2026 SONOMA COUNTY MJHMP
VOLUME I





Sonoma County Hazard Mitigation Plan

Volume I—Basic Plan

May 2026



TETRA TECH



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Sonoma County Hazard Mitigation Plan

VOLUME I—BASIC PLAN

May 2026

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EXECUTIVE SUMMARY

Hazard Mitigation Overview

Hazard mitigation is the use of long-term and short-term policies, programs, projects, and other activities to minimize the loss of life, injury, and property damage that can result from a disaster. Communities, residents, and businesses across the United States have been faced with continually increasing costs associated with natural and human-caused hazards. Hazard mitigation is the first step in reducing risk and is the most effective way to reduce costs associated with hazards.

Sonoma County developed a hazard mitigation plan (HMP) to reduce risks from disasters to the people, property, economy, and environment within the County. Developed by the County and other participating local jurisdictions (the Planning Partners), this HMP updates the 2021 Sonoma County HMP. It includes countywide assessment of hazards, risk, and capabilities. The plan complies with federal and state hazard mitigation planning requirements to establish the Planning Partners' eligibility for funding under Federal Emergency Management Agency (FEMA) grant programs. The following are the jurisdictions in Sonoma County that participated as Planning Partners:

- County of Sonoma
- City of Cloverdale
- City of Cotati
- City of Healdsburg
- City of Petaluma
- City of Rohnert Park
- City of Santa Rosa
- City of Sebastopol
- City of Sonoma
- Town of Windsor
- Bodega Bay Public Utility District
- Cloverdale Fire Protection District
- Gold Ridge Fire Protection District
- North Sonoma Coast Fire Protection District
- Northern Sonoma County Fire Protection District
- Rancho Adobe Fire Protection District
- Santa Rosa Junior College
- Sonoma County Agricultural Preservation and Open Space District (Ag + Open Space)
- Sonoma County Fire Protection District
- Sonoma Valley Fire Protection District
- Sonoma Water
- Timber Cove Fire Protection District

The Planning Process

Overall Approach

To support the planning process, the Planning Partners accomplished the following:

- Developed a Hazard Mitigation Working Group (HMWG) consisting of key County and regional partners and stakeholders
- Reviewed the 2021 Sonoma County Hazard Mitigation Plan

- Identified hazards of concern to be included in the update
- Profiled the hazards of concern
- Estimated the inventory at risk and potential losses associated with these hazards
- Reviewed and updated the mitigation goals and objectives
- Reviewed mitigation strategy and actions outlined in the 2021 HMP to determine progress
- Developed new mitigation actions to reduce the vulnerability of assets from hazards of concern
- Involved a wide range of stakeholders and the public in the plan update process
- Developed mitigation plan maintenance procedures to be executed after obtaining approval of the plan from the California Governor's Office of Emergency Services (Cal OES) and FEMA
- Formally created the planning process through the governing board and participating jurisdictions

Multiple Agency Support for Hazard Mitigation

Primary responsibility for hazard mitigation lies with local governments. Partners at the regional, state, and federal levels are available to assist local communities with their mitigation strategies. FEMA provides grants, tools, guidance, and training to support mitigation planning. In California, Cal OES is the lead agency providing hazard mitigation planning assistance to local jurisdictions.

The participating jurisdictions provided significant input into the preparation of this HMP, in particular the preparation of jurisdiction-specific annexes included in Volume II. They fully coordinated with and solicited participation from county and local governments, relevant organizations and groups, state and federal agencies, and the general public. This coordination ensured that stakeholders had established communication channels and relationships to support mitigation planning and mitigation actions included in the plan.

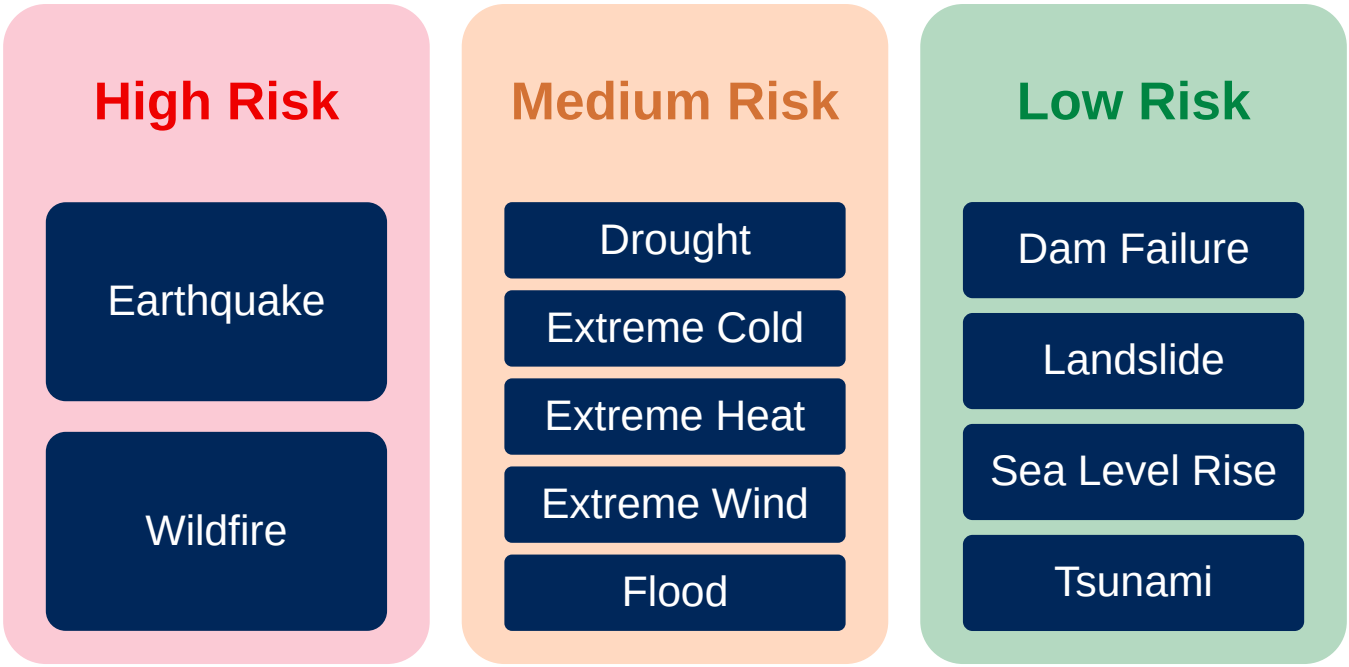
Under the project management of the Sonoma County Department of Emergency Management, the Sonoma County HMWG provided oversight for the preparation of this plan. The HMWG includes representatives from the following:

- Ag + Open Space
- CAL FIRE
- City of Cotati
- City of Petaluma
- City of Santa Rosa
- Permit Sonoma (Sonoma County's community planning department)
- Regional Climate Protection Authority
- Sonoma County Administrator's Office
- Sonoma County Community Development Commission
- Sonoma County Community Organizations Active in Disaster
- Sonoma County Department of Emergency Management
- Sonoma County Department of Health Services
- Sonoma County Office of Equity
- Sonoma County Public Infrastructure
- Sonoma Economic Development Collaborative
- Sonoma Water
- Town of Windsor
- Western Builders

Risk Assessment for Local Hazards of Concern

The Planning Partners evaluated each jurisdiction's risk and vulnerability due to each of the hazards of concern, based on past events, past and predicted future losses, and the expected probability of future occurrence. From these evaluations, hazards were ranked as high, medium, or low risk to each jurisdiction. The hazard rankings were used to focus and prioritize individual jurisdictional mitigation strategies. Summary overall hazard rankings for all of Sonoma County are shown in Figure ES-1.

Figure ES-1. Countywide Hazard Ranking



Capability Assessment and Plan Integration into Other Local Mechanisms

Effective mitigation is achieved when hazard awareness and risk management become integral parts of public activities and decision-making. Sonoma County has many plans and programs that support hazard risk management. This HMP integrates, complements, and references those plans and programs to the extent practical in order for it to be a comprehensive resource for hazard mitigation.

The HMP includes a capability assessment to review relevant local mechanisms for each participating jurisdiction. This assessment identifies where each jurisdiction is currently able to implement hazard mitigation measures and where each would benefit from improved capabilities for such measures. The capability assessment also provides a summary and description of the existing plans, programs, and regulatory mechanisms at all levels of government (federal, state, county and local) that support hazard mitigation in the County. In the jurisdictional annexes, each participating jurisdiction identifies how it has integrated hazard risk management into its existing planning, regulatory and operational/administrative framework, and how it intends to continue to promote this integration.

Mitigation Strategy

Hazard Mitigation Plan Goals and Objectives

The HMP includes mitigation goals for reducing or avoiding long-term vulnerabilities to the identified hazards of concern. The planning process included a review and update of previous mitigation goals and objectives developed to guide the selection of mitigation actions. The goals and objectives were updated based on the updated risk assessment, discussions, research, and input from plan participants and stakeholders. The goal development process considered the goals expressed in the 2023 California State Hazard Mitigation Plan, as well as other relevant county and local planning documents. The following goals were identified for this HMP:

- Goal 1—Protect people and minimize loss of life and injury.
- Goal 2—Minimize potential for loss of property, economic and social impacts, and displacement due to hazards.
- Goal 3—Minimize potential for environmental impacts and consider a broad-range of mitigation strategies, including nature-based solutions where feasible.
- Goal 4—Communicate and improve public understanding of natural hazard risk to the whole community within Sonoma County.
- Goal 5—Support the advancement of effective mitigation policies, programs, and projects that are adaptive, proactive, cost-effective, and environmentally sustainable to build a resilient Sonoma County.
- Goal 6—Enhance the capability/capacity of the Sonoma County planning area to prepare, respond, and recover from the impact of natural hazards.

Implementation of the 2021 Plan

The status of the mitigation projects identified in the 2021 HMP was reviewed for this HMP. Numerous projects and programs have been implemented that have reduced hazard vulnerability to assets in the planning area. Uncompleted projects have been revaluated, modified as necessary, and incorporated into this plan. The Planning Partners' annexes describe these mitigation activities in more detail, and plan maintenance procedures have been developed to encourage thorough integration with local decisions and processes and regular review of implementation progress.

2026 Mitigation Strategy

Sonoma County and the participating jurisdictions identified 410 mitigation actions to pursue over the next five years. Actions chosen represent a wide variety of project types across the eleven hazards of concern. The mitigation strategy for each jurisdiction is available in the annexes of Volume II.

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Part 1: The Planning Process and Planning Area



1. INTRODUCTION

Sonoma County has developed and regularly updated a hazard mitigation plan (HMP) to reduce risks from disasters to the people, property, economy, and environment within the County. This update for 2026, developed by the County and 22 other participating local jurisdictions (the Planning Partners), includes countywide analysis and assessment of hazards, risk, and capabilities.

1.1 OVERVIEW TO HAZARD MITIGATION PLANNING

1.1.1 What Is Hazard Mitigation?

Hazard mitigation is any sustained action taken to reduce or eliminate the long-term risk and effects that can result from hazards. The Federal Emergency Management Agency (FEMA) defines an HMP as the documentation of a state or local government's evaluation of natural hazards and strategies to mitigate them.

Effective mitigation planning helps people, organizations, and government agencies to better prepare for and respond when disasters occur. It also allows local governments to remain eligible for FEMA grant funding for mitigation projects that will reduce the impact of future disaster events. The long-term benefits of mitigation planning and implementation include the following:

- An increased understanding of hazards faced by local communities
- A more sustainable and disaster-resistant community
- Financial savings through partnerships that support planning and mitigation efforts
- Focused use of limited resources on hazards that have the biggest impact on the community
- Reduced long-term impacts and damage to human health and structures
- Reduced costs associated with response and recovery efforts, including repairs

1.1.2 Regulatory Framework

Federal policy regarding disasters encourages communities to assess their vulnerability to hazards before disaster strikes and then take actions to reduce potential risks. A disaster-resistant community can rebound more quickly and cost-effectively from a natural disaster, with less human injury or loss of property. This minimizes other losses associated with disasters, such as the time lost from productive activity by businesses and industries.

The federal Disaster Mitigation Act of 2000 (DMA) encourages hazard mitigation planning by states, tribes, and local governments. Under the DMA, communities seeking certain hazard-related federal funding must identify potential natural hazards to the community's health, safety, and well-being, and identify and prioritize actions that can be taken by the community to mitigate those hazards before disaster strikes.

Regulations implementing the DMA are included in Title 44 of the Code of Federal Regulations, Section 201 (44 CFR 201). To be eligible for hazard mitigation assistance from the federal government, communities must have an HMP to prepare for and reduce the potential impacts of natural hazards. The federal regulations require that states and local governments update HMPs on a 5-year basis.

One goal of the federal regulations is to facilitate cooperation between state and local authorities, prompting them to work together. This enhanced planning process enables local and state governments to better articulate accurate needs for mitigation, resulting in faster allocation of funding and more effective risk reduction projects. In California, responsibility for fulfilling the requirements of the DMA and 44 CFR 201 has been delegated to the California Governor's Office of Emergency Services (Cal OES).

Table 1-1 summarizes the 44 CFR 201 requirements and where each is addressed in this hazard mitigation plan.

Table 1-1. FEMA Local Mitigation Plan Review Crosswalk

Plan Criteria	Primary Location in Plan
Prerequisites	
Adoption by the Local Governing Body: §201.6(c)(5)	Section 2.7; Appendix A
Planning Process	
Documentation of the Planning Process: §201.6(b) and §201.6(c)(1)	Chapter 2
Risk Assessment	
Identifying Hazards: §201.6(c)(2)(i)	Chapter 5
Profiling Hazards: §201.6(c)(2)(i)	Chapters 6 – 16
Assessing Vulnerability: Overview: §201.6(c)(2)(ii)	Chapters 6 – 16
Assessing Vulnerability: Identifying Structures: §201.6(c)(2)(ii)(A)	Chapters 6 – 16
Assessing Vulnerability: Estimating Potential Losses: §201.6(c)(2)(ii)(B)	Chapters 6 – 16
Assessing Vulnerability: Analyzing Development Trends: §201.6(c)(2)(ii)(C)	Chapters 6 – 16; Volume II
Mitigation Strategy	
Local Hazard Mitigation Goals: §201.6(c)(3)(i)	Chapter 19; Volume II
Identification and Analysis of Mitigation Actions: §201.6(c)(3)(ii)	Chapter 19; Volume II
Implementation of Mitigation Actions: §201.6(c)(3)(iii)	Chapter 19; Volume II
Multi-Jurisdictional Mitigation Actions: §201.6(c)(3)(iv)	Volume II
Plan Maintenance Process	
Monitoring, Evaluating, and Updating the Plan: §201.6(c)(4)(i)	Chapter 20
Incorporation into Existing Planning Mechanisms: §201.6(c)(4)(ii)	Chapter 20; Volume II
Continued Public Involvement: §201.6(c)(4)(iii)	Chapter 20

1.1.3 Specialized Terms and Concepts

Like any technical field, hazard mitigation has developed over the years its own set of terms and concepts with particular meanings within the hazard mitigation practice. A full glossary and list of

acronyms is provided in Appendix B. The list below provides a quick reference for specialized terms whose use is especially prominent in this hazard mitigation plan:

- **Adaptive capacity—**the ability of a human or natural system to adjust to climate change by moderating potential damage, taking advantage of opportunities, or coping with the consequences (EPA 2023)
- **Asset—**anything that is important to the character and function of a community (e.g., people, structures, community lifelines, the economy, and natural, historic, and cultural resources) (FEMA 2023)
- **Capability assessment—**an evaluation of which authorities, policies, programs, funding and resources a participant has to accomplish hazard mitigation (FEMA 2023)
- **Cascading hazards—**a primary event, such as heavy rainfall, seismic activity, or rapid snowmelt, followed by a chain of consequences that may range from modest (lesser than the original event) to substantial (National Academies of Sciences, Engineering, and Medicine 2022)
- **Community lifelines—**the most fundamental services in a community that, when stabilized, enable all other aspects of society to function (FEMA 2023)
- **Extent—**the range of anticipated intensities of the identified hazards within a community, most commonly expressed using various scientific scales (FEMA 2022)
- **Hazard profile—**a description of a hazard's location, extent, previous occurrences and probability of future events within a community (FEMA 2023)
- **Hazard ranking—**the process of identifying the hazards that pose the greatest risk to a community, based on how likely the hazard is to occur, the potential consequences if the hazard does occur, and other relevant local factors
- **Impact—**the consequences or effects of a hazard on a community's assets identified in the vulnerability assessment. (FEMA 2023)
- **Integration—**the inclusion of hazard mitigation principles, vulnerability information and mitigation actions into other existing community planning to leverage activities that have co-benefits, reduce risk and increase resilience (FEMA 2022)
- **Mitigation action—**measures, projects, plans or activities proposed to reduce the current and future vulnerabilities identified in the risk assessment (FEMA 2023)
- **Mitigation strategy—** the long-term blueprint for reducing the potential hazard-related losses identified in the risk assessment; the strategy consists of mitigation goals, mitigation actions, and a plan for implementing the actions (FEMA 2023)
- **Natural hazard—**a source of harm or difficulty created by a meteorological, environmental or geological event (FEMA 2023)
- **Plan maintenance—**monitoring and updating a hazard mitigation plan as warranted by changing conditions, availability of new information, and progress on the proposed mitigation actions (FEMA 2023)
- **Planning process—**the procedures used to develop a hazard mitigation plan with broad acceptance across the community

- **Risk—**the potential for damage or loss when natural hazards interact with people or assets (FEMA 2023)
- **Risk assessment—**a data-driven analysis to find where a local jurisdiction is vulnerable to hazards (FEMA 2023)
- **Social vulnerability—**the potential for loss within an individual or social group, as affected by traits that influence an individual's or group's resilience, which is their ability to prepare, respond, cope or recover from an event (FEMA 2023)
- **Stakeholder—**individuals or groups that a mitigation action or policy affects, including businesses, private organizations and residents (FEMA 2023)
- **Vulnerability—**a description of which assets within locations identified to be hazard prone are at risk from the effects of the hazard (FEMA 2023)

1.2 HISTORY OF HAZARD MITIGATION PLANNING IN SONOMA COUNTY

1.2.1 Previous Sonoma County HMPs

As of January 2025, Sonoma County has been included in 36 federal disaster declarations (major disaster, fire management, and emergency) since 1954. The County prepared and adopted its first hazard mitigation plan in 2006. The plan has been regularly updated since then, with updates adopted in 2011, 2016, and 2021. The most recent update, in 2021, identified the following as the greatest hazards of concern in Sonoma County:

- Dam failure
- Drought
- Earthquake
- Flooding
- Landslide/mass movement
- Sea level rise
- Severe weather
- Tsunami
- Wildfire

The 2021 HMP was created with 13 Planning Partners:

- City of Cotati
- City of Santa Rosa
- City of Sonoma
- Town of Windsor
- Cloverdale Fire Protection District
- North Sonoma Coast Fire Protection District

- Northern Sonoma County Fire Protection District
- Rancho Adobe Fire Protection District
- Sonoma Valley Fire District
- Timber Cove Fire Protection District
- Gold Ridge Resource Conservation District
- Sonoma Resource Conservation District
- Sonoma County Agricultural Preservation and Open Space District (Ag + Open Space)

1.2.2 Key Changes in the Current Update

The following are the most significant changes made between the previous County HMP (2021) and the current (2026) update:

- The 2021 plan identified severe weather as a hazard of concern. The County, Planning Partnership, and Hazard Mitigation Working Group re-evaluated the definition of severe weather and chose to focus the hazard on extreme wind.
- The 2026 HMP added both extreme cold and extreme heat as hazard profiles, as Sonoma County's moderate climate is expected to have greater fluctuations in the future. In addition, the County sought to align the HMP with California Assembly Bill 2684, which requires General Plan Safety Elements to address extreme heat by 2028.
- The 2021 HMP included 14 Planning Partners; the 2026 HMP includes 22 Planning Partners. The 2026 Planning Partnership represented a wide array of County interests, including all incorporated municipalities in the County, eight Fire Protection Districts, utilities, academia, and open space preservation.
- In the 2021 HMP, the capability assessment section was presented in Chapter 5, directly after the County Profile. For the 2026 HMP update, the capability assessment was presented immediately before the Mitigation Strategy chapter. The discussion of capabilities in each jurisdictional annex in Volume II has been expanded to include opportunities for integration and risk reduction.

1.3 PLAN ORGANIZATION

The Sonoma County HMP provides a detailed review and analysis of each hazard of concern, resources, and relevant statistical information for the Planning Partners. The plan is organized into two volumes: Volume I includes all information that applies to the entire planning area (Sonoma County); and Volume II includes specific information for each participating jurisdiction.

Volume I is a resource for ongoing mitigation analysis. It includes a description of the County and its jurisdictions as well as information on mitigation planning and how the risk assessment and capability assessment were performed. Volume I of the plan includes the following chapters:

- Part 1—The Planning Process and Planning Area

- Chapter 1, Introduction
- Chapter 2, Planning Process—A description of the plan development process, committee and stakeholder roles and activities, and how the plan will be incorporated into existing programs; includes information regarding the adoption of the plan by each participating jurisdiction
- Chapter 3, County Profile—An overview of Sonoma County, including general information and physical conditions, land use patterns and trends, population and demographics, economy, general building stock, community lifelines, and natural, historic, and cultural resources

- Part 2—Risk Assessment
  - Chapter 4, Methodology—Description of the methodology used to assess hazard risk and the status of local data
  - Chapter 5, Hazards of Concern Identification—Documentation of the process of identifying the natural hazards of concern for further profiling and evaluation
  - Chapters 6 – 16, Hazard profiles and findings of the risk assessment—Estimates of the impact of hazard events on life, safety, and health; general building stock; critical facilities; the economy, and natural, historic, and cultural resources
  - Chapter 17, Hazard Ranking—Description and summary of the hazard ranking process
- Part 3—Capability Assessment
  - Chapter 18, Capability Assessment—A summary and description of the existing plans, programs, and regulatory mechanisms at all levels of government (federal, state, county, local) that support hazard mitigation within the County
- Part 4, Mitigation Strategy
  - Chapter 19, Mitigation Strategy—Information regarding the mitigation goals and objectives identified by the Hazard Mitigation Working Group in response to priority hazards of concern, and the process by which County and local mitigation strategies have been developed or updated
- Part 5—Plan Maintenance
  - Chapter 20, Plan Maintenance Procedures—A system to continue to monitor, evaluate, maintain, and update the plan

Volume II consists of annexes for each participating jurisdiction. Each annex summarizes the jurisdiction's planning, regulatory, and fiscal capabilities; evaluates vulnerabilities to hazards; describes the status of past mitigation actions; and provides a specific mitigation strategy. The annexes provide each jurisdiction with an expedient resource for implementing mitigation projects and maximizing future grant opportunities.

Appendices provide additional detail about general information discussed in the HMP.

2. PLANNING PROCESS

This chapter describes the planning process used to update the Sonoma County HMP, including how it was prepared, who was involved in the process, and how the public was involved. The planning approach aimed to achieve the following results:

- The plan is multi-jurisdictional, including all municipalities in the County. Sonoma County invited all jurisdictions in the County to join in the planning process. All local municipal governments in the County (the Planning Partnership) participated in the 2026 plan update process:
  - Sonoma County
  - City of Cloverdale
  - City of Cotati
  - City of Healdsburg
  - City of Petaluma
  - City of Rohnert Park
  - City of Santa Rosa
  - City of Sebastopol
  - City of Sonoma
  - Town of Windsor
  - Bodega Bay Public Utility District
  - Cloverdale Fire Protection District
  - Gold Ridge Fire Protection District
  - North Sonoma Coast Fire Protection District
  - Northern Sonoma County Fire Protection District
  - Rancho Adobe Fire Protection District
  - Santa Rosa Junior College
  - Sonoma County Ag + Open Space
  - Sonoma County Fire Protection District
  - Sonoma Valley Fire Protection District
  - Sonoma Water
  - Timber Cove Fire Protection District
- The format of this plan is such that other entities can easily join at a later date as part of the regulatory 5-year plan update process.
- The plan considers all natural hazards that pose a risk to the area, as required by 44 CFR 201. Non-natural hazards that pose significant risk were considered as well.
- The plan was developed following FEMA regulations and prevailing FEMA and state guidance. This ensures that all the requirements are met and supports plan review.
- The plan meets criteria for the National Flood Insurance Program (NFIP) Community Rating System (CRS) and the Flood Mitigation Assistance (FMA) programs.

Sonoma County applied for and was awarded a multi-jurisdictional planning grant under the Hazard Mitigation Grant Program (DR-4683-0018-P), which has supported the development of this HMP. Grant administration was the responsibility of the Sonoma County Department of Emergency Management.

2.1 GENERAL MITIGATION PLANNING APPROACH

FEMA provides hazard mitigation planning support to local communities through guidance, resources, and plan reviews. This hazard mitigation plan was prepared in accordance with the following regulations and guidance:

- DMA 2000 (Public Law 106-390, October 30, 2000)

- 44 CFR 201 and 206 (including: Feb. 26, 2002, Oct. 1, 2002, Oct. 28, 2003, and Sept. 13, 2004, Interim Final Rules)
- FEMA Local Mitigation Plan Review Guide, October 1, 2011
- FEMA Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards, January 2013
- FEMA Integrating Hazard Mitigation into Local Planning, March 1, 2013
- FEMA Plan Integration: Linking Local Planning Efforts, July 2015
- FEMA Local Mitigation Planning Policy Guide, April 11, 2025
- FEMA Local Mitigation Planning Handbook, June 2025
- Cal OES Local Hazard Mitigation Planning Fact Sheet, 2023
- Cal OES State Hazard Mitigation Plan, 2023

2.2 ORGANIZATION OF PLANNING PROCESS

2.2.1 Planning Process Participants

Project Management and Planning Consultant

Project management was the responsibility of the Sonoma County Department of Emergency Management. A contract planning consultant (Tetra Tech) was tasked with the following:

- Assistance with forming a Hazard Mitigation Working Group (HMWG) and Planning Partnership
- Assistance with developing and implementing a public and stakeholder outreach program
- Data collection
- Facilitation of and attendance at meetings (HMWG, municipal, stakeholder, public and other)
- Review and update of the hazards of concern, and hazard profiling and risk assessment
- Assistance with the review and update of mitigation planning goals and objectives
- Assistance with the review of past mitigation strategy progress
- Assistance with the screening of mitigation actions and the identification of appropriate actions
- Assistance with the prioritization of mitigation actions
- Authoring of the draft and final plan documents

The core planning team involved in managing the development of this HMP update included the following members:

- Sage Limpp—Sonoma County Department of Emergency Management
- Neil Bregman—City of Santa Rosa
- Tom Jordan—City of Petaluma
- Bart Spencer—Tetra Tech
- Sasha Jones—Tetra Tech

Planning Partnership

In June 2023, the County notified all municipalities in the County of the pending planning process and invited them to formally participate. Jurisdictions were asked to formally notify the County of their intent to participate via a letter of intent and to identify planning points of contact to facilitate their participation and represent the interests of their communities.

The public was informed of the hazard mitigation planning effort commencement at the kickoff meeting and through press releases, news articles, and public service announcements released throughout the planning process.

All participating jurisdictions, including the County, are recognized as Planning Partners and belong to the Planning Partnership for this HMP with participating jurisdictions designated representatives to be actively involved in the Planning Partnership. Representatives were charged with the following:

- Representing their respective jurisdiction throughout the planning process
- Ensuring participation of all departments, divisions, and functions within their jurisdiction that have a stake in mitigation (e.g., planning, engineering, code enforcement, police and emergency services, public works)
- Assisting in gathering information for inclusion in the HMP update, including the use of previously developed reports and data
- Supporting and promoting the public involvement process
- Reporting on progress of mitigation actions identified in prior or existing HMPs, as applicable
- Identifying, developing, and prioritizing appropriate mitigation actions
- Reporting on progress of integration of prior or existing HMPs into other planning processes and municipal operations
- Supporting and developing a jurisdictional annex
- Reviewing, amending, and approving all sections of the plan update
- Adopting, implementing, and maintaining the plan update

Table 2-1 lists the representatives in the Planning Partnership. The jurisdictional annexes in Volume II identify how each individual who represented the jurisdictions during this planning effort contributed to the planning process.

All of the municipalities on the Planning Partnership actively participate in the NFIP and have designated floodplain administrators. The floodplain administrators were informed of the planning process, reviewed the plan documents, and provided direct input to the plan update. Local floodplain administrators are identified as part of each jurisdiction's hazard mitigation planning team, as presented in the jurisdictional annexes in Volume II.

Table 2-1. Sonoma County Hazard Mitigation Planning Partnership Members

Jurisdiction	Primary Point of Contact	Title	Alternate Point of Contact	Title
Bodega Bay Public Utility District	Jenny Melman	District Engineer	N/A	-
City of Cloverdale	Kevin Thompson	City Manager	Derrick Montanye	Public Works Director
City of Cotati	Katie Duran	Senior Management Analyst	Damien O'Bid	City Manager
City of Healdsburg	Kelsey Carreiro	Emergency Manager	N/A	-
City of Petaluma	Tom Jordan	Emergency Manager	N/A	-
City of Rohnert Park	Aaron Johnson	Deputy Chief	Adam Strongman	Lieutenant
City of Santa Rosa	Neil Bregman	Emergency Preparedness Manager	Conor McKay	Planner
City of Sebastopol	Sean McDonagh	Chief of Police	N/A	-
City of Sonoma	Mike Berger	Director	Sarah Tracy	Senior Management Analyst and PIO
Cloverdale Fire Protection District	Jason Jenkins	Fire Chief	N/A	-
County of Sonoma	Sage Limpp	Supervising Hazard Mitigation Coordinator	Katrina Braehmer	Supervising Planner
Gold Ridge Fire Protection District	Dave Bray	Division Chief	N/A	-
North Sonoma Coast Fire Protection District	Bonnie Plakos	Chief	Chuck Brier	Assistant Chief
Northern Sonoma County Fire Protection District	Marshall Turbeville	Chief	N/A	-
Rancho Adobe Fire Protection District	Tim Caldwell	Battalion Chief	N/A	-
Santa Rosa Junior College	Dawn Carter	Emergency Manager	Robert Brownlee	Chief
Sonoma County Ag + Open Space	Sheri Emerson	Stewardship Manager	Allison Schichtel	Senior Conservation Planner
Sonoma County Fire Protection District	Cyndi Foreman	Division Chief/Fire Marshal	N/A	-
Sonoma Valley Fire Protection District	Trevor Smith	Deputy Chief/Fire Marshal	Sean Lacy	Battalion Chief
Sonoma Water	Michell Maxwell	Emergency Management Coordinator	Steven Hancock	Emergency Management and Security Manager
Timber Cove Fire Protection District	Heidi Horovitz	BC Admin	N/A	-
Town of Windsor	Kim Jordan	Planner III	Kristina Owens	Government Operations Manager

The various jurisdictions in Sonoma County have differing levels of capabilities and resources available to apply to the plan update process, as well as differing levels of vulnerability to and impacts from the natural hazards being considered in this plan. It was Sonoma County's intent to encourage participation by all jurisdictions, and to accommodate their specific needs and limitations while still meeting the intent and purpose of plan update participation. Such accommodations included establishing the HMWG, engaging a contract consultant to assume certain elements of the plan update process on behalf of the jurisdictions, and providing alternative mechanisms for planning participation.

Ultimately, jurisdictional participation is evidenced by a completed annex in the HMP, wherein jurisdictions individually identify their planning points of contact, evaluate their risk from the hazards of concern, identify their capabilities to effect mitigation in their community, identify and prioritize a suite of actions to mitigate their hazard risk, and adopt the updated plan via resolution. Annexes are included in Volume II of this HMP.

After completion of the plan, implementation and ongoing maintenance will become a function of the Planning Partnership as described in Chapter 20. The Planning Partnership will be responsible for reviewing the draft plan and soliciting public comment as part of an annual review and as part of the five-year mitigation plan updates.

Hazard Mitigation Working Group

Sonoma County developed the HMWG to provide guidance and direction to the HMP update effort, and to ensure that the resulting document will be embraced by local government leaders as well as all who live and work within the planning area. HMWG members were charged with the following:

- Providing guidance and oversight of the planning process
- Attending and participating in HMWG meetings
- Assisting with the development and completion of certain planning elements, including:
  - Developing a public and stakeholder outreach program
  - Reviewing and updating the hazards of concern
  - Ensuring that the data and information used in the plan update process is the best available
  - Reviewing and updating the hazard mitigation goals
  - Identifying and screening appropriate mitigation strategies and activities
- Reviewing and commenting on plan documents prior to submission to Cal OES and FEMA.

The HMWG provided guidance, leadership, and oversight of the planning process and acted as the point of contact for all participating jurisdictions and interest groups in the planning area. Table 2-2 lists the members of the HMWG.

Table 2-2. Sonoma County Hazard Mitigation HMWG Members

Affiliation	Name	Title
CAL FIRE	Ben Nicholls	Division Chief
CAL FIRE	James Ausboe	Fire Captain
City of Cotati	Damien O'Bid	City Manager
City of Petaluma	Tom Jordan	Emergency Manager
City of Santa Rosa	Neil Bregman	Emergency Preparedness Manager
Permit Sonoma	Shelly Bianchi-Williamson	Geographic Information Technician
Regional Climate Protection Authority	BC Capps	Climate Programs Manager
Permit Sonoma	Katrina Braehmer	Supervising Planner
Sonoma County Administrator's Office	Gilbert Martinez	Communications Specialist
Sonoma County Ag + Open Space	Sheri Emerson	Stewardship Manager
Sonoma County Community Development Commission	Marc Chandler	Affordable Housing Assistant Manager
Sonoma County Department of Emergency Management	Sage Limpp	Supervising Hazard Mitigation Coordinator
Sonoma County Department of Health Services	Ryan DeHart	Public Health Preparedness Section Manager
Sonoma County Community Organizations Active in Disaster	Jeanette Pantoja	COAD Director
Sonoma County Office of Equity	Roxanne Ezzet	Disaster and Recovery Analyst
Sonoma County- Public Infrastructure	Amanda Bouillerce	Grants Program Manager
Sonoma Economic Development Collective	Aleena Decker	Conference & Communications Coordinator
Sonoma Economic Development Collective	Katherine DiPasqua	Director of Special Projects and Partnerships
Sonoma Water	Michelle Maxwell	Emergency Management Coordinator
Town of Windsor	Kim Jordan	Planner III
Western Builders	Robert Cantu	President

2.2.2 Planning Activities

Members of the Planning Partnership (individually and as a whole), as well as key stakeholders, met and communicated as needed to share information. This included workshops to identify hazards, assess risks, update inventories of critical facilities, and assist in updating mitigation goals and strategies. All members of the Planning Partnership had the opportunity to review the draft plan, supported interaction with other stakeholders, and assisted with public involvement efforts. These activities provided continuity through the process to ensure that natural hazard vulnerability information and appropriate mitigation strategies were incorporated.

Table 2-3 summarizes meetings and other planning activities conducted during the development of the plan. It also identifies which 44 CFR 201 requirements each activity satisfies. Documentation of meetings (agendas, sign-in sheets, minutes, etc.) may be found in Appendix C. In addition to the activities listed in the table, there was a great deal of communication between Planning Partnership members and the consultant through individual local meetings, phone, and email.

Table 2-3. Summary of Mitigation Planning Activities

Date	44 CFR 201 Requirement[a]	Description of Activity	Participants
June 2023	2	All municipalities and special districts invited to participate in the planning process.	Sonoma County, Planning Partners
Bi-Weekly	-	Bi-weekly project status meeting to discuss action items in support of the expedited planning process	Core Planning Team
October 16, 2024	2	Pre-kickoff meeting to discuss project management and planning process.	Core Planning Team
November 13, 2024	2	Project startup meeting: Discuss proposed planning process and scope of work including documenting participation, schedule, and public and stakeholder outreach and involvement.	Sonoma County, Planning Partners, interested Stakeholders, Tetra Tech
November 19, 2024	2, 3c	GIS data collection meeting	Sonoma County Department of Emergency Management, Sonoma County GIS Operations, Tetra Tech
November 2024	1b, 2b	Public project website developed	Sonoma County, Planning Team
December 4, 2024	1b,2,3a,3b,3c, 4a	Planning Partners Kickoff Meeting: Discuss planning partner roles and responsibilities, detailed discussion of data collection methods	Sonoma County Department of Emergency Management, Planning Partners, Tetra Tech
December 11, 2024	1b,2,3a,3b,3c, 4a, 5c	HMWG Kickoff Meeting: Introduce HMWG to contract consultant, discuss project overview, HMWG roles and responsibilities, select working group leadership positions, and determine 2026 hazards of concern.	Sonoma County Department of Emergency Management, HMWG, Tetra Tech
December 2024	1b	Online Public Hazard Preparedness and Mitigation survey developed and deployed	Planning Team, Tetra Tech
March 3,2025	-	Two Planning Partner meetings, one with municipalities, and the second with the special districts to discuss mitigation strategy development, new action development, public outreach, and other plan requirements.	Planning Team, Tetra Tech
March 13, 2025	2	HMWG Meeting: Discussed the plan progress and a risk assessment overview	HMWG, Tetra Tech

Date	44 CFR 201 Requirement[a]	Description of Activity	Participants
July 29, 2025		Risk Assessment meeting: To inform the Planning Partners about the hazard ranking overview process and provide information on the risk assessment results for the hazards identified	Planning Team, HMWG, Tetra Tech
October 16, 2025	1b, 2, 3, 4, 5	HMWG Meeting: Plan Maintenance, Draft Plan Review	Planning Team, HMWG, Tetra Tech
October 20, 2025	2	Draft plan posted to public project website	Public and Stakeholders
November 21, 2025	1b, 2	Public and stakeholder comments on draft plan received and incorporated into final plan.	Public and Stakeholders
January 19, 2025	All requirements	Final plan submitted to Cal OES	Sonoma County Department of Emergency Management, Tetra Tech
May 2026	All requirements	Final plan submitted FEMA Region 9	Sonoma County Department of Emergency Management, Tetra Tech
Upon plan approval by FEMA	1a	Plan adoption by resolution by the governing bodies of all participating municipalities	All plan participants

a. *Numbers in column 2 identify specific requirements of 44 CFR 201.6, as follows:*
1a – Prerequisite – Adoption by the Local Governing Body (201.6.a.1)
1b – Public Participation (201.6.b)
2 – Planning Process – Documentation of the Planning Process (201.6.c.1)
3a – Risk Assessment – Identifying Hazards (201.6.c.2.i)
3b – Risk Assessment – Profiling Hazard Events (201.6.c.2.i)
3c – Risk Assessment – Assessing Vulnerability: Identifying Assets (201.6.c.2.ii.A)
3d – Risk Assessment – Assessing Vulnerability: Estimating Potential Losses (201.6.c.2.ii.B)
3e – Risk Assessment – Assessing Vulnerability: Analyzing Development Trends (201.6.c.2.ii.C)
4a – Mitigation Strategy – Local Hazard Mitigation Goals (201.6.c.3.i)
4b – Mitigation Strategy – Identification and Analysis of Mitigation Measures (201.6.c.3.ii)
4c – Mitigation Strategy – Implementation of Mitigation Measures (201.6.c.3.iii)
5a – Plan Maintenance Procedures – Monitoring, Evaluating, and Updating the Plan (201.6.c.4.i)
5b – Plan Maintenance Procedures – Implementation through Existing Programs (201.6.c.4.ii)
5c – Plan Maintenance Procedures – Continued Public Involvement (201.6.c.4.iii)

2.3 STAKEHOLDER OUTREACH AND INVOLVEMENT

The Sonoma County HMP update was written using the best available information obtained from a wide variety of sources. Throughout the HMP update process, a concerted effort was made to gather information from municipal and regional agencies, stakeholders, federal and state agencies, and the residents of the County. The HMWG solicited information from local agencies and individuals with specific knowledge of certain natural hazards and past historical events. In addition, the HMWG and

Planning Partnership took into consideration planning and zoning codes, ordinances, and recent land use planning decisions.

This section details the outreach to, and involvement of, the many agencies, departments, organizations, non-profits, districts, authorities, and other entities that have a stake in managing hazard risk and mitigation, commonly referred to as stakeholders.

Diligent efforts were made to ensure broad regional, county, and local representation in this planning process. A comprehensive list of stakeholders was developed with the support of the HMWG and Planning Partnership. Stakeholder outreach was performed early and throughout the planning process, including mass media notification efforts. Identified stakeholders were invited to attend the Planning Partnership risk assessment meeting, and key stakeholders were requested to participate on the HMWG and/or Planning Partnership. Information and input provided by these stakeholders has been included throughout this plan.

The following sections list the stakeholders who were invited to participate in the development of this plan and describe how they contributed to the plan. This summary information demonstrates the scope and breadth of the stakeholder outreach efforts during the planning process. Beyond those described here, many stakeholders were aware of and/or contributed to this plan through formal and informal outreach efforts by the Planning Partners involved in the plan update.

2.3.1 Federal and State Agencies

The federal and state agencies listed in Table 2-4 were contacted during the planning process. The table describes how each participated.

Table 2-4. Participation of Federal and State Agencies

Agency	Participation
FEMA Region 9	Provided updated planning guidance; provided information on previous federal disasters, conducted plan review.
National Centers for Environmental Information (NCEI) **National Oceanic and Atmospheric Administration (NOAA)** **National Weather Service (NWS)** **Storm Prediction Center (SPC)** **U.S. Army Corps of Engineers (USACE)** **U.S. Census Bureau** **U.S. Geological Survey (USGS)**	Information regarding hazard identification and the risk assessment for this HMP update was requested and received or incorporated by reference
California Governor's Office of Emergency Services (Cal OES)	Provided information on state emergency proclamations, administered planning grant and facilitated FEMA review; provided updated planning guidance; attended HMWG meetings; provided review of Draft and Final Plan.
California Department of Forestry and Fire Protection (CAL FIRE)	Participated in the working group and attended meetings.

2.3.2 County and Regional Agencies

The county and regional agencies listed in Table 2-5 were invited via email to participate during the planning process. The table describes how each participated.

Table 2-5. County and Regional Agencies

Agency	Participation
Sonoma County Department of Emergency Management **Sonoma County Ag + Open Space** **Sonoma Water**	Served on HMWG, attended meetings, completed hazard of concern exercise and goals and objectives exercise and reviewed draft plan.
Permit Sonoma **Regional Climate Protection Authority** **Sonoma County Community Organizations Active in Disaster** **Sonoma County Affordable Housing** **Sonoma County Office of Equity** **Sonoma Economic Development Collective**	Served on HMWG, attended meetings, provided input and reviewed draft plan.
Sonoma County – Public Infrastructure **Western Builders**	Served on the HMWG, provided input, and reviewed draft plan.
Sonoma County Transportation Authority **Sonoma Resource Conservation District** **Sonoma County Health Services** **Sonoma County Information Systems Department—GIS**	Attended meetings, provided input and reviewed draft plan.
Lake County Office of Emergency Services **Mendocino County Office of Emergency Services** **Napa County Office of Emergency Services** **Solano County Office of Emergency Services** **Marin County Office of Emergency Management**	Invited to take the neighboring community survey

2.3.3 Stakeholders

As part of this process, all participating jurisdictions invited relevant stakeholders to contribute to the planning effort through various means, including attending Hazard Mitigation Working Group (HMWG) meetings, completing surveys, sharing subject matter expertise, and reviewing draft materials. Each jurisdiction was encouraged to engage internal departments and agencies with responsibilities related to hazard mitigation, emergency management, planning, and public safety. Table 2-6 through Table 2-11 lists the organizations invited to participate.

Nonprofit and community-based organizations play a vital role in hazard mitigation by supporting populations that are often most vulnerable during disasters. These organizations frequently work directly with underserved communities, including individuals with access and functional needs, low-income households, seniors, and those experiencing homelessness. Their involvement ensures that the planning process reflects the needs of socially vulnerable populations and promotes equitable resilience strategies.

Table 2-6. Organizations Invited to Participate in HMP Planning Process

- California Department of Forestry and Fire Protection (CAL FIRE)
- California Governor's Office of Emergency Services (Cal OES)
- California Department of Transportation (Caltrans)
- California Department of Fish and Wildlife
- California Highway Patrol
- California State Parks
- Municipal Community Development Departments
- City of Cotati Public Works
- City of Cloverdale Public Works Department
- City of Petaluma Fire Department
- City of Petaluma Police Department
- City of Sebastopol Police Department (Emergency Management)
- Cloverdale Fire / Cloverdale Fire Protection District
- Comcast (dba Xfinity)
- County Roads
- County of Sonoma Department of Emergency Management
- County of Sonoma Department of Health
- Fire Safe Sonoma
- Gold Ridge Resource Conservation District
- Graton Fire Protection District
- Healdsburg Emergency Management
- Healdsburg Fire Department
- Healdsburg Police Department
- Marin County Office of Emergency Management
- National Weather Service
- Northern Sonoma County Community Emergency Response Team
- Northern Sonoma County Fire District
- Permit Sonoma
- Public Utilities
- Public Works and Engineering Department
- REDCOM
- Rancho Adobe Fire / Rancho Adobe Fire Protection District
- Santa Rosa Emergency Management
- Santa Rosa Fire Department
- Save the Redwoods League
- Sonoma County Fire District's
- Sonoma County Information Systems Department (ISD)—GIS
- Sonoma County Public Information
- Sonoma County Public Health
- Sonoma County Public Infrastructure
- Sonoma County Sheriff's Office
- Sonoma County Transportation Authority (SCTA)
- Sonoma Water
- Sonoma County/Valley of the Moon Water Agencies
- Sonoma Land Trust
- Sonoma Valley Fire / Sonoma Valley Fire District
- SRJC Police Department
- SRJC Facility Operations
- The Sea Ranch Association – Emergency Management
- The Sea Ranch Water Company
- United States Coast Guard
- United States Fish and Wildlife Service
- U.S. Army Corps Lake Sonoma

Table 2-7 Agencies that Have the Authority to Regulate Development

- Board of Supervisors District 2
- Building Department
- CAL FIRE
- California Environmental Protection Agency
- City of Cotati Planning Department
- City of Sonoma Community Development Department
- City of Sonoma Planning Commission
- Cloverdale Building Department
- Cloverdale Fire Protection District
- Cloverdale Planning Commission
- Community Development
- Community Development Commission
- Economic Development Collaborative
- Office of Supervisor James Gore
- Permit Sonoma
- Sonoma County Agriculture, Weights, and Measures
- Sonoma County Environmental Health
- Sonoma County Local Agency Formation Commission
- Sonoma County Permit & Resource Management Department
- Sonoma County Public Infrastructure
- Sonoma County Regional Parks
- Sonoma Water
- Sonoma Valley Fire District
- SRJC Finance Department
- SRJC Board of Trustees
- Town of Windsor Council
- Town of Windsor Planning Commission
- Town of Windsor Administrative Hearing Officer
- Town of Windsor Community Development Department
- Town of Windsor Public Works Department
- Town of Windsor Building Official

Table 2-8 Neighboring Communities

- Bodega Water Company
- California Department of Fish & Wildlife
- Camp Meeker Recreation and Park District
- City / County of Napa Valley
- City of Cloverdale
- City of Cotati
- City of Healdsburg
- City of Petaluma
- City of Rohnert Park
- City of Santa Rosa
- City of Sebastopol
- Cloverdale Rancheria of Pomo Indians
- Cloverdale Unified School District
- Dry Creek Rancheria Band of Pomo Indians
- Federated Indians of Graton Rancheria
- Forestville
- Gold Ridge Fire Protection District
- Gold Ridge Resource Conservation District
- Graton Fire
- Guidiville Indian Rancheria
- Kashia Band of Pomo Indians of Stewarts Point Rancheria
- Lake County
- Lytton Band of Pomo Indians
- Marin County
- Mendocino County
- Middletown Rancheria
- Mishewal-Wappo Tribe of Alexander Valley
- Monte Rio
- Napa County
- Northern Sonoma County Fire Protection District
- Occidental Fire Department/Community Services District
- Rancho Adobe Fire / Rancho Adobe Fire District
- Russian River Flood Control District
- Santa Rosa Fire
- Schell Vista Fire Protection District
- Sea Ranch
- Sebastopol Fire
- Solano County
- Sonoma County Fire District
- Sonoma County Regional Parks
- Sonoma Resource Conservation District
- Sonoma State University
- Sonoma Valley Fire Rescue Authority
- State of California Department of General Services / State Parks
- Timber Cover Fire Protection District
- Town of Windsor
- Unincorporated Sonoma Valley (Carneros, Schellville, Vineburg, El Verano, Boyes Hot Springs, Fetters Hot Springs, Agua Caliente, Glen Ellen, Kenwood)

Table 2-9 Representatives of Businesses, Academia, and Other Private Organizations

- Alexander Valley Healthcare
- AT&T
- Bennett Valley School District
- Bodega Bay Chamber of Commerce
- Bodega Bay Harbour HOA
- Bodega Bay School District
- Calpine
- Cloverdale Chamber of Commerce
- Cloverdale Unified School District
- Cotati Chamber of Commerce
- Cotati Rohnert Park School District / Cotati-Rohnert Park Unified School District
- Eugene Burger Property Management
- Fircrest Grocery
- Forestville School District
- Geyserville Unified School District
- Geyserville – Alexander Valley Municipal Advisory Committee
- Golden Gate Bridge, Highway and Transportation District
- Graton Casino
- Gravenstein Union School District
- Guerneville School District
- Harmony Union School District
- Kenwood/Penngrove Water Company
- Liberty School District
- Lowes
- Lucky Grocery
- NOAA
- Occidental Hardware
- Olivers Market
- Pacific Markey Grocery
- PG&E (Pacific Gas & Electric)
- Pepperwood Preserve
- Petaluma Chamber of Commerce
- Petaluma City Schools
- Rohnert Park Chamber of Commerce
- Roseland School District
- Rotary Club of Rohnert Park—Cotati
- Safeway Grocery
- Santa Rosa Junior College / Petaluma Campus
- Sea Ranch Association
- Sebastopol Chamber of Commerce
- Sebastopol Hardware
- Sebastopol Union School District
- Sonoma County Agricultural Preservation and Open Space District Advisory Committee
- Sonoma County Fairgrounds
- Sonoma County Office of Education
- Sonoma Water
- Sonoma County Winegrowers
- Sonoma Marin Area Rail Transit
- Sonoma State University (including Regional Resilience Coordinator)
- Sonoma Valley Chamber of Commerce
- Sonoma Valley Hospital
- Sonoma Valley Library
- Sonoma Valley Unified School District
- Sonoma Valley Vintners and Growers Alliance
- Sweetwater Springs Water District
- T-Mobile
- The Sea Ranch Association
- Twin Hills Union School District
- Two Rock union School District
- USGS
- Verizon
- West Sonoma County Union High School District
- Wilmar Union School District
- Windsor Chamber of Commerce
- Windsor Unified School District

Table 2-10 Nonprofit Organizations and Community-Based Organizations

- Alexander Valley Medical Center
- American Red Cross
- Area Council on Aging
- Bear Club Scholars
- Bodega Bay Community Emergency Response Team
- Burbank Housing
- California 2-1-1
- Catholic Charities of the Diocese of Santa Rosa / HOST
- Circuit Riders
- Cloverdale Rancheria
- Coastal Valleys EMS Agency
- Committee on the Shelterless ("COTS")
- Community Action Partnership
- Community Foundation Sonoma County
- Community Housing Sonoma County
- Corazon Healdsburg
- COPE (Citizens Organized to Prepare for Emergencies)
- Dry Creek Rancheria
- Fire Safe Councils / Fire Safe Sonoma
- FireWise Communities
- Friends in Sonoma Helping (F.I.S.H)
- Graton Rancheria
- Guy Fieri Foundation
- Halter Project
- Hanna Center
- HomeFirst
- Homeowners Associations
- Homeless Action Sonoma (H.A.S.)
- landPaths
- La Luz Center
- Legal Aid of Sonoma County
- Listos Sonoma
- Map Your Neighborhood (MYN) and Meet Your Neighbors groups
- Measure H Fuels Crew
- Mendonoma Health Alliance
- Nuestra Communidad
- Our Lady of Guadalupe Church
- Petaluma People Services Center / SAFE Team
- Pet's Lifeline
- Reach for Home
- Redwood Empire Food Bank
- Resilient Cloverdale Steering Committee
- SAFE Team (Specialized Assistance for Everyone)
- Salvation Army
- Sebastopol Area Senior Center
- Sonoma Ag & Open Space
- Sonoma Citizens Prepared for Emergency Groups
- Sonoma Community Animal Response Team (CART)
- Sonoma Community Center
- Sonoma Community Organizations Active in Disaster (COAD)
- Sonoma County Access and Functional Needs Advisory Committee
- Sonoma County Council on Aging
- Sonoma County Fire Chiefs Association
- Sonoma County Health and Human Services
- Sonoma County Social Services
- Sonoma Ecology Center
- Sonoma Land Trust
- Sonoma Overnight Support/Unity Kitchen
- Sonoma Resource Conservation District
- Sonoma State Historic Parks
- Sonoma Valley Boys and Girls Club
- Sonoma Valley Community Health Center
- Sonoma Valley Mentoring Alliance
- Sonoma Valley Volunteer Firefighters Association
- Somos Windsor
- SRJC Foundation
- Stewarts Point
- Sweetwater Spectrum
- St. Vincent de Paul of Sonoma County
- The Sea Ranch Association
- United Way Wine Country
- Unsheltered Friends Outreach
- Vintage House Senior Center
- Windsor Community United Methodist Church
- Windsor Presbyterian Church

Table 2-11 Other Stakeholders

- Citrus Fairgrounds (emergency shelter & staging)
- Sonoma County Animal Services
- SMART (Sonoma-Marin Area Rail Transit)
- Petaluma Valley Hospital
- Sonoma Valley Catalyst Fund
- Private Landowners
- Land Stewards
- Native American Tribal Resources
- Sonoma Valley Historical Society
- Sonoma League for Historic Preservation
- Windsor Historical Society
- Women's Club

2.3.4 Neighboring Community Survey

Surveys were distributed to solicit information from neighboring communities about their experiences with hazards and mitigation approaches. The neighboring community survey was sent to counties and municipalities that border Sonoma County, with the understanding that the effects of hazard events that impact Sonoma County would be similar to those on their neighbors. The survey consisted of five sections: emergency operations and continuity of operations planning; risk and vulnerability; evacuation and sheltering; information sharing; and projects, grants, education and outreach.

Two counties submitted responses to the survey (Lake County and Mendocino County). Feedback was reviewed by the HMWG and integrated where appropriate in the plan. The following sections summarize the responses.

Emergency Operations and Continuity of Operations Planning

Both counties were asked if any shared service or mutual aid agreements are in place between their county and Sonoma County. Mendocino County indicated that emergency staff for evacuations or disaster response are available to assist. In addition, Sonoma County is involved in their county's emergency operations planning through the Master Mutual Aid System for Fire and Law. Each respondent noted that Sonoma County is involved in their Continuity of Operations Planning. One respondent noted that Sonoma County offered resources and support when necessary.

When asked how EOC and COOP activations are communicated between the communities and Sonoma County, Lake County indicated that communication occurs verbally through pre-established connections, as well as by monitoring media and other communications during an incident.

Evacuation and Sheltering

Neither of the respondents indicated whether there is collaboration with Sonoma County on establishing evacuation routes or alternative evacuation routes. However, Lake County noted they would consult with Sonoma County before making evacuation decisions that would impact one another. The respondent also noted that evacuation routes are maintained to the same level of protection across county lines. No shared spaces for temporary housing were identified.

Information Sharing

When asked about opportunities to optimize information sharing between Sonoma County and the community, Mendocino County suggested conducting surveys, holding regular check-ins, and collaborating with Sonoma County on exercises, classes, and meetings.

Projects, Grants, Education, and Outreach

Respondents did not identify any projects as requiring cross-collaboration between county boundaries. However, Mendocino County noted that while they are slightly behind Sonoma County in the process and are finishing their Community Wildfire Protection Plan update, they had not previously considered involving neighboring counties in these efforts.

2.4 PUBLIC OUTREACH

In order to facilitate better coordination and communication between the Planning Partnership and all community members and to involve the public in the planning process, draft documents were made available to the public through a variety of venues, including printed and online format.

2.4.1 Public Information Activities

The Planning Partnership made the following efforts to inform the public about steps in the development and review of the HMP:

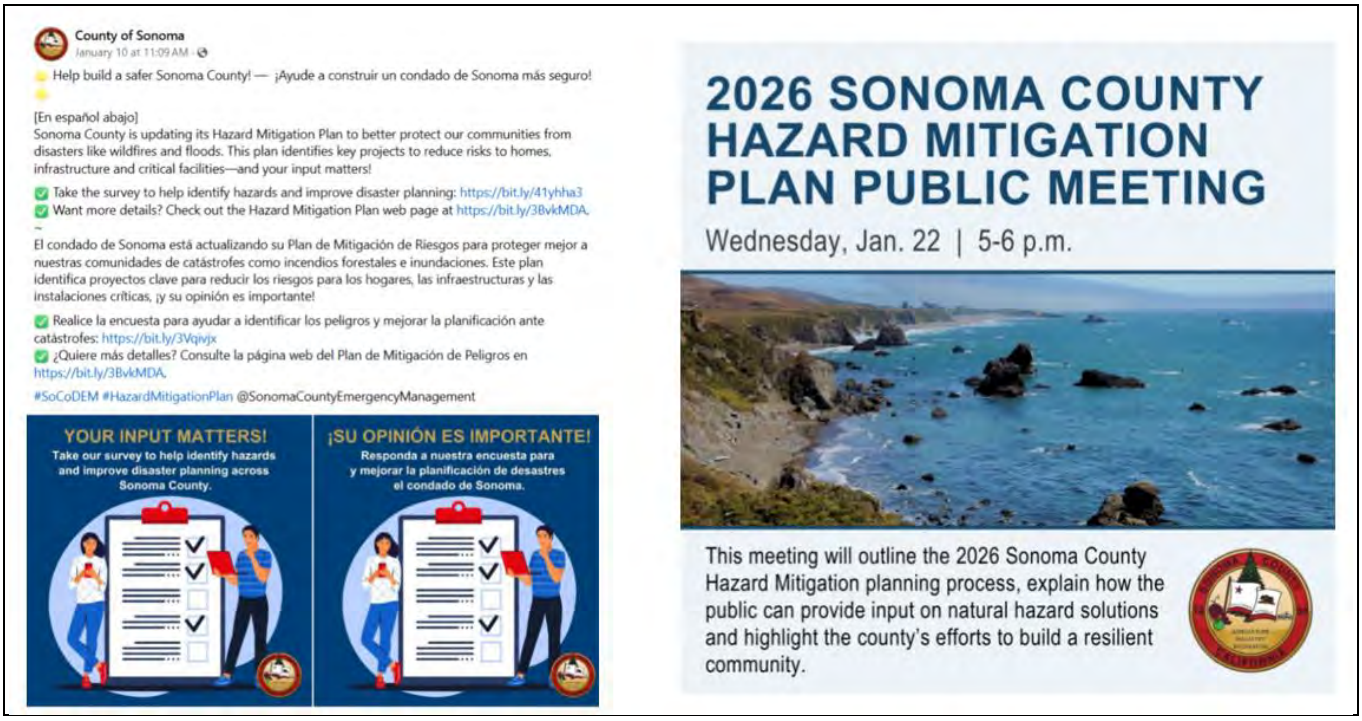
- The public was informed of the hazard mitigation planning effort commencement at the kickoff meeting and through press releases, news articles, and public service announcements released throughout the planning process. Copies of these announcements may be found in Appendix D.
- Media releases were issued to local news sources.
- A public website is being maintained to facilitate communication between the HMWG, Planning Partnership, public and stakeholders (Sonoma County 2025 Hazard Mitigation Plan). The public website contains a project overview, County and local contact information, access to surveys, and sections of the HMP for review and comment.
- All participating jurisdictions have been encouraged to distribute press releases on the project, including links to the project webpage and community and stakeholder surveys. Jurisdictions posting information and supporting online outreach include:
  - Bodega Bay Public Utility District
  - City of Cloverdale
  - City of Cotati
  - City of Healdsburg
  - City of Petaluma
  - City of Rohnert Park
  - City of Santa Rosa
  - City of Sebastopol
  - City of Sonoma
  - Cloverdale Fire Protection District
  - County of Sonoma
  - Gold Ridge Fire Protection District
  - North Sonoma Coast Fire Protection District
  - Northern Sonoma County Fire Protection District
  - Rancho Adobe Fire Protection District
  - Santa Rosa Junior College
  - Sonoma County Ag + Open Space
  - Sonoma County Fire District
  - Sonoma Valley Fire Protection District
  - Sonoma Water
  - Timber Cove Fire Protection District
  - Town of Windsor

Examples of virtual outreach via websites and social media completed by Sonoma County are provided in Figure 2-1 and Figure 2-2. For additional examples, see the jurisdictional annexes in Volume II.

Figure 2-1. Sonoma County HMP Webpage



Figure 2-2. Sonoma County Social Media Outreach



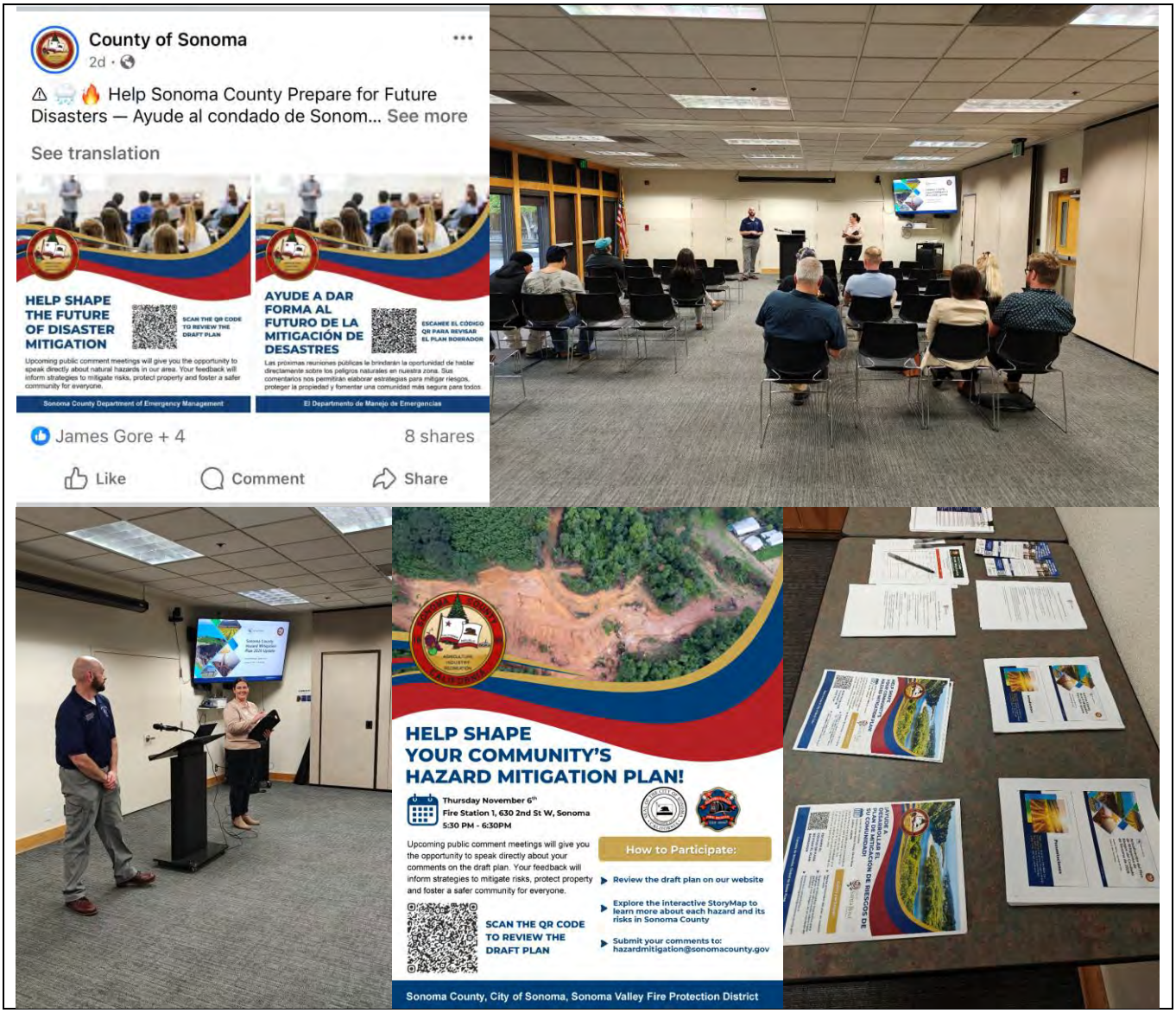
2.4.2 Public Meetings

Sonoma County and the City of Petaluma hosted a public meeting at the Petaluma Fairgrounds on January 22, 2025, for the community to learn about efforts to prepare for natural disasters and participate in creating a resilient community. The meeting provided an overview of the 2026 HMP planning process and described how the public can provide input on natural hazard problems and potential solutions. The meeting was announced via press release, advertised on social media, and posted on public notice bulletin boards. See Figure 2-2 for examples of meeting advertisements.

Sonoma County hosted two additional public meetings when the draft HMP became available for public comment in October. The first was co-hosted with the City of Santa Rosa on October 27, 2025, at the Finley Community Center in Santa Rosa. The second took place online using Microsoft Teams. Both meetings presented an overview of the sections of the draft plan, the results of the risk assessment, and the planning process participants. The meetings presented an opportunity for the community to learn about Sonoma County's plan to reduce risk and to ask questions about the mitigation strategy. They were announced via County press release and advertised by all Planning Partners on social media, newsletters, websites, and public notice bulletin boards. See Figure 2-3 for examples of outreach conducted by Sonoma County; planning partner efforts to advertise the public comment period are represented in the jurisdictional annexes in Volume II.

Spanish translation services were available at all public meetings and the meetings were advertised in both English and Spanish. In addition to the dedicated public meetings, all HMWG meetings were open to the public, with opportunities for comment.

Figure 2-3. Santa Rosa Public Meeting



2.4.3 Public Survey

Contents and Advertisement

An on-line natural hazards preparedness community survey was developed to gauge household preparedness that may impact Sonoma County and to assess the level of knowledge of tools and techniques to assist in reducing risk and loss associated with those hazards. The survey asked questions about community member perception of risk, knowledge of mitigation, and support of community programs. It also included demographic questions to help analyze trends.

The survey was posted on the County website on December 5, 2024, and was available for public input through June 13, 2025. All participating jurisdictions were requested to advertise the availability of the

survey via local homepage links, and other available public announcement methods (e.g., Facebook, Twitter, email blasts, etc.).

Results

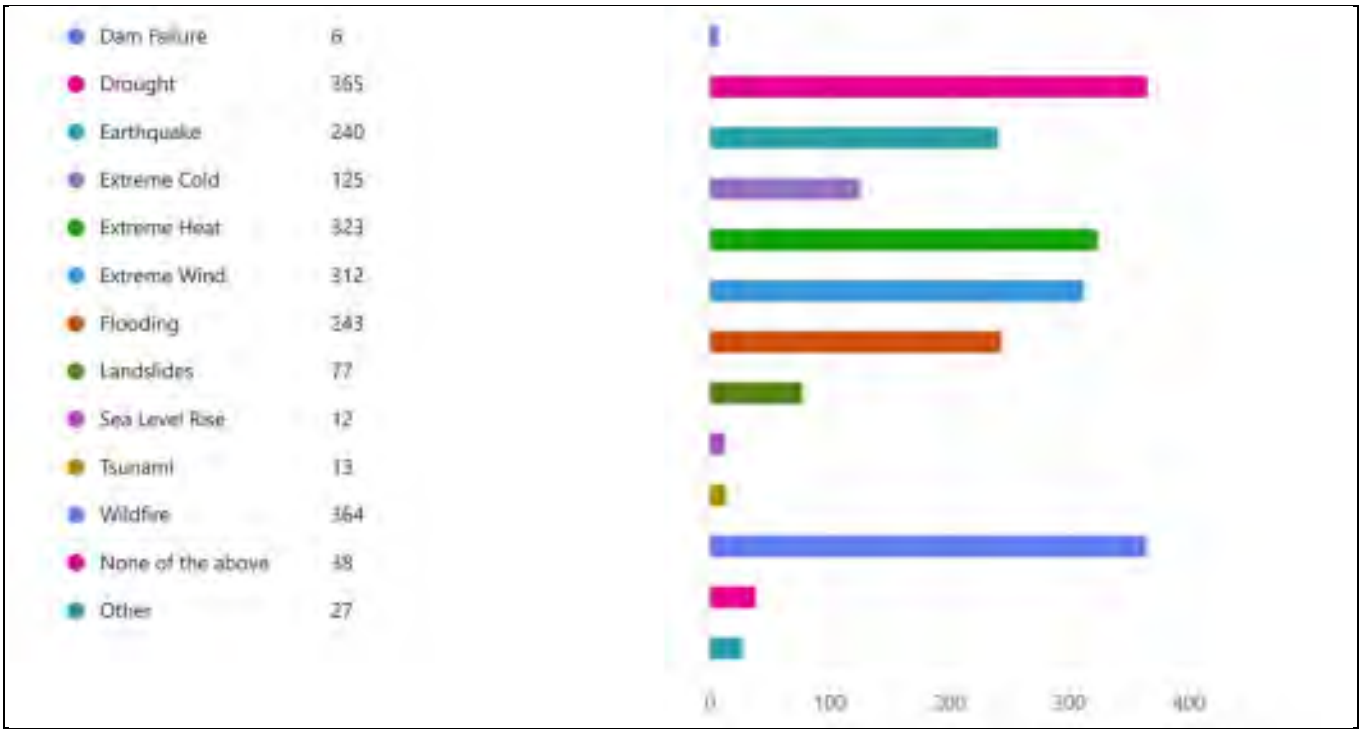
By the closing date, 577 responses to the public survey were submitted. Refer to Appendix E for the full list of survey questions and responses.

Demographically, survey respondents were from 37 municipalities within Sonoma County, with 49 percent having lived in the County for 20 years or more. The most common age range of respondents was over 60. Six responses were received in Spanish, reflecting Sonoma County's commitment to prioritizing inclusive outreach, including non-English speaking residents. By engaging the entire community in the process, the County worked to ensure diverse perspectives were represented.

Most residents said that they receive information concerning a natural hazards through mass notification systems. Over half receive information through TV news or radio news.

Survey respondents identified drought, wildfire, extreme heat, extreme wind, and flooding as the five most frequently occurring natural hazard events in Sonoma County in the past five years (see Figure 2-4).

Figure 2-4. Most Frequently Experienced Natural Hazard Events in Sonoma County



Respondents were asked about their property's location within a floodplain, and if they have flood insurance. Of the 74 respondents who answered this question, 13 percent of residents indicated that

their property is located in a designated floodplain. However, 31 percent indicated their home is covered by flood insurance.

Respondents identified the following as their priorities for natural hazards in Sonoma County:

- Protecting critical facilities and community lifelines
- Protecting and reducing damages in utilities
- Strengthening emergency services (e.g., police, fire, EMS)
- Disclosing natural hazard risks during real estate transactions
- Promoting cooperation among public agencies, residents, non-profit organizations and local businesses

2.4.4 Distribution of the HMP

The Draft Plan was posted to the project website on October 20, 2025, for public review and comment. All public comments were directed to the Sonoma County Department of Emergency Management for collection and review by the HMWG. All public comments received were forwarded to the appropriate jurisdiction and/or agency and incorporated into the final plan as appropriate. The following information was added to the plan in response to public feedback received during the public comment period:

- Additional information about the County's compliance with Assembly Bill 747 and Senate Bill 99.
- Clarification about the definition of "extreme cold" in Sonoma County.
- Further information about the County's existing hazardous materials plans and state guidelines for owners of hazardous materials facilities.
- Clarification about the difference between Fire Hazard Severity Zones and the wildland-urban interface, as well as the difference between State Responsibility Areas and Local Responsibility Areas.
- Action 2026-CW-08 (Evacuation Assessment and Risk Reduction Program) was added to the Sonoma County mitigation strategy to conduct evacuation planning in unincorporated areas of Sonoma County, accounting for roadway networks, access and egress patterns, hazard exposure, and evolving conditions during emergency events.

After approval by Cal OES and FEMA, the final plan will be available for public review and comment in the same manner and format as the draft plan. The Plan will be available to the public through a variety of venues. A printed version will be maintained at the Sonoma County Office of Emergency Management, as well as in hard-copy format as identified in Chapter 20. Cities participating in the FEMA Community Rating System program will comply, as appropriate, with providing hard copies in their city halls, public libraries, and the offices of their floodplain administrators. Participating cities are also encouraged to make the HMP available on their websites.

2.5 INCORPORATION OF EXISTING PLANS, STUDIES, REPORTS AND TECHNICAL INFORMATION

The Sonoma County HMP uses the best available information to support hazard profiling, risk assessment, capability assessment, and the development and prioritization of mitigation strategies. Plans, reports, and other technical information were accessed online through independent research or provided directly by the County, participating jurisdictions, and stakeholders involved in the planning effort. Detailed sources of technical data and information used are listed in the References section.

The asset inventory data used for the risk assessment is presented in the County Profile (Chapter 3). Details of the source of this data, along with technical information on how the data was used to develop the risk assessment, are presented in Chapter 4, as well as throughout the hazard profiles in this HMP. The County and participating jurisdictions provided relevant jurisdiction-specific planning and regulatory documents, which were reviewed to identify:

- Existing jurisdictional capabilities
- Needs and opportunities to develop or enhance capabilities, which may be identified in the County or local mitigation strategies
- Mitigation-related goals or objectives, considered in the review and update of the overall goals and objectives (see Section 19.2)
- Proposed, in-progress, or potential mitigation actions to be incorporated into the updated County and local mitigation strategies

The following regulations, codes, ordinances, and plans were reviewed to develop mitigation planning goals and objectives and mitigation strategies that are consistent across local and regional planning and regulatory mechanisms:

- General plans
- Building codes
- Zoning and subdivision ordinances
- Flood insurance studies
- Flood insurance rate maps
- NFIP flood damage prevention ordinances
- Site plan requirements
- Local waterfront revitalization plans
- Stormwater management plans
- Emergency management and response plans
- Land use and open space plans
- Capital plans
- Community Rating System
- California State Hazard Mitigation Plan, 2023

The County and participating jurisdictions were tasked with updating the assessment of their planning and regulatory capabilities (see capability assessment section of each jurisdictional annex in Volume II). They reviewed relevant plans contributing to the capability of the County and each jurisdiction to integrate effective mitigation efforts into their daily activities. This review is reflected in the capability assessment table in each of the municipal annexes. These tables list plan types, names, and dates, as well as a summary of how each plan supports mitigation and resilience.

2.6 INTEGRATION WITH EXISTING PLANNING MECHANISMS AND PROGRAMS

Effective mitigation is achieved when hazard awareness and risk management approaches and strategies become an integral part of public activities and decision-making. Many existing plans and programs support hazard mitigation in the County. It is critical for this HMP to integrate and complement those existing plans and programs.

The capability assessment presented in Chapter 18 provides a summary and description of the existing plans, programs, and regulatory mechanisms at all levels of government (federal, state, county and local) that support hazard mitigation in the County. In the jurisdictional annexes in Volume II, each participating jurisdiction identifies how it has already integrated hazard mitigation into its planning, regulatory and administrative framework ("integration capabilities") and how it intends to promote this integration ("integration actions"). The following County plans are incorporated into this HMP:

- Climate Change Action Resolution, 2018
- Sonoma County General Plan, 2008, Amended 2016
- Sonoma County Community Wildfire Protection Plan, 2023
- Sonoma County Local Coastal Plan, 2023
- Sonoma County Comprehensive Economic Development Strategy, 2022

Further information on ongoing integration of hazard mitigation is presented in Chapter 20.

2.7 PLAN ADOPTION

Adoption by the local governing bodies of each participating jurisdiction demonstrates the commitment of the Planning Partners to fulfill the mitigation goals and strategies outlined in this HMP. Adoption via a municipal resolution legitimizes the HMP and authorizes responsible agencies to execute their responsibilities. The resolutions issued by each jurisdiction to support adoption of this HMP are included in Appendix A.

All participating jurisdictions will proceed with formal adoption proceedings. Each jurisdiction must submit a copy of its formal adoption resolution or other legal instrument to the Sonoma County HMP Coordinator, Department of Emergency Management. Sonoma County will forward the executed resolutions to Cal OES, after which they will be forwarded to FEMA for the record. FEMA allows two options for submitting adoption resolutions:

- **Submittal of adoption resolutions with plan**—All participating jurisdictions provide documentation of plan adoption when the plan is initially submitted to the state for review. After receiving the draft plan from the state, FEMA conducts its review and will approve the plan if it meets all requirements.
- **Approvable pending adoption**—A draft HMP is submitted to the state and FEMA for approval prior to adoption by the jurisdictions. When FEMA determines that the plan as a whole and each participating jurisdiction have met all the requirements except adoption, FEMA will inform the state that the plan is "approvable pending adoption" (APA). After that, once FEMA receives documentation of adoption resolutions from at least one jurisdiction, the status is changed from APA to approved for the entire plan and for that jurisdiction. Other jurisdictions that participated in the planning process then receive approval once they pass their own adoption resolutions. A jurisdiction with a plan in APA status does not meet the requirement for an approved mitigation plan to apply for and receive funding assistance.

FEMA will transmit acknowledgement of verification of formal plan adoption and the official approval of the plan to the Sonoma County HMP Coordinator. Each jurisdiction is responsible for having its governing body adopt the HMP by resolution. Respective resolutions will be forwarded to both Cal OES and FEMA.

Additional details for HMP plan monitoring and maintenance are in Chapter 20.

2.8 CONTINUED PUBLIC INVOLVEMENT

The Planning Partners are committed to the continued involvement of the public in the hazard mitigation process. This Plan update will be posted on the HMP website (see Section 2.4.1 for link), and jurisdictions will be encouraged to maintain links to the plan website. Further, the County will make hard copies of the Plan available for review at public locations as identified on the plan website. A notice regarding annual updates of the plan and the location of plan copies will be publicized and posted on the HMP website after evaluations to be held annually by the Planning Partnership.

The Planning Partnership will review the plan and accept public comment as part of each annual evaluation and as part of five-year mitigation plan updates. Each jurisdiction's governing body will be responsible for receiving, tracking, and filing public comments regarding this plan.

The HMP Coordinator is responsible for coordinating annual plan evaluation meetings for the Planning Partners, soliciting feedback, collecting, and reviewing the comments, and ensuring their incorporation into the five-year plan update as appropriate. Additional meetings may also be held as deemed necessary by the Planning Partnership. The purpose of these meetings would be to provide the public an opportunity to express concerns, opinions, and ideas about the plan.

Ms. Sage Limpp of the Sonoma County Department of Emergency Management has been identified as the ongoing County HMP Coordinator, and is responsible for receiving, tracking, and filing public comments regarding this Plan Update. Contact information is provided in Chapter 20. Members of the Planning Partnership will assist the HMP Coordinator.

3. COUNTY PROFILE

The planning area for this HMP is the entirety of Sonoma County. This chapter presents general information about the land, people, and assets of the County. This information provides a baseline for understanding the economic, structural, and human assets at risk from the hazards addressed in this HMP.

3.1 LOCATION

Sonoma County, the most northerly of the nine counties in the San Francisco Bay Region, is located along the Pacific coastline about 40 miles north of San Francisco and the Golden Gate Bridge. At just over 1,500 square miles, it is the largest of the nine Bay Area counties. Sonoma County is bordered by the Pacific Ocean on the west, Marin County and San Pablo Bay to the south, Solano, Napa and Lake Counties to the east, and Mendocino County to the north (see Figure 3-1).

