented and administered, such as ideas for implementation, responsible office, potential funding, and timeline are also included. The following hazards were considered a priority for purposes of mitigation action planning:

- Earthquake (w/subhazards)
- Flood: 1%/0.5%/0.2% annual chance
- Levee Failure
- Sea Level Rise
- Severe Weather: Heavy Rains and Storms (Hail, Lightning, Wind)
- Severe Weather: High Winds and Tornadoes

Low priority hazards for mitigation planning include:

- Aquatic Nuisance Species (plant/animal)
- Climate Change
- Dam Failure
- Drought & Water Shortage (w/tree mortality)
- Flood: Localized Stormwater
- Landslide, Mudslide, Debris Flow
- Severe Weather: Extreme Cold and Freeze
- Severe Weather: Extreme Heat
- Subsidence
- Wildfire (with smoke and air quality)

It should be noted that many of the projects submitted by each jurisdiction in Table 5-4 in the Base Plan benefit all jurisdictions whether or not they are the lead agency. Further, many of these mitigation efforts are collaborative efforts among multiple local, state, and federal agencies. In addition, the countywide public outreach action, as well as many of the emergency services actions, apply to all hazards and jurisdictions regardless of hazard priority. Collectively, this LHMP's multi-jurisdictional mitigation strategy includes only those actions and projects which reflect the actual priorities and capacity of each jurisdiction to implement over the next 5-years covered by this plan. It should further be noted, that each jurisdiction has focused on identifying those mitigation actions and projects to address their priority hazards, which are both realistic and reasonable for them to implement for this 5-year planning process, and would like to preserve their right to modify hazard priorities should future projects be identified where the implementing jurisdiction has the future capacity to implement. The participating jurisdictions are not obligated by this document to implement any or all of these projects. Rather this mitigation strategy represents the desires of the jurisdictions to mitigate the risks and vulnerabilities from identified hazards.

The actual selection, prioritization, and implementation of these actions will also be further evaluated in accordance with the mitigation categories and criteria contained in Appendix C.

Mitigation Actions

The District has put forward the actions as shown in Table 4-15. Details of the actions can be found below the table.

Table 4-15 RD 341 Mitigation Actions

Action Title	New Action/ Previous Action	Address Current Development	Address Future Development	Continued NFIP Compliance	Mitigation Type
Action 1. San Joaquin River Setback Levee (previously referred to as San Joaquin River Multi-Benefit Project)	Previous Action	X	X	X	Prevention Property Protection
Action 2. San Joaquin River Multi-Benefit Project	Previous Action	X	X	X	Prevention Property Protection

Action 1. San Joaquin River Setback Levee

Hazards Addressed: Earthquake, Flood, Levee Failure, Sea Level Rise, Heavy Rains and Storms, Wind and Tornadoes

Goals Addressed: 1, 2, 3, 4, 5, 6, 7

Issue/Background (Problem Statement): The levee between stations 175+00 to 199+00 along the San Joaquin River needs to be improved to PL 84-99 standard due to stability issues. This will protect the levees from the natural hazards listed above.

Project Description: The Project will consist of constructing a setback levee and counterbalance berm to improve levee stability and create intertidal habitat along San Joaquin River. The Project consists of two (2) phases of work: landside levee work and waterside levee work. Generally, the work on the landside of the levee consists of the removal of the existing Sacramento County (County) road, placement of fill as compacted embankment, and construction of a new County road. The new levee roadway will incorporate two 10-foot travel lanes with two 2-foot shoulders. Generally, the work on the waterside of the levee consists of excavation of the levee section to construct a habitat bench, the placement of riprap armoring, and the planting of native species on the habitat bench and setback levee waterside slope. The Project will increase levee safety by constructing a wider levee with less porous material than the existing levee. Furthermore, a wider levee roadway will allow the passage of multi-directional flood flight equipment and provide an improved evacuation route for residents of Sherman Island.

Other Alternatives: None

Existing Planning Mechanism(s) through which Action Will Be Implemented: N/A

Responsible Office/Partners: Reclamation District No. 341 / CA Dept. of Water Resources

Benefits (Losses Avoided): Reduces the likelihood of levee failure.

Potential Funding (Local Budgets, Grant Funds, etc.): Reclamation District No. 341 / CA Dept. of Water Resources

Timeline: 48 months

Project Priority (High, Medium, Low): H

Action 2. San Joaquin River Multi-Benefit Project

Hazards Addressed: Earthquake, Flood, Levee Failure, Sea Level Rise, Heavy Rains and Storms, Wind and Tornadoes

Goals Addressed: 1, 2, 3, 4, 5, 6, 7

Issue/Background (Problem Statement): The levee between stations 330+00 to 368+00 along the San Joaquin River needs to be improved to PL 84-99 standard due to stability issues. This will protect the levees from the natural hazards listed above.

Project Description: The Project consists of approximately 3,800 linear feet of levee rehabilitation to the Delta-Specific PL 84-99 standard, replacement of the existing county road, and establishment of approximately 1 acre of hedgerow habitat on the levee toe berm. Prior to construction of the levee improvements, existing power poles and associated overhead utility lines within the Project limits will be relocated outside the construction footprint to accommodate the planned improvements.

Other Alternatives: None

Existing Planning Mechanism(s) through which Action Will Be Implemented: N/A

Responsible Office/Partners: Reclamation District No. 341 / CA Dept. of Water Resources

Benefits (Losses Avoided): Reduces the likelihood of levee failure.

Potential Funding (Local Budgets, Grant Funds, etc.): Reclamation District No. 341 / CA Dept. of Water Resources

Timeline: 48 months

Project Priority (High, Medium, Low): H