3.2 JURISDICTIONS WITHIN THE COUNTY

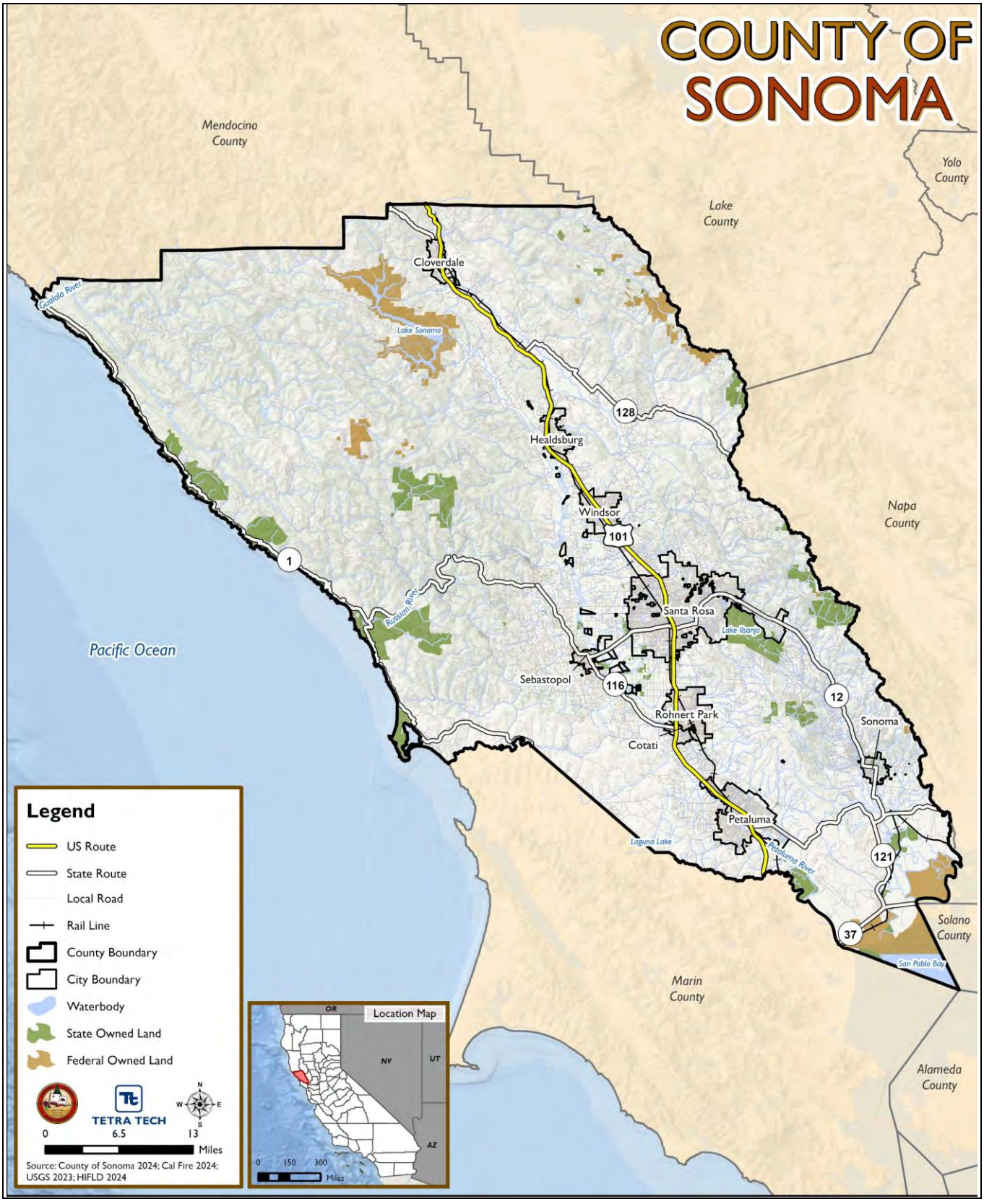
Sonoma County has nine incorporated municipalities:

- City of Cloverdale
- City of Cotati
- City of Healdsburg
- City of Petaluma
- City of Rohnert Park
- City of Santa Rosa
- City of Sebastopol
- City of Sonoma
- Town of Windsor

Santa Rosa, centrally located in the county, is the county seat and most populous city. Unincorporated communities include Annapolis, Bodega, Bodega Bay, Cazadero, Duncans Mills, Forestville, Fort Ross, Freestone, Geyserville, Glen Ellen, Graton, Guerneville, Kenwood, Jenner, Monte Rio, Occidental, Penngrove, Salmon Creek, and The Sea Ranch.

A number of public special districts operate within the boundaries of the County. The Sonoma County Local Agency Formation Commission (LAFCO) regulates 44 special districts in the county. These include fire protection districts, sanitation districts, cemetery districts, water districts, resource conservation districts, among others.

Figure 3-1. Sonoma County Hazard Mitigation Plan Area



3.3 TRANSPORTATION WITHIN THE COUNTY

U.S. Highway 101 is the main highway in the county, running north to south through the county's center. Highway 1 follows the coastline along most of the county's western boundary. Other major roadways are State Highways 12, 37, 116, 121 and 128. Airports include Charles M. Schulz–Sonoma County Airport in Santa Rosa and the Sonoma Valley Airport and Sonoma Skypark in the City of Sonoma. Sonoma County Transit buses run countywide. The SMART Train (Sonoma–Marin Area Rail Transit) carries passengers from the Charles M. Schulz–Sonoma County Airport to Larkspur in Marin County; future extensions as far north as Cloverdale are planned.

3.4 COUNTY GOVERNMENT

The Sonoma County Board of Supervisors is the governing board of Sonoma County and of various special districts such as the Sonoma Water, the Northern Sonoma County Air Pollution Control District, the Agricultural Preservation and Open Space District, County Sanitation Districts, and the Community Development Commission. The Board is composed of five supervisors elected from supervisorial districts for four year terms.

3.5 HISTORY

Early peoples began to settle in Sonoma Valley roughly 12,000 years ago, attracted by fertile soil, water, game, fish, wild oats, berries, acorns, and other natural resources. The name Sonoma may have derived from an indigenous word for "many moons," or may come from "noma," a Miyakmah word for town (Sonomavalley.com 2021). Eventually, these early residents numbered about 5,000 people across a number of tribes:

- Miwoks along the coast
- Wintuns, Wapo and Miyakmahs in the north near the Mayacamas Mountain Range
- Pomos in the lower valley
- Koskiwok near the edge of San Pablo Bay
- Patwins in the southeast corner

In 1812, Russians established the short-lived Fort Ross along the coast north of the Russian River. In the early 19th century, Spanish explorers and missionaries arrived, looking for land and converts and hoping to set up a bulwark against the Russians, who had advanced down the coast from the north. In 1823, Franciscan missionaries established the mission San Francisco Solano de Sonoma. A memorial outside Sonoma's restored mission bears the names of native people who died there.

Sonoma became the county's first town under General Mariano Vallejo. Sections of the county were transformed into land-grant ranchos, such as Vallejo's holdings that extended from today's Petaluma to the town of Sonoma (County of Sonoma n.d.). By the late 1800s, indigenous tribes had all but vanished

as a society. Many died from smallpox and measles; others were sent north to reservations or absorbed into the burgeoning new town of Sonoma.

Sonoma County was one of the original counties when California achieved statehood in 1850. Santa Rosa became the county seat in 1854 (City of Sonoma 2017). Logging along the coast hills, cattle ranching, wheat and potato farming, and the early development of the wine industry supported the sparsely settled county. From the 1860s to the 1890s, Petaluma, at the head of navigation on the Petaluma Creek, enjoyed rapid economic growth that fueled the construction of its downtown.

Later, railroads facilitated the movement of goods and people, leading to the establishment of processing plants and factories along the rail lines. Around the turn of the century, the Russian River developed as a vacation resort, a destination for those in the San Francisco Bay Area. During this time, Santa Rosa saw an increase in population and importance as the center of finance and county government. Until World War II, the poultry industry, the processing of local fruit, and the production of hops sustained the economy throughout the county. In 1935, Sonoma County ranked tenth in the nation in overall agricultural production.

Today the southwestern part of the county continues to support cattle grazing and dairy farms. Toward the north, many of the ranches and orchards have been replaced with acres of vineyards and thriving winery operations. Over the years many of the poultry farms, fruit growers, and dairy operations have relocated to the Central Valley. In their place, small specialty farms and ranches now operate sustainable and organic endeavors. Dotting the countryside throughout the county are modern residences where rural homesteads used to be. The Russian River area still caters to vacationers. The cities along the freeway continue to expand to provide housing and services with new subdivisions, business parks, and strip-mall shopping centers.

3.6 PHYSICAL SETTING

3.6.1 Water Resources

Sonoma County is on the Pacific Ocean, north of San Francisco Bay. The county contains numerous watersheds, but the Russian River is the largest and most significant, draining over 1,485 square miles as it flows south from Mendocino County to the Pacific Ocean. The Russian River is the primary water supply and a key attraction to many communities along its banks. It flows southeast from Mendocino County through the north-central half of Sonoma County and then turns west a few miles south of Healdsburg. After passing through the large resort and recreational areas surrounding Guerneville and Monte Rio, the river empties into the Pacific Ocean.

Santa Rosa lies in the county's central valley near the junction of the Matanzas and Santa Rosa Creeks, which flow to the west from hills that surround a large central valley (U.S. Soil Conservation Service 1972). The Petaluma River connects to San Pablo Bay and thence to the San Francisco Bay in the south. Lake Sonoma is a dam-created reservoir on Dry Creek in the northwest part of the county. Tidal flats reclaimed from the San Pablo Bay are at the lower ends of Sonoma and Petaluma Valleys and the Petaluma plains area.

Natural floodplains are part of the hydrological process, where overflowing flood waters can relieve some of the flood pressure on downstream areas while depositing silt. Areas of the Alexander Valley and the Middle Russian River, from Cloverdale to Windsor, have broad agricultural plains that can temporally store flood water when the river channel overflows.

The Laguna de Santa Rosa in the Santa Rosa Plain is a natural overflow basin covering 254 square miles that connects Mark West Creek and other smaller creeks with the Russian River. Floods along the lower Russian River are attenuated by the Laguna de Santa Rosa. The Laguna de Santa Rosa serves as a natural detention basin that can lower the river's downstream flood levels by more than 10 feet. During floods, the Laguna de Santa Rosa acts as a huge reservoir, storing up to 80,000 acre-feet of water. With current deposition rates and population growth, the flood storage capacity of the Laguna de Santa Rosa may continue to decrease by 50 to 60 acre-feet per year. Projections for future sedimentation indicate that over the next 50 years, the flood elevation in the Laguna de Santa Rosa may increase by 2.5 to 3.0 feet.

3.6.2 Topography and Geology

Topography in the county is varied and includes mountainous areas, rolling hills, broad flat river valleys, and bay flats. The valleys and foothills are predominantly in agricultural uses with some urbanized areas and with a dense population.

In general, the northern half of the county is made up of small, rugged mountains that begin at the coast and rise to an elevation of 3,500 to 4,400 feet. The southwestern part of the County is generally low, rolling grassy hills at an elevation of 500 to 600 feet. The cities of Petaluma and Sonoma are in long narrow valleys in the southwestern and southeastern parts of the county, respectively. East of the Sonoma Plains and on both sides of the Sonoma Valley are grass-covered hills that rise to about 2,000 feet. The broad, flat Santa Rosa Plain, which lies between the Sonoma Mountains on the east and low coastal hills on the west, contains the cities of Santa Rosa, Rohnert Park, and Cotati.

The sparsely settled coastal area of the county includes redwood and mixed conifer forests in the north and rolling oak woodland, dairy lands, and coastal prairies in the south. The Mayacamas Range forms the eastern boundary of the county. The Mayacamas and Sonoma Mountain ranges enclose the Sonoma Valley or "Valley of the Moon," which extends from near Santa Rosa southeast to the City of Sonoma and San Pablo Bay. In the north, the Mayacamas Range and Mendocino Highlands surround the farming regions of Alexander and Dry Creek Valleys. In the far northeast, the remote interior of the Mayacamas Range contains the Geysers geothermal steam field.

3.6.3 Climate

Sonoma County's Mediterranean climate is characterized by a summer dry season followed by a winter rainy season, generally extending from November to April. Rainfall varies throughout the county from 70 to 20 inches annually in the north-central and the southeastern sections of the county, respectively. The quantity of rainfall increases with elevation, with the greatest precipitation occurring over the

highest ridges. The valleys, where most of the water users are located, receive considerably less rainfall, with some areas averaging just over 20 inches of precipitation annually.

In the Russian River Watershed, approximately 93 percent of the annual precipitation normally falls during the wet season, October to May, with a large percentage of the rainfall typically occurring during three or four major winter storms. These major storms often come in the form of an atmospheric river, the horizontal transport of large amounts of water vapor through the atmosphere along a narrow corridor. Atmospheric rivers can produce 30 to 50 percent of the region's annual precipitation in a matter of a few days.

Except for areas immediately along the coast, the weather from May through October is generally warm and dry during the day, with peak summer day temperatures of 80 °F to 100 °F, and relative humidity ranging between 20 and 35 percent. Gradient winds are generally out of the south/southwest at 5 to 10 mph, strengthening to 10 to 15 mph in late afternoon and diminishing by dark. Strong and dry northeast Santa Ana or Foehn winds often occur in the fall.

Coastal onshore flow, often accompanied by fog, frequently prevails after sunset, allowing for good nighttime relative humidity recovery in the warm inland areas. In the inland valleys, fog usually dissipates by 11:00 am. Fog in the county usually is seen at elevations between 1,000 and 1,500 feet. Elevations above this often do not experience fog or receive the same nighttime cooling and moisture recovery as lower elevations.

3.6.4 Vegetative Cover

Sonoma County's varied natural landscapes range from the marine environments of the coastal zone to the extensive forests, woodlands and grasslands of the Coast Range mountains and foothills to the vernal pools and freshwater marshes of the Santa Rosa Plain and other valley floors to the extensive marshlands along San Pablo Bay. Areas of natural vegetation support many native plant and animal species and encompass habitat for special status species, wetlands and sensitive natural communities. The vegetative cover also helps reduce surface runoff, protect water quality, maintain air quality, retain soil, increase recharge, and maintain stream channels. Sensitive natural communities identified in Sonoma County include coastal salt marsh, brackish water marsh, freshwater marsh, freshwater seeps, native grasslands, several types of forest and woodland (including riparian, valley oak, Oregon white oak, black oak, buckeye, Sargent cypress and pygmy cypress), old growth redwood and Douglas fir forest, mixed serpentine chaparral, and coastal scrub, prairie, bluff, and dunes. Many of these communities also support populations of special status species and are important to native wildlife.

Approximately 513,000 acres (about 50 percent of the County land area) in Sonoma County are devoted to forest and woodlands. These include 72,000 acres (7 percent) of conifer forest, 284,000 acres (28 percent) of hardwoods, and 157,000 acres (15 percent) of conifers mixed with hardwoods (Sonoma County General Plan 2016). These areas are often interspersed with grasslands, shrublands or agricultural lands and residences.

3.7 LAND USE

3.7.1 Current Land Use

The Sonoma County General Plan and Land Use Maps govern the types of land uses and development that may occur in different areas of the unincorporated county. Table 3-1 indicates the breakdown of land use as of the 2020 Land Use Element of the General Plan (amended in 2024). Current land use policies promote city and community centered growth and limit new development to levels consistent with adequate infrastructure and services, including public safety. Approximately half of the county is in rugged rural areas with limited access. Most of the development in these areas is limited to open space and timber/natural resource production. Current land uses in Sonoma County are shown on Figure 3-2.

Table 3-1. Sonoma County 2025 Land Use Classification

Category Description	Acreage	% of Total
Diverse Agriculture	66,820	7.1%
General Commercial	140	<0.1%
General Industrial	410	<0.1%
Limited Commercial	176,758	18.7%
Land Extensive Agriculture	70,120	7.4%
Limited Industrial	949	0.1%
Land Intensive Agriculture	1,733	0.2%
Public Facilities	59,656	6.3%
Rural Residential	2,420	0.3%
Resources and Rural Development	490,989	51.9%
Recreation and Visitor Serving Commercial	71,373	7.5%
Urban Residential	4,937	0.5%
Unincorporated Sonoma County (Total)	946,306	100.0%

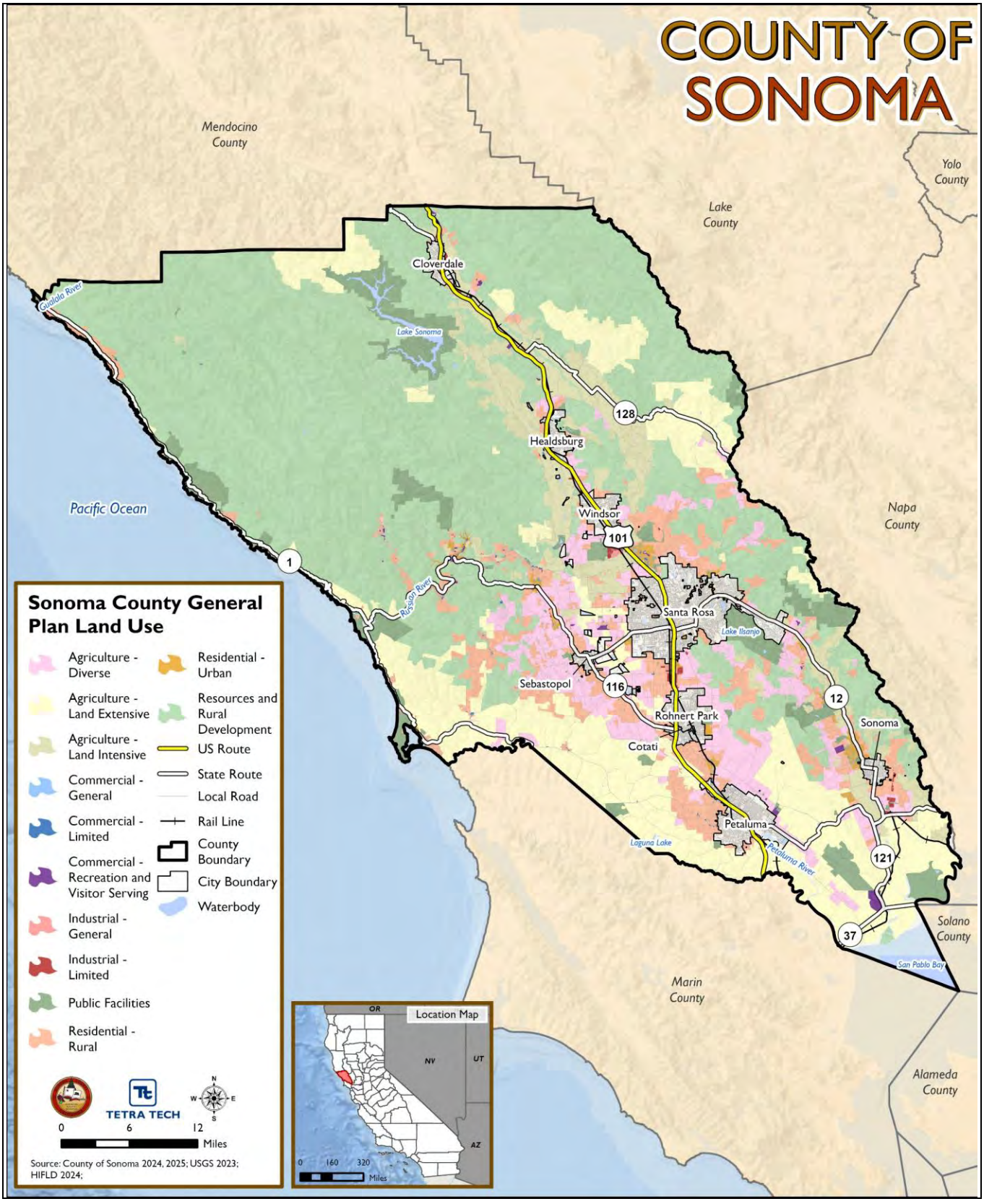
Source: County of Sonoma 2025

3.7.2 Land Use Trends

Land Use Planning

The municipal Planning Partners have adopted general plans that govern land use decision and policy making for their jurisdictions. Decisions on land use will be governed by these programs. This plan will work together with these programs to support wise land use in the future by providing vital information on the risk associated with natural hazards in the planning area. All municipal Planning Partners will incorporate this hazard mitigation plan update in their general plans by reference. This will ensure that future development trends can be informed by the information on risk and vulnerability to natural hazards identified in this plan. County land use policies help reduce the potential impact of new development on hazard vulnerability within the unincorporated areas of Sonoma County.

Figure 3-2. Sonoma County Land Use



Agriculture

Agriculture in Sonoma County has undergone significant changes in recent decades as expanding non-farm development put pressure on landowners for farmland conversion and profitability of certain agricultural markets decreased. According to the 2022 Census of Agriculture, the number of farms in Sonoma County has decreased 14 percent since 2017, total farmland is down18 percent, and the average size of each farm is down 5 percent.

The County has a well-developed fruit and vegetable production sector and is ranked 16th in the state for producing these commodities. Additionally, Sonoma County ranks second in the state, and 49th in the nation, for the value of its cultivated Christmas trees and short rotation woody crops sales.

3.8 POPULATION AND DEMOGRAPHICS

3.8.1 Current Population

Sonoma County is the 17th largest of California's 58 counties. The U.S. Census Bureau estimates the population at 485,642 as of 2024.

3.8.2 Population Trends

Population trends can provide a basis for making decisions on the type of mitigation approaches to consider and the locations in which these approaches should be applied. This information can also be used to support planning decisions regarding future development in vulnerable areas. Table 3-2 shows the population change in Sonoma County from 1960 to 2020. As seen in the table, Sonoma County's population has increased over most decades since 1960.

Table 3-2. Historical Population Change in Sonoma County

Jurisdiction	1960	1970	1980	1990	2000	2010	2020
Sonoma County	147,375	204,885	296,700	384,700	456,899	482,961	490,008
City of Cloverdale	2,848	3,251	3,989	4,890	6.697	8,594	9,026
City of Cotati	-	1,368	3,300	5,625	6,480	7,258	7,607
City of Healdsburg	4,816	5,438	7,250	9,475	10,896	11,249	11,325
City of Petaluma	14,035	24,870	33,350	42,800	53,896	57,791	59,988
City of Rohnert Park	-	6,133	22,450	36,000	42,209	40,952	44,098
City of Santa Rosa	31,027	50,006	82,300	112,200	146,871	167,302	178,484
City of Sebastopol	2,694	3,993	5,435	6,950	7,772	7,380	7,550
City of Sonoma	3,023	4,112	5,975	8,025	9,232	10,605	10,802
Town of Windsor	-	-	-	-	22,529	26,751	26,308

Source: California Department of Finance; (- = not yet incorporated as a municipality)

According to population projections by the California Department of Finance, Sonoma County's population should decrease to 472,108 by 2040. This represents a 3.8 percent decrease from the 2018 population. Table 3-3 shows the projected population change in Sonoma County through 2040.

Table 3-3. Projected Population Change in Sonoma County

1960	1970	1980	1990	2000	2010	2020	2030	2040
147,375	204,885	299,681	388,222	458,614	483,878	488,863	474,759	472,108

Source: California Department of Finance

3.8.3 Socially Vulnerable Populations

The capacity to anticipate, cope with, and adapt to a hazard is an important factor of vulnerability. This capacity can be affected by factors such as wealth, education, race, ethnicity, religion, gender, age, access and functional needs, and health status. Socially vulnerable populations are more susceptible to hazard events based on factors such as their physical and financial ability to react or respond during a hazard, and the location and construction quality of their housing.

The vulnerability of people and groups to hazard events is dynamic, varying with physical location as well as economic, social, geographic, demographic, cultural, institutional, governance, and environmental factors. These factors often overlap spatially, so spatial analysis to locate areas where there are higher concentrations of people experiencing different vulnerabilities can help to focus public outreach, education, and resources to these residents. Understanding communities' makeup and demographic changes over time is important to making decisions that may impact these communities future, such as land used decisions that affect housing, industry, stores, public facilities and services, and transportation.

Specific Causes of Vulnerability

Certain problems that are more common in old age can increase vulnerability. They include decreased strength, poor tolerance of physical activity, functional limitations, and decreased sensory awareness. The severity of the impact of disasters on older people depends on the specific characteristics of the elderly and their environments, the type and severity of the hazard, disaster management systems, and interactions between all of these (Pan American Health Organization 2012).

Children are vulnerable during natural disasters and experience increased problems regarding their physical health, mental health, and learning after exposure. Compared to adults, children suffer more severe physical effects from disasters because they breathe more air per pound of their weight, have thinner skin, are at greater risk in cases of fluid loss, and are more likely to lose body heat. Disasters also can harm children indirectly. When a disaster affects parents and other adults (such as teachers), children's care, protection, and support systems are eroded. Beyond the immediate trauma and harm caused by natural disaster exposure, children may suffer longer-term physical, psychological, and educational deficits (Society for Research in Child Development 2020).

People with disabilities are more likely than the general population to have difficulty responding to a disaster. Local government is the first level of response to assist these individuals, and coordination of efforts to meet their access and functional needs is paramount to life safety efforts. It is important for emergency managers to distinguish between functional and medical needs to plan for incidents that require evacuation and sheltering. Knowing the percentage of population with a disability will allow emergency management personnel and first responders to have personnel available to provide services needed by those with access and functional needs.

Households living in poverty have less time and resources to plan for and respond to hazards. Low-income households also typically occupy more poorly built and inadequately maintained housing. Mobile or modular homes, for example, are more susceptible to damage than other types of housing. In urban areas, families living in poverty often live in older houses and apartments, which are more likely to be made of a building type that is susceptible to earthquake damage. Residents below the poverty level are less likely to have insurance to compensate for losses from natural disasters, and federal aid is designed to restore property to owners, not renters (Howell and Elliott 2018). Personal household economics also significantly impact people's decisions on evacuation.

Research shows that communities of color are less likely to be involved in pre-disaster planning and experience higher mortality rates during a disaster event. Higher proportions of communities of color live below the poverty line than the white population, so these communities have fewer resources to prepare for disasters in advance or recover afterwards.

People experiencing homelessness are disproportionately vulnerable to natural disasters because they often lack safe, stable shelter and access to resources that can protect them during extreme events. Without secure housing, they are directly exposed to hazards such as extreme heat, cold, flooding, or wildfires. Limited access to transportation, communication tools, and emergency alerts can make it difficult to evacuate and seek timely assistance. Social and economic marginalization often means they are excluded from formal preparedness, response, and recovery systems, making it harder to recover and increasing the risk of long-term harm.

Socially Vulnerable Populations in Sonoma County

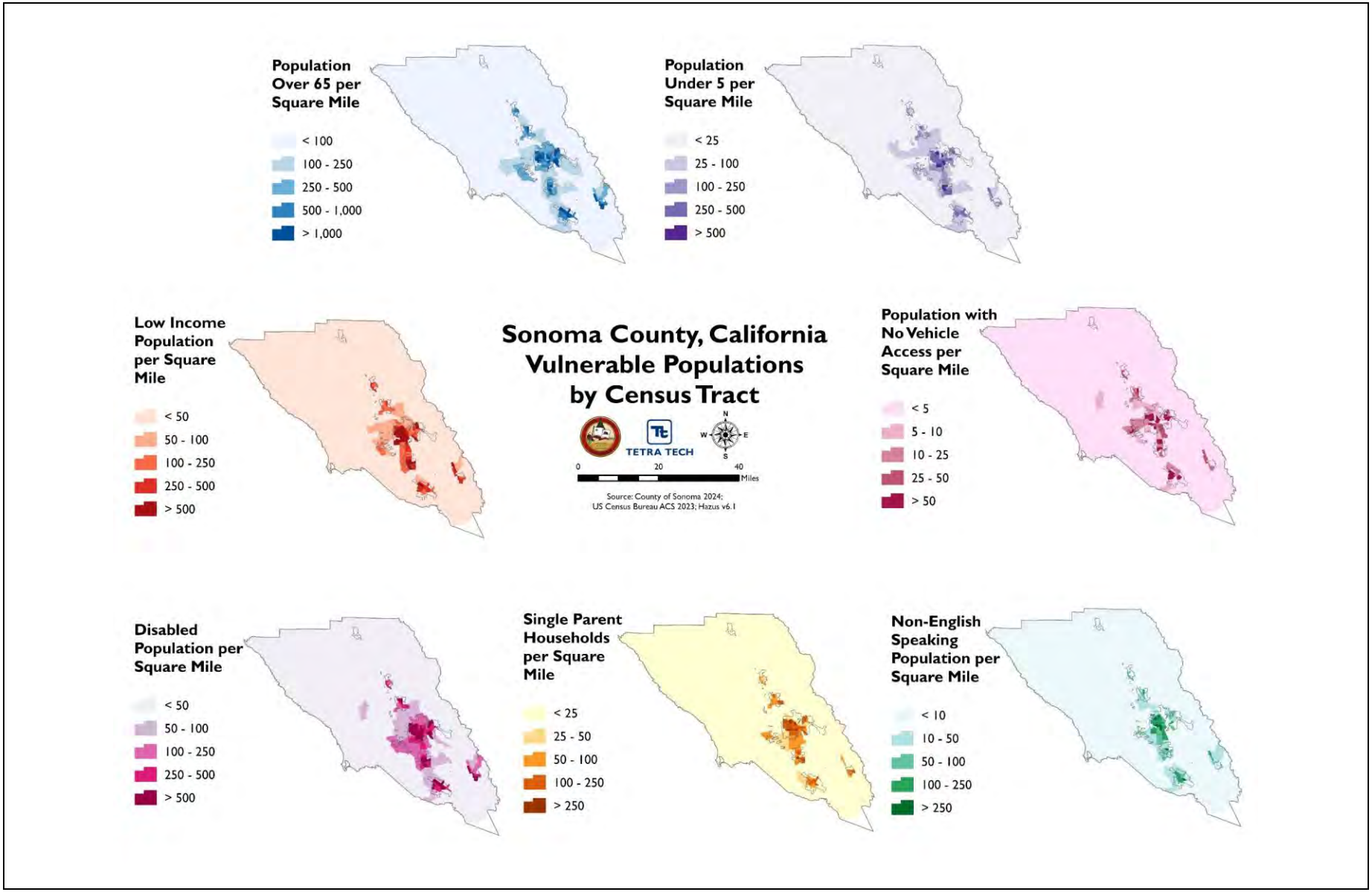
This HMP considers several socially vulnerable population groups: persons over the age of 65, persons under the age of 5, non-English speaking households, people with disabilities, people living below the poverty level (as defined by the U.S. Census Bureau), single-parent households, and people with no access to a vehicle. Refer to Table 3-4 for population statistics for these socially vulnerable populations, for each municipality in the County based on the 2023 U.S. Census Bureau, American Community Survey 5-year Population Estimates. The distributions of the general population density (persons per square mile) for these metrics of social vulnerability are shown in Figure 3-3.

Table 3-4. Sonoma County Demographic Statistics

Jurisdiction	Persons Over 65	% of Total	Persons Under 5	% of Total	Non-English Speaking Persons	% of Total	Persons with a Disability	% of Total	Persons in Poverty	% of Total	Single Parent Households	% of Total	No Vehicle Access	% of Total
City of Cloverdale	1,944	21.8%	216	2.4%	470	5.3%	949	10.6%	395	4.4%	147	1.6%	13	0.7%
City of Cotati	1,122	14.9%	402	5.3%	130	1.7%	821	10.9%	600	8.0%	228	3.0%	0	0.0%
City of Healdsburg	2,667	23.7%	601	5.3%	440	3.9%	1,099	9.7%	1,269	11.3%	247	2.2%	57	2.1%
City of Petaluma	12,647	21.3%	2,556	4.3%	2,308	3.9%	6,532	11.0%	3,619	6.1%	947	1.6%	744	5.9%
City of Rohnert Park	6,104	13.7%	2,680	6.0%	1,445	3.3%	4,893	11.0%	4,501	10.1%	851	1.9%	445	7.3%
City of Santa Rosa	32,980	18.6%	8,691	4.9%	9,700	5.5%	22,312	12.6%	16,620	9.4%	4,171	2.4%	2,021	6.1%
City of Sebastopol	1,970	26.4%	393	5.3%	238	3.2%	856	11.5%	612	8.2%	95	1.3%	115	5.8%
City of Sonoma	3,499	32.6%	328	3.1%	125	1.2%	1,792	16.7%	886	8.3%	218	2.0%	22	0.6%
Town of Windsor	4,471	17.1%	1,223	4.7%	735	2.8%	2,728	10.4%	1,223	4.7%	685	2.6%	163	3.6%
Unincorporated County	34,401	26.0%	5,747	4.3%	4,380	3.3%	16,154	12.2%	11,319	8.5%	2,216	1.7%	760	2.2%
Sonoma County (Total)	101,805	21.0%	22,837	4.7%	19,971	4.1%	58,136	12.0%	41,044	8.5%	9,805	2.0%	4,340	4.3%

Source: U.S. Census Bureau 2023 ACS Vulnerable Population Totals

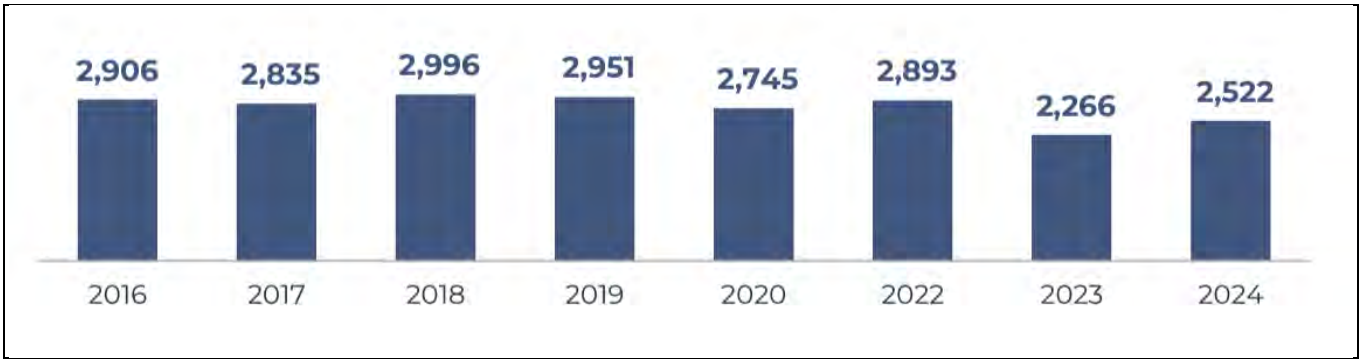
Figure 3-3. Sonoma County Vulnerable Populations by Census Tract



Twenty-one percent of the County's population is over the age of 65, and 4.7 percent of the population is under the age of 5. The 2023 ACS 5-year estimates indicate a total of 8.6 percent of all persons living in households that fall below the poverty level, 4.1 percent of the County's residents live in non-English speaking households, and 12 percent of the County's residents live with a disability. Single-parent households account for 2 percent of County households, and people with no access to a vehicle account for 4 percent of the County population.

The total number of persons experiencing homelessness in Sonoma County fluctuated from a high of 2,996 persons in 2018 to 2,522 persons in 2024, as displayed in Figure 3-4.

Figure 3-4. Total Number of Persons Experiencing Homelessness in Sonoma County, 2016-2024



Source: (SCHC 2024)

3.9 ECONOMY

3.9.1 Major Institutions

Sonoma county has the 17th largest gross domestic product in California, at about $31 billion (BEA 2024). According to the California Governor's Office of Business and Economic Development (GO-Biz), more than 31,000 large and small businesses call Sonoma County home, employing 219,290 workers (GO-Biz 2024). Eight establishments employ more than 1,000 workers and 16 establishments employ 500 to 999 workers. However, the majority of the county's establishments employ just 1 to 4 people, as displayed in Table 3-5.

Sonoma County is home to a diverse array of industries, including strong manufacturing and retail markets. Wholesalers contribute the most to the county's economy, with more than $10 billion in sales annually. Table 3-6 displays the number of businesses, sales, and employees by industry in Sonoma County. More than 219,000 people are employed in Sonoma County.

Table 3-7 lists the top 25 employers in Sonoma County as identified by the California Employment Development Department. Half of the establishments (13) are located in the City of Santa Rosa. Eight establishments are government services, five are related to food community lifeline, and four are related to the health and medical community lifeline.

Table 3-5. Number of Establishments in Sonoma County by Number of Employees

Number of Employees	Establishments	Percent
1-4 Employees	15,663	67.89
5-9 Employees	4,099	17.77
10-19 Employees	1,926	8.35
20-49 Employees	818	3.55
50-99 Employees	375	1.63
100-249 Employees	139	0.6
250-499 Employees	28	0.12
500-999 Employees	16	0.07
1000+ Employees	8	0.03

Source: (GO-Biz 2024)

Table 3-6 Industries in Sonoma County

Industry	Number of Establishments	Percent	Sales	Employees
Accommodation and Food Services	1,757	5.65%	$1,249,171,000	20,890
Administrative and Support; Waste Management; and Remediation Services	1,014	3.26%	$640,537,000	6,641
Agriculture, Forestry, Fishing and Hunting	532	1.71%	$392,369,000	3,236
Arts, Sports, Entertainment, and Recreation	641	2.06%	$270,251,000	4,744
Banking, Finance and Insurance	1,253	4.03%	$1,752,605,000	7,429
Construction	2,256	7.26%	$2,200,605,000	13,561
Education	605	1.95%	$57,548,000	12,761
Health Care and Social Services	6,555	21.09%	$2,917,522,000	29,570
Holding Companies and Managing Offices	53	0.17%	$84,451,000	197
Information	511	1.64%	$867,392,000	4,739
Manufacturing—Chemical, Fuel, Paper, Plastic, Wood	164	0.53%	$302,283,000	1,745
Manufacturing—Electronics, Furniture, Machinery, Metal, Transportation, Misc.	418	1.35%	$1,199,705,000	9,469
Manufacturing—Processed Food, Textiles, Clothing	872	2.81%	$3,263,947,000	11,859
Mineral, Oil and Gas Extraction	29	0.09%	$64,137,000	279
Other Services—Repair, Personal Care, Laundry, Religious, etc.	3,112	10.01%	$746,296,000	14,464
Professional, Scientific, and Technical Services	3,096	9.96%	$1,562,431,000	13,544
Public Administration	571	1.84%	$29,878,000	13,690
Real Estate and Rentals	1,253	4.03%	$1,079,140,000	6,975
Retail: Hobby, Media, General Merchandise	1,856	5.97%	$2,997,129,000	12,452
Retail: Home, Food, Automobiles, Personal Care	1,523	4.90%	$4,579,754,000	16,565

Industry	Number of Establishments	Percent	Sales	Employees
Transportation and Warehousing: Couriers and Messengers, Warehousing and Storage	86	0.28%	$17,800,000	814
Transportation and Warehousing: Private and Public Transportation, Oil and Gas Pipelines, Sightseeing	300	0.97%	$447,269,000	3,706
Unclassified	1,849	5.95%	$23,468,000	730
Utility Services: Power, Gas, Steam, Water, and Sewage	47	0.15%	$139,720,000	360
Wholesalers	723	2.33%	$10,900,390,000	8,870
Total	31,076	100.00%	$37,785,798,000	219,290

Source: (GO-Biz 2024)

Table 3-7 Top 25 Employers in Sonoma County

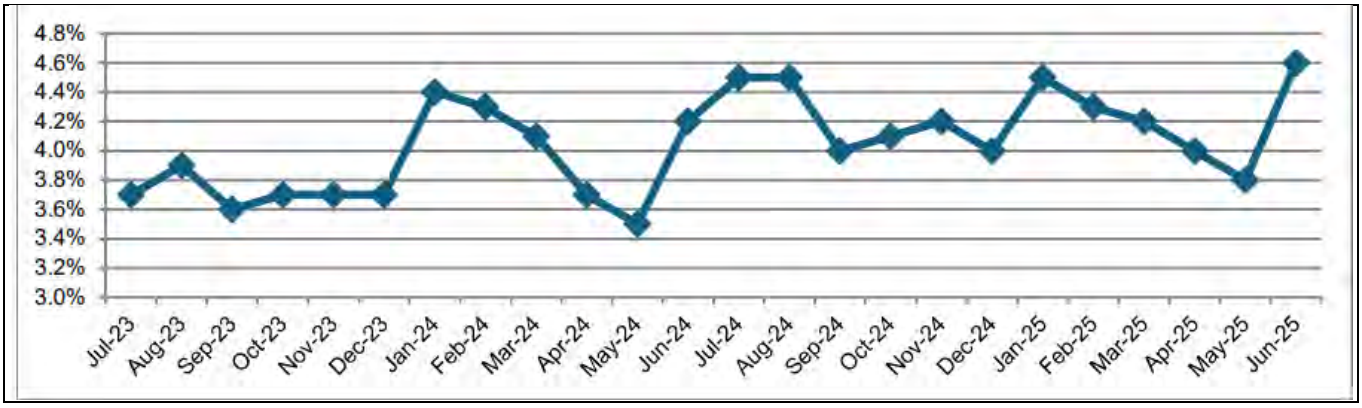
Employer Name	Location	Industry
Aabalat Fine & Rare Wines	Petaluma	Wineries
Amy's Kitchen Inc	Santa Rosa	Frozen Food Processors
Army National Guard Recruiter	Santa Rosa	Government Offices-State
Clover Sonoma	Petaluma	Dry Condensed/Evprtd Dairy Prod
Coast Guard Training Ctr	Petaluma	Federal Government-National Security
County-Sonoma Transit	Countywide	Transportation
Fairmont Sonoma Msn Inn & Spa	Sonoma	Hotels & Motels
First Security Svc	Rohnert Park	Security Guard & Patrol Service
Freeman Toyota	Santa Rosa	Automobile Dealers-New Cars
Ghilotti Construction Co	Santa Rosa	Road Building Contractors
H2Hotel	Healdsburg	Hotels & Motels
Macy's	Santa Rosa	Department Stores
Medtronic	Santa Rosa	Physicians & Surgeons Equip & Supplies
Petaluma Valley Hospital	Petaluma	Hospitals
Protransport-1	Cotati	Transportation Services
Providence Santa Rosa Mem'l Hospital	Santa Rosa	Hospitals
Santa Rosa Police Dept	Santa Rosa	Police Departments
Solairus Aviation LLC	Petaluma	Aircraft Charter Rental & Leasing Svc
Sonoma Water	Santa Rosa	Water Companies-Bottled/Bulk
Sonoma County Office of Education	Santa Rosa	County Government-Education
Sonoma County Sheriff	Santa Rosa	Government Offices-County
Stockham Construction Inc	Cotati	General Contractors
Sutter Santa Rosa Regional Hospital	Santa Rosa	Hospitals
Walmart	Windsor	Department Stores
Walmart	Rohnert Park	Department Stores

Source: (EDD 2024)

3.9.2 Employment

Figure 3-5 shows Sonoma County's unemployment rate since summer of 2023. In June 2025, Sonoma County's unemployment rate reached 4.6 percent, an increase from 3.8 percent in May 2025 and higher than the 4.2 percent recorded in June 2024. During the same period, California's unadjusted unemployment rate was 5.7 percent, while the national rate stood at 4.4 percent (EDD 2024)

Figure 3-5. Unemployment Rate in Sonoma County, 2023-2025



Source: (EDD 2024)

3.9.3 Income

Based on U.S. Census Bureau estimates, per capita income in the planning area between 2019 and 2023 was $54,941, and the median income of all households was $102,840. The median household income in Sonoma County in 2024 was $105,848 and that amount is estimated to rise to $109,848 in 2029 (GO-Biz 2024). Table 3-8 displays the household income distribution in Sonoma County.

Table 3-9 shows the median annual wage across industries in Sonoma County. Healthcare occupations have the highest median wage, whereas farming, fishing, and forestry occupations have the lowest median wage.

The Census estimates that 9.1 percent of all families in the planning area have incomes below the poverty level. To analyze the hazard exposure of socially vulnerable populations, the risk assessment in this hazard mitigation plan identified low-income households as follows:

- County data for 2021 show "low income" (defined as 80 percent of the area median income) as $74,450 for two-person households and $83,750 for three-person households (County of Sonoma 2021).
- The U.S. Census shows an average of 2.6 persons per household in Sonoma County
- The Hazus model used for risk assessment allows analysis of households by income at four levels: $50,000, $60,000, $75,000, or $100,000.
- The $75,000 household income level was chosen as closest to the low-income level for the average Sonoma County household size.

Table 3-8 Household Income Distribution in Sonoma County

	Number of Households	Percent
<$10 K	8,229	4.29%
$10-$20K	7,814	4.08%
$20-$30K	8,547	4.46%
$30-$40K	9,627	5.02%
$40-$50K	10,078	5.26%
$50-$60K	8,798	4.59%
$60-$75K	14,830	7.74%
$75-$100K	23,328	12.17%
> $100K	100,372	52.38%

Source: (GO-Biz 2024)

Table 3-9 Median Annual Wages in Sonoma County

	Median Annual Wage
Management Occupations	$105,358
Business and Financial Operations Occupations	$84,005
Computer and Mathematical Occupations	$103,091
Architecture and Engineering Occupations	$101,091
Life, Physical, and Social Science Occupations	$80,800
Community and Social Service Occupations	$60,571
Legal Occupations	$108,775
Education, Training, and Library Occupations	$68,510
Arts, Design, Entertainment, Sports, and Media Occupations	$56,096
Healthcare Practitioners and Technical Occupations	$119,184
Healthcare Support Occupations	$38,874
Protective Service Occupations	$57,072
Food Preparation and Serving Related Occupations	$37,355
Building and Grounds Cleaning and Maintenance Occupations	$40,133
Personal Care and Service Occupations	$37,856
Sales and Related Occupations	$43,340
Office and Administrative Support Occupations	$51,098
Farming, Fishing, and Forestry Occupations	$36,368
Construction and Extraction Occupations	$65,926
Installation, Maintenance, and Repair Occupations	$61,991
Production Occupations	$48,135
Transportation and Material Moving Occupations	$44,352
Military-only occupations	$36,728

Source: (GO-Biz 2024)

3.9.4 Economic Trends

Sonoma County's economy is developing into a more diverse economy focused on high-technology industry, education, health care, and a growing small and mid-sized business sector. This transformation reflects the national trend from manufacturing. Locally, significant losses in manufacturing have been offset by gains in other sectors, particularly education and financial activities.

The educational services sector and financial activities sector in the region grew between 2001 and 2020 (37 percent and 29 percent, respectively), while jobs in the manufacturing and information sectors declined (39 percent and 51 percent, respectively).

The U.S. Census estimates a civilian labor force in Sonoma County of 268,068. According to the American Community Survey, about 65 percent of the planning area's working-age population (16 and over) is in the labor force. California's and Sonoma County's unemployment trends were compared from 2010 through July 2021. The county and state rates both declined steadily after the 2008-2009 recession until the COVID pandemic in spring of 2020. Although both rates have fallen sharply since the pandemic peak, neither has yet returned to pre-pandemic levels.

3.10 GENERAL BUILDING STOCK

3.10.1 Existing Development

For this plan, 25,224 structures were identified from available tax data and spatial data. These structures account for an estimated replacement cost value (RCV) of $30.8 billion. Content value was estimated as 50 percent of the structure's replacement cost value for residential properties, and 100 percent of the structure's replacement cost value for non-residential properties. Table 3-10 reflects the values of the total replacement cost value in Sonoma County. Figure 3-6 through Figure 3-8 show the distribution of building stock and value density for residential, commercial, and industrial buildings.

Table 3-10 Building Stock Count and Replacement Cost Value (RCV) by Occupancy Type

	Count	Total RCV	Count	Total RCV	Count	Total RCV	Count	Total RCV
City of Cloverdale	2,944	$2,923,439,801	1,307	$838,888,582	70	$223,151,603	71	$201,303,810
City of Cotati	2,169	$2,198,253,443	1,194	$1,030,473,682	51	$259,843,606	39	$66,289,708
City of Healdsburg	4,125	$4,257,777,805	2,420	$2,259,883,168	159	$676,133,903	68	$340,882,939
City of Petaluma	18,768	$20,297,476,387	6,746	$7,316,890,498	296	$2,720,382,390	247	$1,158,043,285
City of Rohnert Park	11,613	$13,637,405,340	2,572	$3,472,430,263	72	$1,119,098,766	96	$457,718,796
City of Santa Rosa	49,869	$53,597,895,038	19,381	$20,316,378,754	432	$2,807,933,954	618	$3,985,288,023
City of Sebastopol	2,533	$2,361,116,785	1,495	$1,484,107,972	15	$44,444,366	59	$234,298,605
City of Sonoma	4,179	$4,729,951,132	1,954	$1,981,531,184	23	$155,685,280	85	$369,875,745
Town of Windsor	8,355	$9,027,725,514	3,043	$2,201,892,916	200	$1,012,703,204	141	$439,509,902
Unincorporated County	48,758	$52,903,520,693	74,284	$33,118,396,146	3,247	$10,654,911,083	23,800	$23,514,200,027
Sonoma County (Total)	153,313	$165,934,561,938	114,396	$74,020,873,165	4,565	$19,674,288,154	25,224	$30,767,410,840

Source: County of Sonoma 2025; LA City Planning 2020; RS Means 2024

a. Other = Government, Religion, Agricultural, and Education

Figure 3-6. Residential Building Stock Value Density in Sonoma County

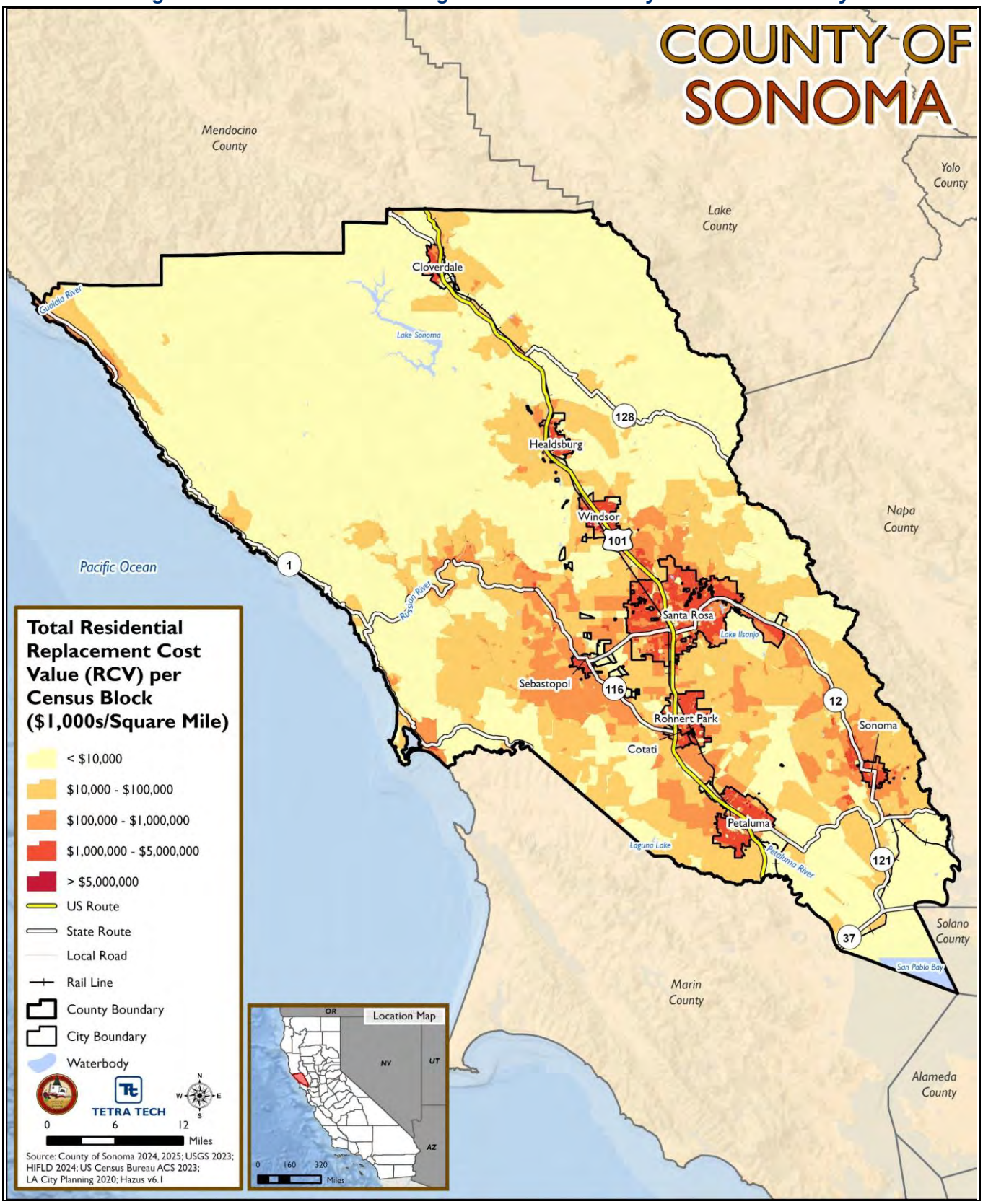


Figure 3-7. Commercial Building Stock Value Density in Sonoma County

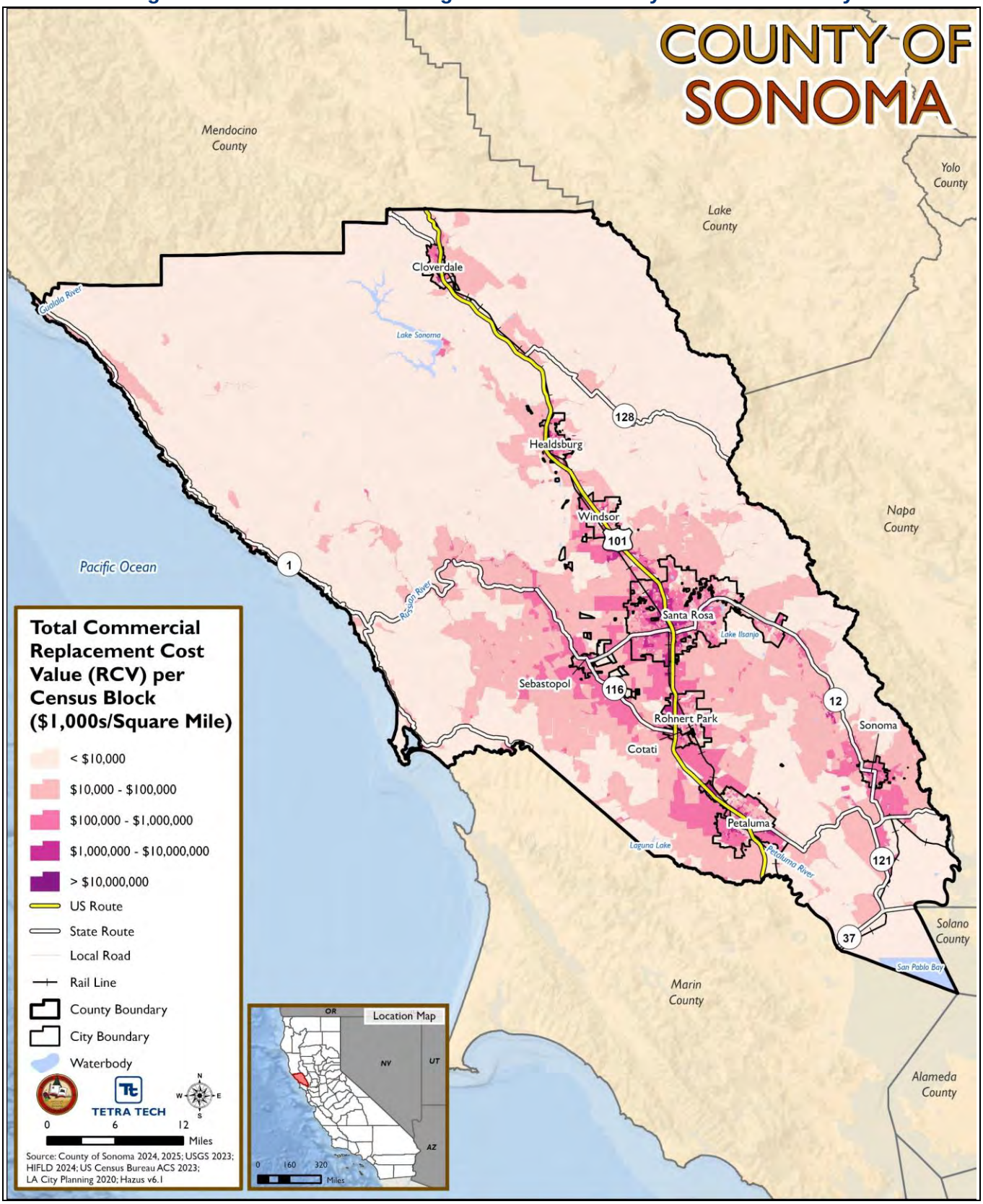
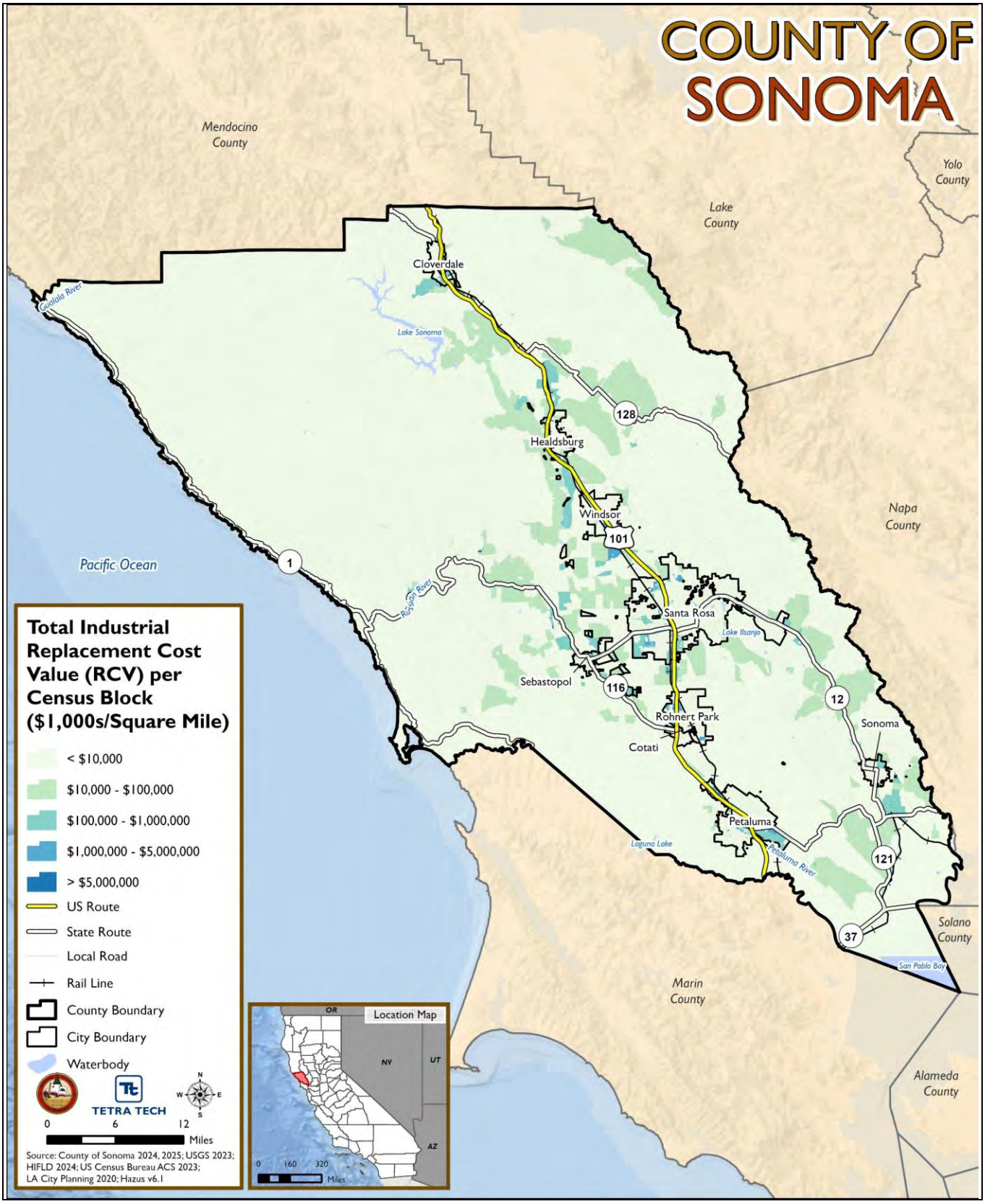


Figure 3-8. Industrial Building Stock Value Density in Sonoma County



3.10.2 New Development

Trends and Projections

For new development, the County uses best available data to avoid potential exposure of development to hazard events where possible. Sonoma County was in the process of updating its General Plan at the time of this hazard mitigation plan update. The following development trends from the previous General Plan (Sonoma County General Plan 2020) are likely to change when the General Plan update will have been completed:

- The number of housing units increased by 21,419 units between 2000 and 2010, with 16.6 percent of the increase in unincorporated county areas.
- Household growth was projected to grow about 38,490 units between 2000 and 2020, an average of 1,920 households per year.
- About 80 percent of 2000 – 2020 projected growth was expected to occur within city urban service areas, with the remainder in unincorporated areas outside of the cities.

Over the past five years, Sonoma County has experienced a moderate level of new development, primarily focused on residential housing, mixed-use projects, and infrastructure improvements to support population growth and economic vitality. Development has been concentrated in urban and suburban areas, with an emphasis on infill projects and some expansion into previously undeveloped lands, including wildland-urban interface zones.

Some new developments have occurred in areas with elevated natural hazard risk, particularly in wildland-urban interface zones prone to wildfires and in flood-prone riparian corridors. These developments potentially increase exposure to hazards. Any future developments that involve expansion into undeveloped or environmentally sensitive areas could elevate the overall risk profile of the county if not carefully managed with stringent hazard mitigation strategies.

Mitigation Measures for Development

The County intends to discourage development within vulnerable areas, areas with high population density, and the Special Flood Hazard Area, while encouraging higher regulatory standards at the local level. Stricter building codes and enhanced mitigation measures have been implemented in the County, leading to decreased vulnerability of structures to some natural hazards:

- Many recent developments have incorporated defensible space requirements and fire-resistant building materials, which have contributed to improved resilience to wildfire.
- New developments in flood-prone areas have been subject to stricter compliance with National Flood Insurance Program (NFIP) standards, including elevation of structures above the base flood elevation, use of flood-resistant materials, and incorporation of adequate drainage and stormwater management systems. These measures help mitigate flood damage and support community eligibility for NFIP flood insurance and federal disaster assistance.

Additionally, the county has worked to update floodplain maps and incorporate the latest flood risk data into planning processes, consistent with NFIP's Community Rating System (CRS) incentives. This has

encouraged developments that avoid or minimize encroachment into floodways and floodplains, thus reducing flood hazard exposure.

While hazard mitigation practices have generally improved and reduced risk in many new developments over the past five years, certain expansions into higher-risk areas have maintained or slightly increased the overall natural hazard exposure in Sonoma County. Continued vigilance in planning, enforcement of hazard-resistant building standards, and integration of hazard mitigation into land-use decisions will be essential to manage and reduce these risks going forward.

3.10.3 Repetitive Loss Properties

The Open FEMA NFIP Multiple Loss Properties dataset provides information on structures that have had multiple NFIP claims across the history of the program. The structures are defined in the following categories of repetitive loss:

- **NFIP Definition of Repetitive Loss**—The NFIP defines a repetitive loss property as any insurable building for which two or more claims of more than $1,000 were paid by the NFIP within any rolling 10-year period since 1978.
- **FMA Definition of Repetitive Loss**—FEMA's Flood Mitigation Assistance (FMA) program defines a repetitive loss property as any insurable building that has incurred flood-related damage on two occasions, in which the cost of the repair, on average, equaled or exceeded 25 percent of the market value of the structure at the time of each such flood event.
- **NFIP Definition of Severe Repetitive Loss**—A residential property covered under an NFIP flood insurance policy and: (a) That has at least four NFIP claim payments over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or (b) For which at least two separate claims payments have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building. In both instances, at least two of the claims must be within 10 years of each other, and claims made within 10 days of each other will be counted as one claim.
- **FMA Definition of Severe Repetitive Loss**—An NFIP-Insured structure that has incurred flood-related damage for which four or more separate claims payments have been made, with the amount of each claim (including building and contents payments) exceeding $5,000; or for which at least two separate claims payments (building payments only) have been made under such coverage, with the cumulative amount of such claims exceeding the market value of the building.

Table 3-11 shows the repetitive loss and severe repetitive loss properties Sonoma County. Individual jurisdictions' repetitive loss figures are presented in the jurisdictional annexes in Volume II.

Table 3-11. Repetitive Loss in Sonoma County

Type of Repetitive Loss		
Repetitive Loss Properties (FMA definition)	54	24
Severe Repetitive Loss Properties (FMA definition)	243	46

Source: (FEMA 2024)

3.11 COMMUNITY LIFELINES AND OTHER CRITICAL FACILITIES

Facilities that are essential to the health and welfare of the population and that maintain essential and emergency functions are designated as critical facilities. These typically include police and fire stations, schools, emergency operations centers, and infrastructure such as roads, bridges and utilities that provide water, electricity, and communications. Facilities that use or store hazardous materials are designated as critical facilities as well. All of these facilities are especially important after any hazard event (FEMA 1997).

FEMA defines some types of critical facilities, as well as public services or activities, as “community lifelines.” Community lifelines provide the fundamental services in a community that, when stabilized, enable all other aspects of society. Following a disaster event, intervention is required to stabilize lifelines. FEMA defines eight categories of community lifelines as summarized in Table 3-12.

A comprehensive inventory of community lifelines in Sonoma County was developed from various sources, including input from the HMWG and Planning Partnership. The following sections describe the inventory of community lifelines that was used for the risk assessment in this HMP. Although many lifeline facilities could fall within numerous categories, each lifeline facility identified for this planning effort was categorized according to its primary function.

Table 3-12. FEMA-Defined Categories of Community Lifelines

Community Lifeline Icon	Community Lifeline Category	Types of Facilities and Services Included
	**Safety and security**	Law enforcement/security, fire service, search and rescue, government service, community safety
	**Food, hydration, shelter**	Food, hydration, 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 materials**	Facilities, hazmat, pollutants, contaminants
	**Water systems**	Potable water infrastructure, wastewater management

Source: FEMA 2023

3.11.1 Safety and Security

Key facilities and services considered for the inventory under the safety and security category include:

- Schools
- Dams
- Emergency operations centers
- Fire stations
- Government buildings
- Municipal halls
- Police stations
- Post offices
- Public works facilities

Figure 3-9 shows the location of safety and security facilities included in the lifelines inventory for this HMP. The inventory includes 492 of these facilities.

3.11.2 Food, Hydration, Shelter

Key facilities and services considered for the inventory under the food, hydration, and shelter category include:

- Food distribution programs
- Emergency shelters

Figure 3-10 shows the location of food, hydration, and shelter facilities included in the lifelines inventory for this HMP. The inventory includes 167 of these facilities.

3.11.3 Health and Medical

Key facilities and services considered for the inventory under the health and medical category include:

- Emergency medical services
- Hospitals
- Medical centers
- Skilled nursing centers
- Urgent care
- Veterinarians

Figure 3-11 shows the location of health and medical facilities included in the lifelines inventory for this HMP. The inventory includes 182 of these facilities.

Figure 3-9. Safety and Security Facilities in Sonoma County

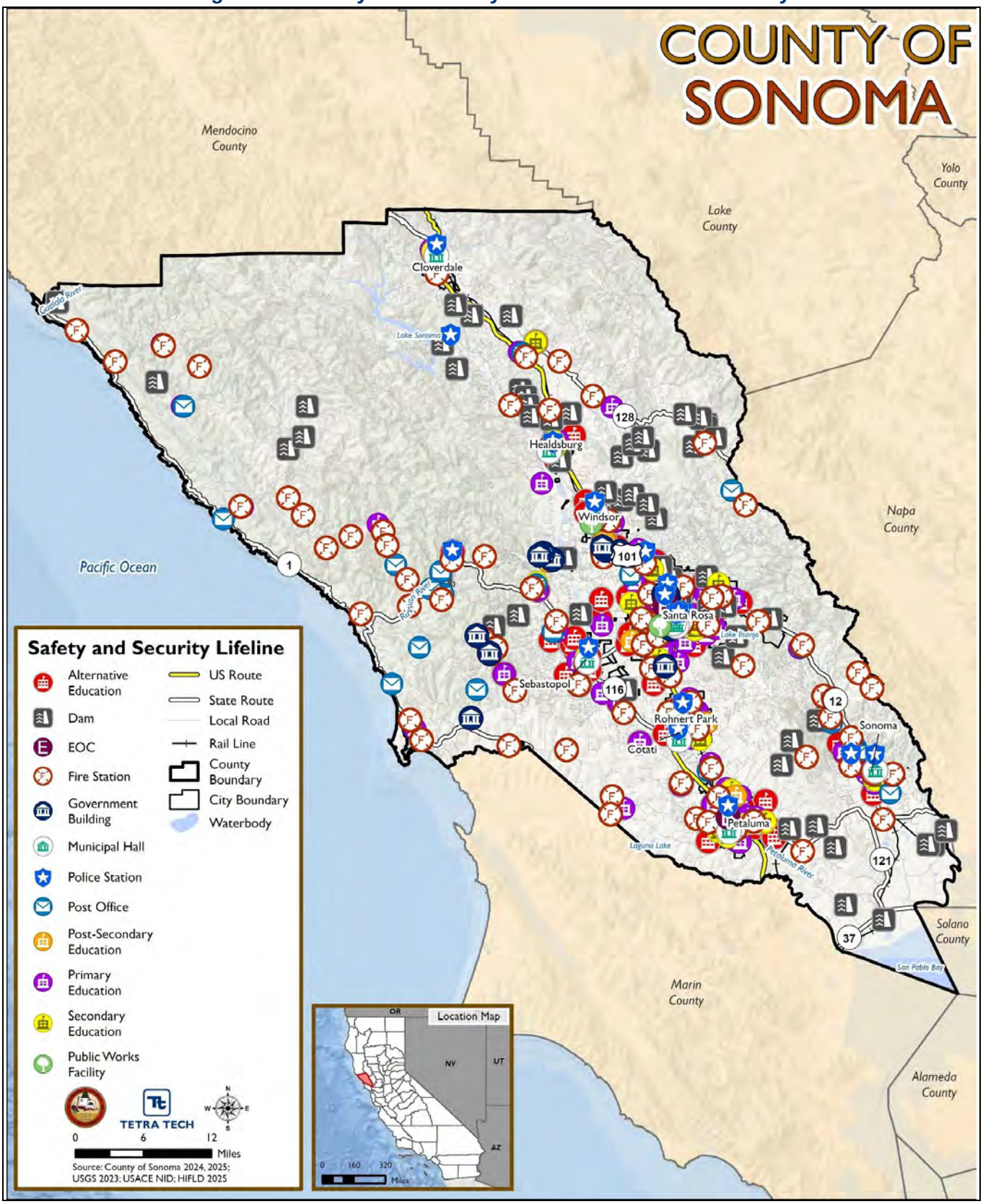


Figure 3-10. Food, Hydration, and Shelter Facilities in Sonoma County

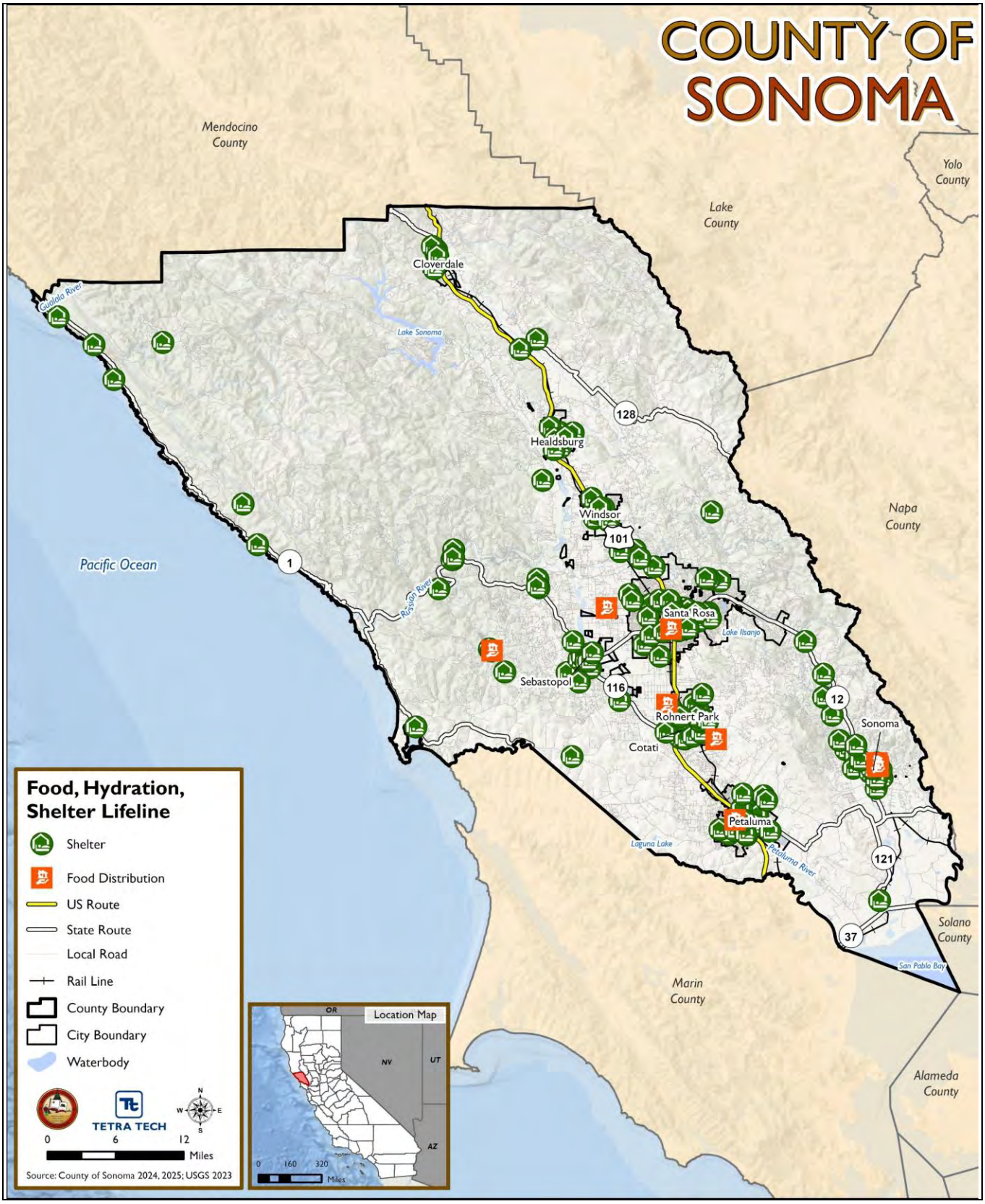
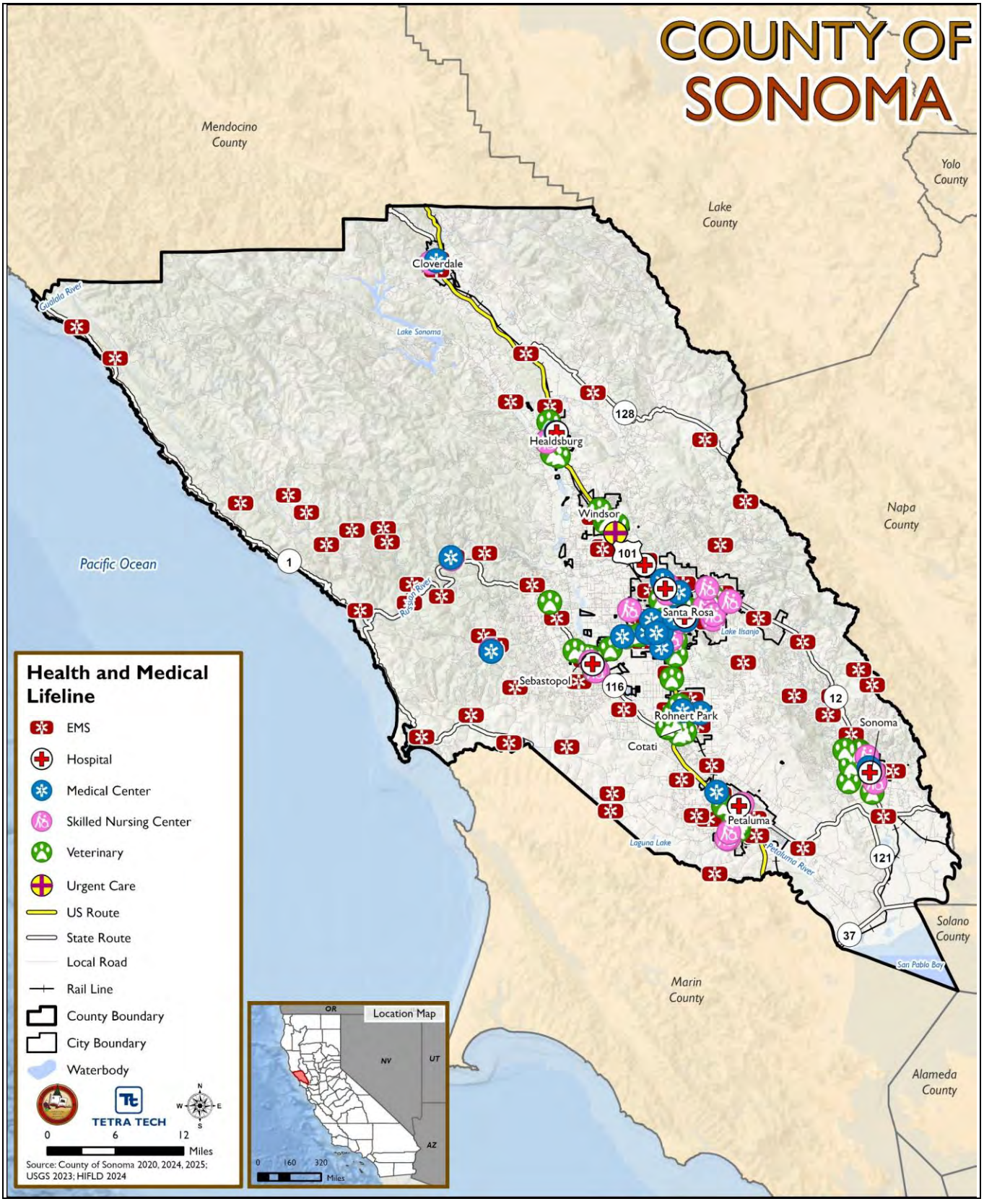


Figure 3-11. Health and Medical Facilities in Sonoma County



3.11.4 Energy

Key facilities and services considered for the inventory under the energy category include:

- Biomass plant
- Geothermal plant
- Hydroelectric plant
- Natural gas plant
- Solar power

Figure 3-12 shows the location of energy facilities included in the lifelines inventory for this HMP. The inventory includes 34 of these facilities.

3.11.5 Communications

Key facilities and services considered for the inventory under the communications category include:

- Bank
- Cellular tower
- Radio station
- Land mobile broadcast tower
- Microwave tower
- Radio repeater

Figure 3-13 shows the location of communications facilities included in the lifelines inventory for this HMP. The inventory includes 516 of these facilities.

3.11.6 Transportation

Key facilities and services considered for the inventory under the transportation category include:

- Airports
- Heliports
- Local bridges
- Ports
- Rail stations
- State highway bridges
- Transit operations center

Figure 3-14 shows the location of transportation facilities included in the lifelines inventory for this HMP. The inventory includes 664 of these facilities.

Figure 3-12. Energy Facilities in Sonoma County

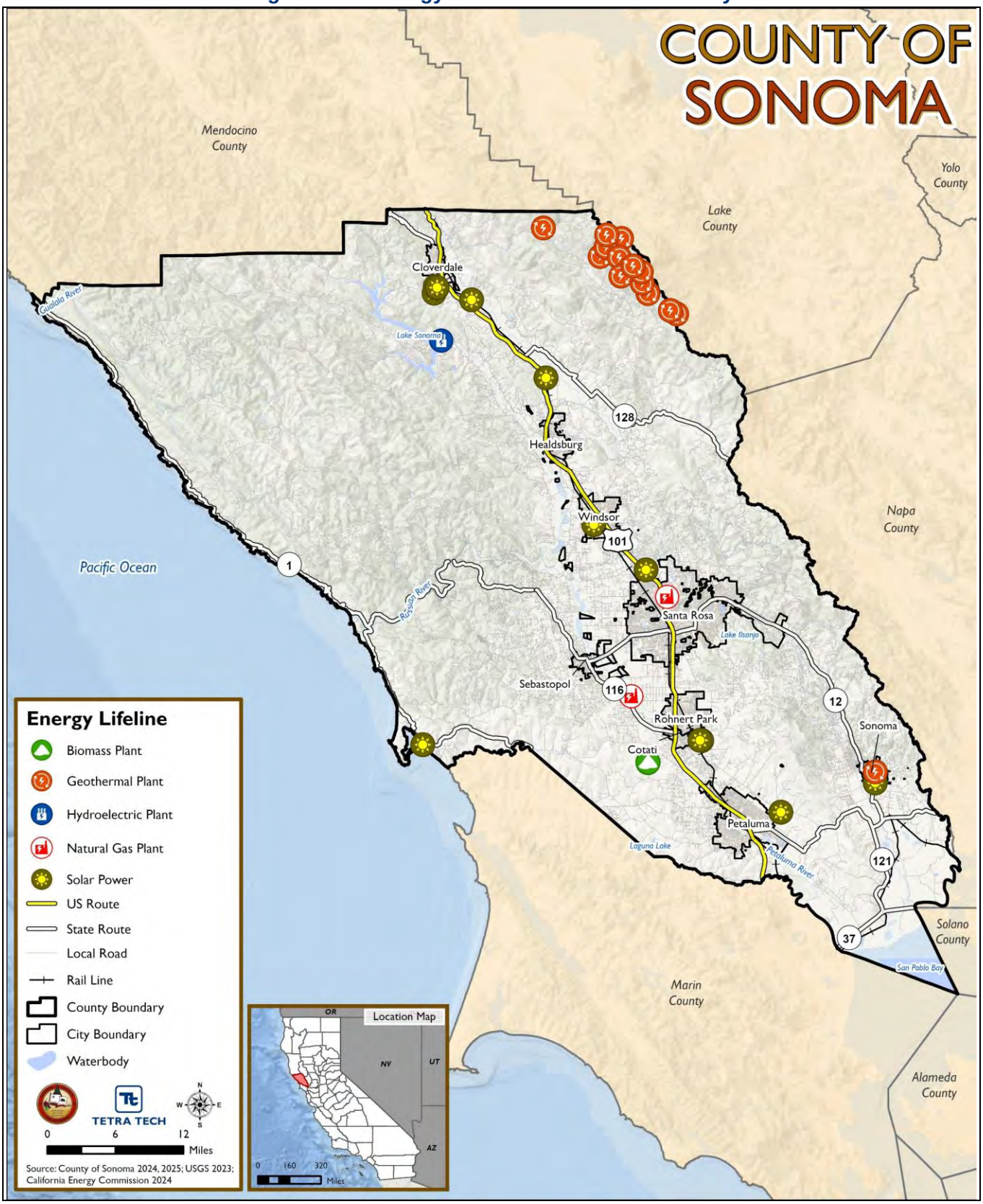


Figure 3-13. Communications Facilities in Sonoma County

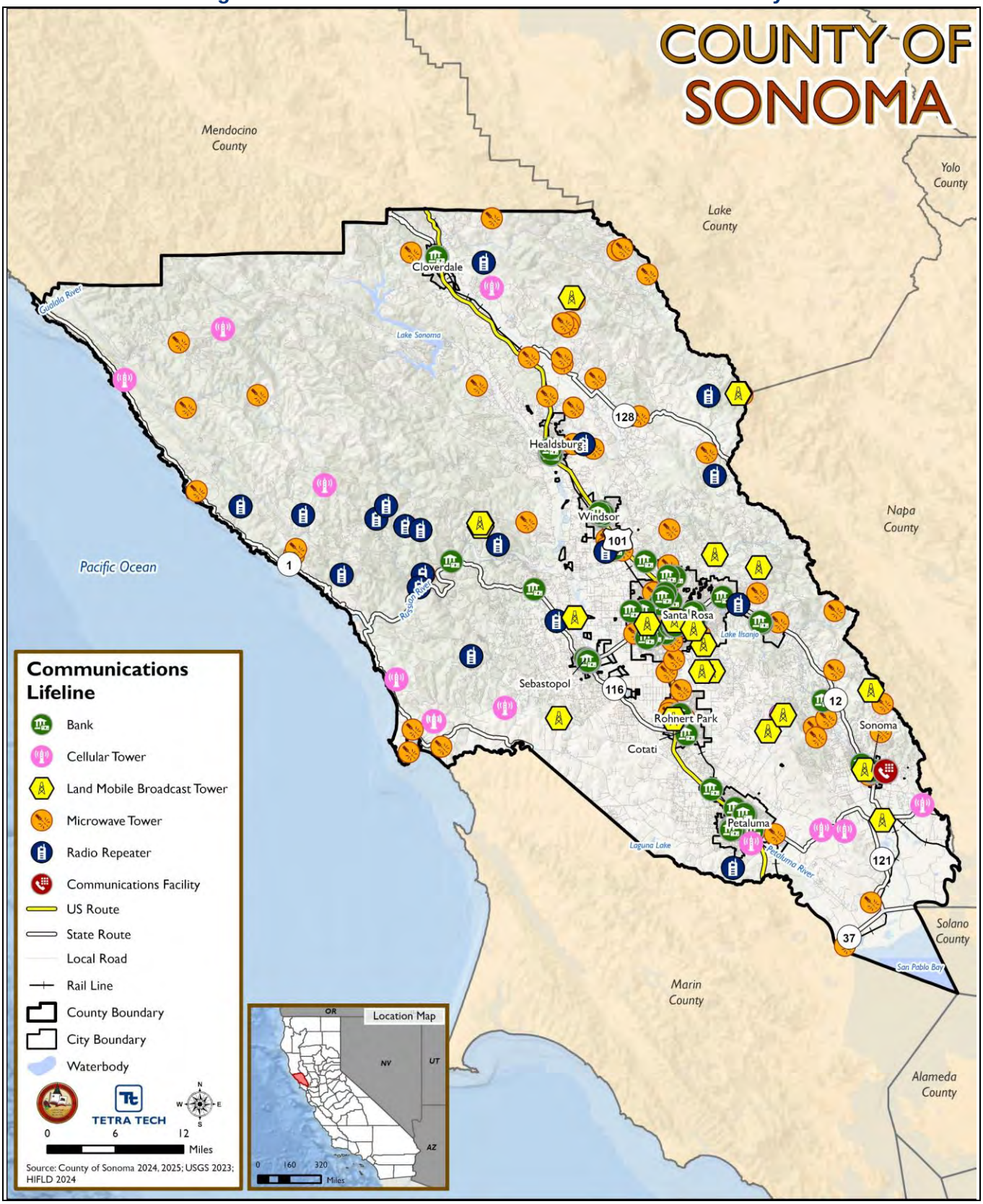
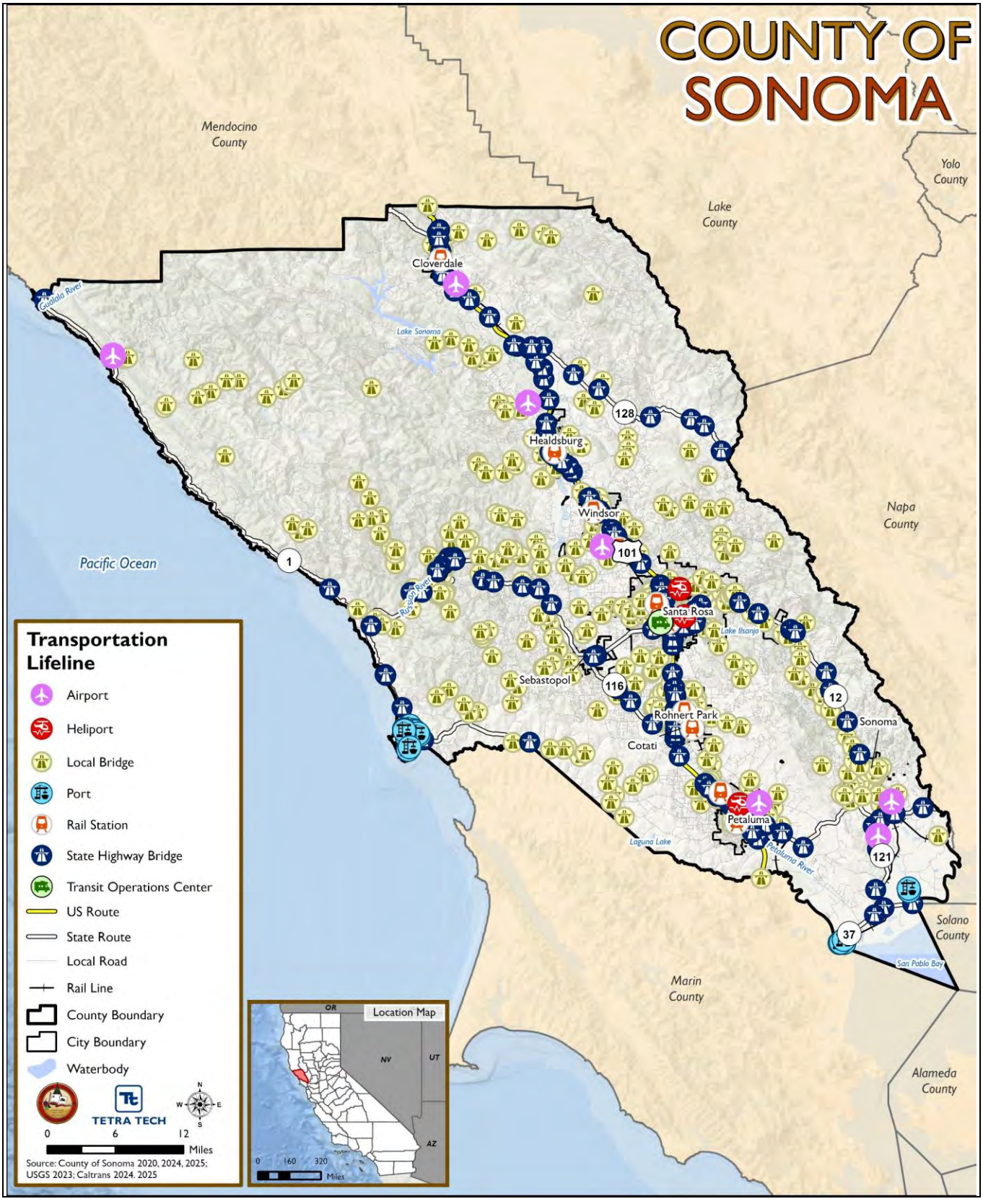


Figure 3-14. Transportation Facilities in Sonoma County



3.11.7 Hazardous Materials

The California Environmental Reporting System (CERS) allows hazardous materials handlers to submit required annual hazardous materials inventories and report hazardous spills and releases. As of November 2025, there are 249,598 facilities listed in CERS statewide (Cal EPA 2025). Facilities include auto repair shops, hospitals, dental offices, veterinary clinics, factories, breweries, dry cleaners, and research labs.

The planning team identified 2,982 CERS facilities in Sonoma County, about a third of all identified potential critical facilities in the county. Most of the CERS facilities in the county do not meet the community lifeline definition of ”fundamental services in a community that enable all other aspects of society.” Many of the CERS facilities that do meet this definition are included in another community lifeline category (i.e. hospitals included in health and medical). For these reasons, CERS facilities were omitted from the critical facility analysis.

No other hazardous materials data was available to use in the analysis. An area for future improvement would be to identify an appropriate inventory of hazardous materials facilities to be used in HMP updates. While facilities are not analyzed in this plan, this does not prevent participating jurisdictions from pursuing hazardous-materials mitigation. A requirement of the CERS program is that each reporting business must maintain a Hazardous Materials Business Plan that includes emergency response plans and procedures to be followed in the event of a reportable release or threatened release of a hazardous material. The County maintains the Hazardous Materials Business Plans for all county facilities where hazardous materials are stored. In addition, there is an oil spill contingency plan available on the Department of Emergency Management website.

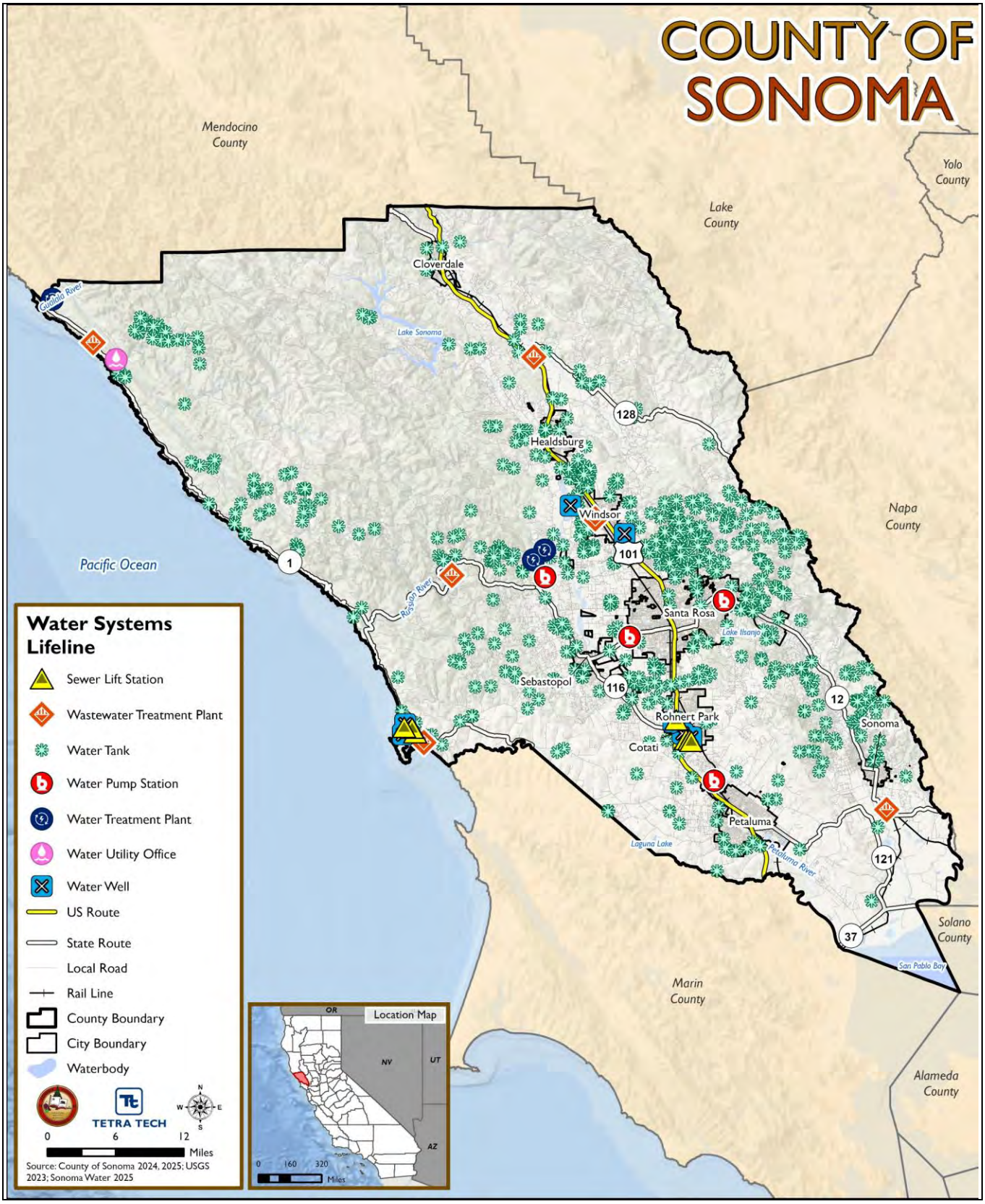
3.11.8 Water Systems

Key facilities and services considered for the inventory under the water system category include:

- Sewer lift stations
- Wastewater treatment plants
- Water pump stations
- Water tanks
- Water treatment plants
- Water utility offices
- Water wells

Figure 3-15 shows the location of water system facilities included in the lifelines inventory for this HMP. The inventory includes 673 of these facilities.

Figure 3-15.Water Systems Lifelines in Sonoma County



3.11.9 Other Critical facilities

Key facilities and services considered for the inventory under the other facilities category include:

- Community centers
- Daycares
- Libraries
- Senior centers

These facilities do not meet the definition of a community lifeline but were determined by the community to be of importance. Figure 3-16 shows the location of other critical facilities included in the lifelines inventory for this HMP. The inventory includes 191 of these facilities.

3.11.10 Summary

Table 3-13 shows a summary of all facilities identified for the critical facilities inventory for this HMP.

Figure 3-16 Additional Critical Facilities

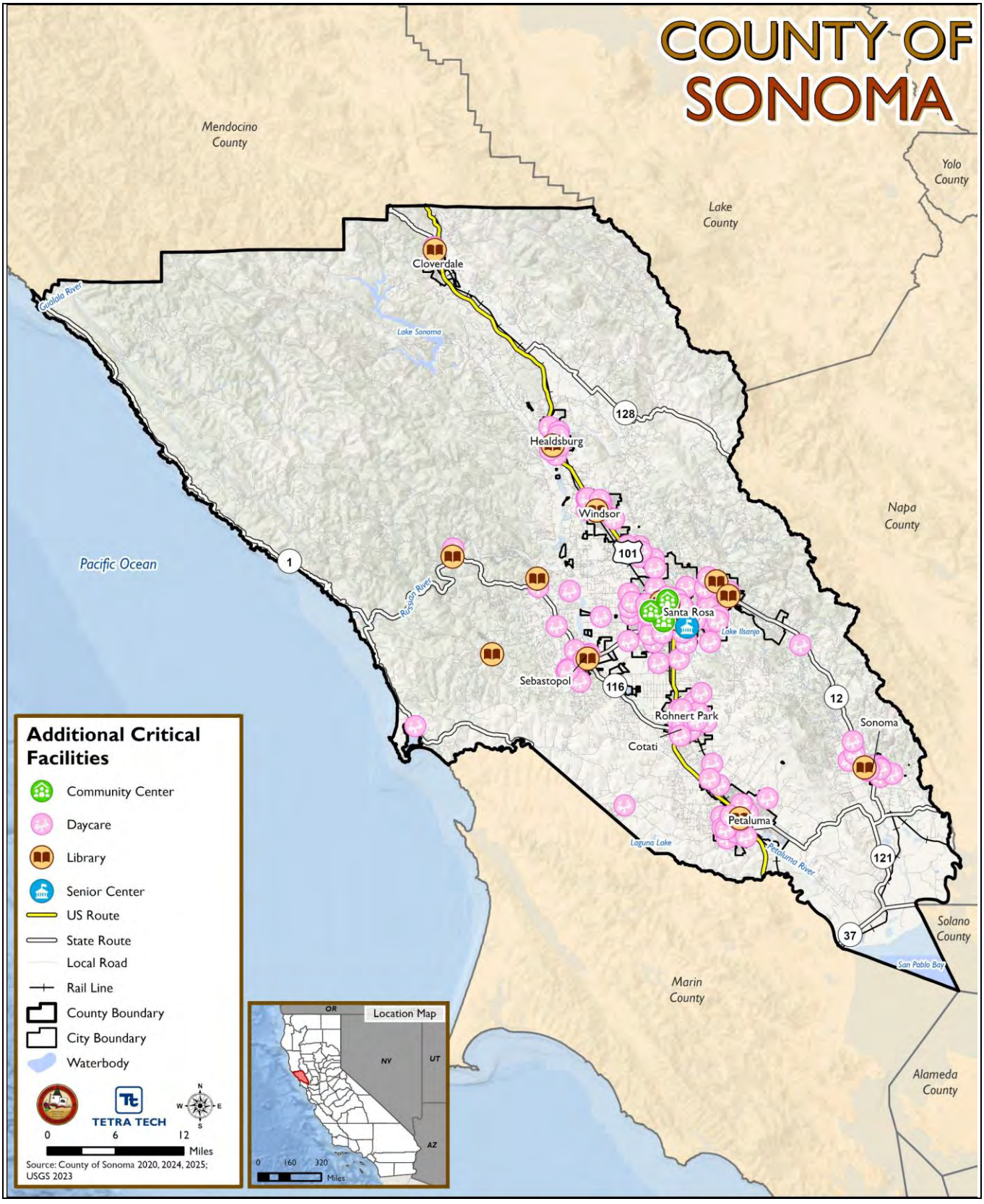


Table 3-13. Community Lifelines and Other Critical Facilities in Sonoma County

Jurisdiction	Communication	Energy	Food, Hydration, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Water Systems	Other Critical Facilities	Total
City of Cloverdale	2	0	9	0	4	11	8	3	6	43
City of Cotati	1	0	3	0	5	5	6	8	10	38
City of Healdsburg	11	0	8	0	8	13	6	1	9	56
City of Petaluma	22	0	14	0	14	40	34	4	23	151
City of Rohnert Park	16	2	14	0	9	21	22	0	12	96
City of Santa Rosa	108	2	39	0	44	124	113	34	64	528
City of Sebastopol	6	0	8	0	9	9	1	3	7	43
City of Sonoma	13	2	11	0	5	9	5	6	10	61
Town of Windsor	7	1	7	0	7	16	24	4	9	75
Unincorporated County	330	27	54	0	77	244	445	610	41	1,828
Sonoma County (Total)	516	34	167	0	182	492	664	673	191	2,919

Source: County of Sonoma 2020, 2025; California Energy Commission 2024; Caltrans 2024, 2025; HIFLD 2024, 2025; USACE NID; Permit Sonoma 2025

3.12 NATURAL, HISTORIC AND CULTURAL RESOURCES

Sonoma County boasts scenic vistas, fertile agricultural lands, redwood forests, a sizeable meandering river, and 50 miles of rocky coastline. The natural resources relevant for hazard mitigation referenced in the Sonoma County General Plan 2020 include:

- **Forests and Woodlands**—About 513,000 acres (50 percent of the county) are forest and woodlands, including conifer forests, hardwoods, and mixed forests. These areas provide critical ecological benefits like wildlife habitat, watershed protection, and recreation but are also susceptible to hazards like wildfire and erosion.
- **Wetlands**—Important wetlands include Laguna de Santa Rosa, vernal pools, San Pablo Bay and Petaluma marshes, and several freshwater marshes. These wetlands are sensitive ecosystems that also play roles in flood control and water filtration.
- **Sensitive Natural Communities**—Rare and vulnerable communities include coastal salt marsh, brackish and freshwater marshes, native grasslands, several types of forest and woodland (including riparian and oak woodlands), old growth redwood and Douglas fir forests, serpentine chaparral, and coastal scrub. These habitats support special status species and are ecologically significant.
- **Timber Resources**—Approximately 232,000 acres are designated timberlands, mostly privately owned. These lands are critical for ongoing timber production but face pressures from development and land conversion. Maintaining timberlands can help reduce hazards like erosion and wildfire spread.
- **Mineral Resources**—Mining operations in the County, mainly for construction aggregates, have environmental impacts like dust and noise. These areas need consideration in hazard mitigation planning to reduce impacts on surrounding natural resources and communities.

In addition to these natural resources, there are cultural and historic landscapes that illustrate the county's historic past with a broad array of properties that mirror the passage of time.

The county includes significant archaeological, historical, and cultural sites that reflect the diverse ethnic, cultural, and economic groups that have lived and worked there, including Native American populations. Historic preservation efforts focus on maintaining reminders of the county's development through surveys of historic buildings in key areas such as Cotati, Sebastopol, Healdsburg, and Sonoma Valley. These resources face threats from development and neglect. Additionally, heritage and landmark trees hold historical and environmental significance.

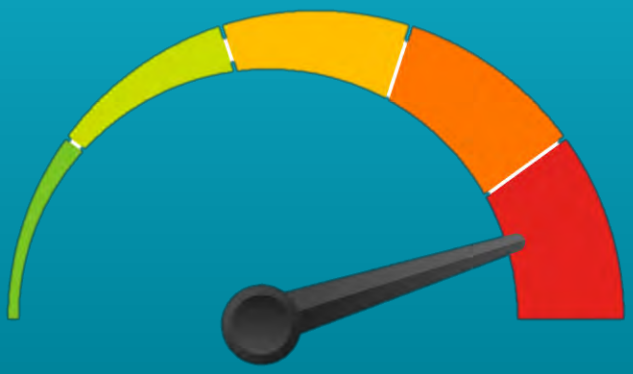
Sonoma County has 79 properties listed in the National Register of Historic Places. These properties are listed for their relevance to the pre-historic, architectural, industrial, commercial, or engineering history of Sonoma County. Table 3-14 lists the properties that have been added to the list since the prior HMP update.

Table 3-14. National Register of Historic Places Additions 2021-2025

Property Name	Community
Fisk's Mill Landing Historical and Archaeological District	Jenner
Petaluma Woman's Club	Petaluma
Belden-Birkhofer House	Guerneville
Fort Ross Landing Historical and Archaeological District	Jenner
NORLINA (shipwreck and remains)	Jenner
Salt Point Landing Historical and Archaeological District	Jenner
Freestone Store	Freestone
Flamingo Hotel	Santa Rosa
Hines House	Sea Ranch

Source: (NPS 2025)

Part 2: Risk Assessment



4. RISK ASSESSMENT METHODOLOGY AND TOOLS

A risk assessment is the process of evaluating the potential loss of life, personal injury, and economic and property damage that could result from identified hazards. Identifying potential hazards and vulnerable assets allows planning personnel to address and reduce hazard impacts and allows emergency management personnel to establish early response priorities. Results of the risk assessment are used in subsequent mitigation planning processes, including determining and prioritizing mitigation actions that reduce each jurisdiction's risk from each hazard. Past, present, and future conditions must be evaluated to assess risk most accurately for the county and participating jurisdictions. The process focuses on the following elements:

- **Identify Hazards of Concern**—Use all available information to determine what types of hazards may affect a jurisdiction.
- **Profile Each Hazard**—Understand each hazard in terms of:
  - Extent—The potential severity of each hazard
  - Location—Geographic area most likely to be affected by the hazard
  - Previous occurrences and losses
  - Probability of future hazard events
- **Assess Vulnerability and Impacts**—Use best available information to estimate to what extent populations and assets may be adversely affected by a hazard now and in the future:
  - Determine vulnerability—Estimate the total number of assets in the jurisdiction that are likely to experience a hazard event if it occurs by overlaying hazard maps with the asset inventories.
  - Estimate potential impacts/losses—Assess the impact of hazard events on the people, property, economy, and lands of the region, including estimates of the losses associated with potential damage or cost that can be avoided by mitigation.
  - Evaluate future changes that may affect vulnerability and impacts—Analyze how demographic changes, projected development, and climate change impacts can alter current vulnerability and potential impacts.

4.1 PREVIOUS EVENTS AND PROBABILITY OF OCCURRENCE

Based on records of previous hazard events and consideration of potential future changes that could affect the frequency of future events, the risk assessment for each hazard assigns a rating for the probability of occurrence of that hazard in the future. Best-available hazard data were used. The following were the primary sources for identifying previous occurrences:

- **FEMA disaster declarations**—The President of the United States has the authority to issue disaster declarations for hazard events that cause more damage than state and local governments can manage without assistance from the federal government. The declaration triggers funding for emergency and recovery efforts led by FEMA. The first federal disaster declaration was issued in 1953. Initially, declarations applied to entire states. Beginning in 1969,

the process was refined to specify the individual counties affected by each declaration. Federally disaster declarations are classified as major disaster (DR), emergency declaration (EM), or fire management assistance (FM).

- **California governor's emergency proclamations**—The governor of California is authorized to proclaim an emergency statewide or at local levels. Such proclamations trigger emergency powers and assistance programs. The governor can issue an emergency proclamation when a state of emergency exists, defined in state code as conditions of disaster or extreme peril to people and property that are of a magnitude to be beyond the control of individual local governments. Emergency proclamations are a prerequisite when requesting a federal disaster declaration (Cal OES 2024).
- **U.S. Department of Agriculture disaster declarations**—The U.S. Secretary of Agriculture is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in contiguous counties.
- **Hazard-specific databases**—Sources that provide records of specific types of hazard events include the National Centers for Environmental Information's Storm Events Database, the CAL FIRE Incident Data Base, the National Integrated Drought Information System's U.S. Drought Monitor, and the U.S. Geological Survey's Earthquake Catalog.
- **News reports and previously published planning documents** such as the California State Hazard Mitigation Plan and the previous Sonoma County Hazard Mitigation Plan.

The probability of occurrence ratings were assigned as follows:

- **Unlikely**—Hazard event has less than a 1 percent annual probability of occurring
- **Rare**—Hazard event has between 1 and 10 percent annual probability of occurring
- **Occasional**—Hazard event has between 10 and 100 percent annual probability of occurring
- **Frequent**—100 percent annual probability; hazard event is likely to occur multiple times per year

4.2 ASSET INVENTORIES

The following types of Sonoma County assets were identified to assess potential vulnerability and impacts associated with the hazards of concern: population, buildings, and critical facilities/community lifelines. Each asset type is described below. To protect individual privacy and the security of critical facilities, information on properties assessed is presented in aggregate, without details about specific individual properties. New development was not analyzed as part of this HMP update, as the Planning Partners did not have this information readily available.

4.2.1 Population

The 2020 Decennial Census and 2019-2023 American Community Survey (ACS) 5-year estimate were used to assess the vulnerability of and potential impacts on the County's population:

- The 2020 U.S. Census data included in FEMA's Hazus program was used to estimate potential population impacts from flood and seismic events—specifically, shelter needs and injuries.
- ACS data was used to estimate vulnerable populations in Sonoma County—specifically, children, older people, those living below the poverty level, non-English speaking individuals, persons with a disability, single parent households, and individuals with no vehicle access.

Population counts at the jurisdictional level were averaged among the residential structures in the county to estimate the population at the structure level. This estimate provides a more precise distribution of population across the county compared to only using the census block or census tract boundaries.

4.2.2 Buildings

Building Footprints and Attributes

The general building stock was updated countywide with a custom-building inventory using 2025 building footprints and parcel information provided by Sonoma County GIS. Attributes provided in the associated files were used to further define each structure, such as year built, number of stories, occupancy class, construction class, and square footage. Information from the City of Los Angeles helped to define the construction classes for residential structures in Sonoma County and is referenced in the applicable data tables in the hazard profiles. The centroid of each building footprint was used to estimate the building location.

Residential classification by project can be: single family homes, multi-unit buildings or residential remodel.

Classification by construction type can be: type V (wood frame), type IV (heavy timber), type III (ordinary), type II (non-combustible), and type I (fire resistive).

Occupancy Class

Occupancy classes available in Hazus were condensed into the categories of residential, commercial, industrial, and "other" (agricultural, religious, governmental, and educational) to facilitate analysis and presentation of results. The residential class includes both multi-family and single-family dwellings.

Building Value

Structural and content replacement cost values (RCV) were calculated for each building using assessor data, the building footprint, and RSMeans 2024 values. RCV is the current cost of returning a destroyed asset to its pre-damaged condition using present-day cost of labor and materials. Total RCV consists of both the structural cost to replace a building and the estimated value of contents of the building. Content value was estimated as 50 percent of the structure value for residential buildings, and 100 percent of the structure value for non-residential buildings. Values were adjusted using the following location factors based on zip code::

- Zip codes beginning with 945 (Vallejo): Residential = 1.19 | Non-Residential = 1.14

- Zip codes beginning with 949 (San Rafae)l: Residential = 1.24 | Non-Residential = 1.18
- Zip codes beginning with 954 (Santa Rosa): Residential = 1.22 | Non-Residential = 1.18

Land use information as of 2025 was provided by Sonoma County and represents the current land use for the unincorporated county. The categories as defined by the County consist of agriculture, commercial, residential, and industrial uses, as well as public facilities and rural development. Information was not available for the incorporated cities.

4.2.3 Critical Facilities/Community Lifelines

A critical facility inventory, which includes essential facilities, utilities, transportation features and user-defined facilities, was created by the Planning Partnership and county jurisdictions. The development involved a review for accuracy, additions, or deletions of new or moved critical assets, identification of backup power for each asset (if known) and whether the critical facility is considered a lifeline in accordance with FEMA's definition.

4.3 VULNERABILITY AND IMPACT ASSESSMENT METHODOLOGY

Sonoma County used standardized tools, combined with local, state, and federal data and expertise to assess potential vulnerability and losses associated with hazards of concern. Three levels of analysis were used, depending upon the data available for each hazard:

- **Qualitative Review—**This analysis includes an examination of historical impacts to understand potential impacts of future events of similar size. Potential impacts and losses are discussed qualitatively using best-available data and professional judgment.
- **Vulnerability Analysis—**This analysis involves overlaying available spatial hazard layers, for hazards with defined locations, on asset mapping in GIS to determine which assets are located in the hazard area.
- **Loss Estimation**—The FEMA Hazus modeling software was used to estimate impact in terms of potential losses for the following hazards: flood, dam failure, earthquake.

Table 4-1 summarizes the type of analysis conducted by hazard of concern.

4.3.1 Hazus

FEMA's Hazus program was used to estimate potential impacts from the flood, dam failure, and earthquake hazards. Hazus is a GIS-based software tool developed by FEMA that uses engineering and scientific risk calculations to estimate damage and loss. It provides a consistent framework for assessing risk across a variety of hazards. Hazus uses GIS technology to produce detailed maps and analytical reports that estimate direct physical damage to building stock, critical facilities, transportation systems and utility systems. To generate this information, Hazus uses default data for inventory, vulnerability, and hazards; this default data can be supplemented with local data to provide a more refined analysis.

Table 4-1. Summary of Risk Assessment Analyses

Hazard	Population	General Building Stock	Critical Facilities
Dam Failure	V, L	V, L	V, L
Drought	Q	Q	Q
Earthquake	V, L	V, L	V, L
Extreme Cold	Q	Q	Q
Extreme Heat	Q	Q	Q
Extreme Wind	Q	Q	Q
Flooding	V, L	V, L	V, L
Landslide	V	V	V
Sea Level Rise	V	V	V
Tsunami	V	V	V
Wildfire	V	V	V

Note: V = vulnerability analysis; L = loss estimation; Q = qualitative review

The following levels of analysis can be conducted using the Hazus software:

- **Level 1**—Hazus provides hazard and inventory data with minimal outside data collection or mapping.
- **Level 2**—Analysis involves augmenting the Hazus-provided hazard and inventory data with more recent or detailed local data for the study region
- **Level 3**—Analysis involves adjusting the built-in loss estimation models used for the hazard loss analyses. This level is typically done in conjunction with the use of local data.

Hazus damage reports can include induced damage (inundation, fire, threats posed by hazardous materials, and debris) and direct economic and social losses (casualties, shelter requirements, and economic impact) depending on the hazard and available local data. For this HMP, losses were estimated in Hazus using depth grids for the flood and dam failure analyses and probabilistic analyses for earthquake hazards. The earthquake probabilistic model generates estimated damage and losses for specified return periods (e.g., 100- and 500-year).

4.3.2 Hazard-Specific Methodologies

Dam Failure

The following data were used to evaluate vulnerability and determine potential future losses for this plan update:

- The high and extremely high dam inundation areas sourced from Cal OES and California Department of Water Resources. Data for several dams were not available and therefore could not be included in the aggregated high and extremely high dam-inundation area. In particular, no data was available for Warm Springs Dam, a major facility located within the City of Santa

Rosa, from either Cal OES or the California Department of Water Resources. As a result, Warm Springs Dam is excluded from the dam-failure analysis presented in this plan. Dams included in the High Hazard Dam Failure Inundation Areas map and in the dam failure analysis are as follows:

- Airport Storage Pond
- Airport Storage Pond 2
- Alpine
- Annadel No 1
- Axell
- Azalea
- Browns Lane
- Conn Creek
- Cook No 2
- Donovan
- Dutcher Creek
- Fern Lake
- Foote #3
- Foote #4
- Foothill Regulating Park
- Foss Creek North Area
- Fountaingrove
- Helen, Lake
- Kellogg Ballpark
- Lagunita
- Lowe
- Lytton
- Mallacomes
- Matanzas Creek
- Meadow Lane
- Merlo
- Middle Fork Brush Creek
- Milliken
- Murray
- Norton No. 2
- Novato Creek
- Piner Creek
- Ralphine, Lake
- Santa Rosa Creek Reservoir
- Shiloh Ranch
- Sleepy Hollow No. 2
- Suttenfield
- The Hill Ranch
- Vonsen

- A depth grid was created from the dam inundation areas and the 2013 1-meter digital elevation model developed by the U.S. Geological Survey.

Vulnerability Analysis

To estimate vulnerability to the dam failure hazard, the combined high and extremely high hazard dam inundation areas were overlaid on the centroids of updated assets (population, building stock, and critical facilities). Centroids that intersected the inundation boundaries were totaled to estimate the building RCV and population vulnerable to dam failure.

Loss Estimation

The Hazus riverine flood model was run to estimate potential losses in Sonoma County for the dam failure event. A Level 2 analysis was performed for the building stock. Buildings located within the inundation areas were imported as user-defined facilities to estimate potential losses at the structural level. Hazus calculated the estimated potential losses to the population (default 2020 U.S. Census data), potential damage to the general building stock, and potential damage to critical facilities based on the depth grid generated and the default Hazus damage functions in the flood model.

Drought

All of Sonoma County is at risk from the impacts of drought events. A qualitative review was conducted to assess the potential impacts from this hazard of concern.

Earthquake

Vulnerability Analysis

Ground shaking is the primary cause of earthquake damage to structures, and soft soils amplify ground shaking. One contributor to the site amplification is the velocity at which the rock or soil transmits shear waves (S-waves). The National Earthquake Hazard Reductions Program (NEHRP) has developed five soil classifications defined by their shear-wave velocity that impact the severity of an earthquake. The soil classification system ranges from A to E, where A represents hard rock that reduces ground motions from an earthquake and E represents soft soils that amplify ground shaking and increase building damage. Class D and E NEHRP soils are the two classes most susceptible to amplified ground motion during an earthquake.

A vulnerability analysis was conducted for the county's assets (population, building stock, and critical facilities) using NEHRP soil data sourced from Cal OES and the California Department of Conservation. The vulnerability analysis defined the hazard area as all areas with Class D and E soil types. Assets with their centroid in the hazard areas were totaled to estimate the numbers and values vulnerable to these soil types.

Loss Estimation

A probabilistic assessment was conducted for the 500-year and 2,500-year mean return period earthquake events through a Level 2 analysis in Hazus. The probabilistic method uses information from historical earthquakes and inferred faults, locations, and magnitudes to compute probable ground shaking levels, by census tract, for a seismic event of a selected a recurrence period.

The default assumption is a magnitude 7.0 earthquake for all return periods. Although damage is estimated at the census tract level, results were presented at the municipal level. Because there are multiple census tracts that contain more than one jurisdiction, an area analysis was used to extract the percent of each tract that falls within individual jurisdictions. The percentage was multiplied against the results calculated for each tract and summed for each jurisdiction.

Damage estimates were calculated for losses to buildings (structural and non-structural) and contents. Structural losses include load carrying components of the structure. Non-structural losses include those to architectural, mechanical, and electrical components of the structure, such as nonbearing walls, veneer and finishes, heating and ventilation systems, boilers, etc.

Extreme Cold

All of Sonoma County is at risk from the impacts of extreme cold events. A qualitative review was conducted to assess the potential impacts from this hazard of concern.

Extreme Heat

All of Sonoma County is at risk from the impacts of extreme heat events. A qualitative review was conducted to assess the potential impacts from this hazard of concern.

Extreme Wind

All of Sonoma County is at risk from the impacts of extreme wind events. A qualitative review was conducted to assess the potential impacts from this hazard of concern.

Flood

The 1- and 0.2-percent annual chance flood events were examined to evaluate the county's risk from the flood hazard. These flood events are generally those considered by planners and evaluated under federal programs such as NFIP. The following data were used to evaluate vulnerability and determine potential future losses for this plan update:

- FEMA's effective Digital Flood Insurance Rate Map (DFIRM) for Sonoma County, dated July 31, 2024.
- A depth grid created from the 2024 effective DFIRM and the 2013 1-meter digital elevation model developed by the U.S. Geological Survey.

Vulnerability Analysis

To estimate vulnerability to the 1 percent and 0.2 percent annual chance flood events, the DFIRM flood boundaries were overlaid on the centroids of updated assets (population, building stock, and critical facilities). Centroids that intersected the flood boundaries were totaled to estimate the building RCV and population vulnerable to the flood inundation areas.

Loss Estimation

The depth grid generated using the DFIRM and 1-meter digital elevation model was integrated into the Hazus flood model and used to estimate potential losses for the 1 percent annual chance flood event. A Level 2 analysis was performed for the building stock. Buildings located within the floodplain were imported as user-defined facilities to estimate potential losses at the structural level. Hazus calculated the estimated potential losses to the population (default 2020 U.S. Census data), potential damage to the general building stock, and potential damage to critical facilities based on the depth grids and the default damage functions in the Hazus flood model.

Landslide

A vulnerability analysis to determine the county's exposure to the landslide hazard was conducted using deep-seated landslide susceptibility data from the California Geological Survey. The county's assets (population, buildings, critical facilities) were examined to determine if they are located in the moderate, high, or very high landslide susceptibility areas. Assets with their centroid located in the hazard areas were totaled to estimate the totals and values at risk from the impacts of landslides.

Sea Level Rise

A vulnerability analysis to determine the county's exposure to the sea level rise hazard was conducted using potential sea level rise data provided by Permit Sonoma (2025) in conjunction with USGS, Our Coast Our Future, and NOAA. The data is consistent with the Sonoma County Local Coastal Plan and

considers an overall extent of potential sea level rise up to 15 feet. The county's assets (population, buildings, critical facilities) were examined to determine if they are built in the sea level rise hazard area. Assets with their centroid located in the hazard area were totaled to estimate the totals and values at risk from the impacts of sea level rise.

Tsunami

A vulnerability analysis to determine the county's exposure to the tsunami hazard was conducted using tsunami data provided by Permit Sonoma (2025) in conjunction with the California Department of Conservation. The county's assets (population, buildings, critical facilities) were examined to determine if they are built in the tsunami hazard area. Assets with their centroid located in the hazard area were totaled to estimate the totals and values at risk from the impacts of tsunami.

Wildfire

A vulnerability analysis was conducted to determine the county's exposure to the wildfire hazard using wildfire data obtained from Permit Sonoma and CAL FIRE (2024); this data was developed prior to the release of the February 24, 2025 2025 Local Responsibility Area Fire Hazard Severity Maps. The moderate, high, and very high fire hazard severity zones were used for the analysis. The county's assets (population, buildings, critical facilities) were examined to determine if they are built in any of the fire hazard severity zones. Assets with their centroid located in the hazard area were totaled to estimate the totals and values at risk from the impacts of wildfire.

4.4 DATA SOURCE SUMMARY

Table 4-2 summarizes the data sources used for the risk assessment for this plan.

Table 4-2. Risk Assessment Data Documentation

Data	Source	Date	Format
Population data	U.S. Census Bureau; American Community Survey 5-Year Estimates	2020; 2023	Digital (GIS) format
Building Inventory	County of Sonoma; LA City Planning	2025; 2020	Digital (GIS) format
Critical Facilities and Lifelines	County of Sonoma; California Energy Commission; Caltrans; HIFLD; USACE NID	2020, 2025; 2024; 2024, 2025; 2024, 2025; n.d.	Digital (GIS) format
Land Use	County of Sonoma	2025	Digital (GIS) format
Digitized Effective FIRM maps	FEMA	2024	Digital (GIS) format
1-Meter Digital Elevation Model	USGS	2013	TIFF
Dam Inundation	Cal OES; California Department of Water Resources	n.d.	Digital (GIS) format

Data	Source	Date	Format
NEHRP Soils (D&E)	Cal OES; California Department of Conservation	n.d.	Digital (GIS) format
Deep-Seated Landslide Susceptibility	California Department of Conservation, California Geological Survey	n.d.	Digital (GIS) format
Geologic Hazard (Alquist-Priolo Earthquake Fault Zones)	Permit Sonoma	2025	Digital (GIS) format
Sea Level Rise Hazard Area	Permit Sonoma; USGS/Our Coast Our Future/NOAA	2025; n.d.	Digital (GIS) format
Tsunami Hazard Area	Permit Sonoma; California Department of Conservation	2025; n.d.	Digital (GIS) Format
Wildfire—Fire Hazard Severity Zones	CAL FIRE; Permit Sonoma	2024	Digital (GIS) Format

Note: CalOES = California Governor's Office of Emergency Services; DOT = Department of Transportation; FEMA = Federal Emergency Management Agency; HIFLD = Homeland Infrastructure Foundation-Level Data; NEHRP = National Earthquake Hazards Reduction Program; NID = National Inventory of Dams; NOAA = National Oceanic and Atmospheric Administration; NRCS = Natural Resources Conservation Service; USACE = United States Army Corps of Engineers; USDA = U.S. Department of Agriculture; USGS = U.S. Geological Survey

4.5 LIMITATIONS

Loss estimates, vulnerability analyses, and hazard-specific impact evaluations rely on the best-available data and methodologies. Uncertainties are inherent in any loss estimation methodology and arise in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from the following:

- Approximations and simplifications necessary to conduct such a study
- Incomplete or dated inventory, demographic, or economic parameter data
- The unique nature, geographic extent, and severity of each hazard
- Mitigation measures already employed by the participating jurisdictions
- The amount of advance notice residents have to prepare for a specific hazard event
- Uncertainty of climate change projections

These factors can result in a range of uncertainty in loss estimates, possibly by a factor of two or more. Therefore, potential vulnerability and loss estimates are approximate. These results do not predict precise results and should be used to understand relative risk. Over the long term, Sonoma County will collect additional data and update and refine existing inventories to assist in estimating potential losses.

Potential economic loss is based on the present value of the general building stock using best-available data. The county acknowledges significant impacts may occur to critical facilities and infrastructure as a result of these hazard events causing great economic loss. However, monetized damage estimates to

critical facilities and infrastructure, and economic impacts were not quantified and require more detailed loss analyses. In addition, economic impacts to industry such as tourism and the real-estate market were not analyzed.

4.6 CONSIDERATIONS FOR MITIGATION AND NEXT STEPS

The following items are to be discussed for considerations for the next plan update to enhance the risk assessment:

- All Hazards
  - Create an updated user-defined general building stock dataset using up-to-date parcels, footprints, and RS Means values.
  - Utilize updated and current demographic data.
  - Use the results of transportation and evacuation studies to inform the risk assessment. Potential integration includes adding evacuation routes to the critical facility inventory (similar to bridges), creating a mapping layer with evacuation routes, or implementing mitigation projects identified in the studies.
- Earthquake
  - Identify unreinforced masonry in critical facilities and privately-owned buildings (i.e., residences) by accessing local knowledge, tax assessor information, and/or pictometry/orthophotos. These buildings may not withstand earthquakes of certain magnitudes and plans to provide emergency response or recovery efforts at these properties can be developed.
- Extreme Cold and Heat
  - Track extreme temperature data for injuries, deaths, shelter needs, pipe freezing, agricultural losses, and other impacts to determine distributions of most at-risk areas.
- Flood
  - The general building stock inventory can be updated to include attributes regarding first floor elevation and foundation type (basement, slab on grade, etc.) to enhance loss estimates.
  - Conduct a Hazus loss analysis for more frequent flood events (e.g., 10- and 50-year flood events).
  - Conduct a repetitive loss area analysis.
  - Continue to expand and update urban flood areas to further inform mitigation.
  - As more current FEMA floodplain data become available (i.e., DFIRMs), update the vulnerability analysis and generate a more detailed flood depth grid that can be integrated into the current Hazus version.
- Landslide
  - As new susceptibility information becomes available, run vulnerability analyses using updated data.
  - Consider analyzing additional factors contributing to the landslide hazard.

- Sea Level Rise
  - Run new vulnerability analyses using updated forecast information.
- Tsunami
  - Run new vulnerability analyses using updated forecast information.
- Wildfire
  - General building stock inventory can be updated to include attributes such as roofing material, fire detection equipment, or distance to fuels as another measure of vulnerability.

5. IDENTIFICATION OF HAZARDS OF CONCERN

5.1 REVIEW OF POTENTIAL HAZARDS

Sonoma County considered a full range of hazards that might have the potential to impact the area and identified and ranked those that present the greatest concern. These hazards of concern were identified based on the following:

- Input from all Planning Partners
- Review of the California State Hazard Mitigation Plan
- Review of the 2021 Sonoma County HMP
- Research on the frequency, magnitude, and costs associated with hazards that have previously or could feasibly impact the region
- Qualitative information regarding natural (not human-caused) hazards and the perceived vulnerability of the study area's assets to them.

Table 5-1 documents the process of identifying the hazards of concern for further profiling and evaluation. Based on the review, 11 hazards of concern were identified to be addressed at the County level in this plan (shown here in alphabetical order):

- Dam failure
- Drought
- Earthquake
- Extreme cold
- Extreme heat
- Extreme wind
- Flood
- Landslide
- Sea level rise
- Tsunami
- Wildfire

Other natural and human-caused hazards of concern have occurred within Sonoma County, but have a low potential to occur, are addressed by other planning mechanisms, and/or do not result in significant impacts within the County. Therefore, these hazards are not addressed in this update. If deemed necessary by the County, these hazards may be considered in future plan updates.

Table 5-1. Identification of Hazards of Concern for Sonoma County

2023 California State Hazard Mitigation Plan	2026 Sonoma County Hazard Mitigation Plan	Comment
Air Pollution	Not included	The HMWG and Planning Partnership do not consider this hazard to be a significant concern for Sonoma County.
Civil Disorder [a]	Not included	The HMWG and Planning Partnership do not consider this hazard to be a significant concern for Sonoma County.
Cyber Threats [a]	Not included	The HMWG and Planning Partnership do not consider this hazard to be a significant concern for Sonoma County.
Dam Failure	Dam Failure	This local hazard aligns with the State Hazard Mitigation Plan.
Drought	Drought	This local hazard aligns with the State Hazard Mitigation Plan.
Earthquake	Earthquake	This local hazard aligns with the State Hazard Mitigation Plan.
Electromagnetic Pulse Attack	Not included	The HMWG and Planning Partnership do not consider this hazard to be a significant concern for Sonoma County.
Energy Shortage	Not included	The HMWG and Planning Partnership do not consider this hazard to be a significant concern for Sonoma County.
Epidemic, Pandemic, Vector-Borne Disease [a]	Not included	The HMWG and Planning Partnership do not consider this hazard to be a significant concern for Sonoma County.
Extreme Cold or Freeze	Extreme Cold	This local hazard aligns with the State Hazard Mitigation Plan.
Extreme Heat	Extreme Heat	This local hazard aligns with the State Hazard Mitigation Plan.
Geomagnetic Storm (Space Weather)	Not included	The HMWG and Planning Partnership do not consider this hazard to be a significant concern for Sonoma County.
Hazardous Materials Release [a]	Not included	The HMWG and Planning Partnership do not consider this hazard to be a significant concern for Sonoma County.
Invasive and Nuisance Species	Not included	The HMWG and Planning Partnership do not consider this hazard to be a significant concern for Sonoma County.
Landslide, Debris Flow, and other Mass Movements	Landslide	This local hazard aligns with the State Hazard Mitigation Plan.
Levee Failure	Not included	The HMWG and Planning Partnership do not consider this hazard to be a significant concern for Sonoma County.
Natural Gas Pipeline Hazards	Not included	The HMWG and Planning Partnership do not consider this hazard to be a significant concern for Sonoma County.
Oil Spills	Not included	The HMWG and Planning Partnership do not consider this hazard to be a significant concern for Sonoma County.
Other Potential Causes of Long-Term Electrical Outage	Not included	The HMWG and Planning Partnership do not consider this hazard to be a significant concern for Sonoma County.
Public Safety Power Shutoff [a]	Not included	This is considered a cascading impact of various other hazards and is addressed in those hazard profiles.
Radiological Accidents	Not included	The HMWG and Planning Partnership do not consider this hazard to be a significant concern for Sonoma County.

2023 California State Hazard Mitigation Plan	2026 Sonoma County Hazard Mitigation Plan	Comment
Riverine, Stream and Alluvial Flood	Flooding	The flood chapter addresses riverine, stormwater, and localized floods.
Sea-Level Rise, Coastal Flooding and Erosion	Sea Level Rise	This local hazard aligns with the State Hazard Mitigation Plan.
Severe Wind, Weather, and Storms	Extreme Wind	This local hazard aligns with the State Hazard Mitigation Plan.
Snow Avalanche	Not included	The HMWG and Planning Partnership do not consider this hazard to be a significant concern for Sonoma County.
Subsidence	Not included	The HMWG and Planning Partnership do not consider this hazard to be a significant concern for Sonoma County.
Terrorism	Not included	The HMWG and Planning Partnership do not consider this hazard to be a significant concern for Sonoma County.
Transportation Accidents Resulting in Explosions or Toxic Releases	Not included	The HMWG and Planning Partnership do not consider this hazard to be a significant concern for Sonoma County.
Tree Mortality	Not included	The HMWG and Planning Partnership do not consider this hazard to be a significant concern for Sonoma County.
Tsunami and Seiche	Tsunami	This local hazard aligns with the State Hazard Mitigation Plan.
Urban Structural Fire	Not included	The HMWG and Planning Partnership do not consider this hazard to be a significant concern for Sonoma County.
Volcano	Not included	The HMWG and Planning Partnership do not consider this hazard to be a significant concern for Sonoma County.
Well Stimulation and Hydraulic Fracturing	Not included	The HMWG and Planning Partnership do not consider this hazard to be a significant concern for Sonoma County.
Wildfire	Wildfire	This local hazard aligns with the State Hazard Mitigation Plan.

a. Have been address in suppletory and/or other planning documents

5.2 HAZARD DEFINITIONS AND GROUPINGS

The HMWG approved use of the following hazard event definitions and groupings:

- Dam failures are any instances when a dam is damaged, destroyed or otherwise overtopped, releasing water or other liquid stored behind the dam.
- A drought is a period characterized by long durations of below normal precipitation.
- An earthquake is the sudden movement of the earth's surface caused by the release of stress accumulated within or along the edge of the earth's tectonic plates, a volcanic eruption, or a human activities that cause geologic stresses.

- Extreme cold events are when temperatures drop well below the normal low temperatures for an area. In some areas, temperatures below freezing are enough to be considered extreme cold.
- Extreme heat is defined as temperatures that hover 10 degree Fahrenheit (°F) or more above the average high temperatures for a region for several days or weeks.
- Types of extreme winds include straight-line winds, downdrafts, downbursts, microbursts, macrobursts, gust fronts, derechos, and bow echoes.
- The flood hazard includes riverine flooding, flash flooding, and urban drainage flooding.
- The landslide hazard includes rock falls, rock topples, rotational slump, transitional slide, earth flows, creep, block slides, debris avalanche, and debris flows.
- Sea level rise refers to the long-term increase in the average height of the ocean's surface, primarily driven by climate change.
- A tsunami is a series of high-energy waves that radiate outward like pond ripples from an area where a generating event occurs, arriving at shorelines over an extended period.
- Wildfire is any non-structural fire that occurs in the wildland. Wildfires result in the disturbance of forest and brush and destruction of real estate and personal property and have secondary impacts on other hazards, such as flooding, by removing vegetation and disturbing watersheds.

Dam Failure

Hazard Ranking:

LOW

A dam is an **artificial barrier** that can store water, wastewater, or liquid-borne materials for many reasons like flood control, human water supply, irrigation, energy generation, and more.

Community Lifelines at Risk

12
Total

Daycare & Library - High Risk

Adaptive Capacity

Moderate

Population at Risk

27,768
Displaced Population

4,112
Persons seeking short-term shelter

Mitigation Projects

- Regular dam inspections and maintenance.
- Emergency Action Plan (EAP) development.
- Early warning systems.

6. DAM FAILURE

6.1 HAZARD PROFILE

6.1.1 Hazard Description

A dam is an artificial barrier that can store water, wastewater, or liquid-borne materials for many reasons—flood control, human water supply, irrigation, livestock water supply, energy generation, containment of mine tailings, recreation, or pollution control. Many dams fulfill a combination of these functions. They are an important resource in the United States (ASDSO 2023).

In California, dams are regulated by the State of California Division of Safety of Dams. The California Water Code defines a dam as any artificial barrier, together with appurtenant works, that does or may impound or divert water, and that meets either of the following conditions:

- It is 25 feet or more in height from the natural bed of the stream or watercourse at the downstream toe of the barrier (or from the lowest elevation of the outside limit of the barrier if it is not across a stream channel or watercourse) to the maximum possible water storage elevation
- It has an impounding capacity of 50 acre-feet or more

Dams can be classified according to their purpose, the construction material or methods used, their slope or cross-section, the way they resist the force of the water pressure, or the means used for controlling seepage. Materials used to construct dams include earth, rock, tailings from mining or milling, concrete, masonry, steel, timber, plastic, rubber, and combinations of these.

Dam failures occur when a dam is damaged or destroyed, or when the spillway is inadequate and excess flow overtops the dam. Internal erosion, known as piping, through the dam or foundation can also lead to dam failures. Many dam failures have been secondary results of other disasters. The most common causes are earthquakes, landslides, extreme storms, equipment malfunction, structural damage, foundation failures, and sabotage. A failure characterized by the sudden and uncontrolled release of water from a dammed impoundment can cause massive destruction to the ecosystems and communities downstream. Any dam has the potential to adversely affect downstream areas and lives. Many dams, should they fail, can also affect the delivery of essential utilities or flood control (FEMA 2013d).

6.1.2 Location

According to the U.S. Army Corps of Engineers' National Inventory of Dams, there are 65 dams that are in Sonoma County or have inundation areas that extend into the county. Figure 6-1 shows the locations of the dams within the county limits. Table 6-1 lists basic data about the 21 dams that are rated as high or extremely high risk in Sonoma County. Figure 6-2 shows areas in Sonoma County that would be inundated in the event of failures of the high-hazard dams; please note that data for all dams was not

available and therefore not depicted in the High Hazard Dam Failure Inundation Areas map or in the dam failure analysis. In particular, no data was available for Warm Springs Dam, a major facility located within the City of Santa Rosa, from either Cal OES or the California Department of Water Resources. As a result, Warm Springs Dam is excluded from the dam-failure analysis presented in this plan. Dams included in the High Hazard Dam Failure Inundation Areas map and in the dam failure analysis are as follows:

- Airport Storage Pond
- Airport Storage Pond 2
- Alpine
- Annadel No 1
- Axell
- Azalea
- Browns Lane
- Conn Creek
- Cook No 2
- Donovan
- Dutcher Creek
- Fern Lake
- Foote #3
- Foote #4
- Foothill Regulating Park
- Foss Creek North Area
- Fountaingrove
- Helen, Lake
- Kellogg Ballpark
- Lagunita
- Lowe
- Lytton
- Mallacomes
- Matanzas Creek
- Meadow Lane
- Merlo
- Middle Fork Brush Creek
- Milliken
- Murray
- Norton No. 2
- Novato Creek
- Piner Creek
- Ralphine, Lake
- Santa Rosa Creek Reservoir
- Shiloh Ranch
- Sleepy Hollow No. 2
- Suttenfield
- The Hill Ranch
- Vonsen

Figure 6-1. Dams in Sonoma County

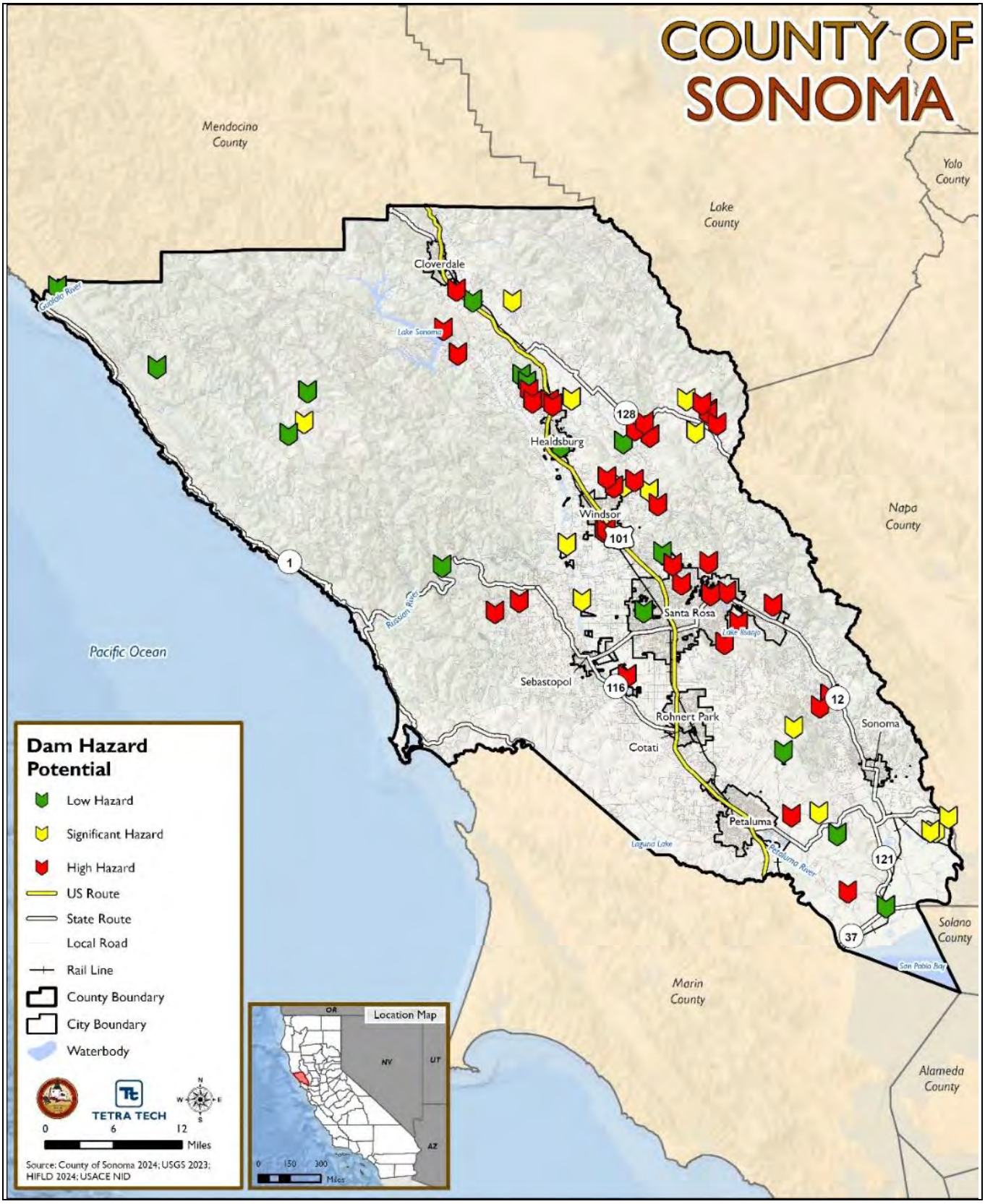


Figure 6-2. High Hazard Dam Failure Inundation Areas in Sonoma County

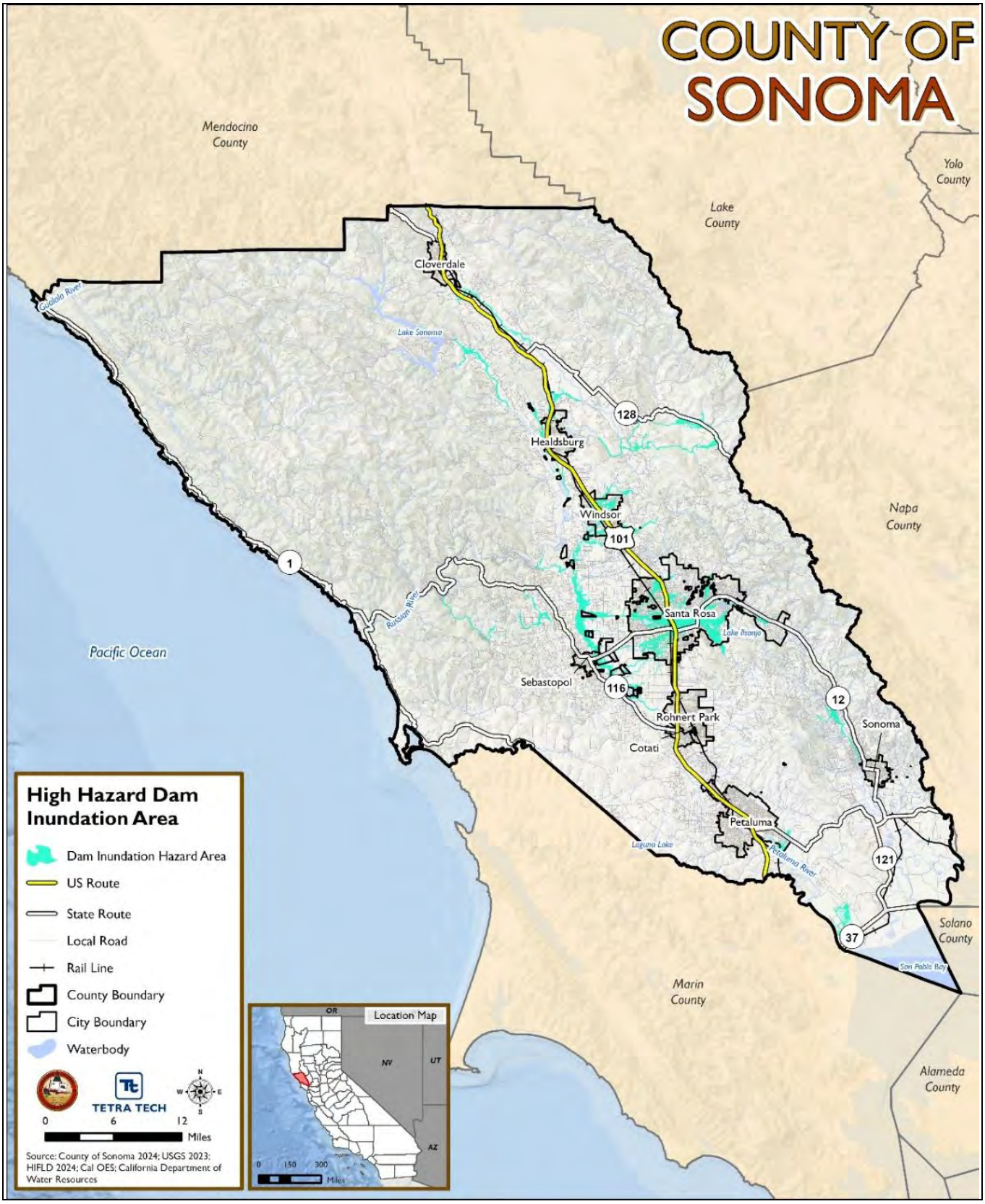


Table 6-1. High Hazard Potential Dams Affecting Sonoma County

Dam Name	Water Course	Owner Names	Year Completed	DWR Hazard Rating	Dam Length (feet)	Height (feet)	Storage Capacity (acre-feet)	Condition Assessment
Airport Storage Pond	Windsor Creek	Sonoma Water	1985	High	3700	22	290	Satisfactory
Airport Storage Pond 2	Windsor Creek	Sonoma Water	1989	High	3628	20	310	Satisfactory
Annadel No. 1	Spring Creek	California Department of Parks and Recreation	1956	Extremely High	400	67	395	Fair
Axell	Franz Creek	Kendall Jackson Wine Estates, LTD	1952	High	355	43	155	Satisfactory
Azalea	North Fork Lancel Creek	Silver Eagle Ranch, LLC	1955	High	140	44	85	Satisfactory
Browns Lane	Unavailable	Jackson Family Wines	Unavailable	High	1600	32	103	Fair
Cook No. 2	Dry Creek	E & J Gallo Winery	1961	High	510	35	82	Satisfactory
Donovan	Windsor Creek	Frederick and Donna Furth	1953	High	295	40	70	Satisfactory
Dutcher Creek	Borrelli Creek	E & J Gallo Winery	1992	High	790	43	186	Satisfactory
Fern Lake	Mill Creek	Department of General Services	1921	High	300	40	241	Satisfactory
Foote #3	Redwood Creek	Knights Valley California, LLC	1970	High	600	28	77	Satisfactory
Foote #4	Kellog Creek	Knights Valley California, LLC	1976	High	319	47	117	Satisfactory
Foothill Regulating Park	Windsor Creek	County of Sonoma Regional Parks Department	1963	High	274	51	109	Satisfactory
Foss Creek North Area	Foss Creek	City of Healdsburg	1998	High	1100	20	85	Satisfactory
Fountaingrove	Mark West Creek	City of Santa Rosa	1953	Extremely High	500	38	427	Satisfactory
Kellogg Ballpark	Franz Creek	Kendall Jackson Wine Estates, LTD	1962	High	525	51	376	Satisfactory
Lagunita	Windsor Creek	Mr. Schaefer Price	1954	Extremely High	308	49	98.5	Satisfactory

Dam Name	Water Course	Owner Names	Year Completed	DWR Hazard Rating	Dam Length (feet)	Height (feet)	Storage Capacity (acre-feet)	Condition Assessment
Lake Helen	Russian River	Robert Maddocks	1966	High	355	39	192	Poor
Lake Ralphine	Santa Rosa Creek	City of Santa Rosa	1882	Extremely High	700	35	387	Satisfactory
Lowe	Franz Creek	Foley Family Farms LP	1959	High	550	30	108	Satisfactory
Lytton	Russian River	Lytton Rancheria of California	1956	High	275	34	410	Satisfactory
Mallacomes	Foote Creek	Knights Valley California, LLC	1951	High	940	57	225	Satisfactory
Matanzas Creek	Matanzas Creek	Sonoma Water	1963	Extremely High	685	95	1500	Satisfactory
Meadow Lane	Unavailable	City of Santa Rosa	1979	High	9500	30	2100	Satisfactory
Merlo	Fall Creek	Harry A. Merlo	1982	High	210	74	930	Satisfactory
Middle Fork Brush Creek	Middle Fork Brush Creek	Sonoma Water	1961	Extremely High	1100	37	138	Satisfactory
Murray	Franz Creek	Coyote Hills Partnership	1970	High	300	55	117	Satisfactory
Norton No. 2	Dry Creek	Ridge Vineyards	1956	High	430	28	102	Satisfactory
Piner Creek	Paulin Creek	Sonoma Water	1962	Extremely High	205	28	172	Satisfactory
Santa Rosa Creek Reservoir	Santa Rosa Creek	Sonoma Water	1963	Extremely High	1950	37	3550	Satisfactory
Shiloh Ranch	Russian River	Shiloh Homeowners' Association	1991	Extremely High	635	61	432	Satisfactory
Sleepy Hollow No. 2	Petaluma Creek	Accolade Petaluma LLC	1949	High	600	39	104	Satisfactory
Suttenfield	Sonoma Creek	Department of General Services	1938	High	965	76	600	Fair
The Hill Ranch	Santa Rosa Creek	Mark Whitt and Thia Kellner Hill Revocable Trust	1955	High	202	49	160	Satisfactory
Warm Springs Dam	Dry Creek	USACE - San Francisco District	1983	High	3000	319	449000	Not Available

Source: (USACE 2025) (California Division of Safety of Dams 2025)

6.1.3 Extent

Dam failure can be catastrophic to all life and property downstream. California's Division of Safety of Dams has developed a hazard potential classification system for state-jurisdiction dams, as shown in Table 6-2. This system is modified from federal guidelines, which recommend three-tier classification. The California system adds a fourth hazard classification of "extremely high" to identify dams that may impact highly populated areas or critical infrastructure or have short evacuation warning times (Cal OES 2018). Seven of the dams listed in Table 6-1 are classified as extremely high hazard in this system and the rest are listed as high hazard.

Table 6-2. State of California Downstream Hazard Potential Classification

Hazard Category	Direct Loss of Life	Economic Environmental, and Lifeline Losses
Low	None expected	Low and principally limited to dam owner's property
Significant	None expected	Yes
High	Probable (one or more expected)	Yes, but not necessary for this classification
Extremely High	Considerable	Yes, major impacts to critical infrastructure or property

Source: California Division of Safety Dams 2017

6.1.4 Previous Occurrences

All Recent Events

No known failures have occurred on dams that impact Sonoma County. However, according to the 2021 *State of California Multi-Hazard Mitigation Plan*, there have been nine failures of federally regulated dams elsewhere in the state since 1950. Overtopping caused two of the nine dam failures in the state, and the others were caused by seepage or leaks. The most catastrophic event was the failure of the St. Francis Dam in Los Angeles County, which failed in 1928 and killed an estimated 450 people.

The state's most recent dam emergency occurred in February 2017 when the Oroville Dam in Butte County was on the verge of overflow. The dam's concrete spillway was damaged by erosion and a massive hole developed. The auxiliary spillway was used to prevent overtopping of the dam, and it experienced erosion problems also. Evacuation orders were issued in advance of a potential large uncontrolled release of water from Lake Oroville, but such a release did not occur. After this incident, state officials ordered that flood-control spillways be re-inspected on 93 California dams with potential geologic, structural or performance issues that could jeopardize their ability to safely pass a flood event.

6.1.5 Probability of Future Occurrences

No recorded failures have occurred on dams that impact the planning area, so no estimate of frequency or probability of future occurrence can be developed based on the historical record. Although the recent Oroville event raised public concern about dam failure, the probability of such failures remains low in

today's regulatory environment. Based on these records and input from the HMWG, the probability of occurrence of dam and reservoir failure in the County is considered "rare."

All dams face a "residual risk" of failure, which represents the risk that conditions may exceed those for which the dam was designed. For example, dams may be designed to withstand a probable maximum precipitation, defined as "theoretically, the greatest depth of precipitation for a given duration that is physically possible over a given storm area at a particular geographical location at a certain time of the year" (Hansen, Schreiner and Miller 1982). The chance of occurrence of a precipitation event of a greater magnitude than that represents residual risk for such dams. This in turn represents a theoretical probability of future occurrence for a dam failure event, though the probability of an event exceeding the assumed maximum is not generally calculated as part of dam design.

6.1.6 Cascading Impacts on Other Hazards

Dam failure events are frequently associated with other natural hazard events such as earthquakes, landslides, or extreme precipitation, which limits their predictability and compounds the hazard. The shaking associated with earthquakes may weaken the structure of a dam, particularly earthen dams, and in very rare cases may cause them to fail. Landslides can directly impact a dam, causing damage or failure. Landslides of the ground around a dam may weaken the ground on which the dam exists, causing the potential for the dam structure to fail. Landslides into the water being impounded by the dam can cause a wave to travel the length of the dam's impoundment area, ultimately crashing on the dam itself. Extreme precipitation can result in large quantities of rain upstream of the dam that will ultimately be impounded by the dam, which could raise water levels behind the dam, resulting in overtopping of the dam or flooding of properties upstream of the dam.

6.2 VULNERABILITY AND IMPACT ASSESSMENT

The planning area's vulnerability to dam failure was assessed based on the exposure of community assets to the mapped inundation areas of high-hazard and extremely-high-hazard dams, as shown in Figure 6-2. Potential impacts were estimated using the Hazus flood model.

6.2.1 Life, Health, and Safety

Overall Population

As shown in Table 6-3, there are 24,416 persons living in the combined high- and extremely high hazard dam-failure inundation area in Sonoma County. The City of Santa Rosa has the greatest population in the hazard area: 22,252 persons, or 12.6 percent of the city's total population. All individuals living within the dam failure inundation zone are considered exposed and at heightened risk during a dam failure event.

Table 6-3. Population in the Combined High Hazard Dam-Failure Inundation Area

Jurisdiction	Total Population (2023 ACS)	Population in the Area	% of Jurisdiction Total
City of Cloverdale	8,933	0	0.0%
City of Cotati	7,533	0	0.0%
City of Healdsburg	11,274	16	0.1%
City of Petaluma	59,321	0	0.0%
City of Rohnert Park	44,461	0	0.0%
City of Santa Rosa	177,216	22,252	12.6%
City of Sebastopol	7,466	0	0.0%
City of Sonoma	10,726	0	0.0%
Town of Windsor	26,179	1,303	5.0%
Unincorporated County	132,533	845	0.6%
Sonoma County (Total)	485,642	24,416	5.0%

Source: U.S. Census Bureau 2023 ACS; Cal OES; California Department of Water Resources

The sudden release of water resulting from a dam failure can force residents to evacuate their homes to avoid life-threatening conditions. The potential for loss of life is influenced by the availability and capacity of evacuation routes. Displaced individuals often seek shelter in designated emergency shelters, which are set up by local authorities and relief organizations. In some cases, residents may also seek refuge with family or friends in safer locations. Table 6-4 presents the number of individuals who would be displaced or require short-term shelter in the event of a dam failure.

Table 6-4. Persons Displaced or Seeking Short-Term Shelter Due to Dam Failure

Jurisdiction	Total Population (2023 ACS)	Displaced Population	Persons Seeking Short-Term Shelter
City of Cloverdale	8,933	0	0
City of Cotati	7,533	0	0
City of Healdsburg	11,274	92	48
City of Petaluma	59,321	0	0
City of Rohnert Park	44,461	0	0
City of Santa Rosa	177,216	24,711	3,517
City of Sebastopol	7,466	3	1
City of Sonoma	10,726	0	0
Town of Windsor	26,179	2,113	303
Unincorporated County	132,533	849	253
Sonoma County (Total)	485,642	27,768	4,122

Source: Hazus v6.1, U.S. Census Bureau 2020, 2023 ACS; CalOES; California Department of Water Resources

Socially Vulnerable Population

Older adults, children, individuals with disabilities, access, or functional needs, and economically disadvantaged individuals may be unable to get themselves out of the inundation area or may require additional time and resources to recover. The vulnerable population also includes individuals who would not have adequate warning from the emergency warning system due to limited access to technology or limited English proficiency. Table 6-5 presents the estimated socially vulnerable populations living in the combined dam-failure inundation hazard area.

6.2.2 General Building Stock

As shown in Table 6-6, there are 11,732 buildings in the combined high- and extremely high-hazard dam inundation area, accounting for 3.9 percent of the County's total general building stock. The replacement cost value (RCV) for these buildings is $13.7 billion, or 4.7 percent of the County total. The City of Santa Rosa has the greatest amount of exposure, with 10,034 buildings, 14.3 percent of the jurisdiction total; these account for $12 billion in RCV, or 14.9 percent of the jurisdiction total.

Table 6-7 categorizes buildings within the combined dam inundation hazard area for Sonoma County by general occupancy class, including 6,995 residential, 4,420 commercial, 87 industrial, and 230 government, religious, agricultural, and educational structures.

The damage caused by dam failure is determined by the depth and velocity of the flooding. Properties closest to the dam have the greatest potential to experience the largest, most destructive surge of water. Table 6-8 summarizes the potential building losses from dam failure in Sonoma County, with an estimated total loss of $653 million, 0.2 percent of the County's total RCV. The City of Santa Rosa accounts for the majority of the losses, with an estimated $613 million, about 0.8 percent of its total RCV. The City of Healdsburg shows a minor estimated loss of $2 million (less than 0.1 percent of its RCV). No losses are projected for the cities of Cloverdale, Cotati, Petaluma, Rohnert Park, Sebastopol, and Sonoma.

6.2.3 Community Lifelines and Other Critical Facilities

A dam failure can lead to significant structural damage to public utilities, potentially disrupting essential services. Power outages and communication failures are likely, and drinking water and wastewater treatment facilities may be temporarily shut down. Table 6-9 summarizes the number of community lifelines located in the combined high- and extremely high- hazard dam inundation area. The hazard area contains 158 critical facilities. Transportation accounts for the largest share with 16 sites, followed by communications. The majority—122 facilities—are located within the City of Santa Rosa.

Table 6-10 shows the estimated level of damage to critical facilities due to the combined high and extremely high-hazard dam inundation event. The most affected categories are communications (26 facilities) and safety and security (22 facilities). Most damage is minor, with the majority of facilities falling under the less than 5 percent damage category. One health and medical facility is expected to experience damage of 50 percent or greater.

Table 6-5. Estimated Vulnerable Populations in the Dam Failure Hazard Area

Jurisdiction	Persons Over 65	% of Total	Persons Under 5	% of Total	Non-English Speaking Persons	% of Total	Persons with a Disability	% of Total	Persons in Poverty	% of Total	Single Parent Households	% of Total	No Vehicle Access	% of Total
City of Cloverdale	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Cotati	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Healdsburg	3	0.1%	0	0.0%	0	0.0%	1	0.1%	1	0.1%	0	0.0%	0	0.0%
City of Petaluma	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Rohnert Park	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Santa Rosa	4,141	12.6%	1,091	12.6%	1,218	12.6%	2,801	12.6%	2,086	12.6%	523	12.5%	253	12.5%
City of Sebastopol	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Sonoma	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Town of Windsor	222	5.0%	60	4.9%	36	4.9%	135	4.9%	60	4.9%	34	5.0%	8	4.9%
Unincorporated County	219	0.6%	36	0.6%	27	0.6%	103	0.6%	72	0.6%	14	0.6%	4	0.5%
Sonoma County (Total)	4,585	4.5%	1,187	5.2%	1,281	6.4%	3,040	5.2%	2,219	5.4%	571	5.8%	265	6.1%

Source: U.S. Census Bureau 2023 ACS Vulnerable Population Totals; Cal OES; California Department of Water Resources

Table 6-6. Buildings in the Combined Dam Failure Inundation Hazard Area

Jurisdiction	Jurisdiction Total Buildings	Replacement Cost Value	Buildings in the Area	% of Jurisdiction Total	Replacement Cost Value	% of Jurisdiction Total
City of Cloverdale	4,392	$4,186,783,797	0	0.0%	$0	0.0%
City of Cotati	3,453	$3,554,860,439	0	0.0%	$0	0.0%
City of Healdsburg	6,772	$7,534,677,815	28	0.4%	$74,834,351	1.0%
City of Petaluma	26,057	$31,492,792,559	0	0.0%	$0	0.0%
City of Rohnert Park	14,353	$18,686,653,165	0	0.0%	$0	0.0%
City of Santa Rosa	70,300	$80,707,495,769	10,034	14.3%	$12,037,916,911	14.9%
City of Sebastopol	4,102	$4,123,967,728	0	0.0%	$0	0.0%
City of Sonoma	6,241	$7,237,043,341	0	0.0%	$0	0.0%
Town of Windsor	11,739	$12,681,831,535	724	6.2%	$782,052,789	6.2%
Unincorporated County	150,089	$120,191,027,948	946	0.6%	$807,841,383	0.7%
Sonoma County (Total)	297,498	$290,397,134,097	11,732	3.9%	$13,702,645,433	4.7%

Source: County of Sonoma 2025; LA City Planning 2020; RS Means 2024; Cal OES; California Department of Water Resources

Table 6-7. Buildings in the Combined Dam Failure Inundation Hazard Area by Occupancy

Jurisdiction	Residential	Commercial	Industrial	Other[a]
City of Cloverdale	0	0	0	0
City of Cotati	0	0	0	0
City of Healdsburg	6	12	8	2
City of Petaluma	0	0	0	0
City of Rohnert Park	0	0	0	0
City of Santa Rosa	6,262	3,600	57	115
City of Sebastopol	0	0	0	0
City of Sonoma	0	0	0	0
Town of Windsor	416	292	7	9
Unincorporated County	311	516	15	104
Sonoma County (Total)	6,995	4,420	87	230

Source: County of Sonoma 2025; LA City Planning 2020; Cal OES; California Department of Water Resources

a. Other = Government, Religion, Agricultural, and Education

Table 6-8. Combined Dam-Failure Inundation Hazard Area Impacts on Buildings

Jurisdiction	Total Replacement Cost Value	All Occupancies Loss Value	% of Total	Residential Properties	Commercial Properties	Industrial Properties	All Other Properties
City of Cloverdale	$4,186,783,797	$0	0.0%	$0	$0	$0	$0
City of Cotati	$3,554,860,439	$0	0.0%	$0	$0	$0	$0
City of Healdsburg	$7,534,677,815	$2,551,759	<0.1%	$128,475	$127,000	$2,286,069	$10,215
City of Petaluma	$31,492,792,559	$0	0.0%	$0	$0	$0	$0
City of Rohnert Park	$18,686,653,165	$0	0.0%	$0	$0	$0	$0
City of Santa Rosa	$80,707,495,769	$612,588,280	0.8%	$286,747,874	$280,401,513	$931,771	$44,507,122
City of Sebastopol	$4,123,967,728	$0	0.0%	$0	$0	$0	$0
City of Sonoma	$7,237,043,341	$0	0.0%	$0	$0	$0	$0
Town of Windsor	$12,681,831,535	$6,389,505	0.1%	$5,270,853	$1,043,162	$58,836	$16,654
Unincorporated County	$120,191,027,948	$31,767,073	<0.1%	$4,426,849	$17,826,405	$5,033,167	$4,480,652
Sonoma County (Total)	$290,397,134,097	$653,296,616	0.2%	$296,574,051	$299,398,079	$8,309,843	$49,014,644

Source: Hazus v6.1; County of Sonoma 2025; LA City Planning 2020; RS Means 2024; Cal OES; California Department of Water Resources

Table 6-9. Facilities in the Dam Failure Inundation Hazard Area, by Lifeline Category

Jurisdiction	Communication	Energy	Food, Hydration, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Water Systems	Other Critical Facilities	Total Facilities in Hazard Area	% of Jurisdiction Total
City of Cloverdale	0	0	0	0	0	0	0	0	0	0	0.0%
City of Cotati	0	0	0	0	0	0	0	0	0	0	0.0%
City of Healdsburg	1	0	0	0	1	0	0	0	0	2	3.6%
City of Petaluma	0	0	0	0	0	0	0	0	0	0	0.0%
City of Rohnert Park	0	0	0	0	0	0	0	0	0	0	0.0%
City of Santa Rosa	33	1	9	0	11	27	29	1	11	122	23.1%
City of Sebastopol	0	0	0	0	0	0	0	0	0	0	0.0%
City of Sonoma	0	0	0	0	0	0	0	0	0	0	0.0%
Town of Windsor	1	0	0	0	0	1	7	1	0	10	13.3%
Unincorporated County	3	0	2	0	0	2	16	0	1	24	1.3%
Sonoma County (Total)	38	1	11	0	12	30	52	2	12	158	5.4%

Source: County of Sonoma 2020, 2025; California Energy Commission 2024; Caltrans 2024, 2025; HIFLD 2024, 2025; USACE NID; Cal OES; California Department of Water Resources

Table 6-10. Facilities Experiencing Damage Due to Dam Failure Event

Lifeline	<5% Damage	5 – 19% Damage	20 – 39% Damage	40 – 49% Damage	50% or Greater Damage
Communications	23	2	1	0	0
Energy	1	0	0	0	0
Food, Hydration, Shelter	4	5	0	0	0
Hazardous Materials	0	0	0	0	0
Health and Medical	5	1	0	0	1
Safety and Security	11	11	0	0	0
Transportation	0	0	0	0	0
Water Systems	0	2	0	0	0

Source: Hazus v6.1; County of Sonoma 2020, 2025; California Energy Commission 2024; Caltrans 2024, 2025; HIFLD 2024, 2025; USACE NID; Cal OES; California Department of Water Resources

6.2.4 Economy

Debris management may be a large expense after a dam failure event. Table 6-11 provides Hazus debris estimates for the combined dam failure scenario in three categories: finishes (drywall, insulation, etc.); structural (wood, brick, etc.) and foundations (concrete slab and block, rebar, etc.). The distinction is made because of the different types of equipment needed to handle the debris.

Table 6-11. Estimated Debris Created During the Evaluated Dam Failure Event

Jurisdiction	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
City of Cloverdale	0	0	0	0
City of Cotati	0	0	0	0
City of Healdsburg	13	13	0	0
City of Petaluma	0	0	0	0
City of Rohnert Park	0	0	0	0
City of Santa Rosa	16,405	12,774	1,873	1,758
City of Sebastopol	2	2	0	0
City of Sonoma	0	0	0	0
Town of Windsor	1,090	1,035	27	27
Unincorporated County	643	270	183	190
Sonoma County (Total)	18,153	14,094	2,084	1,975

Source: County of Sonoma 2025; LA City Planning 2020; Cal OES; California Department of Water Resources

6.2.5 Natural Resources

The environmental impacts of a dam failure can include significant water-quality and debris-disposal issues, as well as severe erosion that can impact local ecosystems. Floodwaters can back up sanitary sewer systems and inundate wastewater treatment plants, causing raw sewage to contaminate residential and commercial buildings and the flooded waterway. The contents of unsecured containers of oil, fertilizers, pesticides, and other chemicals may get added to flood waters. Hazardous materials may be released and distributed widely across the floodplain. Water supply and wastewater treatment facilities could be offline for weeks. After the flood waters subside, contaminated and flood-damaged building materials and contents must be properly disposed of. Contaminated sediment must be removed from buildings, yards, and properties (EPA 2024).

6.2.6 Historic and Cultural Resources

Floodwaters released by a dam failure may damage or destroy irreplaceable historic structures, sites, monuments, districts, and documents. Historic and cultural resources also include “moveable heritage,” such as collections of artifacts, statuary, artwork, and important documents or repositories. These resources are housed in libraries, museums, archives, historical repositories, or historic properties.

6.3 FUTURE CHANGES THAT MAY AFFECT RISK

6.3.1 Potential or Planned Development

Any increases in development in the County taking place within dam failure inundation areas would increase the overall risk from the dam failure hazard.

6.3.2 Projected Changes in Population

In 2020, the County’s population was 488,361. The population decreased to 478,299 in 2025 and the California Department of Finance currently expects the downward trend to continue until it hits a low of 474,013 in 2040. However, the county’s population is expected to rebound for the following 30 years, hitting a population of 514,337 by 2070 (CDOF 2024).

As the population grows, development may expand into areas within dam failure inundation zones. As a result, a greater number of residents and structures could be at risk, increasing the potential of injury, loss of life, and property damage.

6.3.3 Climate Change

Future climate change has the potential to significantly increase the risk of dam failure. Shifts in rainfall intensity and runoff patterns can alter river hydrographs from what was used in dam design, reducing the safety margins and raising the likelihood of overtopping or excessive loading. Dams constructed

before modern regulatory standards and without consideration of projected climate impacts are particularly vulnerable to failure as extreme precipitation events become more frequent and intense. Additionally, climate-driven increases in spillway flows may result in greater downstream discharges and an elevated risk of flooding.

6.4 HAZARD-RELATED ISSUES

The most significant issue associated with dam failure involves the properties and populations in the inundation zone. Flooding as a result of a dam failure would significantly impact these areas. There is often limited warning time for dam failures, which are frequently associated with other natural hazard events such as earthquakes, landslides, or severe weather. Important issues associated with the dam failure hazard include the following:

- Dam infrastructure may require repair and improvement to withstand climate change impacts, such as changing in the timing and intensity of rain events.
- Structures located in the dam inundation zone may be located outside of special flood hazard areas, meaning that they are not constructed to withstand floodwaters and are less likely to be covered by flood insurance. Even structures that have been designed with flood hazards in mind may not be able to withstand the height and velocity of flow from a dam failure event.
- California law requires that a property's location in a dam inundation area be disclosed to a seller if the seller or the seller's agent has knowledge of the property's location within the hazard area or if the local jurisdiction has compiled a list of parcels that are in the inundation area and has posted at the offices of the county recorder, county assessor, and county planning agency a notice that identifies the location of the list. It is unknown if this list has been compiled for the planning area.
- The concept of residual risk associated with structural flood control projects should be considered in the design of capital projects and the application of land use regulations.
- Federally regulated dams have an adequate level of oversight and sophistication in the development of emergency action plans for public notification in the unlikely event of failure. However, the protocol for notification of downstream citizens of imminent failure needs to be tied to local emergency response planning.

Drought

Hazard Ranking:



MEDIUM

Drought is a **significant decrease** in water supply relative to what is needed to sufficiently meet typical demand in each location.

Community Lifelines at Risk



2,919
Total

All FEMA Lifeline Categories - High Risk

Adaptive Capacity



Moderate

Population at Risk

485,642
Persons

100%
Total Population

Mitigation Projects

- Enhancing groundwater recharge.
- Drought-resistant crops.
- Integration of drought risk into land-use planning.

7. DROUGHT

7.1 HAZARD PROFILE

7.1.1 Hazard Description

Drought is a significant decrease in water supply relative to what is needed to sufficiently meet typical demand in each location. It is a normal phase in the climate cycle, originating from a deficiency of precipitation over an extended period, usually a season or more. This leads to a water shortage for some activity, group, or environmental sector. Drought can be characterized based on the following (NOAA 2024):

- **Meteorological drought**—Based on measurements such as precipitation deficit compared to normal or expected precipitation. Anomalies of precipitation and temperature may last from several months to several decades. How long they last depends on interactions between the atmosphere and the oceans, soil moisture and land surface processes, topography, internal dynamics, and the accumulated influence of global weather systems.
- **Agricultural drought**—Based on impacts due to reduced precipitation and water supply (e.g., crop loss, herd culling)
- **Hydrological drought**—Based on measurements of stream flows, groundwater, and reservoir levels relative to normal conditions
- **Socioeconomic drought**—Based on direct and indirect socio-economic impacts on society and the economy. Socioeconomic drought occurs when the demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply. If a community has stored enough water to meet its needs in the event of a shortage of rainfall, then it may not experience socioeconomic drought even though its geographic area experiences meteorological drought.

7.1.2 Location

Drought is a regional phenomenon that has the potential to impact the entire planning area. A drought affects all aspects of the environment and the community simultaneously and has the potential to impact every person directly or indirectly in the planning area as well as adversely affect the local economy.

7.1.3 Extent

The severity of a drought depends on many factors. Driving factors are the amount and timing of precipitation, duration of below average rainfall, and the size and location of the affected area. The longer the duration of the drought and the larger the area impacted, the more severe the potential impacts.

Monitoring and Rating Drought

NOAA Drought Indices

The National Oceanic and Atmospheric Administration (NOAA) has developed several indices to measure drought impacts and severity and to map their extent and locations (NWS 2024):

- The ***Palmer Crop Moisture Index*** measures short-term drought weekly to assess impacts on agriculture.
- The ***Palmer Z Index*** measures short-term drought on a monthly scale.
- The ***Palmer Drought Index*** is based on long-term weather patterns. The intensity of drought in a given month is dependent on current weather plus the cumulative patterns of previous months. Weather patterns can change quickly, and the Palmer Drought Severity Index can respond fairly rapidly.
- The ***Palmer Hydrological Drought Index*** quantifies hydrological effects (reservoir levels, groundwater levels, etc.), which take longer to develop and last longer. This index responds more slowly to changing conditions than the Palmer Drought Index.
- The ***Standardized Precipitation Index*** considers only precipitation. A value of zero indicates the median precipitation amount; the index is negative for drought and positive for wet conditions. The Standardized Precipitation Index is computed for time scales ranging from one month to 24 months.

Maps of these indices show drought conditions nationwide at a given point in time. They are not necessarily indicators of any given area's long-term susceptibility to drought.

U.S. Drought Monitor

The U.S. Drought Monitor (USDM) is a map that is updated weekly to show the location and intensity of drought across the country. The USDM uses a five-category system:

- D0—Abnormally Dry
  - Short-term dryness slowing planting, growth of crops
  - Some lingering water deficits
  - Pastures or crops not fully recovered
- D1—Moderate Drought
  - Some damage to crops, pastures
  - Some water shortages developing
  - Voluntary water-use restrictions requested
- D2—Severe Drought
  - Crop or pasture loss likely
  - Water shortages common
  - Water restrictions imposed

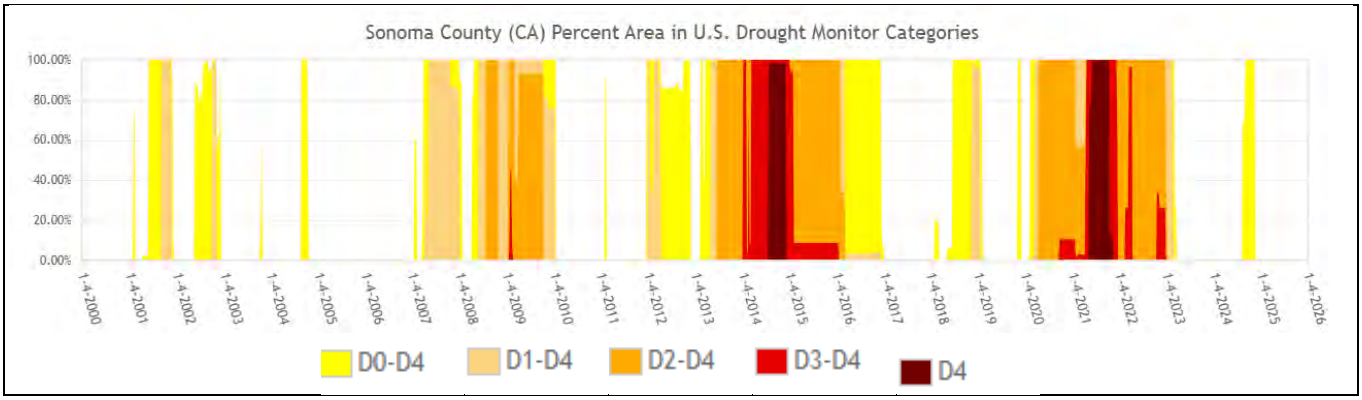
- D3—Extreme Drought
  - Major crop/pasture losses
  - Widespread water shortages or restrictions
- D4—Exceptional Drought
  - Exceptional and widespread crop/pasture losses
  - Shortages of water creating water emergencies

The USDM categories show experts' assessments of conditions related to drought. These experts check variables including temperature, soil moisture, water levels in streams and lakes, snow cover, and meltwater runoff. They also check whether areas are showing drought impacts such as water shortages and business interruptions. Associated statistics show what proportion of various geographic areas are in each category of dryness or drought, and how many people are affected. USDM data goes back to 2000.

Drought Severity in Sonoma County

Sonoma County has a history of severe droughts. As shown in Figure 7-1, at least part of the county has experienced extreme (D3) or exceptional (D4) droughts more than once since 2000.

Figure 7-1. Percent of Sonoma County Affected by Each USDM Rating, 2000-2025



7.1.4 Previous Occurrences

FEMA Disaster Declarations

Table 7-1 lists all drought-related presidentially declared disasters that have included Sonoma County.

Table 7-1. FEMA Disaster Declarations for Drought Events in Sonoma County (1954-2025)

Event Date	Declaration Date	Declaration Number	Event Name
Jan 20, 1977	Jan 20, 1977	EM-3023	Drought

Source: (FEMA 2024)

State Emergency Proclamations

Table 7-2 lists all drought-related state emergency proclamations that have included Sonoma County.

Table 7-2. State Emergency Proclamations for Drought Events in Sonoma County

Event Date	State Proclamation Number	Event Name
April 21, 2021	-	Drought

Source: (Cal OES 2024)

USDA Declarations

Table 7-3 lists drought-related USDA agricultural disaster declarations that have included Sonoma County since the County's previous HMP was developed.

Table 7-3. USDA Declarations for Drought Events in Sonoma County (2020-2025)

Event Date	USDA Declaration Number	Description
10/1/2021	S5146	Drought-FAST TRACK
10/1/2020	S4916	Drought-FAST TRACK
4/14/2020	S4691	Drought-FAST TRACK
4/21/2020	S4697	Drought-FAST TRACK

Source: (USDA 2024)

All Recent Events

Table 7-4 lists major recorded drought-related events that impacted Sonoma County since the previous HMP was developed. For earlier events, refer to the previous HMP.

7.1.5 Probability of Future Occurrences

Based on the historical and more recent drought events in California, Sonoma County has a high probability of future drought events. Sonoma County has been included in USDA drought disaster declarations seven times since 2012. Historical drought data for the planning area indicate there have been four significant multi-year droughts in the last 40 years (1980 to 2025), amounting to a severe drought every 10 to 11 years on average.

Information on previous drought occurrences in the County was used to calculate the probability of future occurrence of such events, as summarized in Table 7-5. Based on historical records and input from the Planning Team, the probability of occurrence for drought in the County is considered "occasional."

Table 7-4. Drought Events in Sonoma County (2020-2025)

Event Date	Declaration or Proclamation Number	Location Impacted	Description
April to September 2020	USDA Declarations S4697 and S4691	Several Counties including Sonoma County	Precipitation was below average, and temperatures were above average.
October 2020 to May 2021	State Proclamation of Emergency and USDA Declaration S4916	Several Counties including Sonoma County	Water Year 2021 was an extreme year in terms of temperature and precipitation, and it followed a Water Year 2020 that was likewise warm and dry. The Colorado River Basin, an important supply for Southern California, continued dry in Water Year 2021, with storage in Lakes Mead and Powell reaching new record lows.
April 27, 2021		Sonoma County	On April 27, 2021, Sonoma County's Board of Supervisors formally proclaimed a local drought emergency, following two exceptionally dry years and critically low reservoir levels (32%-62% of seasonal capacity at Lake Mendocino and Lake Sonoma).
October 1, 2021	USDA Declarations S5146	Sonoma County	Drought

Source: (USDA 2024) (Cal OES 2024)

Table 7-5. Probability of Future Drought Events in Sonoma County

Hazard Type	Number of Occurrences Between 1977 and 2025	Percent Chance of Occurring in Any Given Year
Drought	11	22.4%

Source: (USDA 2024) (Cal OES 2024) (FEMA 2024)

7.1.6 Cascading Impacts on Other Hazards

Drought increases conditions that may trigger fires in the County, such as dead and dying trees and grass. Increasing temperatures and evaporation of moisture are ideal dry conditions for wildfires to occur. Drought is also often accompanied by extreme heat, exposing people to the risk of sunstroke, heat cramps and heat exhaustion. Additionally, droughts can lead to the following (NIDIS 2019).

- Long-term damage to crop quality and crop losses
- Insect infestation leading to crop losses and reduced tree canopy
- Reduction in the ability to perform outdoor activities, which could result in loss of tourism and recreation opportunities

7.2 VULNERABILITY AND IMPACT ASSESSMENT

All of Sonoma County is vulnerable to drought events. The following subsections provide a qualitative discussion of Sonoma County's vulnerability to the drought hazard.

7.2.1 Life, Health, and Safety

Overall Population

Drought can affect people's health and safety and can lower the quantity and quality of potable water for human consumption. A decrease in available water may also impact power generation and availability to residents. Short-term or long-term health effects from drought include heat-related illnesses, waterborne illnesses, recreational risks, limited food availability, and reduced air quality or sanitation. The entire population of Sonoma County (488,361) is exposed to this hazard.

Socially Vulnerable Population

Socially vulnerable populations are susceptible to drought events based on their physical and financial ability to react or respond during a drought. Vulnerable populations can be particularly susceptible due to age, health conditions, and limited ability to mobilize to facilities with shelter, cooling, or medical resources. (CDC 2021). Vulnerable populations include homeless persons, people over 65 years old, low income or linguistically isolated populations, people with life-threatening illnesses, and residents that may struggle to evacuate. The population over the age of 65 may require extra time to evacuate or need assistance to evacuate and are more likely to need medical attention.

7.2.2 General Building Stock

No structures are anticipated to be directly affected by a drought event. However, droughts contribute to conditions conducive to wildfires and reduce fire-fighting capabilities. See Chapter 16 for the wildfire risk assessment.

7.2.3 Community Lifelines and Other Critical Facilities

Drought events generally do not impact buildings; however, droughts have the potential to impact agriculture-related facilities and critical facilities that are associated with water supplies, such as water used with fire-fighting services. Critical facilities in and adjacent to wildfire hazard areas are considered vulnerable to wildfire.

Drought affects groundwater sources, but generally not as quickly as surface water supplies. Groundwater supplies generally take longer to recover. Reduced precipitation during a drought means that groundwater supplies are not replenished at a normal rate. This can lead to a reduction in groundwater levels and problems such as reduced pumping capacity or wells going dry. Shallow wells are more susceptible than deep wells.

7.2.4 Economy

One economic impact of drought is its impact on water supply. When drought conditions persist with little to no relief, water restrictions may be put into place by local or state governments. These restrictions may include placing limitations on lawn watering, car washing services, or recreational/commercial outdoor uses of water supplies. In exceptional drought conditions, watering of lawns and crops may not be an option. If crops are not able to receive water, farmland will dry out and crops will die. This can lead to crop shortages, which, in turn, increases the price of food (NC State University 2013).

Increased demand for water and electricity can also result in shortages and higher costs for these resources. Industries that rely on water for business could be impacted the most. Although most businesses will still be operational, they may be impacted aesthetically. These aesthetic impacts are most significant within the recreation and tourism industry. Moreover, droughts in another area could impact the food supply and price of food for residents within the County.

7.2.5 Natural Resources

Droughts can impact the environment because they can trigger wildfires, increase insect infestations, and exacerbate the spread of disease (IPCC 2016). When a drought occurs, the existing pressure on the ecosystem's natural water supplies are amplified, leading to the loss in the critical services it provides such as purifying water and air, preventing erosion, and providing recreation opportunities (NIDIS n.d.). Droughts also have the potential to lead to water pollution due to the lack of rainwater to dilute any chemicals in water sources. Contaminated water supplies may be harmful to plants and animals. If water is not getting into the soil, the ground will dry up and become unstable. Unstable soils increase the risk of erosion and loss of topsoil (NC State University 2013).

7.2.6 Historic and Cultural Resources

Droughts have significant impacts on historic assets. One primary consequence is an increased risk of wildfires, which can threaten these resources. Additionally, structures—especially historic ones—may experience foundation issues due to the shrink-well cycle of expansive soils. Reduced water availability during drought also affects outdoor recreational activities (FAO 2019).

7.3 FUTURE CHANGES THAT MAY AFFECT RISK

7.3.1 Potential or Planned Development

Any increases in development in the County would increase the overall risk from the drought hazard as development is likely to require additional water resources for drinking water, landscaping, and other uses.

7.3.2 Projected Changes in Population

In 2020, the County's population was 488,361. The population decreased to 478,299 in 2025 and the California Department of Finance currently expects the downward trend to continue until it hits a low of 474,013 in 2040. However, the county's population is expected to rebound for the following 30 years, hitting a population of 514,337 by 2070 (CDOF 2024).

An increase in population increases demand for drinking water, irrigation, landscaping, and industrial use. During drought periods, limited water supplies will be stretched further, increasing the risk of shortages and the need for stricter water use restrictions.

7.3.3 Climate Change

While drought is largely driven by climate change, it also feeds back into the climate system by worsening wildfires and increasing emissions through energy and land use responses. In Sonoma County, this creates a reinforcing cycle that makes building climate resilience and sustainable water management ever more critical.

7.4 HAZARD-RELATED ISSUES

The planning team has identified the following drought-related issues:

- The promotion of additional demand management and water conservation efforts even during non-drought periods should be encouraged.
- The planning area should plan for frequent droughts or multi-year droughts that can limit the ability to successfully recover from one drought and prepare for the next—particularly considering the longevity of the 2012 to 2017 drought.
- Water planning should consider the impacts of additional draw-downs on groundwater supplies as pressure on surface water increases during drought.
- Drought in the county will increase and expand fire-prone areas and adversely affect the timber economy.
- With the possibility of climate change, drought may become a more pervasive issue due to warming trends and wider fluctuations in precipitation patterns. The probability of drought frequencies and durations may increase.
- Alternative water supplies or increased use of recycled water will need to be identified and developed, as well as alternative strategies to allocate and distribute existing water sources.
- Groundwater recharge techniques can be used to increase available water in storage and stabilize the groundwater supply.

Earthquake

Hazard Ranking:



An earthquake is the **vibration** of the earth's surface following a release of energy in the earth's crust. This energy can be generated by a sudden **dislocation** of the crust or by a **volcanic eruption**.

Community Lifelines at Risk

In NEHRP Soils D&E

126
Total



Daycare & Community Center - High Risk

Adaptive Capacity



Moderate

Socially Vulnerable at Risk

In NEHRP Soils D&E

24,308
persons in poverty

59.2%
of all persons in poverty in the county

Mitigation Projects

- Install hazard warning systems.
- Develop post-disaster mitigation plan.
- Seismic retrofitting.

8. EARTHQUAKE

8.1 HAZARD PROFILE

8.1.1 Hazard Description

An earthquake is the vibration of the earth's surface following a release of energy in the earth's crust. This energy can be generated by a sudden dislocation of the crust or by a volcanic eruption. Most destructive quakes are caused by dislocations of the crust. The crust may first bend and then, when the stress exceeds the strength of the rocks, break and snap to a new position. In the process of breaking, vibrations called "seismic waves" are generated. These waves travel outward from the source of the earthquake at varying speeds.

The location of an earthquake is commonly described by its focal depth and the geographic position of its epicenter. The focal depth of an earthquake is the depth from the earth's surface to the region where an earthquake's energy originates (the focus or hypocenter). The epicenter of an earthquake is the point on the earth's surface directly above the hypocenter.

8.1.2 Location

Faults

Sonoma County faces significant earthquake hazards due to its location within a highly active tectonic region of the San Andreas Fault System. Multiple active faults traverse the county, creating risk from surface fault rupture, strong ground shaking, and associated ground failure. Many population centers, transportation routes, and critical facilities are situated in areas with elevated exposure. The following active fault systems pose direct rupture and shaking threats to Sonoma County:

- **Rodgers Creek Fault**—Extends north-south through the Santa Rosa Plain, passing just west of downtown Santa Rosa. Communities including City of Cotati and City of Rohnert Park intersect Alquist-Priolo Earthquake Fault Zones (EFZs) along this fault.
- **Healdsburg Fault**—Runs from the northeast side of Santa Rosa through Windsor and Healdsburg along the east side of the Santa Rosa Plain and Alexander Valley.
- **Maacama Fault**—Continues through the county's northeast exposing communities like Cloverdale to rupture and strong shaking.

Soils Susceptible to Shaking and Liquefaction

A program called the National Earthquake Hazard Reduction Program (NEHRP) creates maps based on soil characteristics to help identify locations subject to liquefaction. NEHRP soil types define the locations that will be significantly affected by an earthquake. The program classifies soils as follows (FEMA n.d.-d):

- NEHRP Soil Type A—Hard Rock
- NEHRP Soil Type B—Firm to Hard Rock
- NEHRP Soil Type C—Dense Soil/Soft Rock
- NEHRP Soil Type D—Stiff Soil
- NEHRP Soil Type E—Soft Clays
- NEHRP Soil Type F—Special Study Soils (liquefiable soils, sensitive clays, organic soils, thick layers of soft clay)

NEHRP Soils A, B and C typically are least likely to generate severe ground shaking. The areas that are commonly most affected by ground shaking and liquefaction have NEHRP Soils D and E. Figure 8-1 shows the locations of these soils types in Sonoma County.

8.1.3 Extent

Magnitude

An earthquake's magnitude is a measure of the energy released at the source of the earthquake. Magnitude is commonly expressed by ratings on the moment magnitude scale (Mw), the most common scale used today (USGS 2023). This scale is based on the total moment release of the earthquake (the product of the distance a fault moved and the force required to move it). The scale is as follows:

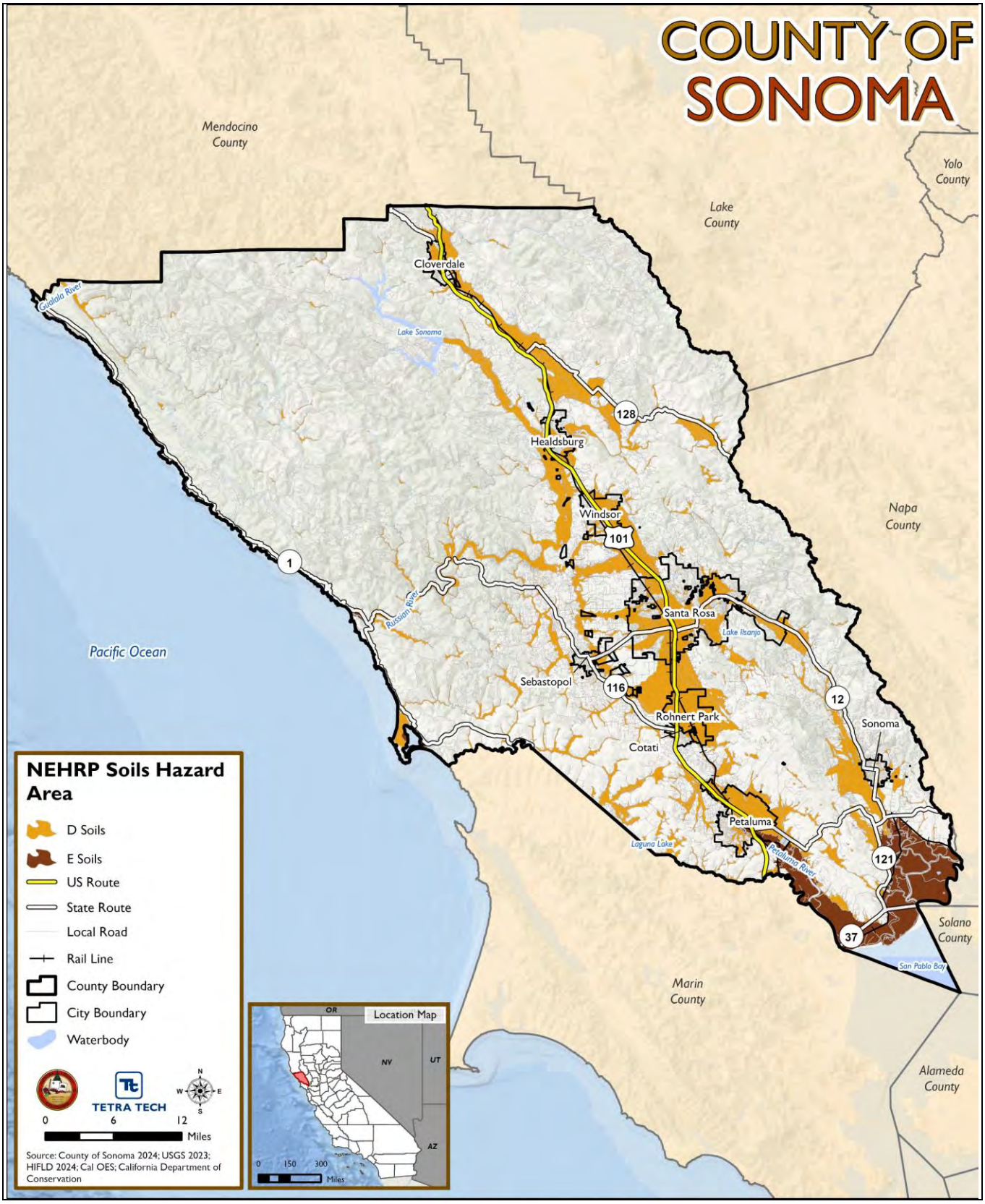
- Great—Mw > 8
- Major—Mw = 7.0 – 7.9
- Strong—Mw = 6.0 – 6.9
- Moderate—Mw = 5.0 – 5.9
- Light—Mw = 4.0 – 4.9
- Minor—Mw = 3.0 – 3.9
- Micro—Mw < 3

Intensity

Intensity is the experience felt by people and structures due to ground shaking caused by an earthquake. An earthquake has only one magnitude and one epicenter, but it produces a range of ground shaking at sites throughout the region, depending on the distance from the earthquake, the rock and soil conditions at sites, and variations in the propagation of seismic waves from the earthquake due to complexities in the structure of the earth's crust.

The ground experiences acceleration when it shakes during an earthquake, and instruments called accelerographs record levels of ground acceleration due to earthquakes at stations throughout a region. The peak ground acceleration (PGA) is the largest acceleration recorded at a particular location during an earthquake. PGA is a measure of how hard the earth shakes in a given geographic area. It is commonly expressed as a percent of the acceleration of gravity (%g).

Figure 8-1. Areas of NEHRP Class D and E Soils in Sonoma County



Intensity scales, such as the modified Mercalli intensity scale, are systems for translating PGA values to the subjective experience of people who feel an earthquake. Ratings of the scale as well as the perceived shaking and damage potential for structures are shown in Table 8-1 shows how PGA is assigned a modified Mercalli scale that represents people's perception of earthquake-caused ground shaking.

Table 8-1. Mercalli Scale and Peak Ground Acceleration Comparison

Modified Mercalli Scale	Perceived Shaking	Estimated PGA[a] (%g)
I	Not Felt	<0.17%
II – III	Weak	0.17% - 1.4%
IV	Light	1.4% - 3.9%
V	Moderate	3.9% - 9.2%
VI	Strong	9.2% - 18%
VII	Very Strong	18% - 34%
VIII	Severe	34% - 65%
IX	Violent	65% - 124%
X – XII	Extreme	>124%

a. PGA = peak ground acceleration. Measured in percentage of g, where g is the acceleration of gravity.
Sources: (USGS 2021, USGS 2011)

Figure 8-2 and Figure 8-3 display the PGA and modified Mercalli intensity rating across Sonoma County for the 500-year and 2,500-year mean return period (MRP) probabilistic earthquake events.

8.1.4 Previous Occurrences

FEMA Disaster Declarations

Table 8-2 lists the single earthquake-related presidentially declared disaster that has included Sonoma County.

Table 8-2. FEMA Disaster Declarations For Earthquake Events in Sonoma County (1954-2025)

Event Date	Declaration Date	Declaration Number	Event Name
August 24, 2014	September 11, 2014	DR-4193	Napa Earthquake

Source: (FEMA 2024)

State Emergency Proclamations

There are no earthquake-related state emergency proclamations that have included Sonoma County since the County's previous HMP was developed.

Figure 8-2. Impacts of a 500-Year MPR Earthquake in Sonoma County

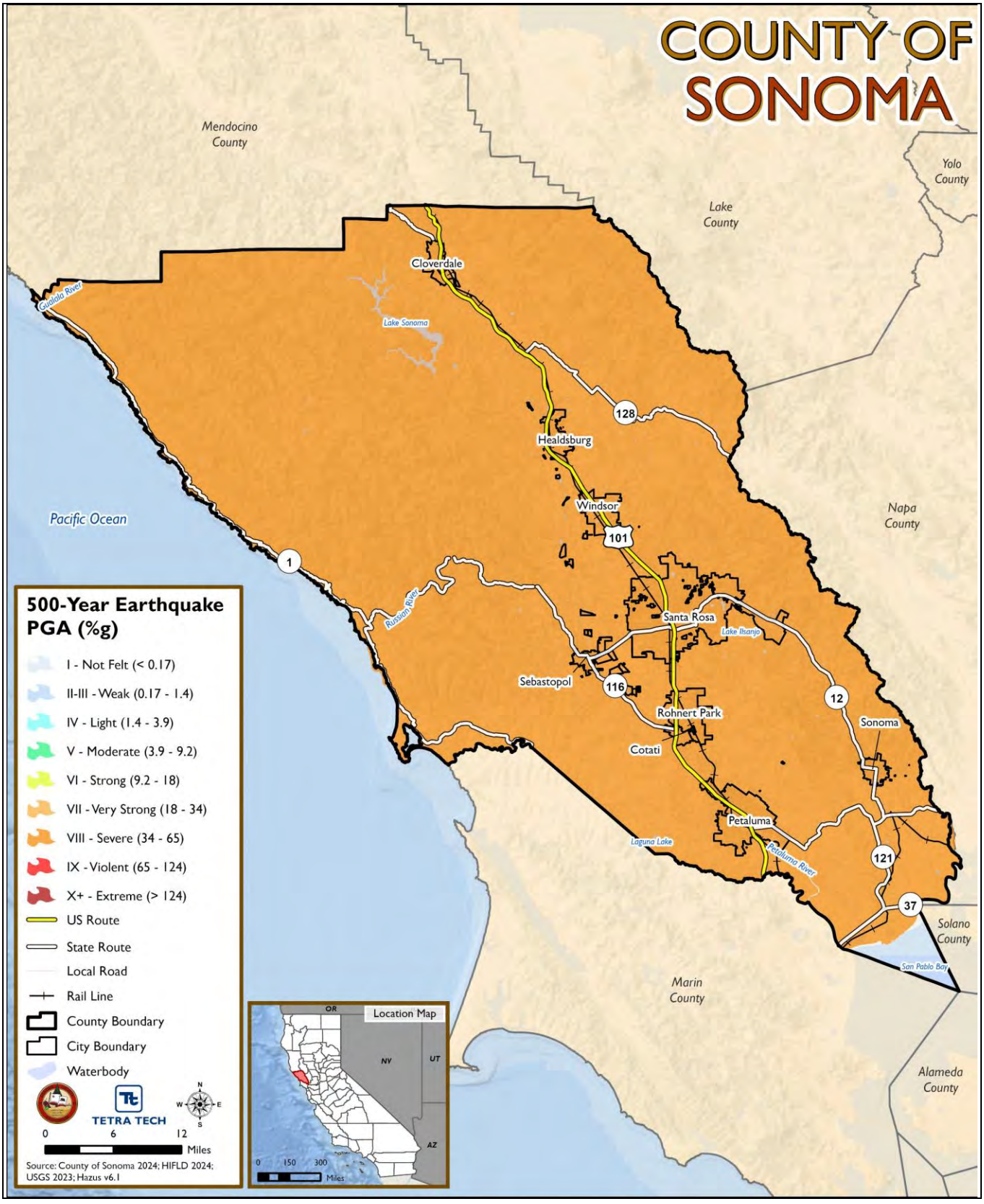
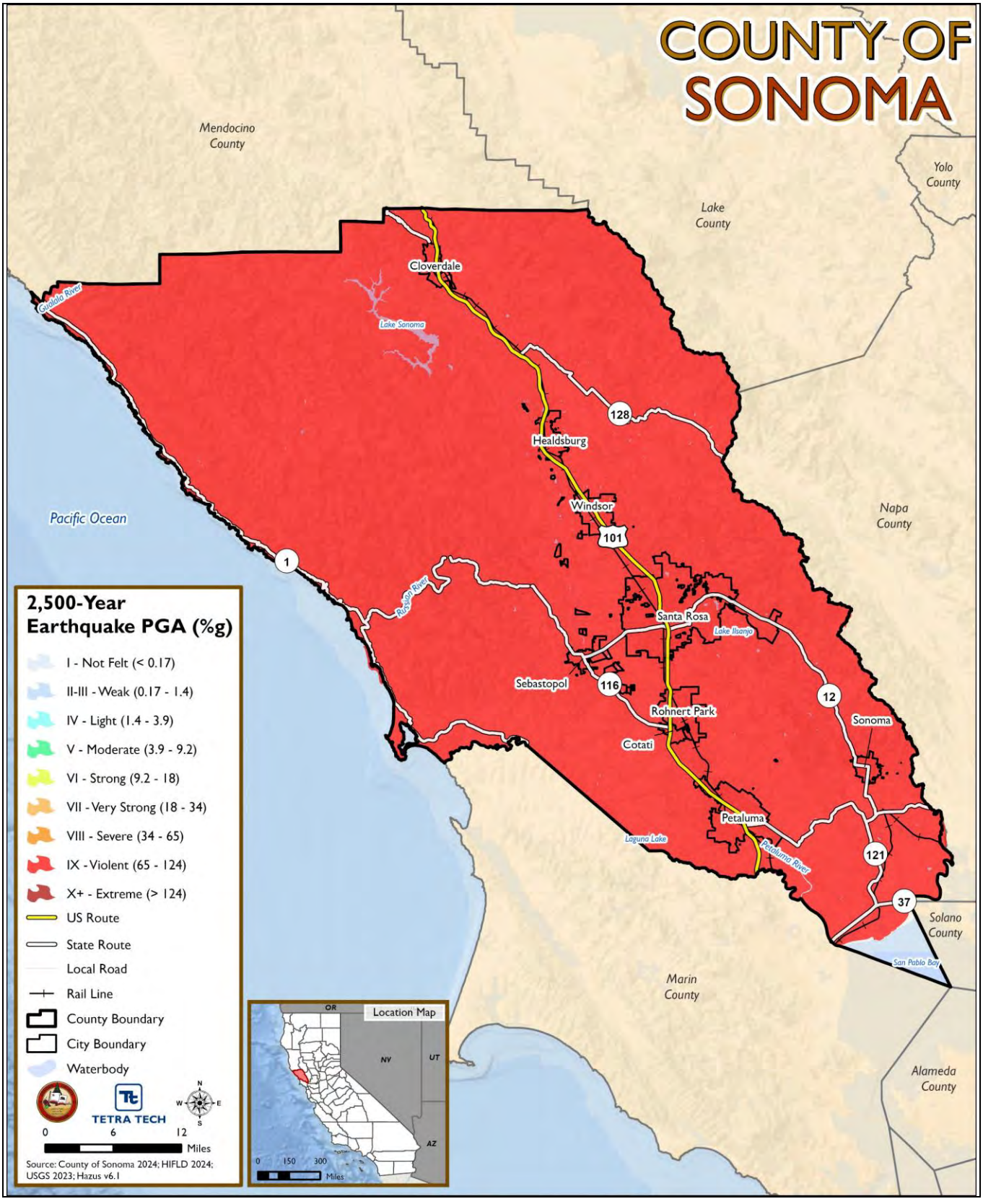


Figure 8-3. Impacts of a 2,500-Year MPR Earthquake in Sonoma County



USDA Declarations

Between 2019 and 2024, Sonoma County was not included in any USDA earthquake-related agricultural disaster declarations (USDA 2024).

All Recent Events

Sonoma County has not experienced any significant earthquake-related events since the development of the previous HMP. However, the sections below provide an overview of major historical earthquakes that have impacted the County.

Pre-1900 Earthquakes

Seven earthquakes are believed to have caused damage to structures in Sonoma County in the 19th century. Reported damage from these earthquakes indicates a Modified Mercalli rating of VI to VIII. Notable events were the 1868 magnitude 7.2 earthquake on the Hayward Fault and the 1898 magnitude 6.7 earthquake on the Rodgers Creek Fault. Although damage from these two events was limited due to the area's sparse population at the time, a recurrence of either of these events would result in significant damage today (County of Sonoma 2017).

1906 San Francisco Earthquake

The April 18, 1906, magnitude 8.3 earthquake on the northern segment of the San Andreas Fault caused major damage in Santa Rosa, Sebastopol, Healdsburg, Petaluma and other communities. Santa Rosa is said to have suffered more damage proportionally to its size than any other Bay Area city. The only reported casualties in Sonoma County were in Santa Rosa, where 65 died. The shaking lasted for about 50 seconds. The Santa Rosa Courthouse was totally destroyed by the shaking and ensuing fire, as were approximately eight blocks of commercial buildings. It was reported that almost all non-wood buildings were destroyed by the shaking alone (County of Sonoma 2017).

1969 Rodgers Creek / Healdsburg Fault Earthquake

The last major earthquakes with an epicenter in Sonoma County occurred on October 1, 1969. Two earthquakes of magnitudes 5.6 and 5.7 originated 2 miles north of Santa Rosa. Damage was concentrated in Santa Rosa and principally confined to the partial collapse of unreinforced masonry buildings and wood frame buildings. In all, 99 structures were significantly damaged, approximately half in the business district and half in residential areas. Total building damage was estimated at $6 million, with dwelling contents losses at $1.25 million. Several County buildings suffered damage, including the library, post office, and veterans memorial building. There was no loss of life from these earthquakes. The mayor of Santa Rosa sought state and federal disaster assistance, but there was not enough damage to public facilities to warrant a declaration. Small Business Administration loans were made available to commercial and residential property owners (County of Sonoma 2017).

1989 Loma Prieta Earthquake

This magnitude 6.9 earthquake was caused by slip along the San Andreas Fault. Damage in Sonoma County was minor (only five dwellings were yellow tagged), but the quake killed 63 people and injured

3,757 throughout Northern California and caused an estimated $6 billion in property damage. It was the largest earthquake to occur on the San Andreas Fault since the 1906 San Francisco earthquake (County of Sonoma 2017).

2014 South Napa Earthquake

On August 24, 2014, a magnitude 6.0 earthquake shook Napa, Solano, and Sonoma County. The epicenter was 9 miles southeast of the City of Sonoma. The earthquake occurred on the West Napa Fault, a fault that was not mapped under the Alquist-Priolo earthquake fault hazard zone. It was the largest event in the Bay Area since the 1989 Loma Prieta earthquake. At least 12 aftershocks followed. The quake injured 257 people and killed one. Several structures in eastern Sonoma County were severely damaged. The governor issued an emergency proclamation for this event and a federal disaster was declared on September 11, 2014. The total economic loss was estimated at $400 million (County of Sonoma 2017).

2016 The Geysers Earthquake

A 5.0 magnitude earthquake occurred 4 miles west of The Geysers and 14 miles southwest of Clearlake on December 14, 2016, following a series of medium size earthquakes in Mammoth Lakes and the Central Coast. This event was primarily felt in the Clearlake and Santa Rosa areas but was also felt throughout the Bay Area.

8.1.5 Probability of Future Occurrences

Historic records of earthquake occurrences give an indication of future probabilities. Seismic activity was more frequent from 1830 to 1930 than it has been since. This leads some scientists to suspect that pressure is building up along the faults in the Bay Area that can result in a large quake. Such a quake could have dramatic and devastating effects throughout the Bay Area. The USGS reports the following earthquake probabilities for the Bay Area over next 30 years ((U.S. Geological Survey n.d.)

- 72 percent probability of an earthquake measuring magnitude 6.7
- 51 percent probability of an earthquake measuring magnitude 7
- 20 percent probability of an earthquake measuring magnitude 7.5

Based on these records and input from the HMWG, the probability of earthquakes occurring in the County is considered occasional.

8.2 VULNERABILITY AND IMPACT ASSESSMENT

8.2.1 Life, Health, and Safety

Overall Population

The entire population of the county is vulnerable to the earthquake hazard. Populations considered most vulnerable to earthquake events are those located in or near buildings at the time of the event, particularly buildings of unreinforced masonry construction. Table 8-3 summarizes the number of people living in areas with seismically sensitive NEHRP Class D soils.

Table 8-3. Population Living on NEHRP Class D and E Soils, Sonoma County

Jurisdiction	Total Population (2023 ACS)	Population in the Hazard Area	% of Jurisdiction Total
City of Cloverdale	8,933	4,754	53.2%
City of Cotati	7,533	2,431	32.3%
City of Healdsburg	11,274	4,020	35.7%
City of Petaluma	59,321	45,694	77.0%
City of Rohnert Park	44,461	44,281	99.6%
City of Santa Rosa	177,216	121,431	68.5%
City of Sebastopol	7,466	173	2.3%
City of Sonoma	10,726	2,176	20.3%
Town of Windsor	26,179	17,762	67.8%
Unincorporated County	132,533	44,192	33.3%
Sonoma County (Total)	485,642	286,914	59.1%

Source: U.S. Census Bureau 2023 ACS; Cal OES; California Department of Conservation

As a result of an earthquake event, residents may be displaced or require temporary long-term shelter. The number of people requiring shelter is generally less than the number displaced as some displaced persons use hotels or stay with family or friends following a disaster event. Table 8-4 shows Hazus estimates of displacement and shelter needs in Sonoma County. The 500-year MRP event could result in 10,089 displaced households and 4,883 individuals requiring short-term shelter, while the 2,500-year MRP event could displace 35,095 households and lead to 16,948 individuals seeking shelter.

Casualty estimates are provided at three different times that represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate represents the maximum residential occupancy load, the 2:00 PM estimate represents the maximum educational, commercial, and industrial sector loads, and the 5:00 PM estimate represents peak commute time. Table 8-5 shows that the severity of impacts increases significantly from the 500-year MRP event to the 2,500-year MRP event. Additionally, the number of injuries, hospitalizations, and casualties varies depending on the time of day, with 2:00 PM generally showing the highest numbers.

Table 8-4. Populations Affected by the 500-Year and 2,500-Year MRP Earthquake Events

Jurisdiction	Total Population (2023 ACS)	500-Year Mean Return Period Earthquake Event: Displaced Households	500-Year Mean Return Period Earthquake Event: Persons Seeking Short-Term Shelter	2,500-Year Mean Return Period Earthquake Event: Displaced Households	2,500-Year Mean Return Period Earthquake Event: Persons Seeking Short-Term Shelter
City of Cloverdale	8,933	125	68	435	230
City of Cotati	7,533	146	69	489	232
City of Healdsburg	11,274	185	83	818	370
City of Petaluma	59,321	1,154	522	3,645	1,642
City of Rohnert Park	44,461	980	493	3,425	1,738
City of Santa Rosa	177,216	4,866	2,437	16,427	8,186
City of Sebastopol	7,466	153	62	493	204
City of Sonoma	10,726	164	66	582	238
Town of Windsor	26,179	303	142	1,129	531
Unincorporated County	132,533	2,013	941	7,652	3,577
Sonoma County (Total)	485,642	10,089	4,883	35,095	16,948

Source: Hazus v6.1, U.S. Census Bureau 2020, 2023 ACS

Table 8-5. Estimated Casualties for the 500-Year and 2,500-Year MRP Earthquake Events

Casualties	500-Year MRP 2:00 AM	500-Year MRP 2:00 PM	500-Year MRP 5:00 PM	2,500-Year MRP 2:00 AM	2,500-Year MRP 2:00 PM	2,500-Year MRP 5:00 PM
Non-hospitalized injuries	1,490	3,436	2,284	4,710	10,428	7,012
Hospitalizations	321	1,074	809	1,177	3,709	3,008
Fatalities	46	275	181	167	994	670

Source: Hazus v6.1

Socially Vulnerable Population

Populations considered most vulnerable are those located in/near the built environment, particularly those near unreinforced masonry construction. Of these most vulnerable populations, socially vulnerable populations, including the elderly (persons over age 65) and individuals living below the poverty threshold, are most susceptible. Factors leading to this higher susceptibility include decreased mobility and financial ability to react or respond during a hazard, and the location and construction quality of their housing.

Table 8-6 presents the estimated socially vulnerable populations located within the NEHRP Soils Class D and E hazard area.

Table 8-6. Vulnerable Persons Living on NEHRP Class D and E Soils

Jurisdiction	Persons Over 65	% of Total	Persons Under 5	% of Total	Non-English Speaking Persons	% of Total	Persons with a Disability	% of Total	Persons in Poverty	% of Total	Single Parent Households	% of Total	No Vehicle Access	% of Total
City of Cloverdale	1,034	53.2%	114	52.8%	250	53.2%	505	53.2%	210	53.2%	78	53.1%	6	46.2%
City of Cotati	362	32.3%	129	32.1%	41	31.5%	264	32.2%	193	32.2%	73	32.0%	0	0.0%
City of Healdsburg	951	35.7%	214	35.6%	156	35.5%	391	35.6%	452	35.6%	88	35.6%	20	35.1%
City of Petaluma	9,741	77.0%	1,968	77.0%	1,777	77.0%	5,031	77.0%	2,787	77.0%	729	77.0%	573	77.0%
City of Rohnert Park	6,079	99.6%	2,669	99.6%	1,439	99.6%	4,873	99.6%	4,482	99.6%	847	99.5%	443	99.6%
City of Santa Rosa	22,598	68.5%	5,955	68.5%	6,646	68.5%	15,288	68.5%	11,388	68.5%	2,858	68.5%	1,384	68.5%
City of Sebastopol	45	2.3%	9	2.3%	5	2.1%	19	2.2%	14	2.3%	2	2.1%	2	1.7%
City of Sonoma	710	20.3%	66	20.1%	25	20.0%	363	20.3%	179	20.2%	44	20.2%	4	18.2%
Town of Windsor	3,033	67.8%	829	67.8%	498	67.8%	1,850	67.8%	829	67.8%	464	67.7%	110	67.5%
Unincorporated County	11,470	33.3%	1,916	33.3%	1,460	33.3%	5,386	33.3%	3,774	33.3%	738	33.3%	253	33.3%
Sonoma County (Total)	56,023	55.0%	13,869	60.7%	12,297	61.6%	33,970	58.4%	24,308	59.2%	5,921	60.4%	2,795	64.4%

Source: U.S. Census Bureau 2023 ACS Vulnerable Population Totals; Cal OES; California Department of Conservation

8.2.2 General Building Stock

The entire general building stock of the county is exposed to the earthquake hazard. Table 8-7 lists the number of buildings on NEHRP Class D and E soils and the replacement cost value (RCV) of those buildings. Table 8-8 categorizes these buildings by occupancy class.

Table 8-9 summarizes the estimated damage from the 500-year MRP earthquake: $13.1 billion in residential damage, $9.2 billion in commercial damage, $2.6 billion in industrial damage, and $2.1 billion in damage to all other occupancy types. Unincorporated Sonoma County is estimated to lose over $12.2 billion (10.2 percent) of its total building and contents from a 500-year MRP earthquake event, which is the most out of all the jurisdictions. Table 8-10 summarizes the estimated damage from the 2,500-year MRP earthquake.

Table 8-11 and Table 8-12 shows that all building occupancy classes are likely to experience all levels of damage severity as a result of the 500-year and 2,500-year MRP events. For the 500-year MRP event, Hazus estimates complete damage to 4,550 residential buildings, 9,569 commercial buildings, 494 industrial buildings, and 1,684 government, religious, agricultural, and educational structures in Sonoma County.

For the 2,500-year MRP event, Hazus estimates complete damage to 18,867 residential buildings, 34,221 commercial buildings, 1,896 industrial buildings, and 5,898 government, religious, agricultural, and educational structures in Sonoma County.

8.2.3 Community Lifelines and Other Critical Facilities

All community lifelines in Sonoma County are exposed to the earthquake hazard. Earthquake events can significantly affect bridges, many of which provide only access to certain neighborhoods. Because softer soil generally follows floodplain boundaries, bridges that cross watercourses should be considered vulnerable. Table 8-13 shows the number of critical facilities located in the NEHRP Class D & E soils hazard area for Sonoma County. A total of 1,341 facilities are located in this hazard area with the highest number among the Transportation lifeline (491). Unincorporated Sonoma County has the highest number of critical facilities (554) located in the NEHRP Class D & E soil hazard area. Table 8-14 and Table 8-15 provide information on lifeline damage and functionality for 500- and 2,500-year mean return period (MRP) earthquake events.

Table 8-7. Buildings on NEHRP Class D & E Soils

Jurisdiction	Jurisdiction Total Buildings	Replacement Cost Value	Buildings in the Hazard Area	% of Jurisdiction Total	Replacement Cost Value	% of Jurisdiction Total
City of Cloverdale	4,392	$4,186,783,797	2,556	58.2%	$2,154,993,583	51.5%
City of Cotati	3,453	$3,554,860,439	1,098	31.8%	$1,509,958,800	42.5%
City of Healdsburg	6,772	$7,534,677,815	2,406	35.5%	$3,003,895,184	39.9%
City of Petaluma	26,057	$31,492,792,559	19,472	74.7%	$25,207,515,410	80.0%
City of Rohnert Park	14,353	$18,686,653,165	14,298	99.6%	$18,655,372,406	99.8%
City of Santa Rosa	70,300	$80,707,495,769	49,724	70.7%	$55,975,758,202	69.4%
City of Sebastopol	4,102	$4,123,967,728	135	3.3%	$200,321,307	4.9%
City of Sonoma	6,241	$7,237,043,341	1,242	19.9%	$1,371,589,456	19.0%
Town of Windsor	11,739	$12,681,831,535	7,465	63.6%	$7,863,229,154	62.0%
Unincorporated County	150,089	$120,191,027,948	43,162	28.8%	$35,914,685,684	29.9%
Sonoma County (Total)	297,498	$290,397,134,097	141,558	47.6%	$151,857,319,188	52.3%

Source: County of Sonoma 2025; LA City Planning 2020; RS Means 2024; Cal OES; California Department of Conservation

Table 8-8. Buildings on NEHRP Class D & E Soils by Occupancy

Jurisdiction	Residential	Commercial	Industrial	Other[a]
City of Cloverdale	1,567	900	36	53
City of Cotati	700	350	42	6
City of Healdsburg	1,471	801	103	31
City of Petaluma	14,457	4,532	272	211
City of Rohnert Park	11,566	2,564	72	96
City of Santa Rosa	34,171	14,729	331	493
City of Sebastopol	59	67	8	1
City of Sonoma	848	373	7	14
Town of Windsor	5,669	1,648	67	81
Unincorporated County	16,258	20,134	1,304	5,466
Sonoma County (Total)	86,766	46,098	2,242	6,452

Source: County of Sonoma 2025; LA City Planning 2020; Cal OES; California Department of Conservation

a. Other = Government, Religion, Agricultural, and Education

Table 8-9. Estimated Damage for 500-Year MRP Earthquake

Jurisdiction	Total Building and Contents Replacement Cost Value (RCV)	Total Estimated Damage Value	% of Total RCV	Residential Estimated Damage	Commercial Estimated Damage	Industrial Estimated Damage	All Other Occupancies Estimated Damage
City of Cloverdale	$4,186,783,797	$288,823,046	6.9%	$137,190,189	$75,866,056	$52,544,384	$23,222,416
City of Cotati	$3,554,860,439	$281,051,543	7.9%	$160,376,306	$88,171,809	$20,380,879	$12,122,549
City of Healdsburg	$7,534,677,815	$709,621,252	9.4%	$320,261,924	$255,957,709	$69,794,774	$63,606,845
City of Petaluma	$31,492,792,559	$2,366,292,655	7.5%	$1,296,500,617	$690,430,436	$214,735,542	$164,626,060
City of Rohnert Park	$18,686,653,165	$1,574,355,695	8.4%	$1,033,462,128	$372,902,097	$96,859,458	$71,132,013
City of Santa Rosa	$80,707,495,769	$8,958,918,513	11.1%	$4,548,966,706	$3,160,837,026	$625,238,769	$623,876,012
City of Sebastopol	$4,123,967,728	$325,102,053	7.9%	$115,299,249	$162,454,376	$26,713,945	$20,634,482
City of Sonoma	$7,237,043,341	$489,156,717	6.8%	$284,004,059	$153,482,369	$25,456,066	$26,214,223
Town of Windsor	$12,681,831,535	$1,030,717,098	8.1%	$577,236,855	$272,993,595	$94,878,616	$85,608,033
Unincorporated County	$120,191,027,948	$12,207,004,012	10.2%	$4,649,091,282	$3,995,913,700	$1,386,911,435	$2,175,087,595
Sonoma County (Total)	$290,397,134,097	$28,231,042,584	9.7%	$13,122,389,314	$9,229,009,173	$2,613,513,868	$3,266,130,229

Source: Hazus v6.1; County of Sonoma 2025; LA City Planning 2020; RS Means 2024

Table 8-10. Estimated Damage for the 2,500-Year MRP Earthquake

Jurisdiction	Total Building and Contents Replacement Cost Value (RCV)	Total Estimated Damage Value	% of Total RCV	Residential Estimated Damage	Commercial Estimated Damage	Industrial Estimated Damage	All Other Occupancies Estimated Damage
City of Cloverdale	$4,186,783,797	$728,560,145	17.4%	$339,590,111	$184,035,610	$146,643,546	$58,290,879
City of Cotati	$3,554,860,439	$671,573,932	18.9%	$381,869,163	$207,896,147	$51,158,741	$30,649,882
City of Healdsburg	$7,534,677,815	$1,842,375,274	24.5%	$862,230,431	$643,793,086	$174,213,061	$162,138,696
City of Petaluma	$31,492,792,559	$5,680,742,023	18.0%	$3,179,112,393	$1,583,851,225	$521,833,383	$395,945,022
City of Rohnert Park	$18,686,653,165	$3,845,162,968	20.6%	$2,464,155,975	$939,357,265	$251,233,495	$190,416,233
City of Santa Rosa	$80,707,495,769	$21,629,518,026	26.8%	$11,655,095,731	$7,075,923,153	$1,398,548,473	$1,499,950,669
City of Sebastopol	$4,123,967,728	$742,365,069	18.0%	$278,423,295	$356,100,034	$60,329,326	$47,512,415
City of Sonoma	$7,237,043,341	$1,175,598,052	16.2%	$686,690,128	$363,595,163	$61,878,027	$63,434,733
Town of Windsor	$12,681,831,535	$2,414,265,163	19.0%	$1,372,866,396	$587,829,949	$232,443,437	$221,125,381
Unincorporated County	$120,191,027,948	$29,916,460,901	24.9%	$11,920,031,310	$9,464,852,721	$3,435,819,649	$5,095,757,221
Sonoma County (Total)	$290,397,134,097	$68,646,621,554	23.6%	$33,140,064,933	$21,407,234,351	$6,334,101,138	$7,765,221,132

Source: Hazus v6.1; County of Sonoma 2025; LA City Planning 2020; RS Means 2024

Table 8-11. Predicted Level of Damage from the 500-Year MRP Earthquake

Occupancy Class	Total Number of Buildings in Occupancy	Severity of Expected Damage	Building Count	Percent Buildings in Occupancy Class
Residential Exposure (Single and Multi-Family Dwellings)	153,720	NONE	35,492	23.1%
		SLIGHT	62,986	41.0%
		MODERATE	41,013	26.7%
		EXTENSIVE	9,678	6.3%
		COMPLETE	4,550	3.0%
Commercial Buildings	115,413	NONE	19,382	16.8%
		SLIGHT	28,560	24.7%
		MODERATE	37,909	32.8%
		EXTENSIVE	19,992	17.3%
		COMPLETE	9,569	8.3%
Industrial Buildings	6,762	NONE	1,146	16.9%
		SLIGHT	1,694	25.1%
		MODERATE	2,278	33.7%
		EXTENSIVE	1,151	17.0%
		COMPLETE	494	7.3%
Government, Religion, Agricultural, and Education Buildings	25,361	NONE	5,589	22.0%
		SLIGHT	7,408	29.2%
		MODERATE	7,418	29.2%
		EXTENSIVE	3,264	12.9%
		COMPLETE	1,684	6.6%

Source: Hazus v6.1; County of Sonoma 2025; LA City Planning 2020
Note: Building count may not match total number of buildings due to rounding.

Table 8-12. Predicted Level of Damage from the 2,500-Year MRP Earthquake

Occupancy Class	Total Number of Buildings in Occupancy	Severity of Expected Damage	Building Count	Percent Buildings in Occupancy Class
Residential Exposure (Single and Multi-Family Dwellings)	153,720	NONE	7,967	5.2%
		SLIGHT	39,949	26.0%
		MODERATE	63,438	41.3%
		EXTENSIVE	23,500	15.3%
		COMPLETE	18,867	12.3%
Commercial Buildings	115,413	NONE	3,066	2.7%
		SLIGHT	12,140	10.5%
		MODERATE	33,756	29.2%
		EXTENSIVE	32,230	27.9%
		COMPLETE	34,221	29.7%
Industrial Buildings	6,762	NONE	171	2.5%
		SLIGHT	703	10.4%
		MODERATE	2,008	29.7%
		EXTENSIVE	1,984	29.3%
		COMPLETE	1,896	28.0%
Government, Religion, Agricultural, and Education Buildings	25,361	NONE	1,087	4.3%
		SLIGHT	4,046	16.0%
		MODERATE	8,336	32.9%
		EXTENSIVE	5,994	23.6%
		COMPLETE	5,898	23.3%

Source: Hazus v6.1; County of Sonoma 2025; LA City Planning 2020

Table 8-13. Facilities in the NEHRP Class D&E Hazard Area, by Lifeline Category

Jurisdiction	Communications	Energy	Food, Hydration, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Water Systems	Other Critical Facilities	Total Facilities in Hazard Area	% of Jurisdiction Total
City of Cloverdale	2	0	8	0	2	10	7	1	6	36	83.7%
City of Cotati	1	0	0	0	1	0	3	3	2	10	26.3%
City of Healdsburg	5	0	2	0	3	5	4	1	5	25	44.6%
City of Petaluma	22	0	12	0	10	29	32	0	12	117	77.5%
City of Rohnert Park	16	2	14	0	9	21	22	0	12	96	100.0%
City of Santa Rosa	93	2	36	0	37	101	100	5	55	429	81.3%
City of Sebastopol	0	0	1	0	1	0	1	0	0	3	7.0%
City of Sonoma	0	1	5	0	1	4	5	0	3	19	31.1%
Town of Windsor	6	1	5	0	6	6	22	1	5	52	69.3%
Unincorporated County	19	6	33	0	33	78	295	64	26	554	30.3%
Sonoma County (Total)	164	12	116	0	103	254	491	75	126	1,341	45.9%

Source: County of Sonoma 2020, 2025; California Energy Commission 2024; Caltrans 2024, 2025; HIFLD 2024, 2025; USACE NID; Cal OES; California Department of Conservation

Table 8-14. Community Lifeline Damage and Functionality, 500-Year MRP Earthquake

Lifeline	Damage: None	Damage: Slight	Damage: Moderate	Damage: Extensive	Damage: Complete	Functionality: Day 1	Functionality: Day 7	Functionality: Day 30	Functionality: Day 90
Communications	12.4%	25.9%	40.2%	18.3%	3.2%	12.4%	38.2%	78.4%	96.7%
Energy	17.7%	30.7%	39.7%	10.1%	1.8%	17.6%	48.2%	88.0%	98.1%
Food, Hydration, Shelter	26.9%	41.7%	26.5%	4.3%	0.5%	26.9%	68.4%	95.1%	99.4%
Hazardous Materials	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Health and Medical	28.2%	47.2%	22.3%	2.2%	0.1%	28.1%	74.2%	97.6%	98.7%
Safety and Security	26.5%	33.7%	31.7%	7.1%	1.0%	26.4%	59.6%	91.8%	96.3%
Transportation	67.5%	12.4%	7.6%	7.7%	4.7%	76.9%	86.2%	88.7%	92.9%
Water Systems	30.5%	45.8%	21.2%	2.4%	0.1%	30.4%	76.0%	97.4%	99.8%

Source: Hazus v6.1; County of Sonoma 2020, 2025; California Energy Commission 2024; Caltrans 2024, 2025; HIFLD 2024, 2025; USACE NID
Note: Results shown for damage represent the average across all facilities in a lifeline category of the probability of a facility experiencing the indicated level of damage

Table 8-15. Community Lifeline Damage and Functionality, 2,500-Year MRP Earthquake

Lifeline	Damage: None	Damage: Slight	Damage: Moderate	Damage: Extensive	Damage: Complete	Functionality: Day 1	Functionality: Day 7	Functionality: Day 30	Functionality: Day 90
Communications	1.5%	8.9%	31.6%	34.8%	23.1%	1.4%	10.4%	42.0%	76.9%
Energy	2.7%	13.2%	40.2%	30.6%	13.3%	2.6%	15.8%	56.0%	86.6%
Food, Hydration, Shelter	6.0%	25.5%	43.5%	18.9%	6.1%	5.9%	31.3%	74.9%	93.8%
Hazardous Materials	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Health and Medical	5.7%	31.5%	45.1%	15.0%	2.7%	5.7%	36.4%	82.3%	89.8%
Safety and Security	4.8%	16.0%	41.7%	27.4%	10.0%	4.8%	20.6%	62.5%	80.5%
Transportation	29.4%	12.4%	12.4%	18.8%	26.9%	41.7%	52.5%	57.6%	69.4%
Water Systems	5.6%	30.5%	44.5%	16.4%	3.0%	5.5%	35.9%	80.5%	96.9%

Source: Hazus v6.1; County of Sonoma 2020, 2025; California Energy Commission 2024; Caltrans 2024, 2025; HIFLD 2024, 2025; USACE NID
Note: Results shown for damage represent the average across all facilities in a lifeline category of the probability of a facility experiencing the indicated level of damage

8.2.4 Economy

Earthquake impacts on the economy include loss of business function, damage to inventory, relocation costs, wage loss, and rental loss due to the repair/replacement of buildings. Hazus estimates the volume of debris that may be generated as a result of an earthquake event. Debris estimates are divided into two categories (FEMA 2024):

- Reinforced concrete and steel that require special equipment to break it up before it can be transported,
- Brick, wood, and other debris that can be loaded directly onto trucks with bulldozers.

Table 8-16 and Table 8-17 summarize Hazus estimates of debris generated county-wide from an earthquake event in Sonoma County. For the 500-year MRP event, approximately 1.8 million tons of brick/wood debris and 3.6 million tons of concrete/steel debris are expected, with unincorporated Sonoma County contributing the largest share, 806,702 tons of brick/wood, and 1,670,077 tons of concrete/steel. For the 2,500-year MRP event, debris estimates rise to 4.6 million tons of brick/wood and 9.3 million tons of concrete/steel, again with unincorporated Sonoma County generating the most, 2.1 million tons of brick/wood and 4.4 million tons of concrete/steel.

8.2.5 Natural Resources

Natural ecosystems may suffer from landslides, soil liquefaction, and altered water flows, which can destroy habitats, contaminate freshwater sources, and disrupt geothermal systems vital to local ecology.

Table 8-16. Debris Generated by the 500-Year MRP Earthquake Events

Jurisdiction	Brick/Wood (tons)	Concrete/Steel (tons)
City of Cloverdale	16,625	29,299
City of Cotati	20,227	29,804
City of Healdsburg	40,021	82,022
City of Petaluma	139,693	253,945
City of Rohnert Park	103,064	144,437
City of Santa Rosa	545,796	1,162,141
City of Sebastopol	23,332	47,467
City of Sonoma	33,531	50,953
Town of Windsor	71,050	122,306
Unincorporated County	806,702	1,670,077
Sonoma County (Total)	1,800,041	3,592,450

Source: Hazus v6.1; County of Sonoma 2025; LA City Planning 2020

Table 8-17. Debris Generated by the 2,500-Year MRP Earthquake Events

Jurisdiction	Brick/Wood (tons)	Concrete/Steel (tons)
City of Cloverdale	41,987	86,788
City of Cotati	49,333	84,954
City of Healdsburg	111,919	236,852
City of Petaluma	356,587	668,058
City of Rohnert Park	254,450	421,638
City of Santa Rosa	1,351,878	2,859,517
City of Sebastopol	52,862	113,874
City of Sonoma	82,486	136,778
Town of Windsor	172,458	299,698
Unincorporated County	2,120,117	4,405,152
Sonoma County (Total)	4,594,076	9,313,309

Source: Hazus v6.1; County of Sonoma 2025; LA City Planning 2020

8.2.6 Historic and Cultural Resources

Historic buildings, temples, churches, and other culturally significant sites are at risk of structural damage or complete loss, threatening the preservation of irreplaceable heritage. Cultural resources, including traditional practices tied to natural landscapes, may be disrupted, and institutions such as museums that house art, artifacts, and historical documents face potential damage, resulting in a profound loss of cultural identity and knowledge.

8.3 FUTURE CHANGES THAT MAY AFFECT RISK

8.3.1 Potential or Planned Development

Any increases in development in the County would increase the overall risk from the earthquake hazard, though new development is likely to be better protected than older building stock due to meeting modern building code requirements.

8.3.2 Projected Changes in Population

In 2020, the County's population was 488,361. The population decreased to 478,299 in 2025 and the California Department of Finance currently expects the downward trend to continue until it hits a low of 474,013 in 2040. However, the county's population is expected to rebound for the following 30 years, hitting a population of 514,337 by 2070 (CDOF 2024).

A growing population may complicate emergency response and recovery efforts. In addition, the financial cost of earthquake recovery such as housing displacement, infrastructure repair and economic disruption, may rise.

8.3.3 Climate Change

The potential direct impacts of climate change on earthquake probability are unknown. However, climate change may increase the risk of cascading hazards related to earthquakes, including landslides.

8.4 HAZARD-RELATED ISSUES

Important issues associated with an earthquake include the following:

- A large percentage of the planning area is located on NEHRP D soils, which are prone to liquefaction. Structures on these soils may experience significant structural damage.
- It is estimated more than a third of the planning area's building stock was built prior to 1975, when seismic provisions became uniformly applied through building code applications. Many structures may need seismic retrofits in order to withstand a moderate earthquake. Residential retrofit programs, such as Earthquake Brace + Bolt, may be able to assist in the costs of these efforts.
- Due to limitations in current modeling abilities, the risk to critical facilities in the planning area from the earthquake hazard is likely understated. A more thorough review of the age of critical facilities, codes they were built to, and location on liquefiable soils should be conducted.
- Damage to transportation systems in the planning area after an earthquake has the potential to significantly disrupt response and recovery efforts and lead to isolation of populations.
- Earthquakes can cause fires in wooden homes and collapse of essential buildings such as fire stations.
- Landslides and tsunamis are major secondary hazards that could have a widespread effect on the county.
- Communities are expected to be self-sufficient up to two weeks after a major earthquake without government response agencies, utilities, private-sector services, and infrastructure components. Education programs are currently in place to facilitate development of individual, family, neighborhood, and business earthquake preparedness. It takes individuals, families, and communities working in concert with one another to be prepared for disaster.
- After a major seismic event, the planning area is likely to experience disruptions in the flow of goods and services resulting from the destruction of major transportation infrastructure across the broader region.
- A seismic event can damage communication systems, complicating efforts to coordinate response to the event.

Extreme Cold

Hazard Ranking:



For Sonoma County, extreme cold is defined as temperatures of **0 °F** or below. Extreme cold events have the potential to happen anywhere in the planning area.

Community Lifelines at Risk



2,919
Total

All FEMA Lifeline Categories - High Risk

Adaptive Capacity



Moderate

Population at Risk

485,642
Persons

100%
Total Population

Mitigation Projects

- Establish warming centers.
- Backup power generators.
- Public education and outreach.

9. EXTREME COLD

9.1 HAZARD PROFILE

9.1.1 Hazard Description

Extreme cold events are when temperatures drop well below the normal low temperatures for an area. In some areas, temperatures below freezing are normal during winter. For Sonoma County, there is no recorded history of temperatures reaching 0 °F, and the community is accustomed to milder temperatures, even in winter. Therefore, this HMP defines extreme cold as temperatures of 32 °F or below, which is the threshold used by the National Weather Service (NWS) to issue a freeze warning. (NWS n.d.).

9.1.2 Location

Extreme cold events have the potential to happen anywhere in the planning area. Mountainous regions experience heavier snowfall and a greater risk of road closures.

9.1.3 Extent

The extent (severity or magnitude) of extreme cold temperatures is generally measured through the wind chill temperature index. The index provides an accurate, understandable, and useful formula for calculating the dangers from wind and cold temperatures. Wind chill temperature is presented in Figure 9-1.

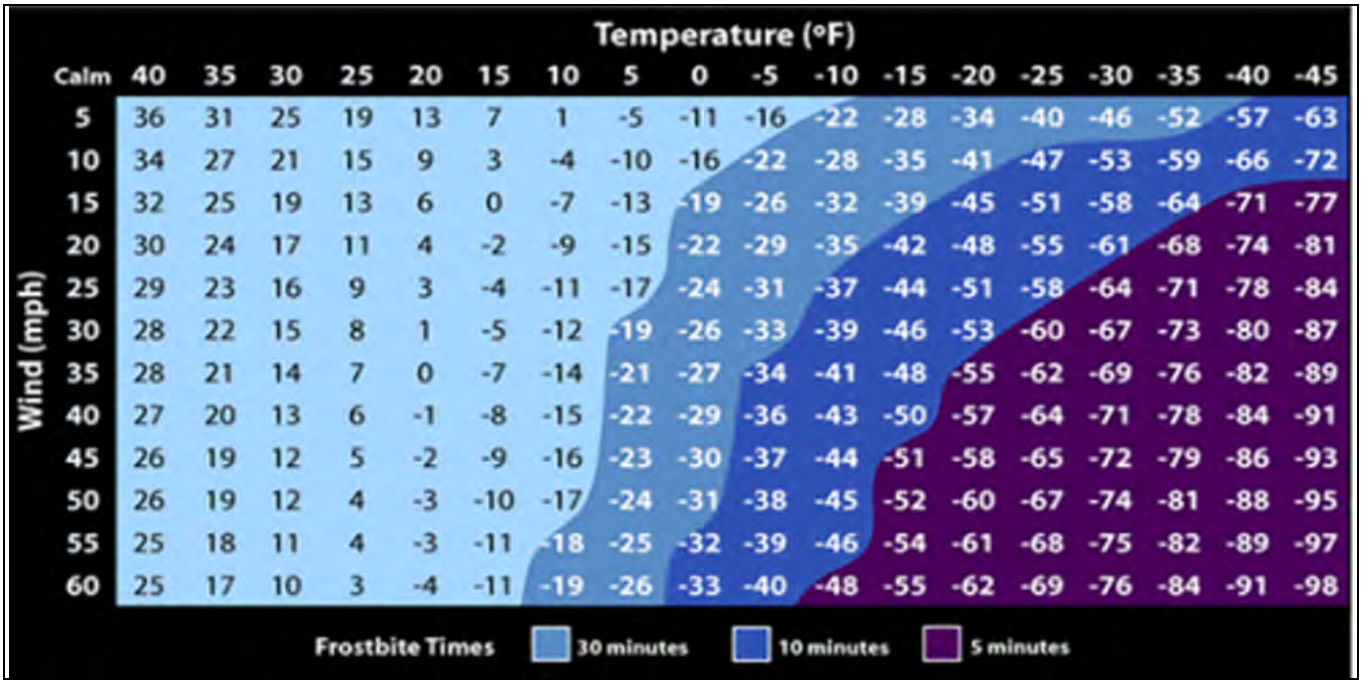
Currently, the only way to headline very cold temperatures is with NWS-designated wind chill advisories or warnings. When actual temperatures reach wind chill warning criteria with little to no wind, extreme cold warnings may be issued (NWS 2021b). Recent low temperatures in Sonoma County have reached 26 °F.

9.1.4 Previous Occurrences

FEMA Disaster Declarations

Table 9-1 lists all extreme cold-related presidentially declared disasters that have included Sonoma County.

Figure 9-1. Wind Chill Index



Source: (NWS 2021b)

Table 9-1. FEMA Disaster Declarations for Extreme Cold Events in Sonoma County (1954-2025)

Event Date	Declaration Date	Declaration Number	Event Name
Dec 19, 1990 – Jan 3, 1991	Feb 11, 1991	DR-894	Freeze of 1991
Jan 3, 1995 – Feb 10, 1995	Jan 10, 1995	DR-1044	Severe Winter Storms, Flooding, Landslides, Mud Flows
Feb 13, 1995 – Apr 19, 1995	Mar 12, 1995	DR-1046	Severe Winter Storms, Flooding, Landslides, Mud Flows
Feb 2, 1998 – Apr 30, 1998	Feb 9, 1998	DR-1203	Severe Winter Storms and Flooding
Jan 3, 2017 – Jan 12, 2017	Feb 14, 2017	DR-4301	Severe Winter Storms, Flooding, and Mudslides
Feb 1, 2017 – Feb 23, 2017	Apr 1, 2017	DR-4308	Severe Winter Storms, Flooding, Mudslides
Feb 24, 2019 – Mar 1, 2019	May 18, 2019	DR-4434	Severe Winter Storms, Flooding, Landslides, and Mudslides
Jan 8, 2023 – Jan 31, 2023	Jan 9, 2023	EM-3591	Severe Winter Storms, Flooding, and Mudslides
Dec 27, 2022 – Jan 31, 2023	Jan 14, 2023	DR-4683	Severe Winter Storms, Flooding, Landslides, and Mudslides
Mar 9, 2023 – Jul 10, 2023	Mar 10, 2023	EM-3592	Severe Winter Storms, Flooding, Landslides, and Mudslides
Feb 21, 2023 – Jul 10, 2023	Apr 3, 2023	DR-4699	Severe Winter Storms, Straight-line Winds, Flooding, Landslides, and Mudslides

Source: (FEMA 2024)

State Emergency Proclamations

Sonoma County has not been included in any extreme cold-related state emergency proclamations since the previous HMP update.

USDA Declarations

No USDA freeze-related disaster declarations placed Sonoma County as a “primary” eligible county. However, the County was included as an adjacent contiguous county for freezing events in 2022.

All Recent Events

Table 9-2 lists major recorded extreme cold-related events that impacted Sonoma County since the previous HMP was developed. For earlier events, refer to the previous HMP.

Table 9-2. Extreme Cold Events in Sonoma County (2020-2025)

Event Date	Declaration or Proclamation Number	Location Impacted	Description
November 10, 2020	N/A	City of Santa Rosa	Mesonet station near Santa Rosa showed temperatures just below 28 °F.
January 26, 2021	N/A	City of Santa Rosa	Santa Rosa CIMIS reported temperatures between 23 °F and 28 °F.
February 23-25, 2021	N/A		Four consecutive mornings of below-freezing temperatures forced some Sonoma County wine grape growers to protect swelling buds following prior weeks of warm, dry weather. The temperature dropped to 26 °F in downtown Santa Rosa on the morning of the 24th, a new daily record.
January 21, 2023	N/A	Cloverdale	Freeze warnings across the North Bay and Southern Salinas Valley. Five people were transported to hospitals after black ice caused a three-car collision on U.S. Highway 101 near the community of Asti, south of Cloverdale.
February 14, 2023	N/A	Sonoma County	The County of Sonoma issued a freeze alert in response to the National Weather Service’s prediction of sub-freezing temperatures.

Source: (NOAA NCEI 2025)

9.1.5 Probability of Future Occurrences

Information on previous extreme cold occurrences in the County was used to calculate the probability of future occurrence of such events, as summarized in Table 9-3. Based on historical records and input from the Planning Team, the probability of occurrence for extreme cold in the County is considered “occasional.”

Table 9-3. probability of Future Extreme Cold Events in Sonoma County

Hazard Type	Number of Occurrences Between 1996 and 2025	Annual Probability of Occurrence
Extreme Cold	8	27%

Source: (NOAA NCEI 2025)

9.1.6 Cascading Impacts on Other Hazards

Extreme cold events can exacerbate the threats from wind and winter weather events for the County. Extreme variation in temperatures could also create ideal atmospheric conditions for severe storms or worsen the outcome of severe winter weather during freezing and thawing periods.

9.2 VULNERABILITY AND IMPACT ASSESSMENT

All of Sonoma County is vulnerable to extreme cold events. The following subsections provide a qualitative discussion of Sonoma County's vulnerability to the extreme cold hazard.

9.2.1 Life, Health, and Safety

Overall Population

For the purposes of this HMP, the entire population of Sonoma County (488,361) is exposed to extreme cold events. The following health hazards are related to extreme cold temperatures (NWS 2022):

- Wind chill measures how wind and cold feel on exposed skin. As the wind increases, heat is carried away from the body at an accelerated rate, driving down the body temperature.
- Frostbite is damage to body tissue caused by extreme cold. A wind chill of -20 °F will cause frostbite in 30 minutes. Frostbite can cause a loss of feeling and a white or pale appearance in extremities.
- Hypothermia is a condition brought on when the body temperature drops to less than 95°F, and it can be deadly. Warning signs of hypothermia include uncontrollable shivering, memory loss, disorientation, incoherence, slurred speech, drowsiness, and apparent exhaustion.

Socially Vulnerable Population

Populations most at risk from extreme cold include the elderly, who are less able to withstand cold temperatures due to health conditions and limited mobility to access shelters; infants and young children; individuals with chronic medical conditions (e.g., heart disease, high blood pressure); and low income persons who cannot afford adequate heating (CDC 2022, CDC 2005).

Those experiencing homelessness are particularly likely to experience the impacts of extreme cold or freezing temperatures. The cumulative effects over several days of continuous exposure to cold

temperatures, without relief, pose additional risks for the homeless, especially those with underlying medical conditions.

9.2.2 General Building Stock

All the building stock in Sonoma County is exposed to the extreme temperature hazard. Extreme cold temperature can damage buildings through freezing/bursting pipes and freeze/thaw cycles, as well as increasing vulnerability to home fires. Additionally, manufactured homes (mobile homes) and old or poorly constructed facilities can have inadequate capabilities to withstand extreme cold events. Proper strategies help safeguard buildings and their contents. Sudden and dramatic fluctuations in heating or cooling should be minimized.

9.2.3 Community Lifelines and Other Critical Facilities

All critical facilities in the County are exposed to the extreme cold hazard. Impacts on lifelines and critical facilities are the same as described for general building stock. It is essential that critical facilities remain operational during natural hazard events.

9.2.4 Economy

Impacts of extreme cold events on the economy include loss of business function and damage to and loss of inventory. Business-owners can be faced with increased financial burdens due to unexpected repairs caused to the building (e.g., pipes bursting), higher than normal utility bills, or business interruption due to power failure (i.e., loss of electricity, telecommunications due to power lines downed by ice).

9.2.5 Natural Resources

Freezing and warming weather patterns can create changes in natural processes (USGS 2020). Extreme cold events can affect ecosystems, which can destroy food webs and deplete resources in the environment.

9.2.6 Historic and Cultural Resources

Historic and cultural resources are vulnerable to freeze and thaw cycles and rapid wetting and drying cycles (NPS 2016). Cultural landscapes may experience declines in vegetation species and faster deterioration of constructed landscape features (e.g., corrosion, decay, desiccation) due to increased freeze and thaw cycles. Furthermore, buildings, facilities, and structures are susceptible to extreme cold, resulting in surface cracking, flaking, and sugaring of building stone, as well as spalling of brick due to wet frost (NPS 2016).

9.3 FUTURE CHANGES THAT MAY AFFECT RISK

9.3.1 Potential or Planned Development

Any increases in development in the County would increase the overall risk from the extreme cold hazard.

9.3.2 Projected Changes in Population

In 2020, the County's population was 488,361. The population decreased to 478,299 in 2025 and the California Department of Finance currently expects the downward trend to continue until it hits a low of 474,013 in 2040. However, the county's population is expected to rebound for the following 30 years, hitting a population of 514,337 by 2070 (CDOF 2024).

An increase in population is likely to result in an increase in overall risk from extreme cold events.

9.3.3 Climate Change

As temperatures warm over time, the occurrence of extreme cold conditions is likely to decrease. However, more severe storms may still result in continued occurrence of extreme cold events.

9.4 HAZARD-RELATED ISSUES

Extreme weather events pose growing public health and infrastructure challenges. Individuals with chronic conditions, such as cardiovascular disease, are more sensitive to cold, and limited access to healthcare during these events can worsen outcomes. Energy reliability is also a concern, cold weather increases demand on the grid, especially in underserved or rural areas, and dependence on electric heating systems heightens vulnerability during outages. While these topics are slightly addressed above, more consideration should be taken to fully understand and plan for their impacts.

Future updates to building codes, energy policies, and emergency response plans should prioritize resilience. Investments in warming centers and targeted public outreach can further strengthen community preparedness and protect vulnerable populations. This can be addressed within the mitigation strategy.

Extreme Heat

Hazard Ranking:



MEDIUM

Extreme heat is defined as temperatures that hover **10 °F** or more above the average high temperatures for a region for several days or weeks.

Community Lifelines at Risk



2,919
Total

All FEMA Lifeline Categories - High Risk

Adaptive Capacity



Moderate

Population at Risk

485,642
Persons

100%
Total Population

Mitigation Projects

- Establish cooling centers.
- Tree planting and vegetation.
- Backup power generators.
- Community alert systems.

10. EXTREME HEAT

10.1 HAZARD PROFILE

10.1.1 Hazard Description

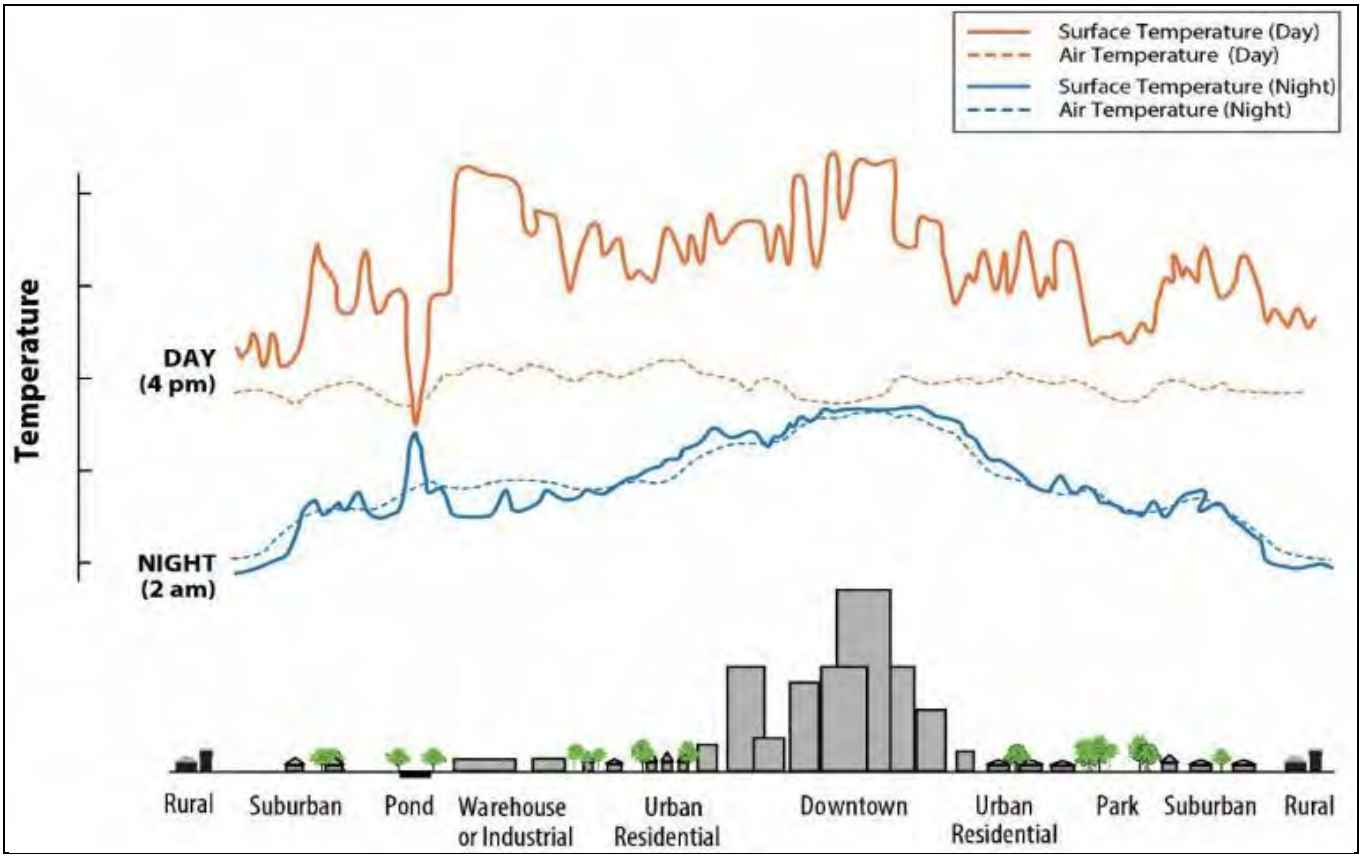
Extreme heat is defined as temperatures that hover 10 ºF or more above the average high temperatures for a region for several days or weeks. Extreme heat events can result in heat-related illnesses and deaths, cause drought, and impact water supplies.

Extreme heat is the primary weather-related cause of death in the United States. In a 10-year record of weather fatalities across the nation (2006 to 2015), excessive heat claimed more lives each year than floods, lightning, tornadoes, and hurricanes. According to the *California Climate Adaptation Strategy*, heat waves have claimed more lives in California than all other declared disaster events combined. Despite this history, not a single heat emergency was proclaimed in California at the state or federal level between 1960 and 2016. Heat waves do not strike victims immediately, but their cumulative effects slowly cause harm to vulnerable populations.

Urban areas face greater risk during an extreme heat event than rural and suburban areas. When urban buildings, roads, and other infrastructure replace open land and vegetation, surfaces that were once permeable and moist become impermeable and dry. These changes cause urban areas to become warmer than the surrounding areas (U.S. EPA 2019). As shown in Figure 10-1, surface temperatures vary more than atmospheric air temperatures during the day. The dip in surface temperatures over the pond area shows how water maintains a nearly constant temperature day and night because it does not absorb the sun's energy the same way as buildings and paved surfaces. Parks, open land, and bodies of water can create cooler areas within a city. Temperatures are typically lower at suburban-rural borders than in downtown areas.

The term "heat island" describes built up areas that are hotter than nearby less-developed areas. The annual mean air temperature of a city with more than a million people can be between 1.8 ºF and 5.4ºF warmer than its surrounding areas. In the evening, the difference in air temperatures can be as high as 22 ºF. Heat islands occur on the surface and in the atmosphere. On a hot, sunny day, the sun can heat dry, exposed urban surfaces to temperatures 50 ºF to 90 ºF hotter than the air. Heat islands can affect communities by increasing peak energy demand during the summer, contributing to air pollution and greenhouse gas emissions, causing heat-related illness and death, and degrading water quality (U.S. EPA 2019).

Figure 10-1. Heat Island Effect Diagram



Source: (U.S. EPA 2019)

10.1.2 Location

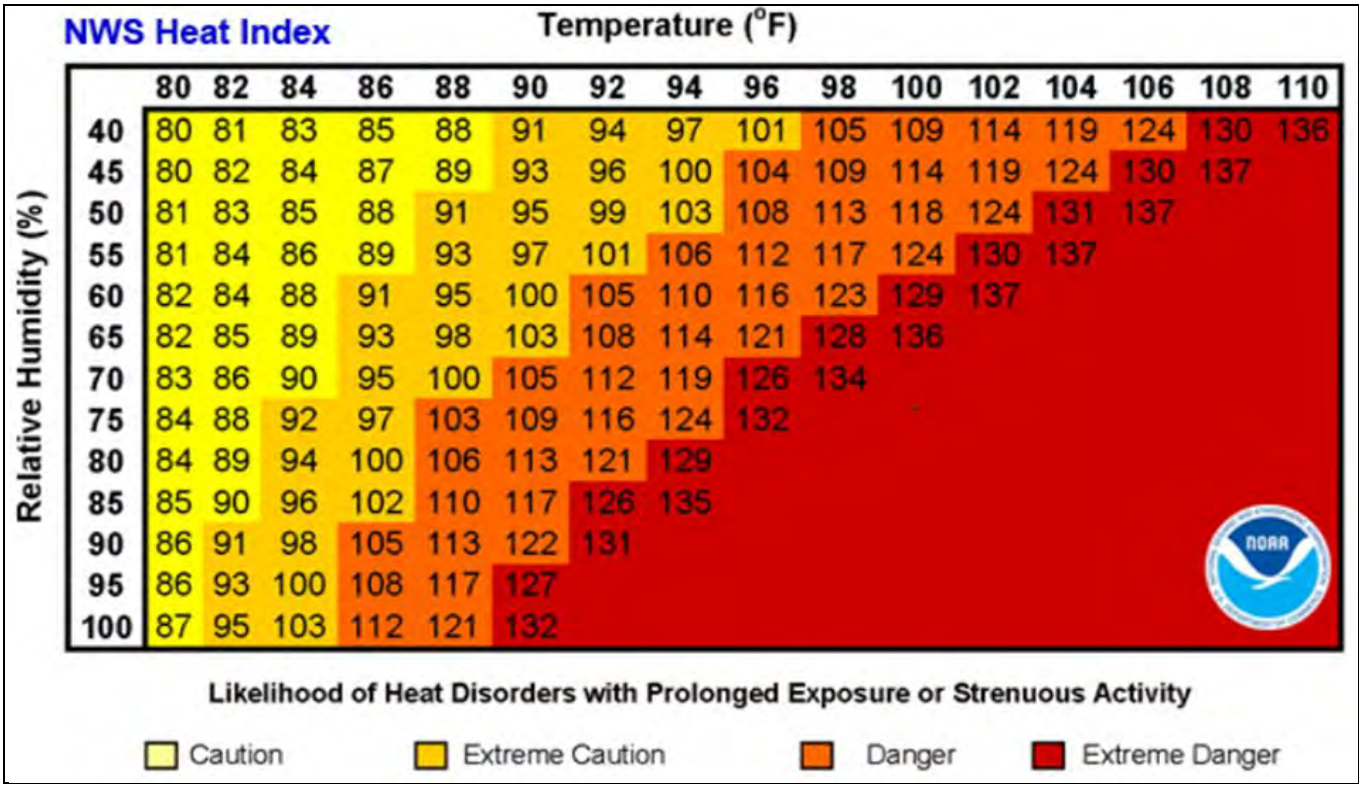
All of Sonoma County is exposed to the extreme heat hazard. Population centers are more likely to experience higher temperatures due to urban heat island effect.

10.1.3 Extent

The extent of extreme heat temperatures is generally measured through the heat index (see Figure 10-2). Created by the NWS, the heat index is a chart that accurately measures apparent temperature of the air as it increases with the relative humidity. The temperature and relative humidity are needed to determine the heat index. Once both values have been identified, the heat index is the corresponding number of both values. This index provides a measure of how temperatures feel; however, the values are devised for shady, light wind conditions.

The NWS issues excessive heat outlooks when the potential exists for an excessive heat event in the next three to seven days. Watches are issued when conditions are favorable for an excessive heat event in the next 24 to 72 hours. Excessive heat warning/advisories are issued when an excessive heat event is expected in the next 36 hours (NWS 2021).

Figure 10-2. NWS Heat Index Chart – Shaded Areas



Source: (NWS 2021)

10.1.4 Previous Occurrences

FEMA Disaster Declarations

Between 1954 and 2025, Sonoma County was not included in any major disaster (DR) or emergency (EM) declarations for extreme heat-related events (FEMA 2025).

State Emergency Proclamations

Emergency proclamations N-14-22 and N-15-22 were declared statewide for the period from August 31 to September 7, 2022, due to an extreme heat event that placed significant demand and strain on California's energy grid (Cal OES 2025).

USDA Declarations

Between 2017 and 2025, Sonoma County was not included in any USDA heat-related agricultural disaster declarations (USDA 2024).

All Recent Events

Table 10-1 lists major recorded extreme heat-related events that impacted Sonoma County.

Table 10-1. Recorded Past Extreme Heat Events in Sonoma County

Event Date	Declaration or Proclamation Number	Location Impacted	Description
July 21-24, 2006	N/A	North Bay Mountains	Heat advisory conditions were met for several days in the North Bay Mountains. Temperatures at 1700 feet reached 105 °F during the day and held in the upper 70s at night.
September 25, 2019	N/A	City of Santa Rosa	Two days of heat advisories along with several daily record high temperatures. Heat related power failure in northwest Santa Rosa left 5,500 customers without power.
September 7-8, 2020	N/A	City of Santa Rosa	The City of Santa Rosa tied its record high temperature for the month of September at 110 °F.
June 17, 2021	N/A	City of Santa Rosa	Santa Rosa climate station reported 104 °F breaking a previous daily record of 101 °F in 1922.
June 10, 2022	N/A	Sonoma County	Sonoma County Airport reached a high of 102 °F
June 21, 2022	N/A	City of Santa Rosa	Downtown Napa and Santa Rosa reached 104 °F. Several other cities in the valleys reached the low to mid 100s.
September 5-6, 2022	N/A	City of Santa Rosa	Santa Rosa co-op site set a new monthly max temperature record of 112 °F., breaking the previous record of 110 °F recorded in 2020, 2017, and 1971. On the 6th, Santa Rosa set an all-time record high temperature of 115 °F, beating its previous record 113 °F set in 1913.
July 1, 2023	N/A	City of Santa Rosa	The Santa Rosa co-op site recorded a daily record high of 104 °F, from a previous record of 101 °F in 1972.
July 16, 2023	N/A	City of Santa Rosa	The Santa Rosa co-op site tied the daily record of 99 °F, also achieved in 1935.
July 3-6, 2024	N/A	Sonoma County	A 28-year old man drowned in the Russian River near the Patterson Point Preserve on Wednesday July 3, while seeking relief from the heat. A 51-year old man drowned in the Russian River on Saturday July 6.
October 2-7, 2024	N/A	Sonoma County	Sonoma County reported 19 calls to 911 for heat related illnesses

Source: (NOAA NCEI 2025)

10.1.5 Probability of Future Occurrences

Information on previous extreme heat occurrences in the County was used to calculate the probability of future occurrence of such events, as shown in Table 10-2. Based on historical records and input from the Planning Team, the probability of occurrence for extreme heat in the County is considered “occasional.”

Table 10-2. Probability of Future Extreme Heat Events in Sonoma County

Hazard Type	Number of Occurrences Between 1996 and 2024	Annual Probability of Occurrence
Extreme Heat	11	38%

Source: (NOAA NCEI 2025)

10.1.6 Cascading Impacts on Other Hazards

Extreme heat events can exacerbate the drought hazard and increase the potential risk of wildfires for the County. For example, extreme heat events may accelerate evaporation rates, which may dry out the air and soils, making some terrestrial plants and soil more susceptible to catching fire. Extreme variation in temperatures could also create ideal atmospheric conditions for severe storms.

Extreme heat events also result in heavy loading on the electrical grid and may cause brownouts or periods of utility failure. Extreme heat can result in very poor air quality. Heat is a major contributor to ozone pollution, which happens when emissions react under heat and sunlight (PBS News 2022).

10.2 VULNERABILITY AND IMPACT ASSESSMENT

All of Sonoma County is vulnerable to extreme heat events. The following subsections discuss Sonoma County's vulnerability, in a qualitative nature, to the extreme heat hazard.

10.2.1 Life, Health, and Safety

Overall Population

The entire population of Sonoma County (488,361) is exposed to extreme heat events. Extreme heat events have potential health impacts including injury and death. The following health hazards are related to extreme heat (CDC 2022b):

- Heat exhaustion is the body's response to an excessive loss of water and salt, usually through excessive sweating. Symptoms can include headache, cramping, dizziness, and weakness.
- Heat stroke is the most serious heat-related illness. It occurs when the body can no longer control its temperature: the body's temperature rises rapidly, the sweating mechanism fails, and the body is unable to cool down. When heat stroke occurs, the body temperature can rise to 106 °F or higher within 10 to 15 minutes. Heat stroke can cause permanent disability or death if the person does not receive emergency treatment.

Table 10-3 summarizes the effects of prolonged exposure to direct sunlight on the human body during extreme heat events. Adhering to extreme temperature warnings and conducting appropriate mitigation and preparation measures can significantly reduce the risk of temperature-related deaths.

Table 10-3. Adverse Effects of Prolonged Exposure to High Heat Index

Category	Heat Index	Effects on the Body
Caution	80 °F – 90 °F	Fatigue possible with prolonged exposure and/or physical activity
Extreme Caution	90 °F – 103 °F	Heat stroke, heat cramps, or heat exhaustion possible with prolonged exposure and/or physical activity
Danger	103 °F – 124 °F	Heat cramps or heat exhaustion likely, and heat stroke possible with prolonged exposure and/or physical activity
Extreme Danger	125 °F or higher	Heat stroke highly likely

Source: (NWS 2021b)

Socially Vulnerable Population

Populations most at risk extreme heat events include the elderly, who are less able to withstand temperatures extremes due to their age, health conditions, and limited mobility to access shelters; infants and children up to 4 years of age; individuals with chronic medical conditions (e.g., heart disease, high blood pressure); and low-income persons that cannot afford adequate cooling; (CDC 2022a, CDC 2005). In addition, populations reliant on medical equipment are especially vulnerable during extreme heat events when brownout or power outages occur.

Individuals with physical or mobility constraints, cognitive impairments, economic constraints, or social isolation are typically at greater risk from the adverse effects of excessive heat events. The average summertime mortality for excessive heat events is dependent upon the methodology used to derive such estimates. Certain medical conditions, such as heat stroke, can be directly attributable to excessive heat, while others may be exacerbated by excessive heat, resulting in medical emergencies.

10.2.2 General Building Stock

All the building stock in the County is exposed to the extreme heat hazard. Extreme or prolonged heat exposure may affect older, poorly built, or uninsulated buildings. Newer built structures generally are not impacted by extreme or prolonged heat exposure; however, elevated summer temperatures increase the energy demand for cooling. Losses can be associated with the overheating of heating, ventilation, and air conditioning systems.

10.2.3 Community Lifelines and Other Critical Facilities

All critical facilities in the County are exposed to the extreme heat hazard. It is essential that these facilities remain operational during natural hazard events. Extreme heat events can cause short periods of utility failures, commonly referred to as brownouts, due to increased usage of air conditioners. Impacts on transportation infrastructure from extreme heat include softening or buckling of road pavement and deterioration of concrete structures, compromising the integrity of roadways or reducing their useful lifetimes. Similarly, bridge joints and other structural elements expand and contract during periods of extreme heat and cold, requiring maintenance and reducing their useful lifetimes (OPR, CNRA, CEC 2018).

10.2.4 Economy

Impacts of extreme heat events on the economy include loss of business function and damage to and loss of inventory. Business-owners can be faced with increased financial burdens due to unexpected repairs caused to the building, higher than normal utility bills, or business interruption due to power failure (i.e., loss of electricity, telecommunications).

10.2.5 Natural Resources

Extreme heat events can have particularly negative impacts on aquatic systems, contributing to fish kills, aquatic plant die offs, and increased likelihood of harmful algal blooms. These events can also affect ecosystems, which can destroy food webs and deplete resources in the environment.

10.2.6 Historic and Cultural Resources

Extreme heat can increase the risk of ignition of fires and their propagation. Fire causes material loss and deformation of cultural heritage assets and may also increase the probability of cracking or splitting in built structures. Under extreme heat, stones can face both macro (e.g., cracking of stones, soot accumulation, color change in stone containing iron) and micro degradation (e.g., mineralogical, and textural changes), leading to potential structural instability. The long-term impacts include weakened stones and increased susceptibility to deterioration processes such as salt weathering and temperature cycling (Sesana, et al. 2021). Outdoor events and festivals may suffer from low attendance or cancellation due to extreme heat conditions.

10.3 FUTURE CHANGES THAT MAY AFFECT RISK

10.3.1 Potential or Planned Development

Any increases in development in the County would increase the overall risk from the extreme heat hazard.

10.3.2 Projected Changes in Population

In 2020, the County's population was 488,361. The population decreased to 478,299 in 2025 and the California Department of Finance currently expects the downward trend to continue until it hits a low of 474,013 in 2040. However, the county's population is expected to rebound for the following 30 years, hitting a population of 514,337 by 2070 (CDOF 2024).

Substantial increases in populated areas may necessitate utility system upgrades to meet demands for water and electricity during extreme temperature events.

10.3.3 Climate Change

Climate change may cause more extreme heat patterns that could impact the planning area. Increased frequency and intensity of heat and heat related events may result in greater damage.

10.4 HAZARD-RELATED ISSUES

Extreme heat can place significant stress on infrastructure, including roads, bridges, and buildings. High temperatures cause materials to expand and contract, leading to cracks and other forms of damage. Additionally, there is often an increased demand for energy during extreme heat events, particularly for cooling. This surge in energy use can lead to power outages and increased stress on energy grids.

Extreme Wind

Hazard Ranking:



MEDIUM

Wind is air moving from **high** to **low pressure**. It is the rough horizontal movement of air (as opposed to an air current) caused by **uneven** heating of the Earth's surface.

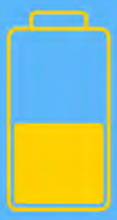
Community Lifelines at Risk



2,919
Total

All FEMA Lifeline Categories - High Risk

Adaptive Capacity



Moderate

Population at Risk

485,642
Persons

100%
Total Population

Mitigation Projects

- Impact-resistant windows and doors.
- Tree maintenance and management.
- Building Codes and Enforcement.

11. EXTREME WIND

11.1 HAZARD PROFILE

11.1.1 Hazard Description

Wind is air moving from high to low pressure. It is the rough horizontal movement of air (as opposed to an air current) caused by uneven heating of the earth's surface. It occurs at all scales, from local breezes generated by heating of land surfaces and lasting tens of minutes to global winds resulting from solar heating of the earth. Types of damaging winds include the following (NOAA 2024):

- **Straight-line wind** is any thunderstorm wind not associated with rotation (e.g., tornadic winds). Straight-line winds are movements of air from areas of higher pressure to areas of lower pressure—the greater the difference in pressure, the stronger the winds.
- A **downdraft** is a small-scale column of air that rapidly sinks toward the ground and usually results in a downburst.
- A **downburst** is a strong downdraft with horizontal dimensions larger than 2.5 miles, resulting in an outward burst or damaging winds on or near the ground. It is usually associated with thunderstorms but can occur with rainstorms too weak to produce thunder.
- A **microburst** is a small, concentrated downburst that produces an outward burst of damaging winds near the surface. It is typically short-lived, lasting only 5 to 10 minutes, with maximum wind speeds of up to 168 miles per hour (mph).
- A **macroburst** is an outward burst of strong winds at or near the surface wider than 2.5 miles across that can occur when a downdraft reaches the surface. While usually associated with thunderstorms, microburst can also occur in storms when no thunder is present.
- A **gust front** is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. It is characterized by a wind shift, temperature drop, and gusty winds ahead of a thunderstorm.
- A **derecho** is a widespread and long-lived windstorm associated with thunderstorms that are often curved. A derecho generally consists of several microbursts, downbursts, and downburst clusters, and these types of wind events are unique in that they travel great distances.
- A **bow echo** is a formation of showers or thunderstorms that exhibits a curved or bowed appearance. These phenomena typically develop from a cluster of storms; however, they can also originate from a single supercell thunderstorm. When a bow echo travels more than 250 miles and produces widespread wind gusts of 58 mph or greater, it is classified as a derecho (NOAA 2023).

Extreme wind can cause injuries and fatalities in a number of ways. Downed trees may fall on homes or cars, killing or injuring those inside them. Objects that are not secured can be picked up in wind events and become projectiles. Structures that collapse or blow over during damaging wind events, especially tornadoes, may kill or injure those seeking shelter inside.

A tornado is a narrow, violently rotating column of air that extends from the base of a thunderstorm to the ground. Tornadoes can cause fatalities and devastate neighborhoods in seconds. Destruction from tornadoes depends on the size, intensity, and duration of the storm. High wind velocity and wind-blown debris, along with lightning or hail, cause most of the damage from tornadoes. These winds can have severe impacts on buildings, pulling off roof coverings, roof deck, or wall siding and pushing or pulling off windows. Damage paths can be greater than one mile wide and 50 miles long. Tornadoes typically move at speeds between 30 and 125 miles per hour and can generate internal winds exceeding 300 miles per hour. The average lifespan of a tornado is five minutes (NOAA 2024).

11.1.2 Location

Extreme wind events have the potential to happen anywhere in the planning area. Wind events are most damaging to areas that are heavily wooded. Under most conditions, the planning area's highest winds come from the northeast.

11.1.3 Extent

Straight-Line Winds

Straight-line wind is a general term used to describe damaging winds that are not tornadoes. They are many different types of straight-line winds. Most damaging straight-line winds are generated by thunderstorm systems, although some result from other types of weather phenomena. Damaging winds are those that exceed 50 to 60 mph. The Beaufort Wind Chart (Table 11-1) provides terminology and a description of potential impacts at different levels (NWS n.d.).

Table 11-1. Beaufort Wind Chart

Beaufort Number	Range (mph)	Terminology	Description
0	0	Calm	Calm. Smoke rises vertically.
1	1-3	Light air	Wind motion visible in smoke.
2	4-7	Light breeze	Wind felt on exposed skin. Leaves rustle.
3	8-12	Gentle breeze	Leaves and smaller twigs in constant motion.
4	13-18	Moderate breeze	Dust and loose paper is raised. Small branches begin to move.
5	19-24	Fresh breeze	Smaller trees sway
6	25-31	Strong breeze	Large branches in motion. Whistling heard in overhead wires. Umbrella use is difficult.
7	32-38	Near gale	Whole trees in motion. Some difficulty when walking into the wind.
8	39-46	Gale	Twigs broken from trees. Cars veer on road.
9	47-54	Sever gale	Light structure damage.
10	55-63	Storm	Trees uprooted. Considerable structural damage.
11	64-73	Violent storm	Widespread structural damage.
12	74-95	Hurricane	Considerable and widespread damage to structures.

Source: (NWS n.d.)

Tornado

Tornadoes are measured by estimating wind speeds based on post-tornado damage to 28 indicators, such as motels, strip malls, small barns, sing family residences, and schools. Tornado severity is classified according to the Enhanced Fujita Scale and assigned a number from EF0 to EF5. Tornado severity classified on the Fujita Scale is shown in Table 11-2.

Table 11-2. Enhanced Fujita Scale

Enhanced Fujita Number	3-Second Gust (mph)
0	65-85
1	86-110
2	111-135
3	136-165
4	166-200
5	Over 200

Source: (NOAA 2007)

11.1.4 Previous Occurrences

FEMA Disaster Declarations

Table 11-3 lists all extreme wind-related federal disasters that have included Sonoma County.

Table 11-3. FEMA Disaster Declarations for Extreme Wind Events in Sonoma County (1954-2025)

Event Date	Declaration Date	Declaration Number	Event Name
Dec 19, 1981 – Jan 8, 1983	Jan 7, 1982	DR-651	Severe Storms, Flood, Mudslides, High Tide
Feb 21, 2023 – Jul 10, 2023	Apr 3, 2023	DR-4699	Severe Winter Storms, Straight-line Winds, Flooding, Landslides, and Mudslides

Source: (FEMA 2024)

State Emergency Proclamation

Table 11-4 lists all extreme wind-related state emergency proclamations that have included Sonoma County between 2020 and 2024.

Table 11-4. State Emergency Proclamations for Extreme Wind Events in Sonoma County

Event Date	Proclamation Type	Description
January 26, 2021	State of Emergency	The governor declared a state of emergency for a winter storm related to an atmospheric river event that struck California, bringing damaging winds, substantial precipitation, flooding, and erosion.
December 27, 2022	State of Emergency	On January 4, 2023, the governor declared a state of emergency for all California counties due to a series of atmospheric rivers that brought high winds, substantial precipitation, and flooding to the state.
Late February, 2023	State of Emergency	On March 1, 2023, the governor added Amador, Kern, Los Angeles, Madera, Mariposa, Mono, Nevada, San Bernardino, San Luis Obispo, Santa Barbara, Sierra, Sonoma, and Tulare counties to an emergency declaration for atmospheric river impacts, including tornado warnings and heavy precipitation.
March, 2024	State of Emergency	The governor added Sonoma County to a State of Emergency Proclamation for March 2024 storms bringing heavy rains, mountain snow, thunderstorms, flooding, landslides, and high winds.

Source: (Cal OES 2024)

USDA Declarations

Between 2020 and 2025, Sonoma County was not included in any USDA extreme wind-related agricultural disaster declarations (USDA 2024).

All Recent Events

Table 11-5 lists major recorded extreme wind related events that impacted Sonoma County since the previous HMP was developed. For earlier events, refer to the previous HMP.

11.1.5 Probability of Future Occurrences

Information on previous extreme wind occurrences in the County was used to calculate the probability of future occurrence of such events. Table 11-6 lists the number of events from various sources over the 71-year period from 1953 to 2024, which is the most complete period of record for all sources reviewed. Based on these records and input from the HMWG, the probability of occurrence for extreme wind in the County is considered “occasional.”

Table 11-5. Extreme Wind Events in Sonoma County (2020-2025)

Event Date	Declaration or Proclamation Number	Location Impacted	Description
March 1-2, 2020	N/A	Healdsburg Hills North	Healdsburg Hills North mesonet (PG&E) site recorded wind gusts between 60 and 70 mph with a peak gust of 72 mph.
October 25-26, 2020	N/A	Healdsburg Hills North	Mesonet (PG&E) station at Healdsburg Hills North reported wind gusts between 60 and 75 mph with a peak gust of 83 mph. The highest peaks and ridges recorded wind gusts at over 80 mph with 89 mph the strongest gust.
January 19, 2021	N/A	Sonoma County	Station reported a wind gust in the mountains of Sonoma County at 97 mph.
November 8, 2021	N/A		A weak to moderate atmospheric river event impacted the SF Bay Area, bringing moderate to locally heavy rain and gusty winds.
January 22,2022	N/A	Sonoma County	Strong winds, and wind gusts up to 90 miles per hour. Power outages were reported in large parts of Sonoma County, including along Chalk Hill Road, in the hills around the Geysers, and along Highway 12 from Glen Ellen to Boyes Hot Springs, as well as to the east of the Town of Sonoma.
March 13, 2023	DR-4699	Sonoma County	Severe Winter Storms, Straight-line Winds, Flooding, Landslides, and Mudslides
January 31, 2024	N/A	Sonoma County	A cold front brought widespread rain and high winds. A water rescue occurred on Mark West Station Road at Starr Road.
February 4, 2024	N/A	Sonoma County	A cyclone and atmospheric river combined, creating a period of strong winds, heavy rain, and high surf. Impacts included fallen trees, and power outages. A tree fell on a car on northbound U.S. Highway 101 near Todd Road in Santa Rosa, injuring a man inside and closing the highway.
February 17, 2024	N/A	Sonoma County	A cold front caused minor nuisance flooding and gusty winds. A second system the next day brought widespread rain and gusty winds.

Source: (NOAA 2024)

Table 11-6. Probability of Future Extreme Wind Events in Sonoma County

Hazard Type	Number of Occurrences Between 1953 and 2024	Percent Chance of Occurring in Any Given Year
Extreme Wind	55	76%

Source: (NOAA 2024) (FEMA 2024)
Note: The time period in this table is the most complete period of record for the various data sources reviewed.

11.1.6 Cascading Impacts on Other Hazards

Higher than normal winds can damage or destroy trees and will increase rates of evaporation. Extreme winds have been linked with worsening wildfire seasons in the western U.S.

11.2 VULNERABILITY AND IMPACT ASSESSMENT

All of Sonoma County is vulnerable to extreme wind events. The following subsections provide a qualitative discussion of Sonoma County's vulnerability to the extreme wind hazard.

11.2.1 Life, Health, and Safety

Overall Population

The entire population of Sonoma County, totaling 488,361, is exposed and vulnerable to extreme wind events. Extreme wind events can significantly impact the overall population of Sonoma County in several ways. High winds pose direct threats to the safety of residents, including the risk of injury from flying debris, falling trees, and structural damage to homes and buildings. These events can also lead to power outages and damage to communication lines, affecting essential services such as electricity, water supply, and telecommunications, thereby disrupting daily activities and hindering emergency response efforts.

Socially Vulnerable Population

Socially vulnerable populations are particularly susceptible to extreme wind events. These populations face isolation and exposure during extreme wind events and could suffer more secondary effects of the hazard. Power outages from extreme winds can be life-threatening to those dependent on electricity for life support and are a significant concern. After extreme wind events, residents may be displaced or require temporary to long-term sheltering. Vulnerability is influenced by several factors, including physical and financial ability to react or respond during a hazard, as well as the location and construction quality of their housing. Because these populations face various forms of isolation, they are more at risk for secondary effects from high wind hazards.

11.2.2 General Building Stock

When estimating the potential impact of extreme winds on individual structures, factors such as structural integrity, mitigation measures, building construction, and date of construction should be considered. Residential structures are generally more susceptible to wind damage than commercial and industrial structures due to differences in construction. Wood and masonry buildings, regardless of occupancy class, tend to experience more damage than concrete or steel buildings. All current and future buildings in Sonoma County, including critical facilities, are at risk from extreme wind events.

11.2.3 Community Lifelines and Other Critical Facilities

All critical facilities and community lifelines in Sonoma County are vulnerable to extreme wind. Facilities without backup power are especially at risk during outages, which are common when high winds damage power transmission lines—particularly in areas with complex terrain. Communication systems can be disrupted when power to landline infrastructure is lost. Facilities near trees or overhead power lines face additional risk from falling debris. In the event of a tornado or other high-wind event, facilities in the direct path would be especially vulnerable. Transportation infrastructure may also be impacted, with roads blocked by downed trees or debris, hindering emergency response and recovery efforts.

11.2.4 Economy

Extreme wind events can profoundly impact Sonoma County's economy. Communication lines, antennas, and towers are vulnerable to damage from strong winds and falling branches, leading to disruptions in telecommunications and broadcasting services. This affects both businesses and residents who rely on these services for daily operations. Business interruptions are a significant concern during extreme wind events. Power outages can halt business operations, leading to financial losses. Extended outages can affect essential services, such as water supply, communication networks, and healthcare facilities, further compounding the economic impact.

Damage to buildings, roads, and vehicles can be extensive and costly. Extreme winds can tear off roofs, shatter windows, and cause structural damage. Debris can block roads, making transportation difficult and delaying emergency response efforts (CBO 2019). The cost of repairs and cleanup can strain local resources and budgets.

Extreme winds also impact tourism in Sonoma County. Outdoor activities become hazardous, leading to a decline in tourist numbers. Extreme winds can damage tourist facilities, resulting in closures and reduced capacity. Transportation disruptions, safety concerns, and negative perceptions of the region as a safe travel destination further deter visitors.

11.2.5 Natural Resources

Extreme wind events can cause widespread damage across natural ecosystems, historic structures, and culturally significant sites. In natural environments, high winds can uproot or damage trees, disrupt local habitats, and increase the risk of erosion and flooding, particularly in coastal areas (Ouranos n.d.). Forests are especially vulnerable, with downed trees and broken limbs contributing to wildfire risk, pest infestations, and the spread of invasive species. The decomposition of damaged vegetation also releases carbon dioxide, contributing to climate change (NWF n.d.).

11.2.6 Historic and Cultural Resources

Strong winds and accompanying debris can damage roofs, windows, and structural elements of historic buildings and monuments, compromising their integrity. Water intrusion from wind-driven rain can lead

to mold, wood rot, and deterioration of interior finishes and artifacts. Culturally significant landscapes and heritage sites may suffer from physical damage and restricted access due to fallen trees or debris, complicating preservation and recovery efforts.

11.3 FUTURE CHANGES THAT MAY AFFECT RISK

11.3.1 Potential or Planned Development

All future development will be affected by extreme wind events. The ability to withstand impacts lies in sound land use practices and consistent enforcement of codes and regulations for new construction.

11.3.2 Projected Changes in Population

In 2020, the County's population was 488,361. The population decreased to 478,299 in 2025 and the California Department of Finance currently expects the downward trend to continue until it hits a low of 474,013 in 2040. However, the county's population is expected to rebound for the following 30 years, hitting a population of 514,337 by 2070 (CDOF 2024). A larger population often leads to increased infrastructure development and maintenance.

11.3.3 Climate Change

Climate change may cause more extreme wind patterns that could impact the planning area. Increased frequency and intensity of storms may result in greater damage.

11.4 HAZARD-RELATED ISSUES

Important issues associated with extreme wind in the planning area include the following:

- The most common direct impact from extreme wind events is loss of power. Power outages that disrupt land line service could cause significant communication disruption.
- Older building stock in the planning area is built to low code standards or none at all. These structures could be highly vulnerable to damaging winds.
- Redundancy of power supply must be evaluated, especially for critical facilities.
- Isolated population centers are most vulnerable to the extreme wind hazard. Rural areas frequently experience extended power outages, loss of communications, and damage to roads due to severe weather. Those residing in higher elevations with limited transportation routes may have the greatest vulnerability to isolation from extreme winds.
- Detailed spatial analysis is needed to locate the most vulnerable populations, followed by focused public education and outreach mitigation activities for these populations.

Flood

Hazard Ranking:



MEDIUM

FEMA defines flood as the general and temporary condition of partial or complete inundation of **two or more acres** of normally dry land area.

Community Lifelines at Risk

In the 0.2% Annual Chance Flood Zone



9 Total

Daycare & Library - High Risk

Adaptive Capacity



Moderate

Socially Vulnerable at Risk

In the 0.2% Annual Chance Flood Zone

5,283 Persons over 65

5.2% of all persons over 65 in the county

Mitigation Projects

- Upsize culverts and stormwater systems.
- Install levees and floodwalls.
- Floodplain zoning and land-use regulations.

12. FLOODING

12.1 HAZARD PROFILE

12.1.1 Hazard Description

Flooding is any overflowing of water onto land that is normally dry. Areas near rivers or streams are at risk from floods during heavy rain or periods of upstream snowmelt. In urban areas, where buildings, highways, driveways, and parking lots reduce the ground's ability to absorb rainfall, the resulting increase in runoff can overwhelm constructed storm drain systems, resulting in flooding of nearby roads and buildings (National Weather Service n.d.). The duration depends on the type of flood: flash flooding occurs within 6 hours of a rain event, while other types of flooding may last a week or more. Floods kill more people in the United States each year than tornados, hurricanes, or lightning (NOAA n.d.).

Floodplains

A floodplain is the area adjacent to a river, creek, lake, or the ocean that becomes inundated during a flood. In general, there are two types of floodplains in the planning area: riverine and coastal.

Riverine Floodplains

Riverine floodplains may be broad, as when a river crosses an extensive flat landscape, or narrow, as when a river is confined in a canyon. Connections between a river and its floodplain are most apparent during and after major flood events. These areas form a complex physical and biological system that not only supports a variety of natural resources but also provides natural flood and erosion control. When a river is separated from its floodplain with levees and other flood control facilities, natural, built-in benefits can be lost, altered, or significantly reduced.

When floodwaters recede after a flood event, they leave behind layers of rock and mud. These gradually build up to create a new floor of the floodplain. Floodplains generally contain unconsolidated sediments (accumulations of sand, gravel, loam, silt, and/or clay), often extending below the bed of the stream. These sediments provide a natural filtering system, with water percolating back into the ground and replenishing groundwater. These are often important aquifers, the water drawn from them being filtered compared to the water in the stream. Fertile, flat reclaimed floodplain lands are commonly used for agriculture, commerce, and residential development.

Coastal Floodplains

Coastal floodplains are adjacent to the ocean and other tidally influenced areas. Like riverine floodplains, coastal floodplains may be broad or narrow, depending on local topography and natural flood defenses such as dune systems or tidal wetlands. Coastal floods are usually caused by coastal storms that, when combined with normal tides, push water toward the shore. This is commonly referred

to as storm surge. The result can be waves that extend further inland, causing damage to development that would not normally be subject to wave action.

FEMA Regulatory Flood Zones

The frequency and severity of flooding for river systems are based on discharge probability. The discharge probability is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. Flood studies use historical records to determine the probability of occurrence for different discharge levels and storm surge levels. These measurements reflect statistical averages only; it is possible for multiple floods with a low probability of occurrence (such as a 1-percent-annual-chance flood) to occur in a short time period. For riverine flooding, the same flood event can have flows at different points on a river that correspond to different probabilities of occurrence.

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

FEMA defines flood hazard areas as areas expected to be inundated by a flood of a given magnitude. These areas are determined via statistical analyses of records of river flow, storm tides, and rainfall; information obtained through consultation with the community; floodplain topographic surveys; and hydrologic and hydraulic analyses. Flood hazard areas are delineated on DFIRMs (Digital Flood Insurance Rate Maps), which provide the following information:

- Locations of specific properties in relation to SFHAs
- Base flood elevations (1-percent-annual-chance) at specific sites
- Magnitudes of flood in specific areas
- Undeveloped coastal barriers where flood insurance is not available
- Regulatory floodways and floodplain boundaries (1-percent and 0.2-percent-annual-chance floodplains).

Land covered by floodwaters of the base flood is the SFHA on a DFIRM—an area where NFIP floodplain management regulations must be enforced, and where mandatory purchase of flood insurance applies. This regulatory boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities because many communities have maps showing the extent of the base flood and likely depths that will occur.

The base flood elevation (the water elevation of a flood that has a 1-percent chance of occurring in any given year) is one of the most important factors in estimating potential damage from flooding. A structure within a 1-percent-annual-chance floodplain has a 26-percent chance of undergoing flood damage during the term of a 30-year mortgage. The 1-percent-annual-chance flood is used by the

NFIP as the basis for insurance requirements nationwide. DFIRMs also depict 0.2-percent-annual-chance flood designations.

DFIRMs and other flood hazard information can be used to identify the expected spatial extent of flooding from a 1-percent and 0.2-percent annual chance event. They depict the following SFHAs and other areas:

- **Zone A (Also known as Unnumbered A-zones**)—SFHAs where no base flood elevations or depths are shown because detailed hydraulic analyses have not been performed.
- **Zones A1-30 and AE—**SFHAs that are subject to inundation by the base flood, determined using detailed hydraulic analysis. Base flood elevations are shown within these zones.
- **Zone AH—**SFHAs that are subject to shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 feet. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
- **Zone AO—**SFHAs subject to inundation by types of shallow flooding where average depths are between 1 and 3 feet. These are normally areas prone to shallow sheet flow flooding on sloping terrain.
- **Zone AR—**Areas with a temporarily increased flood risk due to the building or restoration of flood control system (such as a levee). Mandatory flood insurance purchase requirements apply, but rates do not exceed the rates for unnumbered A zones if the structure is built or restored in compliance with Zone AR floodplain management regulations.
- **Zone A99—**Areas with a 1 percent annual chance of flooding that will be protected by a federal flood control system where construction has reached specified legal requirements. No depths or base flood elevations are shown within these zones.
- **Zone VE, V1-30—**SFHAs along coasts that are subject to inundation by the base flood with additional hazards due to waves with heights of 3 feet or greater. Base flood elevations derived from detailed hydraulic analysis are shown within these zones.
- **Zone B and X (shaded)—**Zones where the land elevation as been determined to be above the base flood elevation, but below the 500-year flood elevation. These zones are not SFHAs.
- **Zones C and X (unshaded)—**Zones where the land elevation has been determined to be above both the base flood elevation and the 500-year flood elevation. These zones are not SFHAs.

The FEMA designated floodway is the channel of a water course and portion of the adjacent floodplain that is needed to convey the base flood without increasing flood levels by more than a specified amount (typically, 1 foot). A floodway may be designated within the SFHA where the deepest, highest velocity flow is expected and any infrastructure will be at risk. Floodways should be kept free of obstructions and development to allow floodwaters to move downstream unobstructed. Any development in a floodway is subject to severe damage and high risks for occupants and emergency responders.

Flood damage may occur outside of SFHAs. FEMA typically does not designate SFHAs for areas subject to flooding from local drainage problems, particularly in urban areas; drainage basins of less

than 1 square mile in area; or hillside areas subject to runoff, erosion, and mudflow. FEMA does not map flooding along the length of all streams or in areas that are undeveloped.

According to FEMA, the coastal high hazard area (or "V zone," where V stands for velocity wave action) is the most hazardous part of the coastal floodplain, due to its exposure to wave effects. The V zone has an increased degree of flood risk compared to coastal flood areas not within the coastal high hazard area (A zones) and is subject to more stringent regulatory requirements. Wave elevations are decreased by obstructions such as buildings, vegetation, and rising ground surface.

12.1.2 Location

Figure 12-1 shows the FEMA-designated flood hazard areas across Sonoma County, and Table 12-1 summarizes the land area in the 1- and 0.2-percent annual chance flood hazard areas by jurisdiction. Throughout this HMP, the 0.2-percent annual chance flood hazard areas include acres, population, and buildings in the 1-percent annual chance flood hazard area.

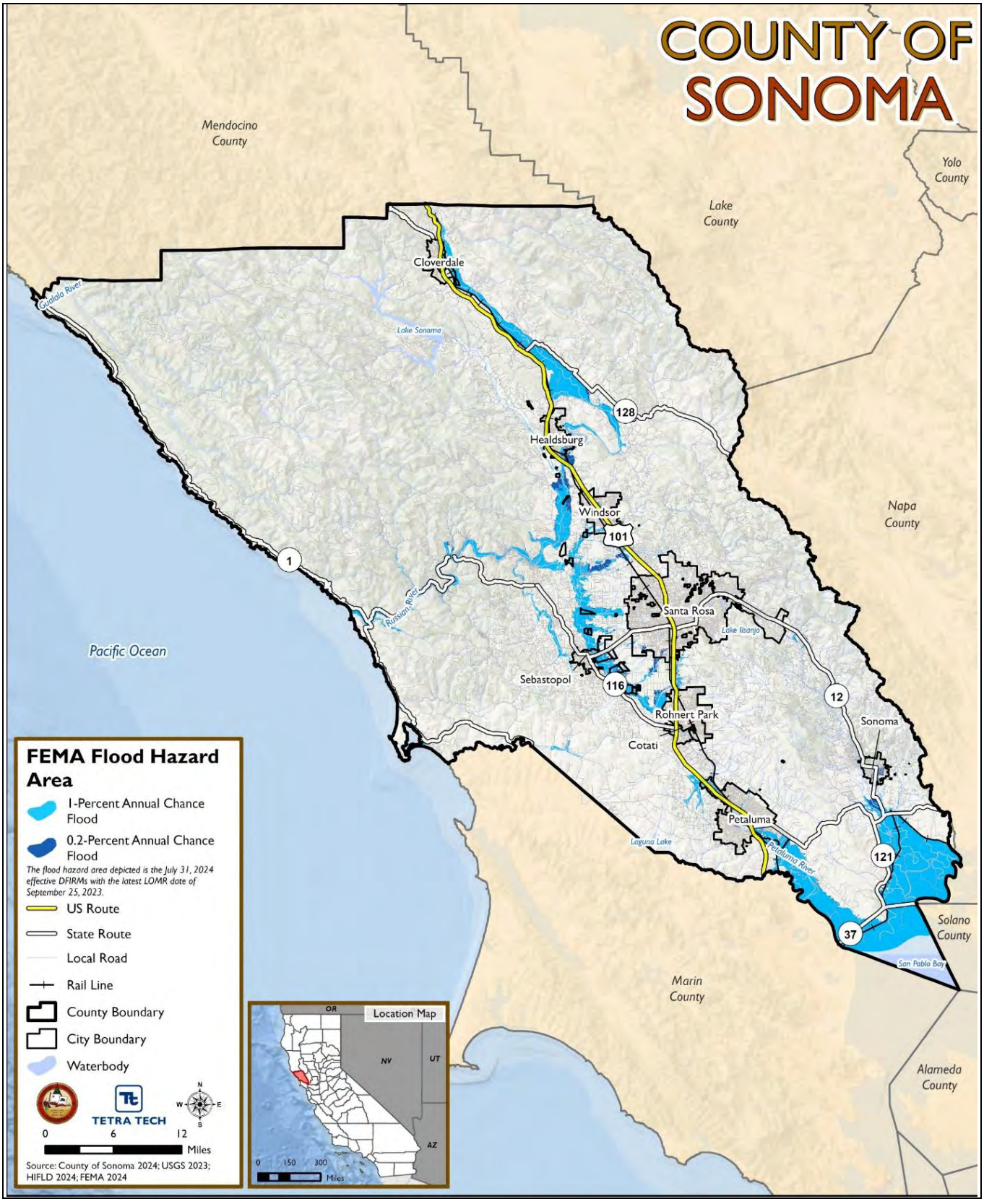
Table 12-1. Land Area in the 1 Percent Annual Chance Flood Hazard Area

Jurisdiction	Total Land Area (Acres) Excludes Waterbodies	Acres in the 1-Percent Annual Chance Flood Hazard Area	% of Jurisdiction Total	Acres in the 0.2-Percent Annual Chance Flood Hazard Area	% of Jurisdiction Total
City of Cloverdale	2,123.5	343.1	16.2%	343.1	16.2%
City of Cotati	1,206.3	58.7	4.9%	245.6	20.4%
City of Healdsburg	2,724.3	169.5	6.2%	333.3	12.2%
City of Petaluma	9,280.2	1,576.2	17.0%	2,022.1	21.8%
City of Rohnert Park	4,668.4	105.0	2.2%	138.2	3.0%
City of Santa Rosa	27,221.1	1,258.9	4.6%	1,726.9	6.3%
City of Sebastopol	1,206.8	198.8	16.5%	226.0	18.7%
City of Sonoma	1,756.3	50.9	2.9%	335.7	19.1%
Town of Windsor	4,780.0	495.5	10.4%	672.0	14.1%
Unincorporated County	962,939.5	61,640.2	6.4%	66,358.5	6.9%
Sonoma County (Total)	1,017,906.6	65,896.8	6.5%	72,401.4	7.1%

Source: County of Sonoma 2024; USGS 2023; FEMA 2024

Countywide, 65,896.8 acres fall within the 1-percent annual chance flood hazard area—6.5 percent of the total county area. Unincorporated Sonoma County accounts for the largest share, at 962,939.5 acres (6.4 percent). In the 0.2-percent flood hazard area, the County includes 72,401.4 acres, representing 7.1 percent of the total jurisdictional area. Unincorporated Sonoma County accounts for the largest share, at 66,358.5 acres (6.9 percent).

Figure 12-1. FEMA Flood Hazard Areas in Sonoma County



Flooding Hazards by Watershed

Flooding is a recurring natural hazard across Sonoma County, with distinct characteristics depending on the watershed. The following descriptions outline typical flood behavior and contributing factors in three major basins: the Petaluma River, Russian River, and Sonoma Creek (FEMA FIS 2024).

Petaluma River and Tributaries

Flooding in the Petaluma River watershed is typically short-lived, with flood events lasting only 3 to 4 hours; however, flood time can be prolonged during high tides, when water levels are highest in the San Pablo Bay. These floods often develop within 24 hours of a storm and recede within a day after the rainfall ends. Tributaries in this basin respond quickly to heavy precipitation, especially when the clay soil is already saturated and water levels can rise rapidly, leading to flooding within hours. Sheet flow flooding can occur along the entire reach of the Petaluma River, and additional flood impacts are often caused by insufficient channel capacity and poor drainage infrastructure in areas adjacent to the river.

Russian River and Tributaries

The Russian River basin experiences flood events that generally last between three and four days. Flash flooding may occur in localized areas, particularly where tributaries rise quickly in response to intense rainfall. Flooding in this watershed is most common during the winter, with the largest events typically occurring between December and March. The rapid onset of flooding in tributaries underscores the need for timely warning systems and responsive mitigation strategies.

Sonoma Creek and Tributaries

Flooding in the Sonoma Creek basin is usually triggered by short bursts of intense rainfall embedded within longer-duration storm systems. The basin has a concentration period of less than 6 hours, meaning runoff accumulates and peaks quickly. Additionally, tidal influences from San Pablo Bay can exacerbate flooding conditions, affecting both the extent of inundation and the duration of floodwaters. These combined factors make flood prediction and management in the Sonoma Creek watershed particularly complex.

12.1.3 Extent

Flood extent, or magnitude, can be defined by peak flow (cubic feet per second) or the height of floodwaters. U.S. Geological Survey (USGS) stream gauge data can determine these factors. There are 27 USGS stream gages in Sonoma County (USGS 2025). Flood studies rely on historical records to establish discharge probability, which is the likelihood that a specific river discharge level will be equaled or exceeded within a given year. In riverine flooding, a single event can result in varying discharge probabilities at different river points.

The primary factors influencing flood damage are depth and velocity. Generally, deeper and faster-moving floodwaters cause greater damage, but shallow flooding with high velocities can be equally destructive. DFRIMs identify the anticipated extent and depth of flooding for the base flood, with water-surface elevations corresponding to discharge levels.

Floods rarely occur without warning, with typical warning times ranging from 24 to 48 hours. The National Weather Service (NWS) issues flood warnings and watches, updating them as necessary and notifying the public when they are no longer in effect:

- **Coastal Flood Advisory**—Issued when minor or nuisance coastal flooding is occurring or imminent.
- **Coastal Flood Watch**—Issued when moderate to major coastal flooding is possible, posing a serious risk to life and property.
- **Coastal Flood Warning**—Issued when moderate to major coastal flooding is occurring or imminent, posing a serious risk to life and property.
- **Flood Advisory**—Indicates that nuisance flooding is occurring or imminent. It may be upgraded to a Flash Flood Warning if conditions worsen.
- **Flood Watch**—Indicates that heavy rain leading to flash flooding is possible. Issued up to 48 hours before expected flash flooding.
- **Flood Warning**—Indicates that flooding in imminent or has been reported along a river.
- **Flash Flood Watch**—Indicates that flash flooding is possible due to causes other than heavy rain (e.g., dam or levee failure) or heavy rain on burn scars.
- **Flash Flood Warning**—Indicates that flooding is occurring or will develop quickly. Residents should take shelter or move to higher ground and avoid driving or walking across flooded roadways.

12.1.4 Previous Occurrences

FEMA Disaster Declarations

Table 12-2 lists all flooding-related presidentially declared disasters that have included Sonoma County.

State Emergency Proclamations

Table 12-3 lists all flooding-related state emergency proclamations that have included Sonoma County.

USDA Declarations

Between 2021 and 2025, Sonoma County was not included in any USDA flood-related agricultural disaster declarations (USDA 2023a).

All Recent Events

Table 12-4 lists major recorded flooding-related events that impacted Sonoma County since the previous HMP was developed. For earlier events, refer to the previous HMP.

Table 12-2. FEMA Disaster Declarations for flooding Events in Sonoma County (1954-2025)

Event Date	Declaration Date	Declaration Number	Event Name
Dec 24, 1964	Dec 24, 1964	DR-183	Heavy Rains & Flooding
Jan 26, 1969	Jan 26, 1969	DR-253	Severe Storms, Flooding
Dec 19, 1981 – Jan 8, 1983	Jan 7, 1982	DR-651	Severe Storms, Flood, Mudslides, High Tide
Jan 21, 1983 – Mar 30, 1983	Feb 9, 1983	DR-677	Coastal Storms, Floods, Slides, Tornadoes
Feb 12, 1986 – Mar 10, 1986	Feb 21, 1986	DR-758	Severe Storms, Flooding
Jan 5, 1993 – Mar 20, 1993	Feb 3, 1993	DR-979	Severe Storm, Winter Storm, Mud & Landslides, Flooding
Jan 3, 1995 – Feb 10, 1995	Jan 10, 1995	DR-1044	Severe Winter Storms, Flooding, Landslides, Mud Flows
Feb 13, 1995 – Apr 19, 1995	Mar 12, 1995	DR-1046	Severe Winter Storms, Flooding, Landslides, Mud Flows
Dec 28, 1996 – Apr 1, 1997	Jan 4, 1997	DR-1155	Severe Storms, Flooding
Feb 2, 1998 – Apr 30, 1998	Feb 9, 1998	DR-1203	Severe Winter Storms and Flooding
Dec 17, 2005 – Jan 3, 2006	Feb 3, 2006	DR-1628	Severe Storms, Flooding, Mudslides, and Landslides
Mar 29, 2006 – Apr 16, 2006	Jun 5, 2006	DR-1646	Severe Storms, Flooding, Landslides, and Mudslides
Jan 3, 2017 – Jan 12, 2017	Feb 14, 2017	DR-4301	Severe Winter Storms, Flooding, and Mudslides
Feb 1, 2017 – Feb 23, 2017	Apr 1, 2017	DR-4308	Severe Winter Storms, Flooding, Mudslides
Feb 24, 2019 – Mar 1, 2019	May 18, 2019	DR-4434	Severe Winter Storms, Flooding, Landslides, and Mudslides
Jan 8, 2023 – Jan 31, 2023	Jan 9, 2023	EM-3591	Severe Winter Storms, Flooding, and Mudslides
Dec 27, 2022 – Jan 31, 2023	Jan 14, 2023	DR-4683	Severe Winter Storms, Flooding, Landslides, and Mudslides
Mar 9, 2023 – Jul 10, 2023	Mar 10, 2023	EM-3592	Severe Winter Storms, Flooding, Landslides, and Mudslides
Feb 21, 2023 – Jul 10, 2023	Apr 3, 2023	DR-4699	Severe Winter Storms, Straight-line Winds, Flooding, Landslides, and Mudslides

Source: (FEMA 2024)

Table 12-3. State Emergency Proclamations for flooding Events in Sonoma County

Event Date	Description
May 3, 2024	March 2024 Storms
Mar 22, 2024	Early February 2024 Storms-Additional Counties
Mar 1, 2023	February-March 2023 Storms
Mar 23, 2022	October 2021 Storms

Source: (Cal OES 2024)

Table 12-4. Flooding Events in Sonoma County (2020-2025)

Event Date	Declaration or Proclamation Number	Location Impacted	Description
January 26-29, 2021	N/A	Greater Bay Area	An Atmospheric River over the Bay Area caused roadway flooding at U.S.-101 N and E Washington St on ramp, and a mudslide on SR-1 and Fort Ross Rd.
November 8, 2021	N/A	Greater Bay Area	An atmospheric river impacted the Bay Area, bringing moderate to locally heavy rain and gusty winds. Heavy rain caused roadway flooding.
December 13, 2021	N/A	Statewide	Heavy rain caused flooding on Labath Ave and the closure of SR 12 between Route 116 and 8th St.
January 9, 2023	DR-4683-CA EM-3591-CA CA23-1	Greater Bay Area	A strong atmospheric river led to widespread flooding across the San Francisco Bay Area and Central Coast. Roadway flooding was reported along Mark West Creek near the communities of Forestville and Trenton. A woman from Ukiah was recovered after her car got stuck in floodwaters.
January 21-22, 2024	N/A	Greater Bay Area	A series of frontal systems led to widespread rainfall and flooding across the Bay Area. Westbound California Route 116 at Travis Road was reported flooded across all lanes. A vehicle was stuck in floodwaters on Eastside Road north of Mark West Station Road. A mudslide was reported on California Highway 1 near Estero Lane. The Shiloh Road offramp from UIS Highway 101 Northbound was closed due to standing water on the roadway. The Arata Lane offramp from U.S. Highway 101 Northbound was closed due to standing water on the roadway. Localized flooding was reported in northern Guerneville. Heavy rain caused flooding from Fife Creek at Sycamore Court Mobile Home Park; 3 inches of water flooded a trailer.
February 17, 2024	N/A	Greater Bay Area	Widespread rain cause roadway flooding at California Route 1 and Kruse Ranch Road; a vehicle was stuck in mud on the right hand side of the road. Standing water was reported halfway across Occidental Road in two spots between Mill Street and California Highway 116. Approximately 3 inches of water rushed across Calistoga Road before and after Alpine Road. Roadway flooding was reported at Arnold Drive and Boyes Blvd. Water flooded the roadway at northbound Olivet Road at Piner Road. Roadway flooding was reported at eastbound California Highway 116 and Bloomfield Road. A landslide blocked eastbound lanes of Mark West Springs Road. A vehicle was stuck in a flooded roadway on Valley Ford Road. California Route 12 was closed until 8 AM due to flooding from Fremont Drive to Watmaugh Road. Creek flowing over Mark West Station Road after heavy rainfall. Mud, dirt, and rock blocking Los Alamos Road.

Source: (NOAA 2024)

12.1.5 Probability of Future Occurrences

Information on previous flood occurrences in the County was used to calculate the probability of future occurrence of such events, as summarized in Table 12-5. Based on historical records and input from the Planning Team, the probability of occurrence for flood in the County is considered “frequent.”

Table 12-5. Probability of Future Flooding Events in Sonoma County

Hazard Type	Number of Occurrences Between 1953 and 2025	Percent Chance of Occurring in Any Given Year
Flooding	89	100%

Source: (NOAA 2024)
Note: The time period presented in this table is the most complete period of record for the various data sources reviewed.; 100% probability indicates that it is statistically likely for an event to occur every year. It does not indicate that the occurrence of an event is a certainty in any given year.

12.1.6 Cascading Impacts on Other Hazards

Bank erosion, a secondary effect of flooding, can be more harmful than actual flooding. This is especially true in the upper courses of rivers with steep gradients, where floodwaters may pass quickly and without much property damage, but scour the banks, edging properties closer to the floodplain. Flooding is also responsible for hazards such as landslides when high flows over-saturate soils on steep slopes, causing them to fail. Hazardous materials spills can be a secondary effect of flooding if floodwaters cause storage tanks to rupture. Other secondary effects of a flood include the following:

- Drinking water supplies may become polluted, especially if sewage treatment plants are flooded. This may result in disease and other health effects.
- Flooded buildings may have gas and electrical service disrupted if the service panel, generator, meter, or other equipment are not elevated above the flood protection level.
- Oversaturated soils may cause utility poles to tip over or fall completely, interrupting the power grid for a potentially large area, especially if the transformer is impacted.
- Transportation systems may be disrupted, resulting in shortages of food and supplies.
- Location of river channels may change as the result of flooding. New channels develop, leaving the old channels dry.
- Sediment deposited by flooding may destroy farmland (although silt deposited by floodwaters could also help to increase agricultural productivity).
- Jobs may be lost due to the disruption of services, destruction of business, etc. (although jobs may be gained in the construction industry to help rebuild or repair flood damage).
- Insurance rates may increase.

12.2 VULNERABILITY AND IMPACT ASSESSMENT

12.2.1 Life, Health, and Safety

Overall Population

There are an estimated 11,083 residents living in the SFHA, or 4.7 percent of the County's total population. Unincorporated Sonoma County has the greatest number of residents living in the 1-percent annual chance flood hazard area with approximately 7,746 residents, or 5.8 percent of the jurisdictional total. Table 12-6 summarizes the population exposed to the flood hazard by jurisdiction for the 1 percent and 0.2 percent annual chance flood.

Table 12-6. Estimated Population Exposed to the 1-Percent Annual Chance Flood Hazard Area

Jurisdiction	Total Population (2023 ACS)	Persons in the 1-Percent Annual Chance Flood Hazard Area	% of Jurisdiction Total	Persons in the 0.2-Percent Annual Chance Flood Hazard Area	% of Jurisdiction Total
City of Cloverdale	8,933	160	1.8%	160	1.8%
City of Cotati	7,533	586	7.8%	1,410	18.7%
City of Healdsburg	11,274	240	2.1%	967	8.6%
City of Petaluma	59,321	1,374	2.3%	2,996	5.1%
City of Rohnert Park	44,461	241	0.5%	861	1.9%
City of Santa Rosa	177,216	298	0.2%	1,886	1.1%
City of Sebastopol	7,466	159	2.1%	212	2.8%
City of Sonoma	10,726	76	0.7%	2,089	19.5%
Town of Windsor	26,179	203	0.8%	1,616	6.2%
Unincorporated County	132,533	7,746	5.8%	10,372	7.8%
Sonoma County (Total)	485,642	11,083	2.3%	22,569	4.6%

Source: U.S. Census Bureau 2023 ACS; FEMA 2024

Flooding in the Petaluma River, Russian River, Sonoma Creek, and other watersheds can develop rapidly with changing weather. Stalled storms, clogged storm drains, burn scars, and blocked flow paths can result in flooding in unexpected areas, leaving emergency responders and the community with little warning time. This presents a direct threat to public safety, especially in areas with limited evacuation routes or high concentrations of socially vulnerable populations. Flash flooding and sheet flow events can trap residents, overwhelm emergency services, and increase the risk of injury or death.

In the aftermath of a flood event, mold can begin growing within 48 hours, creating serious health risks, especially for children, seniors, and individuals with respiratory conditions. Mold exposure can lead to breathing problems or allergic reactions and may render homes unsafe for occupancy.

Flood events can have devastating impacts on communities, often leading to the displacement of residents and the need for emergency shelter. Table 12-7 provides an overview of the number of individuals displaced or seeking shelter as a result of flood events by jurisdiction. In Sonoma County, it is projected that flooding will displace 8,286 individuals, with 2,213 of them requiring short-term shelter. Unincorporated Sonoma County is expected to have the highest number of displaced persons, totaling 5,092. It also has the highest number of individuals seeking short-term shelter, at 926 persons.

Table 12-7. Persons Displaced or Seeking Shelter Due to 1-Percent Annual Chance Flood

Jurisdiction	Total Population (2023 ACS)	Displaced Population	Persons Seeking Short-Term Shelter
City of Cloverdale	8,933	210	98
City of Cotati	7,533	309	127
City of Healdsburg	11,274	212	63
City of Petaluma	59,321	1,204	362
City of Rohnert Park	44,461	269	157
City of Santa Rosa	177,216	462	278
City of Sebastopol	7,466	134	17
City of Sonoma	10,726	108	56
Town of Windsor	26,179	286	129
Unincorporated County	132,533	5,092	926
Sonoma County (Total)	485,642	8,286	2,213

Source: Hazus v6.1, U.S. Census Bureau 2020, 2023 ACS; FEMA 2024

Socially Vulnerable Population

Research indicates that certain populations, while not necessarily facing greater hazard exposure, may suffer more severe impacts and experience longer recovery times when affected by flooding. This heightened vulnerability is often due to factors such as physical and financial limitations that hinder their ability to respond effectively during a disaster.

As noted in Chapter 3, there are at least 2,500 to 3,000 unhoused individuals living in Sonoma County. Recent research by the University of California at Davis shows that as homelessness and climate change increase, urban streams become more susceptible to flash floods, heavy winds and pollution and more dangerous to those sleeping alongside them (UC Davis 2025). Alerting this population to incoming storms and the potential for flash floods is a concern for Sonoma County.

Economically disadvantaged populations may lack the financial resources to evacuate promptly. Older adults are more likely to require medical attention, which may be inaccessible during a flood due to isolation, and they may face greater challenges in evacuating safely. Table 12-8 and Table 12-9 present the estimated socially vulnerable populations living in the 1- and 0.2- percent annual chance flood hazard areas by jurisdictions.

Table 12-8. Vulnerable Populations in the 1-Percent Annual Chance Flood Hazard Area

Jurisdiction	Persons Over 65	% of Total	Persons Under 5	% of Total	Non-English Speaking Persons	% of Total	Persons with a Disability	% of Total	Persons in Poverty	% of Total	Single Parent Households	% of Total	No Vehicle Access	% of Total
City of Cloverdale	34	1.7%	3	1.4%	8	1.7%	17	1.8%	7	1.8%	2	1.4%	0	0.0%
City of Cotati	87	7.8%	31	7.7%	10	7.7%	63	7.7%	46	7.7%	17	7.5%	0	0.0%
City of Healdsburg	56	2.1%	12	2.0%	9	2.0%	23	2.1%	27	2.1%	5	2.0%	1	1.8%
City of Petaluma	293	2.3%	59	2.3%	53	2.3%	151	2.3%	83	2.3%	21	2.2%	17	2.3%
City of Rohnert Park	33	0.5%	14	0.5%	7	0.5%	26	0.5%	24	0.5%	4	0.5%	2	0.4%
City of Santa Rosa	55	0.2%	14	0.2%	16	0.2%	37	0.2%	27	0.2%	7	0.2%	3	0.1%
City of Sebastopol	41	2.1%	8	2.0%	5	2.1%	18	2.1%	13	2.1%	2	2.1%	2	1.7%
City of Sonoma	25	0.7%	2	0.6%	0	0.0%	12	0.7%	6	0.7%	1	0.5%	0	0.0%
Town of Windsor	34	0.8%	9	0.7%	5	0.7%	21	0.8%	9	0.7%	5	0.7%	1	0.6%
Unincorporated County	2,010	5.8%	335	5.8%	256	5.8%	944	5.8%	661	5.8%	129	5.8%	44	5.8%
Sonoma County (Total)	2,668	2.6%	487	2.1%	369	1.8%	1,312	2.3%	903	2.2%	193	2.0%	70	1.6%

Source: U.S. Census Bureau 2023 ACS Vulnerable Population Totals; FEMA 2024

Table 12-9. Vulnerable Populations in the 0.2-Percent Annual Chance Flood Hazard Area

Jurisdiction	Persons Over 65	% of Total	Persons Under 5	% of Total	Non-English Speaking Persons	% of Total	Persons with a Disability	% of Total	Persons in Poverty	% of Total	Single Parent Households	% of Total	No Vehicle Access	% of Total
City of Cloverdale	34	1.7%	3	1.4%	8	1.7%	17	1.8%	7	1.8%	2	1.4%	0	0.0%
City of Cotati	210	18.7%	75	18.7%	24	18.5%	153	18.6%	112	18.7%	42	18.4%	0	0.0%
City of Healdsburg	228	8.5%	51	8.5%	37	8.4%	94	8.6%	108	8.5%	21	8.5%	4	7.0%
City of Petaluma	638	5.0%	129	5.0%	116	5.0%	329	5.0%	182	5.0%	47	5.0%	37	5.0%
City of Rohnert Park	118	1.9%	51	1.9%	27	1.9%	94	1.9%	87	1.9%	16	1.9%	8	1.8%
City of Santa Rosa	351	1.1%	92	1.1%	103	1.1%	237	1.1%	176	1.1%	44	1.1%	21	1.0%
City of Sebastopol	55	2.8%	11	2.8%	6	2.5%	24	2.8%	17	2.8%	2	2.1%	3	2.6%
City of Sonoma	681	19.5%	63	19.2%	24	19.2%	349	19.5%	172	19.4%	42	19.3%	4	18.2%
Town of Windsor	276	6.2%	75	6.1%	45	6.1%	168	6.2%	75	6.1%	42	6.1%	10	6.1%
Unincorporated County	2,692	7.8%	449	7.8%	342	7.8%	1,264	7.8%	885	7.8%	173	7.8%	59	7.8%
Sonoma County (Total)	5,283	5.2%	999	4.4%	732	3.7%	2,729	4.7%	1,821	4.4%	431	4.4%	146	3.4%

Source: U.S. Census Bureau 2023 ACS Vulnerable Population Totals; FEMA 2024

12.2.2 General Building Stock

Structures located within SFHAs are at elevated risk of flood damage. Buildings in low-lying areas near the Petaluma River and Russian River are especially vulnerable due to structures built below current standards related to base flood elevations, inadequate drainage, and historical flood events. Repetitive loss properties are common in these zones, highlighting the need for elevation, floodproofing, or relocation strategies.

Table 12-10 and Table 12-11 summarize estimates of buildings exposed to flooding in Sonoma County. In the 1-percent annual chance flood hazard area, 8,730 buildings are at risk, with an estimated replacement cost value (RCV) of $7.7 billion, representing 2.9 percent of the County's total building inventory. Under the 0.2-percent annual chance flood scenario, 15,643 buildings (5.3 percent of the inventory) are exposed, with an estimated $14.9 billion in RCV, or 5.1 percent of the jurisdictional total. Table 12-12 and Table 12-13 list the buildings located within the 1- and 0.2-percent annual chance flood hazard areas by general occupancy.

The potential damage is the loss that could occur to the exposed inventory, including structural and content values. Table 12-14 presents Hazus-estimated building losses in Sonoma County for the 1 percent annual chance flood, totaling $880 million across all occupancy types, or 0.3 percent of the County's total replacement cost value. Unincorporated Sonoma County accounts for the largest share, with an estimated $753 million in losses.

12.2.3 Community Lifelines and Other Critical Facilities

Flooding can disrupt essential services such as transportation, water, and emergency response. For example, flooding in the Petaluma River basin may be compounded by tidal influences, affecting road access and utility infrastructure. Lifeline systems near flood-prone areas must be assessed for redundancy and resilience to ensure continuity during and after flood events.

Potential flood impacts on community lifelines and other critical facilities are numerous:

- Oversaturated soils from periods of heavy rain and flooding may cause utility poles to tip over or fall, interrupting the power grid for a potentially large area, especially if a transformer is impacted.
- Excess floodwater can contaminate private drinking water sources, such as wells and springs.
- Excess water makes it more difficult for water treatment plants to treat the water efficiently and effectively.
- Floodwater picks up debris, increasing the number of bacteria, sewage, and other industrial waste and chemicals into the water source or leaky pipes. If there is a contamination at any step of the water flow process, this puts consumers at risk of exposure to dangerous toxins that could result in serious harm, such as wound infections, skin rashes, gastrointestinal illnesses, and tetanus; in extreme cases, death may occur.
- Isolation can be caused by bridges being washed out or blocked by floods or debris.

Table 12-10. Buildings in the 1-Percent Annual Chance Flood Hazard Area

Jurisdiction	Jurisdiction Total Buildings	Replacement Cost Value	Buildings in 1-Percent Annual Chance Flood Hazard Area	% of Jurisdiction Total	Replacement Cost Value	% of Jurisdiction Total
City of Cloverdale	4,392	$4,186,783,797	144	3.3%	$146,771,261	3.5%
City of Cotati	3,453	$3,554,860,439	232	6.7%	$211,541,931	6.0%
City of Healdsburg	6,772	$7,534,677,815	126	1.9%	$112,035,222	1.5%
City of Petaluma	26,057	$31,492,792,559	674	2.6%	$1,443,584,869	4.6%
City of Rohnert Park	14,353	$18,686,653,165	99	0.7%	$229,762,619	1.2%
City of Santa Rosa	70,300	$80,707,495,769	198	0.3%	$160,327,249	0.2%
City of Sebastopol	4,102	$4,123,967,728	184	4.5%	$335,392,999	8.1%
City of Sonoma	6,241	$7,237,043,341	44	0.7%	$39,916,206	0.6%
Town of Windsor	11,739	$12,681,831,535	150	1.3%	$248,279,716	2.0%
Unincorporated County	150,089	$120,191,027,948	6,879	4.6%	$4,856,452,878	4.0%
Sonoma County (Total)	297,498	$290,397,134,097	8,730	2.9%	$7,784,064,950	2.7%

Source: County of Sonoma 2025; LA City Planning 2020; RS Means 2024; FEMA 2024

Table 12-11. Buildings in the 0.2-Percent Annual Chance Flood Hazard Area

Jurisdiction	Jurisdiction Total Buildings	Replacement Cost Value	Buildings in 0.2-Percent Annual Chance Flood Hazard Area	% of Jurisdiction Total	Replacement Cost Value	% of Jurisdiction Total
City of Cloverdale	4,392	$4,186,783,797	144	3.3%	$146,771,261	3.5%
City of Cotati	3,453	$3,554,860,439	604	17.5%	$587,873,880	16.5%
City of Healdsburg	6,772	$7,534,677,815	490	7.2%	$564,530,276	7.5%
City of Petaluma	26,057	$31,492,792,559	1,506	5.8%	$3,314,635,810	10.5%
City of Rohnert Park	14,353	$18,686,653,165	272	1.9%	$357,760,728	1.9%
City of Santa Rosa	70,300	$80,707,495,769	891	1.3%	$740,967,872	0.9%
City of Sebastopol	4,102	$4,123,967,728	241	5.9%	$403,047,439	9.8%
City of Sonoma	6,241	$7,237,043,341	1,310	21.0%	$1,320,736,191	18.2%
Town of Windsor	11,739	$12,681,831,535	729	6.2%	$865,065,800	6.8%
Unincorporated County	150,089	$120,191,027,948	9,456	6.3%	$6,634,755,615	5.5%
Sonoma County (Total)	297,498	$290,397,134,097	15,643	5.3%	$14,936,144,872	5.1%

Source: County of Sonoma 2025; LA City Planning 2020; RS Means 2024; FEMA 2024

Table 12-12. Buildings in the 1-Percent Annual Chance Flood Hazard Area by Occupancy

Jurisdiction	Residential	Commercial	Industrial	Other
City of Cloverdale	53	53	33	5
City of Cotati	169	62	0	1
City of Healdsburg	88	21	14	3
City of Petaluma	435	175	53	11
City of Rohnert Park	63	36	0	0
City of Santa Rosa	84	91	23	0
City of Sebastopol	54	117	11	2
City of Sonoma	30	14	0	0
Town of Windsor	65	44	36	5
Unincorporated County	2,850	2,733	222	1,074
Sonoma County (Total)	3,891	3,346	392	1,101

Source: County of Sonoma 2025; LA City Planning 2020; FEMA 2024

a. Other = Government, Religion, Agricultural, and Education

Table 12-13. Buildings in the 0.2-Percent Annual Chance Flood Hazard Area by Occupancy

Jurisdiction	Residential	Commercial	Industrial	Other[a]
City of Cloverdale	53	53	33	5
City of Cotati	406	194	0	4
City of Healdsburg	354	93	38	5
City of Petaluma	948	450	88	20
City of Rohnert Park	225	46	0	1
City of Santa Rosa	531	304	48	8
City of Sebastopol	72	155	11	3
City of Sonoma	814	472	4	20
Town of Windsor	516	161	47	5
Unincorporated County	3,816	4,033	301	1,306
Sonoma County (Total)	7,735	5,961	570	1,377

Source: County of Sonoma 2025; LA City Planning 2020; FEMA 2024

a. Other = Government, Religion, Agricultural, and Education

Table 12-14. 1-Percent Annual Chance Flood Impacts on Buildings

Jurisdiction	Total Replacement Cost Value (RCV)	All Occupancies Value	% of Total RCV	Residential Estimated Losses	Commercial Estimated Losses	Industrial Estimated Losses	Other Occupancies Estimated Losses
City of Cloverdale	$4,186,783,797	$15,160,289	0.4%	$3,586,198	$1,776,425	$9,739,287	$58,379
City of Cotati	$3,554,860,439	$141,588	<0.1%	$0	$95,375	$0	$46,213
City of Healdsburg	$7,534,677,815	$2,130,040	<0.1%	$190,278	$255,302	$1,684,460	$0
City of Petaluma	$31,492,792,559	$45,995,103	0.1%	$3,608,327	$36,848,640	$5,520,244	$17,892
City of Rohnert Park	$18,686,653,165	$1,518,234	<0.1%	$1,450,180	$68,054	$0	$0
City of Santa Rosa	$80,707,495,769	$5,986,685	<0.1%	$15,774	$470,660	$5,500,251	$0
City of Sebastopol	$4,123,967,728	$55,231,689	1.3%	$2,184,956	$50,265,898	$2,552,951	$227,884
City of Sonoma	$7,237,043,341	$10,768	<0.1%	$0	$10,768	$0	$0
Town of Windsor	$12,681,831,535	$723,054	<0.1%	$7,697	$190,120	$519,591	$5,646
Unincorporated County	$120,191,027,948	$753,439,193	0.6%	$356,173,563	$154,089,665	$70,020,825	$173,155,140
Sonoma County (Total)	$290,397,134,097	$880,336,643	0.3%	$367,216,973	$244,070,907	$95,537,609	$173,511,154

Source: Hazus v6.1; County of Sonoma 2025; LA City Planning 2020; RS Means 2024; FEMA 2024

Mitigation planning should consider measures to reduce flood impacts to critical facilities and ensure sufficient emergency and school services remain when a significant event occurs. In cases where short-term functionality is impacted by flooding, facilities of neighboring municipalities may need to increase support response functions.

Table 12-15 and Table 12-16 summarize the number of community lifelines exposed to the 1- and 0.2-percent annual chance flood hazard area by jurisdiction. Of the 239 facilities in the 1 percent flood hazard area, most are transportation-related (179). Unincorporated Sonoma County accounts for the highest number (191). In the 0.2-percent flood hazard area, a total of 304 facilities are exposed, again led by transportation (202 facilities). Unincorporated Sonoma County has the most at-risk facilities (221).

The 1-percent annual chance flood event is expected to cause varying levels of damage to lifeline facilities in Sonoma County. Communications and transportation are among the most affected, with one facility in each category expected to sustain damage of 50 percent or greater. Additionally, one facility each in the health and medical, safety and security, and water systems categories is anticipated to experience damage between 40 to 49 percent. See Table 12-17 for additional information on damage by lifeline category.

12.2.4 Economy

Flooding impacts local economies by damaging commercial properties, interrupting business operations, and reducing tourism in affected areas. Agricultural lands near Sonoma Creek and the Russian River are particularly susceptible, with floodwaters threatening crops, livestock, and supply chains. Recovery costs and insurance premiums also place financial strain on residents and local governments.

Flood impacts on the local and regional economy include general building stock damage and associated tax loss, impacts on utilities and infrastructure, business interruption, impacts on tourism, and impacts on the local tax base. In areas that are directly flooded, renovations of commercial and industrial buildings may be necessary, disrupting associated services. Loss of facility use, functional downtime, and socio-economic factors are likely. Flood damage to public utilities can disrupt delivery of services. Loss of power and communications may occur, and drinking water and wastewater treatment facilities may be temporarily out of operation.

Debris management may also be a large expense after a flood event. Hazus estimates the amount of debris generated from the 1-percent annual chance event. The model breaks down debris into three categories: (1) finishes (drywall, insulation, etc.); (2) structural (wood, brick, etc.) and (3) foundations (concrete slab and block, rebar, etc.). The distinction is made because of the different types of equipment needed to handle the debris. Table 12-18 summarizes the debris estimates for the 1 percent annual chance flood event. Sonoma County is estimated to generate 41,366 tons of debris from the event, with the majority, 37,624 tons, originating from unincorporated Sonoma County.

Table 12-15. Facilities in 1-Percent Annual Chance Flood Hazard Area, by Lifeline Category

Jurisdiction	Communication	Energy	Food, Hydration, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Water Systems	Other Critical Facilities	Total Facilities in Hazard Area	% of Jurisdiction Total
City of Cloverdale	0	0	0	0	0	0	2	0	0	2	4.7%
City of Cotati	0	0	0	0	0	0	2	0	0	2	5.3%
City of Healdsburg	0	0	0	0	0	0	2	0	1	3	5.4%
City of Petaluma	2	0	0	0	1	0	5	0	0	8	5.3%
City of Rohnert Park	0	0	0	0	1	0	2	0	0	3	3.1%
City of Santa Rosa	0	1	0	0	0	2	7	0	0	10	1.9%
City of Sebastopol	1	0	1	0	1	0	1	0	0	4	9.3%
City of Sonoma	0	0	0	0	0	0	5	0	0	5	8.2%
Town of Windsor	1	0	0	0	0	0	10	0	0	11	14.7%
Unincorporated County	7	0	2	0	8	15	143	12	4	191	10.4%
Sonoma County (Total)	11	1	3	0	11	17	179	12	5	239	8.2%

Source: County of Sonoma 2020, 2025; California Energy Commission 2024; Caltrans 2024, 2025; HIFLD 2024, 2025; USACE NID; FEMA 2024

Table 12-16. Facilities in 0.2-Percent Annual Chance Flood Hazard Area, by Lifeline Category

Jurisdiction	Communication	Energy	Food, Hydration, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Water Systems	Other Critical Facilities	Total Facilities in Hazard Area	% of Jurisdiction Total
City of Cloverdale	0	0	0	0	0	0	2	0	0	2	4.7%
City of Cotati	0	0	0	0	2	0	2	0	0	4	10.5%
City of Healdsburg	0	0	0	0	0	1	2	0	1	4	7.1%
City of Petaluma	5	0	0	0	4	2	9	0	0	20	13.2%
City of Rohnert Park	0	0	0	0	1	0	2	0	0	3	3.1%
City of Santa Rosa	0	1	0	0	0	4	11	0	0	16	3.0%
City of Sebastopol	1	0	1	0	1	1	1	0	0	5	11.6%
City of Sonoma	3	1	0	0	0	1	5	0	3	13	21.3%
Town of Windsor	3	0	0	0	1	0	11	0	1	16	21.3%
Unincorporated County	8	0	5	0	12	20	157	15	4	221	12.1%
Sonoma County (Total)	20	2	6	0	21	29	202	15	9	304	10.4%

Source: County of Sonoma 2020, 2025; California Energy Commission 2024; Caltrans 2024, 2025; HIFLD 2024, 2025; USACE NID; FEMA 2024

Table 12-17. Facilities Experiencing Damage Due to the 1-Percent Annual Chance Flood Event

Lifeline	<5% Damage	5 – 19% Damage	20 – 39% Damage	40 – 49% Damage	50% or Greater Damage
Communications	8	0	0	0	1
Energy	0	0	0	0	0
Food, Hydration, Shelter	1	2	1	0	0
Hazardous Materials	0	0	0	0	0
Health and Medical	4	0	2	1	0
Safety and Security	1	2	2	1	1
Transportation	5	3	1	0	0
Water Systems	1	3	2	1	0

Source: Hazus v6.1; County of Sonoma 2020, 2025; California Energy Commission 2024; Caltrans 2024, 2025; HIFLD 2024, 2025; USACE NID; FEMA 2024

Table 12-18. Estimated Debris Created During the 1-Percent Annual Chance Flood Event

Jurisdiction	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
City of Cloverdale	1,300	264	592	444
City of Cotati	42	41	1	1
City of Healdsburg	121	74	22	25
City of Petaluma	607	436	54	117
City of Rohnert Park	84	60	8	15
City of Santa Rosa	608	232	179	197
City of Sebastopol	468	174	156	138
City of Sonoma	305	102	101	102
Town of Windsor	208	140	32	37
Unincorporated County	37,624	11,964	13,482	12,178
Sonoma County (Total)	41,366	13,486	14,626	13,254

Source: Hazus v6.1; County of Sonoma 2025; LA City Planning 2020; FEMA 2024

12.2.5 Natural Resources

Floodwaters can wash pollution from roads, such as oil and hazardous materials, onto normally dry soils, polluting them for agricultural uses. Floodwater can also alter the landscape, for instance, by eroding riverbanks and causing them to collapse. As floodwater carries material from the eroded banks, it suspends sediment in the water, which can degrade water quality and lead to harmful algae blooms. Suspended sediment eventually settles out of the water, which can clog riverbeds and streams, smother aquatic organisms, and destroy habitats. Erosion and sedimentation have a more negative impact on ecosystems that are already degraded or heavily modified.

12.2.6 Historic and Cultural Resources

Historic places, cultural institutions, parks and open spaces, community facilities, and religious institutions are all vulnerable to impacts from flooding. Venues such as museums and historic buildings face structural damage during flood events, with additional risk of damage to important cultural artifacts housed within. Historic structures often are not built to modern building code requirements, including design flood elevation and construction standards. Historic resources and structures were often built close to waterways, increasing their flood risk.

Parks, recreation, and community space closures due to flood events can disrupt residents' lives and hinder access to critical community services. Although parks and recreational areas located near waterways are exposed to flooding, they are often developed with flooding in mind. Many parks are considered as open space to disallow development.

12.3 FUTURE CHANGES THAT MAY AFFECT RISK

Greater floods are possible with increasing precipitation, sea level rise due to climate change, and development pressure along coastal areas. Increasing impervious cover results in higher runoff volumes and increased flooding. Development within floodplains can raise base flood elevations and increase the number of people and properties at risk, leading to more damage, injuries, and loss of life.

12.3.1 Potential or Planned Development

Any increases in development in the County would increase the overall risk from the flood hazard, with the highest risk increase for development within the mapped SFHA.

12.3.2 Projected Changes in Population

In 2020, the County's population was 488,361. The population decreased to 478,299 in 2025 and the California Department of Finance currently expects the downward trend to continue until it hits a low of 474,013 in 2040. However, the county's population is expected to rebound for the following 30 years, hitting a population of 514,337 by 2070 (CDOF 2024).

An increase in population is likely to result in an increase in overall risk from flood events.

12.3.3 Climate Change

Climate change may cause more extensive flood problems due to possible sea level rise and more severe weather patterns. The 0.2 percent-annual-chance floodplain inundation area may become a higher probability risk. Coastal flood hazard ratings may also need to be reviewed.

12.4 HAZARD-RELATED ISSUES

It is anticipated that Sonoma County will continue to experience direct and indirect impacts of flooding events annually that may induce secondary hazards such as infrastructure deterioration or failure, utility failures, power outages, water quality and supply concerns, transportation delays, accidents, and inconveniences.

Landslide

Hazard Ranking:



LOW

Mass movement is the movement of rock and soil down slope under the influence of **gravity**. Landslides are the most commonly recognized type of mass movement.

Community Lifelines at Risk

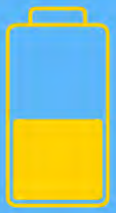
In the High Landslide Susceptibility Zone



11
Total

Daycare & Library - High Risk

Adaptive Capacity



Moderate

Socially Vulnerable at Risk

In the High Landslide Susceptibility Zone

11,208
Persons over 65

11%
of all persons over 65 in the county

Mitigation Projects

- Regrading slopes.
- Remote sensing and GIS.
- Community alert systems.
- Zoning restrictions in high-risk areas.

13. LANDSLIDE

13.1 HAZARD PROFILE

13.1.1 Hazard Description

Landslide Types

A landslide is the movement of rock and soil down slope under the influence of gravity. Common types include the following:

- **Block slides**—Blocks of rock that slide along a slip plane as a unit down a slope.
- **Coastal bluff erosion—**The collapse of coastal bluffs due to undercutting erosive forces of wave action.
- **Creep**—A slow-moving landslide often only noticed through crooked trees and disturbed structures.
- **Debris avalanche**—A debris flow that travels faster than about 10 miles per hour (mph). Speeds in excess of 20 mph are not uncommon, and speeds in excess of 100 mph, although rare, can occur. The slurry can travel miles from its source, growing as it descends, picking up trees, boulders, cars, and anything else in its path.
- **Earth flows**—Fine-grained sediments that flow downhill and typically form a fan structure.
- **Mudslides or Debris Flows**—Rivers of rock, earth, organic matter and other soil materials saturated with water. They develop in the soil overlying bedrock on sloping surfaces when water rapidly accumulates in the ground, such as during heavy rainfall or rapid snowmelt.
- **Rock falls**—Blocks of rock that fall away from a bedrock unit without a rotational component.
- **Rock topples**—Blocks of rock that fall away from a bedrock unit with a rotational component.
- **Rotational slumps**—Blocks of fine-grained sediment that rotate and move down slope.
- **Transitional slides**—Sediments that move along a flat surface without a rotational component.

Factors Causing Landslides

Landslides are caused by a combination of geological and climate conditions, as well as encroaching urbanization. Vulnerable areas are affected by residential, agricultural, commercial, and industrial development and the infrastructure that supports it. Factors causing landslides fall into two categories:

- Factors that increase driving forces:
  - Steepening the slope
  - Adding weight to (loading) the slope, especially the upper parts
  - Increasing the height of a slope (either by human or natural downcutting)
  - Seismic shaking

- Factors that reduce resisting forces:
  - Adding water to the slope, which causes increased pore pressure, which reduces frictional strength
  - Steepening the slope, which reduces normal stress, and thus reduces internal friction
  - Bedding, jointing, or foliation parallel to slope or dipping out of slope—these discontinuities are low-strength zones along which the rock can fail and slide out of the slope
  - Intrinsically weak materials (e.g., deeply weathered, sheared, unconsolidated, or clay-rich materials)
  - Undercutting the slope, which reduces support
  - Removing vegetation, especially trees, which reduces root strength and leads to increased water in soil due to reduced evaporation losses
  - Seismic shaking
  - Coastal bluff erosion caused by wave action

13.1.2 Location

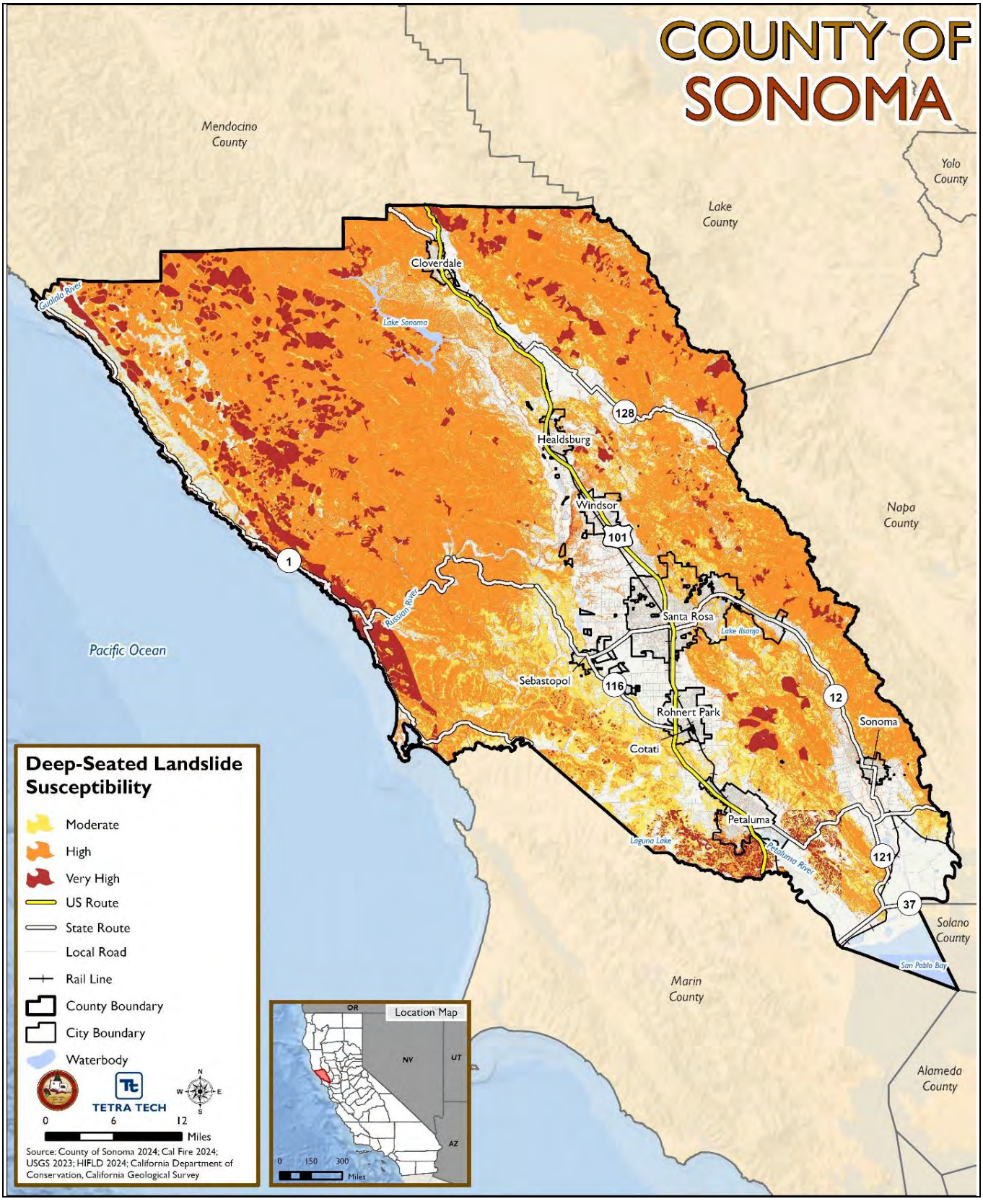
Dormant Sites of Previous Landslides

One of the best predictors of where landslides might occur is the location of past landslides, which can be recognized by distinctive topographic shapes that can remain in place for thousands of years. Such sites range from a few acres to several square miles. Many show no evidence of recent movement and are not currently active. A few may become active in any given year. The recognition of ancient dormant landslide sites is important in the identification of areas susceptible to landslides because they can be reactivated by earthquakes or by exceptionally wet weather. These dormant sites are also vulnerable to construction-triggered sliding. The shoreline contains many large, deep-seated dormant landslides.

Landslide Susceptibility Mapping

The California Geological Survey conducted a statewide analysis using a combination of regional rock strength and slope data to create classes of susceptibility to deep-seated landslides. The analysis assumed, in general, that susceptibility to deep-seated landslides is low on very low slopes in all rock materials and increases with slope and in weak rocks. The analysis also factored in locations of past landslides. Figure 13-1 shows deep-seated landslide susceptibility for Sonoma County.

Figure 13-1. Susceptibility to Deep-Seated Landslides



13.1.3 Extent

Landslides can be measured using the size/volume of the material that was moved during the events. This is also affected by the velocity of the landslide. The rate at which materials move ranges from inches per year to tens of miles per hour (mph) (USGS n.d).

Landslides along the county's coastline, in conjunction with wave action, have resulted in seawall failure, severe erosion, cliff failure, and loss of bluff top area that threatens development. Lots have been significantly reduced in size in the last 25 years, and several houses have been damaged to the extent that they are no longer habitable. Poor road design and construction can contribute to landslide hazards through side-casting on sloping lands, over steepened cut slopes and inadequate drainage facilities (County of Sonoma 2017).

Warning Time

Landslides can occur suddenly or slowly. The velocity may be a slow creep of inches per year for large, deep-seated landslides, while the runout from debris flows may be many feet per second. Earthquake-induced landslides, including rock avalanches, may be almost instantaneous.

The warning time for landslides depends on awareness of the hazard as well as monitoring and alert systems. Conducting assessments of pre-existing landsliding and areas that may be prone to landsliding develops awareness of the hazard and planning for potential slope movement, depending on slope angle, material, and water content. Some methods used to monitor landslides can provide an idea of the type of movement and the amount of time before failure. It is also possible to determine what areas are at risk during general time periods. Assessing geology, vegetation, amount of predicted precipitation, and potential earthquake ground motions can help in these assessments. Warning signs for landslide activity include the following (USGS n.d.):

- Springs, seeps, or saturated ground in areas that have not typically been wet before
- New cracks or unusual bulges in the ground, street pavement, or sidewalk
- Soil moving away from foundations
- Ancillary structures, such as decks and patios, tilting and moving relative to the main house
- Tilting or cracking of concrete floors and foundations
- Broken water lines and other underground utilities
- Leaning telephone poles, trees, retaining walls, or fences
- Offset fence lines
- Sunken or down-dropped roadbeds
- The rapid increase in creek water levels, possibly accompanied by increased turbidity
- A sudden increase in creek water levels while rain is still falling or just recently ended
- Sticking doors and windows, and visible open spaces indicating jambs and frames out of plumb
- A faint rumbling sound that increases in volume as the landslide nears
- Unusual sounds, such as trees cracking or boulders knocking together

For landslides or debris flows that may be triggered by rainfall, improved forecasting of El Niño events or other potentially high rainfall years can provide some advanced warning. Rainfall forecasting allows for better preparation and response to potential slope failures and flood events.

13.1.4 Previous Occurrences

FEMA Disaster Declarations

Table 13-1 lists all landslide-related presidentially declared disasters that have included Sonoma County.

Table 13-1. FEMA Disaster Declarations for Landslide Events in Sonoma County (1954-2025)

Event Date	Declaration Date	Declaration Number	Event Name
Jan 5, 1993 – Mar 20, 1993	Feb 3, 1993	DR-979	Severe Storm, Winter Storm, Mud & Landslides, Flooding
Jan 3, 1995 – Feb 10, 1995	Jan 10, 1995	DR-1044xx	Severe Winter Storms, Flooding, Landslides, Mud Flows
Feb 13, 1995 – Apr 19, 1995	Mar 12, 1995	DR-1046	Severe Winter Storms, Flooding, Landslides, Mud Flows
Dec 17, 2005 – Jan 3, 2006	Feb 3, 2006	DR-1628	Severe Storms, Flooding, Mudslides, and Landslides
Mar 29, 2006 – Apr 16, 2006	Jun 5, 2006	DR-1646	Severe Storms, Flooding, Landslides, and Mudslides
Feb 24, 2019 – Mar 1, 2019	May 18, 2019	DR-4434	Severe Winter Storms, Flooding, Landslides, and Mudslides
Dec 27, 2022 – Jan 31, 2023	Jan 14, 2023	DR-4683	Severe Winter Storms, Flooding, Landslides, and Mudslides
Mar 9, 2023 – Jul 10, 2023	Mar 10, 2023	EM-3592	Severe Winter Storms, Flooding, Landslides, and Mudslides
Feb 21, 2023 – Jul 10, 2023	Apr 3, 2023	DR-4699	Severe Winter Storms, Straight-line Winds, Flooding, Landslides, and Mudslides

Source: (FEMA 2024)

State Emergency Proclamations

Sonoma County has not been included in any landslide-related state emergency proclamations since the last HMP update.

USDA Declarations

Sonoma County was not included in any USDA landslide-related agricultural disaster declarations.

Historic Landslide Events in Sonoma County

April 2006

One of the most destructive landslides in Sonoma County occurred in April 2006. Persistent heavy rainfall caused a massive number of landslides across the Sonoma and Marin County valleys area during the first half of April. About $20 million of damage was done to agriculture, with over $9 million spent in road repair damage in Sonoma County alone. Over $5 million worth of damage was done to single family dwellings in Sonoma—with lesser (but still substantial) amounts of damage experienced to businesses and public buildings. In Marin County the hardest hit areas were Mill Valley, Fairfax, and San Rafael. In Mill Valley, a man was killed after he was buried in a mudslide in his backyard.

January – March 1998

Another landslide occurred during the El Niño winter storms of January 6 – 7, 1998, in the community of Rio Nido. The upper portion of the slide consisted of a large rotational block failure that occurred near the top of the ridge, approximately 600 feet above the elevation of the canyon floor. Two debris flow failures, which are characterized by fluid and high speed downhill flows, were initiated from the face of the block. The southern debris flow traveled 1,500 feet down a narrow ravine, causing the destruction of three homes and damaging four others in Upper Canyon Three. The northern debris flow traveled down an adjacent drainage ravine north of the homes and came to rest within a log-jam 15 to 20 feet high, about 800 feet from the canyon floor. Additional debris flows occurred in the same area on February 21 and March 12, 1998 as a result of additional moderate rainfall.

Residents were evacuated until the stability of the slides could be determined. Geologic studies were performed and movement of the slides monitored for years. Evacuation zones maps were periodically revised and residents gradually permitted to return to some areas. Widespread damage across the state due to these storms prompted the first federally funded landslide acquisition program to permanently remove affected properties. Sonoma County received funds for the acquisition of 45 properties in the four communities that suffered the greatest damage.

Recent Events

Table 13-2 lists major recorded landslide-related events that impacted Sonoma County since the previous HMP was developed. For earlier events, refer to the previous HMP.

13.1.5 Probability of Future Occurrences

Landslides are often triggered by other natural hazards such as earthquakes, heavy rain, floods or wildfires, so their frequency is often related to the frequency of the precipitating hazards. In Sonoma County, landslides typically occur during and after severe storms, so the potential for landslides largely coincides with the potential for sequential severe storms that saturate steep, vulnerable soils. Most weather-induced landslides in the county occur in the winter after the water table has risen. Landslides that result from earthquakes can occur at any time.

Table 13-2. Landslide Events in Sonoma County (2020-2025)

Event Date	Declaration or Proclamation Number	Location Impacted	Description
January 26-29, 2021	N/A	Santa Rosa, Fort Ross	Moisture from the tropical Pacific brought an atmospheric river to the Bay Area, roadway flooding at U.S.-101 N and E Washington St on ramp, and a mudslide on SR-1 and Fort Ross Rd.
March 9, 2023	DR-4699-CA EM-3592-CA CA23-3	California Highway 116	A mud slide moved debris on California Highway 116.
February 4, 2025	N/A	Westside Rd.	A landslide caused a collapse of a part of Westside Road and an unoccupied home to slide into the Russian River. 11 houses along the impacted hillside were evacuated until the hillside was stabilized.
February 5, 2025	N/A	Rincon Valley, Santa Rosa	A landslide tore through a home built on a burn scar from the 2017 Tubbs Fire, trapping two residents until firefighters pulled them to safety. The slide left two homes uninhabitable and triggered an evacuation warning.

The probability of a landslide event occurring in the county in any given year is high. Approximately 50 landslides occur each winter that block county roads (County of Sonoma 2017). Based on historical records and input from the Planning Team, the probability of occurrence for landslides in the County is considered occasional or unlikely.

13.1.6 Cascading Impacts on Other Hazards

Landslides can cause secondary effects such as blocking or washing out roads, which can isolate residents and businesses and delay commercial, public, and private transportation. Other potential problems can result from landslides if vegetation or poles on slopes are knocked over, causing losses to power and communication lines. Landslides also have the potential of destabilizing the foundation of structures, which may result in monetary loss for residents. They can damage rivers or streams, potentially harming water quality, fisheries, and spawning habitat. Landslides into floodways can block the flow of water and cause flooding.

13.2 VULNERABILITY AND IMPACT ASSESSMENT

13.2.1 Life, Health, and Safety

Overall Population

Sonoma County's population is distributed across the evaluated landslide susceptibility zones, as shown in Table 13-3. Areas with moderate landslide susceptibility are home to 55,255 people, representing 11.4 percent of the population. High susceptibility zones contain 47,762 residents, accounting for 9.8 percent, while very high susceptibility areas include 6,391 individuals, or 1.3 percent of the County's total population.

Table 13-3. Population in Landslide Hazards Areas

Jurisdiction	Total Population (2023 ACS)	Persons in the Moderate Hazard Area	% of Jurisdiction Total	Persons in the High Hazard Area	% of Jurisdiction Total	Persons in the Very High Hazard Area	% of Jurisdiction Total
City of Cloverdale	8,933	300	3.4%	1,844	20.6%	6	0.1%
City of Cotati	7,533	1,173	15.6%	246	3.3%	0	0.0%
City of Healdsburg	11,274	931	8.3%	1,205	10.7%	0	0.0%
City of Petaluma	59,321	3,916	6.6%	3,846	6.5%	2,847	4.8%
City of Rohnert Park	44,461	0	0.0%	91	0.2%	0	0.0%
City of Santa Rosa	177,216	15,731	8.9%	11,296	6.4%	92	0.1%
City of Sebastopol	7,466	3,595	48.2%	309	4.1%	0	0.0%
City of Sonoma	10,726	20	0.2%	364	3.4%	0	0.0%
Town of Windsor	26,179	103	0.4%	673	2.6%	0	0.0%
Unincorporated County	132,533	29,486	22.2%	27,888	21.0%	3,446	2.6%
Sonoma County (Total)	485,642	55,255	11.4%	47,762	9.8%	6,391	1.3%

Source: U.S. Census Bureau 2023 ACS; Permit Sonoma 2025; California Department of Conservation, California Geological Survey

Socially Vulnerable Population

Populations with access and functional needs, as well as elderly populations and the very young, may be unable to evacuate quickly enough to avoid the impacts of a landslide. Other vulnerable groups are those experiencing homelessness or residents and visitors whose primary language is not English.

Table 13-4 presents the estimated socially vulnerable populations in areas with moderate landslide susceptibility. Table 13-5 outlines the socially vulnerable populations in high landslide susceptibility areas. Table 13-6 details the socially vulnerable populations in very high landslide susceptibility areas.

13.2.2 General Building Stock

Buildings in the landslide susceptibility hazard areas are listed in Table 13-7 through Table 13-9. In areas with moderate landslide susceptibility, there are 48,382 buildings valued at $43.2 billion. Unincorporated Sonoma County accounts for the largest share in this category, with 37,857 buildings, representing 16.2 percent of its total building stock, and an estimated replacement cost of $29.1 billion. In the high susceptibility zone, there are 35,606 buildings with a total estimated replacement cost of $31.9 billion. In the very high susceptibility zone, there are 4,692 buildings, with an estimated replacement cost value of $4.3 billion.

Table 13-10 through Table 13-12 summarize the number of buildings by occupancy class within landslide hazard areas. In the geologic, high, and very high susceptibility zones, residential buildings represent the highest counts, with 2,135, 16,262, and 2,197 buildings, respectively. In contrast, the moderate landslide susceptibility area has the highest number of commercial buildings, totaling 22,506.

Landslides can damage structures by disrupting their foundations due to ground deformation or the physical impact of moving debris. As a landslide breaks away from a slope and moves, it creates an uneven surface, causing structures and their foundations to experience settlement, cracking, and tilting. Additionally, a water-saturated, fast-moving debris flow, or “mudslide,” can destroy everything in its path, collapsing walls and shifting structures off their foundations.

13.2.3 Community Lifelines and Other Critical Facilities

Highly susceptible areas of the county include mountain and coastal roads and transportation infrastructure. Table 13-13 through Table 13-15 summarize the number of facilities located in the moderate, high, and very high landslide susceptibility hazard areas, categorized by lifeline type. A total of 460 facilities are located in the moderate hazard area, 727 in the high hazard area, and 54 in the very high hazard area. Across all three zones, water systems account for the highest number of facilities, with 205 in the moderate area, 248 in the high area, and 18 in the very high area.

Table 13-4. Vulnerable Persons Living in the Moderate Landslide Susceptibility Hazard Area

Jurisdiction	Persons Over 65	% of Total	Persons Under 5	% of Total	Non-English Speaking Persons	% of Total	Persons with a Disability	% of Total	Persons in Poverty	% of Total	Single Parent Households	% of Total	No Vehicle Access	% of Total
City of Cloverdale	65	3.3%	7	3.2%	15	3.2%	31	3.3%	13	3.3%	4	2.7%	0	0.0%
City of Cotati	174	15.5%	62	15.4%	20	15.4%	127	15.5%	93	15.5%	35	15.4%	0	0.0%
City of Healdsburg	220	8.2%	49	8.2%	36	8.2%	90	8.2%	104	8.2%	20	8.1%	4	7.0%
City of Petaluma	834	6.6%	168	6.6%	152	6.6%	431	6.6%	238	6.6%	62	6.5%	49	6.6%
City of Rohnert Park	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Santa Rosa	2,927	8.9%	771	8.9%	861	8.9%	1,980	8.9%	1,475	8.9%	370	8.9%	179	8.9%
City of Sebastopol	948	48.1%	189	48.1%	114	47.9%	412	48.1%	294	48.0%	45	47.4%	55	47.8%
City of Sonoma	6	0.2%	0	0.0%	0	0.0%	3	0.2%	1	0.1%	0	0.0%	0	0.0%
Town of Windsor	17	0.4%	4	0.3%	2	0.3%	10	0.4%	4	0.3%	2	0.3%	0	0.0%
Unincorporated County	7,653	22.2%	1,278	22.2%	974	22.2%	3,594	22.2%	2,518	22.2%	493	22.2%	169	22.2%
Sonoma County (Total)	12,844	12.6%	2,528	11.1%	2,174	10.9%	6,678	11.5%	4,740	11.5%	1,031	10.5%	456	10.5%

Source: U.S. Census Bureau 2023 ACS Vulnerable Population Totals; California Department of Conservation, California Geological Survey

Table 13-5. Vulnerable Persons Living in the High Landslide Susceptibility Hazard Area

Jurisdiction	Persons Over 65	% of Total	Persons Under 5	% of Total	Non-English Speaking Persons	% of Total	Persons with a Disability	% of Total	Persons in Poverty	% of Total	Single Parent Households	% of Total	No Vehicle Access	% of Total
City of Cloverdale	401	20.6%	44	20.4%	97	20.6%	195	20.5%	81	20.5%	30	20.4%	2	15.4%
City of Cotati	36	3.2%	13	3.2%	4	3.1%	26	3.2%	19	3.2%	7	3.1%	0	0.0%
City of Healdsburg	285	10.7%	64	10.6%	47	10.7%	117	10.6%	135	10.6%	26	10.5%	6	10.5%
City of Petaluma	820	6.5%	165	6.5%	149	6.5%	423	6.5%	234	6.5%	61	6.4%	48	6.5%
City of Rohnert Park	12	0.2%	5	0.2%	2	0.1%	10	0.2%	9	0.2%	1	0.1%	0	0.0%
City of Santa Rosa	2,102	6.4%	554	6.4%	618	6.4%	1,422	6.4%	1,059	6.4%	265	6.4%	128	6.3%
City of Sebastopol	81	4.1%	16	4.1%	9	3.8%	35	4.1%	25	4.1%	3	3.2%	4	3.5%
City of Sonoma	118	3.4%	11	3.4%	4	3.2%	60	3.3%	30	3.4%	7	3.2%	0	0.0%
Town of Windsor	115	2.6%	31	2.5%	18	2.4%	70	2.6%	31	2.5%	17	2.5%	4	2.5%
Unincorporated County	7,238	21.0%	1,209	21.0%	921	21.0%	3,399	21.0%	2,381	21.0%	466	21.0%	159	20.9%
Sonoma County (Total)	11,208	11.0%	2,112	9.2%	1,869	9.4%	5,757	9.9%	4,004	9.8%	883	9.0%	351	8.1%

Source: U.S. Census Bureau 2023 ACS Vulnerable Population Totals; California Department of Conservation, California Geological Survey

Table 13-6. Vulnerable Persons Living in the Very High Landslide Susceptibility Hazard Area

Jurisdiction	Persons Over 65	% of Total	Persons Under 5	% of Total	Non-English Speaking Persons	% of Total	Persons with a Disability	% of Total	Persons in Poverty	% of Total	Single Parent Households	% of Total	No Vehicle Access	% of Total
City of Cloverdale	1	0.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Cotati	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Healdsburg	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Petaluma	607	4.8%	122	4.8%	110	4.8%	313	4.8%	173	4.8%	45	4.8%	35	4.7%
City of Rohnert Park	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Santa Rosa	17	0.1%	4	<0.1%	5	0.1%	11	<0.1%	8	<0.1%	2	<0.1%	1	<0.1%
City of Sebastopol	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Sonoma	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Town of Windsor	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Unincorporated County	894	2.6%	149	2.6%	113	2.6%	420	2.6%	294	2.6%	57	2.6%	19	2.5%
Sonoma County (Total)	1,519	1.5%	275	1.2%	228	1.1%	744	1.3%	475	1.2%	104	1.1%	55	1.3%

Source: U.S. Census Bureau 2023 ACS Vulnerable Population Totals; California Department of Conservation, California Geological Survey

Table 13-7. Buildings in the Moderate Landslide Susceptibility Hazard Area

Jurisdiction	Jurisdiction Total Buildings	Replacement Cost Value	Buildings in the Moderate Hazard Area	% of Jurisdiction Total	Replacement Cost Value	% of Jurisdiction Total
City of Cloverdale	4,392	$4,186,783,797	148	3.4%	$229,778,800	5.5%
City of Cotati	3,453	$3,554,860,439	590	17.1%	$481,022,123	13.5%
City of Healdsburg	6,772	$7,534,677,815	537	7.9%	$666,654,776	8.8%
City of Petaluma	26,057	$31,492,792,559	1,802	6.9%	$1,676,621,160	5.3%
City of Rohnert Park	14,353	$18,686,653,165	0	0.0%	$0	0.0%
City of Santa Rosa	70,300	$80,707,495,769	5,435	7.7%	$9,143,645,448	11.3%
City of Sebastopol	4,102	$4,123,967,728	1,889	46.1%	$1,792,734,865	43.5%
City of Sonoma	6,241	$7,237,043,341	30	0.5%	$39,217,711	0.5%
Town of Windsor	11,739	$12,681,831,535	44	0.4%	$78,004,827	0.6%
Unincorporated County	150,089	$120,191,027,948	37,857	25.2%	$29,141,398,178	24.2%
Sonoma County (Total)	297,498	$290,397,134,097	48,332	16.2%	$43,249,077,888	14.9%

Source: County of Sonoma 2025; LA City Planning 2020; RS Means 2024; California Department of Conservation, California Geological Survey

Table 13-8. Buildings in the High Landslide Susceptibility Hazard Area

Jurisdiction	Jurisdiction Total Buildings	Replacement Cost Value	Buildings in the High Hazard Area	% of Jurisdiction Total	Replacement Cost Value	% of Jurisdiction Total
City of Cloverdale	4,392	$4,186,783,797	824	18.8%	$827,748,763	19.8%
City of Cotati	3,453	$3,554,860,439	116	3.4%	$94,796,326	2.7%
City of Healdsburg	6,772	$7,534,677,815	707	10.4%	$728,179,313	9.7%
City of Petaluma	26,057	$31,492,792,559	1,801	6.9%	$1,835,522,011	5.8%
City of Rohnert Park	14,353	$18,686,653,165	26	0.2%	$24,524,141	0.1%
City of Santa Rosa	70,300	$80,707,495,769	4,154	5.9%	$6,355,525,615	7.9%
City of Sebastopol	4,102	$4,123,967,728	166	4.0%	$157,538,297	3.8%
City of Sonoma	6,241	$7,237,043,341	234	3.7%	$228,263,871	3.2%
Town of Windsor	11,739	$12,681,831,535	318	2.7%	$364,199,452	2.9%
Unincorporated County	150,089	$120,191,027,948	27,260	18.2%	$21,285,365,550	17.7%
Sonoma County (Total)	297,498	$290,397,134,097	35,606	12.0%	$31,901,663,341	11.0%

Source: County of Sonoma 2025; LA City Planning 2020; RS Means 2024; California Department of Conservation, California Geological Survey

Table 13-9. Buildings in the Very High Landslide Susceptibility Hazard Area

Jurisdiction	Jurisdiction Total Buildings	Replacement Cost Value	Buildings in the Very High Hazard Area	% of Jurisdiction Total	Replacement Cost Value	% of Jurisdiction Total
City of Cloverdale	4,392	$4,186,783,797	4	0.1%	$3,177,872	0.1%
City of Cotati	3,453	$3,554,860,439	0	0.0%	$0	0.0%
City of Healdsburg	6,772	$7,534,677,815	1	<0.1%	$1,490,768	<0.1%
City of Petaluma	26,057	$31,492,792,559	1,102	4.2%	$1,500,224,072	4.8%
City of Rohnert Park	14,353	$18,686,653,165	0	0.0%	$0	0.0%
City of Santa Rosa	70,300	$80,707,495,769	49	0.1%	$90,123,828	0.1%
City of Sebastopol	4,102	$4,123,967,728	0	0.0%	$0	0.0%
City of Sonoma	6,241	$7,237,043,341	0	0.0%	$0	0.0%
Town of Windsor	11,739	$12,681,831,535	0	0.0%	$0	0.0%
Unincorporated County	150,089	$120,191,027,948	3,536	2.4%	$2,688,104,436	2.2%
Sonoma County (Total)	297,498	$290,397,134,097	4,692	1.6%	$4,283,120,976	1.5%

Source: County of Sonoma 2025; LA City Planning 2020; RS Means 2024; California Department of Conservation, California Geological Survey

Table 13-10. Buildings in the Moderate Landslide Susceptibility Hazard Area by Occupancy

Jurisdiction	Residential	Commercial	Industrial	Other[a]
City of Cloverdale	99	45	3	1
City of Cotati	338	246	0	6
City of Healdsburg	341	182	8	6
City of Petaluma	1,239	550	5	8
City of Rohnert Park	0	0	0	0
City of Santa Rosa	4,427	961	26	21
City of Sebastopol	1,220	642	3	24
City of Sonoma	8	16	2	4
Town of Windsor	33	11	0	0
Unincorporated County	10,848	19,403	603	7,003
Sonoma County (Total)	18,553	22,056	650	7,073

Source: County of Sonoma 2025; LA City Planning 2020; Permit Sonoma 2025; California Department of Conservation, California Geological Survey

a. Other = Government, Religion, Agricultural, and Education

Table 13-11. Buildings in the High Landslide Susceptibility Hazard Area by Occupancy

Jurisdiction	Residential	Commercial	Industrial	Other[a]
City of Cloverdale	608	203	5	8
City of Cotati	71	45	0	0
City of Healdsburg	441	251	9	6
City of Petaluma	1,217	562	9	13
City of Rohnert Park	24	2	0	0
City of Santa Rosa	3,179	920	28	27
City of Sebastopol	105	60	0	1
City of Sonoma	142	76	2	14
Town of Windsor	215	99	0	4
Unincorporated County	10,260	11,146	638	5,216
Sonoma County (Total)	16,262	13,364	691	5,289

Table 13-12 Buildings in the Very High Landslide Susceptibility Hazard Area by Occupancy

Jurisdiction	Residential	Commercial	Industrial	Other[a]
City of Cloverdale	2	2	0	0
City of Cotati	0	0	0	0
City of Healdsburg	0	1	0	0
City of Petaluma	901	198	0	3
City of Rohnert Park	0	0	0	0
City of Santa Rosa	26	23	0	0
City of Sebastopol	0	0	0	0
City of Sonoma	0	0	0	0
Town of Windsor	0	0	0	0
Unincorporated County	1,268	1,368	67	833
Sonoma County (Total)	2,197	1,592	67	836

Source: County of Sonoma 2025; LA City Planning 2020; Permit Sonoma 2025; California Department of Conservation, California Geological Survey

a. Other = Government, Religion, Agricultural, and Education

Table 13-13. Facilities in the Moderate Landslide Susceptibility Hazard Area

Jurisdiction	Communication	Energy	Food, Hydration, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Water Systems	Other Critical Facilities	Total Facilities in Hazard Area	% of Jurisdiction Total
City of Cloverdale	0	0	0	0	1	0	0	0	0	1	2.3%
City of Cotati	0	0	1	0	0	1	0	0	0	2	5.3%
City of Healdsburg	0	0	1	0	1	0	0	0	1	3	5.4%
City of Petaluma	0	0	0	0	0	0	0	4	0	4	2.6%
City of Rohnert Park	0	0	0	0	0	0	0	0	0	0	0.0%
City of Santa Rosa	8	0	0	0	3	5	7	13	1	37	7.0%
City of Sebastopol	1	0	1	0	3	3	0	3	3	14	32.6%
City of Sonoma	0	0	0	0	0	0	0	6	0	6	9.8%
Town of Windsor	0	0	0	0	0	0	0	0	0	0	0.0%
Unincorporated County	98	8	8	0	15	48	30	179	7	393	21.5%
Sonoma County (Total)	107	8	11	0	23	57	37	205	12	460	15.8%

Source: County of Sonoma 2020, 2025; California Energy Commission 2024; Caltrans 2024, 2025; HIFLD 2024, 2025; USACE NID; California Department of Conservation, California Geological Survey

Table 13-14. Facilities in the High Landslide Susceptibility Hazard Area

Jurisdiction	Communication	Energy	Food, Hydration, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Water Systems	Other Critical Facilities	Total Facilities in Hazard Area	% of Jurisdiction Total
City of Cloverdale	0	0	0	0	0	0	1	2	0	3	7.0%
City of Cotati	0	0	0	0	0	0	0	0	0	0	0.0%
City of Healdsburg	0	0	0	0	0	1	1	0	0	2	3.6%
City of Petaluma	1	0	1	0	1	5	5	0	3	16	10.6%
City of Rohnert Park	0	0	0	0	0	0	0	0	0	0	0.0%
City of Santa Rosa	15	0	0	0	2	2	25	14	4	62	11.7%
City of Sebastopol	1	0	0	0	0	0	0	0	0	1	2.3%
City of Sonoma	0	0	0	0	0	0	1	0	0	1	1.6%
Town of Windsor	0	0	0	0	0	1	4	2	1	8	10.7%
Unincorporated County	119	4	15	0	15	51	197	230	3	634	34.7%
Sonoma County (Total)	136	4	16	0	18	60	234	248	11	727	24.9%

Source: County of Sonoma 2020, 2025; California Energy Commission 2024; Caltrans 2024, 2025; HIFLD 2024, 2025; USACE NID; California Department of Conservation, California Geological Survey

Table 13-15. Facilities in the Very High Landslide Susceptibility Hazard Area

Jurisdiction	Communication	Energy	Food, Hydration, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Water Systems	Other Critical Facilities	Total Facilities in Hazard Area	% of Jurisdiction Total
City of Cloverdale	0	0	0	0	0	0	0	0	0	0	0.0%
City of Cotati	0	0	0	0	0	0	0	0	0	0	0.0%
City of Healdsburg	0	0	0	0	0	0	0	0	0	0	0.0%
City of Petaluma	0	0	0	0	0	1	0	0	2	3	2.0%
City of Rohnert Park	0	0	0	0	0	0	0	0	0	0	0.0%
City of Santa Rosa	0	0	0	0	0	0	0	0	0	0	0.0%
City of Sebastopol	0	0	0	0	0	0	0	0	0	0	0.0%
City of Sonoma	0	0	0	0	0	0	0	0	0	0	0.0%
Town of Windsor	0	0	0	0	0	0	0	0	0	0	0.0%
Unincorporated County	4	1	0	0	3	8	17	18	0	51	2.8%
Sonoma County (Total)	4	1	0	0	3	9	17	18	2	54	1.8%

Source: County of Sonoma 2020, 2025; California Energy Commission 2024; Caltrans 2024, 2025; HIFLD 2024, 2025; USACE NID; California Department of Conservation, California Geological Survey

13.2.4 Economy

Direct costs of landslides include damage to buildings, property, transportation corridors, fuel and energy conduits, and communication lines (USGS 2022). Indirect costs, such as clean-up costs, business interruption, loss of tax revenues, reduced property values, and loss of productivity may also occur. Buildings losses will impact the local tax base and economy. Landslide events that block access to roads can isolate residents and businesses and delay commercial, public, and private transportation.

13.2.5 Natural Resources

A landslide alters topography and can damage or destroy vegetation and wildlife habitat. Soil and sediment runoff accumulating downslope can block waterways and roadways and degrade water quality in streams and other water bodies. Mudflows that erode into downstream waterways can threaten the life of freshwater species (USGS 2020b). The impacts of eroded landscape can travel for miles downstream into adjacent waterways and create issues for surrounding watersheds. Additional environmental impacts include loss of forest productivity.

13.2.6 Historic and Cultural Resources

Landslide impacts on historic and cultural resources are highest in areas near hillsides that are characterized by unstable soil and erosion. Historical structures are often not built to modern building standards and are more prone to damages. Landslides can damage property and infrastructure in and around cultural landmarks, resulting in reduced access and potential closures of assets and areas.

13.3 FUTURE CHANGES THAT MAY AFFECT RISK

13.3.1 Potential or Planned Development

Any areas of growth could be impacted by the landslide hazard if located within the hazard areas or downslope. In general, development of slopes is not recommended due to the increased risk of erosion, stormwater runoff and flooding potential. The additional runoff results in sedimentation of downslope surface waters, which damages habitat and has the potential to damage property.

13.3.2 Projected Changes in Population

In 2020, the County's population was 488,361. The population decreased to 478,299 in 2025 and the California Department of Finance currently expects the downward trend to continue until it hits a low of 474,013 in 2040. However, the county's population is expected to rebound for the following 30 years, hitting a population of 514,337 by 2070 (CDOF 2024).

An increase in population is likely to result in an increase in overall risk from landslide events.

13.3.3 Climate Change

The impact of climate change on landslides is uncertain. If climate change impacts the timing and intensity of rain event, then the frequency of landslide events may increase.

13.4 HAZARD-RELATED ISSUES

Important issues associated with landslides in the planning area include the following:

- An accurate picture of where landslides occurred during previous storms is vital in making intelligent land use planning and mitigation decisions.
- Landslides may result in isolation of neighborhoods due to the fact that large portions of the transportation infrastructure are in areas of high and moderate slope instability. Isolation may result in food shortages, loss of power, and severely reduced economic productivity.
- There are critical facilities in areas of unstable slopes that could result in interruption to utility services, particularly water and power. This creates a need for mitigation and continuity of operations planning to develop procedures for continuing services after a landslide.
- At this time, all infrastructure and transportation corridors identified as exposed to the landslide hazard are considered susceptible to damage until more information becomes available. A more in-depth analysis of the mitigation measures taken by landslide-exposed critical facilities to prevent damage from landslides should be done to determine if they could withstand impacts of a landslide.
- Landslides may result in loss of water quality to the environment and for drinking purposes, due to increased sediment delivery into surface waterways.
- There are homes in landslide hazard areas throughout the planning area. The degree of vulnerability of these structures depends on the codes and standards the structures were constructed to. Information to this level of detail is not currently available.
- The risk associated with the landslide hazard overlaps the risk associated with other hazards such as earthquake, flood, and wildfire. This provides an opportunity to seek mitigation alternatives with multiple objectives that can reduce risk for multiple hazards.
- California's Disclosures in Real Property Transactions law requires disclosure if a property is in a landslide hazard area. Such disclosure is dependent upon knowledge by the seller or the seller's real estate agent or the posting of a landslide hazard map at the offices of the County recorder, County assessor, and County planning agency and a notice identifying the location of the map and any changes to it.
- Future development could lead to more homes in landslide risk areas.
- Mapping and assessment of landslide hazards are constantly evolving. As new data and science become available, assessments of landslide risk should be reevaluated.
- Coastal bluff erosion is particularly susceptible to ocean wave height and the direction of wave approach. El Niño conditions often result in substantial increases in the of coastal bluff retreat. Roads and residential developments are most exposed to these hazards.

Sea Level Rise

Hazard Ranking:



LOW

Sea level rise refers to the long-term **increase** in the average height of the ocean's surface, primarily driven by **climate change**.

Buildings at Risk



844
Total

170 - Residential High Risk

Adaptive Capacity



Moderate

Socially Vulnerable at Risk

0.1%
of all persons over 65 in the county

116
Persons over 65

Mitigation Projects

- Flood barriers and elevated structures.
- Living shorelines.
- Flood hazard modeling.

14. SEA LEVEL RISE

14.1 HAZARD PROFILE

14.1.1 Hazard Description

Sea level rise refers to the long-term increase in the average height of the ocean's surface, primarily driven by climate change. The two major causes of global sea level rise are thermal expansion of warming oceans and the melting of land-based glaciers and polar ice caps. With ongoing sea level rise, the impacts of large El Niño-driven storm events in combination with high tides and large waves will generally become more frequent and more severe in the latter half of this century (California Coastal Commission 2019).

Approximately 85 percent of California's population live and work in coastal counties. The sea level along California's coasts has risen nearly 8 inches in the past century, and the National Research Council projects that by 2100 sea level in California south of Cape Mendocino may rise 66 inches. Extreme sea level rise could put nearly half a million people at risk of flooding by 2100, and threaten $100 billion in property and infrastructure, including roadways, buildings, hazardous waste sites, power plants, and parks and tourist destinations. Coastal erosion could have a significant impact on California's ocean-dependent economy, which is estimated to be $46 billion per year (California Office of the Attorney General 2021).

As sea levels rise, saltwater contamination of the State's delta and levee systems will increase. Saltwater contamination of the Sacramento/San Joaquin Delta will threaten wildlife and the source of drinking water for 20 million Californians. Farmland in low areas may also be harmed by salt-contaminated water (California Office of the Attorney General 2021).

The 2018 report *Conserving California's Coastal Habitats: A Legacy and a Future with Sea Level Rise* identifies numerous potential impacts of sea level rise on coastal and bay land natural resources and natural protections (Conserving California's Coastal Habitats 2018):

- As sea levels rise, coastal habitats may be squeezed into an ever-shrinking area between rising seas and human development and infrastructure. Coastal habitats are at risk of being submerged, and their associated species will be lost without immediate conservation and management actions to give them the space and ability to move inland.
- Natural land and open space may become inundated, including important undeveloped areas that serve as protection of developed areas from flooding.
- Higher seas will mean a higher reach for storm surge, which will increase coastal flooding.
- Saltwater intrusion into surface and groundwater aquifers will push further and further inland, potentially altering natural habitat communities and impacting agricultural practices.
- Currently protected and conserved coastal areas in California and their habitat value, which represents a real and substantial investment for the future, may be impacted or lost.

The report highlights recommendations to conserve California's coastal habitats in the face of rising sea levels by maintaining resilient conservation lands, conserving resilient landscapes, and managing in place for resilience.

Sonoma County's ocean coast regularly experiences erosion, flooding, and significant storm events, and sea level rise would exacerbate these processes. It is critically important that Sonoma County plan and prepare to adapt to sea level rise to ensure public resources and coastal communities are resilient for present and future generations. Future development considerations should include future vulnerabilities to sea level rise and corresponding habitat migration (County of Sonoma, 2019).

14.1.2 Location

Sea level rise is likely to affect all coastal areas of Sonoma County. Figure 14-1 shows the potential sea level rise hazard area for Sonoma County.

14.1.3 Extent

Models projecting sea level rise provide a range of severity scenarios based on assumptions about the rate of climate change. One medium-rate sea level rise scenario for Sonoma County predicts increases from the 1992 baseline sea level as shown in Figure 14-2. While Sonoma County's ocean coast regularly experiences erosion, flooding, and significant storm events, sea level rise would exacerbate these natural processes and lead to significant social, environmental, and economic impacts (County of Sonoma 2019).

14.1.4 Previous Occurrences

FEMA Disaster Declarations

Between 2021 and 2025, Sonoma County was not included in any sea level rise-related disaster declarations.

State Emergency Proclamations

Between 2021 and 2025, Sonoma County was not included in any sea level rise-related state emergency proclamations.

USDA Declarations

Between 2021 and 2025, Sonoma County was not included in any USDA sea level rise-related agricultural disaster declarations (USDA 2024).

Figure 14-1.Potential Sea Level Rise Hazard Area

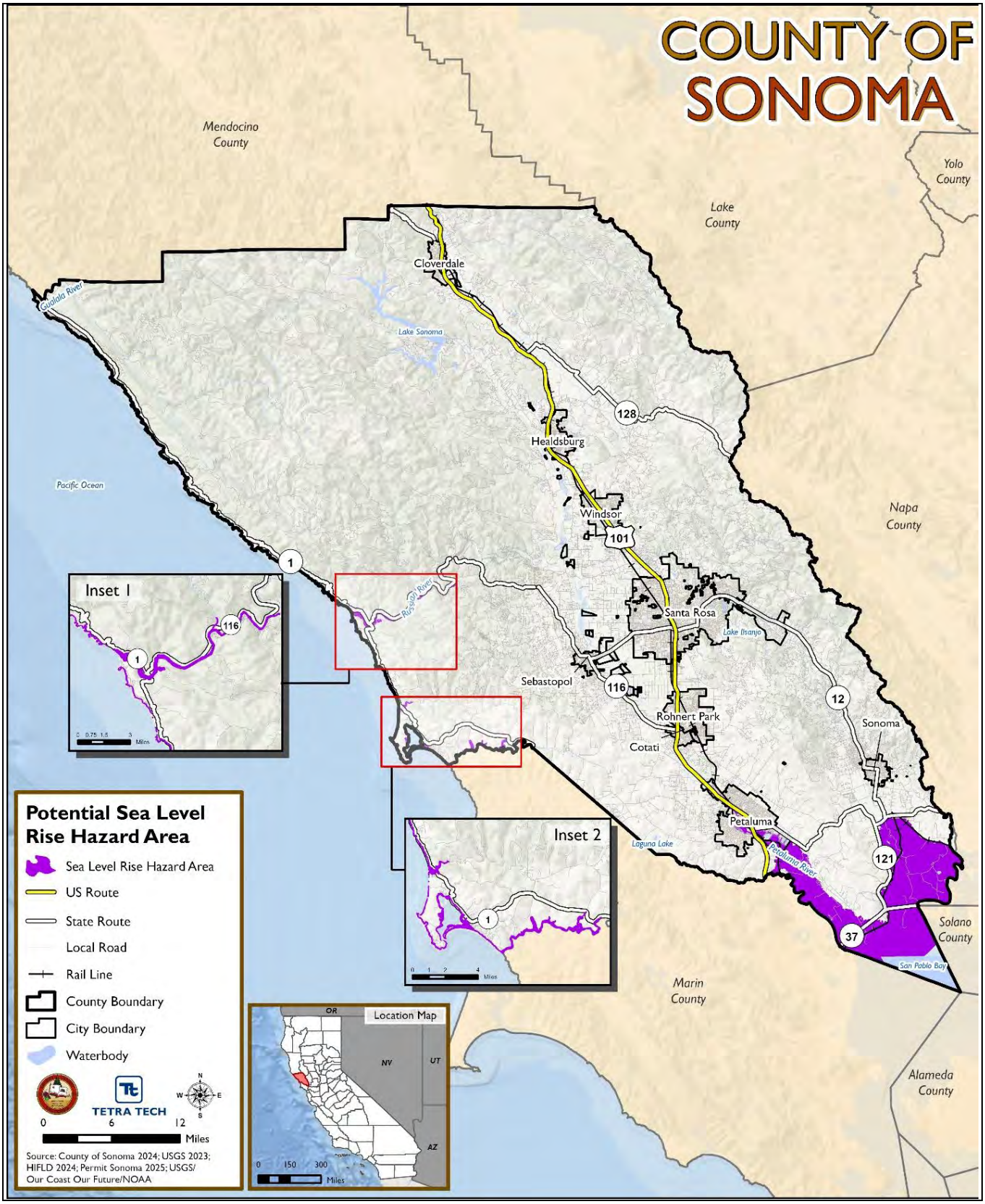
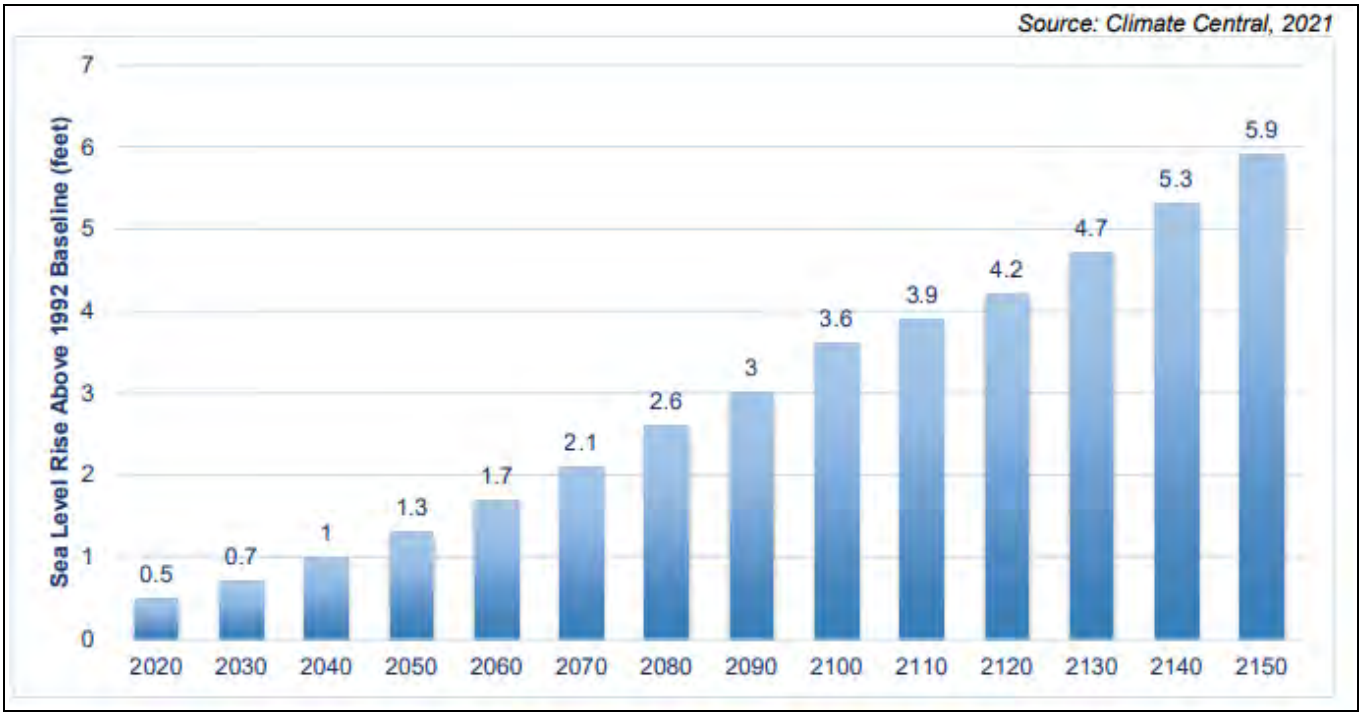


Figure 14-2. Medium Projection for Sonoma County Sea Level Rise Above 1992 Baseline



14.1.5 Probability of Future Occurrences

Although scientists indicate strong confidence levels in projections of future sea level rise, the amount of rise in a single year in the short-term may not have significant impacts in Sonoma County. For this reason, based on input from the Planning Team, the probability of occurrence for sea level in the County is considered “rare.”

14.1.6 Cascading Impacts on Other Hazards

Sea level rise is an ongoing phenomenon that will likely impact the frequency and severity of coastal storms. As sea level rises, flooding from storms will become more frequent and potentially more hazardous.

Storms and flooding in California typically occur during the winter from November to April and are influenced by several climate patterns, most prominently the El Niño Southern Oscillation. Every two to seven years, the Southern Oscillation alternates between two phases—La Niña and El Niño. El Niño years generally result in persistently low air pressure, greater rainfall, and high winds. Low air pressure during a storm causes an immediate rise in sea level above predicted tides, referred to as storm surge. The water levels reached during these large, short-term events have exceeded mean sea levels projected for 2100, so understanding their additive effects is crucial for coastal planning (County of Sonoma 2019).

14.2 VULNERABILITY AND IMPACT ASSESSMENT

14.2.1 Life, Health, and Safety

Overall Population

A total of 503 people in Sonoma County reside within the identified sea level rise hazard area. The City of Petaluma accounts for the largest share, with 300 individuals, representing 0.5 percent of its total population. The remaining 203 individuals, or 0.2 percent of the population, are located within unincorporated Sonoma County. Table 14-1 shows the total population by jurisdiction for this hazard area.

Table 14-1. Population in the Sea Level Rise Hazard Area

Jurisdiction	Total Population (2023 ACS)	Number of Persons	% of Jurisdiction Total
City of Cloverdale	8,933	0	0.0%
City of Cotati	7,533	0	0.0%
City of Healdsburg	11,274	0	0.0%
City of Petaluma	59,321	300	0.5%
City of Rohnert Park	44,461	0	0.0%
City of Santa Rosa	177,216	0	0.0%
City of Sebastopol	7,466	0	0.0%
City of Sonoma	10,726	0	0.0%
Town of Windsor	26,179	0	0.0%
Unincorporated County	132,533	203	0.2%
Sonoma County (Total)	485,642	503	0.1%

Source: U.S. Census Bureau 2023 ACS; Permit Sonoma 2025; USGS/Our Coast Our Future/NOAA

Sea level rise increases the risk of coastal flooding, storm surge, and infrastructure disruption across Sonoma County's coastal areas. As protective features like beaches and dunes erode, more inland areas become susceptible to flooding. This can lead to widespread evacuations, damage to homes and businesses, and interruptions to transportation and utility services.

Socially Vulnerable Population

Socially vulnerable populations face heightened risks and challenges in adapting to and recovering from the impacts of sea level rise. Economically disadvantaged individuals and those with physical limitations may struggle to afford or implement necessary adaptations, such as repairs after storms. Those at risk due to inadequate warning include individuals lacking internet access, non-English speakers, and those who do not regularly use communication tools like cell phones or social media. Table 14-2 presents the estimated socially vulnerable populations in the sea level rise hazard area.

Table 14-2. Vulnerable Persons Living in the Sea Level Rise Hazard Area

Jurisdiction	Persons Over 65	% of Total	Persons Under 5	% of Total	Non-English Speaking Persons	% of Total	Persons with a Disability	% of Total	Persons in Poverty	% of Total	Single Parent Households	% of Total	No Vehicle Access	% of Total
City of Cloverdale	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Cotati	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Healdsburg	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Petaluma	64	0.5%	12	0.5%	11	0.5%	33	0.5%	18	0.5%	4	0.4%	3	0.4%
City of Rohnert Park	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Santa Rosa	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Sebastopol	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Sonoma	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Town of Windsor	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Unincorporated County	52	0.2%	8	0.1%	6	0.1%	24	0.1%	17	0.2%	3	0.1%	1	0.1%
Sonoma County (Total)	116	0.1%	20	0.1%	17	0.1%	57	0.1%	35	0.1%	7	0.1%	4	0.1%

Source: U.S. Census Bureau 2023 ACS Vulnerable Population Totals; Permit Sonoma 2025; USGS/Our Coast Our Future/NOAA

14.2.2 General Building Stock

As shown in Table 14-3, there are 844 buildings in the sea level rise hazard area, accounting for 0.3 percent of the County's total general building stock. The replacement cost value for these buildings is estimated $1.4 billion, which constitutes 0.5 percent of the County's total inventory replacement cost value.

Table 14-3. Buildings in the Sea Level Rise Hazard Area

Jurisdiction	Count	Replacement Cost Value	Buildings in the Hazard Area	% of Jurisdiction Total	Replacement Cost Value	% of Jurisdiction Total
City of Cloverdale	4,392	$4,186,783,797	0	0.0%	$0	0.0%
City of Cotati	3,453	$3,554,860,439	0	0.0%	$0	0.0%
City of Healdsburg	6,772	$7,534,677,815	0	0.0%	$0	0.0%
City of Petaluma	26,057	$31,492,792,559	327	1.3%	$873,523,077	2.8%
City of Rohnert Park	14,353	$18,686,653,165	0	0.0%	$0	0.0%
City of Santa Rosa	70,300	$80,707,495,769	0	0.0%	$0	0.0%
City of Sebastopol	4,102	$4,123,967,728	0	0.0%	$0	0.0%
City of Sonoma	6,241	$7,237,043,341	0	0.0%	$0	0.0%
Town of Windsor	11,739	$12,681,831,535	0	0.0%	$0	0.0%
Unincorporated County	150,089	$120,191,027,948	517	0.3%	$509,823,869	0.4%
Sonoma County (Total)	297,498	$290,397,134,097	844	0.3%	$1,383,346,946	0.5%

Source: County of Sonoma 2025; LA City Planning 2020; RS Means 2024; Permit Sonoma 2025; USGS/Our Coast Our Future/NOAA

Table 14-4 presents the buildings in the hazard area categorized by occupancy class. Sonoma County has a total of 170 residential buildings, 352 commercial buildings, 70 industrial buildings, and 252 buildings classified as government, religious, agricultural, and educational.

Sea level rise significantly increases the vulnerability of buildings and infrastructure in coastal areas. As water levels rise, structures once considered safe may become exposed to frequent coastal flooding and storm surge. This repeated exposure can weaken foundations, accelerate structural deterioration, and lead to increased maintenance and repair costs. Over time, sea level rise can render entire neighborhoods uninhabitable, especially where elevation and floodproofing measures are not in place.

Table 14-4. Building in the Sea Level Rise Hazard Area by Occupancy

Jurisdiction	Residential	Commercial	Industrial	Other[a]
City of Cloverdale	0	0	0	0
City of Cotati	0	0	0	0
City of Healdsburg	0	0	0	0
City of Petaluma	95	167	44	21
City of Rohnert Park	0	0	0	0
City of Santa Rosa	0	0	0	0
City of Sebastopol	0	0	0	0
City of Sonoma	0	0	0	0
Town of Windsor	0	0	0	0
Unincorporated County	75	185	26	231
Sonoma County (Total)	170	352	70	252

Source: County of Sonoma 2025; LA City Planning 2020; Permit Sonoma 2025; USGS/Our Coast Our Future/NOAA

a. Other = Government, Religion, Agricultural, and Education

14.2.3 Community Lifelines and Other Critical Facilities

Table 14-5 summarizes the number of community lifelines in the sea level rise hazard area. Overall, in Sonoma County, there are 29 facilities within this hazard area. Twenty-two of those are within unincorporated Sonoma County, with the remaining seven in the City of Petaluma.

Sea level rise poses significant threats to community lifelines and critical infrastructure in coastal areas. Rising waters can destabilize roads, scour bridge foundations, and expose underground utilities, leading to service disruptions and physical damage. Major transportation routes located near the shoreline are especially vulnerable, which can hinder access to emergency services and evacuation routes. When utility lines are compromised, essential systems such as water, sewer, gas, and electricity may fail, affecting the entire community. The widespread distribution of these systems increases their exposure to sea level rise and relocating them out of hazard zones is often costly and complex.

Table 14-5. Facilities in Sea Level Rise Hazard Area, by Lifeline Category

Jurisdiction	Communication	Energy	Food, Hydration, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Water Systems	Other Critical Facilities	Total Facilities in Hazard Area	% of Jurisdiction Total
City of Cloverdale	0	0	0	0	0	0	0	0	0	0	0.0%
City of Cotati	0	0	0	0	0	0	0	0	0	0	0.0%
City of Healdsburg	0	0	0	0	0	0	0	0	0	0	0.0%
City of Petaluma	3	0	0	0	2	1	1	0	0	7	4.6%
City of Rohnert Park	0	0	0	0	0	0	0	0	0	0	0.0%
City of Santa Rosa	0	0	0	0	0	0	0	0	0	0	0.0%
City of Sebastopol	0	0	0	0	0	0	0	0	0	0	0.0%
City of Sonoma	0	0	0	0	0	0	0	0	0	0	0.0%
Town of Windsor	0	0	0	0	0	0	0	0	0	0	0.0%
Unincorporated County	2	0	0	0	1	0	17	2	0	22	1.2%
Sonoma County (Total)	5	0	0	0	3	1	18	2	0	29	1.0%

Source: County of Sonoma 2020, 2025; California Energy Commission 2024; Caltrans 2024, 2025; HIFLD 2024, 2025; USACE NID; Permit Sonoma 2025; USGS/Our Coast Our Future/NOAA

14.2.4 Economy

Residents, businesses, and industries that currently thrive on the shoreline will be at risk of flooding by the middle of the century if nothing is done to protect, elevate or relocate them. A 16-inch sea level rise (relative to sea level in 2000) could expose 281 square miles of Bay shoreline to flooding, and a 55-inch rise could expose 333 square miles. If no adaptation measures were taken, a 55-inch rise would place an estimated 270,000 people in the Bay Area at risk from flooding, 98 percent more than are currently at risk. The estimated value of Bay Area shoreline development at risk from a 55-inch rise in sea level is $62 billion—two-thirds of all the estimated value of development vulnerable to sea level rise along California's entire coastline. Any increased storm activity resulting from climate change, in combination with higher sea level, could cause even greater flooding (San Francisco Bay Conservation and Developmemt Commission 2011).

14.2.5 Natural Resources

Coastal ecosystems such as wetlands are at risk of inundation and erosion due to sea level rise, leading to habitat loss, particularly for endangered species, as tidal zones shift inland. Saltwater intrusion further degrades soil quality, contaminates freshwater systems, and threatens agricultural productivity.

The habitats fringing a coastline attenuate waves and thus reduce storm-related damage to shorelines from erosion and inundation. North of the Russian River mouth to the northern extent of Sonoma County, kelp forest habitat backed by rocky cliffs dominate the landscape and are generally low exposure. In contrast, south of the Russian River mouth, a greater diversity of habitats (e.g., wetlands, beaches, dune systems) are present and are habitats that are highly exposed to erosion and inundation during storms compared to north of the river mouth. As coastal development and rising sea levels alter or damage these habitats, coastlines and nearby infrastructure become increasingly vulnerable to storms (County of Sonoma 2019).

14.2.6 Historic and Cultural Resources

Many historic buildings, districts, and archaeological sites located near coastlines and river mouths are increasingly vulnerable. Rising groundwater levels, frequent flooding, and erosion can deteriorate building materials, weaken foundations, and damage irreplaceable cultural artifacts.

14.3 FUTURE CHANGES THAT MAY AFFECT RISK

14.3.1 Potential or Planned Development

The overall land area of Sonoma County will decrease as sea level rise permanently inundates the County's lowest areas. This will have significant impacts on land use and planning in local communities. Local general plans as well as climate action/adaptation plans in the planning area will guide this future

development. State mandates have sought to strengthen land use application in areas impacted by sea level rise. Local general plans should be referenced and cross-referenced with the results of this HMP to mitigate future development in areas most vulnerable to sea level rise.

14.3.2 Projected Changes in Population

In 2020, the County's population was 488,361. The population decreased to 478,299 in 2025 and the California Department of Finance currently expects the downward trend to continue until it hits a low of 474,013 in 2040. However, the county's population is expected to rebound for the following 30 years, hitting a population of 514,337 by 2070 (CDOF 2024).

An increase in population is likely to result in an increase in overall risk from sea level rise events.

14.3.3 Climate Change

Sea levels along the Sonoma County coast will rise over the next 80 years and beyond, and the county and coastal cities will be adversely impacted by that rise. The impacts are already happening and will progress over time. The Planning Partners are already preparing for these impacts using programs such as the Local Coastal Plan and other current projections customized for the immediate region. Mitigating the impacts from sea-level rise will take resources and tough land use decisions over the next 30 years, starting immediately.

14.4 HAZARD-RELATED ISSUES

The planning team has identified the following sea-level-rise-related issues:

- Available funding is not adequate to mitigate the impacts from sea level rise.
- The County should consider the adoption of higher regulatory standards to mitigate impacts of sea-level rise on redevelopment.
- The data and science that measure sea-level rise impacts progress rapidly. The County should commit to staying in line with the best available data and science on sea-level rise as it evolves.
- The costs to mitigate impacts from sea-level rise will be extensive and potentially beyond the County's means.
- There needs to be a determination of where people can go when the only option to mitigate the impacts from sea-level rise is to retreat.
- The County will need to find ways to equitably mitigate impacts from sea-level rise.
- Risk communication will be crucial to the successful mitigation of this hazard.

Tsunami

Hazard Ranking:



A tsunami is a series of **high-energy waves** that radiate outward where a generating event occurs, arriving at shorelines over an extended period.

Buildings at Risk



163
Total

68 - Residential High Risk

Adaptive Capacity



Moderate

Socially Vulnerable at Risk

47
Persons over 65

0.1%
of all persons over 65 in the county

Mitigation Projects

- Emergency alert systems.
- Zoning regulations, setback requirements, and elevated structures.
- NOAA National Tsunami Hazard Mitigation Program.

15. TSUNAMI

15.1 HAZARD PROFILE

15.1.1 Hazard Description

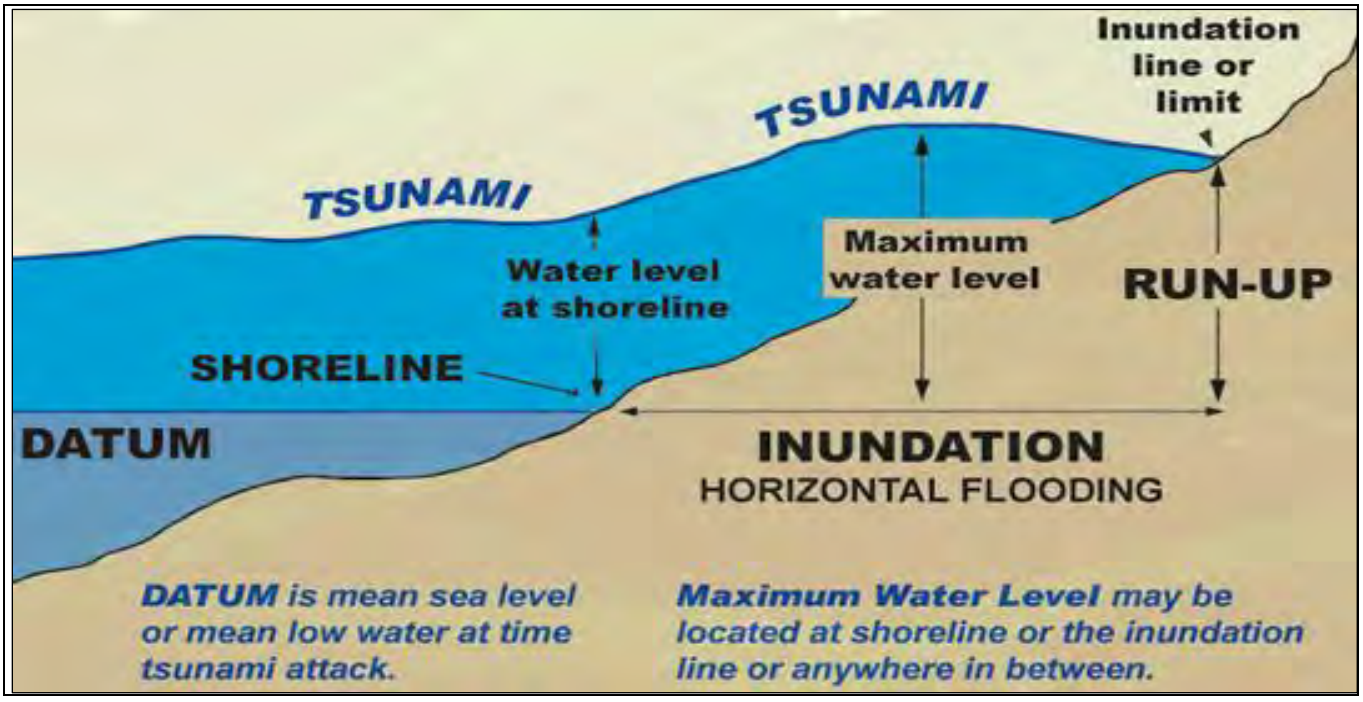
A tsunami is a series of high-energy waves that radiate outward like pond ripples from an area where a generating event occurs, arriving at shorelines over an extended period. Tsunamis can be induced by earthquakes, landslides and submarine volcanic explosions. Tsunamis are typically classified as local or distant, depending on the location of their source in comparison to where waves occur:

- The waves nearest to the generating source represent a local tsunami. Such events have minimal warning time, leaving few options except to run to high ground after a strong, prolonged local earthquake. Damage from the tsunami adds to damage from the triggering earthquake due to ground shaking, surface faulting, liquefaction, and landslides.
- The waves far from the generating source represent a distant tsunami. Distant tsunamis may travel for hours before striking a coastline, giving a community a chance to implement evacuation plans if a warning is received.

In the open ocean, a tsunami may be only a few inches or feet high, but it can travel with speeds approaching 600 miles per hour. As a tsunami enters the shoaling waters near a coastline, its speed diminishes, its wavelength decreases, and its height increases greatly. At the shoreline, tsunamis may take the form of a fast-rising tide, a cresting wave, or a bore (a large, turbulent wall-like wave). The bore phenomenon resembles a step-like change in the water level that advances rapidly (from 10 to 60 miles per hour). The first wave is usually followed by several larger and more destructive waves.

The configuration of the coastline, the shape of the ocean floor, and the characteristics of advancing waves play important roles in the destructiveness of the waves. Bays, sounds, inlets, rivers, streams, offshore canyons, islands, and flood control channels may cause various effects that alter the level of damage. Offshore canyons can focus tsunami wave energy, and islands can filter the energy. It has been estimated that a tsunami wave entering a flood control channel could reach a mile or more inland, especially if it enters at high tide. The orientation of the coastline determines whether the waves strike head-on or are refracted from other parts of the coastline. A wave may be small at one point on the coast and much larger at other points. The inundation area for a tsunami event is often described as run-up as illustrated in Figure 15-1.

Figure 15-1. Run-up Distance and Height In Relation to the Datum and Shoreline



Source: UNESCO, Retrieved from Different Directions: Tsunami, n.d.

15.1.2 Location

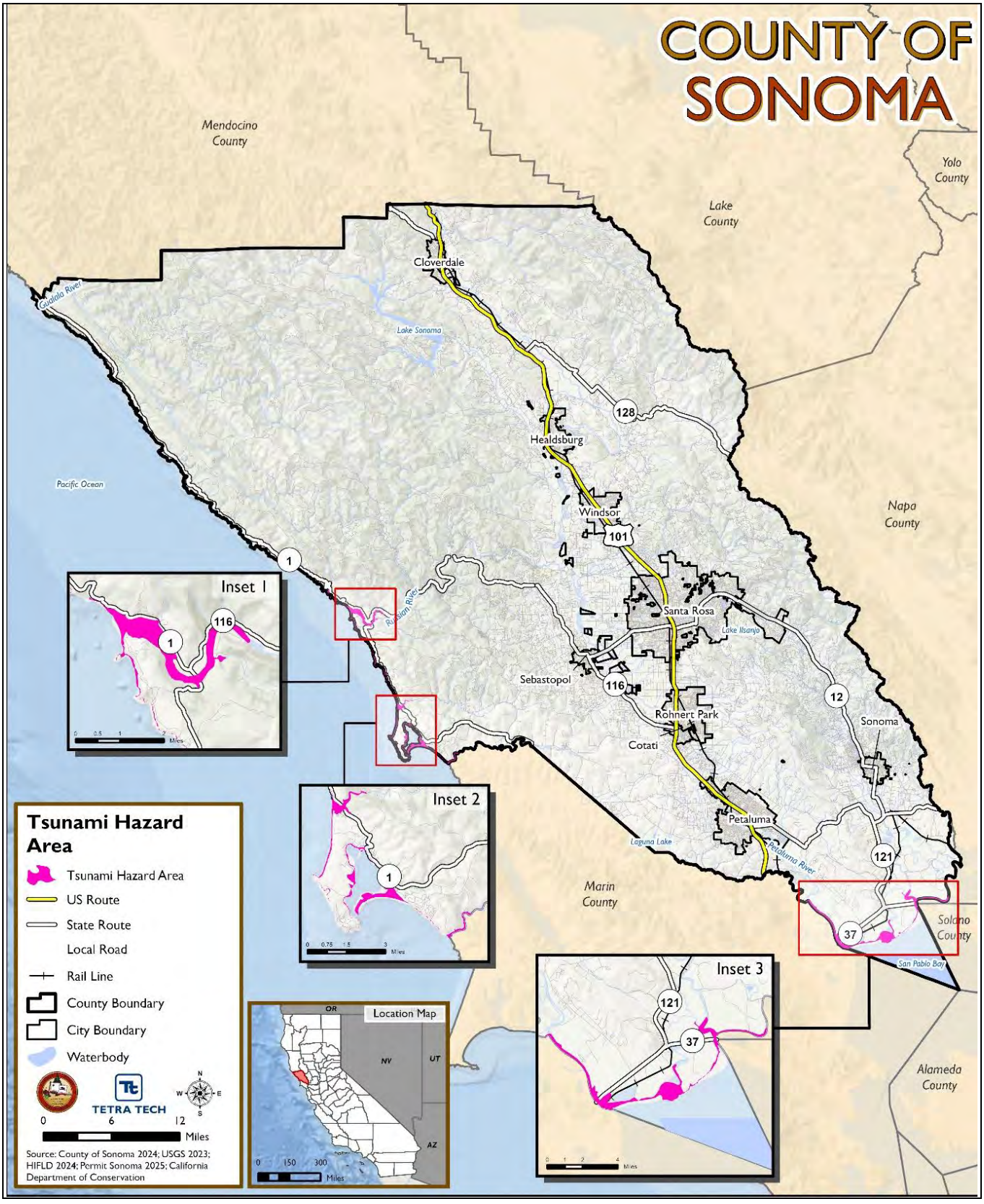
Sonoma County's rugged cliffs and generally elevated coastline reduce its vulnerability to tsunamis. The areas in Sonoma County that have the greatest exposure to potential damage by a tsunami are coastal communities along the southern Sonoma County coast from Jenner to Bodega Bay. Tsunami inundation maps for the Sonoma Coast area near Jenner, Bodega Bay, and the San Pablo Bay were released in 2009 and form the basis for the County's Tsunami Response Plan. Figure 15-2 shows the mapped extent of the tsunami inundation areas for the Sonoma County planning area. The County's Emergency Operations Plan Tsunami Response Annex was updated in 2022.

Spud Point Marina is on the coast in Bodega Bay near the San Andreas Fault. Port Sonoma Marina is at the mouth of the Petaluma River in an area of potentially high liquefaction 3 miles west of the Rodgers Creek Fault. Both of these facilities face a potential risk from earthquake-induced tsunamis.

15.1.3 Extent

In 2022, the California Geological Survey updated its tsunami maps, including tsunami run-up zone for the maximum credible earthquake along the Sonoma Coast, using NOAA's National Tsunami Hazard Mitigation Program (https://maps.conservation.ca.gov/cgs/informationwarehouse/ts_evacuation/). The modeling projected that a tsunami of 25 feet could occur in the coastal areas of Sonoma County, and that areas off San Pablo Bay could experience a 5-foot tsunami. According to the National Tsunami Hazard Mitigation Program, tsunami events with runups of more than 3 feet are the most likely to be dangerous to people and property.

Figure 15-2. Tsunami Hazard Area Map



A tsunami's size and speed and the coastal area's form affect tsunami impacts. At some locations, the advancing wave front will be the most destructive part of the tsunami wave. In other situations, the greatest damage will be caused by the outflow of water back to the sea, sweeping away items on the surface and undermining roads, buildings, bulkheads, and other structures. This outflow action can carry enormous amounts of highly damaging debris, resulting in further destruction. Ships and boats, unless moved away from shore, may be forced against breakwaters, wharves, and other craft, or be washed ashore and left grounded after the withdrawal of the seawater (County of Monterey 2025).

15.1.4 Previous Occurrences

FEMA Disaster Declarations

Between 2021 and 2025, Sonoma County was not included in any tsunami-related disaster declarations.

State Emergency Proclamations

Between 2021 and 2025, Sonoma County was not included in any tsunami-related state emergency proclamations.

All Recent and Past Events

California is at risk from both local and distant tsunamis. About 80 possible or confirmed tsunamis in California have been observed or recorded, including the following:

- A 1960 Chilean earthquake produced a tsunami that impacted the entire Pacific basin. Damage was reported in California ports from San Diego to Crescent City; losses exceeded $1 million.
- A 1964 tsunami generated by a magnitude-9.2 Alaska earthquake killed 12 in Northern California and caused over $15 million in damage. Wave oscillations in San Francisco Bay lasted more than 12 hours, causing nearly $200,000 in damage to boats and harbor structures. Sonoma County experienced slight tsunami impacts from this event.
- The March 11, 2011, tsunami caused by an earthquake near Japan, which resulted in nearly $100 million in damage to the California maritime community, and the February 27, 2010 minor recorded tsunami inundation in California caused by an earthquake near Chile.
- A 2022 Tonga Volcanic Eruption and Tsunami (Hunga Tonga-Hunga Ha'apai eruption and tsunami). Tsunami caused by volcanic eruption are extremely rare. A wave of 1.3 meters was measured in San Luis Obispo County, CA; some flooding occurred in Santa Cruz County; and 1.1 meters measured in Crescent City, CA.
- A 2024 Cape Mendocino offshore earthquake which caused some damage in the Ferndale / Fortuna area of Humboldt County, CA and about 10,000 customers without power. There was minimal damage reported from any wave action.
- A 2025 Kamchatka, Russia 8.0 magnitude earthquake produced a tsunami wave. The Pacific Tsunami Warning Center issued an advisory for the Pacific Coast along with potential strong currents and surges, with waves under 30 cm. (US NWS 2025)

15.1.5 Probability of Future Occurrences

The National Tsunami Hazard Mitigation Program rates the risk from the tsunami hazard to the U.S. west coast as a whole as high to very high (Dunbar and Weaver 2015). However, the historical record of tsunami events in Sonoma County includes a few minor events. The frequency of tsunami events in the planning area can be assumed to be unlikely.

15.1.6 Cascading Impacts on Other Hazards

Aside from the tremendous hydraulic force of the tsunami waves themselves, floating debris carried by a tsunami can endanger human lives and batter inland structures. Flooding can cause contamination of drinking water and can result in the spread of disease.

Tsunami inundation can result in erosion and scouring, debris movement and impact, water contamination, and spread of disease due to standing water. Healthy coastal ecosystems, fisheries, tourism, human health, and public safety can be transformed, degraded, or lost due in part to tsunamis. Indirect economic costs (such as lost business) and adverse socio-psychological impacts on residents and tourists have the potential to negatively affect people and their communities.

15.2 VULNERABILITY AND IMPACT ASSESSMENT

15.2.1 Life, Health, and Safety

Overall Population

Table 15-1 presents the overall population in the tsunami hazard area by jurisdiction. Sonoma County has a total of 184 persons, which is less than 0.1 percent of the jurisdiction total, all located within unincorporated Sonoma County. While only 184 people reside in this area, the Sonoma Coast does see frequent visitors and tourists at various times through the year.

The public health impacts of tsunamis closely resemble those associated with coastal flooding. Beyond the immediate threats to life and property, tsunamis can lead to the contamination of drinking water through saltwater intrusion and inundation of hazardous materials facilities or wastewater treatment plants. Additionally, flooded structures can rapidly develop mold or wood rot, posing significant health risks to inhabitants if not properly addressed.

Table 15-1. Population in the Tsunami Hazard Area

Jurisdiction	Total Population (2023 ACS)	Persons in the Hazard Area	% of Jurisdiction Total
City of Cloverdale	8,933	0	0.0%
City of Cotati	7,533	0	0.0%
City of Healdsburg	11,274	0	0.0%
City of Petaluma	59,321	0	0.0%
City of Rohnert Park	44,461	0	0.0%
City of Santa Rosa	177,216	0	0.0%
City of Sebastopol	7,466	0	0.0%
City of Sonoma	10,726	0	0.0%
Town of Windsor	26,179	0	0.0%
Unincorporated County	132,533	184	0.1%
Sonoma County (Total)	485,642	184	<0.1%

Source: U.S. Census Bureau 2023 ACS; Permit Sonoma 2025; California Department of Conservation

Socially Vulnerable Population

Limited financial resources can prevent economically disadvantaged individuals from adequately preparing for or recovering from a tsunami, and they may live in housing that is more susceptible to damage. Elderly and disabled individuals often have mobility issues that hinder quick evacuation and may require assistance, which can be scarce during emergencies. Health concerns are also significant, as the elderly and those with pre-existing conditions may need medical attention during and after a tsunami, but medical facilities may be overwhelmed or inaccessible.

Table 15-2 presents the estimated socially vulnerable populations within the tsunami hazard area by jurisdiction. In the tsunami hazard area countywide, there are 47 persons over the age of 65, 8 children under the age of 5, 6 non-English speakers, 22 individuals with disabilities, 15 persons living in poverty, 3 single parent households, and 1 with no vehicle access. All of these vulnerable persons are located within unincorporated Sonoma County.

15.2.2 General Building Stock

Table 15-3 summarizes the number of structures located in the tsunami hazard area by jurisdiction. There are 163 total buildings, less than 0.1 percent of the total building stock, in the tsunami hazard area with an estimated $79.9 million of replacement cost value (building and content replacement costs). All of these buildings are located in unincorporated Sonoma County.

Table 15-4 summarizes buildings in the tsunami hazard area by occupancy class. There are a total of 68 resident buildings, 70 commercial buildings, 16 industrial buildings, and 9 buildings classified as government, religious, agricultural, and educational. All of these buildings are located in unincorporated Sonoma County.

Table 15-2. Vulnerable Persons in the Tsunami Hazard Area

Jurisdiction	Persons Over 65	% of Total	Persons Under 5	% of Total	Non-English Speaking Persons	% of Total	Persons with a Disability	% of Total	Persons in Poverty	% of Total	Single Parent Households	% of Total	No Vehicle Access	% of Total
City of Cloverdale	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Cotati	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Healdsburg	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Petaluma	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Rohnert Park	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Santa Rosa	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Sebastopol	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Sonoma	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Town of Windsor	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Unincorporated County	47	0.1%	8	0.1%	6	0.1%	22	0.1%	15	0.1%	3	0.1%	1	0.1%
Sonoma County (Total)	47	<0.1%	8	<0.1%	6	<0.1%	22	<0.1%	15	<0.1%	3	<0.1%	1	<0.1%

Source: U.S. Census Bureau 2023 ACS Vulnerable Population Totals; Permit Sonoma 2025; California Department of Conservation

Table 15-3. Buildings in the Tsunami Hazard Area

Jurisdiction	Jurisdiction Total Buildings	Replacement Cost Value	Buildings in Hazard Area	% of Jurisdiction Total	Replacement Cost Value	% of Jurisdiction Total
City of Cloverdale	4,392	$4,186,783,797	0	0.0%	$0	0.0%
City of Cotati	3,453	$3,554,860,439	0	0.0%	$0	0.0%
City of Healdsburg	6,772	$7,534,677,815	0	0.0%	$0	0.0%
City of Petaluma	26,057	$31,492,792,559	0	0.0%	$0	0.0%
City of Rohnert Park	14,353	$18,686,653,165	0	0.0%	$0	0.0%
City of Santa Rosa	70,300	$80,707,495,769	0	0.0%	$0	0.0%
City of Sebastopol	4,102	$4,123,967,728	0	0.0%	$0	0.0%
City of Sonoma	6,241	$7,237,043,341	0	0.0%	$0	0.0%
Town of Windsor	11,739	$12,681,831,535	0	0.0%	$0	0.0%
Unincorporated County	150,089	$120,191,027,948	163	0.1%	$79,900,569	0.1%
Sonoma County (Total)	297,498	$290,397,134,097	163	0.1%	$79,900,569	<0.1%

Source: County of Sonoma 2025; LA City Planning 2020; RS Means 2024; Permit Sonoma 2025; California Department of Conservation

Table 15-4. Buildings in the Tsunami Hazard Area by Occupancy

Jurisdiction	Residential	Commercial	Industrial	Other[a]
City of Cloverdale	0	0	0	0
City of Cotati	0	0	0	0
City of Healdsburg	0	0	0	0
City of Petaluma	0	0	0	0
City of Rohnert Park	0	0	0	0
City of Santa Rosa	0	0	0	0
City of Sebastopol	0	0	0	0
City of Sonoma	0	0	0	0
Town of Windsor	0	0	0	0
Unincorporated County	68	70	16	9
Sonoma County (Total)	68	70	16	9

Source: County of Sonoma 2025; LA City Planning 2020; Permit Sonoma 2025; California Department of Conservation

a. Other = Government, Religion, Agricultural, and Education

15.2.3 Community Lifelines and Other Critical Facilities

Table 15-5 summarizes the critical facilities within the tsunami hazard area by jurisdiction. Sonoma County has a total of 28 critical facilities; all located within unincorporated Sonoma County. The majority fall under the Transportation sector, with 19 facilities. Both the Water Systems and Communications sectors each contain 4 facilities, while the Energy sector includes 1 facility.

Tsunamis pose a significant threat to community lifelines and critical facilities, disrupting essential services and hindering emergency response and recovery efforts. Water systems, including treatment plants, pipelines, and distribution networks, can sustain severe damage, leading to contamination and loss of potable water, thereby compromising public health and sanitation. Tsunamis can disrupt transportation and communication networks, isolating communities and making it difficult for emergency services to reach those in need. Transportation infrastructure, such as roads, bridges, and airports, is highly susceptible to tsunami damage, impeding evacuation efforts and delaying the arrival of emergency services.

15.2.4 Economy

Tsunamis can have wide-reaching economic impacts on Sonoma County. Direct economic consequences may arise from the destruction of buildings and infrastructure, including power utility poles and lines, potable water and wastewater facilities, and roadways. The force of tsunami waves can devastate piers, breakwaters, and seawalls. Ships, marinas, and fishing fleets may be battered, sunk, moored, or stranded, severely affecting the fishing and tourism industries.

Business interruptions are likely, and damages or alterations to impacted beaches can affect tourism for extended periods after the tsunami. Additionally, the county may experience a decline in tourist numbers due to perceived risks associated with visiting post-tsunami. This reduction in tourism can lead to significant revenue losses for local businesses and the overall economy.

15.2.5 Natural Resources

Tsunamis have the potential to dramatically reshape both the physical and cultural landscape of Sonoma County. These powerful events can cause the land to rise or fall, leading to unexpected flooding, especially if coastal areas subside. Tsunami barriers may be overtopped or fail entirely, and the resulting landslides and sediment shifts can render waterways unnavigable. Coastal features such as beaches may be permanently altered, and wildlife habitats can be lost or transformed. The intrusion of salt water—whether temporary or prolonged—can also compromise the quality and availability of fresh water and render agricultural land unusable. Loss of wetlands from erosion and wetland migration due to tsunami inundation can reduce the natural filtration provided by wetland plants, increasing the likelihood of water quality issues.

Table 15-5. Critical Facilities in the Tsunami Hazard Area

Jurisdiction	Communication	Energy	Food, Hydration, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Water Systems	Other Critical Facilities	Total Facilities in Hazard Area	% of Jurisdiction Total
City of Cloverdale	0	0	0	0	0	0	0	0	0	0	0.0%
City of Cotati	0	0	0	0	0	0	0	0	0	0	0.0%
City of Healdsburg	0	0	0	0	0	0	0	0	0	0	0.0%
City of Petaluma	0	0	0	0	0	0	0	0	0	0	0.0%
City of Rohnert Park	0	0	0	0	0	0	0	0	0	0	0.0%
City of Santa Rosa	0	0	0	0	0	0	0	0	0	0	0.0%
City of Sebastopol	0	0	0	0	0	0	0	0	0	0	0.0%
City of Sonoma	0	0	0	0	0	0	0	0	0	0	0.0%
Town of Windsor	0	0	0	0	0	0	0	0	0	0	0.0%
Unincorporated County	4	1	0	0	0	0	19	4	0	28	1.5%
Sonoma County (Total)	4	1	0	0	0	0	19	4	0	28	1.0%

Source: County of Sonoma 2020, 2025; California Energy Commission 2024; Caltrans 2024, 2025; HIFLD 2024, 2025; USACE NID; Permit Sonoma 2025; California Department of Conservation

15.2.6 Historic and Cultural Resources

Tsunamis pose a serious threat to the county's historic and cultural resources. Historic buildings, monuments, and landmarks are at high risk of damage or destruction, leading to the loss of irreplaceable cultural heritage. Sacred sites may be destroyed, and traditional practices such as fishing can be disrupted, deeply affecting the community's way of life. These cultural losses can weaken the community's connection to its history and traditions, impacting cultural identity and continuity. Recovery from such damage often requires extensive restoration and long-term monitoring to preserve what remains and rebuild what was lost.

15.3 FUTURE CHANGES THAT MAY AFFECT RISK

15.3.1 Potential or Planned Development

Though new development will continue, the rate of development to accommodate future county growth will not be high. The County is subject to state general planning laws and the California Coastal Act. The County and its cities have adopted critical areas and resources lands regulations pursuant to these laws. The information in this plan provides the Planning Partners a tool to ensure that there is no increase in exposure within the mapped tsunami inundation area of the planning area.

The County of Sonoma was officially recognized as a TsunamiReady community in March 2016 by National Weather Service representatives. This designation recognizes voluntary community programs that promote collaborative tsunami hazard preparedness efforts. In order to become a TsunamiReady community, the County developed a local Tsunami Response Plan, mapped inundation areas along the coast, identified evacuation routes, established refuge areas, installed over 160 tsunami signs in the hazard zones, provided education to the public, deployed and maintained redundant and reliable means to disseminate tsunami warnings and participated in readiness exercises (County of Sonoma 2017).

15.3.2 Projected Changes in Population

In 2020, the County's population was 488,361. The population decreased to 478,299 in 2025 and the California Department of Finance currently expects the downward trend to continue until it hits a low of 474,013 in 2040. However, the county's population is expected to rebound for the following 30 years, hitting a population of 514,337 by 2070 (CDOF 2024).

With more people living in coastal areas, the overall vulnerability to tsunamis may increase, leading to increased lives at risk and potentially more damage to infrastructure. Larger populations can also hinder evacuation processes during a tsunami warning.

15.3.3 Climate Change

Climate change may increase tsunami risk by affecting the factors that cause them. Melting glaciers and heavy rainfall can trigger tectonic activity and landslides, respectively, leading to tsunamis. Rising sea levels could amplify the impact of tsunamis, causing more severe flooding. Even smaller future tsunamis could have significant effects due to higher sea levels and increased storm activity.

15.4 HAZARD-RELATED ISSUES

Important issues associated with a tsunami in the planning area include the following:

- Risk from tsunami inundation is not subject to the State of California real estate disclosure law at this time.
- Structures in the planning area built before the cities and County entered the NFIP may not be designed to resist tsunami forces.
- Present building codes and guidelines do not adequately address the impacts of tsunamis on structures. It is anticipated that future updates to the California Building Code will include amendments that address these issues.
- As tsunami warning technologies evolve, the tsunami warning capability within the planning area will need to be enhanced to provide the highest degree of warning to Planning Partners with tsunami risk exposure.
- With the future impacts from climate change, the issue of sea level rise may become an important consideration as probable tsunami inundation areas are identified through future studies.
- Special attention will be focused on vulnerable communities and tourists in the tsunami zone and on hazard mitigation through public education and outreach.

Wildfire

Hazard Ranking:

HIGH

A wildfire is an **unplanned**, **unwanted**, **uncontrolled** fire in an area of combustible vegetation. Wildfires typically start in rural areas but can burn into urban areas.

Community Lifelines at Risk

In the High Fire Hazard Severity Zone

13 Total

Daycare & Library - High Risk

Adaptive Capacity

Moderate

Socially Vulnerable at Risk

In the High Fire Hazard Severity Zone

11,853 Persons over 65

11.6% of all persons over 65 in the county

Mitigation Projects

- Fire-resistant building materials.
- Community Wildfire Protection Plans (CWPPS).
- Firewise USA participation.

16. WILDFIRE

16.1 HAZARD PROFILE

16.1.1 Hazard Description

A wildfire is an unplanned, unwanted, uncontrolled fire in an area of combustible vegetation. Wildfires typically start in rural areas but can burn into urban areas. A wildfire requires fire suppression to prevent damage to the natural or human environment. Though most wildfires are started by humans, they can occur naturally and are important to many ecosystem processes. Fire behavior is based on factors such as the following:

- **Fuel**—Fuel may include living and dead vegetation on the ground, along the surface as brush and small trees, and above the ground in tree canopies. Lighter fuels such as grasses, leaves and needles quickly expel moisture and burn rapidly, while heavier fuels such as tree branches, logs and trunks take longer to warm and ignite. Trees killed or defoliated by forest insects and diseases can be more susceptible to wildfire. Structures in the human-built environment also represent a fuel component.
- **Weather**—Relevant weather conditions include temperature, relative humidity, wind speed and direction, cloud cover, precipitation amount and duration, and the stability of the atmosphere. Conditions are very favorable for extensive and severe wildfires when the temperature is high, relative humidity is low, wind speed is increasing and coming from the east (offshore flow), and there has been little or no precipitation, so vegetation is dry. These conditions occur more frequently inland where temperatures are higher and fog is less prevalent.
- **Topography**—Topography includes slope and elevation. The topography of a region influences the amount of moisture retained in fuels; the impact of weather conditions such as temperature and wind; potential barriers to fire spread, such as roads, vineyards, and lakes; and elevation and slope of landforms (fire spreads more easily uphill than downhill). In steep terrain, common geographic features such as gulches and canyons can funnel air to act as chimneys, pulling hot air, gases, and embers ahead or outside of the main fire. The direction that a slope faces also has a major influence on fire behavior. South-facing slopes receive heating and drying solar radiation from early in the morning until sunset, whereas north-facing slopes only receive solar radiation during a short period of the day when the sun is high in the sky.

California is recognized as one of the most fire-prone regions in the world due to the combination of complex terrain, climate, fire-adapted ecosystem, history of fire suppression, and community development patterns, all of which have contributed to extensive wildfires. Flammable expanses of brush, diseased timberland, overstocked forests, hot and dry summers, extreme topography, intense wind events, summer lightning storms, wildland-urban interface (WUI) communities, and human acts all contribute to California's wildfire threat.

16.1.2 Location

Figure 16-1 shows fire hazard severity zones in Sonoma County as mapped by the California Department of Forestry and Fire Protection (CAL FIRE). The map shows higher-hazard areas on the hills and mountains of the Coast and Mayacamas ranges. Lower-hazard areas line the Pacific coast, San Pablo Bay, and the Sonoma valley.

CAL FIRE has identified several “historic wildland fire corridors” in Sonoma County, including the steep ridges of the coastal ridges in the northwest county, which experienced fires in 1923, 1951, and 1978; and the Geysers area in the northeast Mayacamas range, which has experienced fires in 2004, 2013 and 2019. The 1964 Hanley and Nuns Canyon fire footprints were nearly identical to the 2017 Tubbs and Nuns fires. The Mayacamas mountains south of Santa Rosa above the Sonoma Valley also have a history of repetitive fire loss, where the Cavedale fires of 1925 and 1996 and the 1964 Nuns Canyon fire, and 2017 Sonoma Complex fires caused significant damage.

16.1.3 Extent

Wildfires that burn in isolated natural settings with little or no human development can be part of a natural ecological cycle and can be beneficial to the landscape. Historically, Sonoma County’s ecosystems were kept healthy and in balance by a variety of natural disturbances, including fire, insects, pathogens, floods, weather variations, landslides, avalanches, and earthquakes. This balance has been affected by anthropogenic alterations to forest disturbance cycles, such as fire exclusion/suppression, livestock grazing, roads and development, logging, and introduced plants, animals, and pathogens. Due to these changes, fire behavior may now deviate considerably from the historical fire conditions.

Altered fire regimes can destabilize ecosystems and landscapes, creating conditions that promote catastrophic disturbance events. They may seriously reduce ecosystem resiliency that would allow burned areas to return to prior levels of productivity. Today, historical policies of fire exclusion and aggressive suppression are giving way to a better understanding of the importance fire plays in the natural cycle of certain forest types

16.1.4 Previous Occurrences

FEMA Disaster Declarations

Table 16-1 lists all wildfire-related presidentially declared disasters that have included Sonoma County.

State Emergency Proclamations

Between 2021 and 2025, Sonoma County was not included in any wildfire-related state emergency proclamations.

Figure 16-1. Fire Hazard Severity Zones

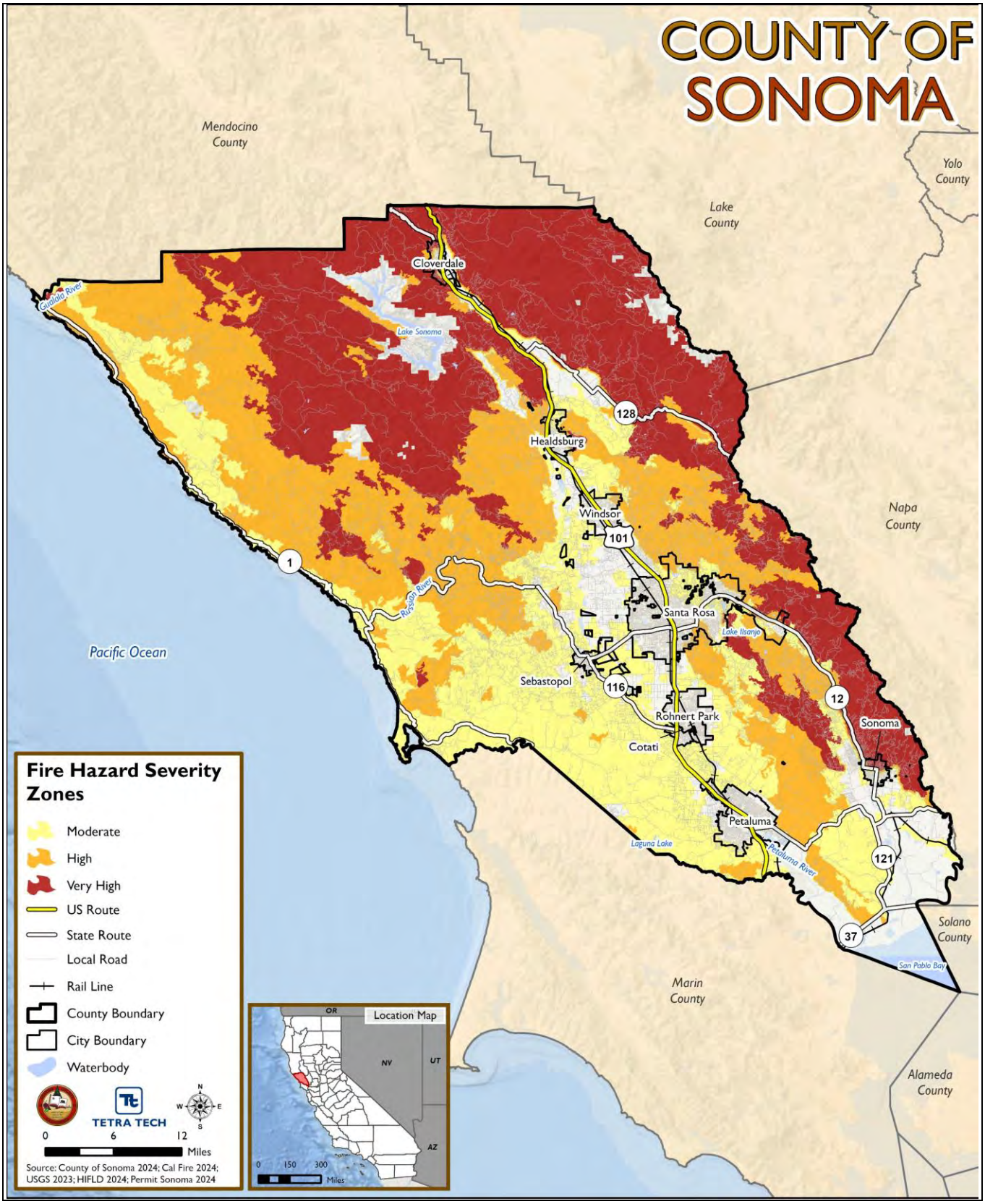


Table 16-1. FEMA Disaster Declarations for Wildfire Events in Sonoma County (1954-2025)

Event Date	Declaration Date	Declaration Number	Event Name
Sep 3, 2004 – Sep 15, 2004	Sep 4, 2004	FM-2554	Geysers Fire
Sep 12, 2015 – Oct 5, 2015	Sep 13, 2015	FM-5112	Valley Fire
Oct 9, 2017	Oct 9, 2017	FM-5222	Patrick Fire
Oct 8, 2017	Oct 9, 2017	FM-5220	Nuns Fire
Oct 8, 2017	Oct 9, 2017	FM-5221	Tubbs Fire
Oct 8, 2017 – Oct 31, 2017	Oct 10, 2017	DR-4344	Wildfires
Oct 24, 2019	Oct 24, 2019	FM-5295	Kincade Fire
Aug 17, 2020	Aug 18, 2020	FM-5331	LNU Lightning Fire Complex
Aug 14, 2020 – Sep 26, 2020	Aug 22, 2020	DR-4558	Wildfires
Sep 27, 2020	Sep 27, 2020	FM-5376	Glass Fire
Sep 4, 2020 – Nov 17, 2020	Oct 16, 2020	DR-4569	Wildfires

Source: (FEMA 2024)

USDA Declarations

Between 2020 and 2025, Sonoma County was not included in any USDA wildfire-related agricultural disaster declarations (USDA 2024).

All Recent Events

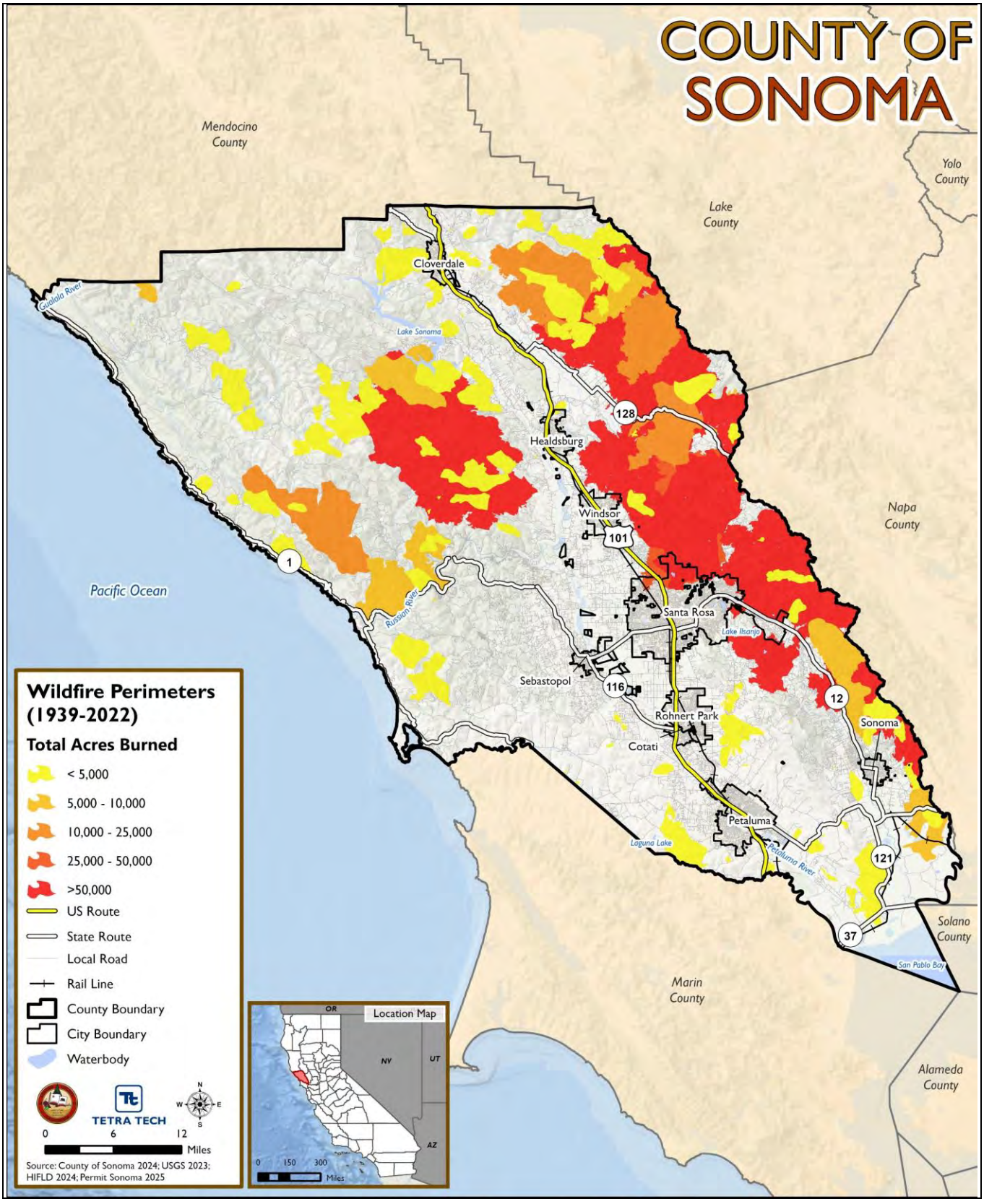
Table 16-2 lists major recorded wildfire-related events that impacted Sonoma County since the previous HMP was developed. Data was only available through 2024. For earlier events, refer to the previous HMP. Sonoma County areas burned by wildfires from 1939 to 2022 are shown in Figure 16-2.

Table 16-2. Wildfire Events in Sonoma County (2020-2025)

#	Incident Name	Incident Created	Incident Extinguished	Acres Burned
1	Lakeville Fire	6/5/2020	6/6/2020	141
2	Gulch Fire	6/6/2020	6/8/2020	107
3	Middle Fire	8/13/2021	8/18/2021	22
4	Alpine Fire	3/1/2022	3/6/2022	21
5	Roblar Fire	6/27/2022	6/27/2022	63
6	Point Fire	6/16/2024	6/24/2024	1,207
7	Preston Fire	6/25/2024	6/27/2024	11
8	Pocket Fire	7/6/2024	7/8/2024	11
9	Flora Fire	7/24/2024	7/28/2024	36
10	Gulch Fire	8/28/2024	8/30/2024	19
11	Two Fire	8/29/2024	8/30/2024	33
12	Cougar Fire	9/15/2024	9/16/2024	53
13	Antonio Fire	9/23/2024	9/24/2024	11

Source: (CAL FIRE n.d.)

Figure 16-2. Historical Wildfire Perimeters in Sonoma County



16.1.5 Probability of Future Occurrences

Information on previous wildfire occurrences in the County was used to calculate the probability of future occurrence of such events, as summarized in Table 16-3. Based on these records and input from the HMWG, the probability of occurrence for wildfire in the County is considered “frequent.”

Table 16-3. Probability of Future Wildfire Events in Sonoma County

Hazard Type	Number of Occurrences Between 2020 and 2025	Percent Chance of Occurring in Any Given Year
Wildfire	13	100%

Source: (CAL FIRE n.d.)

16.1.6 Cascading Impacts on Other Hazards

Wildland fires can generate a range of secondary effects, which in some cases may cause more widespread and prolonged damage than the fire itself. Wildland fires cause the contamination of reservoirs, destroy transmission lines and contribute to flooding. They strip slopes of vegetation, exposing them to greater amounts of runoff. This in turn can weaken soils and cause failures on slopes. Major landslides can occur several years after a wildland fire. Most wildland fires burn hot and for long durations that can bake soils, especially those high in clay content, thus increasing the imperviousness of the ground. This increases the runoff generated by storm events, thus increasing the chance of flooding. Fires can also contaminate drinking water, destroy infrastructure, and degrade air quality

16.2 VULNERABILITY AND IMPACT ASSESSMENT

A vulnerability analysis was conducted to determine the county’s exposure to the wildfire hazard using the CAL FIRE moderate, high, and very high fire hazard severity zones. The county’s assets (population, buildings, critical facilities) were examined to determine if they are built in any of the fire hazard severity zones. The results of the analysis are presented in the following section. Note that the term “risk” is used throughout the section for simplicity, although the underlying analysis is based on fire hazard severity zones and exposure, not probabilistic risk modeling.

As noted in Chapter 2, this HMP update occurred concurrently with CAL FIRE’s release of new fire hazard severity zones and local jurisdictions’ adoption of the Local Responsibility Areas (LRA). As a result, adopted LRA zones were not available when this analysis was conducted. Where available, adopted LRA maps are included in the jurisdictional annexes in Volume II.

In recent years, embers from wildfires driven by high winds have led to extremely damaging urban conflagrations in California. The 2017 Tubbs Fire in Sonoma County destroyed 5,636 structures and the 2025 Eaton and Palisades Fires destroyed a combined 16,246 structures in Los Angeles County (CAL FIRE 2025). When considering the risk to people, buildings, and the economy, it is important to recognize that ember-driven spread is a major factor in destructive wildfires and that the people and

property truly exposed to wildfires may be much higher than the estimates presented in this section. This is especially true for people and buildings in the WUI, no matter which fire hazard severity zone they are listed in.

16.2.1 Life, Health, and Safety

Overall Population

Table 16-4 summarizes the estimated population exposed to wildfire hazards by jurisdiction. Approximately 93,565 residents, 19.3 percent of Sonoma County's population, are located in areas with moderate wildfire risk. An additional 49,797 people (10.3 percent) reside in high-risk areas, while 23,436 individuals (4.8 percent) are in very high-risk zones. Unincorporated Sonoma County has the largest share of the population across all three risk categories, with 50,702 in moderate, 31,620 in high, and 15,265 in very high wildfire hazard areas.

Table 16-4. Population in the Wildfire Hazard Area

Jurisdiction	Total Population (2023 ACS)	Persons in the Moderate Zone	% of Jurisdiction Total	Persons in the High Zone	% of Jurisdiction Total	Persons in the Very High Zone	% of Jurisdiction Total
City of Cloverdale	8,933	1,134	12.7%	2,005	22.4%	3,635	40.7%
City of Cotati	7,533	496	6.6%	0	0.0%	0	0.0%
City of Healdsburg	11,274	2,631	23.3%	1,268	11.2%	303	2.7%
City of Petaluma	59,321	1,763	3.0%	0	0.0%	0	0.0%
City of Rohnert Park	44,461	1,604	3.6%	0	0.0%	0	0.0%
City of Santa Rosa	177,216	29,463	16.6%	13,102	7.4%	1,954	1.1%
City of Sebastopol	7,466	1,055	14.1%	0	0.0%	0	0.0%
City of Sonoma	10,726	1,706	15.9%	1,072	10.0%	2,279	21.2%
Town of Windsor	26,179	3,011	11.5%	730	2.8%	0	0.0%
Unincorporated County	132,533	50,702	38.3%	31,620	23.9%	15,265	11.5%
Sonoma County (Total)	485,642	93,565	19.3%	49,797	10.3%	23,436	4.8%

Source: U.S. Census Bureau 2023 ACS; CAL FIRE 2024; Permit Sonoma 2024

Wildfires have the potential to impact human health and life of residents and responders, structures, infrastructure, and natural resources. The most vulnerable populations include emergency responders and those within a short distance of the interface between the built environment and the wildland environment. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke.

Public health impacts associated with wildfire include difficulty in breathing, odor, and reduction in visibility. Smoke generated by wildfire consists of visible and invisible emissions that contain particulate matter (soot, tar, water vapor, and minerals), gases (carbon monoxide, carbon dioxide, nitrogen

oxides), and toxics (formaldehyde, benzene). Emissions from wildfires depend on the type of fuel, the moisture content of the fuel, the efficiency (or temperature) of combustion, and the weather.

Socially Vulnerable Population

Persons with access and functional needs, the elderly and very young may be especially vulnerable to a wildfire if there is not adequate warning time for them to evacuate. People outside the mapped risk areas are susceptible to health hazards associated with smoke and air pollution from wildfires, especially sensitive populations including children, the elderly, and those with respiratory and cardiovascular diseases. Wildfires also threaten the health and safety of those fighting the fires.

Table 16-5 through Table 16-7 present the socially vulnerable populations living in the evaluated wildfire hazard areas:

- Moderate-risk hazard area—There are 21,528 persons over 65, 4,523 persons under 5, 3,712 non-English speakers, 11,406 persons with a disability, and 8,113 people living in poverty.
- High-risk hazard area—There are 11,853 persons over 65, 2,194 persons under 5, 1,948 non-English speakers, 6,094 persons with a disability, and 4,280 people living in poverty.
- Very high-risk hazard area—there are 5,930 persons over 65, 928 persons under 5, 838 non-English speakers, 2,901 persons with a disability, and 1,868 people living in poverty.

16.2.2 General Building Stock

Table 16-8 through Table 16-10 summarize the estimated building stock inventory located in the defined wildfire hazard areas by jurisdiction. There are 85,454 buildings (28.7 percent of the total building stock) located in the moderate wildfire risk hazard area with an estimated $74 billion of replacement cost value (building and content replacement costs). There are 36,132 buildings (12.1 percent of the total building stock) located in the high wildfire risk hazard area with an estimated $33.1 billion of replacement cost value. In the very high wildfire risk hazard area, there are 16,364 buildings (6.8 percent of the total building stock) with an estimated $18 billion of replacement cost value.

Table 16-11 through Table 16-13 provide a summary of buildings in the wildfire risk hazard areas by occupancy class.

Table 16-5. Vulnerable Persons in the Moderate Fire Hazard Zone

Jurisdiction	Persons Over 65	% of Total	Persons Under 5	% of Total	Non-English Speaking Persons	% of Total	Persons with a Disability	% of Total	Persons in Poverty	% of Total	Single Parent Households	% of Total	No Vehicle Access	% of Total
City of Cloverdale	246	12.7%	27	12.5%	59	12.6%	120	12.6%	50	12.7%	18	12.2%	1	7.7%
City of Cotati	73	6.5%	26	6.5%	8	6.2%	54	6.6%	39	6.5%	15	6.6%	0	0.0%
City of Healdsburg	622	23.3%	140	23.3%	102	23.2%	256	23.3%	296	23.3%	57	23.1%	13	22.8%
City of Petaluma	376	3.0%	75	2.9%	68	2.9%	194	3.0%	107	3.0%	28	3.0%	22	3.0%
City of Rohnert Park	220	3.6%	96	3.6%	52	3.6%	176	3.6%	162	3.6%	30	3.5%	16	3.6%
City of Santa Rosa	5,483	16.6%	1,444	16.6%	1,612	16.6%	3,709	16.6%	2,763	16.6%	693	16.6%	336	16.6%
City of Sebastopol	278	14.1%	55	14.0%	33	13.9%	120	14.0%	86	14.1%	13	13.7%	16	13.9%
City of Sonoma	556	15.9%	52	15.9%	19	15.2%	285	15.9%	140	15.8%	34	15.6%	3	13.6%
Town of Windsor	514	11.5%	140	11.4%	84	11.4%	313	11.5%	140	11.4%	78	11.4%	18	11.0%
Unincorporated County	13,160	38.3%	2,198	38.2%	1,675	38.2%	6,179	38.3%	4,330	38.3%	847	38.2%	290	38.2%
Sonoma County (Total)	21,528	21.1%	4,253	18.6%	3,712	18.6%	11,406	19.6%	8,113	19.8%	1,813	18.5%	715	16.5%

Source: U.S. Census Bureau 2023 ACS Vulnerable Population Totals; Cal FIRE 2024; Permit Sonoma 2024

Table 16-6. Vulnerable Persons in the High Fire Hazard Zone

Jurisdiction	Persons Over 65	% of Total	Persons Under 5	% of Total	Non-English Speaking Persons	% of Total	Persons with a Disability	% of Total	Persons in Poverty	% of Total	Single Parent Households	% of Total	No Vehicle Access	% of Total
City of Cloverdale	436	22.4%	48	22.2%	105	22.3%	213	22.4%	88	22.3%	33	22.4%	2	15.4%
City of Cotati	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Healdsburg	299	11.2%	67	11.1%	49	11.1%	123	11.2%	142	11.2%	27	10.9%	6	10.5%
City of Petaluma	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Rohnert Park	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Santa Rosa	2,438	7.4%	642	7.4%	717	7.4%	1,649	7.4%	1,228	7.4%	308	7.4%	149	7.4%
City of Sebastopol	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Sonoma	349	10.0%	32	9.8%	12	9.6%	179	10.0%	88	9.9%	21	9.6%	2	9.1%
Town of Windsor	124	2.8%	34	2.8%	20	2.7%	76	2.8%	34	2.8%	19	2.8%	4	2.5%
Unincorporated County	8,207	23.9%	1,371	23.9%	1,045	23.9%	3,854	23.9%	2,700	23.9%	528	23.8%	181	23.8%
Sonoma County (Total)	11,853	11.6%	2,194	9.6%	1,948	9.8%	6,094	10.5%	4,280	10.4%	936	9.5%	344	7.9%

Source: U.S. Census Bureau 2023 ACS Vulnerable Population Totals; CAL FIRE 2024; Permit Sonoma 2024

Table 16-7. Vulnerable Persons in the Very High Fire Hazard Zone

Jurisdiction	Persons Over 65	% of Total	Persons Under 5	% of Total	Non-English Speaking Persons	% of Total	Persons with a Disability	% of Total	Persons in Poverty	% of Total	Single Parent Households	% of Total	No Vehicle Access	% of Total
City of Cloverdale	791	40.7%	87	40.3%	191	40.6%	386	40.7%	160	40.5%	59	40.1%	5	38.5%
City of Cotati	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Healdsburg	71	2.7%	16	2.7%	11	2.5%	29	2.6%	34	2.7%	6	2.4%	1	1.8%
City of Petaluma	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Rohnert Park	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Santa Rosa	363	1.1%	95	1.1%	106	1.1%	246	1.1%	183	1.1%	46	1.1%	22	1.1%
City of Sebastopol	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
City of Sonoma	743	21.2%	69	21.0%	26	20.8%	380	21.2%	188	21.2%	46	21.1%	4	18.2%
Town of Windsor	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Unincorporated County	3,962	11.5%	661	11.5%	504	11.5%	1,860	11.5%	1,303	11.5%	255	11.5%	87	11.4%
Sonoma County (Total)	5,930	5.8%	928	4.1%	838	4.2%	2,901	5.0%	1,868	4.6%	412	4.2%	119	2.7%

Source: U.S. Census Bureau 2023 ACS Vulnerable Population Totals; CAL FIRE 2024; Permit Sonoma 2024

Table 16-8. Buildings in the Moderate Fire Hazard Zone

Jurisdiction	Jurisdiction Total Buildings	Replacement Cost Value	Buildings in the Moderate Fire Hazard Severity Zone	% of Jurisdiction Total	Replacement Cost Value	% of Jurisdiction Total
City of Cloverdale	4,392	$4,186,783,797	623	14.2%	$527,465,893	12.6%
City of Cotati	3,453	$3,554,860,439	380	11.0%	$347,072,932	9.8%
City of Healdsburg	6,772	$7,534,677,815	1,331	19.7%	$1,572,160,704	20.9%
City of Petaluma	26,057	$31,492,792,559	752	2.9%	$1,400,394,366	4.4%
City of Rohnert Park	14,353	$18,686,653,165	475	3.3%	$448,471,021	2.4%
City of Santa Rosa	70,300	$80,707,495,769	11,011	15.7%	$15,721,562,777	19.5%
City of Sebastopol	4,102	$4,123,967,728	631	15.4%	$851,215,299	20.6%
City of Sonoma	6,241	$7,237,043,341	974	15.6%	$1,372,629,563	19.0%
Town of Windsor	11,739	$12,681,831,535	1,300	11.1%	$1,346,871,013	10.6%
Unincorporated County	150,089	$120,191,027,948	67,977	45.3%	$50,335,868,688	41.9%
Sonoma County (Total)	297,498	$290,397,134,097	85,454	28.7%	$73,923,712,255	25.5%

Source: County of Sonoma 2025; LA City Planning 2020; RS Means 2024; CAL FIRE 2024; Permit Sonoma 2024

Table 16-9. Buildings in the High Fire Hazard Zone

Jurisdiction	Jurisdiction Total Buildings	Replacement Cost Value	Buildings in the High Fire Hazard Severity Zone	% of Jurisdiction Total	Replacement Cost Value	% of Jurisdiction Total
City of Cloverdale	4,392	$4,186,783,797	946	21.5%	$946,457,572	22.6%
City of Cotati	3,453	$3,554,860,439	0	0.0%	$0	0.0%
City of Healdsburg	6,772	$7,534,677,815	780	11.5%	$1,061,270,321	14.1%
City of Petaluma	26,057	$31,492,792,559	8	<1.0%	$22,632,063	0.1%
City of Rohnert Park	14,353	$18,686,653,165	0	0.0%	$0	0.0%
City of Santa Rosa	70,300	$80,707,495,769	4,487	6.4%	$6,519,556,747	8.1%
City of Sebastopol	4,102	$4,123,967,728	0	0.0%	$0	0.0%
City of Sonoma	6,241	$7,237,043,341	747	12.0%	$870,342,840	12.0%
Town of Windsor	11,739	$12,681,831,535	278	2.4%	$347,017,192	2.7%
Unincorporated County	150,089	$120,191,027,948	28,886	19.2%	$23,388,189,849	19.5%
Sonoma County (Total)	297,498	$290,397,134,097	36,132	12.1%	$33,155,466,583	11.4%

Source: County of Sonoma 2025; LA City Planning 2020; RS Means 2024; CAL FIRE 2024; Permit Sonoma 2024

Table 16-10. Buildings in the Very High Fire Hazard Zone

Jurisdiction	Jurisdiction Total Buildings	Replacement Cost Value	Buildings in the Very High Fire Hazard Severity Zone	% of Jurisdiction Total	Replacement Cost Value	% of Jurisdiction Total
City of Cloverdale	4,392	$4,186,783,797	1,610	36.7%	$1,538,154,682	36.7%
City of Cotati	3,453	$3,554,860,439	0	0.0%	$0	0.0%
City of Healdsburg	6,772	$7,534,677,815	137	2.0%	$119,819,342	1.6%
City of Petaluma	26,057	$31,492,792,559	0	0.0%	$0	0.0%
City of Rohnert Park	14,353	$18,686,653,165	0	0.0%	$0	0.0%
City of Santa Rosa	70,300	$80,707,495,769	646	0.9%	$931,697,926	1.2%
City of Sebastopol	4,102	$4,123,967,728	0	0.0%	$0	0.0%
City of Sonoma	6,241	$7,237,043,341	1,564	25.1%	$1,749,368,203	24.2%
Town of Windsor	11,739	$12,681,831,535	0	0.0%	$0	0.0%
Unincorporated County	150,089	$120,191,027,948	16,364	10.9%	$13,634,717,958	11.3%
Sonoma County (Total)	297,498	$290,397,134,097	20,321	6.8%	$17,973,758,110	6.2%

Source: County of Sonoma 2025; LA City Planning 2020; RS Means 2024; CAL FIRE 2024; Permit Sonoma 2024

Table 16-11. Buildings in the Moderate Fire Hazard Zone by Occupancy

Jurisdiction	Residential	Commercial	Industrial	Other[a]
City of Cloverdale	374	236	0	13
City of Cotati	143	232	1	4
City of Healdsburg	963	335	25	8
City of Petaluma	558	157	26	11
City of Rohnert Park	419	48	0	8
City of Santa Rosa	8,291	2,564	69	87
City of Sebastopol	358	258	10	5
City of Sonoma	665	308	0	1
Town of Windsor	961	326	0	13
Unincorporated County	18,653	38,601	752	9,971
Sonoma County (Total)	31,385	43,065	883	10,121

Source: County of Sonoma 2025; LA City Planning 2020; CAL FIRE 2024; Permit Sonoma 2024

a. Other = Government, Religion, Agricultural, and Education

Table 16-12. Buildings in the High Fire Hazard Zone by Occupancy

Jurisdiction	Residential	Commercial	Industrial	Other[a]
City of Cloverdale	661	264	9	12
City of Cotati	0	0	0	0
City of Healdsburg	464	283	31	2
City of Petaluma	0	0	1	7
City of Rohnert Park	0	0	0	0
City of Santa Rosa	3,687	773	10	17
City of Sebastopol	0	0	0	0
City of Sonoma	418	320	0	9
Town of Windsor	233	45	0	0
Unincorporated County	11,633	10,867	621	5,765
Sonoma County (Total)	17,096	12,552	672	5,812

Source: County of Sonoma 2025; LA City Planning 2020; CAL FIRE 2024; Permit Sonoma 2024

a. Other = Government, Religion, Agricultural, and Education

Table 16-13. Buildings in the Very High Fire Hazard Zone by Occupancy

Jurisdiction	Residential	Commercial	Industrial	Other[a]
City of Cloverdale	1,198	393	8	11
City of Cotati	0	0	0	0
City of Healdsburg	111	26	0	0
City of Petaluma	0	0	0	0
City of Rohnert Park	0	0	0	0
City of Santa Rosa	550	94	2	0
City of Sebastopol	0	0	0	0
City of Sonoma	888	606	21	49
Town of Windsor	0	0	0	0
Unincorporated County	5,616	5,987	693	4,068
Sonoma County (Total)	8,363	7,106	724	4,128

Source: County of Sonoma 2025; LA City Planning 2020; CAL FIRE 2024; Permit Sonoma 2024
a. Other = Government, Religion, Agricultural, and Education

16.2.3 Community Lifelines and Other Critical Facilities

Critical facilities are particularly vulnerable during wildfires. Excessive heat can cause hazardous materials and fuel storage to rupture, fueling the fire and causing rapid spreading. Communication facilities may become inoperable, causing communication difficulties, and compromised fire stations can hinder fire suppression and support services. Utility lines, roads, and bridges are also at risk. Damage to utility lines can compromise the functionality of water, sewer, gas, and electricity systems.

Due to their geographic extent, roads and utility lines have a higher chance of being impacted by wildfires. If any section of a road or utility line is damaged, the entire system may be affected. For instance, a wildfire that makes one area of a road or bridge impassable can block access to other roads or locations. Many roads may have segments within wildfire risk areas rather than the entire road being within a risk area.

Table 16-14 through Table 16-16 summarize the number of critical facilities exposed to the wildfire risk hazard areas by lifeline category:

- There are 653 critical facilities located in the moderate hazard area, with the water systems sector making up the largest portion (eight facilities). Unincorporated Sonoma County contains the highest number of critical facilities in this hazard area, totaling 541.
- In the high-risk hazard area, Sonoma County has 641 critical facilities, with the water systems sector having the most (274 facilities). Unincorporated Sonoma County leads all jurisdictions with 578 facilities.
- For the very high-risk hazard area, Sonoma County has a total of 463 critical facilities, with the Communications sector accounting for 186 of these. Unincorporated Sonoma County has the highest number of critical facilities in this hazard area, totaling 419.

Table 16-14 Facilities in the Moderate Wildfire Hazard Zone by Lifeline Category

Jurisdiction	Communication	Energy	Food, Hydration, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Water Systems	Other Critical Facilities	Total Facilities in Hazard Area	% of Jurisdiction Total
City of Cloverdale	0	0	1	0	0	1	0	0	2	4	9.3%
City of Cotati	0	0	1	0	2	1	0	0	0	4	10.5%
City of Healdsburg	0	0	2	0	2	1	1	1	2	9	16.1%
City of Petaluma	0	0	0	0	0	1	0	1	2	4	2.6%
City of Rohnert Park	0	0	0	0	0	0	0	0	0	0	0.0%
City of Santa Rosa	3	1	4	0	7	14	17	19	3	68	12.9%
City of Sebastopol	0	0	1	0	5	0	1	0	0	7	16.3%
City of Sonoma	3	0	1	0	1	2	1	0	2	10	16.4%
Town of Windsor	0	0	1	0	0	0	4	1	0	6	8.0%
Unincorporated County	56	4	19	0	25	91	153	181	12	541	29.6%
Sonoma County (Total)	62	5	30	0	42	111	177	203	23	653	22.4%

Source: County of Sonoma 2020, 2025; California Energy Commission 2024; Caltrans 2024, 2025; HIFLD 2024, 2025; USACE NID; CAL FIRE 2024; Permit Sonoma 2024

Table 16-15 Facilities in the High Wildfire Hazard Zone by Lifeline Category

Jurisdiction	Communication	Energy	Food, Hydration, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Water Systems	Other Critical Facilities	Total Facilities in Hazard Area	% of Jurisdiction Total
City of Cloverdale	0	0	1	0	2	4	0	0	2	9	20.9%
City of Cotati	0	0	0	0	0	0	0	0	0	0	0.0%
City of Healdsburg	0	0	1	0	0	0	1	0	0	2	3.6%
City of Petaluma	0	0	0	0	0	1	0	0	0	1	0.7%
City of Rohnert Park	0	0	0	0	0	0	0	0	0	0	0.0%
City of Santa Rosa	18	0	0	0	1	5	4	10	1	39	7.4%
City of Sebastopol	0	0	0	0	0	0	0	0	0	0	0.0%
City of Sonoma	6	1	0	0	0	0	0	0	3	10	16.4%
Town of Windsor	0	0	0	0	0	1	0	1	0	2	2.7%
Unincorporated County	73	2	15	0	21	59	138	263	7	578	31.6%
Sonoma County (Total)	97	3	17	0	24	70	143	274	13	641	22.0%

Source: County of Sonoma 2020, 2025; California Energy Commission 2024; Caltrans 2024, 2025; HIFLD 2024, 2025; USACE NID; CAL FIRE 2024; Permit Sonoma 2024

Table 16-16 Facilities in the Very High Wildfire Hazard Zone by Lifeline Category

Jurisdiction	Communication	Energy	Food, Hydration, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Water Systems	Other Critical Facilities	Total Facilities in Hazard Area	% of Jurisdiction Total
City of Cloverdale	0	0	3	0	0	2	1	3	2	11	25.6%
City of Cotati	0	0	0	0	0	0	0	0	0	0	0.0%
City of Healdsburg	0	0	0	0	0	0	0	0	0	0	0.0%
City of Petaluma	0	0	0	0	0	0	0	0	0	0	0.0%
City of Rohnert Park	0	0	0	0	0	0	0	0	0	0	0.0%
City of Santa Rosa	2	0	0	0	0	0	1	2	0	5	0.9%
City of Sebastopol	0	0	0	0	0	0	0	0	0	0	0.0%
City of Sonoma	4	0	8	0	1	3	2	6	4	28	45.9%
Town of Windsor	0	0	0	0	0	0	0	0	0	0	0.0%
Unincorporated County	186	16	5	0	9	34	59	109	1	419	22.9%
Sonoma County (Total)	192	16	16	0	10	39	63	120	7	463	15.9%

Source: County of Sonoma 2020, 2025; California Energy Commission 2024; Caltrans 2024, 2025; HIFLD 2024, 2025; USACE NID; CAL FIRE 2024; Permit Sonoma 2024

16.2.4 Economy

Wildfires can significantly impact Sonoma County's economy in various ways. The destruction of homes, businesses, and infrastructure leads to substantial financial losses for property owners and the local economy. Fires can cause direct economic losses in the reduction of harvestable timber and indirect economic losses in reduced tourism. Additionally, the costs associated with firefighting, debris cleanup, and rebuilding can strain local government budgets and resources. Health impacts from smoke and air pollution increase healthcare costs and reduce productivity, further disrupting economic stability and growth in Sonoma County.

16.2.5 Natural Resources

Wildfires play a crucial role in maintaining ecosystem health, but intense wildfires can severely damage the environment by burning and killing plant and animal life. These fires can also heat narrow and shallow waterways, harming aquatic systems. According to the USGS, post-fire runoff containing debris and contaminants can be extremely detrimental to terrestrial ecosystems and aquatic life (USGS 2023).

16.2.6 Historic and Cultural Resources

Wildfires pose a major threat to historic resources in Sonoma County, with the potential to cause extensive damage and, in some cases, complete destruction. The impact on historic resources, particularly infrastructure, depends heavily on the materials used for construction. Wildfires can burn historic buildings, destroy cultural landscapes, and erode archaeological sites. Outdoor events are likely to be postponed or canceled due to wildfire conditions, as smoke can have harmful impacts on human health.

16.3 FUTURE CHANGES THAT MAY AFFECT RISK

16.3.1 Potential or Planned Development

Urbanization tends to alter the natural fire regime and can lead to expansion of urbanized areas into wildland areas. Placement of additional housing in the wildland/urban interface areas located in high or very high relative fire hazard zones can increase the fire threat, particularly in the historical fire corridors north and east of Santa Rosa and in the Sonoma Valley. Development in these areas can burden existing fire protection services, particularly in areas dependent on volunteer firefighters.

Patterns of land use and development have placed extensive residential infrastructure into places that recent, large fires have placed at severe risk. These fires have resulted in the loss of over 6,000 homes in Sonoma County, as well as thousands of other structures. This risk is expected to increase in coming decades. Fire will likely recur within similar footprints and place the same infrastructure at risk into the near future, as well as occurring in previously unburned areas.

The expansion of development toward wildfire hazard areas can be managed with strong land use and building codes. State and local policies and regulations require landowners to carry out activities such as maintaining defensible space and reducing vulnerability to damage or loss from wildfire. Most of the homes in Sonoma County's WUI areas were constructed before 2008, when California's WUI Building Code went into effect. Permitted building construction in the WUI, State Responsibility Areas, and Very High Local Responsibility Areas requires all structures to be built according to specific requirements listed in the California Wildland-Urban Interface Code. Sonoma County requires all new structures to be built with exterior construction that will minimize the impact on life and property, help the structure to resist the intrusion of flames and burning embers projected by a wildland fire, and contribute to a reduction of losses.

This code was introduced in 2005, starting with the reduction of ventilation and roof protection. In 2008, the model code was introduced during the adoption of the 2007 California Fire Code. Since 2008, structures meeting the scope required building construction standards to be more restrictive. This included the following ignition resistant construction standards:

- Roofing, Sonoma County Ordinance Class A only
- Ventilation
- Exterior covering
- Windows and openings
- Decking
- Accessory structures

In addition, defensible space is regulated in Local Responsibility Areas through Sonoma County Code Chapter 13A. In the State Responsibility Areas, the California Building Code includes minimum standards related to the design and construction of buildings in fire hazard zones. Any newly permitted buildings must conform to standards that manage flammable materials from around the building (defensible space laws) and construct buildings from fire-resistant material. New residential construction in high and very high fire hazard severity zones in the State Responsibility Areas and in very high fire hazard severity zones in the Local Responsibility Areas must be built according to the standards of the 2025 California Building Code. Defensible space in the SRA is regulated through Public Resource Code 4290 and 4291, Title 14 of the California Code of Regulations, and Government Code Sections 51175 through 51189.

The State of California has enacted significant legislation to manage and mitigate wildfire risk. This legislation will have an impact on future development that interfaces a wildfire hazard zone. In addition, the Planning Partners' general plans include policies that address managing development in relative fire hazard zones. The planning area is well equipped with these tools, and this planning process has asked each planning partner to assess its capabilities with regards to the tools. As the planning area experiences future growth, it is anticipated that the exposure to this hazard will remain as assessed or even decrease over time due to these capabilities.

16.3.2 Projected Changes in Population

In 2020, the County's population was 488,361. The population decreased to 478,299 in 2025 and the California Department of Finance currently expects the downward trend to continue until it hits a low of 474,013 in 2040. However, the county's population is expected to rebound for the following 30 years, hitting a population of 514,337 by 2070 (CDOF 2024).

Any growth in population can lead to increased vulnerability to wildfire events. With more people living in wildfire-prone areas, the overall risk to lives and property increases. This expansion in population density means that more homes and infrastructure are at risk of damage, potentially increasing the impact of wildfires on the community. In addition, wildfires often result in no-notice evacuations, and the presence of more people complicates safe and timely evacuations.

16.3.3 Climate Change

Climate change is expected to increase the risk of wildfires in California. Rising greenhouse gas emissions could lead weather conditions that contribute to more frequent and larger fires. In Sonoma County, higher temperatures and drought conditions will dry out vegetation, increasing the likelihood of wildfire ignitions and spread.

16.4 HAZARD-RELATED ISSUES

In the previously fire-adapted landscape of Sonoma County, nearly 100 years of aggressive fire suppression has contributed to the high wildfire risk of today. Absent fire for many years, wildland areas became overstocked with highly flammable vegetation. At the same time, expansion of homes into rural WUI areas increased the number of homes in high-risk areas. Typically, residential property owners do not maintain forested lands, exacerbating wildfire potential. On public lands, available budget for large-scale wildland fuels maintenance is an ongoing issue. Overcrowded conditions degrade overall forest health and degrade the environmental values provided by forest ecosystems.

While in a few areas, recent wildfires burned hot enough to damage wildland ecosystems, in general wildland ecosystems have not sustained irrevocable damage. In many cases fires were beneficial. Large, uncontrolled wildfires can cause significant damage to ecosystem services; however, life, home and economic losses must be considered along with environmental consequences.

Research shows that home loss in wildland fires is primarily driven by two equally important factors:

- **The vulnerabilities of buildings that make them prone to ignition**—Embers cause 80 percent of wildland fire home ignitions. The following elements are most vulnerable to embers but can be retrofitted on existing homes to reduce risk of ignition:
  - Non-Class A roofs
  - Roof edges and soffits
  - Combustible plants and materials within 5 feet of house walls

  - Non-WUI approved venting products that allow for ember entry into structures
  - Wooden attachments, such as fences and decks
  - Non-WUI rated windows
  - Siding
- **The vegetative fuels within 100 feet of structures** (the area referred to as defensible space)—Good defensible space, wherein vegetation has been reduced to reduce fire intensity and spread, is critical to reduce ignition.

Outside of the home and the 100-foot defensible space zone, surrounding wildland fuels can play a role in home destruction, as fire and embers can spread from nearby wildland areas into communities. It is in this area that vegetation management can come into play. This refers to actions taken to alter natural vegetation or plant communities that abut communities, usually on the scale of 10s to 1,000s of acres.

Vegetation management can include prescribed fire, prescribed grazing, timber harvest techniques, invasive plant removal, or mechanical treatment to remove fine fuels, dense stands of fire-prone species, shrubs, and dead and dying vegetation. Fuels are reduced in order to create “community calming zones” or restore ecosystems to less flammable conditions. Strategically placed calming zones can reduce near-community fire intensity and spread, provide safe anchors that firefighters can use to stop forward progress of the fire, and supplement and support near-home mitigation strategies. Roadside fuels treatment can support emergency ingress and egress.

Although the patterns of land use, natural plant communities, topography, weather, soils, and geology vary across the landscapes of Sonoma County, notable patterns are discernible. An approach is needed for deploying existing techniques at the scale of whole communities. Such an approach would be informed by the principles of landscape ecology. It would view the natural lands where fires tend to originate and the built infrastructure of human communities that abut the natural landscapes as a coupled system. Mitigating large-scale loss of life and property can be achieved using relatively well-established techniques of home hardening, defensible space and vegetation management at the scale of whole communities and the natural landscapes that surround them.

17. HAZARD RANKING

Hazard rankings have been used as one of the bases for identifying the jurisdictional hazard mitigation strategies included in Volume II. These rankings may vary among the jurisdictions. For example, a hazard may be ranked low in one municipality but due to differences in vulnerability and impact, be ranked as high for the County or another municipality. Jurisdictional ranking results are presented in each jurisdictional annex in Volume II.

17.1 HAZARD RANKING METHODOLOGY

Each jurisdiction participating in this HMP has differing levels of vulnerability to and potential impacts from each of the hazards assessed in this plan. Each jurisdiction needs to recognize the hazards that pose the greatest risk to its community and direct its attention and resources accordingly to manage risk and reduce losses. To achieve this, the hazards of concern were ranked using methodologies promoted by FEMA's hazard mitigation planning guidance and input from all participating jurisdictions. Relative ranking scores were generated by FEMA's Hazus risk assessment tool.

17.1.1 Categories Used in Ranking

The ranking methodology is based on four risk assessment categories (probability of occurrence, consequence, adaptive capacity, and climate change), with the following scoring parameters defined for each category:

- **Level**—The level is a qualitative description of how each hazard rates in each category (such as low to high, or unlikely to frequent)
- **Benchmark value**—The benchmark values are clearly determinable quantities or descriptions that define which level should apply to each hazard
- **Numeric value**—The numeric value is the hazard's score in each category, based on the assigned level
- **Weighting**—The weighting is a multiplier applied to each hazard's numeric value in each category, to represent the relative importance of the category (the higher the weighting, the more important the category)

The following sections describe the categories and their associated scoring parameters.

Probability of Occurrence

For some hazards, probability of occurrence was based on the likelihood that an event scenario of a specified magnitude (such as a 1 percent annual chance flood or a M7.2 earthquake) would occur in any given year. The hazard ranking methodology for some hazards of concern is based on a scenario event that only impacts specific areas (such as a floodplain), while others are based on their potential risk to the County as a whole. In order to account for these differences, the hazard ranking scores were adjusted using professional judgment.

When no scenario was assessed, an examination of the historical record and judgment was used to estimate the probability of an event that will impact the County. Probability accounts for 30 percent of the total hazard ranking. Table 17-1 summarizes the scoring parameters for probability of occurrence.

Table 17-1. Values for Probability of Occurrence (Weighing 30%)

Level	Benchmark Value	Numeric Value
Unlikely	Hazard event has less than a 1 percent annual probability of occurring.	0
Rare	Hazard event has between 1 and 10 percent annual probability of occurring.	1
Occasional	Hazard event has between 10 and 100 percent annual probability of occurring.	2
Frequent	100 percent annual probability; hazard event is likely to occur multiple times per year.	3

Consequence

Consequence represents the expected vulnerability and impact associated with the hazard. This is rated for three subcategories: vulnerability of people; vulnerability of property; and economic impacts on the community. A numeric value based on defined benchmarks is assigned for each subcategory, and a factor is applied to those values representing the relative importance of each subcategory. The total numeric value for consequence is the sum of the factored numeric values for each subcategory. Consequence accounts for 30 percent of the total hazard ranking. Table 17-2 through Table 17-4 summarize the scoring parameters for consequence.

Adaptive Capacity

Adaptive capacity describes a jurisdiction's administrative, technical, planning/regulatory and financial ability to protect against or withstand a hazard event. Mitigation measures that can increase a jurisdiction's capacity to withstand and rebound from events include codes or ordinances with higher standards to withstand hazards due to design or location; deployable resources; or plans and procedures for responding to an event.

A rating of "weak" for adaptive capacity means a jurisdiction does not have the capability to effectively respond, which increases vulnerability. A "strong" adaptive capacity means the jurisdiction does have the capability to effectively respond, which decreases vulnerability. These ratings were assigned using the results of the core capability assessment, with input from each jurisdiction. Adaptive capacity accounts for 30 percent of the total hazard ranking. Table 17-5 summarizes the scoring parameters for adaptive capacity.

Table 17-2. Values for Population Consequence (Weighing 30%)

Level	Population Benchmark Value	Numeric Value	Factor
None	No population vulnerable to the hazard	0	3
Low	14 percent or less of population is exposed to a hazard with potential for measurable life-safety impact due to its extent and location.	1	3
Medium	15 to 29 percent of population is exposed to a hazard with potential for measurable life-safety impact due to its extent and location.	2	3
High	30 percent or more of population is exposed to a hazard with potential for measurable life-safety impact, due to its extent and location.	3	3

Table 17-3. Values for Property Consequence (Weighing 30%)

Level	Property Benchmark Value	Numeric Value	Factor
None	No property vulnerable to the hazard	0	2
Low	Property vulnerability is 14 percent or less of the total number of structures for the community.	1	2
Medium	Property vulnerability is 15 to 29 percent of the total number of structures for the community.	2	2
High	Property vulnerability is 30 percent or more of the total number of structures for the community.	3	2

Table 17-4. Values for Economic Consequence (Weighing 30%)

Level	Economic Benchmark Value	Numeric Value	Factor
None	No estimated loss due to the hazard	0	1
Low	Estimated loss is 9 percent or less of the total replacement cost for the community.	1	1
Medium	Estimated loss is 10 to 19 percent of the total replacement cost for the community.	2	1
High	Estimated loss is 20 percent or more of the total replacement cost for the community.	3	1

Table 17-5. Values for Adaptive Capacity (Weighing 30%)

Level	Benchmark Value	Numeric Value
Weak	Weak, outdated, or inconsistent plans, policies, codes, or ordinances in place; no redundancies; limited to no deployable resources; limited capabilities to respond; long recovery.	1
Moderate	Plans, policies, codes/ordinances in place and meet minimum requirements; mitigation strategies identified but not implemented on a widespread scale; county/jurisdiction can recover but needs outside resources; moderate county/Jurisdiction capabilities.	0
Strong	Plans, policies, codes/ordinances in place that exceed minimum requirements; mitigation/protective measures in place; county/jurisdiction has ability to recover quickly because resources are readily available, and capabilities are high.	-1

Climate Change

The hazard ranking addresses climate change in order to help guide and prioritize the mitigation strategy as a long-term future vision for mitigating the hazards of concern. Current climate change projections were evaluated as part of the hazard ranking to account for potential increases in severity or frequency of the hazard. The potential impacts that climate change may have on each hazard of concern are discussed in the risk assessment chapters for each hazard. Climate change accounts for 10 percent of the hazard ranking. Table 17-6 summarizes the scoring parameters for climate change.

Table 17-6. Values for Climate Change (Weighing 10%)

Level	Benchmark Value	Numeric Value
Low	No local data are available; modeling projects are uncertain on whether there is increased future risk; confidence level is low (inconclusive evidence).	1
Medium	Studies and modeling projections indicate a potential for exacerbated conditions due to climate change; confidence level is medium to high (moderate evidence).	2
High	Studies and modeling projections indicate exacerbated conditions and increased future risk due to climate change; very high confidence level (strong evidence, well documented, and acceptable methods).	3

17.1.2 Total Ranking Score

The total ranking score based on the categories described above is calculated using the following equation:

Risk Ranking Score Equation

Ranking Score= [(Consequence on Population x 3) + (Consequence on Property x 2) + (Consequence on Economy x 1) x 0.3] + [Adaptive Capacity x 0.3] + [Climate Change x 0.1] + [Probability of Occurrence x 0.3]

Using this equation, the highest possible ranking score is 6.9. The higher the number, the greater the relative risk. Based on the score for each hazard, a hazard ranking is assigned to each hazard of concern as follows:

- Low = Values less than 3.9
- Medium = Values between 3.9 and 4.9
- High = Values greater than 4.9.

All Planning Partners applied the same methodology to develop the hazard rankings to ensure consistency in the overall ranking of risk. However, each jurisdiction had the ability to alter rankings based on local knowledge and experience in handling each hazard.

17.2 HAZARD RANKING RESULTS

Using the methodology described above, the hazard ranking for the identified hazards of concern was determined for each planning partner. The hazard ranking for Sonoma County is detailed in the following tables that present the step-wise process for the ranking:

- Table 17-7 shows the unweighted numeric values assigned for the probability of occurrence for each hazard.
- Table 17-8 shows the numeric values assigned for each subcategory of consequence for each hazard. Results are shown for applying the subcategory factors, but not the category-wide weighting.
- Table 17-9 shows the unweighted numeric values assigned for adaptive capacity and climate change for each hazard.
- Table 17-10 shows the total weighted hazard ranking scores for each hazard of concern.

The countywide hazard ranking includes the entire planning area and may not reflect the highest risk for all Planning Partners. The overall ranking for each jurisdiction is included in Table 17-11 and in the annexes in Volume II.

Table 17-7. Probability of Occurrence for Sonoma County

Hazard of Concern	Probability	Numeric Value
Dam Failure	Rare	1
Drought	Occasional	2
Earthquake	Occasional	2
Extreme Cold	Occasional	2
Extreme Heat	Occasional	2
Extreme Wind	Occasional	2
Flood	Frequent	3
Landslide	Rare	1
Sea Level Rise	Rare	1
Tsunami	Unlikely	0
Wildfire	Frequent	3

Table 17-8. Consequence Rating for Sonoma County

Hazard of Concern	Population Consequence	Numeric Value	Multiplied by Factor (3)	Property Consequence	Numeric Value	Multiplied by Factor (2)	Economy Consequence	Numeric Value	Multiplied by Factor (1)	Total Impact Rating (Population + Property + Economy)
Dam Failure	Low	1	3	Low	1	2	Low	1	1	6
Drought	High	3	9	Low	1	2	Low	1	1	12
Earthquake	High	3	9	High	3	6	High	3	3	18
Extreme Cold	High	3	9	Low	1	2	Low	1	1	12
Extreme Heat	High	3	9	Low	1	2	Low	1	1	12
Extreme Wind	High	3	9	Low	1	2	Low	1	1	12
Flood	Low	1	3	Low	1	2	Low	1	1	6
Landslide	Low	1	3	Low	1	2	Medium	2	2	7
Sea Level Rise	Low	1	3	Low	1	2	Medium	2	2	7
Tsunami	Low	1	3	Low	1	2	Low	1	1	6
Wildfire	Medium	2	6	Medium	2	4	High	3	3	13

Table 17-9. Adaptive Capacity and Climate Change Ratings for Sonoma County

Hazard of Concern	Adaptive Capacity Level	Numeric Value	Climate Change Level	Numeric Value
Dam Failure	Medium	0	Low	1
Drought	Medium	0	High	3
Earthquake	Medium	0	Low	1
Extreme Cold	Medium	0	High	3
Extreme Heat	Medium	0	High	3
Extreme Wind	Medium	0	High	3
Flood	Medium	0	High	3
Landslide	Medium	0	Medium	2
Sea Level Rise	Medium	0	High	3
Tsunami	Medium	0	Low	1
Wildfire	Medium	0	High	3

Table 17-10. Total Hazard Ranking Scores for Sonoma County

Hazard of Concern	Total Hazard Ranking Score	Overall Hazard Ranking	Adjusted Overall Ranking
Dam Failure	2.2	Low	Low
Drought	4.8	Medium	Medium
Earthquake	5.8	High	High
Extreme Cold	4.5	Medium	Medium
Extreme Heat	4.5	Medium	Medium
Extreme Wind	4.5	Medium	Medium
Flood	2.1	Low	Medium
Landslide	2.3	Low	Low
Sea Level Rise	2.7	Low	Low
Tsunami	1.9	Low	Low
Wildfire	4.8	Medium	High

Note: The overall hazard ranking was adjusted based on historical experience, current and future capabilities, and risk assessments at the local level.

Table 17-11. Overall Ranking of Hazards by Jurisdiction

Jurisdiction	Dam Failure	Drought	Earthquake	Extreme Cold	Extreme Heat	Extreme Wind	Flood	Landslide	Sea Level Rise	Tsunami	Wildfire
Sonoma County (All)	Low	Medium	High	Medium	Medium	Medium	Medium[a]	Medium[a]	Low	Low	High
City of Cloverdale	No exposure	Medium	High	Medium	Medium	Medium	Low	Low	No exposure	No exposure	Medium
City of Cotati	No exposure	Medium	High	Low	Medium	Low	Medium	Low	No exposure	No exposure	Medium
City of Healdsburg	Low	Medium	High	Medium	Medium	Medium	Low	Low	No exposure	No exposure	High
City of Petaluma	Low	Medium	High	Medium	Medium	Medium	Medium	Low	Low	Low	Medium
City of Rohnert Park	No exposure	Medium	High	Low	Medium	Low	Medium	Low	No exposure	No exposure	Medium
City of Santa Rosa	Low	Medium	High	Low	Low	Medium	Medium	Medium	No exposure	No exposure	High
City of Sebastopol	No exposure	Medium	Low	Medium	Medium	Medium	Low	Low	No exposure	No exposure	High
City of Sonoma	No exposure	Medium	Medium	Medium	Medium	Medium	Medium	Low	No exposure	No exposure	High
Town of Windsor	Low	Medium	High	Medium	Medium	Medium	Low	Low	No exposure	No exposure	Medium
Unincorporated County	Low	Medium	High	Medium	Medium	Medium	Medium[a]	Medium[a]	Low	Low	High

Note: Low (yellow) = Values less than 3.9; Medium (orange) = Values between 3.9 and 4.9; High (red) = Values greater than 4.9

a. Initial assessments indicated a Low result; results have been modified by the County to Medium which is detailed in chapter 17

Part 3: Capability Assessment



18. CAPABILITY ASSESSMENT

A capability assessment is an inventory of a community's missions, programs, and policies and an analysis of its capacity to carry them out (FEMA 2003). This integral part of the planning process analyzes current governmental programs, policies, regulations, and funding that could either facilitate or hinder mitigation. Through assessing its capabilities, a jurisdiction learns whether it can implement certain mitigation actions by determining the following:

- The range of local and/or state administrative, programmatic, regulatory, financial, and technical resources available to assist in implementing mitigation actions
- Types of mitigation actions that may be technically, legally, administratively, politically, or fiscally challenging or infeasible because they are outside of current capabilities
- Opportunities to enhance local capabilities to support long-term mitigation and risk reduction

This chapter summarizes existing capabilities at all levels of government (federal, state, county, local) for supporting hazard mitigation within the planning area. These capabilities are presented in three categories:

- Planning and regulatory capabilities
- Administrative and technical capabilities
- Fiscal capabilities

Each Planning Partner's annex in Volume II also includes a capability assessment specific to those jurisdictions. In addition to the above categories, the annexes review capabilities in the more localized categories of adaptive capacity and education and outreach. Participating jurisdictions evaluated the effectiveness of their capabilities for supporting hazard mitigation and identified opportunities to enhance those capabilities. Each jurisdiction identified how it has integrated hazard mitigation into its existing planning, regulatory, and operational/administrative framework and how it intends to promote ongoing integration.

18.1 PLANNING AND REGULATORY CAPABILITIES

Planning and regulatory capabilities are based on ordinances, policies, local laws, state statutes, plans, and programs that relate to managing growth and development. Planning and regulatory capabilities refer not only to current plans and regulations, but also to the jurisdiction's ability to change and improve those plans and regulations as needed. This section summarizes planning and regulatory capabilities for Sonoma County. Further information is provided in the jurisdictional annexes in Volume II.

18.1.1 Federal

National Flood Insurance Program

The National Flood Insurance Program (NFIP) is a federal program enabling property owners in participating communities to purchase insurance as a protection against flood losses. Communities participate in the NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. Community participation in the NFIP is voluntary. The NFIP defines minimum standards for such ordinances, but communities may adopt higher regulatory standards.

In exchange for the community's participation, the NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in the community. Flood damage in the U.S. is reduced by nearly $1 billion each year through communities implementing sound floodplain management requirements and property owners purchasing flood insurance. Buildings constructed in compliance with NFIP building standards suffer approximately 80 percent less damage annually than those not built in compliance (FEMA, 2008).

Municipal compliance with the NFIP in Sonoma County is described in each of the jurisdictional annexes in Volume II. The County's municipalities have been compliant with the NFIP. To enhance their flood damage prevention programs and enhance compliance with the NFIP in the future, several municipalities proposed actions in their mitigation strategies to ensure that their floodplain administrators complete training on floodplain management and the NFIP or update their flood damage prevention ordinance. In addition, Sonoma County's mitigation strategy includes an action to maintain compliance with NFIP requirements. Additional information on the NFIP program and its implementation throughout the County may be found in Chapter 12.

NFIP Community Rating System

As an additional component of the NFIP, the Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions meeting the three goals of the CRS: (1) reduce flood losses; (2) facilitate accurate insurance rating; and (3) promote the awareness of flood insurance.

As of July 2025, there are two communities within Sonoma County that participate in the CRS program, the City of Petaluma and Sonoma County. Sonoma County is exploring the program requirements of the Community Rating System (CRS) through technical expertise and assistance to guide interested municipalities through the application process, as well as help maintain and enhance their participation in the program.

U.S. Army Corps of Engineers

Under Section 404(e) of the Clean Water Act, the U.S. Army Corps of Engineers (USACE) can issue general permits to authorize activities that have only minimal individual and cumulative adverse environmental effects. There are three types of USACE permits:

- A nationwide permit is a general permit that authorizes activities across the country unless a district or division commander revokes the nationwide permit in a state or other geographic region. There are 57 nationwide permits, and they authorize a wide variety of activities, including linear transportation projects, bank stabilization activities, residential development, commercial and industrial developments, aids to navigation and certain maintenance activities (USACE 2021). On October 12, 2021, the California State Water Resources Control Board (SWRCB) conditionally granted certification for 15 nationwide permits and denied certification for 28 nationwide permits for activities on non-tribal lands in the State of California (USACE 2021).
- Standard permits are individual permits that involve full public interest review of an individual permit application and includes the issuance of a public notice for any project that does not meet the terms and conditions of a nationwide permit or a Letter of Permission.
- Regional general permits (RGP) are for small, specialized projects. RGP 10 Wildfire Mitigation Activities authorizes activities involving the discharge of dredge or fill material into waters of the United States for the purpose of wildfire protection, prevention, response, clean-up, and recovery. The California SWRCB issued a certification order for RGP 10 on July 7, 2023 (SWRCB 2023).

18.1.2 State

Regulations

Table 18-1 lists state regulations that impact hazard mitigation activities in California.

Table 18-1. State Regulations Impacting Hazard Mitigation

Plan or Regulation	Relevance
AB 70: Flood Liability	A city or county may be required to partially compensate for property damage caused by a flood if it unreasonably approves new development in areas protected by a state flood control project.
AB 162: Flood Planning	Cities and counties must address flood-related matters in the land use, conservation, and safety and housing elements of their general plans.
AB 747: General Plans—Safety Element	The safety elements of cities' and counties' general plans must address evacuation routes and include any new information on flood and fire hazards and climate adaptation and resiliency strategies.
AB 1409: Planning and Zoning, General Plan—Safety Element	This bill requires the safety element to be reviewed and updated to identify evacuation locations.
AB 2140: General Plans—Safety Element	This bill enables state and federal disaster assistance and mitigation funding to communities with compliant hazard mitigation plans.
AB 2800: Climate Change—Infrastructure Planning	This act requires state agencies to take into account the effects of climate change when developing state infrastructure.
Alquist-Priolo Earthquake Fault Zoning Act	This act restricts construction of buildings used for human occupancy on the surface trace of active faults.

Plan or Regulation	Relevance
California Environmental Quality Act	This act establishes a protocol of analysis and public disclosure of the potential environmental impacts of development projects. Any project action identified in this plan will seek full California Environmental Quality Act compliance upon implementation.
California General Planning Law	This law requires every county and city to adopt a comprehensive long-range plan for community development, and related laws call for integration of hazard mitigation plans with general plans.
California Health and Safety Code	Establishes regulations applied to public health and safety resources and services in California. Hazard resistant provisions include Division 32—Seismic Safety Building Rehabilitation Loans.
California Multi-Hazard Mitigation Plan	Local hazard mitigation plans must be consistent with their state's hazard mitigation plan.
California State Building Code	Establishes the regulations applied to construction in California. Hazard-resistant provisions include flood and soil provisions. Local communities must adopt and enforce building codes, which include measures to improve buildings' ability to withstand hazard events. Chapter A3 prescribes provisions for seismic strengthening of cripple walls and sill plate anchorage of light, wood frame residential buildings. Hazard resistant provisions include codes for the voluntary retrofit of single-family residences that are wood-framed and have a raised foundation.
California Water Code	Establishes regulations applied to water resources and water service providers in California. Hazard resistant provisions include Division 5—Flood Control and Division 14—California Water Storage District Law.
Division of the State Architect's AB 300 List of Seismically At-Risk Schools	The Division of the State Architect recommends that local school districts conduct detailed seismic evaluations of seismically at-risk schools identified in the inventory that was required by AB 300.
Senate Bill (SB) 32	This bill requires the California State Air Resources Board to ensure the state's greenhouse gas emissions are reduced to 40 percent below 1990 levels by 2030.
SB 92: Public Resources Portion of Biennial Budget Bill	This bill requires dams (except for low-risk dams) to have emergency action plans that are updated every 10 years and inundation maps updated every 10 years, or sooner if specific circumstances change.
SB 97: Guidelines for Greenhouse Gas Emissions	This bill establishes that greenhouse gas emissions and the effects of greenhouse gas emissions are appropriate subjects for California Environmental Quality Act analysis.
SB 99: General Plans: Safety Element: Emergency Evacuation Routes	This bill requires that safety elements include information to identify residential developments in hazard areas that do not have at least two emergency evacuation routes.
SB 379: General Plans: Safety Element—Climate Adaptation	This bill requires cities and counties to include climate adaptation and resiliency strategies in the safety element of their general plans.
SB 1000: General Plan Amendments—Safety and Environmental Justice Elements	Under this bill, review and revision of general plan safety elements are required to address only flooding and fires (not climate adaptation and resilience), and environmental justice is required to be included in general plans.
SB 1035: Fire, Flood, and Adaptation Safety Element Updates	This bill clarifies that revisions to the safety element to address fire hazards, flood hazards, and climate adaptation and resilience strategies all must occur upon each revision to a housing element or local hazard mitigation program.

Plan or Regulation	Relevance
SB 1241: Fire Hazards	This bill requires the safety element to be reviewed and updated as necessary to address the risk of fire in state responsibility areas and very high Fire Hazard Severity Zones, taking into account the most recent version of the Office of Planning and Research's "Fire Hazard Planning" document.
Standardized Emergency Management System	Local governments must use this system to be eligible for state funding of response-related personnel costs.

Plans and Studies

California Climate Adaptation Strategy—2024

The California Climate Adaptation Strategy is a comprehensive plan that aims to enhance the state's resilience to climate change impacts. It focuses on coordinating efforts across various regions and sectors, aligning state agency actions with key climate resilience priorities, and building upon previous successes and lessons learned. The six climate resilience priorities are:

- Strengthen protections for climate vulnerable communities
- Bolster public health and safety to protect against increasing climate risks
- Build a climate resilient economy
- Accelerate nature based climate solutions and strengthen climate resilience of natural systems
- Make decisions based on the best available climate science
- Partners and collaborate to leverage resources

The California Natural Resources Agency is required by law to update the Climate Adaptation Strategy every three years. This ensures that the plan remains current and responsive to evolving climate challenges.

California's Fourth Climate Change Assessment—2019

California's Fourth Climate Change Assessment provides practical, science-based information to help state and local decision-makers address climate change impacts. It includes detailed regional climate projections for California, tools to incorporate climate data into planning, and recommendations for adapting key sectors like energy, water, and agriculture to climate impacts. The Fourth Assessment includes a statewide report, as well as nine regional and three topical reports—along with additional findings from recent peer-reviewed publications. The following are highlights from the San Francisco Bay Region Report:

- Overall, the Bay Area's average annual maximum temperature increased by 1.7°F from 1950 to 2005
- Sea level in the Bay Area has risen over 8 inches in the last 100 years
- The 2012-2016 record low snowpack resulted in $2.1 billion in economic losses and 21,000 jobs lost in the agricultural and recreational sectors statewide and exacerbated an ongoing trend of groundwater overdraft

The Fifth Climate Assessment is projected to be completed in 2026.

California's Water Supply Strategy: Adapting to a Hotter, Drier Future

California's 2022 Water Supply Strategy is a comprehensive plan developed by state agencies to address the critical challenges of water management in a changing climate. As temperatures rise, the state anticipates potentially losing 10 percent of its water supplies over the next two decades. The strategy focuses primarily on protecting and stabilizing water systems for urban, suburban, and agricultural communities. While its core objectives center on water security for human needs, the plan also encompasses broader environmental and social goals. This includes ongoing efforts to ensure safe drinking water for all Californians and protect ecological systems, demonstrating a holistic approach to water resource management in an increasingly unpredictable climate. Key actions from the strategy include:

- Developing new water supplies through recycling and desalination
- Capturing and saving more stormwater
- Reducing the use of water in cities and on farms
- Improving all water management actions with better data, forecasting, conveyance, and administration of water rights

California Wildfire and Forest Resilience Action Plan

The California 2021 Wildfire and Forest Resilience Task Force's Action Plan serves as a comprehensive roadmap for managing the state's forests and rangelands. This plan implements the Agreement for Shared Stewardship between California and the U.S. Forest Service, while aligning efforts across federal, local, tribal, regional, and private organizations. In executing this plan, the responsible entities are dedicated to advancing California's broader goals of achieving carbon neutrality, enhancing climate resilience, promoting equity, and fostering economic growth. This integrated approach ensures that forest management strategies not only address wildfire risks but also contribute to the state's environmental, social, and economic objectives. The four priorities of the plan are as follows:

- Increase the pace and scale of forest health projects
- Strengthen protection of communities
- Manage forests to achieve the state's economic and environmental goals
- Drive innovation and measure progress

State of California Sea Level Rise Guidance

The Ocean Protection Council developed a statewide collaborative action plan in 2022 aimed at enhancing coastal resilience through coordinated efforts. This action plan addresses both regional and statewide needs, guiding unified and effective actions to support California's coastal communities, ecosystems, and economies. By fostering collaboration among various stakeholders, the plan aims to implement strategies that not only protect these vital areas but also adapt to the challenges posed by climate change and rising sea levels. The plan key themes include the following:

- The entire coast of California should be prepared for sea-level rise
- Sea-level rise adaptation plans should lead to project implementation

- Sea-level rise adaptation planning should include pathways to resiliency to 3.5 feet by 2050 and 6.0 feet by 2100
- Integrate and prioritize equity and social justice in all sea-level rise adaptation planning and projects
- Nature-based solutions should be pursued when possible
- Coastal habitats including wetlands, beaches, and dunes should be protected and conserved

Protecting Californians from Extreme Heat: A State Action Plan to Build Community Resilience

The California Natural Resources Agency released a comprehensive 2022 action plan addressing the state's approach to mitigating the impacts of rising temperatures and heat waves. This plan outlines a coordinated, government-wide strategy to tackle the health, economic, cultural, ecological, and social challenges posed by increasing average temperatures. Building upon a 2013 report jointly developed by the California Department of Public Health and the California Environmental Protection Agency, the new action plan incorporates updated climate projections and expands on previous recommendations. It represents California's latest effort to proactively address the multifaceted risks associated with extreme heat and climate change. Key action tracks include the following:

- Build public awareness and notification
- Strengthen community services and response
- Increase resilience of our build environment
- Utilize nature based solutions

California State Emergency Plan

The California State Emergency Plan, maintained by Cal OES, describes the methods for conducting emergency operations, rendering mutual aid, emergency response capabilities of state agencies, resource mobilization, public information, and continuity of government during an emergency or disaster.

18.1.3 County

Jurisdictions in California have the ability to develop policies and programs and to implement rules and regulations to protect and serve residents. Local policies are typically identified in a variety of community plans, implemented via a local ordinance, and enforced through a governmental body. A summary of County and local planning and regulatory capabilities is provided below. Detailed information on each participating jurisdiction’s planning and regulatory capabilities is provided in Volume II.

Climate Change Action Resolution

On May 8, 2018, the Board of Supervisors of Sonoma County adopted the Climate Change Action Resolution to support a county-wide framework for reducing greenhouse gas emissions and to pursue local actions that support the identified goals therein. Sonoma County agreed to work toward the

RCPA's countywide target to reduce greenhouse gas emissions by 40 percent below 1990 levels by 2030 and 80 percent below 1990 levels by 2050. The resolution commits to the following actions:

- Sonoma County adopts the following goals to reduce greenhouse gas emissions, and will pursue local actions that support these goals:
  - Increase building energy efficiency
  - Increase renewable energy use
  - Switch equipment from fossil fuel to electricity
  - Reduce travel demand through focused growth
  - Encourage a shift toward low-carbon transportation options
  - Increase vehicle and equipment fuel efficiency
  - Encourage a shift toward low-carbon fuels in vehicles and equipment
  - Reduce idling
  - Increase solid waste diversion
  - Increase capture and use of methane from landfills
  - Reduce water consumption
  - Increase recycled water and graywater use
  - Increase water and waste-water infrastructure efficiency
  - Increase use of renewable energy in water and wastewater systems
  - Reduce emissions from livestock operations
  - Reduce emissions from fertilizer use
  - Protect and enhance the value of open and working lands
  - Promote sustainable agriculture
  - Increase carbon sequestration
  - Reduce emissions from the consumption of goods and services
- Sonoma County will continue to work to increase the health and resilience of social, natural, and built resources to withstand the impacts of climate change
- Sonoma County has the goal of increasing resilience by pursuing local actions that support the following goals:
  - Promote healthy, safe communities
  - Protect water resources
  - Promote as sustainable, climate-resilient economy
  - Mainstream the use of climate projections

Sonoma County General Plan

The General Plan, last amended in 2016, is the blueprint for land use in unincorporated Sonoma County. It includes maps that show where agricultural, residential, commercial and other land uses will be located, and a series of policies that guide future decisions about growth, development and conservation of resources. The General Plan provides the basis for development while maintaining the

quality of life that Sonoma County residents treasure. The County is currently working to update the General Plan.

Sonoma County Community Wildfire Protection Plan

The County's 2023 Community Wildfire Protection Plan (CWPP) is incorporated by reference into the Sonoma County annex of this HMP. The CWPP's exclusive focus on wildfire and emphasis on collaboration make it a valuable adjunct to the HMP. In addition to the county CWPP, 18 communities have developed CWPPs. The local CWPPs are referenced in the appropriate annexes in Volume II.

Sonoma County Local Coastal Plan

The 2023 Sonoma County Local Coastal Plan Update guides land use planning in the coastal zone by aligning with current community priorities, California Coastal Commission policies, and the county's General Plan 2020. The plan incorporates new information on critical issues such as sea level rise, biotic resources, cultural heritage, geologic hazards, water resources, and public access. The plan provides a comprehensive and up-to-date framework for sustainable coastal development.

Sonoma County Comprehensive Economic Development Strategy

This 2022 strategy unites public, private, and civic stakeholders to create a vision and action plan that will guide funding for implementation. The Sonoma Mendocino Economic Development District leads the plan's development with input from various jurisdictions, tribes, business owners, non-profits, and community members. An analysis of regional economic conditions highlights the impact of recent challenges, including wildfires, drought, and the pandemic, which have led to significant job losses, increased housing costs, and a decline in the region's gross regional product. The fourth goal in the strategy centers on economic resilience and includes the following objectives:

- Plan for resiliency
- Develop water infrastructure
- Develop green energy solutions
- Build emergency transportation routes
- Increase community fire safety
- Mitigate/adapt to the climate crisis

18.2 ADMINISTRATIVE AND TECHNICAL CAPABILITIES

This section summarizes administrative and technical capabilities in Sonoma County. Further information is provided in the jurisdictional annexes in Volume II.

18.2.1 Federal

Federal Emergency Management Agency

FEMA is responsible for providing assistance before, during, and after disasters. FEMA is the federal reviewer of hazard mitigation plans and sets federal standards for local and state hazard mitigation plans.

National Dam Safety Program

The National Dam Safety Program is a partnership of state and federal agencies and other stakeholders that encourages individual and community responsibility for dam safety to protect people from dam failures. It is administered through the Department of Homeland Security and FEMA. The program improves safety and security around dams by providing grants to state dam safety agencies to assist them in improving their regulatory programs; producing educational materials for dam owners; funding research to enhance technical expertise as dams are built and rehabilitated; establishing training programs for dam safety inspectors; and creating the National Inventory of Dams (FEMA 2023c).

National Weather Service

The National Weather Service (NWS) monitors weather and delivers weather forecasts. Sonoma County is serviced by the San Francisco weather forecast office (NWS n.d.-e).

The NWS also operates the StormReady program, which provides emergency managers with guidelines on how to improve their communities' hazardous weather operations. To be recognized by the program, a community must establish a 24-hour warning point and emergency operations center; have more than one way to receive severe weather warnings and forecasts and to alert the public; create a system that monitors weather conditions locally; promote the importance of public readiness through community seminars; and develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises (NWS n.d.-f). Sonoma County is a county level participant in the program.

U.S. Army Corps of Engineers

USACE builds and maintains public infrastructure. Projects include dredging, storm damage reduction, and ecosystem restoration in and near waterways (USACE n.d.). The USACE Dam Safety Program is responsible for safety inspections of dams that meet size and storage limitations specified in the National Dam Safety Act and maintains the National Inventory of Dams.

18.2.2 State

Table 18-2 identifies administrative and technical capabilities available at the state level in California.

Table 18-2. State Administrative and Technical Capabilities

Agency, Program or Regulation	Hazard Mitigation Area Affected	Relevance
California Department of Parks and Recreation (State Parks)	Wildfire Hazard	State Parks Resources Management Division has wildfire protection resources available to suppress fires on State Park lands.
California Department of Water Resources (DWR)	Flood Hazard	This department is the state coordinating agency for floodplain management. DWR, on behalf of FEMA, provides individual technical assistance to California communities participating in the NFIP by conducting Community Assistance Visits and Community Assistance Contacts. DWR provides statewide NFIP workshops that are designed to interpret and explain the NFIP regulations and to give an overview of the need for community-based floodplain management (Cal OES 2023a).
California Division of Safety of Dams (DSOD)	Dam Failure Hazard	This division of DWR monitors the dam safety program at the State level and maintains a working list of dams in California.
CAL FIRE	Wildfire Hazard	CAL FIRE has responsibility for wildfires in areas that are not under the jurisdiction of the U.S. Forest Service or a local fire organization.
Cal OES	All Hazards	Cal OES serves as the state's leadership hub during all major emergencies and disasters. This includes responding, directing, and coordinating state and federal resources and mutual aid assets. Cal OES also supports local jurisdictions and communities through planning and preparedness activities, training, and facilitating the immediate response to an emergency through the longer-term recovery phase. During this process, Cal OES serves as the state's overall coordinator and agent to secure federal government resources through FEMA (Cal OES 2024a).
California Fire Alliance	Wildfire Hazard	The alliance works with communities at risk from wildfires to facilitate the development of community fire loss mitigation plans.
California Fire Safe Council	Wildfire Hazard	This council facilitates the distribution of National Fire Plan grants for wildfire risk reduction and education.
Office of the State Fire Marshal	Wildfire Hazard	This office has a wide variety of fire safety and training responsibilities.

18.2.3 County and Local

Table 18-3 lists the administrative bodies in Sonoma County that are available to support hazard mitigation initiatives.

Table 18-3. Sonoma County Administrative Bodies

Administrative Body	Responsibilities
Agricultural Preservation and Open Space Advisory Committee	The Committee shall render advice and make recommendations to the Board of Directors on matters that the Board may, from time to time, refer to the Committee for its consideration.
Community Development Committee of Sonoma County	The Sonoma County Community Development Commission (CDC) is governed by the Sonoma County Board of Supervisors, acting as the Commissioners of the CDC. The Community Development Committee acts as an advisory group to the Commissioners. The Committee reviews and makes recommendations on policy and funding matters to come before the Commission.
Emergency Council	The Sonoma County Emergency Council studies, revises and recommends to the Board of Supervisors for adoption the Sonoma County Emergency Plan. Additionally, the council reviews and recommends action upon all proposed mutual aid agreements with the United States, State of California, other political subdivisions, corporations, and groups or individuals. The Emergency Council also reviews and recommends the adoption of such ordinances, resolutions, rules and regulations as may be necessary to implement the County Emergency Plan or other mutual aid agreement entered into pursuant to such plan.
Flood Control Advisory Committee Laguna—Mark West Watershed Zone 1A	Flood Control Zone 1A Advisory Committee members meet to discuss stormwater management and flood control issues and provide recommendations on annual budgets involving expenditures related to flood protection, stream maintenance, and stormwater management.
Flood Control Advisory Committee Petaluma River Watershed Zone 2A	Flood Control Zone 2A Advisory Committee members meet to discuss stormwater management and flood control issues and provide recommendations on annual budgets involving expenditures related to flood protection, stream maintenance, and stormwater management.
Flood Control Advisory Committee Valley of the Moon Watershed Zone 3A	Flood Control Zone 3A Advisory Committee members meet to discuss stormwater management and flood control issues and provide recommendations on annual budgets involving expenditures related to flood protection, stream maintenance, and stormwater management.
Local Agency Formation Commission	The Local Agency Formation Commission is an independent agency established by State law. The commission is responsible for reviewing, approving, or disapproving changes in organization to cities and special districts including annexations, detachments, new formations and incorporations.
Petaluma Valley Groundwater Sustainability Agency Advisory Committee	The Petaluma Valley Groundwater Sustainability Agency is a Joint Powers Agency created to become the official Groundwater Sustainability Agency for the Sonoma Valley for the implementation of the Sustainable Groundwater Management Act. The Act requires development and implementation of a Groundwater Sustainability Plan by January 31, 2022, with the goal of ensuring that groundwater resources are sustainably managed in the basin.
Planning Commission (Board of Zoning and Planning Agency)	The Planning Commission is part of the Sonoma County Planning Agency.

Administrative Body	Responsibilities
Project Review and Advisory Committee	The Project Review and Advisory Committee (PRAC) serves as a technical advisory committee on subdivisions, takes referrals from the Board of Supervisors and Planning Commission, approves minor subdivisions, oversees them, and makes recommendations to the Board and LAFCO concerning them. PRAC also examines projects to determine the necessity of preparing an Environmental Impact Report and recommends on environmental issues.
Santa Rosa Plan Groundwater Sustainability Agency Advisory Committee	The Santa Rosa Plain Groundwater Sustainability Agency is a Joint Powers Agency created to become the official Groundwater Sustainability Agency for the Santa Rosa Plain for the implementation of the Sustainable Groundwater Management Act. The Act requires development and implementation of a Groundwater Sustainability Plan by January 31, 2022, with the goal of ensuring that groundwater resources are sustainably managed in the basin.
Sonoma Mendocino Economic Development District	The Sonoma-Mendocino Economic Development District (EDD) unites the counties of Mendocino and Sonoma in creating the first joint economic development strategy for the two-county region. To be developed in collaboration with input from local partners and community members, the multi-year strategy aims to uncover untapped economic potential in the region and to secure a robust and stable regional economy for many years to come.
Sonoma Valley Groundwater Sustainability Agency Advisory Committee	The Sonoma Valley Groundwater Sustainability Agency is a Joint Powers Agency created to become the official Groundwater Sustainability Agency for the Sonoma Valley for the implementation of the Sustainable Groundwater Management Act. The Act requires development and implementation of a Groundwater Sustainability Plan by January 31, 2022, with the goal of ensuring that groundwater resources are sustainably managed in the basin.

Fire Protection Districts

Fire protection districts are local government entities responsible for providing fire protection and emergency services to specific geographic areas. These districts may vary in size, resources, and the range of services they offer, including fire suppression, emergency medical services, and public education on fire safety. Eight of Sonoma County's 15 Fire Protection Districts participated in the Planning Partnership and developed their own annex.

Permit Sonoma GIS Team

Permit Sonoma GIS manages the development, maintenance, and distribution of comprehensive planning, land development and natural resource spatial datasets and related databases for Permit Sonoma. In addition to providing geographic data and related analysis supporting the Department's mission, Permit Sonoma GIS makes data available to the public through GIS Online Services.

18.3 FISCAL CAPABILITIES

This section summarizes fiscal capabilities in Sonoma County. Further information is provided in the jurisdictional annexes in Volume II. Appendix O of the 2023 California State Hazard Mitigation Plan describes mitigation-related funding available to eligible jurisdictions to fund mitigation actions.

18.3.1 Federal Hazard Mitigation Funding Opportunities

FEMA administers several programs that provide funding for eligible mitigation planning and projects that reduces disaster losses and protect life and property from future disaster damage: the Hazard Mitigation Grant Program (HMGP), and the HMGP Post Fire Grant, the Flood Mitigation Assistance (FMA) Program, and the Pre-Disaster Mitigation (PDM) Program.

- The Hazard Mitigation Grant Program (HMGP) assists in implementing long-term hazard mitigation planning and projects following a federal major disaster declaration. HMGP funding is generally 15 percent of the total amount of federal assistance provided to a state, territory, or federally recognized tribe following a major disaster declaration.
- The Pre-Disaster Mitigation (PDM) program provides funds for hazard mitigation planning and projects. PDM funding depends on the amount Congress appropriates each year.
- Flood Mitigation Assistance (FMA) provides funds for planning and projects to reduce or eliminate risk of flood damage to buildings that are insured under the National Flood Insurance Program (NFIP). FMA funding depends on the amount Congress appropriates each year.

Table 18-4 provides an overview of program funding eligibility and cost share.

Table 18-4. FEMA HMA Grant Cost Share Requirements

Programs	Cost Share(Percent of Federal / Non-Federal Share)
HMGP	75 / 25
HMGP Post Fire	75 / 25
FMA (community flood mitigation, project scoping, individual mitigation of insured properties, and planning grants)	75 / 25
FMA—repetitive loss property(2)	90 / 10
FMA—severe repetitive loss property(2)	100 / 0
PDM	75 / 25
PDM—small and impoverished community	Up to 90 / 10

Source: FEMA 2023; FEMA 2023

Subapplicants should consult their State Hazard Mitigation Officer (SHMO) for the percentage of HMGP subrecipient management cost funding their State has determined to be passed through subrecipients.

To be eligible for an increased federal cost share, a FEMA-approved state or tribal (standard or enhanced) mitigation plan that addressed repetitive loss properties must be in effect at the time of award, and the property is being submitted for consideration must be a repetitive loss property.

Federal mitigation grant funding is available to all communities with a current hazard mitigation plan (this plan); however, most of these grants require a “local share” in the range of 10-25 percent of the total grant amount. Individual homeowners and business owners may not apply directly to FEMA. Eligible local governments may apply on their behalf (FEMA 2023). The FEMA mitigation grant programs are described below.

Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) is a post-disaster mitigation program. It is made available to states by FEMA after each Federal disaster declaration. The HMGP can provide up to 75 percent funding for hazard mitigation measures. The HMGP can be used to fund cost-effective projects that will protect public or private property in an area covered by a federal disaster declaration or that will reduce the likely damage from future disasters. Examples of projects include acquisition and demolition of structures in hazard-prone areas, flood-proofing or elevation to reduce future damage, minor structural improvements, and development of state or local standards. Projects must fit into an overall mitigation strategy for the area identified as part of a local planning effort. All applicants must have a FEMA-approved hazard mitigation plan (this plan).

Applicants who are eligible for the HMGP are state and local governments, certain nonprofit organizations or institutions that perform essential government services, and Indian tribes and authorized tribal organizations. Individuals or homeowners cannot apply directly for the HMGP; a local government must apply on their behalf. Applications are submitted to Cal OES and placed in rank order for available funding and submitted to FEMA for final approval. Eligible projects not selected for funding are placed in an inactive status and may be considered as additional HMGP funding becomes available.

For additional information, see: https://www.fema.gov/hazard-mitigation-grant-program

Flood Mitigation Assistance Program

The Flood Mitigation Assistance (FMA) program combines the previous Repetitive Flood Claims and Severe Repetitive Loss Grants into one grant program. The FMA provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP. The FMA is funded annually; no federal disaster declaration is required. Only NFIP insured homes and businesses are eligible for mitigation in this program. Funding for FMA is very limited and, as with the HMGP, individuals cannot apply directly for the program. Applications must come from local governments or other eligible organizations. The federal cost share for an FMA project is at least 75 percent. At most, 25 percent of the total eligible costs must be provided by a non-federal source. Of this 25 percent, no more than half can be provided as in-kind contributions from third parties. At minimum, a FEMA-approved local flood mitigation plan is required before a project can be approved. The FMA funds are distributed from FEMA to the state. Cal OES serves as the grantee and program administrator for the FMA program.

For additional information, see: https://www.fema.gov/flood-mitigation-assistance-grant-program

Rehabilitation of High Hazard Potential Dams Program

The Rehabilitation of High Hazard Potential Dams (HHPD) grant program provides technical, planning, design, and construction assistance for eligible rehabilitation activities that reduce dam risk and increase community preparedness. The HHPD Grant Program will provide assistance for technical, planning, design, and construction activities toward:

- Repair
- Removal
- Structural/nonstructural rehabilitation of eligible high hazard potential dams

For additional information, see: https://www.fema.gov/emergency-managers/risk-management/dam-safety/rehabilitation-high-hazard-potential-dams

18.3.2 Federal Disaster and Recovery Assistance Programs

The types and levels of federal disaster assistance depend on the severity of the damage and the declarations that result from the disaster event. The following sections describe the general types of assistance that may be provided.

Individual Assistance

Individual Assistance (IA) provides help for homeowners, renters, and some nonprofit entities after disasters occur. FEMA may provide money and other services to help you recover from losses caused by a presidentially declared disaster, such as damage to your home, car, and other personal items. IA programs include housing assistance, serious needs assistance, mass care and emergency assistance, crisis counseling assistance, disaster case management, disaster legal services, and disaster unemployment assistance. The IA housing assistance includes eligible home mitigation activities to help homeowners repair or rebuild stronger, more durable homes.

For additional information, see: https://www.fema.gov/individual-disaster-assistance

Public Assistance

Public Assistance (PA) provides cost reimbursement aid to local governments (state, county, local, municipal authorities, and school districts) and certain nonprofit agencies that were involved in disaster response and recovery programs or that suffered loss or damage to facilities or property used to deliver government-like services. This program is largely funded by FEMA with both local and state matching contributions required.

For additional information, see: https://www.fema.gov/public-assistance-local-state-tribal-and-non-profit

Small Business Administration Loans

The Small Business Administration (SBA) provides low-interest disaster loans to homeowners, renters, business of all sizes, and most private nonprofit organizations. SBA disaster loans can be used to

repair or replace the following items damaged or destroyed in a declared disaster: real estate, personal property, machinery and equipment, and inventory and business assets.

Homeowners may apply for up to $200,000 to replace or repair their primary residence. Renters and homeowners may borrow up to $40,000 to replace or repair personal property (such as clothing, furniture, cars, and appliances) damaged or destroyed in a disaster. Physical disaster loans of up to $2 million are available to qualified businesses or most private nonprofit organizations. An Economic Injury Disaster Loan provides necessary working capital until normal operations resume after a physical disaster.

For additional information, see: https://www.sba.gov/managing-business/running-business/emergency-preparedness/disaster-assistance

Community Development Block Grants

Community Development Block Grants (CDBG) are federal funds intended to provide low and moderate-income households with viable communities, including decent housing, as suitable living environment, and expanded economic opportunities. Eligible activities include community facilities and improvements, roads and infrastructure, housing rehabilitation and preservation, development activities, public services, economic development, planning, and administration. Public improvements may include flood and drainage improvements. In limited instances, and during the times of “urgent need” (e.g., post-disaster) as defined by the CDBG National Objectives, CDBG funding may be used to acquire a property located in a floodplain that was severely damaged by a recent flood, demolish a structure severely damaged by an earthquake, or repair a public facility severely damaged by a hazard event.

For additional information, see: https://www.hudexchange.info/programs/cdbg-entitlement/

U.S. Economic Development Administration

The U.S. Economic Development Administration (USEDA) is an agency of the U.S. Department of Commerce that supports regional economic development in communities around the country. It provides funding to support comprehensive planning and makes strategic investments that foster employment creation and attract private investment in economically distressed areas of the United States. Through its Public Works Program, USEDA invests in key public infrastructure, such as in traditional public works projects, including water and sewer systems improvements, expansion of port and harbor facilities, brownfields, multitenant manufacturing and other facilities, business and industrial parks, business incubator facilities, redevelopment technology-based facilities, telecommunications, and development facilities. Through its Economic Adjustment Program, USEDA administers its Revolving Loan Fund (RLF) Program, which supplies small businesses and entrepreneurs with the gap financing needed to start or expand their business, in areas that have experienced or are under threat of serious structural damage to the underlying economic base. The USEDA may receive a disaster supplemental allocation following a presidentially-declared disaster for a wide variety of activities related to disaster recovery, including economic recovery strategic planning grants, and public works construction assistance.

For additional information, see: https://www.eda.gov/strategic-initiatives/disaster-recovery/supplemental

Federal Highway Administration Emergency Relief

Federal Highway Administration Emergency Relief (FHWA-ER) is a grant program that may be used for repair or reconstruction of Federal-aid highways and roads on Federal lands which have suffered serious damage as a result of a disaster.

For additional information, see: https://www.fhwa.dot.gov/bipartisan-infrastructure-law/er_fact_sheet.cfm

Federal Transit Administration Emergency Relief

Federal Transit Administration Emergency Relief (FTA-E) is a grant program that funds capital projects to protect, repair, reconstruct, or replace equipment and facilities of public transportation systems. Administered by the Federal Transit Authority at the U.S. Department of Transportation and directly allocated to metropolitan transit authorities (MTA) and port authorities, this transportation-specific fund was created as an alternative to FEMA PA.

For additional information, see: https://www.transit.dot.gov/funding/grant-programs/emergency-relief-program

18.3.3 State Hazard Mitigation Funding Opportunities

CAL FIRE Grants

CAL FIRE grant programs provide funding for fire prevention activities, to improve forest health, and to enhance community resilience. Additional benefits to communities include workforce development in rural and tribal communities, business innovation, and new recreation opportunities.

For additional information, see: https://www.fire.ca.gov/what-we-do/grants

California Earthquake Authority Earthquake Brace + Bolt Program

The California Earthquake Authority (CEA) Earthquake Brace + Bolt (EBB) Program helps homeowners strengthen their homes against earthquakes by offering a grant of up to $3,000 toward a seismic retrofit for qualifying houses.

For additional information, see: https://www.californiaresidentialmitigationprogram.com/our-seismic-retrofit-programs/the-retrofits/ebb-retrofit

California Department of Water Resources Proposition 84

Proposition 84 authorizes general obligation bonds to fund safe drinking water, water quality and supply, flood control, waterway and natural resource protection, water pollution and contamination

control, state and local park improvements, public access to natural resources, and water conservation efforts.

For additional information, see: https://bondaccountability.resources.ca.gov/p84.aspx

DWR Small Communities Flood Risk Reduction Program

The Small Communities Flood Risk Reduction Program is a local assistance program whose objective is to reduce flood risk for small communities protected by State Plan of Flood Control facilities, as well as for legacy communities.

For additional information, see: https://water.ca.gov/Work-With-Us/Grants-And-Loans/Small-Communities-Flood-Risk-Reduction

DWR Flood Control Subventions Program

The Flood Control Subventions Program provides financial assistance to local agencies cooperating in the construction of federally authorized flood control projects.

For additional information, see: https://water.ca.gov/Work-With-Us/Grants-And-Loans/Flood-Control-Subventions-Program

DWR Integrated Regional Water Management Grant Programs

The Integrated Regional Water Management Grant Programs are a collaborative effort to manage all aspects of water resources in a region. The grant programs fund planning, implementation, and disadvantaged community and tribal involvement.

For additional information, see: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Work-With-Us/Grants-And-Loans/IRWM-Grants/Files/Prop-1-Implementation/Round-2/2022-Integrated-Regional-Water-Management-Grant-Program-Guidelines.pdf

18.3.4 County and Local

Sonoma County and individual jurisdictions have the authority to fund mitigation projects though existing local budgets, local appropriations (including referendums and bonding), and a variety of federal and state loan and grant programs. Some jurisdictions participating in this HMP are faced with fiscal constraints that limit their ability to implement mitigation actions. In an effort to overcome these fiscal challenges, jurisdictions have continued to leverage the sharing of resources and combining available funding with grants and other sources. Plans and interjurisdictional cooperation are beneficial in obtaining grants.

Flood Elevation Program

The Sonoma County Flood Elevation Program can provide up to 75 percent of the cost of raising a flood-prone residential structure above the 100-year flood level. The assistance is provided as a grant

and the owner must provide the remaining 25 percent of the cost prior to the start of construction. Any residential structure in Sonoma County that has experienced flood damage may be eligible for assistance. Community Development Commission (CDC) staff assist property owners in developing plans, obtaining permits, receiving bids from pre-screened contractors and managing the construction process. The CDC makes payments directly to the contractor after the work has been approved by the County building inspection department. To date, the CDC has elevated over two hundred residential structures, more than any other jurisdiction in the Western United States.

Earthquake Resistant Bracing System

The California state program (also known as the Brace & Bolt Program) is carried out by the County's Community Development Commission. Since 1994, the Commission has installed earthquake bracing on 1,697 homes throughout Sonoma County (including those about to start construction in 2025). This program continues to take applications and funds construction. In addition, the Community Development Commission provides bracing assistance to mobile home owners.

Part 4: Mitigation Strategy



19. MITIGATION STRATEGY

This chapter presents mitigation strategies for Sonoma County to reduce potential vulnerability and losses identified as concerns in the risk assessment portion of this plan. The Planning Partnership reviewed the risk assessment and capability assessment to identify and develop these mitigation strategies.

Mitigation actions address a range of impacts, including impacts on the population, property, the economy, and the environment. They can include activities such as revisions to land-use planning, training and education, and structural and nonstructural safety measures.

19.1 PAST MITIGATION ACCOMPLISHMENTS

The County, through previous and ongoing hazard mitigation activities, has demonstrated that it is proactive in protecting its physical assets and communities against losses from natural hazards. Examples of previous and ongoing actions and projects include the following:

- The County facilitated the development of the original Sonoma County HMP. The current planning process represents the regulatory five-year plan update process, which includes the participation of 22 jurisdictions in the County, along with key County and regional stakeholders.
- All municipalities participating in this HMP update participate in the National Flood Insurance Program (NFIP), which requires the adoption of FEMA floodplain mapping and certain minimum standards for building within the floodplain.
- Reports, plans, and studies relating to or including information on natural hazards or natural hazard policies affecting Sonoma County have been reviewed and incorporated into this plan update as appropriate, as discussed in Chapter 2 (Planning Process) and References.
- The County designed and implemented a Flood Elevation Program, which can provide up to 75 percent of the cost of raising a flood-prone residential structure above the 100-year flood level. The assistance is provided as a grant and the owner must provide the remaining 25 percent of the cost prior to the start of construction. Any residential structure in Sonoma County that has experienced flood damage may be eligible for assistance.
- The County continues to implement the Earthquake Resistant Bracing System Program (ERBS). This program is carried out by the County's Community Development Commission, which continues to take applications and funds construction. In addition, the Community Development Commission provides bracing assistance to mobile homeowners.
- The County implemented Phase 1 of the pilot Sonoma County Wildfire Adapted Program, which to date has completed over 7,600 defensible space assessments and 2,342 home hardening assessments along with more than 30 in-person and virtual presentations to education and engage local stakeholders.

19.2 MISSION STATEMENT, GOALS AND OBJECTIVES

A mission statement focuses the range of objectives and actions to be considered for hazard mitigation in Sonoma County. This is not a goal because it does not describe a hazard mitigation outcome, and it is broader than a hazard-specific objective. The mission statement for this HMP is as follows:

> Create a resilient Sonoma County for the whole community.

For the purposes of this plan, goals and objectives are defined as follows:

- **Goals** are general guidelines that explain what is to be achieved. They are usually broad, long-term, policy-type statements and represent global visions. Goals help define the benefits that the plan is trying to achieve. The success of the plan, once implemented, should be measured by the degree to which its goals have been met (that is, by the actual benefits in terms of hazard mitigation).
- **Objectives** are short-term aims that form a strategy or course of action to meet a goal. Objectives are stand-alone measurements of the effectiveness of a mitigation action. The objectives also are used to help establish priorities. Broadly defined mitigation objectives were eliminated from the updated strategy unless accompanied by discrete actions.

The HMWG reviewed the 2021 goals and objectives and made revisions for the 2026 update based on the following considerations:

- Hazard events and losses since the 2021 plan
- The updated hazard profiles and risk assessment
- The goals and objectives established in the California 2023 SHMP
- The Planning Partnership's interests in integrating this plan with other planning mechanisms, including Sonoma County and local risk management plans
- Direct input from the HMWG, stakeholders, and the public on how the County and jurisdictions need to move forward to best manage their hazard risk
- Discussions and research on existing authorities, policies, programs, resources
- Support for mitigation through the protection of natural systems

As a result of this review process, the goals for the 2026 update were updated to the following list. The effectiveness of a mitigation strategy is assessed by determining how well these goals are achieved.

- Goal 1—Protect people and minimize loss of life and injury.
- Goal 2—Minimize potential for loss of property, economic and social impacts, and displacement due to hazards.
- Goal 3—Minimize potential for environmental impacts and consider a broad-range of mitigation strategies, including nature-based solutions where feasible.
- Goal 4—Communicate and improve public understanding of natural hazard risk to the whole community within Sonoma County.

- Goal 5—Support the advancement of effective mitigation policies, programs, and projects that are adaptive, proactive, cost-effective, and environmentally sustainable to build a resilient Sonoma County.
- Goal 6—Enhance the capability/capacity of the Sonoma County planning area to prepare, respond, and recover from the impact of natural hazards.

The selected objectives meet multiple goals. Therefore, the objectives serve as a standalone measurement of the effectiveness of a mitigation action, rather than as a subset of a goal. The objectives also are used to help establish priorities.

- Objective 1—Incorporate mitigation best management measures into plans, codes, and other regulatory standards for the private sector, nonprofit agencies, and community-based organizations within the planning area.
- Objective 2—Maintain established partnerships in the identification and implementation of mitigation measures in the Sonoma County Planning area.
- Objective 3—Retrofit, purchase, mitigate or relocate structures in high hazard areas, with an emphasis on those subject to repetitive damages.
- Objective 4—Promote and implement hazard mitigation plans and projects that are consistent with state, regional, and local climate action and adaptation goals, policies, and programs.
- Objective 5—Improve and expand systems that provide warning and emergency communications to the whole community
- Objective 6—Increase resilience and capabilities of community lifelines.
- Objective 7—Prevent (or discourage) new development in hazardous areas to ensure that if building occurs in high-risk areas that it is done in such a way as to minimize risk.
- Objective 8—At the local government level, continually improve understanding of the location and potential impacts of natural hazards in all planning mechanisms that address current and future land uses within the planning area.
- Objective 9—Consider the impacts of natural hazards in all planning mechanisms that address current and future land uses within the planning area
- Objective 10—Minimize adverse impacts from flood risk on vulnerable communities.
- Objective 11—Through the enforcement of relevant federal, state, and local regulations, sustain life and property protection measures for all communities and structures located in the Sonoma County planning area.
- Objective 12—All cities, the County, special districts, and tribal organizations will develop, adopt, and implement local hazard mitigation principles that may be integrated with local comprehensive plan safety elements, Community Wildfire Protection Plans, floodplain management plans, facilities master plans, and other local planning initiatives.
- Objective 13—Identify and prioritize mitigation projects that reduce risks for physically and socioeconomically vulnerable populations, ensuring equitable protection and resilience for all communities in the Sonoma County planning area.

19.3 MITIGATION STRATEGY DEVELOPMENT AND UPDATE

19.3.1 Update of Local Jurisdiction Mitigation Strategies

Review of Previous Actions

To evaluate progress on local mitigation actions, each planning partner was provided with a Mitigation Action Review Worksheet, pre-populated with the actions identified for their jurisdiction in the prior (2021) plan. The Planning Partners were asked to indicate the status of each action ("No Progress," "In Progress," "Ongoing Capability," "Completed," "Discontinued"). They were requested to provide comments to quantify the extent of progress and provide reasons for the level of progress or why actions were discontinued. This information is included in the jurisdictional annexes.

Mitigation actions identified as "Complete" or "Discontinued" have been removed from the Planning Partners' updated mitigation strategies. Actions identified as "No Progress" or "In Progress" have been carried forward in their local updated mitigation strategies. Planning partners were asked to provide further details on these projects to help better define the projects, identify benefits and costs, and improve implementation.

Certain continuous or ongoing actions (Ongoing Capabilities) from the previous plan that represent programs that are now fully integrated into the normal operational and administrative framework of the community are identified in the capabilities assessment of each annex and removed from the updated mitigation strategy (marked as "Discontinued").

Identifying New Actions

At the kickoff and during subsequent local level planning meetings, all participating jurisdictions were further surveyed to identify completed mitigation actions, in progress actions, or ongoing capabilities, as well as potential new actions. Planning Partners were made aware of potential new mitigation actions as such actions became evident during the plan update process (e.g., through the capability assessment, risk assessment, or the public and stakeholder outreach process).

Developing the Overall Strategy

Beginning in November 2024, members of the HMWG and contract consultants started working directly with each jurisdiction (by phone, email, or virtual meetings) to update their annex with mitigation strategies that focus on well-defined, implementable projects that meet the definition or characteristics of mitigation. Mitigation actions were selected with a careful consideration of benefits (risk reduction, losses avoided), costs, and possible funding sources (including mitigation grant programs).

Three annex support meetings were held for Planning Partners to assist in the development of additional actions, foster collaboration between neighboring jurisdictions for mitigation actions, discuss actions that involve cooperation between the County and jurisdictions, and identify steps needed to complete the jurisdictional annexes.

Addressing Known Vulnerabilities

To help support the selection of an appropriate risk-based mitigation strategy, each annex includes a summary of hazard vulnerabilities. These were identified during the plan update process by planning partner representatives, through review of available plans and reports, or through the hazard profiling and risk assessment process.

A mitigation strategy workshop was conducted on July 29, 2025, for all participating jurisdictions to support the development of focused problem statements based on the impacts of natural hazards in the County and their communities. These problem statements provide a detailed description of a problem area, including its impacts on the jurisdiction; past damage; loss of service; etc. These problem statements form a bridge between the hazard risk assessment, which quantifies impacts on each community, and the development of actionable mitigation strategies.

Incorporating a Range of Action Types

Concerted efforts were made to ensure that Planning Partners develop updated mitigation strategies that cover the range of mitigation action types described in recent FEMA planning guidance (FEMA "Local Mitigation Planning Handbook" March 2013):

- **Local Plans and Regulations**—These actions include government authorities, policies or codes that influence the way land and buildings are developed and built.
- **Structure and Infrastructure Projects**—These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as community lifelines and other critical facilities. This type of action also involves projects to construct structures to reduce the impact of hazards.
- **Natural Systems Protection**—These are actions that minimize damage and losses to natural systems and preserve or restore their functions.
- **Education and Awareness Programs**—These are actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. These actions may also include participation in national programs, such as the National Flood Insurance Program, Community Rating System, StormReady (NOAA), and Firewise (NFPA).

Efforts were also made to develop mitigation strategies that cover the range of mitigation action types described in recent CRS guidance (FEMA 2018):

- **Preventative Measures**—Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. Examples include planning and zoning, local floodplain laws, capital improvement programs, open space preservation, and stormwater management regulations.
- **Property Protection**—These actions include public activities to reduce hazard losses or actions that involve modification of existing buildings or structures to protect them from a hazard or removal of the structures from the hazard area. Examples include acquisition, elevation, relocation, structural retrofits, storm shutters, and shatter-resistant glass.

- **Public Information**—Actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. Such actions include outreach projects, real estate disclosure, hazard information centers, and educational programs for school-age children and adults.
- **Natural Resource Protection**—Actions that minimize hazard loss and also preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.
- **Structural Flood Control Projects**—Actions that involve the construction of structures to reduce the impact of a hazard. Such structures include dams, setback levees, floodwalls, retaining walls, and safe rooms.
- **Emergency Services**—Actions that protect people and property during and immediately following a disaster or hazard event. Services include warning systems, emergency response services, and the protection of essential facilities

Protecting Critical Facilities

Planning partner mitigation actions that address vulnerable critical facilities have been proposed in consideration of protection against worst-case scenarios. For projects funded through federal mitigation programs, the level of protection may be influenced by cost-effectiveness as determined through a formal benefit-cost analysis. For locally self-funded projects, local jurisdiction discretion will be used. It must be recognized that the County and jurisdictions have limited authority with regard to mitigation at any level of protection over privately owned critical facilities.

Accounting for Climate Change

As discussed in the hazard profiles in this HMP, the long-term effects of climate change are anticipated to exacerbate the impacts of weather-related hazards (e.g., flood, drought, and wildfire). Communities are working to evaluate and recognize these long-term implications and to incorporate their mitigation strategies into planning and capital improvement updates.

19.3.2 Update of County Mitigation Strategy

The update of the County-level mitigation strategies included a review of progress on the actions/initiatives identified in the 2021 HMP using a process similar to that used to review local jurisdiction mitigation strategy progress. The County, through their various department representatives, was provided with a Mitigation Action Plan Review Worksheet identifying all County-level actions and initiatives from the 2021 plan. The County reviewed each action and provided progress. For each action, relevant County representatives were asked to indicate the status of each action (*No Progress*, *In Progress*, *Ongoing*, *Completed*, or *Discontinued*), and provide review comments on each.

Actions identified as "*Complete*," as well as those actions identified as *Discontinued*, have been removed from this plan update. Those actions the County has identified as *No Progress* or *In Progress*

have been carried forward in the County's updated mitigation strategy. Actions considered ongoing capabilities were marked as *Discontinued* and included in the plan as ongoing capabilities.

Throughout the course of the plan update process, additional regional and County-level mitigation actions were identified by the following processes:

- Review of the results and findings of the updated risk assessment
- Review of available regional and County plans, reports, and studies
- Direct input from County departments and other regional agencies, including:
  - Sonoma County Department of Emergency Management
  - Sonoma County Department of Public Infrastructure
  - Sonoma County Community Development Commission
  - Permit Sonoma
  - Sonoma County Administrator's Office
- Input received through the public and stakeholder outreach process

19.3.3 Mitigation Best Practices

Catalogs of hazard mitigation best practices were developed that present a broad range of alternatives to be considered for use in the mitigation strategies, in compliance with 44 CFR Section 201.6(c)(3)(ii). One catalog was developed for each hazard of concern evaluated in this plan. The catalogs present alternatives that are categorized based on the following considerations:

- Who would have responsibility for implementation:
  - Individuals—personal scale
  - Businesses—corporate scale
  - Government—government scale
- What would the alternatives do:
  - Manipulate the hazard
  - Reduce vulnerability to the hazard
  - Reduce impacts from the hazard
  - Build local capacity to respond to or be prepared for the hazard

The alternatives presented include actions that will mitigate current risk from hazards and actions that will help reduce risk from changes in the impacts of these hazards resulting from climate change. The catalogs provide a baseline of mitigation alternatives that are backed by a planning process, are consistent with the established goals and objectives, and are within the capabilities of the Planning Partners to implement. Some of these actions may not be feasible based on the selection criteria identified for this plan. The purpose of the catalogs was to provide a list of what could be considered to reduce risk from natural hazards within the planning area. Appropriate hazard mitigation actions were selected from among the alternatives in the catalogs for inclusion in the mitigation strategies. Actions in

the catalog that are not included for the partnership's mitigation strategy were not selected for one or more of the following reasons:

- The action is not feasible
- The action is already being implemented
- There is an apparently more cost-effective alternative
- The action does not have public or political support.

The catalogs are included in Appendix F.

19.3.4 Mitigation Strategy Evaluation

Section 201.c.3.iii of 44 CFR establishes how mitigation strategies are to be prioritized, implemented, and administered by local jurisdictions. For this plan update, each mitigation strategy was prioritized using criteria suitable for evaluating hazard mitigation strategies. This method provided a systematic approach that considered the opportunities and constraints of implementing each mitigation action.

For the plan update there has been an effort to develop a more clearly defined and action-oriented mitigation strategy. The updated strategy includes actions that are seen by the Planning Partnership as the most effective approaches to advance local mitigation goals within the existing capabilities. Ultimately, the County developed an action-oriented and achievable mitigation strategy.

It is noted that jurisdictions may be carrying forward mitigation actions from prior mitigation strategies that were prioritized using a different, but not inherently contrary, approach. Mitigation actions in the prior (2021) Sonoma County HMP were prioritized based on cost and availability of funding, benefit, number of plan objectives achieved, timeframe for project implementation, and eligibility for grant funding programs. At their discretion, jurisdictions carrying forward prior actions were encouraged to re-evaluate their priority, particularly if conditions that would affect the prioritization criteria had changed.

Benefit/Cost Review

Section 201.6.c.3iii of 44 CFR requires the prioritization of the mitigation strategy to emphasize a benefit/cost comparison of the proposed actions. For all actions identified in the local strategies, jurisdictions identified the associated costs and benefits as follows:

- **Costs** presented include the total project estimation. This can include administrative, construction (engineering, design, and permitting), and maintenance costs.
- **Benefits** are the savings from losses avoided through project implementation. These can include life safety, structure and infrastructure damage, loss of service or function, and economic and environmental damage and losses.

When possible, jurisdictions were asked to identify the actual or estimated dollar costs and associated benefits. Where estimates of costs and benefits were available, the ratings were defined follows:

Low < = $10,000 Medium = $10,000 to $100,000 High > = $100,000

Where numerical costs or benefits could not be quantified, jurisdictions evaluated cost-effectiveness using qualitative *high*, *medium*, and *low* ratings based on the following definitions:

- **High Costs:** Existing funding levels are not adequate to cover the costs of the proposed project, and implementation would require an increase in revenue through an alternative source (e.g., bonds, grants, and fee increases)
- **Medium Costs:** The project could be implemented with existing funding but would require a re-apportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.
- **Low Costs:** The project could be funded under the existing budget. The project is part of or can be part of an existing, ongoing program.

Jurisdictions were asked to identify the benefit of each mitigation strategy as it related to reduction of risk.

- **High Benefits:** Project will have an immediate impact on the reduction of risk exposure to life and property.
- **Medium Benefits:** Project will have a long-term impact on the reduction of risk exposure to life and property or will provide an immediate reduction in the risk exposure to property.
- **Low Benefits:** Long-term benefits of the project are difficult to quantify in the short-term.

Using this approach, projects with positive benefit versus cost ratios (such as high over medium, medium over low, etc.) are considered cost-effective.

Prioritization Scoring

Each mitigation action was assigned a priority based on the following equation and the scores for costs, benefits, goals, and time frame shown in Table 19-1.

Action Prioritization Equation

Priority = [(Costs) + (Benefits) + (Goals Met) + (Time Frame)]

The numerical results were totaled and then used to help prioritize the action as *low*, *medium*, or *high*. Actions that had a numerical value between 0 and 5 were categorized as *low priority*; actions with numerical values between 5 and 7 were categorized as *medium priority*; and actions with numerical values between 7 and 9 were categorized as *high priority*. While this provided a consistent, systematic methodology to support the evaluation and prioritization of mitigation actions, the individual jurisdictions may have additional considerations that influenced the overall prioritization of mitigation actions.

The final, prioritized mitigation strategies are located in Volume II. The implementation time frame used for prioritizing actions is an estimate only and does not represent a commitment by the jurisdictions. Given that funding is required to complete most projects included in the mitigation strategies, the actual timeline for completion will depend on unknown factors such as the availability of grant programs, funding allocations, local match availability, construction costs, etc.

Table 19-1. Scoring System for Prioritizing Mitigation Actions

Criteria	Score
Costs	
High	1 point
Medium	2 points
Low	3 points
Benefits	
High	3 points
Medium	2 points
Low	1 point
Number of Goals Met	
Each Goal	0.077 points
Implementation Time Frame	
1-5 Years	2 points
1-10 Years	1 point

For some of the Sonoma County actions identified, the Planning Partnership may seek financial assistance under FEMA's Hazard Mitigation Assistance (HMA) programs. These programs require detailed benefit/cost analysis as part of the application process. The benefit/cost review for the prioritization of actions in this update did not include the level of detail required by FEMA for project grant eligibility under HMA grant programs. These analyses will be performed when funding applications are prepared, using FEMA's Benefit-Cost Analysis model.

The Planning Partnership is committed to implementing mitigation strategies with benefits that exceed costs. For projects not seeking financial assistance from grant programs that require this sort of analysis, the Planning Partnership reserves the right to define benefits according to parameters that meet its needs and the goals and objectives of this plan.

Part 5: Plan Maintenance



20. PLAN MAINTENANCE AND IMPLEMENTATION PROCEDURES

This chapter details the formal process that will ensure that the hazard mitigation plan remains an active and relevant document and that the Planning Partnership maintains its eligibility for applicable funding sources. The plan maintenance process includes a schedule for monitoring and evaluating the plan annually and producing an updated plan every five years. In addition, this chapter describes how public participation will be integrated throughout the plan maintenance and implementation process. It explains how the mitigation strategies outlined in this plan update will be incorporated into existing planning mechanisms and programs, such as comprehensive land use planning processes, capital improvement planning, and building code enforcement and implementation.

20.1 HMP COORDINATOR AND JURISDICTION POINTS OF CONTACT

The HMP Coordinator is assigned to manage the maintenance and update of the plan during its approval period (the five-year period between FEMA's approval of the plan and its expiration), with the following responsibilities:

- Convene the Planning Partnership
- Be the prime point of contact for questions regarding the plan and its implementation
- Coordinate the incorporation of additional information into the plan
- Manage the monitoring, evaluation, and updating responsibilities identified in this section

Currently, the Sonoma County HMP Coordinator is designated as:

Sage Limpp, Supervising Hazard Mitigation Coordinator
Sonoma County Department of Emergency Management
2300 County Center Drive, Suite B220
Santa Rosa, CA 95403
(707) 565-2097
Email: sage.limpp@sonomacounty.gov

As of the date of this plan, primary and secondary mitigation planning representatives (points of contact) are identified in each jurisdictional annex in Volume II. It will be the responsibility of each jurisdiction and its representatives to inform the HMP Coordinator of any changes in representation.

20.2 MAINTENANCE AND IMPLEMENTATION TASKS

The procedures for monitoring, evaluating, and updating the plan are provided below. The plan maintenance matrix shown in Table 20-1 provides a synopsis of responsibilities for plan monitoring, integration, evaluation, and update, which are discussed in further detail in the sections below.

Table 20-1. Plan Maintenance Matrix

Task	Approach	Timeline	Lead Responsibility	Support Responsibility
Monitoring	Planning partners to recommend update of mitigation strategies, progress toward implementation of actions, identification of new actions, and update of information on funding opportunities.	Annually on the anniversary of the plan approval date or after the occurrence of a federally declared disaster	Jurisdictional points of contact identified in Volume II	Jurisdictional Planning Team identified in Volume II
Integrating	Distribute the safe growth worksheet (see Table 20-2) for annual review and update by all participating jurisdictions.	April each year with interim email reminders to address integration in county and municipal activities	HMP Coordinator	Jurisdictional points of contact identified in Volume II
Evaluating	Review the status of previous actions and assess the effectiveness of the plan; compile and finalize update of mitigation strategy.	Updated progress report completed by April 31 of each year	HMP Coordinator	Jurisdictional points of contact identified in Volume II
Updating	Reconvene the Planning Partners to guide a comprehensive update to review and revise the plan.	Every 5 years or upon major update to General Plan or after the occurrence of a major disaster	HMP Coordinator	Jurisdictional points of contacts identified in Volume II
Grant Monitoring	Notify Planning Partners about grant opportunities, maintain a list of eligible jurisdiction-specific projects for funding consideration, and notify Planning Partners of fiscal year mitigation priorities.	Continuously and as grant opportunities are identified	HMP Coordinator	Jurisdictional points of contact as identified in Volume II
Public Involvement	Maintain the HMP, inform the public of hazard events via social media outlets, promote educational workshops on hazard topics, and track and file public comments received regarding the HMP.	Continuously	County HMP Coordinator and jurisdictional points of contact identified in Volume II	Jurisdictional Planning Team identified in Volume II

20.2.1 Monitoring

The Planning Partnership will be responsible for monitoring and documenting annual progress on the plan. Each year, beginning one year after plan development, Sonoma County and local Planning Partnership representatives will collect and process information from the persons responsible for initiating or overseeing the mitigation projects in each department, agency, and organization involved in implementing mitigation actions identified in their jurisdictional annexes. For the life of the HMP, this will be accomplished using an online performance progress reporting system (the Mitigation Action Planning Tool (MAPT℠)), which will enable each planning partner to:

- Directly access mitigation actions
- Easily update the status of each project
- Document successes or obstacles to implementation
- Add or delete projects to maintain mitigation strategy implementation

Participating partners will be prompted by the tool to update progress on a quarterly basis, encouraging them to refresh their mitigation strategies and to continue implementation of actions. This reporting system facilitates the sorting and prioritization of projects and will support the submittal of an increased number of project grant fund applications. Planning Partnership representatives will be expected to document the following:

- Progress on the implementation of mitigation actions
- Obstacles or impediments to implementation of actions
- Any grant applications filed on behalf of any of the participating jurisdictions
- Hazard events and losses occurring in their jurisdiction
- Additional mitigation actions believed to be appropriate and feasible
- Public and stakeholder input

20.2.2 Integrating the HMP into Municipal Planning Mechanisms

Hazard mitigation is sustained action taken to reduce or eliminate the long-term risk to human life and property from natural hazards. Integrating hazard mitigation into a community's existing plans, policies, codes, and programs leads to development patterns or redevelopment that reduce risk from known hazards. The Planning Partnership was tasked with identifying how hazard mitigation is integrated into existing planning mechanisms. The jurisdictional annexes in Volume II describe how this is done for each planning partner. During this process, many partners recognized the importance and benefits of incorporating hazard mitigation into future local planning and regulatory processes.

Effective mitigation is achieved when hazard awareness and risk management approaches and strategies become an integral part of public activities and decision-making. Within the County, there are many existing plans and programs that support hazard risk management, and it is critical that this HMP integrate and coordinate with and complement those existing plans and programs.

The Capability Assessment (Chapter 18) provides a summary and description of the existing plans, programs, and regulatory mechanisms at all levels of government (federal, state, county, and local) that support hazard mitigation within the County. In the jurisdictional annexes in Volume II, each planning partner identified how it has integrated hazard risk management into its existing planning, regulatory, and administrative framework and how they intend to promote this integration further ("plan integration").

It is the intention of Planning Partnership representatives to incorporate mitigation planning as an integral component of daily government operations. Planning Partnership representatives will work with local government officials to integrate the newly adopted hazard mitigation goals and actions into the

general operations of government and partner organizations. The sample adoption resolution (Appendix A) includes a resolution item stating the intent of the local governing body to incorporate mitigation planning as an integral component of government and partner operations. By doing so, the Planning Partnership anticipates that:

- Hazard mitigation planning will be formally recognized as an integral part of overall emergency management efforts.
- The HMP, comprehensive plans, emergency management plans and other relevant planning mechanisms will become mutually supportive documents that work in concert to meet the goals and needs of county residents.

Other planning processes and programs to be coordinated with the recommendations of the HMP include the following:

- Emergency management and response plans
- Training and exercise of emergency response plans
- Debris management plans
- Recovery plans
- Capital improvement programs
- Municipal codes
- Community design guidelines
- Water-efficient landscape design guidelines
- Stormwater management programs
- Water system vulnerability assessments
- Community wildfire protection plans
- Comprehensive flood hazard management plans
- Resiliency plans
- Community Development Block Grant Disaster Recovery action plans
- Public information and improved public participation
- Educational programs
- Continued interagency coordination

During the HMP annual review process, participating jurisdictions will be asked to document how they are utilizing and incorporating the HMP into their day-to-day operations and planning and regulatory processes. Each municipality will identify additional policies, programs, practices, and procedures that could be modified to accommodate hazard mitigation actions and include these findings and recommendations in the annual HMP progress report. The checklist in Table 20-2, adapted from FEMA's 2025 Local Mitigation Planning Handbook, will help a community analyze how hazard mitigation is integrated into local plans, ordinances, regulations, and policies. Completing the checklist will help jurisdictions identify areas that currently integrate hazard mitigation and where to make improvements and reduce vulnerability to future development.

Table 20-2. Safe Growth Check List

Planning Mechanisms	Yes	No	How is it being done or how will this be utilized in the future?
Operating, Municipal, and Capital Improvement Program Budgets			
When constructing upcoming budgets, are hazard mitigation actions funded as budget allows?			
Are construction projects evaluated to see if they meet the hazard mitigation goals?			
Does the municipality review mitigation actions when allocating funding during annual budget adoption processes?			
Do budgets limit expenditures on projects that would encourage development in areas vulnerable to natural hazards?			
Do infrastructure policies limit extension of existing facilities and services that would encourage development in areas vulnerable to natural hazards?			
Do budgets provide funding for hazard mitigation projects identified in the HMP?			
Human Resource Manual			
Do any job descriptions specifically include identifying and/or implementing mitigation projects/actions or other efforts to reduce natural hazard risk?			
Building and Zoning Ordinances			
Prior to zoning changes or development permitting, does the municipality review the HMP and other hazard analyses to ensure consistent and compatible land use?			
Does the zoning ordinance discourage development or redevelopment within natural areas, including wetlands, floodways, and floodplains?			
Does the zoning ordinance contain natural overlay zones that set conditions?			
Does the zoning ordinance require developers to take additional actions to mitigate natural hazard risk?			
Do rezoning procedures recognize natural hazard areas as limits on zoning changes that allow greater intensity or density of use?			
Does the zoning ordinance prohibit development within or filling of wetlands, floodways, and floodplains?			
Subdivision Regulations			
Do the subdivision regulations restrict the subdivision of land within or adjacent to natural hazard areas?			
Do the regulations provide for conservation subdivisions or cluster subdivisions in order to conserve environmental resources?			
Do the regulations allow density transfers where hazard areas exist?			

Planning Mechanisms	Yes	No	How is it being done or how will this be utilized in the future?
Comprehensive Plan			
Are the goals and policies of the plan related to those of the HMP?			
Does the future land use map clearly identify natural hazard areas?			
Does the plan provide adequate space for expected future growth in areas located outside natural hazard areas?			
Land Use			
Does the future land use map clearly identify natural hazard areas?			
Do the land use policies discourage development or redevelopment in natural hazard areas?			
Transportation Plan			
Does the transportation plan limit access to hazard areas?			
Is transportation policy used to guide growth to safe locations?			
Are transportation systems designed to function under disaster conditions (e.g., evacuation)?			
Environmental Management			
Are environmental systems that protect development from hazards identified and mapped?			
Do environmental policies maintain and restore protective ecosystems?			
Do environmental policies provide incentives to development located outside protective ecosystems?			
Grant Applications			
Are data and maps used as supporting documentation in grant applications?			
Municipal Ordinances			
Is hazard mitigation a priority when updating municipal ordinances?			
Economic Development			
Does the local economic development group take into account information regarding identified hazard areas when assisting new businesses in finding a location?			
Public Education and Outreach			
Does the municipality have any public outreach mechanisms/ programs in place to inform the public on natural hazards, risk, and ways to protect themselves during such events?			

20.2.3 Evaluating

Evaluation of the mitigation plan is an assessment of whether the planning process and actions have been effective, whether the HMP goals are being achieved, and whether changes are needed. The HMP Coordinator will consult with the Planning Partnership members to evaluate the effectiveness of the plan implementation and to reflect changes that could affect mitigation priorities or available funding.

The status of the HMP will be discussed and documented at an annual plan review meeting of the Planning Partnership to be held either in person or via teleconference approximately one year from the date of local adoption of this update and successively thereafter. The HMP Coordinator will be responsible for calling participants, coordinating the annual plan review meeting, and soliciting input regarding progress toward meeting plan goals and objectives. At least two weeks before the annual plan review meeting, the HMP Coordinator will advise Planning Partnership members of the meeting date, agenda, and expectations of the members. These evaluations will assess whether:

- Goals and objectives address current and expected conditions
- The nature or magnitude of the risks has changed
- Current resources are appropriate for implementing the HMP and if different or additional resources are now available
- Actions were cost effective
- Schedules and budgets are feasible
- Implementation problems are present, such as technical, political, legal, or coordination issues with other agencies
- Outcomes have occurred as expected
- Changes in local resources impacted plan implementation (e.g., funding, personnel, and equipment)
- New agencies, departments, and staff are included, involving other local governments as defined under 44 CFR 201.6.

Specifically, the Planning Partnership will review the mitigation goals, objectives, and activities using performance-based indicators, including:

- New agencies/departments
- Project completion
- Underspending/overspending
- Achievement of the goals and objectives
- Resource allocation
- Timeframes
- Budgets
- Lead/support agency commitment
- Resources

- Feasibility

Finally, the Planning Partnership will evaluate how other programs and policies have conflicted with or augmented planned or implemented mitigation actions and will identify policies, programs, practices, and procedures that could be modified to accommodate hazard mitigation actions. Other programs and policies can include those that address:

- Economic development
- Environmental preservation
- Historic preservation
- Redevelopment
- Health and safety
- Recreation
- Land use and zoning
- Public education and outreach
- Transportation

The Planning Partnership should refer to any process and plan review deliverables developed by the County or participating jurisdictions as a part of the plan review processes established for prior or existing local HMPs within the county.

The HMP Coordinator will be responsible for preparing an annual HMP progress report for each year of the approval period based on the information provided by the Planning Partners and other information as appropriate. These annual reports will provide data for the five-year update of this HMP and will assist in pinpointing any implementation challenges. By monitoring the implementation of the HMP, the Planning Partnership will be able to assess which actions are completed, which are no longer feasible, and which require additional funding.

Following any major disasters, the HMP will be evaluated and revised to determine if the recommended actions remain relevant and appropriate. The risk assessment will also be revisited to see if any changes are necessary based on the pattern of disaster damage or if data listed in the hazard profiles of this plan has been collected to facilitate the risk assessment. This is an opportunity to increase the community's disaster resistance and build a better and stronger community.

20.2.4 Updating

44 CFR 201.6.d.3 requires that local hazard mitigation plans be reviewed, revised as appropriate, and resubmitted for approval to remain eligible for benefits awarded under DMA 2000. It is the intent of the Sonoma County HMP Planning Partnership to update this plan on a five-year cycle from the date of initial plan approval.

To facilitate the update process, the HMP Coordinator, with support of the Planning Partnership, will use the second annual Planning Partnership meeting to develop and commence the implementation of a detailed plan update program. Prior to the five-year update, the HMP Coordinator will invite

representatives from Cal OES to provide guidance on plan update procedures. This meeting will establish who will be responsible for managing and completing the plan update effort, items that need to be included in the updated plan, and a detailed timeline with milestones to ensure that the update is completed according to regulatory requirements. At this meeting, the project team will determine what resources will be needed to complete the update and seek to secure these resources. Finally, the HMP Coordinator will contact the California Specialized Training Institute to schedule a mitigation training for the Planning Partnership to take place prior to the 5-year update kickoff.

Following each annual update of the HMP, the updated plan will be distributed for public comment. After all comments are addressed, the HMP will be revised and distributed to all Planning Partners.

20.2.5 Grant Monitoring and Coordination

Sonoma County intends to be a resource to the Planning Partnership in the support of project grant writing and development. The degree of this support will depend on the level of assistance requested by the Planning Partners during openings for grant applications. As part of grant monitoring and coordination, Sonoma County intends to provide the following:

- Notification to Planning Partners about impending grant opportunities
- A current list of eligible, jurisdiction-specific projects for funding pursuit consideration
- Notification about mitigation priorities for the fiscal year to assist the Planning Partners in the selection of appropriate projects.

20.2.6 Continued Public Involvement

The Planning Partners are committed to the continued involvement of the public in the hazard mitigation process. This HMP update will continue to be posted online at the following link: https://sonomacounty.ca.gov/administrative-support-and-fiscal-services/emergency-management/multi-jurisdictional-hazard-mitigation-plan. In addition, public outreach and dissemination of the HMP will include the following:

- Links to the plan on local websites of each jurisdiction with capability
- Continued utilization of existing social media outlets (Facebook, X) to inform the public of natural hazard events, such as floods and wildfires; the public can be educated via the jurisdictional websites on how these applications can be used in an emergency situation
- Promotion of articles or workshops on hazards to educate the public and keep them aware of the dangers of hazards

The HMP Coordinator will be responsible for receiving, tracking, and filing public comments regarding this HMP. The public will have an opportunity to comment on the plan via the hazard mitigation website at any time. The HMP Coordinator will ensure that:

- Public and stakeholder comments and input on the plan, and hazard mitigation in general, are collected, recorded, and addressed as appropriate.
- The Sonoma County HMP website is maintained and updated as appropriate.

- Copies of the latest approved plan are available for review at appropriate county facilities, along with instructions to facilitate public input and comment on the plan.
- Public notices, including media releases, are made (as appropriate) to inform the public of the availability of the plan, particularly during plan update cycles.

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